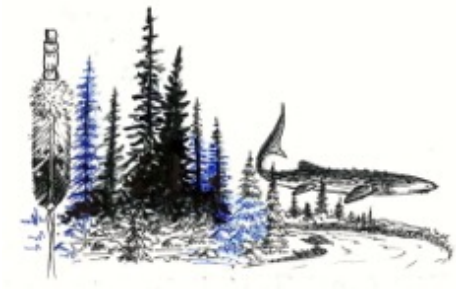

FINAL NOTES

Kootenai River Habitat Restoration Program
Modeling Subgroup Meeting

May 18, 2016
Hampton Inn Spokane Airport, Spokane, WA

Attendance

The following individuals attended some or all of the May 18, 2016 KRHRP modeling subgroup meeting: Zachary Corum (USACE), Matt Daniels (RDG), Ryan Fosness (USGS), Duncan Hay (Oakwood), Sue Ireland (KTOI), Rich McDonald (USGS), Chris Nelson (RDG), Jon Nelson (RDG), Tom Parker (Geum), Alison Squier (ZCR), and Sean Welch (BPA).

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1. Welcome and Review Agenda, Meeting Objectives and Desired Outcomes

Sue I. welcomed everyone to the meeting. Matt D. extended his welcome and noted that the May 2016 meeting is the sixth meeting of the modeling subgroup, the first was in December 2010. The modeling group includes the Tribe's design team, co-managers including BPA and USACE, and independent reviewers including USGS and private consultants.

The purpose of the modeling subgroup meetings is to provide technical support for the Kootenai River Habitat Restoration Program (KRHRP). Specifically, to share data and observations, help to frame modeling tasks to address critical feasibility questions, interpret results of technical analyses, and to document the discussions and recommendations.

The meeting objectives and desired outcomes are to:

- Investigate reach-scale and local effects of project on hydraulics and sediment transport
- Investigate pool sustainability
- Review ability to establish hydraulic conditions that support desired habitat attributes
- Confirm key feasibility questions and recommend approach to confirming those
- Confirm recommendations for future data collection and modeling needs

2. Kootenai River Habitat Restoration Program Orientation and Update

2a. Update on KRHRP progress and planned activities

Matt provided an update on the KRHRP progress to date (see *01_Modeling_Intro.pptx*). The primary focus to date has been in the Braided Reach and has been focused on movement, food, and development of the pool ladder. Seven projects have been completed to date (Figure 1). In 2016 phase 2 of the Bonners Ferry Islands project and the Straight Reach will be constructed.

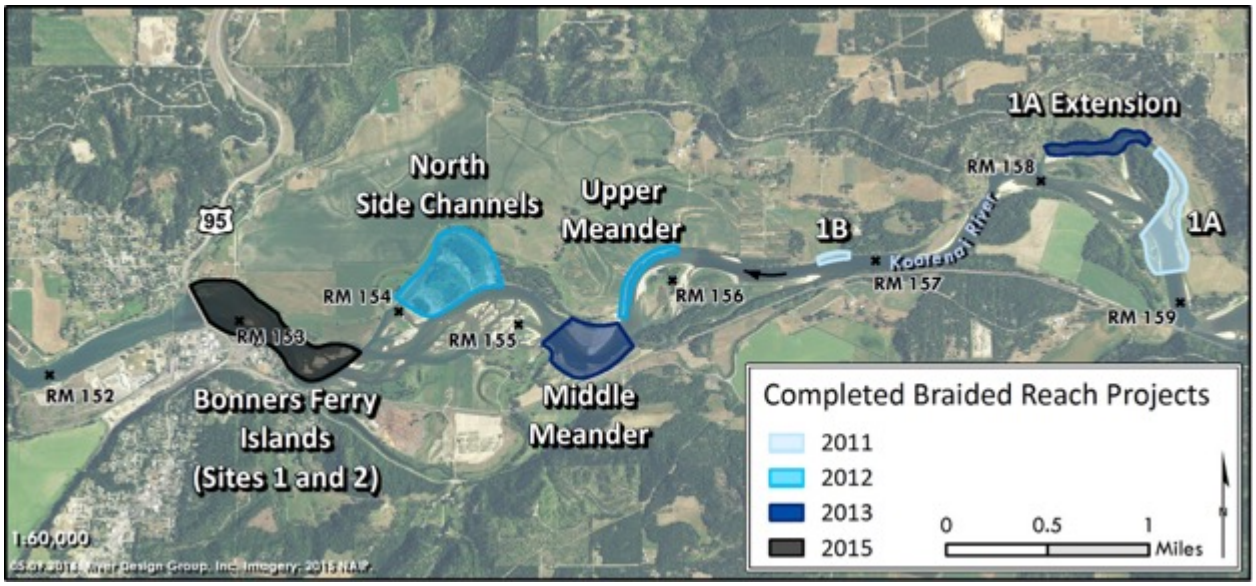

Figure 1. Completed KRHRP Braided Reach projects (2016).

The last currently planned Braided Reach project is the Lower Meander project which would complete the pool ladder concept (Figure 2). The modeling group will be discussing that project in detail later in the meeting.

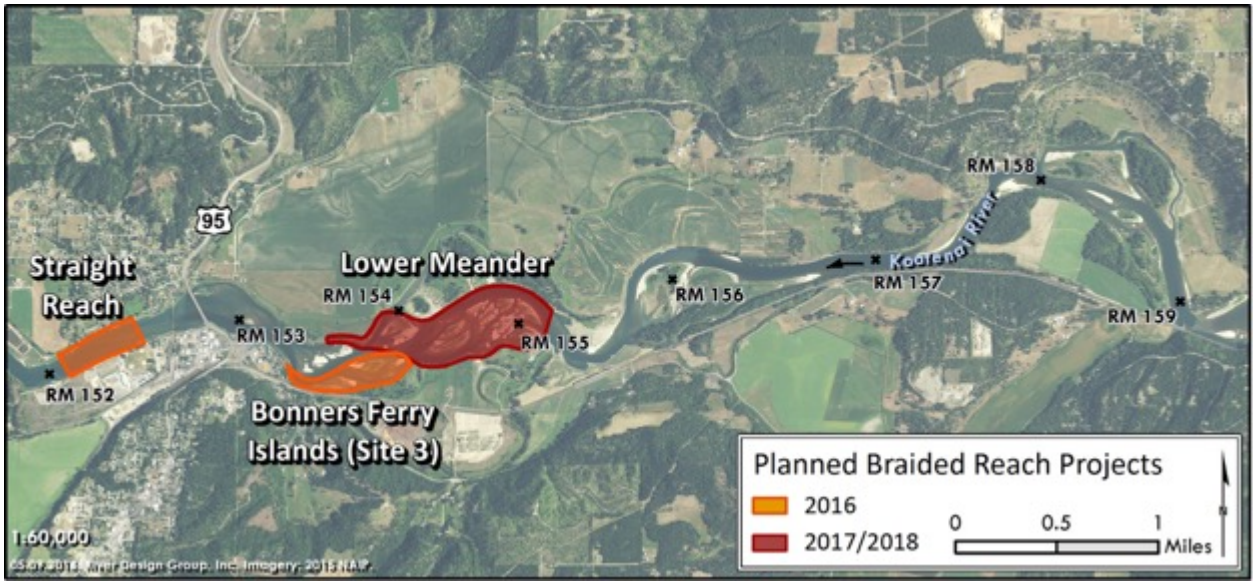

Figure 2. Planned additional Braided Reach projects (2017-2018)

In the Meander Reach the Substrate Enhancement Pilot Project (SEPP) was completed in 2014 (Figure 3). That project includes two sites and is intended to improve habitat in the area of the Meander Reach where Kootenai sturgeon are currently spawning.

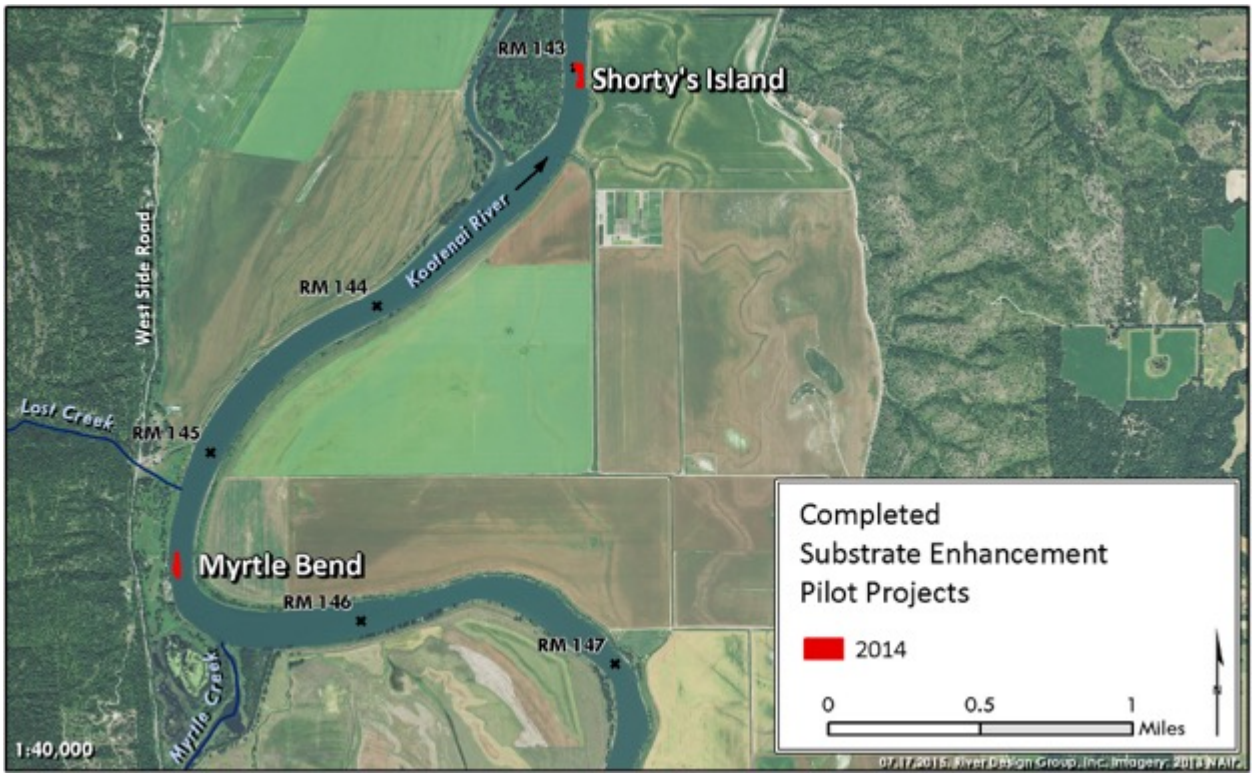

Figure 3. Substrate Enhancement Pilot Projects (2014).

Tentative out-year projects currently include a project at the Kootenai National Wildlife Refuge at Deep Creek and Myrtle Creek, and a project at Ball Creek. The KRHRP team will also be teaming up with the Tribe on a project planned at the Tribally owned Nimz Ranch.

The current tentative timeline for implementation of 2016 through 2020 projects is:

- 2016 – Bonners Ferry Islands Site 3 and Straight Reach
- 2017 – Lower Meander Year 1 and/or Ball Creek Tributary Enhancement
- 2018 – Lower Meander Year 1 or Year 2 and/or Ball Creek Tributary Enhancement
- 2019 – Kootenai National Wildlife Refuge / Myrtle Creek and/or Ball Creek Tributary Enhancement
- 2020 – Kootenai National Wildlife Refuge / Myrtle Creek and/or other projects not identified yet

<u>Questions and discussion:</u>

- Jon N. – At the last meeting we talked about the Wildlife Refuge being a really great opportunity. Is there a reason that's not the highest priority?
    - Matt D. – We had Peer Reviewer Advisory Team (PRAT) and Co-Manager and Agency Review Team (CMART) rank projects at previous meetings as a first step in the planning process. We're working on those projects but are limited by the processes and coordination with landowners in terms of which projects we can move forward.
    - Sue I. – It is critical that we have landowner support in order to move forward with a project. We don't know if it is going to work out with the Refuge or not yet. We've met with them twice and will meet again later this summer. Another factor is fitting the work within the available annual funding.

2b. Bonners Ferry Islands and Straight Reach projects

Matt D. reviewed the iterative development and design process for the Bonners Ferry Islands and Straight Reach projects. The PRAT and CMART provided initial input on project concepts in 2011. The PRAT and modeling subgroup provided technical input on the concept development in 2012 including review of multiple design configurations, evaluation of different structure types, and initial identification and review of performance and risk factors. In 2013, the different design scenarios were evaluated, island shapes were modified, pools were added to the design and flood risk and geomorphic changes were evaluated. In 2014, and Environmental Assessment was completed and in 2015 the final design was completed.

Matt noted that the presence of constraints along the bank margins in the Bonners Ferry Islands project area was an important consideration for electing to pursue a strategy of constructing islands in the middle of the river. By focusing on floodplain surfaces in the middle of the river, many of the features along the bank margins have been excluded from the project extents, and subsequently, potential conflicts with known constraints have been minimized.

The Straight Reach project is a more simplified concept. The objective was to create a little more habitat complexity while being sure to do no harm to the areas that are currently being used for sturgeon spawning.

Construction of the Bonners Ferry Islands north bank Site 1 and Site 2 project components was completed in 2015 (Figure 4).

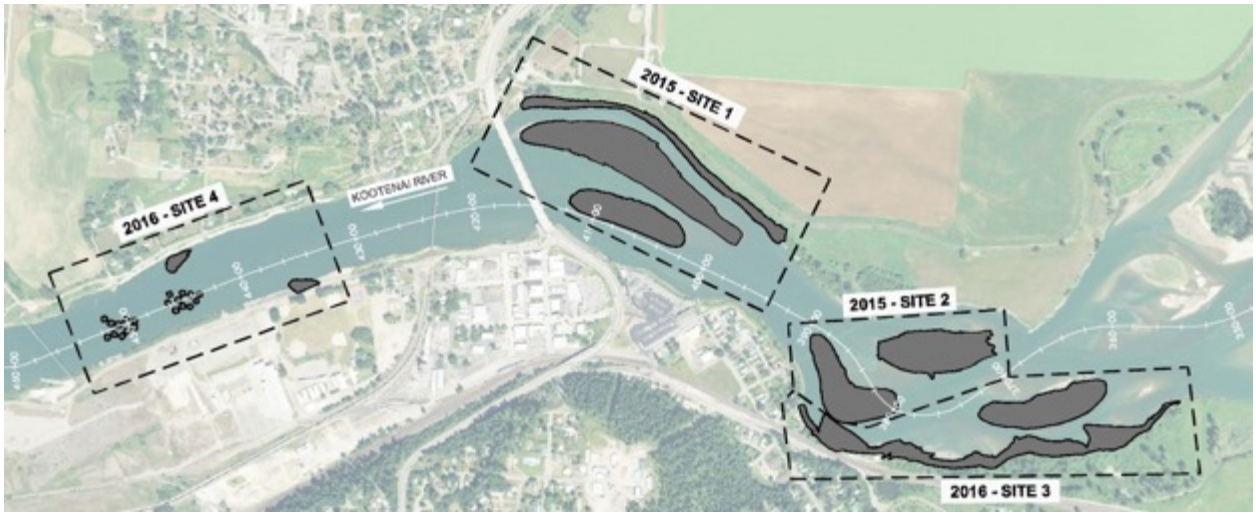

Figure 4. Bonners Ferry Islands and Straight Reach construction phasing.

Matt reviewed the technical risk analysis that the modeling group, PRAT and CMART helped to develop and review. He also reviewed some of the extensive coordination and outreach that had occurred in order to support implementation of the project. Finally, he shared construction photos from the 2015 construction season (see *01_Modeling_Intro.pptx),* noting that in 2015 the construction contractor was able to get into the river approximately five weeks early due to lower flows, which was very helpful.

Questions and discussion:

- Sean W. – That list is really impressive and it speaks to the due diligence of the team to get the project implemented and develop a consensus on the project. How were the foundation conditions on your access roads?
    - Matt D. – It is pretty firm, mostly gravel. When they were digging the pool they encountered a few layers of sand, etc. We had a drone landing pad and that was a really helpful feature given how many drones we had up in the air at once.

- Sean W. – How about turbidly?
    - Matt D. – The plume dissipated by the time it got to the railroad bridge. There were no complaints about turbidity.
- Zac C. – What were the final stable side slopes on the pools?
    - Matt D. – The design was 5:1, that was based on results from previous designs. We used GPS on all equipment for building things. We got some wood out of excavation of the pools. We also did watering to keep the dust down and to keep materials from catching fire or getting too brittle.
- Sean W. – How do you think the survivability of the plantings is going to be?
    - Tom P. – We should get lots of moisture in there and we used a range of elevations. The biggest challenge in this site is the stage variability. Right now things are wet but it will get dryer later. We used willow branches surrounded by conifer bundles.
    - Sue I. – One of our big outreach needs is to explain that technique to the public since those surrounding bundles turn brown. [Note: Tom Parker developed a press release on this which was released to the public in late May/early June 2016).
- Matt D. – Pools are more challenging to build. The pools are about 2-4 feet shallower than the design on first pool. One interesting thing related to the pool construction, with the removal of a big volume of material I think we increased the local gradient upstream and think the bed of the river degraded and washed into the upstream end of the pool. Believe this was construction related. The lesson I learned here is that we didn't anticipate this and it is probably related to fact that this was built in phases. The work on the south bank where we have the structures wasn't built yet and we didn't model this interim condition scenario.
    - Sean W. – What is the sediment character at the head of the pool?
    - Matt D. – It is coarse gravel. The material that went in is pretty loose.
    - Zac C. – what is the gradient out there?
    - Matt D. – It changes.
    - Zac C. – It looks like what you have is an in river gravel mine.
    - Jon N. – How can you be sure that it is construction related? These were made 3-4 months after the pool was cut.
    - Matt D. – It was happening while they were building the pool. They would call and say they were struggling with this end of the pool, that it was filling in overnight. What are you thinking?
    - Jon N. – It's just hard to say that its only due to that. Those lower flows are when you get things to move. I'm not saying anything either way – just questioning how you can say with such confidence that its only construction related. The model results suggest things do move there.
    - Matt D. – I'm skeptical about that. It's just clear water there, I don't see a lot of sediment there.
    - Jon N. – I'm just cautioning and saying we should get another survey.
    - Sean W. – You could stick a GoPro on the excavator.
    - Jon N. – The bed load is moving at low flows.
    - Matt D. – We should look at whether the bed has degraded.

- Rich M. – Tt hasn't. There's a cross survey upstream from there. I think there's no elevation change upstream.

- Duncan – In the past you had a place on your web site where old presentations and notes were posted. I'd like to be able to go back and look at those again.

ACTION:

- This year's final notes as well as previous modeling team presentations and notes will be posted at restorationteam.net. Alison will send details to the modeling team to access the page.

3. Mapping and Sediment Sampling

3a. Braided Reach long-term monitoring cross-sections

Ryan F. reviewed the braided reach long-term monitoring cross sections (*see 02 Mapping and Sediment Sampling.ppsx, slides 3-12*). The USGS is monitoring 17 specific cross-sections within the Braided and Straight reaches for two representative hydrograph periods. They are looking at change in time: seasonal (pre and post freshet), annual, and pre and post restoration. One of the questions is if aggradation/degradation changes are the result of restoration or streamflow? This last year was a low flow year. Ryan said it was difficult to do surveys because you don't get much coverage on the banks.

Questions and discussion:

- Sue I. – When we started doing the KRHRP projects they coincided with flood periods. In 2012 we had the third highest flows on record since the dam went in.
- Rich M. – Modeling would suggest that aggradation you're seeing is the result of pool scour.
- Zac C. – Isn't what you're seeing just the high flow bringing a bunch of sand?
    - Ryan F. – No I think that's a response to construction.
- Sean W. – Has that information been compared to the 1-D sediment routing model? Stan would be interested to look at those changes.
- Ryan F. – It is getting to be an impressive data set. For years nothing changed, and then suddenly there's lots of change.

3b. Bathymetric mapping and as-built pool analysis

Ryan F. reviewed bathymetric mapping and as-built pool analysis for the Upper and Middle Meander projects and sites 1 and 2 of the Bonners Ferry Islands project (*see 02 Mapping and Sediment Sampling.ppsx, slides 13-23*).

For the Upper and Middle Meander projects the target is a post-freshet survey. They surveyed the sites between July 13-15, 2015. For the Bonners Ferry Islands project they surveyed sites 1 and 2 (constructed in 2015) in mid-September to monitor the construction progress. I final survey was conducted in November included the middle and most downstream pools. Ryan said that in 2015 they had problems with the multibeam. They had a timing issue but were finally able to resolve it. Coverage was difficult in September because the water was so shallow.

Ryan also reviewed the planned 2016 surveys which will include RM 134-124, Rock Creek to Copeland Bridge (in 2017 plan to do RM 124-114 and in 2018 RM 114-the Canadian border).

Questions and discussion:

- Matt noted that the pool shifted and increased in overall volume and depth. The maximum as-built depth was 35 ft., then went to 25 ft., then the last survey showed it was a 40 ft. deep. It is moving downstream.
- Sue I. – In the first week of December 2015 we had a massive flashy flood that washed out two major tributary roads, and mobilized a lot of large wood and materials from the tributaries. There was a swirling that was going on in front of the Kootenai River Inn (Sue sent videos of this).
- Ryan F. – Those sediment measures will come up in next year's sediment results.

3c. Substrate Enhancement Pilot Project velocity mapping and videography

Ryan F. reviewed the substrate enhancement pilot project (SEPP) monitoring (*see 02 Mapping and Sediment Sampling.ppsx, slides 24-47*). The pre-construction bathymetry survey was completed in November 2013 and the as-built survey was completed in March 2015.

They also conducted video surveys of the Myrtle and Shorty's SEPP sites. The first survey was in April 2015 and the second was Sept. 2015. There was a lot of algae growth.

Ryan F. said that he is also coordinating the planned biological velocity mapping with IDFG. This will include velocity mapping along predetermined transects in the Straight and Meander Reaches.

Questions and discussion:

- Sue I. noted that if you have clear low water and substrate you get algae and nutrients. The algae might actually help start enhancing nutrient quality in that reach.
- Rich M. – What was the flow like?
    - Ryan F. – There wasn't a well-defined runoff peak.
    - Sue I. – we just have the warmest April ever.
- Sue I. – The purpose of the substrate pilot project is to provide surfaces for egg attachment and places for larvae to hide. As sturgeon are spawning the eggs stick to the rock and then hatch into larvae. Also Burbot spawn in January and February. They get together in a spawning ball and then their eggs fall down into the rocks until they hatch.
- Matt D. – It looks like the algae is gone.
    - Sue I. – That wouldn't be uncommon for it to be there part of the year and then go away.
    - Zac C. – I wonder if the presence of the algae is causing the sand to adhere.
- Ryan F. – To me it doesn't look like its changed that much from the first survey.
- Zac C. – It looks like there are mounds in some places.
    - Matt D. – The approach they took to building these substrate patches was to divide the whole patch into grid cells. Then they would drop material on that 10x10 grid in an individual cell. In some cases, at Shorty's they ended up with mounds. Don't know why they didn't have that same effect at the Myrtle site. I do know they struggled with higher velocities at this site. There was a difference in the as-built. The myrtle patch was smooth with close tolerance and Shorty's was bumpier.
    - Ryan F. – This area has a sand dune that appears and disappears.
- Rich M.– is there any chance of getting out there immediately after spawning?
- Ryan F. – For the velocity mapping we will be targeting the Straight Reach project and SEPP

sites. We will start this mapping effort next month. We are proposing a repeat survey from 2013. There will be about 20 transects. Would like to hear input on how many transects would be best.

    - Matt D. – So you're getting depth average velocity. We've talked about how the cue for sturgeon is a half meter above the bottom can you target that more precisely?
    - Ryan F. – That was the limiting factor of the ADCP. It can't get the top and it can't get the bottom.
    - Jon N. – Some are about to get within 20 cm.
    - Ryan F. – We've got the equipment but the question is if we can process the data.
    - Duncan – Could you put a logarithmic processing through it?

- Sue I. – What are we trying to get with this is to hone in on spawning cues, why are sturgeon spawning here.
- Rich M. – Ideally we would be able see what's happening throughout the year.
- Jon N. – It (the SEPP) could get cleaner during different parts of the year.
- Rich M. – The scouring energy gets higher.
- Ryan F. – In 2015 they had the highest concentration to date.
- Jon N. – For the Shorty's site we could do a 3-D model. It is a small enough area.
- Alison S. – Suggest having Larry H. and Mike P. look at what's proposed and provide input.

3d. Sediment sampling and surrogates

Ryan F. gave an update on the 2015 sediment monitoring and 2016-2017 work plan (see *02 Mapping and Sediment Sampling.ppsx, slides 48-52*). He noted that they just hired a new person from Idaho Power to replace Molly W. on this project, but Molly is still in our office and can provide input and advice.

Questions and discussion:

- Sean W. – I read in the notes from last year that there's a lot of bedload in this section. Where is that bedload in that reach coming from?
    - Ryan F. – From the tributary runoff. March has the highest concentration then it is diminishing after that. It is almost crystal clear by June. These were the highest concentrations we've ever captured on the river this last year.

3e. Group discussion and review of major take-homes

Participants identified the following major take homes from the previous presentations and related discussions:

- Zac C. – The middle meander looks like it is vectoring into the series of islands that are downstream. What I saw, looking at the sequence of photos is that there may be a channel that is enlarging within the series of islands. Also the tail out of the pool is being enlarged. I would be concerned that you may develop a split flow through there and if the river chooses the left stream then it shortens the river. My question is where are we with all the modeling that's been done, is it tracking? Are we on track with where we thought we'd be? Is there anything that we were not expecting and can we use that as we refine the design so that we don't impact things upstream or downstream.

    - Matt D. – It maybe makes sense to dig a little deeper and look beyond the cross sections.
    - Zac C. – You're getting compounding effects from these projects. You're going to have to dive in with fresh eyes and look at what do we think is happing now that we've completed a number of them. If we just walked away and didn't do anything else, what is the trajectory? Then say, if we're going to do these additional things, what will happen?
- Duncan H. – I'm happy to see that the river is still doing things naturally. If you see bank erosion and the islands are moving that's good. We don't expect to see a stable river. There's nothing I hear that's alarming from what I see. We talked about the Middle Meander project, where you have the lowest spur. The concern expressed at that time was the force of the river and we expected to see some erosion. I am surprised that you're not seeing bedload downstream from Moyie. Are we really saying there's not input from bedload there?
    - Ryan F. – I think it's just nonexistent.
    - Duncan H. – Is it armored there? Do we have a bunch of bars moving through?
    - Rich M. – There is transport at Moyie. The loads can be up to two time what they are (looking at Fry Creek).
    - Jon N. – It is the timing that makes this difficult to think about. At Moyie you have a normal relationship with flow and transport. You've got to be there at those specific days. The stuff at Crossport is unusual because of the backwater effect. There is transport at Moyie.
    - Duncan H. – My concern on the system is the lateral movement.
    - Jon N. – It is the same thing.
- Jon N. – Something thing I find interesting is in the lower area and Shorty's we have a short sample period; it isn't many years. We haven't had any major events. You have to resist drawing conclusions. It is good we're not seeing the cobbles move because they're not all really clean. There is not much penetration of interstitial space.
    - Rich M. – You want to get it during the spring high flow when the sturgeon are spawning.
    - Jon – Based on the little evidence we have, we should get it [do the videography] when sturgeon are spawning.
    - Rich – The sturgeon are generally spawning just past the peak.
- Sean W. – Maybe something the group should do after the full presentation is some homework. Consider going back and where you were in terms of the overall risk matrix. How can we use the information from the things we've learned to change our bounds of uncertainty? Maybe as a homework assignment, go back through the risk matrix and provide that information back to RDG and the Tribe. When Zac talks about long-term risk on the river he is drawing from some other examples such as the Howard Hansen project. How did you handle these questions on that project Zac?
- Zac C. – It is a long-term challenge and you're always testing your hypotheses. You're always reviewing your data to see how you're doing. I appreciate the challenges. You've had some specific criteria, you designed the substrate patches on, and the pools. The question is, are those still the right criteria? Can you do some 3-D modeling work on some of this to check?
    - Jon N. – Yes, especially in smaller areas like the substrate.
    - Zac C. – I think the 2-D is too coarse to predict some of this.
    - Jon N. – For these types of pools, looking at the response of the pools using the data we have, the 2-D is doing pretty well. The 3-D would be better for pools with short transitions, the substrate pilot project, etc. Just the enhancement in the data we have in terms of having more bulk samples in the bed changed some of our predictions by as much as a factor of two.

- Jon N. – we should talk about the velocity issues. We're pretty good at processing and we can probably help with processing. The BMT (?) can process the near bed velocity. You can always keep the whole raw traverse and do your pinning (binning?) yourself.
    - Rich – I would say go with fewer cross-sections but more passes per cross-section.
    - Ryan F. – Our standard is six. Jason and Rich said they prefer 12, but you have to understand it depends on how fast you're going.
    - Jon N. – Paul is a good reference to talk about that.
    - Ryan F. – Would it help to physically mount something on a bedload sampler?
    - Jon N. – You could do some targeted measurements; you could drop a bed load sampler.

ACTIONS:

- IDFG and USGS to coordinate videography work during sturgeon spawning for the next season if possible.
- Homework for modeling group (and/or possibly full PRAT) is to review the previous risk matrix developed for previous Braided Reach projects to see how well the predicted risks and mitigation aligned with what actually happened. Complete prior to 2017 final design to help inform final design and implementation.
- RDG will investigate specific areas of change observed in the long-term cross sections including the Middle Meander pool tailout and BFI pool 2 head.

4. Lower Meander Project

4a. Project overview and summary of changes from previous design

Matt D. gave an overview of the Lower Meander project and associated analysis (*see 03 Lower Meander.pptx*). He reviewed the Middle Meander channel evolution (noting that doing so was a suggestion from a PRAT member), which shows what the channel looked like historically, what it is now, and how that related to where we want to go with it. Knowing that we can't reconnect old flood plains the goal is to try to create a setback floodplain.

Matt reviewed the evolution of the design as well as the refined understanding of the processes in the Braided Reach, e.g., limited delivery of wood and sediment, need for more active measures to establish desired morphology, sustainability of "mega pools" recognizing that they are likely to fill slowly without supporting scour mechanisms, the narrow range of elevations available for riparian vegetation due to backwatering, and aggressive native grazers.

Matt reviewed the previous iteration of the Lower Meander, summarized the PRAT feedback received at the May 2015 meeting, and reviewed the revised design. The new design adds a downstream pool-forming structure near the North Side Channels. It is different than previous structures and is more of a gravel bar. The idea is that at lower flows it will become exposed and squeeze the flow. Based on updated revegetation criteria, another change is to build the islands a little higher. In addition, the revised design added side-channel large wood structures. The idea is that you've got side channels that are 100-200 feet wide, if you were to go in and drive timber piles and wrap wood around, you could create scour. The only way to anchor the structures is to add piles.

An additional component of the Lower Meander project includes addressing the car body bank at Site 1 of the Bonners Ferry Islands project. The landowner was surprised to learn what poor shape his bank was in and wanted to see if it could be addressed. As part of the Lower Meander project developed a plan to lay that bank back, create a riparian buffer, and use the material from the bank to create another island. That adds a lot of value to that project.

Matt explained that this current design are the design surfaces that they presented to Rich M. and are the surfaces that Chris N. used for the flood risk analysis.

Questions and discussion:

- Sean W. – Can you talk about the revision to increase elevation and how that will increase vegetation sustainability. In our informal conversations you mentioned some new ideas about recruitment and survival and rethinking those elevations based on what you're learned.
    - Tom P. – When we originally walked around the North Side Channels project we targeted a zone where cottonwoods were coming in as corresponding with roughly 20,000 cfs flow. What we realized is that we generally had higher and longer duration flows during that season. That ended up with a lot of the constructed floodplain being underwater during that time. We realized that as we move downriver the stage variation increases due to the backwater, it is about 12 feet of difference during the growing season. So we decided to plant on a larger variation of elevations and increase the number of plant types. You can auger a hole for a 3-foot root and plant in there. Then you have a plant that can survive a broader range of flow variations. That way you're going higher but also maintaining the lower range. We expect to see more recruitment in the lower range, but that's not necessarily the range we should be targeting.

4b. Lower Meander project technical feasibility questions

Matt presented some specific questions that he wanted to get input from the modeling subgroup on. These questions are part of the larger context of the project risk matrix. He also noted that flow requests are going to be a big factor on this project.

Following are the discussion questions and responses.

Question 1 - Which Lower Meander sites to construct first (construction phasing)?

- Matt D. – If we build the structures first they're going to create scour, but if we build the pools first they may fill. What should the phasing sequence be?
- Rich M. – Have you done the analysis that shows if the structures are relevant to scouring the pools as you've designed them? We haven't modeled the lowest one yet. Do you anticipate needing them to maintain the pool?
- Sean W. – You're talking about lateral compression … I look at site 2 and 3 and how you executed the Middle Meander project. You did both sides of the river at the same time. Would you want to separate those actions based on what you saw at Bonners Ferry Islands?
    - Matt D. – Ideally we would be able to build them both at the same time.
- Zac C. – As a water guy, I would want to understand what the change would be upfront. You look at site 3 that's a big area that you're elevating and roughening. Until you have modeling you're not going to know what's going to happen. My concern with doing site 2 before site 3 is that you'll activate those side channels. Maybe you need to have some kind of isolation. It's a risk tradeoff if you have to do it sequentially. I think the risks are larger with doing site 3 after site 2. That's just my gut since we don't have any modeling to look at yet. There's a lot of ground to look at.
    - Matt D. – We do have some modeling that was done with the previous version of this design. What is different from the scenarios that we modeled is that islands were smaller and we didn't have the third upstream structure.
- Rich M. – Looking at that it looks like it's going to lead to pool filing. If you use the Upper and Middle Meander projects as analogs, the pools are very local to the tops of the structures.

- Duncan H. – The pools that are excavated are borrow sites. They provide material for the islands. The pools that come off the tips are going to be whatever is generated by the structures. The pools that are dug for borrow sites are going to fill in over time. To me there's a disconnect between the pool that will come off the structure and the other kind of pools. They won't be as large as the pools that are being excavated for the borrow sites. It is great that you can go in and excavate to get material for those islands. We need more islands and smaller channels since it's a regulated river. The point that I would make is that yes, if those pools are excavated as part of site 3, the conveyance of that main channel is increased. If you put the spur in and create any backwater, then you'll have more flow through the side channels. I'm not sure the hydraulics that have been modeled so far will be able to show that.
- Zac C. – You could open up that 1958 channel where you've got that hotspot for velocity. You'll want to watch that in your modeling to see if you have enough roughness.
- Matt D. – On the ground the heads of these islands is coarse.
- Sean W. – It seems like if you don't do this in combination you're opening yourself up to more uncertainty.
- Duncan H. – Would you agree that site 1 is more benign? It's good to work upstream then down philosophically. The question is what comes first site 1 or 2 or together.
- Matt D. – Preliminary modeling results for site 1 show the island is not in the flow of the channel.
- Sean W. – The progression should be upstream to downstream. The lack of understanding of how those pools will scour…wouldn't you want to capitalize on some of the sediment in that project? I guess I'm actually saying work downstream to upstream.
- Matt D. – I think it's more likely to fill in the pools. Or if we build the pool-forming structure and let it scour.
- Rich M. – Those pool-forming structures aren't doing much to maintain the pool. You're not increasing the shear stress off of those.
- Zac C. – Do you have a change in surface elevation?
    - Matt D. – Even at low lake levels it is a pretty minor change.
- Zac C. – How much is roughness increasing on those islands? What did you assume for the model? Like a factor of 2?
    - Rich M. – Mitch P. did those simulations and he assumed a grain size.
    - Matt D. – What I'm seeing is the effects are at these lower flows. It will at least tell us where we should be targeting for our boundary conditions for modeling.
- Rich M. – It seems like in general with lower flows, the increase of flow moving through the point bar is coming close and maybe exceeding the impact of the spur dikes. The changes suggest a stronger decrease in velocity. Which means it is more depositional than it is under current conditions. It is hard to say without more quantitative analysis. You build a bigger pool to add more conveyance. You're trying to get to a situation where your accelerating flow through the pools to put it as simply as possible. It looks to me that you don't have a strong enforcement mechanism for those pools. Those large pools are going to be more likely to fill in than the pools that have already filled in. The upstream pools and even pools by the Bonners Ferry Islands have less of a tendency to fill than the pools being proposed here.
    - Matt D. – I think it's not going to fill as quickly as the Bonners Ferry islands
    - Rich M. – It worries me to see that strong deceleration over that first pool. It seems like

you're promoting deposition.

- Zac C. – I would expect to see more flow towards the middle of the channel, but it doesn't look like it's going that way. Those are basically shoots that are running across the bed. A lot of flow is going to go that way. If you don't roughen that area and spread the water out…
- Rich M. – Even 3 or 4 years ago when we first looked at this, several of us had concerns that depending on the order of construction, it would be very easy to create some back water that would create erosion across those back channels and that you might end up having the main channel actually move over in that area. That's one of the reasons I was asking about the Crossport gage. We don't know what the roughness is of those pool forming structures. That's been concerning me lately. I don't know how Chris you've been addressing that in your flood risk modeling. At the 20,000 cfs flow those are basically complete blockages so the roughness shouldn't matter. At the high flows it should be important.
- Zac C. – Did you look at doing site 2 without site 3. They are kind of fighting against each other.

<u>Question 2: Site 1 island is proposed to be built with silty bank material and capped with a layer of gravel. Do you have any concerns with this approach?</u>

- Matt D. – Rather than just clean up car bodies and do the bank restoration, we can build five acres of floodplain. However, that material is going to settle and move. We're proposing to use that material but to mix in gravel and put a gravel cap on top. It is actually pretty similar to what we did at the Phase 1 project.
- Duncan H. – The Middle Meander is forcing flow over to the bank. There's deposition downstream from there (above site 3) that's tending to cut the flow.
- Rich M. – You're actually getting deposition on that right bank. I think there was deposition on both sides, on the left and right bank.
- Matt D. – It sounds like we need to look into what's going on there.
- Jon N. – It seems like if you modify the upstream stuff to encourage more flow through the pools, there is risk that coming out of that reach the water is going to tend to cut into that island. Right now we're concerned about the maintenance of the pools because we don't think we're getting enough water conveyance to maintain them, at least according to your models. But if right now the water coming out of that bend dips strongly to the south around the island your building… if we push more water to river right to maintain pools, then the island you're talking about building is at risk for lateral erosion on the river right.
- Sean W. – Based on what we're looking at it seems like you could be pushing this towards avulsion.
    - Matt D. – It sounds like we need to look at flow through those channels.
- Zac C. – What is the importance of that island? Is it for habitat or hydraulics?
    - Matt D. – It is for cottonwood and it is a place to put the fill.
    - Zac C. – Could you put more of that stuff you don't care about in the center? Maybe put a big "C" shaped area of gravel to protect it.
- Duncan H. – I don't see flow around the north side of the island increasing.
- Jon N. – Rich M. has modeled that reach with the current design, but it shows the pools fill. The next question we need to evaluate is this one.

<u>Question 3 – What do you think of our proposed use of large wood structures in side channel? How can</u>

we improve the stability and function of those structures? Is the size/scale of the structure appropriate? Are their safety or navigation concerns?

- Matt D. – These are structures to provide roughness, bed, habitat diversity, and bank protection. We're proposing about nine timber piles. The question is how stable is this arrangement given the anticipated scour. The sensitivity is with the scour estimates using HEC 18 lies with grain size.
- Zac C. – Lateral forces will likely control the stability. If you're looking at the structure as a whole rather than just the pilings, you may be misled. The bending load on the pile effects the strength. I can provide some recommendations regarding how to look at that. The more wood you have, the bigger the structures will be. It depends on what drag coefficient you use.
    - Matt D. – We used the maximum 1.5 for the drag coefficient.
    - Zac C. – Yes, but it depends on what you're looking at. The drag coefficient for a single piece can be much higher. I'd recommend that you consider driving in batter piles at the back of the structure at an angle and driving that into the structure. Maybe burying those in at a 45-degree angle into the wood pile, so you have lateral bracing. There are two ways to do that, you can have a flexible structure that's allowed to deform, or a highly stable structure. That tradeoff is how much habitat do you want to go for. So maybe start with fewer pieces. When you can push the scour hole away from the pilings you have a lot more stability. You can also go to self-settling structures. That's what we did on the Kootenai in front of Libby Dam. Tim Abbey on the Elwha has been doing a lot of work like that. Putting wood in the middle of the river is a very dramatic position, the river is going to take a side. One or the other bank is going to start to see erosion. Maybe it is better to have alternating structures and ping pong the river back and forth.
    - Matt D. – These are not very big structures.
- Sean W. – What are the functional objectives of these structures? Habitat and structural?
    - Matt D. – It is about providing some complexity in side channel habitat, and roughness in these areas. It is one of those things we added to the concept to enhance habitat features.
- Zac C. – Knowing more about the size of the channel and structure, I'm not as concerned. They'll be effective for creating local pools for habitat enhancement. You do have an opportunity to roughen up the side channels with some more structures. To me that just seems counter to what you're dealing with. You've got a braided river. To try to force it into a plan from is still a decent sized imposition. The smaller structures may be better. You're doing an enhancement. The alternating structures might be more effective at providing that pool habitat. If you force the channel through the island, you'll probably just create a bunch of sediment where the channel was and lose the initial value you created. Consider having parts of them project to be more functional.
- Duncan H. – Is there any rational to the number of those that you've put in?
    - Matt D. – I was trying to go with a certain spacing of structures relative to the width of the channel, thinking of pool spacing and also thinking of areas that they can access to construct them.
- Sean W. – I like the idea. It's something different. keep it experimental. I'd even encourage driving some of those structures in some of your fill zones. Anywhere you've got some stem resistance you'd see stuff racked up and fine deposition and riparian vegetation. Maybe try some for localized pools and to help the riparian zones build stuff up.

- Matt D.– In terms of safety and navigation, they are submerged in higher water, at low flow, they are going to be something people would encounter head on.
    - Sean W. – I think those are good points to address in your risk analysis.
- Sue – People do float this portion of the river, they tube it, they do all kinds of things.
    - Sean W. – Then you need to look at the velocities, what's the reaction time? The USACE has probably done a very complex analysis of those things
- Zac C. – The Seattle district is behind the curve. King County has all their protocols for what they do when they put wood in the stream. That's the strongest most risk-informed approach. When we did a project below Libby Dam, they had us use the Washington Department of Natural Resources analysis. I recommend at least doing something like that. Signage is your best option. Identify where the blockages are, etc.
- Ryan F. – It is a slippery slope. Every year the river is different.
- Duncan H. – The question is how would you minimize the risk. There is a liability associated with that. I can see you minimize it by not having the structures right in the middle of the channel, having them close to the bank instead.
- Zac C. – We had a workshop on this with an attorney. It came down to what is the standard of care? If you're doing less than that you're at risk.

4b. B-stem bank erosion analysis

Matt D. explained that the stability of site 2 (north bank) is a concern and flanking of the pool-forming structures is a risk. They measured bank erosion data between 2007 and 2011. In the past the modeling folks have recommended looking at more than just shear stress. RDG attempted to replicated observed conditions with Bank Stability and Toe Erosion Model (BSTEM) using hydraulic model output. Erosion was consistent in the modeling regardless of flow. The bank is a sand bank and is not representative of the rates of erosion seen on most banks in the reach (i.e., approximately 5 ft. per year compared to about a half foot per year for others).

Options from a design perspective include: addressing it with a bunch of structures, or put in a key-in trench so that as the river erodes and intercepts that trench it will redirect away.

Additional data needs at this point include: measuring recent bank erosion since 2011 and completing grain size analysis at bank erosion sites. RDG is hoping to determine the need for the key-in trench to prevent flanking. The next steps are to review the project with and without the key-in trench using 2-D modeling, look at different bank attack angles, look at changes in velocity, and identify other bank erosion risk sites.

4c. Group discussion and review of major take-homes for the Lower Meander Project

- Jon N. – I'm concerned about the longevity of the pools and what needs to be done to pin that done better.
- Zac C. – I heard the word avulsion come up more than once. That's important to think through.
- Sean W. – You could reduce a lot of uncertainty if you could implement site 2 and site 3 phases concurrently.
- Matt D. – Understanding flow diversion through side channels will give us a better understanding of avulsion risk.

5. Braided Reach Bed Evolution Modeling

5a. Model updates – new substrate data and continued refinements/validation

Rich M. and Jon N. reviewed the USGS Braided Reach bed evolution modeling. Rich said they have looked at bed transport 2 meters above the river bed, and they've looked at suspended sediment transport. This work was primarily motivated by something Mitch P. suggested a few years ago to address how long it would take for the pool to fill in given X amount of sediment loading a year.

Questions and discussion:

- Simulated elevation change (see slides)
    - Sean W. – How do you feel about upstream boundary conditions?
        - Jon N. – You have to be careful about predictions since we don't know the upstream supply.
    - Sean W. – How well do you think the model results compare to Ryan's cross-sections?
        - Rich M. – We we're getting deposition on the right bank, spur, etc. But what we're seeing in the model is less than what Ryan's seeing.
- Measured vs. simulated bedload (see slides)
    - Sean W. – So there's not a lot of sensitivity relative to grain size choice?
        - Jon N. – It is an order of magnitude.
    - Rich M. – When compare the as-built survey in Nov. 2013 and Ryan's re-survey in June of 2014 (post winter operations and post spring high peak), we did very well at modeling the pattern of change, but the magnitude of measured change is greater than we predicted. When you look at the percentage of the pools filled at Bonners Ferry Islands simulated over three years, the pools fill between 1.5 and 13% just from bedload, which is a small amount. This is measured data from Fry Creek. The measured sand load is approximately equal to the measured gravel load. We made another assumption that we could double the filling rate. That gave us an approximate pool filling rate between 4 and 25 years from bedload.
    - Rich M. – We looked at stream-wise trapping of the pool based on predicted sediment distribution above the pool using size class of suspended sediment to come up with a trapping efficiency.
    - Jon N. – The stream-wise trapping efficiency was 10%, 70% of sediment going across the pool was trapped, and overall efficiently was 15%.
    - Rich M. – There are a lot of assumptions in this.
        - Sean W. – Sid you run bed evolution along with this just to see?
    - Jon N. – The big issue with the suspended material is that we don't know how much sand is in the gravel. A small difference is huge in terms of knowing how much is going into the pool. This is the only things that is defensible – anything else is speculation.
    - Matt D. – RDG collected data in the summer and fall at the same sites where had scour chains, plus other sites. Another consideration is that during construction we had that side channel blocked off too.
        - Rich – yes, but the bed is mobile. That pool didn't migrate, it just filled.
    - Matt D. – What this is showing is you're not going to see scour off of those two lower structures.

        - Jon N. – The first question is why. I guess it's because the stresses aren't high enough to move the material. But the other thing is your using a single grain size to model it, but we don't have any better way to do that. It doesn't mean that the flow structures that you'd expect to move sediment aren't there. But the grain size is the major uncertainty of these predictions.
    - Rich M. – Something I've been concerned about for a long time is this barb on the lower meander project is going to encourage deposition on this entrance to the main North Side Channels.
- Velocity changes (see slides)
    - Sean W. – It looks like there is a lot of variability and complexity, a non-uniform response, which is good.
    - Zac C. – So what we're looking at is the channel prior to any restoration and stamping in all of the proposed and completed projects.
        - Rich M. – Yes.
    - Sue I. – Do you have anything like this before the project was built to show natural channel changes?
        - Rich M. – The most extensive survey we had was 2009 and that's what I'm using. Our modeling is showing how some of the velocities are washing out.
    - Jon N. – You've got to remember that it showing absolute velocity changes. On average it is probably more than double what it was. If you normalized it by the velocity of what was there originally it would how much higher velocities.
    - Rich M. – I'm concerned about pushing more flow against this bank (see red areas in upper end).
- Question: Are the pool forming structures necessary or do they pose more of a risk? If you take them out, you don't increase the depositional trend in the middle side channel. Is there any reason to build them if we're not showing any benefit from them?
    - Tom P. – Wouldn't they still have the bank stabilization functions?
    - Chris N. – You could stabilize the bank with smaller structures that don't cause deposition.
    - Matt D. – I don't think we've ever identified erosion as a concern in that area. The only reason we have the pool forming structures is to support scour and support the pool. Are they a big waste of money?
    - Zac C. – Rich has presented the modeling and we have Ryan's work. Are they linked? What is the best representation of what's likely to happen?
    - Rich M. – The best data set we have is what Ryan collected at the Middle Meander. We're just off by a magnitude, there's more deposition and more scour.
    - Jon N. – We have more fine material in the newer samples.
    - Duncan H. – That spur in the lower meander, there was some discussion of that location relative to whether you get a bigger bang for your buck if you moved that.
    - Sean W. – Are any of the structures that have been completed not scouring a pool?
        - Matt D. – All structure completed thus far are scouring a pool.
        - Rich M. – And they are all on the outside of a bend.

- Ryan F. – Does your model take into account the backwater.
    - Rich M. – I did two different calculations. The difference in velocity is just discharge and stage that I modeled for a year at one steady flow. The elevation change they used is the elevations at Bonners Ferry.
    - Zac C. – So you ran an observed hydrograph in an area where we've already done construction.
- Jon N. – With this new data set I think we have better predictions, but the grain size just makes a huge difference in sensitivity.
    - Zac C. – Do you feel like this situation we have here is well suited for the model in terms of bed dynamics?
    - Rich M. – I think in terms of pool fill it is.
- Sean W. –You've been seeing scours associated with every pool forming structure that you put in the river.
    - Matt D. – My impression is that we're going to get some scour off the structures, it's just a question of where is the pool going to be. You also get hydraulic complexity off the lee side.
- Rich M. – I don't think putting a spur in any old place is going to create scour. I think those that are placed in some areas are going to provide very little scour.
- Sean W. – The backwater is probably the biggest difference in these, downstream from further upstream. What spurs do is create a line of deposition in the lee and scour off of the tip.
    - Jon N. – If it's a vertical spur you get huge scour off the tip. But these are more gradual.
- Duncan H. – It would be interesting to run that model with the pools filled in to see what the long term effects of the spur is.
- Rich M. – Another concern I had was that the mega pool. What is the cost benefit analysis if the pools become filled in?
- Duncan H. – In communicating about the project I would downplay the pool ladder because those pools are going to fill in over time. You're lucky to go in and be able to excavate gravel. If you want to accelerate the natural recovery of this river what you're doing is right – build islands. I wouldn't sell to the public that the pools are going to be there for a long time.
    - Sue – The biological opinion for Libby dam called for more depth. Once we investigated what was feasible, and the potential costs and implications, we started talking about ecological processes. The pool ladder was a way to address the depth criteria while also providing other ecological benefits.
- Duncan H. – My gut feeling is with the islands and spurs, geomorphically, you're going to increase the depth.
- Sean W. – That's like the velocity, what you're showing with all of this is increased variability, which is good.
- Duncan H. – But that figure that Rich showed represents changes from historical conditions. What it is showing is that generally there's an increase in velocity in the system.

- Zac C. – What I noticed was that the red in the lower half was mostly in a straight line. The river seems happy there. And that area has never really had much topographic complexity. When the channel gets above the top of the bars it likes to flow straight. If you want it to be a curvy stream and you haven't anticipated the over topping, you'll be challenged. What I would like to see is to watch this thing move around on an accelerated video. We're not there yet. We're doing these small experiments of controlled conditions to test these hypotheses. It is an experiment to test what is really happening. I've floated this section, there was a lot of kinetic energy. Is that still the case?

5b. Bed evolution modeling implications and major take-homes

Participants identified the following:

- Duncan H. – Something I raised last time we were together, there's a threat to increasing flows to the side channels. We talked about maybe putting some structures at the entrances to those side channels. If we're seeing increasing flows at the side channels would we be taking measures to address that?
    - Matt D. – I've thought about that, one concern I have is when you raise the inlet you increase the gradient through the side channel.
    - Duncan H. – Yeah, but you were sort of successful in doing that in Phase 1.
- Zac C. – What I've seen is if it's not localized, typically upstream or downstream it gets captured.
- Jon N. – Going back to the Lower Meander, it seems like if you want to build a deep pool you've got to narrow the channel. In that context, have we done that? Does the design accomplish that purpose? The fact that velocity slows down rather than speeding up, I think we haven't done that.
- Sean W. – My observations on the Middle Meander is that you dug that pool, a lot of it filled in, but you're getting the response you wanted. We need to get to a narrower deeper channel, we're priming the pump by digging the pool, but we need the materials to get there.
    - Matt D. – I think the pools are going to fill, it will put extra stress on the structure and scour a pool in a new location. We're trying to balance how much we need to do to move this in a direction we want.
    - Sean W. – But you still need that material for your floodplain.
    - Duncan H. – I'd close off one of those side channels.
- Chris N. – There was a similar situation on the Skokomish, the solution there was to build a series of posts in those side channels in order to induce deposition, the idea being to prevent the main channel from capturing or avulsing into the side channel.
- Zac C. – My questions are related to the sediment load. Looking at the Elwha dam, when you see there's a lot of flooding, the channel braids really fast. Once the flood recedes the river finds a single threat really quickly and then starts to meander. I look at this and think about the sediment load and what's forcing the braiding. Looking at those old relict meanders and how torturous they are, it looks like its incised. Is this an unstable temporary condition, is it trying to find a single thread? We're talking about pushing it into a single narrower thread, is that sustainable, does the geomorphology support it?
    - Matt – The desired morphology, working with what the river is doing, we have meandering planform transitioning to braided.
- Sean W. – If you had more sediment in the system I think it would develop as a point bar. But

the processes are there that just keep it low.

  - Matt D. – And the river is still getting wider.
  - Zac C. – So is that widening going to be stopped.
  - Matt D. – Yes.
  - Tom P. – Right now the old vegetation is 10 feet above the river. By building these features we're building some morphology in the short term but what will sustain in the longer-term that will be the vegetation.

- Zac – Do you have a geomorphic sequence that you see playing out in 50 years?
- Jon N. – One thing we could do that might help us get our conceptual framework in place to think about the pools, we could do that Middle Meander case without the pool and predict where we would have gotten to in six months. Would we have ended up at the same place?
  - Matt D. – That was a question we put out to our peer reviewers and we got both sides back. The reason we didn't do it was that we would mobilize so much sediment and send that down the river.
  - Jon N. – But we could do that on the case where we have measurements and do it on the Lower Meander. We could look out 2-3 years and see where we'd be without the pool. We might find out we need to build the pool or we create too much aggradation downstream.
- Duncan H. – You could put it another way. Run the model without the spurs to see if the pools are effective.
- Rich M. – Thinking about the function of the river, there's a lot of benefit to the pools being a source for the islands. Maybe the whole pool ladder things aren't that important?
  - Matt D. – we're still creating a migration corridor.
- Jon N. – Building those pools high up on the point bars is slowing down the building of the pools out where they would naturally be. But not building them might lead to a lot of aggradation down river.
- Matt D. – I think it's a worthwhile simulation.

6. Flood Risk Modeling Bonners Ferry Islands, Straight Reach and Lower Meander

Chris N. reviewed the flood risk model (*see 06 Flood Risk Modeling.pptx*). He reviewed the requirements for flood risk management and history of previous coordination for the Bonners Ferry Islands and Straight Reach projects. He identified the adjustments to the model based on updated data for the Braided and Meander reaches.

For the Braided Reach model improvements included:

- Corrected skewed cross sections & downstream reach lengths
- Added cross sections to represent pre- and post-project conditions
- Adjusted ineffective flow areas for side channels
- Used additional gages & stage recorder data for calibration
- Vertically varied roughness using calibrated flow roughness factors

For the Meander Reach model improvements included:

- Corrected stretched cross sections
- Added cross sections to enable representation of pre- and post-project conditions

- Multibeam bathymetry
    - 2012 Bonners Ferry to Trout Creek
    - 2013 Trout Creek to Porthill
- Vertically varied roughness using calibrated flow roughness factors

Chris reviewed the calibration data. He noted that for the Meander Reach they found that using the actual difference in tributary flows produced better calibration. He grouped the Meander Reach tributaries by watershed area.

Chris reviewed the FCM validation, FCM simulations, and unsteady flow modeling results to date. Next steps include:

- Updating the model for the Lower Meander final design
- Possibly adding stage recorders in the Bonners Ferry Islands site 2 project area (South bank) for calibration/validation.
- Consider adding stage recorders in the Meander Reach for calibration/validation
- Refining estimates of tributary contributions for key Meander Reach streams
- Using model to evaluate Meander Reach restoration projects

<u>Questions and discussion:</u>

- Zac C. – On your plots you show observed versus modeled. Are you saying that you over predicted flood stage?
    - Chris N. – The design model shows pretty similar stage, the as-built model is showing an increase over what was observed. We went back and re-created the geometry using the as-built stages and compared that with the observed stage. The as-built shows a higher stage than the design model and the as-built minus observed is similar.
    - Zac C. – You're telling me the peak in December is less than you predicted it would be.
    - Matt D. – And we're showing that the as-built is pretty close to the design.
- Zac C. – What are you seeing down there at low flows? I'm having a hard time understanding why your model is less accurate at low flows.
    - Chris N. – Because it's difficult to account for that range of boundary conditions. Say Kootenay Lake is really low and flows are low, that likely results in a model that doesn't match observed stage really well. [NOTE ADDED: Kootenay Lake elevations vary by more than ten feet for a given flow in the 10 to 40 kcfs range].
- Sean W. – Where did the original published elevations come from on the FEMA map?
    - Chris N. – It wasn't clear where they came from but they came from the USACE.
    - Sean W. – If you look at those assumptions, how is the project addressing those published elevations on that FEMA map?
    - Chris N. – In the flow compliance report we took the set of boundary conditions and plotted it two ways as a function of downstream boundary and flow and looked at difference from design condition and without. We looked at how does the flood frequency change across the project e.g., if you sliced across this, what's the exceedance probability for those set of conditions. How much flow would you need to not release from Libby Dam to offset those conditions.
- Sean W. – What about if the pools fill back up.
    - Chris N. – We ran that too both with the pool filled up and without.
- Rich N. – Early in the presentation you had multibeam cross-sections. We had a short stretch

where we had pretty full bathymetry but most were just cross-sections in the thalweg. Then Ryan F. went back and remapped throughout this reach. That should be helpful.

7. Ball Creek project

7a. Overview project history, design and 2-D hydraulic modeling

Matt D. provide an overview of the Ball Creek project and initial 2-D hydraulic modeling (*see 05 Ball Creek.pptx*). The Tribe is moving this forward with feasibility analysis of this project in case it isn't possible to implement the Lower Meander in 2017, or in case it is preferable to implement it sooner due to budget balancing.

Matt reviewed the historical conditions. Existing conditions and limiting factors include:

- The Ball Creek project area is on an alluvial fan (substrate transitions from boulders to sand)
- Kootenai River backwater affects the lower 2,000 feet
- Impacts include grazing, channelization, dike construction and vegetation clearing
- Used as a migration corridor and for spawning by Kokanee
- No documented sturgeon use
- Aquatic habitat is below potential and lacks cover, complexity and pools
- Riparian area is limited to channel margins and affected by land use and invasive species

Upstream from Ball Creek there was a forest fire in upstream from ball creek that actually jumped the Kootenai River. Flow is estimate to be about 450 cfs. Streambed materials vary from boulders to sand over a short distance. It the tributary enters the top of the alluvial fan there is some bank erosion (about 3%), then the gradient decreases to 1.5%, and material transitions from gravel to coble. Kokanee are using this area. Then closer to the Kootenai River Ball Creek is entrenched and characterized by sandy materials. An interesting thing about Ball Creek is when flows very low, there's a small delta at mouth that's made up of gravel transported under certain conditions.

Three alternatives have been developed based on existing conditions and previous input from the PRAT and CMART. Those include (Figure 5):

- ALTERNATIVE 1: Restore / enhance existing Ball Creek alignment
- ALTERNATIVE 2: Create small channel to divert some flow into historical wetlands
- ALTERNATIVE 3: Realign Ball Creek through historical wetlands

Alternative 1 is currently preferred. RDG has updated the design based on field information. There are eroding banks near bridge. Eventually the site will become a problem for the County. It could be treated and potentially a pool could be created there. If the design involved disturbing the bed, will need to look at vertical stability through the reach. There is an area where there are a series of berms that were piled up on the wetlands. You could also add channels between a complex of ponds.

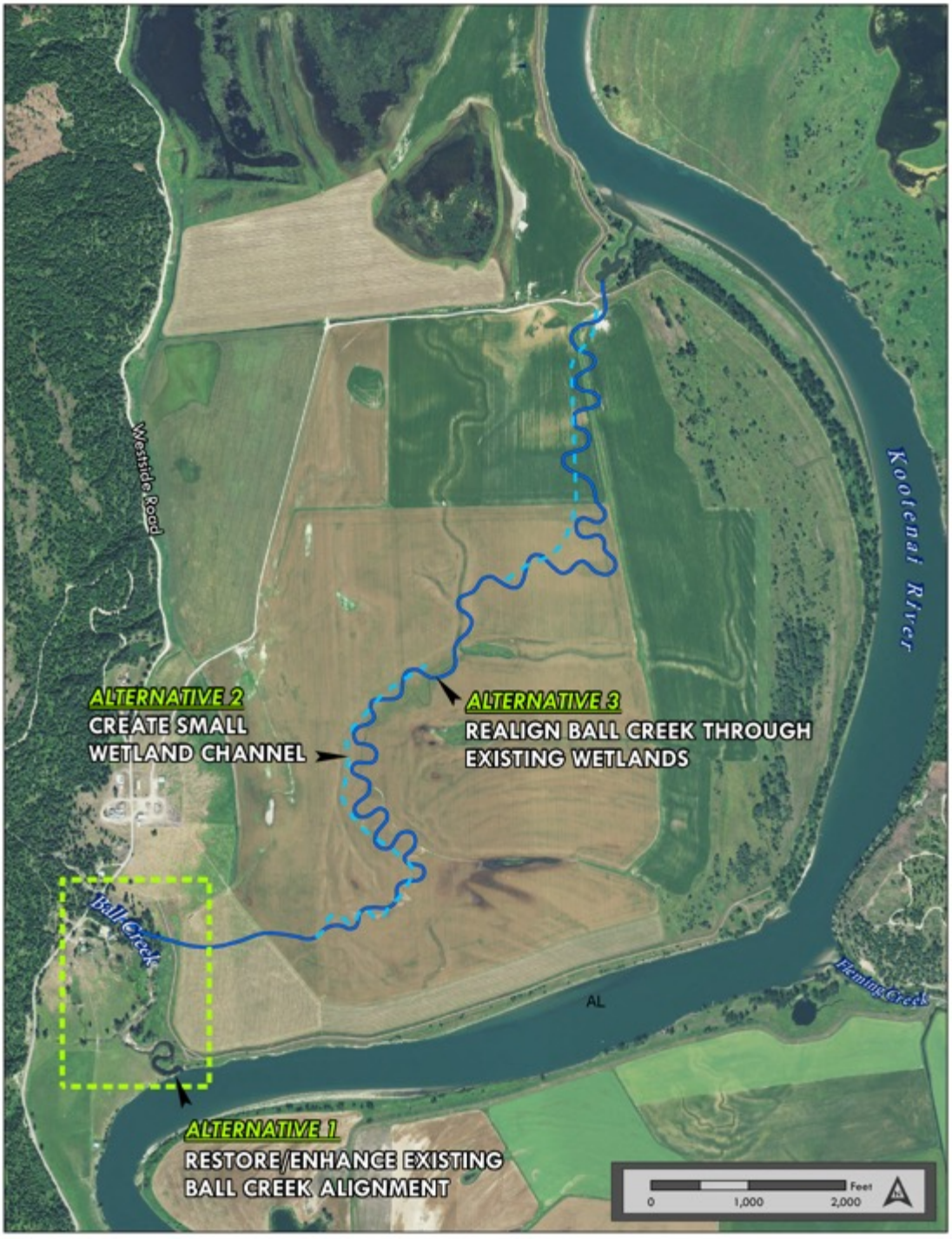

Figure 5.Ball Creek current design alternatives.

Questions and discussion:

- Rich M. – Do you have any idea how long that path from mountain to river has been in that position? Has it ever experiences a historical flood?
    - Matt D. – Good question. We'll follow-up with the people who live in the area.
- Rich M. – when Gary B. and I looked at this site in 2002 there was a tail of gravel nearly 1 km long. Potentially it could have been a spawning area for sturgeon pre-dam. When we first started modeling the Kootenai and modeled pre-dam flow conditions there were higher

velocities in this reach.

- Jon N. – How high is the elevation in the downstream meander there? It looks like it's about to cut off.
    - Matt D. – It may, it may cut off before we build it. Cutting off might be good. As we refine this concept the priority and main objective is to address the area that's used for spawning where we have gravel. We want to make sure that fish can migrate and get to this site. We need pools and depth and the right kind of substrate. We're looking at the whole reach at this point to come up with something that presents a more realistic concept.
- Sean W. – How stable are ponds and do you have temperature data? Do they dry up? I like the idea of hooking them up.
    - Matt D. – I don't know.
    - Sue I. – I'm not sure how they use their land right now.
- Zac C. – How has this been disturbed in the past?
    - Sue I. – The landowner has dredged it periodically. He says there is not a lot of sediment, but they've managed it over time.
    - Zac C. – Do you have LIDAR?
    - Matt D. – Yes.
- Sean W. – Can you get beaver in there, would that address the habitat priorities for the projects?
- Duncan H. – Would your approach be different if there wasn't a house there? The homeowner gets in and takes gravel out because he's concerned. If the objective is to enhance and increase the availability of gravel beds – if he wasn't there you might do something different to advance the gravel. So now you're going to have to buy-in to managing the gravel deposition
    - Matt D. – In front of his house is large cobble.
    - Duncan H. – What's in the berms that have been excavated?
    - Matt D. – I don't know. The landowner has put in his own large wood structure and pool.
- Duncan H. – What I see being done here isn't things you'd be typically doing on an alluvial fan, but rather more of a meandering stream.
    - Matt D. – I think large wood is part of an alluvial fan.
    - Zac C. – Yes and channel switching. You'll create riffles at the tail outs of the pools.

7b. 2-D hydraulic modeling

Chris N. summarized the completed and planned 2-D modeling. He reviewed the available gages and their history. Peak flow data for 1936 - 1948 were maximum mean daily flows. So RDG looked at average differences for the more recent record and then adjusted the 1936 - 1948 records. They used six surveyed cross-sections to create a RAS model and then used that to calculate roughness values. They used the model to estimate bankful flows and came up with range of 250 - 900 cfs. The middle of that range (~450 cfs)coincided reasonable well with projected flow for 2-year peak. Chris set up the 2-D RAS model and ran unsteady flow series.

Modeling recommendations/next steps include:

- Adding bridge geometry
- Infill the 2-D model with bathymetry data
- Obtain stage data for model calibration (need to identify owner of gage)
- Calibrate 2-D model roughness
- Develop proposed condition model

Chris invited the modeling subgroup to provide any additional recommendations.

Questions and comments:

- Zac C– What is causing that big dip (in the bed elevation profile)?
    - Matt D. – I think it's in an area where it widens out.
- Sean W.– Is there a depositional bar there?
    - Zac C. – It is right next to where the guys dig right now.
- Rich M. – Is there some risk of the North side channel drying out, and if not connected to groundwater, warming up?
    - Chis N. – We do have some data from TNC ranch.
- Sean W. – I would be curious to see what you get when you plot your bankful estimates for the drainage area, and the recurrence interval.
    - Chris N. – We did an exercise like that when we were looking at all the tributaries.
- Zac C. – Maybe consider "Alternative 4", build a bridge over the entire channel and let her rip.
- Sean W. – I'm interested to see one of those lower river projects and how that matches with the recruitment failure hypotheses. It would be really interesting to see one of these tributary restorations and what you can do in terms of nutrients. Maybe open it up more as it comes into the Kootenai. Maybe pull more of that back to see if you can develop that node more.
- Sue I. – The other thing that used to be in these tributaries is lots of kokanee, they used to be red with kokanee.
- Matt D. – Another way to approach things is to tie in more with the mainstem to try to create a velocity cue to take advantage of the gravel.
- Sue I. – I think the managed Kootenay Lake backwater effect has made some really strange things happen in the tributaries.
- Duncan H. – I'm fan of boulder clusters!
- Zac C. – Let it go wild!

8. Wrap up

8a. Recommendations and comments for Lower Meander project

Participants provided the following recommendations and comments regarding the Lower Meander project:

- Jon N. – Suggest modeling the Lower and Middle Meander without the pools/pool forming structures see what that looks like. That will help us see if we're getting the right answer with and without bed evolution modeling.
    - Duncan H. – You'll use the rate of inflow that you adjusted.
    - Jon N. – I think we're still at the level where making the models more complicated isn't

beneficial. We use the models as a diagnostic tool. If we fill in the pools, we know we're going to have a lot more material going downstream. There are several interrelated questions related to the role of the pool.

- Duncan H. – With respect for the estimate of 2.5 to 7 years for the pools, additional work isn't going to change that pool sustainability much.
- Zac C. – I haven't heard discussion about influence of hydrology on sedimentation. We looked at one year, what would stop us from doing 10.
    - Rich M. – Previously we looked at 3 years. That included dry, wet and typical.
    - Jon N. – Because of the backwater it doesn't behave the way we'd expect. It is the power peaking flows that do all the work.
- Duncan H. – If you do Site 2 and Site 3 together, I don't see any problem doing Site 1 first.
- Jon N. – Changing things by putting in a simple feature like that is pretty straight forward.
    - Duncan H. – Suggest you model it with one of the Northside channels blocked off to minimize flow more.
- Tom P. – In terms of time frames with these model runs, you're doing relatively smaller timeframes. Is it possible to project farther out so we could see the effects when you've got trees developed?
    - Jon N. – The farther out you go the more uncertainty there is. What hydrograph do you use? How much sediment supply? The farther you go out in time the less reliable information you have to work with.
- Zac C. – I think it would still be worth running a year with a higher roughness for the islands.
    - Jon N. – Yes, that's a good idea. Although roughness doesn't always have as big an effect as you think you want.
    - Zac C. – I'm interested in knowing if there are any long-term processes that are important to the success of the project that we can get at.
- Rich M. – My thought process has evolved from not being too concerned with the pools sustaining themselves, to thinking they really are a source of materials and are helping to build the food web, etc.
- Sue I. – Do you think having one more additional year of information for the Lower Meander would help dial in Site 2 and Site 3 better? Or is it unique in its own right.
    - Tom P. – More years of vegetation response would provide more information.
    - Jon N. – More information always helps a bit. If we have another year of surveys that will provide us additional information. The reality is that we've accepted the fact that the pools are going to fill under some time scale.
- Alison S. – What thoughts do you all have about building Site 2 and Site 3 separately if we had to due to funding or other constraints?
    - Jon N. – Could you consider building the upper half of Site 2 and Site 3 one year and then the lower half of each another year? The two sides influence each other in terms of routing and flow. The spurs essentially balance each other. If you build the first half and then the second half, you could address that issue.
- Rich M. – Another exercise would be to shift the islands a little further to the north where the pools are.

- Jon N. – But you'd still have to do that at the same time.
- Rich M. – Lateral compression is needed.

- Zac C. – Are we going to model Site 3 without Site 2 to see what the effects are? With the size of stuff, you are harvesting there are bigger dredges that you could use, like a suction dredge that could handle this. I can send some information on that.
- Duncan H. – What's your cost per yard for excavation.
  - Matt D. – It is about $10 to $12.

8b. Recommendations and comments for Ball Creek project

Participants provided the following recommendations and comments for the Ball Creek project:

- Jon N. – Do you want us to look at morphologic change on ball creek?
  - Matt D. – Let me think about what we have for data.
  - Jon N. – I don't think you're going to be able to do it with the HEC tools.
- Matt D. – Under what kind of scenario can we expect to see some big changes?
  - Jon N. – It seems like the more changes, the better. As long as you're not eroding away the pile of sediment the guys house is on you are okay.
  - Chris N. – Maybe run a worst case scenario.
- Rich M. – There doesn't appear to be a lot of variability in flow coming out of those small basins in the Selkirk Mountains.
  - Sue I. – They are very forested and intact. If people went and did some logging that would be different. The Myrtle Creek fire influenced the tributary quite a bit.
- Matt D. – Even with Myrtle Creek where they've taken it and routed it off into a ditch, it's been like that for decades and you don't see a lot of instability in what they've done there.

8c. Closing comments

Alison S. asked participants to identify what homework or actions the modeling subgroup or design team might complete between now and the fall 2016 PRAT meeting in order to help inform project design, monitoring design or interpretation, or adaptive management:

- Ryan F. – Monitoring is in place but if others have additional thoughts about other monitoring needs, time of year, location, what data we could collect I'd like to discuss that. We can coordinate that with sediment sampling.
- Jon N. – Here's the list of tasks I recorded: 1) run model without pools in Middle and Lower Meander with comparisons to the same calculations, 2) run what happens if you run one side without the other one year and then the other year, and three sites one year, and 3) what happens if you push the island out when you build. We will need RDG to generate those surfaces. A different modeling exercise would be to talk with Tom P. about running the model longer.
- Duncan H. – If you ran Site 2 by itself and you see some things on the south side – Site 3 – then there's the question of what could be done to mitigate that, then allow Site 2 to go ahead.
- Rich M. – If RDG can send a list of surfaces ASAP then I can get things running in the background.
- Matt D. – Yes, I will have Selita get that to you right away. Think about whether there's value in

doing the upper half and lower half of Site 2 and Site 3. We will hold off until we have results.

- Tom P. – We focus on analytical modeling approaches. Are there any analog modeling approaches that could possible complement those, e.g., maybe a 3-D printing application?
- Duncan H. – On the monitoring side, I have an interest on what happens on the downstream side of the pools. Particularly if we have a number of them. They'll fill upstream before the downstream side fills in. Where we have a risk is if something happens that we haven't anticipated e.g., downstream migration of those pools. I'm surprised with Ball Creek that it doesn't have any channelization.
    - Matt D. – There are some bars but you don't have a main bifurcation.
    - Duncan H. – I'm really interested, everything we've seen in Ball Creek has been plan view. Getting a cross section was a revelation.
- Zac C. – I'll follow-up with Coastal Engineers and get more information on the dredging equipment and possibilities. I'm thinking about the pools and their effect on the river maybe functioning as sediment traps, maybe starving the river of gravel. Doing work on the Yakima River we've been looking at some similar questions. I'd like to look at that a little more and see if maybe a pool length of X would potentially cause some head cutting. I'm curious about this question of whether the pool infill is from construction activity or bed load movement, but I'm not committing to doing that.
- Sue I. – We want to stay on schedule. Want to brainstorm with a smaller group about possible scheduling, what the implications are in terms of other things like landowner outreach etc.
- Chris N. – Want to follow-up with Zac on the flood risk modeling as needed.
    - Zac C. – The Columbia River Treaty folks are updating their models. If you could send us a version of the model that you think is the best representation of existing conditions.
    - Chris N. – Joel F. said there's nothing he's concerned with. Would also like to get Zac's recommendations on 2-D modeling.
- Matt D. – Looking at what Ryan F. highlighted in the cross-sections over the longer-term. The Middle Meander tail out and the transition between middle and lower, I want to look at that in the field. As much as we can coordinate with Rich and Jon to digest what we're working on, that helps a lot.
- Ryan F. – If possible next year I would prefer not to meet in May since it's right during field season. Last year we talked about bulk sediment. Is there a need for different or more bulk sediment?
    - Jon N. – The next step would be to do spatial distributions. The issue is primarily an issue in the Braided Reach. I don't think we need more. It's better to accept the uncertainty. It was well worth collecting this recent stuff it gave us better predictions.
    - Zac C. – If possible to run the model for a little longer, maybe three years.

Adjourn