RECLAMATION

Managing Water in the West

2016 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

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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.

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Acronyms and Abbreviations

ADCP	acoustic Doppler current profile
BA	Biological Assessment
BACI	before/after, control/impact
cfs	cubic feet per second
Corps	U.S. Army Corps of Engineers
CPUE	catch per unit effort
DO	dissolved oxygen
ESA	Endangered Species Act
FERC	Federal Energy Regulatory Commission
IDFG	Idaho Department of Fish and Game
ITS	incidental take statement
O&M	Operations and Maintenance
ODFW	Oregon Department of Fish and Wildlife
Opinion	Biological Opinion
Reclamation	Bureau of Reclamation
RM	river mile
RPM	reasonable and prudent measure
SOP	Standing Operating Procedure
TMDL	total maximum daily load
USFS	U.S. Forest Service
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
WY	water year

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1. INTRODUCTION

The Bureau of Reclamation (Reclamation) consulted with the U.S. Fish and Wildlife Service (USFWS) pursuant to Section 7 of the Endangered Species Act (ESA) on 12 proposed actions involving the effects of future operations and routine maintenance at 12 Federal projects in the upper Snake River basin on six different listed species known to occur in the area at that time (Reclamation 2004). In March 2005, USFWS completed a non-jeopardy Biological Opinion (2005 Opinion) for Reclamation operations and maintenance (O&M) activities in the Snake River basin above Brownlee Reservoir (USFWS 2005). The 2005 Opinion contained a 30-year incidental take statement (ITS) for bull trout and corresponding reasonable and prudent measures (RPMs) that outlined nondiscretionary actions to minimize take of species listed under the ESA that may be impacted by Reclamation operations (USFWS 2005). The 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.

At the time of the 2005 Opinion, bull trout (*Salvelinus confluentus*) were not known to exist in Phillips Reservoir[1] in the Powder River and therefore were not included in the 2005 Opinion or associated documents. In 2011, two bull trout were documented in Phillips Reservoir, necessitating Reclamation to consult with USFWS for bull trout in this area (Reclamation 2013b). The USFWS completed a non-jeopardy Biological Opinion in June 2014 (2014 Opinion) for Reclamation O&M activities in the Powder River (USFWS 2014) as a companion document to the 2005 Opinion. The 2014 Opinion contains a 21-year ITS corresponding to the 2005 ITS and RPMs that outline nondiscretionary actions to minimize take of bull trout in Phillips Reservoir.

The 2014 Opinion also included consultation on bull trout critical habitat for the same area analyzed in the 2005 Opinion. The USFWS concluded that Reclamation's O&M of the upper Snake River projects is not likely to destroy or adversely modify designated critical habitat for bull trout.

In addition to bull trout, the 2005 Opinion also included consultation on the Snake River physa (*Physa* [*Haitia*] *natricina*, hereafter physa). Monitoring for physa was reinitiated in 2012, in response to the Minidoka Dam spillway replacement project. Construction was completed during the summer of 2015. Reclamation consulted on project operations following construction of the spillway. The consultation addressed Reclamation's impact to physa located in the Snake River above Brownlee Reservoir, including the Minidoka Dam spillway. Reclamation received a Biological Opinion (2015 Opinion) on May 8,

[1] Phillips Reservoir was referred to as Phillips Lake in the 2004 Assessment.

2015, finding that Reclamation's proposed operations are likely to adversely affect physa in the Minidoka Dam spillway. An ITS, Terms and Conditions, and RPMs were provided. The consultation was aligned with ongoing actions associated with the long-term O&M of the current 2005 Opinion (USFWS 2005) and is considered a supplement to the 2005 Opinion.

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 USFWS by December 31 of each year that documents incidental take monitoring efforts and implementation status of all RPMs and Terms and Conditions. At Reclamation's request (letter dated November 13, 2007), USFWS agreed to permanently change the submittal date from December 31 to March 31 of the following year.

This document is submitted as Reclamation's annual report for Water Year (WY) 2016 (October 1, 2015, to September 30, 2016).

1.1 Bull Trout

Bull trout are present in five of Reclamation's facilities in the upper Snake River basin. This report covers the four facilities assessed in Reclamation's 2004 Biological Assessment (BA) and 2005 Opinion (Anderson Ranch Dam and Reservoir; Arrowrock Dam and Reservoir; Deadwood Dam and Reservoir, and Agency Valley Dam and Beulah Reservoir), as well as Mason Dam and Phillips Reservoir, which was assessed in the 2013 BA and 2014 Opinion (Figure 1).

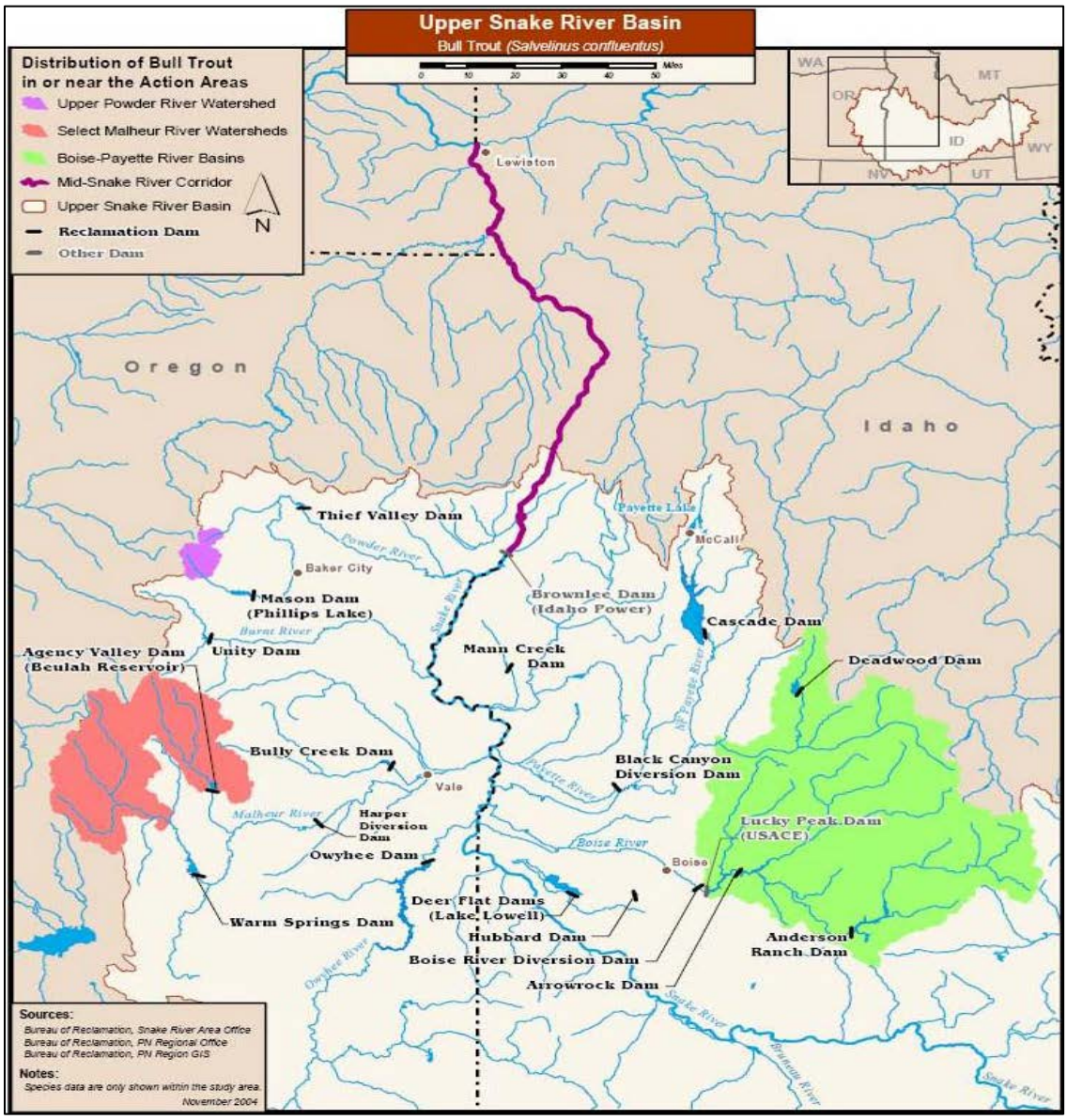

Figure 1. Known distribution of bull trout populations (shaded areas on map) associated with Reclamation facilities in the upper Snake River basin (Reclamation 2004).

1.1.1 Bull Trout Monitoring

This report describes operational thresholds, population monitoring, and other relevant bull trout work managed by Reclamation and work associated with projects that address specific RPMs. In addition, this report discusses other relevant bull trout work that is not managed by Reclamation but is directly relevant to bull trout or bull trout critical habitat within Reclamation's projects.

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 WY16 were monitored, evaluated, and summarized using Reclamation's Hydromet system (Reclamation 2016a).[2] Operational thresholds affecting the amount or extent of anticipated take are described in Section 3.

1.2 Snake River Snails

Previous annual reports to the USFWS documented two species of snails in the Snake River basin: Utah valvata (*Valvata utahensis*) and Snake River physa. USFWS determined that Utah valvata did not meet the definition of an endangered or threatened species under the ESA. The Utah valvata was removed from the ESA list, thereby removing all protections, and subsequent monitoring and reporting requirements, provided by the ESA (75 FR 52272). Accordingly, 2010 was the last year Reclamation monitored the Utah valvata.

The physa remains an ESA-listed species; however, the 2005 Opinion did not provide an ITS, monitoring requirements, or Terms and Conditions for physa due to the uncertainty of their presence in the action area. Subsequent to the 2005 Opinion, physa were confirmed in the action area. A supplemental consultation with USFWS to address possible effects to physa from long-term operation of the newly constructed spillway at Minidoka Dam was completed in 2015. (This supplemental consultation was initiated during construction of the spillway; construction began in 2011 and was completed in the spring of 2015.) The current take coverage for operations is covered under the *Biological Opinion for the Bureau of Reclamation, Operations and Maintenance above Brownlee Reservoir* (2015 Opinion) issued by the USFWS in May 2015 (USFWS 2015). Information reported in this document is related to the most recent requirements set forth in this 2015 Opinion.

Similar to efforts reported in Reclamation's 2013, 2014, and 2015 Annual Reports, the 2016 physa surveys were conducted to gather baseline data that will be used to determine trends of occurrence and abundance within the Minidoka reach (i.e., 10.5-mile reach extending from Minidoka Dam downstream to the I-84 bridge) of the Snake River; determine the effects of a range of spillway flows on physa in the Minidoka Dam spillway; further characterize physa habitats, and meet the reporting requirements of ESA Section 10 (Permit No. TE 056557-5).

1.3 Yellow-billed Cuckoo

Reclamation entered into informal ESA Section 7 consultation with USFWS in the fall of 2016 for the western Distinct Population Segment of the yellow-billed cuckoo (*Coccyzus americanus occidentalis*), following the USFWS determination to list this species as threatened in November 2014 (79 FR 67154). A BA comprehensively evaluating effects to the yellow-billed cuckoo from Reclamation's operations in the Snake River basin above

[2] See Reclamation's Hydromet website at: http://www.usbr.gov/pn/hydromet/select.html

Brownlee Reservoir has been completed and is expected to be finalized with USFWS by early 2017. At the time of the writing of this report, it is expected that a Letter of Concurrence to findings that Reclamation operations are not likely to adversely affect the species, which fulfills Section 7 coverage for this species under the ESA, will be issued to Reclamation by USFWS in the summer of 2017.

2. SUMMARY OF 2016 OPERATIONS

Early in WY2016, the water supply conditions were below average in most of the Snake River basin above Brownlee Reservoir, with below-average carryover following the drought year of 2015. In the Payette, Boise, and Upper Snake basins, November carryover storage from 2015 was 79, 91, and 78 percent of average, respectively.

Above- to near-normal precipitation fell throughout the early winter across the basin, resulting in an above- or near-average snowpack on January 1, 2016. Snowpack on January 1 in the Payette, Boise, and Upper Snake River basins was 134, 143, and 97 percent of average, respectively. By April 1, snowpack in these three basins was at near-average conditions, with 106, 105, and 102 percent of average, respectively.

Near-average precipitation in the basins south and west of the Boise River basin helped to counter the dry pattern of the last few years, which caused historic drought conditions. However, below-average carryover conditions again resulted in below-average reservoir fill, with the reservoirs in the Malheur River basin essentially empty by the end of September.

Observed unregulated runoff for the April-through-July period was below average, with 93 percent of average for the Payette River at Horseshoe Bend, 93 percent for the Boise River near Boise, and 81 percent for the Snake River at Heise. Flood-control releases were required in the Boise River basin in 2016, starting at the end of March and running through the end of May. In the upper Snake River, no excess flows passed Milner once irrigation began in early March until flow augmentation began in late May.

The upper Snake River above Milner reservoir system reached a maximum combined physical storage content of 3,601,119 acre-feet, approximately 585,000 acre-feet below full capacity of 4,185,695 acre-feet. The Boise River system nearly filled, reaching a maximum storage content of 930,232 acre-feet, and would have filled if early flow-augmentation releases hadn't taken place. The Boise River system maximum storage content peaked at approximately 19,500 acre-feet below its full capacity of 949,700 acre-feet. The Payette reservoir system would have filled if early flow-augmentation releases hadn't taken place, but it still reached a maximum combined storage content of 784,408 acre-feet, 24,000 acre-feet short of the full storage of 808,500 acre-feet.

2.1 Idaho

2.1.1 Boise River Basin Operational Indicators

Specific operations or conditions at Anderson Ranch and Arrowrock Dams and Reservoirs that are expected to result in the take of bull trout in the form of death, harm, sub-lethal harassment, injury, or displacement were listed in the USFWS 2005 Opinion. These operations or conditions are summarized as operational indicators for each dam in Table 1 and Table 2.

Two operational indicators were exceeded during the 2016 reporting period in the Boise River basin:

- Anderson Ranch Reservoir stored and released water (Table 1; Figure 2 and Figure 3); however, the 2005 Opinion granted Reclamation an exemption for this action for 30 out of 30 years for which the Opinion is valid. Anderson Ranch Dam did not release water over the spillway in 2016.
- Arrowrock Reservoir volume dropped below 200,000 acre-feet before the end of June (Table 2 and Figure 6). The 2005 Opinion granted Reclamation exemption for this action for 3 out of 30 years for which the Opinion is valid; this exceedance has now been reported in 4 years.[3] There were no complicating flood control factors in the Boise River Basin in 2016 that would mitigate this exceedance.

Discharge from Arrowrock Dam exceeded 695 cubic feet per second (cfs) during the 2016 reporting period (Table 2 and Figure 5); however, the reservoir elevation did not drop below 3111 during the critical season (July through September) or during the period when discharge exceeded 695 cfs. Therefore, this operational indicator was not exceeded.

[3] This operational indicator was formulated based on general assumptions about the relationship between reservoir volume and reservoir productivity. Completion of the Arrowrock Water Quality Model, discussed in more detail in Section 3.1.1 of this document, will allow Reclamation and USFWS to resolve uncertainties specific to Arrowrock Reservoir surrounding the relationship between reservoir volume and productivity. The agencies will continue to work together to determine the most appropriate operational indicators to monitor productivity in Arrowrock Reservoir.

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 2016 reporting period

Anticipated Take	Operational Indicators	Critical Season	Frequency of Exemptions	2016 Operations (October 2015 to September 2016)	Quick Reference: Number of times threshold has been exceeded
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	**2 of 6 years** 2006: 9 days 2014: 3 days
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 WY16 are shown in Figure 2.	**10 of 30 years** Exceeds annually
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**

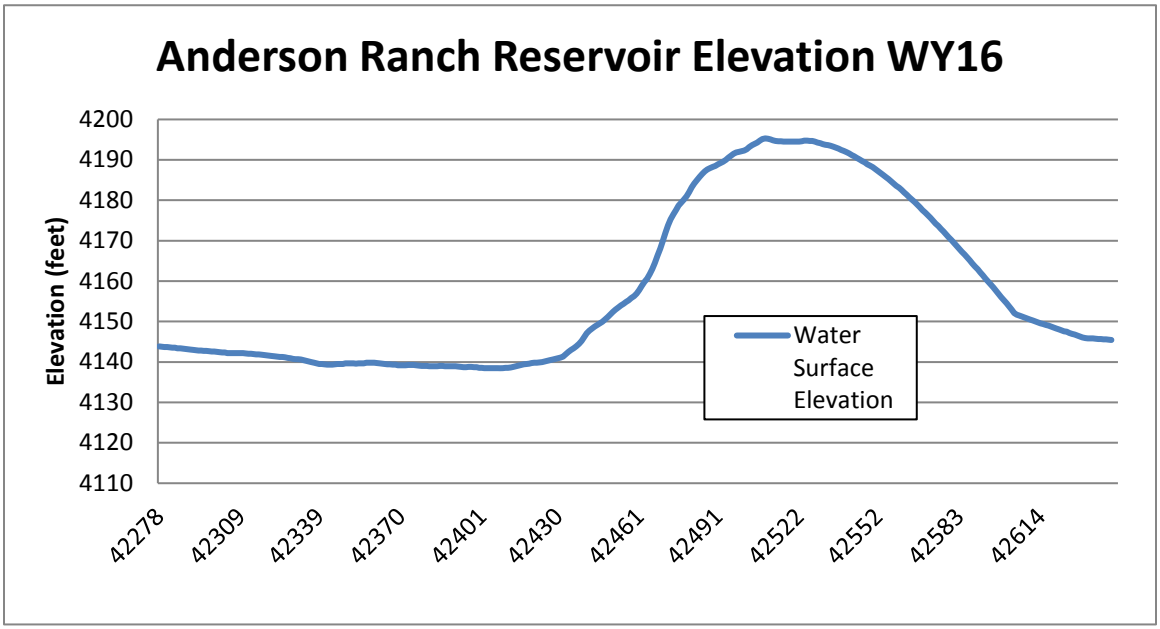

Figure 2. Anderson Ranch Reservoir elevation (feet above sea level) for WY16

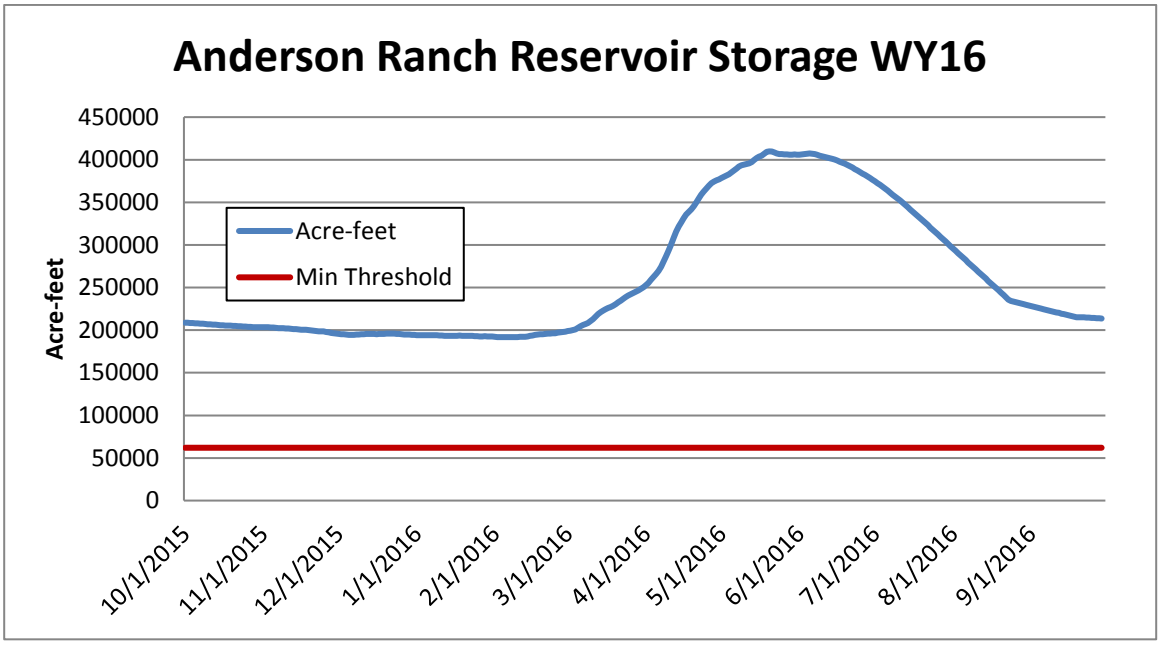

Figure 3. Anderson Ranch Reservoir storage volume (acre-feet) for WY16. The straight line represents Reclamation's Operational Indicator minimum threshold of 62,000 acre-feet of storage.

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 2016 reporting period.

Anticipated Take	Operational Indicators	Critical Season	Frequency of Exemptions	2016 Operations (October 2015 to September 2016)	Quick Reference: Number of times threshold has been exceeded
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	30 Jun	3 of 30 years	Reservoir volume dropped below 200,000 acre-feet on June 23, 2016.	**4 of 3 years** 2007: yes (6/15) 2013: yes (4/24) 2015: yes (6/25) 2016: yes (6/23)
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
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	Discharge exceeded 695 cfs regularly from Feb 16-Sep 19, 2016 (Figure 5). However, reservoir surface elevation did not drop below 3,111 feet during WY16 (Figure 4).	**10 of 30 years** Exceeds annually
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 reporting period in WY 2016 (Figure 4).	**0 of 18 years**
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 3,111 feet in the winter months of 2016 (Figure 4)	**0 of 20 years**

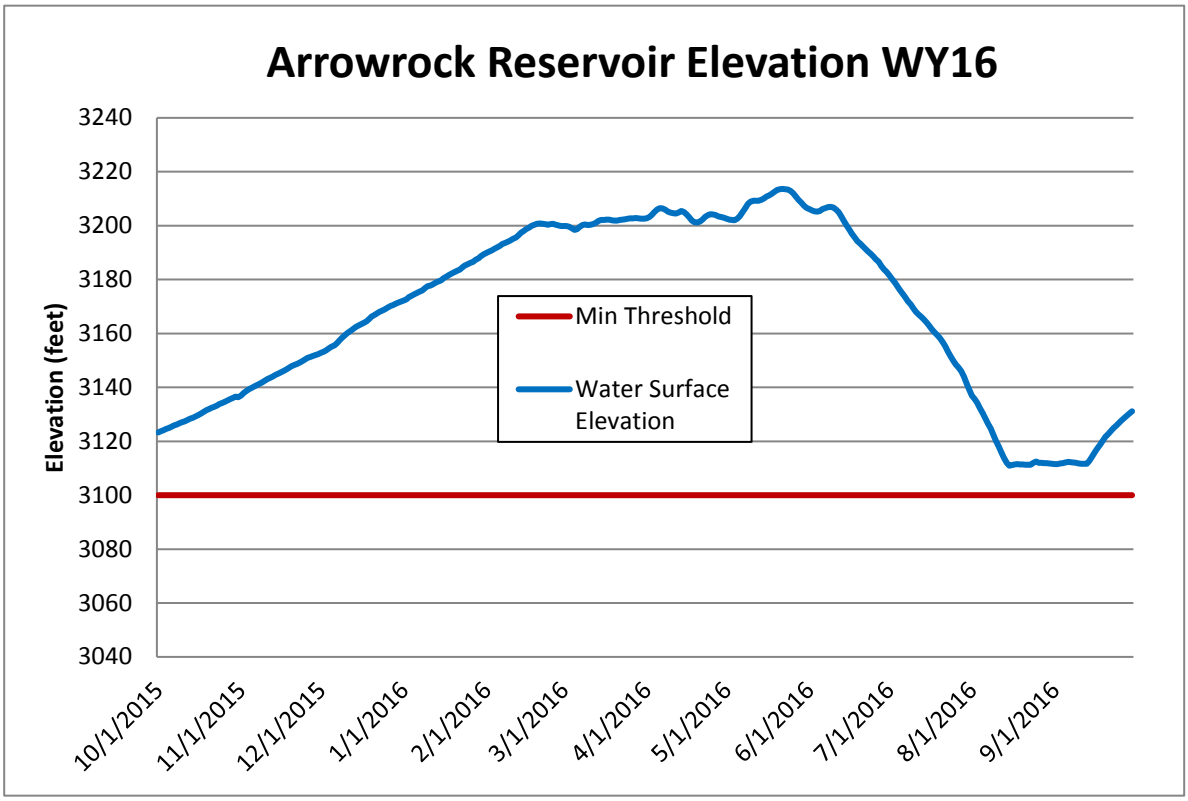

Figure 4. Arrowrock Reservoir surface elevation (feet above sea level) for WY16. The straight red line represents Reclamation's Operational Indicator fall minimum threshold at elevation 3100 feet.

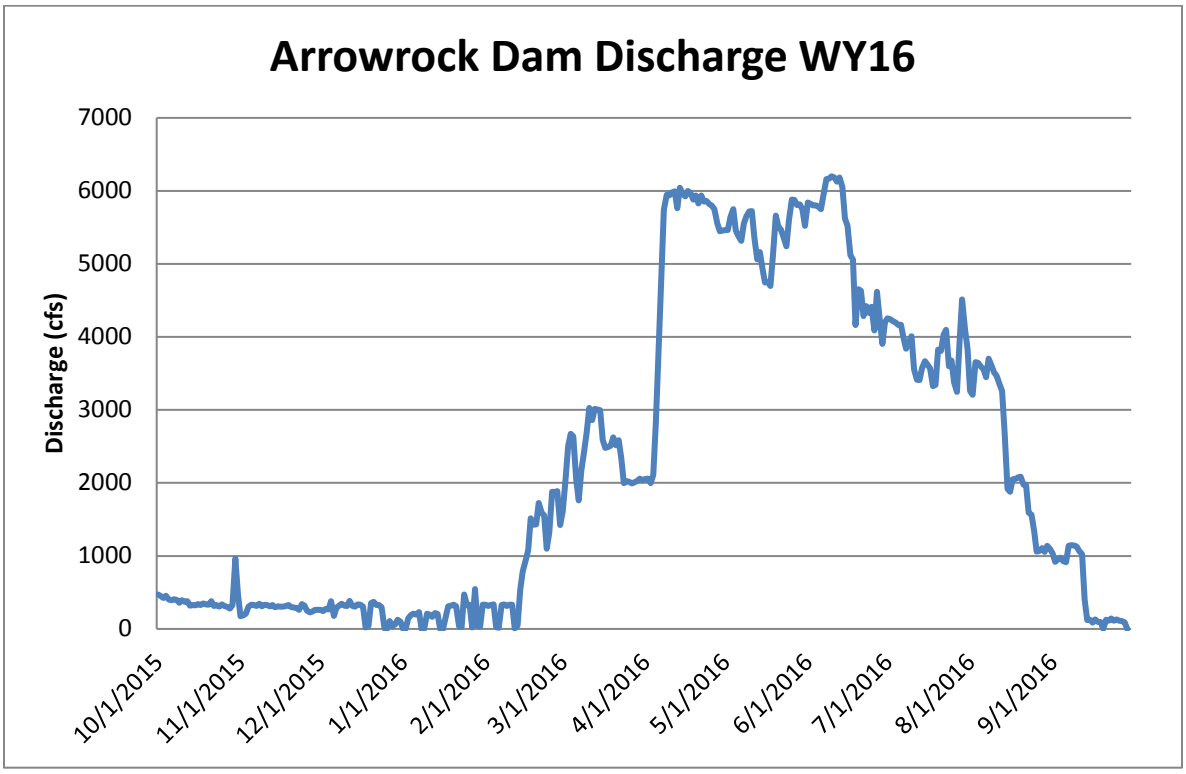

Figure 5. Arrowrock Dam discharge in cfs for WY16

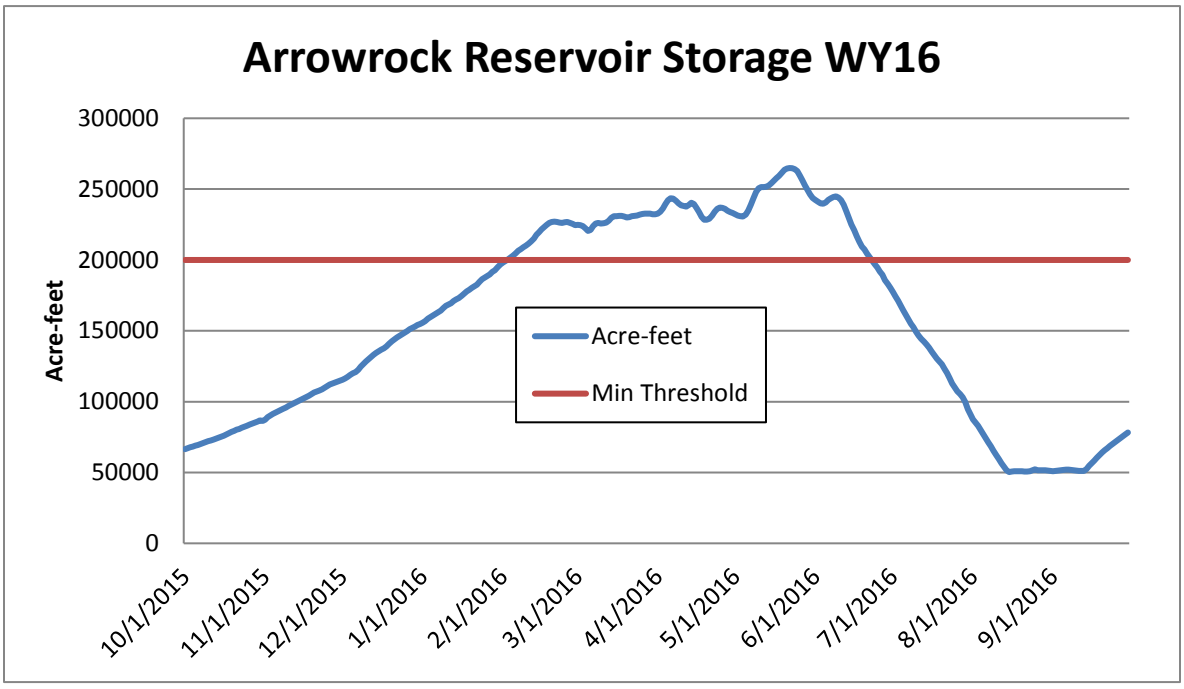

Figure 6. Arrowrock Reservoir storage volume (acre-feet) for WY16. The straight red line represents Reclamation's Operational Indicator of reservoir volume of 200,000 acre-feet; reservoir volume should exceed this minimum at the end of June. On June 30 2016, Arrowrock Reservoir storage volume was 180,279 acre-feet.

2.1.2 Payette River Basin Operational Indicators

Specific operations or conditions at Deadwood Dam and Reservoir that are expected to result in the take of bull trout in the form of death, harm, sub-lethal harassment, injury, or displacement were listed in the USFWS 2005 Opinion. These operations or conditions are summarized as operational indicators for Deadwood Dam and Reservoir in Table 3. Figure 7 illustrates Deadwood Reservoir storage volume in WY16.

One operational indicator was exceeded during the 2016 reporting period in the Payette River basin:

- Deep water releases occurred throughout the year at Deadwood Dam (Table 3); however, the 2005 Opinion granted Reclamation an exemption for this action for 30 of the 30 years for which the Opinion is valid.

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 2016 reporting period.

Anticipated Take	Operational Indicators	Critical Season	Frequency of Exemptions	2016 Operations (October 2015 to September 2016)	Quick Reference: Number of times threshold has been exceeded
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 spillway	Spring	11 of 30 years	Water was not discharged over the spillway in WY16.	**6 of 11 years** 2006: 32 days 2007: 33 days 2008: 33 day 2010: 15 days 2014: 69 days 2015: 50 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 did not drop below 50,000 acre-feet during the reporting period in WY16 (Figure 7).	**0 of 2 years**

Anticipated Take	Operational Indicators	Critical Season	Frequency of Exemptions	2016 Operations (October 2015 to September 2016)	Quick Reference: Number of times threshold has been exceeded
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 not discharged over the spillway during WY16	**6 of 11 years** 2006: 32 days 2007: 33 days 2008: 33 day 2010: 15 days 2014: 69 days 2015: 50 days
All bull trout in the Deadwood River downstream from the dam are affected by low winter streamflows 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	**11 of 30 years** Exceeds annually

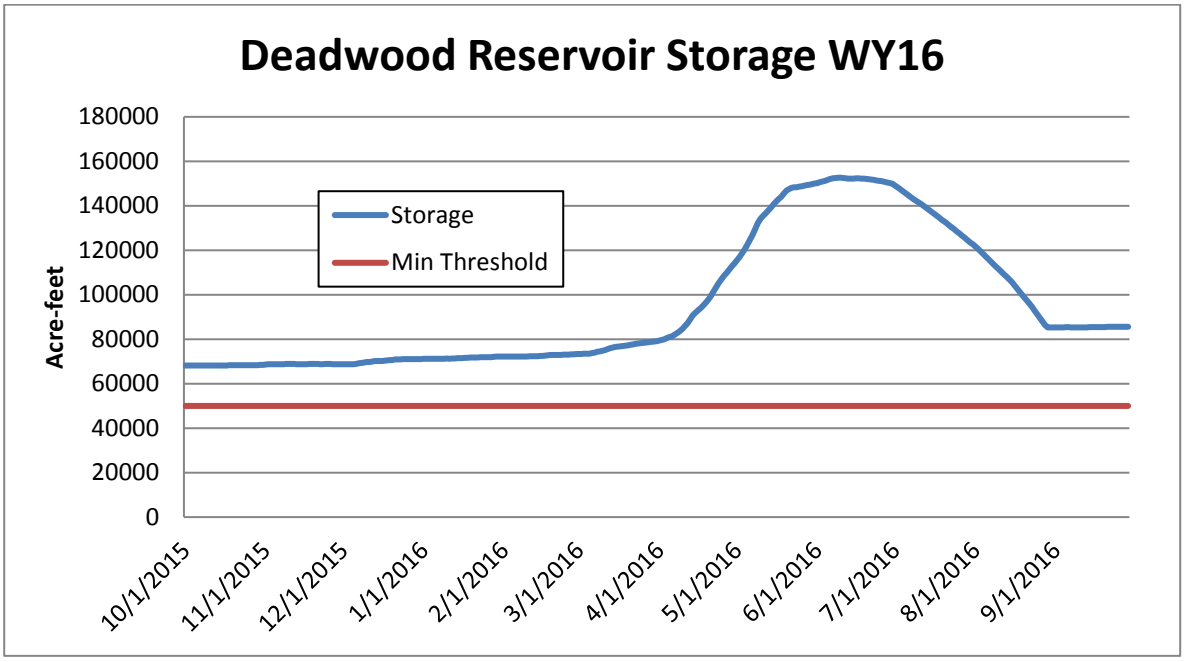

Figure 7. Deadwood Reservoir storage volume (acre-feet) for WY16. The straight red line represents Reclamation's Operational Indicator minimum threshold of 50,000 acre-feet of storage.

2.2 Oregon

Following dry trends in previous years, carryover storage in Beulah Reservoir for WY16 was very low, at 1,977 acre-feet on October 1, 2015 (below the 2,000 acre-foot conservation pool threshold). However, due to precipitation increases in the Malheur River basin in WY16, Beulah Reservoir subsequently filled to a peak of 57,300 acre-feet, or about 97 percent of its capacity (59,212 acre-feet) in early April 2016. Following spring fill, the reservoir was drafted to 2,368 acre-feet (4 percent of reservoir capacity) by the end of September 2016, and did not fall below the 2,000 acre-foot conservation pool threshold for the remainder of WY16.

Flow information for WY16 (October 1, 2015 to September 30, 2016) can be found at Reclamation's Hydromet website. 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.

2.2.1 Malheur River Basin Operational Indicators

Specific operations or conditions at Agency Valley Dam and Beulah Reservoir that are expected to result in the take of bull trout in the form of death, harm, sub-lethal harassment, injury, or displacement were listed by the USFWS 2005 Opinion. These operations or conditions are summarized as operational indicators in Table 4.

One operational indicator was exceeded during the 2016 reporting period in the Malheur River basin:

- Beulah Reservoir storage volume was below 2,000 acre-feet for the first 15 days during WY16 (indicative of extremely low carryover from WY15); however, the 2005 Opinion granted Reclamation an exemption for this action, for 10 out of the 30 years for which the Opinion is valid. Figure 8 illustrates the water storage volume in Beulah Reservoir during WY16.

Table 4. Summary of amount or extent of anticipated take of bull trout associated with Reclamation's Agency Valley Dam and Beulah Reservoir facility operations during the 2016 reporting period.

Anticipated Take	Operational Indicators	Critical Season	Frequency of Exemptions	2016 Operations (October 2015 to September 2016)	Quick Reference: Number of times threshold has been exceeded
Up to 10 percent of bull trout in Beulah Reservoir are entrained into the North Fork Malheur River below the dam	Water is discharged over the spillway	May through June	3 of 30 years	Spillway was not used in WY16	**2 of 3 years** 2006: yes 2011: yes
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 fell below 2,000 acre-feet for 15 days in this reporting period (Figure 8).	**8 of 10 years** 2007: 60 days 2008: 34 days 2009: 53 day 2010: 28 days 2013: 45 days 2014: 56 days 2015: 35 days 2016: 15 days

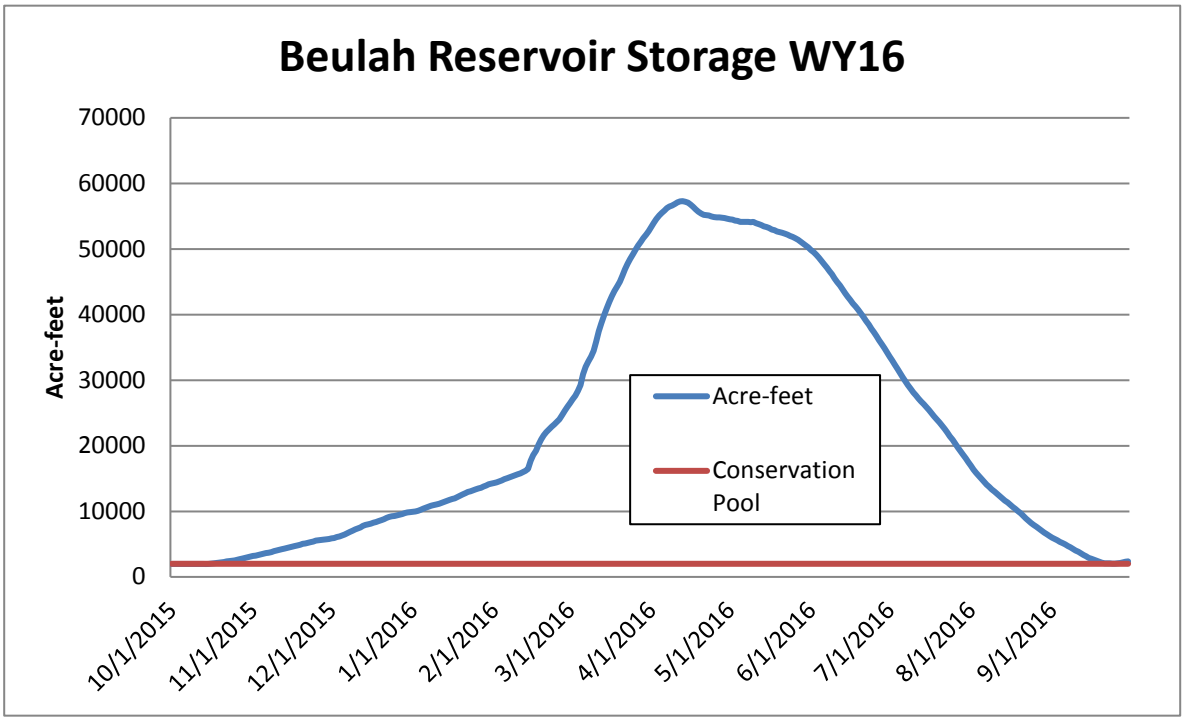

Figure 8. Beulah Reservoir storage volume (acre-feet) for WY16. The straight red line represents Reclamation's Operational Indicator minimum threshold of 2,000 acre-feet of storage.

2.2.2 Powder River Basin Water Year Summary

Bull trout were discovered in Phillips Reservoir in 2011, requiring Reclamation to consult with USFWS for bull trout and bull trout critical habitat in this area (Reclamation 2013b). The USFWS completed a non-jeopardy Biological Opinion in June 2014 for Reclamation O&M activities in the Powder River (USFWS 2014) as a companion document to the 2005 Opinion. The 2014 Opinion contains a 21-year ITS and corresponding RPMs that outline nondiscretionary actions for bull trout in Phillips Reservoir. Specific operations or conditions at Mason Dam and Phillips Reservoir that are expected to result in the take of bull trout in the form of death, harm, sub-lethal harassment, injury, or displacement were identified in Reclamation's Bull Trout Monitoring and Reporting Plan for Phillips Reservoir (Reclamation 2016), which was finalized with USFWS in WY16. Anticipated take and operational indicators as identified in this monitoring plan are shown in Table 5. A summary of operations for WY16 are included in this report. Figure 9 and Figure 10 illustrate the water storage volume in acre-feet and reservoir elevation, respectively, in Phillips Reservoir during WY16.

One operational indicator was exceeded during the 2016 reporting period in the Powder River basin:

- Mean daily reservoir storage elevation was below 4,048 feet for 365 days in the 2016 reporting period (Figure 10); however, the 2016 Monitoring and Reporting Plan granted Reclamation an exemption for this action, for 21 out of the 21 years for which the Opinion is valid.

Table 5. Summary of amount or extent of anticipated take of bull trout associated with Mason Dam and Phillips Reservoir facility operations during the 2016 reporting period, as included in the monitoring and reporting plan finalized in 2016.

Anticipated Take	Operational Indicators	Critical Season	Frequency of Exemptions	2016 Operations (October 2015 to September 2016)	Quick Reference: Number of times threshold has been exceeded
Up to 12 bull trout from resident headwater populations may be displaced during high flow events and be present in the reservoir	Powder River natural flows exceeding 856 cfs (from 2014 Opinion)	Spring through summer	27 percent (6 of 21 years)	Powder River flows did not exceed this threshold in the 2016 reporting period (Figure 11).	**0 of 6 years**
Up to 12 bull trout from resident headwater populations may be displaced during high flow events and be present in the reservoir	Mean daily reservoir elevation falls below 4,048 feet above sea level (from 2016 Monitoring and Reporting Plan)	Spring through summer	100 percent (21 of 21 years)	Reservoir storage volume was below 4,048 feet for 365 days in the 2016 reporting period (Figures 9 and 10).	**2 of 21 years** Exceeds annually

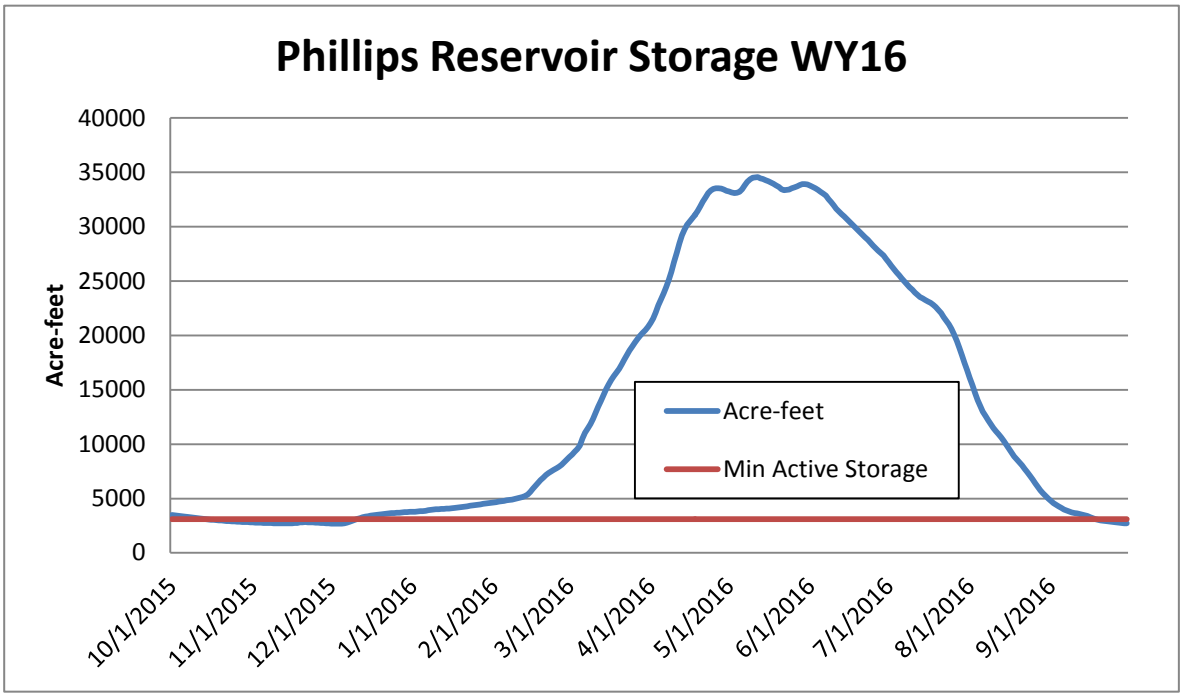

Figure 9. Phillips Reservoir storage volumes (acre-feet) for WY16. Minimum active storage occurs when pool elevation reaches 4,009 feet above sea level (3,100 acre-feet of storage), corresponding to the point of inactive storage.

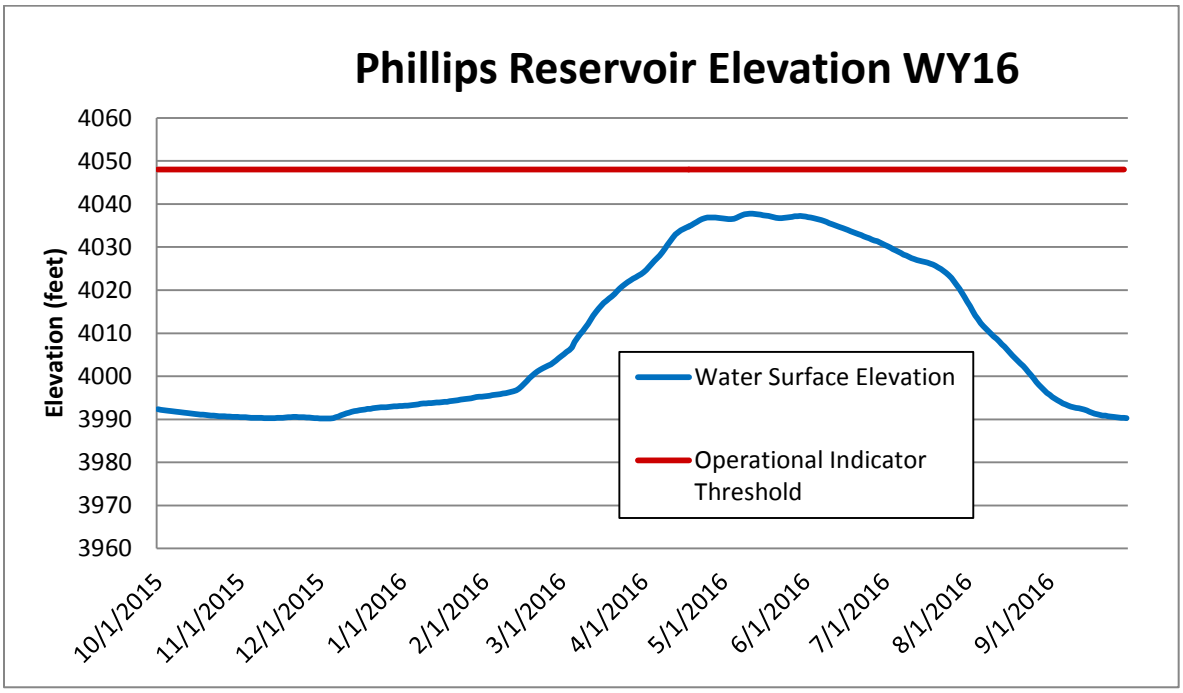

Figure 10. Phillips Reservoir surface elevation (feet above sea level) for WY16. The operational indicator spring/summer minimum for mean daily reservoir elevation of 4048 is indicated by the red line.

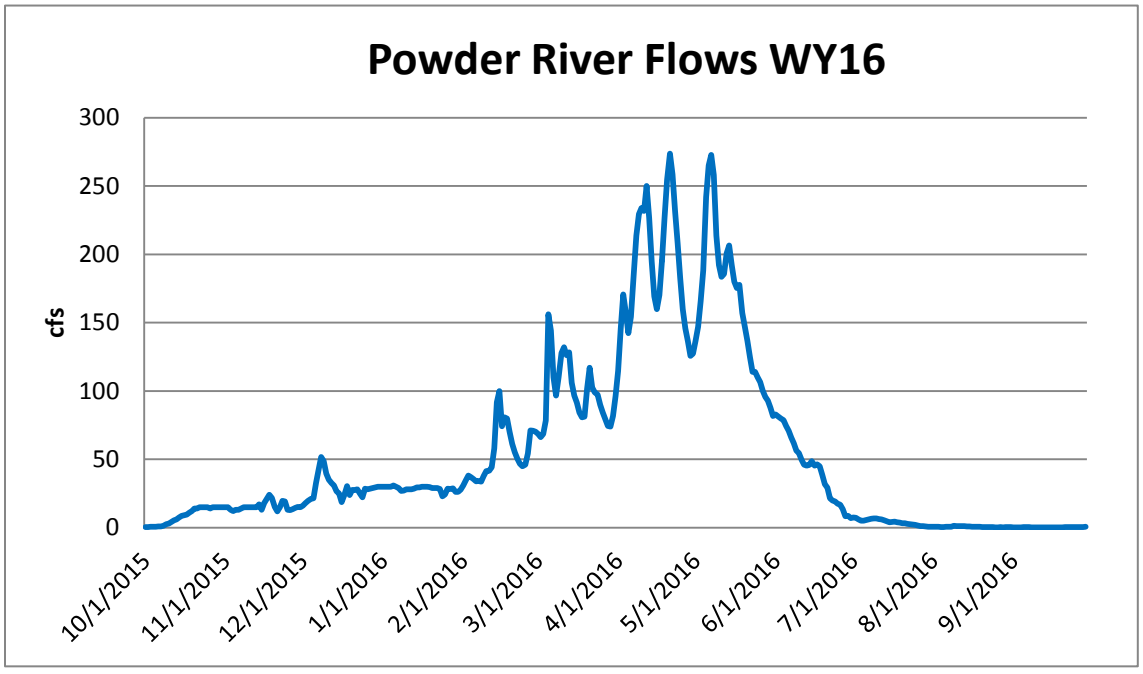

Figure 11. Powder River inflows to Phillips Reservoir, measured in cfs and recorded at USGS Gage # 13275105, Powder River at Husdpeth Lane near Sumpter, OR.

3. BULL TROUT

This chapter describes the bull trout ITS and RPMs, including monitoring efforts during WY16. The ITS includes four RPMs and their associated Terms and Conditions to minimize incidental take of bull trout related to O&M at Reclamation's facilities in the identified action areas where bull trout are present. Collected data 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 2016, Reclamation was involved with RPM activities and/or monitoring at Deadwood, Arrowrock, Anderson Ranch, Beulah, and Phillips Reservoirs.

3.1 Boise River Basin

For the purpose of this report, the Boise River basin study area includes Arrowrock Reservoir; Anderson Ranch Reservoir; the South Fork Boise River below Anderson Ranch Dam; and portions of the Middle and North Fork Boise Rivers; Lucky Peak Reservoir; and Grouse and Cottonwood Creeks, which are tributaries to Arrowrock Reservoir (Figure 11).

The 2005 Opinion identified five Terms and Conditions for Arrowrock Dam and two Terms and Conditions for Anderson Ranch Dam for minimizing the effect and/or amount of take associated with each dam's operation. 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 address Terms and Conditions for both Arrowrock and Anderson Ranch Reservoirs because the influences of both facilities overlap.

A summary of 2016 Arrowrock Hydroelectric Project operations performed by the Boise Project Board of Control and fish stocking performed by the Idaho Department of Fish and Game (IDFG) is also included in this report.

3.1.1 Boise River Basin Data Collection

Streamflow and water temperatures were monitored on the South Fork Boise River (Figure 12). In 2016, Reclamation continued funding the U.S. Geological Survey (USGS) to maintain flow/temperature stream gages at Neal Bridge (USGS gage No. 13192200) on the South Fork Boise River for the purpose of monitoring tributary flow below Anderson Ranch Dam.

Reclamation is collecting data to develop a water quality model for Anderson Ranch Reservoir. This model will be similar to the one developed for Arrowrock Reservoir. The Anderson Ranch Reservoir Model will focus on spatial and temporal availability and variation in water temperatures and dissolved oxygen (DO) levels suitable for and preferred by bull trout.

Reclamation is finalizing a water quality model for Arrowrock Reservoir, using data collected in WY12 through WY16.

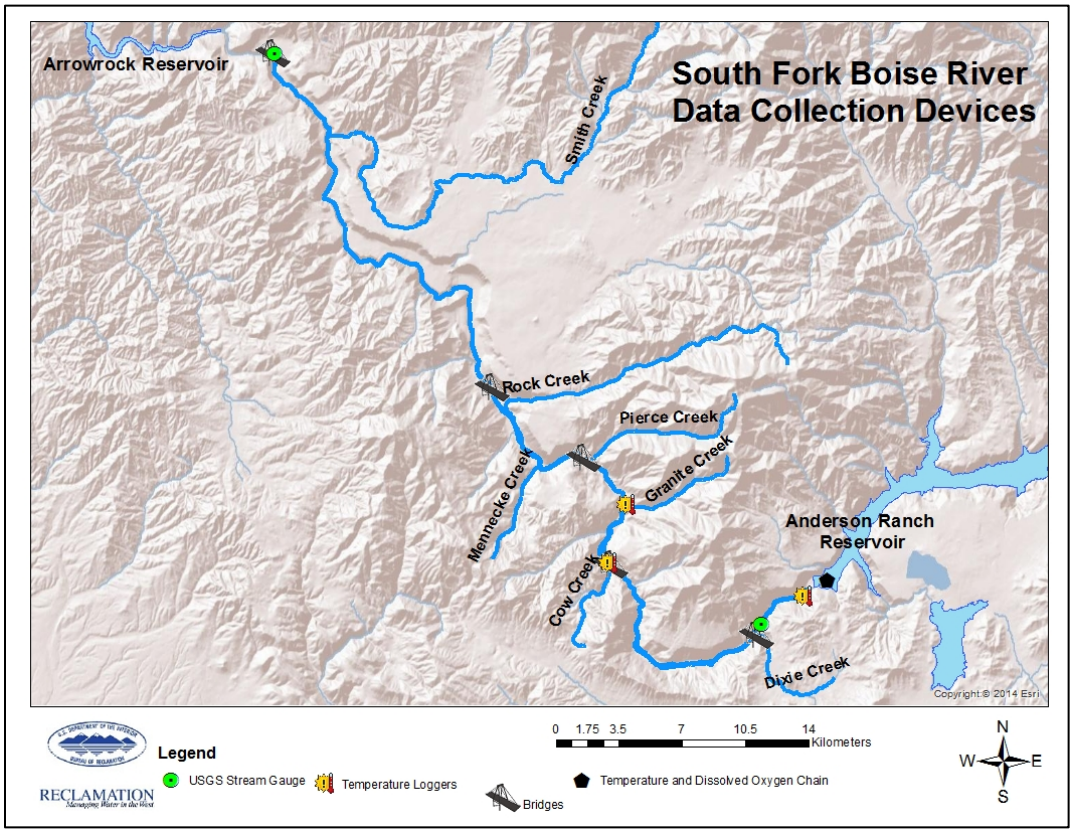

Figure 12. South Fork Boise River basin study area. Locations of Onset® TidbiT temperature loggers, a temperature and dissolved oxygen chain, pressure transducers and USGS gages are shown.

3.1.2 Fish Sampling

Fish sampling to address Term and Condition 1.c (entrainment) is integrated into trap-and-haul efforts to move potentially displaced (entrained) bull trout from Lucky Peak Reservoir back upstream into Arrowrock Reservoir. Trap-and-haul efforts are scheduled to occur in even-numbered years, and any year in which the spillway is used.

3.1.3 Radio Telemetry

The use of radio transmitters and archival temperature tag technology was used in a study designed to address the Terms and Conditions outlined in the 2005 Opinion. Data collection for that study concluded in WY14, and data are being analyzed for inclusion in a future report. No further telemetry tracking occurred during 2016, nor are any telemetry studies currently planned for Arrowrock Reservoir or the Boise River in the near future.

3.1.4 Hydrology and Water Chemistry

Hydrology and water chemistry data were collected in Arrowrock and Anderson Ranch Reservoirs and select tributaries during the reporting period. These data are being used to model water quality in the reservoirs, to address requirements of the 2005 BiOp.

Arrowrock Reservoir

To facilitate water quality modeling, a semi-permanent water quality monitoring station was in operation during the ice-free seasons from 2012 to 2015 at Arrowrock Reservoir.

Limited water profiles, water samples, and phytoplankton and zooplankton samples were collected in 2016 to supplement data with the aim of resolving uncertainties in the Arrowrock Reservoir water quality model. Regular water quality sampling efforts have concluded at Arrowrock Reservoir; however, future water quality sampling may be conducted as needed for model completion and the development of long-term monitoring needs. The Arrowrock Water Quality Model is scheduled for completion in 2017. Future data collection needs will be determined by Reclamation's Regional River and Reservoir Operations Group.

Anderson Ranch Reservoir

Two semi-permanent water quality monitoring stations, composed of Onset® TidbiT temperature thermographs and Minidot temperature/dissolved oxygen sensors arranged at fixed depths throughout the water column, were deployed in the spring of 2016 to gather data on water quality conditions prior to, during, and after thermal stratification at Anderson Ranch Reservoir. Sampling stations were located just upstream from the dam at the deepest part of the reservoir (AND004), and in the middle of the upper bay, offshore from the Curlew Creek boat ramp (AND003) (Figure 13). Reservoir vertical profiles, as well as multiple hydrologic and water quality parameters, were also collected at approximately 6-week intervals throughout the ice-free season at these station locations, as well as at two mid-reservoir locations (AND 009 and AND 010) (Figure 13). Water quality parameters sampled/analyzed for inclusion in reservoir water quality modeling include:

- pH
- Conductivity
- Dissolved Oxygen
- Temperature
- Algal groups and biomass
- Zooplankton groups and biomass
- Turbidity
- Fluorescence
- Total suspended solids
- Total dissolved solids
- Total organic carbon

- Volatile solids
- Total phosphorous
- Chlorophyll-a
- Nitrate-nitrite
- Total Kjeldahl nitrogen
- Dissolved ammonia
- Dissolved organic carbon

Additional physical parameters measured include surface wind speed and direction (taken at multiple water surface points throughout the reservoir) and continuous flow measurements via MiniTroll loggers installed at the inflows of Fall Creek (BOI134) and Lime Creek (BOI131), and from USGS gages at both the reservoir inflow (BOI130) and outflow (AND101, below the dam) of the South Fork Boise River (Figure 13).

Sampling of hydrology and water quality parameters will continue at Anderson Ranch Reservoir in WY17. The Anderson Ranch stations will be redeployed in the spring of 2017 when ice conditions allow. The Anderson Ranch Water Quality Model is scheduled for completion in 2018.

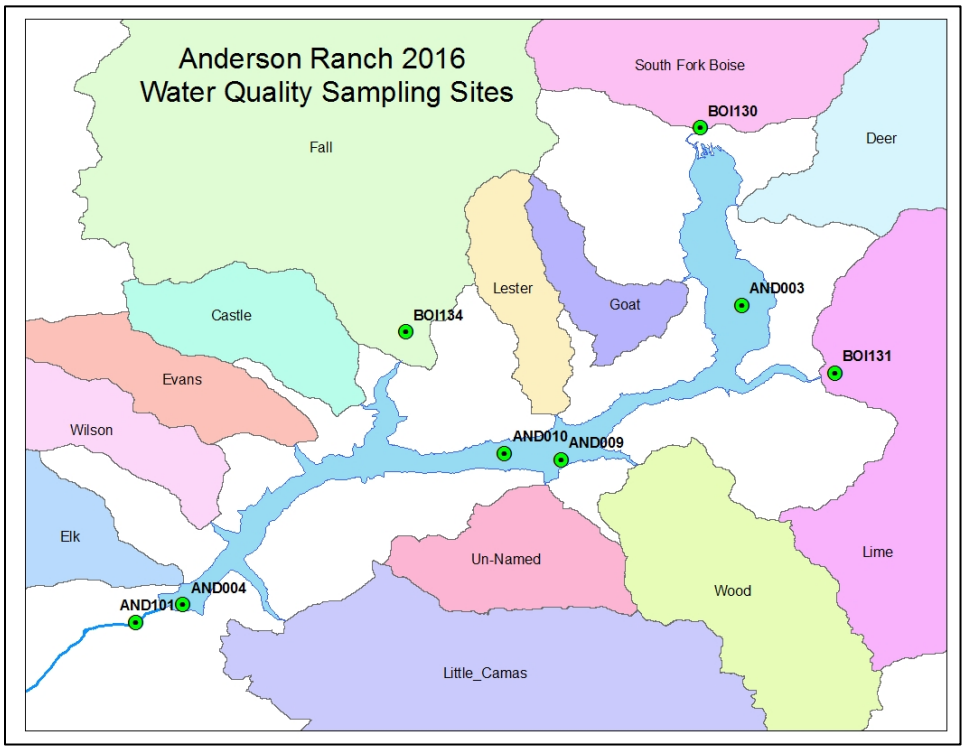

Figure 13. Map showing water quality sampling locations at Anderson Ranch Reservoir. Tributary watershed delineations are shown in differing colors.

3.1.5 Trap-and-Haul Efforts

Trap-and-haul efforts to relocate potentially displaced (entrained) bull trout from Lucky Peak Reservoir back into Arrowrock Reservoir are scheduled to occur in even-numbered

years and as additionally necessitated by spillway usage, and when conditions under which entrainment is expected (discharge exceeding 695 cfs when water surface elevations are less than 3111 feet) occur. Trap-and-haul efforts were conducted during May, June, and July 2016. The spillway at Arrowrock Dam was not operated during the reporting period in WY16.

Lucky Peak trap-and-haul efforts were conducted from May 9 to June 8, 2016, with one additional day on July 7, 2016. A total of 526 fish from 11 species were captured and subsequently released using gill nets during a total of 196 effort hours, with a total catch per unit effort (CPUE) of 2.69. The unit of effort measured is one hour, with each species CPUE rounded up to one tenth of a decimal. Bridgelip sucker *(Catostomus columbianus)*, largescale sucker *(Catostomus macrocheilus)*, and northern pikeminnow *(Ptychocheilus oregonensis)* comprised 85.5 percent of the total catch. No bull trout were caught, and no fish were transported from Lucky Peak Reservoir (Table 6).

Table 6. Catch data for trap-and-haul effort on Lucky Peak Reservoir in 2016. Sampling periods included May, June, and July. The unit of effort for CPUE is one hour.

Number caught	Total Soak Time (hours): 196		
	Totals	CPUE	Percent
Large Scale Sucker *(Catostomus macrocheilus)*	230	1.17	43.7
Bridge Lip Sucker *(Catostomus columbianus)*	124	0.63	23.6
Rainbow Trout *(Oncorhynchus mykiss)*	14	0.07	2.7
Red Sided Shiner *(Richardsonius baltreatus)*	23	0.12	4.4
Yellow Perch (*Perca flavescens)*	7	0.04	1.3
Mountain Whitefish *(Prosopium williamsoni)*	13	0.07	2.5
Small Mouth Bass (*Micropterus dolomieui)*	8	0.04	1.5
Northern Pike Minnow *(Ptychocheilus oregonensis)*	96	0.49	18.3
Chinook *(Oncorhynchus tshawytscha)*	8	0.04	1.5
Chisel Mouth *(Acrocheilus alutaceus)*	3	0.02	0
Bull Trout *(Salvelinus confluentus)*	0	0	0
Total:	526	2.69	100

Trap-and-haul effort sites in Lucky Peak Reservoir were selected based on known geographic and bathymetric conditions similar to those where bull trout were previously captured by Reclamation (2000-2012). Primary locations of historic bull trout capture are at the Arrowrock Dam tailrace and nearby waters, shallow gradient slopes, and in the vicinity of tributary confluences. Physical water data were also collected and used to determine seasonal timing of trap-and-haul efforts and site suitability, as indicated by surface water temperature (<15° C). The gill nets used were experimental in design and were constructed of six 12.5-foot panels of various mesh sizes ranging from 0.5 to 4 inches. Gill nets were deployed to remain perpendicular to the water surface and near or on the bottom of the reservoir. A 300-foot-length gill net soaked for 30 minutes was calculated at one full hour of effort. Individual soak times were limited to 30 minutes to minimize injury and mortality to fish. Gill nets were retrieved, starting from the opposite end from which they were deployed, in order to limit soak time and increase fish survival. Locations of gill net deployments are shown in Figure 14.

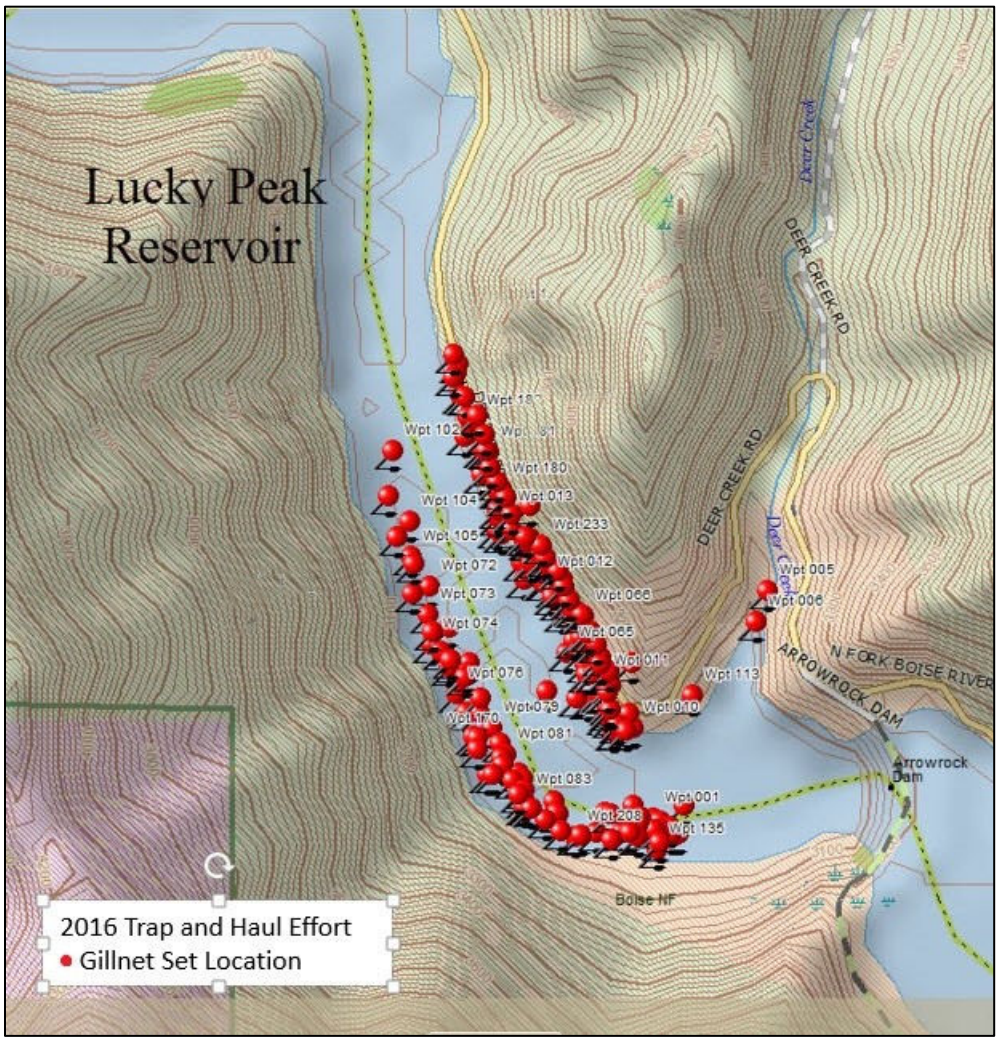

Figure 14. Locations of gill net deployments on Lucky Peak reservoir as part of 2016 trap and haul efforts. No bull trout were captured in Lucky Peak reservoir.

Observed Trends in Lucky Peak Trap-and-Haul Efforts

In 2004, Reclamation replaced the lower ensign release valves at Arrowrock Dam with clamshell valves capable of handling higher discharge volumes. Following that replacement, the upper release valves were taken offline in 2005 (they remain operable but are used only for emergency release purposes). The result is that surface or near-surface water releases, with the exception of uncontrolled spill, have been eliminated from Arrowrock operations.

Since 2004, trap-and-haul efforts have shown a consistent decline in bull trout catch, with no bull trout captured after 2010. The 2016 data are consistent with previous telemetry and acoustic tracking study results that suggest that these post-2005 operational changes at Arrowrock Dam have reduced bull trout entrainment to below detectable levels.

Current-year data and historic trends in biannual trap and haul data are shown in Figure 15.

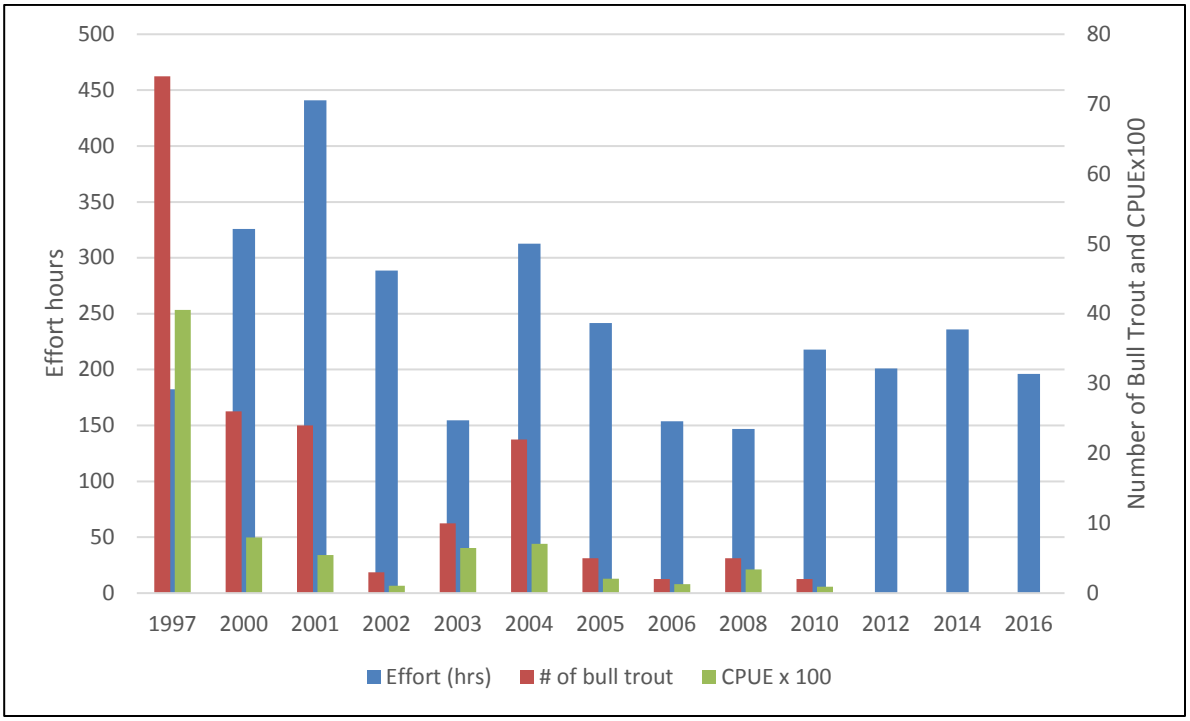

Figure 15. Trap-and-haul trends for historic data, 1997-2016. No bull trout were sampled in 2012, 2014, or 2016.

3.1.6 Other Activities

Arrowrock Dam Hydroelectric Project – Boise Project Board of Control

Arrowrock Dam Hydroelectric Project (Project), Federal Energy Regulatory Commission (FERC) licensee No.4656-020, started operations in 2010. Among the requirements of the FERC license, the licensee (Boise Project Board of Control) was obligated to perform water temperature and dissolved oxygen monitoring in the Arrowrock stilling basin for 5 years, culminating in 2015. Future monitoring recommendations will be prepared by the Boise Board of Control and presented to FERC after review of the Arrowrock Hydro Team.

Annual meetings of the Arrowrock Hydro Team (IDFG, Reclamation, U.S. Army Corps of Engineers [Corps], and USFWS) are expected to continue.

Fish Stocking within Reclamation Projects – Boise River Basin IDFG

IDFG annually stocks fish in the Boise River basin for recreational angling. Stocking practices are determined solely by IDFG, and stocking is not performed to meet Reclamation objectives. A summary of fish stocking[4] for all fish types that occurred at Arrowrock and Anderson Ranch Reservoirs and in the South Fork Boise River in 2016 is shown in Table 7.

[4] Comprehensive stocking data for the state is provided by IDFG and is available at http://fishandgame.idaho.gov/public/fish/stocking/speciesByDate.cfm?region=3

Table 7. Fish stocking by IDFG in 2016 in the Boise River basin for all fish types

Date Stocked	Species Type	Size	Number Stocked
Anderson Ranch Reservoir			
5/31/2016	Chinook Salmon	Fingerling (3-6 in.)	4,800
5/31/2016	Chinook Salmon	Fingerling (3-6 in.)	4,722
6/2/2016	Kokanee	Fingerling (3-6 in.)	172,500
Arrowrock Reservoir			
5/4/2016	Kokanee	Fingerling (3-6 in.)	99,992
10/27/2016	Rainbow Trout	Catchable (6 in. +)	12,627
South Fork Boise River			
5/31/2016	Rainbow Trout	Catchable (6+ in.)	960
6/7/2016	Rainbow Trout	Catchable (6+ in.)	465
6/29/2016	Rainbow Trout	Catchable (6+ in.)	475
7/6/2016	Rainbow Trout	Catchable (6+ in.)	1,260
7/6/2015	Rainbow Trout	Catchable (6+ in.)	1,260
7/12/2016	Rainbow Trout	Catchable (6+ in.)	900
7/12/2016	Rainbow Trout	Catchable (6+ in.)	450
8/8/2016	Rainbow Trout	Catchable (6+ in.)	960
8/14/2016	Rainbow Trout	Catchable (6+ in.)	1,000
8/14/2016	Rainbow Trout	Catchable (6+ in.)	960
8/18/2016	Rainbow Trout	Catchable (6+ in.)	960

3.2 Payette River Basin – Deadwood River System

The 2005 Opinion identified five Terms and Conditions for minimizing the effects to bull trout and the amount of take associated with the operation of Deadwood Dam and Reservoir. Each Term and Condition addresses a different aspect of the effects of operations on bull trout and makes assumptions regarding the effects to bull trout from reservoir operations. Examining the system as a whole allows Reclamation to understand the systemic impacts of individual operational changes. Consequently, Reclamation has been engaged in the multi-year Deadwood Reservoir Operations Flexibility Evaluation (Deadwood Study) to address the Terms and Conditions jointly, and to evaluate operational flexibility to minimize biological impacts system-wide.

Evaluating the flexibility of operations and the effects of varied operational scenarios for Deadwood Dam on water quality conditions and aquatic fauna in both Deadwood Reservoir and the Deadwood River below Deadwood Dam requires an understanding of the potential overall ecosystem response to operational changes over time. Using modeling of physical and biological parameters measured over the course of this project allows for an ecosystem

analysis of the Terms and Conditions for Deadwood Reservoir operations and their influence on bull trout populations. These efforts involved collaboration between multiple agencies and include annual activities not detailed in this report. The results of the Deadwood operations flexibility study are compiled in the *Final Deadwood Reservoir Operations Flexibility Evaluation*, a report from which operations recommendations are being developed in 2017.

3.2.1 Data Collection in the Deadwood River Basin

Physical, hydrologic, and water quality data were collected in Deadwood Reservoir, the Deadwood River below the dam, and selected tributaries, as shown in Figure 16. Due to the proximity of the 2016 Pioneer Fire, the only data obtained in 2016 were from the flow and temperature loggers associated with Reclamation's Hydromet system. TidbiT temperature loggers were still logging data, but access for downloads was not possible during 2016. An attempt to download all of the loggers will be made in fall of 2017. It is possible that debris flows and other fire-related events may preclude future data downloads if loggers are buried or displaced, or that potential logger burial or displacement may result in the logging of subsurface temperature data rather than flowing river temperatures. However, these outcomes will remain unknown until downloading access is possible and data can be checked for accuracy.

Hydrology and Water Chemistry

Data loggers at the locations in Figure 16 were logging data during 2016 and Reclamation will attempt to download these loggers in fall of 2017. Temperature data are stored at Reclamation's Snake River Area Office and are being used for biological and hydrologic modeling (Reclamation 2013a).

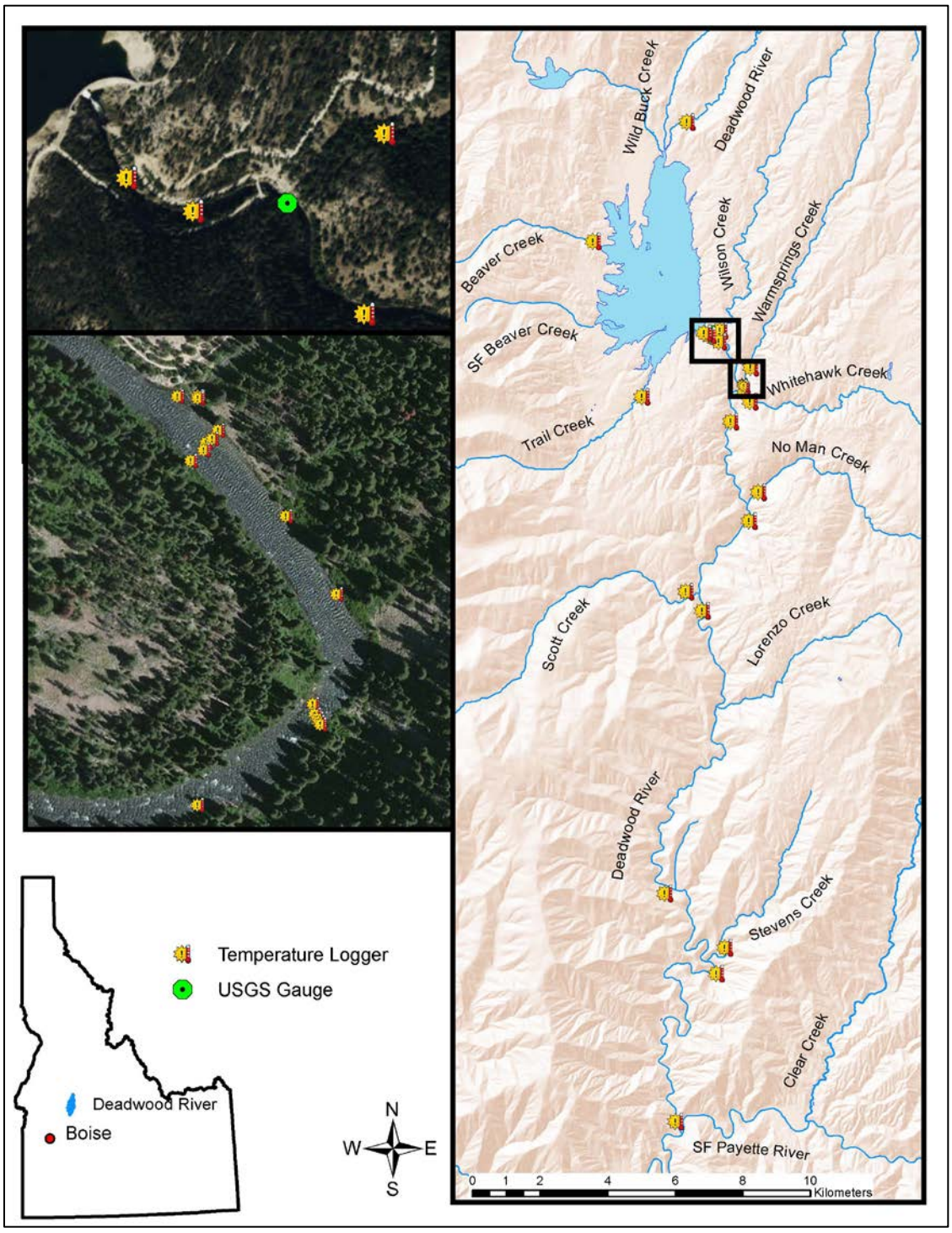

Figure 16. Data logger locations in the Deadwood study area, Idaho, 2016

Other Activities

In 2016, IDFG stocked 6,335 fingerling fall Chinook salmon (larger than 6 inches) and 10,063 fingerling triploid Hayspur rainbow trout into Deadwood Reservoir as a measure to control kokanee and provide a sport fishery (Table 8).

Table 8. Fish stocking by IDFG in 2016 in Deadwood Reservoir for all fish types

Date Stocked	Species Type	Size	Number Stocked
7/19/2016	Chinook Salmon	Catchable (6+ in.)	3,542
7/19/2016	Chinook Salmon	Catchable (6+ in.)	2,793
7/19/2016	Rainbow Trout	Fingerling (3-6 in.)	10,063

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 amount of take associated with the operation of Agency Valley Dam and Beulah Reservoir. Each of the Terms and Conditions addresses a different aspect of the effects of operations on bull trout. Reclamation is working with USFWS to finalize recommendations for a conservation pool in Beulah Reservoir that would maintain a prey base for bull trout that overwinter in the reservoir (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) were conducted during the first 3 years. During the last year, data collected during this study was combined with previous sampling efforts to conduct bioenergetics modeling and to develop a defensible conservation pool recommendation for Beulah Reservoir and the efficacy of prey supplementation (Term and Condition 4.b).

The final reports for this work were completed in June 2015 under two covers and include results of the prey base (Reclamation 2015a) and bioenergetics modeling, and population sustainability (Reclamation 2015b). Results from these efforts will be used to develop the conservation pool recommendations, which are expected to be completed in Fiscal Year 2017. During the 2016 reporting period, no additional data were collected for this study. Reclamation will strive to maintain the reservoir pool elevation at or above 2,000 acre-feet until conservation pool recommendations are presented to USFWS.

3.3.1 Temporary Water Lease

In 2015, Reclamation entered into a 2-year temporary water lease with the Vale Irrigation District to maintain reservoir pool storage at or above 2,000 acre-feet until conservation pool recommendations are presented to the USFWS. (The 2015-2016 water lease extended the minimum study pool that occurred during the studies while the report is being

completed.) The storage at Beulah Reservoir fell below 2,000 acre-feet for a total of 15 days during WY16 (Figure 8). The reservoir was drafted to a minimum storage pool of 1,956 acre-feet (3285.29 feet) on September 11, 2015, and carryover into WY16 was 1,980 acre-feet on September 30, 2015.[5] Beulah Reservoir filled to 2,000 acre-feet of storage again on October 16, 2015, and did not fall below 2,000 acre-feet again in the WY16 reporting period.

During WY16, Standing Operating Procedures (SOPs) were followed to assure the maintenance of a 2,000 acre-feet conservation pool. SOPs involve monitoring water gages above and below the reservoir and using these data to determine adjustments in outflow to maintain or adjust pool elevations.

3.3.2 Trap-and-haul Efforts

Trap-and-haul efforts were not conducted in WY16 because the spillway was not used to release water from the reservoir during this reporting period (Term and Condition 4.d).

3.3.3 Other Activities – Redd Counts

Reclamation participates as a partnering agency in annual survey counts of bull trout redds in the North Fork Malheur River basin, to satisfy coordination and basin monitoring requirements set forth in the 2005 Opinion. 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 17 shows the number of redds observed in the North Fork Malheur River basin and the carryover of reservoir storage in Beulah Reservoir, from previous reporting years to the present. Following several years in which surveys had been precluded by fire conditions, Reclamation assisted redd counts conducted in the Malheur River basin in 2016 during the weeks of August 22-26 and September 26-30. In total, 75 redds were observed over 19.27 surveyed stream miles throughout the North Fork Malheur River and nine smaller tributaries (average 3.8 redds/mile).

[5] Twenty acre-feet is within the expected industry standard of +/- 10% (Maidment 1993).

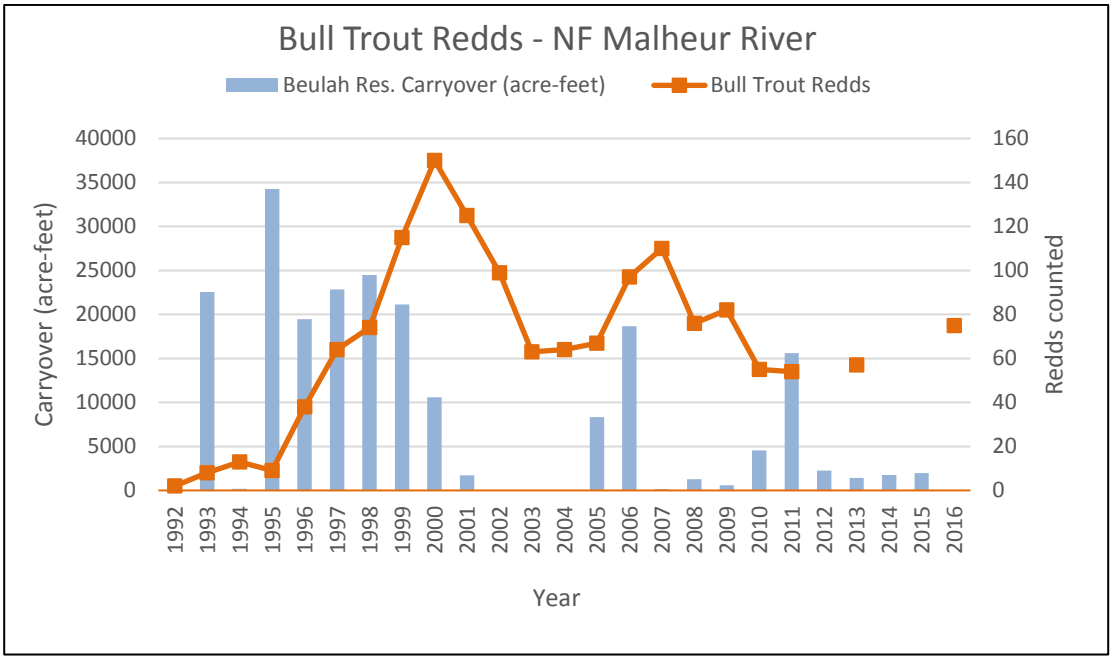

Figure 17. Data on bull trout redd trends observed in the North Fork Malheur River watershed (North Fork Malheur River), and carryover storage in Beulah Reservoir, 1992-2016. The number of redds observed after 2007 has been adjusted by one, to reflect reduced size of area surveyed. No redd count data exist for 2012, 2014, and 2015.

3.4 Powder River Basin – Phillips Reservoir

3.4.1 Bull Trout Monitoring

The 2014 Opinion identifies one Term and Condition associated with minimizing incidental take of bull trout resulting from operations of Phillips Reservoir (decreased water levels and increased temperatures) and from impaired fish migration above Phillips Reservoir. Reclamation accordingly finalized a 5-year Bull Trout Monitoring and Reporting Plan for Phillips Reservoir with USFWS on August 26, 2016 (Reclamation 2016b). This plan was developed in collaboration with Oregon Department of Fish and Wildlife (ODFW) in order to fulfill this Term and Condition. Reclamation continued in 2016 to work to enhance knowledge of project impacts to bull trout and to better determine bull trout use of Phillips Reservoir through fulfillment of this 5-year plan.

In accordance with this monitoring and reporting plan, Reclamation has continued to conduct monitoring of the Powder River gage (USGS gage 13275105 – Powder River at Hudspeth Lane near Sumpter, Oregon) to record the frequency of high inflow events that are expected to lead to bull trout migration into/through the reservoir, and recording the frequency of drawdown that seasonally affects access through the Deer Creek varial zone, through continued monitoring of pool elevation. In the 2016 reporting period, inflow measured at the Powder River gage did not exceed 856 cfs, the operational indicator identified in the monitoring plan.

Reclamation conducted 502.5 hours of fish sampling efforts at Phillips Reservoir between April 18 and May 18, 2016, in an ongoing effort to better determine bull trout use of Phillips Reservoir and assess fish community composition. Sampling was performed via fyke nets, gill nets, and hook-and-line methods at locations throughout the reservoir's inlet arm near the mouths of the mainstem Powder River and Deer Creek, as well as locations dispersed farther down-reservoir, and included 485 hours of sampling via fyke net, 6.25 hours of sampling via gill net, and 11.25 hours of sampling via hook-and-line methods. Fish species sampled include rainbow trout (*Oncorhyncus mykiss*), smallmouth bass (*Micropterus dolomieu*), black crappie (*Pomoxis nigromaculatus*), yellow perch (*Perca flavescens*), redside shiner (*Richardsonius balteatus*), northern pikeminnow (*Ptychocheilus oregonensis*), largescale sucker (*Catostomus macrocheilus*), bridgelip sucker (*Catostomus columbianus*), speckled dace (*Rhinichthys osculus*), sculpins (*Cottidae* spp.), and juvenile suckers (*Catostomus* spp.) that were not identified to the species level. No bull trout were detected.

Data from this sampling effort are summarized in Table 9, and were included in full in the 2016 report for sampling permit *OR STP#20108: Renewal – Phillips Reservoir Bull Trout Monitoring*, submitted to the National Marine Fisheries Service online system for Authorizations and Permits for Protected Species in August 2016.

Table 9. Phillips Reservoir fish sampling data from 2015 effort, including total catch for each species (SPP) by sampling method and catch per unit effort (CPUE) by sampling method.

Species	Gill Net	Fyke (trap) Net	Hook and Line	Total by species
Largescale sucker	14	27	1	42
Yellow perch	3	1,308	0	1,311
Sucker (juvenile, spp. unknown)	0	67	0	67
Northern pikeminnow	1	599	0	600
Bridgelip sucker	1	18	0	19
Redside shiner	0	26	0	26
Smallmouth bass	0	2	0	2
Rainbow trout	2	24	0	26
Sculpin spp.	0	6	0	6
Speckled dace	0	2	0	2
Black crappie	0	3	0	3
Total sampling hours	6.25	485	11.25	502.5
Total fish caught	21	2,092	1	2,114
CPUE	3.36	5.36	0.09	4.21

3.4.2 Other Activities

In 2016, Reclamation implemented experimental eDNA sampling to supplement other sampling methods utilized at Phillips Reservoir as part of the 5-year sampling plan. Four locations were sampled for eDNA repeatedly during each of three sampling event weeks between April 18 and May 18, 2016, including the mouth of the Powder River approximately 20 meters (66 feet) above its inflow into Phillips Reservoir, the mouth of Deer Creek approximately 20 meters (66 feet) above its inflow into Phillips Reservoir, and a sampling location on each bank (north and south) of the Powder River outflow, approximately 50 meters (164 feet) below the outflow from Mason Dam. In partnership with the U.S. Forest Service (USFS) range-wide bull trout eDNA assessment, Reclamation also collected one set of eDNA samples from three locations identified by the USFS in the upper parts of the Deer Creek watershed, including two sites in Lake Creek (a tributary to Deer Creek) and one site at the upper of the Twin Lakes (the headwaters of Lake Creek). Complete results of this eDNA sample analysis will be provided at the conclusion of the sampling period.

4. SNAKE RIVER PHYSA

4.1 Introduction and Background

The 2005 Opinion found that the proposed operations of Minidoka Dam may adversely affect physa in the Minidoka reach of the Snake River; however, insufficient information existed to adequately predict impacts. One of Reclamation's proposed actions in the 2004 BA (Reclamation 2004) was to conduct presence/absence surveys of physa to characterize the environmental variables and physical habitats where physa are found. During surveys conducted from 2006 through 2008, more than 274 live physa specimens were found between Minidoka Dam downstream to above Milner Pool (Figure 18; Gates and Kerans 2010). Live physa were found in low densities, primarily among pebble and gravel substrates in the main channel (thalweg) of the Snake River from below Minidoka Dam downstream to above the Milner Pool. Physa were also found in the spillway area of Minidoka Dam, though sample sizes were too small to characterize habitat use and spatial distribution.

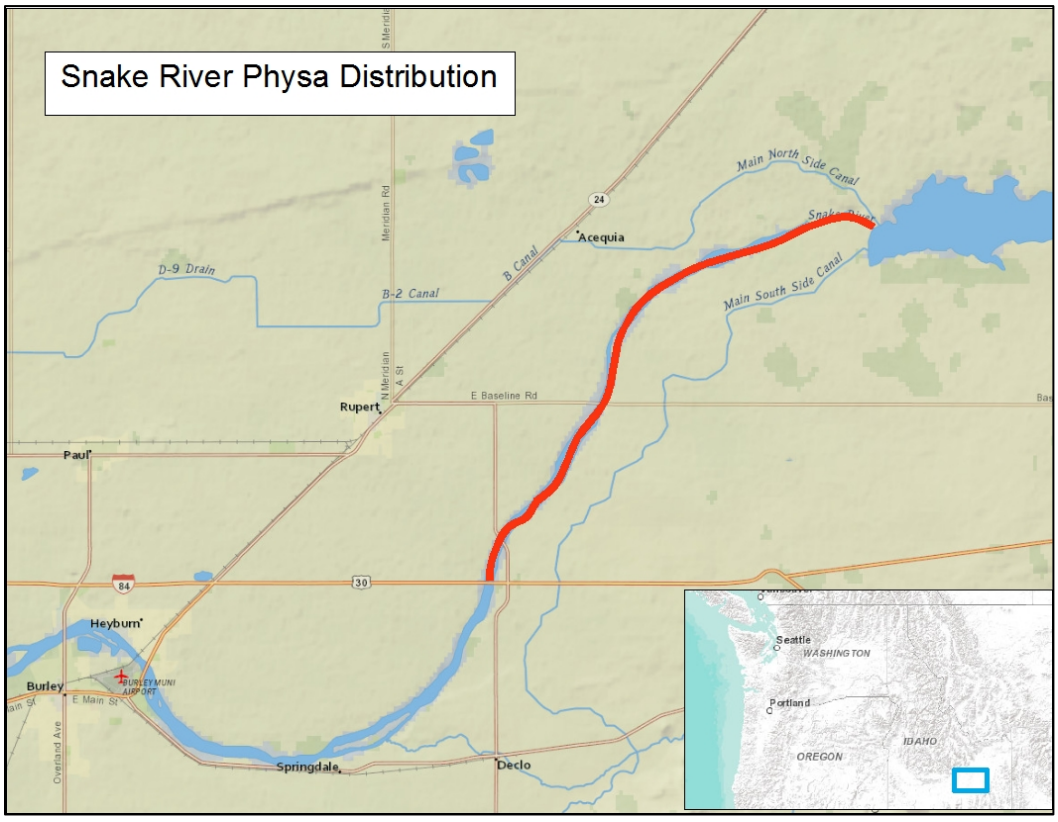

Figure 18. Red line represents the known distribution of Snake River physa in the Snake River above Milner Dam.

Physa surveys were not conducted from 2009 through 2011; however, during this time, data and specimens were analyzed and a completion report was prepared for physa

identification, habitat characteristics, and distribution (Gates and Kerans 2010). Survey efforts were reinitiated in 2012 in response to the Minidoka Dam spillway replacement project. Construction was completed during the summer of 2015. Post-construction operations may include the diversion of more water, when available, through the Inman Powerplant located at Minidoka Dam. In consultation with USFWS and a multi-agency technical team (Technical Team), Reclamation designed a multi-year proposal to reduce minimum spillway flow (Table 10) and monitor physa to determine what effects, if any, reduced flow has on physa occurrence and abundance in the spillway. Due to the complexity of Reclamation's proposed action, Table 10 only identifies minimum spillway and powerplant flows and does not fully represent the proposed post-construction operations comprehensively. Water rights, provisions of spaceholder contracts, commitments to implement the existing biological opinions, and Total Maximum Daily Loads (TMDL) did not change as a result of the spillway replacement project.

Reclamation consulted on project operations following construction of the spillway. The consultation addressed Reclamation's impacts to physa located in the Snake River above Brownlee Reservoir, including the Minidoka Dam spillway. Reclamation received the 2015 Opinion on May 8, 2015, finding that Reclamation's proposed operations are likely to adversely affect physa in the Minidoka Dam spillway. Terms and Conditions and RPMs were provided. The consultation was aligned with ongoing actions associated with the long-term O&M of the current 2005 Opinion (USFWS 2005) and is considered a supplement to the 2005 Opinion. The primary purpose of Table 10 is to illustrate the proposed spillway flow reduction schedule identified in the 2015 Opinion.

The decision was made by Reclamation, in consultation with the Technical Team, to operate Minidoka Dam spillway consistent with previous, preconstruction operations, the first year following completion (2015) of the spillway to assess possible changes in flow patterns associated with the new structure. This was done to allow Reclamation and the Technical Team to discern which differences in flow patterns were attributable to the new structure, as opposed to changes in release rates. Spillway flows from 2014 that were identified in the 2015 Opinion (included in Table 10) were therefore implemented in 2015 as well. Spillway flows identified in the 2015 Opinion (also included in Table 10) for 2016 were not able to be implemented due to an extended outage of the Inman Powerplant, through which flows are typically run instead of through the spillway. General maintenance that would not have altered flows was expected; however opening Unit 9 of the Inman Powerplant revealed that its condition required more extensive repairs than expected. These repairs will be ongoing in 2017, and flows described in the 2015 BiOp will again not be attainable. Flows will be evaluated annually by Reclamation and the Technical Team and adjusted as necessary to support evaluation objectives.

Table 10. Current and proposed minimum spillway and powerplant flows at the Minidoka Dam

Mo.	Spillway Flow (cfs)						Powerplant Flow (cfs)					
	2013	2014	2015	2016	2017	2018	2013	2014	2015	2016	2017	2018
Nov 01	<1	<1	<1	<1	<100	<100	400	400	400	425	425	425
Dec 01	<1	<1	<1	<1	<100	<100	400	400	400	425	425	425
Jan 01	<1	<1	<1	<1	<100	<100	400	400	400	425	425	425
Feb 01	<1	<1	<1	<1	<100	<100	400	400	400	425	425	425
Mar 01	<1	<1	<1	<1	<100	<100	400	400	400	425	425	425
Apr 01	<1,300	<1,300	<1,300	<1,300	<1,000	<500	<5,035	<5,035	<5,035	<5,035	<5,335	<5,835
Apr 15	1,300	1,300	1,300	1,300	1,000	500	<8,850*	<8,850	<8,850	<8,850	<8,850	<8,850
May 01	1,300	1,300	1,300	1,300	1,000	500	<8,850	<8,850	<8,850	<8,850	<8,850	<8,850
Jun 01	1,300	1,300	1,300	1,300	1,000	500	<8,850	<8,850	<8,850	<8,850	<8,850	<8,850
Jul 01	1,900	1,900	1,900	1,500	1,000	500	<8,850	<8,850	<8,850	<8,850	<8,850	<8,850
Aug 01	1,900	1,900	1,900	1,500	1,000	500	<8,850	<8,850	<8,850	<8,850	<8,850	<8,850
Sep 01	1,300	1,300	1,300	1,300	1,000	500	<8,850	<8,850	<8,850	<8,850	<8,850	<8,850
Sep 15	<1,300	<1,300	<1,300	<1,300	<1,000	<500	<5,035	<5,035	<5,035	<5,035	<5,335	<5,835
Oct 01	<1,300	<1,300	<1,300	<1,300	<1,000	<500	400	400	400	425	425	425

*Irrigation season powerplant flows are highly variable within and among years and are dependent upon several factors. Accurate monthly flows cannot be precisely expressed in a single table. The maximum powerplant capacity at Minidoka Dam is 8,850 cfs.

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The objectives of the Minidoka reach physa surveys in 2016 were to gather data that will be used to determine trends of occurrence and abundance within the Minidoka reach; 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 No. TE 056557-5. Data collected in 2015 through 2018 will be compared to data from previous years to determine impacts to physa and their habitat in the Minidoka reach (Figure 18).

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 18, river mile [RM] 675 to RM 663). The Minidoka Dam pool elevation ranges from 4236 to 4245 feet above sea level; however, elevations are generally held at 4245 feet above sea level to maximize power production. The pool elevation is reduced near the end of irrigation season (September) during low-water years to avoid reducing American Falls Reservoir below 100,000 acre-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. Flows through Minidoka Dam consist of regulated discharge through both the original powerplant building and the newer Inman Powerplant, as well as controlled discharge through the spillway structure. Flows from Minidoka Dam downstream to Milner Dam are almost entirely an artifact of controlled releases 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 within 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 more than 400 meters wide, with maximum depths of approximately 4 meters. As a result, approximately 30 percent of the river channel is exposed during non-irrigation season flows. Flows outside of irrigation season at the Jackson Bridge site typically consist of a minimum of 425 cfs through the powerplants. This regulated winter flow is approximately 1.2 meters lower than average August bankfull width flows.

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.

Three randomly selected transects and one permanent reference transect 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, samples were suction-dredged for a timed duration of 60 seconds. 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 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 from each plot were counted 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), and dissolved oxygen (milligrams per liter [mg/L]) were measured at each plot using a Hydrolab® Sonde DS5 meter and Surveyor® handheld monitor. 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. 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 11). 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 11. Substrate classifications used to characterize suction dredge plots surveyed

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

4.4 Results and Discussion

During the 2016 sampling, 40 plots were sampled in the spillway pool and another 40 plots were sampled at the Jackson Bridge site. At the Jackson Bridge site (Control site), three plots (7.5 percent) contained live physa, with the collection of one live physa in one plot and two live physa in each of the other two plots (Figure 19). At the spillway pool site, 26 live physa were collected from 11 plots (27.5 percent) (Impact site; Figure 20). A majority of the 11 plots with live physa had only one individual physa; however, two plots had high numbers, with six and seven individuals collected from each plot, respectively. 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. Unlike previous physa detections, the highest-density sites in the spillway pool were in areas characterized by mostly bedrock substrate with little loose sediment.

Snake River physa shells were counted to serve as a possible surrogate to live snail locations. Although snail shells in general are prone to drifting in fluvial environments, analysis of previous Reclamation data has shown that concentrations of shells serve as indicators of species presence within the general vicinity of the search site. Physa shells were found in 90 percent (n=36) of the Jackson Bridge samples; however, only two physa shells were found in the Minidoka Dam spillway in 2016.

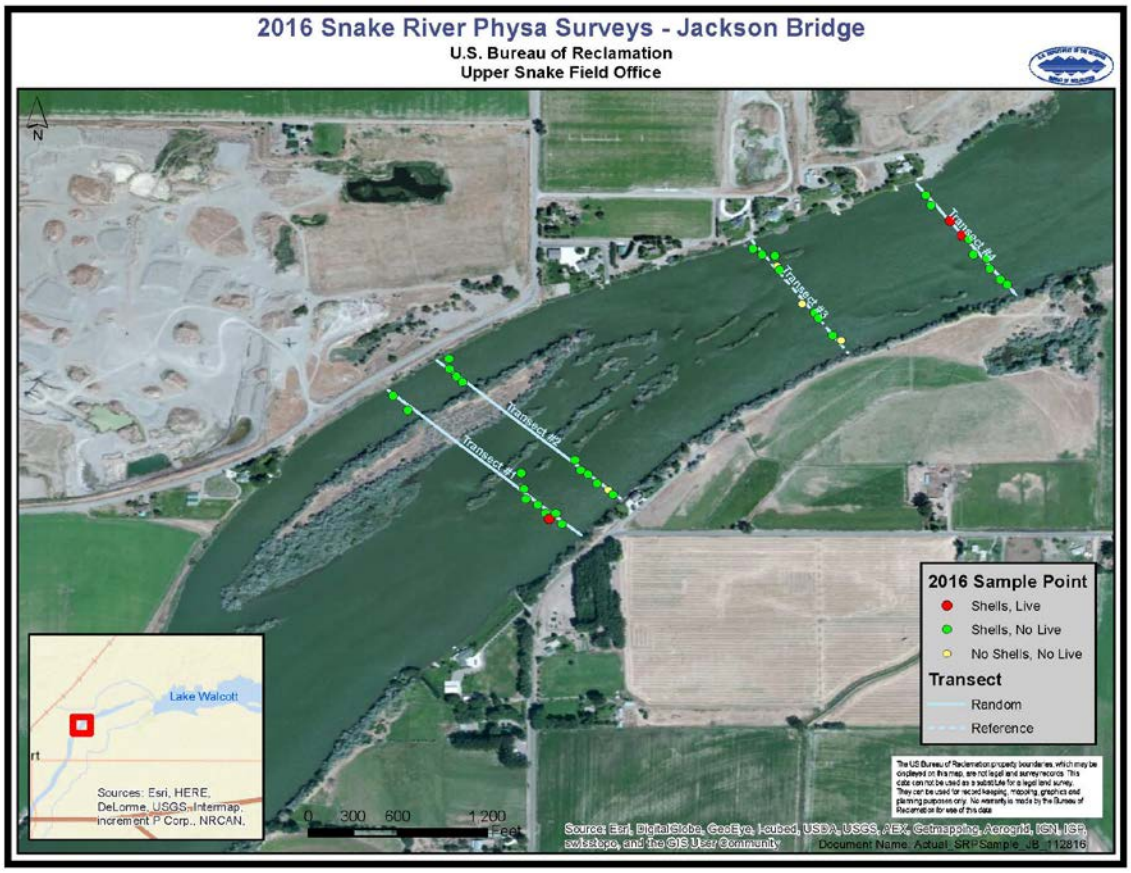

Figure 19. Distribution of Snake River physa at the Jackson Bridge monitoring site in 2016

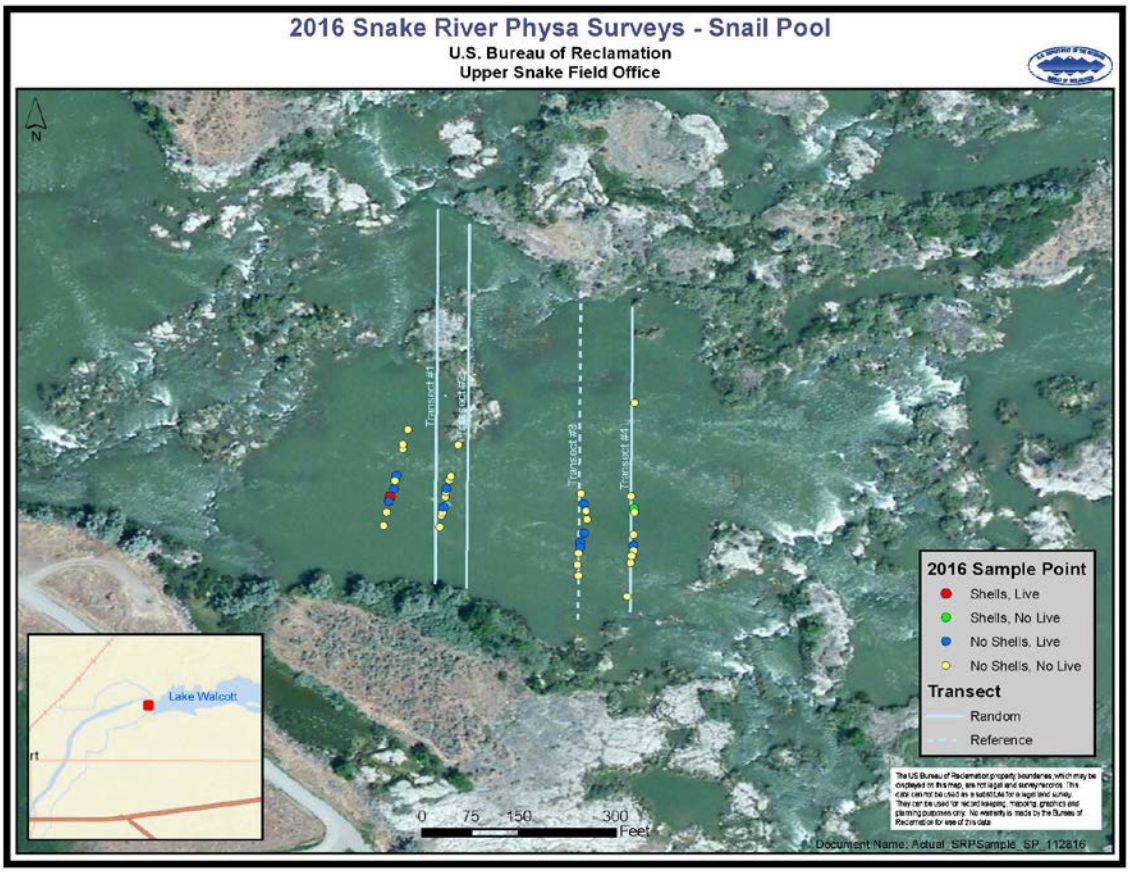

Figure 20. Distribution of Snake River physa at the Minidoka Dam spillway pool monitoring site in 2016

A total of 31 live Snake River physa were collected during field surveys in 2016. As part of an Interagency Agreement between Idaho Power, USFWS, USFS and Reclamation, three specimens were preserved and vouchered from the Jackson Bridge site between August 22 and August 23, 2016. These individuals were sent to the National Genomics Center for Wildlife and Fish Conservation in Montana for developing an eDNA marker for the species. Typically, voucher specimens collected in sampling efforts are placed in the designated depository listed in USFWS ESA Section 10 Permit No. TE056557-5. All of the remaining live Snake River physa were returned to their respective collection location in apparently good condition.

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 were conducted at the spillway pool, resulting in one plot containing one live physa. Physa were not detected in the spillway pool during 2012, 2014, or 2015. In 2013, two live physa were collected from the spillway pool, and 26 live physa were collected in 2016. It had been hypothesized that due the scarcity of the species within the spillway pool sampled prior to 2016, water velocity would likely have to be used as a predictive indicator of possible physa distribution.

Mean physical parameters observed at the two survey sites in 2016 are identified in Table 12, separated by positive and negative occurrences for live Snake River physa. Range and mean physical parameters are displayed in Table 13.

Table 12. Mean physical parameters observed at Jackson Bridge and spillway pool plots with (+) and without (-) physa for 2016

Parameter	Jackson Bridge Physa (+) n=3	Jackson Bridge Physa (-) n=17	Spillway Pool Physa (+) n=0	Spillway Pool Physa (-) n=60
Flow (m/s)	1.38	1.04	0.48	0.65
Temp (°C)	20.79	20.90	20.25	20.28
Turbidity (NTU)	8.00	9.00	14.26	13.89
Depth (m)	1.47	1.45	1.96	1.98

Table 13. Range and mean of physical habitat parameters measured during the 2016 physa survey. The mean ($\bar{x}$) is given in parenthesis.

Site	Current Velocity (m/s)	Temperature (°C)	Turbidity (NTU)	Depth (meters)
Jackson Bridge	0.42-3.15 (1.06)	20.10-21.76 (20.89)	5.8-13.0 (8.92)	0.6-2.2 (1.45)
Spillway Pool	0.07-1.70 (0.60)	19.88-20.72 (20.27)	10.8-16.8 (13.99)	0.7-4.1 (1.98)

5. LITERATURE CITED

Parenthetical Reference	Bibliographic Citation
75 FR 52272	Federal Register. 2010. "Endangered and Threatened Wildlife and Plants; Removal of the Utah (Desert) Valvata Snail from the Federal List of Endangered and Threatened Wildlife." Federal Register, August 25, 2010. Vol. 75, Number 164. pp. 52272 - 52282.
79 FR 67154	Federal Register. 2014. "Endangered and Threatened Wildlife and Plants; Designation of Critical Habitat for the Western Distinct Population Segment of the Yellow-billed Cuckoo *(Coccyzus americanus)*." November 12, 2014. Vol. 79, No. 218. pp. 67154-67155.
Boise Project Board of Control 2016a	Boise Project Board of Control. 2016a. 2015 Annual Report. Article 404 Dissolved Oxygen Monitoring Plan. Arrowrock Dam Hydroelectric Project – FERC 4656-020 for Period from 1/1/2015 to 12/31/2015.
Boise Project Board of Control 2016b	Boise Project Board of Control. 2016b. 2015 Annual Report. Article 406 Fish Salvage and Recovery Plan. Arrowrock Dam Hydroelectric Project – FERC NO. 4656-020 for Period from 1/1/2015 to 12/31/2015.
Gates and Kerans 2010	Gates, K.K. and B.L. Kerans. 2010. Snake River Physa (*Physa (Haitia) natricina* Survey and Study. U.S. Department of the Interior, Bureau of Reclamation Technical Report produced under Agreement 1425-06FC1S202. 88 p.
Maidment 1993	Maidment, D.R.*Ed.* 1993. Handbook of Hydrology. McGraw-Hill, Inc. New York, NY.
Overton et al. 1997	Overton, C.K., S.P. Wollrab, B.C. Roberts, and M.A. Radko. 1997. R1/R4 (Northern/Intermountain Regions) fish and fish habitat standard inventory procedures handbook. Gen. Tech. Rep. INT-GTR-346. Ogden, Utah: U.S. Department of Agriculture, Forest Service, Intermountain Research Station. 73 p.
Reclamation 2004	U.S. Bureau of Reclamation. 2004. *Biological Assessment for the Bureau of Reclamation Operations and Maintenance Activities in the Snake River Basin above Brownlee Reservoir*. U.S. Department of the Interior, Bureau of Reclamation, Snake River Area Office, Boise, Idaho.
Reclamation 2006	U.S. Bureau of Reclamation. 2006. *Utah Valvata and Bull Trout Monitoring and Implementation Plan. Bureau of Reclamation Operations and Maintenance in the Snake River Basin Above*

Parenthetical Reference	Bibliographic Citation
	Brownlee Reservoir. U.S. Department of the Interior, Bureau of Reclamation, Snake River Area Office, Boise, Idaho. March 2006
Reclamation 2008	U.S. Bureau of Reclamation. 2008. *Deadwood Reservoir Flexibility Study Proposal* (note: study results and methodology will be detailed and distributed at the end of this project. Annual updates and progress results for internal use only.) U.S. Department of the Interior, Bureau of Reclamation, Snake River Area Office, Boise, Idaho.
Reclamation 2013a	U.S. Bureau of Reclamation. 2013. *Bureau of Reclamation 2012 Salmon Flow Augmentation Program and Other Activities Associated with the National Marine Fisheries Service 2008 Biological Opinion and Incidental Take Statement for Operations and Maintenance of Bureau of Reclamation Projects in the Snake River Basin above Brownlee Reservoir, Annual Progress Report*. U.S. Department of the Interior, Bureau of Reclamation, Snake River Area Office, Boise, Idaho.
Reclamation 2013b	U.S. Bureau of Reclamation. 2013. *2012 Annual Report, Bureau of Reclamation Report on Monitoring and Implementation of 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, Snake River Area Office, Boise, Idaho. March 2013.
Reclamation 2014	U.S. Bureau of Reclamation. 2014. Deer Creek Geomorphic Evaluation for Fish Passage at Phillips Reservoir, Oregon Technical Memorandum. U.S. Department of the Interior, Bureau of Reclamation, Pacific Northwest Region, Boise, Idaho. November 2014.
Reclamation 2015a	U.S. Bureau of Reclamation. 2015a. *Beulah Reservoir Minimum Pool and Prey Base Studies 2010-2013: Part 1 Prey Base.* U.S. Department of the Interior, Bureau of Reclamation, Technical Service Center Fisheries and Wildlife Resources Group 86-68290.
Reclamation 2015b	U.S. Bureau of Reclamation. 2015c. *Beulah Reservoir Minimum Pool and Prey Base Studies 2010-2013: Part 2 Bioenergetics, Population Sustainability*. U.S. Department of the Interior, Bureau of Reclamation, Technical Service Center Fisheries and Wildlife Resources Group 86-68290.
Reclamation 2016a	U.S. Bureau of Reclamation. 2016a. Hydromet data. U.S. Department of the Interior, Bureau of Reclamation, Snake River Area Office, Boise, Idaho. Accessed on January 9, 2017. http://www.usbr.gov/pn/hydromet/select.html

Parenthetical Reference	Bibliographic Citation
Reclamation 2016b	U.S. Bureau of Reclamation. 2016. *Bull Trout Monitoring and Reporting Plan – Phillips Reservoir, Oregon*. U.S. Department of the Interior, Bureau of Reclamation, Snake River Area Office, Boise, Idaho. August 2016.
Rose and Mesa 2009	Rose, B. and M. Mesa. 2009. *Minimum pool and bull trout prey base investigations at Beulah Reservoir*. Final Report for 2008. Submitted to: United States Department of the Interior, Bureau of Reclamation, Pacific Northwest Region, Boise, Idaho as Final Report for the Study Agreement #29-RO184. January 2009.
USFWS 2005	U.S. Fish and Wildlife Service. 2005. *Biological Opinion for Bureau of Reclamation Operations and Maintenance in the Snake River Basin above Brownlee Reservoir*. U.S. Department of the Interior, Fish and Wildlife Service, Snake River Field Office, Boise Idaho. March 31, 2005.
USFWS 2014	U.S. Fish and Wildlife Service. 2014. *Biological Opinion for Bureau of Reclamation Operations and Maintenance in the Snake River Basin above Brownlee Reservoir. Effects to Bull Trout in the Powder River, Oregon and Critical Habitat in Idaho and Oregon*. U.S. Department of the Interior, Fish and Wildlife Service, Snake River Field Office, Boise Idaho. June 27, 2014.
USFWS 2015	U.S. Fish and Wildlife Service. 2015. *Biological Opinion for the Bureau of Reclamation, Operations and Maintenance in the Snake River above Brownlee Reservoir*. U.S. Department of the Interior, Fish and Wildlife Service, Idaho Fish and Wildlife Office, Boise, Idaho. May 08, 2015.

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