

COLUMBIA RIVER TECHNICAL MANAGEMENT TEAM

May 2, 2018

Facilitator's Summary

Facilitator: Donna Silverberg; Notes: Charles Wiggins, DS Consulting

The following Facilitator's Summary is intended to capture basic discussion, decisions, and actions, as well as point out future actions or issues that may need further discussion at upcoming meetings. These notes are not intended to be the "record" of the meeting, only a reminder for TMT members. Official minutes can be found on the TMT website: <http://www.nwd-wc.usace.army.mil/tmt/agendas/2018/>

Review Meeting Minutes

Approvals of the 4/18 and 4/25 TMT meeting notes were postponed to the next TMT meeting.

FOP Spring Spill Update

Dan Turner, Corps, updated TMT on last week's spill operations. He provided a series of charts and graphs explaining the process the Corps is developing to manage spill operations and comply with the requirements of the Court Order regarding spill. All are available on the TMT web site. The first two charts show daily TDG levels at the lower Snake River and lower Columbia River projects. The last document explains the impact of the factors that can affect TDG levels in addition to spill. These include mixing below the powerhouse, temperature, barometric pressure, wind, and stratification and lateral variation. Spirited discussion helped members better understand the statistical formulae used to make decisions and plan future operations. Dan cited *Colt* (1984) as a useful source reference.

Last week, spill operations resulted in higher than optimal TDG levels throughout the system. Planning was made more difficult because five separate fronts moved through the region, affecting TDG levels. Several projects experienced significant involuntary spill. Today's outage at Lower Granite, approved at the unscheduled TMT meeting on April 30, should not have an effect on spill cap planning.

Spill Priority List

Paul Wagner, NOAA requested a modification to the 2018 Spring spill priority list. Several weeks ago TMT coordinated the list to guide the project priority order for involuntary spill due to lack of load in the system. The list is available on the TMT web site. The group discussed whether to move The Dalles Dam to first priority of the fish passage projects to increase the potential for more spill at that project. This would be helpful because The Dalles is the only major facility with no fish bypass system and the spill cap is currently being limited by the Bonneville forebay. FPAC approved the request, and the Corps can implement the new order immediately. All TMT members concurred.

- **ACTION:** Move The Dalles Dam to the top of each Level on the Spring 2018 Spill Priority List, and publish the revised list on the TMT web site.

Operations Review

Reservoirs

Joel Fenolio and Sheri Sears (Colville tribes) reported on Bureau of Reclamation projects:

Hungry Horse: current elevation 3477.6 ft.; 16 kcfs inflows; 5.6 kcfs released, with spill at 2.5 kcfs. TDG levels are 110 %. They are evaluating how best to refill the reservoir, which is scheduled be full at the end of July. The 8-9 day weather forecast suggests the project may be over flood stage at Columbia Falls.

Grand Coulee: current elevation 1221.9 ft. at the forebay; 108 kcfs outflow to pass inflow. The project will refill to 1228 ft. The ferry will return to service May 10-12.

Lisa Wright reported on Corps projects:

Libby: current elevation 2364.9 ft.; 24.6 inflow; 9.2 kcfs out.

Albeni Falls: current elevation 2056.5 ft.; 81 kcfs inflow; 57.5 kcfs out.

Dworshak: current elevation 1493.1 ft.; 15.9 kcfs inflow; 4.6 kcfs out.

Lower granite: 110.5 kcfs out.

McNary: 324.7 kcfs out.

Bonneville: 342.1 kcfs out.

Lisa reported that Lower Granite is implementing the powerhouse outage for the transmission line work, as coordinated at the TMT meeting on April 30, with work scheduled to last five hours. Flow through the generators will go to zero, then return after repairs are completed. The pool elevation will also creep up as the project holds spill at 50 kcfs and stores the rest of the inflow. The forebay elevation is currently 734.5 ft., and can go to 737.7 ft. at the Lewiston gauge.

Fish

Paul Wagner reported on fish.

Paul reported that for adult fish, 6,887 spring Chinook have been counted to date at Bonneville, which is 12% of the 10-year average (but two times the count last year). 2,611 winter steelhead were counted, with 1,091 wild. Lower Granite counted 29 spring Chinook, or 1% of the 10-year average (but similar to last year). The run is late, “but will be coming.” Summer fish will not show up until about August.

Juvenile fish is “where the action is.” The Lower Granite Dam combined yearling Chinook index count on 5/1 was 269,917 . Yearling Chinook counts at Little Goose and the lower Columbia were strong as well, with steelhead showing the same trend. The DART Quick Look on steelhead shows early passage, and yearling Chinook mostly following the ten-year average. The sockeye counts are probably Kokanee.

Power Supply

Tony Norris, BPA, reported that the system had seen high wind activity and high loads during the past week. He provided a chart demonstrating how load balancing operates to integrate variable renewable resources.

The next TMT meeting is a conference call on May 9.

The face-to-face TMT meeting on May 16 will include a presentation by the Fish Passage Center. Members were also interested in a presentation at that meeting by DART.

Please send TMT meeting agenda items to Lisa Wright.

Columbia River Regional Forum

TECHNICAL MANAGEMENT TEAM OFFICIAL MINUTES

May 2, 2018

Minutes: Melissa Haskin

1. Introduction

Representatives of BPA, NOAA, COE, BOR, Washington, Montana, USFWS, Nez Perce Tribe, Colville Tribe, Oregon and others participated in today's TMT meeting chaired by Lisa Wright, COE.

2. Review Meeting Minutes – April 18 and April 25

The April 18 and April 25 facilitator's summary and meeting minutes were deferred to allow more time for review pending revisions from Julie Ammann, COE. Approval of the April 18 and April 25 summary and minutes was deferred until the next TMT meeting (5/9/2018) to allow more time for review.

3. FOP Spring Spill Update

Dan Turner, Corps-NWD, walked TMT through the TDG levels on the Snake and Columbia Rivers. Dan also provided a presentation on how TDG is calculated. Attachment 5c shows that factors that influence TDG include temperature, barometric pressure, wind, and stratification and lateral variation. Dan shared simplified calculations for TDG for each of the mentioned factors.

3a. [Snake River TDG Overview Table](#)

Spill caps on the Snake River are the spill levels that are estimated to meet, but not exceed the Washington TDG criteria adjustment (120% tailwater/115% forebay). Little Goose was spilling above the spill cap. The spill cap was 28 kcfs but the actual spill was 37 kcfs. The Dalles spill cap was raised from 65 kcfs to 90 kcfs due to a wind storm. Spill caps are rarely changed during involuntary spill because there isn't a lot of information about how it will impact TDG. Forecasts are for a few days voluntary spill, switching to involuntary spill later in the week. The Corps provided the TMT with the following update on the previous weeks (4/25 to 5/1) Lower Snake River spill data.

	value
Table Key	
Most restrictive gauge used to determine spill cap	value
Project spilling above the voluntary spill cap for 6 or more hours	*
TDG measurements exceeded the daily criteria (i.e. gas cap)	
Project operating at minimum generation for 6 or more hours	
1/3 of data or more missing for value calculation	value
No data	--

Spill Cap changes occur at 16:00 PST.

Project	Lower Granite				Little Goose				Lower Monumental				Ice Harbor				
	Spill Cap	Actual Spill	TW	d/s FB	Spill Cap	Actual Spill	TW	d/s FB	Spill Cap	Actual Spill	TW	d/s FB	Spill Cap	Actual Spill	TW	Pasco	d/s FB
	Starting → Change	Daily Average	LGNW	LGSA	Starting → Change	Daily Average	LGSW	LMNA	Starting → Change	Daily Average	LMNW	IHRA	Starting → Change	Daily Average	IDSW	PAQW	MCNA
units	kcfs	kcfs	% sat	% sat	kcfs	kcfs	% sat	% sat	kcfs	kcfs	% sat	% sat	kcfs	kcfs	% sat	% sat	% sat
2018-04-25	39→36	38	117	119	30→28	28	116	118	33	32	116	117	92	89	119	113	115
2018-04-26	36	35	117	119	28	27	116	118	33	32	116	118	92	86	119	113	116
2018-04-27	36→31	34	117	120	28	27	117	119	33→31	30	116	119	92→85	90	120	114	117
2018-04-28	31→33	32	115	119	28	29*	116	119	31	34*	117	118	85	85	119	111	116
2018-04-29	33	33	115	115	28	40*	117	116	31	44*	119	115	85	85	119	114	112
2018-04-30	33	33	115	112	28	42*	118	116	31	47*	119	115	85	85	119	114	113
2018-05-01	33→34	33*	115	111	28	37	117	117	31	41	119	116	85	85	119	114	114

3b. Columbia River TDG Overview Table

The Columbia River experienced involuntary spill at all four projects over the weekend (4/28 and 4/29) and into Tuesday (5/1). The Corps provided the TMT with the following update on the previous weeks (4/25 to 5/1) Lower Columbia River spill data.

	value
Table Key	
Most restrictive gauge used to determine spill cap	value
Project spilling above the voluntary spill cap for 6 or more hours	*
TDG measurements exceeded the daily criteria (i.e. gas cap)	
Project operating at minimum generation for 6 or more hours	
1/3 of data or more missing for value calculation	value
No data	--

Spill Cap changes occur at 16:00 PST.

Project	McLary				John Day				The Dalles				Bonneville		
	Spill Cap	Actual Spill	TW	d/s FB	Spill Cap	Actual Spill	TW	d/s FB	Spill Cap	Actual Spill	TW	d/s FB	Spill Cap	Actual Spill	TW
	Starting → Change	Daily Average	MCPW	JDY	Starting → Change	Daily Average	JHAW	TDA	Starting → Change	Daily Average	TDDO	BON	Starting → Change	Daily Average	CCIW
units	kcfs	kcfs	% sat	% sat	kcfs	kcfs	% sat	% sat	kcfs	kcfs	% sat	% sat	kcfs	kcfs	% sat
2018-04-25	193→175	187	120	118	120→110	117	118	118	75→85	74*	118	118	121	119	120
2018-04-26	175→165	172	120	121	110→100	107	118	118	65	69	117	118	121	122*	121
2018-04-27	165→145	158	119	122	100→90	97	118	119	65	64	118	118	121	121	121
2018-04-28	145	145*	119	120	90	95*	117	115	65	69*	115	114	121	120*	120
2018-04-29	145	172*	118	117	90	128*	119	114	65→90	122*	120	113	121	148*	122
2018-04-30	145	175*	120	113	90	127*	119	113	90	134*	119	116	121	168*	123
2018-05-01	145	163*	119	109	90	146*	120	112	90	137*	118	116	121	165*	123

3c. Presentation on Calculations of TDG

Dan presented to TMT how TDG is measured. He noted that gauges just measure the TDG at one point in a reservoir. While the points are picked carefully, he said, they only show the picture at that point, meaning they may or may not accurately represent the overall reservoir. He noted that there can be both vertical and lateral variations of TDG.

The next topic Dan moved on to was pressure. This section of the presentation garnered a number of questions, particularly on how depth affects pressure.

During the section of the presentation, Dan showed this formula from attachment 3c.

$$TDG (\% \text{ of saturation}) = \frac{TPP (\text{mmHg})}{BP (\text{mmHg})} * 100$$

TPP = Partial pressure of all dissolved gases

BP = Barometric pressure

$$TDG_1 = \frac{TPP_1}{BP_1} \text{ and } TDG_2 = \frac{TPP_2}{BP_2}$$

If TPP doesn't change (i.e. $TPP_2 = TPP_1$) but BP does, then:

$$TDG_2 = TDG_1 \frac{BP_1}{BP_2}$$

Where TPP 1 is the total partial pressure at point one and TPP2 is the total partial pressure at a second date – in this example, two days later.

TDG1 in this example is the upstream forebay and TDG2 is the downstream forebay.

The purpose of the above equation is to evaluate the factors on the downstream gauge. It is not a computation of the upstream gauge.

An audience member noted that as the current moves, the barometric pressure varies and is different from the day before.

Dan agreed this was correct noting that as a low pressure system moves through, the pressure drops (and then will build again).

Paul Wagner, NOAA, asked, "How is depth factored into this – is the partial pressure affected by depth?"

Dan clarified that partial pressure is not dependent on depth whereas hydrostatic pressure is. However, neither play into the measure of the partial pressure of gasses. Partial pressure of gasses are a concentration of gas, he said. So if a gauge is moved upstream, the pressure would not change unless the temperature of the water or the concentration of gasses changed.

Paul made sure he was understanding, "so hydrostatic pressure has no effect on your partial?"

This was followed by a question from Dave Swank: "when you're down at 50 feet [under water], you're under a lot more pressure than you would be at a foot below surface so the gas dissolved should go up, right?"

Dan reiterated that the difference here was hydrostatic pressure versus gas pressure. Partial pressure is determined by the barometric pressure not the pressure at a specific point.

Dave Swank, USFWS wondered why TDG is calculated the way it is since the fish may experience different levels of TDG than the equation provides.

The reason the equation is used, several people in the room noted, is that it is a regulatory requirement and a standard used across all rivers in the country.

From here the discussion moved to temperature where Dan provided a formula (attachment 3c, page 5) and this rule of thumb as a shortcut to the formula: "TDG (%) will increase by 2% for every 1°C (2°F) of warming of the water." Dan used

Colt, 1984, *Computation of Dissolved Gas Concentrations in Water as Functions of Temperature, Salinity, and Pressure* as reference.

Per the equation, if the temperature is warmer, TDG is higher, as noted by Paul Wagner. The model measures the temperature of the gauge at its depth, not the surface.

The next factor in determining TDG discussed was wind.

The equation for how wind affects TDG involves components for wind, wind speed, an exponent and a constant. The constant helps account for any dissipation that would happen without wind as there will always be some dissipation. The exponent helps account for the fact that the relationship between wind and TDG dissipation is not linear – as wind increases so does its impact on TDG dissipation.

Michelle Yuen, Corps asked if the wind was measured as peak winds. Dan clarified that they are measured as hourly averages.

Dan then walked TMT through the last few weeks of TDG levels in comparison to the factors he discussed. The group analyzed how the three model predictions (pressure, wind, temperature) aligned with the actual TDG data from that time period. During April 18-28 TDG climbed from 110% to 121%. There was some question about if the lower graphs, which showed the prediction models could be directly and linearly added into the TDG models and if that would show the resulting actual TDG levels. Dan was hesitant to do that because the actual models are more complex and involve more variables. The model shown is a simplified one and Dan mentioned that to reach a prediction he would have to check his model. The model did show that temperature does play a huge part in TDG levels. Per Julie, the model shows that there is a lot out of control of TMT and forecasting can be difficult. While Dan notes the model is not perfect, he noted, average error levels are about 1-2%.

4. Spill Priority List

Paul Wagner, NOAA, presented a new spill priority list, attachment 4b. The list moved The Dalles Dam (TDA) from priority #7 to priority #1. Wagner said that due to increases in the gas levels generated by upstream projects, The Dalles is a priority area to increase spill.

There was a question about how important the order of the list is since it can be gone through quickly. Wagner and Tony Norris of the BPA both noted that the order is important.

The forecast for the Columbia River is moderate temperatures with flows of 350 kcfs. Demand for energy will be down and the likelihood of a lack of load spill will be high.

Action → Per Julie Ammann, COE, the COE will implement the new spill priority list as of 5/2/2018 per the recommendation of the Salmon Managers. She noted that the list will remain in effect for spring 2018 and then the Corps will revert to the original list for summer 2018 unless it receives other recommendations from the Salmon Managers.

5. Operations Review

5a. Reservoirs. Joel Fenolio, BOR and Lisa Wright, COE, reported.

Hungry Horse is at 3,478 feet elevation passing inflows of is at 16,000 cfs and will probably go up in the next few weeks. The dam is releasing at 5.6 kcfs. The water supply forecast is at 150% of average and there is still significant amount of

snow in the Flathead Basin. Due to testing, only 1 of 4 units are available causing spill, which will continue through May at above 2.5 kcfs.

There is a possibility of flood at Columbia Falls in the next 8 or 9 days due to the snow packs.

Grand Coulee did get below the Flood Risk Management target, which was 1222.7. Currently the forebay reading is at 1221.9 and will be held there until May 5. Coulee is releasing at 180 CFS and will continue to pass inflow.

Libby is at elevation 2364.9 feet, passing inflows of 24.6 kcfs and outflows of 9.2 kcfs. Albeni Falls is at elevation 2056.5 feet with inflows of 81.1 kcfs and releases of 57.5 kcfs. Dworshak is at elevation 1493.1 feet with 15.9 inflows, discharging 4.6 kcfs. Lower Granite outflows are 110.5 kcfs, McNary outflows are 324.7 kcfs, and Bonneville outflows are 342.1 kcfs.

Lisa Wright also mentioned the operations at Lower Granite, which were underway during the meeting. The transition was scheduled to happen from 9:30 a.m. to 2:30 p.m., with the powerhouse going down. 50 kcfs were scheduled to be released and the rest stored with the outflows taking place from 6 p.m. 5/2/2018 and 9 a.m. 5/3/2018.

5b. Fish. Paul Wagner reported.

Adults: Passage is coming along at a similar rate as last year for spring Chinook. Currently 6,887 have passed Bonneville – 12% of 10-year average. Adult steelhead returns to Bonneville are 2691.

Spring Chinook passage at Lower Granite is only 1% of the 10-year average, so far only 39 have passed. Passage rates are similar to last year. The run is late this year.

Juveniles: Passage rates are in-sync with historic timing with both spring Chinook and Steelhead moving at strong rates. Smolts were early to Lower Granite.

Some Sockeye have been observed, but Wagner notes they are easily confused and may not be sockeye.

5c. Power Tony Norris, BPA, reported. Tony guided TMT through the loads and resources graph and noted the rapid increases and decreases in wind generation. Tony showed TMT the balancing reserves graph and indicated that the spikes were due to rapid changes in wind generation and also some issue with the DC.

Tony notes that when a front comes in and the wind picks up quickly if the timing is off, generation forecasts can be off by as much as 3,000-4,000 megawatts.

Dave Swank, USFW asked about the notice to wind producers about wind cutouts. Tony explained that when there is too much wind, wind producers have to stop generating and that happens abruptly.

Tony noted that the spike in the loads and resources graph was due to several factors such as wind, the ramp and issues of the transmission system.

6. Next TMT Meeting

The next TMT meeting will be a conference call on 5/9.

Attendees

TMT

Name	Affiliation
------	-------------

Paul Wagner	NOAA
Trevor Conder	NOAA
David Swank	USFWS
Erick Van Dyke	OR
Charles Morrill	WA
Jim Litchfield	MT
Keith Wolf	Colville
Jay Hesse	Nez Perce
Tom Lorz	Umatilla (CRITFC)
Jen Graham	Warm Springs
Joel Fenolio	BOR
Tony Norris	BPA
Scott Bettin	BPA
Eve James	BPA
Julie Ammann	COE
Lisa Wright	COE
Non-TMT	
Brian Zigler	Snohomish PUD
Charles Wiggins	DS Consulting
Dan Turner	COE
Donna Silverberg	DS Consulting
Laura Hamilton	COE
Leslie Bach	NPCC
Melissa Haskin	Flux Resources
Michael Bryant	Columbia Basin Bulletin
Michelle Yuen	COE
Pat Vivian	

Steve Burrell

COE

Tom Iverson

Yakima Nation Fisheries