

## Summary

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Differences exist between documents.

### New Document:

[FinalEIS](#)

126 pages (11.24 MB)

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Used to display results.

### Old Document:

[Appendices](#)

62 pages (8.95 MB)

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## How to read this report

**Highlight** indicates a change.

**Deleted** indicates deleted content.

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**Appendix D**  
**Ecosystem Restoration Evaluation Report**

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**Draft for Discussion Purposes Only**

**Revised** Draft Ecosystem Restoration Evaluation Report  
Chatfield Reservoir Reallocation Study

**February 4, 2008**

**Prepared by:**  
Great Western Institute  
Miller Ecological Consultants, Inc.  
Denver Water

**Section 1 - Introduction**

Study Objectives  
Study Sponsors

**Section 2 - Approach and Methodology**

Overview  
Methodology  
    Hydrology  
    Quantitative Biology

**Section 3 - Results**

Hydrology  
Biology

**Section 4 - Key Observations**

**Attachments**

A - Habitat Suitability Data for Species of Interest  
B - Cross Section Flow and Wetted Perimeter Analysis  
C - Habitat Flow Relationships  
D - Summary of Wet and Average Year Habitat Area Change for Fish Species of Interest

## **Section 1 Introduction**

The South Platte River corridor provides important natural resources and associated aesthetic and recreational opportunities to millions of people living along its banks in the Colorado Front Range. The river serves to transport water from the mountains down to the thirsty municipal and agricultural water users lining the foothills, stretching out into the state's eastern plains. Along the way, the river's natural ecosystem contains a great diversity of flora and fauna that rely upon the river for food and habitat. The river also provides for numerous, important recreational opportunities, which help to support the local economy.

On its route from the mountains to the eastern plains, the South Platte River passes through the Denver metropolitan area. The river is challenged to maintain its ecological and environmental functions as the urban setting increasingly encroaches on its banks and impacts the water's flow and quality. Upstream reservoirs, channelization, wastewater discharges, and diversions all influence the aquatic habitat quality and riparian corridor. In addition, river flows are at times not sustainable such that in some locations the river is dry and/or discontinuous during various times of the year, especially during the winter months.

A once-in-a-generation opportunity to improve flows below the Chatfield Reservoir is within reach – which involves the retiming of South Platte River runoff by reallocating storage in Chatfield Reservoir. In 1986, the federal government authorized the US Army Corps of Engineers (USACE) to evaluate the:

“...feasibility and economic justification to reassign a portion of of the storage space in the Chatfield Lake project to joint flood control-conservation purposes, including storage for municipal and industrial water supply, agricultural, and recreation and fishery habitat protection and enhancement.”  
(excerpt from Section 808, Water Resources Development Act (WRDA) 1986)

Therefore, through appropriate planning and implementation, water may be placed in the South Platte River at times when it is most needed to help enhance and protect fishery (and other water dependent species) habitat, in conjunction with and without compromising other programmed water uses (e.g., municipal and industrial water supply, etc.).

### **Study Objectives**

The study described and discussed in this white paper was developed to evaluate the opportunities to protect and enhance fishery habitat below Chatfield Reservoir through the management of future water releases from the reallocated storage conservation pool, which for purposes of this white paper was assumed to be 20,600

acre-feet extending for 12 feet above the current Denver Water 27,428 acre-foot pool. Note that improving the fishery habitat is also expected to improve the general river ecosystem and recreational opportunities within and adjacent to the river.

Note that this study is based on analyses conducted in the third and fourth quarter 2006, as well as supplemental analyses conducted in the past three months, from November 2007 to January 2008. The combined set of hydrologic and biologic analyses provided herein are considered to be limited to a set of preliminary options associated with the management of future reservoir releases from the reallocated storage managed for water supply, recreation and fishery habitat protection and enhancement. Additional analyses may be needed to expand the understanding of the benefits of managed releases on the downstream fishery and aquatic habitat – either during the development of the USACE Feasibility Report (as a means to establish a credit for the capital cost of storage), preliminary design of the environmental and recreational mitigation efforts (as a means to reduce mitigation costs and/or receive dispensation from the USACE for ER benefits), or future reservoir operations. ↴

### **Study Sponsors**

The work presented in this white paper was performed as a result of funding provided by the downstream and selected upstream water users associated with the Chatfield Reallocation project including: City of Aurora, the City of Brighton, Castle Pines Metro District, Castle Pines North Metro District, Central Colorado Water Conservancy District, and Western Mutual Ditch Company; as well as the instream users: City and County of Denver, Denver Water (DW), the Greenway Foundation, the City of Littleton, and the Metropolitan Wastewater Reclamation District (Metro).

## Section 2 Approach and Methodologies

### Overview

Technical analyses were performed to characterize the benefit of having retimed flow in the South Platte below Chatfield Reservoir associated with the reallocation of flood storage in Chatfield. Specifically, the analyses involve coupling hydrologic and hydraulic calculations with characteristic habitat suitability information to estimate changes to habitat quantity for selected fish – both juvenile and adult – based on various future river flow regimes for conditions with and without the Chatfield storage reallocation.

The study area was established based on the location of available river cross-sectional information, river gages, and the diversions of downstream water users. Figure 1 presents the overall study area.

The specific flow regimes that were evaluated during this study include two sets of “baseline hydrologic conditions” – including the current configuration of the hydrologic setting (aka 2005 conditions) and the hydrologic setting representing expected build-out of the Chatfield Reservoir system (aka 2050). These two baseline conditions were developed assuming that reallocation of Chatfield storage does not occur now or into the future.

Using these two baseline conditions, two scenarios were developed to simulate future releases from Chatfield assuming that reallocation will occur – the first, based on water user defined releases from both upstream and downstream water users; and the second, based on water user defined releases for the upstream water users only. For this second scenario, it was assumed that the downstream water users would release water only at times when flows at locations downstream of Chatfield fell below 10 cubic feet per second (cfs). The second scenario allowed for reservoir releases whenever downstream flows were less than 10 cfs at any time, as long as water remained in the reallocated storage pool, thus representing a more ecosystem restoration (ER) friendly future water release scenario than the pure water user defined releases used for the first scenario. This second release scenario was compared to the first release scenario to gain insight into how alternative water release schemes could improve the downstream fishery habitat without substantially compromising downstream water supply needs. This study assumes that the downstream water users have complete flexibility in releasing water they have stored in the reallocated Chatfield storage pool.

Physical Habitat Simulation System (PHABSIM) analyses were performed to combine channel hydraulics with habitat use information provided by various sources and approved for use in this study by the Colorado Department of Wildlife.

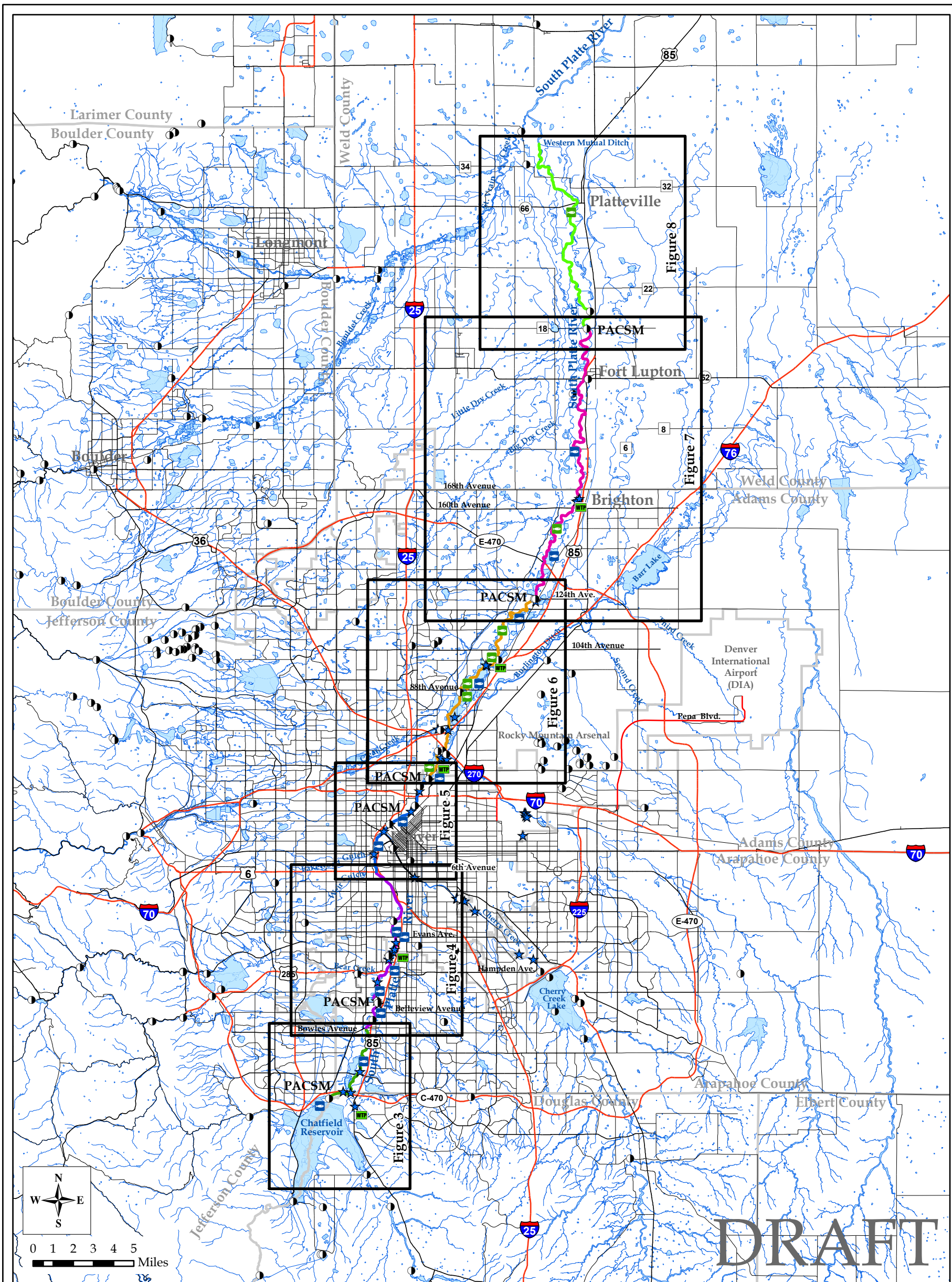


Figure 1 - Ecosystem Restoration Study Area

Chatfield Reservoir  
 Reallocation Environmental/  
 Ecosystem Coalition Project



October 26, 2007

**Legend**

- USGS Gage
- ★ Water Quality Sampling Location
- WTP Wastewater Treatment Plant
- 2005 South Platte CURE Study
- 1993 Metro Study HSI (5 Station Locations)
- Lakes
- Rivers
- Counties
- Interstate/Freeway
- Major Road
- Local Road
- Chatfield to Bowles Avenue
- Bowles Avenue to 6th Avenue
- 6th Avenue to Burlington Ditch
- Burlington Ditch to Henderson Gage
- Henderson Gage to Fort Lupton Gage
- Fort Lupton Gage to Western Mutual Ditch



(DOW) to predict habitat quantity for a range of flows. Using the above alternative flow scenarios, the habitat discharge relationships were combined with flow to produce a quantification of habitat over time.

Specific assumptions and methodologies used for each of the modeling efforts used to analyze the different water release scenarios are discussed in the sections below.

## **Methodology**

**Hydrology** - DW provided information on baseline hydrology in the South Platte River, as well as information on the frequency and duration of future releases from Chatfield Reservoir to the South Platte based on criteria developed by the Technical Working Group in 2006. Specifically, DW used output data from its proprietary PACSM model in a spreadsheet model (described in more detail below) to estimate daily flows at six locations in the river downstream of Chatfield:

- Chatfield Outflow
- Englewood Gage at Union Boulevard
- Denver Gage at 19<sup>th</sup> Street
- Below Burlington Canal above 58<sup>th</sup> Street
- Henderson Gage at 120<sup>th</sup> Street
- Fort Lupton Gage

PACSM is a complex river system model developed and used to determine DW's water supply in the South Platte and Colorado River systems. The model incorporates the water systems and water rights of DW and others at over 450 nodes.

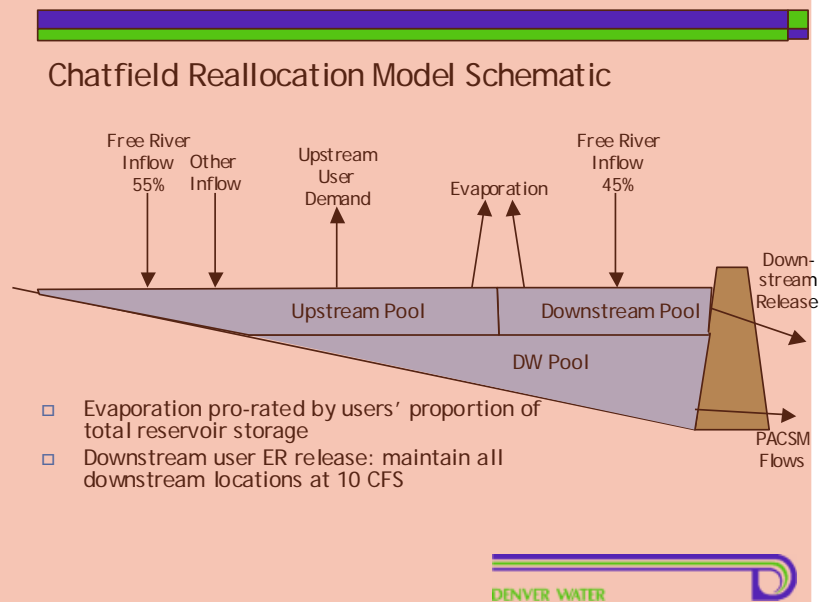
PACSM has been reviewed and accepted for use as a **water allocation** model by numerous experts. It has been reviewed by the USACE for its use in the Moffat EIS. It has also been reviewed by FERC for two re-licensing efforts. Numerous local water providers and consultants have also reviewed it in conjunction with various east and west slope water studies.

Under the two development conditions used for this study - 2005 and 2050 - daily hydrology for the period from 1947 through 1991 was input to PACSM to simulate expected flows at the six stations indicated above (as shown on Figure 1 and Figures 3 through 8) for the situation where the pool elevation does not rise above an elevation of 5,432 feet, which is the top of DW's 27,428 acre-foot pool. Operating Chatfield in this manner was considered the "baseline" condition against which the impact of future releases from the reallocated storage on downstream fishery habitat was compared. ▲

To simulate downstream releases from the reallocated storage pool, which exists above DW’s pool extending from elevation 5,432 to 5,444 feet, PACSM output data was used in a spreadsheet model, which tracked free river inflows, other inflows, upstream water user demand, evaporation and either downstream water user demand or downstream water user releases to maintain 10 cfs in selected reaches. To this end, three simulated flows were developed at each of the six downstream stations for two different baseline conditions. These alternative flow scenarios are summarized in Table 1. A schematic of the spreadsheet conceptual model is provided in Figure 2.

**Figure 2**

DW’s current Chatfield pool operation was represented by storage data from the PACSM model. The reallocation pool was simulated on a daily time step above Denver Water’s pool. For reservoir inflows, the spreadsheet model used inflows available from a new (junior) water storage rights and inflows from other upstream sources to fill the reallocation pool.



**Table 1 - Summary of Hydrologic Simulations**

PACSM Run	Spreadsheet Run	Reservoir Outflow Conditions
Baseline - 2005 Conditions	None	Existing
	Reallocation without ER	Upstream and Downstream User Specified
	Reallocation with ER	Upstream User Specified, Downstream based on river need for 10 cfs
Baseline - 2050 Conditions	None	Existing
	Reallocation without ER	Upstream and Downstream User Specified
	Reallocation with ER	Upstream User Specified, Downstream based on river need for 10 cfs

The spreadsheet model also calculated the releases from the reallocation pool to the South Platte River based on the water available in the reallocation pool. To this point, the spreadsheet model calculated releases based on the alternative downstream flow conditions - either those specifications defined in the EIS by the downstream users or those defined by minimum flow requirements (i.e., the 10 cfs preliminary ER release). The resultant changes in outflows from the baseline conditions were added to, or subtracted from, downstream flows calculated by

PACSM at the six downstream gage locations. Upstream users' outflows were withdrawn directly from Chatfield or its outlet works and did not affect downstream flows, but were nonetheless tracked in the model.

Evaporation from the Chatfield reallocation pool was assumed to equal a pro-rated share of the calculated evaporation based on the water user's portion of the total reservoir storage. The spreadsheet model did not simulate individual water user pools or inflows or outflows, but rather lumped upstream users together and downstream users together. The spreadsheet model did not account for unused inflow, nor did it include carriage losses on water released to the river.

**Quantitative Biology** - The quantitative methodology, as approved by the Technical Working Group, was based upon the linkage of the hydrology with PHABSIM which characterizes changes in stream flow velocity, depth, wetted perimeter, as well as other physical habitat information, for purposes of estimating habitat area for each of the alternative flow scenarios for the South Platte from Chatfield downstream to below Fort Lupton.

PHABSIM was developed using the following data:

Cross-Sections and transects and other related hydraulic data

- The City of Littleton provided 6 cross sections located in South Platte Park to characterize the reach from Chatfield downstream to Englewood;
- The DW provided 11 cross-sections based on from past Two-Forks efforts for locations near Union Street, Evans and Franklin Street; and
- Metro provided 5 cross sections from Burlington Ditch downstream to Fort Lupton.

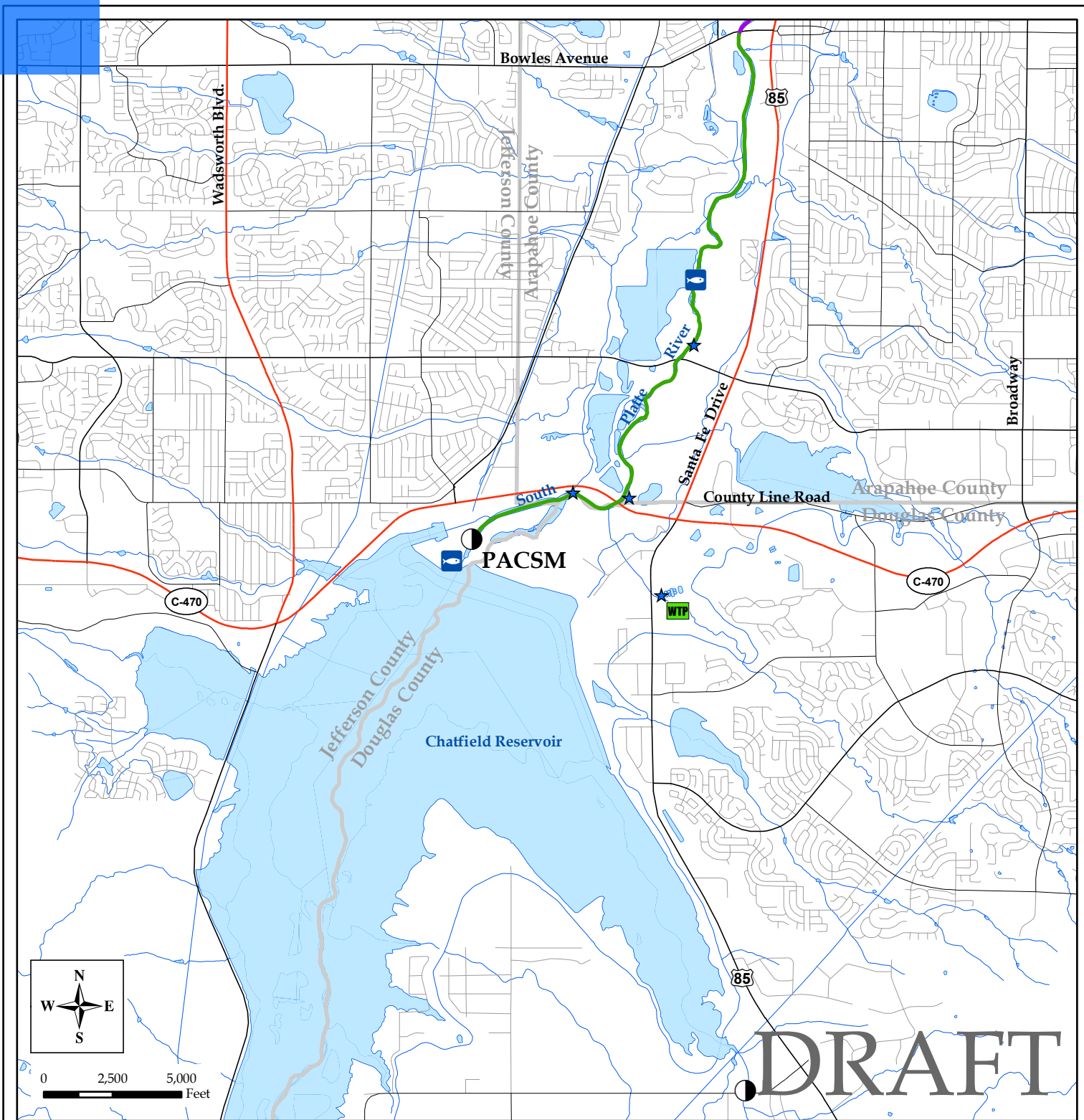
Figures 3 through 8 present the location of each of these reaches of interest and the associated cross sectional information relative to the hydrologic stations.

Location of pools, riffles and glides

The sections provided by Littleton, DW and Metro include characteristic riffles and run within each of the six reaches. Specific information regarding the size and location of the river bed features was developed based on past modeling efforts and recent and past field reconnaissance by Chadwick Ecological Consultants and Miller Ecological Consultants for South Platte CURE, Metro, and other studies in the river.

Habitat suitability data

Habitat suitability data, which was used to develop the flow versus habitat relationships, is contained in Attachment A. These data were based upon DOW approved and/or reviewed studies as follows: ▲



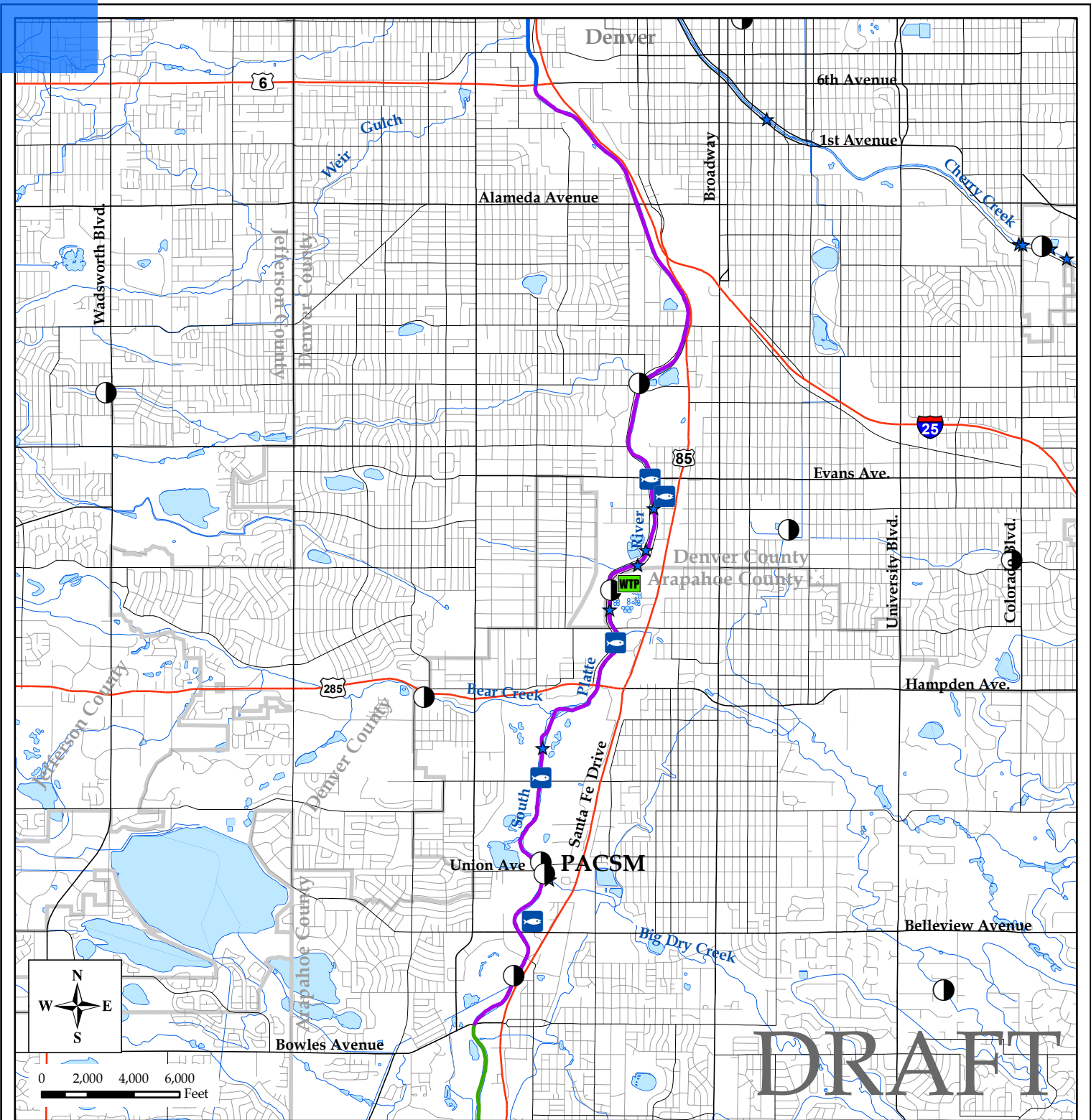
### Legend

- USGS Gage
- ★ Water Quality Sampling Location
- WTP
- 2005 South Platte CURE Study
- 1993 Metro Study HSI (5 Station Locations)
- Lakes
- Rivers
- Counties
- Interstate/Freeway
- Major Road
- Local Road
- Chatfield to Bowles Avenue
- Bowles Avenue to 6th Avenue
- 6th Avenue to Burlington Ditch
- Burlington Ditch to Henderson Gage
- Henderson Gage to Fort Lupton Gage
- Fort Lupton Gage to Western Mutual Ditch

Figure 3 - Chatfield Reservoir to Bowles Avenue Reach

Chatfield Reservoir  
 Reallocation Environmental/  
 Ecosystem Coalition Project





**Legend**

- USGS Gage
- ★ Water Quality Sampling Location
- WTP Wastewater Treatment Plant
- 2005 South Platte CURE Study
- 1993 Metro Study HSI (5 Station Locations)
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- Bowles Avenue to 6th Avenue
- 6th Avenue to Burlington Ditch
- Burlington Ditch to Henderson Gage
- Henderson Gage to Fort Lupton Gage
- Fort Lupton Gage to Western Mutual Ditch

Figure 4 - Bowles Avenue to 6th Avenue Reach

Chatfield Reservoir  
 Reallocation Environmental/  
 Ecosystem Coalition Project



THE GREENWAY FOUNDATION  
 Preserving Metro Denver's Urban Waterways Since 1974

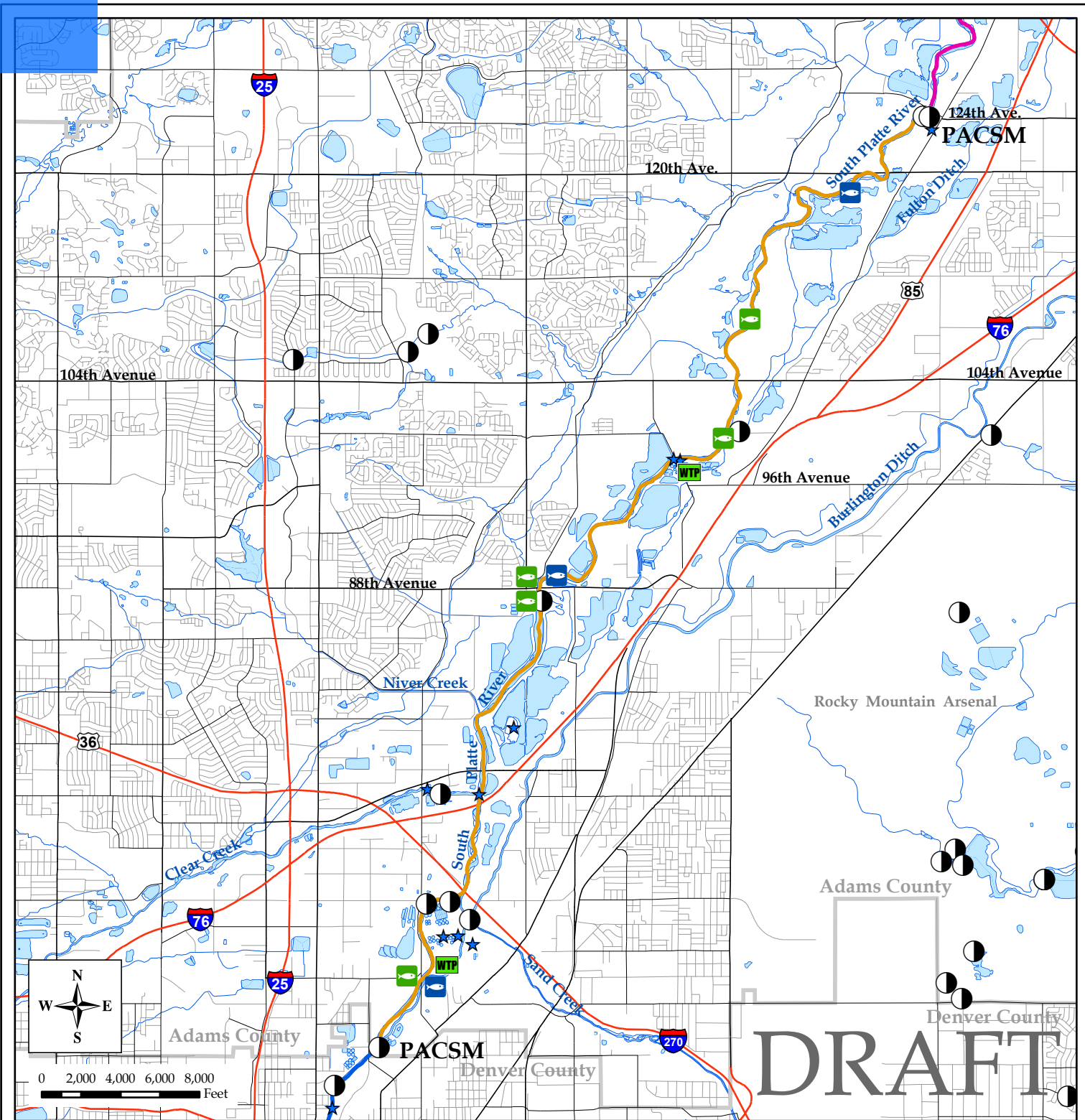


## Legend

- |  |  |
|--|--|
| ● USGS Gage                                | — Interstate/Freeway                       |
| ★ Water Quality Sampling Location          | — Major Road                               |
| WTP Wastewater Treatment Plant             | — Local Road                               |
| 2005 South Platte CURE Study               | — Chatfield to Bowles Avenue               |
| 1993 Metro Study HSI (5 Station Locations) | — Bowles Avenue to 6th Avenue              |
| Lakes                                      | — 6th Avenue to Burlington Ditch           |
| Rivers                                     | — Burlington Ditch to Henderson Gage       |
| Counties                                   | — Henderson Gage to Fort Lupton Gage       |
|  | — Fort Lupton Gage to Western Mutual Ditch |

Figure 5 - 6th Avenue to Burlington Ditch Reach

Chatfield Reservoir  
Reallocation Environmental/  
Ecosystem Coalition Project



**Legend**

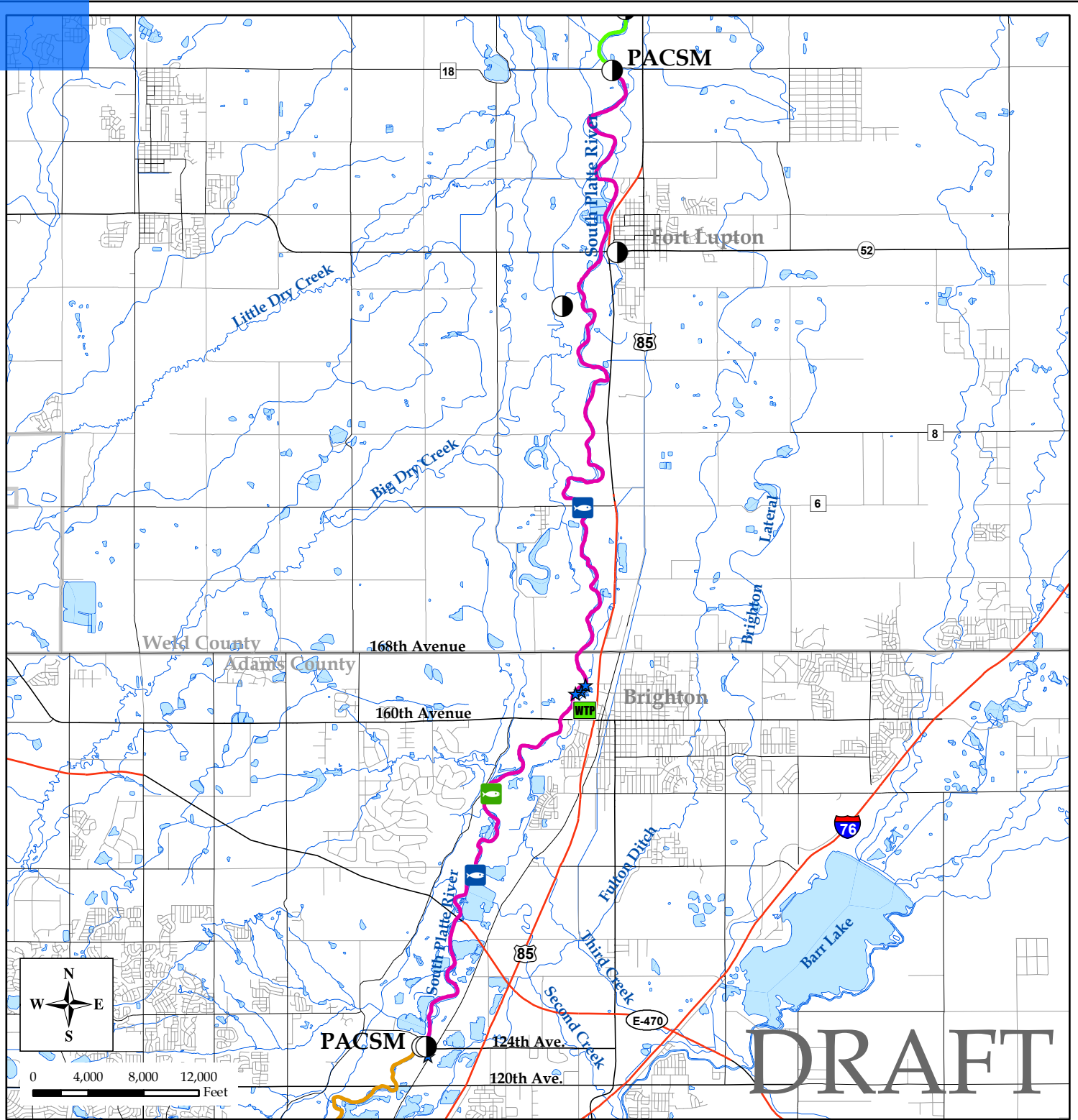
- USGS Gage
- ★ Water Quality Sampling Location
- WTP Wastewater Treatment Plant
- 2005 South Platte CURE Study
- 1993 Metro Study HSI (5 Station Locations)
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- Local Road
- Chatfield to Bowles Avenue
- Bowles Avenue to 6th Avenue
- 6th Avenue to Burlington Ditch
- Burlington Ditch to Henderson Gage
- Henderson Gage to Fort Lupton Gage
- Fort Lupton Gage to Western Mutual Ditch

Figure 6 - Burlington Ditch to Henderson Gage Reach

Chatfield Reservoir  
 Reallocation Environmental/  
 Ecosystem Coalition Project



THE GREENWAY FOUNDATION  
Preserving Metro Denver's Urban Waterways Since 1974



**Legend**

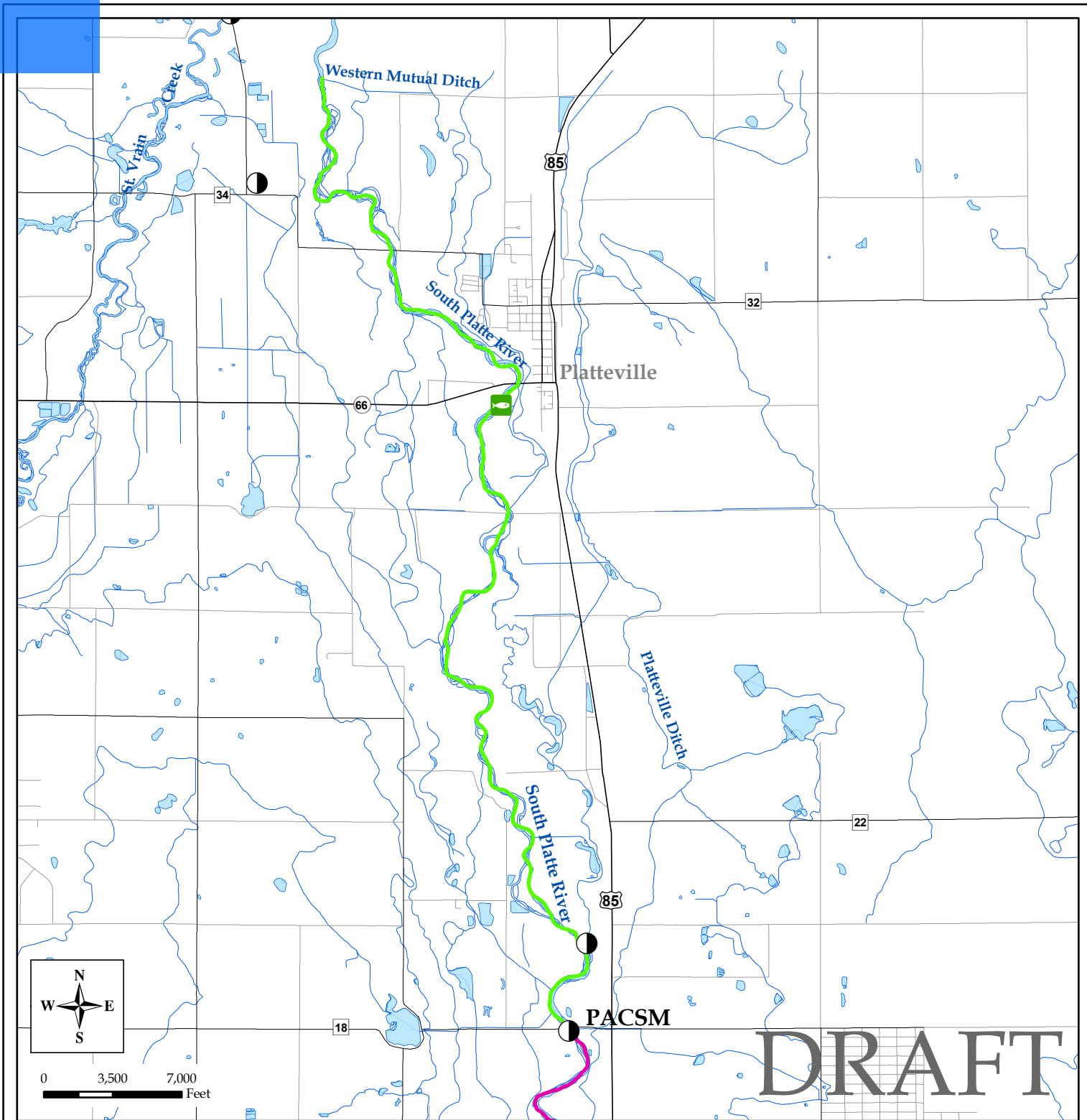
- USGS Gage
- ★ Water Quality Sampling Location
- WTP Wastewater Treatment Plant
- 2005 South Platte CURE Study
- 1993 Metro Study HSI (5 Station Locations)
- Lakes
- Rivers
- Counties
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- Major Road
- Local Road
- Chatfield to Bowles Avenue
- Bowles Avenue to 6th Avenue
- 6th Avenue to Burlington Ditch
- Burlington Ditch to Henderson Gage
- Henderson Gage to Fort Lupton Gage
- Fort Lupton Gage to Western Mutual Ditch

Figure 7 - Henderson Gage to Fort Lupton Gage Reach

Chatfield Reservoir  
 Reallocation Environmental/  
 Ecosystem Coalition Project







## Legend

- |  |  |
|--|--|
| ● USGS Gage                                | — Interstate/Freeway                       |
| ★ Water Quality Sampling Location          | — Major Road                               |
| WTP Wastewater Treatment Plant             | — Local Road                               |
| 2005 South Platte CURE Study               | — Chatfield to Bowles Avenue               |
| 1993 Metro Study HSI (5 Station Locations) | — Bowles Avenue to 6th Avenue              |
| Lakes                                      | — Burlington Ditch to Henderson Gage       |
| Rivers                                     | — Henderson Gage to Fort Lupton Gage       |
| Counties                                   | — Fort Lupton Gage to Western Mutual Ditch |

Figure 8 - Fort Lupton Gage to Western Mutual Ditch Reach

Chatfield Reservoir  
 Reallocation Environmental/  
 Ecosystem Coalition Project



THE GREENWAY FOUNDATION  
 Resolving Metro Denver's Urban Waterscape Strife 1/2/74

CIR TERRA LLC October 26, 2007  
 geographic data solutions

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- Brown and rainbow trout, juvenile and adult - CDOW South Platte River
- Channel catfish, adult - Peters et al. 1989 - Platte River
- Channel catfish, juvenile - Chadwick Platte River
- Common carp, adult - Chadwick Platte River
- Sand shiner, adult - Chadwick Platte River
- Longnose dace, adult - USFWS HSI criteria
- White sucker, adult and juvenile - USFWS HSI criteria

Some of these data may need some “tweaking” in the future depending on the use of the habitat assessment; however DOW is comfortable using this combination of literature for this application since they have been successfully applied to the South Platte in the past. Future adjustments may, nonetheless, be needed to account for the unique combination of warm and cool water environments in the South Platte River below Chatfield Reservoir.

PHABSIM and habitat time series analyses were used to develop habitat unit duration and exceedance curves for the alternative flow scenario impacts on fisheries in the South Platte River. Specifically, the biological modeling proceeded as follows:

- Depth, wetted perimeter, and velocity were estimated over the range of expected flows included within each alternative to characterize habitat within each cross section for each species and fish type (i.e., juvenile and adult);
- Habitat versus flow relationships were developed for each reach and fish type and species over the range of expected flows using the habitat suitability data;
- Simulated daily flows for each alternative hydrologic condition were developed using modeling data for the period from 1947 to 1991 and converted to habitat area in each reach based on the habitat versus flow relationships developed in the last step; and
- Habitat area was evaluated against return period (i.e., habitat vs. time) across the entire reach from Chatfield to Fort Lupton to characterize the benefits of the proposed storage reallocation, and to determine whether or not “ER Releases” would provide additional benefits to the fisheries above and beyond those that are expected to occur when and if the reallocation occurs.

A supplemental analysis was also performed using the hydrology developed by DW. Specifically, PHABSIM was used to characterize the habitat area benefits of retimed releases for wet and average flow years on the river under the various future release scenarios (i.e., Chatfield with and without the ER release for both current and built-out conditions). Note that no supplemental analyses were performed for dry flow year, since there will not be any retimed releases from

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Chatfield in dry conditions and therefore there are no incremental benefits during periods of time when no releases can occur.

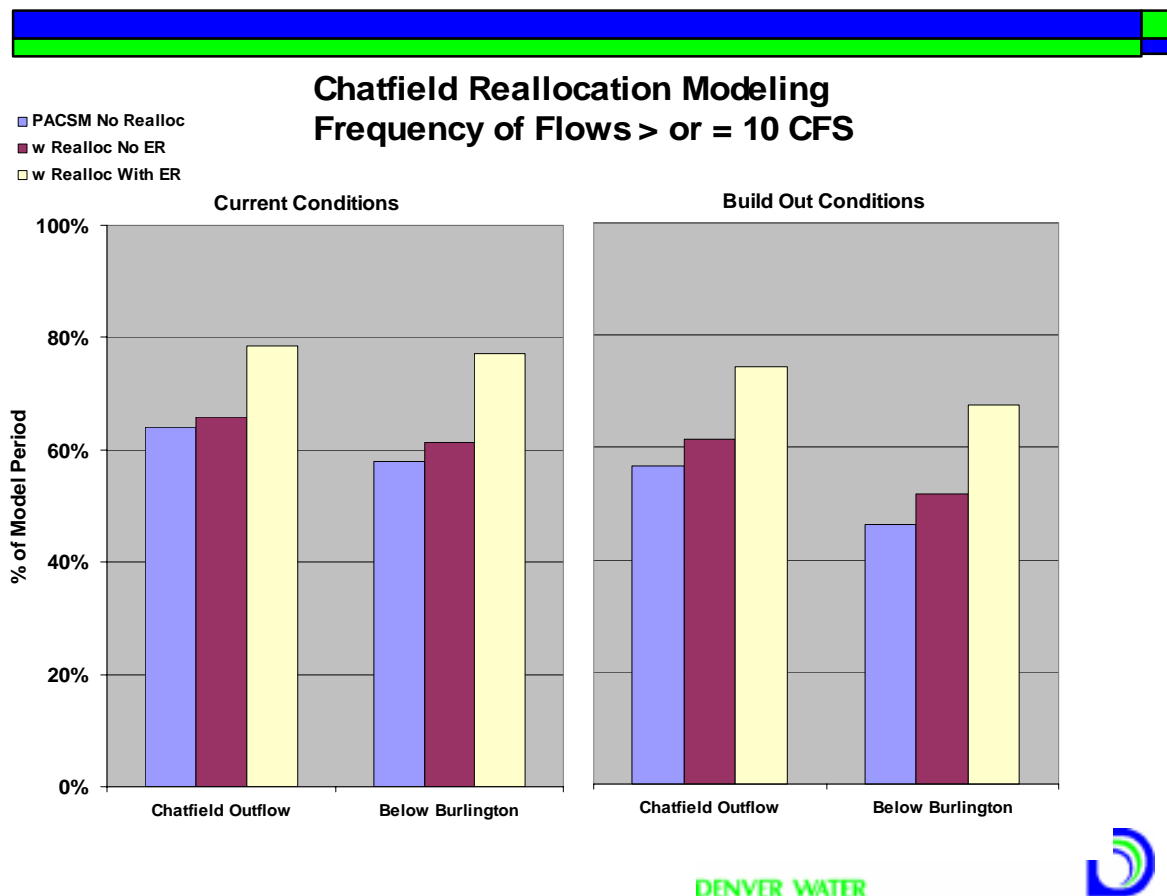
PHABSIM results may have to be amended in the future to allow for a broader analysis to demonstrate other benefits such as those related to migratory birds and water fowl; however, the bird and duck habitat suitability data are not as robust as the fish data, nor is there a process under the current federal authorization for these data to be used to evaluate future environmental conditions along the Platte.

Hydrology

The coupled PACSM and spreadsheet model was able to simulate the various different reservoir release scenarios for Chatfield both with and without the 20,600 acre-feet of reallocated flood storage for both current conditions (2005) and build-out conditions (2050). The results of the simulations indicate, not surprisingly, that capturing South Platte River runoff using the reallocated storage to retime peak flows for release to the downstream users during non-peak periods increases flows during those times when the river at selected places below Chatfield would otherwise be dry or at low flow.

Two locations where the river has historically been observed to have flows below 10 cfs nearly every year includes below the Chatfield Reservoir outfall and below the Burlington Ditch Headgate. Figure 9 presents a graphic representation of how the reallocation will help to decrease the number of days that flow in these two areas drops below 10 cfs.

Figure 9



Based on these results, it can be seen that flows beneath Chatfield are greater than 10 cfs about 60% of the time under current conditions without the reallocation, and will drop to about 55% of the under build-out conditions. With the proposed storage reallocation, the downstream water user specified releases (i.e., with no ER) have incremental benefits to the stream flow below Chatfield. Specifically, the reallocation with the downstream water users EIS specified releases increase by 3 to 12 percent the number of days that have flows below Chatfield and/or below Burlington Ditch at 10 cfs or greater, based on simulations using the 1947 to 1991 hydrology. The greatest incremental benefits related to the flow analyses appear to occur below Burlington Ditch and under build-out conditions; however incremental benefits are shown for both set of watershed conditions (i.e., current and build-out) and at both key locations (i.e., at the Chatfield Outflow and below the Burlington Ditch) with the EIS specified releases.

Another important finding was the ER release scenario, which involved releasing enough water from the reallocated Chatfield Reservoir storage to maintain 10 cfs in the South Platte below Chatfield at key locations (e.g., Chatfield gage and the Burlington gage) substantially decrease the frequency of low flows, especially in the late fall and early winter. The “Reallocation with ER” results provided in Figure 9 illustrate this point. Specifically, the reallocation with ER, which revises the downstream water user releases to address fall and wintertime low flows increases by 23 to 46 percent the number of days that have flows below Chatfield and/or below Burlington Ditch of 10 cfs or greater, based on simulations using the 1947 to 1991 hydrology.

The ER managed flow regime needs to be further characterized with respect to improved and enhanced fish habitat and stream biology, as needed to meet the needs of the instream and water user community; however it is clear that wintertime flow releases can dramatically improve the number of days that the river has greater than 10 cfs flowing in its banks.

## **Biology**

Habitat versus flow relations were developed after the range of flows were simulated within each of the cross sections as presented in Attachment B (note that the actual range of flows included in the cross sections was a broader range than shown in Attachment B). The habitat flow relationships were developed for each of the species of interest by physical reach as indicated in the Table 2.

The resulting habitat flow relationships for each of the physical reaches is presented in Attachment C.

Noteworthy is that for the trout and channel catfish, the flow regime that produces the most habitat is different for juveniles and adults. In general, adults can live in

deeper and faster moving water than the juveniles. Also, many of the fish species were found to have a habitat area that suffers if flows become too large. For non-trout species, a river flow of greater than 100 to 200 cfs was found to have a detrimental impact on habitat area. This was also true for the sand shiner, longnose dace, white sucker and common carp.

**Table 2 - Summary of Habitat to Flow Relationships**

Physical Reach	Reach Numbers	Species
Southern	1, 2	Rainbow trout (juvenile, adult), brown trout (juvenile, adult), channel catfish (juvenile, adult), sand shiner (adult), longnose dace (adult), white sucker (juvenile, adult), common carp (adult)
Middle	3, 4	channel catfish (juvenile, adult), sand shiner (adult), longnose dace (adult), white sucker (juvenile, adult), common carp (adult)
Northeastern	5, 6	channel catfish (juvenile, adult), sand shiner (adult), longnose dace (adult), white sucker (juvenile, adult), common carp (adult)

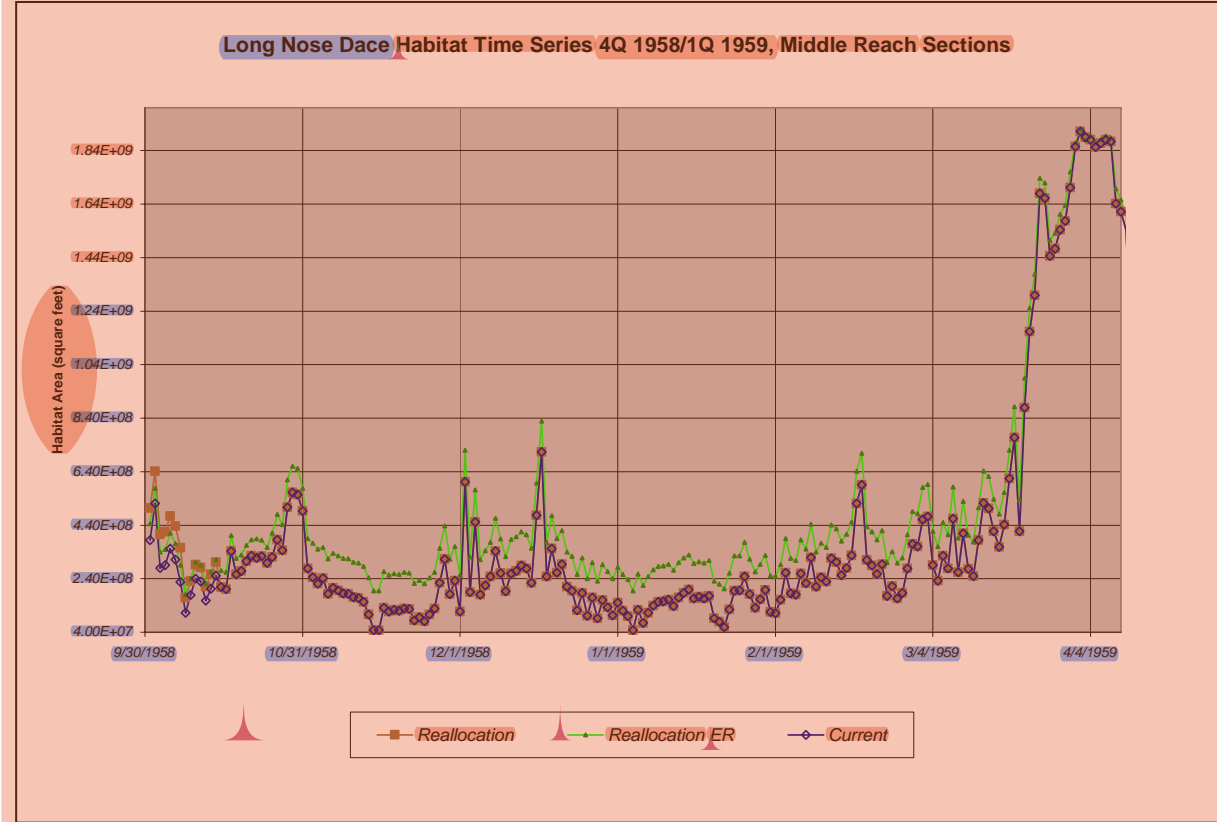
Another important observation was that for trout and channel catfish juveniles and the smaller adult fish (e.g., sand shiner, longnose dace, and white sucker), the biggest jump in habitat area occurs at the lowest flows, especially for flows below 20 to 40 cfs. This same observation held true for common carp, as well. **These observations indicate that protection of low flows with future Chatfield releases may provide substantial benefit to the aquatic fisheries.**

***Habitat Area for the Period of Record***

The habitat flow relationships were used to convert the predicted stream flows to habitat area over time. An example “hydrograph” of the converted stream flow to habitat area for one of the middle reach sections in 1950 (for the period from June to December) is presented in Figure 10 to illustrate the analysis methodology. This figure illustrates the relative magnitude and timing of the habitat benefits for long nose dace based on the increased flows that occur with each alternative flow scenario. For example, habitat area increases are observed in September and early October when reallocation occurs with the downstream water users EIS releases when compared to the current condition without reallocation. The estimated increases include as much as a doubling of habitat area for selected days, or more; and the benefits are seen to last for 5 to 6 weeks.

The increased habitat area created by the reallocation ER releases on the other hand, occur throughout September, October, November and December, since the release rate is lower under this flow scenario, and it is timed to benefit the fall and winter flow period.

**Figure 10**



Once the habitat area had been estimated over time for each species and sub-reach, total habitat area was calculated versus percent exceedances for each species over the entire study area to contrast and compare the incremental benefits of the potential future reallocated storage release scenarios on the fishery habitat. Table 3 presents the results of the total habitat area calculation for selected periods of exceedance for each of the species.

**Table 3 - Summary of Total Habitat Area Impact versus Percent Exceedance (in percent)**

	Channel Catfish				White Sucker				Carp		Sand Shiner		Longnose Dace		Brown Trout				Rainbow Trout			
	w/o ER		w/ ER		w/o ER		w/ ER		w/o ER	w/ ER	w/o ER	w/ ER	w/o ER	w/ ER	w/o ER		w/ ER		w/o ER		w/ ER	
%	J	A	J	A	J	A	J	A	A	A	A	A	A	A	J	A	J	A	J	A	J	A
80	.07	.03	3.6	11.	0.0	0.0	3.5	3.5	0.2	3.1	0.0	28.	0.8	6.0	0.0	0.0	126	163	0.0	0.0	153	117
70	0.5	4.4	0.2	13.	1.1	1.1	4.2	4.2	0.0	10.	2.0	25.	1.4	5.3	31.	40.	75.	97.	39.	29.	91.	70.
60	3.1	6.9	2.1	5.0	3.9	3.9	2.9	2.9	1.0	13.	2.2	7.6	3.3	2.9	28.	41.	22.	33.	26.	33.	21.	26.
50	0.9	1.1	.07	1.0	1.7	1.7	3.0	3.0	0.6	1.0	1.3	0.0	1.3	1.3	1.4	6.4	1.7	7.2	1.4	6.4	2.0	7.0

J - juvenile; A - adult

Figure 11 presents the total habitat area versus percent exceedance curves for four different fish to illustrate how the incremental impacts of retimed flow beneath Chatfield improve fish habitat.

Figure 11 and the contents of Table 3 illustrate that for all fish evaluated, which include all those fish that the DOW considers to be of state interest that are contained in the South Platte River, **habitat area can be improved with future reallocated storage releases** for some return period, typically during dry periods that occur from once in every two years (50%) to once in every five years (80%).

The greatest habitat improvement, based on percent increases in habitat area, was estimated to occur for the cold water species - brown and rainbow trout. For the return period of between once in every three years to once in every five years, habitat areas increased with future reallocated Chatfield storage releases by 21 to 153 percent for juveniles and 26 to 163 percent for adults, depending on species and return period. Adult trout habitat area appears to benefit most from retimed flows that occurred in the once out of every five years return period (i.e., 80 percent exceedance), whereas juvenile trout habitat area appears to benefit most from retimed flows in the once out of every three year return period. Juvenile habitat area does not appear to benefit from the retimed flows for the once in five year return period.

The biggest habitat area improvements for the cool and warm water species, based on percent increase in habitat area, typically occurred at the 60 or 70 percent exceedance for juveniles and the 80 percent exceedance for adults, in a manner consistent with the trout habitat; however the percent increase in habitat area for each of these species was estimated to be substantially less than that for trout, ranging from 0 to 28 percent. Nonetheless **there is a measurable increase in habitat area for all fish species due to the retimed releases from Chatfield.**

These preliminary findings also indicate that for most species of interest, the habitat area benefits related to the future reallocated storage releases can be improved by releasing low flows in the fall and winter months versus having releases during the summertime as currently indicated by the water user release scenarios contained in the EIS. There are some return periods for some species where the water user defined releases are as good if not better at enhancing fishery habitat below Chatfield than the "ER" releases (e.g., at 60% exceedance for white suckers), but these circumstances are the exception rather than the rule.

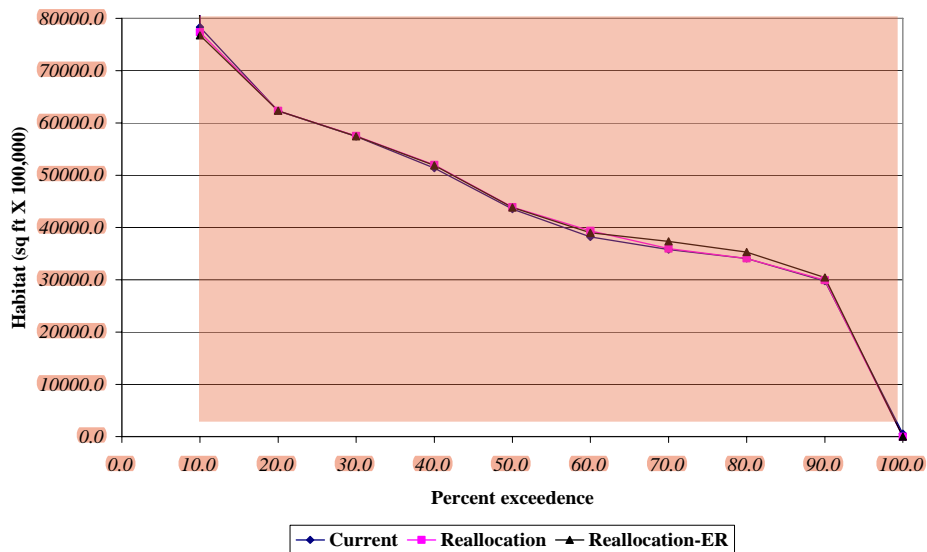
#### ***Wet and Average Conditions Analyses***

To more fully characterize the benefits of ER releases on the downstream fisheries habitat, habitat areas were calculated using composite hydrographs of average and wet river flow conditions developed using the following procedures:

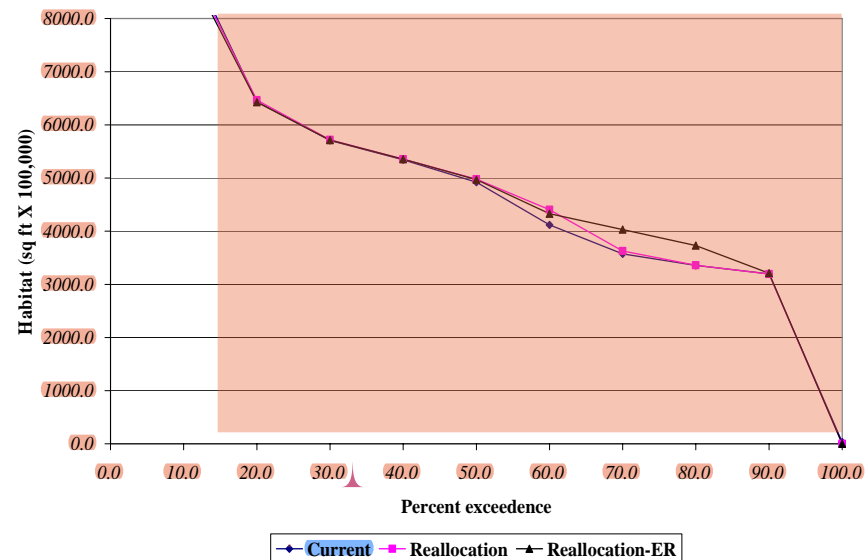


Figure 11

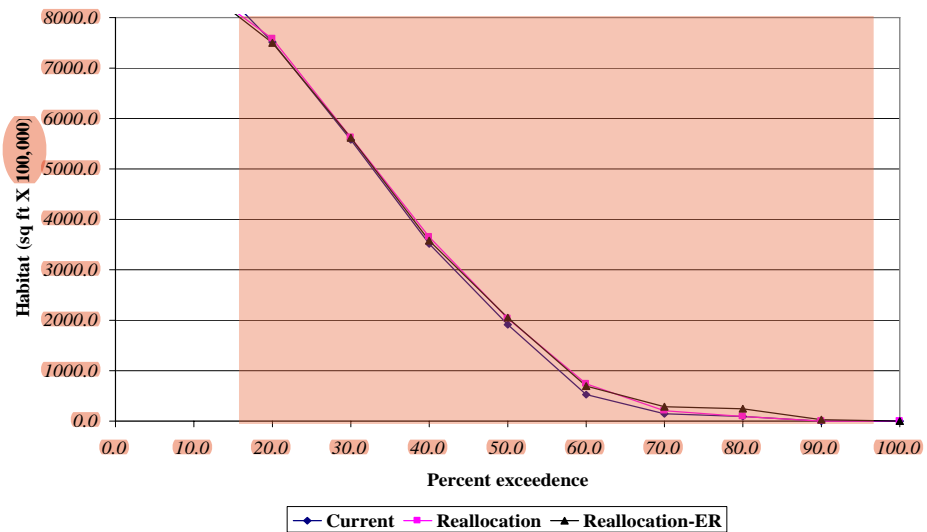
Total habitat exceedence, current conditions, channel catfish juvenile



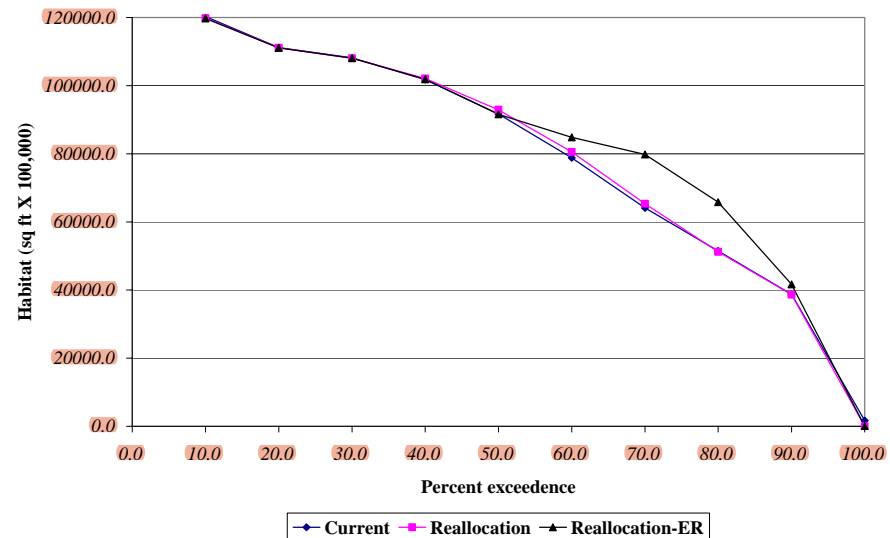
Total habitat exceedence, current conditions, channel catfish adult



Total habitat exceedence, current conditions, Brown trout adult



Total habitat exceedence, current conditions, sand shiner adult



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- An average daily flow was calculated for each river year (1947 to 1991) based on the hydrographs developed for current and build-out conditions under both the water user specified releases and the ER releases described in the subsection on hydrology.
- The average daily flow for each river year were ranked and segregated into the nine wettest years (representing the wettest 20% of years) and nine average years (representing the middle 20% of years) as shown in Figure 12.
- Composite wet year and average year hydrographs were developed at the Chatfield and Burlington gages for both current and build-out conditions for the water user specified releases and the ER releases by taking the average flow for each day using the nine years of data identified through the ranking process.

The composite wet year and average year hydrographs for the various flow conditions are presented in Figures 13a (current conditions) and 13b (build-out conditions).

**Figure 12**

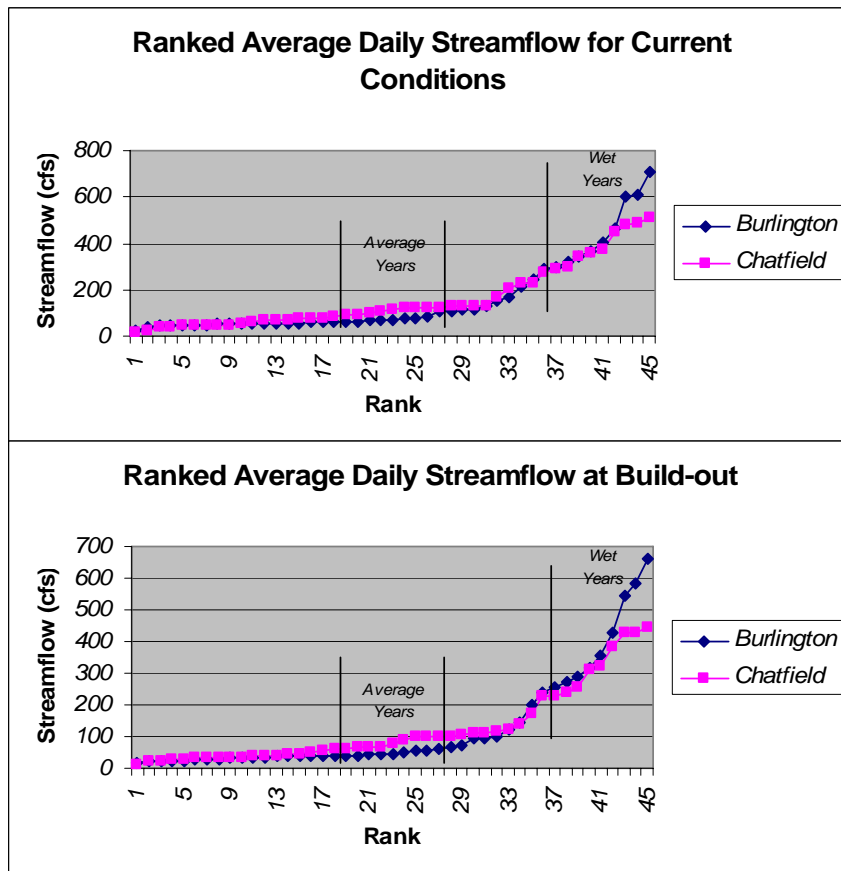
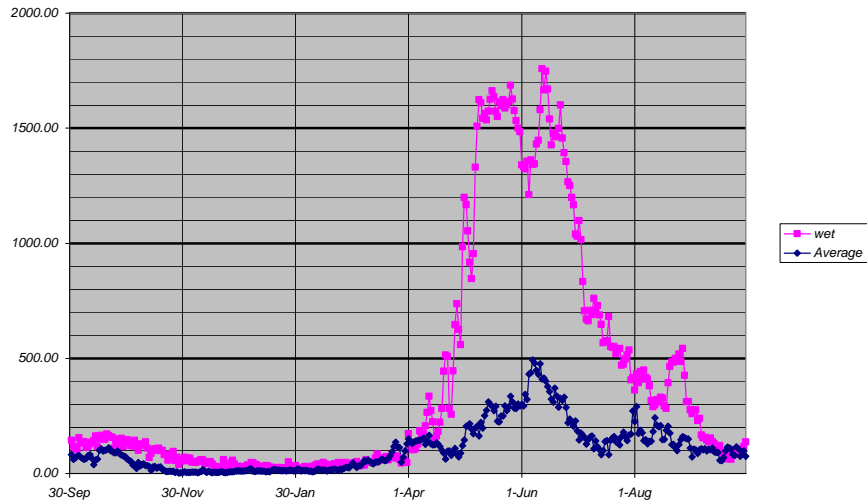
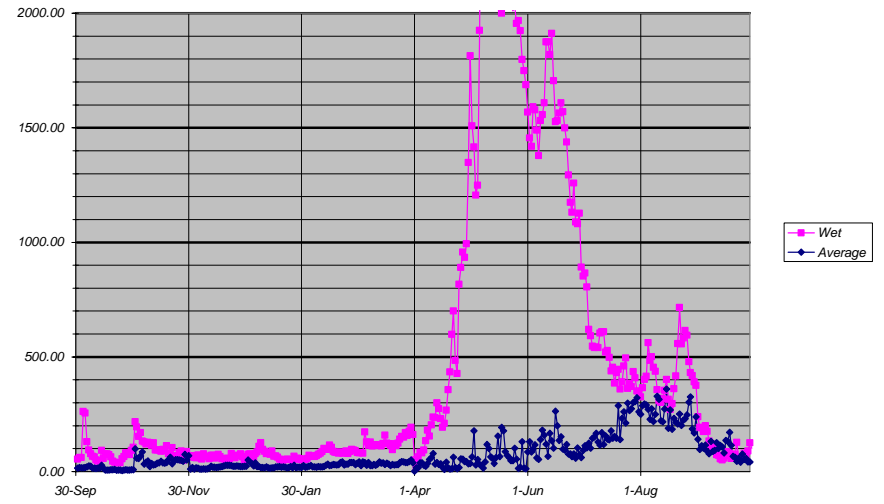


Figure 13a - Current Conditions

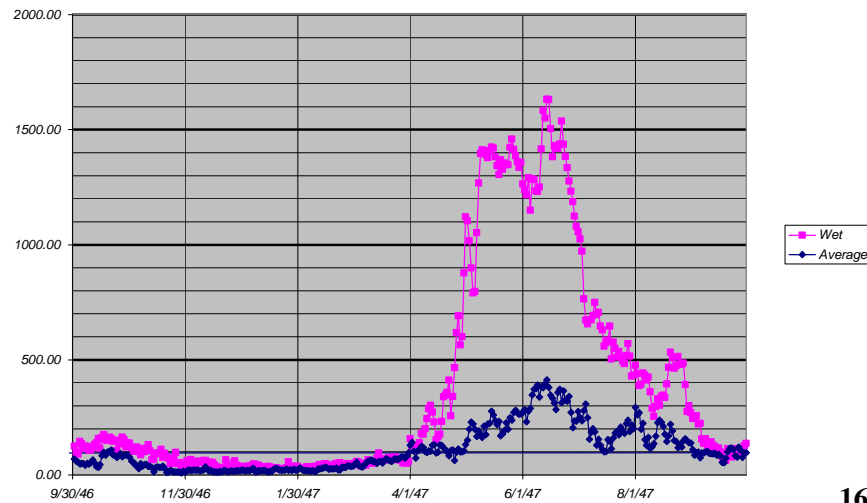
Chatfield Average and Wet Hydrographs  
Reallocation w/o ER



Burlington Wet and Average Hydrographs  
Reallocation w/o ER



Chatfield Average and Wet Hydrographs  
Reallocation w/ ER



Burlington Wet and Average Hydrographs  
Reallocation w/ ER

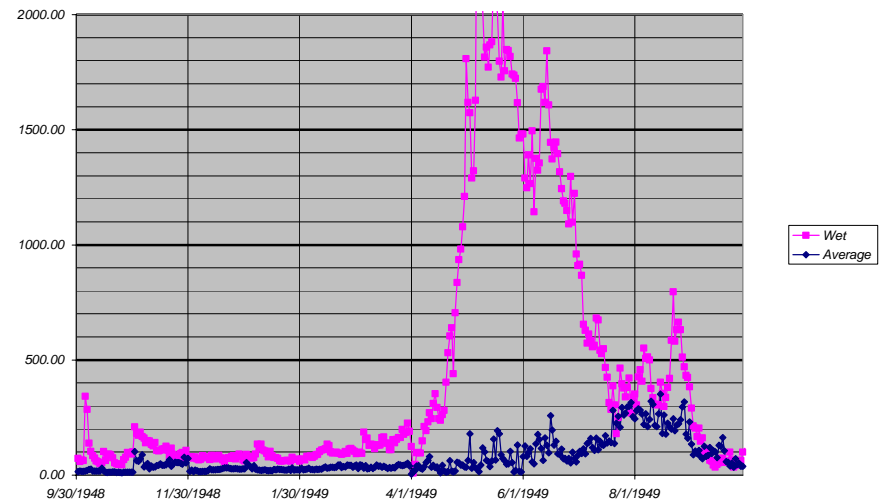
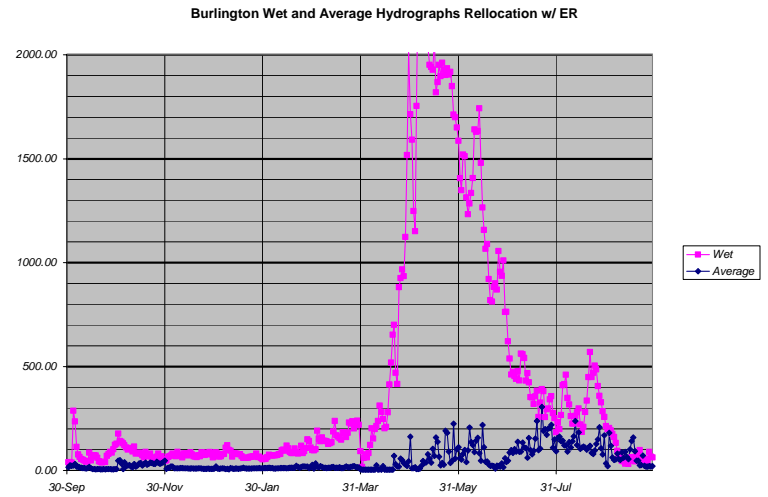
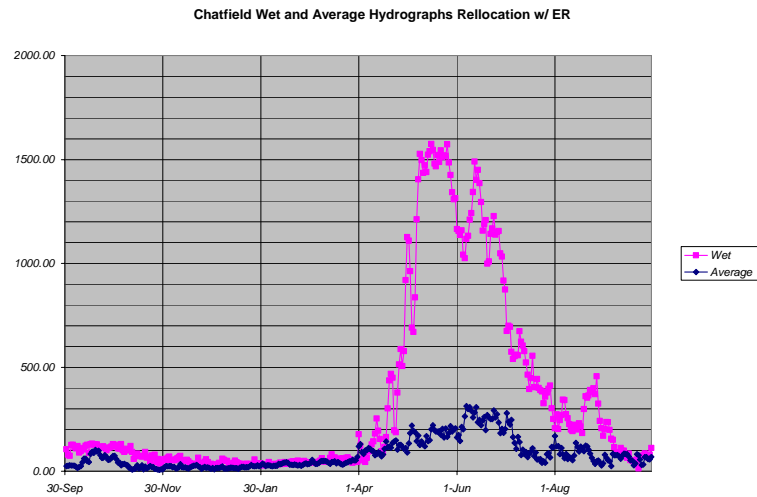
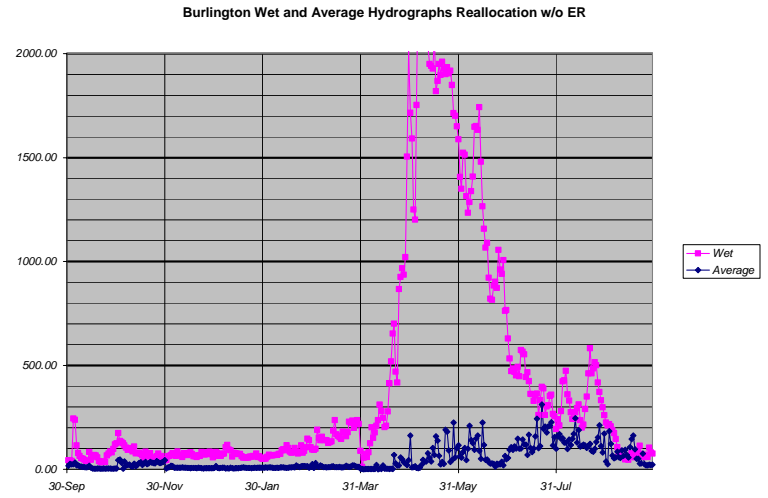
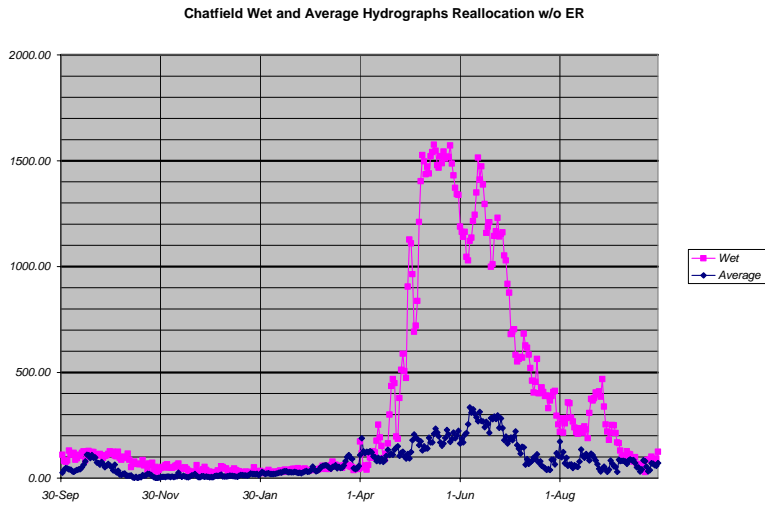


Figure 13b - Build-Out Conditions



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Composite hydrographs were only created at the Chatfield and Burlington gages since these two gages historically demonstrate the lowest wintertime flows in the South Platte below Chatfield due to the configuration of the South Platte and its tributaries and wastewater plant discharges. Therefore these two gages are the most sensitive gages to the proposed ER releases of those gages that currently exist below Chatfield Reservoir. For this reason, the ER releases from Chatfield Reservoir into the South Platte River will provide the greatest incremental benefits to fish habitat at the Chatfield and Burlington gage reaches. Increased habitat areas at these two locations not only will enhance fish populations locally, but may also serve to improve the connectivity of isolated fish populations both upstream and downstream of these localities.

Habitat time series simulations were made for each of the species of interest, including juvenile and adult life stages, based on the habitat versus discharge data presented in Attachment C. Specifically, the following simulations were made:

- Chatfield Gage
  - Reallocation without ER
    - Current conditions – wet and average hydrology
    - Build-out conditions – wet and average hydrology
  - Reallocation with ER
    - Current conditions – wet and average hydrology
    - Build-out conditions – wet and average hydrology
- Burlington Gage
  - Reallocation without ER
    - Current conditions – wet and average hydrology
    - Build-out conditions – wet and average hydrology
  - Reallocation with ER
    - Current conditions – wet and average hydrology
    - Build-out conditions – wet and average hydrology

The results of the Habitat time series modeling for these various simulations are presented in Attachment D. These results are summarized below.

The greatest improvements to habitat area associated with the wintertime ER releases generally occur during the average condition flow regimes, for both current and build-out conditions (Table 4). This is understandable since the flows are substantially lower (four to ten times lower) during average years than during wet years, making the impact of the 10 cfs wintertime releases associated with the ER more pronounced on the river's fish species. There are also benefits to habitat area during wet years associated with the ER releases given that late fall and wintertime low flows are bolstered during those situations when flows at the Chatfield and Burlington gages are below 10 cfs.

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Table 4 - Summary of Percent Habitat Area Changes with ER versus Water Supply User Specified Releases Given Reallocation of Chatfield Storage of 20,600 Acre-Feet

	Current Conditions				Build-Out Conditions			
	Winter*		Summer**		Winter*		Summer**	
	average	wet	average	wet	average	wet	average	wet
<b>Chatfield</b>								
<b>Juvenile</b>								
Brook Trout	47.03%	6.57%	-1.60%	-1.27%	33.90%	5.80%	0.70%	0.40%
Channel Cat	-37.93%	4.60%	-6.13%	-0.77%	-19.60%	5.37%	-0.63%	-0.10%
<b>Adult</b>								
Brook Trout	60.53%	6.57%	3.13%	-0.70%	45.70%	13.00%	2.67%	-0.83%
Channel Cat	55.10%	7.07%	4.10%	-0.53%	40.43%	7.53%	3.10%	-1.10%
Longnose Dace	42.00%	7.10%	0.97%	-0.97%	30.40%	7.47%	1.77%	-0.23%
<b>Burlington</b>								
<b>Juvenile</b>								
Channel Cat	8.67%	-0.37%	-0.53%	-2.37%	22.00%	-0.03%	-1.47%	-1.00%
White Sucker	30.37%	8.17%	0.00%	-0.23%	75.47%	3.17%	-12.80%	0.03%
<b>Adult</b>								
Channel Cat	16.43%	10.70%	-0.57%	-1.97%	28.10%	4.03%	-4.37%	-0.53%
White Sucker	30.37%	8.17%	0.00%	-0.23%	75.47%	3.17%	-12.80%	0.03%
Longnose Dace	15.57%	10.73%	-2.60%	-2.37%	31.87%	3.93%	-5.77%	-1.10%

Table presents the percent change in habitat area caused by the ER releases versus the Water Supply User Specified releases

\* winter is the average percent habitat area increase for the months December, January and February

\*\* summer is the average percent habitat area increase for the months June, July and August

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Of all the species evaluated, only juvenile channel catfish are found to have their habitat area decrease due to the wintertime flow releases. This observation relates directly to the habitat flow relationship that exists for juvenile channel catfish, as indicated in Attachment B. Juvenile channel catfish have a marked habitat area reduction when flow increases above 10 cfs, based in part upon this fish's lack of tolerance for water deeper than 2 feet. Given that the South Platte River has incised banks due to its lack of sediment transport, the juvenile channel catfish will benefit from those periods when the South Platte has dry years, and the other fish, including the adult channel catfish will benefit during average and wet years.

The benefits of the ER release scenario on summertime fish habitat is not nearly as distinct. For the months of June, July and August, only a marginal improvement or decline in habitat area is estimated for the species of interest (with the possible exception of the white sucker under build-out conditions in the vicinity of the Burlington gage). This is presumably due to the fact that flows in these summer months, which are on the declining side of the seasonal peak flows in the South Platte, occur during a time when the water supplier customers have the greatest demand for water. Therefore, the water supplier specified releases occur during this time period placing additional flow in the South Platte improving habitat area. However, habitat area in the summer is already three to as much as twenty times greater in the summer than in the winter, so the small reductions in habitat area associated with the ER release scenario are not considered significant or detrimental to the fish species of interest during this time of year.

## Observations

The key observations that were established based on the hydrologic and biological habitat modeling performed during this study are as follows:

- **There is a measurable increase in habitat area for all fish species due to the retimed releases from Chatfield.**
- **For all fish evaluated**, which include all those fish that the DOW considers to be of state interest that are contained in the South Platte River, **habitat area can be improved with future reallocated storage releases** for some return period..
- These preliminary findings also indicate that for most species of interest, the **habitat area benefits related to the future reallocated storage releases can be improved by releasing low flows in the fall and winter months** versus having releases during the summertime as currently indicated by the water user release scenarios contained in the EIS.
- **The most marked benefits associated with fall and winter month releases occur during average flow years on the River**, when water is available to fill the reallocated storage pool and the river is flowing at levels 4 to 10 times lower than during wet years. During the wet years, the fish habitat is typically 3 to 5 times (300 to 500 percent) greater than during average years, so it is during the average years when the habitat improvements are most needed.
- Additional analyses are needed to better characterize the value and effect of alternative ER releases on the downstream fish habitat; however, **it is clear that retimed South Platte River flows can substantially improve fish habitat downstream of Chatfield, and that fall and winter time releases are more beneficial than summertime releases as proposed by the water users in the EIS.**

## Recommendations

The benefit of ER releases provides a number of opportunities for the water users to improve ecological conditions in the South Platte River below Chatfield. Not only will the fish habitat be improved by the releases, but other flora and fauna dependant and/or coexisting with the fish species of interest, including migratory songbirds and water fowl, birds of prey and various mammals that live in and along the South Platte River riparian corridor could benefit from the increased fall and winter time flows in those river reaches where flows fall beneath 10 cfs on a regular and at times prolonged basis.



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However, benefits to the water users and other Chatfield reallocation project stakeholders extend beyond the ecological. Specifically, **utilizing some portion of the reallocated storage space in Chatfield for ecosystem restoration purposes may also afford significant cost savings to the State and the water users** relate to:

- The capital cost of storage; and
- The environmental and recreational mitigation costs of the reallocation.

With respect to the capital cost of storage, USACE has indicated at numerous planning meeting held in 2006 and 2007 that the portion of the reallocated storage pool that will be dedicated to downstream ER benefits may be deducted from capital costs associated with the storage volume approved for reallocation from the flood storage pool. **This deduction would in essence provide the water users with a credit of millions of dollars against the overall reallocation project cost** - a credit that would not require a federal appropriation to obtain, since no federal expenditures would be needed for the credit to be given. It is possible that the credit could be provided via an approval from the Assistant Secretary of the Army during the review of the Reallocation Study Feasibility Report (FR).

Further discussion of the processes required to obtain the credit with Omaha, Portland, and USACE HQ is needed to fully characterize the review and approval process; however the cost of these discussions and the impact of the discussions on the EIS being completed is not expected to be significant at this time.

With respect to the mitigation costs, reservoir releases that reduced the speed and magnitude of reservoir fluctuations during key seasonal periods (e.g., during the summer when park usage is at its peak) may reduce overall mitigation costs related to both environmental and recreational impacts. Although USACE has indicated that an ER “credit” may be available to offset mitigation costs, such a credit would require a federal appropriation, and therefore may be years away. The more directed and locally controlled approach would involve using the ER analyses presented herein, as a stepping stone to aide in the design and implementation of both the environmental and recreational mitigation projects, such that **reservoir fluctuations could be evaluated and characterized along with downstream ER benefits in a manner that reduces future mitigation costs.**

Inclusion of the benefits of ER into the overall reallocation project will require a high level of water user cooperation and collaboration. The use of the ER benefits to reduce the capital cost of storage will require quick action to allow discussions with USACE Omaha, Portland and HQ to occur within the next few months such that the reallocation FR can be appropriately modified and amended. The process for influencing the FR is not necessarily costly, but it is time sensitive.

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The inclusion of the ER into the mitigation design efforts is altogether more involved and challenging. Numerous issues will influence how the ER is brought into the design effort, not the least of which is the manner in which the EIS and ROD are crafted to allow for multiple future reservoir operations to occur. Early inclusion of these discussions with the CWCB, State Parks and USACE as the EIS is developed will likely benefit the effort. If the key parties agree to include ER analyses in the design and reservoir operations evaluations, additional analyses will likely be needed to best determine how mitigation costs may best be reduced through future ER releases.

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**Attachment A**

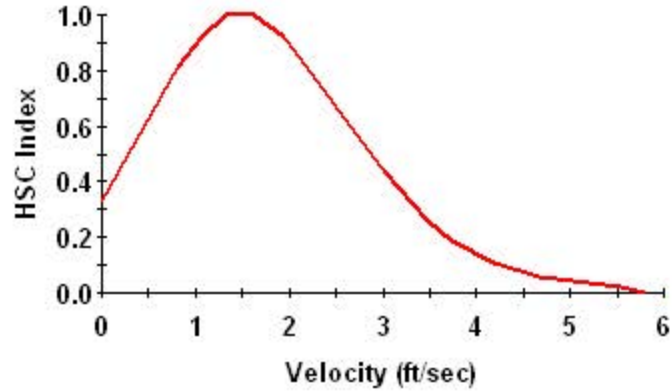
Habitat Suitability Data for Species of Interest

# Habitat Suitability Criteria

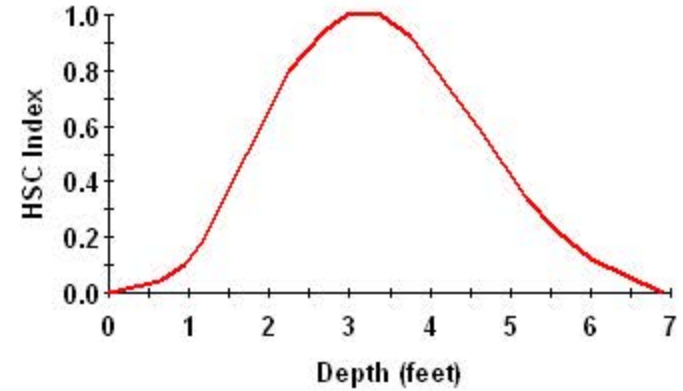
- All data from published studies or Colorado studies
- Sources:
  - Brown and Rainbow Trout - CDOW South Platte River
  - Channel catfish, adult – Peters et al. 1989 – Platte River
  - Channel catfish juvenile – Chadwick Platte River
  - Common carp adult - Chadwick Platte River
  - Sand shiner - Chadwick Platte River
  - Longnose dace – USFWS HSI criteria
  - White sucker - USFWS HSI criteria

# Brown Trout - Adult

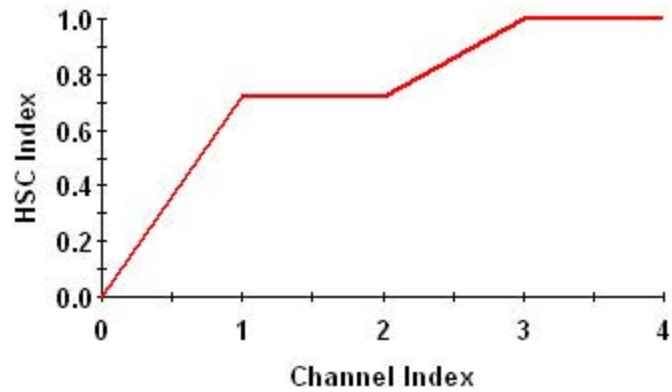
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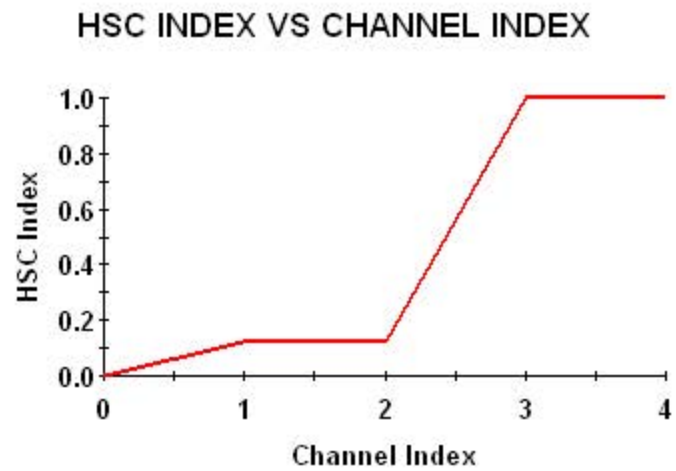
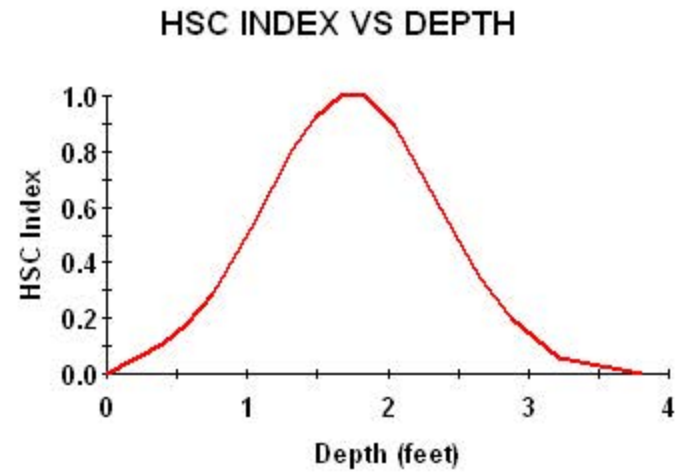
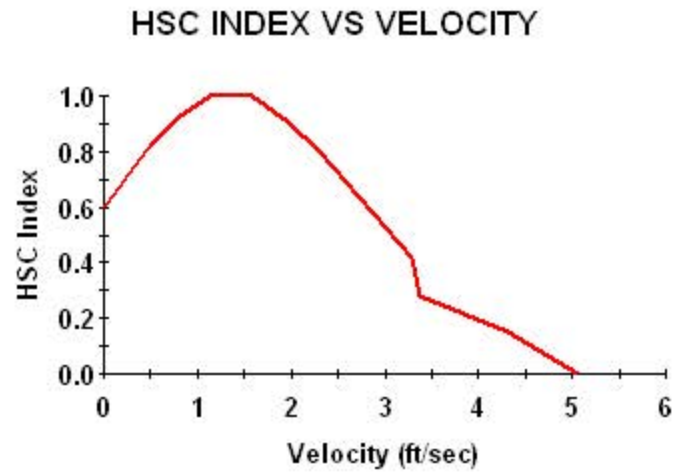
### HSC INDEX VS DEPTH



### HSC INDEX VS CHANNEL INDEX



## Brown Trout - Juvenile

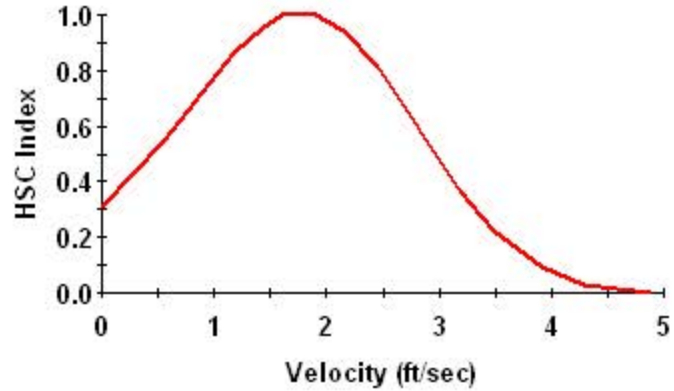


November 17, 2006

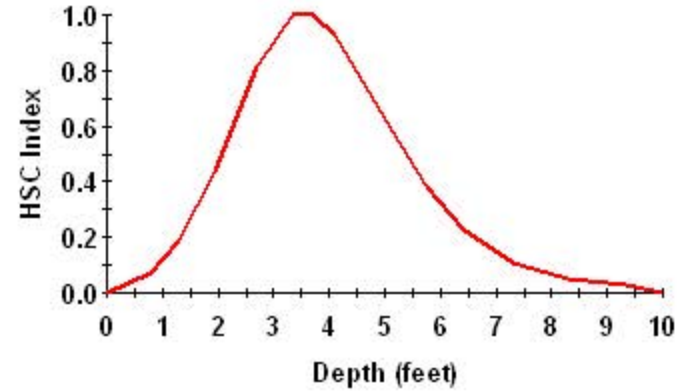
Preliminary Results – Subject to  
Revision

# Rainbow Trout - Adult

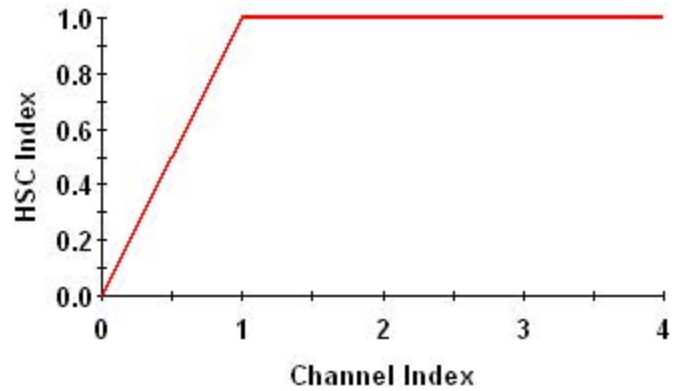
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### HSC INDEX VS DEPTH

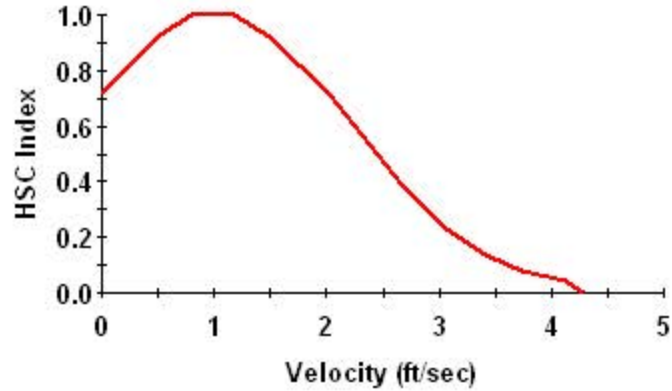


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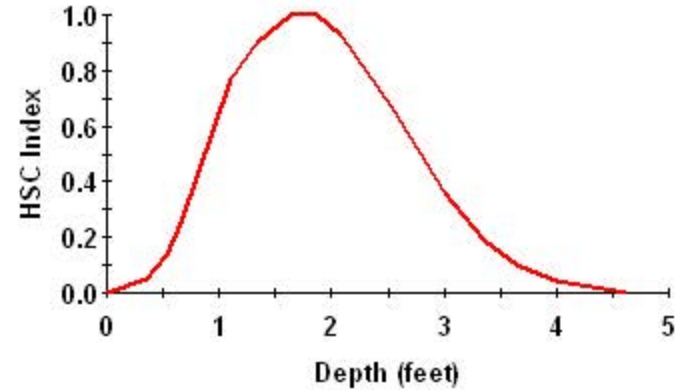


# Rainbow Trout - Juvenile

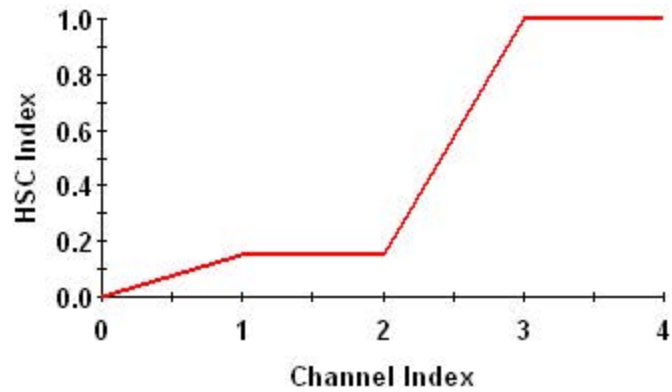
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### HSC INDEX VS DEPTH

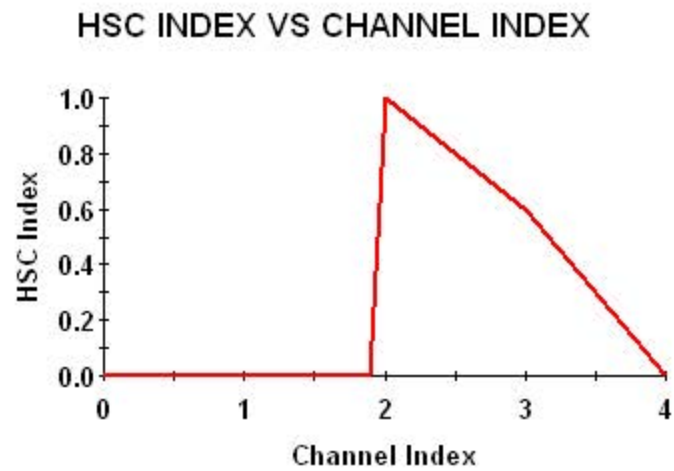
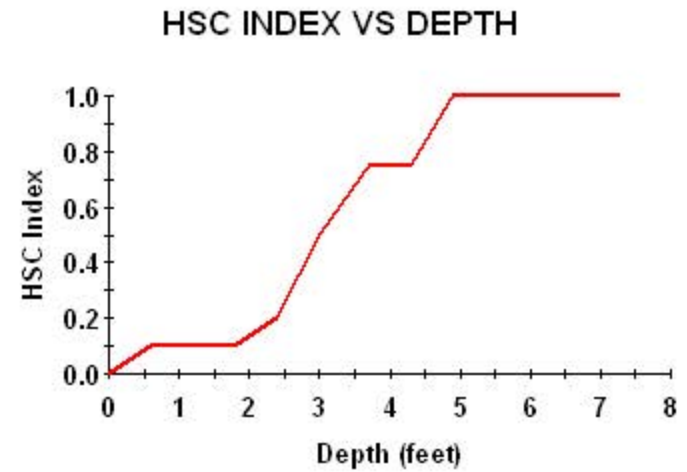
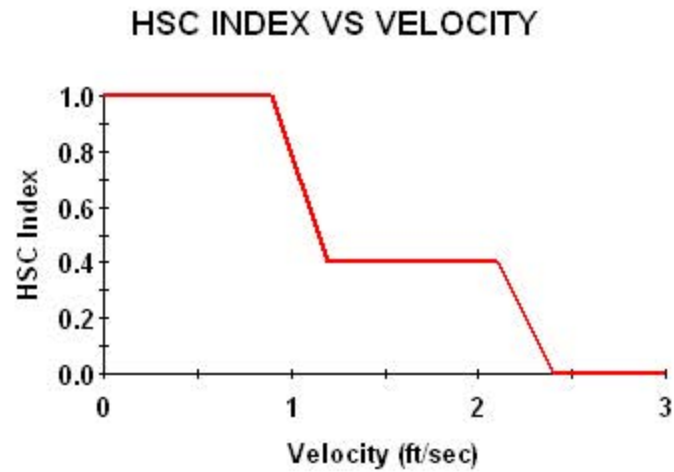


### HSC INDEX VS CHANNEL INDEX



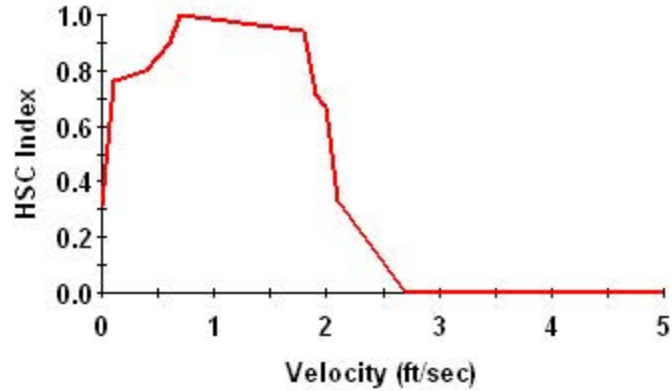


# Channel Catfish - Adult

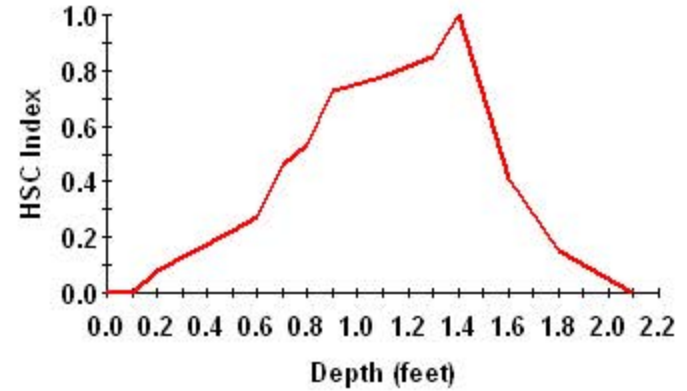


# Channel Catfish - Juvenile

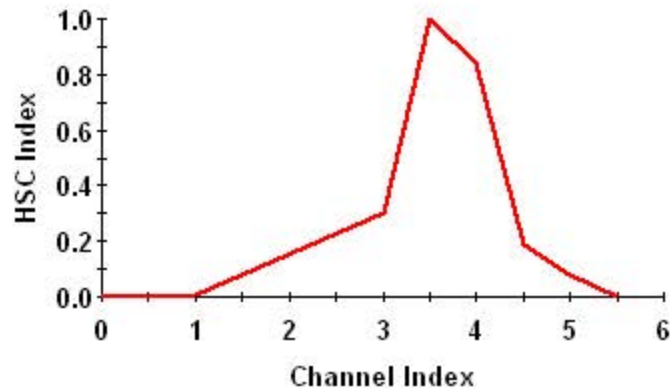
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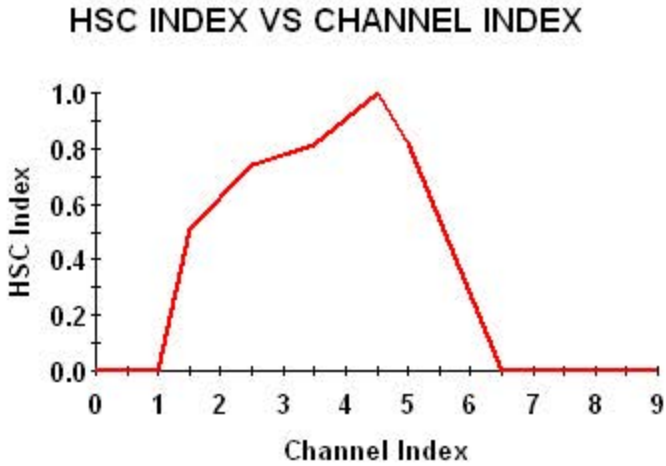
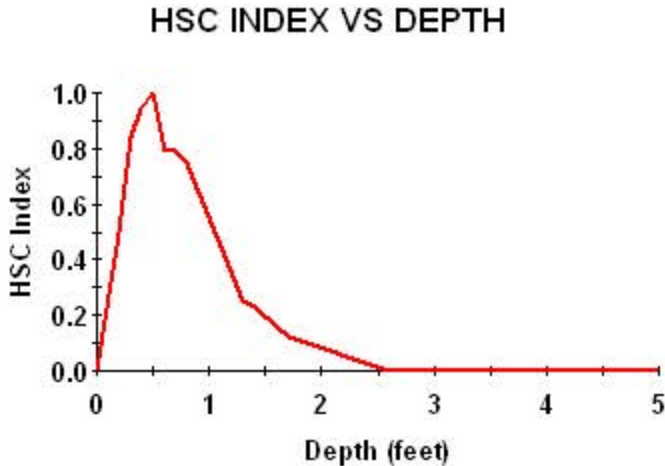
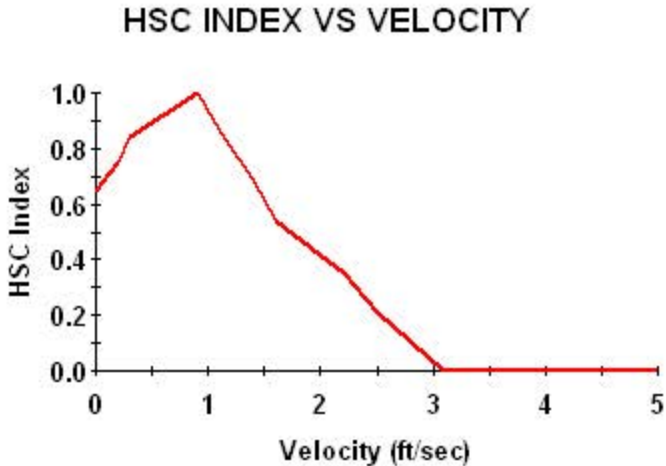
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### HSC INDEX VS CHANNEL INDEX

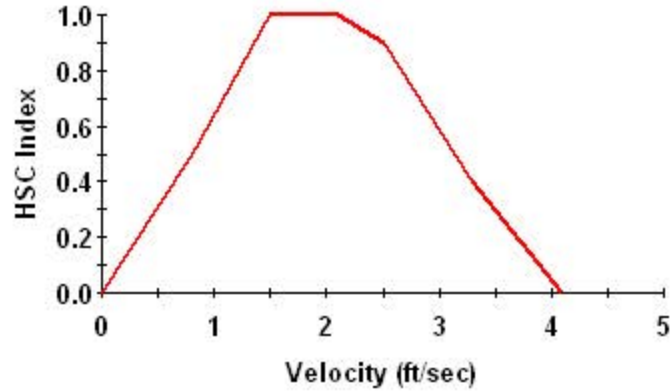


# Sand Shiner - Adult

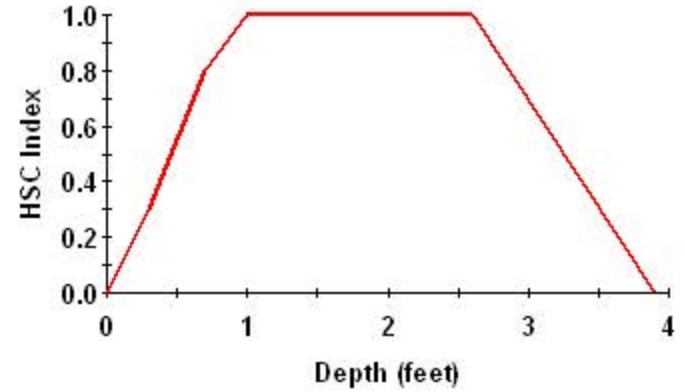


# Longnose Dace - Adult

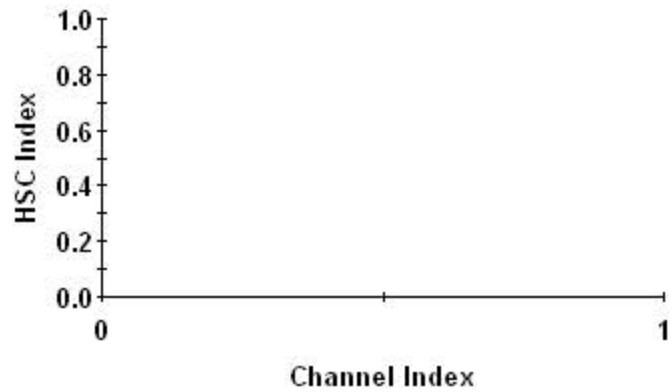
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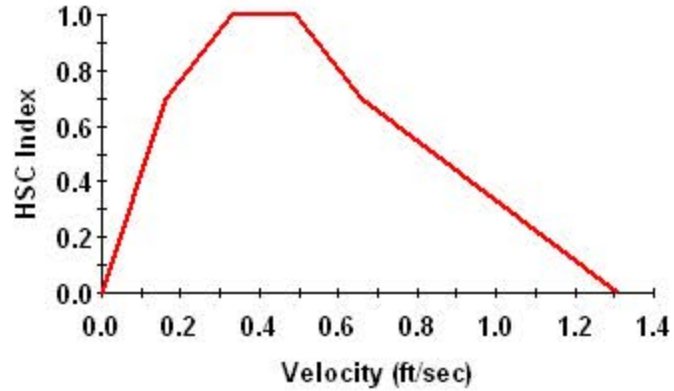


### HSC INDEX VS CHANNEL INDEX

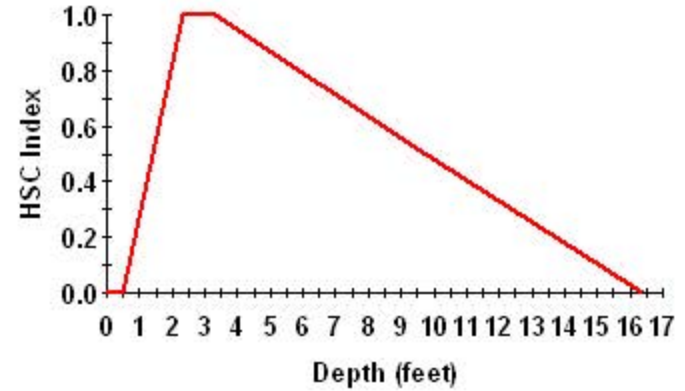


# White Sucker – Juvenile/Adult

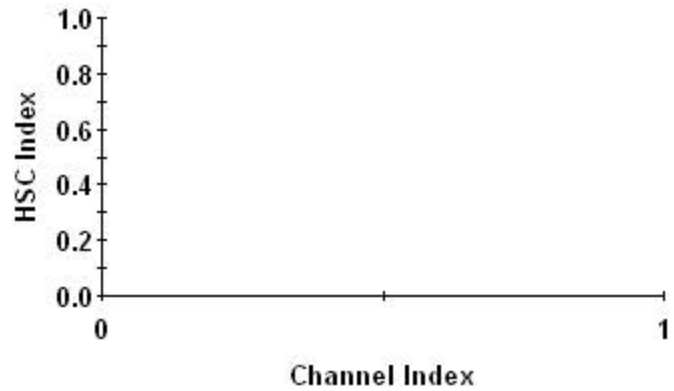
### HSC INDEX VS VELOCITY



### HSC INDEX VS DEPTH

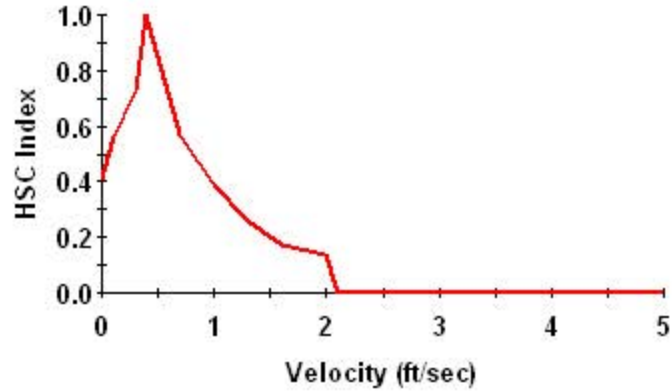


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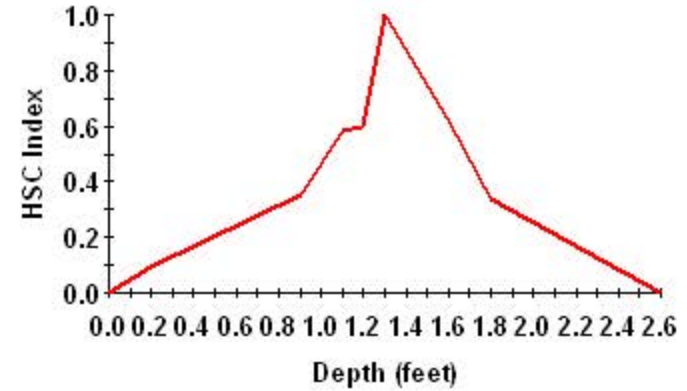


# Common Carp - Adult

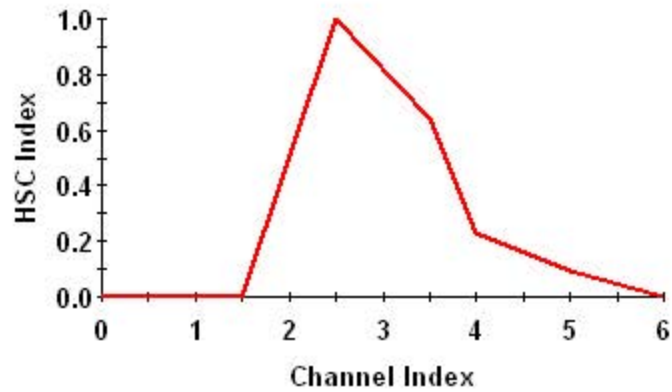
### HSC INDEX VS VELOCITY



### HSC INDEX VS DEPTH



### HSC INDEX VS CHANNEL INDEX

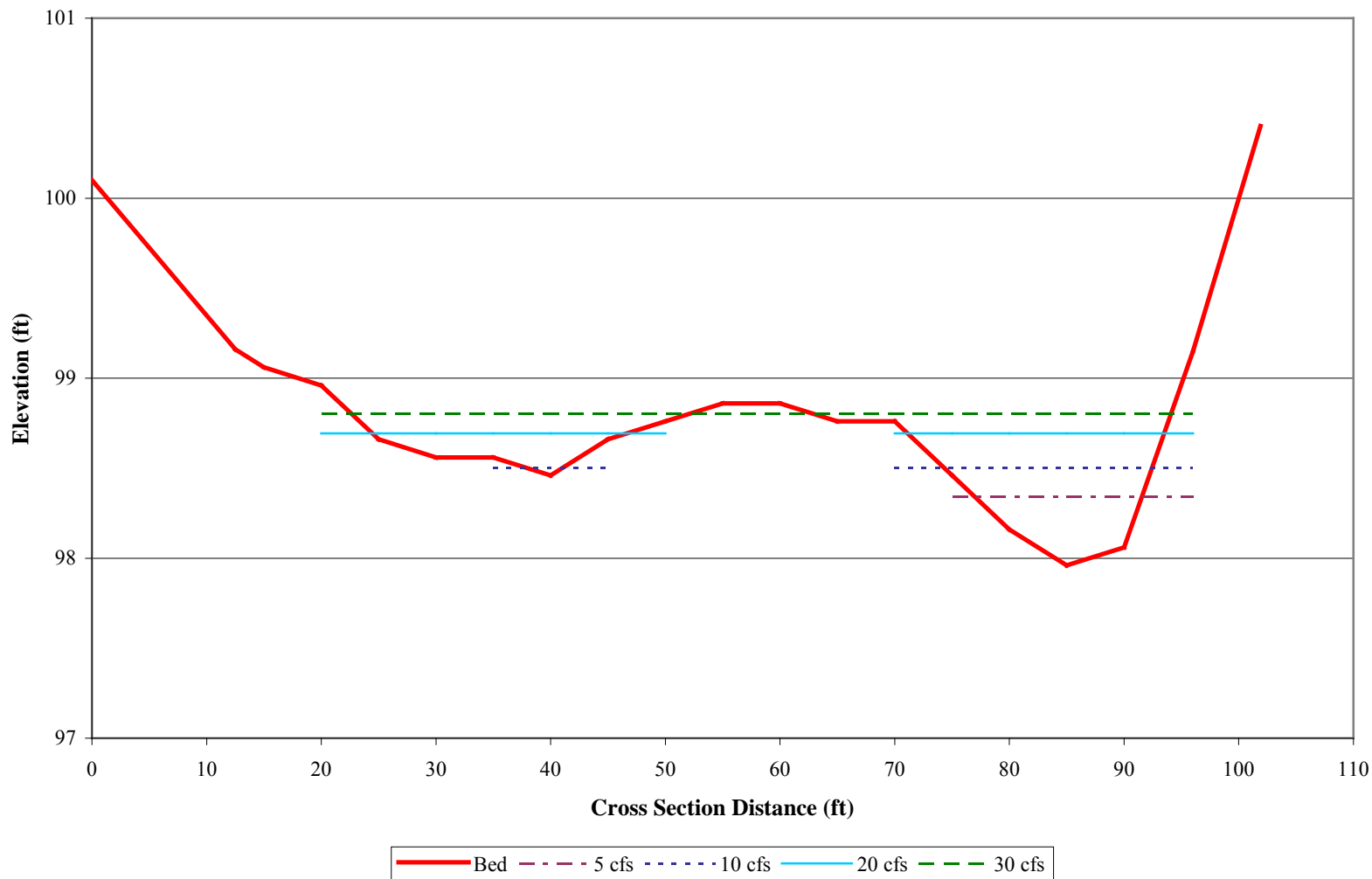


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## **Attachment B**

### Cross Section Flow and Wetted Perimeter Analysis

### South Platte Littleton Bed Profile, Water Surface Elevation - Riffle

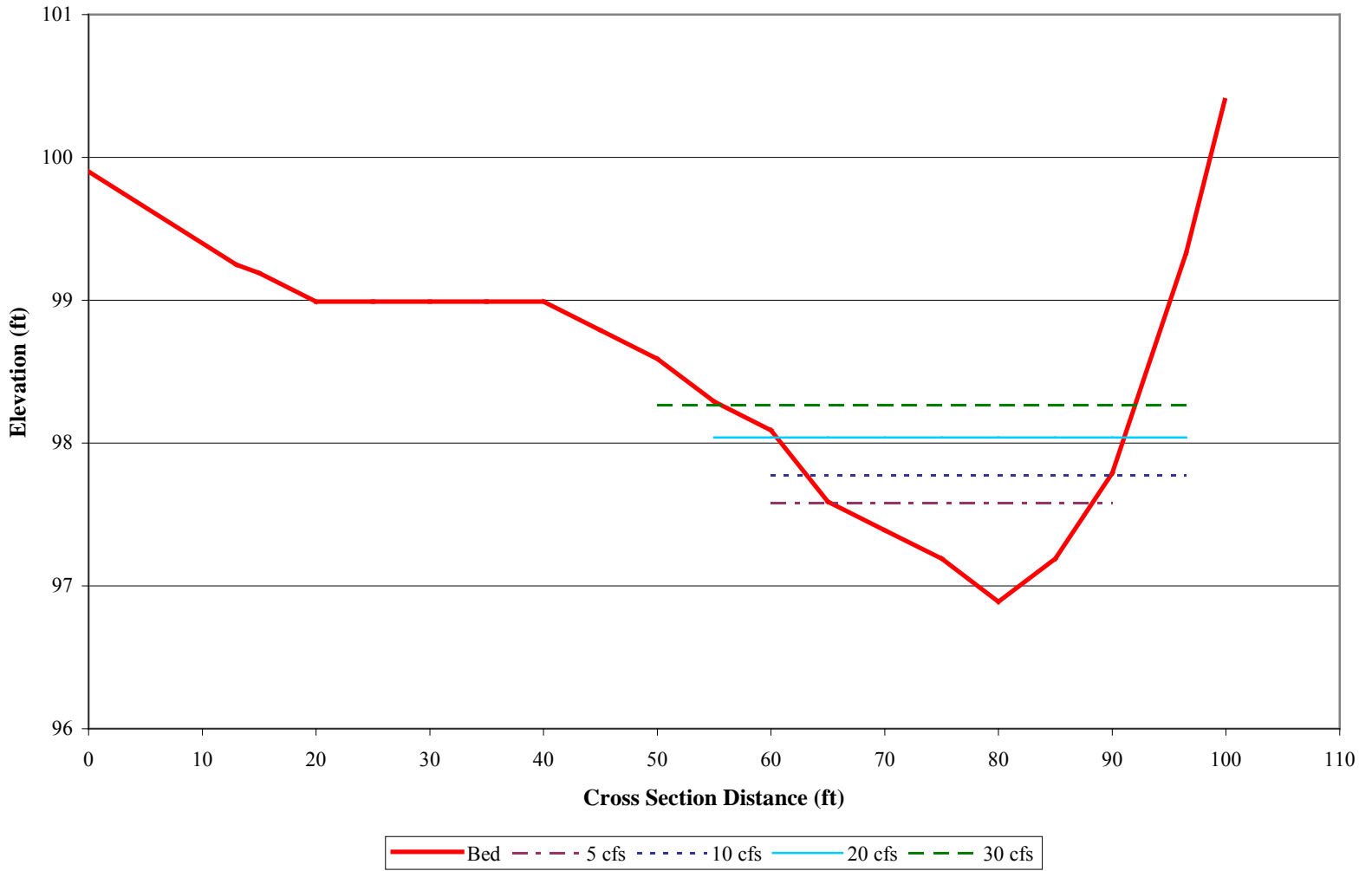


November 17, 2006

Preliminary Results – Subject to  
Revision



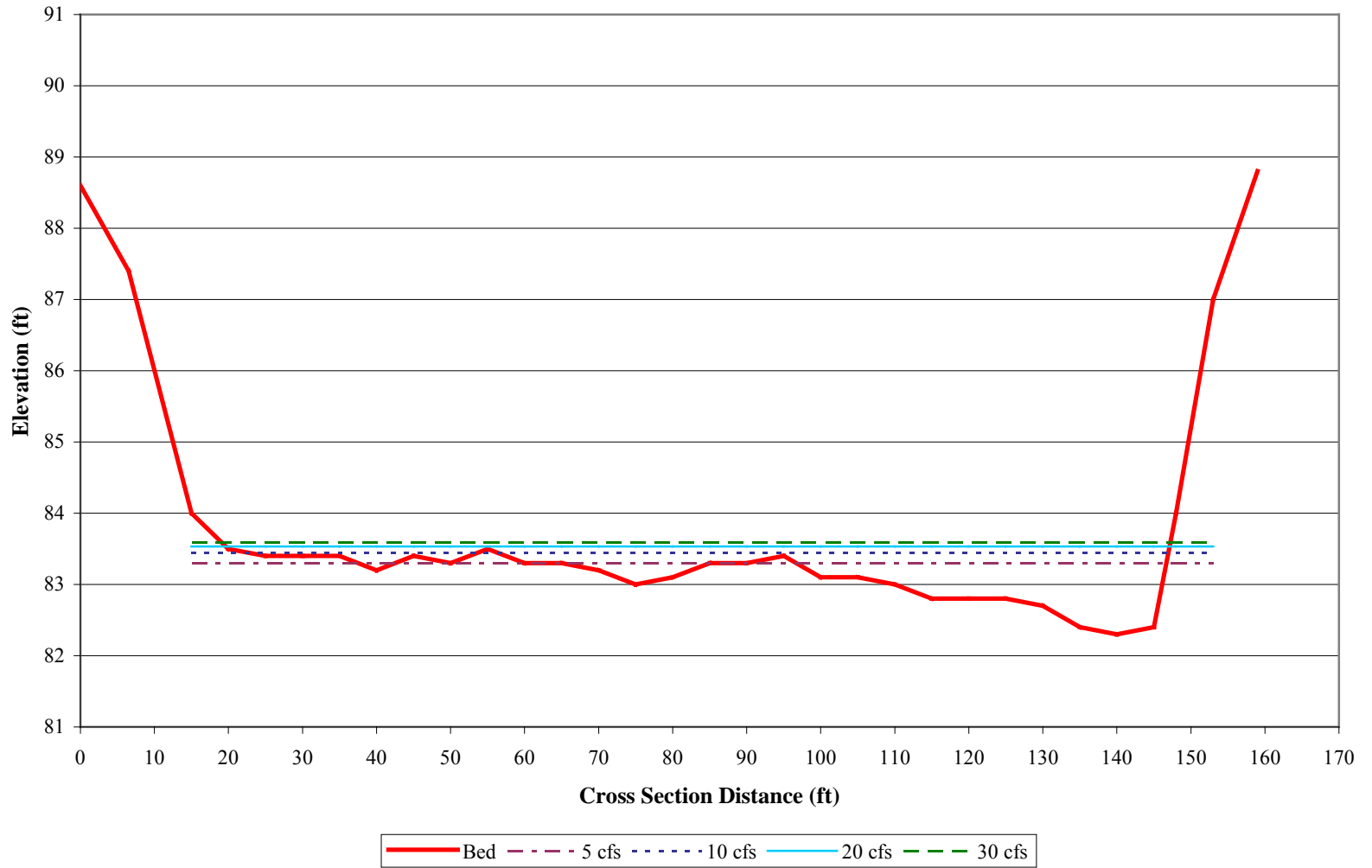
### South Platte Littleton Bed Profile, Water Surface Elevation - Run



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Revision

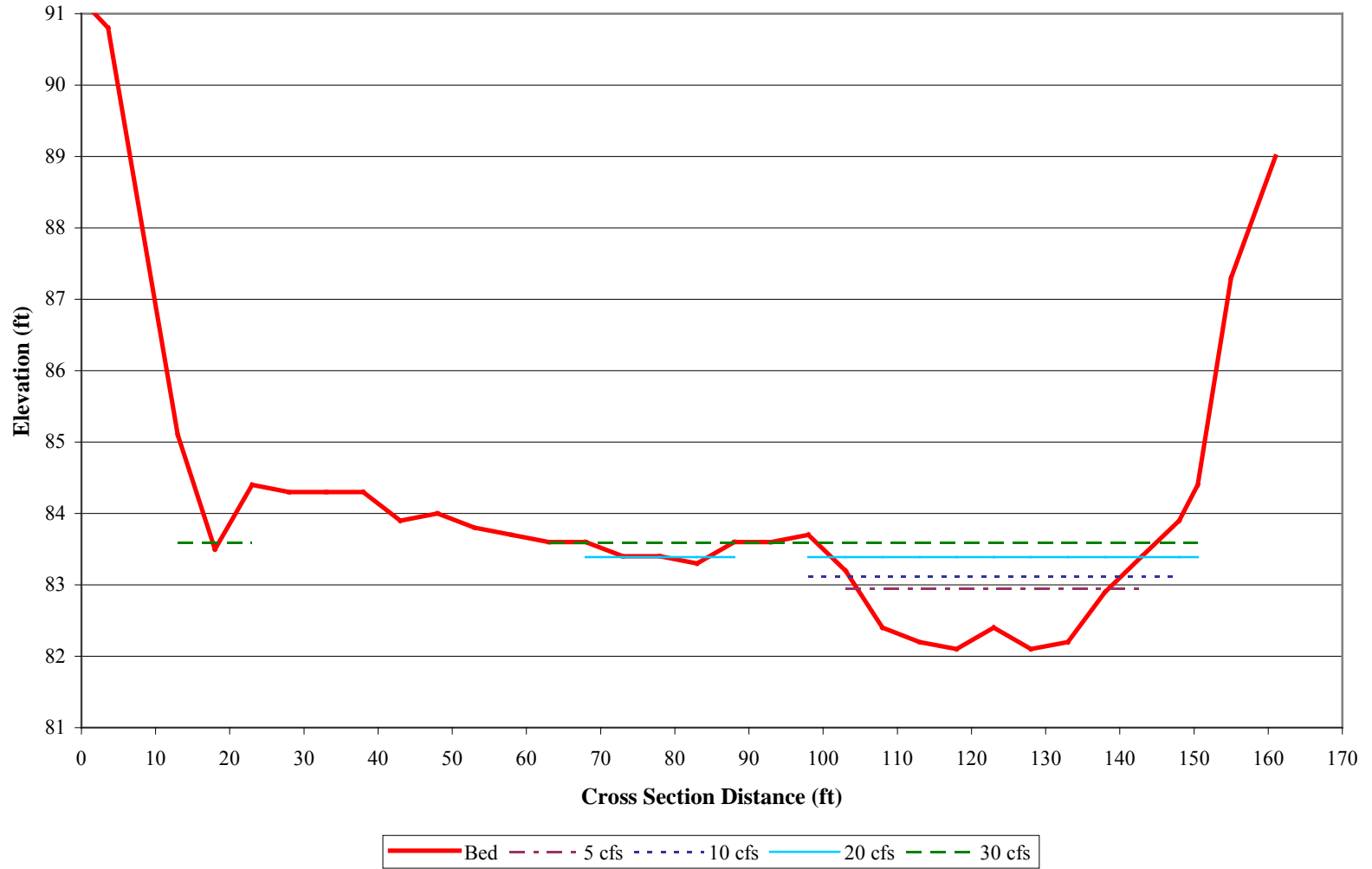
### South Platte at Union St. Bed Profile, Water Surface Elevation - Riffle



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Revision

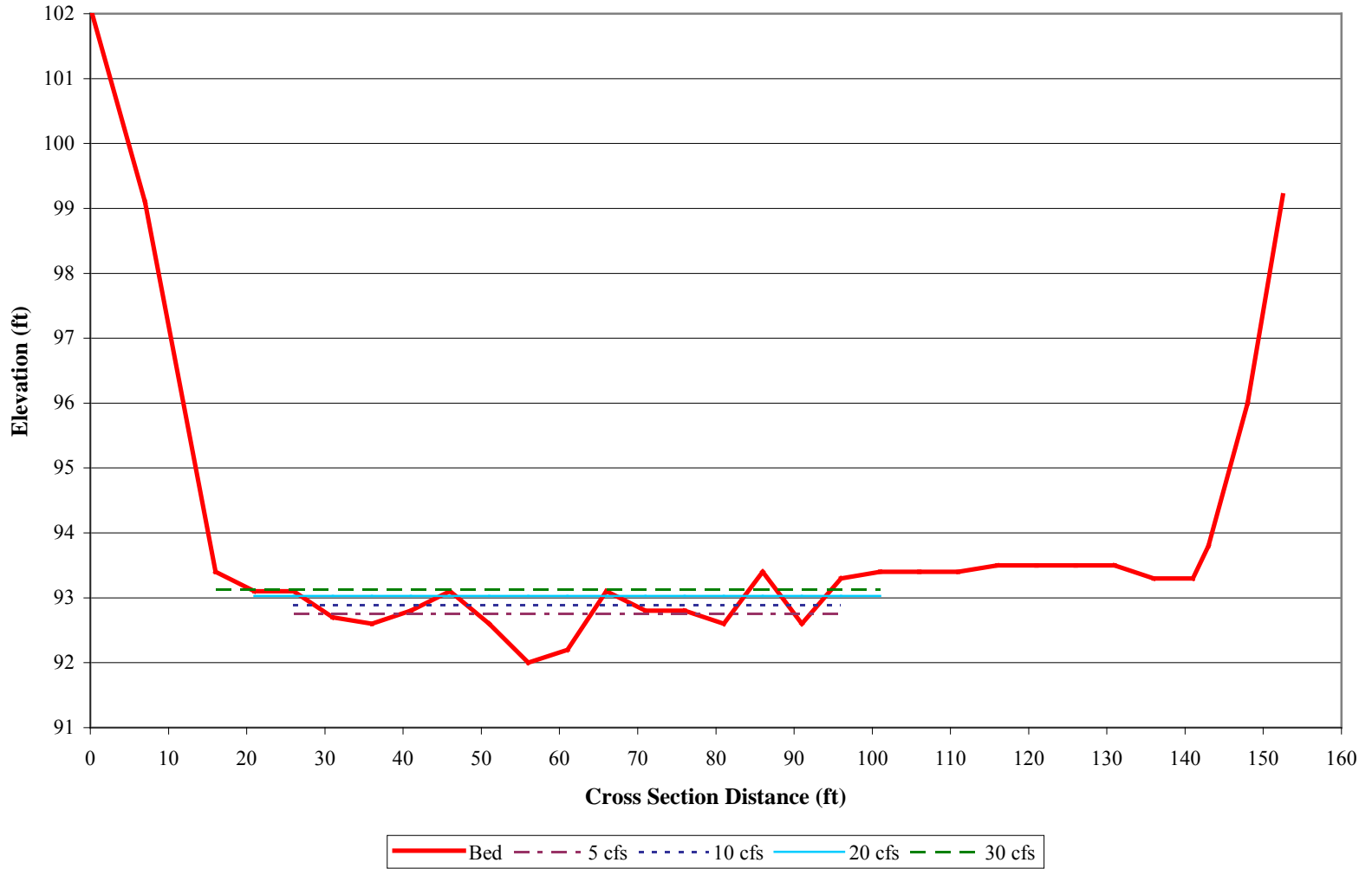
### South Platte at Union St. Bed Profile, Water Surface Elevation - Run



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Revision

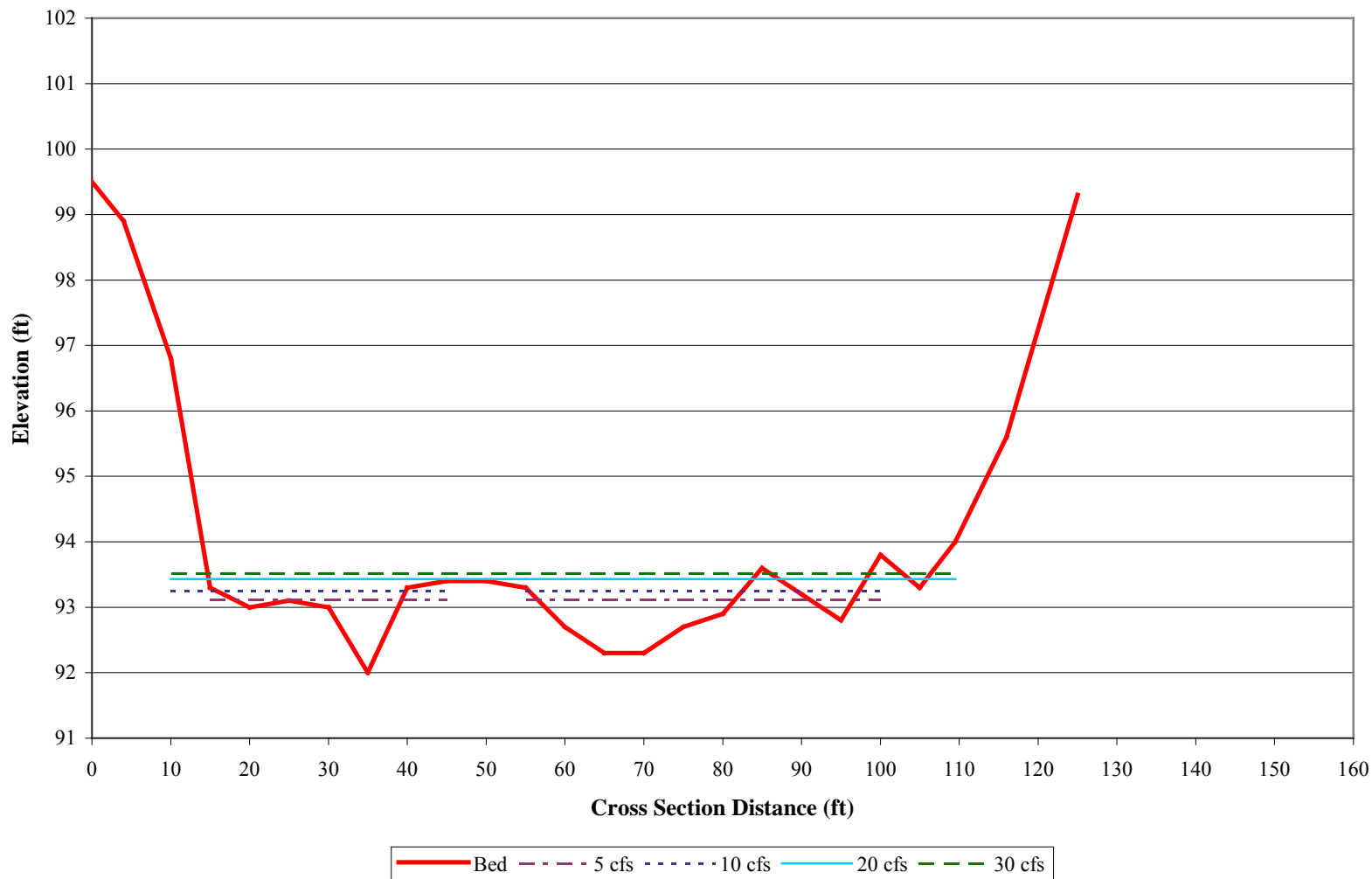
### South Platte at Evans St. Bed Profile, Water Surface Elevation - Riffle



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Revision

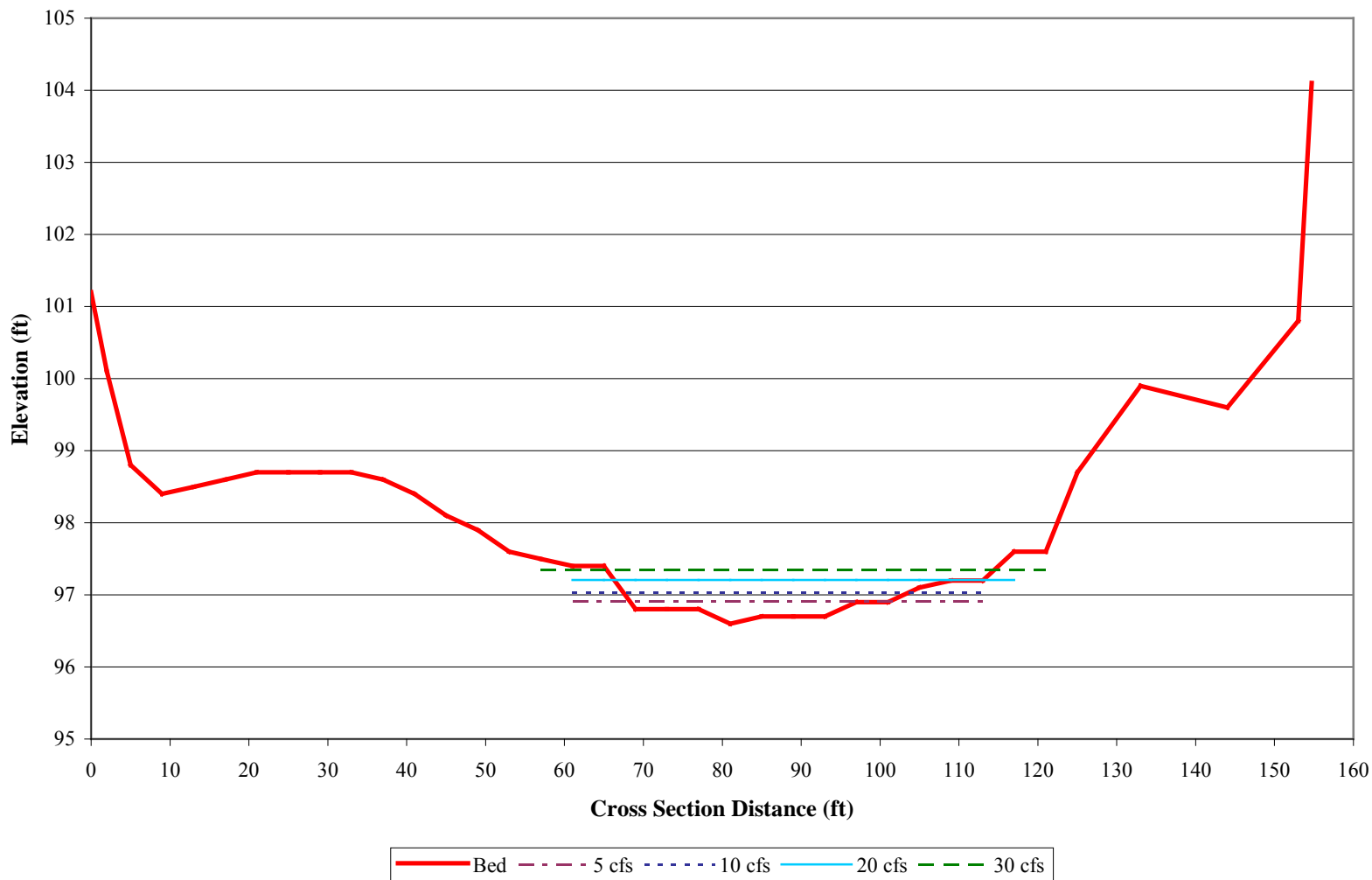
### South Platte at Evans St. Bed Profile, Water Surface Elevation - Run



November 17, 2006

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Revision

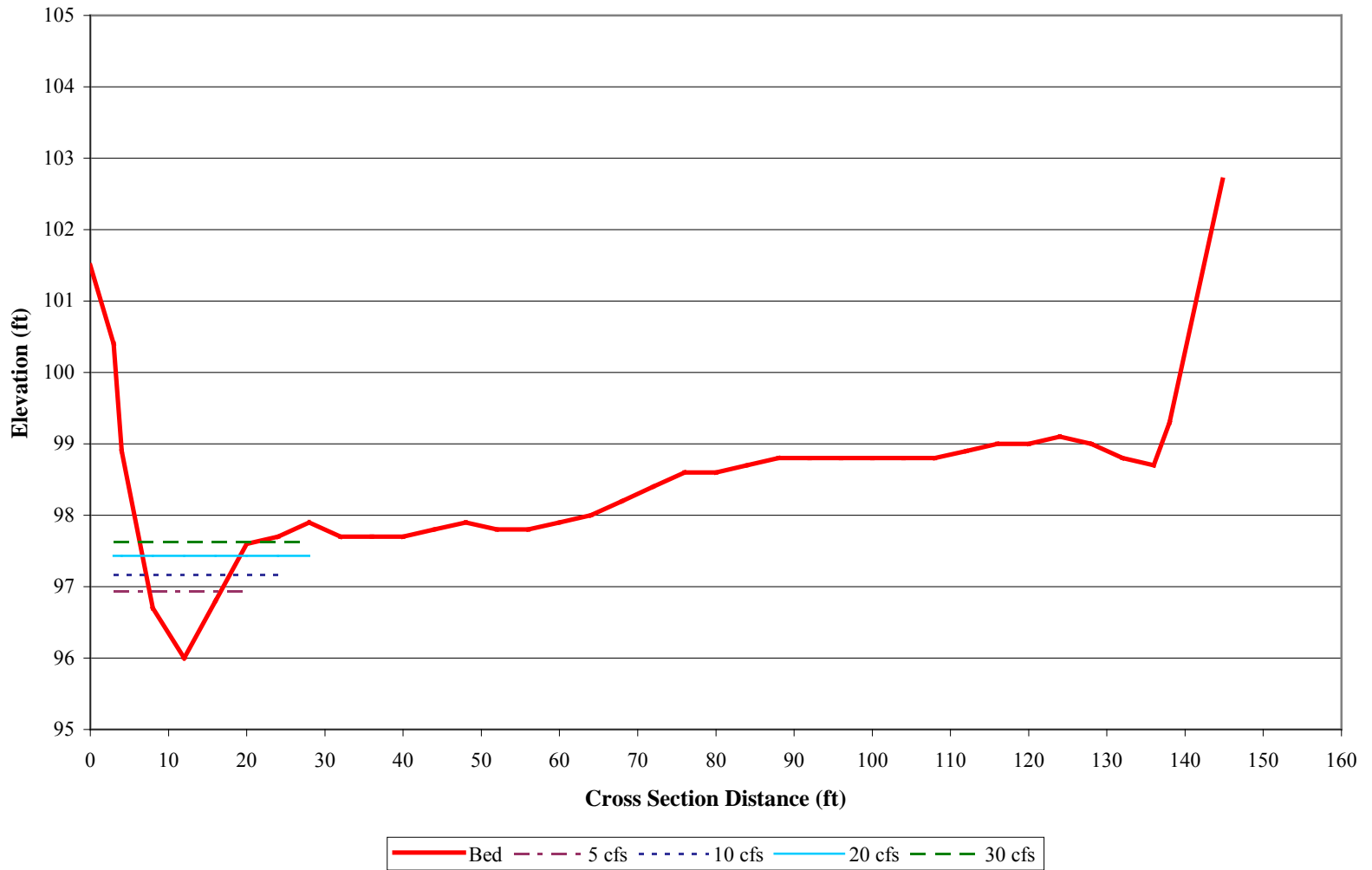
### South Platte at Franklin St. Bed Profile, Water Surface Elevation - Riffle



November 17, 2006

Preliminary Results – Subject to  
Revision

### South Platte at Franklin St. Bed Profile, Water Surface Elevation - Run



November 17, 2006

Preliminary Results – Subject to  
Revision

# South Platte Downstream Bed Profile, Water Surface Elevation - Riffle

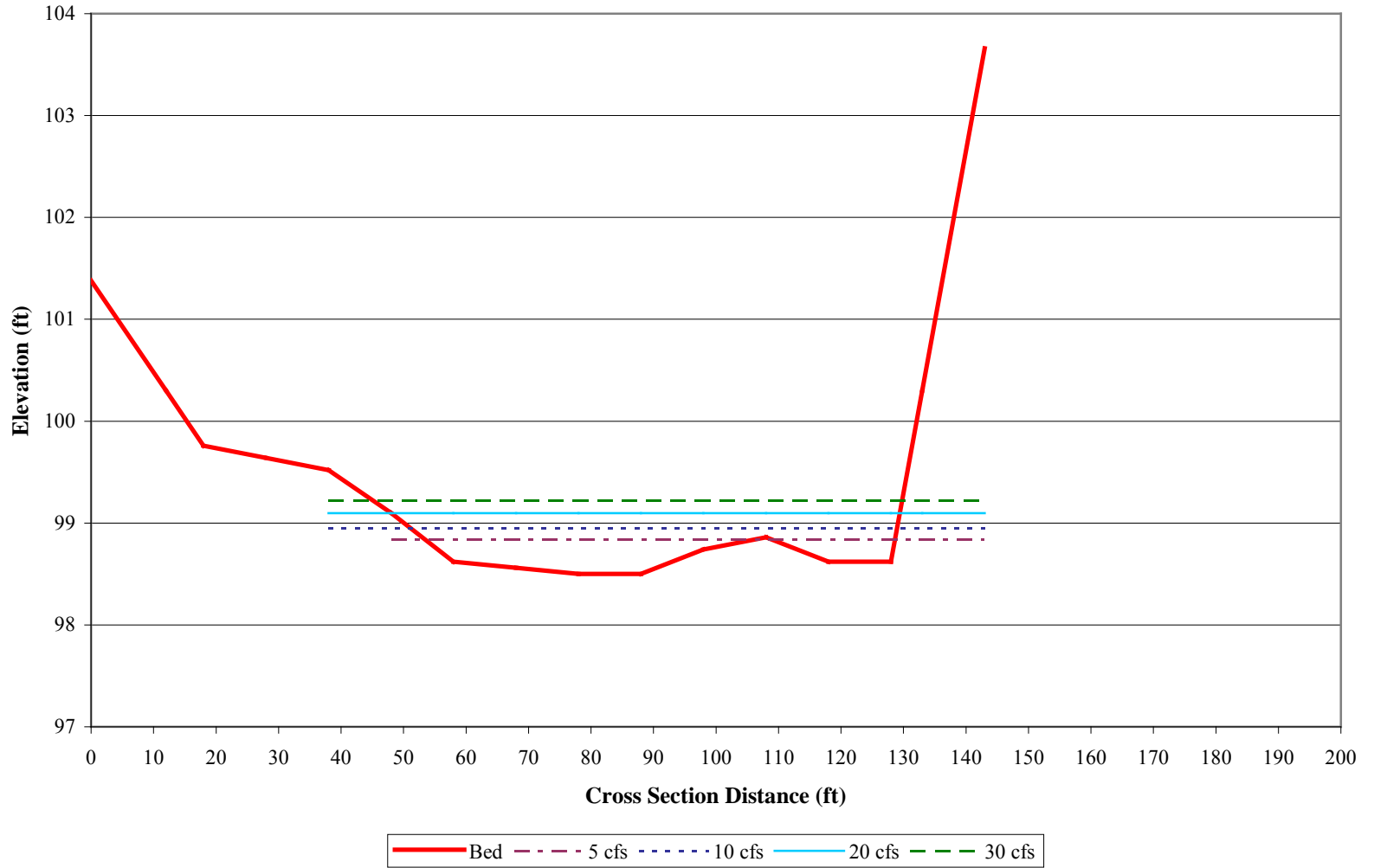


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### South Platte Downstream Bed Profile, Water Surface Elevation - Run



November 17, 2006

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**Attachment C**

**Habitat Flow Relationships**





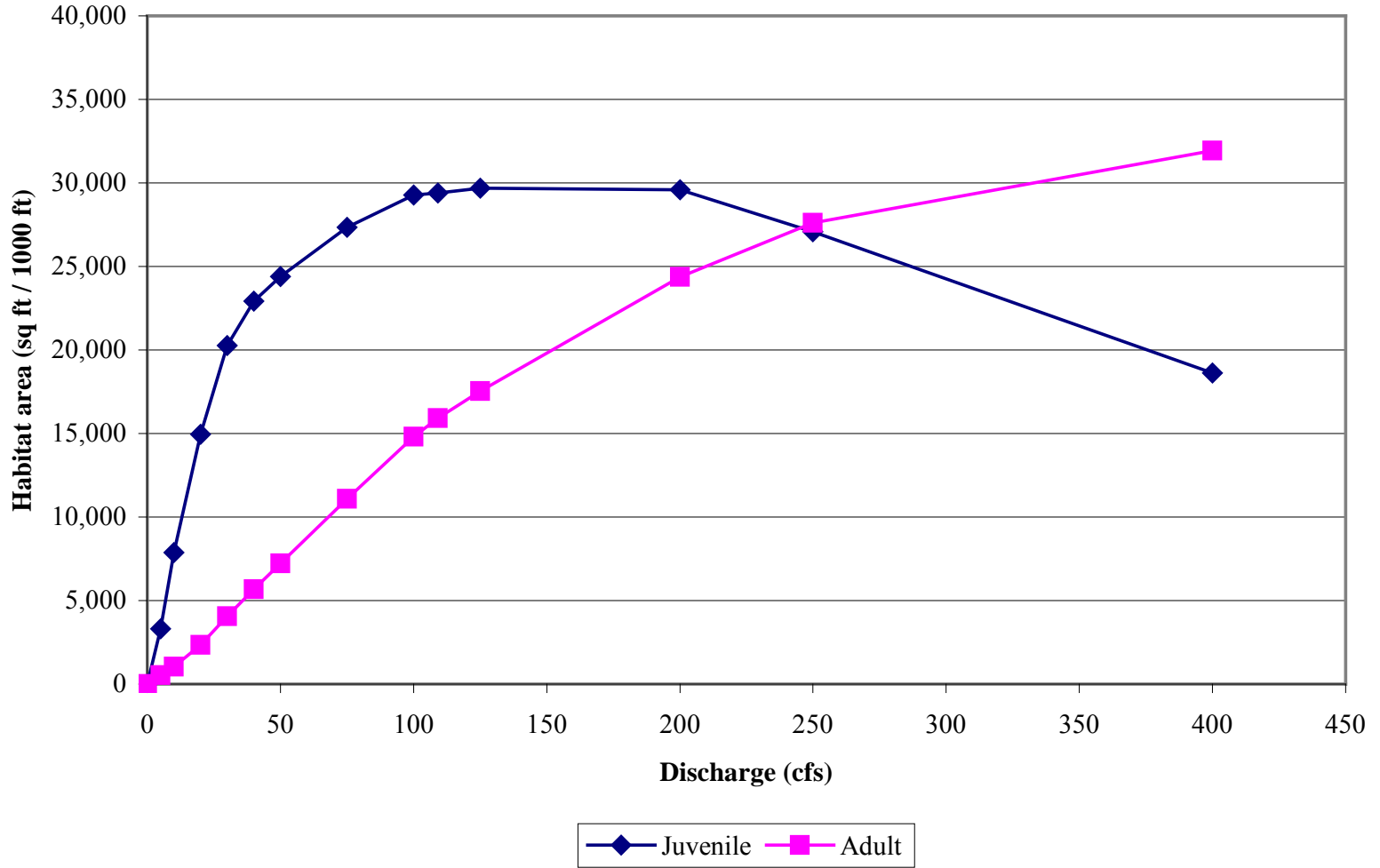
# Habitat flow relationships

## Southern reaches

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### Rainbow Trout Habitat versus Discharge, S. Platte Littleton

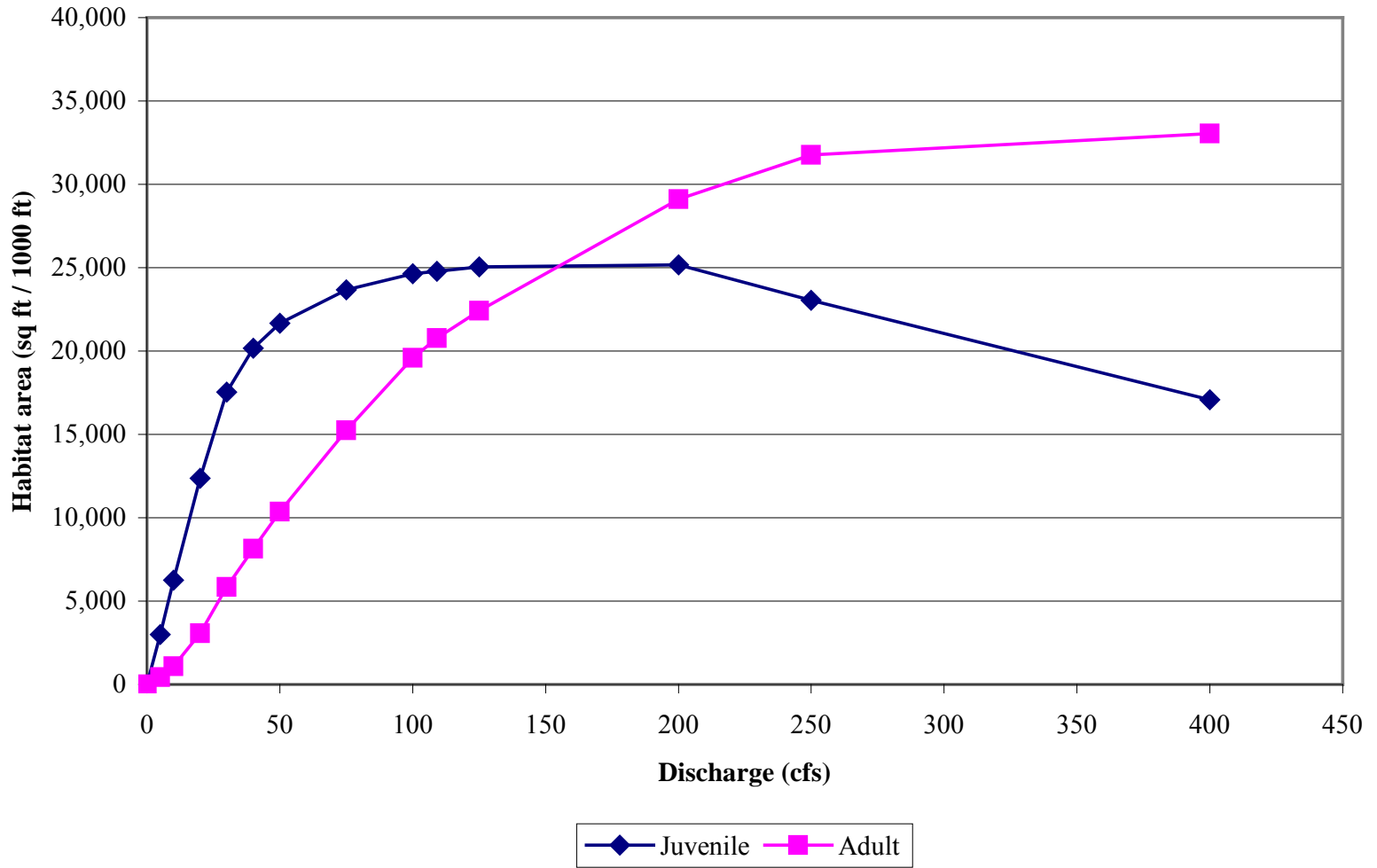


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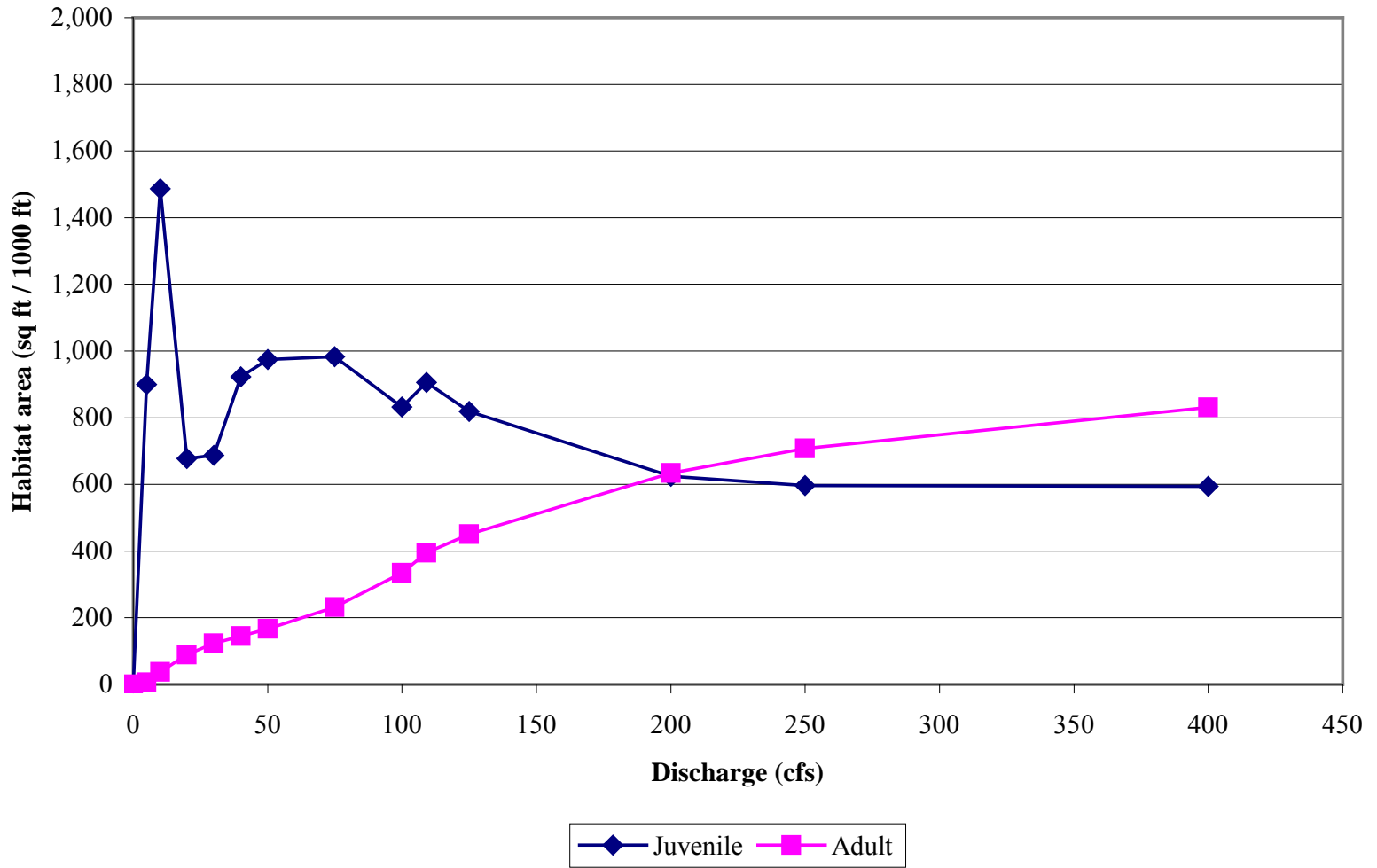
### Brown Trout Habitat versus Discharge, S. Platte Littleton



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Revision

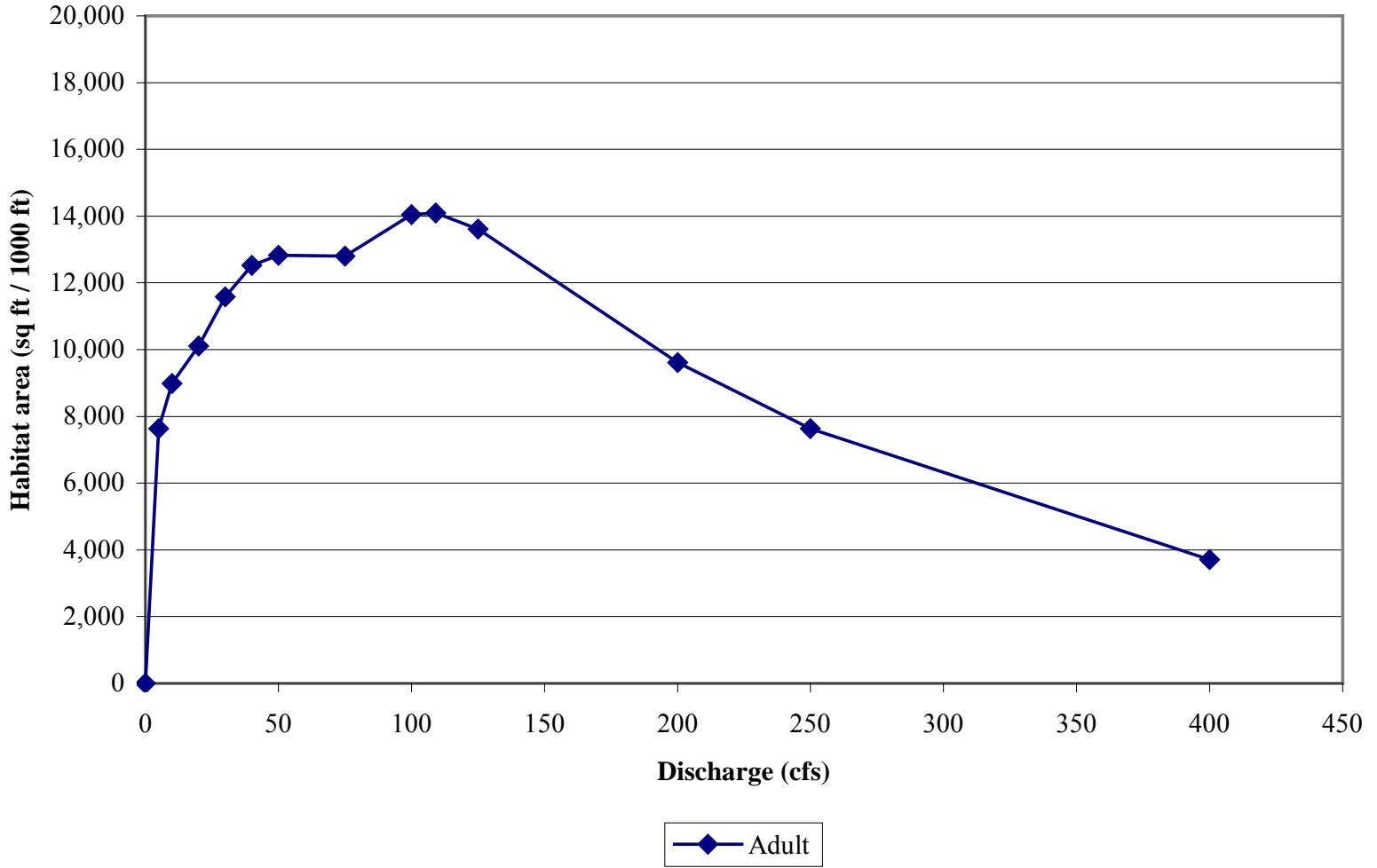
### Channel Catfish Habitat versus Discharge, S. Platte Littleton



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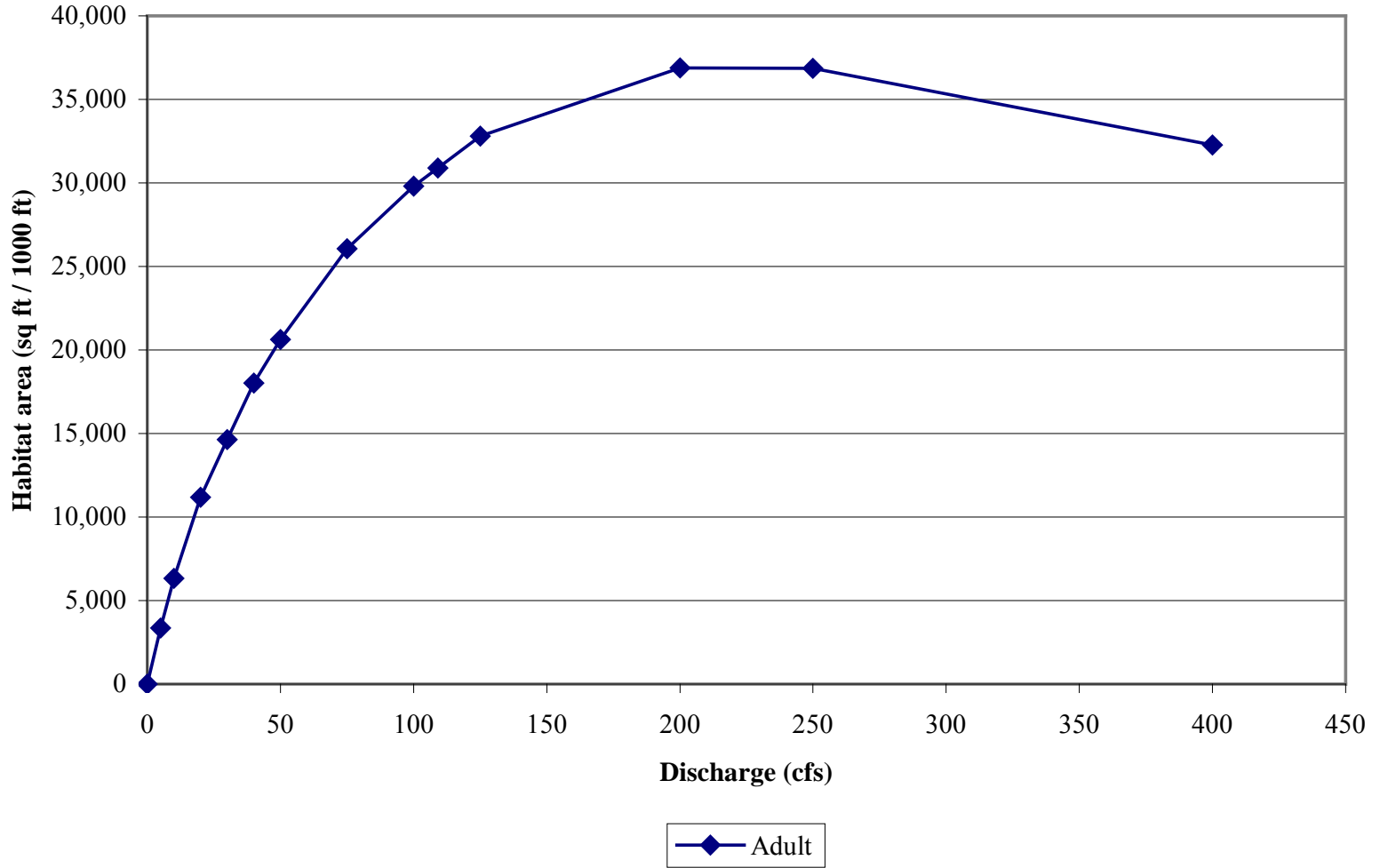
### Sand Shiner Habitat versus Discharge, S. Platte Littleton



November 17, 2006

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### Longnose Dace Habitat versus Discharge, S. Platte Littleton

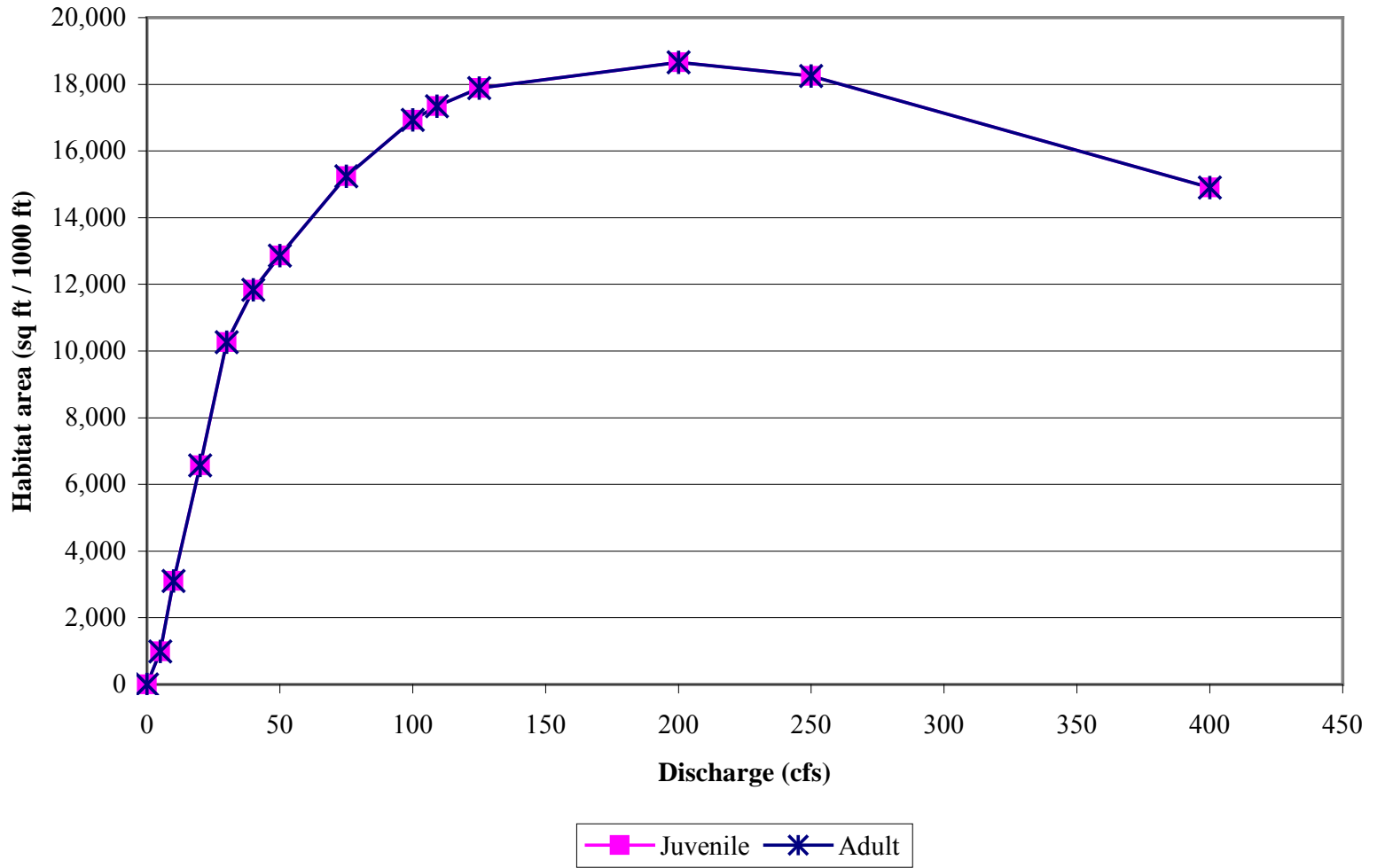


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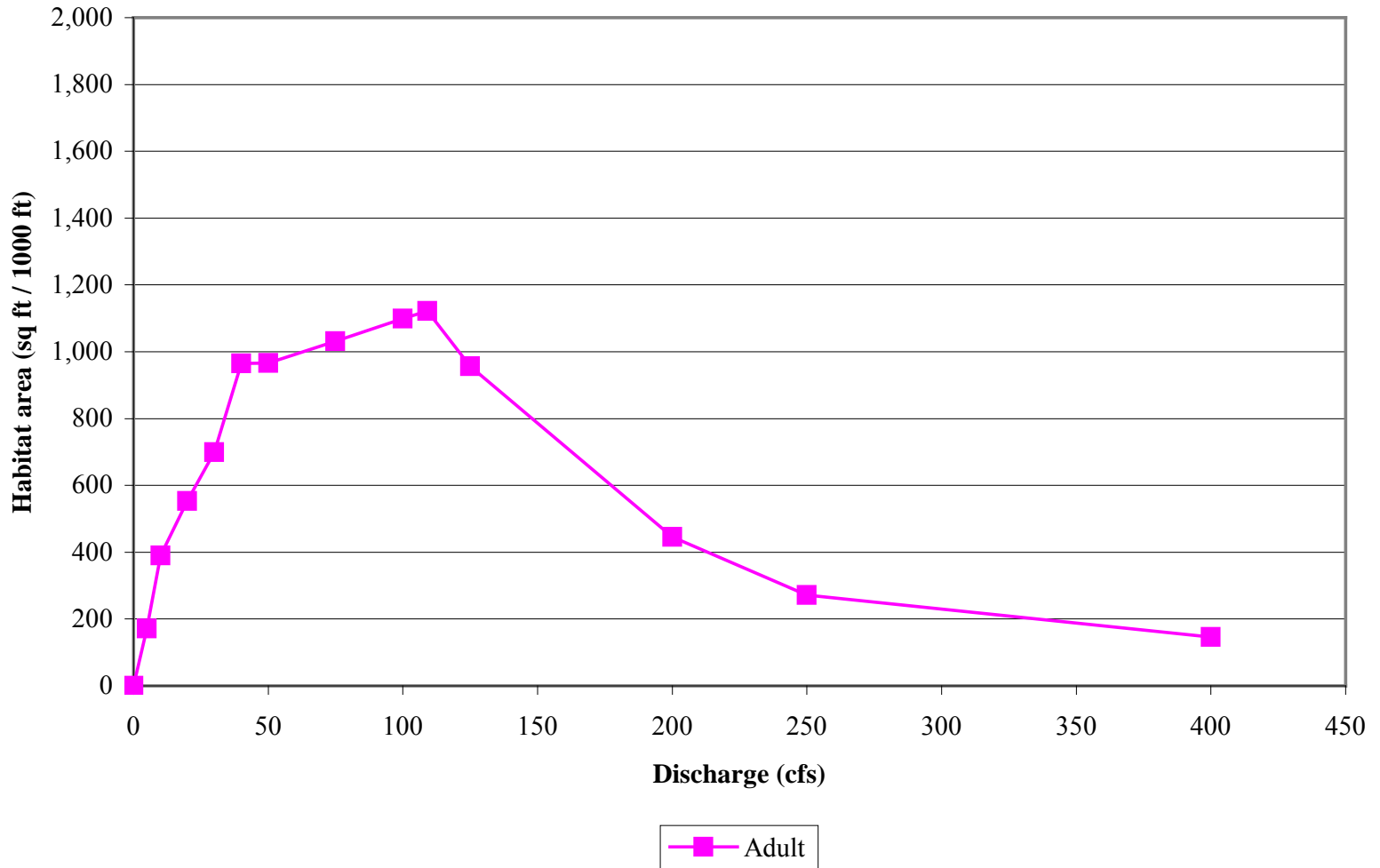
### White Sucker Habitat versus Discharge, S. Platte Littleton



November 17, 2006

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### Common Carp Habitat versus Discharge, S. Platte Littleton



November 17, 2006

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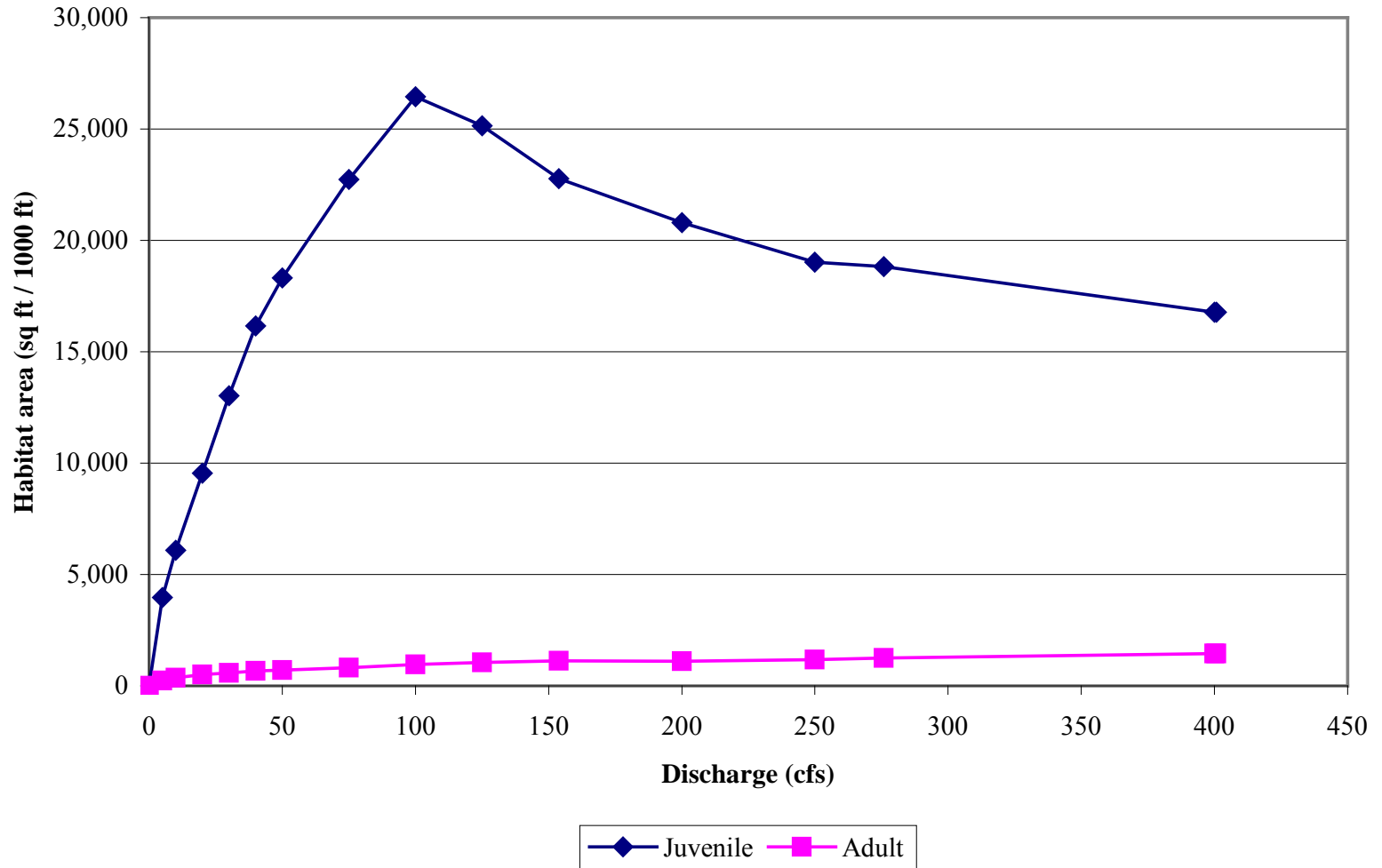
# Habitat flow relationships

## Middle reaches

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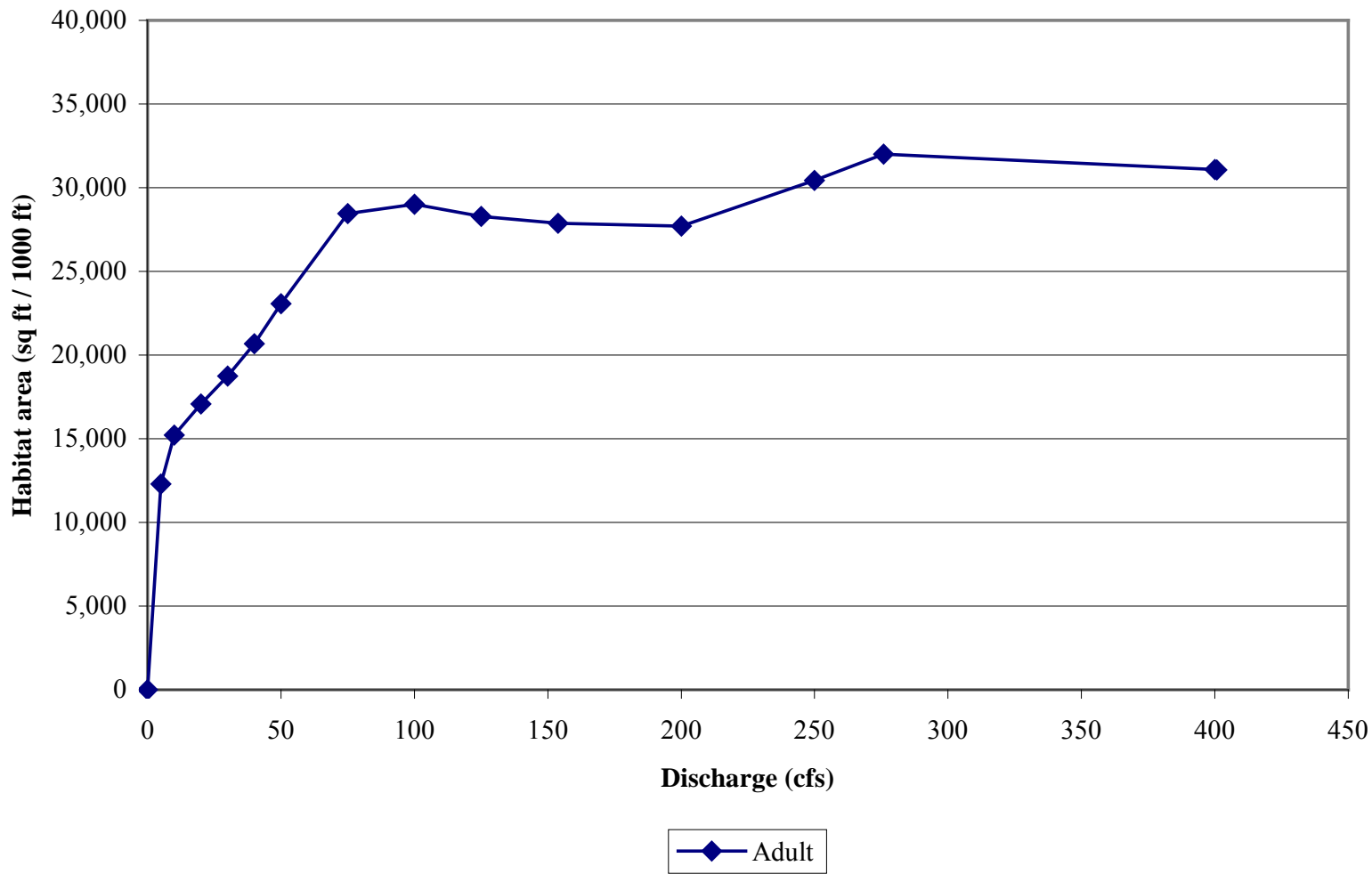
### Channel Catfish Habitat versus Discharge, S. Platte Franklin St.



November 17, 2006

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Revision

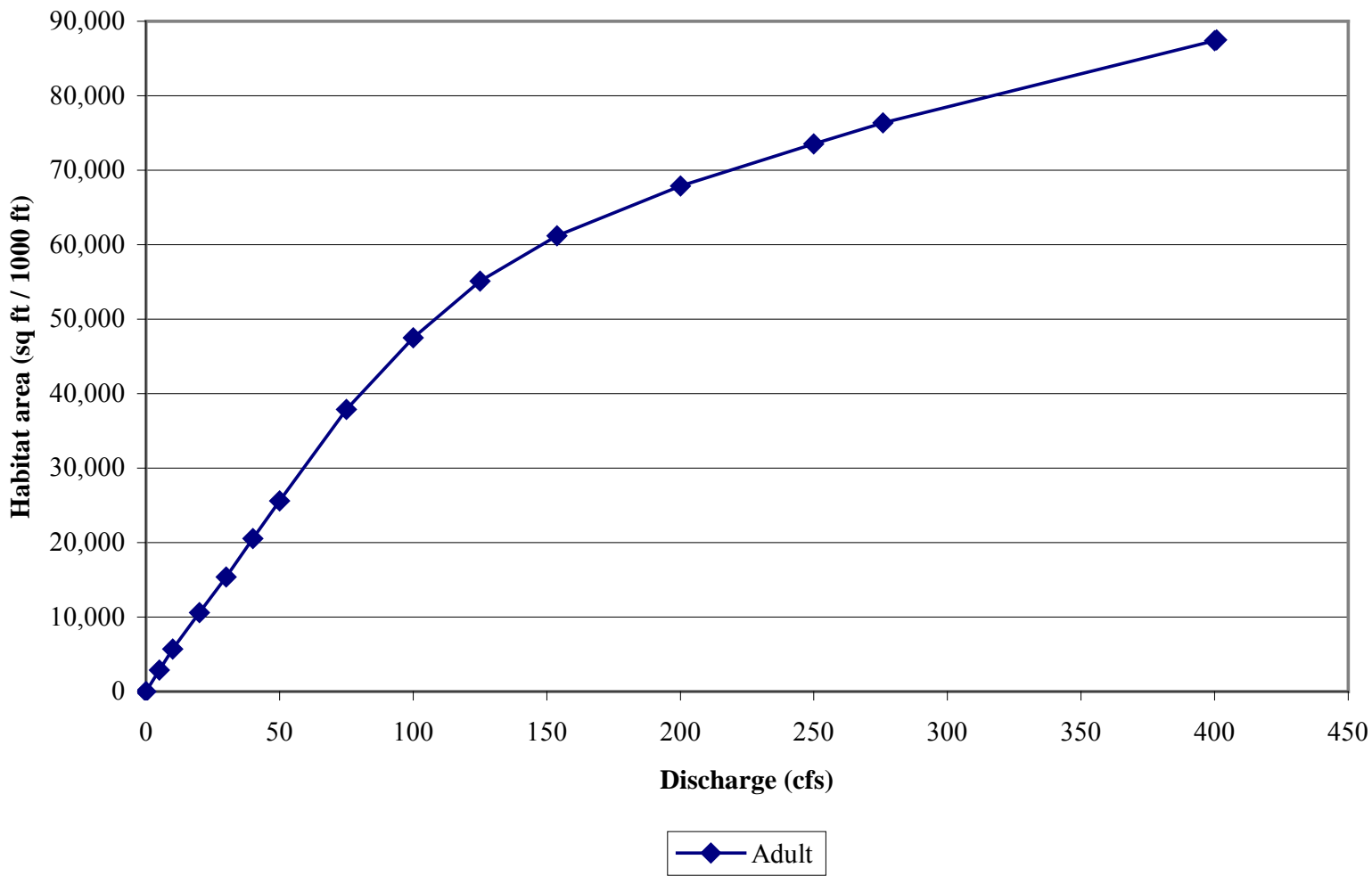
### Sand Shiner Habitat versus Discharge, S. Platte Franklin St.



November 17, 2006

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Revision

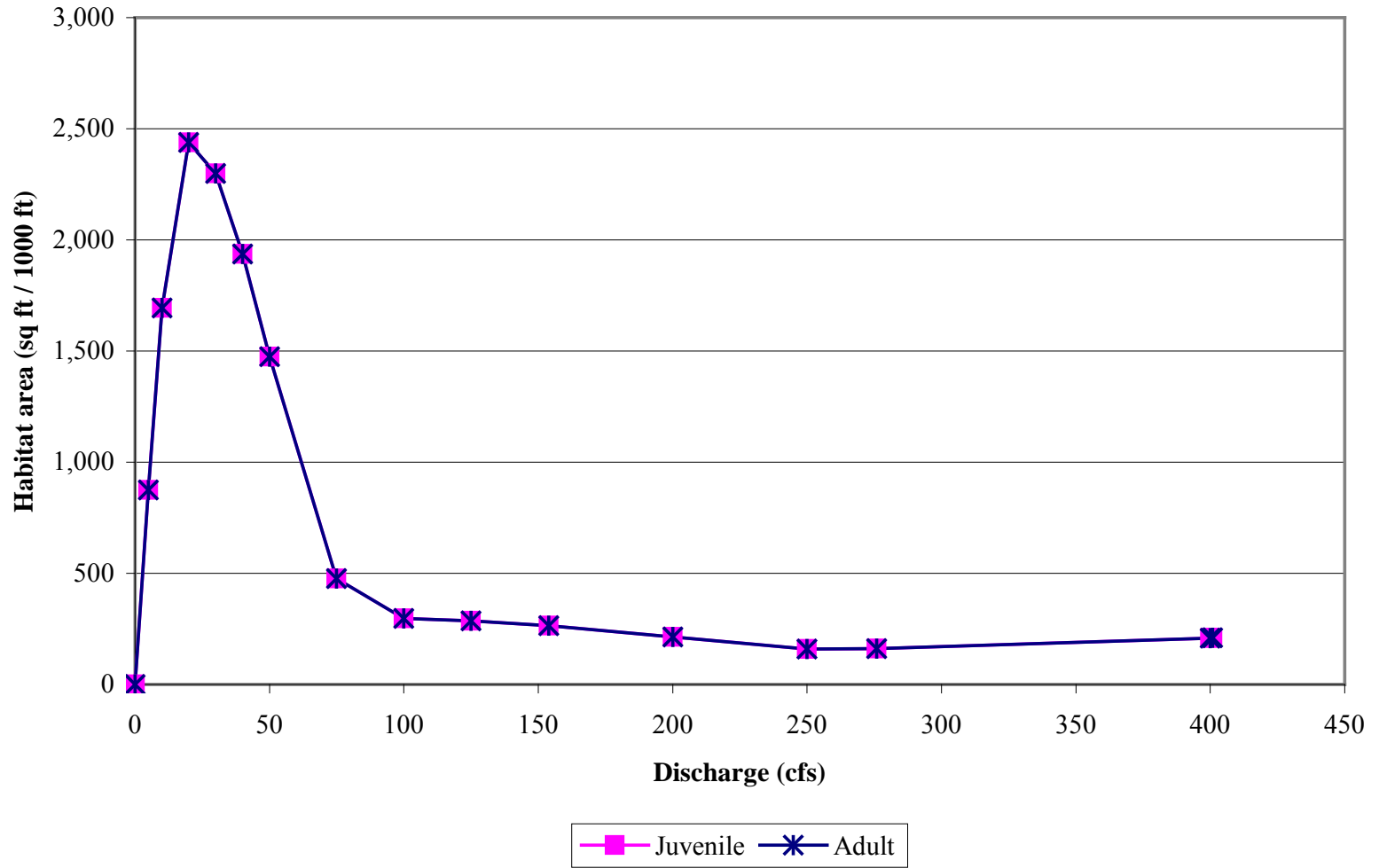
**Longnose Dace Habitat versus Discharge, S. Platte Franklin St.**



November 17, 2006

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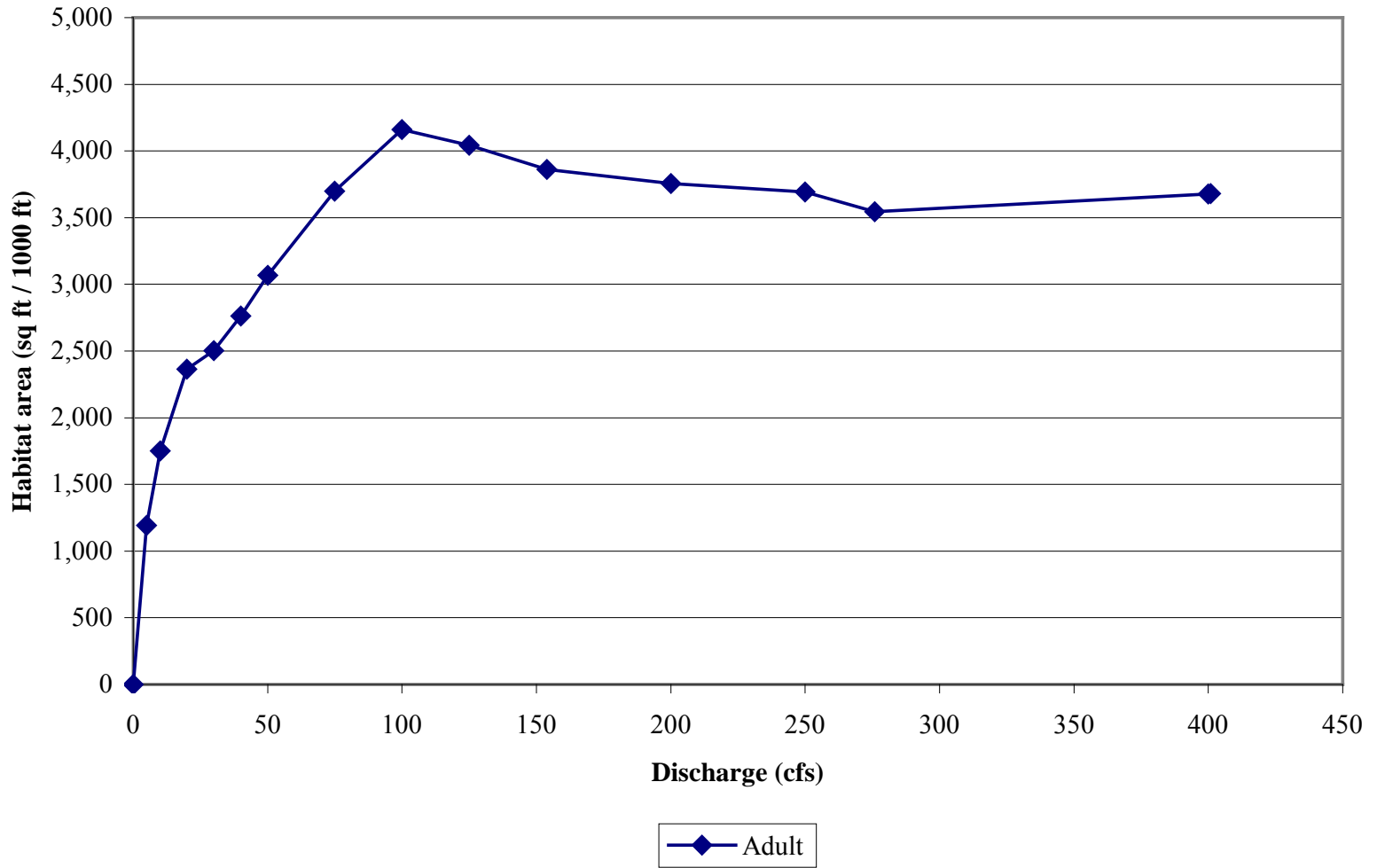
### White Sucker Habitat versus Discharge, S. Platte Franklin St.



November 17, 2006

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### Common Carp Habitat versus Discharge, S. Platte Franklin St.



November 17, 2006

Preliminary Results – Subject to  
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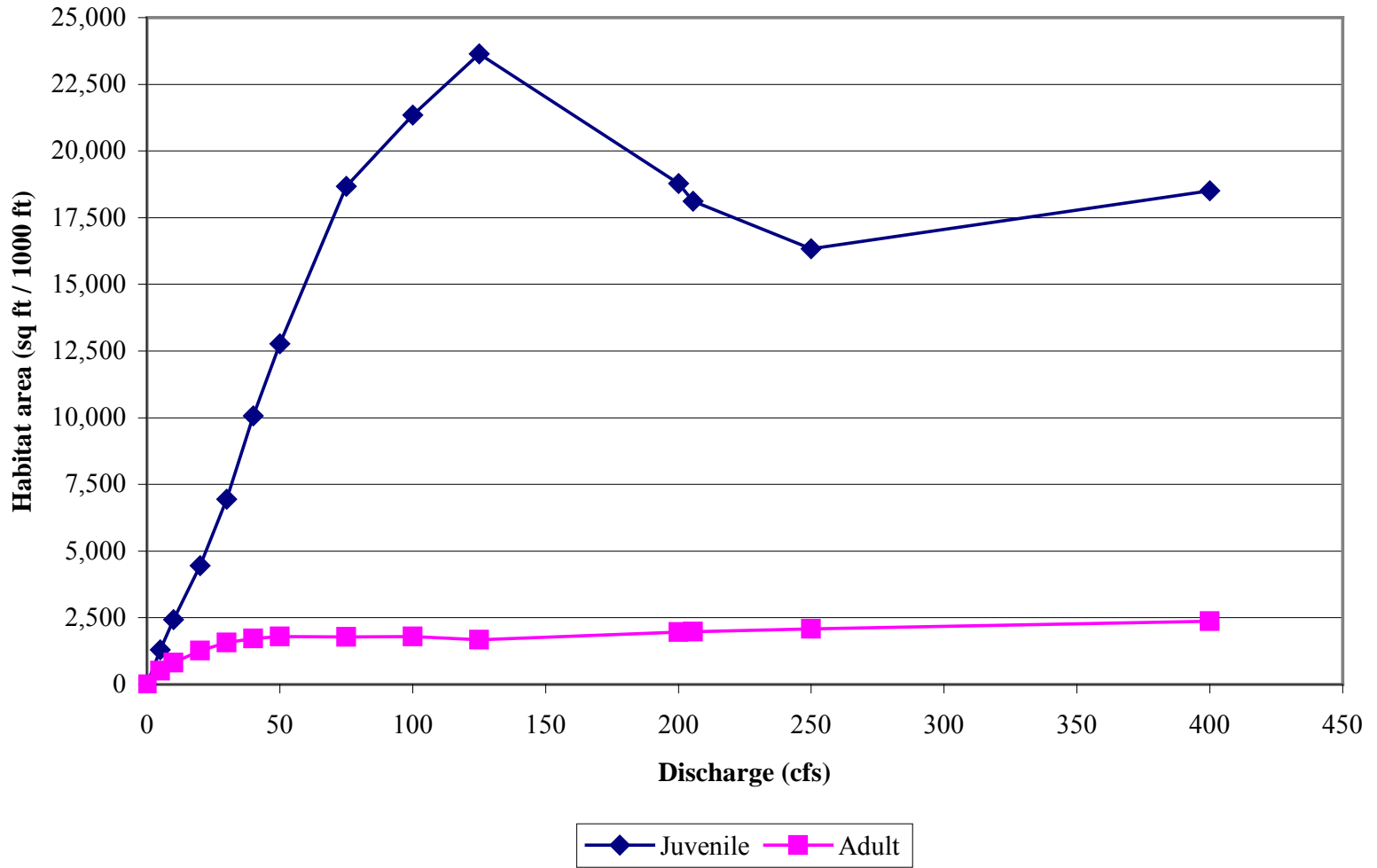
# Habitat flow relationships

## Northeastern reaches

November 17, 2006

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Revision

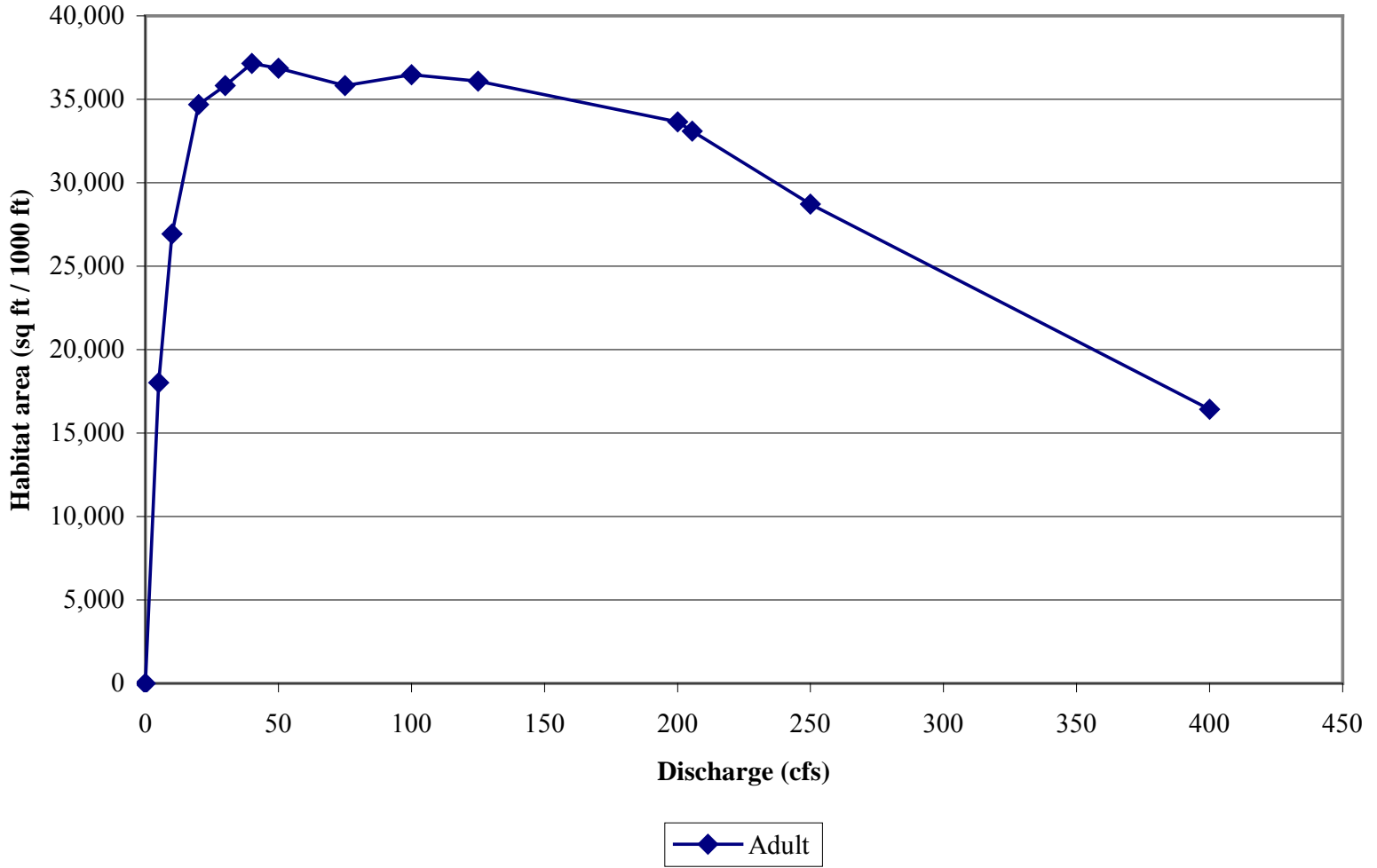
### Channel Catfish Habitat versus Discharge, S. Platte Downstream



November 17, 2006

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Revision

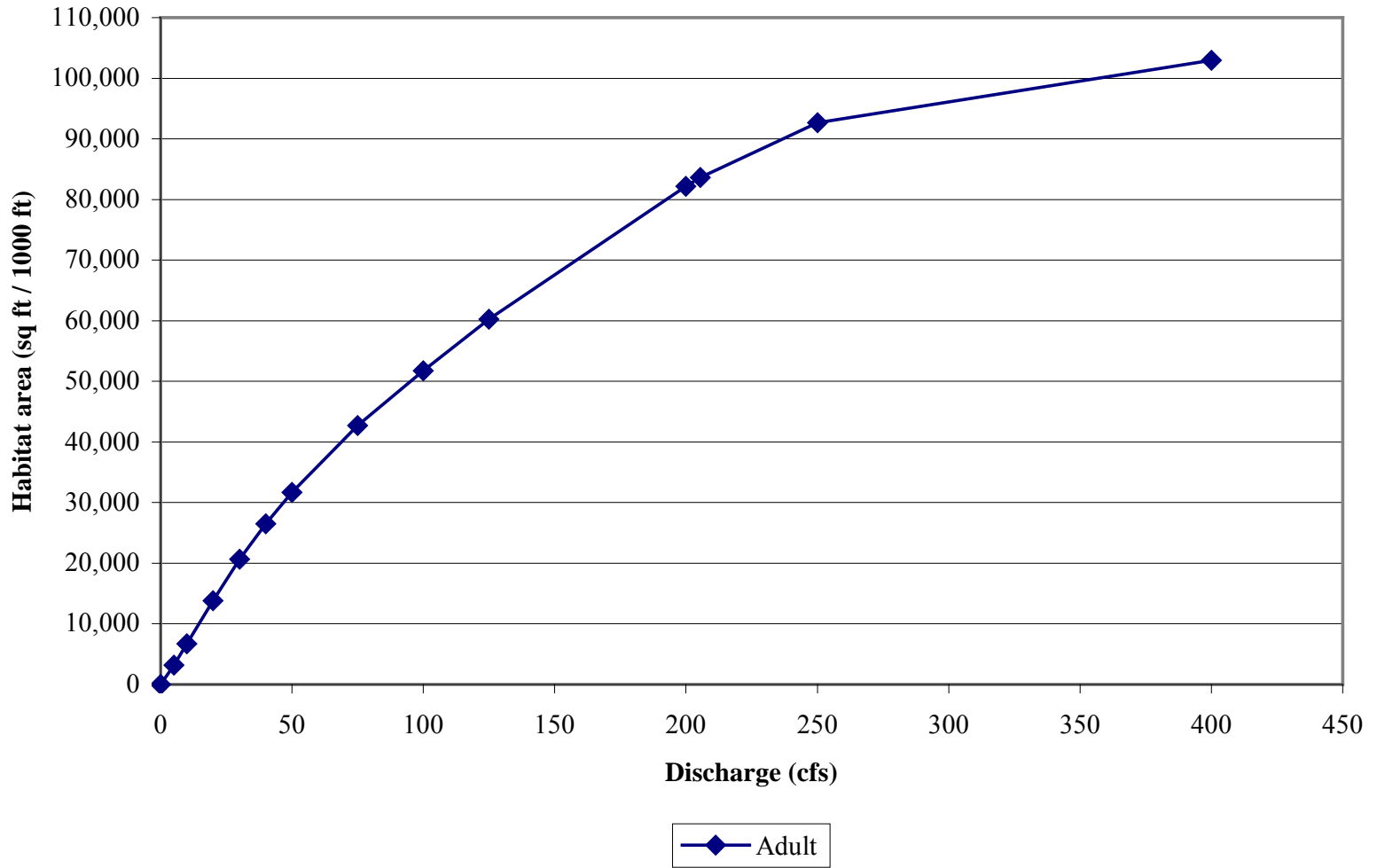
### Sand Shiner Habitat versus Discharge, S. Platte Downstream



November 17, 2006

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Revision

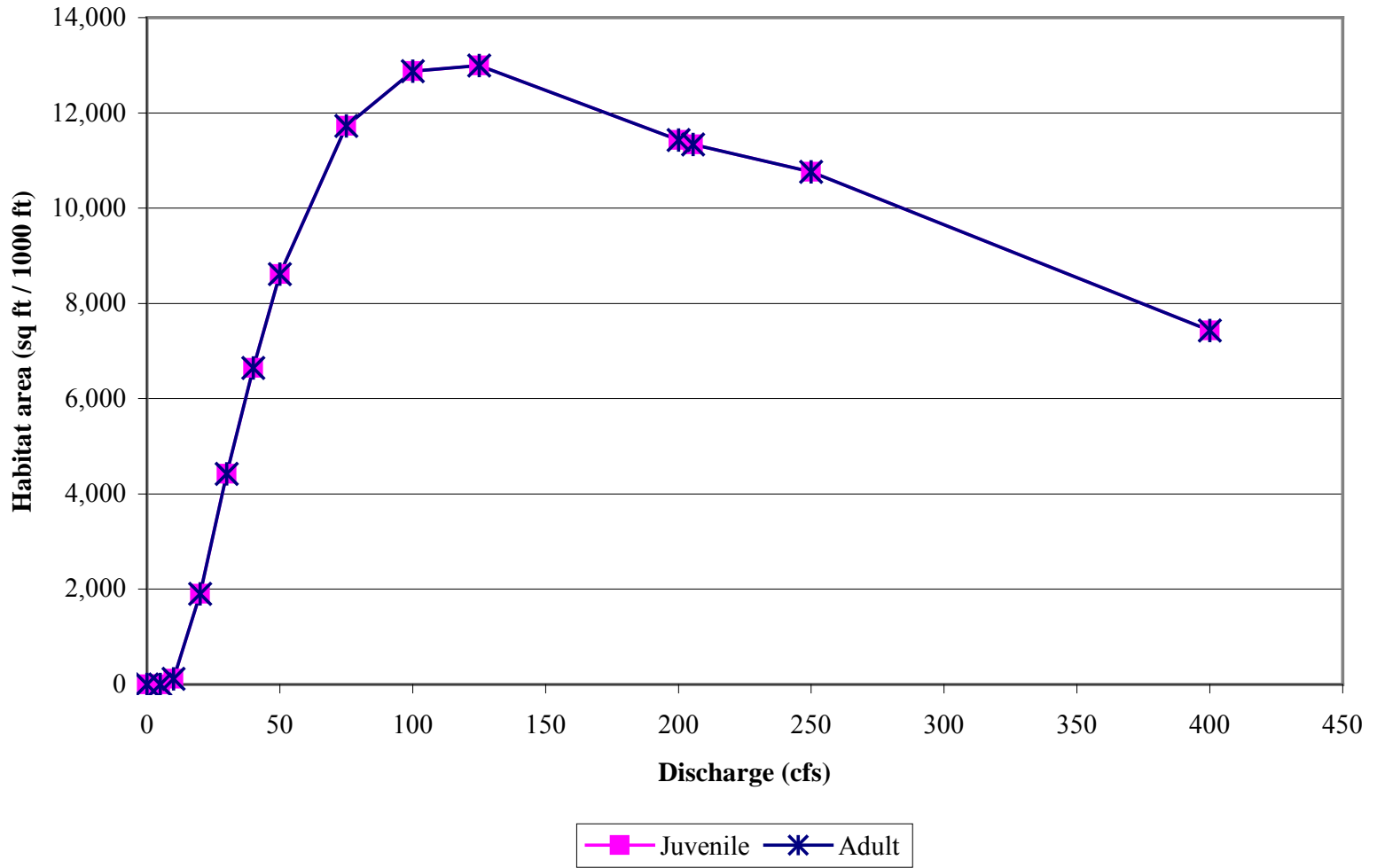
### Longnose Dace Habitat versus Discharge, S. Platte Downstream



November 17, 2006

Preliminary Results – Subject to  
Revision

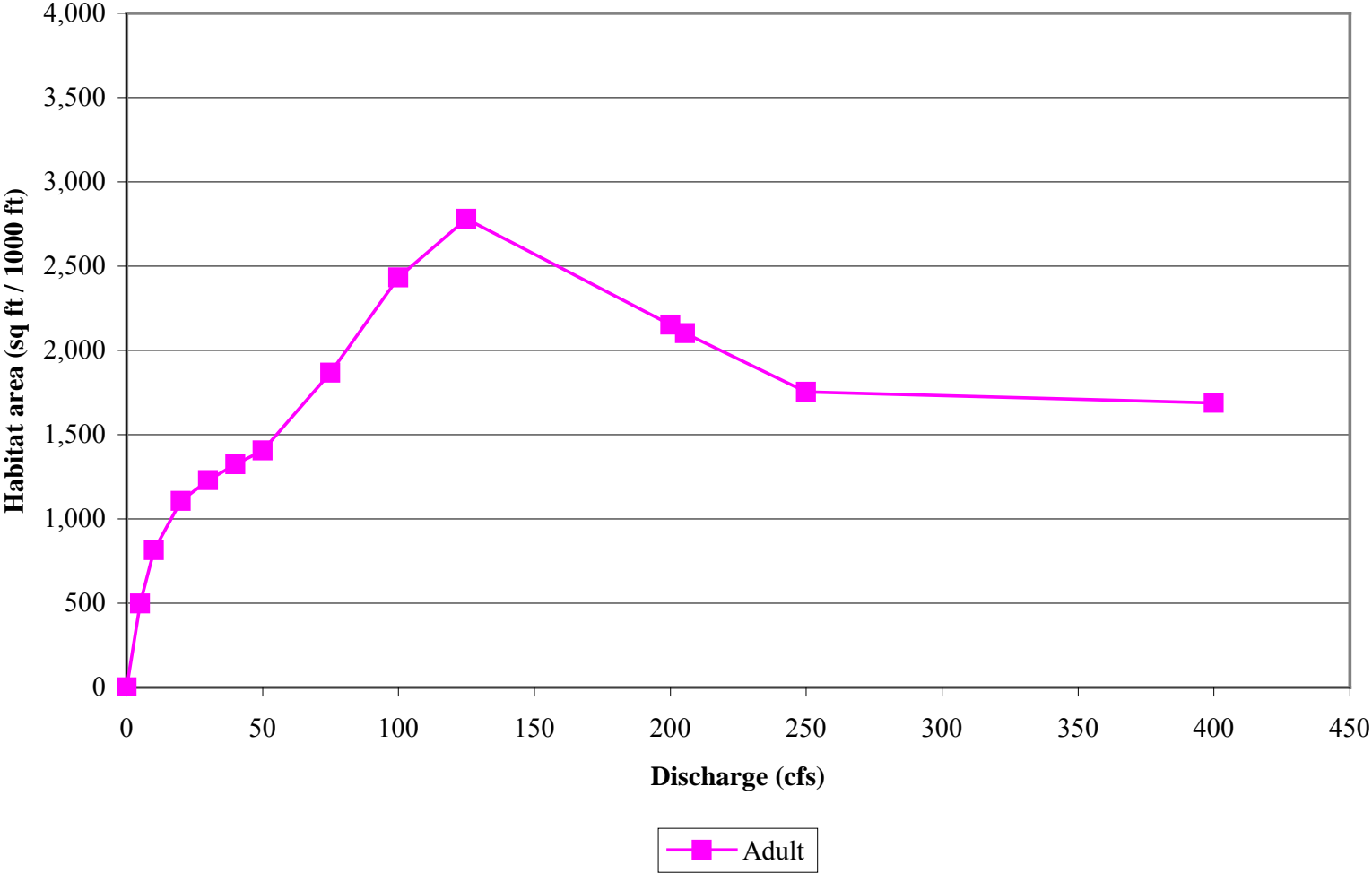
### White Sucker Habitat versus Discharge, S. Platte Downstream



November 17, 2006

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**Common Carp Habitat versus Discharge, S. Platte Downstream**



November 17, 2006

Preliminary Results – Subject to  
Revision

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**Attachment D**

Summary of Wet and Average Year Habitat Area Change for  
Fish Species of Interest

## List of Tables

Table 1. South Platte at Chatfield current conditions, percent change in habitat from reallocation to reallocation with environmental releases (ER), rainbow trout. ....	6
Table 2. South Platte at Chatfield current conditions, percent change in habitat from reallocation to reallocation with environmental releases (ER), brown trout. ....	6
Table 3. South Platte at Chatfield current conditions, percent change in habitat from reallocation to reallocation with environmental releases (ER), longnose dace. ....	7
Table 4. South Platte at Chatfield current conditions, percent change in habitat from reallocation to reallocation with environmental releases (ER), sand shiner. ....	7
Table 5. South Platte at Chatfield current conditions, percent change in habitat from reallocation to reallocation with environmental releases (ER), channel catfish. ....	8
Table 6. South Platte at Chatfield current conditions, percent change in habitat from reallocation to reallocation with environmental releases (ER), white sucker. ....	8
Table 7. South Platte at Chatfield current conditions, percent change in habitat from reallocation to reallocation with environmental releases (ER), common carp. ....	9
Table 8. South Platte at Chatfield buildout conditions, percent change in habitat from reallocation to reallocation with environmental releases (ER), rainbow trout. ....	9
Table 9. South Platte at Chatfield buildout conditions, percent change in habitat from reallocation to reallocation with environmental releases (ER), brown trout. ....	10
Table 10. South Platte at Chatfield buildout conditions, percent change in habitat from reallocation to reallocation with environmental releases (ER), longnose dace. ....	10
Table 11. South Platte at Chatfield buildout conditions, percent change in habitat from reallocation to reallocation with environmental releases (ER), sand shiner. ....	11
Table 12. South Platte at Chatfield buildout conditions, percent change in habitat from reallocation to reallocation with environmental releases (ER), channel catfish. ....	11
Table 13. South Platte at Chatfield buildout conditions, percent change in habitat from reallocation to reallocation with environmental releases (ER), white sucker. ....	12
Table 14. South Platte at Chatfield buildout conditions, percent change in habitat from reallocation to reallocation with environmental releases (ER), common carp. ....	12
Table 15. South Platte at Burlington Ditch current conditions, percent change in habitat from reallocation to reallocation with environmental releases (ER), longnose dace. ....	13
Table 16. South Platte at Burlington Ditch current conditions, percent change in habitat from reallocation to reallocation with environmental releases (ER), sand shiner. ....	13
Table 17. South Platte at Burlington Ditch current conditions, percent change in habitat from reallocation to reallocation with environmental releases (ER), channel catfish. ....	14
Table 18. South Platte at Burlington Ditch current conditions, percent change in habitat from reallocation to reallocation with environmental releases (ER), white sucker. ....	14
Table 19. South Platte at Burlington Ditch current conditions, percent change in habitat from reallocation to reallocation with environmental releases (ER), common carp. ....	15
Table 20. South Platte at Burlington Ditch buildout conditions, percent change in habitat from reallocation to reallocation with environmental releases (ER), longnose dace. ....	15
Table 21. South Platte at Burlington Ditch buildout conditions, percent change in habitat from reallocation to reallocation with environmental releases (ER), sand shiner. ....	16
Table 22. South Platte at Burlington Ditch buildout conditions, percent change in habitat from reallocation to reallocation with environmental releases (ER), channel catfish. ....	16



Table 23. South Platte at Burlington Ditch buildout conditions, percent change in habitat from reallocation to reallocation with environmental releases (ER), white sucker. .... 17

Table 24. South Platte at Burlington Ditch buildout conditions, percent change in habitat from reallocation to reallocation with environmental releases (ER), common carp. .... 17

**List of Figures**

Figure 1. Comparison of habitat area, South Platte at Chatfield, current condition, average year, juvenile rainbow trout. .... 18

Figure 2. Comparison of habitat area, South Platte at Chatfield, current condition, wet year, juvenile rainbow trout. .... 18

Figure 3. Comparison of habitat area, South Platte at Chatfield, current condition, average year, adult rainbow trout. .... 19

Figure 4. Comparison of habitat area, South Platte at Chatfield, current condition, wet year, adult rainbow trout. .... 19

Figure 5. Comparison of habitat area, South Platte at Chatfield, current condition, average year, juvenile brown trout. .... 20

Figure 6. Comparison of habitat area, South Platte at Chatfield, current condition, wet year, juvenile brown trout. .... 20

Figure 7. Comparison of habitat area, South Platte at Chatfield, current condition, average year, adult brown trout. .... 21

Figure 8. Comparison of habitat area, South Platte at Chatfield, current condition, wet year, adult brown trout. .... 21

Figure 9. Comparison of habitat area, South Platte at Chatfield, current condition, average year, adult longnose dace. .... 22

Figure 10. Comparison of habitat area, South Platte at Chatfield, current condition, wet year, adult longnose dace. .... 22

Figure 11. Comparison of habitat area, South Platte at Chatfield, current condition, average year, adult sand shiner. .... 23

Figure 12. Comparison of habitat area, South Platte at Chatfield, current condition, wet year, adult sand shiner. .... 23

Figure 13. Comparison of habitat area, South Platte at Chatfield, current condition, average year, juvenile channel catfish. .... 24

Figure 14. Comparison of habitat area, South Platte at Chatfield, current condition, wet year, juvenile channel catfish. .... 24

Figure 15. Comparison of habitat area, South Platte at Chatfield, current condition, average year, adult channel catfish. .... 25

Figure 16. Comparison of habitat area, South Platte at Chatfield, current condition, wet year, adult channel catfish. .... 25

Figure 17. Comparison of habitat area, South Platte at Chatfield, current condition, average year, adult white sucker. .... 26

Figure 18. Comparison of habitat area, South Platte at Chatfield, current condition, wet year, adult white sucker. .... 26

Figure 19. Comparison of habitat area, South Platte at Chatfield, current condition, average year, adult common carp. .... 27

Figure 20. Comparison of habitat area, South Platte at Chatfield, current condition, wet year, adult common carp.....	27
Figure 21. Comparison of habitat area, South Platte at Chatfield, buildout condition, average year, juvenile rainbow trout.....	28
Figure 22. Comparison of habitat area, South Platte at Chatfield, buildout condition, wet year, juvenile rainbow trout.....	28
Figure 23. Comparison of habitat area, South Platte at Chatfield, buildout condition, average year, adult rainbow trout.....	29
Figure 24. Comparison of habitat area, South Platte at Chatfield, buildout condition, wet year, adult rainbow trout.....	29
Figure 25. Comparison of habitat area, South Platte at Chatfield, buildout condition, average year, juvenile brown trout.....	30
Figure 26. Comparison of habitat area, South Platte at Chatfield, buildout condition, wet year, juvenile brown trout.....	30
Figure 27. Comparison of habitat area, South Platte at Chatfield, buildout condition, average year, adult brown trout.....	31
Figure 28. Comparison of habitat area, South Platte at Chatfield, buildout condition, wet year, adult brown trout.....	31
Figure 29. Comparison of habitat area, South Platte at Chatfield, buildout condition, average year, adult longnose dace.....	32
Figure 30. Comparison of habitat area, South Platte at Chatfield, buildout condition, wet year, adult longnose dace.....	32
Figure 31. Comparison of habitat area, South Platte at Chatfield, buildout condition, average year, adult sand shiner.....	33
Figure 32. Comparison of habitat area, South Platte at Chatfield, buildout condition, wet year, adult sand shiner.....	33
Figure 33. Comparison of habitat area, South Platte at Chatfield, buildout condition, average year, juvenile channel catfish.....	34
Figure 34. Comparison of habitat area, South Platte at Chatfield, buildout condition, wet year, juvenile channel catfish.....	34
Figure 35. Comparison of habitat area, South Platte at Chatfield, buildout condition, average year, adult channel catfish.....	35
Figure 36. Comparison of habitat area, South Platte at Chatfield, buildout condition, wet year, adult channel catfish.....	35
Figure 37. Comparison of habitat area, South Platte at Chatfield, buildout condition, average year, adult white sucker.....	36
Figure 38. Comparison of habitat area, South Platte at Chatfield, buildout condition, wet year, adult white sucker.....	36
Figure 39. Comparison of habitat area, South Platte at Chatfield, buildout condition, average year, adult common carp.....	37
Figure 40. Comparison of habitat area, South Platte at Chatfield, buildout condition, wet year, adult common carp.....	37
Figure 41. Comparison of habitat area, South Platte at Burlington, current condition, average year, adult longnose dace.....	38
Figure 42. Comparison of habitat area, South Platte at Burlington, current condition, wet year, adult longnose dace.....	38

Figure 43. Comparison of habitat area, South Platte at Burlington, current condition, average year, adult sand shiner. ....	39
Figure 44. Comparison of habitat area, South Platte at Burlington, current condition, wet year, adult sand shiner. ....	39
Figure 45. Comparison of habitat area, South Platte at Burlington, current condition, average year, juvenile channel catfish. ....	40
Figure 46. Comparison of habitat area, South Platte at Burlington, current condition, wet year, juvenile channel catfish. ....	40
Figure 47. Comparison of habitat area, South Platte at Burlington, current condition, average year, adult channel catfish. ....	41
Figure 48. Comparison of habitat area, South Platte at Burlington, current condition, wet year, adult channel catfish. ....	41
Figure 49. Comparison of habitat area, South Platte at Burlington, current condition, average year, adult white sucker. ....	42
Figure 50. Comparison of habitat area, South Platte at Burlington, current condition, wet year, adult white sucker. ....	42
Figure 51. Comparison of habitat area, South Platte at Burlington, current condition, average year, adult common carp. ....	43
Figure 52. Comparison of habitat area, South Platte at Burlington, current condition, wet year, adult common carp. ....	43
Figure 53. Comparison of habitat area, South Platte at Burlington, buildout condition, average year, adult longnose dace. ....	44
Figure 54. Comparison of habitat area, South Platte at Burlington, buildout condition, wet year, adult longnose dace. ....	44
Figure 55. Comparison of habitat area, South Platte at Burlington, buildout condition, average year, adult sand shiner. ....	45
Figure 56. Comparison of habitat area, South Platte at Burlington, buildout condition, wet year, adult sand shiner. ....	45
Figure 57. Comparison of habitat area, South Platte at Burlington, buildout condition, average year, juvenile channel catfish. ....	46
Figure 58. Comparison of habitat area, South Platte at Burlington, buildout condition, wet year, juvenile channel catfish. ....	46
Figure 59. Comparison of habitat area, South Platte at Burlington, buildout condition, average year, adult channel catfish. ....	47
Figure 60. Comparison of habitat area, South Platte at Burlington, buildout condition, wet year, adult channel catfish. ....	47
Figure 61. Comparison of habitat area, South Platte at Burlington, buildout condition, average year, adult white sucker. ....	48
Figure 62. Comparison of habitat area, South Platte at Burlington, buildout condition, wet year, adult white sucker. ....	48
Figure 63. Comparison of habitat area, South Platte at Burlington, buildout condition, average year, adult common carp. ....	49
Figure 64. Comparison of habitat area, South Platte at Burlington, buildout condition, wet year, adult common carp. ....	49

**Table 1. South Platte at Chatfield current conditions, percent change in habitat from reallocation to reallocation with environmental releases (ER), rainbow trout.**

	Average change in rainbow trout habitat by month			
	Adult		Juvenile	
	Wet	Average	Wet	Average
<b>October</b>	-4.3%	-20.6%	-0.4%	-4.6%
<b>November</b>	-11.8%	27.1%	-1.9%	22.4%
<b>December</b>	6.1%	69.5%	3.9%	67.1%
<b>January</b>	14.8%	44.1%	7.9%	36.2%
<b>February</b>	13.1%	46.8%	5.7%	34.8%
<b>March</b>	6.4%	-2.8%	0.0%	1.1%
<b>April</b>	-11.5%	-8.3%	-5.4%	0.0%
<b>May</b>	-16.4%	-7.5%	-16.4%	5.4%
<b>June</b>	-4.6%	-4.3%	-4.6%	-1.2%
<b>July</b>	1.6%	13.5%	1.6%	-2.4%
<b>August</b>	1.3%	2.5%	-1.2%	-1.1%
<b>September</b>	1.8%	-3.6%	0.7%	-0.4%

**Table 2. South Platte at Chatfield current conditions, percent change in habitat from reallocation to reallocation with environmental releases (ER), brown trout.**

	Average change in brown trout habitat by month			
	Adult		Juvenile	
	Wet	Average	Wet	Average
<b>October</b>	-3.3%	-18.5%	-0.3%	-3.8%
<b>November</b>	-10.1%	29.8%	-1.5%	22.5%
<b>December</b>	6.6%	77.5%	4.3%	66.2%
<b>January</b>	15.8%	51.4%	8.9%	37.8%
<b>February</b>	13.6%	52.7%	6.5%	37.1%
<b>March</b>	6.2%	-1.2%	0.0%	1.6%
<b>April</b>	-10.0%	-6.1%	-5.5%	-0.3%
<b>May</b>	-16.4%	-4.6%	-16.4%	4.7%
<b>June</b>	-4.6%	-3.5%	-4.6%	-1.7%
<b>July</b>	1.6%	10.9%	1.6%	-2.1%
<b>August</b>	0.9%	2.0%	-0.8%	-1.0%
<b>September</b>	1.7%	-2.8%	0.5%	-0.2%

**Table 3. South Platte at Chatfield current conditions, percent change in habitat from reallocation to reallocation with environmental releases (ER), longnose dace.**

	Average change in longnose dace habitat by month			
	Juvenile		Adult	
	Wet	Average	Wet	Average
October			-1.8%	-10.0%
November			-5.2%	21.7%
December			4.6%	60.7%
January			8.8%	32.7%
February			7.9%	32.6%
March			0.0%	0.2%
April			-7.2%	-3.3%
May			-16.4%	0.5%
June			-4.6%	-2.4%
July			1.6%	4.6%
August			0.1%	0.7%
September			1.3%	-1.2%

**Table 4. South Platte at Chatfield current conditions, percent change in habitat from reallocation to reallocation with environmental releases (ER), sand shiner.**

	Average change in sand shiner habitat by month			
	Juvenile		Adult	
	Wet	Average	Wet	Average
October			0.4%	-1.4%
November			-0.5%	10.7%
December			2.1%	26.2%
January			4.1%	9.8%
February			2.9%	12.3%
March			0.0%	-0.3%
April			-4.4%	4.0%
May			-16.4%	12.5%
June			-4.6%	-0.2%
July			1.6%	-22.0%
August			-3.7%	-5.9%
September			0.8%	-0.6%

**Table 5. South Platte at Chatfield current conditions, percent change in habitat from reallocation to reallocation with environmental releases (ER), channel catfish.**

	Average change in channel catfish habitat by month			
	Juvenile		Adult	
	Wet	Average	Wet	Average
<b>October</b>	0.8%	-0.4%	-6.4%	-16.6%
<b>November</b>	0.8%	6.2%	-13.0%	27.6%
<b>December</b>	3.6%	-20.3%	4.3%	80.9%
<b>January</b>	5.1%	-55.4%	9.1%	44.0%
<b>February</b>	5.1%	-38.1%	7.8%	40.4%
<b>March</b>	0.0%	4.9%	4.7%	-10.1%
<b>April</b>	-5.6%	2.8%	-12.7%	-12.6%
<b>May</b>	-16.4%	3.0%	-16.4%	-7.3%
<b>June</b>	-4.6%	-3.5%	-4.6%	-4.5%
<b>July</b>	1.6%	-12.5%	1.6%	14.1%
<b>August</b>	0.7%	-2.4%	1.4%	2.7%
<b>September</b>	-0.7%	-0.7%	2.7%	-6.4%

**Table 6. South Platte at Chatfield current conditions, percent change in habitat from reallocation to reallocation with environmental releases (ER), white sucker.**

	Average change in white sucker habitat by month			
	Juvenile		Adult	
	Wet	Average	Wet	Average
<b>October</b>	-1.0%	-6.9%	-1.0%	-6.9%
<b>November</b>	-3.3%	25.3%	-3.3%	25.3%
<b>December</b>	4.9%	73.7%	4.9%	73.7%
<b>January</b>	10.4%	42.0%	10.4%	42.0%
<b>February</b>	7.4%	41.7%	7.4%	41.7%
<b>March</b>	2.9%	0.4%	0.0%	0.4%
<b>April</b>	-6.3%	-1.3%	-6.3%	-1.3%
<b>May</b>	-16.4%	2.2%	-16.4%	2.2%
<b>June</b>	-4.6%	-2.0%	-4.6%	-2.0%
<b>July</b>	1.6%	1.4%	1.6%	1.4%
<b>August</b>	-0.2%	0.0%	-0.2%	0.0%
<b>September</b>	1.1%	-0.8%	1.1%	-0.8%

**Table 7. South Platte at Chatfield current conditions, percent change in habitat from reallocation to reallocation with environmental releases (ER), common carp.**

**Average change in common carp habitat by month**

	<b>Juvenile</b>		<b>Adult</b>	
	<b>Wet</b>	<b>Average</b>	<b>Wet</b>	<b>Average</b>
<b>October</b>			0.5%	-3.4%
<b>November</b>			0.3%	21.6%
<b>December</b>			5.2%	57.7%
<b>January</b>			9.6%	24.6%
<b>February</b>			6.5%	27.3%
<b>March</b>			0.0%	3.2%
<b>April</b>			-6.6%	9.0%
<b>May</b>			-16.4%	17.8%
<b>June</b>			-4.6%	-2.2%
<b>July</b>			1.6%	-62.4%
<b>August</b>			-3.0%	-16.9%
<b>September</b>			-0.9%	-1.0%

**Table 8. South Platte at Chatfield buildout conditions, percent change in habitat from reallocation to reallocation with environmental releases (ER), rainbow trout.**

**Average change in rainbow trout habitat by month**

	<b>Adult</b>		<b>Juvenile</b>	
	<b>Wet</b>	<b>Average</b>	<b>Wet</b>	<b>Average</b>
<b>October</b>	2.5%	-27.5%	0.3%	-10.2%
<b>November</b>	7.8%	39.1%	2.1%	37.0%
<b>December</b>	11.2%	62.3%	4.2%	57.7%
<b>January</b>	14.2%	37.1%	6.4%	30.4%
<b>February</b>	12.9%	21.0%	5.2%	11.2%
<b>March</b>	5.8%	-33.6%	0.0%	-6.7%
<b>April</b>	2.4%	-4.8%	0.9%	-0.6%
<b>May</b>	-0.5%	-2.1%	-0.5%	0.3%
<b>June</b>	-0.4%	-1.4%	-0.4%	1.9%
<b>July</b>	-0.6%	4.5%	-0.3%	-0.4%
<b>August</b>	-2.4%	5.5%	2.2%	1.2%
<b>September</b>	-21.5%	-6.6%	-6.1%	-2.1%

**Table 9. South Platte at Chatfield buildout conditions, percent change in habitat from reallocation to reallocation with environmental releases (ER), brown trout.**

**Average change in brown trout habitat by month**

	<b>Adult</b>		<b>Juvenile</b>	
	<b>Wet</b>	<b>Average</b>	<b>Wet</b>	<b>Average</b>
<b>October</b>	2.0%	-29.7%	0.3%	-11.6%
<b>November</b>	7.1%	42.0%	1.8%	37.0%
<b>December</b>	11.1%	70.5%	4.4%	57.6%
<b>January</b>	14.7%	43.8%	7.2%	31.5%
<b>February</b>	13.2%	22.8%	5.8%	12.6%
<b>March</b>	5.6%	-30.3%	0.0%	-6.1%
<b>April</b>	2.1%	-3.8%	0.9%	-0.4%
<b>May</b>	-0.5%	-1.6%	-0.5%	0.3%
<b>June</b>	-0.4%	-0.6%	-0.4%	1.6%
<b>July</b>	-0.6%	3.8%	-0.3%	-0.4%
<b>August</b>	-1.5%	4.8%	1.9%	0.9%
<b>September</b>	-21.4%	-6.3%	-5.7%	-2.0%

**Table 10. South Platte at Chatfield buildout conditions, percent change in habitat from reallocation to reallocation with environmental releases (ER), longnose dace.**

**Average change in longnose dace habitat by month**

	<b>Juvenile</b>		<b>Adult</b>	
	<b>Wet</b>	<b>Average</b>	<b>Wet</b>	<b>Average</b>
<b>October</b>			1.3%	-13.2%
<b>November</b>			4.3%	34.7%
<b>December</b>			6.4%	51.8%
<b>January</b>			8.4%	27.3%
<b>February</b>			7.6%	12.1%
<b>March</b>			0.0%	-15.2%
<b>April</b>			1.5%	-2.2%
<b>May</b>			-0.5%	-0.5%
<b>June</b>			-0.4%	0.6%
<b>July</b>			-0.5%	1.6%
<b>August</b>			0.2%	3.1%
<b>September</b>			-10.2%	-3.4%



**Table 11. South Platte at Chatfield buildout conditions, percent change in habitat from reallocation to reallocation with environmental releases (ER), sand shiner.**

Average change in sand shiner habitat by month

	Juvenile		Adult	
	Wet	Average	Wet	Average
October			-0.4%	-4.8%
November			0.7%	23.4%
December			1.7%	18.1%
January			3.4%	8.8%
February			2.7%	5.6%
March			0.0%	-2.4%
April			0.1%	0.5%
May			-0.5%	1.6%
June			-0.4%	3.5%
July			0.1%	-3.6%
August			5.4%	0.2%
September			-1.2%	-1.2%

**Table 12. South Platte at Chatfield buildout conditions, percent change in habitat from reallocation to reallocation with environmental releases (ER), channel catfish.**

Average change in channel catfish habitat by month

	Juvenile		Adult	
	Wet	Average	Wet	Average
October	-1.4%	-7.0%	3.4%	-16.2%
November	0.4%	10.5%	7.0%	41.7%
December	3.6%	-38.0%	7.1%	70.7%
January	6.7%	-26.6%	8.2%	38.0%
February	5.8%	5.8%	7.3%	12.6%
March	0.0%	-2.5%	3.8%	-24.9%
April	0.1%	1.7%	2.2%	-7.2%
May	-0.5%	1.1%	-0.5%	-2.2%
June	-0.4%	0.2%	-0.4%	-1.4%
July	-0.5%	-1.5%	-0.6%	4.2%
August	0.6%	-0.6%	-2.3%	6.5%
September	5.2%	-0.3%	-21.6%	-5.5%

**Table 13. South Platte at Chatfield buildout conditions, percent change in habitat from reallocation to reallocation with environmental releases (ER), white sucker.**

**Average change in white sucker habitat by month**

	<b>Juvenile</b>		<b>Adult</b>	
	<b>Wet</b>	<b>Average</b>	<b>Wet</b>	<b>Average</b>
<b>October</b>	0.8%	-14.4%	0.8%	-14.4%
<b>November</b>	3.1%	40.4%	3.1%	40.4%
<b>December</b>	5.5%	64.7%	5.5%	64.7%
<b>January</b>	8.3%	35.7%	8.3%	35.7%
<b>February</b>	6.6%	14.8%	6.6%	14.8%
<b>March</b>	2.2%	-9.9%	0.0%	-9.9%
<b>April</b>	1.1%	-1.3%	1.1%	-1.3%
<b>May</b>	-0.5%	-0.1%	-0.5%	-0.1%
<b>June</b>	-0.4%	1.0%	-0.4%	1.0%
<b>July</b>	-0.4%	0.8%	-0.4%	0.8%
<b>August</b>	0.8%	2.0%	0.8%	2.0%
<b>September</b>	-9.8%	-3.0%	-9.8%	-3.0%

**Table 14. South Platte at Chatfield buildout conditions, percent change in habitat from reallocation to reallocation with environmental releases (ER), common carp.**

**Average change in common carp habitat by month**

	<b>Juvenile</b>		<b>Adult</b>	
	<b>Wet</b>	<b>Average</b>	<b>Wet</b>	<b>Average</b>
<b>October</b>			-2.0%	-13.9%
<b>November</b>			1.4%	34.5%
<b>December</b>			4.9%	47.1%
<b>January</b>			9.5%	21.9%
<b>February</b>			6.7%	13.3%
<b>March</b>			0.0%	-5.0%
<b>April</b>			-0.7%	2.2%
<b>May</b>			-0.5%	2.5%
<b>June</b>			-0.4%	3.8%
<b>July</b>			0.0%	-9.1%
<b>August</b>			7.8%	-0.5%
<b>September</b>			-0.1%	-2.5%

**Table 15. South Platte at Burlington Ditch current conditions, percent change in habitat from reallocation to reallocation with environmental releases (ER), longnose dace.**

	Average change in longnose dace habitat by month			
	Juvenile		Adult	
	Wet	Average	Wet	Average
<b>October</b>			3.7%	25.6%
<b>November</b>			8.8%	6.7%
<b>December</b>			10.6%	19.3%
<b>January</b>			11.6%	15.7%
<b>February</b>			10.0%	11.7%
<b>March</b>			0.0%	4.8%
<b>April</b>			-2.0%	6.6%
<b>May</b>			-9.6%	1.4%
<b>June</b>			-8.5%	-3.5%
<b>July</b>			-1.3%	-2.9%
<b>August</b>			2.7%	-1.4%
<b>September</b>			-11.5%	-6.7%

**Table 16. South Platte at Burlington Ditch current conditions, percent change in habitat from reallocation to reallocation with environmental releases (ER), sand shiner.**

	Average change in sand shiner habitat by month			
	Juvenile		Adult	
	Wet	Average	Wet	Average
<b>October</b>			-1.7%	13.4%
<b>November</b>			-0.5%	0.2%
<b>December</b>			-0.7%	4.7%
<b>January</b>			-0.7%	3.7%
<b>February</b>			0.1%	1.1%
<b>March</b>			0.0%	0.4%
<b>April</b>			-5.4%	3.3%
<b>May</b>			-9.6%	0.2%
<b>June</b>			-8.5%	0.3%
<b>July</b>			8.4%	1.0%
<b>August</b>			1.0%	2.0%
<b>September</b>			-0.4%	0.0%

**Table 17. South Platte at Burlington Ditch current conditions, percent change in habitat from reallocation to reallocation with environmental releases (ER), channel catfish.**

	Average change in channel catfish habitat by month			
	Juvenile		Adult	
	Wet	Average	Wet	Average
<b>October</b>	1.0%	17.5%	6.1%	22.6%
<b>November</b>	0.1%	1.8%	3.7%	8.8%
<b>December</b>	0.0%	11.4%	11.9%	19.0%
<b>January</b>	-0.4%	9.1%	12.2%	16.1%
<b>February</b>	-0.7%	5.5%	8.0%	14.2%
<b>March</b>	1.7%	1.9%	0.0%	6.3%
<b>April</b>	-2.3%	4.4%	-5.9%	6.8%
<b>May</b>	-9.6%	0.6%	-9.6%	1.5%
<b>June</b>	-8.5%	-0.2%	-8.5%	-2.5%
<b>July</b>	-1.4%	-0.5%	-0.2%	-0.1%
<b>August</b>	2.8%	-0.9%	2.8%	0.9%
<b>September</b>	-0.1%	-0.6%	-14.9%	-6.6%

**Table 18. South Platte at Burlington Ditch current conditions, percent change in habitat from reallocation to reallocation with environmental releases (ER), white sucker.**

	Average change in white sucker habitat by month			
	Juvenile		Adult	
	Wet	Average	Wet	Average
<b>October</b>	4.8%	55.0%	4.8%	55.0%
<b>November</b>	2.2%	9.4%	2.2%	9.4%
<b>December</b>	9.8%	40.2%	9.8%	40.2%
<b>January</b>	9.5%	29.8%	9.5%	29.8%
<b>February</b>	5.2%	21.1%	5.2%	21.1%
<b>March</b>	-1.3%	7.8%	0.0%	7.8%
<b>April</b>	-74.4%	9.9%	-74.4%	9.9%
<b>May</b>	-9.6%	2.4%	-9.6%	2.4%
<b>June</b>	-8.5%	-1.8%	-8.5%	-1.8%
<b>July</b>	6.2%	0.6%	6.2%	0.6%
<b>August</b>	1.6%	1.2%	1.6%	1.2%
<b>September</b>	-13.0%	-5.8%	-13.0%	-5.8%

**Table 19. South Platte at Burlington Ditch current conditions, percent change in habitat from reallocation to reallocation with environmental releases (ER), common carp.**

	Average change in common carp habitat by month			
	Juvenile		Adult	
	Wet	Average	Wet	Average
October			4.0%	15.8%
November			5.3%	3.3%
December			10.9%	7.3%
January			11.6%	6.0%
February			11.2%	3.4%
March			0.0%	1.5%
April			-4.2%	4.0%
May			-9.6%	0.6%
June			-8.5%	-2.5%
July			2.4%	-0.3%
August			2.4%	1.8%
September			-9.7%	-4.6%

**Table 20. South Platte at Burlington Ditch buildout conditions, percent change in habitat from reallocation to reallocation with environmental releases (ER), longnose dace.**

	Average change in longnose dace habitat by month			
	Juvenile		Adult	
	Wet	Average	Wet	Average
October			3.1%	22.1%
November			4.7%	11.4%
December			4.2%	34.1%
January			4.3%	34.2%
February			3.3%	27.3%
March			0.0%	20.1%
April			2.0%	43.4%
May			-0.1%	3.4%
June			-0.2%	-9.9%
July			-0.9%	-4.7%
August			-2.2%	-2.7%
September			-15.7%	-6.3%

**Table 21. South Platte at Burlington Ditch buildout conditions, percent change in habitat from reallocation to reallocation with environmental releases (ER), sand shiner.**

	Average change in sand shiner habitat by month			
	Juvenile		Adult	
	Wet	Average	Wet	Average
October			-0.4%	19.1%
November			-0.2%	4.3%
December			-0.2%	20.0%
January			-0.2%	20.8%
February			-0.1%	13.1%
March			0.0%	8.0%
April			0.5%	41.8%
May			-0.1%	1.1%
June			-0.2%	-1.1%
July			-0.1%	0.5%
August			1.5%	0.3%
September			1.1%	-0.3%

**Table 22. South Platte at Burlington Ditch buildout conditions, percent change in habitat from reallocation to reallocation with environmental releases (ER), channel catfish.**

	Average change in channel catfish habitat by month			
	Juvenile		Adult	
	Wet	Average	Wet	Average
October	0.7%	19.6%	3.6%	20.6%
November	0.0%	6.9%	4.4%	12.8%
December	0.1%	23.8%	4.5%	30.2%
January	-0.1%	24.2%	4.7%	30.4%
February	-0.1%	18.0%	2.9%	23.7%
March	0.2%	12.6%	0.0%	17.4%
April	1.1%	42.5%	1.2%	43.4%
May	-0.1%	1.8%	-0.1%	3.2%
June	-0.2%	-4.1%	-0.2%	-10.0%
July	-1.0%	-0.2%	-1.0%	-2.8%
August	-1.8%	-0.1%	-0.4%	-0.3%
September	-1.5%	-1.9%	-17.3%	-6.7%

**Table 23. South Platte at Burlington Ditch buildout conditions, percent change in habitat from reallocation to reallocation with environmental releases (ER), white sucker.**

	Average change in white sucker habitat by month			
	Juvenile		Adult	
	Wet	Average	Wet	Average
<b>October</b>	3.1%	52.2%	3.1%	52.2%
<b>November</b>	3.4%	21.7%	3.4%	21.7%
<b>December</b>	3.7%	78.3%	3.7%	78.3%
<b>January</b>	3.7%	78.5%	3.7%	78.5%
<b>February</b>	2.1%	69.6%	2.1%	69.6%
<b>March</b>	-0.2%	52.7%	0.0%	52.7%
<b>April</b>	2.5%	10.1%	2.5%	10.1%
<b>May</b>	-0.1%	9.5%	-0.1%	9.5%
<b>June</b>	-0.2%	-36.3%	-0.2%	-36.3%
<b>July</b>	-0.3%	-2.1%	-0.3%	-2.1%
<b>August</b>	0.6%	0.0%	0.6%	0.0%
<b>September</b>	-15.8%	-10.1%	-15.8%	-10.1%

**Table 24. South Platte at Burlington Ditch buildout conditions, percent change in habitat from reallocation to reallocation with environmental releases (ER), common carp.**

	Average change in common carp habitat by month			
	Juvenile		Adult	
	Wet	Average	Wet	Average
<b>October</b>			1.8%	19.7%
<b>November</b>			4.1%	5.7%
<b>December</b>			4.5%	23.7%
<b>January</b>			4.5%	24.5%
<b>February</b>			3.5%	15.7%
<b>March</b>			0.0%	9.7%
<b>April</b>			0.8%	42.2%
<b>May</b>			-0.1%	1.7%
<b>June</b>			-0.2%	-3.7%
<b>July</b>			-0.7%	-3.0%
<b>August</b>			0.5%	-0.9%
<b>September</b>			-10.4%	-3.3%

Comparison of habitat, South Platte at Chatfield, current condition, average year, rainbow trout juvenile

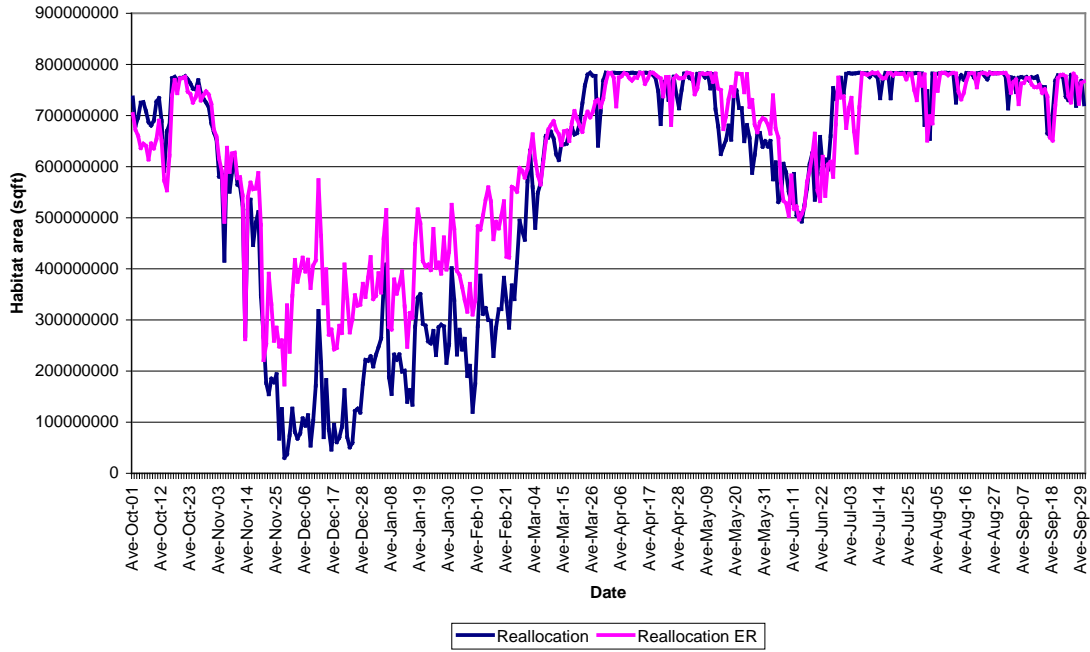


Figure 1. Comparison of habitat area, South Platte at Chatfield, current condition, average year, juvenile rainbow trout.

Comparison of habitat, South Platte at Chatfield, current condition, wet year, rainbow trout juvenile

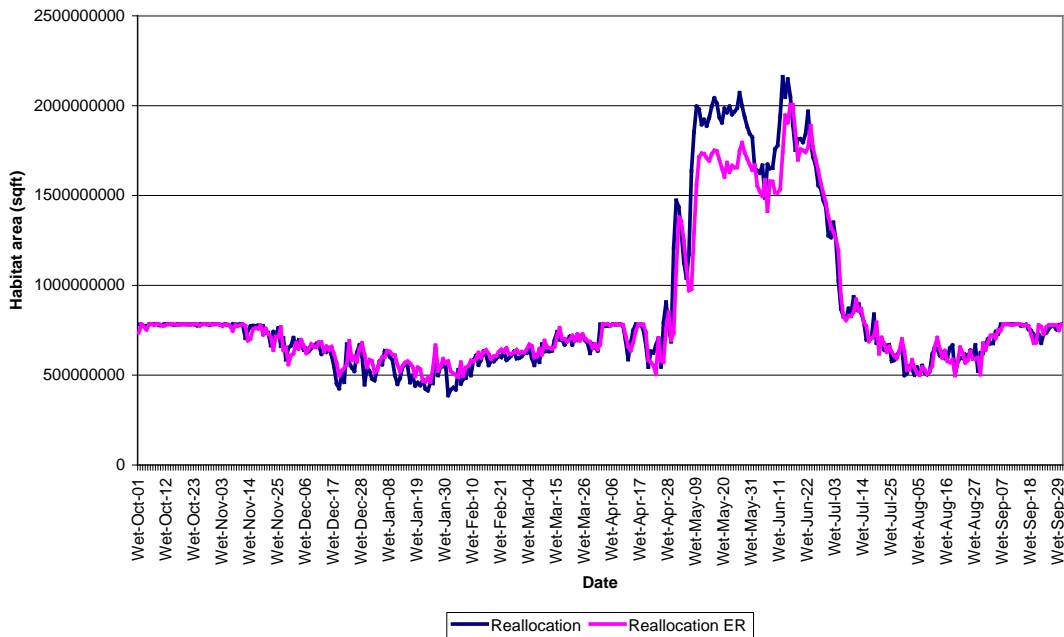
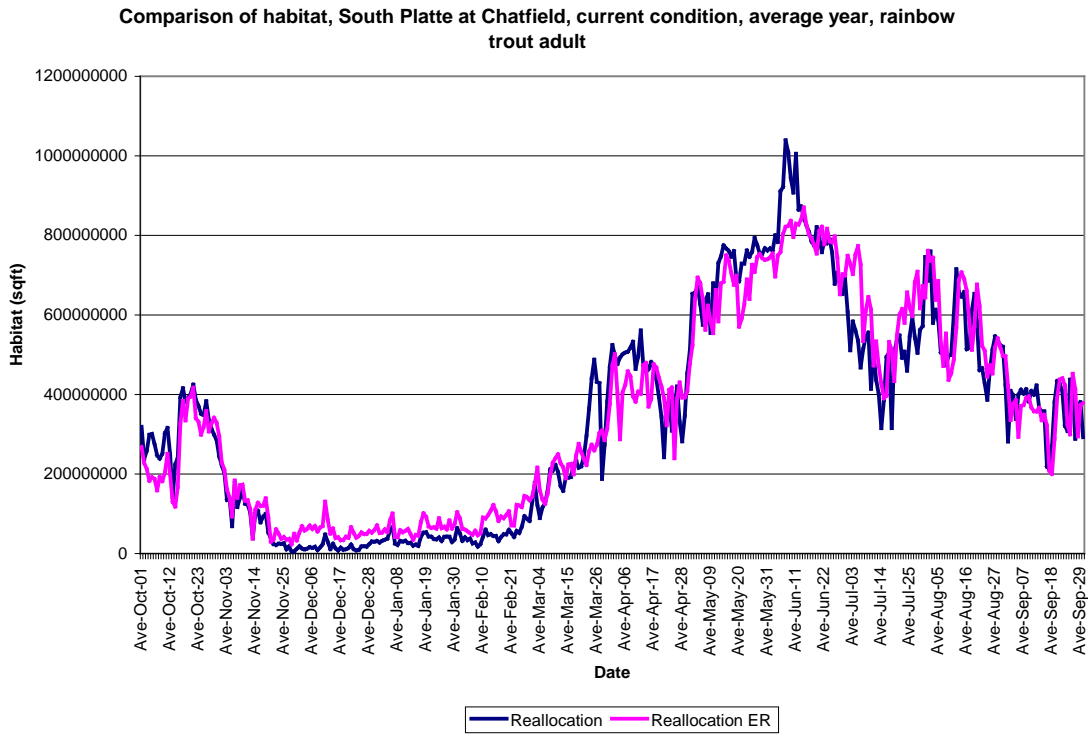
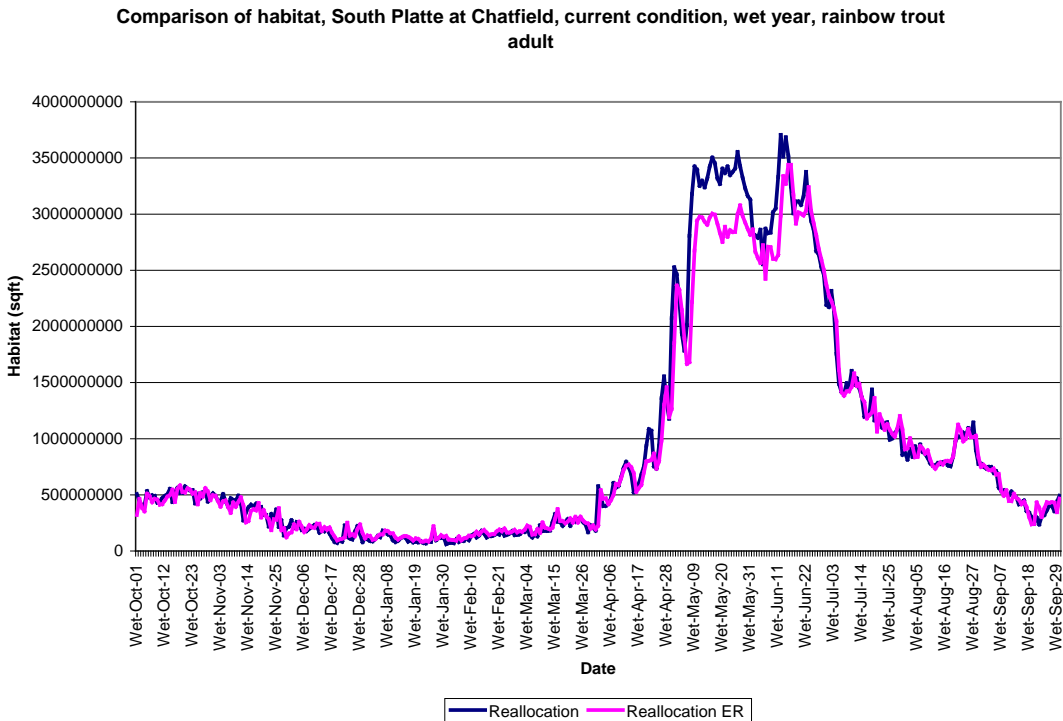


Figure 2. Comparison of habitat area, South Platte at Chatfield, current condition, wet year, juvenile rainbow trout.

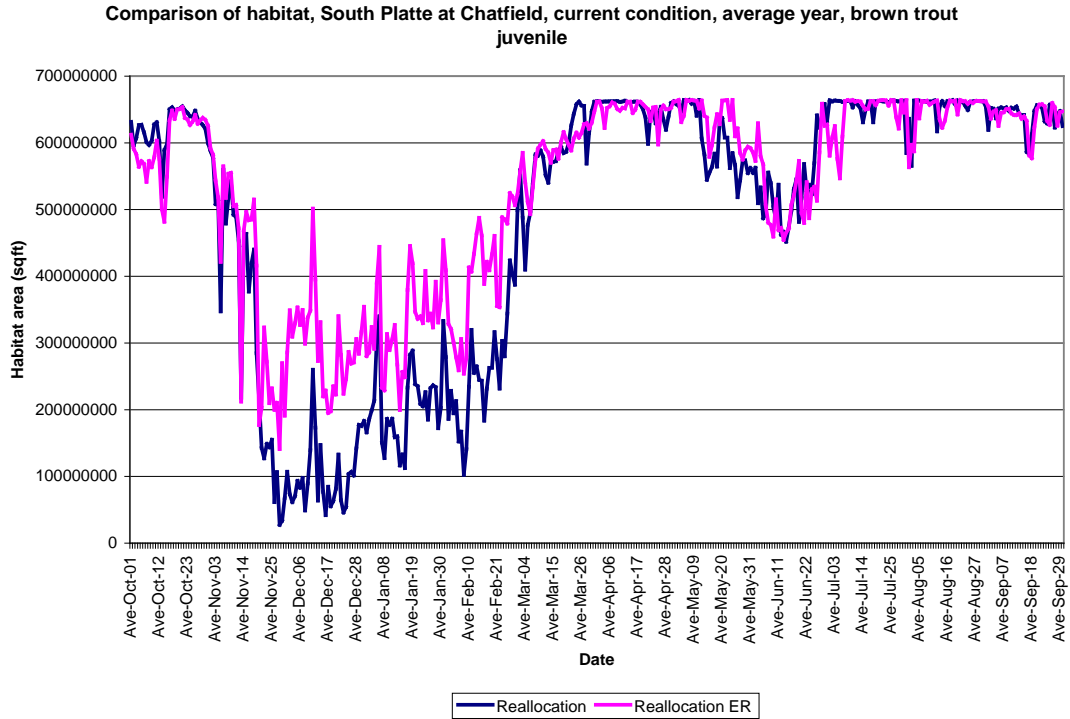




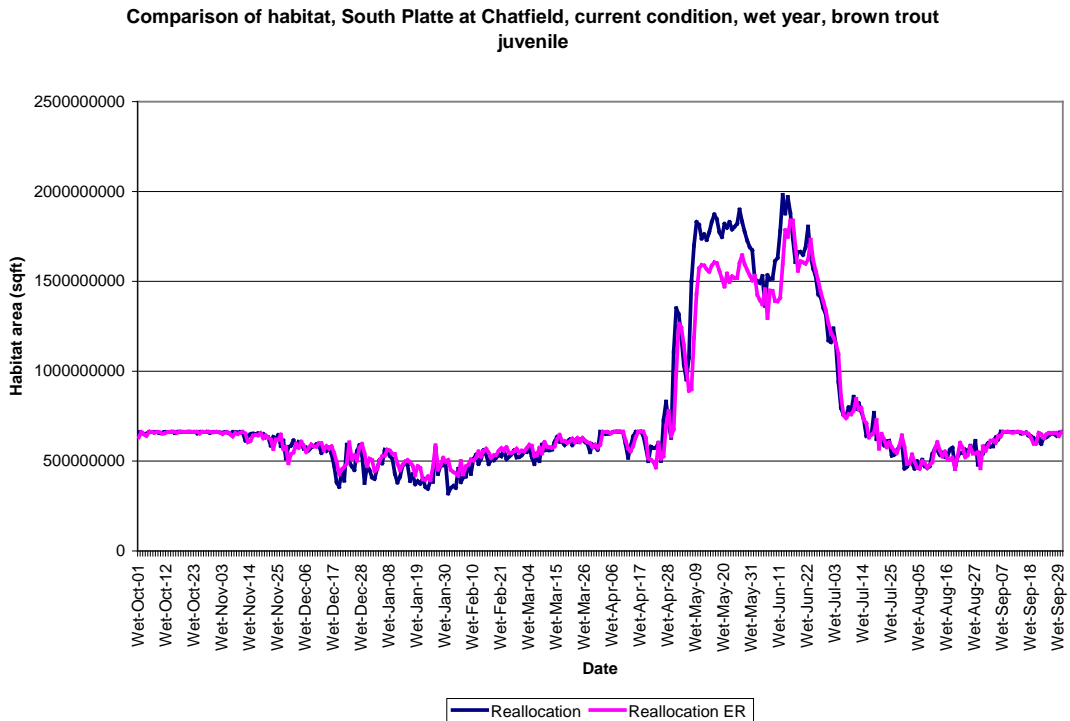
**Figure 3. Comparison of habitat area, South Platte at Chatfield, current condition, average year, adult rainbow trout.**



**Figure 4. Comparison of habitat area, South Platte at Chatfield, current condition, wet year, adult rainbow trout.**



**Figure 5. Comparison of habitat area, South Platte at Chatfield, current condition, average year, juvenile brown trout.**



**Figure 6. Comparison of habitat area, South Platte at Chatfield, current condition, wet year, juvenile brown trout.**

Comparison of habitat, South Platte at Chatfield, current condition, average year, brown trout adult

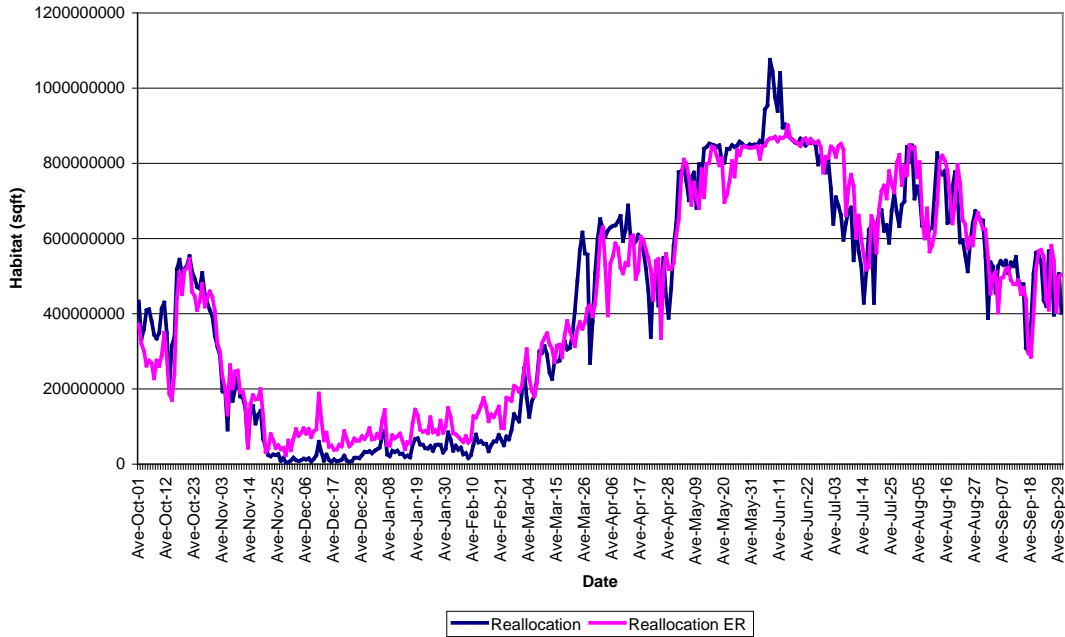


Figure 7. Comparison of habitat area, South Platte at Chatfield, current condition, average year, adult brown trout.

Comparison of habitat, South Platte at Chatfield, current condition, wet year, brown trout adult

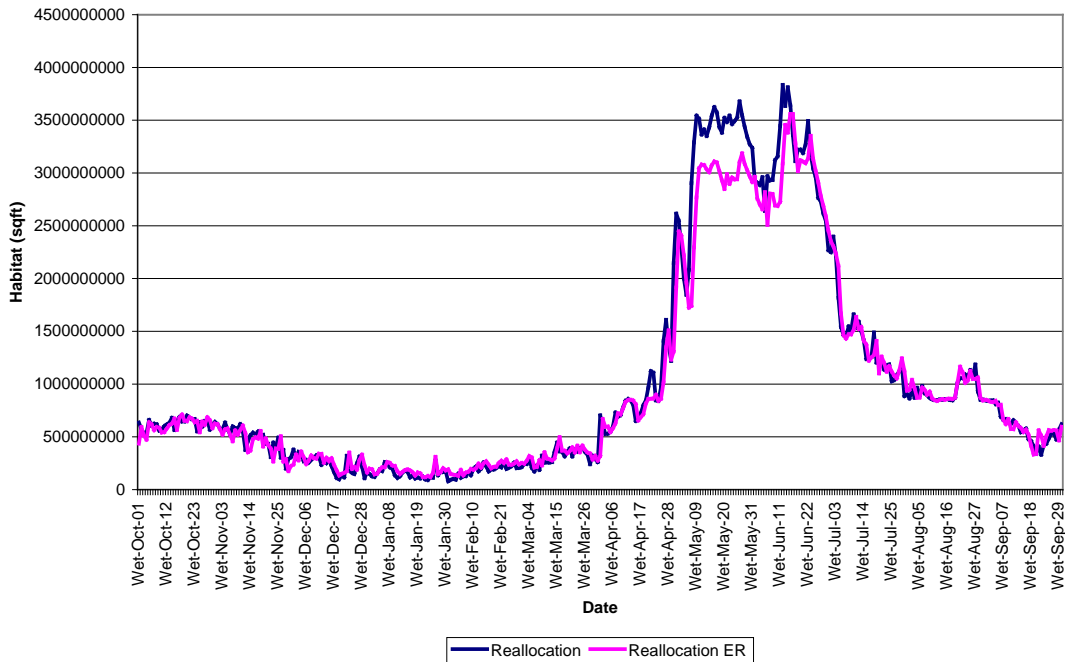
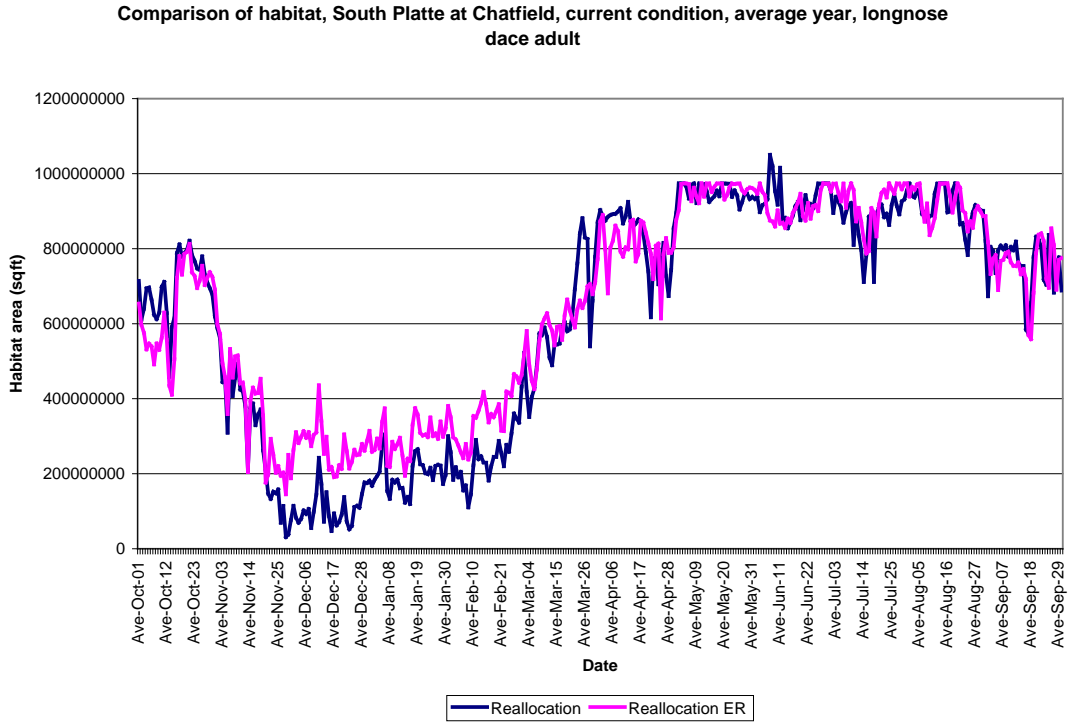
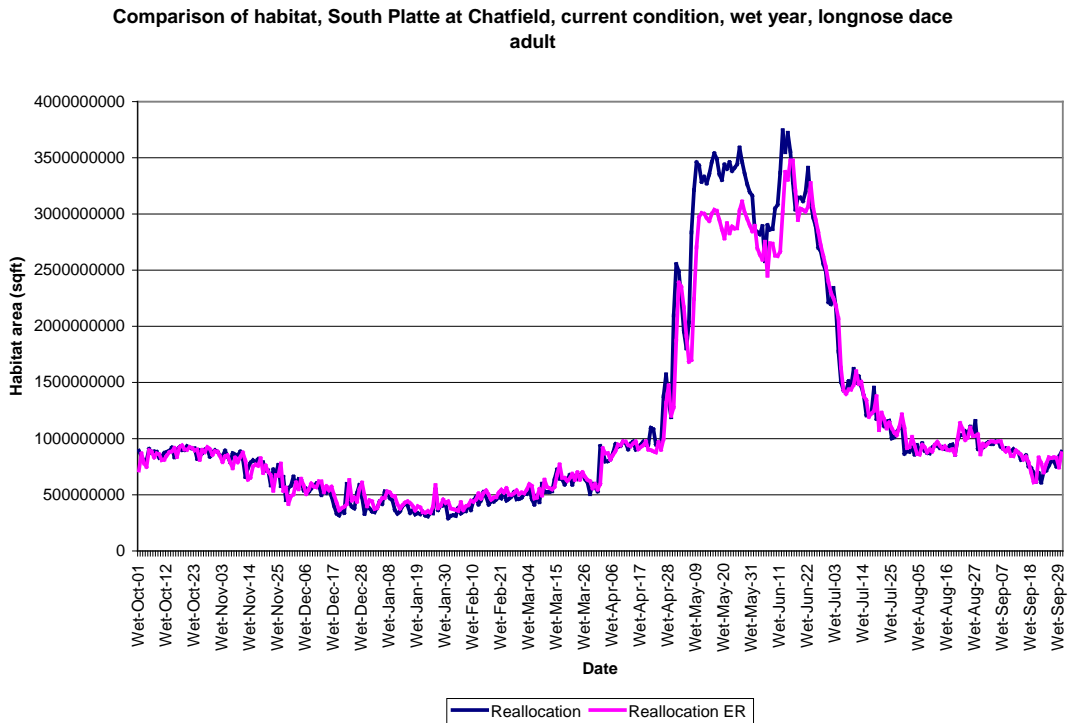


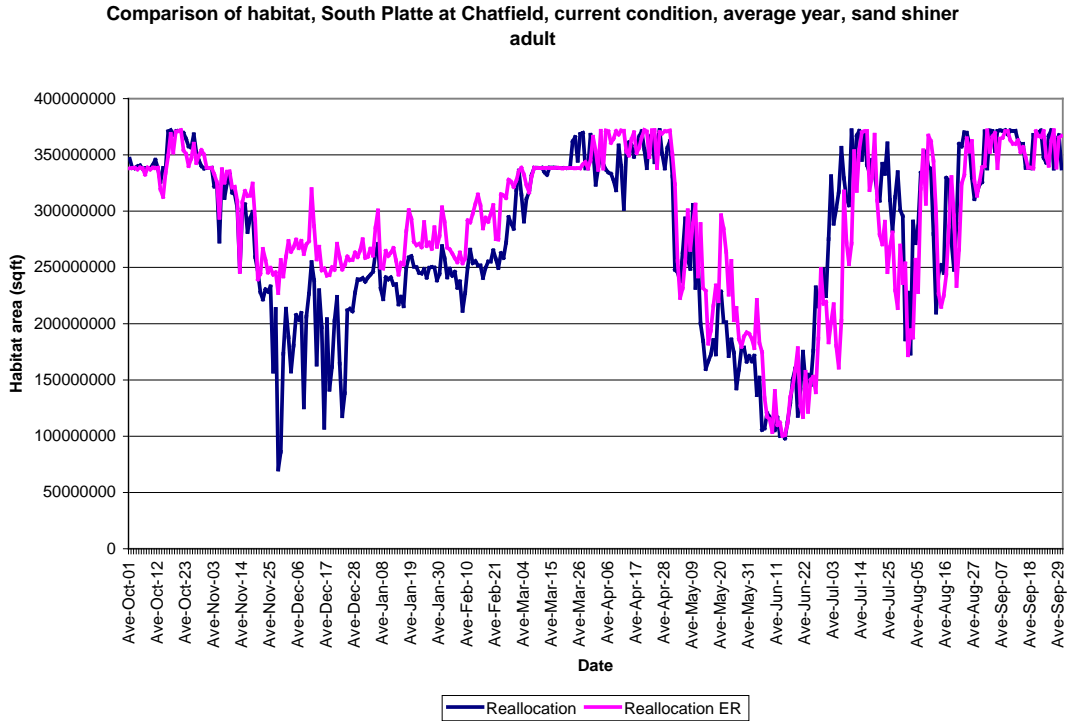
Figure 8. Comparison of habitat area, South Platte at Chatfield, current condition, wet year, adult brown trout.



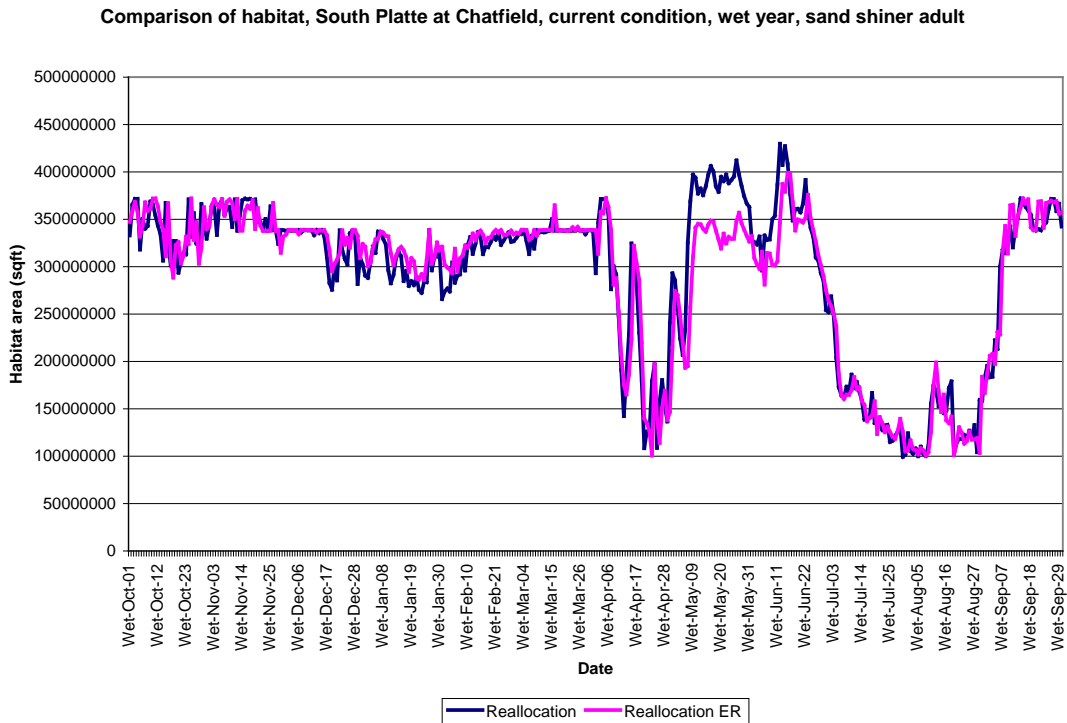
**Figure 9. Comparison of habitat area, South Platte at Chatfield, current condition, average year, adult longnose dace.**



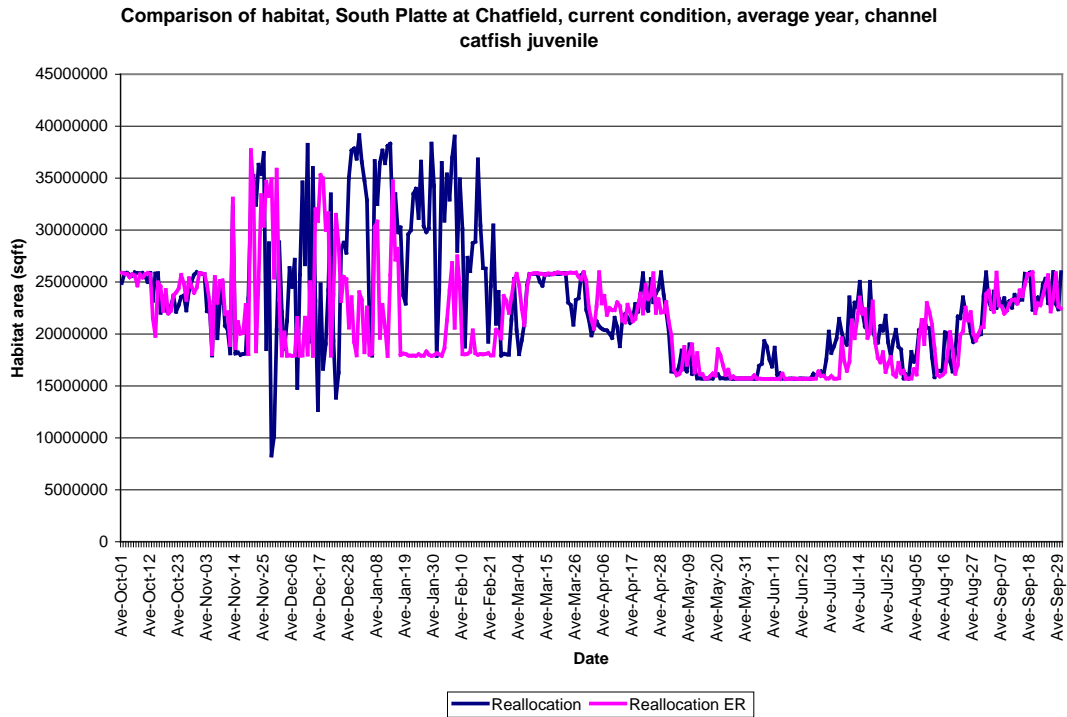
**Figure 10. Comparison of habitat area, South Platte at Chatfield, current condition, wet year, adult longnose dace.**



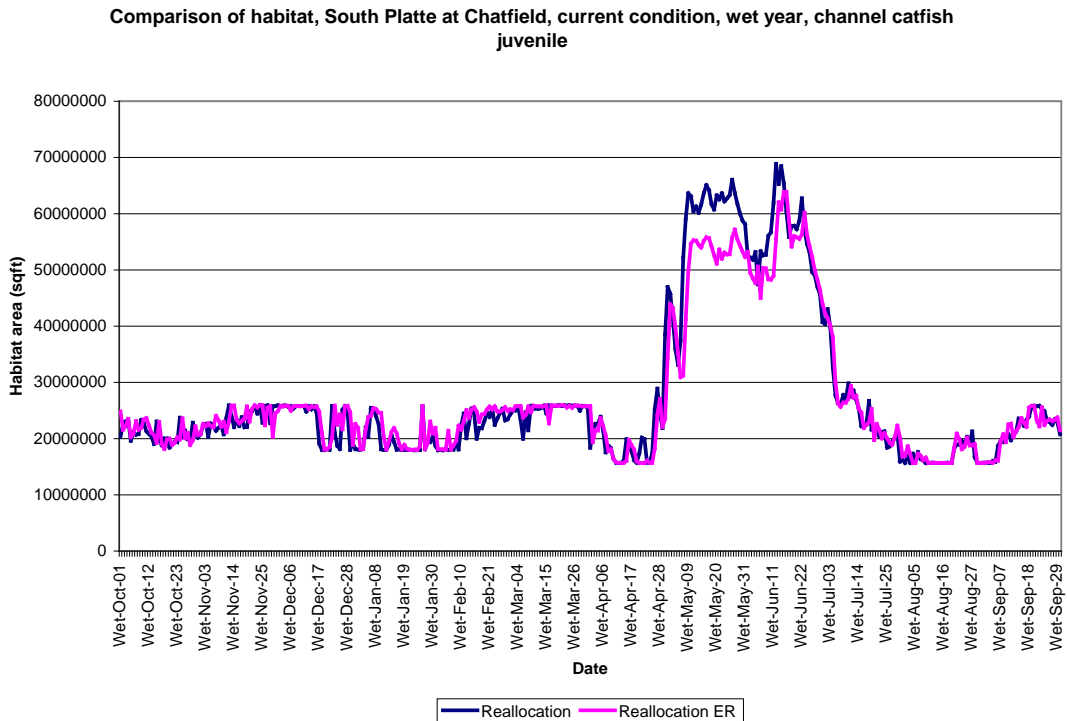
**Figure 11. Comparison of habitat area, South Platte at Chatfield, current condition, average year, adult sand shiner.**



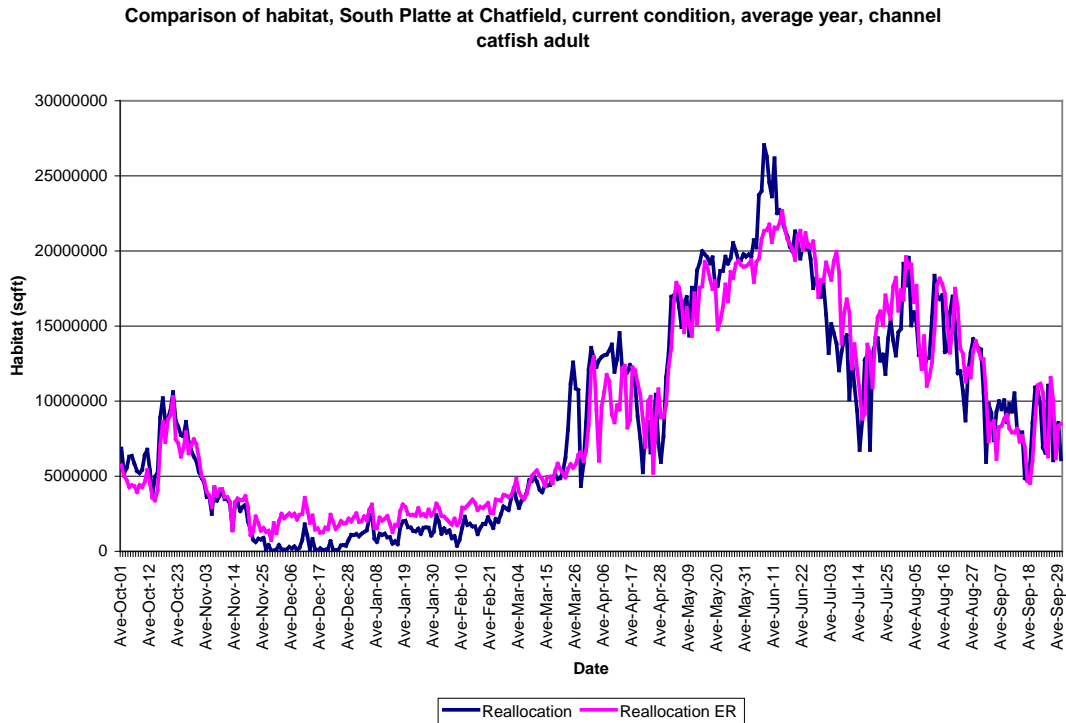
**Figure 12. Comparison of habitat area, South Platte at Chatfield, current condition, wet year, adult sand shiner.**



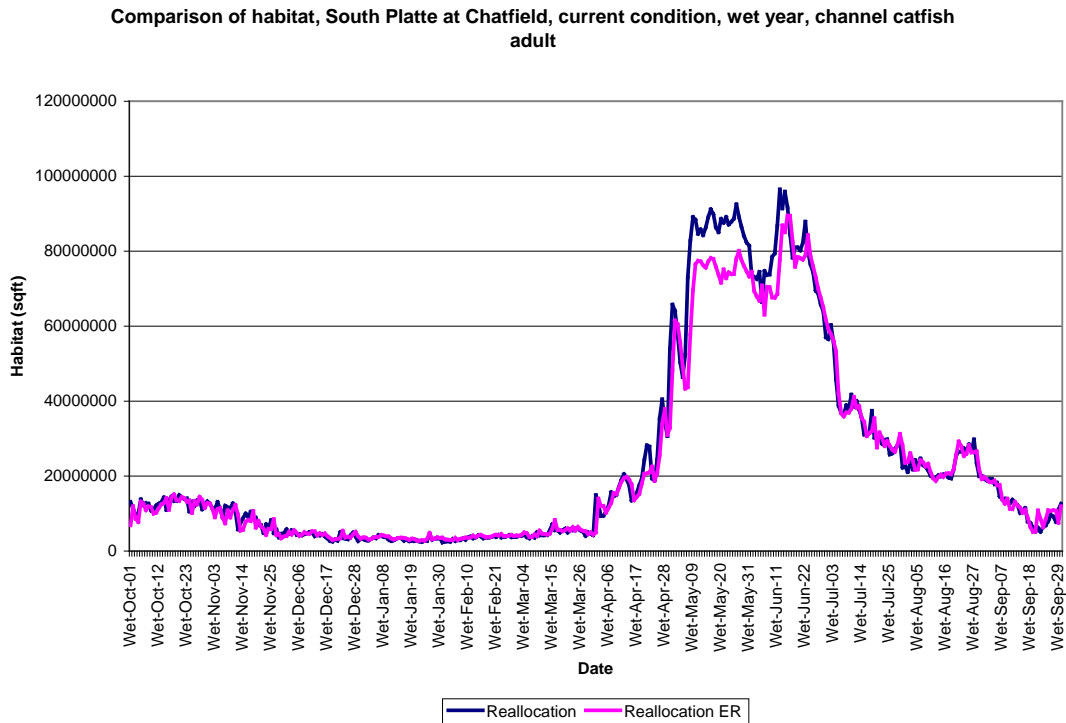
**Figure 13. Comparison of habitat area, South Platte at Chatfield, current condition, average year, juvenile channel catfish.**



**Figure 14. Comparison of habitat area, South Platte at Chatfield, current condition, wet year, juvenile channel catfish.**



**Figure 15. Comparison of habitat area, South Platte at Chatfield, current condition, average year, adult channel catfish.**



**Figure 16. Comparison of habitat area, South Platte at Chatfield, current condition, wet year, adult channel catfish.**

Comparison of habitat, South Platte at Chatfield, current condition, average year, white sucker adult

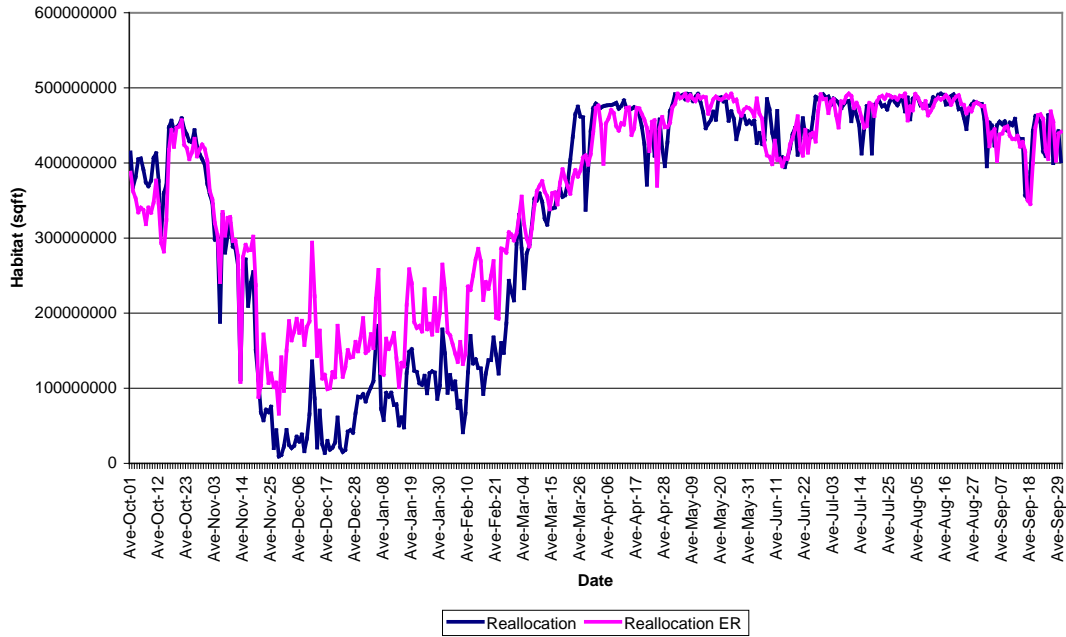


Figure 17. Comparison of habitat area, South Platte at Chatfield, current condition, average year, adult white sucker.

Comparison of habitat, South Platte at Chatfield, current condition, wet year, white sucker adult

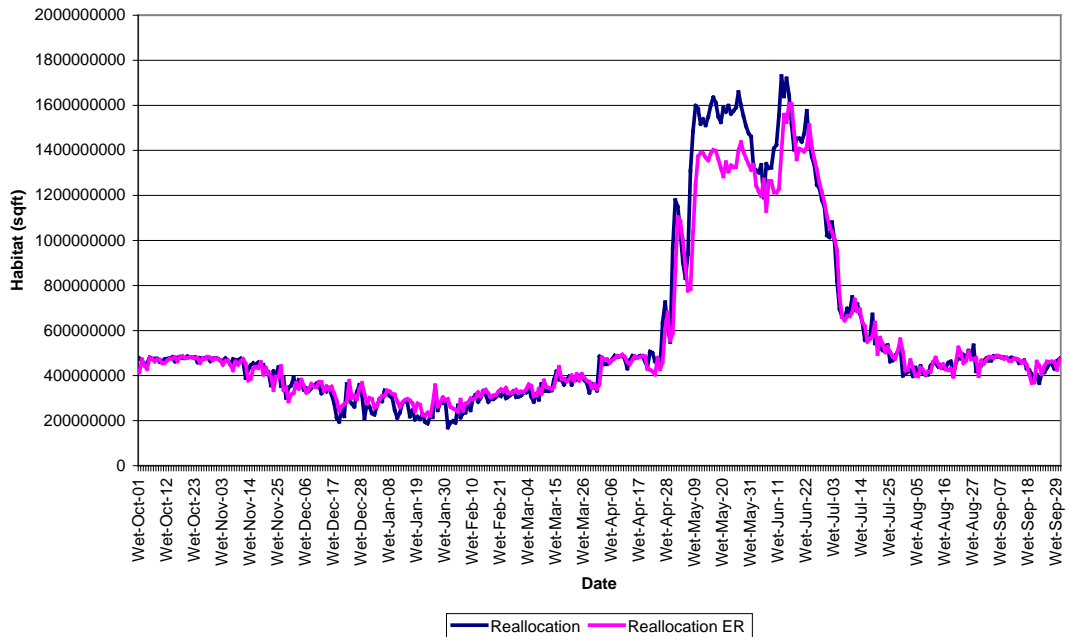
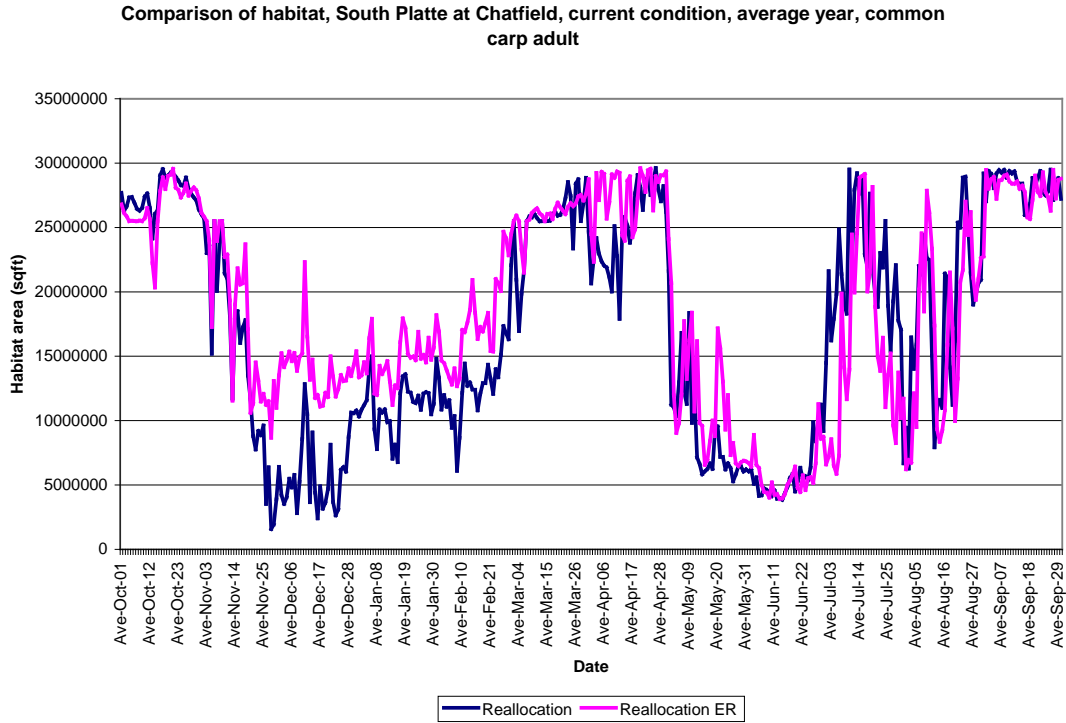
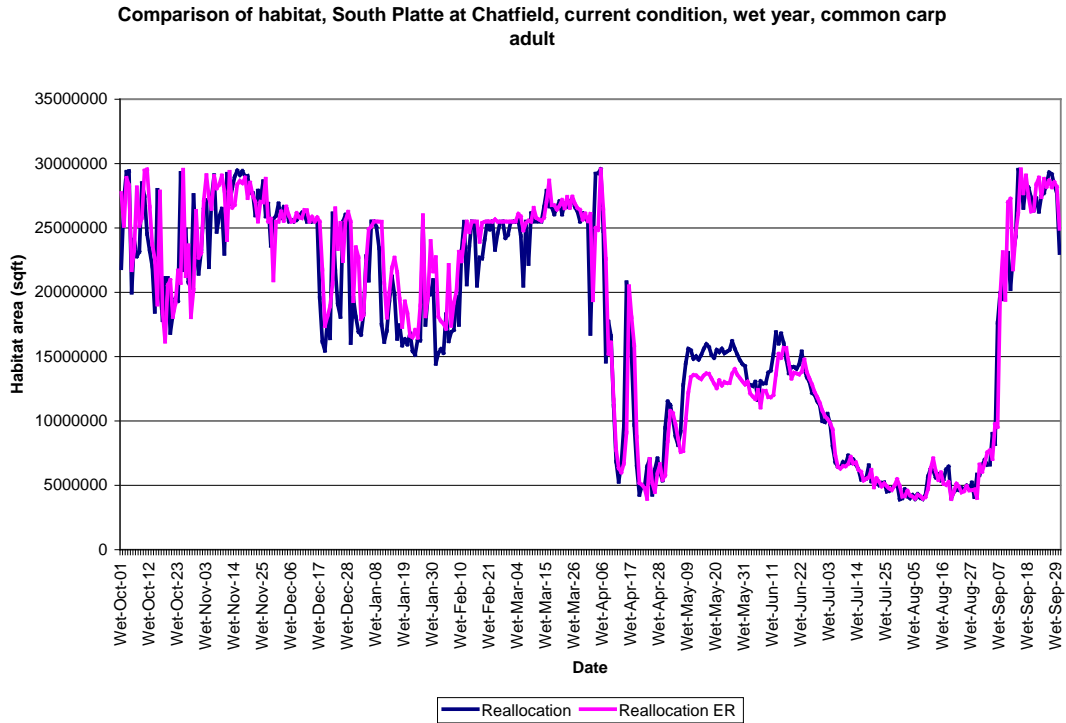


Figure 18. Comparison of habitat area, South Platte at Chatfield, current condition, wet year, adult white sucker.



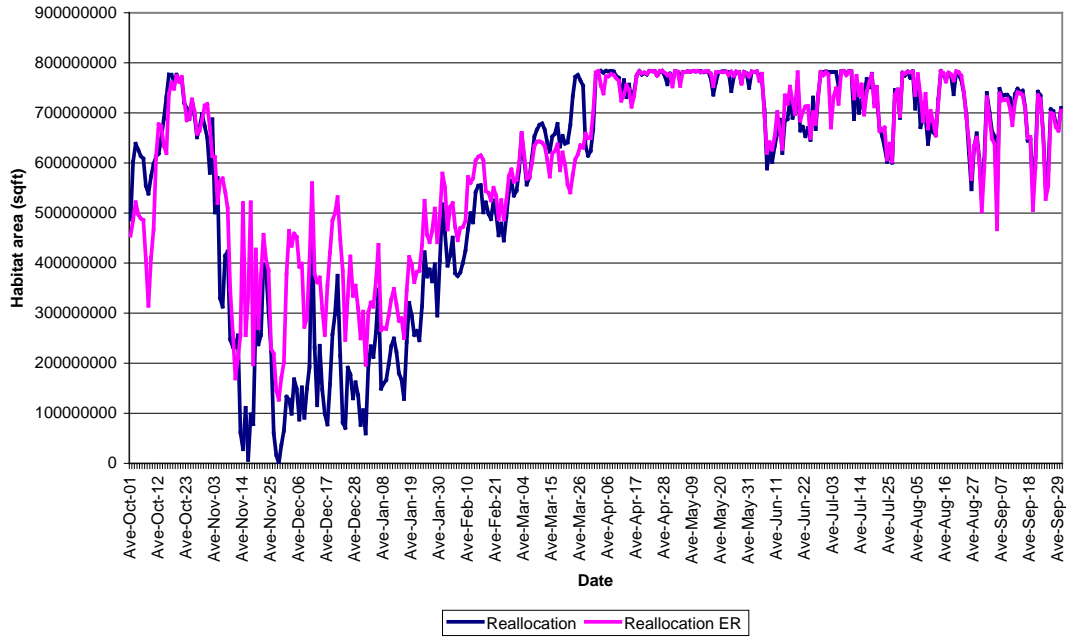


**Figure 19. Comparison of habitat area, South Platte at Chatfield, current condition, average year, adult common carp.**



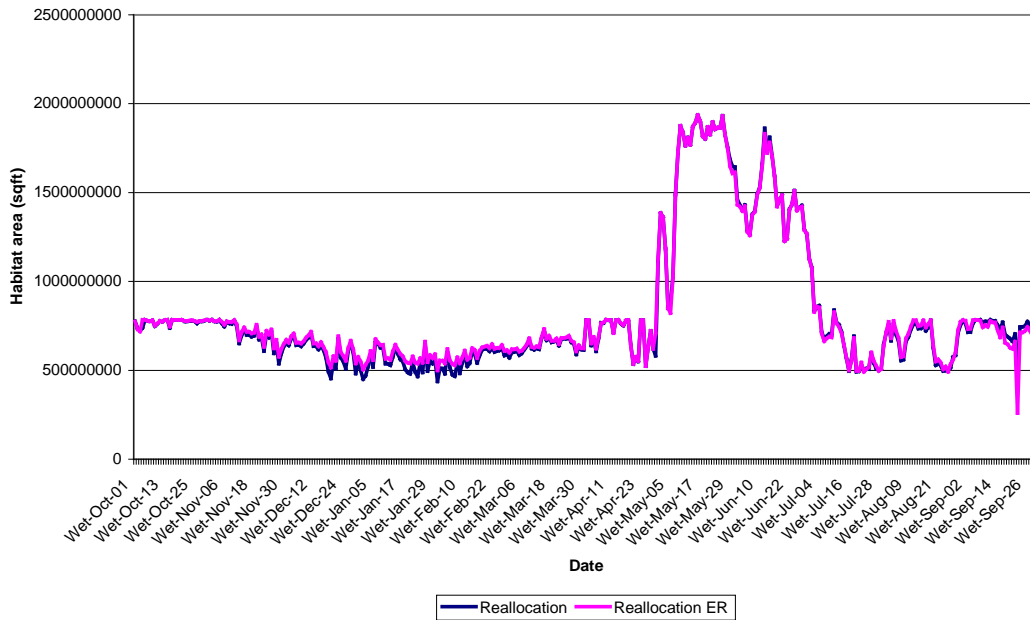
**Figure 20. Comparison of habitat area, South Platte at Chatfield, current condition, wet year, adult common carp.**

**Comparison of habitat, South Platte at Chatfield, buildout condition, average year, rainbow trout juvenile**



**Figure 21. Comparison of habitat area, South Platte at Chatfield, buildout condition, average year, juvenile rainbow trout.**

**Comparison of habitat, South Platte at Chatfield, buildout condition, wet year, rainbow trout juvenile**



**Figure 22. Comparison of habitat area, South Platte at Chatfield, buildout condition, wet year, juvenile rainbow trout.**

Comparison of habitat, South Platte at Chatfield, buildout condition, average year, rainbow trout adult

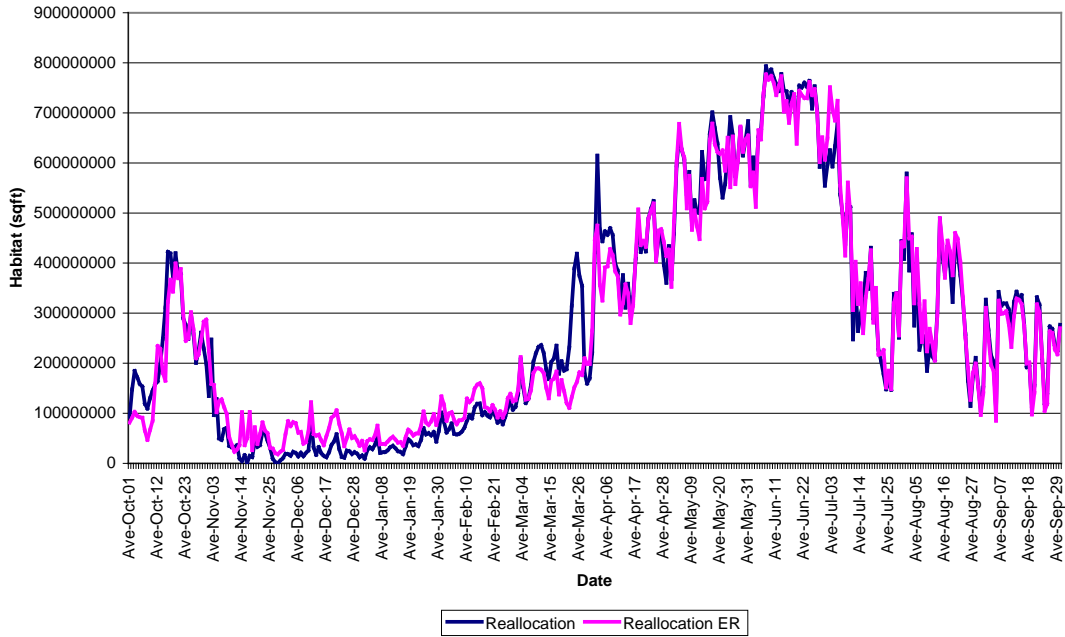


Figure 23. Comparison of habitat area, South Platte at Chatfield, buildout condition, average year, adult rainbow trout.

Comparison of habitat, South Platte at Chatfield, buildout condition, wet year, rainbow trout adult

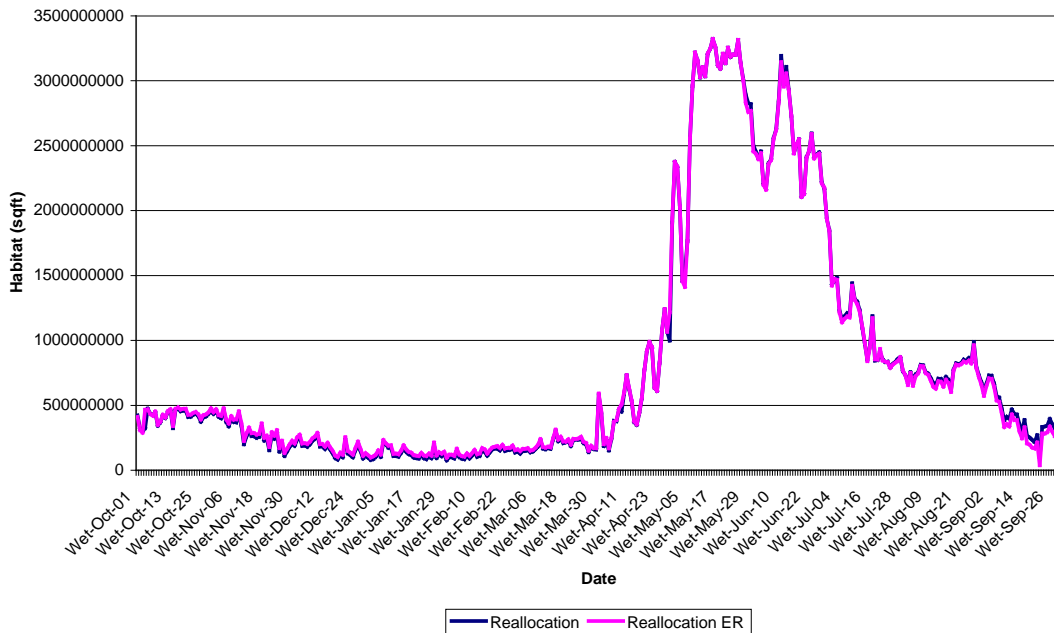


Figure 24. Comparison of habitat area, South Platte at Chatfield, buildout condition, wet year, adult rainbow trout.

Comparison of habitat, South Platte at Chatfield, buildout condition, average year, brown trout juvenile

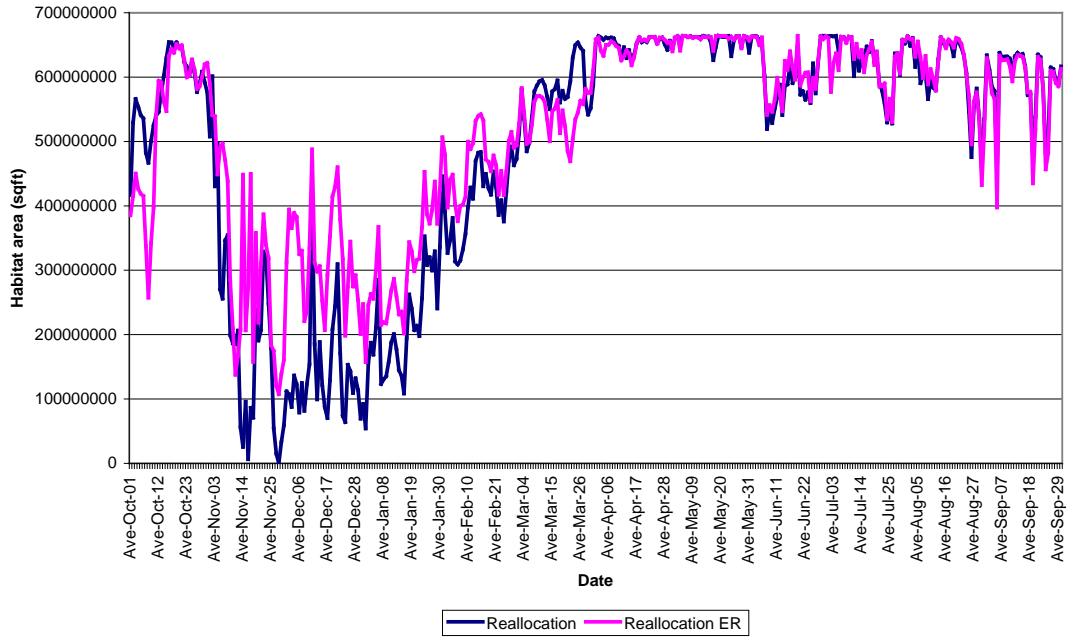


Figure 25. Comparison of habitat area, South Platte at Chatfield, buildout condition, average year, juvenile brown trout.

Comparison of habitat, South Platte at Chatfield, buildout condition, wet year, brown trout juvenile

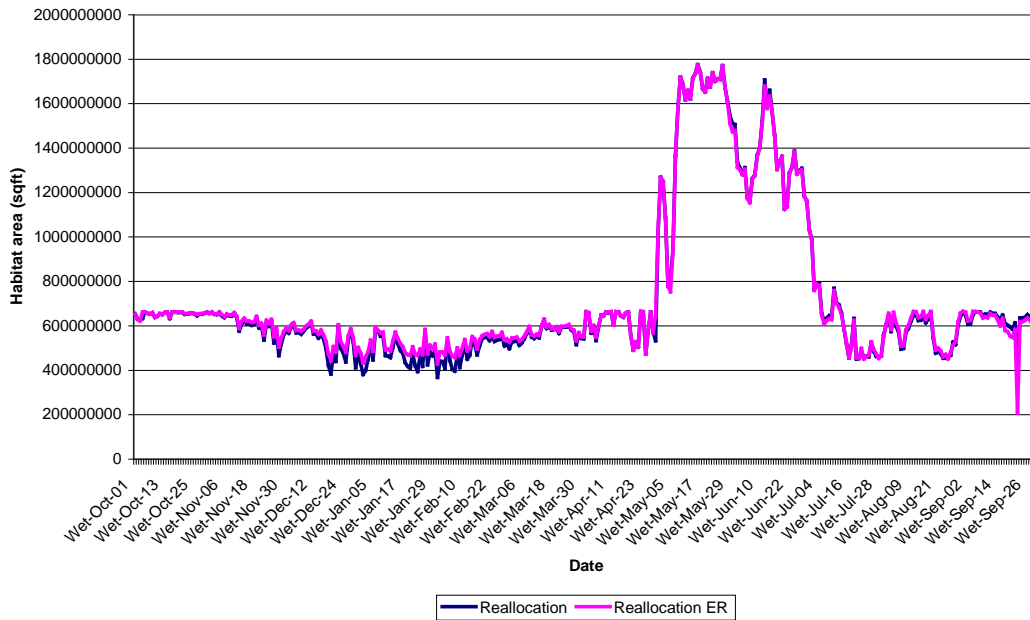


Figure 26. Comparison of habitat area, South Platte at Chatfield, buildout condition, wet year, juvenile brown trout.

Comparison of habitat, South Platte at Chatfield, buildout condition, average year, brown trout adult

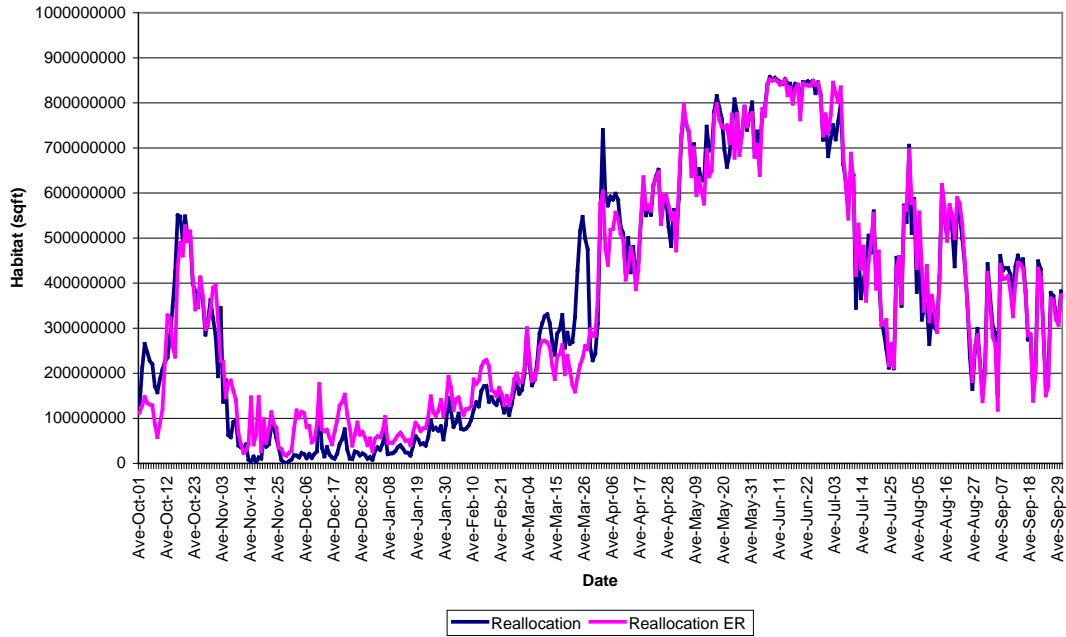


Figure 27. Comparison of habitat area, South Platte at Chatfield, buildout condition, average year, adult brown trout.

Comparison of habitat, South Platte at Chatfield, buildout condition, wet year, brown trout adult

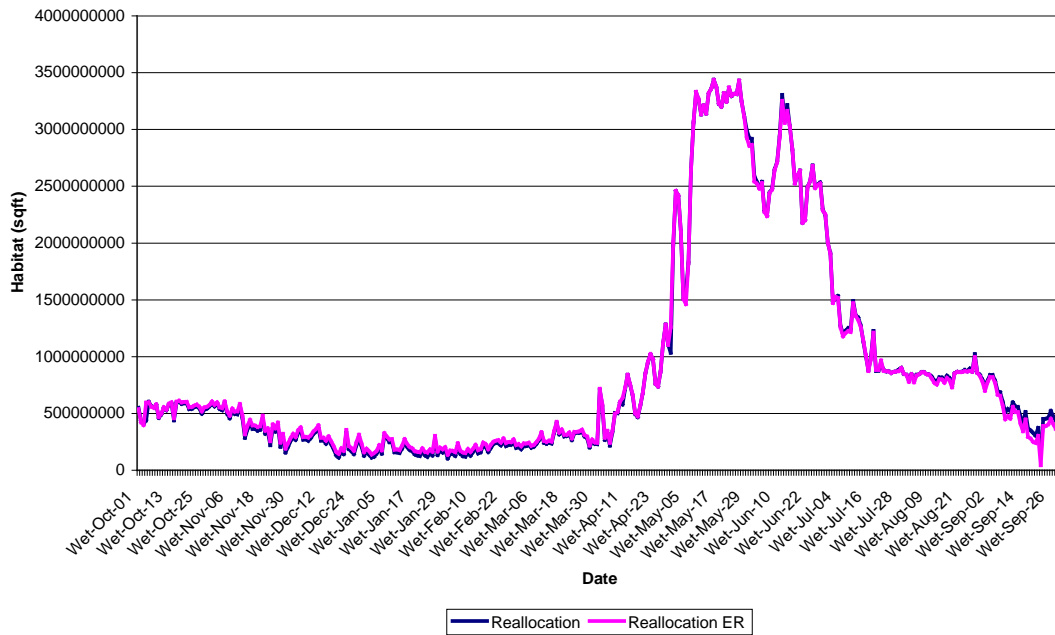


Figure 28. Comparison of habitat area, South Platte at Chatfield, buildout condition, wet year, adult brown trout.

Comparison of habitat, South Platte at Chatfield, buildout condition, average year, longnose dace adult

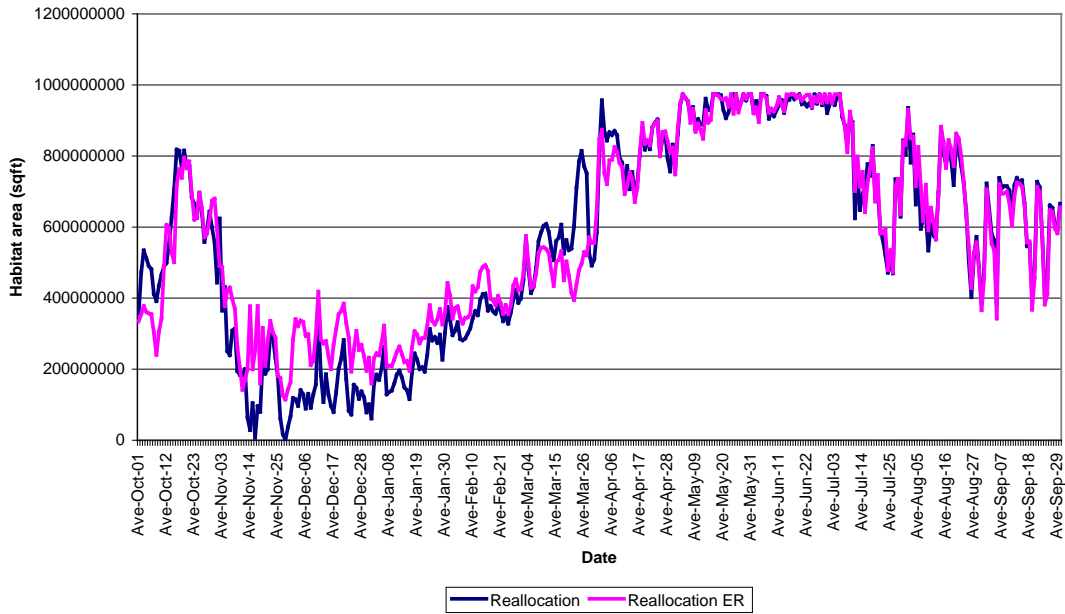


Figure 29. Comparison of habitat area, South Platte at Chatfield, buildout condition, average year, adult longnose dace.

Comparison of habitat, South Platte at Chatfield, buildout condition, wet year, longnose dace adult

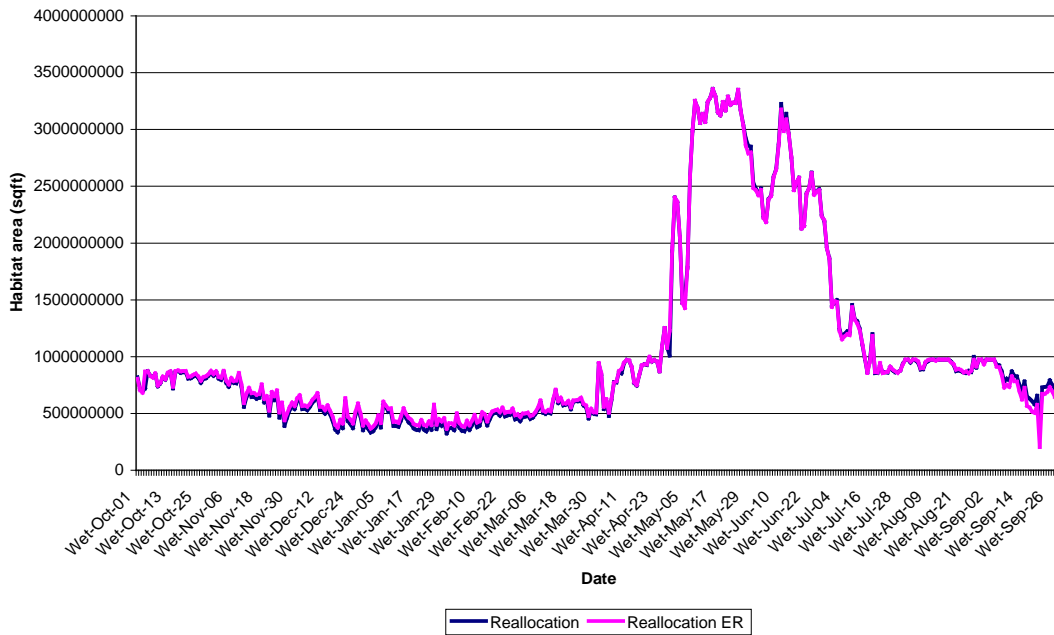


Figure 30. Comparison of habitat area, South Platte at Chatfield, buildout condition, wet year, adult longnose dace.

Comparison of habitat, South Platte at Chatfield, buildout condition, average year, sand shiner adult

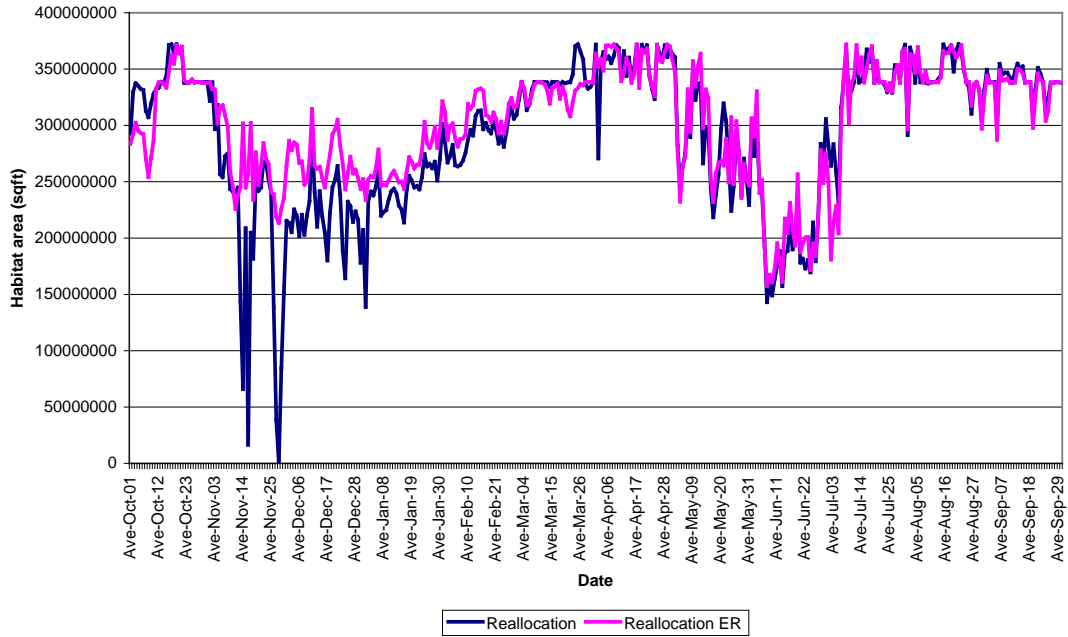


Figure 31. Comparison of habitat area, South Platte at Chatfield, buildout condition, average year, adult sand shiner.

Comparison of habitat, South Platte at Chatfield, buildout condition, wet year, sand shiner adult

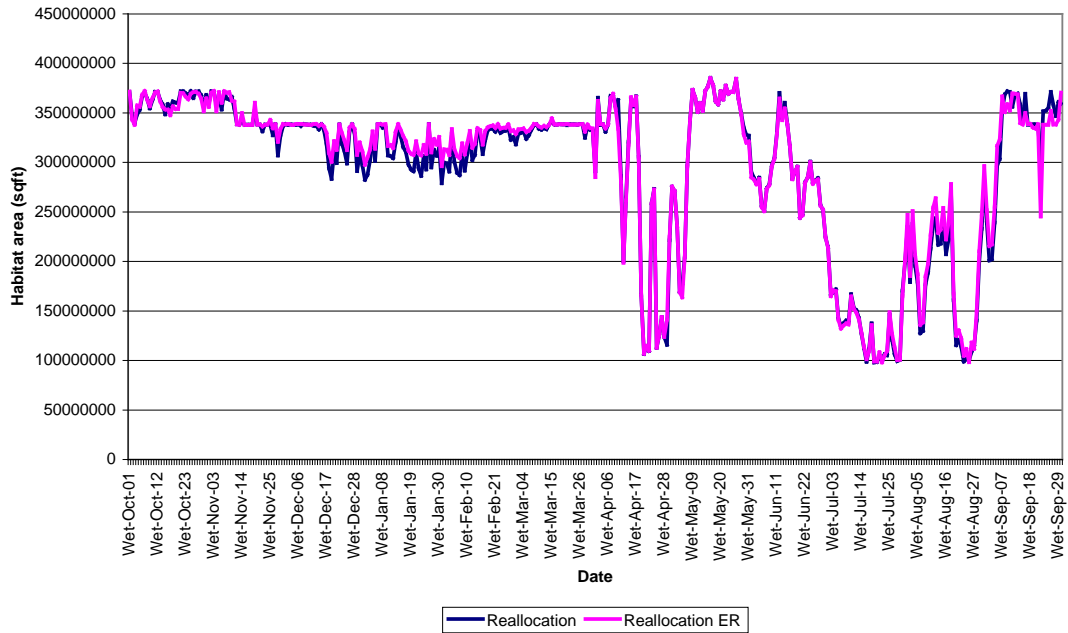


Figure 32. Comparison of habitat area, South Platte at Chatfield, buildout condition, wet year, adult sand shiner.

Comparison of habitat, South Platte at Chatfield, buildout condition, average year, channel catfish juvenile

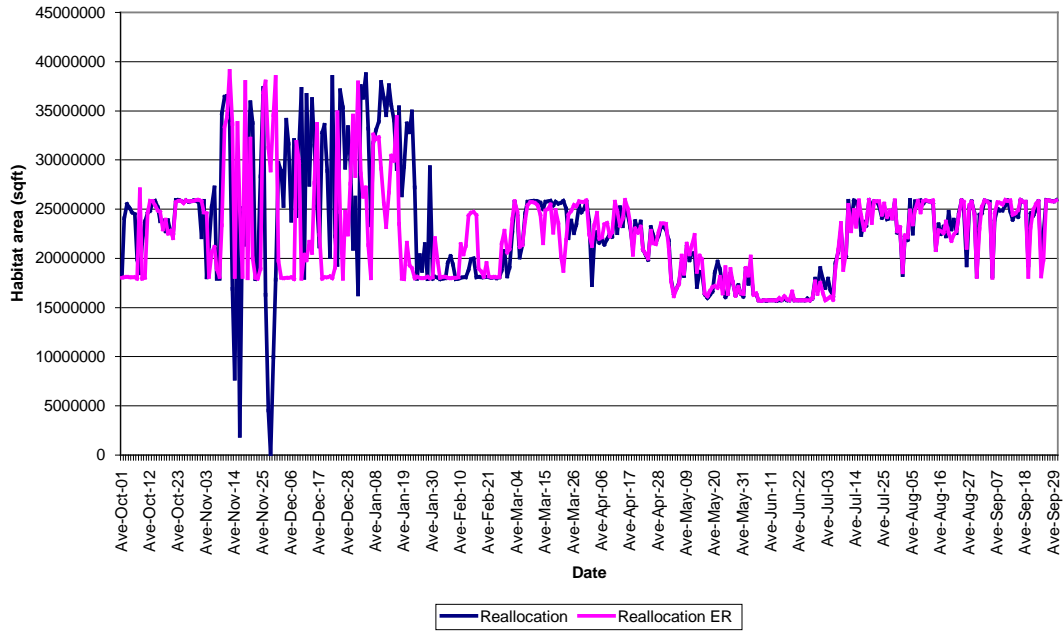


Figure 33. Comparison of habitat area, South Platte at Chatfield, buildout condition, average year, juvenile channel catfish.

Comparison of habitat, South Platte at Chatfield, buildout condition, wet year, channel catfish juvenile

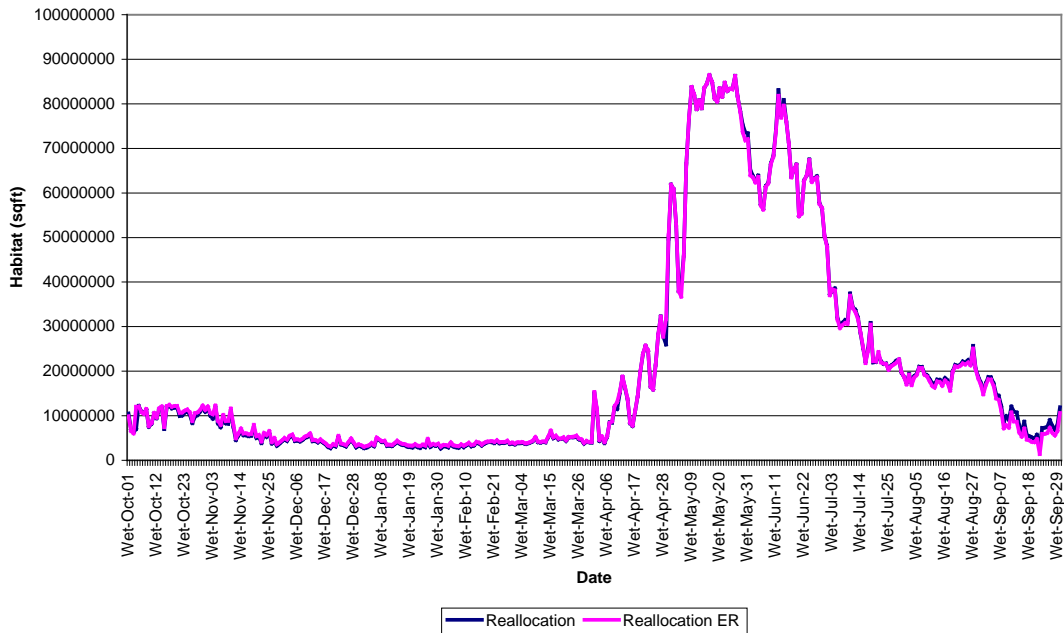
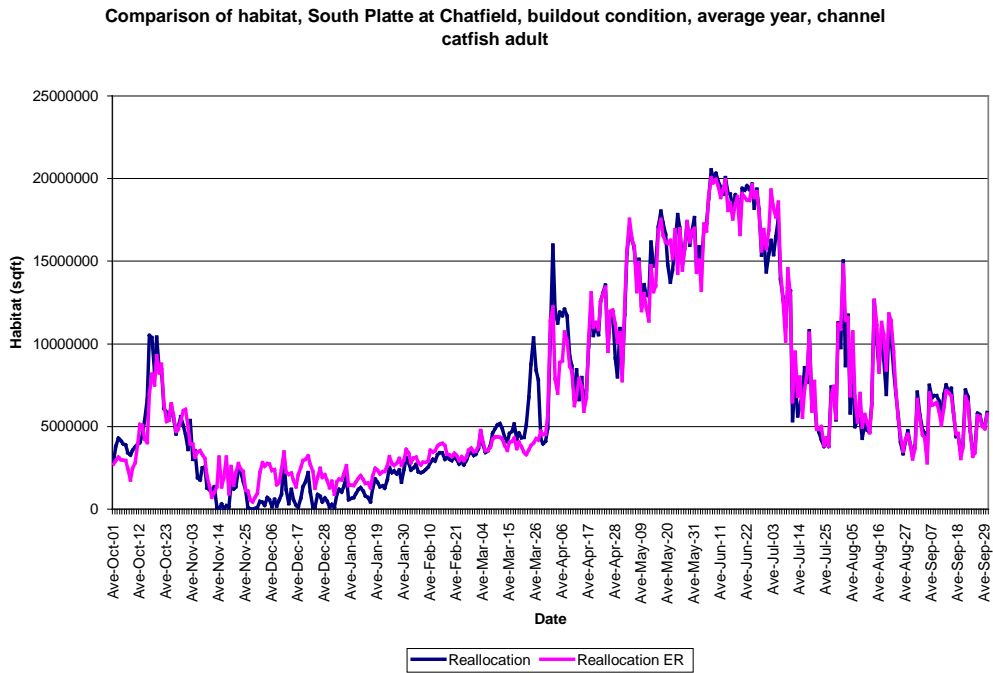
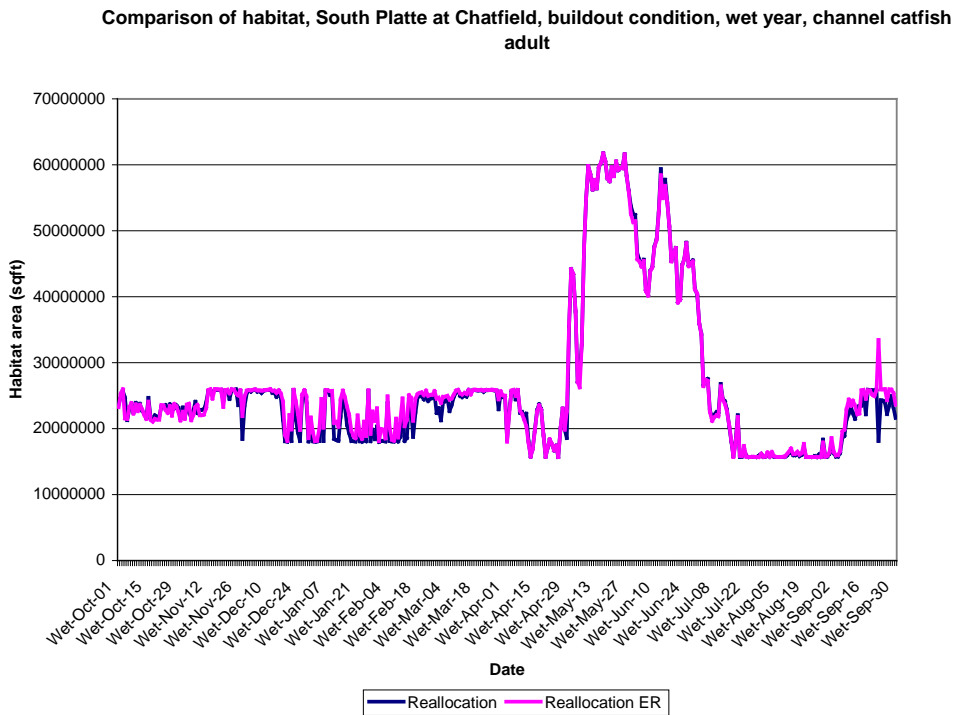


Figure 34. Comparison of habitat area, South Platte at Chatfield, buildout condition, wet year, juvenile channel catfish.





**Figure 35. Comparison of habitat area, South Platte at Chatfield, buildout condition, average year, adult channel catfish.**



**Figure 36. Comparison of habitat area, South Platte at Chatfield, buildout condition, wet year, adult channel catfish.**

Comparison of habitat, South Platte at Chatfield, buildout condition, average year, white sucker adult

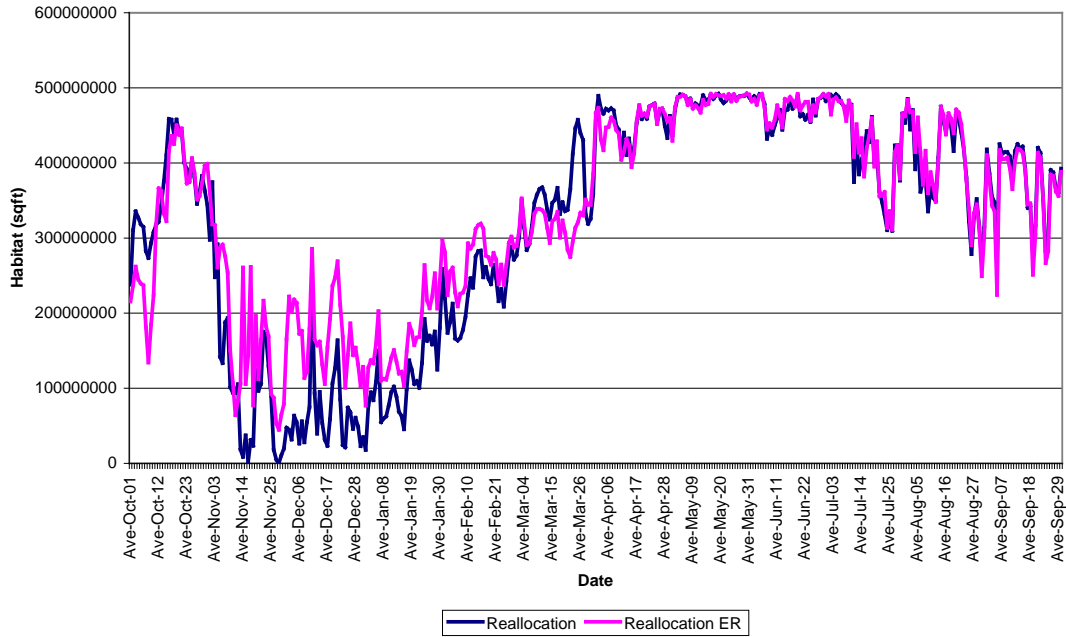


Figure 37. Comparison of habitat area, South Platte at Chatfield, buildout condition, average year, adult white sucker.

Comparison of habitat, South Platte at Chatfield, buildout condition, wet year, white sucker adult

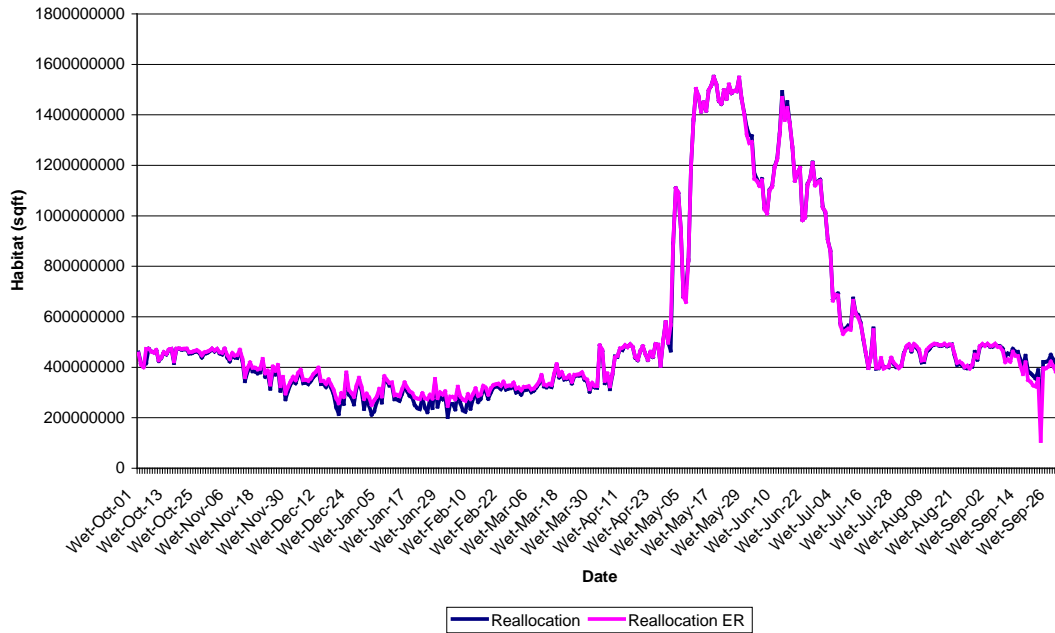
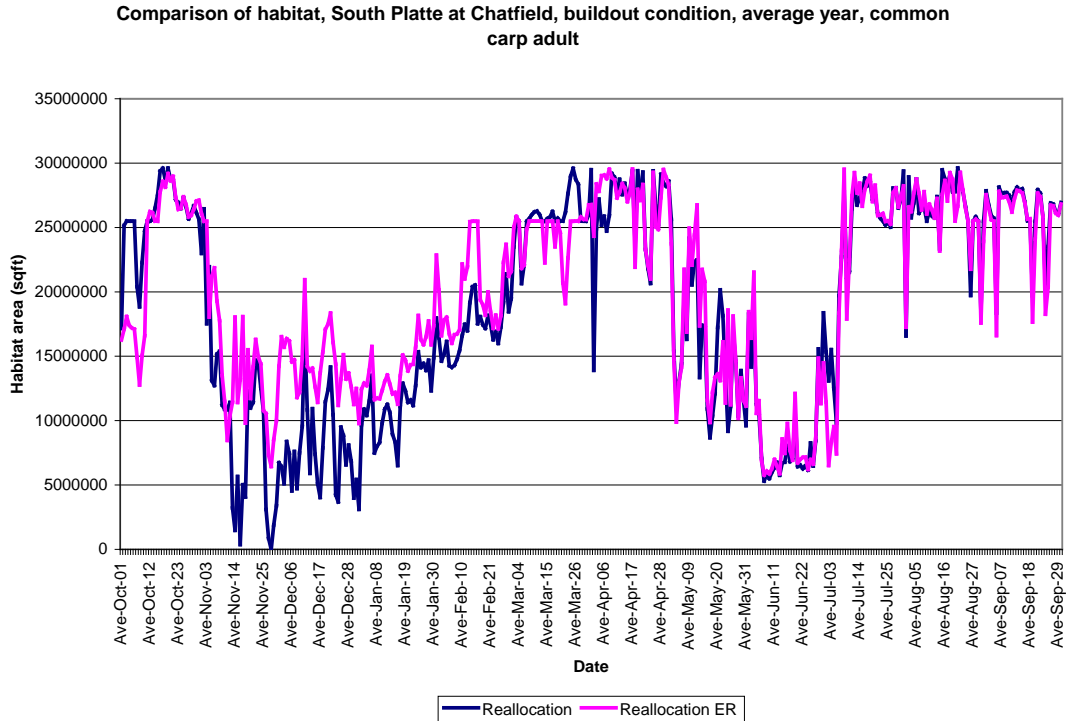
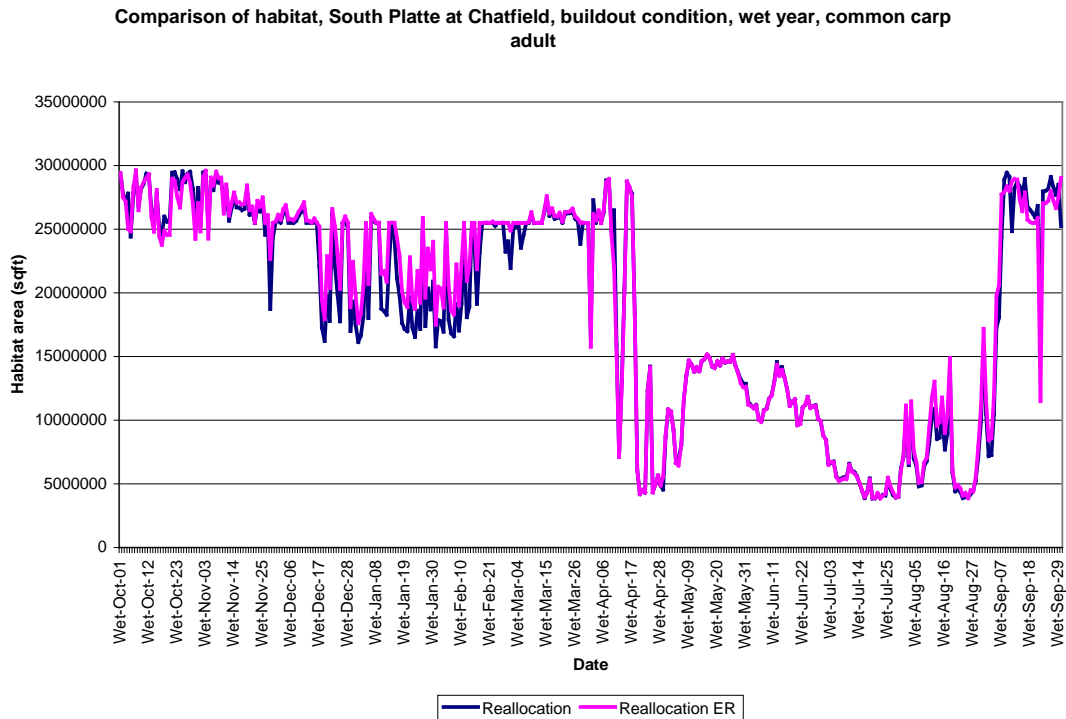


Figure 38. Comparison of habitat area, South Platte at Chatfield, buildout condition, wet year, adult white sucker.



**Figure 39. Comparison of habitat area, South Platte at Chatfield, buildout condition, average year, adult common carp.**



**Figure 40. Comparison of habitat area, South Platte at Chatfield, buildout condition, wet year, adult common carp.**

Comparison of habitat, South Platte at Burlington ditch, current condition, average year, longnose dace adult

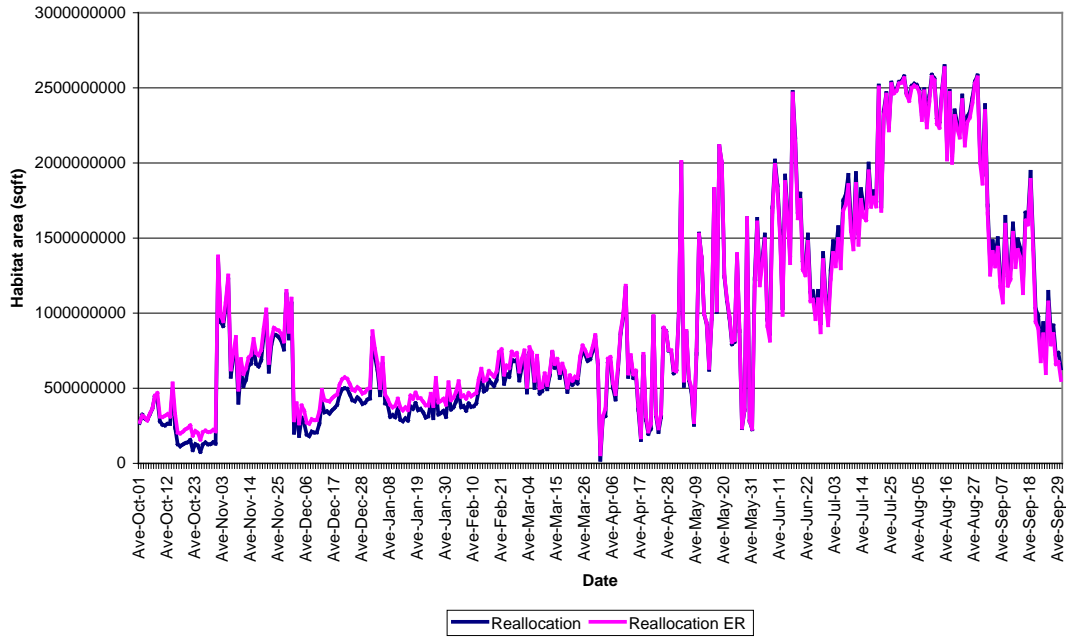


Figure 41. Comparison of habitat area, South Platte at Burlington, current condition, average year, adult longnose dace.

Comparison of habitat, South Platte at Burlington ditch, current condition, wet year, longnose dace adult

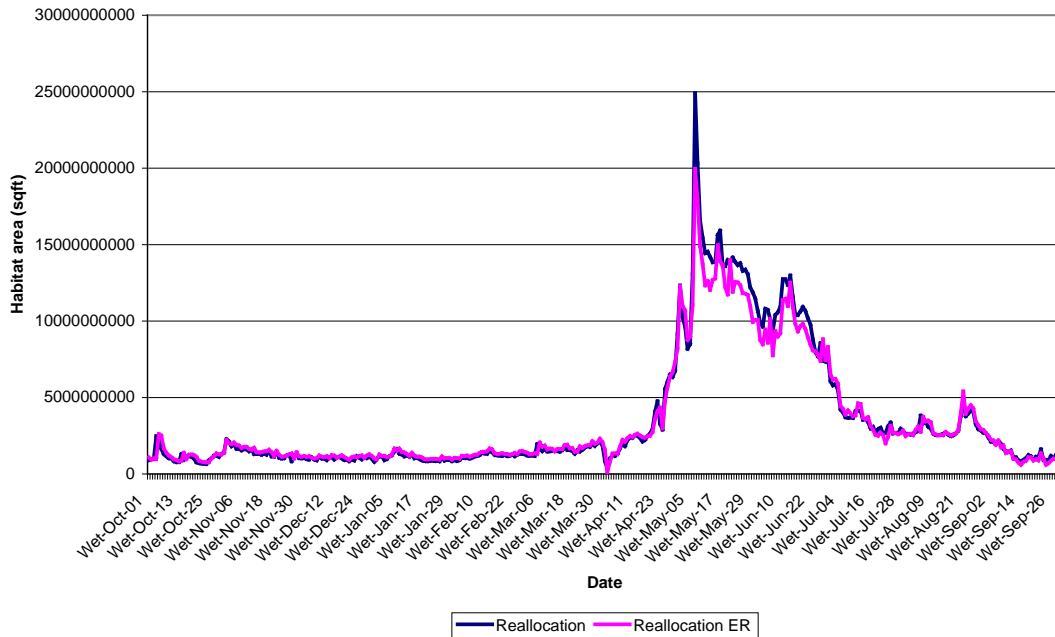
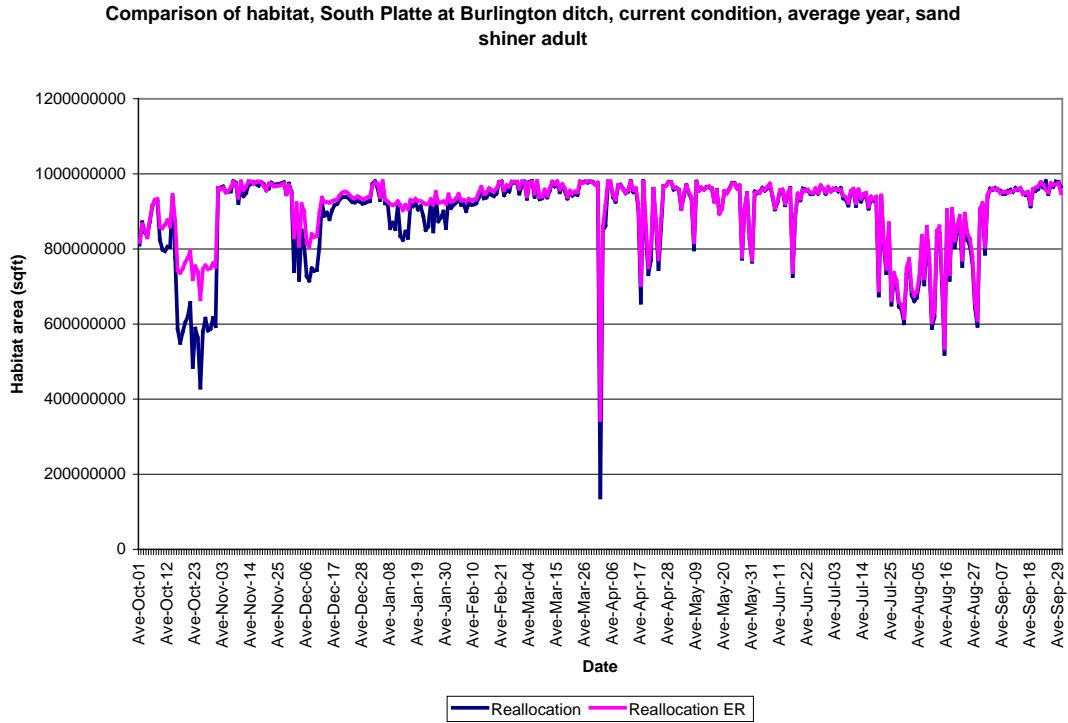
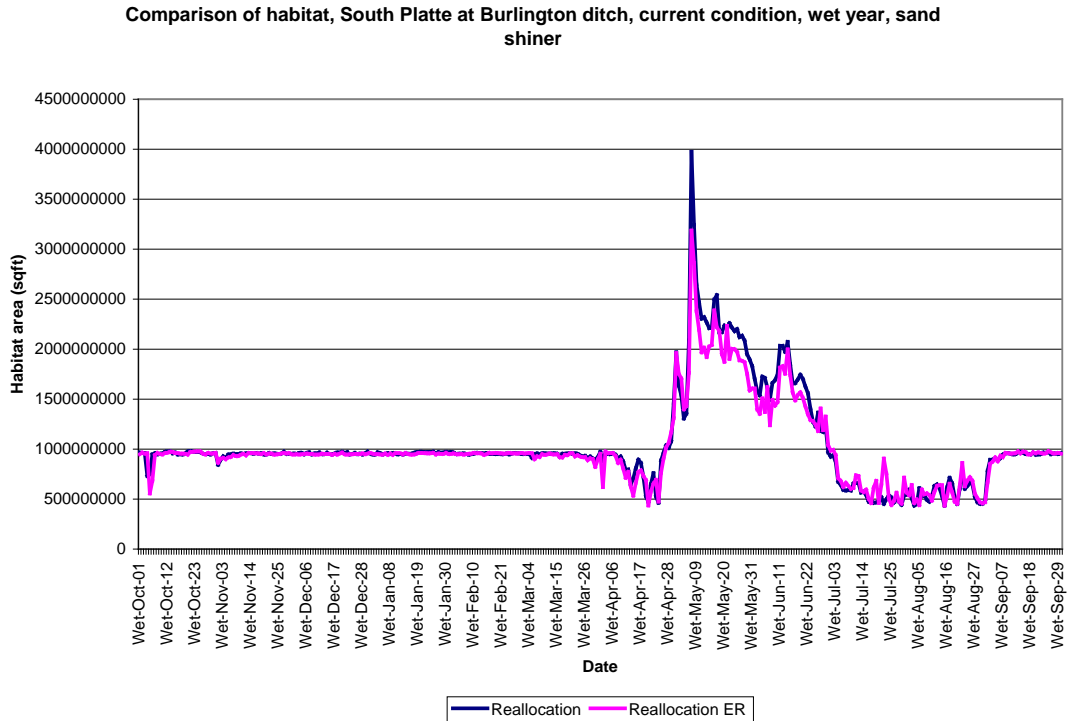


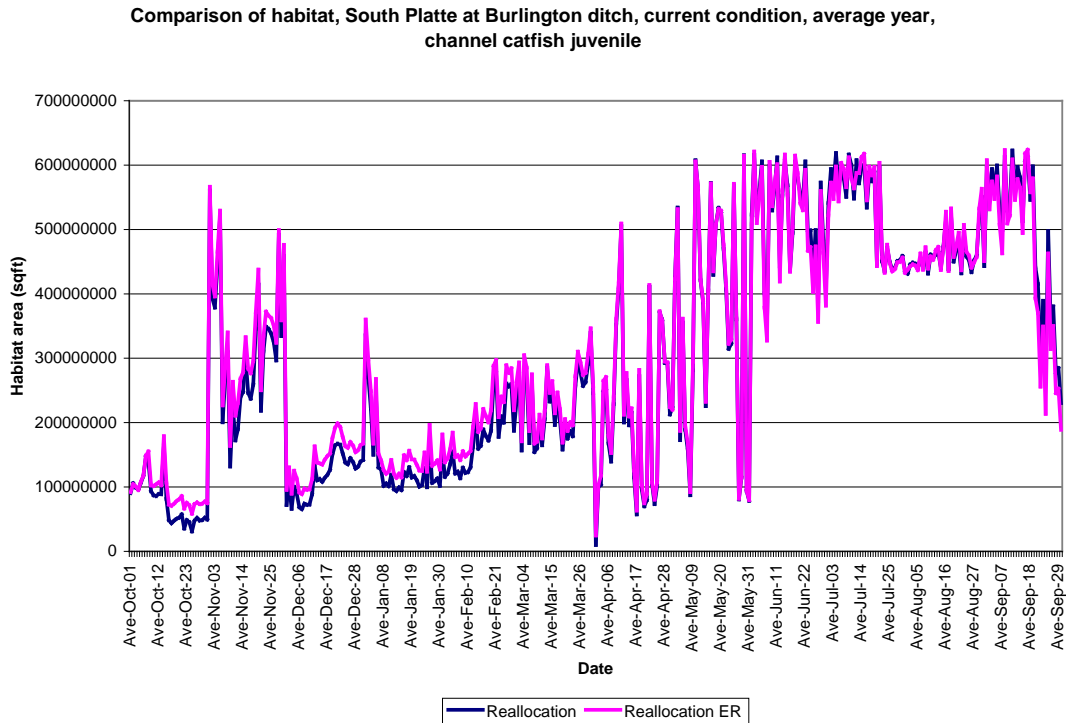
Figure 42. Comparison of habitat area, South Platte at Burlington, current condition, wet year, adult longnose dace.



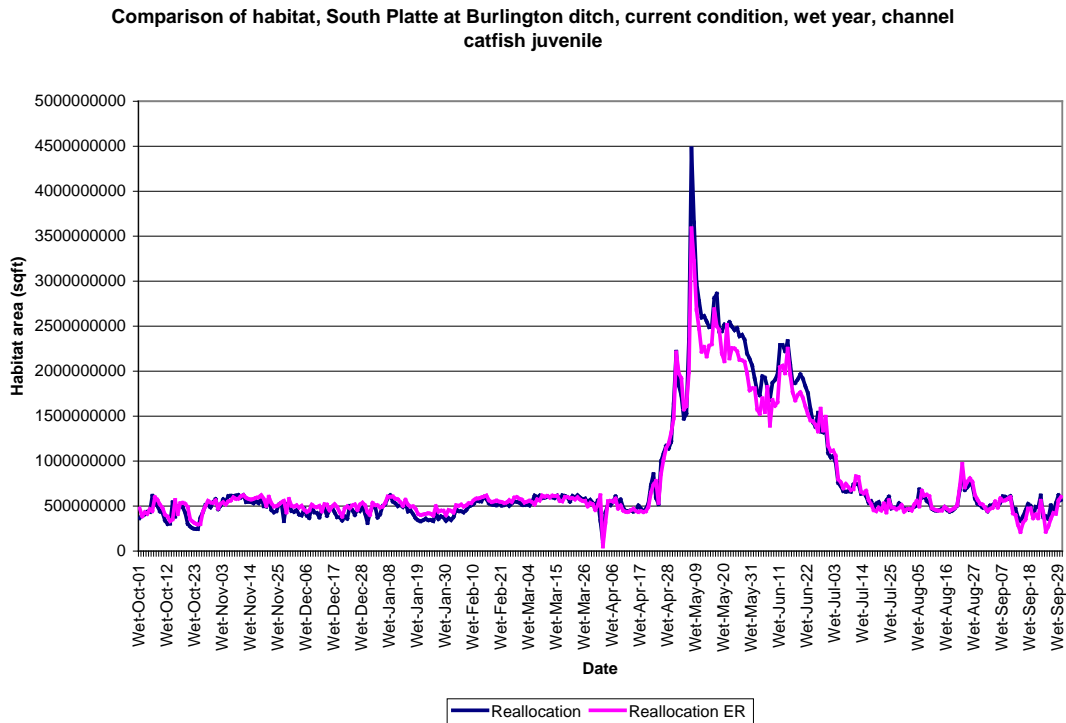
**Figure 43. Comparison of habitat area, South Platte at Burlington, current condition, average year, adult sand shiner.**



**Figure 44. Comparison of habitat area, South Platte at Burlington, current condition, wet year, adult sand shiner.**



**Figure 45. Comparison of habitat area, South Platte at Burlington, current condition, average year, juvenile channel catfish.**



**Figure 46. Comparison of habitat area, South Platte at Burlington, current condition, wet year, juvenile channel catfish.**

Comparison of habitat, South Platte at Burlington ditch, current condition, average year, channel catfish adult

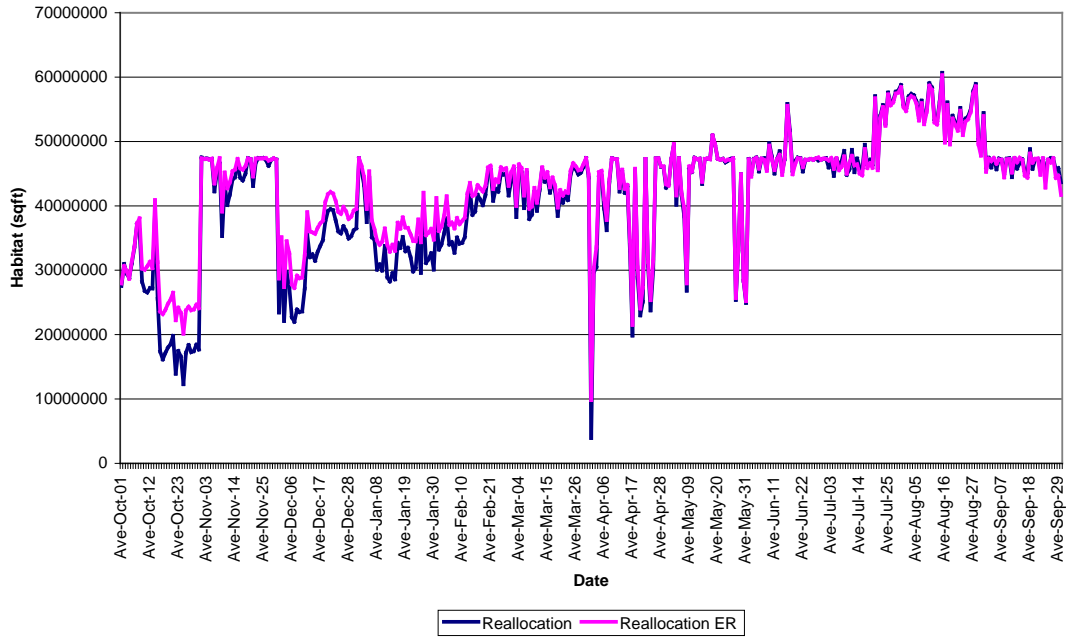


Figure 47. Comparison of habitat area, South Platte at Burlington, current condition, average year, adult channel catfish.

Comparison of habitat, South Platte at Burlington ditch, current condition, wet year, channel catfish adult

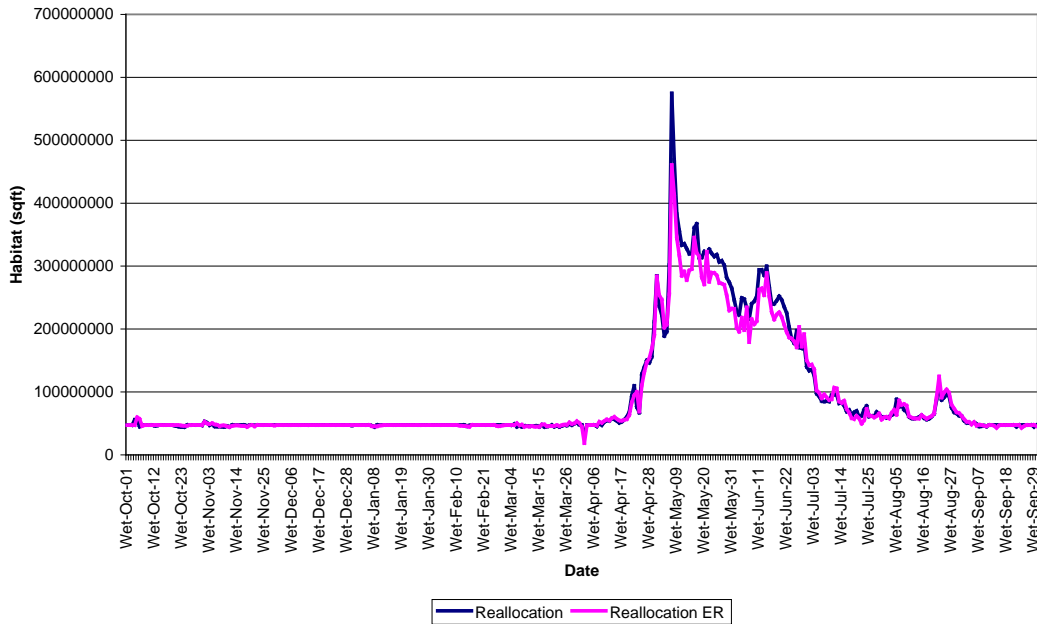


Figure 48. Comparison of habitat area, South Platte at Burlington, current condition, wet year, adult channel catfish.

Comparison of habitat, South Platte at Burlington ditch, current condition, average year, white sucker adult

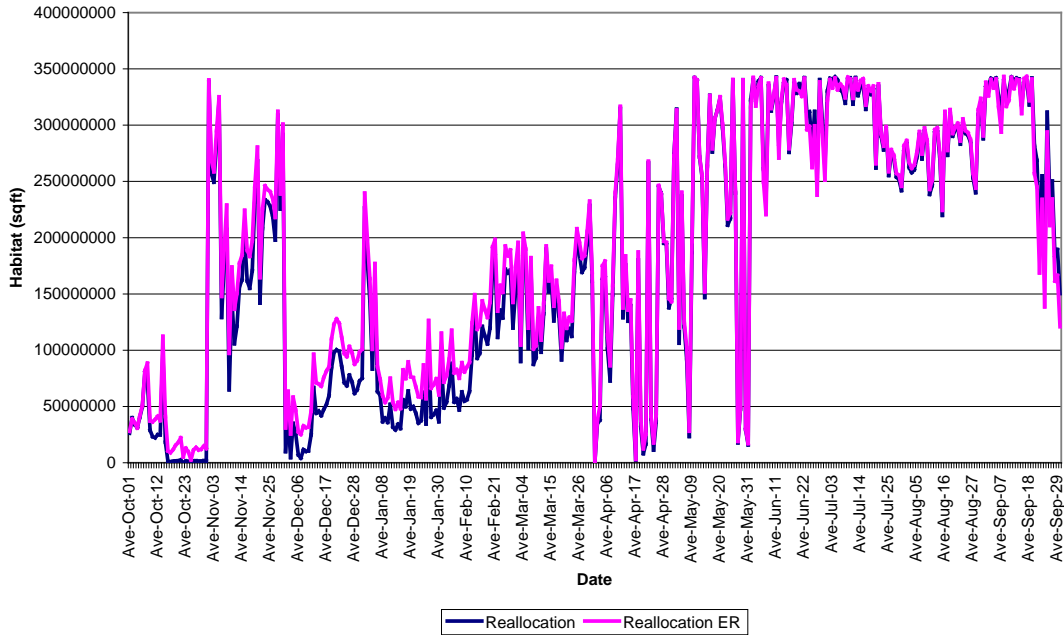


Figure 49. Comparison of habitat area, South Platte at Burlington, current condition, average year, adult white sucker.

Comparison of habitat, South Platte at Burlington ditch, current condition, wet year, white sucker adult

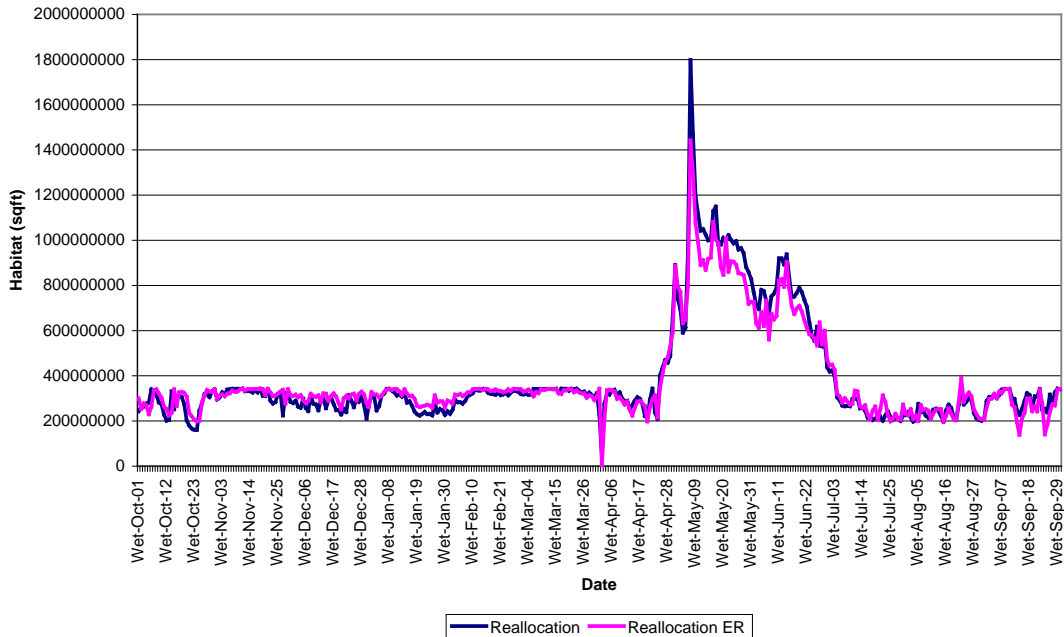
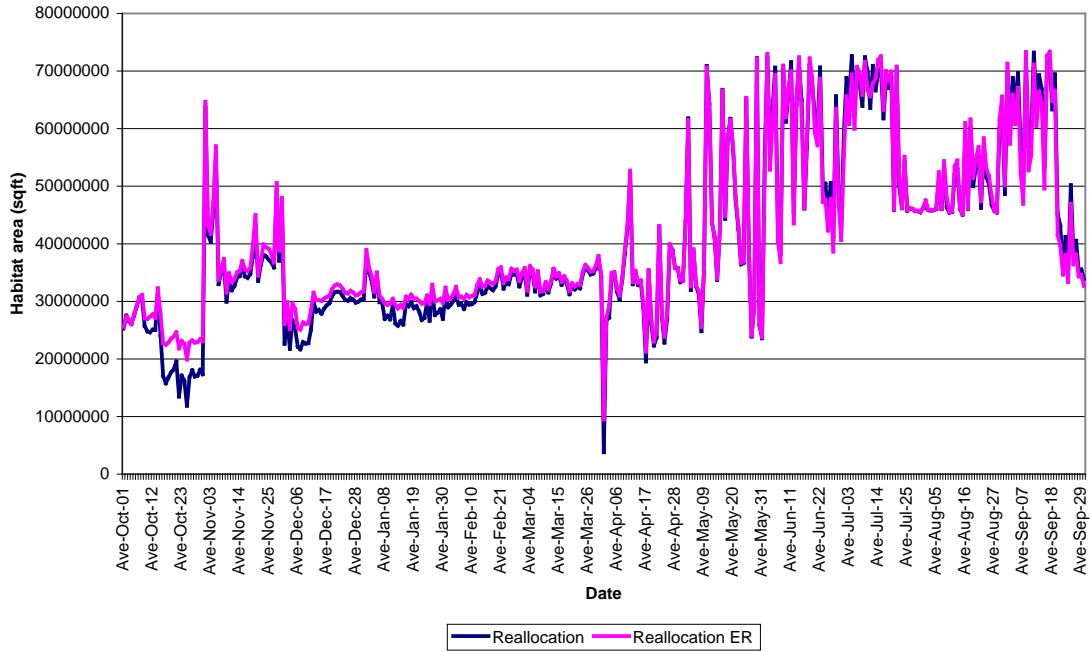


Figure 50. Comparison of habitat area, South Platte at Burlington, current condition, wet year, adult white sucker.

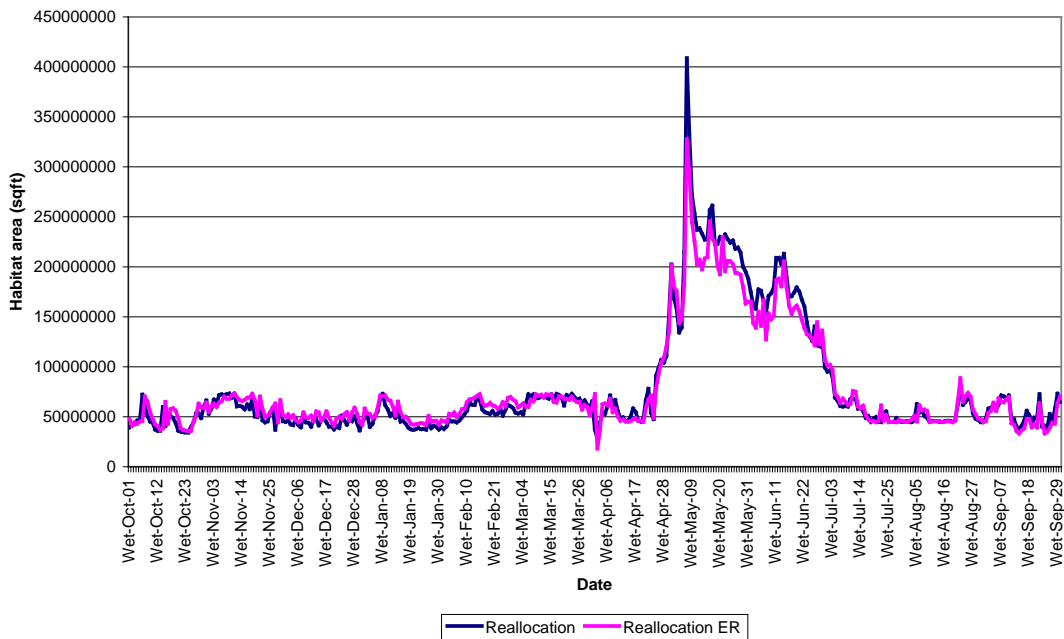


**Comparison of habitat, South Platte at Burlington ditch, current condition, average year, common carp adult**



**Figure 51. Comparison of habitat area, South Platte at Burlington, current condition, average year, adult common carp.**

**Comparison of habitat, South Platte at Burlington ditch, current condition, wet year, common carp adult**



**Figure 52. Comparison of habitat area, South Platte at Burlington, current condition, wet year, adult common carp.**

Comparison of habitat, South Platte at Burlington ditch, buildout condition, average year, longnose dace adult

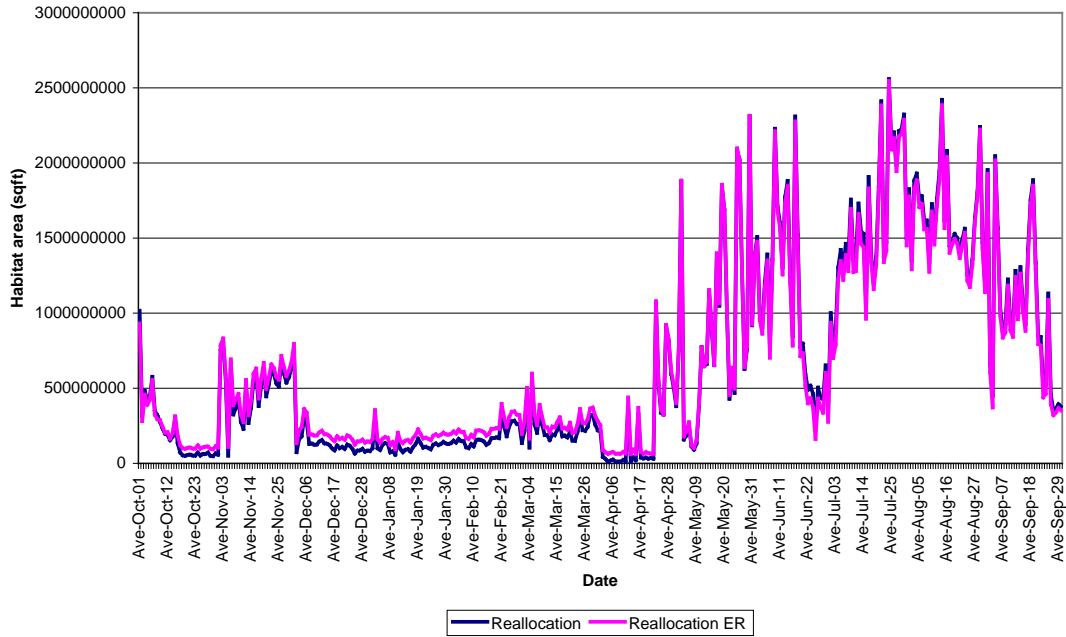


Figure 53. Comparison of habitat area, South Platte at Burlington, buildout condition, average year, adult longnose dace.

Comparison of habitat, South Platte at Burlington ditch, buildout condition, wet year, longnose dace adult

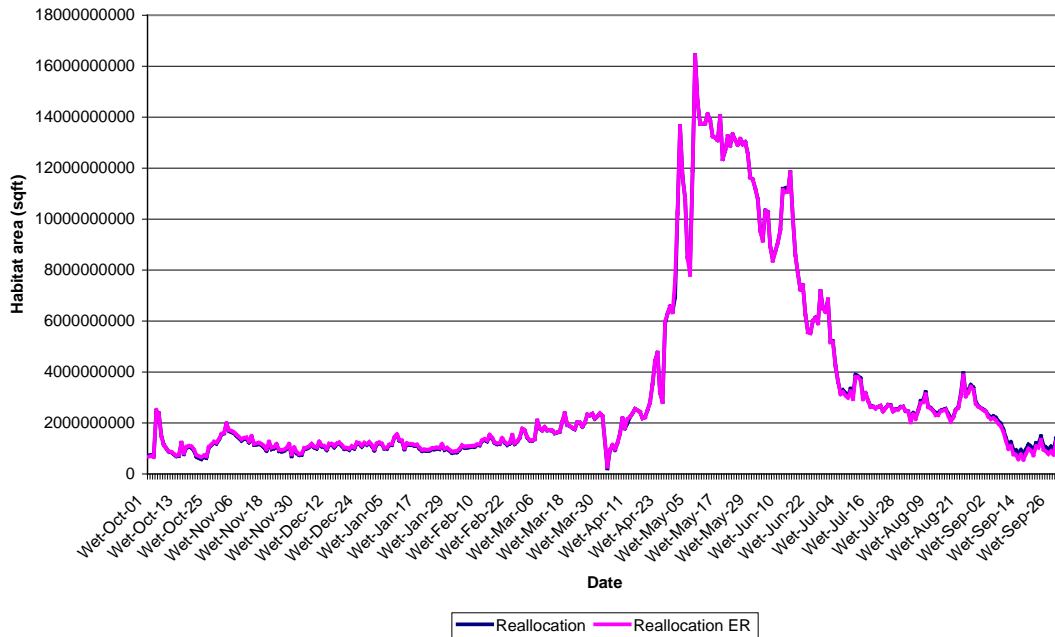


Figure 54. Comparison of habitat area, South Platte at Burlington, buildout condition, wet year, adult longnose dace.

Comparison of habitat, South Platte at Burlington ditch, buildout condition, average year, sand shiner adult

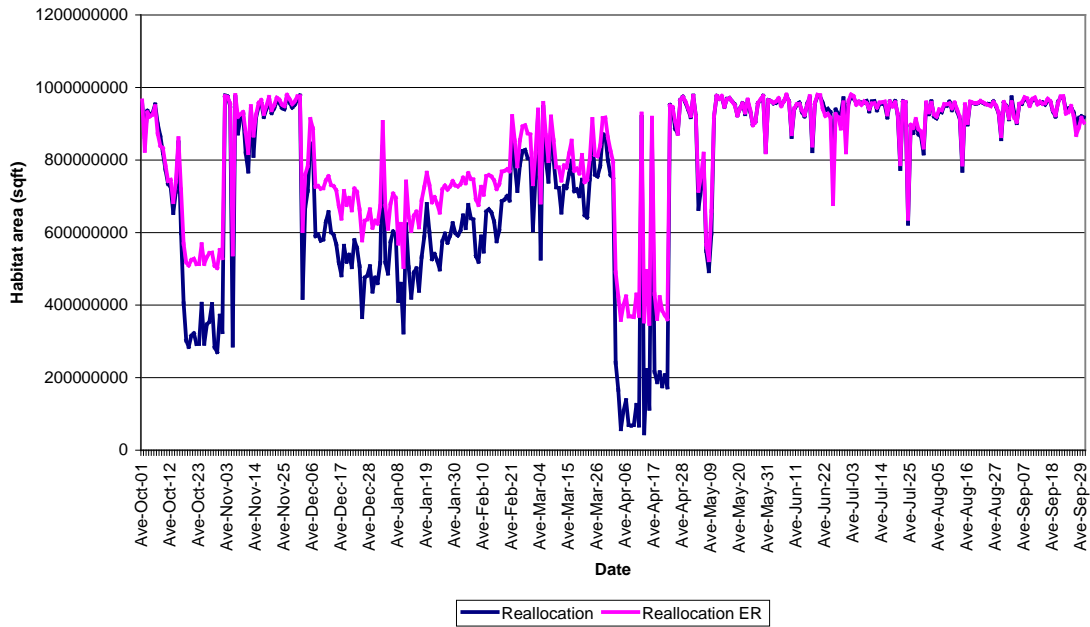


Figure 55. Comparison of habitat area, South Platte at Burlington, buildout condition, average year, adult sand shiner.

Comparison of habitat, South Platte at Burlington ditch, buildout condition, wet year, sand shiner adult

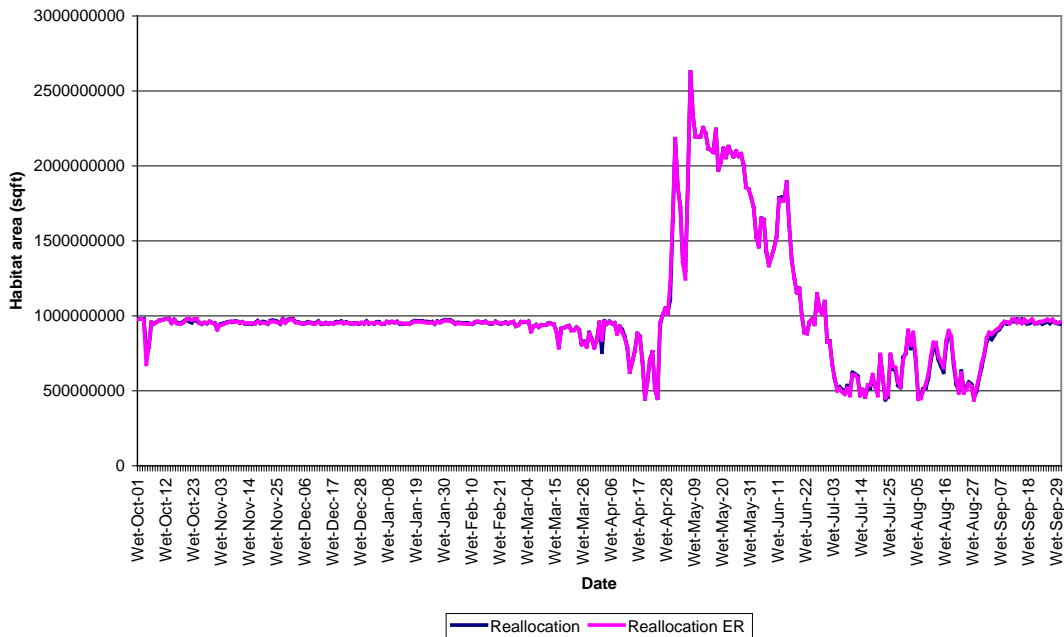


Figure 56. Comparison of habitat area, South Platte at Burlington, buildout condition, wet year, adult sand shiner.

Comparison of habitat, South Platte at Burlington ditch, buildout condition, average year, channel catfish juvenile

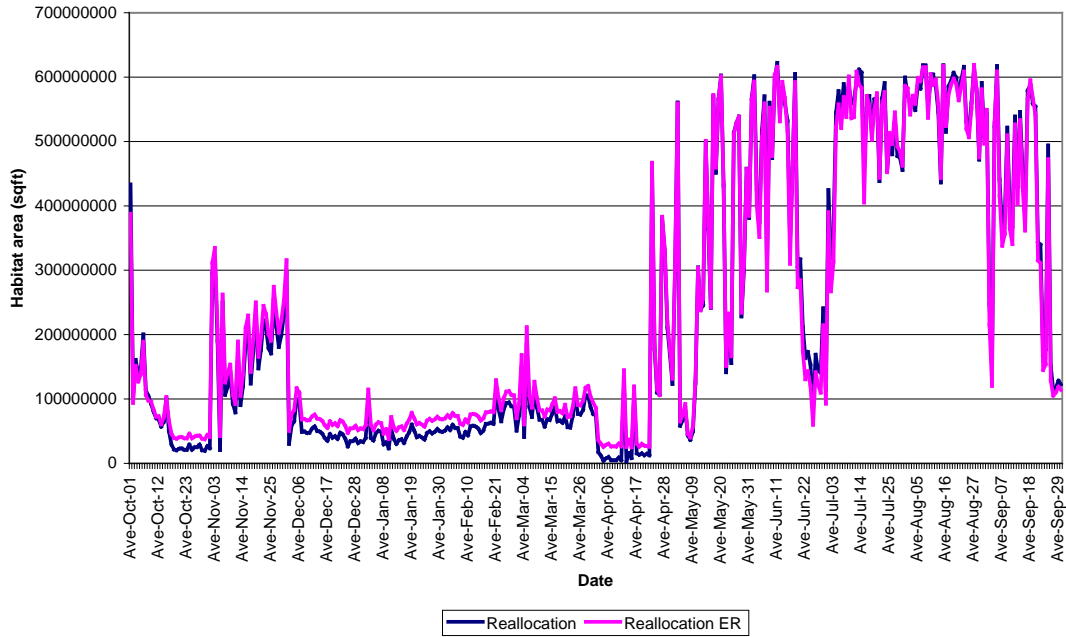


Figure 57. Comparison of habitat area, South Platte at Burlington, buildout condition, average year, juvenile channel catfish.

Comparison of habitat, South Platte at Burlington ditch, buildout condition, wet year, channel catfish juvenile

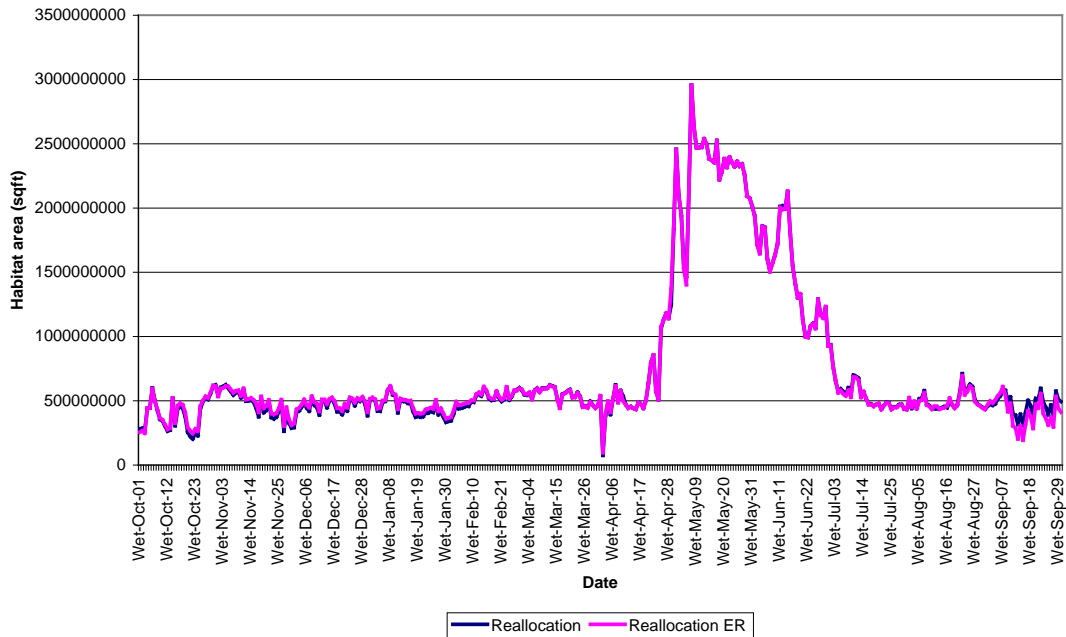
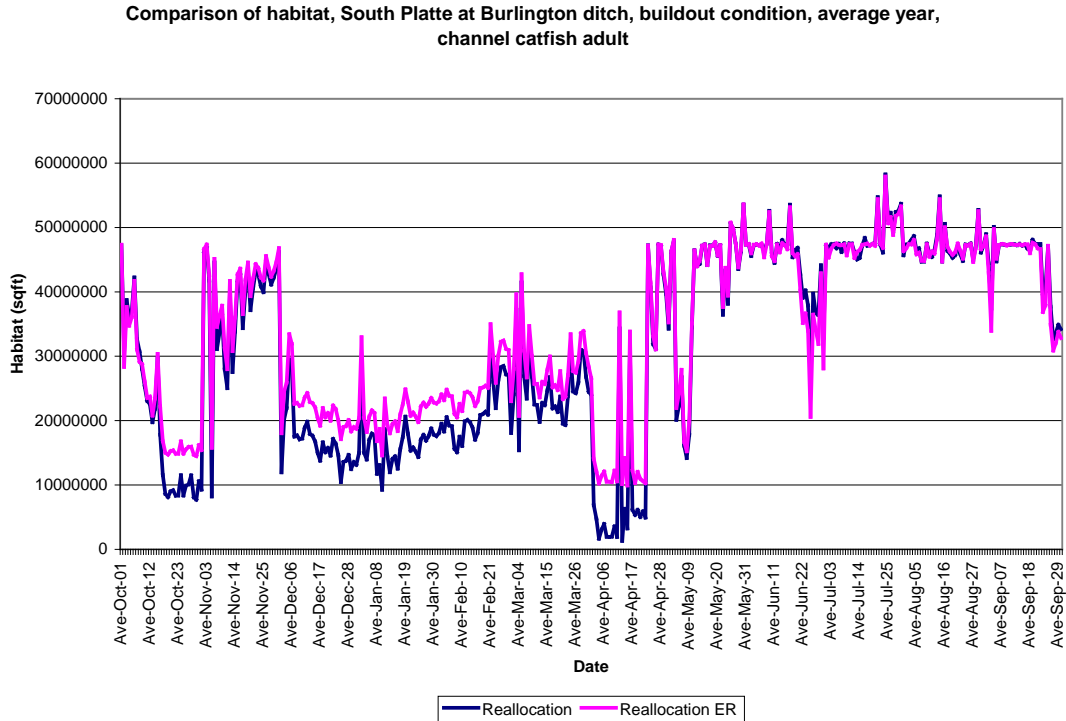
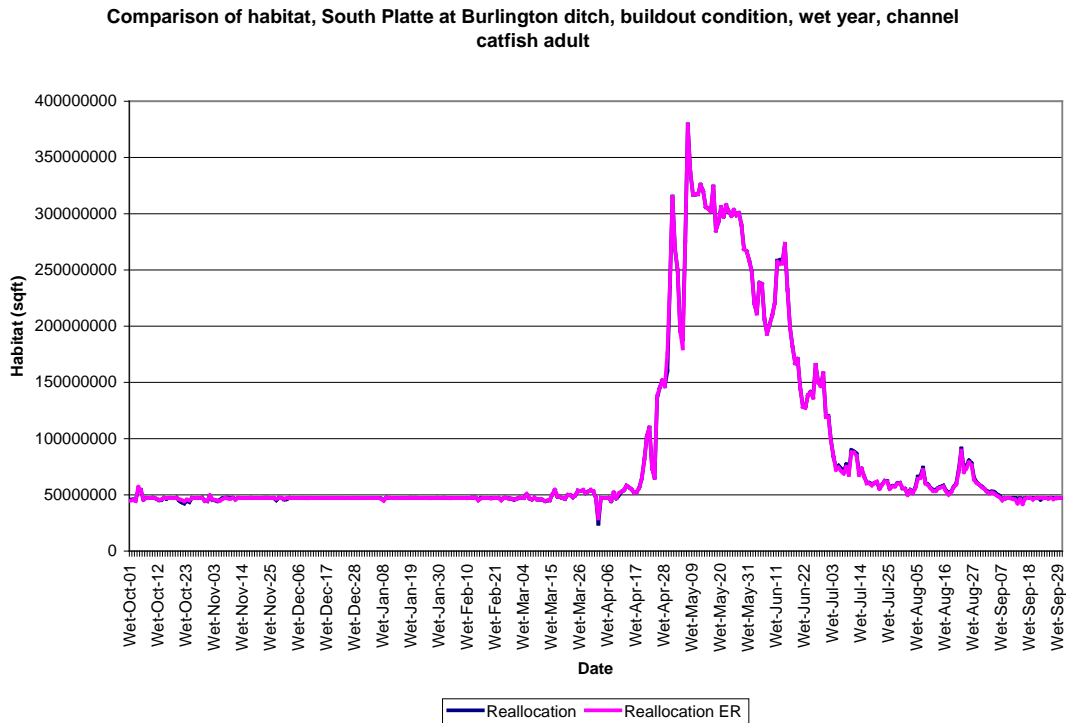


Figure 58. Comparison of habitat area, South Platte at Burlington, buildout condition, wet year, juvenile channel catfish.



**Figure 59. Comparison of habitat area, South Platte at Burlington, buildout condition, average year, adult channel catfish.**



**Figure 60. Comparison of habitat area, South Platte at Burlington, buildout condition, wet year, adult channel catfish.**

Comparison of habitat, South Platte at Burlington ditch, buildout condition, average year, white sucker adult

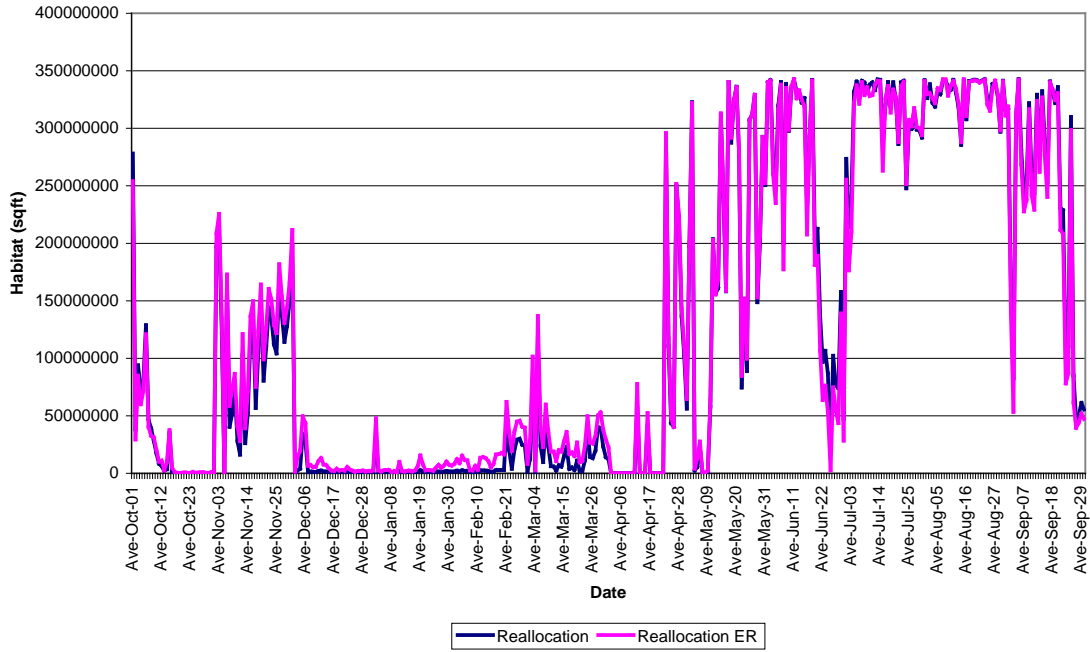


Figure 61. Comparison of habitat area, South Platte at Burlington, buildout condition, average year, adult white sucker.

Comparison of habitat, South Platte at Burlington ditch, buildout condition, wet year, white sucker adult

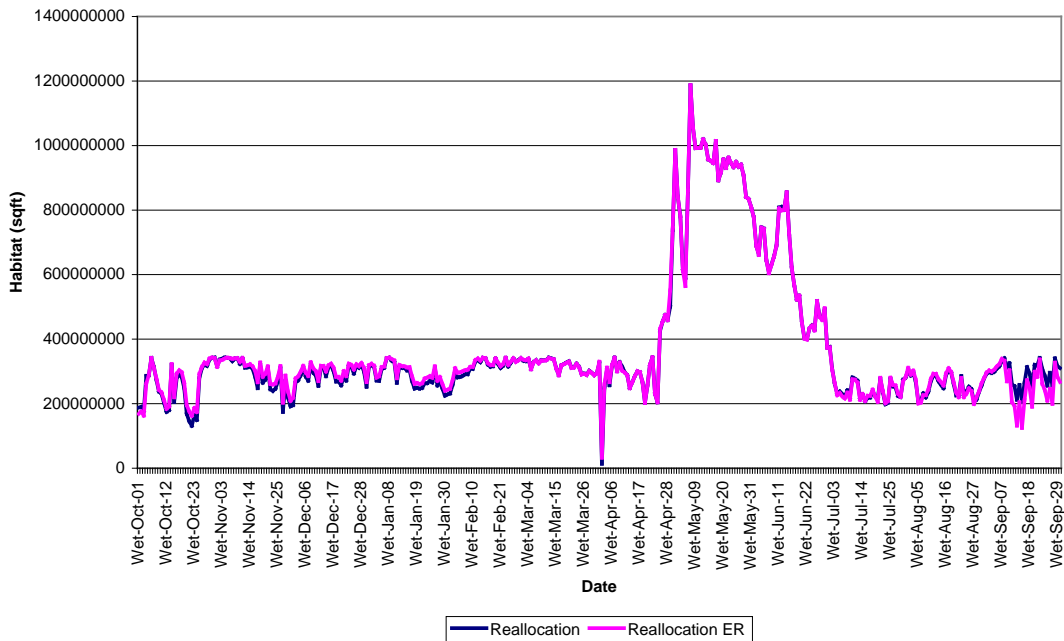
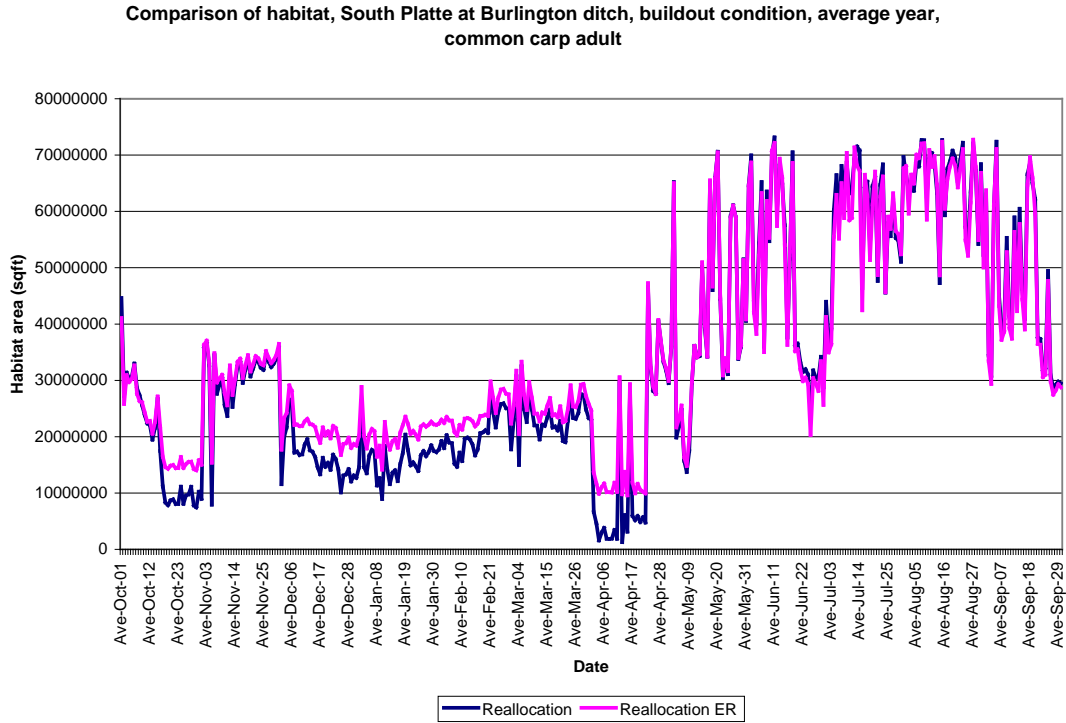
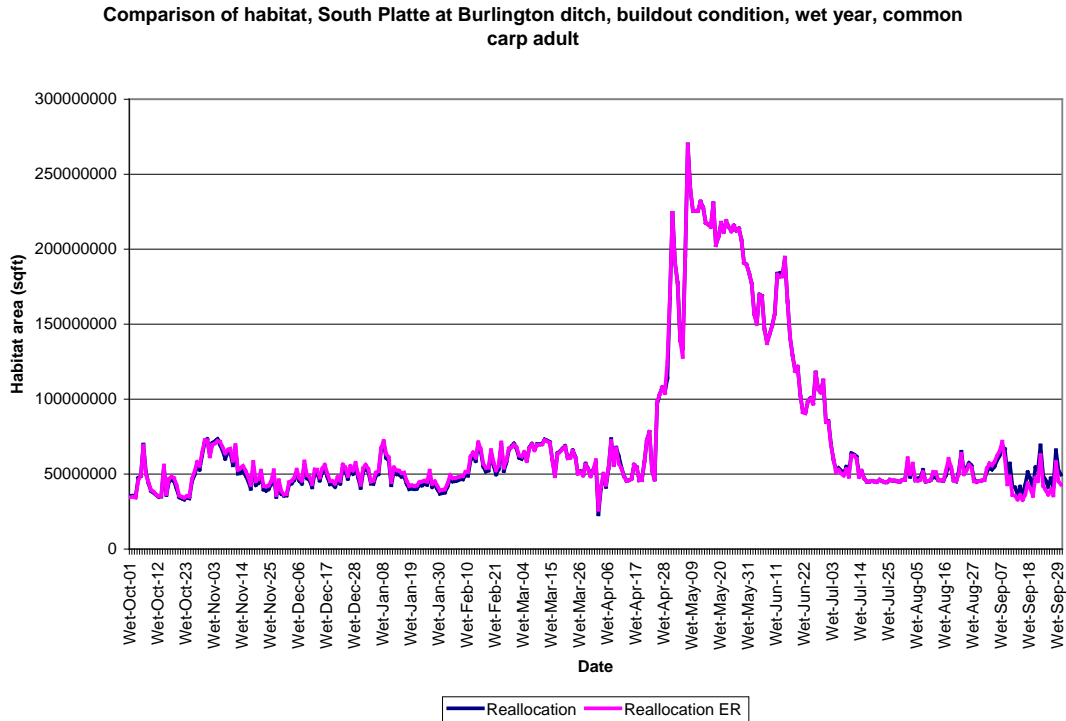


Figure 62. Comparison of habitat area, South Platte at Burlington, buildout condition, wet year, adult white sucker.



**Figure 63. Comparison of habitat area, South Platte at Burlington, buildout condition, average year, adult common carp.**



**Figure 64. Comparison of habitat area, South Platte at Burlington, buildout condition, wet year, adult common carp.**