CHATFIELD RESERVOIR STORAGE REALLOCATION

Draft Integrated Feasibility Report
and
Environmental Impact Statement

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US Army Corps of Engineers ®

DRAFT INTEGRATED FEASIBILITY REPORT/ENVIRONMENTAL IMPACT STATEMENT FOR THE CHATFIELD RESERVOIR STORAGE REALLOCATION STUDY

Lead Agency: U.S. Army Corps of Engineers, Northwestern Division, Omaha District

Abstract: The U.S. Army Corps of Engineers proposes to reallocate 20,600 acre-feet of storage from the exclusive flood control pool to the conservation pool at Chatfield Reservoir. Chatfield Reservoir is well placed to help meet this objective for the following reasons: the reservoir provides a relatively immediate opportunity to increase water supply storage without the development of significant amounts of new infrastructure; it lies directly on the South Platte River (efficient capture of runoff); and it provides an opportunity to gain additional use of an existing federal resource.

The additional storage would be used for M&I water supply, agriculture, recreation, and fishery habitat protection and enhancement purposes. In addition to the no action plan, Penley Reservoir combined with gravel pit storage, three other alternatives were evaluated: non tributary ground water (NTGW) combined with gravel pit storage, reallocation of 20,600 acre-feet and 7,700 acre-feet combined with non-tributary ground water and gravel pit storage. The tentatively recommended plan, reallocation to allow an additional 20,600 acre-feet of water supply storage; would reallocate storage from the flood control pool to the conservation pool. Under this alternative, the base elevation of the flood control pool would be raised from 5,432 to 5,444 feet msl. This alternative would provide storage to help meet part of the growing demand for water in the Denver Metro by using existing federal infrastructure, and lessening the dependence on NTGW.

The Tentatively Recommended Plan meets all federal NED goals providing $10.41 million in annual NED benefits to total annual NED project costs of $8.74 million. It provides an average year yield of 8,539 acre-feet at less cost than other alternatives for water supply. Mitigation will be required to offset impacts to terrestrial based effects (wetland and riparian habitats, including Preble's meadow jumping mouse critical habitat). Positive environmental effects to the fisheries supported by the reservoir include the inundation of terrestrial habitats which will result in increased habitat structure for use by fish and other aquatic life. Additionally, increased shoreline inundation will enhance productivity at virtually every trophic level in the aquatic food web. The Colorado Department of Natural Resources, through its agencies and non-federal project partners, will complete 100% of the integral work at no cost to the federal government per the 1958 Water Supply Act and Section 103(c)(2) of WRDA 1986. Cost of the project is estimated to be $184,400,000. Design and construction include on-site and off-site environmental mitigation; modification/re-construction of all impacted recreation facilities; utility relocations; earthwork and shoreline contouring; road, bridge and parking lot construction; demolition, clearing, and grubbing; and vegetation management.

The reallocation of flood storage to water supply storage would primarily result in greater and more frequent reservoir pool fluctuations at Chatfield Reservoir, but the impact on downstream flood frequency is negligible.

Comments: Please send comments or questions on this Draft Feasibility Study/Environmental Impact Statement to: U.S. Army Corps of Engineers, CENWO-PM-AA, Attention: Gwyn Jarrett, 1616 Capitol Avenue, Omaha, NE 68102-4901, telephone (402) 995-2717, or by email: chatfieldstudy@usace.army.mil. The official closing for receipt of comments will be 60 days from the date of which the notice of Availability of the Draft Feasibility Study/Environmental Impact Statement appears in the Federal Register.

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EXECUTIVE SUMMARY

1.1 Introduction

The NEPA process has been integrated with the Feasibility Study. Like the Corps' six step planning process, NEPA also requires the evaluation and comparison of alternatives. It compares the impacts of the alternatives to the ecological, cultural, and aesthetic resources identified and investigated. The NEPA process documents compliance with applicable environmental statutes, such as the Endangered Species Act, the Clean Air Act, the Clean Water Act, the Fish and Wildlife Coordination Act, and the Historic Preservation Act, among others. The integration of the Feasibility Study and the Environmental Impact Statement is intended to reduce process overlap and duplication. The integrated process helps assure that well-defined study conditions and well-researched, thorough assessments of the environmental, cultural, social, and economic resources affected by the proposed activity are incorporated into planning decisions.

1.1.1 Study Authority and Federal Interest

The Chatfield Dam and Lake project on the South Platte River Basin in Colorado was authorized by the Flood Control Act of 1950 (Public Law (P.L.) 81-516) for flood control purposes. Chatfield Dam is a rolled earthfill dam 13,057 feet long with a top width of 30 feet, an ungated concrete spillway 500 feet wide located in the left abutment, and a gated concrete outlet works located in the right abutment. Construction began in 1967 and was completed in August 1973. Ultimately, the project was operated for flood control (P.L. 81-516, P.L. 99-662) and other purposes: Recreation (P.L. 89-72, P.L. 99-662, P.L. 93-251); Fish/Wildlife (P.L. 99-662) and Water Supply (P.L. 99-662). By authority provided under Section 808 of the Water Resources Development Act (WRDA) of 1986 (P.L. 99-622), as amended by Section 3042 of the WRDA 2007 (P.L. 110-114), the Secretary of the Army, upon request of and in coordination with, the Colorado Department of Natural Resources (CDNR), and upon the Chief of Engineers' finding of feasibility and economic justification, may reassign a portion of the storage space in the Chatfield Lake project to joint flood control-conservation purposes, including storage for municipal and industrial water supply, agriculture, environmental restoration, and recreation and fishery habitat protection and enhancement. The reallocation was conditioned upon the appropriate non-Federal interests agreeing to repay the cost allocated to such storage in accordance with the provisions of the Water Supply Act of 1958, the Federal Water Project Recreation Act, and such other Federal laws as the Secretary determines appropriate. The payments would go to the United States Treasury. The recreation modifications and environmental mitigation work are additionally authorized by Section 103(c)(2) WRDA 1986, requiring non-Federal payment of 100 percent of the costs of municipal and industrial water supply projects, and this work will be cost shared pursuant to that section.

Section 116 of the Omnibus Appropriations Act of 2009 (P.L. 111-8) authorized the CDNR to perform modifications of the Chatfield Reservoir and any required mitigation which results from implementation of the project. In addition, Section 116 directed the Secretary to collaborate with the CDNR and local interests to determine costs to be repaid for reallocated storage (as determined under Section 808, as amended) that reflect the limited reliability of the resource and the capability of non-Federal interests to make use of the reallocated storage space.

This report presents the integrated Feasibility Study and Environmental Impact Statement (EIS) and economic justification required by Section 808, as amended, which the Secretary will consider prior to deciding whether to reassign a portion of the storage space to joint flood control-conservation purposes.

1.1.2 Background

The Colorado Water Conservation Board (CWCB), a division of the CDNR, requested that the U.S. Army Corps of Engineers (USACE; the Corps) consider reallocating space within Chatfield Reservoir for water supply purposes, on behalf of a group of 15 water users (or water providers) in the Denver metropolitan area. While water supply remains primarily a non-federal responsibility, based on current federal authorities, (described in Section 1.4), the Federal Government should participate and cooperate with states and local interests in developing such water supplies in connection with multi-purpose projects. The federally owned Chatfield Reservoir provides an opportunity to help local communities in the Denver metropolitan (Metro) area to meet a growing demand for water. Therefore, it is the purpose of this study to identify alternatives, compare those alternatives, and select the best alternative for meeting the needs based on solid planning principles.

With the main problem being defined as increasing water demand in the Denver Metro area that exceeds available water supplies, the purpose and need is as follows:

> The purpose and need is to increase availability of water, sustainable over the 50-year period of analysis, in the greater Denver area so that a larger proportion of existing and future water needs can be met.

The primary objective of the reallocation is to help enable water providers to supply water to local users, mainly for municipal, industrial, and agricultural needs, in response to rapidly increasing demand. Chatfield Reservoir is well placed to help meet this objective for the following reasons: the reservoir provides a relatively immediate opportunity to increase water supply storage without the development of significant amounts of new infrastructure; it lies directly on the South Platte River (efficient capture of runoff); and it provides an opportunity to gain additional use of an existing federal resource.

Three reservoirs, consisting of Chatfield Reservoir, in conjunction with Cherry Creek and Bear Creek reservoirs (i.e., Tri-Lakes), are managed by the Corps to protect the Denver Metro area from catastrophic floods that have occurred historically. This flood protection function is still critically important today, and cannot be compromised.

With over 1.6 million visitor days annually, Chatfield State Park is one of the most heavily utilized parks, and one of the most vital components, of the Colorado State Parks system. Given its close proximity to both the Denver Metro area and the foothills, Chatfield State Park provides a valuable and unique opportunity for the public to connect to the natural world through camping, boating, hiking, fishing, biking, horseback riding and wildlife viewing. The Colorado Division of Wildlife works closely with Colorado State Parks to protect and enhance fish and wildlife habitat at and around Chatfield State Park.

1.1.3 Project Location

Chatfield Reservoir is located southwest of Denver, at the confluence of the South Platte River and Plum Creek within the South Platte River Basin. The study area encompasses the area in the immediate vicinity of Chatfield Reservoir and extends downstream to where the river intersects the Adams/Weld county line. The reservoir's location is directly on the South Platte River, or "on-channel."

1.1.4 Study Sponsor

The Chatfield Reservoir storage reallocation study is being accomplished jointly between USACE and the local sponsor, the CWCB. The study costs for the project were divided evenly between these two agencies.

1.1.5 Cooperating Agencies

There are a number of entities that have been invited by the Corps to participate in the Chatfield Reservoir storage reallocation study as Cooperating Agencies and Special Technical Advisors. These include selected federal, state, and local government entities, the project participants (i.e., water providers), and several environmental groups. The Cooperating Agencies and Special Technical Advisors were given the opportunity to participate in project meetings and review and comment on the Preliminary Draft chapters of the Feasibility Report/Environmental Impact Statement (FR/EIS). Coordination with agencies and compliance with environmental statutes and regulations are described in Appendix S, including coordination letters.

1.2 Study Objectives

1.2.1 Problems and Opportunities

The water resource problem to be addressed is the inadequate supply of water to meet increasing water supply demand in the Denver Metro area over the next 50 years due to the combined effects of population growth, depletion of nonrenewable groundwater sources, and agricultural water providers' need for augmentation water for alluvial wells.

Problems

1. Population growth resulting in increased municipal and industrial (M&I) water demands:

   The CWCB's "Statewide Water Supply Initiative" (SWSI) estimates the state's population will be between 8.6 and 10.3 million in 2050. The SWSI includes several "Identified Projects and Processes" (IPPs), including the Chatfield Reallocation Project, to meet the needs of the Denver metro area. Even with the IPPs, it is expected that a significant gap in water supply availability would remain (potentially 262,700 to 435,000 acre-feet).

   The 15 prospective recipients of reallocated storage space in Chatfield Reservoir (i.e., water providers) each have immediate and future water needs which will extend beyond current supplies. The water providers project their demand to increase from 249,597 acre-feet in 2010 to at least 365,601 acre-feet in 2050.

2. Reliance of some municipal water providers on nonrenewable Denver Basin groundwater:

The use of Denver Basin groundwater for municipal water supplies has been determined to be an unacceptable long-term supply due to a path of severely increasing costs and the problems of currently reduced water availability and reliability that will continue to worsen in the future (Black & Veatch et al. 2003).

3. Agricultural water providers need augmentation water for alluvial wells:

   The agricultural water providers seeking Chatfield storage space are also facing an urgent water supply situation. Numerous agricultural water wells of these users are located in the alluvium adjacent to the South Platte River. These wells generally have junior water rights and when owners of senior water rights downstream place a call (or request water) during the irrigation season the agricultural usage from the wells is curtailed or completely halted under Colorado water law unless so-called "augmentation water" is available for release to the river to cover the out-of-priority depletions from the well pumping. Currently, well pumping from approximately 450 alluvial water wells has been curtailed completely and pumping from another approximately 2,000 wells have been partially reduced by court order until necessary augmentation water is secured. These wells supply water to 25,000 to 30,000 irrigated acres and divert approximately 25,000 acre-feet of water per year. The drought of 2002 to 2007, considered the worst drought in the last 300 years, exacerbated the situation. The well pumping curtailment is severely impacting well users and adversely impacting local economies.

Opportunities

1. Expanding the use of an existing storage facility to provide additional water supplies:

   Storage projects capture water during high-flow years and seasons to be used during low-flow periods, a function that is critical to providing reliable water supplies in a semiarid climate such as Colorado's where the hydrologic events are highly variable.

2. Chatfield Reservoir's on-channel location:

   The "on channel location of the reservoir is a significant advantage over off-channel reservoirs that are limited by the design capacity of diversion and delivery facilities. Additionally, this location provides for the reservoir immediately capturing all available flows that can be legally stored.

3. Chatfield Reservoir's location at a relatively high elevation within the basin:

   Chatfield Reservoir's location and relatively high elevation within the watershed provides the opportunity to deliver water by gravity flow. Since some providers already receive water deliveries from Chatfield Reservoir, there is less need for the construction of new conveyances (e.g., ditches, pump stations, and pipelines) than there would be from new storage facilities.

4 Ability to store augmentation water for future use.

   The Chatfield Reservoir storage reallocation project would give agricultural water providers additional ability to store augmentation water for later release, thereby giving some relief from the well pumping curtailment situation.

1.2.2 Planning Objectives and Constraints

Planning objectives are the intended purposes of the planning process. Constraints are restrictions that limit the extent of the planning process. Constraints can be legal, policy related or study specific.

Planning Objectives

- Increase availability and reliability of water supply by providing an additional average annual yield of up to 8,500 acre-feet of M & I water, sustainable over a 50-year period, to contribute towards meeting a water supply shortfall projected to be 100,000 acre-feet per year by 2050 for the service area of the 15 study sponsors.
- Provide, over the 50-year planning period, water supply of equivalent quality as currently supplied to the Denver metro region.
- Maintain adequate levels of downstream flood control over the 50-year period of analysis.
- Ensure the provision of in-kind recreation facilities and experiences, to the extent possible, during the 50-year period of analysis.
- Ensure maintenance of environmental benefits by minimizing environmental impacts, fully mitigating unavoidable significant impacts, monitoring to evaluate the level of success and utilizing adaptive management if needed.
- Become less reliant on non-renewal groundwater by utilizing renewable water supplies, thus extending the availability and life of these critical aquifers for use by future generations.
- Be as consistent as possible with the USACE Environmental Operating Principles (EOP).
- Be consistent with the USACE Campaign Plan goals to the extent applicable.
- Find collaborative solutions to future Denver Metro Area water supply needs.

Planning Constraints

- The project must be completed in a reasonable timeframe.
- Financial capability of sponsoring water providers may be constraining because they are responsible for 100% of the costs involved in implementing any alternative.
- The project should not rely on the use of others' land or on their project capability.
- The project should avoid the acquisition of water rights owned by others.
- Institutional acceptability may be a constraint.
- Public acceptability may be a constraint.
- Storage below 5,432 feet msl cannot be reallocated because the water in the existing conservation pool has been previously allocated by the Corps to the State of Colorado and

the State contracted the right to use the space to Denver Water. Therefore, use of the storage space is operated in accordance with provisions of the contracts involving these three entities and the National Park Service.

1.3 Alternatives

1.3.1 Development of Alternatives/Screening

One of the key aspects of the NEPA process is the assessment of how various alternatives that meet the purpose and need could affect the environment. NEPA requires, at a minimum, that a "proposed action" be compared to a "no action" alternative. The No Action Alternative represents the most likely baseline conditions that would occur if the proposed project were not to move forward. The "action alternatives" are then compared to the No Action Alternative in order to determine the extent and severity of potential impacts. In addition to the procedures and requirements set forth in NEPA, Corps guidance requires an in-depth analysis following procedures outlined in the "Economic and Environmental Principles and Guidelines for Water and Related Land Resources Implementation Studies" (also known as the Principles and Guidelines (P&G's). as part of the evaluation. As a test of financial feasibility, the governing annual cost of storage is compared to the annual cost of the most likely, least costly alternative that would provide an equivalent quality and quantity of water that the non-federal interest would undertake in the absence of using the proposed federal project. The action alternatives identified and evaluated in the FR/EIS are designed to determine the best and highest use of Chatfield Reservoir. To reach these selected action alternatives, an initial screening of concepts was conducted using a defined set of criteria.

Prior to selecting the 4 main alternatives considered in detail, other potential alternatives were rigorously explored and evaluated. The alternatives identified for initial screening were evaluated with four general criteria described in the P&Gs: completeness, efficiency, effectiveness, and acceptability. These initial screening criteria definitions were developed based on the planning objectives and constraints identified and summarized in Chapter 2 (Section 2.2). In general terms, these four criteria would encompass the following considerations: 1) Ability to meet purpose and need; 2) Cost; 3) Logistics and technology (including water rights/water availability, land availability, permitting and mitigation feasibility, design and construction feasibility, and operational feasibility); and 4) Environmental impacts (including significance and ability to mitigate). Furthermore, in keeping with Corps guidance, the development of alternatives considered the Corps' Environmental Operating Principles (EOP) and Campaign Plan goals. The broader view of all alternatives to increase the water supplies for the South Platte River Basin is given in SWSI, Sections 8 and 10, which is included as Appendix C of this report. In general, the alternatives considered generally fell within the categories of the following concepts: (1) increased storage, (2) importation of water, (3) conversion from agricultural use to municipal use, (4) increased non-tributary ground water (NTGW) use, and (5) increased water conservation.

The initial screening process demonstrates that alternatives for the importation of water or agricultural conversion have vastly higher expense and increased environmental impacts compared to the other alternatives. Importation and agricultural water conversion projects are very complex, high-impact projects that are feasible only if large volumes of yield are realized. They generally include new storage reservoirs, hundreds of miles of pipelines, and multiple pump stations. They are not realistic alternatives to a project yielding 8,539 acre-feet per year and therefore have been eliminated from further alternative consideration. As such, storage options, NTGW, and water conservation were the main considerations in the analysis found in this report.

1.3.2 Alternatives Considered in Detail

As mentioned above, several concepts were initially developed and screened using the Corps' Planning process. While many alternatives were eliminated from further detailed evaluation, the screening process did lead to the refinement of four main alternatives. The alternatives considered in detail in the FR/EIS are:

1. No Action—Penley Reservoir combined with Gravel Pit Storage. Under the No Action Alternative flood control storage space within Chatfield Reservoir would not be reallocated to joint flood control-conservation storage (hereafter referred to as conservation or water supply storage/pool), and the operation of the reservoir would remain the same. For this alternative it was assumed the water providers would use Penley Reservoir and gravel pit storage to meet their future water needs. The water providers would newly construct Penley Reservoir and would install the infrastructure needed to convert existing gravel pits for water storage.

2. Least Cost Alternative to Chatfield Reservoir storage reallocation—NTGW combined with Gravel Pit Storage. Normally the No Action Alternative is also the Least Cost Alternative. However, the water providers participating in the Chatfield Reservoir reallocation study are opposed to long-term use of NTGW due to water supply management strategies of becoming less dependent on non-renewable water supplies. For this study, it is assumed that NTGW could provide water to a significant part of upstream water providers through the 50-year planning period, and downstream water providers would be served by the development of gravel pits for water storage.

3. Reallocation to allow an additional 20,600 acre-feet of Water Supply Storage. The 20,600 Acre-Foot Reallocation Alternative would reallocate storage from the flood control pool to the conservation pool. The additional storage would be used for M&I water supply, agriculture, recreation, and fishery habitat protection and enhancement purposes. Under this alternative, the base elevation of the flood control pool would be raised from 5,432 to 5,444 feet msl.

4. Reallocation to allow an additional 7,700 acre-feet of Water Supply Storage combined with NTGW and Gravel Pit Storage. The 7,700 Acre-Foot Reallocation Alternative, like Alternative 3, would reallocate storage from the flood control pool to the conservation pool for multiple purposes. Again, the additional storage would be used for M&I water supply, agriculture, recreation and fishery habitat protection and enhancement purposes. Because the average year yield from Chatfield Reservoir storage reallocation for Alternative 4 is less than the average year yield for Alternative 3, additional water supply sources (NTGW and downstream gravel pit storage) are also included in Alternative 4 so that the total average year yield equals 8,539 acre-feet.

For consistent comparison purposes, each alternative was designed to provide an average year yield of 8,539 acre-feet, which corresponds with the yield under the maximum (20,600 acre-feet) reallocation alternative (Alternative 3). Alternatives 1 and 2 do not reallocate storage in Chatfield Reservoir, and as such, the current operations and water levels would remain unchanged with the base elevation of the flood control pool at 5432 feet msl. Alternative 3 and 4 both consider reallocating storage from flood control to M&I water supply, which would result in changes to the reservoir operations and would raise the base elevation of the flood control pool in the reservoir to 5,444 feet msl (Alternative 3) and 5,437 feet msl (Alternative 4). The Corps considers Alternative 3 the preferred alternative. The alternatives are discussed in detail in Chapter 2 of the FR/EIS.

1.3.3 Comparison of Alternatives

Alternatives 1, 2, 3 and 4 are summarized and compared in the following sections.

1.3.3.1 Financial Comparison

Table ES-1 compares the alternative costs needed to provide (yield) 8,539 acre-feet of equivalent quality water to the water providers. The costs to develop, treat, deliver the water, and to operate, maintain, repair, rehabilitate, and replace (OMRR&R) the required facilities for 50 years are included.

Table ES-1
Cost of the Alternatives in Millions

	Alternative 1	Alternative 2	Alternative 3	Alternative 4
Cost of Chatfield Storage	$0.0	$0.0	$14.5	$5.4
Infrastructure Costs	$247.0	$172.8	$10.0	$112.0
O,M,RR&R	$31.4	$32.4	$43.8	$42.6
Environmental Mitigation	$0.0	$0.0	$71.0	$26.5
Recreation Modification	$0.0	$0.0	$45.1	$16.9
Total	$278.4	$205.1	$184.4	$203.4

1.3.3.2 Environmental Comparison

Section 2.8 and summary Table 2-9 of the main report compare the potential environmental impacts of the alternatives. It is difficult to say what the exact new condition of the environmental resources at Chatfield would be for Alternatives 3 and 4 due to the expected but unpredictable high level of fluctuation of water levels associated with these alternatives. For example, it is difficult to say exactly what the impacts to water dependent habitat might be (e.g. cottonwood trees or wetlands) if there is substantial uncertainty in knowing exactly where water surface elevations might be on an annual or seasonal basis. As such, a conservative approach to the impact analysis was taken to reflect the maximum potential impacts that might be associated with the inundation of environmental resources. This worst-case scenario approach was taken to ensure adequate mitigation could be planned and subsequently reasonably attained for any potential impacts that may develop. The table also provides a synopsis of actions to avoid and/or reduce potential impacts. Environmental impacts associated with each alternative are discussed in detail in Chapter 4. In addition, impacts to federally-listed threatened, endangered, and candidate species (T&E species), and their critical habitat, from the preferred alternative (i.e., Alternative 3) are described in the Biological Assessment (Appendix V).

1.3.3.3 Environmental Operating Principles (EOP)

The Environmental Operating Principles (EOP) and associated doctrine highlight the Corps' roles in, and responsibilities for, sustainability, preservation, stewardship, and restoration of our nation's natural resources. It is an important sub-goal of the Corps to meet these EOP. Chapter 2, Section

2.8.3 Compliance of Alternatives with the EOP, includes an assessment of the consistency of each of the alternatives with the seven EOP.

1.3.3.4 Trade-off Analysis

A detailed trade-off analysis is presented in Chapter 5. It should be noted, with Alternative 3, the costs are less than with the other alternatives, it provides storage for renewable surface water in an existing reservoir, and because it is located on the South Platte River it can capture flows associated with water provider's junior water rights more efficiently than the other alternatives. Additionally, Alternative 3 would use surface water, a renewable source, rather than NTGW that is not renewable.

1.3.3.5 Key Risks and Uncertainties

The study includes analyses of impacts and costs, and there are uncertainties associated with the assumptions used in these analyses. Chapter 5 includes a discussion of the main sources of uncertainty, such as the modeling of the reservoir pool elevations and downstream flows. Standard models and conservative assumptions were used in the study in order to reduce the uncertainties. While mitigation and modification plans have been developed (including an adaptive management component) in coordination with resource agencies, there is still a level of concern that implementing a reallocation could lead to a somewhat different condition for which environmental mitigation or recreational facility modification has not been designed appropriately. In order to relieve these concerns, the water providers are working closely with resource agencies to reach consensus on potential projects and/or project features that might be implemented that would provide additional benefits where the mitigation and modification plans leave off. These projects would be implemented as a part of the non-federal requirements that lie outside of the Federal interest. , The evaluation of impact of reallocation on flood control benefits included evaluation of impacts at Chatfield Reservoir, as well as impacts at Bear Creek Reservoir and Cherry Creek Reservoir, and on the South Platte River from Chatfield Reservoir to Julesburg, CO. Impacts on flood control benefits were evaluated through use of a hydrologic model to simulate the operations at Chatfield Reservoir, Cherry Creek, and Bear Creek Reservoirs for the historical period of record. An adjustment was made in the model to historic streamflows to account for current urbanization through the study reach, and the model was used to develop flow and elevation duration and probability relationships for the reservoirs and for the South Platte River downstream of the reservoirs for with and without project conditions. Based upon the hydrologic model used to simulate the historical period of record, flood control capabilities at Chatfield Reservoir, Cherry Creek, or Bear Creek Reservoirs would not be reduced by the proposed reallocation of flood storage to water supply storage. There would be sufficient flood storage space to provide the same level of control of floods that occurred during the modeled period of record 1942 through 2000. Impacts from the reallocation of flood storage to water supply storage would primarily result in greater and more frequent reservoir pool fluctuations at Chatfield Reservoir.

Because the period of record does not include extremely large flood events, the impacts of reallocation on the Reservoir Design Flood and Inflow Design Flood were also evaluated. The Reservoir Design Flood is the size of flood a reservoir is designed to store with minimal or no releases from the reservoir, and this flood normally produces a reservoir pool elevation near the spillway crest. With reallocation, the Reservoir Design Flood could still be controlled with a shorter release shutdown period of three days following that event. The original Reservoir Design Flood was based on a release shutdown period of five days. The Inflow Design Flood (or Spillway

Design Flood) is used to determine the size of the spillway and height of the dam embankment. The evaluation of the Inflow Design Flood included a more detailed analysis of the antecedent flooding conditions. With the proposed reallocation, and use of an antecedent flood of 40% of the Probable Maximum Flood, the resulting maximum pool elevation in the reservoir was 5520.9 ft, as compared to the original maximum pool elevation of 5521.6 ft.

On the South Platte River downstream of Chatfield Reservoir, the with reallocation conditions slightly lowered the flooding potential at the two lower control points, Kersey, and Julesburg for the 10- through 500-year events. Flows at the Denver gage either stayed the same or slightly increased for the with reallocation condition. For instance, when compared to base condition, the 100-year discharge at the Denver gage goes from 24,300 cfs to 24,500 cfs for the with reallocation condition. These differences are considered negligible and would not warrant any changes in existing flood frequency criteria used for flood plain regulation The 2-year discharges either stayed the same or dropped slightly for the with reallocation conditions.

1.3.3.6 Selection of Tentatively Recommended Plan

The Chatfield reallocation alternative with 20,600 acre-feet of reallocated storage was selected as the tentatively recommended plan. This plan is the least cost alternative, the locally preferred plan and would provide $10.41 million in annual NED benefits. The total annual NED project cost would be $8.74 million. The adverse impacts to recreation and the environment are mitigable and would be mitigated to the most sustainable alternative to below a level of significance. The Recreation Modification Plan (Appendix M) provides a detailed plan for addressing recreation impacts at Chatfield State Park. A Compensatory Mitigation Plan (CMP), Appendix K, was developed to address environmental impacts associated with Alternative 3.

The water providers continue to work with Colorado State Parks and Division of Wildlife staff to identify the additional features that will enhance the recreational experience and provide ecological benefits beyond required modification and mitigation plans. The water providers have developed a preliminary list of these additional measures, based on input from staff for Colorado State Parks, staff for the Colorado Division of Wildlife, other non-governmental organizations and the general public. See Chapter 5, Section 5.9.1.

1.3.4 Tentatively Recommended Plan

1.3.4.1 Plan Components

The tentatively Recommended Plan would reallocate 20,600 acre-feet of Chatfield's flood control storage to water supply storage. Environmental mitigation and recreation modifications are significant components of the plan, as they are required to address the adverse impacts caused by changing the operation of the reservoir, which would involve a significant change in how water levels fluctuate within the reservoir. In addition, adaptive management is an integral component of the overall plan, which will help in addressing issues that may arise post-decision.

1.3.4.2 Design/Construction Considerations

The water providers would construct facilities required to collect, transfer, treat, and distribute the additional water reallocated from Chatfield reservoir. The water providers would finance all environmental mitigation and recreation modifications. The Corps of Engineers, U.S. Fish and

Wildlife Service, and State of Colorado would review the design and monitor the construction of mitigation and modification measures.

1.3.4.3 O&M Considerations

The water providers would be responsible for the operation, maintenance, and repair of infrastructure, treatment, and distribution facilities associated with the additional water. They would also provide their share of the Chatfield Project operation, maintenance, repair, rehabilitation, and replacement costs.

1.3.4.4 Financial Feasibility Considerations

Financial feasibility of the tentatively Recommended Plan is established by comparing the alternatives from two standpoints: National Economic Development (NED) costs and financial costs, which are presented in detail in Chapter 5 and Appendix O. Tables ES-1 and ES-2 show the total implementation and OMRR&R financial costs and the annual financial costs, respectively, for the alternatives.

The financial cost comparison identifies the alternative that minimizes the costs the water providers would expend implementing each alternative. To develop comparable alternatives, for both the financial analysis and the NED analysis the costs were adjusted to the same price level taking into consideration that water must be supplied at the same rate over time (benefits) for all alternatives. The costs are adjusted to a base year that is two years after project approval to allow for construction activities (environmental mitigation and recreation modifications) to be completed prior to implementing the reallocation and raising the conservation pool elevation. Identical water supply increments were assumed for development over an 11 year period after approval, in accordance with Tables 11 and 12 in the CMP. Implementation costs for each alternative were then compared by aggregating each alternative's cost over the 50 year planning period into a revised first cost (present value). As shown in Table ES-2, Alternative 3 is identified as having the lowest annual financial costs for the water providers to implement and has the lowest annual financial costs per acre-foot of average year water yield.

Table ES-2
Annual Financial Costs of the Alternatives

	User Costs in $Millions			
	Alternative 1	**Alternative 2**	**Alternative 3**	**Alternative 4**
Initial / Implementation Costs	$246,951,356	$172,784,412	$140,645,975	$160,792,397
Annualized Initial/Implement. Costs	$11,742,782	$8,216,070	$6,687,855	$7,645,838
Annual OMRR&R Costs	$1,495,302	$1,538,602	$2,081,534	$2,026,560
Total Annual Costs	$13,238,084	$9,754,672	$8,769,390	$9,672,398
Annual Implementation Cost/acre-foot	$1,375	$962	$783	$895
Annual OMRR&R Cost/acre-foot	$175	$180	$244	$237
Total Annual Cost/acre-foot	$1,550	$1,142	$1,027	$1,133

The NED comparison identifies the alternative that maximizes net benefits by comparing the first cost and annual costs of each alternative to the least costly no action alternative (Alternative 2). NED costs differ from financial costs in that they include interest during construction (IDC) and NED benefits foregone but do not include the cost of storage. The NED tentatively Recommended Plan is Alternative 3, which has a lower investment cost (first cost plus IDC) and lower annual cost than Alternative 2 by $55,771,547 and $1,668,713, respectively. More details of the tentatively Recommended Plan are provided in Section 1.3.4.5.

1.3.4.5 Plan Accomplishments

The tentatively Recommended Plan meets all federal NED goals providing $10.41 million in annual NED benefits to total annual NED project costs of $8.74 million. It meets Corps of Engineers goals, and all required environmental mitigation and recreation modifications are reasonably attainable. It provides an average year yield of 8,539 acre-feet at less cost than other alternatives for water supply. From a regional economic perspective, the tentatively Recommended Plan will provide benefits of 2,257 person-years of employment over a 50-year period in the study area and approximately $318 million in economic output estimated in the region. Although the tentatively Recommended Plan will require significant modification of existing recreational facilities to offset impacts of the reallocation, the replacement of roads and facilities that are currently over 30 years old can be viewed as a positive aspect of the project. In addition, while the tentatively Recommended Plan will require mitigation to offset impacts to mainly terrestrial based effects (wetland and riparian habitats, including Preble's meadow jumping mouse critical habitat), there will be positive environmental effects to the fisheries supported by the reservoir. Namely, the inundation of terrestrial habitats will result in increased habitat structure for use by fish and other aquatic life. In addition, increased primary productivity as a result of increased shoreline inundation will increase productivity at virtually every trophic level in the aquatic food web.

The evaluation of impact of reallocation on flood control benefits included evaluation of impacts at Chatfield Reservoir, as well as impacts at Bear Creek Reservoir and Cherry Creek Reservoir, and on the South Platte River from Chatfield Reservoir to Julesburg, Colorado. This analysis indicated that reallocation of flood storage to water supply storage would primarily result in greater and more frequent reservoir pool fluctuations at Chatfield Reservoir, but the impact on downstream flood frequency is negligible because the maximum Chatfield release is 5,000 cfs for both the base condition and with reallocation conditions. A hydraulic model of Bear Creek, Cherry Creek, and the South Platte River from Chatfield Reservoir to Julesburg, Colorado was developed to compare water surface elevations for the base condition and with reallocation conditions. This model indicated that in most cases there was no increase in average water surface elevations due to reallocation, and the maximum average difference in water surface elevations was 0.1 feet. These differences are considered negligible and would not warrant any changes to existing flood frequency criteria used for flood plain regulation.

Finally, a payment for the cost of storage estimated to be $15,334,410 at FY2012 price levels will be made to the U.S. Treasury over 30 years at the applicable Federal water supply interest rates.

1.3.4.6 Implementation

The Colorado Department of Natural Resources, through its agencies and non-Federal project partners will complete 100% of the integral work at no cost to the Federal government per the 1958 Water Supply Act for this reallocation. Said work will involve every phase of design and construction including but not limited to:

1. on-site and off-site environmental mitigation;
2. modification/re-construction of all impacted recreation facilities;
3. utility relocations;

4. earthwork and shoreline contouring;
5. road, bridge and parking lot construction;
6. demolition, clearing, and grubbing; and
7. vegetation management

The work tasks identified above are further described in Chapter 5, and Appendices K and M. This work is integral in order to insure in-kind replacement of facilities and to mitigate environmental impacts.

Agreements between the Federal Government, the State of Colorado and the water providers will be executed prior to the reallocation of storage at Chatfield. The water providers would also construct the infrastructure needed to deliver their water for final use. The water providers would be responsible for any specific construction and/or operational costs associated with the reallocation action, environmental mitigation costs, and recreational modification costs. Prior to entering into storage agreements with the Federal Government, the water providers may need to reach separate agreements with the Colorado State Parks Board and/or the Colorado Wildlife Commission related to the Chatfield project, in accordance with Colorado State Law.

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1. PURPOSE OF AND NEED FOR ACTION

The NEPA process has been integrated with the Feasibility Study. Like the Corps' 6 step planning process, NEPA also requires the evaluation and comparison of alternatives. It compares the impacts of the alternatives to the ecological, cultural, and aesthetic resources identified and investigated. The NEPA process documents compliance with applicable environmental statutes, such as the Endangered Species Act, the Clean Air Act, the Clean Water Act, the Fish and Wildlife Coordination Act, and the Historic Preservation Act, among others. The integration of the Feasibility Study and the Environmental Impact Statement is intended to reduce process overlap and duplication. The integrated process helps assure that well-defined study conditions and well-researched, thorough assessments of the environmental, social, and economic resources affected by the proposed activity are incorporated into planning decisions.

1.1 Chatfield Project History

Chatfield Reservoir, in conjunction with the Cherry Creek and Bear Creek reservoirs (i.e., Tri-Lakes), are managed to protect the Denver Metro area from catastrophic floods that devastated the area periodically, as reported for more than 100 years. Construction of Cherry Creek Dam began in 1948 and was completed in 1950. Chatfield Dam was the second dam to be built; construction began in 1967 and dam closure was made in August 1973 (USACE 2002b). Finally, Bear Creek Dam was the last of the three dams to be built; construction was authorized in 1968 and completed in 1982.

Chatfield Reservoir flood control storage space was designed to store flood flows within the reservoir and to release stored water at a maximum rate of 5,000 cubic feet per second (cfs). During flood inflow periods and/or rising pool levels, Chatfield, Bear Creek, and Cherry Creek reservoirs are normally regulated and operated individually of each other (USACE 1973). To provide the best downstream flood risk management, operational procedures call for reduced releases if flooding is occurring downstream of the reservoirs. The control point for operation of the reservoirs is the South Platte River at Denver stream gage, with a target maximum flow rate of 5,000 cfs, which would be made up of combined releases from Chatfield, Cherry Creek, and Bear Creek reservoirs, and the runoff from the drainage area downstream of the reservoirs. During a flood event when the Chatfield Reservoir pool level rises into the flood control zone, releases are increased at a rate of 500 cfs per day up to a level that resulted in a maximum flow of 5,000 cfs at the South Platte River at Denver stream gage. Coordinated regulation of the three projects in parallel is necessary only after flood flows and during flood storage evacuation. USACE is currently revising the reservoir regulation manuals (also known as water control manuals) containing the operating plans for each of the Tri-Lakes reservoirs under existing conditions. The draft revised operating plan (also known as the Water Control Plan) for Chatfield Reservoir based on changes in conservation regulation and flood risk management regulation for the conservation pool (the joint flood control-conservation storage zone) proposed under Alternative 3 is provided in Appendix B.

Chatfield Dam is a rolled earthfill dam 13,136 feet long with a top width of 30 feet, an ungated concrete spillway 500 feet wide located in the left abutment, and a gated concrete outlet works located in the right abutment. The net annual benefits of the dam and reservoir were estimated at over 17.7 million dollars, based on July 1974 price levels. Approximately 90.5 percent of the net annual benefits were for flood risk management and the remaining 9.5 percent were for recreation (USACE 2002a).

Section 4 of the Flood Control Act of 1944 authorized USACE to construct, maintain, and operate public park and recreation facilities at Corps reservoirs. The Preliminary Master Plan for Chatfield Dam and Reservoir was approved in June 1966. This plan stated that USACE would construct basic initial facilities for public use and access. Initial development included roads, parking areas, boat ramps, boat docks, camping facilities, shade shelters, picnic facilities, overlook development, a bathing beach, change house, fish cleaning stations, sanitary facilities and disposal systems, electric distribution, water supply, signs, tree planting, seeding, landscaping, fencing, and cleanup of existing building sites (USACE 2002a). The Colorado Department of Game Fish and Parks, now the Colorado Department of Natural Resources (CDNR) was responsible for obtaining water rights to maintain the conservation pool and contracted with the City and County of Denver in 1979 to provide this water. As described in the following section (Section 1.3.2.2), the existing multipurpose-conservation pool contains water storage rights held by the Denver Water Department (Denver Water).

In July 1974, USACE leased 5,378 acres of land and water to the State of Colorado for the use and benefit of the CDNR and Division of Parks and Outdoor Recreation, also known as Colorado State Parks, for what is now known as Chatfield State Park. On December 31, 1981, USACE, CDNR, Colorado Division of Wildlife[1] (CDOW), and Colorado State Parks were signatories to a sublease of CDNR-leased lands on the downstream side of Chatfield Dam to CDOW for development of fish production and rearing area development including water supply lines, drain lines, ponds, raceways, roads, and parking areas (USACE 2002a). The Chatfield State Fish Unit (SFU), also known as the Chatfield Fish Planting Base, receives its water supply from Chatfield Reservoir via a water supply pipe that is 54 inches in diameter and also feeds City Ditch and Nevada Ditch. Another water supply pipe that is 48 inches in diameter extends downstream of Chatfield Dam to feed the Last Chance Ditch.

The Metropolitan Water Supply Investigation (MWSI) began in 1993 to explore a cooperative approach to meeting future water supply needs of the Denver Metro area. The investigation focused on opportunities to increase water supply without the development of significant amounts of new infrastructure. The study identified Chatfield Reservoir as an important potential source of water storage, highlighting its location on the mainstem of the South Platte River, its capacity compared to the upstream reservoirs, and its proximity to metropolitan area supply systems (Hydrosphere Resource Consultants 1999). The Chatfield Work Group formed within the framework of MWSI, and worked with the Colorado Water Conservation Board (CWCB) and USACE to further investigate the possibilities of either reallocating flood storage or recreation storage. This Chatfield Reservoir storage reallocation project under consideration evolved from an assessment of existing contractual agreements, regulatory requirements, operational constraints, and additional studies and investigations.

[1] "On July 1, 2011, Colorado State Parks and the Colorado Division of Wildlife merged to form Colorado Parks and Wildlife."

1.2 Chatfield Project Authorization

Due to large flood events that occurred along the South Platte River prior to 1974, Chatfield Dam, Chatfield Reservoir, and downstream channel improvements were authorized for flood risk management and related purposes under Section 204 of the Flood Control Act of 1950 (Public Law (P.L.) 81-516). This authorization was in accordance with the recommendation of the Chief of Engineers in House Document [HD] Number 669, 80th Congress, 2nd Session (HD 80-669). The major part of HD 80-669 was a *Survey Report on Flood Control of the South Platte River and Its Tributaries, Colorado, Wyoming, and Nebraska*, USACE 1945, which states:

> The District Engineer recommends the construction of a flood and silt-control dam and reservoir at the Chatfield site on the South Platte River about 8 miles upstream from Denver, Colorado…

Based on this report and subsequent letters, on May 7, 1948, the Secretary of the Army issued his concurrence with this recommendation. The subsequent authorization under Section 204 of the Flood Control Act of 1950 is as follows:

> The projects for flood control and related purposes in the South Platte River Basin in Colorado are hereby authorized substantially in accordance with the recommendations of the Chief of Engineers in House Document Numbered 669, Eightieth Congress, second session, and there is authorized to be appropriated the sum of $26,300,000 for partial accomplishment of the work.

According to the 2002 Chatfield Lake Master Plan (USACE 2002a), all of the South Platte River projects authorized under the Flood Control Act of 1950 were to be designed for multiple uses, if feasible, to maximize benefits. The original authorized purposes of the Chatfield Dam and Lake Project were flood and silt control. The Master Plan states:

> These purposes were later expanded to include recreation, and fish and wildlife… The Department of the Interior recommended that the recreational potential of the proposed projects be studied cooperatively by the National Park Service and the Corps and also that the Fish and Wildlife Service investigate the conclusion of additional provisions for fish and wildlife in connection with the Definite Project Report. Water supply was added later as a project purpose.

Section 808 of the Water Resources Development Act (WRDA) of 1986, as amended by Section 3042 of the Water Resources Development Act of 2007, authorized the Secretary of the Army, "to reassign, a portion of the storage space in the Chatfield Lake project to joint flood-control-conservation purposes, including storage for municipal and industrial water supply, agriculture, environmental restoration, and recreation and fishery habitat protection and enhancement."

1.3 Chatfield Location and Study Area

Chatfield Reservoir is located at the confluence of the South Platte River and Plum Creek within the South Platte River Basin. The reservoir itself is located southwest of Denver in Douglas, Jefferson, and Arapahoe counties (see Figure 1-1). The drainage area for the South Platte River Basin upstream of the reservoir encompasses 3,018 square miles and originates at the headwaters of the North Fork of the South Platte River and the South Fork of the South Platte River in Park County, Colorado.

The U.S. Forest Service (USFS) manages most of the lands along the mainstem of the South Platte River upstream of the reservoir. Plum Creek, the second largest of the reservoir's tributaries, flows through a mixture of rangelands and suburban areas. The Buffalo Creek and Hayman fires burned large areas within the South Platte River Watershed, resulting in the deposition of sediments and other pollutants into the South Platte River drainage. Reservoirs located upstream of Chatfield Reservoir include Strontia Springs (completed in 1983), Cheesman Lake (1905), Elevenmile Canyon (1932), Spinney Mountain (1981), and Antero (1909) reservoirs. Downstream, the South Platte River joins with the North Platte River in western Nebraska to form the Platte River. The Platte River ultimately joins the Missouri River at the Nebraska/Iowa border. The study area (Figure 1-2) encompasses the immediate vicinity of Chatfield Reservoir and extends downstream to where the river intersects the Adams/Weld county line.

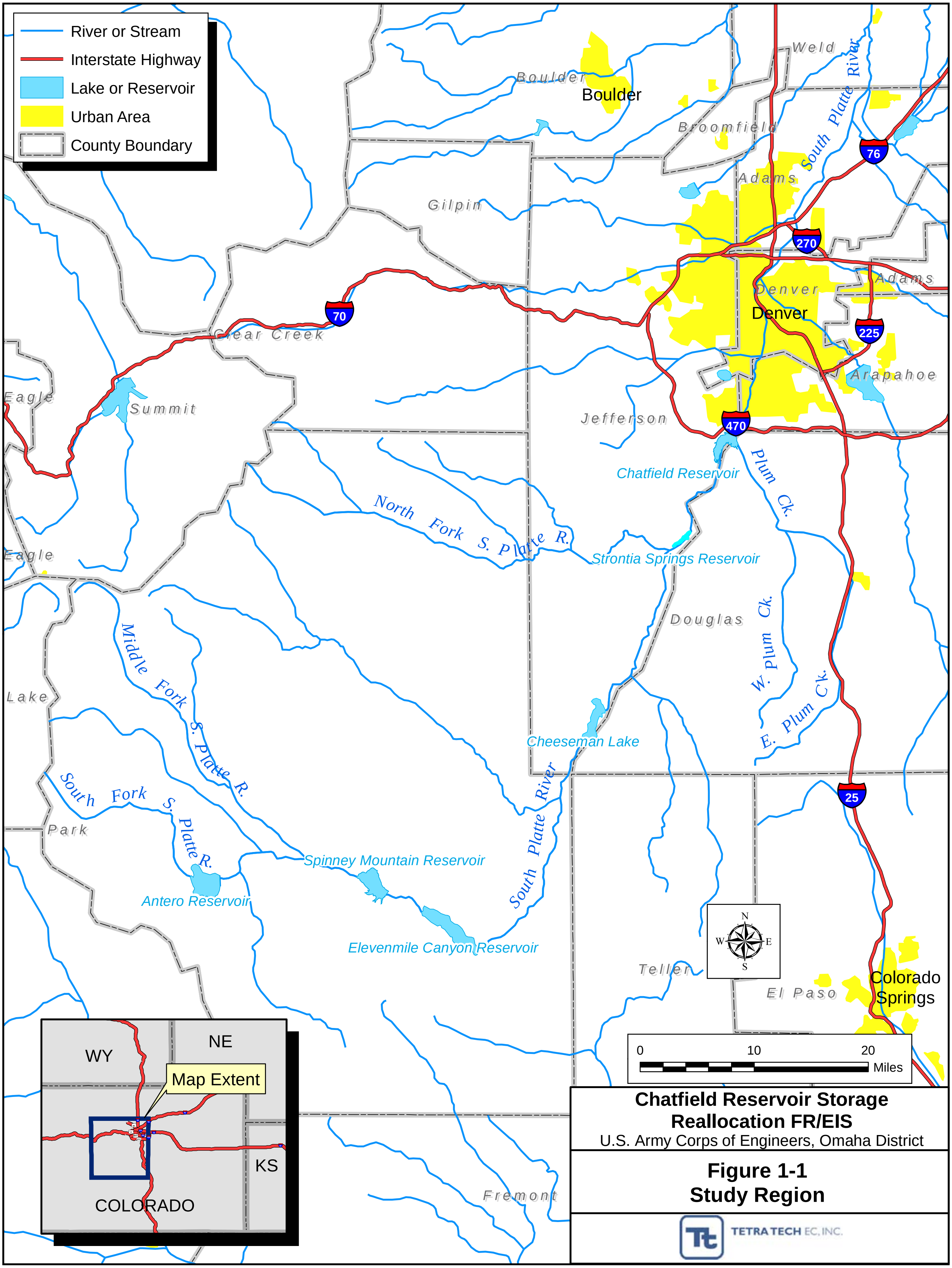
1.4 Study and Implementation Authorities

Congress authorized USACE to conduct a reallocation study and reassignment of storage in Chatfield Lake project to joint flood risk management (flood control)- conservation purposes, including storage for municipal and industrial (M & I) water supply, agriculture, environmental restoration, and recreation and fishery habitat protection and enhancement under Section 808 of the Water Resource Development Act of 1986 (P.L. 99-662), as amended by Section 3042 of the Water Resources Development Act (P.L. 110-114). Policies and plan formulation, economic justification and project implementation developed for use under the general authority for M & I water supply in the Water Supply Act of 1958 are applicable and used in this Chatfield Reallocation Report. The recreation modifications and environmental mitigation work are additionally authorized by Section 103(c)(2) WRDA 1986, requiring non-Federal payment of 100 percent of the costs of municipal and industrial water supply projects, and this work will be paid entirely to the sponsor as described by that section.

The specific legislative language authorizing this work under Section 808 WRDA 1986, as amended by Section 3042 WRDA 2007, states:

> The Project for flood control and other purposes on the South Platte River Basin in Colorado, authorized by the Flood Control Act of 1950 (64 Statute 175) is modified to authorize the Secretary, upon request of and in coordination with the Colorado Department of Natural Resources and upon the Chief of Engineers' finding of feasibility and economic justification, to reassign a portion of the storage space in the Chatfield Lake project to joint flood control-conservation purposes, including storage for M&I water supply, agriculture, environmental restoration, and recreation and fishery habitat protection and enhancement. Appropriate non-federal interests shall agree to repay the cost allocated to such storage in accordance with the provisions of the Water Supply Act of 1958, the Federal Water Project Recreation Act, and such other Federal laws as the Secretary determines appropriate (33 United States Code [USC] Section [§] 2201 et seq.; Public Law 99-662; 100 Statute 4082).

Section 808, as amended, authorizes the Secretary of the Army to implement a reallocation of existing storage at Chatfield Reservoir to any of several named purposes upon meeting two conditions. First, the Colorado Department of Natural Resources (CDNR) must request and coordinate the reallocation. Second, the Chief of Engineers must find the reallocation to be feasible and economically justified. If these conditions are met, the Secretary can approve reallocation



Chatfield Reservoir Storage Reallocation FR/EIS
U.S. Army Corps of Engineers, Omaha District

Figure 1-1
Study Region

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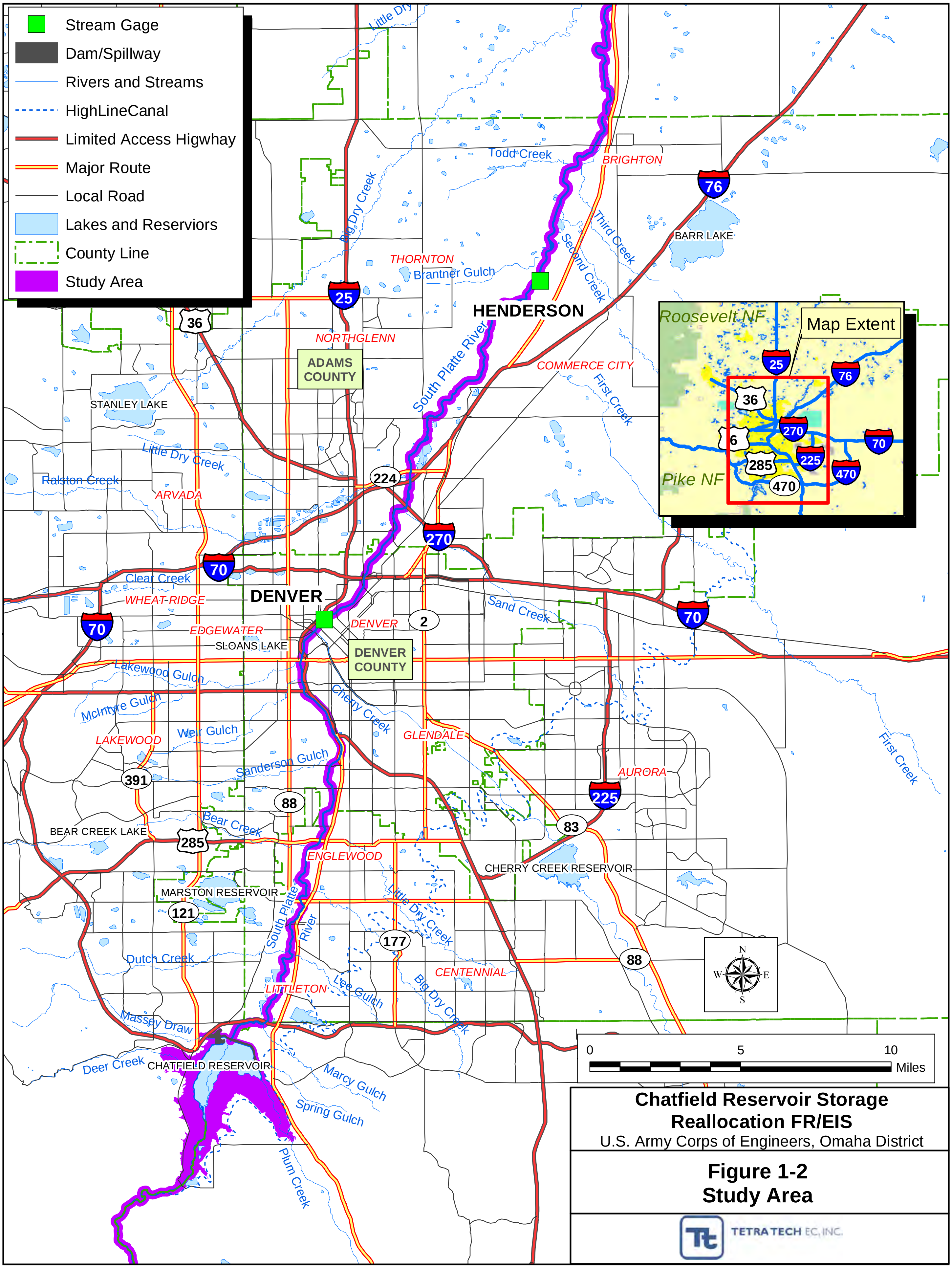

Chatfield Reservoir Storage Reallocation FR/EIS

U.S. Army Corps of Engineers, Omaha District

Figure 1-2
Study Area

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without obtaining additional authority from Congress. This FR/EIS has been prepared under the Section 808 project authorization to document the study, its findings, and the recommendation of a tentatively selected plan and conduct the analyses required to support the Chief of Engineer's findings (ER1105-2-100, page 4-2).

Section 116 of the Omnibus Appropriations Act of 2009 (P.L. 111-8) authorizes CDNR to perform facility modifications and mitigation for the project, provided that the Secretary of the Army collaborates with CDNR and local interests to determine storage cost repayments that reflect the limited reliability of the reallocated storage space. In accordance with Implementation guidance for Section 116 of the Omnibus Appropriations Act of 2009, the Secretary must make a determination whether the in-kind credits that would be afforded to CDNR are integral to the reallocation project. On January 31, 2012 the CDNR reconfirmed interest in the project and on February 10, 2012, through its office the CWCB, identified work that is important for project implementation. Specifically, CWCB identified that work integral to the project to be completed after execution of the Project Partnership Agreement (PPA) at 100 percent non-federal cost includes but is not limited to: 1) on-site and off-site environmental mitigation; 2) modification/re-construction of all impacted recreation facilities; 3) utility relocations; 4) earthwork and shoreline contouring; 5) road, bridge and parking lot construction; 6) demolition, clearing, and grubbing; and 7) vegetation management. Both letters from CDNR are located in Appendix DD.

1.5 Project Allocation

Reservoir water levels vary with the amount and timing of inflows and of releases for flood risk management or water rights. Chatfield Reservoir currently consists of four storage layers referred to as pools (i.e., inactive/sediment storage, multipurpose-conservation, flood control, and maximum surcharge/spillway design flood) that are used for different purposes. These pools are discussed in detail in Chapter 2. The existing multipurpose-conservation pool, which extends from 5,385 to 5,432 feet above mean sea level (msl) , contains existing water storage rights of 10,785 acre-feet between 5,423 and 5,432 feet msl held by Denver Water (USACE 2005a). Denver Water considers its use of this pool to be a vital and permanent component of its water supply system. Denver Water uses water stored in Chatfield Reservoir primarily for exchange to its upstream reservoirs, such as Strontia Springs and Cheesman. Water is released from Chatfield Reservoir to supply a senior water right downstream of Chatfield, in exchange for allowing Denver Water to divert a like amount of water at its upstream reservoirs with more junior water rights. Filling these upstream reservoirs allows Denver Water to deliver water to treatment plants. In addition, Denver Water uses the available space in Chatfield Reservoir to provide bypass flows in the South Platte River between Strontia Springs Dam and Chatfield Reservoir that maintain the trout fishery in Waterton Canyon. Without the storage space in Chatfield Reservoir and the subsequent exchange operations, these flows would be lost from the Denver Water system. Because the 1979 Agreement granting Denver Water the exclusive right to store water in Chatfield Reservoir is only modifiable by mutual agreement, Denver Water considers any alternatives that would decrease the amount of its storage capacity in Chatfield to be unacceptable. As a result, water below 5,432 feet msl is not available for reallocation and cannot be redefined as an integrated pool with other water providers.

The reallocated storage space in the conservation pool would be filled using water rights belonging to a consortium of 15 water providers listed in Table 1-1. This reallocation would enable the providers to better manage existing and future water supplies to be used for municipal, industrial, agricultural, recreational, and fish and wildlife needs in response to population growth in the Denver Metro area. The maximum reallocation under consideration for this Chatfield Reservoir storage reallocation study is 20,600 acre-feet, representing an increase in the permanent pool to 5,444 feet msl, an increase of 12 feet.

Table 1-1
Colorado Water Providers Requesting Storage Space in Chatfield Reservoir

Entity Requesting Storage	Nature of Entity	Purpose of Use of Storage	Maximum Storage Reallocation (acre-feet)	Percent of Costs and Storage Reallocation
Downstream Water Providers				
City of Aurora	Municipality	Municipal and Industrial[2]	3,561	17.3
City of Brighton[1]	Municipality	Municipal and Industrial	1,425	6.9
Central Colorado Water Conservancy District (WCD)	Agricultural	Agricultural	2,849	13.8
Colorado State Parks	Governmental: State Agency	Recreation	1,000	4.9
Denver Botanic Gardens at Chatfield	Governmental: City and County of Denver	Recreation and Agriculture	40	0.2
Western Mutual Ditch Company	Agricultural	Agricultural	1,425	6.9
Upstream Water Providers				
Castle Pines Metropolitan District[3]	Local government serving Denver suburban area	Municipal and Industrial	660.58	3.2
Castle Pines North Metropolitan District[3]	Local government serving Denver suburban area	Municipal and Industrial	822.58	4.0
Centennial Water and Sanitation District (WSD)[3]	Local government serving Denver suburban area	Municipal and Industrial	5,253.95	25.5
Center of Colorado WCD	Governmental: Park County	Municipal and Industrial	131.32	0.6
Mount Carbon Metropolitan District[1]	Local government serving Denver suburban area	Municipal and Industrial	400	1.9
Perry Park Country Club[1]	Private	Municipal	100	0.5
Roxborough WSD[3]	Local government serving Denver suburban area	Municipal and Industrial	500	2.4
Other South Metro Water Supply Authority (SMWSA)[3]	Local governments providing water supplies to Denver suburbs	Municipal and Industrial	1,418.42	6.9
Town of Castle Rock[3]	Municipality	Municipal and Industrial	1,013.16	4.9
Total			**20,600**	**100%**

1 The City of Brighton, Mount Carbon Metropolitan District, and Perry Park Country Club have given written notice to CWCB (March 22, 2010, August 27, 2010, and April 8, 2011, respectively) of their intent to surrender their allocations and withdraw from the Chatfield study. Information pertaining to the reassignment of their allocations will be provided when available. The occurrences of the City of Brighton, Mount Carbon Metropolitan District, and Perry Park Country Club are highlighted in yellow as a place-holder for these changes.

2 Municipal and Industrial uses may include domestic, mechanical, manufacturing, and industrial uses; power generation; fire protection; sewage treatment; street sprinkling; irrigation of parks, lawns, gardens, and grounds; and augmentation and replacement, recharge, use as a substitute water supply, and exchange for water supplies also dedicated to these types of uses.

3 The SMWSA includes the following nine local-government water providers that are participants in the Chatfield Reservoir storage reallocation study: Arapahoe County Water and Wastewater Authority, Castle Pines Metropolitan District, Castle Pines North Metropolitan District, Town of Castle Rock, Centennial WSD, Cottonwood WSD, Roxborough WSD, Stonegate Village Metropolitan District, and Denver Southeast Suburban Water and Sanitation District (doing business as Pinery Water and Wastewater District).

The specific water providers and their CWCB-approved allocations in Table 1-1 were arrived at by consensus of all interested water providers in the following manner. At the request of the Corps and the CWCB, a subcommittee of water providers was formed in June 2004 to determine the allocation among interested water providers of the potentially available 20,600 acre-feet of storage space in Chatfield Reservoir. The subcommittee held 11 meetings over a six-month period to develop a consensus on a fair and equitable storage space allocation. The process emphasized that all potentially interested water providers know of, and have an opportunity to obtain, storage space in Chatfield Reservoir on an equal footing, if such storage space were made available. Extensive efforts were made to have as many potentially interested water providers aware of the process as possible. Thirty water providers participated in the process. Some water providers attended early meetings but then chose not to attend later meetings or otherwise be involved in the process. Sixteen water providers ultimately determined they desired storage space in Chatfield Reservoir and would pay a share of feasibility study costs and cooperate by providing technical information with no guarantee that storage space would be made available. Initially this group, which included municipal, agricultural, and recreational water providers, collectively expressed its desire to acquire approximately twice the maximum storage space potentially available. During early deliberations, the group established a ground rule that any allocation among the water providers must receive unanimous agreement. Therefore, concessions were required by nearly all water providers before the required consensus could be reached. Part of the eventual compromise included the equal splitting of storage space between upstream water providers and downstream water providers, further reinforcing the equitable aspect of the allocation. Downstream water providers included water providers located within the Chatfield Reservoir storage reallocation study area. At a decisive meeting in November 2004, the group unanimously agreed on the allocation. The decision was formalized by CWCB approval on January 27, 2005. Agreements between the CWCB and the 16 participating water providers were signed in March 2005, completing the allocation process.

The agreements included a mechanism to transfer allocation ownership. In 2007, one of the upstream water providers chose not to pursue its allocated maximum 100 acre-feet of storage. This maximum storage allocation was partitioned among the remaining upstream water providers who wished to acquire additional storage at Chatfield Reservoir, according to the mechanism set forth in these agreements. The resulting allocation among the 15 water providers was approved by the CWCB on July 11, 2007. In 2008 one of these water providers, Parker WSD, opted not to participate in the Chatfield storage reallocation. Mount Carbon Metropolitan District assumed the place of Parker WSD, as presented in Table 1-1. Several entities, including Centennial WSD, Castle Pines North, Castle Pines Metro, Center of Colorado WCD and Mount Carbon Metropolitan District, received portions of the Parker WSD allocation, as presented in Table 1-1.

The goal of this Chatfield Reservoir storage reallocation study is to provide decision-makers and the public with an assessment of the positive and negative impacts that could result from the selection of each of the various alternatives, including the tentatively selected alternative. Any decision, then, can be made with the best available information after objectively weighing the positive and negative effects of each alternative. As described in Section 1.4, this study also has been prepared under the Section 808 project authorization to develop the plan and conduct the analyses required for the Chief of Engineers to determine whether the reallocation is feasible and economically justified.

1.6 Purpose and Need Statement

With the main problem being defined as increasing water demand in the Denver Metro area, the next task is to define the project planning objectives, which go hand in hand with a specifically defined purpose and need statement. The statement of purpose and need is important in determining the range of alternatives to be evaluated in this combined feasibility report and environmental impact statement (FR/EIS) as required by the National Environmental Policy Act (NEPA). The purpose and need is as follows:

The purpose and need is to increase availability of water, sustainable over the 50-year period of analysis, in the greater Denver area so that a larger proportion of existing and future (increasing) water needs can be met.

The action is a component in the overall effort to meet the water supply needs of the greater Denver area, and it would contribute to meeting a portion of those needs. One alternative considered the reallocated storage space in Chatfield Reservoir would be filled using existing or new water rights, including wastewater return flows and other decreed water rights, belonging to a consortium of water providers. The primary objective of the reallocation is to help enable water providers to supply water to local constituents, mainly for municipal, industrial, and agricultural needs, in response to rapidly increasing demand. Chatfield Reservoir is well placed to help meet this objective, because the reservoir provides a relatively immediate opportunity to increase water supply storage without the development of significant amounts of new infrastructure, it lies directly on the South Platte River (efficient capture of runoff), and it provides an opportunity to gain additional use of an existing federal resource.

As Colorado's population is projected to approximately double by 2050 (CWCB 2011), there is a significant impact on water planning and management strategies in the Denver Metro area. Some of the water providers in the Denver Metro area (mainly downstream of Chatfield Reservoir) rely mainly on junior surface water rights, surface water exchanges and agricultural transfers, and existing/new gravel lake storage, while others (South Metro providers mainly upstream of Chatfield Reservoir) rely most heavily on nonrenewable, nontributary groundwater (NTGW). Increased reliance on nonrenewable NTGW for permanent water supply brings serious reliability and sustainability concerns. As the NTGW source becomes less reliable, it will become more expensive to obtain. Because its availability is not reliant on weather patterns, NTGW provides a very important supply of water during drought. Because the Chatfield Reservoir storage reallocation project would help lessen reliance on the finite supply of groundwater, the project would assist not only in helping to meet water supply objectives, but also would help upstream water providers meet their management goals of becoming less reliant on groundwater and of extending the availability and life of these critical aquifers for use by future generations. Thus, development of surface water supplies helps meet supply needs during both wet and dry periods in the future.

Several constraints affect the primary objective of helping to meet water demand. Plans to meet the study objectives must avoid violating the constraints, so they are important considerations in selecting a preferred plan. Three reservoirs, consisting of Chatfield Reservoir, in conjunction with Cherry Creek and Bear Creek reservoirs (i.e., Tri-Lakes), are managed to protect the Denver Metro area from catastrophic floods that devastated the area periodically, as reported for more than 100 years prior to their construction. This function is still very important today, and cannot be compromised. In addition, other originally authorized purposes of Chatfield Reservoir include recreation and fish and wildlife. With nearly 1.5 million visitor days annually, Chatfield State Park is one of the most important parks in the Colorado State Parks system. Chatfield also holds a diverse array of habitats that are important to many fish and wildlife species, including the federally protected Preble's meadow jumping mouse. It is very important to ensure that sufficient environmental mitigation and recreational modifications are met upon implementation of a reallocation at Chatfield Reservoir, and the Corps must uphold its responsibility to protect animals and plants (and their critical habitats) protected under the Endangered Species Act (ESA).

In reaffirming its commitment to the environment, USACE formalized a set of seven Environmental Operating Principles (EOP) applicable to all its decision-making and programs. The EOP are identified and explained in Engineer Regulation (ER) 200-1-5, dated October 30, 2003. The EOP and associated doctrine highlight the Corps' roles in, and responsibilities for, sustainability, preservation, stewardship, and restoration of our nation's natural resources. It is an important sub-goal of the Corps to meet these EOP. The EOP are consistent with the stated objectives and sub-objectives of the Chatfield Reservoir storage reallocation study, and can be viewed online at: http://www.hq.usace.army.mil/cepa/envprinciples.htm.

The seven EOP are:

1. Strive to achieve Environmental Sustainability. An environment maintained in a healthy, diverse, and sustainable condition is necessary to support life.

2. Recognize the interdependence of life and the physical environment, and consider environmental consequences of Corps programs and activities in all appropriate circumstances.

3. Seek balance and synergy among human development activities and natural systems by designing economic and environmental solutions that support and reinforce one another.

4. Continue to accept corporate responsibility and accountability under the law for activities and decisions under our control that impact human health and welfare and the continued viability of natural systems.

5. Seek ways and means to assess and mitigate cumulative impacts to the environment; bring systems approaches to the full life cycle of our processes and work.

6. Build and share an integrated scientific, economic, and social knowledge base that supports a greater understanding of the environment and the impacts of our work.

7. Respect the views of individuals and groups interested in Corps activities: listen to them actively, and learn from their perspective in the search to find innovative win-win solutions to the Nation's problems that also protect and enhance the environment.

1.7 National Environmental Policy Act (NEPA)

This section describes NEPA, the scope of the study, the study funding program and sponsors, and the scoping summary.

NEPA of 1969 requires environmental impacts be considered within the federal decision-making process. The Council on Environmental Quality (CEQ) established regulations for implementing

NEPA (under Title 40 of the Code of Federal Regulations [CFR] § 1500). USACE has its own supplemental regulations for complying with NEPA (33 CFR 230) for its Civil Works Program. These regulations call for the preparation of an EIS for authorization of any major federal project that could have significant effects on the environment. An authorization for a major project also requires the preparation of a Feasibility Report (FR). The purpose of the FR is to identify, evaluate, and recommend to decision-makers an appropriate coordinated, implementable solution to the identified water resources problems and opportunities (ER 1105-2-100). NEPA (40 CFR §1500.4(o) and §1506.4) and USACE implementing regulations (33 CFR 230.13, and ER 1105-2-100, Paragraph 4-3.b.(3), April 22, 2000) encourage incorporating the EIS into the FR to reduce paperwork. This report constitutes the FR/EIS for the Chatfield Reservoir storage reallocation study.

WRDA 2007, as amended, and the Corps' Planning Guidance Notebook (ER 1105-2-100) require that mitigation planning be an integral part of the overall planning process. Under Section 2036(a) of WRDA, the Corps must ensure that any report submitted to Congress for authorization does not select a project alternative without either a specific plan to mitigate fish and wildlife losses or a determination of negligible adverse impacts. Specific mitigation plan components are required, including 1) monitoring until successful, 2) criteria for determining ecological success, 3) a description of available lands for mitigation and the basis for the determination of availability, 4) the development of contingency plans (i.e., adaptive management), 5) identification of the entity responsible for monitoring; and 6) establishing a consultation process with appropriate Federal and State agencies in determining the success of mitigation (USACE 2009a). The Corps defines adaptive management as an organized and documented undertaking of goal-directed actions, while evaluating their results to determine future actions. Simply stated, adaptive management is doing, while learning in the face of uncertain outcomes (Barnes 2009). According to the National Research Council's 2004 Adaptive Management for Water Resources Project Planning, adaptive management promotes flexible decision-making that can be adjusted in the face of uncertainties, as outcomes from management actions and other events become better understood. The use of adaptive management in the Chatfield Reservoir storage reallocation study is discussed in Section 4.1.1. The water providers and the Corps are dedicated to implementing the adaptive management strategy detailed in Chapter 4 to address any areas of uncertainty in the impact analysis. The adaptive management strategy will involve several agencies and interested parties.

The USACE Omaha District Commander is the responsible official for NEPA actions within the district boundary. Ultimately the decision whether or not to implement the action recommended in this report will be made at the level of USACE Headquarters in Washington, DC. Compliance with other environmental statutes and regulations, including coordination letters with government agencies, are documented in Appendix S.

1.7.1 Scope of Study

USACE is authorized to carry out civil works water resources projects for navigation, flood damage reduction, ecosystem restoration, storm damage prevention, hydroelectric power, recreation, and water supply. Planning for these water resource projects is based on the P&Gs adopted by the U.S. Water Resources Council. USACE follows a six-step planning process defined in the P&Gs: (1) identify problems and opportunities, (2) inventory and forecast conditions, (3) formulate alternative plans, (4) evaluate alternative plans, (5) compare alternative plans, and (6) select a plan. Civil works studies should be in compliance with state and federal laws. NEPA requires USACE to comply with a process that can include the inventory and assessment of the environmental resources within the study area (ER 1105-2-100).

Reallocation is the reassignment of the use of existing storage space in a reservoir project to another use. A reallocation report is separate from a reallocation action. A report may include future needs, but a reallocation action can only be implemented to satisfy immediate needs. For the alternatives considered, needs are immediate. Whenever a reallocation is contemplated, a reallocation report must be prepared. This report can vary in length depending upon the size of the change and the issues encountered. The purpose of the report and the topics to be discussed are as follows: (1) identify and quantify the new use and user; (2) evaluate the impacts on the project purposes and users; (3) determine environmental effects; (4) determine the price to be charged the new user; and (5) determine appropriate compensation, if any, to existing users/beneficiaries (USACE 1998). The scope of this Chatfield Reservoir storage reallocation study focuses on natural and cultural resources within, upstream from, and downstream from the existing Chatfield Reservoir and how the proposed action and alternatives could affect those resources. Much of the analysis focuses on the effects of water levels in the reservoir, including the increase in elevation, and the fluctuations associated with regular operations. The potential effects of changes in the amount and timing of releases from the reservoir are also addressed.

The operational plan for the proposed action establishes how water levels within the reservoir would be managed to meet the needs of the water suppliers without interfering with Denver Water's contractual commitments to maintain water levels of at least 5,423 feet msl, and 5,426.94 feet msl during the period May 1 through August 31 of each year, at Chatfield State Park except during periods of severe and protracted drought, as determined by the State of Colorado and endorsed by the Omaha District Engineer, USACE. Much of the analysis focuses on the operational plan because water levels within the reservoir have a direct bearing on the potential to affect most of the resources considered in this study. The analysis of the proposed action and alternatives for this study varies by resource but generally identifies the key concerns identified during the scoping process for each resource. For example, the analysis includes parameters such as the acreage of upland and wetland habitat inundated at the reallocated conservation pool elevation or otherwise impacted, an assessment of the effects on recreational activities (boating and fishing, for example) and facilities (such as boat ramps and picnic tables), and the effects of water levels on water quality and aquatic and wildlife habitat. Socioeconomic resources are considered on a regional basis and include the impact of change to Chatfield State Park, concessions operating within it, and the socioeconomic effects of water storage within and outside of Chatfield Reservoir. The analysis also identifies mitigation measures aimed at avoiding or minimizing impacts to particular resources.

1.7.2 Study Funding Program and Sponsors

The Chatfield Reservoir storage reallocation study is being accomplished jointly between USACE and CWCB. The study costs for the project will be divided evenly between these two agencies. USACE's share is provided through General Investigation funds. CWCB's share of funding may be distributed among the water provider groups. CWCB is the local sponsor for the Chatfield Reservoir storage reallocation study.

1.7.3 Scoping Summary

The regulations for implementing NEPA require USACE to employ scoping as an early and open process to identify significant concerns from the public, organizations, and agencies. The concerns identified during scoping and summarized below focused the analysis within the FR/EIS. USACE published a Notice of Intent (NOI) to prepare this FR/EIS in the Federal Register on September 30, 2004, and hosted scoping meetings for the public on October 26 and 27, 2004. An additional agency scoping meeting was held February 10, 2005. USACE received 29 verbal comments at the meetings, as well as 17 letters containing a total of 160 comments and 11 emails with comments, totaling approximately 200 individual comments.

Comments ranged from broad concerns to very specific positions or recommendations for analysis and provided input on all aspects of the FR/EIS process, including authorizations, alternative analyses, baseline conditions, impact analyses, and mitigation.

One comment suggested that the discussion of purpose and need should describe the multipurpose authorities stated in the enabling legislation (i.e., M&I water supply, recreation, fish and wildlife) and explain how they relate to discharges and the operational model. Other comments indicated that the funding authorized through the Land and Water Conservation Fund Act (LWCF) provided funds for Chatfield State Park and that the discussion of authorizations should include the implications of the LWCF funding.

Comments concerning alternatives requested that USACE consider specific water conservation measures as part of either the No Action Alternative or of one that did not involve the reallocation of additional water storage. Recommended conservation measures included:

- Continuing water rate surcharges all year
- Continuing no-water days for the whole watering season (mandatory)
- Giving rebates year-round for the installation of low-flush toilets
- Placing a water rate surcharge on bluegrass and median grass
- Using outlying reservoirs/off-channel storage
- Promoting the use of water budgeting systems in the metropolitan area
- Conserving and reusing
- Stabilizing the population
- Leasing agricultural water rights

Commenters indicated that it was important to know how the additional storage capacity would be filled and managed. One concern was the effect on operations by junior versus senior water rights among the water providers slated for the increased storage. Commenters also suggested a discussion on the effect reallocation could have on operational changes to other reservoirs in the South Platte River Watershed. The most widely expressed concern about operations surrounded the effects of water level fluctuations on numerous resources, including aquatic resources, wildlife habitat, vegetation (including noxious weed establishment and control), water quality, and recreation (including the use of the beach by swimmers and potential hazards to boaters).

Public sector and agency commenters requested the analysis identify a number of species for consideration, including special status plants and animals, migratory birds, water birds, sport fish, and non-sport fish. Specifically, commenters expressed concern about the loss of habitat as a result of the increased water levels and the negative effects that fluctuating water levels could have on breeding and spawning areas.

Recreation-related comments focused on fluctuating water levels and how they could affect access to boating, fishing, swimming, scuba diving, bird watching (including wildlife viewing), and handicapped fishing access. Boaters additionally expressed concern about the potential hazards that would result from trees and brush being inundated. Concerns were also identified regarding the potential to inundate new roads built within the park and the width of proposed bicycle lanes.

Socioeconomic issues raised in scoping comments included the benefits of relatively low costs for increased storage capacity in the reservoir and concern about the loss of revenues for the park and concessionaires operating within it. One commenter also requested that the FR/EIS address environmental justice (Executive Order 12898).

Some comments on Denver Water's proposal to pump water from below the conservation pool elevation in times of drought suggested including the proposal as part of this FR/EIS, while other commenters pointed out that they are two separate and unrelated projects that should not be considered together. The assessment of cumulative impacts calls for all past, present, and reasonably foreseeable projects to be evaluated, however, and because the pump/drawdown proposal is considered reasonably foreseeable, it is included in the discussion of cumulative effects. Other issues identified as appropriate for cumulative effects include the potential impact on South Platte Park from recreational users displaced from Chatfield State Park, as well as the effects of the Last Chance diversion from the South Platte River with a pump at Kassler (upstream of Chatfield Reservoir and downstream of the High Line Canal headgate) and the temporary pump station near the Fox Run picnic area, which pumps water from Chatfield Reservoir.

Commenters from the public, organizations, and agencies offered suggestions on mitigation. One group suggested that mitigation include regularly updated announcements of changes in the water levels via a phone number or website. Other commenters suggested that any relocated recreation facilities be designed to survive flooding. CDOW offered technical guidance on planting, while the Chatfield Basin Conservation Network, Denver Botanic Gardens at Chatfield, and Douglas County all offered assistance in identifying, developing, and/or maintaining mitigation areas in order to maximize benefits.

1.8 Summary of Prior Studies, Reports, and Existing Projects

Over the years, there have been many studies and proposals addressing issues of flood risk management, water storage, recreation, and fish and wildlife habitat. The planning process for this project has relied on these past studies to obtain information about the watershed to guide the analysis.

1.8.1 Colorado Department of Public Health and Environment Water Quality Control Commission: Regulation Number 73 Chatfield Reservoir Control Regulation, 1999 and 2006

The Colorado Water Quality Control Commission (CWQCC) adopted a total maximum annual load (TMAL) for phosphorus within the Chatfield Reservoir in 1989. Regulation Number 73 codifies the

TMAL and establishes phosphorus wasteload allocations to point and non-point source discharges. The regulation also defines the Chatfield Watershed Authority's responsibility in implementing the TMAL and monitoring water quality within the watershed (CWQCC 1999). The control regulation was amended in 2005 with an effective date of January 30, 2006 (CWQCC 2006).

1.8.2 Chatfield Watershed and Reservoir: 1986–1995 Historical Data Analysis and Monitoring Program Review, 1997

The Denver Regional Council of Governments (DRCOG) developed this annual report to CWQCC for the Chatfield Watershed Authority. The report supported the development of Regulation Number 73. The report characterizes water quality monitoring results collected between 1986 and 1995 within the Chatfield Watershed. Data collection included specific chemical, physical, and biological parameters. The report also describes the trophic condition of the reservoir over time, related to nutrient concentrations (Chatfield Watershed Authority 1997).

1.8.3 Chatfield Watershed Authority Annual Reports: 1989–2010

The Chatfield Watershed Authority annually monitors Chatfield Reservoir and inputs from the watershed. A generally continuous collection of surface water quality data in the watershed and reservoir began in 1990. Data collection includes specific chemical, physical, and biological parameters. The Authority produces an annual report summarizing water quality trends in the reservoir and watershed (Chatfield Watershed Authority, 2010. These annual reports and electronic data files track reservoir loading, trophic state, and associated factors affecting water quality management.

1.8.4 Report on Surveys for Preble's Meadow Jumping Mouse and Ute Ladies'-Tresses Orchid, 1998 and Preble's Meadow Jumping Mouse, 2001

The purpose of this report was to define the presence or absence for the Preble's meadow jumping mouse and Ute ladies'-tresses orchid on lands administered by USACE by conducting surveys in the Tri-Lakes project area, which includes the Chatfield Dam and Lake Project area (the area acquired by the USACE near Chatfield Reservoir). The surveys were conducted on the area potentially affected by the flooding of Chatfield Reservoir, including Deer Creek. The survey found the Preble's meadow jumping mouse along the South Platte River above Chatfield Reservoir and along Plum Creek. No Ute ladies'-tresses orchids were found within the Chatfield Dam and Lake Project area (Burns and McDonnell 1998). Another survey was conducted June 25–29, 2001, along Deer Creek upstream and downstream of the culvert under Colorado Highway 121 in areas with suitable habitat for the Preble's meadow jumping mouse; none were found (Burns and McDonnell 2001).

1.8.5 Biological Assessment Routine Operation of Chatfield Dam and Reservoir Effects on Preble's Meadow Jumping Mouse, 1999

In 1998, the U.S. Fish and Wildlife Service (USFWS) issued a final rule to list the Preble's meadow jumping mouse as a federal threatened species under the ESA of 1973, as amended (16 USC 1531 et seq.). Consequently, between August 11 and 20, 1998, a survey was conducted for Preble's meadow jumping mouse at Chatfield State Park. The survey located a total of 13 Preble's meadow jumping mice. Four mice were found on the South Platte River upstream of the dam, and nine were found on Plum Creek (Burns and McDonnell 1999).

1.8.6 Draft Existing Conditions Report for Biological Resources, 2000

This report addressed the existing conditions of biological resources, including vegetation, wildlife, wetlands, fisheries, and special status species. Special status plant and wildlife habitat include potential Ute ladies'-tresses orchid habitat in five areas around Chatfield Reservoir. Additionally, four sites at Chatfield State Park were determined to possess potential Preble's meadow jumping mouse habitat (Foster Wheeler 2000a).

1.8.7 Draft Existing Conditions Report for Cultural Resources, 2000

This report addressed the existing conditions of cultural resources within the Chatfield Reservoir storage reallocation study area. The project area included the identification and recordation of 43 cultural resource locations. These include 26 prehistoric archaeological sites, 3 prehistoric isolates (i.e., fewer than five flakes within a restricted area with no associated features), 11 historic archaeological sites, and 3 archaeological sites that contain both prehistoric and historic components. All of these sites have either been destroyed or are outside of the area potentially affected by the 12-foot rise in the reservoir's elevation (Foster Wheeler 2000b).

1.8.8 Chatfield Lake Project, Colorado: Master Plan Update, Final Environmental Assessment and Finding of No Significant Impact, 2002

This master plan provides direction for project development and use, mainly related to recreation. Its intent is to document policies and analyses that determine appropriate uses and levels of development of project resources, provide a framework to develop and implement the Operational Management Plan and Annual Management Programs, and to establish a basis to evaluate out-grant and recreation development proposals. A finding of no significant impact was based on the environmental assessment of new alternatives proposed in the updated master plan (USACE 2002a).

1.8.9 Chatfield Reallocation Study Storage Use Patterns, 2003

The purpose of this report was to determine the feasibility of diverting water under existing water rights to storage space in Chatfield Reservoir resulting from the proposed reallocation of flood storage to conservation. A spreadsheet model was developed to analyze the potential use of the reallocation pool under 15 potential modes of operation. The results of the modeling indicate that the water rights available to the water providers were sufficient to efficiently use the reallocated reservoir storage space under all pool sizes (CWCB 2003).

1.8.10 Chatfield Reservoir Recreation Facilities Modification Plan, 2010

The 2010 EDAW, Inc. (EDAW) report documents the results of a study to identify opportunities and costs for the modifications of recreation facilities and uses at Chatfield State Park to offset impacts that would result from the reallocation of 20,600 acre-feet of flood control storage to conservation storage in the Chatfield Reservoir. In addition to recreation facility impacts, a portion of the road entrance would need to be realigned and a segment of the main park road would have to be located farther from the lake based on potentially increased water levels. The report also addresses the same issues for the 7,700 acre-foot alternative. The EDAW 2010 report is included as Appendix M in this FR/EIS.

1.8.11 Chatfield Storage Reallocation Project Rare Plant Survey for the Ute Ladies'-Tresses Orchid and the Colorado Butterfly Plant, 2005 and 2006

This report discusses the results of rare plant surveys conducted in 2004 at Chatfield State Park for two federally threatened species, the Ute ladies'-tresses orchid and the Colorado butterfly plant. Six generalized locations where potential habitat may be found in areas possibly impacted by the proposed reallocation project were selected for site reconnaissance prior to the actual survey. Within these 6 locations, 21 specific potential habitat sites were identified. Some sites possessed characteristics for both species, while other sites included habitat for only one species. Intensive surveys were conducted for both species, but no individuals were found (USACE 2005b). An additional season of surveys was conducted in 2005, but again, neither of these rare plants was found. The report of the 2005 survey was finalized in 2006 (USACE 2006).

1.8.12 Class III Cultural Resources Survey of Chatfield State Park, Arapahoe, Douglas and Jefferson Counties, Colorado, 2007

An intensive Class III archaeological pedestrian survey was recently completed for the USACE to provide an assessment of site locations and conditions within Chatfield State Park (Dominguez et al. 2007). A total of 3,605 acres was surveyed, with the identification of 25 previously unrecorded archaeological sites, of which 2 are prehistoric, 21 historic, and 2 contain historic and prehistoric components. Two prehistoric and 2 historic sites have been recommended as eligible for listing on the National Register of Historic Places (NRHP). In addition to the documented sites, the survey recorded 18 isolated finds, which are defined as small scatters of five items or fewer. The findings of this report are further discussed in Chapter 3.

1.8.13 Tri-Lakes Sedimentation Studies Area-Capacity Report, 2001; Chatfield Portion Updated 2007

The Tri-Lakes report documents changes in storage capacity of the Bear Creek, Chatfield, and Cherry Creek reservoirs. Between 1998 and 2001 gross storage in Chatfield Reservoir decreased by 257 acre-feet, or an annual average of 36.7 acre-feet. The original projected storage depletion rate for Chatfield Reservoir was approximately 234 acre-feet per year.

In 2006, the USACE completed a reconnaissance-level sediment survey of portions of Chatfield Reservoir to determine whether the runoff following the Hayman fire had contributed measurable sediment deposition (USACE 2007). They compared cross-section surveys completed in 1977, 1991, 1998, and 2006, and looked for trends of increasing or decreasing sedimentation levels that may have been associated with the 2002 Hayman fire. Analysis of the data did not show additional, unexpected sediment deposition. At several cross sections, annual deposition rates decreased, in part because of severe drought in the basin. Cheesman Reservoir, located on the South Platte River upstream of Chatfield Reservoir, acts as a sediment trap and has likely captured most of the sediment runoff associated with the Hayman fire (USACE 2007). A sedimentation problem could develop in the future if sediments in Cheesman Reservoir were transported into Chatfield Reservoir.

1.8.14 Metropolitan Water Supply Investigation (MWSI), 1999

The focus of the MWSI (Hydrosphere Resource Consultants 1999) was on exploring means for enhancing the cooperative use of existing water supply systems to meet the future water demands of the Denver Metro area. The MWSI evaluated four main areas: conjunctive use, effluent management, interruptible supply arrangements, and other system integration opportunities. This report discusses the idea of reallocation of storage at Chatfield Reservoir, and the scope of a feasibility study that would be required for reallocation.

1.8.15 South Metro Water Supply Study (SMWSS), 2003

The SMWSS investigated water supply options for the south Denver Metro area through the year 2050. The study area included the northern half of Douglas County. The study was authorized by the Douglas County Water Resources Authority (DCWRA), Denver Water, and the Colorado River Water Conservation District. The DCWRA participants included Centennial WSD, Town of Castle Rock, East Cherry Creek Valley WSD, Arapahoe County Water and Wastewater Authority, Cottonwood WSD, Stonegate Metropolitan District, Pinery Water and Wastewater District, Inverness WSD, Meridian Village Metropolitan District, Roxborough WSD, and Castle Pines North WSD. Many of these entities are also participants in the Chatfield Reservoir storage reallocation study. Some excerpts from the study are included in the Water Supply Demand Analysis (Appendix C). The entire document (Black & Veatch et al. 2003) is available online at http://www.crwcd.org/media/uploads/SouthMetroWaterSupplyStudy11-03.pdf.

1.8.16 Statewide Water Supply Initiative (SWSI), 2004 and Colorado's Water Supply Future, SWSI Phase 2, 2007

The SWSI (CWCB 2004) is a comprehensive study that was started in 2003 by the CWCB. Phase 1 of the study focused on Colorado's existing water supplies and the future water demands, and options for meeting those demands. Phase 1 evaluates the eight major river basins within Colorado, while also taking a statewide perspective. Some excerpts from the study are included in the Water Supply Demand Analysis (Appendix C). Phase 2 of the SWSI (currently in the draft final version) (CWCB 2007a) summarizes the work of Technical Roundtables that were formed to conduct detailed analysis of: (1) Water Conservation and Efficiency (Agricultural and Municipal and Industrial), (2) Alternative Agricultural Water Transfer Methods to Traditional Purchase and Transfer, (3) Delineating and Prioritizing Colorado's Environmental and Recreational Resources and Needs, and (4) Addressing the Water Supply Gap (between Current Supply and Current and Future Water Needs) The overall goal of Phase 2 was to develop a range of solutions to sustainably meet future water needs. The entire Phase 1 and 2 SWSI reports are available online at http://cwcb.state.co.us/public-information/publications/pages/studiesreports.aspxhttp://cwcb.state.co.us/IWMD/Pubs.htm.

1.8.17 Facing Our Future: A Balanced Water Solution for Colorado, 2005

This report was prepared in part as a response to the SWSI study. It presents the views of Colorado's major conservation groups on meeting water demands over the next 25 years. It was prepared by Western Resource Advocates, Trout Unlimited, and the Colorado Environmental Coalition, and was endorsed by Audubon Colorado, the Sierra Club, The Wilderness Society and a number of other conservation organizations (Western Resource Advocates et al. 2005). The reports' model for meeting water demands emphasizes water conservation and efficient use, and protection of environmental values. The report can be accessed online at www.ourcolorado.org/water_future.htm.

1.8.18 Preliminary Reservoir Regulation Manual for Chatfield Dam and Lake, Colorado, 1973

This document contains pertinent descriptive and historical information regarding the Chatfield Dam and Lake Project and the basin, including stream flow, channel capacities, and discharge-damage relationships; procedures for collection and distribution of hydrologic data and forecasts; and the regulations and procedures by which Chatfield Reservoir is regulated. The USACE Omaha District has prepared an update of the manual (called the Chatfield Water Control Manual), including updated sections on project history and description, regulation of water in the conservation pool, and regulation for flood risk management, based on existing conditions. If storage is reallocated in Chatfield Reservoir, the Chatfield Water Control Manual will be further revised to incorporate the revised Water Control Plan, which will reflect the change in storage zones, release schedules, and other reservoir regulation procedures. The draft revision of Section 7 of the Water Control Plan is included as Appendix B. The Water Control Plan has not been updated for other alternatives.

1.8.19 Climate change and water resources management—A federal perspective: U.S. Geological Survey Circular 1331, 2009

This report concludes that the best available scientific evidence based on observations from long-term monitoring networks indicates that climate change is occurring, although the effects differ regionally. Potential climate change impacts affecting water availability include changes in precipitation amount, intensity, timing, and form (rain or snow); changes in snowmelt timing; and changes to evapotranspiration. The results from several general circulation models agree that the southwestern United States is likely to experience precipitation and evapotranspiration changes that result in reduced runoff and water availability (Brekke et al. 2009).

1.8.20 Climate Change in Colorado: A Synthesis to Support Water Resources Management and Adaptation, A Report by the Western Water Assessment for the Colorado Water Conservation Board, 2008

Climate models project that Colorado will warm by approximately 2.5°F by 2025 and by approximately 4°F by 2050, relative to 1950 to 1999 baseline temperatures. The projections show summers warming more (+5°F) than winters (+3°F), and suggest that typical summer temperatures in 2050 will be as warm as or warmer than the hottest 10 percent of summers that occurred between 1950 and 1999. Individual model's projections do not agree whether annual mean precipitation will increase or decrease in Colorado by 2050. More mid-winter precipitation throughout the state is predicted, and in some areas, a decrease in late spring and summer precipitation. Regardless of precipitation, the timing of spring runoff is projected to shift earlier in the spring, and late-summer flows may be reduced. The impact of climate change on runoff in the Platte Basin has not been studied extensively.

The consistent projections for a substantial temperature increase over Colorado have important implications for water management (Ray et al. 2009). Increases in temperature imply more evaporation and evapotranspiration leading to higher water demands for agriculture and outdoor watering. Temperature-related changes in the seasonality of streamflows (e.g., earlier runoff) may complicate prior appropriation systems and interstate compact regimes; and modify the interplay among forests, hydrology, wildfires, and pests (e.g., pine beetles). The current state of the science is unable to provide sufficient information to decision makers and stakeholders on a number of crucial scientific issues regarding Colorado's water resources. The wide range of precipitation projections makes it difficult to assess likely changes in annual mean precipitation by mid-21st century. However, a synthesis of findings in this report suggests a reduction in total water supply by then. Furthermore, there is potential for increased drought severity in the region due to higher temperatures alone.

1.8.21 Global Climate Change Impacts in the United States, Regional Climate Impacts: Southwest, 2009

According to this report, water supplies in the southwestern United States are projected to become increasingly scarce, calling for trade-offs among competing uses. Water supplies in some areas of the Southwest are already becoming limited. Groundwater pumping is lowering water tables, while rising temperatures increase water lost to evaporation. Limitations imposed on water supply by projected temperature increases are likely to be made worse by substantial reductions in rain and snowfall in the spring months when precipitation is most needed to fill reservoirs to meet summer demand. The average temperature in the Southwest has already increased roughly 1.5°F compared to a 1960 to 1979 baseline period (Karl et al. 2009). By the end of the century, average annual temperature is projected to rise approximately 4°F to 10°F above the historical baseline, averaged over the Southwest region (Karl et al. 2009).

1.9 Water Supply and Demand Analysis

In the 1990s, Colorado was the third fastest growing state, surpassed only by Nevada and Arizona. Based on Colorado Department of Local Affairs Demography Division projections, it is estimated that Colorado's population will increase by 65 percent, from more than 4.3 million to approximately 7.1 million, between 2000 and 2030 (CWCB 2004). The South Platte River Basin's population is expected to increase at the same rate, 1.7 percent annually. This anticipated population growth has a significant impact on water planning and management strategies. As of 2004, groundwater provided approximately 880,000 acre-feet per year in the basin for irrigation, and 100,000 acre-feet per year to meet the M&I demands (CWCB 2004). Surface water use within the South Platte River Basin has been changing rapidly over the last few years as municipalities make greater use of agricultural water rights. In 1998, 1.1 million acres of agricultural lands were irrigated with approximately 2 million acre-feet of surface water. Within the same time period, municipal uses accounted for an additional 530,000 acre-feet (CWCB 2004).

In 2003, because of Colorado's population increase and water shortage issues, the Colorado legislature authorized CWCB to implement the SWSI to facilitate understanding of, and preparation for meeting, Colorado's long-term water supply needs. The purpose of the SWSI comprehensive study was to examine existing water supplies and projected water demands in each basin and to identify a range of potential options to meet that demand over the next 25 years. The overall objective of this study was to "help Colorado maintain an adequate water supply for its citizens and the environment" (CWCB 2004). For purposes of this FR/EIS, the SWSI study is used along with demand projections from water providers requesting storage space for the demand analysis numbers for the South Platte River drainage area. The numbers represented in this study are the most comprehensive and current available for Colorado (CWCB 2004).

Over half of Colorado's land area and 85 percent of its population (CWCB 2004) lies in the South Platte and Arkansas River basins, which contribute only about 5 percent of the flows leaving the state. Drought conditions, especially since 2002, have caused concern among residents and political leaders. Calls on senior water rights that had previously never been called out occurred in 2002, and reservoir surface elevations reached unprecedented low levels, bringing about mandatory water use restrictions. Based on this widespread concern, SWSI explored recommendations to find alternative sources of water and develop plans to better conserve Colorado's water. Along with population increases, data from Colorado's 2003 Statewide Comprehensive Outdoor Recreation Plan (SCORP) and the 2001 National Survey of Fishing, Hunting, and Wildlife show that the water-based recreation demand has increased over the past 10 years (as cited in CWCB 2004). The SCORP reports an increase in water-based recreation participants of 21.5 percent between 1995 and 2003 (Colorado State Parks 2003). The importance of recreation and tourism in the economy has also increased over the past 10 years (CWCB 2004).

SWSI explored all aspects of Colorado's water use and development on both a statewide and basin-by-basin level. Findings were made available to local providers, citizens, and communities across Colorado to help shape and plan their future water needs. Major findings included the following: (1) a significant increase in population and recreation water use; (2) irrigated agricultural lands will see a greater reduction as M&I water providers seek transfers of water rights if the identified projects and processes are not successfully implemented; (3) there are reliability and sustainability concerns regarding increased reliance on nonrenewable, NTGW (i.e., groundwater that is essentially unconnected to surface streams and is an exhaustible resource); (4) in-basin solutions can help solve the gap between M&I supply and demand; (5) water conservation will be a major tool in meeting future M&I demands; and (6) beyond 2030, more aggressive strategies may be required to provide water to Coloradoans (CWCB 2004). Some examples of conservation efforts that have been used in the Denver Metro area include education, rebates for low-flush toilets and high efficiency washing machines, water use audits, landscape and irrigation system audits, and tiered water rate structures (CWCB 2004).

Without additional conservation, annual M&I and self-supplied industrial water demands would be projected to increase from 1,194,900 acre-feet in 2000 to 1,926,800 acre-feet by 2030 based on population projections and per capita use rates. However, water conservation that results from the 1992 National Energy Policy Act is projected to reduce the estimated 2030 annual demands by about 101,900 acre-feet. This conservation does not reflect the active measures such as metering, and water rate pricing that are being implemented, planned, or considered by many water providers across the state, and that are considered in SWSI as a future water supply option for meeting demands (CWCB 2004).

From these major findings, recommendations were made to (1) continue ongoing dialogue among all water providers; (2) track and support identified projects and processes; (3) develop a program to evaluate, quantify, and prioritize environmental and recreational water enhancement goals; (4) find alternative forms of funding for environmental and recreational enhancements; (5) create a common understanding of future water supplies; (6) develop implementation plans towards meeting future needs; (7) assess potential new state roles in implementing solutions; and (8) develop requirements for standardized annual M&I use data reporting (CWCB 2004).

The future water supply options that water providers are pursuing to meet their needs are termed "identified projects and processes" in the SWSI study. Identified projects and processes to reduce dependence on water and ensure the availability of water through 2030 include water conservation, agricultural transfers, development of additional storage, conjunctive use of surface water and groundwater, M&I reuse, and control of nonnative phreatophytes. Under a best-case scenario, it is estimated that approximately 80 percent of Colorado's statewide future needs can be met by implementation of these options, leaving a 20 percent gap in supply statewide (CWCB 2004, 2007a).

Average municipal and industrial per capita water use in the South Platte River Basin (measured by taking all M&I demand divided by permanent population) is 206 gallons per capita per day. Some areas of the South Platte River Basin currently rely heavily on nonrenewable groundwater to meet existing demands. Gaps are projected in these areas since its supply is not replenished, and continued groundwater pumping will reduce the yield of existing wells, which will further increase the gap between supply and demand. Mountain areas of the South Platte River Basin have limited groundwater availability and future development may be limited unless surface water supplies are developed and delivered to these areas to supplement the limited groundwater. Most water providers indicated they would not be able to meet the 2030 demands. Estimated demand in the South Platte River Basin by 2050 is 409,700 acre-feet per year (CWCB 2009). Estimated demand met by identified projects and processes, as well as additional water conservation, totals 319,100 acre-feet per year (about 78 percent of future needs), leaving a 90,600 acre-foot gap (or 22 percent) in the South Platte River Basin.

The South Platte River Basin is broken into six subbasins, but areas surrounding the project area include Denver Metro and South Metro subbasins. In Adams, Denver, and Jefferson counties (Denver Metro Subbasin), estimated demand met by identified projects and processes include a total of 108,100 acre-feet per year (using the following conservation measures), leaving a 12,500 acre-foot gap (or 10 percent) of the anticipated 2030 demand of 120,600 acre-feet in the Denver Metro Subbasin. The identified projects and processes are:

- Active water conservation (e.g., metering, increasing water rate pricing, rebates for efficient water using appliances, incentives for reducing high water use landscaping, and restrictions on amount of lawn area).
- Existing supplies.
- Denver Northern Firming (Denver Water's transbasin diversion from Grand County).
- The City of Thornton's agricultural water conversion project with the Water Supply and Storage Company.
- Agricultural transfers.
- New storage (including gravel lakes) and reservoir enlargements.
- Reuse for nonpotable irrigation of parks and golf courses and other landscaping.
- Treating lower quality water sources.

In Arapahoe, Douglas, and Elbert counties (South Metro Subbasin), estimated demand met by identified projects and processes include a total of 38,300 acre-feet per year (using the following conservation measures), leaving a 50,300 acre-foot gap (or 56 percent) (CWCB 2004). The identified projects and processes are:

- Active water conservation (e.g., metering, increasing water rate pricing, rebates for efficient water using appliances, incentives for reducing high water use landscaping, restrictions on amount of lawn area)
- Implementation of South Metro Conjunctive Use Plan or alternative
- Rueter-Hess Reservoir
- Aurora Long-Range Plan
- East Cherry Creek Plan
- Agricultural transfers and reuse
- Additional NTGW
- Reuse for nonpotable irrigation of parks and golf courses and other landscaping
- Indirect potable reuse by the discharge of reusable effluent to a water body for later recapture
- Blending of high quality and low quality water supplies to achieve the maximum volume of potable water that is of acceptable quality
- Treating lower quality water sources

The information presented in this chapter establishes the context of the analysis within the USACE authorities and the purpose and need for the project. The focus of the Chatfield Reservoir storage reallocation study on particular aspects of physical, natural, and cultural resources in and around the Chatfield Reservoir results from the topics discussed above. The remaining chapters provide details on the proposed action and alternatives, describe existing and future conditions for the various resources, and assess the potential positive and negative effects of implementing the proposed action or alternatives.

1.9.1 Water Supply and Demand of the Water Providers

The water providers participating in the Chatfield Reservoir storage reallocation study provided their water demand by decade through 2050. The water demand estimates take into account the water provider's conservation programs that are described in Appendix AA. Table 1-2 shows this demand. Most of the participants were projected to meet their 2010 demand. For example, the City of Brighton will use gravel pits currently under development, while the City of Aurora had several means (such as surplus contingency supplies or Denver Basin groundwater for initial service for new growth) to meet demand between 2008 and 2010. The Central Colorado WCD and Western Mutual

Ditch Company will provide augmentation and irrigation water, respectively. Augmentation is the provision of water to an affected stream to allow out-of-priority diversion from the stream, with the augmented water preventing injury to senior water rights holders on the stream. In this instance, these two agricultural water providers need to augment surface water in order to draw on tributary groundwater that is connected to and depletes surface water. Such augmentations must be approved by the water court. Currently, well pumping from approximately 225 alluvial water wells has been curtailed completely and pumping from another approximately 1,000 wells have been partially reduced by court order until necessary augmentation water is secured. The well pumping curtailment is severely impacting well users as well as adversely impacting local economies. These two water providers are not planning to issue additional shares in the future, so the demand would not change over time. Even as growing municipalities purchase participating farms, their demand is expected to change from agriculture to M&I demand such as for parks, lawns, and golf courses. The Denver Botanic Gardens at Chatfield will have an unmet need of 12 acre-feet that would allow expansion of its operation, but growth beyond 2020 is not anticipated at this time.

Most of the upstream water providers currently use groundwater and will have met their 2010 demand from that source. Roxborough WSD will continue to acquire water from the City of Aurora and will meet an additional M&I demand for 28 acre-feet between 2010 and 2020. Perry Park Country Club will not expand its membership in the future, so demand will remain constant; therefore, 76 acre-feet will be unmet in 2010. Center of Colorado WCD expects an increase in demand for augmentation water in Park County by 2010 and does not expect this to increase between 2010 and 2020.

For all water providers, the increase in demand between 2010 and 2050 will need to be met by developing new sources and using existing developed supplies unused in 2010.

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Table 1-2
Demand in Acre-Feet

Water Provider	Water Demand 2010	Supplies other than NTGW 2010	NTGW Supplies 2010	Unmet 2010	Projected Future Demand 2020	2030	2040	2050
Downstream Providers								
City of Aurora	58,800	58,800	0	0	69,490	82,120	97,040	114,670
City of Brighton[1]	14,150	14,150	0	0	22,000	33,000	33,000	33,000
Central Colorado WCD	89,000	18,250	0	70,750	89,000	89,000	89,000	89,000
Colorado State Parks	3,000	1,200	0	1,800	3,000	5,000	5,000	5,000
Denver Botanic Gardens at Chatfield	40	28	0	12	40	40	40	40
Western Mutual Ditch Company	30,000	15,000	0	15,000	30,000	30,000	30,000	30,000
Upstream Providers								
Castle Pines Metropolitan District	1,467	1,030	437	0	1,620	1,620	1,620	1,620
Castle Pines North Metropolitan District	2,290	0	2,290	0	2,518	2,518	2,518	2,518
Centennial WSD	19,500	9,500	10,000	0	22,500	22,500	22,500	22,500
Center of Colorado WCD	267	70	0	197	267	325	375	425
Mount Carbon Metropolitan District[1]	15	15	0	0	815	1,015	1,036	1,036
Perry Park Country Club[1]	166	90	0	76	166	166	166	166
Other SMWSA[2]	11,421	5,894	5,527	0	16,738	18,868	22,038	22,038
Roxborough WSD	1,996	1,996	0	0	2,024	2,024	2,024	2,024
Town of Castle Rock	8,600	1,841	6,759	0	11,900	15,400	15,400	15,400
Totals	240,712	127,864	25,013	87,835	272,078	303,596	321,757	339,437

1 The City of Brighton, Mount Carbon, and Perry Park have not projected demand for 2040 or 2050, total demands beyond 2030 are conservative.
2 Includes Pinery Water and Wastewater District, Arapahoe County Water and Wastewater Authority, Cottonwood WSD, and Stonegate Village Metropolitan District.

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2. ALTERNATIVES

The CEQ regulations for implementing NEPA require that an EIS "rigorously explore and objectively evaluate all reasonable alternatives" including the No Action Alternative (40 CFR 1502.14(a) and (d)). In determining the scope of alternatives to be considered for meeting the purpose and need, the CEQ guidance states: "reasonable alternatives include those that are practical or feasible from the technical and economic standpoint using common sense" (CEQ 1978). The Corps' regulations in 33 CFR 320.4(a)(2)(ii) require an evaluation that considers "the practicability of using reasonable alternative locations and methods to accomplish the objective of the proposed structure or work." Thus, under NEPA, an EIS provides for full disclosure of potential effects of a proposed federal action and of all reasonable alternatives to that proposal to allow for an informed decision made in the public's interest.

This chapter discusses the problems and opportunities that surround the issue of reallocating storage in Chatfield Reservoir. Considering the complexity of water use and water rights in Colorado, the chapter provides some background information to set the stage for describing the components of the alternatives as well as the impact analysis discussions presented in Chapter 4. Readers are referred to the Water Supply Demand Analysis in Appendix C for additional information on the technical and legal framework for water use. This chapter provides a description of the alternative selection process, including the initial screening of alternatives from a large group of potential water supply concepts. This chapter also provides a detailed description of each of the alternatives and their various components for addressing the purpose and need of the project; gives a description of the methodologies used to evaluate the different alternatives; assesses potential economic and environmental impacts; and, lastly, provides a brief summary of the findings detailed in the alternatives' impact analysis presented in Chapter 4.

2.1 Problems and Opportunities

The first step in the planning process, per USACE regulations, is the identification of problems (i.e., undesirable conditions to be solved) and opportunities (positive conditions to be improved) that the planning team seeks to address ER 1105-2-100, Appendix E, p. E-2). Problems and opportunities encompass current as well as future conditions and are defined in terms of their nature, cause, location, dimensions, origin, timeframe, and importance. The water resource problem to be addressed is the inadequate supply of water to meet increasing water supply demand in the Denver Metro area over the next 50 years due to the combined effects of population growth, depletion of nonrenewable groundwater sources, and agricultural water providers need for augmentation water for alluvial wells.

Problems

1. Population growth has resulted in increased M&I water demands:

   In the past, the Colorado water picture has been difficult to bring into focus given the multitude of individual water users and providers, the voluminous information available, and the complexity of developing water supply solutions. As a means to address the collective water communities' desire to understand its water supply situation, the CWCB undertook, at the direction of the Colorado General Assembly, the SWSI in 2003/-2004 and 2009 to identify water supply needs now and in the future and inventory current and future projects and processes that local and regional entities are planning to fulfill the water supply needs.

The SWSI report first looked at the predicted increase in the state's population. Colorado's population is projected to double between the years 2000 and 2050 (CWCB 2009). Similar growth rates are expected during the same time period within the South Platte River Basin, which includes the Denver Metro area (CWCB 2004, 2009). Based upon the rates of growth, expected per capita M&I water use, and a specified level of long-term water conservation by the area's M&I water providers, SWSI predicted that the South Platte River Basin would require about 1.2 million acre-feet of water by 2050 for M&I purposes (medium scenario demand projection, CWCB 2009). This volume represents a 409,000 acre-foot increase over current (i.e., 2000) water supplies in the basin. Local and regional projects and processes, as reported in SWSI, are predicted to provide for about 78 percent of the identified M&I water supply gap, leaving approximately 90,000 acre-feet of unmet needs.

The 15 prospective recipients of storage space in Chatfield Reservoir (i.e., "water providers") each have immediate and future water needs influencing their actions to acquire new Chatfield storage space. The municipal water providers must supply water to the growing metropolitan area population and are therefore stretched beyond current supplies by the water provider's growth projections referenced above. The water providers project their demand to increase from 250,000 acre-feet in 2010 to at least 340,000 acre-feet in 2050. The drought of 2002 to 2007 emphasized to water providers that, despite increased levels of water conservation measures, their existing water supplies have a greater vulnerability to periods of water scarcity than previously realized and that additional water development activities, including expanding existing surface water storage facilities, are urgently needed to provide adequate water for the growing population during future droughts.

2. Water need has resulted in the reliance of some municipal water providers on nonrenewable Denver Basin groundwater:

   Eleven municipal water providers seeking Chatfield storage space, collectively serving over 200,000 residents and businesses in the south portion of the Denver Metro area, are presently using a high percentage of nonrenewable Denver Basin groundwater supplies as their primary water source until more reliable surface water supplies can be developed. The use of Denver Basin groundwater for municipal water supplies has been determined in a recent study to be an unacceptable long-term supply, a path of severely increasing costs and currently reduced water availability and reliability that will continue to worsen in the future (Black & Veatch et al. 2003). The water providers who are now using Denver Basin groundwater have a need to reduce their dependency on this nonrenewable water source if the long-term availability of these sources during periods of drought is to be preserved. This water is legally reusable; however, the practical ability to reuse usually involves recapture (either downstream or upstream by exchange) and storage of effluent after discharge to a stream.

3. Agricultural water providers need augmentation water for alluvial wells:

   The agricultural water providers seeking Chatfield storage space are also facing an urgent water supply situation. Numerous agricultural water wells of these providers are located in the alluvium adjacent to the South Platte River. These wells generally were constructed in the 1950s or later and have relatively junior water rights. Owners of senior water rights downstream from the well users normally place a call (or request water) during the irrigation season. The agricultural water well pumping causes a delayed depletive impact to the river system and, if a senior water right is calling for water, the depletion caused from well pumping is considered "out-of-priority." Colorado water law allows this out-of-priority pumping effect only if so-called "augmentation water" is available for release to the river to cover the out-of-priority depletions from the well pumping. Currently, well pumping from approximately 450 alluvial water wells has been curtailed completely and pumping from another approximately 2,000 wells have been partially reduced by court order until necessary augmentation water is secured. These wells supply water to 25,000 to 30,000 irrigated acres and divert approximately 25,000 acre-feet of water per year. The drought of 2002 to 2007, considered the worst drought in the last 300 years, exacerbated the situation. The well pumping curtailment is severely impacting well users as well as adversely impacting local economies. The Chatfield Reservoir storage reallocation project would give agricultural water providers additional ability to store augmentation water for later release, thereby giving some relief from this critical well shutdown situation.

Opportunities

1. There is an opportunity to expand the use of an existing storage facility (Chatfield Reservoir) to provide additional water supply:

   To address the water shortages resulting from population growth, Colorado water providers have the options of either stretching existing supplies, developing new supplies, or, most likely, both. SWSI identifies several broad strategies for meeting the South Platte River Basin's future water needs including: development of additional storage, M&I reuse, agricultural water transfers, conjunctive use of surface and groundwater, and additional water conservation (SWSI, Section 8, p 8-1). Developing additional storage is further described as either utilizing new storage projects or expanding the use of existing storage facilities. The reallocation of storage space in Chatfield Reservoir is a project that fits into the strategy of expanding the use of existing storage facilities.

   Storage projects capture water during high-flow years and seasons to be used during low-flow periods, a function that is critical to providing reliable water supplies in a semiarid climate such as Colorado's where the hydrologic events are highly variable. SWSI concludes that "new storage and enlargement of existing reservoirs will be major components in meeting 2030 demands" (SWSI, Section 10.1.9.1, page 10-41). The major opportunity offered, of course, by reallocation of storage space in Chatfield Reservoir is that new storage space is made available in an existing structure without the costly and more environmentally impacting action of constructing new storage facilities.

2. Chatfield Reservoir's on-channel location provides the opportunity to logistically and cost-effectively capture available flow:

The reservoir's location directly on the South Platte River, or "on-channel," allows-the reservoir to always immediately capture all available flows that can be legally stored. This is a significant advantage over off-channel reservoirs that are limited by the design capacity of diversion and delivery facilities. In addition, upstream storage at Chatfield Reservoir could be operated in conjunction with existing off-channel storage facilities further downstream to allow certain water providers to maximize the capture of their junior and free river water. For several of the upstream water providers, Chatfield Reservoir is downstream of their wastewater treatment plant outfalls and provides an opportunity for recapture of reusable water for indirect reuse.

3. Chatfield Reservoir's location at a relatively high elevation within the basin provides opportunity to deliver water by gravity flow:

   Chatfield Reservoir's location and relatively high elevation within the watershed provides the opportunity to deliver water by gravity flow. Since some water providers already receive water deliveries from Chatfield Reservoir, there is less need for the construction of new conveyances (e.g., ditches, pump stations, and pipelines) than there would be from new storage facilities.

4. Strategically timed releases of water from Chatfield Reservoir can potentially provide recreational and environmental benefits to the urban and downstream reaches of the South Platte River.

2.2 Planning Objectives and Constraints

The end of the first step in the planning process, per USACE regulations, is to identify planning objectives and constraints. Planning objectives are the intended purposes of the planning process, specifically an asserting of what the alternative should try to achieve. Constraints are restrictions that limit the extent of the planning process.

2.2.1 Planning Objectives

The purpose and need is to increase availability and reliability of water supply by providing an additional average year yield (which is defined as the average annual amount of water expected to result from the storage of available water rights) of up to approximately 8,539 acre-feet of M&I water, sustainable over a 50-year period, to contribute towards meeting a water supply shortfall projected to be 90,000 acre-feet per year by 2050 for the service area of the 15 water providers. The planning objectives for this project are listed below.

- Provide, over the 50-year planning period, water supply of equivalent quality as currently supplied to the Denver metro region.
- Maintain the authorized purposes of the Chatfield Reservoir as they currently exist which includes maintaining adequate levels of downstream flood control over the 50-year period of analysis.
- Ensure the provision of in-kind recreation facilities and experiences, to the extent possible, during the 50-year period of analysis.
- Ensure maintenance of environmental benefits by minimizing environmental impacts, fully mitigating unavoidable significant impacts, monitoring to evaluate the level of success, and implementing an adaptive management strategy involving input from several agencies.

- Become less reliant on non-renewable groundwater by utilizing renewable water supplies, thus extending the availability and life of these critical aquifers.
- Be consistent with USACE Environmental Operating Principles (EOP) and USACE Campaign Plan goals to extent possible, including robust design, risk management and communication, reliability and adaptability to future change.
- Find collaborative solutions to future Denver Metro Area water supply needs.

2.2.2 Constraints

The regulations describe planning constraints as "restrictions that limit the planning process…including resource constraints and legal and policy constraints" (ER 1105-2-100, p. 2-3). Resource constraints are those associated with limits on knowledge, expertise, experience, ability, data, information, money, and time. Legal and policy constraints are those "defined by law, Corps policy and guidance." Planning constraints also include study-specific constraints. Planning studies can evaluate alternatives that would require further authorization or even changes to existing laws and policies to implement.

For efficiency purposes and to save time and money, the study utilizes several recent and relevant water planning studies as cited throughout this FR/EIS. Particularly the analysis focuses on previous South Platte River Basin storage projects as a source of useful information. Data also considered in this analysis were collected from involved water providers to determine the near-term need for water that could be provided by up to a 20,600 acre-foot reallocation at Chatfield Reservoir.

Although the storage reallocation opportunity at Chatfield Reservoir is clearly a favorable water supply option for the various local water providers, the proposed reallocation of storage space does not come without potential conflicts and impacts relating to the existing uses of the reservoir and the land in the immediate vicinity. Reallocation would not impact the primary flood risk management purpose of Chatfield Reservoir. As discussed in Chapter 1, however, Chatfield Reservoir is one of the Colorado State Park's chief attractions. Open space within the park and its environs provides habitat for numerous species of interest including the federally listed Preble's meadow jumping mouse. Increasing the pool elevation and increasing the magnitude of water level fluctuations within the reservoir would affect recreational uses and environmental resources within the area. Significant environmental impacts must be mitigated. Recreation modifications can be accomplished within the boundaries of Chatfield State Park, but availability of local lands for environmental mitigation is a constraint. Sufficient lands would be needed onsite and offsite to mitigate environmental impacts from the project.

Legal and policy constraints include compliance with county, state, and federal permitting or other requirements. The Clean Water Act and other pertinent environmental laws and regulations must be complied with. A summary of environmental compliance is described in Appendix S.

Study-specific constraints are restrictions unique to the project that alternative plans should avoid. They are designed to avoid undesirable changes between without- and with-plan conditions. Study-specific constraints for this project include:

- The project must be completed in a reasonable timeframe.
- Financial capability of sponsoring water providers may be constraining because they are responsible for 100% of the costs involved in implementing any alternative.
- The project should minimize the use of others' land or, to the extent possible, the availability or capability of other projects.
- The project should avoid the acquisition of water rights owned by others.
- Maintain the conservation pool in Chatfield between 5,423 feet msl and 5,432 feet msl consistent with the contract between The Corps of Engineers and the State of Colorado (March 1, 1979). The State of Colorado signed an agreement with Denver Water granting them the exclusive right to store water in Chatfield in the conservation pool. Storage below 5,432 ft. msl cannot be reallocated because of the in place contract and agreement.
- Reallocation of storage above elevation 5,444 feet msl could adversely impact the flood risk management (FRM) purpose of Chatfield Reservoir, as documented in the Corps' Chatfield Antecedent Flood Study (Appendix R). Modifications of project structures that would allow additional storage to be reallocated to avoid affecting Chatfield's FRM functions would require additional Congressional authorization.
- Reallocation of storage less than 7,700 acre-feet was considered by the water providers to provide too little water supply benefits for the costs involved.
- Water providers would need to hold existing or newly acquired water rights and existing, new, or change-case water storage rights in order to store water in Chatfield Reservoir, another reservoir, or in gravel pits.
- The water rights of the sponsoring water providers are relatively junior in seniority, and the sponsors would be able to store water only when their water rights were "in priority", or during "run of the river" high river flows. Consequently, the average year yield is low compared to the water storage volume.
- Water providers desiring to install any infrastructure associated with on- or off-channel water storage or water distribution systems on Corps project lands must apply to the Corps for a land availability determination. If Corps project lands are determined to be available for the proposed infrastructure, the water providers must acquire the appropriate real estate easements and pay any Corps charges in accordance with Corps real estate regulations.
- Unavoidable impacts to environmental resources that are considered significant would need to be fully mitigated. This includes impacts to the federally listed threatened Preble's meadow jumping mouse habitat, migratory bird habitat, and wetlands. Costs of mitigation maintenance and monitoring costs, and any increase in Corps operation costs of an Alternative would be borne 100 percent by the non-federal entities receiving storage.

- The project must comply with the Clean Water Act and other applicable environmental laws and regulations.
- For any recreational facilities and areas that would be impacted by higher pool levels with reallocation, recreation modifications are required in-kind (the same type and amount of facilities) within the boundaries of Chatfield State Park prior to utilization of the reallocated storage. The cost of recreation modifications must be borne 100 percent by the non-federal entities receiving storage, and are included in the total cost of the project included in Table 5-3.
- Design, materials, and elevations of recreation modification structures need to comply with the provisions of the Northwest Division (NWD) Regulation 1110-2-5, Land Development Guidance at Corps Reservoir Projects, as coordinated with USACE, Omaha District staff.
- If reallocation is implemented, losses of income to Colorado State Parks and concessionaires at Chatfield State Park during the construction period for recreation modifications and environmental mitigation must be reimbursed by the non-federal entities receiving storage.
- Water resource infrastructure operations, water sources, including storage and conveyance components, should comprise of proven operational and management practices to minimize risk of failure to provide required yield.
- Any storage expansion or reallocation scenario within an existing reservoir that negatively affects the flood risk management function of the reservoir should be avoided. The Alternatives cannot impact dam safety.

2.3 Development of Alternatives

One of the key aspects of the NEPA process is the assessment of how various alternatives that meet the purpose and need could affect the environment. The purpose and need is as follows:

> The purpose and need (summarized in the previous section and discussed in Chapter 1), is to increase availability of water in the greater Denver area, sustainable over the 50-year period of analysis, so that a larger proportion of existing and increasing water needs can be met.

NEPA requires, at a minimum, that a “proposed action” be compared to a “no action” alternative. The No Action Alternative represents the most likely baseline conditions that would occur if the proposed project were not to move forward. The “action alternatives” are developed and screened from a broad range of concepts identified based on problems and opportunities, and then are then compared to the No Action Alternative in order to determine the extent and significance of potential impacts. An action alternative (proposed action) is developed to describe the various aspects of the proposal by the lead agency (in this case, the Corps’ proposal to reallocate up to 20,600 acre-feet of storage). Other action alternatives may also be developed that reduce the extent of impacts to resource areas while still meeting the purpose and need.

Corps guidance requires an economic analysis as part of the evaluation. As a test of financial feasibility, the governing annual cost of storage is compared to the annual cost of the most likely, least costly alternative that would provide an equivalent quality and quantity of water that the non-federal interest would undertake in the absence of using the federal projects. Normally the No Action Alternative (the one most likely to be implemented if Chatfield Reservoir storage is not reallocated) is also the Least Cost Alternative to the proposed action alternative (that is the least costly financial alternative, but not necessarily least costly in terms of NED). However, in this instance due to the understandable reluctance of area water providers to depend on NTGW as a viable long-term alternative to storage, a separate Least Cost Alternative including this source, referred to as the NTGW/Downstream Gravel Pits Alternative, was developed for the 50-year period of analysis in addition to the No Action Alternative.

History of the Chatfield Reservoir Storage Reallocation Study

Shortly after Chatfield Reservoir was constructed in 1973, local water providers began various individual planning processes with the hope that additional storage space in Chatfield Reservoir might be reallocated. In 1977, Denver Water filed for a conditional storage water right for additional reallocated storage space in Chatfield Reservoir, and by 1985 five other entities had filed their own claims for conditional storage water rights in Chatfield Reservoir. In 1986, the authorization for the Chatfield Reservoir storage reallocation study was secured by Congressional action in Section 808 of the Water Resources Development Act. Section 808 authorizes the Secretary of the Army to implement a reallocation of existing storage at Chatfield Reservoir to any of several named purposes if the CDNR requests and coordinates the reallocation, and if the Chief of Engineers finds the reallocation feasible and economically justified. Section 116 of the Omnibus Appropriations Act of 2009 authorizes CDNR to perform facility modifications and mitigation for the project, if the Secretary of the Army collaborates with CDNR and local interests to determine storage cost repayments that reflect the limited reliability of the reallocated storage space.

The planning efforts intensified with the occurrence of the MWSI, a study process initiated by Colorado Governor Roy Romer and the Colorado General Assembly in 1993. The goal of MWSI was to explore cooperative solutions to future Denver Metro area water supply needs (Hydrosphere Resource Consultants 1999). A MWSI subcommittee on Chatfield Reservoir storage reallocation was formed in 1994 by a consortium of water providers led by the CWCB as project sponsor, per the Section 808 authorization. The MWSI subcommittee held regular meetings with representatives of the Corps and began the formal process requesting the reallocation of Chatfield Reservoir storage space. In the 905(b) Reconnaissance Report (USACE 1996), a preliminary analysis was made of the recreational impacts to Chatfield Reservoir of storing various water quantities and determined that large increases in expenses for recreation facility modifications occurred at elevation levels of 5,435 feet msl; 5,438 feet msl; and 5,445 feet msl. From this work, the initial alternatives to be analyzed were determined to be at elevation levels of 5,434 feet msl (2,900 acre-feet of storage); 5,437 feet msl (7,700 acre-feet of storage); and 5,444 feet msl (20,600 acre-feet of storage). Intermediate storage levels were not evaluated because the costs of recreation modifications for a 5,444-foot-msl pool elevation were believed to be similar to those for a 5,438-foot-msl-pool elevation, resulting in economies of scale that were maximized for the 5,444-foot-msl alternative. Ultimately the group determined that within Chatfield Reservoir, 20,600 acre-feet (at 5,444 feet msl) would be the volume of storage that could be reallocated without major incremental costs or jeopardizing the flood risk management function of the reservoir. This fact was further supported by the Chatfield Antecedent Flood Study (Appendix R), which passed an independent external technical review by the BOR and was approved by the Corps Headquarters in February 2006. The Chatfield Antecedent Flood Study showed that a pool raised 12 feet for water supply (with an adjustment of the reservoir flood control operating criteria) would provide the necessary freeboard without any structural modifications. Such a raise was considered to be a reasonable maximum reallocation alternative.

Thus, the proposed action of the Chatfield Reservoir storage reallocation study is to reallocate 20,600 acre-feet of storage space from flood risk management (flood control) to conservation. As further described below, the other action alternative is reallocation of 7,700 acre-feet of storage space, the third alternative is the No Action Alternative, and the fourth alternative is the NTGW/Downstream Gravel Pits Alternative (Least Cost Alternative to Chatfield Reallocation). The explanations below describe how the process was used to develop these alternatives and eliminate other alternatives.

2.3.1 Alternative Selection Process

The action alternatives identified and evaluated in the FR/EIS are designed to meet project objectives (purpose and need). To reach these selected action alternatives, an initial screening of water supply concepts was conducted using a defined set of criteria. This initial set of concepts was identified based on problems and opportunities identified in Section 2.1. The broader view of all concepts to increase the water supplies for the South Platte River Basin is given in SWSI (CWCB 2004), Sections 8 and 10, which are contained in Appendix C. In general, the concepts are grouped in five categories: (1) increased storage, (2) importation of water, (3) conversion from agricultural use to municipal use, (4) increased NTGW use, or (5) increased water conservation.

Concepts identified for initial screening were evaluated with four general criteria described in the P&Gs: completeness, efficiency, effectiveness, and acceptability. These are specifically detailed in Section 2.6 "Evaluation Criteria". In general terms, these four criteria would encompass the following considerations:

- Ability to meet purpose and need of the action
- Cost
- Logistics and technology
  - Water rights/water availability
  - Land availability/Land Use
  - Permitting and mitigation feasibility
  - Design and construction feasibility
  - Operational feasibility
- Environmental impacts
  - Significance
  - Ability to Mitigate

These initial screening criteria definitions were developed based on planning objectives and constraints identified and summarized in Section 2.2. Initial screening criteria and associated rationale for eliminating an alternative or screening it forward, are summarized in Table 2-1.

Table 2-1
Criteria for Preliminary Screening of Alternatives

Criterion Description	Rationale for Screening Criterion
Purpose and Need	
PN1- The purpose and need is to increase availability of water, sustainable over the 50-year period of analysis, in the greater Denver area so that a larger proportion of existing and future (increasing) water needs can be met.	To advance, a concept must be capable of assisting in providing the water providers with a common regional solution, able to provide a reasonably sufficient portion of the total requested average year yield of approximately 8,539 AF, and not be held up in extensive litigation, extensive permitting, or other timeliness issues.
Cost	
C1- The cost of the project must be affordable The cost of a concept includes a broad estimate of land and water rights acquisition, design and permitting, construction and operation. At this early stage in the analysis, a qualitative estimation of costs was employed because detailed information on costs was not available or could not be estimated within the current scope of the Project.	To advance, an alternative must not be unreasonably costly relative to other concepts. A reasonable cost considers whether the concept has a reasonable size relative to cost, and is substantially less than the costs associated with other water supply projects in the Colorado Front Range.
Logistics and Technology	
LT1- Water Rights/Water Availability	To advance, concepts would not require the acquisition of water rights through new filings or by purchasing and transferring existing water rights from current water providers in a reasonably foreseeable time frame. Sites that are already fully subscribed would be eliminated because the water providers do not have the authority to acquire water or storage or it would take agreements not yet in place and unable to achieve. Preference would be given to sites with on-channel location.
LT2- Land Availability/ Land use	To advance, water sources or infrastructure components must not lie in areas that clearly would not be available for purchase or create a significant obstacle for development.
LT3 - Permitting and Mitigation Feasibility	To advance, water sources should have acceptable mitigation and permitting requirements.
LT4-Design and Construction Feasibility	To advance, water sources, including storage and conveyance components, should comprise of proven technological methods to minimize risk of failure to provide the required yield. Physical conditions resulting in high risk or requiring unusual engineering solutions would be eliminated.
LT5 -Operational Feasibility	To advance, water sources, including storage and conveyance components, should comprise proven operational and management practices to minimize risk of failure to provide required yield. Also, it would not be practical to operate multiple storage facilities, pipelines or treatment facilities to meet the required yield. Advanced treatment, such as reverse osmosis systems, would not be feasible.
Environmental Impacts	
EC1-Significance –direct, indirect and cumulative impacts to wetlands and perennial streams	To advance, a concept should avoid and minimize impacts to aquatic ecosystems.
EC2- Ability to Mitigate	If significant impacts to wetlands or perennial streams are identified, then a commensurate ability to mitigate must also be identified in order to have the concept advance for further evaluation.

Screening criteria were applied to 37 project concepts. A project concept is defined as a source of water available to meet a substantial portion of the Chatfield water provider's requests. Each concept may include various components (e.g., storage facilities, conveyances) that could be independently used, or combined with other components, to make viable alternatives. A description of each concept evaluated in the initial screening process is presented in a summary table (Table 2-2) with a general discussion of the screening process and outcomes provided in the following sections.

Table 2-2
Concepts Considered in Preliminary Screening of Alternatives

	Concept	Description
1.	**Increased Water Conservation**	
1.1	Chatfield Water Providers M&I Conservation Programs	Comprehensive and aggressive water conversation (or demand management) programs implemented by the Chatfield water providers group. Key facets include progressive inclining block rate structures, regulatory ordinances, conservation incentive programs, and supply-side efficiency measures.
1.2.	Central Colorado Water Conservancy District Efficiency Program	This program supplies ultra-efficient irrigation equipment to farmers, and provides outreach seminars and in-field conservation services.
2.0	**Agricultural Transfers**	
2.1	Lower Arkansas River Concept	Delivers water from the lower Arkansas River (near Avondale or La Junta) to the Rueter-Hess Reservoir. Water pumped 96 to 133 miles with static pumping requirement of 3,100 to 3,600 feet. Firming storage required. Reverse osmosis or advanced water treatment would be required.
2.2	Middle & Lower South Platte River Concept	Delivers water from the South Platte River (near Greeley or Sterling) to Brighton. Requires purchase of South Plate River water rights. Water pumped 36 to 84 miles with static pumping requirement of 700 to 1,300 feet. Firming storage required. Reverse osmosis or advanced water treatment would be required.
2.3	Rocky Ford Highline Canal Concept	Delivers water from the Arkansas River Basin to the South Platte River Basin. The project is in a conceptual state with no identified buyer participants nor details on the conveyance route. Requires purchase of water rights and treatment of water.
2.4	South Platte River/ Farmers Reservoir and Irrigation Company (FRICO)	Delivers water from Weld County to East Cherry Creek Valley via the FRICO Ditch. Agricultural water rights are being converted to municipal use, but have not been adjudicated. Treatment would be required.
2.5	Interruptible Agricultural Transfers	Alternative water resource management approaches to traditional purchase and transfer of water from irrigated lands. Example approaches include interruptible water supply agreements, long and short term rotational fallowing, water banks, reduced crop consumptive use, multi-year leases, spot market leases and purchase and lease-back arrangements. Principle goal is to provide some water to other uses while maintaining irrigated agricultural practices
3.0	**Water Importation**	
3.1	Flaming Gorge Reservoir Concept	Delivers water from the Green River to Denver area. A contract with Bureau of Reclamation (BOR) for water from the Flaming Gorge marketable pool would be required. Compact call and legal availability and administration of depletions in Wyoming for use in Colorado would need to be resolved. Conveyance would be 357 to 442 miles of pipeline to the south Denver metropolitan area with static pumping requirements of 1,400 to 3,100 feet. Constructible and permittable West Slope diversion, storage sites, and pipeline routes would need to be evaluated. Estimated yield is 200,000 AF/year. Estimated cost is $3 to $4 Billion.
3.2	Yampa River New Supply Concept	Delivers water from the Yampa River (near Craig) to Denver area. New water rights appropriation required, and Compact call and legal availability related to endangered fish would need to be resolved for a new appropriation. Would require approximately 250 miles of pipeline, with static pumping requirement of 5,000 feet. Constructible and permittable West Slope diversion, storage sites, and pipeline routes would need to be evaluated. Estimated yield is 300,000 AF/year. Estimated cost is $3.2 Billion.
3.3	Green Mountain New Supply Concept	Delivers water from the Blue River to the Denver area via the South Platte River. Water pumped 22 miles with static pumping requirement of 1,000 feet. Requires joint use of Denver Water conveyance system. Estimated yield is 200,000 AF/year. Estimated cost is $700 Million.

Table 2-2
Concepts Considered in Preliminary Screening of Alternatives

	Concept	Description
3.4	Colorado River Return Concept	Delivers water from the Colorado River, downstream of Grand Junction, to the Denver area. New water rights appropriation required, and Compact call and legal availability related to endangered fish would need to be resolved for a new appropriation. West Slope storage would not be required but East Slope storage would be required. Conveyance on East Slope would be via South Platte and Arkansas Rivers. Water pumped 179 miles of pipeline with static pumping requirement of 7,000 feet. Reverse osmosis or advanced water treatment would be required. Estimated yield is 250,000 AF/year. Estimated cost is $3.7 Billion.
3.5	Gunnison River Concept	Delivers water from the Gunnison River, and possibly the Blue Mesa Reservoir, to the Denver area. New water rights appropriation required, and Compact call and legal availability would need to be resolved for a new appropriation. Would require approximately 75 miles of tunnels and conduits. Constructible and permittable Western Slope diversion, pumping stations, storage, and pipeline routes would need to be evaluated.
3.6	San Luis Valley Concept	Delivers water from the Arkansas River Basin to the South Platte River Basin via pipeline. The project is in a conceptual state with no identified water rights nor details on the conveyance route. Requires purchase of water rights.
4.0	**Additional Storage within the South Platte River Basin**	
4.1	New Storage Reservoirs	
4.1.1	Penley Reservoir Site	A potential off-channel reservoir located approximately 11 miles south of Chatfield Reservoir adjacent to Colorado's foothills mountain range. The reservoir site would be created by construction of two embankments approximately 160 feet high with a total length of 3,500 feet, producing approximately 11,300 acre-feet of usable storage space. Delivery of water from the South Platte River includes a 15-mile-long gravity tunnel near Deckers or a 7.5-mile-long tunnel and pump station near Eagle Rock. Water would be delivered into the Penley Reservoir from the South Platte River at the downstream end of Waterton Canyon near the Platte Canyon Reservoir and High Line Canal.
4.1.2	Willow Creek Reservoir	A potential reservoir site located on Willow Creek, a tributary to the South Platte River located approximately one mile south of Chatfield Reservoir, in Douglas County. The property site is owned by the Colorado State Board of Land Commissioners. Planned storage capacity is approximately 4,400 AF.
4.1.3	Hritz Plum Creek Reservoir Site	A privately owned potential reservoir site located off channel, on Plum Creek, south of Kellytown in Douglas County and approximately 1.75 miles south of Chatfield Reservoir. A two –reservoir system was envisioned, with a planned storage capacity of approximately 2,300 AF.
4.1.4	Highland Ranch Reservoir Series (Reservoir Nos. 6, 7, 8, 10, 11 and 12)	Six new reservoir sites are being considered for potential reservoir sites. All located in Douglas County. The Centennial Water and Sanitation District has a 1985 Water Court Filing on these reservoir sites. South Metro Water Supply Authority has a 2004 Water Court Application. Each of the gravel pit reservoirs would require diversions from the South Platte River to the reservoir. Total potential storage capacity is approximately 33,000 AF. Each of the gravel pit reservoirs would require diversions to/from the South Platte River to the reservoir.
4.1.5	Upstream Local Gravel Pit Reservoirs	Three local gravel pits have been identified as potential South Platte River raw water. These sites, and their potential storage capacity include the Titan ARS Reservoir (4,500 AF), Walker Pit (540 AF), and McLean Pit (450 AF). These are located less one mile south of Chatfield Reservoir. Each of the gravel pit reservoirs would require diversions to/from the South Platte River to the reservoir.
4.1.6	Lower South Platte River Gravel Pits	Three new gravel pits identified to contain 9,260 acre-feet of storage volume. Includes Central Colorado WCD Gravel Pit, Aurora Gravel Pits (2 total) and the Brighton Gravel Pit. Each of the gravel pit reservoirs would require diversions from the South Platte River to/from the reservoir.

Table 2-2
Concepts Considered in Preliminary Screening of Alternatives

	Concept	Description
4.2	Storage Expansion of Chatfield Reservoir	
4.2.1	Reallocation of 2,900 AF to Storage	Reallocate storage from the flood control pool to the conservation pool. The base elevation of the exclusive flood control pool would be raised from 5,432 to 5,434 feet msl. Water providers downstream of Chatfield Reservoir would be able to use existing infrastructure to divert their portion of the stored water into their water systems. Some of the downstream water providers would need to construct new delivery facilities to deliver their new water supplies from Chatfield Reservoir. At this level, there is limited wetland inundation and most recreation features can be mitigated without relocation of structures.
4.2.2	Reallocation of 4,500 AF to Storage	Reallocate storage from the flood control pool to the conservation pool. The base elevation of the exclusive flood control pool would be raised from 5,432 to approximately 5,435 feet msl. At this level, some wetlands would be inundated, requiring mitigation. Some recreation facilities would be inundated, requiring relocation.
4.2.3	Reallocation of 7,700 AF to Storage	Reallocate storage from the flood control pool to the conservation pool. The base elevation of the exclusive flood control pool would be raised from 5,432 to 5,437 feet msl. At this level, wetlands would be inundated, requiring mitigation. Many recreation facilities would be inundated, requiring relocation.
4.2.4	Reallocation of 20,600 AF to Storage	Reallocate storage from the flood control pool to the conservation pool. The base elevation of the exclusive flood control pool would be raised from 5,432 to 5,444 feet msl. At this level, wetlands would be inundated, requiring mitigation. Most all recreation facilities would be inundated, requiring relocation.
4.2.5	Reallocation of Greater Than 20,600 AF to Storage	Reallocate storage from the flood control pool to the conservation pool. The base elevation of the exclusive flood control pool would be raised from 5,432 to as high as 5,450 feet msl. At this level, the footprint of the park is severely affected with associated large impacts to wetlands, recreational facilities, park roadways, and local highways. The flood risk management function of the reservoir would be impacted.
4.2.6	Reallocate in the existing conservation pool (i.e., below 5,432 feet msl) for large and/or small amounts	Reallocates some of the storage space below elevation 5,432 feet msl now controlled by Denver Water to the Chatfield water providers. Requires acquisition of the storage space in the existing conservation pool from Denver Water. Would result in sufficient yield with little or no increase in reservoir level and consequential impact to recreation facilities and wetlands.
4.2.7	Reallocate some water in the conservation pool and some in the flood control pool in proportions that would seek to minimize ecosystem habitat flooded and effects on recreation facilities.	Reallocates water from Denver Water to the Chatfield water providers. Could result in sufficient yield with little or no increase in reservoir level and consequential impact to recreation facilities and wetlands.
4.3	Storage Expansion or Reallocation of Other Existing Reservoirs	
4.3.1	Rueter-Hess Reservoir	An off-stream reservoir, located approximately 9.5 miles south of Chatfield Reservoir, which will rely on surface water from nearby Cherry Creek and Newlin Gulch; and groundwater which may be alluvial groundwater or bedrock aquifer groundwater from the Denver Basin. Owned and operated by the Parker Water and Sanitation District (PWSD). Water allocation subscribed and permitted under a separate planning action with the USACE. With completed expansion, reservoir storage will be approximately 70,000 AF.
4.3.2	South Platte Reservoir	A working gravel mine converted into a water storage reservoir in 2007. Located north of the Chatfield Reservoir in Arapahoe and Jefferson counties. The Centennial Water and Sanitation District owns the site. Raw South Platte River water would be pumped to this reservoir, then to McLellan Reservoir for use within Highland Ranch. Storage capacity is 6,400 AF.
4.3.3	McLellan Reservoir	An existing reservoir located on Dad's Clark Gulch, a tributary of the South Platte River in Arapahoe and Douglas Counties located less than one mile northeast of Chatfield Reservoir. Owned by the City of Englewood and leased to the Centennial Water and Sanitation District (CWSD). Reservoir capacity is approximately 5,000 AF. Would require diversions from the South Platte River to the reservoir.

Table 2-2
Concepts Considered in Preliminary Screening of Alternatives

	Concept	Description
4.3.4	Platte Canyon Reservoir	An existing reservoir located on the South Platte River at the mouth of Waterton Canyon in Douglas County, approximately 2 miles south of Chatfield Reservoir. Owned by Denver Water. Water supplied by Highline Canal. Reservoir capacity is approximately 910 AF.
4.3.5	Bear Creek Reservoir	Bear Creek Dam, the last of three dams built to protect the Denver region from floods, is located on the southwest edge of suburban Lakewood at the confluence of Bear Creek and Turkey Creek. Located off channel, would require diversions to/from the South Platte River to the reservoir.
4.3.6	Cherry Creek Reservoir	An existing reservoir on Cherry Creek located approximately 10 miles northeast of Chatfield Reservoir. The first of three dams built to protect the Denver region from floods. Owned and operated by the USACE. Located off channel, would require diversions to/from the South Platte River to the reservoir.
5.0	**Conjunctive Use of Surface and Groundwater**	
5.1	Additional NTGW with Local Gravel Pit Storage	Further acquisition of non-tributary groundwater (NTGW) from the Denver Basin, with storage in local gravel pits. Requires acquisition of water rights, development of groundwater withdrawal wells, development of gravel pit storage reservoir, and accompanying water conveyance facilities.
5.2	Bedrock Aquifer Conjunctive Use	Involves capturing and using surplus South Platte River surface water supplies and injecting into bedrock aquifer for storage. Requires identification and development of subsurface groundwater storage reservoir and development of surface water collection and injection facilities. A large-scale groundwater pumping and storage concept was informally presented to Douglas County water interests, but never developed into a viable project due primarily to unreasonably high costs and a lack of surface water.
5.3	Alluvial Aquifer Conjunctive Use	Involves capturing and using surplus South Platte River surface water supplies and recharging the alluvial aquifer for storage. Requires the development of surface water collection and injection facilities. No specific projects have been identified.
6.0	**Water Reuse**	
6.1	Chatfield Water Providers Local Reuse Programs	Various forms of reuse or recapture are currently being employed, or planned to be employed, by those water providers who have reusable water.
6.2	Regional Reuse- WISE Partnership	The WISE Partnership is a proposed regional project between Denver Water ("Denver"), Aurora Water ("Aurora") and the South Metro Water Supply Authority. The Project is looking at the concept of more efficiently using reusable water supplies from Denver and Aurora municipal return flows, while maximizing the use of existing pipeline and pump station infrastructure principally owned by Aurora and the East Cherry Creek Valley Water and Sanitation District. The Partnership Project is currently in the planning stages

2.3.2 Concepts of Agriculture Transfers and Importation of Water

The initial screening process, which has utilized SWSI and other recent, relevant planning studies (for example, The Colorado River Return Reconnaissance Study Summary Report [Boyle Engineering Corporation 2003]) identified a number of concepts for the importation of water or permanent agricultural conversion. These concepts are listed in Table 2-2. The initial screening process concluded that these concepts have vastly higher expense, difficulties in obtaining water rights and legal agreements for out-of-basin transfers, and increased environmental impacts compared to the other alternatives.

Permanent Agricultural Transfers

Agricultural uses account for greater than 80 percent of the water diverted and consumed in Colorado (CWCB 2009). Many agricultural users hold senior water rights that potentially can be converted to provide a M&I water supply. In agricultural transfers, the associated farmland generally is no longer irrigated and therefore not available for agricultural use in the future.

Four generally known permanent agricultural transfer concepts were considered in the initial screening process: Lower Arkansas River, Middle and Lower South Platte River, Rocky Ford Highline Canal and South Platte River/Farmers Reservoir and Irrigation Company (FRICO). These concepts are described in Table 2-2. These, and projects similar to these, are very complex, high-impact projects that are feasible only if large volumes of yield are realized. For example, they generally include new storage reservoirs, hundreds of miles of pipelines, multiple pump stations, and advanced water treatment techniques (e.g. reverse osmosis) to meet drinking water requirements. They are considered not realistic alternatives to a project yielding approximately 8,539 acre-feet per year and therefore have been eliminated from further alternative consideration.

Interruptible Agricultural Transfers

Interruptible agricultural transfers consist of temporary arrangements where agricultural water rights are used for other municipal or industrial purposes. The agreement with agricultural users allows the temporary cessation of irrigation so that other water needs can be met. Example approaches include interruptible water supply agreements, long- and short-term rotational fallowing, water banks, reduced crop consumptive use, multi-year leases, spot market leases, and purchase and lease-back arrangements.

These concepts were eliminated from further consideration based on cost, logistics, timing, and sustainability. Although these concepts have been discussed for several years and multiple grants are presently studying alternative approaches, no existing examples exist of successfully implemented programs. These concepts, and particularly the institutional and technical arrangements, continue to be in the developmental stage. The movement of water supplies from agricultural water to municipal users would likely require pipelines over very lengthy distances (multiple miles) and water treatment, possibly including reverse osmosis.

Water Importation Concepts

Similar to the major permanent agricultural transfer concepts discussed above, there are a number of regional water supply concepts involving out-of-basin transfer of water supply. Generally known regional water importation concepts include Flaming Gorge Reservoir, Yampa River New Supply Colorado River Return, Gunnison River, and San Luis Valley (Table 2-2)

As with the large-scale agricultural transfer concepts, these projects are feasible only if large volumes of yield are realized. These concepts cannot be implemented within a reasonable timeframe due to the logistics of obtaining water rights and legal agreements for out-of- basin transfers. Conveyance and treatment costs would be substantial that such overall project costs would be substantially greater than costs associated with water supply projects in the Colorado Front Range. They are considered not realistic alternatives to a project yielding approximately 8,539 acre-feet per year and therefore have been eliminated from further alternative consideration.

2.3.3 The Concept of Increased Water Conservation

All 15 water providers recognize the importance of incorporating aggressive and meaningful water conservation efforts in their operations. These entities each are part of the reallocation project because they need additional water, which is ever increasingly costly and difficult to acquire. Thus, these providers need to reduce their demands and stretch their supplies and have therefore included water conservation. The water conservation (or sometimes called demand. management) programs of the water providers have the following common components:

- Progressive inclining block rate structures to send a strong conservation price signal
- Regulatory ordinances, especially with new development, requiring mandatory compliance and enforcement by the entity
- Conservation incentive programs, such as rebates or giveaways, applied to residential, commercial and industrial water users
- Comprehensive education and outreach programs
- Promotion of supply side efficiency measures to include the reuse of legally reusable wastewater and leak detection programs
- Promotion of xeriscape principles

The providers in the southern Denver area have initially developed the non-tributary groundwater resource as part of a conjunctive use supply. Water conservation efforts can reduce demand and give more time to find surface water supplies but do not result in the elimination or lessening of the dependence on the groundwater supplies. Conservation helps to stretch existing resources, but does not solidify additional needed water supplies. The Chatfield Reservoir storage reallocation project would help in the overall need of the water providers to be free of NTGW use.

Similarly, for other municipal providers, such as Aurora and Brighton, who are developing supplies in response to growth, conservation can delay the timing of the need for additional supplies but does not in itself eliminate the need for additional supplies. The agricultural providers are aggressively pursuing conservation but also need the additional supplies from this project to allow the continued use of irrigation water as a result of recent court cases. As a result, the providers seeking additional water supplies from this project represent an increasing demand for water in the Denver Metro Area.

A summary of water conservation programs of each of the 15 water providers is given in Appendix AA. Some of the key elements showing the comprehensiveness and robust nature of their programs are summarized in Tables 2-3 a, b, c, d, and e below. The complete water conservation reports of seven of the water providers with State of Colorado approved plans are available at: www.cwcb.state.co.us/conservation/relatedinformation/WCPs/.

Most of the water providers will, of necessity and with or without the Chatfield Reservoir storage reallocation project, develop even more stringent water conservation measures in the future to reduce their future water demands. Unfortunately, the water shortages of sustainable water supplies faced by the water providers will not be resolved by water conservation measures alone and therefore water conservation is not an equivalent practicable alternative to the proposed project.

Table 2-3a
Municipal and Industrial Water Provider Water Conservation Program Elements

Water Provider	Effluent Reuse	Tiered Rates	Water Budget	Sod Limits	ET Water Controllers	Indoor/ Outdoor Audits	Water Time Restrict	Water Day Restrict	Rebates Xeriscape/ Appliances	Public Education	Water Conservation Staff
City of Aurora	I	I	I	I		I	I	I	I	I	I
City of Brighton		I		I		P	I	I	I	I	I
Mount Carbon Metropolitan District		P	P	P	P		P	P	P	P	
Town of Castle Rock	I	I	P	I			I	I	I	I	I
Centennial WSD	I	I	I		I	I	I	V		I	I
Castle Pines Metropolitan District	I	I			I	I	V	V	I	I	I
Castle Pines North Metropolitan District	I	I	I		I	I	I	I	I	I	
Roxborough WSD		I		I	P	P	I	I	P	I	I
Perry Park Country Club					I						I
Other SMWSA Members											
Pinery Water and Wastewater District	I	I	I				V	V		I	
Arapahoe County Water and Wastewater Authority	I	I	P								
Cottonwood WSD	I	I	I				I	I		I	
Stonegate Village WSD	I	I					I	I		I	

I – In Place; P – Planned in < 5 years; V – Voluntary

Explanation of Program Elements:

Water Budgets: A rate structure based upon the calculation of appropriate water use (or budget) for each customer per pay period.

Sod limits: Limitations on the amount of sod that can be installed

ET Water Controllers: Providing incentives promoting the use of ET water controllers

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Table 2-3b
Agricultural Water Provider Water Conservation Program Elements

Water Provider	Water Meter/ Measurement Device	Water Budget	Public Education	Water Conservation Staff
Central Colorado WCD	P	I	I	I
Western Mutual Ditch Company	I	I	I	

I – In Place; P – Planned in < 5 years; V – Voluntary

Explanation of Program Elements:

W**ater Meter/Measurement Device**: Central Colorado WCD will have meters on every well to monitor pumping by April 1, 2008. Western Mutual Ditch Company has measurement devices installed at every headgate to insure correct allocation of water is being delivered.

Water Budget: Central Colorado WCD water users are limited to yearly quota allocations based on total water supplies available. Western Mutual Ditch Company water users are limited to pro rata portion of total available ditch deliveries.

Table 2-3c
Status of Covered Entities and Approved Water Conservation Plans

Water Provider	"Covered Entity" under Colorado State Statute	Approved Water Conservation Plan on file with the CWCB
City of Aurora	Yes	Yes
City of Brighton	Yes	Yes
Mount Carbon Metropolitan District	No	No
Town of Castle Rock	Yes	Yes
Centennial Water & Sanitation District	Yes	Yes
Castle Pines Metropolitan District	No	Under review by CWCB
Castle Pines North Metropolitan District	No	Yes
Roxborough Water & Sanitation District	No	No
Pinery Water and Wastewater District	Yes	In process
Arapahoe County Water and Wastewater Authority	Yes	Yes
Cottonwood Water & Sanitation District	No	No
Stonegate Village Water & Sanitation District	Yes	In process

* Obtained from list of covered entities at www.cwcb.state.co.us/conservation/relatedinformation/coveredentities. The approved plans can be viewed at www.cwcb.state.co.us/conservation/relatedinformation/WCPs.

Table 2-3d
Consumption Charges of Water Rates for M&I Water Providers

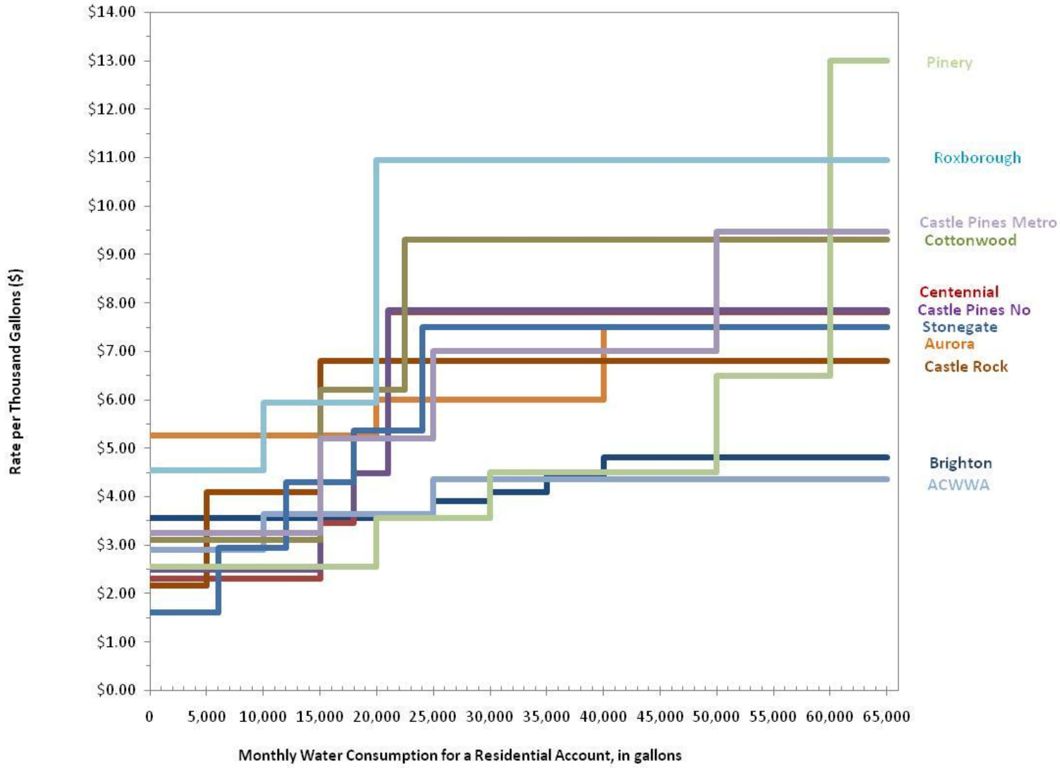

Table 2-3e
Water Conservation Rebate Programs Offered by Chatfield Study Participants

Kind of Rebate	AUR	BRIGH	CPN	TCR	CWSD	CPMD	COT	ROX	STONE
Toilets: Low Flow or High Efficiency	X	X	X		X		X	X	
	$100/$150	$100	$100		$75		$100	$125	
Clothes Washer	X	X	X	X			X		X
	$125	$75	$125	$200			$125		
Waterless/ Ultra Low Flow Urinal		X			X				
		$50			$100				
Dishwasher		X							
		$50							
Low Flow Showerhead			X				X		
			$10				$25		
ET Controllers/ Irrigation Audits	X	X	X	X		X			X
	$300–$5,000	$150	$200	$300–$1,500		$500			
Irrigation Head Replacements						X			X
Landscape Replacements per sq ft	X		X	X					X
	$1.00		$0.40	$1.00					
Xeriscape: Plants and Sub Soil Replacement						X			
						$1,500			

Table 2-3e
Water Conservation Rebate Programs Offered by Chatfield Study Participants

Kind of Rebate	AUR	BRIGH	CPN	TCR	CWSD	CPMD	COT	ROX	STONE
Irrigation System Repairs						X			
						$1,000			
Rain Sensor		X	X		X				
		$25	$100		$25–$50				
Irrigation Clock/Timer			X	X					
			$75	$25					
Water Wise Home				X					
				$2,000					
Water Smart Reader	X								
	$25								
Tipping Bucket Rain Gages						X			
						$100			
Hot Water Recirculation System			X						
			$100						
Sub-metering				X					
				$200					

AUR: City of Aurora
BRIGH: City of Brighton
CPN: Castle Pines North
TCR: Town of Castle Rock
CWSD: Centennial Water & Sanitation District
CPMD: Castle Pines Metro District
COT: Cottonwood Water &Sanitation District
ROX: Roxborough Water & Sanitation District
STONE: Stonegate Village Metropolitan District

The specific conservation measures now being implemented by the municipal and agricultural water providers are summarized in Table 2-3a for M&I water providers and Table 2-3b for agricultural water providers. As these tables show, each entity is providing a consistent effort to achieve significant water conservation. These efforts include a process to periodically assess and refine each entity's water conservation efforts. The M&I water providers have each developed, or are in the process of developing, formal water conservation plans, which, by state statute, are both strongly encouraged and are a prerequisite to obtaining state financial assistance for water projects.

All entities serving over 2,000 AF per year are considered a "covered entity" and must submit plans to the CWCB in compliance with state law. Table 2-3c shows the status of submittal and approval of conservation plans for the water providers in the reallocation project. Several water providers have submitted their plans and been approved before they have needed to. The plans, which are required to have an element of public scrutiny and input, are a combination of strategies for attenuating the volume of water withdrawn from a water supply source, reducing the loss of waste of water, maintaining or improving the efficiency of water use, and increasing the reuse of water.

In addition, below are listed specific examples of the leadership and innovations in water conservation programs shown by selected water providers:

- Aurora's water conservation program ranked highest (most aggressive and effective) in a survey of 13 Front Range communities conducted by the Western Resources Advocates in their study in November, 2007, entitled Front Range Water Meter (Western Resources Advocates 2007). Aurora ranked higher than the other excellent programs of Denver Water, Colorado Springs, and Boulder.

- Centennial Water and Sanitation District was the first provider in Colorado, in 2003, to institute an individual account water budget to its customers. This approach has proven extremely successful and now is being used by numerous other providers including Aurora, Castle Rock, Boulder, Colorado Springs, Castle Pines North, and Cottonwood. Centennial has experienced 20 percent water savings from its water budget and other conservation programs.

- In June, 2006, Castle Pines North Metropolitan District was the first entity to submit and be approved by the Colorado Water Conservation Board as a covered entity under state statutes. Its plan has become the model document followed by numerous other entities.

- All of the municipal water providers in the Chatfield reallocation study have programs in place to maximize their reuse of indoor and outdoor reusable return flows. The use of reclaimed wastewater for irrigation on golf courses started in the southern Denver area in 1975 (at Inverness) and has expanded to numerous courses in the south metro area. In addition, indirect potable reuse from the recapture of reusable return flows after they have been released to surface streams has been utilized by several providers for over 20 years.

- Castle Rock, in 2003, instituted an innovative program requiring the review and approval of all landscape plans, for both existing and new development, to ensure they include the most stringent water savings elements. All designs for development are reviewed to ensure they comply with regulations requiring "water – wise" landscape designs. In 2009, Castle Rock spent $500,000 to retrofit median landscaping into xeriscape designs and efficient irrigation systems.

- Central Colorado Water Conservancy District is a leader in the evaluation by the agricultural community of how its practices can be altered to increase the efficient use of water.

Table 2-3d shows the inclining block rates used by the municipal providers. Inclining block rate structures are recognized as the most effective rate structure for communicating the value of water and encouraging its efficient use. The approach provides an incentive to conserve and ensures that lower income consumers are able to meet their basic water needs at an affordable cost. Both the number of blocks and the increase in price between blocks influence the effectiveness of water rate structure.

Table 2-3e presents the water provider's programs offering incentives for conservation from rebates. Of note is the number and variety of rebates being offered by the water providers. Rebates take considerable administrative effort and reflect the will of management to seek innovative and effective avenues of water savings. The rebate programs are subject to periodic evaluations of their effectiveness and of the financial capabilities of each entity to offer the programs.

Although water conservation for each water provider will be relied upon as a major tool for reducing their future water demands, further conservation measures alone will not be adequate to make up for the shortfall in water needed by the water providers to meet current and future water needs over the next 50-year period. Therefore, it is concluded that increased water conservation alone is not adequate to address the purpose and need of the proposed action and that additional water supplies are required. Current water conservation practices constitute an independent parallel action and therefore were not explicitly carried forward as components of all alternatives selected for detailed evaluation.

2.3.4 The Concept of Conjunctive Use of Surface Water and Groundwater

Conjunctive use of surface water and groundwater can maximize the benefits and reliability of both surface water and groundwater supplies if the physical limitations can be overcome.

Bedrock Aquifer Conjunctive Use

Bedrock aquifer conjunctive use involves collection of surface water supplies and injecting the supplies into the bedrock aquifer through wells. Conjunctive use integrates groundwater and surface water sources, and may be enhanced with aquifer storage and recovery operations. The purpose of this concept is to use available ground-water storage while avoiding the impacts associated with surface water impoundments. Limited aquifer recharge rates, the need for specialized wells and infrastructure for conveyance and treatment, and the need for interim surface storage to capture peak surface water flow often offset the potential benefits of bedrock aquifer storage.

The Bedrock Aquifer Conjunctive Use concept was evaluated for the Chatfield Reservoir study and ultimately eliminated from further consideration due to the necessity to build an interim storage reservoir to capture surplus surface water flows and the cost and logistics of constructing a treatment, injection and pumping system.

Alluvial Aquifer Conjunctive Use

Alluvial aquifer conjunctive use consists of diverting surplus surface water supplies and recharging the alluvial aquifer. Aquifer recharge is generally accomplished by basin or canal infiltration. Groundwater is then pumped for water supply when accretions to the river system are needed to meet demands.

The Alluvial Aquifer Conjunctive Use concept was evaluated for the Chatfield Reservoir study and ultimately eliminated from further consideration due to limited alluvial aquifer storage availability in the area of the project and the requirement to locate and construct aquifer recharge basins.

Use of Non-Tributary Groundwater (NTGW)

Of the water providers seeking storage space in Chatfield Reservoir, 11 of 15 (including the individual water providers in the South Metro Water Supply Authority [SMWSA]) are presently using some amount of NTGW from the Denver Basin as part or all of their water supplies. Collectively 57 percent of their supplies come from NTGW with 7 water providers using more than 85 percent NTGW. The total NTGW usage from all of these providers in 2005 was approximately 30,000 acre-feet.

A major study of this issue has recently been completed that addresses the effects of continued reliance on NTGW for these water providers out to the year 2050. That study is the SMWSS conducted by the South Metro Water Supply Study Board and completed in December 2003 (Black

& Veatch et al. 2003). Selected pages from that study are included in Appendix C. The heavy use of NTGW from the Denver Basin for municipal demands is a relatively new phenomenon principally occurring since the mid-1970s; therefore, the effects of NTGW use are relatively unknown. To estimate the future effect of continued and increasing groundwater withdrawals, a sophisticated model was developed and peer reviewed as the central planning tool for the study.

A key aspect of the issue is that the Denver Basin groundwater is not significantly recharged by surface waters. The use of the water from the basin is the mining of a nonrenewable resource that reduces artesian pressure, which causes a significant drop in the rate of well production to the point when it is no longer feasible to extract. This is in comparison to the use of surface water, which, as part of the hydrologic cycle, is replenished continuously.

The SMWSS determined that further use of the NTGW causes the need to replace groundwater wells at an ever increasing pace to maintain the groundwater production. The study concludes that, in general, based on the assumptions of the study, during a 50-year period when water demands will double, the total number of groundwater wells needed to meet the new demands will increase nine fold. For the 11 participants in the SMWSS, their collective 165 present wells will need to grow to 1,529 to accommodate the demands at 2050. Over that same period, average pumping rates from wells in the Arapahoe Aquifer (the most used and most important Denver Basin aquifer) will decrease from 550 gallons per minute (gpm) to an estimated 100 gpm. The groundwater aquifers will get ever more expensive and difficult to extract water from and ultimately, it would no longer be feasible to extract NTGW.

However, due to discounting, the farther into the future that costs occur, the smaller the fraction of these costs that is added to the present value of the cost of providing NTGW. This results in a less costly alternative than that suggested by the No Action Alternative, which includes significant expenditures for surface storage facilities. Although a nonrenewable resource, NTGW is assumed to be available for the 50-year planning period considered in the economic analysis. Colorado statutes restrict pumping of NTGW to no more than 1 percent per year, thereby providing a theoretical aquifer life of 100 years, although due to pumping cost the economic life might be shorter. As the SMWSS report describes, the projected pumping volume will dissipate the artesian pressure from the Denver Basin aquifers to a large extent over the next 10 to 20 years. The problem with continued pumping of the Denver Basin aquifers is related to a significant drop in the rate of well production (the gallons per minute of withdrawal) and not to the diminishment of total water stored in the aquifers. Regardless, the aquifer is assumed to be available for 50 years, and the NTGW is retained in the analysis in conjunction with storage for downstream providers (gravel pit surface storage). Under NEPA, this NTGW/Downstream Gravel Pits Alternative would be considered technically and economically reasonable for consideration in supporting the purpose and need of increasing availability of water, sustainable over the period of analysis, in the greater Denver area so that a larger proportion of existing and future (increasing) water needs can be met. The NTGW/Downstream Gravel Pits Alternative was screened forward and is discussed in detail in Section 2.4.2.

2.3.5 The Concept of Developing New Surface Water Storage

Background

Surface water storage in the Front Range of Colorado generally takes one of two forms—traditional reservoirs constructed using a dam placed across a flowing (or diverted) water course or excavated gravel pits. Most excavated gravel pits are developed in the process of mining sand and gravel while others (usually smaller) may be simply excavated for the purpose of water storage.

New Construction Storage Reservoirs

Reservoirs are usually located where characteristics such as the potential to capture a large volume of water using a relatively small dam are optimized. The reservoirs can be located either on-channel or off-channel. For on-channel reservoirs, flows are captured directly from streams or rivers with access to the stored water coming from delivery systems consisting of ditches and/or pipelines. The potential locations for such facilities are very limited. Off-channel reservoirs, which are more expensive and less common, require developing facilities to divert and convey water from the stream to the reservoir. The proposed Two Forks Dam project, which was vetoed by the EPA more than 15 years ago, serves as an illustration of the permitting complexities and the environmental and fiscal costs that may be associated with construction of an on-channel new reservoir. The Rueter-Hess Reservoir, an off-channel reservoir under development by the Parker WSD, is an example of a new, successfully permitted storage facility. Development of traditional reservoirs is a very expensive and uncertain venture generally taking 20 to 30 years to accomplish.

Four new storage reservoir concepts were evaluated in the initial screening process including the Penley site, Willow Creek site, Hritz Plum Creek site, and a series of Highlands Ranch reservoir sites (Table 2-2). All sites, with the exception of the Penley site, were eliminated from further evaluation due to their limited storage capacity, and the logistical difficulties of combining reservoirs to meet the storage requirements of the project. The Penley Reservoir site was carried forward because it may provide a reasonable cost, upstream storage body, with sufficient volume and minimal environmental impacts.

Gravel Pit Reservoirs

The nature of the South Platte River valley is such that alluvium deposited over time has accumulated in and adjacent to the river channel. These alluvial deposits serve as a readily available source of sand and gravel and are used in construction and road building. The mining of this material creates excavated areas, or pits, and, once the gravel is completely removed from the pits, they can be lined with an impervious material and used for water storage. Alternatively, the gravel pit can be bounded by slurry walls prior to sand and gravel excavation. The relative ease of planning and permitting gravel pits for water supply makes them an attractive alternative to traditional reservoirs; however, there are limits related to the location and size of these types of water supply facilities.

Gravel pits have been and are being developed in the South Platte River valley from Douglas County to downstream of the Adams/Weld county line near Brighton. There are at least 35 gravel pits in this area either constructed, under construction, or planned to be constructed. One gravel pit reservoir is being constructed a short distance downstream of Chatfield Reservoir. Gravel pits range in size from a few to over 100 acres and are typically 20 to 30 feet deep, producing storage capacities on the order of 500 to 2,000 acre-feet. Gravel pit construction may take from 5 to 10 years to complete.

Two groups of gravel pit reservoirs were identified for initial evaluation (Table 2-2). The first group comprised a number of pits located upstream of the Chatfield Reservoir that could be used to divert water from the South Platte River for storage. This concept was eliminated from further consideration due to limited storage capacity, and the logistical difficulties of combining reservoirs to meet the storage requirements of the project.

The second group consisted of reservoirs locally available to the Lower South Platte River Gravel Pit Users component of the water providers (Table 2-2). These reservoirs were screened forward because they represented a cost-effective off-channel storage option with minimal environmental impacts.

Storage Expansion or Reallocation of Other Existing Reservoirs

A number of existing reservoirs serve to store and allocate water supply to Colorado Front Range communities, similar to the water storage function of the Chatfield Reservoir. Depending on respective storage availability, physical attributes, and future plans, one or more reservoirs may be available to meet the needs of the Chatfield Reservoir study. Options for increasing storage in existing facilities include raising dams, raising mean water levels, dredging sediments and deepening the reservoir.

Six existing reservoirs located near the project site were evaluated for potential water supply storage expansion and/or re-allocation, including Rueter-Hess Reservoir, South Platte Reservoir, McLellan Reservoir, Platte Canyon Reservoir, Bear Creek Reservoir, and Cherry Creek Reservoir (Table 2-2). In most cases, these reservoirs were not available due to current storage commitments. In the case of Cherry Creek Reservoir, any expansion of storage would impact the flood control function of the reservoir.

2.3.6 Storage Expansion and Reallocation Concepts for Chatfield Reservoir

As previously discussed, reallocation of storage space in Chatfield Reservoir would provide an estimated 8,539 acre-feet per year of average year yield, to be compared with the identified shortfall of 90,000 acre-feet per year for the South Platte River Basin. An initial preliminary screening study for this project looked at a number of aspects of reallocation within Chatfield Reservoir including water rights, use patterns, demands, and water level fluctuations in terms of four alternatives (CWCB 2003). The 20,600 Acre-Foot Reallocation (5,444 feet msl) and 7,700 Acre-Foot Reallocation (5,437 feet msl) alternatives were retained for full analysis and are discussed below. The 20,600 Acre-Foot Reallocation Alternative was selected because it was considered a reasonable maximum reallocation storage volume based on flood risk management and modification of recreational facilities (Brown and Caldwell 2003). The 7,700 Acre-Foot Reallocation Alternative was selected as an intermediate reallocation storage volume, with lesser impacts to recreational facilities and environmental resources than the 20,600 Acre-Foot Reallocation Alternative. The Brown and Caldwell study also evaluated the reallocation of 4,500 acre-feet (5,435 feet msl) and 2,900 acre-feet (5,434 feet msl). The results indicated that the 4,500 acre-foot reallocation alternative was essentially identical to the 7,700 Acre-Foot Reallocation Alternative in regard to effects on recreation facilities; therefore, it was subsequently dropped from further consideration. The 2,900 acre-foot reallocation alternative was determined to provide too little additional storage to make it worth pursuing from the perspective of the water providers. Thus, the 2,900 acre-foot reallocation alternative was not carried through the final analysis because it was not acceptable to the water providers.

The water providers also evaluated creative ways of reallocating water in the conservation pool and some water in the flood control pool in proportions that would seek to minimize ecosystem habitat flooded and effects on recreation facilities. In two variations of this concept evaluated (Table 2-2), both were eliminated due to current storage commitments. Denver Water has no plans to make their storage space in Chatfield Reservoir available to others.

2.3.7 The Concept of Water Reuse

Comments generated during this FR/EIS scoping process identified the possibility of using reuse to provide additional water supplies. Various forms of reuse or recapture of reusable water are presently aggressively being employed or are planned to be employed by the various water providers who have reusable water. Water providers are motivated to maximize this reuse or recapture. The additional new water supply yield that would result from reuse was not screened forward in the FR/EIS as a separate alternative. Instead, the ability of storage in Chatfield Reservoir to facilitate water recapture and reuse or exchange was accounted for in the average year yields of the reallocation alternatives.

One regional water reuse concept was identified for consideration. The Water Infrastructure and Supply Efficiency (WISE) Partnership is a proposed regional project between Denver Water ("Denver"), Aurora Water ("Aurora") and the South Metro Water Supply Authority. The Project is looking at the concept of more efficiently using reusable water supplies from Denver and Aurora municipal return flows, while maximizing the use of existing pipeline and pump station infrastructure principally owned by Aurora and the East Cherry Creek Valley Water and Sanitation District. The project is currently in the planning stages and was eliminated based on unknown cost, logistics and timing. The final configuration and completion date are unknown and cost estimates have not yet been developed for key components of the project. Additionally, the quality of the water delivered would require either advanced treatment or significant blending with other water of which there is a very limited supply. Finally, the timeframe for the WISE Project implementation is unknown.

2.3.8 Summary of the Initial Screening Process

A total of 37 concepts, comprising the family of general concepts of water development or conservation categories described by SWSI, were evaluated in the initial screening process. This initial set of concepts was identified based on problems and opportunities identified in Section 2.1. These initial screening criteria were developed based on planning objectives and constraints identified and summarized in Section 2.2 and Table 2-1.

The results of this screening process are summarized in Table 2-4. Consistent with identified planning objectives and constraints, those concepts involving large costs, prohibitive logistics or inability to obtain water rights or legal agreements for water transfers were eliminated in favor of local, in-channel and cost effective concepts.

Table 2-4
Summary Results of Initial Screening of Concepts

	Concept*	Relevant Screening Criteria	Rationale for Screening Forward or for Elimination
Increased Water Conservation			
1.1	Chatfield Water Providers M&I Conservation Programs	PN1	An independent parallel action and therefore not explicitly included as components of each alternative. Conservation measures alone would not meet the overall purpose and need of the project.
1.2	Central Colorado Water Conservancy District Efficiency Program	PN1	An independent parallel action and therefore not explicitly included as components of each alternative. Conservation measures alone would not meet the overall purpose and need of the project.
Agricultural Transfers			
2.1	Lower Arkansas River Concept	C1, LT1	Eliminated based on cost, logistics and timing. This alternative cannot be implemented within a reasonable timeframe due to logistics of obtaining water rights and legal agreements for out-of- basin transfers. Conveyance and treatment costs would be substantial.
2.2	Middle & Lower South Platte River Concept	C1, LT1	Eliminated based on cost, logistics and timing. This alternative cannot be implemented within a reasonable timeframe due to logistics of obtaining water rights. Conveyance and treatment costs would be substantial.
2.3	Rocky Ford Highline Canal Concept	C1, LT1	Eliminated based on cost, logistics and timing. This alternative cannot be implemented within a reasonable timeframe due to logistics of obtaining water rights and legal agreements out-of- basin transfers. Conveyance and treatment costs would be substantial.
2.4	South Platte River/ FRICO	LT1	Eliminated based on logistics and timing. This alternative cannot be implemented within a reasonable timeframe due to logistics of obtaining water rights.
2.5	Interruptible Agricultural Transfer	LT 1, LT4, C1	Eliminated based on cost, logistics and timing. Although these concepts have been discussed for several years and multiple grants are presently studying alternative approaches, no existing examples exist of successfully implemented programs. These concepts, and particularly the institutional and technical arrangements, continue to be in the developmental stage.
Water Importation Concepts			
3.1	Flaming Gorge Reservoir Concept	C1, LT1	Eliminated based on cost, logistics and timing. This alternative cannot be implemented within a reasonable timeframe due to logistics of obtaining water rights and legal agreements out-of- basin transfers. Conveyance and treatment costs would be substantial such that overall project costs would be substantially greater than costs associated with water supply projects in the Colorado Front Range.
3.2	Yampa River New Supply Concept	C1, LT1	Eliminated based on cost, logistics and timing. This alternative cannot be implemented within a reasonable timeframe due to logistics of obtaining water rights and legal agreements for out-of- basin transfers. Conveyance and treatment costs would be substantial such that overall project costs would be substantially greater than costs associated with water supply projects in the Colorado Front Range
3.3	Green Mountain New Supply Concept	C1, LT1	Eliminated based on cost, logistics and timing. This alternative cannot be implemented within a reasonable timeframe due to logistics of obtaining water rights and legal agreements for out-of- basin transfers. Conveyance and treatment costs would be substantial such that overall project costs would be substantially greater than costs associated with water supply projects in the Colorado Front Range.
3.4	Colorado River Return Concept	C1, LT1	Eliminated based on cost, logistics and timing. This alternative cannot be implemented within a reasonable timeframe due to logistics of obtaining water rights and legal agreements for out-of- basin transfers. Conveyance and treatment costs would be substantial such that overall project costs would be substantially greater than costs associated with water supply projects in the Colorado Front Range.

Table 2-4
Summary Results of Initial Screening of Concepts

	Concept*	Relevant Screening Criteria	Rationale for Screening Forward or for Elimination
3.5	Gunnison River Project	C1, LT1	Eliminated based on cost, logistics and timing. This alternative cannot be implemented within a reasonable timeframe due to logistics of obtaining water rights and legal agreements. Overall project costs would be substantially greater than costs associated with water supply projects in the Colorado Front Range.
3.6	San Luis Valley Project	C1, LT1	Eliminated based on cost, logistics and timing. This alternative cannot be implemented within a reasonable timeframe due to logistics of obtaining water rights and legal agreements for out-of- basin transfers.
New Storage Reservoirs			
4.1.1	Penley Reservoir Site	PN1, LT1, LT2, LT3, EC1	Carried forward in the FR/EIS to form a component of the No Action Alternative (Alternative 1). Appears to provide reasonable cost, upstream off-channel storage with minimal environmental impacts.
4.1.2	Willow Creek Reservoir	PN1, LT1, LT5	Eliminated due to limited storage capacity, and the logistics of combining with other small capacity reservoirs in the area.
4.1.3	Hritz Plum Creek Reservoir	PN1, LT1, LT5	Eliminated due to limited storage capacity, and the logistics of combining with other small capacity reservoirs in the area.
4.1.4	Highland Ranch Reservoir Series (Reservoir Nos. 6, 7, 8, 10, 11 and 12)	PN1,LT1, LT5	Eliminated due to its current storage commitments and the logistics of combining with the other small capacity reservoirs in this series.
4.1.5	Local Upstream Gravel Pit Reservoirs	PN1, LT5	Eliminated due to limited storage capacity, and the logistics of combining with the other small capacity reservoirs in the area.
4.1.6	Lower South Platte Gravel Pits (Central Colorado WCD Gravel Pit, Aurora Gravel Pits (2 total) and the Brighton Gravel Pit)	PN1	Carried forward in the FR/EIS to form a component of the No Action Alternative (Alternative 1). Provides reasonable cost, upstream off-channel storage with minimal environmental impacts. Also carried forward in the FR/EIS to form a component of Alternative 2.
Storage Expansion of Chatfield Reservoir			
4.2.1	Reallocation of 2,900 AF to Storage	PN1, LT5	Eliminated due to insufficient storage capacity and the logistics of combining with other small capacity reservoirs in the area.
4.2.2	Reallocation of 4,500 AF to Storage	PN1, LT5	Eliminated due to insufficient storage capacity and the logistics of combining with other small capacity reservoirs in the area.
4.2.3	Reallocation of 7,700 AF to Storage	PN1, LT1, LT2, LT3, LT5, EC2	Carried forward in the FR/EIS as Alternative 4. In channel and existing infrastructure. Does not require acquisition of additional water rights, acceptable permitting, and operational requirements. Significant, but mitigable environmental impacts and recreational impacts.
4.2.4	Reallocation of 20,600 AF to Storage	PN1, LT1, LT2, LT3, LT5, EC2	Carried forward in the FR/EIS as Alternative 3. In channel and existing infrastructure. Does not require acquisition of additional water rights, acceptable permitting, and operational requirements. Significant, but mitigable environmental impacts and recreational impacts.
4.2.5	Reallocation of Greater Than 20,600 AF to Storage	LT2, LT5	Eliminated due to the extensive inundation that would impact wetlands, recreational facilities, park roadways, and local highways. The flood risk management function of the reservoir would be impacted.
4.2.6	Reallocate in the existing conservation pool (i.e. below 5,432 feet msl) for large and/or small amounts	LT1, LT2	Eliminated due to current storage commitments. Denver Water has no plans to make their storage space in Chatfield available to others. Additionally, if 20,600 AF of space was used by the Chatfield water providers, the conservation pool would sometimes drop below the current low level of 5,423 feet msl.

Table 2-4
Summary Results of Initial Screening of Concepts

	Concept*	Relevant Screening Criteria	Rationale for Screening Forward or for Elimination
4.2.7	Reallocate some water in the conservation pool and some in the flood control pool in proportions that would seek to minimize ecosystem habitat flooded and effects on recreation facilities.	LT1, LT2	Eliminated due to current storage commitments. Denver Water has no plans to make their storage space in Chatfield Reservoir available to others.
Storage Expansion or Reallocation of Other Existing Reservoirs			
4.3.1	Rueter-Hess Reservoir	PN1, LT1	Eliminated due to its current storage commitments. PWDS has no plans to make this reservoir available.
4.3.2	South Platte Reservoir	PN1, LT1	Eliminated due to its current storage commitments. CWDS has no plans to make this reservoir available.
4.3.3	McLellan Reservoir	PN1, LT1	Eliminated due to its current storage commitments. CWDS has no plans to make this reservoir available.
4.3.4	Platte Canyon Reservoir	PN1, LT1	Eliminated due to its current storage commitments. Denver Water has no plans to make this reservoir available.
4.3.5	Bear Creek Reservoir	PN1, LT5	Eliminated due to limited storage capacity, and the cost and logistics of combining with other small capacity reservoirs in the area
4.3.6	Cherry Creek Reservoir	PN1, LT5	Eliminated due to limited storage capacity. The flood risk management function of the reservoir would be impacted.
Conjunctive Use of Surface and Ground water			
5.1	Additional NTGW with Local Gravel Pit Storage	PN1	Carried forward in the FR/EIS to form a component of Alternative 2. Considered technically and economically reasonable for consideration in supporting the purpose and need of increasing availability of water, sustainable over the period of analysis.
5.2	Bedrock Aquifer Conjunctive Use	C1, LT4	Eliminated due to the necessity to build an interim storage reservoir to capture surplus surface water flows and the cost and logistics of constructing a treatment, injection and pumping system.
5.3	Alluvial Aquifer Conjunctive Use	C1, LT4	Eliminated due to limited alluvial aquifer storage availability in the area of the project and the requirement to locate and construct aquifer recharge basins.
Water Reuse			
6.1	Chatfield Water Providers Local Reuse Programs	PN1	Eliminated based on the fact that all Chatfield study participants already have in place systems to recapture and reuse the majority of their available reusable wastewaters. This has been a cost effective water management alternative that has already been maximized to the extent that there is no significant additional water supplies available from this concept.
6.2	Regional Reuse-WISE Partnership	C1, LT1, PN1, LT 4	Eliminated based on unknown cost, logistics and timing. The project is currently in the planning stages. And its configuration and completion date are unknown. Additionally, the quality of the water delivered would require either advanced treatment or significant blending with other water of which there is a very limited supply. Finally, the timeframe for the WISE Project implementation is unknown.

*Concepts in bold text were carried forward in the FR/EIS.

A number of existing reservoirs located near the project site were evaluated for potential water supply storage expansion and/or re-allocation. These reservoirs were not available due to current storage commitments and/or any potential expansion of storage would impact the flood mitigation function of the reservoir.

New storage reservoir concepts were also considered in the initial screening process. All potential sites, with the exception of the Penley site, were eliminated from further evaluation due to their limited storage capacity, and the logistical difficulties of combining reservoirs to meet the storage requirements of the project. The Penley Reservoir site was carried forward because it may provide a reasonable cost, upstream storage body, with sufficient volume and minimal environmental impacts.

Consistent with identified planning objectives, a number of configurations of local storage reallocation within Chatfield Reservoir were eliminated due to insufficient storage capacity (e.g. 2,900 AF and 4,500 AF alternatives). And, consistent with planning constraints, reservoir scenarios involving prohibitively large volumes (>20,600 AF alternative) that would impede flood control functions, and involving acquisition of storage or water rights from Denver Water were eliminated.

Water conservation and reuse practices of the Water Providers constitute an independent parallel action and therefore were not explicitly included as components of all alternatives selected for detailed evaluation.

Alternatives selected for detailed evaluation are described in Section 2.4.

2.4 Alternatives Considered in Detail

The alternatives considered in detail in this analysis are:

- Alternative 1—No Action, Penley Reservoir combined with Gravel Pit Storage
- Alternative 2—NTGW combined with Gravel Pit Storage (Least Cost Alternative to Chatfield Reservoir Storage Reallocation)
- Alternative 3—Reallocation of 20,600 acre-feet to Storage (20,600 Acre-Foot Reallocation)
- Alternative 4—Reallocation of 7,700 acre-feet to Storage (7,700 Acre-Foot Reallocation) and use of NTGW and Gravel Pit Storage

Each of the alternatives was designed to reach an average year yield of 8,539 acre-feet, which corresponds with the average year yield under the maximum (20,600 acre-feet) reallocation alternative (Alternative 3). The alternatives correspond to the maximum water pool elevations in the reservoir of 5,432 feet msl (Alternatives 1 and 2), 5,444 feet msl (Alternative 3), and 5,437 feet msl (Alternative 4). Each alternative implicitly includes the increased water conservation programs currently planned or implemented (see Section 2.3.3 for details). The following section provides a description of each of the alternatives analyzed in detail.

Background on Chatfield Reservoir

The Chatfield Dam and Lake Project was authorized under Public Law 81-516 with the primary purpose of providing flood control storage. The project was designed to maximize benefits by meeting multiple objectives; secondary uses include recreation, silt control, and fish and wildlife habitat. The initial authorization allocated 180,000 acre-feet to flood risk management storage and 20,000 acre-feet to silt control and for fish and wildlife purposes (USACE 2002b, Design Memorandum PC-46, Master Plan). By contract in 1979, Denver Water is allowed to store approximately 27,000 acre-feet in Chatfield Reservoir with the conditions that 10,785 acre-feet of storage can be regulated solely by Denver. Denver will use its efforts "as nearly as practicable" to maintain water at or above elevation 5,426.94 feet msl (i.e., 20,000 acre-feet of water in storage) from May 1 to August 31 each year, and only during "severe and protracted drought" conditions, as determined by the State of Colorado and endorsed by the Omaha District Engineer (USACE), will the pool be allowed to fall below 5,423 feet msl. Storage in the reservoir is allocated into four pools: inactive/sediment storage, multipurpose-conservation, flood control, and maximum surcharge/spillway design flood. Table 2-5 presents the elevations of the different pools, the volume of storage, and the surface areas under each of the alternatives.

The following characteristics of the reservoir and dam would remain the same under all alternatives[1]:

▪ Dam	
– Top Elevation	5,527 feet msl
– Length of Dam	13,136 feet
– Height of Dam	147 feet
▪ Spillway	
– Discharge Capacity	188,000 cfs (at elevation 5,521.6 feet msl)
– Crest Elevation	5,500 feet msl
– Width	500 feet
– Gross Storage (5,521.6 feet msl)	350,676 acre-feet
▪ Outlet Works	
– Number and size of conduits	Two 11-foot x 16-foot oval conduits (bottom release)
– Conduit length	1,280 feet
– Number/Size/Type of Gate(s)	Two 6-foot x 13-foot hydraulic slide Two 2-foot x 2-foot slide gate on gate One 6-foot butterfly
– Discharge Capacity	8,400 cfs at elevation 5,500 feet msl

[1] Source: USACE 2002b

2.4.1 No Action (Alternative 1)

The No Action Alternative, also known as the "without-project" condition, is the most likely condition expected to exist in the future in the absence of the proposed action, i.e., the Chatfield Reservoir storage reallocation project. In this case, the No Action Alternative means that flood storage space within Chatfield Reservoir would not be reallocated to conservation storage and the operation of the reservoir would remain the same. Since there would be no change in water levels or operations of the reservoir, there would be no observable impacts to users or resources within the immediate vicinity of Chatfield State Park. But, since the water providers desiring Chatfield Reservoir storage space will continue to have their individual water supply needs as described in Chapter 1, the No Action Alternative needs to describe the most likely action or actions that would be taken to realize equivalent benefits to the proposed action. The No Action Alternative constitutes the benchmark against which other alternative plans are evaluated for other than economic purposes. An alternative screening analysis has been conducted to determine what the most likely No Action Alternative would be.

Table 2-5
Comparison of Pool Levels and Volumes Under Each Alternative

Feature	Elevation (feet msl)			Capacity (acre-feet)			Surface Area (acres)		
Alternative	No Action or NTGW*	20,600 Acre-Foot Reallocation	7,700 Acre-Foot Reallocation	No Action or NTGW*	20,600 Acre-Foot Reallocation	7,700 Acre-Foot Reallocation	No Action or NTGW*	20,600 Acre-Foot Reallocation	7,700 Acre-Foot Reallocation
Maximum Surcharge/Spillway Design Flood c/	5,500–5,521.6	5,500–5,521.6	5,500–5,521.6	116,469	116,469	116,469	5,991	5,991	5,991
Flood Control Pool a/, b/, c/, d/	5,432–5,500	5,444–5,500	5,437–5,500	206,779	186,179	199,079	4,779	4,779	4,779
Multipurpose-Conservation Pool b/, c/	5,385–5,432	5,385–5,444	5,385–5,437	27,405	48,005	35,105	1,429	2,009	1,668
Inactive/Sediment Storage Pool c/	5,377–5,385	5,377–5,385	5,377–5,385	23	23	23	N/A	N/A	N/A

* NTGW refers to the NTGW/Downstream Gravel Pits Alternative.

Sources

a/ Scoping document
b/ Water Control Plan (Appendix B of the FR/EIS)
c/ Master Plan
d/ Calculated (206,729-20,600=186,129 and 206,729-7,700=199,029)
N/A not applicable

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The set of potential "no action" options was screened by the providers based on several factors including cost, environmental impacts, project timing, water rights considerations, and likelihood of implementation. The water providers then collectively developed the most likely "no action" alternative, as described below.

For the analysis of a development of storage No Action Alternative, numerous options were identified and screened including alternative reservoirs at the following locations: Willow Creek site, Hritz Plum Creek site, Walker pit site, McClean pit site, Highlands Ranch site 11, Titan ARS pit site, Deer Creek quarry site, and the Tarryall Reservoir site. These are sites for an upstream reservoir location and several unnamed gravel pit sites for downstream reservoir locations that were analyzed. The conclusion from this analysis is that the most likely and lowest cost No Action Alternative for each of the water providers would be either the construction of alternative new storage, with pump and pipeline facilities, at several sites, or, for one user, the combination of a small acquisition of new water rights and storage space in an existing facility.

The main feature of the No Action Alternative is the development of other alternative surface storage units to contain surface water supplies of the same approximate yield of the Chatfield Reservoir storage reallocation project. In addition, it is important to also consider how the water provider's demand will be met until major surface storage features come online. For upstream water providers, primary supply in lieu of a reallocation at Chatfield Reservoir is NTGW until other surface storage is developed. Downstream water providers supplies are accommodated by junior and senior surface water rights, existing surface water storage and recharge facilities, reuse, and purchase/transfer of agricultural water rights leasing agreements until an alternative surface storage unit can be developed.

The water providers have developed No Action Alternatives generally based upon two logical regional groupings, the so-called Penley Reservoir Users consisting of water providers located approximately at, above, or slightly below the elevation of Chatfield Reservoir, and the so-called Lower South Platte Gravel Pit Users who are either located or able to take water deliveries considerably downstream of Chatfield Reservoir. One water provider has a unique circumstance, which is described as Other User. Because the NTGW and other supplies that will provide water supply in lieu of a reallocation at Chatfield Reservoir are all currently in existence and being used, additional environmental impacts are relatively minor. Therefore, detailed environmental impact analyses will mainly focus on surface storage.

2.4.1.1 Penley Reservoir User Group

The so-called Penley Reservoir User Group includes Mount Carbon Metropolitan District, the nine SMWSA members that are participants in the Chatfield study (see Table 1-1), the Colorado State Parks, Center of Colorado WCD, and Perry Park Country Club.

The collective No Action Alternative for the Penley Reservoir Users is to construct a new regional storage reservoir, known as the Penley Reservoir, at the site shown in Figure 2-1. This site was chosen after analyzing eight alternative storage sites in the nearby area. Many Penley Reservoir Users are participating in the project with this specific goal in mind. Note that the "Proposed Plum Creek Reservoir" shown in Figure 2-1 is not a component of the Chatfield storage reallocation study. It is a project being developed independently by the Castle Pines Metropolitan and Castle Pines North Metropolitan Districts and the town of Castle Rock and its development is not contingent on the outcome of the Chatfield study (see Section 4.19.1.20 for additional details).

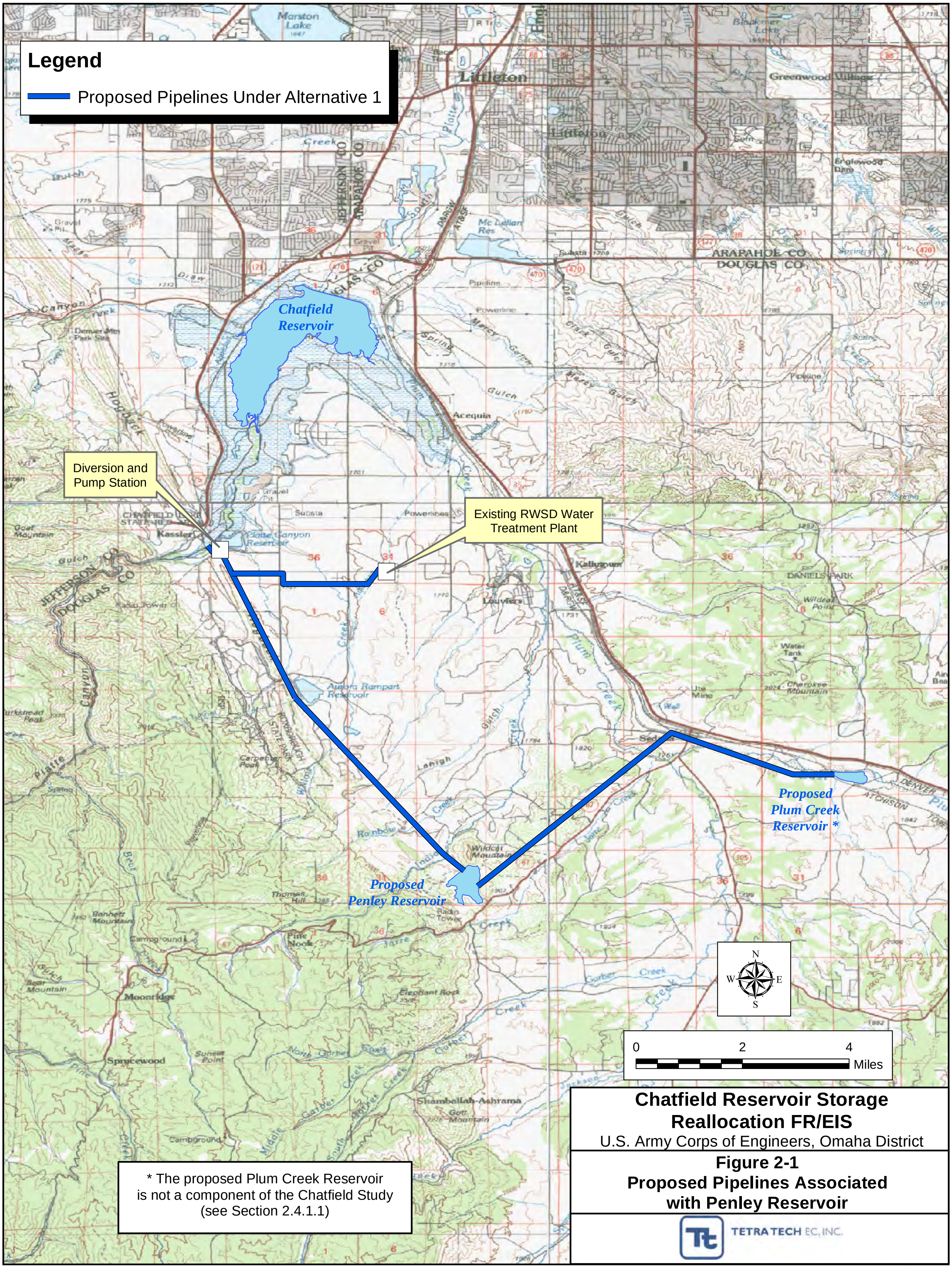
The possible sites for a regional reservoir meeting the collective volume requirement for the Penley Reservoir Users are extremely limited. No reservoir site located upon the South Platte River channel, which would be equivalent to Chatfield Reservoir in its on-channel benefits, was considered practicable. Expenses and impacts are minimized by making this a single regional storage facility to serve multiple water providers. The SMWSA listed Penley Reservoir as a proposed regional storage site in SMWSA's water right application, Colorado Division One water court case number 04CW309, filed in December 2004.

The proposed Penley Reservoir, as shown in greater detail in Figure 2-2, would be an off-channel reservoir located approximately 11 miles south of Chatfield Reservoir adjacent to Colorado's "foothills" mountain range. The reservoir site would be created by construction of two embankments approximately 160 feet high with a total length of 3,500 feet, producing approximately 11,300 acre-feet of usable storage space (this is the same storage volume the collective Penley Reservoir Users would realize from the 20,600 Acre-Foot Reallocation Alternative). An outlet works approximately 1,100 feet long would be constructed in the northwest embankment. The surface area of the reservoir at a storage volume of 11,300 acre-feet would be approximately 155 acres.

Options considered for delivery of water from the South Platte River to Penley Reservoir included a 15-mile-long gravity tunnel near Deckers and a 7.5-mile-long tunnel and pump station near Eagle Rock. The most favorable option is to deliver water into the Penley Reservoir from the South Platte River at the downstream end of Waterton Canyon near the Platte Canyon Reservoir and High Line Canal; this option is used in Alternative 1. This diversion would require a pump station and an approximately 8-mile-long, 48-inch-diameter pipeline to the reservoir (see Figure 2-3) with a capacity of approximately 60 cfs. The anticipated approach is to utilize existing Denver Water facilities (i.e., the High Line Canal and the Platte Canyon Reservoir), thereby avoiding the need for a new diversion structure on the river. This approach would require the approval of Denver Water. If no approval can be obtained, a costly new diversion structure would be required.

Delivery of water from the reservoir to the users would be done using two general approaches. For some water providers, including SMWSA, Centennial WSD, Center of Colorado WCD, Perry Park Country Club, and Colorado State Parks, the pipeline carrying water to the reservoir would also be used to deliver water back to the South Platte River and to Chatfield Reservoir for subsequent release or diversion. This pipeline would be approximately 8 miles long. A joint inlet and outlet facility would be used. For other water providers in the Penley Reservoir User Group, including Roxborough WSD, Castle Pines Metropolitan District, Castle Pines North Metropolitan District, and town of Castle Rock, a separate delivery system of pipeline and booster pump facilities would be used to deliver water to their respective water systems.

Roxborough WSD would use both part of the 8-mile outlet pipeline carrying water back towards the South Platte River and a new pipeline diverting their water to their water system. The new pipeline would be approximately 3.8 miles long. The same pipeline and pump station facilities are estimated to be used for the Castle Pines Metropolitan District, Castle Pines North Metropolitan District, and Town of Castle Rock; the other water providers would each have their own water delivery facilities. The Castle Pines metropolitan districts/Town of Castle Rock pipeline would be approximately 6.95 miles long. Figures 2-4 and 2-5 show the layouts of each of these proposed facilities.



Chatfield Reservoir Storage Reallocation FR/EIS
U.S. Army Corps of Engineers, Omaha District

Figure 2-1
Proposed Pipelines Associated with Penley Reservoir

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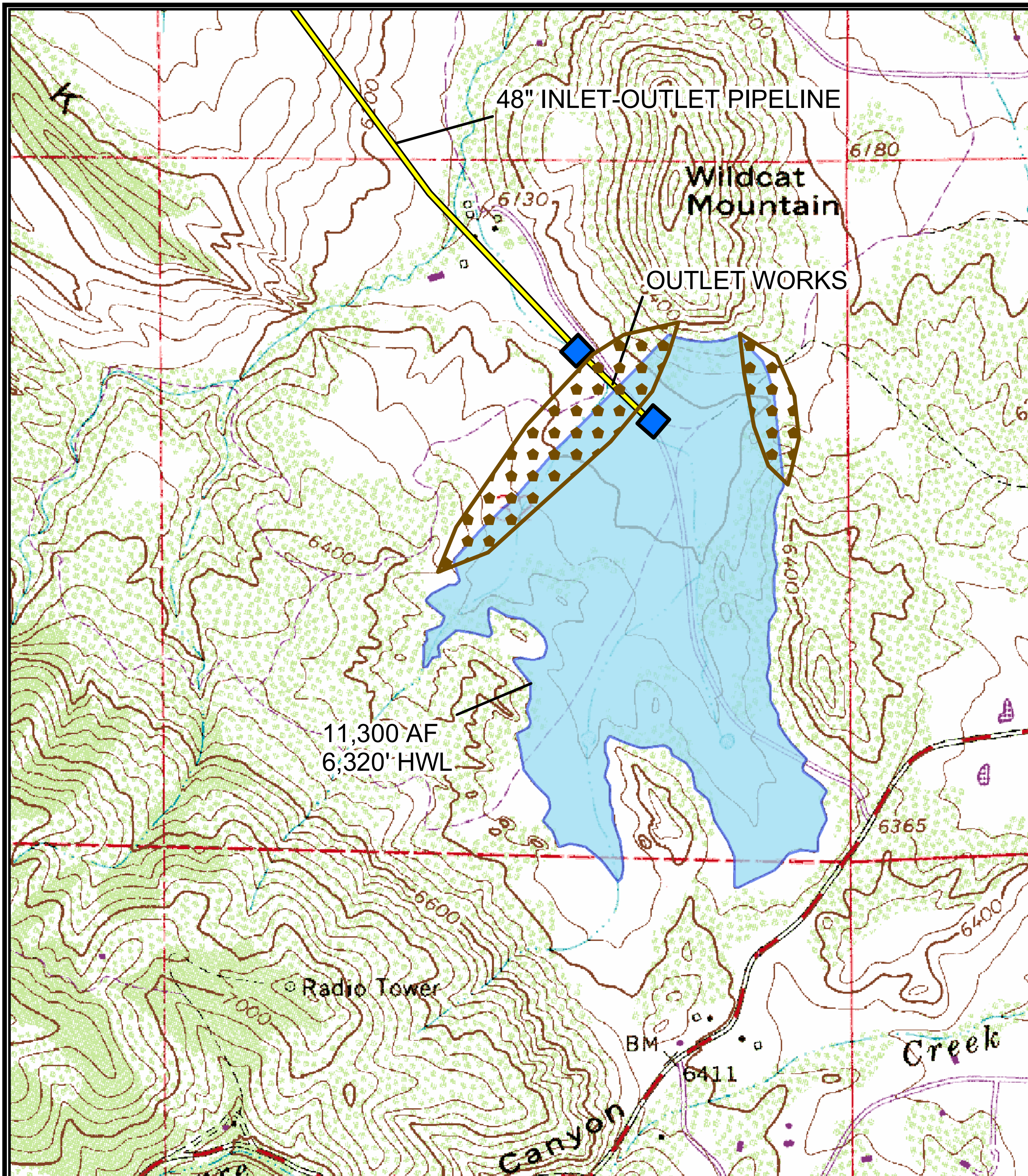

Source: Kassler USGS 7.5' Topographic Quadrangle (1994)

1,000 500 0 1,000 Feet

FIGURE 2-2
PROPOSED PENLEY RESERVOIR
11,300 ACRE FEET

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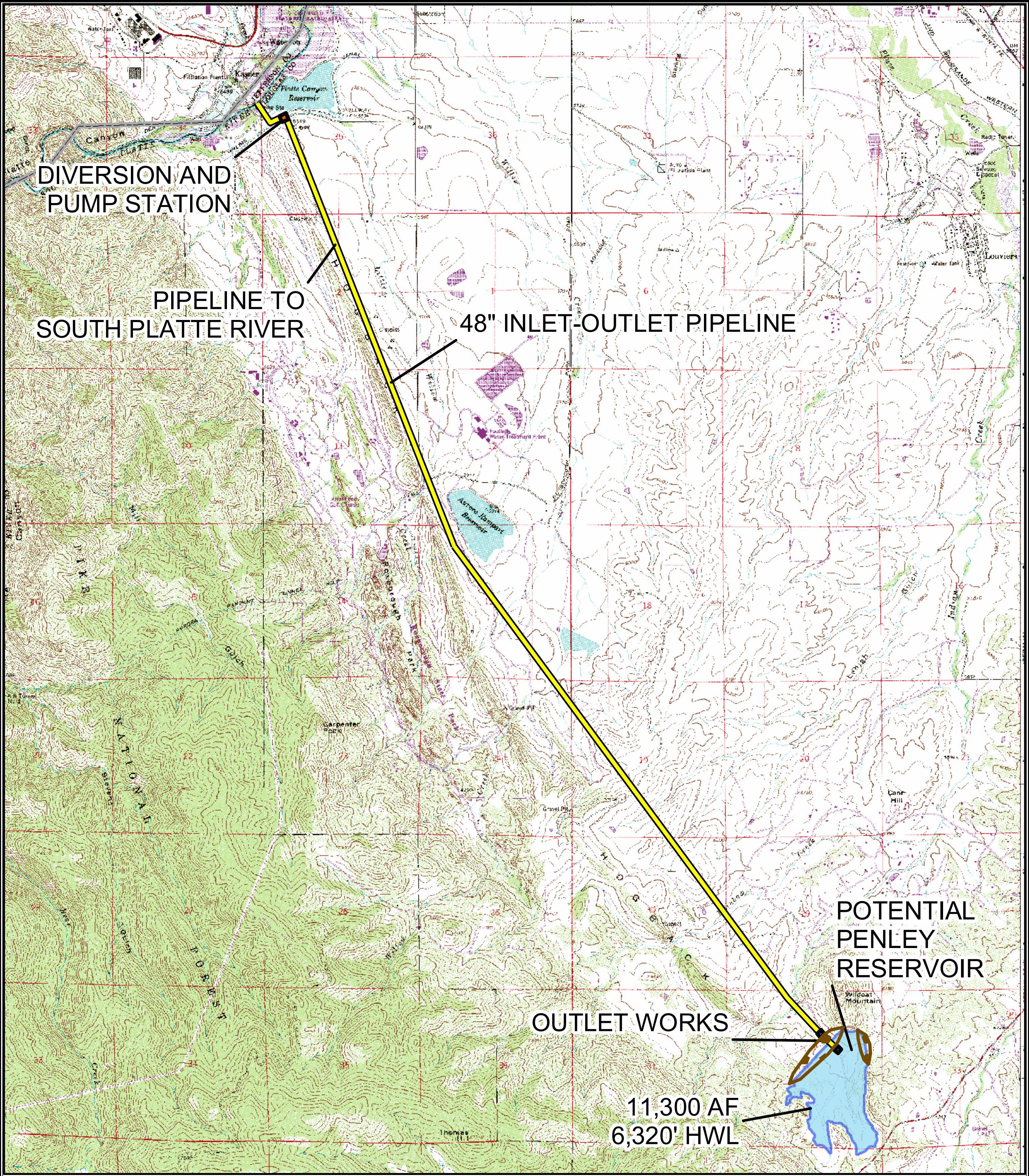

Source: Kassler USGS 7.5'
Topographic Quadrangle (1994)

1 0.5 0 1 Miles

FIGURE 2-3
PROPOSED PENLEY RESERVOIR DIVERSION, PUMP STATION AND PIPELINES

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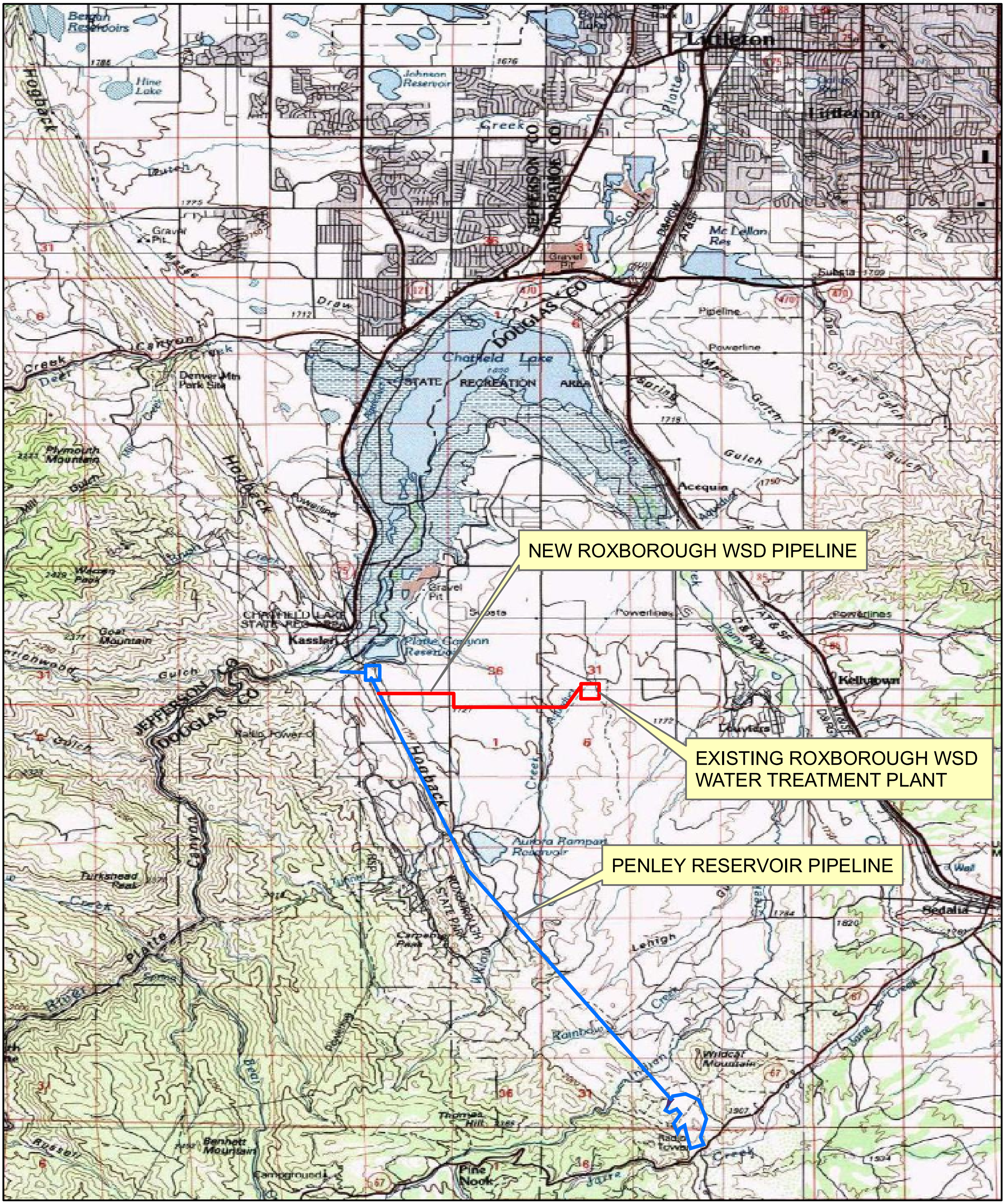
Figure 2-4 Roxborough WSD No Action Alternative



0 5,000 10,000
Feet

1 inch equals 10,000 feet

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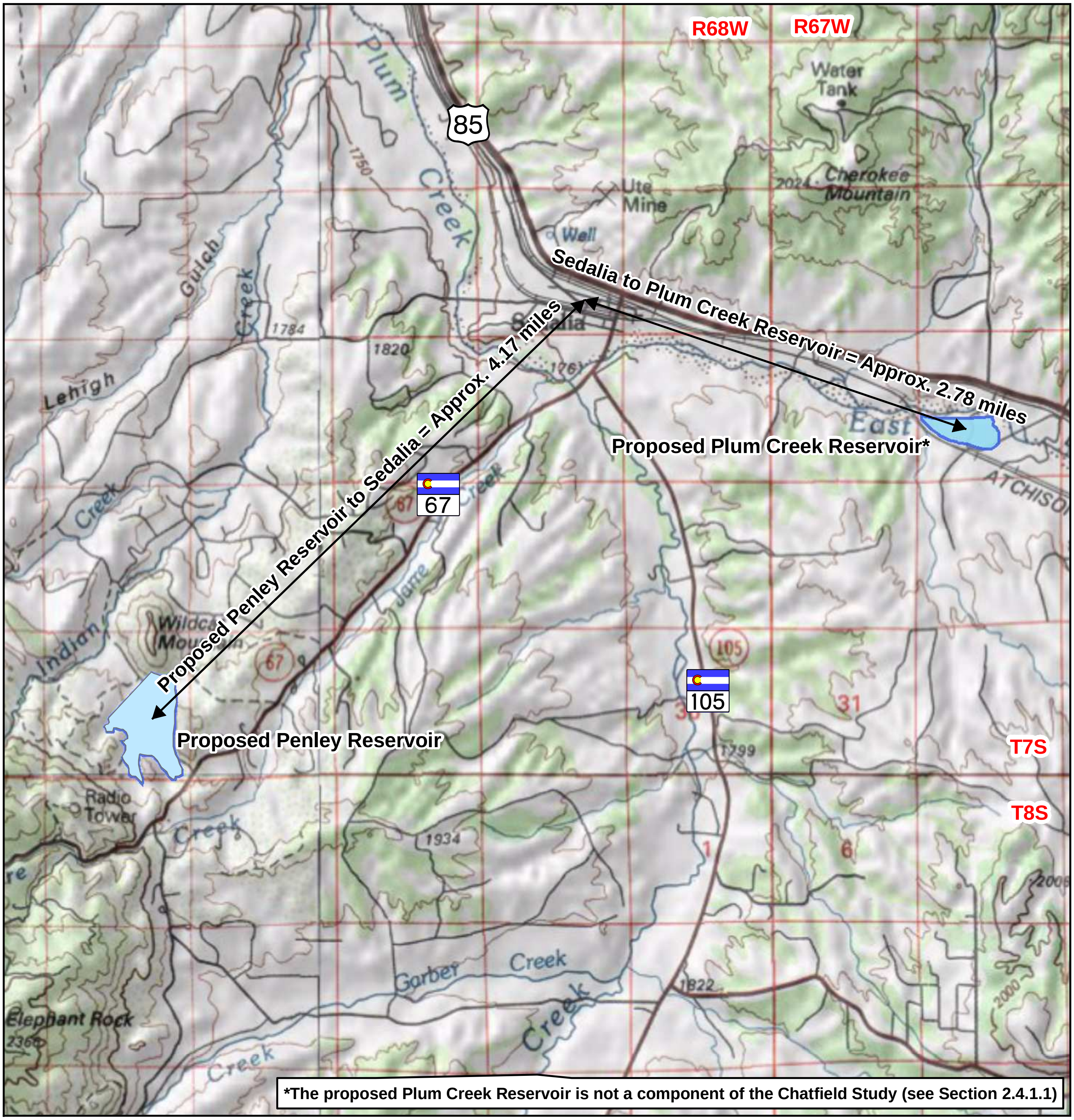

Sources:
Basemap Created From: Topo!®,
National Geographic Holdings, Inc. ©2002.

USGS 7.5' Quadrangles
Sedalia, 1980, 20' Contour Interval

Projection:
UTM NAD83

Job No.: 126.111
Prepared by: CE 01/29/07
Revised by: KCD 11/06/09
Checked by: TJD 11/06/09

N W E S

0 0.5 1 Miles

1 inch equals 1 mile

Jehn Water Consultants, Inc.
1565 Gilpin Street
Denver, CO 80218
(303) 321-8335
(303) 321-8346 fax

Relative Locations of the Proposed Penley and Plum Creek Reservoirs

Figure 2-5

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Water Rights Considerations for the Penley Reservoir User Group. Most Penley Reservoir Users would not acquire new water rights for the Penley Reservoir alternative. Instead, they would each use the same water rights they had anticipated using in a Chatfield Reservoir storage reallocation project after they had been successful with a so-called change case process in water court to change the place of storage of the water rights. The one exception is the SMWSA, who have already listed Penley Reservoir as an alternative storage location in their pending water rights application, and would proceed to acquire that new junior water right. Use of these water rights would give the Penley Reservoir Users approximately the equivalent yield, estimated as 4,605 acre-feet per year of average year yield, compared to the average year yield the users would get with the 20,600 Acre-Foot Reallocation Alternative, since both groups of water rights are relatively junior in their priority. This yield estimate does not account for the possible limitation from the minimum stream flow requirements in Waterton Canyon.

2.4.1.2 Lower South Platte Gravel Pit User Group

The so-called Lower South Platte Gravel Pit User Group is composed of city of Aurora, city of Brighton, Central Colorado WCD, and Western Mutual Ditch Company. If the Chatfield Reservoir storage reallocation project does not happen, these downstream water providers would most likely each develop an individual gravel pit storage reservoir, located to maximize water supply benefits and minimize connection costs with the user's existing water supply system.

The Lower South Platte Gravel Pit Users considered several other alternatives prior to identifying gravel pit storage as the most likely, as well as least cost, alternative to storage in Chatfield Reservoir. Alternatives that would achieve equivalent benefits to the reallocated storage space in Chatfield Reservoir were developed. These included gravel pit storage along the lower South Platte River; the acquisition of additional direct flow water rights to supply direct flow water that would otherwise be available through storage in Chatfield Reservoir; and participation in a large regional pipeline to convey water to the downstream users from other basins. These alternatives were screened for costs, timing of construction, and institutional considerations (including environmental permitting needs). Based on this screening effort, gravel pit storage was determined to be the least costly option with the highest likelihood of success. Institutional constraints and likely environmental impacts were also the smallest for gravel pit storage. Each Lower South Platte Gravel Pit User then identified a potential gravel pit storage site, based on optimizing the connection with its existing water supply system and infrastructure. These locations, all in Adams County, are identified in Figure 2-6.

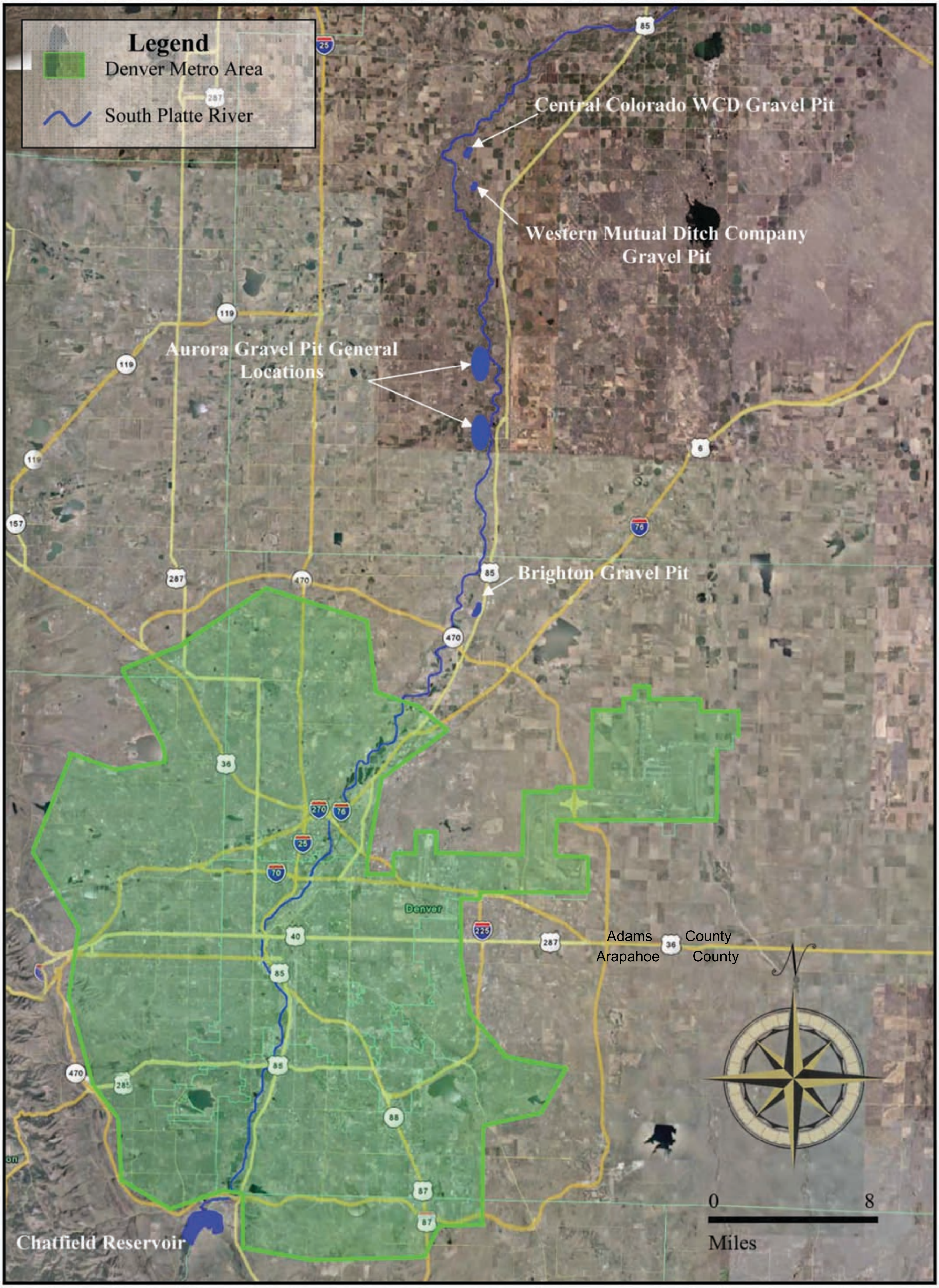
Based on depth to bedrock in the general area, each of the gravel pits was assumed to be approximately 20 feet deep. Each of the pits would be surrounded by a slurry wall down to bedrock, and would require inlet and outlet works with associated pumps to allow the gravel pits to fill and return water to the South Platte River as needed. Inlet facilities would be sized to allow adequate capacity to pump from the South Platte River under free water conditions (this also approximates the diversion capability of an on-channel reservoir). Free water consists of inflows available to be stored in Chatfield by the new users when inflows are so high that their relatively junior water rights are in priority. Adequate outlet structures would also be needed to allow the return of required augmentation water. In some cases, agricultural rights would be transferred to fill the gravel pits, which would involve conversion of irrigated agricultural lands to dry land agriculture or taking lands out of agricultural production. For example, a single gravel pit facility with 1,425 acre-feet of storage space (and 485 acre-feet yield) would require approximately 76 acres of surface disturbance, including required freeboard, room for the slurry wall, and appropriate setbacks. The estimated agricultural land that would be converted for this same gravel pit with 1,425 acre-feet of storage would be 1,020 acres of agricultural lands. This is based on a ratio of 2.1 acres of dry-up per 1 acre-foot of fully consumable irrigation water (yield) (Beck 2007). Two Lower South Platte Gravel Pit Users would need to construct 1,425 acre-feet of storage; one would need to construct 2,849 acre-feet of storage, and the other would need 3,561 acre-feet. Figures 2-7, 2-8, 2-9, and 2-10 show these facilities.

Water Rights Considerations for the Lower South Platte Gravel Pit User Group. The junior water rights that the Lower South Platte Gravel Pit Users currently hold or have pending in Division 1 water court associated with the Chatfield Reservoir storage reallocation project do not list other future gravel pit storage sites contemplated along the lower South Platte River as points of storage. Like the Penley Reservoir Users, the water rights pending in water court or decreed in Division 1 would have to be amended through a change of water right to allow diversion and storage at locations other than Chatfield Reservoir. Amending applications or changing adjudicated decrees could result in more restrictive and adverse terms and conditions for other non-Chatfield Reservoir related components that the applications and decrees are seeking to adjudicate or have adjudicated respectively. Attempts to change these adjudicated and pending water rights could result in a reduction in the yield of the water rights or a loss of the appropriation dates; thus, this process would only be undertaken as a last resort.

Given this background, the specific actions anticipated by each Lower South Platte Gravel Pit User for the No Action Alternative are identified. The two agricultural users, the Central Colorado WCD and the Western Mutual Ditch Company, would file for a change case to allow their existing Chatfield Reservoir storage water rights to be used to fill their new gravel pit facilities. If this process had unforeseen difficulties, they would each file for new junior water rights.

Absent a successful change of city of Aurora's pending and adjudicated decrees, Aurora would need to appropriate and adjudicate new, more junior water rights in an effort to replace the lost yield. Whether new appropriations would be successful in replacing the lost yield of the already adjudicated and pending water rights is not known. Such filings would entail significant legal and engineering costs. To that end Aurora would not pursue a change case but would instead file for a new junior storage right at the new gravel pit facilities to avoid the risks of filing a change of water right.

The city of Brighton would obtain nearby agricultural water rights and file a new change case application to transfer them to M&I use and allow the storage of these rights within its new gravel pit. This option was chosen because (1) it allows for the optimal use of Brighton's existing infrastructure for the purpose of making replacements; (2) it considers the limited availability of upstream water rights in comparison to downstream agricultural water rights; (3) it reduces the amount lost due to transit loss, evaporation, and carriage of upstream water to a downstream location; and (4) it eliminates obstacles associated with exchanging.



Lower South Platte Gravel Pit Users
Approximate Gravel Pit Locations

Figure Number: 2-6

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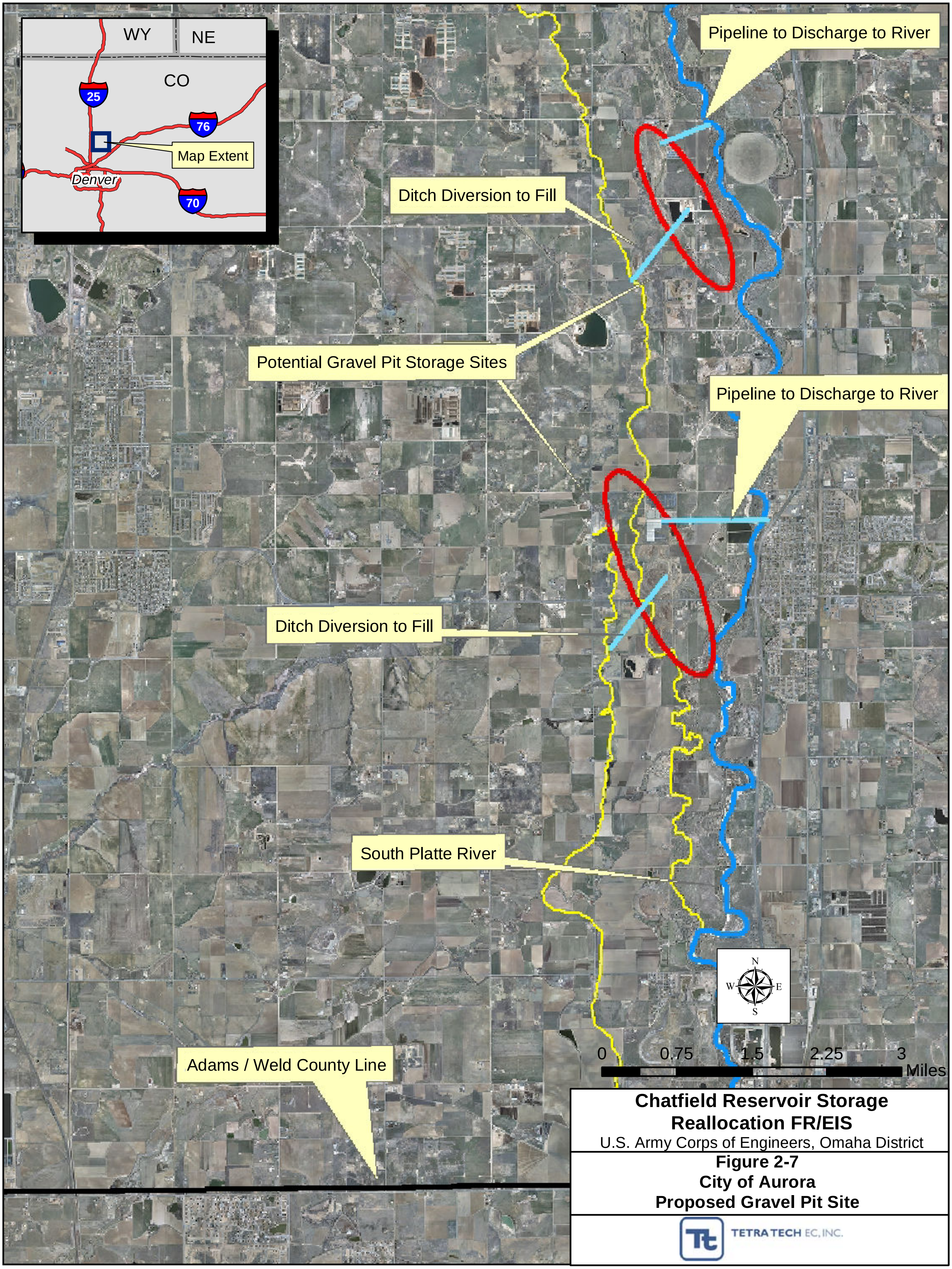

Chatfield Reservoir Storage Reallocation FR/EIS

U.S. Army Corps of Engineers, Omaha District

Figure 2-7
City of Aurora
Proposed Gravel Pit Site

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Figure 2-8 Western Mutual Ditch Company
No Action Alternative
Chatfield EIS

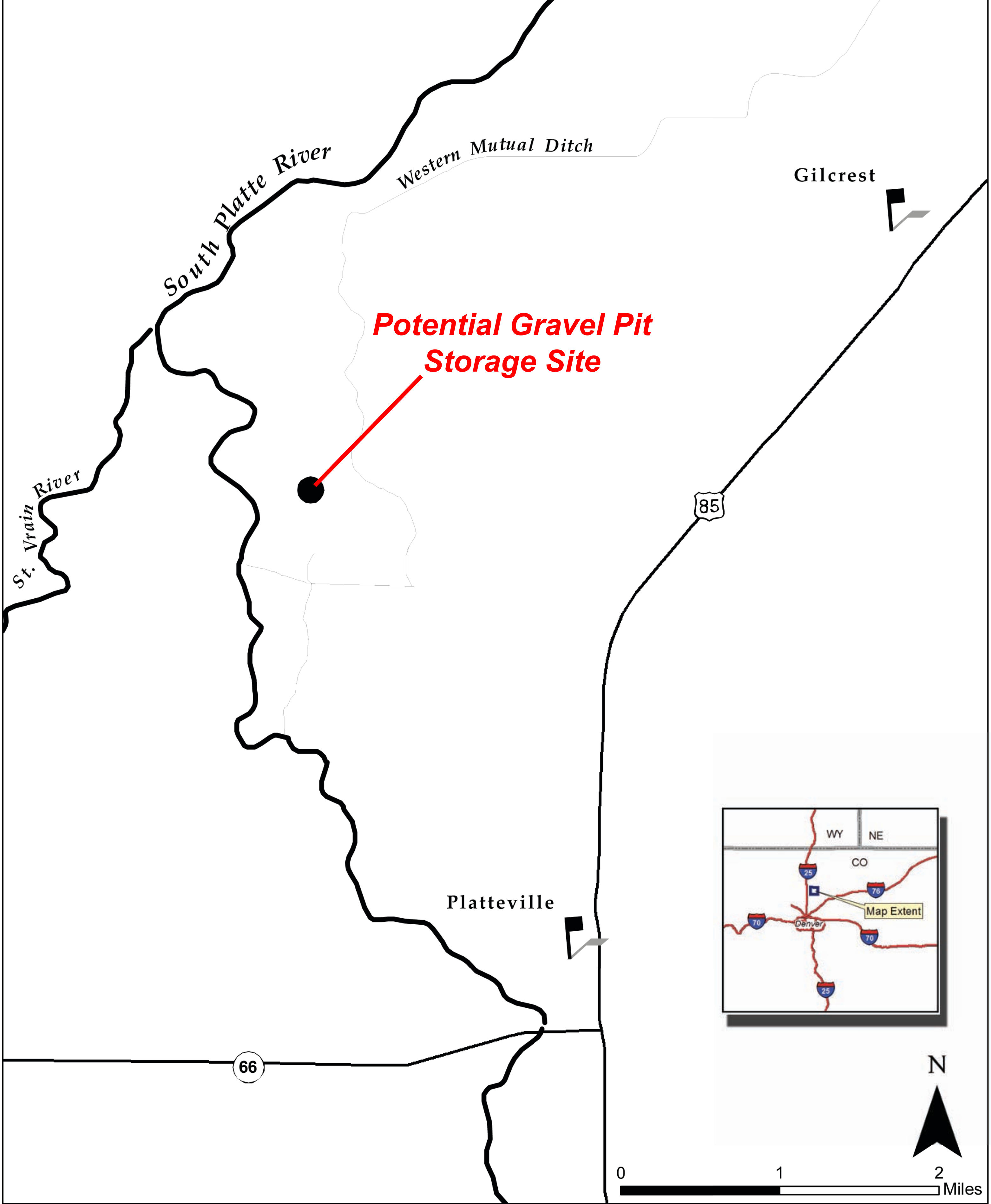

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Figure 2-9 Central Colorado Water Conservancy District
No Action Alternative
Chatfield EIS

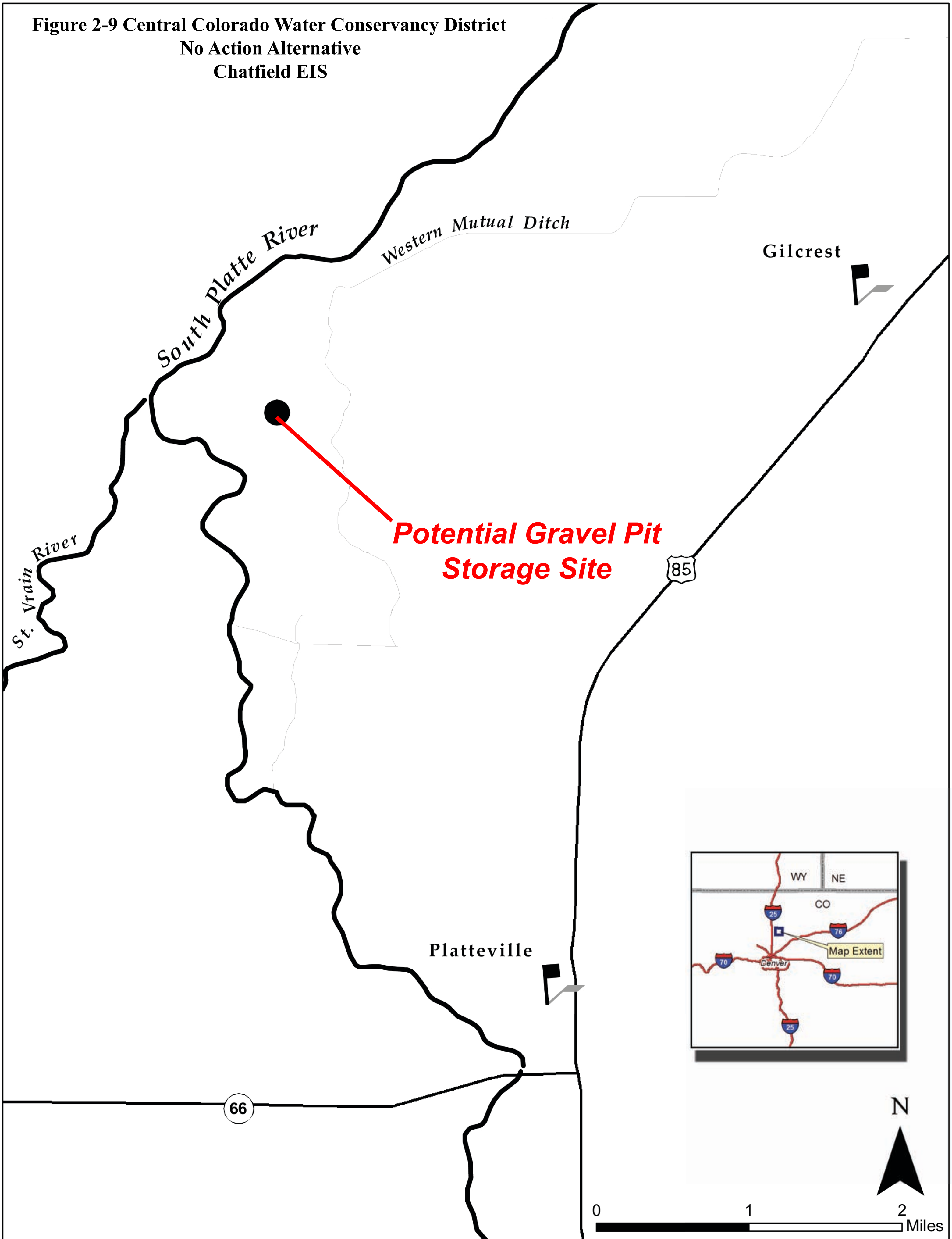

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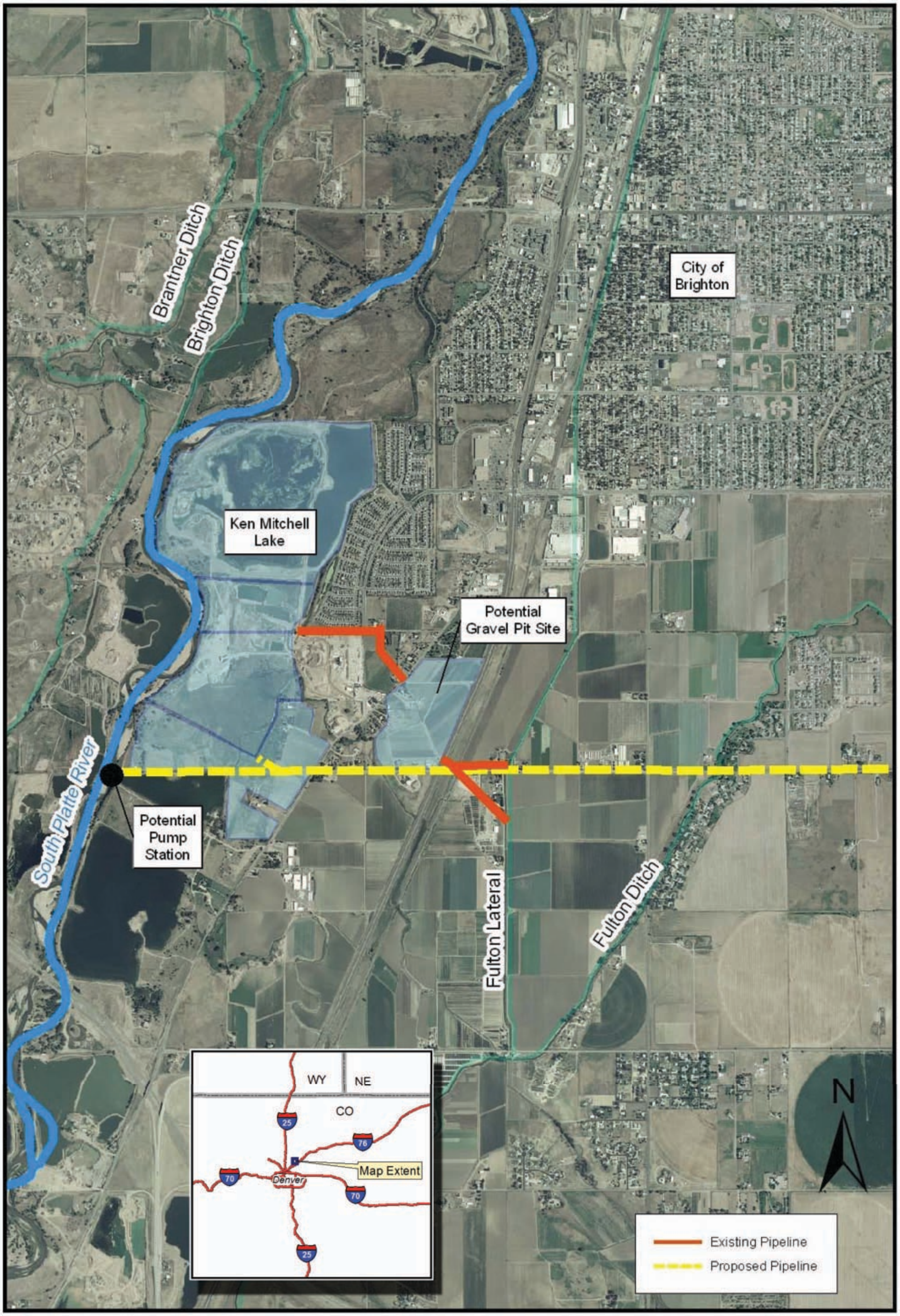
Figure 2-10 City of Brighton Proposed Gravel Pit Site



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Each of the proposed water court transactions described above would entail significant legal and engineering expenses. The average year yield of these collective water rights, estimated as 3,537 acre-feet per year, are generally equivalent to the yield of the water rights that are planned to be used for the Chatfield Reservoir 20,600 Acre-Foot Reallocation Alternative.

2.4.1.3 Other User

Denver Botanic Gardens at Chatfield is hoping to realize a 40 acre-foot storage space allocation from the Chatfield Reservoir storage reallocation project to assist with its water needs for its facility located at Chatfield Reservoir. The storage space is planned to be used as a backup irrigation supply for an annual pumpkin patch and corn maze attraction at the gardens. Also, the storage space is expected to supply water to support future prairie restoration projects to continue the education mission of Denver Botanic Gardens at Chatfield. The No Action Alternative for Denver Botanic Gardens at Chatfield is expected to be the acquisition of the equivalent water yield expected from the Chatfield Reservoir storage reallocation project consisting of acquiring 10 acre-feet of senior surface water rights or nontributary water rights combined with the acquisition of 25 acre-feet of storage on Deer Creek or near Chatfield Reservoir.

2.4.1.4 Assumptions Used in the Cost Estimates for the No Action Alternative

Penley Reservoir User Group's No Action Alternative Assumptions

Assumptions for the development of off-channel storage at the proposed Penley Reservoir are presented in Table 2-6.

Table 2-6
Assumptions for Penley Reservoir User Group's No Action Alternative

Storage Volume (acre-feet)	Reservoir Disturbance Footprint (acres)	Infrastructure Disturbance* (acres)	Entity Constructing Infrastructure	Inlet Works	Outlet Works
11,300	165	97 (Inlet/Outlet)	Multiple water providers in the Penley Reservoir User Group	Pipeline/Pump	Pipeline/Pump
		85	Town of Castle Rock, Castle Pines Metropolitan District, and Castle Pines North Metropolitan District	Joint facility	Pipeline/Pump
		30	Roxborough WSD	Joint facility	Pipeline/Pump
11,300	165	212	Total		

* Assumed pipeline and/or pump station disturbance width is 100 feet.

Lower South Platte Gravel Pit User Group's No Action Alternative Assumptions

Based on the assumption that four new gravel pits would be required to contain the 9,260 acre-feet of storage volume, further assumptions can be made about infrastructure requirements to serve as the basis for the impact analysis. Each of the gravel pit reservoirs would require diversions from the South Platte River to the reservoir. Diversion channels are relatively small (only a few feet wide) and generally located throughout the project area; therefore, developing lateral lines to serve the reservoirs would involve less than 2 acres each. Outlet works and pump stations are also relatively small and under a conservative estimate (overestimation of size) would require one additional acre for each reservoir. The length of pipeline necessary to reach from the reservoir to the water provider's treatment and distribution system would depend on the specific location of each, and whether that entity has existing infrastructure in place. For purposes of this analysis it was assumed that half of the water providers have infrastructure available to move the water and half do not. Table 2-7 summarizes the assumptions for the gravel pit storage.

Table 2-7
Assumptions for Lower South Platte Gravel Pit User Group's No Action Alternative

User	Storage Volume (acre-feet)	Reservoir Disturbance Footprint (acres)	Infrastructure Disturbance* (acres)	Ag land dry-up (acres)	Inlet Works	Outlet Works
City of Aurora	3,561	190	3	0	Ditch	Pump/pipe
Central Colorado WCD	2,849	152	3	0	Ditch	Pump/pipe
City of Brighton	1,425	76	3	1,020	Pump/pipe	Pump/pipe
Western Mutual Ditch Company	1,425	76	3	0	Ditch	Ditch
	9,260	494	12	Totals		

* Assumed pipeline and/or pump station disturbance width is 100 feet.

2.4.1.5 Operation of Chatfield Reservoir for Alternative 1

Chatfield Reservoir is managed based on the elevation of the water level at a given time. When water levels are within the multipurpose-conservation pool (i.e., conservation pool), the State Engineer's Office coordinates discharges from the reservoir based on Colorado water law and the demand for water supply while minimizing water level fluctuations during the recreation season (May 1 through September 30). When water levels reach the flood control pool (above 5,432 feet msl), the Corps manages the discharges in order to release the maximum amount of water possible while keeping below a target flow of 5,000 cfs in the South Platte River at the Denver Gage. Once the pool elevation falls back to the multipurpose-conservation pool, the State Engineer's Office resumes responsibility for managing the discharge. During the recreation season, the State of Colorado and Denver Water (the only provider with Chatfield Reservoir storage water rights presently allowed to store water in the reservoir) have entered an agreement to maintain pool elevations between 5,423 and 5,432 feet msl with the goal of maintaining the reservoir level at a minimum of 5,426.94 feet msl from May 1 through August 31 of each year as much as practicable. In times of severe and prolonged drought, the State of Colorado and the Corps' District Engineer may agree to allow the pool level to fall below 5,423 feet msl (USACE 1979, 2002b).

On a historical note, the lowest pool elevation on record since the reservoir began operations was 5,423 feet msl in December 1995. The highest pool elevation recorded in Chatfield Reservoir was 5,447.6 feet msl in May 1980 (USACE 2002b).

2.4.2 NTGW/Downstream Gravel Pits (Alternative 2)

Normally the No Action Alternative is also the Least Cost Alternative. However, when USACE procedures were applied, continued development and future use of NTGW during the 50-year period of analysis was less costly than the no action surface water supply alternative. Because this NTGW/Downstream Gravel Pits Alternative is significantly less costly than the No Action Alternative, it is used in the project economic analysis even though the water providers have indicated that they would not continue to rely on NTGW as has been the case during recent decades.

For water providers using NTGW, information about Alternative 1A in the SMWSS report (Black & Veatch et al. 2003) was the basis for the NTGW/Downstream Gravel Pits alternative. Alternative 1A evaluates the buildout of the south Denver Metro area based primarily on concentrated development of its NTGW reserves. Alternative 1A assumes that most of the future development is served through continued development of NTGW supplies, with peak demands met through pumping. In addition, Alternative 1A includes a component of conservation and aggressive development of reusable supplies. Centennial WSD, Town of Castle Rock, Roxborough WSD, and Castle Pines North Metropolitan District are the four members of the SMWSA group that participated in the SMWSS.

For the Chatfield Reservoir storage reallocation study, it is assumed that NTGW could provide water to a significant portion of the upstream water providers through the 50-year planning period (approximately 4,270 acre-feet per year based on average year yield). The water providers that would be served by NTGW are Town of Castle Rock, Centennial WSD, Roxborough WSD, Castle Pines Metropolitan District, Castle Pines North Metropolitan District, the SMWSA, and Colorado State Parks. A few upstream water providers near the edge of the aquifer may not be able to utilize NTGW through the 50-year period of analysis. They may need to pursue alternative sources of water. Due to uncertainties regarding the courses of action of the affected water providers, it is assumed their water needs are satisfied with NTGW for the purposes of this study. To the extent that other alternative water sources are more costly than NTGW, the NTGW/Downstream Gravel Pits Alternative is a conservative least-cost alternative to the Chatfield Reservoir storage reallocation project.

Downstream water providers, including city of Aurora, city of Brighton, Central Colorado WCD, and Western Mutual Ditch Company, do not currently use appreciable NTGW due to limitations on available aquifers and high cost of development. These water providers would continue to depend on surface water supplies in the NTGW/Downstream Gravel Pits Alternative, which would include development of gravel pits for water storage (with an average year yield of 4,270 acre-feet). See the No Action Alternative discussion (Section 2.4.1) for information on gravel pit storage.

2.4.3 20,600 Acre-Foot Reallocation (Alternative 3)

The 20,600 Acre-Foot Reallocation Alternative would reallocate storage from the flood control pool to the conservation pool. The additional storage would be used for M&I water supply, agriculture, recreation, and fishery habitat protection and enhancement purposes. Under this alternative, the base elevation of the exclusive flood control pool would be raised from 5,432 to 5,444 feet msl. The average year yield is estimated at 8,539 acre-feet.

The reallocation would require a change in the operations of the reservoir and would require the construction of additional recreational infrastructure and relocation of some of the existing roads and facilities.

Water providers both upstream and downstream of Chatfield Reservoir would be able to use existing infrastructure to divert their portion of the stored water into their water systems. No new infrastructure would be needed at Chatfield by any water provider.

Operations at Chatfield Reservoir for Alternative 3

Under Alternative 3, operations at Chatfield Reservoir would be based on the four pools described for Alternative 3 in Table 2-5. The base elevation of the flood control pool would be raised from 5,432 ft to 5,444 feet msl, and the State Engineer would be responsible for managing discharges for water levels within the conservation pool. During forecast high runoff years when Chatfield pool elevation is forecast to exceed 5,444 ft, the Corps and the state of Colorado would jointly operate the conservation pool. During the joint operation, Chatfield Reservoir could be drawn down while the surface elevations are still within the conservation pool to accommodate the anticipated high volume of runoff. This would provide benefits during high runoff years such as a lower maximum release resulting in less downstream impacts and possibly fewer in-pool impacts because of less need for exclusive flood control storage. The operations for Alternative 3 are detailed in Appendix B, Water Control Plan. As under the No Action Alternative, the Corps would take control of discharges once the water level reached the exclusive flood control pool elevation, in this case 5,444 feet msl. The pool elevation of 5,444 feet msl would not be achieved every year due to fluctuations in the amount of runoff. There would be no change to the need for Denver water to maintain a pool at 5,423 feet msl.

The number of water providers with storage rights within the reservoir would increase from one (Denver Water) under the No Action Alternative to 15, including Denver Water (see Table 1-1), under the 20,600 Acre-Foot Reallocation Alternative. While the State Engineer would continue to manage the discharge within the conservation pool, the demand on the additional storage rights would change the volume and pattern of the discharge from that observed under the No Action Alternative. The result is that the pool level could fluctuate more widely than under the No Action Alternative. The analysis presented in Chapter 4 considers the changes in fluctuations by using a model that superimposes operations of Chatfield Reservoir under the existing (base) conditions versus the "with project" conditions.

2.4.4 7,700 Acre-Foot Reallocation/NTGW/Downstream Gravel Pits (Alternative 4)

The 7,700 Acre-Foot Reallocation Alternative would also reallocate storage from the flood control pool to the conservation pool for multiple purposes. Again, the additional storage would be used for M&I water supply, agriculture, recreation, and fishery habitat protection and enhancement purposes.

In this case, the base elevation of the exclusive flood control pool would be raised from 5,432 to 5,437 feet msl. The average year yield for the 7,700 Acre-Foot Reallocation Alternative would be approximately 3,192 acre-feet. The reallocation would also require a change in the operations of the reservoir and the construction of additional infrastructure and relocation of some of the existing roads and facilities. Because the average year yield from Chatfield Reservoir storage reallocation for Alternative 4 is less than the average year yield for Alternative 3, additional water supply sources (NTGW and downstream gravel pit storage) are also included in Alternative 4 so that the total average year yield equals 8,539 acre-feet. Under Alternative 4, NTGW and downstream gravel pit storage would each yield approximately 2,674 acre-feet. The footprint of the gravel pits would be approximately 143 acres, and an additional 6 acres for infrastructure disturbance.

Operations at Chatfield Reservoir for Alternative 4

Under Alternative 4, operations at Chatfield Reservoir would be based on the four pools described for Alternative 4 in Table 2-5. The base elevation of the flood control pool would be raised from 5,432 ft to 5,437 feet msl, and the state engineer would be responsible for managing discharges for water levels within the conservation pool. During forecast high runoff years when Chatfield Reservoir pool elevation is forecast to exceed 5,437 feet, the Corps and the state of Colorado would jointly operate the conservation pool. During the joint operation, Chatfield Reservoir could be drawn down while the surface elevations are still within conservation pool to accommodate the anticipated high volume of runoff. This would provide benefits during high runoff years such as a lower maximum release resulting in less downstream impacts and possibly fewer in-pool impacts because of less need for exclusive flood control storage. As under the No Action Alternative, the Corps would take control of discharges once the water level reached the exclusive flood control pool elevation, in this case 5,437 feet msl. The pool elevation of 5,437 feet msl would not be achieved every year due to fluctuations in the amount of runoff.

While the State Engineer would continue to manage the discharge within the conservation pool, the demand on the additional storage rights would change the volume and pattern of the discharge from that observed under the No Action Alternative. The result is that the pool level could fluctuate more widely than under the No Action Alternative. The analysis presented in Chapter 4 considers the changes in fluctuations by using a model that superimposes operations of Chatfield Reservoir under the existing (base) conditions versus the "with project" conditions. Because the top of the conservation pool would only be at an elevation of 5,437 feet msl, the degree of fluctuation within the reservoir would be intermediate between the fluctuations of the other alternatives.

2.5 Comparison of Alternatives

The main difference among the reallocation alternatives on Chatfield Reservoir water levels is the amount of water that can be stored below the exclusive flood control pool, which is directly reflected in the maximum water level of the base of the exclusive flood control pool. However, these differences would not necessarily be clear to an observer at the reservoir on any given day. The operation of the reservoir and the resulting water levels is based on a number of factors including the water elevation at the time, flow conditions downstream, the priority of water rights of downstream water providers, requests for release of stored water, precipitation, and evaporation.

The simplest way of looking at water levels in the reservoir under the different alternatives, as well as outflows from the reservoir and flow conditions downstream, is to look at how these factors would appear when considered against historical flow data. Based on known factors and inputs, the Corps is able to use a model (HEC-5) to describe the behavior of water levels in the reservoir. The model is also able to predict how the water levels would have behaved in years prior to its construction. By changing the model parameters, the Corps is also able to determine how the reservoir would behave under the action alternatives as well, based on data from the period of record (POR) from 1942 to 2000. Therefore, the model can describe the pool elevation, the inflow, and the outflow for Chatfield Reservoir for any day during the POR under each of the three alternatives. The impact analysis presented in Chapter 4 uses the modeling results to compare the behavior of Chatfield Reservoir under current or base conditions (No Action Alternative) to conditions under the two action alternatives.

Table 2-8 presents a summary of elevation data describing monthly fluctuations within Chatfield Reservoir. The data are the results of calculations that considered the maximum elevation for the month minus the minimum elevation for the month over the POR (USACE's spreadsheet Annual Monthly Stats.xls, November 2007). The table presents the average fluctuation for each month and the high and low values over the POR. The model used historical data to predict water levels in the reservoir for the years prior to the reservoir's existence. Note that the values for the NTGW/ Downstream Gravel Pits Alternative are the same as the No Action Alternative, as indicated in the table.

Table 2-8
Monthly Pool Elevation Fluctuations (High, Average, Low) within Chatfield Reservoir over the Period of Record (1942–2000) for each Alternative (in feet)

	No Action or NTGW/Downstream Gravel Pits			20,600 Acre-Foot Reallocation			7,700 Acre-Foot Reallocation/NTGW/ Downstream Gravel Pits		
	High	Average	Low	High	Average	Low	High	Average	Low
January	2.4	0.8	0.0	2.0	0.7	0.0	2.3	0.8	0.0
February	1.7	0.4	0.0	2.7	0.6	0.0	2.9	0.6	0.0
March	7.9	0.6	0.0	11.2	0.9	0.0	11.3	0.7	0.0
April	19.6	1.6	0.0	15.9	1.9	0.0	18.0	1.6	0.0
May	26.1	3.3	0.1	21.7	3.5	0.1	23.1	3.4	0.1
June	18.6	2.7	0.0	21.3	2.7	0.0	20.8	2.7	0.0
July	5.7	2.4	0.2	8.9	2.7	0.3	6.8	2.7	0.3
August	8.3	2.1	0.1	14.3	2.9	0.5	10.2	2.6	0.1
September	2.6	1.0	0.0	4.8	1.6	0.0	3.0	1.2	0.0
October	3.3	0.9	0.0	5.0	1.1	0.0	3.4	0.9	0.0
November	2.6	0.8	0.0	3.1	1.0	0.0	3.7	1.0	0.0
December	3.1	0.9	0.0	2.5	0.9	0.0	2.8	0.9	0.0

Source: "AnnualMonthlyStats.xls" spreadsheet from USACE, November 2007.

2.6 Evaluation Criteria

Each of the four alternatives was evaluated using the Corps' *Economic and Environmental Principles and Guidelines for Water and Related Land Resources Implementation Studies* (USACE 1983). The P&Gs call for a project to be evaluated on the following criteria: completeness, effectiveness, efficiency, and acceptability. As defined in ER 1105-2-100, pages 2-4, E-4, and E-5, completeness refers to the extent to which an alternative plan provides and accounts for all necessary investments or other actions to ensure the realization of the planning objectives and/or planned effects. Effectiveness refers to the extent to which an alternative plan contributes to achieve the planning objectives and/or alleviates the specified problems and achieves the specified opportunities. Efficiency is the extent to which an alternative plan is the most cost effective means of achieving the planning objectives and/or alleviating the specified problems and realizing the specified opportunities, consistent with protecting the environment. Acceptability is the workability and viability of the alternative with respect to acceptance by state and local entities and the public, and compatibility with existing laws, regulations, and public policies. The evaluation included environmental and economic impacts, environmental and economic benefits, and project costs.

2.7 Evaluation Methodology

2.7.1 Environmental Impact Evaluation Methodology

The focus of the environmental impact evaluation is to compare how each of the alternatives affects each of the resources. The environmental impacts evaluation includes a wide range of resources including water quality, recreation, wildlife, sensitive species, aquatic resources, vegetation, wetlands, socioeconomics, and cultural resources. The methods for the evaluation vary depending on the resource and include quantitative and qualitative assessments. For example, water quality is addressed quantitatively with the use of models to predict changes in water quality that would result from changes in storage volume, while the effect of recreational users observing a "bathtub ring" in times of low water levels is addressed qualitatively.

A variety of tools were used to assess impacts. A geographical information system (GIS) was used to combine a base map of the area with data sets representing resources such as soil types, vegetation/habitat types, and wetlands to determine the acreages affected under existing conditions and under each of the alternatives. To determine the behavior of water levels in the reservoir under the four alternatives, outputs from the Corps' model discussed in Section 2.5 were imported into a statistical analysis software package (MINITAB). The statistical software is able to extract values based on queries about water levels over specific time frames. For example, water level fluctuation (particularly drawdown) at key times in the spring can be detrimental to successful spawning of some fish species. Therefore, the statistical package extracted water level fluctuation data over the POR from March through June. These values were then compared across alternatives to assess potential impacts on fish spawning. This approach was used to assess water levels at strategic times for a number of resources. The discussions in Chapter 4, Environmental Consequences, provide greater detail on the specific methodologies used to assess impacts on each resource.

2.7.2 Economic Impact and Benefit Evaluation Methodology

The economic impacts have been determined for each alternative. The hydrology analysis of the downstream flood control showed no significant impacts for any alternative. Chatfield State Park recreation facilities costs were determined for all alternatives. Recreation benefits at Chatfield Reservoir are also presented for each of the alternatives. The recreation benefits are estimated using current Corps' National Economic Development (NED) procedures. These estimates are the basis for determining alternative NED impacts.

The methodology employed to evaluate the costs and benefits involves a quantitative assessment of all the costs involved in implementing each of the alternatives. In the case of the No Action Alternative, costs include the development of additional storage, distribution, and treatment facilities (as necessary) that would provide an equal amount and quality of water as the proposed action. An alternative's benefit is the difference between its cost and the cost of the least-costly alternative.

The economic benefit evaluation involves a comparison of the total cost of storage in Chatfield Reservoir to its benefit standard. This standard is the cost of the least costly alternative to be implemented if a Chatfield Reservoir storage reallocation project is not implemented. Reallocation of storage in Chatfield Reservoir is economically justified if it has positive net benefits, or in other words if the total cost of storage in Chatfield Reservoir is less than the cost of the least-costly alternative to Chatfield reallocation.

The total cost of storage includes specific and joint use costs. The specific costs are expenditures needed by the water supply users to access their Chatfield Reservoir water. These include costs to modify and/or relocate existing facilities within Chatfield State Park; costs associated with revision of the Chatfield, Cherry Creek, and Bear Creek water control manual; cost of environmental mitigation; cost associated with dependable yield mitigation water (DYMW); and the costs of building, operating, maintaining, and replacing water supply facilities within the Chatfield Reservoir storage reallocation project and outside of the project. The joint use costs are costs associated with the 20,600 acre-feet of reallocated storage for the construction and operation of Chatfield Reservoir. These include the updated cost of embankment construction and the joint use operation, maintenance, repair, replacement, and rehabilitation (OMRR&R) costs, prorated by the ratio of reallocated storage to gross storage capacity (i.e., top of flood control pool) at Chatfield Reservoir.

The cost of storage to be paid to the U.S. Treasury is normally established as the highest of: (1) the NED benefits foregone; (2) revenues to the U.S. Treasury foregone; (3) the replacement cost of flood control and hydropower benefits foregone; and (4) the updated cost of storage in the federal project. The updated cost of storage is determined by updating all joint use costs and prorating them by the ratio of reallocated storage to total usable storage space in Chatfield Reservoir. For purposes of this calculation, total usable storage does not include space set aside for sediment distribution.

2.8 Evaluation of Alternatives

2.8.1 Environmental Impact Evaluation Summary

Table 2-9 compares impacts among the alternatives that are discussed in detail in Chapter 4. For Alternative 1, impacts include those at the Penley Reservoir site as well as impacts from construction of pipelines and other infrastructure on- and/or off-project, from use of NTGW until Penley Reservoir is completed, and from development and use of gravel pit storage. For Alternative 2, impacts include those from increased use and development of NTGW, from construction of water supply infrastructure on- and/or off-project, and from development and use of gravel pit storage. For Alternative 3, impacts include those at Chatfield Reservoir project and in the South Platte River downstream from Chatfield Dam, as well as impacts from construction of water supply infrastructure on- and/or off-project. For Alternative 4, impacts include those at Chatfield Reservoir project and in the South Platte River downstream from Chatfield Dam, and impacts from construction of water supply infrastructure on- and/or off-project, from some use and development of NTGW, and from some development and use of gravel pit storage. If no impacts are cited for a component of an alternative, that component has no adverse effects during and after construction/development of that component.

Table 2-9
Summary Comparison of Environmental Impacts of Alternatives

Resource Area	Alternative			
	Alternative 1: No Action	Alternative 2: NTGW/Downstream Gravel Pits[1]	Alternative 3: 20,600 Acre-Foot Reallocation	Alternative 4: 7,700 Acre-Foot Reallocation/NTGW/ Downstream Gravel Pits
Geology and Soils	Low potential for soil erosion. Best management practices (BMPs) would reduce potential for soil erosion during construction of Penley Reservoir and pipelines.	Low potential for soil erosion; impacts would be less than Alternative 1 because of smaller construction area.	Low potential for soil erosion. Moderate to moderately high risk for wind erosion if vegetation is removed. Relatively high runoff potential. BMPs would reduce potential for soil erosion during construction. No immediate dam safety concerns identified,	Low potential for soil erosion. Moderate to moderately high risk for wind erosion if vegetation is removed, but less than Alternative 3. Relatively high runoff potential. BMPs would reduce potential for soil erosion during construction. Footprints from gravel pits and infrastructure would be less than Alternatives 1 and 2. No immediate dam safety concerns identified,
Hydrology	155 acres inundated at Penley Reservoir. No change from current conditions at Chatfield: 9 feet of pool fluctuations. Maximum pool elevation (5,432 feet msl) reached 31 percent of years. Continued nonrenewable NTGW use until Penley Reservoir is completed.	No change from current conditions at Chatfield. Would contribute to regional problems with NTGW. Approximately 1,364 new wells needed to meet regional water demands with NTGW. Loss of production in Arapahoe Aquifer up to 85 percent by 2050.	587 acres inundated beyond current operations at top of conservation pool. 21 feet of pool fluctuations. Target pool elevation (5,444 feet msl) reached 18 percent of years. No effect on nonrenewable NTGW. Adaptive management would minimize impacts using operation strategies once reallocation begins.	215 acres inundated beyond current operations at top of conservation pool. 14 feet of pool fluctuations. Target pool elevation (5,437 feet msl) reached 25 percent of years. Minimum effect on nonrenewable NTGW. Adaptive management would minimize impacts using operation strategies once reallocation begins.
Water Quality	No anticipated impact. BMPs would reduce potential water quality impacts during construction of Penley and pipelines.	With BMPs, short-term impacts from well construction and conversion of gravel pits to water storage reservoirs not anticipated to be significant.	Possible eutrophication and algae in Chatfield Reservoir and South Platte River downstream. Worst-case, localized model predicts: 0.037 to 0.071 mg/L instantaneous maximum total phosphorus in short term, 0.055 to 0.050 mg/L instantaneous maximum total phosphorus in long term. Regional statistical model shows minimal change (slight decrease) in	Possible eutrophication and algae in Chatfield Reservoir and South Platte River downstream. Total phosphorus, chlorophyll-a, and metals intermediate between Alternatives 1 and 2 and Alternative 3. No impact to E. coli. Removal of vegetation before inundation could reduce nutrient loads.

Table 2-9
Summary Comparison of Environmental Impacts of Alternatives

Resource Area	Alternative 1: No Action	Alternative 2: NTGW/Downstream Gravel Pits[1]	Alternative 3: 20,600 Acre-Foot Reallocation	Alternative 4: 7,700 Acre-Foot Reallocation/NTGW/ Downstream Gravel Pits
			chlorophyll-a concentrations compared with Alternative 1. Lower metals. Escherichia coli (E. coli) in vicinity of swim beach is not expected to change. Operating the reservoir to manage the outflow (e.g., increasing the retention time) could reduce nutrient concentrations, but may not be implementable given the timing and objectives of water uses. Removal of vegetation before inundation could reduce nutrient loads. Aeration or mixing of Chatfield Reservoir to limit anaerobic conditions would reduce potential impacts, Increased monitoring and adaptive management would be used to address uncertainty in impacts to water quality. BMPs would reduce potential water quality impairment during construction.	Increased monitoring and adaptive management would be used to address uncertainty in impacts to water quality. BMPs would reduce potential water quality impairment during construction.
Aquatic Life and Fisheries	No impacts at Chatfield Reservoir. No impacts at Penley site because no significant water resources currently exist there. Reservoir construction would create aquatic habitat that could be used for aquatic life and fisheries. Pipelines associated with Penley Reservoir would cross several streams that could support fish populations, including Indian Creek, Rainbow Creek, Willow Creek, and Plum Creek. Temporary adverse impacts on fish populations could result during the construction of underground pipelines. If	No impacts at Chatfield Reservoir. Aquatic habitat could potentially be created in converting downstream gravel pits to reservoirs.	"New reservoir" effect of nutrient inputs would benefit aquatic ecosystem short-term at Chatfield Reservoir. If pool drawdowns occur during spawning, this could adversely impact crappie, bluegill, smallmouth bass, and largemouth bass. Positive impact to gizzard shad and other forage fish during increased pool elevations, except mid-May to mid-June. Benefit to crayfish populations would result in increased forage for smallmouth and largemouth bass populations.	At Chatfield, "New reservoir" effect benefit would be smaller than Alternative 3; otherwise same as Alternative 3, but effects would be less. Under Alternative 4, a small portion of the South Platte River above Chatfield Reservoir (slightly smaller than Alternative 3) would be intermittently inundated. Impacts to this reach are similar to those described in Alternative 3, although less of the stream reach would be impacted.

Table 2-9
Summary Comparison of Environmental Impacts of Alternatives

Resource Area	Alternative: Alternative 1: No Action	Alternative 2: NTGW/Downstream Gravel Pits[1]	Alternative 3: 20,600 Acre-Foot Reallocation	Alternative 4: 7,700 Acre-Foot Reallocation/NTGW/ Downstream Gravel Pits
	appropriate construction techniques were implemented, the proposed pipelines would have no significant adverse impacts on aquatic life and fisheries. Aquatic habitat could potentially be created in converting downstream gravel pits to reservoirs.		Generally positive effect for sport fish and forage fish. Keeping fallen trees as anchored fish structures would create positive shallow water habitat. Increased flow in July positive for downstream aquatic biota. Slight decrease in baseflow, minimal or no impact to aquatic biota. Reservoir drawdowns in March and April could adversely impact the walleye spawning operation conducted by Colorado Division of Wildlife (CDOW) to collect eggs for statewide walleye propagation by CDOW hatcheries. Managing water releases from reservoir could mitigate any adverse effects. An approximate 0.7-mile reach of the South Platte River directly above Chatfield Reservoir would be intermittently inundated by the increased pool elevation. The increased perimeter of Chatfield Reservoir would alter the fish and macroinvertebrate community composition of this reach from cool and cold-water species to warmer water species. Maintaining instream flow on South Platte downstream, and to Chatfield State Fish Unit, by adaptive management would mitigate adverse effects.	Aquatic habitat could potentially be created in converting downstream gravel pits to reservoirs, but less than under Alternatives 1 or 2 because pits would be smaller or fewer. Any adverse impacts would be mitigated through adaptive management.

Table 2-9
Summary Comparison of Environmental Impacts of Alternatives

Resource Area	Alternative			
	Alternative 1: No Action	Alternative 2: NTGW/Downstream Gravel Pits[1]	Alternative 3: 20,600 Acre-Foot Reallocation	Alternative 4: 7,700 Acre-Foot Reallocation/NTGW/ Downstream Gravel Pits
Vegetation	Inundation of Penley area would impact grasslands and non-unique deciduous oak and mesic upland shrub plant communities. Minimal vegetative loss from buried pipeline. Installation of pipelines and infrastructure to move water to and from existing gravel ponds could have a temporary effect on grasslands, riparian and wetland plant communities. No likely impacts to vegetation from NTGW wells are anticipated.	Less impact than Alternative 1 because there would be no construction of Penley Reservoir or associated pipelines. Temporary impacts of downstream gravel pit development same as Alternative 1. Impacts to vegetation from the downstream gravel pits would be minimal because gravel pits are already present and vegetation has been removed. No likely impacts to vegetation from NTGW wells are anticipated.	Complete or significant kill of cottonwoods between 5,432 to 5,442 feet above median sea level (msl) due to prolonged inundation, with some uncertainty at elevations above 5,439 feet msl. New lower limit of mature cottonwood approximately 5,444 feet msl. Willows established at 5,442 feet msl, based on the frequency of inundation from year to year. An estimated loss from inundation of 474.8 acres of vegetation between 5,432 feet msl to the top of the conservation pool (5,444 feet msl). Less hydric vegetation along the new shoreline. Lost habitat would be offset by establishing similar habitat, emphasizing weed management and native species.	Vegetation, including cottonwoods, likely killed from 5,432 up to 5,437 feet msl due to prolonged inundation. New lower limit of mature cottonwood approximately 5,437 feet msl. An estimated loss from inundation of 199.0 acres of vegetation between 5,432 feet msl to the top of the conservation pool (5,437 feet msl. Lost habitat would be offset by establishing similar habitat, emphasizing weed management and native species. Impacts to vegetation for NTGW and gravel pits would be less than under Alternative 2.
Wetlands	Approximately 0.26 acres wetlands impacted by Penley construction. Penley Reservoir inundation may enhance wetlands. Pipelines would impact approximately 12 acres wetlands. These impacts would be minimized through BMPs. Mitigation would occur for any unavoidable impacts. Gravel pits would impact a maximum of 12 acres of wetland vegetation.	Gravel pits would impact maximum of 12 acres of wetland vegetation.	Approximately 157.2 acres vegetated wetlands (mostly scrub/shrub) inundated if water levels sustained at 5,444 feet msl for extended periods. Road and recreation facility relocations could adversely impact wetlands. Depending on water level flux, long-term adverse impact from changing wetland to more water-tolerant species or establishing new wetlands within new zone of fluxing inundation. On-site and off-site enhancements and wetland creation would mitigate impacts. Mitigation would occur for any unavoidable impacts.	Approximately 119.8 acres vegetated wetlands (mostly scrub/shrub) eliminated if the water levels sustained at 5,437 feet msl for extended periods. Road and recreation facility relocations would adversely impact wetlands. Smaller water level flux than under Alternative 3. Gravel pits would impact fewer acres than under Alternatives 1 or 2. On-site and off-site enhancements and wetland creation would mitigate impacts.

Table 2-9
Summary Comparison of Environmental Impacts of Alternatives

Resource Area	Alternative			
	Alternative 1: No Action	Alternative 2: NTGW/Downstream Gravel Pits[1]	Alternative 3: 20,600 Acre-Foot Reallocation	Alternative 4: 7,700 Acre-Foot Reallocation/NTGW/ Downstream Gravel Pits
			Adaptive management would minimize impacts using operation strategies once reallocation begins.	Mitigation would occur for any unavoidable impacts. Adaptive management would minimize impacts using operation strategies once reallocation begins.
Wildlife	Habitat loss for grassland and upland wildlife species during and after Penley construction. 155 acres inundated at Penley Reservoir. Habitat for wetland and water dependent species would increase. Gravel pit reservoirs would increase habitat for riparian species.	Gravel pit reservoirs would increase habitat for riparian species.	Up to 586 acres of terrestrial wildlife habitat would be converted to aquatic or semi-aquatic habitats, disturbing resident and migratory species. Up to 90 acres of shoreline would be inundated but would be replaced with the same or greater amounts of new shoreline associated with reallocation. Approximately 30 acres of grasslands would be impacted by the permanent footprints of relocated recreational facilities. An additional 2.54 acres of wildlife habitat would be impacted by the relocation of the recreation trail at the Plum Creek day use area. Would adversely impact terrestrial wildlife, including upland or grassland wildlife, some raptors, large mammals, songbirds, herons, shrub wildlife, and waterfowl. Depending on timing, could benefit shoreline and aquatic wildlife. Loss of mature cottonwood forest habitat. Mitigation would occur to offset impacted habitat. Adaptive management would minimize impacts using operation strategies once reallocation begins.	Fewer terrestrial habitat acres would be converted to aquatic or semi-aquatic habitats than under Alternative 3. Up to 328 acres of terrestrial wildlife habitat would be converted to aquatic or semi-aquatic habitats, disturbing resident and migratory species. Up to 78 acres of shoreline would be inundated but would be replaced with the same or greater amounts of new shoreline associated with reallocation. Approximately 30 acres of grasslands would be impacted by the permanent footprints of relocated recreational facilities. An additional 2.54 acres of wildlife habitat would be impacted by the relocation of the recreation trail at the Plum Creek day use area. Effects same as Alternative 3 but to lesser extent. Mitigation would occur to offset impacted habitat. Adaptive management would minimize impacts using operation strategies once reallocation begins.

Table 2-9
Summary Comparison of Environmental Impacts of Alternatives

Resource Area	Alternative 1: No Action	Alternative 2: NTGW/Downstream Gravel Pits[1]	Alternative 3: 20,600 Acre-Foot Reallocation	Alternative 4: 7,700 Acre-Foot Reallocation/NTGW/ Downstream Gravel Pits
Endangered, Threatened, and Candidate Species, Species of Special Concern, and Sensitive Communities	Construction of Penley and pipelines could benefit bald eagle. There is a potential for loss of habitat for Preble's mouse, plains sharp-tailed grouse, Colorado butterfly plant, and Ute ladies' tresses orchid, if these habitats occur near Penley. Impacts to these habitats would be mitigated. No impacts on Preble's mouse, bald eagle, Ute's ladies tresses, and Colorado butterfly plant if they do not occur in area of gravel pits. Aquatic species could benefit from the creation of aquatic habitats at the gravel pits.	No impacts on Preble's mouse, bald eagle, Ute's ladies tresses, and Colorado butterfly plant habitats if they do not occur in the area of the gravel pits. Aquatic species could benefit from creation of aquatic habitats at the gravel pits. No impacts from NTGW well or gravel pits are expected from development.	Potential inundation of approximately 454 acres of Preble's mouse habitat, including approximately 80.0 acres of Critical Habitat in the Upper South Platte critical habitat unit (mostly High Value Riparian habitat) and approximately 75.2 acres of Critical Habitat in the West Plum Creek critical habitat unit. An additional 2.54 acres of Preble's habitat, including 0.48 acres of critical habitat, would be impacted by the relocation of the recreation trail at the Plum Creek day use area. Bald eagle, white pelican, and Iowa darter would benefit. Whooping crane, pallid sturgeon, piping plover, and interior least tern would not be affected assuming SPWRAP is implemented. Small adverse impact on hunting range of ferruginous hawk. Northern leopard frog may be adversely impacted. Impacts would be mitigated through on-site and off-site mitigation including wetland, riparian, and terrestrial habitats. Other mitigation actions may include development or maintenance of wildlife corridors, management of water levels during the growing season, recontouring and revegetation, and anchoring snags and downed trees as large woody debris if consistent with boater safety. Adaptive management would minimize impacts using operation strategies once reallocation begins.	Potential inundation of approximately 270 acres of Preble's mouse habitat, including approximately 40.7 acres of Critical Habitat in the Upper South Platte critical habitat unit (mostly High Value Riparian habitat) and approximately 46.9 acres of Critical Habitat in the West Plum Creek critical habitat unit. An additional 2.54 acres of Preble's habitat, including 0.48 acres of critical habitat, would be impacted by the relocation of the recreation trail at the Plum Creek day use area. Otherwise, effects and mitigation actions are the same as Alternative 3 but to lesser extent. Adaptive management would minimize impacts using operation strategies once reallocation begins.

Table 2-9
Summary Comparison of Environmental Impacts of Alternatives

Resource Area	Alternative 1: No Action	Alternative 2: NTGW/Downstream Gravel Pits[1]	Alternative 3: 20,600 Acre-Foot Reallocation	Alternative 4: 7,700 Acre-Foot Reallocation/NTGW/ Downstream Gravel Pits
Land Use	1,020 acres irrigated lands could become non-irrigated with purchase of water rights for gravel pits. Use of NTGW prior to completion of Penley could affect farming if pumping rates declined, but this effect would be less than under Alternative 2.	1,020 acres irrigated lands could become nonirrigated with purchase of water rights for gravel pits. Use of NTGW could affect farming if pumping rates declined to the point that agricultural lands irrigated by NTGW could no longer produce sufficient water from existing wells. Because most agricultural providers rely on alluvial groundwater, this impact is not likely to be significant.	Some open space at the Chatfield State Park would be used to accommodate the relocation of recreation facilities (such as parking lots and structures).	Fewer acres of irrigated lands would become nonirrigated than under Alternatives 1 or 2. Use of NTGW would have less effect on farming than under Alternative 2.
Hazardous, Toxic, and Radiological Wastes	No impacts anticipated.	No impacts anticipated.	No impacts anticipated.	No impacts anticipated.
Air Quality	No long-term impacts anticipated. BMPs would reduce potential air quality impairment during construction.	Same as Alternative 1 except that, depending on the energy sources used, drilling and operating NTGW wells could contribute to greenhouse gas emissions and other air pollution	Short-term impacts from construction. BMPs would reduce potential air quality impairment during construction.	Impacts would be of the same type but less in extent than under Alternative 3 because of shorter construction period and less pool fluctuation. BMPs would reduce potential air quality impairment during construction.
Noise	Noise levels reduced at gravel pits. Short-term construction noise during development of gravel pit storage and Penley Reservoir.	Impacts would be less than under Alternative 1 because there would be no construction at Penley. Noise levels reduced at gravel pits. Short-term construction noise.	Temporary construction (3–5 years) noise in park. On-site construction noise may periodically exceed EPA noise threshold (70 decibel level [dBA]), but public would not be exposed continuously. Noise predicted at less than 50 feet from source. Noise from off-site construction traffic would increase background noise levels, but within normal variation in the area. Construction traffic noise would comply with county ordinances. No exceedances of standards or guidelines.	Same impacts near Chatfield as Alternative 3 except with a shorter construction period. Noise levels reduced at gravel pits. Short-term construction noise, but less than under Alternatives 1 or 2 because gravel pits would be fewer or smaller.

Table 2-9
Summary Comparison of Environmental Impacts of Alternatives

Resource Area	Alternative 1: No Action	Alternative 2: NTGW/Downstream Gravel Pits[1]	Alternative 3: 20,600 Acre-Foot Reallocation	Alternative 4: 7,700 Acre-Foot Reallocation/NTGW/ Downstream Gravel Pits
Aesthetics	Aesthetics at Penley and gravel pits could be impaired during construction due to views of equipment, but would have positive viewsheds after construction completed. Pipelines would not adversely impact views.	Aesthetics at gravel pits would be affected the same as for Alternative 1.	Water fluctuation could produce more visible mudflats and shoreline rings. During construction, short-term impacts from bare ground and construction vehicles. Planting trees and shrubbery could mitigate impacts on aesthetics.	Same effects at Chatfield as Alternative 3 except with smaller water fluctuations and a shorter construction period. Aesthetic impacts at gravel pits would be of the same type but less in extent than under Alternatives 1 or 2 because gravel pits would be fewer or smaller.
Socioeconomic Resources	Gravel pit conversion would employ approximately 25 workers/day for 2 years for construction. 1,020 acres (0.1 percent of irrigated agriculture in South Platte Basin) converted to dryland agricultural with corresponding 4 jobs lost. Employment benefits estimated at approximately 4,376 person-years of employment over 50-year period in the study area. Project financial costs estimated at $278.4 million. $623.1 million in economic output estimated in the region.	Similar to Alternative 1 except there would be fewer construction jobs since Penley and the associated pipelines would not be constructed. There would, however, be additional NTGW well-drilling jobs. Four jobs lost due to conversion of irrigated agriculture to dryland agriculture. Employment benefits estimated at approximately 2,742 person-years of employment over 50-year period in the study area. Project financial costs estimated at $205.1 million. $391.5 million in economic output estimated in the region.	Construction in the marina area would occur during the off-season to minimize impacts. Colorado State Parks expected to lose $3.4 million over 50-year analysis period, including revenue associated with concessionaire agreements. Reduction in NED recreation benefits of approximately $14.2 million over 50 years. The water providers would ensure Colorado State Parks is compensated for any lost revenue or increased costs incurred as a result of this project. Employment benefits estimated at approximately 2,257 person-years of employment over 50-year period in the study area. Project financial costs estimated at $184.4 million. $318.0 million in economic output estimated in the region.	Same impacts related to reallocation as Alternative 3 except with a shorter construction period, resulting in lower revenue losses but fewer worker-years. Fewer impacts related to downstream gravel pits and NTGW as Alternative 2. Two jobs lost due to conversion of irrigated agriculture to dryland agriculture. Colorado State Parks is expected to lose about $2.7 million over 50-year analysis period, including revenue associated with concessionaire agreements. Reduction in NED recreation benefits of approximately $12.1 million over 50 years. The water providers would ensure Colorado State Parks is compensated for any lost revenue or increased costs incurred as a result of this project. Employment benefits estimated at approximately 2,946 person-years of

Table 2-9
Summary Comparison of Environmental Impacts of Alternatives

Resource Area	Alternative: Alternative 1: No Action	Alternative: Alternative 2: NTGW/Downstream Gravel Pits[1]	Alternative: Alternative 3: 20,600 Acre-Foot Reallocation	Alternative: Alternative 4: 7,700 Acre-Foot Reallocation/NTGW/ Downstream Gravel Pits
				employment over 50-year period in the study area. Project financial costs estimated at $203.4 million. $419.4 million in economic output estimated in the region.
Transportation	No impacts at Chatfield State Park. Traffic would decrease at gravel pits. Traffic would increase in the Penley area during construction.	No impacts at Chatfield State Park. Traffic would decrease at gravel pits. Traffic would increase temporarily during drilling of new NTGW wells.	Realign part of entrance road and part of main park road, including new bridge. Traffic would temporarily increase during construction. Short-term heavy construction traffic likely. Mitigation would include construction when recreation use is low and during daylight. Construction during daylight is per Colorado law, to avoid nighttime disturbance to residences. It is also to reduce hazards/disturbance to wildlife.	Some facilities would be relocated. Traffic would temporarily increase during construction. Similar short-term access issues as Alternative 3, but with shorter duration. Mitigation would include construction when recreation use is low and during daylight. Construction during daylight is per Colorado law, to avoid nighttime disturbance to residences. It is also to reduce hazards/disturbance to wildlife.
Recreation	No impacts anticipated.	No impacts anticipated.	North Boat Ramp partially inundated, affecting two boat ramps, paved parking, support facilities (trails, day use shelters). Substantial fill used to raise portion of parking area. Recreation capacity of Massey Draw reduced. Entire Swim Beach, parking, trails, restrooms, concession building, first aid station, volleyball, and horseshoe pits inundated. Gravel parking and portable restroom at Eagle Cove and half of Deer Creek area inundated. Entire Jamison area relocated to south. Portion of entrance road realigned major segment of main park road moved.	North Boat Ramp partially inundated, making it inoperable and affecting two boat ramps Remaining areas unaffected. Recreation capacity of Massey Draw reduced but parking area and restroom not inundated. Entire Swim Beach, parking, trails, restrooms, concession building, first aid station, volleyball, and horseshoe pits inundated. Unlike Alternative 3, road not adversely impacted. Kingfisher area inundated. Unlike Alternative 3, gravel ponds not inundated. Most parking in Marina area

Table 2-9
Summary Comparison of Environmental Impacts of Alternatives

Resource Area	Alternative: Alternative 1: No Action	Alternative 2: NTGW/Downstream Gravel Pits[1]	Alternative 3: 20,600 Acre-Foot Reallocation	Alternative 4: 7,700 Acre-Foot Reallocation/NTGW/ Downstream Gravel Pits
			Most entrance roads, parking areas, shelters, restrooms, utilities at Catfish Flats and Fox Run group use areas inundated. Kingfisher/Gravel Ponds/Platte River Trailhead areas inundated. Increase in pool fluctuations would affect operations of Riverside Marina. Facilities at Marina Point, south boat ramp, Roxborough day use area inundated. Plum Creek area facilities inundated. Overall visitor use at Chatfield expected to decrease by 17.6 percent (from 1.66 million to 1.37 million visitors) during construction, by 9.4 percent (to 1.51 million visitors) 1 to 5 years after construction, and by 4.1 percent (to 1.60 million visitors) 6+ years after construction. Recreation impacts would be mitigated through relocation and construction of new facilities, construction of berm around large gravel pond, and scheduling construction to avoid the high recreation season. Adaptive management would minimize impacts using operation strategies once reallocation begins.	inundated, impacted use of most facilities. Plum Creek day use area, trailhead, and some segments of the Plum Creek trail inundated. Overall visitor use at Chatfield expected to decrease by 14.1 percent (from 1.66 million to 1.43 million visitors) during construction, by 8.0 percent (to 1.51 million visitors) 1 to 5 years after construction, and by 3.3 percent (to 1.61 million visitors) 6+ years after construction. Recreation impacts would be mitigated through relocation and construction of new facilities and scheduling construction to avoid the high recreation season. Adaptive management would minimize impacts using operation strategies once reallocation begins.

Table 2-9
Summary Comparison of Environmental Impacts of Alternatives

Resource Area	Alternative			
	Alternative 1: No Action	Alternative 2: NTGW/Downstream Gravel Pits[1]	Alternative 3: 20,600 Acre-Foot Reallocation	Alternative 4: 7,700 Acre-Foot Reallocation/NTGW/ Downstream Gravel Pits
Cultural Resources	Pipeline would adversely impact Atchison, Topeka & Santa Fe Railroad (ATSF), eligible for NRHP listing. Site would be avoided through pipeline installation techniques. If avoidance not possible, then there would be thorough documentation in accordance with Colorado SHPO guidelines and standards.	No significant impacts.	Ten prehistoric and historic sites within zone of potential inundation. However, none of these sites are NRHP-eligible and therefore are not protected. No adverse impacts on NRHP-listed or potentially eligible properties.	Same as Alternative 3.

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2.8.2 Economic Benefit Evaluation Summary

The benefits from a water supply plan are measured using the cost of the alternative most likely to be implemented in the absence of Chatfield Alternative 3. Alternative 2 (NTGW/Downstream gravel pits) represents the most likely No Action scenario for providing 8,539 acre feet of water annually to water providers in the absence of storing water at Chatfield, and serves as the baseline against which costs for other alternatives are compared. The average annual costs for Alternative 2 are estimated at $10.4 million. Benefits for other alternatives are estimated as the difference between their average annual costs relative to those for Alternative 2 for providing the same quantity and quality of water. The NED process for selecting a plan for implementation requires the identification of net (benefits less costs) NED benefits. The NED plan is the plan that maximizes net NED benefits. Table 2-10 shows present valued cost and the results of the benefit analysis using annual costs and annual benefits for the alternatives. Alternative 3 is the NED plan because it maximizes net NED benefits.

Table 2-10
National Economic Development Account in Millions

	No Action	NTGW/Downstream Gravel Pits	20,600 Acre-Foot Reallocation	7,700 Acre-Foot Reallocation
NED Cost	$317.1	$219.0	$***183.9***	$***199.8***
Annual NED Cost*	$15.08	$10.41	***$8.74***	***$9.50***
Annual NED Benefit*	$10.41	10.41	$10.41	$10.413
Net Annual NED Benefit*	-$4.67	$0.00	***$1.67***	***$0.91***

* Annual entries were calculated using an interest rate of 4.125 over the 50-year planning period.

2.8.3 Compliance of Alternatives with the EOP

In reaffirming its commitment to the environment, USACE formalized a set of seven Environmental Operating Principles (EOP) applicable to all its decision-making and programs. They are identified and explained in ER 200-1-5, dated October 30, 2003. The EOP and associated doctrine highlight the Corps' roles in, and responsibilities for, sustainability, preservation, stewardship, and restoration of our nation's natural resources. It is an important sub-goal of the Corps to meet these EOP. These EOP are consistent with the stated goals and sub-goals of the Chatfield Reservoir storage reallocation study, and can be viewed online at: http://www.hq.usace.army.mil/cepa/envprinciples.htm. Corps guidance includes assessing the consistency of proposed actions or projects with the seven EOP. Table 2-11 displays the extent of consistency of each of the four alternatives with each EOP, and the major differences in compliance among the alternatives.

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Table 2-11
Evaluation of Consistency of the Four Alternatives with the Corps' Seven Environmental Operating Principles

Environmental Operating Principles	Alternative 1: No Action	Alternative 2: NTGW/Downstream Gravel Pits[1]	Alternative 3: 20,600 Acre-Foot Reallocation	Alternative 4: 7,700 Acre-Foot Reallocation/NTGW/Downstream Gravel Pits
1. Strive to achieve environmental sustainability.	Partial. 4,270 of 8,539 acre-foot average year yield for 15 years from non-renewable NTGW until Penley Reservoir finished. Alternative is based on non-sustainable resources.	No. 4,270 of 8,539 acre-foot average year yield will be from nonrenewable NTGW for the entire 50-year period of analysis. Alternative is based on non-sustainable resources.	Yes. All 8,539 acre-feet of average year yield is from renewable surface water; none is from nonrenewable NTGW.	Partial. 2,674 of 8,539 acre-foot average year yield will be from nonrenewable NTGW for the entire 50-year period of analysis. Alternative is based on non-sustainable resources.
2. Recognize interdependence of life and the physical environment, and consider environmental consequences.	Yes. All biotic impacts fully mitigated, and NTGW aquifer depletion will abate in 15 years after Penley Reservoir is completed.	Partial. All biotic impacts fully mitigated, but NTGW aquifer depletions will continue for the entire 50-year period of analysis.	Yes. All biotic, abiotic, and socioeconomic impacts are assessed and if significant, are receiving full mitigation.	Yes. All biotic, abiotic, and socioeconomic impacts are assessed and if significant, are receiving full mitigation.
3. Seek balance and synergy among human development activities and natural systems.	Partial. Model integrates value of surface water storage 15 years in the future with environmental improvements/mitigation.	No. Model shows NTGW aquifer depletion over 50-year period without balancing economic and environmental concerns.	Yes. Model integrates value of surface water storage with environmental mitigation; synergy by additional capture/reuse yields.	Partial. Same as for Alternative 3, but NTGW depletion less than that of Alternative 2 will occur for the entire 50-year analysis period.
4. Accept responsibility and accountability for Corps activities impacting human welfare/natural systems.	Yes. Corps actions required for implementation comply with NEPA and all other environmental laws/regulations.	Yes. Corps actions required for implementation comply with NEPA and all other environmental laws/regulations	Yes. This Corps Action Alternative complies with NEPA and all other environmental laws/regulations.	Yes. This Corps Action Alternative complies with NEPA and all other environmental laws/regulations.
5. Assess and mitigate cumulative environmental impacts; bring systems approaches to full life cycle.	Partial. Cumulative biotic impacts mitigated, but 15-year delay for reduction of NTGW mining.	No. Cumulative biotic impacts mitigated, but NTGW mining is not mitigated in 50-year period of analysis.	Yes. Any cumulative significant biotic/physical/socio-economic environmental impacts are fully mitigated.	Partial. Except for NTGW use, cumulative significant biotic/physical/socio-economic environmental impacts are fully mitigated.
6. Build and share integrated scientific/economic/social knowledge base for under-standing the environment and impacts.	No. Non-shared Corps/ sponsor development of knowledge base limited to data needed for Section 404 permit/land availability for water distribution pipelines.	No. Non-shared Corps/ sponsor development of knowledge base limited to data needed for Section 404 permit/land availability for water distribution pipelines.	Yes. Requires most extensive Corps/sponsor knowledge base to be developed and shared to understand and model environmental impacts and mitigation plans.	Yes. Corps/sponsor knowledge base a bit less extensive than for Alternative 3 to be developed and shared to understand and model environmental impacts and mitigation plans.

Table 2-11
Evaluation of Consistency of the Four Alternatives with the Corps' Seven Environmental Operating Principles

Environmental Operating Principles	Alternative 1: No Action	Alternative 2: NTGW/Downstream Gravel Pits[1]	Alternative 3: 20,600 Acre-Foot Reallocation	Alternative 4: 7,700 Acre-Foot Reallocation/NTGW/Downstream Gravel Pits
7. Respect others' views and learn from their perspective to find innovative win-win solutions to problems that also protect the environment.	Partial. If reallocation is not implemented, Alternative 1 would be innovative, but not win-win because Alternative 1 is the most costly.	No. NTGW use not innovative or win-win; sponsor wishes to reduce use of NTGW by developing surface water storage even though it is more costly than NTGW in 50-year analysis period.	Yes. Corps agreed to sponsor request for real- location study; would be a win-win innovation, with maximum possible Corps aid to solution of regional water supply deficit.	Yes. Corps agreed to sponsor request for real- location study; Alternative 4 is innovative but lower win-win than Alternative 3, as it aids regional deficits less and still uses some NTGW.

[1] Alternative 2 is also the Least Cost Alternative to Chatfield Reservoir storage reallocation

2.8.4 Compliance with USACE's Campaign Plan

Corps decision documents are required to address how the Chatfield Reservoir storage reallocation study incorporates the key points of the "Campaign Plan of the U.S. Army Corps of Engineers", particularly robust design, risk, reliability, and adaptability to future change. These points are addressed below.

The Chatfield Storage Reallocation FR/EIS employs an integrated, comprehensive systems-based approach to contribute to a solution to water supply demands in the Denver Metro. It evaluates a broad array of environmental, social, economic, and health and safety impacts. Through collaboration with the project's stakeholders which involved Cooperative Agencies, Special Technical Advisors, contractors, and wildlife experts a sustainable water storage alternative utilizing an existing federal facility is proposed to provide a viable solution to an immediate need. The Corps solicited and welcomed collaboration with 26 Cooperating Agencies and 7 Special Technical Advisors as well as several contractors due to the complexity of this project and the many issues involved. Seamless and transparent communication and integration was provided by: 1) holding project progress meetings in the Denver area, so all collaborators had the opportunity to attend; and 2) having these collaborators (and their attorneys) review and comment on chapters of the Preliminary Draft FR/EIS as they were completed by the Corps and its contractors.

The planning process embraced a variety of economic, social, and environmental goals and constraints. Water policies, regulations, procedures, methods and modeling were completed to support national priorities. The conceptual compensatory mitigation plan and the process for designing the conceptual recreation modification plans in the FR/EIS integrated both natural and social system features: the vegetation and wildlife settings of recreation facilities and the amount and types of public use appropriate for the mitigation sites.

The FR/EIS identifies the risk of a greatly reduced water supply to populations in the study area if they continue to rely on NTGW. The FR/EIS also communicates the residual risk that water storage in Chatfield will provide only a small portion of the Denver metro area's unmet water needs. The non-federal sponsors of the FR/EIS are well aware that to meet their future water needs, they must pursue additional sources of water other than NTGW, as well as continuing to reduce per capita water demands through water conservation measures.

The proposed action in the FR/EIS will focus on sustainability of water supplies by reducing dependence on non-renewable NTGW in the Denver metro area. The proposed action is also fully compatible with all seven of the Corps' environmental operating principles, as described in Table 2-10 and in Chapter 5. Assets will be more sustainable because they will be floodable without sustaining significant damage. Sustainability of mitigation sites will be enhanced over the long term because costs of monitoring, operation, and maintenance will be borne by the sponsors, and details in this regard will be included in executed agreements between the CDNR and the Chatfield Water Providers setting out respective obligations for carrying out the Compensatory Mitigation Plan and recreation modifications.

The study encompassed ground breaking information as well as creativity to find solutions to complex issues. As situations were resolved, successful utilization of existing technology available between offices was achieved and creative use of new technology was embraced assuring transparency while considering economics. To provide for expected and unexpected changes and satisfy the public over the project's life cycle, adaptive management by manipulation of water releases will be used to enable the mature trees within 2 feet of the top of the reallocated storage pool to survive rather than die and be cut down. Climate change will bring increased variability (more floods and more/longer droughts); this variability will be taken into account by mitigating for environmental impacts from inundation higher than would be expected from the 1942-2000 period of record.

Research efforts to improve the resilience of structures resulted in a Win/Win for the Corps and State Parks because the Corps determined that the design and materials of proposed recreation facility modifications had previously withstood flooding without damage, enabling the Corps to grant a partial waiver regarding the amount of fill required to comply with NWD Regulation 1110-2-5. The waiver lowered fill costs for the sponsors; enabled more functional site designs to be implemented that will largely preserve visitation at Chatfield State Park long-term after reallocation; reduced the number/size of borrow areas that would have been created at Chatfield State Park to provide the fill; and consequently decreased the amount of soil erosion and disturbed areas invaded by weeds. Research to identify the Ecological Functional Values (EFVs) of wetlands that would be impacted by reallocation and of potential wetland mitigation sites used the Beta version of the Functional Assessment of Colorado Wetlands Methodology (FACWet), which is also used by the Corps' Littleton, CO Regulatory Office, thus providing synergy in the use of FACWet. New communications technologies were used extensively; much information was shared by the Corps, contractors, sponsors, other Cooperating Agencies, and Special Technical Advisors at a contractor-operated ftp site; in addition, information about the FR/EIS was made available to the general public at several internet sites.

By approaching this study holistically, an integrated, comprehensive systems-based approach was studied and carefully developed to contribute to a solution to water supply demands in the Denver Metro. A broad array of environmental, social, economic, and health and safety impacts received scrupulous evaluation in the preparation of the Chatfield Water Storage FR/EIS and provides documented information for all alternatives regarding robust design, risk, reliability, and adaptability to future change, which also relate to the USACE Campaign Goals as detailed in the following paragraphs.

Robust Design (USACE Campaign Goals 1, 2, and 4)

The planning processes for developing the compensatory environmental mitigation plan and the recreation modification plan integrated both natural and social system features: the vegetation and wildlife settings of recreation facilities and the amount and types of public use appropriate for the mitigation sites. Collaborative planning involved 26 Cooperating Agencies, 7 Special Technical Advisors, contractors, and other wildlife experts in designing the locally based model for quantifying impacts to and potential mitigation measures for wetlands, Preble's meadow jumping mouse habitat, and bird/wildlife habitat in terms of ecological functional units. Seamless and transparent integration was provided by: 1) holding project progress meetings in the Denver area, so all collaborators had the opportunity to attend; and 2) having these collaborators (and their attorneys) review and comment on chapters and the entire Preliminary Draft FR/EIS as they were completed by the Corps and its contractors.

The process for prioritizing mitigation sites for Preble's mouse habitat utilizes a systems approach to maximize ecological benefits to Preble's mouse, focusing on connectivity of mitigation sites to parcels that are already protected from development as part of the Recovery Plan for Preble's mouse. To add to the robustness of the design, the Corps has had the ecological functional unit models reviewed by the Corps' center of expertise and independent experts. The recreation modification plan was developed through collaborative planning with the Cooperating Agencies, especially Colorado State Parks. The plan went through numerous drafts beginning with conceptual designs. The Corps' developed the tree management plan through collaboration with Colorado State Parks, the Colorado Division of Wildlife, and the Colorado State Forest Service. A modified UDV analysis of the effects on NED recreation benefits at Chatfield State Park of all alternatives that were evaluated in detail included stakeholder participation resulting in better planned and designed recreation facilities. UDV analyses are ordinarily prepared for entire projects or recreation areas within a project, with a maximum of 750,000 annual visits. Although the annual visitation at Chatfield State Park as a whole exceeds 750,000, use of either individual primary activities or individual recreation sites within Chatfield State Park as the unit of analysis for assigning UDV point values would meet the criterion of a maximum of 750,000 annual visits. Because Chatfield State Park visitor counts are activity based, and because the effects of reallocation would be expected to differ among recreational activities, use of UDVs for individual activities (instead of recreation sites) was utilized.

Risk (USACE Campaign Goals 3 and 4)

The Chatfield Storage Reallocation FR/EIS evaluates a broad array of environmental, social, economic, and health and safety impacts. The FR/EIS identifies the risk to much of the population in the study area of a greatly reduced water supply in the future if non-tributary ground water (NTGW) is continued to be relied upon for most of the water supply. The FR/EIS also communicates the residual risk that water supply alternatives evaluated would provide only a small portion of the Denver metro area's unmet water needs. The non-Federal sponsors of the FR/EIS are well aware that to meet their future water needs, they must pursue additional sources of water other than NTGW, as well as continuing to reduce per capita water demands through water conservation measures.

The consequences regarding the physical, biological, cultural, and other aspects of the human environment are fully disclosed in the FR/EIS for all four alternatives. These consequences include the decline in, and increased costs of, NTGW production if NTGW continues to be relied on to the same extent in the future. Environmental impacts to federally listed threatened Preble's meadow jumping mouse habitat, wetlands, and habitat for migratory birds and other wildlife are also identified. Impacts to recreational enjoyment and recreation benefits, along with the variability in impacts of reallocation within and among different recreation activities as perceived by activity participants is included in the FR/EIS and detailed in an appendix. The FR/EIS also includes the risks of downstream flooding and the variability in annual and monthly reservoir water level fluctuations.

To reduce risk for engineered systems and to identify the potential maximum amount of additional water supply to be evaluated for all alternatives regarding Chatfield, two studies were conducted by the Corps and included in the FR/EIS as appendices. First, an antecedent flood study was conducted by the Corps and reviewed by the Bureau of Reclamation. The results of this study determined that 20,600 acre-feet was nearly all the storage that could be reallocated without impacting the freeboard and flood risk management function of the Chatfield Dam and Lake Project. Secondly, to determine whether any seismic issues at Chatfield were severe enough to face termination of the reallocation FR/EIS, the Corps conducted seismic studies to ensure that storage of additional water in Chatfield Reservoir would not significantly increase any risks to human health, safety, and property posed by existing seismic conditions. In addition, comments provided by members of the general public who recreate at Chatfield are provided in an appendix to the FR/EIS; many of these comments contain suggestions for reducing impacts of reallocation on specific activities or facilities.

Reliability (USACE Campaign Goals 2 and 3)

The proposed action in the FR/EIS would focus on sustainability of water supplies by reducing dependence on non-renewable NTGW in the Denver metro area. All alternatives were compared regarding their compatibility with all seven of the Corps' environmental operating principles (EOPs), as described in Table 2-11 and in Chapter 5. Assets would be more sustainable because they would be floodable without sustaining significant damage. Sustainability of mitigation sites would be enhanced over the long term because costs of monitoring, operation, and maintenance would be borne by the sponsors, and details in this regard would be included in the water supply contract with the Corps.

The monitoring plans for the compensatory mitigation plan mitigation sites is robust and would extend for a sufficient time to adequately determine the likelihood of success continuing over the 50-year project life.

The FR/EIS has undergone a chapter-by-chapter Internal Technical Review (ITR) by Omaha District staff, Cooperative Agencies, and Special Technical Advisors; an Agency Technical Review (ATR) of the 75 percent completed Preliminary Draft; and an Independent External Peer Review (IEPR) is also planned.

Adaptability to Future Change (USACE Campaign Goals 2 and 3)

Adaptive management is used in the Chatfield Reservoir storage reallocation study and is discussed in Section 4.1.1. Adaptive management promotes flexible decision-making that can be adjusted in the face of uncertainties, as outcomes from management actions and other events become better understood. Adaptive management would be used in effectively managing potential impacts to specific resource areas as indicated in Section 4.1.1.

The potential effects of climate change on the study are discussed in Section 4.3 and elsewhere in the FR/EIS. Climate change would likely result in increased variability (more floods and more/longer droughts); this variability would be taken into account by mitigating for environmental impacts from inundation higher than would be expected from the 1942–2000 period of record.

3. AFFECTED ENVIRONMENT

3.1 Introduction

This chapter addresses the baseline conditions for the proposed reallocation of flood storage to conservation in Chatfield Reservoir. This study focuses mainly on the affected environment at Chatfield Reservoir and surrounding state park, but because there is a potential for flooding and a concern about downstream flow regimes, the neighborhoods downstream from the reservoir to the Adams/Weld county line, adjacent to the South Platte River, are also considered.

Unless otherwise noted, land use data were obtained for the Chatfield Reservoir storage reallocation study area, including the South Platte River flood plain (300 feet on each side of the river) downstream from the reservoir to the Adams/Weld county line.

Chapter 3 focuses on the 17 resources that define the current affected environment within the study area (Figure 1-2):

- Geology and Soils
- Hydrology
- Water Quality
- Aquatic Life and Fisheries
- Vegetation
- Wetlands
- Wildlife
- Endangered, Threatened, and Candidate Species, Species of Special Concern, and Sensitive Communities
- Land Use
- Hazardous, Toxic, and Radiological Wastes
- Air Quality
- Noise
- Aesthetics
- Socioeconomic Resources
- Transportation

- Recreation
- Cultural Resources

It should be noted that not all resources may be relevant to all portions of the study area. For example, noise from recreation may not affect downstream landowners. In addition, a number of issues were identified through the scoping process and agency consultations. These issues, described in the public involvement chapter (Chapter 6), are addressed throughout this section based on the applicable resource areas.

3.1.1 Jurisdiction and Ownership

Chatfield Reservoir is located at the confluence of the South Platte River and Plum Creek within the South Platte Basin. The reservoir itself is located southwest of Denver in Douglas, Jefferson, and Arapahoe counties. The drainage area for the South Platte River Basin upstream of the reservoir encompasses 3,018 square miles and originates at the headwaters of the North Fork of the South Platte River and the South Fork of the South Platte River in Park County, Colorado. USFS manages most of the lands along the mainstem of the South Platte River upstream of the reservoir. Plum Creek, the second largest of the reservoir's tributaries, flows through a mixture of rangelands and suburban areas. The Buffalo Creek and Hayman fires burned large areas within the South Platte Watershed, resulting in the deposition of sediments and other pollutants into the South Platte River drainage. Reservoirs located upstream of Chatfield include Strontia Springs, Cheesman Lake, Elevenmile Canyon, Spinney Mountain, and Antero reservoirs. Downstream, the South Platte River joins with the North Platte River in western Nebraska to form the Platte River. The Platte River ultimately joins the Missouri River at the Nebraska/Iowa border. The study area (Figure 1-2) encompasses the area in the immediate vicinity of Chatfield Reservoir and extends downstream to where the river intersects the Adams/Weld county line.

A Real Estate Plan (Appendix L) was prepared to describe the types of estates needed for construction and the legal requirements necessary to operate and maintain the Chatfield Reservoir Reallocation Project. The Real Estate Plan (REP) recommends that the non-Federal sponsor acquire fee simple interest in the lands to be used to mitigate the environmental impacts associated with the recommended alternative. In cases where the sponsor is unable to acquire a fee interest in the mitigation areas, the REP recommends the use of a non-standard Conservation easement as an alternative. Prior to the sponsor using such an easement, the non-standard easement would need to be submitted to USACE and the Department of Justice for approval.

Under Alternative 3, project construction would take place on Federally owned lands, the majority of which are leased to the State of Colorado, the City and County of Denver, the City of Littleton and to the Highlands Ranch who manage the lands for public park and recreation purposes. The project also includes numerous outgrants, such as recreational trails; public parks; overhead and buried fiber optics cable; road maintenance, right-of-way and maintenance, operation and maintenance of electric powered water intake pumping station including installation, operation and maintenance, buried feeder power lines; pipeline easements; operation and maintenance on sewer lines, roads, water lines, water pump stations, telephone facilities, buried communication cable; buried gas line; return flow ditch; overhead electric lines; drainage easement for runoff. Privately owned improvements lie within the proposed project area. Most of these improvements were constructed in conjunction with third-party agreements held by the State of Colorado, the City of Denver, County of Denver, and Highland Ranch. Improvements include campground areas, a marina, recreational trails, roads, toilets, and wild life habitat.

The State of Colorado owns no lands within the project footprint. CDNR would be required by the Project Partnership Agreement to acquire lands for ecosystem mitigation, of which most would be offsite (Appendix K). The Project Partnership Agreement would require the CDNR to incrementally acquire mitigation lands after the determination of available onsite mitigation areas. CDNR would not acquire the offsite mitigation lands until project approval. The available onsite mitigation lands would be determined after the water elevation began to increase. The Corps Project Manager would develop a schedule if Alternative 3 were selected. The reallocation of the water would not take place until documentation of the required acquisitions had been provided, reviewed, and confirmed as stated in the Project Partnership Agreement. The CDNR would construct the project with oversight by the Corps. The offsite mitigation lands would not be open to the public.

CDNR has provided the Corps with a map with a listing of owners and the probable mitigation lands available on each parcel. This project is a willing seller only, and CDNR would not subject any owner to condemnation. The issue of water rights is highly sensitive; therefore, an agreement that the CDNR would acquire the appropriate number of mitigation units (acreage vary by habitat available) as the project progresses is stated within the Project Partnership Agreement. The CDNR would be required to self-certify the ability and experience to acquire and provide the Land, Easements, Rights-Of-Way, Relocation, and Disposal Areas (LERRD) for construction, operation, maintenance of the project, including its condemnation authority and quick-take capability.

3.1.2 Water Rights

The existing conservation pool contains existing water rights held by Denver Water that are used for M&I uses. The reallocated storage space would be filled using existing or future water rights belonging to a consortium of water providers (Table 1-1). This reallocation would enable the providers to supply water to local users for municipal, industrial, agricultural, recreational, and fishery needs in response to population growth in the Denver Metro area. In the State of Colorado, water rights are based on the doctrine of prior appropriation, or first in time, first in right (Colorado Constitution, Article XVI, Sections 5 and 6). Senior water rights, therefore, are those with a relatively early date of water right establishment. Junior water rights are those with a later date than the senior water rights. Water providers include entities supplying water to the municipal jurisdictions (Table 1-1). Water providers are typically municipalities that provide water to consumers within their jurisdiction. Water users include consumers, businesses, and agricultural consumers.

3.2 Geology and Soils

This section describes the regional and local geology along the Front Range and soils for parts of Adams, Arapahoe, Denver, Douglas, and Jefferson counties. These characteristics apply to the entire study area in which geology and soils could be affected, including Chatfield Reservoir, the proposed Penley Reservoir, the proposed pipeline area, and the downstream gravel pits.

Sediment transport was not modeled in this FR/EIS because it is not a significant issue. Channel form is the product of a range of discharges and the temporal sequence of flow events (Knighton

1998). The return period for the effective discharge depends on the flow and sediment-transport regime of an individual river or reach. Hey (1997, referenced in Biedenharn and Copeland 2000) indicates that the effective discharge lies within the range 1.01 and 3 years, regardless of the type of river. The USACE modeled streamflows with a 2-year return interval (Q_2) at more than 1,000 river stations along more than 250 miles of the South Platte River downstream of Chatfield Reservoir. This modeling effort is described in Section 3.3, and modeled Q_2 results are presented in Appendix I. The alternatives would not substantially alter the frequency of effective discharge flows. At most, Q_2 would decrease by 2 percent, from 5,100 cfs under Alternatives 1 and 2 to 5,000 cfs under Alternatives 3 and 4, over approximately 12 miles of the South Platte River downstream of the reservoir. As a result, changes to sediment transport downstream of the reservoir are not anticipated. Related impacts to stream morphology or associated ecological communities of the South Platte River are not expected under any alternative.

3.2.1 Regional and Local Geology

The Rocky Mountain foothills near Chatfield State Park are within the Denver Formation and consist of hogbacks and valleys that expose scenic dipping plates, spires, and monoliths from the Precambrian to Late Mesozoic age. Cenozoic Age Rocky Flats alluvium, cobble, gravel, and silt washed down from the Front Range overlie older sediments. Recent alluvium, eroded from the rock formations, is deposited in the valleys and along drainages (Colorado State Parks 2005a).

Potential geological hazards within the study area may include seismic activity from active faults, including earthquakes, and potential flooding hazards. USACE conducted a Seismic Safety Review of Chatfield Dam (USACE 2005c). The findings of that study included the recommendation to further evaluate the seismic hazards for Chatfield Dam based on the fact that the state-of knowledge has changed and the site ground motions calculated in a previous evaluation (USACE 1986) need to be confirmed as still valid. The Seismic Hazard Evaluation for Chatfield Dam was completed and documented in a report entitled "Seismic and Ground Motion Study, Chatfield Dam & Lake, South Platte River Basin, Denver, Colorado" prepared by William Lettis & Associates (2010). Results from the Seismic Hazard Evaluation were used in subsequent evaluations, including the Chatfield Liquefaction Assessment (USACE 2009b), Post-Liquefaction Stability Analysis (USACE 2010b, included in Appendix A), and Seismic Analysis of the Intake Tower and Effect of Pool Reallocation (USACE 2010c). These documents were evaluated in preparing the Chatfield Dam Potential Failure Mode Analysis (USACE 2010a) and the Water Supply Re-Allocation Study Dam Safety Evaluation (Appendix A). A summary of each of these studies follows.

Geotechnical/Structural Dam Safety Evaluation. This evaluation addressed potential dam safety concerns based on a permanent increase in the reservoir elevation due to reallocation. The evaluation was based strictly on static loading and specifically addressed instrumentation data, past visual inspections, slope protection, slope stability, and seepage. The study concluded that the new "normal" pool elevation proposed under Alternative 3 would not adversely impact the integrity of the embankment or structures. The study recommended the development and implementation of a Reservoir Raise Monitoring Plan, which would include additional inspections, instrumentation data acquisition, and data analysis. The study also recommended updating, as appropriate, the Project Surveillance Plan and Emergency Action Plan. The study further recommended installation of additional instrumentation prior to the pool raise, along with an increase in instrumentation readings and inspection frequencies during and following the pool raise. The evaluation emphasized that any dam safety concerns that develop during the pool raise could result in lowering the reservoir elevation and/or a pool restriction.

The current Dam Safety Action Classification (DSAC) is IV, or Priority. The DSAC scale includes I (Urgent and Compelling) through V (Normal). The DSAC rating at Chatfield Dam is not permanent and could change depending on future assessments and dam performance.

Liquefaction Assessment. The liquefaction assessment evaluated the liquefaction susceptibility of both the Chatfield Dam embankment and foundation for the existing conservation reservoir and a 12-foot raise proposed under Alternative 3. The assessment utilized information obtained from original design documents, studies, and limited field work. Results of the assessment indicated probable zones of liquefaction both upstream and downstream for the valley and right abutment. The assessment recommended a follow-on Post-Liquefaction Stability Analysis (see details below) to determine if the embankment would remain stable if zones of the foundation were to liquefy after a Maximum Credible Earthquake.

Post-Liquefaction Stability Analysis. A Post-Liquefaction Stability Analysis was performed as a result of the recommendation from the Liquefaction Assessment. The study evaluated whether the embankment would remain stable if zones of the foundation were to liquefy after a Maximum Credible Earthquake. Results of the study indicated the embankment and foundation would remain stable after this event. No further seismic studies related to the embankment or foundation were recommended.

Seismic Analysis of the Intake Structure. A modal analysis of the intake structure was conducted to evaluate performance of the intake structure during and immediately after a Maximum Design Earthquake. The analysis concluded that the intake structure meets or exceeds Corps criteria for during and immediately after a Maximum Design Earthquake, at the current normal pool snf the proposed pool elevation under Alternative 3. No additional seismic studies for the intake structure were recommended.

Potential Failure Mode Analysis (PFMA). A Potential Failure Mode Analysis was completed April 2010. The analysis was conducted to identify and evaluate potential failure modes at Chatfield Dam as the result of the reallocation. Nine potential failure modes were identified to be credible failure modes which are those potential failure modes that are physically possible under a specified loading condition. Although none of the failure modes identified during the PFMA were determined to be significant, items were identified to further investigate many of the failure modes identified. These investigations will be incorporated into the on-going dam safety program. The PFMA can be found in Appendix EE. The five counties within the study area are located within a geographic area that can receive intensely heavy rainfall. The streams and drainage ways, primarily along Plum Creek, Cherry Creek, and the South Platte River, can flood in these instances. Chatfield Reservoir provides flood protection, and while the dam may not prevent all flooding, it substantially reduces the amount of flooding downstream.

3.2.2 Soils

Chatfield State Park is situated in the lower foothills of Colorado's Front Range on the southwestern edge of the Denver Metro area. The park occupies a gently rolling plain layered with Pleistocene and recent silty loess and alluvial cobble, gravel, sand, silt, and clay; some older sandstones and shales are also exposed. From these materials, the following soil types are found at Chatfield State Park: predominantly mollisols (found in drier areas of the humid continental climate), and a few entisols (newer soils) and aridisols (found in arid and semiarid climates). Soil textures range from clays to gravelly loams and sands.

Soil erodibility is an estimate of the ability of soils to resist water and wind erosion, based on the physical characteristics of each soil. Generally, soils with faster infiltration rates, higher levels of organic matter and improved soil structure have a greater resistance to erosion. Sand, sandy loam, and loam-textured soils tend to be less erodible than silt, very fine sand, and certain clay textured soils. Soil K factors represent a relative index of susceptibility to particle detachment and transport by rainfall as compared to bare, cultivated soil. Based on the low K factors of the soil types, which range from 0.05 to 0.28 (Natural Resources Conservation Service [NRCS] 2005a), erodibility is expected to be low.

In general, the primary source of sediment deposition into Chatfield Lake is watershed sheet, rill, and gully erosion, followed by shoreline erosion as the secondary source (USACE 2007). Reservoir deposits generally accumulate near or below the sediment pool elevation of 5,426 feet msl, except during storm events. No significant storm events have occurred between 1998 and 2006 (USACE 2007). Deposition in the flood control zone (5,500 to 5,430 feet msl) is confined within the former stream channel banks and would be progressively redistributed into the sediment pool zone during subsequent flows.

The loss of vegetation makes soil vulnerable to erosion by wind and water. Plants provide protective cover on the land and prevent soil erosion for the following reasons: (1) plants slow down water as it flows over the land, allowing much of the rain to soak into the ground; (2) plant roots hold the soil in position and prevent it from being blown or washed away; (3) plants break the impact of a raindrop before it hits the soil, reducing the soil's potential to erode; and (4) plants in wetlands and on the banks of rivers slow down the flow of the water, and their roots bind the soil, preventing erosion.

3.2.2.1 Fires

Chatfield Reservoir is a part of the Upper South Platte Watershed, which has been identified as a watershed at risk to catastrophic wildfire by the Upper South Platte Watershed Protection and Restoration Project (USFS 2000). This watershed is within the South Platte River Basin, which includes the river and its tributaries from the Rocky Mountains in Colorado into Wyoming and Nebraska. Because soils in a high-intensity burn area often become hydrophobic, or water repellent, which increases flood and erosion potential, downstream water quality can become degraded. Soils that are water repellent exhibit a decreased water infiltration rate and an increased water runoff rate, creating extreme soil erosion potential. Initially, rainwater will run off hydrophobic soils instead of infiltrating and promoting germination of seed and growth of roots. This makes it difficult to establish a stand of vegetation. If torrential rains occur in a burn area, the non-stabilized soils travel along the rivers and streams towards the watershed’s reservoirs, including Chatfield Reservoir.

In 1996 and 2002, respectively, the Buffalo Creek and Hayman fires occurred in the South Platte River Basin upstream of Chatfield Reservoir. The Buffalo Creek fire burned nearly 12,000 acres.

Following the fire, several torrential rainstorms occurred, which resulted in over 300,000 cubic yards of sediment moving into the Strontia Springs Reservoir, upstream of Chatfield Reservoir (Agnew et al. 2000). Volumes of sediment captured in Strontia Springs Reservoir increased from an average of 20,000 cubic feet per year prior to the Buffalo Creek fire to 67,000 cubic feet per year after the fire (Bob Peters, personal communication 2007). Nutrients contained within this sediment introduced thousands of tons of nitrogen and phosphorus into Chatfield Reservoir, which affected the water quality at Chatfield (Wohl 1998).

The Hayman fire was the largest recorded wildfire in Colorado, burning nearly 138,000 acres and destroying 600 structures. After the Hayman fire, crews entered the burned areas and attempted to stabilize soils by raking, seeding, and hydro-mulching the surface. This soil stabilization reduced runoff, and helped to protect both the ecosystem and the watershed (Cyberwest Magazine 2003). Similar to the Buffalo Creek fire, the Hayman fire caused increased total levels of phosphorus and metal runoff into Chatfield Reservoir, which impeded attainment of water quality standards.

In 2006, the USACE completed a reconnaissance-level sediment survey of portions of Chatfield Reservoir to determine whether the runoff following the Hayman fire had contributed measurable sediment deposition (USACE 2007). They compared cross-section surveys completed in 1977, 1991, 1998, and 2006, and looked for trends of increasing or decreasing sedimentation levels that may have been associated with the 2002 Hayman fire. Analysis of the data did not show additional, unexpected sediment deposition. At several cross sections, annual deposition rates decreased, in part because of severe drought in the basin.

Cheesman Reservoir, located on the South Platte River upstream of Chatfield Reservoir, acts as a sediment trap and has likely captured most of the sediment runoff associated with the Hayman fire (USACE 2007). A sedimentation problem could develop in the future if sediments in Cheesman Reservoir were transported into Chatfield Reservoir. Under a permit issued by USACE, Denver Water periodically removes sediment from traps in Cheesman Reservoir, including 17,000 cubic yards from the Goose Creek sediment trap and 28,000 cubic yards from the Turkey Creek trap in 2005, and another 60,0000 cubic yards from the Turkey Creek trap in 2006 (Bob Peters, personal communication 2007).

The Chatfield Watershed Authority produces an annual report that describes the water quality of the entire Chatfield Reservoir watershed. Since the Hayman fire, this report has included the results of a special monitoring program for South Platte River inflow and reservoir water quality for selected fire-related runoff parameters. USFS estimates that the Hayman burn area could take 20 to 50 years for full recovery. A minimum of 10 years are needed to begin revegetation of grasses and the forest recovery could take decades (Chatfield Watershed Authority 2006). This large burn area could generate considerable amounts of erosion, even with best mitigation efforts, until revegetation has occurred. Long-term erosional potential causes uncertainty about sediment, nutrient and metal loading to downstream waterbodies. The erosion potential from the runoff area affected by the Hayman fire remains extreme (Chatfield Watershed Authority 2006). Downstream water quality data for 2003 to 2005 show that some nutrients and metals exceed historic data trends. Wildfire runoff pollutants could exceed numeric water quality standards.

Chatfield data show a nutrient-loading problem associated with fire runoff (Chatfield Watershed Authority 2006). The data are variable and the magnitude of the loading is difficult to predict.

Historic average loading of total phosphorus in surface water in the Chatfield Reservoir has increased since the 2002 Hayman fire, from less than 30 micrograms per liter (µg/L) between 1997 and 2002, to 38, 40, 27, and 31 µg/L in each subsequent year. Chatfield Reservoir exceeded the growing season total phosphorus standard in 2003 and 2004 despite extremely low runoff from the burned area because of drought. Although 2006 inflow into Chatfield Reservoir was below normal, the flow-based phosphorus loading was increased as a result of runoff from the Upper South Platte River Watershed. Increasing runoff in the South Platte River could continue to carry phosphorus into the reservoir.

3.2.2.2 Prime and Unique Farmland

This section addresses farmland in Douglas, Jefferson, Denver, Arapahoe, Adams, Weld, and Morgan counties, including prime and unique farmland as defined by the NRCS. Weld and Morgan counties were included in this analysis to address potential impacts farther downstream, such as drying of agricultural lands if water rights were transferred from irrigation to other users.

Congress passed the Agriculture and Food Act of 1981 (Public Law 97-98) containing the Farmland Protection Policy Act (Subtitle I of Title XV, Section 1539–1549) as a result of the drastic loss of agricultural lands throughout the nation. This act protects prime and unique farmland and is intended to minimize the impact federal programs have on the unnecessary and irreversible conversion of farmland to nonagricultural uses.

Prime Farmland

Prime farmland is defined as "land that has the best combination of physical and chemical characteristics for producing food, feed, fiber, forage, oilseed, and other agricultural crops with minimum inputs of fuel, fertilizer, pesticides, and labor, without intolerable soil erosion, as determined by the Secretary [of Agriculture]" (NRCS 2002). Non-irrigated farmland in Colorado is not considered to be prime farmland by NRCS.

Unique Farmland

Unique farmland is defined as "land other than prime farmland that is used for the production of specific high value food and fiber crops, as determined by the Secretary [of Agriculture]. It has the special combination of soil quality, location, growing season, and moisture supply needed to economically produce sustained high quality or high yields of specific crops when treated and managed according to acceptable farming methods" (NRCS 2002).

Information on soils within the study area was obtained from NRCS soil maps for the five-county study area. According to the maps, none of the soil units identified supported prime or unique farmland. Some soils would be classified as prime or unique if certain requirements were met—if the land was irrigated and/or reclaimed of excess salts and sodium. As noted in the discussion of economics, less than 1 percent of employment is related to farming in the study area, with the exception of Weld County, which has over 5 percent of employment related to farming. However, there were many farmland soils that are of statewide importance (NRCS 2005a). In Colorado, all agricultural lands that are irrigated, regardless of soil quality considerations, are considered farmlands of statewide importance.

3.3 Hydrology

This section describes hydrological conditions in the South Platte River Watershed, including its mountains-and-plains climate, temperature, and precipitation patterns. These characteristics apply to the entire study area, including Chatfield Reservoir, the proposed Penley Reservoir, the proposed pipeline area, and the downstream gravel pits. Surface water and groundwater conditions also are presented for the study area.

3.3.1 Climate, Temperature, and Precipitation

According to the Colorado Climate Center (2004), Colorado has a continental-type climate modified by topography, with large temperature ranges (from -30 to 100 degrees Fahrenheit) and irregular seasonal and annual precipitation. Colorado's Front Range climate is considered semiarid. Winter and fall are dry seasons, and spring and summer are wet seasons. The weather is highly changeable and includes abbreviated periods of high winds and occasional thunderstorms with damaging hail. The growing season lasts about 138 days.

Precipitation patterns in the South Platte River Basin upstream of Chatfield Reservoir depend on altitude. The greatest amount of annual precipitation (30 inches) occurs in the mountains as snow and less than 15 inches of annual precipitation occurs on the plains. Most of the precipitation on the plains occurs from April to September as thunderstorms. From 1971 to 2000, the annual average temperature in the Denver Metro area was 50 degrees Fahrenheit, and the average annual precipitation was 15.81 inches (National Oceanic and Atmospheric Administration [NOAA] 2003).

The impact of climate change on runoff in the Platte Basin has not been studied extensively (Ray et al. 2009). The average temperature in the southwestern United States has increased roughly 1.5°F compared to a 1960—1979 baseline period (Karl et al. 2009). Climate models project that Colorado will warm by approximately 2.5°F by 2025 and by approximately 4°F by 2050, relative to a 1950—1999 baseline period (Ray et al. 2009). The projections show summers warming more (+5°F) than winters (+3°F), and suggest that typical summer temperatures in 2050 will be as warm as or warmer than the hottest 10 percent of summers that occurred between 1950 and 1999. Individual models projections do not agree whether annual mean precipitation will increase or decrease in Colorado by 2050. More mid-winter precipitation throughout the state is predicted, and in some areas, a decrease in late spring and summer precipitation. Regardless of precipitation, the timing of spring runoff is projected to shift earlier in the spring, and late-summer flows may be reduced (Ray et al. 2009).

3.3.2 Surface Water Hydrologic Conditions

The primary sources of water in Colorado are snowmelt and stormwater runoff. These sources discharge into Rocky Mountain rivers and lakes and provide the water supply for one-quarter of the nation. East of the Continental Divide, the Arkansas, Missouri, North and South Platte, and Yellowstone rivers flow toward the Gulf of Mexico. On the east side of the mountains, water supports agriculture, municipal supplies, and recreation (Stohlgren 2005).

The South Platte River originates as snowmelt in central Colorado at an elevation of about 12,500 feet. From its source, the river flows southeastward, then northeastward, and after crossing the Colorado-Nebraska border, flows almost due east to join the North Platte River. The South Platte

River is about 450 miles long and drains approximately 24,300 square miles (USGS 2005). The Platte River flows through Nebraska and joins the Missouri River south of Omaha, Nebraska.

In the South Platte River Basin, stream water quality generally depends more on adjacent land use than on upstream land use because upstream water often is removed from the river by diversions. The SWSI (CWCB 2004), which used U.S. Geological Survey (USGS) 1992 National Land Cover Data, found that approximately one-third of the South Platte River Basin is publicly owned. The majority of those lands are forest areas in the mountains. Western portions of the basin and montane and subalpine areas are primarily forested, while the High Plains region is mainly grassland and planted/cultivated land. According to USGS (1998), rangeland comprised 41 percent of the land use in the South Platte River Basin in 1992—1995, but this use had a relatively small effect on water quality because of the lack of overland flow and minimal water use. Irrigated agriculture comprised only 8 percent of the land area in the basin in 1992—1995 but accounted for 71 percent of the water use in 1990 (USGS 1998). Urban lands comprised only 3 percent of the basin in 1992—1995 but accounted for 12 percent of the water use in 1990, or 27 percent if power generation is considered an urban water use (USGS 1998). The SWSI (CWCB 2004) reports gross water use for the South Platte River Basin in 2003. Self-supplied industrial use and M&I use, combined, comprised 23 percent (772,400 acre-feet per year) of the total demand. Agricultural use accounted for the remaining 77 percent (2,606,000 acre-feet per year) in 2003 (CWCB 2004). Comparing these studies, irrigated agriculture use of surface water in South Platte Basin appears to have increased from 71 percent in 1990 to 77 percent in 2003. Urban water use appears to have increased from 12 percent in 1990 to 23 percent in 2003.

Historical (1942 to 2000) data from South Platte River stream gages and Chatfield Reservoir operations (beginning after the reservoir was constructed) were entered into a Corps' computer model (HEC-5). A detailed description of the modeling effort is described in Chapter 4 and included in Appendices H and I. The hydrology of the reservoir pool elevations, the flows coming into the reservoir from upstream, and the flows leaving the reservoir have varied considerably during the 61-year POR. The record captures cycles of wetter and drier periods. Drought is a regular feature in Colorado (Colorado State University 2007). In the 1900s alone, four prolonged dry spells occurred, beginning with one in the 1910s. Another in the 1930s caused the dust-bowl period. The second worst drought on record occurred in the 1950s. A series of hot, dry summers following a period of low mountain snowpack created water shortages. The fourth drought hit parts of Colorado in the late 1970s. In the 21st century, the most severe drought since 1723 hit the state in 2002.

Chatfield Reservoir inflows from the South Platte River upstream consist primarily of snowmelt and stormwater, which generally occur in spring and late summer, respectively. Mean flow for the entire period of record is 231 cfs. Flows provided by streamflow regulation via Antero and Spinney reservoirs are sustained throughout the year. These baseflows allow Chatfield Reservoir operators to minimize potential impacts to the reservoir caused by rapid spring runoff or large storm events. Flows greater than approximately 500 cfs occur less than 10 percent of the time.

3.3.3 Groundwater Hydrologic Conditions

Groundwater generally occurs in one of two forms. One form, alluvial or shallow groundwater occurs within the sands and gravel below and adjacent to stream and river channels. Alluvial groundwater is closely tied to surface water as the water may readily flow from the streambed into the alluvium and vice versa. Groundwater also occurs within water-bearing geologic formations deep below the surface within "confining" layers and without any direct contact to surface water flows. Both types of aquifers exist within the study area.

The Denver Basin aquifer system is a deep groundwater source, composed of four principal aquifers (Dawson, Denver, Arapahoe, and Laramie-Fox Hills). An overlying alluvial aquifer occurs along the South Platte River and its tributaries (USGS 1995). The deep aquifer system underlies an area of about 7,000 square miles that extends from Greeley south to near Colorado Springs and from the Front Range east to near Limon. The aquifer consists of a 600- to 1,000-foot-thick series of moderately consolidated, interbedded shale, claystone, siltstone, and sandstone. Water-yielding layers of sandstone and siltstone occur in poorly defined irregular beds that are dispersed within relatively thick (100 to 300 feet) sequences of claystone and shale.

The Denver Basin groundwater was deposited millions of years ago when the basin was formed. Because of the nature of the confining layers and the limited connection between these aquifers and surface water, groundwater in the aquifers is considered nonrenewable (USGS 1995). The USGS (1987) estimated the total volume of groundwater in storage within the Denver Basin aquifers at 89 million acre-feet with a volume of 42 million acre-feet recoverable. CDNR reported that 467 million acre-feet occurs within the aquifer in and adjacent to the Denver Metro area with 150 million acre-feet recoverable (CWCB 2002). According to USGS (1987), the estimated recoverable water in storage in the Denver Basin (including the Dawson, Denver, Arapahoe, and Laramie-Fox Hill aquifers) is 269 million acre-feet.

Historically, the Denver Metro area relied on surface water; however, in the past 30 years new housing developments, particularly in the south metropolitan area, have relied on groundwater from the bedrock aquifers since surface water is essentially fully appropriated and in short supply. The principal means of groundwater discharge from the Denver Basin aquifers are withdrawal from wells and inter-aquifer movement of water from the bedrock to overlying alluvial aquifers. Estimated groundwater withdrawal from the bedrock aquifers increased from about 14,000 acre-feet per year during 1960 to about 29,000 acre-feet per year during 1980. The CDNR estimated that annual pumping rates reached 57,000 acre-feet in 1998 (CWCB 2002).

On average, about 5 million acre-feet of water falls as precipitation each year on the Denver Basin. Over 4.9 million acre-feet of this water is lost to evaporation, transpiration by plants, or surface runoff. The remaining water, about 40,000 acre-feet, recharges the four Denver Basin aquifers (USGS 1995).

The alluvial aquifer occurs along much of the South Platte River valley ranging in width from 1 to 10 miles and from less than 5 to more than 100 feet deep. Sand and gravel are the principal water yielding materials in the alluvial aquifer, and depth to water usually ranges from 0 to 40 feet. The alluvial aquifer is estimated to hold 8 million acre-feet of water (CWCB 2002). Shallow, discontinuous alluvial aquifers overlie parts of the Denver Basin aquifer system, primarily along small streams that extend south from the South Platte River. The alluvial aquifers generally are thicker and more extensive in the northern half of the Denver Basin, where they supply water for irrigation, stock, and domestic use. The surface water in streams and reservoirs and water used for irrigation purposes are the principal sources of recharge for these aquifers. Water discharged to alluvial aquifers can contribute to the flow in the aquifers or streams adjacent to them or can be lost to evapotranspiration (USGS 1995).

USGS (1998) conducted a survey from 1992 to 1995 in the South Platte River Basin. The study concluded that groundwater levels in the mountains and plains showed seasonal patterns. Groundwater levels in the mountains fluctuated in response to snowmelt and subsequent infiltration of water, which resulted in the highest water levels occurring between March and June. Groundwater levels in the alluvial aquifer in the plains fluctuated in response to the application of irrigation water for agriculture, which resulted in the highest water levels occurring between July and September. The South Platte alluvial aquifer in the plains is used primarily for irrigation, but also as a source of domestic water in rural areas of the state.

3.4 Water Quality

The following section presents a discussion of federal water quality criteria for and location-specific details of water quality measurements in the study area, including ambient water quality and surface water and groundwater quality in the South Platte River Basin. These characteristics apply to the entire study area, including Chatfield Reservoir, the proposed Penley Reservoir, the proposed pipeline area, and the downstream gravel pits.

3.4.1 Ambient Water Quality

Controlling water pollution is necessary to protect public health and welfare, as well as the environment. Clean water has other positive benefits, including the maintenance of aquatic life, wildlife habitats, vegetation, and aesthetics.

Section 304 (a)(1) of the Clean Water Act of 1972 (33 USC §§ 1251–1387; Public Law 92-500, as amended in 1990) requires EPA to develop and publish criteria for water quality accurately reflecting the latest scientific knowledge. EPA developed freshwater, saltwater, and human health criteria for priority pollutants, non-priority pollutants, and organoleptic (i.e., taste, odor) effects (EPA 1999). These criteria provide guidance for states adopting their own water quality standards under Section 303 (c) of the Act. Compliance with the Clean Water Act of 1972 and coordination with the EPA is described in Appendix S.

CWQCC has identified beneficial uses for all waters of the State by individual stream segment and developed water quality standards necessary to protect those uses. Table 3-1 presents the designated uses and water quality standards by segment for waters within the study area. The CWQCC adopted the Chatfield Reservoir Control Regulation (Colorado Regulation Number 73) to address specific water quality regulatory requirements for Chatfield Reservoir Watershed and Chatfield Reservoir. The control regulation assures watershed point and nonpoint source water quality compliance consistent with adopted stream standards and classifications.

3.4.2 Surface Water

The main surface waters within the study area include the South Platte River, Plum Creek, Cherry Creek, and Bear Creek with the South Platte River and Plum Creek being the major contributors to Chatfield Reservoir. The Chatfield Watershed Authority is the designated water quality management agency for the Chatfield Reservoir Watershed, which consists of the area upstream from the outlet of Chatfield Reservoir. The agency manages long-range planning of municipal wastewater treatment (point source pollution) and non-permitted (nonpoint) sources of pollution. Under Colorado Regulation Number 73, the Chatfield Watershed Authority is also responsible for implementing the control regulation and monitoring water quality and trends.

Chatfield Reservoir maintains a State water quality classification of Class E recreation and Class 1 cold-water aquatic life. The Class E recreation classification is designated to protect primary body contact uses. As defined by these regulations, these surface waters are suitable for recreation activities in or on the water where the ingestion of small quantities of water is likely to occur. The Class 1 cold-water aquatic life classification defines acceptable water quality conditions as set forth in Table 3-1. Waters with this classification contribute no substantial impairment of the abundance and diversity of species and are capable of sustaining a wide variety of cold-water biota, including sensitive species (CWQCC 2009a).

The Chatfield Reservoir Clean Lakes Study identified potential water quality problems for Chatfield Reservoir because of increases along the eutrophication scale caused by nutrient loading and other pollutants (DRCOG 1984, Chatfield Watershed Authority 2006). The study recommended several standards and treatment options to protect the water quality at the reservoir (CWQCC 2009b). In 1984, CWQCC used water quality data and hydrologic conditions from 1982 along with estimates of future conditions to establish a TMAL for phosphorus of 59,000 pounds total phosphorus in conjunction with 261,000 acre-feet of water, resulting in a phosphorus standard within the reservoir at 0.027 milligrams per liter (mg/L). The TMAL distributions of total phosphorus by sources were based on a spreadsheet model developed specifically for Chatfield Reservoir by local authorities and later approved by the State. Point sources of phosphorus to Chatfield Reservoir were limited to 7,533 pounds per year with 51,291 pounds per year allocated to nonpoint and background sources (CWQCC 2009b).

However, total phosphorus loads generally have not caused Chatfield Reservoir to exceed the TMAL or the chlorophyll-a goal of 0.017 mg/L. The Chatfield Watershed Authority (2005) has observed that total phosphorus within Chatfield Reservoir varies with the water yield in the basin. In natural lakes and streams, phosphorus concentrations of inflows tend to correlate with phosphorus concentrations in the lakes. According to Dr. James Saunders, Surface Water Standards Scientist of the Colorado Water Quality Control Division, the relationship in Chatfield Reservoir is not as strong because a significant amount of sediment (and phosphorus) settles out of the South Platte River as the flows are detained in Strontia Springs and Cheesman Reservoirs upstream of Chatfield Reservoir (Chatfield Watershed Authority 2008). As a result, the sediment that remains in the water flowing to Chatfield Reservoir appears finer than in a natural system. It tends to remain suspended longer and, in general, is more likely to be flushed out of Chatfield Reservoir. Exceptions occur occasionally when Chatfield Reservoir receives sediment-laden waters as Denver Water flushes out upstream reservoirs. Also, an underflow may develop in the upstream reservoirs where sediment is sucked through the system during high flows (Chatfield Watershed Authority, 2008).

Table 3-1
Chatfield Reservoir Stream Classifications and Water Quality Standards

Basin: Upper South Platte River		Numeric Standard						
Stream Segment Description	Classifications	Physical and Biological	Inorganic (mg/L)		**Metals (µg/L)**			Temporary Modifications and Qualifiers
6a. Mainstem of the South Platte River from the outlet of Cheesman Reservoir to the inlet of Chatfield Reservoir	Aquatic Life Cold 1 Recreation E Water Supply Agriculture	T=TVS(CS-II) ºC D.O. = 6.0 mg/L D.O. (sp)=7.0 mg/L pH = 6.5-9.0 E. Coli=126/100mL	NH_3(ac/ch)=TVS Cl_2(ac)=0.019 Cl_2(ch)=0.011 CN=0.005	S=0.002 B=0.75 NO_2=0.05 NO_3=10 Cl=250 $S0_4$=WS	As(ac)=340 As(ch)=0.02(Trec) Cd(ac)=TVS(Tr) Cd(ch)=TVS CrIII(ac)=50(Trec) CrVI(ac/ch)=TVS Cu(ac/ch)=TVS	Fe(ch)=WS(dis) Fe(ch)=1000(Trec) Pb(ac/ch)=TVS Mn(ac/ch)=TVS Mn(ch)=WS(dis) Hg(ch)=0.01(Tot)	Ni(ac/ch)=TVS Se(ac/ch)=TVS Ag(ac)=TVS Ag(ch)=TVS(Tr) Zn(ac/ch)=TVS	
6b. Chatfield Reservoir	Aquatic Life Cold 1 Recreation E Water Supply Agriculture	T=TVS(CLL) ºC April-December $T_{(WAT)}$=23.5ºC D.O. = 6.0 mg/L D.O. (sp)=7.0 mg/L pH = 6.5-9.0 E. Coli=126/100mL P(Tot)=0.030 mg/L chlorophyll=10 ug/L measured through samples that are representative of the mixed layer during July-September, with an allowable exceedance frequency of 1 in 5 years	NH_3(ac/ch)=TVS Cl_2(ac)=0.019 Cl_2(ch)=0.011 CN=0.005	S=0.002 B=0.75 NO_2=0.05 NO_3=10 Cl=250 $S0_4$=WS	As(ac)=340 As(ch)=0.02(Trec) Cd(ac)=TVS(Tr) Cd(ch)=TVS CrIII(ac)=50(Trec) CrVI(ac/ch)=TVS Cu(ac/ch)=TVS	Fe(ch)=WS(dis) Fe(ch)=1000(Trec) Pb(ac/ch)=TVS Mn(ac/ch)=TVS Mn(ch)=WS(dis) Hg(ch)=0.01(Tot)	Ni(ac/ch)=TVS Se(ac/ch)=TVS Ag(ac)=TVS Ag(ch)=TVS(Tr) Zn(ac/ch)=TVS	The following criteria shall be used when assessing whether 6b is in attainment of the specified standard. chlorophyll = 11.2 µg/l, summer average, 1 in 5 year allowable exceedance frequency phosphorus(Tot) = 0.035 mg/l, summer average, 1 in 5 year allowable exceedance frequency
7. All tributaries to the South Platte River, including all wetlands from a point immediately below the confluence with the North Fork of the South Platte River to the outlet of Chatfield Reservoir except for specific listings in Segments 8, 9, 10, 11, 12, and 13.	Aquatic Life Cold 2 Recreation E Agriculture	T=TVS(CS-II) ºC D.O. = 6.0 mg/L D.O. (sp)=7.0 mg/L pH = 6.5-9.0 E. Coli=126/100mL	NH_3(ac/ch)=TVS Cl_2(ac)=0.019 Cl_2(ch)=0.011 CN=0.005	S=0.002 B=0.75 NO_2=0.05 NO_3=100	As(ac)=340 As(ch)=100(Trec) Cd(ac)=TVS(Tr) Cd(ch)=TVS CrIII(ac/ch)=TVS CrVI(ac/ch)=TVS Cu(ac/ch)=TVS	Fe(ch)=1000(Trec) Pb(ac/ch)=TVS Mn(ac/ch)=TVS Hg(ch)=0.01(Tot)	Ni(ac/ch)=TVS Se(ac/ch)=TVS Ag(ac)=TVS Ag(ch)=TVS(Tr) Zn(ac/ch)=TVS	
10a. Mainstems of East Plum Creek, West Plum	Aquatic Life Warm 1	T=TVS(WS-I) ºC D.O.= 5.0 mg/L	NH_3(ac/ch)=TVS Cl_2(ac)=0.019	S=0.002 B=0.75	As(ac)=340 As(ch)=0.02(Trec)	Fe(ch)=WS(dis) Fe(ch)=1000(Trec)	Hg(ch)=0.01(Tot) Ni(ac/ch)=TVS	Temporary modifications: Cu (ac/ch)=TVSx2.4 on

Table 3-1
Chatfield Reservoir Stream Classifications and Water Quality Standards

Basin: Upper South Platte River		Numeric Standard							
Stream Segment Description	Classifications	Physical and Biological	Inorganic (mg/L)		**Metals (µg/L)**			Temporary Modifications and Qualifiers
Creek, and Plum Creek from the boundary of National Forest lands to Chatfield Reservoir, mainstems of Stark Creek and Gove Creek from the boundary of National Forest lands to their confluence.	Recreation E Water Supply Agriculture	pH = 6.5-9.0 E. Coli=126/100mL	Cl_2(ch)=0.011 CN=0.005	NO_2=0.5 NO_3=10 Cl=250 $S0_4$=WS	Cd(ac/ch)=TVS CrIII(ac)=50(Trec) CrVI(ac/ch)=TVS Cu(ac/ch)=TVS	Pb(ac/ch)=TVS Mn(ac/ch)=TVS Mn(ch)=WS(dis)	Se(ac/ch)=TVS Ag(ac/ch)=TVS Zn(ac/ch)=TVS	East Plum Creek and Plum Creek below the Plum Creek Wastewater Authority Discharge (Type iii). Expires 12/31/2015.
14. Mainstem of the South Platte River from the outlet of Chatfield Reservoir to the Burlington Ditch diversion in Denver, Colorado.	Aquatic Life Warm 1 Recreation E Water Supply Agriculture	T=TVS(WS-I) ºC summer=14 Feb - Nov D.O.=5.0 mg/L pH=6.5-9.0 E. Coli=126/100mL	NH_3(ac/ch)=TVS Cl_2(ac)=0.019 Cl_2(ch)=0.011 CN=0.005	S=0.002 B=0.75 NO_2=0.5 NO_3=10 Cl=250 $S0_4$=WS	As(ac)=340 As(ch)=0.02(Trec) Cd(ac/ch)=TVS CrIII(ac)=50(Trec) CrVI(ac/ch)=TVS Cu(ac/ch)=TVS Fe(ch)=WS(dis)	Fe(ch)=1000(Trec) Pb(ac/ch)=TVS Mn(ch)=190(dis) Mn(ac/ch)=TVS Hg(ch)=0.01(Tot) Ni(ac/ch)=TVS	Se(ac/ch)=TVS Ag(ac/ch)=TVS Zn(ac/ch)=TVS	Temporary modifications: Cu(ac/ch)=TVSx2.7 (Type iii). Applies below the confluence with Marcy Gulch. Expires 12/31/2014. T=current conditions (Type iii). Expires 12/31/2015. Se(ac/ch)=current conditions (Type iii). Expires 12/31/2013.

Table 3-1
Chatfield Reservoir Stream Classifications and Water Quality Standards

Basin: Upper South Platte River		Numeric Standard							
Stream Segment Description	Classifications	Physical and Biological	Inorganic (mg/L)		**Metals (µg/L)**			Temporary Modifications and Qualifiers
15. Mainstem of the South Platte River from the Burlington Ditch diversion in Denver, Colorado, to a point immediately below the confluence with Big Dry Creek.	Aquatic Life Warm 2 Recreation E Water Supply Agriculture UP designation	T=TVS(WS-I) ºC D.O. as follows: Early Life Stage Protection Period (April 1 through July 31) 1-Day=3.0 mg/L (acute) 7-Day Average =5.0 mg/L Older Life Stage Protection Period (August 1 through March 31) 1-Day=2.0 mg/L (acute) 7-Day Mean of Minimums=2.5 mg/L 30-Day Average=4.5 mg* pH = 6.5-9.0** E. Coli=126/100mL	NH_3(ac/ch)=TVS Cl_2(ac)=0.019 Cl_2(ch)=0.011 CN=0.005	S=0.002 B=0.75 NO_2=1.0 NO_3=10 Cl=250 $S0_4$=WS	As(ac)=340 As(ch)= 0.02-10(Trec) Cd(ac/ch)=TVS CrIII(ac)=50(Trec) CrVI(ac/ch)=TVS Cu(ac/ch)=TVS Fe(ch)=WS(dis)	Fe(ch)=1000(Trec) Pb(ac/ch)=TVS Mn(ch)=400(dis) Mn(ac/ch)=TVS Hg(ch)=0.01(Tot)	Ni(ac/ch)=TVS Se(ac/ch)=TVS Ag(ac/ch)=TVS Zn(ac/ch)=TVS	*For the purpose of determining attainment of the standard, dissolved oxygen measurements shall only be taken in the flowing portion of the stream and at mid depth, and at least six inches above the bottom of the channel. Dissolved oxygen measurements in man-made pools are not to be used for determination of attainment of the standards. **pH=6.0-9.0 from 64th Ave. downstream 2 miles. Temporary modifications: NH3(ac)=TVS(old) NH3(ch)=0.10 mg/l (Type i). Expires 12/31/2014. Cu(ac/ch)=TVSx2.3 (Type iii). Expires 12/31/2015. T=current conditions (Type iii). Expires 12/31/2015.

Source: Source: CWQCC 2010

ac	acute (1-day)	dis	Dissolved	Se	Selenium
Ag	Silver	D.O.	Dissolved oxygen	sp	spawning
As	Arsenic	E. coli	Escherichia coli	SO_4	Sulfate
B	Boron	Fe	Iron	T	Temperature
Cd	Cadmium	Hg	Mercury	Tr	Trout
ch	Chronic (30-day)	mg/L	Milligrams per liter	Tot	Total
Cl	Chloride	mL	Milliliters	Trec	Total recoverable
Cl_2	Residual chlorine	Mn	Manganese	TVS	Table value standard

Table 3-1
Chatfield Reservoir Stream Classifications and Water Quality Standards

Basin: Upper South Platte River		Numeric Standard			
Stream Segment Description	Classifications	Physical and Biological	Inorganic (mg/L)	**Metals (µg/L)**	Temporary Modifications and Qualifiers

CLL	Cold large lake temperature tier	NH_3	ammonia as N (nitrogen)	µg/L	Micrograms per liter
CN	free cyanide	Ni	Nickel	UP	Use-protected
Cold 1	Cold water aquatic life	NO_2	Nitrite as N (nitrogen)	Warm 1	Warm water aquatic life
Cold 2	Cold and warm water aquatic life	NO_3	Nitrate as N (nitrogen)	Warm 2	Cold and warm water aquatic life
CrIII	trivalent chromium	P	Phosphorus	WAT	Weekly average temperature)
CrVI	Hexavalent chromium	Pb	Lead	WS	See (**) below
CS-II	Cold stream temperature tier two	pH	potential of Hydrogen	WS-I	Warm stream temperature tier one
Cu	Copper	Recreation E	Existing primary contact use	Zn	Zinc
ºC	degrees Celsius	S	Sulfide as undissociated hydrogen sulfide		

** For all surface waters with an actual water supply use, the less restrictive of the following two options shall apply as numerical standards, as specified in the Basic Standards and Methodologies at 31.11(6); (i) existing quality as of January 1, 2000; or (ii) Iron = 300 µg/l (dissolved), Manganese = 50 µg/l (dissolved), SO4 = 250 mg/l. For all surface waters with a "water supply" classification that are not in actual use as a water supply, no water supply standards are applied for iron, manganese or sulfate, unless the Commission determines as the result of a site-specific rulemaking hearing that such standards are appropriate.

*** As used in the "Temporary Modifications and Qualifiers" column of the tables, the term "type i" refers to a temporary modification adopted pursuant to subsection 31.7(3)(a)(i) of the Basic Standards and Methodologies for Surface Water (i.e., "where the standard is not being met because of human-induced conditions deemed correctable within a twenty (20) year period"). The term "type iii" refers to a temporary modification adopted pursuant to subsection 31.7(3)(a)(iii) of the Basic Standards and Methodologies for Surface Water (i.e., "where there is significant uncertainty regarding the appropriate long-term underlying standard").

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In July 2007, the CWQCC heard evidence that the phosphorus standard in Chatfield Reservoir had been exceeded in 5 of the previous 6 years, while the chlorophyll goal was not exceeded. During this triennial review hearing, the CWQCC agreed that the linkages between in-lake chlorophyll and total phosphorus concentrations and between total phosphorus concentrations and total phosphorus load to the reservoir were critical to the TMAL and called for their review. The CWQCC held a rule-making hearing in November 2008 to consider revisions to the control regulation and related water quality standards in Regulation Number 38. They directed the Water Quality Control Division to conduct a Technical Review of the TMAL and the underlying standard. Based on the results of the Technical Review, the CWQCC adopted revised site-specific standards for total phosphorus and chlorophyll for Chatfield Reservoir in relevant sections of Regulation Number 38, which became effective on March 30, 2009. These current standards are total phosphorus of 0.030 mg/L and chlorophyll-a of 10 μg/L. As a result of these changes, the CWQCC adopted a new allowable load of total phosphorus of 19,600 pounds per year under a median inflow of 100,860 acre-feet per year. The new allowable load better reflects the linkage between watershed total phosphorus load and the in-lake total phosphorus concentration. Revised allocations of the load will be developed to complete revisions to the TMAL. Until that time, the previous load allocations remain in effect.

Since 1985, the reservoir has been generally considered to have good water quality, although Trophic State Index data have indicated the reservoir was in a slightly eutrophic condition because of elevated nutrient levels. Phosphorus levels established in the TMAL have been exceeded in 11 out of 24 years between 1982 and 2006 (Chatfield Watershed Authority 2007) while the chlorophyll-a goal has been met continuously. Water quality data also indicate that the reservoir generally maintains pH values in compliance with the standard, in the range of 6.5 to 9.0. Four metals (copper, iron, mercury, and manganese) exceeded standards in 2004. These metals are generally associated with erosion and runoff from wildfire burn areas (i.e., Hayman fire).

Large water bodies, including Chatfield Reservoir, become thermally stratified as cold water sinks to the bottom and warm water stays near the surface. The chemistry between the layers differs as cold water remains on the bottom due to its relatively high density and the dissolved oxygen is used and not replenished; ultimately an anoxic zone forms in which oxygen concentration is too low to support aquatic life. For purposes of this analysis the anoxic zone occurs where oxygen concentrations are less than 2.0 mg/L. These low oxygen levels also influence the chemistry of bottom sediments allowing nutrients and metals that had been attached to sediments to re-enter the water column. Phosphorus is released from sediments more quickly under anoxic conditions. When the thermal layers naturally turn over due to seasonal temperature changes in the water body, the nutrients and metals within the anoxic zone can become mixed throughout the water column. However, according to Dr. James Saunders, anoxia appears to be a rare phenomenon in Chatfield (Chatfield Watershed Authority 2008). As a result, internal loading (i.e., the amount of phosphorus that is re-suspended from the sediments on the bottom of the reservoir) does not appear to contribute significantly to phosphorus levels in Chatfield Reservoir. The impact analysis presented in Chapter 4 addresses the potential for changes in the size and behavior of the anoxic zone with changes in water levels of the reservoir.

Water quality within the South Platte River below Chatfield Reservoir is generally in compliance with water quality standards for most parameters. The 303(d) list identifies portions of water bodies where water quality standards are being exceeded and a total maximum daily load (TMDL) will need to be developed to address pollutant loadings. The List of Water Quality-Limited Segments Requiring TMDLs (i.e., the 303(d) list) adopted by the CWQCC in 2006 includes two segments of the South Platte River within the study area. The segments from Bowles Avenue to the Burlington Ditch and portions of the segment from Burlington Ditch to Big Dry Creek (specifically the reaches from Clear Creek to the Fulton Canal diversion and from the Burlington Canal headgate to the Metro Wastewater Reclamation District) are both listed for E. coli. According to the Colorado Department of Public Health and Environment (CDPHE) (2007), four TMDLs have been completed for the segments of the South Platte River that are listed in Table 3-1, including two in Segment 14 (Bowles Avenue to Burlington Ditch), and two in Segment 15 (Burlington Ditch to Big Dry Creek). A TMDL for E. coli was also completed in Segment 14 and released for public comment in September 2006. In addition, EPA approved a TMDL for nitrate in Segment 14, with an establishment date of June 4, 2004. In Segment 15, EPA approved a TMDL for dissolved oxygen with an establishment date of July 30, 2000, and for cadmium with an establishment date of September 8, 2006.

3.5 Aquatic Life and Fisheries

The aquatic resources portion of the Chatfield Reservoir storage reallocation study is broken down to four sections and includes: 1) Chatfield Reservoir; 2) the South Platte River from the reservoir downstream to the Adams County/Weld county line; 3) tributaries draining to the Chatfield Reservoir including Plum Creek, Deer Creek, and the South Platte River upstream to Strontia Springs Reservoir; and 4) the proposed Penley Reservoir, the proposed pipeline area, and the downstream gravel pits.

Table 3-2 lists all fish species present in the aquatic study area. Special status fish species are discussed in Section 3.9.

Table 3-2
Fish Species Present In the Study Area

Family	Scientific Name	Common Name	Location [(a)]
Herrings	*Dorosoma cepedianum*	Gizzard shad*	aCR, CR
Carps/Minnows	*Campostoma anomalum*	Stoneroller*	aCR
	Cyprinus carpio	Common carp	aCR, CR, bCR
	Luxilus cornutus	Common shiner*(1)	aCR
	Notropis dorsalis	Bigmouth shiner*	aCR, bCR
	Notropis hudsonius	Spottail shiner	aCR, CR
	Notropis stramineus	Sand shiner*	aCR, bCR
	Phoxinus eos	Northern redbelly dace*	aCR
	Pimephales promelas	Fathead minnow*	aCR, CR, bCR
	Rhinichthys cataractae	Longnose dace*	aCR, CR, bCR
	Semotilus atromaculatus	Creek chub*	aCR, bCR
Suckers	*Catostomus catostomus*	Longnose sucker*	aCR, bCR
	Catostomus commersoni	White sucker*	aCR, CR, bCR
Bullhead catfishes	*Ameiurus melas*	Black bullhead*	bCR
	Ictalurus punctatus	Channel catfish*	CR, bCR
Pikes	*Esox lucius X E. masquinongy*	Tiger muskellunge	CR
Trout	*Oncorhynchus mykiss*	Rainbow trout	aCR, CR
	Salmo trutta	Brown trout	aCR, CR, bCR

Table 3-2
Fish Species Present In the Study Area

Family	Scientific Name	Common Name	Location [(a)]
Killifishes	*Fundulus sciadicus*	Plains topminnow*	aCR, bCR
Sticklebacks	*Culaea inconstans*	Brook stickleback*	aCR, bCR
Sunfishes	*Lepomis cyanellus*	Green sunfish*	CR, bCR
	Lepomis gibbosus	Pumpkinseed sunfish	CR, bCR
	Lepomis humilis	Orangespotted sunfish*	CR, bCR
	Lepomis macrochirus	Bluegill	CR, bCR
	Micropterus dolomieu	Smallmouth bass	CR, bCR
	Micropterus salmoides	Largemouth bass	CR, bCR
	Pomoxis nigromaculatus	Black crappie	CR, bCR
Perches	*Etheostoma exile*	Iowa darter*(2)	aCR, CR, bCR
	Etheostoma nigrum	Johnny darter*	aCR, bCR
	Perca flavescens	Yellow perch	CR, bCR
	Sander vitreus	Walleye	CR, bCR
Goldfish	*Carassius auratus*	Goldfish	bCR
Mosquitofish	*Gambusia affinis*	Mosquitofish	bCR

Source: Nesler 2003.

Location (a): aCR = above Chatfield Reservoir (tributaries draining to reservoir); CR = within Chatfield Reservoir; bCR = below Chatfield Reservoir

* Represents species that are native to the South Platte River drainage

(1) State Threatened

(2) State Species of Special Concern

3.5.1 Chatfield Reservoir

Chatfield Reservoir is suitable to cold-water fish species as well as cool- and warm-water species. The reservoir has a state designation of Class I for recreation and cold-water aquatic life. The Class I cold-water aquatic life designation defines acceptable water quality conditions, flow conditions, and bed material for cold-water aquatic species. While the reservoir has been generally considered to have good water quality, it is slightly eutrophic because of elevated phosphorus levels (USFWS 2006).

Chatfield Reservoir has a robust sport fish community managed by the CDOW. Important sport fish in the reservoir include walleye, yellow perch, black crappie, bluegill, smallmouth bass, largemouth bass, channel catfish, brown trout, and rainbow trout. Of these, rainbow trout, channel catfish, and walleye are stocked by the CDOW. The balance of the sport fish community is produced via natural reproduction. In addition, Chatfield Reservoir is important as one of the primary walleye brood fish and wild egg collection sources for the CDOW as approximately 25 million wild eggs are secured annually from this population for statewide stocking needs (CDOW 2005a).

Sport fish in Chatfield Reservoir are heavily reliant on certain forage species to maintain growth and population balance. Primary forage species in the reservoir include gizzard shad, spottail shiner, and crayfish. Additional forage production also comes from young-of-the-year production of certain game fish, primarily yellow perch and bluegill.

A few species native to the South Platte drainage do exist within Chatfield Reservoir and include gizzard shad, white sucker, and green sunfish. Of these species, none are recognized as sensitive, threatened, endangered, or a Species of Special Concern in Colorado and all are commonly found in many aquatic habitats throughout the state.

3.5.2 South Platte River below Chatfield Reservoir

The aquatic resources study area for the South Platte River below Chatfield is defined as the South Platte River from Chatfield Reservoir to the Adams/Weld county line. Overall riverine habitat through this section is characterized by wide, shallow, gravel riffles and long runs; there are few instream habitat structures throughout the reach (USGS 2006). This reach has little sinuosity as a large portion has been channelized by the Corps.

Relatively cool water temperatures occur in the upstream portion of the reach due to releases of cold water from the reservoir but shifts to warm-water habitat in the downstream portions of the reach. Abundance and diversity decrease downstream of the reservoir due to lower flows and sediment loading resulting in this reach having little useable habitat (USFWS 2006). This reach is also subject to highly fluctuating flow releases from the reservoir during spring runoff or during periods of demand.

The fisheries community in this reach includes a wide variety of sport fish, non-sport fish, and native fish species (Table 3-2). Sport fish include walleye, yellow perch, smallmouth bass, largemouth bass, green sunfish, orangespotted sunfish, pumpkinseed sunfish, channel catfish, black bullhead, and brown trout. Native sport species include channel catfish, green sunfish, and black bullhead (Nesler 2003).

Non-sport fish in this reach include white sucker, longnose sucker, common carp, longnose dace, fathead minnow, sand shiner, bigmouth shiner, brook stickleback, johnny darter, Iowa darter, mosquitofish, creek chub, plains topminnow, and common goldfish. Native non-sport fish include brook stickleback, fathead minnow, longnose dace, longnose sucker, white sucker, sand shiner, bigmouth shiner, johnny darter, Iowa darter, and plains topminnow (Table 3-2).

3.5.3 Tributaries Draining to the Chatfield Reservoir

The aquatic resources study area for the tributaries draining to the Chatfield Reservoir includes Plum Creek, Deer Creek, and the South Platte River from Chatfield Reservoir upstream to Strontia Springs Reservoir. The upper reach of the South Platte River is a clean, cold-water stream that has good riparian habitat and other characteristics that sustain populations of rainbow and brown trout (USFWS 2006). Other species that commonly occur in this reach include white sucker, longnose sucker, and longnose dace (Nesler 2003). The dam at Strontia Springs Reservoir, 8.88 river miles upstream of the Chatfield Reservoir, partially controls flows in this reach. Releases at the Strontia Springs dam maintain both minimum winter and summer flows (USFWS 2006).

Other major tributaries to the Chatfield Reservoir include Plum Creek and Deer Creek. The lower reach potentially impacted along Plum Creek is highly braided, with few quality pools. The lower reach of Deer Creek potentially impacted is an intermittent stream that is limited in quality of game fish habitats (USFWS 2006).

3.5.4 Penley Reservoir, Pipeline Area, and Downstream Gravel Pits

The proposed Penley Reservoir and the downstream gravel pits currently contain no water; therefore, fisheries do not currently exist in these areas. The proposed pipeline area (associated with Penley Reservoir) would likely cross Indian Creek, Rainbow Creek, Willow Creek, and their tributaries. These small, warm-water, perennial streams likely contain a mix of native and non-native warm-water fish species. Native species may include white sucker, brook stickleback, fathead minnow, and longnose dace. The streams probably do not contain significant warm-water game fish.

3.6 Vegetation

This section describes the types of vegetation that may be found in the entire study area including Chatfield Reservoir, the proposed Penley Reservoir, the proposed pipeline area, and the downstream gravel pits.

3.6.1 Chatfield Reservoir

The Chatfield Reservoir area lies at the western limits of the Great Plains Physiographic Province, with some representative vegetation from the adjacent montane ecosystem of the Rocky Mountains (USACE 2002a). Six vegetation community types occur within the study area around the reservoir: shortgrass steppe, shrubland, riparian, weedy/disturbed, landscape plantings, and wetlands. Wetlands have special characteristics that extend beyond vegetation communities and so are discussed in Section 3.7. The location and acreage of each vegetation community type is indicated on Figure 3-1. The rocky areas shown along the inside of the dam are included on the figure as a land cover type and are included in the discussion of wildlife habitat (Section 3.8). These areas are not discussed as part of the vegetation type because they are generally unvegetated. Special status plant species and rare plant communities are discussed in Section 3.9.

3.6.1.1 Shortgrass Steppe Community

The shortgrass steppe community comprises the largest acreage within the study area. This community generally occurs adjacent to riparian areas on the rolling hills and flat plateaus surrounding Chatfield Reservoir. Species typical within this community type include blue grama (*Bouteloua gracilis*), buffalograss (*Buchloe dactyloides*), western wheatgrass (*Agropyron smithii*), alyssum (*Alyssum minus*), and scarlet globemallow (*Sphaeralcea coccinea*). Several shrubs, half-shrubs, and succulents are also scattered throughout this community and include rubber rabbitbrush (*Chrysothamnus nauseosus*), fringed sage (*Artemisia frigida*), and prickly pear cactus (*Opuntia polyacantha*).

3.6.1.2 Shrubland Community

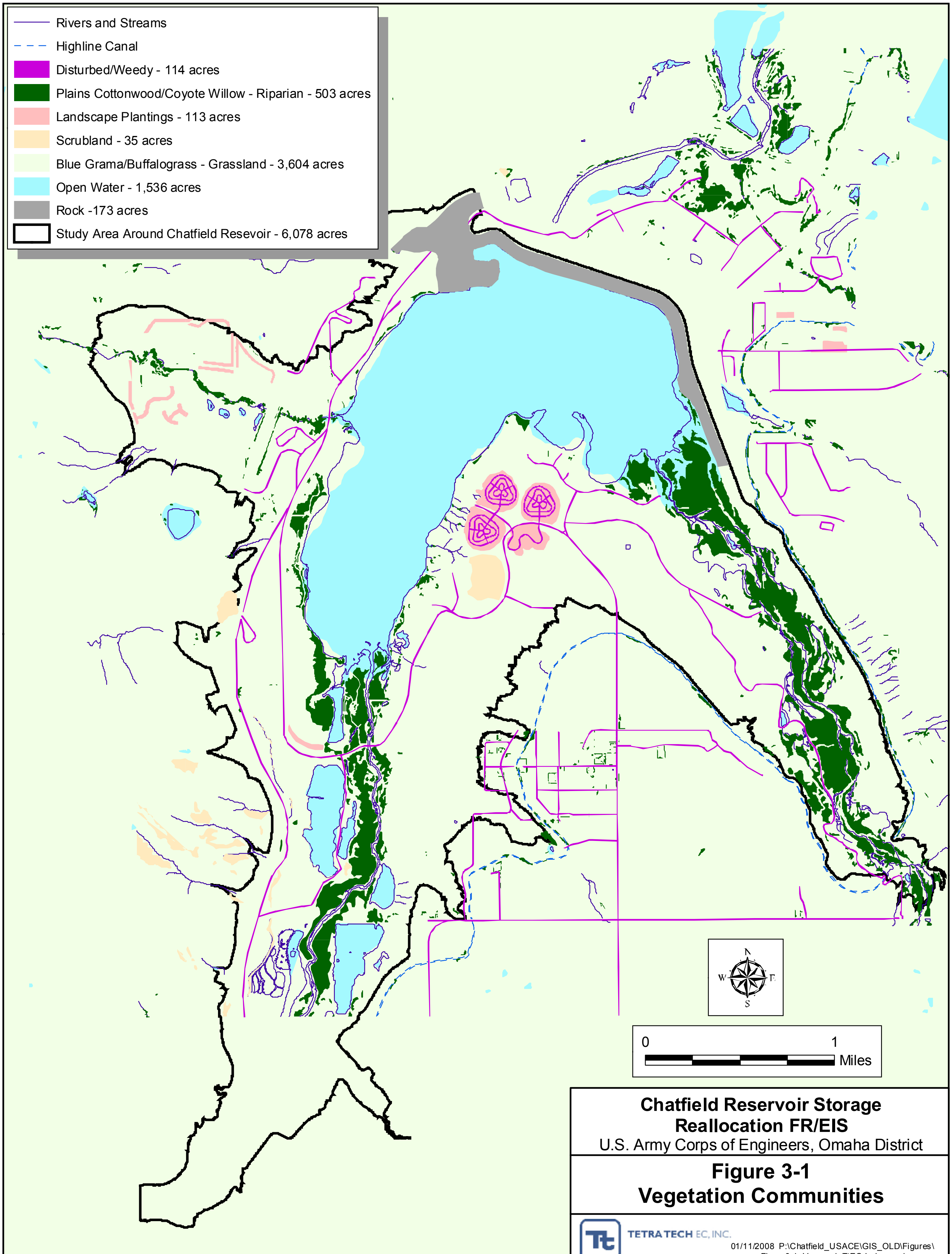
Two shrubland communities occur within the study area, the mountain mahogany (*Cercocarpos montanus*) community and a mixed deciduous shrubland community. This community is found west of Chatfield Reservoir in the transition zone from plains to montane. Plant species in this community include mountain mahogany, blue grama, prairie junegrass (*Koeleria macrantha*), mountain muhly (*Muhlenbergia montana*), scarlet globemallow, and Colorado locoweed (*Oxytropis lambertii*). The mixed deciduous shrubland community is found in the swales south of the reservoir, near the campground and along the north- and west-facing hillsides. Typical plant species in this community include chokecherry (*Prunus virginiana*), skunkbush (*Rhus trilobata*), antelope bitterbrush (*Purshia tridentata*), smooth sumac (*Rhus glabra*), blue grama, Indian ricegrass (*Oryzopsis hymenoides*), and prairie goldenrod (*Solidago missouriensis*).

3.6.1.3 Riparian Community

The cottonwood/willow riparian community occurs in association with Plum Creek, Deer Creek, and the upstream and downstream reaches of the South Platte River; their respective flood plains; and along the southwestern shoreline of Chatfield Reservoir. Most of this community consists of forested, scrub/shrub, and riverine wetlands, but open water and uplands occur as well. Sizes of this community vary from narrow bands along Deer Creek to large expanses within the drier flood plains along Plum Creek, the South Platte River, and along the southwestern shoreline of the reservoir. The canopy of this community includes species such as plains cottonwood (*Populus deltoides*), peachleaf willow (*Salix amygdaloides*), boxelder (*Acer negundo*), green ash (*Fraxinus pennsylvanica*), and narrowleaf cottonwood (*Populus angustifolia*). The shrub layer includes coyote willow (*Salix exigua*), snowberry (*Symphoricarpos occidentalis*), redtwig dogwood (*Cornus stolonifera*), and golden currant (*Ribes aureum*). The understory is dominated by a variety of herbaceous vegetation such as broad-leaved cattail (*Typha latifolia*), reed canarygrass (*Phalaris arundinacea*), and great bulrush (*Scirpus validus*). Weed species also occur within this community including Canada thistle (*Cirsium arvense*), musk thistle (*Carduus nutans*), and leafy spurge (*Euphorbia esula*). The expanse of cottonwoods along the southwestern shoreline of the reservoir and the other riparian areas within the study area along the South Platte River and Plum Creek are important habitats for migratory birds and many other species of wildlife. In general, riparian corridors provide crucial stopover habitat for birds during migration and nesting areas for many breeding birds. They also provide habitat corridors, food, and shelter for many other species of wildlife. Riparian areas are one of the most diverse and productive wildlife habitats.

3.6.1.4 Disturbed/Weedy Community

The plants within this community are weedy species that are indicative of the disturbed nature of the study area and are found where frequent and perpetual soil disturbance occurs. The construction of Chatfield Dam disturbed land to the east, south, and west of the existing reservoir. In addition, much of the South Platte River corridor through what is now Chatfield State Park was disturbed with gravel operations, which were still ongoing when portions of the park were first opened to recreation. This disturbance, coupled with the recreational use of the area, has allowed the influx of weedy species along the roadways, campgrounds, marina, old gravel mining areas, and shorelines. Native vegetation has been removed or damaged, and weedy, opportunistic species have infiltrated. Species in this community are usually annual and produce a large seed source. Plants in this community include musk thistle, leafy spurge, Canada thistle, diffuse knapweed (*Centaurea diffusa*), reed canarygrass, hoary cress (*Cardaria draba*), dalmation toadflax (*Linaria genistifolia*), and annual sunflower (*Helianthus annuus*). The weedy species are also intermixed into reclaimed areas dominated by smooth brome, crested wheatgrass (*Agropyron crisatum*), and thickspike wheatgrass (*Agropyron dasystachyum*).



Chatfield Reservoir Storage Reallocation FR/EIS

U.S. Army Corps of Engineers, Omaha District

Figure 3-1
Vegetation Communities

TETRA TECH EC, INC.

01/11/2008 P:\Chatfield_USACE\GIS_OLD\Figures\Figure3-1_Veg.mxd TtEC-Lakewood

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3.6.1.5 Landscape Plantings

A number of tree plantings have occurred throughout Chatfield State Park and have also been added to the campgrounds and surrounding recreation areas for aesthetic reasons and to provide shade, windbreaks, and privacy. These plantings, which also occur along bike trails and in parks along the South Platte River below Chatfield Reservoir, include red cedar (*Juniperus scopulorum*), ponderosa pine (*Pinus ponderosa*), green ash, locust (*Gleditsia triacanthos inermis*), and quaking aspen (*Populus tremuloides*).

3.6.2 Penley Reservoir and Pipeline Area

The proposed Penley Reservoir lies within the Great Plains Physiographic Province (USACE 2002a). Three vegetation communities occur within this area, deciduous oak, mesic upland shrub, and wetlands (Figure 3-2). Wetlands have special characteristics that extend beyond vegetation communities and so are discussed in Section 3.7. The deciduous oak and mesic upland shrub communities are described below. No agriculture use was identified. Special-status plant species and rare plant communities are discussed in Section 3.9.

The proposed pipeline area that would be associated with Penley Reservoir, if constructed, would be located to the south and east of Chatfield Reservoir in Douglas County. Based on the Colorado Gap Analysis Land Cover Map (Thompson et al. 1996), the pipelines would cross seven land cover types: deciduous oak, mesic upland shrub, tallgrass prairie, midgrass prairie, foothills/mountain grassland, dry-land crops, and irrigated crops (Figure 3-3). The vegetation associated with these land cover types is briefly described in the following paragraphs, based on Thompson et al. (1996).

3.6.2.1 Deciduous Oak Community

The deciduous oak community comprises the largest area near the proposed Penley Reservoir. Within this shrub community, Gambel oak (*Quercus gambeli*) accounts for more than 25 percent of the vegetative cover (Natural Diversity Information Source [NDIS] 2008a). Gamble oak does not occur north of Denver, but it can be found on the western slope of the Rocky Mountains into Wyoming. The main shrub species that occur are mountain mahogany (*Cercocarpus sp.*), Utah serviceberry (*Amelanchier utahensis*), Saskatoon serviceberry (*Amelanchier alnifolia*), big sagebrush (*Artemisia tridentate*), and mountain snowberry (*Symphoricarpus oreophilus*).

3.6.2.2 Mesic Upland Shrub Community

Lesser amounts of mesic upland shrub communities are found within the area of the proposed Penley Reservoir. Mesic upland community types encompass a variety of plant compositions that grow in mesic sites. Common species include, but are not limited to, Rocky Mountain maple (*Acer glabrum*), serviceberry (*Amelanchier* sp.), and chokecherry. Mesic shrub species make up over 25 percent of this plant community (NDIS 2008a).

3.6.2.3 Tallgrass Prairie

Tallgrass prairie is also referred to as “true prairie”. This grassland habitat received the most rainfall of the grassland types in the central plains. The vegetation in this habitat is predominantly bunch grasses, sod-forming grasses, and long-lived perennials. The dominant grass species are big bluestem (*Andropogon gerardii*), Indian grass (*Sorghastrum nutans*), and little bluestem (*Schizachyrium scoparium*).

3.6.2.4 Midgrass Prairie

This habitat type is a mix of tallgrass and shortgrass prairie and has the greatest plant diversity of the grassland types in the central plains. The dominant plant species in midgrass prairie habitat include: sideoats grama (*Bouteloua curtipendula*), galleta (*Hilaria jamesii*), foxtail barley (*Hordeum jubatum*), western wheatgrass, bluebunch wheatgrass (*Pseudoregeneria spicata*), little bluestem, New Mexico feathergrass (*Stipa neomexicana*), and green needlegrass (*Stipa viridula*).

3.6.2.5 Foothills/Mountain Grasslands

This habitat type occurs on steep south-facing slopes in Douglas-fir and ponderosa pine (Thompson et al. 1996). Typical plant species include Parry's oatgrass (*Danthonia parryi*), Arizona fescue (*Festuca arizonica*), Idaho fescue (*Festuca idahoensis*), Thurber's fescue (*Festuca thurberi*), slimstem muhly (*Muhlenbergia filiculmus*), mountain muhly, and bluebunch wheatgrass.

3.6.2.6 Dryland Agriculture

This habitat type includes non-irrigated cropland; fallow lands; dryland improved pastures; and rural development, farm and ranch facilities, and shelter belts. Crops that are characteristic of this land include: wheat, barley, rye, and small grains.

3.6.2.7 Irrigated Agriculture

This habitat type includes any irrigated agricultural land. Typical crops of this land type include: corn, beans, row crops, irrigated hayfields, and pastures.

3.6.3 Downstream Gravel Pits

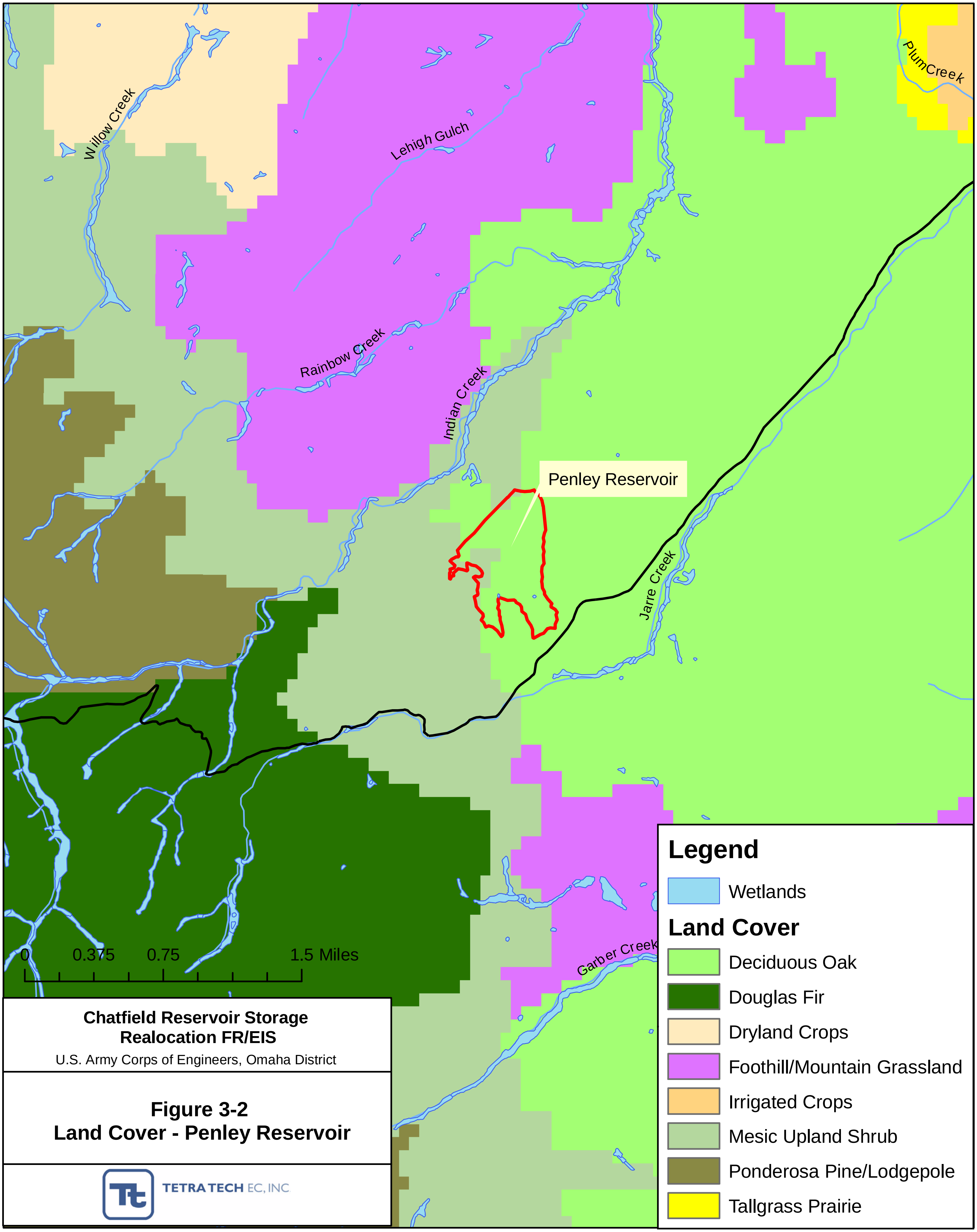
The downstream gravel pits that would be developed into water storage as part of Alternatives 1, 2, and 4 are located within the Great Plains Physiographic Province (USACE 2002a). These areas are currently highly disturbed due to ongoing gravel extraction, and are currently believed to be unvegetated; however, they occur near a variety of wetland habitat types. The previous classification of this land is irrigated crop or dry-land crop (Figures 3-4, 3-5, and 3-6). [Note: Figure 3-4 will be revised when information is available on Brighton's replacements.]

3.7 Wetlands

This section describes the types of wetlands that may be found in the study area, including Chatfield Reservoir, the proposed Penley Reservoir, the proposed pipeline area, and the downstream gravel pits.

3.7.1 Chatfield Reservoir

Wetland systems can occur within any of the other vegetation communities discussed in Section 3.6. Wetlands are a productive and biologically diverse type of ecosystem. They serve many different functions including providing habitat for many different species of aquatic and terrestrial wildlife, protecting and improving water quality, storing floodwaters, protecting shorelines, recharging groundwater aquifers, and maintaining surface water flow during dry periods. Wetlands also serve as transitional areas or ecotones between terrestrial and aquatic systems.



Chatfield Reservoir Storage Realocation FR/EIS

U.S. Army Corps of Engineers, Omaha District

Figure 3-2
Land Cover - Penley Reservoir

TETRA TECH EC, INC

Land Cover obtained from: United States Geological Survey. 2007. Available at http://gapanalysis.nbii.gov.
Wetlands obtained from: Colorado Division of Wildlife. 2007. Available at http://ndis.nrel.colostate.edu.

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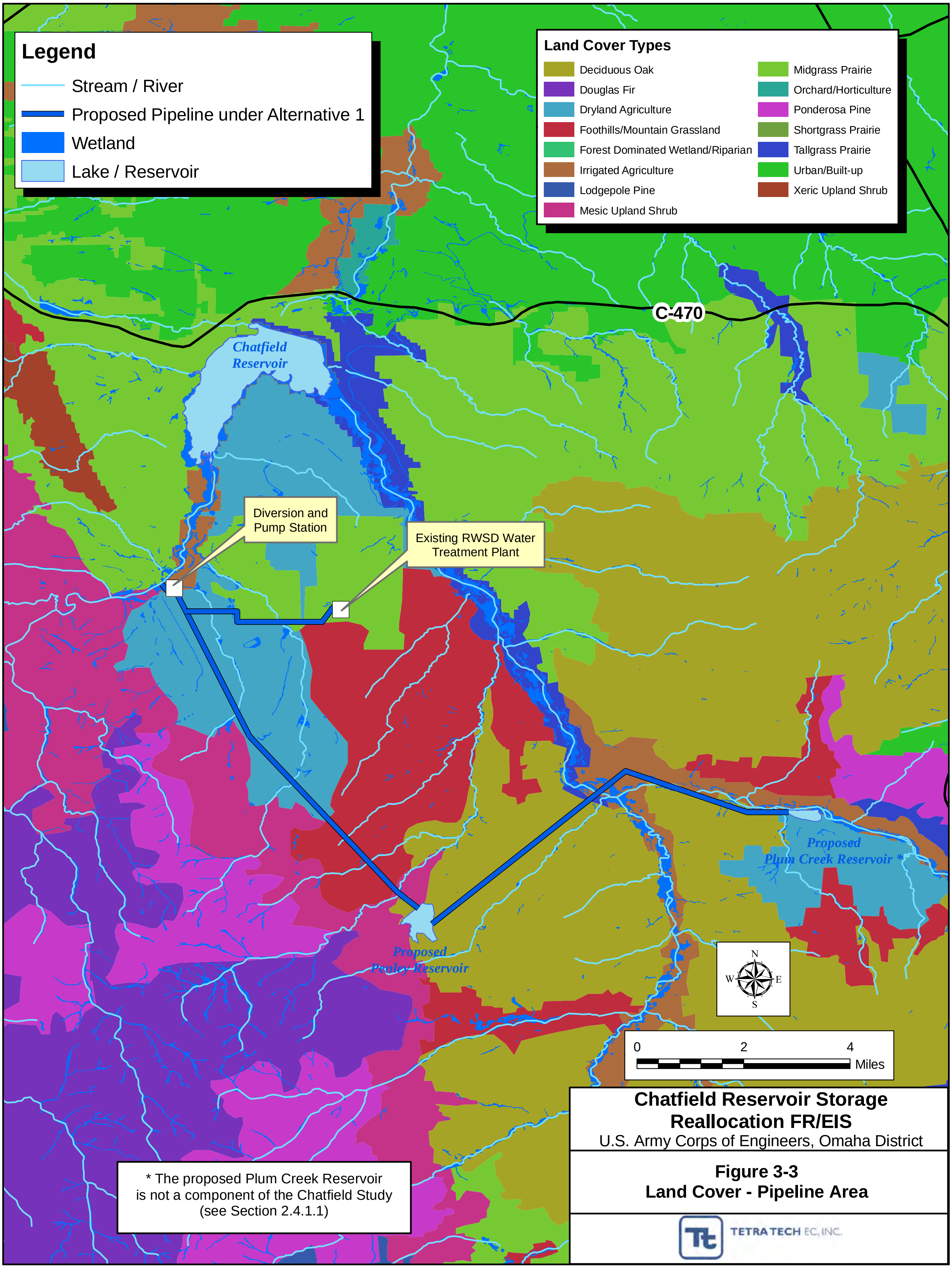

Chatfield Reservoir Storage Reallocation FR/EIS

U.S. Army Corps of Engineers, Omaha District

Figure 3-3
Land Cover - Pipeline Area

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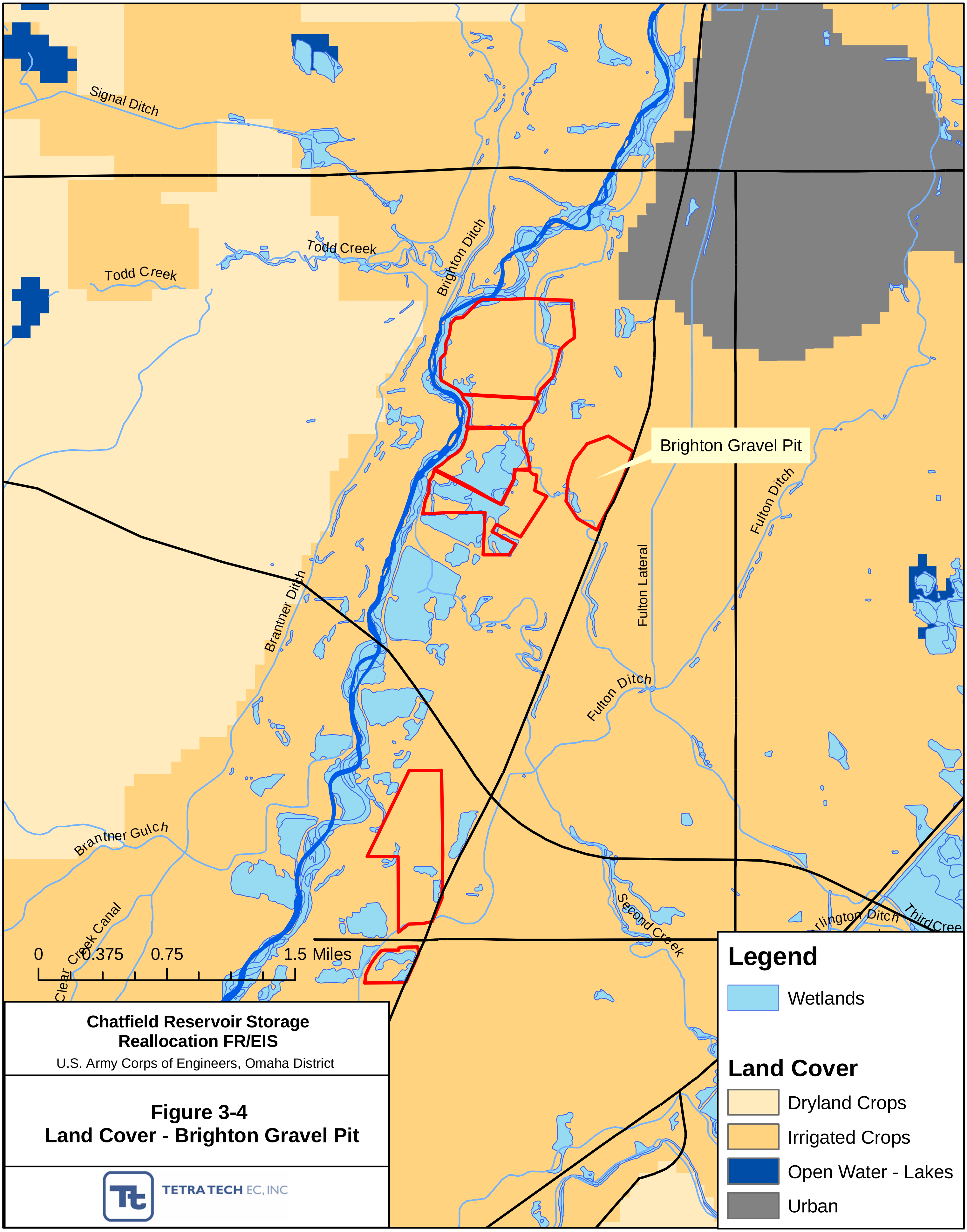

Chatfield Reservoir Storage Reallocation FR/EIS

U.S. Army Corps of Engineers, Omaha District

Figure 3-4
Land Cover - Brighton Gravel Pit

TETRA TECH EC, INC

Land Cover obtained from: United States Geological Survey. 2007. Available at http://gapanalysis.nbii.gov.
Wetlands obtained from: Colorado Division of Wildlife. 2007. Available at http://ndis.nrel.colostate.edu.

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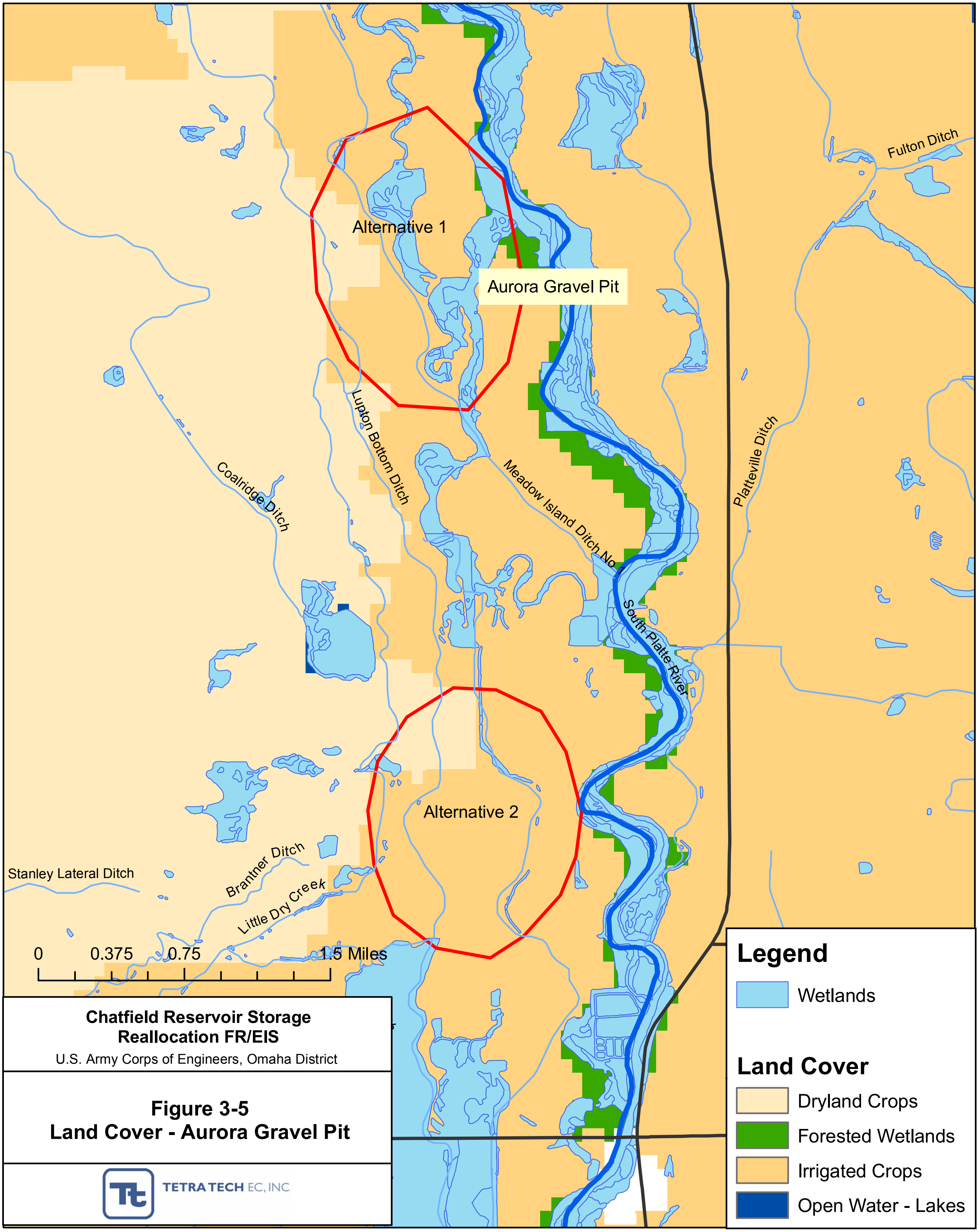

Chatfield Reservoir Storage Reallocation FR/EIS

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Figure 3-5
Land Cover - Aurora Gravel Pit

TETRA TECH EC, INC

Land Cover obtained from: United States Geological Survey. 2007. Available at http://gapanalysis.nbii.gov.
Wetlands obtained from: Colorado Division of Wildlife. 2007. Available at http://ndis.nrel.colostate.edu.

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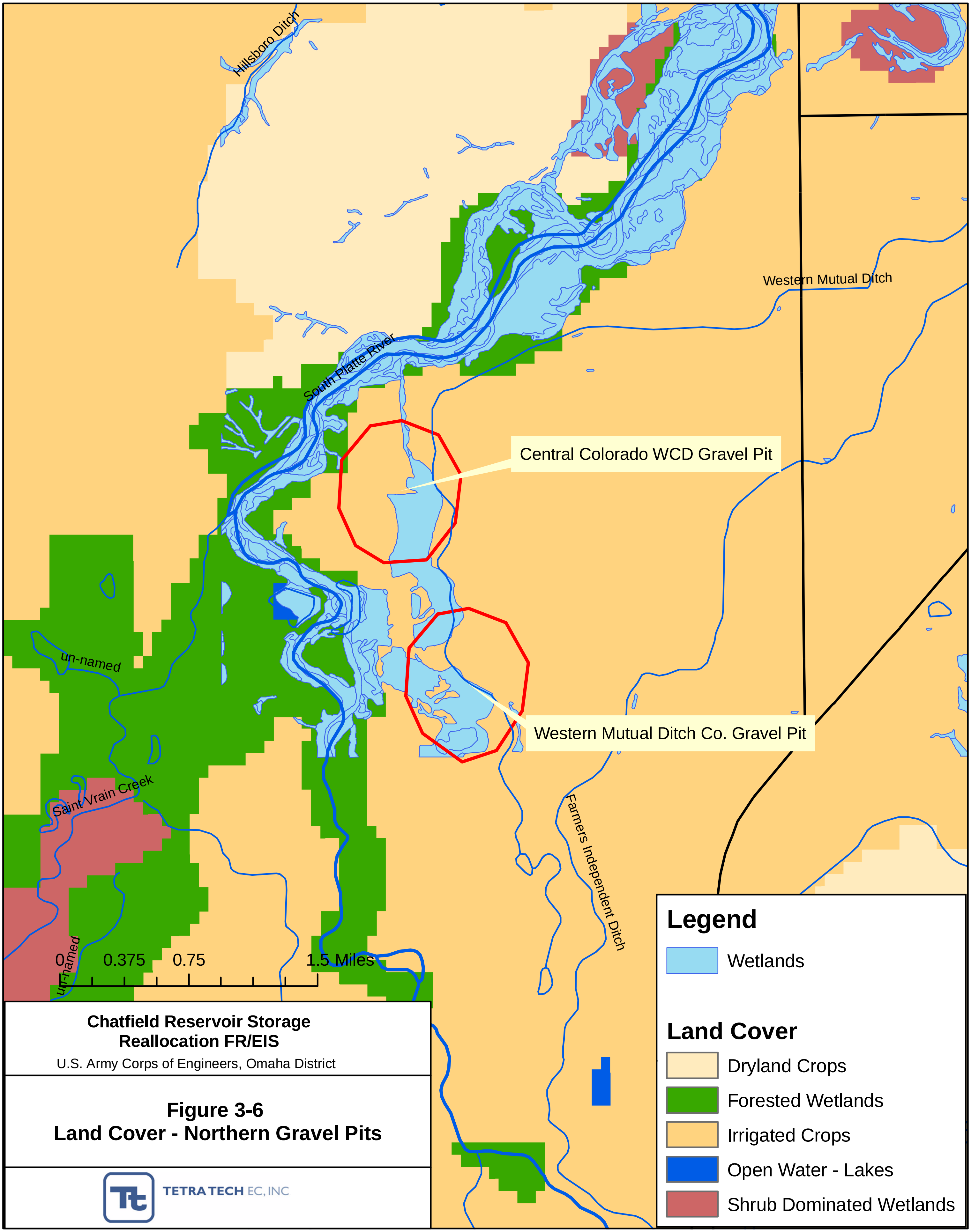

Chatfield Reservoir Storage Reallocation FR/EIS

U.S. Army Corps of Engineers, Omaha District

Figure 3-6
Land Cover - Northern Gravel Pits

Land Cover obtained from: United States Geological Survey. 2007. Available at http://gapanalysis.nbii.gov.
Wetlands obtained from: Colorado Division of Wildlife. 2007. Available at http://ndis.nrel.colostate.edu.

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The variety of hydrology and topography within the study area provides a range of wetland types including riverine, palustrine, and lacustrine. The riverine system includes all wetlands and deepwater habitats contained within a channel. The riverine system is bounded on the landward side by upland, by the channel bank (including natural and man-made levees), or by wetlands dominated by trees, shrubs, and persistent emergents such as cattails (Cowardin et al. 1979). There are two types of riverine systems within the study area: lower perennial (i.e., slow-flowing waters) and upper perennial (i.e., fast-moving and swift-flowing waters).

The palustrine system consists of forested wetlands dominated by trees, scrub/shrub wetlands dominated by shrubs, and emergent wetlands dominated by non-woody species that are outside tidal influences (Cowardin et al. 1979). This system is found in association with the adjacent flood plain wetland pockets along Plum Creek, Deer Creek, the South Platte River upstream and downstream of the reservoir, shorelines of the various ponds to the south of Chatfield Reservoir and to the west of the South Platte River, and natural or human-made depressions near and adjacent to the reservoir itself.

The lacustrine system includes wetlands and deepwater habitats situated on a topographic depression. This system lacks trees, shrubs, and persistent emergents with greater than 30 percent cover, and the total area exceeds 20 acres in size (Cowardin et al. 1979). Chatfield Reservoir is categorized as a lacustrine system, as are the ponds that occur south of the reservoir and west of the upstream section of the South Platte River, and additional scattered ponds along the river downstream of the reservoir. These lacustrine systems are important fisheries in the study area.

National Wetland Inventory (NWI) maps provide reconnaissance level data for site investigations and an approximation of wetland areas. Furthermore, they do not provide jurisdictional boundaries for wetlands. In order to gain a firm understanding of impacts to wetlands from the proposed project from a regulatory standpoint, wetlands within the study area were mapped in the field and from aerial photography by investigating hydric characteristics. USACE (1987) characterizes wetlands as those areas containing hydrophytic vegetation, hydric soils, and wetland hydrology. Many areas identified on NWI maps do not meet this stricter definition.

Within the study area, biologists mapped areas that met all three of the wetland characteristics (wetland areas) in areas that are proposed to be affected by the project surrounding Chatfield Reservoir. Wetland areas were grouped into five main categories: emergent, submergent, scrub/shrub, forested, and seasonal wetlands. These categories were developed with input from the USACE and include natural or man-made wetlands. These categories follow Cowardin classification (Cowardin et al. 1979). Additional categories were added to enhance wetland mapping and include "Other" and "Uplands."

Emergent wetlands include all areas dominated by rooted herbaceous plant species that extend above the water or hydric soils. These include areas within riverine and palustrine systems and typically include such plant species as sedges (*Carex* sp), rushes (*Juncus* sp), or cattails (*Typha* sp). In Plum Creek, invasive wetland species including reed canarygrass (*Phalaris arundinacea*) and common reed (*Phragmites australis*) are prevalent in emergent wetlands as well as wetlands with woody vegetation. Submergent wetlands are those areas below the water along shallow shorelines of lacustrine systems. Typical aquatic plants of shorelines within eastern Colorado are coon's tail (*Ceratophyllum demersum*) and native milfoil (*Myriophyllum* sp.). One off-channel pond along the South

Platte River supports the noxious weed, Eurasian water milfoil (*Myriophyllum spicatum*). Scrub/shrub areas support woody vegetation including hydrophytic trees and shrubs that extends above the water or hydric soils. Common plant species include coyote willow (*Salix exigua*) and peach-leafed willow (*Salix amygdaloides*). The woody vegetation does not need to be dominant, but must be at least present over 30 percent of the vegetative cover. Forested wetlands include trees of 20 feet or higher. Typical plant species include narrow-leaved cottonwood (*Populus angustifolia*) and plains cottonwood (*Populus sergentii*). Seasonal wetland areas are found along the shoreline of the reservoir and include areas that are flooded frequently due to reservoir operations. These areas have sandy soils and support hydrophytic vegetation seasonally, but are greatly influenced from year to year by fluctuating water levels. Typical species can include sprangletop (*Leptochloa fascicularis*), toad rush (*Juncus bufonius*) and pigweed (*Amaranthus* sp.).

The majority of natural wetlands in the study area occur adjacent to Plum Creek and the South Platte River. Forested wetlands and scrub/shrub wetlands dominate the drainages upstream and downstream of the reservoir along the Plum Creek and South Platte River. Figures 3-7, 3-8, and 3-9 illustrate wetlands designated by NWI. Appendix E supplements these figures and includes 11 maps and associated table taken from the Draft Existing Conditions Report for Biological Resources (Foster Wheeler 2000a) that illustrate NWI wetlands and deepwater habitats by type.

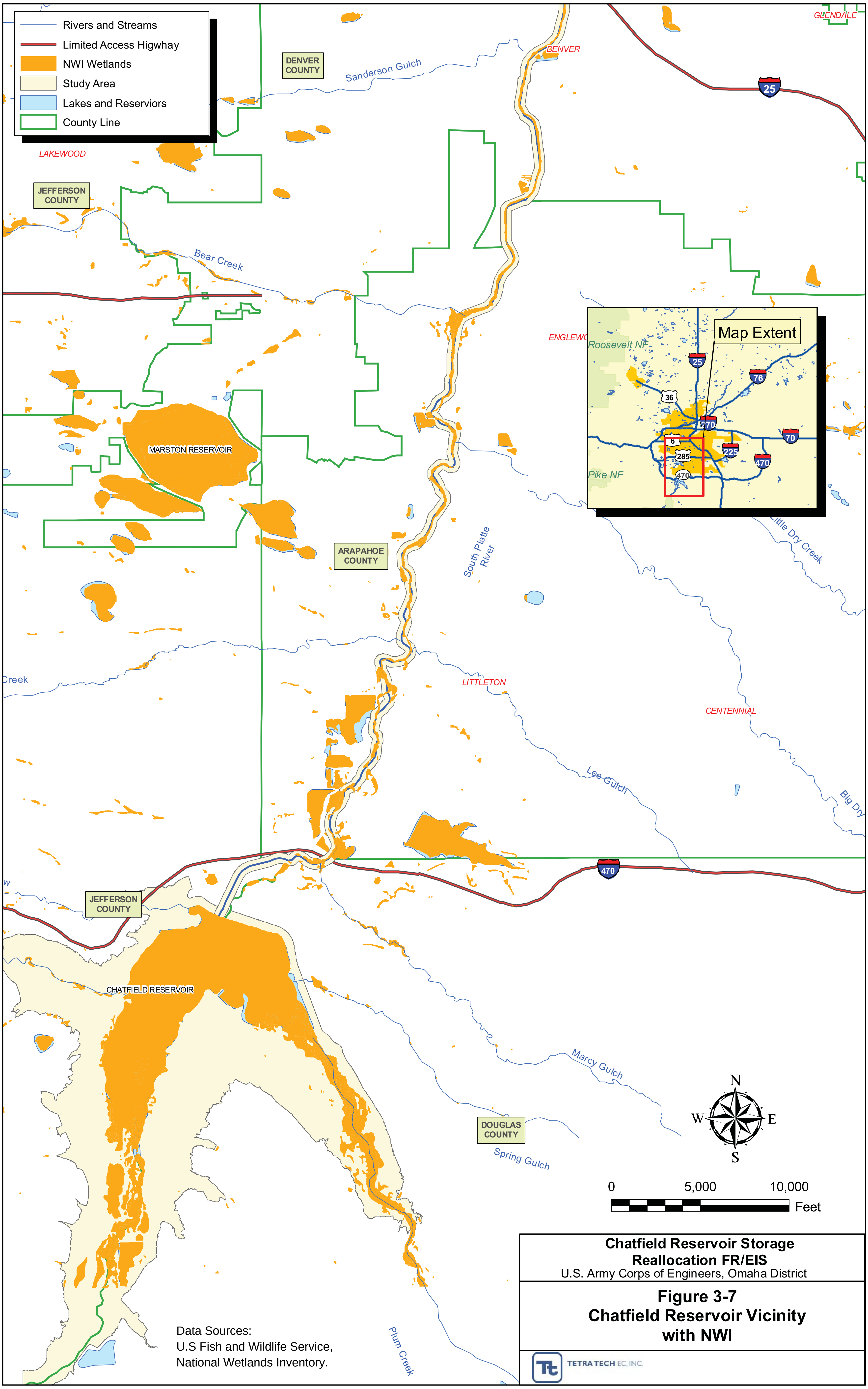
In addition to naturally occurring wetlands, approximately 20 acres of wetlands have been created upstream of the reservoir west of the South Platte River through a partnership of the Colorado Department of Transportation, CDOW, Colorado State Parks, Denver Water, Ducks Unlimited, Martin Marietta Astronautics, and USACE. Appendix E includes additional information on wetlands.

3.7.2 Penley Reservoir and Pipeline Area

Two small wetlands are located near the proposed Penley Reservoir; however, these areas were classified as non-riparian upland grass and upland shrub by Natural Diversity Information Source (NDIS) (2007, Figure 3-2). Pipelines associated with Penley Reservoir, if constructed, would likely cross numerous wetland types including those associated with Indian Creek, Rainbow Creek, Willow Creek, and their tributaries.

3.7.3 Downstream Gravel Pits

The downstream gravel pits proposed as part of Alternatives 1 and 2 all occur within close proximity to the South Platte River and therefore occur near a wide variety of wetland habitat types (NDIS 2007). The Brighton Gravel Pit area is located within riparian habitats classified as deciduous cottonwood, herbaceous grasses, willow shrub, and open water (Figure 3-4). The Aurora Gravel Pit area contains herbaceous grasses, deciduous cottonwood, willow shrub, and open water riparian habitats (Figure 3-5). The Western Mutual Ditch Company and Central Colorado WSD Gravel Pit areas contain herbaceous grasses, deciduous cottonwood, and open water (Figure 3-6). All of these gravel pits were previously agricultural land and are currently being mined for gravel. As a result, wetland vegetation may no longer exist in these areas.



Chatfield Reservoir Storage Reallocation FR/EIS
U.S. Army Corps of Engineers, Omaha District

Figure 3-7
Chatfield Reservoir Vicinity with NWI

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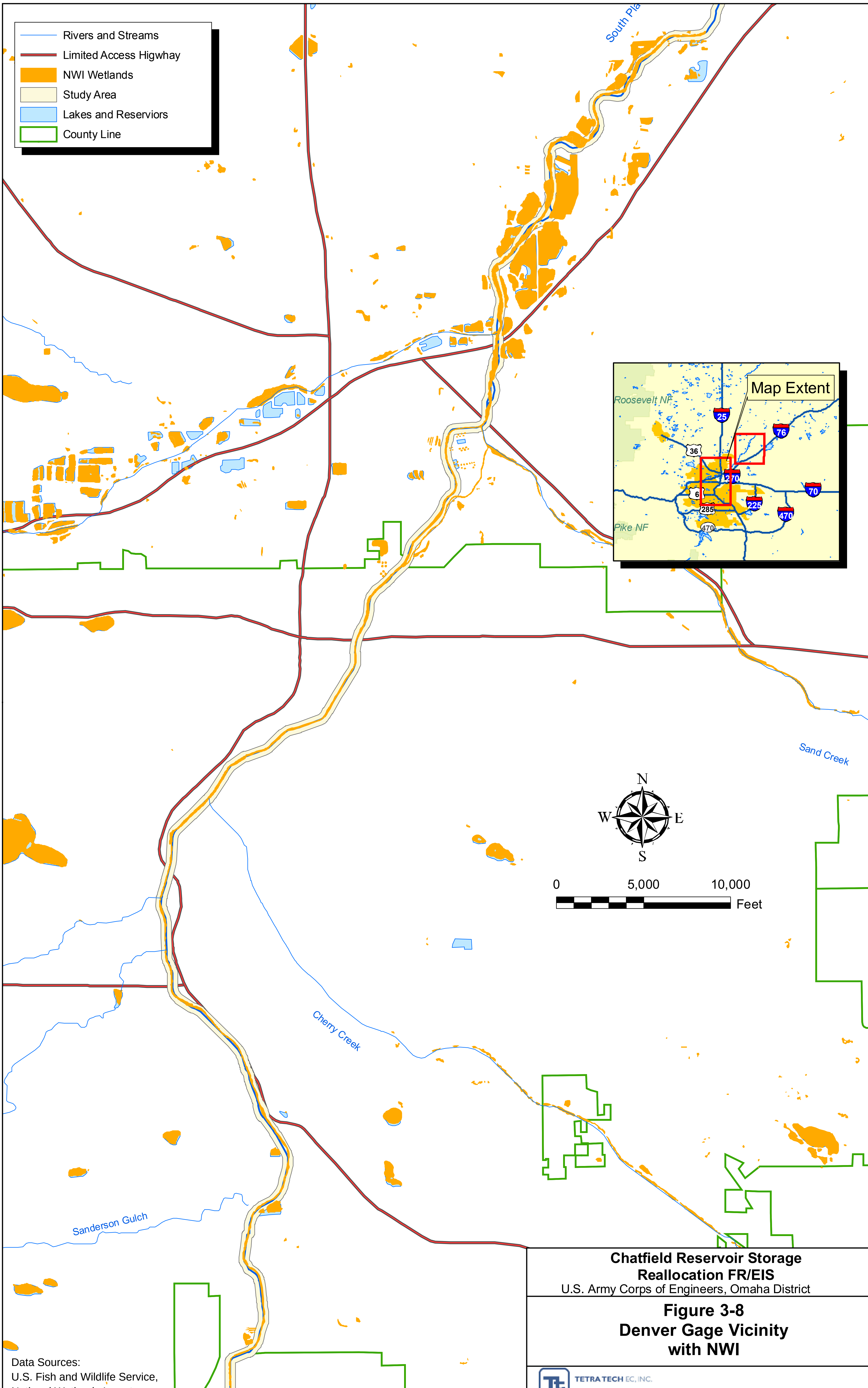

Chatfield Reservoir Storage Reallocation FR/EIS

U.S. Army Corps of Engineers, Omaha District

Figure 3-8
Denver Gage Vicinity with NWI

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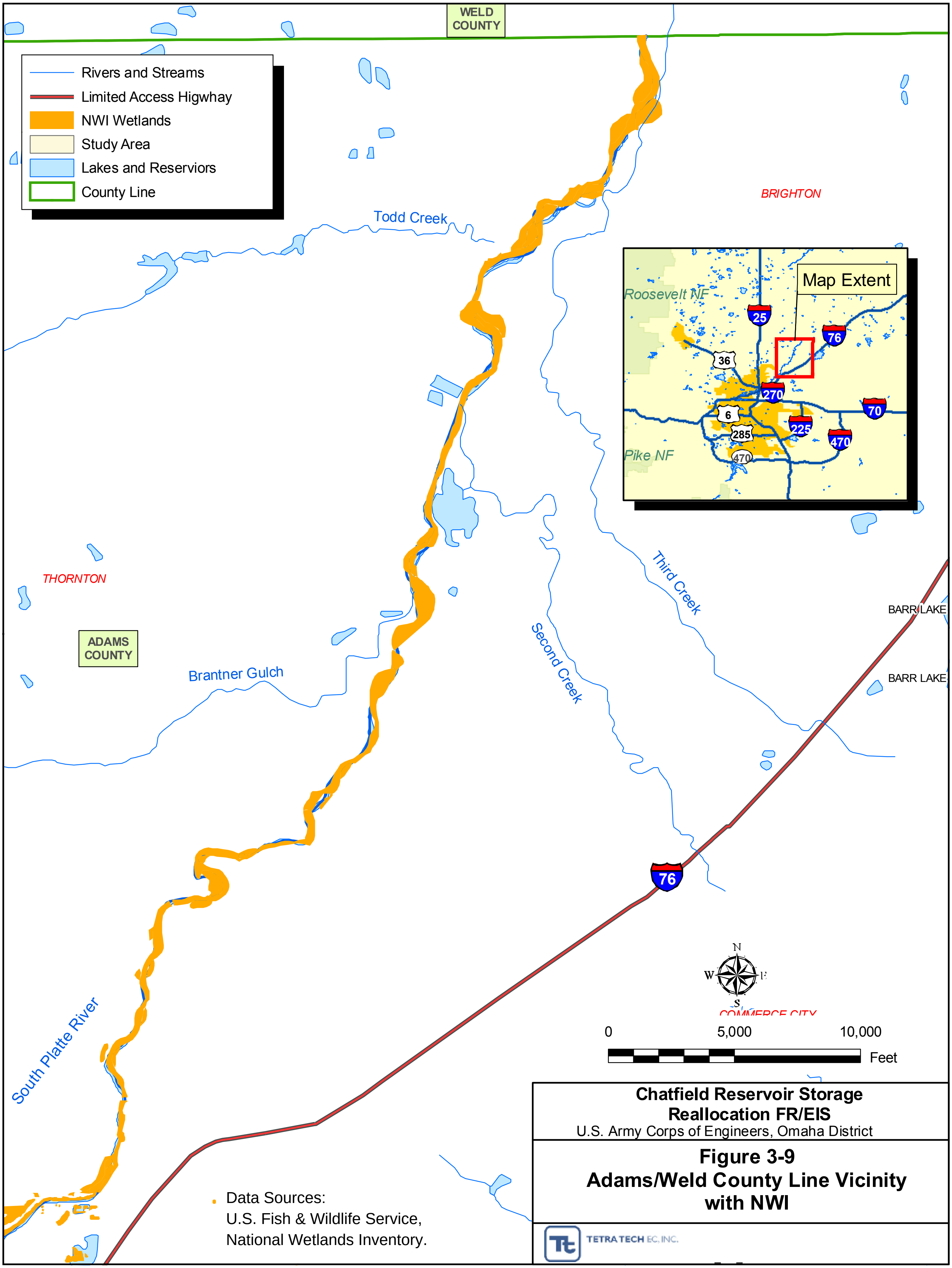

Chatfield Reservoir Storage Reallocation FR/EIS

U.S. Army Corps of Engineers, Omaha District

Figure 3-9
Adams/Weld County Line Vicinity with NWI

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3.8 Wildlife

This section describes the types of wildlife that may be found in the study area, including Chatfield Reservoir, the proposed Penley Reservoir, the proposed pipeline area, and the downstream gravel pits.

3.8.1 Chatfield Reservoir

Wildlife habitats within the study area include grasslands, shrubland, open water, rocky areas, landscaped/disturbed areas, and riparian areas, which include wetlands. Wildlife known to occur within the study area are listed in Appendix F. Common large mammals present in the study area include mule deer and white-tailed deer. Riparian habitats provide essential cover and browse for these species, and grasslands and scrublands are used as forage areas in the early mornings and evenings. Mule deer also use the landscaped areas in the winter when other browse is sparse. Mule deer activity within the study area includes concentration areas west, northeast, and south of Chatfield Reservoir. Winter concentration areas and severe winter range lie west of the study area within the foothills west of Denver, and summer range lies west and south of the study area (CDOW 2005a). Appendix F provides additional information on wildlife in the area.

Resident populations of elk occur south of the study area, but elk activity occurs throughout the study area. Winter and severe winter ranges occur southwest and west of the study area. According to CDOW, range coverage for elk is associated with montane meadows, scrublands, and forests west and south of the study area (CDOW 2005a).

Large carnivores in the area include black bear, bobcat, and mountain lion. Black bear are not common within the study area, but may wander into the vicinity in search of food. Suitable black bear habitat lies in the foothills to the west of Chatfield Reservoir. Mountain lions and bobcat may also occur around Chatfield Reservoir. Both cats occur in rocky, broken land of the foothills and canyonlands, preferably in pinyon-juniper woodlands, shrublands, and montane forests (CDOW 2008a).

Avian predators, such as raptors and owls, occur within the study area. Species most commonly observed during the breeding season include Swainson’s hawks, red-tailed hawks, and great-horned owls. These species nest in large trees that surround Chatfield Reservoir; however, they can be sensitive to human activity so nests may be uncommon. Avian predators are long-lived species with low reproductive rates and will reuse a nest for multiple years.

Grasslands dominate most of the habitat in the study area and occur in upland areas surrounding Chatfield Reservoir. These areas provide habitat for a variety of wildlife species including mammals, birds, reptiles, amphibians, and invertebrates. Common species include western meadowlark, red-tailed hawk, coyote, raccoon, mule deer, white-tailed deer, western fence lizard, and the six-lined racerunner.

Pockets of scrubland habitat are interspersed in swales in the upland habitat surrounding Chatfield Reservoir. This habitat is generally more mesic than the grassland habitat and provides cover for several species of wildlife including mule deer, white-tailed deer, raccoon, and a variety of bird species.

Open water habitat occurs as Chatfield Reservoir, ponds located south of the reservoir and west of the South Platte River, and the flowing water portions of Deer Creek, Plum Creek, and the South Platte River. Open water provides habitat for several species of waterfowl, shorebirds, and amphibians. Common bird species that use open water habitat include double-crested cormorant, white pelican, mallard, Canada goose, California gull, and great blue heron. Waterfowl that are relatively common in open water habitats during spring or fall migration include pied-billed grebe, eared grebe, western grebe, gadwall, northern shoveler, green-winged teal, common goldeneye, and common merganser (Kellner and Spencer 2006). Rocky areas occur primarily as riprap along the northeast and east sides of Chatfield Reservoir. This riprap was placed along the dam to counteract the effects of erosion and scouring that can result from wave action. These areas may provide habitat for small mammals (e.g., deer mouse [*Peromyscus maniculatus*], meadow vole [*Microtus pennsylvanicus*]), amphibians (e.g., tiger salamander [*Ambystoma tigrinum*], western chorus frog [*Pseudacris triseriata*], northern leopard frog [*Rana pipiens*]), and invertebrates (various species of crayfish and aquatic insects).

Landscaped/disturbed areas such as picnic areas, campgrounds, concession areas, parking lots, and wildlife viewing areas occur in developed areas of Chatfield State Park and along the South Platte River. These areas most likely do not provide significant habitat for wildlife although several species of wildlife may be found in these areas on a temporary basis.

Riparian habitats are biologically diverse and productive ecosystems and provide several important ecological functions including providing food, water, and cover for resident and migratory wildlife species. Riparian habitats occur along the shoreline of the reservoir; along Plum Creek, Deer Creek, and the South Platte River as they flow into Chatfield Reservoir; and along the South Platte River downstream throughout the study area to the Adams/Weld county line. Cover in riparian habitats is predominantly provided by cottonwood trees around Chatfield Reservoir with lesser amounts of other tree species. Along with willow shrubs, trees create riparian woodlands stretching out along the river and stream floodplains. These woodland areas are particularly important to songbirds and many mammalian species and often support many wildlife species for at least some part of their life cycle. Numerous species of birds (including raptors, waterfowl, shorebirds, and songbirds), mammals, reptiles, and amphibians all use the biologically diverse riparian habitats. Suitable habitat for the federally threatened Preble's meadow jumping mouse includes well-developed riparian woodlands and wetland areas. This and other special status species are further discussed in Section 3.9.

Riparian habitats create natural connectivity or travel corridors for wildlife due to their linear nature. Conservation biologists researching species viability and the design and configuration of conservation reserves have found that connectivity between reserves increases dispersal, allows genetic interchange, provides avenues for nearby meta-populations to recolonize reserves, and improves overall population viability (Beier and Noss 1998; Beier and Loe 1992; Sondgerath and Schroder 2002). In addition to federally listed as threatened or endangered bird species discussed in Section 3.9, the USFWS has identified birds of conservation concern (BCC) and in greatest need of conservation action, by region (USFWS 2002). Among those listed in USFWS Region 6, the Mountain-Prairie Region, that have been confirmed to occur within the study area are:

- Northern harrier (*Circus cyaneus*)

- Swainson's hawk (*Buteo swainsoni*)
- Ferruginous hawk (*Buteo regalis*)
- Golden eagle (*Aquila chrysaetos*)
- Peregrine falcon (*Falco peregrinus*)
- Prairie falcon (*Falco mexicanus*)
- Solitary sandpiper (*Tringa solitaria*)
- Upland sandpiper (*Bartramia longicauda*)
- Stilt sandpiper (*Calidris himantopus*)*
- Long-billed curlew (*Numenius americanus*)
- Marbled godwit (*Limosa fedoa*)
- Wilson's phalarope (*Phalaropus tricolor*)
- Short-eared owl (*Asio flammeus*)
- Lewis's woodpecker (*Melanerpes lewis*)
- Red-headed woodpecker (*Melanerpes erythrocephalus*)
- Loggerhead shrike (*Lanius ludovicianus*)
- Virginia's warbler (*Vermivora virginiae*)
- Cassin's sparrow (*Aimophila cassinii*)
- Brewer's sparrow (*Spizella breweri*)
- Harris's sparrow (*Zonotrichia querula*)*
- Grasshopper sparrow (*Ammodramus savannarum*)

*Species is on National BCC List, not USFWS Region 6 BCC List

All of the species above are migratory and could seasonally be found in the study area. However, only Swainson's hawk is likely to breed regularly in the study area.

Chatfield Reservoir and the South Platte River are also important areas for waterfowl. The following species of waterfowl are on the USFWS list of "Birds of Management Concern/Game Birds Below Desired Condition" (USFWS 2004b) and have been confirmed at South Platte Park: canvasback (*Aythya valisineria*), ring-necked duck (*Aythya collaris*), wood duck (*Aix sponsa*), mallard (*Anas platyrhynchos*), northern pintail (*Anas acuta*), redhead (*Aythya americana*), greater scaup (*Aythya marila*), and lesser scaup (*Aythya affinis*). Of these waterfowl species, wood duck and mallard have been confirmed as nesting at South Platte Park (South Platte Park 2008).

The riparian areas within Chatfield State Park, along the tributaries of Chatfield Reservoir, and adjacent to the South Platte River provide important habitat for numerous species of migratory birds during the breeding season, nesting season, spring and fall migration, and winter. Chatfield State Park has been documented as a swallow staging and feeding area during spring migration, and the reservoir itself attracts large numbers of waterfowl during spring and fall migration. Chatfield State Park also hosts the largest populations of breeding American redstarts and least flycatchers in Colorado (Audubon Colorado 2004).

Because this area offers important habitat to many different species of birds, Chatfield State Park has been designated as an Important Bird Area (IBA) by Audubon Colorado (Audubon Colorado 2004). An IBA is a site that provides essential habitat to one or more bird species during some portion of the year, including breeding season, migration, and/or winter. Chatfield State Park meets four of the five IBA criteria, including (1) being important to endangered or threatened species in

Colorado; (2) containing rare or unique habitat that holds important species or species assemblages largely restricted to a distinctive habitat type; (3) significant numbers of birds concentrate for breeding, during migration, or in the winter (waterfowl, heronries, and landbirds); and (4) the site is important for long-term research and/or monitoring projects that contribute substantially to ornithology, bird conservation, and/or education.

To gain a better understanding of migratory bird habitat use in the study area, biologists consulted with members of the Audubon Society of Greater Denver, who in turn provided contact information for bird data for the Chatfield study area. Observations of birds at Chatfield State Park have been recorded by a number of sources, including Joey Kellner, Hugh Kingery, Rocky Mountain Bird Observatory (RMBO), CDOW, and Bioblitz (Kellner 2006; Bonnell 2006a, 2006b; RMBO 2006; CDOW 2006; and Colorado Urban Wildlife Partnership 2006, 2007). Collectively these sources report a total of 351 species of birds that have been observed at Chatfield State Park. Some of the most commonly seen species during the breeding season (May through July) are double-crested cormorant, great blue heron, mallard, killdeer, belted kingfisher, rock dove, mourning dove, western kingbird, black-billed magpie, American crow, tree swallow, violet-green swallow, barn swallow, cliff swallow, black-capped chickadee, house wren, American robin, European starling, yellow warbler, common yellowthroat, yellow-breasted chat, song sparrow, red-winged blackbird, western meadowlark, common grackle, and brown-headed cowbird (Kellner 2006). Chatfield is home to the largest breeding populations of American redstarts and least flycatchers in Colorado (Audubon Colorado 2007).

The most recent bird checklist for Chatfield State Park (Colorado State Parks 1998) indicates that there are a total of 345 species that have been observed at the park. This includes 83 species that are summer or year-round residents, 23 additional species that spend the winter at Chatfield, and 98 species that are migrants. About 141 species are reported as "Infrequently Seen." Thirty species were not reported on the Chatfield State Park list that were reported from the other sources cited above. Thus, the total number of species observed at Chatfield based on all of these sources is 375 species.

In addition and at the request of USFWS, biologists conducted point count surveys (50-meter radius) in three types of riparian habitats in June 2006 (see Appendix Q). This information was used to better characterize breeding birds in riparian areas likely to be affected by the proposed project including herbaceous wetlands/non-woody areas, riparian shrublands, and cottonwood forest. Twelve point count stations (50-meter radius) were established in these three habitat types; each type having four stations each. Wetland/non-woody areas included herbaceous wetlands, mudflats, and backwaters that were associated with riparian areas. Riparian shrublands included areas dominated by coyote willow. Tree-dominated areas included successional and mature forest types. Successional forest types included cottonwood, box elder, and narrow-leaf cottonwood forests that are even aged or simply smaller in stature. Mature forest types were comprised of large cottonwood trees that represent mature bottomland forest. The mature forests are restricted to areas along the South Platte River.

The findings in Table 3-3 are based on one breeding season of field data (2006; see Appendix Q) and information from Audubon Society of Greater Denver. Additional years of field data would increase precision. Field data were summarized by calculating averages of species richness, abundance, and diversity. A dominant species is listed for each habitat type.

Table 3-3
Breeding Bird Ecological Parameters[1] by Riparian Habitat Type

Habitat Type	Species Richness	Abundance (# per ha)[5]	Diversity[2]	Dominant Species[3]
Wetlands	7.13	14.16	8.87	Red-winged blackbird or common yellowthroat[4]
Shrublands	7.88	18.30	9.90	Song sparrow, spotted towhee
Woodlands	6.75	14.64	12.37	Yellow warbler, hairy woodpeckers, great horned owls

[1] Parameter values are averages; n = 8
[2] Simpson's Reciprocal Index of Diversity
[3] Dominant species observed during June 2006 surveys
[4] Cattail dominated or sedge/rush dominated, respectively
[5] 1 hectare (ha) equals approximately 2.5 acres.

Based on the results of the June 2006 point count surveys, a total of 43 bird species was identified in at least one of the riparian habitat types. Riparian shrublands comprised the greatest variety of species (species richness = 7.88, Table 3-3, Figure 3-10) and had the greatest number of birds per area. Woodlands had the lowest variety of species, but the species present tended to be relatively even in abundance resulting in the greatest diversity of the three habitat types sampled (Figure 3-10).

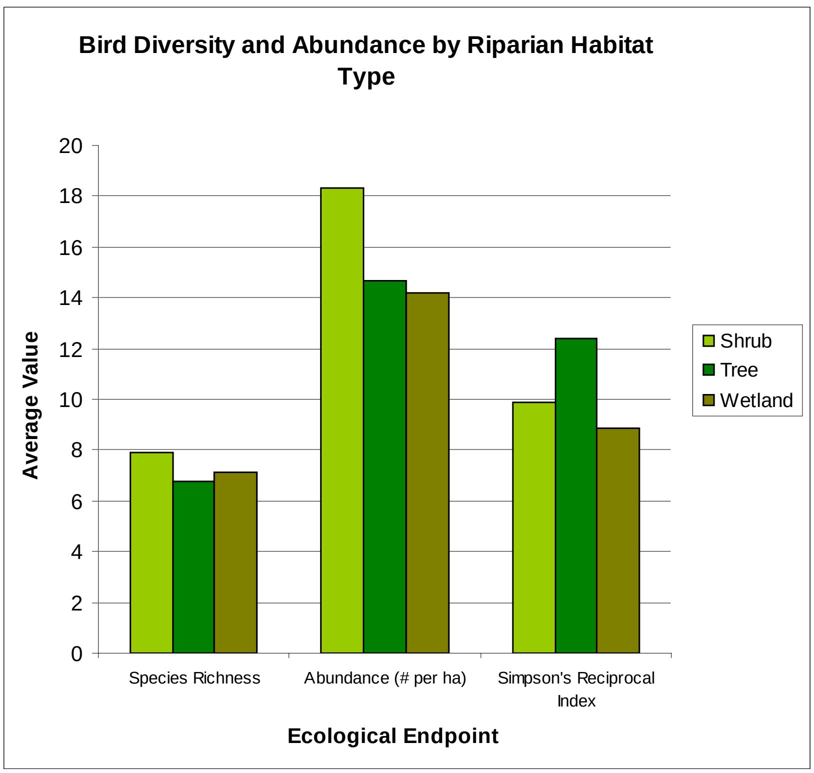

Figure 3-10. Bird Diversity in Riparian Habitats at Chatfield

Each habitat type supports a different community of bird species, with additional bird species using two or all three habitat types. The most dramatic difference is between wetlands and woody vegetation, such as woodlands and shrubs. Wetlands support a distinct group of birds including shorebirds, red-winged blackbirds, killdeer, and yellow warblers depending on the type and height of vegetation present. Red-winged blackbirds and many shorebirds nest exclusively in wetland habitats;

however, killdeer and yellow warbles are more widespread. Woody vegetation supports a variety of passerines, woodpeckers, and owls not found in wetlands.

Less dramatic is the difference in bird communities among woodlands and shrublands. Spotted towhees, willow flycatchers, and gray catbirds are most often found in shrublands. Woodlands support many cavity nesting birds, including woodpeckers, black-capped chickadees, and house wrens. Woodlands with thick understory support Bullock's orioles, red-eyed vireos, yellow-breasted chats and many other warbler species. Open woodlands support western wood-peewees, least flycatchers, and American redstarts.

One forest type that is rather unique along the foothills and plains interface of Colorado's Front Range is mature cottonwood forest. The study area has over 50 acres of mature cottonwood forest along the South Platte River that offer a variety of habitats as understory, midstory, and canopy layers. This forest type is rich in diversity and provides habitat niches for a variety of birds including red-eyed vireos and thrushes.

In more general terms, the study area provides riparian and wetland habitats for birds and other wildlife species. In Colorado's semiarid environment, riparian and wetland habitats are essential to many wildlife species. Riparian habitats harbor 2 to 10 times as many individual birds as do adjacent, non-riparian, vegetation (Rich 2002). Many species depend on riparian habitats for at least some part of their life cycle. In terms of breeding birds, species that nest in riparian habitats over 90 percent of the time are considered "riparian obligate species." Species that nest over 60 percent of the time in riparian habitats are considered "riparian dependent species." Table 3-4 lists bird species observed during the 2006 breeding season that are either riparian obligates or dependent species.

Table 3-4
Bird Species Supported by Riparian Habitats at Chatfield Reservoir

Bird Species	Riparian Use[1]	Riparian Habitat Observed[2]
American Redstart	O	Wet
Belted Kingfisher	O	Wet
Broad-tailed Hummingbird	O	Wet, Shrub, Wood
Common Yellowthroat	O	Wet
Song Sparrow	O	Wet, Shrub, Wood
Willow Flycatcher	O	Wet
Yellow Warbler	O	Wet, Shrub, Wood
Yellow-breasted Chat	O	Wet, Shrub, Wood
American Goldfinch	D	Wet, Shrub, Wood
Black-Capped Chickadee	D	Shrub, Wood
Bullock's Oriole	D	Wood
Gray Catbird	D	Wet, Shrub
House Wren	D	Wet, Shrub, Wood
Red-eyed Vireo	D	Wood
Tree Swallow	D	Wet
Western Wood-Peewee	D	Wet, Shrub, Wood

Source: Bird Species – 2006 Chatfield Breeding Bird Surveys (see Appendix Q)

1 Riparian Use: Obligate (O) or Dependent (D) (based on Rich 2002)

2 Riparian Habitat Observed: Wetlands (Wet); Shrublands (Shrub); Woodland (Wood)

The Bureau of Land Management (BLM) states that the presence of the yellow-breasted chat and song sparrow indicates healthy riparian habitats especially along the South Platte River (BLM no date). This coupled with the presence of many other obligate and dependent riparian bird species indicate that the riparian habitats within the study area are in good health.

Bird habitats at Chatfield should be considered as breeding habitat and as migration habitat. The study area including the habitats mentioned above is considered ideal stop-over habitat providing fresh water, protection from predators, and food resources (Duncan et al. 2001). Stop-over habitat allows birds to regain mass lost during migration and allows birds to replenish themselves in order to continue migration. The stop-over habitat is likely most important to small forest dwelling birds that typically require frequent stops during migration. The forested portions of the study area, especially along the South Platte River and Plum Creek, provide all the resources forest dwelling birds need during migration. Given the large body of water and the extensive shoreline, the study area is important stop-over habitat for shorebirds as well.

Considering areas that may be inundated by the proposed project, biologists created a habitat map (Figure 3-11) of six bird habitats, including the three bird survey habitats. The bird habitats that were mapped included wetlands, woodlands (including mature cottonwood forest), shrublands, open water, shorelines, and upland habitats. Although this habitat map does not comprise habitats throughout the entire study area, it provides a tool to assess impacts to bird habitats surrounding Chatfield Reservoir resulting from the implementation of selected alternatives. Biologists used high-resolution aerial photography to map habitats in the field. The field maps were digitized into a GIS where they could be further summarized and analyzed. This GIS analysis of the bird habitat maps is discussed further in Chapter 4.

South Platte Park is a municipal park located downstream of Chatfield State Park in Littleton, along an unchannelized portion of the South Platte River. This site is also designated as an IBA by Audubon Colorado. The 878-acre site meets two of the IBA criteria, including (1) significant numbers of birds concentrate for breeding, during migration, or in the winter (waterfowl and landbirds) and (2) the site is important for long-term research and/or monitoring projects that contribute substantially to ornithology, bird conservation, and/or education. The site is a lowland riparian ecosystem that includes wetlands, grasslands, mature cottonwood forests, and shrub thickets. Observers have recorded 253 species of birds at the site, and have confirmed 59 species of breeding birds and an additional 9 species that are possibly nesting (Cecily Mui, personal communication, 2008; Audubon Colorado 2004).

Data from Denver Botanic Gardens at Chatfield (formerly Chatfield Arboretum) provide an indication of the variety of butterfly species that are likely to inhabit the study area (Wiseman 2006). Annual butterfly surveys conducted each July from 1992 to 2001 (except 1998) identified 17 to 26 species each year (mean = 21), with a total of 44 butterfly species identified over the survey period. The observed species of butterflies represented 8 families and 31 genera. Appendix G provides additional information on the butterfly survey.

3.8.2 Penley Reservoir, Pipeline Area, and Downstream Gravel Pits

Bird surveys are not available for the proposed Penley Reservoir site. However, given the similarities in location and habitat, the species of birds using the proposed Penley Reservoir site are likely to be similar to those occurring in comparable habitat types at Roxborough State Park (Bonnell 2007). Birds in the grassland areas of the proposed Penley Reservoir site would likely include western meadowlark, horned lark, robin, bluebird, and a variety of sparrows and finches. A mix of pine and oak is found on the steeper slopes surrounding the grassland areas. These areas likely support a variety of bird species, including woodpeckers, flycatchers, jays, chickadees, nuthatches, wrens, and warblers.

The proposed pipeline area associated with the Penley Reservoir, if constructed, would cross a broader variety of wildlife habitats than the reservoir itself. Grasslands predominate, but lesser amounts of deciduous forest and forested wetlands are also present. These areas provide habitat for a variety of mammals, birds, reptiles, amphibians, and invertebrates. Common species include mule deer, white-tailed deer, coyote, black-tailed prairie dog, horned lark, meadowlark, Swainson's hawk, and western fence lizard. Deciduous oak and forested wetlands are also found along the pipeline corridor. These habitats likely contain forest obligate species such as robins, woodpeckers, flycatchers, jays, chickadees, nuthatches, wrens, and warblers. Other wildlife species likely present in the vicinity of the proposed Penley Reservoir site are white-tail deer, squirrel, raccoon, and a variety of bat species.

The downstream gravel pits occur in close proximity to urban areas and agricultural land. Wildlife diversity is likely to be low except where native or wetland habitats exist. Common species present within the gravel pits' inundation area likely include squirrel, rabbit, black-tailed prairie dog, coyote, rock pigeon, house sparrow, and house finch; however, less common mammal, bird, reptile, amphibian, and invertebrate species are also possible in the riparian corridor surrounding the South Platte River.

3.9 Endangered, Threatened, and Candidate Species, Species of Special Concern, and Sensitive Communities

This section describes special status species that may be found in the study area, including Chatfield Reservoir, the proposed Penley Reservoir, the proposed pipeline area, and the downstream gravel pits. USFWS (2004a, 2010), CDOW (2005a), and Colorado Natural Heritage Program (CNHP) (2000) were consulted in regard to special status species, those species having federal or state protection as threatened, endangered, or some other special protective status, and potentially occurring within the study area.

3.9.1 Chatfield Reservoir

Special status species that were identified as potentially occurring within the study area are listed in Table 3-5.

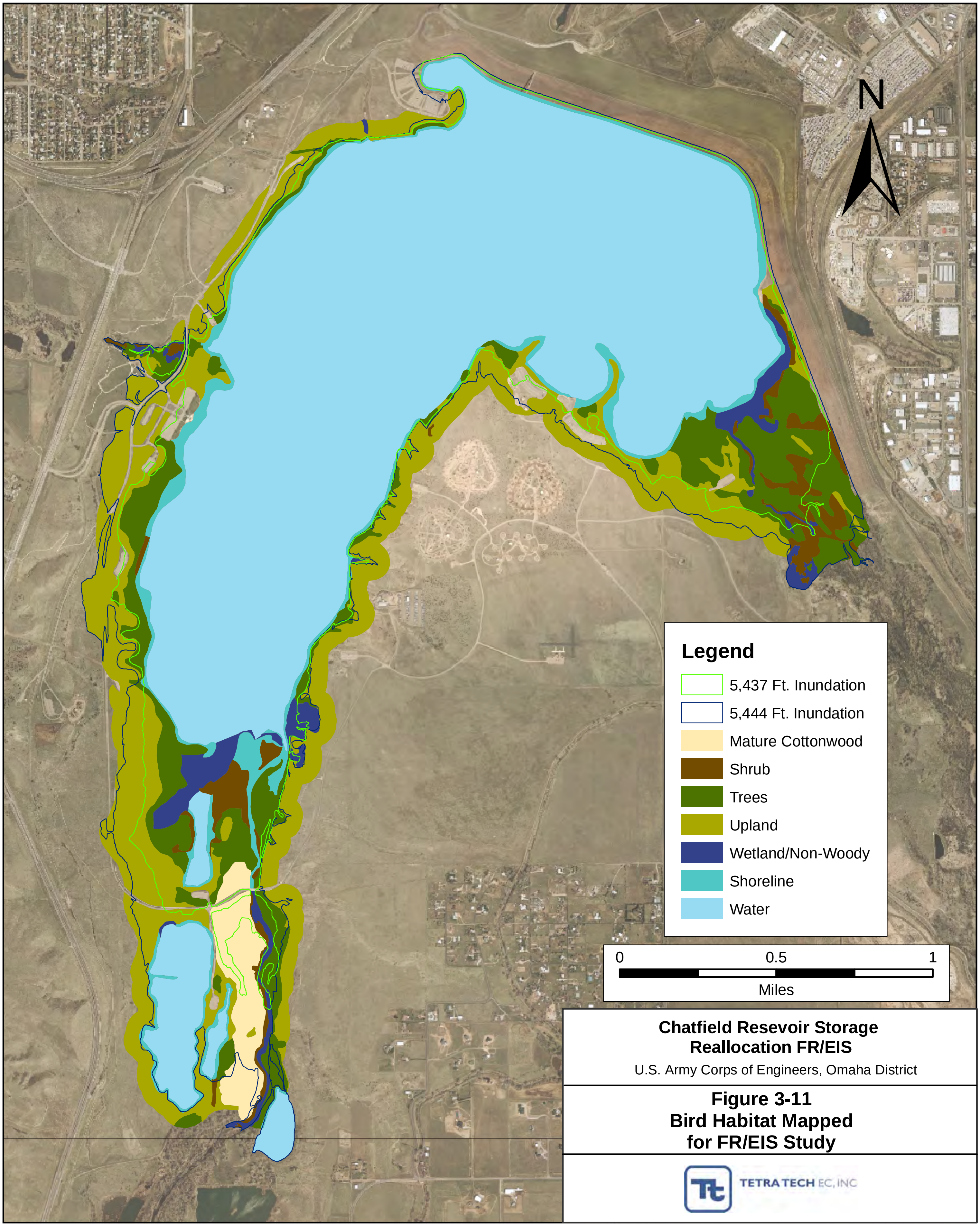

Figure 3-11
Bird Habitat Mapped for FR/EIS Study

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Table 3-5
Special Status Species Found or Potentially Found Within the Study Areas

Common Name (Scientific Name)	Special Status			Area of Potential Occurrence			
	Federal[1]	State[2]	CNHP[3]	Chatfield Reservoir	Down-stream South Platte River	Penley Reservoir and Pipeline Area	Down-stream Gravel Pits
Plants							
American currant (*Ribes americanum*)			G5; S2	•		•	
Bell's twinpod (*Physaria bellii*)			G2; S2	•			
Colorado butterfly plant (*Gaura neomexicana ssp. Coloradensis*)	FT		G3T2; S1	•		•	•
Colorado watercress (*Rorippa coloradensis*)			GH; SH				•
Dog parsley (*Lomatium nuttallii*)			G3; S1				•
Dwarf milkweed (*Asclepias uncialis ssp. uncialis*)			G3G4T2T3; S2				•
Front Range alum-root (*Heuchera hallii*)			G3; S3			•	
Front Range milkvetch (*Astragalus sparsiflorus*)			G3; S3			•	
Forktip three-awn (*Aristida basiramea*)			G5; S1	•			
Gay-feather (*Liatris ligulistylis*)			G5; S1S2				•
Jeweled blazingstar (*Mentzelia speciosa*)			G3; S3			•	
Mountain cat's-eye (*Cryptantha cana*)			G5; S2				•
New Mexico cliff fern (*Woodsia neomexicana*)			G4; S2			•	
Peck sedge (*Carex peckii*)			G4G5; S1			•	
Plains milkvetch (*Astragalus gilviflorus*)			G5; S1				•
Prairie violet (*Viola pedatifida*)			G5; S2			•	•
Richardson alum-root (*Heuchera richardsonii*)			G5; S1			•	
Rocky Mountain bulrush (*Schoenoplectus saximontanus*)			G5; S1				•
Rocky Mountain sedge (*Carex saximontana*)			G5; S1			•	
Sandhill goosefoot (*Chenopodium cycloides*)			G3G4; S1				•
Selkirk violet (*Viola selkirkii*)			G5; S1			•	
Sensitive fern (*Onoclea sensibilis*)			G5; SH			•	
Ute ladies'-tresses orchid (*Spiranthes diluvialis*)	FT		G2; S2	•			•
Western prairie fringed orchid (*Platanthera praeclara*)	FT				•		
Wyoming feverfew			G3; S1				•

Table 3-5
Special Status Species Found or Potentially Found Within the Study Areas

Common Name (Scientific Name)	Special Status			Area of Potential Occurrence			
	Federal[1]	State[2]	CNHP[3]	Chatfield Reservoir	Down-stream South Platte River	Penley Reservoir and Pipeline Area	Down-stream Gravel Pits
(*Parthenium alpinum*)							
Plant Communities							
Xeric tallgrass prairie (NA)			G2; S2	•			
Plains cottonwood/ chokecherry (NA)			G1Q; S1Q	•			
Mammals							
Black-footed ferret (*Mustela nigripes*)	FE	SE	G1; S1	•			•
Black-tailed prairie dog (*Cynomys ludovicianus*)		SC	G3G4; S4	•			•
Canada lynx (*Lynx canadensis*)	FT	SE	G5; S1	•			
Northern pocket gopher (*Thomomys talpoides*)		SC	G5; T3	•		•	
Northern pocket gopher subspecies (*Thomomys talpoides macrotis*)		SC	G5T1; S1			•	
Preble's meadow jumping mouse (*Zapus hudsonius preblei*)	FT	ST	G5T2; S1	•		•	•
Swift fox (*Vulpes velox*)		SC	G3; S3				•
Townsend's big-eared bat (pale sp.) (*Plecotus townsendii pallescens*)		SC	G4; S2	•			
Birds							
American peregrine falcon (*Falco peregrinus anatum*)		SC	G4; S2B	•		•	
American white pelican (*Pelecanus erythrorhynchos*)			G3; S1B	•			•
Bald eagle (*Haliaeetus leucocephalus*)	FP	ST	G4; S1B, S3N	•	•	•	•
Black-necked stilt (*Himantopus mexicanus*)			G5; S3B				•
Chestnut-collared longspur (*Calcarius ornatus*)			G5; S1B				•
Golden eagle (*Aquila chrysaetos*)	FP		Not tracked	•			
Ferruginous hawk (*Buteo regalis*)		SC	G4; S3B, S4N	•			•
Greater prairie chicken (*Tympanuchus cupido pinnatus*)			G4T4; S3				•
Greater sandhill crane (*Grus canadensis tabida*)		SC	G4; S2B, S4N	•			
Interior Least Tern (*Sterna antillarum*)	FE	SE	G4; S1B	•	•		
Lewis's woodpecker (*Melanerpes lewis*)			G4; S4			•	•
Long-billed curlew (*Numenius americanus*)			G5; S2B				•
McCown's longspur (*Calcarius mccownii*)			G4; S2B				•
Mexican spotted owl	FT	ST	G3T3; S1B,	•		•	

Table 3-5
Special Status Species Found or Potentially Found Within the Study Areas

Common Name (Scientific Name)	Special Status			Area of Potential Occurrence			
	Federal[1]	State[2]	CNHP[3]	Chatfield Reservoir	Down-stream South Platte River	Penley Reservoir and Pipeline Area	Down-stream Gravel Pits
(*Strix occidentalis lucida*)			SUN				
Mountain plover (*Charadrius montanus*)		SC	G2; S2B	•			•
Ovenbird (*Seiurus aurocapilla*)			G5; S2B			•	
Piping plover (*Charadrius melodus*)	FT	ST	G3; S1B	•	•		
Plains sharp-tailed grouse (*Tympanuchus phasianellus jamesi*)		SE	G4T4; S1	•		•	
Snowy egret (*Egretta thula*)			G5; S2B				•
Western burrowing owl (*Athene cunicularia*)		ST	G4; S4B	•			
Western snowy plover (*Charadrius alexandrinus*)		SC	G5	•			
Western yellow-billed cuckoo (*Coccyzus americanus occidentalis*)	FC	SC	G5T3Q	•			
White-faced Ibis (*Plegadis chihi*)			G5; S2B				•
Whooping crane (*Grus americana tabida*)	FE	SE	G1; SNA		•		
Amphibians							
Northern leopard frog (*Rana pipiens*)		SC	G5; S3	•		•	•
Fish							
Common shiner (*Luxilus cornutus*)		ST		•			
Greenback cutthroat trout (*Oncorhynchus clarki stomias*)	FT	ST	G4T2T3; S2	•			
Hornyhead chub (*Nocomis biguttatus*)			G5; SX				•
Iowa darter (*Etheostoma exile*)		SC		•			
Northern redbelly dace (*Phoxinus eos*)		SE	G5; S1	•		•	•
Pallid sturgeon (*Scaphirhynchus albus*)	FE				•		
Mullusks							
Cylindrical papershell (*Anodontoides ferussacianus*)		SC	G5; S2				•
Invertebrates							
American burying beetle (*Nicrophorus americanus*)	FE				•		
Colorado blue (*Euphilotes rita coloradensis*)			G3G4T2T3; S2				•
Hops feeding azure (*Celastrina humulus*)			G2G3; S2			•	
Moss's elfin (*Callophrys mossii schryveri*)			G4T3; S2S3	•		•	
Mottled dusky wing (*Erynnis martialis*)			G3G4; S2S3			•	

Table 3-5
Special Status Species Found or Potentially Found Within the Study Areas

Common Name (Scientific Name)	Special Status			Area of Potential Occurrence			
	Federal[1]	State[2]	CNHP[3]	Chatfield Reservoir	Down-stream South Platte River	Penley Reservoir and Pipeline Area	Down-stream Gravel Pits
Ottoe Skipper (*Hesperia ottoe*)			G3G4; S2			●	●
Pawnee montane skipper (*Hesperia leonardus montana*)	FT		G4T1; S1	●		●	
Rhesus skipper (*Polites rhesus*)			G4; S2S3				●
A tiger beetle (*Cicindela nebraskana*)			G4; S1			●	
Wiest's sphinx moth (*Euproserpinus wiesti*)			G3G4; S2				●

1 Federal Status: FE = federally listed endangered; FT = federally listed threatened; FC = federal candidate species, FP= federally protected

2 Colorado State Status: SE = state endangered; ST = state threatened; SC = state Species of Special Concern

3 Colorado Natural Heritage Program Ranking:

Ranks:

G1/S1 Critically imperiled globally/state because of rarity (5 or fewer occurrences in the world/state or 1,000 or fewer individuals) or because some factor of its biology makes it vulnerable to extinction

G2/S2 Imperiled globally/state because of rarity, or because other factors demonstrably make it very vulnerable to extinction throughout its range

G3/S3 Vulnerable through its range or found locally in a restricted range

G4/S4 Apparently secure globally, though it may be quite rare in parts of its range, especially at the periphery

G5/S5 Demonstrably secure globally, though it may be quite rare in parts of its range, especially at the periphery

S#B Refers to the breeding season imperilment of elements that are not permanent residents

S#N Refers to the non-breeding season imperilment of elements that are not permanent residents

NA Accidental; infrequent and outside its usual range

SU Unrankable because there is a lack of information or because the information conflicts substantively

Subranks:

N Refers to the non-breeding population

T Status of a subspecies or varieties

Q Questionable taxonomy

3.9.1.1 Special Status Plant Species

Five special status plant species are known to occur or potentially occur within the study area (Table 3-5). Two of these species are federally listed as threatened and are also ranked by CNHP. The other three species are not state or federally listed, but are ranked by CNHP. Two plant communities listed by CNHP also potentially occur within the study area. An additional federally threatened plant species, the western prairie fringed orchid, may be potentially impacted by water depletions in the Platte River system.

The federally listed threatened Ute ladies'-tresses orchid (57 Federal Register 2048) has limited distribution in the western U.S., including four counties in Colorado's front range (Jefferson, Boulder, Larimer, and Weld counties) (Fertig et al. 2005). It is not currently reported from any locations along the South Platte River (Fertig et al. 2005). This orchid is found in seasonally moist soils and wet meadows near springs, lakes, or perennial streams and their associated flood plains below 6,500 feet msl. Typical sites include old stream channels, abandoned meanders, alluvial terraces, sub-irrigated meadows, and other sites where soils are saturated to within 18 inches of the surface, at least temporarily, during the spring and summer growing season (USFS 1994). In October 2004, USFWS initiated a status review to assess the orchid population abundance and distribution, recovery progress, and existing threats. Upon conclusion of the status review, USFWS will issue a finding regarding whether the orchid should remain listed or should be proposed for delisting (69 Federal Register 60605).

In a 1998 survey, five areas around Chatfield Reservoir were considered to be potential Ute ladies'-tresses orchid habitat. All sites were surveyed for the orchid and no individuals or populations were found (Burns and McDonnell 1998). In 2004, six general areas were identified as potential orchid habitat around Chatfield Reservoir. These sites were surveyed and no individuals or populations were found (USACE 2005b). Surveys for the Ute ladies'-tresses orchid within the study area were conducted again in August 2005. Although potential habitat exists within the study area, no Ute ladies'-tresses orchid plants were found (USACE 2006).

The federally listed threatened Colorado butterfly plant (65 Federal Register 62302) is endemic to southeastern Wyoming, western Nebraska, and northeastern Colorado, including Boulder, Douglas, Larimer, and Weld counties in Colorado (Spackman et al. 1997). This short-lived, perennial herb grows in moist soils in mesic or wet meadows of flood plain areas at elevations of 5,800 to 6,200 feet msl. In 2004, five general areas were identified as potential habitat and surveyed for the Colorado butterfly plant within the study area. No individuals or populations were found (USACE 2005b). In January 2005, USFWS designated 3,538 acres of critical habitat along approximately 50 stream miles within Platte and Laramie counties in Wyoming (70 Federal Register 1940). Surveys for the Colorado butterfly plant within the study area were conducted again in August 2005. Potential habitat was found within the study area; however, no Colorado butterfly plants were found (USACE 2006).

The three plant species listed only by CNHP include American currant, Bell's twinpod, and forktip three-awn. The American currant may occur in the study area because potential suitable habitat exists and because a known population is located nearby in South Platte Park. Bell's twinpod is endemic to the Niobrara Formation limestone and calcareous shale outcrops in Larimer, Boulder, and Jefferson counties (CNPS 1997). Because the study area does not encompass the Niobrara Formation, the occurrence of Bell's twinpod is unlikely. CNHP indicates that forktip three-awn has been identified in Jefferson County in the vicinity of Chatfield Reservoir and the South Platte River, so it may occur within the study area (CNHP 2000).

Two rare plant communities were identified by CNHP as potentially occurring within the study area (CNHP 2000). The xeric tallgrass prairie community is dominated by big bluestem and little bluestem. The CNHP database shows this community as occurring along the southern edge of the study area. It is an extension of the tallgrass prairie that used to dominate the central plains of the nation. This remnant community is rare because most of it has been lost to development, agriculture, and commercialization.

The plains cottonwood/chokecherry community lies in association with the South Platte River south of Chatfield Reservoir (CNHP 2000). It occurs in mesic flood plains that are seasonally flooded. It also occurs in association with swales within the surrounding low hills. This community is rare because chokecherry generally occurs as a monoculture without an overstory component. Plains cottonwood usually occurs with coyote willow as the dominant woody mid-story species.

3.9.1.2 Special Status Animal Species

Table 3-5 lists the special status animal species that may occur in the study area based on the literature and agency database review. The potential occurrence of these species in the study area is discussed in this section.

Mammals

The federally listed endangered black-footed ferret (35 Federal Register 8495) is not expected to occur within the study area. Natural populations of black-footed ferrets are presently known to exist only in Wyoming, in the Shirley Basin, and in Colorado, in the Coyote Basin and near Dinosaur National Monument (CDOW 2005a). USFWS has established minimum areas of prairie dog habitat (80 acres of black-tailed prairie dog towns and 200 acres of white-tailed prairie dog towns) needed to support black-footed ferrets (USFWS 1989). A small black-tailed prairie dog town is present within the study area, southeast of the model airplane flying field at Chatfield State Park (Wiley 2000). This town is less than 80 acres in size and is not large enough to support the black-footed ferret. All project components for all alternatives are also within the 2009 Black-Footed Ferret Block-Clearance Area where USFWS has determined that ferrets are unlikely to occur and black-footed ferret surveys are not required (USFWS 2009).

In Colorado, the black-tailed prairie dog is classified as a small game species and inhabits areas east of the foothills up to 6,000 feet msl. The largest areas of active prairie dog colonies are located along the Front Range and in the south-central and southeastern portions of Colorado. Black-tailed prairie dogs form large towns in shortgrass or mixed prairie and dig complex burrow systems with entrances marked by conspicuous mounds (CDOW 2005a). In 1998, USFWS received two petitions to list the black-tailed prairie dog as an endangered or threatened species. In August 2004, after completing an evaluation of the status of black-tailed prairie dog, USFWS determined the prairie dog is not likely to become an endangered or threatened species in the near foreseeable future and is not warranted for listing (69 Federal Register 51217). A recent review by USFWS, completed in December 2009, again found that the black-tailed prairie dog does not warrant listing as threatened or endangered (74 Federal Register 63343).

The federally listed threatened Canada lynx (65 Federal Register 16051) is a medium-sized cat that inhabits boreal forests of northern North America. The principal food of the lynx is snowshoe hare (*Lepus americanus*), which comprises 80 percent of the lynx's diet. Habitat includes dense spruce-fir stands in association with rock outcrops and large boulders in the subalpine zone and timberline where lynx use caves, rock crevices, overhanging banks, or hollow logs for denning. The Canada lynx was historically found in high-elevation forested areas in Colorado in the late 1800s; by 1930, however, they were considered rare. By the mid 1970s the lynx population in Colorado was extirpated or reduced to a few animals. In 1999, CDOW began a reintroduction program using lynx from Alaska and Canadian provinces for release in southwestern Colorado. As of February 2005, a total of 166 adult lynx have been released in the mountains of Colorado. Most of the lynx released remain in the core release area: New Mexico north to Gunnison, west as far as Taylor Mesa, and east to Monarch Pass. Some movement of lynx into Utah, Wyoming, and New Mexico has also occurred (CDOW 2005a). There is no potential habitat for the Canada lynx in the study area.

The northern pocket gopher prefers deep soils along streams and in meadows and cultivated fields. It occurs in a wide range of habitats from grasslands, sagebrush steppe, mountain meadows and tundra, agricultural fields, and suburban lawns. This species does not hibernate and is active throughout the year. In Colorado, this species is found at elevations greater than 5,000 feet msl (CDOW 2008b). This species is unlikely to occur within the study area because it is not known to occur west of U.S Highway (US-85) and not known to occur in Douglas County.

The Preble's meadow jumping mouse is found in and near shrub-dominated riparian (streamside) areas along Colorado's Front Range from Colorado Springs north into southeastern Wyoming. It hibernates from September or October until May. Preble's meadow jumping mouse occupied range (those areas where Preble's mice are known or very likely to occur) (NDIS 2006) within the study area is illustrated in Figure 3-12. This mouse is a rare subspecies of the meadow jumping mouse (*Zapus hudsonius*) and was listed as a federally threatened species in 1998 (63 Federal Register 26517). In June 2003, USFWS designated critical habitat (68 Federal Register 37275-37332) for the mouse along 359 stream miles in Colorado and Wyoming, including portions of the Upper South Platte River (i.e., the Upper South Platte critical habitat unit (CHU)). Critical habitat is a term used in the ESA and is defined as those areas essential for the conservation of a federally protected species (USFWS 2000a). On the Upper South Platte River, USFWS (68 Federal Register 37275-37332a) defines critical habitat as extending 460 feet outward from normal high water on both sides of the Upper South Platte River above Chatfield Reservoir. Within the study area around Chatfield Reservoir, approximately 297.3 acres of critical habitat are within the "Chatfield subunit" of the Upper South Platte CHU. In December 2010, USFWS designated additional areas of critical habitat for the mouse, including Unit 9 "West Plum Creek" (i.e., the West Plum Creek CHU), which includes much of the Plum Creek/West Plum Creek Watershed (75 Fed. Reg. 78430 (December 15, 2010)). Plum Creek from Chatfield Lake upstream to its confluence with East Plum Creek and West Plum Creek is included in Unit 9, with the exception of 0.14 miles of Plum Creek at the Highline Canal crossing.

In February 2005, USFWS was petitioned to delist the Preble's meadow jumping mouse. On November 1, 2007, the USFWS revised their proposed rule to amend the listing of the Preble's mouse to specify over what portion of its range the subspecies is threatened. Also noted, is the finding that the Preble's meadow jumping mouse (*Zapus hudsonius preblei*) is a valid subspecies and remains federally protected. A final rule was published in July 2008 (73 Federal Register 39789-39838).

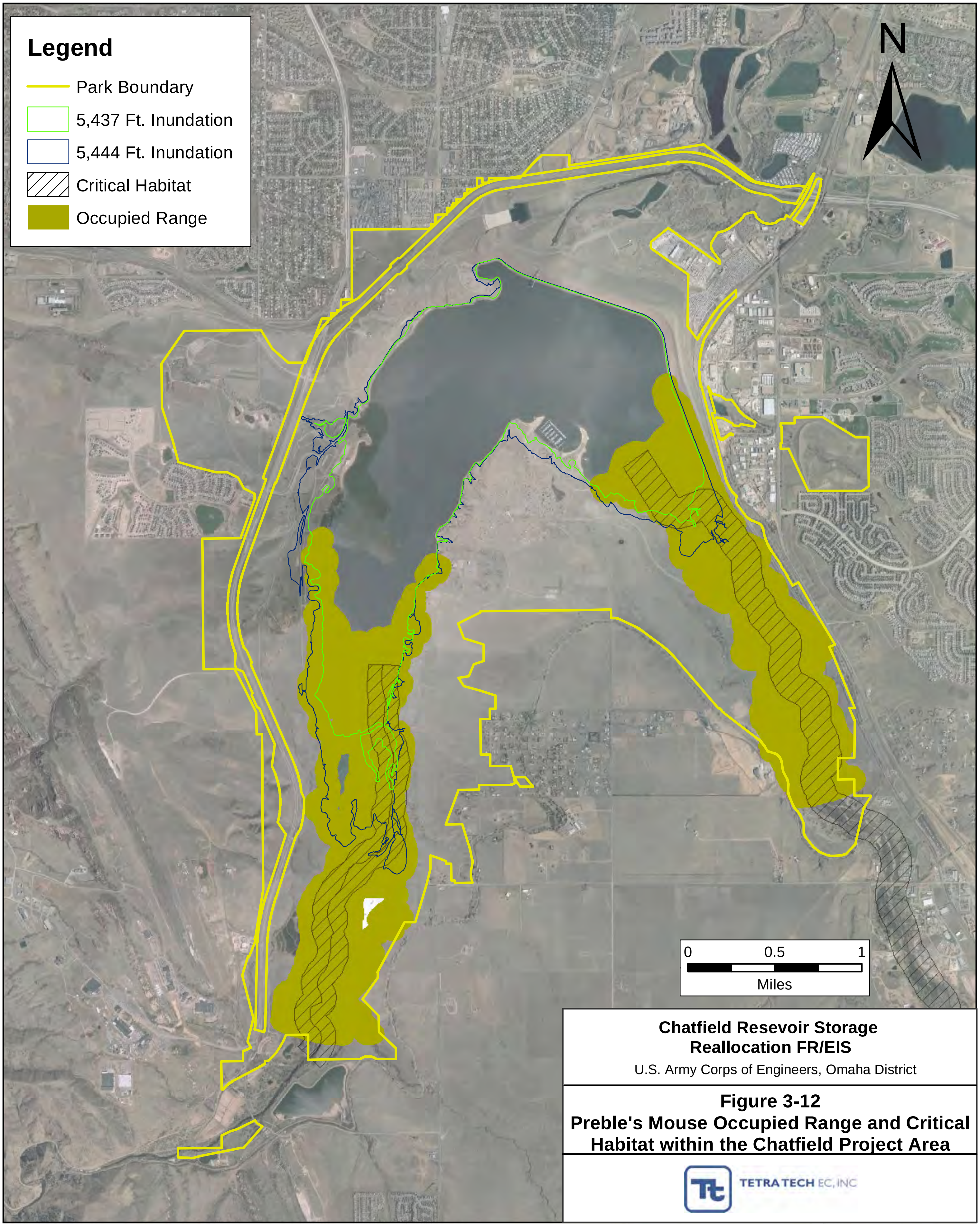
Habitat for the mouse is found along the South Platte River and Plum Creek above Chatfield Reservoir. Approximately 552 acres of potential habitat exists within the study area around Chatfield Reservoir. Not all of this potential habitat is considered occupied but areas trapped along the South Platte River and Plum Creek have relatively high numbers of captures (Burns and McDonnell 1998) indicating moderate to high densities at the time of trapping. Potential habitat below the reservoir has been previously disqualified by the USFWS by a block-clearance of the Denver Urban Drainage and Flood Control District (USFWS 2004c), but did not include South Platte Park and areas below the Chatfield Dam. No Preble's meadow jumping mice have been captured in the Chatfield study area below Chatfield Reservoir or along Deer Creek despite recent trapping efforts. The USFWS updated their Denver Urban Drainage and Flood Control District Block-Clearance by adding the area of South Platte Park south to Colorado State Highway C-470 (C-470) (USFWS 2007). The Preble's meadow jumping mouse was identified at two sites in the study area in 1998, the South Platte River above Chatfield Reservoir and along Plum Creek. It is expected that the mouse populations in these areas extend beyond the survey area. Elevation of the South Platte River site was 5,440 feet msl and the elevation for the Plum Creek site was 5,460 feet msl (Burns and McDonnell 1998).

Preble's mouse habitat is comprised of well-developed plains riparian vegetation with adjacent, relatively undisturbed grassland communities and a nearby water source. These riparian areas include a relatively dense combination of grasses, forbs, and shrubs. Preble's mice are known to regularly range outward into adjacent uplands to feed and hibernate. Considering areas that may be inundated by the proposed project, biologists created a habitat map of four Preble's mouse habitat components to include "high quality riparian areas," "low quality riparian areas," "upland habitat," and "non-habitat areas" (Figure 3-13). These map units are defined as:

- High quality riparian areas—stream-side habitats within the floodplain that contain dense stands of vegetation often in multi-vegetative strata such as herbaceous ground cover, riparian shrubs, young trees, or combinations of all three in an arrangement that creates thick vegetative cover.
- Low quality riparian areas—stream-side habitats with limited vegetative cover. This includes mid-succession riparian forest lacking a shrub or grass/forb understory or recently inundated areas that may support vegetation but not enough to provide thick cover.
- Uplands habitat—dense mesic grasslands, shrublands, or combinations of both adjacent to riparian areas. Uplands may be part of the floodplain or extend beyond the floodplain up to 300 feet.
- Non-habitat areas—includes roads, buildings, parking lots, and other human-altered features not considered habitat for the Preble's mouse.
- These map units are intended to be large blocks of habitat found within known and suspected occupied range within the study area. For example, small patches of low quality habitat would be incorporated into larger blocks of high quality habitat if the low quality patch was less than an acre.

Although this habitat map does not comprise habitats throughout the entire study area, it provides a tool to assess impacts to the Preble's mouse in terms of habitat surrounding Chatfield Reservoir resulting from the application of selected alternatives. Biologists used high-resolution aerial photography to map habitats in the field. The field maps were digitized into a GIS where they could be further summarized and analyzed. This GIS analysis of the Preble's mouse habitat maps is discussed further in Chapter 4.

Townsend's big-eared bat is found in riparian habitats within forests, shrublands, grasslands, and deserts. Maternal roosts occur in caves and mine tunnels and night roosts are in caves, buildings, and trees cavities. This bat feeds on various flying insects, particularly moths, near the foliage of trees and shrubs. This bat may occur in the study area in the summer, particularly if roosting habitat is available.



Legend
Park Boundary
5,437 Ft. Inundation
5,444 Ft. Inundation
Critical Habitat
Occupied Range
N
0
0.5
1
Miles
Chatfield Resevoir Storage
Reallocation FR/EIS
U.S. Army Corps of Engineers, Omaha District
Figure 3-12
Preble's Mouse Occupied Range and Critical Habitat within the Chatfield Project Area
TETRA TECH EC, INC

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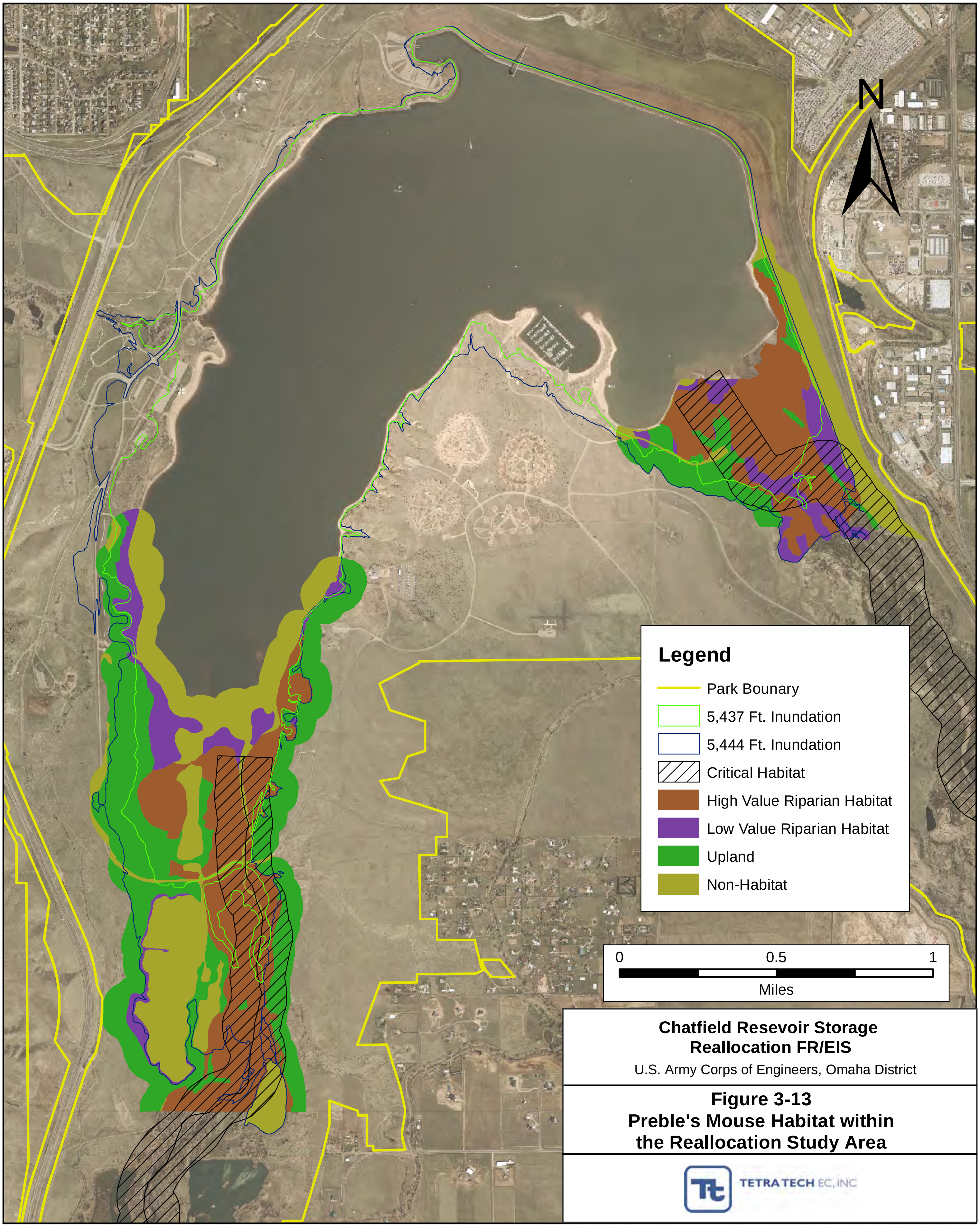

Figure 3-13
Preble's Mouse Habitat within the Reallocation Study Area

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Birds

The American peregrine falcon is a subspecies of the peregrine falcon that can be identified by its intermediate coloration between the pale arctic subspecies and the dark northwestern subspecies. This falcon is found along cliffs and tall buildings in forested, shrubland, and urban habitats. This species nests on cliff faces with sheltering overhangs and tall buildings. It feeds primarily on medium-sized passerines and small waterfowl. This raptor currently nests in Waterton Canyon and may occur in the study area while foraging or during the wintering season, but nesting habitat is not present.

The bald eagle was federally listed and reclassified from endangered to threatened in 1995 (60 Federal Register 35999), and was delisted by the USFWS July 9, 2007, effective on August 8, 2007 (72 Federal Register 37346). However, bald eagles remain protected under provisions of the Bald and Golden Eagle Protection Act (16 USC 668) and the Migratory Bird Treaty Act (16 USC 703-712). The bald eagle migrates in summer to northern breeding grounds but returns to lower latitudes during the winter. Winter habitat consists of roost trees along rivers and other large open bodies of ice-free waters that allow access to fish (USFS 1994). Typical nesting sites include trees on reservoir edges, cottonwoods along rivers, and conifers near lakes or streams (Kingery 1998). The bald eagle is a regular winter visitor to Chatfield Reservoir and is often seen perched on trees along the shoreline or standing on the ice. Principal eagle food resources available in the project area include fish, waterfowl, and prairie dogs (USFWS 2006). A bald eagle nest was present in 2004 at South Platte Park, north of Chatfield Sate Park. However, successful breeding did not occur, and in 2005 great-horned owls occupied the nest. In 2005, bald eagles built a nest along the Highline Canal just south of Chatfield State Park (USFWS 2006). The nesting attempt was abandoned. It is highly likely that bald eagles will continue to attempt nesting in the vicinity of Chatfield Reservoir (USFWS 2006). According to the NDIS (2008c) there are no roost sites including winter roost sites at Chatfield or the surrounding area. The South Platte River and the reservoir are considered winter range and winter foraging areas for bald eagles.

The golden eagle, like the bald eagle, is protected under provisions of the Bald and Golden Eagle Protection Act (16 USC 668) and the Migratory Bird Treaty Act (16 USC 703-712). Golden eagles are more common in western Colorado, but are observed especially in winter in eastern Colorado often along the foothills. Additionally, golden eagles are known to nest in eastern Colorado but this is considered uncommon (Andrews and Righter 1992). Golden eagles have been known to nest along the hogback at Roxborough State Park, the Lockheed Martin Property, and possibly near the proposed Penley Reservoir and associated pipelines.

The ferruginous hawk occupies grasslands and shrub-steppe communities. These hawks avoid areas of intensive agriculture, high human disturbance, high elevation interior forests, and narrow canyons. Breeding birds nest in isolated trees, on rock outcrops and structures such as windmills and power poles, or on the ground. Prey availability influences habitat selection and the ferruginous hawk tends to be most numerous where black-tailed prairie dog towns are plentiful. The ferruginous hawks found east of the Rocky Mountains winter primarily in grasslands, particularly where prairie dogs are abundant. On Colorado's eastern plains, these hawks are considered a rare to uncommon summer resident and a fairly common winter resident (CDOW 2005a). This hawk may occur in the study area as a winter resident.

The greater sandhill crane is a frequent migrant in Eastern Colorado. It is unclear if the sandhill cranes use the study area during migration. Typically, sandhill cranes use river channels as roosts and adjacent agricultural fields and grasslands to feed while stopping over during migration. The study area does not provide these types of habitats. River bottoms are heavily wooded and do not provide the open river channels used by cranes. Therefore, it is unlikely that greater sandhill cranes use the study area.

Interior least terns were federally listed endangered in 1985 (50 Federal Register 21784). They are highly dependent on the presence of dry, exposed sandbars and favorable river flows that support a forage fish supply and isolate the sandbars from the riverbanks. Characteristic riverine nesting sites are dry, flat, sparsely vegetated sand and gravel bars within a wide, unobstructed, water-filled river channel. Nests are initiated only after spring and early summer flows recede and dry areas on sandbars are exposed, usually at higher elevations away from the water's edge (Nebraska Game and Parks Commission [NGPC] 2005). Following regulation of the Platte River that decreased flows, the establishment of trees and shrubs on the flood plain greatly reduced the habitat for the least tern (Currier et al. 1985). In Nebraska, least terns currently breed along the Platte River from its mouth, west to North Platte, at one or two isolated sites along the South Platte River, along the lower reaches of the Niobrara River, along reaches of the Loup and Elkhorn rivers, and on the unchannelized section of the Missouri River below the Fort Randall and Gavins Point dams. A few least terns nest on the shoreline of Lake McConaughy on the North Platte River, usually in years when low lake levels expose wide, sandy beaches (NGPC 2005).

The federally listed threatened (58 Federal Register 14248) Mexican spotted owl has been observed in the Pikes Peak, South Platte, and San Carlos Ranger Districts of the Pike National Forest. All nests in Colorado found to date occur on cliff ledges or caves along canyon walls (USFS 1994). This species occupies either large, steep canyons with exposed cliffs and dense old-growth mixed forest of Douglas-fir, white fir, and ponderosa pine or canyons in pinyon-juniper areas with small and widely scattered patches of old Douglas-firs. In 2004, USFWS designated 8.6 million acres of Critical Habitat within the owl's geographic range, including 322,326 acres in Colorado (69 Federal Register 53181). The nearest Critical Habitat Unit is located in the southern areas of Douglas and Jefferson counties on land managed by USFS. This owl is not expected to occur within the study area, however, because there is a lack of suitable habitat and the area lies at the edge of the owl's geographic distribution.

The mountain plover occurs in shortgrass prairie grassland, primarily on level areas with very short grass and a low density of cactus, and often with a heavy grazing regime. Prairie dog towns also appear to be important habitat for the mountain plover. The plover avoids taller grassland habitats and steep hillsides. Colorado is the primary breeding ground for the mountain plover—more than half of the world's plover population nests in the state. Major breeding areas exist at the Pawnee National Grasslands and in southeastern Colorado (CDOW 2005a). The mountain plover was proposed for listing as a threatened species in 1999. In September 2003, USFWS withdrew the proposal for listing because new information indicated that the threats to the species included in the proposed listing were not as significant as earlier believed (68 Federal Register 53083). All counties within the study area except Jefferson County and Denver County are included in the NDIS mountain plover occurrence map (NDIS 2007). This species may occur within the study area.

The northern Great Plains breeding population of the piping plover was federally listed threatened in 1985 (50 Federal Register 50726). It is found in Nebraska along the Platte River, preferring riverine island habitat that is largely unvegetated and made of sand, sediment, and gravel (Currier et al. 1985). In Nebraska, the Platte River was included in the critical habitat designated in 2002 (67 Federal Register 57638). This species has been affected through habitat loss by woody plant encroachment as a result of decreased flows in the Platte River (NGPC 2005). An October 11, 2005, court ruling vacated critical habitat for the piping plover in Nebraska; it has been recommended to the USFWS for possible rededication (USFWS 2006).

The plains sharp-tailed grouse inhabits a mix of tall and short grasses interspersed with stands of shrubs, especially where the shrubs form a dense cover with a relatively open understory. The woody cover is especially important for brood cover. Croplands and riparian areas are also used, especially in fall and winter. Leks, or traditional courting grounds, are located in wet meadows, on ridges and knolls, or in recently burned areas (Colorado Partners in Flight [CPIF] 2005). Although this species has not been identified within the study area, habitat is present and a population is known to occur nearby and it is possible that this species could occasionally occupy available habitat within the study area.

In Douglas County, the plains sharp-tailed grouse has suffered population declines and state strongholds are now in northeastern Colorado (Ron Beane, personal communication 2008; and Andrews and Righter 1992). The present population in Douglas County has not successfully bred in several years. However, the last known documented occurrences are approximately 1.5 miles southeast of the Chatfield State Park boundary along Plum Creek. Several formal lek sites are also found within Douglas County several miles south of Chatfield State Park.

In Colorado, the western burrowing owl is a migratory species, and can be found from late March or early April through October on the eastern plains where prairie dog burrows occur. Owls have also been observed, but are uncommon, in mountain parks and on the Western Slope. During winter, western burrowing owls in Colorado migrate to Mexico and Central America. The burrowing owl is a grassland specialist that is dependent on the presence of fossorial, or burrowing, mammals. These owls use well-drained, flat to gently sloping grassland habitats with sparse vegetation and a relatively large proportion of bare ground. This species nests in underground burrows in grasslands and grazed pastures, and other dry, open habitats such as deserts and grassy urban areas, including golf courses, airports, cemeteries, vacant lots, and road rights-of-way (CDOW 2005a). Although this species has not been identified within the study area, burrowing owls have been identified south of Chatfield Reservoir during the breeding season. Because suitable habitat does occur in the study area, the owl could potentially move into this habitat.

The western snowy plover is found along playa salt flats, sand dunes, and sandy shores of rivers, lakes, and ponds. It nests on the ground in bare open beaches or salt flats where vegetation is sparse, but it is sensitive to human disturbance. It eats insects and small crustaceans that it picks from the substrate. This species could occur in the study area if beaches are left undisturbed by humans.

The western yellow-billed cuckoo is found in open woodlands with thick undergrowth, parks, and deciduous riparian woodlands. This subspecies requires patches of at least 25 acres of dense riparian forest with a canopy cover of at least 50 percent in both the understory and overstory. Given the strict habitat requirements of this subspecies, the western yellow-billed cuckoo is unlikely to occur in the study area.

The American white pelican is summer resident and migrant on the eastern plains of Colorado and an occasional migrant elsewhere in the state. Individual birds or flocks are often seen flying over areas far from reservoirs; and many reservoirs on the eastern plains have large populations of nonbreeders. White pelicans are known to breed at three reservoirs in Colorado: Riverside Reservoir in Weld County, Antero Reservoir in Park County, and McFarlane Reservoir in Jackson County (CDOW 2005a). The white pelican is known to feed at Chatfield Reservoir and therefore occurs within the study area.

Amphibians

The northern leopard frog inhabits wet meadows and the banks and shallows of marshes, ponds, glacial kettle ponds, beaver ponds, lakes, reservoirs, streams, and irrigation ditches. The frogs are active from March until October or November, when they become dormant for the winter. The northern leopard frog occurs throughout Colorado, excluding most of the southeastern and east-central portions of the state. Its elevation range extends from below 3,500 feet msl in northeastern Colorado to above 11,000 feet msl in southern Colorado (Hammerson 1999, NDIS 2008b). The distribution of the northern leopard frog includes portions of Jefferson, Douglas, and Arapahoe counties that include the study area.

Fish

The common shiner is currently present in the upper reaches of Plum Creek. Colorado is west of the major distribution of this species, which is centered around the Great Lakes and upper Mississippi River (Lee et al. 1980). This species was never considered abundant in Colorado, and by some historical accounts, it has been considered rare and restricted to the eastern part of Colorado. In recent years only Goettl (1980 and 1981) reported common shiners in the mainstem South Platte River; one individual near Sterling and one in Denver. Of all sections of South Platte River streams sampled during a warm-water stream sampling survey, the West Plum Creek system contained the highest concentration of this species (Propst 1982). These stream areas are at least 13 miles upstream from Chatfield Reservoir. The common shiner is apparently restricted in this system to tributaries near the foothills. The limited distribution of this species in the South Platte River system is likely a result of its preference for small, less-turbid streams and spawning habitat, such as gravel beds in flowing water (Woodling 1985). The tributary streams of the Chatfield Reservoir are not likely to have habitat characteristics that would support this species. This species, therefore, is not expected to occur within the study area.

The historical range of the federally listed threatened greenback cutthroat trout (43 Federal Register 16343) includes much of the South Platte River drainage from its headwaters to the confluence with the Cache la Poudre River just upstream from Greeley, Colorado, and the headwaters of the Arkansas River upstream from Pueblo, Colorado. However, current distribution is limited to a few streams and lakes in the upper headwaters of these drainages. These sites are not currently within the study area or under project influences. Introduction of nonnative trout species was the primary reason for the species decline, but habitat degradation and over harvesting also contributed to the decline. Habitat requirements include clear, cold streams and lakes and clean gravel in flowing streams during spring for spawning. The objective of the 1998 greenback cutthroat trout recovery plan included actions intended to allow removal of the species from the threatened list, which was to be accomplished by establishing 20 stable populations of greenback trout. All areas identified in the 1998 plan for locating these 20 populations are in headwater areas of the South Platte and Arkansas River drainages, far from the current study area (USFWS 1998a). Currently, greenback trout occur in 58 lakes and streams and 23 of these bodies meet the population criteria required by recovery goals. Many of the historic and restored populations are located in Rocky Mountain National Park (CDOW 2005a). The greenback trout, therefore, is not expected to occur within the study area.

Distribution of the Iowa darter in Colorado is limited. Populations are found in the South Platte Park reach of the South Platte River; some northeastern plains streams, including Plum Creek; and in single locations on the Saint Vrain and Big Thompson rivers. Characteristic habitat includes cool, clear water over a sand or organic matter substrate (Trautman 1957). Populations in Colorado are found in lakes, over mats of rooted aquatic plants, and in streams with vegetation along the stream bank extending into the water (Propst 1982). This species may occur within the study area.

The northern redbelly dace is present in the upper tributaries of Plum Creek. Primary distribution of this fish is typically far north of Colorado, ranging in a narrow band from Newfoundland through the Great Lakes to western Montana, Alberta, and northeastern British Columbia (Lee et al. 1980). It is considered extremely rare in Colorado either because of habitat modification or because it is located on the periphery of its range. In a survey of Colorado Platte River warm-water streams, only two specimens were found, both near or in Garber Creek, a tributary to Plum Creek. This stream is located more than 13 miles upstream from Chatfield Reservoir. The characteristic habitat of this species is slow-flowing streams with abundant vegetation. The habitat where they were found consists of a small section of stream (less than 4 feet wide) below irrigation ponds with substrate of small gravel and a fine silt surface layer (Propst 1982). Three specimens were collected from a farm pond adjacent to a Plum Creek tributary (Woodling 1985). Currently, some of the farm ponds in the area may be a refuge for the northern redbelly dace and common shiner. As with the common shiner, habitat in or near Chatfield Reservoir does not appear suitable for this species. This species is therefore not expected to occur within the study area.

Invertebrates

The Moss' elfin butterfly species occupies the foothills and lower montane canyons between 6,000 and 8,000 feet msl from Larimer County south to Pueblo County. Its distribution is the eastern foothills of the Front Range of the Rocky Mountains, specifically the north-central part of Colorado. The CNHP database identifies the Moss' elfin as being found along the South Platte River just south of Chatfield Reservoir. The species is highly dependent on its host plant, stonecrop (*Sedum lanceolatum*), which occurs in shortgrass steppe communities (CNHP 2000). Marginal habitat for this species occurs within the study area, so this species may occupy the study area.

The federally listed threatened Pawnee montane skipper (52 Federal Register 36176) inhabits dry, open ponderosa pine woodlands with sparse understory at 6,000 to 7,500 feet msl with moderately steep slopes and soils derived from Pikes Peak granite. Blue grama grass and prairie gayfeather (*Liatris punctata*) are two necessary components of the ground cover. The Pawnee montane skipper occurs only on the Pikes Peak Granite Formation in the South Platte River drainage system in Colorado, involving portions of Jefferson, Douglas, Teller, and Park counties. An intensive distribution survey found the range of the skipper to be centered at Deckers, Colorado, and to extend northwest just beyond Pine, Colorado, and southward to the point where the Teller, Park, Jefferson, and Douglas county lines nearly converge (USFWS 1998b). Based on this habitat and distribution information, the Pawnee montane skipper is not expected to occur in the study area.

3.9.2 Downstream in the South Platte River

USFWS identified several special status species that may be potentially impacted by water depletions in the Platte River drainage downstream of the study area (USFWS 2000b, USFWS 2004a). These species are listed in Table 3-5 and are further discussed in this section.

The Platte River Recovery Implementation Program, established January 2007, is implementing actions designed to assist in the conservation and recovery of the above species and their associated habitats along the central and lower Platte River in Nebraska through a basin-wide cooperative approach agreed to by the states of Colorado, Nebraska, and Wyoming and the U.S. Department of the Interior. The program addresses the adverse impacts of existing and new water related activities with depletive effects to the South Platte River drainage and provides ESA compliance for effects to the species and critical habitat from such activities.

3.9.2.1 Special Status Plants Species

The western prairie fringed orchid was listed as a threatened species under both the federal (54 Federal Register 39857) and Nebraska endangered species acts in 1989 because its numbers declined as a result of development and conversion of tallgrass prairie to cropland. The range of the orchid extends from the Mississippi River westward to the Sandhills of Nebraska, north to Manitoba, Canada, and as far south as Oklahoma (NGPC 1993). The orchid occurs in wet prairies and sedge meadows associated with tallgrass prairie overlying glacial drift and calcium-rich loess soils (Farrar 1990).

3.9.2.2 Special Status Animal Species

Birds

Bald eagles are known to winter along the South Platte River system in riparian woodlands (Currier et al. 1985) but tend to avoid densely urbanized areas with limited riparian cottonwood corridors. General life history information about the bald eagle can be found in Section 3.9.1.2. Reduced or altered river flows as a result of diversions and dams can severely affect the ability of the aquatic system to attract wintering waterfowl or to support an adequate fishery for nesting or wintering eagles (NGPC 2005).

Interior least terns were federally listed endangered in 1985 (50 Federal Register 21784). General life history information about the interior least tern can be found in Section 3.9.1.2. The northern Great Plains breeding population of the piping plover was federally listed threatened in 1985 (50 Federal Register 50726). General life history information about the piping plover can be found in Section 3.9.1.2. Whooping cranes were federally listed endangered in 1970 (35 Federal Register 8495). They migrate through Nebraska twice each year on their way to and from wintering grounds in the Aransas National Wildlife Refuge in Texas to summer grounds on freshwater marshes in Alberta, Canada. The primary migration route through Nebraska is approximately 140 miles wide; the Big Bend Region of the Platte River in Nebraska is an important stopover area (NGPC 2005). This area was designated as critical habitat in 1978 (43 Federal Register 20938). No whooping cranes occur at Chatfield Reservoir.

Fish

The pallid sturgeon was federally listed as endangered in 1990 (55 Federal Register 36641). The range of the pallid sturgeon extends over 3,500 river miles, including the Missouri River from Fort Benton, Montana, to its confluence with the Mississippi River, and the Mississippi River mouth. The lower 200 miles of the Yellowstone River and lowermost portion of some of the major tributaries within this range, including the Kansas and Platte rivers, comprise part of the pallid sturgeon's known range. Pallid sturgeon require large, turbid, free-flowing river habitat with rocky or sandy substrate (Gilbraith et al. 1988). These sturgeon are more often found in deep, swift water and in the Missouri and Mississippi rivers in sandy bottom areas. During spring, they are known to make spawning migrations in the Yellowstone River in response to increased flows. Pallid sturgeons have been present in the Platte River or near its mouth, most often during above-normal spring flows (Berg 1981). No pallid sturgeons occur at Chatfield Reservoir.

Invertebrates

The American burying beetle was federally listed as endangered in 1989 (54 Federal Register 29652) and seems to be restricted to areas largely undisturbed by human influence. In Nebraska, it is known to occur in the Sandhills, Gothenburg, Brady, North Platte, and the Valentine National Wildlife Refuge. Habitats in Nebraska where these beetles have been recently found consist of grassland prairie, forest edge, and scrubland. Specific habitat requirements are unknown (NGPC 2005).

3.9.3 Penley Reservoir and Pipeline Area

This section identifies special status species that may potentially occur in the area of the proposed Penley Reservoir and the proposed pipeline area. Figure 3-14 shows the proposed location of Penley Reservoir and the four downstream gravel pits as discussed in Chapter 2. It also shows the counties where these features would be located. Figure 2-1 shows the pipeline area that would be associated with the proposed Penley Reservoir. Special status species that were identified as potentially occurring within the study area are listed in Table 3-5.

3.9.3.1 Special Status Plant Species

The Colorado butterfly plant, is federally listed as threatened and is also ranked by CNHP. General life history information about the Colorado butterfly plant can be found in Section 3.9.1.1. Site-specific survey data are not available for this species in the Penley area. The likelihood of occurrence within the proposed Penley Reservoir site is low to moderate based on absence of open meadow habitat, as identified from Gap Analysis Project (GAP) data (Figure 3-2).

CDOW has identified 11 plant species within Douglas County in decline at the state level or species whose population status is not well known but thought to be in decline (CDOW 2007c, Table 3-5). These include American currant, Front Range alum-root, Front Range milkvetch, jeweled blazingstar, New Mexican cliff fern, peck sedge, prairie violet, Richardson alum-root, Rocky Mountain sedge, Selkirk violet, and sensitive fern. Species mentioned here are those monitored by the CNHP and may not be a complete list of sensitive species within the proposed Penley Reservoir area and its associated pipeline corridor.

3.9.3.2 Special Status Animal Species

Of the 31 species listed as federally endangered, threatened, or candidate species in the State of Colorado, three federally threatened, endangered, or candidate wildlife species occur within Douglas

County (CDOW 2007c). All species monitored by the CNHP that occur within the vicinity of the proposed Penley Reservoir are included in Table 3-5.

Mammals

The federally threatened Preble's meadow jumping mouse is found in thickly vegetated riparian habitats with adjacent grasslands (EPA 1997). In Colorado, this species occurs throughout the South Platte River and its tributaries (NatureServe 2007). A more detailed description of this species habitat requirements and range is found in Section 3.9.1.2. The known occupied range of this species does not occur within the proposed location of Penley Reservoir. Pipeline construction in the proposed pipeline area could cross Preble's meadow jumping mouse habitats and occupied range (Figures 3-15 and 3-16).

Birds

The federally listed threatened (58 Federal Register 14248) Mexican spotted owl has been observed in the Pikes Peak, South Platte, and San Carlos Ranger Districts of the Pike National Forest. All nests in Colorado found to date occur on cliff ledges or caves along canyon walls (USFS 1994). General life history information about the Mexican spotted owl can be found in Section 3.9.1.2. This owl is not expected to occur within the proposed Penley Reservoir site or within the pipeline area.

Bald eagles may be either seasonal or permanent residents in Colorado, foraging or nesting along the South Platte River year-round. Because of the close proximity of proposed Penley Reservoir and its associated pipelines to the South Platte River, the likelihood of occurrence is high (Figures 3-15 and 3-16). General life history information about the bald eagle can be found in Section 3.9.1.2.

Invertebrates

The federally listed threatened Pawnee montane skipper (52 Federal Register 36176) inhabits dry, open ponderosa pine woodlands. General life history information about the Pawnee montane skipper can be found in Section 3.9.1.2. Based on this habitat and distribution information, the Pawnee montane skipper is not expected to occur in the proposed Penley Reservoir site or pipeline area.

State Protected Species and Other Species in Need of Conservation

CDOW has identified 8 vertebrate species within Douglas County that are state listed or of special concern (CDOW 2007c; Table 3-5). Of the 74 state listed species, 6 could occur within the Penley Reservoir area: a subspecies of the northern pocket gopher, American peregrine falcon, bald eagle, plains sharp-tailed grouse, northern leopard frog, and northern red-bellied dace (Table 3-5). In addition, CNHP monitors seven species within Douglas Country that are not state or federally listed (i.e., Lewis's woodpecker, ovenbird, hops feeding azure, Moss's elfin, mottled dusky wing, Ottoe skipper, and a tiger beetle). Species mentioned here are those monitored by the CDOW and may not be a complete list of threatened species within the area, particularly for elusive species or for highly mobile species such as birds.

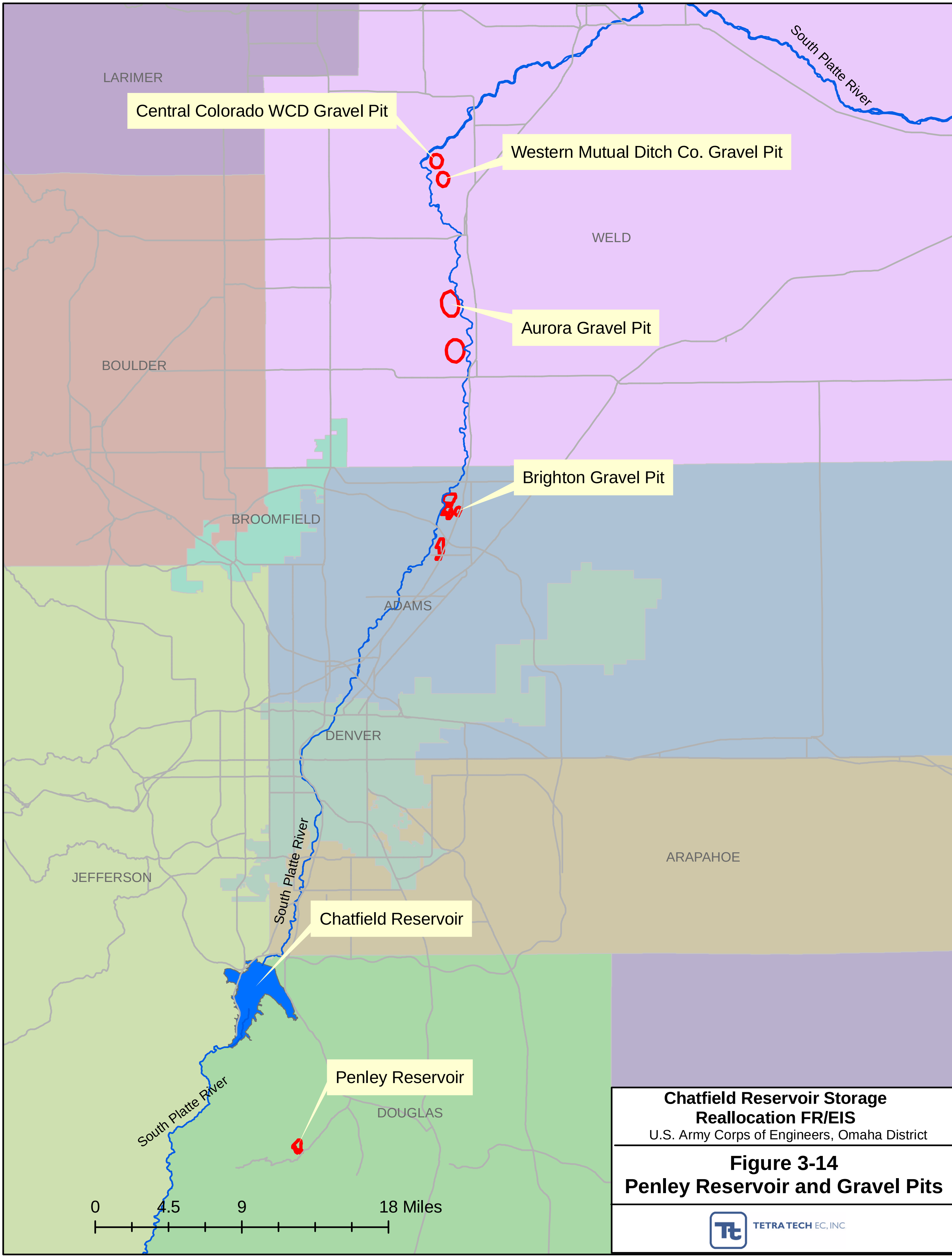

Figure 3-14
Penley Reservoir and Gravel Pits

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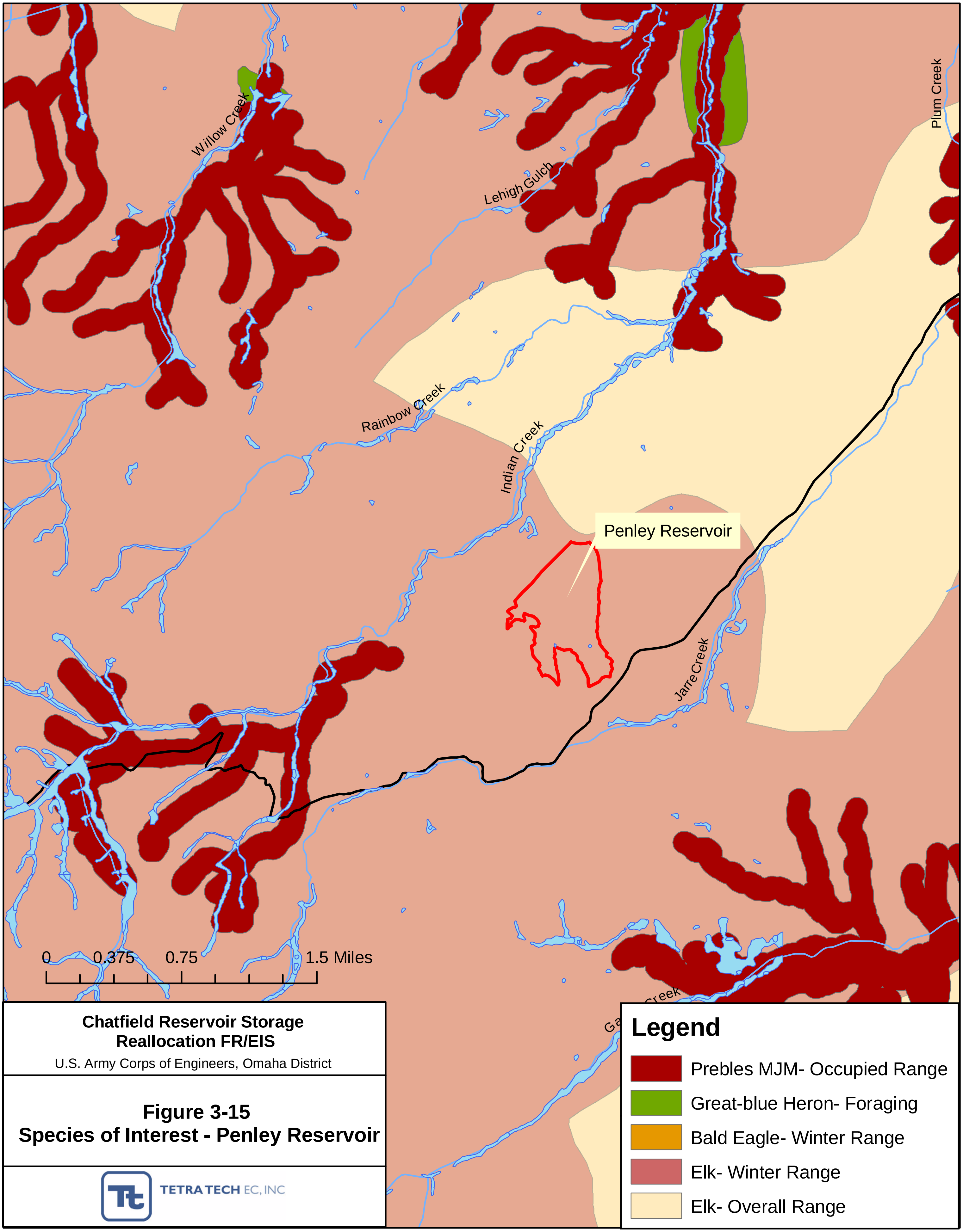

Chatfield Reservoir Storage Reallocation FR/EIS

U.S. Army Corps of Engineers, Omaha District

Figure 3-15
Species of Interest - Penley Reservoir

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Wetlands and species data obtained from: Colorado Division of Wildlife. 2007. Available at http://ndis.nrel.colostate.edu.
RWSD = Roxborough Water and Sanitation District

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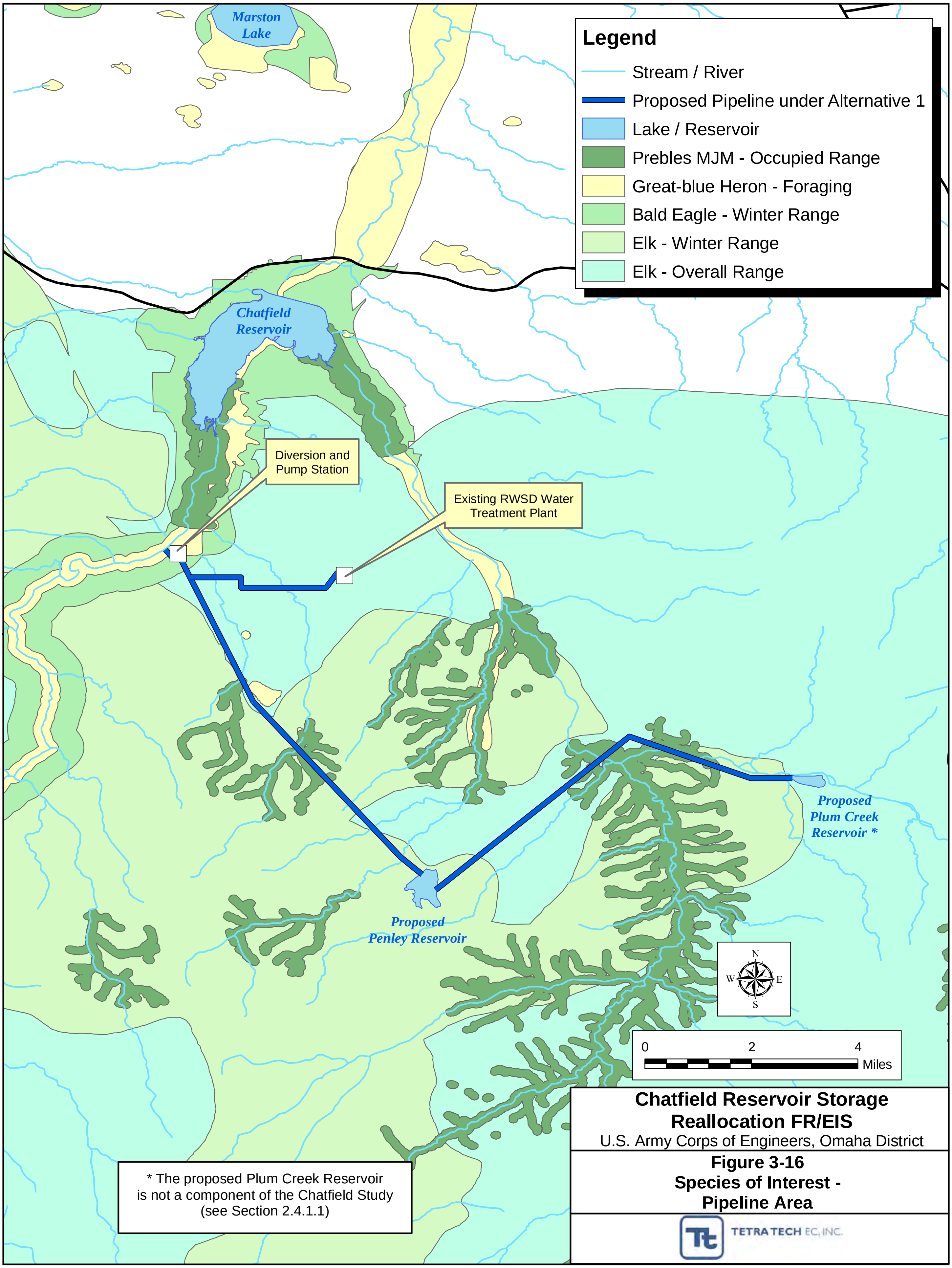

Legend
Stream / River
Proposed Pipeline under Alternative 1
Lake / Reservoir
Prebles MJM - Occupied Range
Great-blue Heron - Foraging
Bald Eagle - Winter Range
Elk - Winter Range
Elk - Overall Range
Marston Lake
Chatfield Reservoir
Diversion and Pump Station
Existing RWSD Water Treatment Plant
Proposed Plum Creek Reservoir *
Proposed Penley Reservoir
N
W
E
S
0
2
4
Miles
* The proposed Plum Creek Reservoir is not a component of the Chatfield Study (see Section 2.4.1.1)
Chatfield Reservoir Storage Reallocation FR/EIS
U.S. Army Corps of Engineers, Omaha District
Figure 3-16
Species of Interest - Pipeline Area
TETRA TECH EC, INC.

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3.9.4 Downstream Gravel Pits

This section assesses special status species that may potentially occur within the downstream South Platte River gravel pits. Figure 3-14 shows the locations of the four gravel pits. Special status species that were identified as potentially occurring within the area are listed in Table 3-5.

3.9.4.1 Special Status Plant Species

The federally threatened Colorado butterfly plant is found in low depressions along wide meandering streams at the interface between riparian meadows and dry grassland. General life history information about the Colorado butterfly plant can be found in Section 3.9.1.1. The likelihood of occurrence within the four gravel pit sites is low based on the high level of disturbance already present within the gravel pits.

The federally threatened Ute ladies'-tresses are found in moist soils on flood plains of rivers and wet meadows, and habitats suitable for this species occur within close proximity to the South Platte River. General life history information about the Ute ladies'-tresses can be found in Section 3.9.1.1. The potential of species occurrence within the two gravel pits located in Weld County is low based on the disturbance already present in the area, but Ute ladies'-tresses could occur in the proposed pipeline area near the South Platte River if native habitats are present. CDOW has identified 10 plant species within Adams and Weld counties in decline at the state level or species whose population status is not well known but thought to be in decline (CDOW 2007c; Table 3-5). These include Colorado watercress, dog parsley, dwarf milkweed, gay-feather, mountain cat's-eye, plains milkvetch, prairie violet, Rocky Mountain bulrush, Sandhill goosefoot, and Wyoming feverfew. Species mentioned here are those monitored by the CNHP and may not be a complete list of sensitive species within each of the four gravel pit areas and their associated pipeline corridors, particularly for elusive species.

3.9.4.2 Special Status Animal Species

Of the 31 species listed as federally endangered, threatened, or candidate species in the State of Colorado, two federally threatened, endangered, or candidate wildlife species occur within Adams or and Weld counties (CDOW 2007c). All state or federally listed species that are monitored by the CNHP that occur within the vicinity of the four gravel pit areas are included in Table 3-5.

Mammals

The federally threatened Preble's meadow jumping mouse is found in thickly vegetated riparian habitats with adjacent grasslands (EPA 1997). In Colorado, this species occurs throughout the South Platte River and its tributaries (NatureServe 2007). A more detailed description of this species habitat requirements and range is found in Section 3.9.1.2. The known occupied range of this species does not occur within any of the proposed gravel pit areas (Figures 3-17 through 3-19). [Note: Figure 3-17 will be revised when information is available on Brighton's replacement.]

The federally endangered black-footed ferret is found in short- to midgrass prairies where there is an abundance of prairie dogs. General life history information about the black-footed ferret can be found in Section 3.9.1.2. The likelihood of occurrence within the No-Action Alternatives is low based on low populations size and a high level of disturbance already present in the proposed gravel pit areas.

Birds

General life history information about the bald eagle can be found in Section 3.9.1.2. Because of the close proximity of all gravel pit areas to the Platte River, the likelihood of occurrence is high (Figures 3-17 through 3-19).

State Protected Species and Other Species in Need of Conservation

CDOW has identified 10 species within Adams and Weld counties that are state listed or of special concern (CDOW 2007c, Table 3-5). Of the 74 state listed species, 7 could occur within the four gravel pit areas: black-tailed prairie dog, swift fox, ferruginous hawk, mountain plover, northern leopard frog, northern red-bellied dace, and cylindrical papershell (Table 3-5). In addition, CNHP monitors 14 species within Adams and Weld counties that are not state or federally listed (i.e., black-necked stilt, chestnut-collared longspur, greater prairie chicken, Lewis's woodpecker, long-billed curlew, McCown's longspur, snowy egret, white-faced ibis, American white pelican, hornyhead chub, Colorado blue, Ottoe skipper, Rhesus skipper, and Weist's sphinx moth). Species mentioned here are those monitored by the CDOW and may not be a complete list of threatened species within each of the five sites, particularly for elusive species or for highly mobile species such as birds.

3.10 Land Use

This section presents an evaluation of land uses associated with the study area, specifically agriculture land uses, not considered prime or unique. As mentioned previously, land use data was obtained for the Chatfield study area, including the South Platte River flood plain (300 feet on each side of the river) downstream from the reservoir to the Adams/Weld county line. However, due to irrigated farming and water related issues, this section also addresses Weld and Morgan counties.

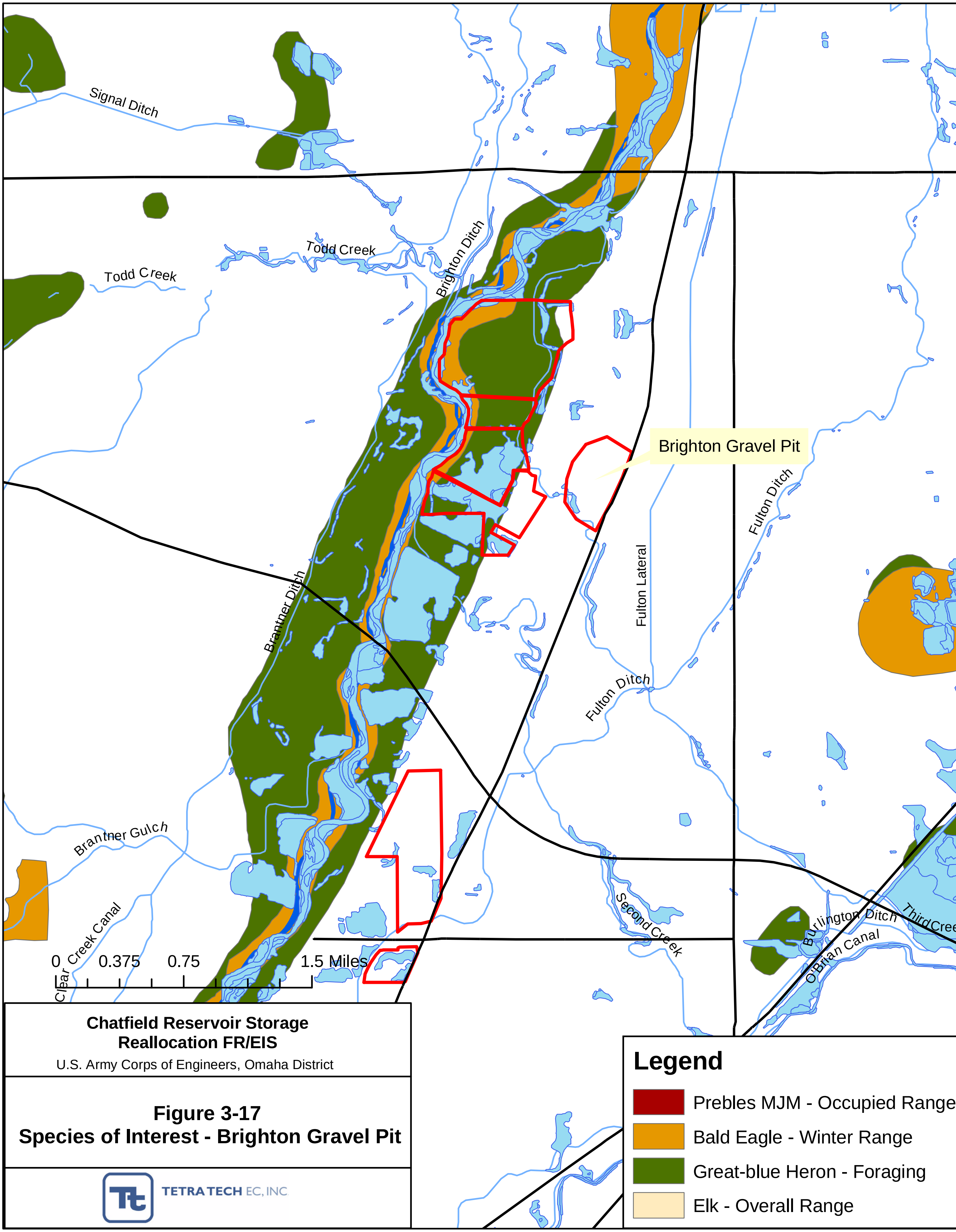
3.10.1 Chatfield Reservoir

When Chatfield Reservoir was first constructed, the land surrounding the lake was predominantly in agricultural use. The large population increases in Douglas and Jefferson counties since the 1950s has changed the land use. Existing land uses in and around Chatfield Reservoir include urban and industrial development, open space and parks, and irrigated and dryland farming downstream of Chatfield.

The Corps' land surrounding the lake includes easements for utilities, including a natural gas pipeline (XCEL Energy), a water pipeline (Chatfield South Water District), and a water pump station and associated utility lines (Denver Water). The locations of these easements are shown in Figure 3-20. An easement is under development for an additional natural gas pipeline for XCEL Energy.

3.10.2 Penley Reservoir and Pipeline Areas

The proposed location for Penley Reservoir is south of the Chatfield Reservoir in Douglas County. Current land use in the Penley Reservoir area is privately owned rangeland. Pipelines associated with Penley Reservoir, if constructed, would cross seven land cover types including deciduous oak, mesic upland shrub, tallgrass prairie, midgrass prairie, foothills/mountain grassland, irrigated crops, and dryland crops (Figure 3-3).



Chatfield Reservoir Storage Reallocation FR/EIS

U.S. Army Corps of Engineers, Omaha District

Figure 3-17
Species of Interest - Brighton Gravel Pit

TETRA TECH EC, INC

Wetlands and species data obtained from: Colorado Division of Wildlife. 2007. Available at http://ndis.nrel.colostate.edu.

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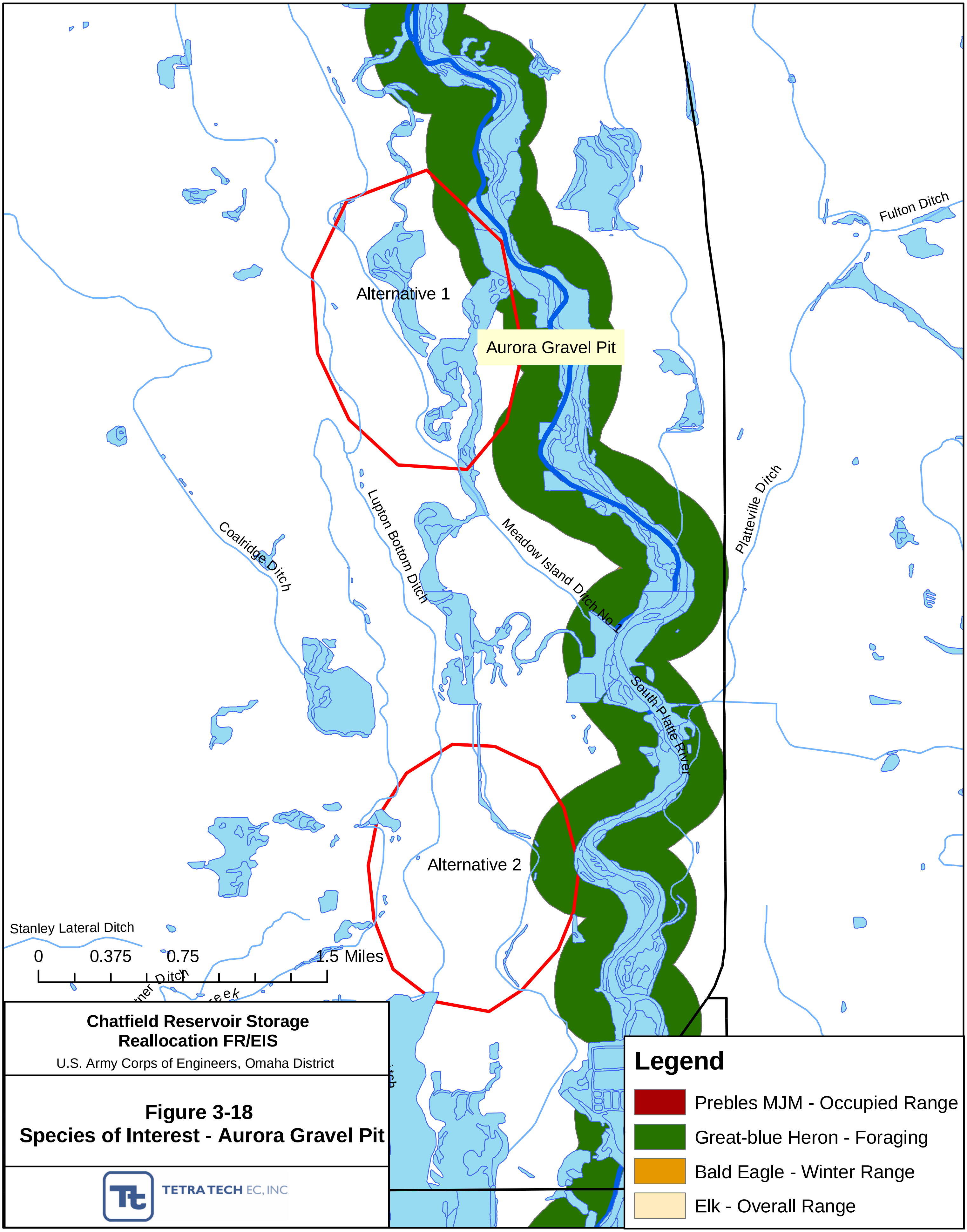

Wetlands and species data obtained from: Colorado Division of Wildlife. 2007. Available at http://ndis.nrel.colostate.edu.

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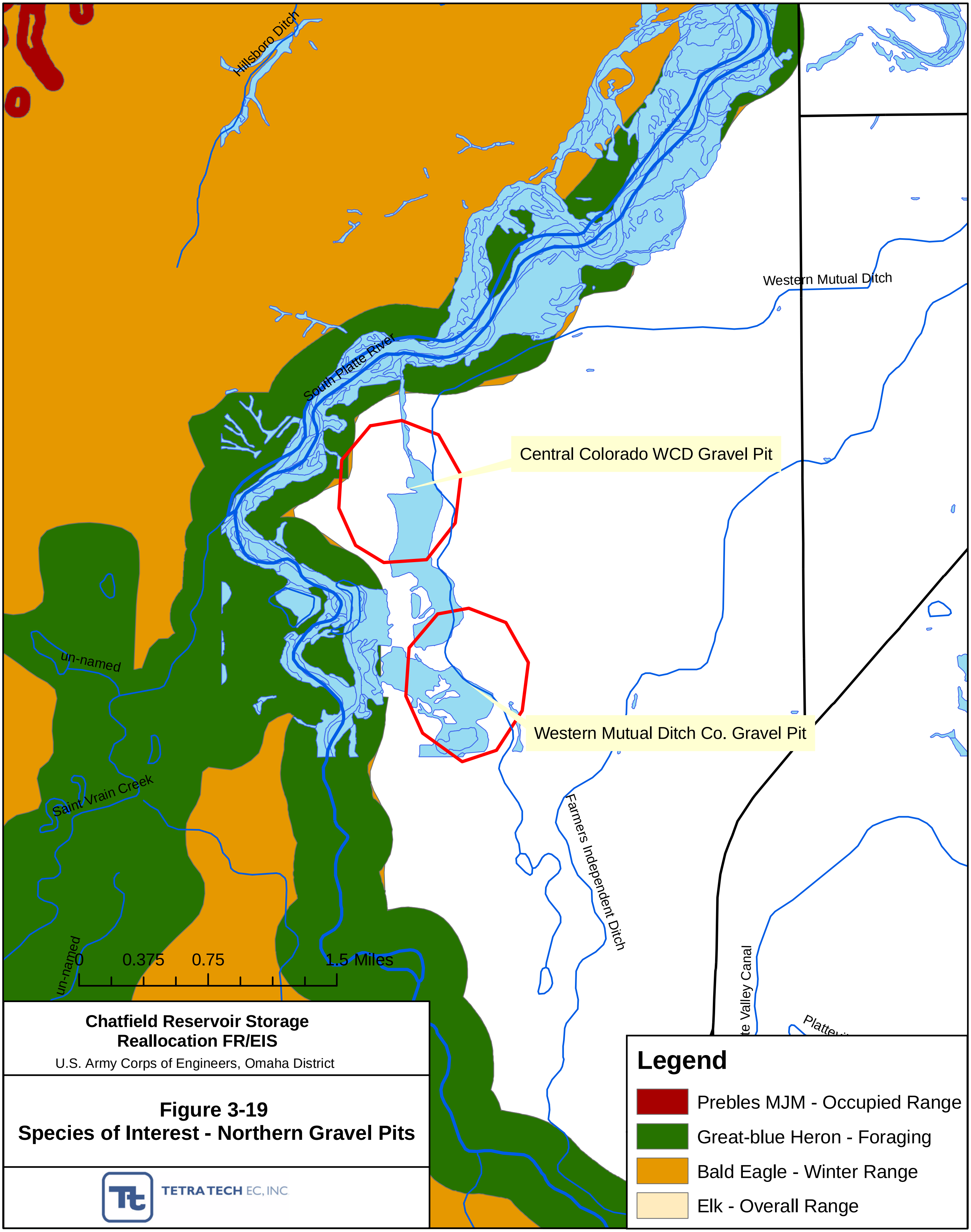

Chatfield Reservoir Storage Reallocation FR/EIS

U.S. Army Corps of Engineers, Omaha District

Figure 3-19
Species of Interest - Northern Gravel Pits

TETRA TECH EC, INC

Wetlands and species data obtained from: Colorado Division of Wildlife. 2007. Available at http://ndis.nrel.colostate.edu.

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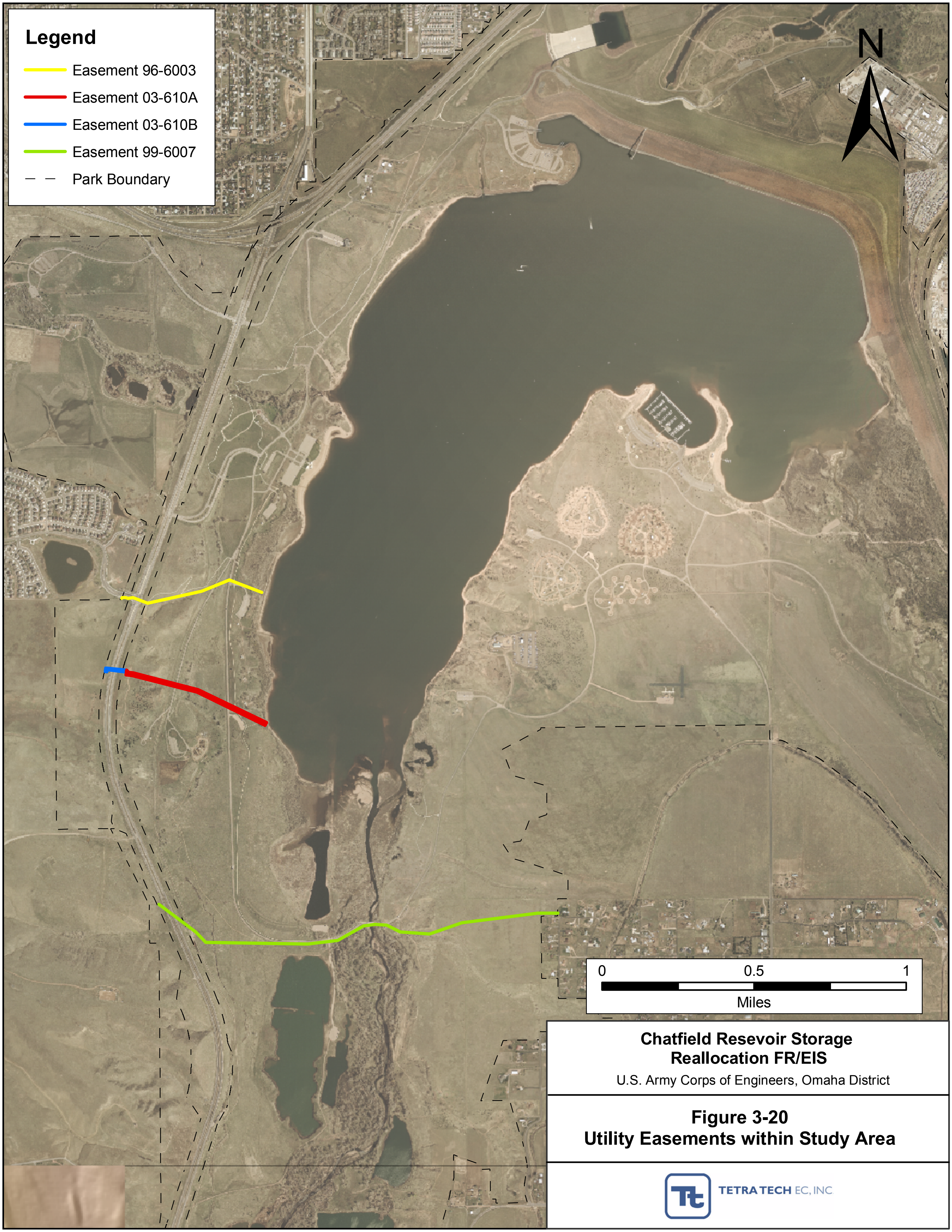

Figure 3-20
Utility Easements within Study Area

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3.10.3 Downstream Gravel Pits

Land use at and immediately adjacent to the four gravel pit areas is used primarily for dryland and irrigated farming. However, over the past years the actual gravel pit footprints have been converted into active gravel mining operations. The gravel pits are discussed in more detail below.

Brighton Gravel Pit

The Brighton Gravel Pit is located north of Denver and west of Brighton along US-85 in Adams County. The predominant land use within this area is primarily used for irrigated cropland, but the inundation area is now used as an open gravel pit. The areas immediately adjacent to the Brighton Gravel Pit, including any associated pipeline routes, are used primarily for irrigated cropland.

Aurora Gravel Pit

The Aurora Gravel Pit is located north of Denver along US-85 in Adams County. The predominant land use within this area is primarily used for irrigated and dry cropland, but the inundation area is currently being used as an open gravel pit. The areas immediately adjacent to the Aurora Gravel Pit, including any associated pipeline routes, are used primarily for irrigated cropland.

Western Mutual Ditch Company Gravel Pit

The West Mutual Ditch Company Gravel Pit is located north of Denver along US-85 in Weld County. The predominant land use within this area is primarily used for irrigated cropland, but the inundation area is currently used as an open gravel pit. The areas immediately adjacent to the Western Mutual Ditch Company Pit, including any associated pipeline routes, are used primarily as irrigated cropland and forested wetlands.

Central Colorado WCD Gravel Pit

The Central Colorado WCD Gravel Pit is located north of Denver along US-85 in Weld County, just northwest of the Western Mutual Ditch Company Gravel Pit. The predominant land use within the area is irrigated cropland, but the inundation area is a heavily disturbed open gravel pit. The areas immediately adjacent to the Western Mutual Ditch Company Pit, including any associated pipeline routes, are used primarily as irrigated cropland and forested wetlands.

3.10.4 Downstream Agriculture

According to the 2002 U.S. Census of Agriculture (2002) Adams, Arapahoe, Denver, Douglas, Jefferson, Morgan, and Weld counties had a total of nearly 3.9 million acres of land in farms. Adams, Morgan, and Weld counties accounted for the most acreage, accounting for 701,471 acres (about 18 percent of the total) in Adams County, 757,946 acres in Morgan County (about 19 percent of the total), and more than 1.8 million acres (about 47 percent of the total) in Weld County. Of the total land in farms for all seven counties, 497,318 acres (about 13 percent of the total) was irrigated farmland.

3.11 Hazardous, Toxic, and Radiological Wastes

3.11.1 Chatfield Reservoir

This section describes existing conditions within Chatfield State Park pertaining to potential environmental contamination on the site, or removal of various facilities due to inundation. Most of this information is based on the Environmental Review Guide for Operations (ERGO) report (USACE 1995). Additional information is based on EPA Region 8, queried databases.

ERGO was established to ensure USACE compliance with all applicable environmental regulations. The ERGO manual is intended to serve as the primary tool for conducting environmental compliance evaluations at USACE facilities. The objectives of the manual are to (1) compile applicable federal and engineering regulations associated with USACE operations and activities; (2) synthesize environmental regulations, good management practices, and risk management issues into consistent and easy-to-use checklists; (3) serve as a reference document for daily operations; (4) serve as a standard for evaluation of environmental compliance; and (5) serve as a guide for implementing USACE's Environmental Strategy Into the 21st Century, which emphasizes environmental stewardship.

An ERGO assessment considers 13 major environmental categories, or protocols. Each protocol includes engineering regulations, engineering manuals, federal regulations, and good management practices. The assessment team was aware of applicable state and local regulations that were considered during the assessment. This assessment considered 13 protocols, where no findings were found for 7 protocols: (1) air emissions management (no findings); (2) cultural and historical resources management (no findings); (3) hazardous materials management; (4) hazardous waste management (no findings); (5) natural resources management (no findings); (6) pesticide management; (7) petroleum, oil, and lubricant management; (8) solid waste management; (9) special pollutants (radon, asbestos, polychlorinated biphenyls [PCBs], lead); (10) underground storage tank management (no findings); (11) wastewater management; (12) water quality management (no findings); and (13) floating plant management (no findings).

An environmental audit was conducted by USACE at Chatfield Reservoir in July 1994 as part of the ERGO report. There were no significant findings; however, six major findings were reported in the audit. The major findings were found in 5 of the 13 protocols, and suggested solutions accompanied each major finding. Many of the findings dealt with hazardous materials management and pesticide management, specifically, the storage and the marking of containers and storage areas.

Findings at Chatfield State Park included the presence of transformers that potentially contained PCBs. The report stated that USACE must check the transformers at the swim beach and marina parking lot to see if they contained PCBs. The transformer at the swim beach is a submersible transformer installed in 1983 and is subject to flooding at high pool levels. The transformer in the marina parking lot is built up on a mound of dirt to reduce the hazard of it being flooded during a high pool level. Both transformers have since been tested and do not contain PCBs.

Other potentially hazardous wastes not addressed in the ERGO report include additional transformers not mentioned in the report, tanks, sewage lift stations, and facilities (e.g., vault toilets). In addition to the two transformers mentioned above, three other transformers exist at the North Ramp, Deer Creek, and Catfish Flats. No aboveground or underground tanks are located within the potentially affected area (at 5,444 feet msl). However, several fuel storage tanks are located at the park. The fuel tanks and chemical storage areas are located at the shop and office complex in higher elevations, and these should not be impacted. Additionally, the marina has a floating fuel tank located at the dock. Lift stations are located at North Ramp, the swim beach, Jamison, Catfish Flats, and Roxborough Cove. There are several pit toilets in the park but no septic systems. There is an abandoned evaporation pond from Colorado State Park's wastewater system, which has a fence around it and is located east of the Plum Creek entrance road. The Park and the Corps are planning to remove this facility from the park in 2008.

Table 3-6 identifies the percentage of recreation and electrical facilities/utilities potentially affected by a raise in the reservoir's elevation. Any facilities or use areas that fall below, or close to 5,444 feet msl are evaluated for replacement or adjustments. An important assumption that guided the conceptual design effort was that no facility or program area would lose any capacity or functionality as the result of relocation or modification (EDAW 2010).

In addition to the ERGO report, EPA, Region 8 databases (Enviromapper StoreFront Database and Emergency Response Notification System Database) were queried. The databases indicated no record of any violations of the Resource Conservation and Recovery Act; no Comprehensive Environmental Response, Compensation, and Liability Act or Superfund sites; and no record of underground storage tanks at Chatfield State Park (EPA 2005a; EPA 2005b). Colorado Department of Labor and Employment (CDLE), Division of Oil and Public Safety found no events (or reported releases of petroleum) within the park (CDLE 2005). The Colorado Department of Public Health and Environment (CDPHE) found no major record of any oil spills occurring in the study area (CDPHE 2005). No spills were reported into Chatfield Lake within this time period. The Emergency Response Notification System Database was searched for any reported releases of hazardous or toxic substances into Chatfield Reservoir from 2000 to the present (EPA 2005b). Again, no spills were reported into Chatfield Lake within this time period.

3.11.2 Penley Reservoir, Pipeline Area, and Downstream Gravel Pits

EPA, Region 8 databases were queried (using EnviroMapper for Envirofacts) for the proposed Penley Reservoir site, the proposed pipeline area, and the downstream gravel pits. The pipeline that would traverse the area between Chatfield Reservoir and the proposed Penley Reservoir would be built near the Denver Water Foothills Water Treatment Plant, an EPA small hazardous waste generator with a National Pollutant Discharge Elimination System-permitted discharge point. This same pipeline would also pass near the Robinson Brick Company Hogback Property and the Sacred Heart Retreat, both of which are monitored under the Colorado Permit Compliance System.

Another proposed pipeline would reach the Roxborough WSD Water Treatment Plant #1, which also is monitored under the Colorado Permit Compliance System. The other proposed features do not occur near EPA regulated sites.

The databases indicated no record of any violations of the Resource Conservation and Recovery Act; and no Comprehensive Environmental Response, Compensation, and Liability Act or Superfund sites (EPA 2005a) in the proposed Penley Reservoir area, the proposed pipeline area, or the downstream gravel pits. CDLE, Division of Oil and Public Safety found no events (or reported releases of petroleum) within the proposed Penley Reservoir, the Brighton Gravel Pit, Aurora Gravel Pit, or Northern Gravel Pit areas (CDLE 2005). The CDPHE found no major record of any oil spills occurring in any of these areas (CDPHE 2005). The Emergency Response Notification System database was searched for any reported releases of hazardous or toxic substances (EPA 2005b). No spills were reported.

Table 3-6. Percentage of Recreation and Electrical Facilities and Utilities within Chatfield State Park Potentially Affected by Pool Elevations of 5,444 Feet above Mean Sea Level

Items	North Ramp (%)	Massey Draw (%)	Swim Beach (%)	Eagle Cove (%)	Deer Creek (%)	Jamison (%)	Catfish Flats (%)	Fox Run (%)	Kingfisher (%)	Gravel Ponds (%)	Platte River Trailhead (%)	Marina Area (%)	Plum Creek (%)
Parking Area													
Asphalt	PI		100		50	100	100					100	
Gravel				75					100	100		100	100
Boat Facilities													
Concrete Boat Ramp	100											100	
Dock												R	
Marina												100	
Marina Slip												R	
ADA[1] Fishing Pier												100	
Trails													
Concrete	PI		100		100	100	100	50			50	100	100
Asphalt		50											
Architecture													
Shower/Restroom			100	100		100	100		100	100		100	100
Information Kiosk			100									100	
Concession			100									100	
Day Use Shelter	100											100	
First Aid Station			100										
Recreational													
Beach Volleyball Court		100						100				100	100
Horse Shoe Pits		100						100				100	
Furniture													
Picnic Table/Bench	50	100	100		100	100	100	100		100		100	100
Trash/Dumpster	50	100	100	100	100	100	100	100	100	100		100	100
Bollards	100		100										
Grills	50	100	100		100	100							
Regulatory Signs	30		100	100	50	100	100	50	100	100		100	100

Table 3-6. Percentage of Recreation and Electrical Facilities and Utilities within Chatfield State Park Potentially Affected by Pool Elevations of 5,444 Feet above Mean Sea Level

Items	North Ramp (%)	Massey Draw (%)	Swim Beach (%)	Eagle Cove (%)	Deer Creek (%)	Jamison (%)	Catfish Flats (%)	Fox Run (%)	Kingfisher (%)	Gravel Ponds (%)	Platte River Trailhead (%)	Marina Area (%)	Plum Creek (%)
Water Fountain			100			100	100	100				100	
Utilities													
Water Hydrant	50		100				100					100	
Lift Station			100			100	100					100	
Telephone			100										
Electrical													
Light Pole			100									100	
Transformer			100			100	100					100	

Source: EDAW 2010
PI = partial inundation
R = relocate
[1] Americans with Disabilities Act

3.12 Air Quality

This section presents an evaluation of the air quality associated with the study area, including a definition of climate and typical weather conditions that potentially could affect the dispersion of air emissions along Colorado's Front Range and the Clean Air Act's regulatory framework for National Ambient Air Quality Standards (NAAQS), which EPA enforces. Additionally, it describes the existing ambient air quality that is considered representative of the study area, including Chatfield Reservoir, the proposed Penley Reservoir, the proposed pipeline area, and the downstream gravel pits.

3.12.1 Chatfield Reservoir

As Colorado's population continues to increase in the Denver Metro area, so does the number of people who depend on cars as their primary source of transportation (DRCOG 1999). Automobile emissions and sand and dust particulates can contribute to health and safety issues. Other sources of air emissions in the metropolitan area include coal-fired power plants, wood burning, diesel-powered construction equipment, and other commercial and industrial sources.

Air quality at Chatfield Reservoir is generally good, even though the reservoir is located near a population center and just south of C-470.

The Clean Air Act of 1970 (43 USC 7401 et seq., as amended in 1990) provides the principal framework for federal and state efforts to protect air quality and requires the adoption of NAAQS to protect health, safety, and welfare from known or anticipated effects of air pollution. EPA sets standards and regulates pollutants into the air and has established NAAQS for eight pollutants:

- Particulate matter less than 10 microns in diameter (PM10)
- Particulate matter less than 2.5 microns in diameter (PM2.5)
- Carbon monoxide
- Nitrogen dioxide
- Sulfur dioxide
- One-hour ozone
- Eight-hour ozone
- Lead

EPA implemented the NAAQS for 8-hour ozone and PM2.5 the two primary pollution concerns in the Denver Metro area, in 1997 and 2001, respectively. The State of Colorado adopted seven of the eight pollutant standards and has been designated by EPA as meeting the attainment/maintenance level for all seven.

The Denver Metro and North Front Range areas became nonattainment areas for the federal ozone standard on November 20, 2007, when a deferral by the EPA expired (Colorado Air Quality Control Commission [CAQCC] 2004; CDPHE 2008a). The nonattainment designation is a result of a violation of the federal 8-hour ozone standard. The standard is based on a 3-year average of monitoring data. Air quality monitoring data for the 2005–2007 averaging period confirms a violation of the 8-hour health-based standard. One of the ozone pollutant monitoring stations is located at Chatfield Reservoir.

The process of developing an Ozone Action Plan to bring the North Front Range area into compliance with the 1997 federal 8-hour ozone standard has been completed. The plan was developed during 2008 and was approved by the Colorado Air Quality Control Commission in December 2008 (CDPHE 2010a).

However, EPA issued a new, more stringent ozone standard in March 2008 that replaces the 1997 standard. Colorado is evaluating the impact of the new standard, which was tightened from 80 parts per billion to 75 parts per billion averaged over an 8-hour period. The state is determining which areas will violate the standard and which additional ozone control measures are needed to meet the standard (CDPHE 2010b). In March 2009, the state recommended that the current Denver Metro/North Front Range 8-hour nonattainment area be designated as nonattainment for the 2008 revised 8-hour ozone standard. This recommendation is based on monitoring information that indicates the region is not in compliance with the 2008 8-hour ozone standard and detailed technical review and analysis (CDPHE 2009).

3.12.2 Penley Reservoir, Pipeline Area, and Downstream Gravel Pits

The information relevant to the Denver Metro area described under Chatfield Reservoir above also applies to the proposed Penley Reservoir, the proposed pipeline area, and the downstream gravel pit sites. Like Chatfield Reservoir, air quality at the proposed Penley Reservoir site and in the pipeline area is generally good. Near the gravels pits, extraction, processing, and shipping gravel is dusty. Existing BMPs, including calcium treatments on internal roads, paved entrances, and truck tarps, help to reduce dust levels.

3.13 Noise

This section discusses current noise levels at and around Chatfield State Park, as well as noise levels at and around the proposed Penley Reservoir, the proposed pipeline area, and the downstream gravel pits.

3.13.1 Chatfield Reservoir

Managing noise within the Denver Metro area is complicated by the varied character and amount of sources in the particular area. The ambient sound pressure level in a particular region is comprised of a variety of natural and manmade sources. Sound levels are determined by small variations in air pressure and these pressures are referenced to a logarithmic scale in the units of decibels. Human response to sound is a function of the magnitude of pressure variations and the frequency distribution of the sound energy.

The A-weighting scale was developed to approximate the human ear's sensitivity to certain frequencies by emphasizing the middle frequencies and de-emphasizing the lower and higher frequencies. This scale, expressed as decibel level (dBA), best correlates with the human response to sound and is commonly used as a descriptor for ambient sound levels.

The threshold of human hearing is about 10 dBA, while the loudest sounds that humans hear are about 120 dBA. Table 3-7 presents typical sound levels for common conditions or activities referenced to the dBA scale.

Table 3-7
Typical Sound Levels for Common Conditions and Activities

Type of Noise	Sound Level (dBA)
Jackhammer, power drill	130 dBA
Gravel plant	Average 102 dBA; range from 88-106 dBA
Front-end loader	Average 90 dBA; range from 87-92 dBA
Personal watercraft	79 (operating 50 feet from an observer onshore) to 94 dBA
Freeway traffic	70 dBA
Daytime urban area	55 dBA
Quiet residential area	40 dBA
Quiet bedroom at night	30 dBA

Source: League for the Hard of Hearing 2003; ELCOSH 2002

Based on Table 3-7, noise levels at Chatfield Reservoir would be expected to be in the 40 to 94 dBA range, or moderate to high. The wide variation is primarily a result of wind speed and direction. The lowest levels occur late at night under calm conditions, while the higher levels occur during the daytime coinciding with activity in and surrounding the state park. These noise levels are moderate because of the presence of regional traffic along C-470, local traffic, and recreational (e.g., motorboat, personal watercraft) noise.

3.13.2 Penley Reservoir, Pipeline Area, and Downstream Gravel Pits

Based on Table 3-7, noise levels at the proposed Penley Reservoir and the pipeline area are about the same as noise levels at Chatfield Reservoir. Noise levels at the downstream gravel pits would be expected to be in the 70 to 106 dBA range, or moderate to high. However, most construction equipment operates with a noise level between 75 and 90 dBA as measured at a distance of 50 feet. These noise levels are moderate to high because operation of the gravel pits requires stripping, extraction of materials, processing, and shipping. This includes daily operation noise (e.g., scrapers, front-end loaders) and traffic noise (e.g., tri-axle or tractor-trailer gravel trucks).

3.14 Aesthetics

This section discusses the aesthetics at Chatfield Reservoir and the surrounding state park, including the visual setting surrounding the reservoir and state park and viewer group expectations. Additionally, this section generally discusses the aesthetics at and around the proposed Penley Reservoir site, the proposed pipeline area, and the downstream gravel pits.

3.14.1 Chatfield Reservoir

The visual setting at Chatfield Reservoir, located on Denver's urban fringe, is rural, consisting of views of the foothills; open space; residential areas; the state park, which includes camping and picnicking areas, miles of hiking and biking trails, and bird watching; environmental education programs; and the reservoir. Various amenities such as the beach, marina, and picnic tables are available to those who come to the park to recreate and enjoy views of the mountains. Views to the west towards the Rocky Mountain foothills, including Plymouth Mountain (7,295 feet msl) and Warren Peak (8,001 feet msl), typically dominate the landscape. Areas to the north, east, and south of Chatfield Reservoir are currently open space or have been developed for residential purposes. The largest development, Highlands Ranch, lies to the east of the reservoir. Topography varies from broad expansive flat farming (open space) areas to higher outcroppings along the foothills with exceptional views. Vegetation consists of wetlands and riparian areas found near the reservoir, to landscaped residential properties and historic farming areas in the distance.

The water levels in Chatfield Reservoir fluctuate during droughts and drawdown periods (which varies each year depending on precipitation), causing aesthetic degradation. Denver Water holds all of the water rights up to the top of the multipurpose pool, 5,432 feet msl. Once the pool rises above 5,432 feet msl, USACE is responsible for management of water in the flood control pool. During the summer months (typically May 1 to September 30), the reservoir stays at a minimum of nearly 5,427 feet msl, but can rise above this elevation based on precipitation, and the remainder of the year the reservoir is typically drawn down to a minimum of 5,423 feet msl.

Visual sensitivity is dependent on viewer attitudes, the types of activities in which people are engaged when viewing the site, and the distance from which the site will be seen. Overall, higher degrees of visual sensitivity are correlated with areas where people live, are engaged in recreational outdoor pursuits, or participate in scenic or pleasure driving. Conversely, visual sensitivity is considered low to moderate in industrial or commercial areas where the scenic quality of the environment does not affect the value of the activity.

The expectation of many visitors at Chatfield State Park is either water-based (e.g., swimming, fishing, sailing, boating, scuba diving) or land-based (e.g., walking, running, hiking, biking, bird watching, dog training, air ballooning) depending on the chosen activity. The water-based and land-based visitors may be considered sensitive viewers because of the nature of their recreational pursuits, which include enjoying viewsheds of the reservoir and foothills.

3.14.2 Penley Reservoir and Downstream Gravel Pits

The visual setting at the proposed Penley Reservoir is a rural area adjacent to multiple recreation areas, including Pike National Forest to the west and Roxborough State Park to the northwest. The proposed pipeline area ranges from rural to rural-industrial. The visual setting of the downstream gravel pits is rural-industrial, with irrigated and dryland farming and related agricultural operations dominating land use, with interspersed areas of gravel pit operations.

3.15 Socioeconomic Resources

This section discusses the social and economic conditions in the study area, located in Adams, Arapahoe, Denver, Douglas, and Jefferson counties. The socioeconomic resources study area also includes Weld and Morgan counties to address impacts to downstream agriculture. Morgan County is discussed only in the downstream agriculture section. All seven counties (including Morgan County, which is discussed only in the downstream agriculture impacts section) are located fully within the South Platte River Basin.

3.15.1 Population

The six-county study area had a total population of 2.4 million in 2003, with a majority of this population residing in Denver (23 percent), Jefferson (22 percent), and Arapahoe (21 percent) counties. Adams, Douglas, and Weld counties are located farther away from the core metropolitan area and are less populated. As stated above, Morgan County is discussed only in the downstream agriculture section.

County population densities ranged from 209 persons per square mile in Douglas County to 3,617 persons per square mile in Denver County in 2000. The statewide average population density was 42 persons per square mile in 2000 (U.S. Census Bureau 2005).

Colorado is presently the third fastest-growing state in the nation (CWCB 2004). Total population increased by 31 percent in the 1990s and has continued to increase in this decade, increasing by an estimated 7 percent between 2000 and 2003 (Table 3-8). Population increased in all six counties in the 1990s. The increases range from 19 percent in Denver County to 191 percent in Douglas County (Table 3-11). Again, from 2000 to 2003, the population of Douglas County increased 28 percent and Weld County increased 16 percent, while the increases observed in the remaining counties all averaged less than 7 percent (Table 3-8). Population projections generated by the State of Colorado anticipate continued growth in all six counties through 2020 (Table 3-9).

Table 3-8
Population by State and County 1990, 2000, and 2003

State/County	1990	2000	2003	1990 to 2000		2000 to 2003	
				Absolute Change	Percent Change (%)	Absolute Change	Percent Change (%)
Colorado	3,294,394	4,301,261	4,601,403	1,006,867	30.56	300,142	6.98
Adams	265,038	363,857	385,262	98,819	37.29	21,405	5.88
Arapahoe	391,511	487,967	520,501	96,456	24.64	32,534	6.67
Denver	467,610	554,636	566,173	87,026	18.61	11,537	2.08
Douglas	60,391	175,766	225,694	115,375	191.05	49,928	28.41
Jefferson	438,430	527,056	529,479	88,626	20.21	2,423	0.46
Weld	131,821	180,936	209,649	49,115	37.26	28,713	15.87

Source: Colorado Department of Local Affairs 2005

Table 3-9
Population Projections 2010 and 2020

State/County	2000 Population	2010 Population Projection	2020 Population Projection	2000 to 2010		2010 to 2020	
				Absolute Change	Percent Change (%)	Absolute Change	Percent Change (%)
Colorado	4,301,261	5,131,089	6,009,699	829,828	19.29	878,610	17.12
Adams	363,857	454,372	573,479	90,515	24.88	119,107	26.21
Arapahoe	487,967	564,180	624,448	76,213	15.62	60,268	10.68
Denver	554,636	605,203	673,735	50,567	9.12	68,532	11.32
Douglas	175,766	286,990	377,580	111,224	63.28	90,590	31.57
Jefferson	527,056	567,494	636,470	40,438	7.67	68,976	12.15
Weld	180,936	264,853	360,335	83,917	46.38	95,482	36.05

Source: Colorado Department of Local Affairs 2005

Population projections from Colorado's Department of Local Affairs Web site are based on assumptions about future demographic trends, as defined by the U.S. Census Bureau. Projections are estimates of the population for future dates. They illustrate plausible courses of future population change based on assumptions about future births, deaths, international migration, and domestic migration. Projected numbers are based on an estimated population consistent with the most recent decennial census as enumerated, projected forward using a variant of the cohort-component method. It is anticipated that population numbers will continue to increase throughout the balance of the 50-year period of analysis, although precise demographic trends are difficult to predict.

The age distribution of visitors to Chatfield State Park is concentrated among three age groups (PricewaterhouseCoopers 2002). The majority of visitors are between the ages of 25 to 54 (76 percent), with the 35 to 44 age group representing the largest single age group. Many families with small children also visit Chatfield State Park but are not represented in the visitor profile, which defined State Park Users as having a minimum age of 18 years. The data were collected through telephone interviews conducted as part of the State Parks Market Assessment (PricewaterhouseCoopers 2002). The demographic profile of visitors is summarized below (EDAW 2010). Note that the percentages sum to 99 percent because of rounding.

- 18 to 24 years of age (4 percent)
- 25 to 34 years of age (22 percent)
- 35 to 44 years of age (32 percent)
- 45 to 54 years of age (22 percent)
- 55 to 64 years of age (10 percent)
- 65+ years of age (9 percent)

3.15.2 Economy

Total full- and part-time employment is presented for 2002 for the six-county study area, as well as the State of Colorado in Table 3-10. The data presented in this table are by place of employment, not place of residence.

Table 3-10
Employment by Sector for State and County 2002

Employment Sector	Colorado	Adams	Arapahoe	Denver	Douglas	Jefferson	Weld
Total full-time and part-time employment	2,947,476	193,479	399,651	537,005	85,225	271,216	102,949
Percent of Total Employment By Type							
Wage and salary employment	78.69%	78.99%	73.62%	87.30%	80.01%	81.11%	76.33%
Proprietors employment	21.31%	21.01%	26.38%	12.70%	19.99%	18.89%	23.67%
Percent of Total Employment By Industry							
Farm employment	1.46%	0.82%	0.10%	0.00%	1.01%	0.26%	5.63%
Nonfarm employment	98.54%	99.18%	99.90%	100.00%	98.99%	99.74%	94.37%
Agricultural services, forestry, fishing, and other	0.36%	0.18%	0.07%	NA	0.25%	0.10%	1.43%
Mining	0.79%	0.33%	0.75%	NA	0.47%	0.55%	1.57%
Construction	7.80%	12.93%	7.31%	5.08%	11.28%	7.90%	9.38%
Manufacturing	6.01%	7.62%	2.86%	5.11%	2.71%	7.36%	11.04%
Transportation and public utilities	2.75%	8.39%	1.47%	5.03%	NA	1.18%	2.98%
Wholesale trade	3.58%	7.58%	4.39%	5.44%	3.52%	2.66%	3.58%
Retail trade	10.47%	10.58%	10.66%	6.34%	18.04%	12.99%	10.55%
Finance, insurance, and real estate	5.33%	3.27%	9.64%	6.57%	6.11%	4.93%	4.57%
Other services except public administration	5.26%	5.70%	5.02%	4.73%	6.37%	5.89%	5.51%

Table 3-10
Employment by Sector for State and County 2002

Employment Sector	Colorado	Adams	Arapahoe	Denver	Douglas	Jefferson	Weld
Government and government enterprises	13.50%	10.70%	8.38%	13.90%	9.96%	12.95%	13.07%
Federal, civilian	1.75%	1.39%	0.64%	2.76%	0.23%	3.08%	0.56%
Military	1.30%	0.55%	0.51%	0.40%	0.37%	0.30%	0.56%
State and local	10.44%	8.76%	7.23%	10.74%	9.36%	9.58%	11.95%

Source: Sonoran Institute 2005
Note: Full and part-time employment includes self-employed individuals.
NA—Data not available for 2002.

Presently, there are approximately 26 total full-time employees and approximately 54 seasonal employees (generally from May 1 to September 30) working at Chatfield State Park. Colorado State Parks employs 14 full-time staff and an additional 40 seasonal workers, typically employed 3 to 6 months annually. USACE has 7 employees working full-time at the Tri-Lakes (Chatfield, Cherry Creek, and Bear Creek lakes) office located at Chatfield's USACE Visitor Center. Concessionaires operating within the park (i.e., marina, equestrian center, swim beach) employ approximately 5 fulltime workers and about 14 seasonal workers (not including volunteers). The laundry concessionaire does not have staff located at Chatfield—just service/repairmen and coin collectors.

3.15.2.1 Chatfield State Park Economy

Potentially affected industries at Chatfield State Park include recreation, tourism, concessionaires, and commercial activities (e.g., hot air ballooning, scuba diving, guided fishing, and photography). Nearly 1.5 million visitors days were spent in the park in 2006 (Chatfield State Park 2006). Recreation resources exist at the park, and general land-based activities (e.g., picnicking, sightseeing, special events, wildlife viewing, model airplanes, dog training, bird watching, visitor center), trail use (e.g., walking, hiking, running, biking, horseback riding), and water activities (e.g., boat fishing, water skiing, windsurfing, personal watercraft use, swimming, fishing, sailing, kayaking, canoeing), respectively, generate the greatest number of annual visitors (CDNR 2003). Additionally, Chatfield State Park offers campgrounds, marinas facilities, horse stables, and laundry services that provide additional revenue to the park. The parks total operating budget is nearly $1.2 million annually. In 2006, the park's total revenue generated exceeded $1.9 million, which included fees associated with each concessionaire (the concessionaires have different contracts with Colorado State Parks, each with varying terms and conditions). This revenue does not include camping fees (by reservation), which calculates revenue in fiscal years. Table 3-11 illustrates Chatfield State Park's annual revenue and visitation from 1995–2006, including concessionaire revenue.

Table 3-11
Revenue and Visitation at Chatfield State Park

Year	Chatfield Visit or Days	Chatfield Revenue ($)	Concession Revenue[1] ($)	Revenue Paid to State[2] ($)	Camping Fees Revenue[3] ($)
1995	1,410,886	705,443	739,679	40,754	54,387
1996	1,530,520	765,260	922,348	56,910	64,919
1997	1,375,761	927,596	876,663	54,248	68,007
1998	1,329,689	1,022,883	966,756	59,157	79,287
1999	1,096,203	967,131	942,569	58,332	98,995

Table 3-11
Revenue and Visitation at Chatfield State Park

Year	Chatfield Visit or Days	Chatfield Revenue ($)	Concession Revenue[1] ($)	Revenue Paid to State[2] ($)	Camping Fees Revenue[3] ($)
2000	1,187,947	1,152,700	1,110,941	65,480	106,771
2001	1,373,600	1,156,775	1,109,674	64,637	109,654
2002	1,448,895	1,318,580	1,045,166	58,552	118,685
2003	1,566,580	1,464,447	1,063,049	58,195	145,428
2004	1,496,264	1,378,339	1,043,326	58,210	238,198
2005	1,582,811	1,523,196	1,146,182	41,022	139,095
2006	1,476,930	1,934,550	unknown	39,280	254,427

Source: Chatfield State Park 2005a; Chatfield State Park 2006

[1] Concessionaire revenue includes combined marina, equestrian center, swim beach, and laundry facilities.

[2] Concessionaire revenue paid to state is included in Chatfield's revenue.

[3] Camping fee by reservation revenue is in fiscal year dollars (July 1, 1995–June 30, 1996 to July 1, 2004–June 30, 2006).

Four separate concessionaires are located in Chatfield State Park including a: (1) marina concessionaire, (2) horse stable concessionaire, (3) swim beach concessionaire, and (4) laundry concessionaire. The marina concessionaire includes a restaurant, marina slip rentals, dry storage, fuel sales, and a grill. The equestrian center concessionaire includes rentals and boarding, the swim beach concessionaire includes a food stand, and the laundry concessionaire consists of various laundry facilities in the campgrounds. Based on unforeseeable events (e.g., low water levels), gross revenue for each concessionaire fluctuates annually. Table 3-11 illustrates total concessionaire revenue.

3.15.2.2 Special Use Permits

Special activities include any event that has the "potential for a significant adverse impact on park values or the health, safety, or welfare of park visitors, or which may otherwise require special planning/scheduling for proper management. Special activities shall require prior approval in the form of a special activities permit" (Colorado State Parks 2005b). Fishing guides and outfitters, hot air balloon guides and outfitters, scuba diver trainers, and photographers that use Chatfield State Park for commercial activities are required to purchase a special use permit. Commercial outfitters are similar to concessionaires, but they are required to obtain a special use permits and there is minimal (if any) contractual agreement with Chatfield State Park.

3.15.2.3 Flood Damages

Flood damages downstream from Chatfield Dam can occur when flows exceed the channel capacity and can result in damage to property. The change in damage potential downstream from the dam was evaluated for the study alternatives. Hydrology and hydraulic studies presented in Appendices H and I investigate the flood damage potential for each alternative. These studies estimate flows and resulting water elevations for various floods that could be experienced along the South Platte River and present alternative differences in those areas.

3.15.2.4 Downstream Agriculture

Table 3-12 shows various statistics from the 2002 Census of Agriculture, Colorado County Level Data, published by the U.S. Department of Agriculture. The three counties shown (i.e., Adams, Morgan, and Weld counties) are most likely the sources of additional water rights that would be needed under Alternatives 1, 2, and 4. Alternative 3 would have the existing water rights needed for implementation.

Table 3-12
County Agriculture Statistics

Agricultural Metrics	Adams County	Morgan County	Weld County
Harvested Acres	260,664	190,850	422,385
Irrigated Harvested Acres	24,799	127,816	300,959
Farm Workers	2506	1527	7898
Market Value of Agricultural Products	$98,670,000	$448,000,000	$1,127,900,000

These counties produce typical crops found in Colorado, including corn, sorghum, wheat, barley, and beans. Of the three counties, Adams County has the fewest irrigated harvested acres and the lowest market value of agricultural products sold. Morgan County has the fewest number of farm workers. Weld County has the greatest number in each category.

3.15.3 Environmental Justice

U.S. Executive Order 12898, Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations (59 CFR 7629, 16 February 1994) directs federal agencies to "make…achieving environmental justice part of its mission" and to identify and address "…disproportionately high and adverse human health or environmental effects of its programs, policies, and activities on minority and low-income populations."

This subsection is further broken down to identify minority populations and low-income populations within the five-county study area.

3.15.3.1 Minority Populations

The first step in analyzing the environmental justice issue is to identify minority and low-income populations that might be affected by implementation of the proposed action or alternatives. Demographic information on ethnicity, race, and economic status is provided in this section as the baseline against which potential effects of future land use decisions can be identified and analyzed.

Minority populations are persons of Hispanic or Latino origin, Blacks or African Americans, American Indians or Alaska Natives, Asians, and Native Hawaiian and other Pacific Islanders. Minority populations for 2010 are identified in Table 3-13. CEQ identifies these groups as minority populations when either (1) the minority population of the affected area exceeds 50 percent or (2) the minority population percentage in the affected area is meaningfully greater than the minority population percentage in the general population or appropriate unit of geographical analysis (CEQ 1997).

Table 3-13
Minority Populations (2010)

Race	Colorado	Adams	Arapahoe	Denver	Douglas	Jefferson	Weld	Total Six Counties
Total Population	5,029,196	441,603	572,003	600,158	285,465	534,543	252,825	2,686,597
White	3,520,793	234,970	361,747	313,012	243,297	427,160	170,827	1,751,013
Percent	70.0	53.2	63.2	52.2	85.2	79.9	67.6	65.2
Black	188,778	12,207	55.657	58,388	3,245	5,001	2,054	136,552
Percent	3.8	2.8	9.7	9.7	1.1	0.9	0.8	5.1
American Indian/Alaskan Natives	31,244	2,478	2,386	3,525	803	2,638	1,419	13,249
Percent	0.6	0.6	0.4	0.6	0.3	0.5	0.6	0.5
Asian	135,564	15,431	28,595	19,925	10,563	13,682	2,873	91,069
Percent	2.7	3.5	5.0	3.3	3.7	2.6	1.1	3.4
Native Hawaiian/Pacific Islander	5,661	476	1,036	495	175	390	158	2,730
Percent	0.1	0.1	0.2	0.1	0.1	0.1	0.1	0.1
Hispanic or Latino (of any race)	1,038,687	167,878	105,522	190,965	21,392	76,445	71,680	633,882
Percent	20.7	38.0	18.4	31.8	7.5	14.3	28.4	23.6
Some Other	7,622	677	1,002	1,208	387	715	359	4,348
Percent	0.2	0.2	0.2	0.2	0.1	0.1	0.1	0.2
Two or More	100,847	7,486	16058	12,640	5,603	8,512	3,455	53,754
Percent	2.0	1.7	2.8	2.1	2.0	1.6	1.4	2.0

Source: 2010 Census summary file.

Due to the size of the six-county area, consideration of impacts to minority and low income populations could be masked by county or metropolitan statistics. Data by Census tracts or the smaller Census block groups are more appropriate. Because data for persons living in poverty is not available at the block group level, it was determined for uniformity that Census tract data would be used for both evaluations.

There are 10 Census tracts surrounding or in close proximity to Chatfield Reservoir. These tracts include all major impacts of the several alternatives. Emphasis is placed on modifications to Chatfield Reservoir, Penley Reservoir, and downstream off-channel water storage at gravel pits. The installation of pipelines and wells are similar to normal construction that occurs throughout the impacted area annually, are short term in nature, and are not considered to be significant regardless of the population impacted.

Populations by race for the Census tracts considered are presented for the 10 tracts considered below (Table 3-14). The Penley Reservoir site is wholly contained within Census tract 142.02 in Douglas County.

Table 3-14
Racial Composition of Census Tracts Near Chatfield Reservoir, 2010

Geographic I.D.	Total Population	White	Percent	Black/African American	Percent	American Indian/Alaska Native	Percent	Asia	Percent	Native Hawaiian/ Pacific Islander	Percent	Hispanic/Latino	Percent	Some Other	Percent	Two or More	Percent
Census Tracts																	
141.24, Douglas County	5,456	4,608	84.5	55	1	13	0.2	190	3.5	3	0.1	461	8.4	14	0.3	112	2.1
141.30, Douglas County	7,591	6,380	84	57	0.8	14	0.2	339	4.5	3	0	619	8.2	10	0.1	169	2.2
141.31, Douglas County	3,283	2,899	88.3	38	1.2	7	0.2	136	4.1	1	0	147	4.5	3	0.1	52	1.6
141.35, Douglas County	2,412	2,139	88.7	22	0.9	11	0.5	81	3.4	0	0	132	5.5	6	0.2	21	0.9
142.02, Douglas County	1,845	1,741	94.4	6	0.3	2	0.1	11	0.6	0	0	66	3.6	1	0.1	18	1
142.03, Douglas County	6,272	5,519	88	32	0.5	19	0.3	100	1.6	5	0.1	477	7.6	8	0.1	112	1.8
142.04, Douglas County	3,188	2,720	85.3	16	0.5	13	0.4	55	1.7	0	0	304	9.5	10	0.3	70	2.2
120.36, Jefferson County	3,707	3,304	89.1	13	0.4	5	0.1	92	2.5	0	0	231	6.2	9	0.2	53	1.4
120.55, Jefferson County	3,706	3,177	85.7	20	0.5	8	0.2	72	1.9	2	0.1	357	9.6	2	0.1	68	1.8
120.57, Jefferson County	5,705	4,926	86.3	31	0.5	8	0.1	122	2.1	2	0	493	8.6	3	0.1	120	2.1
Total	43,165	37,413	86.7	290	0.7	100	0.2	1,198	2.8	16	0	3,287	7.61	66	0.2	795	1.8

Although some variations between Census tracts are indicated, as a whole, the 10-tract area generally has a smaller concentration of minorities than either Douglas or Jefferson counties of which it is a part, and minority concentrations are significantly lower than in the six-county impact area and the State of Colorado.

3.15.3.2 Low-Income Populations

According to the Department of Housing and Urban Development, low-income neighborhoods are those where more than 50 percent of the population has an income less than 50 percent of the median per capita income for the whole community. Low-income populations for 2010 are illustrated in Table 3-15.

Table 3-15
Low-Income Populations 2010

Geography	Population Below Poverty Level (Past 12 months)	Percent Below Poverty Level (Past 12 months)
Colorado	673,912	13.4
Adams County, Colorado	57,850	13.1
Arapahoe County, Colorado	66,924	11.7
Denver County, Colorado	129,634	21.6
Douglas County, Colorado	9,420	3.3
Jefferson County, Colorado	47,574	8.9
Weld County, Colorado	37,671	14.9
Total Six Counties	349,074	13.0

2010 ACS 1-Year Estimate

For the purposes of this analysis, median household income, unemployment rate, and median home value are presented along with percent below poverty level to better describe the social and economic conditions in the impacted area. These are shown by Census tract in the table below.

Table 3-16
Median Household Income, Unemployment Rate, and Median Home Value in Census Tracts Near Chatfield Reservoir

Geographic ID	Median Household Income (2010)	Percent Below Poverty Level	Unemployment Rate	Median Home Value (2010)
Census Tracts				
141.24, Douglas County	112,908	2.1	7.7	329,900
141.30, Douglas County	111,619	0.6	1.1	291,400
141.31, Douglas County	94,167	1	3.9	570,700
141.35 Douglas County	131,696	1.4	8.4	649,000
142.02, Douglas County*	126,538	7.2	9.3	454,300
142.03, Douglas County	107,662	2.4	6.1	373,300
142.04, Douglas County	102,029	4.1	2.6	235,600
120.36, Jefferson County	119,375	1.6	5.8	447,300
120.55, Jefferson County	81,838	2.5	5.2	288,500
120.57, Jefferson County	69,331	2.6	7.6	210,800

*The Penley Reservoir site is wholly contained within this Census tract.

As shown, the area around the alternatives considered in detail is composed of middle and upper middle class suburbs. Median home values range from a low of $210,800 to $649,000. Median family incomes range from $69,331 to $131,696, well above the Colorado State average of $56,456. Although some variations between Census tracts are indicated, as a whole, the 10-tract area generally has a smaller percentage of households below the poverty rate than either Douglas or Jefferson counties, and a lower percentage than the six-county impact area and the State of Colorado; with the exception of Census Tract 142.02, which is higher than that of Douglas County as a whole, but still significantly lower than the 13 percent present in the six-county area.

3.15.4 Penley Reservoir, Pipeline Area, and Downstream Gravel Pits

The above information on population, economy, and environmental justice is for a six-county area, which includes Chatfield Reservoir, the proposed Penley Reservoir, the proposed pipeline area, and the downstream gravel pits.

3.16 Transportation

This section discusses public access to Chatfield Reservoir and the surrounding state park, including access issues to, from, and within the park. Additionally, it includes a minimal discussion on transportation at the proposed Penley Reservoir, the proposed pipeline area, and the downstream gravel pits.

3.16.1 Chatfield Reservoir

The primary transportation system at Chatfield State Park serves visitors driving to and from the park. Chatfield State Park-managed routes provide public access to a wide array of recreational activities as described in Section 3.17. The state park road system is primarily a low-standard, paved road (approximately 2 miles are unpaved). Public access to the park requires a road system, although once a visitor has arrived at the park, designated parking areas are available from which miles of trails can be accessed. Nearby residents can access the park via foot or bike. State Highway C-470 borders the park on the north and west, while US-85 (Santa Fe Drive) borders the park on the east, and Titan Parkway is the main access road located near the park on the south. Access to the park includes the main entrance at Deer Creek off of State Highway 121 (Wadsworth Boulevard), accessed from C-470. As an alternate route, visitors can access the Plum Creek entrance at Roxborough Park Road, off Titan Parkway.

Once inside park boundaries, visitors may access various recreational facilities (e.g., picnic tables, marina, horse stable, trails) with 24 miles of road access. Vehicle parking areas provide 2,528 parking spaces and access to 20 miles of hard surface trails with various recreation opportunities for many types of users (EDAW 2010). Additionally, trail users can access the Colorado Trail from within park boundaries (Colorado Trail 2005).

3.16.2 Penley Reservoir, Pipeline Area, and Downstream Gravel Pits

The primary transportation route needed to access the proposed Penley Reservoir is via I-25 and CO-67, which leads to Sedalia, Colorado, along the Front Range. Travelers along CO-67 are either residents/commuters from Sedalia to Denver, or travelers heading into the mountains. Parts of the pipeline area would pass along utility corridors along Plum Creek and along US-85. Other pipeline areas would run parallel to CO-67, or through relatively open areas. Additionally, all of the downstream gravel pits are located along the South Platte River, which generally follows US-85. Other secondary roads are located off of that route. All three of the primary roads above are considered standard-grade, paved highway roads.

3.17 Recreation

This section identifies the existing recreational uses and potentially affected areas within the study area, including water- and land-based recreation activities. Most of the recreation information in this section was gathered from the "Chatfield Reservoir Recreation Facilities Modification Plan" report prepared by EDAW (2010). (Appendix M of the FR/EIS).

Chatfield State Park must remain in outdoor recreation uses pursuant to Section 6(f) of the Land and Water Conservation Fund Act (LWCF) Act (Public Law 88-578, as amended) because LWCF assistance was used by the Colorado Division of Parks and Outdoor Recreation to obtain water for Chatfield Reservoir. The National Park Service (NPS), with assistance from Colorado State Parks, oversees compliance with the LWCF Act. The NPS has issued a letter concurring with Colorado State Parks that the Chatfield Reservoir Storage Reallocation project will not result in a Section 6(f)(3) conversion (see Attachment 3 in Appendix S). Many recreational opportunities are available at Chatfield State Park. This approximately 5,300-acre park receives more than 1.5 million visitor days annually because its amenities are popular with the public and because the park is close to Denver (see Table 3-11). Chatfield is one of the most diverse parks in Colorado. Major facilities include 197 campsites, 10 group campsites, 4 major group picnic areas, 139 family picnic sites, 3 major boat ramps, 20 miles of paved trails, 33.3 miles of paved roadway, 9.6 miles of unpaved roadway, 2,528 parking spaces, 38 restrooms, 6 shower buildings, a maintenance shop, and a swim beach complex. The park also includes a horse stable, marina, and hot air ballooning launch area (EDAW 2010).

The 2002 Master Plan for Chatfield Reservoir identified the following annual activity mix at the Reservoir (Table 3-17). These data were based on averages for fiscal year 1993 to fiscal year 2000 (USACE 2002b).

Table 3-17
Annual Activity Mix at Chatfield Reservoir, Compiled from USACE and Colorado State Parks Visitation Data

Activity	Average Percent Activities Per Visit[2]	Average Percent of Total[2]	Average Percent Activities Per Visit[3]	Average Percent of Total[3]
Camping	1.80%	1.05%	5.49%	3.65%
Picnicking	39.98%	22.94%	10.54%	7.00%
Boating	5.34%	3.11%	7.55%	5.02%
Fishing	40.91%	23.83%	27.58%	18.33%
Hunting	—	—	—	—
Skiing	0.77%	0.45%	0.93%	0.62%
Swimming	2.20%	1.28%	3.03%	2.02%
Other [1]	51.62%	30.08%	77.24%	51.33%
Sightseeing	29.63%	17.26%	18.11%	12.04%
Winter Activities (e.g., sledding, ice skating, etc.)	—	—	—	—
Total[4]	172.25%	100%	150.48%	100%

1 "Other" includes, but is not limited to, hiking/walking, jogging/running, bicycling, horseback riding, dog training/tracking/search and rescue, interpretive activities, wildlife observation/enjoying viewsheds, bird watching, photography, hot air ballooning, scuba diving, and participation in special events.

2 Source: USACE 2002b. Data are based on current fiscal year seasonal traffic counts and formulas developed from surveys and traffic counts in 1992–1995.

3 Source: Monthly Visitation Data from Chatfield State Park on Activity Days and Visitors (Visitor Days), October 2006–September 2007 (fiscal year 2007). Data are based on current fiscal year traffic counts on roads and trails and formulas developed and updated from surveys and traffic counts every 5 years.

4 The total of 172 percent means that the average visitor to Chatfield State Park participates in 1.72 activities per visit. The total of 150 percent means that the average visitor to Chatfield State Park participates in 1.5 activities per visit, based on State Parks data.

3.17.1 Recreational Areas within Chatfield State Park

Recreation use areas potentially affected by storage reallocation at Chatfield Reservoir would include the North Boat Ramp, Massey Draw, Swim Beach Area (including Eagle Cove, Deer Creek, and Jamison areas), Catfish Flats and Fox Run group use areas, the Kingfisher/gravel ponds/Platte River Trailhead areas, Marina Area (including Marina Point, South Boat Ramp, Riverside Marina, and Roxborough day use areas), and Plum Creek area (EDAW 2010). These areas are discussed below, and Table 3-18 identifies the recreational facilities at each of these areas.

The North Boat Ramp is located on the west side of the reservoir. Facilities provided here include two ramps, paved parking and circulation areas, and a variety of support facilities, including picnic shelters and restrooms (EDAW 2010).

The Massey Draw area is a popular use area located on the west side of the reservoir and south of the north boat ramp. Facilities provided here include gravel parking and circulation areas, and a variety of support facilities, including picnic tables and restrooms (EDAW 2010).

The Swim Beach Area is heavily visited. Major development has occurred in the swim beach area, including large parking areas, a swim beach with graded slopes and sand, and a wide variety of support facilities, including restrooms and concession buildings. Directly south of the swim beach area is the Jamison group use area which includes a paved parking area, restroom, and picnic tables. The swim beach area also includes the Eagle Cove and Deer Creek areas. Eagle Cove is a use area north of the swim beach and just north of Deer Creek. This area includes limited facilities such as a small parking area (wheel stops), a portable restroom, and a few trash receptacles. Deer Creek includes hot air balloon launch facilities and day use sites (EDAW 2010).

The Catfish Flats and Fox Run group use areas are on the west side of the reservoir and include picnic areas, restrooms, parking, and related facilities. Specifically, the Catfish Flats area includes paved parking, a restroom, covered tables, and a few group picnic areas. The Fox Run area includes gravel parking, two portable restrooms, covered tables, and a group picnic area (EDAW 2010).

A variety of uses occur on the southern portion of the reservoir, especially around the gravel ponds that lie upstream of the reservoir and the main park road that leads to the campground and marina area. Dog training clubs, non-motorized boaters, fishermen, and scuba divers use the large gravel pond and there are relatively few developed facilities in this area, primarily parking areas and trails. The Kingfisher area includes gravel parking, a portable restroom, and a few trash receptacles (EDAW 2010). The Platte River Trailhead area is located near the gravel pond area and includes paved parking, a restroom, and a few trash receptacles (EDAW 2010).

The Marina Area includes Marina Point, South Boat Ramp, Riverside Marina, and Roxborough day use area. The Riverside Marina is a floating facility designed to allow for water-level fluctuations between 5,423 and 5,432 feet msl. All docks and the floating platform for the restaurant and store have anchor posts extending 4 feet underwater, a depth that allows most boats to moor at the marina slips when reservoir levels are at or above 5,423 feet msl. The marina facilities also include a floating gasoline tank and gasoline pump. This is a high-use area that has been extensively developed to include the marina, a fishing pier, extensive paved parking areas, a boat ramp, group picnic sites, and an extensive network of walkways and trails. Marina Point facilities include a parking area, group day use area, volleyball and horseshoe pits. The South Boat Ramp is located next to the Riverside Marina on the south side of Chatfield Reservoir. The Roxborough day use area is also included in the Riverside Marina area (EDAW 2010).

The Plum Creek area facilities include a trailhead, a day use area with picnic tables, a restroom, and a gravel parking area (EDAW 2010

3.17.2 Water-Based Recreation

Water-based recreational uses at Chatfield State Park include a variety of seasonal and year-round activities geared towards local residents and visitors. The primary water-based recreational opportunities include fishing, swimming, sailing, boating, and scuba diving (in the large gravel pond). A large population of rainbow trout and smallmouth bass are stocked in Chatfield Reservoir, as are channel catfish, yellow perch, tiger muskie, crappie, and walleye. Ice fishing is a major water-based winter recreation activity. Open water fishing for rainbow trout begins in the spring, and throughout the summer, smallmouth bass, yellow perch, crappie, and channel catfish are popular catches (Chatfield State Park 2005b).

Table 3-18
Existing Recreation Facilities

Items	North Boat Ramp	Massey Draw	Swim Beach	Eagle Cove	Deer Creek[8]	Jamison	Catfish Flats	Fox Run	Kingfisher	Gravel Ponds	Platte River Trailhead	Marina Area	Plum Creek[9]
Parking Area													
Asphalt[2]	9.18		5.46		0.60	0.95	1.40				0.44	3.40	
Gravel[2]		0.78		0.30	0.78			0.71	0.87	1.99			0.80
Wheel Stops		34	274	29	28	61	79		28	38	87	36	
Boat Facilities													
Concrete Boat Ramp[2]	0.39											0.11	
Dock	4												
Marina												1	
Marina Slip												320	
Parking/Boat Storage												265	
ADA[3] Fishing Pier												1	
Trails													
Concrete[5]	1.42		0.12		0.43	0.71	0.44	1.13			0.21	0.17	0.17
Asphalt[5]		0.22											
Foot Bridge (linear feet)					15								
Shower/Restroom	2	1	1		1	1	1				1	1	1
Information Kiosk	2		2		1							1	
Concessions			1									1	
Group Picnic Area							2	1				2	
Day Use Shelter[6]	8											1	
First Aid Station			1										
Furniture													
Portable Restroom				1				2	1	1			
Picnic Table	32	8	12		12	4	5			4		10	11
Bench	1	3	7		1	1	1				2	1	1
Water Fountain	4		2		2	2	2					1	
Dumpster	3	2	4	1	1	1	1	1	1	1		4	1
Trash Receptacle	7	3	10	1	2	1	1	2	1	1	2	4	
Bollard	4		6		4								
Grill	8	8	8		11	4							

Table 3-18
Existing Recreation Facilities

Items	North Boat Ramp	Massey Draw	Swim Beach	Eagle Cove	Deer Creek[8]	Jamison	Catfish Flats	Fox Run	Kingfisher	Gravel Ponds	Platte River Trailhead	Marina Area	Plum Creek[9]
Regulatory Sign	46	12	17	2	5	9	9	5	3	18	7	37	2
Fencing (linear feet)		487	929	84				716	375	596	743		697
Recreational Facilities													
Beach Volleyball Court		1						1				1	1
Horse Shoe Pits		2						2				2	
Utilities													
Water Hydrant	2		2		1		3	1					
Lift Station	2		1			1	1						
Telephone	1		2										
Transformer	1		2		1	1	1						
Light Pole	26		1										

Source: EDAW 2010

1 Units are measured in acres.
2 Units were in square feet, but were changed to acres.
3 Americans with Disabilities Act.
4 Units are measured in miles.
5 Units were in square feet, but were changed to miles. Most concrete trails are 8 feet wide (one is 10 feet wide), so this was used for the calculation.
6 Includes group shelters.
7 Includes 197 regular campsites and 10 large group campsites.
8 Includes Deer Creek Entrance station and balloon launch area.
9 Includes pedestrian bridge over Plum Creek.

3.17.3 Land-Based Recreation

Land-based recreational uses at Chatfield State Park include the marina, beaches, campsites, and trails. These recreational uses are primarily associated with popular public areas and visitor attractions that provide views of the reservoir and surrounding foothills. At the Chatfield stables, horses may be leased for a fee, or visitors can bring their own horses to the west side of the park. The park is fully accessible to visitors with disabilities. The 20 miles of paved trails are wide and relatively flat to accommodate wheelchairs. An Americans with Disabilities Act (ADA) accessible fishing pier is located near the marina on the east side of the lake, and an access trail is located along the South Platte River (Chatfield State Park 2005b).

Other parks in the area include South Platte Park which is located just north of Chatfield State Park. The two parks are separated by C-470 and are connected by a trail that passes under C-470. South Platte Park is an 878-acre natural open space area along the South Platte River owned by the city of Littleton and managed by South Suburban Parks and Recreation District. Amenities include a 2.5-mile-long paved regional trail system, 4 miles of unpaved walking trails, 5 lakes and 2.5 miles of the river open to fishing, a wildlife reserve area, over 300 species of vertebrates, a free public nature center, and a classroom. South Platte Park is visited by over 4,000 program participants per year, 12,000 nature center visitors, and hundreds of thousands of trail users (The Orion Society 2006).

3.17.4 Penley Reservoir, Pipeline Area, and Downstream Gravel Pits

Similar to Chatfield Reservoir, the proposed Penley Reservoir site is surrounded by nearby recreation areas, including Roxborough State Park and the Pike National Forest. . . The route of the proposed pipeline from the South Platte River to Penley Reservoir is within one mile of the eastern border of Roxborough State Park (Figure 2-1). The routes of the other proposed pipelines are not in the proximity of the recreation areas. Additionally, the gravel pits are located along the South Platte Reservoir, so there are likely opportunities for fishing.

3.18 Cultural Resources

This section describes cultural resources within the project Area of Potential Effects (APE) based on available literature and site-specific studies. Cultural resources in the vicinity of the proposed Penley Reservoir, the proposed pipeline area, and the downstream gravel pits are also discussed.

3.18.1 Chatfield Reservoir

Cultural resources are those aspects of the physical environment that relate to human culture, society, and cultural institutions that hold communities together and link them to their surroundings. Cultural resources include expressions of human culture and history in the physical environment, such as prehistoric and historic sites, buildings, structures, objects, districts, natural features, and biota that are considered important to a culture or community. Cultural resources also include aspects of the physical environment that are a part of traditional lifestyles and practices and are associated with community values and institutions.

Archaeological site investigations in the Chatfield State Park area date back to the late 1940s, although the earliest recorded archaeological work in the project area began in 1966 with the inception of the National Historic Preservation Act (NHPA) (Public Law 89-665 and the amendments thereto, 16 USC § 470 et seq.). This policy calls for the consideration of the effect on historic properties by undertakings funded by federal agencies or in pursuit of federal permitting

(Hutt et al. 1999). The Colorado Office of Archaeology and Historic Preservation maintains the official state site files and makes determinations on their eligibility for listing on the National Register of Historic Places (NRHP). Coordination between the USACE and the Colorado Office of Archaeology and Historic Preservation regarding the National Historic Preservation Act is included in Appendix S. Letters were sent to 14 tribes on October 13, 2005, requesting comments and their participation in the Section 106 process of the NHPA regarding the proposed Chatfield reallocation (for additional information see Appendix S).

During the summers of 1965 and 1966, an archaeological team from the University of Denver under contract to the National Park Service conducted reconnaissance studies and identified 31 prehistoric sites within the proposed area of Chatfield Reservoir (Withers 1972). The National Park Service sponsored further archaeological investigations in the late 1970s during which test excavations were undertaken at several of the sites previously identified by Withers (Nelson 1979). In 1986, archaeologists from the Colorado Highway Department monitored construction activities on 60 acres at Chatfield Reservoir. No previously undocumented archaeological resources were identified during that effort (Baugh 1986, Baugh and Angulski 1986). Reconnaissance level investigations were conducted by the National Park Service in 1995 and 1996 to evaluate the impacts of dam construction and maintenance activities on the sites identified by the University of Denver team in the 1960s (Foster Wheeler 2000b). Most of these sites could not be relocated and were interpreted as destroyed. Those archaeological sites that could be relocated were evaluated as significantly impacted by activities related to the construction and maintenance of Chatfield Reservoir. Foster Wheeler (2000b) conducted an archival records search in 2000 and visited several of the sites recorded within the APE from the reservoir to the Denver Gage. Field visits were limited to those sites that were relocated during the 1995–96 reconnaissance. Sites downstream of Chatfield Reservoir were not field verified during the 2000 field visit. In 2005, an archival records search was conducted from the Denver Gage to the Adams/Weld county line.

An intensive Class III archaeological pedestrian survey was recently completed for the USACE to provide an assessment of site locations and conditions within Chatfield State Park, an area that includes Chatfield Reservoir (Dominguez et al. 2007). A total of 3,605 acres was surveyed, with the identification of 25 previously unrecorded archaeological sites, of which 2 are prehistoric, 21 historic, and 2 with historic and prehistoric components. Two prehistoric and 2 historic sites have been recommended as eligible for listing on the NRHP. One prehistoric site and the 2 multi-component sites with prehistoric deposits consist of lithic debris only and have been classified as open lithic scatters. This site type is characterized by a discrete scatter of flaked lithic debris with no associated shelter. Another prehistoric site is defined as an open camp type and contained flaked lithic tools, lithic debris, and two manos exhibiting use-wear polish. In addition, small amounts of charcoal were recovered from test excavations. None of the NRHP-eligible sites are contained within proposed APE for Alternatives 3 or 4 for the Chatfield Reservoir storage reallocation project.

One of the NRHP-eligible historic sites consists of a standing cribbed log cabin. A limited number of scattered agricultural implements, fence posts, and domestic artifacts suggest this structure was a late 19th to early 20th century farmhouse. As an example of vernacular rural architecture, this site is a distinctive historic type. The second NRHP-eligible historic site is composed of a remnant cellar hole, two smaller depressions interpreted as outbuildings, a stone-lined privy, and a scatter of artifacts indicating probable use as a farmstead from the late nineteenth to early 20th century.

In addition to the documented sites, the survey recorded 18 isolated finds, which are defined as small scatters of five items or fewer. Of these isolated finds, 6 were prehistoric finds of nondiagnostic flaked lithic debris, and 12 consisted of single historic finds or limited trash scatters.

In previous investigations, 77 cultural resource locations were identified and recorded in Chatfield State Park. These include 28 prehistoric archaeological sites, 9 isolated prehistoric localities (i.e., defined as fewer than 5 flakes within a restricted area with no associated features), 23 historic archaeological sites, 12 historic isolated finds, and 5 archaeological sites that contain both prehistoric and historic components. The majority of these sites were destroyed by construction of Chatfield Dam and associated infrastructure, or by inundation of Chatfield Reservoir. Twenty-six sites are extant but are located outside the proposed APE. There are no NRHP-listed or NRHP-eligible sites within the APE for elevated pool levels associated with Alternatives 3 or 4 of the Chatfield Reservoir storage reallocation project.

3.18.2 Penley Reservoir, Pipeline Area, and Downstream Gravel Pits

The proposed Penley Reservoir and the proposed pipeline area traverse the ecotone between the plains to the east and the Rocky Mountain Front to the west, an area of rich environmental diversity. Numerous prehistoric archaeological sites have been identified in the foothills of the Hogback Valley, dating from the Early Archaic to the Woodland periods (6,000 B.C. to AD 1,000). An extensive survey was conducted in the region in the early 1970s by the University of Colorado Museum to assess the impact of planned water projects by Denver Water, during which dozens of archaeological sites were identified (Scott and Gillio 1973). This survey confirmed earlier assumptions about the high concentration of archaeological sites in the Hogback Valley. A subsequent inventory of sites in Roxborough State Park by the Office of the State Archaeologist led to the eventual designation of the park as an archaeological district listed in the NRHP (Tate and Black 1979). Approximately 40 archaeological sites have been identified and determined to be potentially eligible for listing on the NRHP within Roxborough State Park. Within 1 mile of the proposed APE, outside of the park precinct, an additional 29 prehistoric archaeological sites have been determined to be potentially eligible for NRHP listing.

One of the proposed pipelines partially follows the course of East Plum Creek, which is situated between Cherokee Mountain to the north and highly dissected uplands to the south. Nineteenth century railroad builders took advantage of the low gradient of East Plum Creek to site the Denver & Rio Grande Railroad (in 1871) and the Atchison, Topeka & Santa Fe Railroad (ATSF) (in 1887) along it on their Pueblo to Denver routes. Railroad construction generated increased opportunities for settlement along East Plum Creek, spurring growth in the towns of Castle Rock, Sedalia, and Louviers. Documented cultural resources within 1 mile of the proposed reservoir and pipeline include seven historic properties in Sedalia and its vicinity, and five small prehistoric localities in proximity to the drainage. Among the historic properties, the Santa Fe Railroad Water Tank, dating from 1906, is listed in the NRHP. South of Sedalia, ranching landscapes in the West Plum Creek drainage have retained a high degree of integrity from their 19th and early 20th century origins, and have been listed in the NRHP as the Bear Canon Agricultural District. The district incorporates approximately 800 acres along a 2 ½-mile section of West Plum Creek, and includes a number of extant historic structures dating from its period of significance, 1850 to 1924.

Previous surveys within the proposed APE are portrayed in Table 3-19.

Table 3-19
Archaeological Surveys within the Proposed APE

Author	Date	Title	Report Findings
Chatfield Reservoir			
Arnold Withers (Department of Anthropology, University of Denver)	1972	Archaeological Survey of the Chatfield Reservoir, Colorado, 1968	31 prehistoric sites within reservoir Project Area
Sarah Nelson (National Park Service, Denver, Colorado)	1979	Archaeological Investigations in Chatfield Reservoir, Colorado	Testing at various sites recorded by Withers
Susan Thomas Baugh (Colorado Department of Highways)	1986	Archaeological Survey of Chatfield Arboretum, Jefferson County, Colorado	60 acres surveyed; 2 sites noted, but not impacted by project
Susan Thomas Baugh and Debra Angulski (Colorado Department of Highways)	1986	Archaeological Monitoring at the Chatfield Arboretum, Jefferson County, Colorado	60 acres monitored; no new sites noted during monitoring
Debra Angulski (Colorado Department of Highways)	1991	Cultural Resource Survey of the Proposed Wetland Area South of Chatfield Reservoir, Jefferson County, Colorado	43 acres surveyed; 1 prehistoric site, and 3 isolated prehistoric localities
Ed Brodnicki (USACE, Omaha District)	1995–96	unpublished	Updating site locations and conditions; many sites evaluated as severely impacted
Chris Bevilacqua (4G Consulting)	2006	Background Research and Field Reconnaissance Survey Regarding the Cultural Resources of Cherry Creek and Chatfield Reservoirs, South of Denver, Colorado	Survey of Chatfield State Park to identify disturbed areas unlikely to contain archaeological resources
Steven Dominguez et al. (RMC Consulting)	2007	Class III Cultural Resources Survey Of Chatfield State Park, Arapahoe, Douglas, and Jefferson Counties, Colorado	3,605 acres surveyed; 2 prehistoric sites, 21 historic sites, and 2 sites with prehistoric and historic components
Penley Reservoir and Pipeline Area			
Marcia Tate and Kevin Black	1979	Cultural Resource Inventory of Roxborough State Park, Douglas County, Colorado.	39 potentially eligible prehistoric sites identified, datable from Archaic to late-prehistoric periods; 1 historic homestead.
Douglas D. Scott and David A. Gillio	1973	A Report on the Archaeological Impact of the Proposed Foothills Project of the Denver Water Commissioners	Dozens of eligible and potentially eligible sites from paleo-Indian to historic period.

Sources: Foster Wheeler 2000b; Dominguez et al 2007; Colorado Office of Archaeology and Historic Preservation on-line cultural resource database (COMPASS).

4. ENVIRONMENTAL CONSEQUENCES

4.1 Environmental Consequences Introduction

This chapter addresses the environmental consequences of the proposed reallocation of flood storage to conservation in Chatfield Reservoir that would result from implementation of the proposed action or alternatives. This study focuses mainly on the environmental consequences at Chatfield Reservoir and surrounding state park, but because Chatfield Reservoir provides flood reduction benefits to downstream neighborhoods and businesses, and because components of other alternatives being considered occur downstream adjacent to the South Platte River (gravel pit storage), areas downstream from the reservoir to the Adams/Weld county line are also considered in the analysis. In addition, the area south of Chatfield Reservoir that would be used to construct Penley Reservoir and associated pipelines under Alternative 1 (No Action) is also discussed where appropriate. Section 2.4 reports the number of acres of disturbance from the construction and infrastructure associated with each alternative, including the proposed Penley Reservoir and pipeline areas under Alternative 1 (Table 2-6) and the gravel pits under Alternatives 1 and 2 (Table 2-7) and 4.An impact analysis was conducted for each of the 17 resources introduced in the affected environment chapter (Chapter 3). Consideration was given to whether potential environmental consequences would result from the proposed action or alternatives and whether the consequences are short term or long term, insignificant or significant, and adverse or beneficial. This study specifically focuses on four alternatives as described in Chapter 2:

- Alternative 1—No Action, Penley Reservoir combined with gravel pit storage
- Alternative 2—NTGW combined with gravel pit storage
- Alternative 3—Reallocation of 20,600 acre-feet to storage (20,600 Acre-Foot Reallocation)
- Alternative 4—Reallocation of 7,700 acre-feet to storage (7,700 Acre-Foot Reallocation) and use of NTGW and gravel pit storage so average annual yield totals 8,539 acre-feet per year

Under the No Action Alternative (Alternative 1), Chatfield Reservoir would not be reallocated to multipurpose storage and the operation of the reservoir would remain unchanged. Water levels would remain unchanged at 5,432 feet msl, but since there is a need for water storage, this alternative would include the construction of Penley Reservoir and downstream gravel pit storage. Under Alternative 2 the status of Chatfield Reservoir would remain the same as Alternative 1, except that future water demands would be met through NTGW and the downstream gravel pits. Alternative 3 is proposed to raise the target water level 12 feet to an elevation of 5,444 feet msl. Alternative 4 is proposed to raise the target water level 5 feet to an elevation of 5,437 feet msl.

The level of impact is based on regulatory standards, criteria and ordinances, available scientific documentation, and professional judgment of the resource specialists. Based on the impact analysis, additional mitigation and modification measures may be proposed in this chapter to further minimize potential adverse impacts. Cumulative impacts are also discussed in this chapter.

4.1.1 Adaptive Management

Each of the alternatives would use adaptive management to evaluate conditions and minimize potential impacts. Adaptive management involves an iterative process of cycling through several steps: problem assessment, design, implementation, monitoring, evaluation, adjustment, and continued cycling through earlier steps (Barnes 2009). Successful adaptive management programs use iterative decision-making (i.e., evaluating results and adjusting actions on the basis of what has been learned). They allow for feedback between monitoring and decision-making, and they embrace risk and uncertainty as a way of building understanding (Barnes 2009). Adaptive management is framed within the context of structured decision making, with an emphasis on uncertainty about resource responses to management actions and the value of reducing that uncertainty to improve management. Though learning plays a key role in adaptive management, it is a means to an end, namely good management, and not an end in itself (Williams et al. 2009).

As described in Section 1.3.3, the WRDA of 2007, as amended, and the Corps' Planning Guidance Notebook (ER 1105-2-100), require that mitigation planning be an integral part of the overall planning process. Under Section 2036(a) of WRDA, the Corps must ensure that any report submitted to Congress for authorization does not select a project alternative without either a specific plan to mitigate fish and wildlife losses or a determination of negligible adverse impacts. Specific mitigation plan components are required, including "the development of contingency plans (i.e., adaptive management)" (USACE 2009a, p.1). The Corps defines adaptive management as an organized and documented undertaking of goal-directed actions, while evaluating their results to determine future actions. Simply stated, adaptive management is doing, while learning in the face of uncertain outcomes (Barnes 2009). According to the National Research Council's 2004 Adaptive Management for Water Resources Project Planning, adaptive management promotes flexible decision-making that can be adjusted in the face of uncertainties, as outcomes from management actions and other events become better understood.

Discussions of adaptive management as applied to specific resources can be found throughout this FR/EIS, including in Sections 4.3.5 under Hydrology; 4.4.5 under Water Quality; 4.6 Vegetation; 4.7.5 under Wetlands; 4.8.5 under Wildlife; and 4.9.5 under Endangered, Threatened, and Candidate Species, Species of Special Concern, and Sensitive Communities; as well as in Appendices J, Water Quality; K, Compensatory Mitigation Plan; V, Draft Biological Assessment; and Z, Tree Management Plan. In addition, adaptive management for each potentially impacted resource is summarized in Table 4-1.

Below is a summary of the adaptive management plan contained in the CMP. In the CMP (Appendix K) adaptive management will be used to address anticipated and unanticipated issues that affect compensatory mitigation activities. Monitoring will determine the degree to which issues and events adversely affect proposed compensatory mitigation activities, as well as document benefits greater than estimated for the CMP. Strategies outlined in the CMP will be used to adaptively manage issues that adversely affect mitigation. All adaptive management proposals will be distributed to the Project Coordination Team and the Technical Advisory Committee for review and comment. Once established, the Project Coordination Team and Technical Advisory Committee will be available to advise on other adaptive management issues (e.g., tree management, water quality, recreation) related to Chatfield that do not fall under the CMP. For additional details on adaptive management under the CMP see Appendix K, Section7.5.

Table 4-1
Summary of Adaptive Management Measures to Address Potential Impacts and Uncertainty

Resource	Potential Impact	Uncertainty	Required Adaptive Management
Hydrology	Under Alternatives 3 and 4 pool elevations would fluctuate more than under Alternatives 1 and 2.	Climate change may result in more floods and more or longer periods of drought, which cannot be accurately predicted now. The Corps model uses inflows during the 1942–2000 POR, which tend to be greater on average than predicted for future conditions for all alternatives. This results in a greater probability of adequate mitigation for all types of inundation-related environmental impacts.	In terms of hydrology, potential changes in pool fluctuations would be difficult to minimize under Alternatives 3 or 4. The effects of those fluctuations on other resources (e.g., wildlife, recreation) and ways to reduce effects through adaptive management are discussed under those resources.
Water Quality	Under Alternatives 3 and 4, increases in total phosphorus are expected. Removal of vegetation prior to inundation could reduce nutrients released, but concentrations could exceed Alternative 1 because of hypolimnion increase and nutrient release from inundated soils.	Nutrient analysis shows uncertainty in internal loading from increased anaerobic conditions due to higher pool levels and inundated vegetation. Internal loading is not currently a concern in Chatfield Reservoir because anoxic conditions are lacking.	Under Alternatives 3 or 4, water providers will use adaptive management to address water quality uncertainty. Monitoring will be conducted to identify water quality impacts. Potential adaptive management measures include: • Removing terrestrial vegetation prior to inundation. • Aeration/mixing of reservoir to limit stratification and anaerobic conditions. • Altered management of inflows and outflows to manage flushing and hydraulic residence time.
Aquatic Life and Fisheries	Fluctuating pool levels during fish spawning and embryo development could impact reproductive success of warm-water fish species in the reservoir. Low flows and higher temperatures could increase stressors put on the aquatic community downstream of the reservoir.	The level of impact on warm-water fish in the reservoir or on species in the South Platte River below it depends on many factors. Future water demands unrelated to this project could change flow patterns in the South Platte River and impact aquatic life.	Water providers will use adaptive management to address uncertainty. Potential measures include: • Managing the release of water from Chatfield Reservoir. • Distributing water releases from the reservoir more evenly throughout the year. • Keeping instream flow rates high on the South Platte River below the reservoir during times of low flow and higher temperature.
Vegetation	Under Alternatives 3 and 4, existing vegetation would be lost on the reservoir margins, and weeds and non-native species could establish.	Impacts to vegetation under a more highly fluctuating reservoir are uncertain. Depending on pool elevations and the durations of pool fluctuations, inundated vegetation may or may not survive, and the types and degrees of proliferation of weeds and non-native species are uncertain.	Under Alternatives 3 and 4, water providers and the Corps will continue to consult with EPA and other agencies to implement adaptive management to minimize impacts of a more highly fluctuating reservoir (see Appendix K). Adaptive management will include monitoring of impacts and implementation of mitigation strategies including: • Frequent monitoring of drawdown zone for weedy species and implementation of Integrated Pest Management methods and inundation to actual weedy species. • Introduction of aggressive native species to compete against weeds. • Preservation/enhancement of riparian and adjoining upland habitats in nearby off-site areas.

Table 4-1
Summary of Adaptive Management Measures to Address Potential Impacts and Uncertainty

Resource	Potential Impact	Uncertainty	Required Adaptive Management
			• Creation of wetland habitat within Chatfield State Park. • Enhancement of upland, riparian, and wetland habitat within Chatfield State Park.
Wetlands	Under Alternatives 3 or 4, wetlands could be transformed and/or wetlands functions reduced with changing pool elevations.	Impacts to wetlands depend on pool fluctuations, which are uncertain.	Under Alternatives 3 and 4, potential impacts to wetlands would be minimized through adaptive management, including: • Changing the amount and timing of releases. • Seeding or plantings. • Weed control. Adaptive management would involve on-site and off-site enhancements of quality and functions of existing wetlands and creating new wetlands. Compensatory mitigation of wetlands would be maximized, as described in Appendix K. The Corps has consulted with the EPA on how to implement adaptive management to minimize impacts of a more highly fluctuating reservoir.
Wildlife	Acres of habitat and their associated ecological functions are expected along the shoreline near new target pool elevations under Alternatives 3 and 4. Affected habitats include Preble's meadow jumping mouse, overall wildlife habitat represented by a diverse avian community (birds), and wetlands.	Impacts to wildlife habitat depend on pool elevation fluctuations (timing, levels, and durations).	A committee of local experts familiar with Chatfield Reservoir developed the adaptive management strategy, which includes ecological function values for Preble's meadow jumping mouse, overall wildlife habitat represented by birds, and wetlands (Appendix K). By tracking functional values, this approach will minimize lost acres and ecological functions of inundated habitat. Adaptive management by an established group will minimize impacts by monitoring and adjusting operation strategies. Approaches include: • Changes to reservoir operation (e.g., holding water at a certain elevation at a specific time of year). • Actively managing the drawdown zone created by fluctuating water levels by changing amounts and timing of release flows. • Planting, seeding, and weed control.
Endangered, Threatened, and Candidate Species, Species of Special Concern, and Sensitive Communities	Habitats would be lost due to the rise in target pool elevations under Alternatives 3 and 4. Riparian habitat would be impacted, including 210 EFUs of Preble's non-critical habitat, 65 EFUs of critical habitat in the Plum Creek unit (Unit 9), and critical habitat in the South Platte unit (Unit SP13). Fluctuating water levels could impact the northern leopard frog. The removal of trees killed by inundation could affect wildlife by removing an environment from the area.	Impacts to habitat are uncertain and depend on pool elevation fluctuations and impacts to vegetation (including trees).	Adaptive management will be used to mitigate potential impacts, as developed by a committee of local experts and described in Appendix K. Once an alternative is implemented, actual impacts will be assessed "real-time" and be off-set by on-site and off-site mitigation. This accounting system will track how mitigation is progressing and if alterations to mitigation activities are needed. Mitigation will account for acres of lost habitat and associated ecological functions. Adaptive management may include: • Changes to reservoir operations (e.g., holding water at a certain elevation at a specific time of year).

Table 4-1
Summary of Adaptive Management Measures to Address Potential Impacts and Uncertainty

Resource	Potential Impact	Uncertainty	Required Adaptive Management
	Increase of snags/downed trees could provide valuable habitat for raptors, cavity nesting birds, herons, and aquatic life. Impacts to ecological functions of wetlands, riparian habitat (and mature cottonwoods), bird/wildlife terrestrial habitat, Preble's meadow jumping mouse habitat, and shoreline habitat are evaluated in Appendix K.		• Plantings, seeding, and weed control. • Actively managing the drawdown zone created by fluctuating water levels. • On-site and off-site mitigation (through Ecological Functions Approach), including riparian habitats, riparian wildlife corridors to connect Preble's mice and aid movement. • Clearing, leaving, or scattering standing/downed trees as needed. • Releasing flows when Denver Water sweeps water from the river and the SFU.
Socioeconomic Resources	Construction near the marina under Alternatives 3 and 4 could result in revenue loss to the marina operator and Colorado State Parks.	Impacts on concessionaire and State Parks revenues are based on user interviews and other information, but will depend on visitor use during and after construction.	Under Alternatives 3 and 4, monetary reimbursements from the water providers would be required to offset any revenue losses. The Corps and State Parks have agreed to allow the swim beach and marina to remain open from May through September during the entire construction period to minimize impacts.
Recreation	Some recreation facilities would be inundated under Alternatives 3 and 4, as described in detail in Appendices M and N. During and after construction, visitor use could decline, as described in Appendices M and U.	The impact of fluctuating water levels on recreation facilities and visitor use would depend on the timing and duration of different pool levels and the perceived impacts on recreational experiences, both of which involve uncertainty.	Adaptive management by an established group would minimize impacts to recreation once reallocation begins. Detailed modification measures proposed under Alternatives 3 and 4 are discussed for each of the affected recreation use areas in Chatfield State Park in Appendices M and N. Modification plans incorporate Colorado State Park's goal of replacing affected facilities and use areas in kind. Regardless of the final design details and construction cost estimates, the water providers have affirmed their support of the continued operation of a quality marina at Chatfield State Park, and to keep the marina operator financially whole for the duration of their lease. Additional adaptive management could include: • Adjusting construction schedules to minimize impacts to the public and to operations by State Parks and the Corps. • Altering reservoir operations to minimize impacts to recreation facilities or visitors.

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In summary, this FR/EIS discloses potential impacts to many resources based on the best available information. Many of those impacts depend on the timing and duration of pool level fluctuations under the proposed reallocation alternatives (Alternatives 3 and 4) or on other sources of uncertainty. Several factors contribute to the pool elevation at Chatfield Reservoir, including hydrologic conditions, reservoir operations, and even long-term climate change. To address uncertainty in mitigating impacts under all alternatives, the water providers and the Corps are dedicated to implementing a strong adaptive management strategy involving active monitoring and mitigation adjustments based on actual conditions. The adaptive management strategy will be executed with involvement of many additional entities, including the CWCB, the Project Coordination Team, and the Technical Advisory Committee. Table 4-1 summarizes the main areas of uncertainty identified as this DEIS is released for public review, and how adaptive management will address them. A detailed assessment of impacts for every affected resource follows in the remaining sections of Chapter 4.

4.2 Geology and Soils

The four proposed alternatives could have potential adverse impacts on geology and soils. Specific issues include possible impacts of the alternatives on geologic hazards (mass wasting and flooding) and possible impacts on soils (erosion and compaction). Mass wasting is a general term used for any downslope movement of rock, soil, snow, or ice under the influence of gravity, including landslides, creep, rock falls, and avalanches. Potential damages from downstream flooding are addressed in Section 4.15. The remaining issues are evaluated by alternative in the following sections.

4.2.1 Alternative 1—No Action

Under Alternative 1, reservoir levels and operations at Chatfield Reservoir would remain unchanged (Table 4-2 and Figure 4-1). Mass wasting, flooding, soil erosion, and soil compaction near the reservoir would not be affected under this alternative. The primary source of sediment deposition into Chatfield Lake is watershed sheet, rill, and gully erosion; the secondary source is shoreline erosion (USACE 2007). However, to achieve sufficient water storage, additional facilities, pumps, and pipelines would be constructed by the non-federal entities. Groundwater would be pumped, agricultural water rights would be purchased, and services would be reduced. Several of these changes could affect geology and soil resources.

Table 4-2
Area of Inundation Beyond Current Operations at Chatfield Reservoir Under Each Alternative

Alternative	Conservation Pool Elevation (feet msl)	Total Area That Would Be Inundated at Maximum Pool Elevation (acres)	Area Beyond Current Operations That Would Be Inundated at Maximum Pool Elevation (acres)
1	5,432	1,507	0
2	5,432	1,507	0
3	5,444	2,094	587
4	5,437	1,722	215

Following the assumptions of ground disturbance outlined in Chapter 2, this alternative could include up to 506 acres of disturbance related to gravel pit water storage (Table 2-7), and up to 377 acres of disturbance related to water storage facilities (i.e., Penley Reservoir) (Table 2-6). The impact to geology and soils related to these potential projects would depend on the affected geologic units, slopes, and soil types. In general, geologic hazards would not likely be increased under this alternative, especially because the proposed Penley Reservoir would be constructed off-channel (as opposed to impounding a stream for storage). Soils would be compacted and likely irreversibly committed in areas of ground disturbance. Although these projects would be implemented on private lands, they should be coordinated with the Corps' Regulatory office as early as possible in the project planning process in regard to Section 404 and Section 401 permit actions, appropriate NEPA documentation, and other requirements.

Under the No Action Alternative, prime and unique farmland within the study area, as well as prime and unique farmland outside of the study area but within the watershed, would not significantly change unless the municipalities build another reservoir (i.e., Penley Reservoir) or buy out the farmers' water rights. Only the city of Brighton would develop water rights under the No Action Alternative. Approximately 1,020 acres of irrigated land would be converted to dryland agriculture for the downstream gravel pits (Table 2-7).

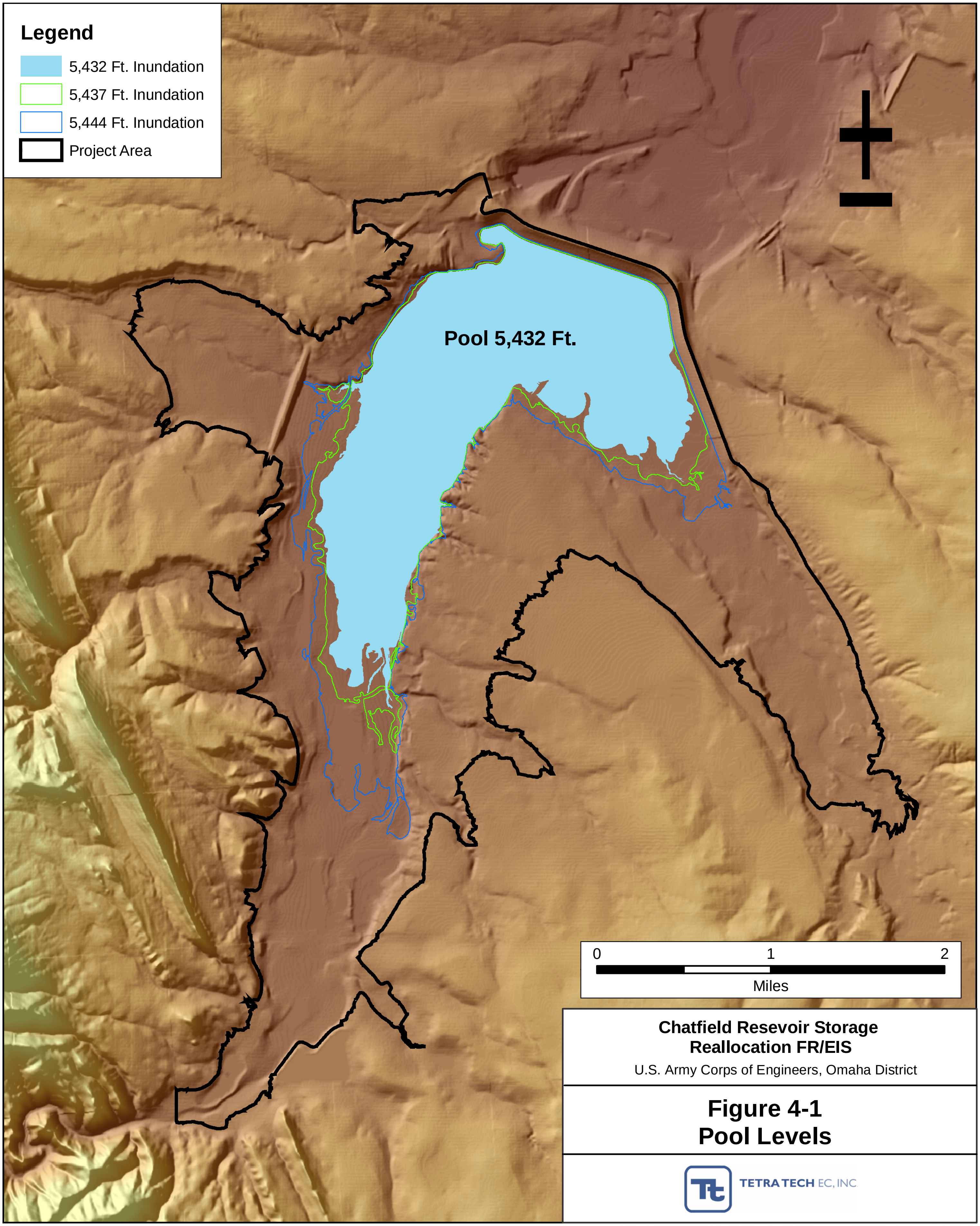
4.2.2 Alternative 2—NTGW/Downstream Gravel Pits

Under Alternative 2, gravel pits would be converted to water storage reservoirs, the same as under Alternative 1. The impacts on geology and soils related to the use of downstream gravel pits would be the same as described under Alternative 1. Under Alternative 2, however, the remaining water storage would be obtained from NTGW instead of surface water resources. Construction of additional groundwater wells and pipelines to connect them into the distribution system would be needed to meet both existing and growth-related production demands. This construction could disturb soils locally, with approximately 1 acre of disturbance for each well. No additional impacts to geology and soils from the use of NTGW would be expected.

Based on studies cited in Section 4.3, the continued long-term use of NTGW would reduce the pumping rates for water wells in the area. Agricultural lands, including prime and unique farmland, that rely on NTGW would be affected under this alternative. The same drying up of 1,020 acres of irrigated lands described under Alternative 1 would also occur with downstream gravel pits under Alternative 2.

4.2.3 Alternative 3—20,600 Acre-Foot Reallocation

Under this alternative, the management of the conservation pool would be changed to target 20,600 acre-feet of reallocated storage by allowing the water level to rise to as much as 5,444 feet msl. Based on elevation contours generated using field survey data of the area immediately surrounding the reservoir, increased water levels would inundate additional acres of land adjacent to the existing reservoir. Table 4-2 and Figure 4-1 show the area beyond current operations that would be inundated at the top of the conservation pool under each alternative. Under Alternative 3, approximately 587 additional acres would be inundated at water levels of 5,444 feet msl.



Chatfield Resevoir Storage Reallocation FR/EIS

U.S. Army Corps of Engineers, Omaha District

Figure 4-1
Pool Levels

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Under this alternative the Chatfield Reservoir level would fluctuate more than under the other alternatives. As a result, portions of the shoreline that would be commonly under water under this alternative, and therefore have little stabilizing vegetative cover, would be exposed to erosion by wind and water. Furthermore, silt and fine sediments would likely accumulate in inundated areas. As the waterline receded, these fine sediments would be susceptible to erosion by wind and water. Because this alternative would involve the greatest inundated area and the most fluctuations in water levels, the potential for erosion of these fine materials would be greatest. For more information on the potential impacts of wind erosion on air quality, see Section 4.12. For more information on the potential impacts of sediment erosion on water quality, see Section 4.4.

Changes in the potential for mass wasting would not be expected under Alternative 3 because of the relatively gentle slopes immediately surrounding Chatfield Reservoir. Alternative 3 would involve changing the water management at the reservoir, but would not require construction of a new reservoir, which would translate into a lower likelihood for soil compaction or irretrievable soil commitment than under Alternative 1. Alternative 3 would not involve the construction of pumps or pipelines to transport water from Chatfield Reservoir. However, there would be land disturbance from construction for relocation of recreation facilities and roads.

The soil map units that would be inundated when the conservation pool reached 5,444 feet msl, according to NRCS soil mapping, are shown in Table 4-3 and Figure 4-2. Relevant soil characteristics are presented for each unit. Acres are summed for the total inundated area (referred to as the total including water) and for the inundated area not including water mapped by NRCS (referred to as the total excluding water).

Of the additional acres that would be inundated under Alternative 3 (587 acres), approximately 18 percent (108 acres) are characterized as gravel pits, dam, or water by the NRCS. Because these soil map units are not susceptible to erosion or compaction, they would not be impacted by the proposed changes in operations. Of the remaining 82 percent that would be inundated, soil textures range from fine loams to coarse sands with Kw factors between 0.05 and 0.28. Soil K factors represent a relative index of the susceptibility of bare, cultivated soil to particle detachment and transport by rainfall. This quantitative measure of soil erodibility and runoff potential is based primarily on the percentage of silt, sand, and organic matter; soil structure; and soil permeability. K factors include both Kf, which represents the K factor of the fine fraction of the soil, and Kw, which represents the K factor of the whole soil, including rock fragments. For the purposes of indicating the potential surface erodibility by water of different soils near the Chatfield Reservoir, the Kw factor is shown. By convention, Kw factors range from 0.02 to 0.69 (NRCS 2005b). Other factors being equal, the higher the value, the more susceptible the soil is to sheet and rill erosion by water. The area-weighted average Kw factor for the soils listed in Table 4-3 is 0.19. These Kw factors reflect a relatively low potential for surface soil erosion by water under Alternative 3. The impacts to surface soil erosion by water are insignificant. However, this does not apply to shoreline erosion.

Wind erodibility indices range from 0 to 180 in the area affected by Alternative 3. The wind erodibility index is assigned based on groupings of soils that have similar properties affecting their resistance to soil blowing in cultivated areas. The soil properties that are most important with respect to soil blowing are soil texture, organic matter content, effervescence from carbonate reaction with hydrochloric acid, rock fragment content, mineralogy, and moisture. By convention, the wind erodibility index ranges from 0 to 310 (NRCS 2005b). Other factors being equal, the higher the value, the more susceptible the soil is to erosion by wind. The weighted average wind erodibility index for the soils listed in Table 4-3 is 87. These indices reflect a relatively low potential for surface soil erosion by wind under Alternative 3. For most soils at the Chatfield Reservoir storage reallocation project, the impacts to surface soil erosion by wind are insignificant. The two soils rated with the highest wind erodibility indices, 134 and 180, represent a total of 8 percent of the additional inundated area. If vegetation were removed during periodic inundation, these areas could be considered at moderate to moderately high risk for wind erosion. These areas are outside the pool.

The soil hydrologic group is a group of soils having similar runoff potential under similar storm and cover conditions. Soil properties that influence runoff potential are depth to a seasonally high water table, intake rate and permeability after prolonged wetting, and depth to a very slowly permeable layer. Hydrologic groups range from A to D, with A representing the lowest runoff potential and D representing the highest runoff potential (NRCS 2005b). The hydrologic group with the greatest extent (37 percent) that is mapped in the additional inundated area under Alternative 3 is soil hydrologic group C, soils with a high runoff rate. Approximately 13 percent is mapped with a soil hydrologic group of A, 15 percent is B, and 19 percent is D. The remaining 16 percent consists of the dam and mapped water and is not classified.

The soils that would be inundated when the pool reached 5,444 feet msl would have a relatively high potential for runoff. Because these soils are not highly erodible (as explained in the previous paragraphs), the soils themselves would not likely erode. However, if fine sediments were deposited as water levels subsided, these materials would be relatively likely to be eroded by rainfall and transported back into the reservoir. The net impacts to soil erosion based on the soil hydrologic classifications are insignificant. However, this does not apply to shoreline erosion.

Under Alternative 3, prime and unique farmland within the study area and surrounding watershed would not change significantly. No agricultural water rights would be transferred under Alternative 3.

As described in Section 3.2.1, according to the Dam Safety Report (Appendix A), no immediate dam safety concerns have been identified based on a projected reservoir elevation of 5,444 feet msl, considering static loading. All of the structures at the site have been designed to withstand the small increase in loading caused by the proposed pool elevations. In addition, the most recent periodic inspection report (2008) found these structures to be in very good condition, which provides confidence that these structures are functioning as designed. Raising the normal pool elevation by up to 12 feet would not have a direct bearing on the adequacy of the slope protection material. Furthermore, the slope protection material would continue to be monitored during routine dam safety inspections (e.g., monthly, annual, periodic). Existing areas of riprap displacement also would be inspected during low reservoir elevations.

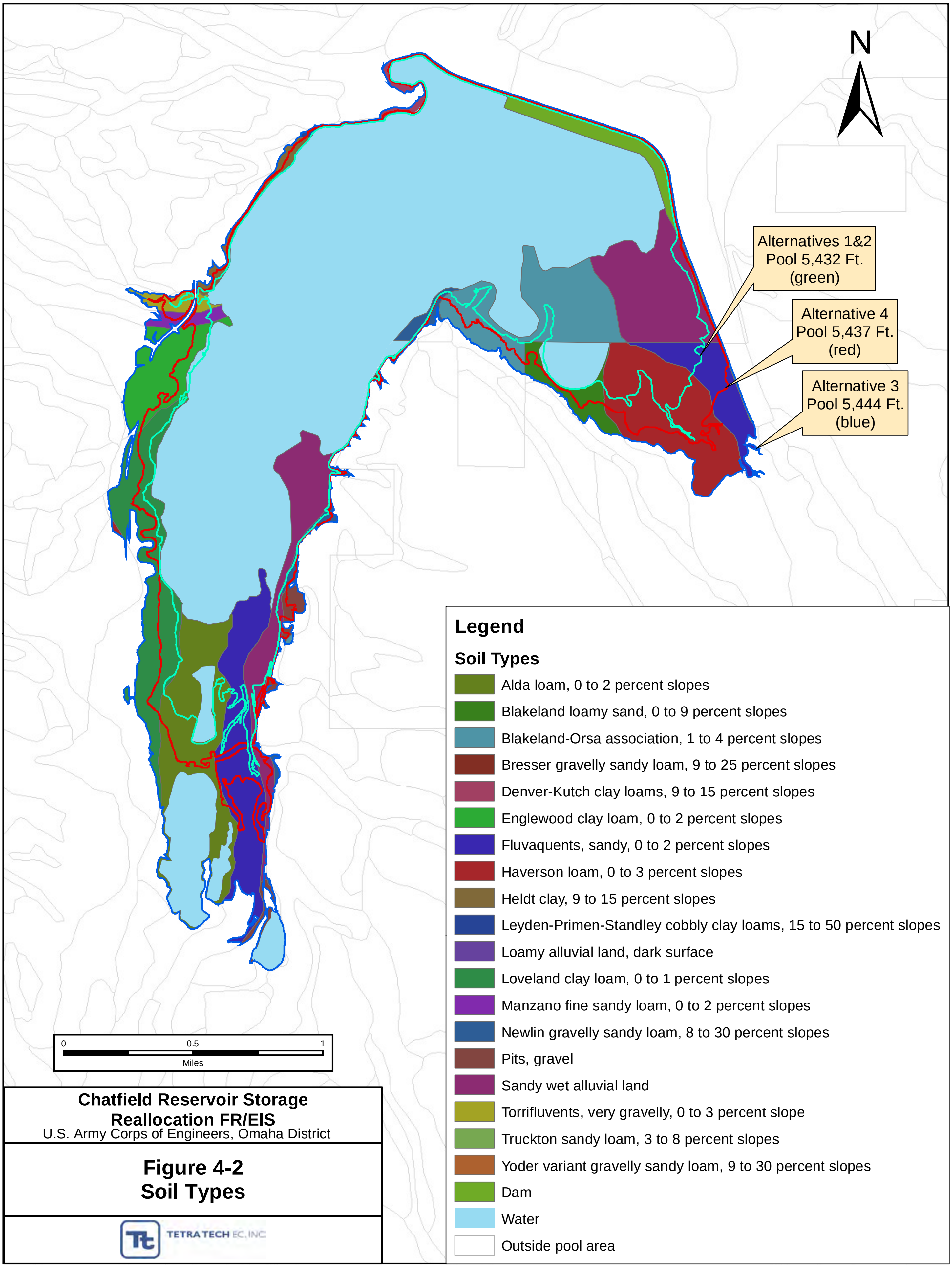
Table 4-3
Soil Types, Extents, and Descriptions Within Area of Inundation Under Alternative 3

Soil Map Unit Name	Soils Inundated Under Alternative 3 (20,600 acre-feet)				Dominant Surface Soil Texture	Dominant Surface Erosion Factors		Dominant Hydrologic Group[3]
	Area Including Water (acres)	Extent Including Water (%)	Area Excluding Water (acre)	Area Excluding Water (%)		Kw[1]	Wind Erodibility Index[2]	
Alda loam, 0 to 2 percent slopes	56.0	10	56.0	11	Loam	0.24	86	C
Blakeland loamy sand, 0 to 9 percent slopes	21.9	4	21.9	4	Loamy sand	0.10	134	A
Blakeland-Orsa association, 1 to 4 percent slopes	27.2	5	27.2	5	Sandy loam	0.20	86	A
Bresser gravelly sandy loam, 9 to 25 percent slopes	2.4	<1	2.4	0	Gravelly sandy loam	0.15	86	A
Denver-Kutch clay loams, 9 to 15 percent slopes	6.0	1	6.0	1	Clay loam	0.17	48	C
Englewood clay loam, 0 to 2 percent slopes	48.2	8	48.2	10	Clay loam	0.17	48	C
Fluvaquents, sandy, 0 to 2 percent slopes	90.5	15	90.5	18	Gravelly sandy loam	0.15	86	D
Haverson loam, 0 to 3 percent slopes	73.3	12	73.3	14	Loam	0.28	86	B
Heldt clay, 9 to 15 percent slopes	12.2	2	12.2	2	Clay	0.17	86	C
Leyden-Primen-Standley cobbly clay loams, 15 to 50 percent slopes	2.2	<1	2.2	0	Cobbly clay loam	0.10	48	C
Loamy alluvial land, dark surface	0.1	<1	0.1	0	Sandy loam	0.20	86	C
Loveland clay loam, 0 to 1 percent slopes	89.6	15	89.6	18	Clay loam	0.20	86	C
Manzano fine sandy loam, 0 to 2 percent slopes	7.2	1	7.2	1	Fine sandy loam	0.20	86	B
Newlin gravelly sandy loam, 8 to 30 percent slopes	9.7	2	9.7	2	Gravelly sandy loam	0.10	86	B
Sandy wet alluvial land	23.0	4	23.0	5	Coarse sand	0.15	180	D
Torrifluvents, very gravelly, 0 to 3 percent slope	9.5	2	9.5	2	Variable to 6 inches	0.05	0	A
Truckton sandy loam, 3 to 8 percent slopes	<0.1	<1	<0.1	<1	Sandy loam	0.24	86	B

Table 4-3
Soil Types, Extents, and Descriptions Within Area of Inundation Under Alternative 3

Soil Map Unit Name	Soils Inundated Under Alternative 3 (20,600 acre-feet)				Dominant Surface Soil Texture	Dominant Surface Erosion Factors		Dominant Hydrologic Group[3]
	Area Including Water (acres)	Extent Including Water (%)	Area Excluding Water (acre)	Area Excluding Water (%)		Kw[1]	Wind Erodibility Index[2]	
Yoder variant gravelly sandy loam, 9 to 30 percent slopes	0.1	<1	0.1	0	Gravelly sandy loam	0.15	86	B
Pits, gravel	13.7	2	13.7	3	Gravel	Not applicable	Not applicable	A
Dam	13.6	2	13.6	3	Not applicable	Not applicable	Not applicable	Not applicable
Water	80.3	14	--	--	Not applicable	Not applicable	Not applicable	Not applicable
Total Including Water	586.6	100	--	--				
Total Excluding Water	--	--	506.3	100				

Sources: NRCS 1974, 1984.
1 See Section 4.2.3 text for discussion of Kw.
2 See Section 4.2.3 for discussion of wind erodibility index.
3 See Section 4.2.3 for discussion of hydrologic group.



Chatfield Reservoir Storage Reallocation FR/EIS
U.S. Army Corps of Engineers, Omaha District

Figure 4-2
Soil Types

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Increased monitoring of the project would be pursued as part of the routine dam safety program to assure continued safe operation of the dam. A Reservoir Raise Monitoring Plan would be developed and implemented, and would include additional inspection efforts, instrumentation data acquisition, and data analysis. The Project Surveillance Plan and Emergency Action Plan also would be updated as appropriate. Installation of additional instrumentation prior to rising pool levels, along with an increase in instrumentation readings and inspection frequencies during and following the pool raise, would be warranted.

Under Alternative 3, Chatfield Dam would be subject to elevated dam safety monitoring and evaluation. Water supply storage could be reduced by Interim Risk Reduction Measures (IRRM) or other remediation if deemed necessary by USACE. Alternative 4—7,700 Acre-Foot Reallocation/NTGW/Downstream Gravel Pits

4.2.4 Alternative 4—7,700 Acre-Foot Reallocation/NTGW/Downstream Gravel Pits

Under this alternative, the management of the conservation pool would be changed to target 7,700 acre-feet of reallocated storage by allowing the water level to rise to as much as 5,437 feet msl. As shown in Figure 4-1 and Table 4-2, approximately 215 acres of land adjacent to the existing reservoir would become inundated at the top of the conservation pool. An additional 5,347 acre-feet (for a total yield of 8,539 acre-feet, same as Alternative 3) would be obtained from NTGW and from downstream gravel pits. Under Alternative 4, gravel pits would be converted to water storage reservoirs. This would result in an approximately 143 acre footprint from gravel pit storage and 6 acres of disturbance from construction of infrastructure. Alternative 4 would not involve the construction of pumps or pipelines to transport water from Chatfield Reservoir. However, there would be land disturbance from construction for relocation of recreation facilities and roads. The impacts on geology and soils related to the use of downstream gravel pits would be less than those described under Alternative 1. Under Alternative 4, the remaining water storage would be obtained from NTGW. Those impacts are described under Alternative 2.

Under this alternative the Chatfield Reservoir level would fluctuate less than under Alternative 3. Although smaller than under Alternative 3, portions of the shoreline that would be commonly under water under Alternative 4, and therefore have little stabilizing vegetative cover, would be exposed to erosion by wind and water. Similar to Alternative 3, silt and fine sediments would likely accumulate in inundated areas. As the waterline receded, these fine sediments would be susceptible to erosion by wind and water. This alternative would involve a smaller inundated area and fewer fluctuations in water levels than Alternative 3.

Changes in the potential for mass wasting would not be expected under Alternative 4 because of the relatively gentle slopes immediately surrounding Chatfield Reservoir. Like Alternative 3, construction of a new reservoir would not be required under Alternative 4, which would translate into a lower likelihood for soil compaction or irretrievable soil commitment than under Alternative 1. The soil map units that would be inundated when the target pool reached 5,437 feet msl, according to NRCS soil mapping, are shown in Table 4-4 and on Figure 4-2. Relevant soil characteristics are presented for each unit. Acres are summed for the total inundated area (referred to as the total including water) and for the inundated area not including water mapped by NRCS (referred to as the total excluding water).

Of the additional acres that would be inundated under Alternative 4 (215 acres), approximately 6 percent (13 acres) are characterized as gravel pits, dam, or water by the NRCS. These soil map units would not be impacted by the proposed changes in operations. Of the remaining 94 percent that would be inundated, soil textures range from fine to coarse loams with Kw factors between 0.05 and 0.28. The area-weighted average Kw factor for the soils listed in Table 4-4 is 0.19. These Kw factors reflect a relatively low potential for surface soil erosion by water under Alternative 4. The impacts to surface soil erosion by water are insignificant. However, this does not apply to shoreline erosion.

Wind erodibility indices range from 0 to 180 in the area affected by Alternative 4. The weighted average wind erodibility index for the soils listed in the Table 4-4 is 90. These indices reflect a relatively low potential for surface soil erosion by wind under Alternative 4. For most soils at the Chatfield project, the impacts to surface soil erosion by wind are insignificant. The two soils rated with the highest wind erodibility indices, 134 and 180, represent a total of 11 percent of the additional inundated area. If vegetation were removed during periodic inundation, these areas could be considered at moderate to moderately high risk for wind erosion. These areas are outside the pool level under Alternative 1 and would therefore not be inundated under the No Action Alternative.

Under Alternative 4, the hydrologic group with the greatest extent (36 percent) that is mapped in the additional inundated area is soil hydrologic group C, soils with a high runoff rate. Approximately 14 percent is mapped with a soil hydrologic group of A, 20 percent is B, and 25 percent is D. The remaining 5 percent consists of the dam and mapped water and is not classified. The soils that would be inundated when the pool reached 5,437 feet would have a relatively high potential for runoff. Because these soils are not highly erodible (as explained in the previous paragraphs), the soils themselves would not likely erode. However, if fine sediments were deposited as water levels subsided, these materials would be relatively likely to be eroded by rainfall and transported back into the reservoir. The net impacts to soil erosion based on the soil hydrologic classifications are insignificant. However, this does not apply to shoreline erosion.

Under Alternative 4, prime and unique farmland within the study area and surrounding watershed would not change significantly. Because fewer and/or smaller downstream gravel pits would be converted to water storage under Alternative 4 than under Alternatives 1 and 2, the city of Brighton would buy fewer acre-feet of water from agriculture, resulting in fewer acres converted to dryland irrigation. As described under Alternative 3, no immediate dam safety concerns have been identified under Alternative 4, considering static loading (Appendix A). Under Alternative 4, Chatfield Dam would be subject to elevated dam safety monitoring and evaluation. Water supply storage could be reduced by Interim Risk Reduction Measures (IRRM) or other remediation if deemed necessary by USACE.

4.2.5 Reduction of Potential Impacts

Potential impacts to soil resources from ground disturbing activities can be avoided or minimized through implementation of BMPs. For example, avoiding disturbances while soils are wet, stockpiling topsoil, and reseeding disturbed areas following construction would reduce both the magnitude and duration of potential impacts to soil resources. The CDPHE offers more detailed examples of appropriate BMPs for construction activities in the Stormwater Management Plan Preparation Guidance document (CDPHE 2008b).

Table 4-4
Soil Types, Extents, and Descriptions Within Area of Inundation Under Alternative 4

Soil Map Unit Name	Soils Inundated Under Alternative 4 (7,700 acre-feet)				Dominant Surface Soil Texture	Dominant Surface Erosion Factors		Dominant Hydrologic Group[3]
	Area Including Water (acre)	Extent Including Water (%)	Area Excluding Water (acre)	Extent Excluding Water (%)		Kw[1]	Wind Erodibility Index[2]	
Alda loam, 0 to 2 percent slopes	23.5	11	23.5	11	Loam	0.24	86	C
Blakeland loamy sand, 0 to 9 percent slopes	8.6	4	8.6	4	Loamy sand	0.10	134	A
Blakeland-Orsa association, 1 to 4 percent slopes	12.5	6	12.5	6	Sandy loam	0.20	86	A
Bresser gravelly sandy loam, 9 to 25 percent slopes	0.8	<1	0.8	0	Gravelly sandy loam	0.15	86	A
Denver-Kutch clay loams, 9 to 15 percent slopes	1.1	1	1.1	1	Clay loam	0.17	48	C
Englewood clay loam, 0 to 2 percent slopes	11.8	5	11.8	6	Clay loam	0.17	48	C
Fluvaquents, sandy, 0 to 2 percent slopes	38.0	18	38.0	18	Gravelly sandy loam	0.15	86	D
Haverson loam, 0 to 3 percent slopes	35.4	17	35.4	17	Loam	0.28	86	B
Heldt clay, 9 to 15 percent slopes	5.8	3	5.8	3	Clay	0.17	86	C
Leyden-Primen-Standley cobbly clay loams, 15 to 50 percent slopes	0.9	<1	0.9	0	Cobbly clay loam	0.10	48	C
Loveland clay loam, 0 to 1 percent slopes	34.9	16	34.9	17	Clay loam	0.20	86	C
Manzano fine sandy loam, 0 to 2 percent slopes	3.7	2	3.7	2	Fine sandy loam	0.20	86	B
Newlin gravelly sandy loam, 8 to 30 percent slopes	3.7	2	3.7	2	Gravelly sandy loam	0.10	86	B
Sandy wet alluvial land	15.6	7	15.6	7	Coarse sand	0.15	180	D
Torrifluvents, very gravelly, 0 to 3 percent slope	5.5	3	5.5	3	Variable to 6 inches	0.05	0	A
Pits, gravel	3.0	1	3.0	1	Gravel	Not applicable	Not applicable	A
Dam	4.8	2	4.8	2	Not applicable	Not applicable	Not applicable	Not applicable
Water	5.0	2	--	--	Not applicable	Not applicable	Not applicable	Not applicable
Total Including Water	214.5	100	--	--				
Total Excluding Water	--	--	209.5	100				

Sources: NRCS 1974, 1984.

1 See Section 4.2.4 text for discussion of Kw.

2 See Section 4.2.4 for discussion of wind erodibility index.

3 See Section 4.2.4 for discussion of hydrologic group.

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4.3 Hydrology

This section discusses the impacts of implementing the alternatives on the hydrological conditions of Chatfield Reservoir and the South Platte River downstream of the reservoir (Figure 1-2). Chapter 2 describes the alternatives in detail, including the water supply management strategies that would be implemented under each alternative. Under any of the alternatives, when flows enter the reservoir, the first commitment would be to meet senior water rights needs. Once those needs were met, any excess flow would be retained in the available storage of the reservoir (below the maximum elevation of the pool containing conservation storage). After the water levels reached the base elevation of the exclusive flood control pool, any excess flows would be released downstream. Identified hydrological issues include the quantity and quality of surface water, as well as the control of floodwaters. The impacts of the alternatives on water quality are discussed in Section 4.4; the impacts on flooding are discussed in Section 4.15. The following sections describe the potential impacts of the proposed alternatives on hydrology. Appendices H and I include additional information on USACE hydrology and hydraulics modeling, respectively.

To examine the potential hydrologic impacts of Alternatives 1, 3, and 4, historical (1942 to 2000) data from South Platte River stream gages and Chatfield Reservoir operations (beginning after the reservoir was constructed) were entered into a Corps reservoir simulation computer model (HEC-5). The hydrologic modeling of Chatfield Reservoir under Alternative 1 also represents the reservoir levels and fluctuations that would be expected under Alternative 2. A detailed description of the modeling efforts, including the model assumptions, is included in Appendices H and I. The model output describes the daily pool elevation, inflow, and outflow for Chatfield Reservoir over the POR under each of the three alternatives. In summary, this study used historical flow data over the POR, which will reflect any impacts to the river flows over time, including changes in available water rights, water supply needs, timing of runoff, or additional reservoirs constructed upstream. Since this study used historical flow data with no corrections for present day conditions, there is a tendency for the model to overestimate the water available for the potential new water supply in Chatfield. Because of this tendency, the average pool levels reflected in the reallocation alternatives would likely be lower than what is shown in the tables and on the graphs in this chapter. Thus the results of the impact analysis based on the modeled reservoir pools under the reallocation alternatives will tend to show somewhat greater impacts than would likely be experienced in an actual reallocation scenario, but will provide a good basis for relative comparison between alternatives.

Although the historical data represent a wide range of possible future flow conditions, it is possible that future flows may include periods of wet or dry conditions that are outside the range observed in the historical record, particularly as a result of climate change and increased hydrologic variability. As described in greater detail in Section 4.19, with climate change the southwestern United States is likely to experience precipitation and evapotranspiration changes that result in less runoff and water availability (Brekke et al. 2009; Ray et al. 2008). Additional research is needed to quantify the uncertainty in current estimates to better understand the risks of current and future water resource management decisions. The uncertainties include the actual uncertainty in the climate response as well as the uncertainty caused by differences in methodological approaches and model biases. Recognizing this need, a group of Front Range water agencies is working together on the Joint Front Range Climate Change Vulnerability Study (http://cwcb.state.co.us/Home/ClimateChange/JointFRCCVulnerabilityStudy/).

This study, which is still in progress, intends to provide the education, tools, and methodology necessary to examine the effects of climate change scenarios on several watersheds, including the South Platte. This regional unified approach is intended to give Colorado water providers the opportunity to work from the same historic and projected hydrometeorological data, historic natural streamflow, and methodology. The central objective of the climate change vulnerability study is to assess potential changes in the timing and volume of hydrologic runoff for the years 2040 and 2070 as compared with 1950-1999. Two hydrologic models will be calibrated and implemented in the study for this purpose. Modeled streamflows will be compared to historic streamflows to estimate the sensitivity of water supplies to climate change.

To interpret the behavior of reservoir water levels and downstream flows under the alternatives, outputs from the HEC-5 model (described in Appendix H) were imported into a statistical analysis software package (Minitab®) and analyzed, as appropriate, for each resource in this FR/EIS. The statistical results and plots generated in Minitab® are used in the following subsections to demonstrate the differences in the quantity of water stored in Chatfield Reservoir and released to the South Platte River between alternatives.

Chatfield Reservoir inflows used in the computer model are identical under all of the alternatives. Waters in the South Platte River upstream of Chatfield Reservoir consist primarily of snowmelt, which generally occurs in spring and early summer, as shown in Figure 4-3, and (to a lesser extent) stormwater. Mean flow for the entire POR is 231 cfs. A flow duration curve (Figure 4-4) illustrates that flows entering Chatfield Reservoir, which are affected by streamflow regulation at Antero, Spinney Mountain, Eleven Mile, Cheesman, and Strontia Springs reservoirs, are sustained throughout the year. These base flows allow Chatfield Reservoir operators to minimize potential adverse impacts on the reservoir caused by rapid spring runoff or large storm events. Flows greater than approximately 500 cfs occur less than 10 percent of the time in the POR. Inflows could fluctuate depending on future conditions, but would not be affected by the activities proposed under any of the alternatives.

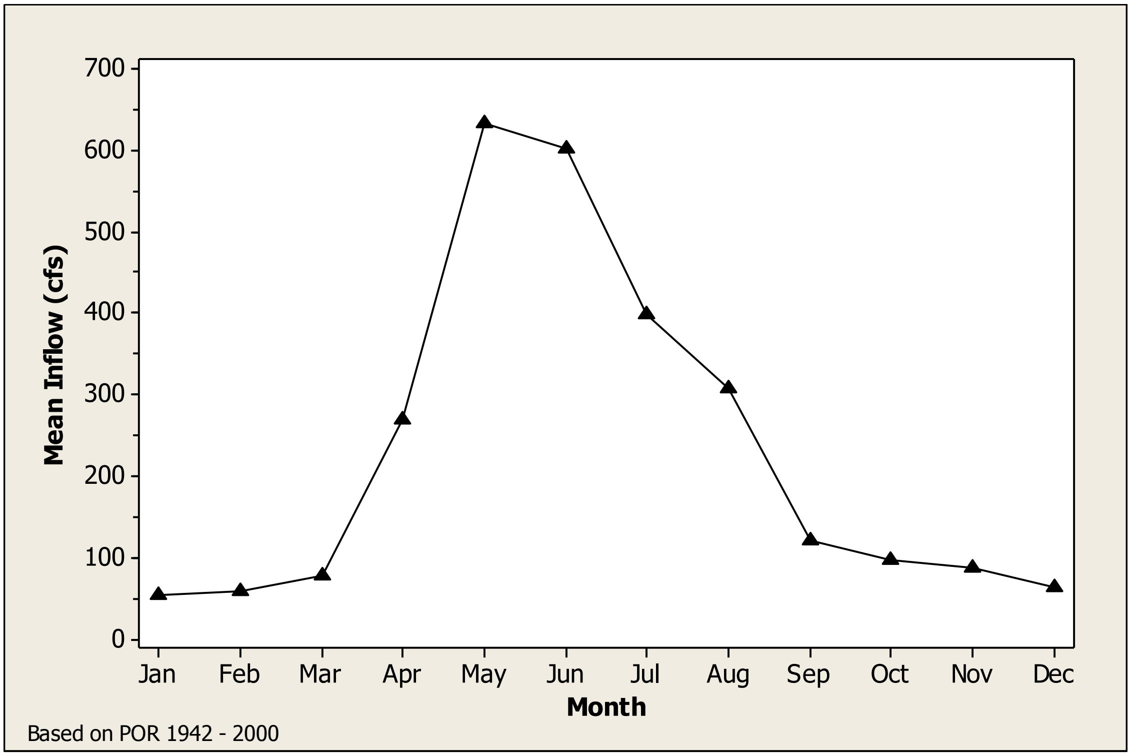

Figure 4-3
Mean Monthly Inflow to Chatfield Reservoir

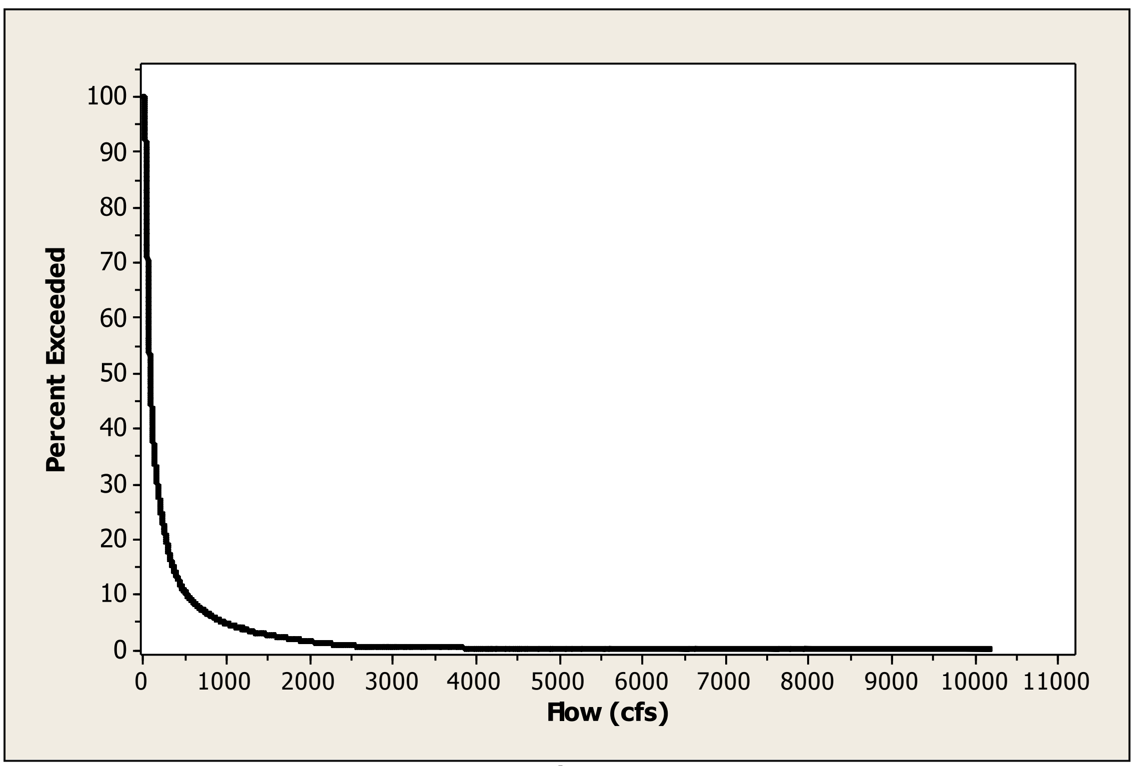

Figure 4-4
Daily Inflows to Chatfield Reservoir over the POR

Note: The flow duration curve was created by ranking all the daily mean stream flows for the POR in order of magnitude then computing the percentage of time each flow volume is equaled or exceeded.

Summary of Impacts on Flood Control Benefits

The evaluation of impacts of reallocation on flood control benefits included evaluation of impacts at Chatfield Reservoir, as well as impacts at Bear Creek Reservoir and Cherry Creek Reservoir, and on the South Platte River from Chatfield Reservoir to Julesburg, CO. This analysis is described in Appendix H, USACE Hydrology Report: Chatfield Dam and Reservoir. Impacts on flood control benefits were evaluated through use of a hydrologic model to simulate the operations at Chatfield Reservoir, Cherry Creek, and Bear Creek Reservoirs for the historical period of record. Because the period of record does not include extremely large flood events, the impacts of reallocation on the Reservoir Design Flood (RDF) and Inflow Design Flood (IDF) were also evaluated.

At Chatfield Reservoir, for peak pool probabilities, the 100-year pool elevation is 5465.5 feet msl for the base condition, and increasing the top of conservation pool to 5444 feet msl resulted in a 100-year pool of 5474.3 feet msl, or an increase of 8.8 feet when compared to the base condition. For release flow probabilities at Chatfield Reservoir, the base condition and the with reallocation condition are nearly identical. The with reallocation condition had slightly lower outflow values for the 10-year return periods. The 50-, 100-, and 500-year Chatfield outflows are all 5,000 cfs for both the base condition and with reallocation. This is due to the releases being constrained to a maximum allowable outflow of 5,000 cfs until the pool reaches the uncontrolled spillway crest. Table 4-5 shows the flow probability relationship for baseline and with reallocation conditions at Chatfield, Cherry Creek, and Bear Creek Reservoirs and at selected locations along the South Platte River downstream of Chatfield Reservoir.

Table 4-5
Peak Discharge Probability - South Platte River Basin, Colorado
Comparison of Baseline and With Reallocation Conditions

Location	Chatfield Conservation Pool (feet msl)	Peak Discharge Probabilities (cfs)				
		2-Year	10-Year	50-Year	100-Year	500-Year
	5432	950	4,300	5,000	5,000	5,000
	5437	950	3,800	5,000	5,000	5,000
Chatfield Releases	5444	950	4,000	5,000	5,000	5,000
	5432	230	790	1,750	2,000	2,000
	5437	230	790	1,750	2,000	2,000
Bear Creek Releases	5444	230	790	1,750	2,000	2,000
	5432	150	1,250	5,000	5,000	5,000
	5437	150	1,250	5,000	5,000	5,000
Cherry Creek Releases	5444	150	1,250	4,100	5,000	5,000
	5432	9,800	16,200	21,900	24,300	30,100
	5437	9,700	16,100	21,900	24,300	30,300
Denver	5444	9,700	16,200	22,000	24,500	30,600
	5432	11,600	21,800	31,900	36,500	47,900
	5437	11,500	21,700	31,800	36,400	47,800
Henderson	5444	11,500	21,800	32,100	36,800	48,600
	5432	11,200	21,800	32,600	37,500	50,000
	5437	11,200	21,700	32,400	37,400	49,800

Table 4-5
Peak Discharge Probability - South Platte River Basin, Colorado
Comparison of Baseline and With Reallocation Conditions

Location	Chatfield Conservation Pool (feet msl)	Peak Discharge Probabilities (cfs)				
		2-Year	10-Year	50-Year	100-Year	500-Year
Kersey	5444	11,100	21,700	32,400	37,300	49,800
	5432	6,800	18,600	34,200	42,400	65,500
	5437	6,700	18,500	34,100	42,200	65,300
Julesburg	5444	6,700	18,400	33,800	41,900	64,800

For Cherry Creek and Bear Creek Reservoirs, there is minimal impact to both pool elevations and reservoir releases for the with reallocation conditions. The only impact was just a slight decrease in flows for Cherry Creek for the 10- and 50-year return period for the with reallocation condition. This is due to a small change in the priority of releases between Cherry Creek and Chatfield Reservoirs that was dependent upon conditions in the reservoirs during high flow periods for the with reallocation conditions.

For extremely large floods, an evaluation was made of the impacts of reallocation on the RDF and the IDF. More detailed information about these evaluations is contained in Appendix R, Antecedent Flood Study. The RDF is the size of flood a reservoir is designed to store with releases that are within the downstream channel capacity, and this flood normally produces a reservoir pool elevation near the spillway crest. At Chatfield Reservoir the original design storage for the RDF was based on releasing no water for five days after the heaviest portion of the rainfall, then initiating a release of 500 cfs and increasing releases of 500 cfs a day until a release of 5,000 cfs was achieved. With reallocation, the maximum pool elevation during the RDF does not stay below the spillway crest when using the original design criteria of a 5-day shutdown period with a 500 cfs per day stepped-release. Alternative design criteria for reservoir operations were evaluated that included: a) a shutdown period adjusted to three days while the stepped-release remained 500 cfs per day, and b) a shutdown period at five days and increased the stepped-release to 1,300 cfs per day. Both alternatives are considered acceptable design assumptions and during the RDF both resulted in a maximum pool elevation below the spillway crest. If storage reallocation is implemented, during flood control operations the primary consideration in determining reservoir releases will continue to be keeping releases as large as possible up to the 5,000 cfs target at the Denver gage on the South Platte River. However, consideration will also be given to the design assumptions for shutdown period and rate of stepping up releases. This will ensure adequate capacity for the Chatfield Reservoir to control the RDF without uncontrolled spillway releases and not compromising flood control benefits downstream.

The IDF (or Spillway Design Flood) is used to determine the size of the spillway and height of the dam embankment. Corps of Engineers regulations for routing the IDF requires consideration of an antecedent flood of a magnitude of 50 percent of the IDF assumed to occur five days prior to the occurrence of the IDF. For Chatfield Dam, the IDF is based on the Probable Maximum Precipitation (PMP) occurring over the upstream watershed. A statistical analysis of streamflow and meteorological data was conducted to determine if the 50 percent criteria was appropriate or if some other value would be more appropriate for use in the Chatfield IDF routings (Appendix R). Based upon this analysis, approval was obtained from HQUSACE to use an antecedent flood of 40% of the PMF instead of the traditional 50%. With the proposed reallocation, and use of an antecedent flood of 40% of the PMF, the resulting maximum pool elevation in the reservoir was 5520.9 feet msl, as compared to the original maximum pool elevation of 5521.6 feet msl.

A hydraulic analysis was conducted to develop water surface profiles to be used in the evaluation of impacts of reallocation on downstream flood stages. More detailed information about this evaluation is contained in Appendix I, USACE Hydraulic Analysis. The basis for the information used in this analysis was a HEC-RAS hydraulic model of the South Platte River from the Chatfield Reservoir to the Colorado-Nebraska State line, Cherry Creek from the Cherry Creek Reservoir to the confluence with the South Platte River and Bear Creek from the Bear Creek Reservoir to the confluence with the South Platte River. Utilizing this model, water surface profiles for the baseline and with reallocation conditions were calculated for the 2-, 10-, 50-, 100- and 500-year flood events using flow values from the above Table 4-5. The following Table 4-6 shows a comparison of average water surface elevations for the baseline and reallocation conditions. As shown on Table 4-6, in most cases there was no increase in average water surface elevations due to reallocation, and the maximum average difference in water surface elevations was 0.1 feet. These differences are considered negligible and would not warrant any changes to existing flood frequency criteria used for flood plain regulation.

Table 4-6
Water Surface Profiles - South Platte River Basin, Colorado
Comparison of Baseline and With Reallocation Conditions

Location	Chatfield Conservation Pool (feet msl)	Average Difference in Water Surface Elev. (feet)				
		2-Year	10-Year	50-Year	100-Year	500-Year
	5437	0.0	0.0	0.0	0.0	0.0
Bear Creek	5444	0.0	0.0	0.0	0.0	0.0
	5437	0.0	0.1	0.0	0.0	0.0
Cherry Creek	5444	0.0	0.1	0.0	0.0	0.1
	5437	0.0	-0.1	0.0	0.0	0.0
South Platte River	5444	0.0	0.0	0.0	0.0	0.1

4.3.1 Alternative 1—No Action

Under Alternative 1, flood storage space within Chatfield Reservoir would not be reallocated to conservation storage, and the operation of the reservoir would remain the same. (Refer to Chapter 2 for a description of current operations.) The impact on hydrology under Alternative 1 would be to develop surface water resources to meet the future water demands that would otherwise be met by Chatfield. The specific approach considered under Alternative 1 to meet the water demand would involve construction of Penley Reservoir and associated pipelines, as well as conversion of downstream gravel pits into water storage reservoirs.

Operations of the reservoir would not change under Alternative 1. Like the other alternatives, when flows enter the reservoir, the first commitment would be to meet senior water rights needs. Once those needs were met, any excess flow would be retained in the available storage of the reservoir (below the maximum elevation of the pool containing conservation storage). After the water levels reached the base elevation of the exclusive flood control pool, any excess flows would be released downstream. The maximum elevations of the pool containing conservation storage would be lower under Alternative 1 (5,432 feet msl) than under Alternative 3 (5,444 feet msl) or Alternative 4 (5,437 feet msl). As a result, water levels would be more likely to reach the maximum elevation of the conservation pool under Alternative 1 than under the reallocation alternatives. During low flows, the pool levels could drop below 5,432 feet msl under each alternative. During most of the year (outside of low flows), more water would be released downstream under Alternative 1 than the reallocation alternatives because the pool level would reach 5,432 feet msl before 5,437 or 5,444 feet msl. Under Alternatives 3 and 4, water would continue to be stored in the conservation pool until the target pool elevations were reached.

Based on the output from the HEC-5 model, the mean annual outflow from the reservoir into the South Platte River would range from approximately 56.2 to 780.4 cfs under Alternative 1, compared to the slightly lower mean annual ranges under Alternative 3 (54.2 to 759.3 cfs) or under Alternative 4 (55.4 to 772.5 cfs), which reflect storage of some flows in Chatfield Reservoir. Figure 4-5 shows the mean annual outflow for each alternative, and Figure 4-6 shows monthly outflows. The magnitude of difference between mean annual outflows under Alternative 1 and under the reallocation alternatives is greatest in the wettest water years, when the most water is available to store or release downstream. Higher flows in the South Platte River downstream of Chatfield Reservoir under Alternative 1 would typically occur in the months of May and June because of increased flow into the reservoir and greater potential for some inflows to be stored under Alternatives 3 and 4 rather than released as outflows during spring runoff events (Figures 4-7 and 4-8). Still, the magnitude of difference in downstream flows between the alternatives would be insignificant, which reflects storage of some flows in Chatfield Reservoir. Section 4.15 and Appendix I disclose the effects of hydrology on downstream flooding.

No new inflows would be added to the reservoir under any of the alternatives. Outflows from Chatfield Reservoir consist of both water rights releases and flood control releases. Water rights releases are made pursuant to a directive from the State Engineer's office to satisfy a call by those whose water rights are in priority. Flood control releases are made in accordance with the Corps' Water Control Plan. While more water rights releases would occur under Alternatives 3 and 4 than under Alternative 1, the amounts would be relatively small compared to the excess (flood) flows that would be released more regularly under Alternative 1. Furthermore, the extra stored water in these alternatives would result in a pool with a larger surface area, which would be subject to greater evaporation. Also, not all of the water rights flows provided under the reallocation alternatives would be released downstream; some of the flows that would have been released downstream under Alternative 1 would be diverted directly from the reservoir (upstream of the reservoir outlet). However, because more water would be stored under Alternatives 3 and 4 and some of that water would be released downstream later in the year than under Alternative 1, average outflows would be slightly greater under the reallocation alternatives during some months (such as July), which is an insignificant beneficial effect, and less during other months.

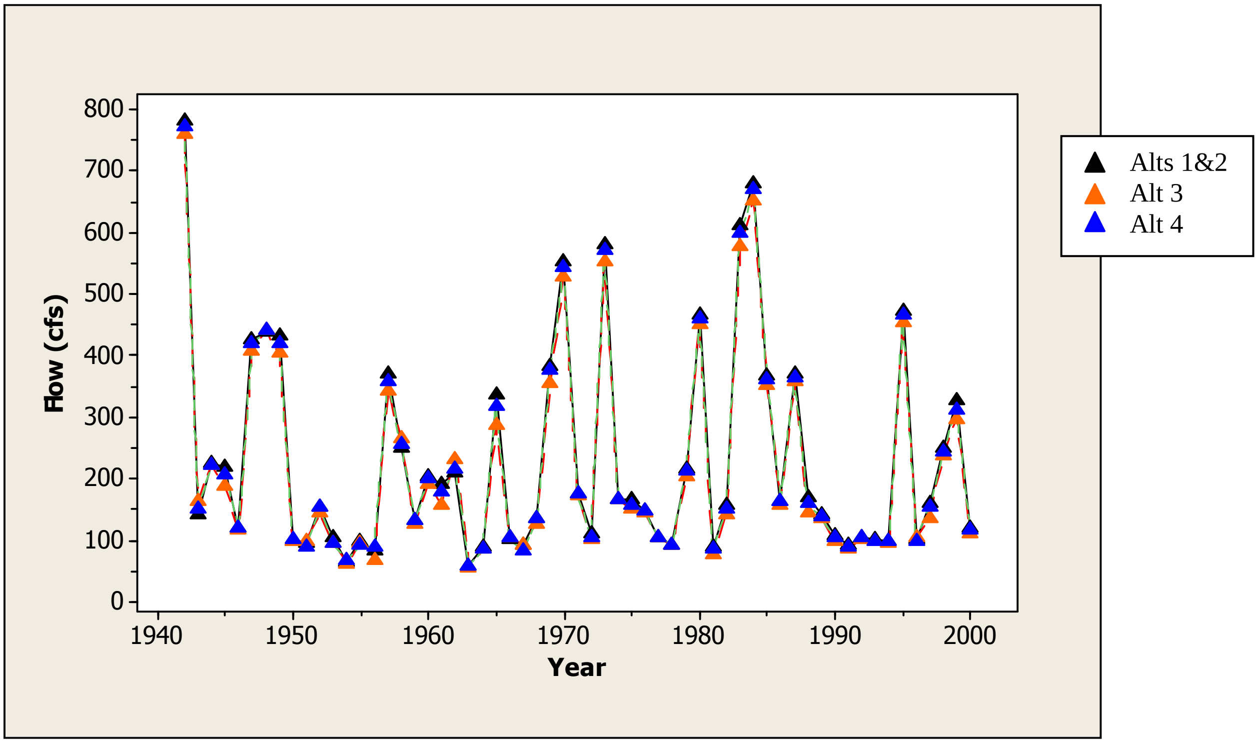

Figure 4-5
Mean Annual Outflow from Chatfield Reservoir by Alternative

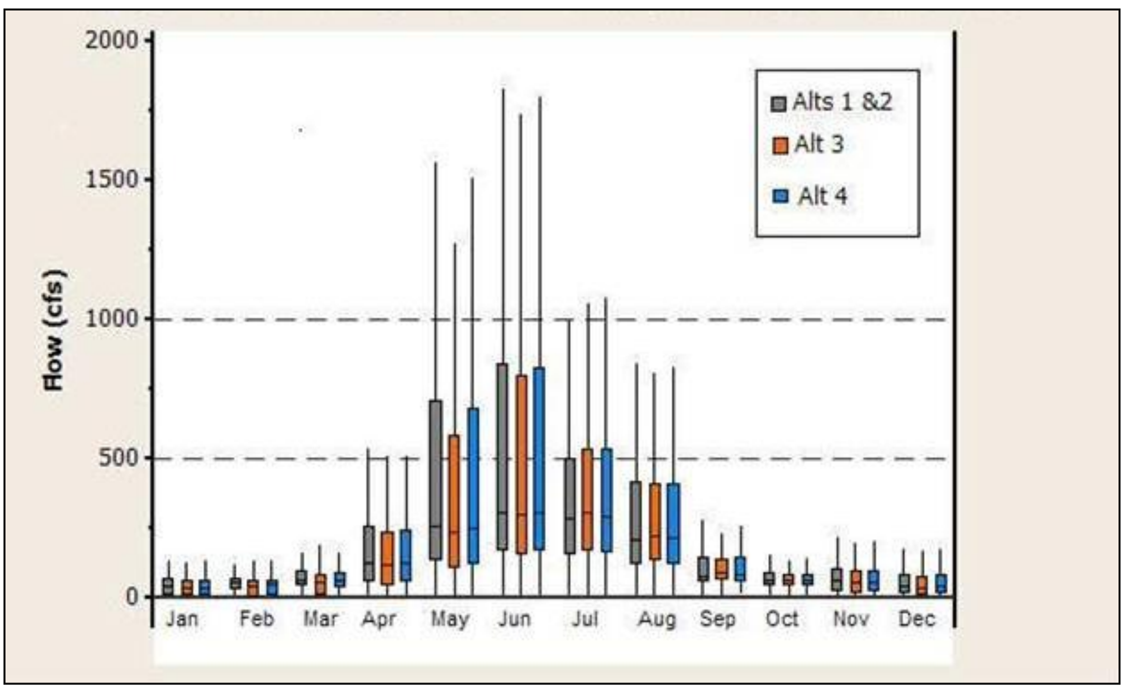

Figure 4-6
Comparison of Outflows by Month

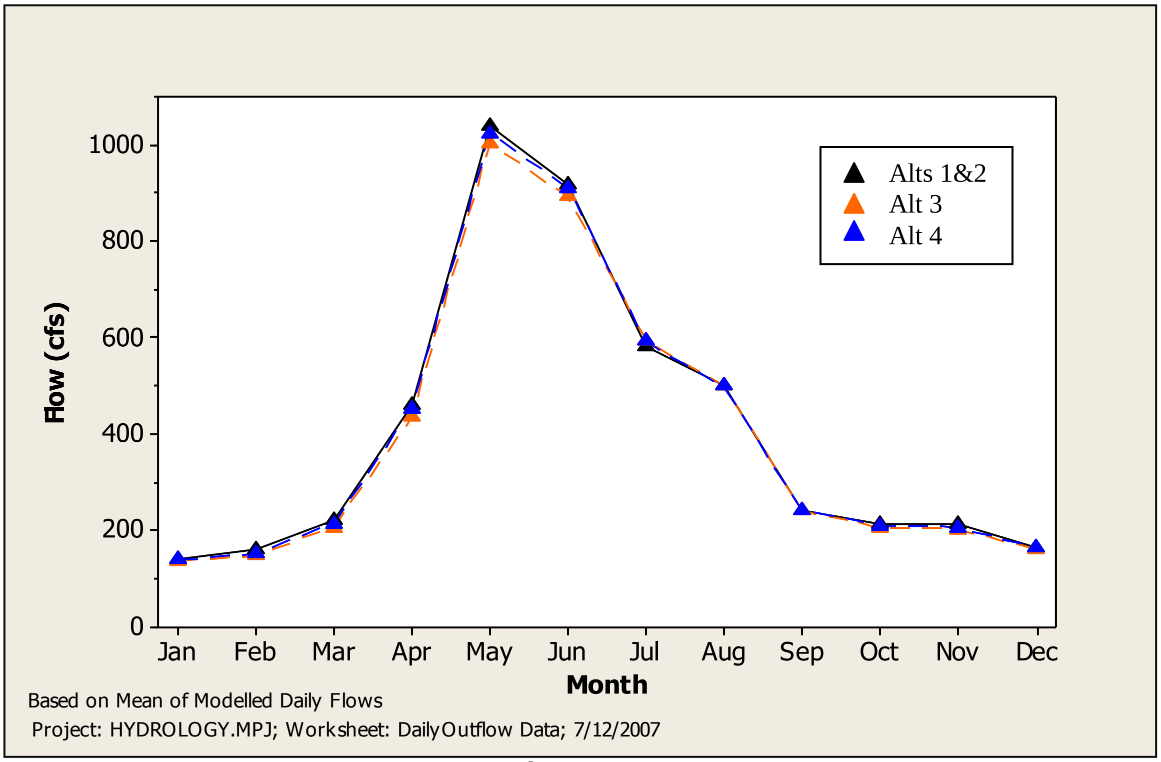

Figure 4-7
Mean Monthly Flow at the Denver Streamgage on the South Platte River

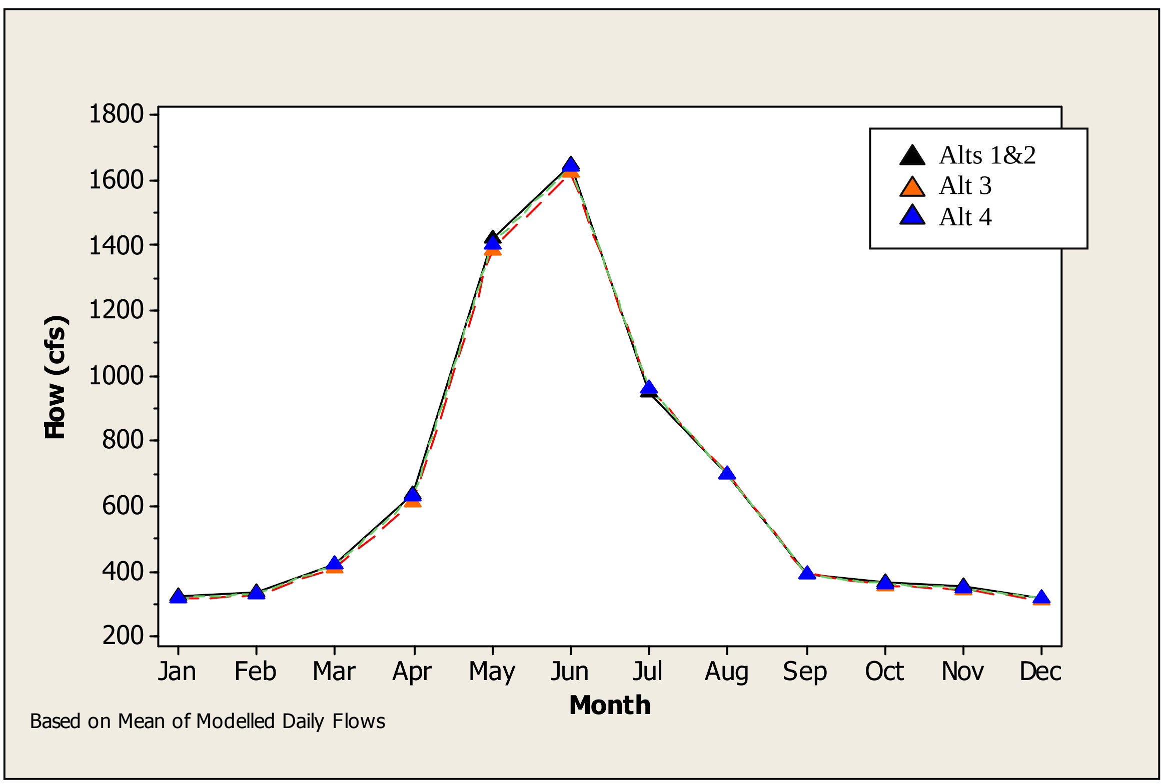

Figure 4-8
Mean Monthly Flow at the Henderson Streamgage on the South Platte River

Note: The Denver and Henderson gage locations are shown on Figure 1-2.

The most notable hydrologic difference between alternatives would be the magnitude of pool level fluctuations that could occur. Based on the HEC-5 model, the pool elevation would fluctuate the least (9 feet) under Alternative 1 compared to the reallocation alternatives, from the historical low elevation of 5,423 feet msl to the maximum conservation pool elevation of 5,432 feet msl. The maximum conservation pool elevation (5,432 feet msl) would not be reached in approximately 69 percent of the days in the POR (Table 4-7). Losses of water through evaporation of the conservation pool would be the smallest under Alternative 1 compared to the reallocation alternatives because the maximum surface area of the reservoir would be the smallest.

Table 4-7
Pool Elevation Statistics by Alternative

Parameter	Alternative 1 or 2	Alternative 3	Alternative 4
Target Pool Elevation	5,432 feet msl	5,444 feet msl	5,437 feet msl
Percent of Days in POR Below Target	69	82	75
Maximum Fall in Pool Elevation Below Target	9.0 feet	21.0 feet	14.0 feet
Difference Between Pool Elevation and Target Equaled or Exceeded in 10 Percent of Days in POR that were Below Target	7.5 feet	17.3 feet	12.0 feet
Difference Between Pool Elevation and Target Equaled or Exceeded in 50 Percent of Days in POR that were Below Target	3.0 feet	5.5 feet	3.8 feet
Difference Between Pool Elevation and Target Equaled or Exceeded in 90 Percent of Days in POR that were Below Target	0.2 feet	0.75 feet	0.3 feet

As described above, to meet the water demand under Alternative 1, upstream water providers would construct Penley Reservoir (Figure 2-1) and associated pipelines, and downstream water providers would convert gravel pits into surface water storage reservoirs. The proposed Penley Reservoir would be constructed off-channel and would therefore not inundate existing streams in the area. Inundating the off-channel site would result in 155 acres under water at Penley Reservoir.

The pipelines that would be built to transport the water from the South Platte River to the proposed Penley Reservoir would cross several perennial streams, including Indian Creek, Rainbow Creek, and Willow Creek. Several techniques are available to minimize the impact of constructing pipelines through water bodies. These are designed to maintain water flow and minimize changes in waterbody flow characteristics. For example, standard upland, cross-country construction methods can be used in intermittent streams or ditches that are dry or non-flowing at the time of construction. For flowing water bodies, several types of dry crossing techniques are possible (i.e., flume, dam and pump). The flume method typically is used to cross small to intermediate flowing water bodies that are either fish-bearing or non-fish-bearing streams. The flume technique involves diversion of stream flow into a carefully positioned pipe of suitable diameter to convey the maximum flow of the stream across the work area, and ensures that stream flow rate is not interrupted. With the dam and pump method, stream flow is diverted around the work area by pumping water through hoses over or around the construction work area. The goal of this technique is to create a relatively "dry" work area to minimize the transport of sediment and turbidity downstream of the crossing. If appropriate construction techniques were implemented, the proposed pipelines would have little impact on hydrology.

Conversion of downstream gravel pits to water storage reservoirs would involve constructing slurry walls down to bedrock around the entire circumference of the gravel pit between the pits and the South Platte River and pumping water into the gravel pits from the river. This diversion of water from the river would reduce flows slightly in the South Platte by the amount pumped from the river. The effect of acquiring water rights from agricultural land for the City of Brighton's water storage in downstream gravel pits is described under Section 4.15.

4.3.2 Alternative 2—NTGW/Downstream Gravel Pits

Under Alternative 2, water demands would be met by using NTGW and the downstream gravel pits along the South Platte River. The impacts on hydrology from converting downstream gravel pits to water storage reservoirs would be the same as those described under Alternative 1. The impacts to hydrology from relying on NTGW are described below, and focus on overall demand of the entire Denver Metro area. It should be noted that the average annual yield of 8,539 acre-feet that would be achieved under the reallocation alternatives represents only a portion of the overall pressure being placed on NTGW.

As described in Chapter 2, the South Metro Water Supply Board completed a major study (the SMWSS) in December 2003 (Black & Veatch et al. 2003) analyzing the potential impacts of continuing to rely on NTGW through 2050. The information presented in the following discussion primarily comes from the SMWSS.

NTGW has been an excellent source of municipal water supply in Denver, but it is a resource that recharges at very minimal rates and is essentially a non-renewing water resource that is being mined at ever increasing rates. In south metropolitan Denver, NTGW comes from the Denver Basin, which includes (from top to bottom) the Dawson Aquifer, the Denver Aquifer, the Arapahoe Aquifer, and the Laramie-Fox Hills Aquifer. Of these, the Arapahoe Aquifer contains the greatest number of productive wells and is used extensively for municipal purposes. Water quality in this aquifer is very high and meets state and federal drinking water standards.

The USGS has estimated that the Denver Basin aquifers store 467 million acre-feet of groundwater. Of that total, 257 million acre-feet is considered potentially recoverable, and of that, 58.1 million acre-feet occur within the study area. A portion of this groundwater is NTGW, which is either not directly connected to the surface water system or legally defined as NTGW. Water levels in the bedrock aquifers have been decreasing steadily since the early 1980s. Between 1995 and 2000, water levels in the Arapahoe Aquifer declined at an average rate of almost 30 feet per year in the study area. Even so, the amount of water that resides in storage in the Denver Basin bedrock aquifers is enormous. However, the geologic character of the bedrock aquifers (i.e., the hydraulic conductivity of the more permeable materials that comprise the aquifers, together with the complicating effects associated with the low-permeability interbeds within the aquifers) results in steep drawdowns immediately near pumping wells. In other words, accessing the abundant water in storage is not easy.

Falling water levels in the Denver Basin have reduced the ability to obtain NTGW by reducing the artesian pressure. The ability to pump water is directly proportional to pressure. While the water loss associated with the loss in artesian pressure is a small percentage of the total water volume in the aquifer, the loss in pressure represents a large percentage of the total pressure available to obtain water from the aquifers. As such, the problem with continued pumping of the Denver Basin bedrock aquifers is much more related to a significant drop in the rate of well production (the gpm of withdrawal) than to a scarcity in the total water stored in the aquifers. Furthermore, reasonably high pumping rates are required to meet urban water demands.

Under Alternative 2, it is assumed that NTGW would continue to be pumped from the Denver Basin bedrock aquifers to provide an average annual yield of 8,539 acre-feet, equivalent to the yield expected under the reallocation alternatives. The SMWSS developed and peer reviewed a sophisticated model to estimate the potential impacts of an alternative similar to Alternative 2. Again, the model considered a much greater yield than Alternative 2 or the reallocation alternatives would provide. Interpreting the output of this model suggests that the volume of pumping projected to meet water demands in the south Denver Metro area would continue to dissipate the regional head from these aquifers. Aquifer levels would be drawn down over time and would not recover as annual pumping continued. Water would be pumped locally at much greater rates than could be replenished through natural recharge or from inflow from around the perimeter of the pumping area. As described previously, this situation is largely the result of the geologic characteristics of the Denver Basin aquifers, which are tight sandstones with relatively low transmissivities.

According to the SMWSS, the loss in regional head also would be compounded by the interference between nearby wells that would occur if these aquifers were pumped at the rates predicted to meet peak water demands in the Denver Metro area. The SMWSS evaluated this potential well-to-well interference with an individual well analysis, which evaluated the maximum well pumping rates and the number of additional wells that would be needed to meet water demands. The analysis predicted that 1,364 additional wells would need to be constructed to meet water demands solely with continuing use of NTGW (even during peak demands). Well-to-well interference could reduce water levels by 100 to 300 feet. Under this scenario, pumping rates would also decrease, as shown in Figure 4-9.

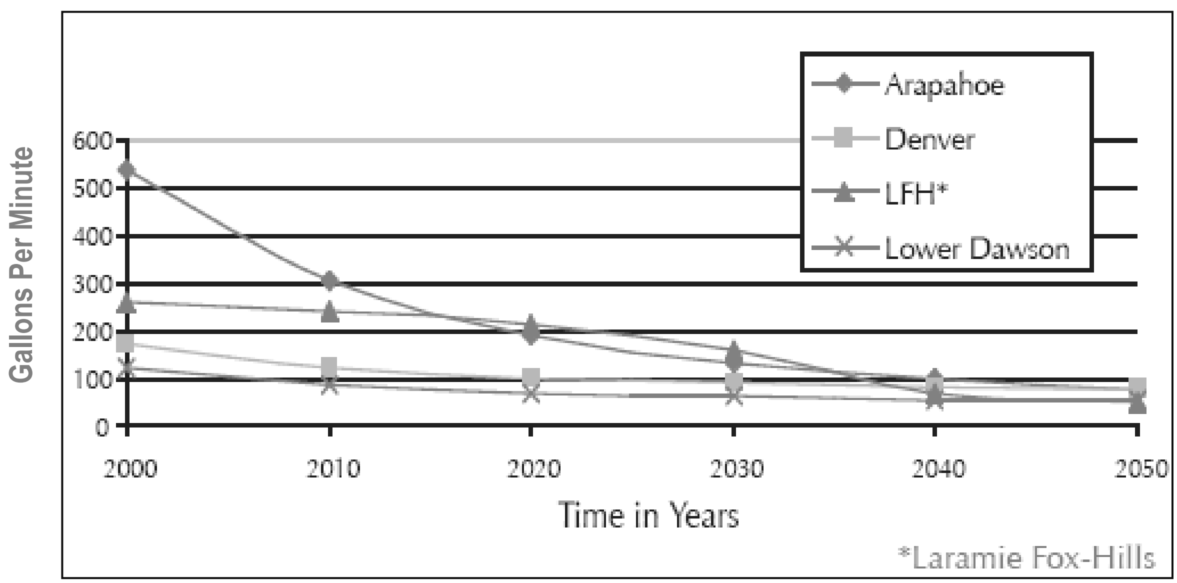

Figure 4-9
Average Pumping Rates by Aquifer under Simulation of Continuing to Use NTGW to Meet Increased Water Demands

Efficient well production combined with good water quality makes the Arapahoe Aquifer the most desirable of the Denver Basin aquifers for municipal water supply (Colorado Foundation for Water Education 2007). As a consequence, its water levels are dropping the fastest, particularly in the south Denver Metro area. The combined effect of the drop in regional water levels and the well-to-well interference could result in a loss of production in the Arapahoe Aquifer of as much as 85 percent by 2050. In 2003, the maximum Arapahoe Aquifer pumping rates in the study area ranged from 500 to 600 gpm. Under Alternative 2, the regional trend is that the pumping rate in a typical well could drop to 300 gpm by 2010, and to 80 gpm by 2050. By 2050, a well producing 100 gpm would be considered successful in terms of production. However, at that rate the well would be uneconomical for municipal use. Because 80 gpm is an average rate, some wells could be pumping more than 100 gpm. Uneconomic wells would be replaced by additional wells at new locations, which is accounted for in the cost estimates related to Alternative 2. Results in the other three aquifers show the same significant regional declines in production as these aquifers are used to meet increasing production.

The SMWSS also modeled the costs of continued reliance on NTGW at the exclusion of other potential water sources and concluded that this approach would result in very large increases in production costs in the foreseeable future, and the eventual loss of NTGW as an economically viable resource. Continued increases in pumping would severely affect well production rates over the next 20 years, and costs of facilities would be several times the current costs. Under Alternative 2 pumping would become increasingly expensive in the foreseeable future and would be economically unsustainable in the long term if continued use of NTGW was not supplemented with surface supplies. Although the reallocation alternatives would only provide a small portion of water to help meet the overall demand, this portion would be considered an important piece to reduce reliance on NTGW.

The SMWSS predicted that without any storage to meet peak demands, 1,364 additional wells would be required to meet demands by 2050. Well construction and infrastructure are very costly and these wells represent huge increases in required capital facilities costs. To maintain existing production rates new wells will need to be drilled on an increasing frequency because the yield of the new wells will be smaller and smaller over time. The total costs of relying on NTGW without any storage to meet peak demands were modeled at over $4 billion, including approximately $2.3 billion for initial construction costs and approximately $41 million in annual operations and maintenance costs.

Other documents that provide additional, recent perspectives related to the problems and high costs associated with continued NTGW use include the SMWSA Regional Water Master Plan (CDM and Meurer & Associates 2007); the Water Resources Strategic Master Plan for Town of Castle Rock (CH2MHILL 2006); the Castle Pines North Metropolitan District Integrated Water Resources Plan (CDM and Applegate Group 2006); the Engineering Report for the Long Range Master Plan for the Castle Pines Metropolitan District (Rothberg, Tamburini & Windsor, Inc. 2006), which includes the Long Range Master Plan for the Castle Pines Metropolitan District (prepared by Jehn Water Consultants) as Appendix A; the Water Resources Implementation Plan for the Town of Castle Rock, the Castle Pines Metropolitan District, and the Castle Pines North Metropolitan District (CDM 2008); the Citizen's Guide to Denver Basin Groundwater (Colorado Foundation for Water Education 2007); and Aquifers of the Denver Basin, Colorado (Topper 2004). These documents present the collective conclusion of water providers to develop alternative sources of surface water and surface water storage as soon as possible. Highlights from each are summarized below.

According to the SMWSA Regional Water Master Plan, the SMWSA's aggregate NTGW rights of about 111,000 acre-feet per year could nearly meet buildout demands. However, because of concerns related to the long-term sustainability of NTGW, the group's members intend to substantially transition away from groundwater, using less than 15,000 acre-feet per year (approximately 13 percent of total supplies) of NTGW at buildout. The Master Plan builds on the SMWSS (Black & Veatch et al. 2003), but does not evaluate continued groundwater pumping. Rather, the Master Plan identifies phased ways of meeting the entire renewable water supply goal of each SMWSA water provider. Some providers, such as Castle Pines North Metropolitan District, anticipate eliminating groundwater use completely.

The Town of Castle Rock Water Resources Strategic Master Plan explains that by 2055 NTGW will be relied upon to provide only 17 percent of the town's water needs, as opposed to the 100 percent reliance on groundwater the town had in 2005. The Town of Castle Rock intends to work in partnership with other South Metro area providers to import surface water to reach an overall water supply mix of renewable and reusable water that is 75 percent sustainable. The Town of Castle Rock concluded that investing $250 million in a groundwater system that did not meet their long-term needs did not make sense. Looking beyond 2055, groundwater levels and the amount of water that wells can produce will decline to such an extent that it will become economically, and probably technically, unfeasible to produce groundwater at rates needed to meet the town's water demands. Determination of an exact time when the groundwater may become unfeasible depends on many variables and cannot be reliably predicted, but extrapolation of modeling suggests it could happen by 2060.

The Castle Pines North Metropolitan District Final Integrated Water Resource Plan describes the Denver Basin bedrock aquifers as the primary source of water supply to Castle Pines North Metropolitan District. Groundwater levels and well production rates are declining in most of the district's 10 wells (including at least 6 in the Arapahoe Aquifer) as a result of the groundwater pumping needed to meet the area's water demands. Within approximately 20 years, the Castle Pines North Metropolitan District's well production will decline and water levels will fall below the maximum allowable levels for operational purposes. It is very likely that the district will face an unacceptable production decline in less than 20 years because of well production declines during the peak summer pumping period. Under current conditions, within approximately 15 to 20 years the district will not be able to adequately meet peak monthly demands during the irrigation season. Increased costs with decreasing groundwater levels will occur, including electrical costs because well pumps will have to lift water a greater distance up to the surface, and equipment costs associated with upgrading existing pumps, electrical systems, and discharge piping to handle the increased lift. As an example, one of the district's Arapahoe Aquifer wells recently had a new pump, motor, electrical system, and piping replaced at a cost of approximately $400,000. To achieve a sustainable water supply, the Castle Pines North Metropolitan District is pursuing renewable water supplies.

The Long Range Master Plan for the Castle Pines Metropolitan District and the related Engineering Report indicate that the District currently is growing at approximately 6 percent per year. If the District were to maintain this growth rate, it is projected they would reach build out in 2021. The District currently relies solely on nonrenewable groundwater supplies to meet water demands. The District also has surface water rights on East Plum Creek. This water is currently not available for consumption because the District does not have any surface water conveyance or treatment facilities, or wells and pipelines from East Plum Creek. Developing the infrastructure to use surface water rights is estimated to cost $37.1 million through 2056. The estimated cost for relying on NTGW was estimated to be $42.3 million through 2056. Much of the cost to continue to use NTGW is predicted to occur in the future, to install additional wells to maintain supply. The large future cost suggests that it would continue to be considerably more costly to rely on NTGW beyond 2056. The report concludes that it would be more cost effective for the District to develop infrastructure to utilize their East Plum Creek water rights in conjunctive use with their existing groundwater supply than to continue to solely rely on groundwater.

The Town of Castle Rock, the Castle Pines Metropolitan District, and the Castle Pines North Metropolitan District participated in the Water Resources Optimization Study (WROS). The results of the WROS were incorporated in the Water Resources Implementation Plan (CDM 2008), a joint project undertaken to establish a plan to fully utilize water supplies and return flows that are currently unused or under-utilized. These entities rely primarily on NTGW supplies to meet the water needs of their respective service areas. Looking towards development of sustainable water supplies, these entities are planning for development of a regional approach to using the local renewable supplies.

The Citizen's Guide to Denver Basin Groundwater describes that although the Denver Basin contains about 200 million acre-feet of recoverable water in storage, water levels are declining at rates of one inch per day (30 feet per year). Water level trends in the dominant municipal water supply aquifers (the Arapahoe and Laramie-Fox Hills) are not favorable. Between 1990 and 2000, development in the south Denver Metro area resulted in localized declines up to 40 feet per year in the Arapahoe Aquifer. The future prospects for this aquifer are of great concern to water managers. The Laramie-Fox Hills Aquifer, used for municipal water supply in the southeast Denver Metro area, has experienced localized water-level declines of up to 125 feet in the past decade. Furthermore, much of the estimated recoverable water is spread across the eastern part of the basin, where demand is minimal and the cost of extraction and conveyance is presently prohibitive. It is likely that economics will prevent the Denver Basin aquifers from being completely exhausted. Over time, large-capacity pumping may become so expensive that it simply becomes too costly to drill more wells or keep pumping existing wells with diminishing returns. Drilling more wells is not necessarily a viable long-term solution because of well-to-well interference, particularly in areas with high demand. Some well users on the western margin of the Denver Basin in Douglas County already have been forced to deepen their wells or pumps in an attempt to find more water.

Aquifers of the Denver Basin, Colorado, is a peer-reviewed article that describes that available water reserves in the Denver Basin may be one-third less than previously estimated. There is no legal protection for pressure levels in the aquifer, and water managers are becoming increasingly concerned about the rapid water level declines (30 feet per year). Approximately 33,700 wells of record have been completed in the sedimentary rock aquifers of the Denver Basin for municipal, industrial, agricultural, and domestic purposes. The volume of annual withdrawal appears to indicate a significant acceleration in groundwater withdrawal from the Denver Basin aquifers between 1985 and 1995.

4.3.3 Alternative 3—20,600 Acre-Foot Reallocation

Alternative 3 would reallocate storage from the flood control pool to the conservation pool. Under this alternative, the elevation of the conservation pool would be raised from 5,432 feet msl (under Alternative 1) to 5,444 feet msl. The average annual yield under Alternative 3 is estimated at 8,539 acre-feet. The "average annual yield" is the amount of water that consistently could be expected from a project on an annual basis. The pool elevation of 5,444 feet msl would not be achieved every year due to fluctuations in the amount of runoff available on an annual basis.

The mean annual outflow from the reservoir into the South Platte River under Alternative 3 would range from 54.2 to 759.3 cfs, based on the output from the HEC-5 model. Of the alternatives, mean annual outflows into the South Platte River would be smallest under this alternative (Figure 4-5) because more water would be maintained in the conservation pool to reach the targeted 5,444 feet msl pool elevation. However, the magnitude of difference in outflows between the alternatives is small. The reduced flows in the South Platte River would be most noticeable in the months of May and June when incoming runoff is retained to fill the reservoir (Figures 4-7 and 4-8). The small magnitude of differences between alternatives appears constant at the Chatfield Reservoir outflow, the Denver gage downstream, and the Henderson gage further downstream.

Peak flows would not be significantly different under Alternative 3 than under Alternatives 1 or 2. The USACE modeled 500-year streamflows (Q_{500}) under each Alternative (see Appendix I for results). The alternatives would not substantially alter the frequency of Q_{500}. The magnitude of Q_{500} along the South Platte River downstream of the reservoir would change by $\pm$2 percent under Alternative 3 compared with Alternatives 1 and 2.

The largest observable difference between alternatives appears to be the magnitude of pool elevation fluctuations. Under Alternative 3, elevations would fluctuate up to 21 feet (from the historical low elevation of 5,423 feet msl to the maximum elevation under Alternative 3 of 5,444 feet msl) (Table 4-7). The demand on the additional water storage rights would change the volume and pattern of the discharge from that observed under Alternative 1, allowing the pool level to fluctuate more widely under Alternative 3 than under Alternative 1. The maximum conservation pool elevation (5,444 feet msl) would not be reached in approximately 82 percent of the days in the POR (Table 4-7). Several of the following sections address the potential impacts of pool fluctuations on habitat of the shoreline and aquatic wildlife and vegetation, as well as recreational users. Losses of water through evaporation of the conservation pool would be the largest under Alternative 3 because the surface area of the reservoir would be the largest.

4.3.4 Alternative 4—7,700 Acre-Foot Reallocation/NTGW/Downstream Gravel Pits

Alternative 4 would also reallocate storage from the flood control pool to the conservation pool. In this case, the pool containing conservation storage would be raised from 5,432 to 5,437 feet msl. The average annual yield would be approximately 3,192 acre-feet. Under Alternative 4, the additional 5,348 acre-feet would be obtained from NTGW and downstream gravel pits. The impacts on hydrology related to the use of downstream gravel pits would be less than those described under Alternative 1. Under Alternative 4, the remaining water storage would be obtained from NTGW. Those impacts are described under Alternative 2.

The mean outflow from the reservoir into the South Platte River under Alternative 4 would range from 55.4 to 772.5 cfs, based on the output from the HEC-5 model. Outflows into the South Platte River under Alternative 4 would fall between the other two alternatives because water would be maintained in the pool containing conservation storage at a level between the other two alternatives (Figure 4-5). However, the magnitude of the differences would be small. The difference in flows in the South Platte River would be most noticeable in the months of May and June when incoming runoff is retained to fill the reservoir (Figures 4-7 and 4-8).

Peak flows would not be significantly different under Alternative 4 than under Alternatives 1 or 2. The magnitude of Q_{500} along the South Platte River downstream of the reservoir would change by ±1 percent under Alternative 4 compared with Alternatives 1 and 2 (Appendix I).

Because the pool containing conservation storage would increase only to an elevation of 5,437 feet msl, the degree of fluctuation (approximately 14 feet) within the reservoir would be greater than under Alternative 1 and less than under Alternative 3. The target pool elevation (5,437 feet msl) would not be reached in approximately 75 percent of the days in the POR (Table 4-7). Losses of water through evaporation of the conservation pool would fall between Alternatives 1 and 3 because the surface area of the reservoir would fall between the two.

4.3.5 Reduction of Potential Impacts

Climate change will result in greater variability in climate. There may be more floods and more or longer periods of drought, which cannot be accurately predicted at this time (Ray et al. 2008). The Corps model uses inflows during the 1942–2000 POR, which tend to be greater on average than predicted for future conditions for all alternatives. This results in a greater probability of adequate mitigation for all types of inundation-related environmental impacts.

Alternative 2 could contribute to the loss of production in the Arapahoe Aquifer over the Denver Metro area. As a regional problem, this issue would cause a significant adverse impact on hydrology. This impact would be difficult to reduce without decreasing the reliance on NTGW required under Alternative 2.

The largest potential impact on hydrology under Alternatives 3 and 4 compared to Alternative 1 would be the amount of fluctuations in pool elevations. In terms of hydrology, potential changes in pool fluctuations would be difficult to minimize. The effects of those fluctuations on other resources (e.g., wildlife, recreation) and ways to reduce fluctuations and their effects through adaptive management are discussed under those resources. Adaptive management by an established group would be used to implement operation strategies to minimize impacts once reallocation begins.

4.4 Water Quality

Interested parties were invited to participate in a water quality workgroup to determine the scope of the water quality modeling necessary for this FR-EIS. Participants included representatives from the Chatfield Watershed Authority, Colorado State Parks, CDOW, the water providers, the Corps, and Tetra Tech (who assisted the Corps in preparing the FR-EIS). Four workgroup meetings were held between April and September 2005. The workgroup reviewed, evaluated, and considered scoping comments on water quality; identified the water quality parameters of greatest concern; and developed the following approach for addressing water quality concerns associated with storage reallocation at Chatfield Reservoir.

Three broad categories were identified as the primary water quality issues associated with the proposed alternatives: changes in nutrient levels, metals concentrations, and bacteria counts. Available physical, chemical, and biological data for the reservoir were evaluated, and the proposed conditions under each alternative were modeled. A detailed description of the approach is presented in the complete water quality impacts report in Appendix J. The analysis provided a simplified, conservative assessment of potential impacts on water quality under each alternative. As discussed in Section 4.3, the average pool levels reflected in the reallocation alternatives would likely be lower than the Corps model predicts. Because the water quality model includes average lake levels, water quality impacts may vary from those predicted. Because simple models generally do not represent fully the dynamic, time-variable nature of a system, they involve a high level of uncertainty. Potential sources of uncertainty are disclosed in Appendix J. Despite some limitations, simple modeling approaches can be useful analytical tools. The water quality workgroup considered more complex modeling approaches but ultimately determined that the approach documented in Appendix J was adequate and reasonable to evaluate the potential impacts associated with the proposed project.

Potential impacts on water quality from the proposed Penley Reservoir, pipeline areas, and gravel pit reservoirs are also discussed below, as applicable, by alternative.

Nutrients. Two types of nutrient analyses were conducted—a simple analysis (using the EUTROMOD water quality model) to evaluate historical total phosphorus loadings and estimate total phosphorus, chlorophyll-a, secchi depth, and Carlson's Trophic State Index (TSI); and a second separate and more detailed localized analysis to address the uncertainty regarding possible increases in anaerobic and inundated vegetation nutrient fluxes due to orthophosphorus (PO_4) and ammonia nitrogen (NH_3-N).

The EUTROMOD model predicts lake eutrophication response based on a set of regional statistical models. This analysis focused on estimating mean concentrations across the entire reservoir for several years. Historical incoming total phosphorus loadings along with the corresponding hydraulic residence time and change in volume for the baseline and reservoir storage reallocation condition were used to predict reservoir eutrophication potential and chlorophyll-a to evaluate possible occurrence and magnitude of water quality impacts to the Chatfield Reservoir.

The second assessment of the potential impacts on nutrients of the alternatives focused on potential changes in the volume of the hypolimnion (i.e., the cold bottom layer of water in the reservoir, characterized by low dissolved oxygen conditions) and the resulting effects on nutrient loading and concentrations in Chatfield Reservoir. Excessive nutrients stimulate plant growth (e.g., algae, weeds). When that plant material dies, the decomposition process reduces the amount of dissolved oxygen in the hypolimnion. Water with a low concentration of dissolved oxygen is called hypoxic; water with no dissolved oxygen is anoxic. These conditions can limit aquatic life and mobilize sediment-bound nutrients (including phosphorus) through oxidation-reduction processes that would not occur to the same extent under more oxygen-rich conditions. Releasing additional phosphorus can further increase eutrophication in the reservoir.

As described in Chapter 3, the TMAL for Chatfield Reservoir includes a phosphorus standard of 0.030 mg/L and a chlorophyll-a (a measure of eutrophication) standard of 0.010 μg/L measured through the collection of samples that are representative of the mixed layer during summer months (July, August, and September) and with a maximum allowable exceedance frequency of once in five years. The modeled changes under each alternative are compared with these standards to determine the impacts of each alternative on nutrients.

Metals. The evaluation of the potential impacts of the proposed alternatives on metals concentrations considered that increasing the bottom surface area of the reservoir could lead to greater releases of metals bound to bottom sediments. A simple model was used to compare the predicted metals releases under each alternative. The fluxes of sediment-based metals to and from the water column were estimated for the reservoir bottom. Fluxes depended on environmental conditions and varied by orders of magnitude. Only four metals (copper, iron, mercury, and manganese) exceeded water quality standards historically in the reservoir. The exceedances occurred in 2004 and likely resulted from accelerated sedimentation from burn areas associated with the Hayman fire. Metals considered in the water quality impacts analysis were copper, lead, mercury, cadmium, selenium, and arsenic. There were limited sediment data for these metals (one data point during August every year), but they were sufficient to perform simple analysis calculations. The estimated metals concentrations under the alternatives were compared with the copper, mercury, lead, cadmium, selenium, and arsenic water quality standards of 15.3 mg/L, 1.4 mg/L, 75 mg/L, 4.96 mg/L, 18.4 mg/L, and 50 mg/L, respectively (assessed water quality standard is based on a hardness value of 111 mg/L).

Bacteria. The assessment of the potential effects of the proposed alternatives on bacteria focused on the swim beach and surrounding areas where changes would be most likely to occur. Waterfowl and shorebird usage of the reservoir could increase with increasing shoreline area. With increasing usage, additional bacteria loading would be expected, which would affect bacteria levels at the swim beach. The water quality impacts analysis considered the relationship among the surface area and volume of the beach, the amount of use by birds and humans (especially children), and the potential E. coli bacteria concentration. Further discussion of E. coli is included in Appendix J.

4.4.1 Alternative 1—No Action

Nutrients. Nutrient analysis for Alternative 1 focused on conditions based on a regional statistical model (EUTROMOD) and conditions based on a localized loading model. The EUTROMOD model was used for the regional analysis (see Appendix J for details). Historical incoming total phosphorus loading, inflow, mean depth, and hydraulic residence time were specified for the years 1986 to 2007. The total incoming load comprised the South Platte River and Plum Creek contributions. The years 1987 and 2003 corresponded to high flow and low flow years based on incoming inflow data (90th percentile year and 10th percentile year, respectively), while the year 2000 corresponded to a median year. The hydraulic residence time was computed using modeled water surface elevation and outflows for each year based on results provided from the Corps reservoir simulation computer model. The model predicted the resulting in-lake growing season average total phosphorus, chlorophyll-a concentrations, and reservoir eutrophication potential using TSI. The model showed that the total phosphorus growing season concentration was greater than the total phosphorus standard of 0.030 mg/L for a few years. Predicted total phosphorus concentrations ranged from 0.195 mg/L to 0.033 mg/L with the predicted median concentration being 0.025 mg/L. The predicted chlorophyll-a concentrations ranged from 4.79 µg/L to 6.26 µg/L, with a median of 5.81 µg/L. The chlorophyll-a concentrations were always less than the chlorophyll-a standard of 10 µg/L. There is minimal inter-year variability in the reservoir eutrophication predictions based on the TSI predictions. The TSI results indicate that the reservoir remains in the mesotrophic to eutrophic range, while tending towards the lower bounds of the eutrophic range (approximately 49 to 54).

The EUTROMOD model provided a simplistic view of the nutrient analysis from which the internal loading is inferred from algorithms based on relationships derived from regionalized lakes. A more detailed localized analysis to address the uncertainty regarding possible increases in anaerobic and inundated vegetation nutrient fluxes due to PO_4 and NH_3-N was also evaluated for Alternative 1. Under Alternative 1 two cases were evaluated; the first assumed a 1-meter anaerobic hypolimnion and the second assumed no anaerobic hypolimnion. For the no-hypolimnion case only aerobic fluxes were assumed. The analysis considered separate components of the total load from several sources, including the South Platte River and Plum Creek watersheds upstream of the reservoir, atmospheric deposition, and the internal load from the reservoir (Figure 4-10). The anaerobic depth shown in Figure 4-10 corresponds to the depth of the hypolimnion. The proposed condition in this figure refers to Alternative 3. Alternative 1 would not involve periodic increases in water levels above 5,432 feet msl, as would Alternatives 3 and 4. As such, the evaluation of nutrient loading under Alternative 1 did not address inundated soil and vegetation above 5,432 feet msl. Sediment nutrient fluxes were estimated using a sediment flux model developed by DiToro (2001) (see Appendix J for details).

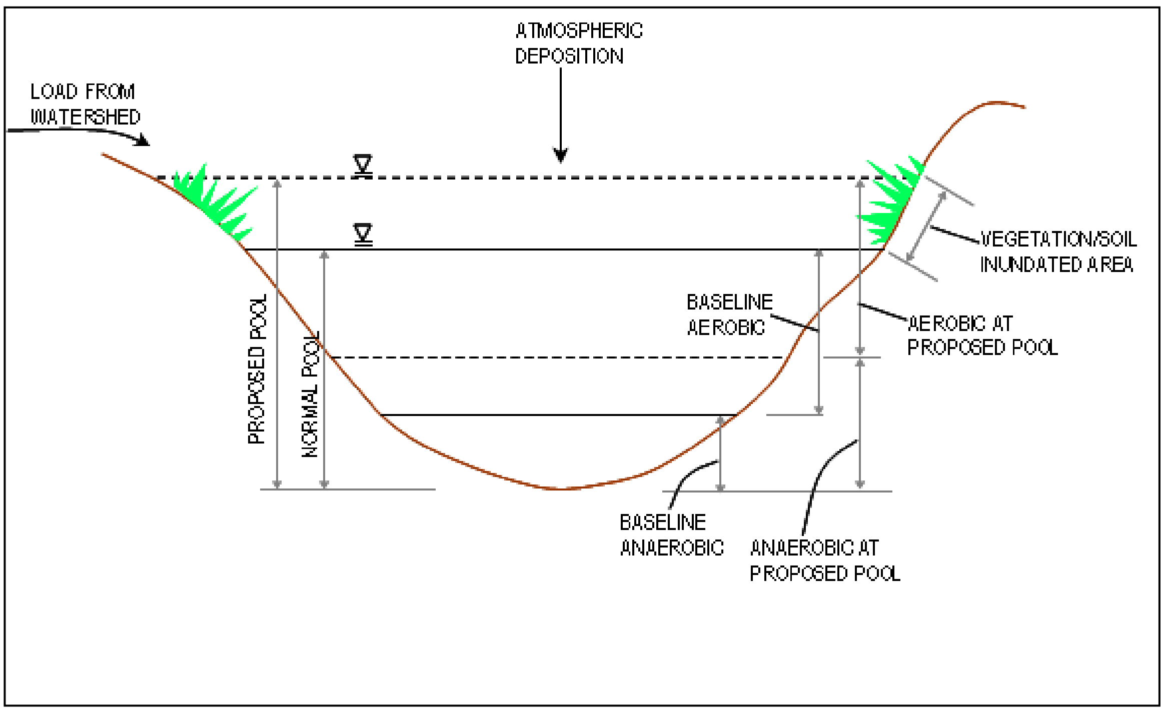

Figure 4-10
Phosphorus Sources to the Chatfield Reservoir Considered in the Nutrient Analysis

The detailed analysis showed that there may be water quality concerns regarding internal loading from increased anaerobic conditions due to increase in reservoir pool levels and inundated vegetation in Alternative 3 or 4 compared to Alternative 1. The model predicted steady-state nutrient concentrations in the reservoir for the growing period that were lower under Alternative 1 than under either Alternative 3 or 4. Converting the PO_4 concentrations to total phosphorus, the predicted concentration under Alternative 1 for the 1-meter hypolimnion was approximately 0.035 mg/L, greater than the current phosphorus standard (0.030 mg/L) under the TMAL. For the no-hypolimnion condition the predicted total phosphorus concentration under Alternative 1 was estimated to be approximately 0.018 mg/L, which is less than the current phosphorus standard (0.030 mg/L) under the TMAL. The NH_3-N concentration under Alternative 1 for the no-hypolimnion condition was estimated at approximately 0.02 mg/L.

Metals. Metal loads for copper, lead, mercury, cadmium, selenium, and arsenic from the watershed and from internal loads were evaluated under Alternative 1. The analysis indicated that metals concentrations in the reservoir under the maximum pool elevations (i.e., 5,432 feet msl for Alternative 1) would be higher under Alternative 1 than under Alternative 3 or 4. The concentrations of copper, mercury, lead, cadmium, selenium, and arsenic were estimated at 6.75, 0.63, 0.15, 0.022, 0.0005, and 0.123 µg/L, respectively, under Alternative 1. The standards for all these metals except mercury and arsenic are table value standards, which means that the standard is computed based on site-specific hardness values. Table value standards were calculated using representative hardness values in the reservoir (Chatfield Watershed Authority 2006). None of the predicted metals concentrations exceeds the applicable standard. According to the Chatfield Watershed report, a maximum concentration of 68.8 µg/L for copper was reported in 2006, which exceeded the acute copper standard, a table value standard dependent on water hardness (as presented in Chapter 3). Mercury, measured in the dissolved form, has also exceeded the total mercury standard of 0.01 µg/L in the reservoir. None of the other metals were reported as exceeding standards in 2006.

E. coli. Changes in the number of birds using the swim beach area or in the number of recreational users could affect E. coli concentrations. Under Alternative 1, the swim beach and nearby areas would not be modified. As a result, the shoreline and beach areas are not expected to change, and E. coli concentrations would not be affected.

Penley Reservoir, Pipeline Areas, and Downstream Gravel Pits. The potential effects on water quality of constructing Penley Reservoir and associated pipelines under Alternative 1 would be limited to the amount of sedimentation or potential spills that occurred during and immediately following construction activities. Ground disturbance could lead to soil erosion and transport of sediments to water bodies, which could result in short-term increases in turbidity. With effective construction BMPs and successful implementation of stormwater, erosion control, and spill prevention plans, the long-term adverse impact of these activities on water quality likely would be minor. Similarly, the construction of slurry walls in downstream gravel pits could result in localized, short-term increases in sedimentation that could reach the nearby South Platte River. BMPs and implementation of stormwater, erosion control, and spill prevention plans would reduce the potential for adverse impacts on water quality. These impacts on water quality would not be significant.

4.4.2 Alternative 2—NTGW/Downstream Gravel Pits

NTGW. No direct impacts are anticipated to water quality from using NTGW. Short-term indirect adverse impacts could occur if many additional wells were constructed to meet water demands. Ground disturbances could lead to short-term increases in turbidity at nearby water bodies, and the use of drilling rigs and related construction equipment could increase the potential for spills. With proper BMPs, these impacts are not anticipated to be significant.

Downstream Gravel Pits. The potential impacts on water quality from the conversion of downstream gravel pits to water storage reservoirs would not be significant, as explained above under Alternative 1.

4.4.3 Alternative 3—20,600 Acre-Foot Reallocation

Nutrients. In reviewing the water quality analysis, it is important to consider that Chatfield Reservoir does not contribute phosphorus and would not under the proposed alternatives. Instead, phosphorus inputs from the watershed upstream of Chatfield Reservoir influence concentrations in the reservoir. Changing the operation of Chatfield Reservoir could influence the reactivity of those minerals. Internal loading is not currently a concern in Chatfield Reservoir because of the lack of anoxic conditions (Chatfield Watershed Authority 2008). Furthermore, according to Regulation No. 38 (page 191), "Chatfield Reservoir presently has good water quality and uses are being attained… The data record amassed through more than 20 years of water quality monitoring shows that trophic condition has remained stable... The Commission believes that eutrophication of Chatfield Reservoir has been averted through the control of phosphorus loads from the watershed."

The evaluation of nutrients for Alternative 3 included two analyses, the first analysis used a simplistic but conservative regional nutrient loading model (EUTROMOD) and the second analysis used a more detailed site-specific loading model. For the EUTROMOD model the same historical incoming total phosphorus load and inflow as in Alternative 1 were specified for the years 1986 to 2007. The mean depth and hydraulic residence time were specified based on the Corps modeling of the maximum possible increase in proposed pool for the different years. The EUTROMOD model predicted an overall decrease in concentration for all estimated parameters (except secchi depth, which increased) from Alternative 1. This was expected because for the proposed condition the hydraulic residence time and mean depth based on the Corps modeling data are higher than the baseline, and the influent total phosphorus load was set to be the same as the baseline, thus resulting in a greater loss from the system (the internal loading is inferred from the model algorithms based on relationships derived from regional lakes). Chlorophyll-a concentrations were also estimated. Alternative 3 results indicate a minimal change (slight decrease) in chlorophyll-a concentrations from the baseline. In addition the model results show a very small change in the TSI. The TSI estimates indicate that the reservoir will remain in the mesotrophic to eutrophic range, while tending towards the lower bounds of the eutrophic range (approximately 47 to 53). Sensitivity analysis indicates that the key eutrophication parameters are sensitive to the hydraulic residence time. An increase in residence time results in a corresponding decrease in concentration and vice versa. This illustrates that by proper management of the volumes and outflow (i.e., the hydraulic residence time) for the reservoir the desired goals reasonably can be achieved.

An additional nutrient analysis was conducted to address the shortcomings of the simplistic analysis. This analysis assumed that increased depth and reduced outflow under increased storage promoted stronger summer thermal stratification and results in possible anoxic conditions in the hypolimnion that would increase internal phosphorus loading from bottom sediments. As under Alternative 1, nutrient loads (including the watershed, atmospheric deposition, and internal loads) for PO_4 and NH_3-N were evaluated under Alternative 3. The internal loading from the reservoir was estimated based on an increase in the depth of the hypolimnion and the resulting increase in sediment nutrient fluxes. The maximum possible increase in the depth of the conservation pool (i.e., 12 feet) was modeled. This condition would occur only during relatively high flows and would not last throughout the entire growing season. According to the hydrology model (see Section 4.3 for details on the model), the maximum pool elevation of 5,444 feet msl would be reached during summer months (June through August) only in 32 of the 59 years modeled. In other words, in almost half of the years, this maximum pool elevation would not be reached during the summer. In years where the maximum pool elevation was reached, the model output indicates that it would never be maintained throughout an entire summer. Only in 9 of the 59 years modeled would the target pool elevation be reached for more than half of the days in the summer months. Furthermore, as noted in Chapter 3, Dr. James Saunders, Surface Water Standards Scientist of the Colorado Water Quality Control Division, has asserted that anoxia appears to be a rare phenomenon in Chatfield (Chatfield Watershed Authority, 2008). As a result, internal loading (i.e., the amount of phosphorus that is re-suspended from the sediments on the bottom of the reservoir) does not appear to contribute significantly to phosphorus levels in Chatfield Reservoir and is not expected to contribute significantly under Alternative 3. Modeling a 12-foot hypolimnion provides a very conservative prediction of the impacts of Alternative 3 on phosphorus.

Under the modeled scenario, the increase in the depth of the hypolimnion could range from little to the entire 12 feet, the maximum increase in the pool elevation. The unlikely, worst-case scenario of 12 feet of hypolimnion was modeled. Under Alternative 3, water would inundate periodically the soil and vegetation between 5,432 and 5,444 feet msl that would not be inundated under Alternative 1. This inundation would occur only during relatively high flows. The nutrient model considered the short-term additional PO_4 load that would result from the initial inundation of the soils and vegetation. The model incorporated a site-specific estimate of PO_4 releases from vegetation and sediment. The model used the combined estimate for vegetation releases (3,000 pounds) and for sediment releases (5,000 pounds) or an annual total increase in phosphorus of 8,000 pounds. The model also assumed an inundated area of 568 acres, flooded for 197 days. Most of the phosphorus release is expected to occur in the first year after inundation and to decrease substantially with time.

The model indicates that the reservoir would experience an increase in total phosphorus (converted from PO_4) and NH_3-N concentrations under Alternative 3 above those modeled under Alternative 1. This conservative modeling approach predicts an approximate doubling of instantaneous maximum concentrations of both total phosphorus (to approximately 0.071 mg/L) and NH_3-N (to approximately 0.14 mg/L). This worst-case scenario phosphorus estimate assumes that nutrients would be released from the newly inundated soil and vegetation. However, most of the phosphorus would be released in the first year after inundation (see Appendix J for details). Over the longer term, instantaneous maximum concentrations of total phosphorus under this worst-case scenario would reach approximately 0.055 mg/L, about a 60 percent increase over Alternative 1. Again, the conditions that were modeled represent that worst-case scenario, which would not necessarily occur under Alternative 3 and would be unlikely to occur every year. In the unlikely event the hypolimnion did increase by 12 feet in one year, it would not likely persist at that depth throughout the growing season. This modeled prediction is useful because it provides an upper bound for the instantaneous maximum concentrations that could be expected under Alternative 3.

Nutrient concentrations were also modeled based on the more typical pool elevations expected under Alternative 3. As with the worst-case scenario, the increase in the depth of the hypolimnion was assumed to be the same as the total typical increase in pool elevation (calculated as 9.3 feet in the hydrology model). Based on modeling, nutrient concentrations still would be expected to be greater under this more typical condition than under Alternative 1, with total phosphorus (converted from PO_4) instantaneous maximum concentrations of approximately 0.066 mg/L in the short term and 0.050 mg/L after the first year of inundation, and an NH_3-N concentration of approximately 0.13 mg/L.

The model also predicted that nutrient concentrations would increase under Alternative 3 even if the hypolimnion did not dominate, and fluxes were aerobic instead of anaerobic (i.e., the minimum case with no hypolimnion for a 12-foot increase in pool elevation). The predicted concentrations were not as high as those compared to the maximum 12-foot increase or typical 9.3-foot increase case with hypolimnion. For the no-hypolimnion case under Alternative 3 the total phosphorus instantaneous maximum concentration (converted from PO_4) was estimated to be approximately 0.037 mg/L, and predicted NH_3-N concentration was approximately 0.020 mg/L.

The simple analysis using a regional model (EUTROMOD) suggests the increased retention under Alternative 3 would result in a decreased concentration. The conservative, detailed localized analysis shows that increases in pool levels and inundated vegetation under Alternative 3 could increase internal loading under anaerobic conditions. However, as described above, internal loading is not currently a concern in Chatfield Reservoir because of the lack of anoxic conditions (Chatfield Watershed Authority 2008). In general under Alternative 3, the added volume of water that would fill the reservoir at the target pool elevation or typical pool elevation would not offset (or dilute) potential increased nutrient loading. Under the worst-case scenario modeling, increasing the hypolimnion could increase the instantaneous maximum nutrient concentrations and could alter water quality in the Chatfield Reservoir for several years. However, the hypolimnion is not likely to change as much as modeled in the worst-case scenario. The scenario with no hypolimnion and only aerobic fluxes also indicates an increase in instantaneous maximum nutrient concentrations, but to a much lesser extent compared to the worst-case scenario. This simple approach provides an upper and lower bound for concentrations that can be expected, with instantaneous maximum total phosphorus concentrations ranging from 0.037 mg/L to 0.071 mg/L and NH_3-N concentrations ranging from 0.020 mg/L to 0.14 mg/L under Alternative 3.

Operating the reservoir to manage the outflow under Alternative 3 (e.g., increasing the retention time) could possibly reduce nutrient concentrations, but may not be implementable given the timing and objectives of water uses. In addition, the reallocation could change the way in which pollutants were diluted or assimilated in the reservoir because of changes in physical properties that could occur under a reallocation scenario. The contribution of phosphorus from inundated vegetation and soil would likely increase nutrients in the short term, but would likely decrease substantially with time.

Metals. As with Alternative 1, metal loads for copper, lead, mercury, cadmium, selenium, and arsenic from the watershed and from internal loads also were evaluated under Alternative 3. The analysis indicated that metals concentrations in the reservoir under the maximum pool elevations (i.e., 5,444 feet msl for Alternative 3) would be lower under Alternative 3 than under either Alternative 1 or 4. A worst-case analysis of metals resulted in an estimated decrease in metals concentrations in Chatfield Reservoir under Alternative 3. The predicted increase in volume at the maximum pool elevation would provide sufficient dilution to offset the decreased outflow (i.e., longer hydraulic retention time) and increased metals loading from the newly inundated areas. The concentrations of copper, mercury, lead, cadmium, selenium, and arsenic were estimated at 6.29, 0.53, 0.13, 0.021, 0.0004, and 0.120 μg/L, respectively, under Alternative 3. These correspond with decreases that range from approximately 2 percent (for arsenic) to 20 percent (for selenium) compared with concentrations predicted under Alternative 1. These predicted concentrations are estimates based on estimated diffusive fluxes and could change if sediment core sampling were performed to more precisely estimate the site-specific sediment metal fluxes.

E. coli. As with Alternative 1, possible changes in the number of birds in the immediate vicinity of the swim beach or in the number of recreational users using the swim beach were considered during the evaluation of the potential effects of Alternative 3 on E. coli concentrations. Under Alternative 3, the swim beach and nearby areas would be modified as described in Appendix M. To meet the goal of replacing affected facilities and use areas "in-kind", the relocation plan is based on maintaining current walking distances at the swim beach. Under this conceptual design, the beach area would be graded to minimize the distance between swim beach facilities and the water's edge at low water conditions. As a result, the configuration of the shoreline near the beach area and the overall dimensions of the swim beach would be similar to current conditions. Given this proposed modification to the swim beach, changes in E. coli concentrations are not expected under Alternative 3.

Part of the mainstem South Platte River (from Bowles Avenue to the Burlington Ditch Diversion) has been on the 303(d) list of water-quality impaired waterbodies since 1998 for fecal coliform and/or E. coli. This segment periodically exceeds current E. coli standards of 126/100 mg/L. As indicated in Chapter 3, an E. coli TMDL exists in this segment to protect recreational uses and public health. Although this segment occurs downstream of Chatfield Reservoir, the TMDL assessment states that significant E. coli contributions to this segment are conveyed through urban stormwater collection systems during storm events and dry weather conditions. Contributions from Chatfield Reservoir are not mentioned, and Alternative 3 is not expected to contribute E. coli.

Pipeline Areas. Alternative 3 would not involve constructing pipelines to transport water from Chatfield Reservoir thus there would be no impacts to water quality from construction of infrastructure under this alternative.

4.4.4 Alternative 4—7,700 Acre-Foot Reallocation/NTGW/Downstream Gravel Pits

Nutrients. The likely water pool elevations and depths of the hypolimnion under Alternative 4 would be intermediate between Alternatives 1 and 3. As a result, the predicted nutrient concentrations also would be intermediate between the concentrations predicted for those alternatives. The maximum elevation of the conservation pool under Alternative 4 would be 5,437 feet msl. As described under Alternative 3, this condition would occur only during relatively high flows (see Section 4.3 for more information) and would not last throughout the entire growing season. The correlated increase in the depth of the hypolimnion could range from little to the entire

5 feet. Similar to Alternative 3, under Alternative 4 water would inundate periodically the soil and vegetation between 5,432 and 5,437 feet msl that would not be inundated under Alternative 1. The 5,437 foot msl elevation would be reached only during relatively high flows. The predicted total phosphorus and NH_3-N concentrations would be expected to be lower than those reported under Alternative 3 and higher than those reported under Alternative 1.

As in Alternative 3, increasing the hypolimnion could affect nutrient concentrations and could alter water quality in Chatfield Reservoir for several years. However, internal loading is not currently a concern in Chatfield Reservoir because of the lack of anoxic conditions (Chatfield Watershed Authority 2008). The contribution of phosphorus from inundated vegetation and soil would likely increase nutrients in the short term, but would likely decrease substantially with time.

Metals. Metals concentrations in the reservoir at the target pool elevation (i.e., 5,437 feet msl for Alternative 4) would be intermediate between concentrations under Alternatives 1 and 3. As in Alternative 3, the predicted increase in volume at the target pool elevation would provide sufficient dilution to offset the decreased outflow (i.e., longer hydraulic retention time) and increased metals loading from the newly inundated areas. The magnitude of the decrease would be expected to be lower than under Alternative 3 because the volume increase would be lower.

E. coli. Like Alternative 3, changes in E. coli concentrations are not expected under Alternative 4, given the proposed modification to the swim beach area (described in Appendix 5 of Appendix M). Under the conceptual design, the beach would be graded to minimize the distance between the swim beach facilities and the water's edge at low water conditions. As a result, the configuration of the shoreline and the dimensions of the swim beach would be similar to current conditions, and E. coli concentrations would not be affected.

Pipeline Areas. Alternative 4 would not involve constructing pipelines to transport water from Chatfield Reservoir thus there would be no impacts to water quality from construction of infrastructure under this alternative.

NTGW and Downstream Gravel Pits. An additional 5,348 acre-feet would be obtained from use of NTGW and downstream gravel pits. The potential effects on water quality from conversion of downstream gravel pits to water storage reservoirs and use of NTGW are disclosed under Alternatives 1 and 2, respectively. Fewer and/or smaller gravel pit reservoirs would be needed under Alternative 4 than under Alternative 1 or 2. These impacts on water quality would not be significant.

4.4.5 Reduction of Potential Impacts

Increases in total phosphorus are expected under Alternatives 3 and 4. Under Alternative 1, using a worst-case scenario, modeled maximum instantaneous concentrations of total phosphorus reach 0.035 mg/L, however the average total phosphorus concentration is not expected to exceed the standard of 0.030 mg/L, which is measured as the July-September average. The worst-case scenario under Alternative 3 was modeled with a maximum instantaneous concentration of 0.071 mg/L. Removal of vegetation prior to inundation could reduce the amount of nutrients released under Alternatives 3 or 4, but the concentrations would still be greater than those predicted under Alternative 1 because of the increase in the hypolimnion and the initial release of nutrients from the inundated soils.

The nutrient analysis shows that there may be water quality uncertainty regarding internal loading from increased anaerobic conditions due to increases in reservoir pool levels and inundated vegetation. Internal loading is not currently a concern in Chatfield Reservoir because of the lack of anoxic conditions (Chatfield Watershed Authority 2008). Adaptive management would be used to address this uncertainty should the proposed Chatfield Reservoir storage reallocation project be implemented. In addition, water quality monitoring will be conducted on an on-going basis to identify any water quality impacts and evaluate their level of significance. Adaptive management measures that could be implemented to mitigate any problems caused by increased internal nutrient loading include:

- Removing terrestrial vegetation prior to inundation
- Aeration/mixing of Chatfield Reservoir to limit stratification and development of anaerobic conditions, similar to measures recently installed at other Corps reservoirs (i.e., Cherry Creek Reservoir and Bear Creek Reservoir)
- Altered management of inflows and outflows from Chatfield Reservoir to manage flushing and the hydraulic residence time of the reservoir

As described in Section 4.1.1, adaptive management planning will involve an iterative process of cycling through several steps: problem assessment, design, implementation, monitoring, evaluation, adjustment, and continued cycling through earlier steps (Barnes 2009). Adaptive management will involve structured decision making, with an emphasis on incorporating water quality monitoring results into decision-making to minimize potential impacts to water quality. The Project participants will coordinate their adaptive management work related to water quality with the Chatfield Watershed Authority, because they are working to maintain and improve the water quality of Chatfield Reservoir. Water providers will use adaptive management (including increased water quality monitoring) to address State concerns that water quality could be impacted by shoreline erosion caused by increased water level fluctuations. Adaptive management will also be used to monitor the State’s concern that under a “worst-case” scenario, dissolved oxygen levels could decrease, releasing mercury from the sediments and potentially accumulate in aquatic species in Chatfield Reservoir. Water quality modeling conducted as part of this analysis suggests that mercury levels would decrease under the reallocation alternatives.

Potential increases in turbidity or spills to water bodies could be reduced through careful implementation of BMPs, as well as stormwater, erosion control, and spill prevention plans during construction activities.

4.5 Aquatic Life and Fisheries

4.5.1 Alternative 1—No Action

Under Alternative 1, Chatfield Reservoir would continue under baseline conditions with a top of multipurpose pool elevation of 5,432 feet msl (Figure 4-1 and Table 4-2). Adverse impacts on aquatic biota in the Chatfield Reservoir study area would not occur. Water levels would continue to fluctuate with the current maximum 9-foot annual range in water level goal and therefore no augmentation would be required regarding Chatfield Reservoir’s current management of sport fish, forage fish, or any native species present. Pool fluctuation shows how many feet, on average, the pool elevation ranges (between highest and lowest elevations) in a given month. Even Alternative 1 fluctuates because the inflow to Chatfield Reservoir does not necessarily match the outflow from Chatfield Reservoir; the pool fluctuates up or down depending on which flow is higher.

Alternative 1 would not change the current fluctuations in flow in the South Platte River and thus would not change the impacts on the aquatic biota present. The river would continue to fluctuate by the controlled release from Chatfield Reservoir and therefore would not affect the South Platte River's cool- or warm-water fish species present.

In addition, tributaries to Chatfield Reservoir would not be affected under Alternative 1. There would be no further inundation of the tributaries from Chatfield Reservoir. The dam releases at Strontia Springs Reservoir would continue to maintain both minimum winter and summer flows in the South Platte River above Chatfield Reservoir.

Penley Reservoir would be constructed under Alternative 1. Existing aquatic life and fisheries would not be impacted because no significant water resources currently exist in the area that would be inundated by Penley Reservoir. Reservoir construction would create aquatic habitat that could be used for aquatic life and fisheries. Diversion of water to the reservoir may impact fisheries resources downstream by decreasing flows in streams and rivers.

Pipelines associated with Alternative 1 would cross several streams that could support fish populations, including Indian Creek, Rainbow Creek, Willow Creek, and Plum Creek (Figure 2-1). The precise pipeline location is not yet known; therefore, alignment to the various waterways could change. Temporary adverse impacts on fish populations could result during the construction of underground pipelines, but these impacts can be minimized if proper techniques were used to reduce changes in hydrologic conditions during construction. Culverts at road crossings could alter stream flow and decrease fish movement upstream and downstream. Changes to vegetation and temperature along the stream bank could decrease spawning habitat. If appropriate construction techniques were implemented, the proposed pipelines would have no significant adverse impacts on aquatic life and fisheries.

The downstream gravel pits would not affect existing aquatic life and fisheries because none currently occur in these active gravel pits. Converting the gravel pits to water storage would create aquatic habitat for aquatic life and fisheries.

4.5.2 Alternative 2—NTGW/Downstream Gravel Pits

Under Alternative 2, reservoir levels and operations at Chatfield Reservoir would remain unchanged as in Alternative 1. As in Alternative 1, aquatic biota in Chatfield Reservoir or downstream in the South Platte River would not be affected. Penley Reservoir would not be constructed because water would be obtained from underground sources (NTGW). Aquatic life would not be impacted by NTGW use. Impacts resulting from converting downstream gravel pits to water reservoirs would be the same as under Alternative 1.

4.5.3 Alternative 3—20,600 Acre-Foot Reallocation

Alternative 3 would generally provide a positive impact to the Chatfield Reservoir aquatic ecosystem. As pool levels increase, the inundation of new organic material and associated expansion of the littoral zone of the reservoir would lead to what is commonly referred to as a "new reservoir" effect.

Under a new reservoir effect, new nutrients are released to a reservoir as organic material decays, resulting in increased primary productivity within the reservoir and a resulting positive benefit to food chain production in virtually all trophic levels. Precise quantification of increases in primary productivity may be difficult to determine between the two reallocation alternatives (Alternatives 3 and 4); however, an index of potential benefits can be gained when comparing pool area and pool perimeter increases.

There would be a 587-acre gain in pool area and a 27,748-foot increase in pool perimeter under Alternative 3 (Figure 4-1). On average, the pool area would increase by approximately 49 acres, and the perimeter would increase approximately 2,312 feet, for every 1 foot of pool elevation increase between 5,432 and 5,444 feet msl. The rate of increase in pool area and perimeter is larger between 5,437 and 5,444 feet msl than between 5,432 and 5,437 feet msl because the ground surface levels out at higher elevations, especially in the southern portion of Chatfield Reservoir. The areas inundated due to this reallocation would essentially be shallow water areas within the reservoir. These shallow water areas would potentially affect several key components of the reservoir's aquatic community. These include impacts on sport fish, forage fish, and native species populations.

Reservoir filling to 5,444 feet msl could potentially influence natural reproduction by cool- and warm-water fish communities in the reservoir. Timeframes for natural reproduction by various cool-water sport fish in Chatfield Reservoir begin in mid-March, when walleye spawn and egg-taking operations commence. As currently projected, pool elevations would increase during this period, with filling occurring during spring runoff and from seasonal storm events (Figure 4-11). However, based on filling and storage scenarios for Alternative 3, there would not be a negative impact on natural reproduction of these sport fish species in Chatfield Reservoir. Natural reproduction for the primary sport fish of concern would be finished before the decrease in water levels occurs. In addition, populations of walleye, rainbow trout, and channel catfish in Chatfield Reservoir have been and would continue to be maintained by annual stocking (CDOW 2007a).

Warm-water sport fish spawning occurs from May to mid-June when fish including crappie, bluegill, smallmouth bass, and largemouth bass spawn. Increased pool elevation would create new shallow water habitat areas that these warm-water species require for spawning. However, greatly decreasing pool elevations during their spawning period would have a negative impact on spawning success and, in turn, could impact warm-water fish populations within Chatfield Reservoir. As shown in Figure 4-11, projected water withdrawals would begin in late spring and continue through the summer months. Larger predator fish species could also be negatively impacted by the increase in shallow water zones, creating more habitat and therefore more protection for the forage fish.

As with sport fish, the inundation of new pool areas under Alternative 3 would provide a generally positive impact on forage fish populations in the reservoir. Increases in primary productivity would especially benefit gizzard shad populations, which are dependent on plankton populations as primary food sources. Inundation of new pool areas and the resultant infusion of new nutrients from decay of organic material would enhance plankton populations in the reservoir and provide a positive impact to gizzard shad and other forage fish populations during the period of increased pool elevations. One possible limit to positive impacts is that gizzard shad reproduction occurs from approximately mid-May to mid-June depending on reservoir water temperature. The onset of greatly decreasing water levels under Alternative 3 during reproduction along with slight increases in water temperatures would adversely affect gizzard shad populations.

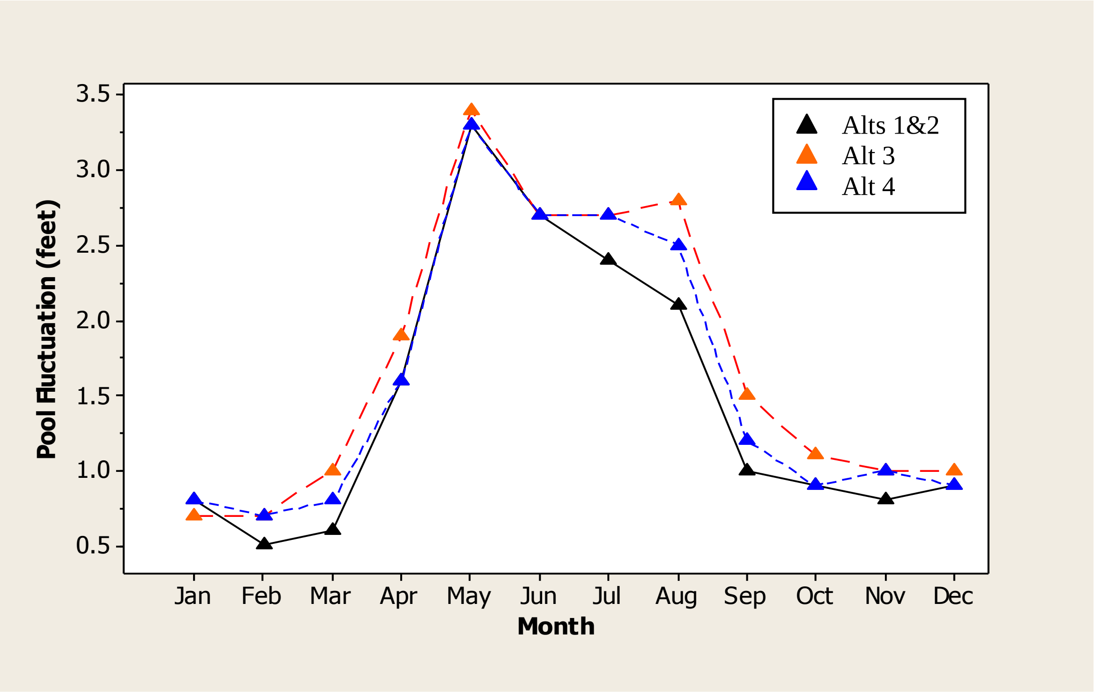

Figure 4-11
Average Monthly Pool Fluctuations in Chatfield Reservoir[1]

Crayfish populations would benefit from newly inundated pool areas with a resulting enhancement of forage for smallmouth and largemouth bass populations. Additional forage production consists of young-of-the-year (YOY) of certain game fish, primarily yellow perch and bluegill (Nesler 2003).

A few native fish species exist within Chatfield Reservoir and include the gizzard shad, western white sucker, and green sunfish. None of these species are recognized as sensitive, threatened, or of special status concern in Colorado and all are likely to be found in many aquatic habitats throughout Colorado. One other native species, Iowa darter, has been sampled in Chatfield Reservoir by CDOW. However, only two individuals have been collected over an 8-year sampling period (CDOW 2007a). Iowa darters are more commonly found in and associated with a limited number of streams in northeastern Colorado (Woodling 1985). Consistent with previously discussed impacts, it is anticipated that the higher pool elevations experienced under Alternative 3 would enhance habitat conditions for the native species in Chatfield Reservoir and would not adversely impact them.

Prolonged low pool levels after drawdown or during drought under Alternative 3 could increase temperatures in the bottom of the reservoir. This creates possible eutrophication and algal issues in Chatfield Reservoir and also in downstream sections of the South Platte River. Because of the potential for stored water to be carried over from prior non-drought years, however, low pool levels would not occur as frequently under Alternative 3 as under Alternative 1.

[1] This figure portrays the average monthly pool fluctuations in Chatfield Reservoir by alternative, based on the modeling described in Appendix H. The water quality modeling (described in Appendix J) evaluates more extreme (and less probable), worst-case pool fluctuations.

Another potential impact under Alternative 3 to Chatfield Reservoir is the periodic inundation of two ponds to the south of the reservoir near the inlet of the South Platte River (Figure 4-1). All fish species present in these ponds are currently found in Chatfield Reservoir, so inundation of these areas would not impact the species composition of Chatfield Reservoir (CDOW 2007a). However, the species composition of the ponds could change, as these ponds will be inundated and become incorporated into the reservoir perimeter.

Under Alternative 3, the South Platte River below Chatfield Reservoir would have minimal changes during base flow conditions and a small increase in flow during the late summer months (Figure 4-12). Figure 4-12 shows that there could be a slight decrease in flows below the reservoir during May and June, when inflows are captured and the reservoir is filling. It is possible that these reduced flows could affect spawning, but the significance of the effect would be very small. Managing the timing, duration, and amount of flow from the Chatfield Reservoir is an important tool in enhancing aquatic biota in the South Platte River. For example, a projected increase in flow during July would have a positive effect on aquatic biota downstream of the reservoir. The current cool- and warm-water species present experience stress during late summer months from increased water temperatures and decreased flow.

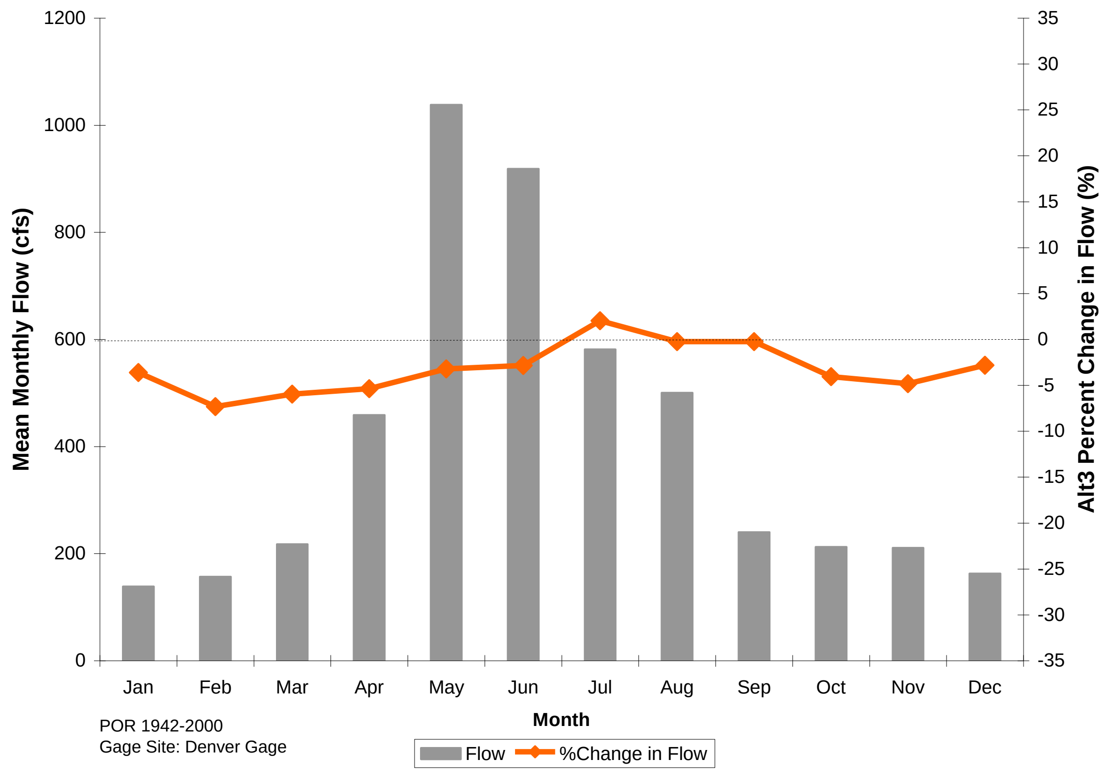

Figure 4-12
Percent Change in Flow from Baseline in the South Platte River Below Chatfield Reservoir if Alternative 3 Were Implemented

Another critical aquatic stressor is base flow conditions during the winter months. Based on the Corps' modeling results, the projected change during winter base flow conditions would result in a slight decrease that would result in minimal or no impact to aquatic biota present. Appendix D, prepared by Great Western Institute et al., includes additional modeling and evaluation of wintertime flows in the South Platte River under various water release scenarios from Chatfield Reservoir. These analyses indicate that the proper management of outflow from the Chatfield dam to the South Platte River by maintaining a minimum of 10 cfs could greatly improve the habitat available for fish in this downstream reach.

While sport fish are present in the fish community below Chatfield Reservoir, the population is not actively managed by the CDOW as a sport fishery. Virtually all the sport fish found in this reach of the South Platte River are more typically found in standing water habitats, and are actually migrants from Chatfield Reservoir or adjacent pond habitats connected to the river. It is believed that most of these fish are not year-round residents of the river, and size distribution of this population indicates that most of these fish are YOY to 1-year-old fish with little adult representation of the species (CDOW 2007a). In addition, none of the sport or non-sport native fish species found in the South Platte River below Chatfield Reservoir are currently recognized as special status, threatened, or endangered species and all are considered common in Colorado (Nesler 2003).

An increased flow to the South Platte River below Chatfield Reservoir during the warmer months and low-flow periods would help in protecting aquatic biota from poor water quality conditions that currently exist. For example, treated wastewater effluent can account for as much as 100 percent of stream flow downstream from Denver during these months and this effluent was the primary source of nitrate, ammonia, and phosphorus in the South Platte River and adjoining Front Range streams (National Water-Quality Assessment Program [NAWQA] 2002). An addition of cool, flowing water would assist in flushing high nutrient content and lowering instream water temperatures, and thus help prevent possible eutrophication. Much of the downstream water from Chatfield Reservoir is recycled at some point for municipal use, and any increase in flow would be beneficial to all aquatic biota present. For further documentation on water quality impacts, see Section 4.4.

Alternative 3 would not have adverse impacts on aquatic life in the tributaries to Chatfield Reservoir. Increases in flow would primarily occur along the South Platte River, which is partially controlled by the release of water from Strontia Springs Reservoir (see Section 3.5). The South Platte River above Chatfield supports cold-water habitats that contain cold-water game fish such as rainbow and brown trout. Also occurring are white sucker, longnose sucker, and longnose dace. The other reservoir tributaries, Plum Creek and Deer Creek, described above, are limited in flows and in quality of game fish habitats (USFWS 2006).

Under Alternative 3, an approximate 3,643-foot (0.69-mile) reach of the South Platte River directly above Chatfield Reservoir would be intermittently inundated (Figure 4-1). This reach is within the flood control pool of Chatfield Reservoir and has been periodically inundated in the past during large storm events. However, under Alternative 3 the duration of inundation of this reach is expected to be longer than under flood events, and this could result in changes in the aquatic habitat and the composition of species utilizing the habitat. This reach of the South Platte River contains typical cold-water riverine habitat and aquatic biota as well as some occasional warm-water species that migrate from the reservoir. The increased perimeter of Chatfield Reservoir would alter the fish and macroinvertebrate community composition of the inundated tributaries. Fish composition would change from cold- and cool-water species to more warm-water species by increasing the shallow still-water areas along the reservoir perimeter. The macroinvertebrate community in the South Platte River contains many sensitive taxa such as Ephemeroptera, Plecoptera, and Trichoptera (EPT) orders of insects that typically best thrive in cold-water streams. Inundation of this small stretch could alter the species composition of macroinvertebrates by removing or reducing stream-sensitive species and increasing taxa that are tolerant of a larger range of temperature and dissolved oxygen conditions.

4.5.4 Alternative 4—7,700 Acre-Feet Reallocation/NTGW/Downstream Gravel Pits

In addition to the reallocation, another 5,348 acre-feet would be obtained from NTGW and downstream gravel pits under Alternative 4. The potential effects on aquatic life from conversion of downstream gravel pits to water storage reservoirs and use of NTGW are disclosed under Alternatives 1 and 2, respectively. Fewer and/or smaller gravel pit reservoirs would be needed under Alternative 4 than under Alternative 1 or 2.

Alternative 4 would generally provide a positive impact to the Chatfield Reservoir aquatic ecosystem. As discussed in Alternative 3, the inundation of new organic material and associated expansion of the littoral zone of the reservoir would lead to what is commonly referred to as a “new reservoir” effect. Under a new reservoir effect, new nutrients are released to a reservoir as organic material decays, resulting in increased primary productivity within the reservoir and a resulting positive benefit to food chain production in virtually all trophic levels. An overall increase in productivity under Alternative 4 would be less than under Alternative 3. Precise quantification of increases in primary productivity may be difficult to determine between the two reallocation alternatives; however, an index of potential benefits can be gained when comparing increases in pool area and pool perimeter.

There would be a 215-acre gain in pool area and a 2,854-foot increase in pool perimeter between Alternatives 1 and 4 (Figure 4-1). On average, the pool area would increase by approximately 43 acres, and the perimeter would increase approximately 2,854 feet, for every 1 foot of increase in pool elevation. The areas inundated due to the reallocation would essentially be shallow water areas within the reservoir. These shallow water areas would increase overall productivity and could potentially affect several key components of the reservoir’s aquatic community. These include impacts on sport fish, forage fish, and native species populations.

Reservoir filling to 5,437 feet msl could potentially influence natural reproduction by cool- and warm-water fish communities in the reservoir. Timeframes for natural reproduction by various cool-water sport fish in Chatfield Reservoir begin in mid-March, when walleye spawn and egg-taking operations commence. As currently projected, pool elevations would increase during this period, with filling occurring during spring runoff and from seasonal storm events (Figure 4-11). However, based on filling and storage scenarios for Alternative 4, there would not be an adverse impact on natural reproduction of these sport fish species in Chatfield Reservoir. Natural reproduction for the primary sport fish of concern would be finished before the decrease in water levels. As mentioned previously, populations of walleye, rainbow trout, and channel catfish in Chatfield Reservoir are and would continue to be maintained by annual stocking (CDOW 2007a).

Warm-water sport fish spawning occurs in mid-June when fish including crappie, bluegill, smallmouth bass, and largemouth bass spawn. Declining water levels during this time period could have negative impacts on successful natural reproduction for these species and adversely impact their populations within Chatfield Reservoir. As shown in Figure 4-11, projected water withdrawals would begin in late spring and continue through the summer months.

As with sport fish, the inundation of new pool areas under Alternative 4 would provide a generally positive impact on forage fish populations in the reservoir, although not to the same degree as in Alternative 3. Increases in primary productivity would especially benefit gizzard shad populations, which are dependent on plankton populations as primary food sources. Inundation of new pool areas and the resultant infusion of new nutrients from decay of organic material would enhance plankton populations in the reservoir and provide a positive impact to gizzard shad and other forage fish populations during the period of increased pool elevations. One possible limit to positive impacts is gizzard shad reproduction, which occurs from approximately mid-May to mid-June depending on reservoir water temperature. The onset of decreased water levels under reallocation Alternative 4 during reproduction along with slight increases in water temperatures could adversely affect gizzard shad populations.

Crayfish populations would benefit from newly inundated pool areas with a resulting enhancement of forage for smallmouth and largemouth bass populations. Additional forage production consists of YOY of certain game fish, primarily yellow perch and bluegill (Nesler 2003). As with sport fish, the inundation of new pool areas under Alternative 4 would provide a generally positive impact to forage fish populations in Chatfield Reservoir.

A few native fish species exist within Chatfield Reservoir and include the gizzard shad, western white sucker, and green sunfish. None of these species are recognized as sensitive, threatened, or of special status concern in Colorado, and all are likely to be found in many aquatic habitats throughout Colorado. One other native species, Iowa darter, has been sampled in Chatfield Reservoir by CDOW. However, only two individuals have been collected over an 8-year sampling period (CDOW 2007a). Iowa darters are more commonly found in and associated with a limited number of streams in northeastern Colorado (Woodling 1985). Consistent with previously discussed impacts, it is anticipated that the higher pool elevations experienced under Alternative 4 would enhance habitat conditions for the native species in Chatfield Reservoir and would not adversely impact them.

Under Alternative 4, similar conditions would exist in the South Platte River below Chatfield Reservoir, with minimal changes during base flow conditions and a very small increase in flow during the late summer months (Figure 4-13). Managing the timing, duration, and amount of flow from the Chatfield Reservoir is an important tool in enhancing aquatic biota in the South Platte River. For example, a projected increase in flow during July would have a positive effect on aquatic biota downstream of the reservoir. The current cool- and warm-water species present experience stress during late summer months from increased water temperatures and decreased flow.

Another critical aquatic stressor is base flow conditions during the winter months. Based on the Corp's modeling results, the projected change during winter base flow conditions is a very slight decrease that would have minimal impact on the aquatic biota present. However, this decrease in base flow may impact the Chatfield SFU during the late fall or winter months. Currently, there are no minimum base flows required below Chatfield Dam and senior water right holders can choose to use all available water during the late fall and winter months. This action often leaves the river dry until the next water effluent is reached (likely Marcy Gulch). Therefore, a decrease, however slight, would further decrease water needed for CDOW's SFU, also known as the Chatfield Fish Planting Base, which is below Chatfield Reservoir.

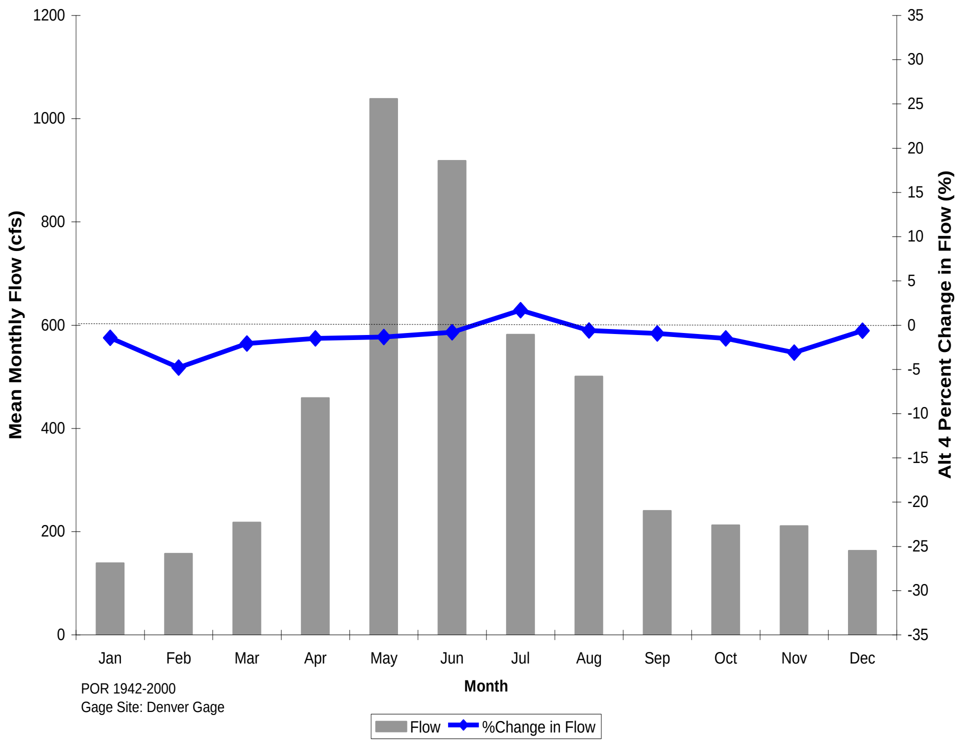

Figure 4-13
Percent Change in Flow from Baseline in the South Platte River Below Chatfield Reservoir if Alternative 4 Were Implemented

For impacts to the sport fish community and to water quality to the South Platte River below Chatfield Reservoir, see Alternative 3 and Section 4.4. Alternative 4 would not adversely impact aquatic life in the tributaries to Chatfield Reservoir. Increases in flow would primarily occur along the South Platte River, which is partially controlled by the release of water from Strontia Springs Reservoir (see Section 3.5). The South Platte River above Chatfield Reservoir supports cold-water habitats that contain coldwater game fish such as rainbow and brown trout. Also occurring are white sucker, longnose sucker, and longnose dace. The other reservoir tributaries, Plum Creek and Deer Creek, described above, are limited in flows and in quality of game fish habitats (USFWS 2006).

Under Alternative 4, a small portion of the South Platte River above Chatfield Reservoir (slightly smaller than Alternative 3) would be intermittently inundated (Figure 4-1). Impacts to this reach are similar to those described in Alternative 3, although less of the stream reach will be impacted.

4.5.5 Reduction of Potential Impacts

Managing the release of water from Chatfield Reservoir could be an important tool in enhancing all aquatic communities present. If the releases of water from the reservoir were more evenly distributed throughout the year so that appropriate pool levels were maintained during fish spawning and embryo development, there could be less impact on reproductive success of warm-water fish species in the reservoir. Similarly, keeping instream flow rates high on the South Platte River below the reservoir during times of low flow and higher temperature could reduce stressors put on the aquatic community in this reach. However, future water demands would dictate alterations in current flow patterns in the South Platte River regardless of increased storage capacity in Chatfield Reservoir (USFWS 2006).

Increased habitat structure would be expected to occur with the inundation of trees adjacent to Chatfield Reservoir. As indicated in the Tree Management Plan (Appendix Z), selected trees within the inundated area will be cut and anchored in place for fisheries habitat. This would create positive habitat for fish, aquatic insects, and aquatic flora that inhabit these areas. Visitor and dam safety will take priority in determining where trees can be retained and anchored.

The Corps has conducted coordination and informal consultations with the USFWS regarding potential impacts to fish and wildlife resources and their recommendations for mitigation, including a Planning Aid Report (February 2006) and progress letter (July 2010) (see Appendix X).

The walleye broodstock program and Front Range trout stocking programs rely heavily on Chatfield Reservoir. Benefits are anticipated to reservoir fisheries resources (including walleye), and impacts are not anticipated to the fish-rearing station downstream. Because of the critical importance of these fisheries, however, a Coordinated Reservoir Operations Plan will be developed to limit releases of water stored in the reallocated pool during critical seasonal periods. This adaptive management approach will minimize any adverse impacts to fish spawning or water supply to the downstream hatchery. The initial outline of a reservoir operation plan can be found in the CMP. The adaptive management process will allow the water providers, Corps, and resource agencies to be responsive to issues should they arise. In addition, beyond the mitigation measures that are part of the tentatively Recommended Plan, the water providers propose to fund stream habitat improvements on up to 0.7 mile of the mainstem of the South Platte River above Chatfield Reservoir. Also, while this analysis does not suggest a significant loss of habitat downstream, to allay CDOW concerns, the water providers have agreed to pursue stream habitat improvement on up to 0.5 mile of the mainstem of the South Platte River downstream of Chatfield Reservoir. The specific sites and project designs for these measures will be selected in coordination with CDOW.

4.6 Vegetation

All types of vegetation are susceptible to the impacts of flooding and inundation. Trees are more susceptible to the impacts of flooding and inundation during the growing season (Kozlowski 1997), and flooding during the dormant season typically has little impact on trees (Bell and Johnson 1974). Thus, the analysis of impacts on trees focused on the pool elevations reached during the growing season. This analysis of impacts on trees is also based on the maximum level of inundation for each alternative, or the worst-case scenario. The growing season at the Chatfield study area was estimated from data from the Colorado Climate Center for a weather station at Kassler, Colorado (Doesken 2006). The boundaries of the growing season were based on the median dates at which 28 degrees Fahrenheit is last reached in the spring and first reached in the fall, based on the years 1975 to 2005. These dates are April 25 and October 11, respectively, and correspond to a growing season of approximately 170 days.

Trees that are tolerant of flooding, including the plains cottonwood, may withstand an entire growing season of inundation. However, they are killed when they are inundated for two consecutive growing seasons (USFS 1993, Teskey and Hinckley 1978, Whitlow and Harris 1979). Some studies indicate that flooding for even one growing season can result in significant mortality in mature cottonwoods (Yin et al. 1994). Saplings are even more susceptible to flooding than mature trees (Yin et al. 1994).

The reservoir modeling results were used to calculate the number of days in each growing season that exceeded specific pool elevations. These results were used to estimate at what pool elevations trees are likely to be killed. The analysis focused on the plains cottonwood (*Populus deltoides* var. *occidentalis*) since it is the dominant tree in the area potentially inundated by increased storage in Chatfield Reservoir.

The drawdown zone would be alternately inundated and exposed for variable periods each growing season. The cyclic disturbance would allow invasion of both native and exotic species that must be monitored and managed. Likely invasive species are listed in the following paragraphs and further identified in Chapter 3 (see Section 3.6). A combination of exotic species control and native species encouragement would be needed to prevent exotic species domination. A complex of factors that control vegetation establishment would vary each year and require an adaptive management approach to achieve the desired goal. Factors that would affect vegetation establishment include the duration and timing of inundation, soil characteristics, water quality, availability of native and exotic species propagules, and proposed treatments.

The duration of inundation, as well as the duration and depth of soil saturation, are the primary factors affecting the establishment of plant species and succession of plant communities on the reservoir margin. Over the short term, changes can be expected to be quite variable since the natural availability of native or exotic weed seed combined with the site-specific conditions can be unpredictable. Over the long term, vegetation management can enhance the establishment of targeted native species and prevent exotics from proliferating by using monitoring data from weed control efforts to develop more effective control procedures.

The highest priority should be the management of weedy perennials such as the woody species tamarisk (*Tamarix ramosissima*), crack willow (*Salix fragilis*), and Russian olive (*Eleagnus angustifolia*), as well as aggressive herbaceous species that are perennials such as Canada thistle (*Breea arvensis*) and reed canarygrass (*Phalaris arundinacea*) or annuals such as puncturevine (*Tribulus terrestris*). Vegetation management should also include the intentional establishment of native species such as plains cottonwood and sand bar willow (*Salix exigua*) in areas with shorter periods, or lower frequencies, of inundation, and aggressive natives such as foxtail barley (*Critesion jubatum*) in areas that are regularly inundated for longer periods.

The drawdown zone would be in a cycle of disturbance that would limit vegetation establishment to annuals, biennials, and short-lived perennials. It is anticipated that woody species such as plains cottonwood, crack willow, sandbar willow, and potentially tamarisk could become naturally established apart from any intentional vegetation establishment program at the upper extent of the drawdown zone where soil conditions are adequate for germination. However, any natural establishment would be restricted, as mentioned above, by the duration and timing of inundation, precipitation, soil characteristics, water quality, and availability of native and weed species propagules. The necessary convergence of timely precipitation throughout the spring and early summer during the first one or two growing seasons, the presence of live seed of native riparian species, the absence or low competitive pressure from aggressive weedy species, and a high pool elevation to charge the groundwater table make the likelihood of natural establishment very low in the short term, although probable in the long term. Therefore, the short-term uncertainty associated with natural establishment would mean that natural establishment would only serve as a fortunate support system to any intensive, adaptive management program for vegetation establishment at or immediately above the drawdown zone. The next cycle of inundation would be expected to kill those newly established individuals that are submerged. Those individuals above the ordinary high water mark (OHWM) may survive if precipitation and an elevated groundwater level coincide.

A Tree Management Plan (Appendix Z) has been developed to address the removal of trees that would be inundated under Alternatives 3 or 4. In general, under Alternative 3, the majority of trees between 5,432 and 5,439 feet msl would be removed prior to raising the pool elevation. Selected trees in some areas may be retained for fisheries or wildlife habitat. These areas will be determined based on a review by USACE, State Parks, and CDOW. Additionally, implementation of an inundation alternative would be conducted in a step-wise fashion allowing maximum water levels to be achieved only after mitigation for partial inundation was achieved or at least underway. For example, under Alternative 3, the mitigation for an intermediate pool elevation (e.g., 5,440 feet) would be allowed, but the ability to fill to the maximum elevation of 5,444 feet would not be allowed until mitigation was underway for impacts at the intermediate level of 5,440 feet. This phased or step-wise implementation is discussed in the CMP (Appendix K, Section 7.2). Once the selected alternative is fully implemented and use of the maximum pool elevation is approved and established, the tree management plan would use an adaptive management approach to monitor trees that are partially inundated to determine if additional trees need to be removed.

Once the annual cycle of the reservoir drawdown has been established for a few years, a successional sequence of vegetation can be expected at the upper end of the drawdown zone. This fringe of vegetation would be closely linked to a gradient of soil moisture conditions. The zone of saturated soils above the OHWM would extend for variable distances from the upper end of the drawdown zone depending on soil texture, slope, and the upgradient conditions including the normal depth of the water table. For each of the alternative pool elevation targets, the successional changes would occur in established uplands, so a complex successional sequence would include competition between established upland and pioneering riparian species. The current vegetation along the reservoir margin may probably be replicated over the long term if weedy species were controlled, and the intentional planting of target native species could accelerate this process. However, these successional changes are dependent on the many variables discussed in the preceding paragraph and long-term successional increases in riparian or wetland communities are not used to temper the estimates of vegetation community losses described in Table 4-8. An assessment of the potential future plant communities is discussed by alternative in the following sections. The potential plant communities described for Alternatives 3 and 4 (Tables 4-8, 4-9, and 4-10) are based on the current distribution of communities on the reservoir margin and an assumption that moisture will be available during the growing season for sufficient duration at or slightly above target pool elevations. This current distribution of plant communities is based on a vegetation map of Chatfield State Park prepared by CDNR in 2001 (CDNR 2001). The exact new condition for each alternative is unknown due to the high fluctuation of the water levels associated with certain alternatives.

Table 4-8
Vegetation and Feature Losses due to Inundation

Dominant Vegetation Class with Species Composition[1]	Alternative 3 Inundation loss 5,432–5,444 feet msl (acres)	Alternative 4 Inundation loss 5,432–5,437 feet msl (acres)
Total Area Inundated from 5,432 feet msl to Top of Conservation Pool (includes Facilities, Ponds, and Vegetation)	**587**	**223**
Total Acres of Facilities and Ponds Inundated from 5,432 feet msl to Top of Conservation Pool	**112.2**	**24.0**
Total Acres of Vegetation Inundated from 5,432 feet msl to Top of Conservation Pool (includes the three vegetation categories below in bold)	**474.8**	**199.0**
Total Riparian/Wetland Native Forest, Woodland or Shrubland	**204.0**	**111.4**
narrowleaf cottonwood and plains cottonwood	72.3	27.5
Plains cottonwood (including mature cottonwood forest)	113.4	76.6
Plains cottonwood seedlings	0.0	0.0
Plains cottonwood, diffuse knapweed, mullein	1.2	1.2
sandbar willow	16.7	6.1
smartweed, witchgrass, cottonwood seedlings	0.1	0.1
skunkbrush, smooth sumac	0.3	0.1
Total Upland Introduced Annual and Perennial Grasslands and Forbs	**257.8**	**80.6**
Canada thistle, diffuse knapweed	0.7	0.7
cheatgrass, sand dropseed	3.6	2.4
cheatgrass, sand dropseed, mullein	66.9	21.0
cheatgrass, smooth brome, leafy spurge, diffuse knapweed	0.4	0.1
crested wheatgrass, cheatgrass, smooth brome	0.0	0.0
crested wheatgrass, sand dropseed, smooth brome, intermediate wheatgrass	9.7	6.0
diffuse knapweed	19.6	8.9
smooth brome	151.1	40.4
smooth brome, crested wheat, diffuse knapweed	4.6	0.7
mowed grass	1.3	0.4
Total Upland Native Perennial Grassland	**13.0**	**7.0**
blue grama and sand dropseed	3.6	3.2
blue grama, three awn, side oats grama, cheatgrass	1.2	0.3
needle and thread, sand dropseed	0.1	0.1
sand dropseed	2.1	0.9
sand dropseed, buffalo grass	1.2	1.0
sand dropseed, crested wheat, smooth brome	4.8	1.5

[1] Vegetation composition and existing acreages are based on CDNR (2001).

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Table 4.9
Estimated Change in Acreage of Existing Vegetation Types Within 0–6 foot Elevation Band above Proposed OHWMs for Alternatives 3 and 4 (acres)

Dominant Vegetation Class with Species Composition	Alternative 3 Increase (Decrease)	Alternative 3 Existing Acreage	Alternative 3 Expected New Total Acreage	Alternative 4 Increase (Decrease)	Alternative 4 Existing Acreage	Alternative 4 Expected New Total Acreage
Riparian/Wetland Native Forest or Shrubland	79.2	50.1	129.2	79.3	80.8	160.1
narrowleaf cottonwood and plains cottonwood	8.0	27.9	35.9	3.2	38.5	41.8
plains cottonwood	65.0	18.2	83.2	73.7	33.0	106.7
plains cottonwood seedlings	0.0	0.0	0.0	0.0	0.0	0.0
plains cottonwood, diffuse knapweed, mullein	1.1	0.0	1.1	1.4	0.0	1.4
sandbar willow	5.1	3.7	8.8	0.9	9.1	9.9
skunkbrush, smooth sumac	(0.2)	0.3	0.1	(0.1)	0.2	0.1
smartweed, witchgrass, cottonwood seedlings	0.1	0.0	0.1	0.1	0.0	0.1
Upland Introduced Annual and Perennial Grasslands and Forbs	(59.0)	164.4	105.4	(28.7)	147.4	118.7
Canada thistle, diffuse knapweed	0.7	0.0	0.7	1.0	0.0	1.0
cheatgrass, sand dropseed	3.7	0.0	3.7	2.8	1.2	3.9
cheatgrass, sand dropseed, mullein	(21.3)	47.5	26.2	(7.4)	37.4	30.0
cheatgrass, smooth brome, leafy spurge, diffuse knapweed	(0.5)	0.6	0.1	(0.2)	0.2	0.1
crested wheatgrass and cheatgrass	(0.1)	0.1	0.0	0.0	0.0	0.0
crested wheatgrass, cheatgrass, smooth brome	(0.7)	0.7	0.0	(0.0)	0.0	0.0
crested wheatgrass, sand dropseed, smooth brome, intermediate wheatgrass	4.7	2.5	7.2	5.3	3.4	8.6
diffuse knapweed	0.2	10.9	11.1	4.0	9.0	13.0
mowed grass	0.4	0.2	0.6	(0.2)	0.8	0.6
smooth brome	(40.4)	95.3	54.9	(32.0)	92.4	60.4
smooth brome, crested wheat, diffuse knapweed	(5.5)	6.5	1.0	(2.1)	3.2	1.1
Upland Native Perennial Grassland	(2.6)	10.5	7.9	4.4	5.3	9.6
blue grama and sand dropseed	3.3	0.1	3.4	4.0	0.4	4.4
blue grama, buffalo grass, threeawn	(0.0)	0.0	0.0	0.0	0.0	0.0
blue grama, three awn, side oats grama, cheatgrass	(0.8)	1.3	0.4	(0.3)	0.7	0.5
needle and thread, sand dropseed	(4.7)	4.7	0.0	(0.1)	0.1	0.0
sand dropseed	0.5	0.6	1.2	0.1	1.1	1.2
sand dropseed, buffalo grass	1.1	0.0	1.1	1.2	0.2	1.4
sand dropseed, crested wheat, smooth brome	(1.9)	3.8	1.9	(0.6)	2.9	2.2

Table 4-10
Comparison of Estimated Changes in Acreage of Existing Vegetation Types for Alternatives 3 and 4

Dominant Vegetation Class with Species Composition	Alternative 3 - 5,444 feet msl			Alternative 4 - 5,437 feet msl		
	Inundation loss	Increase (Decrease)	Overall Increase (Decrease)	Inundation loss	Increase (Decrease)	Overall Increase (Decrease)
Total Riparian/Wetland Native Forest, Woodland or Shrubland	(204.0)	79.2	(124.8)	(111.4)	79.3	(32.1)
narrowleaf cottonwood and plains cottonwood	(72.3)	8.0	(64.3)	(27.5)	3.2	(24.3)
plains cottonwood (including mature cottonwood forest)	(113.4)	65.0	(48.4)	(76.6)	73.7	(2.9)
plains cottonwood seedlings	0.0	0.0	0.0	0.0	0.0	0.0
plains cottonwood, diffuse knapweed, mullein	(1.2)	1.1	(0.1)	(1.2)	1.4	0.2
sandbar willow	(16.7)	5.1	(11.6)	(6.1)	0.9	(5.3)
skunkbrush, smooth sumac	(0.3)	(0.2)	(0.5)	(0.1)	(0.1)	(0.2)
smartweed, witchgrass, cottonwood seedlings	(0.1)	0.1	(0.0)	(0.1)	0.1	0.0
Total Upland Introduced Annual and Perennial Grasslands and Forbs	(257.8)	(59.0)	(316.8)	(80.6)	(28.7)	(109.3)
Canada thistle, diffuse knapweed	(0.7)	0.7	(0.0)	(0.7)	1.0	0.3
cheatgrass, sand dropseed	(3.6)	3.7	0.1	(2.4)	2.8	0.4
cheatgrass, sand dropseed, mullein	(66.9)	(21.3)	(88.2)	(21.0)	(7.4)	(28.4)
cheatgrass, smooth brome, leafy spurge, diffuse knapweed	(0.4)	(0.5)	(0.9)	(0.1)	(0.2)	(0.3)
crested wheatgrss and cheatgrass	0.0	(0.1)	(0.1)		0.0	0.0
crested wheatgrass, cheatgrass, smooth brome	0.0	(0.7)	(0.7)	0.0	(0.0)	(0.0)
crested wheatgrass, sand dropseed, smooth brome, intermediate wheatgrass	(9.7)	4.7	(5.0)	(6.0)	5.3	(0.7)
diffuse knapweed	(19.6)	0.2	(19.4)	(8.9)	4.0	(5.0)
mowed grass	(1.3)	0.4	(0.9)	(0.4)	(0.2)	(0.6)
smooth brome	(151.1)	(40.4)	(191.5)	(40.4)	(32.0)	(72.4)
smooth brome, crested wheat, diffuse knapweed	(4.6)	(5.5)	(10.1)	(0.7)	(2.1)	(2.8)
Total Upland Native Perennial Grassland	(13.0)	(2.6)	(15.6)	(7.0)	4.4	(2.6)
blue grama and sand dropseed	(3.6)	3.3	(0.3)	(3.2)	4.0	0.8
blue grama, buffalo grass, three awn	0.0	(0.0)	(0.0)		0.0	0.0
blue grama, three awn, side oats grama, cheatgrass	(1.2)	(0.8)	(2.0)	(0.3)	(0.3)	(0.6)
needle and thread, sand dropseed	(0.1)	(4.7)	(4.8)	(0.1)	(0.1)	(0.2)
sand dropseed	(2.1)	0.5	(1.6)	(0.9)	0.1	(0.8)
sand dropseed, buffalo grass	(1.2)	1.1	(0.1)	(1.0)	1.2	0.2
sand dropseed, crested wheat, smooth brome	(4.8)	(1.9)	(6.7)	(1.5)	(0.6)	(2.1)

4.6.1 Alternative 1—No Action

Cottonwoods are not currently found within the normal conservation pool of 5,432 feet msl. Significant adverse impacts on trees have not been observed during past flood events that have caused short-term spikes in the pool elevation. Pool elevation data from the Tri-Lakes Office at Chatfield indicated that there were three high-water events from the period of 1975 to 2006. These occurred in 1980, 1983, and 1995. The maximum water level reached approximately 5,448 feet msl. During these events, the pool was above 5,432 feet msl for about 45 to 70 days. These events did not result in significant adverse impacts on trees (Rios 2007 and Sitoski 2007).

Output from the hydrology model (Appendix H) indicates that there is only 1 year in the POR where the pool elevation in the growing season is above 5,432 feet msl for more than 30 days. The maximum duration above 5,432 feet msl was 37 days. The maximum pool elevation reached for more than 30 days was 5,443 feet msl, 11 feet above the normal pool elevation. The maximum pool elevation reached was 5,459 feet msl, 27 feet above the normal pool elevation. There are no years when a pool elevation of 5,432 feet is exceeded for the entire growing season.

Based on the historical data and the modeling results, adverse impacts on vegetation, especially trees, are not expected above the normal pool elevation of 5,432 feet msl. Resulting acreage loss to vegetation for Alternative 1 is not included here as it is assumed there are no impacts.

Inundation of Penley Reservoir would result in the loss of deciduous oak and mesic upland shrub plant communities. These communities are not unique to this area and occur in other regions throughout Colorado (NDIS 2008a). Pipeline construction associated with Penley Reservoir would result in the conversion of seven land cover types including deciduous oak, mesic upland shrub, tallgrass prairie, midgrass prairie, foothills/mountain grassland, dryland agriculture, and irrigated agriculture (Figure 3-3). Because the pipeline would be buried underground, impacts to vegetation would be temporary and habitat loss would not be significant. Construction-related traffic can introduce non-native and noxious weeds into the area; thus, appropriate weed control measures would be used to avoid these types of impacts.

The downstream gravel pits are currently being mined (or are already mined out) for gravel and are therefore unvegetated. Inundation of these pits would not result in the loss of vegetation. However, temporary impacts to vegetation may occur during construction of the gravel pit infrastructure; these impacts will be minimized by revegetating with native plants as soon as practicable after infrastructure installation.

4.6.2 Alternative 2—NTGW/Downstream Gravel Pits

Under Alternative 2, reservoir levels and operations at Chatfield Reservoir would remain unchanged. Thus, vegetation at Chatfield Reservoir would not be adversely impacted. As in Alternative 1, there would be no impacts on vegetation from the conversion of downstream gravel pits to water reservoirs. However, temporary impacts to vegetation may occur during construction of the gravel pit infrastructure; these impacts will be minimized by revegetating with native plants as soon as practicable after infrastructure installation. Under Alternative 2 Penley Reservoir would not be constructed, thus vegetation in the Penley area would not be affected.

4.6.3 Alternative 3—20,600 Acre-Foot Reallocation

Under Alternative 3, there would likely be complete or significant kill of cottonwoods between pool elevations of 5,432 to 5,442 feet msl due to prolonged inundation during the growing season. The anticipated loss of existing vegetation communities due to inundation is presented in Table 4-8. This table describes an estimated loss from inundation of 474.8 acres of vegetation between 5,432 feet msl to the top of the conservation pool (5,444 feet msl); including 204 acres of riparian and/or wetland communities. These acreages are based on a vegetation map of Chatfield State Park prepared by CDNR in 2001 (CDNR 2001).

Conversely, the higher pool levels projected in Alternatives 3 and 4 would likely enhance soil moisture in many areas that are currently at elevations too high to benefit from lateral infiltration of reservoir water. Table 4-9 describes the probable change (i.e., "Increase" or "Decrease") in vegetation communities in a 6-foot elevation band immediately above the projected pool elevation levels for Alternatives 3 and 4. A 6-foot elevation band is referenced due to GIS mapping and analysis of the vegetation communities that currently exist at the study site. Based on this analysis it is assumed that the vegetation communities immediately surrounding the reservoir (within 0 to 6 feet of the pool elevation) have a water table that is somewhat affected by the existing reservoir elevation fluctuations. This relationship is tied to the elevated water tables commonly found adjacent to reservoirs and soil composition. The existing established communities within this 6-foot band were then used as a model to estimate the future, long-term establishment (or loss) of plant communities that would be affected by implementation of Alternatives 3 or 4. Of course, this modeling and the assumptions described in Table 4-9 are hypotheses of vegetation community change above the alternative maximum pool levels and do not affect the estimated impact figures from inundation provided in Table 4-8. Likewise, the figures provided in Table 4-9 do not represent promises of mitigation and should not be the sole basis of mitigation proposals.

In order to develop the projections provided in Table 4-9, the current ratio of vegetation communities within this 6-foot band is applied to the acreage of land that would have this same relative elevation (i.e., 0-6 feet) above the alternative targeted pool elevations. When comparing impacts to vegetation as a result of inundation under Alternatives 3 and 4, it is important to realize that the vegetation losses will be somewhat offset by successional changes at the new OHWM as explained above. For example, dry grassland areas may be transformed into valuable riparian shrublands as more water becomes available at higher elevations. The impacts and offsetting successional changes do not necessarily occur in the same areas and are not typically additive or subtractive in terms of numbers of acres gained or lost. Instead, the amounts of vegetation gains and losses depends on slopes, existing vegetation, distance from the new OHWM, and future weather events and future disturbances. Therefore, values in Table 4-9 are arrived at using spatial analysis and not simple arithmetic methods.

The "Expected New Total Acreage" of vegetation communities presented in Table 4-9 is a combination of the areas of previously mapped vegetation communities located within the 6-foot bands and estimated "Increase" or "Decrease" of those same vegetation communities based on the above-mentioned spatial analysis. For example, if 100 acres of a specific vegetation community is expected above the new pool elevation, but 45 acres of that vegetation community already exist, then the change would be an increase of 55 acres in that vegetation community.

Table 4-9 indicates that implementation of Alternative 3 would affect an estimated 79.2-acre increase in riparian/wetland native forest or shrublands, a 2.6-acre decrease in native perennial grasslands, and a 59.0-acre decrease in upland annual and perennial grasslands and forbs. However, these would be long-term, not immediate, changes caused by implementation of the alternative. Table 4-10 provides a direct comparison of the projected vegetation community losses due to inundation described in Table 4-8 and the projected long-term changes described in Table 4-9 for both Alternatives 3 and 4.

The hydrology model output shows that pool elevations of greater than 5,440 feet msl are reached for the entire growing season in 10 of the 59 years (17 percent) of the POR and there are three instances where this occurs in consecutive years. Pool elevations of greater than 5,441 feet msl are reached for essentially the entire growing season in 7 of the 59 years (12 percent) of the POR, and there is one instance where this occurs 2 years in a row. Pool elevations of greater than 5,442 feet msl are reached for essentially the entire growing season in 4 years of the POR, and there is one instance where this occurs in consecutive years. In addition, there are 7 years in the POR that exceed 5,442 feet msl for at least 85 percent of the growing season. Thus, it is possible there could be significant kill of cottonwood trees at 5,442 feet msl.

There are no years in which the pool reaches more than 5,443 feet msl for the entire growing season. There is only 1 year in which this elevation is inundated for more than 90 percent of the growing season. There are 2 consecutive years where the area is inundated for more than 80 percent of the growing season. Because saplings are more sensitive to flooding than are mature trees, it is likely that saplings would be killed at this degree of inundation. The impact to mature trees may be less severe than at lower elevations, but it is likely that at least some mature cottonwoods would be killed. Each of these events would likely be accompanied by germination of cottonwoods, and other species, in areas with exposed saturated soil.

There are no years when 5,444 feet msl is exceeded for the entire growing season. The modeling results indicate that there is only 1 year in the POR where the pool elevation in the growing season is above 5,444 feet msl for more than 30 days. The maximum duration above 5,444 feet was 36 days. The maximum pool elevation reached for more than 30 days was 5,452 feet msl, 8 feet above the target pool elevation. The maximum pool elevation reached during this event was 5,466 feet msl, 22 feet above the target pool elevation.

Based on this assessment, the new upper limit of the drawdown zone disturbance that would prohibit the establishment of mature cottonwood would be somewhere between 5,442 and 5,444 ft. Willow shrubs (*Salix exigua*) would be prohibited from becoming established at a level slightly below the cottonwoods based on field observations of surviving vegetation at the current target elevation of 5,432 feet msl. It is likely that willows would become established at 5,442 feet msl and perhaps lower, given modeling results, but this would be based on the frequency of inundation from year to year. For example, if several years passed where flooding was absent or temporary (i.e., 30 days or less), willows could become established and thrive for several years, but once inundated for long durations (likely more than one growing season), they would die back and begin the establishment process over again.

Based on the average monthly pool fluctuations (Figure 4-11), the drawdown would be nearly identical with the exception of a plateau that extends from June to August. This would suggest that the hydrologic conditions at the upper edge of the pool, which would affect vegetation, would be about the same, even though the exposed area below this line would be larger.

However, reviewing year-to-year fluctuations based on changes in pool elevations during the growing season indicates that as the target pool elevation increases, the pool fluctuations increase. Based on the range of values between the 1st and 3rd quartile of data for all years combined, the fluctuation increases from approximately 4.2 feet of fluctuation under Alternative 1 or 2 (Figure 4-14), to 5.0 feet of fluctuation under Alternative 4 (5-foot rise) (Figure 4-16), and up to 7.1 feet of fluctuation for Alternative 3 (12-foot rise) (Figure 4-15). These data suggest that the shoreline water table would be available less often at the upper end of the exposed shoreline indicating that conditions along the shoreline would tend to be dryer as the target pool level increased. Therefore, conditions would favor dryer vegetation along the new shoreline due to drawdown that would be more extreme than under current conditions. This also indicates that the expected net charges in vegetation communities (Tables 4-8, 4-9, and 4-10) are at the upper end of the range of possibilities and likely overestimate future conditions.

4.6.4 Alternative 4—7,700 Acre-Foot Reallocation/NTGW/Downstream Gravel Pits

In addition to the reallocation, another 5,348 acre-feet would be obtained from NTGW and downstream gravel pits under Alternative 4. The potential effects on vegetation from conversion of downstream gravel pits into water storage and use of NTGW are disclosed under Alternatives 1 and 2, respectively. Fewer and/or smaller gravel pit reservoirs would be needed under Alternative 4 than under Alternative 1 or 2.

Vegetation, including cottonwoods, from 5,432 up to 5,437 feet msl would likely be killed due to prolonged inundation. The anticipated loss of existing vegetation communities due to inundation is presented in Table 4-8. This table described an estimated loss from inundation of 199.0 acres of vegetation between 5,432 feet msl to the top of the conservation pool (5,437 feet msl); including 111.4 acres of riparian and/or wetland communities. This acreage includes approximately 15.3 acres of mature cottonwood forest. These acreages are based on the current distribution of communities on the reservoir margin and an assumption that moisture will be available during the growing season for sufficient duration at or slightly above target pool elevations. The current distribution of plant communities is based on a vegetation map of Chatfield State Park prepared by CDNR in 2001 (CDNR 2001).

Table 4-9 indicates that implementation of Alternative 4 may affect an estimated 79.3-acre increase in riparian/wetland native forest or shrublands, a 4.4-acre increase in native perennial grasslands, and a 28.7-acre decrease in upland annual and perennial grasslands and forb. However, these are estimates and would be long-term, not immediate, changes caused by implementation of the alternative. Table 4-10 provides an overall summary of the inundation losses and vegetation community type changes associated with both Alternatives 3 and 4.

Output from the hydrology model (Appendix H) indicates that pool elevations of greater than 5,434 feet msl are reached for the entire growing season in 7 of the 59 years (12 percent) of the POR, including one instance where this occurs 2 years in a row. Above 5,435 feet msl, there are 4 years where essentially the entire growing season is inundated, including one instance of 2 consecutive years.

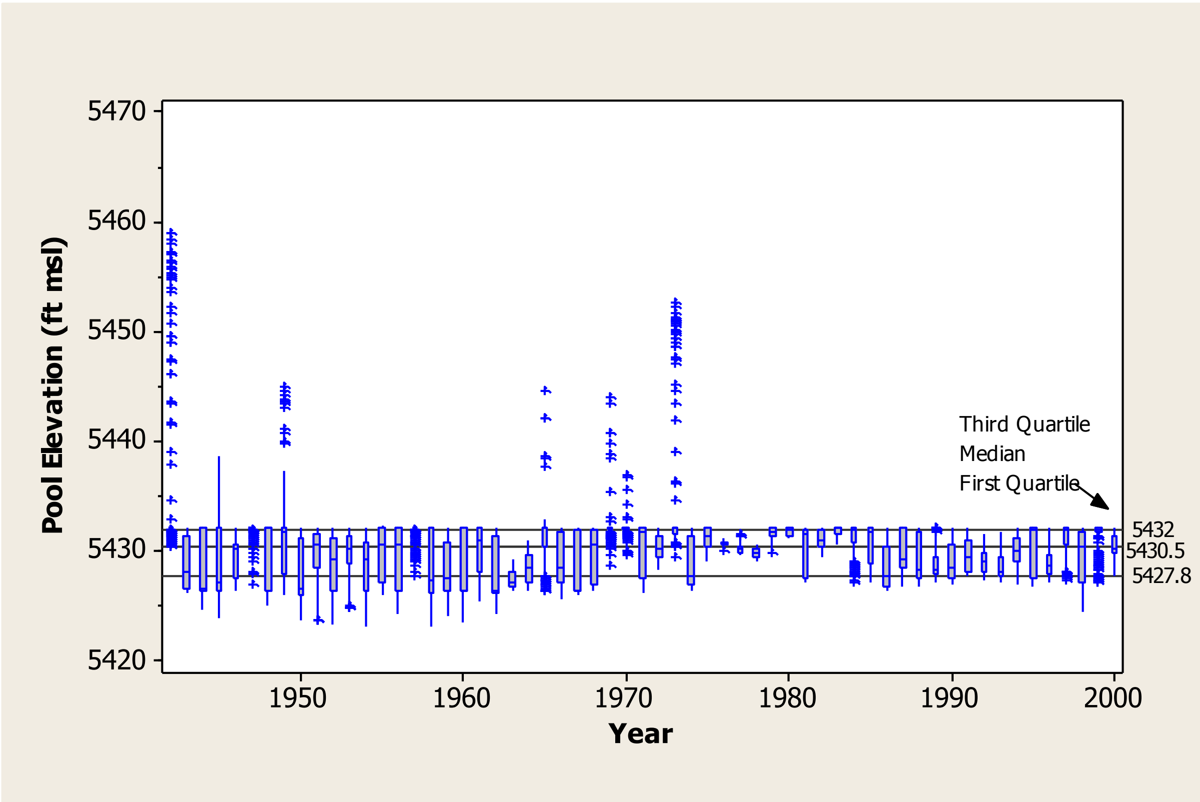


Figure 4-14
Pool Fluctuation During Growing Season Under Alternative 1 or 2

Note: Figure 4-14 is a box and whisker plot. The "box" includes the middle 50 percent of the data and the horizontal line through the box represents the "median" value. Half of the observations are less than the median and half are greater than the median. The "+" symbols above or below the box represent extreme values for that year. The figure also shows that the variability in pool elevation is generally greater in the years before the dam was completed in 1973, as compared to the years after the dam was completed. This difference in variability occurs because the inflows to Chatfield Reservoir and the withdrawals from Chatfield Reservoir were modeled for the years before the dam was completed, and were based on measured values for the years after the dam was completed. Natural variability also contributes to the difference in variability.

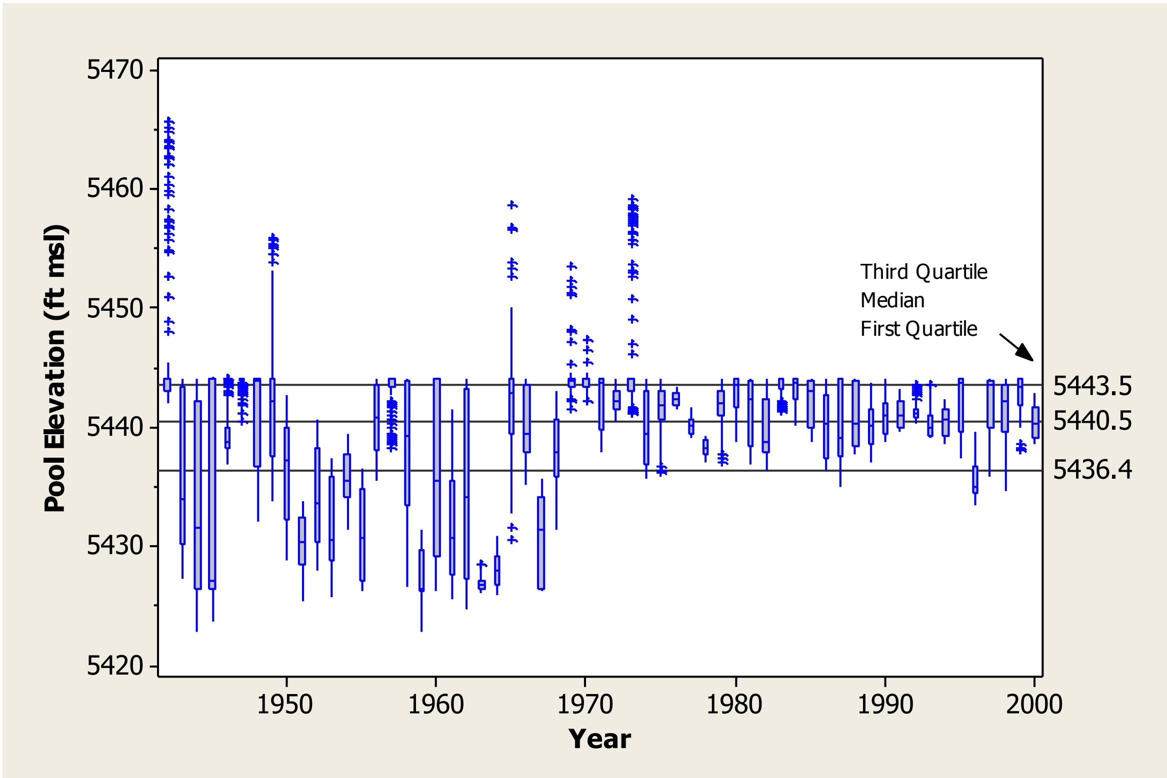


Figure 4-15
Pool Fluctuation During Growing Season Under Alternative 3

Note: Figure 4-15 is a box and whisker plot. The "box" includes the middle 50 percent of the data and the horizontal line through the box represents the "median" value. Half of the observations are less than the median and half are greater than the median. The "+" symbols above or below the box represent extreme values for that year. The figure also shows that the variability in pool elevation is generally greater in the years before the dam was completed in 1973, as compared to the years after the dam was completed. This difference in variability occurs because the inflows to Chatfield Reservoir and the withdrawals from Chatfield Reservoir were modeled for the years before the dam was completed, and were based on measured values for the years after the dam was completed. Natural variability also contributes to the difference in variability

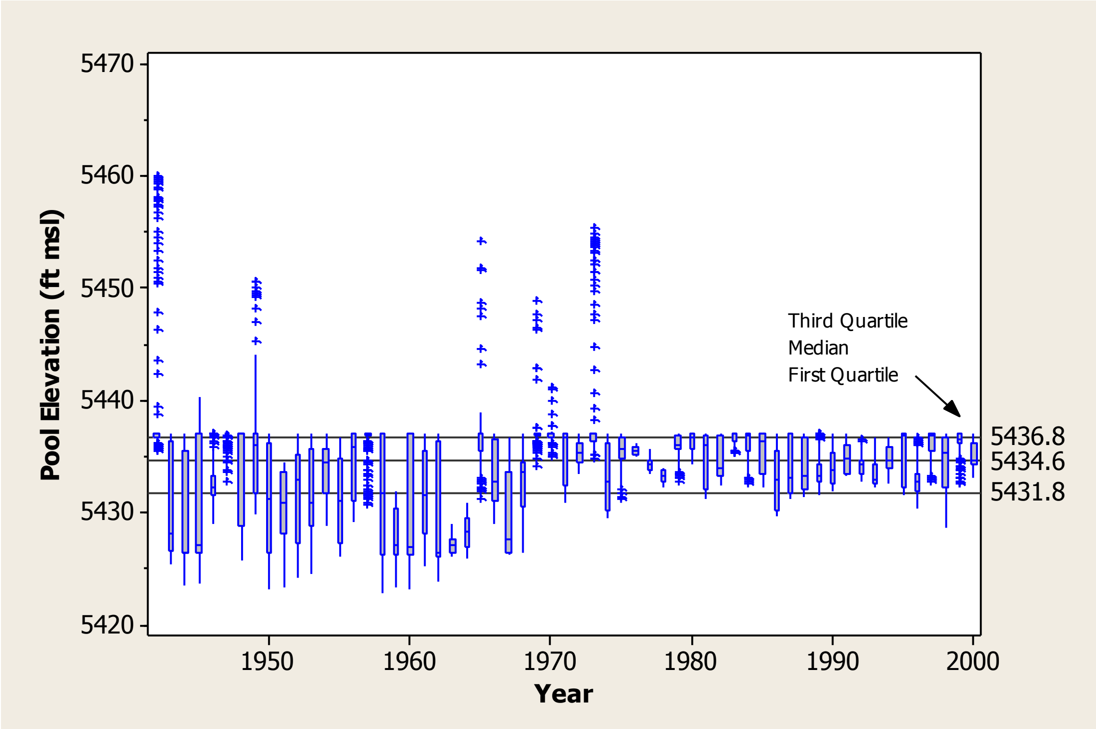


Figure 4-16
Pool Fluctuation During Growing Season Under Alternative 4

Note Figure 4-16 is a box and whisker plot. The "box" includes the middle 50 percent of the data and the horizontal line through the box represents the "median" value. Half of the observations are less than the median and half are greater than the median. The "+" symbols above or below the box represent extreme values for that year. The figure also shows that the variability in pool elevation is generally greater in the years before the dam was completed in 1973, as compared to the years after the dam was completed. This difference in variability occurs because the inflows to Chatfield Reservoir and the withdrawals from Chatfield Reservoir were modeled for the years before the dam was completed, and were based on measured values for the years after the dam was completed. Natural variability also contributes to the difference in variability.

There are no years in which the pool reaches 5,437 feet msl for the entire growing season. However, there are 4 years in which the area is inundated for more than 90 percent of the growing season. This includes 2 consecutive years when more than 94 percent of the growing season is inundated. Because saplings are more sensitive to flooding than are mature trees, it is likely that saplings would be killed to an even greater extent than mature trees. The impact to mature trees may be less severe than at lower elevations, but it is likely that a significant number of mature cottonwoods would be killed. Each of these events would probably be accompanied by germination of cottonwoods, and other species, in areas with exposed saturated soil.

The hydrology model output indicates that there is only 1 year in the POR where the pool elevation in the growing season is above 5,437 feet msl for more than 30 days. The maximum duration above 5,437 feet msl is 32 days. The maximum pool elevation reached for at least 30 days was 5,442 feet msl, 5 feet above the target pool elevation. The maximum pool elevation reached during this event was 5,460 feet msl, 23 feet above the target pool elevation. Based on this assessment, the new upper limit of the drawdown zone disturbance that would prohibit the establishment of mature cottonwood would be about 5,437 feet msl.

Based on an estimated upper limit of the drawdown zone, the lower limit of persistent vegetation is assumed to be about 5,438 feet msl. Based on this, the estimated acreage and class of vegetation anticipated for areas that would have enhanced soil moisture is presented in Table 4-9.

4.6.5 Reduction of Potential Impacts

Mitigation of the loss of the existing vegetation on the reservoir margins would have as a goal the re-establishment of similar habitat, but done in the context of mitigation for habitat of three specific resources: the Preble’s meadow jumping mouse, overall wildlife habitat represented by a diverse avian community (birds), and wetlands. The current vegetation that would be lost is a mix of both high and lower quality vegetation communities. The lower quality communities typically have a higher abundance of non-native species, and the high quality communities have more mature native cottonwoods and shrubs that are typical of riparian habitat. Reduction of potential impacts should focus on weed management and native species establishment. Therefore, the mitigation provided for impacts to Preble's meadow jumping mouse habitat, wetlands, and avifauna habitat (described in the CMP, Appendix K) also would replace the ecological functions provided by vegetation and thus mitigate for impacts to vegetation. The mitigation for impacts to Preble's meadow jumping mouse habitat, wetlands, and avifauna habitat would focus on riparian/wetland native forest or shrubland, which comprise about 43 percent of the vegetation impacts for Alternative 3 and 55 percent of the vegetation impacts for Alternative 4. These mitigation measures could include preservation and enhancement of riparian and adjoining upland habitats in nearby off-site areas, creation of wetland habitat within Chatfield State Park, and enhancement of upland, riparian, and wetland habitat within Chatfield State Park. This mitigation for wetland/riparian impacts is detailed in the CMP (Appendix K). The Corps has consulted with the EPA on how to implement adaptive management to minimize impacts of a more highly fluctuating reservoir (see Appendix K, Section 7.5.2.2).

Weed Management

Weed management includes frequent monitoring of the drawdown zone for the presence of weedy species. Weed control shall employ standard IPM (Integrated Pest Management) methods with the addition of inundation as a management tool. Treatment options would be based on an adaptive management program that responds to existing conditions. Although the cyclic disturbance to the drawdown zone can be anticipated, the actual weedy species that would invade in any particular year or at a particular location cannot. Introduction of aggressive native species such as foxtail barley is one option for competing against the weedy species.

The fluctuating boundary between the drawdown zone and the persistent vegetation can be a primary source for reseeding the drawdown zone each annual cycle. Weedy species established in this area as well as the immediately adjacent zone of persistent vegetation shall be closely monitored, especially during the flowering and seed stages for the weedy species.

Weed management above the drawdown zone would not be able to use inundation as a control method. Standard weed management practices apply for these areas with special focus on weedy trees and shrubs. Simultaneous removal of non-preferred species and the planting of the preferred species, as discussed in the next section, would aid in the acceleration of habitat restoration.

Native Species Establishment

Natural community succession can be accelerated, and weed control can be assisted, by the establishment of native species. Due to a changed pool elevation, some areas would have improved soil moisture conditions that would allow the establishment of species that previously could not survive at these sites. Tree and shrub communities can be established at these locations, and intentionally planting these species can accelerate the successional process and the restoration of habitat. It may take several cycles of the pool elevation to establish the new soil moisture conditions and allow proper site evaluation for the installation of planted species. Tree species such as cottonwood need to be in contact with the water table when first planted and may need supplemental water for the first few years until roots can develop that would follow the water table down to its lowest level.

Herbaceous species can also be used at locations where vegetation is not currently established, or has been removed by inundation. Some native species such as foxtail barley are adapted to the fluctuating conditions found on reservoir margins. Adaptive management would be used to monitor for additional appropriate species to use as competitors for the weedy species.

4.7 Wetlands

The proposed alternatives could have potential impacts on wetlands. Specific issues include possible wetland impacts from implementing the alternatives to include inundation and transformation of specific wetland areas. These issues are evaluated by alternative in the following sections. Appendix K provides additional information on the Compensatory Mitigation Plan. This analysis of impacts on wetlands is based on the maximum level of inundation for each alternative, or the worst-case scenario. The exact new condition for each alternative is unknown due to the high fluctuation of the water levels associated with certain alternatives.

4.7.1 Alternative 1—No Action

Under Alternative 1, reservoir levels and operations at Chatfield Reservoir would remain unchanged (Table 4-2 and Figure 4-1). Wetlands in riverine, palustrine, and lacustrine systems around Chatfield Reservoir would be unaffected.

Penley Reservoir and Downstream Gravel Pits

The Penley Reservoir inundation area contains two small, isolated wetlands that total about 0.26 acres; therefore, impacts on wetlands would be limited. Conversely, inundation may potentially enhance wetland habitats, particularly if the resulting lake shoreline is vegetated with natural plant communities.

The Penley Reservoir project also would involve the construction of 32.05 miles of underground pipelines to deliver water to the reservoir and to water providers in the area. Pipelines would cross numerous wetlands and jurisdictional waters of the United States. Based on the estimated 100-foot buffer around pipelines, 12 acres of wetlands could be impacted. This is an approximate value based on approximate locations of pipelines.

The downstream gravel pits are currently being mined (or are already mined out) for gravel and are therefore unvegetated and inundation of these pits would not result in the loss of wetland vegetation. Inundation of the gravel pits could enhance wetland habitats, particularly if the shorelines were vegetated with natural plant communities. Seepage from earthen ditches also could create wetlands downgradient of ditches.

Based on information in Chapter 2, each of the four downstream gravel pits would include a diversion channel that is several feet wide and each would disturb about 2 acres of land area. If the disturbed area includes wetlands then there would be potential impacts on wetlands. The impact would be up to 2 acres per gravel pit, for a total of up to 8 acres. It is also assumed that each gravel pit would include outlet works (including distribution lines) and a pump station occupying 1 acre. If wetlands are present in these areas then up to 4 additional acres of wetlands would be disturbed. The maximum area of wetlands disturbed by the infrastructure for the four gravel pits is 12 acres.

The total area of wetland impacts from alternative 1 is up to 24.26 acres, based on 0.26 acres within the Penley Reservoir footprint, 12 acres of impacts from pipelines associated with Penley Reservoir, and 12 acres of impacts from the diversion channels and infrastructure at the gravel pits (see Tables 4-11 and 4-12).

4.7.2 Alternative 2—NTGW/Downstream Gravel Pits

Under Alternative 2, reservoir levels and operations at Chatfield Reservoir would remain unchanged. Wetlands in riverine, palustrine, and lacustrine systems around Chatfield Reservoir would be unaffected. Impacts on wetlands from the conversion of downstream gravel pits to water storage would be the same as those described under Alternative 1 (i.e., a maximum of 12 acres), see Tables 4-11 and 4-12). However, impacts on wetlands in the Penley Reservoir area under Alternative 1 would not occur under Alternative 2 because water would be obtained from NTGW.

Table 4-11
Estimate of Acres of Wetlands Impacted by Each Alternative

Wetland Type	Alternative 1 (a)	Alternative 2 (a)	Alternative 3 (c)	Alternative 4 (c)
Submergent (Palustrine Aquatic Bed)	NA	NA	9.0	5.9
Emergent (Palustrine Emergent)	NA	NA	26.3	15.2
Seasonal (Lacustrine Emergent – nonpersistent)	NA	NA	14.7	14.7
Scrub/Shrub (Palustrine Scrub/Shrub)	NA	NA	73.0	59.2
Forested (Palustrine Forested)	NA	NA	34.2	24.8
Total	**24.26**	**12.0**	**157.2 (b)**	**119.8**

(a) "Wetland Type" is not available (NA) for Alternatives 1 and 2.

(b) Of 157.2 wetland acres for Alternative 3, 157.2 acres are also bird habitat and 137.3 acres are also habitat for Preble's meadow jumping mouse.

(c) The values in this column are based on the number of acres inundated (see text for explanation).

Table 4-12
Estimate of Acres of Wetlands Impacted by Each Alternative, Total by Drainage

Wetland Type	South Platte River Drainage				Plum Creek Drainage			
	Alternative 1(a)	Alternative 2 (a)	Alternative 3 (c)	Alternative 4 (c)	Alternative 1 (a)	Alternative 2 (a)	Alternative 3 (c)	Alternative 4 (c)
Submergent (Palustrine Aquatic Bed)	NA	NA	3.8	1.6	NA	NA	5.2	4.3
Emergent (Palustrine Emergent)	NA	NA	11.1	7.8	NA	NA	15.2	7.4
Seasonal (Lacustrine Emergent – nonpersistent)	NA	NA	10.5	10.5	NA	NA	4.2	4.2
Scrub/Shrub (Palustrine Scrub/Shrub)	NA	NA	33.7	28.0	NA	NA	39.3	31.2
Forested (Palustrine Forested)	NA	NA	4.3	3.8	NA	NA	29.9	21.0
Total	**18.0 (b)**	**12.0**	**63.4**	**51.7**	6.26 (b)	**0.0**	**93.8**	**68.1**

(a) "Wetland Type" is not available (NA) for Alternatives 1 and 2.
(b) The total acres for Alternative 1 assumes half of the Penley Reservoir pipeline impacts are in the South Platte Drainage (i.e., 6 acres) and half are in the Plum Creek Drainage (i.e., 6 acres).
(c) The values in this column are based on the number of acres inundated (see text for explanation).

4.7.3 Alternative 3—20,600 Acre-Foot Reallocation

Under this alternative, the infrastructure of the pool containing conservation storage would be changed to target 20,600 acre-feet of reallocated storage by allowing the water level to rise to a target pool elevation of 5,444 feet msl. This level of inundation represents a maximum level or in terms of impacts, a worst-case scenario. Based on hydrologic modeling, this maximum pool elevation would not be reached every year (see Section 4.6). Based on elevation contours generated using field survey data of the area immediately surrounding the reservoir, when reached this maximum increase in water level would inundate additional acres of land area as shown on Table 4-2 and Figure 4-1. Under Alternative 3, approximately 587 acres of additional land area would be inundated at a water level of 5,444 feet msl. Because the maximum pool elevation would not be reached every year not all acres would be inundated all years, and some acres would be inundated for only a short period.

Inundation at a water level of 5,444 feet msl would result in an inundation of approximately 157.2 acres of vegetated wetlands based on field mapping of wetlands in potential areas of inundation (Table 4-11). The greatest loss would be of scrub/shrub type wetlands. An additional 0.8 acres of wetlands (palustrine scrub/shrub) would be permanently impacted as a result of relocation of recreational facilities above 5,444 feet msl (i.e., the recreation trail across Plum Creek).

To further understand impacts to wetland resources, it is helpful to understand that the 587 acres potentially inundated by Alternative 3 includes many different land types. Some of these 587 acres are areas that are currently open water, or man-made structures such as parking lots. Other acres include wildlife habitat. It is within the wildlife habitat that wetlands also exist. Therefore, it is important to note that the 157.2 acres potentially inundated by this alternative overlap with habitat for other wildlife resources (Table 4-11). This will be explained further in Section 4.8.

The process of inundating areas works to remove vegetation in the near term and to transform vegetation in the long term. As water levels inundate new areas, the soils become saturated first, and then are completely covered in water. Once water covers the soil, oxygen cannot be exchanged for plant respiration. Plants use up the available oxygen in the soil, but if inundation persists, soil conditions become anaerobic. Only plant species that can adapt to these harsh conditions would survive. If inundation lasts for extended periods, even the adapted plants would die (see Section 4.6 for additional discussion on the effects of inundation on plants especially trees). If the plants are covered completely, all respiration shuts down and the plants die rapidly (within days). If the water levels are sustained at the maximum elevation (5,444 feet msl) for extended period, this alternative would result in converting approximately 157.2 acres of wetland (approximately 63.4 acres in the South Platte River drainage and 93.8 acres in the Plum Creek drainage; Table 4-12) to deep water habitat.

The relocation of roads and recreation facilities would impact wetland areas as well. The total impacts on specific wetland areas would include direct loss of wetlands and possibly the indirect loss or modification of wetland areas caused by increased runoff creating erosion or changing the frequency at which an area receives water.

Under Alternative 3, pool levels could fluctuate up to a maximum of 28.2 feet during the growing season, although typically the pool fluctuations within a growing season would be much less. Based on the range of values between the 1st and 3rd quartile of data for all years combined, the fluctuation increases from approximately 4.2 feet of fluctuation under Alternative 1 (Figure 4-14), to 5.0 feet of fluctuation under Alternative 4 (Figure 4-16), and up to 7.1 feet of fluctuation for Alternative 3 (Figure 4-15). These data suggest that the shoreline water table would be available less often at the upper end of the exposed shoreline, indicating that conditions along the shoreline would tend to be drier as the target pool level increased. Therefore, conditions would favor less hydrophytic vegetation along the new shoreline due to drawdown that would be more extreme than under current conditions.

It is useful to look at fluctuations during the growing season to understand the impacts on wetlands from this alternative. The vegetation growing season corresponds roughly to beginning at week 17 and ending at week 41 (i.e., late April 25 to October 11) and corresponds to a growing season of approximately 170 days (see Section 4.6 for details). During an average year, as modeled using POR data, pool levels would begin to increase prior to the onset of the growing season until reaching the peak between weeks 19 and 25. Then pool levels would recede modestly (2 to 3 feet) for a major portion of the growing season, then level off toward the end of the growing season and for the remainder of the year (Figure 4-17). Within the growing season, the POR data predict that the pool level during an average year would approximate 5,440 feet msl with fluctuations ± 2 feet (Figure 4-17). Pool levels during the majority of the growing season may also be influenced by reservoir management. During the recreation season (May 1 through September 30), pool level variations are currently restricted and restrictions may continue under this alternative (see Section 4.17, Recreation, for details). This would aid in maintaining pool levels during the majority of the growing season. Outside of the growing season, pool levels would continue to decrease during average years to elevations approximating 5,436 feet msl in a typical year (Figure 4-15).

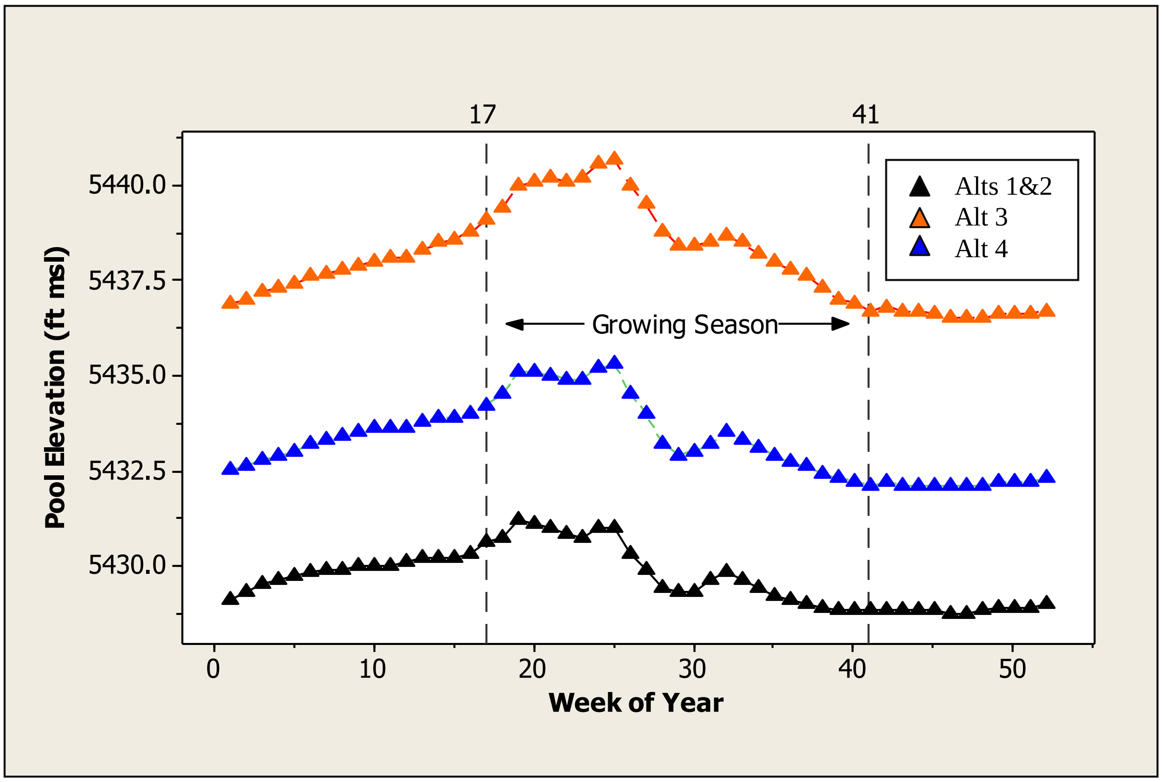


Figure 4-17
Weekly Mean Pool Elevations for the Entire Year for All Alternatives

Heavy precipitation events could raise water levels above 5,444 feet msl. Based on the POR database of pool elevations, future water levels could rise to as much as 5,465 feet msl for extended periods of time during the growing season. However, such extremes in water levels are rare from year-to-year over the POR (Figure 4-18), approximating 1 out of 10 years. Dependent on the flux of water levels, wetlands may be inundated for varying periods of time having a long-term adverse impact of changing the composition of existing wetlands (i.e., changing to more water-tolerant species such as from shrubs to cattails or from semi-aquatic habitats to aquatic) or establishing new wetlands within the new zone of fluxing inundation.

The number of wetland acres impacted in the Plum Creek drainage is over 50 percent higher than in the South Platte River drainage (Table 4-12). In both drainages the major wetland impacts are to scrub/shrub wetlands, which constitute over 50 percent of the wetland acres impacted in the South Platte River drainage. On the other hand, the percent of inundated wetland acres that are forested is nearly four times higher in the Plum Creek drainage than in the South Platte River drainage.

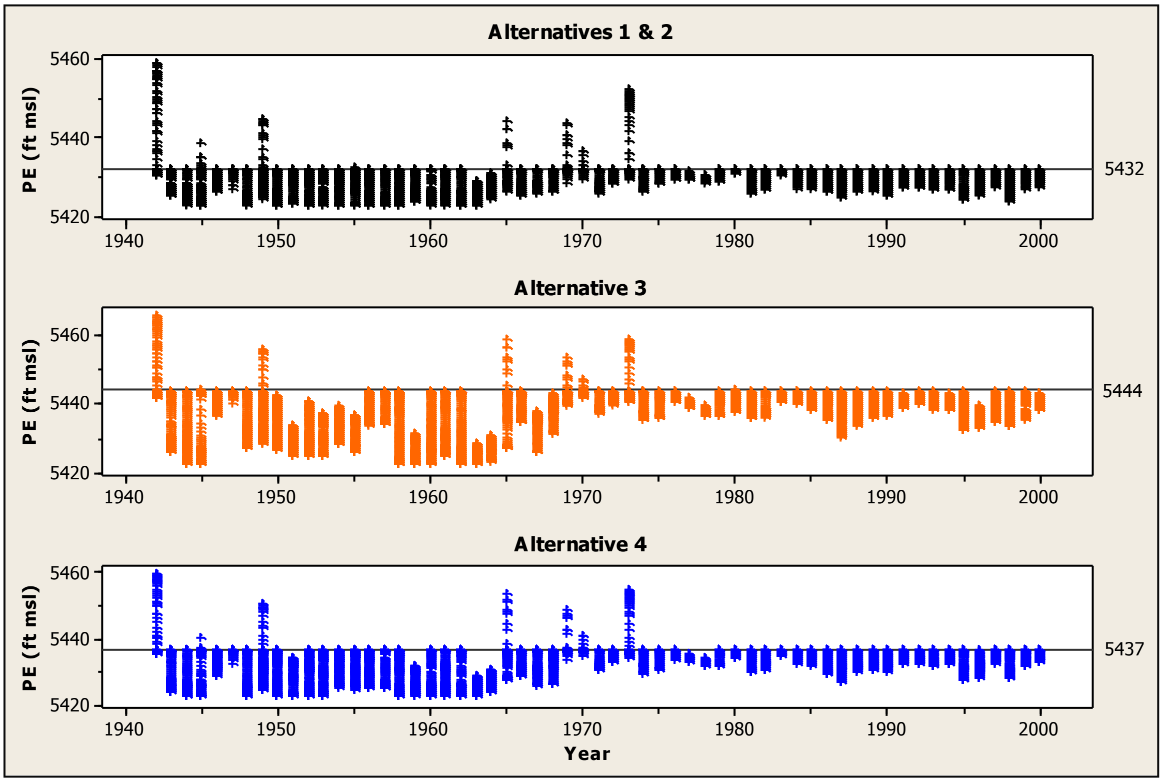


Figure 4-18
Pool Elevations over the POR by Alternative

Under Alternative 3 the Chatfield Reservoir level would fluctuate more than under the other alternatives. Over the length of an entire year, the average pool level difference would reach 6 to 7 feet; but during the growing season, it is estimated that the average pool level would peak in mid-June and would drop throughout the rest of the season, resulting in an average difference in pool elevations of only 2 to 3 feet. As a result, new wetlands could become established in areas that are inundated during a part of the growing season, including new "backwater" areas and shoreline areas on gradual slopes. However, a 2- to 3-foot drop in pool levels could also result in many areas in the flux zone being devoid of vegetation or having annual (weedy) upland communities, dependent on the slope of land at a particular site and the duration of inundation at a site. For example, areas at the peak of the elevation change would be inundated for the shortest period of time, but after the water levels drop 5 feet, are left too dry to support wetland vegetation only. Instead, these sites may be a mixture of wetland plants and upland vegetation. Wetland vegetation needs several weeks of inundation to establish itself and out-compete most terrestrial vegetation. Moreover, some sites could support upland vegetation that may be disturbed on a regular basis. In areas at the lower end of the gradient, the time of inundation would be too great for any plants (upland or wetlands) to become established and therefore would remain as bare ground or at least poorly vegetated. In between this gradient would be areas where conditions are right for wetlands.

The mitigation of potential impacts, described in the CMP (Appendix K), is guided by the development of an Ecological Functions Approach (EFA), an accounting system used to value the overlapping ecological values that wildlife habitats provide on lands surrounding Chatfield Reservoir. Ecological Functional Units (EFUs) are calculated in the CMP to capture the ecological functions provided by the individual target environmental resources as well as their overlap. The assessment of impacts is initially estimated using a conservative approach where it is assumed that the target elevation pool would be met and maintained and therefore inundate the maximum acreage. The CMP uses these acreages to compute EFUs for the combined values of the specific resources. Based on the number of acres of wetlands impacted, the CMP estimates this equates to 123 EFUs of wetlands (see Appendix K for additional details).

4.7.4 Alternative 4—7,700 Acre-Foot Reallocation/NTGW/Downstream Gravel Pits

In addition to the reallocation, another 5,348 acre-feet would be obtained from NTGW and downstream gravel pits under Alternative 4. The potential effects on wetlands from the conversion of downstream gravel pits to water storage and the use of NTGW are disclosed under Alternatives 1 and 2, respectively. Fewer and/or smaller gravel pit reservoirs would be needed under Alternative 4 than under Alternative 1 or 2. Under Alternative 4, the maximum area of wetlands disturbed by the infrastructure for gravel pit storage is 6 acres.

Under this alternative, the infrastructure of the pool containing conservation storage would be changed to target 7,700 acre-feet of reallocated storage by allowing the water level to rise to a multipurpose pool elevation of 5,437 feet msl. Again, heavy precipitation events could raise water levels beyond 5,437 feet msl for brief periods, but this would be rare from year to year. As shown in Table 4-2, this increased water level would translate into approximately 215 acres of additional land area that would become inundated at 5,437 feet msl.

Raising water levels under this alternative would have the near-term adverse impact of eliminating approximately 119.8 acres of vegetated wetlands (approximately 51.7 acres in the South Platte River drainage and 68.1 acres in the Plum Creek drainage, Tables 4-11 and 4-12) if the water levels are sustained at 5,437 feet msl for extended periods. Plum Creek wetlands are affected more under this alternative due to the shallow nature of the Plum Creek delta at the confluence of the stream with the reservoir. More acres of land are inundated with a given rise in water level. Plum Creek impacts mainly affect scrub/shrub type wetlands. Within the South Platte River drainage, scrub/shrub type impacts are also the majority, but impacts on emergent (non-woody) wetlands are relatively large and impacts on forested wetlands are lower compared to impacts on those types in the Plum Creek drainage. An additional 0.8 acres of wetlands (palustrine scrub/shrub) would be permanently impacted as a result of relocation of recreational facilities above 5,444 feet msl (i.e., the recreation trail across Plum Creek).

As was the case under Alternative 3, the 215 acres potentially inundated under Alternative 4 are acres that are shared by multiple resources such as birds and the Preble's meadow jumping mouse as well as wetlands.

Under this alternative the Chatfield Reservoir level would fluctuate less than under Alternative 3. This may provide more areas with conditions conducive to supporting wetlands at the new water levels. However, there would likely be areas that are disturbed and weedy or lacking vegetation altogether, depending on slope and duration of inundation at specific sites.

4.7.5 Reduction and Mitigation of Potential Impacts

Potential impacts that would transform wetlands and/or reduce wetlands functions would be minimized as much as possible through adaptive management, including changing the amount and timing of releases, seeding or plantings, and weed control. Adaptive management planning would involve an iterative process of cycling through several steps: problem assessment, design, implementation, monitoring, evaluation, adjustment, and continued cycling through earlier steps (Barnes 2009). Mitigation for impacts associated with Alternatives 3 and 4 would be a combination of on-site and off-site enhancements of quality and functions of existing wetlands as well as wetland creation. Compensatory mitigation of wetlands would be maximized, to the extent practicable, at Chatfield State Park through the creation, enhancement, and restoration of wetlands within and/or adjacent to the park (see the CMP, Appendix K). The mitigation of impacts to wetlands would also occur as part of the mitigation provided for impacts to Preble's meadow jumping mouse and avifauna habitat. The mitigation for impacts to these resources would focus on riparian/wetland native forest or shrubland. Mitigation measures could include preservation and enhancement of riparian and adjoining upland habitats in nearby off-site areas, creation of habitat within Chatfield State Park, and enhancement of upland, riparian, and wetland habitat within Chatfield State Park. Of the 123 EFUs of wetlands impacted, 30 EFUs would be mitigated on-site and 93 EFUs would be mitigated off-site (Appendix K). The Corps has consulted with the EPA on how to implement adaptive management to minimize impacts of a more highly fluctuating reservoir (refer to Appendix K, Section 7.5.2.2 for further details). Adaptive management by an established group would facilitate discussion of minimizing impacts by operation strategies once reallocation begins.

For Penley Reservoir, downstream gravel pits, pipelines, and other associated infrastructure, impacts to wetlands would be avoided and minimized to the extent possible and, if necessary, mitigated in accordance with Corps regulatory requirements so that the resulting net impacts to wetlands are insignificant.

The Corps has conducted coordination and informal consultations with the USFWS regarding potential impacts to wetlands and their recommendations for mitigation, including a Planning Aid Report (February 2006) and progress letter (July 2010) (see Appendix X).

4.8 Wildlife

The four proposed alternatives could have potential impacts on wildlife resources. Specific issues include possible impacts of the alternatives on habitat by inundation of wetland, riparian, and upland areas currently used by wildlife. Additionally, the relocation of recreational facilities and roads may adversely impact wildlife habitats. Potential impacts to endangered, threatened, and candidate wildlife species and wildlife species of special concern are addressed in Section 4.9. Table 4-13 presents the estimated acres of inundated wildlife habitat for all four of the alternatives, and Table 4-14 presents the estimated acres of inundated wildlife habitat for all four of the alternatives, by drainage.

4.8.1 Alternative 1—No Action

Under Alternative 1, reservoir levels and operations at Chatfield Reservoir would remain unchanged (Table 4-2 and Figure 4-1). Impacts on wildlife resources at Chatfield Reservoir would not occur.

Construction of Penley Reservoir would result in the loss of 155 acres of terrestrial habitat for grassland and upland wildlife species; however, habitat for wetland and water-dependent wildlife species would increase. The entire footprint of the proposed reservoir (155 acres) includes valuable habitat for elk, mule deer, and white-tailed deer, including the following range designations per NDIS (2008b): elk winter range and severe winter range, mule deer summer range, winter concentration and severe winter range, and white-tailed deer concentration area and winter range. The footprint of the reservoir is small compared to the areas encompassed by these range designations and therefore significant adverse impacts are not expected for elk, mule deer, and white-tailed deer.

Table 4-13
Estimate of Acres of Wildlife Habitats Impacted by Alternative

Habitat Type	Alternative 1 (a)	Alternative 2 (a)	Alternative 3 (b)	Alternative 4 (b)
Mature Cottonwood	0.0	0.0	43	16
Other Trees	0.0	0.0	211	162
Shrub	0.0	0.0	53	35
Upland	167	12	222	72
Wetland/Non-woody	0.0	0.0	57	43
Shoreline*	0.0	0.0	90	78
Water	0.0	0.0	1367	1296
Total (not including water)	167	12	676	406

* Shoreline habitat was calculated by determining the area of digitized polygons derived from aerial photographs.
(a) The values in this column are based on the assumption that all 12 acres of impact at the gravel pits is “Upland” habitat type.
(b) The values in this column are based on the number of acres inundated (see text for explanation).

Table 4-14
Estimate of Acres of Wildlife Habitats Impacted by Alternative, Total by Drainage

Habitat Type	South Platte Drainage				Plum Creek Drainage			
	Alternative 1 (a)	Alternative 2 (a)	Alternative 3 (b)	Alternative 4 (b)	Alternative 1	Alternative 2	Alternative 3 (b)	Alternative 4 (b)
Mature Cottonwood	0.0	0.0	43	16	0.0	0.0	0.0	0
Other Trees	0.0	0.0	114	90	0.0	0.0	97	72
Shrub	0.0	0.0	24	20	0.0	0.0	29	15
Upland	12	12	161	45	155	0.0	61	27
Wetland/Non-Woody	0.0	0.0	37	27	0.0	0.0	20	16
Shoreline	0.0	0.0	65	53	0.0	0.0	25	25
Total	12	12	444	251	155	0.0	232	155

(a) The values in this column are based on the assumption that all 12 acres of impact at the gravel pits is “Upland” habitat type.
(b) The values in this column are based on the number of acres inundated (see text for explanation).

Construction of pipelines may impact wildlife resources by creating temporary adverse impacts on habitat. Roads used during construction would be temporary and the disturbed areas would be revegetated with native plants as soon as practicable to restore native habitat. If these best management practices are followed, any impacts to wildlife resources from pipeline construction would be short term.

The downstream gravel pits are currently being mined (or are already mined out) for gravel and are therefore unvegetated and inundation of these pits would not result in the loss of terrestrial vegetation. The infrastructure associated with developing the gravel pits into water storage structures would result in habitat loss for some species, but inundation of the gravel pits would result in habitat creation for other riparian or water-dependent wildlife species. Gravel deposits are typically in or near flood plains and therefore are likely to contain high diversity of wildlife species and important habitat for birds, mammals, reptiles, and amphibians. Development of gravel pits into storage structures may impact wildlife habitat during installation of the necessary infrastructure (i.e., diversion channel, outlet works, and pump station). After inundation of the gravel pit storage areas, wildlife habitat would increase for riparian species, including amphibians, waterfowl, and riparian-associated mammal and reptile species, particularly if shorelines contained riparian vegetation. However, associated infrastructure may disrupt travel corridors for some terrestrial species. Based on information in Chapter 2, each of the four downstream gravel pits would include a diversion channel that is several feet wide and each would disturb about 2 acres of land area. The impact to terrestrial habitat from the diversion channels would be up to 2 acres per gravel pit, for a total of up to 8 acres for four gravel pits. It is also assumed that each gravel pit would include outlet works (including distribution lines) and a pump station occupying up to 1 acre of terrestrial habitat for each gravel pit. The maximum area of terrestrial habitat disturbed by the infrastructure for the four gravel pits is 12 acres (see Tables 4-13 and 4-14.

4.8.2 Alternative 2—NTGW/Downstream Gravel Pits

Under Alternative 2, reservoir levels and operations at Chatfield Reservoir would remain unchanged as in Alternative 1. Adverse impacts on wildlife resources at Chatfield Reservoir would not occur. Impacts on wildlife resources at the gravel pits would be the same as under Alternative 1, along with impacts from the construction of associated pipelines and other infrastructure. As described under Alternative 1, the maximum area of terrestrial habitat disturbed by the infrastructure for the four gravel pits is 12 acres (see Tables 4-13 and 4-14). However, impacts on wildlife from Penley Reservoir and construction of associated pipelines would not occur because water would be obtained from NTGW.

4.8.3 Alternative 3—20,600 Acre-Foot Reallocation

Under this alternative, the infrastructure of the pool containing conservation storage would be changed to target 20,600 acre-feet of reallocated storage by allowing the water level to rise as high as 5,444 feet msl. As indicated in Section 4.2.3, under Alternative 3, approximately 587 acres above the conservation pool elevation (5,432 feet msl) would be inundated at water levels of 5,444 feet msl (Table 4-2 and Figure 4-1). However, the total acres of wildlife habitat inundated under Alternative 3 is greater than 587 acres(676 acres, not including “Water”) because there are trees and shrubs growing below 5,432 feet msl and these are included in the total acres of habitat inundated (see Tables 4-13 and 4-14).

It is important to note that the 676 acres potentially inundated by this alternative includes overlapping habitat for multiple resources including birds, the Preble’s meadow jumping mouse (Table 4-16), and wetlands (Table 4-11). Although “shoreline” habitat is shown in Tables 4-13 and 4-14, it is not considered a loss of habitat because the present shoreline would be replaced with the same or greater amounts of new shoreline associated with reallocation. Under Alternative 3 the total acres of wildlife habitat inundated, not including shoreline, is 586 acres.

In addition, approximately 30 acres of grasslands would be permanently impacted by the footprints of relocated recreational facilities (see CMP, Appendix K).

An additional 2.54 acres of wildlife habitat would be impacted by the relocation of the recreation trail at the Plum Creek day use area. This includes the following habitat types: 0.19 acres of mature cottonwood, 0.20 acres of shrub, 1.97 acres of upland, and 0.18 acres of wetland/non-woody habitat.

Impacts under Alternative 3 are substantial, converting hundreds of acres of terrestrial habitat acres to aquatic or semi-aquatic habitats. It likely would benefit fisheries and other aquatic life, but would adversely impact terrestrial wildlife species by reducing the overall acreage of wildlife habitat within the study area by reducing the available forage, protective cover, breeding sites, and nesting sites. This would occur as a result of the inundation of riparian or upland vegetation, which removes or transforms the present vegetation and corresponding wildlife habitat.

It is unlikely that the pool elevation of 5,444 feet msl would be maintained for long periods of time and may not be attained in some years at all. Therefore, a portion of the habitat acres listed in Tables 4-13 and 4-14 would only be inundated for short periods of time or not at all during some years. This could likely transform terrestrial habitats to wetter environments instead of eliminating them.

In Section 4.6, an estimate of vegetation gains and losses under future conditions for the inundation alternatives (i.e., Alternatives 3 and 4) is presented in Table 4-10. The estimate is based on the current ratio of vegetation communities at specific elevational increments and is applied to the acreage of land that would have these same relative elevations (i.e., 0–2 feet, 2–4 feet, 4–6 feet) above the alternative targeted pool elevations (see Section 4.6). When comparing impacts to vegetation as a result of inundation under Alternatives 3 and 4, it is important to realize that the vegetation losses will be somewhat offset by successional changes at the new OHWM. This also pertains to gains and losses of wildlife habitat. However, these successional changes are dependent on the many variables discussed in the preceding paragraph and long-term successional increases in riparian or wetland communities are not used to temper the estimates of wildlife habitat losses described in Table 4-14.

The mitigation of potential impacts, described in the CMP (Appendix K), is guided by the development of an Ecological Functions Approach (EFA), an accounting system use to value the overlapping ecological values that terrestrial wildlife habitats provide on lands surrounding Chatfield Reservoir (see Section 4.8.5). Ecological Functional Units (EFUs) are calculated in the CMP to capture the ecological functions provided by the individual target environmental resources as well as their overlap. The assessment of impacts is initially estimated using a conservative approach where it is assumed that the target elevation pool would be met and maintained and therefore inundate the maximum acreage. The CMP uses these acreages to compute EFUs for the combined values of the specific resources. Based on the number of acres of bird habitat impacted, the CMP estimates this equates to 377 EFUs of bird habitat. Mitigation of vegetation is assumed to be accomplished by mitigation for the habitat of these specific resources. Once an alternative is implemented, actual impacts would be assessed "real time" and be off-set by on-site and off-site mitigation and by tracking the gains of habitat due to increased water availability associated with newly established pool elevations (i.e., new OHWM). This accounting system would track how mitigation is progressing and whether alterations to mitigation activities are needed. See the CMP (Appendix K) for further details.

Under Alternative 3, the Chatfield Reservoir level would fluctuate more than under the other alternatives, having an average peak fluctuation of 3 feet during late spring or early summer (Figure 4-12). Modeling of maximum levels using the POR water levels illustrate that maximum pool fluctuations from year to year can be substantially more than the average fluctuations, on rare occasions changing more than 20 feet for short periods of time. Fluctuations, either average or maximums, would result in habitat transformations differing from those areas being permanently inundated. Within this zone of fluctuation, new wetlands and riparian areas would establish at higher land elevations and at lower elevations closest to shorelines; weedy areas or barren shorelines would be created, depending on the duration of inundation. These changes all have impacts on mammals, birds, reptiles, amphibians, and invertebrates.

The study area includes many different habitat types. The grasslands, shrubland, open water, rocky areas, landscaped/disturbed areas, and riparian areas in the area around Chatfield Reservoir provide habitat for a wide array of wildlife, although many habitats, especially in uplands, are of low quality, typically degraded by the presence and even dominance of non-native plant species (Table 4-9). Increasing the water level of Chatfield Reservoir, as in Alternative 3, would cause inundation of up to 587 acres of wildlife habitat (Table 4-13). The disturbance of this land would cause impacts to animal species known to reside in these areas.

Uplands (e.g., grasslands) comprise the largest amount of affected area. These areas typically provide foraging and nesting habitat for a variety of different wildlife including large mammals, small mammals, songbirds, reptiles, and invertebrates. Amphibians may also spend a portion of their life cycle in uplands, especially to forage. To submerge these lands, even intermittently, would greatly change or remove the vegetation and habitat. The area bounded by Chatfield State Park and west to the hogback has high quality habitat for mule deer and supports greater densities than the surrounding areas (NDIS 2008b). The loss of habitat could push mule deer into adjacent grasslands and shrublands and also possibly into landscaped residential areas. Due to loss of foraging habitat, the competition for food and cover would increase and potentially place stress on individuals. The impacts of lost habitat to mule deer and other terrestrial wildlife could be exacerbated by 10-, 50-, and 100-year flood events, although these events may not have lasting effects. Raptor species would also be affected by the loss of woodland and upland habitat. Tree nesting raptors would initially benefit from the increase in dead trees for roosting, but as trees decay over time, there would be fewer roosting sites overall. Many raptors prefer grasslands when hunting. As upland areas become flooded, these forage areas would be lost, thereby reducing the available grasslands for raptors to hunt. Osprey and bald eagles would likely benefit from increased foraging areas as new aquatic habitats are created by inundation.

Riparian areas would be affected under Alternative 3 as woodlands and shrublands along Plum Creek and the South Platte River are inundated (Table 4-14). Riparian areas provide food, water, cover, and nesting areas. They also provide corridors to enable organisms to move along river systems avoiding more exposed areas and serve as resting areas for migrating songbirds. Loss of riparian habitat would have many adverse ecological impacts including local impacts on populations of breeding and migratory songbirds, many of which are already in decline. Large mammal populations, such as deer and elk, rely on riparian habitat for cover and forage.

The proposed action alternative could result in loss of up to 43 acres of mature cottonwood habitat (which is a subset of cottonwood) and up to 211 acres of other tree cover due to repeated inundation (Tables 4-13 and 4-14). Large mammals would have fewer areas at Chatfield providing thick cover and woody foraging areas. Songbirds also rely on tree habitat for nesting and foraging during the nesting season and as resting and foraging areas during migration. This includes the 43 acres of mature cottonwood trees that are a special feature of Chatfield State Park. This area of mature cottonwood forest offers habitat for birds that is rather unique within the Denver Metro area and possibly along the South Platte River. Loss of this habitat for songbirds would cause long-term adverse impacts that are not easily mitigated. Beyond loss of currently mature cottonwoods, there would be loss of additional cottonwoods that would become mature in the next 50 years. Since the development of Chatfield Lake, there have been three heronries, none of which are active today. Herons may abandon their nests due to an increased presence of humans near nesting sites (EPA, 2010) or having water levels dropping too early in the season and leaving the tree bases out of the water. The proposed addition of water into the reservoir could create a more secluded area of trees/snags surrounded by water, which the herons and cormorants prefer. These species and related bird species could potentially benefit under Alternative 3 as the proposed inundation would likely create potential nesting habitat, provided some large trees below 5,444 feet msl are not removed prior to inundation (as discussed in the Tree Management Plan, Appendix Z). Remote locations such as the mouth of Plum Creek could become future nesting areas, especially if some trees below 5,444 feet msl are left standing. The shrub habitat, including riparian shrubs, as stated in Section 3.6, tends to provide cover for many mammal species, such as deer, elk, raccoons, and also many bird species. Although similar to tree habitat, shrubs provide a differing type of cover due to the multiple stems and lower height of the vegetation. Inundating these shrublands, even temporarily, would most likely kill the vegetation and force any wildlife into surrounding habitat and eliminate some nesting areas. Although inundation would likely kill most woody plants up to the 5,439 to 5,440 foot msl elevation (see Section 4.6), some of the trees and shrubs would eventually reestablish themselves at the new water line. This would take years or even decades and push wildlife to other areas.

An addition of water to the preexisting reservoir would affect many shorebird species and waterfowl. Ground nesting along shorelines by Canada geese, mallards, other waterfowl, and shorebirds currently occurs at the reservoir. Increases in water levels during the nesting season could inundate these nests. Changes to vegetation could remove protective cover important to some nesters. The amount, frequency, and timing of exposed shoreline supporting macroinvertebrates would also have a part in dictating whether shorebirds would be positively or negatively affected by the flooding actions. If exposed shoreline is available during the nesting season, then there would likely be a benefit to ground nesting shorebirds that use barren shorelines. Some adverse impacts on water birds may result due to changes in food availability; however, overall, ducks, geese, and other waterbirds would likely benefit under Alternative 3. Within newly created open water areas, inundated trees may provide temporary habitat for some bird species such as cavity nesters; however, many of these trees may be removed prior to flooding to increase boater safety, reducing this benefit to cavity nesters.

As indicated in Table 4-13, approximately 90 acres of shoreline would be inundated and transformed to aquatic habitat under Alternative 3. Shorebirds, waterfowl, reptiles, and some species of small mammals prefer shoreline habitat for nesting and foraging. High populations of invertebrates are also commonly found along shorelines and provide food for a variety of wildlife species. Flooding of 90 acres of shoreline may negatively impact wildlife species if it occurred during the nesting season, but would produce a net benefit for wildlife species that use shoreline habitat because the present shoreline would be replaced with the same or greater amounts of new shoreline associated with reallocation.

Rocky areas provide habitat for small mammals, amphibians, and invertebrates. Most rocky areas are found along the edge of the reservoir; they reduce erosion and scouring from wave action and have developed into niches for smaller wildlife species. A 12-foot rise in the current pool elevation would flood some rocky outcrops and have an adverse impact on these species; however, although the amount of rocky habitat potentially inundated was not calculated, it is thought to be minimal and habitats would be quickly reestablished at the new target pool levels. Inundating rocky areas of the reservoir would not have significant impacts on wildlife.

Significant adverse impacts on migratory birds downstream from Chatfield Reservoir would not occur under Alternative 3. Under Alternative 3, the South Platte River below Chatfield Reservoir would have minimal changes during base flow conditions and a small increase in flow during the late summer months (Figure 4-12). Figures 4-7 and 4-8 show negligible differences between Alternatives 1 and 2, 3, and 4 in winter flows at the Denver and Henderson gages on the South Platte River. Additionally, the additional discharge from various tributaries to the South Platte River through this section constitutes a large percentage of the total flow during the winter months. If flow regimes downstream are affected, limited negative impacts on water birds may result, primarily through decreased food availability and loafing areas.

Overall, Alternative 3 would have the largest adverse impact on a variety of wildlife species compared to Alternatives 1, 2 and 4. The overall impacts on migratory birds would be adverse given the variety of important habitats that would be inundated under Alternative 3 (Tables 4-13 and 4-14). Among terrestrial species, including neotropical migrants, the loss of palustrine wetlands and riparian communities through repeated inundation would cause the greatest adverse impacts. A significant area of mature woodlands would be impacted under the action alternatives, especially near the mouths of the South Platte River and Plum Creek. Inundated trees, if left standing, may provide temporary habitat for woodpeckers and other cavity nesters. Overall, terrestrial birds would be adversely impacted by Alternative 3. Mammals, reptiles, and amphibians would also lose habitat due to inundation (USFWS 2006).

4.8.4 Alternative 4—7,700 Acre-Foot Reallocation/NTGW/Downstream Gravel Pits

In addition to the reallocation, another 5,348 acre-feet would be obtained from NTGW and downstream gravel pits under Alternative 4. The potential effects on wildlife of converting downstream gravel pits to water storage and using NTGW are disclosed under Alternative 1 and 2, respectively. Fewer and/or smaller gravel pit reservoirs would be needed under Alternative 4 than under Alternative 1 or 2. Under Alternative 4, the maximum area of terrestrial habitat disturbed by the infrastructure for gravel pit storage is 6 acres.

Under this alternative, the infrastructure of the pool containing conservation storage would be changed to target 7,700 acre-feet of reallocated storage by allowing the water level to rise to as much as 5,437 feet. As shown in Table 4-2 and Figure 4-1, this higher water level would inundate an additional 215 acres of land adjacent to the reservoir at the target pool elevation. Under this alternative the Chatfield Reservoir level would fluctuate less than under Alternative 3, but more than under current conditions (Alternative 1).

Under Alternative 4 (7,700 acre-feet of reallocated storage), impacts on wildlife habitats would be similar to those under Alternative 3, except to a lesser extent (Table 4-13). The total acreage of wildlife habitat inundated under Alternative 4 is 406 acres (not including "Water") (Table 4-13). Only 72 acres of upland grassland would be affected by the flooding from the reservoir as opposed to the 222 acres that would be affected under Alternative 3. Mammals, birds, reptiles, invertebrates, and amphibians all use upland grassland habitat for foraging or nesting habitat and would be affected under this alternative, only to a lesser degree than under Alternative 3.

Because nearly all the shrublands, wetlands, and woody habitat are associated with riparian areas (Tables 4-13 and 4-14), they constitute about 256 acres of the riparian habitats that would be flooded at Chatfield Reservoir under Alternative 4. Riparian areas are arguably one of the most biologically diverse habitats providing food, shelter, transportation corridors, nesting sites, breeding sites, protection, and water. Most wildlife species spend at least some part of their life cycle in riparian areas. Songbirds, mammals such as deer and elk, raptors, shorebirds, reptiles, amphibians, and invertebrates are all likely to lose some important habitat. Only 16 acres of mature cottonwood habitat would be inundated under Alternative 4, compared to a total of 43 acres under Alternative 3. Approximately 162 acres of woodlands other than mature cottonwoods would be inundated, and approximately 35 acres of shrublands would be inundated under this alternative. Wetlands inundated at Chatfield Reservoir under this alternative total approximately 43 acres. Table 4-14 divides these habitat areas into the South Platte River and the Plum Creek drainages.

Open water areas would increase by less than an acre under Alternative 4. Any increase would benefit waterfowl by increasing loafing and foraging areas. Any increase also would benefit bald eagles and osprey by expanding their hunting and foraging area.

As indicated in Table 4-13, approximately 78 acres of shoreline at Chatfield Reservoir would be inundated and transformed to aquatic habitat under Alternative 4. Shorebirds, waterfowl, reptiles, and some species of small mammals prefer shoreline habitat for nesting and foraging. High populations of invertebrates are also commonly found along shorelines and provide food for a variety of wildlife species. Inundation of 78 acres of shoreline may negatively impact wildlife species if it occurs during the nesting season, but it would produce a net benefit for wildlife species that use shoreline habitat because the present shoreline would be replaced with the same or greater amounts of new shoreline associated with reallocation, and thus it is not considered a loss of habitat. Under Alternative 4 the total acres of wildlife habitat inundated, not including shoreline, is 328 acres.

In addition, approximately 30 acres of grasslands would be permanently impacted by the footprints of relocated recreational facilities.

An additional 2.54 acres of wildlife habitat would be impacted by the relocation of the recreation trail at the Plum Creek day use area. This includes the following habitat types: 0.19 acres of mature cottonwood, 0.20 acres of shrub, 1.97 acres of upland, and 0.18 acres of wetland/non-woody habitat.

Significant adverse impacts on migratory birds downstream from Chatfield Reservoir would be unlikely under Alternative 4. Under Alternative 4, the South Platte River below the Chatfield Reservoir would have minimal changes during base flow conditions and a small increase in flow during the late summer months, and both these changes in flow are smaller than those under Alternative 3 (Figure 4-13). Alternative 4 could potentially have a slightly positive effect on waterbirds along this reach of the South Platte River.

Overall, Alternative 4 would adversely impact a variety of wildlife species by inundating a variety of wildlife habitats. Compared to Alternative 3, the area inundated would be less (Table 4-13). However, as is true with Alternative 3, these acres of inundation include habitats shared by multiple resources. Some habitats may experience gains at new elevations as is explained in the discussion of Alternative 3 above. Compared to Alternative 1, the effects on wildlife within the study area would be greater under Alternative 4.

4.8.5 Reduction and Mitigation of Potential Impacts

Prior to the implementation of an alternative, actions to reduce the level of impacts will be considered. These may include changes to the operations of the reservoir (e.g., holding water at a certain elevation at a specific time of year), or by actively managing the drawdown zone created by fluctuating water levels. For example, habitat losses along the shoreline near the new target pool elevation would be reduced through adaptive management measures including changing amounts and timing of release flows, plantings, seeding, and weed control.

The mitigation of potential impacts, as described in the CMP (Appendix K), is guided by the development of an Ecological Functions Approach, an accounting system use to assign and track ecological value of overlapping terrestrial wildlife habitats provided on lands surrounding Chatfield Reservoir. This assigning was done by a committee of local experts familiar with Chatfield Reservoir. Habitat attributes were derived and given values for specific resources: the Preble's meadow jumping mouse, overall wildlife habitat represented by a diverse avian community (birds), and wetlands. Mapped habitats for each of the three specific resources were incorporated to total across the functional values in order to provide an index of specific resource habitats. These indexes were then combined to represent the ecological function values for every acre of land that could be potentially lost to inundation. This approach provides a means to assess the value of what habitat values were lost and of potential mitigation areas. Finally, by tracking the functional values lost due to inundation, whether from Alternative 3 or 4, mitigation will be sure to account not only for the acres of habitat lost but their associated ecological function. Adaptive management by an established group would facilitate discussion of minimizing impacts by operation strategies once reallocation begins. Mitigation is considered in detail in the CMP (Appendix K).

Habitat lost due to the rise in the target pool elevation would be mitigated in a combination of on-site and off-site mitigation activities. The CMP did not include open water bird habitat and shoreline bird habitat because these habitats are not considered lost as they will occur in similar or greater amounts with reallocation. Of the 377 EFUs of bird habitat impacted, 9 EFUs would be mitigated on-site and 368 EFUs would be mitigated off-site (Appendix K). Riparian habitats would be expanded on site as much as possible, and riparian habitats along Plum Creek and along the South Platte River would be preserved, enhanced, or both. In addition, in selecting mitigation sites, the CMP (Appendix K) places an emphasis on the added ecological value of the connectivity of parcels along riparian corridors. An acre of land for off-site mitigation would be credited with more EFUs if it provides a connection to other protected lands and occurs within specified areas near Chatfield State Park, thus there is an incentive to select mitigation sites with higher connectivity. All of these efforts would benefit wildlife species. Refer to the CMP (Appendix K) for further details. The Corps has conducted coordination and informal consultations with the USFWS regarding potential impacts to wildlife and their recommendations for mitigation, including a Planning Aid Report (February 2006) and progress letter (July 2010) (see Appendix X).

4.9 Endangered, Threatened, and Candidate Species, Species of Special Concern, and Sensitive Communities

The four proposed alternatives could have potential impacts on federally threatened and endangered (T&E) species or to state listed (threatened or endangered) species and species of special concern. Species of special concern include species tracked by the CDOW or the CNHP due to declining populations or observed risks to habitats. Collectively, these species, including federally protected, state protected, and species of concern, are referred to in this document as Threatened, Endangered, and Sensitive Species (TES). Specific issues include possible impacts of the alternatives on habitat by inundation of wetland, riparian, and upland areas currently used by TES species. Additionally, the relocation of recreational facilities and roads and construction of new surface storage facilities and associated infrastructure may impact TES species and their habitats. Table 4-15 lists federal and state threatened, endangered, and candidate species and species of special concern with potential to occur or be affected by the Chatfield Reservoir storage reallocation project. Consultation with USFWS on the recommended alternative is required under Section 7 of the ESA. In compliance with the ESA, a Biological Assessment (BA) was prepared, for submittal to USFWS, to address potential effects to T&E species, and their designated critical habitat, from construction, operation, and maintenance of the recommended alternative. The BA is found in Appendix V.

Table 4-15
Federal and State Threatened, Endangered, and Candidate Species and Species of Special Concern with Potential to Occur or be Affected by the Chatfield Reservoir Storage Reallocation Project

Common Name	Scientific Name	Status	
		Federal	State
Mammals			
Black-footed ferret	*Mustela nigripes*	E	E
Black-tailed prairie dog	*Cynomys ludovicianus*	-	SC
Canada lynx	*Lynx canadensis*	T	E
Preble's meadow jumping mouse	*Zapus hudsonius preblei*	T	T
Townsend's big-eared bat *(pale* ssp.)	*Corynorhinus townsendii pallescens*	-	SC
Birds			
American peregrine falcon	*Falco peregrinus anatum*	-	SC
Bald eagle	*Haliaeetus leucocephalus*	-	T
Golden eagle	*Aquila chrysaetos*	FP	-
Ferruginous hawk	*Buteo regalis*	-	SC
Greater sandhill crane	*Grus canadensis tabida*	-	SC
Interior least tern[1]	*Sterna antillarum athalossos*	E	E
Long-billed curlew	*Numenius americanus*	-	SC

Table 4-15
Federal and State Threatened, Endangered, and Candidate Species and Species of Special Concern with Potential to Occur or be Affected by the Chatfield Reservoir Storage Reallocation Project

Common Name	Scientific Name	Status	
Mexican spotted owl	*Strix occidentalis lucida*	T	T
Mountain plover	*Charadrius montana*	-	SC
Piping plover[1]	*C. melodius circumcenctus*	T	T
Plains sharp-tailed grouse[2]	*Tympanuchus phasianellus jamesii*	-	E
Western burrowing owl	*Athene cunicularia*	-	T
Western snowy plover	*Charadrius alexandrinus*	-	SC
White pelican	*Pelicanus erythrorhynchos*	-	SC
Whooping crane[1]	*Grus americana*	E	E
Amphibians			
Northern leopard frog	*Rana pipiens*	-	SC
Fish			
Iowa darter	*Etheostoma exile*	-	SC
Northern redbelly dace	*Phoxinus eos*		SE
Common shiner	*Luxilus cornutus*		ST
Greenback cutthroat trout	*Oncorhynchus clarki stomias*	T	T
Pallid sturgeon[1, 3]	*Scaphirhynchus albus*	E	-
Insects			
Pawnee montane skipper	*Hesperia leonardus montana*	T	CNHP
Moss' elfin butterfly	*Callophrys mossii schryveri*	-	CNHP
Plants			
American currant	*Ribes americanum*	-	CNHP
Colorado butterfly plant	*Guara neomexicana coloradensis*	T	-
Forktip three-awn	*Aristida basiramea*	-	CNHP
Ute ladies'-tresses orchid	*Spiranthes diluvialis*	T	-

Key: E = Endangered (state or federal), T = Threatened (state or federal), C = Candidate for Listing (federal), FP = Federally Protected Species (federal), SC = Special Concern (state)

1 Water quality or depletions may affect the species and critical habitat in downstream reaches in other states.

2 This species is not known to occur in El Paso County but occurs in adjacent Douglas County.

3 This species is not known to occur in Colorado.

4.9.1 Alternative 1—No Action

Under Alternative 1, reservoir levels and operations at Chatfield Reservoir would remain unchanged (Table 4-2 and Figure 4-1). The target pool elevation would remain at 5,432 feet msl. Impacts on TES species at Chatfield Reservoir would not occur. Water depletions at Penley Reservoir and downstream gravel pits would equal those from the Chatfield Reservoir storage reallocation project and therefore would affect Platte River T&E species. Platte River T&E species include the federally protected whooping crane (*Grus americana*), the piping plover (*Charadrius melodus*), the interior least tern (*Sterna antillarum*), and the pallid sturgeon (*Scaphirhynchus albus*).

Under the No Action Alternative, the construction and filling of Penley Reservoir and the associated pipelines could result in impacts on several T&E species. Federally protected wildlife species known to occur within the vicinity are the threatened Preble's meadow jumping mouse (Preble's mouse) and the federally protected bald and golden eagles. While no longer listed as threatened species under the ESA, bald and golden eagles are still protected under the Bald and Golden Eagle Protection Act and the Migratory Bird Treaty Act. Bald and Golden Eagle nest sites are now protected under the definition of "disturb" under the Bald and Golden Eagle Protection Act (50 CFR 22.3). According to the Act, disturb means "to agitate or bother a bald or golden eagle to a degree that causes, or is likely to cause, based on the best scientific information available; 1) injury to an eagle, 2) a decrease in its productivity, by substantially interfering with normal breeding, feeding, or sheltering behavior; or 3) nest abandonment, by substantially interfering with normal breeding, feeding, or sheltering behavior." CDOW has established the following seasonal restriction and nest site buffer guidelines for bald and golden eagles: 1) no surface occupancy beyond that which historically occurred in the area, within ¼-mile radius of active nests; and 2) seasonal restriction to human encroachment within ½-mile radius of active nests from December 15 through July 15.

Habitat loss to Preble's meadow jumping mouse could result from reservoir construction and subsequent water use along Indian Creek near Penley Reservoir. Populations may be affected directly though habitat loss, or indirectly by water diversion that would decrease the quality of habitat. Pipeline construction may impact Preble's mouse habitat unless the pipeline is routed underneath habitat areas. If directional drilling under habitat occurs, adverse impacts from pipelines would be minimal. Bald eagles may benefit from Penley Reservoir, particularly if it supports fish populations and is eventually surrounded by large trees for nesting and roosting. Bald and golden eagles nesting in the vicinity of Penley Reservoir may be affected by a loss of foraging areas and nesting could be disturbed by the initial reservoir or 48-inch pipeline construction if construction areas fall within ½ mile from an active eagle nest.

There could be a loss of habitat for plains sharp-tailed grouse if it occurs in the area of Penley Reservoir. Some of the last remaining habitat within Douglas County is found in the vicinity of Penley Reservoir. The Colorado butterfly plant and Ute ladies'-tresses orchid, both federally listed threatened plant species, occur in riparian habitats along streams. If these plants occur at the proposed Penley Reservoir, a loss of habitat for these plant species could result from construction activities.

Fish populations including the common shiner, Iowa darter, and the northern redbellied dace may be affected by the proposed Penley Reservoir construction or the water diversion that the project creates.

Construction of buried pipelines for the proposed Penley Reservoir would result in temporary adverse impacts on habitat. The areas disturbed during construction would be revegetated to restore native habitats.

Development of gravel pits into storage structures would not likely impact TES species since these areas are already heavily disturbed from the extraction of the gravel. However, infrastructure for the gravel pits, such as pipelines, could cause additional habitat disturbance that could affect TES species if they occur in the area. The downstream gravel pits are located in close proximity to the South Platte River and contain a variety of wetland habitats. TES species that potentially occur in these areas are Preble's meadow jumping mouse, bald eagle, Ute ladies'-tresses, and Colorado butterfly plant. Inundation of these gravel pits could also increase habitat for these species, particularly it wetlands are created and shorelines are vegetated with native plant species.

4.9.2 Alternative 2—NTGW/Downstream Gravel Pits

Under Alternative 2, reservoir levels and operations at Chatfield Reservoir would remain unchanged as in Alternative 1. Impacts on Platte River T&E species would not occur. Impacts on TES species for the gravel pits would also be the same as under Alternative 1, along with impacts from the construction of associated pipelines, canals, and ditches. However, impacts on TES species in the Penley Reservoir area would not occur because water would be obtained from NTGW.

4.9.3 Alternative 3—20,600 Acre-Foot Reallocation

Under this alternative, the infrastructure of the conservation pool would be changed to target 20,600 acre-feet of reallocated storage by allowing the water level to rise to an elevation of 5,444 feet msl, up to a 12 foot increase in pool elevation. Based on elevation contours generated using field survey data of the area immediately surrounding the reservoir, this increased water level would inundate additional acres of land area adjacent to the reservoir as shown in Table 4-2 and Figure 4-1. Under Alternative 3, approximately 676 acres of wildlife habitat would be inundated at a water level of 5,444 feet msl. Tables 4-13 and 4-14 present the estimated number of acres inundated by habitat type and by drainage. It is important to understand that the total acres potentially inundated (676 acres) include overlapping habitats for multiple terrestrial resources, including habitat for birds, habitat for the Preble's mouse, and wetlands.

To better understand the inundation process and the associated impacts on TES species from changing the current target pool elevation of 5,432 feet msl by 12 feet to 5,444 feet msl, several parameters and actions surrounding the reallocation need to be explained. These include:

1. Actions to prepare the project area before inundation occurs—tree removal and relocation of road and recreation facilities
2. Estimated pool levels during average years during the growing season, both seasonally and from year to year including range of variability
3. Estimated pool levels during flood years that may raise levels above 5,444 feet msl
4. Downstream flow changes
5. Upstream flow changes

Using the POR flow and pool elevation data, these parameters and actions were analyzed and estimated. The modeling using POR data assumes that conditions of the past can predict conditions in the future. Modeling does not take into account climate change, which may result in more floods and more or longer periods of drought that cannot be accurately predicted at this time (Ray et al., 2008). In addition, the inflows during the entire POR tend to be greater on average than those expected during future conditions for all alternatives. This results in a greater probability of adequate mitigation for all types of inundation-related environmental impacts. The analyses in this section were conducted to understand the potential adverse impacts on TES species.

Adverse impacts under Alternative 3 are substantial, converting hundreds of acres of terrestrial habitats to aquatic or semi-aquatic habitats. It likely would benefit reservoir fisheries, but would negatively impact terrestrial wildlife species by reducing the overall acreage of wildlife habitat within the study area by reducing the available forage, protective cover, breeding sites, and nesting sites. This would occur as a result of the inundation of upland, riparian, or wetland vegetation that kills or transforms the present vegetation and corresponding wildlife habitat. Under Alternative 3, the Tree Management Plan (Appendix Z) calls for removing the majority of trees below 5,439 feet msl prior to raising the pool elevation. Selected trees would be left in place to provide wildlife habitat, or felled and anchored to provide habitat for fish and other aquatic organisms. Visitor and dam safety will take priority in determining where trees can be retained and anchored. An adaptive management approach would be used to monitor trees that are partially inundated to determine if additional trees need to be removed to ensure visitor and dam safety.

The relocation of roads and recreation facilities in the park would impact riparian, wetland, and upland habitats (see Section 4.17 and Appendix M). The adverse impacts would include direct loss of habitat used by TES species, fragmentation of habitat, increase of human/wildlife interactions, and increased weed invasion. For example, the relocation of the Kingfisher Parking lot could impact Preble's meadow jumping mouse upland habitat. Plum Creek trail head and parking area relocation would also impact Preble's mouse habitat and would require mitigation.

The average pool level on an annual basis would be subject to seasonal fluctuations of up to 21 feet, although annual fluctuations of 6 to 7 feet would be typical (Figure 4-18). In terms of impacts on TES species it is useful to look at fluctuations during the growing season and also useful to look at fluctuations when hibernators are active or dormant and when migratory animals are present or absent. The vegetation growing season corresponds roughly to beginning at week 17 and ending at week 41 (i.e., April 25 to October 11) and corresponds to a growing season of approximately 170 days (see Section 4.6 for details). During an average year, as modeled using POR data, pool levels would begin to increase prior to the onset of the growing season until reaching the peak during weeks 19 or 20, soon after the growing season starts. Then pool levels would recede modestly (2 to 3 feet) for a major portion of the growing season, then level off toward the end of the growing season and for the remainder of the year (Figure 4-17). Within the growing season, the POR data predict that the pool level during an average year would approximate 5,440 feet msl with fluctuations equal to ±2 feet (Figure 4-15). See Figures 4-14, 4-15, and 4-16 for yearly range with quartiles during the growing season for all years in the POR for Alternatives 1 and 2, 3, and 4, respectively. Pool levels during the majority of the growing season may also be influenced by reservoir management. During the recreation season (May 1 through September 30), pool level variations are currently restricted and restrictions may continue under Alternative 3 (see Section 4.17 for details). This would aid in maintaining pool levels during the majority of the growing season and reservoir management options are being discussed. Outside of the growing season, pool levels would continue to decrease during average years to elevations approximating 5,436 feet msl in a typical year (Figure 4-17). The modeling of average pool levels reveals that the target pool elevation of 5,444 feet msl may not be attained in a typical year. Therefore, a portion of the habitat acres listed in Tables 4-13 and 4-14 would typically not be inundated, or at least inundated for only short periods of time. Under Alternative 3, the Tree Management Plan (Appendix Z) calls for removing the majority of trees below 5,439 feet msl prior to raising the pool elevation. Vegetation between 5,439 and 5,444 feet msl would be inundated less frequently than the vegetation below 5,439 feet msl, and vegetation in this zone would not be removed prior to inundation. Vegetation in this zone would likely transform from terrestrial habitats to wetter environments instead of being completely eliminated. This could occur naturally through succession by decreasing or eliminating woody vegetation (trees and shrubs) and encouraging the growth of water-tolerant vegetation including wetland plants. As trees die and decay, they would provide habitat for raptors, herons, and cormorants as roosting areas, and provide habitat for cavity nesting birds. An adaptive management approach would be used to monitor trees in this zone to determine if additional trees need to be removed to ensure visitor and dam safety.

In Section 4.6, an estimate of vegetation gains and losses under future conditions for the inundation alternatives (i.e., Alternatives 3 and 4) is presented in Table 4-10 based on the current ratio of vegetation communities at specific elevational increments and is applied to the acreage of land that would have these same relative elevations (i.e., 0–2 feet, 2–4 feet, 4–6 feet) above the alternative targeted pool elevations (see Section 4.6). When comparing impacts to vegetation and therefore wildlife habitat as a result of inundation under Alternatives 3 and 4, it is important to realize that the losses may be somewhat offset by succession changes at the new OHWM. This also pertains to gains and losses of certain T&E species' habitat.

In terms of annual fluctuations outside of the typical conditions, what may happen to pool levels during flood years and drought years is needed to further understand impacts on TES species. Figure 4-18 presents POR modeling showing pool elevations per year over the POR for each alternative. Chatfield Reservoir's flood control function would result in periodic rises in water levels above the target pool elevation. Compared to Alternative 1, flooding occurs with the same frequency over the POR and of similar duration for each event. However, the pool elevations reached during the peak of an event is higher for Alternative 3, and therefore floods a larger area. Adverse impacts on vegetation would be minimal because the flooding, especially at the highest elevations, is for a short duration (several days). Modeling of maximum levels using the POR water levels illustrate that fluctuations in maximum water elevations from year to year can be more than the average fluctuations and on extremely rare occasions can change more than 20 feet for extended durations. For example, the largest flood recorded was in 1942 when water levels would equate to pool elevations exceeding 5,465 feet msl and flooding above 5,444 feet msl lasted for 40 days. This extreme flood event simply shows the variability of possible events and was during a time when few if any water management practices were being conducted within the watersheds. If a flood similar to 1942 occurs again, vegetation would be altered no matter what pool levels are allowed, but dams and diversions would greatly attenuate the impacts of such a flood. By reviewing Figure 4-18, flooding predicted over the POR at the new pool elevation of 5,444 feet msl would have occurred during 6 out of 59 years (10 percent). The duration of these flood events ranges widely from 30–40 days for the largest floods to 5–10 days for the more moderate floods. Currently, flooding along the South Platte River is dampened by the reservoirs upstream constructed in the 1970s. Although not quantified, the influence of the upstream reservoirs further lessens the probability of flooding along the South Platte River. Any diversions along Plum Creek likely dampen flooding on this drainage as well.

During drier years, pool levels can fall below the predicted average pool level of 5,440 feet msl and much lower than the target pool level of 5,444 feet msl. However, the frequency of these drier years occurs as frequently as flood years, about 10 percent of the time (Figure 4-18). Therefore, the majority of the time (roughly 80 percent on average) the pool levels are at an average level, about 5,440 feet msl during the growing season (and therefore during the wildlife breeding season and the Preble's mouse active season). Pool levels maintained at this elevation would help to stabilize vegetation above 5,444 feet msl and provide consistent habitat within a margin area of ± 2 feet at the average pool level of 5,440 feet msl.

Under this alternative, the Chatfield Reservoir level would fluctuate within the year more often and more widely than under the other alternatives. It is possible that the pool level could fluctuate over a distance of 21 feet under the worst conditions, likely an extended drought. The multipurpose pool level can recede to an elevation of 5,423 feet msl under Alternative 3, which is the same level as under the other alternatives including current conditions. However, under Alternative 3, the pool level can rise much more than under the other alternatives. Although the average peak fluctuation of 3 feet (Figure 4-12) during late spring or early summer is expected, over an entire year the pool level would have the potential to fluctuate 21 feet. Although the maximum pool elevation under this alternative is predicted to be attained only once every 3–4 years, the minimum levels could reach 5,423 feet msl (Figure 4-18). According to POR modeling, reservoir levels have the potential of being at this elevation during some part of the year 1 out of every 3 years. Under current conditions (Alternative 1), storage capacity is managed in an attempt not to exceed 9 feet of fluctuation annually.

Downstream impacts—Specifics of utilization of additional conservation storage capacity would determine the effect on flows below Chatfield Reservoir. Capture of up to 20,600 acre-feet appears to have the potential to decrease existing releases and alter timing of flows downstream. However, water stored and later released to downstream providers has potential to temporarily augment flows. Specific changes in flow are addressed in Section 4.5, Aquatic Life and Fisheries.

Upstream impacts—The potential for secondary impacts from additional conservation storage capacity to flows upstream of the study area on the South Platte River and Plum Creek is dependent on whether utilization of storage capacity at Chatfield Reservoir would change the current management of water in these drainages, both by providers of the reallocated storage at Chatfield Reservoir and potentially by other entities such as Denver Water. Available inflows to be stored in Chatfield by the new providers would be from both junior water rights and “free river” diversions, which would be exercised when there is available runoff for the taking ("free water"). The reallocation of storage at Chatfield simply enables waters to be stored in Chatfield that now flow downstream through and beyond the study area. Under the current understanding of how water providers would access and store water at Chatfield, there are no expected direct or indirect impacts on upstream areas outside of the study area.

Impacts on Federally Protected Species

Preble’s Meadow Jumping Mouse—The proposed increase of the target pool level to 5,444 feet msl would result in the potential inundation of approximately 454 acres of Preble’s mouse habitat, including approximately 155 acres of designated critical habitat along the South Platte River and Plum Creek. Tables 4-16 and 4-17 present the estimated acres of Preble’s habitat and critical habitat, respectively, that are inundated under each alternative. Acres are broken into high and low quality riparian habitat and upland habitat by drainage.

Table 4-16
Total Acres of Preble's Mouse Habitat Affected by Alternative and Drainage

	South Platte River Drainage			Plum Creek Drainage			Total		
	Alts 1 and 2	Alt 3	Alt 4	Alts 1 and 2	Alt 3	Alt 4	Alts 1 and 2	Alt 3	Alt 4
High Value Riparian Habitat	0.0	139.0	85.0	0.0	102.5	80.4	0.0	241.5	165.4
Low Value Riparian Habitat	0.0	42.5	35.7	0.0	35.3	16.6	0.0	77.8	52.3
Upland	0.0	95.2	33.9	0.0	39.3	18.3	0.0	134.5	52.2
Total Acres	**0.0**	**276.7**	**154.6**	**0.0**	**177.1**	**115.3**	**0.0**	**453.8**	**269.9**
Percentage of Occupied Range in Drainage Potentially Impacted	0.0	28.1%	15.7%	0.0	22.7%	14.8%	0.0	25.7%	15.3%

Notes: Acres of Total Occupied Range in Study Area = 1,764.1
Acres of Total Occupied Range in Plum Creek Portion of Study Area = 779.4
Acres of Total Occupied Range in South Platte River Portion of Study Area = 984.7

Table 4-17
Total Acres of Preble's Mouse Critical Habitat Affected by Alternative and Drainage

	South Platte River Drainage			Plum Creek Drainage			Total		
	Alts 1 and 2	Alt 3	Alt 4	Alts 1 and 2	Alt 3	Alt 4	Alts 1 and 2	Alt 3	Alt 4
High Value Riparian Habitat	0.0	79.1	40.4	0.0	44.6	30.6	0.0	123.7	71.0
Low Value Riparian Habitat	0.0	0.2	0.2	0.0	17.9	9.2	0.0	18.1	9.4
Upland	0.0	0.7	0.1	0.0	12.7	7.1	0.0	13.4	7.2
Total Acres	**0.0**	**80.0**	**40.7**	**0.0**	**75.2**	**46.9**	**0.0**	**155.2**	**87.6**

The entire Upper South Platte River critical habitat unit (CHU) extends from Chatfield Reservoir to Deckers many miles upstream of Chatfield Reservoir and is broken into several portions of habitat along the river and its tributaries and are designated as subunits of critical habitat [Upper South Platte critical habitat unit (SP13) (FR68(120)37276-37332)]. The Upper South Platte critical habitat unit contains approximately 43.8 miles of river and streams. Federal land along the Upper South Platte River within the USACE Chatfield property is designated as one subunit within the Upper South Platte critical habitat unit; the subunit totals 297.3 acres of critical habitat. Alternative 3 would inundate approximately 80.0 acres of Preble's mouse critical habitat within the Chatfield subunit, including 79.1 acres of high value riparian habitat, 0.2 acres of low value riparian habitat, and 0.7 acres of upland habitat (Table 4-17). Therefore, approximately 27 percent of the subunit would be inundated under this alternative. The increased storage proposed under Alternative 3 would affect the Preble's mouse in two ways, directly as water rises and indirectly through the alteration of existing habitat. Initial and subsequent rise in water to the target pool level could, depending on the season and rate of rise, drown hibernating adults or young in maternal nests, or displace individuals as water rises. Preble's mice swim well (Schorr 2001) and it seems unlikely that active adults or self-sufficient young would be drowned. It should be noted that the current increases in water level associated with flooding within the study area have similar direct impacts on Preble's mice. In addition to direct mortality, inundation of Preble's habitat could cause secondary mortality from displacement, reduced population, and increased vulnerability based on a smaller population. Current population densities within the study area are unknown at this time, so it is difficult to determine the number of individuals that may be affected by this alternative.

The West Plum Creek critical habitat unit extends upstream from Chatfield Reservoir to include approximately 90 miles of streams in the Plum Creek Watershed (75 Fed. Reg. 78430 (December 15, 2010)). The Proposed Action would inundate approximately 75.2 acres of Preble's critical habitat along 2.8 stream miles in the Plum Creek arm of Chatfield Reservoir, including 44.6 acres of high value riparian habitat, 17.9 acres of low value riparian habitat, and 12.7 acres of upland habitat (Table 4-17).

Preble's mouse habitat would be affected by direct inundation and by transformation as the new pool levels are established. The inundated acres shown in Tables 4-16 and 4-17 assume constant inundation at the target pool elevation, and therefore an estimate of maximum impacts. However, this is not how inundation is likely to occur. As discussed earlier in this section, it is more likely that during a typical year, the water level would be at 5,440 ±2 feet msl. Vegetation below this level would likely be completely lost but a ring of vegetation above this elevation may be transformed. This may result in a loss of woody vegetation or an increase in understory cover as more water becomes available closer to the surface. Additionally, at the new water level, a zone just below the area of habitat transformation may still support vegetation but due to intermittent inundation, the vegetation would be composed of annual plants including good seed producers and weedy species. This also, depending on reservoir management, may positively or negatively impact the Preble's mouse.

An additional 2.54 acres of Preble's habitat would be impacted by the relocation of the recreation trail at the Plum Creek day use area. This includes the following habitat types: 0.66 acres of high value riparian habitat and 1.88 acres of low value riparian habitat. Approximately 19 percent (0.48 acres) of this area is designated critical habitat in the West Plum Creek CHU.

Upstream or downstream conditions related to this alternative appear not to affect the Preble's mouse. Upstream conditions are thought to remain similar to baseline conditions as discussed previously in this section. Downstream conditions may change slightly but no Preble's mouse populations are known to exist downstream of Chatfield Reservoir to the Adams-Weld county line.

In conclusion, a change in the target pool elevation to 5,444 feet msl would adversely affect the Preble's mouse habitat within the study area and affect critical habitat along the South Platte River.

Black-Footed Ferret—The black-footed ferret has likely been extirpated from the eastern half of Colorado and is not currently found within the study area. A change in the target pool elevation to 5,444 feet msl would have no effect on the black-footed ferret.

Canada Lynx—The Canada lynx has been reintroduced to Colorado in recent years as discussed in Chapter 3. However, no habitat for the lynx is found in the study area. Therefore, a change in the target pool elevation to 5,444 feet msl would have no effect on the Canada lynx.

Bald Eagle—The bald eagle is no longer protected under the ESA, but remains federally protected under the Bald and Golden Eagle Protection Act and the Migratory Bird Treaty Act (FR72(130)37346-37372 July 9, 2007). Bald and golden eagle nest sites are now protected under the definition of "disturb" under the Bald and Golden Eagle Protection Act (50 CFR 22.3). According to the Act, disturb means "to agitate or bother a bald or golden eagle to a degree that causes, or is likely to cause, based on the best scientific information available; 1) injury to an eagle, 2) a decrease in its productivity, by substantially interfering with normal breeding, feeding, or sheltering behavior; or 3) nest abandonment, by substantially interfering with normal breeding, feeding, or sheltering behavior." CDOW has established the following seasonal restriction and nest site buffer guidelines for bald and golden eagles: 1) no surface occupancy beyond that which historically occurred in the area, within ¼-mile radius of active nests; and 2) seasonal restriction to human encroachment within ½-mile radius of active nests from December 15 through July 15.

If mature trees that die in inundated areas along the shorelines are allowed to remain standing this would reduce the loss of bald eagle perch sites in the short term since bald eagles use both live and dead trees. Ultimately, however, as trees decay, those perches would decrease below pre-inundation numbers and would eventually adversely impact the eagles by providing fewer perches for hunting and roosting. This is a temporary adverse impact and lost trees would eventually be replaced by live trees along the new pool elevation. As described in the Tree Management Plan (Appendix Z), an adaptive management approach would be used to monitor trees below 5,444 feet msl that are not removed prior to inundation to determine if additional trees need to be removed to ensure visitor and dam safety. The Tree Management Plan attempts to minimize the amount of large trees removed by minimizing the number of trees that are removed above elevation 5,439 feet msl due to their higher likelihood of survival. In addition, the CMP identifies onsite mitigation to be the number one priority for mitigating ecological resources, thus in completing onsite mitigation, replacement of lost riparian areas will occur. Furthermore, the water providers have agreed to work with the State to provide for the reforestation of certain areas in response to State Parks concerns about preserving park aesthetics and providing shade for visitors. These additional plantings are being considered outside of the tentatively Recommended Plan.

Bald eagle prey, primarily fish within and surrounding the study area, would benefit from the increased water levels proposed in Alternative 3. Section 4.5, Aquatic Life and Fisheries, provides additional details. Waterfowl would also benefit from more open water and additional acres of shoreline under Alternative 3. Because its principal prey groups (fish and waterfowl) would benefit, the bald eagle would also benefit from increased pool elevations. In conclusion, the bald eagle may be affected by Alternative 3, but this effect would likely be beneficial.

Golden eagles have been observed in the vicinity of the Lockheed Martin property west of the study area. In addition, peregrine falcons historically nested up Waterton Canyon and prairie falcons are known to nest along the hogback. However, no active nests for golden eagles, peregrine falcons, or prairie falcons are known within a ½ mile of the study area. Therefore, impacts to these species are considered minimal or non-existent.

Mexican Spotted Owl—The Mexican spotted owl is found in mature coniferous forest typically in steep mountainous canyons such as those in the Pike-San Isabel National Forest and other forests in the southwest. No habitat for the Mexican spotted owl is found within the study area and upstream portions of the South Platte River on National Forest land would not be affected by increased pool elevations at Chatfield. Therefore, there would be no adverse impact on the Mexican spotted owl.

Pawnee Montane Skipper—Pawnee montane skippers inhabit dry, open Ponderosa pine woodlands with sparse understory at 6,000 to 7,500 feet msl. Blue grama grass (*Bouteloua gracilis*), the larval food plant and prairie gay feather, the primary nectar plant, are two necessary components of the ground cover. The skipper occurs only on the Pikes Peak Granite Formation in the South Platte River drainage system in Colorado involving portions of Jefferson, Douglas, Teller, and Park counties. The total known habitat within the range is estimated to be 37.9 square miles (98.2 square kilometers). However, given the elevation restrictions of its habitat, the skipper does not occur in the study area and therefore would not be affected by a change in the pool elevation at Chatfield Reservoir as proposed under Alternative 3. Therefore, there would be no adverse impact on the Pawnee montane skipper.

Greenback Cutthroat Trout—The greenback cutthroat trout is found only in a few streams and lakes within the headwaters of the South Platte River and Arkansas River systems. Habitat requirements include clear, cold streams and lakes and clean gravel in flowing streams during spring for spawning. No habitat for the greenback cutthroat trout is found within the study area. Therefore, there would be no adverse impact on the greenback cutthroat trout.

Ute Ladies' Tresses Orchid—Rare plant surveys for the Ute ladies' tresses orchid were conducted at Chatfield State Park in 1998, 2004, and 2005. No orchid plants were found after intensive surveys during the correct time of year when other nearby orchid populations were in bloom. No Ute ladies' tresses orchids are known from the study area. Therefore, the raising of the pool elevation at Chatfield Reservoir as described under Alternative 3 would have no adverse impact on the Ute ladies' tresses orchid.

Colorado Butterfly Plant—Rare plant surveys for the Colorado butterfly plant were conducted at Chatfield State Park in 2004 and 2005. No Colorado butterfly plants were found after intensive surveys during the proper time of year. No Colorado butterfly plants are known from the study area. Therefore, the raising of the pool elevation at Chatfield Reservoir as described under Alternative 3 would have no adverse impact on the Colorado butterfly plant.

Central Platte River Species, Nebraska—Platte River species include the whooping crane (and designated critical habitat in Nebraska), the pallid sturgeon, the piping plover (northern Great Plains population), the interior least tern, and the western prairie fringed orchid. These species may be affected downstream in Nebraska by depletions resulting from the proposed Chatfield Reservoir storage reallocation project. Because these species are federally protected, the federal action agency project proponents must seek consultation with the USFWS to ensure that no federally protected species under the ESA will be jeopardized or have their critical habitat adversely affected by the actions of the project. The whooping crane, interior least tern, and piping plover, are Platte River T&E species that occur in Nebraska and also have the potential to occur in the Chatfield Reservoir study area.

The Platte River Recovery Implementation Program (PRRIP) was established to protect and recover the Central Platte River target species and to offset the depletive effects of existing and new water related activities in Colorado and the other basin states. In Colorado, individual water projects such as the Chatfield Reservoir reallocation project may rely on the PRRIP for ESA compliance purposes through the participants' membership and financial participation in the South Platte Water Related Activities Program, Inc. (SPWRAP) a water providers' organization. The SPWRAP assists in fulfilling Colorado's programmatic contributions to the PRRIP. The participants of the Chatfield project are all members of the SPWRAP (see Appendix V for certificates of membership).

Under Alternative 3, the South Platte River below Chatfield Reservoir would have minimal changes during base flow conditions and a small increase in flow during the late summer months (Figure 4-12).The projected change during winter base flow conditions is 12 cfs less than under current conditions (Alternative 1). By agreeing to participate in the PRRIP, the participants of the

Chatfield Reservoir storage reallocation project, which is subject to Section 7 ESA consultation, can ensure compliance relative to the Platte River target species, can avoid the potential for prohibited "take" of these species under ESA Section 9, and can take advantage of predefined procedures and expectations going into the ESA consultation process. The PRRIP benefits Platte River species by creating offsetting measures, including measures that will substantially reduce shortages to target flows in the central Platte River, and that will obtain and restore habitat for the target species. Therefore, net impacts to these species are not expected to be significant as a result of depletions from the proposed Chatfield Reservoir reallocation project. The potential effects of project depletions on the Platte River species are addressed in the streamlined PRRIP Biological Assessment that will be submitted by the Corps (the federal action agency) to the USFWS and will be covered through a "tiered" Biological Opinion confirming the project is in compliance with the ESA based on implementation of the PRRIP. The PRRIP BA is included in the FR/EIS as Attachment 1 of the BA (Appendix V).

Two of the Platte River species can also occur in Colorado, the piping plover and the interior least tern. These two species have potential to occur in the study area during migration as they both are attracted to gravelly or sandy shorelines. Based on 10 years of observations at Chatfield Reservoir (1996 to 2006), each of these species was observed only once, the piping plover in September 2001 and the interior least tern in July 1998 (Kellner 2006) (see Appendix V for additional information). Increased exposure of shorelines that may potentially occur under Alternative 3 may be a benefit to migrating piping plovers or interior least terns.

Impacts on State Listed Species and Species of Concern

Black-tailed Prairie Dog and Associated Species—A small, isolated black-tailed prairie dog colony is found within the study area in close proximity to the radio-controlled airplane field at Chatfield State Park. This is an upland site and would not be inundated from the increase of the pool elevation as proposed in Alternative 3. Therefore, there would be no impacts on black-tailed prairie dogs.

Other species of concern are typically found in association with prairie dog colonies. Prairie dogs are considered a keystone species, meaning that they provide habitat to a variety of other animal species and enrich the environment they inhabit. These associated species include the western burrowing owl, the swift fox, the mountain plover, and the ferruginous hawk. Although these species are not totally dependent on prairie dog colonies, they typically are associated with them. Most often, these species are also associated with the shortgrass prairie of eastern Colorado and wide open spaces. Therefore, habitat for the swift fox or the mountain plover is not considered to exist within the study area and these species would not be affected by this alternative.

The western burrowing owl could be present during migration and during the breeding season. The only appropriate habitat would be the prairie dog colony described above. Because the prairie dog colony would not be affected by this alternative, the burrowing owls would also not be affected.

The ferruginous hawk, like the black-tailed prairie dog, the swift fox, and the mountain plover, is an eastern plains grassland species. But unlike the plover and fox, it may winter along Front Range rivers and streams and therefore may be found in the study area during migration and as a winter resident. Being a species dependent on open upland habitats, the ferruginous hawk is unlikely to be directly affected by increases to the pool elevation and marginal inundation of their preferred habitat. An indirect effect to upland habitat may be the relocation of roads and recreational facilities; however, the prairie dog colony is not identified as a location to relocate any recreational facilities. A loss of upland habitat in general, whether from inundation or relocation of recreational facilities would affect the ferruginous hawk winter habitat and potentially reduce hunting areas. Ferruginous hawks hunt over a wide area compared to the area that may be affected by inundation or relocation of facilities. Thus, the adverse impact on their hunting range would be relatively small.

Plains Sharp-tailed Grouse—The sharp-tailed grouse is found in very isolated locations in Douglas County but is not found within the study area. Therefore, the sharp-tailed grouse would not be affected by Alternative 3.

Townsend's Big Eared Bat—Townsend's big eared bat is a Colorado species of special concern and inhabits very specific habitats including caves and mine shafts that have the proper temperature for roosting and hibernating. No caves or mines are found within the study area and therefore, the Townsend's big eared bat would not be affected by this alternative.

White Pelican—The white pelican frequents Chatfield Reservoir in large groups of non-breeding summer residents. They would likely benefit, along with the bald eagle, because of an increase in fish resulting from the increase in pool elevation at Chatfield Reservoir proposed under Alternative 3. (See Section 4.5, Fisheries and Aquatic Life, for details of positive impacts on the Chatfield fishery.) In addition, more exposed shoreline habitat at a variety of water levels may increase loafing and roosting sites for pelicans. Therefore, the impacts of Alternative 3 on the white pelican would likely be positive.

American Peregrine Falcon—The American peregrine falcon is a species that has recovered from past population declines. Recent surveys across North America have indicated that populations are secure (USFWS 2003); however, it is still considered a species of special concern as its recovery has only happened recently. Peregrines may frequent the study area hunting their favorite prey, birds. Some bird habitats would be lost, such as riparian woodlands, as the pool elevations rise as proposed under Alternative 3, but other bird habitats, such as shoreline and open water habitats, would increase. Given that some habitat may actually increase, it is unlikely that the number of prey birds available to peregrines would decrease significantly enough to have an effect on peregrine falcon populations.

Greater Sandhill Crane—Greater sandhill cranes can be observed in the study area during migration. They may use the area around Chatfield Reservoir on a limited basis as a stopover site during migration. Therefore, it is unlikely that the impacts on upland and wetland habitat as projected by the implementation of Alternative 3 would have an effect on greater sandhill crane populations.

Northern Leopard Frog—Northern leopard frog habitat within areas affected by pool level increases would be at least temporarily lost. Greater variation in water levels may permanently affect wetland or shoreline habitat used by the frogs. Although new wetland areas would eventually establish and create new habitat, it is likely that there would be a period of time before these areas are established and frog habitat is available. Management of water levels during the growing season may lessen impacts to the northern leopard frog if water levels are held constant during the breading season and if the establishment of habitat at the new water levels is enhanced by recontouring land and vegetation plantings/seeding. Therefore, the northern leopard frog may be affected by Alternative 3.

Iowa Darter—The Iowa darter, a native fish species of concern, has been sampled in Chatfield Reservoir by the CDOW; however, only two individuals have been collected over an 8-year sampling period (CDOW 2006a). Iowa darters are more likely to be found in and associated with a limited number of streams in northeastern Colorado. Consistent with previously discussed impacts (see discussion in Section 4.5, Aquatic Life and Fisheries), it is anticipated that increased pool elevations for both Alternative 3 and Alternative 4 would enhance habitat conditions for this species in Chatfield Reservoir and would not adversely impact them.

Other Fish Species of Concern—The northern redbelly dace and the common shiner are present in the upper reaches of Plum Creek (as is the Iowa darter). Since these reaches are well upstream, only secondary impacts associated with flow alterations outside of the study area would be of concern.

Rare Plants—Two species of rare plants of concern, the American currant and the Forktip three-awn, are thought to potentially occur with the study area. Rare plant surveys for the Ute ladies'-tresses orchid and the Colorado butterfly plant were conducted at Chatfield State Park in 1998, 2004, and 2005. No American currant plants were observed during this survey work, which was conducted in much of the potential habitat for the American currant. Therefore it is unlikely that this rare plant species occurs within the study area and consequently it would not be affected by the activities associated with Alternative 3.

Forktip three-awn is an upland plant that inhabits recently disturbed sites such as old railroad grades or road right-of-ways with gravelly substrate. Such upland areas are not proposed to be inundated under Alternative 3; therefore the forktip three-awn would not be affected.

4.9.4 Alternative 4—7,700 Acre-Foot Reallocation/NTGW/Downstream Gravel Pits

In addition to the reallocation, another 5,348 acre-feet would be obtained from NTGW and downstream gravel pits under Alternative 4. The potential effects on sensitive wildlife from conversion of downstream gravel pits to water storage reservoirs and use of NTGW are disclosed under Alternatives 1 and 2, respectively. Fewer and/or smaller gravel pit reservoirs would be needed under Alternative 4 than under Alternative 1 or 2.

Under this alternative, the conservation pool would target 7,700 acre-feet of reallocated storage by allowing the water level to rise to 5,437 feet msl. As shown in Table 4-2 and Figure 4-1, this increased water level would inundate approximately 215 acres of land adjacent to the reservoir at the target pool elevation.

Under this alternative the Chatfield Reservoir level would fluctuate less than under Alternative 3. Additionally, less terrestrial habitat would be inundated.

Impacts on Federally Protected Species

Preble's Meadow Jumping Mouse—The proposed increase of the pool elevation to 5,437 feet msl would result in the potential inundation of approximately 270 acres of Preble's mouse habitat, including 87.6 acres of designated critical habitat along the South Platte River and Plum Creek. Tables 4-16 and 4-17 present the estimated acres of Preble's habitat and critical habitat, respectively, inundated under each alternative. Alternative 4 has much less adverse impact to Preble's critical habitat than Alternative 3 and would inundate approximately 87.6 acres of critical habitat, including approximately 40.7 acres in the Upper South Platte CHU and approximately 46.9 acres on Plum Creek in the West Plum Creek CHU. The 40.7 acres in the Upper South Platte CHU includes 40.4 acres of high value riparian habitat, 0.2 acres of low value riparian habitat, and 0.1 acres of upland habitat (Table 4-17). The 46.9 acres in the West Plum Creek CHU includes 30.6 acres of high value riparian habitat, 9.2 acres of low value riparian habitat, and 7.1 acres of upland habitat (Table 4-17).

As in Alternative 3, the reallocated storage proposed under Alternative 4 would affect the Preble's mouse in two ways, directly as water rises and indirectly through the alteration of existing habitat. Initial and subsequent rise in water to the target pool elevation could, depending on the season and rate of rise, drown hibernating adults or young in maternal nests, or displace individuals as water rises. Preble's mice swim well (Schorr 2001) and it seems unlikely that active adults or self-sufficient young would drown. It should be noted that the current increases in water level associated with flooding within the study area have similar direct adverse impacts on Preble's mice. Current population densities within the study area are unknown at this time so it is not possible to determine the number of individuals that may be affected by this alternative.

Preble's mouse habitat would be affected by direct inundation and by transformation as the new pool levels are established. The inundated acre values in Tables 4-16 and 4-17 assume constant inundation at the target pool elevation. However, as presented in Figure 4-17, it is more likely that during a typical year, the water level would be at 5,434 ±2 feet msl. Vegetation below this level would likely be completely lost but a ring of vegetation above this elevation may be transformed to a wetter form of vegetation. This may mean a loss of woody vegetation or an increase in understory cover as more water becomes available closer to the surface. Additionally, at the new water level, a zone just below the area of habitat transformation may still support vegetation but due to intermittent inundation, the vegetation would be composed of annual plants that include good seed producers and weedy species. This also, depending on reservoir water level management and weed control, may positively or adversely impact the Preble's mouse.

An additional 2.54 acres of Preble's habitat would be impacted by the relocation of the recreation trail at the Plum Creek day use area. This includes the following habitat types: 0.66 acres of high value riparian habitat and 1.88 acres of low value riparian habitat. Approximately 19 percent (0.48 acres) of this area is designated critical habitat in the West Plum Creek CHU.

As in Alternative 3, upstream or downstream conditions related to this alternative appear not to affect the Preble's mouse. Upstream conditions are thought to remain similar to baseline conditions as discussed previously in this section. Downstream conditions may change, but no Preble's mouse populations are known to exist downstream of Chatfield Reservoir to the Adams/Weld county line.

In conclusion, a change in the pool elevation at Chatfield Reservoir to 5,437 feet msl is likely to adversely affect the Preble's mouse within the study area and affect critical habitat along the South Platte River.

Bald Eagle—The bald eagle would likely benefit from a change in the pool elevation to 5,437 feet msl. As discussed in Alternative 3, the potential increase in the bald eagle's food supply (fish and waterfowl) would benefit the bald eagle.

Mature trees that did not survive in inundated areas could, if left standing, provide more available snags along shorelines and thus benefit bald eagles in the short term. Ultimately, however, as trees decay, those perches would decrease below pre-inundation numbers and would eventually adversely impact the eagles by providing fewer perches for hunting and roosting. This would be a temporary adverse impact because trees would eventually be replaced along the new target pool elevation.

*Other Federally Protected Specie*s—Other federally protected species including the black-footed ferret, Canada lynx, Mexican spotted owl, Pawnee montane skipper, greenback cutthroat trout, Ute ladies'-tresses orchid, and Colorado butterfly plant would not be affected by this alternative for similar reasons as discussed in the previous section for Alternative 3. These species do not exist or do not have habitat within the study area and do not exist in the areas that may be indirectly affected by the project.

Platte River Species—Platte River species include the whooping crane, the pallid sturgeon, the piping plover, and the interior least tern. These species may be affected by downstream changes in flow that Alternative 4 may cause. Because these species are federally protected, any federal project must seek consultation with the USFWS to ensure that no federally protected species under the ESA will be jeopardized or have their critical habitat adversely affected by the actions of the project.

The PRRIP (as discussed under Alternative 3 and in Appendix V, Attachment 1) provides streamlined procedures available to project proponents to seek ESA coverage under the PRRIP umbrella when the project actions may deplete the Platte River. Under Alternative 4, the South Platte River below Chatfield Reservoir would have minimal changes during base flow conditions and a small increase in flow during the late summer months (Figure 4-13). Managing the timing, duration, and amount of flow from the Chatfield Reservoir is an important tool in enhancing aquatic biota in the South Platte River. For example, a projected increase in flow during July would have a positive effect on aquatic biota downstream of the reservoir. The current cool- and warm-water species present experience stress during late summer months from increased water temperatures and decreased flow. Another critical aquatic stressor is base flow conditions during the winter months. The projected change during winter base flow conditions is only 11 cfs less than under Alternative 1. By participating in the PRRIP, projects resulting in Platte River depletions (which will affect, rather than "are not likely to affect", T&E species) can undergo streamlined Section 7 consultation to avoid a jeopardy opinion regarding the effect of the depletions. This means that if a project's depletions are relatively small, then they can participate in the program. By agreeing to be covered by the PRRIP, proponents of water-related projects subject to Section 7 ESA consultation can ensure compliance relative to the Platte River target species, can avoid the potential for prohibited "take" of these species under ESA Section 9, and can take advantage of pre-defined procedures and expectations going into the ESA consultation process. This is made possible by the offsetting measures being implemented during the first increment of the Program, including measures which will substantially reduce shortages to target flows in the central Platte River, and which will obtain and restore habitat for the target species. The potential effects of project depletions on the Platte River species are addressed in the streamlined PRRIP Biological Assessment that will be submitted by the Corps to the USFWS and will be covered through a "tiered" Biological Opinion confirming the project is in compliance with the ESA based on implementation of the PRRIP. The PRRIP BA is included in the FR/EIS as Attachment 1 of the BA (Appendix V).

Two of the Platte River species can also occur in Colorado, the piping plover and the interior least tern. These two species have potential to occur in the study area during migration as they both are attracted to gravelly or sandy shorelines. Based on 10 years of observations at Chatfield Reservoir (1996 to 2006), each of these species was observed only once, the piping plover in September 2001 and the interior least tern in July 1998 (Kellner 2006) (see Appendix V for additional information). Increased exposure of shorelines that potentially would occur under Alternative 4, albeit less than Alternative 3, may be a benefit to migrating piping plovers or interior least terns.

Impacts on State Listed Species and Species of Concern

Black-tailed Prairie Dog and Associated Species—A small, isolated black-tailed prairie dog colony is found within the study area in close proximity to the radio-controlled airplane field at Chatfield State Park. This is an upland site and would not be inundated from the increase of the pool elevation as proposed in Alternative 4. Therefore, there would be no impacts on black-tailed prairie dogs or species associated with prairie dog colonies including western burrowing owl, swift fox, mountain plover, and ferruginous hawk (for additional details see the discussion under Alternative 3).

American Peregrine Falcon—The American peregrine falcon is a species that has recovered from past population declines. Recent surveys across North America have indicated that populations are secure (USFWS 2003); however, it is still considered a species of special concern. Peregrines may frequent the study area hunting their favorite prey, birds. Some bird habitats such as riparian woodlands would be lost as the pool elevations rise as proposed under Alternative 4, but other bird habitats, such as shoreline and open water habitats, would increase. Given that some hunting habitat may actually increase, it is unlikely that the number of prey birds available to peregrines would decrease significantly enough to have an effect on peregrine falcon populations.

Greater Sandhill Crane—Greater sandhill cranes can be observed the study area during migration. They may use the area around Chatfield Reservoir on a limited basis as a stopover site during migration. Therefore, it is unlikely that the impacts on upland and wetland habitat as projected by the implementation of Alternative 4 would have an adverse impact on greater sandhill crane populations.

Northern Leopard Frog—Northern leopard frog habitat within areas affected by pool level increases would be at least temporarily lost. Greater variation in water levels may permanently affect wetland or shoreline habitat used by the frogs. Although new wetland areas would eventually establish and create new habitat, it is likely that there would be a period of time before these areas are established and frog habitat is available. Therefore, the northern leopard frog may be affected by Alternative 4, but less so than under Alternative 3.

Other State Species of Concern—As previously explained under Alternative 3, the following species would not be affected by Alternative 4: sharp-tailed grouse, Townsend's big eared bat, white pelican, Iowa darter, northern redbelly dace, common shiner, American currant, and forktip three-awn.

4.9.5 Reduction and Mitigation of Potential Impacts

Generally speaking, under each alternative impact to protected species by contractors during construction activities at federal projects would be avoided or minimized by specific contract provisions for avoiding and minimizing such impacts.

Prior to the implementation of an alternative, actions to reduce the level of impacts will be considered. These may include changes to the operations of the reservoir (e.g., holding water at a certain elevation at a specific time of year), or by actively managing the drawdown zone created by fluctuating water levels.

Habitats lost due to the rise in the target pool elevation would be mitigated in a combination of on-site and off-site mitigation activities. Riparian habitats would be expanded on site as much as possible, and riparian habitats along Plum Creek and along the South Platte River would be preserved, enhanced, or both. In addition, riparian wildlife corridors would be established that connect areas where Preble's mice exist in order to aid in movement among important sites in Douglas County (see the CMP, Appendix K). Of the 210 EFUs of Preble's non-critical habitat impacted, 43 EFUs would be mitigated on-site and 167 EFUs would be mitigated off-site. The 65 EFUs of critical habitat in the West Plum Creek CHU would all be mitigated within that unit, and likewise the critical habitat in the Upper South Platte CHU would all be mitigated within that unit. The mitigation of potential impacts is guided by the development of an Ecological Functions Approach, an accounting system use to assign and track the ecological values of the overlapping terrestrial wildlife habitats. This assigning was done by a committee of local experts familiar with Chatfield Reservoir. Habitat attributes were derived and given values for specific resources: the Preble's meadow jumping mouse, overall wildlife habitat represented by a diverse avian community (birds), and wetlands. Mapped habitats for each of the three specific resources were incorporated to total across the functional values in order to provide an index of specific resource habitats. These indices were then combined to represent the total ecological function values for every acre of land that could be potentially lost to inundation. The assessment of impacts is initially estimated using a conservative approach where it is assumed that the target elevation pool would be met and maintained and therefore inundate the maximum acreage.

This approach provides a means to track ecological values lost and those gained on future mitigation areas or by gains realized at or above the future OHWM. Once an alternative is implemented, actual impacts would be assessed "real-time" and be off-set by on-site and off-site mitigation. This accounting system will track how mitigation is progressing and if alterations to mitigation activities are needed. Finally, by tracking the functional values lost due to inundation, whether from Alternative 3 or 4, mitigation will be sure to account not only for the acres of habitat lost but their associated ecological function. Mitigation is considered in detail in the CMP (Appendix K).

Habitat losses along the shoreline near the new target pool elevation would be reduced through adaptive management measures including changing amounts and timing of release flows, plantings, seeding, and weed control. Adaptive management planning would involve an iterative process of cycling through several steps: problem assessment, design, implementation, monitoring, evaluation, adjustment, and continued cycling through earlier steps (Barnes 2009).

Specifically, management of water levels during the growing season may lessen impacts to the northern leopard frog if water levels are held constant during their breeding season and if the establishment of habitat at the new water levels is enhanced by recontouring land and vegetation plantings/seeding. Operational Management options are being considered in mitigation implementation. Adaptive management by manipulation of water levels beyond what is dictated by water providers' needs would lessen impacts to vegetation and hence a wide variety of wildlife species including TES species.

The removal of trees killed by inundation has the potential to affect many wildlife species by removing a potential environment currently not found within the study area. The increase of snags (standing dead trees) and downed trees could provide valuable habitat for raptors, cavity nesting birds, herons, and aquatic life. They could also benefit aquatic life including warm-water fisheries, macroinvertebrates, and amphibians, and could be used to offset impacts to terrestrial wildlife on the basis of ecological value and services. In addition, some of the removed trees could be scattered in Preble's habitat within the Park to enhance the habitat for Preble's. Woody debris has been found to be a component of Preble's mouse high use areas (Trainor et al. 2007). Trees to be retained for aquatic and wildlife habitat, or removed and used for woody debris would be reviewed by resource managers to ensure visitor and dam safety.

Reduction of winter flows, albeit minor, in the South Platte River and the Chatfield SFU could be offset by water providers providing needed flows when Denver Water exercises its senior rights and sweeps water from the river and the SFU. As the Chatfield SFU was originally considered mitigation for the reservoir project, the amount of water needed to adequately run the facility should be seriously considered to lessen impacts of reallocation.

All of these efforts would benefit wildlife species, including TES species. Impacts to ecological functions of wetlands, riparian habitat (and mature cottonwoods), bird/wildlife terrestrial habitat, Preble's meadow jumping mouse habitat, and shoreline habitat are evaluated in Appendix K, which also proposes priority measures that will ensure full, cost-effective compensatory mitigation. Adaptive management by an established group would facilitate discussion of minimizing impacts by operation strategies once reallocation begins. Refer to the CMP (Appendix K) for further details.

The Corps has conducted coordination and informal consultations with the USFWS regarding potential impacts to T&E species and their recommendations for mitigation and the CMP for Preble's mouse (see Appendix X).

In addition to these measures, the water providers, in coordination with State Parks and CDOW, may pursue other measures to provide ecological benefits above and beyond where the CMP has planned to replace lost ecological functions. While not considered part of the tentatively Recommended Plan, the State may require the water providers to fund these features prior to entering into contracts for water supply at Chatfield. Beyond the measures described in the CMP, the water providers propose to fund stream habitat improvements on up to 0.7 mile of the mainstem of the South Platte River above Chatfield Reservoir. Also, while this analysis does not suggest a significant loss of habitat downstream, to allay CDOW concerns, the water providers have agreed to pursue stream habitat improvement on up to 0.5 mile of the mainstem of the South Platte River downstream of Chatfield Reservoir. The specific sites and project designs for these measures will be selected in coordination with CDOW.

4.10 Land Use

This section describes the impacts of the alternatives on land use within the park, as well as outside of the park, where applicable.

4.10.1 Alternative 1—No Action

Under Alternative 1, the water levels at Chatfield Reservoir would remain unchanged from existing conditions. Water would be stored in alternate locations that include Penley Reservoir and four downstream gravel pits. Pipelines would be built to transfer water to Penley Reservoir (Figure 2-1).

Impacts on downstream agricultural users were raised as a specific issue during the scoping meetings under the No Action Alternative. However, under the No Action Alternative the water providers would obtain water from other locations, as discussed below. The City of Brighton would convert approximately 1,020 acres of irrigated land to dryland agriculture for the downstream gravel pits under the No Action Alternative (Table 2-7).

Penley Reservoir

If the No Action Alternative were chosen, the proposed Penley Reservoir would be built and the proposed storage volume would be 11,300 acre-feet. Approximately 377 acres (approximately 165 acres disturbed by the reservoir and 212 acres disturbed by the infrastructure) of land would be disturbed during construction and operation of the project. Associated infrastructure would include outlet works, a pipeline, and a pump station. The outlet works would be 1,100 feet long. The 48-foot-diameter, 8-mile-long buried pipeline would extend from the South Platte River at the downstream end of Waterton Canyon near the Platte Canyon Reservoir and Highline Canal to Penley Reservoir. Additionally, a pump station would be located near the water diversion. Water diversions could be different depending on the water provider as discussed below:

- Most water providers would use the same pipeline that carries water to the reservoir, and the water would be delivered back to the South Platte River and Chatfield Reservoir. This would include about 97 acres of disturbance.
- Castle Pines Metropolitan District and the town of Castle Rock would construct new buried pipelines and would pump the water to the Plum Creek Reservoir, which would include about 85 acres of disturbance. The pipeline’s total length would be approximately 7 miles.
- Roxborough WSD would pump water to the existing Roxborough WSD water treatment plant, which would require a new buried pipeline. This would include about 30 acres of disturbance.

Downstream South Platte River Gravel Pits

In addition to the proposed Penley Reservoir, the water providers would use four gravel pits to store water if the No Action Alternative were selected. These gravel pits would require inlet and outlet works with associated pumps to allow the gravel pits to fill and return water to the South Platte River as needed. Assuming that the diversion channels are relatively small (i.e., only a few feet wide), the channels to the gravel pits would require less than 2 acres for each channel. Again, assuming that the outlet works and pump stations are relatively small, an additional 1 acre would be required for each gravel pit. The proposed storage volume at these gravel pits is estimated to be about 9,260 acre-feet, and would disturb a total of 506 acres (494 acres for the reservoirs and another 12 acres would be disturbed for associated infrastructure). These gravel pits could vary depending on the water provider as discussed below:

- The City of Aurora would build a diversion channel from the ditch to the gravel pit, and a buried pipeline from the gravel pit to the South Platte River. The acreage is unknown at this time.
- The City of Brighton would use the general assumptions listed above for these potential gravel pits.
- Details were not available for Central Colorado WCD and Western Mutual Ditch Company; therefore, the assumptions listed above were used.

4.10.2 Alternative 2—NTGW/Downstream Gravel Pits

Similar to Alternative 1, under Alternative 2 the water levels would remain unchanged from their existing levels at Chatfield Reservoir. Water would be stored in the same downstream gravel pits as described under Alternative 1. Additional water needs for upstream providers would be met through NTGW.

Using underground water sources could affect farming (changing from irrigated land to non-irrigated land), if pumping rates declined to the point that agricultural lands irrigated by NTGW could no longer produce sufficient water from existing wells. However, most agricultural users rely on alluvial groundwater and not on NTGW, so this impact is not likely to be significant. If gravel pits were converted to water storage reservoirs, impacts on land use would be the same as described for gravel pits under Alternative 1.

4.10.3 Alternative 3—20,600 Acre-Foot Reallocation

Under this alternative, the reallocated storage capacity of Chatfield Reservoir would be 20,600 acre-feet. The water providers would use existing infrastructure to divert water, so no pipelines would be constructed under this alternative. The land affected by construction and operation of the project would be land immediately around Chatfield Reservoir, including lands within Chatfield State Park.

4.10.4 Alternative 4—7,700 Acre-Foot Reallocation/NTGW/Downstream Gravel Pits

In addition to the reallocation, another 5,348 acre-feet would be obtained from NTGW and downstream gravel pits under Alternative 4. The potential effects on land use from conversion of downstream gravel pits to water storage reservoirs and use of NTGW are disclosed under Alternatives 1 and 2, respectively. Fewer and/or smaller gravel pit reservoirs would be needed under Alternative 4 than under Alternative 1 or 2.

Under this alternative, the reallocated storage capacity would be 7,700 acre-feet. The water providers would use existing infrastructure to divert the water, so no pipelines would be constructed under this alternative. As under Alternative 3, the land affected by construction and operation of the project would be land immediately around Chatfield Reservoir.

4.10.5 Reduction and Mitigation of Potential Impacts

Some land would be consumed for project construction and operation of the pipelines. However, most adverse impacts would be temporary, and the disturbed areas would be revegetated with native plants. Potential adverse impacts to land use during construction and operation of the project can be minimized through implementation of BMPs such as clearing only the amount of land needed to build the pipelines.

4.11 Hazardous, Toxic, and Radiological Wastes

This section describes the impacts of each alternative on hazardous, toxic, and radiological wastes within the park, as well as the impacts of the no action alternative outside of the park.

4.11.1 Alternative 1—No Action

Environmental concerns pertaining to hazardous, toxic, or radiological wastes have not been identified for Penley Reservoir, pipeline areas, or downstream gravel pits under the No Action Alternative. Construction activities would be monitored to avoid spills of potentially hazardous materials (e.g., fuel, hydraulic fluid). It is anticipated that there would be no short- or long-term, insignificant or significant, adverse or positive impacts on hazardous, toxic, or radiological wastes as a result of implementing the no action alternative.

4.11.2 Alternative 2—NTGW/Downstream Gravel Pits

Impacts are not expected on hazardous, toxic, or radiological wastes under Alternative 2. Similar to Alternative 1, construction activities related to new well installation or conversion of gravel pits would be monitored to avoid spills of potentially hazardous materials (e.g., fuel, hydraulic fluid).

4.11.3 Alternative 3—20,600 Acre-Foot Reallocation

Under Alternative 3, some lift stations and transformers would be removed and relocated prior to raising the water levels in the reservoir. No spills, reported releases, or underground tanks have been identified in the affected area. Therefore, with these best management practices, activities associated with reallocation implementation would not result in adverse impacts from hazardous, toxic, and radiological wastes.

4.11.4 Alternative 4—7,700 Acre-Foot Reallocation/NTGW/Downstream Gravel Pits

In addition to the reallocation, another 5,348 acre-feet would be obtained from NTGW and downstream gravel pits under Alternative 4. The potential effects on hazardous, toxic, and radiological wastes from conversion of downstream gravel pits to water storage reservoirs and use of NTGW are disclosed under Alternatives 1 and 2, respectively. Fewer and/or smaller gravel pit reservoirs would be needed under Alternative 4 than under Alternative 1 or 2.

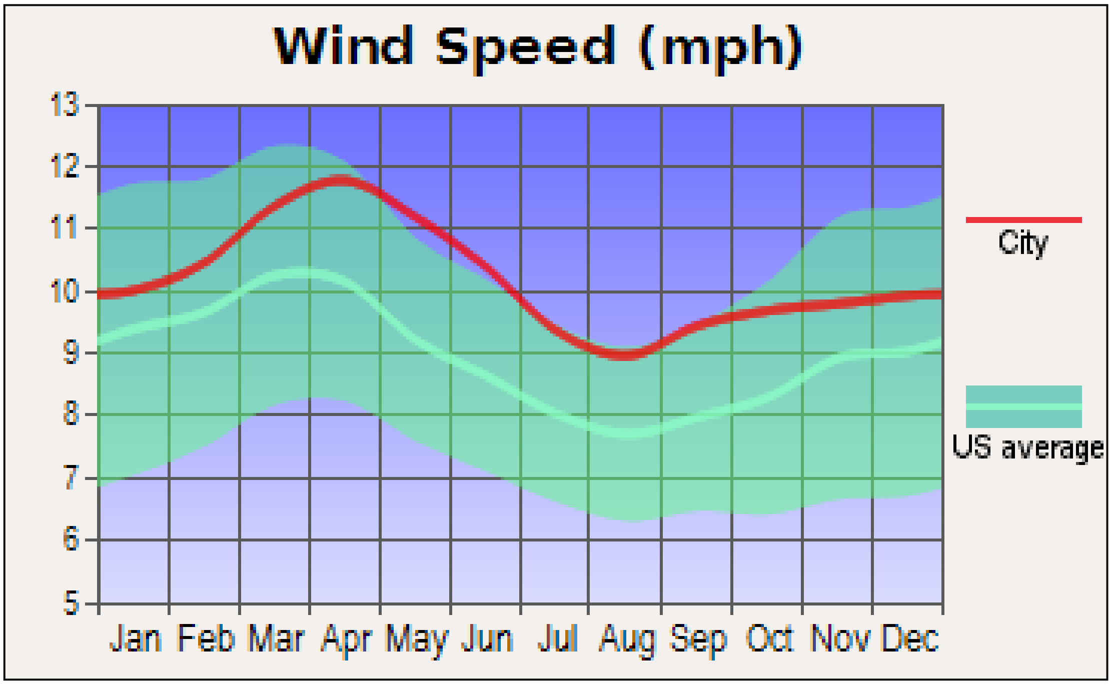
Under this alternative, some lift stations and transformers may need to be removed and relocated prior to raising the water levels in the reservoir. As under Alternative 3, no spills, reported releases, or underground tanks have been identified in the affected area. Therefore, with these best management practices, activities associated with reallocation implementation would not result in adverse impacts from hazardous, toxic, and radiological wastes.

4.11.5 Reduction of Potential Impacts

Measures to prevent spills of potentially hazardous materials are described under Section 4.4, Water Quality.

4.12 Air Quality

This section addresses potential impacts on air quality from the study alternatives. Air quality was not raised as a specific issue during the scoping meetings. The analysis addresses construction activities that could result in short-term adverse impacts on air quality, and impacts on air quality associated with changes in pool fluctuation that result in drying of exposed soils/sediments around the reservoir. These impact levels are influenced by the speed of the wind, which can erode unvegetated soil and increase particulate levels. Spring is the windiest season in the Denver area.



Wind speeds are greatest from March through May (Figure 4-19).

Figure 4-19
Average Wind Speeds in Denver, Colorado, Based on Data from 4,000 Weather Stations (from City-Data.com, 2007)

4.12.1 Alternative 1—No Action

The construction of Penley Reservoir and the associated pipelines would likely result in short-term adverse impacts on air quality during the period of construction. There would also be short-term adverse impacts on air quality from infrastructure constructed at the gravel pits. No long-term adverse impacts on air quality are expected under Alternative 1. Relatively little energy would be needed over the long term to maintain water storage at the gravel pits under Alternative 1. In the short term, fossil fuels would be combusted to run construction equipment under Alternative 1. Overall, this alternative would result in relatively little energy consumption or greenhouse gas emissions.

4.12.2 Alternative 2—NTGW/Downstream Gravel Pits

Alternative 2 would have fewer short-term adverse impacts on air quality than Alternative 1 because of the lack of major construction. Like Alternative 1 there would be short-term adverse impacts due to construction of infrastructure at the gravel pits. More energy would be needed to drill and operate additional wells with larger pumps and motors. Depending on future energy sources, long-term impacts to air quality could include greenhouse gas emissions and other air pollution from coal-fired power plants that would supply the larger energy requirements needed to produce the same water under Alternative 2 as under the other alternatives. However, if other energy sources were used, including renewable or nuclear energy, these indirect impacts to air quality would not occur.

4.12.3 Alternative 3—20,600 Acre-Foot Reallocation

Alternative 3 would require construction to relocate recreational facilities and realign the park road that crosses the South Platte (see Section 4.17 and Appendix M for details.) Air quality could be adversely impacted due to construction traffic and dust generated by earth moving and other construction activities. Adverse impacts on air quality from construction are considered short term and would not be significant. In the short term, fossil fuels would be combusted to run construction equipment under Alternative 3. This alternative would result in relatively little energy consumption or greenhouse gas emissions.

Alternative 3 would result in changes in the timing and extent of pool fluctuation at the reservoir. This would result in changes in the area of soils that are exposed to inundation and drying, and thus a change in the "bathtub ring" (see Section 4.14, Aesthetics, for details.) As described in Section 4.2.3, the inundated area between 5,432 and 5,444 feet msl has soils with an average wind erodibility index of 87. This rating indicates that these soils have a relatively low potential for surface soil erosion by wind. The two soils types that could be inundated under Alternative 3 that are rated with the highest wind erodibility indices, 134 and 180, represent a total of 8 percent of the inundated area. Thus, the potential for wind erosion in the inundated area is relatively low. Vegetative growth would vary according to the degree of fluctuations of the pool levels. More vegetation would protect soils from erosion by wind and reduce airborne particulates. If vegetation were removed from the inundated areas, the potential for wind erosion would increase, and these areas could be considered at moderate to moderately high risk for wind erosion.

The bathtub ring that would be exposed with fluctuations in pool elevations under Alternative 3 could be as much as 587 acres larger than the current bathtub ring (under Alternative 1). The maximum bathtub ring area would be exposed if pool levels dropped from the target elevation of 5,444 feet msl to the minimum elevation predicted by the hydrologic model of 5,423 feet msl. This full 21-foot fluctuation would not occur every year. Even in the wettest of years, the model predicts that the pool would reach the target elevation in over 50 days of the year. The minimum pool elevations also would be higher during wet years. In the driest of years, the target pool elevation would not be reached at all.

According to the hydrology model, the pool elevation of 5,444 feet msl would be reached in 42 of the 59 years modeled. In 17 years, this pool elevation would never be reached. In years where the pool elevation was reached, the model output indicates that it would never be maintained throughout the entire spring (March through May), Denver's windiest season. Only in 10 of the 59 years modeled would the target pool elevation be reached for more than half of the days in the spring months (March through May). Based on this analysis, particulate matter (PM10) concentrations would not increase on a continuous basis. As a result, wind erosion of exposed shoreline would likely be more of a nuisance issue than an air quality issue.

4.12.4 Alternative 4—7,700 Acre-Foot Reallocation/NTGW/Downstream Gravel Pits

In addition to the reallocation, another 5,348 acre-feet would be obtained from NTGW and downstream gravel pits under Alternative 4. The potential effects on air quality from conversion of downstream gravel pits to water storage reservoirs and use of NTGW are disclosed under Alternatives 1 and 2, respectively. Fewer and/or smaller gravel pit reservoirs would be needed under Alternative 4 than under Alternative 1 or 2. Relatively little energy would be needed over the long term to maintain water storage at gravel pits under Alternative 4. In the short term, fossil fuels would be combusted to run construction equipment. Some energy would be required over the long term to drill and operate additional wells to capture NTGW. This alternative would result in some energy consumption and, depending on energy sources, some greenhouse gas emissions. However, less energy and fewer greenhouse gases are anticipated than under Alternative 2 which would rely on more extensive NTGW development.

Alternative 4, like Alternative 3, would require construction to relocate recreational facilities. However, under Alternative 4, the road would not be realigned over the South Platte (see Section 4.17, Recreation, and Appendix M for details). Thus, construction-related adverse impacts on air quality would be less than under Alternative 3. Air quality could be adversely impacted due to construction traffic and dust generated by earth moving and other construction activities. Adverse impacts on air quality from construction are considered short term and would not be significant. Construction traffic is described in section 4.16 Transportation.

Alternative 4, like Alternative 3, could have an increase in the bathtub ring that would increase the potential for wind erosion. The soils in the susceptible area generally have low potential for wind erosion. Vegetative growth would vary according to the degree of fluctuations of the pool levels. More vegetation would protect soils from erosion by wind and reduce airborne particulates. If vegetation were removed from the areas to be inundated, then the potential for wind erosion would increase.

Potential adverse impacts on air quality for Alternative 4 would be less than for Alternative 3 because the amount of exposed soil would be less and the magnitude of pool fluctuations would be less. The bathtub ring that could be exposed with fluctuations in pool elevations under Alternative 4 could be as much as 215 acres larger than the current bathtub ring (under Alternative 1). The maximum area would be exposed if pool levels dropped from the target elevation of 5,437 feet msl to the minimum elevation predicted by the hydrologic model of 5,423 feet msl. This full 14-feet fluctuation would not occur every year. Even in the wettest of years, the model predicts that the pool would reach the target elevation 40 days of the year. The minimum pool elevations also would be higher during wet years. In the driest of years, the target pool elevation would not be reached at all.

According to the hydrology model, the pool elevation of 5,437 feet msl would be reached in 51 of the 59 years modeled. In years where the pool elevation was reached, the model output indicates that it would never be maintained throughout the entire spring period (March through May), Denver's windiest season. Only in 19 of the 59 years modeled would the target pool elevation be reached for more than half of the days in the spring months. Based on this analysis, particulate matter (PM10) concentrations would not increase on a continuous basis. As a result, wind erosion of exposed shoreline would likely be more of a nuisance issue than an air quality issue.

4.12.5 Reduction of Potential Impacts

Implementation of BMPs would reduce the potential short-term adverse impacts during construction activities, so that impacts on particulate levels during construction are not significant.

If vegetation were removed from the inundated areas to mitigate adverse impacts to other resources (such as nutrients as described under water quality), the potential for wind erosion would increase. Leaving the vegetation intact would reduce potential adverse impacts to air quality from windblown sediments. As part of the adaptive management strategy to minimize adverse impacts, vegetation on the banks of Chatfield Reservoir below the target elevation would be removed only as needed, and vegetation growing below but near the new target elevation may not be removed, so that impacts of reallocation on particulate levels are not significant.

4.13 Noise

This section describes the effects of the alternatives on noise levels within the park. Noise was not raised as a specific issue during the scoping meetings, although short-term direct adverse impacts would occur within the park under Alternatives 3 and 4 and outside of the park to varying degrees under all alternatives. These noise-related issues include use of existing roads for construction traffic, and operation of equipment during the road rebuilding and moving of facilities phase of the project. Noise from construction is unavoidable but considered short term and not predicted to be significant. Current noise levels at Chatfield State Park are typically within the 40 to 94 decibel (dBA) range, or moderate to high (when motorized boats pass within 50 feet). Current noise levels at the gravel pits (Alternatives 1 and 2) are in the 88 to 106 dBA range, or high. Indirect adverse impacts are not anticipated. No significant long-term adverse impacts from noise are anticipated.

No mitigation or monitoring activities are identified based on the assumptions used to analyze noise. If assumptions regarding construction and relocation of facilities change, the anticipated noise levels would need to be reviewed with respect to the noise standards and guidelines.

4.13.1 Alternative 1—No Action

The No Action Alternative assumes that road construction and relocation of associated facilities would not occur within the park. Increases or decreases in noise levels occur during various times of the year, typically coinciding with the amount of recreational use and traffic at the time. These noise variations would continue to occur under the No Action Alternative.

Under the No Action Alternative, the proposed Penley Reservoir and other gravel pits in the Denver Metro area would be used to store water. Construction impacts similar to those listed in Alternative 3 would occur; however, construction would occur in a shorter period of time, and would not be constructed in phases since there would be no recreation at this reservoir and associated gravel pits. Noise levels at the converted gravel pits would be reduced under this alternative, and construction noise would be short-term rather than long-term.

4.13.2 Alternative 2—NTGW/Downstream Gravel Pits

Impacts under Alternative 2 would be similar to impacts under Alternative 1 for the gravel pits. Reliance on NTGW could result in the need for additional water wells, which would result in temporary increases in noise during construction.

4.13.3 Alternative 3—20,600 Acre-Foot Reallocation

This alternative would include short-term construction, including road rebuilding and relocation of some facilities. Table 3-6 identifies the percentage of recreation and electrical facilities and/or utilities potentially affected by a raise in the reservoir's target elevation to 5,444 feet msl. This temporary construction (3 to 5 years) would be expected to generate noise levels within the park, including use of existing roads for construction traffic and operation of equipment during the construction phase of the project. This potential increase in noise levels would be due to road construction of segments of the park road that would be inundated unless rebuilt on higher elevations. Additionally, the removal of recreation facilities such as park benches and trees would generate short-term noise. These increased noise levels would decline to the current noise levels after construction was complete. These direct adverse impacts are not considered significant since they are short term and would occur during the winter months when recreational use is not heavy. Winter construction was included in the EDAW report (EDAW 2010) because Colorado State Parks wants to minimize impacts on visitors. It may not be realistic for some facilities and would increase costs due to the need for periodic remobilization and higher costs during out-years.

The numbers, types, and manner of use of equipment proposed to relocate facilities and rebuild the road are summarized below. Assumptions for analysis of on-site construction noise include:

- Construction would occur during weekday shifts of 8 to 10 hours per day during the construction period.
- Access to the construction areas would be restricted to maximize public safety and proximity to equipment operation.
- Earthmoving equipment such as loaders, backhoes, scrapers, and heavy trucks would be used to rebuild the road.
- Other stationary and materials hauling equipment such as concrete mixers would be used to rebuild the road.
- Construction equipment used by contractors is assumed to function as designed and would conform to applicable noise emission standards.

Off-site construction-related noise would include traffic using site access roads, such as C-470 and Highway 121 (Wadsworth Boulevard). Residential areas may be affected by construction traffic during weekday, daytime hours. Projections for estimated peak hour construction trips are described in Section 4.16, Transportation. Assumptions for the analysis of off-site construction noise include:

- Types of traffic making daily or regular trips to the site, such as construction worker vehicles, concrete mixers to rebuild the road, and earthmoving equipment to help relocate facilities
- Access roads most frequently used, which include C-470 and Highway 21 (Wadsworth Boulevard)

No significant short- or long-term adverse impacts are anticipated from on- or off-site construction noise. On-site construction noise may periodically exceed the EPA noise threshold of 70 dBA for public exposure, but the public would not be exposed to these levels on a continuous basis. The noise levels described are predicted at distances of less than 50 feet from the source and would be temporary and remote from the general public. Above this distance, noise levels diminish rapidly. The noise impacts from off-site construction traffic would contribute to the overall background noise levels. The degree that background noise levels may increase would be consistent with the normal variation currently experienced in the area. Construction traffic noise would comply with county ordinances. The proposed activities are not predicted to exceed relevant standards or guidelines.

4.13.4 Alternative 4—7,700 Acre-Foot Reallocation/NTGW/Downstream Gravel Pits

In addition to the reallocation, another 5,348 acre-feet would be obtained from NTGW and downstream gravel pits under Alternative 4. The potential effects on noise from conversion of downstream gravel pits to water storage reservoirs and use of NTGW are disclosed under Alternatives 1 and 2, respectively. Fewer and/or smaller gravel pit reservoirs would be needed under Alternative 4 than under Alternative 1 or 2.

This alternative would be similar to Alternative 3 but includes a shorter (2 to 4 years) construction period. Construction equipment needs are similar to those in Alternative 3, but fewer facilities would be relocated. The existing road would not be inundated, and therefore it would not be moved and rebuilt. Noise levels from all sources would be either similar to or less than those analyzed for Alternative 3. No significant short- or long-term adverse impacts from Alternative 4 are anticipated.

4.13.5 Reduction of Potential Impacts

No mitigation or monitoring activities are identified based on the assumptions used to analyze noise. If assumptions regarding construction and relocation of facilities change, the anticipated noise levels would need to be reviewed with respect to the noise standards and guidelines.

4.14 Aesthetics

This section describes the impacts of the alternatives on visual quality within and outside of the park. The main aesthetic issue identified during scoping was the potential impact of the reservoir's water fluctuation on visual quality. Fluctuation would create a wider shoreline area without vegetation and could have an adverse impact on aesthetics. Changing water levels may positively or negatively affect aesthetics. High water levels versus exposing reservoir rings or mudflats can result in visual impacts. Mudflats are visually displeasing, whereas high water levels are visually pleasing.

For this analysis, it was assumed that minimizing exposed reservoir bottoms and shoreline ring effects resulting from lower pool levels would help maintain or enhance the positive scenic character and attractiveness of Chatfield Reservoir. Table 4-18 provides a summary of the shoreline ring analysis for each alternative based on anticipated pool elevations relative to the target pool elevations over a 59-year POR at Chatfield Reservoir (based on the hydrologic modeling results in Appendix H). Figure 4-20 shows the target pool elevations of each alternative in relation to facilities at the park. The analysis focuses on two aspects of pool fluctuation: 1) the frequency at which the pool is below the target pool elevation, and 2) the magnitude by which the pool fluctuates from the target pool elevation. Alternatives 1 and 2 do not involve any changes to operations at Chatfield Reservoir and thus the pool elevations at Chatfield would be the same under these alternatives. Under Alternatives 1 and 2, Chatfield Reservoir is below the target pool elevation (5,432 feet msl) for 69 percent of the time (or 14,948 days in the modeled POR of 21,550 days). Under Alternative 3, the reservoir would be below the target pool elevation (5,444 feet msl) about 82 percent of the time (17,674 days in the POR); and under Alternative 4, the reservoir would be below the target pool elevation (5,437 feet msl) 75 percent of the time (16,232 days in the POR).

Table 4-18
Summary Statistics for Shoreline Ring Analysis

Parameter	Alternative 1	Alternative 2	Alternative 3	Alternative 4
Target Pool Elevation (feet msl)	5,432	5,432	5,444	5,437
Number of years in POR (1942–2000) with at least 1 day below the target pool elevation	59	59	59	59
Number of days in POR below the target pool elevation	14,948	14,948	17,674	16,232
Percent of days in POR below the target pool elevation	69%	69%	82%	75%
Minimum number of days per year below the target pool elevation	33	33	56	40
Maximum number of days per year below the target pool elevation	366	366	366	366
Mean (average) days per year below the target pool elevation	253	253	300	275
Mean (average) of values below the target pool elevation (feet)	3.5	3.5	7.3	5.0
Maximum of values below the target pool elevation (feet)	9.1	9.1	21.3	14.3
Minimum pool elevation based on the maximum feet below the target pool elevation (feet msl)	5,422.9	5,422.9	5,422.7	5,422.7

Note: "Percent Equal or Exceed" is based on nearest value.

At baseline (Alternatives 1 and 2), the pool elevation is below its targeted pool elevation a minimum of 33 days annually, up to a maximum of 366 days annually. Under Alternative 3, the minimum number of days per year the pool elevation is below target is 56 days and the maximum number of days is the same as baseline, at 366 days annually. Under Alternative 4, the minimum number of days per year the pool elevation is below target is 40 days and the maximum number of days is the same as baseline at 366 days annually. On average, at baseline the pool is below its targeted pool elevation 253 days annually, and would increase to 300 days annually under Alternative 3, and 275 days annually under Alternative 4.

In addition to understanding the frequency at which the pool is below the target pool elevation, it is also important to understand the magnitude (in vertical feet) by which the pool deviates from the target pool elevation. Under Alternatives 1 and 2, when the pool is below the target pool elevation, it is on average a distance of 3.5 vertical feet, with the maximum being 9.1 feet below the target pool elevation. Under Alternative 3, when the pool is below the target pool elevation, it is on average a distance of 7.3 vertical feet below the target pool elevation, with a maximum of 21.3 feet below the target pool elevation. Under Alternative 4, when the pool is below the target pool elevation, it is on average a distance of 5.0 vertical feet below the target pool elevation, with a maximum of 14.3 feet below the target pool elevation.

The summary statistics for the "Bathtub Ring" evaluation are based on the Corps modeling results (Appendix H) and the evaluation performed in Minitab.

4.14.1 Alternative 1—No Action

Under the No Action Alternative, no changes would occur at Chatfield Reservoir and the water levels would continue to fluctuate. Generally, during the summer months the reservoir stays at a minimum of 5,427 feet msl, and the remainder of the year the reservoir is typically drawn down to a minimum of 5,423 feet msl. The existing scenic integrity levels would continue to be a component of the viewed landscape.

The aesthetic quality at Penley Reservoir and the gravel pits would stay intact if these projects were to be built. The water-filled reservoirs may, in fact, add an element of scenery that was not there before, especially at the gravel pits. The associated pipeline routes would not significantly impact views. During construction, the ground would be bare and construction vehicles would be on site. However, the area would be revegetated after construction and visual impacts would be minimal.

4.14.2 Alternative 2—NTGW/Downstream Gravel Pits

Alternative 2 would be similar to Alternative 1, but it would not include the Penley Reservoir. Impacts under this alternative potentially could be positive to the area surrounding the gravel pits. The area around the Penley Reservoir site would not be affected.

4.14.3 Alternative 3—20,600 Acre-Foot Reallocation

Under Alternative 3, the water would fluctuate the most; therefore, mudflats and shoreline rings would be more visible than with any other alternative. During construction, the ground would be bare and construction vehicles would be on site. However, the area would be revegetated after construction and visual impacts would be short-term.

4.14.4 Alternative 4—7,700 Acre-Foot Reallocation/NTGW/Downstream Gravel Pits

In addition to the reallocation, another 5,348 acre-feet would be obtained from NTGW and downstream gravel pits under Alternative 4. The potential effects on aesthetics from conversion of downstream gravel pits to water storage reservoirs and use of NTGW are disclosed under Alternatives 1 and 2, respectively. Fewer and/or smaller gravel pit reservoirs would be needed under Alternative 4 than under Alternative 1 or 2.

Under Alternative 4, the water would fluctuate more so than at baseline, but less than Alternative 3. Similar to Alternative 3, the mudflats and shoreline rings would be more visible than at baseline. During construction, the ground would be bare and construction vehicles would be on site. However, the area would be revegetated after construction and visual impacts would be short-term.

4.14.5 Reduction of Potential Impacts

The project could alter the views at Chatfield Reservoir. If either Alternative 3 or 4 were selected, the water would fluctuate more than under current conditions or the other alternatives. However, some measures that would reduce potential impacts could include planting trees and shrubbery to help reduce the adverse effects.

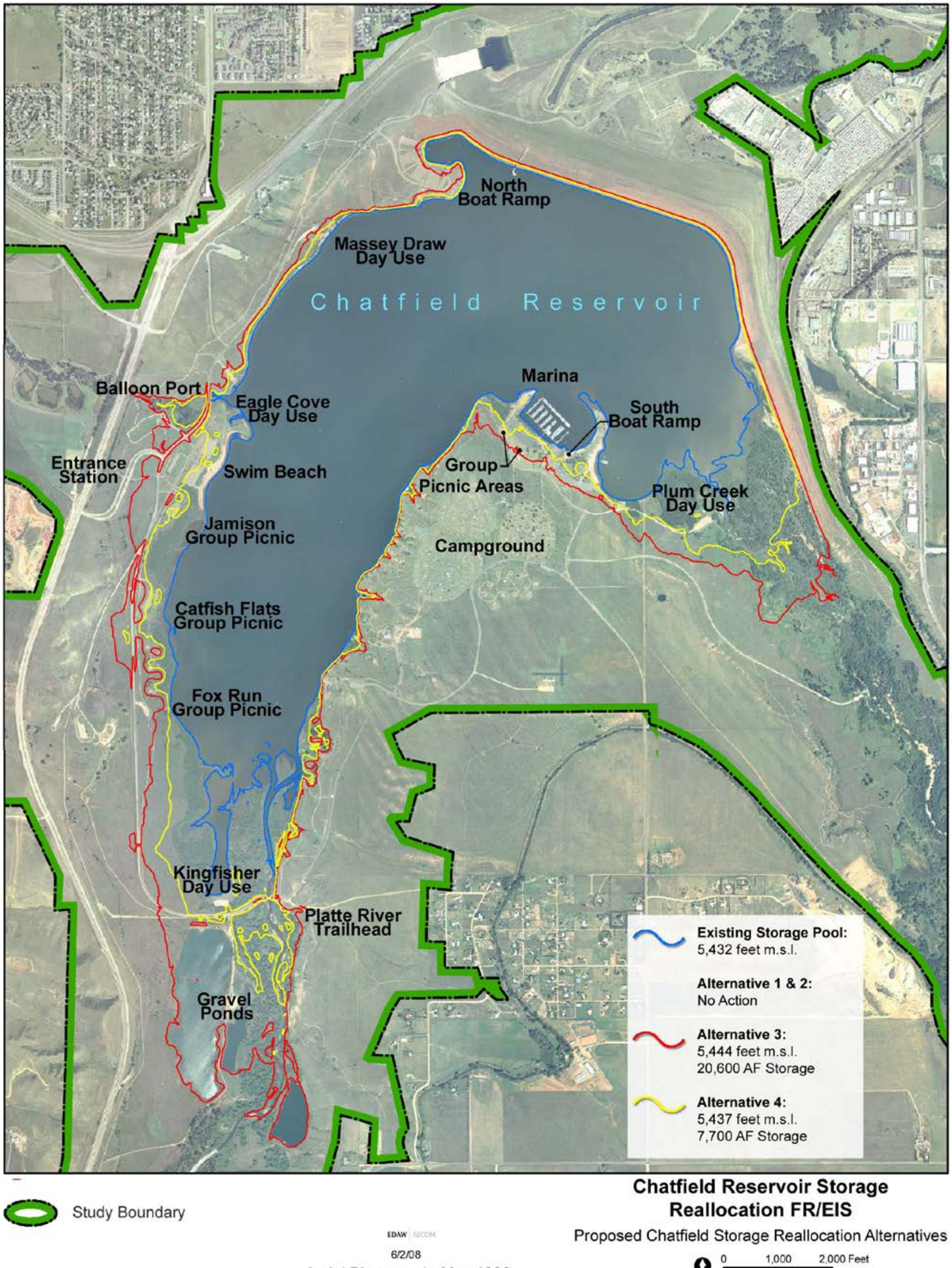


Figure 4-20
Target Pool Elevations and Park Facilities(from WebbPR, rev. 2-2010)

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4.15 Socioeconomic Resources

The four proposed alternatives could result in impacts on socioeconomic resources. This section considers the potential social and economic impacts of the four alternatives.

There would be no difference in flood damages among the four alternatives because the peak flood flows downstream of Chatfield are not significantly different among the alternatives, based on the results of certified/approved hydrologic and hydraulic engineering models described in Appendices H and I and elsewhere in the FR/EIS (e.g., Section 4.3) and the water control operating rules in the Water Control Plan (Appendix B). Documentation of concurrence dated May 11, 2010 from the Corps' Flood Risk Management Planning Center of Expertise and from engineers on the Corps' Agency Technical Review team for this FR/EIS is included in Appendix BB, Policy Waivers, as it waives the need for an economic flood damage analysis (HQUSACE Policy Guidance Memorandum, June 22, 2009, paragraph 6).

4.15.1 Alternative 1—No Action

Recreation Visitation Losses

No changes to recreation are expected under Alternative 1.

Employment Impacts

No changes to park activities are expected under Alternative 1. The number of jobs lost under this alternative would be a total of four jobs due to dryland farming.

During gravel pit conversion under Alternative 1, it is anticipated that an average of 25 construction workers would be needed each day for approximately 2 years based on other gravel pits in the area that were converted into water storage reservoirs (Rick McLoud, Centennial WSD, personal communication 2007b). It is assumed that these workers would commute from existing residences in the Denver Metro area. Construction worker relocation is expected to be minor.

According to the "Chatfield Reservoir Reallocation Project Regional Economic Development and Other Social Effects Analyses" report prepared by BBC Research and Consulting (BBC 2010), implementation of Alternative 1 would generate direct, indirect, and induced jobs. This alternative would temporarily support a labor force hired to physically construct the proposed elements, as well as for construction management and oversight services. In addition to construction, there would be ongoing annual employment to operate the proposed facilities and delivery systems. In total, the employment benefits of Alternative 1 are estimated to be approximately 4,376 person-years of employment over the 50-year analysis period in the study area. More than half of that total is attributable to ongoing operations expenditure. These additional jobs per year (Exhibit 1V-2, Appendix U), averaging approximately 88 jobs annually are approximately 0.007 percent of the 1,214,448 jobs in the 5-county Denver metropolitan area in 2009 (Exhibit II-2, Appendix U). More information is available in Appendix U.

Agricultural Land Conversion

Under the No Action Alternative, only the City of Brighton would purchase agricultural water rights for water storage in downstream gravel pits. Approximately 1,020 acres of irrigated land would be converted to dryland agriculture for the downstream gravel pits (Table 2-4). These lands could be used as dryland farming, but the crop production would be less economical. CWCB (2004) estimated that 1,003,500 irrigated acres exist in the South Platte Basin. Only 0.1 percent of these acres would be converted to dryland agricultural under the No Action Alternative. The socioeconomic impacts on agricultural land would be insignificant based on its percentage of irrigated acres in the six-county area, as illustrated in Tables 3-10 and 3-12.

Project Costs

The FY 2011 financial cost of this alternative is estimated at $278.4 million. The participants will raise the funds for this alternative. The project costs include the capitalized construction, operation and maintenance, and rehabilitation and replacement costs for NTGW and the gravel pits using an interest rate of 4.125% and a study period of 50 years. The NTGW component includes costs from the SMWSS and operation and maintenance costs associated with the 111 wells required over the 50-year horizon for providing water.

According to BBC (2010), Alternative 1 is expected to generate a total of $623.1 million in economic output in the region. Implementation of this alternative would result in substantial construction-related expenditures and generate demand for construction labor and support services, which would generate a positive short-term impact to the regional economy. Expenditures on construction materials and equipment that are made within the region would generate additional economic benefits as spending flows through the local economy through industry linkages. As described above, implementation of this alternative would temporarily support a labor force. Labor income earned by construction-related workers would be re-spent, in part, in the local economy, generating additional economic activity. In addition to construction, there would be ongoing annual expenditure to operate the proposed facilities and delivery systems.

4.15.2 Alternative 2—NTGW/Downstream Gravel Pits

Recreation Visitation Losses

As under the No Action Alternative, no changes to recreation are expected under Alternative 2.

Employment Impacts

The number of jobs lost under this alternative would be a total of four jobs due to dryland farming.

During gravel pit conversion under Alternative 2, it is anticipated that an average of 25 construction workers would be needed each day for approximately 2 years based on other gravel pits in the area that were converted into water storage reservoirs (Rick McLoud, Centennial WSD, personal communication, 2007b). It is assumed that these workers would commute from existing residences in the Denver Metro area.

According to BBC (2010), implementation of Alternative 2 would generate direct, indirect, and induced jobs. This alternative would temporarily support a labor force hired to physically construct the proposed elements, as well as for construction management and oversight services. In addition to construction, there would be ongoing annual employment to operate the proposed facilities and delivery systems. In total, the employment benefits of Alternative 2 are estimated to be approximately 2,742 person-years of employment over the 50-year analysis period in the study area. About half of that total is attributable to ongoing operations expenditure. These additional jobs per year (Exhibit 1V-2, Appendix U), averaging approximately 55 jobs annually are approximately 0.005

percent of the 1,214,448 jobs in the 5-county Denver metropolitan area in 2009 (Exhibit II-2, Appendix U). More information is available in Appendix U.

Agricultural Land Conversion

The long-term use of NTGW could reduce the pumping rates for water wells in the area. Agricultural lands that rely on NTGW could be affected under this alternative. As under Alternative 1, only approximately 0.1 percent (1,020 acres) of irrigated land in the South Platte Basin would be converted to dryland agriculture for Brighton's water storage in the downstream gravel pits. The socioeconomic impacts on agricultural land would be insignificant based on its percentage of irrigated acres in the six-county area, as illustrated in Tables 3-10 and 3-12.

Project Costs

The FY 2011 financial cost of this alternative is estimated at $205.1 million. The participants will raise the funds for this alternative. The project costs include the capitalized construction, operation and maintenance, and rehabilitation and replacement costs for NTGW and the gravel pits using an interest rate of 4.125% and a study period of 50 years. The NTGW component includes costs from the SMWSS and operation and maintenance costs associated with the 111 wells required over the 50-year horizon for providing water.

According to BBC (2010), Alternative 2 is expected to generate a total of $391.5 million in economic output in the region. As in Alternative 1, implementation of this alternative would result in substantial construction-related expenditures and generate demand for construction labor and support services, which would generate a positive short-term impact to the regional economy. Expenditures on construction materials and equipment that are made within the region would generate additional economic benefits as spending flows through the local economy through industry linkages. Labor income earned by construction-related workers would be re-spent, in part, in the local economy, generating additional economic activity. In addition to construction, there would be ongoing annual expenditure to operate the proposed facilities and delivery systems.

4.15.3 Alternative 3—20,600 Acre-Foot Reallocation

Recreation Visitation Losses

Under this alternative, potential impacts to visitation, concessionaire revenues, and Colorado State Parks revenues could occur as outlined in BBC (2010). Based on the report, impacts were calculated by estimating visitation loss and associated decline in visitor spending within Chatfield State Park and at local retailers and service providers. The estimates also included a portion of lost visitor spending recovered through substitute recreation sites. The full report is available as Appendix U.

According to the BBC report (2010), Colorado State Parks is estimated to lose approximately $217,000 annually as a result of visitation reduction at Chatfield during the construction period and approximately $107,000 annually during the incremental reallocation period. Additionally, Colorado State Parks is estimated to lose approximately $57,000 annually when park management stabilizes at Chatfield. Colorado State Parks is expected to lose about $3.4 million over the 50-year analysis period, including revenue associated with concessionaire agreements. Net Colorado State Parks revenue loss includes direct revenue loss from reduced visitation, loss revenue from the concessionaire share, and a recovery of a portion of lost revenue through substitute recreation site provisions (BBC 2010).

In addition, USACE prepared a report entitled "Recreation Benefit Analysis Using the Corps' Unit Day Value Methodology to Determine the Effect of Reallocation of Storage at Chatfield Reservoir on National Economic Development (NED) Recreation Benefits at Chatfield State Park" (USACE 2011a). This report addresses the impacts to recreational enjoyment in dollars under the proposed alternatives. USACE used the Unit Day Value (UDV) method which is typically prepared for projects where the maximum annual visits are less than 750,000. Chatfield State Park visitor counts are activity-based, and the effects of reallocation would be expected to differ among recreational activities. Therefore, USACE (2011a) calculated UDVs for individual activities, each of which met the criterion of a maximum of 750,000 annual visits.

USACE conducted recreation assessment workshops for assigning UDV points. Approximately 69 members of the recreating public, including two marina owners, four horse stable operators/wranglers, and the campground hosts were contacted by USACE and invited to participate in one of two workshops held at Chatfield State Park. Information on the proposed recreation modifications was presented at the workshops and then the park users were asked to complete UDV assessments of recreation at Chatfield State Park. Of those asked to join one of the workshops, only a few declined the invitation. Invitees were contacted primarily because of their participation in one particular activity, but many volunteered to assign UDV points for additional activities that they participate in at Chatfield State Park. The goal was to obtain at least four or five UDV ratings for each activity, to achieve a robust statistical analysis. To meet this goal for certain activities that would otherwise have had relatively low sample sizes, Chatfield State Park and USACE Tri-Lakes staff that are knowledgeable about these activities completed UDV assessments for these activities. Workshop attendees who assigned UDV points included: 43 Chatfield State Park recreationists, two marina owners, seven Chatfield State Park staff, and two USACE Tri-Lakes staff. Assumptions used in assigning point values to the five criteria (accessibility, carrying capacity, environmental, recreation experience, and availability of opportunity) for the three alternatives and two time periods were based on the information (PowerPoint slides), responses to questions and general instructions received from USACE, and the individual perspectives of the raters.

A spreadsheet was compiled for each of the 29 recreational activities chosen by USACE to calculate the annual recreation benefits for ten scenarios (including no action at Chatfield, 7,700 acre-foot reallocation, and 20,600 acre-foot reallocation). The UDV points assigned to each of the five criteria were added and this sum was converted to fiscal year 2011 dollars per day for that activity in accordance with Economic Guidance Memorandum 11-03, Unit Day Values for Recreation, Fiscal Year 2011, dated November 5, 2010. The present value of NED recreation benefits foregone during the 2-year construction period prior to reallocation is about $1.5 million for Alternative 3. The 12-foot reallocation (Alternative 3) shows a reduction in NED recreation benefits of approximately $14.2 million over 50 years. The present value of recreation benefits over 50 years for Alternative 3 is about $209.3 million, compared to about $223.5 million without the reallocation (Alternatives 1 and 2). More details on the UDV analysis can be found in Appendix T.

Employment Impacts

According to the BBC report (2010), Alternative 3 would generate direct, indirect, and induced jobs. In addition to the approximate 324 construction jobs per year directly supported by this alternative over the first two years of construction, an additional 292 annual jobs would be generated in the study area, for a total of about 615 annual jobs in the study area per year during the first two years of project construction. Payment associated with water storage leaving the region represents a loss of about 154 total jobs (i.e., direct, indirect, and induced jobs) during the first year of construction under Alternative 3. Ongoing operational spending is estimated to support about 22 total jobs per year. In total, the employment benefits of project construction and operations are estimated to be approximately 2,257 person-years of employment over the 50-year analysis period in the study area under Alternative 3. About half of that total is attributable to ongoing operations expenditure. These additional jobs per year (Exhibit 1V-2, Appendix U), averaging approximately 45 jobs annually are approximately 0.004 percent of the 1,214,448 jobs in the 5-county Denver metropolitan area in 2009 (Exhibit II-2, Appendix U).

Agricultural Land Conversion

No irrigated land would be converted to dryland agriculture to provide water storage under Alternative 3. The socioeconomic impacts on agricultural land would be insignificant based on its percentage of irrigated acres in the six-county area, as illustrated in Tables 3-10 and 3-12.

Project Costs

The FY 11 financial cost of this alternative is estimated at $184.4 million. This includes the capitalized cost of storage, operation and maintenance, rehabilitation and replacement costs, and recreation and environmental mitigation pits using an interest rate of 4.125% and a study period of 50 years.

The participants would raise the funds for this alternative. The cost of storage would be paid to the U.S. Treasury so it would not be spent in the region.

According to BBC (2010), Alternative 3 is expected to generate a total of $318.0 million in economic output in the region, which includes the direct impact of the project ($186.4 million) and the resulting economic activity generated in response to project demands for goods and services (indirect impacts) and spending attributed to direct and indirect labor earnings (induced impacts), which total an additional $131.6 million. Implementation of this alternative would result in substantial construction-related expenditures and generate demand for construction labor and support services, which would generate a positive short-term impact to the regional economy. Expenditures on construction materials and equipment that are made within the region would generate additional economic benefits as spending flows through the local economy through industry linkages. Labor income earned by construction-related workers would be re-spent, in part, in the local economy, generating additional economic activity. In addition to construction, there would be ongoing annual expenditure to operate the proposed facilities and delivery systems.

4.15.4 Alternative 4—7,700 Acre-Foot Reallocation/NTGW/Downstream Gravel Pits

In addition to the reallocation, another 5,348 acre-feet would be obtained from NTGW and downstream gravel pits under Alternative 4. The potential effects on socioeconomic resources from conversion of downstream gravel pits to water storage reservoirs and use of NTGW are disclosed under Alternatives 1 and 2, respectively. Fewer and/or smaller gravel pit reservoirs would be needed under Alternative 4 than under Alternative 1 or 2.

Recreation Visitation Losses

According to the BBC report (2010), Colorado State Parks is estimated to lose approximately $278,000 annually as a result of visitation reduction at Chatfield during the construction period. After construction, the facilities would reopen and would be expected to recover. Colorado State Parks is expected to lose about $2.7 million over the 50-year analysis period, including revenue associated with concessionaire agreements. Net Colorado State Parks revenue loss includes direct revenue loss from reduced visitation, loss revenue from the concessionaire share, and a recovery of a portion of lost revenue through substitute recreation site provisions (BBC 2010). As described under Alternative 3, USACE (2011a) addresses the impacts to recreational enjoyment in dollars using the UDV method. Based on input gathered during recreation assessment workshops, a spreadsheet was compiled for each of the 29 recreational activities chosen by USACE to calculate annual recreation benefits. The UDV points assigned to each of the five criteria were added and this sum was converted to fiscal year 2011 dollars per day for that activity in accordance with Economic Guidance Memorandum 11-03, Unit Day Values for Recreation, Fiscal Year 2011, dated November 5, 2010. The present value of NED recreation benefits foregone during the 2-year construction period prior to reallocation is about $1.3 million. The 5-foot reallocation (Alternative 4) shows a reduction in NED recreation benefits of approximately $12.1 million over 50 years. The present value of recreation benefits over 50 years for Alternative 4 is about $211.4 million, compared to about $223.5 million without the reallocation (Alternatives 1 and 2). More details on the UDV analysis can be found in Appendix T.

Employment Impacts

The number of jobs lost under this alternative would be a total of two jobs due to dryland farming.

According to the BBC report (2010), Alternative 4 would generate direct, indirect, and induced jobs. In addition to the approximate 542 construction jobs per year directly supported by this alternative over the first two years of construction, an additional 488 annual jobs would be generated in the study area, for a total of about 1,030 annual jobs in the study area per year during the first two years of project construction. Payment associated with water storage leaving the region represents a loss of about 57 total jobs (i.e., direct, indirect, and induced jobs) during the first year of construction under Alternative 4. Ongoing operational spending is estimated to support about 15 total jobs per year. In total, the employment benefits of project construction and operations are estimated to be approximately 2,946 person-years of employment over the 50-year analysis period in the study area under Alternative 4. About half of that total is attributable to ongoing operations expenditure. These additional jobs per year (Exhibit 1V-2, Appendix U), averaging approximately 59 jobs annually are approximately 0.005 percent of the 1,214,448 jobs in the 5-county Denver metropolitan area in 2009 (Exhibit II-3, Appendix U).

Agricultural Land Conversion

Fewer irrigated acres would be converted to dryland agriculture under this alternative than under Alternatives 1 and 2. The long-term use of NTGW could reduce the pumping rates for water wells in the area. Agricultural lands that rely on NTGW could be affected under this alternative.

Project Costs

The FY 2011 financial cost of this alternative is estimated at $203.4 million. This includes the capitalized construction, operation, maintenance, repair, rehabilitation and replacement costs for NTGW and the gravel pits using and interest rate of 4.125% and a study period of 50 years. The NTGW component includes costs from the SMWSS and operation and maintenance costs associated with the 42 wells required over the 50-year planning horizon. Additionally, the cost includes the capitalized cost of storage, operation and maintenance, rehabilitation and replacement, and recreation modifications and environmental mitigation for the 7,700 acre-foot Chatfield reallocation.

The participants would raise the funds for this alternative. The cost of storage would be paid to the U.S. Treasury so it would not be spent in the region.

According to BBC (2010), Alternative 4 is expected to generate a total of $419.4 million in economic output in the region, which includes the direct impact of the project ($237.0 million) and the resulting economic activity generated in response to project demands for goods and services (indirect impacts) and spending attributed to direct and indirect labor earnings (induced impacts), which total an additional $182.3 million. Implementation of this alternative would result in substantial construction-related expenditures and generate demand for construction labor and support services, which would generate a positive short-term impact to the regional economy. Expenditures on construction materials and equipment that are made within the region would generate additional economic benefits as spending flows through the local economy through industry linkages. Labor income earned by construction-related workers would be re-spent, in part, in the local economy, generating additional economic activity. In addition to construction, there would be ongoing annual expenditure to operate the proposed facilities and delivery systems.

4.15.5 Reduction and Modification of Potential Impacts

The USACE and State Parks have agreed to allow the swim beach and marina to remain open from May through September during the entire construction period to minimize impacts to park visitors and the marina operators. In addition, while it is outside of the tentatively Recommended Plan, the water providers would reimburse Colorado State Parks and the marina operators on an annual basis for lost revenues that result as a consequence of reallocation, as well as any increased costs that Colorado State Parks incurs.

Because flood damages along the South Platte downstream from Chatfield would remain essentially the same under all four Alternatives, no modification is anticipated.

4.15.6 Environmental Justice

Although it has been shown that some Census tracts in the impacted area have varied concentrations of minority and low income populations, these variations are small compared with the concentration of low income and minorities in individual counties and in the six-county area. Additionally, it cannot be shown, and it is not reasonable to assume that minority and low income populations in the middle and upper middle class suburbs surrounding the impact area are affected by any of the alternatives to any greater degree than the rest of the population. The impacts are primarily to the physical environment with no secondary health or welfare impacts. These would be shared by the surrounding communities and, in the case of Chatfield Reservoir, by project users. No impacts to the health of residents of any race or to subsistence fishing, hunting, or food gathering are known or likely. Accordingly none of the alternatives are evaluated further.

4.16 Transportation

This section describes the impacts of the alternatives on transportation within the park. Transportation was not raised as a specific issue during the scoping meetings, although short-term direct adverse impacts would occur inside and outside of the park during construction. Potential impacts on transportation on roadways in the study area are associated with temporary construction traffic and ongoing maintenance and recreation traffic in the vicinity of Chatfield State Park.

4.16.1 Alternative 1—No Action

The No Action Alternative assumes that road construction and relocation of associated facilities would not occur at Chatfield State Park. Increases or decreases in visitor access occur during various times of the year, typically coinciding with the amount of recreational use and traffic at the time. These access variations would continue to occur under the No Action Alternative.

Instead, Penley Reservoir and the gravel pits would be built, and after their construction these would not require any new roads, nor would transportation be greater than it is now. The gravel pits would likely result in less traffic than what is currently operating in the area during active mining.

4.16.2 Alternative 2—NTGW/Downstream Gravel Pits

The NTGW/Downstream Gravel Pits Alternative is similar to the No Action Alternative above. However, only the gravel pits would be constructed, not Penley Reservoir, and again, this would decrease operation traffic to the area.

4.16.3 Alternative 3—20,600 Acre-Foot Reallocation

Under Alternative 3, a portion of the entrance road would be realigned and a major segment of the main park road would have to be located farther away from the reservoir. Realignment of the main park road would require a new bridge crossing over Deer Creek. Under this alternative, traffic would temporarily increase during the construction periods, which would be implemented in phases over a 2- to 5-year period. Assuming that the construction period does not conflict with the high-use recreation times, transportation would not be a significant factor.

Short-term access issues would occur. Road rebuilding and associated facility relocation would take approximately 3 to 5 years to complete. During construction of the road, the volume of traffic would increase. At times, construction traffic may be heavy during each phase of the project. For example, earth moving equipment and bulldozers may be needed during facility relocations, and asphalt paving machines and concrete trucks may be needed during road building activities. Delivery trucks may be required to deliver certain items to the park, and additionally, construction worker traffic would be required for the approximately 50 construction workers working in the area (see Section 4.15, Socioeconomic Resources).

New roads projected in the recreation study (EDAW 2010) are just a few feet in elevation above the reallocation levels. When floods occur, much damage occurs to the road base, as has been demonstrated in previous floods at the park. Access to and within the park would not be significantly impacted by the long-term increases in pool elevations under Alternatives 3 or 4.

4.16.4 Alternative 4—7,700 Acre-Foot Reallocation/NTGW/Downstream Gravel Pits

In addition to the reallocation, another 5,348 acre-feet would be obtained from NTGW and downstream gravel pits under Alternative 4. The potential effects on transportation from conversion of downstream gravel pits to water storage reservoirs and use of NTGW are disclosed under Alternatives 1 and 2, respectively. Fewer and/or smaller gravel pit reservoirs would be needed under Alternative 4 than under Alternative 1 or 2.

Under Alternative 4, the road would not be realigned and reconstructed. However, some facilities would be relocated, which would require construction vehicles in the park. Similar to Alternative 3, it is anticipated that the traffic would temporarily increase during the facility relocation which could be implemented in phases over a 2- to 4-year period. Assuming that the facility relocation/construction period does not conflict with the high-use recreation times, transportation would not be a significant factor. Transportation from all sources would be either similar to or less than those analyzed for Alternative 3. No significant short- or long-term adverse impacts from this alternative are anticipated.

Short-term access issues would occur under Alternative 4 that are similar to those described under Alternative 3. The duration of impacts on access and traffic would be slightly shorter under Alternative 4 than under Alternative 3. Long-term impacts to access are not anticipated.

4.16.5 Reduction of Potential Impacts

To minimize impacts, construction periods would be limited to certain times of the year when recreation use is low. Construction should also occur during daylight hours, per Colorado law, so that it does not disturb nearby residences. This would also reduce disturbance to wildlife at night.

During the construction period, construction would meet the applicable noise standards for Colorado, as provided in Section 25-12-103, Colorado Revised Statutes (C.R.S). The Colorado absolute noise limits are assessed at the facility property line, but no closer than 25 feet from the noise source (i.e., worst-case scenario would be if construction were to occur within 25 feet of a property line.) In residential areas, from 7 a.m. to 7 p.m., the absolute noise limits are 55 A-weighted dBA, and from 7 p.m. to 7 a.m., the absolute noise limits are 50 dBA, according to state stature. Table 4-19 illustrates the maximum noise limits as follows:

Table 4-19
Maximum Noise Limits

Zone	7:00 a.m. to next 7:00 p.m.	7:00 p.m. to next 7:00 a.m.
Residential	55 dBA	50 dBA
Commercial	60 dBA	55 dBA
Light Industrial	70 dBA	65 dBA
Industrial	80 dBA	75 dBA

The Colorado statute states that, "Construction projects shall be subject to the maximum permissible noise levels specified for industrial zones for the period within which construction is to be completed pursuant to any applicable construction permit issued by proper authority or, if no time limitation is imposed, for a reasonable period of time for completion of project." Therefore, during construction only, the Project area construction noise is required to be at or below the 80/75 dBA limit. This section may not be applicable to the use of property by this state, or a political subdivision of this state.

4.17 Recreation

This section describes the impacts of the four alternatives on recreation. Adverse impacts on recreation resources at Chatfield State Park, such as the swim beach, marina, and boat ramps may occur as a result of increased water levels in Chatfield Reservoir. Direct short-term adverse impacts may result from road construction and relocation/installation of new facilities development at the Park. Direct long-term adverse impacts may occur at the Swim Beach area if visitors are required to walk longer distances to access the beach. No indirect adverse impacts would occur. Most information in this section comes from the "Chatfield Reservoir Recreation Facilities Modification Plan" (EDAW 2010), which is included in this FR/EIS as Appendix M. Impacts on visitation and revenue at Chatfield State Park are discussed in more detail in Section 4.15.

4.17.1 Alternative 1—No Action

The No Action Alternative assumes that relocation of recreation facilities would not occur because portions of the park would not be inundated with water under normal operating conditions. The average recreational season (June through September) water surface elevation under historic operations is 5,432 feet with 4.8 feet of fluctuation. Under the No Action Alternative, there would not be an increased frequency of larger, seasonal water surface fluctuations (measured June 1 through September 30 over a 59-year period). The associated pipeline infrastructure would be outside of the park and would not affect recreation resources in the park. Chatfield State Park's authority under the LWCF Act would not apply because relocation of recreation facilities would not occur.

No recreation would occur at Penley Reservoir, nor would it occur at the gravel pits.

4.17.2 Alternative 2—NTGW/Downstream Gravel Pits

The NTGW/Downstream Gravel Pits Alternative is similar to Alternative 1 in that no recreation would occur at the gravel pits, and there would be no impacts at Chatfield State Park.

4.17.3 Alternative 3—20,600 Acre-Foot Reallocation

Under Alternative 3, the raised water surface in Chatfield Reservoir would increase the average recreational season (June through September) pool fluctuation to approximately 12 feet, an increase of 5.2 feet. A more significant operations challenge may be presented by larger fluctuations that occur infrequently but regularly. Over the 59-year period (1942 to 2000) that was modeled, historic operations (5,432 feet msl) had 5 years with more than 15 feet of fluctuation during the primary recreational use season. In contrast, the 5,444 feet msl alternative had 20 years when the water surface elevation fluctuation was greater than 15 feet (EDAW 2010, Appendix M).

The discussion that follows focuses on the affected use areas at Chatfield State Park and provides an area-by-area description of what facilities would have to be relocated or redeveloped. Areas that would not be influenced are not considered in this discussion. The main areas that would be affected include the North Boat Ramp, Massey Draw, Swim Beach area (including Eagle Cove, Deer Creek, and Jamison areas), Catfish Flats and Fox Run group use areas, the Kingfisher/Gravel Ponds/Platte River Trailhead areas, Marina area (including Marina Point, South Boat Ramp, Riverside Marina, and

Roxborough day use areas), and Plum Creek area (EDAW 2010, Appendix M). These areas are discussed below in more detail.

The North Boat Ramp would be partially inundated under Alternative 3. Facilities affected include two boat ramps, paved parking, and a variety of support facilities, including trails and day use shelters (see Table 2.2 and Map 2.3 in EDAW 2010, Appendix M). Additionally, this alternative requires a substantial amount of fill to raise a portion of the parking area (EDAW 2010).

The recreation capacity of Massey Draw would be reduced but the parking area would not be inundated. The service tank for the existing vault restroom is below 5,444 feet msl; therefore, it would need to be relocated (see Table 2.3 and Map 2.4 in EDAW 2010, Appendix M).

Under Alternative 3, adverse impacts on the Swim Beach area are the most substantial of all facilities located along the shoreline. The entire swim beach site and associated parking area, including a number of other facilities (e.g., trails, restrooms, concession building, first aid station, volleyball, and horseshoe pits) would be inundated (see Tables 2.6 and 2.7 and Map 2.5 in EDAW 2010, Appendix M). The gravel parking area and portable restroom at Eagle Cove would be inundated, while approximately half of the Deer Creek area would be inundated at this level (see Tables 2.4 and 2.5 and Map 2.5 in EDAW 2010, Appendix M). The Jamison area also would be inundated (see Table 2.7 and Map 2.5 in EDAW 2010, Appendix M). In addition to adverse impacts on recreation facilities, a portion of the entrance road would be realigned and a major segment of the main park road would have to be located farther inland (EDAW 2010). Impacts on roads are discussed further in Section 4.16, Transportation.

The majority of entrance roads, parking areas, shelters, restrooms, and utilities at the Catfish Flats and Fox Run group use areas would be inundated at 5,444 feet msl (see Tables 2.8 and 2.9 and Map 2.6 in EDAW 2010, Appendix M). Specifically, the parking area, restroom, and picnic shelters would be inundated at the Catfish Flats area, while the entrance to the parking area at the Fox Run group use area would be reconstructed due to the new location of the main park road (EDAW 2010).

The Kingfisher and Gravel Ponds areas would be entirely inundated if Alternative 3 were implemented. The Platte River Trailhead restroom, parking area, and trailhead would not be inundated; however, inundation of existing trails that lead to the river would be inundated (see Tables 2.10, 2.11, and 2.12 and Map 2.7 in EDAW 2010, Appendix M). Modification measures are discussed in Section 4.17.5.

Recreation facilities at the Marina area would be significantly affected under this alternative (see Table 2.13 and Map 2.8 in EDAW 2010, Appendix M). The increase in average pool level fluctuation would affect the operations of Riverside Marina. The existing anchors are not capable of handling the increase in pool elevation and they would need to be replaced to operate correctly. At Marina Point the parking area, group day use area, volleyball and horseshoe pits, and the accessible fishing pier would all be inundated, as would the south boat ramp. Additionally, the Roxborough day use area would be entirely inundated at a water elevation of 5,444 feet msl (EDAW 2010).

The Plum Creek area facilities include a trailhead and a day use area with picnic tables, a restroom, and parking (see Table 2.14 and Map 2.9 in EDAW 2010, Appendix M). Under Alternative 3, the Plum Creek day use area would be entirely inundated.

As stated above, Chatfield State Park must remain in outdoor recreation uses pursuant to Section 6(f) of the LWCF Act because LWCF assistance was used by the Colorado Division of Parks and Outdoor Recreation to obtain water for Chatfield Reservoir. According to David Giger (David Giger, Colorado State Parks, personal communication, 2008), there are presently several LWCF grants at Chatfield. One LWCF grant is used for water in the reservoir. The other LWCF grants (approximately four to five grants) were used to purchase facilities that could be inundated under Alternative 3. If these facilities are inundated under this alternative, they must be replaced elsewhere in the park, and Colorado State Park staff must submit a formal letter to the National Park Service recognizing the changes and stating that the park is not in default. If the facilities are removed and not relocated, then the state would be in default. However, all facilities are planned to be relocated, so this should not be a conflict with the LWCF Act and the State of Colorado.

As described in Section 4.15, the USACE prepared a report entitled "Recreation Benefit Analysis Using the Corps' Unit Day Value Methodology to Determine the Effect of Reallocation of Storage at Chatfield Reservoir on National Economic Development (NED) Recreation Benefits at Chatfield State Park" (USACE 2011a). This report addresses the impacts to recreational enjoyment under the proposed alternatives. To estimate visitation loss at Chatfield State Park during construction, surveys were distributed to representatives of Chatfield recreation user groups, who were specifically assembled by the USACE on April 16, 2009 to review the reallocation and facility modification plan for Alternative 3. As described in Section 4.15, the information gathered during the meeting forms the basis of the NED analysis completed by the USACE and the Regional Economic Development (RED) prepared by BBC.

Attendees were asked to describe their primary, secondary, and tertiary (if applicable) recreation activity at the park. Attendees reported the number of days they use the park per activity and if there were any local substitute sites for their primary recreation activity. The attendees were then shown graphics that depicted the new facilities and water levels that would exist under Alternatives 3 and 4. To gauge visitation loss, respondents were asked to review the reallocation plan and estimate the extent to which their usage may change during construction, one to five years after construction when water is incrementally reallocated to the reservoir conservation storage pool, and when park and water management practices stabilize. Attendees were aware that they were providing responses as a representative of a broad user group.

Forty-five individuals completed the survey reporting 88 activities, indicating each respondent was involved in nearly two activities at the park. Among all responses, 22 types of activities were identified. The breadth of activities suggests that all visitation groups were represented. In this analysis, uses were aggregated into like categories. For instance, "water dog training," "scuba diving," and other like uses were placed in the category "Gravel Pond Use" because these groups exclusively use that facility and would likely have similar reactions to park facility changes. Detailed results are presented in Appendices T and U.

Results are calculated based on total days among all survey respondents. For example, trail hikers, joggers, and walkers will have an estimated loss of 23.3 percent of visitation during construction. All of the visitors who specified this activity in the survey were asked to estimate the number of days they visit the park each year. Respondents were then asked by how many days they would reduce their visits during construction. All of the respondents' visitor days were summed (total visitor days) and all respondents' reduced days were summed (total decreased days). The total number of reduced days was divided by the total number of visitor days yielding the percent visitation loss.

Reported sightseers at the park are reduced by the average reduction of all other recreation users. Sightseers are defined as participating in no particular recreation activity and most often accompany other recreators at the park.

Visitors who indicated they would not visit Chatfield during and after construction may choose to recreate at other parks and recreation areas in the study area. Many survey respondents indicated they would substitute their visit to Chatfield with a visit to another local recreation site, either at another state park or municipal or county recreation area. For example, trail users reported substitute sites including Bear Creek Trail, Washington Park, and the Platte River trail. State Parks has indicated that nearby substitute parks, especially Cherry Creek State Park, reach capacity during summer weekends.

Under Alternative 3, overall visitor use at Chatfield is expected to decrease by 17.6 percent (from 1.66 million to 1.37 million visitors) during construction, by 9.4 percent (to 1.51 million visitors) 1 to 5 years after construction, and by 4.1 percent (to 1.60 million visitors) 6+ years after construction.

4.17.4 Alternative 4—7,700 Acre-Foot Reallocation/NTGW/Downstream Gravel Pits

In addition to the reallocation at Chatfield Reservoir, another 5,348 acre-feet would be obtained from NTGW and downstream gravel pits under Alternative 4. The potential effects on recreation from conversion of downstream gravel pits to water storage reservoirs and the use of NTGW are disclosed under Alternatives 1 and 2, respectively. Fewer and/or smaller gravel pit reservoirs would be needed under Alternative 4 than under Alternative 1 or 2.

Recreation facilities at Chatfield State Park would be adversely impacted under Alternative 4, as discussed in the following sections and in Appendix M. The discussion that follows focuses on the affected use areas at Chatfield State Park and provides an area-by-area description of what facilities would have to be relocated or redeveloped. Areas that would not be influenced, such as the campgrounds, are not considered in this discussion. The areas that would be affected include the North Boat Ramp, Massey Draw, and the Swim Beach, Kingfisher, Marina, and Plum Creek areas (EDAW 2010). These areas are discussed below in more detail.

Under this alternative, the North Boat Ramp would be partially inundated, making it inoperable. Facilities affected include the two boat ramps (see Appendix 5 in EDAW 2010, Appendix M). Remaining areas, including most of the parking, the picnic shelters, and circulation roads, would remain above the normal high water line.

The recreation capacity of Massey Draw would be reduced but the existing parking area and restroom would not be inundated (see Appendix 5 in EDAW 2010, Appendix M).

Under Alternative 4, adverse impacts on the Swim Beach area are the most substantial of all facilities located along the shoreline. The entire swim beach site and associated parking area, including a number of other facilities (e.g., trails, restrooms, concession building, first aid station, volleyball, and horseshoe pits) would be inundated (see Appendix 5 in EDAW 2010, Appendix M). Unlike Alternative 3, this would not adversely impact the road.

The Kingfisher area would be entirely inundated under this alternative. However, unlike Alternative 3, the gravel ponds would not be inundated at this level (see Appendix 5 in EDAW 2010, Appendix M).

In the Marina area there is significantly higher topography, which somewhat limits the impacts to the shoreline facilities. However, most of the parking areas would be inundated under this alternative which results in impacts to the use of most of the facilities. Thus all of the facilities would need to be relocated, or rebuilt on filled areas, in order to maintain the same recreational benefits (see Appendix 5 in EDAW 2010, Appendix M).

Under this alternative, the Plum Creek day use area and trailhead would be entirely inundated at the proposed water elevation. Some segments of the Plum Creek trail would also be inundated (see Appendix 5 in EDAW 2010, Appendix M).

As stated above, Chatfield State Park must remain in outdoor recreation uses pursuant to Section 6(f) of the LWCF Act because LWCF assistance was used by the Colorado Division of Parks and Outdoor Recreation to obtain water for Chatfield Reservoir. According to David Giger (David Giger, Colorado State Parks, personal communication, 2008), there are presently several LWCF grants at Chatfield. One LWCF grant is used for water in the reservoir. The other LWCF grants (approximately four to five grants) were used to purchase facilities that could be inundated under Alternative 4. If these facilities are inundated under this alternative, they must be replaced elsewhere in the park, and Colorado State Park staff must submit a formal letter to the National Park Service recognizing the changes and stating that the park is not in default. If the facilities are removed and not relocated, then the state would be in default. However, all facilities are planned to be relocated, so this should not be a conflict with the LWCF Act and the State of Colorado.

In the UDV survey (described under Alternative 3 above), respondents were asked to state their visitation responses to Alternative 3 only. Because Alternative 4 would have similar but less severe effects on facilities at the park during and post-construction, BBC (2010) estimated impacts for Alternative 4 using Alternative 3 as an estimate boundary.

Under Alternative 4, overall visitor use at Chatfield is expected to decrease by 14.1 percent (from 1.66 million to 1.43 million visitors) during construction, by 8.0 percent (to 1.51 million visitors) 1 to 5 years after construction, and by 3.3 percent (to 1.61 million visitors) 6+ years after construction. Detailed information is available in Appendices T and U.

4.17.5 Reduction and Modification of Potential Impacts

Modification measures proposed under Alternatives 3 and 4 are discussed for each of the affected recreation use areas in Chatfield State Park. More detailed information can be found in Appendix M (EDAW 2010). In addition to the modification measures discussed below, the water providers continue to work with staff of Colorado State Parks to identify additional recreational features that could be implemented in order to enhance the recreational experience beyond what is captured within the federal plan. These features, while not considered part of the tentatively Recommended Plan, may be required by the State of the water providers prior to entering into contracts for water supply at Chatfield. These additional features provide additional assurance to State Parks that a like-kind recreational experience at Chatfield State Park would occur following a reallocation of storage space, as well as to ensure Colorado State Parks is compensated for any lost revenue or increased costs incurred as a result of this project. These additional measures are summarized at the end of this section, following modifications proposed as part of the tentatively Recommended Plan.

According to BBC (2010), the USACE and State Parks plan to minimize visitation loss under Alternative 3 by developing a construction schedule with minimal impact during high season (May 1 to September 30) and extensive impact during low season. The USACE and State Parks have agreed to allow the swim beach and marina to remain open from May through September during the entire construction period. Construction would begin in mid-September of year 1 and continue, uninterrupted, until mid-May of year 4. The overall construction period is estimated at 32 months. The construction period for recreation related economic impacts is estimated to occur over 2 years, as all facility closures would take place within the first 24 months of construction. EDAW (2010) documents an analysis that was performed to determine the best construction concept to minimize impacts to the public and to operations by State Parks and the Corps, balancing time and cost to complete the proposed recreation modifications. Six different construction schedules were evaluated. After careful consideration of the factors influencing the use and operation of the park, a combination of off-season and high-use season construction phasing was proposed. Under this option, construction would occur over a two-year, 8-month period, beginning in September of the first year. Construction activities would be sequenced to fit into 7-month, off-season (September 16 to May 14) periods. The north boat ramp, swim beach area, and marina area would remain open during the high-use season (May 1 through September 30). The portion of the park under construction would be closed during the off-season. Multiple crews would work 8- to 10-hour days simultaneously at multiple locations. Some activities would be performed during double-shifts to fit the proposed facility replacement into the 7-month off-season window. Smaller facilities would be reconstructed (in alternative locations) during the high-use season.

For any of the recreation modification facilities that would require fill placed within the flood control pool above elevation 5,444 feet msl, an equal amount of excavation would be required at similar elevations. For gently sloping areas, adaptive management, including proper signage and marking of hazards, will be used to minimize boating hazards in shallow waters during implementation.

As a modification measure for the North Boat Ramp, the boat ramps would be reconstructed to extend to the elevation of the existing ramps in order to operate at lower water levels. The slope on the new ramps would be reduced and day use shelters, furniture, and trails would be relocated (see Map 3.1 in EDAW 2010, Appendix M).

Modification to the Massey Draw area would include importing fill material to raise the elevation above 5,444 feet msl and create a useable recreational area in the same location with a similar amount of useable area that currently exists. Existing beach volleyball and horseshoe pits would be rebuilt. Furniture would be stored and relocated to the future area. Additionally, the service tank for the vault restroom would be relocated (see Map 3.2 in EDAW 2010, Appendix M).

Given Colorado State Park's goal of replacing affected facilities and use areas "in kind," the EDAW (2010) report (Appendix M) is based on maintaining current walking distances at the swim beach. To construct a new swim beach, the existing facilities would be demolished and excavated EDAW (2010) Sand would be saved and imported to create the new swim beach environment. The excavated material could be used to fill low areas that would be inundated at 5,444 feet msl to increase the amount of useable area. Additionally, the current buildings, lawn area, and recreational facilities would be rebuilt in the new location (Figure 4-21, also Map 3.3.1 in EDAW 2010, Appendix M). The proposed location would require a segment of the main park road to be relocated (see Appendix 2 in EDAW 2010, Appendix M). Costs associated with redevelopment and relocation of recreation facilities are presented in Appendix M.

As an additional modification measure, construction in the Swim Beach area would not occur between June and September of each year until complete. Redesigning the swim beach would carefully consider options that allow visitors to walk less distance to access the shoreline.

As part of the swim beach area, the Eagle Cove gravel parking area would be redeveloped in the same general area. Additionally, all affected existing facilities at the Deer Creek area would be redeveloped within the same area (EDAW 2010). The Deer Creek hot air balloon launch site would not be relocated. Instead, fill would be brought into the area to raise the balloon launch site to ensure that the area would not be inundated throughout the year (EDAW 2010). The Jamison day use area would be relocated south of its current location and parking and restroom facilities would be replaced (EDAW 2010).

The Catfish Flats and Fox Run group use areas would be modified slightly. The Catfish parking area, restroom, and picnic shelters would be relocated, while the Fox Run entrance to parking area would be reconstructed due to the new location of the main park road (see Map 3.4 in EDAW 2010, Appendix M).

To protect the Kingfisher area and gravel ponds that would be entirely inundated if Alternative 3 were implemented, one modification measure would include creating a berm and raising the park road in its current location (see Appendix 3 in EDAW 2010, Appendix M). A new bridge would be constructed across the South Platte River. A cross section and more detail are presented in Appendix M. This avoidance modification measure would ensure that the gravel ponds are not inundated, and therefore, the ponds still would be used for a variety of recreational uses. Additionally, new parking areas would be developed and existing trail connections and concrete trails would be redeveloped above the high waterline to provide similar recreation opportunities (see Map 3.5 in EDAW 2010, Appendix M).

Modification to the Riverside Marina would include constructing new breakwaters and placing earth fill on an elevated surface (Figure 4-22, also Map 3.6.1 in EDAW 2010, Appendix M). Below the Riverside Marina, the reservoir floor would be excavated down to a depth of 5,412 feet msl to enable it to operate at extreme low water levels. This excavated material could be used to raise the breakwater elevations and provide fill for other locations. The marina would operate close to the existing location. Due to a potential increase in water fluctuations, the existing cable and winch system would be replaced with a modern electronic winch system. The marina would be developed on a flotation system designed for the occurrence of water above 5,444 feet msl. The parking areas, day use shelters, group use area, and recreational areas associated with the south boat ramp areas in their present locations would be rebuilt on fill areas in the same general location where they

Source: Map 3.3.1 from Appendix M.

Figure 4-21
Swim Beach Area Modification Plan (5,444 ft) under Alternative 3

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Source: Map 3.6.1 from Appendix M

Figure 4-22.
Marina Area Modification Plan (5,444 ft) under Alternative 3

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currently exist. Trails and walkways in the inundated area would need to be rebuilt. Additionally, the Roxborough day use area would need to be relocated to a new location close to the existing one, where easy access to the shoreline, which it currently enjoys, would remain (EDAW 2010).

As a modification measure, construction in the marina area would occur between November and March of each year. This would ensure that park visitors and concessionaires (discussed more in Section 4.15, Socioeconomic Resources) are not significantly impacted.

For the purpose of this Feasibility level report and NEPA disclosure, Appendix M, ”Recreation Facilities Modification Plan” includes the EDAW report and Appendix N, “Chatfield Marina Reallocation Impact Assessment Report” includes the JJR report each depicting alternative designs and configurations for the marina. Each report presents different proposed relocation/modification measures and cost estimates. Future studies and final design work will assist with developing necessary details along with updated cost estimates for marina facility modification. Estimated costs from the EDAW report were originally included in the overall financial analysis and economic feasibility considerations by the federal sponsor. No parties are bound by either cost estimate, and they are included for informational purpose of scale and range only. The actual relocation/modification may take an alternative form reflecting additional factors which may result in actual costs that differ from those presented in this document.

Regardless of the final design details and construction cost estimates, the water providers affirm their support of the continued operation of a quality marina at Chatfield State Park, and to keep the marina operator financially whole for the duration of their lease. The water providers are committed to the costs of planning, design, engineering, permitting, and construction of in-kind replacement facilities to ensure the quality of the marina recreational experience remains the same, to the extent possible. The continuation of park and marina services will be planned to continue before, during, and following reallocation construction activities at Chatfield. Planning for the sequence of actions has begun with the initial EDAW report in the FR/EIS, and has continued with the funding and delivery of the JJR report in late 2010.

A more specific plan will be developed by the involved parties including the current lessee, North Shore Marina Chatfield, Inc., CWCB, Colorado State Parks, and the water providers and submitted to the Corps of Engineers for approval. The plan will address the marina relocation in its entirety, including elements identified in both the EDAW report and JJR report.

Modification measures to the Plum Creek area would include relocating the day use area to the southern edge of the reservoir. The recreational facilities would be replaced at this location and a new restroom would be built. Additionally, Plum Creek trailhead would be relocated to this area and inundated trail segments would be replaced (see Map 3.7 in EDAW 2010, Appendix M). A new trail bridge would be built to span the creek. Adaptive management by an established group would facilitate discussion of minimizing impacts by operation strategies once reallocation begins. Costs associated with redevelopment and relocation of recreation facilities are presented in Appendix M.

In addition, several features are being pursued by the water providers and the State outside of the tentatively Recommended Plan. One feature is grading, where not completed as a result of implementing the Recreation Modification Plan. Specifically, water providers have agreed to fund re-contouring along the south shoreline, portions of the west shoreline, and potentially other select sites to minimize the appearance of a "bathtub ring." To deal with recreation density issues, the water providers propose to work with State Parks and landowners adjacent to Chatfield State Park to maximize buffer areas (via easements) to offset the loss of usable land. Where the Recreation Modification Plan, Tree Management Plan, and CMP do not provide immediate replacement of natural shade for park visitors, the water providers have agreed to work with the State to provide for the reforestation of certain areas where State Parks feels it would help preserve park aesthetics and provide shade. In addition, as described in Section 4.15.5, while it is beyond the requirements of the tentatively Recommended Plan, the water providers will reimburse Colorado State Parks and the operators of the marina on an annual basis for lost revenues that result as a consequence of the reallocation.

4.18 Cultural Resources

This section describes the impacts of the study alternatives on cultural resources within the proposed APE. Adverse impacts on a significant cultural resource may occur as a result of pipeline construction under Alternative 1.

The APE would include a sufficient buffer around the lake to account for all needed facility relocations, and would also include a 50-foot buffer around all construction areas. Additionally, the APE would include a 50-foot buffer around the downstream gravel pits and the proposed Penley Reservoir and pipelines. No downstream adverse impacts are anticipated because modeling results show that flooding discharges downstream would be less than the current baseline conditions. The river stages resulting from these flows would also be reduced from the current baseline.

Archaeological Inventoried and Identified Sites

An online review of the Colorado Office of Archaeology and Historic Preservation Site Files System (COMPASS) resulted in the identification of 117 cultural properties that are listed in, eligible for listing, or potentially eligible for listing in the NRHP, within 1 mile of the APE for all study alternatives. Of these recorded sites and districts, one NRHP-eligible property could be affected within the project APE of Alternative 1 (Table 4-20).

Table 4-20
NRHP-Eligible Cultural Resources within Project APE

Site #	Site Name	Site Type	Site Age	National Register Status	Project Segment	Alter-native	Town-ship	Range	Section	Quarter
5DA922.1	Atchison, Topeka & Santa Fe Railroad (ATSF)	Trans-portation	1887	eligible	Plum Creek Reservoir Pipeline	1	7S	68W	19/20	SE/SW

4.18.1 Alternative 1—No Action

Review of state site files indicate that pipeline and infrastructure installation would adversely impact the Atchison, Topeka & Santa Fe Railroad (ATSF), a cultural resource that is eligible for NRHP listing. The ATSF was chartered in 1859 and was a major rail link between the Plains and the Rocky Mountain regions. A segment of the ATSF built in 1887 east of the town of Sedalia, Colorado, would be adversely affected by the proposed construction of the Plum Creek Reservoir Pipeline near the proposed Plum Creek Reservoir (Figure 2-1). The High Line Canal was constructed in 1883 for water control purposes. The Denver & Rio Grande Railroad was built in 1871, just 2 years after the completion of the first transcontinental railroad. After review of state site files, no NRHP-listed, eligible, or potentially eligible sites were identified in the proposed Penley Reservoir or the gravel pit locations associated with this alternative.

4.18.2 Alternative 2—NTGW/Downstream Gravel Pits

Alternative 2 proposes using NTGW and four downstream gravel pits for storage. No NRHP-listed, eligible, or potentially eligible cultural resources would be affected by this alternative.

4.18.3 Alternative 3—20,600 Acre-Foot Reallocation

The implementation of Alternative 3 would result in the inundation of 587 additional acres around the lake (Table 4-2). The effects of shoreline erosion are anticipated to be slight as changes to the target pool would occur slowly over a period of seasonal variation. Previous archeological investigations have identified 10 prehistoric and historic sites that are located within the zone of potential inundation. Based upon a recent cultural resources survey conducted by RMC Consultants on 3,605 acres within Chatfield State Park (Dominguez et al. 2007), the proposed change in pool elevation associated with Alternative 3 would not adversely affect any NRHP-listed or potentially eligible properties.

4.18.4 Alternative 4—7,700 Acre-Foot Reallocation/NTGW/Downstream Gravel Pits

In addition to the reallocation, another 5,348 acre-feet would be obtained from NTGW and downstream gravel pits under Alternative 4. The potential effects on cultural resources from conversion of downstream gravel pits to water storage reservoirs and use of NTGW are disclosed under Alternatives 1 and 2, respectively. Fewer and/or smaller gravel pit reservoirs would be needed under Alternative 4 than under Alternative 1 or 2.

Alternative 4 would result in the inundation of 215 additional acres of shorefront around the lake. As in Alternative 3, alterations in the target pool would occur slowly, minimally affecting shoreline erosion during seasonal drawdown and filling. Based upon the results of Dominguez et al. (2007), it is concluded that no significant cultural resources would be adversely affected by the proposed change in pool level.

4.18.5 Reduction and Mitigation of Potential Impacts

It is recommended that project-generated adverse impacts on the linear NRHP-eligible property (the ATSF) be avoided by direct-drill installation of proposed pipelines beneath the affected property. If adverse impacts on the properties cannot be avoided in this manner, then mitigation of adverse impacts should be undertaken by thorough documentation of the affected property in accordance with the Colorado State Historic Preservation Office (SHPO) guidelines and standards.

4.19 Cumulative Impacts

This section describes the potential cumulative impacts that would result from the proposed alternatives combined with other projects and activities. In general, discussions emphasize the alternatives that would affect each resource. Alternatives that would not affect a resource are generally not addressed in the cumulative impacts discussions.

The CEQ regulations for implementing NEPA define cumulative impacts as "the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions and regardless of what agency (Federal or non-Federal) or person undertakes such actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time" (40 CFR 1508.7).

The cumulative impacts of a proposed alternative can be viewed as the total impacts on a resource, ecosystem, or human community of the actions included in that alternative and all other activities affecting that resource. In many ways, scoping is the key to analyzing cumulative impacts; it provides the best opportunity for identifying important cumulative impact issues, setting appropriate boundaries for analysis, and identifying relevant past, present, and future actions.

Past, present, and reasonably foreseeable future projects that may have cumulative impacts on the resources in Chatfield State Park, and downstream of Chatfield are presented in this section. These projects and their relationships to the Chatfield FR/EIS study and each resource are described below.

In addition, the best available scientific evidence based on observations from long-term monitoring networks indicates that climate change is occurring and will continue to occur (Brekke et al. 2009). Climate change affects affect water availability, water demand, water quality, stormwater and wastewater infrastructure, flood infrastructure, wildland fires, and ecosystem functioning. These factors affect the water resources projects operated by the Corps, many of which were designed and constructed before climate change was recognized as a potential influence (USACE 2010d). Potential climate change impacts affecting water availability include changes in precipitation amount, intensity, timing, and form (rain or snow); changes in snowmelt timing; and changes to evapotranspiration (Brekke et al. 2009). Water supplies in the southwestern United States are projected to become increasingly scarce, calling for trade-offs among competing uses (Karl et al. 2009). However, the current state of the science is unable to provide sufficient information to decision makers and stakeholders on a number of crucial scientific issues regarding Colorado's water resources (Ray et al. 2008). Four overlapping areas with unresolved issues are climate models, research specific to Colorado, drought, and reconciling hydrologic projections (Ray et al. 2008).

The results from several general circulation models agree that the southwestern United States is likely to experience precipitation and evapotranspiration changes that result in less runoff and water availability (Brekke et al. 2009). The consistent projections for a substantial temperature increase across Colorado have important implications for water management (Ray et al. 2008). Increases in temperature imply more evaporation and evapotranspiration leading to higher water demands for agriculture and outdoor watering. Temperature-related changes in the seasonality of streamflows (e.g., earlier runoff) may complicate prior appropriation systems and interstate compact regimes; and modify the interplay among forests, hydrology, wildfires, and pests (e.g., pine beetles) (Ray et al. 2008). The wide range of Colorado precipitation projections makes it difficult to assess likely changes in annual mean precipitation by mid-21st century. However, a synthesis of findings (Ray et al. 2008) suggests a reduction in total water supply by then. Limitations imposed on water supply by projected temperature increases are likely to be made worse by reductions in rain- and snow-fall in spring months when precipitation is most needed to fill reservoirs to meet summer demand (Karl et al. 2009). Furthermore, there is potential for increased drought severity in the region due to higher temperatures alone.

4.19.1 Project Descriptions

The following 20 projects were identified based on comments during scoping, as well as discussions with the water providers as past, present, or reasonably foreseeable future projects that could have a cumulative impact on the resources evaluated under the Chatfield FR/EIS study. Table 4-21 provides a summary of the projects, along with references for additional information.

Table 4-21
Past, Present, and Foreseeable Future Projects Considered As Part of the Cumulative Impacts Analysis

Project	County	Timeframe	Reference
Chatfield Reservoir Drought Drawdown	Arapahoe, Douglas, Jefferson	Reasonably foreseeable future	Denver Water and USACE - Reference not available
Halligan-Seaman Water Management Project	Larimer	Reasonably foreseeable future	City of Fort Collins and City of Greeley - http://www.halligan-seaman.com
Northern Integrated Supply Project	Larimer, Weld	Reasonably foreseeable future	Northern Colorado WCD - http://www.ncwcd.org/project_features /nisp_main.asp
Denver Water Moffat System Improvement Project	Boulder, Clear Creek, Douglas, Gilpin, Jefferson, Park, Summit, Teller	Reasonably foreseeable future	USACE - https://www.nwo.usace.army.mil/html/od-tl/eis-info.htm
Rueter-Hess Reservoir Project	Douglas	Reasonably foreseeable future	Parker WSD - http://www.rueterhess.com/
Issuance of Permit for Incidental Take of Preble's Mouse	Boulder, Douglas, Jefferson	Past	Denver Water - http://www.epa.gov/fedrgstr/EPA-IMPACT/2003/February/Day-10/i3133.htm and http://www.epa.gov/fedrgstr/EPA-SPECIES/2003/June/Day-03/e13783.htm
Last Chance Water Diversion to Conduit 20 at Kassler	Arapahoe, Douglas, Jefferson	Past	Denver Water (Bob Peters)
Denver Water Temporary Chatfield Pump Station	Arapahoe, Douglas, Jefferson	Past	Denver Water (Bob Peters)
Wastewater System Improvements/Wastewater Interceptor Project for the Roxborough Wastewater Treatment Plant	Douglas	Past	Roxborough Water and Sanitation District - http://www.tstenvironmental.com/ projects.html and http://denver.yourhub.com/Roxborough/ Stories/News/About-Town/Story~1520.aspx
Re-routing of Sewer across Plum Creek	Douglas	Past	Chatfield State Park and USACE - Roberts and Johnson, 2003
CDOT Projects – Widening U.S. 85/Santa Fe Drive	Douglas	Present	CDOT - http://www.southi25.com/ US85_Widening.htm
CDOT Projects: Widening I-25/ Castle Rock	Douglas	Present	CDOT – http://www.southi25.com/ SI25_Widening.htm
CDOT Projects: 2030 Metro Vision	Adams, Arapahoe, Boulder, Broomfield, Denver, Douglas, Jefferson	Present/ Reasonably foreseeable future	CDOT - http://www.drcog.org/ index.cfm?page=Regional Transportation Plan
CDOT Projects: C470 Corridor Plan	Jefferson	Present/ Reasonably foreseeable future	CDOT - http://co.jefferson.co.us/ planning/planning_T59_R12.htm
CDOT Projects: South Jefferson	Jefferson	Present/	CDOT -

Table 4-21
Past, Present, and Foreseeable Future Projects Considered As Part of the Cumulative Impacts Analysis

Project	County	Timeframe	Reference
County Community Plan		Reasonably foreseeable future	http://co.jefferson.co.us/planning/ planning_T59_R24.htm
Lockheed Martin Wetland Projects	Jefferson	Past/Present	Lockheed Martin - http://www.voc.org/site/ static/pdfs/factSheets/ VOCProjectFactSheet2005 ChatfieldWetlands.pdf? PHPSESSID=401595c0bcf5.
South Platte Reservoir Project	Arapahoe	Past	Centennial WSD - http://www.deereault.com/ damandreservoir.html#2
Gravel Pits	Multiple	Present/ Reasonably foreseeable future	Multiple Water Providers
Residential Development Projects	Douglas, Jefferson	Present/ Reasonably foreseeable future	Multiple Developers - http://www.douglas.co.us/ community/planning/Zoning.html and http://www.jeffco.us/planning/
Plum Creek Reservoir	Douglas	Reasonably foreseeable future	Town of Castle Rock, Castle Pines Metropolitan District, and Castle Pines North Metropolitan District

4.19.1.1 Project 1—Chatfield Reservoir Drought Drawdown

A draft proposal by Denver Water for the Chatfield Reservoir Drought Drawdown is being considered to operate a pump station at the outlet works of Chatfield Reservoir to access its stored water below 5,423 feet msl. The reservoir has not been below 5,423 feet msl since the reservoir first filled in 1979. The pump station could be used to manage water levels during normal conditions and for municipal water supply needs during drought conditions. The pump station would cause the reservoir to drop by a constant rate of 100 acre-feet per day, which includes a 20-acre-foot drop via the Chatfield ditches and a 20-acre-foot drop via evaporative loss. This pumping would allow use of water in the drought pool, between 5,423 and 5,385 feet msl.

In addition to the proposed action described in the previous paragraph, the draft proposal also analyzes a No Action Alternative. Under this alternative, no efficient means to move water out of storage below the 5,423 feet msl exists. To meet customers' water needs during a drought, another source of water and additional pipelines would need to be developed. Information about the location or total length of pipeline that would be necessary is unavailable.

4.19.1.2 Project 2—Halligan-Seaman Water Management Project

The Halligan-Seaman Water Management Project has been proposed by the cities of Fort Collins and Greeley and six other water providers. Plans involve two water supply projects designed to provide drought protection for existing and future water demands, more efficiency in managing the existing or future water rights of the six other water providers, some operational redundancy, and possibly environmental benefits. The project involves enlarging two existing reservoirs: Halligan Reservoir and Milton Seamen Reservoir, resulting in approximately 88,592 acre-feet of additional storage capacity in the Cache la Poudre River Basin. Fort Collins and Greeley have proposed a preferred configuration of the project(s), which involves the construction of new, larger dams immediately downstream of the existing Halligan and Seaman dams. Preliminary analyses by the cities indicate that the enlarged reservoirs would fill primarily during the summer and fall months from North Fork Poudre River flows. Milton Seaman Reservoir also would fill via a pump station on the Poudre River mainstem near the dam site. Small releases are proposed throughout the year on a periodic basis to maximize operational efficiency. Fort Collins and Greeley anticipate that both reservoirs are expected to remain mostly full except during drought periods. The Halligan-Seaman Water Management Project would be a non-federal project constructed, owned, and operated by the cities and/or other water providers.

4.19.1.3 Project 3—Northern Integrated Supply Project

The Northern Integrated Supply Project (NISP) is a collaborative regional water supply project between 15 water providers and the Northern Colorado WCD acting by and through the Northern Integrated Supply Project Water Activity Enterprise. The project would provide approximately 37,000 acre-feet of new reliable water supply, which would meet a portion of the estimated 2025 additional water supply needs of the 15 water providers. Currently, most of the providers predominantly rely on Colorado-Big Thompson units to meet their growing water supply needs. The proposed project would occur in Larimer and Weld counties in Colorado. It would include a proposed Glade Reservoir with a capacity of approximately 177,000 acre-feet. Associated with Glade Reservoir are a forebay, pump station, and canal upgrade to convey water diverted from the Cache la Poudre River to the proposed reservoir. A pipeline connecting the proposed Glade Reservoir to the existing Horsetooth Reservoir is proposed. Glade Reservoir would inundate a section of U.S. Highway 287 and require the relocation of about 7 miles of the highway. Additionally, Glade Reservoir would inundate a section of the North Poudre Supply Canal and a portion of the canal would need to be rerouted. The proposed project also would include a proposed Galeton Reservoir with a capacity of approximately 30,000 acre-feet. Associated with Galeton Reservoir are a forebay, pump station, and pipeline to deliver South Platte River water to Galeton Reservoir. Water exchanges between the Galeton Reservoir and Glade Reservoir diversion locations are proposed. NISP would be a non-federal project constructed, owned, and operated by the Northern Integrated Supply Project Water Activity Enterprise.

4.19.1.4 Project 4—Denver Water Moffat System Improvement Project

The Denver Water Moffat System Improvement Project was proposed by the City and County of Denver, acting by and through its Board of Water Commissioners (Denver Water). Denver Water identified four needs in the Moffat Collection System that have to be solved. First, existing water demands served by Denver Water's Moffat Collection System exceed available supplies from the Moffat Collection System during a drought, causing a water supply reliability problem. Second, Denver Water's collection system is vulnerable to manmade and natural disasters because 90 percent of available reservoir storage and 80 percent of available water supplies rely on the unimpeded operation of Strontia Springs Reservoir and other components of Denver Water's South System. Third, Denver Water's treated water transmission, distribution, and water collection systems are subject to failures and outages caused by routine maintenance, pipe failures, treatment plant problems, and a host of other unpredictable occurrences that are inherent in operating and maintaining a large municipal water supply system. These stresses to Denver Water's ability to meet its customers' water demands require a level of flexibility within system operations that is not presently available. Finally, Denver Water's near-term water resource strategy and water service obligations that have occurred since the Integrated Resources Plan was developed in 1997 and updated in 2002, has resulted in a need for 18,000 acre-feet of new near-term water supplies. Denver Water has proposed meeting those needs by enlarging Gross Reservoir in Boulder County. Denver

Water is in the process of amending the FERC license and drafting an EIS for the project. In fall 2008, the Corps completed the Preliminary EIS and the Draft EIS was released October 30, 2009. The Final EIS is expected to be published in fall 2010.

4.19.1.5 Project 5—Rueter-Hess Reservoir Project

The Rueter-Hess Reservoir is an existing reservoir located east of Chatfield Reservoir. The Parker WSD will expand the Rueter-Hess Reservoir to provide sufficient storage of Denver Basin groundwater, and the associated reuse water from initial Denver Basin use, for selected South Metro Denver area water providers, and to assist in sustaining the Denver Basin aquifers. The project was conceived to allow the reservoir to serve as a regional water management facility for multiple water providers in northern Douglas County; enable them to meet peak demands; greatly enhance water management in the region; and help extend the yield of the Denver Basin aquifers, a non-renewable water source and the primary source of water for the South Metro area. Expansion of the reservoir will result in direct impacts on an additional 0.21 acres of wetlands and 4 miles of intermittent stream channel (in addition to the 6.7 acres of wetlands and 5 miles of other waters of the U.S. permitted as part of the 16,200-acre-foot reservoir).

Parker WSD will enlarge the Rueter-Hess Reservoir from the currently permitted design of 16,200 acre-feet by 55,800 acre-feet for a total storage capacity of approximately 72,000 acre-feet. This is considered the site's maximum storage capacity based on the site's topography. The proposed expanded reservoir pool will inundate approximately 1,140 acres (an additional 672 acres). Parker WSD will maintain a 5,000 acre-feet emergency reserve pool in the reservoir (elevation 6,110 feet msl) to be used as needed to provide a reliable water supply for its customers. The design involves raising the currently permitted dam (embankment) by 60 feet, to a crest elevation of 6,219 feet, using a downstream raise concept. In addition to the expanded reservoir, new pipelines will be installed to deliver the water to and from the new project participants (Town of Castle Rock, Castle Pines North Metropolitan District, and Stonegate Metropolitan District).

Groundbreaking for the dam expansion began on September 5, 2008. The dam expansion is expected to be complete in fall 2009, and the enlarged reservoir is expected to be filled by summer 2010.

4.19.1.6 Project 6—Issuance of Permit for Incidental Take of Preble's Mouse

In February 2003, the City and County of Denver, acting by and through its Board of Water Commissioners (Denver Water) applied to the USFWS for an Incidental Take Permit (ITP) pursuant to section 10(a)(1)(B) of the ESA of 1973, as amended. The permit authorized the loss and modification of habitat associated with Denver Water's Operations and Maintenance (O&M) activities and the incidental take of Preble's meadow jumping mouse (*Zapus hudsonius preblei*), federally listed as threatened. In June 2003, the USFWS issued a permit for incidental take of threatened species. The permit is in effect for 30 years from the date of issuance. The application included a proposed Habitat Conservation Plan (HCP) and Environmental Assessment (EA) for the Preble's meadow jumping mouse on Denver Water properties.

The applicant's plan to conduct O&M activities necessary for Denver Water to meet its mission of providing a safe and high quality water supply to its customers covers properties that may constitute Preble's mouse habitat in Boulder, Jefferson, and Douglas counties in Colorado. Such activities would include repair and maintenance of infrastructures and facilities (e.g., conduits, siphons), ditch/canal maintenance, road repair and maintenance, construction of new conduits, burial of pipeline, and other activities necessary for municipal water supply. The planning area for the permit application covers approximately 6,000 acres of properties that may constitute Preble's mouse habitat. The O&M activities would permanently alter no more than 10 acres of potential Preble's mouse habitat, but are estimated to only permanently impact 1 acre. Additionally, up to 74 acres of potential Preble's mouse habitat would be temporarily impacted, with total impacts not to exceed 75 acres (either 1 acre permanent and 74 acres temporary or ranging up to no more than 10 acres permanent and 65 acres of temporary disturbance).

Alternatives considered were: No Action; individual ITPs on a site-by-site or project-by-project basis, as needed; waiting for approval of and participating in three separate countywide HCPs; waiting for and participating in a single Statewide HCP; and the Preferred Alternative–a single ITP held by Denver Water, achieved through the proposed HCP. None of these alternatives, except No Action, eliminated potential take of Preble's mouse.

4.19.1.7 Project 7—Last Chance Water Diversion to Conduit 20 at Kassler

While the Kassler Water Treatment Plant was in operation (prior to 1985), Conduit 20 was used as part of the plant's water distribution system. This pipeline originates in Waterton Canyon approximately 3 miles upstream from the Waterton Canyon entrance and is still used as part of the water distribution system in this area. In 2002 Denver Water constructed a pipeline to carry water from the South Platte River in the former Last Chance Ditch to a pump located at the Kassler Plant. The pump delivers the water diverted to Conduit 20. Denver Water is required to maintain flow in the South Platte River below the Last Chance Ditch diversion to Chatfield. From mid-September to mid-May, a minimum of 15 cfs must be maintained. During the rest of the year, flows are maintained at 60 cfs, unless Denver Water has implemented water use restrictions. As water restrictions become more severe, the amount of water that Denver Water allows to flow downstream can be reduced.

4.19.1.8 Project 8—Denver Water Temporary Chatfield Pump Station

Denver Water installed submersible pumps in Chatfield Reservoir that can be operated while the reservoir is between 5,432 feet msl and 5,427 feet msl. Water is pumped to Conduit 20, which goes to Marston Reservoir.

4.19.1.9 Project 9—Wastewater System Improvements/Wastewater Interceptor Project for the Roxborough Wastewater Treatment Plant

The Roxborough Wastewater Treatment Plant was proposed to connect Roxborough to the Littleton/Englewood Wastewater Treatment Plant. TST, Inc. designed a lift station and 7 miles of force main pipeline to connect the District to the Littleton/Englewood Wastewater Treatment Plant. The proposed project crossed the South Platte River, a Chatfield Watershed Authority Section 404 jurisdictional water and lands managed by the USACE for flood storage in the Chatfield Reservoir pool. TST, Inc., with assistance from ERO Resources, completed an EA for the area affected by the proposed lift station and force main pipeline. Potential adverse impacts on protected and sensitive species (bald eagles, Preble's meadow jumping mouse, and black-tailed prairie dogs) were specifically considered as part of the report. Wetlands, 100-year flood plains, surface and groundwater quality and quantity, cultural and historical resources, air quality, and geology were also assessed in the NEPA document. The EA included development of a GIS database with numerous resource layers facilitating impact assessment. Construction of facilities was completed in August 2007 and was operational in November 2007.

4.19.1.10 Project 10—Re-routing of Sewer across Plum Creek

In October 2002, the USACE issued a Nationwide Permit for the construction of a 5,960-foot sewer force main pipeline near Plum Creek on Chatfield State Park. During the planning process, the project was determined to have potential temporary adverse impacts on 0.75 acres of wetland and Preble's mouse habitat. Two acres of off-site Preble's mouse habitat enhancement and restoration were proposed as mitigation and approved by regulatory agencies after the completion of ESA Section 7 consultations. In January 2003 the USFWS approved a 2.00-acre mitigation site located approximately 250 feet south of the pipeline restoration area. Conditions of the Section 404 permit included stockpiling and redistributing topsoil; reseeding with native species and herbaceous, shrub, and tree species; planting to minimize erosion; implementing weed control to limit coverage of noxious weeds to less than 5 percent of the construction and mitigation area; avoiding construction during the active season for Preble's mouse; monitoring revegetation; and protecting plantings in the mitigation area from large herbivore browsing.

4.19.1.11 Project 11—CDOT Projects: Widening U.S. 85/Santa Fe Drive

The Colorado Department of Transportation (CDOT) proposed to widen U.S. 85/Santa Fe Drive just north of Sedalia. Work included widening the highway in concrete from two to four lanes (0.5 mile), new median construction, drainage improvements, landscaping, signing, and striping. CDOT also completed earthwork and relocating utilities just south of Sedalia. Sema Construction Inc. of Centennial, Colorado, is the contractor for the $2.8 million project, which was completed in 2007.

4.19.1.12 Project 12—CDOT Projects: Widening I-25/Castle Rock

Construction to widen I-25 through Castle Rock, from 5th Street to Meadows/Founders Parkway, started on August 28, 2006. This project involves expansion of I-25 to three lanes in each direction, and flattening the existing curves in this section. Construction has been completed on the major interchanges in this segment.

4.19.1.13 Project 13—CDOT Projects: 2030 Metro Vision

The 2030 Metro Vision Regional Transportation Plan (2030 MVRTP) addresses the challenges and guides the development of a multimodal transportation system over the next 26 years. It is an element of the overall Metro Vision 2030 Plan adopted by the DRCOG. To meet current and future challenges, the 2030 MVRTP includes plans to enhance the relationship between transportation and land use development, provide for maintenance of the existing system, incorporate transportation management actions to increase the existing system's efficiency, include travel demand management efforts to slow the growth of single-occupant vehicle trips, identify transit and roadway improvements to increase the system's people-carrying and freight movement capacity, add bicycle and pedestrian facilities, prioritize improvements considering limited resources, integrate plan components to result in a connected and complete system, encourage coordination between neighboring communities and between agencies, and support the Metro Vision urban center, extent of development, environmental quality, and freestanding community elements.

4.19.1.14 Project 14—CDOT Projects: C470 Corridor Plan

A 1999 Jefferson Economic Council (JEC) study revealed that only 4,000 acres of developable commercial and industrial land remained within Jefferson County. The Jefferson County Planning Commission directed JEC and the Planning and Zoning Department to write Land Development Policies to remedy this shortage. Approved policies were incorporated into the county's Policy and Procedures Manual in 2002 by the Board of County Commissioners.

In 2001, the Planning Commission and the Board of County Commissioners directed staff to develop a plan for the C-470 corridor to identify and designate locations for employment-generating land uses. Three prime locations for employment-generating land uses along the C-470 corridor were identified: Bowles, Belleview, and Ken-Caryl. The C-470 Corridor Plan is intended to encourage the development of job opportunities along the C-470 corridor to improve the county's jobs-to-population imbalance. This plan provides land use recommendations for office development and smaller-scale retail that would support office development. This plan includes the C-470 area adjacent to Chatfield Reservoir.

4.19.1.15 Project 15—CDOT Projects: South Jefferson County Community Plan

The South Jefferson County Community Plan is a set of policy recommendations developed for the southeastern portion of Jefferson County. Its purpose is to serve as a guide for land use and service decisions now and in the future. Included in the plan are guidelines for land use activities, including activity centers, arterial/arterial intersections, open spaces, trails, parks, utilities and services, and redevelopment to encourage the reuse of existing facilities. In addition, subareas are identified within the plan as areas west of the Hogback and in the rural plains, and guidelines are laid out specific to these areas to maintain their unique character. This plan includes the area around Chatfield Reservoir.

4.19.1.16 Project 16—Lockheed Martin Wetland Projects

The Chatfield Wetlands were created in the mid-1990s by Martin Marietta, the predecessor to Lockheed Martin, in partnership with Colorado State Parks, the USACE, and Ducks Unlimited. Approximately 13 acres of wetlands were constructed in Chatfield State Park west of the South Platte River near the southern boundary of the park. The wetlands contain many cells of varying sizes that filtered effluent from Lockheed Martin. The effluent reached the wetlands by flowing through a ditch located close to a viewing platform and interpretive area. Usage was discontinued prior to 2007 by order of the CDPHE when water quality testing showed one of the components of the effluent exceeded State of Colorado standards. The effluent now flows through a pipeline that was installed across Chatfield State Park near the wetlands and is discharged into the South Platte River.

Lockheed Martin also discharges effluent to the South Platte River upstream of Chatfield Reservoir. The water quality of the effluent is monitored under the Colorado Discharge Permit System and must meet applicable water quality standards.

4.19.1.17 Project 17—South Platte Reservoir Project

The South Platte Reservoir Project was built over a 13-year timeline and completed in 2007 by Centennial WSD. This former gravel pit, which was condemned for the reservoir, provides raw water storage to the district, which provides water service to Highlands Ranch. This reservoir covers approximately 215 acres, and is about 60 feet deep. Water is taken out using a pump station and a 48-inch, 60-cfs pipeline to McLellan Reservoir or the district's water treatment plant. A Section 404 permit was required to build the project. To mitigate the 0.45 acres of wetlands disturbed by construction, the permit required that all disturbed wetlands plants be replaced. Specific numbers of plants and types of plants are listed as follows: 110 shrubs, 15 cottonwoods, and 360 bulrush plants. Surveys were conducted for Preble's meadow jumping mouse and Ute ladies'-tresses orchid, and none were found. The reservoir was operational in spring 2008, and the capacity is 6,400 acre-feet of raw water storage for domestic use. The reservoir site will not be used for public use.

4.19.1.18 Project 18—Gravel Pits

Approximately 41 gravel pits located north of Denver have been built or are planned to be converted into reservoirs, similar to the South Platte Reservoir Project above (Table 4-22). About half of these gravel pits have been built or are under construction, and the remaining half are planned to be built in the future. The gravel pits are or would be located along the South Platte River from Denver to Brighton and possibly even farther downstream. Based on the available information, the largest gravel pit (Lupton Lake) would hold approximately 11,000 acre-feet of water, and the smallest gravel pit (Tanabe) would hold approximately 700 acre-feet of water (Table 4-20). These gravel pits would have pipeline facilities; however, information about these pipelines was not available at the time of the study.

Table 4-22
Existing or Planned Gravel Pit Reservoirs North of Denver

No.	Name	Owner	Built or Under Construction	Planned	Size (acre-feet)	Surface Area (acres)	Year Put into Service
1	Cat	Denver Water (DW)/ South Adams County Water and Sanitation District (SACWSD)	X		1,700		2009
2	Miller	Denver Water/SACWSD	X		2,100		2009
3	South Tani Reservoir	Thornton	X		7,241	237	1988
4	East Gravel Lake #4	Thornton	X		2,807	112	1988
5	South Dahlia	Thornton	X		1,777	86	1998
6	West Gravel (3)	Thornton	X		2,840	100	1990
7	North Dahlia	Thornton	X		2,568	104	2002
8	Sprat Platte Ranch aka East Sprat Platte	Thornton	X		1,700	87	2002
9	West Sprat Platte	Thornton	X		1,900	62	2002
10	Cooley Lake West (3)	Thornton	X		4,400	200	2008
11	Cooley Lake East	Thornton	X		5,100		2013
12	Tanabe	DW/SACWSD		X	700		
13	Howe Haller A&B	DW/SACWSD		X	6,350		
14	Hazeltine/Rd Runn II	DW/SACWSD		X	5,600		
15	Dunes	DW/SACWSD		X	5,200		
16	Mann Lake So (3)	Adams County	X		5,000		
17	Brannon	FRICO/United	X	X	6,000		
18	Worthing			X			
19	Tower			X	2,100		
20	So. Hammer	Thornton	X				
21	No. Hammer	Thornton	X		1,600		
22	Bromley Lakes (3) aka Ken Mitchell Lakes	Brighton	X	X	9,000		Partially 2007
23	Rogers	Thornton	X		2,500		
24	Wattenburg	Westminster	X		1,200		
25	Platte Valley			X			

Table 4-22
Existing or Planned Gravel Pit Reservoirs North of Denver

No.	Name	Owner	Built or Under Construction	Planned	Size (acre-feet)	Surface Area (acres)	Year Put into Service
26	Fort. Lupton (3)	Thornton	X		2,700		
27	Walker	Aurora	X				
28	Stillwater/Brighton Resources	Aurora		X			
29	Lupton Lake	Denver		X	11,000		2020
30	Koenig	Central Colorado WCD	X		1,300		2001
31	124th Ave (Brighton)	Brighton	X		1,000		2004
32	Tucson	Aurora	X				
33	Arvada Pit	Arvada	X				
34	120th Avenue/Hwy 85	120th Estate Partners	X	X	1,300	41	
35	Erger Pond	Ready-Mixed/Boral	X	X	1,600	94	
36	Crabb Trust Pond	Crabb Family		X			
37	E-470 Pond	E-470 Authority		X		33	
38	Front Range Agg.	Front Range Agg.		X			
39	Aggregate Ind.	Aggregate Ind.					
40	Aggregate Ind.	Aggregate Ind.					
41	Albert Frei (2)						

Source: McLoud 2007a

4.19.1.19 Project 19—Residential Development Projects: Jefferson/Douglas Counties

Residential development is happening around Chatfield, mostly to the south of the reservoir. This development is removing wildlife habitat by building housing communities in the area. Currently, the open spaces of undeveloped land to the south of the park are ad-hoc wildlife habitats.

The U.S. Census Bureau (2006) data indicate that there are a total of 226,195 housing units in Jefferson County and a total of 95,511 housing units in Douglas County. In 2005, a total of 3,671 housing units were built in Jefferson County, and another 6,902 housing units were built in Douglas County. These data are not site specific, so the locations where the houses were built within each of the counties could not be determined. However, there are some undeveloped properties located near Chatfield that could be developed in the future, as illustrated by the Jefferson and Douglas county zoning maps (see discussion below).

Jefferson County

The Jefferson County zoning map identifies a few pockets of open space around Chatfield State Park. The portion of Jefferson County south of C-470 and east of Wadsworth is zoned Agriculture-One Zone District (A-1). The A-1 district is "intended to provide for limited farming, ranching and agriculturally related uses while protecting the surrounding land from any harmful effects. A revision in March 1972 increased the minimum land area for this district to 5 acres. Contained in this section are the allowed land uses, building and lot standards (including minimum setbacks) and other general requirements specified for this zone district" (Zoning Resolution). The Lockheed Martin property is zoned Industrial-One Zone District (I-1). The I-1 district is "intended to provide areas for medium industrial development. Contained in this section are the allowed land uses, building and lot standards (including minimum setbacks) and other general requirements specified for this zone district" (Zoning Resolution). South and west of the Lockheed Martin property, it is zoned

Agriculture-Two Zone District (A-2) but there are several small pockets of residential development scattered throughout that area (it appears those subdivision pockets were rezoned). The A-2 district is intended to provide for general farming, ranching, intensive agricultural uses and agriculturally related uses while protecting the surrounding land from any harmful effects. A revision in March 1972 increased the minimum land area for this district to 10 acres. Contained in this section are the allowed land uses, building and lot standards (including minimum setbacks) and other general requirements specified for this zone district" (Zoning Resolution). The Chatfield Green (owned by the City of Littleton) is the subdivision just north of Lockheed Martin on the west side of Wadsworth. It is surrounded by open space. The city of Littleton has numerous subdivisions on the north side of C-470.

Douglas County

Everything south of Chatfield State Park is currently zoned, planned, or zoned A-1. North of Titan Road and south of Chatfield State Park, there are several subdivisions. Also, east of Santa Fe Drive, there are multiple subdivisions and industrial areas. There are some planned (urban and non-urban) developments in these areas too. Industrial developments are abundant along Santa Fe Drive. South of Titan Road and west of Santa Fe Drive, development against the mountain range is planned. The east side of Santa Fe Drive is being developed heavily at this time, down to Castle Rock and I-25.

4.19.1.20 Project 19—Plum Creek Reservoir

The Town of Castle Rock, Castle Pines Metropolitan District, and Castle Pines North Metropolitan District are considering constructing the "Plum Creek Reservoir" in Douglas County. The proposed location is about 3 miles southeast of Sedalia, CO and is shown in Figure 2-5. The reservoir would have a capacity of 1,200 to 1,700 acre-feet. Studies are being conducted regarding the size and economic feasibility of the reservoir. Castle Pines Metropolitan District and Castle Pines North Metropolitan District jointly have applied for Water Court Decrees allowing storage in Plum Creek Reservoir of existing and applied-for conditional East Plum Creek water rights. The Districts also seek rights of exchange from Chatfield Reservoir to Plum Creek Reservoir and would store recaptured reusable water rights in the Plum Creek Reservoir if the Chatfield Reallocation project were approved. However, as indicated in Section 2.4.1.1, the reservoir will be constructed regardless of whether the Chatfield reallocation is approved. Currently, there is not a firm construction schedule, but the parties expect that construction likely will occur within the next five to ten years.

4.19.2 Geology and Soils

Current and projected land development would not result in significant cumulative impacts on geological hazards (i.e., potential slope failure, seismicity, and stability). Cumulative impacts on geologic resources are considered negligible. Land and transportation development unavoidably involves disturbance to soils during construction. Inundation of soils with water storage projects would also result in long-term commitment of soils. Short- and long-term adverse impacts on soils include excavation, removal, erosion, inversion of soil layers, compaction, and covering by buildings and pavement. These activities result in soil loss, mixing or burial of topsoil, reduction in surface soil quality, and arresting of normal soil development. Soils that are located under buildings or pavement can be considered to be permanently lost. Soils that become irrigated lawns or gardens may be improved through tillage, soil amendment, and fertilization. Erosion would be limited because of state requirements for stormwater management and fugitive dust control plans. For soils with high shrink-swell potential, this limitation should be considered in foundation design and home landscaping. Soil impacts would generally be confined to the individual construction areas and are considered minor. There would be no interaction between impacts in different parts of the study area (impacts would be additive and not synergistic).

4.19.3 Hydrology

Cumulative impacts on NTGW relate to the increased population growth and related demand for Denver Basin aquifer NTGW. Under Alternative 2 the cumulative impact of relying on NTGW would be to significantly reduce the pressure in the NTGW aquifers, which would result in significantly lower production rates (Black & Veatch et al. 2003). Few of the listed activities would further rely on NTGW.

In terms of surface water, the South Platte River Basin was considered for potential cumulative impacts on hydrology. Previous water storage and water diversion projects have historically impacted the study area by altering the amount and duration of flows. Historically, flows in the Platte River were estimated at about 2.6 million acre-feet annually, or approximately 3,590 cfs (Sidle and Faanes 1997). Mean annual flows in the Platte River at Overton, Nebraska, have ranged from 320.9 to 2,622 cfs in the past 10 years (USGS 2008). The scale of the proposed alternatives, in combination with the list of past, present, and foreseeable future water development projects, would not significantly alter the hydrologic regime of this river basin. The Chatfield Reservoir Drought Drawdown, the Denver Water Moffat System Improvement Project, the Rueter-Hess Reservoir Project, the Last Chance Water Diversion to Conduit 20 at Kassler, the Denver Water Temporary Chatfield Pump Station, and the gravel pit reservoirs could each affect the amount and timing of water in the South Platte River locally. For many of these projects, quantitative analyses of their potential impacts on local South Platte flows are not available. The Final Supplemental EIS for the Rueter-Hess Reservoir Expansion indicates that the project will not result in flow depletions in the South Platte River. Given the scale of the flows in the river system, the overall cumulative impact of these projects on the river's hydrologic regime would not likely be significant.

The proposed transportation and development projects could increase the flashiness (i.e., shorten the time between a storm event and the rising of stream waters, as in a flash flood) of this portion of the South Platte River Basin by reducing infiltration and routing water directly to the river. The activities under the proposed alternatives would not increase the imperviousness of the area.

Climate change may result in less runoff and water availability in the Southwest (Brekke et al. 2009). Projected increases in temperature over Colorado could translate into increased water demands and earlier snowpack runoff. Total water supplies in Colorado may be reduced by mid-century (Ray et al. 2008). The potential for changes to hydrology in Colorado will be better understood with additional research focusing on Colorado and the Platte Basin.

4.19.4 Water Quality

Cumulative impacts from the proposed alternatives and land development projects include indirect adverse impacts along the Plum Creek drainage causing a possible increase in sedimentation and nutrient levels, particularly phosphorus. Future land development along the Plum Creek drainage could impact water quality but the cumulative impact would be minor because most of this river reach is already developed. An increase in nutrient loading and sediment levels in Plum Creek could also affect water quality in Chatfield Reservoir and the South Platte River downstream of the reservoir. Prolonged levels of drawdown in Chatfield Reservoir, such as from the Chatfield Reservoir Drought Drawdown, could also increase temperatures in the bottom of the reservoir, creating possible eutrophication and algal issues in Chatfield and also in downstream sections of the South Platte River.

Cumulative impacts from sedimentation would be minimized by state and local regulations requiring BMPs and stormwater management controls for construction activities and non-point sources. Increased sedimentation from the proposed alternatives would have only short-term, adverse impacts. The incremental effect with the degree of development in the area would be insignificant. Alternatives 3 and 4 do not contribute directly to phosphorus loads in Chatfield Reservoir but could indirectly increase the phosphorus loading in the reservoir through changes in reservoir operations. Other development activities upstream of the reservoir that could mobilize sediments could contribute to phosphorus and other mineral levels. However, as noted in Regulation No. 38, to date, eutrophication of Chatfield Reservoir has been averted through the control of phosphorus loads from the watershed, despite development activities. For example, there has been no trend for increasing phosphorus in Plum Creek, where most development has occurred. In Regulation No. 38, the Water Quality Control Division recognizes domestic dischargers for their role in minimizing impacts to Chatfield Reservoir.

4.19.5 Aquatic Life and Fisheries

Cumulative impacts from Alternatives 3 and 4 and land development projects include indirect adverse impacts along the riparian buffers of the Plum Creek drainage causing a possible increase in sedimentation and nutrient levels, particularly phosphorus. Future land development along the Plum Creek drainage could adversely impact the native fish species present (see section 4.19.9 for a list of protected species). There would be little cumulative impact from land development downstream of Chatfield Reservoir, as a large majority of this river reach is already developed. An increase in nutrient loading and sediment levels in Plum Creek could not only affect the aquatic community in Plum Creek but also the Chatfield Reservoir and South Platte River species downstream of the reservoir.

Cumulative impacts from Alternatives 3 and 4 and water-related projects could impact the study area in various ways. Previous water storage and water diversion projects have historically impacted the study area by altering the amount and duration of flows as well as fish species composition and range throughout the South Platte River. Increased base flows in the South Platte River for water demands both upstream and downstream of Chatfield Reservoir would benefit in-stream aquatic life and fisheries. Decreases in water levels below current low water levels in Chatfield Reservoir, such as from the Chatfield Reservoir Drought Drawdown, could have an adverse impact on successful spawning of warm water fish species that inhabit the reservoir. Prolonged levels of drawdown could also increase temperatures in the bottom of the reservoir, creating possible eutrophication and algal issues in Chatfield and also in downstream sections of the South Platte River.

4.19.6 Vegetation

Cumulative impacts from Alternatives 3 and 4 and land development projects include unavoidable loss of large areas of native prairie grassland vegetation and smaller areas of shrubland, riparian, and wetland communities. Native vegetation would be replaced by pavement, lawns, other horticultural plants, buildings, and other structures. Some of the existing riparian plant community including riparian wetlands, throughout the South Platte River Basin below 7,600 feet, is within federal lands, state lands, or public open space and is generally protected from development. As the Front Range Urban Corridor becomes more urbanized, this trend continues. Low-lying areas, including wetlands and riparian areas, tend to be selected for open space and preservation by local governments. Alternative 3 would increase protected areas or enhance riparian vegetation in Plum Creek and the Upper South Platte and also involve habitat improvements in the Chatfield Lake project area. The federal protection provided to the Preble's mouse, a riparian obligate species, greatly aids in the protection of riparian habitat and adjacent uplands. The cumulative impacts of Alternatives 3 and 4 and land development may slightly decrease the amount of riparian vegetation but would increase protected areas.

The combined effects of past, present, and foreseeable future projects that involve alluvial groundwater pumping and discharge of treated water are likely to increase stream base flows. The increased base flow may increase the amount and density of wetland riparian vegetation adjacent to the active South Platte River channel.

Alternatives 3 and 4 and other water-related projects would adversely impact grasslands, shrublands, riparian, and wetland communities, including direct loss of vegetation communities, conversion of some communities (such as grassland to shoreline), or temporary loss of vegetation communities due to construction and installation of infrastructure. Additionally, most water-related projects have some federal nexus and therefore must consider the loss of all vegetation communities including wetlands. Sensitive communities such as relic tallgrass prairie, shortgrass prairie, riparian areas, and wetlands should be avoided or mitigated. Federal projects must also address the functional loss of wetlands. If wetland functions are changed or lost, federal projects would be required to mitigate for this loss. Therefore, losses to all vegetation communities resulting from the cumulative impacts of water-related projects would not be expected to increase if storage in Chatfield Reservoir is reallocated.

4.19.7 Wetlands

Cumulative impacts from Alternatives 3 and 4 and land development projects include unavoidable loss of large areas of native prairie grassland vegetation and smaller areas of shrubland, riparian, and wetland communities. Land development projects would replace native vegetation with pavement, lawns, other horticultural plants, buildings, and other structures. Much of the existing riparian plant community including riparian wetlands, throughout the South Platte River Basin below 7,600 feet, is within federal lands, state lands, or public open space and is generally protected from development. Alternatives 3 and 4 would increase the area of protected or enhanced riparian vegetation in Plum Creek and the Upper South Platte River and also involve habitat improvements in the Chatfield Lake Project area.

Impacts on wetlands that are under the jurisdiction of the Corps permitting for Section 404 of the Clean Water Act would have to be avoided, minimized, or mitigated. Non-jurisdictional wetlands including isolated wetlands may be lost due to development projects, especially those outside of riparian and floodplain areas.

4.19.8 Wildlife

Land development projects would affect several thousand acres of native wildlife habitats upstream and downstream of Chatfield Reservoir. Depending on housing densities after land development, existing wildlife would be displaced and likely replaced by species characteristic of or compatible with urban and suburban habitats. The quality of wildlife habitat within the study area may decline as lands adjacent to the Chatfield Lake Project area are developed. Adverse impacts would be greatest for species inhabiting prairie grassland, such as grassland birds, because upland areas are typically where most of the development would take place. Adverse impacts would be lower for shrublands and riparian areas due to the greater likelihood that some natural vegetation would be preserved for open space and flood control. Human activities and hunting by roaming cats and dogs would adversely affect wildlife beyond the limits of developments. New roads and higher traffic volumes would cause more fragmentation of habitat and mortality from collisions with vehicles.

Alternative 3 would affect over 500 acres of wildlife habitat. Off-site mitigation would preserve or enhance hundreds of acres within Plum Creek and the Upper South Platte River with a special effort to preserve areas that provide linkages to existing preserved areas to enhance wildlife corridors (see the CMP, Appendix K). Furthermore, county planning departments including Douglas, Boulder, and Larimer counties have developed open space programs that seek to preserve riparian areas and emphasize wildlife corridors. Therefore, implementation of Alternative 3 and the accompanying compensatory mitigation plan would not be expected to increase cumulative adverse impacts on wildlife and their habitats and will, in fact, preserve wildlife movement corridors.

Cumulative impacts from other water-related projects would permanently alter some wildlife habitat areas and have temporary impacts on others. Developing new reservoirs from gravel pits or enlarging pre-existing reservoirs would displace terrestrial wildlife in these specific areas. Aquatic species and water birds would benefit from such activities. Corresponding infrastructure for water projects would create temporary disturbances for underground pipelines and fragment habitat with new roads and facilities. Increased base flows in the South Platte River Basin would benefit aquatic and riparian species. However, decreased magnitude of flooding may reduce establishment of new riparian shrubs and trees on terraces above the stream. As older trees on higher terraces die from natural causes, the width of the non-wetland riparian zone may be decreased over a span of many decades. This would have a long-term effect on riparian wildlife species and other species that use riparian habitat for some part of their life cycle.

4.19.9 Endangered, Threatened, and Candidate Species, Species of Special Concern and Sensitive Species

Land development and highway projects include direct and indirect adverse impacts of native vegetation communities and wildlife habitat in numerous locations throughout the South Platte River Basin below 7,600 feet msl elevation. Land development projects must address potential impacts on federally protected species and must mitigate for adverse impacts. Activities covered under an ITP would be subject to compliance with Section 10 of the ESA. Furthermore, project activities permitted under Section 404 of the Clean Water Act (impacts on wetlands) also must avoid, minimize, or mitigate wetland areas and must address federally listed species under Section 7 of the ESA. Therefore, cumulative impacts on federally listed species from land development and the proposed alternatives would not adversely affect federally listed species as impacts would be minimized or mitigated given the current regulatory framework. Habitat improvement projects and land preservation efforts resulting from Preble's mouse impact mitigation, including Alternative 3, would benefit other riparian/wetland species of concern including the northern leopard frog and American currant. Land development projects would adversely affect some other species of special concern, especially the northern red-bellied dace, Iowa darter, common shiner, sharp-tailed grouse, and if present, black-tailed prairie dog, burrowing owl, and forktip three-awn. These species are found in drier habitats or in streams and would be directly impacted from development in upland areas or indirectly by increased runoff and sedimentation into streams. Additionally, species of special concern in drier habitats generally would not benefit from Preble's mouse impact mitigation projects. Furthermore, development projects can indirectly affect species of special concern by habitat fragmentation and isolation as no statewide planning or regulations guide development outside of the NEPA process. Generally, landscape level planning does not occur outside of the level of county planning departments and counties are free to analyze for landscape level impacts on wildlife or to focus efforts elsewhere. Additionally, planning among counties is not required for landscape level impacts from development projects by any state regulations.

There would be minimal cumulative impacts from land development downstream of Chatfield Reservoir to the Weld County boundary, as a large majority of land along this river reach is already developed and federally protected species or species of special concern generally do not occur within this area. For example, this area is not thought to contain Preble's mice and is excluded through a block clearance agreement with the USFWS.

Cumulative impacts from Alternatives 3 and 4 and other water-related projects could occur in or near areas of Preble's mouse habitat and potential habitat for bald eagles, Ute ladies'-tresses orchid, Colorado butterfly plant, and other species of special concern. Activities permitted under Section 404 of the Clean Water Act would be subject to compliance with Section 7 of the ESA. Adverse impacts on these species would be mitigated and there would be no net adverse cumulative impacts to federally listed species. Adverse impacts on species of special concern would generally be temporary, and these species would likely benefit from habitat improvement projects resulting from Preble's mouse impact mitigation.

Projects involving water depletions would be required to mitigate those depletions, so there would be no net adverse cumulative impacts on endangered and threatened species in the Central and Lower Platte River Valley.

4.19.10 Land Use

Minimal cumulative impacts on land use are anticipated as a result of the proposed alternatives and other projects. As discussed above, about 55 acres would be required for Alternative 3. However, projects located in the vicinity of Chatfield Reservoir (e.g., Chatfield Reservoir Drought Drawdown, Last Chance Water Diversion to Conduit 20 at Kassler, Denver Water Temporary Chatfield Pump Station) have either already occurred in the past, or could occur in the reasonably foreseeable future. Residential development projects are still occurring around the study area; however, there are pockets of open space located near Chatfield Reservoir. Therefore, few cumulative impacts are anticipated to be associated with land use. Implementation of Chatfield storage reallocation may actually have a beneficial cumulative effect on land use if it results in fewer acres of agricultural land drying up after acquisition of irrigation water rights for conversion to municipal and industrial water uses.

4.19.11 Hazardous, Toxic, and Radiological Wastes

The cumulative impacts of the proposed alternatives and the other past, present, and reasonably foreseeable future activities in the area on hazardous, toxic, and radiological wastes are likely to be negligible. Although various hazardous materials, including fuels and hydraulic fluids, would be used during construction under the alternatives and other projects, their storage, use, and disposal would be subject to local, state, and federal regulations. Individual construction areas would require monitoring of fuels and other hazardous materials. Over the long term, the proposed alternatives would have little to no adverse impact on hazardous, toxic, and radiological wastes. Any short-term impacts would generally be confined to the individual construction areas and are considered minor. There would be no interaction between impacts in different parts of the study area (impacts would be additive and not synergistic).

4.19.12 Air Quality

The proposed water storage reallocation project and alternatives would occur in a rapidly developing area of Jefferson and Douglas counties. Short-term construction emissions for the project and alternatives may be noticeable above ongoing emissions. Construction of the proposed reservoir (under Alternative 1), pipeline areas (under Alternatives 1), and conversion of gravel pits (under Alternatives 1 and 2) could affect air quality in the short term. However, these and other residential, transportation, and water development projects in the area would be required to implement dust control measures that would reduce construction-related dust emissions. In addition, exhaust emissions from heavy-duty construction equipment would be reduced by measures that decrease nitrogen oxides (NOx) emissions from heavy-duty construction equipment. Furthermore, increasing use of low-sulfur diesel fuel would reduce sulfur dioxide (SO_2) emissions.

Long-term cumulative adverse impacts on air quality are not expected from the implementation of the alternatives, including emissions from gravel pit reservoir and pipeline area maintenance and fugitive dust. Vehicle emissions are expected to be insignificant, particularly in comparison with regional emissions and with emissions resulting from the additional residential and transportation development in the area. Fugitive dust emissions may occur because of increasing levels of fluctuation in water levels at Chatfield Reservoir under Alternatives 3 and 4. Unvegetated land would be exposed when water receded. However, fugitive dust emissions from wind erosion would be relatively low.

4.19.13 Noise

Minimal cumulative impacts of noise are anticipated as a result of the proposed alternatives and other projects. As discussed above, minor, short-term temporary increases to noise volumes are expected as result of the construction and associated pipeline facilities under different alternatives. However, projects located in the vicinity of Chatfield Reservoir (e.g., Chatfield Reservoir Drought Drawdown, Last Chance Water Diversion to Conduit 20 at Kassler, Denver Water Temporary Chatfield Pump Station) have either already occurred in the past, or could occur in the reasonably foreseeable future. Construction schedules of these projects likely would not overlap with the project. The remaining projects are located farther away from Chatfield and would not affect noise in or around Chatfield Reservoir. Therefore, few (if any) cumulative impacts on noise are anticipated. State noise regulations would be followed during construction at Chatfield, most of which would occur in the winter months to minimize noise impacts on visitors. As a result, Chatfield reallocation activities would not be expected to add significantly to cumulative noise impacts.

4.19.14 Aesthetics

Aesthetic impacts of the proposed alternatives would occur within the context of landscape modifications associated with past, current, and reasonably foreseeable future uses in the Chatfield Reservoir. As discussed above, the existing environment includes the dam and its infrastructure, as well as fluctuations in water levels. The area has been substantially modified since the 1970s when the reservoir was first built (creating a dam on what was once naturally flowing water). Since the dam was built, and in more recent years, other projects have been implemented near the reservoir (e.g., Last Chance Water Diversion to Conduit 20 at Kassler, Denver Water Temporary Chatfield Pump Station) that may have further altered the visual appearance. Alternative 3 would further alter the visual appearance of the lake because of fluctuating water levels, and the addition of another potential project (e.g., Chatfield Reservoir Drought Drawdown) could increase the visual impact even more. There could be a noticeable change near the water level which would be viewed by users within the park, primarily users along in boats and near the shoreline. It is not anticipated that these additional cumulative impacts would substantially alter the nearby views.

4.19.15 Socioeconomic Resources

Regarding socioeconomic resources, the biggest concern for flooding potential would be that of the reasonably foreseeable future projects that are planning on distributing their water into the South Platte River. It is unknown at this time how much more or less water would be coming from these other projects and running into the South Platte River. If they are similar to Alternative 3, then cumulative impacts would not be expected. Because any monetary losses to State Parks or concessionaires would be fully compensated by the Chatfield Reservoir storage reallocation project proponents, and construction activities at Chatfield would have a beneficial cumulative effect on jobs available for Denver-area residents, no significant increases in cumulative socioeconomic impacts would be expected from implementation of storage reallocation at Chatfield Reservoir.

NTGW is a component of Alternatives 1, 2, and 4. Operation and maintenance costs are expected to increase over time as water levels decline and threaten the viability of this water source. The SWSI report (CWCB 2004), portrays this with this statement: "In the South Metro Denver area, it is anticipated that aquifer production will decline by 40 to 85 percent by the year 2050, and that municipal wells in this part of the Denver Basin that can produce even 100 gpm will be considered to be a good producing well. Current production rates average 540 gpm for the Arapahoe aquifer and 120 gpm for the Lower Dawson. To maintain current production, an increase in the number of wells would be needed. It is estimated that it will cost $2.7 to $4 billion for infrastructure by 2050 for supplies provided by the non-tributary sources."

The SMWSS (Black and Veatch, 2003) states: "The results of this study indicate that continued reliance on the ground water aquifers to meet urban demands in the South Metro Area will result in very large increases in the production costs in the foreseeable future, and the eventual loss of the ground water as an economically viable resource. Therefore, the measures identified to maintain the aquifers by reducing the rate of water withdrawals should be implemented." The results of the study indicate that the problem faced through intensive development of the Denver Basin aquifers is not one of depleting the non-renewable supply, but rather reducing the production of the supply to a point where it is no longer economically feasible to product the supply."

4.19.16 Transportation

Overall positive cumulative impacts regarding transportation are anticipated as a result of the proposed alternatives and other projects. As discussed above, minor, short-term temporary increases to traffic volumes are expected as a result of the construction and associated pipeline facilities under different alternatives. However, projects located in the vicinity of Chatfield Reservoir (i.e., Chatfield Reservoir Drought Drawdown, Last Chance Water Diversion to Conduit 20 at Kassler, Denver Water Temporary Chatfield Pump Station) have either already occurred in the past, or could occur in the reasonably foreseeable future. Construction schedules of these projects are not expected to overlap with the proposed project. The CDOT projects are likely to improve the transportation system and ease traffic congestion near Chatfield Reservoir. The remaining projects are located farther away from Chatfield and would not affect transportation in or around Chatfield Reservoir. Construction equipment would be using State Park roads during the winter months when park visitation is relatively low, thereby minimizing potential road use conflicts and traffic delays in and near Chatfield State Park. Therefore, cumulative impacts regarding transportation are not anticipated to increase significantly as a result of implementation of reallocation at Chatfield.

4.19.17 Recreation

No cumulative impacts on recreation facilities or activities are anticipated to occur based on Alternative 3 and the other projects mentioned above because these impacts will be mitigated. Recreation users may be slightly impacted by the visual quality of the reservoir when they are on boats or near the shoreline. None of the other nearby projects is expected to affect recreation significantly. Although the reservoir projects in Weld and Larimer counties (Table 4-21) may increase opportunities for fishing and boating locally, they are located outside of the scope of analysis for the cumulative impacts on recreation. Although there may be short-term impacts on enjoyment for some recreation activities, because of the new facilities and subsequent maturing of vegetation mitigation plantings, long-term increases to cumulative impacts on recreation are not anticipated.

4.19.18 Cultural Resources

The expansion of water control and delivery infrastructure and improvements to transportation systems in the 12-county region of north-central Colorado, from Fort Collins to Colorado Springs, creates the potential for changes to land use patterns that could generate cumulative adverse impacts on recorded cultural resources within the region, and on properties that have the potential to contain cultural resources.

The principal cause of these impacts is likely to be new residential development. Because most residential and commercial development does not take place on federal land or with federal funding, federal involvement often occurs through Section 404 of the Clean Water Act, which requires permitting of certain activities involving wetlands impacts. Once a federal nexus is identified, properties potentially eligible for listing on the NRHP must be identified, avoided, or mitigated. Without a federal nexus, these steps are not required, which may result in some form of adverse impact upon cultural resources by potential developments. As a number of local communities and counties throughout the state have enacted historic preservation ordinances, cultural resources affected by construction impacts might fall within the jurisdiction of one or more of these administrative actions, even in the absence of state or federal regulations upon a specific project.

Road and highway construction projects are not likely to result in cumulative impacts on cultural resources. In general, cultural resources may be affected as new residential and commercial developments are linked to established zones of economic activity in towns and cities. However, as the recipient of federal funds, CDOT must comply with a variety of federal environmental laws. Two of these laws focus on cultural resources: Section 106 of the National Historic Preservation Act and Section 4(f) of the U.S. Department of Transportation Act (USDOT) Act. Through Section 106, the department takes into account project effects on historic and archeological resources through consultation with the Colorado Office of Archaeology and Historic Preservation. Section 4(f) requires that the Federal Highway Administration, a USDOT agency and principal source of CDOT's federal funds, avoid the use of land from these resources unless "no feasible and prudent alternative" can be identified. Through implementation of these two sections of federal environmental acts, cumulative impacts on recorded and potential cultural resources, in general, can be avoided or mitigated.

4.20 Collective Operational Scenario that Could Reduce Environmental Impacts

The water providers participating in the Chatfield Reallocation study have worked with representatives from the EPA and the CWCB to develop and evaluate a range of potential mitigation scenarios for operating the reallocated storage in a manner that has the goals of minimizing impacts to environmental resources while meeting the needs of the water providers for use of the reallocated storage. After evaluating a variety of operational scenarios, the EPA, the CWCB, and the water providers focused on one potential operational scenario that appears to come closest to meeting these goals. The following is a description of this potential operational scenario, the benefits it could provide, and the steps needed to determine the feasibility of implementing the scenario.

The operational scenario under consideration is intended to cooperatively manage water stored in the reallocated space at a potentially higher reservoir level. Per a 1979 agreement with the State of Colorado, Denver Water makes its “best efforts” to manage its water stored in Chatfield Reservoir to maintain reservoir levels above 20,000 acre-feet of storage (5,426.94 feet msl based on the latest bathymetric survey of the reservoir) between May 1 and August 31 (summer season) to benefit reservoir recreation. Management of these water levels has also benefited the target environmental resources of wetlands and riparian habitat. Denver Water’s commitments under the 1979 agreement would be unchanged by the potential future operational scenario being proposed.

The historical management of Chatfield Reservoir has led to the development of wetlands and riparian habitats, including extensive cottonwood woodlands, around the upper portions of the reservoir. The historical management and Denver Water’s best efforts under the 1979 agreement have accomplished two key management objectives during the summer season: 1) maintained relatively high reservoir levels, and 2) minimized fluctuation. The EPA and the water providers are hopeful that more frequent higher reservoir levels during the summer season in the reallocated space should lead to the development of similar resources in the future.

As proposed, the operational scenario would involve all of the water providers implementing "collective operations" of the reallocated storage using the water providers' best efforts to maintain water levels at or above a new target water level elevation, during the same summer season of May 1 to August 31. Since the water rights for the water that would be stored by the water providers in the reallocated storage space have a relatively junior priority for storage (i.e., the water providers would on average be able to fill the entire reallocated space less than 50 percent of the time), there would be years when the water providers would not have either the legal priority and/or physical availability of water to store water in the reallocated space.

In order to potentially keep water levels higher during the summer season, other water sources and storage capabilities would be needed to supplement the water providers' ability to store water in the reallocated space. The only entity capable of providing this supplemental storage water is Denver Water. The Chatfield water providers have had discussions with Denver Water regarding a possible cooperative operational scenario where Denver Water would store water in unused reallocated storage space when it has water available that cannot otherwise be managed, and would withdraw its water when needed. For instance, Denver Water has a minimum flow requirement on the South Platte River between Strontia Springs Reservoir and Chatfield Reservoir. Occasionally, Denver Water's existing pool in Chatfield is insufficient to manage the minimum flows. During those conditions, Denver Water could store its minimum flows in available reallocated space. Denver Water also has a 1977 storage right for Chatfield, which is senior to the storage rights of the water providers participating in the Chatfield Reallocation study. There would be occasional opportunities to store water in available space using Denver Water's 1977 Chatfield storage right. These operations would be on an "as available" basis; there would be no requirement for Denver Water to store water in the reallocated space, and no expectation as to how or when the water would be withdrawn.

This cooperative operational scenario, which would increase water levels during the summer season in some years, while meeting the needs of those storing water in the reallocated space, would require cooperation among the water providers and Denver Water. In preliminary discussions between Denver Water and the water providers, Denver Water officials have determined that they may be open to participating in the operational scenario, but need to perform further analysis to ensure that participation in the operational scenario would have no adverse impact on Denver Water, and to discuss Denver Water's role in the scenario with the CDNR. The water providers are in discussions with State Parks that could also shape this operational scenario.

If the cooperative operational scenario were implemented and successful at reducing impacts to environmental resources, implementation of the CMP would need adjustment to compensate for fewer impacts to the target environmental resources. The water providers would be responsible for any adjustment of the CMP associated with the operational scenario (see Appendix K, Section 7.5.2.2., for additional details on how the CMP would be adjusted).

5. ECONOMIC ANALYSIS, COMPARISON OF ALTERNATIVES, AND PLAN SELECTION

5.1 Introduction

This chapter describes the process that was used to evaluate the alternatives and ultimately recommend the 20,600 Acre-Foot Reallocation Alternative as the tentatively selected plan for implementation at Chatfield Reservoir. Corps guidance requires an economic analysis as part of the evaluation of alternatives. The Planning Guidance Notebook (ER 1105-2-100, USACE 2000), the USACE Water Supply Handbook (Revised Institute for Water Resources Report 96-PS-4, USACE 1998), and the *Economic and Environmental Principles and Guidelines for Water and Related Land Resources Implementation Studies* (P&Gs) (U.S. Water Resources Council 1983) provided guidance for identifying and assessing the proposed alternatives. The Economic Guidance Memorandum (EGM) 11-01, Federal Interest Rate for Corps of Engineers Projects for Fiscal Year 2011 (USACE, November 5, 2010) provided current interest rates that were used to perform the National Economic Development (NED) and financial analysis of the four proposed alternatives and the local repayment amount for project costs. The chapter summarizes information from previous chapters and Appendix O, compares the four alternatives, and identifies the tentatively selected plan. It also identifies costs of the tentatively selected plan in more detail at October 2011 (FY 2012) price levels and using FY 2012 federal interest rates found in EGM 12-01 (USACE, October 21, 2011). In addition, it presents a summary description of the features of the tentatively selected plan.

5.2 Alternatives Considered in Detail

This study focuses on four alternatives as described in Chapter 2:

- Alternative 1—No Action, Penley Reservoir combined with Gravel Pit Storage
- Alternative 2—NTGW combined with Gravel Pit Storage (Least Cost Alternative to Chatfield Reservoir Storage Reallocation)
- Alternative 3—Reallocation of 20,600 acre-feet to Storage (20,600 Acre-Foot Reallocation)
- Alternative 4—Reallocation of 7,700 acre-feet to Storage (7,700 Acre-Foot Reallocation) and use of NTGW and Gravel Pit Storage

A detailed description of each of the alternatives and their various components for addressing the purpose and need of the project is presented in Section 2.4. These alternatives met the federal objective as well as the objectives and sub-objectives presented in the Purpose and Need Statement that responds to the water supply/demand analysis described in Chapter 1. The federal objective is to reasonably maximize NED consistent with protecting the Nation's environment, and consistent with the Corps' Environmental Operating Principles (EOP) (described in Section 1.2). The objectives and sub-objectives are to develop alternatives that:

- Increase availability and reliability of water supply by providing an additional average year yield of 8,539 acre-feet of M&I water, sustainable over a 50-year period, to contribute towards meeting a water supply shortfall projected to be 90,000 acre-feet per year by 2050 for the service area of the 15 water providers.

- Provide, over the 50-year planning period, water supply of equivalent quality as currently supplied to the Denver metro region.
- Maintain adequate levels of downstream flood control over the 50-year period of analysis.
- Ensure provision in-kind of recreation facilities and experiences during the 50-year period of analysis.
- Ensure maintenance of environmental benefits by minimizing environmental impacts, fully mitigating unavoidable significant impacts, monitoring to evaluate the level of success, and implementing an adaptive management strategy involving input from several agencies.
- Become less reliant on non-renewable groundwater by utilizing renewable water supplies, thus extending the availability and life of these critical aquifers for use by future generations.
- Are consistent with USACE EOP and USACE Campaign Plan goals to extent possible, including robust design, risk management and communication, reliability and adaptability to future change.
- Find collaborative solutions to future Denver Metro area water supply needs.

The major components of the proposed alternatives shown in Table 5-1 are combined to provide equal amounts and quality of water for an additional average year yield of 8,539 acre-feet over the planning period. The NED procedure and the financial analysis require assessment of all of the costs involved in implementing each alternative. The evaluation therefore considers the specific components that comprise each alternative and date when each component would be available to supply water. Because the Chatfield Reservoir storage reallocation project is assumed to be implemented in 2012, that year is defined as the base year and the start of the 50-year planning period for the purpose of this analysis. Alternatives would provide water in the base year and continue that supply until 2062. Penley Reservoir is a key component of the No Action Alternative (Alternative 1); however, this proposed reservoir could not yield water supply in the base year. NTGW would be required to provide water until Penley Reservoir was available. The reallocation of 7,700 acre-feet of Chatfield Reservoir storage (Alternative 4) would not provide a water supply equivalent to Alternatives 1, 2, and 3. Gravel pits and NTGW components were added to 7,700 acre-feet of Chatfield Reservoir storage reallocation to make the Alternative 4 yield comparable to the other alternatives.

Table 5-1
Water Supply Sources

	Alternative 1 No Action*	Alternative 2 NTGW/ Downstream Gravel Pits	Alternative 3 20,600 Acre-Foot Reallocation	Alternative 4 7,700 Acre-Foot Reallocation/NTGW/ Downstream Gravel Pits
Upstream Water Providers	NTGW, Penley Reservoir	NTGW	Chatfield Reservoir	Chatfield Reservoir, NTGW
Downstream Water Providers	Gravel Pits	Gravel Pits	Chatfield Reservoir	Chatfield Reservoir, Gravel Pits

* Surface water from Penley Reservoir would replace NTGW in 2027.

5.2.1 Water Supply Yields (Benefits) by Source for Each Alternative

Each alternative provides 8,539 acre-feet average year yield of additional water supply when fully online. The upstream water provider's share of this average year yield is 4,270 acre-feet and the downstream water providers would acquire 4,270 acre-feet average year yield based on their level of participation in the 20,600 acre-foot storage reallocation and the ability to capture some NTGW in Chatfield Reservoir for reuse. These average year yields are based on volumes that could be stored from inflows during the 1942–2000 period of record (POR), including some years of severe drought when the only water stored were flows that were captured for reuse, for a minimum drought-year yield of 2,379 acre-feet. Table 5-2 presents the average year yield associated with the components identified for each alternative. It is assumed that the demand for water is independent of the alternative source of water. Therefore the alternatives would not change the rate at which water is demanded.

Table 5-2
Water Supply Quantities, Average Year Yield (Acre-Feet)

	Alternative 1 No Action	Alternative 2 NTGW/Downstream Gravel Pits	Alternative 3 20,600 Acre-Foot Reallocation	Alternative 4 7,700 Acre-Foot Reallocation/NTGW/ Downstream Gravel Pits
Upstream Water Providers				
NTGW	4,270	4,270	0	2,674
Penley Reservoir*	4,270*	0	0	0
Chatfield Reservoir	0	0	4,270	1,596
Total	4,270	4,270	4,270	4,270
Downstream Water Providers				
Gravel Pits	4,270	4,270	0	2674
Chatfield Reservoir	0	0	4,270	1,596
Total	4,270	4,270	4,270	4,270

* Surface water from Penley Reservoir would replace NTGW in 2027.

The Compensatory Mitigation Plan (CMP) presents an implementation processes in Section 7.0 Implementation. For the purposes of this analysis it was conservatively assumed that the Chatfield water providers would not be able to fully meet the mitigation milestones and that they would not be able to fully use the reallocated storage immediately. If yield is related to the use of storage, the average year yield would be reduced from the 8,539 acre-feet. All alternatives would develop water sources at the same rate as Chatfield (Alternative 3).

The No Action Alternative (Alternative 1) combines Penley Reservoir with NTGW for the upstream water providers and gravel pit storage for the downstream providers. The wells and gravel pits would be developed as needed over 11 years to match the same phased implementation of the use of storage that is described for Alternative 3. NTGW would be used until construction of Penley Reservoir was completed in 2027. Penley Reservoir storage would reduce the use of NTGW. When this reduction would be realized is not known and would vary by participant because of the nature of their water rights. Despite this, the average year yield of 8,539 acre-feet was used in this analysis.

With Alternative 2, the upstream providers would develop NTGW to meet their needs. The downstream providers would develop gravel pits for their needs. The wells and gravel pits would be developed over 11 years.

Alternative 3 would reallocate 20,600 acre-feet of Chatfield flood control storage to water supply storage. NTGW use would be reduced with this alternative. When this reduction would be realized is not known and would vary by participant because of the nature of their water rights. To alleviate this uncertainty, the average year yield of 8,539 acre-feet was assumed.

Alternative 4 would combine NTGW and gravel pits with reallocation of 7,700 acre-feet of Chatfield Reservoir flood control storage to water supply storage. The reallocation of 7,700 acre-feet at Chatfield Reservoir is about 3,192 acre-feet average year yield. NTGW and gravel pits would provide 5,348 acre-feet average year yield to bring the total average year yield for this alternative to 8,539 acre-feet. These components would be implemented simultaneously over the 11-year period of storage usage.

5.3 Comparison of Alternatives

The plans were compared by their financial and NED costs and impacts in four accounts: NED, Regional Economic Development (RED), Environmental Quality (EQ), and Other Social Effects (OSE).

5.3.1 Financial Costs

The financial costs represent the Participant's cost to implement, operate, and maintain an alternative. The costs include the cost of storage, environmental mitigation, and recreation modifications, operation, maintenance, repair, rehabilitation, and replacement (OMRR&R), and specific cost for infrastructure needed to deliver the water. Water supply projects are 100 percent non-federal costs. The financial cost analysis estimates the costs providers would have to pay for each alternative and determines the feasibility of the alternatives. For Alternatives 1 and 2 the financial analysis both estimates the cost and feasibility. For Alternatives 3 and 4 this is not the case. Two different analyses are performed – one to determine the provider's cost and another for feasibility. The provider's cost of storage is presented for Fiscal Year (FY) 2012 in Table 5-3. The federal discount rate and the water supply discount rate from the Economic Guidance Memorandum 12-01 are 4 percent and 4.125 percent, respectively for FY 2012. The costs were updated from FY 2011 to FY 2012 using EM1110-2-1304 Civil Works Construction Cost Index System (CWCCIS). Financial feasibility of the alternatives compared to the no-action alternative (Alternative 2) can best be demonstrated when alternative costs are less than Alternative 2. The cost of storage, infrastructure, environmental mitigation, recreation modifications, and OMRR&R costs are financial costs. Appendix O presents these costs in greater detail.

Table 5-3
Cost of Storage Analysis

	Cost In Millions (FY 2012 $)
Benefits Foregone	$15.0
Revenue Foregone	0
Replacement Cost	0
Updated Cost of Storage	$15.3

5.3.1.1 Method for Determining Cost of Storage

Paragraph (a) on Page 3-34 of ER 1105-2-100 defines the cost of reallocated storage as the greatest of revenue foregone, benefits forgone, replacement flood control benefit costs, or the updated cost of storage; see Appendix O for detailed definitions of these four costs. The cost of storage is applicable to Alternatives 3 and 4. The information that follows shows the comparison to determine which of the four categories would be used for the cost of storage at FY 2012 price levels for Alternative 3, the tentatively selected plan. The updated cost of storage is greater than the other categories.

5.3.1.2 Calculation of Updated Cost of Storage

The updated cost of storage for Alternatives 3 and 4 was calculated using the Use of Facilities cost allocation procedure described in ER 1105-2-100, Appendix E, paragraph E-57.d.(2)(d) using FY 2011 price levels. When Alternative 3 became the tentatively selected plan, its updated cost of storage was recalculated at FY 2012 price levels, as described in detail below. The joint-use costs for the construction of the Chatfield Dam and Lake Project were derived from as-built construction costs between 1967 and 1979. These were updated from 1973, which is the midpoint of the construction period, to FY 2012 price levels using CWCCIS factors. These are in Table 5-4.

Table 5-4
Updated Joint-Use Costs

Code	Construction Component/Activity	Joint-use Cost	Joint-use Cost 2012 FY12/2Q
01	Lands and damages (acquisition started May 1967)	$15,595,200	$79,072,185
02	Relocations	$15,161,300	$75,347,276
03	Reservoir	$1,121,300	$5,488,028
04	Dams	$31,398,900	$158,524,411
08	Roads, rail roads, and bridges	$112,000	$556,608
09	Channels and canals	$6,803,600	$35,658,756
11	Levees and floodwalls	$4,300	$22,452
14	**Recreation facilities**	$11,148,500	$57,602,574
15	Structures	$10,500	$51,741
19	Buildings, grounds, and utilities	$1,715,300	$8,862,690
20	Permanent operating equipment	$70,700	$365,296
	Subtotal	$83,141,600	$421,552,016
30	Engineering and design	$7,864,100	$40,145,858
31	Supervision and administration	$3,974,900	$20,291,676
	Total Construction	$94,980,600	$481,989,551

Table 5-4
Updated Joint-Use Costs

Code	Construction Component/Activity	Joint-use Cost	Joint-use Cost 2012 FY12/2Q
	Less Specific **Recreation Facilities**	$11,148,500	$57,602,574
	Total Joint-use Storage Construction Cost	$83,832,100	$424,386,977

The joint-use costs are obtained by removing the specific recreation costs from the construction costs and they are associated with the total usable storage. The cost of storage for an alternative is derived from the joint-use cost and the reallocated storage. For Alternative 3, 20,600 acre-feet is the reallocated storage. The updated cost of storage is derived from the updated joint-use cost and the ratio of reallocated storage to usable storage. The usable storage at Chatfield Reservoir is the total storage less the inactive/sediment storage pool or 233,747 acre-feet. The reallocated storage for Alternative 3 is 20,600 acre-feet. The storage numbers and ratio are in Table 5-5.

Table 5-5
Storage Analysis
Alternative 3

Total storage AF	233,775
Sediment storage AF	28
Usable Storage	233,747
Reallocated storage AF	20,600
Cost of storage ratio	0.0881
Percent of usable storage	8.81

The cost of storage ratio is calculated from the formula reallocated storage/usable storage or 0.0881=20,600/ (233,775-28) where 233,775 – 28 is the usable storage. In terms of percent the ratio is 8.81 percent. The ratio is multiplied by the joint-use costs to obtain the cost of storage. The FY 2012 updated cost of storage is currently estimated to be $37.4 million ($424,386,977 x 8.81 percent/100) and an estimated $5.3 million (capitalized value) for OMRR&R.

Assistant Secretary of the Army for Civil Works (ASA(CW)) granted an exemption of the policy for the determination of the updated cost of storage. Based on the high costs for riparian habitat impacts, recreation modifications, low dependable water yield, and the updated cost of storage, the cost per acre-foot was shown to be about four times greater than the next highest cost for a Corps reallocation project. The ASA(CW) exempted Chatfield Reservoir reallocation from the existing policy and established a one-time reduction of the estimated updated cost of storage. The cost of storage to be paid by the water providers is 41 percent of the estimated cost of storage. The cost of storage is an amount that is repaid to the United States Treasury for that portion of Chatfield costs for the reallocated water storage. That set the FY 2012 cost of storage at $15.3 million shown in Table 5-6. The exception reduced the cost per acre-foot of storage nearer to the national average cost per acre-foot. For FY 2012 using the federal water supply discount rate of 4.125 percent amortized over 30 years, the longest period for which repayment is allowed, the annual cost would be $900,300.

Table 5-6.
Updated Cost of Storage
FY 2012 Price Levels

Updated Cost of Storage Alternative 3	$37,401,001
Cost of Storage with exemption Alternative 3	$15,334,410

The annual OMRR&R was estimated from actual costs incurred at Chatfield Reservoir between 1997 and 2006. The average annual amount at September 2006 prices was updated to $1,758,415 at FY 2011 prices, and then to $1,860,980 at FY 2012 prices using CWCCIS factors. An estimate for Alternative 3 was calculated by multiplying the storage factor of 8.81 percent (0.0881) by $1,860,980. Additional OMRR&R resulting from implementation would be incurred at the reservoir for Alternatives 3 and 4. Additional OMRR&R is for dam safety instrumentation and monitoring at the new conservation pool levels, Master Plan Supplement, review of proposed reallocation-related facility plans and real estate activities, update of area capacity tables, increased number of water releases and pre-release calculations, and additional operations. OMRR&R detail is shown in Table 5-7 for Alternative 3 at FY 2012 price levels.

Table 5-7
Annual Chatfield-Related OMRR&R, Alternative 3

	Chatfield	Additional	Total
2012 Price Levels	$164,007	$83,383	$247,390

The water providers must repay the cost of storage over 30 years, starting when the water supply agreement is signed, at the water supply interest rate in effect at the signing or could choose to pay upfront. In FY 2012 the rate is 4.125 percent. The actual OMRR&R costs are indeterminate at this time, but would be estimated and paid at the beginning of each year. At the end of the year, the actual amount would be reconciled with the payment made at the beginning of the year. The OMRR&R would be paid in perpetuity beyond the 30 years for cost of storage repayment. Estimates of the annual costs for FY 2012 are shown in Table 5-8. The planning horizon of 50 years is broken into the first 30 years when payments are made for cost of storage and OMRR&R and the remaining 20 years when only OMRR&R payments are made.

Table 5-8
Annual Cost Related to Chatfield Storage
FY 2012 Price Levels

	Annual Cost Years 1–30	Annual Cost Years 31–50
Annual Cost of Storage (using ASA(CW) Exemption)	$900,300	$0
Annual OMRR&R	$247,390	$247,390
Total	$1,147,690	$247,390

Additionally, the providers would be responsible for infrastructure, environmental mitigation, and recreation modifications. These are itemized in Table 5-9 at FY 2012 price levels. The total annual cost for Alternative 3 is shown in Table 5-9 at FY 2012 price levels. Despite price level increases, FY 2012 annualized first costs and total annual costs for Alternative 3 are less than in FY 2011 due to lower environmental mitigation costs. The costs are presented for the period when cost of storage is being repaid (years 1–30) and for the period after cost of storage has been repaid. These are estimates since costs would be determined when the Water Supply Agreement is signed and the years following.

Table 5-9
Financial Costs, FY 2012 Price Levels

	Years 1–30	Years 31–50
Annual Cost of Storage	$900,300	0
Annualized First Cost without Cost of Storage	$5,531,733	$5,531,733
Total Annual OMRR&R	$2,269,081	$2,269,081
Total Annual Costs	$8,701,113	$7,800,814

Table 5-10 presents the implementation costs and the present value of 50 years of annual OMRR&R costs for the alternatives at December 2010 (FY 2011) price levels. These costs were discounted and annualized at the FY 2011 rate of 4.125 percent. Water provided by Alternative 3 is the least expensive of the alternatives. Appendix O presents these costs in detail.

Table 5-10
Present Value, Financial Cost of the Alternatives, FY 2011 Price Levels

	Alternative 1	Alternative 2	Alternative 3	Alternative 4
Initial/Implementation Costs				
Cost of Storage	$0	$0	$14,512,333	$5,424,513
Specific (Infrastructure)	$246,951,356	$172,784,412	$9,991,580	$111,955,560
Recreation Modifications	$0	$0	$45,116,744	$16,864,026
Environmental Mitigation	$0	$0	$71,025,318	$26,548,299
Total Implementation Costs	$246,951,356	$172,784,412	$140,645,975	$160,792,397
Present Value, 50 Years of OMRR&R Costs	$31,446,285	$32,356,886	$43,774,777	$42,618,670
Present Value of Total Costs	$278,397,641	$205,141,298	$184,420,752	$203,411,067

5.3.2 National Economic Development Account

The NED cost includes the costs to implement, maintain, and operate each alternative. Alternatives 3 and 4 include an additional cost associated with the lost recreation benefits associated with the change in lake levels and recreation modifications at Chatfield Reservoir.

The NED account compares the alternatives based on NED cost at FY 2011 price levels and interest rates, which includes first cost, interest during construction (IDC), lost recreation benefits and OMRR&R costs. Annual NED cost, annual NED benefit, and net annual NED benefit are used to determine the NED Plan. Net annual NED benefit is the difference between the annual NED benefit and annual NED cost. Flood control benefits are not included in the NED account because the hydrologic analysis of the alternatives indicated that no significant differences occur between the alternatives' water surfaces downstream from Chatfield Reservoir. Recreation benefits are not included in the annual NED benefit according to Paragraph (1) on Page 3-35 of ER 1105-2-100, which states the NED water supply benefits are measured by the cost of the alternative most likely to be implemented in the absence of the proposed plan, which in this case is Alternative 2. The NED recreation benefits lost are considered as part of the cost of reallocated storage (Appendix E of ER 1105-2-100). For this project the NED recreation benefits lost are included in the NED costs along with the environmental mitigation and recreation modification costs. All alternatives therefore have the same annual NED benefits because Alternatives 1, 3, and 4 provide the same water supply benefits as Alternative 2. Table 5-11 summarizes the NED account for each of the proposed alternatives. Appendix O presents the NED costs in detail.

Table 5-11
National Economic Development Account in Millions, FY 2011 Price Levels

	Alternative 1 No Action	Alternative 2 NTGW/ Downstream Gravel Pits	Alternative 3 20,600 Acre-Foot Reallocation	Alternative 4 7,700 Acre-Foot Reallocation/NTGW/ Downstream Gravel Pits
NED Cost	$312.6	$216.1	$183.9	$199.8
Annual NED Cost*	15.08	10.41	8.74	9.50
Annual NED Benefit*	10.41	10.41	10.41	10.41
Net Annual NED Benefit*	-4.67	0.00	1.67	0.91

* Annual entries were calculated using an interest rate of 4.125 over the 50-year planning period.

The recreation benefits under Alternatives 1 and 2 are the current benefit level since no recreation change would occur at Chatfield Reservoir. Construction and operation of Alternative 3 would affect recreational activity at Chatfield State Park if recreational facilities were closed to accommodate construction activities. Alternative 3 would decrease recreation benefits by $0.7 million per year. Under Alternative 3, visitor use at Chatfield is expected to decrease by 17.6 percent (from 1.66 million to 1.37 million visitors) during construction, by 9.4 percent (to 1.51 million visitors) 1 to 5 years after construction, and by 4.1 percent (to 1.60 million visitors) 6+ years after construction (BBC 2010). Under Alternative 4, visitor benefits would decrease by $0.57 million per year. Under Alternative 4, visitor use at Chatfield is expected to decrease by 14.1 percent (from 1.66 million to 1.43 million visitors) during construction, by 8.0 percent (to 1.53 million visitors) 1 to 5 years after construction, and by 3.3 percent (to 1.61 million visitors) 6+ years after construction.

The NED cost includes costs required to implement the alternatives including construction and operation and maintenance cost. Interest during construction is also included. Alternative 1 includes costs for two components, NTGW and Penley Reservoir for the upstream water providers. These components provide the same amount of water to the upstream water providers, totaling 4,270 acre-feet. Penley Reservoir would replace the use of NTGW. To make the cost of implementing Alternative 1 comparable to the other alternatives' costs, the discounted cost (discounted from 2027 to 2012 at 4. 125 percent) of the NTGW component was removed from the account. Alternative 1 has negative net annual NED benefits compared to Alternative 2.

5.3.3 Regional Economic Development Account

The RED account addresses economic characteristics important to the state, counties, and communities in the study area. Items in this account relate to economic activities such as employment and income.

Expenditures in conjunction with the reallocation of water supply at Chatfield Reservoir are of two types. The first is the payment to the Federal Treasury for the cost of the reallocated storage. The second regards the expenditures for the cost of construction and related costs for water supply infrastructure related to the project and mitigation. The cost of storage for Alternative 3 is a payment in lump sum or over a 30-year period of $14.0 million in FY 2010 dollars, which was updated to $14.5 million in FY 2011 and $15.3 million in FY 2012. Although an outflow from the regional economy to the national economy this figure is small compared to the size of the Denver Metropolitan area economy and would not have a significant effect. For example according to the U.S. Census Bureau, State Metropolitan Area Data Book: 2006, Metropolitan and Micropolitan Area Data Tables, the personal income for the Denver Metropolitan Statistical Area was $86,526,000,000 in 2002. The outflow of about $0.8 million per year would be 0.0009 percent of the personal income. The employment impact would be of similar magnitude. The second component, consisting primarily of construction, does not result in a major outflow or inflow of funds to the regional economy and would not appreciable affect RED any more than a similar expenditure would if the funds are not used for the reallocation activity. In both instances the funds are the responsibility of local sponsors and would be derived from sinking funds, bond sales, and/or income. No federal funds would be allocated to this effort. In the event the local sponsors choose to take advantage of federal financing, they pay for reallocated storage over time along with appropriate level of interest (repayment period not to exceed 30 years). In any event, no significant RED impact is considered likely and the cost of an input output study to better identify the impacts is not believed to be warranted for this analysis. The recreation impacts would affect concessionaires by reducing their income during and after construction. Assuming the concessionaires are local, these impacts would be local. The State of Colorado would experience reduced income from concession sales and visitation during both construction activities and the recovery period following completion of construction. Local businesses that cater to Chatfield State Park visitors and/or sell recreation equipment would also experience reduced income. The farm impacts would occur in counties where water rights were transferred to municipalities.

Table 5-12 summarizes the RED impacts for each of the proposed alternatives. The RED analysis, prepared by BBC (2010) and included as Appendix U, was based upon FY 2010 cost estimates that have since been updated. The proposed alternatives would adversely affect recreation at the reservoir during relocation of recreation facilities. After construction, visitation would recover but is expected to continue below normal levels after a period. As described earlier, visitor use at Chatfield under Alternative 3 is expected to decrease by 17.6 percent (from 1.66 million to 1.37 million visitors) during construction, by 9.4 percent (to 1.51 million visitors) 1 to 5 years after construction, and by 4.1 percent (to 1.60 million visitors) 6+ years after construction (BBC 2010). This would adversely affect income of the concessionaires and the State of Colorado. Alternative 3 is expected to generate a total of $318.0 million in economic output in the region, which includes the direct impact of the project ($186.4 million) and the resulting economic activity generated in response to project demands for goods and services (indirect impacts) and spending attributed to direct and indirect labor earnings (induced impacts), which total an additional $131.6 million. Each alternative would also generate direct, indirect, and induced jobs. In addition to the approximate 324 construction jobs per year directly supported by Alternative 3 over the first two years of construction, an additional 292 annual jobs would be generated in the study area, for a total of about 615 annual jobs in the study area per year during the first two years of project construction. Payment associated with water storage leaving the region represents a loss of about 154 total jobs (i.e., direct, indirect and induced jobs) during the first year of construction under the proposed alternative. Ongoing operational spending is estimated to support about 22 total jobs per year. In total, the employment benefits of project construction and operations are estimated to be approximately 2,257 person-years of employment over the 50-year analysis period in the study area under Alternative 3. About half of that total is attributable to ongoing operations expenditure.

Table 5-12
Regional Economic Development Impacts

	Construction (Year 1-2)	Year 3	Storage Payment	Operations (Year 4-50)	50-Year Total
No Action					
Income (millions)	$251.6	$2.5	Not applicable	$2.5	$623.1
Employment (jobs)	1,748.5	18.3	Not applicable	18.3	4,375.4
NTGW/Downstream Gravel Pits					
Income (millions)	$167.2	$1.2	Not applicable	$1.2	$391.5
Employment (jobs)	1,162.3	8.7	Not applicable	8.7	2,742.2
20,600-Acre-Foot Reallocation					
Income (millions)	$88.5	$19.7	($21.1)	$3.0	$318.0
Employment (jobs)	615.4	136.8	(154.0)	22.2	2,257.0
7,700 Acre-Foot Reallocation/NTGW/Downstream Gravel Pits					
Income (millions)	$148.2	$32.9	($7.8)	$2.1	$419.4
Employment (jobs)	1,029.8	228.8	(57.2)	15.2	2,945.6

Source: BBC 2010

The No Action Alternatives would adversely affect income and farm employment resulting from water rights transfers that dry up farmland. Approximately 1,020 acres of irrigated land (0.1 percent of the irrigated acres in the South Platte Basin, CWCB 2004) would be converted to dryland agriculture for the downstream gravel pits under Alternatives 1 and 2, and fewer acres under Alternative 4. These impacts would likely occur in Adams, Morgan, and/or Weld counties. The estimated number of jobs and income lost from drying up of irrigated farmland were estimated for Alternatives 1, 2, and 4 from information in the Northern Integrated Supply Project Draft Environmental Impact Statement; Socioeconomic Resources Technical Report (HDR, Inc. and BBC Research & Consulting 2008). Impacts were determined using the input–output model IMPLAN developed by the USFS and representative yield, price, and irrigated acre data from Weld and Larimer counties. Alternatives 1 and 2 have no impact on recreation at the reservoir.

Based upon the size of the regional economy and the financial costs in Table 5-10, none of the alternatives would have a significant impact on employment, income, or output of the Denver region. Alternative 1 would have the greatest impact on the Denver Metropolitan Statistical Area personal income at 0.013 percent.

5.3.4 Environmental Quality Account

The potential environmental issues, impacts, mitigation, and related information associated with each alternative are summarized in Table 2-9 and discussed in more detail in Chapter 4. The major potential adverse impacts that have been identified include:

- The loss of grassland and upland habitat during Penley Reservoir construction and impacts on species, onsite wetlands, and wetland disturbance at diversion pipe under Alternative 1.

- The loss of production in NTGW wells under Alternative 2. The determination of significant impacts to NTGW hydrology under Alternative 2 is based on the SMWSS study, which includes peer-reviewed hydrologic and economic models. These models considered a much greater yield than Alternative 2 or the reallocation alternatives would provide, but the same conclusions from the SMWSS study apply to Alternative 2.

- The increase in total phosphorus in Chatfield Reservoir under Alternatives 3 and 4.
- The killing of cottonwoods and conversion of vegetative and wetland types under Alternatives 3 and 4.
- The loss of wetland functions under Alternatives 3 and 4.
- The conversion of acres of terrestrial wildlife and migratory bird habitats to aquatic or semi-aquatic habitats, and the periodic inundation of acres of habitat, disturbing resident species, under Alternatives 3 and 4.
- The potential inundation of Preble's meadow jumping mouse habitat, including Critical Habitat in Plum Creek and the South Platte River, under Alternatives 3 and 4.
- The adverse impacts on northern leopard frog under Alternatives 3 and 4.
- Depletion of winter base flows below Chatfield Reservoir under Alternatives 3 and 4.
- The loss of recreation fees and revenues for the marina operator and Chatfield State Park during construction under Alternatives 3 and 4. (This was included in the RED Account.)
- The loss and relocation of recreation facilities from inundation under Alternatives 3 and 4. (This was included in the NED Account.)
- The potential impacts on NRHP-eligible sites under each alternative.

These adverse impacts would be mitigated to the maximum extent possible, as discussed in Chapter 4 and Appendices K and M.

5.3.5 Other Social Effects Account

The OSE account compares the alternatives in areas of life, health, and safety and community cohesion. Downstream life, safety, and health would not be affected because no alternative would affect flooding. The Chatfield embankment is considered adequate to prevent flooding. The Corps conducted a study to assess the risk of embankment failure during seismic events that may occur in the Chatfield area. As described in Section 3.2.1, the studies found that the raised pool would not increase the risk of failure during a seismic event (Appendix A). Community cohesion would be adversely affected by Alternatives 1, 2, and 4 because irrigated farmland would be dried up to develop gravel pit water storage. The city of Brighton would not seek to change their Chatfield water rights for use at gravel pits. For these alternatives, they would develop new rights that would result in approximately 1,020 acres of irrigated farmland being dried up under Alternatives 1 and 2, and fewer acres under Alternative 4. Alternative 3 would not affect farmland because it would use existing water rights for Chatfield water. Table 5-13 summarizes the OSE impacts for each of the proposed alternatives:

Table 5-13
Other Social Effects Impacts

	Alternative 1 No Action	Alternative 2 NTGW/Downstream Gravel Pits	Alternative 3 20,600 Acre-Foot Reallocation	Alternative 4 7,700 Acre-Foot Reallocation/NTGW/Downstream Gravel Pits
Life, Safety, and Health				
Flood Plain Buildings	No change	No change	No change	No change
Community Cohesion		Many personal and community sacrifices due to very strict water conservation measures as NTGW declines		
Flood Potential	No change in downstream flood damages	No change in downstream flood damages	No change in downstream flood damages	No change in downstream flood damages
Water Supply	Adds 8,539 acre-feet	Adds 8,539 acre-feet	Adds 8,539 acre-feet	Adds 8,539 acre-feet
Farmland Dried Up (acres)	1,018	1,018	0	381
Public Safety	No added stress on project structures	No added stress on project structures	The raised pool would not increase the risk of failure during a seismic event	The raised pool would not increase the risk of failure during a seismic event

5.3.6 Impacts on Other Project Purposes (Benefits Foregone)

The authorized and operating purposes of the Chatfield Dam and Reservoir project are presented below, along with impacts of the alternatives at FY 2011 prices in carrying out these purposes.

- Flood Control (NED)—No effect (Alternatives 1, 2, 3, and 4).

- Recreation (NED)—Alternatives 1 and 2 have no effect on recreation facilities at Chatfield. Alternatives 3 and 4 would result in $2.1 and $0.8 Million, respectively, in annualized costs over 50 years for relocating roads and recreational facilities; these are included in modification costs to be paid 100 percent by non-federal interests and are in the total NED costs (without interest during construction) of the proposed action.

- Recreation (NED)—Alternatives 1 and 2 have no effect on recreation benefits at Chatfield. Alternatives 3 and 4 would result in an estimated $676,800 and $574,100, respectively, in annual average loss/year in recreation benefits based on Unit Day Values (UDVs) over 50 years. This is due to losses in Chatfield State Park visitation and to reduced UDVs for: 1) those using substitute recreation sites; 2) most Chatfield State Park visitors during construction; and 3) some Chatfield State Park visitors for at least the next 10 years, while newly planted trees mature.

- Recreation (RED)—Alternatives 1 and 2 would not affect visitor expenditures at Chatfield. Alternatives 3 and 4 are projected to result in reduced visitor spending at Chatfield and elsewhere in Colorado that would impact the regional economy by $0.75 and $0.56 Million, respectively, in annualized decreases over 50 years in recreation-related business income, including lost income for concessionaires and Colorado State Parks. Yearly reimbursements to Colorado State Parks and Chatfield concessionaires for documented losses in income will be paid 100 percent by non-federal interests.

- Fish and Wildlife (EQ)—Alternatives 1 and 2 would not affect wetlands or riparian habitat at Chatfield. Alternatives 3 and 4, respectively, are estimated to result in loss of ecological functions due to potential inundation of, or relocation of recreation facility modifications on, the following acreage of habitat at Chatfield: up to 157.2 and 119.8 acres of wetland/riparian habitat, up to 456.54 and 272.54 acres of Preble's meadow jumping mouse habitat (including approximately 155.68 and 88.08 acres of Designated Critical Habitat), and up to 618.54 and 360.54 acres of habitat for birds and other wildlife. The cost to mitigate these impacts is $3.9 Million annually.

- The costs of offsetting these impacts are included in mitigation costs to be paid 100 percent by non-federal interests and in total costs of the proposed action.

Construction and operation of Alternative 3 would decrease recreational benefits at Chatfield State Park by $0.7 million per year due to reductions in UDVs and in Chatfield SP visitors. Some Chatfield visitors would use a substitute site in Colorado instead, but at a reduced UDV. Most Chatfield visitors during construction would also have reduced UDVs due to the views, noise, and access problems from construction activities. After recreation modifications are constructed, many activities will return to pre-reallocation visitor levels, but with reduced UDVs, mainly due to views of the unvegetated shoreline resulting from pool fluctuations and to the lack of mature trees. For some activities for which mature trees are important, such as nature interpretation, bird watching, outdoor photography, horseback riding, and picnicking, Chatfield visitation losses and reduced UDVs would be moderate during the first 5 to 10 years after construction and would be of lesser extent during years 11–50 after construction, when most of the newly planted trees will have matured.

5.4 Evaluation of Alternatives

The proposed alternatives were compared by their contributions to the planning objectives, response to planning constraints and their acceptability, completeness, effectiveness, and efficiency with respect to the planning objectives. An additional planning objective is consistency with the Corps' seven EOP, guidelines with a multi-generational timeframe, in accordance with ER 200-1-5. The EOP were listed in Chapter 1, and consistency of each alternative with each EOP was summarized in Table 2-11. This evaluation is summarized in Table 5-14.

Table 5-14
Plan Evaluation

	Alternative 1 No Action	Alternative 2 NTGW/Downstream Gravel Pits	Alternative 3 20,600 Acre-Foot Reallocation	Alternative 4 7,700 Acre-Foot Reallocation/NTGW/ Downstream Gravel Pits
1. Contribution to Planning Objectives				
Minimize Environmental Impacts	Meets objective with mitigation.	Meets objective with mitigation.	Meets objective with mitigation of impacts at Chatfield Reservoir	Meets objective with mitigation of impacts at Chatfield Reservoir and other mitigation
Minimize Recreation Impacts	No Impact.	No Impact.	Meets objective with mitigation of impacts at Chatfield State Park.	Meets objective with mitigation of impacts at Chatfield State Park
Reliable Water Supply	Penley Reservoir replaces NTGW.	NTGW available for droughts.	Depends on junior water rights.	Needs long-term replacement of NTGW.

Table 5-14
Plan Evaluation

	Alternative 1 No Action	Alternative 2 NTGW/Downstream Gravel Pits	Alternative 3 20,600 Acre-Foot Reallocation	Alternative 4 7,700 Acre-Foot Reallocation/NTGW/ Downstream Gravel Pits
	Downstream providers depend on junior water rights.	Needs long-term replacement of NTGW beyond 50-year planning horizon.		Depends on junior water rights.
2. Response to Planning Constraints				
Financial Capability of Water providers	Within user capability.	Within user capability.	Within user capability. Least costly.	Within user capability.
Institutional Acceptability	Water court action needed.	Water court action needed.	No water court action needed.	Water Court action needed.
Public Acceptability	Implementable. Reduces NTGW use.	Implementable. Uses NTGW. Least acceptable.	Implementable. Reduces NTGW use. Most acceptable.	Implementable. Reduces NTGW use somewhat
3. Consideration of Four P&G Criteria				
Completeness	Meets objectives.	Meets objectives.	Most complete.	Meets objectives.
Effectiveness	Meets objectives.	Meets objectives.	Most effective.	Meets objectives.
Efficiency	Least Efficient.	Most efficient no action plan.	Most efficient.	Meets objectives.
Acceptability	Meets objectives.	Least acceptable.	Most acceptable.	Meets objectives.
4. *EOP Consistency*				
Extent of consistency with the 7 Environmental Operating Principles	Fully consistent with 2 EOP; partially consistent with 4 EOP; inconsistent with 1 EOP.	Fully consistent with 1 EOP; partially consistent with 1 EOP; inconsistent with 5 EOP.	Fully consistent with all 7 EOP.	Fully consistent with 4 EOP; partially consistent with 3 EOP.

5.4.1 Contribution to Planning Objectives

None of the alternatives would change the downstream flood damage potential. Alternatives 3 and 4 would affect environmentally sensitive sites at or near Chatfield Reservoir. Mitigation would minimize these impacts. Alternatives 3 and 4 would adversely affect recreation. Buildings and facilities relocated because of pool elevation changes would reduce visitation and income to concessionaires and State Parks. Recreation modifications and Sponsor reimbursements to concessionaires and State Parks would minimize these impacts.

The final planning goal is to provide a reliable water supply to the providers requesting storage space in Chatfield Reservoir. All alternatives would meet this goal during the 50-year planning period. NTGW is not renewable so water supply storage would need to be developed eventually under Alternatives 2 and 4. Because gravel pit or reservoir storage relies on junior surface water rights, the water supply for all alternatives, to some degree, would be unreliable during dry periods. NTGW is reliable during droughts.

5.4.2 Response to Planning Constraints

Planning constraints include the financial capabilities of the providers, institutional acceptability, and public acceptability. All alternatives are within the financial capabilities of the water providers requesting storage space in Chatfield Reservoir because they have non-negative net benefits and are capable of paying for the alternatives. Alternative 3 is the least costly alternative so it would rank above the others.

Section 2.4.1.1 indicates that all alternatives except Alternative 3 would require a change case process in water court to change water rights from Chatfield Reservoir to Penley Reservoir or transfer or develop other water rights. Each Penley Reservoir participant except SMWSA would need to transfer their water rights. Section 2.4.1.2 states that the downstream water providers would either use the change case to transfer their Chatfield water rights or file for new water rights for Alternatives 1, 2, and 4. Based on these constraints, Alternative 3 is the most institutionally acceptable alternative because it would not require a change case action by the water court.

All alternative plans are implementable or publicly acceptable (i.e., acceptable to the participating entities). Because NTGW is non-renewable, alternatives using this source are less publicly acceptable. Alternatives 1, 3, and 4 reduce NTGW use because they incorporate storage components. Alternative 3 is most acceptable to the water providers because it is the least costly, reduces NTGW usage upon implementation, and provides renewable water supply. Alternatives 3 and 4 would change the existing recreation and environmental resources at Chatfield Reservoir. This may result in these alternatives being less acceptable to the general public. The appearance of the lake and adjacent areas would be different after mitigation and during the new operations of the dam. Sites familiar to current park users may be inundated or socially changed. These changes could be considered negatively by some of the general public.

5.4.3 Consideration of Four P&G Criteria

The four proposed alternatives were identified for further consideration because they met the planning objectives. Table 5-14 summarizes the response of these alternatives to the four P&G criteria: acceptance, completeness, effectiveness, and efficiency. Other alternatives not chosen for further study failed to meet these objectives in one or more of these areas.

Completeness reflects the degree to which an alternative plan contains the necessary measures to ensure the planned effects. All alternatives are essentially complete. As described in Section 5.4.2, Alternatives 1, 2, and 4 would require additional steps to transfer or develop water rights. Costs for these steps have been included for these alternatives. Alternative 3 is the most complete alternative because it would not require the transfer of water rights.

Effectiveness is the extent to which an alternative plan alleviates the identified problems. All alternatives are effective because they meet the planning objectives. Alternative 3 is the most effective because it maximizes net NED benefits and minimizes adverse RED impacts.

Efficiency is the extent to which an alternative is the most cost-effective means of addressing problems while protecting the nation's environment. Alternatives 2 and 3 have non-negative net NED benefits and are therefore efficient. Alternatives 1 and 4 are not efficient because they have negative net benefits. Alternative 2 is the most efficient No Action alternative. Alternative 1 is the most costly alternative. When Penley Reservoir is available in 2027, use of this source would reduce the use of NTGW and associated pumping costs. Alternative 3 is the most efficient of the four alternatives because it provides 8,539 acre-feet of water supply at the least cost. With mitigation measures, it preserves the nation's environment.

Acceptability is addressed in Section 5.4.2. All of the alternative plans are acceptable to the public in that all are implementable; however, Alternative 3 is the most acceptable to the water providers because it is the least costly, reduces NTGW usage upon implementation, and provides renewable water supply. Alternatives 3 and 4 may be less acceptable to the general public because of the impacts to existing recreation and environmental resources.

5.5 Description of Tentatively Selected Plan

5.5.1 Risk Analysis and Uncertainties

The Chatfield Reservoir storage reallocation study includes analyses of resource impacts and project costs. There are varying degrees of uncertainty associated with the assumptions used in these analyses. This section discusses the main sources of uncertainty. Standard models and conservative assumptions were used in the study in order to reduce the uncertainties.

5.5.1.1 Hydrologic and Hydraulic Modeling

The hydrologic and hydraulic modeling of Chatfield and downstream flows in the South Platte River play a key role in the study, as the output from these modeling efforts are used in the impacts analysis for a variety of resources including fish, wildlife, wetlands, and recreation. The potential hydrologic impacts of the alternatives were evaluated using historical (1942 to 2000) data from South Platte River stream gages and Chatfield Reservoir operations (beginning after the reservoir was constructed), and the Corps' reservoir simulation computer model (HEC-5). Detailed descriptions of the hydrologic and hydraulic modeling efforts, including the model assumptions, are included in Appendices H and I, respectively. The historical flow data reflect any impacts to the river flows over time, including changes in available water rights, water supply needs, timing of runoff, or additional reservoirs constructed upstream. Because the historical flow data were used with no corrections for present day conditions, there is a tendency for the hydrologic model to overestimate the water available for the potential new water providers at Chatfield. Because of this tendency, the average pool levels reflected in the reallocation alternatives would likely be lower than what is shown in the tables and on the graphs in this chapter. Thus the results of the impact analysis based on the modeled reservoir pools under the reallocation alternatives tends to show somewhat greater impacts than would likely be experienced in an actual reallocation scenario, but provides a good basis for relative comparison between alternatives.

There is uncertainty about the potential effects of climate change on future conditions in the Chatfield study area. Climate change would likely result in greater variability in climate. There may be more floods and more/longer periods of drought, which cannot be accurately predicted at this time. The Corps model uses inflows during the 1942–2000 POR, which tend to be greater on average than expected for future conditions for all alternatives. This results in a greater probability of adequate mitigation for all types of inundation-related environmental impacts.

5.5.1.2 Reliability of Water Supplies

It is important to recognize that 20,600 acre-feet of new storage capacity in Chatfield Reservoir does not equate to 20,600 acre-feet of new water yield. For this study it is assumed that the average year yield for 20,600 acre-feet of storage is 8,539 acre-feet. Several factors, including precipitation, runoff, and the seniority of water rights, play a key role in the availability of water and storage opportunities in any given year. The actual yield of water supplies that would be realized from use of the storage space would vary every year. The water rights of the 15 water providers that would allow them to store water in Chatfield Reservoir are, in general, very junior in their relative priority and therefore they are expected to be in priority relatively infrequently. One estimate of water supply yield is the so-called “average year yield,” which is defined as the average annual amount of water expected to result from the storage of available water rights.

One of the limitations related to water supplies is that Chatfield State Park must remain in outdoor recreation uses pursuant to Section 6(f) of the LWCF Act (Public Law 88-578, as amended) because LWCF assistance was used by the Colorado Division of Parks and Outdoor Recreation to obtain water for Chatfield Reservoir. The National Park Service, with assistance from Colorado State Parks, oversees compliance with the LWCF Act. If facilities funded with LWCF grants were inundated under the tentatively selected plan, they would have to be replaced elsewhere in the park, and Colorado State Park staff would have to submit a formal letter to the National Park Service recognizing the changes and stating that the park was not in default. If the facilities were removed and not relocated, then the state would be in default (per Section 8(f)(3) of the LWCF Act). However, because all recreation facilities are planned to be relocated in-kind under the tentatively selected plan, the tentatively selected plan would comply with the LWCF Act. The National Park Service has issued a letter concurring with Colorado State Parks that the Chatfield Reservoir Storage Reallocation project will not result in a Section 6(f)(3) conversion (see Attachment 3 in Appendix S).

Another limitation related to water supplies is that the existing conservation pool in Chatfield Reservoir contains water storage rights of 10,785 acre-feet (between 5,423 and 5,432 feet msl) held between the State of Colorado and Denver Water. Denver Water considers its use of this pool to be a vital and permanent component of its water supply system. Because the 1979 Agreement granting Denver Water the exclusive right to store water in Chatfield Reservoir is only modifiable by mutual agreement, Denver Water considers any alternatives that would decrease the amount of its storage capacity in Chatfield Reservoir to be unacceptable. As a result, water below 5,432 feet msl is not available for reallocation and cannot be redefined as an integrated pool with other water providers. Because senior water rights were considered in the hydrology analysis, Denver Water’s water right would not limit the reliability of water supplies under the tentatively selected plan.

An uncertainty regarding the reliability of water supplies as it relates to the development of alternatives is that for a few upstream providers near the edge of the aquifer, it may not be physically possible to utilize NTGW through the 50-year period of analysis. They may need to pursue alternative sources of water. Due to uncertainties regarding the courses of action of the affected entities, it is assumed their water needs are satisfied with NTGW for purposes of this study. To the extent that other alternative water sources are more costly than NTGW, the NTGW/Downstream Gravel Pits Alternative is a conservative least-cost alternative to the Chatfield Reservoir storage reallocation project.

5.5.1.3 Downstream Damages

Future storm events would affect downstream damages. Storms downstream from Chatfield would have similar damages for all alternatives. Storms upstream from Chatfield would be affected by Chatfield Dam. For upstream storms, downstream damages would reflect the risk and uncertainty associated with the alternative's hydrology and hydraulics. The results of hydrologic and hydraulic modeling, detailed in Appendices H and I respectively, showed that flood flows in the South Platte downstream of Chatfield Dam would not differ significantly among the four alternatives. Future development in the downstream floodplain would occur outside of the Federal Emergency Management Agency-designated floodway. Uncertainty to damages under future conditions would be dependent on alternative risk and uncertainty defined by the hydrology and hydraulics.

5.5.1.4 Antecedent Flood Study

The antecedent flood study used conservative modeling assumptions to determine whether the 5 feet of freeboard requirement would be met if the pool is raised to 5,444 feet msl. Corps regulations require consideration of an antecedent flood of 50 percent of the Inflow Design Flood. This assumption was reviewed based on local and regional historical storm data. Based on this review, it was concluded that the 50 percent value was overly conservative and that a maximum value of 40 percent would represent the actual data and also be sufficiently conservative. There is some uncertainty with this assumption, but the analysis is considered sufficiently conservative and protective. An Independent Technical Review by the U.S. Bureau of Reclamation was performed of the study, and a waiver was granted to the 50 percent antecedent flood criteria by USACE headquarters.

5.5.1.5 Water Quality

The water quality analysis used a number of assumptions to model the concentrations of nutrients, metals, and bacteria. The load quantification process and concentration predictions do not consider the complex interactions among evaluated parameters and those not explicitly considered, and the analysis should be considered a gross quantification of impacts. There were uncertainties associated with a number of the parameters, such as the hydraulic residence time, the hypolimnetic volume, flux rates, background loads of bacteria, and the use of the swim beach by birds and humans. In order to address the key sources of uncertainty, concentrations were modeled using a range of values for the most important parameters and outputs were provided for minimum, average, and maximum cases. Thus, the uncertainty is effectively addressed by capturing the range of possible outcomes.

5.5.1.6 Vegetation and Wildlife

The analysis of impacts to vegetation and wildlife are dependent on the hydrologic and hydraulic modeling, and thus are affected by the uncertainties associated with those modeling activities. Several other sources of uncertainty are discussed below.

Habitat Mapping. The mapping of Preble's mouse, bird, and wetlands habitat was conducted in the field using a recent aerial photograph of the Chatfield Lake study area. Due to the uncertainty associated with this method, the estimated number of acres may be up to 5 percent more or less than the actual number of acres. This level of uncertainty is not considered significant in selecting the plan.

Analysis of Future Vegetation Conditions. The estimates of acres of vegetation at future water levels assumes that water would be available at a sufficient amount to encourage long-term successional changes in vegetation. This was based on current proportions of vegetation types at existing water levels and spatial analysis of slope and elevation of land at the future water levels. The analysis looks at vegetation in a band 0 to 6 feet above the proposed future levels. The estimates likely over-estimate the amount of vegetation that is predicted to change. This is because the hydrologic model of the reservoir may overestimate the degree to which water levels fluctuate under Alternatives 3 and 4. The over-estimation of the change in vegetation types is not considered significant.

Fisheries and Downstream Flows in the South Platte River. The hydrologic modeling was developed to predict flood levels at relatively large timeframes (e.g., months and years versus days and hours). Therefore, the predictions that mean monthly discharges from the Chatfield Dam would be minimal may mask the more detailed data that would indicate that substantial decreases in flow may be reached for specific days or hours of a day. This more detailed data may show that there are times when daily discharge rates may be impacting flows immediately downstream from Chatfield Reservoir. However, the abundance of tributaries that provide water to the river would quickly offset any decreases in flows further downstream and thus minimize the potential for flow-related impacts to fisheries.

5.5.1.7 Recreation

The analysis of impacts to recreation at Chatfield State Park is dependent on the hydrologic modeling and thus is affected by the uncertainties associated with the model.

5.5.1.8 Cost Uncertainty

In general, future economic conditions in the Denver region, the nation, and the world would affect alternative costs. Depressed conditions would tend to reduce the costs of material and labor, whereas expanding conditions would have the opposite effect. Alternatives with more immediate implementation costs may be less subject to cost uncertainty than other alternatives. Alternative 1 costs would be more uncertain than Alternatives 2, 3, and 4 because Penley dam construction would not be immediate. The uncertainty of operation and maintenance costs would be similar for all alternatives because these costs would be expended over time. Future climatic conditions would affect alternative operation costs if different from the POR. Yields of storage measures could differ from the averages used in the study, which are based on the POR. NTGW usage patterns would affect the operation and maintenance cost.

5.5.2 Trade-off Analysis

The analysis shows that the alternatives are very comparable in their performance. Each alternative plan provides additional water in the same quantity and quality (8,539 acre-feet), is implementable, and mitigates adverse impacts. From an NED and financial perspective, Alternative 3 is the least expensive, and provides storage for renewable surface water in an existing reservoir. Alternative 1 requires the construction of a new reservoir and Alternative 2 depends in part on the use of nonrenewable NTGW. However, Alternatives 1 and 2 would not have impacts at Chatfield Reservoir. Alternative 4 also provides storage for renewable surface water, but the storage capacity would be less than that provided by Alternative 3, and part of this difference would be provided by nonrenewable NTGW. The impacts at Chatfield from implementing Alternative 4 would be less than the impacts from Alternative 3. However, the impacts at Chatfield from Alternatives 3 and 4 can all be mitigated.

Although Alternative 3 would be the least expensive in total costs, there are cost trade-offs. Table 5-15 shows this with implementation cost and annual OMRR&R costs valued using FY 2011 price levels and 4.125 percent federal interest rate. The Chatfield alternatives have greater environmental mitigation and recreation modification costs (see Table 5-10) than the No Action Alternatives. This represents disruption to the environment and recreation at Chatfield that would not be present with Alternatives 1 or 2. Alternatives 1, 2, and 4 would mitigate their impacts for dried farmland. Alternative 3 would not impact this resource. The impacts for all alternatives can be mitigated. Alternative 4 would require additional NTGW and storage to provide the same amount of water as Alternative 3 (see Table 5-2). Alternative 3 would minimize infrastructure investment represented by the Cost of Storage and Specific Costs (costs required to develop, access, treat, and deliver the Participant's water) compared to the other alternatives. Alternatives 1 and 2 would require the greatest infrastructure investment. The Cost of Storage would be paid to the U.S. Treasury and would not result in regional investment. Regional investment would be the greatest with Alternative 1. The net effect of this investment would be minimal on a regional basis since the source for the funds is from the region. Alternative 3 would require the greatest OMRR&R outlays from the water providers. Table 5-15 also shows the cost per acre-foot of average year water yield for annualized implementation costs, for annual OMRR&R costs and total annual cost. Alternative 3 has the least cost per acre-foot for annualized implementation and total annual cost. Alternative 1 has the least cost per acre-foot for annual OMRR&R cost.

Table 5-15
Annual Financial Costs of the Alternatives per Acre-Foot of Average Year Yield, FY 2011 Price Levels

	User Costs			
	Alternative 1	Alternative 2	Alternative 3	Alternative 4
Initial/Implementation Costs	$246,951,356	$172,784,412	$140,645,975	$160,792,397
Annualized Initial/Implementation Cost	$11,742,782	$8,216,070	$6,687,855	$7,645,838
Annual OMRR&R Costs	$1,495,302	$1,538,602	$2,081,534	$2,026,560
Total Annual Costs	$13,238,084	$9,754,672	$8,769,390	$9,672,398
Annualized Implementation Cost/acre-foot	$1,375	$962	$783	$895
Annual OMRR&R Cost/acre-foot	$175	$180	$244	$237
Total Annual Cost/acre-foot	$1,550	$1,142	$1,027	$1,133

Alternatives 1, 2, and 4 use NTGW to some extent (see Table 5-2). This is a nonrenewable source and it is not sustainable over a long period (beyond the 50-year planning period). The upstream water providers would be affected. NTGW would be available during long dry periods possibly at high costs. The downstream water providers would also be affected during extended dry periods because their surface water rights may not yield water. With Alternative 3 surface water rights may not yield water during extended dry periods.

Alternatives 3 and 4 would be able to more effectively capture during high flows because Chatfield is located on the South Platte River. Storage components (Penley and gravel pits) with the other alternatives would be located on tributaries or adjacent to the South Platte River and therefore they would not be as effective at capturing water during high flows due to the pumping capacity used to collect the flows.

5.5.3 Plan Designations

Alternative 3 maximizes NED benefits and therefore is the designated NED plan. Alternative 3 also is the alternative that best meets the water supply needs of the water providers for the local communities and therefore is designated the Locally Preferred Plan. Alternative 3 is also the Least Environmentally Damaging alternative because: 1) the environmental impacts of Alternative 3 at Chatfield can all be fully mitigated; 2) Alternative 3 does not result in the drying up of any farmland or include the use of non-renewable NTGW; and 3) Alternative 3 is the plan most in compliance with the Corps' seven EOP.

Alternative 3 is the NED Plan and the Locally Preferred Plan of the water providers. It is also in full compliance with the Corps' EOP. It is designated the tentatively Selected Plan.

5.5.4 Selection Criteria

The 20,600 Acre-Foot Reallocation Alternative (Alternative 3) is the tentatively selected plan because it is the alternative that minimizes the cost of supplying water and therefore maximizes net NED benefits. It offers $6.4 million more in net annual benefits than Alternative 1, $1.7 million more net annual benefits than Alternative 2, and $0.8 million more than Alternative 4. Mitigation measures ensure that important environmental resources are preserved and recreation modifications would maintain the recreation experience at Chatfield Reservoir. Alternative 3 is also the Locally Preferred Plan.

5.5.5 Tentatively Selected Plan Features

5.5.5.1 General

This reallocation would fully meet the purpose of and need for the project, which is to increase the availability of water, sustainable over the 50-year period of analysis, in the greater Denver area so that a larger proportion of existing and future water needs can be met. The tentatively recommended plan meets all federal NED goals providing $10.41 million in annual NED benefits to total annual NED project costs of $8.74 million. This alternative would provide storage to help meet part of the growing demand for water in the Denver Metro area by using existing federal infrastructure, and lessening the dependence on NTGW. The Colorado Department of Natural Resources (CDNR), through its agencies and non-federal project partners, will complete 100 percent of the integral work at no cost to the federal government per the 1958 Water Supply Act and Section 103(c)(2) of WRDA 1986.

5.5.5.2 Water Supply

The tentatively recommended plan, reallocation to allow an additional 20,600 acre-feet of water supply storage, would reallocate storage from the flood control pool to the conservation pool. Under this alternative, the base elevation of the flood control pool would be raised from 5,432 to 5,444 feet msl. This amount of storage would provide an average year yield of 8,539 acre-feet. Mitigation will be required to offset impacts to terrestrial based effects (wetland and riparian habitats, including Preble's mouse critical habitat). The CDNR, through its agencies and non-federal project partners, will complete 100 percent of the integral work at no cost to the federal government per the 1958 Water Supply Act and Section 103(c)(2) of WRDA 1986. The CDNR is the non-federal signatory to the Water Supply Agreement. The water providers seeking storage space in Chatfield Reservoir are the Penley Reservoir User Group (Upstream Group) and the Lower South Platte Gravel Pit User Group (Downstream Group). The Penley Reservoir User Group includes Mount Carbon Metropolitan District, Town of Castle Rock, Centennial WSD, Roxborough WSD, Castle Pines Metropolitan District, Castle Pines North Metropolitan District, the South Metro Water Supply Authority (SMWSA) (a group of 13 water providing entities in the south metro area), Colorado State Parks, Center of Colorado Water Conservancy District, and Perry Park Country Club. The Lower South Platte Gravel Pit User Group is composed of Aurora, Brighton, Central Colorado WCD, and Western Mutual Ditch Company.

5.5.5.3 Recreation

In developing the recreation facilities modification plan for Chatfield State Park, operating conditions, including the relationship between water levels and existing facilities and how visitors use the park, was considered. Below is a list of impacted areas, modifications to occur, and estimated cost for modifications as shown in Appendix 1 of the Recreation Facilities Modification Plan (Appendix M).

- *North Boat Ramp:* Parking areas, concrete boat ramp, trails, day use shelter, picnic tables, trash receptacles, bollards, grills, regulatory signs, and water hydrants. Estimated cost: $636,228.

- *Massey Draw:* Asphalt trails, picnic tables, benches, trash receptacles, grills, beach volleyball court, and horse shoe pit. Estimated cost: $357,851.

- *Eagle Cove:* Parking area, portable restroom, dumpsters, trash receptacles, regulatory signs, and fencing. Estimated cost: $222,432.

- *Deer Creek Day Use and Balloon Launch Area:* Parking area, trails, picnic tables, trash receptacles, grills, and regulatory sign. Estimated cost: $779,343.

- *Swim Beach:* Parking area, shower/restroom building, concession, first aid station, information kiosk, picnic tables, benches, water fountain, dumpsters, trash receptacles, bollards, grills, regulatory signs, fencing, beach volleyball court, horse shoe pits, sand, and utilities. Estimated cost: $5,109,500.

- *Jamison Area:* Parking area, trails, restroom, picnic tables, benches, water fountain, dumpsters, trash receptacles, grills, regulatory signs, utilities, and electrical transformer. Estimated cost: $999,890.

- *Catfish Flats*: Parking areas, trails, restroom building, group picnic shelters, picnic tables, benches, water fountain, dumpsters, regulatory signs, utilities, and electrical transformer. Estimated cost: $902,609.

- *Fox Run:* Trails, group picnic area, picnic tables, benches, water fountain, dumpsters, trash receptacles, regulatory signs, beach volleyball court, and horse shoe pits. Estimated cost: $160,574.

- *Kingfisher Area:* Parking area, portable restrooms, dumpsters, trash receptacles, regulatory signs, fencing. Estimated cost: $154,280.
- *Gravel Ponds Area:* Parking area, portable restrooms, picnic tables, dumpsters, trash receptacles, regulatory signs, and fencing. Estimated cost: $113,640.
- *Platte River Trailhead Area:* Trails. Estimated cost: $58,575.00
- *Marina Point:* Parking area, trails, shower/restroom building, concession, day use area, information kiosk, riverside marina slips, group picnic area, picnic tables, benches, water fountain, dumpsters, trash receptacles, regulatory signs, beach volleyball court, horse shoe pits, sand, and utilities. Estimated cost: $6,023,353.
- *Roxborough Cove:* Portable restroom, regulatory signs, picnic tables, trash receptacles, grills, and sand. Estimated cost: $213,949.
- *Plum Creek Inventory:* Parking areas, trails, restroom building, picnic tables, benches, dumpsters, regulatory signs, fencing, and volleyball court. Estimated cost: $249,943.

5.5.5.4 Environmental Mitigation

On-site mitigation would occur within Chatfield Reservoir project lands. Twenty-nine potential on-site mitigation sites are being evaluated for their mitigation potential. The mitigation sites occur within four general areas of the Chatfield Reservoir project lands: Lower Marcy Gulch, Deer Creek, West Plum Creek, and South Platte River. The on-site mitigation site locations are shown in Appendix K (CMP Figures 7 through 15). Two potential mitigation sites totaling 17.4 acres are located in Lower Marcy Gulch, four potential mitigation sites totaling 13.6 acres are located in the Deer Creek area, 10 potential mitigation sites totaling 54.1 acres are located in the West Plum Creek arm of Chatfield Reservoir, and 13 potential mitigation sites totaling 80.2 acres are located in the South Platte River arm of Chatfield Reservoir. All of the on-site mitigation sites are designed to provide gains in EFUs for the target environmental resources (Preble's, wetlands, and birds). Similar to how the target environmental resources overlap within the Chatfield Reservoir project lands, the on-site mitigation areas will provide overlapping and combined resources for the target environmental resources. Detailed information for each potential mitigation site, including the existing conditions and proposed habitat gains can be found in Appendix K (CMP, Appendix G).

Off-site mitigation would occur outside the boundaries of Chatfield Lake project and would include:

- Permanent protection of habitat associated with the target environmental resources (Preble's, wetlands, and birds) from an estimated 888 acres (of the 5,917 acres identified) by conservation easements put in place on property purchased in fee from willing sellers or through conservation easement agreements with willing property owners. This habitat protection will be acquired from willing sellers only and the Non-Federal Sponsor (CDNR) will not subject any owner to condemnation;
- Off-site habitat conversion and enhancement activities associated with protection of the estimated 888 acres of protected habitat described above; and

- Protection of up to 22.5 acres of off-site existing mature cottonwood habitat and designation of up to 10 acres for cottonwood regeneration associated with protection of the estimated 888 acres of protected habitat described above.

In addition to the on-site and off-site mitigation actions discussed above, mitigation for impacts to Preble's designated critical habitat would include:

- On-site mitigation of approximately 17 acres in the Upper South Platte CHU and 6 acres in the West Plum Creek CHU as described in Section 6.3.1 of Appendix K; and

- Off-site mitigation in the form of sediment control and riparian habitat extension along 4.5 stream miles of Sugar Creek in the Upper South Platte CHU on U.S. Forest Service land, and up to 65 Preble's EFUs in the West Plum Creek CHU through permanent protection, management, and enhancement on private lands, included in the estimated 888 acres of off-site mitigation discussed above.

5.5.5.5 Other Features

Upon approval by the ASA(CW) and signing of agreements, the following actions will be required for the federal project: dam safety instrumentation and monitoring, Master Plan supplement, review and real estate activities, update capacity tables, water release and calculations, and additional operations. There are non-federal features that are required as the result of discussions between non-federal entities. These non-federal actions will be implemented separately by the providers and state separate from this reallocation project.

The State Engineer determines the releases needed to satisfy water rights in the conservation zone (5,385–5,432 feet msl) and the joint-use pool (5,432–5,444 feet msl). If the pool elevation is forecast to rise above the top of the joint use zone (5,444 feet msl), the Corps will have the option to take control of the reservoir releases. When the pool is in the flood control zone (5,444–5,500 feet msl), the Corps determines the releases needed to safely evacuate flood storage and reduce flood risk downstream. In the event of an emergency the Corps will determine the necessary releases to ensure safety of the dam. See Appendix B, Water Control Plan, for further details. Allowing water providers downstream of Chatfield Reservoir to use existing infrastructure to divert their portion of the stored water into their water systems, the number of water providers with storage rights within the reservoir would increase from one (Denver Water) to 15.

Table 5-16 shows the current estimate of the costs to reallocate storage in Chatfield Reservoir at FY 2012 price levels.

Table 5-16
User Costs for the Tentatively Selected Plan (Million Dollars, FY 2012 Price Levels)

	Annual Costs	Capital Costs
Construction and Implementation Costs		
Cost of Storage*	$0.71	$15.3
First Costs		
Specific Infrastructure **	$0.49	$10.6
Environmental Mitigation	$2.81	$60.3
Recreation Modifications	$2.23	$48.0

Table 5-16
User Costs for the Tentatively Selected Plan (Million Dollars, FY 2012 Price Levels)

	Annual Costs	Capital Costs
Total Construction & Implementation	$6.25	$134.2
OMRR&R Costs		
Joint-use Cost of Storage	$0.25	$5.3
Specific Infrastructure	$1.39	$29.9
Environmental Mitigation	$0.63	$13.6
Recreation Modifications	$0.00	$0.0
Total OMRR&R	$2.27	$48.7
Total User Costs	$8.52	$182.9

* Costs are annualized over 50 years, although Cost of Storage will be repaid within 30 years
** Costs required to develop, access, treat, and deliver the Participant's water

The following measures were developed in coordination with the water providers, State Parks, and Colorado Division of Wildlife (CDOW) to provide additional assurances of a like recreational experience, to compensate State Parks for lost revenue or increased costs, and to provide ecological benefits above and beyond where the CMP has planned to replace lost ecological functions. These actions are over the tentatively recommended plan. Recreation plans that are being developed include: re-contouring the south shore, portions of the west shoreline, and potentially other select sites to minimize the appearance of a "bathtub ring"; maximizing buffer areas, reforestation of areas for aesthetics and shade; and reimbursement to Colorado State Parks and the marina operator on an annual basis for lost revenue. Environmental discussions include: funding up to 0.7 mile of the mainstem of the South Platte River above Chatfield Reservoir and up to 0.5 mile of the mainstem of the South Platte River downstream of Chatfield Reservoir for stream habitat improvements, work closely with CDOW on reservoir operations to address potential impacts to walleye and brood rearing facility, and use monitoring and adaptive management to address potential water quality issues.

5.5.6 Evaluations Required by Authorizing Legislation

5.5.6.1 Section 808 Findings

Section 808 authorizes the Secretary of the Army to implement a reallocation of existing storage at Chatfield Reservoir if the CDNR requests and coordinates the reallocation, and the Chief of Engineers finds the reallocation to be feasible and economically justified. This FR/EIS has been prepared under the Section 808 project authorization to develop the plan and conduct the analyses required for the Chief of Engineers findings.

The analyses presented in the FR/EIS show that Alternative 3, the tentatively selected plan, is economically justified, feasible considering potential engineering constraints, and socially and environmentally acceptable.

The Recommended Plan meets all federal NED goals providing $10.41 million in annual NED benefits to total annual NED project costs of $8.74 million. It is the least costly alternative providing an average year yield of 8,539 acre-feet meeting a portion of the demand that is expected to continue to increase.

The proposed raise in lake level will meet dam safety requirements and does not impact the primary flood risk management purpose at Chatfield Reservoir. Flood control capabilities at Chatfield Reservoir would not be reduced by the proposed reallocation of flood storage to water supply storage.

The proposed mitigation and recreation will off-set any significant impacts to project purposes. Mitigation and modifications are included in the plan to avoid or compensate for adverse effects to those resources. Mitigation will be required to offset impacts to terrestrial based effects (wetland and riparian habitats, including Preble's mouse critical habitat). Positive environmental effects to the fisheries supported by the reservoir include the inundation of terrestrial habitats which will result in increased habitat structure for use by fish and other aquatic life. Additionally, increased primary productivity as a result of increased shoreline inundation will enhance productivity at virtually every trophic level in the aquatic food web. Impacted recreation facilities will be replaced with new facilities.

The Colorado Department of Natural Resources, through its agencies and non-Federal project partners will complete 100% of the integral work at no cost to the Federal government per the 1958 Water Supply Act and Section 103(c)(2) of WRDA 1986. Cost of the project is estimated to be $184,600,000. Design and construction includes on-site and off-site environmental mitigation; modification/re-construction of all impacted recreation facilities; utility relocations; earthwork and shoreline contouring; road, bridge and parking lot construction; demolition, clearing, and grubbing; and vegetation management. Design and construction of environmental mitigation features and recreation modifications will follow Corps standards and regulations. All plans will be approved by the Corps.

Population growth within the Denver, Colorado, metropolitan area continues to create a demand on water providers. Colorado's population is projected to be between 8.6 and 10.3 million in 2050. The Statewide Water Supply Initiative (SWSI), commissioned by the State Legislature, estimates that by 2050, Colorado will need between 600,000 and 1 million acre-feet/year of additional municipal and industrial water. This proposed reallocation project will help enable water providers to utilize a surface water supply source to provide water to local users, mainly for municipal, industrial, and agricultural needs, in response to rapidly increasing demand and lessen dependence on non-tributary ground water. Chatfield Reservoir is well placed to help meet this objective for the following reasons: the reservoir provides a relatively immediate opportunity to increase water supply storage without the development of significant amounts of new infrastructure; it lies directly on the South Platte River (efficient capture of runoff); and it provides an opportunity to gain additional use of an existing federal resource.

Extensive coordination has occurred. Representatives from federal, state, and local governments, as well as technical advisors from nongovernmental groups such as Sierra Club and Audubon Society, provided extensive input to the development of this draft FR/EIS. Because of the comprehensive transparent collaboration that has occurred, consideration was given to varying aspects attempting to present a plan that balances numerous interests. The expectation is that the plan presented in this FR/EIS during Draft Pubic Review will be socially and environmentally acceptable.

5.5.6.2 Land and Water Conservation Fund Act

Chatfield State Park must remain in outdoor recreation uses pursuant to Section 6(f) of the LWCF Act because LWCF assistance was used by the Colorado Division of Parks and Outdoor Recreation to obtain water for Chatfield Reservoir. If facilities purchased with LWCF grants are inundated, they will be replaced elsewhere in the park, and Colorado State Park staff will submit a formal letter to the National Park Service recognizing the changes and stating that the park is not in default. If the facilities are removed and not relocated, then the state would be in default. However, because all recreation facilities are planned to be relocated in-kind under the tentatively selected plan, the tentatively selected plan would comply with the LWCF Act. As indicated in Section 5.5.1.2, the National Park Service has issued a letter concurring with Colorado State Parks that the Chatfield Reservoir Storage Reallocation project will not result in a Section 6(f)(3) conversion (see Attachment 3 in Appendix S).

5.5.6.3 Financial Feasibility

The test for financial feasibility compares the financial implementation costs and OMRR&R of the tentatively selected plan to the most likely, least costly no action alternative, which is Alternative 2. Table 5-17 shows this comparison using annual implementation and OMRR&R costs, which would differ from annual NED costs. The financial costs include the cost of storage and exclude interest during construction, and recreation benefits foregone. Alternative 3 is less costly than Alternative 2 by about $0.99 million per year. It is also less costly than Alternative 1 and 4 by about $4.5 million per year and $0.9 million per year, respectively. The NED costs for the alternatives include interest during construction and recreation benefits foregone that are not included in the financial costs. The difference of costs between Alternative 2 and Alternative 3 would need to decrease by $0.98 million annually (a capitalized value of $ 20.7 million) before Alternative 2 would be equal in cost to Alternative 3. However, based on the presented costs, the tentatively selected plan would be feasible to implement by the water providers because of its lower cost.

Table 5-17
Financial Test (FY 2011 Price Levels)

	Alternative 1	Alternative 2	Alternative 3	Alternative 4
Annualized Initial/Implementation Costs	$11,742,782	$8,216,070	$6,687,855	$7,645,838
Annual OMRR&R Costs	$1,495,302	$1,538,602	$2,081,534	$2,026,560
Total Annual Costs	$13,238,084	$9,754,672	$8,769,390	$9,672,398

Uncertainty would affect the costs and performance of the alternatives. Weather would affect the yield of all alternatives because all use storage to some extent. NTGW usage would also be affected if used to replace surface water during extended dry periods. Population growth location and rates would affect the use of NTGW and would change the surface water runoff characteristics. Mitigation performance would affect the costs of Alternatives 3 and 4. Additional measures may be required to ensure adequate mitigation. The Cost of Storage may change due to Federal Government decisions.

5.5.7 Cost Account Adjustments

There are no hydropower capabilities at Chatfield Reservoir. Therefore, there would be no revenues to the U.S. Treasury foregone and no cost account adjustments are needed.

5.5.8 Compensation for Recreation and Environmental Impacts

The impacts of the tentatively selected plan can be fully compensated for. Section 116 of the Omnibus Appropriations Act of 2009 authorizes CDNR to perform facility modifications and mitigation for the project, provided that the Secretary of the Army collaborates with CDNR and local interests to determine storage cost repayments that reflect the limited reliability of the reallocated storage space. The compensatory mitigation plan for impacts to wetlands, to the federally listed threatened Preble's meadow jumping mouse habitat (including Designated Critical Habitat), and to bird habitat that also provides habitat for other wildlife, is provided in the CMP (Appendix K). The recreation modifications plan for impacts to recreation facilities is provided in Appendix M. A summary of the major features of the CMP and recreation modification plan, which would be paid for by the non-federal sponsors of the Chatfield Reservoir storage reallocation project, is presented here.

5.5.8.1 Recreation Considerations

The recreation modification plan is considered to be an integral component of the tentatively Recommended Plan, as it is required to address the adverse impacts caused by operating the reservoir under the new system, which involves a significant change in how water levels fluctuate within the reservoir. The recreation modifications can be fully accomplished within the current boundaries of Chatfield State Park, and are considered sufficient for maintaining recreational purposes of the Corps project.

The water providers will also compensate State Parks for any lost revenue or increased costs incurred as a result of this project.

The recreation modification plan would include the on-site actions listed below. Appendix M should be consulted for details about the recreation modifications.

- Construction of new boat ramps, changes in ramp gradients, and facility relocation at the North boat ramp;
- Relocation of facilities at the Massey Draw day use area;
- Reconstruction of beach, facility and parking relocation, and road relocation at swim beach area (including Eagle Cove, Deer Creek, and Jamison day use area);
- Relocation of facilities and parking lot entrance at Catfish Flats and Fox Run day use areas;
- Creation of new parking areas, facility relocation, borrow pit enhancement, road development on berms, dike creation, trail segment creation, pier accessibility improvement, and road grading at Kingfisher day use area, gravel ponds, and Platte River trailhead;
- Facility relocation, breakwater construction, fishing pier replacement, new anchor construction, winch replacement, installation of floating platforms, relocation of trails and walkways in the marina area, including Roxborough day use area; and
- Relocation of Plum Creek day use area, rerouting of trail, and relocating sanitary sewer line.

- The recreation modification plan includes a small amount of dredge and fill of wetlands. The potential impacts of these actions are evaluated in Appendix W and summarized below in Section 5.5.7.2.

- In addition to the items specified above, the recreation modification plan will replant trees as part of relocating facilities; however the ability of those trees to immediately provide shade and aesthetic value will be limited. The Tree Management Plan (Appendix Z) attempts to minimize the amount of large trees removed by minimizing the number of trees that are removed above elevation 5,439 feet msl due to their higher likelihood of survival. In addition, the CMP (discussed in environmental considerations below) also identifies onsite mitigation to be priority for mitigating ecological resources. In completing onsite mitigation, replacement of lost riparian areas and wetlands will occur, not only helping to replace ecological values, but also will eventually provide some replacement value for shade and aesthetics.

5.5.8.2 Environmental Considerations

The major impacts to environmental resources for each of the four alternatives are detailed in Chapter 4. In addition, as part of the FR/EIS and in compliance with Section 7(b) of the Endangered Species Act (ESA), a Biological Assessment (BA) was prepared to address potential effects to federally listed threatened, endangered, and candidate species (T&E species), and their critical habitat, from construction, operation, and maintenance of the proposed action (i.e., Alternative 3). The proposed increase of the target pool level to 5,444 feet msl would result in the potential inundation of approximately 454 acres of Preble's mouse habitat, including 80 acres of designated critical habitat in the Upper South Platte Critical Habitat Unit (CHU) and 75 acres of critical habitat along Plum Creek in the West Plum Creek CHU. The BA concluded that the Proposed Action is likely to adversely affect the Preble's mouse and adversely modify its designated critical habitat. The impacts to environmental resources, including T&E species, are summarized in Table 2-9 and the BA is located in Appendix V of the FR/EIS.

The impacts of the tentatively selected plan can be fully mitigated. Section 116 of the Omnibus Appropriations Act of 2009 authorizes CDNR to perform facility modifications and mitigation for the project, provided that the Secretary of the Army collaborates with CDNR and local interests to determine storage cost repayments that reflect the limited reliability of the reallocated storage space. The compensatory mitigation plan for impacts to wetlands, to the federally listed threatened Preble's meadow jumping mouse habitat (including Designated Critical Habitat), and to bird habitat that also provides habitat for other wildlife, is provided in the CMP (Appendix K) and summarized in Section 5.5.7.1. The recreation modifications plan for impacts to recreation facilities is provided in Appendix M. A summary of the major features of the CMP and recreation modification plan, which would be paid for by the non-federal sponsors of the Chatfield Reservoir storage reallocation project, is presented here.

The CMP describes that proposed mitigation activities would include on-site mitigation, off-site mitigation, and mitigation for impacts to Preble's designated critical habitat, each of which would include monitoring and adaptive management. Appendix K should be consulted for specific details about the mitigation activities listed below.

On-site mitigation would occur within Chatfield Reservoir project lands. Twenty-nine potential on-site mitigation sites are being evaluated for their mitigation potential. The mitigation sites occur within four general areas of the Chatfield Reservoir project lands: Lower Marcy Gulch, Deer Creek, West Plum Creek and South Platte River. The on-site mitigation site locations are shown in Appendix K (CMP Figures 7 through 15). Two potential mitigation sites totaling 17.4 acres are located in Lower Marcy Gulch, four potential mitigation sites totaling 13.6 acres are located in the Deer Creek area, 10 potential mitigation sites totaling 54.1 acres are located in the West Plum Creek arm of Chatfield Reservoir, and 13 potential mitigation sites totaling 80.2 acres are located in the South Platte River arm of Chatfield Reservoir. All of the on-site mitigation sites are designed to provide gains in EFUs for the target environmental resources (Preble's, wetlands and birds). Similar to how the target environmental resources overlap within the Chatfield Reservoir project lands, the on-site mitigation areas will provide overlapping and combined resources for the target environmental resources. Detailed information for each potential mitigation site, including the existing conditions and proposed habitat gains can be found in Appendix K (CMP, Appendix G)

Off-site mitigation would occur outside the boundaries of Chatfield Lake project and would include:

- Permanent protection of habitat associated with the target environmental resources (Preble's, wetlands and birds) from an estimated 888 acres (of the 5,917 acres identified) by conservation easements put in place on property purchased in fee from willing sellers or through conservation easement agreements with willing property owners. This habitat protection will be acquired from willing sellers only and the Non-Federal Sponsor (CDNR) will not subject any owner to condemnation;

- Off-site habitat conversion and enhancement activities associated with protection of the estimated 888 acres of protected habitat described above ; and

- Protection of up to 22.5 acres of off-site existing mature cottonwood habitat and designation of up to 10 acres for cottonwood regeneration associated with protection of the estimated 888 acres of protected habitat described above.

In addition to the on-site and off-site mitigation actions discussed above, mitigation for impacts to Preble's designated critical habitat would include:

- On-site mitigation of 17 acres in the Upper South Platte CHU and 6 acres in the West Plum Creek CHU as described in Section 6.3.1 of Appendix K; and

- Off-site mitigation in the form of sediment control and riparian habitat extension along 4.5 stream miles of Sugar Creek in the Upper South Platte CHU on U.S. Forest Service land, and up to 65 Preble's EFUs in the West Plum Creek CHU through permanent protection, management, and enhancement on private lands, included in the estimated 888 acres of off-site mitigation discussed above.

Summary of Compensatory Mitigation Plan

The CMP (Appendix K) was developed to provide full mitigation for the impacts under Alternative 3 to the target environmental resources. Preble's meadow jumping mouse habitat, bird habitat, and wetlands were identified in the FR/EIS as "target environmental resources" of particular concern and warranting specific mitigation strategies for the estimated adverse impacts to these resources. The CMP is designed to offset the adverse impacts to these target environmental resources associated with Alternative 3, should Alternative 3 be approved as proposed. The CMP, as presented in this report, is considered an integral part of the recommended plan, and as such, its implementation must be carried out concurrently as part of the overall project.

The CMP concludes the following: 1) there are adequate opportunities within the Chatfield Reservoir watershed to mitigate for adverse impacts to the target environmental resources; 2) the proposed compensatory mitigation measures have a high likelihood of being successfully implemented; and 3) the estimated costs for implementing, managing, and monitoring the proposed mitigation are within the range of feasibility for the Chatfield Water Providers. The CMP is ecologically based and the "currency" of the CMP is ecological functional units (EFUs). The EFUs capture the ecological functions provided by the individual target environmental resources as well as accounts for the substantial geographic overlap of the target environmental resources. The CMP establishes quantifiable objectives and maximizes the amount of mitigation that would occur on Corps lands in the vicinity of Chatfield Reservoir. The CMP provides requirements for monitoring, reporting, and adaptive management.

The CMP is estimated to take 6 years to implement and another 5 years of management and habitat improvement to realize the target EFU gains. Table 5-18 summarizes the key components of the CMP and where these components are discussed in detail in the CMP (Appendix K).

Table 5-18
Summary of Key Components of the Compensatory Mitigation Plan

Key CMP Components	Description	Location in CMP (Appendix K of the FR/EIS)
Funding	No federal funds. The Chatfield Water Providers are responsible for the full cost of implementing the CMP.	Sections 7.3 and 8.2.6
Estimated Present Value Costs	$71.03 Million	Section 8.2.6
Objectives	1. Provide the total compensatory mitigation needed. 2. Mitigate impacts to designated critical habitat. 3. Provide a diversity and balance of resources for compensatory mitigation.	Section 5.0
Target Environmental Resources	1. Wetlands. 2. Preble's meadow jumping mouse habitat (includes designated critical habitat). 3. Bird habitat.	Sections 1.0 and 6.0
Approach	1. Prioritize mitigation. 2. Consider the context of mitigation activities. 3. Account for the overlap of habitat for the target environmental resources. 4. Replace lost ecological functions.	Sections 3.0 and 4.0 Table 1

Table 5-18
Summary of Key Components of the Compensatory Mitigation Plan

Key CMP Components	Description	Location in CMP (Appendix K of the FR/EIS)
Compliance with Mitigation Policies and Guidance	The CMP complies with: • Department of the Army Planning Guidance Notebook – ER 1105-2-100 (April 22, 2000) six-step planning process and Appendix C Environmental Evaluation and Compliance; • Water Resources Development Act of 2007 (WRDA 07) – Mitigation for Fish and Wildlife and Wetlands Losses (August 31, 2009) (P.L. 110-114), Section 2036, Mitigation for Fish and Wildlife and Wetlands Losses; • Memorandum addressing Implementation Guidance for Section 2036(a) of the Water Resources Development Act of 2007; • The Corps and EPA rule for the compensatory mitigation for losses of aquatic resources for activities authorized by Section 404 of the CWA (73 Fed. Reg. 19594 (April 10, 2008); and • U.S. Fish and Wildlife Service policy under Endangered Species Act addressing mitigation of impacts to designated critical habitat.	Section 2.0 as well as the entirety of Appendix B address how the CMP complies with these various polices and guidance.
Locations	All mitigation will occur within the Chatfield Reservoir basin watershed. Mitigation occurs on-site within Chatfield State Park to the maximum practicable. Off-site mitigation for impacts to Preble's designated critical habitat on the South Platte River arm of Chatfield Reservoir will occur along Sugar Creek, a tributary to the South Platte River within the Upper South Platte CHU about 12 miles from Chatfield Reservoir. Off-site mitigation for impacts to Preble's designated critical habitat on the Plum Creek arm of Chatfield Reservoir will occur along Plum Creek and its tributaries upstream of Chatfield State Park, within the West Plum Creek CHU. The remainder of the off-site mitigation for noncritical habitat will occur in the Plum Creek watershed.	Sections 6.1.1, 6.2.1, 6.3.1, and 6.3.2 Figures 7 through 15 and 23
Enforceability	The Corps, the Colorado Department of Natural Resources (CDNR), and the water users (Chatfield Water Providers) will each have complementary responsibilities for ensuring the accomplishment of the reallocation, and of the Compensatory Mitigation Plan and the Recreation Modification Plan (the Plans), as described in this Report. The Department of the Army and the CDNR will enter into a Project Partnership Agreement (PPA) after execution of the Record of Decision, setting out their respective obligations for reallocating the designated water supply storage, and for accomplishing the two Plans. The CDNR will then execute sub-agreements, identical in their terms and conditions, with each of the Chatfield Water Providers. The sub-agreements will set out the responsibilities of the Chatfield Water Providers to the CDNR for funding the reallocation of the water supply storage under the PPA, and for undertaking the CDNR's obligations to the Government under the PPA for implementing the Plans. The sub-agreements, however, will not affect the ultimate duty of the CDNR and the Government to fulfill their reciprocal obligations under the PPA, unless the PPA is suitably modified by mutual consent of the Corps and the CDNR.	Section 7.3 Appendix E sets forth the Challenge Cost Share Agreement which follows the required USFS format and has been agreed to by all parties to the agreement.

Table 5-18
Summary of Key Components of the Compensatory Mitigation Plan

Key CMP Components	Description	Location in CMP (Appendix K of the FR/EIS)
Protection of Mitigation Lands	The Corps, the Colorado Department of Natural Resources (CDNR), and the water users (Chatfield Water Providers) will each have complementary responsibilities for ensuring the accomplishment of the reallocation, and of the Compensatory Mitigation Plan and the Recreation Modification Plan (the Plans), as described in this Report. The Department of the Army and the CDNR will enter into a Project Partnership Agreement (PPA) after execution of the Record of Decision, setting out their respective obligations for reallocating the designated water supply storage, and for accomplishing the two Plans. The CDNR will then execute sub-agreements, identical in their terms and conditions, with each of the Chatfield Water Providers. The sub-agreements will set out the responsibilities of the Chatfield Water Providers to the CDNR for funding the reallocation of the water supply storage under the PPA, and for undertaking the CDNR's obligations to the Government under the PPA for implementing the Plans. The sub-agreements, however, will not affect the ultimate duty of the CDNR and the Government to fulfill their reciprocal obligations under the PPA, unless the PPA is suitably modified by mutual consent of the Corps and the CDNR. The on-site mitigation will be protected and managed as part of Chatfield State Park. The off-site mitigation along Sugar Creek will occur within the Pike National Forest and will be protected and managed as part of the Pike National Forest. The remainder of the off-site mitigation is proposed to occur on private lands and will be protected by a conservation agreement. The conservation agreement will protect lands which could be transferred to qualified land management agencies (e.g., Douglas County Land Trust or Douglas County Open Space). Off-site mitigation will not receive credit until the land has been protected in perpetuity.	Section 7.4 and Appendix E (sets forth the Challenge Cost Share Agreement which specifies the mitigation activities and their maintenance on Pike National Forest lands.)
Monitoring	All mitigation activities will be monitored to determine that they have been fully and properly implemented. Monitoring has been designed to: 1. Determine if the estimated maximum impacts to the target environmental resources stated in the CMP that form the basis of the mitigation objectives need to be revised. 2. Document that compensatory mitigation activities are properly and fully implemented. 3. Ensure the defined compensatory mitigation objectives are met. 4. Provide information needed for adaptive management.	Section 7.4
Oversight	The Corps, the Colorado Department of Natural Resources (CDNR), and the water users (Chatfield Water Providers) will each have complementary responsibilities for ensuring the accomplishment of the reallocation, and of the Compensatory Mitigation Plan and the Recreation Modification Plan (the Plans), as described in this Report. The Department of the Army and the CDNR will enter into a Project Partnership Agreement (PPA) after execution of the Record of Decision, setting out their respective obligations for reallocating the designated water supply storage, and for accomplishing the two Plans. The CDNR will then execute sub-agreements, identical in their terms and conditions, with each of the Chatfield Water Providers. The sub-agreements will set out the responsibilities of the Chatfield Water Providers to the CDNR for funding the	Section 7.3 and 7.6, and Figure 24

Table 5-18
Summary of Key Components of the Compensatory Mitigation Plan

Key CMP Components	Description	Location in CMP (Appendix K of the FR/EIS)
	reallocation of the water supply storage under the PPA, and for undertaking the CDNR's obligations to the Government under the PPA for implementing the Plans. The sub-agreements, however, will not affect the ultimate duty of the CDNR and the Government to fulfill their reciprocal obligations under the PPA, unless the PPA is suitably modified by mutual consent of the Corps and the CDNR. The purpose of the established oversight plan is to determine whether the CMP: • Is being implemented according to the approved management plans; • Is trending positively in meeting the success criteria defined in the approved management plans; • Needs adjustments; and • Has been fully implemented and successfully meets the success criteria defined in the approved management plans.	
Reporting	The Corps, the Colorado Department of Natural Resources (CDNR), and the water users (Chatfield Water Providers) will each have complementary responsibilities for ensuring the accomplishment of the reallocation, and of the Compensatory Mitigation Plan and the Recreation Modification Plan (the Plans), as described in this Report. The Department of the Army and the CDNR will enter into a Project Partnership Agreement (PPA) after execution of the Record of Decision, setting out their respective obligations for reallocating the designated water supply storage, and for accomplishing the two Plans. The CDNR will then execute sub-agreements, identical in their terms and conditions, with each of the Chatfield Water Providers. The sub-agreements will set out the responsibilities of the Chatfield Water Providers to the CDNR for funding the reallocation of the water supply storage under the PPA, and for undertaking the CDNR's obligations to the Government under the PPA for implementing the Plans. The sub-agreements, however, will not affect the ultimate duty of the CDNR and the Government to fulfill their reciprocal obligations under the PPA, unless the PPA is suitably modified by mutual consent of the Corps and the CDNR. It is envisioned the Chatfield Water Providers will provide annual monitoring reports to the Project Coordination Team and the Technical Advisory Committee for review and comment. The reporting will include: • Documentation that the mitigation activity has been fully implemented (e.g., as-built report, recordation of a conservation agreement for protected properties, or report on habitat enhancement activities); • Documentation of progress in meeting the success criteria; • Recommended corrective actions; • Management or corrective actions taken since last monitoring; and • Number of EFUs gained to date.	Section 7.4.1

Table 5-18
Summary of Key Components of the Compensatory Mitigation Plan

Key CMP Components	Description	Location in CMP (Appendix K of the FR/EIS)
Adaptive Management	Adaptive management will be used to address anticipated and unanticipated issues and events that affect compensatory mitigation activities. Monitoring will determine the degree to which issues and events adversely affect or limit proposed compensatory mitigation activities, as well as document benefits greater than estimated for the CMP. The CMP identifies strategies to be used to adaptively manage issues and events that could adversely affect or limit proposed compensatory mitigation.	Section 7.5
Estimated Schedule	Mitigation implemented in years following the FR/EIS: • On-site mitigation and critical habitat mitigation – year 3; • Off-site mitigation – year 7; and • Management of mitigation sites and continued monitoring – years 8-13+.	Section 7.2 and Table 13

The WRDA mitigation policy establishes a priority for consideration of the use of approved wetland mitigation bank credits to offset impacts to wetlands. The use of approved wetland mitigation bank credits is not a component of the proposed CMP because many of the wetlands that would be adversely affected by the reallocation are also Preble's habitat. There are currently no approved wetland mitigation banks that also include Preble's habitat.

Preble's habitat overlaps substantially with wetlands and riparian habitat types; however, there are no approved Preble's habitat mitigation banks in Colorado and there are no wetland mitigation banks in Colorado that occur within known Preble's habitat. Therefore, use of an approved wetlands mitigation bank to provide separate compensatory mitigation for impacts to wetlands at Chatfield Reservoir would not compensate for impacts to Preble's habitat (which are similar in total area as impacts to wetlands). As such, it would not be practicable to singularly pursue wetland mitigation banks that do not compensate for other lost resources (especially Preble's habitat.).

Because the target environmental resources have substantial geographic overlap, habitat variables in a particular location can provide overlapping ecological functions for each of the target environmental resources. The CMP uses an ecological functions approach (EFA) to quantify impacts for the overlapping ecological functions of the target environmental resources and to quantify benefits gained from mitigation activities proposed in the CMP. To provide an ecologically meaningful assessment of the overlapping habitats of the target environmental resources, an ecological function index (EFI) was developed for each target resource habitat type. The EFIs for the habitat types were generated using an ecological function model. The model was evaluated by independent experts as part of the Corps' formal model review process. The overall approach to developing the model was to convene an Ecological Functions Technical Committee of locally recognized experts with expertise in the three target environmental resources. The number of EFUs for a particular resource in a particular area is the product of the EFI of the habitat type and the acreage of the area. For instance, if a particular area of Preble's habitat has an EFI of 0.63 and the area is 12 acres, the area provides 7.56 EFUs (0.63 x 12) for Preble's. If four of those 12 acres are inundated, 2.5 EFUs (4 x 0.63) would no longer be available. The CMP dedicates substantial discussion to why EFUs are used as the currency for impacts and mitigation (Sections 3.3 and 4.0 and Appendix C).

About 789 acres and 1,180 EFUs of the target environmental resources are estimated to be impacted by Alternative 3. The CMP maximizes the amount of mitigation that would occur on-site; up to 338 acres and 203 EFUs of mitigation are proposed to occur on-site above the maximum pool elevation of 5,444 feet msl. An estimated 384 EFUs would be mitigated on-site and in place with the restoration of the borrow areas and utility relocations, and up to 85 EFUs of combined wetland and riparian habitat would be created on-site that would benefit Preble's and birds, including up to 23 acres of Preble's critical habitat. Proposed on-site compensatory mitigation has been maximized to the degree practicable for the following reasons:

- On-site mitigation provides the least amount of risk regarding the ability to acquire lands and ensure mitigation is fully implemented.
- U.S. Fish and Wildlife Service (Service) policy establishes that mitigation for impacts to designated critical habitat must occur within the same CHU. There are two separate CHUs within Chatfield State Park (USFWS 2004d).
- Ecological resources are an important part of the overall makeup and feel of Chatfield State Park. Maximizing on-site mitigation to compensate for adverse impacts to these ecological resources helps restore the overall integrity of Chatfield State Park by providing comparable resources to the extent practicable following reallocation.
- Agencies that manage resources within Chatfield State Park have been involved in development of the principles that guide the CMP. The Colorado Division of Parks and Wildlife manages the park for recreation, fisheries, and wildlife and the Service oversees compliance with the ESA and has designated the South Platte River and Plum Creek arms of Chatfield Reservoir as critical habitat for Preble's.
- Local environmental groups that use Chatfield State Park (e.g., Audubon Society) were invited by the Corps to participate as special technical advisors for the FR/EIS process because of their expertise and knowledge of ecological resources in Chatfield State Park. These organizations and the agencies above have provided valuable input for developing and prioritizing mitigation strategies.
- On-site compensatory mitigation is considered a priority by the Corps and EPA when it is practicable (EPA and Department of the Army 1990).
- No federal funds will be used to implement the proposed compensatory mitigation. The cost of on-site compensatory mitigation is estimated to be more expensive than the cost of off-site compensatory mitigation; however, compensatory mitigation will be entirely funded by the Chatfield Water Providers.

The mitigation for the remaining EFUs (up to 711) would occur off-site. The CMP focuses mitigation efforts first in on-site areas. However, it is recognized that mitigation requirements would exceed what is available within on-site areas. The majority of the off-site mitigation would occur on private lands in the Plum Creek watershed upstream of Chatfield Reservoir through the permanent protection, enhancement, and management of riparian habitats and adjoining uplands to benefit the target environmental resources. The CMP identifies the portions of these watersheds with potential to provide off-site mitigation. The final number and extent of off-site mitigation areas would be determined by how many EFU credits are generated from each mitigation area. Unlike on-site mitigation areas, most off-site areas would require legal real estate instruments to ensure perpetual protection and management of the mitigation areas to benefit the target environmental resources

U.S. Fish and Wildlife Service policy requires that impacts to designated critical habitat be mitigated within the same CHU. The Plum Creek arm of Chatfield Reservoir occurs in the West Plum Creek CHU and the South Platte River arm occurs in the separate Upper South Platte CHU. With the exception of the South Platte River arm of Chatfield Reservoir, the Upper South Platte CHU occurs on the Pike National Forest. Off-site mitigation for impacts to Preble's critical habitat in the Plum Creek arm of Chatfield Reservoir would involve the permanent protection and, where needed, enhancement of Preble's habitat within the West Plum Creek CHU that includes lands designated for a large Preble's recovery population.

Off-site conservation measures for impacts to Preble's critical habitat in the South Platte River arm of Chatfield Reservoir are proposed to involve implementation of the Sugar Creek Sediment Mitigation Project and other habitat enhancement measures in the Pike National Forest, located about 12 miles west of Chatfield Reservoir within the watershed that feeds Chatfield Reservoir. The Upper South Platte CHU within the Pike National Forest is distributed over eight drainage segments and includes more than 3,000 acres. The entire CHU was reviewed to determine sites with the potential for enhancing, restoring, or creating habitat for Preble's. The drainage segments designated as critical habitat with sites that could potentially provide suitable conservation measures were reviewed to determine what types of mitigation could be implemented and where conservation measures could be feasibly implemented. Although the designated critical habitat within the Pike National Forest is extensive, opportunities for habitat enhancement, restoration, and creation are limited in most drainages by existing high-quality habitat, steep topography, constructability issues, and poor access. The most feasible opportunities for habitat restoration and enhancement within the designated critical habitat occur on Sugar Creek (Section 6.3.2.1, Table 5, and Appendix H of the CMP). The Service has reviewed the selection of the Sugar Creek site and concurs that it is the site with the greatest potential for habitat improvement and conservation measures in the Upper South Platte CHU.

If the reallocation is approved, the Chatfield Water Providers would begin implementing the CMP as soon as practicable following the approval. The Chatfield Water Providers will establish an environmental escrow fund that will be at least equal to the estimated cost of fully implementing and completing the CMP including a reasonable contingency. The establishment of the escrow fund prior to any storage in the reallocated space will allow the Chatfield Water Providers to fully use the reallocated storage subject to the following conditions:

1. Storage between elevations of 5,444 feet msl and 5,442 feet msl cannot exceed 30 days within any calendar year until the CMP is fully implemented; and

2. If the Chatfield Water Providers are unable to meet the mitigation schedules shown in Table 5-19 and Table 5-20, the ability to use storage will be defined by the mitigation milestones and reallocated storage available in Table 5-19 and Table 5-20 until mitigation implementation and EFUs gained meet the defined mitigation milestones.

This approach ensures that the Chatfield Water Providers continually make progress toward meeting goals and objectives of the CMP or they will not fully benefit from use of the storage reallocation. The compensatory mitigation activities have two major components: 1) implementation, and 2) meeting the success criteria for gained EFUs. The mitigation schedule and use of reallocated storage milestones (Table 5-19 and Table 5-20) are linked to these two major components. Because the environmental mitigation is substantial and would take years to implement, the CMP would be implemented incrementally according to its respective priorities. On-site mitigation also needs to coincide with the recreation facilities modification, which would also disturb Chatfield State Park, so that the total disturbance and duration of disturbance to Chatfield State Park is minimized. The CMP is multifaceted and involves a substantial amount of land transactions. It is anticipated that it would take 6 years to fully implement the CMP. The milestones in Table 5-19 are listed in order of priority and are additive when determining if the percent of water stored in the reallocated space is available to the Chatfield Water Providers. For example, all of the on-site compensatory mitigation needs to be implemented before credit toward the use of reallocated storage is given for the implementation of Preble's critical habitat mitigation. The schedule in Table 5-20 assumes it would take an average of about 5 years of management and habitat improvement to realize the target gains in EFUs.

Table 5-19
Compensatory Mitigation Implementation Schedule and Reallocated Storage Milestones

Year Following Approval	Milestone	Estimated EFUs Gained Per Milestone[4]	Estimated Running Total of EFUs Gained Per Milestone	Estimated % of EFUs Gained of Total EFUs Needed	% of Reallocated Storage Available	Approximate Maximum Pool Elevation (ft)[5]
3	Complete implementation of all on-site compensatory mitigation, including on-site mitigation in critical habitat[1]	85	85	9	10	5,433.0
3	Complete implementation of all off-site mitigation of impacts to Preble's critical habitat on the South Platte River arm	--[2]	--[2]	--[2]	20	5,435.0
3	Complete implementation of off-site mitigation to gain 100% of needed Preble's EFUs in the West Plum Creek CHU including implementation of 25% of off-site mitigation	178	263	26	25	5,435.5
4	Complete implementation of 50% of off-site mitigation	178	441	44	45	5,437.5
5	Complete implementation of 70% of off-site mitigation	142	583	59	60	5,440.0
6	Complete implementation of 90% of off-site mitigation[3]	142	725	73	80	5,442.0

1 Includes restoration and revegetation of borrow areas and temporary impacts associated with the relocation of recreation facilities.

2 Preble's critical habitat impacts and mitigation in the Upper South Platte CHU are calculated in terms of acres and stream miles. For purposes of the CMP schedule, completion of the implementation of all mitigation of Preble's Upper South Platte CHU will allow use of another 10 percent of the reallocated storage.

3 The last increment (10 percent) of off-site mitigation will be based on the results of meeting the success criteria defined in the approved management plans in accordance with the CMP.

Table 5-20
EFUs Gained and Reallocated Storage Milestones

Year Following Approval	% of Total EFUs Gained	Additional % of Reallocated Storage Available[1]
7	80	0[2]
8	85	5
9	90	10
10	95	15
11	100	20

1 Additive to the percent of reallocated storage available to the Chatfield Water Providers once the CMP has been 90 percent implemented.

2 No credit is given for providing up to 80 percent of the EFUs because it is estimated that 80 percent of the EFUs will be provided with implementation of the mitigation activities.

The limitation on storage above 5,442 feet in elevation until the CMP is fully implemented is intended to delay losses of woody riparian vegetation until the CMP is fully implemented. The limitation in storage above 5,442 feet in elevation assumes an estimated new OHWM of 5,442 feet and that water would be infrequently stored above 5,442 feet with reallocation. The elevations between 5,444 feet and 5,442 feet contain a substantial amount of vegetation that could be lost to inundation. Information presented in Chapter 4 demonstrates that most of the riparian vegetation associated with a new OHWM would likely tolerate up to 30 days of inundation. The mitigation milestones (Table 5-19 and Table 5-20) must be met when using either mitigation track. Table 5-21 presents an estimated schedule for environmental mitigation relative to key events in the reallocation review and approval process (e.g., release of the draft FR/EIS and Record of Decision [ROD]). More detailed information on the mitigation tracks and mitigation schedule is presented in Section 7.2 of the CMP (Appendix K).

Table 5-21
Estimated Schedule for Environmental Mitigation

Year	Activities
0	Draft FR/EIS released to public.
1	Recreation facilities design and environmental mitigation design in progress.
2	Record of Decision, Reallocated Storage Contracts, recreation facilities modification begin, on-site environmental mitigation begins, and off-site Preble's critical habitat mitigation begins.
3	Recreation facility modification, on-site environmental mitigation, and off-site critical habitat mitigation continue. Environmental mitigation monitoring begins.
4	Recreation facility modification, on-site environmental mitigation, off-site critical habitat mitigation, and implementation of 25 percent of off-site noncritical habitat mitigation completed. Environmental mitigation monitoring continues.
5	Complete implementation of 50 percent of off-site noncritical habitat mitigation. Environmental mitigation monitoring continues.
6	Complete implementation of 70 percent of off-site noncritical habitat mitigation. Environmental mitigation monitoring continues.
7	Complete implementation of 90 percent of off-site noncritical habitat mitigation. Environmental mitigation monitoring continues.
9–13+	Management of environmental mitigation sites continues to meet success criteria. Environmental mitigation monitoring continues.

The CMP provides an estimated 743.13 average annual equivalents of EFUs. The CMP fully mitigates the estimated loss of 796 EFUs because the estimated loss of EFUs would occur over several years and in the first few years of implementing the CMP, mitigation gains would exceed impacts. Three scenarios estimating the timing of impacts (EFUs lost) were developed to determine if the CMP would fully mitigate the estimated impacts when considering the losses and gains of EFUs over 50 years (Table 5-22). All three scenarios assume that in the first three years of mitigation implementation, seven EFUs per year would be lost associated with the relocation of the recreation facilities, but during these first three years, mitigation implementation would result in a gain of about 100 EFUs per year. After year 3, the EFUs lost per year varies with each scenario. This variation would be affected by availability of water to store, length of storage, operations, adaptive management, and tolerance of vegetation to inundation. The three scenarios demonstrate that the estimated average annual equivalent of EFUs lost is less than the estimated average annual gain of 743.13 EFUs provided by the CMP.

Table 5-22
Estimated EFUs Lost by Reservoir Elevation, Chatfield Reallocation

Year Following Approval	Scenario 1			Scenario 2			Scenario 3		
	Approximate Reservoir Elevation (feet msl)	EFUs Lost in Yr.	Cumulative EFUs Lost	Approximate Reservoir Elevation	EFUs Lost in Yr.	Cumulative EFUs Lost	Approximate Reservoir Elevation	EFUs Lost in Yr.	Cumulative EFUs Lost
1	5432.00	7.00	7.00	5432.0	7.00	7.00	5432.0	7.00	7.00
2	5432.00	7.00	14.00	5432.0	7.00	14.00	5432.0	7.00	14.00
3	5432.00	7.00	21.00	5432.0	7.00	21.00	5432.0	7.00	21.00
4	5433.00	301.67	322.67	5433.0	301.67	322.67	5433.0	301.67	322.67
5	5435.00	100.30	422.97	5435.5	123.96	446.63	5435.5	123.96	446.63
6	5435.50	23.66	446.63	5437.5	96.80	543.43	5437.5	96.80	543.43
7	5437.50	96.80	543.43	5440.0	102.82	646.25	5440.0	102.82	646.25
8	5440.00	102.82	646.25	5440.0	0.00	646.25	5440.0	0.00	646.25
9	5440.00	0.00	646.25	5442.0	75.34	721.59	5442.0	75.34	721.59
10	5442.00	75.34	721.59	5442.0	0.00	721.59	5442.0	0.00	721.59
11	5443.00	44.77	766.36	5443.0	89.53	811.12	5443.0	44.77	766.36
Yrs 12–50	5444.00	44.76	31,633.68	5444.0	0.00	31,633.68	5444.0	44.76	31,633.68
Total			36,191.83			36,535.21			36,490.45
Average Annual Equivalent EFUs:			723.84			730.70			729.81

The CMP is based on conservative assumptions including that all of the target environmental resources will be lost below 5,444 feet in elevation and none of the target environmental resources will reestablish below 5,444 feet in elevation. Impacts associated with inundation may be less than have been conservatively estimated. Adaptive management, informed by mitigation monitoring, would be used as needed to adjust mitigation in response to impacts, issues, and events that affect compensatory mitigation. The CMP presents a process and defined actions for mitigation monitoring, adaptive management, and oversight of mitigation implementation monitoring.

Summary of Potential Impacts of Proposed Dredge and Fill Materials

The Section 404(b)(1) Guidelines (40 Code of Federal Regulations [CFR] 230) are the substantive criteria used in evaluating discharges of dredged or fill materials in waters of the United States. The 404(b)(1) Analysis (Appendix W) is an integral aspect of the FR/EIS and evaluates the effects of the proposed dredge and discharge activities proposed to occur incidental to the tentatively

Recommended Alternative (Alternative 3) and consistency with Section 404(b)(1) Guidelines under Section 404 of the Clean Water Act. As proposed, the modification of recreation facilities and certain environmental mitigation activities would involve the discharge of dredge and fill material into waters of the United States, including wetlands. These discharge activities would involve an estimated temporary impact to about 5.5 acres of wetlands and a loss of about 6.9 acres of wetlands.

The purpose of the analysis is to demonstrate that the proposed discharge of dredge and fill material associated with the implementation of the proposed Recreation Facilities Modification Plan (Appendix M) and CMP (Appendix K) comply with the Section 404(b)(1) Guidelines. Evaluation criteria included potential impacts on physical and chemical characteristics of the aquatic ecosystem (physical substrate, suspended particulates/turbidity, water quality, water fluctuations and circulation), potential impacts on biological characteristics of the aquatic ecosystem (threatened and endangered species, fish, crustaceans, mollusks, and other aquatic organisms), potential impacts on special aquatic sites (wetlands, mudflats and vegetated shallows) and potential effects on human use characteristics (municipal and private water supplies, recreational and commercial fisheries, water-related recreation, aesthetics). The analysis also evaluates alternatives to the proposed discharges.

The CMP (Appendix K) identified and addressed the unavoidable environmental impacts associated with the reallocation of storage under the Recommended Alternative and impacts to wetlands, and habitat for Preble's and birds associated with the dredge and fill activities incidental to the Recommended Alternative. The CMP identified a limited number of on-site areas where habitat conversion would occur to change upland grasslands to wetlands. This type of conversion is generally accomplished by manipulating ground surface elevations, and surface water and groundwater, to provide hydrology adequate to support mesic riparian and wetland habitat. In most cases, the habitat conversion activities would require heavy equipment and earthwork, including the installation of sheet pile cutoff structures to raise the ground water table closer to the surface, the creation of new secondary channels, ditches, or backwaters to bring surface water to mitigation areas, and the modification of surface topography to lower the ground surface closer to ground water or to better retain surface water. These activities entail localized in-place excavation and grading and would not impact long-term water quality or the aquatic ecosystem. In many locations, the proposed activities would provide a beneficial effect on sediment erosion control and riparian habitat preservation.

Off-site mitigation includes conversion of upland grassland to scrub-shrub wetland primarily on private lands upstream of the Chatfield State Park in the Plum Creek and West Plum Creek Watersheds. Off-site habitat conversion would generally be similar to that described for the on-site habitat conversion, with on-site mitigation activities, with no impacts to long-term water quality or the aquatic ecosystem, and the ancillary benefit of improved sediment erosion control.

Modifications to the recreational facilities comprise the vast majority of actions involving dredge and fill activities. The Recreation Facilities Modification Plan identified ten areas where fill material would be required for site preparation, such as slope adjustment and general grading. The Plan considered cut and fill requirements that allowed for minimal impact to the reservoir under the proposed operational high water elevation of 5,444 ft above msl.

Modifications to three of the recreational facilities would require dredging below the current ordinary high water mark of 5,432 feet msl. The North Boat Ramp and Riverside Marina would require limited dredging to shape channels for boat ramps and local boat access. This dredging would be scheduled to occur during low reservoir periods such that there would be no impact to benthos, turbidity, and general water quality during construction. Impacts to the Swim Beach area are the most substantial of all facilities located along the shoreline. The Swim Beach would be relocated to the southwest of the current facility. In order to construct the beach, the existing facility would be demolished and excavated. Sand would be saved and also imported to create the new beach.

Fill material for the modification of recreation facilities would be derived from five borrow sources within the park boundary. Based on analysis in the Recreation Facility Modification Plan, approximately 65,000 cubic yards of fill material would be needed to make the improvements to the ten recreation areas. The five borrow areas have varying topographic conditions including flat ground, drainage channel, depression, local knob, and rolling hill. The ground is covered with native grasses, weeds and some trees. All borrow locations are located above the current mean reservoir elevation so there would be no impacts to water quality caused by excavation.

Use of the proposed fill sites would have a limited effect on federally listed threatened or endangered species or their critical habitats, as well as other wildlife and aquatic life in and around the reservoir. Approximately 2.54 acres of Preble's habitat and 2.54 acres of bird habitat would be impacted by land disturbance associated with relocation of the Plum Creek Day Use Area. There would be a temporary impact to recreational fishing access during the relocation of the North Boat Ramp and the Riverside Marina. Similarly, there would be a temporary and limited impact to water-related recreation during the relocation of the various recreational facilities. The preliminary construction implementation concept and schedule, associated with the Recreation Facilities Modification Plan, indicated that the optimum construction concept would comprise a three-year construction season, with maintenance of operations of the North Boat Ramp, Swim Beach and Riverside Marina during each high-use season (May 1 to September 30) and with closure for relocation occurring during one off season. The remaining lower use facilities would be sequenced for relocation during high-use and low-use seasons.

The in-kind replacement of recreation facilities would result in similar levels of continued recreation at Chatfield State Park and Chatfield Reservoir. The water-based recreation can have effects on the aquatic ecosystem of Chatfield Reservoir through the introduction of oil and gas from gas motor-powered boats, increased shoreline erosion and turbidity associated with power boats and prop wash, and the potential introduction of nonnative aquatic invasive species (e.g., zebra mussels and Eurasian milfoil). The in-kind replacement of recreation facilities would not increase these secondary effects, but would continue the potential for these effects to occur.

The secondary effects of environmental mitigation are primarily beneficial and consistent with the purpose of environmental mitigation (i.e., creating wetlands and Preble's and bird habitat). The on-site creation of wetlands and riparian habitat involve the conversion of xeric upland grasslands to these mesic and hydric habitats. The conversion of the upland grasslands would result in fewer upland grasslands, which are common at Chatfield State Park and would provide less habitat for the wildlife that use these upland grasslands.

Cumulative impacts of the proposed dredge and fill activities on the aquatic ecosystem are expected to be small. These proposed activities associated with the recreational facility modification plan, in total, would have little effect on the aquatic ecosystem due to limited dredge and fill footprints of the respective sites relative to the overall area and volume of the reservoir. Off-site mitigation includes conversion of upland grassland to scrub-shrub wetland primarily on private lands upstream of the Chatfield State Park in the Plum Creek and West Plum Creek Watersheds. As with the on-site mitigation activities, there would be no impacts to long-term water quality or the aquatic ecosystem, and the benefit of improved sediment erosion control.

Dredge and fill activities associated with the tentatively selected plan would not violate any applicable State water quality standards or any Toxic Effluent Standard or Prohibition Under Section 307 of the Clean Water Act, and they would not degrade Waters of the United States.

5.5.9 Consistency of the Tentatively Selected Plan with the Corps' Seven Environmental Operating Principles

The tentatively selected plan is consistent with each of the seven EOP in the following major ways (see Table 2-11 for additional details).

EOP 1—The tentatively selected plan promotes sustainability by increasing opportunities to better utilize renewable surface water, including facilitating recapture and reuse of upstream effluents. The tentatively selected plan also does not entail any increase in use (mining) of NTGW, thereby promoting the conservation of NTGW for future generations.

EOP 2—The tentatively selected plan recognizes the interdependence of life and the physical environment, especially human dependence on water and the consequences in the near-term and long-term of not having adequate multi-year storage for surface water or not having enough NTGW to weather droughts. The tentatively selected plan also considers environmental consequences of the impacts of storage reallocation and provides for full mitigation of all significant environmental impacts, giving priority attention to sustained compliance with environmental laws and regulations.

EOP 3—The tentatively selected plan achieves balance and synergy by providing for a sound water resources solution to the problem of adequate water availability. The tentatively selected plan facilitates continuation of (sustainable) economic development while fully mitigating environmental impacts in a manner that ensures recovery and sustainability of lost or impaired ecological functions (ecosystem health)

EOP 4—The tentatively selected plan enabled the Corps to meet its responsibilities to ensure that resources, including water resources, are used wisely while adhering to all environmental laws and regulations. Collaboration with a panel of wildlife habitat experts, including representatives of the USFWS, CDOW, and Corps Regulatory staff, ensured the Corps' accountability for achieving full mitigation of environmental impacts. The tentatively selected plan was also developed in conjunction with 25 Cooperating Agencies and 9 Special Technical Advisors (non-governmental organizations) that ensured compliance with the National Environmental Policy Act and all other environmental laws.

EOP 5—The tentatively selected plan includes an assessment of cumulative environmental impacts and, where required, mitigation. The mitigation plan for Preble's meadow jumping mouse habitat, called the "Systems Approach", focuses on enabling the USFWS' Recovery Plan for Preble's to be achieved by concentrating on maximizing habitat connectivity in addition to habitat attributes, and ecological functional units rather than acres alone.

EOP 6—The tentatively selected plan resulted from an integration of economic data and social knowledge base from the Non-Federal Sponsor with scientific knowledge provided by Corps staff, contractors, and representatives of other Federal, State, and local agencies and non-governmental organizations. These entities shared their knowledge in FR/EIS progress meetings coordinated by the CWCB and open to the public; in subcommittees or working groups comprised of Cooperating Agencies and Special Technical Advisors; on a panel of experts providing input to decision-making on mitigation for impacts to three types of wildlife habitat; and in a group of Chatfield State Park recreation activity participants who assessed short-term and long-term impacts of reallocation on recreation enjoyment based on the Corps' Unit Day Value method of calculating recreation benefits.

EOP 7—The tentatively selected plan, the level of quality, and progress on the FR/EIS was made possible by all participants respecting others' views and perspectives and feeling free to share privileged information with the group, secure in the knowledge that the other Cooperating Agencies and Special Technical Advisors had pledged to keep any such information confidential. The collaboration among stakeholders and customers fostered and strengthened strategic alliances that resulted in innovative win-win solutions for all participating agencies, organizations, and individuals to achieve the maximum amount of reallocated storage available while protecting and enhancing the environment.

5.5.10 Plan Implementation

Section 808 authorizes the Secretary of the Army to reallocate storage at Chatfield Reservoir. Existing infrastructure would be used if CDNR requests and coordinates the reallocation, and if the Chief of Engineers finds the reallocation feasible and economically justified. If these conditions are met, the Secretary can approve reallocation without obtaining additional authority from Congress. Section 116 authorizes CDNR to perform facility modifications and mitigation for the project, provided that the Secretary of the Army collaborates with CDNR and local interests to determine storage cost repayments that reflect the limited reliability of the reallocated storage space.

The CDNR has requested this reallocation project. Through its agencies and non-federal project partners, the project will complete 100 percent of the work at no cost to the Federal Government per Division C, Section 116 of the Omnibus Appropriations Act of 2009 (P.L. 111-8). Said work will involve every phase of design and construction including but not limited to: 1) on-site and off-site environmental mitigation; 2) modification/re-construction of all impacted recreation facilities; 3) utility relocations; 4) earthwork and shoreline contouring; 5) road, bridge and parking lot construction; 6) demolition, clearing, and grubbing; and 7) vegetation management.

In accordance with Section 103(c)(2) of WRDA 1986 (P.L. 99-662), the cost to reallocate storage in Chatfield Reservoir is a non-federal responsibility. It includes the cost of storage, specific costs, recreation modifications, and environmental mitigation costs. Although price levels increased over time, the FY 2012 overall annual and capital costs for Alternative 3 were lower than those calculated in FY 2011 (see Tables 5-15 and 5-17) due to lower estimated environmental mitigation costs. Table 5-16 shows the current estimate of these costs at FY 2012 price levels.

The water providers could repay the cost of storage ($15,334,410 at FY 2012 price levels) up-front or repay the cost over a 30-year period, beginning with the date of signing the new water supply agreement by the Assistant Secretary of the Army (Civil Works). The signing date would be determined in the future. Applying the FY 2012 water supply interest rate of 4.125 percent over a period of 30 years, the current estimated annual cost is approximately $900,300 at FY 2012 price levels assuming no cash is paid up front by any of the water providers. The cost of storage was derived using the Use of Facilities cost allocation procedure (Appendix E of ER 1105-2-100). This procedure picks the greatest among benefits foregone, revenue foregone, updated cost of storage, or replacement costs for the cost of storage. The procedure develops the joint-use project construction costs and prorates that cost by the ratio of the reallocated storage to the total usable storage to determine the cost of the 20,600 acre-foot reallocation. The final cost of storage reallocation would be updated prior to signing the new agreement from the mid-point of construction to the beginning of the month in which the new water supply agreement is signed.

The OMRR&R annual costs of the Federal Government associated with the reallocated storage (joint-use project) is also a non-federal responsibility. This would be paid annually at the beginning of each year. At the end of the year, final adjustments would be made for the year. The Use of Facilities cost allocation procedure would be applied to the joint-use OMRR&R cost to determine the final OMRR&R costs. In addition to the OMRR&R associated with the joint-use project, increased OMRR&R costs of the Corps related to the reallocation of storage are a non-federal responsibility. The sum of these two OMRR&R costs is currently estimated to be $247,390 per year over 50 years at FY 2012 price levels. This second type of OMRR&R would cover the costs of additional operation and instrumentation-based monitoring activities.

The specific construction and OMRR&R cost estimates were provided by the water providers and are associated with features needed by the water providers to access their water at Chatfield Reservoir. The water providers would finance and pay these costs. The interest rate would vary by user; therefore, the actual annual amount is not known. The total amount is currently estimated to be $40.5 million or $1.9 million per year at FY 2012 price levels and the FY 2012 federal interest rate of 4.0 percent over 50 years.

The costs of environmental mitigation and recreation modifications would be paid by the water providers. These estimated costs are shown in Table 5-16. The actual costs for each water provider would vary due to the different interest rates and level of participation in the Chatfield Reservoir storage reallocation project. The OMRR&R costs associated with mitigation are the responsibility of the water providers. The total environment mitigation and recreation modification costs are $73.8 million and $48.0 million, respectively.

The Corps, the Colorado Department of Natural Resources (CDNR), and the water users (Chatfield Water Providers) will each have complementary responsibilities for ensuring the accomplishment of the reallocation, and of the Compensatory Mitigation Plan and the Recreation Modification Plan (the Plans), as described in this Report.

The Department of the Army and the CDNR will enter into a Project Partnership Agreement (PPA) after execution of the Record of Decision, setting out their respective obligations for reallocating the designated water supply storage, and for accomplishing the two Plans. The CDNR will then execute sub-agreements, identical in their terms and conditions, with each of the Chatfield Water Providers.

The sub-agreements will set out the responsibilities of the Chatfield Water Providers to the CDNR for funding the reallocation of the water supply storage under the PPA, and for undertaking the CDNR's obligations to the Government under the PPA for implementing the Plans. The sub-agreements, however, will not affect the ultimate duty of the CDNR and the Government to fulfill their reciprocal obligations under the PPA, unless the PPA is suitably modified by mutual consent of the Corps and the CDNR.

After execution of the PPA, the Chatfield Water Providers will place the funds then judged necessary to satisfy all of the non-Federal obligations under the PPA into an escrow account. The Chatfield Water Providers will also create a new non-profit corporation called the Chatfield Reservoir Mitigation Company as a vehicle for facilitating the coordinated management of the process for implementing the Plans.

In accordance with the terms of the PPA, general oversight of the design, construction and implementation of the Chatfield Reallocation Project will reside in the Project Coordination Team, which will consist of representation from the Corps and the CDNR. The Project Coordination Team will work closely, and consult frequently, with the Chatfield Water Providers. The Project Coordination Team, in turn, may make recommendations to the Omaha District Commander. The Corps has the final authority on acceptance or rejection of the Team's recommendations.

Schedule/Phasing Sequencing

If the reallocation is approved, the Chatfield Water Providers will begin implementing the actions to fulfill mitigation obligations as soon as practicable following the signing of the Corps/CDNR Water Supply Storage/Project Partnership Agreement and the Water Provider subagreements with CDNR. It is anticipated that the implementation of mitigation measures relating to recreational facilities modifications will take approximately three years to complete. The actions to construct facilities or structures related to environmental mitigation are estimated to take up to six years. Some of the actions involve establishment of vegetation which requires time for monitoring and adaptive management in order to help ensure success of the actions. The recreational modification and environmental mitigation implementation activities will be conducted simultaneously to the extent possible. The monitoring of selected environmental mitigation actions will continue until all mitigation obligations are completely fulfilled. The Corps will determine when all project obligations have been successfully met.

The public will be provided an opportunity to review and comment on this FR/EIS and the revised Chatfield Water Control Plan. The Water Control Plan that would be used to operate Chatfield Reservoir if the tentatively selected plan is implemented is provided as Appendix B.

5.5.11 Summary of Proposals Between the Colorado Department of Natural Resources and the Water Providers Beyond the Tentatively Recommended Plan

The water providers propose to fund and undertake additional measures for recreation modifications and environmental mitigation activities (Table 5-23). These additional measures were developed in coordination with the water providers, State Parks, and Colorado Division of Wildlife[1] to provide additional assurances of a like recreational experience, to compensate State Parks for lost revenue or increased costs, and to provide ecological benefits above and beyond where the CMP has planned to replace lost ecological functions.

Table 5-23
Summary of Measures that are Being Developed Between the Colorado Department of Natural Resources and the Water Providers Independently from the tentatively Recommended Plan

Recreation:
Water Providers fund re-contouring along the south shoreline, portions of the west shoreline and potentially other select sites in order to minimize the appearance of a "bathtub ring"
Water Providers work with State Parks and landowners adjacent to Chatfield State Park to maximize buffer areas (via easements) to add usable upland acres
Water Providers work with the State to provide for the reforestation of certain areas where State Parks feels it would help preserve park aesthetics and provide shade
Water providers will reimburse Colorado State Parks and the operators of the marina on an annual basis for lost revenues
Environmental:
Water Providers fund stream habitat improvements on up to 0.7 miles of the mainstem of the South Platte River above Chatfield Reservoir
Water Providers fund stream habitat improvement on up to 0.5 miles of the mainstem of the South Platte River downstream of Chatfield Reservoir
Water Providers and Corps will work closely with CDOW on Operations of Reservoir to address potential impacts to walleye and brood rearing facility downstream of the dam
Water Providers use monitoring and adaptive management to address potential water quality issues. It is thought that mitigation would improve water quality, thus monitoring of mitigation sites would provide insight to improved water quality contribution. Adaptive management and Operations of Reservoir would also address water quality concerns.

Appendices N and CC list items of non-federal cooperation. These are conceptual and intended to provide the public with information for review and comment during the NEPA Process, and provide decision makers a basis upon which to base their decisions.

[1] On July 1, 2011, Colorado State Parks and the Colorado Division of Wildlife merged to form Colorado Parks and Wildlife.

6. PUBLIC INVOLVEMENT, REVIEW, AND CONSULTATION

6.1 Introduction

The Chatfield Reservoir storage reallocation FR/EIS involves a wide range of potentially affected/interested parties, including federal and state government agencies, local government and elected officials, interest groups, and the general public. As the sponsors of the project, USACE and CWCB consulted with federal, state, and local government agencies during the FR/EIS planning process. Input from interest groups and the general public was also solicited and all comments and recommendations were reviewed and considered in developing this document.

As the lead agency for the project, USACE developed a public involvement plan to ensure open communications from the beginning of the NEPA process. Specifically, the public involvement program objectives were to:

- Ensure that affected/interested parties receive accurate, timely information throughout the project by mailing the Scoping Notice and Draft FR/EIS Notice of Availability to parties recorded on the mailing list.
- Provide opportunities for affected/interested parties to convey their concerns and opinions and to ask questions as part of the NEPA process and FR public involvement requirements.
- Comply with NEPA, other applicable laws, and USACE regulations.

Table 6-1 presents a summary of NEPA public involvement performed by USACE for the Chatfield Reservoir storage reallocation study. The dates marked as to be determined will be revised by the Corps when this information becomes available.

Table 6-1. Public Involvement Activities for the Chatfield Reservoir Storage Reallocation Study

Activity	Date
Published Notice of Intent	September 30, 2004
Developed and Hosted Project Websites	Ongoing
Mailed Scoping Notice to Public	October 14, 2004
Scoping Open House (Littleton, Colorado; 7-9 p.m.)	October 26, 2004
Scoping Open House (Greeley, Colorado; 7-9 p.m.)	October 27, 2004
Agency Scoping Meeting	February 10, 2005
Scoping Comments Received[1]	March 30, 2005
Published Public Notice and News Release of Draft FR/EIS Availability	June 8, 2012
Draft FR/EIS Released	June 8, 2012
Draft FR/EIS Comment Period	June 8, 2012 – August 7, 2012
Public Meetings on Draft FR/EIS	June 25, 26, 27, 2012
Published Public Notice of Final FR/EIS Availability/Final FR/EIS Released[2]	TBD

[1] USACE received approximately 200 individual comments from October 26, 2004, to March 30, 2005. Ten comments were received by letter after March 30, 2005.

[2] Final FR/EIS dates are to be determined (TBD)

6.2 Public and Agency Scoping Involvement

Scoping and public participation are very important parts of the NEPA process. The scoping period provides the opportunity for any parties who may be interested in or affected by the project to review the proposed action and provide input that will assist USACE in identifying significant issues related to the proposed action. The objectives were to (1) identify the affected public and agencies, (2) define the issues and reasonable alternatives evaluated in the Draft and Final EISs, and (3) help ensure that the Draft EIS adequately addresses relevant issues, thus avoiding extensive revisions or supplements.

The NOI (Notice of Intent), scoping meeting notice, and scoping meetings were used to achieve the NEPA scoping requirements. The primary scoping comment period opened October 26, 2004, and scoping comments were formally received though March 2005. USACE published a NOI to prepare the FR/EIS in the Federal Register on September 30, 2004 (69 Federal Register 58412-58414). After submitting the NOI, USACE mailed a public notice to eight local newspapers on October 15, 2004, and a scoping notice was prepared and mailed to approximately 210 individuals and agencies identified on the mailing list. The scoping notice discussed general background information about the project, as well as the dates and times of the public scoping meetings.

USACE hosted public scoping meetings on Tuesday, October 26, 2004, in Littleton, Colorado, and Wednesday, October 27, 2004, in Greeley, Colorado. In addition to representatives of USACE and its contractor Tetra Tech EC, Inc., 18 people attended the Littleton meeting and 1 person from the general public attended the Greeley meeting; attendance was low because no newspapers printed the information provided by the news release. An agency scoping meeting was held February 10, 2005, in Littleton and, in addition to USACE and Tetra Tech EC, Inc. staff, 37 representatives of federal, state, and local governmental agencies attended. The meetings consisted of a brief presentation by USACE and displays, including maps showing the Chatfield Reservoir and different pool elevations. USACE received 29 verbal comments at the meetings, as well as 160 comments in letters and 11 comments in emails, totaling approximately 200 individual comments from October 26, 2004, to March 30, 2005 (comments received from both the public scoping meetings and the agency scoping meeting). In addition, 10 comments were received by letter after March 30, 2005. Appendix P contains a detailed spreadsheet of all scoping comments pertaining to the FR/EIS. Additionally, full comment letters are part of the public record and available for review at the USACE Tri-Lakes Information Office at Chatfield Dam and Lake.

In addition to the above public outreach approach, CWCB developed a project website (formerly http://www.cwcb.state.co.us/flood/chatfield.htm, now at http://cwcb.state.co.us/WatershedProtectionFloodMitigation/ProgramsProjects/ChatfieldReservoirReallocationProject/). USACE has provided materials for posting on the site. The CWCB website was set up for the public to view the project schedule, public involvement information, meeting minutes, and reports associated with this project. A more detailed project website was developed by the water providers, in cooperation with CWCB and USACE, and was launched in January 2009; it is located at http://www.chatfieldstudy.org. This website provides the public with a number of options for obtaining additional information, including joining the mailing list, or contacting the study team via email or a toll-free phone number.

Project update flyers were prepared in October 2007, January 2009, February 2010, and April 2011 and distributed to the public via email, the project website, and at the park gates and information centers at Chatfield State Park.

6.3 Public and Agency Scoping Comments

The regulations for implementing NEPA require USACE to employ scoping as an early and open process to identify significant concerns from the public, organizations, and agencies. The concerns identified during scoping focused the analysis within the FR/EIS. USACE received about 200 scoping comments that focused the analysis. Some comments submitted related to broad concerns, while others addressed very specific positions or recommendations for analysis and provided input on all aspects of the FR/EIS process, including authorizations, alternative analyses, baseline conditions, impact analyses, and mitigation.

6.3.1 Authorizations

One comment suggested that the discussion of purpose and need should describe the multipurpose authorities stated in the enabling legislation (i.e., municipal and industrial water supply, recreation, fish and wildlife) and explain how they relate to discharges and the operational model. Other comments indicated that the funding authorized LWCF (Land and Water Conservation Fund Act) program funds for Chatfield State Park and that the discussion of authorizations should include the implications of the LWCF funding.

Commenters indicated that it was important to know how the reallocated storage capacity would be filled and managed. One concern was the effect on operations by junior versus senior water rights holders among the water providers slated for the reallocated storage. Commenters also suggested a discussion on the effect reallocation could have on operational changes to other reservoirs in the South Platte River Watershed. The most widely expressed concern about operations surrounded the effects of water level fluctuations on numerous resources, including aquatic resources, fishery, wildlife habitat, vegetation (including noxious weed establishment and control), water quality, and recreation (including the use of the beach by swimmers and potential hazards to boaters).

6.3.2 Alternative Analyses

Comments concerning alternatives requested that USACE consider (1) offsite water storage alternatives, (2) building a wave action parapet wall around the existing structure, (3) increasing outlet releases during severe flood events, (4) increasing the size of the spillway, (5) conducting a site-specific antecedent flood study, and (6) examining conservation alternatives for water supply to the Denver Metro area. Of the conservation comments received, commenters requested that USACE consider specific water conservation measures as part of either the No Action Alternative or of one that did not involve the reallocation of additional water storage. Recommended conservation measures included:

- Continuing water rate surcharges all year.
- Continuing no-water days for the whole watering season (mandatory).
- Giving rebates year-round for the installation of low-flush toilets.
- Placing a water rate surcharge on bluegrass and median grass.
- Using outlying reservoirs/off-channel storage.
- Promoting the use of water budgeting systems in the metropolitan area.

- Conserving and reusing.
- Stabilizing the population.
- Leasing agricultural water rights.

6.3.3 Cumulative Effects

Cumulative effects concerned the evaluation of Denver Water's proposal for the Chatfield Reservoir pump station (as a potential future baseline condition). Some comments on Denver Water's proposal to pump water from below the conservation pool elevation in times of drought suggested including the proposal as part of this FR/EIS, while other commenters pointed out that they are two separate and unrelated projects that should not be considered together. Other issues related to cumulative effects include the potential impact on South Platte Park from recreational users displaced from Chatfield State Park, as well as the effects of other diversions from the reservoir. Details regarding cumulative effects of these and other projects are provided in the Cumulative Impacts section of Chapter 4.

6.3.4 Mitigation

Commenters from the public, organizations, and agencies offered suggestions on mitigation. One group suggested that mitigation include regularly updated announcements of changes in the water levels via a phone number or Web site for recreation purposes. Other commenters suggested that any relocated recreation facilities be designed to survive flooding. CDOW offered technical guidance on planting, including trees, shrubs, grasses, and forbs. The Chatfield Basin Conservation Network offered assistance in identifying buffered conservation areas for threatened or endangered species, such as Preble's meadow jumping mouse. Denver Botanic Gardens at Chatfield offered assistance in identifying mitigation areas and how Denver Botanic Gardens at Chatfield might become stewards for these mitigation areas. Douglas County offered assistance in identifying wetland and riparian areas along the reservoir, Plum Creek, and South Platte River, as well as proposing a tree/shrub corridor between Chatfield State Park, Plum Creek, and the South Platte River.

6.3.5 Pool Elevation Fluctuation

Fluctuation creating a wider shoreline area without vegetation could have the following negative impacts: (1) noxious weed spread, (2) wind erosion and deposition, (3) decreased accessibility to water-based recreation opportunities, (4) decreased recreation use, and (5) aesthetics. Fluctuation could also have the following positive impacts: (1) supporting nesting and migrating shorebirds, waterfowl, wading birds, and other bird species and wildlife and (2) creating an attraction to wildlife that provides viewing opportunities for visitors.

6.3.6 Water Quality

Commenters noted that an existing TMDL (total maximum daily load) may need to be modified, if retention times within the reservoir change. Commenters also voiced concerns about nutrient levels (especially phosphorus) with the changes in retention times and fluctuation of the pool. Some scoping comments wanted the FR/EIS to recognize metals mobility from sediment, including possible contaminants such as mercury sedimentation loads from the Hayman fire. Several commenters mentioned nutrient loading and addressing related impacts. Additionally, *E. coli* came up as an issue during the water quality work group meetings, and it is therefore included in the FR/EIS.

6.3.7 Aquatic Life and Fisheries

Scoping comments concerning aquatic resources included (1) identifying aquatic impacts above and below the reservoir because of water flow levels, (2) addressing impacts to reservoir fish populations, and (3) a statement that flooding vegetation can provide good habitat for fish and other aquatic species.

6.3.8 Riparian Habitat, Ecosystem, and Wetlands

Public sector and agency commenters requested the analysis identify a number of species for consideration, including special status plants and animals, migratory birds, water birds, sport fish, and non-sport fish. Specifically, commenters expressed concern about the loss of habitat as a result of the increased water levels and the negative effects that fluctuating water levels could have on breeding and spawning areas. Additionally, some scoping comments addressed concern about the effects of inundation around the reservoir and upstream from the reservoir, as well as change in stream flows downstream and their subsequent effects. Other comments included the release of water downstream that would benefit the ecosystem of the urban reach of the South Platte River.

6.3.9 Vegetation

Scoping comments suggested the need to look at impacts on riparian habitats around, upstream, and downstream of the reservoir. Impacts on threatened and endangered species, such as the Colorado butterfly plant and Ute ladies' tresses orchid, also need to be addressed. Regarding noxious weeds/invasive species, a few scoping comments suggested the need for a noxious weed control plan because the pool elevation fluctuations would be expected to aid the spread of noxious weeds, especially tamarisk.

6.3.10 Wildlife

Scoping comments included concerns about impacts to the Preble's meadow jumping mouse population and their habitat, as well as impacts to the riparian habitat, important to migratory birds and songbirds. Comments identified threatened and endangered species and state species of concern, including the bald eagle, Mexican spotted owl, piping plover, whooping crane, Canada lynx, Preble's meadow jumping mouse, Pawnee montane skipper, heron (rookery), western burrowing owl, white pelicans, ferruginous hawk, northern leopard frog, deer, and black-tailed prairie dog. Mitigation measures were also suggested and included conservation of tributary streams (Willow Creek) and surrounding upland habitat that could be vital to the perpetuation of the Preble's meadow jumping mouse.

6.3.11 Socioeconomic Resources

Socioeconomic issues raised in scoping comments included the benefits of relatively low costs for increased storage capacity in the reservoir and concern about the loss of revenues for the park and concessionaires operating within it (i.e., reducing recreation services, lower water levels). One commenter also requested that the FR/EIS address environmental justice (U.S. Executive Order 12898).

6.3.12 Recreation

Recreation-related comments focused on fluctuating water levels and how they could affect access to boating, fishing, swimming, bird watching (wildlife viewing), and handicapped fishing access.

Boaters additionally expressed concern about the potential hazards that would result from trees and brush being inundated. Concerns were also identified regarding the potential to inundate new roads built within the park and the width of proposed bicycle lanes. Comments specifically stated that (1) recreation use may be hindered by the pool elevation fluctuation; (2) relocated facilities may not be useable because of the low pool elevation (in drought years); (3) potential changes may occur in recreational experiences, even after the relocation of recreation facilities; (4) USACE must evaluate the "Conversion of Use" this project proposes with the LWCF Act Section 6(f)(3) (Public Law 88-578, as amended); and (5) the recreation study should address pool fluctuation.

6.4 Public and Agency Involvement Regarding the Draft FR/EIS

The Corps and CWCB have held many meetings during the course of the Chatfield Reservoir storage reallocation study. Many of these meetings have been open to the public, and a number of these meetings have been conducted pursuant to advance CWCB public notice and are documented on CWCB's current project Web site (http://cwcb.state.co.us/WatershedProtectionFloodMitigation/ProgramsProjects/ChatfieldReservoirReallocationProject/).

In addition, there have been a number of public actions that have taken place related to the Chatfield Reservoir storage reallocation study. These include CWCB meetings and decisions, proposed state legislation, and resolutions and letters of support from elected officials and cooperators (The Greenway Foundation 2008). In March 2006, Colorado's seven representatives to the U.S. House of Representatives submitted a letter to Congress requesting continued funding of the Chatfield study (DeGette et al. 2006). In May 2007, CWCB approved Resolution 2007-2 in support of the Chatfield Reservoir Reallocation Study (CWCB 2007). Also in 2007, the Colorado State Senate approved Senate Joint Resolution 07-019 in support of the Chatfield Reallocation project (State of Colorado 2007). In January 2008, Colorado Governor Bill Ritter issued a letter of support for funding the Chatfield Reservoir Reallocation EIS (Ritter 2008).

There are a number of entities that have been invited by the Corps to participate in the Chatfield Reservoir storage reallocation study as Cooperating Agencies and Special Technical Advisors (see Table 6-2). The Cooperating Agencies and Special Technical Advisors were given the opportunity to review and comment on the Preliminary Draft chapters of the FR/EIS. Under authority of the Fish and Wildlife Coordination Act, the U.S. Fish and Wildlife Service (a cooperating agency) has provided the Corps with a Planning Aid Report (February 2006) and a progress letter (July 2010) (see Appendix X). Appendix S summarizes compliance of the preferred alternative with Federal environmental statutes and regulations, and includes coordination letters between the USACE and other agencies.

A project update was prepared in October 2007 and copies were provided to the public at Chatfield State Park and through the CWCB's Web site. Copies were also provided at the annual stakeholder's meeting of the Chatfield Basin Conservation Network (October 2007). In January 2009, the information was made available through http://www.chatfieldstudy.org. Additional project updates were prepared and distributed in January 2009, February 2010, April 2011, and March 2012.

Table 6-2. List of Cooperating Agencies and Special Technical Advisors for the Chatfield Reservoir Storage Reallocation Study

Audubon Society of Greater Denver
Capitol Representatives
Castle Pines Metro District
Castle Pines North Metropolitan District
Centennial Water and Sanitation District
Center of Colorado Water Conservancy District
Central Colorado Water Conservancy District
Chatfield Basin Conservation Network
Chatfield Watershed Authority
City and County of Denver
City of Aurora
City of Brighton
City of Littleton
Colorado Division of Wildlife
Colorado Environmental Coalition
Colorado State Parks
Colorado Water Conservation Board
Denver Botanic Gardens at Chatfield
Denver Water
ERO Resources Corporation
Great Western Institute
Greenway Foundation
Hock Hocking L.L.C.
Kent Wiley (former Chatfield State Park Manager)
Metro Wastewater Reclamation District
Mount Carbon Metropolitan District
Parker Water and Sanitation District
Perry Park Country Club
Roxborough Park Metropolitan District
Sierra Club, Rocky Mountain Chapter
South Metro Water Supply Authority
South Suburban Parks & Recreation District
Town of Castle Rock
Trout Unlimited
U.S. Fish and Wildlife Service
Western Mutual Ditch Company
Western Resource Advocates

On June 8, 2012, the Notice of Availability was posted in the Federal Register. The Chatfield Reservoir Storage Reallocation FR/EIS is available online at http://www.nwo.usace.army.mil/html/pd-p/Plan_Formulation/GI/GI_Chatfield.html. The comment period will be open from June 8, 2012 to August 7, 2012.

Hard copies will be available at the following community libraries and Corps of Engineers Chatfield Project Office no later than June 15, 2012.

- Highlands Ranch Library, 9292 Ridgeline Blvd., Highlands Ranch, CO 80129, 303-647-6642.
- Colorado Water Conservation Board, 1313 Sherman Street, Room 721, Denver, CO 80203, 303-866-3441.
- Columbine Library, 7706 West Bowles Avenue, Littleton, CO 80123, 303-235-5275.
- Lincoln Park Library, 919 7th Street, Suite 100, Greeley, CO 80631, 970-546-8460.
- Aurora Public Library, 14949 E. Alameda Parkway, Aurora, CO 80012, (303) 739-6600
- US Army Corps of Engineers, Tri-Lakes Project Office, 9307 S. Wadsworth Blvd., Littleton, CO 80128, (303)-979-4120.

Public involvement meetings are scheduled from 5:30 PM to 8:30 PM at the following locations on the specified date:

1. Monday, June 25th—The Wildlife Experience, 10035 S. Peoria St., Parker, CO 80134, (720) 488-3300.
2. Tuesday, June 26th—Dakota Ridge High School, 13399 West Coal Mine Avenue, Littleton, CO 80127, (303) 982-1970.
3. Wednesday, June 27th—Valley High School, 1001 Birch St, Gilcrest, CO 80623, (970) 73-2494.

7. CONCLUSIONS AND RECOMMENDATIONS

Upon receiving and considering comments from the public and agencies during the public review of this Draft Feasibility Report/Environmental Impact Statement (FR/EIS), this recommendations section will be revised for the Final FR/EIS to present the recommendations of the Commander of the Corps of Engineers Omaha District.

Subject to the consideration of comments on the Draft FR/EIS, Alternative 3, 20,600 Acre-Foot Reallocation, is tentatively selected as the best alternative for addressing the vastly growing demand for water supply in the Denver Metro area.

Alternative 3, 20,600 Acre-Foot Reallocation, would involve:

- Reallocating water storage from the flood control pool to the conservation pool to provide an estimated average year yield of 8,539 acre-feet for Municipal and Industrial water supply.
- This reallocation would raise the top elevation of the conservation pool from 5,432 to 5,444 feet msl, although pool levels would fluctuate with runoff and water supply withdrawals, and 5,444 feet msl would not be achieved every year.
- A recreation modification plan would be implemented to relocate and replace existing recreation facilities, resources, and project roads that will be inundated by the pool raise.
- An environmental mitigation plan, with monitoring and adaptive management, would be implemented to replace or compensate for the loss of habitat inundated by the pool raise, including wetlands, bird habitat and habitat (including Designated Critical Habitat) of the federally listed threatened Preble's meadow jumping mouse.
- The State Engineer determines the releases needed to satisfy water rights in the conservation zone (5,385–5,432 feet msl) and the joint-use pool (5,432–5,444 feet msl). If the pool elevation is forecast to rise above the top of the joint use zone (5,444 feet msl), the Corps will have the option to take control of the reservoir releases. When the pool is in the flood control zone (5,444–5,500 feet msl), the Corps determines the releases needed to safely evacuate flood storage and reduce flood risk downstream. In the event of an emergency, the Corps will determine the necessary releases to ensure safety of the dam. See Appendix B, Water Control Plan, for further details.
- Water providers downstream of Chatfield Reservoir would be allowed to use existing infrastructure to divert their portion of the stored water into their water systems. The number of water providers with storage rights within the reservoir would increase from one (Denver Water) to 15.

The estimated first cost of the Chatfield Reservoir storage reallocation project at FY 2012 price levels is $134.2 million, consisting of Cost of Storage of $15.3 million (using ASA (CW) exemption), recreation modifications of $48.0 million, environmental mitigation of $60.3 million, and the water provider's water supply infrastructure of $10.6 million. The annual OMRR&R costs are estimated to be $2.27 million at FY 2012 price levels. All costs are 100 percent non-federal.

The Colorado Department of Natural Resources (CDNR) will serve as the Non-Federal Sponsor for the Chatfield Reservoir storage reallocation project and enter into a Water Supply Storage/Project Partnership Agreement with the Corps of Engineers. CDNR, in turn, will enter into Reallocated Storage User Agreements with each of the 15 individual water providers, who will use their water rights to store water in the reallocated 20,600 acre-feet and will distribute the project costs in proportion to their amount of storage.

The proposed project would supply water to meet the growing demand while avoiding significant adverse impacts to the environment.

7.1 Items of Non-Federal Cooperation

Federal implementation of the tentatively selected plan will be subject to the Non-Federal Sponsor, the CDNR, agreeing in a Project Partnership Agreement to comply with applicable Federal laws and policies, including but not limited to:

A. Reallocation of Water Storage

1. Provide 100 percent of the reallocated cost of storage as calculated in accordance with the Water Supply Act of 1958, as amended (43 U.S.C. 390b), and implementing regulations, including the policy exception granted by the Assistant Secretary of the Army (Civil Works) on January 22, 2009;

2. Provide the applicable pro-rata percentage of the Chatfield Lake project repair, rehabilitation, and replacement joint costs, and 100 percent of the annual operations and maintenance expenses of the specific water support facilities operated by the Non-Federal Sponsor;

3. Hold and save the Government, including its officers, agents and employees harmless from liability of any nature or kind for or on account of any claim for damages which may be filed or asserted as a result of the storage in the Chatfield Lake project, or withdrawal or release of water from the Chatfield Lake project, made or ordered by the Non-Federal Sponsor or as a result of the construction, operation, or maintenance of the water supply facilities and appurtenances thereto owned and operated by the Non-Federal Sponsor except for damages due to the fault or negligence of the Government or its contractors.

B. Recreation Modifications and the Environmental Mitigation Features

1. Provide 100 percent of the cost of the recreation modifications and the environmental mitigation features, either by cash contributions or by in-kind work pursuant to Section 116 of the Omnibus Appropriations Act of 2009 (P.L. 111-8);

2. Provide any lands, easements, and rights-of-way not currently owned or possessed by the Government necessary for the construction, operation, and maintenance of the recreation modifications and the environmental mitigation features;

3. Shall not use funds from other Federal programs to meet any of the non-Federal obligations unless the Federal agency providing the Federal portion of such funds verifies in writing that such funds are authorized to be used to carry out the recreation modifications and the environmental mitigation features;

4. Hold and save the Government free from all damages arising from the construction, operation, maintenance, repair, rehabilitation, and replacement of the recreation modifications and the environmental mitigation features, except for damages due to the fault or negligence of the Government or its contractors;

5. Keep and maintain books, records, documents, and other evidence pertaining to costs and expenses incurred pursuant to the project, for a minimum of 3 years after completion of the accounting for which such books, records, documents, and other evidence is required, to the extent and in such detail as will properly reflect total cost of construction of the project, and in accordance with the standards for financial management systems set forth in the Uniform Administrative Requirements for Grants and Cooperative Agreements to State and local governments at 32 CFR, Section 33.20;

6. Comply with all applicable Federal and State laws and regulations, including, but not limited to: Section 601 of the Civil Rights Act of 1964, P.L. 88-352 (42 U.S.C. 2000d), and Department of Defense Directive 5500.11 issued pursuant thereto; Army Regulation 600-7, entitled "Nondiscrimination on the Basis of Handicap in Programs and Activities Assisted or Conducted by the Department of the Army"; and all applicable Federal labor standards requirements including, but not limited to, 40 U.S.C. 3141-3148 and 40 U.S.C. 3701-3708 (revising, codifying and enacting without substantive change the provisions of the Davis-Bacon Act (formerly 40 U.S.C. 276a et seq.), the Contract Work Hours and Safety Standards Act (formerly 40 U.S.C. 327 et seq.), and the Copeland Anti-Kickback Act (formerly 40 U.S.C. 276c));

7. In the case of 2. above, perform, or ensure performance of, any investigations for hazardous substances as are determined necessary to identify the existence and extent of any hazardous substances regulated under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), 42 U.S.C. 9601–9675, that may exist in, on, or under lands, easements, or rights-of-way that the Federal Government determines to be required for the recreation modifications and the environmental mitigation features. However, for lands, easements, or rights-of-way that the Government determines to be subject to the navigation servitude, only the Government shall perform such investigations unless the Federal Government provides the Sponsor with prior specific written direction, in which case the Sponsor shall perform such investigations in accordance with such written direction;

8. In the case of 2. above, assume, as between the Federal Government and the Non-Federal Sponsor, complete financial responsibility for all necessary cleanup and response costs of any hazardous substances regulated under CERCLA that are located in, on, or under lands, easements, or rights-of-way that the Federal Government determines to be required for the recreation modifications and the environmental mitigation features;

9. In the case of 2. above, comply with the applicable provisions of the Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970, P.L. 91-646, as amended, (42 U.S.C. 4601-4655), and the Uniform Regulations contained in 49 CFR 24, in acquiring lands, easements, and rights-of-way necessary for construction, operation, and maintenance of the recreation modifications and the environmental mitigation features, including those necessary for relocations, the borrowing of material, or the disposal of dredged or excavated material; and inform all affected persons of applicable benefits, policies, and procedures in connection with said act;

10. To the maximum extent practicable, perform its obligations in a manner that will not cause liability to arise under CERCLA;

11. In the case of 2. above, provide the non-Federal share of that portion of the costs of mitigation and data recovery activities associated with historic preservation that are in excess of 1 percent of the total amount authorized to be appropriated for the project; and

12. Prevent obstructions or encroachments (including prescribing and enforcing regulations to prevent such obstructions and encroachments) such as any new developments on lands, easements, or rights-of-way required for the recreation modifications and the environmental mitigation features, or the addition of facilities which might hinder the operation and maintenance of the Chatfield Project, or interfere with Chatfield Project's proper function.

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9. LIST OF PREPARERS

Name	Contributions	Degree(s)	Years of Experience
U.S. Army Corps of Engineers			
Gwyn Jarrett	Project Management	BS; MA Public Administration	11
Eric Laux	NEPA, Fisheries, ESA, Wetlands, Environmental	BS Biology MS Fisheries	18
Doug Clemetson	Hydrology	BS Civil Engineering	32
Gene Sturm	Economics	BS Urban Planning MA Community/Regional Planning	40
Betty Peake	Economics, Recreation	BA Social Studies BS Biology MA Geography MS Geography	37
Joel Knofczynski	Hydrology	BS Civil Engineering	23
Dave Jensen	Water Quality	BS Fishery Biology BS Zoology MS Fish and Wildlife Biology	32
Katie Seefus	Water Control	BS Civil Engineer	5
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Randy Behm	Flood Plains	BS Civil Engineering	27
Robert Worden	Seismic Analysis	BS Civil Engineering	23
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Sandy Barnum	Cultural Resources	BA Sociology/Anthropology MA Anthropology MA Museum Studies	25
Vicki French	Real Estate	2 years of college	10
Mike Kelly	Static Analysis		Retired
Tim Temeyer	Water Control		Retired
Tetra Tech			
Gary Drendel	Project Manager - FR/EIS, Ecology, Biological Assessment, Tree Management Plan, Water Quality	BS Zoology MS Zoology and Entomology	25+
Stephanie Phippen	Soils, Hydrology, Water Quality	BA Geology MS Geology/Watershed Science	12
Chuck Hillerson	Economic Analysis, Flood Damages	BS Mathematics	25+
Tony Truschel	Alternatives, 404(b)(1) Analysis	BS Geology BA Geography MS Engineering (Hydrology/Hydrogeology)	25+
Tom Ryon	Biology, Biological Assessment	BS Wildlife Biology MS Environmental Science – Ecology	25+
Pat Murphy	Wetlands, Vegetation	BA MA Vegetation Ecology	25+

Name	Contributions	Degree(s)	Years of Experience
Ed Fleming	Fisheries	BS Aquatic Biology	18
Andrew Parker	Water Quality Modeling	BS Civil Engineering ME Environmental Engineering	16
Mustafa Faizullabhoy	Water Quality Modeling	BE Civil Engineering MS Civil & Environmental Engineering	12
Dan Heidenreich	GIS Specialist	BA Geology/Geography	21
ERO Resources			
Steve Dougherty	Compensatory Mitigation Plan	BS Biology Graduate Studies - Environmental Science	25+
Mary Powell	Compensatory Mitigation Plan	BA Biology MA Biology	19
Ron Beane	Compensatory Mitigation Plan	BS Wildlife Biology MA Biology	25+
EDAW			
Scott Sinn	Recreation Facilities Modification Plan	Bachelor of Landscape Architecture	16

10. DISTRIBUTION OF THE DRAFT FR/EIS

Individuals on the distribution list (presented in Table 10-1) were notified of the availability of the Draft FR/EIS by email or by ground mail depending on the address provided. If both addresses were provided, they received an email notification. The notifications included the internet address for downloading the document online and the addresses of community libraries where hard copies will be available. Federal agencies (EPA, Department of the Interior, and U.S. Forest Service) will receive an additional email and letter from the Corps of Engineers providing notification and the Executive Summary. The Federal agencies will also be mailed a hard copy of the Draft FR/EIS.

Table 10-1. Distribution List for the Draft FR/EIS—Government Officials

Affiliation	Last Name	First Name
Federal Agency Representatives		
EPA	Mylott	Rich
EPA	Valentine	Julia
U.S. Fish and Wildlife Service	Perez	Noemi
National Park Service	Barna	David
National Park Service	Richardson	Samantha
U.S. Forest Service	Wallace	Rebecca
U.S. Army Corps of Engineers	Brandon	David A.
U.S. Army Corps of Engineers	Cone	Steve
U.S. Army Corps of Engineers, Chief of Planning Branch	Eckert Uptmor	Kayla
U.S. Army Corps of Engineers	Fleming	Lisa
U.S. Army Corps of Engineers	Fredericks	Jim K.
U.S. Army Corps of Engineers	Rios	Fred
U.S. Army Corps of Engineers	Thompson	Brad
State Agency Representatives		
Colorado Department of Agriculture	Lightcap	Christi
Colorado Department of Public Health and Environment	Salley	Mark
Colorado Department of Natural Resources Colorado Conservation Board	Browning	Tom
Colorado Department of Natural Resources	Hartman	Todd
Colorado Department of Natural Resources	Mitchell	Becky
Colorado Parks and Wildlife	Rousch	Scott
Colorado Parks and Wildlife	Kehmeier	Ken
Colorado Division of Water Resources	Rein	Kevin
Elected Officials		
State Representative- District 40 Arapahoe	Acree	Cindy
State Senator -District 32 Denver/Jefferson	Aguilar	Irene
State Senator- District 14	Bacon	Bob
State Representative- District 39 Arapahoe	Balmer	David
State Representative- District 57	Baumgardner	Randy
State Representative - District 62 Adams, Cheyenne,	Becker	Jon

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Affiliation	Last Name	First Name
Crowley, Kiowa, Kit Carson, Lincoln, Morgan, Washington, Yuma		
Senator	Bennet	Michael
State Senator- District 21	Boyd	Betty
State Representative- District 55	Bradford	Laura
State Rep. - District 33 Adams, Boulder, Broomfield, Weld	Breezley	Don
State Senator- District 1	Brophy	Greg
State Rep. - District 59 Archuleta, La Plata, Montezuma, San Juan	Brown	Paul
State Senator- District 10	Cadman	Bill
State Senator- District 29	Carroll	Morgan
State Representative- District 32 Adams	Casso	Edward
Congressman	Coffman	Mike
State Rep. District 38 Araphahoe, Jefferson	Conti	Kathleen
State Rep. District 58 Delta, Dolores, Montezuma, Montrose, Ouray, San Miguel	Coram	Don
State Representative- District 6 Arapahoe	Court	Lois
Congresswomen	Degette	Diana
State Rep. District 51 Larimer	DelGrosso	Brian
State. Rep District 5 Denver	Duran	Crisanta
State Representative- District 2 Denver	Ferrandino	Mark
State Rep. District 42 Arapahoe	Fields	Rhonda
State Representative- District 53 Larimer	Fischer	Randy
State Senator- District 35	Foster	Joyce
State Representative- District 21	Gardner	Bob
Congressman	Gardner	Cory
State Representative- District 25 Jefferson	Gerou	Cheri
State Senator District 3 Pueblo	Giron	Angela
State Senator District 2 Baca, Bent, Crowley, Custer, Fremont, Huerfano, Las Animas, Otero, Pueblo	Grantham	Kevin
State Senator - District 34 Denver	Guzman	Lucia
State Rep. - District 56 Eagle, Lake, Summit	Hamner	Millie
State Senator- District 30	Harvey	Ted
State Senator- District 18	Heath	Rollie
State Senator- District 25	Hodge	Mary
State Rep. District 44 Douglas	Holbert	Chris
State Senator- District 19	Hudak	Evie
State Representative- District 10	Hullinghorst	Dickey
State Senator - District 20 Jefferson	Jahn	Cheri
State Senator - District 33 Denver	Johnston	Michael
State Rep. District 12 Boulder	Jones	Matt
State Rep. - District 14 El Paso	Joshi	Janak
State Representative- District 3 Arapahoe	Kagan	Daniel
State Representative- District 52	Kefalas	John
State Representative- District 26 Jefferson	Kerr	Andy

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State Representative- District 28 Jefferson	Kerr	Jim
State Representative- District 54	King	Steve
State Senator- District 12	King	Keith
State Representative- District 1 Arapahoe	Labuda	Jeanne
State Representative- District 14	Lambert	Kent
Congressman	Lamborn	Doug
State Rep. - District 18 El Paso	Lee	Pete
State Representative- District 13	Levy	Claire
State Representative- District 16	Liston	Larry
State Senator- District 15	Lundberg	Kevin
State Representative- District 60	Massey	Tom
State Representative- District 8 Denver Co	McCann	Beth
State Representative- District 64 Baca	McKinley	West
State Representative- District 43 Douglas	McNulty	Frank
State Representative- District 9 Denver	Miklosi	Joe
State Senator- District 23	Mitchell	Shawn
State Senator- District 11	Morse	John
State Representative- District 45 Douglas	Murray	Carole
State Senator - District 22 Jefferson	Neville	Tim
State Senator- District 26	Newell	Linda
State Senator - District 16 Boulder, Clear Creek, Gilpin, Grand, Jefferson, Summit	Nicholson	Jeanne
State Representative- District 49	Nikkel	BJ
State Rep. - District 4 Denver	Pabon	Daniel
State Representative- District 46	Pace	Sal
State Representative- District 35 Adams	Peniston	Cherylin
Congressman	Perlmutter	Ed
Congressman	Polis	Jared
State Representative- District 30 Adams Co	Priola	Kevin
State Rep. - District 29 Jefferson	Ramirez	Robert
State Senator- District 13	Renfroe	Scott W.
State Representative- District 59	Roberts	Ellen
State Representative- District 36 Arapahoe	Ryden	Su
State Representative- District 24	Schafer	Sue
State Senator- District 4	Scheffel	Mark
State Senator- District 5	Schwartz	Gail
State Rep. - District 54 Delta, Mesa	Scott	Ray
State Senator- District 17	Shaffer	Brandon
State Rep. - District 11	Singer	Jonathan
State Representative- District 31 Adams	Solano	Judy
State Representative- District 65 Logan	Sonnenberg	Jerry
State Representative- District 34 Adams	Soper	John
State Senator- District 27	Spence	Nancy
State Representative- District 20	Stephens	Amy
State Representative- District 22 Jefferson	Summers	K

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State Rep. - District 47 Fremont, Pueblo	Swerdfeger	Keith
State Rep. - District 27 Jefferson	Szabo	Libby
Congressman	Tipton	Scott
State Senator- District 24	Tochtrop	Lois
State Representative- District 41 Arapahoe	Todd	Nancy
Senator	Udall	Mark
State Representative- District 48 Weld Co	Vaad	Glenn
State Representative- District 62	Vigil	Edward
State Representative- District 15	Waller	Mark
State Senator- District 8	White	Al
State Rep. - District 7 Denver	Williams	Angela
State Senator- District 28	Williams	Suzanne
State Rep. - District 61 Eagle, Garfield, Gunnison, Hinsdale, Pitkin	Wilson	Roger Ben
State Rep. - District 50 Weld	Young	Dave

Table 10-2. Distribution List for the Draft FR/EIS—Public Information Officers/Communications Contacts

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Central Colorado Water Conservancy District	Bieri	Justin
City and County of Broomfield	Doran	Rosann
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City and County of Denver	Miller	Amber
City of Aurora	Stuart	Kim
City of Boulder	von Keyserling	Patrick
City of Boulder	Jacobson	Jody
City of Brighton	Falconburg	Marv
City of Centennial	Witten	Allison
City of Commerce City	Halstead	Michelle
City of Englewood	Flaherty	Mike
City of Fort Collins	Newcomer	Kelli
City of Golden	Tilley	Karlyn
City of Greeley	Pantaleo	John
City of Littleton	Narde	Kelli
City of Lone Tree	Kivela	Michelle
City of Longmont	Leal	Rigo
City of Loveland	Hiller	Andy
City of Northglenn	Olinger	Celeste

Table 10-2. Distribution List for the Draft FR/EIS—Public Information Officers/Communications Contacts

Affiliation	Last Name	First Name
City of Thornton	Wilson	Lisa
Colorado Division of Parks and Outdoor Recreation	Frazier	Deb
Colorado Division of Wildlife	Churchill	Jennifer
Denver Botanic Gardens at Chatfield	Jones	Will
Denver Community Planning and Development	Burns	Andrea
Denver Water	Chesney	Stacey
Denver Water	Thompson	Travis
Department of Natural Resources	Stein	Theo
Douglas County	Holmes	Wendy
Jefferson County	Heider	Kathryn
Town of Castle Rock	McGrath	Karen
Town of Parker	Penington	Elise

Table 10-3. Distribution List for the Draft FR/EIS—Individuals

Last Name	First Name	Personal Affiliation, if noted
Abel	Judith	
Abound	Frank	
Ackerman	Lynn	Douglas County Citizens for Wildlife
Alfonso	Josh	
Allen	Betty	Douglas County Department of Community Development
Allin	Laurie	
Anderson	Victor	Parker Water & Sanitation District
Anderson	David	Colorado Natural Heritage Program
Anderson	Mikkel	International Risk Group, LLC
Anderson	Mikk	Ducks Unlimited Colorado
Andrews	Ed	
Angier	Carol F.	U.S. Army Corps of Engineers
Antone	Mike	
Anziano	Michael	
Anziano	Marcia	Open Water Swimmers
Apple	Carol	
Archuleta	Katherine	City and County of Denver, Mayor's Senior Advisor on Policy and Initiatives
Armstrong	Bob	CDM
Arthur	Shannon	
Atkin	Gary	Arapahoe County Water and Wastewater Authority, General Manager
Atwell	Joseph	
Ayers	James	
Baker	Dave	Town of Brush
Balay	Eric	Colorado Rotor-Heads
Barker	Chris	Kiewit Western Co
Barry	Hamlet	Denver Water
Barry	Robert	

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Last Name	First Name	Personal Affiliation, if noted
Bartleson	Mike	City and County of Broomfield, Deputy Director of Public Works
Bassett	Denise	Castle Pines North Metro Dist.
Baus	Terry	City and County of Denver, Chief Water Quality Engineer
Bechmann	Elisabeth	
Beckman	Susan	Arapahoe County Board of County Commissioners, Commissioner
Bedan	Mike	
Belaski	Catherine	
Belz	Steve	Black Creek Hydrology
Bennett	David	Denver Water
Bennett	Grant	
Bentley	Dave	Jefferson County Open Space
Berger	W.Bart	Denver Mountain Parks
Bergmann	Alma	Town of Bow Mar
Bergmann	Kelly	
Bergmann	Damon	
Berube	Tim	
Bestor	Michael C.	City of Golden, City Manager
Beucke	Verle	Dog Exercise
Bierdsdorfer	Jack	
Biggs	Barbara	Metro Wastewater Reclamation District
Bissett	Bruce	
Blodgett	Bob	Clifton CPA
Bloom	Barry	
Blosten	Charlie	City of Littleton
Blume	Scott	U.S. Coast Guard Auxiliary, 8th Coast Guard Divison 1 Commander Denver Flotilla Commander
Boand	Steve	Douglas County Board of Commissioners, Commissioner
Boardman	Barb	Denver Water Citizens Advisory Committee
Bockenfeld	Rod	Arapahoe County Board of County Commissioners, Commissioner
Bohan	Suzanne	(Portuguese water dog owner, closely involved with PWD permit; Associate Regional Counsel, EPA)
Bohon	Denny	U.S. Fish and Wildlife Service- So. Platte Ranger District
Bolton	Randy	
Bonacci	Robert	President and CEO, Butterfly Pavilion
Bonnell	Ann	Audubon Society of Greater Denver/ South Platte Group Sierra Club, Board Member
Bornstein	Jacob	Former Director- Colorado Watershed Authority
Bouvette	Tracey	Great Western Institute, Executive Director
Brand	Cortney	R. W. Beck
Brandt	Richard	Town of Parker
Brauer	Rod	CH2MHill
Bredenberg	Carolyn S.	
Brehmer	Judson	
Brennan	Bill	Metro Wastewater Reclamation District

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Last Name	First Name	Personal Affiliation, if noted
Brethauer	Gerrold	Town of Kersey
Brink	Ken	Colorado Department of Natural Resources Division of Parks and Outdoor Recreation, Park Manager
Brinkley	Jason	
Broderick	William	Denver Regional Council of Goverments
Brower	Cynthia	
Brown	Warren	Tri-County Health
Brown	Dan	Fischer, Brown, Bartlett & Gunn, PC, Attorney
Brown	Stan	Lambert Ranch
Brown	Bill	Fischer, Brown, Bartlett & Gunn, PC
Brown	Marc	
Browne	Claudia	Biohabitats
Browning	Carolyn	CH2MHill
Brummert	Karl	Executive Director, Audubon Society of Greater Denver
Buckels	Devon	City of Denver Parks and Recreation
Burger	Mary Cay	Denver Field Ornithologists,President
Burger	Mary Cay	Denver Field Ornithologists
Burkhart	Randy	Douglas County Parks and Trails
Burrin	Allen	
Bussey	Niki	Mulhern MRE, Inc. (Stonegate
Cables	Rick	U.S. Forest Service, Regional Forester
Campbel	Dru	Douglas County, Staffer
Campbell	Doug	Highlands Ranch Community Association
Campbell	Todd	U.S. Coast Guard Auxiliary, Director of 8th Coast Guard District
Campbell	Ellen	
Capesius	Joseph P.	U.S. Geological Survey
Carey	Mary	
Carlson	Mark	Castle Pines North Metro Dist.
Carpenter	Lance	Colorado Department of Natural Resources Division of Wildlife
Carpenter	Jim	Office of Gov. Bill Ritter
Carrington	Chris	
Cartaya	Kristina	
Carter	Lisa	
Casas	Yoli	CWW Team, 300-400 triathletes, 100-150 of whom use Chatfield
Casias	Jesse	
Cassidy	Earl	U.S. Geological Survey
Cech	Tom	Central Colorado Water Conservancy District, Executive Director
Cederlund	Tommy and Sasha	Sunny Day Come Fly Away
Chaney	Julie	President, Back Country Horseman
Chaney	Jim	Former President, Back Country Horseman
Chaplin	Patty	
Chapple	Will	University Of Wyoming

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Last Name	First Name	Personal Affiliation, if noted
Chestnutt	Michele	
Christensen	Jack	Castleton Water and Sanitation District
Christman	Jenifer	Ducks Unlimited
Chung	JiYoung	
Ciardullo	Dan	Stapac
Clark	Scott	Burns, Figa & Will, PC, Attorney
Clark	Tom	Mount Carbon Metropolitan District
Clayshulte	Russell	Bear Creek Watershed Association, Director
Clements	Gregg	City of Commerce City, City Manager
Coe	Eric	Chairman of Cherry Ck Lake Water Conservation Board
Cole	Andy	ERO Resources
Comstock	Kathy	
Conklin	Amy	Chatfield Watershed Authority
Conklin	Don	Chadwick Ecological Consultants
Conover	Beth	City and County of Denver
Conovitz	Pete	Colorado Department of Natural Resources Division of Wildlife
Cortese	Phil	City of Littleton, Deputy City Manager
Cosgrove	James	
Coulter	Amy	
Court	Amanda	
Courtney	Brian	
Craig	Caren	Rocky Mountain Windsurfing Assoc
Crane	Jeff	Colorado Watershed Assembly, Executive Director
Crozier	Cliff	COMSA Member
Crumpacker	David W.	University of Colorado, Boulder
Cruz	Doris	South Platte Park
Culichia	James W.	Felt, Monson and Culichia, Attorney
Culver	Steve	U.S. Fish and Wildlife Service- So. Platte Watershed Protection Project, Fisheries Biologist
Curd-Goulette	Stephanie	
Cushing	Amanda	Bureau Veritas NA
Dalrymple	John	Town of Fort Morgan
Dalton	Hope	Tri-County Health
Dannecker	Michael	Denver Sailing Association, Commodore
Dannels	Paul	Castle Pines Metropolitan District, District Manager
Darling	Lisa	Aurora Water, Program Manager
Davenhill	Casey	Cherry Creek Partnership, Colorado Watershed Network
Davidson	Kirk	Ducks Unlimited Colorado, Regional Director
DeBoard	Doug	Douglas County, County Administrator
DeBus	Gary	Highlands Ranch Community Association
Dechant	David	
Decker	Brian	MarineMax of Denver, Inc.
Dederick	Jim	Douglas County Engineering
Deignan	Timothy	Tetra Tech
DeKoevend	Gery	Fantasy Balloons; he & his wife organize Rocky Mt. Balloon

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Last Name	First Name	Personal Affiliation, if noted
		Festival
DeLaney	Ginger	CBA Board
Dempsey	Mike	Pebble Creek Partners
Denslow	Denise	Clifton (Northern Douglas County)
Detwiler	Henry	Southwest Birders
DeVito	Tony	Colorado Department of Transportation, Region 1, Regional Director
Diebel	Jon	CH2MHill
Distler	Emily	Horseback Riding - Spring Gulch
Dixon	Jan	
Doenges	Jim	
Doe-Torres	Amy	
Doiel	Montgomery	Public Safety Promotions
Donaldson	Liesel	
Doran	Alicia	Jefferson County Open Space
Dorsch	Jim	Metro Wastewater Reclamation District
Dowaliby	Mark	Park County Board of Commissioners
Duffey	Alyson	Thorne Ecolocial Institute
Dugan	Heather	Colorado State Parks
Duncan	Sara	Denver Water, Intergovernmental Affairs Coordinator
Dyer	Jim	Arapahoe County Board of County Commissioners
Eachus	Luke	Guide
Eaton-Snovak	Angela	Search and Rescue Dogs
Eckhardt	Bonnie & Frank	Western Mutual Ditch Company
Eden	Bill	
Eisel	Leo	Brown and Caldwell
Elbeck	Michael	
Elbeck	Debra	
Elliot	Tom	Jefco Aeromodelers
Ellis	Courtney	
Emig	Jeff	
Engelmann	Claudia	Colorado Department of Natural Resources Division of Water Resources
English	Robert	
Eppers	Sherry	Centennial Water & Sanitation District
Espegren	Greg	Colorado Water Project, Aquatic Specialist
Estelle	Jim	
Ethredge	Jack	City of Thornton, City Manager
Evans	Tim	La Salle
Evans	Don	CH2MHill
Evans	Dave	Bicycle Trail
Everett	Justin	COHOPE (Council of HOA's)
Evert	Carole-Joy	Denver Foothills Tracking Ass'n
F.	Maria	
Falicchio	Megan	

Table 10-3. Distribution List for the Draft FR/EIS—Individuals

Last Name	First Name	Personal Affiliation, if noted
Farah	Buddy	
Farrell	Lee	Professional Photogtrapher
Fehr	Todd	Trout Unlimited- Denver Chapter, Vice President
Felicissimo	Dawn	
Fendel	Katie	Leonard Rice Engineers, Inc (City of Brighton)
Fields	Linda	
Fifield	Jerry	Douglas County Soil Conservation District Board
Fischer	W. R. "Skip"	Adams County Board of County Commissioners, Commissioner
Flaig	David	City of Littleton
Flannery	Jerry	City of Commerce City, City Manager
Flores	David	Town of Platteville
Flowers	Dale	Audubon Society of Greater Denver
Fontana	John	
Forrest	Charles	
Forsberg	Steve	Burlington Northern Santa Fe Railway Co., General Director of Public Affairs
Fox	Brooke	Chatfield Basin Conservation Network
Fox	Ed	Rural Water
Fox	Bret	Brownstein Hyatt Farber Schreck, LLP
Frank	Steve	Community Sailing of Colorado Limited, Director
Frenzel	Sharon	
Friday	Tim	Castle Rock
Friedlander	Bob	Great Lakes Marine
Friedman	Jonathan	U.S. Geological Survey- Biological Services
Friesen	Orlando	Titan RV Storage
Frisbie	Susan	
Frohboese	Karil	
Fugett	Robyn	South Platte Group of the Sierra Club, Staff Director
Funk	Casey	Denver Water Dept. Legal Division
Gabel	Dale	CH2MHill
Gabel	Pat	Berg Hill Greenleaf & Ruscitti, LLP
Gallamore	Allan	Colorado State Forest Service
Garber	Jen	Centennial Water and Sanitation District
Garrison	Kristin	Colorado State Forest Service, District Forester, Franktown
Gavin	Ann	
Gentry	Rhonda	Douglas County, Communications Adminstrator
Gerard	Deb	Greenway Foundation Board of Directors
Gerlich	Greg	Colorado Department of Natural Resources Division of Wildlife
Gianti	Sarah	WebbPR
Giebel	Mark	Highlands Ranch Community Association, Backcountry Supervisor
Giger	Dave	Colorado Department of Natural Resources Division of Parks and Outdoor Recreation
Gimbel	Jennifer	Colorado Department of Natural Resources Colorado Water Conservation Board

Table 10-3. Distribution List for the Draft FR/EIS—Individuals

Last Name	First Name	Personal Affiliation, if noted
Giustina,	Gennifer	Horseback Riding - Spring Gulch
Glaser	Don	Bureau of Reclamation
Glaser	Kelli	
Glidden	Mark	CH2MHill
Goff	Wes	CDOT R. 1
Gomez	Maria	Arapahoe Water & Wastewater
Gorden	Andrea	
Grace	Tom	Denver Chapter, Colorado Bass Federation, President
Graham	Gary	Audubon Colorado, Executive Director
Gray	John	Castle Pines Metropolitan District, District Engineer
Green	Allen	Natural Resource Conservation Service
Green	Judy	
Green	Jason	
Greene	Kevin	South Suburban Park and Recreation District
Greene	Clyde	
Greene	Stephen	
Greinke	Pamylle	
Griffin	Faye	Jefferson County Board of County Commissioners
Griswold	Dave	
Gronli	Sherri	
Groom	Carolyn	
Gurnee	Grant	Ecosystem Services, LLC
Haarberg	Kim	ARS
Haider	Paul	
Hall	Phil	CH2MHill
Hamer	Toby	
Hamilton	Kyle	CH2MHill
Handley	Gabrielle	
Hanson	William	
Hantschel	Bob	
Hanvey	Kathleen	
Hardin	William	Ducks Unlimited Colorado, Denver West - South
Harmon	Doug	
Harris	Robert	Western Resource Advocates, Staff Attorney
Harris	Alan	
Hartenstine	Curtis	Colorado River Watch
Hartman	Kathy	Jefferson County Board of County Commissioners, Commissioner
Hartman	Dan	City of Golden
Hatami	Bahman	Colorado State Parks
Hatton	Tom	Applegate Group
Haverland	Mike	Model Airplane Club
Hegeman	Phil	Colorado Department of Public Health and Environment- Water Quality Control Commission
Helvenston	Edward	

Table 10-3. Distribution List for the Draft FR/EIS—Individuals

Last Name	First Name	Personal Affiliation, if noted
Hendrick	John	Centennial Water & Sanitation District
Heninger	Jennifer	
Herman	Gary	Central Colorado Water Conservancy District
Hernandez	Ramon	City of Fort Lupton, Director of Public Works
Hertzke	Greg	Central Colorado Water Conservancy District, External Affairs Manager
Hessheimer	Dawn	City of Brighton, Water Resources Specialist
Hickenlooper	John	City and County of Denver, Mayor
Hickman	Bobby	
Hidahl	Jack	City of Lone Tree, City Manager
Hilbert	Jack	Douglas County Board of Commissioners
Hilbig	Jean	Denver Foothills Tracking Assn
Hilles	Stephanie	Centennial Pony Club
Hindman	Paul	Urban Drainage & Flood Control District, Executive Director
Hoagland	Jack	Dominion Water and Sanitation District
Hobbs	Mike	Trout Unlimited- Denver Chapter, President
Hobbs	Greg	Colorado Supreme Court
Hoby	Tom	Highlands Ranch Metro District
Hodge	Dick	City of Brighton (City Council Mayor Pro-tem)
Hodges	Dick	Park County Board of Commissioners
Hoenniger	Corbett	
Hoffman	Jane	Chatfield HOA
Hohn	Roy	
Holst	Pete	
Holton	Dave	
Holtum	Ian	
Holwick	Scott	Lyons Gaddis Kahn & Hall, P.C.
Hooser	Tom	Jefco Aeromodelers Club, President
Horn	Ron	Water Rescue Dogs
Hough	Andy	Douglas County Department of Community Development
Hounsell	Michael	
Howlett	David	Capitol Representatives
Howlett	Ruth	Capitol Representatives
Hudson	Matt	
Huff	Jeff	Douglas County Republicans
Hughes Goetz	Melanie	Hughes & Stuart
Hullett	Royt S	
Hulsizer	Shawn	WARP Inc
Hundermark	Charles	
Hunholz	Eliza	Colorado Department of Natural Resources Division of Wildlife
Hunsaker	James	Grimshaw & Harring, PC
Hunter	Chris	
Hursch	Robert	
Ihrig	Mike	(H) Water Rescue Dogs
Inglefield-Cozard	Melanie	

Table 10-3. Distribution List for the Draft FR/EIS—Individuals

Last Name	First Name	Personal Affiliation, if noted
Irwin	Rich	
Iseman	Tom	The Nature Conservancy
Iskiyan	Thomas	
Italiano	Peter	Douglas County Division of Community Dvelopment and Planning
Iturreria	Julio	Arapahoe County, Long Range Planner
Jackman	Helen	
Jacob	Jaime	
Jacoby	Jack	
Jaeger	Frank	Parker Water and Sanitation District
Jahnke	Jeff	Colorado State Forest Service, Director
Jambor	Bruno	
Jehn	Jim	Jehn Water Consultants, Inc.
Jehn-Dellaport	Theresa	Jehn Water Consultants, Inc.
Jepsen	John	
Jerke	Bill	Interbasin Compact Committee
Johnson	Leigh	
Johnson	Kurt	Telluride Energy LLC
Jones	Elise	Colorado Environmental Coalition, Denver Office
Jones	Tina	
Jones	P. Andrew	Lawrence Jones Custer Grasmick LLP
Jones	Williams	RET. COE/FWS
Justice-Waddington	Jan	
Kaemmerer	Lynn	Pembroke Welsh Corgi Club of the Rockies
Kafka	Frank	Chatfield Balloonport Assn.
Kafka	Frank	Retired; President of Chatfield Balloonport Association Board; owned CO Balloon Rides
Kahler	Keith	Colorado Department of Natural Resources Division of Parks and Outdoor Recreation, Interim Park Manager
Kaiser	Richard & Liz	
Kallenberger	Larry	Colorado Counties Incorporated, Executive Director
Kassen	Melinda	Trout Unlimited
Kaunisto	Dave	East Cherry Creek Valley Water & Sanitation District
Kaussner	Karen	COMSA
Kayton	Mike	Hot Air Balloon Sporting
Kazemian	Reza	City and County of Denver, Wastewater Operations Director
Kehmeier	Ken	Colorado Department of Natural Resources Division of Wildlife, Aquatic Biologist
Keith	Tom	EDAW
Kelley	Del	Friends of Roxborough
Kelley	Evelyn	
Kellner	Joey	Nature Study
Kemper	Doug	Colorado Water Congress
Kendall	Carol	
Kennedy	Mike	Mike's Colorado Fishing.com

Table 10-3. Distribution List for the Draft FR/EIS—Individuals

Last Name	First Name	Personal Affiliation, if noted
Kennedy	Don	Denver Water
Kern	Jenny	
Kernohan	Greg	Ducks Unlimited
King	Alan	City and County of Broomfield
Kinnear	Kevin	Porzak Browning & Bushong LLP
Klassen	Jon	Centennial Water and Sanitation District
Kline	Kari	
Kline	Robert	Local Sailing Club; also dog exercise park & trail hiking
Klumpp	Cassie	
Knofczynski	Joel D.	U.S. Army Corps of Engineers
Kochran	Brad	
Koger	Will	Nolte Associates
Kohlenberg	Bryan	Urban Drainage & Flood Control District
Konefal	Mike	City of Fort Lupton, City Administrator
Kopatich	Amy	
Kramer	Lynn	Central Colorado Water Conservancy District, Contracts Manager
Kramer	Ed	
Kramlien	Bruce	South Metro Land Conservancy
Krassa	Bob	Krassa & Miller, LLC
Kreeger	Mary	
Krieger	AJ	City of Sheridan
Krogh	Charlie	Pinery Water & Wastewater District
Kueter	David	Harvey Curtis & Associates (Perry Park)
Kuharich	Rod	South Metro Water Supply Authority
Kulberg	Tom	
Kunze	Frank	Jefferson County Open Space
Kwong	Jeffery	
La Force	Jeffery	
LaBelle	Jason	Colorado Archeological Society (Denver Chapter) President
Labossiere	Steve	
Lacey	Brian	
Ladd	Larry	
Lagomarcino	John	Lagomarcino Group
Lammers	Wes	
Lance	Sharon	Trout Unlimited- Cutthroat Chapter of Colorado, Interim President
Lance	Sharon	Trout Unlimited- Cutthroat Chapter of Colorado
Landeck	Jim	City of Brighton, Director of Public Works
Langel	Jean	
Langley	Mike	
Larrat	Dennis	Chatfield Community Association
Larson	Allan	Ducks Unlimited Colorado
Larson	Alan	Ducks Unlimited Colorado
LaRue	Jamie	Douglas County Libraries

Table 10-3. Distribution List for the Draft FR/EIS—Individuals

Last Name	First Name	Personal Affiliation, if noted
Latona	Skot	South Suburban Park and Recreation District
Laurson	Edward	
Laux	Eric A.	U.S. Army Corps of Engineers, Project Manager
Lawrence	Kristen	
Laws	Sandra	
Lay	John	Southeast Business Partnership
Leak	Alan	WRC Engineering
Lear	Brett	Lakewood Library
Lebow	Deborah	Environmental Protection Agency
Lee	Patricia	
Lehnen	Douglas	Town of Castle Rock; Castle Rock Town Council
Lewis	Jim	Denver Angler
Lewis	Don	Aurora Marine; Board of Directors for the Colorado Marine Dealers Assoc
Lewis	David	
Lewis	Don	Aurora Marine; Board of Directors for the Colorado Marine Dealers Assoc
Lewis	Jim	Denver Angler
Linner	Susan	U.S. Fish and Wildlife Service
Linton	Donna	Colorado Marine Dealers Association
Little	David	Denver Water
Livedalen	Kristi	Jackson Kelly
Lochhead	John	John Lochhead LLC
Long	Jodi	Douglas County Water Resource Authority
Long	Becky	Colorado Environmental Coalition, Denver Office, Water Caucus Coordinator
Lorenz	David	South Suburban Park and Recreation District
Ludlow	Patricia	Lockheed Martin Astronautics
Lukez	Rudy	
Lunde	Bruce	JR LLC
Lurie-Janicki	Ellain	
Lutkus	Matt	Rocky Mountain Sea Kayak Club, President
Lydden	Alexander	Gobe Divers
Lydden	Peter	Gobe Divers
Macy	Sydney	The Conservation Fund
Madsen	Shane	Jackson Kelly
Magle	Michael	
Magouirk	Jeff	Masters swimmer who coordinates with SP rangers
Major	Les	City of Golden, Utilities Superintendent
Malouff	Bob	Chatfield Sail & Yacht Club
Mamet	Sam	Colorado Municipal League, Executive Director
Manes	Mike	Edge of Space Sciences (Ballooning)
Manker	William	Town of Platteville
Mannino	Carroll	Columbine Library
Mansfield	MK	

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Last Name	First Name	Personal Affiliation, if noted
Marcy	Keith	
Mariani	Karen	
Marino	Susan	Friends of Waterton Canyon Gateway
Marrs	Connie	
Marsicek	Rick	Aurora Water
Martin	Stephanie	
Martinache	Dave	Colorado Scuba
Martinez	Matt	Colorado Department of Natural Resources Division of Wildlife
Matthews	Cheryl	Douglas County Division of Open Space and Natural Resources
Maurer	Kristen	
Mawhinney	Chuck	Rocky Mountain Windsurfing Assoc
May	Diane	
McAuliffe	Dan	Colorado Department of Natural Resources Colorado Water Conservation Board
McBride	Terri	
McBurney	Meredith	Rocky Mountain Bird Observatory
McCaig	Vega	Colorado Water Conservation Board, Section Chief- Office of Water Conservation and Drought Planning
McCarthy	Sarah	Neighborhood Resource Center
McCasky	Kevin	Jefferson County Board of County Commissioners
McCormic	Jack	Plum Valley Heights
McCurdy	Jenny	
McEwen	Roisin	Chatfield Community Association Address
McGinnis	Betty	
McGrady	Jim	Castle Pines North Metropolitan District, General Manager
McHarge	Jean	
McKinley	Marv	Chatfield Balloon Port Association
McLaughlin	Terry	
McLoud	Rick	Centennial Water & Sanitation District
McMahon	Sue	
McMinimee	Daniel	Douglas County School District, Director of Schools
McNeill	Grady	Colorado Department of Natural Resources Division of Wildlife
McNulty	Frank	Southeast Business Partnership
McVicker	Lisa	Center of Colorado Water Conservancy District
McWilliams	Vaughn	Colorado Department of Natural Resources Colorado Water Conservation Board
Measner	Linda	Town of Milliken
Medina	Abraham	
Meigs	Gerald	Water Consultant
Menefee	Michael	Colorado Natural Heritage Program, Environmental Review Coordinator
Mercer	Michele	
Mesec	Patricia	
Meyer	John	Cutthroat Chapter of Colorado Trout Unlimited- Member
Meyer	John	Trout Unlimited- Cutthroat Chapter of Colorado

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Last Name	First Name	Personal Affiliation, if noted
Micik	John	U.S. Army Corps of Engineers
Middleton	Scott	
Miller	Craig	Parker Water and Sanitation District
Miller	Bart	Western Resource Advocates
Miller	Brian	Underwater Phantaseas South
Miller	Bill	Miller Ecological / Littleton
Miller	Brian	Underwater Phantaseas South
Mills	Michael	
Modesitt	Larry	
Monson	Wayne	Franktown Business Area Metro District
Montarelli	Frank	
Moore	Larry	Roxborough Water and Sanitation District
Moore	Don	Douglas County Planning/Com. Dev.
Moreland	Brooke	Chatfield Sail & Yacht Club
Moser	Robert	Columbine Tax & Accounting, LLC.
Mosher	Todd	
Mosher	Sally	
Mueller	Michael	South Platte Group of the Sierra Club
Mueller	Amy	City and County of Denver
Mui	Cecily	South Suburban Parks aand Recreation, South Platte Park, Resource Specialist
Mulhern	Patrick	Inverness Water and Sanitation; Cottonwood Water & Sanitation District, Stonegate Village Metro District
Murrell	Timothy R.	Douglas County Department of Community Development
Myers	Mike	Trout Unlimited- Cutthroat Chapter of Colorado, Newsletter Editor
Myers	Lynn	Southeast Business Partnership
Myers	Stephanie	Tetra Tech, EC
Nahwoosky	Fred	Comanche Tribe
Narkari	Ken	Roxborough State Park
Natale	Paul	City of Commerce City, Mayor
Nebel	Bob	
Nelson	Pat	CH2MHill
Nelson	Sarah	
Nemechek	Sharon	
Neubecker	Ken	Colorado Trout Unlimited, President
Neville	Tim	
New	Veronica	
Newman	Kate	Jefferson County
Newton	Mike	
Nichol	Alice	Adams County Board of County Commissioners
Nickum	David	Colorado Trout Unlimited
Noe	Pamela	
Noonan	Pat	Arapahoe County Board of County Commissioners, Commissioner

Table 10-3. Distribution List for the Draft FR/EIS—Individuals

Last Name	First Name	Personal Affiliation, if noted
Norbeck	Carl	Executive Director, Audubon Society of Greater Denver
Norbeck	Carl	Denver Audubon Society
Nordlund	James	
Nosal	Dan	Natural Resource Conservation Service
Novak	Kathleen	City of Northglenn, Mayor
Nunnery	David	
Nuttle	Joni	Colorado Lake and Reservoir Management Association, Director
Nyre	Eric	Canoe Colorado
Ohlinger	Deb	Olsson Associates
Olson	Jan	Resident
O'Neill	Suzanne	Colorado Wildlife Federation, Executive Director
Onofrio	Joe	Chatfield Sailing & Yacht Club
Orens	Adam	Associate, BBC Research & Consulting
Orlovski	Jimmie & Linda	Chatfield HOA
Ormiston	Steve	Shea Homes
Ostendorf	Jody	Environmental Protection Agency
Ostrowski	Jack	Castle Pines Village/Plum Creek Wastewater Authority
Otto	Roy	City of Greeley, City Manager
Owens	Roger	
Pace	Larry	Adams County Board of County Commissioners, Commissioner
Pacetti	Chris	Ken-Caryl Ranch Master Association
Pague	Chris	The Nature Conservancy
Palmer	Andrea	
palochko	John	
Parachini	Dick	Colorado Department of Public Health and Environment Water Quality Control Division
Parker	Kathy	Central Colorado Water Conservancy District, External Affairs Specialist
Pawlowski	Jan	City of Brighton, Mayor
Peak	David	Roxborough Village Metro District
Peake	Elizabeth B.	U.S. Army Corps of Engineers
Pearson	Jim	Central Colorado Water Conservancy District
Pedersen	Jana	
Pedrow	Gordon	City of Longmont, City Manager
Pentermann	Meira	
Perez	Isabella	
Perkins	Ed	Colorado Department of Natural Resources Division of Wildlife
Perry	Linda and Roger	Chatfield Marine
Pesch	Brian	York Management
Peternell	Drew	Trout Unlimited
Peters	Bob	Denver Water, Water Resource Engineer
Peterson	Trudy	Town of Kersey
Peterson	Michael	Jefco Aeromodelers Club, Newsletter Editor
Peterson	Brandon	

Table 10-3. Distribution List for the Draft FR/EIS—Individuals

Last Name	First Name	Personal Affiliation, if noted
Peterson	Pat and Russ	Camping
Petrocco	Dave	Central Colorado Water Conservancy District
Pfleeger	Jennifer	
Pharo	Tom	
Phelan	Vincent	(S) Open Water Dive Certification Training
Pickett	Jacqueline	Jefferson County, Community Development Director
Pieplow	Nathan	Colorado County Birding
Pifher	Mark	Aurora Water, Director
Pike	Dan	Colorado Open Lands
Pilon	Deborrah	Willows Water & Sanitation District
Piza	Holly	Urban Drainage and Flood Control District
Plage	Peter	U.S. Fish and Wildlife Service
Platt	Amy	EPA
Pollard	Kristi	Southeast Business Partnership
Porzak	Glenn	Porzak Browning & Bushong LLP
Poticha	Myrna	Colorado Clean Water Action
Preisser	Rod	
Price	Marge	Capitol Representatives
Price	Kathryn	
Priddy	Jim	South Suburban Parks and Recreation District
Provo	Stacey	
Puga	Tony	Natural Resource Conservation Service
Pye	Randy	City of Centennial, Mayor
Quinn	Terrance	Douglas County Department of Community Development
Quinney	Patrick	CVL Consultants
R	Thomas	
Radabaugh	Cristyn	Martin and Wood Water Consultants, Inc., Project Engineer
Radcliffe	Veronica	
Rademacher	Dale	City of Longmont
Ragsdale	Linda	Shea Homes
Ramsey	Bill	South Suburban Park and Recreation District
Randall	Jason	Trout Unlimited
Raskin	Jerry	
Rasmussen	Jim	Cuttroat Chapter, Trout Unlimited
Ratliff	Pat	Ratliff & Assoc, Lobbyist
Rautus	Toni	Denver Field Ornithologists
Ray	John	
Rayl	Sandy L.	U.S. Army Corps of Engineers
Ream	Bruce	Model Airplane Club
Redd	Ron	Town of Castle Rock, Utilities Director
Redin	Gail	U.S. Coast Guard Auxiliary
Reed	Micheal	Town of Julesburg
Reetz	Pauline	Audubon Society of Greater Denver
Reetz	Gene	

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Last Name	First Name	Personal Affiliation, if noted
Rehberger	Lena	
Rein	Kevin	Colorado Department of Natural Resources Division of Water Resources
Remington	Tom	Colorado Department of Natural Resources Division of Wildlife, Director
Repella	Jill	Douglas County Board of Commissioners
Rettig	Mel	Mesa County Farm Bureau
Reuben	Michael	
Reyna	Geri	
Rhodes	Evelyn	
Rice	Josh	Brown and Caldwell
Rice	Scott	
Ridgeway	Alan	
Riefenberg	Jennifer	Wildlife expert & wildlife observer
Riegle	Geoff	
Rightmyre	Vicki	Growing Entrepreneurs, LLC, Community Planner
Rigsby	Margaret	
Roan	Carolyn	
Robertson	Brad	Douglas County Public Works
Robinson	J. Grayson	Arapahoe County Sheriff
Robotham	Doug	Colorado Department of Natural Resources
Rockne	Doug	
Rodriguez	Janet	CH2MHill
Rodriguez	Alfredo	Aurora Water
Rodriguez	Glenn	
Rodriquez	Christian	
Rogers	Allen	Ken Caryl Ranch Metropolitan District
Rogers	Michael	
Rose	Kathy	
Rose	Janet	
Roush	Scott	Colorado State Parks
Routen	Larry	State Land Board
Rozinski	Bob	PROF WILDLIFE PHOTOGRAPHY
Rueschhoff	SuzAnn	
Rugg	Tana	
Rumbold	Ed	
Runco	Guy	Teklanika Nature Photography
Runge	Wayne	Cool Toys Marine, Inc., Owner
Russell	Kirk	Colorado Department of Natural Resources Colorado Water Conservation Board
Rutherford	Sharon	
Ruzzo	Bill	Denver Botanic Gardens at Chatfield
Ryon	Tom	OtterTail Environmental
Sables-Baus	Sharon	City of Denver
Sachs	Nancy	Platte Valley Pony Club

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Last Name	First Name	Personal Affiliation, if noted
Sackbauer	Rick	Vail Resorts
Salak	Jennifer	USACE
Sanchez	Deborah	
Sanderson	Jim	City of Greenwood Village, City Manager
Sanderson	Jackie	Douglas County Division of Open Space and Natural Resources
Sandoval	Sarah	ECI Site Construction
Sandquist	Ronda	Jackson Kelly PLLC
Saunders	Jim	Colorado Department of Public Health and Environment Water Quality Control Division
Schaeffer	Barry	Town of La Salle
Schaufele	Jennifer	Denver Regional Council of Goverments, Executive Director
Schell	Ralph	Jefferson County Open Space, Director of Open Space
Schermerhorn	Marci	
Scherschel	Marc	
Schierling	Shannon	
Schmick	Dan	Castle Pines North Metropolitan District
Schmit	Dave	Arapahoe County
Schmoker	Bill	Colorado Field Ornithologist
Schoen	Mary	
Schroege	Diana	Centennial Water & Sanitation
Schulte	Greg	
Schultz	Rick	Town of Castle Rock
Schwarz	Sara	
Scott	Doug	Shea Properties
Scott	Thomas	Water Resources Management, LLC
Seaholm	Randy	Colorado Department of Natural Resources Colorado Water Conservation Board, Section Chief
Searns	Bob	Urban Edges, Inc.
Segura	Keith	
Seltzer	Nicole	Colorado Foundation for Water Education
Serlet	Mike	Colorado Department of Natural Resources Colorado Water Conservation Board
Severs	Scott	
Shattil	Wendy	PROF WILDLIFE PHOTOGRAPHY
Sheffield	Bobbie	South Metro Land Conservancy
Sherman	Harris	Colorado Department of Natural Resources
Shissler	Barbara	
Shively	Mark	Castle Pines North Metropolitan District, Board Member
Shoemaker	Jeff	The Greenway Foundation
Shore	Lynn	Ducks Unlimited Colorado, State Chairman
Shultz	Debbie	
Siel	Judy	Bicycle Trail
Simmons	RJ	Colorado Rotor-Heads, President
Simmons	Bill	City of Northglenn

Table 10-3. Distribution List for the Draft FR/EIS—Individuals

Last Name	First Name	Personal Affiliation, if noted
Simpson	Erin	Aurora Water
Simpson	Ross	Chatfield Sailing & Yacht Club
Sisks	Jonathan	
Skinner	Jay	Colorado Department of Natural Resources Division of Wildlife
Skoglund	Lou	Bicycle Trail; also pleasure motor boating
Slingsby	Paul	
Smethills	Harold	Sterling Ranch (Dominion W&SD)
Smith	Terry	Rocky Mountain Balloon Festival
Smith	Mike	City of Fort Collins, Utility Services
Smith	Margery	Bemis Public Library, Director
Smith	Earl	Town of Evans
Smith	Dave	
Smith	Cindy	
Smith	David	
Smith	Tyson	
Smith	Terry	Rocky Mountain Balloon Festival
Smith	Mark	U.S. Geological Survey
Smith	Susan	National Wildlife Federation, former Exec Dir of Audubon
Smith	Jim	etired, former Chatfield SP Operations Manager; works part-time as maintenance technician wirth Arapahoe Co. open space program
Sneider	Stacie	WARP Inc
Snyder	Leslie	
Somers	Michelle	
Sorter	Jason	Trout Unlimited
Sortman	Vince	Biohabitats
Spector	David	Kaplan Kirsch
Spellman	Andy	Rocky Mountain Windsurfing Assoc
Sperger	Ray	Chatfield Basin Conservation Network
Squillace	Mark	University of Colorado Natural Resources Law Center
Stabrava	Tracy	Chatfield Community Association
Stabrava	Jerry	
Stack	Sheela	Harvey Curtis & Associates (Perry Park)
Stafford	John	
Stanley	Susan	
Stansbury	Charles	Trout Unlimited- Denver Chapter
Steele	Michael	
Steinke	Bree	
Stephenson	Ken	Denver Sailing Association, Webmaster
Stephenson	Mark	Rocky Mountain Diving Center
Stocker	Nancy	
Stone	Ernie	Ken Caryl Ranch Master Association
Strother	Britta	South Metro Water Supply Authority
Sturgill	Cristi	
Sturm	Gene	U.S. Army Corps of Engineers

Table 10-3. Distribution List for the Draft FR/EIS—Individuals

Last Name	First Name	Personal Affiliation, if noted
Suchomel	Diane	
Sudol	Laurie	
Sullivan	Don	DU Dept. of Geography
Summitt	Micheal	
Suthiwan	Khemarat	
Swanson	Rebecca	Office of Gov. Bill Ritter, Senior Policy Analyst
Sweetman King	Linda	Mount Carbon Metropolitan District
Swenson	Cari	
Szymanski	Susan	
Tadolini	Ken	Balloon Port Flyers, Rocky Mountain Hot Air LLC & member of Chatfield Balloonport Association
Taylor	Scott	Open Water Dive Certification Training
Teronde	Don	South Platte Group of the Sierra Club
Thiel	Freda	
Thomas	Jay	
Thompson	Gary	W.W. Wheeler & Associates
Thompson	Bruce	Castle Pines North Metropolitan District
Thormahlen	Lee	Cherokee Ranch Wildlife Committee
Thorpe	Kristi	ICF International
Tighe	John	Park County Board of Commissioners
Timmerwilke	Martin D.	U.S. Army Corps of Engineers
Tindale	Robert	alternative options of colo
Toll	Bob	Arapahoe County, Open Space Program
Tomany	Andi	
Tomkins	Rob	
Topolnicki	Austin	
Tripplet	Larry	Parker/Aurora Chapter, Colorado Bass Federation, President
Truckenmiller	Dale	
Trudell	Janine	
Truskowski	Brent	Environmental Protection Agency
Tryggeseth	Jackie	
Tuohy	Mark	
Turner	Richard	Jefferson County Planning and Zoning Department
Typher	Rick	Denver Angler
Ulrich	Don	CH2MHill
Uppendahl	Mark	Colorado Department of Natural Resources Division of Wildlife
Vail	Michael	
Van Gorder	Sean	Lockheed Martin Space Systems – Denver
VanVurst	Beth	Colorado State Parks
Vargas-Madrid	Vicki	Colorado Department of Natural Resources Division of Wildlife
Vasko	Drew	Denver Divers
VerCauteren	Tammy	Rocky Mountain Bird Observatory Headquarters, Director of Outreach Division
Veterling	Don	City of Boulder
Vickerman	Larry	Denver Botanic Gardens at Chatfield, Director

Table 10-3. Distribution List for the Draft FR/EIS—Individuals

Last Name	First Name	Personal Affiliation, if noted
Vidal	Bill	City and County of Denver
Vidmar	Rich	Aurora Water, Water Resources Engineer
Waage	Marc	Denver Water, Water Resource Engineer
Wade	Ben	Colorado Water Conservation Board
Wade	Shannon	
Wahl	Kelly	
Walker	James	
Wang	Todd	CH2MHill
WARNER	JACK	FISH CHATFIELD WEEKLY
Warner	Jack	
Warren	Sean	Ken Caryl Ranch Master Association
Waskom	Reagan	Colorado State University
Waterman	Ray	South Metro Water Supply Authority
Watt	RB	
Weathers	Roger	Kiewit Western Co
Weaver	Steve	Weaver's Dive & Travel Center President, Colorado Scuba Retailers Association
Webb	Pete	WebbPR
Weber	Dan	Colorado State Parks
Weber	Nicole	
Weddig	Frank	Arapahoe County Board of County Commissioners
Weglinski	Gene	Tetra Tech, Inc.
Weingarden	Michele	City and County of Denver, Director of Greenprint Denver
Weissmann, Ph.D.	Michael	Kallima Consultants, Inc.
Wells	Patricia	Denver Water, Director of Planning
Wenner	Chauncey	
West	Cindy	Pine Ridge Pony Club
Westbrook	Casey	Colorado Department of Natural Resources Division of Wildlife
Wettersten	Erik	Ducks Unlimited Colorado
Weyhmiller	Janet	
Whaley	Debbie	
Whit	Tim	Stockton's Plum Creek Stables
White	Dan	
Whittermore	Jennifer	
Wibbens	Russell	
Widstrom	Brad	
Wiesburg	Harold	Evans
Wiley	Kent	Audubon Society of Greater Denver, Board Member
Wiley	Kent	Audubon & former Chatfield State Park Manager
Wilkinson	Nathan	Wilkinson Water Consulting Inc.
Williams	Jeff	Littleton Chapter, Colorado Bass Federation, President
Williams	Don	City of Loveland
Williams	Liz	
Willis	Noel	Denver Water, Electronic Communications Specialist
Wilson	Wes	Environmental Protection Agency

Table 10-3. Distribution List for the Draft FR/EIS—Individuals

Last Name	First Name	Personal Affiliation, if noted
Wilson	Donna	Cherokee Ranch and Castle Foundation
Wilson	Ryan	Underwater Phantaseas
Wilson	E H	
Windes	Darrell	Ken Caryl Ranch Metropolitan District
Winkle	Paul	Colorado Department of Natural Resources Division of Wildlife, Aquatic Biologist
Winstanley	Dean	Colorado Department of Natural Resources Division of Parks and Outdoor Recreation
Wiseman	David	
Witter	Steve	ACCWA, Water Resources Manager
Wogsland	Justine	
Wolforth	John	Jefferson County, Planning Director
Woodcock	H. Wm. (Bill)	South Suburban Park and Recreation District, Manager of Planning and Development
Woodis	Amy	Metro Wastewater Reclamation District
Woodland	Mike	
Woods	Jim	City of Littleton, City Manager
Woodward	John	Denver Water
Wooldridge	Jamie	
Worley	Melanie	Douglas County Board of Commissioners, Commissioner
Wyatt	Cathy	
YAKLICH	Larry	
Yasuhara	Susan	(H) Open Water Swimmers
Young	Cameron	Center for Snake Conservation
Yslas-Brandt	Maria	Colorado Department of Natural Resources Division of Parks and Outdoor Recreation- State Parks Board of Directors, Staff Contact
Yu	Hope	Tri-County Health
Zaring	Ken	HydroSource Water Brokers
Zelinsky	Nathan	Fishing Guide
Zgol	Mike	
Zgol	Sue	Water Trial Judge for Portuguese Water Dogs
Zimmer	Bernie	Water Research Management LLC
Zimmerman	Virginia	
Zimmerman	Bill	Model Airplane Club
Zuckerman	Bart	Personalized Scuba
Zullo	Dennis	

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11. LIST OF ACRONYMS AND ABBREVIATIONS

A-1	Agriculture One Zone District
A-2	Agriculture Two Zone District
ACWWA	Arapahoe County Water and Wastewater Authority
ADA	Americans with Disabilities Act
AF	Acre-feet
APE	Area of Potential Effect
ATSF	Atchison, Topeka & Santa Fe Railroad
BCC	Birds of Conservation Concern
BLM	Bureau of Land Management
BMP	Best Management Practices
BOR	United States Bureau of Reclamation
C-470	Colorado State Highway C-470
CAQCC	Colorado Air Quality Control Commission
CBOD	Carbonaceous Biochemical Oxygen Demand ultimate
CCI	Construction Cost Index
CCR	Control Commission Regulations
CDLE	Colorado Department of Labor and Employment
CDNR	Colorado Department of Natural Resources
CDOT	Colorado Department of Transportation
CDOW	Colorado Division of Wildlife
CDPHE	Colorado Department of Public Health and Environment
CEQ	Council on Environmental Quality
CFR	Code of Federal Regulations
cfs	Cubic Feet Per Second
CHS	Colorado Historical Society
CHU	Critical habitat unit
CMP	Compensatory Mitigation Plan
CNDIS	Colorado Natural Diversity Information Source
CNHP	Colorado Natural Heritage Program
COMPASS	Colorado Office of Archaeology and Historic Preservation Site Files System
Corps	United States Army Corps of Engineers (USACE)
CPIF	Colorado Partners in Flight
C.R.S.	Colorado Revised Statues
CSFS	Colorado State Forest Service
CWA	Clean Water Act
CWCB	Colorado Water Conservation Board
CWCCIS	U.S. Army Corps of Engineers Civil Works Construction Cost Index System
CWQCC	Colorado Water Quality Control Commission
CWSD	Centennial Water and Sanitation District
dBA	Decibel Level
DCWRA	Douglas County Water Resources Authority

Denver Water	Denver Water Department
DO	Dissolved Oxygen
DRCOG	Denver Regional Council of Governments
DSAC	Dam Safety Action Classification
DYMW	Dependable Yield Mitigation Water
E. Coli	Escherichia coli
EA	Environmental Assessment
EAD	Expected Annual Damage
EDAW	EDAW, Inc.
EFA	Ecological Functions Approach
EFI	Ecological Functioning Index
EFU	Ecological Function Unit
EFV	Ecological Functional Value
EIS	Environmental Impact Statement
EOP	Environmental Operating Principle
EPA	Environmental Protection Agency
EPT	Ephemeroptera, Plecoptera, and Trichoptera
EQ	Environmental Quality
EQRs	Equivalent Residential Units
ER	Engineer Regulation
ERGO	Environmental Review Guide for Operations
ESA	Endangered Species Act
EUTROMOD	Eutrophication Model
FACWet	Functional Assessment of Colorado Wetlands Methodology
FR	Feasibility Report
FRICO	Farmers Reservoir and Irrigation Company
FRM	Flood Risk Management
FY11	Fiscal Year 2011
GAP	Gap Analysis Project
GIS	Geographical Information System
gpm	Gallons per minute
ha	Hectare
HASP	Headwater Authority of the South Platte
HCP	Habitat Conservation Plan
HD	House Document
HEA	Habitat equivalency analysis
HEP	Habitat evaluation procedures
HQUSACE	Headquarters of the U.S. Army Corps of Engineers
HRT	Hydraulic residence time
HSI	Habitat suitability indices
IBA	Important Bird Area
IDC	Interest during construction
IDF	Inflow Design Flood

IPM	Integrated Pest Management
IRRM	Interim Risk Reduction Measures
ITP	Incidental Take Permit
JEC	Jefferson Economic Council
JWPP	Joint Water Purification Plant
LER	Lands, easements and rights of way
LERRD	Land, Easements, Rights-Of-Way, Relocation, and Disposal Areas
LUDP	Land Use Development Policy
LWCF	Land and Water Conservation Fund Act
M&I	Municipal and industrial
m^2	meter squared
m^3	meter cubed
μg/L	micrograms per liter
mg/L	milligrams per liter
MGD	Million gallons per day
MINITAB	Statistical analysis software package
mL	milliliters
msl	Above Mean Sea Level
MVRTP	Metro Vision Regional Transportation Plan
MWSI	Metropolitan Water Supply Investigation
NAAQS	National Ambient Air Quality Standards
NADP	National Atmospheric Deposition network
NAWQA	National Water Quality Assessment Program
NCDC	National Climatic Data Center
NDIS	Natural Diversity Information Source
NED	National Economic Development
NEPA	National Environmental Policy Act
NGPC	Nebraska Game and Parks Commission
NHD	National Hydrography Dataset
NH_3-N	Ammonia Nitrogen
NHPA	National Historic Preservation Act of 1966
NISP	Northern Integrated Supply Project
NOAA	National Oceanic and Atmospheric Administration
NOI	Notice of Intent
NPS	National Park Service
NRCS	Natural Resources Conservation Service
NRHP	National Register of Historic Places
NTGW	Non-tributary groundwater
NWD	Northwest Division (of U.S. Army Corps of Engineers)
NWI	National Wetland Inventory
O&M	Operation and Maintenance
OHWM	Ordinary High Water Mark

OMRR&R	Operation, Maintenance, Repair, Rehabilitation, and Replacement
OSE	Other Social Effects
P&G	Principles and Guidelines
PCB	Polychlorinated biphenyl
PE	Pool Elevation
PFMA	Potential Failure Mode Analysis
PGN	Planning Guidance Notebook
PM10	Particulate matter less than 10 microns in diameter
PM2.5	Particulate matter less than 2.5 microns in diameter
PMF	Probable Maximum Flood
PMP	Probable Maximum Precipitation
PO_4	Orthophosphorus
POR	Period of Record
PPA	Project Partnership Agreement
Preble's	Preble's meadow jumping mouse
PRRIP	Platte River Recovery Implementation Plan
PWWD	Pinery Water and Wastewater District
Q_{500}	500-year streamflows
RDF	Reservoir Design Flood
RED	Regional Economic Development
RMBO	Rocky Mountain Bird Observatory
SC	Species of special concern
SCORP	Statewide Comprehensive Outdoor Recreation Plan
SedFlux	sediment flux model
SFE	Single family equivalent
SFU	State Fish Unit
SHPO	State Historic Preservation Office
SLS	State listed threatened or endangered species
SMWSA	South Metro Water Supply Authority
SMWSS	South Metro Water Supply Study
SOD	Sediment oxygen demand
SP13	Upper South Platte critical habitat unit
SWSI	Statewide Water Supply Initiative
T&E species	Federally listed threatened and endangered species
TES	All Federal and State threatened, endangered and special status species
TIN	Triangulated Irregular Network
TMAL	Total Maximum Annual Load
TMDL	Total Maximum Daily Load
TOC	Total organic carbon
TP	Total phosphorus concentration (mg/L)
TSI	Carlson's Trophic State Index
UDV	Unit Day Value

Unit 9	West Plum Creek critical habitat unit
USACE	United States Army Corps of Engineers
USC	United States Code
USDOT	United States Department of Transportation
USFS	United States Forest Service
USFWS	United States Fish and Wildlife Service
USGS	United States Geological Survey
WCD	Water Conservancy District
WISE	Water Infrastructure and Supply Efficiency
WRDA	Water Resources Development Act
WRIS	Water Resources Implementation Study
WROS	Water Resources Optimization Study
WSD	Water and Sanitation District
YOY	Young of the Year

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12. INDEX

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