Appendix 4

Total Dissolved Gas

Management Plan

Updated April 2026

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1. Introduction

Throughout the Columbia River System elevated levels of total dissolved gas (TDG) saturation are observed where spill occurs at U.S. Army Corps of Engineers (Corps) dams. This TDG Management Plan (Plan) describes the process and procedures for implementing planned spill for fish passage, forced spill, use of the Spill Priority List, and setting spill caps.

The Corps, the U.S. Bureau of Reclamation (Reclamation), and the Bonneville Power Administration (BPA) (collectively referred to as the "Action Agencies") develop an annual Fish Operations Plan (FOP) that provides detailed information on the fish operations, including the fish passage spill program and its implementation, informed by adaptive management and the regional forum process. The FOP identifies target spill for spring, summer, and fall/winter spill operations and is included as Appendix E of the annual Fish Passage Plan (FPP).[1] The Action Agencies have also developed a Water Quality Plan for TDG and Temperature in the Mainstem Columbia and Snake Rivers which documents implementation of the Endangered Species Act (ESA), Clean Water Act (CWA) and TDG monitoring. The Corps will manage spill for fish passage consistent with the State of Washington and the State of Oregon TDG water quality standards (WQS).[2,3] The current TDG standards are reiterated in the FOP. To implement the planned spill for fish passage, both states have provided allowances for less stringent TDG criteria but require biological monitoring (i.e., Gas Bubble Trauma, GBT). The GBT monitoring program and consequences to the TDG criteria are discussed in the Biological Monitoring Plan.

2. Spill and TDG production

TDG management measures differ depending on whether spill planned, i.e., spill for the benefit of fish migration through the Columbia River System; or forced, i.e., spill that is dictated by conditions beyond the Corps' control. The following describe circumstances that result in various types of spill or other TDG producing operations.

Gas Cap – applicable State TDG WQS (in percent TDG). The TDG standard for the States of Idaho, Washington, and Oregon is 110%. Oregon and Washington have provided exceptions to the TDG standard for fish passage spill operations on the lower Snake and lower Columbia Rivers. If applicable state WQSs differ, the Corps applies the more stringent criteria.

Gas Cap Spill – spill to the maximum spill level that meets, but does not exceed, the TDG criteria allowed under state law.

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[1] The Fish Passage Plan may be found at the following link: https://public.crohms.org/tmt/documents/fpp/

[2] WASH. ADMIN. CODE § 173-201A-200(l)(f) provides the maximum TDG criteria for each of the aquatic life use categories and displays Table 200 (I)(f) that states: "Total dissolved gas shall not exceed 110 percent of saturation at any point of sample collection." The code also addresses exceptions and adjustments, including a provision allowing for an adjustment of the TDG criteria to aid fish passage over hydroelectric dams.

[3] OR. ADMIN. R. 340-041-0031 provides in part: "the concentration of TDG relative to atmospheric pressure at the point of sample collection may not exceed 110 percent of saturation." OR. ADMIN. R. 340-041-104(3) identifies findings the Environmental Quality Commission must make for the purpose of allowing increased spill for salmon migration. *See* https://www.oregon.gov/deq/wq/Documents/tmdlTDGmod0225.pdf

Performance Standard Spill – spill levels intended to meet NOAA's performance standard survival objectives, as described in the 2020 Biological Opinion.

Spill Cap – spill level (flow through the spillway measured in kcfs) at each project that is estimated to maximize spill to a level that meets, but does not exceed, the gas cap in the tailrace and the next downstream forebay (if applicable).

Planned spill for fish passage (formerly Voluntary Spill) – the Corps provides spill for the benefit of fish passage at the four lower Snake River and four lower Columbia River dams as specified in the Fish Operations Plan (FOP) which is responsive to the U.S. District Court for the District of Oregon's (District Court) Preliminary Injunction Order issued February 25, 2026 and amended on March 2, 2026.

Forced Spill (formerly Involuntary Spill) – quantity of water that exceeds the capacity of a dam to either temporarily store the water upstream of the dam or pass the water through its turbines. In these circumstances, water must be released through the spillway. Forced spill occurs due to either **Lack of Load Spill** or **Over Capacity Spill**, but can also occur as a result of the management of reservoirs for flood risk[4], scheduled or unscheduled turbine unit outages or transmission outages of various durations, passing debris, or any other operational and/or maintenance activities required to manage dam facilities for safety and authorized project uses.

a) **Lack of Load Spill:** Occurs when the available market for hydropower is less than the power that could be produced by the current river flow with available turbine capacity, also known as lack of market spill. When BPA cannot access sufficient market demand to sell hydropower and there is insufficient storage capability, the river flow must be released over the spillway or through other regulating outlets. Lack of load spill generally occurs during times of high flows (e.g., in the spring when power demands are low both in California and the Pacific Northwest). Releases from upstream storage dams during high load periods (generally morning and evening) can result in high flows at downstream dams during low load periods (e.g., middle of the night), causing lack of load spill. Lack of load spill is managed on a system-wide basis to distribute TDG levels across the Federal projects using the Spill Priority List. The Spill Priority List is a lack of load TDG management plan that has been developed for forced spill that results in exceeding the TDG standard when lack of load conditions require spill. The Corps works with regional federal, state, and tribal partners of the Technical Management Team (TMT) to develop the Spill Priority List that identifies the order in which projects spill to minimize TDG system-wide.

[4] The Corps directs operations of storage projects in the Columbia Basin to manage flood risk. Storage reservoir pools are drafted in the winter and early spring to provide space to capture part of the spring runoff, reducing peak flows in the river. This flood risk management operation may require spill from storage reservoirs, which may result in elevated levels of TDG in the river system. The Corps and other action agencies work to manage system flood risk operations in a manner that reduces the need to spill at levels that exceed TDG water quality standards; however, there are conditions in which fulfilling the Corps' flood risk management authorities necessitates drafting storage reservoirs.

b) **Over Capacity Spill:** Occurs when flows exceed the hydraulic capacity of the available power generation facilities at a specific dam. Over capacity spill can be affected by high river flows, planned and unplanned unit outages, planned and unplanned transmission outages, and other transmission constraints. Any of these conditions physically limit the potential for hydropower production. Over capacity spill will generally be the amount of project outflow in excess of the maximum amount that can be released through all available generators and other outlet structures (e.g., sluiceways and fish ladders). In general, when this condition occurs, the affected project will be operating at maximum generation, but within the Fish Passage Plan turbine operating criteria capability to minimize the amount of spill.

   Over capacity spill can also occur when turbines cannot be used because their capacity must be held in reserve to provide mandatory reserve power capacity (reserves) for contingencies and load balancing. **Reserves** (Reserve Power Capacity) are the amount of generation capacity above the amount currently in use that is immediately available to maintain system reliability. At projects that must carry reserve power capacity, these projects can only be loaded to the maximum available generation minus the reserve capacity allocated to that project. Spill for maintaining reserves primarily occurs at Grand Coulee, Chief Joseph, The Dalles, John Day, Bonneville, and occasionally McNary dams.

c) **Miscellaneous flow:** Occurs when water is passed through various dam structures other than the spillway or turbines. These structures include the fish ladders, juvenile fish bypass system, navigation locks, ice and trash sluiceways, Bonneville Powerhouse 2 corner collector, etc. Miscellaneous spill occurs most hours during the year and especially during April through August when fish are migrating.

d) **Special Spill Events:** Occur for the purposes of passing debris or operational and/or maintenance activities required to manage dam facilities for safety and multiple uses. These are infrequent and generally of short duration.

Speed-no-load: A turbine operation that provides station service during powerhouse outages for maintenance (e.g., Doble testing). At the lower Snake River projects, approximately 7 kcfs through one turbine is a typical speed-no-load flow rate. The remaining inflow may be stored in the reservoir or passed via the spillway. TDG production up to 140% saturation was observed during a speed-no-load operation with no spill downstream of Lower Granite in September 2013. In December 2022 during a speed-no-load operation, 3.5 kcfs of spill via the spillway resulted in a large reduction of TDG at the tailwater gauge. Turbines may also be run at speed-no-load for testing before or after maintenance.

Bonneville Dam Powerhouse 2 Corner Collector (B2CC): The B2CC provides a surface passage route for fish, completed in 2004. The flow through the B2CC ranges between 4 and 6 kcfs depending on forebay elevation. Based on monitoring and modeling, the outflow of the corner collector likely produces TDG in excess of 130% saturation and causes an observable increase at the Warrendale gauge.

Bonneville Dam Fish ladders: The Cascades Island gauge downstream of Bonneville Dam is not influenced by powerhouse TDG and primarily indicates TDG production of the Bonneville Dam spillway. However, when there is no spill, TDG measurements can increase above the WQS. It appears this TDG is generated by fish ladders but the overall influence on fully mixed TDG at the downstream Warrendale gauge is minimal.

3. TDG Management During Planned Fish Passage Spill

The FOP is the planning document for fish passage spill at the four lower Snake River and four lower Columbia River dams. Spill will be reduced or otherwise managed if TDG exceeds the water quality criteria (see Section 7.0 Procedure for Setting Spill Caps). If GBT thresholds are exceeded, the water quality criteria is reduced (see Section 8.0 Gas Bubble Trauma Monitoring).

During periods of high spring runoff, which may result in TDG production above targeted levels of 125% saturation, the Action Agencies may operate turbines above the ±1% of peak efficiency range to mitigate for TDG.[5] The purpose of mitigating TDG production is to reduce the duration and magnitude of water quality standards exceedances in the tailraces of each project due to forced spill. While TDG management may occur at lower flows if there are a high number of turbine outages, operation above ±1% would occur when minimum flow levels reach or exceed 160 kcfs on the lower Snake River and 340 kcfs on the lower Columbia River. During these high flow conditions, all available turbines will be operated before exceeding the upper ±1% of peak efficiency range. Since this operation occurs on an hourly timescale, BPA will implement without explicit instructions from the Corps.

During periods designated in the FOP, the Corps will provide fall/winter surface spill. The applicable Washington TDG criteria is 115% in the downstream forebay and 120% in the tailrace.[6] The applicable Oregon TDG criterion is 120% TDG in the project tailrace.[7] The Corps does not anticipate exceedances of the WQS during the fall/winter surface spill operation, however, if the TDG criteria is exceeded, the Reservoir Control Center (RCC) will evaluate available data and coordinate operational changes with NOAA.

In 2024, Oregon DEQ clarified that the 105% criterion for shallow water does not apply on the mainstem Columbia River.[8]

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[5] 2020 National Marine Fisheries Service Columbia River System Biological Opinion
[6] Letter from Vincent McGowan, Department of Ecology to Fish Passage Advisory Committee members regarding the "Clarification of Total Dissolved Gas Standards during Fall/Winter Spill Operations" dated October 5, 2022.
[7] Email from Steve Mrazik, Water Quality Manager, Oregon DEQ , dated March 9, 2026, approving additional period of the 2024 Order Approving a Modification to Oregon's Water Quality Standard for Total Dissolved Gas.
[8] Letter from Jennifer Wigal, Oregon Department of Environmental Quality dated January 29, 2024 regarding clarification on the applicability of the 105% TDG criterion.

4. TDG Management During Forced Lack of Load Spill

4.1 Spill Priority List

The Spill Priority List identifies the order and amount of spill at the Corps' Columbia River Basin dams and Grand Coulee Dam for management of lack of load spill and the expected TDG production system-wide. The Spill Priority List is used throughout the year during times of forced spill for lack of load. The Spill Priority List consists of levels based on ascending TDG values, a spill rate for each project that is estimated to produce the TDG values and an order of projects.

4.2 Spill Levels

Values on the Spill Priority List serve as a reference for expected TDG production at the dams. During the period of no fish passage, the levels of the Spill Priority list are shown in Table 1.

Table 1. Spill priority list TDG levels in tailwaters during the period of no fish passage spill.

Project	Level 1	Level 2	Level 3	Level 4	Level 5	Level 6
All Projects	110%	115%	120%	122%	125%	130%

During the fish passage season, estimated spill levels are grouped into different TDG production levels on the Spill Priority List as shown in Table 2 and Table 3. Level 1 spill shown in the tables are consistent with the FOP which is based on current operative documents and is consistent with applicable WQS.

TDG is evaluated at the appropriate fixed monitoring stations. For fish passage spill and lack of load spill, the Bonneville Dam spill rate will be limited to 150 kcfs to limit the movement of rocks into the stilling basin which can cause subsequent damage.

Table 2. The TDG target for each level of the Spill Priority List by project during spring spill.

Project	Level 1	Level 2	Level 3	Level 4
Fish passage projects	125% Gas Cap	127%	130%	135%
CHJ	110% Gas Cap or degassing cap	122%	125%	130%
GCL, DWR.	110% Gas Cap	122%	125%	130%

Table 3. The TDG target for each level of the Spill Priority List by project during summer spill.

Project	Level 1	Level 2	Level 3	Level 4	Level 5
Fish passage projects	115%/120% Gas Cap	120%	122%	125%	130%
CHJ	110% Gas Cap or degassing cap	115%	120%	122%	125%
GCL, DWR.	110% Gas Cap	115%	120%	122%	125%

4.3 Factors for Setting Spill Priority

When establishing the order dams will spill above planned spill for fish passage, the following factors are considered:

- Location of Fish: Location and number of adult and juvenile fish in the migratory corridor.[9]
- Location of High TDG: When TDG levels are elevated (greater than the water quality standard), dams may be shifted on the list to manage system-wide TDG levels.
- Location of Fish Research: When fish research is planned or in progress, those dams are low on the priority list to minimize detrimental impact to the studies.
- River Reaches: Dams are considered in one of three blocks: the lower Snake River, the lower Columbia River, and the middle Columbia River. For example, if several of the lower Snake dams need to be moved to a lower priority on the Spill Priority List, then the whole block of dams (Lower Granite, Little Goose, Lower Monumental and Ice Harbor dams) may be moved to last position on the list.
- Special Operations: Dams with special operations such as construction, maintenance or repair are placed last on priority list.
- Collector Dams: During low flow years, the dams where fish are collected for transport may be placed lower on the priority list.
- Special Fish Conditions: If there are special fish conditions, such as disease or a special release, the dam may be moved higher or lower on the priority list depending on circumstances.
- System-wide TDG management: Grand Coulee, Chief Joseph, Dworshak and other projects are included on the Spill Priority List to help balance system-wide TDG levels during periods of lack of load spill.

5. TDG Management Policy, Guidance and Considerations

The Corps will consider water quality effects along with the results of spill studies, biological evaluations, and the relationship to achieving performance standards and incorporate the following TDG management policies in its decision making:

- Implement the 2026 FOP which is responsive to the U.S. District Court for the District of Oregon's (District Court) Preliminary Injunction Order issued February 25, 2026 and amended on March 2, 2026. The Corps will manage TDG consistent with that order.
- Manage dam operations to the extent practical in accordance with CWA and State WQS, modified through standard modifications and rule adjustments.
- Provide fish passage spill consistent with applicable biological opinion requirements and current regional agreements while avoiding high TDG levels or adult fallback problems. Specific spill levels will be provided for fish passage at each dam in accordance with the current FOP, consistent with the applicable State TDG WQS.

[9] This type of input is often provided through a regional forum, such as TMT.

- Operate dams to the authorized project purposes.
- Regulate flows to maximize potential for fish passage spill.
- Discontinue or reschedule 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 ESA listed fish are present.
- Accommodate special spill requirements/restrictions for research, adult passage, etc. that have been coordinated with the TMT.
- Manage the system in coordination with Reclamation and BPA to avoid forced spill and minimize TDG production when possible, without jeopardizing flood risk management objectives.
- Implement the Spill Priority List discussed in Section 4.0.
- Chief Joseph Dam is not included in the Washington TDG criteria adjustment, but it is used for managing system TDG during periods of forced spill. Chief Joseph Dam has very effective flow deflectors, so TDG due to spill rarely exceeds 120% TDG. Therefore, it is used as a tool for reducing higher TDG coming from Grand Coulee and is an effective location to spill to meet contingency reserves needs or due to lack of load conditions. When the Chief Joseph Dam forebay and tailrace both exceed 110% TDG and project spill results in lower TDG in the tailrace than in the upstream forebay, it is appropriate to raise the Level 1 spill cap to provide lower TDG downstream. In these events, Level 1 no longer represents the 110% gas cap, but degassing at the project will result in lower downstream TDG than would have otherwise occurred.

The Corps will continue to coordinate with the States of Oregon and Washington on planned fish passage spill,[10] and provide technical information to inform the process. Future spill operations may be modified through the implementation planning process and adaptive management.

6. TDG Monitoring Program

The management of spill at each dam is based on TDG levels measured at specific forebay and tailwater fixed monitoring stations (FMS) as appropriate. The current locations of these gauges are based on extensive studies that have been conducted since 1996. In support of the spill management program, a TDG monitoring program has been established and is described in the TDG Monitoring Plan.[11] This monitoring program is revised to include changes in the FMS system and evaluated by regional representatives.

6.1 Malfunctioning TDG Gauges

In the event that an FMS is out of service for an extended period of time, RCC will use all available tools to estimate the TDG readings for the malfunctioning gauge. These tools may include one of the following:

[10] The Corps coordinates with the State of Washington on planned fish passage spill at the lower Snake and lower Columbia River projects; and with the State of Oregon on planned fish passage spill at the lower Columbia River projects.

[11] TDG Monitoring Plan can be found here: https://www.nwd.usace.army.mil/CRWM/Water-Quality/

- SYSTDG – the SYSTDG model can be used to provide estimated TDG levels for the malfunctioning gauge and those TDG estimations may be used for spill management. As needed, the Corps will share estimates of TDG.
- An alternate gauge – in the Bonneville Dam tailrace, the Warrendale gauge is considered an alternate gauge for the Cascades Island FMS.

7. Procedure for Setting Spill Caps

To successfully implement gas cap spill for the spring migration season and set appropriate spill caps during the summer, fall, and winter, the Corps will apply the following procedures:

1. TDG WQS
   a. At the four lower Snake River projects, only the State of Washington TDG WQS applies.
   b. The lower Columbia River borders the States of Washington and Oregon, therefore both States' TDG WQS apply to McNary, John Day, The Dalles, and Bonneville projects.
   c. The Corps will operate to the more restrictive State TDG WQS at these projects to maintain TDG within all applicable state standards.
   d. Spill caps will be set to meet but not exceed both the 12-hour average and the 2-hour average criteria in the project tailrace. Washington's TDG maximum two-hour average criterion of 126% is more restrictive than Oregon's criteria, so it will be used to set spill caps.
   e. Each day from April 3 through June 20 (lower Snake River projects) and from April 10 through June 15 (lower Columbia River projects), the spill caps[12] will be reviewed and adjusted so as not to exceed the applicable 125% (12-hr average) / 126% (2-hr max) TDG WQS. Daily 12-hour TDG concentrations will be calculated using hourly TDG data from FMS placed in the tailrace of each project, in accordance with the applicable state's methodology, which includes rounding TDG levels to the nearest whole number.
   f. Both Oregon and Washington have a more restrictive TDG criteria if GBT data exceed thresholds (see Section 8.0 Gas Bubble Trauma Monitoring).
   g. Each day from June 21 through July 31 (lower Snake River projects) and from June 16 through July 31 (lower Columbia River projects), the project 115%/120% TDG spill caps will be reviewed and adjusted so as not to exceed the applicable State TDG WQS.
   h. Spill caps may be less than the performance standard spill.
   i. The Corps will perform daily spill review but does not expect a need to change spill caps from August 1 through August 31 since the lower Snake River projects will only be spilling through the spillway weirs (7 to 8 kcfs) and at lower rates not expected to exceed water quality standards at the lower Columbia River projects.

2. Spill Caps

[12] Spill cap is the maximum spill level (flow through the spillway measured in kcfs) at each project that is estimated to meet, but not exceed, the gas cap in the tailrace. The Corps manages "gas cap spill" by establishing spill caps for each project (which constitute the "target spill" levels for each project) and operates each project to achieve the target spill levels to the extent feasible.

a. Spill caps will be set starting at Lower Granite Dam (the most upstream fish passage project) and adjusted in downstream order to Bonneville Dam in response to resulting TDG levels.
b. Spill caps at a project will be set at the maximum level estimated to meet, but not exceed, the TDG water quality standard (see Section 4.2 for more detail).
c. Spill cap estimates are influenced by several factors that cannot be precisely predicted, including (1) environmental conditions, such as total flow, wind, ambient temperature, barometric pressure, incoming TDG from upstream projects, and travel time from the upstream project tailrace to the next downstream project forebay[13]; and (2) project operations, such as spill level, spill pattern, tailwater elevation, proportion of flow through the turbines, and project configuration. As a result, in many instances, spill caps will not always meet the gas cap (i.e., actual TDG levels may be above or below the gas cap).
d. It may be necessary to adjust spill at John Day Dam to manage TDG levels in The Dalles tailwater since both spill and powerhouse TDG impact The Dalles tailwater gauge. Observed TDG responses to John Day Dam spill cap adjustments at The Dalles forebay will be evident within 24 hours.
e. Spill caps should consider downstream criteria. In the event an upstream project's Gas Cap is greater than a downstream project, the spill cap at the upstream project may need to be reduced to meet but not exceed the downstream project's criteria. For example, if Gas Bubble Trauma causes a reduction in the TDG criteria in the Lower Monumental forebay, Lower Granite's spill cap may have to be reduced to meet but not exceed the downstream criteria.

3. Daily Process used to Set Spill Caps.
   a. Daily data review.[14] Each day from April 3 through August 31, Corps staff will review observed spill levels and resulting TDG data, GBT data, flow and weather forecast information, tailwater elevation, unit outage information, and other water quality data. In addition, staff will assess the need for a TDG criteria adjustment due to exceeding GBT criteria per State WQS.
   b. Run SYSTDG Model.[15] The SYSTDG model will be used when appropriate as a real-time operations tool to forecast the TDG production levels for all the projects. As warranted, Corps staff will cross-check projected spill caps with SYSTDG model simulation results to make appropriate spill cap adjustments. It may be necessary to

[13] Water travel time between John Day and The Dalles projects is a consideration since The Dalles forebay is very influential on The Dalles tailwater TDG levels.
[14] When the observed total river flows on the lower Snake and lower Columbia rivers reach a low level such that there is diminished likelihood of planned fish passage spill producing TDG above the State standards, RCC will conduct spill review and set daily spill caps for the weekend on the last working day of the week. These conditions usually occur beginning in late July. Spill caps through the weekend will be set and recorded in the CWMS database.
[15] Comprehensive spill review, which includes SYSTDG modeling when appropriate, will occur during regular work week hours. The Corps will continue the current spill review process for holidays and weekends, i.e., a condensed spill review process will be implemented considering observed data and applied engineering judgment. SYSTDG model runs are not likely to occur for the condensed review.

simulate iteratively until the appropriate spill caps for all projects are determined, since a change at one project affects projects downstream.

c. Determine spill cap. Corps staff will use the data review and SYSTDG modeling steps described above to determine the appropriate spill caps based on their best professional judgment. Initially, the Corps anticipates making relatively small adjustments in spill caps to allow TDG levels to equilibrate because large and frequent adjustments at multiple projects could lead to overcompensation in setting spill caps and result in fluctuations of high or low TDG levels. Weekday spill caps will be coordinated with NOAA Fisheries.[16]

d. Notification. Spill cap adjustments will be provided to each project and BPA duty schedulers daily or as changes are made. Corps staff will typically complete the daily spill cap process by 1400 hours.

e. Coordination with regional sovereigns. Spill caps will be posted to the Corps website each day.[17]

4. Other Considerations. In addition to the factors described above that may influence spill levels, there are other considerations described in the FOP that may result in adjustments to spill levels that are different than gas cap spill. See Section 4.1 of the FOP for a list of these considerations.

8. Gas Bubble Trauma Monitoring

Both Oregon and Washington WQS require GBT monitoring to implement the planned spill for fish passage in the spring. The details of monitoring and evaluation are in the Corps' 2026 Biological Monitoring Plan and summarized below.

If an exceedance of GBT incidence action criteria is detected either in juvenile salmonids or non-salmonids (with a minimum sample size of 50 juvenile salmon and 50 non-salmonids required weekly) during fish passage spring spill operations up to 125% TDG, the Corps will immediately contact Washington Department of Ecology (WDOE) and Oregon Department of Environmental Quality (ODEQ). Upon notification and conferring with the states, the protocol below will be followed by the Corps to reduce spill to 120% TDG in the tailrace (Oregon and Washington) and 115% TDG in the forebay (Washington). Washington GBT action criteria state that spill must be reduced to the levels in the previous sentence when there are exceedances of:

a. GBT in non-paired fins of 15%; or

b. GBT in non-paired fins of 5% and gas bubbles occlude more than 25% of the surface area of the fin (i.e. severe fin GBT).

Oregon GBT action criteria state that the ODEQ Director has discretion to require spill reduction to 120% TDG in the tailrace when there are exceedances of:

a. GBT in eyes or non-paired fins of 15%; or

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[16] NMFS, 2020, ESA Section 7(a)(2) Biological Opinion and Magnuson-Stevens Fish Conservation and Management Act Essential Fish Habitat Response, Continued Operation and Maintenance of the Columbia River System.

[17] Spill Caps: https://public.crohms.org/tmt/documents/ops/spill/caps/

b. GBT in eyes or non-paired fins of 5% and gas bubbles occlude more than 25% of the surface area of the fin or eyes (i.e. severe GBT).

Washington and Oregon have indicated that sample size in and of itself was not intended to be an additional action criterion for reducing spill up to 125% TDG. Additionally, the states have indicated that the GBT thresholds are applicable to all sample sizes.

USGS and FPC will email GBT monitoring results to the Corps RCC as soon as they are available, typically on the afternoon on the day of collection. Publicly available GBT data can be found here: https://www.fpc.org/smolt/Q_smolt_smoltgbt_subsite.php and an example screenshot of the 2-week summary is shown below in Figure 1 and Figure 2.

Date	Species Examined	Total Fish Examined	Total Fish w/ GBT	Total Fish w/ Fin GBT	Pct Fish w/ GBT	Pct Fish w/ Fin GBT	Pct Fish w/ Severe GBT	Pct Fish w/ Severe Fin GBT	Number of Fish w/ GBT by Rank			
									1	2	3	4
4/9/2025	CH1+ST	102	9	4	8.8%	3.9%	0.0%	0.0%	9	0	0	0
Calculation method =	Oregon	Washington		Criteria <=	15%	15%	5%	5%				

Figure 1: Example of salmonid GBT monitoring from FPC. The states' different methods to compare to the criteria are indicated with a colored box. To determine exceedances of the criteria, these values will be rounded to the nearest whole number.

Date	Species Origin/State Rule	Species Examined	Total Fish Examined	Total Fish w/GBT	Total Fish w/Fin GBT	Pct Fish w/GBT	Pct Fish w/Fin GBT	Pct Fish w/Severe GBT	Pct Fish w/Severe Fin GBT	Number of Fish w/ GBT by Rank			
										1	2	3	4
4/8/2025	Native	Northern Pikeminnow	95	0	0					0	0	0	0
	Native	Sculpin, species	11	1	1					1	0	0	0
		Traditional - Native Only	**106**	**1**	**1**	**0.9%**	**0.9%**	**0.0%**	**0.0%**	**1**	**0**	**0**	**0**
		Traditional - All Species	**106**	**1**	**1**	**0.9%**	**0.9%**	**0.0%**	**0.0%**	**1**	**0**	**0**	**0**
		Stratified Mean - Native Only				**4.5%**	**4.5%**	**0.0%**	**0.0%**				
		Stratified Mean - All Species				**4.5%**	**4.5%**	**0.0%**	**0.0%**				
Calculation method =	Oregon	Washington			Criteria <=	15%	15%	5%	5%				

Figure 2: Example of non-salmonid GBT monitoring from FPC. The states' different methods to compare to the criteria are indicated with a colored box. To determine exceedances of the criteria, these values will be rounded to the nearest whole number.

The Stratified Mean Proportion Methodology (native species only, fin GBT only per WDOE) will be used for managing non-salmonid GBT at the Snake River sites while the more restrictive of the Traditional Methodology (all species combined, GBT in fin and/or eyes per ODEQ) and the Stratified Mean Proportion Methodology (native species only, fin GBT only per WDOE) will be used to manage non-salmonid GBT at the lower Columbia sites.

If a GBT criterion is exceeded at a monitoring location, the TDG criteria will be reduced to 115% forebay / 120% tailwater TDG at the project where the exceedance was observed and at projects in that geographic zone that do not have site-specific sampling. For planned spill, the 125% TDG gas cap spill operation will be replaced with a 115% forebay / 120% tailwater TDG gas cap spill operation. Performance standard spill will continue as described in the FOP. The reduction will be made as part of the daily spill decision by no later than 1100 hours, and new spill caps will be sent by no later than 1400 hours that day. GBT data received by 1000 hours

will be incorporated into the daily spill review process for the same day, otherwise it will be factored into the following day's evaluation.

Under high river flow conditions that result in lack of turbine capacity in the spring, which force projects to spill above 125 % TDG levels, then the following points will be applied:

a. GBT monitoring data shall be excluded from comparison to biological thresholds when higher than normal river flow results in excess spill above 125 % TDG.

b. This monitoring data exclusion shall apply for one full calendar day after every project (that spills up to 125 percent TDG for fish passage) within an assigned zone is not exceeding 125 percent TDG.

The geographic zones include the lower Snake River zone (Lower Granite, Little Goose, Lower Monumental, and Ice Harbor dams) and the lower Columbia River zone (McNary, John Day, The Dalles, and Bonneville dams). In the event an action criterion exceedance is detected at McNary Dam forebay, which is just below the confluence of the Snake and Columbia rivers, TDG levels in the middle Columbia River and lower Snake River would need to be evaluated to determine if the exceedance was the result of spill operations in the lower Snake River zone exclusively, or if conditions in the middle Columbia River were also contributing to the action criterion exceedance. Generally, if an exceedance was observed at McNary Dam forebay, spill would be reduced at all projects in the lower Snake River zone. If an exceedance is observed downstream of McNary, projects in the lower Columbia River zone would be reduced. If an exceedance was observed at Bonneville Dam, then spill at all projects in the lower Columbia River zone would be reduced, including Bonneville Dam. Table 7 shows the extent of reduction if an exceedance is observed at any one of the six monitoring locations.

Table 4. TDG criteria after a GBT exceedance finding at the only the Exceedance Location (non-salmonid). Assumes no forced spill on the reach where the exceedance was detected.

Exceedance Location	TDG Criteria by Location							
	BON	**TDA**	**JDA**	**MCN**	**IHR**	**LMN**	**LGS**	**LWG**
BON tailrace	120%	115/120%	115/120%	125%	125%	125%	125%	125%
MCN tailrace	125%	115/120%	115/120%	115/120%	125%	125%	125%	125%
IHR tailrace	125%	125%	125%	125%	115/120%	115/120%	115/120%	125%
LWG tailrace	125%	125%	125%	125%	125%	115/120%	115/120%	115/120%

The spill priority list in Table 8 will be used to communicate spill caps to meet the applicable water quality criteria (Level 1) and used to distribute lack of market spill in the event of a GBT exceedance.

Table 5. The TDG target for each level of the Spill Priority List by project if there is an exceedance of the GBT threshold.

Project	Level 1	Level 2	Level 3	Level 4	Level 5	Level 6
Zone without GBT exceedance	125%	125%	125%	125%	130%	135%
Zone with GBT exceedance	115%/120%	120%	122%	125%	130%	135%
CHJ	110% or degassing cap	120%	122%	125%	130%	130%
GCL, DWR.	110%	120%	122%	125%	130%	130%

If the TDG criteria has been reduced to 115%/120% TDG, then further GBT monitoring must demonstrate the incidence of gas bubble trauma is below action criteria to reinstate 125% TDG spring spill. Spill rates based on the 115%/120% TDG criteria will apply for a minimum of 7 days.