RECLAMATION
Managing Water in the West

2012 Annual Report

Bureau of Reclamation
Report on Monitoring and Implementation Activities Associated with the USFWS 2005 Biological Opinion For Operation and Maintenance of the Bureau of Reclamation Projects in the Snake River Basin above Brownlee Reservoir

U.S. Department of the Interior
Bureau of Reclamation
Pacific Northwest Region
Snake River Area Office
Boise, Idaho

March 2013

Mission of the U.S. Department of the Interior

Protecting America's Great Outdoors and Powering our Future

The U.S. Department of the Interior protects America's natural resources and heritage, honors our cultures and tribal communities, and supplies the energy to power our future.

Mission of the Bureau of Reclamation

The mission of the Bureau of Reclamation is to manage, develop, and protect water and related resources in an environmentally and economically sound manner in the interest of the American public.

Photograph on front cover: Arrowrock Reservoir, Idaho, overlooking the South Fork Boise River arm.

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1.0 INTRODUCTION

The Bureau of Reclamation (Reclamation) consulted with the U.S. Fish and Wildlife Service (USFWS) on 12 proposed actions involving the effects of future operations and routine maintenance at 12 Federal projects in the upper Snake River basin (Reclamation 2004). In March 2005, USFWS completed a non-jeopardy Biological Opinion (2005 Opinion) for Reclamation operations and maintenance activities in the Snake River basin above Brownlee Reservoir (USFWS 2005). The 2005 Opinion contained a 30-year incidental take statement (ITS) and corresponding reasonable and prudent measures (RPMs) that outlined nondiscretionary actions to minimize take ESA-listed species impacted by Reclamation operations (USFWS 2005).

The ITS has two main components: 1) a monitoring component to ensure the action agency does not exceed the amount or extent of incidental take described in the ITS, and 2) RPMs to minimize the amount or extent of take without altering the basic design, location, scope, duration, or timing of the action. The 2005 Opinion requires Reclamation to provide an annual report to the USFWS by March 31 of each year reporting incidental take monitoring efforts and implementation status of all RPMs and terms and conditions. The submittal date was changed from December 31 to March 31 after USFWS agreed to a request by Reclamation for a permanent change (letter dated November 13, 2007).

This document is submitted as Reclamation's annual report for Water Year (WY) 2012 (October 1, 2011 to September 30, 2012). This is an appropriate reporting period, but presents a challenge because annual minimum reservoir contents occur near the end of the reporting period.

1.1 Bull Trout

Bull trout are present in four of Reclamation's facilities in the upper Snake River basin (Figure 1):

- Anderson Ranch Dam and Reservoir.
- Arrowrock Dam and Reservoir.
- Deadwood Dam and Reservoir.
- Beulah Dam and Reservoir.

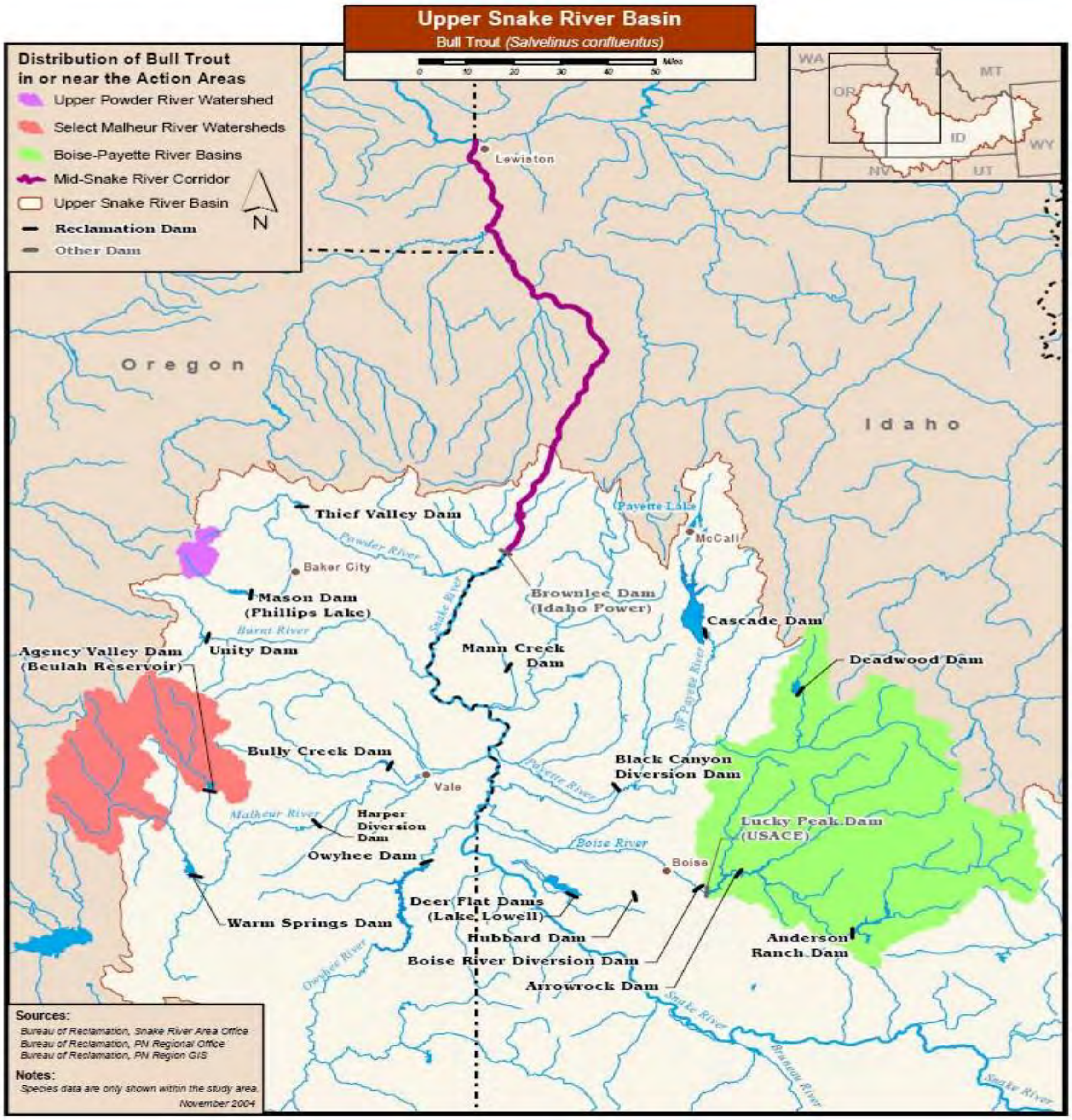

Figure 1. Known distribution of bull trout populations (shaded areas on map) associated with Reclamation facilities in the upper Snake River basin (Reclamation 2004).

Operational thresholds, population monitoring, and other relevant bull trout work managed by Reclamation and work associated with research projects that address specific RPMs are described in this report. In addition, other relevant bull trout work not managed by Reclamation may be discussed in this report if directly relevant to bull trout or bull trout critical habitat within Reclamation's projects.

USFWS determined incidental take by correlating frequencies and magnitudes of streamflow and reservoir conditions at specific facilities with an estimate of population effects during critical seasonal time periods in the bull trout's life history. USFWS then described the amount or extent of incidental take at each facility based on operational thresholds.

1.1.1 Bull Trout Monitoring

The Monitoring and Implementation Plan (Reclamation 2006) identifies how Reclamation will monitor bull trout throughout the duration of the 2005 Opinion. Monitoring elements include evaluating operational indicators and tracking population trends. To monitor compliance with the operational thresholds defined in the ITS, operations for WY 2012 were monitored, evaluated, and summarized using Reclamation's Hydromet system (Reclamation 2013). Operational thresholds affecting the amount or extent of anticipated take are described in Section 2. Monitoring population trends do not occur annually at each of the four facilities.

1.2 Snake River Snails

In addition to bull trout, previous annual reports to the USFWS reported on two species of snails in the Snake River basin: Utah valvata and Snake River physa. The USFWS determined that Utah valvata did not meet the definition of an endangered or threatened species under the Act. The Utah valvata was removed from the ESA List, thereby removing all protections, and subsequent monitoring and reporting requirements, provided by the Act (75 FR 52272). Accordingly, 2010 was the last year Reclamation monitored the Utah valvata.

The Snake River physa (physa) is still an ESA-listed species and activities associated with monitoring physa are reported in this document. The 2005 Opinion did not provide an ITS for physa. The current take coverage for operations is covered under Minidoka Spillway Construction Biological Opinion (USFWS 2010). The construction of the spillway began in 2011 and is scheduled for completion in 2014. In 2012, physa surveys were conducted to gather baseline data that can be used to determine trends of occurrence and abundance across their known range; determine the effects of reduced spillway flows on physa in the Minidoka Dam Spillway; further characterize physa habitats; and meet the reporting requirements of ESA Section 10, Permit #TE 056557-5.

Currently Reclamation is working on long-term ESA coverage for operations through an informal Section 7 consultation process. This is expected to be finished with the long-term operation consultation when the spillway construction is completed. Information reported in this document on physa are related to the requirements of the Minidoka Spillway Construction Biological Opinion, but are relevant to the 2005 Opinion and long-term operation of the Minidoka Project and so are reported in this document.

2.0 SUMMARY OF 2012 OPERATIONS

2.1 Idaho

November carryover storage from WY 2011 was very abundant thanks to the large runoff and late snowmelt experienced in 2011, with carryover in the Payette River basin at 111 percent, the Boise River basin at 124 percent, and the upper Snake River basin above Milner Dam at 134 percent. This high carryover was especially beneficial in the upper Snake River basin given the below average runoff in 2012 that eventually occurred there. The winter season progressed differently between the upper Snake and middle Snake River basins. Snowpack in the upper Snake River basin was normal early in the season, but the early advantage was slowly lost the rest of the winter as the storm track often missed the basin, especially in spring. The opposite was true for the middle Snake River basins, with a very slow start to the snow accumulation season. Unlike the upper Snake River basin, however, the storm track favored the Boise and Payette River basins the remainder of winter and snow accumulated at a near normal rate. A very wet March also helped to regain the early season deficits. The middle Snake River basins also benefitted from a large rain event in late April, following several days of hot temperatures, which resulted in very high inflows. This storm resulted in the peak inflows for the season, which is abnormally early, and necessitated several weeks of flood control releases in the Payette and Boise River basins. In the upper Snake River basin, the dry spring and slow snowmelt resulted in excess flows past Milner Dam ramping down as irrigation demand developed in April, reaching 0 cfs by the end of the month. Except for a few days in early May when American Falls Reservoir filled and passed excess inflow, no flows passed Milner Dam until flow augmentation began in early June. Observed unregulated runoff for the April through July period was 111 percent for the Payette River at Horseshoe Bend, 108 percent for the Boise River near Boise, and 82 percent of average for the Snake River at Heise, based on the 30-year average for the 1971-2000 period.

Due to lower than expected runoff, flood control operations, and early season irrigation demands, the upper Snake River above the Milner Reservoir system reached a maximum combined physical storage content about 465,500 acre-feet below full capacity of 4,045,695 acre-feet. The Boise and Payette reservoir systems had sufficient water to refill completely, but were deliberately held slightly below full (13,134 acre-feet on the Boise system, and 6,807 acre-feet on the Payette system) in order to move the flow augmentation release to an earlier timeframe as outlined in the 2007 Biological Assessment. Sufficient water was available in 2012 to provide 487,000 acre-feet for Reclamation’s flow augmentation program for salmonid species below Brownlee Reservoir. This amount is the upper limit of flow augmentation to be provided in any given year. Contributions to the flow augmentation included 190,179 acre-feet from the upper Snake River above Milner Dam, 167,668 acre-feet from the Payette River basin, 51,504 acre-feet from the Boise River basin, and 77,649 acre-feet of natural flows, 17,649 acre-feet of which originated in Oregon.

2.1.1 Boise River Basin Operational Indicators

Two operational indicators were exceeded during the 2012 reporting period in the Boise River basin. Anderson Ranch Reservoir stored and released water (Table 1, Figure 2, and Figure 3); however, Reclamation has an exemption for this action 30 of the 30 years in the 2005 Opinion. Also, the reservoir surface elevation in Arrowrock Reservoir was less than 3111 feet for 4 days (September 3-6, 2012) (Table 2, Figure 4, and Figure 5). Reclamation has an exemption for this action 30 of 30 years.

This report reflects corrections to the operational indicator for Arrowrock Reservoir. An error was detected in the 2010 and 2011 reporting for exceedence at Arrowrock Reservoir for the Operational Indicator describing "Reservoir volume of less than 200,000 acre-feet at the end of June." Previous annual reports indicated that the term and condition of 200,000 acre-feet by the end of June was violated in 2010 and 2011 because the reservoir was still below 200,000 acre-feet in early June in both of those years. However, a review of the reservoir data revealed that Arrowrock Reservoir was still refilling in early June in 2010 and 2011, reached nearly full levels in mid-June, and remained above 200,000 acre-feet by June 30.

Arrowrock Reservoir volumes for 2010 and 2011 are shown in Figure 6 (Reclamation 2013). Water years 2010 and 2011 had later runoff conditions causing the whole Boise system to still be in refill mode in the first half of June. Arrowrock Reservoir storage was still rising in early June and was above 200,000 acre feet by June 30 and thus, the condition was not violated.

Table 1. Summary of amount or extent of anticipated take of bull trout associated with Reclamation's Anderson Ranch Dam and Reservoir facility operations during the 2012 reporting period.

Facility	Anticipated Take	Operational Indicators	Critical Season	Frequency of Exemptions	2012 Operations (October 2011 to September 2012)	Quick Reference: Number of times threshold was exceeded
Anderson Ranch Dam and Reservoir	Up to 50 percent of the Middle and North Fork populations are affected by spillway discharges that disrupt timing of migration and spawning and that alter metabolic rates and up to 10 percent of bull trout in the reservoir are entrained into the South Fork Boise River	Water is discharged over the spillway	spring	6 of 30 years	Spillway use did not occur during the reporting period	1 of 6 years 2006: 9 days 2007: 0 2008: 0 2009: 0 2010: 0 2011: 0 2012: 0

Facility	Anticipated Take	Operational Indicators	Critical Season	Frequency of Exemptions	2012 Operations (October 2011 to September 2012)	Quick Reference: Number of times threshold was exceeded
Anderson Ranch Dam and Reservoir	Up to 50 percent of the Middle and North Fork populations are affected by the altered flow and temperature regime that disrupts migration and spawning and that increases metabolic rates	Water is stored and released at Anderson Ranch Dam	Spring through fall	30 of 30 years	Anderson Ranch Reservoir elevations for WY 2012 are shown in Figure 2	7 of 30 years 2006: spring/fall 2007: spring/fall 2008: spring/fall 2009: spring/fall 2010: spring/fall 2011: spring/fall 2012: spring/fall
	Up to 4 percent of bull trout in the reservoir experience degraded water quality	Reservoir storage volume falls below 62,000 acre-feet (Figure 3)	Summer	2 of 30 years	Reservoir storage volume was maintained above 62,000 acre-feet (Figure 3)	0 of 2 years 2007: 0 2008: 0 2009: 0 2010: 0 2011: 0 2012: 0

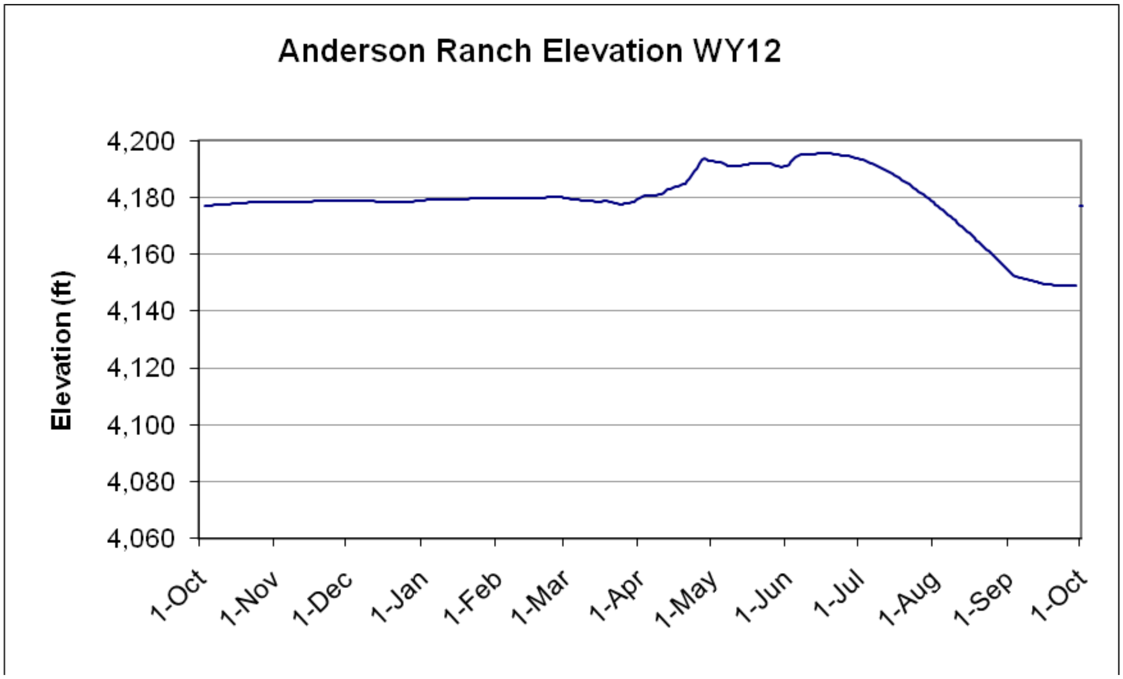

Figure 2. Anderson Ranch Reservoir elevations (feet above sea level) for Water Year 2012 (WY12).

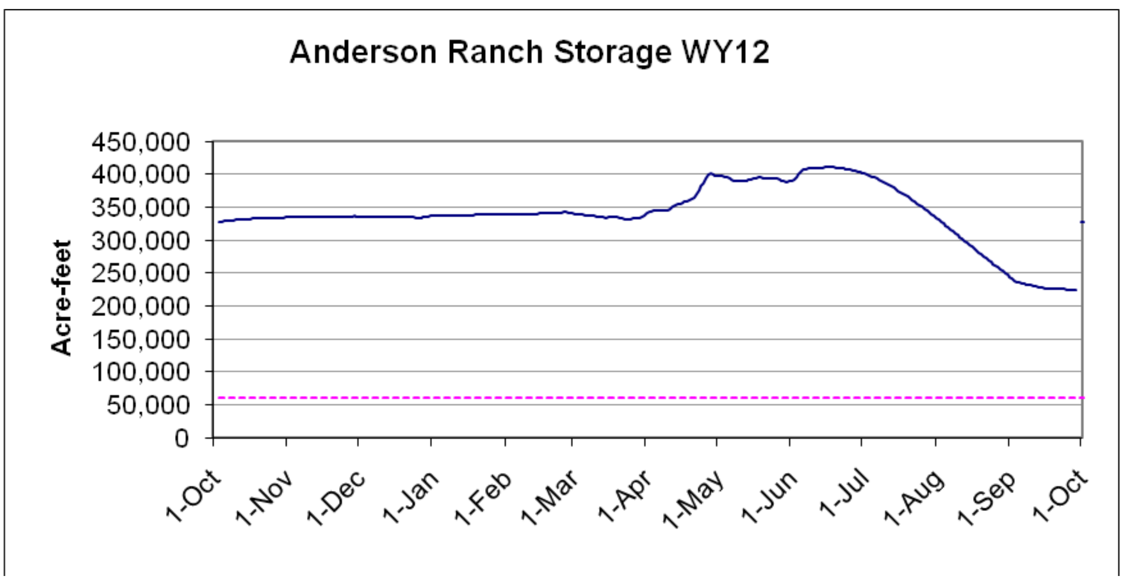

Figure 3. Anderson Ranch Reservoir storage volumes (acre-feet) for Water Year 2012 (WY12). The dotted line represents Reclamation's Operational Indicator minimum threshold of 62,000 acre-feet of storage.

Table 2. Summary of amount or extent of anticipated take of bull trout associated with Reclamation's Arrowrock Dam and Reservoir facility operations during the 2012 reporting period. The asterisks (*) denote a change from past reports. Data was reviewed for 2010 and 2011 and values were found to not be in exceedence (see page 5 for an explanation and Figure 6); data reported in this annual report supersede values from previous reports.

Facility	Anticipated Take	Operational Indicators	Critical Season	Frequency of Exemptions	2012 Operations (October 2011 to September 2012)	Quick Reference: Number of times threshold was exceeded
Arrowrock Dam and Reservoir	Up to 50 percent of the Middle and North Fork populations are affected by low reservoir productivity and decreased prey.	Reservoir volume of less than 200,000 acre-feet at the end of June	June 30	3 of 30 years	Reservoir volume was not below 200,000 acre-feet at the end of June 2012	1* of 3 years 2006: 0 2007: yes 2008: 0 2009: 0 2010: 0* 2011: 0* 2012: 0
	Up to 8 percent of bull trout in the reservoir are entrained into Lucky Peak Reservoir, as averaged over any consecutive 5-year period.	Water is discharged over the spillway.	March through June	15 of 30 years	Spillway use did not occur during the reporting period.	1 of 15 years 2006: 9 days 2007: 0 2008: 0 2009: 0 2010: 0 2011: 0 2012: 0

Facility	Anticipated Take	Operational Indicators	Critical Season	Frequency of Exemptions	2012 Operations (October 2011 to September 2012)	Quick Reference: Number of times threshold was exceeded
Arrowrock Dam and Reservoir	Up to 2 percent of bull trout in the reservoir are entrained into Lucky Peak Reservoir	Discharge exceeds 695 cfs while the reservoir water surface elevation is less than 3111 feet	July through September	30 of 30 years	Reservoir Surface elevation dropped below 3111 feet for 4 days during September 2012 (September 3-6, 2012)	5 of 30 years 2006: 6 days 2007: 48 days 2008: 1 day 2009: 3 days 2010: 0 days 2011: 0 days 2012: 4 days
	Up to 20 percent of bull trout in the reservoir, as averaged over any 5 consecutive years, experience habitat degradation and predation	Mean daily reservoir elevation falls below 3100 feet	September 15 through October 31	18 of 30 years	Reservoir surface elevation did not drop below 3100 feet during the WY 2012 (Figure 4)	0 of 18 years 2008: 0 2007: 0 2008: 0 2009: 0 2010: 0 2011: 0 2012: 0
	Up to 5 percent of bull trout in the reservoir are entrained into Lucky Peak Reservoir, as averaged over any consecutive 5-year period	Discharge exceeds 695 cfs while the reservoir water surface elevation is less than 3111 feet (Figure 5)	Winter	20 of 30 years	Reservoir elevations did not drop below 3111 feet in the winter months of 2012 (Figure 4)	0 of 20 years 2006: 0 2007: 0 2008: 0 2009: 0 2010: 0 2011: 0 2012: 0

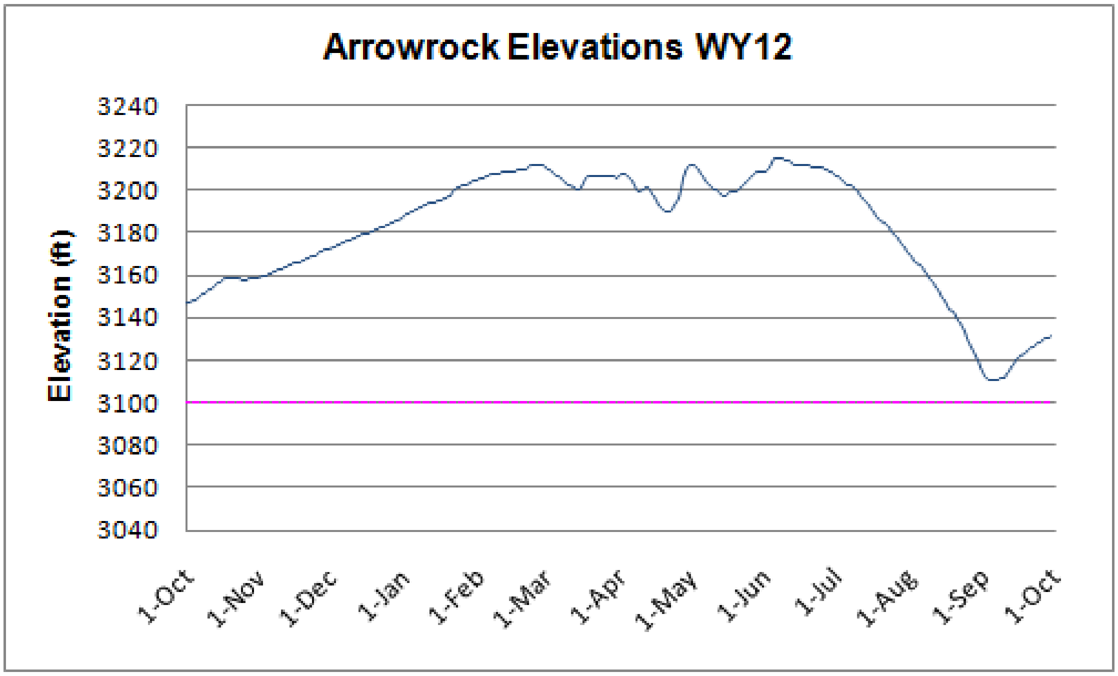

Figure 4. Arrowrock Reservoir elevation (feet above sea level) for Water Year 2012 (WY12). The dotted line represents Reclamation's Operational Indicator fall minimum threshold at elevation 3100 feet.

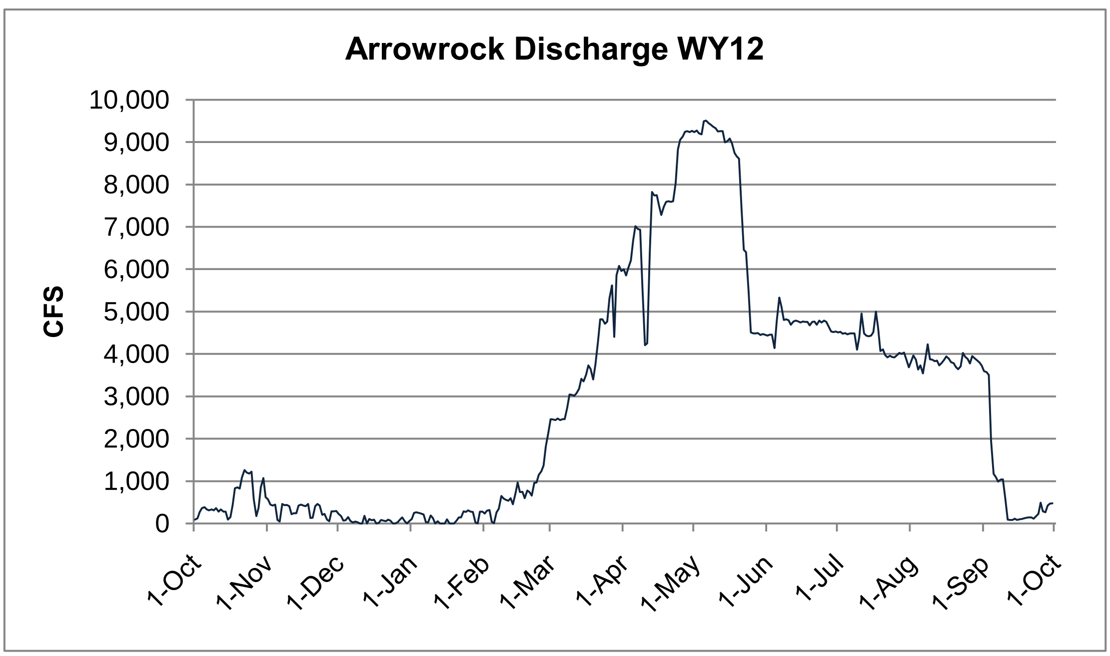

Figure 5. Arrowrock Reservoir discharge in cubic feet per second (cfs) for Water Year 2012 (WY12).

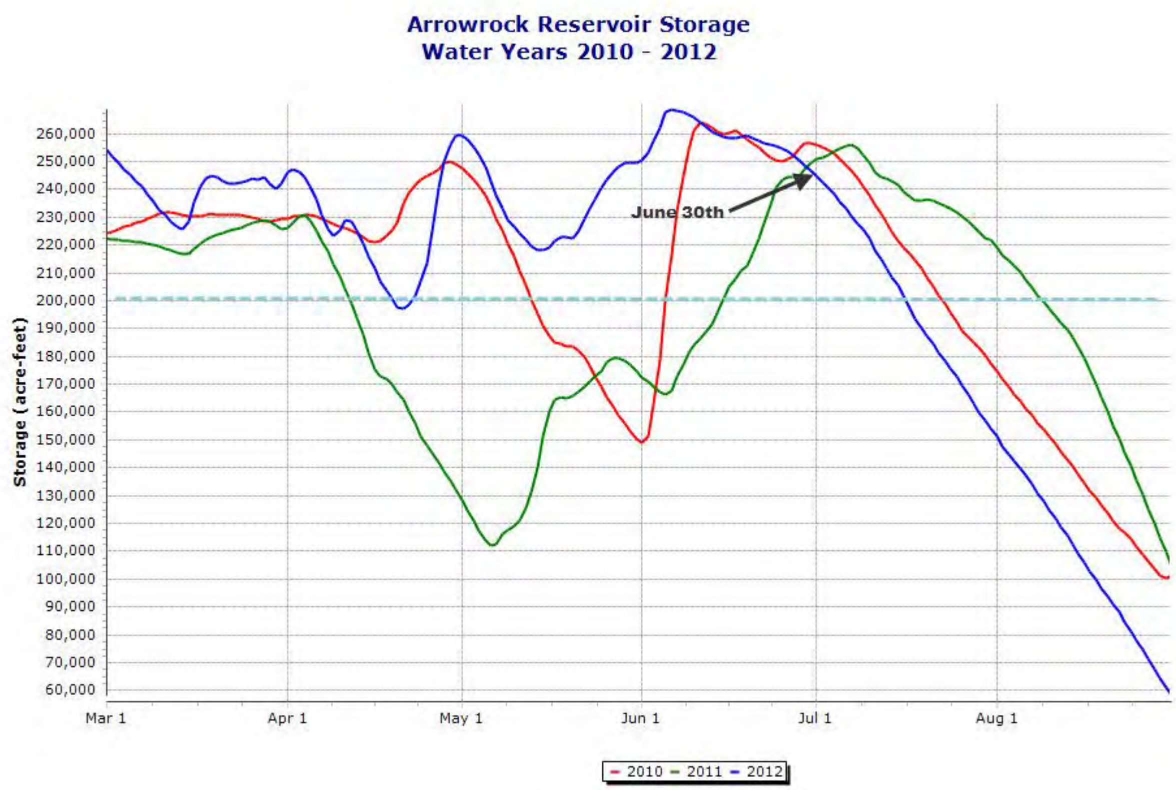

Figure 6. Arrowrock Reservoir volume storages, Water Years 2010-2012.

1.1.1 Payette River Basin Operational Indicators

One operational indicator was exceeded during the 2012 reporting period in the Payette River basin with deep water releases occurring throughout the year at Deadwood Dam (Table 3). Reclamation has an exemption for this action 30 of the 30 years. Figure 7 illustrates Deadwood Reservoir storage volume in WY 2012.

Table 3. Summary of amount or extent of anticipated take of bull trout associated with Reclamation's Deadwood Dam and Reservoir facility operations during the 2012 reporting period.

Facility	Anticipated Take	Operational Indicators	Critical Season	Frequency of Exemptions	2012 Operations (October 2011 to September 2012)	Quick Reference: Number of times threshold was exceeded
Deadwood Dam and Reservoir	Up to 2 to 4 percent of bull trout in Deadwood Reservoir are entrained into the Deadwood River below the dam	Water is discharged over the spilway	Spring	11 of 30 years	Water was discharged over the spillway for 0 days during WY 2012	4 of 11 years 2006: 32 days 2007: 33 days 2008: 33 day 2009: 0 days 2010: 15 days 2011: 0 days 2012: 0 days
	Up to 2 to 4 percent of bull trout in Deadwood Reservoir are affected by degraded water conditions	Reservoir storage volume falls below 50,000 acre-feet	August through October	2 of 30 years	Reservoir storage volumes were maintained between 82,789 and 152,965 acre-feet in WY 2012 (Figure 7)	0 of 2 years 2006: 0 2007: 0 2008: 0 2009: 0 2010: 0 2011: 0 2012: 0

Facility	Anticipated Take	Operational Indicators	Critical Season	Frequency of Exemptions	2012 Operations (October 2011 to September 2012)	Quick Reference: Number of times threshold was exceeded
Deadwood Dam and Reservoir	All bull trout in the Deadwood River downstream from the dam are affected by spillway discharges that disrupt timing of migration and spawning and that alter metabolic rates	Water is discharged over the spillway	May through July	11 of 30 years	Water was discharged over the spillway for 0 days during water year 2012	4 of 11 years 2006: 32 days 2007: 33 days 2008: 33 day 2009: 0 days 2010: 15 days 2011: 0 days 2012: 0 days
	All bull trout in the Deadwood River downstream from the dam are affected by low winter stream flows and temperatures that affect bull trout movement and growth and reproduction of bull trout and the prey base	Deep water releases at Deadwood Dam and low flows below the dam	Spring- temperature increases and flow decreases; Summer – temperature decreases and flow increases; Fall – temperature increases and flow reductions; Winter – temperature increases and flow reductions	30 of 30 years	All releases are deep water releases except for water discharged over the spillway	7 of 30 years 2006: all year 2007: all year 2008: all year 2009: all year 2010: all year 2011: all year 2012: all year

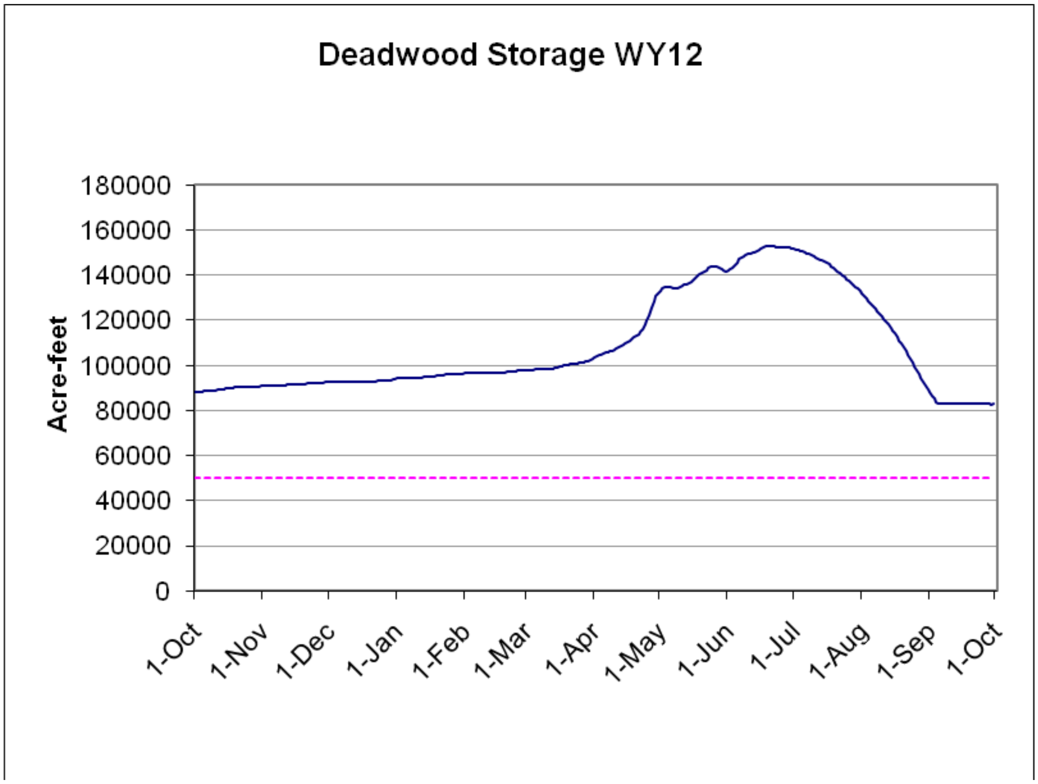

Figure 7. Deadwood Reservoir storage volumes (acre-feet) for Water Year 2012 (WY12). The dotted line represents Reclamation's Operational Indicator minimum threshold of 50,000 acre-feet of storage.

2.2 Oregon

Carryover storage going into WY 2012 was substantial and much improved over the previous year for the Malheur River basin. The watershed above Beulah Reservoir represents approximately 20 percent of the Malheur River basin. Carryover storage in Beulah Reservoir for WY 2012 was about 18,210 acre-feet, or 300 percent of the 2000-2010 average due to heavy runoff in 2011. WY 2012 was a near-average year in the Malheur River basin, and unregulated runoff for the April through July period was 95 percent of the 1971-2000 average for Beulah Reservoir. In 2012, Beulah Reservoir filled to 57,562 acre-feet, or about 97 percent of its capacity (59,212 acre-feet), and was drafted to 6 percent of reservoir capacity (3,689 acre-feet) on September 30. The Malheur River basin does not contribute to Reclamation's flow augmentation program.

Flow information for the 2012 WY (October 1, 2011 to September 30, 2012) can be found at Reclamation's Hydromet website (Reclamation 2013). Reservoir water operations, including daily average reservoir elevations, contents in acre-feet, storage, and outflow, for Reclamation facilities are discussed in detail later in this report.

1.1.1 Malheur River Basin Operational Indicators

No operational indicators were exceeded during the 2012 reporting period in the Malheur River basin (Table 4). Figure 8 illustrates the water storage volume in Beulah Reservoir during WY 2012.

Table 4. Summary of amount or extent of anticipated take of bull trout associated with Reclamation's Beulah Dam and Reservoir facility operations during the 2012 reporting period.

Facility	Anticipated Take	Operational Indicators	Critical Season	Frequency of Exemptions	2012 Operations (October 2011 to September 2012)	Quick Reference: Number of times threshold was exceeded
Beulah Dam	Up to 10 percent of bull trout in Beulah Reservoir are entrained into the North Fork Mahleur River below the dam	Water is discharged over the spillway	May through June	3 of 30 years	Spillway was not used in WY 12	2 of 3 years 2006: yes 2007: 0 2008: 0 2009: 0 2010: 0 2011: yes 2012: 0
	All bull trout returning to Beulah Reservoir to over-winter are affected by a reduced prey base	Reservoir storage falls below 2,000 acre-feet	August through October	10 of 30 years	Reservoir storage volume did not fall below 2,000 acre-feet in this reporting period (Figure 8)	4 of 10 years 2006: 0 days 2007: 60 days 2008: 34 day 2009: 53 days 2010: 28 days 2011: 0 days 2012: 0 days

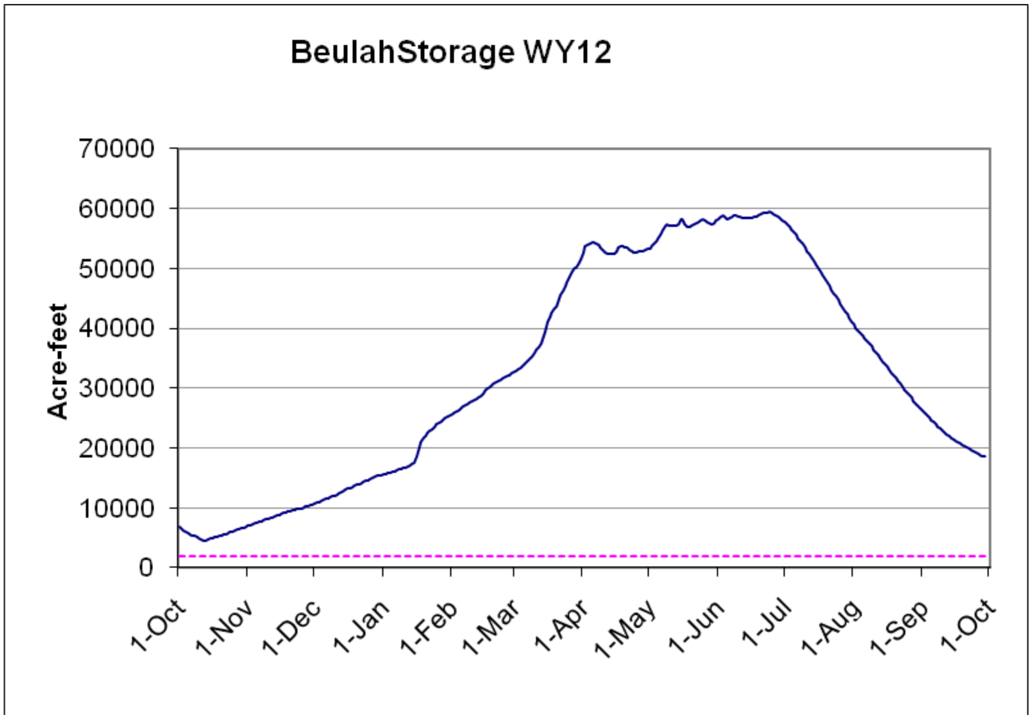

Figure 8. Beulah Reservoir storage volumes (acre-feet) for Water Year 2012 (WY12). The dotted line represents Reclamation's Operational Indicator minimum threshold of 2,000 acre-feet of storage.

3.0 Implementation of RPMs and Associated Terms and Conditions for Bull Trout

This chapter describes the bull trout ITS and RPMs, including monitoring efforts during WY 2012. The ITS includes four RPMs and their associated terms and conditions to minimize incidental take of bull trout related to operations at Reclamation's facilities in the identified action areas where bull trout are present. Data collected to address these efforts may be used to satisfy the terms and conditions and/or monitoring requirements. For example, data collected during a fish sampling activity may be used to help monitor population trends. In 2012, Reclamation was involved with RPM activities and/or monitoring at Deadwood, Arrowrock, Anderson Ranch, and Beulah reservoirs.

3.1 Boise River Basin

The 2005 Opinion identified five terms and conditions for minimizing the effect and/or amount of take associated with the operation of Arrowrock Dam and two terms and conditions were identified for Anderson Ranch Dam. Each of the terms and conditions addresses a different aspect of the effects of operations on bull trout or bull trout critical habitat. Most data collection efforts described in the following sections will be used to assess terms and conditions for both Arrowrock and Anderson reservoirs because the influences of both projects overlap.

Data collection efforts discussed for the Boise River basin during this reporting period include fish sampling; tracking radio-tagged bull trout; hydrologic and water chemistry sampling; trap-and-haul; a review of 2012 Arrowrock Hydroelectric Project operations; and fisheries management activities performed by the Idaho Department of Fish and Game (IDFG). For the purpose of this report, the Boise River basin study area includes the Arrowrock Reservoir; the South Fork Boise River below Anderson Ranch Dam; the Middle and North Fork Boise rivers; and Grouse and Cottonwood creeks (Figure 9). Sampling locations in Arrowrock Reservoir are depicted in Figure 10 and sampling locations in the South Fork Boise River are depicted in Figure 11.

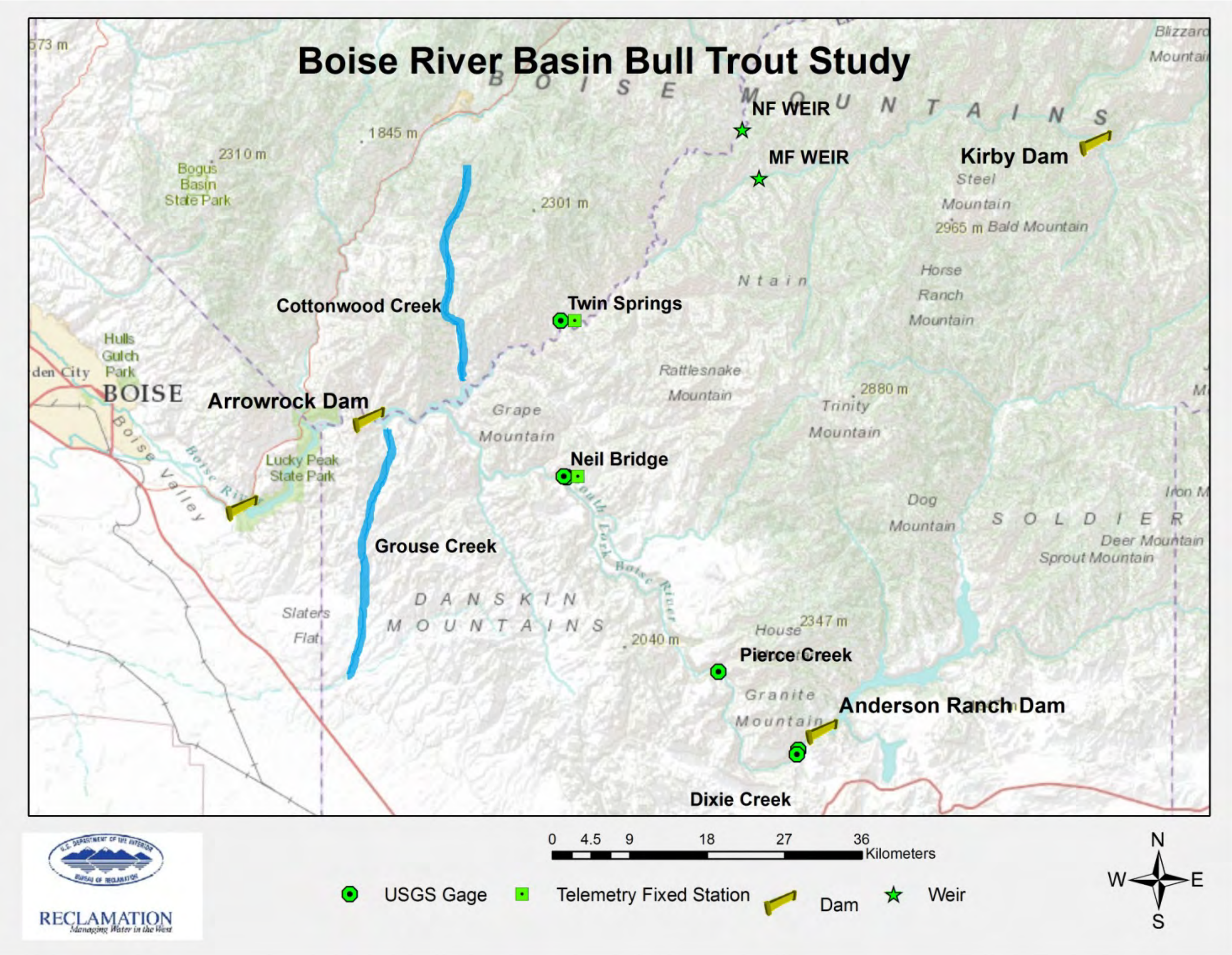

Figure 9. Boise River basin study area, 2012. Labels on map refer to reference points in Chapter 3. This figure shows locations for U.S. Geological Survey water gages (USGS gages) which also house telemetry receivers and weir locations on Middle Fork Boise River (River Mile 107) and North Fork Boise River (River Mile 10), Boise County, Idaho. Weirs were not operated during the 2012 reporting period.

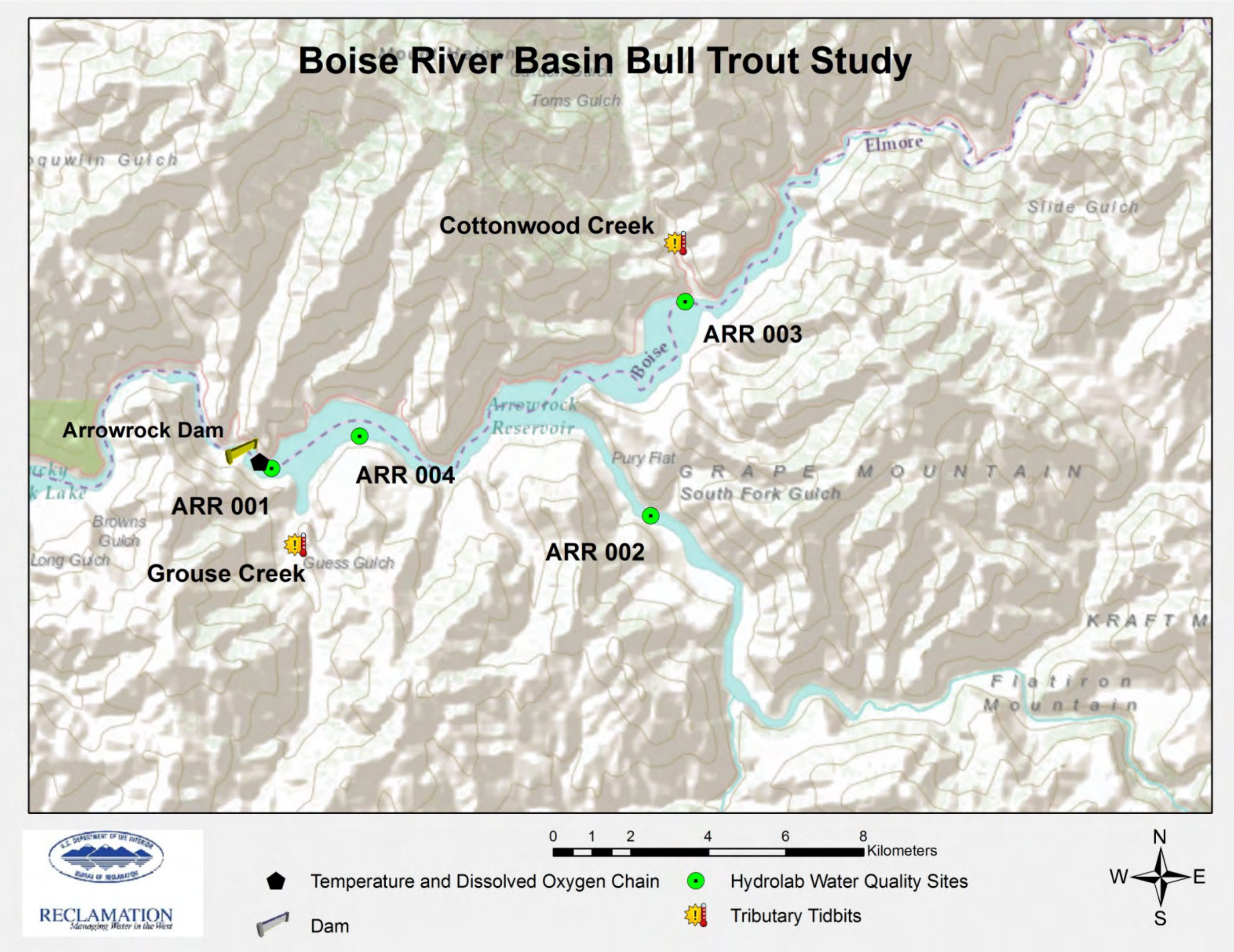

Figure 10. Limnologic and hydrologic sampling locations in Arrowrock Reservoir, Idaho 2012. This figure shows locations for Tidbit temperature loggers, a temperature and dissolved oxygen chain, and water profile stations.

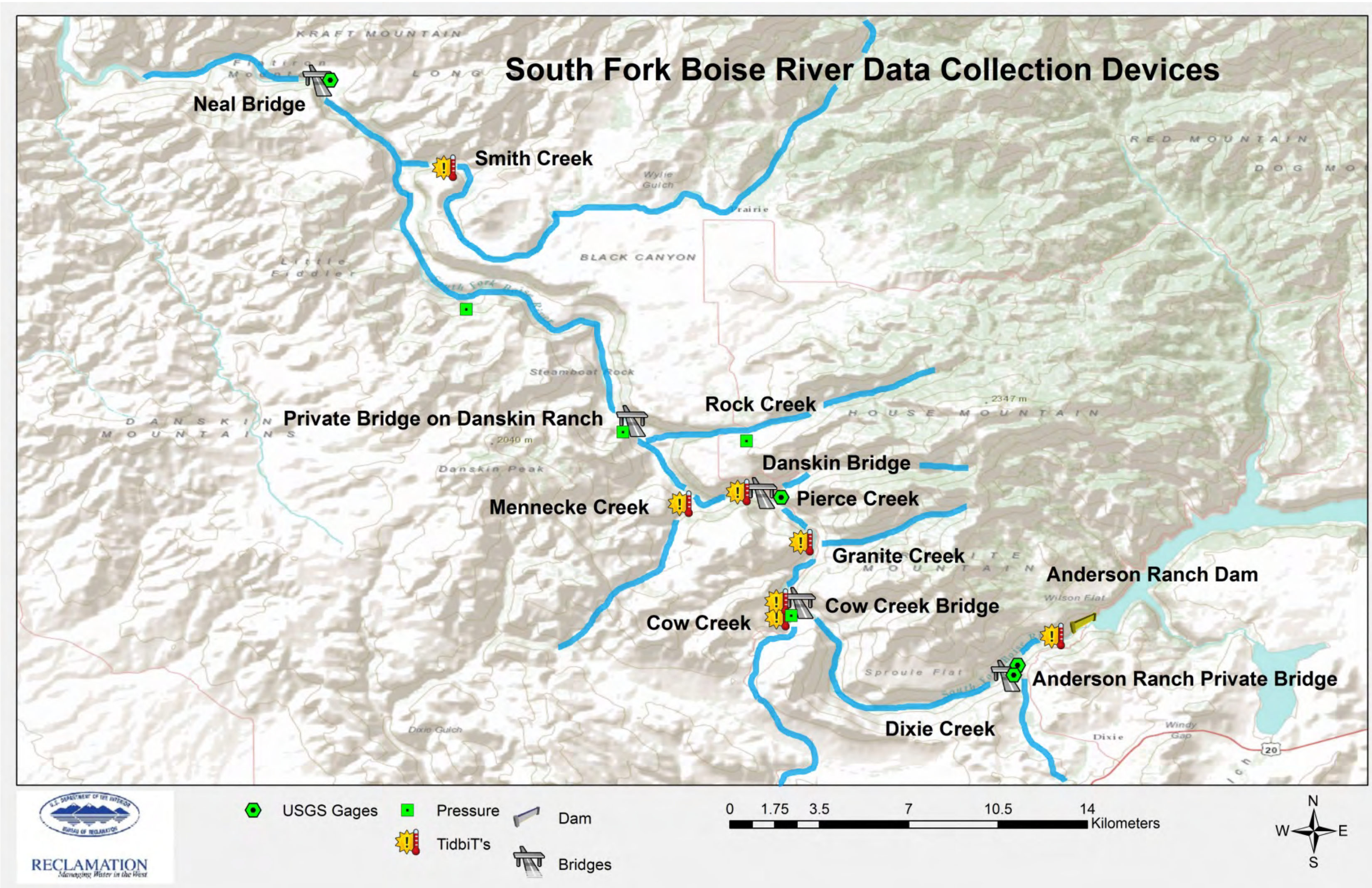

Figure 11. South Fork Boise River basin study area, 2012. This figure shows locations of TidbiT temperature loggers, U.S. Geological Survey water gages (USGS gages) which also house telemetry receivers, and pressure transducers.

3.1.1 South Fork Boise River Data Collection and Arrowrock Reservoir Data Collection

South Fork Boise River data collection included both hydrology and fisheries efforts necessary to address Term and Condition 2.a and 2.b which directs Reclamation to determine ramping rates that reduce harassment to bull trout and to examine system flexibility to minimize impacts associated with disruption of migratory cues. Bull trout migration behavior and river hydrology conditions will be coupled to assess how operations at Anderson Ranch Dam influence bull trout in the South Fork Boise River below the dam.

Bull trout were radio tagged and tracked in the South Fork Boise River and are described in Section 3.1.2. Streamflow and temperature were monitored on the South Fork Boise River and selected tributaries (Figure 11). In 2012, Reclamation continued funding the U.S. Geological Survey (USGS) to maintain flow/temperature gages at Neal Bridge on the South Fork Boise River and two tributaries to the South Fork Boise River (Pierce Creek, and Dixie Creek) for the purpose of monitoring flow below Anderson Ranch Dam. Data from these gages will be used in conjunction with the bull trout migration work and water quality monitoring for Arrowrock Reservoir.

Data collection in Arrowrock Reservoir focuses on water quality, prey base, and fish migration data necessary to address the Terms and Conditions 1.a through 1.e. which directs Reclamation to minimize impacts to bull trout resulting from habitat loss, reduction in reservoir productivity, impacts to food base, and entrainment. Water quality parameters and prey base conditions will be used in conjunction with bull trout migration behavior to assess how operations at Arrowrock Dam influence bull trout in the Arrowrock Reservoir.

3.1.2 Fish Sampling

The fish tracking and migratory data collection efforts overlap both the South Fork Boise River and Arrowrock Reservoir because it is an open system and fish move freely between the two water bodies. Fish sampling was performed to address Terms and Conditions 1.c, 2.a, and 2.b and included the following objectives: 1) tag at least 60 fish with radio tags and 75 fish with archival temperature tags; 2) recover archival tagged fish to retrieve stored data; and 3) tag bull trout that could be used in calculating a population estimate. Monitoring requirements were also met by conducting this work (Reclamation 2006). Migration weirs, scheduled to be operated on the Middle and North Fork Boise rivers, were not installed during 2012 due to the Trinity Ridge wildfire. A total of four sampling events occurred during this reporting period: 1) Arrowrock Reservoir in the spring by Reclamation, 2) Arrowrock Reservoir in the fall by Reclamation, 3) Kirby Dam in the summer by Reclamation, and 4) South Fork Boise River in the fall by IDFG. Sampling events performed by Reclamation are described in the following text and in Section 3.1.5.5. The sampling effort conducted by IDFG is described in Section 3.1.5.4.

A total of 8,885 fish representing 11 species, including 169 bull trout (including recaptures), were sampled in the Boise River study basin between March and November 2012. One bull trout was sampled at Kirby Dam and included in that total, but is described in Section 3.1.5.5. As shown in Table 5, large scale sucker *(Castostomus macrocheilus)* and northern pikeminnow *(Ptychocheilus oregonensis*) made up over 83 percent of the total catch. Bull trout made up 1.96 percent of the total sample.

Table 5. Total catch summary for Boise River basin gill netting in 2012, including numbers of each species captured (total catch) and percent of total catch.

Species	Total Catch	Percent
Bull trout (*Salvelinus confluentus*)	168	1.96
Rainbow trout (*Oncorhynchus mykiss*)	175	1.97
Mountain whitefish (*Prosopium williamsoni*)	444	5.00
Rainbow trout/Cutthroat Hybrid	1	0.01
Largescale sucker (*Catostomus macrocheilus*)	3,462	38.97
Bridgelip Sucker (*Castostomus columbianus*)	108	1.22
Northern pikeminnow (*Ptychocheilus oregonensis*)	3,951	44.47
Kokanee salmon (*Oncorhynchus nerka kennerlyi*)	425	4.78
Yellow perch *(Perca flavescens)*	27	0.30
Chiselmouth *(Acrocheilus alutaceus)*	40	0.45
Smallmouth bass *(Micropterus dolomieui)*	77	0.87
Total	**8,878**	**100**

All captured fish were identified by species and enumerated and total length (millimeter [mm]) was recorded for all game species. All bull trout were scanned for a Passive Integrated Transponder (PIT) tag from Biomark Incorporated, Boise, Idaho for individual identification; those without had one installed. Newly captured bull trout that met weight requirements were implanted with radio telemetry transmitters (radio tags Lotek models MCFT2-3BM, MCFT2-3EM, MCFT2-3FM, SR-TP11-25, and SR-TP11-35) and archival temperature recording tags (archival tags Lotek Internal model 1410 or Lotek External model 1100). Radio tags were implanted with the modified shielded needle technique described by Ross and Kleiner (1982). The external archival tags were attached with the method described by Howell et al. (2010). The 12 mm PIT tags were inserted into the dorsal sinsus of all bull trout greater than 125 mm in total length. Fish were anesthetized by electronarcosis, a method described by Hudson et al. (2011).

Biological samples collected from bull trout included fin clips (n=151) and scales (n=173) while the bull trout were anesthetized. None of the methods for taking these biological samples were lethal to the fish. Fin clips were sent to the USFWS Genetics Lab in Abernathy, Washington for storage and potential future genetic analysis. Genetic analysis may be used for population assignment within the Boise River basin.

Bull trout scales are being analyzed by Reclamation staff to determine general age and growth patterns in the population. A digital image of each scale sample was created and multiple readers will assign ages to each fish by identifying growth annuli. Aging techniques and backcalculating length at age measurements for scales are described by Devries and Frie (1996). Scale samples are being housed at Reclamation's Snake River Area Office in Boise, Idaho.

3.1.2.1 Gill Netting

Two gill net sampling efforts took place in 2012, one in the spring and one in the fall that replaced the picket weir sampling that was canceled due to wildfires in the North Fork Boise and Middle Fork Boise river basins in the fall. Gill net mesh sizes were selected to maximize catch of bull trout and minimize bycatch; therefore, catch summaries are not representative of all age classes or relative abundance. For all gill netting activities, the IDFG permit (Permit #F-02-07-12) limited gill net sets in bull trout waters to 45 minutes maximum. Individual gill nets ranged from 50 meters to 100 meters in length and were often fished simultaneously by tying them end-to-end to increase sampling efficiency. To reduce mortalities, Reclamation standardized gill net sets to 30 minutes (0.5 hour). Each 50 meters of gill net fished constituted 0.5 hours of effort (i.e., 150 meters of gill net equaled 1.5 hours of sampling effort). Gill nets were retrieved from the opposite end they were deployed in order to minimize soak time.

In spring 2012, a total of 5,902 fish representing 10 species were sampled, including 66 bull trout, using gill nets for a total of 815.64 soak hours in Arrowrock Reservoir from March 26 to April 17, 2012 (Table 6). Gill net soak times were recorded for 81,564 meters of net. Largescale sucker and northern pikeminnow comprised 83.33 percent of the total catch while bull trout represented only 1.12 percent of the total catch.

Table 6. Gill net sampling summary for Arrowrock Reservoir in spring of 2012, including species, total count, catch per unit of effort (CPUE), and percent of total catch.

Species	Soak Time(hrs): 815.64		
	Total Count	**CPUE**	**Percent**
Bull trout (*Salvelinus confluentus*)	66	0.081	1.12
Bridgelip sucker *(Catostomus columbianus)*	82	0.101	1.39
Chiselmouth (*Acrocheilus alutaceus*)	39	0.048	0.66
Rainbow trout (*Oncorhynchus mykiss*)	85	0.104	1.44
Kokanee salmon *(Oncorhynchus nerka)*	346	0.424	5.86
Large scale sucker *(Catostomus macrocheilus)*	1,212	1.486	20.54
Northern pikeminnow *(Ptychocheilus oregonensis)*	3,706	4.544	62.79
Small mouth bass *(Micropterus dolomieui)*	5	0.006	0.08
Mountain whitefish (*Prosopium williamsoni*)	339	0.416	5.74
Yellow perch *(Perca flavescens)*	22	0.027	0.37
Total	**5,902**	**7.237**	**100**

Newly captured bull trout were implanted via dorsal sinus with a 12 mm PIT tag (n=55). These bull trout ranged from 206 mm to 775 mm in total length. Bull trout were surgically implanted with radio tags (n=6) or acoustic tags (n=18) and/or archival tags (n=16) as long as the tag weight did not exceed 4 percent of the host fish weight. Behavior of radio and archival tagged bull trout will be summarized upon completion of this project.

A total of 6 bull trout (9.0 percent of the total catch) expired in the Boise River basin during the 2012 spring sampling. This level of mortality was better than expected based on previous sampling efforts using similar methods in Glacier National Park, Montana; Lake Pend Oreille, Idaho; and Priest Lake, Idaho (Dux 2012). Otoliths were extracted from all mortalities and will be analyzed at a later date.

During the 2012 fall sampling effort on Arrowrock Reservoir, a total of 2,976 fish representing 11 species were sampled, including 102 bull trout, using gill nets for a total of 519.72 soak hours in Arrowrock Reservoir from October 1 to November 2, 2012 (Table 7). Gill net soak times were recorded for 51, 972 meters of net. Largescale sucker and northern pikeminnow comprised 83.83 percent of the total catch while bull trout represented only 3.43 percent of the total catch.

Table 7. Gill net sampling summary for Arrowrock Reservoir in the fall of 2012, including species, total count, catch per unit of effort (CPUE), and percent of total catch.

	Soak Time (hrs): 519.72		
Species	**Total Count**	**CPUE**	**Percent**
Bull trout (*Salvelinus confluentus*)	102	0.196	3.43
Bridgelip sucker *(Catostomus columbianus)*	26	0.050	0.87
Chiselmouth (*Acrocheilus alutaceus*)	1	0.002	0.03
Rainbow trout (*Oncorhynchus mykiss*)	90	0.173	3.02
Rainbow Cutthroat Hybrid (*Oncorhynchus clarki x mykiss*)	1	0.002	0.03
Kokanee salmon *(Oncorhynchus nerka)*	79	0.152	2.65
Large scale sucker *(Catostomus macrocheilus)*	2,250	4.329	75.60
Northern pikeminnow *(Ptychocheilus oregonensis)*	245	0.471	8.23
Small mouth bass *(Micropterus dolomieui)*	72	0.139	2.42
Mountain whitefish (*Prosopium williamsoni*)	105	0.202	3.53
Yellow perch *(Perca flavescens)*	5	0.010	0.17
Total	**2,976**	**5.726**	**100**

Newly captured bull trout from all fall sampling were implanted via dorsal sinus with a 12 mm PIT tag (n=95). These bull trout ranged from 251 mm to 709 mm in total length. Bull trout were surgically implanted with radio tags (n=75) and/or archival tags (n=72) as long as the tag weight did not exceed 4 percent of the host fish weight. Behavior of radio and archival tagged bull trout will be summarized upon completion of this project.

A total of 4 bull trout (3.9 percent of total catch) expired in the Boise River basin during the 2012 fall field season. This level of mortality was much better than expected based on previous sampling efforts using similar methods in Glacier National Park, Montana; Lake Pend Oreille, Idaho; and Priest Lake, Idaho (Dux 2012). Otoliths were extracted from all mortalities and will be analyzed at a later date.

3.1.2.2 Radio Telemetry

The use of radio and archival tag technology is used to address the terms and conditions outlined in the 2005 Opinion. Bull trout spatial and temporal use of Arrowrock Reservoir and South Fork Boise, North Fork Boise, and Middle Fork Boise rivers can be documented with these technologies. Information collected on bull trout movement patterns coupled with continuous measurements of water temperature and discharge will be used to identify migratory cues for bull trout migration. Ultimately, this will provide information to implement ramping rates that minimize harassment and/or harm of bull trout in the South Fork Boise River below Anderson Ranch Reservoir.

As part of this investigation, 135 bull trout with surgically implanted radio tags or archival tags were being tracked at the end of the reporting period. Of those 135 tagged fishes, 112 were tagged with radio tags; 90 of these 112 were also tagged with either an internal or external archival tags. Twenty-three bull trout were surgically implanted with archival tags only. Data from the radio and archival tags will be summarized upon completion of this project.

Movement of radio-tagged fish was monitored using fixed telemetry sites, mobile tracking, and boat tracking. Fixed telemetry sites were located with the USGS flow monitoring equipment at Neal Bridge (South Fork Boise River) and Twin Springs (Middle Fork Boise River) (Figure 9). Mobile tracking occurred at least biweekly, but more often occurred weekly during 2012. Mobile telemetry was limited in the North Fork Boise and Middle Fork Boise rivers during the fire season. Mobile telemetry was conducted in the South Fork Boise River weekly during 2012. Also, 24-hour tracking took place during all ramping events in the South Fork Boise River to monitor any behavioral changes that could be associated with dam operations (Term and Conditions 2.a and 2.b). All telemetry efforts will continue weekly on both the North Fork Boise and Middle Fork Boise rivers through the 2013 field season.

3.1.3 Hydrology and Water Chemistry

Hydrology and water chemistry data were collected in Arrowrock Reservoir and selected tributaries during this reporting period. These data are being used to assess Term and Condition 1.b and coupled with bull trout migration behavior to assess Term and Condition 2.b. Reservoir vertical profiles were collected monthly from May through October and every 6 weeks from November to April. Seven water quality parameters were measured at four locations on the reservoir (Figure 10). Water quality parameters included water temperature, dissolved oxygen concentration, pH, conductivity, turbidity, florescence, and barometric pressure. Hydrology and water quality samples will continue to be sampled through the 2013 field season.

Onset TidbiT temperature thermographs were deployed in Grouse Creek and Cottonwood Creek on May 12, 2011, and set to record water temperature hourly (Figure 10). Data are manually downloaded a minimum of two times a year. Water temperatures will continue to be collected in Grouse and Cottonwood creeks through the 2013 field season.

On June 15, 2012, a semi-permanent water quality monitoring station was installed at Arrowrock Reservoir. The station is located approximately 200 yards upstream of the dam in the deepest basin of the reservoir (approximately 264 feet deep at full pool; Figure 10). Onset Tidbit temperature thermographs were attached to a rope at 1-meter intervals from 1- to 25-

meters depths. Three mini Minidot temperature/dissolved oxygen sensors were attached at 4 meters, 8 meters, and 20 meters to measure dissolved oxygen above, within, and below the anticipated annual thermocline. Tidbit temperature data sensors were installed at depths from 2 meters to 16 meters on June 15, 2012. Additional tidbit sensors were installed at 1 meter and 17- to 25-meter depths on June 21, 2012. Data were downloaded from sensors at 2-week intervals during the same days the vertical profile data were collected. The station was removed on November 6, 2012 for winter storage. The site will be redeployed in the spring of 2013 when conditions allow.

3.1.4 Trap-and-Haul Efforts

Trap-and-haul efforts were conducted during April and May 2012 to relocate potentially-displaced (entrained) bull trout from Lucky Peak Reservoir back to Arrowrock Reservoir. This effort is required every 2 years to meet the current conditions of the 2005 Opinion. Sampling performed during the 2012 trap-and-haul effort was distributed throughout the reservoir using gill nets, targeting previous capture sites and habitat types where bull trout were known to occur (Figure 12). Each gill net was constructed using one size of 1.5- to 4-inch stretch mesh that measured 150 feet long and 6 feet high. The gill nets were constructed to remain perpendicular to the water surface and near or on the bottom of the reservoir. A gill net fished for 1 hour constituted 1 hour of effort. Multiple (1 to 4) gill nets were fished simultaneously by tying them end-to-end. This manner of effort allowed staff to reduce bull trout mortality by limiting set duration to 30 minutes or less (e.g., two nets fished for 30 minutes equals one hour of effort). Gill nets were retrieved from the opposite end they were deployed in order to minimize soak time, and potentially higher bull trout mortality, at the end of the initially set.

Lucky Peak trap-and-haul efforts were conducted from April 24 to May 24, 2012 (Table 8). A total of 1,231 fish representing 9 species were captured using gill nets during a total of 201 effort hours. Largescale sucker and northern pikeminnow comprised 89.60 percent of the total catch, and there were no bull trout caught.

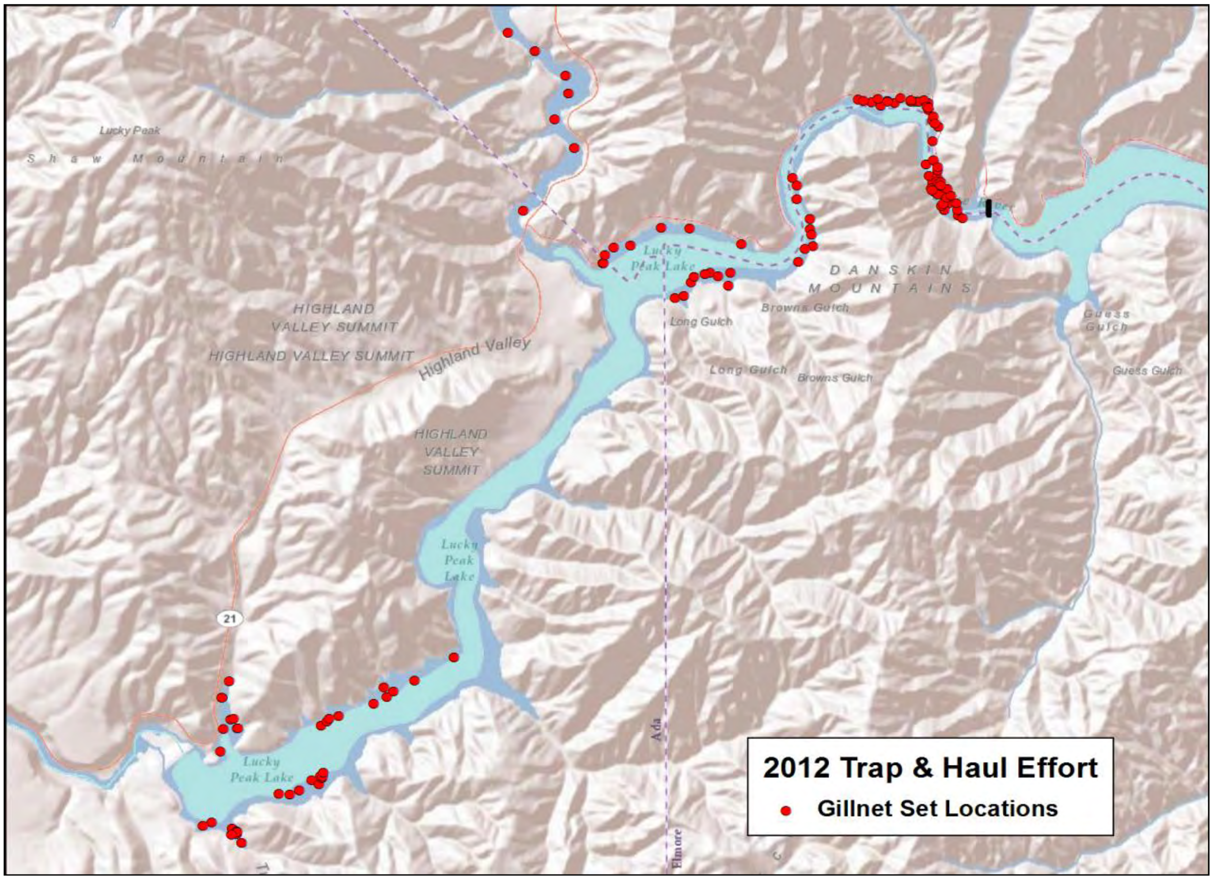

Figure 12. Locations of 2012 bull trout trap-and- transport efforts on Lucky Peak Reservoir. No bull trout were captured in Lucky Peak Reservoir.

Table 8. Catch data for trap-and-haul effort on Lucky Peak Reservoir in 2012. Sampling periods included April and May.

	Soak Time(hrs): 201		
Species	**Total Count**	**CPUE**	**Percent**
Bull trout (*Salvelinus confluentus*)	0	0.00	0.0
Bridgelip sucker *(Catostomus columbianus)*	7	0.03	0.57
Chiselmouth (*Acrocheilus alutaceus*)	32	0.16	2.60
Rainbow trout (*Oncorhynchus mykiss*)	26	0.13	2.11
Kokanee salmon *(Oncorhynchus nerka)*	15	0.07	1.22
Large scale sucker *(Catostomus macrocheilus)*	1,010	5.02	82.05
Northern pikeminnow *(Ptychocheilus oregonensis)*	93	0.46	7.55
Small mouth bass *(Micropterus dolomieui)*	25	0.12	2.03
Mountain whitefish (*Prosopium williamsoni*)	21	0.10	1.71
Yellow perch *(Perca flavescens)*	2	0.01	0.16
Total	**1,231**	**6.12**	**100**

3.1.4.1 Observed trends in Lucky Peak Trap-and-Haul Efforts

Results of the 2012 Lucky Peak Reservoir bull trout trap-and-haul effort are consistent with a declining bull trout catch-per-unit-effort observed since operational changes were implemented at Arrowrock Dam to meet the 2005 Opinion terms and conditions. Trap-and-haul efforts have been conducted during select years from 2000 through 2013. The 2005 Opinion stipulates that a trap-and-haul effort will be conducted every 2 years. Since 2005, efforts have been made to follow the two operational indicators that address entrainment: near surface discharge and spill. Results of these efforts and the potential effects on the Lucky Peak trap-and-haul effort are discussed here.

3.1.4.2 Operational Indicators

Discharge exceeds 695 cfs while the reservoir water surface elevation is less than 3,111 feet in winter and September 15 through October 31. In 2004, the lower ensign release valves at Arrowrock Reservoir were replaced with clamshell valves. In 2005, the upper release valves at Arrowrock Dam were taken offline, though they remain operational for emergency release purposes only. The result of these operational changes is that no surface or near-surface water is discharged from Arrowrock Dam, unless there is an uncontrolled spill event. Arrowrock Dam experienced uncontrolled spill events in 2000 and 2006, but otherwise has discharged water from a minimum depth of 74 feet below ambient pool elevation continuously since 2005 (Figure 13).

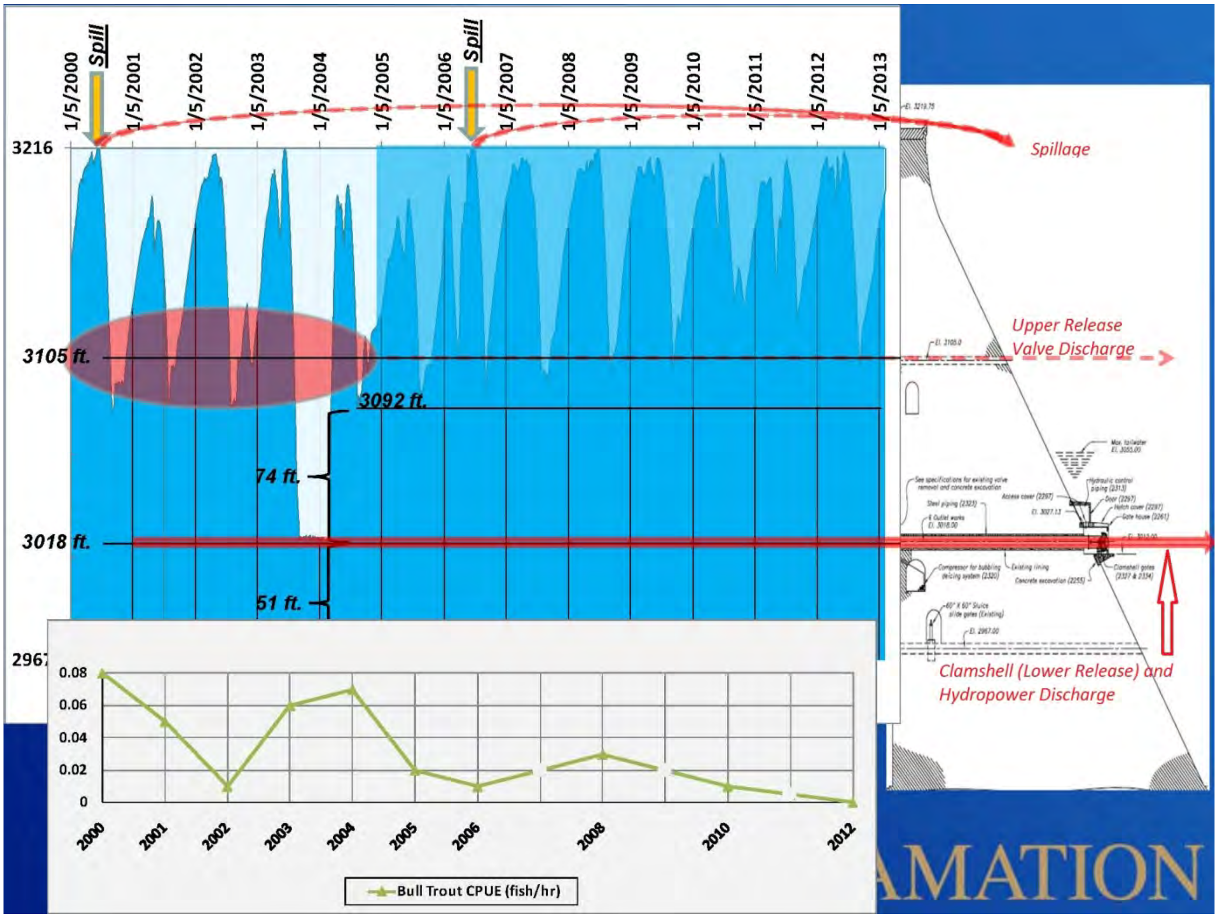

Figure 13. Arrowrock Reservoir pool elevation history and bull trout catch-per-unit-effort (CPUE) during Lucky Peak Reservoir trap-and-haul efforts, 2000-2013. Reservoir elevations (dark blue) are scaled to a diagram of the cross section of the dam (right of graph). The figure depicts water surface elevations (feet above sea-level; left of graph) to the three discharge points on the Dam: the spillway, the upper release valves, and the lower release valves. Uncontrolled spills occurred in 2000 and 2006 (shown by the dashed red lines). Upper release valves were used prior to 2005 (depicted by the red oval timeframe). Lower release valves have been in continuous use as the primary discharge point. Bull trout CPUE during Lucky Peak trap-and-haul efforts is shown at the bottom of the graph. This graph is scaled, in years, to reservoir operations, and illustrates the downward trend in CPUE for Lucky Peak Reservoir trap-and-haul efforts, 2000-2013.

Based on multiple study results and the best available science, it appears that operational changes at Arrowrock Dam that address requirements in the 2005 Opinion have either eliminated, or reduced to undetectable levels, bull trout entrainment from Arrowrock Reservoir into Lucky Peak Reservoir. Long-term efforts by Reclamation and USGS staff conducting gill net trapping, radio-telemetry, and acoustic tracking efforts of bull trout in Arrowrock Reservoir have yielded compelling results. These studies resulted in no bull trout tracked or captured within 500 feet of the dam, and few (9 of 168) within the 5-mile-long main basin of the reservoir during 2012 efforts (Figure 14). Acoustic tracking results detected no bull trout within 1.5 miles of Arrowrock Dam throughout the April to August study period (Figure 15), which includes the spring full pool elevation period when bull trout are most likely to be entrained to Lucky Peak Reservoir. USGS conducted an acoustic tag study in Arrowrock Reservoir in 2012 results of this work will be summarized in 2013 (USGS 2013). Finally, Reclamation staff installed a semi-permanent radio-telemetry tracking station atop Arrowrock Dam during May 2012. No radio-tagged bull trout have been detected using this station, indicating that no tagged bull trout have been entrained into Lucky Peak Reservoir since then. The collective body of scientific evidence suggests bull trout are no longer being entrained from Arrowrock Reservoir into Lucky Peak Reservoir at detectable levels.

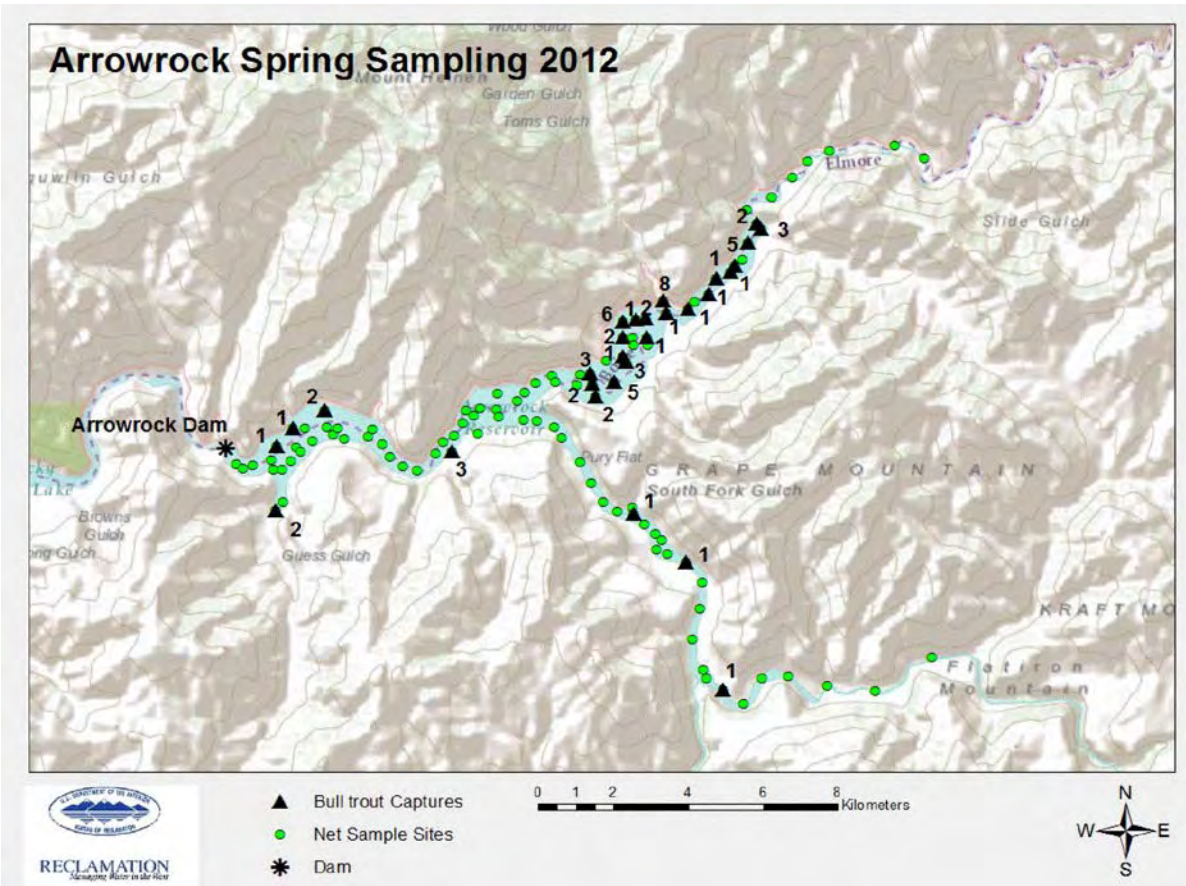

Figure 14. Spatial distribution of Arrowrock Reservoir bull trout captures, spring 2012. Green points indicate effort locations. Black triangles indicate locations of actual bull trout captures. A total of 168 bull trout were captured in Arrowrock Reservoir. Only nine of these fish were captured within 5 miles of Arrowrock Dam.

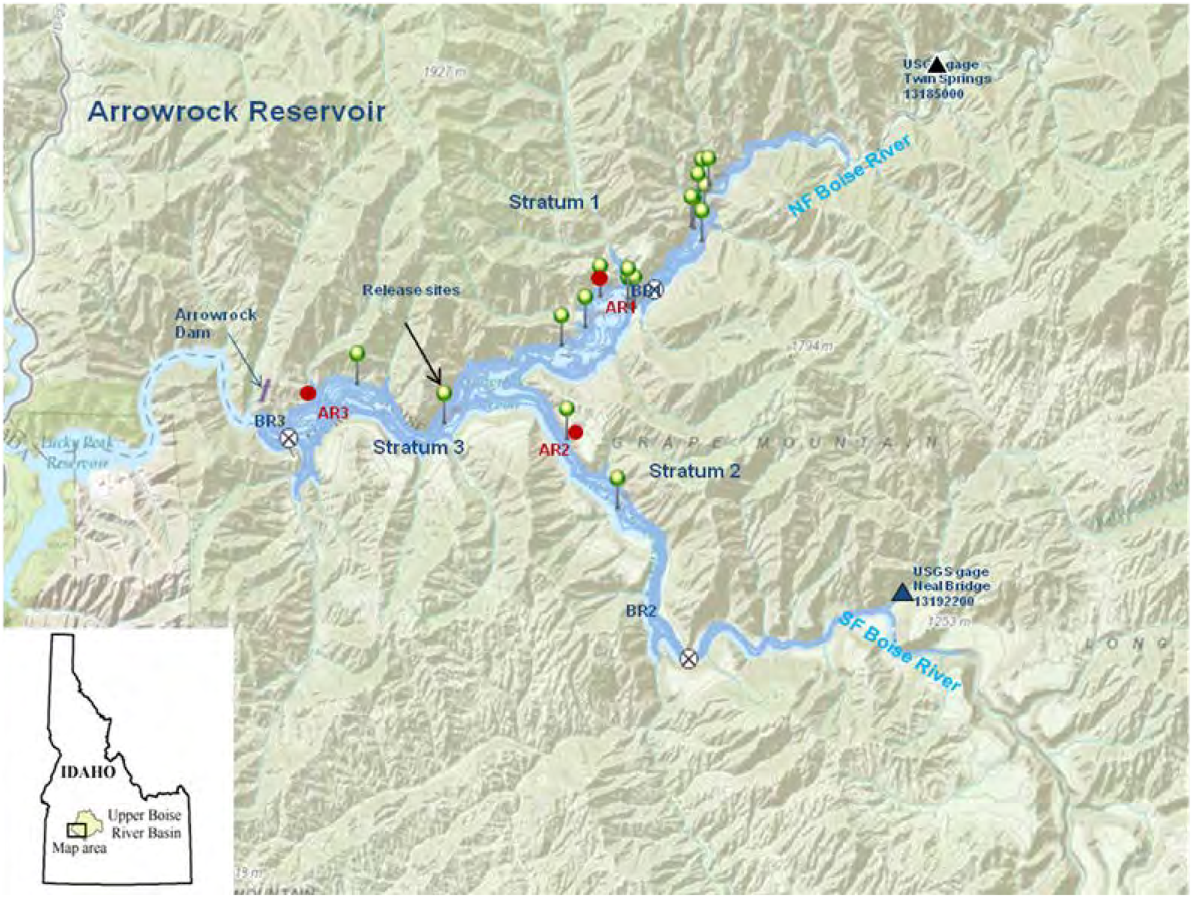

Figure 15. Spatial distribution of bull trout during 2012 acoustic tracking study (USGS). Green pins indicate locations of bull trout released and tracked. Red points indicate approximate locations of acoustic tracking transponders used to echo-locate tagged bull trout.

3.1.5 Other Activities

3.1.5.1 Arrowrock Dam Hydroelectric Project – Boise Project Board of Control

Arrowrock Dam Hydroelectric Project (Project), Federal Energy Regulatory Commission (FERC) licensee #4656-020, started operations in 2010. Among the requirements of the FERC license, the licensee is obligated to:

1. Monitor water temperature and dissolved oxygen of the water that exits the project.
2. Conduct a fish salvage effort in the project tailrace if a shutdown occurs for more than 24 hours when the Lucky Peak Reservoir pool elevation is below 3022 feet.
3. Meet with the Arrowrock Hydro Team (IDFG, Reclamation, U.S. Army Corps of Engineers, and USFWS) annually to report operations of the project.

The annual coordination meeting between the licensee and the Hydro Team has not been conducted prior to the completion of this report. Results of WY2012 monitoring will be reported in the WY 2013 report.

3.1.5.2 Fish Management in Arrowrock Reservoir – IDFG

IDFG assisted with fish sampling efforts conducted by Reclamation in 2012 with the goal of removing nongame fishes. Nongame fishes are known to compete with bull trout for the same prey items (macroinvertebrates and zooplankton). A total of 3,570 suckers (largescale and bridgelip), 40 chiselmouth, and 3,951 pikeminnow were removed from Arrowrock Reservoir during these efforts (Butts et al. in press). A total of 103,910 triploid rainbow trout were stocked into Arrowrock Reservoir between April and October 2012 (IDFG 2013)

3.1.5.3 Stranding Pool Pilot Study in South Fork Boise River – Reclamation, IDFG, and Trout Unlimited

Reclamation, IDFG, and Trout Unlimited cooperatively designed and conducted a pilot study to investigate the occurrence of stranding pools in the South Fork Boise River during the annual fall down-ramping events. A total of 51 stranding pools were recorded between Anderson Ranch Dam and Danskin Bridge in September 2012. Stranding pool measurements were recorded (length, width, average depth, distance from channel, and temperature) and stranded fish were identified and numbers estimated. Rainbow trout, mountain whitefish, and sculpin were sampled, but no bull trout were observed during the down-ramping events. A summary report is being prepared for this effort and will be available under a separate cover. Results from this pilot effort are being used to design a more comprehensive study looking at the effect and occurrence of stranding pools in the South Fork Boise River.

3.1.5.4 Mark-Recapture Population Estimate in South Fork Boise River below Anderson Ranch Dam – IDFG

IDFG conducts a mark-recapture population estimate on the South Fork Boise River every 3 years and was scheduled for 2012. In October, IDFG electroshocked three 1,000-meter reaches two times each, one week apart. During the first sampling event, all trout captured were measured and marked with a hole punch on the caudal fin for a temporary visual identifier, and mountain whitefish were measured and counted. During the second week, the same reaches were sampled and all trout were measured and noted if the hole punch was present. A total of 1,332 fish were sampled during the 2-week effort, including 18 bull trout (17 individual fish, 1 recapture), 787 rainbow trout, and 528 mountain whitefish (Butts et al. in press). IDFG held five bull trout for Reclamation to install transmitters and external archivals, following the same protocols in Section 3.1.2. The five bull trout were deployed with transmitters and external archivals were included in the total telemetry results in Table 8.

3.1.5.5 Bull Trout Capture at Kirby Dam in the Middle Fork Boise River – Bureau of Reclamation and U.S. Forest Service

Reclamation and the U.S. Forest Service entered into an interagency agreement (R12-PG-11-418) to track the North Fork and Middle Fork Boise rivers for radio-tagged bull trout during their migration period (summer and fall). During this time, the tracking technician observed multiple bull trout milling in the pool near the base of the Kirby Dam fish ladder. The following day, Reclamation's fish crew successfully captured one bull trout and installed a transmitter before releasing the fish in the same pool it was captured. Installation of the transmitters used the same protocols listed in Section 3.1.2 and the fish were included in the total telemetry results.

3.1.5.6 Picket Migration Weirs

Boise River basin bull trout population trend monitoring activities (North Fork and Middle Fork migration weirs) were planned to occur during WY 2012, but were cancelled due to wildfires in the area. Gill netting was conducted in Arrowrock Reservoir during the fall 2012 in place of the migration weirs to collect age and growth data and as a marking effort for calculating a population estimate of adfluvial bull trout in the Arrowrock Reservoir system. A data summary is provided in Section 3.1.2.1 of this report.

3.2 Payette River Basin – Deadwood River System

The 2005 Opinion identified five terms and conditions for minimizing the effects to bull trout and/or amount of take associated with the operation of Deadwood Dam. Each term and condition addressed a different aspect of the effects of operations on bull trout and made assumptions regarding the reservoir operation effects on bull trout. Addressing each aspect individually limited Reclamation's understanding of how much flexibility it has in the operation of the system as a whole and the systemic impacts of individual changes in operations; therefore, before an evaluation of the operational flexibility could be done, those impacts needed to be understood and quantified. By addressing the terms and conditions jointly and looking at the system in its entirety, Reclamation can evaluate operational flexibility to minimize biological impacts.

The year 2011 was the final year of an intensive data collection process to establish a comprehensive understanding of physical and biological factors limiting bull trout productivity as well as understanding bull trout movement in the reservoir and in the river below the dam. The primary focus of the 2012 data collection process was the recovery of archival temperature fish tags that were deployed in the 2011 field season and to download and replace water temperature recording Onset TidbiTs. Archival temperature tag sampling efforts were combined to assist with bull trout radio tagging as part of an additional study to examine travel time through the varial zone of tributaries into the reservoir. Results of this work will be described under a separate cover. A final comparison between all previous years' data will be summarized in the final Deadwood Flexibility Study Report. A detailed description of the methods can be found in the Flexibility Study Proposal (Reclamation 2008) and detailed fish sampling results can be found in Reclamation's 2012 fish sampling report to IDFG (Reclamation 2012b). The Flexibility Study involved data collection methods for fish population dynamics, productivity, hydrology, and water chemistry monitoring (Reclamation 2008) and these data are being used in physical and hydrodynamic modeling. Instruments in Deadwood Reservoir and the Deadwood River above and below the dam recorded hydrology and water quality data such as temperature, river channel morphology, and inflow and outflow quantities. The information collected from the reservoir is key to understanding how releases from the dam affect the habitat conditions below the dam under varying operational conditions.

Evaluating the flexibility of the operations and the effects of Deadwood Dam on aquatic fauna requires an understanding of the potential overall ecosystem response to an operational change over time. Using modeling and physical and biological parameters measured over the course of this project has allowed for an ecosystem analysis of the terms and conditions for Deadwood Reservoir operations and its influence on bull trout populations. These efforts involve collaboration between multiple agencies and include annual activities not detailed in this report. The results of the Flexibility Study will be provided at the completion of the project and reported under a separate cover titled Deadwood Flexibility Study.

3.2.1 Data Collection in the Reservoir and Tributaries above the Dam

In the Deadwood River system above Deadwood Dam, four methods of fish sampling were used in 2012 in the Deadwood River and Trail Creek: fyke netting, hook-and-line, gill netting, and picket weirs. All fishes, including bull trout, were released at the point of capture. Captured bull trout that were of proper size (large enough that the tag weight did not exceed 4 percent of the fish's body weight) were surgically fitted with radio transmitters before being released. In addition to sampling bull trout, physical, hydrologic, and water quality data were collected in the river, reservoir, and selected tributaries as outlined in the Flexibility Study Proposal (Reclamation 2008).

3.2.2 Fish Sampling

A total of 3,631 fish representing 10 species, including 44 bull trout, were sampled between June and September 2012 in Deadwood Reservoir and tributaries to the reservoir (Table 9; Reclamation 2011). Redside shiner (*Richardsonius balteatus*) and mountain whitefish

(*Prosopium williamsoni*) accounted for 57.91 percent of the total catch. Cutthroat/rainbow hybrid and sculpin (*Cottus spps.*) were the least abundant of the sampled species, collectively accounting for less than 1 percent of the total catch.

Table 9. Total catch summary for 2012 including numbers of each species captured (total catch) and percent of total catch. Includes catches from fyke nets, hook-and-line, and gill nets. Sampling occurred in Deadwood Reservoir and tributaries upstream of Deadwood Dam, Idaho.

Species	Total Catch	Percent of total
Bull trout (*Salvelinus confluentus*)	44	1.21
Westslope cutthroat trout (*Oncorhynchus clarki lewisi*)	170	4.68
Cutthroat/Rainbow hybrid	8	0.22
Rainbow trout (*Oncorhynchus mykiss*)	154	4.24
Redside shiner (*Richardsonius balteatus*)	2,101	57.86
Sculpin (*Cottus spps.*)	6	0.17
Longnose dace (*Rhinichthys cataractae)*	152	4.19
Mountain whitefish (*Prosopium williamsoni*)	712	19.61
Kokanee salmon (*Oncorhynchus nerka)*	91	2.51
Speckled Dace (*Rhinichthys osculus*)	193	5.32
Total	**3,631**	**100.01**

All captured fish were identified by species and enumerated; total length was recorded for all game species. Some of the newly captured bull trout were implanted with radio tags (Lotek models SR-TP11-25, MCFT-3A, MST-930, NTC6-2 and SR-TP16-25). PIT tags (12 mm) were inserted into the dorsal sinus of all previously untagged bull trout greater than 125 mm in total length. Fish were anesthetized using electronarcosis as described by Hudson et al. (2011). Surgery methods used to implant radio transmitters followed a modified shielded needle technique described by Ross and Kleiner (1982).

In 2012, a total of 32 radio transmitters were deployed. Additionally, four bull trout tagged with radio transmitters in 2011 were targeted for recapture in order to recover archival temperature tags. Of those four fish, three were recaptured and archival temperature tags were surgically removed. Data recorded from the recovered archival temperature tags will be presented in the final Deadwood Flexibility Study report.

One bull trout was known to expire in the 2012 sampling season (2.2 percent of the total catch). Otoliths were extracted and will be analyzed at a later date. In addition, 11 radio transmitters were found expelled in the 2012 sampling season. All 11 tags were from the 2012 tagging season for an expulsion and/or mortality rate of 27.5 percent; the median for the previous six years was 36.7 percent.

Biological samples collected from bull trout included fin clips (n=29) and scales (n=44), taken while bull trout were anesthetized. None of the methods for taking these biological samples were lethal to the fish. Fin clips were sent to the USFWS Genetics Lab in Abernathy, Washington. Genetic analysis may be used for population assignment within the South Fork Payette River basin using methods described in DeHann and Ardren (2008).

Bull trout scales are being analyzed by Reclamation staff to determine general age and growth patterns in the population. Digital images of scales from each fish are created and multiple readers assign ages by identifying growth annuli. Aging techniques and back-calculating length-at-age measurements from scales are described by Devries and Frie (1996). Scale samples are being housed at Reclamation's Snake River Area Office in Boise, Idaho.

3.2.2.1 Fyke Netting

Fyke nets were operated in Deadwood Reservoir Monday through Friday from June 18 to September 12, 2012 for a total of 861.18 hours (Table 10; Reclamation 2012b). A total of 3,609 fish representing 10 species, including 41 bull trout, were captured. Species composition was similar to previous accounts for littoral fish assemblages in the reservoir. Redside shiner and mountain whitefish were the most abundant fish sampled (cumulatively 77.73 percent of the total catch) while bull trout represented 1.14 percent of the total catch. The total catch per unit effort (CPUE) increased from 2.01 fish per hour in 2011 to 4.19 fish per hour in 2012.

Table 10. Fyke net sampling summary for Deadwood Reservoir in 2012, including species, total catch, catch per unit of effort (CPUE), and percent of total catch.

Species	Soak Time Hours = 861.18		
	Total Catch	CPUE (fish/hour)	Percent of total
Bull Trout (*Salvelinus confluentus*)	41	0.05	1.14
Cutthroat Trout (*Oncorhynchus clarki lewisi*)	164	0.19	4.54
Cutthroat/Rainbow hybrid	8	0.01	0.22
Rainbow Trout (*Oncorhynchus mykiss*)	149	0.17	4.13
Redside Shiner (*Richardsonius balteatus)*	2,101	2.44	58.22
Sculpin (*Cottus spps.)*	6	0.01	0.17
Longnose Dace (*Rhinichthys cataractae)*	152	0.18	4.21
Mountain Whitefish (*Prosopium williamsoni*)	704	0.82	19.51
Speckled Dace (*Rhinichthys osculus*)	193	0.22	5.35
Kokanee salmon (*Oncorhynchus nerka*)	91	0.11	2.52
Total	**3,609**	**4.19**	**100.01**

All newly captured bull trout were fitted with a 12 mm PIT tags (n=28). PIT tags were inserted via dorsal sinus for all bull trout greater than 125 mm. Bull trout captured ranged from 105 mm to 540 mm in total length. Bull trout were surgically implanted with radio transmitters (n=29) as long as the tag weight did not exceed 4 percent of the body weight of that fish. Behavior of radio-tagged bull trout will be summarized upon completion of this project.

3.2.2.2 Hook-and-Line Sampling

Four bull trout were captured during hook-and-line sampling in 2012. One of the four bull trout was a recapture with an expired radio transmitter that was surgically removed and replaced with a new radio transmitter. Two of the four bull trout were recaptured from the fyke net sampling and surgically implanted with radio transmitters and fitted with a PIT tag following the methods described previously. The fourth bull trout was PIT tagged and released. No other species were documented during hook-and-line sampling in 2012.

3.2.2.3 Picket Weirs

In 2012, two picket migration weirs were operated by IDFG, one at the mainstem inflow of the Deadwood River into the Deadwood Reservoir and the other in Trail Creek just above the AquaRod water level gauge (AquaRod) and the Onset TidbiT temperature logger (TidbiT) location (Figure 16). IDFG operated these weirs for the purpose of collecting kokanee broodstock. The mainstem weir was operated from August 19 to September 24, 2012, but no bull trout were captured. Reclamation aided in the operation of the Trail Creek weir from August 15 to September 16, 2012, when the weir was removed. On August 28, the Trail Creek weir was relocated further upstream to the same location as the 2011 weir site to provide more cover for bull trout migrating upstream. Prior to relocation, Fish 22 on frequency 149.620 was tracked holding under a rock against the weir. After the weir relocation, Fish 22 moved further upstream and held under the rocks below the weir until September 11 when it was captured and released upstream of the weir. One bull trout was captured in the downstream migration trap box. Behavior of radio-tagged bull trout will be summarized upon completion of this project.

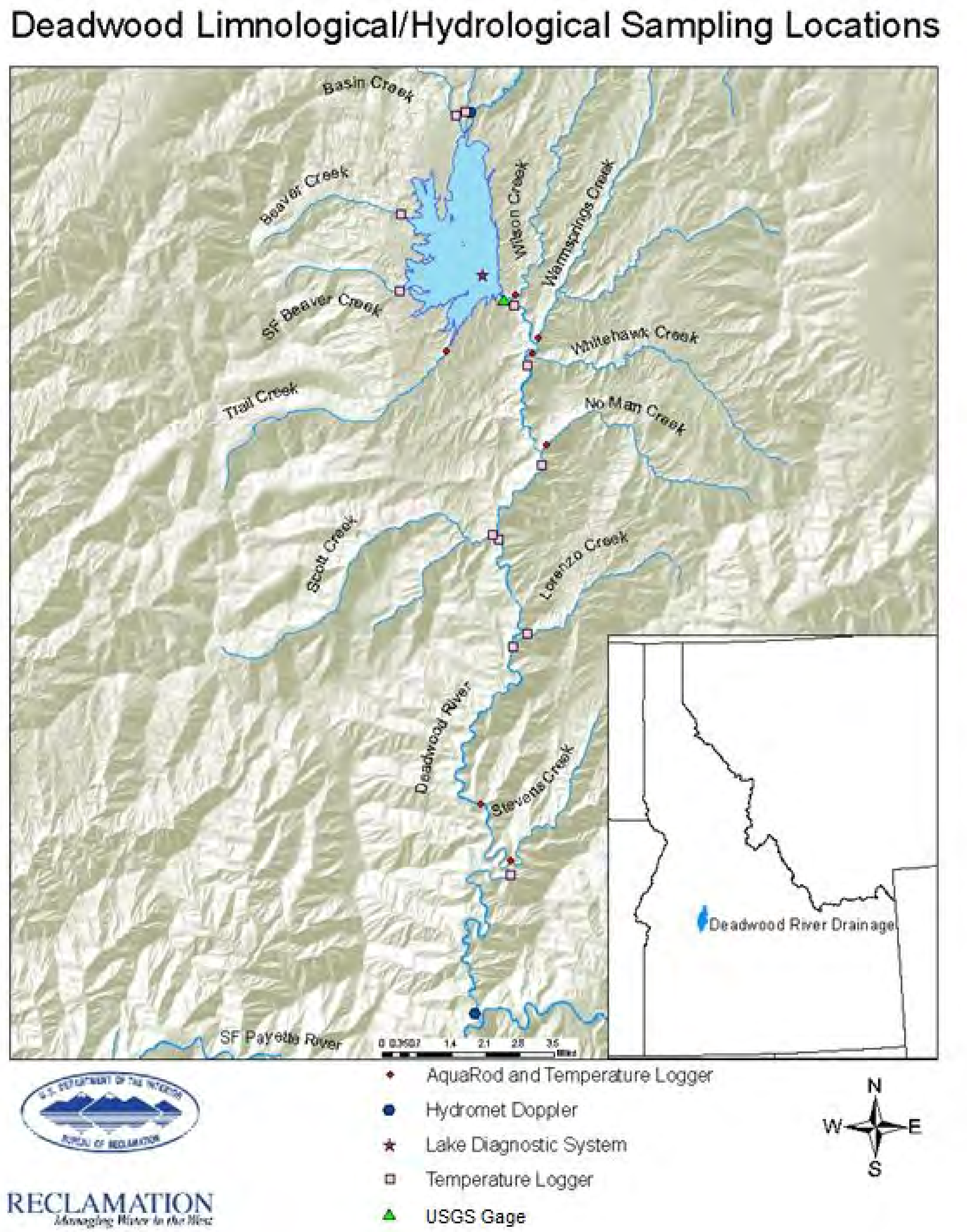

Figure 16. Limnologic and hydrologic sampling locations in the Deadwood study area, Idaho 2012. Equipment used to record data varied between locations and included AquaRods and Onset TidbiTs, a lake diagnostic system, an Acoustic Doppler Current Meter, and a U.S. Geological Survey water gage (USGS gage).

3.2.2.4 Gill Netting

Gill net sampling was used to specifically target bull trout with temperature archival tags. A total of two bull trout were captured during gill net sampling in 2012. Both of the bull trout contained archival temperature tags that were surgically removed and downloaded. Mountain whitefish were the most abundant fish sampled (38.18 percent of the total catch) while bull trout represented 9.52 percent of the total catch.

Table 11. Gill net sampling summary for Deadwood Reservoir in 2012, including species, total catch, catch per unit of effort (CPUE), and percent of total catch.

Species	Soak Time Hours = 2.0		
	Total Catch	CPUE (fish/hour)	Percent of total
Bull Trout (*Salvelinus confluentus*)	2	1.00	9.52
Cutthroat Trout (*Oncorhynchus clarki lewisi*)	6	3.00	28.57
Rainbow Trout (*Oncorhynchus mykiss*)	5	2.50	23.81
Mountain Whitefish (*Prosopium williamsoni*)	8	4.00	38.10
Total	**21**	**10.50**	**100**

3.2.2.5 Radio Telemetry

Behavior of radio-tagged bull trout has varied since the radio telemetry work started in 2006 and will be summarized upon completion of this project. In general, tributary inflow (timing and extent of spring runoff) as well as reservoir and tributary water temperatures appear to influence the behavior and migration timing of bull trout in and out of the reservoir.

3.2.3 Hydrology and Water Chemistry

Hydrology and water quality data collection for the Flexibility Study was completed in 2011. Use of these data in the modeling efforts, as well as additional study background information, is described in the Flexibility Study Proposal (Reclamation 2008).

The collection of water temperature data continued in 2012 in five tributaries to the reservoir using Onset TidbiTs in the following tributaries: Trail Creek, South Fork Beaver Creek, Beaver Creek, Basin Creek, and Wildbuck Creek. Onset TidbiTs recorded hourly water temperature data that were manually downloaded a minimum of one time per year. The Deadwood River inflow was monitored with a Sontek Acoustic Doppler Current Meter (ADCM) which collected water temperatures at 15-minute intervals. The ADCM was removed in the fall of 2012. An AquaRod in Trail Creek that recorded flow stage was decommissioned in the 2012 field season. All temperature, flow, and stage data is stored on Reclamation's Hydromet database and is being used for the biological and hydrology modeling (Reclamation 2013).

3.2.4 Other Activities

Trawling and hydroacoustic surveys were conducted by IDFG on July 17, 2012 to provide estimates of kokanee recruitment. The IDFG also stocked 5,088 catchable Chinook salmon (6 inches or greater) and 10,400 fingerling triploid troutlodge kamloop rainbow trout (6 inches or less) into Deadwood Reservoir as a measure to control kokanee salmon and provide a sport fishery. All work performed by the IDFG is summarized in the IDFG Regional Fisheries Management Investigations, Southwest Region Report (Butts et al. in press).

3.2.5 Data Collection in the Deadwood River Reach Downstream of Deadwood Dam

Prior to 2007, no bull trout had been sampled in the Deadwood River below the dam using a combination of gill nets, fyke nets, tributary weirs, hook-and-line, and electrofishing methods. Since 2007, 42 bull trout have been sampled in the mainstem Deadwood River and 197 bull trout in tributaries below the dam. Movement of radio-tagged fish has varied between years and seasons. During the 2012 reporting period, no bull trout were captured below Deadwood Dam. The batteries from all 18 radio tags that were deployed in Scott Creek in 2010 expired prior to the 2012 field season. No radio tracking occurred below the dam in 2012.

In 2012, backpack electroshocking was the only method used for sampling fish during the stranding pool surveys in the Deadwood River system below Deadwood Dam. All fishes were released in close proximity to their capture location. In addition to conducting stranding pool surveys, physical, hydrologic, and water chemistry data were also collected throughout the year as outlined in the Flexibility Study Proposal (Reclamation 2008).

3.2.5.1 Stranding Pool Survey

A stranding pool survey effort was conducted in the Deadwood River below the dam as an ongoing effort from work started in 2010. A continued stranding pool effort was conducted from September 4-7, 2012, when flows from the dam were reduced to 50 cfs.

Reclamation used green LiDAR data to delineate the 24 miles of the Deadwood River from the dam to the South Fork Payette River into 16 separate reaches based on geomorphological features. In 2012, Reclamation assessed 9 reaches and conducted surveys on 15 stranding pools.

Smith-Root backpack electroshockers were used to determine if fish were stranded in stranding pools. A total of 55 fish were captured from the 15 surveyed stranding pools (Table 12). The fish assemblage from stranding pools sampled in 2012 were similar to those in 2011, with rainbow trout being the most abundant species 58.33 percent of the total catch in 2011 and 69.09 percent of the total catch in 2012. Mountain whitefish being the least abundant with 4.17 percent of the total catch in 2011 compared to 10.91 in 2012. No bull trout were found in the survey. All fishes were released into the closest mainstem pool habitat.

Table 12. Summary of fish species captured (total catch) and percent of total catch for all 2012 stranding pool salvage efforts along the mainstem Deadwood River below Deadwood Dam.

	Area (m^2) = 886.35	
Species	**Total Catch**	**Percent of Total**
Rainbow Trout (*Oncorhynchus mykiss*)	38	69.09
Mountain Whitefish (*Prosopium williamsoni*)	6	10.91
Sculpin (Cottus spps.)	11	20.00
Total	**55**	**100**

3.2.5.2 Radio Telemetry

Three remote telemetry stations have been operated in recent years to track radio-tagged bull trout in the Deadwood River system below the dam (Reclamation 2011). Remote telemetry station locations included 1) the dam (upper), 2) the confluence of Scott Creek with the Deadwood River (middle), and 3) the confluence of the Deadwood River and South Fork Payette River (lower). The middle and lower remote stations were removed in the summer of 2012. The uppermost of the three stations is still currently operating and positioned on Deadwood Dam to record fish movement both above and below the dam. Telemetry data will be summarized in the Deadwood Flexibility Report.

3.2.6 Hydrology and Water Chemistry

Onset TidbiT temperature thermographs continued monitoring water temperatures downstream of Deadwood Dam in the mainstem Deadwood River and in seven tributaries to the Deadwood River: Wilson Creek, Whitehawk Creek, No-Man Creek, Scott Creek, Lorenzo Creek, Julie Creek, and Stevens Creek (Figure 10). Thermographs recorded water temperature hourly throughout the year and were manually downloaded a minimum of once per year. Locations of all temperature thermographs in the Deadwood River basin are illustrated in Figure 16.

An ADCM located near the confluence of the Deadwood River with the South Fork Payette River was maintained and continued to record water temperature, water velocity, and water depth data until late fall 2010 when it was replaced by USGS with a pressure transducer to record water temperature and depth. The pressure transducer was damaged in the spring of 2012 and removed in the fall of 2012. Data from this location was transmitted via satellite to Reclamation's Hydromet website, listed as site DRMI (Reclamation 2013).

AquaRods in Wilson, Warmsprings, Whitehawk, and Stevens creeks and in the Deadwood River near Julie Creek were removed in September 2012. The AquaRods recorded flow stage every 30 minutes from July through September and hourly during the rest of the year.

The network of Onset TidbiTs that were deployed in the mouth of Warmsprings Creek, but within the Deadwood River, to track the thermal "plume" or "regime" of Warmsprings Creek (the creek is geothermally influenced) were downloaded during the 2012 field season. The goal of this data collection effort was to characterize the thermal signature, determine whether it provides a thermal refuge for bull trout, and/or how a different operation of the dam may affect the warm water entering the river from Warmsprings Creek.

All temperature, flow, and stage data is stored in Reclamation's Hydromet database and is being used for the biological and hydrologic modeling. Results will be available in the final report upon completion of the project following the outline described in the Flexibility Study Proposal (Reclamation 2008).

3.3 Malheur River Basin - Beulah Reservoir and the North Fork Malheur River

The 2005 Opinion identifies four Terms and Conditions for minimizing the effect and/or amount of take associated with the operation of Agency Valley Dam (Beulah Reservoir). Each of the Terms and Conditions addresses a different aspect of the effects of operations on bull trout. Reclamation is working to develop recommendations for a minimum pool level for Beulah Reservoir that would maintain a prey base for bull trout returning to the reservoir to overwinter (Terms and Conditions 4.a and 4.c).

In 2010, USFWS approved a time extension to allow Reclamation to collect additional data at Beulah Reservoir and its tributaries. A 4-year study was initiated in 2010 to extend fish, invertebrate, zooplankton, and water quality sampling to lower drawdown levels and to complete bioenergetics modeling. Prey base and bull trout studies (Term and Condition 4.a) will be conducted during the first 3 years; in the last year, the collected data will be combined with previous sampling efforts to conduct bioenergetics modeling and to develop a defensible minimum pool recommendation for Beulah Reservoir and the efficacy of prey supplementation (Term and Condition 4.b).

Bull trout marking and tagging is being used to determine bull trout population levels, seasonal use of Beulah Reservoir, and the timing and extent of migration. A migration weir fish trap is being installed in the North Fork Malheur River near the inlet to Beulah Reservoir during spring and fall periods of 2011 through 2013 when conditions allow. A PIT-tagging program was instituted in 2011 with the installation of a PIT-tag antenna array on the North Fork Malheur River near the inlet to Beulah Reservoir to record bull trout migration to and from the reservoir. A PIT-tag antenna array was also installed below the dam in 2012 to monitor for the entrainment of PIT tagged bull trout. Hydroacoustic surveys are being conducted to estimate fish numbers and distribution in the deeper portions of the reservoir where other sampling methods are not effective.

The reservoir pool elevation will be kept at or above 2,000 acre-feet until minimum pool recommendations are presented to USFWS (April 2015 deadline). New work will build from past prey base studies by increasing the sampling effort for prey fish and benthic invertebrates and adding sampling for zooplankton. Basic limnology data will also provide information on primary and secondary productivity. A final summary report for the prey base, bioenergetic modeling, and fish salvage work will be prepared by the April 30, 2015 deadline.

Other bull trout work performed during this reporting period included limnologic and macroinvertebrate surveys in the reservoir. The spillway at Agency Valley Dam was not used during this reporting period and thereby not requiring a trap-and-haul effort for bull trout in the tailrace below the dam (Term and Condition 4.d). Bull trout spawning nest surveys (redd counts) have been conducted annually since 1992, but were not performed in 2012 because of budget limitations by all partnering agencies. Redd counts are expected to resume in 2013.

3.3.1 Beulah Reservoir and Tributary Data Collection

Fish sampling efforts conducted during this reporting period included reservoir fish sampling (fyke and gill netting), hydroacoustics survey on the reservoir, a migration weir on the North Fork Malheur River, and tributary backpack electroshocking and hook-and-line sampling. Fish sampling efforts were conducted to meet the following objectives:

1. Pit tag bull trout to monitor migration to and from the reservoir.
2. Estimate the population of adfluvial bull trout using Beulah Reservoir.
3. Estimate and describe the bull trout prey base in Beulah Reservoir seasonally (spring and fall).

By tagging adfluvial bull trout in the reservoir and tributaries, Reclamation will also be able to monitor the entrainment risk of bull trout through Agency Valley Dam (Term and Condition 4.d). Methods and results are summarized below and described in more detail in the Fish and Wildlife Service Annual Sampling Permit report (Best 2013).

3.3.2 Fish Sampling

In the Malheur River basin five methods of fish sampling were conducted in 2012: fyke netting, picket migration weirs, backpack electroshocking, hook-and-line sampling, and gill netting. All bull trout captured during the sampling were anesthetized in a solution of one tablet of Alka Seltzer Gold in 2.5 L of water. Bull trout were then tagged with a floy tag and a 23 mm half-duplex PIT tag inserted into the dorsal sinus if the fish was over 300 mm in total length. The fork length (mm) and weight (g) were also recorded for each fish. Stomach samples were collected on all bull trout captured in the reservoir. Recaptured bull trout were not subjected to repeat stomach pumping to minimize negative effects.

3.3.2.1 Fyke Netting

In 2012, spring reservoir sampling was conducted between April 10 and May 11. Fyke nets were usually set in the afternoon to fish overnight and pulled the following day. Thirty-six bull trout were collected in fyke nets; five of these were recaptured during the spring sampling (Figure 17). Total lengths of sampled bull trout averaged 315 mm and ranged between 247 and 600 mm. Weights averaged 450 grams, and ranged between 184 and 2,687 grams.

Fall reservoir sampling was conducted between October 3 and October 19. Twenty-nine bull trout were collected in fyke nets (Figure 18). Total lengths of sampled bull trout averaged 359 mm and ranged between 243 and 441 mm. Weights averaged 474 grams and ranged between 145 and 845 grams. Nineteen of the bull trout were recaptures.

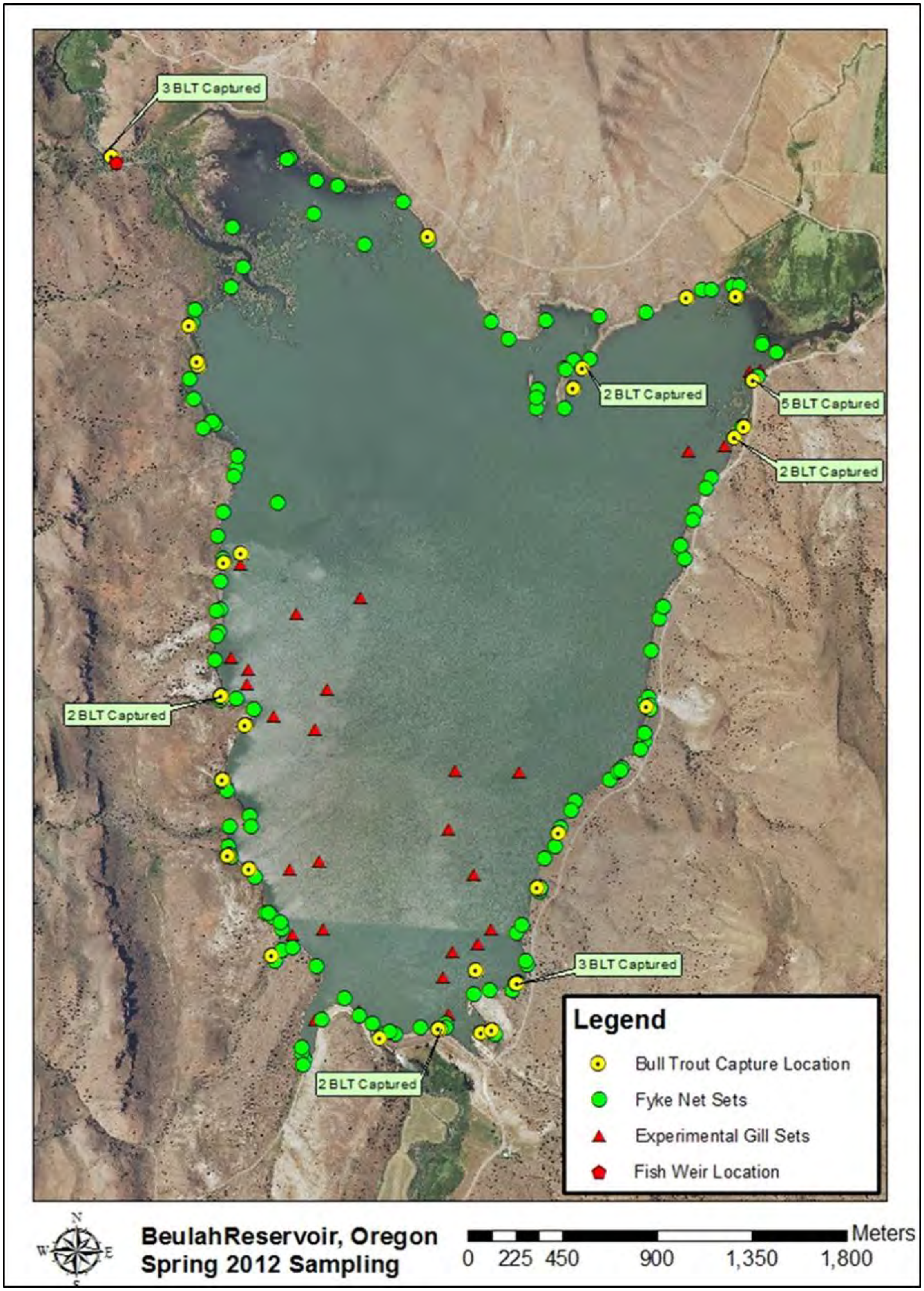

Figure 17. Locations of experimental gill net and fyke net sets and bull trout capture locations during the spring 2012 sampling in Beulah Reservoir.

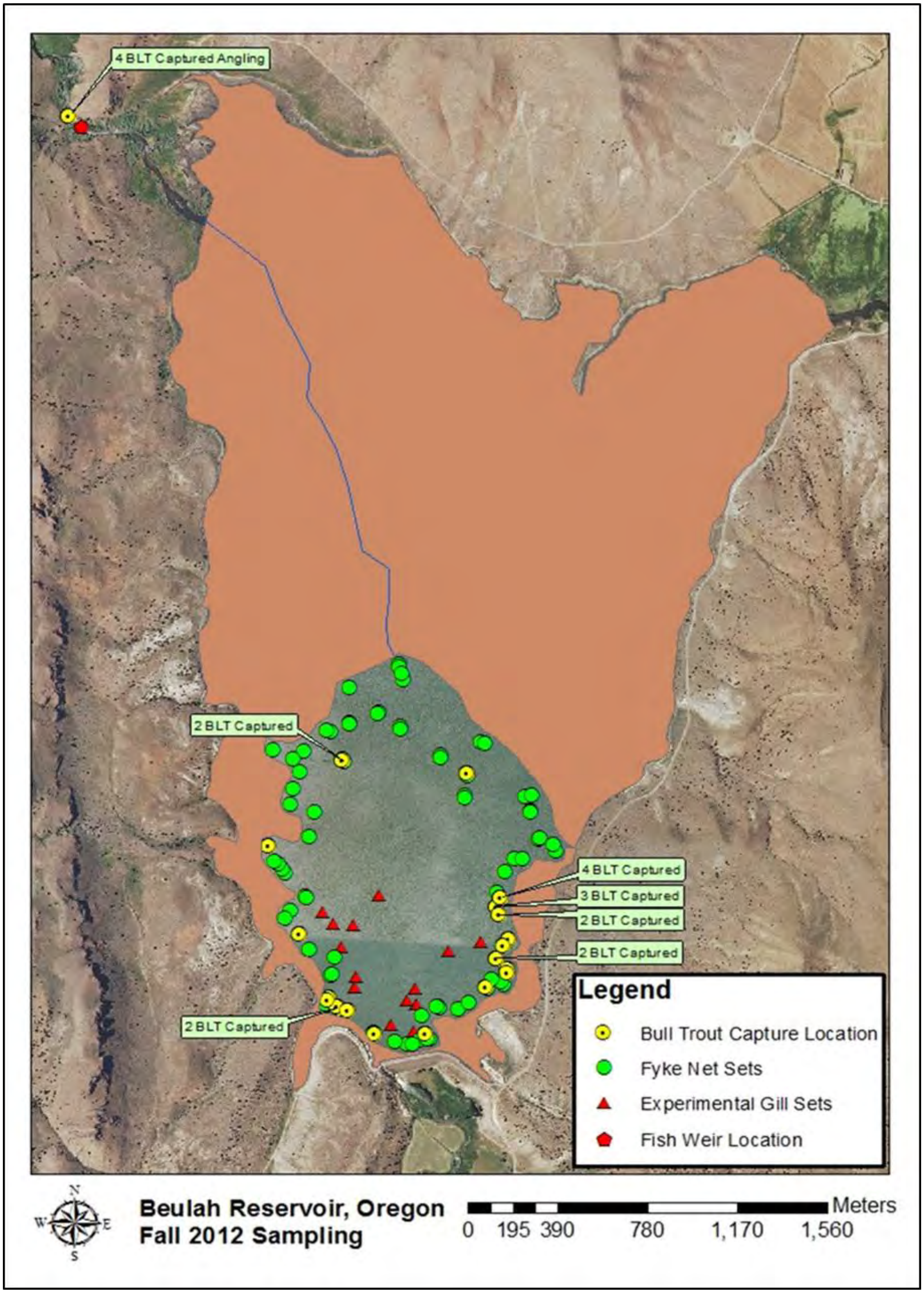

Figure 18. Locations and numbers of experimental gill net and fyke net sets locations during the fall 2012 sampling in Beulah Reservoir.

3.3.2.2 Picket Migration Weirs

A migration weir was installed on the North Fork Malheur River adjacent to the existing gaging station in the inlet to Beulah Reservoir. In 2012, high flows (746 cfs) in the North Fork Malheur River caused weir failure during the April-May sample period. Prior to the weir failure, three bull trout were collected (Figure 18). Total lengths of the bull trout averaged 379 mm and ranged between 367 and 384 mm. Weights averaged 530 grams and ranged between 471 and 568 grams.

The weir was successfully operated throughout the fall sampling period. Bull trout appeared to stack up behind the weir and would not enter the trap despite modifications from the 2011 sampling effort. After removal of the weir, three tagged bull trout were immediately detected by the PIT-tag array traveling downstream into the reservoir. The bull trout were tagged through the hook-and-line sampling described below.

3.3.2.3 Backpack Electroshocking

Backpack electrofishing took place using a backpack electroshocker (LR-24 Electrofisher, Smith Root Inc., Vancouver, Washington) to capture bull trout in the North Fork of the Malheur River and tributaries upstream of the reservoir from July 24 to July 25. Twelve bull trout were captured with a backpack electroshocker that averaged 271 mm in total length and ranged between 205 mm and 370 mm. Weights averaged 206 grams and ranged from 120 to 470 grams. One bull trout was captured in Swamp Creek; the other 11 were captured in the North Fork Malheur River.

3.3.2.4 Hook-and-Line Sampling

Hook-and-line surveys were conducted on October 5, 8, and 10, 2012 in the North Fork Malheur River immediately upstream of the weir in an attempt to capture bull trout that would not pass through the weir. Four bull trout were collected during this effort. The total lengths of the bull trout averaged 413 mm and ranged between 322 and 482 mm. Weights averaged 650 grams, ranging between 318 and 917 grams. Half-duplex tags (12 mm) allowed tagging of fish down to 100 mm; however, when tagging quotas (as defined in the sampling permit) were met, all other bull trout could only be floy tagged.

3.3.2.5 Gill Netting

In 2012, spring reservoir sampling was conducted between April 10 and May 11. Experimental mesh gill nets were generally fished on the bottom during daylight hours for 30 minutes or less (Figure 18). Two bull trout were captured using gill nets and one which expired. The bull trout averaged 283 mm in total length, ranging from 278 to 288 mm; weights averaged 251.6 grams, ranging between 216.8 to 286.4 grams.

Gill nets were not used during the fall reservoir sampling.

3.3.2.6 Malheur Productivity

Hydroacoustic surveys and limnological and aquatic macroinvertebrate samples were also collected during the spring and fall survey periods. The lab and data analysis of these was not completed in time for this report.

3.3.3 Temporary Water Lease

In 2011, Reclamation entered into a 4-year temporary water lease with the Vale Irrigation District to maintain reservoir pool elevation above 2,000 acre-feet until minimum pool recommendations are presented to the USFWS (April 2015 deadline). The pool elevation at Beulah Reservoir stayed above 2,000 acre-feet throughout the year. Minimum pool elevation (3,686 acre-feet) occurred on September 30, 2012 and carryover was 3,686 acre-feet.

3.3.4 Trap-and-haul Efforts

During 2012, trap-and-haul efforts were not conducted because the spillway was not used to release water from the reservoir (Term and Condition 4d). In 2010, Reclamation and the Burns Paiute Tribe signed a contract for the Tribe to conduct trap-and-haul efforts from 2011 through 2014 if the Agency Valley spillway is used to release water from the reservoir.

3.3.5 Redd Counts

Bull trout redd counts were not conducted in the North Fork Malheur River in 2012 because of budget restrictions for all partnering agencies. The Malheur Technical Team agreed at its annual meeting on January 16, 2013, to re-evaluate the redd count methodology and if possible continue the redd counts.

In 2011 (the last year the surveys were completed), a total of 53 bull trout redds were counted in the North Fork Malheur River basin; however, the survey area was reduced from previous surveys (Perkins 2009). Assuming 2.68 bull trout per redd (Al-Chokhachy et al. 2005), an estimated 142 adfluvial adult bull trout were present in 2011. Figure 18 depicts the number of redds observed in the North Fork Malheur River Basin and the carryover of reservoir storage in Beulah Reservoir. Carryover storage in Beulah Reservoir has been shown to affect the bull trout prey base (Rose and Mesa 2009); however, a direct link between carryover pool elevations and bull trout redd counts remains speculative.

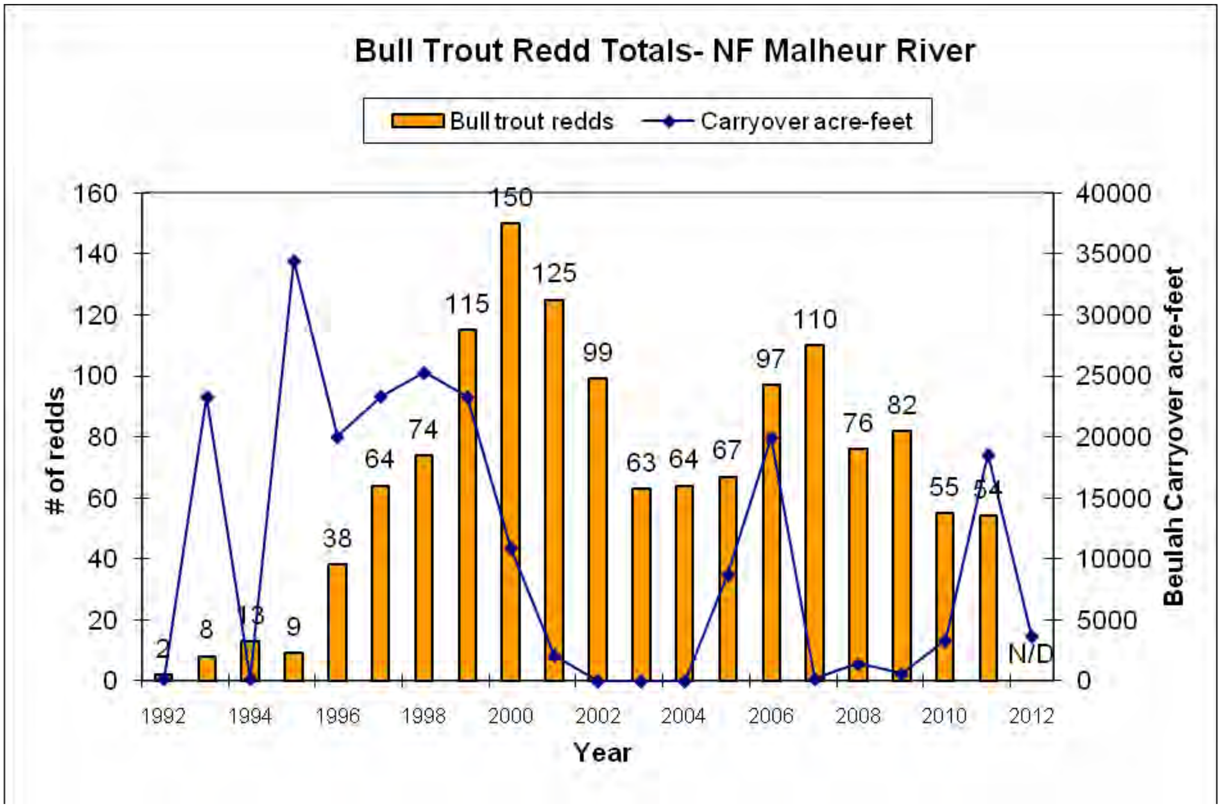

Figure 19. Bull trout redds observed in the North Fork Malheur River watershed (North Fork Malheur River) between 1992 and 2011 and carryover storage in Beulah Reservoir. The number of redds observed in 2008 and after is adjusted to reflect the area no longer surveyed. The adjusted value in each year is 1 redd. Surveys were not conducted in 2012, designated by "N/D".

4.0 SNAKE RIVER PHYSA

4.1 Introduction and Background

The 2005 Opinion found that operations associated with the proposed operations of Minidoka dams may adversely affect Snake River physa (*Physa [Haitia] natricin*a, hereafter physa) in the Minidoka reach of the Snake River; however, inadequate information existed to adequately predict impacts. One of Reclamations proposed actions was to conduct presence/absence surveys of physa to characterize the environmental variables and physical habitats where they are found. During surveys conducted from 2006 through 2008, over 274 live physa specimens were found between Minidoka Dam downstream to above Milner Pool (Figure 20; Gates and Kerans 2010). Live physa were found in low densities, primarily among pebble and gravel substrates in the main channel of the Snake River. Physa were also found in the spillway area of Minidoka Dam, though sample sizes were too small to characterize habitat use and spatial distribution there.

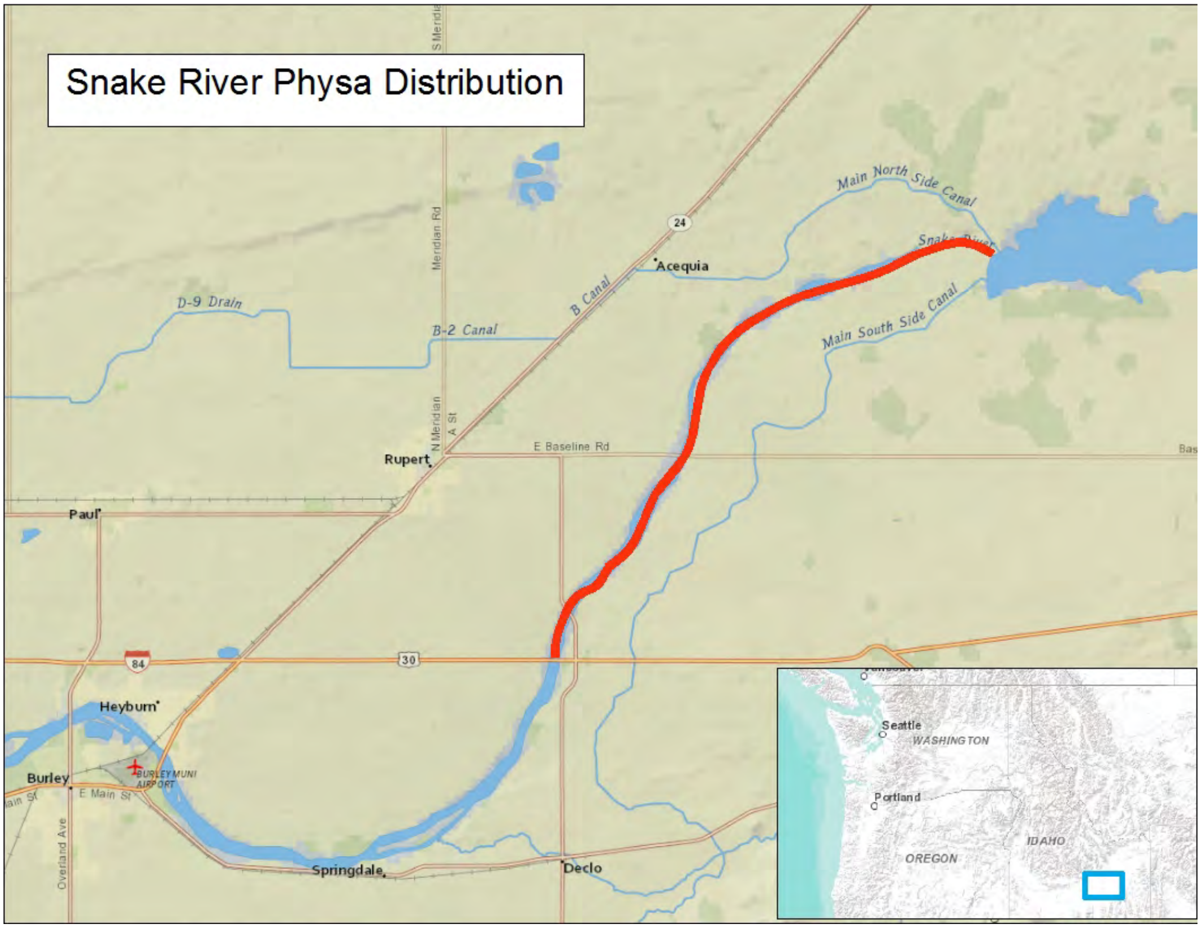

Figure 20. Distribution of Snake River physa (*Physa natricina*) in the upper Snake River.

Physa surveys were not conducted from 2009 through 2011; during this time, the data was being analyzed and a completion report prepared for physa distribution (Gates and Kerans 2010). The survey started again in 2012 in response to the Minidoka Spillway Replacement Project and the requirements of its Biological Opinion. Current and future Reclamation management of Minidoka Dam includes replacement of the spillway structure and diversion of more water through the Inman Power Plant. In consultation with USFWS and a multiagency technical team, Reclamation designed a multiyear proposal to reduce minimum spillway flow (Table 13) and monitor physa to determine what, if any, effects reduced flow has on physa occurrence and abundance in the spillway.

Table 13. Current and proposed changes in flow at the Minidoka Dam.

	Spillway Flow					Power Plant Flow				
	2012	**2013**	**2014**	**2015**	**2016**	**2012**	**2013**	**2014**	**2015**	**2016**
Nov. 01	100	100	100	100	100	400	400	400	400	400
Dec. 01	100	100	100	100	100	400	400	400	400	400
Jan. 01	100	100	100	100	100	400	400	400	400	400
Feb. 01	100	100	100	100	100	400	400	400	400	400
Mar. 01	100	100	100	100	100	400	400	400	400	400
Apr. 01	100	100	100	100	100	400	400	400	400	400
May 01	1,300	1,300	1,300	1,000	500	1,400	1,400	1,400	1,700	2,200
June 01	1,300	1,300	1,300	1,000	500	4,700	4,700	4,700	5,000	5,500
July 01	1,900	1,900	1,500	1,000	500	5,100	5,100	5,500	6,000	6,500
Aug. 01	1,000	1,000	1,000	1,000	500	400	400	400	400	900
Sep. 01	900	900	900	900	500	400	400	400	400	800
Sep. 15	100	100	100	100	100	1200	1200	1200	1,200	1,200
Oct. 01	100	100	100	100	100	400	400	400	400	400

The objectives of Minidoka reach physa surveys in 2012 was to gather baseline data that can be used to determine trends of occurrence and abundance across their known range, to determine the effects of reduced spillway flows on physa in the Minidoka Dam Spillway, to further characterize physa habitats, and to meet the reporting requirements of ESA Section 10, Permit #TE 056557-5.

4.2 Survey Area

The survey area is located in south-central Idaho and includes the Snake River from Minidoka Dam downstream to the upper end of Milner Pool (Figure 13, River Mile [RM] 675-663). The elevation ranges from 4134 feet to 4245 feet. Minidoka Dam is operated by Reclamation and managed primarily for water storage and hydroelectric generation. Powerplant and spillway discharges from Minidoka Dam bifurcate flow between the original wetted channel of the Snake River and a series of bedrock outcrops not originally wetted, respectively. Flows through Minidoka Dam consist of regulated discharge through the Reclamation and Inman powerplants, controlled and uncontrolled spillage, and approximately 100 to 300 cubic feet per second (cfs) seepage through and beneath the existing spillway. A replacement spillway is scheduled for completion in 2014 which will eliminate seepage flows. Flows from Minidoka Dam downstream to Milner Dam are almost entirely regulated by controlled releases and spillage at Minidoka Dam, as there are no major tributaries or irrigation returns in the Snake River along this reach.

4.3 Methods

4.3.1 Sample Locations

A before/after, control/impact (BACI) study design was implemented to examine changes in the occurrence and abundance of physa at the Minidoka Dam spillway before, during, and after planned reductions in spillway flow. Analyzing physa occurrence and abundance at the spillway in comparison to a downstream location where changes in flow are not expected to occur seeks to provide the ability to detect changes in physa occurrence and abundance due to spillway management, as opposed to changes in physa occurrence that may be simultaneously occurring throughout the study area. Two long-term survey sites were selected at locations where physa were collected during previous surveys (Gates and Kerans 2010).

The downstream site (Control) near the demolished Jackson Bridge (RM 669) is in the original Snake River channel and consists primarily of gravel substrate within a wide, shallow, braided channel. The bankfull width of the Snake River along the Jackson Bridge site is over 400 meters wide, with maximum depths of approximately 4 meters. As a result, approximately 30 percent of the river channel is dewatered during winter low flows. Winter low flow levels at the Jackson Bridge site consist of approximately 100 to 300 cfs seepage through the existing spillway and a minimum of 400 cfs through the powerplant which is released to avoid overheating damage to the generators. This regulated winter low flow is approximately 1.2 meters lower than that during the August bankfull width flow.

The upstream site (Impact) is located at the Minidoka Dam spillway pool (RM 674.5). The spillway pool, wetted as a result of spillway releases since Minidoka Dam was constructed in 1906, is characterized by braided flows over primarily bedrock and sand substrate. Live physa were discovered in a portion of the spillway area in 2005. It is unknown whether physa colonized the spillway from upstream or downstream, how long they have persisted in the spillway area, or whether they are ephemeral in this nonnative habitat.

Four randomly selected transects were derived by dividing the shoreline length of each site into 1-meter-wide cross-sections perpendicular to the channel. Each transect was divided into 1-square-meter segments, and 20 segments were randomly selected along each transect as potential sampling plots. The Jackson Bridge sampling plots were selected by sampling the first 10 plots occupied from south to north at depths equal to or greater than 1.2 meters deep, since previous surveys found virtually no physa in the seasonally-dewatered channel (Gates and Kerans 2010). Spillway sampling sites were selected by sampling the first 10 plots occupied along each transect that were at least 1 meter deep, from north to south.

4.3.2 Snail Collection

Each station was sampled using a venturi suction dredge operated by a SCUBA diver. A 0.25-square-meter plot was excavated to approximately 2.5 centimeters deep at stations where the primary substrate consisted of unconsolidated material such as mud, sand, and gravel. At stations having consolidated substrates such as cobble, boulder, and bedrock, timed samples were suction dredged for a timed duration of 60 seconds. Timed samples were collected for variable sized areas, and hence, suitable only for presence/absence analysis. Each sample was transported through flexible tubing and collected in a 1,000-micrometer sieve on board the boat or buoy station from which dive operations were being conducted. Samples were immediately transferred to plastic trays and examined by trained samplers from Reclamation and USFWS under the direction of John Keebaugh from the Orma J. Smith Museum of Natural History. Live physa were enumerated for each plot and returned in proximity to the location from which they were collected.

4.3.3 Habitat Measurements

Physical water quality measurements were made at each sampling plot. Water depth (meters), temperature (°C), pH, dissolved oxygen (milligrams per liter [mg/L]), and turbidity (NTU) were measured at each plot using a Hydrolab® Sonde DS5 meter and Surveyor® handheld monitor (Table 14). Current velocity (meters per second [m/s]) was measured approximately 10 centimeters above the substrate at each plot using a SonTek® Argonaut ADV current meter operated by USGS staff (Table 15). Acoustic Doppler Current Profiles (ADCP) were also collected by USGS staff at each transect using a TRDI® Rio Grande ADCP operating at 12 kHz. Dominant and subdominant substrate types were classified by particle size as modified from Overton et al. (1997) (Table 16). Estimates of dominant and secondary substrate composition were made by direct observation of each sampling plot by a SCUBA diver and from inspection of the sieved contents of each sampling plot by snail collection samplers on board the dive vessel.

Table 14. Physical parameters observed at Jackson Bridge plots with (+) and without (-) physa and spillway pool plots (Standard error in parenthesis).

Parameter	Jackson Bridge physa (+) n=20	Jackson Bridge Physa (-) n=20	Spillway Pool Physa (-) n=40
Flow (m/s)	0.36 (0.02)	0.29 (0.02)	0.12 (0.02)
Temp (°C)	21.84 (0.23)	21.98 (0.15)	20.62 (0.04)
DO (mg/L)	9.99 (0.20)	10.17 (0.11)	8.36 (0.05)
Depth (m)	1.91 (0.066)	1.71 (0.10)	1.86 (0.14)
pH	8.42 (0.02)	8.46 (0.01)	8.21 (0.01)
Turbidity (NTU)	21.28 (0.64)	22.31 (0.67)	21.97 (0.37)

Table 15. Range and mean of physical habitat parameters measured during the 2012 physa survey. The mean (x) is given in parenthesis.

Site	Depth (m)	Current Velocity (m/s)	pH	Temp (°C)	Dissolved Oxygen (mg/L)	Dissolved Oxygen (% Sat.)	Turbidity (NTU)
Jackson Bridge	1.2-2.7 (1.8)	0.13-0.52 (0.33)	8.2-8.6 (8.4)	20.0-23.3 (21.9)	7.9-11.2 (10.1)	95.6-144.7 (127.1)	17.9-27.4 (21.8)
Spillway Pool	1.0-4.0 (1.8)	0.01-0.39 (0.12)	8.1-8.3 (8.2)	20.2-21.0 (20.6)	8.0-9.0 (8.4)	98.0-111.3 (102.8)	18.7-25.5 (22.0)

Table 16. Substrate classifications used to characterize suction dredge plots surveyed in 2012.

Substrate Type	Size Class (mm)
Bedrock	Solid rock
Boulder	>256
Cobble	64-256
Gravel	16-64
Pebble	2-16
Sand	0.1-2
Silt	<0.1

4.4 Results

Forty plots were sampled at each the Jackson Bridge and spillway pool sites in 2012. At the Jackson Bridge site, 20 plots (50 percent) contained live physa, ranging in abundance from 1 to 7 per plot (Figure 21). No live physa were found among the 40 samples collected at the spillway pool site (Figure 22). Similar to previous studies, physa were broadly distributed in low densities in the permanently wetted channel of the Snake River at the Jackson Bridge site. The frequency of occurrence data for physa collected at the Jackson Bridge site in 2006, 2007, and 2012 resulted in no detectable difference between years (Table 17).

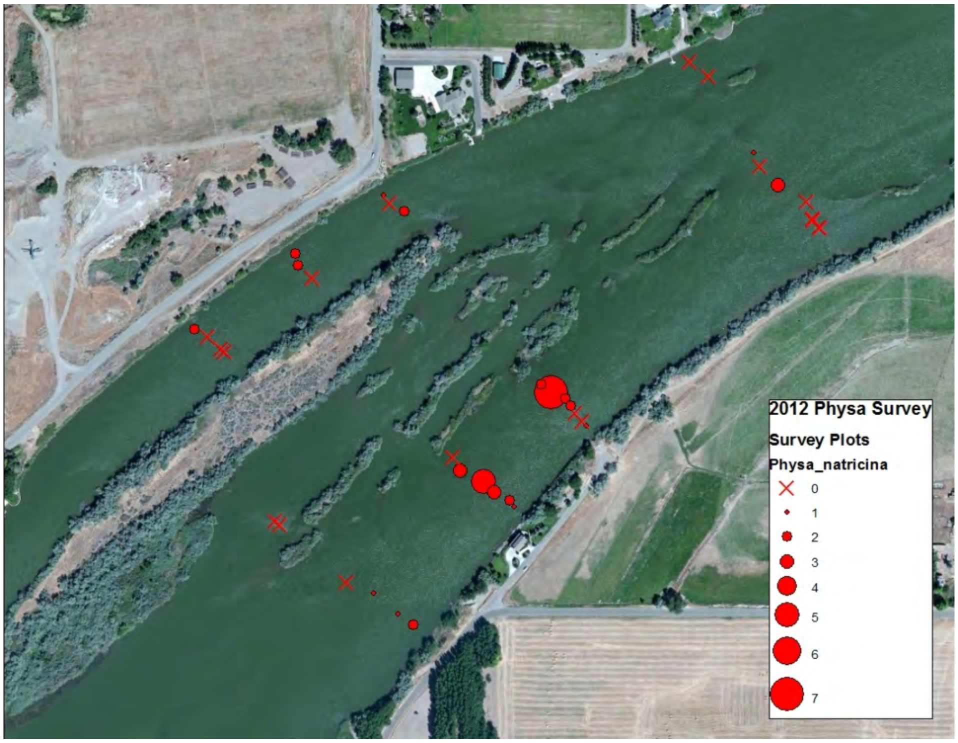

Figure 21. Distribution and abundance of physa at the Jackson Bridge monitoring site in 2012.

Figure 22. Distribution and abundance of physa at the spillway pool monitoring site in 2012.

Table 17. Physa occurrence at the Jackson Bridge site during 2006, 2007, and 2012.

Year	Sample Size (n)	Mean	Standard Deviation	Proportion of Samples Containing Physa
2006	32	2.500	3.835	0.500
2007	28	3.000	3.702	0.689
2012	40	1.125	1.539	0.500

A total of eight timed sample plots were conducted at the spillway site in 2006. Of these plots, physa occurrence was 50 percent and ranged in abundance from 1 to 15 per plot. In 2007, 17 timed sample plots conducted at the spillway pool resulted in one plot containing one live physa. The absence of physa collected at the spillway pool site in 2012 may preclude assessment of the direct effects of changes in spillway flow on this species in future years. Continued monitoring for physical and environmental parameters, however, will provide the basis for assessing the effects of reduced spillway flow on the suitability of the spillway pool waters for physa occurrence.

Post-hoc analyses of environmental and physical parameters between sites resulted in significant differences for factors that are likely to affect the survival and persistence of physa. Current velocity and dissolved oxygen were significantly lower at the spillway pool sample stations than at the Jackson Bridge stations (t-test, $\alpha=0.05$, both $P<0.001$ [Figure 23]). In addition, substrates composed primarily of cobble, gravel, and pebble substrates with lesser amounts of embedding fines (such as sand and silt) comprised the entirety of benthic habitats where physa occurred in 2012. Substrates composed predominantly of cobble, gravel, and pebble were found in 100 percent of the samples collected at the Jackson Bridge site, but only 8 percent of the samples collected at the spillway pool site (Figure 24 and Figure 25). Future efforts to sample the spillway may be stratified by depth and substrate type in order to ascertain presence/absence of physa there. Efforts to resample specific sites where physa occurred from 2006 through 2008 will also be considered.

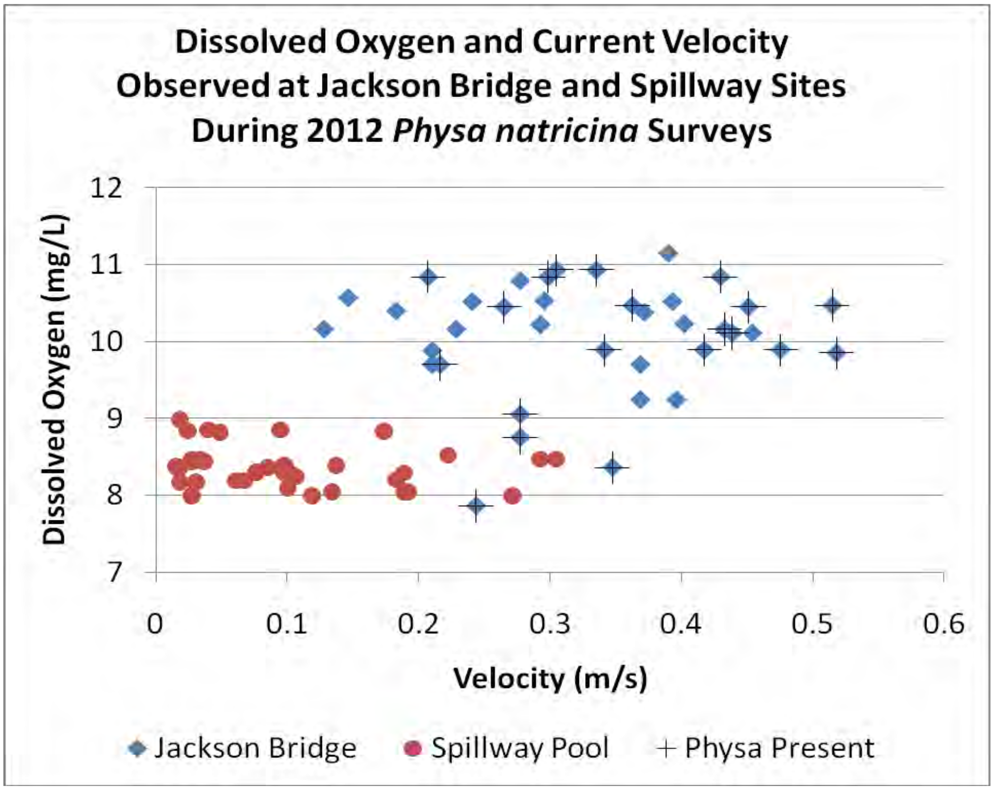

Figure 23. Dissolved oxygen (mg/L) and current velocity (m/s) measured at Jackson Bridge and spillway pool sampling sites during the 2012 physa sampling effort.

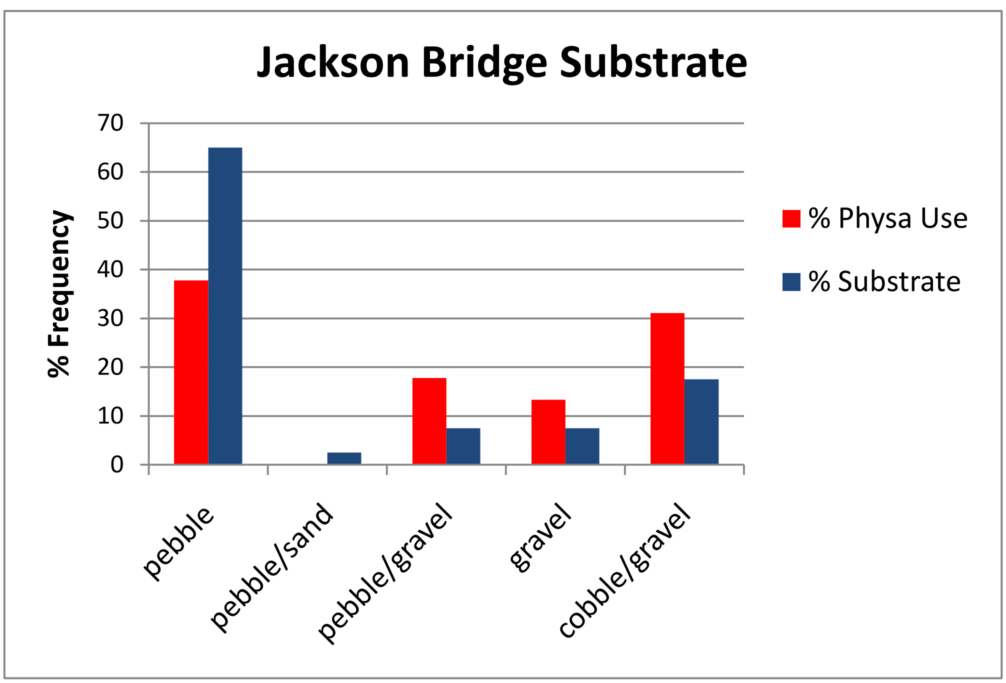

Figure 24. Substrate and physa observed at the Jackson Bridge site during 2012 survey.

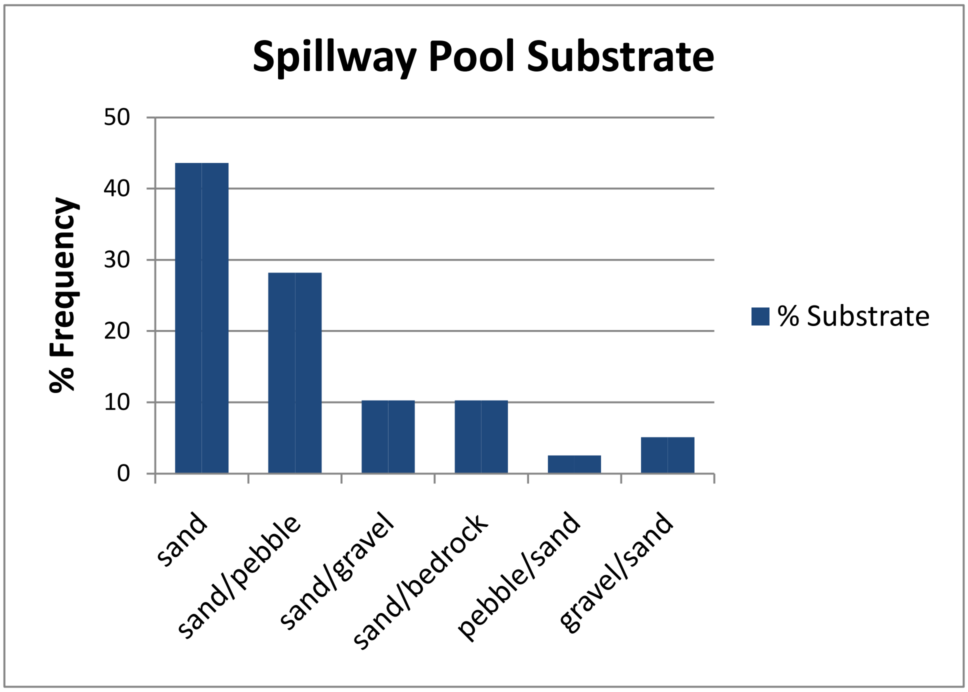

Figure 25. Substrate observed at the spillway pool site during 2012 survey.

5.0 OTHER ACTIVITIES

5.1 Water Quality

Reclamation participated in several water quality related activities in the upper Snake River basin during 2012. As part of Idaho and Oregon's ongoing Total Maximum Daily Load development and implementation activities, Reclamation staffs from the Snake River Area Office and Pacific Northwest Regional Office participated in all appropriate watershed advisory groups and watershed council meetings in the upper Snake River basin. These included activities in the North Fork Payette River, Lower Payette River, Middle Snake River, Lake Walcott, and American Falls Reservoir Watershed Advisory Groups, as well as the Malheur Watershed Council.

Reclamation also provided technical assistance to irrigation system operators and other appropriate entities throughout its project areas in the upper Snake River basin. Reclamation's Pacific Northwest Region Laboratory provided analytical laboratory services to several entities in the basin, including:

- Idaho Department of Environmental Quality
- Aberdeen Springfield Irrigation District
- Burley Irrigation District
- Lower Boise River Watershed Advisory Group
- A & B Irrigation District
- Minidoka Irrigation District
- Lake Walcott Watershed Advisory Group
- University of Idaho (Kimberly Field Office)
- Oregon Stream Restoration Monitoring
- Malheur Soil & Water Conservation District

In addition, Reclamation has developed and implemented a basin-wide temperature monitoring study for the upper Snake River basin. In 2012, Reclamation and USGS maintained a total of 52 stream temperature loggers throughout the basin. The intent of the ongoing study is to describe temperature regimes in the Snake River relative to Reclamation's management activities; this work will continue through 2013. The information from this study was reported in Reclamation's 2012 Annual Report to the NOAA Fisheries Service (Reclamation 2013).

Reclamation also performed routine water sampling across the region. Reclamation monitored nutrients in the drains that return water to Lake Lowell to identify the affects of added nutrients on the water quality in Lake Lowell. In 2012, Reclamation performed routine water quality sampling at Jackson Lake, Island Park, Little Wood, American Falls, Deadwood, Arrowrock, Anderson Ranch, Beulah, Ririe, Palisades, Owyhee, Black Canyon, Thief Valley, Bully Creek, Lake Lowell, Cascade and Walcott reservoirs. This sampling was performed as part of an ongoing regional reservoir sampling regime and invasive species monitoring (zebra/quagga mussels). Similar sampling is scheduled for the 2013 field season. The conditions at American Falls Reservoir did not trigger sediment and nutrient monitoring in 2012. When threshold conditions are met, monitoring is performed to track the effects of low pool elevations on water quality below the reservoir.

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