# Draft
# 2008/2007 Water Management Plan
# New Format

**August 20, 2007**

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# 1 Introduction

## *1.1 Updated Proposed Action, Biological Opinion and Preliminary Injunction Order*

The Corps of Engineers (COE), Bureau of Reclamation (Reclamation), and Bonneville Power Administration (BPA), collectively referred to as the Action Agencies (AA), consult on the effects of the operation of the dam and reservoir projects in the Federal Columbia River Power System (FCRPS) on listed species with NOAA Fisheries (also National Marine Fisheries Service or NMFS) and the U.S. Fish and Wildlife Service (USFWS).

For the listed anadromous species the AA prepared a Final Updated Proposed Action (UPA), which was the basis for ESA consultation resulting in the NOAA Fisheries Revised 2004 Biological Opinion (2004 BiOp) on the Operation of the FCRPS and Upper Snake River flow augmentation on November 30, 2004.

The 2004 UPA can be found at
http://www.salmonrecovery.gov/Biological_Opinions/FCRPS/biop_remand_2004/docs/upa_final/FinalUPANov242004.pdf.

The NOAA Fisheries 2004 BiOp can be found at
http://www.salmonrecovery.gov/biological_Opinions/FCRPS/biop_remand_2004/index.cfm.

The 2004 Final UPA and BiOp were prepared in response to the court ordered remand of the 2000 FCRPS BiOp in National Wildlife Federation v. NMFS.

In May 2005, the District Court of Oregon invalidated the 2004 NOAA Fisheries FCRPS BiOp. In October 2005, the Court remanded the BiOp to NOAA Fisheries to produce a BiOp consistent with the Court's order by October 2006. The Court has granted extensions with the current deadline for completing the NOAA Fisheries BiOp October 31, 2007. The Court also ordered NOAA Fisheries and the Action Agencies to collaborate with sovereign states and tribes on the

development of a new proposed action and a jeopardy framework. During the remand, the Court left the 2004 BiOp in effect. Remand discussions are now occurring, both to determine annual river operations and longer range actions to protect ESA-listed anadromous fish species. The Actions Agencies continue to operate according to the 2004 UPA and BiOp, unless modified by Court order.

In addition USFWS released the "Fish and Wildlife Service Biological Opinion Regarding the Effects of Libby Dam Operations on the Kootenai River White Sturgeon, Bull Trout and Kootenai Sturgeon Critical Habitat" on February 18, 2006. This BiOp can be found at: http://www.fws.gov/easternwashington/documents/Final%20Libby%20Dam%20BiOp%202-18-06lr3.pdf

The 2000 USFWS FCRPS Biological Opinion, "Effects to Listed Species from Operation of the Federal Columbia River Power System," is operative for the remainder of the FCRPS projects and can be found at:

http://www.fws.gov/pacific/finalbiop/BiOp.html

Corps of Engineers prepared a Determination and Finding of Columbia River Flood Control Operation at Libby Dam for the 2007 Operating Year. This document describes the implementation of VARQ flood control procedures that can be expected at Libby Dam in 2007. The document can be found at:

http://www.nws.usace.army.mil/PublicMenu/documents/PUBLICAFFAIRS/Libby_Decision_Document_07.pdf

## *1.2 Upper Snake Biological Assessment and Biological Opinion,*

Reclamation operates 11 projects in the Upper Snake above Hells Canyon. In November 2004 Reclamation completed a Biological Assessment for 12 separate actions involving the operation and routine maintenance of 12 federal projects. The BA was formally transmitted to NOAA Fisheries on November 30, 2004. The Upper Snake BA can be found at http://www.usbr.gov/pn/programs/UpperSnake/index.html. NOAA released their 2005 BiOp on the operations and routine maintenance actions in the Upper Snake River on March 31, 2005. The Upper Snake BiOp can be found at http://seahorse.nmfs.noaa.gov/pls/pcts-pub/sxn7.pcts_upload.summary_list_biop?p_id=22363.

American Rivers and other plaintiffs filed a lawsuit in early 2004 against NOAA Fisheries and Reclamation alleging ESA violations associated with NOAA Fisheries' 2001 Upper Snake BiOp and its 2002 extension. The Court denied plaintiffs' Summary Judgment Motion because a new consultation was underway, but left open the option for the plaintiffs to challenge the new Upper Snake BiOp that NOAA Fisheries issued on March 31, 2005. Plaintiffs filed the new action on December 21, 2005. On May 23, 2006, Oregon U.S. District Judge James Redden, held that NOAA Fisheries BiOp on the operation of Reclamation's upper Snake River projects was legally flawed. On September 26, 2006, Redden issued an Opinion and Order of Remand providing

details on how Federal defendants must revise the consultation. Redden held that federal agencies may conduct separate consultation on the operation of Reclamation's upper Snake Projects and on the operation of the Federal Columbia River Power System. However, and regardless of how federal agencies combine or segregate the actions for consultation, they must comprehensively analyze the effects of both actions, *combined* with the environmental baseline. The requirement to aggregate was imposed in reaction to the approach federal agencies had used in the FCRPS and upper Snake consultations, where they sought to identify the incremental impacts to listed salmon and steelhead from the operations of the projects evaluated.

Judge Redden has given the FCRPS until October 31, 2007 to produce a draft BiOp to be presented to the Court.final BiOP. The upper Snake BiOp is due one month later.

## *1.3 Preparation of Plans*

The Action Agencies have prepared this Water Management Plan (WMP) for 2008 as part of the implementation planning process outlined in the 2004 UPA concerning the operation of FCRPS dams. This plan describes how the FCRPS dams and reservoirs will be operated for the 2008 water year (October 1, 2007 through September 30, 2008) to implement water management measures in a manner consistent with the actions proposed in the UPA and called for in the USFWS BiOp, and to make progress towards meeting the biological performance standards specified in the NOAA 2004 BiOp while also meeting non-BiOp related requirements and purposes such as flood control, hydropower, irrigation, navigation, and recreation. The FCRPS hydrosystem performance standards are discussed in section 11.

The Action Agencies will prepare annually a 1-year WMP that covers FCRPS hydro operations in the upcoming water year. These plans will generally be drafted in July and completed by the end of September. The plan will cover the upcoming water year, which begins on October 1 and ends on September 30 the following year. This 1-year plan is written when very little information is known about the future year's water supply. Therefore, the annual WMP will provide a general description of how the FCRPS will be operated during the year. It will also include any special operations (such as any special tests, flood control procedures planned for the year, etc.) that are known at the time the plan is developed.

The Action Agencies will also develop more detailed in-season action plans to describe how the FCRPS projects will be operated under actual conditions with current water supply forecasts. The first action plan will be prepared in the fall to address the fall/winter operation of the FCRPS projects. A spring update will be drafted in January and finalized in the March/April time period to address the spring and summer operation of the FCRPS projects. These action plans will take into account changes in the operations due to water supply or other factors for this time frame.

The Corps of Engineers also prepares a Fish Passage Plan (FPP) each year that provides detailed operating criteria for project fish passage facilities, powerhouses, and spillways to allow for the efficient passage of migratory fish. The FPP contains appendices that describe special operations

for studies, the juvenile fish transportation program, operation of units within 1% of best efficiency, spill for fish passage, total dissolved gas monitoring, and dewatering procedures. The plan is coordinated through the Fish Passage Operations and Maintenance Coordination Team (FPOM) and is available on the web at http://www.nwd-wc.usace.army.mil/tmt/documents/fpp/.

## *1.4 UPA, ESA, and Implementation Plan Strategies*

This WMP addresses strategies to enhance juvenile and adult fish survival through a coordinated set of hydro project management actions to achieve performance standards, and to provide benefits to resident fish. The plan is structured to address water management actions associated with the following strategies and substrategies, as defined for anadromous fish in the UPA and for resident fish in the ESA 2004/2004-2008 Implementation Plan for the FCRPS.

### 1.4.1 2004 UPA Hydro Strategies for Listed Species of Anadromous Fish

Hydro Strategy 2 – Manage water to improve juvenile and adult fish survival

Substrategy 2.1 – Reservoir operations to enhance fish survival: Actions under this substrategy are project operations that benefit fish at or near the project or its reservoir.

Substrategy 2.2 – System flow management to improve fish survival: This substrategy includes coordinated system operations for mainstem flow management and redd protection.

Substrategy 2.3 – Spill operations for project passage: This substrategy includes spill operations at individual projects to provide a better project passage for juvenile fish while avoiding high dissolved gas levels or adult fallback problems.

Substrategy 2.5 – Operate to achieve maximum fish benefits in a cost effective manner: This substrategy highlights the Action Agencies' objective to meet biological performance standards in a cost effective manner.

Hydro Strategy 3 – Operate and maintain fish passage facilities to improve fish survival

Substrategy 3.3 – Juvenile fish transport actions to enhance fish survival: This substrategy includes the transportation of juvenile fish around FCRPS dams.

### 1.4.2 ESA and Implementation Plan Strategies for Listed Species of Resident Fish

Strategy 1 – Promote the reproduction and recruitment of Kootenai River white sturgeon (KWS).

Substrategy 1.1 – Create conditions below Libby Dam that facilitate KWS natural reproduction and juvenile survival: This substrategy includes operations at and below Libby Dam that aid in KWS recovery.

Strategy 2 – Determine the impacts of the FCRPS on bull trout and mitigate for those impacts.

Substrategy 2.2 – Operate and modify FCRPS dams to protect, provide, and reconnect bull trout habitats: This substrategy includes actions to improve conditions for bull trout.

## *1.5 Non-BiOp Operations*

Each year the Action Agencies implement water management actions that are not part of our ESA obligations, but are aimed at meeting other project requirements and purposes such as flood control, power generation, irrigation, navigation, recreation, and fish and wildlife not listed under the ESA. table below includes fish and wildlife related non-ESA water management actions that may be implemented and the time of year such actions typically occur. These actions are further described in section 12.

| **Action** | **Time of Year** |
|---|---|
| Keenleyside Dam (Arrow) mountain whitefish actions | December - January |
| Keenleyside Dam (Arrow) rainbow trout actions | April - June |
| Libby - burbot actions | December - February |
| Dworshak – flow increase for hatchery release | March |
| Grand Coulee – kokanee | September – October |
| Hanford Reach Protection Flows | March – June |
| Vernita Bar Protection Flows | November – April |
| McNary - waterfowl nesting | March – May |
| McNary - waterfowl hunting enhancement | October – January |
| John Day - goose nesting | March – May |
| John Day - waterfowl hunting enhancement | October – January |
| Bonneville - Tribal fishing | April – September |
| Bonneville - Spring Creek Hatchery release | March |

## *1.6 Changes from Last Year's Plan*

by Dam will operate to VARQ flood control by adhering to the guidance developed using the VARQ Operating Procedures at Libby Dam. There will be no flexibility to reduce the proscribed VARQ refill flow except to protect human life and safety to lower the stage at Bonners Ferry below elevation 1764 feet for one or two days if needed.

# 2 Hydro System Operation

## *2.1 Priorities*

The 2004 UPA, 2004 BiOp and USFWS BiOp list the following strategies for flow management:

- Limit the winter/spring drawdown of storage reservoirs to increase spring flows and the probability of reservoir refill.
- Draft from storage reservoirs in the summer to increase summer flows.
- Provide minimum flows in the fall and winter to support mainstem spawning and incubation flow below Bonneville Dam.

The Action Agencies have reviewed these strategies and other actions called for in the UPA and BiOps and developed the following priorities (in order) for flow management and individual reservoir operations after ensuring adequate flood damage reduction is provided:

1. Operate storage reservoirs (Hungry Horse and Libby) to meet minimum flow and ramp rate criteria for resident fish.
2. Refill the storage projects to provide summer flow augmentation. A late snowmelt runoff may delay refill in order to avoid excessive spill.
    - Hungry Horse refill by June 30 to provide summer flow augmentation.
    - Dworshak refill by June 30 to provide summer flow augmentation.
    - Grand Coulee refill by June 30 to provide summer flow augmentation.
    - Libby reservoir refill in 2008 may be less likely than previous years as the result of operating in strict accordance with the VARQ Operating Procedures at Libby Dam as described in the Determination and Finding Document with the tiered sturgeon volume as recommended in the 2006 USFWS BiOp. These operating assumptions provide probability of Libby refill to within one foot of full by July 31 of about 12%. This is further described in the Corps 2006 EIS. See table 3 – 15 below from the EIS. Alternative LV1 is the refill at Libby using VARQ flood control procedures plus a sturgeon operation where outflow from Libby is within powerhouse capacity. Alternative LV2 is the refill at Libby using VARQ flood control procedures plus a sturgeon operation where outflow from Libby is powerhouse capacity plus 10,000 cfs. The table shows the likelihood of refilling Libby reservoir to within 1 foot and 5 feet from full by July 31 in the years studied for the EIS.

**Table 3-15. Simulated Likelihood of Reservoir Refill. Refill likelihood for LVB would fall between LV1 and LV2, while refill likelihood for LSB would fall between LS1 and LS2.**

| Alternative | Percent of years filling to 2458 feet (1 foot from full pool) elevation before July 31 | Percent of years filling to 2454 feet (5 feet from full pool elevation by July 31) |
|---|---|---|
| LS1 | 6 | 12 |
| LV1 | 12 | 31 |
| LS2 | 6 | 10 |
| LV2 | 10 | 31 |
| Benchmark | | |
| LS | 92 | 98 |
| LV | 92 | 98 |

3. Operate storage projects to be at their April 10 flood control elevations to increase available flows for spring flow management.

4. Provide fall and winter flows for chum salmon spawning and incubation.

The Action Agencies implement several independent FCRPS project operations to benefit fish at or near each project or in its reservoir. Reservoirs are to be operated to meet project minimum outflows, to reduce outflow fluctuations to avoid stranding fish and degrading fish habitat and productivity, to reduce cross sectional area to speed juvenile passage, and to make specific temperature releases to improve water temperatures for fish. These operations are generally the highest priority and not likely to change.

In an operating year that begins on October 1, the flow needs are not encountered in the same order as the BiOp priorities (e.g. the first decision to be made is for chum spawning flows which ultimately have a lower priority than summer flows). Therefore, the Action Agencies will attempt to operate chronologically during the year as follows.

The initial objective is to operate the storage reservoirs (Dworshak, Hungry Horse, Libby, and Grand Coulee) to be on the flood control upper rule curve by early April. This level varies by runoff forecast. Reaching early April flood control levels will be affected by how much water was released for flood control, power generation, and fishery flows to support both lower Columbia chum and Hanford reach fall Chinook spawning, and to meet Columbia Falls minimum flow requirements. If projects are maintained through the winter and spring near their flood control elevations (within the constraints of Vernita Bar and chum flows), there is an increased likelihood of refilling projects by June 30th with a minimal impact on spring flows. The next objective is to refill the storage reservoirs by about June 30[1] without spill (unless required for flood control), in order to maximize available storage of water for the benefit of summer migrants. The June 30 refill objective generally has priority over spring flow (April, May, June) objectives, while attempting to meet the spring flow objectives and other fish needs.

[1] Libby Dam refill probability is likely to be later into July as defined in the VARQ Flood Control Operating Procedures and supporting effects analysis.

The final objective is the management of available storage to augment summer (July and August) flows to attempt to meet flow objectives and for water temperature moderation. The storage reservoirs will be drafted to their specified August 31 draft limits to augment summer flows and/or moderate river temperatures. At Dworshak the summer draft limit will be reached in September. Draft limits are a higher priority than the summer flow objectives in order to meet other project uses and reserve water in storage for the following year.

These objectives are intended as general guidelines in overall system operations. The 2004 UPA, the 2004 and 2006 BiOps also embrace the concept of adaptive management. Adaptive management is the concept that the operation of the system should be adjusted based on acquired knowledge about current conditions in the system and effects of our management actions on it, as opposed to following a rigid set of rules. Some items to be considered are current information on fish migration, stock status, biological requirements, biological effectiveness, and hydrologic and environmental conditions. System managers recognize that there is often insufficient water to meet all the actions specified in the 2004 UPA and the 2004 and 2006 BiOps while meeting other system uses such as flood protection, power system reliability, irrigation, recreation, and navigation needs. The use of water for any one fish species or project purpose will most likely affect the amount of water available for other fish species or project purposes. Therefore, the Action Agencies, in coordination with regional parties through the TMT, endeavor to consider the multiple uses of the system, while providing, as a high priority, the measures to benefit listed species.

## *2.2 Conflicts*

As stated above, water availability may not be sufficient in the Columbia River basin to meet every action item stated in the 2004 UPA and the 2004 and 2006 BiOps while providing for other project purposes. Below are some of the main conflicts that may occur.

### 2.2.1 Flood control draft versus project refill

One way to maximize flood control is to provide abundant storage space in the event a large flood occurs. Conversely, the 2004 UPA and 2004 and 2006 BiOps specify that the storage projects be as full as possible to increase the likelihood of refill and provide flows for spring flow management and summer flow augmentation.

Flood control procedures specify the amount of storage needed to provide flood damage reduction. In furtherance of the flood damage reduction objective, storage space is provided to reduce the risk of forecast and runoff uncertainty. In an effort to reduce forecast error and to better anticipate the runoff timing or water supply for a given year, the 2004 BiOp calls for the Action Agencies to study system flood control requirements and forecast procedures to determine if they can be improved.

### 2.2.2 The provision of spring flows versus project refill and summer flow augmentation

Again, because water supply and runoff forecasts are not 100 percent accurate, it is difficult to estimate how much water is available for spring flows and still assure refill at the storage projects by June 30 (or in July for Libby Dam). If too much water is allowed to flow through the storage reservoirs in the spring, there is an increased risk of not refilling the projects. This will reduce the water supply available for summer flow augmentation. On the other hand, if the reservoirs fill too early in the spring, late season rain or snowmelt may cause flood damage downstream, or cause excessive spill and produce higher dissolved gas levels.

### 2.2.3 Chum tailwater elevations versus refill/spring flows

Setting the Bonneville tailwater elevation level for chum spawning and incubation in the Ives Island complex in recognition of the spring refill priority is one of the decisions that the Action Agencies, in consultation with the TMT, have to make with little reliable information available. Decisions about the tailwater elevation level for chum spawning and incubation are made in the October/November time period, long before the Action Agencies have reliable information on the coming year's expected water supply. The early season Southern Oscillation Index (SOI) provides an indication of the upcoming year's water supply. If the tailwater elevation level selected is too high (causing higher flows), there is a risk of refill failure. Conversely, choosing to refill runs the risk of reducing the tailwater elevation that can be supported through the spawning season and dewatering chum redds.

### 2.2.4 Sturgeon pulse versus summer flow augmentation

Water released from Libby Dam for spring sturgeon flows (pulse) during April -through July may reduce the water available for summer flow augmentation from Libby.

### 2.2.5 Fish operations versus other project uses

In addition to flood control operation, there are other project purposes that may conflict with operations carried out for the purpose of enhancing fish survival. For example, keeping the flow steady below a project for resident and anadromous fish needs conflicts with the ability to use a project to follow electrical load changes; spilling water for juvenile fish passage reduces the amount of power that can be generated to meet demand; and, augmenting flows during fish migration periods may conflict with the shape of power demand. Additionally, irrigation demands and recreation elevations at headwater reservoirs may impact the amount of water available for spring flows. The development of the BiOps for the FCRPS included consultations with the federal operating agencies on hydrosystem operations and the impact on listed species. These consultations included consideration of the multiple uses of the FCRPS. The multiple uses of the FCRPS are part of the foundation of the UPA and BiOp.

#### 2.2.6 Conflicts and priorities

The conflicts described above pose many challenges to the Action Agencies in meeting the multiple uses of the hydrosystem. Given these challenges, the priorities for flow management and individual reservoir operations outlined in section 2.1 will guide the Action Agencies in their operational decision-making when conflicts arise. Discussion of conflicts between operational requirements and alternatives for addressing such conflicts will occur in TMT with disputes taken to IT and at times to the Federal Executives.

### *2.3 Emergencies*

The UPA and 2000 BiOp acknowledge that emergencies and other unexpected events occur and may cause deviations from fish operations. Such deviations may be short in duration, such as a deviation to respond to an unexpected unit outage or power line failure, or longer in duration, such as experienced in 2001 in response to the low water conditions and unprecedented power market conditions. Emergencies must be declared and documented as to their nature, cause and proposed resolution following the guidelines in Appendix 1: Emergency Protocols which . TMT has developed Emergency (See Appendix 1 or see TMT homepage at http://www.nwd-wc.usace.army.mil/tmt/documents/wmp for current version of protocols.)

### *2.4 Research*

Research studies sometimes require special operations that differ from routine operations otherwise described in the UPA and BiOp. These studies are generally developed through technical workgroups of the Regional Forum (e.g., System Configuration Team (SCT)) and the Corps' Anadromous Fish Evaluation Program Fish Facilities Design Review Work Group (FFDRWG) and Studies Review Work Group (SRWG). They are further described in the Corps of Engineers' Fish Passage Plan and the Action Agencies' seasonal updates to the WMP. In most cases, operations associated with research entail relatively minor changes from routine operations and are coordinated in technical forums (e.g., TMT and FPOM). In some cases, the nature or magnitude of operational changes for research may require further coordination and review in policy forums (e.g., Implementation Team (IT)). Generally, research planning and coordination occurs throughout the late fall and winter, with final research plans established by late winter/early spring. In extraordinary events such as extreme low runoff conditions or an emergency, planned research may be modified prior to implementation to accommodate anticipated unique circumstances and/or to reallocate resources to obtain the greatest value given the circumstances.

## 3 Decision Points and Water Supply Forecasts

### *3.1 Decision Points*

Table 1 below lists the key water management decisions/actions and when they need to be made. Some decision points, such as setting flow objectives, are clearly articulated in the 2004 UPA and BiOps. Other decision points, such as setting weekly flow augmentation levels, require thorough discussion and coordination. The decision points given below are spelled out in the UPA or BiOps, or are based on experience. These decisions are made by the Action Agencies in consideration of actions called for in the UPA and BiOps, and input received through the

Regional Forum (TMT, IT, Regional Executives).

**Table 1.** Water Management Decision Points/Actions

| | Early October | November | Winter (December – March) | Early April | Early May | June | Early July |
|---|---|---|---|---|---|---|---|
| ***Operations*** | • Assess potential of providing tailwater elevations/flows for chinook populations below Bonneville Dam *(Non-BiOp Action)*<br>• Assess potential tailwater elevations / flow levels to support chum spawning below Bonneville Dam<br>• Preliminary discussions of flood control/ project refill strategy<br>• Albeni Falls fall/winter drawdown strategy discussion<br>• Hanford Reach /Vernita Bar flows set *(Non-BiOp Action)* | • Early season forecast using SOI<br>• Evaluate likely tier for sturgeon water volume<br>• Consider Kootenai burbot operation | • Determine winter/spring chum flow levels below Bonneville Dam<br>• Determine flood control and refill strategies, including any available flood control shifts<br>• Minimum flows from Hungry Horse Dam and minimum Columbia Falls flows are set by April-August forecast<br>• Begin discussing spring operations<br>• Spring Creek Hatchery release – March *(Non-BiOp Action)*<br>• Begin spring transport discussions<br>• Hanford Reach operations *(non-BiOp action)* discussed, beginning in January. | • Spring flow objectives are set by the April final volume forecasts<br>• Determine spring flow management strategy including priority for refill<br>• Determine start dates and levels by project for spring spill<br>• Determine start date for MOP at Lower Snake River projects<br>• Determine John Day forebay elevations | • Use May final forecast to calculate the appropriate volume of the sturgeon tiered flow release from Libby using new, coordinated formula<br>• Determine required outflow from Libby for bull trout. | • Summer flow objective at Lower Granite determined by June final volume forecast<br>• Determine summer flow augmentation strategy (early June)<br>• Complete Dworshak temperature modeling and determine release strategy<br>• Decision on McNary juvenile fish transportation (late June)<br>• Switch to 30% spill 24 hours a day at John Day. | • Grand Coulee summer reservoir draft limit determined by July Final April – August volume forecast |

| | Early October | November | Winter (December – March) | Early April | Early May | June | Early July |
|---|---|---|---|---|---|---|---|
| | | | Perform analysis to determine amount of flexibility Dworshak has to operate above minimum flow and still reach spring refill targets. Prepare *o*utlook for meeting flow objectives.<br>• Determine end of December flood control elevation at Libby, using December SOI –based forecast | | | | |
| ***Plans*** | Develop fall/winter update to the annual WMP | | Preliminary work on spring/summer update to the annual WMP | Start operational plans for Libby and Hungry Horse Dams | Libby and Hungry Horse operational plans due | | |
| ***Forecasts*** | | | January, February, and March volume forecasts released by the RFC | April final forecast released by RFC | May final forecast released by RFC | June final forecast released by RFC | |

## *3.2 Water Supply Forecasts*

Water supply forecasts serve as a guide to how much water is available for fish and other operations. Flow projections are provided to the TMT regularly during the flow management season (April 3 – August 31).

The National Weather Service's Northwest River Forecast Center, USACE Northwestern Division Hydrologic Engineering Branch, Reclamation, and others prepare water supply forecasts to manage the Columbia River. Table 2 below lists the forecasts used to implement actions referenced in the UPA and BiOps. Table 3 summarizes the major fish-related reservoir and flow operations by project. More detailed descriptions of each of these operations follow.

**Table 2**. Water Supply Forecasts Used to Implement UPA and BiOp Actions

| Forecast Point | Forecast period | Forecast | UPA actions determined |
|---|---|---|---|
| Hungry Horse | April – August | January, February, and March Final provided by Reclamation | Columbia Falls and Hungry Horse minimum flows |
| The Dalles | April – August | April Final provided by ? | Spring flow objective at McNary Dam |
| Lower Granite | April – July | April Final provided by ? | Spring flow objective at Lower Granite |
| Lower Granite | April – July | June Final provided by ? | Summer flow objective at Lower Granite |
| The Dalles | April – August | July Final provided by ? | Grand Coulee summer draft limit |
| Libby | April – August | May Final for sturgeon flow provided by ? | Volume of water for sturgeon flow at Bonners Ferry and minimum bull trout flows to begin May 15 |

**Table 3**. Major Reservoir and Flow Operations for ESA-listed fish species.

| Project | Flood Control & Refill | Sturgeon | Bull Trout | Spring Anadromous | Summer Anadromous | Chum |
|---|---|---|---|---|---|---|
| **Libby** | Winter: Operate to VARQ flood control rule curve and achieve appropriate elevation by April 10<br><br>Spring: Adhere to VARQ Operating Procedures at Libby Dam and supply the appropriate tiered volume for sturgeon. Refill by June 30 will be less likely in 2008 than previous years. | April – July Augment flows at Bonners Ferry for sturgeon pulse. Refill by June 30 will be less likely in 2008 than previous years. | Year Round: Operate to minimum flows and project ramping rates to minimize adverse affects of flow fluctuations | Operate to meet flow objectives and with refill by June 30 in 2008 less likely than previous years. l | July/August: Draft for summer flow augmentation, not to exceed reservoir draft limit of 2,439 feet | Fall/winter storage may be used to support chum flows |
| **Hungry Horse** | Winter: Operate to VARQ flood control by April 10<br><br>Spring: Refill by June 30 if possible without excessive spill and operate to meet flow objectives | | Year Round: Operate to Columbia Falls minimum flows and project ramping rates to minimize adverse affects of flow fluctuations | Operate to meet flow objectives and June 30 refill if possible without exceeding TDG limits | July/August: Draft for summer flow augmentation, not to exceed reservoir draft limit of 3540 feet | Fall/winter storage may be used to support chum flows |
| **Albeni Falls** | Winter: Operate to flood control rule curve<br><br>Spring: Refill by June 30 and operate to meet flow objectives | | Fall/Winter: Reach 2051-2055 feet msl Recommendation will be made by TMT by November 20 and maintain this elevation until kokanee fry emergence | | | Fall/winter storage may be used to support chum flows |

| Project | Flood Control & Refill | Sturgeon | Bull Trout | Spring Anadromous | Summer Anadromous | Chum |
|---|---|---|---|---|---|---|
| **Grand Coulee** | Winter: Operate to 85% confidence of meeting April 10 flood control elevation<br><br>Spring: Refill by June 30 and operate to meet flow objectives | | | Draft from April 10 FC to April 30 FC to increase the likelihood of achieving spring flow objectives in the Lower Columbia river.<br><br>Operate to meet the Spring flow objective at Priest Rapids Dam. | July-August: Draft for summer flow augmentation, not to exceed reservoir draft limit of 1,280 feet (>/= 92 maf forecast at The Dalles) or 1,278 feet (< 92 maf forecast at The Dalles) | Fall/winter storage may be used to support chum flows |
| **Grand Coulee (continued)** | | | | | July/August: Operate Banks Lake at elevation 5 feet less than full to provide more water for summer flow augmentation | |
| **Dworshak** | Winter: Operate to flood control rule curve by April 10<br><br>Spring: Refill by June 30 and operate to meet flow objectives | | | | Draft for summer flow augmentation and water temperature reduction, not to exceed reservoir draft limit of 1,520 feet in September | Fall/winter storage may be used to support chum flows |
| **Lower Granite** | | | | Flow objective of 85-100 kcfs<br><br>Operate within 1 foot of MOP to reduce juvenile travel time<br><br>Apr 1 – Oct 31 Operate within 1% of best efficiency | Flow objective of 50-55 kcfs<br><br>Operate within 1 foot of MOP to reduce juvenile travel time<br><br>Apr 1 – Oct 31 Operate within 1% of best efficiency | |
| **Little Goose** | | | | Operate within 1 foot of MOP to reduce juvenile travel time<br><br>Apr 1 – Oct 31 Operate within 1% of best efficiency | Operate within 1 foot of MOP to reduce juvenile travel time<br><br>Apr 1 – Oct 31 Operate within 1% of best efficiency | |

| Project | Flood Control & Refill | Sturgeon | Bull Trout | Spring Anadromous | Summer Anadromous | Chum |
|---|---|---|---|---|---|---|
| **Lower Monumental** | | | | Operate within 1 foot of MOP to reduce juvenile travel time<br><br>Apr 1 – Oct 31<br>Operate within 1% of best efficiency | Operate within 1 foot of MOP to reduce juvenile travel time<br><br>Apr 1 – Oct 31<br>Operate within 1% of best efficiency | |
| **Ice Harbor** | | | | Operate within 1 foot of MOP to reduce juvenile travel time<br><br>Apr 1 – Oct 31<br>Operate within 1% of best efficiency | Operate within 1 foot of MOP to reduce juvenile travel time<br><br>Apr 1 – Oct 31<br>Operate within 1% of best efficiency | |
| **McNary** | | | | Flow objective of 220-260 kcfs<br><br>Apr 1 – Oct 31<br>Operate within 1% of best efficiency | Flow objective of 200 kcfs<br><br>Apr 1 – Oct 31<br>Operate within 1% of best efficiency | |
| **John Day** | | | | Apr 10-Sep 30<br><br>Operate within 1.5 feet of minimum level that provides irrigation pumping to reduce juvenile travel time<br><br>Apr 1 – Oct 31<br>Operate within 1% of best efficiency | Apr 1 – Oct 31<br><br>Operate within 1% of best efficiency | |
| **The Dalles** | | | | Apr 1 – Oct 31<br>Operate within 1% of best efficiency | Apr 1 – Oct 31<br>Operate within 1% of best efficiency | |

| Project | Flood Control & Refill | Sturgeon | Bull Trout | Spring Anadromous | Summer Anadromous | Chum |
|---|---|---|---|---|---|---|
| **Bonneville** | | | | Apr 1 – Oct 31 Operate within 1% of best efficiency | Apr 1 – Oct 31 Operate within 1% of best efficiency | Provide support to chum if hydrologic conditions indicate system can likely maintain minimum project tailwater elevation (on Oregon side 0.9 miles downstream of first powerhouse and 50 feet upstream of Tanner Creek) during spawning and incubation ,.<br><br>. |

# 4 Project Operations

## *4.1 Keenlyside Dam (Arrow)*

### 4.1.1 Mountain Whitefish

Spawning flow levels are set the third week in December between 45 and 55 kcfs. Spawning continues through mid-January. Egg protection flows are set 5 to 15 kcfs lower than the spawning flow through the end of March.

### 4.1.2 Rainbow Trout

Rainbow trout spawning begins in April. Protection levels begin somewhere between 15 and 25 kcfs. The goal is to have stable flows or ever-increasing flows through June

## *4.2 Hungry Horse Dam*

### 4.2.1 Spring Operations

The purpose of the following actions is to refill Hungry Horse as much as possible in order to achieve a high probability *Define "high probability" for this project and cite reference.of* reaching flood control upper rule curve elevation by April 10, for spring flows. Hungry Horse will operate to refill by June 30 to provide summer flow augmentation, except as specifically provided by the TMT.

During the spring, the Action Agencies will operate the FCRPS to meet the flow and refill objectives at Hungry Horse. If both these objectives cannot be achieved, the TMT will make an in-season recommendation, weighing considerations unique to each particular year and project. Because research results indicate that increased flows have more direct survival benefits for summer migrants than for spring migrants, depending upon the actual base spring flow being provided, modest reductions in spring flows to facilitate reservoir refill would generally be preferable to refill failure.

### 4.2.2 Summer Operations

During the summer, the Action Agencies draft Hungry Horse within the NOAA BiOp's specified draft limits based on flow recommendations provided by TMT. TMT considers a number of factors when developing its flow recommendations, such as: the status of the migration, attainment of flow objectives, water quality, and the effects that reservoir operations will have on other listed and resident fish populations.

### 4.2.3 Flood Control

Hungry Horse began operating using VARQ starting January 1, 2001. The purpose of this action is to provide more water for spring flow augmentation.

Hungry Horse will be operated during the months of January through March to achieve a high probability of water surface elevations within 0.5 foot of the flood control rule curve by April 10 and to refill by June 30, except as specifically provided by the TMT. A late snowmelt runoff may delay refill to sometime after June 30 in order to avoid excessive spill. The Bureau of Reclamation computes Hungry Horse Dam's April 10 elevation objective by linear interpolation between the March 31 and April 15 forecasted flood control elevations based on the March Final Water Supply Forecast (WSF). The April Final WSF is not received until April 7th of each year and then the flood control elevations are computed by the Corps of Engineers. Real-time operations during the months of June to March, April and May must account for changes in flood control, avoiding spill and transmission limitation.

In many years the flow from Hungry Horse required to meet minimum flows at Hungry Horse and at Columbia Falls draft the Hungry Horse below flood control.

### 4.2.4 VARQ

Reclamation began operating with VARQ flood control at Hungry Horse in 2001, pending completion of an Environmental Impact Statement. As stated above, the VARQ FEIS was made available for public review on April 21, 2006.

### 4.2.5 Refill

During the spring, the Action Agencies will operate Hungry Horse to contribute to meeting the flow objectives and refill by approximately June 30.

### 4.2.6 Summer anadromous fish

During the summer (July and August) Reclamation will operate Hungry Horse to help meet the flow objectives. The summer reservoir draft limit is 3,540 feet. This limit determines the maximum draft available for summer flow augmentation from Hungry Horse.

The NWPCC Mainstem Amendments call for an evaluation of the relative risks posed to downstream resident fish versus the benefits provided to anadromous fish by drafting the reservoir to 3,540 feet by September 30 in the lowest 20% of volume runoff years as measured at The Dalles Dam and to elevation 3550' by September 30 in all other years. The TMT will consider implementation of this plan during the fall season.

### 4.2.7 Reporting

Reclamation will fulfill the USFWS recommendation for annual and monthly reporting by contributing to the annual WMP and presenting weekly and biweekly reports of Hungry Horse operations through the TMT process.[2]

Reclamation will also fulfill the USFWS recommendation for reporting actual operations by making available pertinent historic elevations and flows as related to Hungry Horse Dam through its current website at http://www.usbr.gov/pn/hydromet/esatea.html

### 4.2.8 Minimum Flows and Ramp Rates

The following ramp rates will guide project operations to meet various purposes, including power production.

**Table 8.** Ramp rates prescribed for Hungry Horse Dam releases to protect resident fish and their food organisms in the Flathead River.

| **Daily and Hourly Maximum Ramp Up Rates for Hungry Horse Dam (as measured by daily flows, not daily averages, restricted by hourly rates).** | | |
|---|---|---|
| **Flow Range (measured at Columbia Falls)** | **Ramp Up Unit (Daily Max)** | **Ramp Up Unit (Hourly max)** |
| 3,200 - 6,000 cfs | Limit ramp up 1,800 cfs per day | 1,000 cfs/hour |
| > 6,000 - 8,000 cfs | Limit ramp up 1,800 cfs per day | 1,000 cfs/hour |
| > 8,000 - 10,000 cfs | Limit ramp up 3,600 cfs per day | 1,800 cfs/hour |
| > 10,000 cfs | No limit | 1,800 cfs/hour |

| **Daily and Hourly Maximum Ramp Down Rates for Hungry Horse Dam (as measured by daily flows, not daily averages, restricted by hourly rates)** | | |
|---|---|---|
| **Flow Range (measured at Columbia Falls)** | **Ramp Down Unit (Daily max)** | **Ramp Down Unit (Hourly max)** |
| 3,200 - 6,000 cfs | Limit ramp down to 600 cfs per day | 600 cfs/hour |
| > 6,000 - 8,000 cfs | Limit ramp down to 1,000 cfs per day | 600 cfs/hour |
| > 8,000 - 12,000 cfs | Limit ramp down to 2,000 cfs per day | 1,000 cfs/hour |
| > 12,000 cfs | Limit ramp down to 5,000 cfs per day | 1,800 cfs/hour |

Daily and hourly ramping rates may be exceeded during flood emergencies to protect health and public safety and in association with power or transmission emergencies.

Variances to ramping rates during years where runoff forecasting or storage shortfalls occur, or variances are necessary to provide augmentation water for other listed species, will be coordinated through the TMT process. This is expected in only the lowest 20$^{th}$ percentile water years.

Note: The ramp rates will be followed except when they would cause a unit(s) to operate in a zone that could result in premature wear or failure of the units. In this case the project will utilize a ramp rate, which allows all units to operate outside the rough zone. The Action Agencies will provide additional information to the USFWS describing operations outside the "rough zone."

The minimum outflow for Hungry Horse Dam will be determined monthly based on the Reclamation Water Supply Forecast (WSF) for the inflows into Hungry Horse for the period April 1 to August 31. The minimum flows is set monthly starting with the January forecast, and then set for the remainder of the year based on the March final runoff forecast. These forecasts will be provided by Reclamation to the TMT. If the April to August forecast is greater than 1,790 kaf, the minimum flow will be 900 cfs. If the forecast is less than 1,190 kaf, the minimum flow will be 400 cfs. If the forecast is between 1,190 and 1,790 kaf, the minimum flow will be linearly interpolated between 400 and 900 cfs.[3] The minimum flow from Hungry Horse can be lowered to 300 cfs for flood control operations in the Flathead Valley. The official flood stage for the Flathead River at Columbia Falls is 14 feet but Reclamation operates to 13 feet when feasible.

The minimum flow at Columbia Falls will be determined monthly based on the Reclamation Water Supply Forecast (WSF) for the inflows into Hungry Horse for the period April 1 to August 31. The minimum flow is set monthly starting with the January forecast, and then set for the remainder of the year based on the March final runoff forecast.. If the April to August forecast is greater than 1,790 kaf, the minimum flow will be 3,500 cfs. If the forecast is less than 1,190 kaf, the minimum flow will be 3,200 cfs. If the forecast is between 1,190 and 1,790 kaf, the minimum flow will be linearly interpolated between 3,200 and 3,500 cfs.

## *4.3 Albeni Falls Dam*

### 4.3.1 Fall draft for fish

The reservoir will be drafted by November 20th to an elevation [2055 to 2051] for Kokanee spawning. This elevation will be maintained as a minimum until Kokanee emergence ends. The elevation and date will be determined by current conditions and needs and a recommendation will be provided by TMT.

### 4.3.2 Spring Operations

The purpose of the following actions is to refill Albeni Falls as much as possible in order to achieve a high probability *Define "high probability" for this project and cite reference.*of reaching flood control upper rule curve elevation by April 10, for spring flows.

During the spring, the Action Agencies will operate the FCRPS to meet the flow and refill objectives at Albeni Falls. If both these objectives cannot be achieved, the TMT will make an in-season recommendation, weighing considerations unique to each particular year and project.

[3] USFWS BiOp at Section 3.A.1 Page 6

Because research results indicate that increased flows have more direct survival benefits for summer migrants than for spring migrants, depending upon the actual base spring flow being provided, modest reductions in spring flows to facilitate reservoir refill would generally be preferable to refill failure.

#### 4.3.3 Flood Control Draft

Albeni Falls will be operated during the winter season using standard flood control criteria.

#### 4.3.4 Refill

During the spring, Albeni Falls will be refilled in accordance with standard flood control criteria. The Action Agencies will operate Albeni Falls to meet the flow objectives and refill by approximately June 30.

#### 4.3.5 Albeni Falls Coordination

The Action Agencies, the USFWS, and Idaho Department of Fish & Game will meet annually to evaluate Lake Pend Oreille kokanee monitoring results and make necessary adjustments through subsequent in-season management. The purpose of this action is to review IDFG monitoring results and to ensure winter lake operation protocol is addressing the needs of kokanee spawning and hence, threatened bull trout, which feed on kokanee. IDFG and USFWS have proposed an annual decision tree as guidance for winter elevations of Lake Pend Oreille.

#### 4.3.6 Lake winter elevation

In 2007 IDFG and USFWS presented a draft decision-tree proposal to TMT for possible use in the future. This decision tree may assist TMT in deciding an appropriate winter operation level for Lake Pend Oreille. Albeni Falls Dam will operate to hold the lake winter elevation that is decided upon unless a change is necessary to meet flood damage reduction objectives.

### *4.4 Libby Dam*

#### 4.4.1 Spring Operations

The purpose of the following actions is to refill Libby as much as possible in order to achieve a high probability *Define "high probability" for this project and cite reference.*of reaching flood control upper rule curve elevation by April 10, for spring flows. Libby will provide flows for sturgeon and bull trout during spring, and salmon during summer, while attempting to minimize a double-peak in June. Based on adhering to the VARQ refill flood control guidance and providing the sturgeon flow operation, Libby Dam refill may occur by July 31.

During the spring, the Action Agencies will operate the FCRPS to meet the flow and refill objectives at Libby. If both these objectives cannot be achieved, the TMT will make an in-season recommendation, weighing considerations unique to each particular year and project. Because research results indicate that increased flows have more direct survival benefits for summer migrants than for spring migrants, depending upon the actual base spring flow being

provided, modest reductions in spring flows to facilitate reservoir refill would generally be preferable to refill failure.

### 4.4.2 Summer operations

During the summer, the Action Agencies draft Libby within the NOAA BiOp's specified draft limits based on flow recommendations provided by TMT. TMT considers a number of factors when developing its flow recommendations, such as: the status of the migration, attainment of flow objectives, water quality, and the effects that reservoir operations will have on other listed and resident fish populations.

### 4.4.3 Summer anadromous fish

During the summer migration season (July and August), the Action Agencies will operate Libby to help meet the flow objectives for juvenile salmon out-migration in the Columbia River. The summer reservoir draft limit is 2,439 feet, which determines the maximum draft available for summer flow augmentation from Libby. Arrangements for retention of July/August water in Lake Koocanusa is possible under a Libby-Canadian storage water exchange under the current Libby Coordination Agreement, which was signed February 16, 2000. However, this operation cannot be guaranteed in any given year because it must be mutually beneficial to the Canadian Entity and the U.S. Entity. To make such a determination, needed information, such as the magnitude of the water year, is not available until well into the migration season. This type of operation, if any, for a given water year is generally not finalized until June or July of that year. A benefit of this exchange agreement is to reduce or eliminate the second flow peak in the Kootenai River created by July/August salmon flow augmentation thus protecting bull trout and sturgeon. Additionally, the exchange agreement reduces the draft of Lake Koocanusa and increases upstream benefits

The NWPCC Mainstem Amendments call for an evaluation of the relative risks posed to resident fish versus the benefits provided to anadromous fish by drafting the reservoir to 2439' by September 30 in the lowest 20% of volume runoff years and to elevation 2449' by September 30 in all other years. The TMT will consider implementation of this plan during the late summer season.

### 4.4.4 Flood Control

The Corps will continue to use the new SOI forecast procedure in December to determine the December 31 flood control elevation. In water years of less than 95% of average the end of December draft elevation may be higher than 2411 feet. In water year of 88% of average the end of December target elevation is 2426 feet. The end of December elevation is a straight line sliding scale between 88% and 95%.

Libby will be operated during January through March to the Storage Reservation Diagram (SRD) developed for VARQ flood control. During the refill period from about April through July, Libby Dam will release flow in accordance with the refill guidance developed using the VARQ Operating Procedures at Libby Dam. The VARQ refill outflow will begin about 10 days prior to the Initial Controlled Flow (ICF) at The Dalles, and Libby outflow will be no lower than the

computed outflow. Changes to reduce the VARQ outflow will not occur unless a reduction is necessary for a short duration (one or two days) to protect human life and safety when river stage as measured at Bonners Ferry, Idaho, is at or below elevation 1764 feet.

### 4.4.5 Libby VARQ

During January through March, Libby will operate to the Storage Reservation Diagram (SRD) developed for VARQ flood control. During the refill period (generally 10 days prior to the Initial Controlled Flow (ICF) at The Dalles) from about mid to late April through July, Libby Dam will release flow in accordance with the refill guidance developed using the VARQ Operating Procedures. These procedures are attached to the Corps January 2007 Decision and Finding on Operation for Flood Control at Libby Dam. Libby outflow will be no lower than the computed outflow unless a reduction is necessary for a short duration (one or two days) to protect human life and safety to lower the stage at Bonners Ferry, Idaho, below elevation 1764 feet.

The VARQ refill outflow will be recalculated each week considering new forecasts (or review of weather conditions) and outflows will be adjusted in accordingly each week. If the VARQ refill guidance requires discharges above powerhouse capacity, spill from Libby Dam will occur.

Libby Dam will provide the tiered volume for sturgeon flows as described in the 2006 USFWS BiOp. The outflow provided for sturgeon will be equal to or greater than the VARQ refill outflow. An accounting method will be developed prior to commencement of the sturgeon tiered flow release.

### 4.4.6 Libby Storage Reservation Diagram and Runoff Volume Forecast Procedure

The Variable 31 December draft point and the December forecast are used to determine an appropriate end of December flood control elevation.

### 4.4.7 Sturgeon Operation

Libby Dam will provide the tiered volume for sturgeon flows as described in the 2006 USFWS BiOp. The outflow provided for sturgeon must be equal to or greater than the VARQ outflow. An accounting method will be developed prior to commencement of the sturgeon tiered flow release.

### 4.4.8 TDG and Water temperature monitoring

Water temperature profiles in the south end (near-dam, or forebay area) of Lake Koocanusa during May and June will be monitored to provide information necessary for timing of sturgeon spawning/rearing flow augmentation. Also, water temperature profiles in the forebay are used to determine whether warmer temperatures may be provided to assist sturgeon spawning

A TDG monitoring sensor at a fixed monitoring station below Libby Dam is on the spillway side of the river (left bank, looking downstream) directly across the river from the USGS stage gage.

During the winter months from November through January, the water temperature in the Libby reservoir and downstream at Bonners Ferry may be monitored and enhanced for burbot needs near Bonners Ferry. During the periods when burbot move upstream (typically December and January) Libby reservoir may release cold water.

### 4.4.9 Coordination

The Action Agencies will continue to coordinate Libby operations at TMT.

### 4.4.10 Sturgeon

The purpose of the actions below is to provide water for sturgeon spawning.

Water will be stored in Libby reservoir and used to supply water volume during May and June for sturgeon flows, following the "tiered" approach as defined in the 2004 Supplemental Biological Assessment (BA supplement) and 2006 USFWS Biological Opinion, and as summarized in the table below. This water will be in addition to storage needs for listed bull trout, salmon, and will be measured above the 4,000 cfs minimum releases from Libby. Accounting on these total tiered volumes will begin when the USFWS determines benefits to conservation of sturgeon are most likely to occur. Sturgeon flows will generally be initiated between mid-May and the end of June to augment lower basin runoff entering the Kootenai River below Libby Dam, consistent with the BA supplement, Kootenai River Ecosystem Function Restoration Flow Plan Implementation Protocol and 2006 BiOp.

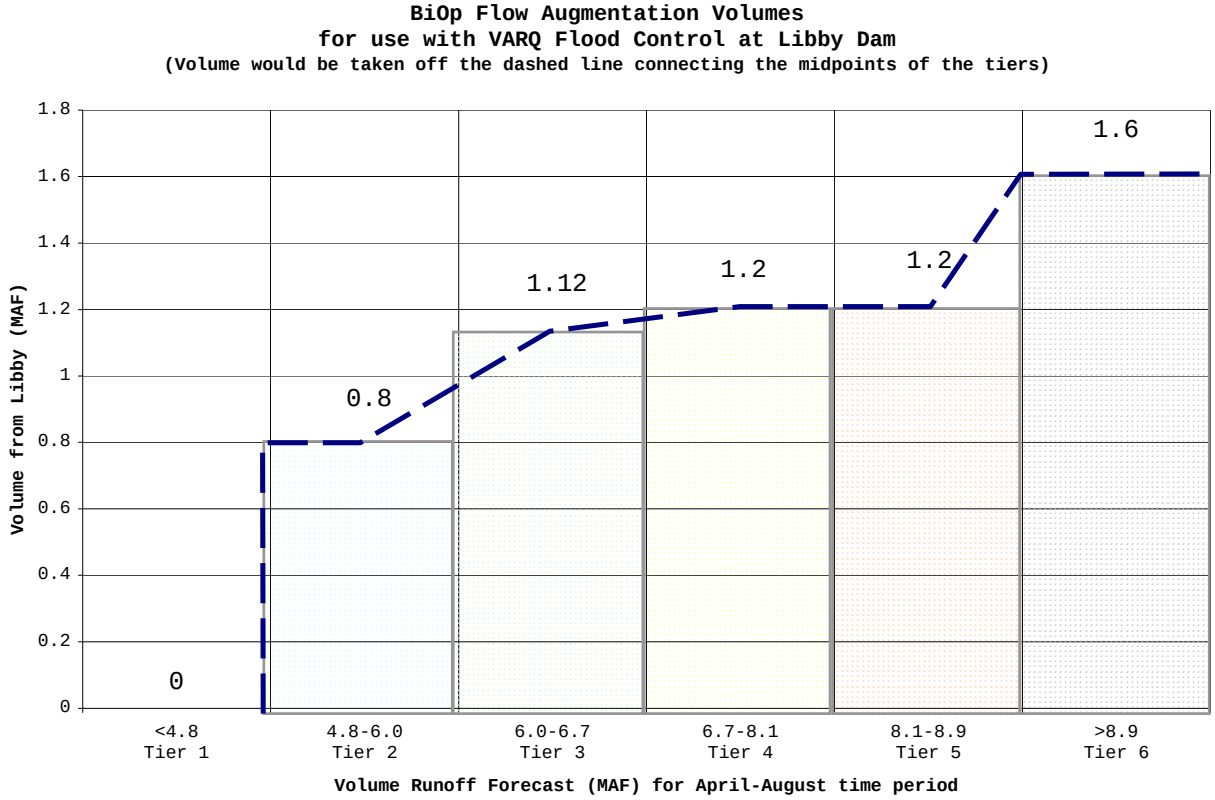


**Table 5.** "Tiered" volumes of water for sturgeon flow enhancement to be released from Libby Dam according to the Libby May final forecast of April - August volume. Actual flow releases would be shaped according to seasonal requests from the USFWS and in-season management of water actually available.

The tiered sturgeon volume and the release operations for that volume in 2007 have not been determined at this time (see 7.1.2). TMT will coordinate with USFWS for 2007 sturgeon operations.

Efforts will be coordinated to attempt to limit sturgeon-spawning flows so they do not exceed a river stage elevation of 1,764 feet at Bonners Ferry. (Note: This may not always be possible during periods of unusual local runoff that may be beyond the control of Libby Dam.)

During sturgeon recruitment flow periods, local inflow will be allowed to supplement Libby Dam releases to the maximum extent feasible, while assuring public safety by monitoring water levels throughout relevant areas of the Kootenai River basin.

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### 4.4.11 Coordination

Libby Dam flows will be regulated consistent with existing treaties, Libby Project authorization for public safety, other laws, and the 1938 International Joint Commission order to achieve water volumes, water velocities, water depths, and water temperature at a time to maximize the probability of allowing significant sturgeon recruitment, while also meeting flood damage reduction objectives.

### 4.4.12 Bull Trout

Per the 2006 USFWS BiOP, the sliding scale bull trout minimum flow will be provided from 15 May through 30 September. The bull trout minimum flow may be from 6,000 cfs to 9,000 cfs, and minimum flows of 4,000 cfs will be provided for the rest of the year. The table below show how to determine the bull trout minimum flow.

**Table 6.** Minimum bull trout releases from Libby Dam.

| Forecast runoff Volume (maf*) at Libby | Min bull trout flows between sturgeon and salmon flows |
|---|---|
| 0.00 < forecast < 4.80 | 6 kcfs |
| 4.80 < forecast < 6.00 | 7 kcfs |
| 6.00 < forecast < 6.70 | 8 kcfs |
| 6.70 < forecast < 8.10 | 9 kcfs |
| 8.10 < forecast < 8.90 | 9 kcfs |
| 8.90 < forecast | 9 kcfs |

**maf = million acre-feet*

### 4.4.13 Ramp Rates and Daily Shaping

The purpose of the following actions is to provide better conditions for resident fish by limiting the flow fluctuations and setting minimum flow levels. These new ramp rates were proposed in the BA supplement to minimize impacts to bull trout and are included in the 2006 USFWS Biop.

The following ramp rates will guide project operations to meet various purposes, including power production.

**Table 7.** Prescribed ramp rates to protect resident fish and their food organisms, and to minimize levee erosion, in the Kootenai River.

| | | Summer (05/01 - 09/31) | |
|---|---|---|---|
| | | Hourly | Daily |
| Ramp Up | 4-6 kcfs | 2500 cfs | 1 unit |
| | 6-9 kcfs | 2500 cfs | 1 unit |
| | 9-16 kcfs | 2500 cfs | 2 units |
| | 16-QPHC | 5000 cfs | 2 units |
| Ramp Down | 4-6 kcfs | 500 cfs | 500 cfs |
| | 6-9 kcfs | 500 cfs | 1000 cfs |
| | 9-16 kcfs | 1000 cfs | 2000 cfs |
| | 16-QPHC | 3500 cfs | 1 unit |

| | | Winter (10/01 - 04/30) | |
|---|---|---|---|
| | | Hourly | Daily |
| Ramp Up | 4-6 kcfs | 2000 cfs | 1 unit |
| | 6-9 kcfs | 2000 cfs | 1 unit |
| | 9-16 kcfs | 3500 cfs | 2 units |
| | 16-QPHC | 7000 cfs | 2 units |
| Ramp Down | 4-6 kcfs | 500 cfs | 1000 cfs |
| | 6-9 kcfs | 500 cfs | 2500 cfs |
| | 9-16 kcfs | 1000 cfs | 1 unit |
| | 16-QPHC | 3500 cfs | 1 unit |

(USFWS 2006 BiOp at Description of the proposed action, page 7, Table 1.

Daily and hourly ramping rates may be exceeded during flood emergencies to protect health and public safety and in association with power or transmission emergencies.

Variances to these ramping rates during years when water supply forecasting errors overestimate actual runoff, or variances are necessary to provide augmentation water for other listed species or other purposes, will be coordinated through the TMT process. This is expected in only the lowest 20th percentile water years.

Note: At the project, the ramp rates will be followed except when they would cause a unit(s) to operate in the rough zone, a zone of chaotic flow in which all parts of a unit are subject to increased vibration and cavitation that could result in premature wear or failure of the units. In this case the project will utilize a ramp rate, which allows all units to operate outside the rough zone.

### 4.4.14 Burbot

Providing low flows and/or low temperatures from Libby Dam to aid upstream migration of burbot to spawning areas above Kootenay Lake on the Kootenai River in Idaho is considered each winter. These low flows and/or temperatures may occur over several periods of time or

may last for an extended period from December through February. The details of this operation for 2007 are being developed and may be included in the fall/winter update. An interagency Memorandum of Agreement for this species was completed in June 2005. Use of VARQ and implementation of the variable end of December flood control target elevation may aid this operation in years with below average runoff forecasts, this variable December draft limit may help when it is implemented.

## *4.5 Grand Coulee Dam*

### 4.5.1 Spring Operations

The purpose of the following actions is to refill Grand Coulee, Hungry Horse as much as possible in order to achieve a high probability *Define "high probability" for this project and cite reference.*of reaching flood control upper rule curve elevation by April 10, for spring flows. Grand Coulee will operate to refill by June 30 to provide summer flow augmentation, except as specifically provided by the TMT.

During the spring, the Action Agencies will operate the FCRPS to meet the flow and refill objectives at Grand Coulee. If both these objectives cannot be achieved, the TMT will make an in-season recommendation, weighing considerations unique to each particular year and project. Because research results indicate that increased flows have more direct survival benefits for summer migrants than for spring migrants, depending upon the actual base spring flow being provided, modest reductions in spring flows to facilitate reservoir refill would generally be preferable to refill failure.

### 4.5.2 Summer Operations

During the summer, the Action Agencies draft mainstem storage reservoirs (Libby, Hungry Horse, Dworshak, Grand Coulee, Banks Lake) within the NOAA BiOp's specified draft limits, based on flow recommendations provided by TMT. TMT considers a number of factors when developing its flow recommendations, such as: the status of the migration, attainment of flow objectives, water quality, and the effects that reservoir operations will have on other listed and resident fish populations.

Opportunities to shift system flood control requirements from Brownlee and Dworshak to Grand Coulee will be considered. These shifts may be implemented after coordination with TMT. The purpose of this action is to provide more water for flow augmentation in the lower Snake River. This will occur when the shifts will not compromise flood control and they have been coordinated.

### 4.5.3 Summer anadromous fish

During the summer (July and August) the Action Agencies will operate Grand Coulee to help meet the flow objectives for juvenile salmon out migration. The July Final forecast produced by RFC determines the summer reservoir draft limit. The draft limit is 1,280 feet in years when the April through August forecast for The Dalles is equal to or exceeds 92 maf. If the forecast is less

than 92 maf the draft limit will be 1,278 feet. This limit determines the maximum draft available for summer flow augmentation from Grand Coulee.

### 4.5.4 Banks Lake Summer Draft

Banks Lake will be drafted to elevation 1,565 feet by the end of August. The purpose of this action is to provide more water for summer flow augmentation.

### 4.5.5 Flood Control

Grand Coulee will be operated during the months of January through March in order to achieve an 85% probability of water surface elevations within 0.5 foot of the flood control rule curve by April 10, and the TMT may recommend other specific operations. The Bureau of Reclamation computes Grand Coulee Dam's April 10 elevation objective by linear interpolation between the March 31 and April 15 forecasted flood control elevations based on the March Final Water Supply Forecast (WSF). The April Final WSF is not received until April 7$^{th}$ of each year and then the flood control elevations are computed by the Corps of Engineers. Real-time operations during the months of April and May must account for the flows at Priest Rapids Dam, changes in the amount of flood control shift from Dworshak or Brownlee, changes in flood control and draft rate limitations.

### 4.5.6 Refill

During the spring, the Action Agencies will operate Grand Coulee to refill by approximately June 30.

### 4.5.7 Project Maintenance

Drum gate maintenance is planned to occur during April and May annually. The reservoir must be at or below elevation 1255 feet to accomplish this work. Typically the flood control elevations during this time of year provide the required elevations and sufficient time to accomplish this work. The drum gates are extremely important dam safety features and must be maintained at a satisfactory level. Therefore, there will be some years when the project must be operated to accomplish this work. Reclamation will coordinate such an operation with TMT.

### 4.5.8 Kokanee

Fill Grand Coulee to 1,283 feet by September 30 and maintain an elevation 1,283 to 1,285 feet or greater through the middle of November for brood stock collection, spawning access to tributaries, and increased retention time during a critical period for zooplankton production.

## 4.6 Priest Rapids Dam

### 4.6.1 Spring operations

The spring flow objective at Priest Rapids Dam is 135 kcfs. The planning dates are from April 10 to June 30. There is no summer flow objective for Priest Rapids Dam.

### 4.6.2 Hanford Reach Protection Flows

Grant County PUD limits outflow from Priest Rapids Dam to minimize juvenile fish stranding.

### 4.6.3 Vernita Bar Protection Flows

Flow management occurs from Priest Rapids Dam in the fall to ensure that fall chinook salmon establish redds (spawn) at an elevation that enables the redds to have a high likelihood of not being dewatered prior to emergence of fry. Daytime flows are regulated to a range between 50 and 70 kcfs during October and November when redds are being established. Flow fluctuations are limited from the time of fish emergence in early April through early June. (Note: This is included pursuant to the Vernita Bar Settlement Agreement and the annual Hanford reach stranding agreement.)

## 4.7 Upper Snake Dams

### 4.7.1 Upper Snake River Reservoir Operation for Flow Augmentation

The purpose of this action is to provide water from the upper Snake Reservoirs for flow augmentation.

Reclamation will attempt to provide 487 kaf of flow augmentation from the Reclamation projects in the upper Snake River basin consistent with its Proposed Action as described in the November 2004 Biological Assessment for O&M of its projects in the Snake River basin above Brownlee. Reclamation's flow augmentation program is dependent on willing sellers and must be consistent with Idaho State law.

## 4.8 Dworshak Dam

### 4.8.1 Spring Operations

The purpose of the following actions is to refill Dworshak as much as possible in order to achieve a high probability *Define "high probability" for this project and cite reference.*of reaching flood control upper rule curve elevation by April 10, for spring flows. Summer flow augmentation provided from Dworshak may cool water temperatures in the lower Snake River.

During the spring, the Action Agencies will operate the FCRPS to meet the flow and refill objectives at Dworshak. If both these objectives cannot be achieved, the TMT will make an in-season recommendation, weighing considerations unique to each particular year and project. Because research results indicate that increased flows have more direct survival benefits for summer migrants than for spring migrants, depending upon the actual base spring flow being

provided, modest reductions in spring flows to facilitate reservoir refill would generally be preferable to refill failure.

### 4.8.2 Flow increase for Dworshak National Fish Hatchery release.

Release 4 – 6 kcfs from Dworshak in order to move juvenile fish into the mainstem Clearwater River during the spring hatchery release.

### 4.8.3 Summer Operations

During the summer, the Action Agencies draft Dworshak within the NOAA BiOp's specified draft limits based on flow recommendations provided by TMT. TMT considers a number of factors when developing its flow recommendations, such as: the status of the migration, attainment of flow objectives, water quality, and the effects that reservoir operations will have on other listed and resident fish populations.

Opportunities to shift system flood control requirements from Brownlee and Dworshak to Grand Coulee will be considered. These shifts may be implemented after coordination with TMT. The purpose of this action is to provide more water for flow augmentation in the lower Snake River. This will occur when the shifts will not compromise flood control and they have been coordinated.

### 4.8.4 Summer anadromous fish

During the summer (July and August) the Action Agencies will operate Dworshak to help meet the flow objectives. The summer reservoir draft limit is 1,520 feet. This limit determines the maximum draft available for summer flow augmentation from Dworshak. The Action Agencies plan to draft Dworshak to 1520 feet in September. The extension of the draft limit into September reflects assumed releases of about 200 kaf consistent with the agreement with the Nez Perce Tribe and the Snake River Basin Adjudication process.

### 4.8.5 Flood Control

Dworshak will be operated during the winter season in order to achieve a high probability of water surface elevations within 0.5 foot of the flood control rule curve by April 10 and to refill by June 30, except as specifically recommended by the TMT.

### 4.8.6 Refill

During the spring, the Action Agencies will operate Dworshak to meet the flow objectives and refill by approximately June 30.

After summer fish operations are completed, flows from Dworshak will be limited to minimum one turbine operation (approximately 1,500 cfs) unless higher flows are required for flood

control, emergencies, chum flows below Bonneville Dam, or other project uses. The purpose of these actions is to manage the filling of Dworshak reservoir while operating the project for multiple uses. Flows from Dworshak also may be maintained above minimum flow if Corps analysis determines there is flexibility to release a volume of water above minimum flow and still maintain a high reliability of meeting spring refill objectives.

#### 4.8.7 Water quality

During the summer, releases will be made from Dworshak to attempt to maintain water temperatures at the Lower Granite tailrace fixed monitoring site at or below 68 F. Although a previous FCRPS BiOp stated the goal was to maintain the forebay at this temperature, modeling and experience have demonstrated that the tailrace temperature is more representative of river conditions and temperature exposure of migrating salmonids. The purpose of this action is to improve water quality (by lowering water temperature) in the lower Snake River.

### *4.9 Brownlee*

Opportunities to shift system flood control requirements from Brownlee and Dworshak to Grand Coulee will be considered. These shifts may be implemented after coordination with TMT. The purpose of this action is to provide more water for flow augmentation in the lower Snake River. This will occur when the shifts will not compromise flood control and they have been coordinated.

### *4.10 Lower Granite Dam*

#### 4.10.1 Reservoir Operations

Lower Granite will operate within 1 foot of Minimum Operating Pool (MOP) from approximately April 3 until small numbers of juvenile migrants are present. This normally occurs in late August. Lower Granite Dam will not return to normal operating pool until enough natural cooling has occurred in the fall, generally after October 1. TMT will provide a recommendation. The purpose of this action is to provide a smaller reservoir cross section to reduce juvenile salmon travel time and reduce flow fluctuations. Elevations may be modified to maintain the minimum navigation channel requirements.

#### 4.10.2 Turbine Operations

To enhance juvenile passage survival, turbines at Lower Granite will be operated within 1% of peak efficiency during the juvenile and adult migration seasons (April 1 through October 31). (See appendix C, Corps of Engineers 2007 Fish Passage Plan)

#### 4.10.3 Spring operations

The April final runoff volume forecast at Lower Granite Dam for April to July determines the spring flow objective at Lower Granite Dam. When the forecast is less than 16 million acre-feet (maf) the flow objective will be 85 kcfs. If the forecast is between 16 maf and 20 maf the flow objective will be linearly interpolated between 85 kcfs and 100 kcfs. If the forecast is greater

than 20 maf the flow objective will be 100 kcfs. The planning dates for the spring flow objective are from April 3 to June 20.

#### 4.10.4 Summer operations

The June final runoff volume forecast at Lower Granite Dam for April to July determines the summer flow objective at Lower Granite Dam. When the forecast is less than 16 maf the flow objective will be 50 kcfs. If the forecast is between 16 maf and 28 maf the flow objective will be linearly interpolated between 50 kcfs and 55 kcfs. If the forecast is greater than 28 maf the flow objective will be 55 kcfs. The planning dates for the summer flow objective are from June 21 to August 31.

#### 4.10.5 Spill Operations

This 2004 UPA hydro-strategy for listed species of anadromous fish addresses spill at certain FCRPS projects to provide improved survival and better project passage for juvenile fish while avoiding adult fallback problems and creating greater than 120% saturation levels of total dissolved gas in the tail race and 115 % at the designated downstream monitoring stations at the forebay of the next dam downstream.

The dates for spring and summer spill for juvenile fish migration range in the Snake River are from April 3 to June 20 and June 21 – August 31

### *4.11 Little Goose Dam*

#### 4.11.1 Reservoir Operations

Little Goose will operate within 1 foot of Minimum Operating Pool (MOP) from approximately April 3 until small numbers of juvenile migrants are present. This normally occurs in late August. The purpose of this action is to provide a smaller reservoir cross section to reduce juvenile salmon travel time and reduce flow fluctuations. Elevations may be modified to maintain the minimum navigation channel requirements.

#### 4.11.2 Turbine Operations

To enhance juvenile passage survival, turbines at Little Goose will be operated within 1% of peak efficiency during the juvenile and adult migration seasons (April 1 through October 31). (See appendix C, Corps of Engineers 2007 Fish Passage Plan)

#### 4.11.3 Spill Operations

This 2004 UPA hydro-strategy for listed species of anadromous fish addresses spill at certain FCRPS projects to provide improved survival and better project passage for juvenile fish while avoiding adult fallback problems and creating greater than 120% saturation levels of total dissolved gas in the tail race and 115 % at the designated downstream monitoring stations at the forebay of the next dam downstream.

The dates for spring and summer spill for juvenile fish migration range in the Snake River are from April 3 to June 20 and June 21 – August 31

## *4.12 Lower Monumental Dam*

### 4.12.1 Reservoir Operations

Lower Monumental will operate within 1 foot of Minimum Operating Pool (MOP) from approximately April 3 until small numbers of juvenile migrants are present. This normally occurs in late August. The purpose of this action is to provide a smaller reservoir cross section to reduce juvenile salmon travel time and reduce flow fluctuations. Elevations may be modified to maintain the minimum navigation channel requirements.

### 4.12.2 Turbine Operations

To enhance juvenile passage survival, turbines at Lower Monumental will be operated within 1% of peak efficiency during the juvenile and adult migration seasons (April 1 through October 31). (See appendix C, Corps of Engineers 2007 Fish Passage Plan)

### 4.12.3 Spill Operations

This 2004 UPA hydro-strategy for listed species of anadromous fish addresses spill at certain FCRPS projects to provide improved survival and better project passage for juvenile fish while avoiding adult fallback problems and creating greater than 120% saturation levels of total dissolved gas in the tail race and 115 % at the designated downstream monitoring stations at the forebay of the next dam downstream.

The dates for spring and summer spill for juvenile fish migration range in the Snake River are from April 3 to June 20 and June 21 – August 31.

## *4.13 Ice Harbor Dam*

### 4.13.1 Reservoir Operations

Ice Harbor will operate within 1 foot of Minimum Operating Pool (MOP) from approximately April 3 until small numbers of juvenile migrants are present. This normally occurs in late August. The purpose of this action is to provide a smaller reservoir cross section to reduce juvenile salmon travel time and reduce flow fluctuations. Elevations may be modified to maintain the minimum navigation channel requirements.

### 4.13.2 Turbine Operations

To enhance juvenile passage survival, turbines Ice Harbor will be operated within 1% of peak efficiency during the juvenile and adult migration seasons (April 1 through October 31). (See appendix C, Corps of Engineers 2007 Fish Passage Plan)

### 4.13.3 Spill Operations

This 2004 UPA hydro-strategy for listed species of anadromous fish addresses spill at certain FCRPS projects to provide improved survival and better project passage for juvenile fish while avoiding adult fallback problems and creating greater than 120% saturation levels of total dissolved gas in the tail race and 115 % at the designated downstream monitoring stations at the forebay of the next dam downstream.

The dates for spring and summer spill for juvenile fish migration range in the Snake River are from April 3 to June 20 and June 21 – August 31

## *4.14 McNary Dam*

### 4.14.1 Turbine Operations

To enhance juvenile passage survival, turbines at McNary projects will be operated within 1% of peak efficiency during the juvenile and adult migration seasons (April 1 through October 31).

### 4.14.2 Spring Operations

The spring flow objective at McNary Dam is set according to the April final runoff volume forecast at The Dalles Dam for April to August. When the forecast is less than 80 maf the flow objective will be 220 kcfs. If the forecast is between 80 maf and 92 maf the flow objective will be linearly interpolated between 220 kcfs and 260 kcfs. If the forecast is greater than 92 maf the flow objective will be 260 kcfs. The planning dates for the spring flow objective will be from April 10 to June 30.

Weekend flows are often lower than weekday flows due to less electrical demand in the region. During the spring and summer migration period (April through August), the Action Agencies will strive to maintain MCN flows during the weekend at a level which is at least 80% of the previous weekday average.

### 4.14.3 Summer Operations

The summer flow objective at McNary Dam is 200 kcfs. The planning dates for the summer flow objective will be from July 1 to August 31.

### 4.14.4 Spill Operations

This 2004 UPA hydro-strategy for listed species of anadromous fish addresses spill at certain FCRPS projects to provide improved survival and better project passage for juvenile fish while avoiding adult fallback problems and creating greater than 120% saturation levels of total

dissolved gas in the tail race and 115 % at the designated downstream monitoring stations at the forebay of the next dam downstream.

The dates for spring and summer spill for juvenile fish migration in the lower Columbia River are from April 10 to June 30 and July 1 – August 31.

#### 4.14.5 Waterfowl nesting

To improve waterfowl nesting conditions in the McNary pool between March and May each year, we operate the pool in the top 1 foot of the pool range for several hours every 4 days.

#### 4.14.6 Waterfowl hunting enhancement

In order to enhance Waterfowl hunting, we hold the McNary pool constant several times a week from October to January.

### *4.15 John Day Dam*

#### 4.15.1 Reservoir Operations

John Day pool will operate within a 1½-foot range of the minimum level that provides irrigation pumping from April 10 to September 30. The purpose of this action is to provide a smaller reservoir cross section to reduce juvenile salmon travel time.

#### 4.15.2 Turbine Operations

To enhance juvenile passage survival, turbines at all the Lower Columbia projects will be operated within 1% of peak efficiency during the juvenile and adult migration seasons (April 1 through October 31).

#### 4.15.3 Spill Operations

This 2004 UPA hydro-strategy for listed species of anadromous fish addresses spill at certain FCRPS projects to provide improved survival and better project passage for juvenile fish while avoiding adult fallback problems and creating greater than 120% saturation levels of total dissolved gas in the tail race and 115 % at the designated downstream monitoring stations at the forebay of the next dam downstream.

The dates for spring and summer spill for juvenile fish migration in the lower Columbia River are from April 10 to June 30 and July 1 – August 31.

#### 4.15.4 Goose nesting

To encourage geese to nest in areas that are not typically inundated by frequent fluctuations in the John Day pool between March and May each year, we operate the pool in the top 1 foot of the pool range for several hours every 4 days.

#### 4.15.5 Waterfowl hunting enhancement

In order to enhance Waterfowl hunting, we hold the John Day pool constant several times a week from October to January.

#### 4.15.6 Tribal Fishing

To accommodate tribal fishing, the John Day pool may operate within a 1.5 foot operation range during tribal fishing seasons.

## *4.16 The Dalles Dam*

#### 4.16.1 Turbine Operations

To enhance juvenile passage survival, turbines at all the Lower Columbia projects will be operated within 1% of peak efficiency during the juvenile and adult migration seasons (April 1 through October 31).

#### 4.16.2 Spill Operations

This 2004 UPA hydro-strategy for listed species of anadromous fish addresses spill at certain FCRPS projects to provide improved survival and better project passage for juvenile fish while avoiding adult fallback problems and creating greater than 120% saturation levels of total dissolved gas in the tail race and 115 % at the designated downstream monitoring stations at the forebay of the next dam downstream.

The dates for spring and summer spill for juvenile fish migration in the lower Columbia River are from April 10 to June 30 and July 1 – August 31.

## *4.17 Bonneville Dam*

#### 4.17.1 Turbine Operations

To enhance juvenile passage survival, turbines at all the Lower Columbia projects will be operated within 1% of peak efficiency during the juvenile and adult migration seasons (April 1 through October 31).

#### 4.17.2 Spill Operations

This 2004 UPA hydro-strategy for listed species of anadromous fish addresses spill at certain FCRPS projects to provide improved survival and better project passage for juvenile fish while avoiding adult fallback problems and creating greater than 120% saturation levels of total dissolved gas in the tail race and 115 % at the designated downstream monitoring stations at the forebay of the next dam downstream.

The dates for spring and summer spill for juvenile fish migration in the lower Columbia River are from April 10 to June 30 and July 1 – August 31.

#### 4.17.3 Tribal Fishing

To accommodate tribal fishing, the Bonneville pool is normally held between elevation 75.0 and 76.5 feet during tribal fishing seasons.

#### 4.17.4 Spring Creek Hatchery Release

The U.S. Fish and Wildlife Service typically releases between 7 and 8 million tule fall chinook fry from the Spring Creek National Fish Hatchery upstream of Bonneville Dam in March. The WY 2008 operation, which could include spill and/or corner collector operations, will be coordinated and included in the 2008 Spring Summer Update to the WMP.

# 5 Specific Operations

## *5.1 Chum operations*

The Action Agencies plan to operate the FCRPS to provide flows to support chum salmon spawning, incubation and egress in the Ives/Pierce Islands Complex, Hamilton Creek and Hardy Creek below Bonneville Dam.

The Ives/Pierce Islands Complex below Bonneville Dam represents about 10% of the natural spawning area for the ESA listed Columbia River chum. Non-listed lower Columbia River bright fall Chinook also spawn in the area. The 2004 BiOp recognizes that access to spawning habitat in the Ives/Pierce area is primarily a function of the water surface elevations greater than 11.5 feet above mean sea level (msl). Managing the water surface elevation with the operation of Bonneville Dam has proven to be an effective means of protecting this spawning area.

Providing spawning access to Hamilton Creek and Hardy Creek is similarly a function of sufficient tailwater elevation but must be coupled with sufficient rainfall events to get the creeks flowing sufficiently.

As addressed in the 2004 UPA and BiOp,chum salmon spawning operations are not to adversely affect implementation of higher priority actions, such as reservoir refill, or the ability to provide operations consistent with the Vernita Bar agreement. If the UPA and BiOp objectives cannot be met, the Action Agencies will work with NOAA Fisheries and the regional salmon managers to identify operations that would best benefit salmon while maintaining other fish protection measures.

### 5.1.1 Spawning Phase

During the spawning phase of the Bonneville/Ives Island chum salmon life cycle, the tailwater elevation will be held at minimum of 11.5 – 11.7 feet during the daylight hours and 15.1 feet (~175 - 185) during night time hours. This operation is generally requested (per the 2004 UPA and BiOp) to begin by TMT when a significant number of chum salmon present are spawning. Normally this occurs in the first week of November but can occur in late October through mid-November. The flow associated with providing an 11.5 foot msl tailwater is generally assumed to be between 110 kcfs and 125 kcfs. This is a conservative approach to managing chum spawning which is intended to discourage redd development at higher elevations which cannot be maintained through the incubation period. If higher flows materialize, the protection level may be increased or a decision needs to be made whether or not redds at high elevations will be protected.

During non-daylight hours the tailwater elevation generally increases due to the nature of the operation required to maintain a stable tailwater during the day. The volume of water held over during the day must generally be released at night. This operation is difficult to maintain at all times because of the influence of significant rain events that occur below GCL, and Bonneville Dam is nearly three hundred miles below the nearest storage reservoir. makes.

Research performed in 2005 to asses the impacts of higher flows (day and night) on chum salmon redd development by Tiffen (cite Tiffen, USGS if published) indicates that increases in flows above 175 kcfs delayed spawning until flows dropped back to base levels (125 kcfs) but did not force fish to abandon their redds and search for new locations. Additional research in the fall of 2006 should refine the effects of elevated flows and variable tailwater elevations on chum salmon spawning behavior and redd site selection.

### 5.1.2 Incubation and Egress

ODFW will determine when chum spawning is completed, this usually occurs around December 23rd. Then the operation is shifted to provide a tailwater elevation equal to or greater than the elevation of the highest established redds established by TMT. This elevation is typically around 11.3 or 11.5 feet msl during normal water years. This operation continues until the completion of emergence and egress which usually extends through to the spring flow management season starting around April 10. At that time spring flow augmentation volumes generally provide sufficient flows to maintain the protection elevations necessary. If the emergence period extends beyond April 10th and the tailwater is being maintained, TMT will need to discuss the impacts of TDG associated with spill for fish in the gravel. A delay in the start of spill at BON may be needed.

### 5.1.3 Typical Operation Specifications

During an average year, the following operation should begin in the first week of November or when fish arrive in sufficient numbers:

Bonneville project tailwater is held to the elevation range 11.3' - 11.7' between 0700 - 1900 hours. A project tailwater elevation of 11.7' must not be exceeded in any hour.

Tailwater will be measured 0.9 miles downstream from the first powerhouse, 50 feet upstream from Tanner Creek and at R.M. 144.5. This is the "project tailwater" as opposed to the powerhouse tailwater.

After spawning is declared complete, the TMT establishes a recommended protection level considering the number of redds above the protection level provided during the operation to date. The protection elevation is then held as a minimum not to be exceeded in any hour until the end of emergence and egress.

After emergence and egress is declared complete by TMT, chum operations end.

### 5.1.4 General Chum Operation Considerations

1. Operating Bonneville Dam to meet the minimum effective tailwater elevation of 11.5 feet or greater cannot be sustained over the needed duration of November through April exclusively from water stored in upstream reservoirs.

2. Augmenting flows for chum can significantly diminish the stored water available for migration of salmon in the spring.

3. Early season forecasts can be used by TMT to inform recommendations for spawning elevations below Bonneville. Recommendations for tailwater elevations at 11.5' is prudent in most years.

4. Tides, precipitation, increases in incremental flows below Grand Coulee, the flow in the Willamette River and the operation of Bonneville Dam can all contribute to minimizing the impact on the upstream storage reservoirs.

5. Requests to start the chum operation or change the current protection level should consider that the water from Grand Coulee Dam takes a few days to arrive at Bonneville Dam. If the start or a change is expected to occur over a weekend the request must come by at least Wednesday of that week.

6. Incremental flows added to the river downstream of Grand Coulee are difficult to predict and can raise the daytime tailwater elevation above the planned elevation. High night time spikes in temperature of short duration can be used to discourage redd development in low velocity areas at night.

7. High flows from the Willamette River can affect the tailwater at Bonneville Dam significantly by providing low velocity access to some areas in the Ives/Pierce complex. These areas may be difficult to protect once the Willamette recedes.

8. It is not possible to operate the system to provide desired tailwater elevations at spawning areas downstream of the Ives/Pierce complex (i.e. Multnomah Falls/I-205).

9. Any spill required for the March release of the Spring Creek Hatchery including the use of the corner collector can produce high TDG levels that may impact emerging chum salmon at a very vulnerable stage in their lifecycle

10. When spring flows are low and the spill season has begun it might be necessary to delay spill at Bonneville Dam to avoid impacting any emerging chum with excess TDG.

### 5.1.5 Considerations for Dewatering Chum Redds

While a conservative approach to managing the quantity of water used during spawning reduces the risk of confronting a decision to dewater redds, it does not eliminate dewatering as a possibility. The conditions in each year vary too dramatically to allow for the development of set dewatering criteria, therefore he basis for a dewatering decision depends greatly on in-season conditions and are best made in the Regional Forum process. Factors that should be considered in making a dewatering decision include:

- The number and percentage of the total redds which would be affected by the decision
- The percentage of the total chum population that spawned in the creeks
- The percentage of the total chum population that spawned at other locations
- The component of the overall population that these redds represent
- Status of the FCRPS reservoir elevations
- Expected benefit to reservoir levels and river operations which would be provided by the dewatering decision
- Precipitation and runoff forecasts
- Expected river operations due to power market environment
- Status of the upriver listed stocks
- Existence and status of a brood contingency plan

### 5.1.6 Dewatering Options

Consideration of options to minimize the impacts should a decision be made to lower the protection level for the spawning, incubation and egress follow:.

1. If water supply conditions indicate that it is not possible to maintain this minimum tailwater elevation at Bonneville Dam, flow will be provided at times during the chum-emergence season to allow juveniles to depart from Hamilton and Hardy Creeks. Details will be set through coordination in TMT.

2. Early season forecasts can be used by TMT to determine a level of caution when choosing the spawning elevations to provide below Bonneville. A general apprehension to provide tailwater elevations above 11.5’ is prudent in most years. Fall precipitation

can lead to chum spawning at higher elevations than intended. It may be difficult to commit to providing those elevations without a solid water supply forecast.

3. Manage flows below what is necessary for mainstem spawning to discourage redds from being established in the area.

4. Shaping flows in a manner that would discourage redd development above a particular elevation. Reverse load factoring with nighttime discharges more than 75 kcfs over the daytime discharge level have occurred without impacting where chum redds were placed.

5. Shaping flows as low as possible during the day with one or two spikes of flow as short of duration as possible can also discourage redd development.

6. If water supply conditions indicate that it is not possible to maintain this minimum tailwater elevation at Bonneville Dam, flow will be provided at times during the chum-spawning season to allow access to Hamilton and Hardy Creeks if the creeks are flowing

### 5.1.7 Broodstock Collection

Lower Columbia River adult chum salmon will continue to be captured for broodstock to maintain the Duncan Creek Program in 2007. The NPCC's Duncan Creek project outlines the logistics for the brood movement and fry-rearing program. The salvage operation would expand the numbers of fish captured and reared in this newly established brood collection program to make up for the lack of mainstem spawning. Also, the Implementation Team requested that criteria used by NOAA Fisheries be included in making decisions regarding the provision of water for chum salmon spawning. A memo responding to this request is attached in Appendix 5.

## 5.2 Flow Objectives

The purpose of the flow objectives is to aid in achieving the hydro system biological performance standards by providing better streamflow to aid in juvenile salmon and steelhead migration and enhance water quality. However, as recognized in the 2004 UPA and 2004 BiOp, it is not possible to achieve the flow objectives in many water years because there is limited water and reservoir storage. This WMP strives to achieve the best possible mainstem passage conditions, recognizing the priorities established in this document and the need to balance the limited water and storage resources available in the region.

## 5.3 Canadian Storage for Flow Augmentation

The purpose of the actions below is to see if more water from Canadian storage projects can be obtained for flow augmentation.

One (1) MAF of Treaty storage will be requested and negotiated when available with BC Hydro to be provided and released during the migration season.

BPA will continue to work with BC Hydro to negotiate a non-Treaty storage agreement to provide for storage during the spring with subsequent release in July and August, for flow enhancement as long as operations forecasts indicate that water stored in the spring can be released in July and August.

A study regarding the shaping and release of water behind Canadian Treaty storage projects in July and August was completed in 2001.

## 5.4 Public Coordination

The purpose of the following actions is to provide for better regional coordination.

Actions in the WMP will be coordinated with NOAA Fisheries, USFWS, and the states and tribes in preseason planning and in-season management of flow and spill operations. This coordination will occur in the Technical Management Team process.

At all appropriate decision points, the Action Agencies will routinely seek timely input and concurrence from the USFWS on all matters affecting USFWS listed fish through the Columbia River Treaty, International Joint Commission Orders, and all other decision making processes involving transboundary waters in the Columbia River basin. This will include notification of all meetings and decision points and provision of opportunities to advise the Action Agencies during meetings and in writing, as appropriate.

## 5.5 Juvenile Fish Transport

This 2004 UPA hydro-strategy for listed species of anadromous fish addresses actions to collect juvenile fish at some FCRPS projects while providing a balance between transported and in-river juvenile fish migration. Details of the juvenile transportation program are included in the Fish Passage Plan and will be coordinated during the fish passage season through TMT.

# 6 Water Quality

## *6.1 Water Quality Plans*

The Corps completed a comprehensive Water Quality Plan (WQP) outlining the physical and operational changes that could be used to improve the overall water quality in the mainstem waters of the Clearwater, Snake, and Columbia rivers. The plan was first completed in April 2003 and updated in December 2003 and again in November 2006. The goals of the WQP are as follows:

- To assist in understanding system wide loading capacity and loading allocation by assessing the existing effects at Federal and non-Federal dams and tributaries.

- To provide an organized, coordinated approach to improving water quality, with the long-term goal of meeting water quality standards that the states and Tribes can integrate into their water quality management programs.

- To provide a framework for identifying, evaluating, and implementing reasonable actions for dam operators to use as they work toward reducing temperature and dissolved gas levels.

- To provide a record of the actions that are and are not feasible for structural and operational improvements aimed at improving water quality conditions and meeting water quality standards. This information may provide a basis for future beneficial use and water quality criteria revisions.

- To bring basin wide information into the decision processes regarding dissolved gas and temperature, and to provide technical assessment of a project's relative value in terms of water quality.

- To integrate dissolved gas and temperature work into one process for both Federal and non-Federal dams on the mainstem Columbia River and Snake River system.

Over the long term, with a focus on water quality, WQP implementation anticipates that EPA, NOAA, and the Federal Action Agencies will properly integrate with TMDL development and implementation activities on the mainstem and in the sub-basins.

### 6.1.1 Total Dissolved Gas Monitoring

Exposure to high levels of TDG over long periods of time can be harmful or lethal to fish. Environmental monitoring at the dams is necessary where voluntary spill is employed for juvenile fish passage to ensure that gas levels do not exceed TDG thresholds established in the NOAA BiOp, and variance levels established by the state water quality agencies.

There are two purposes for the Corps to monitor TDG and water temperature at 10 Columbia River Basin dams: 1) to monitor project performance in relation to water quality standards, and 2) to provide water quality data for anadromous fish passage at Columbia/Snake mainstem dams. The monitoring program is considered an integral part of the Corps' Reservoir Control Center water management activities.

The physical TDG monitoring program is to include the QA/QC provisions stipulated in the "Data Quality Criteria for Fixed Monitoring Stations" completed in 2002 and approved by the Water Quality Team. This report describes the accuracy, precision, and completeness of data required at each fixed monitoring station. To achieve these goals, procedural methodologies are specified. These methodologies are characterized in three parts: calibration protocols (data quality control), data review and corrections (data quality assurance), and completeness of data (a substitute quality assurance program for station redundancy). Each fixed monitoring station will be assessed at the end of the monitoring season against these criteria and a performance report will be included in the Annual Dissolved Gas and Water Temperature Monitoring Report provided to the states of Oregon and Washington.

TDG is the primary water quality parameter monitored. High saturation level TDG can cause physiological damage to fish. Water temperature is also measured because it affects TDG saturation levels, and because it influences the health of fish and other aquatic organisms. Both TDG and water temperature are closely linked to project water management operations (e.g., water released over the spillways, releases through the powerhouses and other facilities, and forebay and tailwater water surface elevations).

One component of the water quality strategy was for the Corps to take the actions necessary to implement the spill program at the dams indicated in the UPA, including obtaining variances from appropriate State water quality agencies. In December 2002, the Corps provided information to the Oregon Department of Environmental Quality in support of a modification in the TDG standard to spill water over McNary, John Day, The Dalles, and Bonneville dams to assist out-migrating threatened and endangered juvenile salmon smolts. This Oregon Environmental Quality Commission approved the modification from April 1st to August 31st through the 2007 fish passage season. In January 2005, the Corps provided information to the Washington Department of Ecology (WDOE) in support of an adjustment in the Washington State TDG standard to spill water over lower Columbia and Snake River dams to assist downstream migration of juvenile salmonids. The WDOE approved this adjustment for all spills related to fish passage through March 31st, 2008. These rule modifications/adjustments provide for a revision of the TDGstandard from 110% to a revised standard of 115% in the forebays and 120% in the tailwaters of the lower Columbia and Snake River projects. The 115% and 120% caps are based on the 12 highest hourly measurements per calendar day. Also, a cap of TDG of 125%, based on the one highest hour (Washington) or highest two hours (Oregon), is in effect.

The Reservoir Control Center is responsible for monitoring the TDG and water temperature conditions in the forebays and the tailwaters of the lower Columbia River/lower Snake River dams, and selected river sites. The operational water management guidelines in Oregon are to change spill levels and, subsequently, spill patterns at the dams (daily if necessary) so that the forebays do not exceed, daily (12 highest hours) average of 115% TDG, and the tailwater levels do not exceed, daily (12 highest hours) average of 120% TDG.

The Corps prepares a Total Dissolved Gas Management Plan (TDG Management Plan)each year (see Appendix 4), which is a supporting document for the WMP. The TDG Management Plan summarizes the roles and responsibilities relating to dissolved gas monitoring. The TDG Management Plan stipulates what to measure, how, where, and when to take the measurements, and how to analyze and interpret the resulting data. The Plan also provides for periodic review

and alteration or redirection of efforts when monitoring results and/or new information from other sources justifies a change. The Plan identifies channels of communication with other cooperating agencies and interested parties.

# 7 FCRPS Hydrosystem Performance Standards

The Action Agencies will operate the FCRPS hydrosystem as described in this WMP, in an adaptive management framework, to make progress towards meeting biological performance goals. Those goals are contained in the 2004 UPA and addressed in the 2004 NOAA Fisheries Biological Opinion. Adult and juvenile fish survival estimates from research, monitoring, and evaluation studies will be considered in annual planning as future plans are developed.

# 8 Conclusion

This final 2008 WMP has been coordinated with the Technical Management Team. Seasonal action plans will be developed as described in the introduction to this plan. Additionally, operations may be adjusted in-season based on recommendations from the TMT.