Endangered Species Act
Federal Columbia River Power System
2014 Annual Progress Report: Section 2

Detailed Description of Reasonable and Prudent Alternative (RPA) Action Implementation

Under Reasonable and Prudent Alternative (RPA) Action 2, the Bonneville Power Administration (BPA), United States Army Corps of Engineers (Corps), and the Bureau of Reclamation (Reclamation), collectively referred to as the Action Agencies, submit an annual progress report that describes the status of implementation for the previous calendar year. Section 2 describes the prior calendar year's implementation progress and Research, Monitoring, and Evaluation (RME) project information. Section 3 includes a list of projects implemented in 2014 along with their associated RPA subactions.

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Hydropower Implementation Reports, RPA Actions 4–33

This document reports on actions taken during calendar year 2014. The Hydropower RPA actions are intended to be implemented over the term of the National Oceanic and Atmospheric Administration's National Marine Fisheries Service (NMFS) (*hereafter* NOAA Fisheries) 2014 Federal Columbia River Power System (FCRPS) Supplemental Biological Opinion[1] (BiOp). Although many of these actions were under way or being implemented during 2014, some will be implemented later in the BiOp period. For hydropower system (hydro) operations, actions are reported by water year (October through September) and through calendar year 2014 because this is consistent with the actual approach for project operations.

Table 1. Hydropower strategy reporting.

RPA Action No.	Action	Annual Progress Report
	Hydropower Strategy 1	
4	Storage Project Operations	Prepare an annual year-end review.
5	Lower Columbia and Snake River Operations	Prepare an annual year-end review.
6	In-Season Water Management	Annual progress reports will describe Federal Columbia River Power System (FCRPS) operations for the fish passage season. There is no other physical or biological monitoring or reporting.
7	Forecasting and Climate Change/Variability	Annual progress reports will include a summary of the annual forecast review and any new, pertinent climate change information or research.
8	Operational Emergencies	Annual progress reports will describe any emergency situations and actions taken per the emergency protocols. There is no other physical or biological monitoring or reporting.
9	Fish Emergencies	Annual progress reports will describe any fish emergency situations and actions taken. There is no other physical or biological monitoring or reporting.
10	Columbia River Treaty Storage	Annual progress reports will describe actions taken to provide 1 million acre-feet (Maf) of storage in treaty space. There is no other physical or biological monitoring or reporting.
11	Non-Treaty Storage (NTS)	Annual progress reports will describe actions taken to refill NTS space. There is no other physical or biological monitoring or reporting.
12	Non-Treaty Long-Term Agreement	Annual progress reports will describe actions taken to develop long-term and/or annual agreements that affect Lower Columbia River flows during the April through August period. There is no other physical or biological monitoring or reporting.
13	Non-Treaty Coordination with Federal Agencies, States, and Tribes	Annual progress reports will describe actions to coordinate NTS agreements. There is no other physical or biological monitoring or reporting.
14	Dry Water Year Operations	Annual progress reports will describe actions taken during dry water years. There is no other physical or biological monitoring or reporting.

[1] *The NOAA Fisheries 2014 FCRPS Supplemental BiOp incorporates, in whole, the NOAA Fisheries 2008 Biological Opinion, the 2009 FCRPS Adaptive Management Implementation Plan, and the 2010 Biological Opinion.*

RPA Action No.	Action	Annual Progress Report
15	Water Quality Plan for Total Dissolved Gas and Water Temperature in the Mainstem Columbia and Snake Rivers	Annual progress reports will describe actions taken to implement Endangered Species Act (ESA) commitments. There is no other physical or biological monitoring or reporting.
16	Tributary Projects	Status of the consultations for Reclamation's tributary projects will be provided in the annual progress reports.
17	Chum Spawning Flows	Annual progress reports will describe in-season water management actions taken during the water year, which includes part of the previous calendar year.
	Hydropower Strategy 2	
18	Configuration and Operational Plan for Bonneville Project	Annual progress reports will describe status of the actions taken in the Configuration and Operational Plan (COP) and the results of the associated research, monitoring, and evaluation (RME).
19	Configuration and Operational Plan for The Dalles Project	Annual progress reports will describe the status of the actions taken in the COP and the results of the associated RME.
20	Configuration and Operational Plan for John Day Project	Annual progress reports will describe the status of the actions taken in the COP and the results of the associated RME.
21	Configuration and Operational Plan for McNary Project	Annual progress reports will describe the status of the actions taken in the COP and the results of the associated RME.
22	Configuration and Operational Plan for Ice Harbor Project	Annual progress reports will describe the status of the actions taken in the COP and the results of the associated RME.
23	Configuration and Operational Plan for Lower Monumental Project	Annual progress reports will describe status of the actions taken in the COP and the results of the associated RME.
24	Configuration and Operational Plan for Little Goose Project	Annual progress reports will describe the status of the actions taken in the COP and the results of the associated RME.
25	Configuration and Operational Plan for Lower Granite Project	Annual progress reports will describe the status of the actions taken in the COP and the results of the associated RME.
26	Chief Joseph Dam Flow Deflector	Annual progress reports will describe the status of the flow deflector construction. Note: This construction project was completed in spring 2009.
27	Turbine Unit Operations	Annual progress reports are developed by BPA.
28	Columbia and Snake River Project Adult Passage Improvements	Annual progress reports will describe the status of the actions taken.
	Hydropower Strategy 3	
29	Spill Operations to Improve Juvenile Passage	Spill operations are reported annually.
30	Juvenile Fish Transportation in the Columbia and Snake Rivers	Annual progress reports will provide the number of fish collected and transported in an annual report each February.
31	Configuration and Operational Plan Transportation Strategy	Annual progress reports will describe the status of the construction and operational actions and associated RME to support the transportation strategy.
	Hydropower Strategy 4	
32	Fish Passage Plan (FPP)	Not applicable.
	Hydropower Strategy 5	
33	Snake River Steelhead Kelt Management Plan	Status of project implementation (including project milestones) through December of the previous year for all actions identified in implementation plans.

RPA Action 4 – Storage Project Operations

The Action Agencies will operate the FCRPS storage projects (Libby, Hungry Horse, Albeni Falls, Grand Coulee, and Dworshak projects) for flow management to aid anadromous fish. These storage project operations will be included in the Water Management Plan. These projects are operated for multiple purposes including fish and wildlife, flood control, irrigation, navigation, power, and recreation.

The Action Agencies operated the FCRPS storage projects to provide flows to improve juvenile and adult fish survival consistent with Hydropower Strategy 1 of the BiOp as described in the 2014 Water Management Plan (WMP) (BPA et al. 2013a). In accordance with the adaptive management provisions of the 2008 BiOp, the WMP was developed to meet RPA water management actions identified in the NOAA Fisheries 2008 BiOp, the NOAA Fisheries 2010 Supplemental BiOp, and the NOAA Fisheries 2014 Supplemental BiOp (collectively referred to as the 2014 FCRPS BiOp) and the U.S. Fish & Wildlife Service (USFWS) 2000 and 2006 BiOps and describes the Action Agencies' annual plan for implementing specific operations. The 2014 WMP was developed in the fall of 2013 with regional coordination.

The dams in the FCRPS were authorized by Congress for multiple purposes, which are implemented in a manner that is consistent with the BiOp RPA. Details of how the projects were operated to improve juvenile and adult survival are described in the following sections and shown in Figures 1 through 6. This information is presented from the start of the 2014 water year — October 2013 through December 2014. Real-time operations follow RPA Action 4 specifications as adjusted in-season with recommendations from the Technical Management Team (TMT), an oversight group consisting of regional sovereign biologists and hydrologists. Further discussion of these operations is included in the minutes of the TMT "2014 Year End Review Session" (TMT 2014a; 2014b).

Figure 1 provides a high level summary of the operational constraints (fish operations, flood risk management, power operation) that have been put in place and actions that are taken

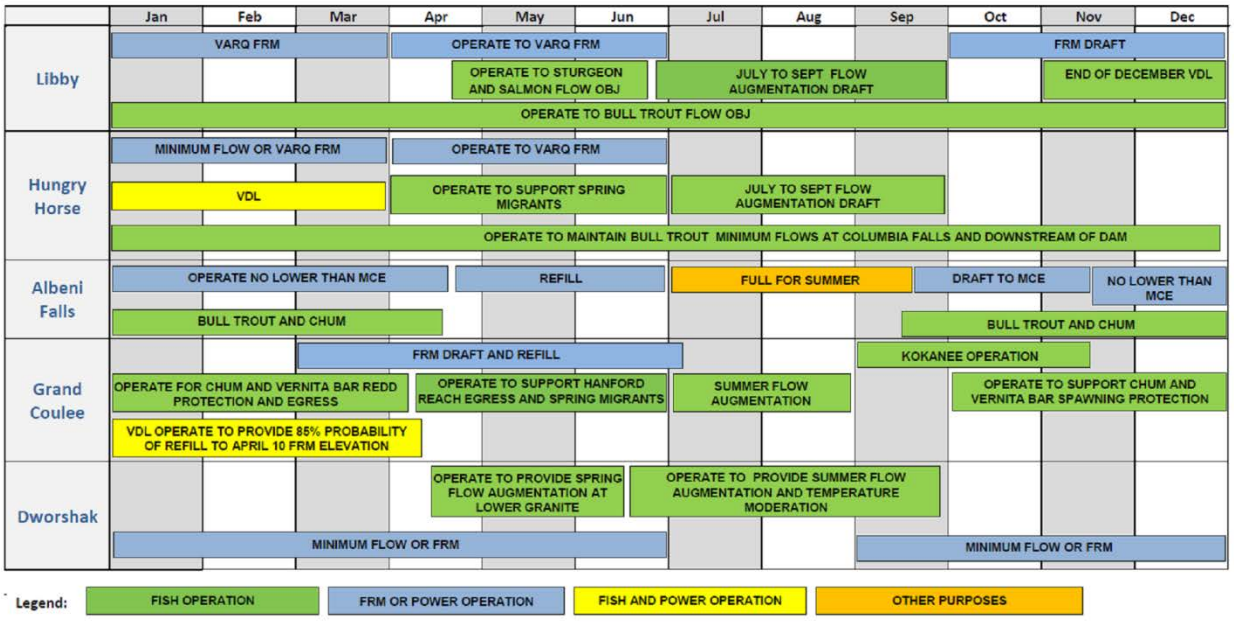

Figure 1. Storage projects operations timeline. VARQ = variable discharge. FRM = Flood Risk Management. VDL = Variable Draft Limit. MCE = Minimum Control Elevation.

during the year to provide improved conditions for fish at FCRPS storage projects. Operations for purposes such as power generation occur within the constraints established for flood risk management and fish operations shown in this figure.

Dworshak Dam

From October 2013 until February 26, 2014, the Corps operated Dworshak Dam to release near minimum flows, approximately 1,600 to 1,700 cubic feet per second (cfs), except for some minor turbine unit testing. Dworshak Reservoir began January 2014 at elevation 1524.6 feet, well under flood control elevations due to lack of water inflows. Beginning on February 27 the project increased outflow to meet future flood-control targets. During March the reservoir was drafted to elevation 1511.0 feet on March 31.

Water forecasts and snowpack were below normal through February. As a result of the below normal forecasts, except for a brief increases for turbine testing, the discharge from Dworshak was held at minimum through the end of February. During this period, the reservoir slowly filled to 1529.8 feet by the end of February. On April 1 the water supply forecast for April to July runoff volume was 3,111 thousand acre-feet (kaf) (128 percent of normal). The flood control requirement for the end of April based on the water supply forecast, called for the reservoir elevation at or below 1445 feet. Due to the very rapid increase in water supply forecast in March it was not possible to draft the reservoir to meet the April flood risk reduction elevations, therefore a Deviation from normal flood control procedure was requested by Walla Walla District and approved by Northwestern Division Corps of Engineers to release approximately 20 kcfs starting on March 22 and continuing through April 17 when the Flood Control Refill curve was intersected. This operation was coordinated at TMT and minimized the impact of elevated total dissolved gas on fish in Dworshak National Fish Hatchery and in the Clearwater River downstream of Dworshak Dam. On April 17, the reservoir reached the Flood Control Refill Curve, which indicates the spring runoff has started and a refill operation is recommended to insure the reservoir refills. The Deviation also included a provision to hold discharge from Dworshak at full powerhouse (about 10 kcfs) through the end of April to aid juvenile salmon out-migration. However, at the April 30 TMT meeting some Salmon Managers requested discharge be maintained at full powerhouse level (approximately 10 kcfs) through May 2 followed by a reduction to 5 kcfs on May 3 and begin the refill operation (2.4 kcfs release) on May 4. The request was discussed at TMT, and was implemented by the Corps. On May 14 discharge was increased for three days to 4.8 kcfs at the request of BPA. The operation was discussed at the May 14 TMT meeting and the increase was made after the meeting. The wetter than forecasted weather in the second week of May provided the additional water to release without adversely impacting the likelihood of refill.

On June 1, the discharge was increased to 4.4 kcfs to slow the rate of refill until after a snow flight was conducted to observe the amount of snow covered area remaining in the North Fork Clearwater River basin above Dworshak. The snow flight concluded there was less than 10 percent snow-covered area remaining, so discharge was reduced to minimum on June 12. The reservoir was full on June 27 and held full until July 7 when the summer temperature operations started. Discharges varied between 7.5 kcfs and 13.7 kcfs during the month of July. The reservoir was drafted to elevation 1573.4 feet on July 31. During the month of August the discharge varied between 6.6 kcfs and 12.0 kcfs as the reservoir was drafted to elevation 1541.9 feet by August 31 (BiOp target is 1535 feet). On August 15, a short in Unit 3 at Dworshak caused a forced outage of Unit 3 until September 22. The Unit 3 outage reduced the capacity of the powerhouse by about 60 percent limiting the 110 percent total dissolved gas discharge to less than 7 kcfs. The Corps coordinated with the

State of Idaho to increase total dissolved gas to 117 percent. Due to issues at the Dworshak National Hatchery the Corps targeted approximately 115 percent total dissolved gas (about 8.8 kcfs) for the remainder of the fish migration season. The reservoir was drafted to elevation 1535 feet on September 7. Additionally, under an agreement with the Nez Perce Tribe, the Corps released 200 kaf of storage during September, targeting 1520.0 feet by September 24.

During July through mid-September, the Corps managed Dworshak Dam to regulate outflow temperatures and attempt to maintain water temperatures at Lower Granite tailwater gauge at or below 68 degrees Fahrenheit. The water temperatures were modeled using CEQUAL-W2 (a 2-dimensional hydrodynamic and water quality model) and weather forecasts to plan releases on a daily basis. During this time the Lower Granite Dam tailwater exceeded 68 degrees on the following dates: August 10 through 12 and August 23 through 27. The first period was unavoidable due to extremely warm temperatures coupled with wind events on August 10 and 11 that mixed the Lower Granite reservoir resulting in high tailwater temperatures. The second period occurred due to the Unit 3 forced outage which hindered the Corps ability to release enough cool water to offset the higher temperatures coming from the Snake River and solar radiation in the Lower Granite Reservoir. During the 8 days in which the water temperature exceeded 68 degrees in the Lower Granite tailwater, all the exceedances were less than 69 degrees Fahrenheit. Due to the very warm conditions in July and August, all the Dworshak temperature management ability was exhausted by September 24 with the reservoir drafted to elevation 1520 feet.

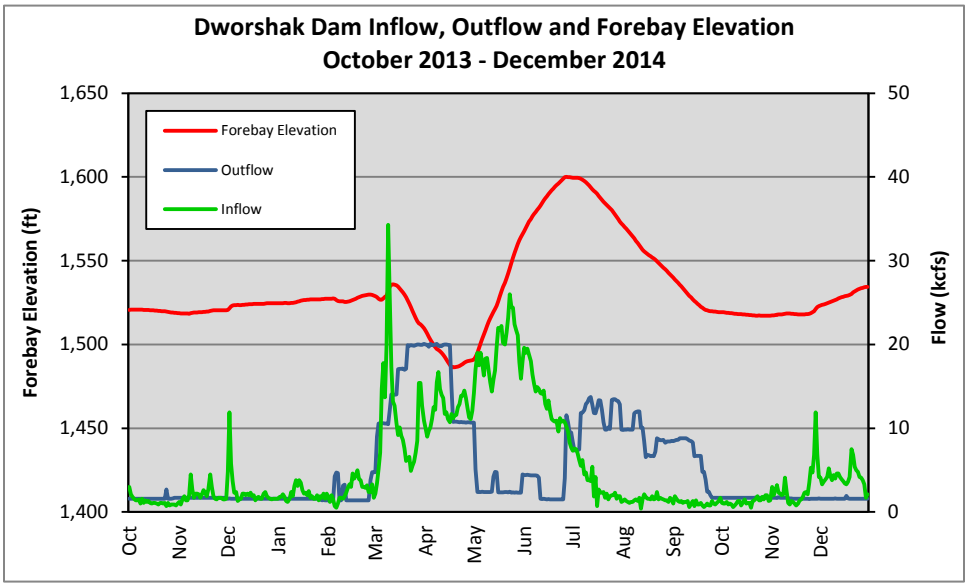

Figure 2. Dworshak Dam inflow, outflow, and forebay elevation from October 1, 2013, through December 31, 2014.

From October to December 2014, Dworshak Dam released near minimum flows between 1,500 and 1,700 cfs. It ended December 2014 at elevation 1,534.4 feet.

Libby Dam

Libby Dam started October 2013 at a pool elevation of 2449.8 feet. For October 5 through 31 the Corps operated the project at its minimum release of 4 kcfs. To reach its end of December pool elevation, Libby Dam released an average of 15.8 kcfs during the month of

November. Inflows for November were 4.7 kcfs. The end November elevation was 2437.38 feet, which resulted in a draft of 15 feet for the month. The December water supply forecast was issued on December 7, with an April-August volume of 5446 kaf, which set the end of December required elevation to 2436.7 feet. The actual December 31 elevation was 2426.3 feet. December inflows averaged 3.4 kcfs, and outflows averaged 10.7 kcfs.

The January water supply forecast for Libby Dam was issued with a volume of 5432 kaf. The forecast set the end of month required elevation to 2426.7 feet. January inflows averaged 3.1 kcfs, and outflows averaged 4.0 kcfs. The February water supply forecast was issued with a volume of 5213 kaf. The February forecast set the end of month required elevation to 2436.4 feet, which was 9.7 feet above the end of January elevation. The project outflow remained at the 4 kcfs minimum through February to minimize the draft. February inflows averaged 2.5 kcfs, and outflows averaged 4.0 kcfs. The end of February elevation was 2422.8 feet.

The March water supply forecast was issued March 6. It stayed relatively consistent with a value of 5505 kaf. This set the end of month required elevation to 2440.9 feet. The project outflow then remained on minimum of 4 kcfs for the month of March. Inflow for the month averaged 4.2 kcfs. The end of March elevation was 2418.1 feet. The April water supply forecast was issued April 4, and increased to a value of 6868 kaf, 117 percent of average, setting the end of month required elevation to 2377.8 feet. The large jump in the forecast between March and April was due to 200 to 300 percent of average precipitation that caused a jump in the snowpack from 85 percent of average to 115 percent of average. Knowing that the forecast was increasing dramatically, releases were increased to 15 kcfs in late March and then to 25 kcfs for the month of April to create space and try to be as close to 2377 feet at the end of April at powerhouse capacity. The Corps' Northwestern Division office declared that Libby Dam could begin refill on April 29. At that time the releases were held to powerhouse capacity and slowly ramped down to a flow of 16 kcfs which was 1.8 kcfs higher than the VarQ flow to manage refill in the spring. On May 5 the water supply forecast was issued with a value of 6996 kaf, which was 115 percent of average. On May 16 the sturgeon augmentation flow began with Libby Dam releasing full powerhouse capacity, 24.5 kcfs. The first period of full powerhouse for the sturgeon flow ended May 23, when discharge was lowered to 18 kcfs over a day. The second period of full powerhouse for the sturgeon flow began on June 2, with outflow remaining at that level until June 9. The end of May elevation was 2413.8 feet. May inflows averaged 34.0 kcfs, a volume of 2090 kaf. May outflows averaged 19.8 kcfs.

The June water supply forecast was issued on June 4, with a volume of 7073 kaf, which was 122 percent of average. On June 18 discharge was 17 kcfs and the sturgeon volume of 1.17 Maf was exhausted. The 17 kcfs was held through the end of June to control refill.

Through the first part of July releases were 15 kcfs as inflow approached the outflows the releases were reduced to 13 kcfs and then to 9 kcfs through August to target an end of August elevation of about 2451 feet. Lake Koocanusa peaked at elevation 2453.1 feet on July 22. Libby Dam reached the required 2449 foot target elevation on September 18. Release was ramped down to 8 kcfs and this release was held until releases were ramped down to 6 kcfs on Sept 28. The 6 kcfs discharge is the minimum flow required in September for bull trout pursuant to the 2006 USFWS Biological Opinion regarding the operation of Libby Dam. The elevation at the end of September was 2447.5 feet. From October 1 to 2 Libby Dam's discharge was reduced from 6 kcfs to 4 kcfs. The 4 kcfs discharge was held for the duration of October. October inflow averaged 4.9 kcfs and outflows averaged 4.1 kcfs. To reach its end of December elevation, Libby Dam increased releases to 9 kcfs on November 3 and held that through November 9. Releases averaged

19.1 kcfs for the rest of the month as Libby Dam drafted to an elevation of 2435.5 feet by the end of the month.

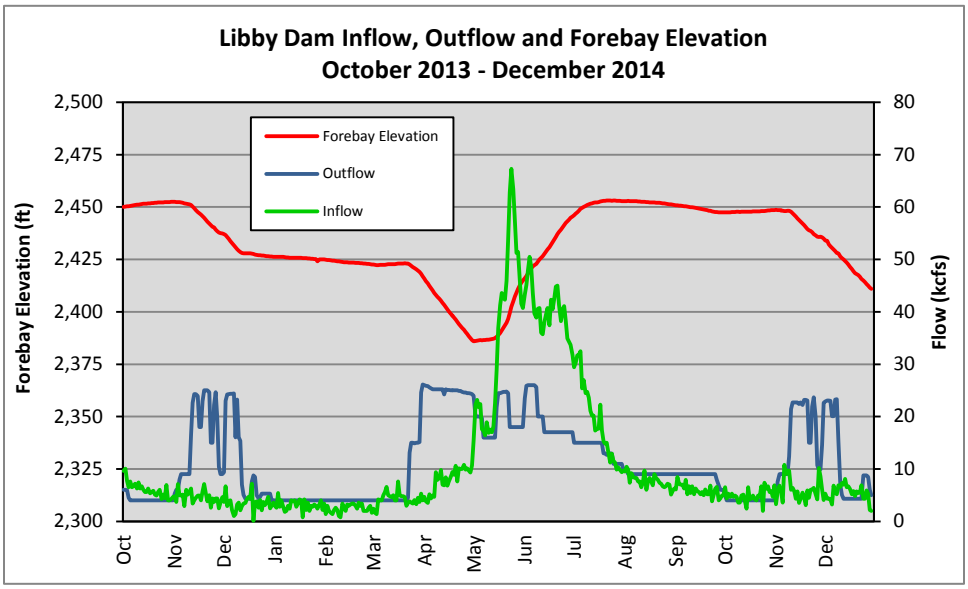

Figure 3. Libby Dam inflow, outflow, and forebay elevation from October 1, 2013, through December 31, 2014.

Grand Coulee Dam

In 2014, Reclamation operated Grand Coulee Dam consistent with the WMP and adjusted in-season to meet real-time considerations such as changing water conditions. The Project supported flows during the juvenile salmonid migration season (e.g., managing reservoir elevations and drafting Banks Lake), and helped support flows for chum salmon.

Lake Roosevelt behind Grand Coulee Dam was drafted slightly in November 2013 to support chum spawning below Bonneville Dam. In December 2013, Lake Roosevelt was drafted for power during a cold snap; however, the power operations did not result in an increased tailwater elevation below Bonneville Dam for spawning and incubation of chum salmon.

The 2014 water year started colder than normal and dryer than average with slightly below average precipitation from October through December 2013, and much below average precipitation in January 2014. There was a dramatic shift to a much wetter period in February and March. Heavy mountain snow accumulations and well above average precipitation, with several daily rainfall records broken, dramatically increased the water supply outlook during February and March. April precipitation was near normal, with above normal temperatures in late April and early May. The peak runoff occurred in mid-May and leveled out in early June. July was warm with a gradual recession of streamflow.

The Northwest River Forecast Center (NWRFC) in Portland, Oregon, provided the April—August volume forecast for Grand Coulee and The Dalles. The April through August water supply forecasts varied, ranging from a low of 83 percent of average in February to a high of 111 percent of average in May at The Dalles. Table 2 shows the water supply forecasts for The Dalles and Grand Coulee Dam, and the April 30 flood control upper rule curve elevation at Grand Coulee Dam.

Table 2. The Dalles and Grand Coulee water supply forecasts and Grand Coulee April 30 flood control elevations.

	Jan	Feb	Mar	Apr	May	Jun	Jul
The Dalles Apr-Aug forecast (percent of average)	97	83	101	105	111	109	109
Grand Coulee Apr-Sep forecast (percent of average)	96	85	102	106	114	111	112
Grand Coulee Apr 30 flood control elevation (feet)	1243.2	1282.7	1236.7	1235.2	N/A	N/A	N/A

The January forecast was near normal so operators started drafting Lake Roosevelt toward an April 30 flood control elevation of 1243.2 feet. A decrease in water supply forecast between January and February increased the April 30 flood control elevation to 1282.7 feet. Operations of Grand Coulee were adjusted to start refilling slightly. Heavy February precipitation resulted in a large increase in the March forecast and a 20 foot lower April 10 elevation target (1256.0 feet), and a 50 foot lower April 30 flood control elevation. Grand Coulee discharges were increased in March to meet the lower elevation targets.

The water elevation at Lake Roosevelt dropped below 1249 feet on April 10 as the project drafted toward the April 30 flood control target of 1235.2 feet. Lake Roosevelt continued to be drafted until May 4 to support spring flow with a maximum draft of 1231.7 feet. Operators began refilling Lake Roosevelt soon after with discharges ranging from 103 to 178 kcfs to control the rate of refill. Grand Coulee Dam was operated to refill Lake Roosevelt by early July to provide summer flow augmentation. Figure 4 shows inflows, outflows and reservoir operations through the water year at Grand Coulee Dam.

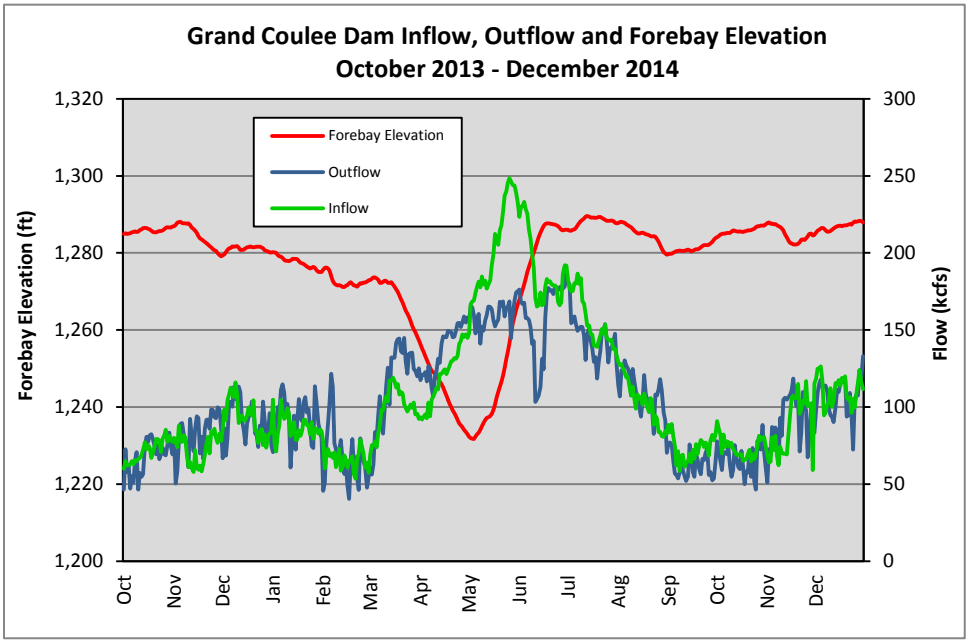

Figure 4. Grand Coulee Dam inflow, outflow, and forebay elevation from October 1, 2013, through December 31, 2014.

Grand Coulee Dam spilled a few days during mid-March, April, May, late June and early July. Spill during April and May was through the outlet works, increasing the total dissolved gas (TDG) levels to 116 percent from 108 percent in the forebay. The spill in March, June and July was over the drum gates so the TDG levels downstream were not increased from levels

in the forebay. In late June and early July the TDG levels were 116 percent below the dam; however, TDG levels flowing into Lake Roosevelt were at 119 percent so spill over the drum gates actually reduced TDG levels slightly.

In order to demonstrate that water was released from Grand Coulee Dam under the Lake Roosevelt Incremental Storage Release Program (LRISRP), operations staff targeted a refill elevation and end of August draft following a recommendation from the Fish Flow Releases Advisory Group. The refill target elevation was 1289.8 feet which is 0.2 feet below the full pool elevation. Lake Roosevelt was refilled to 1289.7 feet on July 14, 2014, the first weekend after July 4, and began the summer draft shortly after. The summer draft for flow augmentation is set by the NWRFC's July Final April-August water supply forecast at The Dalles Dam. The Final April-August water supply forecast at The Dalles was 95.2 Maf which set the draft for flow augmentation to 1280 feet. The end of August draft for the LRISRP was 0.3 feet. Lake Roosevelt was drafted to elevation 1279.6 feet on August 31, 2014.

Banks Lake is drafted to elevation 1565 feet by August 31 to provide water for summer flow augmentation. In 2014, pumping to Banks Lake was reduced and irrigation for the Columbia Basin Project was met by drafting the reservoir 5 feet from full (elevation 1565 feet) by August 31. Operators drafted Banks Lake to elevation 1564.75 feet on August 31, 2014.

Hungry Horse Dam

Reclamation operated Hungry Horse Dam during the fall of 2013 and throughout 2014 to maintain minimum flows in the Flathead River at Columbia Falls and in the South Fork Flathead River below the dam. Minimum flows are for ESA-listed bull trout and were calculated from a sliding scale based on the Hungry Horse Dam inflow volume forecast. The calculated minimum flows from October 2013 to December 2013 are listed in Table 3. Fall 2013 minimum flows were based on the March 2013 final water supply forecast. Minimum flows for 2014 were based on the water supply forecast for January through March, with the March final water supply forecast setting the minimum flows from March to December 2014. The March 2014 final water supply forecast for April to August was 2,110 kaf (109 percent of average) which set the minimum flow requirements on the South Fork Flathead River below Hungry Horse and on the mainstem Flathead River at Columbia Falls at 900 cfs and 3,500 cfs, respectively.

Table 3. Minimum flow requirements from October 2013 to December 2014.

Period	Hungry Horse Minimum Flow (cfs)	Columbia Falls Minimum Flow (cfs)
October-December 2013	900	3,500
January 2014	900	3,500
February 2014	900	3,500
March-December 2014	900	3,500

Operators followed VARQ flood control procedures in 2014. In January, the May-to-September water supply forecast for Hungry Horse Dam was at 106 percent of average and increased to 109 percent of average by the March forecast. The target April 10 elevation based on the March final forecast was 3531.6 feet and the April 30 flood control elevation was 3526.4 feet; however, the project was drafted to elevation 3510.0 feet and 3494.6 feet respectively in anticipation of high inflows to reduce spill and associated TDG generation

during refill. The state TDG standard of 110 percent was exceeded for 30 days peaking at nearly 115 percent, when water was spilled through the jet flow valves. Spill ranging from 2 to 4 kcfs was released from April 3 through April 30, and again on May 13 and 14.

The end of September draft is based on the May final water supply forecast at The Dalles. As the May final water supply forecast at The Dalles for 2014 was not in the lowest 20 percentile, end of September draft for flow augmentation was limited to 10 feet. Hungry Horse Dam operators targeted a September 30, 2014, elevation of 3550.0 feet using steady or slowly declining discharges. Actual operations reached elevation 3549.87 feet on September 30, 2014. Hungry Horse operators aimed to provide a stable flow during the summer flow augmentation period, with an average flow from August through September 2014 of 2.8 kcfs. Figure 5 shows inflows, outflows and forebay elevations through the water year at Hungry Horse Dam.

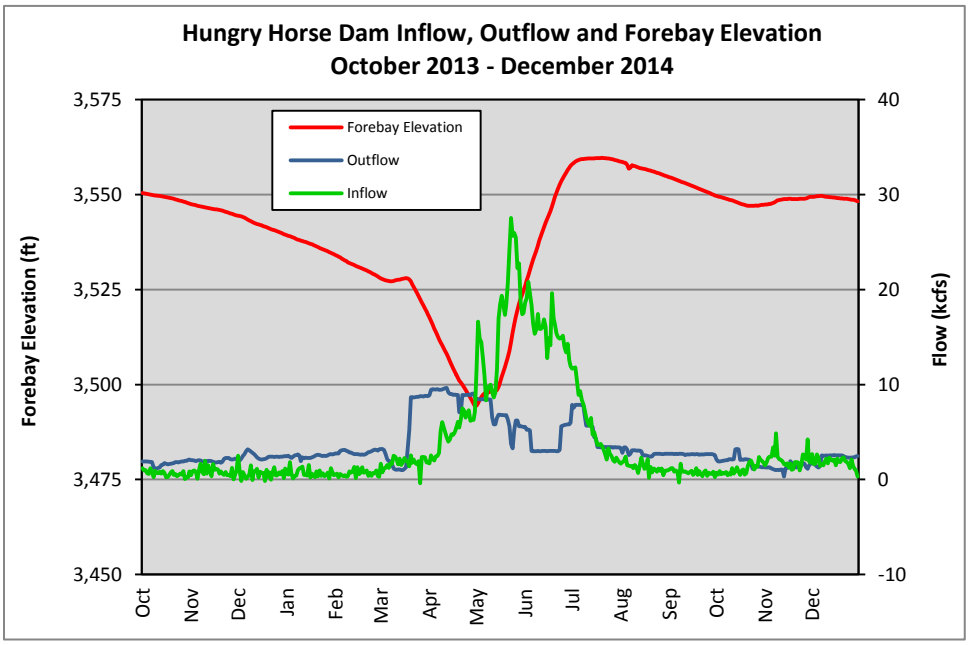

Figure 5. Hungry Horse Dam inflow, outflow, and forebay elevation from October 1, 2013, through December 31, 2014.

Albeni Falls Dam

In late 2012, the Idaho Department of Fish and Game (IDFG) presented information that showed they could not say whether lake levels had benefited kokanee recruitment. As a result, neither USFWS nor IDFG made a System Operation Request for the winter of 2013–14. Since there was no system operational request, the winter minimum control elevation level was set to 2051.0 feet. The target elevation was reached by November 10, 2013.

Lake Pend Oreille was operated in a range of 2051.0–2051.5 feet, as measured at the Hope gauge, from November 10 through December 27, 2013, in order to support kokanee spawning. Kokanee spawning was declared over on December 19, 2013. The minimum control elevation for kokanee spawning and incubation was set at 2051.0 feet for the winter of 2013–14.

Between December 20, 2013, and March 7, 2014, Albeni Falls Dam was operated to maintain Lake Pend Oreille elevation within a 1-foot elevation band (2051 to 2052 feet). After March 7 Lake Pend Oreille was slowly filled to elevation 2054.8 feet on April 30. The slow refill was due to flood risk management; snowpack in the Clark Fork and Flathead River basins upstream of Lake Pend Oreille was about 140 percent of average.

The May 1 water supply forecast for April–July 2014 was 124 percent of average. This forecast led to the start of a cautious refill of Lake Pend Oreille on May 1. The peak outflow for the year was approximately 90.8 kcfs on June 4. Project outflow averaged 67 kcfs in May and 71 kcfs in June. The lake reached its normal summer operating range, between 2062.0 feet and 2062.5 feet on June 26, 2014. For the remainder of the summer the project operated in the normal summer operating range, with the fall draft beginning on September 17.

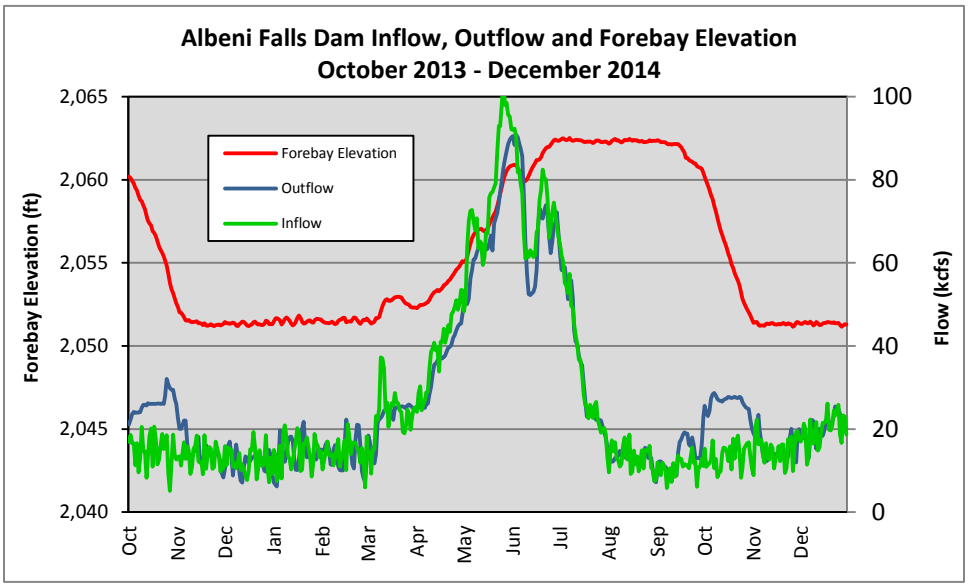

Figure 6. Albeni Falls Dam inflow, outflow, and forebay elevation from October 1, 2013 through December 31, 2014.

The lake was drafted to within a half a foot of the winter minimum control elevation of 2051 feet on November 2, 2014. The fall draft was expedited to allow for a habitat restoration project at the Clark Fork Delta, the inlet from the Clark Fork River to Lake Pend Oreille. The lake was held within 2051 to 2051.5 feet through December 31 to give the lowest possible elevations during the construction period and for kokanee spawning in November and December.

RPA Action 5 – Lower Columbia and Snake River Operations

The Action Agencies will operate the FCRPS run-of-river mainstem lower Columbia River and Snake River projects (Bonneville, The Dalles, John Day, McNary, Ice Harbor, Lower Monumental, Little Goose and Lower Granite projects) to minimize water travel time through the lower Columbia and Snake rivers to aid in juvenile fish passage. These run-of-river operations will be included in the annual WMP (see RPA Action 6).

The 2014 WMP included operations for these run-of-river projects. The projects were operated consistent with the WMP, the 2014 Spring Fish Operations Plan (FOP), and the

2014 Summer FOP, which were consistent with the NOAA Fisheries and USFWS Biological Opinions to guide spill operations for juvenile fish passage and to also minimize water travel time through the Lower Columbia and Snake rivers to aid in juvenile fish passage and water temperature management. Specific operating rules are used at individual reservoirs to provide salmon flows, protect resident fish, control floods, and operate for navigation and other authorized purposes. These operations are discussed further in the minutes of the TMT "2014 Year End Review Session" (TMT 2014a; 2014b). At Lower Monumental, Ice Harbor, Little Goose, and Lower Granite Projects, the plan was to operate at minimum operating pool (MOP) from April 3 through August 31, 2014. The Corps also continued the variable MOP-plus-2 operation for the Lower Granite pool in 2014 based on System Operational Request 2011-01 from the Columbia River Towboat Association. Variable MOP-plus-2 is to provide safe navigation conditions in the Lower Granite reservoir, which in 2014 was compromised by sedimentation in the federal navigation channel. The MOP-plus-2 operation minimizes the duration that Lower Granite Dam must be operated outside of MOP for safe navigation.

The storage projects in the Columbia and Snake River systems, which are described under RPA Action 4 above, have limited ability to shape natural runoff. This limited storage capability can be managed to make modest adjustments in river flows for fish but cannot improve a low-water year or store water from an above-average water year for use in future below-average water years. As a result, flow objectives for juvenile fish are goals that cannot be physically achieved under some conditions. The flow objectives were used for pre-season planning and in-season water management to guide decision making. Figures 7, 8, and 9 show the observed outflow at McNary, Lower Granite, and Priest Rapids dams relative to the flow objectives.

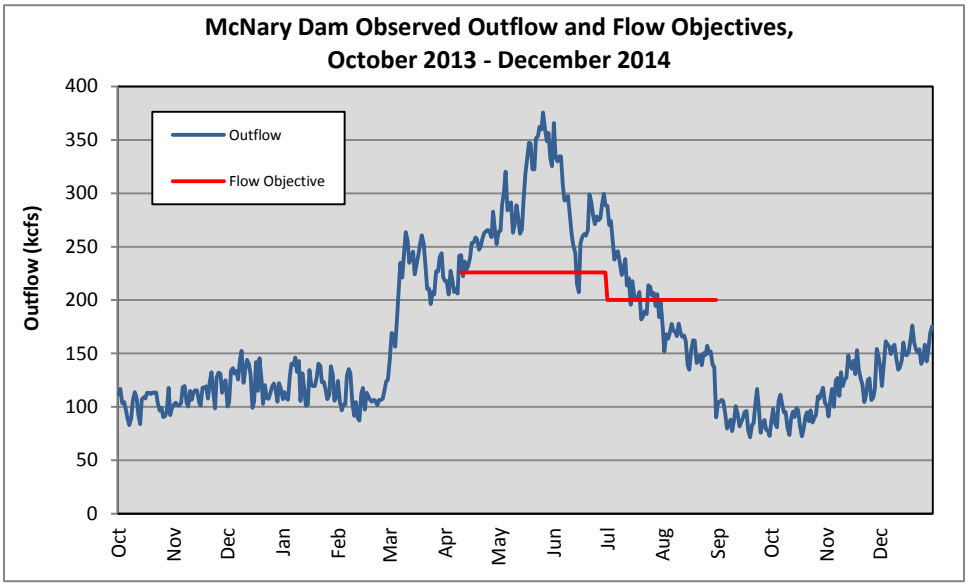

Figure 7. McNary Dam, observed outflow and flow objectives, October 1, 2013, through December 31, 2014. April 10, 2014, to June 20, 2014, actual mean flow 286.9 kcfs, flow objective 226 kcfs. July 01, 2014, to August 31, 2014 actual mean flow 186.6 kcfs, flow objective 200 kcfs. The flow objectives are not achievable in all water conditions; rather they are used for pre-season planning and in-season water management to guide decision making.

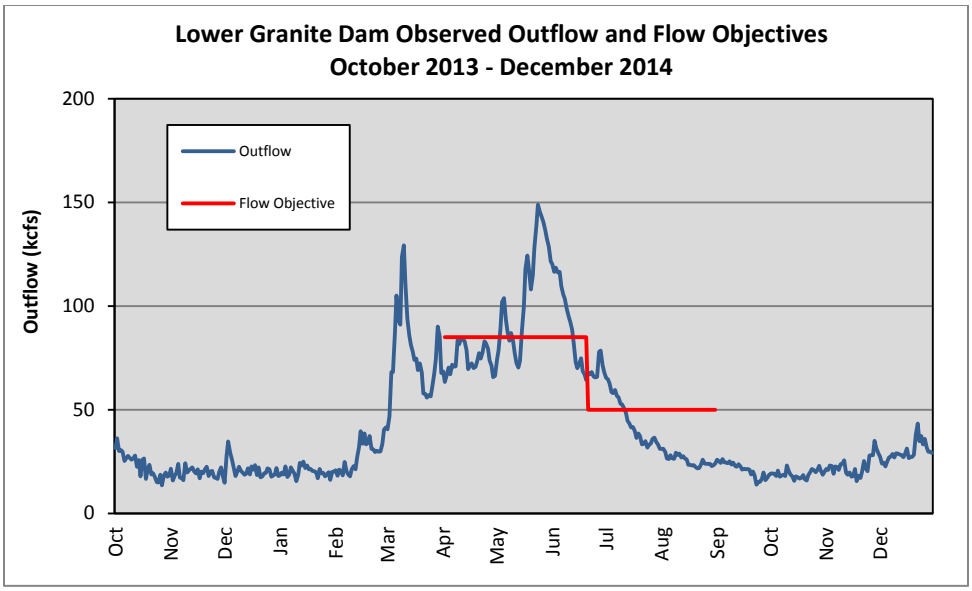

Figure 8. Lower Granite Dam, observed outflow and flow objectives, October 1, 2013, through December 31, 2014. April 3, 2014, to June 20, 2014, actual mean flow 91.9 kcfs, flow objective 85 kcfs. June 21, 2014, to August 31, 2014, actual mean flow 39.9 kcfs, flow objective 50 kcfs. The flow objectives are not achievable in all water conditions; rather, they are used for pre-season planning and in-season water management to guide decision making.

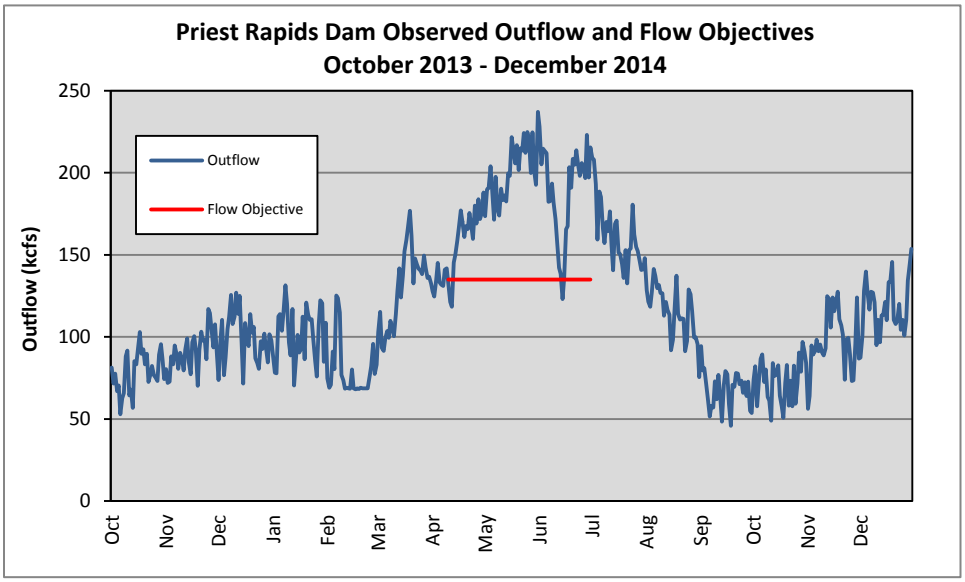

Figure 9. Priest Rapids Dam, observed outflow and flow objectives, October 1, 2013 through December 31, 2014. April 10, 2013, to June 30, 2014 actual mean flow 186.8 kcfs, flow objective 135 kcfs. The flow objectives are not achievable in all water conditions; rather, they are used for pre-season planning and in-season water management to guide decision making.

In 2014, the Columbia River had a slightly above average water year according to NWRFC. The January to July volume as measured at The Dalles Dam (108.1 Maf) was 107 percent of normal (101.3 Maf for period rankings 1981–2010). The Snake River volume from April to July, as measured at Lower Granite (19.7 Maf), was 99 percent of normal (19.8 Maf for period rankings 1981–2010).

RPA Action 6 – In Season Water Management

Prioritization of the use of flow augmentation water is done through in-season management by the Regional Forum. Each fall, the Action Agencies will prepare an annual Water Management Plan (WMP) and seasonal updates that describe planned hydrosystem fish operations for the upcoming fall and winter, and for the spring, and summer passage seasons. The annual WMP strives to achieve the best possible mainstem passage conditions, recognizing the priorities established in the FCRPS BA and the need to balance the limited water and storage resources available in the region. Fall/winter and spring/summer updates are prepared as more data is available on the water conditions for that year. A draft update of the WMP will be prepared by October 1 each year, with a final plan completed by January 1. The fall/winter update to the WMP will be drafted by November 1 and finalized by January 1. A draft of the spring/summer update to the WMP will be prepared by March 1 and finalized by May 15.

The annual WMP for the 2014 operating season (October 1, 2013, through September 30, 2014) was developed collaboratively with the region in accordance with the NOAA Fisheries' 2008 Biological Opinion and their 2010 and 2014 Supplemental Biological Opinions. A draft of the WMP for the 2014 operating season was released on October 1, 2013. The final WMP was released on December 30, 2013.

Prior to 2011, the Action Agencies provided a fall/winter and spring/summer update to the WMP. The TMT indicated that these bi-annual updates were not providing them updated information frequently enough to assist in making informed recommendations to the Action Agencies. In an effort to increase the frequency of updates to the WMP, the TMT recommended discontinuing the semi-annual WMP updates and changing to a "seasonal update" format. At minimum, the seasonal update would be posted two times per year with a goal of posting at a greater frequency. During the 2014 operating season the Action Agencies posted five seasonal updates. Changes to the updating mechanism to the WMP were coordinated with the TMT.

RPA Action 7 – Forecasting and Climate Change/Variability

The Action Agencies will hold annual forecast performance reviews looking at in-place tools for seasonal volume forecasts and to report on the effectiveness of experimental or developing/emerging technologies and procedures. As new procedures and techniques become available and are identified to have significant potential to reduce forecast error and improve the reliability of a forecast, the Action Agencies will discuss the implementation possibilities with regional interests. The purpose is to improve upon achieving upper rule curve elevations by reducing forecasts errors and thereby providing for improved spring flows. The Action Agencies will work collaboratively with other agencies and research institutions to investigate the impacts of possible climate change scenarios to the Pacific Northwest and listed salmon and steelhead. Focus areas will cover (1) modeling the hydrology and operations of the Columbia River system using possible future climate change scenarios, (2) investigating possible adaptation strategies for the system, (3) monitoring the hydrologic system for trends, cycles, and changes, and (4) staying abreast of research and studies that address climate cycles, trends, and modeling.

Columbia River Forecast Group

The Columbia River Forecast Group (CRFG) continues to work collaboratively to assist the Action Agencies in implementing this RPA action. The CRFG annual reports are available at http://www.salmonrecovery.gov/Hydro/Operations.aspx.

Because the CRFG has now been in existence since the NOAA Fisheries 2008 Biological Opinion, the group used 2014 to review all forecast procedures now used in the basin since its inception. Several forecast techniques and procedures have improved since 2009, while ensemble streamflow predictions (ESPs) grew into wider use and acceptance. Because ESPs can be prepared and issued much more frequently than statistical forecasts, decision makers have gained considerable advance notice when conditions are changing rapidly in the basin – either wetter or drier. The CRFG is still learning how to use these forecasts, though, since they have their own shortcomings (i.e. under-dispersion of potential range of outcomes, longer range/lower skill precipitation forecasts occasionally caused sharp swings in forecasts).

The group found through its year-long forecast evaluations that statistical water supply forecasts remain powerful tools to guide decision-making at headwater projects, especially when statistical variables used in the equations have solid reasoning and meteorological backing. In 2014, after two years of science and statistical feedback from CRFG, the updated Libby forecast was adopted for regular use.

Climate Change Studies

The River Management Joint Operating Committee (RMJOC) and its research partners at the University of Washington and Oregon State University continued the RMJOC-II Climate Change Study Project and related research. The CRFG will function as the main technical body to review project progress. The project began in 2014 and will continue through 2017. The overall objective is to use the latest data from the Global Climate Models, published as part of the Coupled Model Intercomparison Project Phase 5 (CMIP-5) and generate a new temperature, precipitation and streamflow dataset for use in future planning studies and activities. Initial evaluations of the new climate modes indicate a somewhat warmer and slightly wetter trend for the Pacific Northwest through the 2040s compared to the CMIP-3 dataset. However, the new global climate models show a slightly larger range in possible future temperatures in the Pacific Northwest, and a continued large spread in future basin precipitation.

Future flows at over 300 locations Columbia River basin-wide will be generated for use in the BPA, Corps, and Reclamation water resource models to evaluate the impact of future climate change on reservoir operations, power, and flooding. Future flow simulations will be generated by the University of Washington in 2016, after which the Action Agencies will begin their analyses. Additionally, NRNI (no regulation no irrigation) flows have been finalized and made available on the BPA Modified Flows website: http://www.bpa.gov/power/streamflow/default.aspx.

RPA Action 8 – Operational Emergencies

The Action Agencies will manage interruptions or adjustments in water management actions, which may occur due to unforeseen power system, flood control, navigation, dam safety, or other emergencies. Such emergency actions will be viewed by the Action Agencies as a last resort and will not be used in place of operations outlined in the annual WMP. Emergency operations will be managed in accordance with TMT Emergency Protocols, the Fish Passage Plan (FPP) and other appropriate Action Agencies emergency procedures. The Action Agencies will take all reasonable steps to limit the duration of any emergency impacting fish.

Little Goose Dam: Between April 27 at 0001 hours and April 30 at 0800 hours, Little Goose Dam operated above the MOP elevation of 633-634 feet in order to properly store the navigation lock bulkhead. Due to an emergency navigation lock outage that occurred at Little Goose Dam between the dates of March 25 and April 21, the project was unable to conduct this operation as previously scheduled prior to April 3. This operation was coordinated during the April 23 TMT meeting and there were no objections.

RPA Action 9 – Fish Emergencies

The Action Agencies will manage operations for fish passage and protection at FCRPS facilities. They may be modified for brief periods of time due to unexpected equipment failures or other conditions. These events can result in short periods when projects are operating outside normal specifications due to unexpected or emergency events. Where there are significant biological effects of more than short duration resulting from emergencies impacting fish, the Action Agencies will develop (in coordination with the in-season management Regional Forum) and implement appropriate adaptive management actions to address the situation. The Action Agencies will take all reasonable steps to limit the duration of any fish emergency.

McNary Dam: For a total of 5 days (May 28 at 0600 hours to May 29 at 0700 hours; May 29 at 1600 hours to June 1 at 0700 hours; June 2 at 0700 hours to 1600 hours; and June 5 at 0700 hours to June 6 at 0700 hours) spill at McNary Dam increased by approximately 12–17 kcfs during special operations to limit turbine units to the mid-point of the ±1 percent peak efficiency range. These special turbine operations were implemented in an effort to help reduce descaling of bypassed juvenile salmon, particularly sockeye, which increased to a high of 36.8 percent on May 27. Juvenile sockeye sampled during the mid-point operations had descaling rates of 16.7 percent on May 29, 14.9 percent on May 31 and 25.0 percent on June 6, compared to descaling rates during normal turbine operations of 19.8 percent on June 2, 16.0 percent on June 4, and 0.0 percent on June 8. Concurrent debris removal efforts included spill operations to pass debris on May 29–30, which required intermittent closure of both spillway weirs for boat safety. Due to decreasing juvenile sockeye passage and inconclusive information regarding effects of turbine operations on descaling, the Corps resumed operating all available turbine units within the full ±1 percent peak efficiency operating range on June 6 at 0700 hours. The Corps implemented the operations in conjunction with debris removal efforts, as coordinated with NOAA Fisheries and other TMT members, on May 27–29, June 4, and June 6. TMT members supported or did not object to the operations.

RPA Action 10 – Describe Actions Taken to Provide 1 Maf of Treaty Storage

BPA and the Corps will pursue negotiations with Canada of annual agreements to provide 1 Maf of storage in Treaty space by April 15 consistent with:

1. *Providing the greatest flexibility possible for releasing water to benefit U.S. fisheries May through July.*

2. *Giving preference to meeting April 10 upper rule curve elevation or achieving refill at Grand Coulee Dam over flow augmentation storage in Canada in lower water supply conditions.*

3. *Releasing flow augmentation storage to avoid causing damaging flow or excessive TDG in the United States or Canada.*

BPA and the Corps will coordinate with Federal agencies, States and Tribes on Treaty operating plans.

The Columbia River Treaty Operating Committee (CRTOC) agreed to allow the U.S. to store up to 1 Maf of water in Treaty storage space as in previous years. The CRTOC Agreement on Operation of Treaty Storage for Non-Power Uses for December 1, 2013, through July 31, 2014, (Non-Power Uses Agreement) was executed on November 22, 2013. Under this agreement, one Maf of flow augmentation water was stored in Canadian reservoirs in January 2014. All flow augmentation storage was released by July 31, 2014, under terms of the agreement.

A new Non-Power Uses Agreement for 2015 was executed on November 6, 2014, which provides for one Maf of flow augmentation water storage under the same terms as the prior agreement.

BPA and the Corps held meetings with federal agencies, states and tribes in spring 2014 and fall 2014 to discuss the Treaty and non-Treaty storage (NTS) operations and Treaty operating plans.

RPA Action 11 – Non-Treaty Storage

BPA, in concert with BC Hydro, will refill the remaining non-Treaty storage space by June 30, 2011, as required under the 1990 non-Treaty storage agreement. Refill will be accomplished with minimal adverse impact to fisheries operations.

In January 2011, BPA and the Corps completed the return of NTS called for under the 1990 Non-Treaty Storage Agreement (NTSA). Refill was accomplished outside of fish passage season to minimize adverse impact to fisheries.

RPA Action 12 – Non-Treaty Long-Term Agreement

BPA will seek to negotiate a new long-term agreement on use of non-Treaty space in Canada so long as such an agreement provides both power and non-power benefits for BC Hydro, BPA, and Canadian and U.S. interests. As part of these negotiations, BPA will seek opportunities to provide benefits to ESA-listed fish, consistent with the Treaty. If a new long-term, non-Treaty agreement is not in place, or does not address flows for fisheries purposes, BPA will approach BC Hydro about possibly negotiating an annual/seasonal agreement to provide U.S. fisheries benefits, consistent with the Treaty.

BPA entered into a new long-term Columbia River NTSA with BC Hydro on April 10, 2012, (2012 NTSA) which expires in 2024. The 2012 NTSA allows for coordinated use of NTS in Canada to shape flows within the year for fisheries benefits, and provides up to an additional one-half Maf of water to benefit fish in the lowest water conditions.

As noted under RPA Action 10, BPA and the Corps held meetings with federal agencies, states and tribes in spring 2014 and fall 2014 to discuss the Treaty and NTS operations and Treaty operating plans.

RPA Action 13 – Non-Treaty Coordination with Federal Agencies, States, and Tribes

Prior to negotiations of new long-term or annual non-Treaty storage agreements, BPA will coordinate with Federal agencies, States, and Tribes to obtain ideas and information on possible points of negotiation, and will report on major developments during negotiations.

As explained in RPA Action 12, BPA entered into the new 2012 NTSA with BC Hydro. The 2012 NTSA allows for coordinated use of NTS in Canada to shape flows within the year for fisheries benefits, and provides up to an additional one-half Maf of water to benefit fish in the lowest water conditions. This action continued to be implemented in 2014.

RPA Action 14 – Dry Water Year Operations

Flow management during dry years is often critical to maintaining and improving habitat conditions for ESA-listed species. A dry water year is defined as the lowest 20th percentile years based on the NWRFC averages for their statistical period of record (currently 1971 to 2000) using the May final water supply forecast for the April to August period as measured at The Dalles. The Action Agencies will complete the following activities to further the continuing efforts to address the dry flow years:

1. *Within the defined "buckets" of available water (reservoir draft limits identified in RPA Action 4), flexibility will be exercised in a dry water year to distribute available water across the expected migration season to optimize biological benefits and anadromous fish survival. The Action Agencies will coordinate use of this flexibility in the Regional Forum TMT.*
2. *In dry water years, operating plans developed under the Treaty may result in Treaty reservoirs being operated below their normal refill levels in the late spring and summer, therefore, increasing flows during that period relative to a standard refill operation.*
3. *Annual agreements between the U.S. and Canadian entities to provide flow augmentation storage in Canada for U.S. fisheries needs will include provisions that allow flexibility for the release of any stored water to provide U.S. fisheries benefits in dry water years, to the extent possible.*
4. *BPA will explore opportunities in future long-term NTS storage agreements to develop mutually beneficial in-season agreements with BC Hydro to shape water releases using NTS space within the year and between years to improve flows in the lowest 20th percentile water years to the benefit of ESA-listed ESUs, considering their status.*
5. *Upon issuance of the FCRPS Biological Opinion, the Action Agencies will convene a technical workgroup to scope and initiate investigations of alternative dry water year flow strategies to enhance flows in dry years for the benefit of ESA–listed ESUs.*
6. *In very dry years, the Action Agencies will maximize transport for Snake River migrants in early spring, and will continue transport through May 31.*

BPA will implement, as appropriate, its Guide to Tools and Principles for a Dry Year Strategy to reduce the effect energy requirements may pose to fish.

The BiOp defines a dry year as a year when the NWRFC May final forecast for April-to-August runoff at The Dalles Dam is below the 20th percentile for the NWRFC statistical period of record. The statistical period of record is now 1981 to 2010, for which the 20th percentile value is 72 Maf. The 2014 water year was not a dry year, with the May forecast coming in at 96.7 Maf or 111 percent of average for the April–August period. The actual runoff volume was 94.6 Maf, or 108 percent of average.

The Action Agencies convened a technical workgroup, which scoped and initiated investigations of alternative dry water year flow strategies to enhance flows in dry years for the benefit of ESA-listed fish. The group's analysis contributed to the development of a dry water year's provision of the 2012 NTSA (see RPA Action 12).

RPA Action 15 – Water Quality Plan for Total Dissolved Gas and Water Temperature in the Mainstem Columbia and Snake Rivers

The Action Agencies will continue to update the Water Quality Plan for Total Dissolved Gas and Water Temperature in the Mainstem Columbia and Snake Rivers (WQP) and implement water quality measures to enhance ESA-listed juvenile and adult fish survival and mainstem spawning and rearing habitat. The WQP is a comprehensive document which contains water quality measures needed to meet both ESA and Clean Water Act responsibilities. For purposes of this RPA, the WQP will include the following measures to address TDG and water temperature to meet ESA responsibilities:

1. *Real-time monitoring and reporting of TDG and temperatures measured at fixed monitoring sites,*

2. *Continued development of fish passage strategies with less production of TDG, and*

3. *Update the SYSTDG model to reflect modifications to spillways or spill operations,*

4. *Continued development and use of SYSTDG model for estimating TDG production to assist in real-time decision making, including improved wind forecasting capabilities as appropriate,*

5. *Continued development of the CEQUAL-W2 model for estimating river temperatures from Dworshak Dam on the Clearwater and Upper Snake River near the confluence with the Grand Ronde River (USGS Anatone gauge) through the lower Snake River (all four Corps lower Snake River projects) to assist in real-time decision making for Dworshak Dam operations, and*

6. *Expand water temperature modeling capabilities to include Columbia River from Grand Coulee to Bonneville dams to better assess the effect of operations or flow depletions on summer temperatures, and*

7. *Investigate alternatives to reduce total mass loading of TDG at Bonneville Dam while maintaining juvenile survival performance, and*

8. *Continued operation of the Lower Snake River projects at MOP.*

Real-time TDG and temperature values are reported hourly on the water quality pages of the TMT website at http://www.nwd-wc.usace.army.mil/ftppub/water_quality/tdg/.

The *2014 Final Water Quality Plan* provides the overall framework for addressing water quality measures needed to meet both the ESA and Clean Water Act responsibilities. In 2014, spill at the projects was managed consistent with the 2014 Total Dissolved Gas Management Plan, which is Appendix 4 of the 2014 Water Management Plan (BPA et al. 2013a). Real-time monitoring was conducted consistent with the 2010–2014 Dissolved Gas Monitoring Plan of Action (ACOE 2008).

The System Total Dissolved Gas (SYSTDG) model was used as a real-time decision support tool to manage spill at Lower Columbia and Snake Rivers projects. A statistical evaluation of SYSTDG's performance was conducted to assess how well the model estimated percent TDG. The predictive errors that SYSTDG computed in 2014 compared favorably with the predictive errors from previous years. A summary of the predictive error for each fixed monitoring station can be found in Appendix F, Tables F1-F8, of the 2014 Total Dissolved Gas Report (ACOE 2014a).

The following improvements were made to the SYSTDG model in 2014:

1. The link between the coefficients of the weather station and the Little Goose Dam TDG production equations was corrected.

2. SYSTDG was converted to pull the current year's data from the Corps Water Management System database (instead of from two Access databases that were populated from various internet websites). This improvement was initiated in 2013 and completed in 2014.

3. The Washington method of calculating 12-hour average percent TDG based on 12 consecutive hours was added to SYSTDG, as recommended in Appendix G of the 2009 Total Dissolved Gas and Water Temperature Report.

4. The feature of entering spill patterns into SYSTDG was added to Chief Joseph Dam, as recommended in Appendix G of the 2013 Total Dissolved Gas and Water Temperature Report.

5. A revised Lower Monumental spill pattern with gate settings for spill levels as low as 6 kcfs was incorporated into the model for the 2014 spill season, as recommended in the 2013 Appendix G of the 2013 Total Dissolved Gas and Water Temperature Report.

6. The Reservoir Control Center Water Quality group requested an expanded McNary spill pattern that covers high-flow spillway discharges (up to 300 kcfs) for the 2015 spill season, as recommended in Appendix G of the 2013 Total Dissolved Gas and Water Temperature Report.

7. The workbooks and equations used in the statistical analysis to generate Appendix G of the 2014 Total Dissolved Gas and Water Temperature Report were added to SYSTDG.

The CEQUAL-W2 model was used from late June through September 2014 to support decisions regarding operation of Dworshak Dam for flow augmentation and temperature management on the lower Snake River. The results were presented and discussed routinely with TMT members and Action Agencies to develop best management strategies.

Development and calibration of the water quality model for Grand Coulee reservoir has been completed. The model spans the extent of Lake Roosevelt from the international border with Canada down to and including Grand Coulee Dam. The model incorporates the Kettle, Colville, Spokane, and Sanpoil River reaches via U.S. Geological Survey (USGS) gauging stations. The model also uses Reclamation AgriMet weather station data as the forcing variables for meteorological conditions. The model was built using CEQUAL-W2 and is currently calibrated to model Grand Coulee Dam outflow temperatures using recent historical data. Model calibration was limited by the amount of available meteorological data and was only performed for calendar years 2000, 2006, and 2011. The calibration report, authored by Portland State University, is currently in draft format with final reviews in progress.

Work included the development and calibration of a RiverWare model to supplement the CEQUAL-W2 model for Grand Coulee Dam. The RiverWare model contains modeling assumptions and rules that simulate operations at Grand Coulee Dam with regard to powerhouse operations as well as Banks Lake pumping and generation. Given projected

inflows and operational assumptions, the RiverWare model is used to route Grand Coulee Dam outflows to the left, right, or third powerhouses, Banks Lake, or spill. RiverWare outputs are used as inputs for CEQUAL-W2 to determine outflow temperatures at each outlet and the weighted average temperature for the total outflow. The RiverWare model was completed and calibrated.

Lower Snake River projects were operated to the minimum operating pool (MOP) per the 2014 Spring and Summer FOPs. Lower Granite is operated from MOP to MOP+2 feet in order to provide adequate water depths for navigation up through Lewiston and Clarkston, Idaho. Dredging operations in the winter of 2015 should help alleviate these higher pool levels at Lower Granite Reservoir for the 2015 operating season.

RPA Action 16 – Tributary Projects

The tributary projects that have not yet completed ESA Section 7 consultation are located in the Yakima, Okanogan, and Tualatin river basins. Reclamation will, as appropriate, work with NOAA Fisheries in a timely manner to complete supplemental, project-specific consultations for these tributary projects. These supplemental consultations will address effects on tributary habitat and tributary water quality, as well as direct effects on salmon survival in the tributaries. The supplemental consultations will address effects on mainstem flows only to the extent to which they reveal additional effects on the instream flow regime not considered in the FCRPS and Upper Snake River BA/Comprehensive Analysis.

The Bureau of Reclamation submitted Biological Assessments (BAs) to NOAA Fisheries on the Okanogan, Tualatin, and Yakima projects. Reclamation is currently working with NOAA Fisheries on each of these tributary specific consultations. The current status on each consultation and the predicted future work schedules for these project consultations are provided below.

Tualatin Project Consultation

NOAA Fisheries issued a final Tualatin Project Biological Opinion to Reclamation on October 1, 2014. This Biological Opinion was a non-jeopardy opinion that included both monitoring and reporting reasonable and prudent measures (RPMs) as part of the Incidental Take Statement. Reclamation began implementing the RPMs that were included in the Tualatin Project Final Biological Opinion.

Okanogan Project Consultation

Reclamation submitted a Biological Assessment (BA) for the future operation and maintenance of the Okanogan Project in 2008. This consultation covers Upper Columbia Steelhead. Since 2009 Reclamation has been collecting data in the Okanogan Basin to determine if the proposed action can be modified to address concerns raised by NOAA Fisheries. Data collection continued into the 2014 to 2018 period. It is anticipated that Reclamation will reinitiate consultation with NOAA Fisheries in the 2015 through 2016 time period. The objective would be to provide an updated proposed action to NOAA Fisheries at the end of 2016 and to conclude Section 7 consultation with NOAA Fisheries in 2017.

Yakima Project Consultation

Reclamation and the NOAA Fisheries re-initiated consultation at the end of 2012 on mid-Columbia Steelhead. Through 2014, Reclamation and the Services (NOAA Fisheries and USFWS) were revising the 2000 BA, the 2009 BA Supplement, and integrating new

information obtained from the 2012 Integrated Water Resource Management Planning effort into a new BA. Reclamation and NOAA Fisheries continued to meet on this consultation through 2014 and will continue efforts through 2015.

RPA Action 17 – Chum Spawning Flows

1. *Provide adequate conditions for chum spawning in the mainstem Columbia River in the area of the Ives Island complex and/or access to the Hamilton and Hardy Creeks for this spawning population.*

2. *Provide a tailwater elevation below Bonneville Dam of approximately 11.5 feet beginning the first week of November (or when chum arrive) and ending by December 31, if reservoir elevations and climate forecasts indicate this operation can be maintained through incubation and emergence.*

3. *Through TMT, if water supply is deemed insufficient to provide adequate mainstem spawning or continuous tributary access, provide, as appropriate, mainstem flow intermittently to allow fish access to tributary spawning sites if adequate spawning habitat is available in the tributaries.*

4. *Make adjustments to the tailwater elevation through the TMT process consistent with the size of the spawning population and water supply forecasts.*

5. *After the completion of spawning, use the TMT process to establish the tailwater elevation needed to provide protection for mainstem chum redds through incubation and the end of emergence.*

6. *If the emergence period extends beyond April 10th and the decision is made to maintain the tailwater, TMT will discuss the impacts of TDG associated with spill for fish in the gravel.*

7. *Bonneville Dam typically starts its spring spill around April 10, but a delay in the start of spill may be needed.*

8. *Revisit the chum protection level decision at least monthly through the TMT process to assure it is consistent with the need to provide spring flows for listed Columbia and Snake River stocks.*

2013-2014 Operation

All actions below were carried out in coordination with the TMT.

On November 7, 2013, the Action Agencies initiated the chum operation. The Action Agencies issued the following guidance to operators at Bonneville Dam to provide habitat for spawning chum salmon: (1) operate the tailwater within a range of 11.3 to 11.7 feet, targeting 11.5 feet during the day, and (2) up to 18.5 feet at night.

On December 5, 2013, the Action Agencies implemented the following revised chum operation due to increasing inflows: (1) operate the tailwater within a range of 12.7 to 13.1, targeting 12.9 feet, during the day and (2) up to 18.5 feet at night.

On December 12, 2013, the Action Agencies implemented the following revised chum operation due to decreasing inflows: (1) operate the tailwater within a range of 11.6 to 12.0 feet, targeting 11.8 feet, during the day and (2) up to 18.5 feet at night.

On December 24, 2013, the Action Agencies discontinued the day/night spawning operation and began the 11.5 feet minimum tailwater operation at all hours for chum incubation.

On April 2, 2014, the Action Agencies ended the chum operation because the fish had emerged from the gravel so the operation was no longer needed.

2014-2015 Operation

All actions below were carried out in coordination with the TMT.

On November 1, 2014, the Action Agencies initiated the chum operation. The Action Agencies issued the following guidance to operators at Bonneville Dam to provide habitat for spawning chum salmon: (1) During all hours operate project outflow to provide a tailwater elevation in the range of 11.5 to 12.5 feet, (2) if necessary to increase project outflow, tailwater may be operated up to 13.0 feet at any time and return to a tailwater range of 11.5 to 12.5 feet whenever possible, (3) if necessary to increase project outflow the tailwater may be operated up to 16.5 feet during the night, (4) then if necessary to increase project outflow the tailwater may be operated up to 18.5 feet during the night (5) if increasing river flows exceeds the projects ability to manage tailwater in accordance with the previous steps, operate to provide a tailwater elevation in the range of 13.0 to 16.5 feet during the day and up to the maximum within project 24-hour ramp rate limits during the night.

On December 19, the Action Agencies discontinued the day/night spawning operation and began the 13.0 feet minimum tailwater operation on all hours for chum incubation.

On April 10, 2015, the Action Agencies ended the chum operation because the fish had emerged from the gravel so the operation was no longer needed.

RPA Action 18 – Configuration and Operation Plan (COP) for Bonneville Project

The Corps will consider all relevant biological criteria and prepare, in cooperation with NOAA Fisheries and the co-managing agencies, a Configuration and Operational Plan for the Bonneville Project (2008). As part of the first phase of modifications, the Corps will investigate, and implement the following reasonable and effective measures to reduce passage delay and increase survival of fish passing through the forebay, dam, and tailrace as warranted. Initial modifications will likely include:

Bonneville Powerhouse I

1. *Sluiceway modifications to optimize surface flow outlet to improve fish passage efficiency and reduce forebay delay (2009).*

   Powerhouse I sluiceway improvements, which converted the sluiceway to a surface flow outlet, were completed in 2010.

2. *Minimum-gap turbine runner installation to improve survival of fish passing through turbines (2009).*

   Installation of the final minimum-gap turbine runners at Powerhouse I was completed in 2010.

Bonneville Powerhouse II

3. *Screened bypass system modification to improve fish guidance efficiency and reduce gatewell residence time (2008).*

Modifications to the juvenile bypass system to improve fish guidance efficiency (FGE) were completed in 2008. However, after those modifications a fish injury problem was identified. In 2013 the Corps continued an alternatives study to address those increased injury rates. A prototype of the recommended alternative, a gate slot filler, was constructed and tested hydraulically and biologically. Preliminary fish condition and survival testing using hatchery fish was sufficient to determine that the gate filler prototype did not increase survival sufficiently to function as a standalone alternative.

The Corps Powerhouse II FGE program, in collaboration with the Fish Facility Design Review Work Group (FFDRWG), re-assessed and refined the remaining alternatives. A supplement to the Engineering Documentation Report in 2014 utilized Computational Fluid Dynamics modeling to evaluate and rank the updated alternatives. In 2014, a prototype gatewell flow reduction alternative was installed in a Powerhouse II turbine unit and hydraulically measured. Following these tests a biological evaluation was planned for implementation in 2015.

In 2014, Powerhouse II turbine units continued to be operated at the lower end of the ±1 percent peak efficiency range, as coordinated through FPOM. This operation reduces flow into the gatewells, thereby reducing the injury to fish passing into the juvenile bypass system.

4. *Shallow behavioral guidance screen installation to increase Corner Collector efficiency and reduce forebay delay (prototype 2008).*

   Testing of a shallow behavioral guidance structure at Powerhouse II was completed in 2010. Due to minimal benefits and high operation and maintenance costs, the structure was removed prior to the 2011 migration season.

Bonneville Dam Spillway

5. *Spillway operation or structure (e.g., spillway deflectors) modification to reduce injury and improve survival of spillway passed fish; and to improve conditions for upstream migrants (2013).*

   Hydraulic modeling and fish survival studies were completed and spillway operations that increased survival of juvenile salmonids passing through the spillway were implemented in 2008. A study to identify and evaluate structural fish passage improvements to the spillway was completed in 2009. Further development of structural improvements is on hold pending results of performance testing.

The COP will be updated periodically and modifications may be made as new biological and engineering information is gathered. The COP and modifications will be coordinated through the Regional Forum. Comments developed by NOAA Fisheries on the draft COPs shall be reconciled by the Corps in writing to NOAA Fisheries' satisfaction before release of the final COP. If Phase I actions fail to meet the intended biological targets, the COP will be updated to identify additional Phase II actions for further implementation.

Performance standard testing was conducted in 2011 for yearling Chinook salmon and juvenile steelhead and in 2012 for subyearling Chinook salmon (Table 4). In 2011, dam passage survival estimates for yearling Chinook were slightly below the 96-percent BiOp performance standard, at 95.6 percent, while juvenile steelhead dam passage survival exceeded the standard at 97.6 percent during the portion of the study period when the target spill level (100 kcfs) was attained (April 30-May 13). The 95 percent confidence

intervals of 2011 steelhead survival estimates exceeded the ± 3 percent BiOp requirement by ±0.5 percent.

Table 4. Dam passage survival (with standard errors), passage times, and spillway passage efficiency for yearling Chinook salmon, juvenile steelhead, and subyearling Chinook at Bonneville Dam in 2011 and 2012 (Skalski et al. 2012a; 2013a). Spill passage efficiency includes spillway and other surface passage route passage.

Species	Dam Passage Survival (Percent with Standard Error)	Forebay/Tailrace Passage Time (Hours)	Spill Passage Efficiency (Percent)
100-kcfs Spill (April 30-May 13, 2011)			
Yearling Chinook	95.7 (0.4)	n/a	n/a
Juvenile Steelhead	97.6 (1.8)	n/a	n/a
181-kcfs Season-wide Spill (April 30-May 31, 2011)			
Yearling Chinook	96.0 (1.8)	0.6/0.4	56.6
Juvenile Steelhead	96.5 (2.1)	0.9/0.4	54.4
149 kcfs Season-wide Spill (June 19 – July 22, 2012)			
Subyearling Chinook	97.4 (0.7)	0.5/0.4	53.2

An additional year of performance standard testing may be required at Bonneville Dam. Pending the results of additional performance standard testing, the Corps will work with NOAA and other regional partners to determine if the juvenile dam passage survival standards have been met or if additional actions and/or operation adjustments may be necessary to meet the performance standards.

RPA Action 19 – Configuration and Operation Plan for The Dalles Project

The Corps will consider all relevant biological criteria and prepare, in cooperation with NOAA Fisheries and the co-managing agencies, a Configuration and Operational Plan for The Dalles Project (2008). As part of the first phase of modifications, the Corps will investigate, and implement the following reasonable and effective measures to reduce passage delay and increase survival of fish passing through the forebay, dam, and tailrace as warranted. Initial modifications will likely include:

1. *Turbine operation optimization to improve overall dam survival (2011).*

   A model turbine runner was fabricated in 2009 in preparation for future turbine operation improvements.

   A Phase II Turbine Optimization report was completed in 2013. For more details on this report, see RPA 27.

2. *Extended tailrace spill wall to increase direct and indirect survival of spillway passed fish (2010).*

   The extended length spillwall was completed in 2010. Additional avian predation deterrent wires were installed over the spillway tailrace in 2011.

The COP will be updated periodically and modifications may be altered as new biological and engineering information is gathered. The COP and modifications will be coordinated through the Regional Forum. Comments developed by NOAA Fisheries on the draft COPs shall be reconciled by the

Corps in writing to NOAA Fisheries' satisfaction before release of the final COP. If Phase I actions fail to meet the intended biological targets, Phase II actions, as described in the FCRPS BA – Appendix B.2.1 will be considered for further implementation.

The COP was updated in 2009 and recommended installation of an extended length spillwall as the preferred alternative to improve juvenile fish passage survival. The spillwall construction was completed in 2010 and juvenile fish performance testing conducted in 2010–2012. Current performance testing results are shown in Table 5 below. All juvenile fish survival performance tests have been completed. Dam passage survival standards for all tests were met except for steelhead in 2010 (95.3 percent). Following the 2010 test, avian deterrent wires were installed over the spillway tailrace and the avian predator hazing effort was increased at the project. In 2011, steelhead survival was 99.5 percent. Required precision levels were met for all tests. In addition, all identified survival model assumptions were met in each year (Johnson et al. 2011; Skalski et al. 2012b; 2013b). Observed SPE values were within or above the range of Columbia Basin Fish Accord SPE values for all species tested. Forebay residence times were estimated over a 1 km distance in the performance standard tests, but only over a 100 meter distance in the accord metrics. Therefore a direct comparison of the two values is not a useful way to evaluate whether forebay delay has improved or declined from the estimates included in the accords. In general, overall passage times remain relatively short at The Dalles Dam.

Table 5. Dam passage survival (with standard errors), passage time, and spill passage efficiency for yearling Chinook, juvenile steelhead, and subyearling Chinook at The Dalles Dam in 2010, 2011, and 2012 (Johnson et al. 2011; Skalski et al. 2012b; 2013b). Spill passage efficiency includes spillway and other surface passage route passage.

Species	Dam Passage Survival (Percent with Standard Errors)	Forebay Passage Time (Hours)	Spill Passage Efficiency (Percent)
2010 – 40 Percent Spill			
Yearling Chinook	96.4 (1.4)	1.28	94.7
Juvenile Steelhead	95.3 (1.4)	1.28	95.4
Subyearling Chinook	94.0 (0.9)	1.20	83.0
2011 – 40 Percent Spill			
Yearling Chinook	96.0 (1.0)	0.97	83.1
Juvenile Steelhead	99.5 (0.8)	0.81	89.2
2012 – 40 Percent Spill			
Subyearling Chinook	94.7 (0.6)	1.08	70.7

RPA Action 20 – Configuration and Operation Plan for John Day Project

The Corps will consider all relevant biological criteria and prepare, in cooperation with NOAA Fisheries and the co-managing agencies, a Configuration and Operational Plan for the John Day Project (2008). As part of the first phase of modifications, the Corps will investigate, and implement the following reasonable and effective measures to reduce passage delay and increase survival of fish passing through the forebay, dam, and tailrace as warranted. Initial modifications will likely include:

1. *Full-flow bypass and PIT Tag detection installation to reduce handing stress of bypassed fish (2007).*

A full-flow passive integrated transponder (PIT) tag detector was installed in the juvenile bypass system in 2007.

2. *Turbine operation optimization to improve overall dam survival (2011).*

   Hydraulic and numerical model studies of the turbine environment, laboratory studies on fish, and field studies were conducted to develop and verify a turbine operating point for John Day Dam turbines. However, an evaluation of total mortality, which also incorporates pressure effects on fish, was determined to be infeasible at this time.

   A Phase II Turbine Optimization report was completed in 2013. For more details on this report, see RPA 27.

3. *Surface flow outlet(s) construction to increase fish passage efficiency, reduce forebay delay and improve direct and indirect survival (prototype 2008 with final installation by 2013), and improve tailrace egress conditions.*

   Spillway weirs were installed in spillbays 18 and 19 in 2010. In 2013, the two prototype spillway weirs and associated handling equipment were modified so they would be suitable for long-term operation and maintenance.

   As part of the surface flow outlet system, three tailrace improvements were implemented.

   - An extended-length spillway deflector was installed in Bay 20 to improve tailrace egress.
   - An expanded avian wire array was installed in 2010. In 2013, the avian wire array was modified to improve reliability and future maintenance.
   - New spill patterns were implemented to optimize tailrace egress in conjunction with spillway weir flow.

The COP will be updated periodically and modifications may be altered as new biological and engineering information is gathered. The COP and modifications will be coordinated through the Regional Forum. Comments developed by NOAA Fisheries on the draft COPs shall be reconciled by the Corps in writing to NOAA Fisheries' satisfaction before release of the final COP. If Phase I actions fail to meet the intended biological targets, Phase II actions, as described in the FCRPS BA – Appendix B.2.1, will be considered for further implementation.

The COP was completed in 2007 and recommended installing surface flow outlets and tailrace improvements as Phase I actions. All Phase I configuration modifications have been constructed and tested.

Two years of juvenile survival performance tests have been completed for yearling Chinook, steelhead and subyearling Chinook salmon (Table 6). Results for spring migrants indicate John Day Dam is meeting performance standard goals. In 2014 survival estimates for subyearling results fell below the target (93 percent) at both 30 percent and 40 percent spill. The Corps will work with NOAA and other regional partners to determine if additional actions and/or operation adjustments may be necessary to meet the performance standards for subyearling Chinook salmon.

Table 6. Dam passage survival (with standard errors), passage time, and spill passage efficiency for yearling Chinook salmon, juvenile steelhead, and subyearling Chinook at John Day Dam in 2011, 2012, and 2014 (Skalski et al. 2012c; 2013c; 2015a).

Species	Dam Passage Survival (Percent with Standard Error)	Passage Time (Hours) Forebay/Tailrace	Spill Passage Efficiency (Percent)
2011 – 30-Percent Spill			
Yearling Chinook	96.7 (1.0)	2.0/0.6	61.2
Juvenile Steelhead	98.4 (0.9)	4.3/0.6	61.2
2011 – 40-Percent Spill			
Yearling Chinook	97.8 (1.1)	1.5/0.6	66.4
Juvenile Steelhead	99.0 (1.0)	3.2/0.6	65.9
2011 – Seasonwide Spill			
Yearling Chinook	96.8 (0.7)	1.4/0.6	63.7
Juvenile Steelhead	98.7 (0.6)	2.9/0.6	62.9
2012 – Seasonwide Spill			
Yearling Chinook	96.7 (0.7)	1.2/0.4	74.6
Juvenile Steelhead	97.4 (0.3)	2.4/0.5	74.5
Subyearling Chinook	94.1 (0.3)	1.0/0.5	69.6
2014 – 30-Percent Spill			
Subyearling Chinook	92.0 (0.6)	2.3/0.6	55.5
2014 – 40-Percent Spill			
Subyearling Chinook	91.3 (0.8)	1.9/0.6	71.3
2014 – Seasonwide Spill			
Subyearling Chinook	91.7 (0.6)	2.1/0.6	63.7

RPA Action 21 – Configuration and Operational Plan for the McNary Project

The Corps will consider all relevant biological criteria and prepare, in cooperation with NOAA Fisheries and the co-managing agencies, a Configuration and Operational Plan for the McNary Project (2009). As part of the first phase of modifications, the Corps will investigate, and implement the following reasonable and effective measures to reduce passage delay and increase survival of fish passing through the forebay, dam, and tailrace as warranted. Initial modifications will likely include:

1. *Turbine operation optimization to improve survival of fish passing through turbines (2013).*

   The Phase II Turbine Optimization report was completed in 2013. For more details on this report, see RPA 27.

2. *Improve debris management to reduce injury of bypass and turbine passed fish (2011).*

   Screen cleaning data were evaluated in 2009 and 2010, and the frequency of screen cleaning was increased. Beginning in 2010, debris was removed from trashracks a minimum of four times (March, April, May, June) during the passage season. Prior to this, raking occurred initially before watering up the juvenile fish facility in late March

and on an as-needed basis after that. The Corps hopes to acquire a boat in 2015 to assist with moving mats of forebay debris over to the spillway for passage.

3. *Relocate juvenile bypass outfall to improve egress, direct, and indirect survival on bypassed fish (2011).*

   Juvenile bypass outfall relocation was completed in 2012.

4. *Surface flow outlet installation to increase fish passage efficiency, reduce forebay delay, and improve direct and indirect survival (temporary structure testing in 2007 and 2008 to develop a permanent system).*

   Two spillway weirs were installed in 2007, tested in several spillbays, and moved to their expected permanent locations in 2010.

The COP will be updated periodically and modifications may be altered as new biological and engineering information is gathered. The COP and modifications will be coordinated through the Regional Forum. Comments developed by NOAA Fisheries on the draft COPs shall be reconciled by the Corps in writing to NOAA Fisheries' satisfaction before release of the final COP. If Phase I actions fail to meet the intended biological targets, Phase II actions, as described in the FCRPS BA—Appendix B.2.1, will be considered for further implementation.

The Final Draft of the McNary COP was distributed in 2013.

In addition, a study evaluating and comparing fish guidance efficiency with turbine unit head gates in the raised and stored positions was completed in 2013 (Ham et al. 2013). The study included two operating points and was split between spring and summer migrants. No significant difference in fish guidance efficiency was found between head gate positions or operations for spring or summer migrants. Head gates were lowered to the design storage position for 7 of the 14 turbine units in 2014. The head gates for the remaining turbines were stored in the raised position due to pending maintenance requirements to facilitate lowering to the design storage position.

Two years of performance standard testing have been completed for both spring and summer migrants at McNary Dam (Table 7). Pending the results of additional performance standard testing, the Corps will work with NOAA and other regional partners to determine if the juvenile dam passage survival standards have been met or if additional actions and/or operation adjustments may be necessary to meet the performance standards.

Table 7. Dam passage survival (with standard errors), passage time, and spill passage efficiency for yearling and subyearling Chinook salmon and juvenile steelhead at McNary Dam in 2012 and 2014 (Skalski et al. 2013d; 2015b). Target spill was 40 percent spring and 50 percent summer.

Species	Dam Passage Survival (Percent)	Passage Time (Hours) Forebay/Tailrace	Spill Passage Efficiency (Percent)
2012			
Yearling Chinook	96.2 (1.4)	1.8/0.4	72.5
Subyearling Chinook	97.5 (1.1)	1.8/0.4	78.3
Juvenile Steelhead	99.1 (1.8)	1.8/0.3	83.2
2014			
Yearling Chinook	96.1 (1.3)	1.7/0.4	71.4
Subyearling Chinook	92.4 (1.8)	2.2/0.5	53.8
Juvenile Steelhead	97.0 (1.4)	2.6/0.4	84.3

RPA Action 22 – Configuration and Operation Plan for the Ice Harbor Project

The Corps will consider all relevant biological criteria and prepare, in cooperation with NOAA Fisheries and the co-managing agencies, a Configuration and Operational Plan for the Ice Harbor Project (2008). As part of the first phase of modifications, the Corps will investigate, and implement the following reasonable and effective measures to reduce passage delay and increase survival of fish passing through the forebay, dam, and tailrace as warranted. Initial modifications will likely include:

1. *Guidance screen modification to improve fish guidance efficiency (2010).*

   A regional team evaluated the biological effects of possible fish guidance efficiency improvements to the existing standard length traveling screens and concluded that no significant survival benefit would be gained. Therefore, this action was not recommended in the draft COP and has been indefinitely deferred due to a lack of regional support.

2. *Turbine operation optimization to improve survival of turbine passed fish (2011).*

   A Phase II Turbine Optimization report was completed in 2013. For more details on this report, see RPA 27.

3. *Spillway chute and/or deflector modification to reduce injury and improve survival of spillway passed fish through the removable spillway weir (2009).*

   A construction contract for spillway chute and deflector modifications to reduce injury and improve survival of spillway-passed fish through the removable spillway weir was awarded in 2014 and construction completed during the winter of 2014-2015.

4. *Turbine unit 2 replacement to improve the survival of fish passing through turbines and reduce oil spill potential (2015).*

   The Ice Harbor test turbine project will replace Units 1–3. Turbines were designed for optimal fish passage and reliability with greatly reduced risk of oil leaks. A fixed

blade runner will be installed in unit 2 and adjustable blade runners will be installed in units 1 and 3. Manufacturing on the fixed blade runner began in 2013, while in 2014 the contractor began procuring materials for manufacture of the first adjustable blade runner.

The COP will be updated periodically and modifications may be altered as new biological and engineering information is gathered. The COP and modifications will be coordinated through the Regional Forum. Comments developed by NOAA Fisheries on the draft COPs shall be reconciled by the Corps in writing to NOAA Fisheries' satisfaction before release of the final COP. If Phase I actions fail to meet the intended biological targets, Phase II actions, as described in the FCRPS BA—Appendix B.2.1, will be considered for further implementation.

The Action Agencies believe the current project configuration is ready for full performance standard testing.

RPA Action 23 – Configuration and Operation Plan for the Lower Monumental Project

The Corps will consider all relevant biological criteria and prepare, in cooperation with NOAA Fisheries and the co-managing agencies, a Configuration and Operational Plan for the Lower Monumental Project (2010). As part of the first phase of modifications, the Corps will investigate, and implement the following reasonable and effective measures to reduce passage delay and increase survival of fish passing through the forebay, dam, and tailrace as warranted. Initial modifications will likely include:

1. *Primary bypass operations with PIT Tag detection installation to reduce handling stress of bypassed fish (2007).*

   Installation of PIT tag detection in the juvenile bypass system was completed in 2007.

2. *Juvenile bypass system outfall relocation to improve egress, direct and indirect survival on bypassed fish (2011).*

   Relocation of the juvenile bypass outfall and improvements to the smolt monitoring raceway structures at Lower Monumental Dam were completed in early 2012.

3. *Turbine operation optimization to improve the survival of fish passing through turbines (2013).*

   A Phase II Turbine Optimization report was completed in 2013. For more details on this report, see RPA 27.

4. *Removable spillway weir installation to improve fish passage efficiency, reduced forebay delay, and improved direct and indirect survival (2008).*

   Spillway weir installation was completed in 2008.

The COP will be updated periodically and modifications may be altered as new biological and engineering information is gathered. The COP and modifications will be coordinated through the Regional Forum. Comments developed by NOAA Fisheries on the draft COPs shall be reconciled by the Corps in writing to NOAA Fisheries' satisfaction before release of the final COP. If Phase I actions fail to meet the intended biological targets, Phase II actions, as described in the FCRPS BA—Appendix B.2.1, will be considered for further implementation.

The final COP report was distributed to the Region in 2013. Performance standard testing at

Lower Monumental Dam was conducted in 2012 and 2013 (Table 8). In 2012, survival estimates for subyearling Chinook salmon met the performance standard requirement of 93 percent survival. In 2013 the performance study evaluated survival at 17 kcfs spill for subyearling Chinook. Pending the results of additional performance standard testing, the Corps will work with NOAA Fisheries and other regional partners to determine if the juvenile dam passage survival standards have been met or if additional actions and/or operation adjustments may be necessary to meet the performance standards

Table 8. Dam passage survival (with standard errors), passage time, and spill passage efficiency for yearling Chinook, juvenile steelhead, and subyearling Chinook salmon at Lower Monumental Dam in 2012 and 2013 (Skalski et al. 2013e; 2014). Values in this table are rounded to the nearest tenth. The reported 2013 value for subyearling Chinook was 92.97 percent.

Species	Dam Passage Survival (Percent)	Median Forebay Passage Time (Hours)	Spill Passage Efficiency (Percent)
2012			
Yearling Chinook	98.7 (1.8)	2.4	78.9
Steelhead	98.3 (0.4)	2.2	65.9
Subyearling Chinook	97.9 (1.6)	2.6	83.6
2013			
Subyearling Chinook	93.0 (1.1)	3.0	89.1

RPA Action 24 – Configuration and Operation Plan for the Little Goose Project

The Corps will consider all relevant biological criteria and prepare, in cooperation with NOAA Fisheries and the co-managing agencies, a Configuration and Operational Plan for the Little Goose Project (2009). As part of the first phase of modifications, the Corps will investigate, and implement the following reasonable and effective measures to reduce passage delay and increase survival of fish passing through the forebay, dam, and tailrace as warranted. Initial modifications will likely include:

1. *Turbine operation optimization to improve the survival of fish passing through turbines (2014).*

   Phase II Turbine Optimization report was completed in 2013. For more details on this report, see RPA 27.

2. *Primary bypass operations with PIT Tag detection installation to reduce handling stress of bypassed fish (2008).*

   Installation of PIT tag detectors in the Juvenile Bypass System primary bypass pipe was completed in 2010.

3. *Primary bypass outfall relocation to improve egress, direct and indirect survival on bypassed fish (2009).*

   The Juvenile Bypass System primary outfall relocation was completed in 2010.

4. *Surface spillway weir and deflector installation to improve fish passage efficiency, reduce forebay delay and improve direct and indirect survival (2009).*

Installation of a spillway weir in spillbay 1, along with flow deflectors in spillbays 1 and 8 were completed in 2009.

The COP will be updated periodically and modifications may be altered as new biological and engineering information is gathered. The COP and modifications will be coordinated through the Regional Forum. Comments developed by NOAA Fisheries on the draft COPs shall be reconciled by the Corps in writing to NOAA Fisheries' satisfaction before release of the final COP. If Phase I actions fail to meet the intended biological targets, Phase II actions as described in the FCRPS BA—Appendix B.2.1 will be considered for further implementation.

Performance standard testing Little Goose Dam was conducted in 2012 and 2013. In 2013 the performance study evaluated survival at 30 percent spill for subyearling Chinook. Survival estimates for subyearling Chinook salmon in 2013 were below the performance standard requirement of 93 percent survival (Table 9). The Corps is working with regional partners to determine what actions are necessary to meet the performance standard. This will be documented for review in a revised Little Goose COP scheduled for 2015.

Table 9. Dam passage survival (with standard errors), passage time, and spill passage efficiency for subyearling Chinook salmon at Little Goose Dam in 2013 (Skalski et al. 2013f; 2014).

Species	Dam Passage Survival (Percent)	Median Forebay Passage Time (Hours)	Spill Passage Efficiency (Percent)
Little Goose 2012			
Yearling Chinook	98.2 (0.8)	2.58	65.3
Steelhead	99.5 (0.8)	2.67	56.1
Subyearling Chinook	95.1 (1.0)	2.80	72.5
Little Goose 2013			
Subyearling Chinook	90.76 (1.39)	3.66	76.8

RPA Action 25 – Configuration and Operation Plan for the Lower Granite Project

The Corps will consider all relevant biological criteria and prepare, in cooperation with NOAA Fisheries and the co-managing agencies, a Configuration and Operational Plan for Lower Granite Project (2009). As part of the first phase of modifications, the Corps will investigate, and implement the following reasonable and effective measures to reduce passage delay and increase survival of fish passing through the forebay, dam, and tailrace as warranted. Initial modifications will likely include:

1. *New juvenile fish facility including orifice configuration changes, primary dewatering, holding for transport, and primary bypass to improve direct and indirect survival for all collected fish (2012).*

   Design of modifications to the juvenile bypass system continued in 2014, including design of improvements to gatewell orifices, dewatering, and bypass routes, including new primary and emergency outfalls. Contract solicitation, award, and kickoff of initial construction activities associated with improvements to the upstream portions of the juvenile bypass system were completed in 2014 (Phase 1a). Improvements to the primary outfall and secondary bypass structures (Phase 1b) continued to be designed in 2014 with anticipated contract award in 2015 and 2016. All Phase 1 components are anticipated to be completed by March 2017.

In addition, gatewell egress and injury assessment for two prototype overflow weir designs: a broad-crested weir and sharp-crested weir, and an enlarged 14-inch orifice, tested with existing orifice lighting as well as a prototype light ring were biologically evaluated in 2014. These features were tested to determine how to replace or improve existing features including collection channel orifices (O'Connor et al. 2015). The biological testing showed relatively consistent results between the related structures and that 14-inch orifices with existing orifice lighting strategies are the prudent path forward as part of Phase 1 construction efforts.

2. *Turbine operation optimization to improve survival of turbine passed fish (2014).*

   A Phase II Turbine Optimization report was completed in 2013. For more details on this report, see RPA 27.

The COP will be updated periodically and modifications may be altered as new biological and engineering information is gathered. The COP and modifications will be coordinated through the Regional Forum. Comments developed by NOAA Fisheries on the draft COPs shall be reconciled by the Corps in writing to NOAA Fisheries' satisfaction before release of the final COP. If Phase I actions fail to meet the intended biological targets, Phase II actions as described in the FCRPS BA—Appendix B.2.1 will be considered for further implementation.

A draft Lower Granite COP was developed for Agency review in 2014. Once regionally reviewed and coordinated in 2015 the final COP will be completed. Commencement of juvenile migrant dam survival Performance Standard testing will begin in 2017 when the new juvenile bypass system (Phase 1A and 1B construction) have been completed.

RPA Action 26 – Chief Joseph Dam Flow Deflectors

The Corps will complete the flow deflector construction at Chief Joseph Dam by 2009.

Construction of flow deflectors on all 19 spillway bays at Chief Joseph Dam was completed in September 2008. This completed the structural component for reduction of TDG downstream of Chief Joseph and Grand Coulee dams. A successful spill test occurred in spring 2009 and no further testing is planned. Chief Joseph Dam was used for system TDG management in 2014.

RPA Action 27 – Turbine Unit Operations

The Action Agencies will operate turbine units to achieve best fish passage survival (currently within 1 percent of best efficiency at mainstem dams on the Lower Columbia and Lower Snake rivers from April 1–October 31 (hard constraint) and from November 1–March 31 (soft constraint) each year. Continue turbine operations evaluations and apply adaptive management to operate units in their optimum configuration for safe fish passage.

In 2014, turbine units on mainstem dams on the Lower Columbia and lower Snake Rivers were operated within 1 percent of best efficiency from April 1 to October 31 (hard constraint) and from November 1 to March 31 (soft constraint).

Building upon the works of Carlson et al. (2010), the Corps pursued an external tag laboratory and subsequent field study to test a tag for turbine passage that would reduce the potential bias in turbine survival estimates due to the presence of an internal tag. Field

testing of the external tag was completed in 2012 (Brown et al. 2013; also see RPA Action 55).

The Phase II Turbine Optimization report (ACOE 2013); referred to as the Biological Index Testing report) was completed with available data by the TSP in 2013 including specific appendices for Bonneville, John Day, McNary and Lower Monumental Dams. This report considered past turbine modeling and laboratory and field study data collection to provide Project-specific recommendations for turbine operations Best Operating Point (BOP) that are expected to provide a juvenile fish passage benefit. Future efforts will be made to implement the BOP at these Projects and collect data for the remaining FCRPS projects while they continue to operate within the 1 percent of peak efficiency range.

Turbine passage survival data collected at Bonneville Powerhouse 1 was analyzed from 2010–12 performance standard testing for operations within and above the 1 percent of peak efficiency range (Weiland et al. 2015). Results indicated high smolt survival (≥95 percent) at operating ranges from the low end of 1 percent efficiency to the generator limit (beyond 1 percent efficiency range), and no difference in survival between operations within and above the 1 percent range. Physical and numerical modeling was conducted to compliment this information. As a result of these efforts, operating Bonneville Powerhouse I at the BOP for fish passage under high flow was included in the 2014 Fish Passage Plan.

A detailed biological study design for testing of the new Ice Harbor runners was completed in 2013 (Trumbo et al. 2013). The study design was used by the Pacific Northwest National Laboratory (PNNL) in 2014 to develop a draft multi-year implementation plan for biological testing of the new runners post-installation. Preliminary Sensor Fish data were collected in 2014 and will continue in 2015.

Three-dimensional JSATS (Juvenile Salmon Acoustic Tag System) data were analyzed to estimate the acclimation depth for turbine-passed fish based on forebay behavior in 2014 (Deng et al. 2014; Li et al. 2015). These data were compared to data collected at the Lyon's Ferry Bridge, located between Little Goose and Lower Monumental dams, as a reference location. Turbine-passed fish were deeper in the forebay than fish that passed via the spillway or the Juvenile Bypass System (JBS). Mean acclimation depths will be applied to juvenile salmonids directly released into the new Ice Harbor turbines during biological testing to estimate the risk of barotrauma relative to pressure nadirs measured by Sensor Fish.

RPA Action 28 – Columbia and Snake River Project Adult Passage Improvements

The Corps will implement the following structural improvements to adult passage at the mainstem Columbia and Snake river projects:

Bonneville Dam

1. *Improve the Bradford Island ladder system to reduce stress and improve reliability of upstream adult passage (2013).*

   In 2012, the second phase of a two-phase project was completed to assess the fishway condition and recommend feature repairs/replacement for the Bradford Island fishway. The results of the study will be used by the Corps to establish priorities and budget funds for repairs/replacement.

In addition, the Corps has accomplished the following repairs to the Bradford Island Ladder during 2008-2013:
- repaired A-branch diffusers
- repaired fish valve FV4-3
- refurbished the count station crowder
- repaired a hole in the fish ladder floor at FG3-12
- removed a wooden bulkhead in the south collection channel

In 2014, a new Project Delivery Team was organized to determine which Bonneville Project features should be included in the Major Rehabilitation Report and what features should be included in one or more Major Maintenance Reports. The purpose of a major rehabilitation study is to establish the engineering condition of a structure and determine the need to reduce risks and/or invest in reliability or efficiency improvements. The fish ladders and spillway were identified, among other features, to be analyzed for potential failure modes in FY 2015. The results of the study will be used by the Corps to establish priorities and budget funds for repairs/replacement.

To address the BiOp Conservation Recommendations for Bonneville Dam Adult Trap Modifications, a Project Delivery Team was organized in 2012 to work in collaboration with FPOM and FFDRWG to improve handling, passage conditions, and survival of fish passing through the Adult Fish Facility. Structural and operational modifications completed in 2014 resulted in significantly less mortality during the 2014 research season compared to recent years.

The Dalles Dam

2. *East ladder emergency auxiliary water supply system and/or modifications that return adult salmon and steelhead use of the North ladder to pre-spillwall conditions to improve reliability of upstream adult passage (2013).*

The Corps, in coordination with the FFDRWG, identified a preferred alternative for an emergency backup for the east ladder back-up auxiliary water supply in 2012, developed a design documentation report in 2013, and began development of the plans and specifications package in 2014 in preparation for construction.

North Ladder Passage: In 2004, a 150-foot spillway training wall was constructed between spillbays 6 and 7, and a 6-bay spill pattern was implemented to improve juvenile fish survival. Adult passage through the north ladder was notably reduced following the change in spill operation due to the new training wall and spill patterns, particularly during periods of high spill (e.g., >100 kcfs). In 2010, a longer training wall was constructed between spillbays 8 and 9, and an 8-bay spill pattern was implemented. A 2010 radio-telemetry study suggested that adult spring-summer Chinook passage was not delayed as a result of the new tailrace conditions and structure, but the percentage of tagged salmon using the north ladder was lower during higher spill conditions (100-150 kcfs) (Jepson et al. 2011). The percent of fish using the north shore ladder before construction of the spillwall (2000-2003) versus after construction of the extended wall (2010–2012) was assessed as well based on the fish count data. There has been no substantial reduction in north shore ladder use by Chinook and steelhead. Sockeye use of the north shore ladder, however, was substantially lower post-spillwall vs. pre-spillwall. A two year radio-telemetry study was initiated in 2013 and continued through 2014. Results are pending final analysis and reporting.

The large fall Chinook run in 2013 prompted an investigation into the potential for overcrowding in The Dalles Dam east ladder after spill ends on August 31 and there is no attraction flow to the north ladder. The investigation involved a 2014 trip to the physical model of the project at the Corps' Engineer Research and Development Center in Vicksburg, Mississippi, to develop a new spill pattern with the goal of attracting more fish to the north ladder and reducing overcrowding at the east ladder should overcrowding be identified. The spill pattern developed during that trip was field tested during the 2014 fall Chinook run, resulting in some increase in north ladder passage during the test periods. The Corps and BPA are continuing to coordinate with FPOM to review the test results to inform the development of a pattern and to define triggers for implementation.

John Day Dam

3. *Adult ladder systems modifications to improve upstream adult passage conditions (2011).*

   Structural improvements to the count station and control (exit) section of the North Fish Ladder were completed in spring 2010, and modifications to the lower ladder, entrance, and auxiliary water supply system were completed in 2013. A two year radio-telemetry study was initiated in 2013 and continued through 2014. Results are pending final analysis and reporting.

Ice Harbor Dam

4. *Repair or replace north shore fishway auxiliary water supply equipment, as needed, so that any two of the three pumps can meet flow criteria.*

   Improvements to the Ice Harbor Dam auxiliary water supply were completed in 2009.

Little Goose Dam

5. *Investigate adult passage and determine whether structural, operational, or tailrace modifications can alleviate adult passage delays or blockages during spill operations for optimum juvenile passage (See RM&E Action 54).*

   Beginning in 2011 a new spill pattern, with spillbay 8 operating first, was implemented to reduce adult passage delay. This operation was continued in 2014. The Little Goose 1:55 scale physical hydraulic model was utilized in 2014 to further investigate adult passage effects of spill pattern adjustments during low flow events (inflows <50 kcfs) and investigated spill patterns with restoration of the north shore jetty that eroded in 2011.

   In 2013 a design was developed for construction of a new adjustable spillway weir. The design allowed closure of the weir and provided more flexibility in meeting passage goals for adult and juvenile fish. In 2014 a contract was issued to build and install the weir, but was later cancelled. In 2014 and continuing in 2015 a new adjustable weir is being designed and will be contracted to be built in 2016 and 2017. The current plan is to have the new weir operational for the juvenile fish outmigration in 2017.

Lower Granite Dam

6. *Investigate and, if necessary, provide additional auxiliary water supply for the new adult trap at lower Granite so that it can operate at full capacity when the forebay is operated at MOP without affecting the fishway auxiliary water supply (2012).*

   In 2010 a valve was replaced, allowing the adult trap to receive adequate water supply at MOP. In addition, the modifications to the new juvenile bypass system will route excess water to the adult trap (JBS Phase 1 completion anticipated March 2017).

7. *Adult fishway modification to improve upstream adult passage conditions impaired by temperature differentials (the need will be determined by results of further research).*

   In 2014, in response to high temperature differentials and resulting passage delays, three temporary pumps were used to add cooler water from deeper in the forebay directly to the front of diffuser 14 inlet. In addition, spill and turbine operations were varied to minimize passage delay. The Corps is currently designing permanent modifications to the auxiliary ladder pump intakes and discharge routing, to cool the Lower Granite Dam adult fish ladder with construction and installation in late 2015 and early 2016 to be operational for the 2016 fish passage season.

RPA Action 29 – Spill Operations to Improve Juvenile Passage

The Corps and BPA will provide spill to improve juvenile fish passage while avoiding high TDG supersaturation levels or adult fallback problems. Specific spill levels will be provided for juvenile fish passage at each project, not to exceed established TDG levels (either 110 percent TDG standard, or as modified by State water quality waivers, currently up to 115 percent TDG in the dam forebay and up to 120 percent TDG in the project tailwater, or if spill to these levels would compromise the likelihood of meeting performance standards (see RPA action table, RM&E Strategy 2). The dates and levels for spill may be modified through the implementation planning process and adaptive management decisions. The initial levels and dates for spill operations are identified in Table 2 of the RPA action table. Future Water Management Plans will contain the annual work plans for these operations and spill programs, and will be coordinated through the TMT. The Corps and BPA will continue to evaluate and optimize spill passage survival to meet both the hydrosystem performance standards and the requirements of the Clean Water Act (CWA).

Spill operations were implemented in accordance with the 2014 Fish Operations Plan (FOP) consistent with the 2011 Court Order. The FOP is Appendix E of the 2014 Fish Passage Plan (ACOE 2014b, see RPA Action 32 below). Implementation of these operations and regional coordination on in-season adjustments are reported on a monthly basis during the migration season and can be found in Appendix D of the 2014 Total Dissolved Gas Report (ACOE 2014a). This report describes the Corps' Columbia River Basin spill and water quality monitoring program for 2014 and covers the Columbia and Snake River dams located in Washington, Idaho and Oregon. The report provides information requested by Oregon and Washington water quality agencies, and also includes the following additional technical information:

- Flow and runoff conditions for the spill season.
- Duration and volume of spill for fish passage versus spill for other reasons for each project.

- Data from the physical and biological monitoring programs, including incidences of gas bubble trauma.

- Progress on implementing measures contained in the lower Columbia and lower Snake rivers TDG total maximum daily load documents.

Spring Fish Passage Spill Operations

During 2014, spring fish passage spill at the lower Columbia and lower Snake River projects was implemented consistent with the 2014 FOP (Appendix E of the 2014 Fish Passage Plan, ACOE 2014b) and the Corps' 2014 Total Dissolved Gas Management Plan (Appendix 4 of the 2014 Water Management Plan, BPA et al. 2013b). Spring fish passage spill began April 3, 2014, and continued through June 20 at the lower Snake River projects. In the lower Columbia River, spring fish passage spill began April 10, 2014, and continued through June 15.

The 2014 FOP called for the following spill operations:

- Lower Granite Dam: 20 kcfs, 24 hours per day.

- Little Goose Dam: 30 percent of total project outflow, 24 hours per day.

- Lower Monumental Dam: TDG Cap, 24 hours per day.

- Ice Harbor Dam: 45 kcfs during the daytime and TDG Cap from April 3 – April 28, then alternating between (a) 30 percent of total project outflow 24 hours per day and (b) 45 kcfs during the day and TDG Cap at night through June 20.

- McNary Dam: 40 percent of total project outflow.

- John Day Dam: 30 percent of total project outflow from April 10 through April 27, 2014; alternating between 30 and 40 percent of total project outflow from April 28 through June 15, 2013.

- The Dalles Dam: 40 percent of total project outflow.

- Bonneville Dam: 100 kcfs, 24 hours per day.

Consistent with the 2014 Supplemental BiOp and the 2011 Court Order, in-season adjustments addressing real-time conditions were implemented in coordination with regional sovereigns.

Summer Fish Passage Spill Operations

During 2014, consistent with the FOP, summer spill began June 21 and continued through August 31 at the lower Snake River projects. Summer spill on the lower Columbia River began June 20 at McNary Dam, July 1 at John Day and The Dalles dams, and June 16 at Bonneville Dam. Spill continued through August 31.

The 2014 FOP called for the following summer spill operations:

- Lower Granite Dam: 18 kcfs, 24 hours per day
- Little Goose Dam: 30 percent of total project outflow, 24 hours per day
- Lower Monumental Dam: 17 kcfs, 24 hours per day
- Ice Harbor Dam: From June 16 through July 13, spill alternating between (a) 30 percent of the river flow 24 hours per day and (b) 45 kcfs during the day and TDG Cap at night. From July 13 through August 31, 45 kcfs during the day and TDG Cap at night.
- McNary Dam: Spill 50 percent of total project outflow
- John Day Dam: Alternating between 30 and 40 percent of total project outflow from June 16 through July 20, and 30 percent of total project outflow, 24 hours per day from July 21 through August 31.
- The Dalles Dam: 40 percent of total project outflow.
- Bonneville Dam: Spill alternating between (a) 85 kcfs during the day and 121 kcfs during the night and (b) 95 kcfs 24 hours per day.

Consistent with the 2014 Supplemental BiOp and the 2011 Court Order, in-season adjustments addressing real-time conditions were implemented in coordination with regional sovereigns.

2014 River Conditions and TDG Monitoring

During the 2014 fish passage spill season, system flows were generally average due to the average runoff volume (as seen at The Dalles). This resulted in average to below average releases at some of the FCRPS projects as demonstrated in the three examples below: Bonneville for the lower Columbia, Ice Harbor for the lower Snake, and Chief Joseph for the middle Columbia reach. For most of the fish migration season, spill for fish passage was provided at the lower Snake and Columbia River fish passage projects at the levels specified in the 2014 spring and summer FOPs. On intermittent occasions, additional spill occurred at individual projects in circumstances when river flows exceeded powerhouse hydraulic capacity, due to equipment malfunction or modeling and forecasting uncertainties, or for other purposes, such as ensuring power and transmission system stability, passing debris, or flood risk management.

Daily average total river flows on the lower Columbia River, as measured at Bonneville Dam, from April 1 through August 31, ranged from 138 kcfs to 372 kcfs, averaging 244 kcfs. Daily average flow peaked on May 27. Total river flows began to recede gradually in the first half of June and at the end of June continued a steady recession until the end of August when flows reached 141 kcfs.

On the lower Snake River, as measured at Ice Harbor Dam, daily average total river flow from April 1 through August 31, ranged from 23 kcfs to 149 kcfs, averaging 69 kcfs. Daily average flow peaked on May 25. Flows began to recede after the May peak with a gradual recession ending the month of August at about 26 kcfs.

Daily average total river flows on the mid-Columbia River, as measured at Chief Joseph Dam from April 1 through August 31, ranged from 89 kcfs to 190 kcfs, averaging 142 kcfs. Flows had two peaks, June 1 and July 1 (the maximum), and began to decrease and continued to recede until the end of August when flows dropped to 91 kcfs on August 31.

There were a total of 218 instances out of 2,448 gauge-days in 2014 where TDG exceeded[2] the modified State water quality standards. These included 140 instances due to circumstances when river flows exceeded powerhouse hydraulic capacity or to ensure power and transmission system stability, 27 instances due to mechanical malfunction, and 51 instances due to modeling and forecasting uncertainties. This information with additional detail is provided in the 2014 Total Dissolved Gas Report (ACOE 2014a).

Excessive TDG levels can result in gas bubble trauma (GBT). Examination of data obtained from the Fish Passage Center (under "Smolt Data" at www.fpc.org) showed that in 2014 14,259 juvenile fish were examined for GBT at Corps dams from April through August. Of the fish examined, 36 (0.25 percent) were found to have non-severe signs of GBT, and none exhibited severe signs. The symptoms occurred during periods of high river flows. The overall incidence of GBT in 2014 was in the lower range among the past 18 years.

RPA Action 30 – Juvenile Fish Transportation in the Columbia and Snake Rivers*

The Corps and BPA will continue the juvenile fish transportation program toward meeting system survival performance metrics of Snake and Columbia River salmon and steelhead with some adaptive management modifications based on results of RM&E. The Corps and BPA will continue to collect and transport juvenile fish at Lower Granite, Little Goose, Lower Monumental, and McNary dams, although under a modified operation as described in Table 3 and Table 4 of the RPA action table. While the dates mentioned in this section should be considered firm planning dates, if in-season information or results of ongoing RM&E indicates a need for adaptive management (for example, if modifying these dates are likely to increase in-river or system survival and would be likely to provide equivalent or increased SARs of the species transported), the Action Agencies will consider revising the dates and operations through the Regional Forum.

**** The language below reflects changes made by the 2014 BiOp:***

Table 3 is no longer in effect. Instead the Action Agencies will continue transport operation at Snake River collector dams according to the following criteria and schedule (See Section 3.3.3.4 Juvenile Transport and IP RPA Action 30 for more details):

Annual Review of Information

- *Data on fish survival, adult returns, current year inriver conditions, and water supply forecast will be reviewed with RIOG each year to determine the best operation for the fish.*

Transport Start Date

- *TMT will review the results of transport studies annually and provide an annual recommendation on how to operate the juvenile transport program to achieve the goal of transporting about 50% of juvenile steelhead.*

- *Planning dates to initiate juvenile transport at Lower Granite Dam will be April 21 to April 25, unless the Corps adopts a recommendation by TMT that proposes a later start date (No Later Than*

[2] *The magnitude and duration of exceedences varies.*

May 1) and accompanying alternative operation in their annual recommendation to achieve the goal of transporting about 50% of juvenile steelhead.

- *Transport will begin up to 4 days and up to 7 days after the Lower Granite start date at Little Goose and Lower Monumental dams, respectively.*

- *Transport will continue until approximately September 30 at Lower Monumental and through October 31 at Lower Granite and Little Goose dams.*

Table 4 is no longer in effect. Transportation operations have ceased at McNary Dam.

The 2014 transportation program was conducted in accordance with the Juvenile Fish Transportation Program criteria in the 2014 Fish Passage Plan. The start dates for transport operations were coordinated with the TMT and were implemented simultaneously at Snake River operating projects. Collection of juvenile fish for barge transport began May 1, 2014, at Lower Granite, Little Goose, and Lower Monumental dams. Before transport began, sampling operations were conducted at the Lower Granite, Little Goose, and Lower Monumental facilities in support of research activities, BPA-sponsored smolt monitoring activities, and assessment of bypass system conditions. Smolt Monitoring Program activities occurred daily at Lower Granite Dam throughout the entire season. Transport operations at the Snake River facilities continued through October 1 at Lower Monumental Dam and through October 31 at Little Goose and Lower Granite dams. Since fish are no longer transported from McNary Dam, sampled and collected fish at this location were bypassed to the tailrace. Routine fish sampling operations did take place at McNary Dam every other day from April 6, 2014 to September 30, 2014, to support research and BPA-sponsored smolt monitoring activities, as well as to assess bypass system conditions.

Juvenile fish barged during 2014 were released at varying locations below Bonneville Dam consistent with past permit requirements. The ending collection date for the barging season in 2014 was August 16 at Lower Monumental, Little Goose, Lower Granite dams. Fish transport by truck commenced on August 18. Because of suspected *Columnaris* sp. infections and increased fish mortality rates, the Lower Monumental facility began to collect fish only for the day of transport and bypass fish to the tailrace on alternate days, beginning on September 12. Otherwise, Snake River facilities transported juvenile fish by trucks from August 16 through the end of the transport season. Most trucked fish were released into the Bonneville Juvenile Monitoring Facility outfall flume. Some late season fish were trucked and released at Dalton Point below Bonneville Dam to avoid piscivorous birds at the monitoring facility outfall flume. On October 25, fish collected at Lower Granite Dam were released into the McNary bypass outfall after the semi-tractor and tanker trailer hauling the fish encountered mechanical difficulties. Trucking operations continued to October 1 at Lower Monumental Dam and to October 31 at Lower Granite and Little Goose dams. No early season (April) trucking took place in 2014.

Estimates of the number of fish collected, bypassed, and transported as part of the juvenile fish transportation program are based on sampling portions of the fish collected. Sampled numbers were expanded according to the percentage of the time sampling occurred and are not meant to be an exact enumeration of individuals. At Snake River operating projects, the sampled fish were hand-counted and differentiated by species and the presence of adipose fins. Approximately 6,688,226 juvenile fish were collected at Lower Granite Dam, with 2,653,853 of these fish bypassed to the river and 4,029,934 transported. At Little Goose Dam, approximately 4,153,395 juvenile salmon and steelhead were collected in 2014. Of these, 397,842 were bypassed to the river, and 3,752,781 were transported. At Lower Monumental Dam, approximately 2,146,639 juvenile salmon and steelhead were collected in 2014. Of these, 1,207 fish were bypassed, and 2,143,206 were transported. At

McNary Dam in 2014, approximately 4,464,404 juvenile salmon and steelhead were collected, 4,461,967 of the fish collected were bypassed to the river, and no juvenile fish were transported. A total of 12,988,260 juvenile salmon and steelhead were collected at all transport program locations (Lower Granite, Little Goose and Lower Monumental dams) in 2014, with 9,925,921 fish transported (76 percent) and 3,052,902 bypassed (24 percent). Of the fish transported, 9,894,912 were transported by barge (99.7 percent) and 31,009 were trucked (0.3 percent). Estimates of the percent of fish transported collectively from Snake River projects by species and rearing origin are contained in Table 10.

Table 10. Estimated proportion of non-tagged spring/summer Chinook and steelhead smolts transported in the Snake River in 2014 (Faulkner et al. 2015).

Species	Percent Transported in 2014
Snake River Spring Chinook—Wild	30.9
Snake River Spring Chinook—Hatchery	38.3
Snake River Spring Steelhead—Wild	39.9
Snake River Spring Steelhead—Hatchery	34.6

RPA Action 31 – Configuration and Operational Plan Transportation Strategy*

The Corps, in coordination with the Regional Forum, will initiate a Configuration Operational Plan in 2009. The plan will be completed in 2010 and will present a strategy for prioritizing and carrying out further transportation actions at each dam. Comments developed by NOAA Fisheries on the draft COPs shall be reconciled by the Corps in writing to NOAA Fisheries' satisfaction before release of the final COP. Construction actions for transportation are primarily in the context of changes to juvenile bypass systems. Changes meant to increase adult salmon returns through the juvenile fish transportation process are being evaluated. Some changes include additional barges, a new juvenile fish facility at Lower Granite Dam and modifications to the juvenile fish facilities at Little Goose, Lower Monumental and McNary dams.

**** The language below reflects changes made by the 2014 BiOp:***

McNary Dam will no longer be considered in the Configuration and Operational Plan Transportation Strategy.

The Transport COP draft was completed in September 2013 and in October was distributed to regional entities for review. The draft contains broad alternatives for transport and focuses on increasing smolt-to-adult return ratios (SARs) for ESA-listed Snake River salmonids. Comments were due December 2013. The COP was then modified in response to comments received in 2013 and changes to RPA 31 in the 2014 supplemental FCRPS BiOp. An updated draft will be distributed for regional review in 2015.

RPA Action 32 – Fish Passage Plan (FPP)*

The Corps will annually prepare a FPP in coordination with NOAA Fisheries and the Regional Forum through the FPOM. The Corps will operate its projects (including juvenile and adult fish passage facilities) year-round in accordance with the criteria in the FPP. Comments developed by NOAA Fisheries on the draft FPP shall be reconciled by the Corps in writing to NOAA Fisheries' satisfaction before release of the final FPP. Key elements of the plan include:

- *Operate according to project-specific criteria and dates to operate and maintain fish facilities, turbine operating priorities, and spill patterns;*

- *Operate according to fish transportation criteria;*

- *Maintain turbine operations within the 1 percent of best efficiency range;*

- *Maintain spillway discharge levels and dates to provide project spill for fish passage;*

- *Implement TDG monitoring plan;*

- *Operate according to protocols for fish trapping and handling;*

- *Take advantage of low river conditions, low reservoir elevations or periods outside the juvenile migration season to accomplish repairs, maintenance, or inspections so there is little or no effect on juvenile fish;*

- *Coordinate routine and non-routine maintenance that affects fish operations or structures to eliminate and/or minimize fish operation impacts;*

- *Schedule routine maintenance during non-fish passage periods;*

- *Conduct non-routine maintenance activities as needed; and*

- *Coordinate criteria changes and emergency operations with FPOM.*

Operations and Maintenance

- *Provide redundancy or contingency plans, developed in coordination with NOAA Fisheries and the Regional Forum, which will assure that key adult fish passage facility equipment operates as necessary to minimize long-term adult passage delays.*

- *Evaluate the condition of items necessary (e.g., spillway hoist systems, cranes, turbine units, auxiliary water supply systems, etc.) to provide safe and effective fish passage and develop a prioritized list of these items that are likely to require maintenance now or within the term of this Opinion.*

**** The language below reflects changes made by the 2014 BiOp:***

The Action Agencies will no longer consider transport at McNary Dam in the development of Transportation Strategy Configuration and Operation Plan

The draft 2014 FPP was released in October 2013. The final FPP (ACOE 2014b) was released in March 2014 at: http://www.nwd-wc.usace.army.mil/tmt/documents/fpp/2014/index.html. The FPP was completed in full coordination with the region. Corps fish passage facilities were operated in accordance with criteria in the FPP. Any deviations from the FPP were coordinated with the region and were necessary to protect fish or conduct emergency repairs on vital equipment.

RPA Action 33 – Snake River Steelhead Kelt Management Plan

The BPA and Corps will prepare a Snake River Kelt Management Plan in coordination with NOAA Fisheries and the Regional Forum. The BPA and Corps will implement the plan to improve the productivity of interior basin B-Run steelhead populations as identified in Sections 8.5. Key considerations in the development and implementation of the plan should include:

- *Measures to increase the in-river survival of migrating kelts,*
- *Potential for the collection and transport (either with or without short-term reconditioning) of kelts to areas below Bonneville Dam,*
- *Potential for long-term reconditioning as a tool to increase the number of viable females on the spawning grounds, and*
- *Research as necessary to accomplish the elements of this plan.*

BPA and the Corps completed the 2014 Kelt Management Plan (KMP) supplement. The goal of kelt management actions is to improve survival and productivity of listed steelhead by allowing kelts to successfully survive and spawn in a subsequent year. The 2014 version of the KMP built upon the framework of previous plans, but also identified future direction through the remainder of the BiOp (2014-2018). The 2014 KMP reviews the goals of the plan and summarizes progress on reconditioning efforts. The 2014 KMP also summarizes results from a retrospective data analysis on 2012–13 steelhead kelt downstream migration behavior through FCRPS dams.

In 2014, Snake River B-Run kelts were reconditioned at Dworshak National Fish Hatchery through funding in BPA Project 2007-401-00. Thirty-four reconditioned wild female B-Run kelts were released to the Columbia River below Bonneville Dam in December of 2014. Collection of good condition kelts at Lower Granite has become more challenging over the years; fewer fish are available for collection in the JBS due to the fact most kelts now pass the dam via the spillway weir. In addition, kelts using the existing JBS are often in poor condition when collected. Improvements currently being made to this system are expected to reduce the kelt injury rate, increasing the number of kelts available for reconditioning. In addition, efforts to expand collection to known B-run steelhead tributaries such as Fish Creek continued in 2014 with successful results. Several categories of reconditioning research were continued in 2014 including assessments of fish culture techniques such as diet composition, monitoring of ocean return rates of kelts released from different reconditioning programs, experimental treatments, and stock origins, and estimation of reproductive success rates including long-term reconditioned kelts which did not undergo a repeat ocean migration. Additional information can be found in the Kelt Management Plans at http://www.salmonrecovery.gov/Hatchery/Keltreconditioning.aspx.

No transportation of kelts occurred in 2014. In-river migration and reconditioning strategies are currently prioritized over the transportation strategy when there is a shortage of kelts available for full program implementation. The Action Agencies may resume transportation when the number of collected kelts exceeds the capacity of reconditioning programs.

The 2014 reconditioning release represents progress towards meeting the Snake River 6 percent increased abundance target. As part of further efforts to develop the reconditioning program, CRITFC and the Nez Perce Tribe produced a Draft Reconditioning Master Plan for review in 2014 that recommends the long term facility needs of the program.

A direct injury and survival study comparing the turbine and spillway weir passage routes for adult steelhead at McNary Dam was completed in 2014 (Normandeau 2014). A follow-on study to evaluate spillway weir passage efficiency for overwintering adult steelhead and steelhead kelts began in November, 2014, and will conclude in March, 2015.

Habitat Implementation Reports, RPA Actions 34–38

Table 11. Habitat strategy reporting

RPA Action No.	Action	Annual Progress Report
Habitat Strategy 1		
34	Tributary Habitat Implementation 2007 to 2009 – Progress Toward 2018 Habitat Quality Improvement Targets	Status of project implementation (including project milestones) through December of previous year for all 2007–2009 actions. Report physical metrics for implementation achieved (e.g., miles of access, cfs of streamflow acquired, numbers of screens, miles or acres of habitat protected or enhanced, and miles of complexity enhanced) relative to the project objectives.
35	Tributary Habitat Implementation 2010–18 – Achieving Habitat Quality and Survival Improvement Targets	Status of project implementation (including project milestones) through December of previous year for all actions identified in implementation plans. Report physical metrics for implementation achieved (e.g., miles of access, cfs of streamflow acquired, numbers of screens installed, miles of acres of habitat protected or enhanced, and miles of complexity enhanced by benefited population(s)) relative to the total needed to complete the project and achieve the estimated survival benefits, by project.
Habitat Strategy 2		
36	Estuary Habitat Implementation 2007 to 2009	Status of project implementation (including project milestones) through December of previous year for all 2007–09 actions. Report physical metrics for implementation achieved (e.g., number of acres protected/restored/enhanced; riparian miles protected) relative to the total needed to complete project and achieve the estimated survival benefits.
37	Estuary Habitat Implementation 2010–18 – Achieving Habitat Quality and Survival Improvement Targets	Status of project implementation (including project milestones) through December of previous year for all actions identified in implementation plans. Report physical metrics for implementation achieved (e.g., number of acres protected, restored, enhanced; riparian miles protected) relative to the total needed to complete the project and achieve the estimated survival benefits, by project. By evolutionarily significant unit (ESU), report progress toward ESU/distinct population segment (ESU/DPS)-specific survival benefit. Where ESU/DPS-specific survival benefits are not achieving the progress guidelines above, identify processes or projects in place to ensure achievements by the next comprehensive report.
38	Piling and Piling Dike Removal Program	Status of project implementation (including project milestones) through December of previous year for all actions identified in implementation plans. Report physical metrics for implementation achieved (e.g., number of pilings/pile dikes removed, habitat area restored) by project.

RPA Action 34 – Tributary Habitat Implementation 2007 to 2009 – Progress Toward 2018 Habitat Quality Improvement Targets

The Action Agencies will provide funding and technical assistance necessary to implement the specific projects identified for implementation in 2007 to 2009 as part of a tributary habitat program to achieve the population-specific overall habitat quality improvement identified in Table 5 of the RPA action table.

If projects identified for implementation in 2007-2009 prove infeasible, in whole or in part, the Action Agencies will implement comparable replacement projects in 2010-2013 to maintain estimated habitat quality improvements to achieve equivalent survival commitments at the population level, or alternatively at the major population group (MPG) or ESU level. Habitat and population-specific survival benefits in each implementation plan cycle must also compensate for not meeting estimated

benefits in the previous implementation plan cycle. Replacement project selection will follow Action 35 below.

This RPA Action is complete and, as envisioned by the RPA, tributary habitat implementation through 2018 is being continued under RPA Action 35. Previous FCRPS Annual Progress Reports and the 2013 Comprehensive Evaluation have reported the progress on RPA 34 actions by Reclamation, BPA, and partners.

RPA Action 35 – Tributary Habitat Implementation 2010–2018 – Achieving Habitat Quality and Survival Improvement Targets

The Action Agencies will identify additional habitat projects for implementation based on the population specific overall habitat quality improvement still remaining in Table 5 (of the 2008 FCRPS BiOp RPA) below. Projects will identify location, treatment of limiting factor, targeted population or populations, appropriate reporting metrics, and estimated biological benefits based on achieving those metrics. Pertinent new information on climate change and potential effects of that information on limiting factors will be considered.

The technical foundation of the tributary habitat program is a method for estimating (1) the changes in tributary habitat function likely to result from implementing tributary habitat improvement actions and (2) the corresponding change in fish survival likely to occur as a function of habitat changes.

The approach relies on identifying factors that limit the productivity of salmon and steelhead tributary habitat; identifying actions that reduce the magnitude of effect of those limiting factors as a function of habitat improvement; using expert judgment to estimate the change in habitat function as a result of implementing habitat improvement actions; and application of an empirically based model to estimate the overall change in habitat function and related change in egg-to-smolt survival.

BPA and Reclamation continue to fund and provide technical assistance to improve habitat for more than 80 interior Columbia Basin spring/summer Chinook and summer/winter steelhead populations. For the 56 populations under this FCRPS consultation, actions completed in 2014 were guided by the 2010–2013 Implementation Plan[3] (2010–2013 IP) (FCRPS 2010a and the 2014–2018 IP (BPA et al. 2014a). Physical metrics (e.g., acres of habitat, acre feet of flow) associated with habitat actions are reported consistent with the format of RPA Action 35 Table 5 (Table 12 in this report, below). Cumulative habitat quality improvement and survival estimates for the 56 populations from 2007 through 2011 were reported in the 2013 Comprehensive Evaluation (2013 CE) (BPA et al. 2014b).

Section 1 of this Annual Progress Report summarizes the cumulative result of habitat actions completed between 2007 and 2014 for water quantity and quality, instream habitat complexity, and riparian condition; restored access, and reduced entrainment at irrigation diversions. Specific information for individual projects and associated actions is in Section 3, Attachment 2, Table 1. This table summarizes metrics at the population level for tributary habitat measures implemented with funding from BPA or with technical assistance from

[3] RPA Action 35 requires development of implementation plans at three-year intervals between 2010 and 2018. The first implementation plan (IP) was developed for the period between 2010 and 2013 (FCRPS 2010). The 2014-2018 IP (BPA et al. 2014a) includes specific habitat actions for a five-year (rather than a three-year) period, in response to the 2011 Court Order on the remanded 2010 FCRPS BiOp. The actions in the 2014-2018 IP specify location, treatment/action type, limiting factor (ecological concern), population, metrics, and estimated biological benefits.

Reclamation in 2014 relative to limiting factors. The BPA business management systems for tracking contracted work and accomplishments (e.g., Pisces and Taurus) are discussed in detail in the 2013 CE and the 2014-2018 IP as well as in the 2014 FCRPS BiOp. Project links in Section 3, Attachment 2, Table 1, direct the user to the project web pages on http://www.cbfish.org.

Further details on actions with Reclamation involvement are included in Section 3, Attachment 2, Table 2. In most cases, Reclamation and BPA projects and associated actions are complementary (both agencies participate in the effort), in which case both BPA and Reclamation project numbers are provided. Reclamation has produced additional reports to document tributary habitat accomplishments. The 2014 reports are listed in Section 3, Attachment 3, and all reports can be accessed at: http://www.usbr.gov/pn/fcrps/habitat/projects/index.html.

Table 12. 2014 tributary habitat completed metrics. All Chinook projects on this list also benefit steelhead, and therefore show up again in the steelhead projects portion of this table. As a result, the "Total Steelhead (All DPSs)" numbers on the last row of this table provide valid metrics for the tributary habitat restoration program as a whole, e.g., the total length of all streams with improved access.

			Water Quantity		Entrain-ment	Passage		Channel Complexity	Water Quality Riparian Protection and Enhancement			
ESU/DPS	MPG	Population* 18 Priority Populations in Bold	Acre-feet Protected	CFS protected	# of screens addressed	# of barriers addressed	Stream miles with improved access	Instream miles improved	Stream miles protected	Stream miles improved	Riparian acres protected	Riparian acres improved
Snake River Spring/ Summer-run Chinook Salmon ESU	Dry Clearwater	Lapwai/Big Canyon	0	0	0	0	0	0	0.16	7.60	11.30	83.78
		Potlatch River	0	0	0	1	35.0	0.93	0	18.81	0	162.50
		Laywer Creek	0	0	0	0	0	0	0.16	0	0	0
		Upper South Fork Clearwater	0	0	0	7	208.35	0	0	6.10	0	33.61
	Grande Ronde /Imnaha	Catherine Creek	905.0	4.76	0	2	7.25	4.46	0	2.40	0	3.21
		Big Sheep Creek	0	0	0	0	0	0	0	0	0	0
		Grande Ronde River upper mainstem	327.0	4.0	0	0	0	18.18	3.72	7.75	67.00	64.0
		Imnaha River mainstem	0	0	0	0	0	0	0	0	0	0
		Lostine River	1,188.0	15.0	0	2	11.0	0	0	0	0	0
	Lower Snake	Asotin Creek	0	0	0	0	0	1.0	0	2.75	0	15.0
		Tucannon River	0	0	0	1	25.0	8.22	0	0.43	0	24.06
	Middle Fork Salmon River	Big Creek	0	0	0	0	0	0	0	0	0	0
		Camas Creek	0	0	0	0	0	0	0	0	0	0
		Marsh Creek	0	0	0	0	0	0	0	0	0	0
		Chamberlain Creek	0	0	0	0	0	0	0	0	0	0
	South Fork Salmon River	East Fork South Fork Salmon River	0	0	0	0	0	0	0	0	0	0.60
		Little Salmon River	0	0	0	1	1.10	0	0	0	0	0
		Secesh River	0	0	0	0	0	0	0	0	0	2.50
		South Fork Salmon River mainstem	0	0	0	0	0	0	0	0	0	0
	Upper Salmon River	East Fork Salmon River	0	0	0	0	0	0	1.05	0	0.25	0
		Lemhi River	6454.70	16.50	4	10	17.40	3.15	3.50	2.27	10.00	53.28
		Pahsimeroi River	0	0	1	0	0	0	2.17	0.37	30.50	1.20
		Panther Creek	0	0	0	0	0	0	0	0	0	0
		Salmon River lower mainstem below Redfish Lake	5841.20	12.78	3	4	3.00	0	0	0	0	0
		Salmon River upper mainstem above Redfish Lake	737.9	6.0	0	1	3.60	0.10	1.88	0	29.10	0

			Water Quantity		Entrain-ment	Passage		Channel Complexity	Water Quality Riparian Protection and Enhancement			
ESU/DPS	MPG	Population* 18 Priority Populations in Bold	Acre-feet Protected	CFS protected	# of screens addressed	# of barriers addressed	Stream miles with improved access	Instream miles improved	Stream miles protected	Stream miles improved	Riparian acres protected	Riparian acres improved
		Valley Creek	0	0	0	0	0	0	0	0	0	0
		Yankee Fork	0	0	0	1	0.5	4.0	0	0.71	0	1.61
	Wet Clearwater	Lochsa River	0	0	0	2	1.25	0	0	1.00	0	7.50
		Meadow Creek	0	0	0	1	1.00	0	0	0	0	0
		Lolo Creek	0	0	0	2	6.20	0	0	0	0	0
Snake River Spring/Summer-run Chinook Salmon ESU		ESU Total:	**15,453.80**	**59.04**	**8.00**	**35.00**	**320.65**	**40.04**	**12.64**	**50.19**	**148.15**	**452.85**
Upper Columbia River Spring-run Chinook Salmon ESU	Upper Columbia/East Slope Cascades	Entiat River	0	0	0	2	1.00	3.26	0	0	0	0.12
		Methow River	3977.90	9.65	1	5	8.53	1.85	0	0.96	10.0	81.81
		Wenatchee River	0	0	0	3	5.85	0.20	0	0.20	0	152.0
Upper Columbia River Spring-run Chinook Salmon ESU		ESU Total:	**3,977.90**	**9.65**	**1.00**	**10.00**	**15.38**	**5.31**	**00**	**1.16**	**10.00**	**233.93**
TOTAL Chinook Salmon (All ESUs)			19,431.70	68.69	9.00	45.00	336.03	45.35	12.64	51.35	158.15	686.78
Middle Columbia River Steelhead DPS	Cascades Eastern Slope Tributaries	Deschutes River - eastside	0	0	0	4	0	0.18	0	17.04	0	18.25
		Deschutes River - westside	988.20	2.33	0	0	0	0	0	0	0	10.0
		Fifteenmile Creek (winter run)	1,772.70	21.71	0	1	0	0	3.06	28.0	58.26	75.0
		Klickitat River	0	0	0	0	0	0.70	1.0	11.33	13.75	35.50
		Rock Creek	0	0	0	0	0	0	0	2.0	0	16.0
		White Salmon River	166.0	0.80	0	0	0	0	0	0	0	0
		Crooked River	0	0	0	2	2	0	0	0	0	0
	John Day River	John Day River lower mainstem tributaries	0.40	0.30	5	0	0	4.06	46.02	8.75	822.88	2.75
		John Day River upper mainstem	187.20	1.55	8	1	11.5	0	12.70	8.70	46.0	205.35
		Middle Fork John Day River	0	0	0	1	0.5	0.4	13.10	5.40	253.0	225.50
		North Fork John Day River	0	0	0	3	9.7	0.10	3.00	7.90	26.65	370.50
		South Fork John Day River	0	0	0	0	0	0	0	2.0	0	1.0
	Umatilla and Walla Walla River	Touchet River	239.0	2.08	0	0	0	0	6.00	18.0	0	250.25
		Umatilla River	495.40	3.85	4	4	5.82	0	0	30.73	425.00	347.19
		Walla Walla River	3368.50	24.28	3	1	39	0	0	3.50	0	36.40

			Water Quantity		Entrain-ment	Passage		Channel Complexity	Water Quality Riparian Protection and Enhancement			
ESU/DPS	MPG	Population* 18 Priority Populations in Bold	Acre-feet Protected	CFS protected	# of screens addressed	# of barriers addressed	Stream miles with improved access	Instream miles improved	Stream miles protected	Stream miles improved	Riparian acres protected	Riparian acres improved
		Willow Creek	0.10	0.01	0	0	0	0	1.50	0	17.68	0
	Yakima River Group	Naches River	0	0	0	0	0	0	0	1.56	0	2.10
		Satus Creek	0	0	0	0	0	0	0	0	0	270.0
	Yakima River Group	Toppenish	0	0	0	1	4	0	0	1.0	0	14.0
		Yakima River upper mainstem	1454.80	5.58	4	2	6.2	2.0	0	4.0	0	15.10
Middle Columbia River Steelhead DPS		DPS Total:	**8672.30**	**62.49**	**24.00**	**20.00**	**78.72**	**7.44**	**86.38**	**149.91**	**1663.22**	**1894.89**
Snake River Basin Steelhead DPS	Clearwater River	Clearwater River lower mainstem	0	0	0	1	35	0.93	0.32	26.41	11.30	246.28
		Lochsa River	0	0	0	2	1.25	0	0	1.0	0	7.50
		Lolo Creek	0	0	0	2	6.2	0	0	0	0	0
		Selway River	0	0	0	1	1	0	0	0	0	0
		South Fork Clearwater River	0	0	0	7	208.35	0	0	6.10	0	33.61
	Grande Ronde River	Grande Ronde River lower mainstem tributaries	0	0	0	0	0	0	0	0	0	0.25
		Grande Ronde River upper mainstem	1232.0	8.76	0	2	7.25	22.64	3.72	15.36	67.0	137.59
		Joseph Creek	0	0	0	0	0	0	0	3.0	0	20.0
		Wallowa River	1188.0	15.0	0	2	11	0	0	0	0	0
	Imnaha River	Imnaha River	0	0	0	0	0	0	0	0	0	0
	Lower Snake	Asotin Creek	0	0	0	0	0	1.0	2.0	4.25	40.0	26.0
		Tucannon River	0	0	0	1	25	8.22	0	0.43	0	24.06
	Salmon River	Big, Camas, and Loon Creek	0	0	0	0	0	0	0	0	0	0
		East Fork Salmon River	341.20	3.58	1	1	2.6	0	1.05	0	0.25	0
		Chamberlain Creek	0	0	0	0	0	0	0	0	0	0
		Lemhi River	6454.70	16.50	4	10	17.4	1.15	3.50	2.27	10.00	53.28
		Middle Fork Salmon River upper mainstem	0	0	0	0	0	0	0	0	0	0
		Little Salmon and Rapid River	0	0	0	1	1.1	0	0	0	0	0
		Pahsimeroi River	4000.00	9.20	3	3	1.6	0	2.17	0.37	30.50	1.20
		Panther Creek	0	0	0	0	0	0	0	0	0	0

			Water Quantity		Entrain-ment	Passage		Channel Complexity	Water Quality Riparian Protection and Enhancement			
ESU/DPS	MPG	Population* 18 Priority Populations in Bold	Acre-feet Protected	CFS protected	# of screens addressed	# of barriers addressed	Stream miles with improved access	Instream miles improved	Stream miles protected	Stream miles improved	Riparian acres protected	Riparian acres improved
		Salmon River upper mainstem	737.90	6.0	0	1	0.5	4.00	1.88	0.71	29.10	1.61
		Secesh River	0	0	0	0	0	0	0	0	0	2.50
		South Fork Salmon River	0	0	0	0	0	0	0	0	0	0.60
Snake River Basin Steelhead DPS		DPS Total:	**13953.80**	**59.04**	**8.00**	**34.00**	**318.25**	**37.94**	**14.64**	**59.90**	**188.15**	**554.48**
Upper Columbia River Steelhead DPS	Upper Columbia / East Slope Cascades	Entiat River	0	0	0	2	1	3.26	0	0	0	0.12
		Methow River	3977.90	9.65	1	5	8.53	1.85	0	0.96	10.0	81.81
		Okanogan River	120.50	0.77	30	4	35.5	0.10	0	8.20	0	47.79
		Wenatchee River	0	0	0	3	5.85	0.20	0	0.20	0	152.0
		Crab Creek	599.80	3.37	0	0	0	0	0	0	0	100.10
Upper Columbia River Steelhead DPS		DPS Total:	**4698.20**	**13.79**	**31.00**	**14.00**	**50.88**	**5.41**	**0**	**9.36**	**10.00**	**381.82**
TOTAL Steelhead (All DPSs)			27,324.30	135.32	63.00	68.00	447.85	50.79	101.02	219.17	1861.37	2,831.19

a. *During 2010 to 2018, the Action Agencies will provide funding and/or technical assistance to implement specific habitat projects to achieve the specified habitat quality improvements listed in Table 5. Habitat quality improvements associated with projects will be estimated in advance of project selection by expert panels. The Action Agencies will convene expert panels to estimate changes in habitat limiting factors from the implementation of Action Agency habitat actions.*

The Action Agencies provided funding and/or technical assistance to implement specific habitat actions listed in Appendix A of the 2010–2013 IP (FCRPS 2010a) and Appendix A of the 2014–2018 IP (BPA et al. 2014a). The Implementation Plans included the expert panel estimates for changes in limiting factors projected to result from implementing these habitat actions. Progress on actions implemented in 2014 resulted in:

- 27,324 acre-feet of water protected;
- 51 miles of stream habitat treated to enhance complexity;
- 2,831 acres of riparian habitat improved for better function;
- 63 fish screens installed or addressed for fish protection; and
- 448 miles of improved access to fish habitat.

Detailed 2014 habitat metrics by population that contribute to these metrics are presented in Section 3 of this report.

1) *The Action Agencies shall convene an expert panel to evaluate the percent change in overall habitat quality at the population scale from projects implemented previously (if quantitative objectives not met) and projects proposed for the implementation until the next check-in.*

The Action Agencies have improved the expert panel process since they convened the first expert panel workshop in 2007. This included making information on habitat condition and fish-habitat relationships available to the panels for their consideration. The most recent panel workshops were convened in 2012. The outputs of the 2012 workshops informed the Action Agencies 2013 CE and 2014–2018 IP as well as the 2014 FCRPS BiOp. The 2014 FCRPS BiOp incorporated several recommendations for process improvements to the expert panel workshops. In late 2013 and early 2014, the Action Agencies with NOAA Fisheries initiated a series of discussions to determine how best to respond to recommendations in the 2014 FCRPS BiOp. Specific recommendations included better documentation of information type and quality the panels use to make each estimate. The panels will be reconvened in 2016 to evaluate the 2012–2015 and the 2016–2018 implementation periods incorporating the 2014 BiOp recommendations into expert panel process.

2) *The Action Agencies will continue to maintain a data management system for storing the material compiled, reviewed, and finalized by the expert panels. The expert panel will use methods consistent with the NWF v NOAA Fisheries E Remand Collaboration Habitat Workgroup process.*

The Action Agencies continue to maintain the Pisces and Taurus data management systems for storing expert panel work products. The expert panels continue to

follow the Remand Collaboration Habitat Workgroup process to evaluate changes in habitat limiting factors associated with completed and planned actions. Decisions on the expert panel framework for evaluating the status of limiting factors and the rationale for changes to limiting factors will continue be documented.

3) *Project proposals will clearly describe the completed project in terms of quantitative habitat metrics which can be used to quantitatively evaluate progress and completion of individual projects.*

Quantitative habitat metrics for habitat improvement actions completed in 2014 are presented in Section 3, Attachment 2, Table 1 of this report.

4) *The Action Agencies will use the expert panels to provide input on changes in habitat quality and function as a result of limiting factor improvements from project actions for the priority population areas and this information will be used to assess improvements to salmonid survival.*

At the 2012 workshops, expert panels estimated changes in limiting factor function that resulted from implementation of habitat improvement actions completed from 2009 to 2011, as described in the 2013 CE. Habitat Quality Improvement (HQI) estimates were then compiled and calculated by the Action Agencies for the "Look Back" (2009 to 2011) and the "Look Forward" (2012 to 2018). The Section 3 Tables include habitat actions implemented in 2014, including actions for priority populations and populations requiring supplemental actions. The Action Agencies began planning for the 2016 panels in late 2014.

5) *If actions from the previous cycle prove infeasible, in whole or in part, the Action Agencies will ensure implementation of comparable replacement projects in the next implementation plan cycle to maintain estimated habitat quality improvements at the population level and achieve equivalent survival benefits. If infeasible at the population level, then alternatively replacement projects will be found to provide benefits at the MPG or ESU/DPS level. Selection of replacement projects to ensure comparable survival benefits will be made based on input from expert panels, regional recovery planning groups, the Northwest Power and Conservation Council, and NOAA Fisheries.*

The Action Agencies will continue to fund and provide technical assistance for, and implement habitat actions identified in the 2010–2013 and 2014–2018 IPs. Actions determined to be infeasible, in whole or in part, will be replaced with comparable actions. Local watershed groups, which generate proposals for the expert panel process, typically maintain lists of actions that can replace actions determined to be infeasible.

6) *The Action Agencies will continue to work cooperatively with the Council to identify priorities and obtain ISRP review of projects proposed for BPA funding.*

The Action Agencies continue to cooperate with the Northwest Power and Conservation Council (NPCC) to identify program priorities and obtain Independent Scientific Review Panel (ISRP) review of projects as appropriate. In 2012 and 2013, actions proposed by project sponsors through the BPA's Fish and Wildlife Program were included in the NPCC's 2013 geographic categorical review. Project sponsors were directed to identify the BiOp relevance of proposed actions in their proposals. The Action Agencies included charts showing limiting factors and their weights in the template for the geographic categorical review to encourage proposals for habitat actions that would result in the greatest benefits to fish populations.

7) *RM&E will inform the relationship between actions, habitat quality and salmon productivity for use in a model developed through the FCRPS RM&E Strategy 3, Action 57 and new scientific information will be applied to estimate benefits for future implementation.*

The Action Agencies have entered into the fifth year of monitoring under the Columbia Habitat Monitoring Program (CHaMP) project. CHaMP and the Integrated Status and Effectiveness Monitoring Program (ISEMP) provide data on habitat status and trends and fish presence and abundance that can be correlated to estimate fish-habitat status and trends. These data inform the Action Agencies and others in the region about habitat status and trends and about relationships between habitat and fish population productivity. The data are used in development of life cycle models, which the Action Agencies continue to fund, consistent with the 2010 and 2014 FCRPS Supplemental BiOps.

Results from IMWs, together with data derived through Action Effectiveness Monitoring (AEM) are informing the relationship between actions, habitat quality, and salmon productivity. Expert panel determinations of limiting factor weights and function, and of change in limiting factor function as a result of implementing habitat improvement actions, will continue to be informed by data and results of research. As more data becomes available in formats that can be used by the expert panels, the Action Agencies will make these products available to the panels.

8) *If new scientific or other information (except incomplete implementation or project modifications) suggests that habitat quality improvement estimates for projects from the previous cycle were significantly in error, the Action Agencies will examine the information and review the project or projects in question and their estimated benefits. This review will occur as part of the 2009 Annual Report and the Comprehensive RPA Evaluations in 2013 and 2016 and will be performed in conjunction with NOAA Fisheries. In the event such review finds that habitat quality improvement benefits were significantly overstated, the Action Agencies will implement replacement projects (selected as per Action 35 above) to provide benefits sufficient to achieve the habitat quality improvement and population-or MPG-specific survival benefit estimated for the original project or projects.*

New scientific or other information has not suggested that previous habitat quality improvement estimates are significantly in error. RME data and results that are brought to bear in discussions of habitat limiting factors will also be considered in the evaluation of future estimates of habitat quality improvement. New information on the habitat quality improvement estimates for actions from 2012 to 2015 will be examined as part of the 2016 expert panel workshops. Actions from the 2012 to 2015 “Look Back” and from the 2016 to 2018 “Look Forward” will be examined as part of the 2016 expert panel workshops. The supplemental actions identified in the 2014-2018 IP will also be considered in the 2016 expert panel process.

b. *During 2010-2018, for non-bolded populations in Table 5, the Action Agencies may provide funding and/or technical assistance for replacement projects should they become necessary for the Action Agencies to achieve equivalent MPG or ESU survival benefits.*

In 2014, the Action Agencies provided funding and technical assistance for actions that improve habitat for non-bolded populations in RPA Action 35, Table 5. The actions are part of a larger effort to address limiting factors in other watersheds to benefit listed species. See Appendix D, 2014-2018 IP, and Section 3, Attachment 2 Tables of this Annual Progress Report.

RPA Action 36 – Estuary Habitat Implementation 2007 to 2009

The Action Agencies will provide funding to implement specific actions identified for implementation in 2007–2009 as part of a 10-year estuary habitat program to achieve the estimated ESU survival benefits of 9.0 percent and 6.0 percent for ocean type and stream-type ESUs, respectively. Projects in an early state of development such that quantitative physical metrics have not been related to estimated survival benefits will be selected per Action 37. If projects identified for implementation in 2007–2009 prove infeasible, in whole or in part, the Action Agencies will implement comparable replacement projects in 2010–2013 to provide equivalent habitat benefits needed to achieve equivalent survival benefits.

Actions for this RPA Action are found in the 2009 FCRPS Annual Report (FCRPS 2010b). Some projects scheduled for completion in 2007–2009 were carried forward to the 2010–2013 period and the associated benefits are included in the estimates for the 2010–2013 implementation cycle.

During the 2007–2009 implementation period some projects proved infeasible in whole or in part. The Action Agencies implemented additional projects in 2010–2013 to provide survival benefits equivalent to those of the projects that proved infeasible. This RPA Action is complete and, as envisioned by the RPA, estuary habitat implementation through 2018 is being continued under RPA Action 37.

RPA Action 37 – Estuary Habitat Implementation 2010 – 2018 – Achieving Habitat Quality and Survival Improvement Targets

The Action Agencies will provide funding to implement additional specific projects as needed to achieve the total estuary survival benefits identified in the FCRPS BA. Projects will identify location, treatment of limiting factor, targeted ESU/DPS or ESUs/DPSs, appropriate reporting metrics, and estimated biological benefits based on the achieving of those metrics. Pertinent new information on climate change and potential effects of that information on limiting factors will be considered.

In 2014 the Action Agencies provided funding for implementation of projects progressing toward achieving the total FCRPS BiOp estuary survival benefits called for by 2018. Most projects implemented in the estuary are selected on an annual basis. Out year planning and scheduling was also conducted.

The Action Agencies use the Expert Regional Technical Group (ERTG) to evaluate the biological benefits of estuary habitat projects. This review combines available scientific data and expert opinion to estimate the benefits to all up-river ESA-listed ESU/DPSs including interior populations of listed juvenile salmonids. This review evaluates habitat quality and quantity, access (includes fish entering the site and food exported from the site), and the likelihood that the project will function as designed. The ERTG incorporates new information into their process as it becomes available.

In 2014, the Action Agencies completed on-the-ground habitat actions for eight projects in the estuary and continued planning and development of additional projects for future implementation. (See Section 3, Attachment 4 for status of projects). These projects yielded 3.1 Ocean Survival Benefit Units (SBUs) and 1.2 Stream SBUs by restoring 1,182 acres throughout the Columbia River estuary.

The Action Agencies continue to use the Columbia Estuary Ecosystem Restoration Plan (CEERP) to guide their estuary restoration efforts. The purpose of CEERP is to establish the strategic, adaptively managed scientific basis for the ecosystem restoration and associated

RME that the Action Agencies are funding in the Lower Columbia River estuary (LCRE). In 2014, the CEERP documents were again updated to include any new lessons and associated adaptive management (BPA and ACOE 2014; Johnson et al. 2014a). Some of these new adjustments include the removal of floodplain lakes from consideration until further data on fish densities/use is available, being cognizant of data concerning elevations and the establishment of reed canary grass during design, and giving priority to projects close to the mainstem and/or within 7-8 km of the mainstem.

As part of the CEERP, the Action Agencies have developed an out-year prioritization process that evaluates cost, SBUs and implementation likelihood of all potential estuary actions. This process was described in detail in the 2013 Comprehensive Evaluation. In 2014, the Action Agencies met monthly with project sponsors to refresh the cost, SBU, and implementation likelihood data of current and future actions. All changes to estuary action data are catalogued in cbfish.org at http://www.cbfish.org/EstuaryAction.mvc/Index. If these changes resulted in an action being revised or no longer feasible, the Action Agencies drew on the reserve of candidate projects developed in cooperation with implementation partners to ensure the total estuary habitat project portfolio includes a sufficient number of SBUs that will collectively achieve the percent estuary survival improvements called for in the RPA. See Section 3, Attachment 4 for more details.

In 2014, the Action Agencies funded, and with their partners, completed the following actions:

Chinook River Restoration – With the recent acquisition of 201 low-lying acres immediately north and east of the tide gates, WDFW is adjusting their tide gate operations to be open most of the year. A modified operations scheme allows greater tidal flows and increases the area of saline inundation in the floodplain by 310 acres. WDFW will close the tide gates during storm events that are modeled to flood beyond the proposed inundation acreage. Planning and feasibility of the site are on-going in an effort to provide for permanent and more natural juvenile salmon ingress/egress and hydrology. This could lead to habitat improvement actions that provide incremental SBUs in future project construction phases.

Sharnelle Fee – The Columbia River Estuary Study Taskforce (CREST) restored hydrology and juvenile salmonid access to approximately 50 acres of historical Sitka Spruce swamp in the Youngs River watershed. The site is part of a growing complex of intact (reference) and restored habitats. The levee at the Sharnelle Fee site was breached in three locations and a setback levee was constructed to protect adjacent lands to the West. In two additional areas, the levee was lowered to enhance juvenile salmonid ingress/egress.

Brix Bay | Deep River Confluence – Hancock Acquisition – The Columbia Land Trust acquired a third parcel at their Brix Bay | Deep River Confluence site to complement two previously acquired parcels. Future restoration will include the removal and replacement of tidegates with bridge or large culvert structures. Channel enhancements, ditch filling, and invasive plant control will also be part of the restoration. Passive restoration will transition the site from its current land use to ecological uses, allowing natural plant communities to re-establish in preparation for future active restoration.

Julia Butler Hansen NWR Steamboat Slough – The Steamboat Slough Restoration project is a Corps project authorized under Section 536 of the Water Resources Development Act of 2000. The primary goal was to reconnect more of the historical floodplain to the mainstem and to restore wetland function in 67 acres within the Julia Butler Hansen National Wildlife Refuge located in Wahkiakum County, Washington. Major

elements of the project include: breaching a mainstem estuary levee in two locations, excavating channels and reshaping the disturbed landscape to expand topographic diversity, and constructing a setback levee to protect adjacent land.

Karlson Island Restoration – CREST improved hydrologic connectivity and juvenile salmonid access to approximately 313 acres of Karlson Island tidal marsh wetlands. Project elements include four major levee breaches to improve hydrology and five additional breaches to expand ingress/egress points for fish access. Improvements to native plant communities included invasive plant control and native plantings.

Sauvie Island, Phase II – CREST removed water control structures to restore hydrology and juvenile salmonid access to two floodplain wetland sites in the northern tip of Sauvie Island. The two sites include Millionaire and Widgeon-Deep Lakes. In addition, wetland surfaces were scraped down in key locations to lower elevations, allowing a larger portion of the wetlands to be inundated at deeper depths for longer periods of time, benefiting native plant species. Upriver and local volitional juvenile salmonid access was restored to approximately 130 acres of high-quality historical habitats.

Thousand Acres – The Lower Columbia Estuary Partnership (LCEP, formerly LCREP) restored hydrology and juvenile salmonid access to approximately 28 acres of historical estuary floodplain on the Sandy River Delta. The project removed a collapsed tidegate, water control structure, and a culvert. Historical channels were excavated to re-establish hydrology between the river and interior wetlands. Habitat complexity will be enhanced by replacing invasive non-native reed canarygrass with structurally diverse native wetland plant communities, promoting beaver activity, and installing large wood habitat structures.

Multnomah & Wahkeena Creeks, Benson Lake – LCEP improved the access and capacity of juvenile salmonid habitat in Multnomah and Wahkeena Creeks. This was accomplished by reforesting three acres of riparian corridor, reducing the amount of diverted flow entering warm water ponds, improving instream habitats, and treating stormwater runoff from nearby parking lots. Stream temperatures in Multnomah Creek were reduced post implementation by several degrees providing thermal refugia for juvenile salmonids.

In 2014 the Action Agencies also took the following actions to implement the steps called for in RPA Action 37 above:

1. *Action Agencies will actively engage the LCREP Science workgroup to identify project benefits in coordination with other regional experts, using recovery planning products and the modified LCREP project selection criteria (FCRPS BA Attachment B.2.2-3) to identify projects that will benefit salmon considered in this RPA.*

   In 2014, the Action Agencies continued to use the ecosystem criteria developed by the Lower Columbia Estuary Program's (LCEP's) Science Workgroup to help select restoration and protection projects in the Lower Columbia River and estuary. Additionally, the LCEP's Project Review Committee was instrumental in reviewing all potentially BPA-funded projects to evaluate ecological benefits to the estuary.

2. *To support project selection the Action Agencies will convene an expert regional technical group. This group will use the habitat metrics to determine the estimated change in survival which would result from full implementation.*

   The ERTG was established in 2009 and began evaluating federal projects for their survival benefit potential. The ERTG has five members, representing the scientific

expertise of: the Oregon Department of Fish and Wildlife (ODFW); the Washington Department of Fish and Wildlife (WDFW); NOAA Fisheries' Northwest Fisheries Science Center; the Department of Energy's Pacific Northwest National Laboratory; and the Skagit River System Cooperative. In 2014, the ERTG completed the following:

- Reviewed and scored the SBUs for 13 proposed estuary actions; and
- Produced one formal work product: "Significant Digits for Survival Benefit Units" (ERTG 2014).

3. *Project proposals will clearly describe the completed project in terms of quantitative habitat metrics which can be used to quantitatively evaluate progress and completion of individual projects.*

   The ERTG continues to refine its template to ensure that it has the best available information on proposed projects. In 2013 the template was updated to include a requirement for a landscape level map in addition to the site specific map, which allows them to better evaluate how individual projects fit into the landscape scale of the CEERP Program. In 2014, as recommended by the Independent Scientific Advisory Board (ISAB) in their review of the ERTG process (ISAB 2014), the ERTG initiated development of a document that outlines their process for reviewing and scoring estuarine ecosystem restoration projects. As recommended by ISAB, that document will be submitted for publication in a peer-reviewed journal.

4. *The expert regional technical group will use the approach originally applied in the FCRPS BA (Attachment B.2.2) (Estimated Benefits of Federal Agency Habitat Projects in the Lower Columbia River Estuary) and all subsequent information on the relationship between actions, habitat and salmon productivity models developed through the FCRPS RM&E to estimate the change in overall estuary habitat and resultant change in population survival.*

   The ERTG previously reviewed and improved the approach for determining SBU values applied in the FCRPS BA. The improved approach was used to estimate biological benefits (SBUs) during 2014.

5. *If actions from the previous cycle prove infeasible, in whole or in part, the Action Agencies will ensure implementation of comparable replacement estuary projects in the next implementation plan cycle to maintain estimated habitat quality improvements at the ESU/DPS level and achieve equivalent survival benefits. Selection of replacement projects, to ensure comparable survival benefits, will be made based on input from expert panels, regional recovery planning groups, the Northwest Power and Conservation Council, and NOAA Fisheries.*

   Some projects planned for implementation in 2014 proved infeasible. In 2014, the Action Agencies and project partners continued out-year planning and prioritization to identify future project opportunities, some of which may be drawn upon to replace SBUs from projects that have been revised or proven infeasible. This ongoing process prioritizes project opportunities based on cost, biological benefit (survival benefit units), and implementation likelihood. Out-year project selection continued to be guided by input from expert panels, regional recovery planning and implementation groups, the NPCC, and NOAA Fisheries.

6. *FCRPS RM&E results will actively inform the relationship between actions, estuary habitat change and salmon productivity and new scientific information will be applied to estimate benefits for future implementation.*

As information from FCRPS estuary research and restoration project effectiveness monitoring becomes available, it is applied to the process of estimating benefits for projects implemented between 2010 and 2018. This process is outlined in the CEERP documents.

7. *If new scientific or other information (except incomplete implementation of project modification) suggests that habitat quality improvement estimates for projects from the previous cycle were significantly in error, the Action Agencies will examine the information and review the project or projects in question and their estimated benefits. This review will occur as part of the 2009 Annual Report and the Comprehensive RPA Evaluations in 2013 and 2016 and will be performed in conjunction with NOAA Fisheries. In the event such review finds that habitat based survival improvement were significantly overstated, the Action Agencies will implement replacement projects (selected as per new projects above) to provide benefits sufficient to achieve the ESU/DPS-specific survival benefit estimated for each affected project.*

   In 2013, in preparing the 2008–2012 Comprehensive Evaluation, the Action Agencies engaged research agencies, consultants, LCEP's Science Workgroup, the Corps' Anadromous Fish Evaluation Program (AFEP), the ERTG, and other sources regarding new scientific information. The Action Agencies examined that information, and found no indication that any habitat quality improvement estimates for projects completed in the 2010 implementation cycle were "significantly overstated." The Action Agencies will continue to coordinate with LCEP's Science Workgroup and the ERTG regarding new scientific information. When available, new scientific information resulting from FCRPS RME will be applied to estimate benefits for projects implemented between 2013 and 2018.

RPA Action 38 – Piling and Piling Dike Removal Program*

**** The language below reflects changes made by the 2014 BiOp:***

RPA Action 38 is no longer required.

Based on the available information, it is not possible to determine whether the removal of pile structures would actually provide survival benefits to juvenile salmon and steelhead. All survival benefit units attributed to this program in the Action Agencies' 2007 Biological Assessment will now be acquired by implementing additional projects under RPA Action 37.

Hatchery Implementation Reports, RPA Actions 39–42

Table 13. Hatchery strategy reporting.

RPA Action No.	Action	Annual Progress Report
Habitat Strategy 1		
39	FCRPS Funding of Mitigation Hatcheries – Programmatic	Status of submittal/approval of Hatchery and Genetic Management Plans (HGMPs), including site-specific application of Best Management Practices.
40	Reform FCRPS Hatchery Operations to Reduce Genetic and Ecological Effects on ESA-Listed Salmon and Steelhead	Status of implementation through December of the previous year for all reforms identified in the BiOp RPA table, action 40, Table 6. Status of implementation of future reforms identified by the Action Agencies following the Hatchery Scientific Review Group process.
Hatchery Strategy 2		
41	Implement Safety Net Programs to Preserve Genetic Resources and Reduce Short-term Extinction Risk	Status of implementation through December of the previous year for all safety net programs identified in the BiOp RPA table, action 41, Table 7.
42	Implement Conservation Programs to Build Genetic Resources and Assist in Promoting Recovery	Status of implementation through December of the previous year for all conservation programs identified in the BiOp RPA table, action 42, Table 8.

RPA Action 39 – FCRPS Funding of Mitigation Hatcheries – Programmatic

The FCRPS Action Agencies will continue funding hatcheries in accordance with existing programs, and will adopt programmatic criteria for funding decisions on mitigation programs for the FCRPS that incorporate BMPs. The Hatchery Effects Report, the August 2006 NOAA Fisheries paper to the PWG and the NOAA Fisheries 2007 Guidance Paper should be considered in developing these criteria in addition to the BMPs in the Action Agencies' BA. Site specific application of BMPs will be defined in ESA Section 7, Section 10, or Section 4(d) consultations with NOAA Fisheries to be initiated and conducted by hatchery operators with the Action Agencies as cooperating agencies.

In 2008 and 2009, NOAA Fisheries asked the Action Agency-funded hatchery operators to update the hatchery and genetic management plans for their respective hatchery programs. The Action Agencies have since worked collaboratively with hatchery program operators on the development and submittal of hatchery and genetic management plans for consultation. Information from the reports of the USFWS Hatchery Review Team process, the Columbia Basin Hatchery Scientific Review Group process, and regionally reviewed best management practices has guided and informed the development of program-specific hatchery and genetic management plans.

In 2014, the Action Agencies continued to fund mitigation hatcheries in accordance with existing programs and used the programmatic funding criteria developed in 2008 to complete checklists for FCRPS mitigation program funding decisions. The hatchery programs funded by the Action Agencies are described briefly in Tables 14 through 16.

Table 14. FCRPS–funded hatchery programs in the upper Columbia region.

Program	Basin	Operator	Lead Action Agency	Status of Consultation Process, December 2014
Leavenworth National Fish Hatchery (NFH) Spring Chinook	Wenatchee	USFWS	Reclamation	USFWS submitted Supplemental BA November 17, 1014. NOAA began revising draft BiOp.
Entiat NFH Summer Chinook Program	Entiat	USFWS	Reclamation	NOAA Fisheries issued BiOp and permits April 18, 2013. Current BiOp and permits expire April 1, 2023.
Winthrop NFH Methow Composite Spring Chinook	Methow	USFWS	Reclamation	NOAA Fisheries issued a BiOp and permits for production for transfer to the Okanogan program. Methow production in Draft BiOp and permit review.
Winthrop NFH Steelhead	Methow	USFWS	Reclamation	NOAA Fisheries issued a letter of sufficiency on March 2013 and began drafting BiOp.
Methow Coho	Methow	Yakama Nation (YN)	BPA	NOAA Fisheries issued a letter of sufficiency in December 2010. BiOp has been drafted.
Wenatchee Coho	Wenatchee	YN	BPA	NOAA Fisheries issued a letter of sufficiency in December 2010. BiOp has been drafted.

Table 15. FCRPS-funded hatchery programs in the mid-Columbia region.

Program	Basin	Operator	Lead Action Agency	Status of Consultation Process, December 2014
Yakima Spring Chinook	Yakima	YN	BPA	NOAA Fisheries issued BiOp and permits November 2013.
Yakima Summer-Fall Chinook 1	Yakima	YN	BPA	NOAA Fisheries issued BiOp and permits November 2013.
Yakima Coho	Yakima	YN	BPA	NOAA Fisheries issued BiOp and permits November 2013.
Touchet Endemic Steelhead	Walla Walla	WDFW	BPA (Lower Snake River Compensation Plan)	NOAA Fisheries issued a letter of sufficiency in March 2011. Status of consultation is ongoing in 2014, expected completion in 2015
Lyons Ferry Summer Steelhead	Walla Walla	WDFW	BPA (Lower Snake River Compensation Plan)	NOAA Fisheries consultation completed in 2007.
Umatilla Spring Chinook	Umatilla	Oregon Department of Fish and Wildlife (ODFW) & Confederated Tribes of the Umatilla Indian Reservation (CTUIR)	BPA	NOAA Fisheries issued BiOp and permits April 2011.
Umatilla Fall Chinook 2	Umatilla	ODFW & CTUIR	BPA and Corps	NOAA Fisheries issued BiOp and permits April 2011.
Umatilla Coho 3	Umatilla	ODFW & CTUIR	BPA	NOAA Fisheries issued BiOp and permits April 2011.

Program	Basin	Operator	Lead Action Agency	Status of Consultation Process, December 2014
Umatilla Summer Steelhead	Umatilla	ODFW & CTUIR	BPA	NOAA Fisheries issued a letter of sufficiency in March 2011. Status in 2014 is consultation "to be scheduled".

Table 16. FCRPS-funded hatchery programs in the Snake River region.

Program	Basin	Operator	Lead Action Agency	Status of Consultation Process, December 2014
Lyons Ferry Summer Steelhead	Lower Snake	WDFW	BPA (Lower Snake River Compensation Plan)	NOAA Fisheries issued a letter of sufficiency in May 2011. Status in 2014 is consultation in process, expected completion in 2015.
Snake River Stock Fall Chinook (Lyons Ferry Hatchery) 1	Lower Snake	WDFW	BPA (Lower Snake River Compensation Plan)	NOAA Fisheries issued BiOp and permits in 2012.
Tucannon Summer Steelhead Endemic	Tucannon	WDFW	BPA (Lower Snake River Compensation Plan)	NOAA Fisheries issued a letter of sufficiency in May 2011. Status in 2014 is consultation in process, expected completion in 2015.
Tucannon Spring Chinook	Tucannon	WDFW	BPA (Lower Snake River Compensation Plan)	NOAA Fisheries issued a letter of sufficiency in August 2011. Status in 2014 is consultation in process, expected completion in 2015.
NF Clearwater River Summer Steelhead (B-Run-Clearwater River Hatchery)	Clearwater	IDFG	BPA (Lower Snake River Compensation Plan)	NOAA Fisheries issued a letter of sufficiency in August 2011. Status in 2014 is hatchery co-operators are updating the HGMPs to reflect current program.
Clearwater River Basin Spring/Summer Chinook (Clearwater Hatchery)	Clearwater	IDFG	BPA (Lower Snake River Compensation Plan)	NOAA Fisheries issued a letter of sufficiency in August 2011. Status in 2014 is hatchery co-operators are updating the HGMPs to reflect current program.
Clearwater River Basin Spring/Summer Chinook (Kooskia Hatchery)	Clearwater	NPT	BPA (Lower Snake River Compensation Plan)	NOAA Fisheries issued a letter of sufficiency in August 2011. Status in 2014 is hatchery co-operators are updating the HGMPs to reflect current program.
NF Clearwater Summer Steelhead (B-Run-Dworshak NFH)	Clearwater	USFWS	Corps	Applicant updating the HGMP to reflect changes to the program that have occurred since the original HGMP submittal.
NF Clearwater Spring Chinook (Dworshak NFH)	Clearwater	USFWS	BPA (Lower Snake River Compensation Plan)	HGMP submitted in 2011. Formal review and comments from NOAA Fisheries was pending until hatchery co-operators began updating the HGMPs to reflect current program in 2014.

Program	Basin	Operator	Lead Action Agency	Status of Consultation Process, December 2014
Clearwater Spring Chinook (NPTH-Hatchery)	Clearwater	Nez Perce Tribe (NPT)	BPA	HGMP submitted in 2011. Formal review and comments from NOAA Fisheries was pending until hatchery co-operators began updating the HGMPs to reflect current program in 2014.
Clearwater Fall Chinook (NPTH-Hatchery)	Clearwater	NPT	BPA	NOAA Fisheries issued BiOp and permits in 2012.
Grande Ronde Summer Steelhead-Wallowa Stock (Cottonwood Creek/Lyons Ferry Hatchery)	Grande Ronde	WDFW	BPA (Lower Snake River Compensation Plan)	NOAA Fisheries issued a letter of sufficiency in May 2011. Status in 2014 is hatchery co-operators are updating the HGMPs to reflect current program.
Grande Ronde Summer Steelhead (Wallowa Stock)	Grande Ronde	ODFW	BPA (Lower Snake River Compensation Plan)	NOAA Fisheries issued a letter of sufficiency in May 2011. Status in 2014 is hatchery co-operators are updating the HGMPs to reflect current program.
Upper Grande Ronde River Spring/Summer Chinook Salmon Stock	Grande Ronde	ODFW & CTUIR	BPA (Lower Snake River Compensation Plan)	NOAA Fisheries issued a letter of sufficiency in August 2011. Status in 2014 is hatchery co-operators are updating the HGMPs to reflect current program.
Catherine Creek Spring/Summer Chinook	Grande Ronde	ODFW & CTUIR	BPA (Lower Snake River Compensation Plan)	NOAA Fisheries issued a letter of sufficiency in May 2011. Status in 2014 is hatchery co-operators are updating the HGMPs to reflect current program.
Wallowa/Lostine Spring Chinook	Grande Ronde	ODFW, NPT & CTUIR	BPA (Lower Snake River Compensation Plan)	NOAA Fisheries issued a letter of sufficiency in August 2011. Status in 2014 is hatchery co-operators are updating the HGMPs to reflect current program.
Lookingglass Creek Spring/Summer Chinook	Grande Ronde	ODFW	BPA (Lower Snake River Compensation Plan)	NOAA Fisheries issued a letter of sufficiency in March 2012. Status in 2014 is hatchery co-operators are updating the HGMPs to reflect current program.
Little Sheep Creek Summer Steelhead	Imnaha	ODFW	BPA (Lower Snake River Compensation Plan)	NOAA Fisheries issued a letter of sufficiency in August 2011. Status in 2014 is hatchery co-operators are updating the HGMPs to reflect current program.
Imnaha Spring/Summer Chinook	Imnaha	ODFW	BPA (Lower Snake River Compensation Plan)	NOAA Fisheries issued a letter of sufficiency in August 2011. Status in 2014 is hatchery co-operators are updating the HGMPs to reflect current program.

Program	Basin	Operator	Lead Action Agency	Status of Consultation Process, December 2014
Upper Salmon River B-Run Steelhead	Salmon	IDFG	BPA (Lower Snake River Compensation Plan)	NOAA Fisheries issued a letter of sufficiency in August 2011.
Upper Salmon Spring Chinook (Sawtooth Hatchery)	Salmon	IDFG	BPA (Lower Snake River Compensation Plan)	NOAA Fisheries issued a letter of sufficiency in August 2011.
South Fork Salmon Summer Chinook (McCall Fish Hatchery)	Salmon	IDFG	BPA (Lower Snake River Compensation Plan)	NOAA Fisheries issued a letter of sufficiency in August 2011.
Johnson Creek Summer Chinook (South Fork Salmon)	Salmon	IDFG & NPT	BPA (Lower Snake River Compensation Plan)	Applicant subbmitted HGMP in 2011. Formal review and comments from NOAA Fisheries pending.
Yankee Fork Summer Steelhead Streamside Incubation Supplementation	Salmon	IDFG & Shoshone-Bannock Tribes	BPA	NOAA Fisheries issued a letter of sufficiency in August 2011.
Yankee Fork Summer Steelhead Supplementation	Salmon	IDFG & Shoshone-Bannock Tribes	BPA	NOAA Fisheries issued a letter of sufficiency in August 2011.
Yankee Fork Chinook Supplementation	Salmon	IDFG & Shoshone-Bannock Tribes	BPA	Operator updating the HGMP to reflect current program.
Panther Creek Chinook Supplementation	Salmon	IDFG & Shoshone-Bannock Tribes	BPA	Operator developing an HGMP to be submitted in 2014.
SF Salmon-Dollar Creek Summer Chinook (McCall FH-Egg Box)	Salmon	IDFG & Shoshone-Bannock Tribes	BPA	HGMP submitted in 2011. Formal review and comments from NOAA Fisheries pending.
E. Fork Salmon River Natural integrated Steelhead (Sawtooth)	Salmon	IDFG	BPA (Lower Snake River Compensation Plan)	HGMP submitted in 2011. Formal review and comments from NOAA Fisheries pending.
Little Salmon River A&B Run Steelhead (Niagara/Magic Valley)	Salmon	IDFG	BPA (Lower Snake River Compensation Plan)	HGMP submitted in 2011. Formal review and comments from NOAA Fisheries pending.
Upper Salmon River A-Run Steelhead (Sawtooth/ Magic Valley/Hagerman National)	Salmon	IDFG	BPA (Lower Snake River Compensation Plan)	HGMP submitted in 2011. Formal review and comments from NOAA Fisheries pending.
Snake River Sockeye	Salmon	IDFG	BPA (Lower Snake River Compensation Plan)	NOAA Fisheries issued BiOp and permits in 2013.

RPA Action 40 – Reform FCRPS Hatchery Operations to Reduce Genetic and Ecological Effects on ESA-Listed Salmon and Steelhead

The Action Agencies will undertake/fund reforms to ensure that hatchery programs funded by the Action Agencies as mitigation for the FCRPS are not impeding recovery. The Action Agencies will work with FCRPS mitigation hatchery operators to cost effectively address needed reforms of current hatchery programs while continuing to meet mitigation responsibilities. Specific reforms to be implemented under this action (following any necessary regulatory approval) are listed in Table 6 of the RPA action table. Other reforms will be identified and implemented following the conclusion of the Columbia River Hatchery Scientific Review Group process.

1. *For Lower Columbia Chinook: The COE will review the John Day Hatchery Mitigation Program.*

   The Corps continued an engineering study in 2014. The report will recommend specific improvements to the current John Day Mitigation production program.

2. *For Snake River Steelhead: Fund the Tucannon River steelhead supplementation program to transition to local broodstock using BMPs.*

   This action is funded by BPA and implemented by the Lower Snake River Compensation Plan program office, WDFW, and the Lower Snake River Compensation Plan hatchery program operator for the Tucannon River steelhead supplementation program. For Tucannon steelhead, WDFW developed a revised HGMP (released September 22, 2011) to eliminate releases of Lyons Ferry Hatchery steelhead in the Tucannon River and to increase production of the endemic Tucannon River summer steelhead program.

3. *For Middle Columbia Steelhead: Fund the Touchet River steelhead supplementation program to transition to local broodstock using BMPs.*

   This action is funded and implemented by the Lower Snake River Compensation Plan program office and WDFW. In 2014, the program continued at the same production level: 50,000 brood year 2013 smolts were released and new smolts were raised to allow for an expected 2015 release of 52,000.

   Twelve years of RME data has indicated that the current supplementation program may not be supporting the native Touchet River population as intended. Hatchery co-managers and technical representatives are engaging in regional discussions for a potential change in the endemic program.

4. *For Upper Columbia Steelhead: For the Winthrop NFH steelhead program, implement measures to transition to local broodstock and to manage the number of Winthrop NFH-produced steelhead on the spawning grounds. Such broodstock and adult escapement reform measures, including capital construction, would be identified through development of an updated HGMP and ESA consultation. Implementation of reform measures is contingent on a finding, in consultation with NOAA Fisheries, that the measures are biologically and economically feasible and effective. Implementation of reforms will be prioritized and sequenced.*

   The Winthrop NFH has transitioned to local broodstock by collecting all brood from the Methow Sub-basin via hatchery volunteers (Winthrop NFH, Methow Fish Hatchery [MFH], and Twisp Weir), coordinated transfers between agencies, limited tangle netting, and angling. Local broodstock collection in 2014 was a success. The 2-year smolt program was comprised entirely of natural origin adults for an anticipated 2016 release of 135,000 smolts. The USFWS furthered efforts to manage returning

Winthrop NFH-produced, Wells Hatchery, and unknown hatchery-origin steelhead on the spawning grounds in 2014. All hatchery-produced steelhead collected at the hatchery or via angling were removed from the naturally spawning population.

These efforts were previously defined through Reclamation's Value Planning Process with Methow Sub-basin stakeholders. In 2014, per the recommendation from the team, Reclamation continued to provide funding to USFWS to increase local broodstock collection, enhance returning hatchery fish management, and monitor these efforts.

RPA Action 41 – Implement Safety Net Programs to Preserve Genetic Resources and Reduce Short-term Extinction Risk

The Action Agencies will continue to fund the operation of on-going "safety net" programs that are providing benefits to ESA-listed stocks at high risk of extinction by increasing genetic resources and will identify and plan for additional safety-net programs, as needed.

1. *For Snake River sockeye: Continue to fund the safety net program to achieve the interim goal of annual releases of 150,000 smolts while also continuing to implement other release strategies in nursery lakes such as fry and parr releases, eyed-egg incubation boxes, and adult releases for volitional spawning (see Action 42 for expansion of the program for building genetic resources and assisting in promoting recovery).*

   BPA continued to fund BPA Project 2007-402-00 (Snake River Sockeye Salmon Captive Broodstock) to preserve this species. The program has produced hundreds of thousands of progeny from remnants of the wild stock. Since 1999, 6,219 adults from the program have returned to Redfish Lake in Idaho.

2. *For Snake River Spring/Summer Chinook: For the Tucannon River spring/summer Chinook safety-net supplementation program fund capital construction, operation and monitoring and evaluation costs to implement a program that builds genetic diversity using local broodstock and a sliding scale for managing the composition of natural spawners comprised of hatchery-origin fish.*

   BPA Project 2000-019-00 (Tucannon River Spring Chinook Captive Brood), a one-generation safety-net program, was completed as planned in 2010. BPA, through the Lower Snake River Compensation Plan Direct Funding Agreement, continues to fund an integrated conservation hatchery program for Tucannon River spring/summer Chinook salmon with an annual production goal of 225,000 yearling smolts. Approximately 255,000 brood-year 2012 smolts were released in 2014.

3. *For Snake River Spring/Summer Chinook: For the Upper Grande Ronde and Catherine Creek safety net supplementation programs fund capital construction, operation and monitoring and evaluation costs to implement a program that builds genetic diversity using local broodstock, and a sliding scale for managing the composition of natural spawners comprised of hatchery origin fish.*

   BPA continued to fund this safety-net program through BPA Project 2007-404-00 (Spring Chinook Captive Propagation—Oregon). The Catherine Creek and Lostine River have met adult return goals of 150 spawning adults in nature, therefore these two safety-net programs have now been phased out. Adult return goals have not been met for the upper Grande Ronde stock; this safety-net work continues to be funded under this project.

4. *For Snake River Spring/Summer Chinook: Fund the Johnson Creek/South Fork Salmon River safety net supplementation program, as described in the existing Section 10 permit.*

   BPA continued to fund implementation of this RPA action through BPA Project 1996-043-00 Johnson Creek Artificial Propagation Enhancement Project. This project releases up to 110,000 spring/summer Chinook salmon smolts annually in Johnson Creek, Idaho, as a safety net program. Only natural origin Johnson Creek fish are used for broodstock. Egg incubation and rearing occur at McCall Fish Hatchery.

5. *For Snake River Spring/Summer Chinook: Fund the experimental captive rearing program for East Fork and West Fork Yankee Fork Salmon River (until phased out by IDFG).*

   All captive rearing in this experimental program has ended and the last remaining brood year (2005) was released as mature adults to their natal waters in 2010. During 2014, the project continued to monitor the reproductive performance of captive-reared Chinook salmon released to spawn in natal streams through BPA Project No. 2007-403-00 Idaho Snake River Spring Chinook Captive Propagation.

6. *For Snake River Steelhead, as a project to benefit primarily B-Run steelhead, the Action Agencies will work with NOAA Fisheries to develop a trigger for future artificial propagation safety-net planning or to identify populations for immediate safety-net planning.*

   The Action Agencies continued to fund collection of B-Run steelhead population viability data in order to inform development of a trigger (see also RPA Subaction 50.5). The 2014 NOAA Fisheries Supplemental BiOp stated that calculation of average A- and B-run populations is no longer valid and that initial monitoring results indicated that some populations assumed to be either A-run or B-run may instead support a mixture of the two run times. Ongoing RME efforts and studies using adult PIT tag detections should allow for more improved population specific assessments in NOAA Fisheries' next 5-year status review. At that time, NOAA Fisheries and the Action Agencies will review the development of a trigger, as described above.

RPA Action 42 – Implement Conservation Programs to Build Genetic Resources and Assist in Promoting Recovery

The Action Agencies will implement conservation programs for ESA–listed stocks where the programs assist in recovery.

1. *For Upper Columbia Spring Chinook: Fund reintroduction of spring Chinook salmon into the Okanogan Basin consistent with the Upper Columbia Salmon Recovery Plan including capital construction, operation and monitoring and evaluation costs to implement a transition to local broodstock and a sliding scale for managing the composition of natural spawners composed of hatchery origin fish. Re-introduction will be coordinated with the restoration and improvement of spring Chinook habitat in the Okanogan Basin and will be contingent on the availability of within ESU broodstock from the Methow Basin.*

   On October 27, 2014, NOAA Fisheries issued Section 10(a)(1)(A) permit Number 18928. This permit authorizes the propogation of Methow Composite spring Chinook eyed eggs or juveniles at Winthrop NFH and the transfer of those fish to the Chief Joseph Hatchery Program for additional rearing and release of up to 200,000 smolts into the Okanogan River via the Tonasket Acclimation Pond. The hatchery program is intended to create a non-essential, experimental population in the Okanogan Basin as authorized under 10(j) of the ESA.

2. *For Upper Columbia Steelhead: Fund a program to recondition natural origin kelts for the Entiat, Methow and Okanogan basin, including capital construction, operation and monitoring and evaluation costs.*

   BPA continued to fund this action through BPA project 2008-458-00. In 2014 Upper Columbia steelhead reconditioning efforts were promising; 76 natural origin females were obtained for reconditioning from various collection locations, including Winthrop NFH, Methow Salmon Hatchery and temporary weirs. Fifty-eight of those survived to be released in the fall, which represents a 76.3 percent survival for 2014 reconditioning efforts.

3. *For Upper Columbia Steelhead: Fund a program that builds genetic diversity using local broodstock and accelerates steelhead recovery in the Okanogan Basin as steelhead habitat is restored and improved, including capital construction, operation, and monitoring and evaluation costs.*

   This action is being implemented by the Confederated Tribes of the Colville Reservation through BPA Project 2007-212-00 (Locally Adapted Okanogan Steelhead Broodstock). A draft Master Plan was completed in September 2014 (Step 1 of the NPCC's Three-Step Process).

4. *For Middle Columbia Steelhead: Fund a program to recondition natural origin kelts in the Yakima River basin including capital construction, implementation and monitoring and evaluation costs.*

   BPA continued to fund this action through BPA Project 2007-401-00 (Kelt Reconditioning/Reproductive Success). The project collects steelhead kelts from Mid-Columbia DPS populations (e.g., Satus Creek, Toppenish Creek, and Naches River) at Prosser Dam on the Yakima River for reconditioning. In 2014, a total of 481 kelts were collected for long-term reconditioning. Survival to to release was 61 percent or 295 fish. Out of the 295 reconditioned steelhead kelts, 198 were consecutive spawning kelts and were released to the Yakima River.

5. *For Snake River Steelhead: For the East Fork Salmon River, fund a small-scale program (no more than 50,000 smolts) including trapping locally returning steelhead in the East Fork Salmon River for broodstock, and follow BMPs for rearing, release, and adult management strategies. Fund capital construction, operation, and monitoring and evaluation costs to implement a program that builds genetic diversity using local broodstock and a sliding scale for managing the composition of natural spawners comprised of hatchery origin fish.*

   In 2014, BPA continued to fund operation and maintenance for this action through the Lower Snake River Compensation Plan Direct Funding Agreement. An HGMP for this program was submitted to NOAA Fisheries in 2011. Approximately 61,700 brood year 2013 smolts were released in 2014. Site-specific application of BMPs will be defined during the ESA consultation, which is expected to be completed in 2015.

6. *For Snake River Spring/Summer Chinook Salmon: For the Lostine and Imnaha rivers, contingent on a NOAA Fisheries approved HGMP, fund these hatchery programs including capital construction, operation and monitoring and evaluation costs to implement supplementation programs using local broodstock and following a sliding scale for managing the composition of natural spawners composed of hatchery origin fish.*

   Supplementation programs using local broodstock for the Lostine and Imnaha rivers are being implemented by the Nez Perce Tribe through BPA Project 1998-007-02 and by ODFW through the Lower Snake River Compensation Plan (LSRCP). HGMPs for the

Lostine and Imnaha rivers supplementation programs were submitted to NOAA Fisheries for ESA consultation by the NPT and ODFW in May 2011 and received sufficiency letters. In 2014, NMFS began drafting a Biological Opinion for this consultation.

7. *For Snake River Sockeye: Fund further expansion of the sockeye program to increase total smolt releases to between 500,000 and 1 million fish.*

   Construction of the Springfield Sockeye Hatchery was completed in 2013 and this new facility, combined with existing facilities, will enable the Snake River sockeye captive propagation program to achieve release goals consistent with this RPA Subaction. The construction and the operation and maintenance of the new hatchery is funded under BPA Project 2007-402-00 (Snake River Sockeye Captive Broodstock). At the end of 2014, there were two brood years of Snake River sockeye being reared at Springfield Hatchery: approximately 215,000 brood year 2013 yearlings and 650,000 brood year 2014 smolts.

8. *For Snake River Sockeye: The Action Agencies will work with appropriate parties to investigate feasibility and potentially develop a plan for ground transport of adult sockeye from LGR Dam to Sawtooth Valley lakes or artificial propagation facilities.*

   The Action Agencies, together with state and federal fishery agencies, implemented a pilot project in 2010 to evaluate feasibility of ground transport from the Lower Granite Dam adult trap to IDFG's Eagle Hatchery. Ground transport would be a feasible option if future river conditions and low return numbers warrant its use, and if NOAA Fisheries and the fishery co-managers, in coordination with the Action Agencies, decide to implement this option. (In July 2015, as a result of Snake River water temperatures and flows, ground transport was implemented.)

9. *For Columbia River Chum: Fund a hatchery program to re-introduce chum salmon in Duncan Creek including capital construction, implementation and monitoring and evaluation costs as long as NOAA Fisheries considers it beneficial to recovery and necessary to reduce extinction risk of the target population.*

   This RPA Subaction has been incorporated into the RPA Subaction 42.10 below.

10. *For Columbia River Chum: Fund assessment of habitat potential, development of reintroduction strategies, and implementation of pilot supplementation projects in selected Lower Columbia River tributaries below Bonneville Dam.*

    BPA continued to fund BPA Project 2008-710-00 which addresses chum reintroduction and habitat assessment actions associated with RPA Subactions 42.9 and 42.10 (BPA Project 2001-053-00, Reintroduction of Chum Salmon into Duncan Creek associated with RPA Subaction 42.9, was merged into BPA Project No. 2008-710-00 (Development of an Integrated Strategy for Chum Salmon Restoration in the Tributaries below Bonneville Dam). In 2014, this project continued to collect chum salmon broodstock to be used for suppplementing Duncan Creek and in artificial production programs, and continued monitoring and evaluation activities throughout the project area.

Predation Management Implementation Reports, RPA Actions 43 – 49

Table 17. Predation management strategy reporting.

RPA Action No.	Action	Annual Progress Report
Predation Management Strategy 1		
43	Northern Pikeminnow Management Program (NPMP)	Annual progress reports will describe actions taken, including: - Number of pikeminnow removals, - Estimated reduction of juvenile salmon consumed, - Average exploitation rate, - Effectiveness of focused removals at mainstem dams - Results of periodic program evaluations (including updates on age restructuring and compensatory responses).
44	Develop strategies to reduce non-indigenous fish	Beginning in 2010, annual progress reports will describe actions taken as a result of the workshop.
Predation Management Strategy 2		
45	Caspian Tern	Annual progress reports will describe actions taken toward the implementation of the Caspian Tern Management Plan.
46	Double-Crested Cormorant	Progress will be documented in the Action Agencies' annual implementation reports.
47	Inland Avian Predation	Annual progress reports will describe actions taken if warranted.
48	Other Avian Deterrent Actions	Annual deterrent actions will not be reported.
Predation Management Strategy 3		
49	Marine Mammal Control Measures	Not applicable.

RPA Action 43 – Northern Pikeminnow Management Program*

**** The language below reflects changes made by the 2014 BiOp:***

The Action Agencies will continue to annually implement the base program and continue the general increase in the reward structure in the northern pikeminnow sport-reward fishery consistent with the increase that started in 2004.

1. *The Action Agencies will fund and update northern pikeminnow exploitation and consumption models using best available information including a range of estimated inter and intra-specific compensation, as needed, to more accurately estimate salmonid survival benefits of the NPMP.*

   The 2010 NOAA Fisheries Supplemental BiOp called for BPA to increase tagging efforts to boost the number of tagged northern pikeminnow to better inform and increase the statistical significance of the biological evaluation of pikeminnow removals. The evaluation component of the NPMP uses tag recoveries in sponsored fisheries to quantitatively measure the benefit of removals within the year and cumulatively. Evaluation indicates that, as a result of the program, pikeminnow predation on juvenile salmon has declined 40 percent, saving 3 to 5 million juvenile salmon annually that would otherwise have been eaten by this predator. In 2014, researchers continued to maintain higher tagging effort. The general increase in tagging and resultant improvement in estimation is consistent with the 2008 BiOp and with recommendations of the Independent Scientific Advisory Board (ISAB) (Hankin and Richards 2000).

In 2014, the exploitation rate on northern pikeminnow was 11.5 percent, within the program objective based on the hypothesis that a 10 to 20 percent exploitation rate (on northern pikeminnow 9 inches or longer) could achieve up to a 50 percent reduction in predation mortality (Rieman and Beamesderfer 1990). The exploitation rate was based on a numerical catch of 170,482 from the sport reward and dam angling fisheries.

2. *The Action Agencies will evaluate the feasibility of using improved electrofishing methods to meet the current monitoring goals while reduce take of ESA-listed salmonids.*

   Changes made to the electrofishing methods involve measures instituted to minimize interactions specifically with Pacific salmon or sturgeon. Upon encountering these taxa, delivery of the electric current is ceased immediately and the boat is moved out of the area (i.e., downstream) before the electrical field is reestablished. Sampling typically is conducted in areas where water depth is between one and two meters (i.e., near shore). In the event Pacific salmon or sturgeon are encountered continuously as sampling progresses downstream, electrofishing activities are relocated to deeper water, off shore, for the remainder of the sampling event. Finally, a threshold of 500 encounters with juvenile has been established for a given sampling event. If this number is met at any point during an electrofishing run, sampling is discontinued in that area. Interactions with Pacific salmon have varied among field seasons throughout the past ten years of the program. The measures described above have been implemented to minimize these encounters while maintaining sampling efficiencies.

3. *The Action Agencies will evaluate the effectiveness of focused removals of northern pikeminnow at Columbia and Snake River Dams to investigate the cost and benefits of dam angling in increasing juvenile salmonid survival.*

   As part of the ongoing annual evaluation of the NPMP, managers determined that continued implementation of the dam angling program component is warranted based on the 2014 catch of 6,424 from the forebays and tailraces of The Dalles and John Day Dams. This represents a 1.59-percent increase in catch from 2013.

RPA Action 44 – Develop Strategies to reduce non-indigenous Fish

The Action Agencies will work with NOAA Fisheries, states and tribes to coordinate to review, evaluate, and develop strategies to reduce non-indigenous piscivorous predation. The formation of a workshop will be an initial step in the process.

In 2013, the Action Agencies funded the last year of a study to address the prioritized non-native fish predation issues resulting from a series of workshops in 2009. The study objectives were to evaluate the physiological condition of smallmouth bass, walleye and channel catfish as they head into the over-wintering time-period, and to determine whether American shad, as a prey item, may be contributing to an enhanced physiological condition of non-native predators. Generally, the study concluded that predators that ate mostly fish were in better condition than those that ate mostly crustaceans or other items, and the notion that consumption of American shad may be significantly enhancing the condition of nonnative predators, and perhaps improving their overwinter survival and making them more effective predators on juvenile salmonids, was inconclusive. There was no further action in 2014.

RPA Action 45 – Reduce Caspian Terns on East Sand Island in the Columbia River Estuary

The FCRPS Action Agencies will implement the Caspian Tern Management Plan. East Sand Island tern habitat will be reduced from 6.5 to 1.5 to 2 acres. It is predicted that the target acreage on East Sand Island will be achieved in approximately 2010.

In November 2006, the USFWS and Corps signed separate records of decision adopting the Caspian Tern Management Plan. NOAA Fisheries completed the BiOp for the proposed action on February 16, 2006. In 2008, the Corps began the implementation of the Caspian Tern Management Plan with the construction of a one-acre island in Fern Ridge Reservoir. Since then, the Corps has constructed a total of nine sites, but one site (Dutchy Island) was later removed. In 2014, a total of 6.8 acres was available to terns nesting in southern Oregon and northern California. These sites are listed in Table 18, below. Due to the number of alternative nest sites made available in interior Oregon and northern California, in 2014 the area made available for tern nesting at East Sand Island was limited to 1.55 acres, slightly less than the 1.58 acres available the previous two years. In 2014 the Corps also started construction of additional tern nesting habitat in the Don Edwards National Wildlife Refuge in San Francisco Bay.

The Caspian tern colony on East Sand Island in the Columbia River estuary, the largest of its kind in the world, consisted of 6,270 breeding pairs in 2014. This is a decrease from the estimate of 7,400 pairs in 2013 and the smallest Caspian tern colony size recorded at East Sand Island since the initiation of reductions in tern nesting habitat on the island in 2008, as part of the Caspian Tern Management Plan. This represents a decline of about 41 percent in the size of the Caspian tern colony on East Sand Island from its peak in 2008 (ca. 10,670 breeding pairs); but remains above the goal set forth in the Tern EIS, 3,125–4,375 breeding pairs respectively. In 2014, the tern colony area was reduced to 1.55 acre, 0.03 acre less than 2013. This restriction resulted in an average nesting density of 1.06 nests/m^2.

The average proportion of juvenile salmonids in the diet of Caspian terns during the 2014 nesting season was 33 percent, similar to the average observed over the previous eight nesting seasons. The estimated total smolt consumption by Caspian terns nesting at East Sand Island in 2014 was 4.5 million (95 percent c.i. = 3.9–5.1 million), not significantly different from total annual smolt consumption during 2011, 2012, and 2013. Predation rates on specific populations of salmonids (ESUs/DPSs) by Caspian terns in 2014 were similar to those observed during 2011–2013, but were generally lower than those observed during the period 2007–2010. Similar to previous years, Caspian tern predation rates were 5-10 times higher on populations of steelhead smolts (8.6–11.4 percent, depending on DPS) compared with populations of salmon (0.9–1.6 percent, depending on ESU).

Table 18. Status of Caspian tern nesting islands for the 2014 breeding season (Roby et al. 2015a).

Location	Acres Available in 2014	Completion Date	Social Attraction	Watered
Fern Ridge Reservoir (OR)	1.0	Feb 2008	No	Yes
Crump Lake (OR)	1.0	Mar 2008	No	Yes
East Link Unit, Summer Lake Wildlife Area (OR)	0.5	Dec 2008	Yes	Yes
Dutchy Lake, Summer Lake Wildlife Area (OR) *	0.0	Feb 2009	NA	NA
Sump 1B, Tule Lake NWR (CA)	2.0	Aug 2009	Yes	Yes
Gold Dike Unit, Summer Lake Wildlife Area (OR)	0.5	Sep 2009	Yes	Yes
Orems Unit, Lower Klamath NWR (CA)	0.0	Sep 2009	No	No
Sheepy Lake, Lower Klamath NWR, (CA)	0.8	Feb 2010	Yes	Yes
Malheur Lake, NWR (OR)	1.0	Feb 2012	Yes	Yes
*Island removed in 2012. No management or monitoring in 2014.				

RPA Action 46 – Double-Crested Cormorants*

**** The language below reflects changes made by the 2014 BiOp:***

The FCRPS Action Agencies will develop a cormorant management plan (including necessary monitoring and research) and implement warranted actions to reduce cormorant predation in the estuary to Base Period levels (no more than 5,380 to 5,939 nesting pairs on East Sand Island).

East Sand Island is home to the largest double-crested cormorant colony in western North America and is the largest known breeding colony of the species world-wide. In 2014, all of East Sand Island was available to double-crested cormorants.

In 2014, the colony consisted of about 13,626 breeding pairs, down from the 14,916 pairs recorded in 2013 but higher than the average annual estimate of 10,776 for 1997–2013. Predation rates in 2014 were higher than those observed in 2013 for all ESUs/DPSs evaluated. Predation rates on some salmon ESUs in 2014 were the highest recorded since the colony was first scanned for PIT tags in 1999. For example, predation rates by East Sand Island double-crested cormorants on Snake River spring Chinook salmon in 2014 (8.5 percent; 95 percent c.i. = 6.1–13.2 percent) were roughly 2–10 times higher than those recorded during 1999–2013 (ca. 0.9–6.8 percent). Predation rates by double-crested cormorants nesting on East Sand Island were generally higher on steelhead populations compared with salmon populations; analysis suggests that double-crested cormorants consume juvenile salmonids in relative proportion to their availability on an annual basis.

In 2012, the Corps initiated development of a Draft Environmental Impact Statement (DEIS) for Double-Crested Cormorant Management to Reduce Predation of Juvenile Salmonids in the Columbia River Estuary. Development of that DEIS continued through 2013 with the consideration of a range of alternative management actions. The DEIS was published in the Federal Register and offered for public comment on June 12, 2014. The Corps received a substantial number of comments, which were incorporated into the Final Environmental Impact Statement (FEIS). Significantly, comments regarding the cumulative impacts to the western population of double-crested cormorants led the Corps to modify an

existing alternative to better address these concerns. Upon further analysis, this alternative was selected as the preferred alternative for inclusion in the FEIS. The Corps continued to work towards publishing the FEIS during the remainder of 2014 (and published a Notice of Availability in the Federal Register on February 13, 2015).

RPA Action 47 – Inland Avian Predation

The FCRPS Action Agencies will develop an avian management plan (for Double-Crested Cormorants, Caspian Terns, and other avian species as determined by RM&E) for Corps-owned lands and associated shallow water habitat.

In 2014, the Action Agencies finished development of the Inland Avian Predation Management Plan (IAPMP) for Corps owned and managed lands and associated shallow water habitat upriver of Bonneville Dam. Based on results of RME conducted as part of RPA Action 68, the Corps and Reclamation agreed to expand the scope of the plan to include Reclamation-owned lands at Goose Island in Potholes Reservoir (near Othello, Washington), where a Caspian tern colony was preying heavily on Upper Columbia River steelhead. The final IAPMP was released in January 2014 with the Corps signing a Finding of No Significant Impact (FONSI) January 23, 2014 and Reclamation signing a FONSI January 24, 2014. Implementation of the IAPMP subsequently began in late January 2014. IAPMP actions in 2014 focused primarily on dissuading Caspian terns from Goose Island at Potholes Reservoir as part of implementing Phase I of the IAPMP, and developing Caspian tern nesting habitat at Don Edwards National Wildlife Refuge (San Francisco Bay) for subsequent implementation of IAPMP Phase II actions in 2015. Management efforts in 2014 reduced the Goose Island colony predation rate on Upper Columbia River steelhead from a 2007-2013 average of 15.7 percent to 2.9 percent in 2014, and the predation rate on listed Upper Columbia River Spring Chinook from a 2009-2013 average of 2.6 percent to 0.5 percent in 2014 (Roby et al. 2015a).

The IAPMP is a habitat based management plan primarily addressing Caspian tern predation within the Columbia River basin upstream of Bonneville Dam. The Corps' avian deterrent program at the 8 lower Columbia and Snake River hydroelectric facilities continued to be addressed through the Fish Passage Operations and Maintenance (FPOM) group and was included in the Fish Passage Plan (FPP) per RPA Action 48.

RPA Action 48 – Other Avian Deterrent Actions*

**** The language below reflects changes made by the 2014 BiOp:***

*The Corps will monitor avian predator (terns, cormorants, and gulls) activity and continue to implement and improve avian deterrent programs at all lower Snake and Columbia River dams. This program will be coordinated through the Fish Passage Operations and Maintenance Team and included in the Fish Passage Plan**.***

Avian deterrent actions, such as long-term hazing and wire arrays, were implemented in consultation with FPOM and in accordance with the FPP (ACOE 2014b), as called for by RPA Action 48.

The Corps avian deterrent actions on the Lower Snake and McNary Dams continued through 2014. New actions in 2014 included avian monitoring and deterrence plans specific to each project, summarized for the FPP. Other new action was implementing limited lethal take of gulls to augment bird hazing.

RPA Action 49 – Marine Mammal Control Measures

The Corps will install and improve, as needed, sea lion excluder gates at all main adult fish ladder entrances at Bonneville Dam annually. In addition, the Corps will continue to support land and water based harassment efforts by Oregon Department of Fish and Wildlife (ODFW), Washington Department of Fish and Wildlife (WDFW), and Columbia River Inter-Tribal Fish Commission (CRITFC) to keep sea lions away from the area immediately downstream of Bonneville Dam.

In 2014, the Corps again implemented and evaluated a variety of sea lion deterrents, from physical barriers to non-lethal harassment (Stansell et al. 2014). Sea lion exclusion devices (SLEDs) were installed at Powerhouse II and Cascades Island ladder entrances on February 13, at B-branch ladder entrances on February 24, and at Powerhouse I entrances on February 25. The SLEDs feature 15.38-inch (39.05-centimeter) gaps that are designed to allow fish passage. Floating orifice gates were also equipped with SLED-like barriers. All SLEDS were removed on June 2.

Since 2006, the Corps has contracted with the U.S. Department of Agriculture (USDA) Wildlife Services to harass sea lions away from fishways and other dam structures. In 2014, Dam-based harassment by USDA agents began the first week in March and continued seven days per week through the end of May. Dam-based harassment involved a combination of acoustic, visual, and tactile non-lethal deterrents, including above-water pyrotechnics (cracker shells), and rubber buckshot from shotguns.

CRITFC conducted boat-based harassment from the first week in March 2014 through mid-May. While boats were granted access to the Bonneville Dam tailrace boat restricted zone, they could not operate within 30 meters of dam structures or within 50 meters of fishway entrances. To minimize the impact to fish, the use of “seal bomb” deterrents was prohibited within 100 meters of fishways, collection channels, or fish outfalls for the Powerhouse II corner collector and smolt monitoring facility. Boat crews ceased use of seal bombs after adult salmonid passage exceeded 1,000 fish per day.

Corps biologists coordinated with USDA agents and boat-based crew from CRITFC on all sea lion harassment activities at Bonneville Dam to ensure safety and increase the effectiveness of harassment efforts. SLEDs and orifice gates continued to be effective at keeping sea lions out of the fishways. Non-lethal hazing with pyrotechnics from both the dam face and by boat continued to have short term impacts at driving or keeping some sea lions away from the fishways; however, some individual sea lions were not chased away at all and continued to hunt near the dam.

RME Implementation Reports, RPA Actions 50–73

The 2014 NOAA Fisheries Supplemental BiOp includes a large, comprehensive research and monitoring program covering status monitoring, action effectiveness research, and critical uncertainties research in the areas of fish population status, hydro, tributary habitat, estuary/ocean, harvest, hatchery, and predation. This program includes numerous individual projects, many of which have been collecting needed data for multiple years. The following sections list the individual projects that support each RME RPA subaction and include computer links to find detailed, information through access to the Project technical and annual reports. These reports are the products of the contracted agency and/or tribal staff and do not necessarily represent the scientific or policy interpretation of any entity including the Action Agencies or NOAA Fisheries.

In 2014, many RME projects collected additional data as part of a multiyear study design. Summaries of the results of these research and monitoring efforts can be found in Section 1 of this Annual Progress Report under RME.

For all RPA RME actions in RPA Actions 50-73, individual BPA project information can be found at: http://www.cbfish.org/BiologicalOpinionAction.mvc/Index/2013/BiOpRpaStatus

A 2014 compilation of annual reports for these projects can be found at http://www.cbfish.org/Content/2013_Sponsors_RPA_Annual_Reports_Final.pdf

Individual Corps of Engineers project information and research reports are available upon request.

Table 19. RME strategy reporting.

RPA Action No.	Action	Annual Progress Report
RME Strategy 1		
50	Fish Population Status Monitoring	Status of project implementation (including project milestones) through December of the previous year for all actions identified in Attachment B.2.6-1 or subsequent implementation plans.
51	Collaboration Regarding Fish Population Status Monitoring	Status of project implementation (including project milestones) through December of the previous year for all actions identified in implementation plans.
RME Strategy 2		
52	Monitor and Evaluate Fish Performance within the FCRPS	Status of project implementation (including project milestones) through December of the previous year for all actions identified in implementation plans.
53	Monitor and Evaluate Migration Characteristics and River Condition	Status of project implementation (including project milestones) through December of the previous year for all actions identified in implementation plans.
54	Monitor and Evaluate Effects of Configuration and Operation Actions	Status of project implementation (including project milestones) through December of the previous year for all actions identified in implementation plans.
55	Investigate Hydro Critical Uncertainties and Investigate New Technologies	Status of project implementation (including project milestones) through December of the previous year for all actions identified in implementation plans.
RME Strategy 3		
56	Monitor and Evaluate Tributary Habitat Conditions and Limiting Factors	Status of project implementation (including project milestones) through December of the previous year for all actions identified in implementation plans.
57	Evaluate the Effectiveness of Tributary Habitat Actions	Status of project implementation (including project milestones) through December of the previous year for all actions identified in implementation plans.
RME Strategy 4		
58	Monitor and Evaluate Fish Performance in the Estuary and Plume	Status of project implementation (including project milestones) through December of the previous year for all actions identified in implementation plans.
59	Monitor and Evaluate Migration Characteristics and Estuary/Ocean Conditions	Status of project implementation (including project milestones) through December of the previous year for all actions identified in implementation plans. Tabulate the amount of absolute acreage by habitat type that is restored or protected every year. (Initiate in FY 2007–09 projects.) Report annually on indices of productivity for the estuary and ocean (i.e., Pacific Decadal Oscillation, primary productivity indices).

RPA Action No.	Action	Annual Progress Report
60	Monitor and Evaluate Habitat Actions in the Estuary	Status of project implementation (including project milestones) through December of the previous year for all actions identified in implementation plans.
61	Investigate Estuary/Ocean Critical Uncertainties	Status of project implementation (including project milestones) through December of the previous year for all actions identified in implementation plans.
RME Strategy 5		
62	Fund Selected Harvest Investigations	Status of project implementation (including project milestones) through December of the previous year for all actions identified in implementation plans.
RME Strategy 6		
63	Monitor Hatchery Effectiveness	Status of project implementation (including project milestones) through December of the previous year for all actions identified in implementation plans.
64	Investigate Hatchery Critical Uncertainties	Status of project implementation (including project milestones) through December of previous year for all actions identified in implementation plans.
65	Investigate Hatchery Critical Uncertainties	Status of project implementation (including project milestones) and analysis of new information through December of the previous year.
RME Strategy 7		
66	Monitor and Evaluate the Caspian Tern Population in the Columbia River Estuary	Status of project implementation (including project milestones) through December of the previous year for all actions (habitat actions are population response) identified in implementation plans.
67	Monitor and Evaluate the Double-Crested Cormorant Population in the Columbia River Estuary	Status of project implementation (including project milestones) through December of the previous year for all actions (habitat actions are population response) identified in implementation plans.
68	Monitor and Evaluate Inland Avian Predators	Status of project implementation (including project milestones) through December of the previous year for all actions (habitat actions are population response) identified in implementation plans.
69	Monitoring Related to Marine Mammal Predation	Status of project implementation (including project milestones) through December of the previous year for all actions (habitat actions are population response) identified in implementation plans.
70	Monitoring Related to Piscivorous (Fish) Predation	Status of project implementation (including project milestones) through December of the previous year for all actions identified in implementation plans.
RME Strategy 8		
71	Coordination	Status of coordination of RME projects through December of the previous year will be provided.
72	Data Management	Status of data management projects through December of the previous year will be provided.
RME Strategy 9		
73	Implementation and Compliance Monitoring	The Action Agencies will use the project-level detail contained in the Action Agencies' BA databases to track results and assess our progress in meeting programmatic-level performance targets. This performance tracking will be reported through annual progress reports and the 2013 and 2016 comprehensive reports.

RPA Action 50 – Fish Population Status Monitoring

The Action Agencies will enhance existing fish population status monitoring performed by fish management agencies through the specific actions listed below. In addition, ancillary population status and trend information is being obtained through several ongoing habitat and hatchery improvement projects.

1. *Implement and maintain the Columbia River Basin passive integrated transponder (PIT)-Tag Information System (annually).*

   BPA Project 1990-080-00 (Columbia Basin PIT Tag Information) covered the PTAGIS which is operated and maintained at http://www.ptagis.org/ptagis. PIT tags are primarily used for hydro system and tributary survival assessments, as well as tributary assessments of population adult return abundance and diversity to help assess viable salmon population attributes of spawner abundance, adult productivity, spatial distribution, and diversity.

   BPA Project 2003-017-00 (ISEMP) is a collaborative effort between the ISEMP project and Columbia River Basin PIT Tag Information project supported rapid reduction of PIT tag data to support assessment of adult returns in the tributaries.

2. *Monitor adult returns at mainstem hydroelectric dams using both visual counts and the PIT Tag detection system (annually). (See Hydrosystem section).*

   This RPA calls for the continued acquisition of adult return information at key dams in the FCRPS. Visual counts occur at all sites. PIT tag detection systems are now installed at adult ladders at Bonneville, The Dalles, McNary, Lower Monumental, Little Goose and Lower Granite dams. BPA Project 2005-002-00 (Lower Granite Dam Adult Trap Operations) utilized an adult trap at Lower Granite Dam for broodstock collection, sampling, genetic stock identification (GSI), and PIT tag status monitoring of wild adult steelhead and wild adult Chinook. The Corps selected the Dalles Dam for installation of an adult PIT tag detection system to further monitoring.

   In 2014, the Corps implemented its adult fish count program as described in the Fish Passage Plan (ACOE 2014b). Results are available in the 2014 Annual Fish Passage Report: Columbia and Snake Rivers (ACOE 2015).

   In 2014, the Corps completed the installation and testing of temporary PIT antennas at the adult count windows at Little Goose and Lower Monumental Dams.

3. *Monitor juvenile fish migrations at mainstem hydroelectric dams using smolt monitoring and the PIT Tag detection system (annually). (See Hydrosystem section)*

   BPA Project 1987-127-00 (Smolt Monitoring Program) is a long-term effort involving multiple agencies to gather data on abundance, passage timing, system travel time and survival, and physical condition of smolts moving out of tributaries and past Snake and Columbia River hydro projects.

   BPA Project 1989-107-00 (Statistical Support for Salmon) has provided guidance and technical assistance in mark-recapture study design and data analysis to multiple tribal, state, and federal agencies. Program ATLAS (http://www.cbr.washington.edu/analysis/apps/atlas) was developed to analyze acoustic-tag data and provide tag-life-adjusted survival estimates.

BPA Project 1990-055-00 (Idaho Steelhead Monitoring and Evaluation Studies (ISMES)) conducted additional tagging of hatchery populations to improve the resolution of watershed estimates of juvenile hydrosystem survival and wild steelhead populations in the Clearwater River and upper reaches of the Snake River.

BPA Project 1991-029-00 (RME of emerging issues and measures to recover the Snake River fall Chinook salmon ESU) conducted wild and hatchery origin fall Chinook tagging with a special focus on investigating passage timing of the 'reservoir-type' yearling life history type and the 'ocean-type' subyearling migrants observed among fall Chinook above Lower Granite Dam.

BPA Project 1994-033-00 (Fish Passage Center) provided technical analysis, data summaries, graphic representations for the state, federal and tribal fishery managers' use in developing their recommendations for fish passage management to the federal operators and regulators and the National Marine Fisheries Service. The Fish Passage Center (FPC) designs and oversees the implementation of the Smolt Monitoring Program (SMP), including the dissolved gas trauma monitoring, and distributes the data daily to public and private entities in the region.

BPA Project 1996-020-00 (Comparative Survival Study (CSS)) built a long-term database monitoring smolt-to-adult return rates and passage characteristics of specific wild and hatchery groups of spring/summer Chinook and steelhead throughout the Columbia River Basin. CSS conducted additional tagging of hatchery populations to improve the resolution of watershed estimates of juvenile survival. Marked fish utilized in the analysis may be from groups PIT tagged specifically for this program and from groups marked for other research studies.

BPA Project 2007-083-00 (Grande Ronde Supplementation Monitoring and Evaluation on Catherine Creek/Upper Grande Ronde River) conducted additional tagging of hatchery populations to improve the resolution of watershed estimates of juvenile hydrosystem survival. The Umatilla Tribe provided additional spring Chinook tag groups in the upper Grande Ronde River and Catherine Creek.

BPA Project 2008-311-00 (Natural Production Management and Monitoring) conducted additional tagging of hatchery populations to improve the resolution of watershed estimates of juvenile hydrosystem survival and in Idaho tagged additional steelhead and spring Chinook in the Warm Springs River and Shitike Creek.

4. *Fund status and trend monitoring as a component of the pilot studies in the Wenatchee, Methow, and Entiat river basins in the Upper Columbia River, the Lemhi and South Fork Salmon river basins, and the John Day River Basin to further advance the methods and information needed for assessing the status of fish populations. (Initiate in FY 2007-2009 Project Funding, review and modify annually to ensure that these projects continue to provide a means of evaluating the effectiveness of tributary mitigation actions).*

BPA Project 1991-073-00 (Idaho Natural Production Monitoring and Evaluation) monitored and evaluated the status of wild Snake River spring-summer Chinook salmon and summer steelhead populations in the Salmon and Clearwater river subbasins, including the Lemhi and South Fork Salmon rivers. The Idaho Natural Production Monitoring and Evaluation Project study is to determine effectiveness of habitat mitigation for steelhead and spring/summer Chinook in Idaho. This project assesses population characteristics, survival, and productivity.

BPA Project 1998-016-00 (Escapement and Productivity of Spring Chinook and Steelhead) provided basin-wide status and trend data for anadromous salmonids in the John Day River Basin. To accomplish this, researchers estimate out-migrant abundance of summer steelhead, physical characteristics of outmigrant salmonids, SARs for summer steelhead, summer steelhead life-history patterns, and productivity of summer steelhead populations.

BPA Project 2003-017-00 (ISEMP) implemented both status and trend monitoring (fish and habitat) and watershed-level action effectiveness monitoring in five IMWs throughout the Columbia River Basin. The IMWs continued in the Entiat River, Bridge Creek, and Lemhi River watersheds, while status and trend monitoring is implemented in the Wenatchee, John Day, and Lemhi river watersheds.

BPA Project 2010-034-00 (Upper Columbia Spring Chinook and Steelhead Juvenile and Adult Abundance, Productivity and Spatial Structure Monitoring) evaluated precision and accuracy of the smolt monitoring methodology for both steelhead and spring Chinook; estimated the proportion of hatchery steelhead in each primary population; estimated the precision of redd counts for both steelhead and spring Chinook; and evaluated the accuracy of the steelhead spawning ground survey design.

BPA Project 1987-127-00 (Smolt Monitoring by Non-Federal Entities) implemented tagging of fish which are used and assessed in the ISEMP project. The SMP provides data on movement of salmonid smolts out of major drainages and past the series of dams on the Snake and Columbia rivers. Indices of migration strength and migration timing are provided for the run-at-large at key monitoring sites. In addition, marked smolts from hatcheries, traps, and dams provide measures of smolt speed and in-river survival through key reaches. The support to this RPA is ancillary with additional tagging of fish that return to the tributaries.

BPA Project 2002-060-00 (Nez Perce Harvest Monitoring on Snake and Clearwater Rivers) provided ancillary information, specifically Adult Harvest information, which is used in adult run reconstruction to support Adult-to-Adult productivity. The primary objective of the Nez Perce Harvest Monitoring Project is to develop and implement a biologically sound anadromous fish harvest monitoring program through a step-wise harvest planning and implementation approach to specific fisheries.

BPA Project 2010-036-00 (Lower Columbia Coded Wire Tag (CWT) Recovery Project) provided ancillary information, specifically adult harvest information, which is used in adult run reconstruction to support Adult-to-Adult productivity which may be to support Pilot studies in the upper Columbia and Salmon MPGs. Washington's current tag recovery program in the lower Columbia River is centered on the recovery of CWTs from fisheries and escapement sampling, and development of escapement estimates primarily for Chinook salmon.

5. *Provide additional status monitoring to ensure a majority of Snake River B-Run steelhead populations are being monitored for population productivity and abundance. (Initiate by FY 2009, then annually.)*

BPA implemented 13 projects to support this RPA. In addition NOAA Fisheries supported the Potlatch River as an IMW with fish-in fish-out intensive monitoring efforts.

BPA Project 1983-350-03 (Nez Perce Tribal Hatchery Monitoring and Evaluation) monitored and evaluated hatchery and natural fish through PIT tagging, weir operation and/or spawning ground surveys, screw trapping, habitat surveys, genetic analysis, and harvest monitoring.

BPA Project 1989-098-00 (The Salmon Studies in Idaho Rivers- IDFG) supported smolt trap infrastructure used to monitor B-Run Steelhead in coordination with the ISEMP project. This project was completed and ongoing required monitoring will be integrated into 1990-055-00 (ISMES) and 1991-073-00 (Idaho Natural Production Monitoring and Evaluation Project) in 2015.

BPA Project 1990-055-00 (ISMES) continued to operate temporary weirs to estimate escapement in Fish Creek (Lochsa River), Rapid River (Little Salmon River), and Big Creek (lower Middle Fork Salmon River). Wild fish were sampled further; scales were collected, and a small portion of the anal fin was removed for a genetics tissue sample.

BPA Project 1991-073-00 (Idaho Natural Production Monitoring and Evaluation Project) is a long-term monitoring and research project to determine the effectiveness of habitat mitigation for Idaho steelhead and spring/summer Chinook through assessments of population characteristics, survival, and productivity.

BPA Project 2003-017-00 (ISEMP) implemented both status and trend monitoring (fish and habitat) and watershed-level action effectiveness monitoring in five IMWs throughout the Columbia River Basin. The IMWs continued in the Entiat River, Bridge Creek, and Lemhi River watersheds, while status and trend monitoring is implemented in the Wenatchee, John Day, and Lemhi river watersheds.

BPA Project 2005-002-00 (Lower Granite Dam Adult Trap Operations) supported PIT tagging of adult steelhead returns for adult escapement assessments and parental-based tagging for GSI. Ongoing discussions with NOAA Fisheries, the Action Agencies and the sponsors are underway to ensure increased trapping does not increase ESA take and that the study design for representational marking is not compromised.

BPA Project 2009-005-00 (Influence of Environment and Landscape on Salmonid Genetics) supported single nucleotide polymorphism genetic analysis of steelhead samples from other projects. The project focuses on evaluation of thermal adaptation, smoltification, and summaries for ongoing and future work on several traits of interest including disease resistance, run timing, heritability of age-at-maturity, and ongoing work for thermal adaptation. The most applicable component of the study for B-Run steelhead is genetic associations to run timing and heritability of age-at-maturity.

BPA Project 2010-026-00 (Chinook and Steelhead Genotyping for GSI at Lower Granite Dam) conducted the evaluation and maintenance of single nucleotide polymorphism panels for GSI in the Snake River Basin. Summarized efforts to update and maintain genetic baselines for both steelhead and Chinook salmon in the basin to monitor genetic diversity and for use as a reference for GSI. In addition, the project addresses the use of GSI to estimate proportions, abundance, and biological parameters for wild stocks (both juveniles and adults) at Lower Granite Dam.

BPA Project 2010-031-00 (Snake River Chinook and Steelhead Parental Based Tagging) continued development and evaluation of a new genetic technology called Parentage Based Tagging (PBT). PBT can serve as a versatile tool for the genetic tagging steelhead and Chinook salmon in the Snake River Basin. To support this RPA, Objective 2, creation of genetic parental databases, serves as a major component of the RPA strategy.

BPA Project 2010-038-00 (Lolo Creek Permanent Weir Construction) was closed because it is believed the existing PIT tag infrastructure and analysis methods may support the fish in and Fish out needs for the Clearwater MPG.

BPA Project 2010-057-00 (B-Run steelhead supplementation effectiveness research) continued to support additional marking and tagging of fish and supported infrastructure used to monitor B-Run Steelhead in the Clearwater River.

6. *Review and modify existing Action Agencies' fish population status monitoring projects to improve their compliance with regional standards and protocols, and ensure they are prioritized and effectively focused on critical performance measures and populations.*

BPA Project 1983-350-03 (Nez Perce Tribal Hatchery Monitoring and Evaluation) monitored and evaluated hatchery and natural fish through PIT tagging, weir operation and/or spawning ground surveys, screw trapping, habitat surveys, genetic analysis, and harvest monitoring.

BPA Project 1987-127-00 (Smolt Monitoring by Non-Federal Entities) provides data on movement and condition of salmonid smolts out of major drainages and past the series of dams on the Snake and Columbia rivers and implemented tagging of fish assessed primarily in the ISEMP project. Indices of migration strength and migration timing are provided for the run-at-large at key monitoring sites. In addition, marked smolts from hatcheries, traps, and dams provide measures of smolt speed, and survival through key reaches.

BPA Project 1988-022-00 (Umatilla Fish Passage Operations) continued to collect data during adult trapping operations includes date, number of fish trapped, species, age and sex composition, marks and disposition.

BPA Project 1988-053-03 (Hood River Production Monitoring and Evaluation-ODFW) implemented, monitored, and evaluated actions for Chinook salmon in the Hood River Master Plans for consistency with Hood River Production Plan (HRPP) goals.

BPA Project 1988-053-04 (Hood River Production Monitoring and Evaluation-ODFW) monitored and evaluated actions taken to re-establish spring Chinook salmon in the Hood River subbasin. Data will be used to develop, and refine, management objectives for the HRPP.

BPA Project 1988-053-08 (Hood River Production Operation and Maintenance and Powerdale) funded capturing all upstream migrant Chinook salmon escaping to East Fork Hood River, West Fork Hood River, and Neal Creek Fish Traps.

BPA Project 1989-024-01 (Evaluate Umatilla Juvenile Salmon and Steelhead Outmigration) was requested by the Oregon Department of Fish and Wildlife (ODFW) and the Confederated Tribes of the Umatilla Indian Reservation (CTUIR) based on both a local and regional high priority need for information on life history

characteristics, survival, and success of hatchery- and naturally-reared salmon and steelhead in the Umatilla River and provides estimates of smolt abundance, migration timing and survival, life history characteristics and productivity status and trends for all anadromous salmonid species in the Umatilla River basin.

BPA Project 1989-098-00 (Salmon Studies in Idaho Rivers-IDFG) helped determine the utility of supplementation as a potential recovery tool for imperiled stocks of spring and summer Chinook salmon in Idaho. The goals are to assess the use of hatchery Chinook salmon to restore or augment natural populations, and to evaluate the effects of supplementation on the survival and fitness of existing natural populations. This project was completed and ongoing required monitoring for this RPA will be integrated into 1990-055-00 (ISMES) and 1991-073-00 (Idaho Natural Production Monitoring and Evaluation Project) in 2015.

BPA Project 1990-005-00 (Umatilla Hatchery Monitoring and Evaluation) funds the Umatilla Fish Hatchery which was constructed to supplement summer steelhead in the Umatilla River. The Umatilla Hatchery Monitoring and Evaluation project began in 1991 to evaluate hatchery rearing techniques and juvenile and adult production goals.

BPA Project 1990-005-01 (Umatilla Basin Natural Production Monitoring and Evaluation Project) provided information to tribal, state and federal fisheries managers by monitoring the status and trends in the abundance, distribution, movement and survival of summer steelhead and spring Chinook salmon during adult migration, spawning, rearing and juvenile migration in the Umatilla River Drainage. BPA evaluated these trends in relation to environmental, ecological, and anthropogenic factors.

BPA Project 1990-055-00 (Idaho Steelhead Monitoring and Evaluation Studies) continued to operate temporary weirs to estimate escapement in Fish Creek (Lochsa River), Rapid River (Little Salmon River), and Big Creek (lower Middle Fork Salmon River). Wild fish were sampled further; scales were collected, and a small portion of the anal fin was removed for a genetics tissue sample.

BPA Project 1991-028-00 (PIT Tagging Wild Chinook) assessed the migrational characteristics and estimate parr-to-smolt survival for Snake River wild spring/summer Chinook salmon smolts at Lower Granite Dam. Characterize parr and smolt survival and movement out of natal rearing areas of selected streams and examine the relationships between fish movement, environmental conditions within the streams, and weather and climate data.

BPA Project 1991-073-00 (Idaho Natural Production Monitoring and Evaluation) is a long-term research project that originated in the 1980s to determine effectiveness of habitat mitigation for steelhead and spring/summer Chinook in Idaho. This project assessed population characteristics, survival, and productivity in 2013.

BPA Project 1992-026-04 (Grand Ronde Early Life History of Spring Chinook and Steelhead) investigated the critical habitat, abundance, migration patterns, survival, and alternate life history strategies exhibited by spring Chinook salmon and summer steelhead juveniles from distinct populations in the Grande Ronde River and Imnaha River subbasins. This project provides information on abundance of spring Chinook salmon and steelhead parr and estimated for egg-to-parr and parr-to-smolt survival

for spring Chinook salmon and parr-to-smolt survival for steelhead, and assessed stream health in selected study streams.

BPA Project 1995-063-25 (Yakima River Monitoring and Evaluation-Yakima/Klickitat Fisheries Project) monitored and evaluated activities for the Yakima River Subbasin assigned to the Yakama Nation Fisheries staff. This monitoring and evaluation project continued efforts to gather baseline information on habitat quantity and quality, and demographics, life history and abundance of Klickitat spring Chinook, steelhead, and other species of interest. Methods of detecting indices of increasing natural production for these stocks were developed, as well as methods of detecting a realized increase in natural production.

BPA Project 1995-063-35 (Klickitat River Monitoring and Evaluation-Yakima/Klickitat Fisheries Project) continues efforts to gather baseline information on habitat quantity and quality, and demographics, life history and abundance of Klickitat spring Chinook, steelhead, and other species of interest. Methods of detecting indices of increasing natural production for these stocks were developed, as well as methods of detecting a realized increase in natural production.

BPA Project 1996-019-00 (Data Access in Real Time) addressed multiple fish populations for this RPA through compilation of data. They also create ad host software to analyze PIT tag data systems. Without this customized software, sponsors would have a difficult time synthesizing PIT tag data for adult escapement for key fish-in and fish-out populations.

BPA Project 1996-035-01 (Yakama Reservation Watershed Project) conducted biological monitoring including spawning ground surveys, snorkel surveys, and smolt trapping.

BPA Project 1996-043-00 (Johnson Creek Artificial Propagation Enhancement) continued the small-scale supplementation initiative integrated with a monitoring and evaluation program that was designed to increase survival of a weak but recoverable spawning aggregate of summer Chinook salmon.

BPA Project 1997-015-01 (Imnaha River Smolt Monitoring) provided the FPC's Smolt Monitoring Project with tributary specific emigration data from the Imnaha River. It continues to collect a time series of Chinook salmon and steelhead data.

BPA Project 1998-007-02 (Grand Ronde Supplementation Operation and Maintenance, and Monitoring and Evaluation on Lostine River) supports spawning assessments of adult returns.

BPA Project 1998-007-03 (Grand Ronde Supplementation Operation and Maintenance on Catherine Creek/Upper Grande Ronde River) preserves the genetic variability and enhance the population size of the depressed spring Chinook salmon populations in Catherine Creek and the Upper Grande Ronde River using a hatchery program based on the indigenous stock.

BPA Project 1998-016-00 (Escapement and Productivity of Spring Chinook and Steelhead) provided status and trend data for anadromous salmonids in the Middle Fork and South Fork populations in the John Day River Basin. To accomplish this, researchers estimated out-migrant abundance of summer steelhead, physical

characteristics of outmigrant salmonids, SARs for summer steelhead, summer steelhead life-history patterns, and productivity of summer steelhead populations.

BPA Project 1998-019-00 (Wind River Watershed) is a collaborative effort to restore wild steelhead in the Wind River, and to measure, track and document steelhead population, life histories, and interactions, and to share information across agency and non-agency boundaries.

BPA Project 1999-020-00 (Analyze persistence and Dynamics in Chinook Redds) addressed long-term status and trends of wild Chinook salmon populations in the Salmon River.

BPA Project 2002-032-00 (Snake River Fall Chinook Salmon Life History Investigations) objectives are: increase the understanding of how reservoir water temperature, reservoir water velocity, and migration timing affect juvenile fall Chinook salmon behavior, survival, and life history; to increase the understanding of when to spill water and transport fish in the Snake River to increase juvenile fall Chinook salmon survival; and decrease the uncertainty in how the reservoir life history affects estimates of smolt-to-adult return rates of Snake River fall Chinook salmon.

BPA Project 2002-053-00 (Asotin Creek salmon Population Assessment) assessed the status of anadromous salmonid populations in the Asotin Creek watershed. It is also estimated the abundance, productivity, survival rates, and temporal and spatial distribution of steelhead and Chinook salmon.

BPA Project 2002-060-00 (Nez Perce Harvest Monitoring on Snake and Clearwater Rivers) provided ancillary information, specifically Adult Harvest information, which is used in adult run reconstruction to support Adult-to-Adult productivity. The primary objective of the Nez Perce Harvest Monitoring Project is to develop and implement a biologically sound anadromous fish harvest monitoring program through a step-wise harvest planning and implementation approach to specific fisheries.

BPA Project 2003-017-00 (ISEMP) implemented both status and trend monitoring (fish and habitat) and watershed-level action effectiveness monitoring in five IMWs throughout the Columbia River Basin. The IMWs continued in the Entiat River, Bridge Creek, and Lemhi River watersheds.

BPA Project 2003-022-00 (Okanogan Basin Monitoring and Evaluation Program) continues to monitor and assess adult and juvenile steelhead status for the Okanogan basin.

BPA Project 2007-083-00 (Grand Ronde Supplementation Monitoring and Evaluation on Catherine Creek/Upper Grande Ronde River) monitored and evaluated the effectiveness of supplementation in recovering spring Chinook salmon populations in the upper Grande Ronde River and Catherine Creek.

BPA Project 2007-402-00 (Snake River Sockeye Captive Propagation) recovery efforts are collaborative in nature and directly involve the Idaho Department of Fish and Game (IDFG), the National Marine Fisheries Service (NOAA Fisheries), the Shoshone-Bannock Tribes, the Oregon Department of Fish and Wildlife (ODFW), and the University of Idaho. Efforts in 2013 included: fish culture, genetic support,

maintenance of captive broodstocks, broodstock rearing and research, habitat limnological research and monitoring and evaluation.

BPA Project 2009-004-00 (Monitoring Recovery Trends in Key Spring Chinook Habitat Variable and Validation of Population Viability Indicators) focused on monitoring Upper Grande Ronde Chinook recovery trends through identifying areas that have depressed populations creating a baseline and future modeling.

BPA Project 2010-028-00 (Estimate Adult Steelhead Abundance in Small Streams Associated with Tucannon & Asotin Populations) continued to assess adult abundance associated with Tucannon and Asotin Chinook and steelhead populations.

BPA Project 2010-030-00 (Viable Salmonid Population Estimates for Yakima Steelhead MPG) improved tracking of the Upper Yakima and Naches population distributions and abundance is the primary focus of this project.

BPA Project 2010-032-00 (Imnaha River Steelhead Status Monitoring) quantified adult steelhead escapement into the Imnaha River Subbasin and described the population's spatial distribution within the subbasin. A properly monitored Imnaha steelhead population will contribute towards understanding the status and viability of the entire Snake River ESU and informed management decisions.

BPA Project 2010-034-00 (Upper Columbia Spring Chinook and Steelhead Juvenile and Adult Abundance, Productivity and Spatial Structure Monitoring) objectives are: (1) evaluate precision and accuracy of the smolt monitoring methodology for both steelhead and spring Chinook; (2) estimate the proportion of hatchery steelhead in each primary population; (3) estimate the precision of redd counts for both steelhead and spring Chinook; (4) and evaluate the accuracy of the steelhead spawning ground survey design.

BPA Project 2010-035-00 (Abundance, Productivity and Life History of Fifteen Mile Creek Winter Steelhead) funded ODFW to establish a comprehensive monitoring and evaluation program for abundance, productivity, and life history of steelhead in the Fifteen Mile Creek population, which is ESA-listed as a component of the Mid-C steelhead DPS.

BPA Project 2010-038-00 (Lolo Creek Permanent Weir Construction) was closed because it is believed the existing PIT tag infrastructure and analysis methods may support the fish-in and fish-out needs for the Clearwater MPG.

BPA Project 2010-042-00 (Tucannon Expanded PIT Tagging) increased the detection of PIT tagged steelhead (Snake River steelhead DPS) and spring Chinook salmon (Snake River spring/summer Chinook ESU) that enter the river upon return as adults. In the future it will be continued and integrated into project 2010-028-00.

7. *Fund marking of hatchery releases from Action Agencies funded facilities to enable monitoring of hatchery-origin fish in natural spawning areas and the assessment of status of wild populations (annually).*

In 2014, BPA continued to support and fund a policy of 100 percent mark of all hatchery fish to meet viable salmonid population, hatchery, and habitat action effectiveness evaluation needs identified under several RPAs and regional recovery

plans. However, while mark rates achieve this goal for the majority of hatcheries, there are some programs that still do not mark 100 percent of their fish releases.

BPA continued to work with regional agencies on the importance of high, known mark rates, and to require better reporting of hatchery fish mark rates to better assess where there may be deficiencies or issues that need to be addressed.

8. *Report available information on population viability metrics in annual and comprehensive evaluation reports. (Initiate in FY 2008).*

The Action Agencies continued to support the reporting of available population viability metrics through StreamNet project data collection and transfer to the NOAA Fisheries Salmon Population Summary database to facilitate population viability assessments (http://q.streamnet.org/Request.cfm?cmd=BuildPicklist&NewQuery=BuildCriteria&PicklistItem=DataCategory). In addition to the StreamNet project and the multiple monitoring projects listed above under the RPA 50 subactions that support population viability assessments, BPA participated in and supported the Coordinated Assessments Project. The Coordinated Assessments Project is a collaborative effort working with fishery management co-managers and NOAA Fisheries to develop data exchange templates to facilitate assessments for viable salmonid population indicators such as adult spawner abundance, spawner to adult ratios, and recruit per spawner relationships for ESA-listed populations. BPA also developed guidelines and templates for RME reporting to facilitate more consistent and timely reporting of monitoring results and actively supported the development and required use of a monitoring protocol documentation tool and other coordination tools under the Pacific Northwest Aquatic Monitoring Partnership to help further advance coordination, data sharing, evaluation, and reporting of population viability metrics.

RPA Action 51 – Collaboration Regarding Fish Population Status Monitoring

The Action Agencies will enhance existing fish populations status monitoring performed by fish management agencies through the following collaboration commitments:

1. *Support the coordination, data management, and annual synthesis of fish population metrics through Regional Data Repositories and reports (Annually).*

BPA Project 1988-108-04 (StreamNet – Coordinated Information System/Northwest Environmental Database (NED)) managed by PNAMP staff at the USGS continued to support the implementation of the Coordinated Assessments Projects through PNAMP, the Columbia Basin Fish and Wildlife Authority (CBFWA), and StreamNet to develop standard data exchange templates across the Northwest for the indicators of adult spawner abundance and juvenile salmonid out-migrant production.

BPA Project 1989-098-00 (Salmon Studies in Idaho Rivers-IDFG) helped determine the utility of supplementation as a potential recovery tool for imperiled stocks of spring and summer Chinook salmon in Idaho. Our goals are to assess the use of hatchery Chinook salmon to restore or augment natural populations, and to evaluate the effects of supplementation on the survival and fitness of existing natural populations.

BPA Project 1994-033-00 (Fish Passage Center) provided technical analysis, data summaries, graphic representations for the state, federal and tribal fishery managers' use in developing their recommendations for fish passage management to the federal operators and regulators and NOAA Fisheries. The FPC designs and oversees the implementation and conducts the analysis of the SMP, including the dissolved gas trauma monitoring, and distributes the data daily to public and private entities in the region.

BPA Project 1996-019-00 (Data Access in Real Time (DART)) supported ISEMP and PTAGIS in development of software to rapidly assess PIT tag array detections for population adult escapement which could be supported across the basin.

BPA Project 1996-043-00 (Johnson Creek Artificial Propagation Enhancement) has been on-going since 1996. The project evaluated the life cycle of natural- and hatchery-origin supplementation spring/summer Chinook salmon from Johnson Creek (part of the Snake River spring/summer Chinook ESU). Key performance measures associated with abundance, survival-productivity, distribution, genetics, life history, habitat, and in-hatchery metrics were quantified.

BPA Project 1997-030-00 (Chinook Salmon Adult Abundance Monitoring) monitored escapement of natural-origin spring/summer Chinook salmon (Snake River spring/summer Chinook ESU) escapement was estimated using dual frequency identification sonar (DIDSON) technology. Validation monitoring of DIDSON target counts with underwater optical cameras occurred for the purpose of species identification.

BPA Project 1999-020-00 (Analyze persistence and Dynamics in Chinook Redds) research addressed at least three critical needs identified in Regional Program documents: (1) the need for long-term information to assess trends in wild Chinook salmon populations; (2) the need for evaluation of broad scale population sampling and inventory methods; and (3) the need for analysis of the spatial structure of wild Chinook salmon populations.

BPA Project 2003-017-00 (ISEMP) implemented both status and trend monitoring (fish and habitat) and watershed-level action effectiveness monitoring in five IMWs throughout the Columbia River Basin. The IMWs continued in the Entiat River, Bridge Creek, and Lemhi River watersheds, while status and trend monitoring is implemented in the Wenatchee, John Day, and Lemhi river watersheds.

BPA Project 2004-002-00 (Pacific Northwest Aquatic Monitoring Program Coordination) charged the Pacific Northwest Aquatic Monitoring Program with providing a forum for coordination of aquatic monitoring efforts in the region to promote consistency in monitoring approaches and protocols; follow a scientific foundation; support monitoring policy and management objectives; and collect and present information in a manner that can be shared.

BPA Project 2007-407-00 (Upper Snake River Tribe Coordination) funded the Upper Snake River Tribe to pursue, promote and initiate efforts to restore the Upper Snake River Basin, its affected tributaries, and lands to a natural condition.

BPA Project 2008-507-00 (CRITFC's Tribal Data Network Accord Project) demonstrated implementation of coordination and standardization tools though

evaluation and application of handheld technologies for data capture (e.g., the Digital Pen).

BPA Project 2010-036-00 (Lower Columbia Coded Wire Tag (CWT) Recovery Project) provided ancillary information, specifically adult harvest information, which was used in adult run reconstruction to support Adult-to-Adult productivity which supported Pilot studies in the upper Columbia and Salmon MPGs. Washington's tag recovery program in the lower Columbia River centered on the recovery of CWTs from fisheries and escapement sampling, and development of escapement estimates primarily for Chinook salmon.

2. *Facilitate and participate in an ongoing collaboration process to develop a regional strategy for status and trend monitoring for key ESA fish populations. (Initiate in FY 2008).*

BPA Project 1989-107-00 (Statistical Support for Salmon) funded Columbia Basin Research to create and support tagging analysis software, and participated in regional coordination of PIT-tag tagging studies.

BPA Project 2004-002-00 (Pacific Northwest Aquatic Monitoring Program Coordination) funded the Pacific Northwest Aquatic Monitoring Program to provide a forum for coordination of aquatic monitoring efforts in the region to promote consistency in monitoring approaches and protocols; follow a scientific foundation; support monitoring policy and management objectives; and collect and present information in a manner that can be shared.

BPA Project 2010-026-00 (Chinook and Steelhead Genotyping for GSI at Lower Granite Dam) conducted the evaluation and maintenance of single nucleotide polymorphism panels for GSI in the Snake River Basin. Summarized efforts to update and maintain genetic baselines for both steelhead and Chinook salmon in the basin to monitor genetic diversity and for use as a reference for GSI. In addition, the project addresses the use of GSI to estimate proportions, abundance, and biological parameters for wild stocks (both juveniles and adults) at Lower Granite Dam.

3. *Provide cost-shared funding support and staff participation in regional coordination forums such as the Pacific Northwest Aquatic Monitoring Partnership fish population monitoring workgroup and the Northwest Environmental Data Network to advance regional standards and coordination for more efficient and robust monitoring and information management (annually).*

BPA Project 1989-107-00 (Statistical Support for Salmon) Columbia Basin Research continued to provide statistical software and analytical support for estimation of fish movement and survival using release-recapture data as a function of environmental and experimental effects.

BPA Project 1994-033-00 (Fish Passage Center) provided technical analysis, data summaries, graphic representations for the state, federal and tribal fishery managers' use in developing their recommendations for fish passage management to the federal operators and regulators and NOAA Fisheries. The FPC designs, oversees the implementation, and conducts the analysis of the SMP, including the dissolved gas trauma monitoring, and distributes the data daily to public and private entities in the region.

BPA Project 1996-043-00 (Johnson Creek Artificial Propagation Enhancement) continued the small-scale supplementation initiative integrated with a monitoring and evaluation program in 2013 that was designed to increase survival of a weak but recoverable spawning aggregate of summer Chinook salmon.

BPA Project 2004-002-00 (Pacific Northwest Aquatic Monitoring Program Coordination) funds the Pacific Northwest Aquatic Monitoring Program to provide a forum for coordination of aquatic monitoring efforts in the region to promote consistency in monitoring approaches and protocols; follow a scientific foundation; support monitoring policy and management objectives; and collect and present information in a manner that can be shared.

RPA Action 52 – Monitor and Evaluate Fish Performance within the FCRPS

The Action Agencies will monitor the following biological responses and/or environmental attributes involved in passage through the hydrosystem, and report these estimates on an annual basis:

1. *Monitor and evaluate salmonid dam survival rates for a subset of FCRPS projects.*

   In 2014 studies to evaluate compliance with the Juvenile Salmon Dam Passage Performance Standards were conducted at John Day Dam for summer migrants and at McNary Dam for spring and summer migrants (Skalski et al. 2015a; 2015b). See RPA actions 20 and 21.

   Survival rates from compliance tests at Bonneville, The Dalles, John Day, McNary, Lower Monumental and Little Goose dams for yearling Chinook, steelhead, and subyearling Chinook are reported under RPAs 18 through 24 above, in Tables 4 through 9.

   The Corps completed a diagnostic study on the 2013 Little Goose summer-run Juvenile Salmon Dam Passage Performance Standard evaluation, which did not achieve the 93 percent juvenile salmon dam survival (Harnish et al. 2015). Route-specific survival and egress rates were examined to develop operations for increased survival during low discharge periods. Options are being developed with the region.

   BPA Project 1987-127-00 (Smolt Monitoring Program) gathered data on abundance, passage timing, system travel time and survival, and physical condition of smolts moving out of tributaries and past Snake and Columbia River hydro projects.

   BPA Project 1989-107-00 (Statistical Support for Salmon) funded the University of Washington to provide software, technical assistance and guidance in mark-recapture study design and data analysis to tribal, state, and federal agencies. In 2014, the program TribPit (http://www.cbr.washington.edu/analysis/apps/tribPit/) was developed to estimate juvenile cohort survival from the tributaries to the mainstem dams. They evaluated the benefits and optimal allocation of spillway weir PIT-tag detectors for monitoring juvenile survival through the Columbia and Snake rivers.

   BPA Project 1991-051-00 (Modeling and Evaluation Statistical Support for Lifecycle Studies) assisted other projects in statistical analysis of tag detection data.

BPA Project 1997-015-01 (Imnaha River Smolt Monitoring) tagged and monitored steelhead and Chinook smolts during outmigration from Imnaha.

BPA Project 2003-041-00 (Evaluate Delayed (Extra) Mortality Associated with Passage of Yearling Chinook Salmon through Snake River Dams) estimated the final year of adult returns for a seven year experiment (2005-2011) comparing survival of yearling Chinook transported and released at McNary Reservoir with their cohort traveling through four lower Snake dams.

2. *Monitor and evaluate juvenile salmonid in-river and system survival through the FCRPS, including estimates of differential post-Bonneville survival of transported fish relative to in-river fish (D-value), as needed. Monitor and evaluate adult salmonid system survival upstream through the FCRPS.*

The 2008 FCRPS BiOp established a methodology to annually estimate system survival rates of listed adult salmonids through defined hydrosystem reaches based on PIT tagged fish detections at Bonneville, McNary, and Lower Granite Dams with corrections for harvest and straying.

Long-term adult system survival performance is evaluated for five stocks using a 5-year rolling average of annual system survival estimates. Snake River spring/ summer Chinook and Snake River steelhead are used as surrogates for Snake River sockeye and mid-Columbia steelhead. Results are reported in Section 1.

BPA Project 1993-029-00 (Survival Estimate for Passage through Snake and Columbia River Dams) NOAA Fisheries completed their twenty-second year of an annual survival study monitoring survival, travel time, and transported fraction of yearling spring migrants of Chinook, steelhead and sockeye salmon over the Lower Granite Dam – Bonneville Dam and McNary Dam – Bonneville Dam, and above Lower Granite Dam reaches using PIT-tagged hatchery and wild groups.

BPA Project 1994-033-00 (Fish Passage Center) provided technical analysis, data summaries, graphic representations of fish survival and abundance data for state, federal and tribal fishery managers.

BPA Project 1996-020-00 (Comparative Survival Study (CSS)) estimated travel time and survival of in-river and transported fish, and smolt-to-adult survival indices (including D) for both yearling and subyearling migrant Chinook and summer steelhead, mostly originating above Lower Granite Dam.

3. *Monitor and evaluate adult salmonid system survival upstream through the FCRPS.*

In 2014 PIT detection was added to both ladders at Lower Monumental Dam and to the single ladder at Little Goose Dam to improve estimates of conversion and reascension and formulate count discrepancy corrections.

The second year of a two year of adult salmon and steelhead upstream migration study was conducted in 2014. Objectives included estimating conversion rates from Bonneville to McNary Dam, assessing the effects of lamprey passage improvements on adult passage behavior at Bonneville Dam, an assessment of The Dalles spillwall on adult passage, and an evaluation of the John Day North ladder improvements.

BPA Project 1991-051-00 (Modeling and Evaluation Statistical Support for Lifecycle Studies) used their program ROSTER to analyze lifecycle data of spring and fall Chinook and steelhead sorted by brood year, and hatchery and wild release groups.

BPA Project 2008-908-00 (FCRPS Water Studies & Passage of Adult Salmon & Steelhead) investigated factors influencing adult fish mortality in the lower Columbia River, and explored whether mortality rates vary by source population. In 2014, they estimated BON-MCN adult conversion rates, compared two approaches for adjusting for harvest and straying, and evaluated survival for Upper Columbia vs. Snake River steelhead and Chinook.

4. *Provide additional PIT Tag marking of Upper Columbia River populations to provide ESU specific estimates of juvenile and adult survival through the Federal mainstem dams.*

BPA Project 1987-127-00 (Smolt Monitoring Program) gathered data on abundance, passage timing, system travel time and survival, and physical condition of smolts moving out of tributaries and past Snake and Columbia River hydro projects.

BPA Project 1994-033-00 (Fish Passage Center) provided technical analysis, data summaries, graphic representations of fish movement and survival for state, federal and tribal fishery managers.

BPA Project 1996-020-00 (Comparative Survival Study (CSS)) helped fund additional tagging of Chinook and steelhead juveniles from Entiat, Methow, Chiwawa, and Wenatchee tributaries, and hatchery Chinook from Leavenworth NFH. The study estimated in-river survival in the mainstem Columbia and smolt-to-adult survival indices.

BPA Project 1993-029-00 (Survival Estimate for Passage through Snake and Columbia River Dams) funded NOAA Fisheries to produce annual survival estimates for yearling spring migrants over the Lower Granite Dam – Bonneville Dam and McNary Dam – Bonneville Dam reaches using PIT tagged hatchery and wild groups.

BPA Project 2003-017-00 (Integrated Status and Effectiveness Monitoring Program (ISEMP)) implemented both status and trend monitoring (fish and habitat) and watershed-level action effectiveness monitoring in five IMWs throughout the Columbia River Basin. The IMWs continued in the Entiat River, Bridge Creek, and Lemhi River watersheds, while status and trend monitoring is implemented in the Wenatchee, John Day, and Lemhi river watersheds

5. *Assess the feasibility of PIT Tag marking of juvenile Snake River Sockeye Salmon for specific survival tracking of this ESU from the Stanley Basin to Lower Granite Dam and through the mainstem FCRPS projects.*

BPA Project 2010-076-00 (Characterizing migration and survival for juvenile Snake River sockeye salmon between the upper Salmon River basin and Lower Granite Dam) used PIT tags and radio telemetry to determine locations of mortality between upper Salmon River and Lower Granite Dam for smolts tagged at Sawtooth and Oxbow fish hatcheries.

BPA Project 1994-033-00 (Fish Passage Center) provided technical analysis, data summaries, graphic representations of fish survival and movement for the state, federal and tribal fishery managers.

BPA Project 1996-020-00 (Comparative Survival Study (CSS)) has tagged Snake River sockeye from the Sawtooth hatchery program since 2013, and has estimated sockeye in-river survival and smolt-to-adult survival indices since 2009.

6. *Develop an action plan for conducting hydrosystem status monitoring (analytical approaches, tagging needs, methods, and protocols) in ongoing collaboration with the State and Federal fishery agencies and Tribes. This will be done in coordination with status monitoring needs and strategies being developed for estuary/ocean, habitat, hatcheries, and harvest. (Initiate in FY2009).*

   The Action Agencies and NOAA Fisheries developed the report "The Status and Needs of the Columbia Basin PIT Tag Information System as Related to FCRPS BiOp RME Requirement" (BPA et al. 2013b). This report provides a review of the status and needs of PIT tagging and detection capabilities and identifies needed assessments to optimize the use of PIT tags supporting several hydro FCRPS BiOp RPA actions. Further progress in 2014 included the deployment of an online PIT tag database (www.ptagis.org/services/forecaster) to inventory and forecast future tagging efforts.

7. *Cooperate with NOAA Fisheries, US v Oregon parties, Confederated Tribes of the Colville Reservation, and other co-managers to (1) review relevant information and identify factors (migration timing, spatial distribution, etc.) that might explain the differential conversion rates (BON to MCN) observed for Upper Columbia River steelhead and spring Chinook salmon compared to Snake River steelhead and spring/summer Chinook salmon (see RPA Table 7 and **SCA - Adult Survival Estimates Appendix); (2) develop a monitoring plan to determine the most likely cause of these differential losses (considering the potential use of flat plate PIT Tag detectors in tributaries or fishery areas, additional adult detectors at The Dalles and John Day fishways, etc., to provide improved estimates of harvest or stray rates for improved conversion rate estimates in the future); and (3) implement the monitoring plan.*

   BPA Project 2008-908-00 (FCRPS Water Studies & Passage of Adult Salmon & Steelhead) was an ongoing study by the Colville Confederated Tribes to investigate adult salmon and steelhead passage survival and determine sources of differential mortality in the lower Columbia River for adults returning to different watersheds.

   BPA Project 2008-105-00 (Selective Gear Deployment) compared efficiency of different gear types to minimize mortality of non-target species.

   BPA Project 1994-033-00 (Fish Passage Center) provided technical analysis, data summaries, graphic representations of fish survival and movement for state, federal and tribal fishery managers.

8. *Monitoring adult passage counts is a cornerstone monitoring activity that must be performed on an annual basis. Adult fish counting is typically performed 16 hours per day, during daylight hours, by either video or visual counting methods, at all of the Corps projects that pass fish. Adult fish counting will continue at a minimum on the schedule presented in Table 8.*

   Adult fish counts were conducted as called for in Table 8 of the RPA with the following exceptions:

   - At The Dalles, John Day, McNary and Ice Harbor Dams, adult fish were counted from April 1 through October 31, 2014.

- At Lower Granite, 24-hour counts were conducted from June 15 through September 30, 2014, rather than through August 31, 2014.

All changes were fully coordinated during development of the FPP and through the FPOM workgroup process. Results are available in the 2014 Annual Fish Passage Report (ACOE 2015).

RPA Action 53 – Monitor and Evaluate Migration Characteristics and River Condition

The Action Agencies will monitor and evaluate the following biological and physical attributes of anadromous fish species migrating through the FCRPS on an annual basis.

1. *Monitor and estimate the abundance of smolts passing index dams.*

   BPA Project 1987-127-00 (Smolt Monitoring Program) gathered data on abundance, passage timing, system travel time and survival, and physical condition of smolts moving out of tributaries and past Snake and Columbia River hydro projects.

   BPA Project 1991-051-00 (Modeling and Evaluation Statistical Support for Lifecycle Studies) estimated smolt passage indices at all FCRPS dams, plus Rocky Reach and Rock Island dams. The data was posted daily in a tool on the DART database, allowing visualization of the in season and historical trends.

   BPA Project 1994-033-00 (Fish Passage Center) provided technical analysis, data summaries, graphic representations for the state, federal and tribal fishery managers.

   BPA Project 1991-029-00 (Research, monitoring, and evaluation of emerging issues and measures to recover the Snake River fall Chinook salmon ESU) estimated daily passage abundances and timing distribution at Lower Granite Dam for natural and hatchery subyearling fall Chinook salmon.

2. *Monitor and describe the migration timing of smolts at index dams, identify potential problems, and evaluate implemented solutions.*

   BPA Project 1991-028-00 (PIT Tagging Wild Chinook) estimated parr-to-smolt survival and passage timing for 19 populations of wild Snake River spring/summer Chinook above Lower Granite Dam.

   BPA Project 1987-127-00 (Smolt Monitoring Program) gathered data on abundance, passage timing, system travel time and survival, and physical condition of smolts moving out of tributaries and past Snake and Columbia River hydro projects.

   BPA Project 1994-033-00 (Fish Passage Center) provided technical analysis, data summaries, graphic representations for the state, federal and tribal fishery managers. 2014 passage indices by species were posted on the FPC website.

   BPA Project 1996-020-00 (Comparative Survival Study (CSS)) estimated smolt-to-adult survival indices for spring-, summer- and fall-run Chinook, sockeye, and summer steelhead, mostly originating above Lower Granite Dam.

BPA Project 1991-029-00 estimated the timing and abundances of fall Chinook PIT tagged in the upper and lower Snake and Clearwater rivers, and inferred that density encourages faster downstream movement.

BPA Project 1993-029-00 (Survival Estimate for Passage through Snake and Columbia River Dams) funded NOAA Fisheries to produce annual survival and run timing estimates for yearling spring migrants over the Lower Granite Dam – Bonneville Dam and McNary Dam – Bonneville Dam, and above-Lower Granite Dam reaches using PIT tagged hatchery and wild groups. They analyzed how 2014 patterns compared with previous years and made the data available for use in NOAA's COMPASS model.

BPA Project 1991-051-00 (Modeling and Evaluation Statistical Support for Lifecycle Studies) used their RealTime program to forecast and monitor percent run to date, and date to specified percentiles for 24 PIT tagged stocks of wild Chinook, sockeye and steelhead ESUs and 25 indexed runs at large. The data was published daily on the DART website.

3. *Monitor and document the condition (e.g., descaling and injury) of smolts at all dams with juvenile bypass systems, identify potential problems, and evaluate implemented solutions.*

The Corps conducted hydraulic modeling and field flow measurements within the gatewells at Bonneville's Second Powerhouse in an effort to identify and design modifications aimed at reducing mortality and injury for fish using the juvenile bypass system. A flow-control device was selected, installed, and hydraulic modeling results were verified at the project. A biological evaluation of fish condition and survival using the flow-control device is planned for the 2015 outmigration.

As part of the Lower Granite Juvenile Bypass System upgrade, the Corps carried out a second year of testing of gatewell egress and injury rates for 14-inch gatewell orifices. The Corps also tested a sharp-crested weir (as opposed to the broad-crested weir tested in 2013) (O'Connor et al. 2015).

BPA Project 1987-127-00 (Smolt Monitoring Program) gathered data on abundance, passage timing, system travel time and survival, and physical condition of smolts moving out of tributaries and past Snake and Columbia River hydro projects. Fish condition monitoring for sites with juvenile bypass systems in 2014 plus historical data is available to the public at http://www.fpc.org/smolt/SMP_queries.html.

BPA Project 1994-033-00 (Fish Passage Center) provided technical analysis, data summaries, graphic representations for the state, federal and tribal fishery managers.

4. *Monitor and enumerate adult salmonids passing through fishways in the FCRPS, identify potential problems, evaluate implemented solutions.*

In 2014, the Corps again implemented its adult fish count program as detailed in the FPP. Results are available in the 2014 Annual Fish Passage Report: Columbia and Snake Rivers (ACOE 2015).

Fishways were monitored on a regular basis, as per FPP specifications. Results are discussed in an annual Fishway Inspection Report prepared for each project. Fishways were also inspected by representatives from NOAA Fisheries and other

agencies. Results of those inspections are available at http://www.fpc.org/documents/Fishway_Inspection_Reports.html. See also the discussion of adult passage improvements under RPA Action 28 above.

The Corps continued a two-year study to evaluate the effects of modifications at dams on adult salmon passage. Specific fish ladder modifications being evaluated include the lamprey flume at Bonneville Powerhouse II, effects of The Dalles Spillwall, north shore ladder improvements at John Day Dam, and McNary South Shore lamprey entrance (2014 only).

The Corps also conducted three 1:55 scale physical hydraulic model studies at its Vicksburg, Mississippi, lab to assess mechanisms of passage delay and develop corrective operations for adult steelhead and adult spring/summer Chinook passing Little Goose and Lower Granite dams in 2013. A telemetry study of passage through Little Goose was also conducted through 2013 into 2014 (Clabough et al. 2014).

5. *In addition to current operations (generally April 10 - August 31), evaluate operation of the Bonneville (second powerhouse) PH2 corner collector from March 1 through start of spill as a potential means to provide a safer downstream passage route for steelhead kelts, and implement, if warranted.*

   From 2008 through 2012, the Corps evaluated operation of the corner collector as a means to provide safe passage for downstream-migrating steelhead. Based on these past evaluations, and in consultation with the Fish Passage Operations and Maintenance subcommittee, operation of the corner collector was determined to provide a benefit. Annual operation of the corner collector has been incorporated into the Fish Passage Plan.

   In 2014, the Bonneville corner collector was opened for steelhead kelt passage on March 17, 2014. Normal spill operations began on April 10, 2014. This provided 25 additional days of downstream passage for steelhead kelts.

   BPA Project 1994-033-00 (Fish Passage Center) provided technical analysis, data summaries, graphic representations for the state, federal and tribal fishery managers.

RPA Action 54 – Monitor and Evaluate Effects of Configuration and Operation Actions

The following will be conducted at specific projects for specific years as operations or configurations change, or new problems are identified.

1. *Monitor and evaluate the effects of existing spillways, modifications, and operations on smolt survival.*

   Data collected at Little Goose during 2013 performance testing (Skalski et al. 2014) were analyzed in 2014 to assess potential reasons why subyearling Chinook dam passage survival was less than the expected 93 percent (Harnish et al. 2015). Spillways at John Day and McNary dams were evaluated in 2014 as part of the Juvenile Salmon Dam Passage Performance Standard compliance studies (Skalski et al. 2015a; 2015b).

2. *Monitor and evaluate the effectiveness of traditional juvenile bypass systems and modifications to such, on smolt survival and condition.*

   The Corps used hydraulic modeling and flow measurements to evaluate gatewell hydraulic conditions at Bonneville's Second Powerhouse in an effort to identify and design modifications aimed at reducing mortality and injury for fish using the juvenile bypass system. A flow-control device was selected, installed, and hydraulic modeling results were verified at the project. A biological evaluation of fish condition and survival using the flow-control device is planned for the 2015 outmigration.

   Juvenile Bypass systems at John Day and McNary dams were evaluated in 2014 as part of the Juvenile Salmon Dam Passage Performance Standard compliance studies (Skalski et al. 2015a; 2015b).

   Data collected at Little Goose during 2013 performance testing (Skalski et al. 2014) were analyzed to assess potential reasons why subyearling Chinook dam passage survival was less than the expected 93 percent (Harnish et al. 2015).

   A second year of prototype gatewell passage structure testing was conducted at Lower Granite Dam to evaluate various passage structure configurations of a 14-inch orifice and sharp-crested weir (O'Connor et al. 2015). This work is part of the Lower Granite Juvenile Bypass System Phase 1A upgrade.

   BPA Project 1993-029-00 (Survival Estimate for Passage through Snake and Columbia River Dams) funded NOAA Fisheries to produce annual survival estimates for yearling spring migrants over the the Lower Granite Dam to Bonneville Dam reach, the McNary Dam to Bonneville Dam reach, and the above-Lower Granite reaches using PIT tagged hatchery and wild groups.

3. *Monitor and evaluate the effectiveness of surface bypass structures and modifications on smolt survival and condition.*

   Surface passage at John Day and McNary dams was evaluated in 2014 as part of the Juvenile Salmon Dam Passage Performance Standard compliance studies (Skalski et al. 2015a; 2015b).

   Data collected at Little Goose during 2013 performance testing (Skalski et al. 2014) were analyzed to assess potential reasons why subyearling Chinook dam passage survival was less than the expected 93 percent (Harnish et al. 2015).

   BPA Project 2001-003-00 (Adult PIT detector Installation) completed design of a prototype ogee transceiver in 2014. The finished transceiver was installed permanently in the corner collector flume at Bonneville Dam, and has a detection rate 10% above the level of the original transceiver. This project was merged with BPA Project 1983-319-00 in 2014.

4. *Monitor and evaluate the effectiveness of turbine operations and modifications on smolt survival and condition.*

   Post-hoc analysis of passage data collected at Bonneville during 2010-2012 performance testing was conducted in 2013 and 2014. Objectives included estimating and comparing juvenile fish survival within and above the one percent peak efficiency range at Powerhouse I and Powerhouse II. At both powerhouses results indicate that there is no measureable difference in turbine passage survival

based on turbine operation. In addition to analyzing fish survival data, work continued in 2014 to determine the safest operating range for fish passing through existing FCRPS turbines. Physical model studies and numerical model studies were conducted to further this understanding.

A Turbine Survival Program Phase II report was completed in 2013 which identifies the best target operating range for each project. The recommended target operating ranges are based on maximizing turbine passage survival.

Turbine operations at John Day and McNary dams were evaluated in 2014 as part of the Juvenile Salmon Dam Passage Performance Standard compliance studies (Skalski et al. 2015a; 2015b).

Data collected at Little Goose during 2013 performance testing (Skalski et al. 2014) were analyzed to assess potential reasons why subyearling Chinook dam passage survival was less than the expected 93 percent (Harnish et al. 2015).

The Turbine Survival Program continued to develop a biological index test through computational fluid dynamics modeling and physical modeling at the Corps' Engineer Research and Development Center.

5. *Monitor and evaluate overall dam passage with respect to modifications at projects (including forebay delay and survival).*

Juvenile fish performance standard testing was conducted at John Day and McNary dams. Results from these tests included estimates of forebay residence times and survival rates in the forebay. These results are presented under RPA Actions 20 and 21.

Data collected at Little Goose during 2013 performance testing (Skalski et al. 2014) were analyzed to assess potential reasons why subyearling Chinook dam passage survival was less than the expected 93 percent (Harnish et al. 2015).

BPA Project 1987-127-00 (Smolt Monitoring Program) gathered data on abundance, passage timing, system travel time and survival, and physical condition of smolts moving out of tributaries and past Snake and Columbia River hydro projects.

BPA Project 1994-033-00 (Fish Passage Center) provided technical review of dam performance testing study designs, analyses, and draft reports. http://www.fpc.org/documents/FPC_memos.html

6. *Monitor and evaluate the effectiveness of the juvenile fish transportation program and modifications to operations.*

In 2014, the Action Agencies continued to monitor and evaluate the effectiveness of the juvenile fish transportation program; this effort included seven BPA projects. Information resulting from the 2014 RME will enable further progress in identifying the benefits of transportation and supporting adaptive management actions. Significant 2014 RME are as follows:

Spring Migrants: The Action Agencies continued research to determine the potential of transportation to increase adult returns of anadromous salmon. A PIT tag study to evaluate weekly SARs for spring Chinook salmon and steelhead transported from

Lower Granite Dam continued in 2014. More precise temporal transportation data should help clarify effects of transportation and relationships to environmental variables. Overall, ratio of SARs of transported to in-river migrating fish reported by NOAA Fisheries show that transport is a benefit throughout most of the season for spring migrants. The greatest transport benefit for wild Chinook salmon usually occurs after May 1, but in most years transport is beneficial by the third week of April. Another trend observed in the data is that SARs for in-river migrants tend to decrease throughout the season. This is consistent with the observation that while transport may be beneficial early in the migration season, it usually becomes even more beneficial later in the season.

Summer Migrants: In 2013, the Action Agencies continued implementing the 2007 fall Chinook salmon consensus proposal and long-term framework developed collaboratively with regional fish management agencies and Tribes. This intensive RME effort for subyearling fall Chinook salmon will help determine the appropriate management strategy to optimize adult returns. In 2014, NOAA Fisheries and USFWS completed an analysis report and analyzed two years of complete adult returns (2006 and 2008). The report was distributed for regional review and comment and is expected to be completed in 2015.

BPA Project 1994-033-00 (Fish Passage Center) provided technical analysis, data summaries, graphic representations of the juvenile fish transportation program and modifications to operations for state, federal and tribal fishery managers. They maintained a dam count database at their website: http://www.fpc.org.

BPA Project 1996-020-00 (Comparative Survival Study (CSS)) estimated smolt-to-adult survival indices for transported and non-transported spring-, summer-, and fall-run Chinook, sockeye, and summer steelhead, mostly originating above Lower Granite Dam.

BPA Project 1990-055-00 (Idaho Steelhead Monitoring and Evaluation Studies) gathered data on steelhead population dynamics, life-history, and genetics.

BPA Project 2001-003-00 (Adult PIT Detector Installation) installed PIT tag detection systems around the Columbia River Basin, and helped to improve detection at the Bonneville Corner Collector in 2014. This project was closed and merged with project 1983-319-00 in 2014.

BPA Project 1993-029-00 (Survival Estimate for Passage through Snake and Columbia River Dams) funded NOAA Fisheries to produce annual survival estimates for yearling spring migrants over the Lower Granite Dam – Bonneville Dam and McNary Dam – Bonneville Dam, and above-Lower Granite Dam reaches using PIT tagged hatchery and wild groups.

7. *Monitor and evaluate the effects of environmental conditions affecting juvenile fish survival.*

BPA Project 1987-127-00 (Smolt Monitoring Program) gathered data on abundance, passage timing, system travel time and survival, and physical condition of smolts moving out of tributaries and past Snake and Columbia River hydro projects.

BPA Project 1993-029-00 (Survival Estimate for Passage through Snake and Columbia River Dams) funded NOAA Fisheries to produce annual survival estimates for yearling spring migrants over the Lower Granite Dam – Bonneville Dam and

McNary Dam – Bonneville Dam reaches using PIT tagged hatchery and wild groups. They compared daily measures of flow, temperature, and spill at Snake dams with the daily smolt index and survival. They also continued experimentation with an alternative towed mobile antenna in the estuary.

BPA Project 1994-033-00 (Fish Passage Center) provided technical analysis, data summaries, graphic representations of fish movement and survival for state, federal and tribal fishery managers.

BPA Project 1996-020-00 (Comparative Survival Study (CSS)) estimated smolt-to-adult survival indices for spring-, summer-, and fall-run Chinook, sockeye, and summer steelhead, mostly originating above Lower Granite Dam, and continued their work estimating correlations between survival and river and operational factors. The CSS incorporated fall Chinook adult returns in 2014.

BPA Project 2003-041-00 (Evaluate Delayed (Extra) Mortality Associated with Passage of Yearling Chinook Salmon through Snake River Dams) estimated the final year of adult returns for a seven year experiment (2005-2011) comparing survival of yearling Chinook transported and released at McNary Reservoir with their cohort traveling through four lower Snake dams.

BPA Project 1989-108-00 (Modeling and Evaluation Support/Columbia River Integrated Statistical Program) conducted data analyses to identify environmental factors influencing the performance of the Comprehensive Fish Passage (COMPASS) model in predicting juvenile timing and survival during outmigration, and the influence of fish size and condition on hydrosystem survival and smolt-to-adult survival. They modeled the relationship between ocean survival and smolt length.

8. *Monitor and evaluate the effectiveness of reducing predation toward improving juvenile fish survival.*

   BPA Project 1990-077-00 (Development of System-wide Predator Control) continued the Northern Pikeminnow Management Program to reduce predation on juvenile salmonids by harvesting pikeminnow in FCRPS reservoirs and estuary.

   The Action Agencies continue to implement habitat and dam-based actions to reduce predation on juvenile and adult salmonids. See also RPA Actions 43 through 49 and 66 through 70 for detailed information on related activities.

9. *Investigate, evaluate and deploy alternative technologies and methodologies for fish passage and the RME Action.*

   A second year of prototype gatewell passage structure testing was conducted at Lower Granite Dam to test various passage structure configurations of a 14-inch orifice and sharp-crested weir (O'Connor et al. 2015). This work was conducted as part of the Lower Granite Juvenile Bypass System Phase 1A upgrade.

   BPA Project 1983-319-00 (New Marking and Monitoring Technologies) funded NOAA Fisheries to develop new designs for fish tags and tag detection systems, including a prototype for spillway PIT tag detection. NOAA tested large 8' by 20' antennas with multiplexing transceivers at a pile dike location.

10. *Determine if actions directed at benefiting juveniles have an unintended effect on migrating adults (e.g., certain spill operations).*

The Corps continued a two-year study to evaluate the effects of modifications at dams on adult salmon passage. Specific juvenile passage modifications being evaluated include The Dalles Dam Spillwall and the spillway weirs and new spill pattern at John Day Dam.

The Corps continued physical model studies to evaluate Little Goose Dam spill patterns. Objectives of this work included identifying pattern adjustments that minimize adult salmon delays associated with spillway weir operation, and providing design information for restoring the eroded north shore jetty. BPA Project 1994-033-00 (Fish Passage Center) provided technical analysis, data summaries, graphic representations for the state, federal and tribal fishery managers.

11. *Install and maintain adult PIT Tag detectors in fish ladders at key dams in the FCRPS and evaluate adult survival (conversion rates).*

Temporary PIT detectors were installed and became fully functional in the count windows of both ladders at Lower Monumental and the single ladder at Little Goose dams in 2014. These systems were originally intended to be temporary. However, they have higher than anticipated detection efficiencies (>99 percent) and appear to be durable and reliable, so will be likely be maintained by the Corps as long-term systems in order to correct between dam count discrepancies and diagnose conversion loss mechanisms between dams due to effects including straying and sport harvest.

BPA Project 2001-003-00 (Adult PIT Detector Installation) designed a PIT tag detection system for the counting windows at The Dalles Dam.

12. *Monitor and evaluate the effects of fish ladder operations and configurations on adult passage rates.*

The Corps conducted the second year of a two-year study to evaluate the effects of modifications at dams on adult salmon passage. Specific fish ladder modifications being evaluated include the lamprey flume at Bonneville Powerhouse II (2013–2014), the north shore ladder at John Day Dam (2013–2014) and a new lamprey entrance at McNary Dam's south shore fish ladder (2014 only).

The Lower Granite Dam ladder temperature differential effects to adult passage delay that occurred during the 2013 low flow and high water temperature regime also occurred during 2014, although sub-lethal temperatures began about a month later in July 2014. The operation was managed through operation of the auxiliary forebay pumps and an additional submerged pump system supplying >60 feet deep sourced water into the diffuser 14 intake. This operation was successful at reducing ladder temperature differentials by 1–2 degrees C.

In 2014, video monitoring occurred at the raised picketed lead sections of counting stations at McNary and Ice Harbor dams for determining impacts to migrating salmon. In addition, newly-installed lamprey passage entrance structure, installed in the McNary Dam south shore fishway entrance, was monitored for negative impacts on salmon passage using a combination of optical, video and acoustic imaging (Thompson et al. 2015).

BPA Project 1994-033-00 (Fish Passage Center) organizes and oversees monthly fishway inspections: http://www.fpc.org/documents/Fishway_Inspection_Reports.html.

13. *In addition to the current sluiceway operation (generally April 1–November 30), evaluate operation of The Dalles Dam sluiceway from March 1–March 31 and from December 1–December 15 as a potential means to provide a safer fallback passage route for overwintering steelhead and kelts, implement if warranted.*

    Results from two years of evaluations of downstream passage through The Dalles Dam sluiceway by overwintering summer steelhead and outmigrating steelhead kelts indicated that there are large enough benefits (0.9 percent of a 6 percent target for Snake River B-run steelhead) to justify operating this route early and to keep this surface route open later, March 1 to 15 December (Tackley and Clugston 2011). In 2014, the sluiceway was operated March 1–31 and December 1–15 to provide safer passage conditions for overwintering steelhead and steelhead kelts.

14. *Investigate surface-flow outlets during wintertime to provide safer fallback opportunity for over wintering steelhead (need will be determined by results of further research).*

    A direct injury and survival study comparing the turbine and spillway weir passage routes for adult steelhead at McNary Dam was completed in 2014 (Normandeau 2014). A follow-on study to evaluate spillway weir passage efficiency for overwintering adult steelhead began in November 2014.

RPA Action 55 – Investigate Hydro Critical Uncertainties and Investigate New Technologies

The Action Agencies will fund selected research directed at resolving critical uncertainties that are pivotal in lifecycle model analyses. Specific actions include:

1. *Investigate and quantify delayed differential effects (D-value) associated with the transportation of smolts in the FCRPS, as needed. (Initiate in FY 2007–2009 Projects).*

   The Corps held a regional workshop on the potential selectivity of juvenile bypass systems in June 2013 and several presenters provided data and associated analyses addressing the question of whether bypass systems are selective for specific traits (e.g., length). Overall, there appeared to be evidence of selectivity in bypass systems from multiple researchers and some presented information suggesting there was either no selectivity or the selectivity was not thought to be biologically meaningful. At the conclusion of the workshop broad consensus was that this issue deserved more attention and that it is a critical uncertainty in the operation of the FCRPS.

   Several multiyear research studies continue to assess and estimate differential delayed effects associated with the transportation of juvenile salmon and steelhead. The parameter D is the ratio of post Bonneville survival of barged and in-river migrants. Other indices of transportation benefit provide more direct and readily interpretable results, including various transport-to-in-river migrant ratios such as TIR and ratio of smolt to adult return of transported to in river migrating fish indices.

   BPA Project 1989-108-00 (Modeling and Evaluation Support/Columbia River Integrated Statistical Program) developed a model to evaluate hypotheses that

seasonal timing of arrival of transported juveniles to the estuary, and thermal stress of migrating in-river may influence seasonal patterns of transport related delayed mortality for Chinook salmon. They further explored the relationship of seasonal patterns of D with timing of transportation and physiological maturity and condition of juveniles.

BPA Project 1994-033-00 (Fish Passage Center) provided technical analysis, data summaries, graphic representations of fish movement and survival for state, federal and tribal fishery managers.

BPA Project 1996-020-00 (Comparative Survival Study (CSS)) estimated smolt-to-adult survival indices including D and TIR for spring-, summer-, and fall-run Chinook, sockeye, and summer steelhead, mostly originating above Lower Granite Dam. They also explored the relationship between spill rates, flow, and D.

BPA Project 1991-028-00 (PIT Tagging Wild Chinook) estimated parr-to-smolt survival for wild Snake River spring/summer Chinook above Lower Granite Dam.

BPA Project 1989-098-00 (Salmon Studies in Idaho Rivers) studied hatchery supplementation as a recovery tool for threatened stocks of spring/summer Chinook in Idaho rivers.

2. *Investigate the post-Bonneville mortality effect of changes in fish arrival timing and transportation to below Bonneville. (Initiate in FY 2007-2009).*

BPA Project 2003-041-00 (Evaluate Delayed (Extra) Mortality Associated with Passage of Yearling Chinook Salmon through Snake River Dams) estimated the final year of adult returns for a seven year experiment (2005–2011) comparing survival of yearling Chinook transported and released at McNary Reservoir with their cohort traveling through four lower Snake dams.

BPA Project 1994-033-00 (Fish Passage Center) provided technical analysis, data summaries, graphic representations for the state, federal and tribal fishery managers, and oversaw the Comparative Survival Study and Smolt Monitoring Program

BPA Project 1993-029-00 (Survival Estimate for Passage through Snake and Columbia River Dams) funded NOAA Fisheries to produce annual survival estimates for yearling spring migrants over the Lower Granite Dam – Bonneville Dam and McNary Dam – Bonneville Dam reaches using PIT tagged hatchery and wild groups.

BPA Project 1987-127-00 (Smolt Monitoring Program) gathered data on abundance, passage timing, system travel time and survival, and physical condition of smolts moving out of tributaries and past Snake and Columbia River hydro projects.

3. *Conduct a workshop every other year with members of the Independent Scientific Advisory Board (ISAB) to review current research and monitoring approaches on post Bonneville mortality for transported and non-transported fish. (Initiate in FY 2009).*

The Corps commissioned a synopsis and literature review of differential delayed mortality, identified critical uncertainties, and sponsored the Snake River Basin Differential Delayed Mortality Workshop in May 2011. A draft report was produced and sent to regional fish managers for review and comment. Results from the

synopsis were presented at the Corps Annual AFEP review in December 2011. The final report (Anderson et al. 2012) was sent to the ISAB for review in the spring of 2012. A workshop has not been conducted since, as relatively little new information has become available since the 2011 workshop.

4. *Investigate, describe and quantify key characteristics of the early life history of Snake River Fall Chinook Salmon in the mainstem Snake, Columbia, and Clearwater rivers. (Initiate in FY 2007-2009 Project).*

   BPA Project 2002-032-00 (Snake River Fall Chinook Salmon Life History Investigations) used adult otolith microchemistry to estimate the fraction of returning adults which entered the ocean as subyearlings and yearlings, and their site of spawning.

   BPA Project 1991-029-00 (Research, monitoring and evaluation of emerging issues and measures to recover the Snake River Fall Chinook Salmon ESU) monitored weight, length, abundance, and timing of fry and parr stage fall Chinook as they appeared in Lower Granite Reservoir and upper reaches of the Snake.

   BPA Project 1987-127-00 (Smolt Monitoring Program) gathered data on abundance, passage timing, system travel time and survival, and physical condition of smolts moving out of tributaries and past Snake and Columbia River hydro projects.

   BPA Project 1994-033-00 (Fish Passage Center) provided technical analysis, data summaries, graphic representations for the state, federal and tribal fishery managers.

   BPA Project 1996-020-00 (Comparative Survival Study (CSS)) conducted a simulation to assess the potential for bias in SAR estimates for fall Chinook based on detection rates of migrants passing Lower Granite during winter or holding over until spring.

   BPA Project 1989-107-00 (Statistical Support for Salmon) provided software, technical assistance and guidance in mark-recapture study design and data analysis to tribal, state, and federal agencies. Program TribPit (http://www.cbr.washington.edu/analysis/apps/tribPit/) was developed to estimate survival of juvenile fall Chinook salmon during their in-tributary life phase using data from instream PIT-tag antenna arrays. Program TribPit SampleSize (http://www.cbr.washington.edu/analysis/apps/TribPitSampleSize) is helping investigators and regional planners with sample size guidance to conduct tributary PIT-tag studies of juvenile cohort (brood year) survival.

   BPA Project 1989-108-00 (Modeling and Evaluation Support/Columbia River Integrated Statistical Program) developed a bioenergetics model predicting initiation of migration of juvenile fall Chinook.

5. *Complete analysis and reporting of a multi-year (2000–2007) investigation on the effects of adult passage experience in the FCRPS on pre-spawning mortality (2008). Following reporting, SRWG will review the results and provide a recommendation on the need and nature of future research. Future research will be coordinated through the Regional Forum.*

   This action was completed in 2008.

6. *Continue development of state-of-the-art turbine units to obtain improved fish passage survival through turbines with the goal of using these new units in all future turbine rehabilitation or replacement programs.*

   The Ice Harbor test turbine project will replace Units 1–3. A fixed blade runner will be installed in unit 2 and an adjustable blade runner will be installed in units 1 and 3. Manufacturing on the fixed blade runner began in 2013. In 2014, design of the adjustable blade runners was completed, and the contractor began procuring materials for manufacture of the first of those adjustable blade runners. Reducing strike, turbulence, and nadir pressure were the driving design criteria (Trumbo et al. 2014).

7. *Investigate feasibility of developing PIT Tag detectors for spillways and turbines.*

   In 2014, the Corps continued developing a prototype spillway PIT tag monitoring project. The Corps is working with NOAA Fisheries and other regional resource management offices in technology development and testing.

   Additionally in 2014, the Corps developed an alternative spillway/surface outlet PIT antenna monitoring system. A contract was awarded to design, build, and evaluate a prototype "hydrofoil" antenna in 2014 that was installed and tested at the entrance to the Bonneville corner collector in early 2014. The concept was unstable in the dynamic hydraulic conditions associated with the Bonneville corner collector and further testing and evaluations on the "hydrofoil" were canceled.

   BPA project 1983-319-00 (New Marking and Monitoring Technologies) funded NOAA Fisheries continued development of a prototype spillway ogee detection system, and tested detection rates at 3'-4' water depths over a range of water velocities and antenna configurations

8. *Evaluate new tagging technologies for use in improving the accuracy and assessing delayed or indirect hydro effects on juvenile or adult fish.*

   BPA Project 1983-319-00 (New Marking and Monitoring Technologies) funded NOAA Fisheries to develop new designs for fish tags and tag detection systems. In 2014, they did not evaluate any new tagging technologies. The project continued development of a spillway ogee detection system, and tested detection rates of 32 m/sec vs. 16 m/sec tags of both 9 mm and 12 mm lengths with prototype antennas at the Pasco Research Station.

   BPA Project 1989-107-00 (Statistical Support for Salmon) worked with several agencies to investigate several new technologies for tagging studies. These include:
   - Micro-injectable acoustic tags for smaller salmonids.
   - Backpack or saddleback acoustic tags to avoid barotrauma during turbine passage.
   - Suture technologies to find the best approach to retain acoustic tags and prevent post-surgical problems.
   - Design and analysis of bioassays to assess tag effects and identify minimum tagging sizes for fish.

9. *Assess the feasibility of developing PIT Tag detectors for use in natal streams and tributaries, or other locations, as appropriate to support more comprehensive and integrated All-H monitoring designs and assessments of stray rates.*

   BPA Project 1983-319-00 (NOAA Fisheries New Marking and Monitoring Technologies) is the primary project affiliated with this subaction. This project continued design and development work on a multiplexing transceiver system, to be tested in the John Day River.

   BPA Project 1989-107-00 (Statistical Support for Salmon) developed the program BRANCH to analyze the adult tributary PIT-tag data. The software will also let investigators know whether their detection schematic will permit survival and stray rate estimation or not.

RPA Action 56 – Monitor and Evaluate Tributary Habitat Conditions and Limiting Factors

The Action Agencies will:

1. *Implement research in select areas of the pilot study basins (Wenatchee, Methow and Entiat river basins in the Upper Columbia River, the Lemhi and South Fork Salmon river basins, and the John Day River Basin) to quantify the relationships between habitat conditions and fish productivity (limiting factors) to improve the development and parameterization of models used in the planning and implementation of habitat projects. These studies will be coordinated with the influence of hatchery programs in these habitat areas.*

   Reclamation Project R14-PG-49 (Integrative Data Modeling, Analyst and Management Activities) with USGS developed a model from first principles to quantify the relationships between habitat conditions and fish productivity in the Methow. This project also funded the collection of the aquatic metabolism data to parameterize the primary production portion of the model and Reclamation continues to collect post-floodplain treatment fish production data to help parameterize the model (see e.g., Bellmore and Baxter 2013; Bellmore et al. 2013, 2014, 2015; Benjamin et al. 2013; Romine et al. 2013).

   BPA Project 1989-098-00 (Salmon Studies in Idaho Rivers-Idaho Department of Fish and Game (IDFG)) assessed the use of hatchery Chinook salmon to restore or augment natural populations, and to evaluate the effects of supplementation on the survival and fitness of existing natural populations. The program has collected data from 30 streams throughout Idaho.

   BPA Project 1990-055-00 (Idaho Steelhead Monitoring and Evaluation Studies) monitored and evaluated the status of wild steelhead populations in the Clearwater and Salmon River drainages.

   BPA Project 1998-016-00 (Escapement and Productivity of Spring Chinook and Steelhead) provided basin-wide status and trend data for steelhead and spring Chinook in the John Day River Basin.

   BPA Project 2003-017-00 (Integrated Status and Effectiveness Monitoring Program (ISEMP)) implemented both status and trend monitoring (fish and habitat) and watershed-level action effectiveness monitoring in five IMWs throughout the Columbia River Basin. The IMWs continued in the Entiat River, Bridge Creek, and

Lemhi River watersheds, while status and trend monitoring is implemented in the Wenatchee, John Day, and Lemhi river watersheds. Work with ISEMP's quantile regression forests (QRFs) on identifying factors that predict carrying capacity continued to be refined in 2014.

BPA Project 2008-471-00 (Upper Columbia Nutrient Supplementation) quantified and evaluated nutrient status and availability in the Twisp River, a tributary to the Methow River.

BPA Project 2010-034-00 (Upper Columbia Spring Chinook and Steelhead Juvenile and Adult Abundance, Productivity and Spatial Structure Monitoring) evaluated precision and accuracy of smolt monitoring and the precision of redd counts for both steelhead and spring Chinook, estimate the proportion of hatchery steelhead, and evaluate the accuracy of the steelhead spawning ground survey design in Upper Columbia Rivers.

BPA Project 2011-006-00 (Columbia Habitat and Monitoring Program (CHaMP)) developed and implemented a standardized habitat monitoring program covering at least one population per MPG for habitat status and trend to support habitat and fish relationship development used in limiting factor assessments and for planning and evaluation of habitat actions. With the NREI (Net Rate of Energy Intake) model operational, NREI and carrying capacity have been simulated in the Asotin, Entiat, John Day and Lemhi basins for 2011-2013. NREI outputs can be used to compare habitat quality, fish capacity, and alternative habitat scenarios as well as map spatial distributions of good to poor habitat at sites where CHaMP data is collected. Using this tool, watershed managers have been provided reach/site-level carrying capacities for spring Chinook and/or steelhead where requested.

2. *Implement habitat status and trend monitoring as a component of the pilot studies in the Wenatchee, Methow and Entiat river basins in the Upper Columbia River, the Lemhi and South Fork Salmon river basins, and the John Day River Basin. (Initiate in FY 2007-2009 Projects, annually review and modify annually to ensure that these projects continue to provide a means of evaluating the effectiveness of tributary mitigation actions.)*

BPA Project 2003-017-00 (Integrated Status and Effectiveness Monitoring Program) (ISEMP)) continued to support habitat status and trend monitoring through watershed-level action effectiveness studies (IMWs) in the John Day (Bridge Creek), Entiat, and Lemhi and ongoing habitat status and trends monitoring in the Wenatchee.

BPA Project 2008-471-00 (Upper Columbia Nutrient Supplementation) quantified and evaluated nutrient status and availability in the Twisp River, a tributary to the Methow River. This project monitors and tracks nutrients and food within a watershed in the Methow River Basin and will contribute, along with CHaMP and Reclamation data, to habitat status and trend monitoring within the Methow River Basin.

BPA Project 2011-006-00 (Columbia Habitat and Monitoring Program) developed and implemented a standardized habitat monitoring program for habitat status and trend (including the 6 basins identified in this RPA subaction) to support habitat and fish relationship development used in limiting factor assessments and for planning and evaluation of habitat actions. In 2014, CHaMP completed its fourth year of

monitoring, with crews applying standardized habitat monitoring protocols at over 400 sites.

3. *Facilitate and participate in an ongoing collaboration process to develop a regional strategy for limited habitat status and trend monitoring for key ESA fish populations. This monitoring strategy will be coordinated with the status monitoring needs and strategies being developed for hydropower, habitat, hatchery, harvest, and estuary/ocean.*

   BPA Project 2003-017-00 (Integrated Status and Effectiveness Monitoring Program) (ISEMP)) continued to work collaboratively with the region on the development of protocols and new technologies, indicators, sample designs, analytical, data management and communication tools and skills, and restoration experiments that support the development of a region-wide Research, Monitoring and Evaluation (RME) strategy to assess the status of anadromous salmonid populations, their tributary habitat and restoration and management actions.

   BPA Project 2003-022-00 (Okanogan Basin Monitoring & Evaluation Program) measured habitat conditions and steelhead natural production in the Okanogan River Basin. The project also consolidated information related to sockeye and Chinook salmon. Okanogan Basin Monitoring and Evaluation Program data are used to help identify limiting factors, support adaptive management, prioritize and select restoration actions, manage local fisheries, and develop new restoration actions.

   BPA Project 2004-002-00 (Pacific Northwest Aquatic Monitoring Program Coordination) funded the Pacific Northwest Aquatic Monitoring Program to provide a forum for coordination of aquatic monitoring efforts in the region to promote consistency in monitoring approaches and protocols; follow a scientific foundation; support monitoring policy and management objectives; and collect and present information in a manner that can be shared.

   BPA Project 2009-004-00 (Monitoring Recovery Trends in Key Spring Chinook Habitat Variables and Validation of Population Viability Indicators) assessed the status and trend of stream habitat conditions in the upper Grande Ronde River and Catherine Creek to evaluate the potential of freshwater habitat restoration in aggregate, applied in a spatially diffused manner to these basins, to improve the viability of spring Chinook salmon populations.

   BPA Project 2011-006-00 (Columbia Habitat and Monitoring Program) continued to develop and implement a standardized habitat monitoring program for habitat status and trend (consistent with the Anadromous Salmonid Monitoring Strategy (ASMS) regional collaborative strategy and ISRP review) to support habitat and fish relationship development used in limiting factor assessments and for planning and evaluation of habitat actions.

RPA Action 57 – Evaluate the Effectiveness of Tributary Habitat Actions

The Action Agencies will evaluate the effectiveness of habitat actions through RME projects that support the testing and further development of relationships and models used for estimating habitat benefits. These evaluations will be coordinated with hatchery effectiveness studies.

1. *Action effectiveness pilot studies in the Entiat River Basin to study treatments to improve channel complexity and fish productivity.*

   BPA Project 2003-017-00 (Integrated Status and Effectiveness Monitoring Program) determined the effectiveness of restoration at improving Chinook and steelhead freshwater productivity for the Entiat River IMW. The primary restoration action to be tested is active instream modifications via engineered structures that increase habitat complexity and diversity by creating large pools and off-channel areas. The Entiat River IMW study design calls for phased implementation of four rounds of habitat actions over the study period.

   BPA Project 2010-034-00 (Upper Columbia Spring Chinook and Steelhead Juvenile and Adult Abundance, Productivity and Spatial Structure Monitoring) evaluated precision and accuracy of smolt monitoring and the precision of redd counts for both Entiat River steelhead and spring Chinook, estimated the proportion of hatchery steelhead, and evaluated the accuracy of the steelhead spawning ground survey design in Upper Columbia Rivers. The application of identical fish monitoring protocols/methods in the Entiat benefit directly from this project.

   BPA Project 2011-006-00 (Columbia Habitat and Monitoring Program) developed preliminary summaries of habitat quality indices for the Entiat River Basin. See RPA Subactions 56.1, 56.2, and 56.3 for further descriptions of CHaMP. Although CHaMP has only collected one year of habitat data within the Entiat River Basin, over time it will document changes in habitat conditions at the basin, assessment unit, and site scales. This will allow researchers to assess the effects of restoration actions on habitat conditions at three spatial scales.

2. *Pilot study in the Lemhi River Basin to study treatments to reduce entrainment and provide better fish passage flow conditions.*

   BPA Project 2003-017-00 (Integrated Status and Effectiveness Monitoring Program) evaluated the effectiveness of reconnecting numerous small tributaries to the mainstem Lemhi River for the Lemhi IMW. While tributary reconnections are the major restoration focus, the Lemhi River IMW also evaluates additional habitat actions including channel modifications, riparian fencing, diversion removals and screening, and side-channel development. Potential restoration scenarios and actions that would meet or exceed survival targets in the basin for spring/summer Chinook salmon have been explored using the ISEMP-developed life cycle model.

   BPA Project 2011-006-00 (Columbia Habitat and Monitoring Program) developed and continued to implement a standardized habitat monitoring program for habitat status and trend that included the Lemhi.

3. *Action effectiveness pilot studies in Bridge Creek of the John Day River Basin to study treatments of channel incision and its effects on passage, channel complexity, and consequentially fish productivity.*

   BPA Project 1998-016-00 (Escapement and Productivity of Spring Chinook and Steelhead) provided basin-wide status and trend data for anadromous salmonids in the John Day River Basin.

   BPA Project 2003-017-00 (Integrated Status and Effectiveness Monitoring Program) examined the effects of restoration actions on aggrading incised stream channels and restoring floodplain connectivity on steelhead growth, survival, abundance, and production. Restoration is aimed at causing aggradation of the incised stream channels by installing a series of instream beaver dam support structures, (vertical wood post driven into the stream bottom) designed to assist beaver in the construction of stable, longer-lasting dams.

   BPA Project 2011-006-00 (Columbia Habitat and Monitoring Program) developed and implemented a standardized habitat monitoring program for habitat status and trend to support habitat and fish relationship development used in limiting factor assessments and for planning and evaluation of habitat actions, preliminary summaries of habitat quality indices for the John Day River Basin.

4. *Project and watershed level assessments of habitat, habitat restoration and fish productivity in the Wenatchee, Methow, and John Day basins.*

   Reclamation Project R14 PG 49 (Integrative Data Modeling, Analyst and Management Activities) with USGS developed a model from first principles to assess the effectiveness of habitat treatments in the Methow River Basin. In addition, a Chinook salmon life-cycle model constructed in 2014 is being used to evaluate longer-term population trajectories following habitat improvements. Preliminary simulation modeling suggests an increase in local fish productivity associated with habitat improvements. Finally, on-the-ground efforts continued to collect data to compare with pre-project data (Martens and Connolly, 2014), and earlier studies documented the benefits of barrier removal (Martens and Connolly 2010; Weigel et al. 2013a; 2013b; USGS 2014a; 2014b).

   BPA Project 2003-017-00 (Integrated Status and Effectiveness Monitoring Program) examined the effects of restoration actions on aggrading incised stream channels and restoring floodplain connectivity on steelhead growth, survival, abundance, and production in Bridge Creek, John Day Basin. Restoration is aimed at causing aggradation of the incised stream channels by installing a series of instream beaver dam support structures, (vertical wood post driven into the stream bottom) designed to assist beaver in the construction of stable, longer-lasting dams.

   BPA Project 2010-034-00 (Upper Columbia Spring Chinook and Steelhead Juvenile and Adult Abundance, Productivity and Spatial Structure Monitoring) evaluated precision and accuracy of smolt monitoring and the precision of redd counts for both Methow River and Entiat River steelhead and spring Chinook, estimated the proportion of hatchery steelhead, and evaluated the accuracy of the steelhead spawning ground survey design in Upper Columbia Rivers. The application of fish monitoring protocols/methods in the Wenatchee and Methow benefit directly from this project.

BPA Project 2011-006-00 (Columbia Habitat and Monitoring Program) developed and implemented a standardized habitat monitoring program for habitat status and trend to support habitat and fish relationship development used in limiting factor assessments and for planning and evaluation of habitat.

5. *Action Agencies will convene a regional technical group to develop an initial set of relationships in FY 2008, and then annually convene the group to expand and refine models relating habitat actions to ecosystem function and salmon survival by incorporating research and monitoring results and other relevant information.*

BPA Project 2004-002-00 (Pacific Northwest Aquatic Monitoring Program Coordination) funded the Pacific Northwest Aquatic Monitoring Program providing a forum for coordination of aquatic monitoring efforts in the region to promote consistency in monitoring approaches and protocols; follow a scientific foundation; support monitoring policy and management objectives; and collect and present information in a manner that can be shared. Reclamation's Interagency Agreement with USGS (IA R13-PG-10-428) also provides funding for PNAMP. PNAMP work supported development of modeling approaches through products that provided more accessible data and standardized metadata.

BPA Project 2009-004-00 (Monitoring Recovery Trends in Key Spring Chinook Habitat Variables and Validation of Population Viability Indicators) continued to monitor status and trends in fish habitat characteristics (limiting factors) for spring Chinook populations, evaluate effectiveness of stream restoration actions on limiting factors and develop a life cycle model to link biotic responses of spring Chinook to projected changes in stream habitat conditions. In 2014, structural equation models continued to confirm that large wood in stream channels has a direct positive effect on rearing densities for juvenile salmon as well as an indirect positive effect on rearing densities through the association of wood with pools. Completed stream temperature analyses will be used to inform and apply spatial stream network modeling to the Grande Ronde using temperature data collected locally by CRITFC and ODFW and to augment and improve NorWeST temperature model predictions. Spring Chinook life cycle model results to date indicate that key variables in predicting smolt outmigration survival include water transit time, contact with powerhouses, and Pacific Decadal Oscillation and upwelling index in the ocean. Coordination and participation on completed work and in data sharing occurred with various partners including the Grande Ronde ATLAS, CHaMP, ODFW, and ISEMP.

BPA Project 2003-017-00 (Integrated Status and Effectiveness Monitoring Program) participated in NOAA Fisheries Life Cycle Modeling workshops for the tributaries to discuss fish and habitat monitoring modeling approaches and data needs.

BPA Project 2012-001-00 (AMIP Salmonid Life Cycle Model Support) collaboratively worked with several regional entities on fish and habitat relationships and associated life cycle modeling approaches. In 2014, modelers made progress gathering data to estimate relationships between habitat conditions and survival and spawner and parr capacity for spring Chinook in the Grande Ronde River and Upper Columbia, and for Chinook and steelhead in the Salmon River.

RPA Action 58 – Monitor and Evaluate Fish Performance in the Estuary and Plume

The Action Agencies will monitor biological responses and/or environmental attributes, and report in the following areas:

1. *Monitor and evaluate smolt survival and/or fitness in select reaches from Bonneville Dam through the estuary.*

   BPA Project 2003-007-00 (Lower Columbia River Estuary Ecosystem Monitoring) collected data on juvenile salmonid lipid content at monitoring sites throughout the LCRE during 2014. Lipid content can be an indicator of smolt fitness or condition.

2. *Develop an index and monitor and evaluate life history diversity of salmonid populations at representative locations in the estuary.*

   Corps Project EST-P-09-01 (Evaluation of Life History Diversity, Habitat Connectivity, and Survival Benefits Associated with Habitat Restoration Actions in the Lower Columbia River and Estuary) applied the early life history diversity (ELHD) index for juvenile salmon and steelhead in the lower Columbia River and estuary. Factors of diversity include species, forklength and time of capture; and incorporates fish abundance, richness, and evenness. This index can be applied to compare changes in life history diversity at the same locale, but across time (e.g., status and trends) or across space (e.g., different locales, or habitats). The ELHD index has application as a high-level indicator to track trends in the status of the recovery of salmon and steelhead populations in the Columbia River basin. This methodology was published in Johnson et al. 2014b.

3. *Monitor and evaluate juvenile salmonid growth rates and prey resources at representative locations in the estuary and plume.*

   BPA Project 1998-014-00 (Ocean Survival of Salmonids) collected information regarding juvenile salmonid growth (IGF-1) rates during June 2014 from the Canada-USA Shelf study to compare juvenile salmonid growth rates with environmental measurements. Researchers used productivity as a means to estimate prey abundance in the Columbia River plume and northern California current.

   BPA Project 2003-007-00 (Lower Columbia River Estuary Ecosystem Monitoring) provided dissolved oxygen, temperature, and conductivity data at habitat and fish monitoring locations and collected data on juvenile salmonid prey resources throughout the LCRE through the Estuary Partnership in conjunction with USGS during 2014.

   BPA Project 2003-009-00 (Canada-USA Shelf Salmon Survival Study) assessed the effects of ocean conditions on the production of Columbia River Basin salmon. The information generated in this study is intended to map the ocean conditions that determine the growth and survival of Pacific salmon along the west coast of North America from southern British Columbia to southeast Alaska, and to identify which stocks of Columbia River salmon forage in these areas. Field work was completed in 2012. During 2014 the contractor finished analyses, completed a project summary report, and served as Dept. of Fisheries and Oceans Canada technical point-of-contact for the ongoing plume study and the Northwest Power and Conservation Council's Ocean Forum.

Corps Project EST-P-10-01 (The contribution of tidal fluvial habitats in the Columbia River Estuary to the recovery of diverse salmon ESUs) in 2014 continued the analysis of data from field work done in 2010 through 2013. Results were reported in Roegner et al. 2015.

4. *Monitor and evaluate temporal and spatial species composition, abundance, and foraging rates of juvenile salmonid predators at representative locations in the estuary and plume.*

   BPA Project 1998-014-00 (Ocean Survival of Salmonids) collected spatial information on the species composition, relative abundance, and diets of predatory marine fishes in salmon habitat influenced by the plume during June 2014. Marine bird and mammal surveys provided information on temporal and spatial changes in the species composition and abundance of avian and mammalian predators which occur in the plume. In addition, estuary purse seine data provided information on the seasonal and inter-annual species composition and abundance of large fish predators at sites in the Columbia River estuary.

   Corps Project AVS-P-08-01 and AVS-P-08-02 (Avian Predation Research, Monitoring, and Evaluation) monitored predation impacts by Caspian terns in 2014 by examination of diet contents (to estimate amount of juvenile salmon consumed by species). Predation impacts by Caspian terns and double-crested cormorants were also evaluated by recovery of PIT tags to estimate predation impact by ESU/DPS.

RPA Action 59 – Monitor and Evaluate Migration Characteristics and Estuary / Ocean Conditions

The Action Agencies will monitor and evaluate selected ecological attributes of the estuary, which include the following or equivalent:

1. *Map bathymetry and topography of the estuary as needed for RM&E.*

   BPA Project 2003-007-00 (Lower Columbia River and Estuary Ecosystem Monitoring) contributed to developing a seamless elevation dataset for the LCRE. This dataset represents the most up-to-date, comprehensive, and highest resolution elevation dataset (including high-resolution light detection and ranging data) that has been generated for mapping bathymetry and topography in the LCRE. There was no further action in 2014.

2. *Establish a hierarchical habitat classification system based on hydrogeomorphology, ground-truth it with vegetation cover monitoring data, and map existing habitats.*

   BPA Project 2003-007-00 (Lower Columbia River and Estuary Ecosystem Monitoring) supports multiple efforts in the estuary by mapping ecosystem processes to specific locations in the estuary to better organize current efforts (habitat actions and RME). This effort also helps to better predict how the LCRE landscape will evolve over time. This was conducted in 2014.

3. *Develop an index of habitat connectivity and apply it to each of the eight reaches of the study area.*

   In 2014, the Corps further developed and applied an Area Time Inundation Index (ATIIM) model at East Sand Island, Oregon, for purposes of evaluating alternative, modified site conditions for habitat improvement projects. The ATIIM evaluates

spatial and temporal inundation patterns, and integrates modeled or scenario-based hourly water-surface elevation data and terrain elevation data to evaluate habitat connectivity. Hydrological metrics include inundation frequency, duration, maximum area, and maximum frequency area. The model can inform evaluation of proposed restoration sites, e.g.: determine trade-offs between water-surface elevation and habitat opportunity, contrast alternative restoration designs, predict impacts of altered flow regimes, and estimate nutrient and biomass fluxes (Coleman et al. 2015).

4. *Evaluate migration through and use of a subset of various shallow-water habitats from Bonneville Dam to the mouth toward understanding specific habitat use and relative importance to juvenile salmonids.*

   BPA Project 2004-002-00 (Pacific Northwest Aquatic Monitoring Program Coordination) funded the Pacific Northwest Aquatic Monitoring Program to provide a forum for coordination of aquatic monitoring efforts in the region to promote consistency in monitoring approaches and protocols; follow a scientific foundation; support monitoring policy and management objectives; and collect and present information in a manner that can be shared. For example, standards for data sharing from PNAMP were adopted and incorporated into Oncor. There was no further action in 2014.

   BPA Project 2003-007-00 (Lower Columbia River Estuary Ecosystem Monitoring) assessed annual trends in the presence and residency of juvenile salmonids at monitoring sites throughout the LCRE during 2014.

   Corps Project EST-P-10-01 (The contribution of tidal fluvial habitats in the Columbia River Estuary to the recovery of diverse salmon ESUs) in 2014 completed a multi-year analysis of juvenile salmon use of tidal wetland habitats in the Columbia River estuary, 2010–2013 (Roegner et al. 2015).

   Corps Project EST-P-11-01 (Multi-Scale Salmon Ecosystem Action Effectiveness Monitoring and Research in the Lower Columbia River and Estuary) reported on landscape scale juvenile salmon catch density and ecology in tidal freshwater habitats (Sather and Johnson 2014).

5. *Monitor habitat conditions periodically, including water surface elevation, vegetation cover, plant community structure, primary and secondary productivity, substrate characteristics, dissolved oxygen, temperature, and conductivity, at representative locations in the estuary as established through RM&E.*

   BPA Project 2003-007-00 (Lower Columbia River Estuary Ecosystem Monitoring) assessed annual trends in habitat status at restoration and reference sites during 2014 and has been the primary contributor to habitat monitoring throughout the LCRE.

   Corps Project EST-P-11-01 (Multi-Scale Salmon Ecosystem Action Effectiveness Monitoring and Research in the Lower Columbia River and Estuary) investigated water surface elevation and temperature at four sites in the Sandy River delta for post-project evaluation (Sather and Johnson 2014).

RPA Action 60 – Monitor and Evaluate Habitat Actions in the Estuary

The Action Agencies will monitor and evaluate the effects of a representative set of habitat projects in the estuary, as follows:

1. *Develop a limited number of reference sites for typical habitats (e.g., tidal swamp, marsh, island, and tributary delta to use in action effectiveness evaluations).*

   BPA Project 2003-007-00 (Lower Columbia River Estuary Ecosystem Monitoring) assessed annual trends in habitat status at restoration and reference sites in 2014 and has been the primary contributor to habitat monitoring throughout the LCRE. Reference sites are used to inform restoration design and as a comparison for action effectiveness studies.

2. *Evaluate the effects of selected individual habitat restoration actions at project sites relative to reference sites and evaluate post-restoration trajectories based on project-specific goals and objectives.*

   BPA Project 2003-011-00 (Lower Columbia River/Estuary Habitat Restoration) intensively monitored water surface elevation, bathymetry and topography, sediment accretion, vegetation composition and percent cover, and terrestrial macroinvertebrates at five habitat restoration sites during 2014. This project evaluates the effectiveness of restoration projects. This is level 3 of the AEMR.

   Corps Project EST-P-11-01 (Multi-Scale Salmon Ecosystem Action Effectiveness Monitoring and Research in the Lower Columbia River and Estuary) investigated water surface elevation and temperature at four sites in the Sandy River delta for post-project evaluation (Sather and Johnson 2014). This work was done per the CEERPs programmatic research and monitoring strategy for level 1 data collection.

3. *Develop and implement a methodology to estimate the cumulative effects of habitat conservation and restoration projects in terms of cause-and-effect relationships between ecosystem and controlling factors, structures, and processes affecting salmon habitats and performance.*

   Corps Project EST-P-12-01 (Synthesis and Evaluation of Research, Monitoring, and Restoration Project Data in the Lower Columbia River and Estuary) continued work on the development of a web-based, geospatial data management and analysis system (called “Oncor”) for research, monitoring and evaluation (RME) data. Work in 2014 included (1) coordination with agencies and regional stakeholders; for example, a workshop was held in January 2014 to beta test data reduction procedures; (2) database construction; (3) analysis and synthesis of data (fish, vegetation, photo points, water surface elevation, water temperature, and sediment accretion); and (4) formulation of data reduction procedures and data exchange templates for nine monitoring indicators. Work on Oncor occurred thru May 2014.

   Corps Project EST-P-12-01 (Synthesis and Evaluation of Research, Monitoring, and Restoration Project Data in the Lower Columbia River and Estuary) undertook habitat restoration and related RME which was adaptively managed under the Columbia Estuary Ecosystem Restoration Program (CEERP). This program provided critical guidance to regional managers, including action agencies and restoration practitioners; and was used to prioritize research and monitoring objectives, particularly action effectiveness evaluations. Together these programmatic work efforts provided a cumulative sum benefit to the Columbia Estuary Ecosystem

Restoration Program by optimizing resource investments and focusing study designs on critical information gaps. Work on this task occurred thru May 2014.

RPA Action 61 – Investigate Estuary/Ocean Critical Uncertainties

The Action Agencies will fund selected research direct at resolving critical uncertainties that are pivotal in understanding estuary and ocean effects.

1. *Continue work to define the ecological importance of the tidal freshwater, estuary, plume, and near shore ocean environments to the viability and recovery of listed salmonid populations in the Columbia River Basin.*

   BPA Project 1989-108-00 (Modeling and Evaluation Support/Columbia River Integrated Statistical Program) explored the relationship of Chinook salmon adult migration timing with locations of meso-scale eddies, where Chinook concentrate to feed in the ocean, and developed a model of ocean predator-prey interactions.

   BPA Project 1998-014-00 (Ocean Survival of Salmonids) examined causal mechanisms affecting survival such as food-web structure and growth conditions in the plume and coastal ocean during June 2014.

   BPA Project 2003-007-00 (Lower Columbia River Estuary Ecosystem Monitoring) monitored juvenile salmon use of shallow-water habitats in Reaches A-H during 2014. This project analyzed salmonid densities, fish community composition, salmonid age-size structure, genetic stock identity, salmon diet, residence times, spatial and temporal distribution, growth rates and habitat characteristics.

   BPA Project 2003-009-00 (Canada-USA Shelf Salmon Survival Study) investigated habitat use in the nearshore ocean that was used to analyze the relative ecological importance of this environment. Field work was completed in 2012. During 2014 the contractor finished analyses, completed a project summary report (Trudel et al. 2015), and served as Department of Fisheries and Oceans Canada technical point-of-contact for the ongoing plume study and the Northwest Power and Conservation Council's Ocean Forum.

   Corps Project EST-P-10-01 (The contribution of tidal fluvial habitats in the Columbia River Estuary to the recovery of diverse salmon ESUs) in 2014 analyzed and synthesized results from 2010–2013 estuary studies (Roegner et al. 2015). Summarized data for: salmon habitat use and genetic stock composition in reach F habitats; temporal variations in fish community structure and life history of out-migrant salmon near the estuary mouth; stock sources, travel times, and residency of PIT tagged salmon entering selected wetland tidal channels in reaches B, C, and F; otolith-derived growth estimates for juvenile Chinook salmon collected at main-stem, back-water, and confluence habitats across the tidal fluvial estuary (Reaches C through H); Chinook salmon diet composition and instantaneous ration at main-stem and back-channel habitats in Reaches D and H (selected months March 2010 to September 2011); otolith-derived growth and survival estimates of adult spawning populations from two lower tributaries (Lewis River, Willamette River), two main-stem sites (Ives Island and Hanford Reach), and two upper Columbia River tributaries (Methow River and Wenatchee River); and shallow habitat opportunity modeling, including a new methodology based on depth criteria thresholds adjusted for bioenergetic (temperature), salinity, and velocity conditions.

2. *Continue work to define the causal mechanisms and migration/behavior characteristics affecting survival of juvenile salmon during their first weeks in the ocean.*

   BPA Project 2003-009-00 (Canada-USA Shelf Study) examined causal mechanisms affecting survival such as food-web structure and growth conditions in the plume and coastal ocean. Field work was completed in 2012. During 2014 the contractor finished analyses, completed a project summary report, and served as Dept. of Fisheries and Oceans Canada technical point-of-contact for the ongoing plume study and the Northwest Power and Conservation Council's Ocean Forum.

   BPA Project 1998-014-00 (Ocean Survival of Salmonids) examined causal mechanisms affecting survival such as food-web structure and growth conditions in the plume and coastal ocean during June 2014.

3. *Investigate the importance of early life history of salmon populations in tidal freshwater of the lower Columbia River.*

   BPA Project 2003-007-00 (Lower Columbia River Estuary Ecosystem Monitoring) monitored salmonid density, fish community composition, salmonid age-size structure, genetic stock identity, residence times, spatial and temporal distribution, growth rates, and habitat characteristics throughout the LCRE in 2014 to further investigate the importance of early life history diversity.

   Corps Project EST-P-10-01 (The contribution of tidal fluvial habitats in the Columbia River Estuary to the recovery of diverse salmon ESUs) analyzed data pertaining to life history diversity of juvenile salmon in the Columbia River estuary from 2010–2013. This analysis in 2014 showed that Chinook salmon stocks and life histories are not uniformly distributed through the lower Columbia River estuary, but exhibit broad seasonal and spatial patterns. These patterns were generally consistent between years. Juvenile salmon data from reaches E and F indicate high stock diversity and evenness, reflecting a diverse mixture of Willamette River, lower basin, and interior stock groups (Roegner et al. 2015).

4. *Continue development of a hydrodynamic numerical model for the estuary and plume to support critical uncertainties investigations.*

   BPA Project 1998-014-00 (Ocean Survival of Salmonids) collected information regarding juvenile salmonid growth (IGF-1) rates from Canada-USA Shelf study to compare juvenile salmonid growth rates with environmental measurements in the plume during June 2014. Researchers used productivity as a means to estimate prey abundance in the Columbia River plume and northern California current.

   Corps Project EST-P-10-01 (The contribution of tidal fluvial habitats in the Columbia River Estuary to the recovery of diverse salmon ESUs) summarized modeling efforts from 2010 thru 2013. Results of this analysis in 2014 showed a strong influence of seasonal river flow and temperature criteria on habitat-opportunity for juvenile salmon in reach F. Modeling scenarios suggest that salmon habitat opportunities in the estuary could be sensitive to future sea-level rise because of increased salinity intrusion, particularly during summer and fall. Results are reported in Roegner et al. 2015.

RPA Action 62 – Fund Selected Harvest Investigations

The Action Agencies will fund selected harvest investigations linked to FCRPS interests:

1. *Evaluate the feasibility of obtaining PIT Tag recoveries between Bonneville and McNary dams to determine whether recoveries can help refine estimates of in-river harvest rates and stray rates used to assess adult survival rates.*

   BPA Project 2008-502-00 (Expanded Tribal Catch Sampling (CRITFC)) improved the monitoring and catch sampling of the Zone 6 tribal fisheries by increasing the collection of tribal catch data through increased sample rates and employing the use of additional data collection methods.

   BPA Project 2008-508-00 (Release Mortality Analysis) assessed rates of post-release mortality reported for non-retention and mark-selective fisheries in order to improve the accuracy of parameters used in harvest models.

2. *Evaluate methods to develop or expand use of selective fishing methods and gear.*

   BPA Project 2008-105-00 (Selective Gear Deployment (Colville Confederated Tribes)) continued use of selective fishing gear to harvest non-sensitive salmon species (hatchery-origin summer Chinook and natural-origin sockeye) for tribal utilization while simultaneously releasing ESA-listed sensitive salmon stocks (i.e., spring Chinook and summer steelhead) and natural origin summer Chinook. The project is a continuation of project 2007-249-00 Evaluate Live Capture Gear, which ended in 2011.

   BPA Project 1993-060-00 (Select Area Fisheries Enhancement (WDFW, ODFW, Clatsop Co.)) continued investigation and implementation of the use of off-channel terminal fishing locations in concert with hatchery rearing and acclimation protocols to offer harvest opportunities when conventional mainstem fisheries are constrained or eliminated because of ESA limitations.

3. *Evaluate post-release mortality rates for selected fisheries.*

   BPA Project 2008-105-00 (Deployment of Live Capture Gear) has ceased evaluating post-release mortality rates, and did not do so in 2014.

4. *Support coded-wire tagging and coded-wire tag recovery operations that inform survival, straying, and harvest rates of hatchery fish by stock, rearing facility, release treatment, and location.*

   BPA Project 1982-013-01 (Coded Wire Tag - Pacific States Marine Fisheries Commission (PSMFC)) covered operation of the regional CWT database (the Regional Mark Information System), catch sampling and recovery of CWT and PIT tags from commercial and sport fisheries, spawning ground surveys, and lab extraction of CWTs.

   BPA Project 1982-013-02 (Coded Wire Tag-Oregon Department of Fish & Wildlife (ODFW)) funded adipose fin clip and insertion of CWTs and lab extraction of CWTs by ODFW.

   BPA Project 1982-013-03 (Coded Wire Tag-U.S. Fish & Wildlife Service (USFWS)) funded adipose fin clip and insertion of CWTs and lab extraction of CWTs by WDFW.

BPA Project 1982-013-04 (Coded Wire Tag-Washington Department of Fish & Wildlife (WDFW)) funded adipose fin clip and insertion of CWTs and lab extraction of CWTs by WDFW.

BPA Project 1983-350-03 (Nez Perce Tribal Hatchery Monitoring and Evaluation) monitored and evaluated hatchery and natural fish through PIT tagging, weir operation and/or spawning ground surveys, screw trapping, habitat surveys, genetic analysis, and harvest monitoring. In 2014, it was estimated that the natural adult escapement above Lower Granite was 20,425 (39.9%) and 6,336 (33.5%) natural jacks. Natural and hatchery jacks made up 27.0% of the fall Chinook escapement above Lower Granite Dam in 2013.

BPA Project 1988-053-03 (Hood River Production Monitoring and Evaluation-Warm Springs) implemented, monitored, and evaluated actions in the Hood River Master Plans for consistency with Hood River Production Program goals. In 2014, a pre-season spring Chinook salmon adult run forecast was generated with multiple regression forecast models, which predicted a return of 949 (90% C.I. 383-1,584) hatchery spring Chinook and 215 (90% C.I. 150-270) naturally produced spring Chinook for 2013.

BPA Project 1995-063-25 (Yakima River Monitoring and Evaluation-Yakima/Klickitat Fisheries Project (YKFP)) monitored and evaluated activities under this project for the Yakima River Subbasin assigned to the Yakama Nation.

BPA Project 1997-015-01 (Imnaha River Smolt Monitoring (Nez Perce)) tagged and monitored steelhead and Chinook smolts during outmigration from Imnaha. In the 2014, it was estimated that a minimum of 145,179 (95% C.I. 132,673 to 159,930; C.V. 4.68%) natural Chinook salmon juveniles emigrated past the trap, with approximately 52.6% of the juveniles emigrating during the fall trapping period and 47.5% migrating during the spring and summer trapping period.

BPA Project 2002-060-00 (Nez Perce Harvest Monitoring on Snake and Clearwater Rivers) designed sampling strategies to provide greater data precision in treaty catch reports and exploitation rates during select Nez Perce fishery seasons. In 2014, it was reported that Nez Perce fishers harvested an estimated 1,174 spring/summer Chinook and 3 summer steelhead from Zone 6 in 2013. Estimated Snake Basin harvests of adult spring/summer Chinook salmon, fall Chinook salmon, coho salmon and summer steelhead were 3,494, 1,322, 79 and 2,240, respectively

BPA Project 2010-036-00 (Lower Columbia Coded Wire Tag Recovery Project (WDFW)) funded catch sampling and recovery of CWT and PIT tags from commercial and sport fisheries, spawning ground surveys, management of the WDFW trap, weirs, and surveys and spawning ground survey databases, and escapement analysis.

5. *Investigate the feasibility of genetic stock identification monitoring techniques.*

BPA Project 1983-350-03 (Nez Perce Tribal Hatchery Monitoring & Evaluation) monitored and evaluated for hatchery and natural fish through PIT tagging, weir operation and/or spawning ground surveys, screw trapping, habitat surveys, genetic analysis, and harvest monitoring.

BPA Project 1989-096-00 (Genetic Monitoring and Evaluation Program for Salmon and Steelhead (ODFW, NOAA Fisheries)) monitored genetic changes associated with hatchery propagation in multiple Snake River subbasins for Chinook salmon and steelhead and derives estimates of reproductive success for individual families and groups of fish.

BPA Project 1989-098-00 (Salmon Studies in Idaho Rivers-Idaho Department of Fish & Game (IDFG)) analyzed DNA from adult and juvenile Chinook salmon for parentage analysis and genetic monitoring.

BPA Project 1990-055-00 (Idaho Steelhead Monitoring and Evaluation (IDFG)) monitored and evaluated the status and trends of wild steelhead populations in Idaho.

BPA Project 1991-073-00 (Idaho Natural Production Monitoring and Evaluation (IDFG)) monitored trends in abundance, productivity, spatial structure, and diversity for spring/summer Chinook salmon and steelhead trout in the Salmon, Clearwater, and minor middle Snake tributaries in the Idaho portion of Hells Canyon, as well as for the Snake River spring/summer Chinook ESU.

BPA Project 1995-063-25 (Yakama River Monitoring and Evaluation-Yakima/Klickitat Fisheries Project (YKFP)) collected genetic data samples to detect significant genetic changes in extinction risk, within-stock genetic variability, between-stock genetic variability, and domestication selection.

BPA Project 1996-043-00 (Johnson Creek Artificial Propagation Enhancement (NPT)) quantified 38 key performance measures, which are being standardized throughout the Columbia River Basin, and contributed to regional RME efforts addressing six major categories: (1) abundance, (2) survival-productivity, (3) distribution, (4) genetic, (5) life history, and (6) habitat.

BPA Project 1997-015-01 (Imnaha River Smolt Monitoring (NPT)) tagged and monitored steelhead and Chinook smolts during outmigration from the Imnaha River.

BPA Project 1997-030-00 (Chinook Salmon Adult Abundance Monitoring (NPT)) monitored escapement of natural-origin spring/summer Chinook salmon (Snake River spring/summer Chinook ESU).

BPA Project 1997-038-00 (Listed Stock Chinook Salmon Gamete Preservation (NPT)) continued in a maintenance phase with no gamete collections in 2013. Samples stored at the Washington State University repository were monitored and securely maintained.

BPA Project 1998-007-02 (Grande Ronde Supplementation Operations and Maintenance and Monitoring and Evaluation on the Lostine River (NPT)) monitored and evaluated the Chinook salmon conventional hatchery program for the Lostine River.

BPA Project 1998-016-00 (Escapement and Productivity of Spring Chinook and Steelhead (ODFW)) provided basin-wide status and trend data for anadromous salmonids in the John Day River Basin.

BPA Project 2002-030-00 (Salmon and Steelhead Progeny Markers (CTUIR)) took fin clips from returning adult steelhead, broodstock held at Minthorn Springs facility and juveniles collected for otolith extraction. Genetic information gathered is used for determining maternal origins in validation of a transgenerational mark.

BPA Project 2002-053-00 (Asotin Creek Salmon Population Assessment (WDFW)) collected DNA samples from adult steelhead and adult Chinook salmon when captured incidentally.

BPA Project 2003-054-00 (Evaluate the Relative Reproductive Success of Hatchery-Origin and Wild-Origin Steelhead Spawning Naturally in the Hood River (Oregon State University)) used gene expression profiling to identify potential traits that differ genetically between hatchery and wild fish.

BPA Project 2003-063-00 (Natural Reproductive Success and Demographic Effects of Hatchery-Origin Steelhead in Abernathy Creek, Washington (WDFW)) evaluated relative reproductive success between hatchery-origin and natural-origin steelhead trout, simultaneously investigating methods of operating a conservation hatchery and the effectiveness of integrated artificial production programs toward supporting naturally spawning populations.

BPA Project 2007-404-00 (Spring Chinook Captive Propagation-Oregon (ODFW, NPT)) maintained captive broodstock and evaluated growth, health, survival to maturation, age and size at maturation, fecundity and other characteristics for individuals of each brood year and of each experimental treatment group (eggs vs. parr and fully vs. partially covered tanks).

BPA Project 2008-907-00 (Genetic Assessment of Columbia River Stocks (CRITFC)) combined four interrelated projects from the Accords that address Single Nucleotide Polymorphism Discovery, Genetic Baseline Expansion, GSI to Evaluate Catch, and GSI of fishes passing Bonneville Dam.

BPA Project 2009-005-00 (Influence of Environment and Landscape on Salmon and Steelhead Genetics (CRITFC)) determined correlation of watershed characteristics such as elevation, barriers, migration distance, and temperature to genetic structure of Chinook salmon and steelhead populations, and tests for association of single nucleotide polymorphisms and gene expression results with traits of interest that are related to recovery of steelhead populations.

BPA Project 2010-026-00 (Chinook and Steelhead Genotyping for GSI at Lower Granite Dam (IDFG)) developed and maintained Columbia River basinwide single nucleotide polymorphism baselines for steelhead and Chinook salmon as well as develops and implements GSI techniques for Snake River steelhead and Chinook salmon monitoring.

BPA Project 2010-028-00 (Estimate Adult Steelhead Abundance in Small Streams Associated with Tucannon & Asotin Populations (WDFW)) collected tissue samples for inclusion in Snake Basin genetic characterization of steelhead for future run reconstruction estimates at Lower Granite Dam (coordinated with Project 2010-026-00).

BPA Project 2010-030-00 (Provide Viable Salmonid Population Estimates for Yakima Steelhead MPG (YN,WDFW)) conducted biological and DNA sampling at the Chandler

juvenile, and Prosser and Roza adult monitoring facilities, as well as analysis of steelhead DNA samples to improve the genetic profile for all four populations in the MPG.

BPA Project 2010-031-00 (Snake River Chinook and Steelhead Parental Based Tagging (IDFG)) genotyped approximately 16,500 samples (annually) to create the first parental genetic baselines for hatchery steelhead and Chinook salmon in the Snake River basin.

BPA Project 2010-032-00 (Imnaha River Steelhead Monitoring (NPT)) collected tissue samples from adult to describe the genetic stock structure, gene flow between spawning aggregates, and determine effective population size.

RPA Action 63 – Monitor Hatchery Effectiveness

The Action Agencies will continue to fund selected monitoring and evaluation of the effectiveness of Hatchery Actions. The evaluation of hatchery projects will be coordinated with the Tributary Habitat monitoring and evaluation program.

1. *Determine the effect that safety-net and conservation hatchery programs have on the viability and recovery of the targeted populations of salmon and steelhead. (Initiate in FY 2007–2009 Projects).*

Snake River Spring/Summer Chinook ESU and Steelhead DPS

BPA Project 1989-096-00 (Genetic Monitoring and Evaluation Program for Salmon and Steelhead) provides gene frequency monitoring for Snake River Basin Chinook and steelhead, and has quantified and described genetic diversity in natural populations and hatchery brood stocks. This project also investigates the structure of populations, genetic relationships between populations, and documented the stability of those connectivity patterns in the presence of various levels of hatchery straying as well as changes in overall abundance through time. Reproductive success of some of the Chinook and steelhead populations is also measured through this project.

BPA Project 1989-098-00 (Salmon Studies in Idaho Rivers-Idaho Department of Fish and Game) focused on collecting information on the Snake River Chinook ESU (Salmon River, which are listed under ESA and Clearwater River Chinook, which are not listed) to determine the benefits and risks of hatchery supplementation.

BPA Project 1996-043-00 (Johnson Creek Artificial Propagation Enhancement) has been ongoing since 1996 to evaluate the life cycle of natural- and hatchery-origin supplementation spring/summer Chinook salmon from Johnson Creek (part of the Snake River spring/summer Chinook ESU) to quantify key performance measures associated with abundance, survival-productivity, distribution, and diversity metrics.

BPA Project 2010-057-00 (B-Run Steelhead Supplementation Effectiveness Research) research is linked to RPA Action 41, which focuses on B-Run steelhead supplementation effectiveness research to better address the abundance, productivity, spatial structure, and diversity of B-Run steelhead in the Clearwater River Basin.

BPA Project 1992-026-04 (Grande Ronde Early Life History of Spring Chinook and Steelhead) focused on the Snake River ESU and DPS on the Grande Ronde River

populations of Chinook salmon and summer steelhead. The objectives of this study are to estimate egg-to-migrant survival for spring Chinook salmon and migrant survival for steelhead, estimate the smolts-per-spawner for four populations of spring Chinook salmon, and assess stream conditions in selected study streams.

BPA Project 1998-007-02 (Grande Ronde Supplementation Operation and Maintenance, and Monitoring and Evaluation on Lostine River) was initiated to assess status and trends of natural- and hatchery-origin spring Chinook salmon using life history, survival, and productivity performance measures for the Lostine River and the SRCP.

BPA Projects 1998-007-03 (Grande Ronde Supplementation Operation and Maintenance on Catherine Creek/Upper Grande Ronde River) and 1998-007-04 (Grande Ronde Spring Chinook on Lostine/Catherine Creek/ Upper Grande Ronde Rivers) reported on fish culture activity (holding and spawning of adults, rearing juveniles, fish health monitoring, and redd surveys) for these programs, which are run in conjunction with the Lower Snake River Compensation Plan. These projects are associated with this subaction because they also collect spawner (redd count) information.

BPA Project 1998-016-00 (Escapement and productivity of spring Chinook and steelhead) collected information on the status, trends, and distribution of spawning activity, juvenile salmonids, and aquatic habitat conditions within the John Day River Basin. This project also collected information on steelhead (mid-Columbia River steelhead DPS) and Chinook salmon (non-listed mid-Columbia Chinook ESU) in the John Day River. This project is important because there are no hatchery fish released into the basin and therefore this basin can be as a comparison reference condition.

BPA Project 2007-083-00 (Grande Ronde Supplementation Monitoring and Evaluation on Catherine Creek/Upper Grande Ronde River) monitored and evaluated supplementation of endemic spring Chinook salmon in Catherine Creek and the upper Grande Ronde River, which are part of the Snake River spring/summer Chinook ESU. This study continued to collect important information on abundance, productivity, and life history attributes of Snake River Chinook ESU and steelhead DPS.

BPA Project 2010-042-00 (Tucannon Expanded PIT Tagging) is focused on increasing the detection of PIT tagged steelhead (Snake River steelhead DPS) and spring Chinook salmon (Snake River spring/summer Chinook ESU) that enter the river upon return as adults. Increased detection will assist managers in determining abundance and origin of primarily steelhead (Chinook redd count and carcass surveys are much more effective than steelhead surveys) entering the Tucannon River and detect fish that may stray into the river.

Snake River Sockeye Salmon ESU

BPA Project 2007-402-00 (Snake River Sockeye Salmon Captive Broodstock) is intended to utilize captive broodstock technology to conserve the population's unique genetics of the Snake River sockeye salmon ESU. The long-term goal is to reach interim abundance guidelines for delisting and provide for sport and tribal harvest.

Lower Columbia River Chum Salmon ESU

BPA Project 2008-710-00 (Development of an Integrated strategy for Chum Salmon Restoration in the tributaries below Bonneville Dam) goals include: (1) reintroduction of chum salmon (that are part of the lower Columbia River chum salmon ESU) into Duncan Creek by providing off-channel high-quality spawning and incubation areas; and (2) simultaneously evaluation of natural recolonization, direct adult supplementation, and hatchery fed-fry supplementation.

Basin-wide

Efforts to facilitate the formation of a regional workgroup (currently designated the Columbia River Hatchery Effects Evaluation Team (CRHEET)) to coordinate monitoring of regional hatchery effectiveness, as well as implementation of the recommendations made by the Ad Hoc Supplementation Work Group are on hold while NOAA Fisheries completes the ESA consultations on FCRPS mitigation hatcheries (see AMIP Amendment 6 of this document).

2. *Determine the effect that implemented hatchery reform actions have on the recovery of targeted salmon and steelhead populations.*

Upper Columbia River Steelhead DPS

BPA Project 1993-056-00 (Advance Hatchery Reform Research) is currently focused on assessing whether steelhead raised at the Winthrop National Fish Hatchery (Upper Columbia steelhead DPS) over a two-year period perform better (survival and reproductive success) than steelhead raised in a typical one-year period. In addition, laboratory studies are determining the physiological and behavioral mechanisms that affect body size, smolt development, age-at-maturity, and rates of residualism, migration, and survival for the various groups of fish.

Snake River Spring Summer Chinook ESU and Steelhead DPS

BPA Project 2010-042-00 (Tucannon Expanded PIT Tagging) and 2010-050-00 (Evaluation of the Tucannon Endemic Program), addressed this RPA subaction regarding steelhead and Chinook populations in the Tucannon River (Snake River spring summer Chinook ESU and steelhead DPS). See additional information under RPA 63.1 above.

RPA Action 64 – Investigate Hatchery Critical Uncertainties

The Action Agencies will continue to fund selected research directed at resolving artificial propagation critical uncertainties:

1. *Continue to estimate the relative reproductive success of hatchery-origin salmon and steelhead compared to reproductive success of their natural-origin counterparts for ESA-listed spring/summer Chinook population in the Upper Grande Ronde, Lostine River, and Catherine Creek; listed spring Chinook in the Wenatchee River; and listed steelhead in the Hood River. Continue to fund the ongoing relative reproductive success feasibility study for Snake River fall Chinook to completion in 2009.*

Snake River Spring/Summer Chinook ESU and Steelhead DPS

BPA Project 1989-096-00 (Genetic Monitoring and Evaluation Program for Salmon and Steelhead) collected information on adult returns, age class, and genetic pedigree analysis that enabled the researchers to estimate reproductive success in hatchery- and natural-origin steelhead in Little Sheep Creek and spring/summer Chinook salmon in the Lostine River and Catherine Creek.

BPA Project 2007-083-00 (Grande Ronde Supplementation Monitoring and Evaluation on Catherine Creek/Upper Grande Ronde River) continued to monitor and evaluate supplementation of endemic spring Chinook salmon in Catherine Creek and the upper Grande Ronde River, which are part of the Snake River spring/summer Chinook ESU. This study continues to collect important information on abundance, productivity, and life history attributes of Snake River Chinook ESU and steelhead DPS.

Upper Columbia Spring Chinook ESU

BPA Project 2003-039-00 (Monitoring and Evaluation Reproductive Success and Survival in Wenatchee River) continued to quantitatively evaluate the Relative Reproductive Success (RRS) of naturally spawning hatchery- and natural-origin spring Chinook salmon in the Wenatchee River (upper Columbia River spring Chinook ESU). Research is currently focused on the mechanisms that may be causing the reduced RRS of hatchery-origin fish compared to natural-origin fish.

Lower Columbia River Steelhead DPS

BPA Project 2003-054-00 (Evaluate the Relative Reproductive Success of Hatchery-Origin and Wild-Origin Steelhead Spawning Naturally in the Hood River) evaluated the RRS of hatchery- versus natural-origin steelhead in the Hood River (lower Columbia River steelhead DPS). Information collected primarily consisted of genetic sampling of returning adults passing Powerdale Dam (now removed). In 2014, three peer-reviewed articles were published based on the results of this research.

2. *Determine if properly designed intervention programs using artificial production make a net positive contribution to recovery of listed populations.*

Snake River Fall Chinook ESU

BPA Project 1990-005-00 (Umatilla Hatchery Monitoring and Evaluation) concerns fall Chinook salmon (Snake River fall Chinook ESU; this project also tracks Mid-Columbia spring/summer Chinook salmon and Mid-Columbia steelhead). The primary goal of this project is to monitor and evaluate different rearing and release scenarios by documenting travel time and survival from release to Three Mile Dam (Umatilla River Basin) and Columbia River dams. In addition, straying of adult returns outside the Umatilla Basin is also documented.

Snake River Spring/Summer Chinook ESU and Steelhead DPS

BPA Project 2010-031-00 (Snake River Chinook and Steelhead Parental Based Tagging) continued to develop and evaluate a new genetic technology called Parental Based Tagging (PBT), that can serve as a versatile tool for mass marking of steelhead and Chinook salmon in the Snake River Basin (Snake River spring/summer Chinook ESU and steelhead DPS). It is anticipated that this tool will have the

capability to address aspects of hatchery evaluation and reform, salmonid life history, harvest patterns, and trait heritability.

BPA Project 1997-030-00 (Chinook Salmon Adult Abundance Monitoring) continued to monitor escapement of natural-origin spring/summer Chinook salmon (Snake River spring/summer Chinook ESU) in the Secesh River and steelhead (Snake River DPS) in Joseph Creek. Escapement in the Secesh River is estimated using dual frequency identification sonar (DIDSON) technology. Validation monitoring of DIDSON target counts with underwater optical cameras occurs for the purpose of species identification. The project is also collecting escapement, origin, age structure, sex composition, and population life history information on Joseph Creek steelhead by capturing adult steelhead by use of a floating weir.

BPA Project 1997-015-01 (Imnaha River Smolt Monitoring) continued to monitor spring Chinook salmon and steelhead (Snake River spring/summer Chinook ESU and steelhead DPS) emigrating from the Imnaha River and report the real-time information to the FPC.

BPA Project 2010-032-00 (Imnaha River Steelhead Adult Monitoring Project) continued to provide status information on Snake River steelhead in the Imnaha River Subbasin by collecting information to inform the VSP parameters. In addition to population viability monitoring, a sub-goal is to ensure that the information can be used to inform the co-managers on potential fisheries.

Mid-Columbia Steelhead DPS

BPA Project 2000-039-00 (Walla Walla River Basin Monitoring and Evaluation) continued to provide information on the reintroduction of spring Chinook salmon (non-listed hatchery stock) through a hatchery program and natural-origin steelhead (Mid-Columbia DPS) by assessing population status.

BPA Project 2007-299-00 (Investigation of Relative Reproductive Success of Stray Hatchery & Wild Steelhead & Influence of Hatchery Strays on Natural Productivity in Deschutes) continued to assess the effects that naturally spawning hatchery steelhead have on the viability of their wild steelhead counterparts in the Deschutes River Basin (mid-Columbia steelhead DPS).

BPA Project 1990-005-00 (Umatilla Hatchery Monitoring and Evaluation concerns steelhead (mid-Columbia steelhead DPS) continued to monitor and assess juvenile migration timing and survival of hatchery smolts to Three Mile Falls Dam and Columbia River dams.

Lower Columbia River Chinook ESU and Steelhead DPS

BPA Project 1988-053-04 (Hood River Pelton Ladder Evaluation Studies) continued to collect information related to the Hood River Production Program. This project collects information to estimate juvenile production with screw traps; harvest (all species); natural production of steelhead; natural production of cutthroat; natural production of bull trout; migration timing and other life history traits for adult summer and winter steelhead (lower Columbia River steelhead DPS), jack and adult spring and fall Chinook salmon, and coho. For hatchery production, broodstock information collected includes the number of juveniles released and post-release survival.

BPA Project 1988-053-15 (Parkdale NOAA Fisheries Comparative Hatchery Study) continued to implement one of the Hood River Production Program's objectives to "provide co-managers with the best available information for determining a long-term biologically sound and cost-effective spring Chinook salmon (lower Columbia River Chinook ESU) production strategy for the Hood River Basin that balances harvest needs with ecological considerations." The objective of this evaluation is to conduct a multi-year (2008–2018) comparative study of Hood River spring Chinook reared at three different hatchery facilities prior to being moved to the West Fork Hood River for final acclimation and release.

BPA Project 2003-063-00 (Natural Reproductive Success and Demographic Effects of Hatchery-Origin Steelhead in Abernathy Creek, Washington) continued to assess natural reproductive success and mean relative fitness of hatchery-origin and natural-origin steelhead (lower Columbia River steelhead DPS) in Abernathy Creek, Washington, and to assess the overall demographic effects of hatchery fish.

Mid-Columbia Spring Chinook ESU (Non-listed)

BPA Project 1990-005-00 (Umatilla Hatchery Monitoring and Evaluation) concerns spring Chinook salmon (non-listed hatchery stock) continued to monitor and assess juvenile migration timing and survival of hatchery smolts to Three Mile Falls Dam and Columbia River dams.

BPA Project 1995-063-25 (Yakima River Monitoring and Evaluation-YKFP) focuses on Yakima River spring Chinook salmon (mid-Columbia spring Chinook salmon ESU) which are not listed under the ESA. The goal of the project is to monitor, evaluate, and conduct research related to the YKFP. The project includes research occurring over many facets of artificial supplementation. The project has targeted research regarding relative reproductive success, ecological interactions between non-target taxa of concern and hatchery-origin salmon, effects of domestication on predation and competitive dominance, reproductive ecology, and effects of predation on natural production.

BPA Project 2008-458-00 (Upper-Columbia River Steelhead Kelt Reconditioning Project) is a kelt reconditioning project within the UCR (Upper Columbia River steelhead DPS) to test whether the abundance of naturally-produced UCR steelhead on natural spawning grounds can be increased through the use of long-term kelt reconditioning methods. Kelts have been collected for the project through live-spawning of NOR steelhead broodstock, the application of temporary tributary traps, and collection at Rock Island Dam. Long-term recondition methods consisting of feeding and treatment regiments were applied for approximately 6 months. Kelts were returned to their rivers of origin (or near their respective capture sites) following reconditioning. Ongoing monitoring and evaluation efforts have focused on comparing movement and survival between reconditioned kelts and maiden spawners and evaluating reproductive success of reconditioned kelts.

Multiple DPS of Steelhead

BPA Project 2007-401-00 (Kelt reconditioning and reproductive success evaluation research) provides research, monitoring, and evaluation (RME) of kelt reconditioning and ultimately reproductive success. Fish used as part of this project originate from Yakima River Basin (mid-Columbia River steelhead DPS) and the Snake River Basin (Snake River steelhead DPS). The objectives are to evaluate methodologies to

produce viable artificially reconditioned repeat steelhead spawners and to determine the productivity of repeat spawners.

Multiple ESUs of Chinook

BPA Project 2002-031-00 (Growth modulation in salmon supplementation) continued to compare the physiology and development of naturally rearing wild and hatchery-reared salmon in the mid-Columbia and Snake River basins. This project has focused on quantifying minijack rates prior to release in hatchery programs throughout the Columbia basin and, through laboratory and hatchery scale experimentation, developed hatchery reform protocols to control unnaturally high rates of minijack production.

3. *In collaboration with the other entities responsible for steelhead mitigation in the Methow River, BPA will fund a new relative reproductive success study for ESA-listed steelhead in the Methow River. BPA will also fund a new relative reproductive success study for listed fall Chinook in the Snake River. NOAA Fisheries will provide technical assistance to the Action Agencies in development of conceptual study designs suitable for use by the Action Agencies in obtaining a contractor to implement the new studies.*

For this subaction, projects are being funded to support RME for the specific populations described within the subaction.

Information needed to support this RPA subaction includes uncertainty research, including metrics such as abundance, origin, genotype, and age structure.

In the following section, a summary of the projects that are covering this RPA subaction is discussed.

Snake River Fall Chinook ESU

BPA Project 2003-060-00 (Evaluate the Relative Reproductive Success of Wild and Hatchery Origin Snake River Fall Chinook Spawners Upstream of Lower Granite Dam) continued to address components of this RPA subaction. After it was determined in 2011 that BPA Project 2003-060-00 (Evaluate the Relative Reproductive Success of Wild and Hatchery Origin Snake River Fall Chinook Spawners Upstream of Lower Granite Dam) would be infeasible to implement at this time, a letter dated February 2, 2012, was sent to BPA from NOAA Fisheries concerning monitoring needs associated with satisfying RPA Actions 64 and 65 as they relate to Snake River fall Chinook salmon. The monitoring actions associated with the letter are consistent with the two HGMPs that cover Snake River fall Chinook salmon, from the WDFW and the NPT. The letter from NOAA Fisheries identifies alternative actions that will satisfy the states that the intent of RPA Actions 64 and 65 with regards to Snake River fall Chinook. Research questions addressed in this project include investigation of release site fidelity and fall back at Lower Granite Dam.

Upper Columbia Steelhead DPS

BPA Project 2010-033-00 (Study Reproductive Success of Hatchery and Natural Origin Steelhead in the Methow) continued to monitor and evaluate reproductive success of Methow River steelhead (upper Columbia River steelhead DPS) and a suite of demographic characteristics. Differences in the run-timing, spawn-timing, age-composition, length-at-age, sex-ratio, and spawning distribution are measured

between hatchery- and natural-origin fish that may explain differences in relative reproductive success if it occurs.

RPA Action 65 – Investigate Hatchery Critical Uncertainties

The Action Agencies will fund research directed at resolving critical uncertainties:

1. *In the mainstem Snake River above the Lower Granite Dam, estimate the effectiveness/fitness in nature of hatchery-origin fall Chinook salmon from federally funded Snake River hatchery programs relative to natural origin Snake River fall Chinook.*

   Snake River Fall Chinook ESU

   BPA Project 1991-029-00 (RME of emerging issues and measures to recover the Snake River fall Chinook salmon ESU) continued to collect data that is intended to inform the management and recovery of fall Chinook salmon (Snake River fall Chinook ESU). Research includes monitoring of redd counts, spawning site use, parr growth and survival, post-release performance of hatchery-origin fish through the Snake and Columbia rivers, comparison of different hatchery release strategies, and growth and food habits of Snake River fall Chinook salmon.

   BPA Project 2012-013-00 (Snake River Fall Chinook Monitoring and Evaluation) expands monitoring of Snake River fall Chinook (Snake River fall Chinook salmon ESU) adult distribution by tracking the fidelity of returning adult hatchery-origin fish to release sites. This information will inform estimates of pHOS (the percentage of fish on the spawning grounds that are of hatchery origin) for specific spawning aggregates within the entire Snake River Basin. In addition, information on the fallback rate of adults to areas downstream of Lower Granite Dam will help refine estimates of adult escapement upstream of Lower Granite Dam.

2. *Estimate fall Chinook hatchery program effects on the productivity of the fall Chinook salmon ESU.*

   BPA Project 1991-029-00 (RME of emerging issues and measures to recover the Snake River fall Chinook salmon ESU) conducted RME associated with management and recovery of fall Chinook salmon (Snake River fall Chinook ESU). Research that addresses this RPA focuses on (1) numeric and habitat use responses by natural- and hatchery-origin spawners, (2) phenotypic and numeric responses by natural-origin juveniles, and (3) predator responses in the Snake River upper and lower reaches as abundance of adult and juvenile fall Chinook salmon increased in the last 10 years.

   BPA Project 1983-350-03 (Nez Perce Tribal Hatchery Monitoring and Evaluation) includes the monitoring and evaluation of hatchery and natural fish. This project is involved in PIT tagging, weir operation and spawning ground surveys, and screw trap monitoring among other monitoring and evaluation activities.

   BPA Project 1998-010-04 (Monitor and Evaluate Performance of Juvenile Snake River Fall Chinook Salmon from Fall Chinook Acclimation Project) evaluated the success of fall Chinook supplementation above Lower Granite Dam and informs management decisions for the future conservation and perpetuation of naturally spawning populations of fall Chinook salmon in the Snake and Clearwater Rivers above Lower Granite Dam.

BPA Project 2012-013-00 (Snake River Fall Chinook Monitoring and Evaluation) expands monitoring of Snake River fall Chinook (Snake River fall Chinook salmon ESU) adult distribution by tracking the fidelity of returning adult hatchery-origin fish to release sites. This information will inform estimates of pHOS for specific spawning aggregates within the entire Snake River Basin. In addition, information on the fallback rate of adults to areas downstream of Lower Granite Dam will help refine estimates of adult escapement upstream of Lower Granite Dam.

3. *NOAA Fisheries will provide technical assistance to the Action Agencies in development of conceptual study designs suitable for use by the Action Agencies in obtaining a contractor to implement new studies.*

   NOAA Fisheries and other regional technical experts provided technical assistance to BPA in 2010 to support development of targeted solicitations for the new Snake River fall Chinook salmon relative reproductive success study and any additional study or studies needed to estimate the effects of the fall Chinook hatchery programs on productivity of the ESU. In addition, there has been associated monitoring and evaluation under development in order to meet and satisfy research needs identified in the HGMP. The Action Agencies and NOAA Fisheries have agreed that there are necessary prerequisite studies which need to be conducted prior to the implementation of a relative reproductive success study or other studies of hatchery effects in Snake River fall Chinook.

RPA Action 66 – Monitor and Evaluate the Caspian Tern Population in the Columbia River Estuary

The Action Agencies will monitor the tern population in the estuary and its impacts on outmigrating juvenile salmonids, as well as the effectiveness of the Caspian tern management plan.

One BPA project was continued to fully address this RPA subaction. BPA Project 1997-024-00 (Avian Predation on Juvenile Salmonids) provided for the monitoring of the Caspian tern colony on East Sand Island. Colony size, reproduction rates, diet composition, and predation rates were monitored to determine the effect of the colony on juvenile salmon.

Corps study AVS-P-08-02 continued to monitor the effectiveness of Caspian tern habitat creation / enhancement at six alternate sites in interior Oregon and Northern California in 2014. In addition, stock-specific predation by Caspian terns on East Sand Island was investigated in 2014.

RPA Action 67 – Monitor and Evaluate the Double-Crested Cormorant Population in the Columbia River Estuary

The Action Agencies will monitor the cormorant population in the estuary and its impacts on outmigrating juvenile salmonids and develop and implement a management plan to decrease predation rates, if warranted.

In 2014 the double-crested cormorant colony size on East Sand Island was monitored via aerial surveys of the island.

RPA Action 68 – Monitor and Evaluate Inland Avian Predators

The Action Agencies will monitor avian predator populations in the Mid-Columbia River and evaluate their impacts on outmigrating juvenile salmonids and develop and implement a management plan to decrease predations rates, if warranted.

The final Inland Avian Predation Management Plan developed by the Corps and Reclamation, was completed and released in January 2014 with primary 2014 actions focused on the Caspian tern colony at Goose Island (Potholes Reservoir). Monitoring and evaluation of avian predation on the Columbia Plateau by the Corps and Reclamation focused on select Caspian tern colonies in 2014 to evaluate effects associated with implementing the Inland Avian Predation Management Plan (IAPMP). A report discussing 2014 IAPMP implementation results was finalized in June 2015 (Roby et al. 2015b).

RPA Action 69 – Monitoring Related to Marine Mammal Predation

1. *Estimate overall sea lion abundance immediately below Bonneville Dam. (Initiate in FY 2007–2010 Projects).*

   From January 9 to May 31, 2014, the Corps continued to visually monitor the abundance of California and Steller sea lions in the Bonneville Dam tailrace observation area. In addition, BPA Project No. 2008-004-00 (Sea Lion Nonlethal Hazing and Monitoring) estimated general sea lion abundance while conducting in-river hazing on sea lions. See the discussion in Section 1 of this report for more detail.

2. *Monitor the spatial and temporal distribution of sea lion predation attempts and estimate predation rates. (Initiate in FY 2007-2010 Projects).*

   In 2014, the Corps continued land-based visual observations to monitor sea lion predation on adult salmonids, white sturgeon, and lamprey in the Bonneville Dam tailrace observation area. The Corps also monitored the date and location of individual sea lion predation events. BPA Project No. 2008-004-00 (Sea Lion Nonlethal Hazing and Monitoring) observed the total number of sea lion predation events and recorded their location and time. See the discussion in Section 1 of this report for more detail.

3. *Monitor the effectiveness of deterrent actions (e.g., exclusion gates, acoustics, harassment and other measures) and their timing of application on spring runs of anadromous fish passing Bonneville Dam. (Initiate in FY 2007-2010 Projects).*

   The effectiveness of deterrent actions and the timing of application on spring runs were determined in 2014 through BPA- and Corps-funded efforts.

RPA Action 70 – Monitoring Related to Piscivorous (Fish) Predation

The Action Agencies will:

1. *Continue to update and estimate the cumulative benefits of sustained removals of northern pikeminnow since 1990.*

BPA Project 1990-077-00 (Development of System-wide Predator Control (PSMFC)) continued the Northern Pikeminnow Management Program which is a basin-wide program to harvest northern pikeminnow that was started in 1991 to reduce predation by northern pikeminnow on juvenile salmonids during their emigration to the ocean. The project conducts annual research to evaluate the exploitation rate of northern pikeminnow and the cumulative benefits of sustained removal. In 2014, system-wide exploitation of northern pikeminnow greater than or equal to 200 mm FL during the Sport Reward Fishery was 9.0% (95% confidence interval 5.0–13.0%

2. *Continue to evaluate if inter- and intra-compensation is occurring.*

   BPA Project 1990-077-00 (Development of System-wide Predator Control (PSMFC)) encompasses the Northern Pikeminnow Management Program which is a basin-wide program to harvest northern pikeminnow that was started in 1991 to reduce predation by northern pikeminnow on juvenile salmonids during their emigration to the ocean. Under the PSMFC program, annual monitoring is conducted to test for the possibility of a compensatory response by northern pikeminnow and other piscivorous fish due to the pikeminnow removal program.

3. *Evaluate the benefit of additional removals and resultant increase in exploitation rate's effect on reduction in predator mortality since the 2004 program incentive increase.*

   BPA Project 1990-077-00 (Development of System-wide Predator Control (PSMFC)) The Northern Pikeminnow Management Program conducts annual research to evaluate the exploitation rate of northern pikeminnow and the cumulative benefits of sustained removal, including the 2015 program incentive increase.

4. *Develop a study plan to review, evaluate, and develop strategies to reduce non-indigenous piscivorous predation.*

   BPA Project 2008-719-00 (Research Non-Indigenous Actions (USGS)) documented the food habits of non-native predators in the lower Columbia River during the late summer and fall to assess the role of juvenile American shad in their diets and any impacts on their health and condition, and assessed the potential efficacy of localized reductions of smallmouth bass for predation control. Results of the study have been published and researchers determined that for walleye and smallmouth bass, consumption of juvenile shad did not improve their condition or overwintering survival.

RPA Action 71 – Coordination

The Action Agencies will coordinate RM&E activities with other Federal, State and Tribal agencies on an ongoing annual basis, including:

1. *Organizing and supporting the Corps AFEP.*

   The Corps has, since 1952, sponsored biological studies in an integrated, applied research program. These RME studies are managed under the AFEP. In 2014, the Corps again implemented the AFEP program. The primary activity was the development and selection of experimental designs and methodologies of research projects to be carried out in 2015. This process was extensively coordinated with other federal agencies, states, and tribal interests through their involvement in the Studies Review Work Group, which met several times throughout the planning year.

In December 2014, an annual review, open to all interested parties, was held to present the results of AFEP funded research conducted during the year.

The AFEP program also includes the FFDRWG, which provides ongoing review of fish facility design activities. The FPOM Workgroup is outside of AFEP and provides ongoing review of operational activities related to fish passage. All federal, state, and tribal fishery agencies are invited to participate in the quarterly FFDRWG meetings and monthly FPOM meetings.

2. *Supporting and participating in the Council's Columbia River Basin Fish and Wildlife Program project planning and review efforts.*

BPA continued to work with the NPCC in coordinating BPA's Fish and Wildlife Program and the FCRPS BiOp to achieve an integrated program. Achievements beyond the annual review of projects and budgets included the review and update of the Fish and Wildlife Program, the collaborative Fish Tagging Forum, and the Geographic Review of habitat work (see http://www.nwcouncil.org/fw/reviews/ for more detailed information on review efforts).

3. *Supporting the standardization and coordination of tagging and monitoring efforts through participation and leadership in regional coordination forums such as PNAMP.*

Under BPA Project 2004-002-00 (Pacific Northwest Aquatic Monitoring Program), and Reclamation Project 4930 and Reclamation Interagency Agreement with USGS (IA R13-PG-10-428), continued funding for PNAMP was provided for facilitation, technical support and a collaborative forum for the standardization and coordination of fish and habitat monitoring. PNAMP continued promoting integration of monitoring resources and building several tools to support monitoring in 2014. Their 2014 report highlighted efforts to manage a monitoring protocol and method library (with 833 protocols and 1,535 methods in the system at the end of 2013);

4. *Working with regional monitoring agencies to develop, cooperatively fund, and implement standard metrics, business practices, and information collection and reporting tools needed to cooperatively track and report on the status of regional fish improvement and fish monitoring projects.*

BPA Projects 1988-108-04 (StreamNet – Coordinated Information System/Northwest Environmental Database (NED) managed by PNAMP staff at the USGS continued to support the implementation of the Coordinated Assessments Projects through PNAMP, CBFWA, and StreamNet to develop standard data exchange templates across the Northwest for the indicators of adult spawner abundance and juvenile salmonid out-migrant production. In 2014, an initial pilot effort was completed and Data Exchange Standards (DES) were developed for priority fish population indicators. Additional progress on advancing data exchange for hatchery indicators was initiated in 2014.

BPA Project 2004-002-00 (Pacific Northwest Aquatic Monitoring Program Coordination) and Reclamation Interagency Agreement with USGS (IA R13-PG-10-428) continued the PNAMP's Coordinated Assessments Project, in collaboration with CBFWA and StreamNet to develop integrated data-sharing for anadromous-fish-related data among the co-managers (state fish and wildlife agencies and tribes) and Action Agencies of the Columbia River Basin.

BPA Project 2007-083-00 (Grande Ronde Supplementation Monitoring and Evaluation on Catherine Creek/upper Grande Ronde River) supported CTUIR participation in the Coordinated Assessments workshops.

BPA Project 2003-017-00 (ISEMP) supported development of the data dictionaries in www.monitoringmethods.org related to habitat classifications. The ISEMP project also played a critical role in supporting the PNAMP ISTM project in development of the Master Sample which is now being managed under the www.monitoringresources.org Sample Designer tool.

BPA Project 2003-022-00 (Okanogan Basin Monitoring & Evaluation Program - OBMEP) continued BPA's participation in the PNAMP steering committee and supported development of the data dictionaries in monitoringmethods.org related to habitat classifications and attended the Coordinated Assessments workshops resulting in the development of their data management strategy to exchange fish abundance data.

BPA Project 2008-507-00 (CRITFC's Tribal Data Network Accord Project) was implemented to demonstrate implementation of coordination and standardization tools through evaluation and application of handheld technologies for data capture (e.g., the Digital Pen). In the first phase of the data inventory, CRITFC and all four member tribes have identified repositories for some of their monitoring data and submitted this information to Monitoringmethods.org.

BPA Project 2011-006-00 (Columbia Habitat and Monitoring Program - Pilot (CHaMP-P)) developed and implemented a standardized habitat monitoring program for habitat status and trend to support habitat and fish relationship development used in limiting factor assessments and for planning and evaluation of habitat actions. In 2014, a pilot effort was implemented to assess the use of an online "cloud" service to process model outputs with significant computation requirements.

5. *Coordinating the further development and implementation of Hydrosystem, Tributary Habitat, Estuary/Ocean, Harvest, Hatchery, and Predation RM&E through leadership and participation in ongoing collaboration and review processes and workgroups.*

BPA Project 2003-017-00 (Integrated Status and Effectiveness Monitoring Program (ISEMP) provided extensive coordination of the development and implementation of tributary habitat RME in the pilot watersheds.

BPA Project 2004-002-00 (The Pacific Northwest Aquatic Monitoring Program Coordination Project) supported regional coordination and standardization of fish population and habitat monitoring programs in 2014.

6. *Coordinating implementation with other appropriate regional collaboration processes. This includes coordination related to statutory provisions for the Federal government (BPA/Council), voluntary coordination among Federal agencies (Federal Caucus), and coordination with regional processes for Federal/non-Federal engagement (Technical Management Team (TMT), System Configuration Team (SCT), PNAMP, Northwest Environmental Data- Network (NED), and others.*

The Action Agencies actively participated in regional forums and accomplished this subaction through subactions 71.1-71.5 above. Coordination related to statutory provisions for the federal government (BPA/NPCC), federal agencies (Federal

Caucus), and coordination with regional processes for federal/non-federal engagement (TMT, SCT, PNAMP) continued to support the FCRPS BiOp.

AMIP Category III required a coordinated monitoring strategy to be completed at the end of 2009. The Anadromous Salmonid Monitoring Strategy (ASMS) was completed in 2009 and outlined distinctions in monitoring requirements for the FCRPS BiOp and other regulatory needs to support ESA recovery monitoring needs. This work continued to support planning and implementation of monitoring in 2014.

RPA Action 72 – Data Management

The Action Agencies will ensure that the information obtained under the auspices of the FCRPS RM&E Program is archived in appropriate data management systems.

1. *Continue to work with regional Federal, State and Tribal agencies to establish a coordinated and standardized information system network to support the RM&E program and related performance assessments. The coordination of this development will occur primarily through leadership, participation, and joint funding support in regional coordination forums such as the NED workgroup, and PNAMP and the ongoing RM&E pilot studies in the Wenatchee River, John Day River, Upper Salmon River, and Columbia River Estuary. (Initiate in FY 2007- 2009 Projects).*

   BPA Project 1988-108-04 (StreamNet – Coordinated Information System/Northwest Environmental Database) managed by StreamNet Staff at the PSMFC. The USGS continued to support the implementation of the Coordinated Assessments Projects by PNAMP, CBFWA, and StreamNet to develop standard data exchange templates across the Northwest for the indicators of adult spawner abundance and juvenile salmonid out-migrant production. In 2014, an initial pilot effort was completed and Data Exchange Standards (DES) were developed for priority fish population indicators. Additional progress on advancing data exchange for hatchery indicators was initiated in 2014.

   BPA Project 1990-080-00 (Columbia Basin PIT Tag Information) manages the PTAGIS data system which is operated and maintained at http://www.ptagis.org/ptagis. PTAGIS continued to further develop exchange format to ensure PIT tag data is consumable other data systems and integrated into other tag management systems, like the Fishgen.net data system for genetics management. PIT tags are primarily used for hydro system and tributary survival assessments, as well as tributary assessments of population adult return abundance and diversity to help assess viable salmon population attributes of spawner abundance, adult productivity, spatial distribution, and diversity. In 2014, data loading processes, validation, and notifications were significantly enhanced, two new adult detection sites were installed at Little Goose and Lower Monumental dams, coordinated and planned a 2015 PIT Tag Workshop.

   BPA Project 1996-019-00 (Data Access in Real Time (DART)) supported ISEMP and PTAGIS in development of software to rapidly assess PIT tag array detections for population adult escapement which could be supported across the basin.

   BPA Project 2003-007-00 (Lower Columbia River Estuary Ecosystem Monitoring Program) supported development of data exchange templates and standard data entry forms to exchange estuary monitoring data with the Corps' Oncor database being developed by the Corps. In addition, the Lower Columbia River Estuary

Partnership (LCREP) further developed its website in 2014 to display the Columbia River estuary habitat classification and Catena GIS data at http://maps.lcrep.org.

BPA Project 2003-017-00 (Integrated Status and Effectiveness Monitoring Program) integrated data management efforts with project 2011-006-00 and 1988-108-04 to replace the STEM data system.

BPA Project 2003-022-00 (Okanogan Basin Monitoring & Evaluation Program) continued to develop a needs assessment to upgrade the database software, but to create a comprehensive data management system that includes tools for data storage, data collection, quality assurance/quality control (QA/QC) of the data, and analysis and reporting.

BPA Project 2004-002-00 (Pacific Northwest Aquatic Monitoring Program Coordination) continued the mission of NED in PNAMP through regional coordination of the Data Management Leadership team (DMLT). PNAMP further developed the Monitoring Resources tools to facilitate standards in protocol and location documentation at www.monitoringresources.org. Reclamation's Interagency Agreement with USGS (1A R13-PG-10-428) also provided funding for PNAMP to support Monitoring Resources Tool Development. The 2014 PNAMP report highlighted efforts to manage a monitoring protocol and method library (with 833 protocols and 1,535 methods in the system at the end of 2013).

BPA Project 2008-507-00 (Tribal Data Network) explored use of digital pens to support improved data transfer and QA/QC to biologist to improve data exchange processes, in addition to providing parallel by project 1998-031-00. In the first phase of the data inventory, CRITFC and all four member tribes have identified repositories for some of their monitoring data and submitted this information to Monitoringmethods.org.

BPA Project 2011-006-00 (Columbia Habitat and Monitoring Program), through CHaMP, led the way in protocol documentation in the www.monitoringmethods.org tool to demonstrate the level of information required to support metadata development with creation of standard data entry forms for rapid exchange of data from the field to the data systems. In 2014 CHaMP improved standardization of its salmonid habitat monitoring protocol and advanced development of powerful and innovative approaches to analyzing CHaMP metrics and topographic survey data. These include Geomorphic Change Detection (GCD) software, the River Bathymetry Toolkit (RBT), extrapolation frameworks, and integration with other programs (i.e., U.S. Forest Service PACFISH/INFISH Biological Opinion (PIBO), and BPA's Action Effectiveness Monitoring (AEM) program).

AFEP Project EST-P-12-01 (Synthesis and Evaluation of Research, Monitoring, and Restoration Project Data in the Lower Columbia River and Estuary) in 2014 further developed RME project database ("Oncor") in coordination with regional managers, including the Estuary Partnership Science Work Group which is represented by state and federal agencies, tribal nations and non-governmental organizations managing habitat restoration in the lower Columbia River estuary. Product development included data exchange templates, data reduction protocols and field, data collection protocols.

2. *Contribute funding for data system components that support the information management needs of individual Hydrosystem, Tributary Habitat, Estuary/Ocean, Harvest, Hatchery, and Predation RM&E. (Initiate in FY 2007-2009 Projects).*

AFEP Project EST-P-12-01 (Synthesis and Evaluation of Research, Monitoring, and Restoration Project Data in the Lower Columbia River and Estuary) developed a web-based, geospatial data management and analysis system (called "Oncor") for research, monitoring and evaluation (RME) data. Development included (1) coordination with agencies and regional stakeholders to establish key analysis questions and database needs; (2) database construction; (3) analysis and synthesis of data (fish, vegetation, photo points, water surface elevation, water temperature, and sediment accretion); and (4) formulation of data reduction procedures and data exchange templates for nine monitoring indicators.

BPA Projects 1988-108-04 (StreamNet – Coordinated Information System/Northwest Environmental Database (NED) managed by StreamNet Staff at the PSMFC USGS continued to support the implementation of the Coordinated Assessments process by PNAMP, CBFWA, and StreamNet to develop standard data exchange templates across the Northwest for the indicators of adult spawner abundance and juvenile salmonid out-migrant production.

BPA Project 1990-080-00 (Columbia Basin PIT Tag Information) managed the PTAGIS data system which is operated and maintained at http://www.ptagis.org/ptagis. PTAGIS continued to further develop exchange format to ensure PIT tag data is consumable other data systems and integrated into other tag management systems, like the Fishgen.net data system for genetics management. PIT-tags are primarily used for hydro system and tributary survival assessments, as well as tributary assessments of population adult return abundance and diversity to help assess viable salmon population attributes of spawner abundance, adult productivity, spatial distribution, and diversity).

BPA Project 1996-019-00 (Data Access in Real Time (DART)) supported ISEMP and PTAGIS in development of software to rapidly assess PIT tag array detections for population adult escapement which could be supported across the basin. In-season real-time run predictions for juvenile and adult stocks with an annual review of run-timing predictions were completed for 2014.

BPA Project 1997-015-01 (Imnaha River Smolt Monitoring) provided the FPC's SMP with tributary specific emigration data from the Imnaha River. It continued a collection of a time series data set for Chinook salmon and steelhead smolt arrival and survival information to mainstem dams.

BPA Project 2003-017-00 (Integrated Status and Effectiveness Monitoring Program) integrated data management efforts with project 2011-006-00 and 1988-108-04 to replace the STEM data system.

BPA Project 2004-002-00 (Pacific Northwest Aquatic Monitoring Program Coordination) continued the mission of NED in PNAMP through regional coordination of the Data Management Leadership team (DMLT). PNAMP further developed the Monitoring Resources tools to facilitate standards in protocol and location documentation at www.monitoringresources.org. Reclamation's Interagency Agreement with USGS (1A R13-PG-10-428) also provided funding for PNAMP to support Monitoring Resources Tool Development. The 2014 PNAMP report highlighted

efforts to manage a monitoring protocol and method library (with 833 protocols and 1,535 methods in the system at the end of 2013).

BPA Project 2008-507-00 (Tribal Data Network) explored use of digital pens to support improved data transfer and QA/QC to biologist to improve data exchange processes, in addition to providing parallel support in BPA Project 1998-031-00. In the first phase of the data inventory, CRITFC and all four member tribes have identified repositories for some of their monitoring data and submitted this information to Monitoringmethods.org.

BPA Project 2011-006-00 (Columbia Habitat and Monitoring Program), through CHaMP, led the way in protocol documentation in the www.monitoringmethods.org tool to demonstrate the level of information required to support metadata development with creation of standard data entry forms for rapid exchange of data from the field to the data systems.

Reclamation Project R15-AC-00005 (Building an Integrated Data Harvester and Analysis Software for the Methow Basin) with the Washington State University and the Methow Salmon Recovery Fund (Cooperative Agreement R09-AC-10045) (Methow Data Management Support) both continued to create a pilot data management tool for the Methow IMW.

3. *Participate in Northwest regional coordination and collaboration efforts such as the current PNAMP and NED efforts to develop and implement a regional management strategy for water, fish and habitat data. (Initiate in FY 2007-2009 Projects).*

BPA Projects 1988-108-04 (StreamNet – Coordinated Information System/Northwest Environmental Database (NED) managed by PNAMP staff at the USGS continued to support the implementation of the Coordinated Assessments Projects through PNAMP, CBFWA, and StreamNet to develop standard data exchange templates across the Northwest for the indicators of adult spawner abundance and juvenile salmonid out-migrant production. In 2014, an initial pilot effort was completed and Data Exchange Standards (DES) were developed for priority fish population indicators. Additional progress on advancing data exchange for hatchery indicators was initiated in 2014.

BPA Project 2003-007-00 (Lower Columbia River Estuary Ecosystem Monitoring Program) supported development of data exchange templates and standard data entry forms during 2014 to exchange estuary monitoring data with the Oncor database being developed by the Corps. In addition, LCEP further developed its website to display the Columbia River estuary habitat classification and Catena GIS data at http://maps.lcrep.org/.

BPA Project 2004-002-00 (Pacific Northwest Aquatic Monitoring Program Coordination) continued the mission of NED in PNAMP through regional coordination of the Data Management Leadership team (DMLT). PNAMP further developed the Monitoring Resources tools to facilitate standards in protocol and location documentation at www.monitoringresources.org. Reclamation's Interagency Agreement with USGS (1A R13-PG-10-428) also provided funding for PNAMP to support Monitoring Resources Tool Development. The 2014 PNAMP report highlighted efforts to manage a monitoring protocol and method library (with 833 protocols and 1,535 methods in the system at the end of 2013).

BPA Project 2008-507-00 (Tribal Data Network) explored use of digital pens to support improved data transfer and QA/QC to biologist to improve data exchange processes, in addition to providing support in BPA Project 1992-031-00. In the first phase of the data inventory, CRITFC and all four member tribes have identified repositories for some of their monitoring data and submitted this information to Monitoringmethods.org.

BPA Project 2011-006-00 (Columbia Habitat and Monitoring Program) through CHaMP led the way in protocol documentation in the www.monitoringmethods.org tool to demonstrate the level of information required to support metadata development with creation of standard data entry forms for rapid exchange of data from the field to the data systems.

RPA Action 73 – Implementation and Compliance Monitoring

The Action Agencies will use the project-level detail contained in the Action Agencies' Biological Opinion databases to track results and assess our progress in meeting programmatic level performance targets. This performance tracking will be reported through annual progress reports and the comprehensive reports scheduled for 2013 and 2016.

1. *Annually monitor the successful implementation of projects through standard procedures and requirements of contract oversight and management, and review of project deliverables and final reports.*

   The implementation of all BPA projects is tracked in the Pisces database. Pisces data includes project status, implementation metrics, focal species, location, and budget.

2. *Maintain project and action level details for planning and reporting purposes. This approach will provide the most up-to-date information about the status of actions and projects being implemented.*

   To further support coordination and planning within the Action Agencies and beyond, of monitoring projects that support the FCRPS BiOp, BPA contracted PNAMP through Project 2008-727-00 which was consolidated into contract 2004-002-00 to develop a www.monitoringresources.org "Monitoring Explorer" tool.

3. *Maintain a comprehensive habitat project tracking system where relevant project information is contained in an accessible comprehensive data system. The data system will contain project level information that is needed for both implementation and effectiveness monitoring. The system will include the set of minimum metrics and metadata for RM&E data design listed in Data Management Needs for Regional Project Tracking to Support Implementation and Effectiveness Monitoring (Katz et al. 2006). (Initiate in FY 2008).*

   The Action Agencies have recorded project implementation and associated metric information for tributary habitat actions since implementation of tributary habitat actions became part of the FCRPS BiOp RPA in 2000. Examples of these data are presented in Section 3 for RPA Actions 35 and 37. These data for BPA and Reclamation currently are tracked in BPA's Pisces contracting database and reported in the Taurus database at www.cbfish.org for BPA-funded restoration actions. Actions for which Reclamation provides technical assistance are tracked in a separate Reclamation database.

BPA developed an automated report through the Taurus system to annually provide habitat restoration action information to the NOAA Fisheries Pacific Coast Salmon Recovery Fund system. The automated exchange of that information was completed in 2012 and occurs annually to fully comply with this RPA. The list of BPA metrics and relationships to the NOAA Fisheries system is available at http://www.cbfish.org/WorkElement.mvc/Landing.

Adaptive Management Implementation Plan (AMIP) Actions

In September 2009, the FCRPS 2008 BiOp was enhanced through an Adaptive Management Implementation Plan, which includes accelerated actions, additional research related to fish status and climate change, and precautionary use of biological triggers and contingency plans in case there is an unexpected, significant fish decline. The original AMIP actions and six new implementation actions that were amended to the AMIP were incorporated into the NOAA Fisheries 2010 Supplemental BiOp. The following table provides information on BiOp AMIP actions implemented by NOAA Fisheries and the Action Agencies as of 2014. Information on the status of continuing or ongoing actions follows the table.

Table 20. Status of AMIP actions for 2014.

AMIP Ref	Action Description	Status
AMIP Category: II Acceleration & Enhancement of RPA Mitigation Actions		
II. A	Estuary Habitat Improvement & Memorandum of Agreement on Columbia River Estuary Actions with State of Washington	See Section II. A following this table.
II. B	Reintroduction *The NWFSC is now initiating an evaluation of additional opportunities for reintroduction of listed fish in areas downstream of Chief Joseph Dam and the Hells Canyon Complex. The NWFSC will examine the potential benefits of additional reintroductions, considering locations where reintroduction will advance recovery and further lower the risk of extinction.* • *The NWFSC will evaluate the conditions under which reintroduction would be a robust strategy and describe the relative costs and benefits in this and other situations.* • *The NWFSC will evaluate the costs and benefits of the alternative reintroduction strategies and techniques.* *The NWFSC will complete a report outlining potential reintroduction projects in the Columbia Basin by December 2010. This report will guide both decisions regarding which Long-term Contingency Actions should be implemented if a trigger is tripped and actions taken to implement recovery plans. This report will be discussed with the federal agencies and the Regional Implementation Oversight Group (RIOG).*	This action is completed. NOAA Fisheries developed a manuscript on principles of reintroduction for anadromous salmonids in collaboration with the Federal, State and Tribal members of the Recovery Science Implementation Team. That document is available at http://www.salmonrecovery.gov/Files/2011%20APR%20files/New%20Folder%203/McClure_et_al_2011_Reintro_gnrl_prncpls_v5_final_review_draft_100411.pdf
II. C	Predator & Invasive Species Controls *The Action Agencies and NOAA Fisheries will move forward in the three highest priority areas to establish baseline information for future predator*	The action was completed on schedule in 2010.

AMIP Ref	Action Description	Status
	control activities: 1. *Shad: document the influence of juvenile shad on the growth and condition of introduced predators in the fall as they (the predators) prepare for overwintering* 2. *Catfish: document the distribution and predation rates of channel catfish* 3. *Smallmouth bass: document whether removals of smallmouth bass in areas of intense predation could reduce the mortality of juvenile salmonids* *For these three priority approaches and in order to accelerate implementation of the RPA, by November 2009 BPA will develop a research study design proposal, and will promptly request an expedited review of the proposal by the Independent Scientific Review Panel (ISRP) to accelerate field implementation. The Action Agencies will implement the research study during the next field season(s), anticipated by December 2010. Once this research supports a specific management strategy, the Action Agencies could implement site-specific removals of smallmouth bass and could exclude adult American shad from upper mainstem dams as early as the following migration season.*	
II. D	Spill	See Section II. D following this table.
AMIP Category: III Enhanced Research Monitoring & Evaluation		
	Collaborate with state and tribal co-managers to develop a shared Columbia Basin Monitoring Strategy. The goal of the collaboration is to develop an efficient salmon and steelhead monitoring framework and implementation strategy that will support viable salmonid populations and habitat and hatchery effectiveness monitoring needs, including those of the 2008 BiOp and RPA, recovery plans, regional fisheries management objectives, and other programs. This collaborative process will be completed in December, 2009.	A monitoring strategy was completed on schedule in 2009. The ISRP's review of the Anadromous Salmonid Monitoring Strategy (ASMS) was subsequently completed in February 2011 and is found at http://www.salmonrecovery.gov/Files/2011%20APR%20files/New%20Folder%203/ISRP_ISAB_2011-1.pdf.
III. A	Enhanced Life-Cycle Monitoring for Evaluation of Contingencies	See Section III. A following this table.
III. B	Adult Status & Trend Monitoring *By December 2011, NOAA Fisheries will improve existing adult status and trend monitoring to obtain adult natural spawner abundance and full life-cycle productivity estimates, with known statistical certainty and power, for additional ESA-listed populations. These improvements will better inform decisions regarding which Rapid Response Actions and Long-term Contingency Actions will be taken if a trigger is tripped, as well as ongoing viability assessments. Additionally, by December 2010, NOAA Fisheries will develop mechanisms for the timely and efficient reporting and dissemination of these data, in order to ensure they can provide for the early detection of regional or population specific changes in status.*	Mechanisms for data reporting and dissemination were completed on schedule in 2010. NOAA Fisheries' NWFSC created the Salmon Population Summary database, which is available online at https://www.webapps.nwfsc.noaa.gov/apex/f?p=238:home:0 to disseminate data to enable early detection of regional population specific changes in status.

AMIP Ref	Action Description	Status
III. C	Juvenile Status & Trend Monitoring	The strategy was completed on schedule in 2010. Consistent with ISRP comments, in 2011 BPA proceeded with partial implementation and evaluation for CHaMP and associated paired fish population monitoring.
III. D	Habitat Condition Status & Trend Monitoring	In 2011, BPA proceeded with partial implementation and evaluation of CHaMP consistent with ISRP comments
III. E	Intensively Monitored Watersheds *The Action Agencies are implementing IMWs under RPA Actions 56 and 57 for fish status monitoring and habitat effectiveness monitoring in the John Day, Wenatchee, Entiat, Methow, Lemhi, and South Fork Salmon basins. NOAA Fisheries funds five additional or complementary IMWs in interior subbasins in Idaho (Upper Potlatch River, Lemhi River); Oregon (Upper Middle Fork John Day River); and Washington (Yakima River, Asotin Creek).* *The Action Agencies' IMWs have been through independent science evaluation and review by the NPCC. Under the RPA provisions, enhancements to these efforts are already planned or underway.* *As part of an enhanced commitment to IMWs, by September, 2010, NOAA Fisheries and the Action Agencies will complete an analysis of existing IMWs to ensure:* 1. *Timely funding and implementation of intensive habitat actions to ensure, where practical, an adequate treatment effect* 2. *Sufficiently diverse representation of IMWs (geographically and with respect to limiting factors) and appropriate monitoring (e.g., temperature, flow) to detect climate change impacts* 3. *Results are applicable to future habitat planning and for the implementation of Rapid Response Actions* *This review will inform the prioritization of BPA placeholder funds budgeted for IMWs, as well as the allocation of new or re-focused NOAA Fisheries funds (e.g., distributed through the Pacific Coastal Salmon Recovery Fund). IMW updates will go through an independent science review process and review by the NPCC. Results will be coordinated with the RIOG and reported annually to the region.*	The action was completed on schedule in 2010 as documented in the Action Agencies/NOAA Fisheries/NPCC RME Workgroup "Recommendations for Implementing Research, Monitoring and Evaluation for the 2008 NOAA Fisheries FCRPS BiOp" (May 2010) consistent with the regional Anadromous Salmonid Monitoring Strategy. This documents is available at http://www.salmonrecovery.gov/Files/RME/RM&E%20Recommendations%20Report%20w%20revised%20Appendix.pdf.
III. F	Climate Change Monitoring & Evaluation	See Section III. F following this table.
AMIP Category: IV Contingency Plans in Case of Early Warning or Significant Fish Declines		
IV. A.1.	Early Warning Indicator for Chinook Salmon & Steelhead *The Action Agencies and NOAA Fisheries will develop, in coordination with the RIOG, at least one additional Early Warning Indicator by December, 2010, which may be revised pending additional analyses and discussion. Specifically, the additional Early Warning Indicator(s) would evaluate whether a species is likely to have substantially reduced abundance (and*	The action was completed in 2011. The NWFSC developed a forecasting tool that satisfies this requirement.

AMIP Ref	Action Description	Status
	productivity) in the future based on two years of adult return information, preliminary biological information, and environmental indicators or known environmental disasters. *These indicators may include, but are not limited to, low jack counts or numbers of juvenile outmigrants (biological), indicators of ocean conditions predicting very low abundance of adult returns for recent outmigrants (environmental indicators), or wide-spread forest fires, increased distribution and virulence of pathogens, new invasive species, prolonged severe droughts, etc. environmental disasters). Unlike the interim Early Warning Indicators, which evaluates information at the species level, the additional Early Warning Indicators may use information more representative of effects on major population groups (MPGs), important management units (e.g., A-run vs. B-Run Snake River steelhead, or key populations).* *Responses to impacts affecting a specific MPG or subset of populations would be tailored to the appropriate scale.*	
IV. A.2.	Significant Decline Trigger for Chinook Salmon & Steelhead *The Action Agencies and NOAA Fisheries, in coordination with the RIOG, will further improve the Significant Decline Trigger no later than December 2010 by incorporating a metric indicative of trend.*	The action was completed in 2010. The approach developed by NWFSC, NOAA and AA staff was adopted and memorialized in a letter from L. Bodi, BPA, to Barry Thom, NOAA on 12/23/10.
IV. A.3.	Contingency Plan Implementation for Snake River Sockeye Salmon	See Section IV. A. 3 following this table.
IV. B	Rapid Response Actions – Hydro, Predator Control, Harvest, Safety Net Hatchery Programs *Within 90 days of NOAA Fisheries determining that a significant decline trigger has been tripped, the Action Agencies, in coordination with NOAA Fisheries and the RIOG, will assess alternative Rapid Response Actions and determine which action(s) will be implemented. The Rapid Response Actions will be implemented as soon as practicable after a decision is made, and not later than 12 months after a Significant Decline Trigger is tripped. Most, if not all, Rapid Response Actions will be temporary in nature.* *By December 2011, the Action Agencies and NOAA Fisheries will develop a Rapid Response Plan, which will include a detailed description of these potential Rapid Response Actions together with implementation milestones.*	The Rapid Response Plan addressed all actions at left and was finalized on schedule in 2011. The Plan was subsequently modified to incorporate comments and was delivered to NOAA Fisheries on February 7, 2012. The plan is available at https://www.salmonrecovery.gov/Files/2011%20APR%20files/2011_RRandLTC_Plan.pdf
IV. C	Long-Term Contingency Action – Hydro, Reintroduction, Predator Control, Harvest, Conservation Hatcheries, Hatchery Reform, John Day Reservoir Operation at MOP, Breaching Lower Snake River Dams: Within four to six months of a Significant Decline trigger being tripped, the Action Agencies (in coordination with NOAA Fisheries, the RIOG and other regional parties) will conduct an All-H Diagnosis and life-cycle model analysis to determine if the Rapid Response	The Long-Term Contingency Plan that addresses actions 1 through 6 (left) (Phase II Hydro Actions, Reintroduction, Predator Control, Harvest, Conservation Hatcheries, Hatchery Reform) of this action was completed on schedule in 2011. The plan is available at https://www.salmonrecovery.gov/Files/2011APR files/2011_RRandLTC_Plan.pdf . The Corps submitted the final plan of study for

AMIP Ref	Action Description	Status
	Action(s) are likely to be sufficient or if Long-term Contingency Actions will need to be implemented, and if so, what Long-term Contingency Actions are appropriate for implementation. If necessary, the Long-term Contingency Actions will then be implemented as soon as practicable thereafter. Unlike the Rapid Response Actions, all of which have been determined to be implementable within 1 to 12 months of a triggering event, each Long-Term Contingency Action has a unique timeline for implementation depending on its complexity. *By December 2011, the Action Agencies and NOAA Fisheries will develop a Long-term Contingency Plan, which will include a detailed description of potential Long-term Contingency Actions, a selection process and implementation milestones for the following potential Long-term contingency actions as further described in the AMIP:* *1. Phase II Hydro Actions* *2. Reintroduction* *3. Predator Control* *4. Harvest* *5. Conservation Hatcheries* *6. Hatchery Reform* *7. John Day Reservoir at Minimum Operating Pool from April – June.* *8. Breaching Lower Snake River Dams: By March, 2010, the Corps in coordination with NOAA Fisheries and the other Action Agencies will complete a "Study Plan" for breaching of lower Snake River dams.*	the John Day Minimum Operating Pool (action 7 left) to NOAA Fisheries on July 26, 2012. The plan is available at https://www.salmonrecovery.gov/Files/BiologicalOpinions/2012/JDA%20MOP%20Final%20Plan%20of%20Study%20with%20letter%20comments%20and%20responses%20(071112).pdf The Corps completed the study plan for the breaching of lower Snake River dams in 2010 (action 8 left). The plan is available at http://www.nww.usace.army.mil/Library/DamBreachingPlanofStudy.aspx.
AMIP Category: Amendments		
Amend-ment 1	Identify the use and location of adult salmon thermal refugia in Lower Columbia and Lower Snake Rivers *Under RPA Action 55 the Action Agencies will undertake selected hydrosystem research to resolve critical uncertainties. As part of this action, by June 2012, the Corps will complete a report to identify the use and location of adult salmon thermal refugia in the lower Columbia and lower Snake Rivers using existing information on adult migration, temperature monitoring data, and modeling efforts. Additional investigation or action may be warranted based on the results.*	The Corps completed the Location and Use of Adult Salmon Thermal Refugia in the Lower Columbia and Lower Snake Rivers FCRPS Pools report in 2012. The report is available at https://www.salmonrecovery.gov/Files/BiologicalOpinions/2010/Thermal%20refugia%20report%20Feb%2014%202013.pdf
Amend-ment 2	Assess feasibility of adding adult PIT Tag detection systems at The Dalles Dam and John Day Dam.	See Amendment 2 following the table.
Amend-ment 3	Action Agencies to provide temperature data for NOAA's regional temperature database.	See Amendment 3 following the table.
Amend-ment 4	Action Agencies to provide tributary habitat effectiveness study data for NOAA's regional climate change database.	See Amendment 4 following the table.
Amend-ment 5	Action Agencies will provide available invasive species and site-specific toxicology information for consideration by the expert panels.	See Amendment 5 following the table.
Amend-ment 6	Action Agencies will assist NOAA to develop or modify existing studies that address the Ad Hoc Supplementation Workgroup Recommendations Report.	See Amendment 6 following the table.

AMIP Category II – Acceleration and Enhancement of RPA Mitigation Actions (Actions A-D) Ongoing Actions

II. A. Estuary Habitat Improvement & Memorandum of Agreement on Columbia River Estuary Actions with State of Washington

Under RPA Actions 36 and 37, the Action Agencies are implementing a major program of estuary habitat restoration and research. The Washington Estuary Memorandum of Agreement will enhance this effort significantly by identifying and describing estuary projects and augmenting the suite of RPA actions in the 2008 RPA. In selecting the projects for inclusion in the Washington Estuary Memorandum of Agreement, an initial suite of potential projects was evaluated by Washington Department of Fish and Wildlife (WDFW) scientists for biological benefits and certainty of success using the scientific methodology described in the RPA (Actions 36 and 37). As a result of this evaluation, an additional 21 projects were selected for implementation.

Acceleration & Enhancement of RPA Mitigation Actions (Actions A-D) II. A. Estuary Habitat Improvement & Memorandum of Agreement on Columbia River Estuary Actions with State of Washington: Under RPA Actions 36 and 37, the Action Agencies are implementing a major program of estuary habitat restoration and research. The Washington Estuary Memorandum of Agreement will enhance this effort significantly by identifying and describing estuary projects and augmenting the suite of RPA actions in the 2008 RPA. In selecting the projects for inclusion in the Washington Estuary Memorandum of Agreement, an initial suite of potential projects was evaluated by Washington Department of Fish and Wildlife (WDFW) scientists for biological benefits and certainty of success using the scientific methodology described in the RPA (Actions 36 and 37). As a result of this evaluation, an additional 21 projects were selected for implementation.

The MOA was executed by parties on September 16, 2009. The estuary program was accelerated in 2013; see the discussion in RPA 37 for information on habitat actions.

II. D. Spill

Spring Spill: *Assess data from previous years and discuss with the RIOG parties each year to inform transport/spill operation decisions for the subsequent year. There is no longer a presumptive spill/transport operation for the spring RPA action 29.*

This process was carried out in 2011 as specified in the AMIP.

Summer Spill: *To further enhance the summer spill program, the Action Agencies will develop an appropriate safeguard, based on adult returns, that continues summer spill at the Snake River projects through August 31, during the subsequent juvenile outmigration. Using this trigger, low abundance of naturally-produced Snake River fall Chinook in one year would trigger spill through August 31 at the Snake River projects the following year, regardless of the number of juveniles collected. The Agencies will coordinate with the RIOG in developing the trigger, to be in place for the 2010 juvenile fish migration.*

Completed on schedule in 2010. Consistent with this AMIP requirement, a June 11, 2010 letter from Witt Anderson to Barry Thom indicated that spill would continue through August 31 only in years following a year in which 400 or fewer natural-origin adult Snake River fall Chinook salmon are counted at Lower Granite Dam. However, pursuant to the opinion and order from the United States District Court for the District of Oregon, dated August 2, 2011, the Action Agencies continued summer spill at the Snake River projects through August 31 in prior years, consistent with the Court's previous spill orders.

AMIP Category III – Enhanced Research Monitoring & Evaluation (Actions A-F) Ongoing Actions

Collaborate with state and tribal co-managers to develop a shared Columbia Basin Monitoring Strategy. The goal of the collaboration is to develop an efficient salmon and steelhead monitoring framework and implementation strategy that will support viable salmonid populations and habitat and hatchery effectiveness monitoring needs, including those of the 2008 BiOp and RPA, recovery plans, regional fisheries management objectives, and other programs. This collaborative process will be completed in December, 2009.

III. A. Enhanced Lifecycle Monitoring for Evaluation of Contingencies

Starting in 2010, NOAA Fisheries and the Action Agencies will jointly fund and implement updates to the existing life cycle models. The updates to the life-cycle models will be implemented by December, 2012. These enhancements will be developed using the same approach as for the COMPASS model, a transparent process and independent science peer review. Results will be discussed with the RIOG and reported annually to the region.

The life cycle modeling project began in 2010 and has continued through 2014. The model development group consists of scientists from state (IDFG, WDFW, ODFW), tribal (CRITFC, Nez Perce), and federal (NOAA, USGS, BOR, USFWS) agencies. The group completed a document in December 2012 that described model developments and presented model results. This document was publicly reviewed and then presented to the ISAB for review in June 2013. The model development group met quarterly and continues to meet and make progress. The modeling has made progress in the following areas:

1. Incorporating habitat relationships into life cycle models: There are ongoing efforts to gather data and estimate relationships between tributary habitat conditions and capacity or survival for spring Chinook in the Grande Ronde and Upper Columbia, and Chinook and steelhead in the Salmon River.

2. Continued development of hydro scenarios for rapid response and long-term contingency planning: An avian predation survival relationship was added to the COMPASS model.

3. Steelhead and subyearling Chinook salmon life-history characterizations: In 2014, a team from the USFWS, Nez Perce tribe, and USGS assembled multiple years of data for a stock-recruitment model for fall-run Chinook in the Snake River Basin. They were able to incorporate subyearling and yearling (reservoir type) outmigration patterns, estimate density effects at the life stages upstream and downstream of Lower Granite Dam, and estimate survival metrics for hatchery and wild origin fish.

4. Estuary and ocean survival NOAA has estimated predation rates by pinnipeds on spring-run Chinook in the estuary for several years, and this may soon be available for incorporation in COMPASS and other models.

5. Climate change scenario characterizations: Relationships between flow, temperature, and survival rates were estimated for tributaries of the Salmon River.

6. Modeling of hatchery-wild interactions based on ongoing analyses: In 2014, scientists in the AMIP modeling group reported a major analysis of stock

recruitment rates for Chinook and steelhead populations in the interior Columbia River Basin (2014 Suppl. BiOp, Appendix C). They concluded that density-dependence processes influence abundance patterns and population trends in most of the wild ESUs.

III. F. Climate Change Monitoring & Evaluation

This AMIP Action enhances or clarifies other RPA actions as follows:

1. *RPA Action 2 requires the inclusion of new climate change research findings in the Action Agencies' annual progress reports NOAA Fisheries will annually provide the Action Agencies with a literature review relevant to the implementation of the RPA.*

   On September 29, 2014, NOAA Fisheries provided the Action Agencies with a Northwest Fisheries Science Center review of new literature on climate science and oceanographic conditions relevant to Columbia River Basin salmonids (see Appendix A).

2. *Consistent with RPA Actions 56-61, data on habitat conditions and action effectiveness will be collected during ongoing and enhanced tributary habitat and ocean research. By December 2011, the Action Agencies and NOAA Fisheries will ensure that this information is appropriately managed in a database allowing changes to be tracked over time.*

   The action is ongoing. BPA funded the creation of the CHaMP data system for tributary habitat status and trend monitoring associated with RPAs 56 and 57 at http://www.champmonitoring.org. BPA and NOAA Fisheries' NWFSC funded tributary habitat action effectiveness monitoring for RPA 56 and 57, the ISEMP Project 2003-017-00, found at http://www.nwfsc.noaa.gov/research/divisions/cbd/mathbio/isemp/index.cfm, which tracks and manages data in the Status and Trend Effectiveness Monitoring Databank at https://www.webapps.nwfsc.noaa.gov.

   For estuarine habitat data, the Corps funded the AFEP "Synthesis and Evaluation" project with Battelle's Pacific Northwest Labs for the development of the data system to track and maintain BPA habitat status and trends and action effectiveness. In the estuary, BPA also co-funds a site of the Science and Technology University Research Network within the Center for Coastal Margin Observation & Prediction. Data related to food web and water quality (flow, temperature, dissolved oxygen, pH, plankton (nontoxic or pharmaceutical)) is stored at http://www.stccmop.org/saturn.

   For ocean habitat conditions, data from BPA and NOAA Fisheries' NWFSC Project 1998-014-00 (Ocean Survival of Salmonids) may be found at the NOAA Fisheries' Ocean Indicators Tool (http://www.nwfsc.noaa.gov/research/divisions/fed/oeip/a-ecinhome.cfm). Additional data on ocean conditions for the BPA-funded "Canada-USA Shelf Salmon Survival Study," conducted with the Canadian Department of Fisheries and Oceans (DFO), are reported in the Pacific Region Oceanography Database at http://www.pac.dfo-mpo.gc.ca/science/oceans/data-donnees/index-eng.htm.

3. *Under RPA Actions 35-57, the Action Agencies will use the new climate change information to guide tributary and estuary habitat project selection and prioritization and other aspects of adaptive management.*

The action is ongoing. The 2011 and 2012 reviews of new climate change literature provided by NOAA Fisheries under AMIP Action III.F (AMIP pg. 25) were shared with the tributary habitat Expert Panels in advance of the workshops held in 2012 on the Expert Panel Website.

The Action Agencies are also tracking juvenile fish status and trends at monitoring sites throughout the estuary to support the early detection of substantial changes in abundance, productivity, or survival over time. These trends may be correlated with trends of habitat indicators (e.g., temperature); and by tracking habitat status and trends (including water quality and temperature) at monitoring sites throughout the estuary to detect changes in baseline conditions over time. These may be correlated with status and trends of juvenile fish densities.

4. *Under RPA Action 7, the Action Agencies investigate the impacts of possible climate change scenarios on listed salmon and steelhead. As part of this effort, the Action Agencies will use new climate change information to improve regional hydrological models. In addition, the Action Agencies will review existing forecasting tools. As new procedures and techniques are identified with significant potential to reduce forecast error and improve forecast reliability, the Action Agencies will review these with the RIOG and other interested parties.*

   This action is ongoing. The results of the work from the three agencies are available in three major reports and a summary report as part of the Climate and Hydrology Datasets for use in the RMJOC Agencies' Longer-Term Planning Studies at http://www.bpa.gov/power/pgf/HydrPNW.shtml. Reclamation, BPA, and the Corps engaged in a collaborative effort to focus on how water supply changes due to climate change could impact the Columbia River Basin and the operation of federal dams in the future. The RMJOC's four-part climate change reports were completed in 2011. The report titles and dates completed are:

   Part I – Future Climate and Hydrology Datasets, dated December 2010;

   Part II – Reservoir Operations Assessment for Reclamation Tributary Basins, January 2011;

   Part III – Reservoir Operations Assessment: Columbia Basin Flood Control and Hydropower, May 2011; and

   Part IV – Summary, Climate and Hydrology Datasets for Use in the River Management Joint Operating Committee (RMJOC) Agencies' Longer-Term Planning Studies, September 2011.

   The reports can be found at http://www.bpa.gov/power/pgf/HydrPNW.shtml. BPA also solicited comments from stakeholders and the public on the Summary report in August 2011, and these are posted at: http://www.bpa.gov/applications/publiccomments/CommentList.aspx?ID=134.

5. *Enhanced monitoring of adult status and trends, juvenile status and trends, habitat condition status and trend and IMWs (flows and temperature) will contribute to climate change assessments. Climate change information will be discussed with the RIOG and reported to the region annually.*

   The action is ongoing. Enhanced monitoring in 2013 under AMIP III B, C, D, and E (adult, juvenile, habitat status, and IMWs) all support and contribute to climate change assessments. See these sections above for more information.

AMIP Category IV – Contingency Plans in Case of Early Warning or Significant Fish Declines

IV. A. Expanded Contingency Process

IV. A. 3. – Contingency Plan Implementation for Snake River Sockeye Salmon: *The Action Agencies will continue the safety net hatchery program; further expand the sockeye program (up to 1 million fish released as smolts); investigate the feasibility of transporting adults from Lower Granite Dam to Sawtooth Valley lakes or artificial production facilities; and investigate the highly variable juvenile mortality rates between Sawtooth Valley and Lower Granite Dam.*

The safety net hatchery program is ongoing. The investigation of adult transport feasibility is complete.

Contingency actions include the safety net hatchery program; construction, operation, and maintenance of the Springfield Sockeye Hatchery to expand smolt production up to one million smolts; and a multi-year investigation of the highly variable juvenile mortality rates between Sawtooth Valley and Lower Granite Dam.

AMIP Category: Amendments with Ongoing Actions

Amendment 2

Under RPA Action 52, the Action Agencies will enhance fish population monitoring. As part of this action, in February 2011 the Corps will initiate a study at The Dalles and John Day Dams to determine a cost-effective adult PIT Tag detection system design and whether installation of PIT Tag detectors will improve inter-dam adult survival estimates. The study will be completed by December 2012. Following the results of the study, by April 2013, the Action Agencies will determine in coordination with NOAA Fisheries if one or both of these PIT Tag detectors substantially improve inter-dam adult loss estimates. If warranted, the Action Agencies will proceed to construction. Funding will be scheduled consistent with the RPA requirement and priorities for performance standard testing and achievement of these performance standards at the projects.

Adult PIT tag monitoring systems were installed at The Dalles Dam in 2013. These were originally intended to be temporary. However, since they proved to have very high detection efficiencies and appear to be durable and reliable, they will be maintained by the Corps as the long-term systems.

Amendment 3

Under RPA Action 15, the Action Agencies are providing water quality information and implement water quality measures to enhance fish survival and protect habitat. As part of this action, the Action Agencies will contribute to regional climate change impact evaluations by providing NOAA Fisheries past and future water temperature data from their existing monitoring stations, to be used as part of a regional temperature database. The Action Agencies will begin to provide data to NOAA Fisheries within 6 months following the establishment of a regional database and annually thereafter. NOAA Fisheries anticipates having a regional database established no later than 2012.

NOAA Fisheries and the Action Agencies are satisfying this requirement by submitting data developed for FCRPS BiOp RME to the USFS's Rocky Mountain Research stream and air temperature database (http://www.fsJed.us/rm/boise/AWAE/projects/streamtemperature.shtml). This project will provide a mapping tool to help those in the western U.S. organize temperature monitoring efforts.

Amendment 4

Under RPA Action 35, the Action Agencies are identifying tributary habitat projects for implementation and consider potential effects of climate change on limiting factors. As part of this action, the Action Agencies will continue to coordinate with NOAA Fisheries in its efforts to use existing tributary habitat effectiveness studies, IMWs, and the NOAA Fisheries enhanced lifecycle modeling to track climate change impacts. Starting in September 2011, the Action Agencies will annually provide NOAA Fisheries with study data to be used as part of a regional climate change database. After 2011, new climate change findings will be provided to the tributary habitat expert panels to apply and use to help identify and prioritize habitat improvement actions.

The Action Agencies regard the climate science research as limited in the ability to improve understanding of the impact of habitat actions in ameliorating for effects of climate impacts. Given this, the Action Agencies focus is on the ability of habitat action to improve habitat condition and/or species and habitat resilience, believing that increased diversity and resilience can contribute to population persistence in the face of a changing climate. To that end, the Action Agencies continued to coordinate with NOAA in 2014 by sharing habitat effectiveness study results, IMW results, and life cycle model updates. As reported in the 2013 CE, climate change information was shared during the 2012 expert panel process and updates to these data will be shared during the 2016 expert panel process.

The Action Agencies continue to fund the development of climate data and to participate in regional discussions to update thinking on climate change. In 2014, regional meetings were convened by Federal Caucus member agencies and attended by their staff, including Action Agency staff. When data and information become available the Action Agencies encourage[4] the expert panels to consider climate impacts when evaluating habitat improvement actions and the effect on limiting factors. By looking at the types of actions funded by the tributary habitat program (e.g., riparian restoration, flow acquisition, water conservation, floodplain reconnection; dike, levee, and mine tailing removal; barrier removal; culvert replacement; road improvement and obliteration; establishment of conservation easements; land acquisition the Action Agencies can evaluate whether and to what degree the actions increase diversity or improve resilience as a function of ameliorating for effects from changes in flow quantity, timing, and duration; changes in precipitation patterns; changes in water and air temperature; and changes in vegetation composition.

Amendment 5

Under RPA Action 35, the Action Agencies are identifying tributary habitat projects for implementation based on the population specific overall habitat quality improvement identified in the RPA Action. As part of this action, after 2011, the Action Agencies will include as a consideration in the expert panel

[4] Beyond research to predict changes in timing of flow events; peak and base flows; shifts in air and water temperature; and changes in precipitation patterns the existing body of climate science work is limited insofar as its utility for examining the effect of habitat improvement actions in ameliorating for effects of climate change.

project evaluation process (1) the presence of invasive species and (2) site-specific toxicology issues, based on information made available by the appropriate state and Federal agencies.

The action was completed on schedule for the 2012 expert panels. This information will be updated in preparation for the 2016 panels and included as part of the science findings/input being prepared to support the 2016 panels.

Amendment 6

Under RPA Action 64 and under the AMIP Hatchery Effects p. 22, the Action Agencies are supporting efforts to resolve hatchery critical uncertainties. As part of this effort, beginning in December 2010, the Action Agencies will assist NOAA Fisheries to further develop or modify existing studies that address the Ad Hoc Supplementation Workgroup Recommendations Report and that additionally address potential density-dependent impacts of FCRPS hatchery releases on listed species. These studies would provide support for future hatchery management actions to reduce potential adverse hatchery effects. By December 2010, the Action Agencies will work with NOAA Fisheries to convene a technical workgroup with fishery managers to discuss potential studies and potential management tools. The goal for the workgroup will be to complete its work by December 2011.

The CRHEET was proposed, in part, to respond to the AMIP requirement to convene a technical workgroup with fishery managers. NOAA Fisheries has postponed implementation of the CRHEET to allow for the undertaking of an extensive ESA consultation process on FCRPS mitigation hatchery programs (RPA 39). These consultations require significant involvement from many of the people proposed to participate in CRHEET. Recognizing this overlap, BPA agreed with NOAA Fisheries that CRHEET would best be informed by the outcomes of the consultations and so further development of CRHEET has been deferred.

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Acronyms

The “Action Agencies” refers to Bonneville Power Administration, the U.S. Army Corps of Engineers Northwestern Division, and the U.S. Bureau of Reclamation Pacific Northwest Region. Any references in this report to “we” or “us,” or to “our” activities, etc., refer collectively to these agencies.

AEM	Action Effectiveness Monitoring
AFEP	Anadromous Fish Evaluation Program
AMIP	Adaptive Management Implementation Plan
ASMS	Anadromous Salmonid Monitoring Strategy
ATIIM	Area-Time Inundation Index Model
BA	Biological Assessment
BiOp	Biological Opinion
BPA	Bonneville Power Administration
CBFWA	Columbia Basin Fish and Wildlife Authority
cfs	cubic feet per second
CEERP	Columbia Estuary Ecosystem Restoration Plan
CEQUAL-W2	Two dimensional (longitudinal/vertical), hydrodynamic and water quality model
CHaMP	Columbia Habitat Monitoring Program
COMPASS	COMprehensive Fish PASSage Model
COP	Configuration and Operational Plan
Corps	U.S. Army Corps of Engineers
CREST	Columbia River Estuary Study Taskforce
CRFG	Columbia River Forecast Group, formed by the Action Agencies and Fish Accord partners
CRHEET	Columbia River Hatchery Effects Evaluation Team
CRITFC	Columbia River Inter-tribal Fish Commission
CRTOC	Columbia River Treaty Operating Committee
CSS	Comparative Survival Study
CTUIR	Confederated Tribes of the Umatilla Indian Reservation
CWT	coded wire tag
DART	Data Access In Real Time
DEIS	Draft Environmental Impact Statement
DIDSON	dual frequency identification sonar
DMLT	Data Management Leadership Team
DPS	distinct population segment
EIS	Environmental Impact Statement
ERTG	Expert Regional Technical Group
ESA	Endangered Species Act
ESP	Ensemble Streamflow Prediction
ESU	evolutionarily significant unit
FCRPS	Federal Columbia River Power System
FEIS	Final Environmental Impact Statement
FFDRWG	Fish Facility Design Review Workgroup
FGE	fish guidance efficiency
FONSI	Finding of No Significant Impact
FOP	Fish Operations Plan
FPC	Fish Passage Center
FPOM	Fish Passage Operations and Maintenance Workgroup

FPP	Fish Passage Plan
GBT	gas bubble trauma
GSI	genetic stock identification
HGMP	Hatchery and Genetic Management Plan
HQI	Habitat Quality Improvement
HRPP	Hood River Production Plan
IAPMP	Inland Avian Predation Management Plan
IDFG	Idaho Department of Fish and Game
IMW	intensively monitored watershed
ISAB	Independent Scientific Advisory Board
ISEMP	Integrated Status and Effectiveness Monitoring Program
ISRP	Independent Scientific Review Panel
ISTM	PNAMP's Integrated Status and Trends Monitoring program
JSATS	Juvenile Salmon Acoustic Telemetry System
kaf	thousand acre feet
kcfs	thousand cubic feet per second
km	kilometers
KMP	Kelt Management Plan
LCRE	Lower Columbia River and Estuary
LCEP	Lower Columbia Estuary Partnership, formerly the Lower Columbia River Estuary Partnership or LCREP
LRISRP	Lake Roosevelt Incremental Storage Release Program
Maf	million acre-feet
MOP	minimum operating pool
MPG	major population group
NED	Northwest Environmental Database
NEPA	National Environmental Policy Act
NFH	National Fish Hatchery
NMFS	NOAA's National Marine Fisheries Service
NOAA Fisheries	Alternative designation for National Oceanic and Atmospheric Administration's National Marine Fisheries Service
NPCC	Northwest Power and Conservation Council
NPMP	Northern Pikeminnow Management Program
NPT	Nez Perce Tribe
NTS	non-treaty storage
NTSA	Non-Treaty Storage Agreement
NWFSC	Northwest Fisheries Science Center
NWRFC	Northwest River Forecast Center
ODFW	Oregon Department of Fish and Wildlife
PH2	Second Powerhouse (Bonneville Dam)
pHOS	percentage of hatchery-origin fish on the spawning grounds
PIT	Passive Integrated Transponder
PNAMP	Pacific Northwest Aquatic Monitoring Partnership
PNNL	Pacific Northwest National Laboratory
PSMFC	Pacific States Marine Fisheries Commission
PTAGIS	PIT Tag Information System
Reclamation	U.S. Bureau of Reclamation
RIOG	Regional Implementation Oversight Group
RME or RM&E	research, monitoring, and evaluation
RMJOC	River Management Joint Operating Committee
RPA	Reasonable and Prudent Alternative
RPM	Reasonable and Prudent Measure
SAR	smolt-to-adult return ratio

SBU	Survival Benefit Unit
SLED	sea lion exclusion device
SMP	Smolt Monitoring Program
SYSTDG	System Total Dissolved Gas
TDG	total dissolved gas
TMT	Technical Management Team
USDA	U.S. Department of Agriculture
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
VARQ	variable outflow flood risk management procedure
WDFW	Washington Department of Fish and Wildlife
WMP	Water Management Plan
YKFP	Yakima/Klickitat Fisheries Project
YN	Yakama Nation

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Appendix A – Literature Review for 2014 Citations for BiOp: Biological Effects of Climate Change

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