# 2007 Total Dissolved Gas Management Plan

## 1.0 Introduction

High total dissolved gas (TDG) saturation levels are observed in various parts of the Columbia and Snake River systems where spill occurs, sometimes creating conditions that may adversely affect fish survival. Therefore, a plan to control TDG is developed annually along with a water management plan based on the runoff and the resulting spill for that year. This document outlines the TDG management plan adopted by the Technical Management Team (TMT) for 2007. It includes a review of voluntary and involuntary spill, applicable management options, and a detailed TDG management plan with spill priority list and spill caps. This plan reflects relevant provisions of both the U.S. Fish and Wildlife Service and the National Marine Fisheries Service (NMFS) Federal Columbia River Power System (FCRPS) Biological Opinions (BiOps).

## 2.0 Voluntary and Involuntary Spill

### *2.1 Voluntary Spill*

Voluntary spill is defined as the passing of water through the spillway gates of a dam to facilitate passage of juvenile salmon past the project or passage of water to aid fish downstream. Spill at projects that pass juvenile salmonids is done to decrease the residence time of juvenile salmon in the forebay of dams, which increases their passage and survival in the FCRPS. Spill, as a fish passage strategy, has a higher survival rate than most other routes of passage at the dam. The amount of voluntary spill is adjusted so that the resulting TDG levels associated with spill are consistent with applicable State water quality criteria. These criteria specify that TDG levels are not to exceed 120% in the tailwaters and 115% in the forebays of downstream projects as measured as the average of the twelve highest hourly readings in any one day. They also specify that TDG levels are not to exceed 125% on a one-hour basis (State of Washington) or on a two-hour basis (State of Oregon). These TDG levels are referred to as “gas caps”. The term “spill cap” is defined as the amount of spill necessary for TDG levels to reach the gas cap.

Another reason for spill is for flow augmentation. The NMFS and USF&WS BiOps call for flow augmentation in the Columbia and Snake Rivers. There are instances where spill at some projects is required to obtain the flow objectives called for in these BiOps.

### *2.2 Involuntary Spill*

Involuntary spill is caused primarily by project and/or system operational limitations. There are two primary causes for involuntary spill:

1. When hydrologic conditions result in flows which exceed the hydraulic capacity of power generation facilities, and/or

2. When potential power generation from water moving through the reservoir exceeds the available market, especially during light load hours at night and on weekends.

Other causes for involuntary spill include management of reservoirs for flood control, scheduled or unscheduled turbine unit outages of various durations, passing debris, or any other operational and/or maintenance activities required to manage project facilities for safety and multiple uses. For example, in managing the project for flood control, the water supply forecast may underestimate the seasonal streamflows resulting in inadequate space available in the reservoirs to capture incoming water. In other instances, unusually high winter precipitation in January through March may force the operators to store water in the reservoirs above the flood control elevations during the month, causing involuntary spill to occur later in the month as the water is evacuated to get to end of the month reservoir flood control elevations.

The anticipated frequency and extent of involuntary spill due to hydrologic conditions cannot be predicted until the 2007 (April Final) January through July forecast for the Columbia River at The Dalles is completed. Isolated instances of involuntary spill, prompted by scheduled or unscheduled turbine unit outages of various durations and/or other operational and maintenance activities, are expected to occur in 2007.

# 3.0 Management Options

## *3.1 2007 Fish Passage Implementation Plan Spill Guidance:*

On May 26, 2005, the U.S. District Court invalidated the 2004 NOAA Fisheries BiOp. On October 7, 2005 the Court remanded the BiOp to NOAA Fisheries to produce a BiOp consistent with the court's Order. In the interim, the 2004 BiOp is to remain in effect unless modified by Court Order. 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 jeopardy framework.

An agreement was reached concerning project operations for the 2007 fish passage season. These operations are described below.

**Lower Granite Dam:** Voluntary spill will begin at Lower Granite Dam at 0001 hrs on April 3rd and will end at 2400 hrs on August 31st. Voluntary spill during the spring (April 3 through June 20) will consist of 20 kcfs spill using the removable spillway weir (RSW). This spill entails passing approximately 6 kcfs through the RSW and the remaining 14 kcfs through other spill gates as "training spill." Summer voluntary spill (June 21 through August 31) will consist of 18 kcfs spill using the RSW. This spill entails passing approximately 6 kcfs through the RSW and the remaining 12 kcfs through other spill gates as "training spill." Both spring and summer spill regimes will occur 24 hours per day but may be limited by the gas caps. Spill may also be limited by the minimum generation requirement. The minimum generation requirement for this project is approximately 11.5 kcfs. However, this minimum may vary due to generation at other projects as well as the status of the transmission system. This minimum may not be utilized at all times.

**Table 1.** Spill Guidelines at Lower Columbia and Snake River projects.

**Table 1**
**2007 Spill Guidance Table**

| Project | Planning Dates | Time | Amount [c] | Minimum Generation Requirements kcfs |
|---|---|---|---|---|
| Lower Granite | April 3 - June 20 | 24 hours per day | 20 kcfs (RSW with training) | 11.5 [a] |
| Lower Granite | June 21 - August 31 | 24 hours per day | 18 kcfs (RSW with training) | 11.5 [a] |
| Little Goose | April 3 - August 31 | 24 hours per day | To the spill cap up to 30% of project outflow | 11.5 [a] |
| Lower Monumental | April 3 - June 20 | 24 hours per day | To the spill cap (~27 kcfs) | 11.5 [a] |
| Lower Monumental | June 21 - August 31 | 24 hours per day | To the spill cap up to 17 kcfs | 11.5 [a] |
| Ice Harbor | April 3 - August 31 | 500 - 1800 | 45kcfs | 7.5 - 9.5 [a] |
| Ice Harbor | April 3 - August 31 | 1800 - 500 | To the spill cap | 7.5 - 9.5 [a] |
| Ice Harbor | TBD | 24 hours per day | Spill will alternate between to the spill cap up to 30% of project outflow and 45kcfs daytime/spill cap at night [b] | 7.5 - 9.5 [a] |
| McNary | April 10 - June 30 | 24 hours per day | To the spill cap up to 40% of project flow | 50 |
| McNary | July 1 - August 31 | 24 hours per day | Spill will alternate between to the spill cap up to 40% of project flow and to the spill cap up to 60% of project flow [b] | |
| John Day | April 10 - June 20 | 600-1800(1900) [e] | 0 | 50 |
| John Day | April 10 - May 15 | 1800 - 600 [e] | To the spill cap or 60 % of project outflow | 50 |
| John Day | May 15 - June 30 | 1900 - 600 [e] | To the spill cap or 60 % of project outflow | 50 |
| John Day | July 1 - August 31 | 24 hours per day | To the spill cap or 30% of project outflow[f] | 50 |
| John Day | April 10 - August 31 | 24 hours per day | Minimum spill is 25% of project outflow | 50 |
| The Dalles | April 10 - August 31 | 24 hours per day | To the spill cap or 40% of project outflow | 50 |
| Bonneville | April 10 - June 30 | 24 hours per day | To the spill cap up to 100 kcfs | 30 |
| Bonneville | July 1 - August 31 | daytime [d] | To the spill cap up to 75kcfs | 30 |
| Bonneville | July 1 - August 31 | nighttime [d] | To the spill cap (~120 kcfs) | 30 |
| Bonneville | April 10 - August 31 | 24 hours per day | minimum spill is 50 kcfs | 30 |

a - Minimum generation requirements at the Lower Snake River projects depend on the status of generation at other projects as well as the status of the transmission system and may not be needed all the time.

b - There is a fish test occurring at this project. See Fish test section

c - Spill cap is defined as the maximum spill amount that will keep the High 12 hr %TDG average within the State WQ standards of 115% in the forebay or 120% in the tailwater

d - Day and nighttime for Bonneville vary during the spill season and are set in the Fish Passage Plan.

e - Day and nighttime for John Day usually changes on May 15.

f - Minimum spill percentage at John Day is 25%. No voluntary spill less 25% of project outflow.

**Little Goose Dam:** Voluntary spill will begin at Little Goose Dam at 0001 hrs on April 3rd and will end at 2400 hrs on August 31st. For both spring and summer seasons, spill at Little Goose will consist of spilling to the gas caps up to 30% of total project outflow, on an hourly basis, 24 hours per day unless limited by the minimum generation requirement. Daily average spill will be 30%, however, may exceed 30% of total outflow due to involuntary spill or may be less than 30% when limited by the spill cap or the minimum generation requirement. The minimum generation requirement for this project is approximately 11.5 kcfs. However, this minimum may vary due to generation at other projects as well as the status of the transmission system. This

minimum may not be utilized at all times. Additionally, fourteen days of nighttime spill (1800-0600 hours) to the spill cap will be provided during the period April 22-May 15 as per recommendation by the salmon managers.

**Lower Monumental Dam:** Voluntary spill will begin at Lower Monumental Dam at 0001 hrs on April 3rd and will end at 2400 hrs on August 31st. Voluntary spill during the spring (April 3 through June 20) will consist of spilling to the gas caps 24 hours per day unless limited by the minimum generation requirement. It is estimated that the spill caps to achieve the gas cap TDG percentages in the spring will be about 27 kcfs. Voluntary spill during the summer (June 21st through August 31st) will consist of spill to the gas cap up to 17 kcfs 24 hours per day unless limited by the minimum generation requirement. The minimum generation requirement for this project is approximately11.5 kcfs. However, this minimum may vary due to generation at other projects as well as the status of the transmission system. This minimum may not be utilized at all times.

**Ice Harbor Dam:** Voluntary spill will begin at Ice Harbor Dam at 0001 hrs on April 3rd and will end at 2400 hrs on August 31st. Voluntary spill during both the spring and summer seasons will consist of spilling 45 kcfs during the daytime (0500 to 1800 hrs) and to the spill cap at night (1800 hrs to 0500 hrs). During this spill season, research studies are planned where spill will alternate between the normal spring operations described above and an operation that consists of spilling to the gas caps up to 30% of total project flow, on an hourly basis, 24 hours per day unless limited by the minimum generation requirement. Daily average spill will be 30%, however, may exceed 30% of total outflow due to involuntary spill or may be less than 30% when limited by the spill cap or the minimum generation requirement. During both spill operations, the RSW at Ice Harbor will be utilized. When the studies are being conducted, spill regimes will alternate between the two operations. The specific details of the study and the schedule of spill regimes will be provided at a later date. The minimum generation requirement for this project is approximately 9.5 kcfs. However, this minimum may vary due to generation at other projects as well as the status of the transmission system.

**McNary Dam:** Voluntary spill will begin at McNary Dam at 0001 hrs on April 10th and will end at 2400 hrs on August 31st. Voluntary spill during the spring spill season (April 10 through June 30) will consist of spilling to the gas caps up to 40% of total project flow, on an hourly basis, 24 hours per day unless limited by the minimum generation requirement. Daily average spill will be 40%, however, may exceed 40% of total outflow due to involuntary spill or may be less than 40% when limited by the spill cap or the minimum generation requirement. Voluntary spill for research during the summer spill season (July 1 through August 30) will consist of alternating between spilling to gas caps up to 40% of project outflow and spilling to the gas caps up to 60% of project outflow 24 hours per day. The specific details of the study and schedule of spill regimes will be provided at a later date. The minimum generation requirement for this project is approximately 50 kcfs. However, this minimum may vary due to generation at other projects as well as the status of the transmission system.

**John Day Dam:** Voluntary spill will begin at John Day Dam at 0001 hrs on April 10th and will end at 2400 hrs on August 31st. Voluntary spill during the spring spill season (April 10 through June 30) will consist of spilling 0 kcfs during the day and to the gas caps up to 60% of project outflows, on an hourly basis, during the night unless limited by the minimum generation

requirement. Nighttime is defined as 1800 hrs to 0600 hours from April 10th to May 15th and from 1900 hrs to 0600 hours from May 16th to June 30th. Nighttime average spill will be 60%, however, may exceed 60% of total outflow due to involuntary spill or may be less than 60% when limited by the spill cap or the minimum generation requirement. Voluntary spill during the summer spill season (July 1 through August 31) is to spill to the gas caps up to 30% of project flows, on an hourly basis, 24 hours per day unless limited by the minimum generation requirement. Daily average spill will be 30%, however, may exceed 30% of total outflow due to involuntary spill or may be less than 30% when limited by the spill cap or the minimum generation requirement. The minimum generation requirement for this project is approximately 50 kcfs. However, this minimum may vary due to generation at other projects as well as the status of the transmission system.

**The Dalles Dam:** Voluntary spill will begin at The Dalles Dam at 0001 hours on April 10th and will end at 2400 hrs on August 31st. Voluntary spill during both the spring and summer seasons will consist of spilling to the gas caps up to 40% of project outflows on an hourly basis, 24 hours per day unless limited by the minimum generation requirement. The minimum generation requirement for this project is approximately 50 kcfs. However, this minimum may vary due to generation at other projects as well as the status of the transmission system.

**Bonneville Dam:** Voluntary spill will begin at Bonneville Dam on April 10th and will end on August 31st. Voluntary spill during the spring (April 10 to June 30) will consist of spill to the gas caps at the Cascades Island (CCIW) and Camas-Washougal (CWMW) fixed monitoring stations up to 100 kcfs 24 hours per day unless limited by the minimum generation requirement. Voluntary spill during the summer season (July 1 through August 31) will consist of spilling to the gas caps at CCIW and CWMW up to 75 kcfs during the day and to these gas caps at night unless limited by the minimum generation requirement. Nighttime hours at Bonneville dam changes several times throughout the spring and summer (see the 2006 Fish Passage Plan). Minimum voluntary spill at the project is 50 kcfs. The minimum generation requirement for this project is approximately 30 kcfs. However, this minimum may vary due to generation at other projects as well as the status of the transmission system.

## *3.2 Spill Management to the TDG Gas Caps:*

Spill caps will be assigned to each project and will be adjusted in-season, based on actual TDG readings and a variety of other factors. TDG measurements will be reviewed on a daily basis and minor adjustments to the voluntary spill at each project will be made to the daily spill cap in order for TDG concentrations as close as possible, but not exceeding 120% in the tailraces and 115% in the forebays. The assignment of spill caps at each individual project is dependent upon an array of variables. Factors that are evaluated in the determination of spill caps are as follows,

1. Physical Design and Operation of Projects: TDG levels that are generated in the tailwaters of each project depend upon many factors including the amount of spill passing through the spillway, the pattern of spill through the spillway, the amount of flow through the powerhouse, structure of the stilling basin, the presence (or absence) of flow deflectors, the presence (or absence) of divider walls, the presence (or absence) of fish screens (which can influence decisions regarding distribution of spill at specific projects) , and river

characteristics immediately below each project. These individual characteristics are taken into account when assigning spill caps.

2. Travel Time: The time it takes water to move from one project to the next depends upon the distance between projects and the flow rate in the river. Because of this, changes in spill at an upstream project and the resulting change in TDG levels will not be seen in the forebays of the downstream project for several hours or days.

3. Water Temperature: Climatic conditions can cause increases in water temperatures, which in turn can cause increases in TDG levels. The rule of thumb for water temperature is that a $1^{o}C$ ($1.8^{o}F$) increase in water temperature can result in a 2 to 3% increase in TDG. Since the impact of changing climactic conditions on water temperature cannot be directly predicted, air temperature is used as a surrogate. If it is expected that significant increases air temperature are expected in a specific region, then it will be assumed that water temperatures would also be increasing and spill caps will be adjusted appropriately.

4. River Characteristics: Characteristics of the river channel can influence TDG levels. For example, the forebay of Lower Monumental Dam is shallow and therefore susceptible to heating by sunlight. Other projects have forebays that are deeper, and therefore less susceptible to heating effects.

5. Degassing: As waters flow from one project to another, degassing can occur. Experience has shown that winds above 10 mph enhance degassing. Therefore, wind conditions are used to predict levels of degassing. In addition, flows below 200 kcfs, significant degassing of TDG occurs in the river between the Bonneville dam and the Camas/Washougal FMS. However, when flows increase above 200 kcfs, little or no degassing has been observed.

6. Flow Variations: Spill decisions are often affected by forecasts of flows for the near future. For example, when high flows are anticipated, shifting of spill priorities at different projects may occur in order to develop an overall river-wide strategy to minimize TDG exceedances. Also, there are variations in flow on a weekly basis. On weekends, demand for power typically drops as compared to during the workweek. This results in decreases in flow through project powerhouses. As a result, the relative proportion of spilled water flow (which typically has higher TDG levels) to powerhouse flow (which typically has lower TDG levels) increases. If this condition is not taken into account, then tailwater TDG levels will be higher than what was predicted. The opposite occurs on Mondays where powerhouse flow generally increases over the flow on the weekends due to an increase in power demand as the workweek begins.

7. Maintenance and Repairs: Scheduled maintenance and repair activities can modify the amount of flow through a particular project. The type of maintenance and repair activity and how it will affect flows through the project need to be taken into account in order to assign appropriate spill caps.

8. Experimental Test Schedules: The scheduling of various investigative studies can result in alterations in the normal operation of a project. Examples of such alterations including modified spill pattern tests, Removable Spillway Weir tests, and modified spill operations

(e.g. at Ice Harbor, 50% spill operations for 24 hours for two days and then BiOp spill operations for the next two days).

## 4.0 2007 TDG Management Plan

The 2007 TDG Management Plan is similar to previous years' plans. Storage reservoirs will be operated to flood control rule curves and are projected to provide some cushion that will minimize incidences of involuntary spill. No pre-emptive reservoir drafting below flood control elevation will be attempted, as the Salmon Managers are also concerned about reservoir refill. Flows will be regulated to maximize potential for voluntary spill. When project voluntary spill occurs, the projects will be operated to try to keep TDG at or below 115%/120%/125% criteria as long as possible without jeopardizing flood control objectives. When TDG cannot be managed to 115%/120%/125%, the river will be managed in the best interest of listed salmon stocks. It is recognized that measures designed to physically reduce TDG could have significant impact on migrating salmon. Therefore, input from Federal, State and Tribal salmon managers will be sought when attempting to use those TDG control measures.

The essence of the 2007 TDG Management Plan is as follows:

- Implement spill for fish passage at all mainstem Federal dams as specified in Section 3.0 of this document up to the TDG waiver gas caps. The gas caps are defined as 120% TDG in mainstem project tailraces and 115% in the forebays of downstream dams as measured as the average of the twelve highest hourly TDG readings in a given day and 125% as measured on an hourly basis.

- Adjust spill as needed, based on real-time TDG data, and fish movement and biological conditions in that order.

- Operate unit operation within 1% of peak efficiency.

- Accommodate special spill requirements/restrictions for research, adult passage, etc. that have the full endorsement of all concerned parties. Also, continue to implement fish transportation program as agreed to and using calculation method endorsed by NMFS (or an equivalent method agreed to at TMT).

- If systemwide TDG exceed 120%, update and implement the spill priority outlined in Attachment 1, with incremental system TDG control objectives. Unless and until a different reach priority is recommended by the TMT, spill will start as specified in the Spill Priority List.

- Discontinue or postpone field research and non-critical unit service and maintenance schedules that create (or have potential for creating) high localized TDG levels, especially when and where high numbers of listed fish are present.

- If regionally coordinated and approved by the TMT, operate turbines outside their respective 1% peak efficiency flow range at projects where measurable reduction in TDG

(at least 3%, given the accuracy range of the instrumentation) and no intolerable adverse fish impacts can be expected.

- If regionally coordinated and approved by the TMT, store water at lower Snake reservoirs above MOP, if this would result in a measurable (3% or more, based on instrumentation accuracy) reduction in TDG levels.

- Experiment with promising new spill patterns.

- Implement other operations or measures recommended by the TMT or the IT. This may include appropriate changes in transportation targets when TDG exceeds levels that are universally recognized as lethal (130% more for 1 week or longer, per NOAA Fisheries) or when obvious in-river lethal conditions exist.

## 5.0 2007 TDG Monitoring Plan of Action

In support of the spill management program, a TDG monitoring program has been established. Each year, this monitoring program is evaluated by the Regional Forum Water Quality Team (WQT). The draft plan for 2007 was presented to the WQT at the October 2006 meeting and discussed at the November 2006 meeting. Based on discussions at these meetings and submitted written comments, the final plan for 2007 was completed by November 30, 2006. A copy of the 2006 plan can be obtained at the TMT/Water Quality Programs webpage at http://www.nwd-wc.usace.army.mil/TMT/wqwebpage/mainpage.htm. The 2007 plan is similar to the 2006 plan except for the frequency of recalibration for gauges operated by the Walla Walla District (extending from once every two weeks to once every three weeks). The completion date for next years monitoring plan is earlier than in past years due to the need to have the plan completed and ready for submission to the Oregon Department of Environmental Quality in support of a multi-year TDG waiver process from the State of Oregon.

## 6.0 TDG Modeling

Total Dissolved Gas caused by large volumes of water spilled over dams can result in injury and mortality of juvenile salmonids. Development and continued refinement of a systemwide TDG model would assist with in-season management of involuntary spill.

In response to RPA 133 of the NMFS 2000 Biological Opinion, the Corps began developing a TDG model to be used as a river operations management tool. During the 2004 spill season, this model (SYSTDG) was utilized on a trial basis to evaluate TDG in the Columbia River Basin and to assist in the setting of spill caps at each of the projects where voluntary spill occurred. At the conclusion of the spill season, a review of the performance of SYSTDG was completed and included in the 2004 Dissolved Gas and Water Temperature Monitoring Report. The same was done for the 2005 and 2006 spill seasons. These reports were included in the annual "Total Dissolved Gas and Temperature Annual Report" for each of those seasons and are available on the TMT/Water Quality Programs webpage at;http://www.nwd-wc.usace.army.mil/TMT/wqwebpage/mainpage.htm .

SYSTDG will again be used as a TDG management tool in 2007. As the season progresses, modification of the model will occur as necessary due to modifications in project operations.

# 7.0 Temperature Management

The 2004 NOAA Fisheries Biological Opinion calls for cold-water releases from Dworshak reservoir. These releases serve the dual purpose of providing additional flows of water to assist passage of juvenile salmonids past the lower Snake River projects and to help moderate water temperatures of that water. The management of the temperatures of these release waters is possible due to the presence of selector gates at Dworshak Dam which can move vertically and draw water from varying elevations in the reservoir.

The management of the flows and water temperatures from Dworshak reservoir is coordinated with TMT. The Water Quality Unit (WQU) of the Corps' Reservoir Control Center will provide TMT with water temperature stratification data from the Dworshak reservoir as well as temperatures of release water derived from the Dworshak tailwater fixed monitoring station (DWQI). The WQU will also provide TMT with recommendations concerning the amount of storage of cool waters in the reservoir to ensure that these sufficient quantities will be maintained through mid-September and what outflow water temperatures will be expected when the operation concludes and the projects returns to minimum flows.

## Attachment
## SPILL PRIORITY LIST and SPILL CAPS (April 20 - August 31)

This attachment provides project priority for spill and allowable spill levels to be used in an attempt to control total dissolved gas (TDG) to 120%, 125%, 130% and 135%. When systemwide TDG is at or below 120%, provide spill for fish passage on the Lower Columbia and Lower Snake rivers up to the 120% TDG tailwater and 115% TDG in the forebays of downstream projects as stipulated in the NOAA Fisheries 2004 Biological Opinion. The states of Oregon and Washington have provided TDG waivers for generating TDG at the levels specified in the BiOp during fish passage season. When systemwide TDG exceeds 120% TDG, then try to control systemwide TDG to 125%, then to 130%, and so on by spilling up to the spill caps indicated for those TDG levels at lower Columbia, Snake, mid-Columbia, HGH, and Willamette projects in the specified order. The listing order of the projects on the Spill Priority List depends upon specific river conditions, locations of juvenile and adult salmonids, specific configurations of the projects, and any special operational conditions (e.g. research studies, maintenance outages, etc.). The listing order and the specific spill quantities to achieve the various TDG levels will be updated as necessary to account for changing conditions in the rivers.

**Table A-1.**

**Initial Spill Priority List for 2007**

| Project | Spill Cap to Generate Specific Percentage of Total Dissolved Gas (TDG) | | | | | |
|---|---|---|---|---|---|---|
| | 110% | 115% | 120% | 125% | 130% | 135% |
| LWG | 20 | 30 | 42 | 90 | 125 | 200 |
| LGS | 20 | 25 | 32 | 80 | 110 | 250 |
| LMN | 10 | 15 | 40 | 55 | 110 | 250 |
| BON | 50 | 65 | 100 | 150 | 250 | 270 |
| JDA | 20 | 60 | 95 | 240 | 300 | 600 |
| TDA | 20 | 60 | 91 | 250 | 260 | 600 |
| WAN | 10 | 15 | 20 | 50 | 100 | -- |
| WEL | 10 | 15 | 25 | 45 | 130 (1) | -- |
| RRH | 05 | 10 | 20 | 30 | 150 (1) | -- |
| RIS | 05 | 10 | 20 | 30 | 150 (1) | -- |
| PRD | 20 | 30 | 40 | 40 | 40 | -- |
| MCN | 40 | 80 | 155 | 230 | 290 | 450 |
| IHR | 30 | 45 | 105 | 125 | 135 | 240 |
| GCL | 20 | 25 | 30 | 75 | -- | -- |
| CHJ | 05 | 10 | 15 | 33 | 45 | -- |

(1) Limit daytime spill to 100 kcfs.