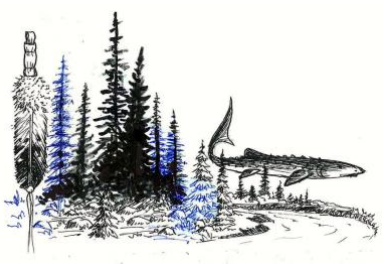
Kootenai River Habitat Restoration Program
Modeling Subgroup Meeting

June 18 and 19, 2015
Hampton Inn Spokane Airport



Thursday June 18, 2015

Meeting participants

The following individuals participated in some, or all, of the meeting: Zac Corum (USACE), Chris Cristiansen (BPA), Matt Daniels (RDG), Sarah Flynn (Geum), Ryan Fossness (USFS), Stanford Gibson (USACE), Duncan Hay (Oakwood Consulting), Sue Ireland (KTOI), Rich McDonald (USGS), Chris Nelson (RDG), Jon Nelson (USGS), Mitch Price (RDG), Alison Squier (ZIJI), and Molly Wood (USGS).

1. Project overview and progress update

Project overview

Sue I. welcomed everyone and Matt D. provided an overview of the agenda and meeting objectives. Sue gave a presentation summarizing the Kootenai River Habitat Restoration Program (KRHRP) for the benefit of those new to the project. *See presentation: 01_Modeling_Intro_SI*

KRHRP progress update

Matt D. gave an update on KRHRP progress, schedule and critical modeling tasks; presented the final design for Bonners Ferry Islands (BFI) and Straight Reach (SR); reviewed the technical risk matrix for BFI and SR projects, and provided a summary of the substrate pilot project implementation. See *01 Modeling Intro.pptx.*

One of the reasons for construction phasing in year one is to excavate the pool first using an existing gravel bar to access that site. Also didn't want to split the crews between two sides of the river. Matt said that at this modeling meeting they would like the group to think about the risk matrix during each of the presentations. At the suggestion of BPA, the matrix was how technical risks were framed and addressed. At the modeling meeting last year we reviewed these and it was helpful in terms of characterizing risk. Looking for things to add to this or update it. Want to incorporate modeling group input on the final report on this project.

Questions and discussion:

- Costs for the substrate project were a little higher than anticipated due to the time it took to move the materials on the barges.
- Chris C. – Having gone through and done the analysis, would you want the patch to be high or lower? Is there a significant difference?
    - Matt D. – We talked a lot about the thickness of the patch. What matters according to the biologists, is that the surface stays clean and the interstitial spaces remain largely clear. The gradation for the substrate was developed by biologists (suitability indices for the size of substrate) as part of the USACE/KTOI co-managed 1135 project.

    - Rich M. – Initially the patches were sized high enough so that dunes wouldn't overwhelm it. But when we moved the patches to the clay shelves, that was no longer an issue.

- Matt D. – We had pre-project bathymetry and the USGS resurveyed any changes to the riverbed prior to construction. As-builts were based on multibeam surveys taken in Nov. 2013. Then we had a year of winter operations, high flows, and an early season rain-on-snow tributary-driven high flow event that postponed the ability to remap. Ryan F. remapped the site after the February high flow event. The bottom line is it has seen a pulse of sediment and high flow move over it.
- Sue I. – IDFG has VRAP system, D-ring and egg mats in place to monitor the substrate patches. Noted that burbot also used the spawning rocks this last February.
- Matt D. - As part of as-built that Goodfellow Brothers Inc. did, they also sent divers down to walk and video over the patches. At the Shorty's site they filmed a juvenile sturgeon swimming by.

2. Bathymetric and substrate video monitoring

Ryan Fosness gave a presentation on the 2014 and 2015 bathymetric surveys, and pre-construction and as-built surveys of the substrate enhancement pilot project. See presentation: *02_Kootenai_River_Bathymetric_Surveys_Water_Year 2014-2015_RF.*

Discussion: Mapping of pools and observed geomorphic change

- Rich M. – You've got early spring post construction survey through that reach?
    - Ryan F. – Yes, we were out there June 27, 2014 post construction and we're going out July this year. Would have to change the map just for the upper half.
    - Rich M. – Would it be possible to get a shape file of the survey footprint?
    - Ryan F. – Yes.
- Ryan F. – The Bonners Ferry Islands survey is planned for between October and November. It will be tricky since we will have lower flows then.
    - Jon N. – In December we won't be using our new multi-beam so you could actually run both.
    - Ryan F. – It is also a low pool time of year so don't have the backwater.
- Ryan F. – For the Braided Reach cross-sections, we started going back to 2006 at some sites. In 2011 we started an annual survey where we survey on ascending and descending limb so have four years of those surveys. The most downstream site is near Ambush Rock up to Moyie River.
- Matt D. – Can see those two early peaks this year. The one in February was when Fisher River was up and contributing a lot of sediment, there were desynchronized flows.
    - Sue I. – On December 31 Libby Dam has to be at certain elevation regardless of snow pack etc. After that they manage based on rule curve and water supply.
- Rich M. – Would like to have an above water survey as well as underwater @ RM 155.882 (which is the Upper Meander project site).
    - Mitch P. – RDG can do it if Ryan can't get out of the boat to do it (it is not funded under current USGS SOW).

- Ryan F. – The Crossport section @ RM 156.895 shows a few feet of cyclical change, it has aggraded and then scoured. Now it is sort of back in the middle. RM 157.995 is where Phase 1 side channel comes back in and the downstream end of the bar scoured 5 feet and then filled back in.
    - Matt D. – The June 2014 survey seems like it is about a foot above everything in every cross section.
    - Ryan F. – It's the same coordinate system, etc.
    - Mitch P. – There was a datum error on the provisional data that was recently adjusted for these plots. Will plan to revisit the datum for the WY2014 data.
    - Ryan F. – These surveys are planned to continue through 2017 under current 5-year USGS SOW.
- Mitch P. – Somewhere around 2018 when the entire set of Braided Reach projects is constructed there is a SOW placeholder for the USGS to complete a multibeam survey of the entire reach.
- Zac C. – What was the % of discharge design criteria for Phase 1A side channel?
    - Matt D. – It was to take 5-10% of the flow. Prior to the project it was consistently taking 9% of flow from main channel.
    - Stanford G. – It is impressive how stable it is.
- Duncan H. – What's the take away message from these long term monitoring cross sections? We're not seeing a channel that is armored. From Crossport on down it is still a very dynamic channel. There's movement taking place (largely gravel movement). What do these cross sections tell us?
    - Matt D. – Quasi-stable.
    - Mitch P. –Considering the size of the river system, the sediment deposition trends appear to be fairly low.
    - Jon N. – That intermediate area (between Braided 1 and Braided 2) is where you have the largest effect. The downstream area is backwatered, it's just a few days a year where it's not backwatered and you have big impacts.
- Duncan H. – If you take the Crossport section and look at variability from year to year, that sediment doesn't move upstream it's moving downstream. The take away to me is that area is pretty lively.
    - Jon N. – You have to be careful because there's variability there. It's pretty accurate but it's only a few feet.
    - Mitch – This reach (upstream of RM156) is always the highest bedload transport but this is still relatively low compared to other river systems.
    - Matt D. – The term we used last year was quasi-stable, meaning there is some change but its not really changing the morphology.
- Chris C. – Has this bathymetry information been correlated with the model?
    - Mitch P. – We haven't done that with this year's survey data yet. But we've evaluated it in the past and what we're seeing is that the cut and fills generally balance at each cross section. This is consistent with the routing model which shows the reach as quasi-stable. Correlation with the model requires longitudinally extrapolating the section data which introduces a lot of error.

- Stanford G. – We have a new tool for extrapolating cross section volumes that will help with that.

- Zac C. – Is the goal here to see the geomorphic response of the river to the projects without the background change in the river?
    - Mitch P. – We want to look at whatever change is observed and tie that back to the flow operations (post FRM and post freshet) in the river. But it's hard to always time the survey exactly.
    - Ryan F. – Ideally you'd go out again in November and January to survey the river.
    - Zac C. – As you get downstream from those obvious effects things can start snowballing.
    - Mitch P. – We've got nine months and sampling takes place over about three months of the pre- and post- freshet. More data is good to a point, but it's always a trade off with how much it costs to collect.
- Rich M. – Trying to understand the redistribution of local sediment sources is important especially in terms of time.

Discussion: Video monitoring at Substrate Enhancement Pilot Project

Myrtle bend survey

- Matt D. – In the before and after survey the shape file of the post construction survey extent is not the outline of the actual placement of substrate.
    - Ryan F. –The area where the substrate was placed has been clean clay since we began surveying years ago.
- Ryan F. – To do the post-construction survey the plan used a simple 10-meter grid. The goal was to hit every grid position. We used the bedload sampler with one camera mounted on the front so we're seeing what's on the bottom real-time and then clamped a GoPro camera on the bed load sampler. It worked great. The survey with the videos was completed after the Fischer River input. A better way to do the survey would be 3 meters. This was the first round with the GoPro, we usually like to time stamp the process with GPS, but GoPro doesn't work will with GPS. We have figured out how to address that challenge for next time.

Shorty's

- Matt D. – The construction conditions at the Shorty's site were more challenging than at Myrtle. The contractor at Shorty's said they struggled more with positioning the barge at the Shorty's side. It was later in the season with higher velocity. The Shorty's clay shelf is a slope and the Myrtle site was a bench. Getting the rock to stick at Shorty's was harder. They also encountered a garbage dump upstream. We wanted them to go more to the river right but they couldn't get to it because the river flow was too low.
- Jon N. – Something that surprises me about both 2015 survey sets is that it seems like there's a cross-stream coherence that's larger than the grid bins.
- Ryan F. – Shorty's was quantifiably cleaner than Myrtle in the survey. The next survey is slated for August; they will try to get it as low flow as possible.
- Stanford G. – We're collecting sand and keeping a cover layer. Is the sand in a clogged zone just below the cover layer or is it two feet?
    - Matt D. – Don't know. If it were full of sand than it would be about 70%.

- Chris N. – Could you put a measuring stick on so that you're able to get some sense of vertical scale?

- Sanford G. – The hypothesis was that the there would be some cover on the order of 1-1.5x the D90. In general looks good.

3. Sediment data collection and gage network - Molly Wood, USGS

Molly Wood gave an update on the ongoing sediment sampling and sediment surrogates work and also updated the group on the status of the SIR. See presentation: *03_Sediment_Surrogates_2015_MW.*

Molly said they are continuing using fixed acoustic monitoring at three sites. The past two years they got four samples on peak flow, and the descending limb last year. This year they deployed the field crew but had lots of boat and sample problems. They did get samples in March. That will conclude sampling for this year. The 2015 results are not available yet. Molly noted that it is generally hard to get a good model fit with this technology at concentrations less than 20 mg/L. That makes it difficult in a river with such low concentrations as in Kootenai River.

Discussion: Sediment supply related to pool sustainability discussion

- Mitch P. – The models use a breakpoint between low and high concentration specific to the Kootenai. In general, most of the Kootenai sample concentrations are low when compared to other systems. Since the Kootenai breakpoint is tuned to a relatively low concentration dataset, I'm wondering if there is some supplemental data from a higher concentration system that could be used to extrapolate beyond the ~100 mg/L upper limit of the Kootenai and what would that look like?

- *Full discussion related to sediment supply and related questions were deferred until later in the meeting.*

4. Bonners Ferry Islands and Straight Reach 2D hydraulics

Mitch Price gave an update on the Bonners Ferry Islands and Straight Reach hydraulic modeling and results of review of changes between preliminary and final designs. See presentation: *04_BFI_Hydraulics_MP..*

Mitch explained that they developed boundary conditions based on 85-year synthetic period of record. They looked at the changes between the existing conditions and the preliminary and final designs. Final design changes included changing the side slopes to increase stability, pools were increased in size to balance out cut and fill (there is about 15% excess material coming out of pools that they expect to compact or loose to turbidity). For the upstream pool the preliminary design missed a chunk of the island that they'd intended to capture in the grading. It shows up as a hot spot because it is going from an island to the bottom of a pool.

Discussion: Bonners Ferry Islands Hydraulic Modeling

- Zac C. – What are the pool forming features here? What is going to maintain that acceleration and clean out the pools over time?

    - Mitch P. – Because of the seasonal backwater, pool forming structures would only be effective for a limited time each year and would have to be fairly large potentially have flood stage implications. One thought is that during winter operations when clear-water dam

release flows cyclically ramp between 5kcfs and 30kcfs and downstream lake levels are low, this could create intermittent hydraulic conditions that may help to sustain those pools.

  - Zac C. – So do you think just by constructing the pool the flows will help to sustain that?
  - Mitch P. – Not necessarily. During the low gradient conditions that occur when the backwater is present, it's just really difficult to create any conditions that can sustain those needed hydraulics.
  - Zac C. – I'm wondering if some submerged materials could help maintain those? But I understand that might have impacts in terms of flood measures.

- Matt D. – What we have going for us in this reach is the lack of sediment supply. The pool-forming structures protect the banks and provide eddies, which are helpful. We hoped to get some constriction effect out of those but the modeling is showing those don't really provide that. Based on the modeling, the only thing we can say that is keeping the pools from filling is low sediment supply.
- Chris C. – In what you looked at is there anything you looked at that would indicate there was a better location for a pool?
  - Matt D. – We really didn't see it. We put them in the locations that we thought would be the most sustainable. There is one area with a deeper thread of water and a harder bank with car bodies. That's a landowner that we've only recently been able to coordinate with, it might be an option in the future.
  - Rich M. – Might still have similar problems at that location.
  - Mitch P. – Also trying to keep the pools more centered to streamline the flow to maintain floodway conveyance.
- Matt D. – Another important aspect to remember with the pools is they are going to provide some habitat functions.
- Duncan H. – How did you evaluate the water intake?
  - Mitch P. – We evaluated proposed change in sheer stress, transport potential and unit discharge around the intake.
  - Matt D. – The City's concern wasn't that it would fill in; it was that they'd lose their ability to take in the water, i.e., that it would result in a change in unit discharge.
  - Sue – We provided the City with the analysis that RDG did and asked for their formal concurrence with the analysis. They said they were fine with it.
- Matt D. – For the habitat evaluation we wanted to look at any potential change in habitat for sturgeon. We looked at habitat suitability indices for green sturgeon (peak values for depth and velocity). Also looked at egg mat data for Kootenai River and the HSI developed by Mike P. for the lower Columbia. The original intent was to be able to look at the Straight Reach and see how the structures were increasing that type of habitat. We were able to apply these to the whole restoration area. We've also done mapping of bottom velocity knowing that for sturgeon the preference is three-feet-per-second at one meter off the bottom.
  - Rich M. – With these HSIs you lump all discharge information into one curve, but when you separate out that information you see that it looks like sturgeon are choosing the highest velocities in that reach. Also noted that the KRWS labeled HSI is from the Parsley Lower Columbia Data.

- Jon N. – But the correlations were never that tight. For depth it was significantly lower. From the actual data in the Kootenai you'd have a hard time doing any correlation. Even in Green sturgeon areas I think this kind of HSI analysis is on its way out. Having spatial information on the fish, what the actual hydraulics are, and what the fish are doing is far more important.

- Zac C. – Have you talked to USACE about the EWAM model?
    - Jon N. – We talked to John Nestler a lot. We've looked at all kinds of different models - there's a whole bunch of them. We know that flow structure is critical. But even though vorticity is about being on an eddy, vorticity itself isn't even that informative. Why use vorticity? For sturgeon I don't know.
- Sue I. – That was a problem all along with the BiOp, trying to find measureable things that will cause the fish to have recruitment is really difficult.
- Duncan H. – If we measured turbulence we'd have another parameter.

5. BFI bed evolution modeling

Rich McDonald and Jon Nelson gave a presentation on their Bonners Ferry Islands bed evolution modeling. See presentation: *05_ Bed_Evolution_MM_JN_RM.*

There is nothing maintaining pools in the Bonners Ferry Islands area when compared to the other Braided Reach pools. For bedload sampling they ran all 13 years since WY2001, but there was little variation between years so they focused on three time periods. Something that's a real challenge is that there's not that much subsurface sediment information in the reach. They used surface and bulk sediment samples from old USGS study but; there's a weird distribution with bulk sediment samples. In bedload modeling they used two-grain size distributions: median for surface and for bulk. They compared that to bed load samples taken at top of reach and Moyie. They ran the annual hydrograph from October 1 to the following year. It takes about five days to run that simulation. Pool 1 is the upstream pool.

Discussion: Bonners Ferry Islands Bed Evolution Modeling

- Sanford G. – Is there any longitudinal trend (with bulk sediment samples)?
    - Jon N. – No, some samples were collected on tops of bars, etc. Don't know about Wolman pebble counts, but there's often a bias.
- Zac C. – Can you use pool 1 to trap sediment?
- Duncan H. – How much upstream of Pool 1 did you look? What was the total bedload transport of that pool?
    - Rich M. – All we have is the bedload transport data collected at Crossport. We didn't integrate across the model to check.
- Duncan H. – The estimate of average bedload upstream of Crossport was 200 tons per year.
    - Rich M. – We did compare the model results to the bedload model at the upstream extent. Another sensitivity, it is potentially a higher transport rate when you move down into the backwatered area, which would potentially make the number of years to fill in smaller.
- Matt D. – We had four composite subsurface gradations from the BFI corings that went down ~ 13 feet. The percentage passing fine gravel ranged from 20% to 50% with an average of 37%…

- Stanford G. – The bulk distributions look like a composite sample to me even though this is a very supply limited sample.
- Zac C. – Is the table showing the percentage, the percentage of the pool volume, or percentage of mobile sediment?
    - Jon N. – It is the percentage of what is predicted to be mobile at the top of the pool and what gets trapped in the pool.
- Jon N. – To look at cross-sectional load we picked a time during this simulation and calculated width across pool (unit discharge weighted by ability to discharge sediment). So you're essentially capturing 70% of sediment moving down river in Pool 1. The other 30% is going on either side of the pool. The high stress area at the top of the pool is where the sediment goes in.
    - Rich M. – The basic answer is that 10% of the annual load gets trapped by the pool (Pool 1). Which would give a filling rate of 10-20 years for just suspended load. Rich so we have bedload and suspended bedload and what's in between.
    - Jon N. – So, the worst case scenario for Pool 1 is five years or less to fill.
- Stanford G. – In terms of the risk matrix, we always consider the worse year happening the year after it is built and the associated public perception.
    - Jon N. – It's the year with the most intermediate flows that are possibly the worse year in this scenario because that's when you get the highest stress events. This is a very imprecise calculation.
- Stanford G. – I think it might be worth communicating risk to the stakeholders and letting them know that if we got the 80-year event the pool might fill in more quickly. What we've come at is the low end of three years if we get flows like the ones we've seen in the last decade but there could be a flow that we haven't seen that drops this to one-year. As you move downstream the suspended issue won't be worse since it's the bedload component.
- Sue I. – Would like help from Jon, Stanford, Rich, etc. figuring how to be describe the process and sustainability of the pools to the public.
    - Jon N. – Basically, the pools that are in this area are depositional and are going to fill.
    - Sue I. – The pool lifespan may be sufficient during the next few years to provide a biological benefit as well as answer questions. Other species will also benefit from pools regardless of depth.
    - Matt D. – An important part of the construction of the pools is also cut and fills balance.
- Duncan H. – There will be redistribution of some of the sediment that may be distributed down the stream. You're going to increase the movement of sediment by the disturbance. Ideally would like to reorder the construction sequencing of the pools.
- Rich M. – More material has moved than what you can explain by what's there.
- Chris C. – You talked about suspended load and bedload is the sustainability both.
    - Jon N. - Bedload and suspended sediment together takes five years.
- Molly W. – Recent bedload survey at Crossport is 95% bedload.
- Chris C. – If it were 95% it would fill faster, could you model that?
    - Jon N. – We'd have to look at it. It would depend on the stress rates.

- Rich M. – Used the site above fry creek site.
- Mitch P. – Think the numbers are right but the above fry creek label is wrong.
- Jon N. – There are a million sensitivities we could investigate but at some point it's just not worth it.

- Mitch – Is annual physical monitoring going to be sufficient?
  - Jon – As the pool fills it will fill in at a slower rate after that. We're trying to be conservative on the short side of things. How slow it could fill would be 20 years. If you could get more gradation what would that look like, e.g., capture bottom of pool, middle of the pool, top of the pool.
  - Stanford G. – It's going to look like a reservoir bed.

6. BFI Flood Risk Modeling

Chris Nelson and Mitch Price gave a presentation on the Bonners Ferry Islands flood risk modeling results. See presentation: *06_Flood_Risk_Modeling_CN_MP.*

Discussion: Bonners Ferry Islands Flood Risk Modeling

Stanford G. – Did USACE do a coincident frequency analysis for the previous 2005 flood study?

- Zac C. – I don't know.
- Chris N. – They didn't do a coincident frequency analysis but they did establish an exceedance stage for the flood study. *[FOLLOWUP NOTE CN 8/5/2015: Bonners Ferry Flood Level Assessment (USACE 2005) did consider coincidence and timing of annual peak flows used to develop the 1%, 0.5% and 0.2% exceedance stage estimates for the Kootenai River, however, the analysis was not completed using the specific method that Stanford referenced in this question. Details regarding the coincident frequency determination can be found on pages 30 - 34 of the 2005 Flood Level Study.]*

- Stanford G. – We have an approach to this problem and you've done all of the work except that final step. Coincident frequency analysis can simplify this really quickly.
  - Mitch P. – This is inherently addressed because the 85 year synthetic regulated record provided by USACE manages the watershed variability as a 10% stage exceedance risk at Bonners Ferry.
  - Stanford G. – If the FIS did coincident frequency analysis I think this analysis should include that information. Let's talk details after the meeting.
- Zac C. – From a risk communication standpoint, what the USGS said is if your project lifetimes are 50 years there is 100% chance the pools will fill. Maybe we could be a little more optimistic. If the pools fill your impacts are a couple inches and that's a tolerable risk. The key point is the USACE isn't going to take up the slack if that's what occurs. Libby Dam staff can't manage for those small amounts <1kcfs. In your monitoring and adaptive management you will need to be prepared to say we have increasing stage and what are we going to do. Don't know how far along you are in your adaptive management and monitoring plan. I'd be thinking about having a plan that you can present to the local community that says if we see an increase of X this is what we'll be doing (for example: pool dredging or island scalping). The low hanging fruit is to change the FEMA map to show the small rise that you're seeing. I think the risk that that would occur is low but it is there. I would encourage you to play devil's advocate and have a pool filling plan. Based on what I've heard

from Joel Fenolio and others the USACE is not prepared to change operations based on channel changes that may occur in this reach. The impacts are basically just numerical noise. But depending on where you are in the FEMA model the impacts change. It doesn't mean that you can't do a project there; you just have to communicate that risk. If pool filling is something we expect to occur, what do we plan to do about that? I think it would be helpful to take some of this information back just to ground truth my responses. I don't see the USACE being eager to go beyond what they are already doing because of the complexities and the risks of trying to manage for these small operational changes. I'm just concerned about the idea that the USACE would change operations to offset and increase in stage. We still need to have another conversation to give you the final word on that.

- Jon N. – From a pragmatic standpoint it is hard to argue that it's a meaningful change in stage. We just looked at it, in one place it's a difference of 7 cm and on the other side its 20 cm.
- Zac C. – That was Karl Ericksen's point, that this is noise. But the USACE is not the regulator of the floodplain. It is the county and city ultimately. We want to see from Boundary County that they understand the impacts of the project and they're comfortable with the project. The USACE isn't going to adjust the dam operations to make this a no impact project.
- Matt D. – we understand that the USACE will continue to manage to the same thresholds and that the community needs to understand what the risk is (e.g., it's going to be the 80-year event rather than the 85-year event). When you can tell them that for example, in 2012 it would have been X much higher, that's more understandable to the community. As far as asking them if they want to add two tenths to the flood map I don't know that's something you could do.
- Mitch P. – The 10% stage exceedance event is contained within the levees. The largest stage change observed in the FCM model is for the lower flow conditions with higher lake levels. One other option might be that the USACE annually review the three-way look up table based on the latest measured data. If we continue to collect time series data and can document a statistically significant shift in the three-way rating curve relative to pre-project conditions that would be the canary in the coalmine. An approach based on measured data might help get away from the modeling aspect of it.
- Zac C. – Yes, you have the luxury of long lead times.

ACTIONS:

- ***Zac to follow-up with Joel F. and others at USACE to confirm response to project flood risk.***

7. Review and confirm recommendations from first day

Participants provided the following recap of their take-homes from the first day's presentations and discussion.

Comments and Recommendations

- Chris C. – One of the things we want to know at BPA is what is the bang for the buck for this project, what is the life span? I'm just looking at it. I'm satisfied with the modeling that's been done that this is the best guess. If we look at a five-year life span for the amount of expenditure, I would think that a lot more effort would go into something that would be more sustainable. That's one of the things that I take away from this. I don't know what additional analysis has been done to see if there are other options that could be implemented that would be more sustainable. We have concerns about the short time frame. I'm not saying there isn't benefit to it from a sediment

transport and hydraulic standpoint. I'm surprised that you didn't explore other options that would be more sustainable. Do the pools fill in a short-time frame; if so I think that's a failure. If we get good information that says the fish came come upstream to spawn that's a different question. I think we should look for something that is closer to 30 years.

- Matt D. – The only way to create mechanisms to make pools in this reach is to do really big things that would create flood risk. We've looked at other options but were really limited by the flood risk and infrastructure constraints. That's one of the reasons this was the last project we're looking at in this reach. It is largely driven by potential biological benefit to an aging population. It's a reach that's been prioritized over the years to do something.
- Zac C. – The reality is that the USACE spends millions of dollars nourishing beaches and if we get the habitat benefit here I think that warrants perpetual management.
- Sue I. – You need to understand the requirements of the BiOp for background, the USACE and BPA were sued. The litigants requested that they add turbines to Libby Dam, there was a settlement requirement that required they do a spill test. The turbines would have cost a lot more. The co-managers and others recognized that this broader approach we're doing under the KRHRP, which goes well beyond just pools, is necessary that just doing more flows will not address the needs of the endangered sturgeon.
- Stanford – One of the initiatives at the USACE right now is how can we use hydraulic processes to reduce dredging. We have this huge program called "engineering with nature" that is based on this idea. I know in the last years this meeting has looked at monster spur dikes to sustain these pools but the flood risk implications weren't manageable. The fact that we're right in the middle of an urban area makes it really difficult.
- Zac C. – I don't see dredging of these pools as a failure, it is just maintenance.
- Mitch P. – BC Hydro had a concept back around 2010 to potentially dredge Grohman Narrows by 3-4 meters. This concept is still progressing as the "Grohman Narrows Channel Improvement Project". If the project were to be implemented, the backwater and sediment deposition characteristics in this reach would be substantially changed; we might just be talking about depositional features eroding away instead of pools filling.
- Molly W. – In terms of communicating with public about pool sustainability, just give your best guess about what it is and be clear about that.
- Stanford G. – I think your best estimate is 8 years for Pool 1.
- Jon N. – It is an estimate based on a small amount of data. Even if you had a ton of data you'd still have the difference in annual supply. That's why we argued that collecting that additional data isn't worth it.
- Zac C. – [He had to leave after day 1 so provided broader general comments about the project at this point.] I recommend a biannual flood compliance report to back up the modeling. Post-project at some point at least, there needs to be an assessment of the project relative to flooding. I'm thinking maybe you could pick a couple of boundary conditions that you could use to check and reevaluate.
    - Mitch P. – I like the idea of continually updating the three-way look up as part of annual reporting.
    - Zac C. – Agree that would be a good idea and coordinating with the USACE on that would be a good idea.

    - Chris N. – Having actual data to use to help guide modeling makes good sense.

- Zac C. – Don't know if you want us to talk with the County and City along with you guys. I can help arrange that. Do you feel like the County and City understand the nuances of the project or do you think they hear that the USACE says they are okay with it, and therefore the County and City say they are okay.
    - Sue I. – The community is really oriented around river elevation. They understand 1764. The City and County have said that they are okay as long as USACE continues to manage to flood elevations.
- Zac C. – What I'm seeing is that the range of flood impacts is X to X. That's what you can present to the County and City.
    - Matt D. – We need them to say that those ranges are okay in writing. Where we left it was, that what I presented to them was preliminary and we would go back and show it to them when it's final. The last thing the County wants to do is involve FEMA.
- Zac C. – When you're standing there and watch the duck go by the size of the duck's wake is what you'll see.

Kootenai River Habitat Restoration Program
Modeling Subgroup Meeting

June 18 and 19, 2015
Hampton Inn at the Spokane Airport

Friday June 19, 2015

1. Out-year projects (2017 and beyond)

Matt Daniels briefly reviewed the proposed out-year Braided Reach project (Lower Meander) and possible out-year Meander Reach concepts (Ball Creek and concepts on Kootenai National Wildlife Refuge). He reviewed the input received on the project and concepts in the recent Peer Reviewer Advisory Team and Co-Manager-Agency Review Team meeting and modeling completed to date. He also requested input from the modeling team on data collection and modeling needs in support of the out-year project/concepts. See presentation: *07_Modeling_Out-Year_Projects_MD.*

Discussion: Preliminary modeling results for Lower Meander

Matt D. explained the challenge is figuring out how to create structures that will be able to maintain pool scour given the distance from pools to structures. In addition, access to excavate pools in the Lower Meander site is challenging.

- Duncan H. – Concern would be blocking the most northern entrance to the North Side Channels as a result of pool forming structure.
    - Matt D. – This channel is a pretty static channel, it wouldn't necessarily be a bad thing if it got blocked off.
- Matt D. – One of the challenges of creating a pool at this site is there's no high feature to build off of, so the opportunity to squeeze the flow there is pretty limited.
    - Mitch P. – There is a higher bank between the first and second structures which may be an opportunity to maintain an eddy fence, and perhaps help with the tail out of the pool. Could also excavate out a small pool behind the structure to provide some holding habitat.
    - Matt D. – That was one of the suggestions at the PRAT.
- Sue I. – Is there enough land to build that lower structure?
    - Matt D. – It would almost be like a gravel bar that would influence things at lower flow. It would just be built with coarse gravel and cobble. The upper one would be more likely built with pile structures like the others.
- Mitch P. – One area that will require more consideration is the inlet of the proposed side channel at the upstream end of the bank treatment (left back that transition over to the first island). If the thalweg exiting the middle meander mega pool was to slightly realign, it might cause a lot of flow to be barreling at that side channel inlet.

    - Matt D. –The timeline for implementing the Lower Meander project would be 2017 so there's more time to develop these concepts and learn from projects that have been implemented.

- Stanford G. – Are their flood risks in this reach that are the same as the Bonners Ferry area.
    - Chris N. – No, the FEMA detailed study boundary doesn't extend this far upstream.
    - Sue I. – There's a landowner that has their house right next to the river.
- Duncan H. – Have you measured the flow right next to the bank? That would be helpful to have.
    - Ryan F. – I have old data going back to 2008 also have ADCP cross-sections.
- Stanford G. – For being one of the most data rich reaches in the country there's a surprising lack of bulk bed gradation data. If we were going to do pool modeling, bed gradation data would be something we might want to add.
- Jon N. – It would be nice to get some subsurface information.
    - Sue I. – We did get some grab samples from the mega pool excavation.
- Jon N. – That upstream spur seems likely to develop pool on its own. It might be worth looking at how much can be removed in a season. You're going to get a pool along that side, maybe you can get the river to do some construction for you and it might be more sustainable long-term. It depends what those grain sizes are.
- Rich M. – When you lower the flow for the next round of construction that would be a good time to go out and get some subsurface samples this summer.
- Stanford G. – It just needs to be that subsurface layer so you don't have the bias effect. I'm a little suspicious of the gradations that you had yesterday.
- Mitch P. – Some surficial bed data we do have in the braided reach is the scour chain data and the RSI and three largest particles over the chain.
- Rich M. – That's good for mobility but we really need to know subsurface.
- Mitch – Under pre-Libby Dam conditions, the backwater extended upstream into the Braided 1 reach; wondering if subsurface lenses of gravel might be present in the Braided 2 reach.
- Ryan F. – How many cores have been done in this area? We can revisit Gary's work to check. We still have those physical cores they are in the warehouse in Tacoma. Those were from 2007.
- Rich M. – Did that ever get written up?
    - Ryan F. – No. The cores were in four-feet sections and each was about 50 feet.
- Stanford G. – My gut reaction is that it seems like the left bank, if it's feasible to build, the left bank structures to make that second pool sustainable are critical. That second pools looks stranded.
- Mitch P. – Will need to evaluate the potential for the apex structure to be flanked depending on the thalweg approach angle.
- Duncan H. – Flow partitioning, for the Phase 1 project we talked about 10%. If the aim is to keep most of the flow in the main channel you don't want to bleed too much off into the side channel. What is the objective? Do you want more in the main or the side channel? It is a design choice. If you want to maintain your velocities and potential for moving sturgeon upstream you probably want to put more flow in the main channel.

- Jon N. – You've got a lot of sensitivity for adjusting flows with very simple structures at the top end. We've done other calculations at other projects where people wanted to divert more water. You could put a simple split that would help to maintain the pool at the expense of having more flow in the main channel.

- Rich M. – It seems like you've increased the angle of attack at the downstream structure where the eddy reattaches. Also, I know it's a sediment-starved system but typically you'd expect to see deposition at the entrance to the North Side Channels.
- Duncan H. – One of my comments prior to this meeting was to move the structure up farther upstream.
- Rich M. – Understanding deposition in that reach between the structures would help to better understand what is happening in this reach.
- Sue I. – I found the map for the 2007 coring we did: it a 6" casing with an 8" bore. There isn't one in the area were talking about but there is one at the upstream end of the North Side Channels.

Data collection and modeling needs for the Meander Reach and tributaries out-year projects

Discussion: Myrtle Creek/Refuge Concepts

Matt D. requested input on data collection and modeling needs to support out-year projects in the Meander Reach and its tributaries. Sue noted that the USFWS National Wildlife Refuge was a former diking district and is surrounded by a levee system. The USFWS management has been using the existing features to manage for wetlands and, as is the case for most of the USFWS National Wildlife Refuges, particularly fall waterfowl hunting.

The City of Bonners Ferry water supply comes from a diversion along Myrtle Creek (not on the Refuge). The Refuge also diverts water. The rest of Myrtle Creek has been straightened to flow into the Kootenai River. The elevation of the majority of the Refuge is lower relative to the Kootenai River. The Meander Reach is a former lake. The levees are built on top of natural sand bars that were formed alongside the river over the years. That effects the tributaries in that they came out of the mountains and pooled up and formed wetlands until eventually they breached the natural levees and reached the river.

- Chris C. – Has there been talk about taking the dike down along the river.
    - Matt D. – We've talked about it but it isn't cost effective. There are multiple feasibility considerations if you breached the levees as well.
- Mitch P. – So the 10% exceedance is based on the peak values from the 85 year synthetic record. The duration of those peaks might be short. Is the objective for short term (flooded then dry) or longer term inundation?
    - Chris N. – Showed another map with 10% exceedance, this is the extent of inundation you would expect to see for about 10% of the time cumulatively if the levee was breached.
- Chris N. – Do they have the ability to let these dry out? Have you had those discussions with them?
    - Matt D. – Up to this point we've had three meetings with the Refuge manager. The first was to reach out to them about talk about the program, the second meeting was getting their ideas and, the third was to show them some of the preliminary concept designs.
- Stanford G. – What's the aquatic target?
    - Sue I. – Nutrients, other fish species, and food for larval sturgeon.

- Jon N. – If you can do something to speed up development of the riparian, etc. that would help.
- Stanford G. – Seems like the Myrtle Creek options would assist with nutrients a lot.
- Matt D. – You can contrast the approximately 58 acres of floodplain created in Braided Reach with the potential in the Refuge, which could result in closer to 1,000 acres. We've reviewed some of the data and will want to look at the stage recorders to a get better understanding of groundwater.
    - Sue I. – Look at Berenbrock's report to see what wells were included in that.
    - Chris N. – I recall that there are three wells on the Refuge.
- Stanford G. – Getting some sense of the load coming off Myrtle Creek would be helpful. Seems like a low risk but could be a potential failure avenue. That's a high gradient substantial watershed. Just telling the story of where the sediment is would help set aside the potential major failure mode.
- Matt D. – The approach to Myrtle wouldn't be to try to control what happens on the alluvial fan, rather we would route it to a place that's pretty low risk and let it go. A lot of the Refuge buildings are built above the 1% peak stage exceedance threshold.
- Sue I. – We also need to make sure that we don't do anything to impact any of the other diking districts. We have to stay within that district. There are agreements among the districts.
- Molly W. – Do you have the ability to model temperature effects? Do you have a model structure to model temp effects of each of the alternatives?
    - Stanford G. – RAS would do it. That seems like an important consideration relative to how to manage for nutrients and control the temperatures if needed.
    - Duncan H. – Don't know how you would manage it. The fact that there are cold temperatures in that little creek is a historical hiccup. How are you going to control temperatures in that bathtub?
    - Duncan H. – Something that came out of the PRAT is that you're better off with passive systems.
    - Chris N. – If you were monitoring water it wouldn't be that much more effort to monitor temperature as well.
- Rich M. – When do bull trout use that creek?
    - Sue I. – During spawning. We should get USFWS to do snorkel surveys.
- Sue I. – IDFG developed MacArthur Lake that's really warm and full of non-native species, so periodically they empty the lake and all of those are released into the Kootenai River. We should take a look at that and make sure we don't create that situation. It is all tradeoffs.
- Chris C. – I'm pleased that you've had three meetings with the Refuge staff. They'll probably have a different long-term objective. There will need to be more discussion with those folks. Additional data collection from them too. Need to ask them, do you really understand what will happen if we do this and the possible impact that might have on your objectives?
- Matt D. – Our next step with the Refuge is to capture this in a narrative document that the Refuge manager can take to her higher ups.
- Sue – the Refuge is looking at how to deal with aging infrastructure, personnel loss, etc.
- Matt D. – One of the programs they have on the refuge is called FLAP. Chris N. is working on another project on the Lost Trail National Wildlife Refuge. That's a restoration project that's about

10 years ahead of where we are. They have a road that's being moved with the FLAP money, that's a program that Diane the Refuge manager is aware of.

Discussion: Ball Creek Concepts

- Rich M. – When Gary B. and I videoed the stream in 2006 there was a clear tail of gravel downstream of Ball Creek. It was also a hot spot of velocity. Might be that conditions were there for sturgeon to spawn historically. Under current conditions it's too backwatered. Under historical conditions there would have been more velocity there. We looked with the idea that some of those tributaries from the mountain being sources of gravel that sturgeon could have used pre-dam. Also Clear Creek could have been the same way, and also Myrtle. Gary B. had seen in his core data that there was three meters of gravel. We saw there was gravel between the point bar and the source.
- Chris C. – There's currently no connection with wetlands right now?
    - Matt – I'm not sure, going to poke around in there.
- Duncan H. – Regarding Alternative 3, I think it's presumptuous to think that's the only channel it went down.
    - Chris C. – Not convinced (Alternative 3) that channel went through in the area where you'd have to excavate. Might have been two discontinuous cells.
- Rich M. – With this alternative you've got that course sediment load coming out, you're going to have a lot of deposition. It seems like it would be hard to control to keep in this channel. Seems like the channel is going to start switching on you.
    - Matt D. – I think that was their [GeoEngineers] intent, to get it out into this area and then spend more effort reconstructing the outlet channel.
    - Rich M. – I think that's going to be difficult.
    - Matt D. – This channel would only appear as a channel during low flow conditions most of the time it would just be submerged.
- Rich M. – Think about how these functioned naturally. Normally as the flow came up you'd have some overtopping and get some flow over the top into the wetland, then the stage would get to equilibrium and then you'd get flow coming back into it. Thinking about how that backwatering has a way of introducing water into the wetland during high flows, and then the tributaries introduce water during other periods. Try to get to the more natural way those wetlands functioned historically.

Recommendations: Out-Year Monitoring and Modeling

- Jon N. – Do we have bathymetry in any of the existing side channels?
    - Ryan F. – Can't get it in a boat. Would need to wade those to get it.
    - Matt – We've got cross-sections.
- Jon N. – Seems like on all of these the ground water connection is huge in the floodplain areas.
- Ryan F. – There was a proposal a while ago looking at finding the gravel veins through the valley. There's a huge monitoring network in place, the State has all sorts of cores.
- Rich M. – Rosgen may have collected bedload samples way back.
- Matt D. – Hollenbeck may have collected samples too for the Forest Service in Bonners Ferry. Bones could help maybe.

ACTIONS:

- ***Get video of gravel that Rich M. and Gary B. took. Rich may have the video.***
- ***Consider collecting more video there next year (note there may be a timing issue). The evidence that gravel was there is important.***

Recommendations: Top Priorities for Out-Year Projects

- More information about the ground water connection.
- Bathymetry in the current channel to understand what stresses are, i.e., what can and can't move.
- Hydrology, specifically stage related back to discharge.
- Additional wetland assessment.
- For Lower Meander project in Braided Reach
    - Subsurface samples (recommend get as far into the channel as possible at low flow this construction season).
    - Continue to get good multi-beam series (time series of channel evolution) to see how the channel is responding to the existing projects in order to understand how sediment is routing through the system. (Mitch noted that the challenge has been the timing.)
    - Mitch will revisit the boundary for supplemental surveys for the Upper, Middle and Lower Meander projects for the SOW updates.
- For the Meander reach concepts
    - It would be nice to put a HOBO gage in the tributaries at the backwater slope break now so when the time comes we have the data. Jon noted that the USGS HOBO gages have temperature on them. Ryan F. noted the new ones in the Braided Reach include a larger better probe. Jon N. clarified they are talking about stage and temperature where the tributaries come in. Jon would like to see at least one put in above the backwater. Ryan noted there's an old gage at Ball Creek. Ryan said it would be nice to tie one in with the old ones.
    - Sue noted there's some temperature monitoring going on for the water quality work. Talk to Genny Hoyle with the Tribe. She said everything they had was QA/QC'd and added to the climate model for the Northwest.
    - Mitch P. – Another data gap for the mainstem is multibeam bathymetry for the lower thirty miles of the Meander Reach. We've previously discussed whether there are other clay shelves that could be nodes for substrate enhancement projects. Maybe it isn't preferred to map the entire Meander Reach but instead identify locations in the mainstem that might provide sites for additional substrate placement. Ryan – it will go quick – you could do about 2 miles a day. Plan will be to cost out this mapping as part of the USGS SOW updates.
- Stanford G. –The hypotheses that Ball Creek crossed that floodplain is questionable, you could do some geophysics to establish a relic channel. If you're leaning towards Alterative 1 then it's a moot point. But if you do go down the road of Alternative 3 it would be worth investigating.
- Duncan H. – A recommendation for Myrtle Creek. Punch through levee in one spot (Matt D. said there's a pump/pipe there) to allow Kootenai River water to come in to cool down the water.

- Rich M. – Questions about property on Ball Creek across from point bar. Is that property you have access to for possible floodplain? Matt D. said it is very high there.

ACTIONS:

- ***RDG and Tribe to follow-up with modeling team to see if they have further input on additional data needs.***
- ***Jon N., Rich M. and Chris C. to provide additional input on specific recommendations regarding out-year alternatives***

2. Review and confirm recommendations from meeting

Participants were asked to respond to the question, "Is there anything you've seen that would make you change your mind on how characterizing the risks?"

Comments and Recommendations

- Duncan H. – The pool downstream near the bridge and the possibility of that migrating downstream. Use the model to look at that. Basically, it is classical downstream migration of a borrow pit as it relates to bridge. But with the pool there, having it migrate could propose a risk. Don't want to raise that to be alarmist. But it's something that should be investigated.
    - Matt D. – May be able to look at that with mobile bed results.
    - Rich M. – Don't know if we can do that with the grain size uncertainty.
    - Matt D. – We looked into this with the bed evolution modeling and 2D hydraulics. We didn't see anything that suggested it would propagate downstream.
    - Jon N. – Typically it's like a bedform. If you're maintaining the form it's a problem, but I think in this case it's going to fill before it gets there.
    - Duncan H. – It is not so much the whole pool, the downstream end flattens to the depth. In late 1960-70 in the Frasier River, a sand bed river with lots of bridges, we were engaged in doing 1D modeling and we did see migration downstream. Has there been enough work done to satisfy if that's a risk?
    - Chris N. followed up on this question and looked at pool depths relative to the bottom of the piers. He found that the minimum elevation for pool 3 immediately upstream of the Highway 95 Bridge is 1734 ft (NAVD88). This elevation is at or above the top of the pile caps for all piers.
- Chris C. – The morphological changes were rated as a moderate. I'd call that a high risk because of the discussions were having. I don't know what we do about it. I would question the classification of moderate risk.
    - Matt D. – Does it jeopardize channel stability in the context of risk?
    - Chris C. – There are forces at play that might change the static or dynamic nature of the reach. Have we done enough risk analysis? Maybe run the model for 20 years. Do we have enough data to do that?
    - Jon N. – We can do that but I don't like to do calculations where the uncertainties are so high. I don't know if we can stand by the results that far out. We told Matt and Mitch this is the best we can do, and they encouraged us to try harder. I don't know that there's value in doing that.

- Matt D. – Is mapping and monitoring a way to get at this? Do annual bathymetric surveys address these concerns?
- Rich M. – Especially as you move further downstream into the Braided Reach the faith in the model results are less as we get there.
- Jon N. – The only evolution calculation we did was for bed load. The uncertainties are too high to really do suspended sediment load without knowing more about sand size distribution in the subsurface.
- Chris N. – Also we need to look at the depth of bridge piers and scour. Our initial calculations were very conservative.
- Alison S. – Would our resources be better served doing more aggressive monitoring?
- Jon N., Chris C., Rich M. – Yes.
- Duncan H. – Look at where foundations are relative to the deepest part of pool. The annual bridge survey is already programmed in.
- Mitch P. – We could plan for an additional bridge monitoring survey pre-freshet if flows are high enough.

- Jon N. – Don't remember seeing anything with a spatially delineated evaluation about bank erosion. Don't have a very good sense of where untreated and treated banks are. There are a lot of places where there are significant changes, are they sufficiently hardened. If Matt is confident that that's been dealt with that fine. But there are places where the bank attack has been changed a lot.
  - Mitch P. – We did look at the shear stresses along both the treated and untreated banks relative to existing and proposed conditions.
  - Jon N. – Looking at bed stress along steep banks isn't the best way to get at that. The untreated banks, some of them are armored. We weren't drastically changing the angle of attack on any of the untreated banks but we should look at that again. Take any angled bank attack formula; take near bank velocity at angle to bank and use the empirical relationship to say everything is below a critical threshold.
  - Mitch P. – When we looked at the range of attack angles rather than one-velocity sector changes they weren't as drastic.
  - Jon N. – I just don't remember seeing anything on how that was evaluated.
  - Mitch P. – So not looking at the resultant bed stress from the quasi-3d output.
  - Jon N. – There's a lateral stress as well. There are six components of stress. It has to do with lateral shear to the bank. Take both FASTMECH components and rectify to the bank orientation. Suggest doing it just in case there are some places that aren't hardened.
- Molly W. – Question about bank erosion. Have landowners concerned about bank erosion been at public meetings?
  - Matt D. – For the most part we've addressed the bulk of the bank erosion. Think the main one was Glen Fodge and he went ahead and rip rapped his bank, which is now being flanked on both sides.
  - Molly W. – What opportunities do landowners have to comment?
  - Sue I. – We held a lot of scoping meetings when we started this project and we've held a couple meetings each year. We didn't want people to start thinking this was a program to

fix bank erosion so we had to emphasize that this was a fish mitigation habitat program. We wanted people to understand that we selected projects if they were within our area of interest.

  - Matt D. – There are eroding banks out there and its part of the natural system.
  - Molly W. – Specifically, have landowners responded in a way that they feel that it will increase erosion?
  - Sue I. – No. One landowner upstream from Fodge, he thought the one upstream structure was causing the water to come around with more force, but we went out there and looked at it and it didn't seem that way. RDG did a couple model runs to address his question.

- Sanford G. – My overall impression is that the risk is lower and better characterized than what we saw last year. The first time I saw the pools I was a little terrified. The USGS work is what was needed to characterize the uncertainties. Next year we'll be back talking about pools. Let's not have the uncertainties we did this year. Let's do bathymetry and also look at aggradation. We're building bedload traps so let's get the data from these bedload traps. In terms of running the data for 20 years, you'll get better data by getting the bed aggradation and running the model for five years again. I don't know how you can get good subsurface aggradation samples from the main channel, but that's key. Maybe sending down a diver? I have done some modeling on that flattening out of the nose. Armoring is going to be the primary issue. The nose will flatten but eventually its will run into cobbles. That's an aggradation question. I think you're using materials that are too coarse, but eventually you're going to armor. Let's improve the USGS models by parameterizing and getting good samples.
  - Jon N. – Agree with everything you said, but there will still be a factor of two in uncertainty because of the unpredictable hydrology.
  - Ryan F. – In terms of gradation, would it be useful to identify sections of cross sections that have filled and target those for sampling? Then you would know these particles have settled.
  - Stanford G. – If it is on the nose of the downstream leeside; that will have more of the subsurface materials.
- Duncan H. – Communication question. Think the modeling is pretty tight. When you talk about a 100-year flood the public's mind is, okay that happens every hundred years. But encounter probabilities are a better way to talk about it. If you say this is the probability that you're going to equal or exceed this flood stage and this is what it is with the project versus without the project, that's an effective communication tool.
  - Chris N. – Similar to what FEMA has used very effectively – cumulative risk in talking about a house flooding over the life of a mortgage.
- Ryan F. – Had Jon and Rich tried to simulate any of the previous work?
  - Rich – Yes, we have been hind casting the models to validate the previous results. We're using it to validate whether the predictions that we're making downstream are accurate. We're getting less change in the models than we are seeing.
- Mitch P. – Rich do you have thoughts on the supplemental surveys. Do you have any feeling on whether doing it 2 times a year (e.g., post-FRM) would be helpful?
  - Rich M. – It would be great to have it every two years. There's a lot of change post Middle Meander project. You see it on the left side, it's moving downstream into that old channel,

and Ryan's survey didn't even capture all of the change. Think that's really crucial to getting a better handle on what's going to happen.

- Ryan F. – Is the better window the pre- and post-winter flows? We do it now; it is all backwatered.
- Matt D. – The projects are going to change the most right after they're built and flows come up. Maybe the pre-freshet would be best, see what happens in March.
- Ryan F. – As long as you get out there before the lake comes up. My concern is that we'll miss that first spring change.

- Sue I. – Can we learn from the pools that are already constructed?
  - Rich M. – The current constructed pools are pretty well controlled by the structures.
  - Jon N. – The results we got show the patterns are quite good. We under-predicted some of the scour by about half. If we just adjusted the aggradation a very small amount we can match the data we have.
  - Ryan F. – Are there any other areas that are similar e.g., Lower Meander where there's the Detroit riprap that's stayed the same way for a long time?
  - Rich M. – Most of the flow that hole gets is off the North Side Channel project, it's not getting the main core of the flow.
  - Matt D. – There's no sediment flowing over it to fill it in.
- Rich M. – If you move that pool one over by half the width it would make a big difference in the fill.
  - Chris C. – Would it make a big difference to move the pool over and would it help the longevity of the pool?
  - Matt D. – Pool one and two, we're taking everything we can reach from an excavator.
  - Jon N. – If you move pool one, the locus of the high transport rate that would make a big difference in the fill rate. Look into the possibility of that.
  - Mitch P. – At the lower flows that flow field is across.
  - Jon N. – What flow?
  - Rich M. – The main thing is the rise of the winter operations. Any kind of high flow during winter, esp. rain on snow event.
  - Matt D. – What we're focusing on is winter operations, but we're using a sediment relationship based on samples at the same flow level.
  - Jon N. – No we predicted the suspended sediment concentration over the entire annual hydrograph so that it calculated the measured sediment concentrations.
  - Rich M. – We calibrated it so that it matched the measurements made in that reach.

ACTION:

- ***USGS and RDG to coordinate on looking at possible benefits of moving Pool 1 over a little. If beneficial look at what is needed to make those changes.***

4. Closing comments

- Matt D. – Thank you for participating and all the work. It is nice to have a range of presenters and have everyone thinking about these things.
- Chris N. – Ditto.
- Mitch P. – Thanks for input.
- Stanford G. – The last conversation reminded me that the construction is going from downstream to upstream. That will affect the sustainability of these structures. Think about that in the future. The quality of modeling is helping reduce risks.
- Molly W. – Nothing to add.
- Chris C. – For those two downstream pools does it make sense to sequence those so pool two is built first at least?
    - Matt D. – Pool 2 has to be built before the side structures get built. Thought the biggest concern is the adjustment we'd see in Pool 1 creating a pulse of disturbance. There are specific reasons that we decided to sequence the construction in the way we did.
- Chris C. – I'm feeling more comfortable with what we're putting together. Still have some concerns but it's a good project. All the modeling is good, there's lots of due diligence. I would like to come and see the Refuge stuff when you put together a tour.
- Jon N. – Nothing to add. Need to coordinate on the USGS scope of work, etc. prior to August 22.
- Rich M. – I love this project thanks for letting me be involved.
- Sarah F. – Thanks for letting me be here. There are lots of ideas about how vegetation can be incorporated.
- Sue I. – Thanked everyone for all their help with the project, it wouldn't be possible without them.

Adjourn