2004 – 2011 Water Management Report
Duchesne River Working Group

August 2013

Prepared by:

Central Utah Water Conservancy District

Table of Contents

Cover Photo: Myton Townsite Diversion

Purpose

This report summarizes the efforts of the Duchesne River Working Group (DRWG) to provide and protect instream flows in the Duchesne River as called for in the U.S. Fish and Wildlife Service's (USFWS) May 4, 2005 "Update to the Reasonable and Prudent Alternative (RPA) in the July 1998 Biological Opinion for the Duchesne River Basin" (2005 Update).

Both the July 1998 biological opinion and the 2005 Update address impacts to endangered fish species (Colorado pikeminnow, razorback sucker, bonytail, and humpback chub) caused by historic water operations and future water development in the Duchesne River Basin. The 2005 Update amended the original 1998 biological opinion with up-to-date information on the biology and habitat usage of Colorado pikeminnow and razorback sucker, and refined flow recommendations in the Duchesne River for the two species. The actions called for in the 2005 Update, including flow protection, are part of the Upper Colorado River Endangered Fish Recovery Program's (Recovery Program) Recovery Implementation Program Recovery Action Plan (RIPRAP).

Developed and updated cooperatively by Recovery Program participants, the RIPRAP is the long range plan for recovery of the federally listed fish in the Upper Colorado River Basin. The RIPRAP uses the most scientifically sound and up-to-date information available to guide recovery and identifies specific actions and timeframes necessary for full species recovery. Actions are specified for major drainages, including the Duchesne River Basin, and as necessary these action items serve as part of the reasonable and prudent alternative (RPA) in biological opinions for projects that affect listed Colorado River fishes.

Pages 8 and 9 of the 2005 Update detail Item: I. (Provide and Protect Instream Flows) of Green River Action Plan for the Duchesne River. As part of the Recovery Program's July 16, 2010 Memorandum of Sufficient Progress, the task for this action item was updated to account for the work that had been done by the DRWG since 2005. The current language for this action item is as follows:

> "In cooperation with the Service, the CUWCD will draft a water management report (chronicling how flow recommendations have been met over the past 5 years, describing yearly efforts, available water, and evolution of past operations [release triggers, etc.]) This report will replace the "water management plan" that the 2005 Biological Opinion called for by December 2009. A second or third draft will be presented at the fall 2010 DRWG meeting. The DRWG will continue to examine the feasibility of other options for obtaining water."

The remainder of this report documents the DRWG's efforts to provide, protect, and manage instream flows in the Duchesne River from approximately 2004 through 2011, inclusive. All annual references in this report are in water years (October 1 through September 30).

Location Maps and Photographs

The location maps in Appendix A show the area from Starvation Dam, on the Strawberry River, to the confluence of the Duchesne and Green rivers. This is a distance of approximately 74.3

river miles. Releases from Starvation Dam, which are used to augment flows in the Duchesne River, first travel 6.5 river miles along the Strawberry River before reaching the confluence with the Duchesne River. The location of Knight Diversion Dam, a Central Utah Project (CUP) facility on the Duchesne River is also shown. The Knight Diversion diverts excess and off-season flows from the Duchesne River for storage in Starvation Reservoir. Additionally, the maps are annotated with the canal diversions (including the Myton Townsite Diversion), gaging stations, and river confluences, which are located in the portion of the Duchesne River system under review. Following the maps are photographs of many of the annotated sites.

High Flow Recommendations

High flow recommendations for the Duchesne River were formalized in the 2005 Update and serve to provide for the geomorphic processes that form and maintain current habitat for Colorado pikeminnow and razorback sucker. These processes are based on the flows needed to mobilize bed load, maintain channel movement, and transport fine sediment. The recommendations are based on an evaluation of the high flows that occurred during the 1977-2002 period of record and the response of sediment and other channel characteristics to these flows. Two alternatives were proposed in the 2005 Update for providing compliance with high flow recommendations.

> Alternative 1 recommends staged flow quantity and flow duration targets dictated by the anticipated hydrologic year. The hydrologic years are divided into four categories: dry, average, wet, and extremely wet. Within each category is a series of flow quantities and expected flow durations. The flow values reach 8,400 cfs and the durations extend up to 17 days.
>
> Alternative 2 recommends that an average annual channel-forming stream volume of at least 7,000 cfs-days per year above 4,000 cfs be provided to promote channel migration and maintain channel integrity. The 2005 Update includes a high flow recommendation that an average of 7,000 cfs-days above 4,000 cfs must be maintained. Based on additional analysis of the 1977 to 2005 period of record, the 2005 Update indicated that no special or extraordinary management is considered necessary to meet the high flow component of these recommendations.

The DRWG has used Alternative 2 during the report period to determine compliance with high flow recommendations.

Target Base Flow Recommendations

The base flow recommendations provided in the 2005 Update are targets listed in priority, to be met in the Duchesne River at the Randlett United States Geological Survey (USGS) gaging station (Randlett Gage). As targets, it is recognized that significant flow fluctuations above and below the established values will occur due to the interrelated complexity of canal operations, weather patterns, and system geographical extent. However, it is the goal of the DRWG to learn how to avoid significant fluctuations below the targets and to continually work towards meeting the base flow recommendations. These prioritized recommendations, as established in the 2005 Update (Appendix A, page 8), are as follows:

1) Highest priority should be given to implementing actions to meet the 50 cfs aquatic productivity base flow during the months of July through October. Maintaining habitat during the summer growing season will likely provide the greatest benefit to organisms that are important to aquatic productivity in the river system.

2) Consideration should be given to enhancing flows to meet a 50 cfs target during the months of March through June during low flow years. Providing minimum flows during those months would enhance the aquatic productivity of the system by providing favorable conditions for aquatic production early in the growing season.

3) During extreme low flow years, water supplies, if available, should be managed to meet a 50 cfs target during the winter months of November through February. Providing a flow of at least 50 cfs during the winter months would help prevent winter kill of organisms and loss of habitat through desiccation.

4) Consideration should also be given to supplementing flows to meet passage requirements (115 cfs) for Colorado pikeminnow during the March through June period if water is available. However, base flows to maintain aquatic productivity are considered a higher priority.

In addition to providing a framework for base flow delivery priorities, the Service stated the following to recognize the challenges associated with meeting flow recommendations in the Duchesne River:

> "The USFWS recognizes that the flow recommendations may not be achievable in all years. However, by using the recommendations as a framework to help guide flow management in the system, conditions can be improved for the endangered fishes such that the Duchesne can contribute to the overall recovery of the Colorado pikeminnow and razorback sucker."

Water Supply

To date, the annual water supply available to augment Duchesne River flows is a minimum of 3,330 acre-feet. Any water beyond the 3,330 acre-feet is obtained by diverting water used to maintain flows in tributaries above Starvation Reservoir for storage in the reservoir. Amounts available from each source are explained below:

1) Daniels Replacement Project Water: An annual allotment of 2,900 acre-feet with no multi-year, carry-over provision in Starvation Reservoir.

2) Central Utah Project Completion Act (CUPCA) Section 207 Water: An annual allotment of 430 acre-feet with a multi-year, carry-over provision

in Starvation Reservoir not subject to spill. Of this 430 acre-feet, 365 acre-feet are under temporary contracts with renewal provisions.

3) Re-diversion of 44,400 acre-feet of streamflow mitigation water (44,400 Water): An annual allotment that varies depending upon how much of the water used to maintain minimum streamflows in the four, main-stem Strawberry Aqueduct and Collection System (SACS) streams (Rock Creek, West Fork, Currant Creek, and Strawberry River) can be re-diverted and stored in Starvation Reservoir. Historically, re-diversions have ranged from zero to approximately 9,900 acre-feet. This water has a multi-year, carry-over provision, but is the first block of water to spill from Starvation Reservoir if the reservoir fills and additional water enters the reservoir. Starvation Reservoir normally fills and spills every water delivery season with occasional exceptions.

Future additional annual water supply may be acquired as CUPCA Section 207 water contracts are completed with CUP water users. The CUPCA Section 207 program allows funding for water conservation projects and can designate conserved water be made available for instream flow purposes. In 2011 a contract was completed that made 1,500 acre feet of water available on a temporary basis. Delivery of this water will be made via Big Sand Wash Dam and the associated Roosevelt Pipeline.

These water supply components above have the benefit of a reservoir storage element. In addition to these storable waters, there is another major supply of water that does not include storage. A significant portion of the 44,400 Water is bypassed from Starvation Dam and Knight Diversion Dam to the Duchesne River during the non-irrigation season (November 1 through March 30) and during the early runoff season (April 1 through June 30). This is due to winter drawdown targets that dictate the maximum reservoir level at specific dates. These targets can restrict some storing of water during these time periods. These bypasses, plus the re-diverted 44,400 Water that spills from Starvation Reservoir, all contribute to helping meet the target base flow recommendations.

There is one other target base flow contribution resulting from Starvation Reservoir operations that particularly benefits the Priority 4 period. CUWCD reservoir filling operations for Starvation Dam commonly include storing water immediately following the irrigation season until the reservoir is at a status of adequate water supply for the upcoming irrigation season, coupled with adequate available storage for pending high runoff. Once that reservoir state has been achieved, flows are bypassed, usually beginning in the early March period, thus significantly contributing to the Priority 4 target base flow recommendation. This operational scenario is followed most years, within the constraints imposed by federally-mandated flood control requirements and other CUWCD needs.

For information purposes, Appendix B includes a series of bar graphs showing the calculated water supply needs, organized by priority, to meet the base flow recommendations at the Randlett Gage by individual water year from 1943 to 2005. The graphs also are annotated with the average annual needs for the 1943 to 2005 period and the 1988 to 2005 period; the latter

being the period of time with the SACS in full operation. In summary, the average annual needs for the 1988 to 2005 period for the four priorities were:

Priority 1 (50 cfs target from July 1 through October 31):	1,337 acre-feet
Priority 2 (50 cfs target from March 1 through June 30):	853 acre-feet
Priority 3 (50 cfs target from November 1 through February 28):	187 acre-feet
Priority 4 (115 cfs target from March 1 through June 30):	5,893 acre-feet*

*This value includes the 853 acre-feet required to meet the Priority 2, 50-cfs target.

To meet a 50 cfs target year-round (Priorities 1, 2, & 3), a total of 2,377 acre-feet would be needed on average. Note that the above values represent the average need for the period from 1998 to 2005 and additional water may be needed in specific years to meet the targets. The values above also represent the amount needed above that provided by the aforementioned, non-storable, 44,400 Water releases. Also note that the values, as shown later in this report for 2004, were influenced by experimental target base flow releases.

Flow Measurement

A critical element of flow monitoring is accurate flow measurement. Another RPA action item was to determine gaging station needs along the Duchesne River and its tributaries. (See 2005 Update, page 12, Item I.F.) Upon review by the DRWG, it was determined that adequate river monitoring could be accomplished by maintaining USGS gaging stations at the following river sites:

Duchesne River at Myton, Utah (Station Number 09295000)
Duchesne River above Uinta River near Randlett, Utah (Station Number 09295100)
Uinta River at Randlett, Utah (Station Number 09301500)
Duchesne River near Randlett, Utah (Station Number 09302000)

Funding for maintaining these sites is being provided by the Recovery Program. Funding was also provided by the Recovery Program to conduct sediment transport studies at the Randlett Gage from April to July during 2006, 2007, and 2008. The sediment transport data is summarized in a USGS report (Williams et al. 2009). Sediment loads increased as flows increased with the spring runoff. During the sampling period, the minimum daily sediment load was 4.8 tons on July 18, 2006, and the maximum daily sediment load was 3,730 tons reported on June 11, 2006.

As experimental and early augmentation flows were released between 2004 and 2006, it became apparent that a major modification to the Myton Townsite Diversion on the Duchesne River would be necessary. The Myton Townsite Diversion, located approximately 31.5 river miles downstream of Starvation Dam and owned by the Ute Tribe, is operated as a dry-dam diversion with excess flows spilling over a river-wide crest. Though real-time spill data were available via the Internet, the accuracy of the data was in question due to the condition of the crest. After review by the DRWG, modifications to the structure were made. These included placing a steel blade across the crest to enhance measurement accuracy, replacing the river release radial gate,

and replacing the canal headworks. These modifications were completed between November 2008 and April 2009. Funds for the rehabilitation were provided primarily by the Recovery Program and a Water 2025 grant from the U.S. Bureau of Reclamation.

Photos of the above referenced gaging stations and the Myton Townsite Diversion are found in Appendix A.

Water Management

Meeting High Flow Recommendation

Complying with the high flow recommendation under Alternative 2 (see High Flow Recommendations section above) calls for maintaining an annual average of 7,000 cfs-days above 4,000 cfs. A cfs-day is defined as one cfs of flow for one full day. For example, one day of 5,000 cfs flow would provide 1,000 cfs-days above 4,000 cfs, whereas ten days of flows at 4,001 cfs would provide 10 cfs-days above 4,000 cfs. Therefore, to meet the 7,000 cfs-days in a year, flows could be 11,000 cfs for one day or they could be 5,000 cfs for 7 days amongst other possible scenarios.

In defining this recommendation, the 2005 update indicated that no special or extraordinary management is considered necessary to meet this high flow recommendation. Since 2004, two years (2005 and 2011) have produced flow events generating cfs-days above 4,000 cfs. In 2005, there were 34,190 cfs-days above 4,000 cfs and 2011 produced 95,400 cfs-days above 4,000 cfs. With these two years, the annual 7,000 cfs-days average will be maintained without any additional high flow events until the year 2022.

Year	CFS-Days Above 4,000 CFS
2004	0
2005	34,190
2006	0
2007	0
2008	0
2009	0
2010	0
2011	95,400
Annual Average	**16,199**

Meeting Base Flow Recommendations

Water management to provide target base flows has evolved from an early, experimental stage in 2004 to a more refined, but still developing, system in 2011. The cooperation of DRWG membership has been critical to the success of the augmented flow delivery. Of particular note is the voluntary, at-will cooperation of private, senior, water-right holders who allow target base flow releases to bypass their respective diversions without the legal requirement to do so. This type of cooperation has led to a respected, beneficial balance between agrarian and fisheries interests.

Graphs showing the level of compliance for 2000 through 2011 to the target base flow recommendations are shown in Appendix C. The first graph shows the days of non-compliance with the 50 cfs target (Priorities 1, 2, and 3) during the respective water years followed by a graph showing the number of days less than 115 cfs during the period of March 1 through June 30 (Priority 4). The water years of 2000 through 2004 are included to show the difference between pre- and post-augmentation eras.

The following table, with accompanying footnotes, describes a water-year-by-water-year summary of management operations and deliveries. This information is also shown graphically as hydrographs in Appendix D and is described conceptually in the Water Year Narratives section of this report. Overall, target goals were met with more frequency from 2008 to 2011, as operators became more adept at the process for effectively providing the water downstream.

Year	Water Available (acre-feet)[1]	Water Delivered (acre-feet)	Dates of Augmen-tation[2]	Days of Augmen-tation[2]	Additional Water Needed[3] (acre-feet)	Days Flow Target Not Met[3]
2004	5,381	2,481	Jun 22 to Sep 30	101	8,626	247
2005	3,332	0	None	None	1,053	19
2006	3,762	0	None	None	214	14
2007	4,192	4,170	Jul 2 to Oct 1	92	2,108	72
2008	3,352	299	Jul 20 to Jul 25	6	1,484	63
2009	3,782	91	May 5 to May 8	4	34	4
2010	4,212	3,244	Jul 17 to Sep 23	69	317	25
2011	6,142	0	None	None	34	3

[1]Values represent the total water supply available as of October 1 of a given year. As described under the Water Supply section of this report, each water supply component has varying carry-over and accruing aspects. During the reporting period (2004 through 2011), no 44,400 Water was available during the Priority 1 period due to prior spillage from Starvation Reservoir. Beginning in 2011, 1,500 acre-feet of water was available from Big Sand Wash Reservoir.

[2]Information represents dates and number of days, respectively, when flow augmentation was attempted. It may include intermittent days when no augmented flows were released due to a variety of operating conditions.

[3]Values are to be interpreted in the context of the necessary water needed to meet a 50 cfs target year-round (Priorities 1, 2, and 3). The "Additional Water Needed" is, in some cases, somewhat misleading because target base flow releases were not made during the Priority 2 and 3 periods in an effort to save water for the Priority 1 period. Also, the "trigger" water management mechanism, as described later, inherently required the postponement of target base flow releases. Finally, it needs to be noted that real-time, provisional USGS data were used to determine target base flow release patterns with values commonly being modified by the USGS for final publication.

Water Year Narratives

2004: Experimental target base flow releases were made beginning June 22, 2004, and extended to the end of the irrigation season. This initial experimental period revealed that water user diversion patterns, weather variability, and released flow lag times were all complexities associated with the delivery of target base flows. Total deliveries were 2,481 acre-feet.

2005: Due to above-average runoff and other favorable hydrologic conditions, target base flows were met without augmented flow deliveries during a great majority of the water year. Target base flows were not met during the early water year period due to lack of revised implementation guidelines following the experimental period.

2006: Due to above-average runoff and other favorable hydrologic conditions, target base flows were met without augmented flow deliveries during a great majority of the water year. Those periods when target base flows were not met in the late irrigation season are attributed to brief periods of sporadic flows caused by intermittent thunderstorm activity.

At the request of the USFWS, CUWCD released water to augment flows to approximately 500 cfs in the Duchesne River between Myton City and the Green River from October 1 to October 7, 2005. This flow level was required to allow USFWS and Ute Tribe personnel to navigate the river more easily during the capture and removal of non-native fish.

The concept of "triggers" was developed by the parties of the DRWG during 2006 wherein under reduced hydrologic conditions at the Randlett Gage, flows would be released from Starvation Dam. The initial triggers were based on a specific observed flow level (35 cfs or below) and a duration (for 3 days). When the aforementioned "triggers" were met, flows were to be released from Starvation Dam to augment target base flows. As management practices became more sophisticated, current and pending weather conditions, anticipated usage or non-usage of water by water users, and the descending or ascending nature of the real-time hydrographs were also taken into account. The specific flow triggers for all years, in terms of an observed flow for a given number of days, can be found as annotations on the hydrographs in Appendix D.

2007: After the runoff season, flows began to drop substantially in mid-June. In response to these declining flows, target base flow releases were made from July 2 through October 1, 2007. Total deliveries were 4,170 acre-feet. Target base flow releases made in response to triggers created a hydrograph that oscillates above and below the 50 cfs target. This is because operators waited for a target of 35 cfs of 3 days, then released water, which then had a lag time to reach the gauge. Then as releases were stopped, flows decreased back to the trigger levels and the cycle repeated.

Learning travel times for releases was an important lesson from 2007. The travel times for target base flow releases began to be refined during the 2007 water year. For a 10 to 20 cfs increase, the time from Starvation Dam to the Duchesne River at Myton gaging station (34.4 river miles) is approximately 17 to 20 hours and to the Randlett Gage (58.5 river miles) is approximately 34 to 40 hours. These travel times are based on a base flow at the Randlett Gage of 35 cfs, the trigger flow for 2007.

2008: Target base flow releases were made from July 20 through July 25, 2008. Total deliveries were 299 acre-feet. Releases to augment target base flows were successful in July, with only two periods of below-target base flows. However, target base flows were not met during the early water year period because the existing triggers to release water were not being met.

Documentation, in the form of aerial photos, of the extensive beaver dam system along the lower Duchesne River was completed by the Utah State Engineers Office in November 2007. Of special concern is the affect beaver dams adjacent to gaging stations have in relation to real-time flow management. On multiple occasions, the flow values for the Uintah River at Randlett gage were erroneously high due to beaver dam impact. An additional concern with beaver dams is their negative impact on fish passage. Representative photographs showing beaver dam obstruction of the Duchesne River are included in Appendix A.

2009: Target base flow releases were made from May 5 through May 8, 2009 in response to a dramatically falling hydrograph. Releases prevented flows from falling below the target base flow levels except for a very brief period of time. Total deliveries were only 91 acre-feet because flows were largely above target levels. It is important to note that all periods of flow below target levels in 2009 were short in duration and barely below the target levels.

Rehabilitation of the Myton Townsite Diversion was completed between November 2008 and April 2009.

2010: In 2010, a revised trigger was used in an attempt to keep the flows from falling much below the 50 cfs target. A new trigger of 45 cfs for two days attempted to release water as flows were falling. In response to these triggers, target base flow releases were made from July 17 to September 23, 2010. Total deliveries were 3,244 acre-feet. Only three periods of below target flows occurred during the irrigation season.

Releases were interrupted on September 23 through October 1, 2010, while federal, state, local, and tribal emergency management personnel battled a petroleum product contamination in the Strawberry River below Starvation Dam and along the Duchesne River below the Duchesne/Strawberry rivers confluence.

The 2010 data shown in the graphs in Appendix D includes a period of estimated daily mean discharge that has been approved for release by the USGS.

2011: Due to above-average runoff and other favorable hydrologic conditions, target base flows were met without augmented flow deliveries except for 3 days at the beginning of the water year. These days at the beginning of the water year were related to the petroleum product contamination mentioned in the Water Year 2010 discussion.

High flows in 2011 substantially exceeded the 4,000 cfs threshold described in the High Flow Recommendations section of this report. In fact, because of high runoff and reservoir management, flows exceeded 4,000 cfs for almost a month from mid-June to mid-July.

Conclusions

1. Water management to meet target base flow recommendations in the lower Duchesne River has been an adaptive process from 2004 to 2011. Experimental releases in 2004 helped identify the amount of releases and accommodations necessary to meet targets. Additional work in later years has aided in determining the travel time from Starvation Reservoir to the gaging stations downstream.

2. Most periods of below target base flows have occurred between July 1 and November 1. Many years have below target base flows in October, as the new water year begins.

3. Focusing on "triggers" for initiating water deliveries from Starvation Reservoir has resulted in poor response times for supplying water to meet targets. In fact, most periods of below-target base flows could have been avoided had releases been made earlier in anticipation of a decline. As a result, water managers have learned to anticipate water use, weather patterns, and other variables in order to release water early enough to prevent a period of below-target base flows.

4. River obstruction by beaver continues to be an issue at multiple locations along the Duchesne River starting at the Myton Townsite Diversion and continuing downstream.

5. The progress in meeting target base flow recommendations has been made due to the cooperation of the DRWG membership. The voluntary cooperation exhibited by water right holders along the Duchesne River, that has allowed flow releases to bypass their diversions, has been key in meeting the recommendations.

Recommendations

1. Water management by operations personnel needs to focus on anticipating and reacting to basin-wide hydrologic conditions as opposed to focusing on "triggers." As hydrologic and irrigation water delivery conditions allow, water managers should continue to use travel time data to begin releases in anticipation of falling flows. Travel times at base flows are approximately 1.5 to 1.75 days from Starvation Reservoir to the Randlett Gauge, indicating that planning 2 days in advance will promote routinely meeting the base flow targets.

2. Releases in October should be made to continue trying to meet target base flows through the end of the Priority 1 period. In years 2005, 2008, 2009, and 2011, water was unused at the end of the year that could have supported higher flows in October.

3. As part of the effort to meet target base flow targets, established flow measurement stations must continue to be operated and maintained.

4. Any impacts due to river channel obstructions (e.g. beaver dams) must continue to be monitored and mitigated. For example, beaver dams that modify conditions near gauging stations and cause incorrect readings should be removed, or gauges should be recalibrated.

5. Coordinated efforts need to continue to acquire, as possible, and deliver water to meet target base flow recommendations. Through the work and cooperation of all parties of the DRWG, progress will continue to be made.

6. Efforts need to continue to maintain the cooperative relationship that has been built. As such, the DRWG should continue to meet semi-annually to review and discuss target base flow recommendation progress including water supply, water delivery, and related issues.

7. An update to this report needs to be prepared at a future date, of not less than 5 years, as agreed upon by the DRWG.

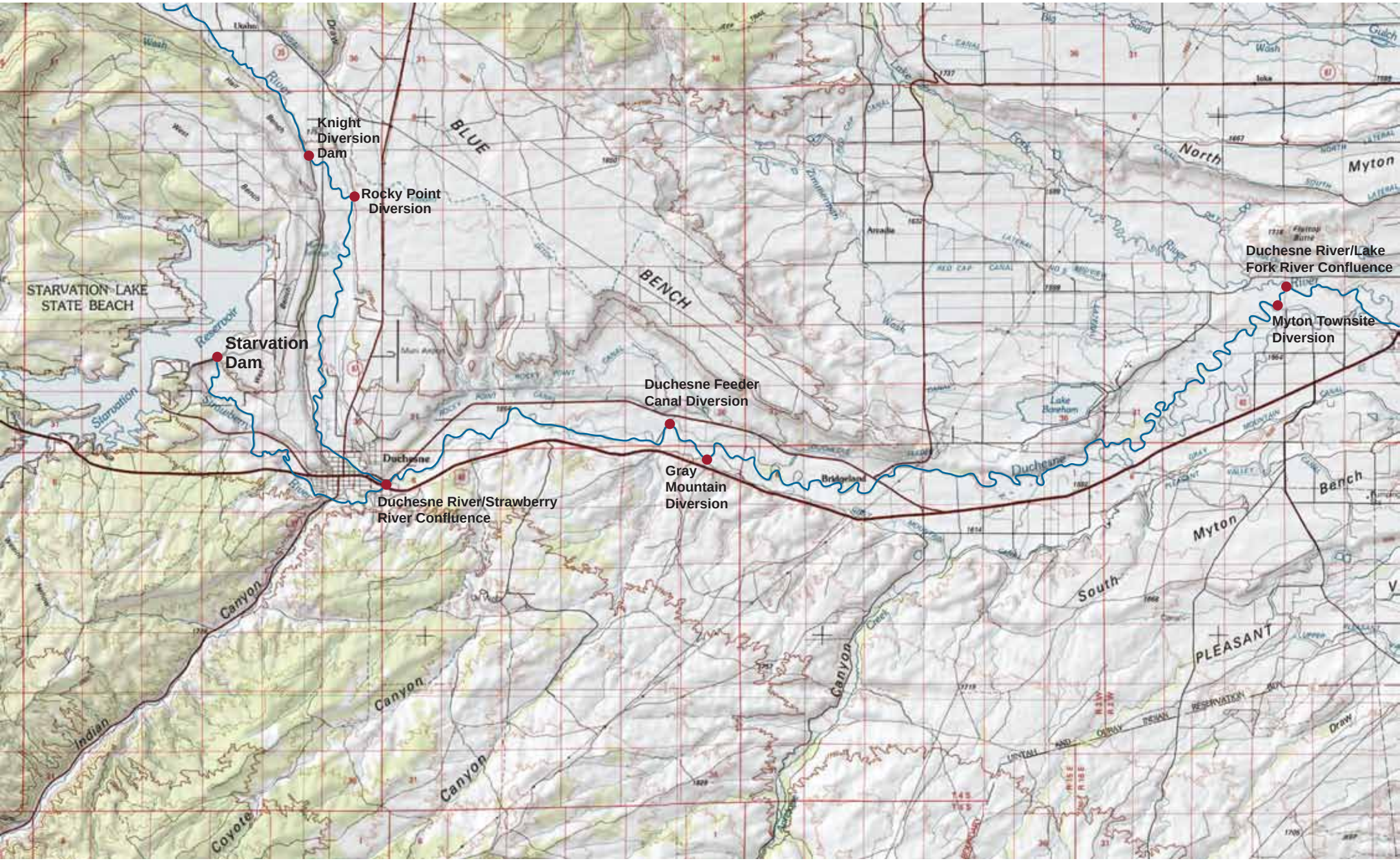
Literature Cited

Williams, C.A., Gerner, S.J., and Elliott, J.G., 2009, Summary of fluvial sediment collected at selected sites on the Gunnison River in Colorado and the Green and Duchesne Rivers in Utah, water years 2005–2008: U.S. Geological Survey Data Series 409, 123 p.

Appendix A
Location Maps and Photographs

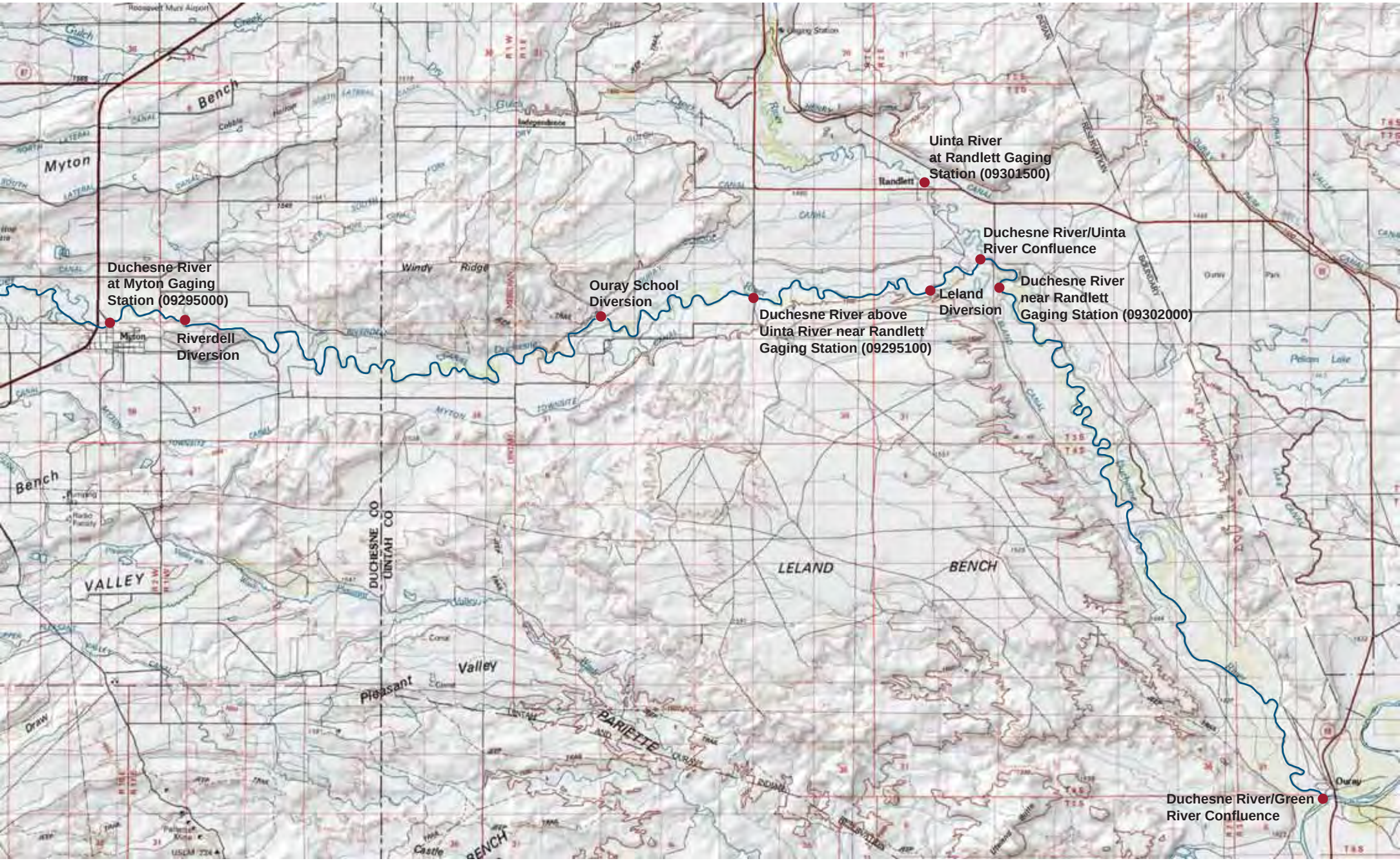
Duchesne River

Starvation Dam to Myton Townsite Diversion



Duchesne River

Myton City to Duchesne River/Green River Confluence



Starvation Dam

Knight Diversion Dam

Myton Townsite Diversion

Myton Townsite Diversion

Strawberry River/Duchesne River Confluence

Uinta River/Duchesne River Confluence

Duchesne River/Green River Confluence

Duchesne River/Green River Confluence

Duchesne River at Myton, Utah (USGS Gaging Station No. 0929500)

Duchesne River above Uintah River near Randlett, Utah (USGS Gaging Station No. 09295100)

Uinta River at Randlett, Utah (USGS Gaging Station No. 09301500)

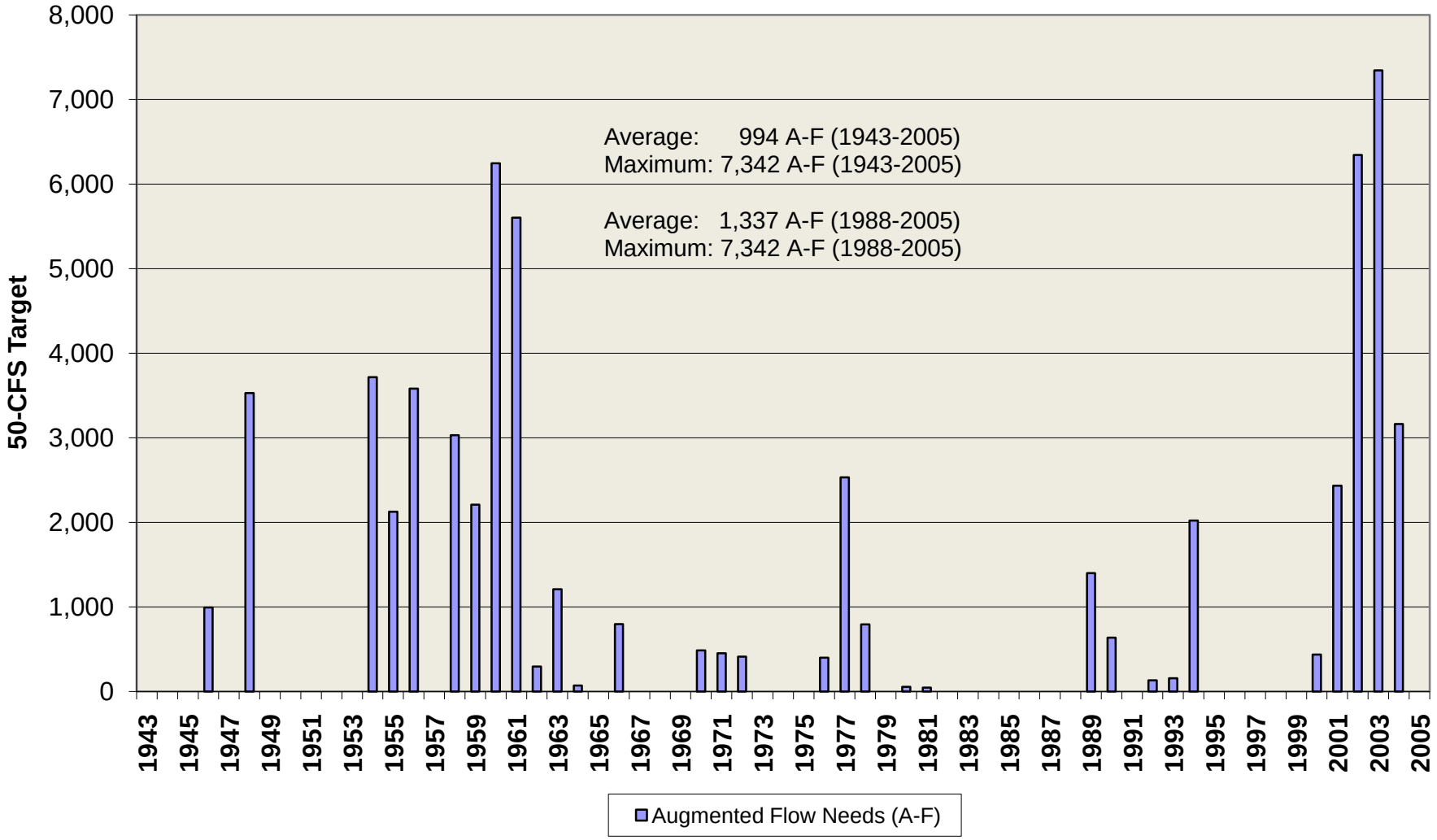
Duchesne River near Randlett, Utah (USGS Gaging Station No. 09302000)

Beaver dam located on the lower Duchesne River (November 2007).

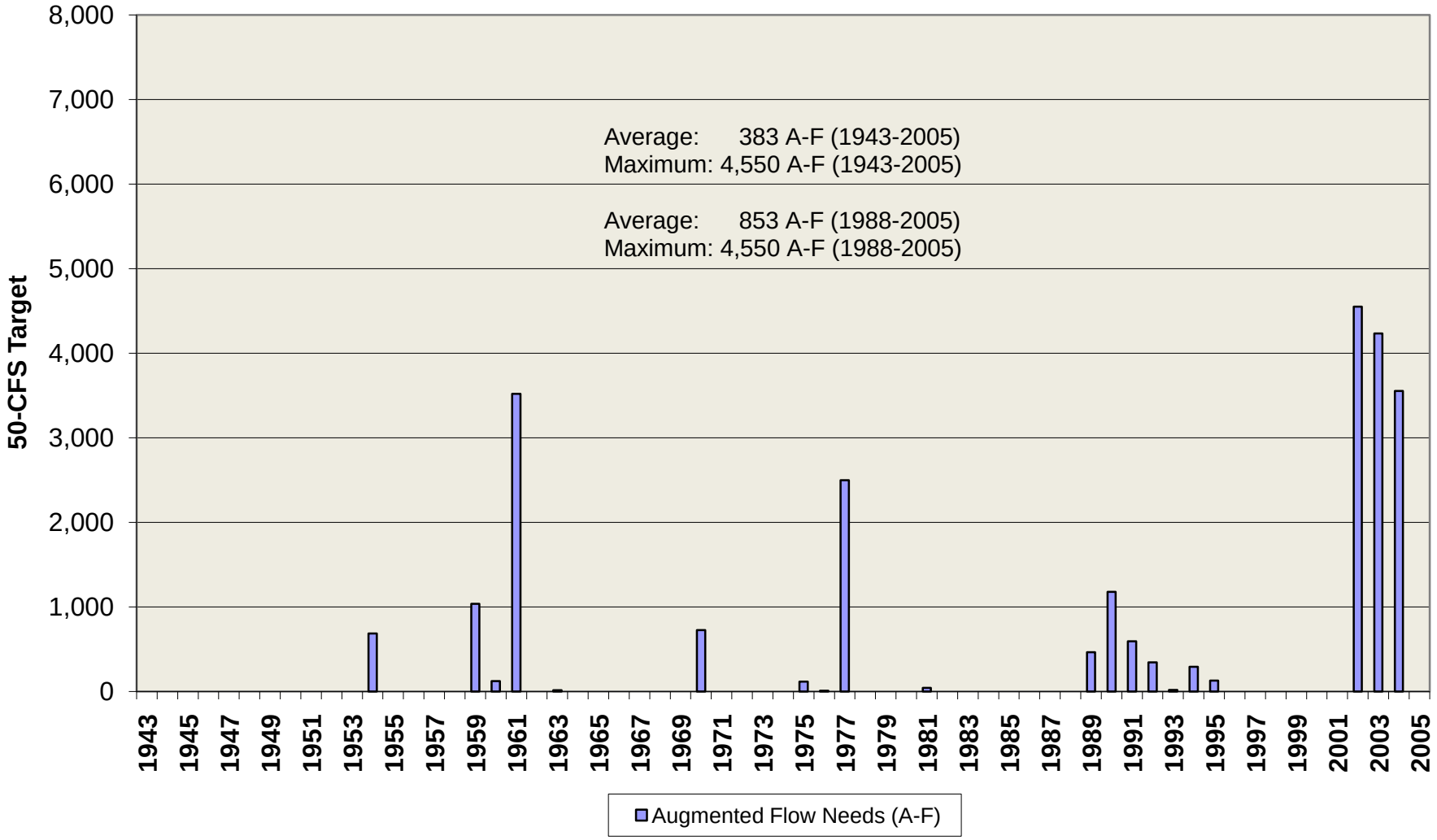
Beaver dam located on the lower Duchesne River (November 2007).

Appendix B
Augmented Flow Needs Graphs

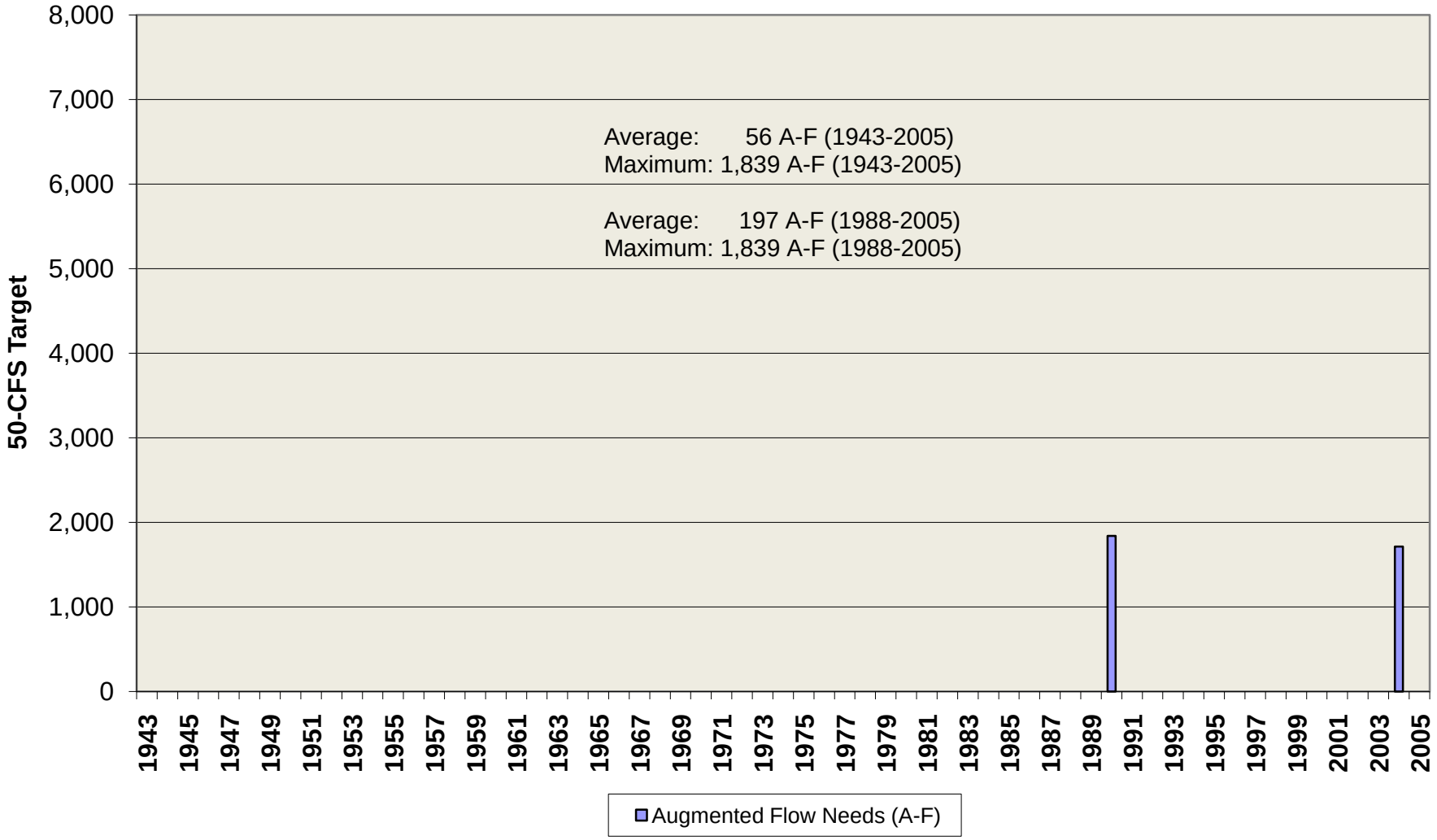
Duchesne River Near Randlett
Jul 1 to Oct 31 Augmented Flow Needs (Priority 1, 50-CFS Target)



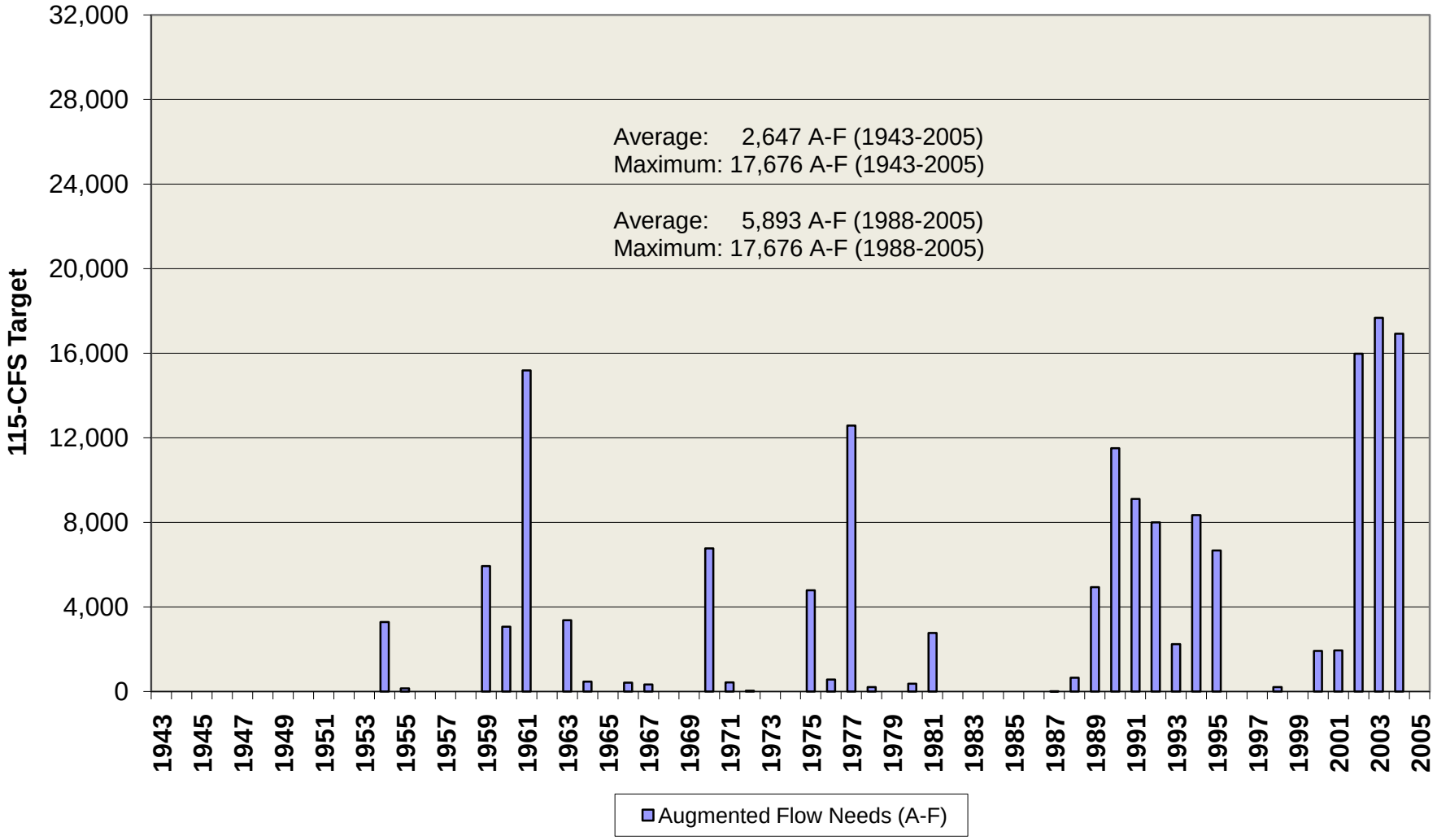
Duchesne River Near Randlett
Mar 1 to Jun 30 Augmented Flow Needs (Priority 2, 50-CFS Target)



Duchesne River Near Randlett
Nov 1 to Feb 28 Augmented Flow Needs (Priority 3, 50-CFS Target)

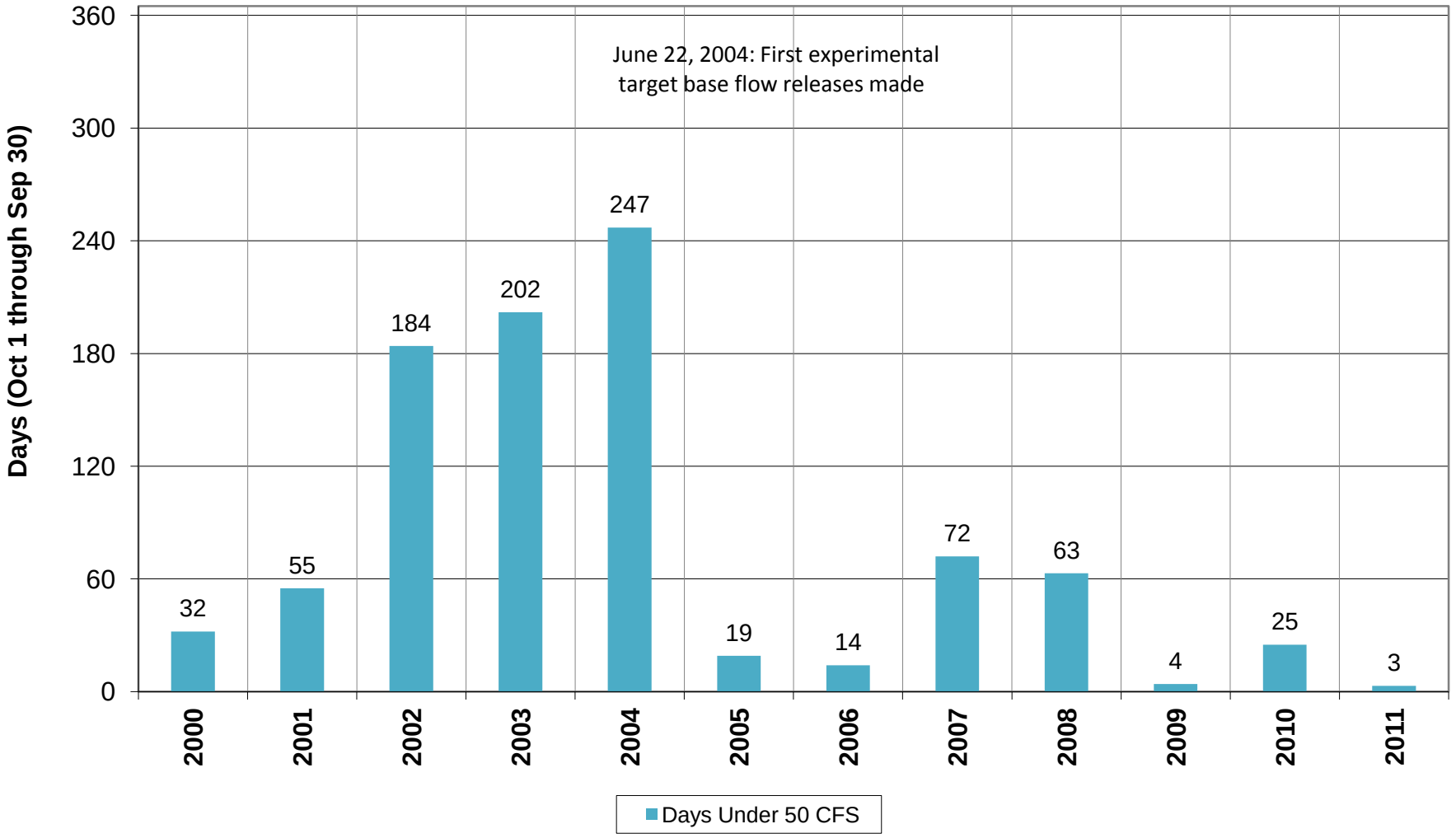


Duchesne River Near Randlett
Mar 1 to Jun 30 Augmented Flow Needs (Priority 4, 115-CFS Target)

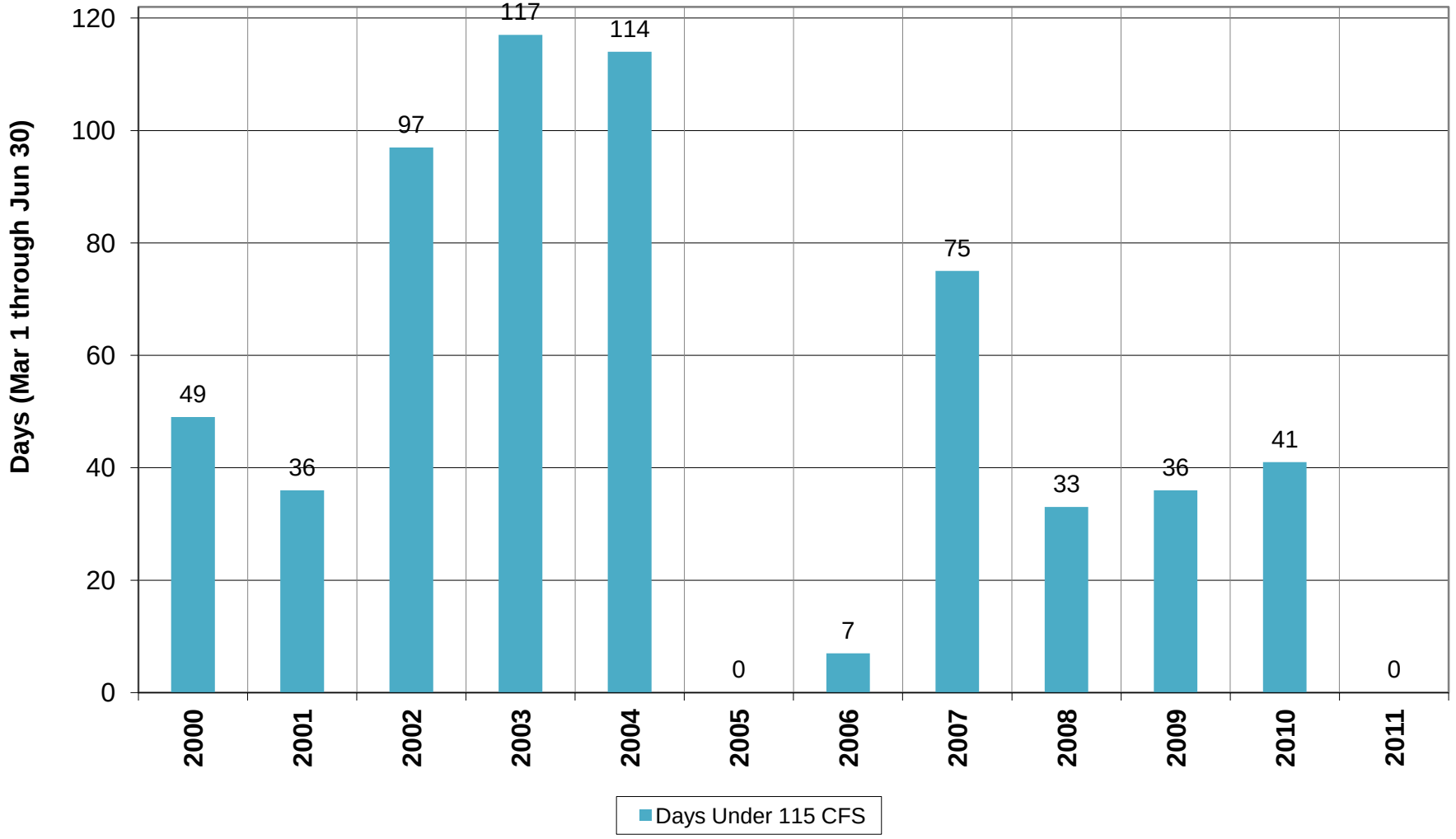


Appendix C
Compliance Graphs

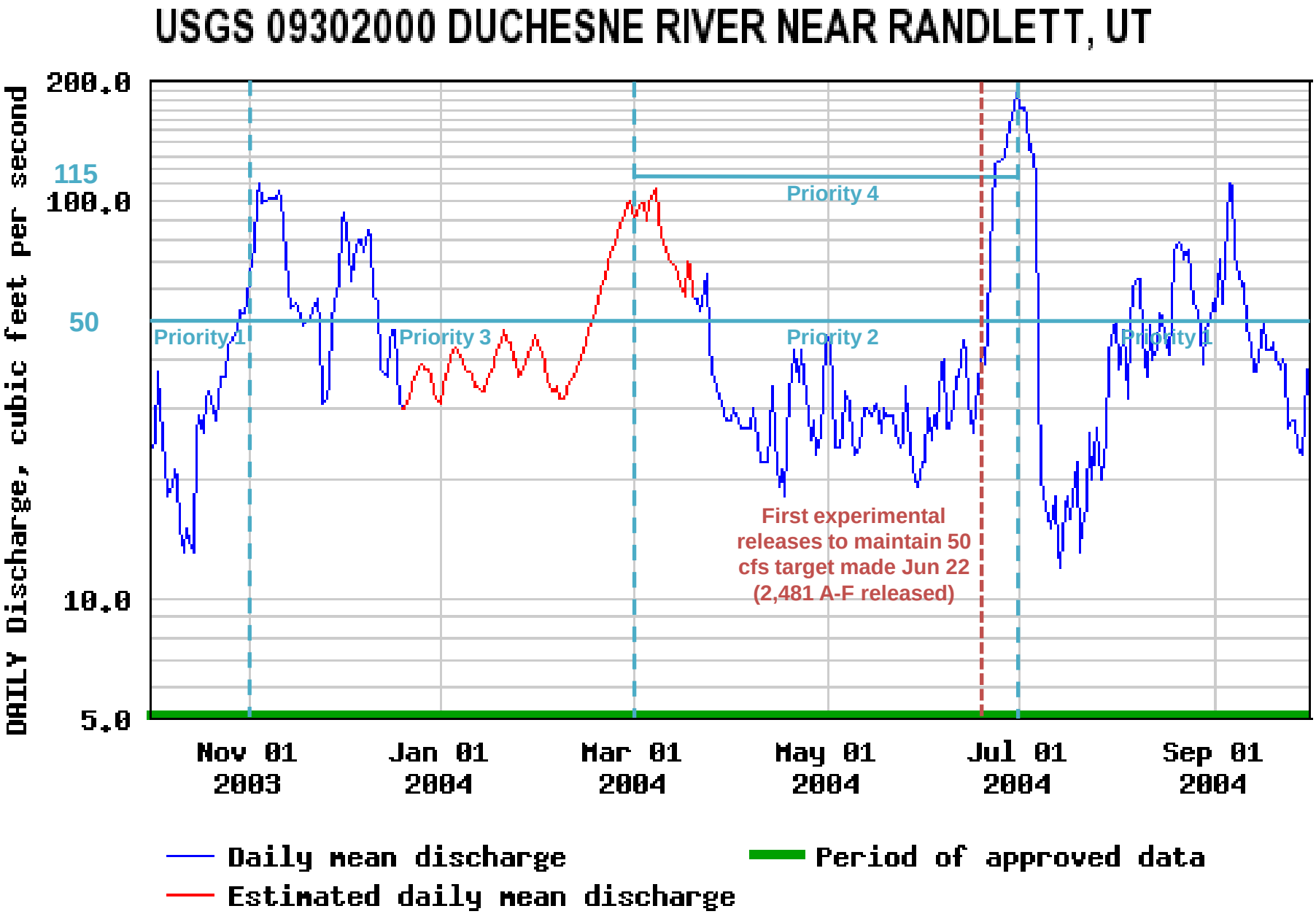
Duchesne River Near Randlett
Number of Days below 50-CFS Target (Priority 1, 2, and 3)



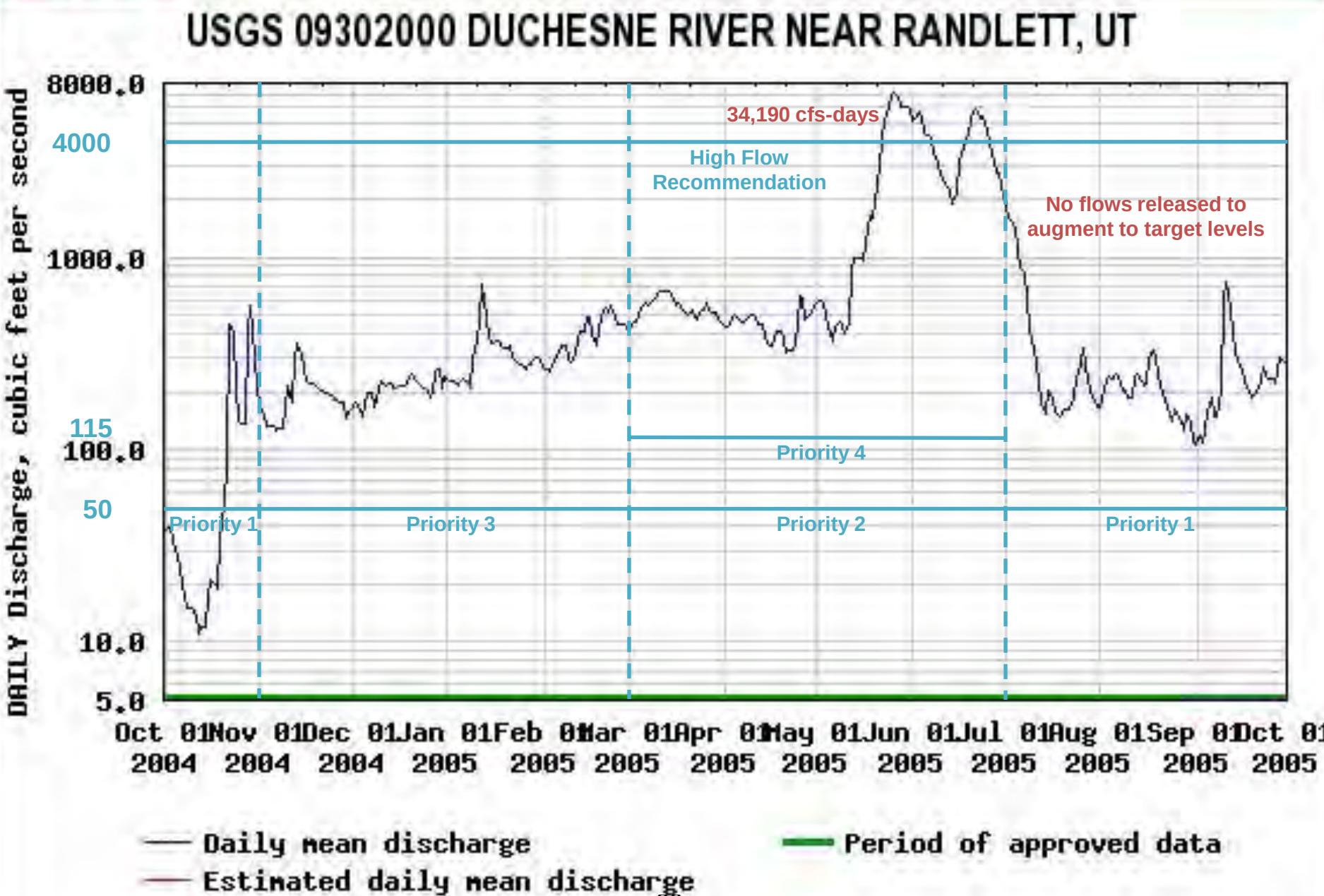
Duchesne River Near Randlett
Number of Days below 115-CFS Target (Priority 4)



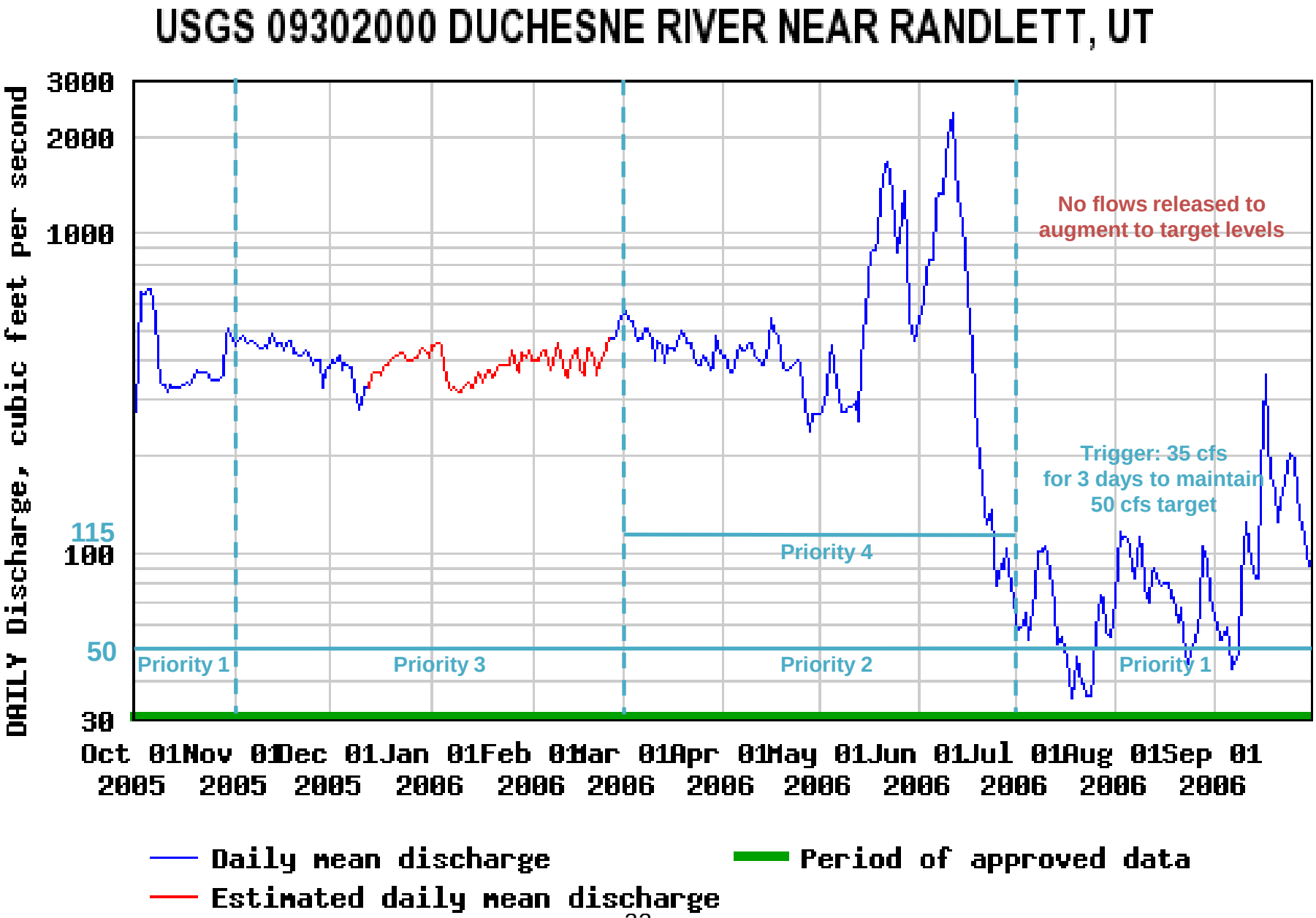
Appendix D
Randlett Gage Hydrographs


USGS 09302000 DUCHESNE RIVER NEAR RANDLETT, UT
DAILY Discharge, cubic feet per second
200.0
115
100.0
50
10.0
5.0
Priority 1
Priority 3
Priority 4
Priority 2
Priority 1
First experimental releases to maintain 50 cfs target made Jun 22 (2,481 A-F released)
Nov 01 2003
Jan 01 2004
Mar 01 2004
May 01 2004
Jul 01 2004
Sep 01 2004
Daily mean discharge
Estimated daily mean discharge
Period of approved data

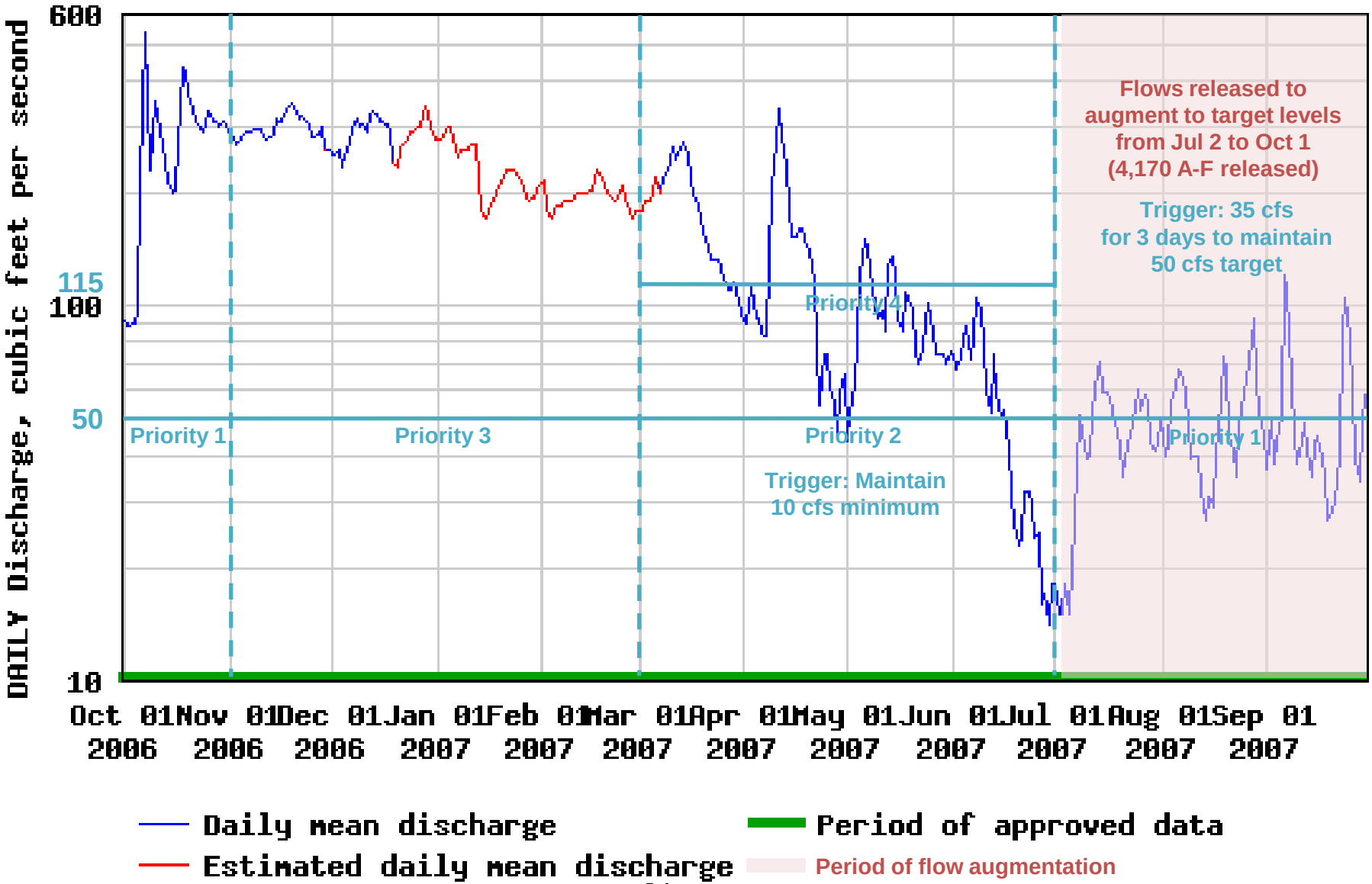
WY 2005


USGS 09302000 DUCHESNE RIVER NEAR RANDLETT, UT
DAILY Discharge, cubic feet per second
8000.0
4000
1000.0
115
100.0
50
10.0
5.0
34,190 cfs-days
High Flow
Recommendation
No flows released to
augment to target levels
Priority 4
Priority 1
Priority 3
Priority 2
Priority 1
Oct 01 2004
Nov 01 2004
Dec 01 2004
Jan 01 2005
Feb 01 2005
Mar 01 2005
Apr 01 2005
May 01 2005
Jun 01 2005
Jul 01 2005
Aug 01 2005
Sep 01 2005
Oct 01 2005
Daily mean discharge
Estimated daily mean discharge
Period of approved data

WY 2006

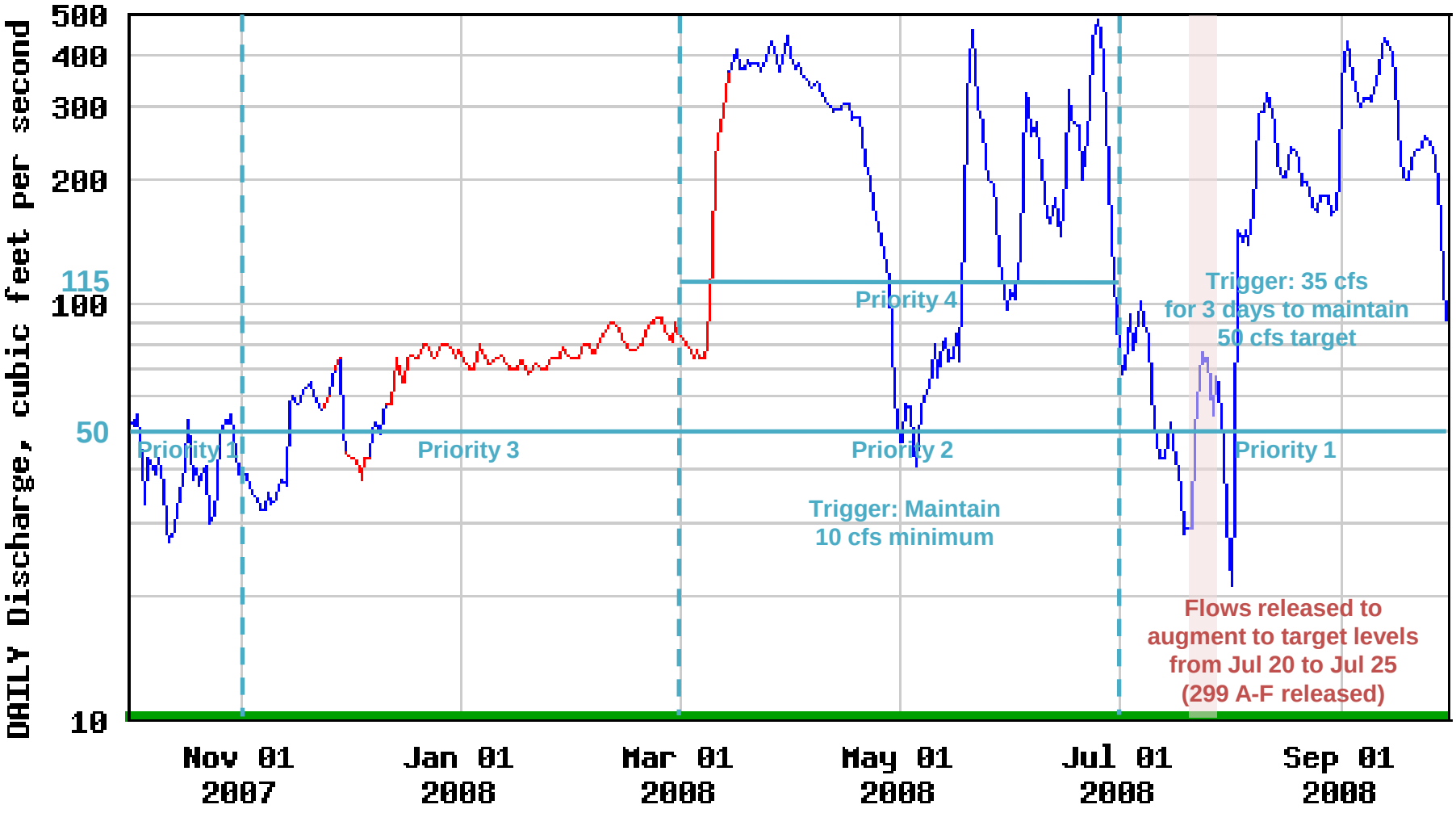

USGS 09302000 DUCHESNE RIVER NEAR RANDLETT, UT
DAILY Discharge, cubic feet per second
3000
2000
1000
115
100
50
30
No flows released to augment to target levels
Trigger: 35 cfs for 3 days to maintain 50 cfs target
Priority 4
Priority 1
Priority 3
Priority 2
Priority 1
Oct 01 2005
Nov 01 2005
Dec 01 2005
Jan 01 2006
Feb 01 2006
Mar 01 2006
Apr 01 2006
May 01 2006
Jun 01 2006
Jul 01 2006
Aug 01 2006
Sep 01 2006
Daily mean discharge
Estimated daily mean discharge
Period of approved data

USGS 09302000 DUCHESNE RIVER NEAR RANDLETT, UT



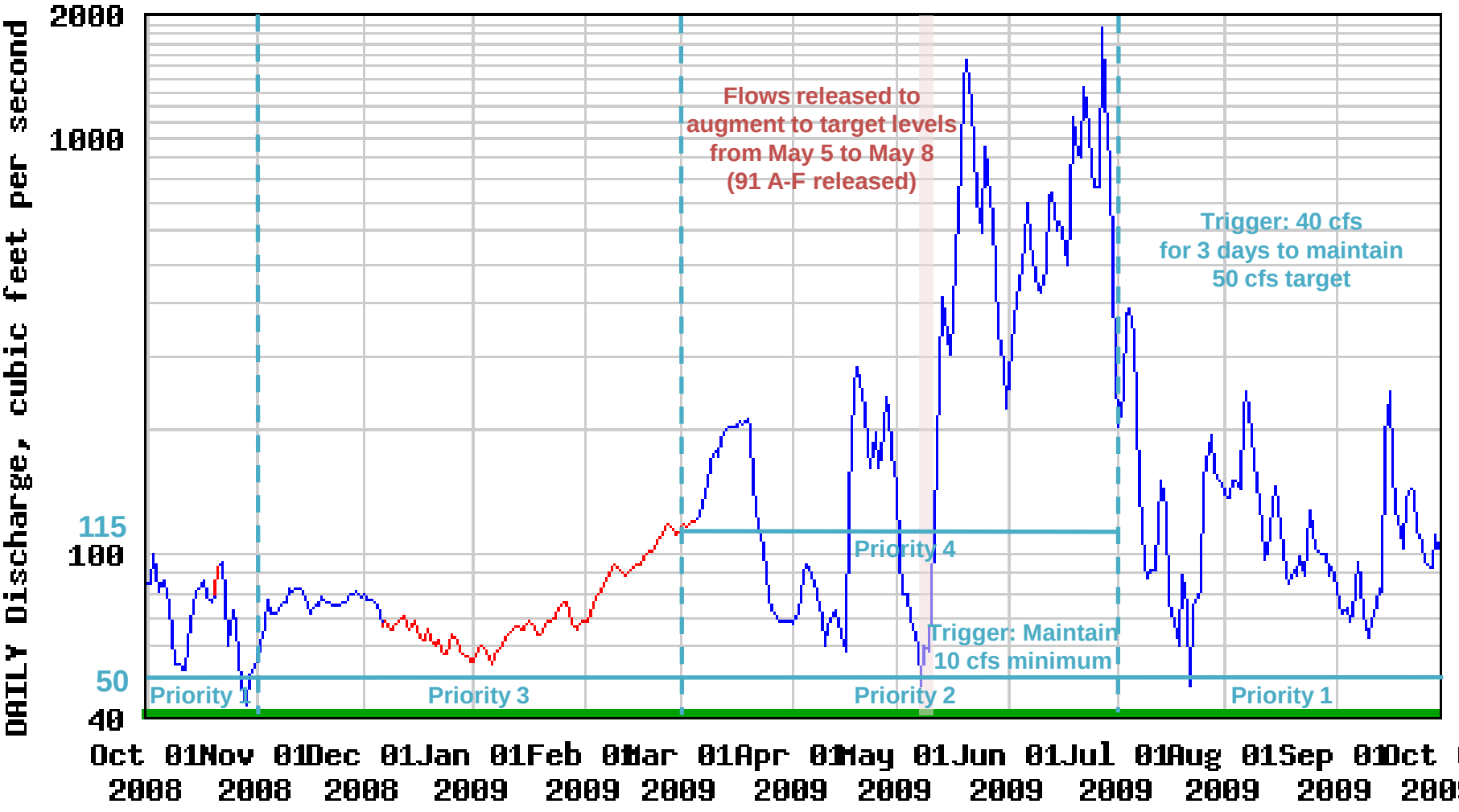
WY 2008

USGS 09302000 DUCHESNE RIVER NEAR RANDLETT, UT



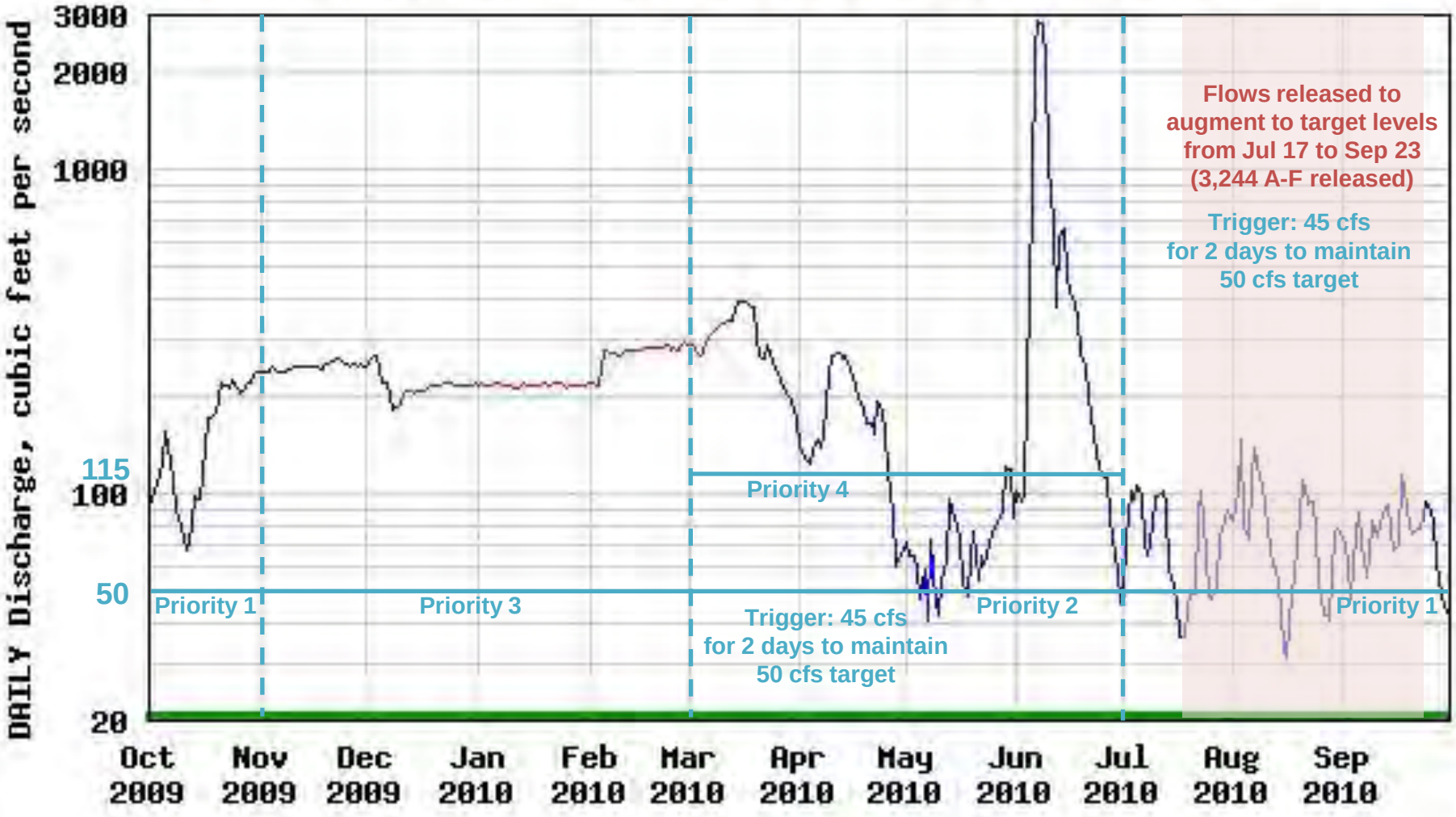
WY 2009

USGS 09302000 DUCHESNE RIVER NEAR RANDLETT, UT



WY 2010

USGS 09302000 DUCHESNE RIVER NEAR RANDLETT, UT



WY 2011

USGS 09302000 DUCHESNE RIVER NEAR RANDLETT, UT