FULL PROPOSAL FORM

Lewis River Aquatic Fund

Form Intent:
To provide a venue for an applicant to clearly indicate the technical basis and support for proposed project. Specifically the project's consistency with recovery plans, Settlement Agreement Fund objectives and priorities: technical studies and assessments which support the proposed action and approach.

Full Proposal format:
Please complete the following form for your Full Proposal. Maps, design drawings and other supporting materials may be attached.

The deadline for a draft Full Proposal Form submission is **December 15, 2017**. Please submit materials to:

Frank Shrier
PacifiCorp – LCT 1500
825 NE Multnomah Street
Portland, OR 97232

1. Project Title
Lewis River 21 Phase II

2. Project Manager (name, address, telephone, email)
Greg Robertson
Mount St. Helens National Volcanic Monument
42218 NE Yale Bridge Road
Amboy, WA 98601
360-449-7833
360-449-7801-FAX
gregrobertson@fs.fed.us

3. Identification of problem or opportunity to be addressed

The Lewis River 21 Phase II site is a moderately confined reach with a relatively low gradient (<1%). Pool depths are shallow (<3') for a large river and contributes to the observed high bankfull width to depth ratios. Recently deposited large wood complexes from the 2015 high flow event have improved channel conditions although the large wood is highly mobile, lacking embedded key pieces that would offer long term stability.

The Lewis River 21 Phase II project area site problems are unstable off channel habitat and banks, shallow pool depths, limited floodplain connectivity, and low levels of suitable spawning gravels. All of these problems contribute to primary limiting factors of poor channel stability, reduced sediment routing, and limited key habitat which are from lack of large wood causing homogeneous water depths throughout the project reach.

The existing side channels have been observed by Forest Service staff over the last decade to be intermittently active during base flow conditions and dependent upon the flux of large wood on the mid channel gravel bar. Currently, the side channel complex is active and several pieces of large wood have been deposited on the gravel bar that bisects the project reach. These few large wood pieces have been observed to facilitate sediment routing through the project reach and currently allow flow in the side channel during high flow events. Stabilizing the large wood on the gravel bar by adding large wood structures will capture and retain future large wood recruitment, allowing future perennial access into the side channel complex and restore long term sediment routing through the reach. The project will also stabilize the eroding bank of the terrace, reducing associated sediment input, creating deeper pools through local scour and increasing spawning gravel deposition.

4. Background

The LCFRB Plan (2010) summarized the limiting factors for Upper Lewis salmonid species, spring Chinook, coho, and winter steelhead life stages (LCRFRB). The most critical life stage was egg incubation and the second most critical life stage was 0-age summer rearing for all three species. For spring Chinook egg incubation, channel stability and sediment were primary limiting factors, and key habitat a secondary limiting factor. Competition (hatchery) and habitat diversity were primary limiting factors, and food, predation and key habitat secondary limiting factors for spring Chinook 0-age summer rearing.

The U.S. Forest Service identified the Upper Lewis River mainstem habitat as high priority reaches for Chinook and steelhead, while side channels and other slow water habitats were identified as high priority for coho. The mainstem habitat has been negatively effected by past timber harvest reducing large wood recruitment and by sediment production from roads that was delivered to the mainstem during high flow events (USFS 1995b).

5. Project Objective(s)

The goal of the Lewis River 21 Phase II project is to address stream channel habitat structure & bank stability and off channel & side channel habitat restoration needs and thereby improve egg incubation and summer rearing by improving three limiting factors; channel stability, habitat diversity and key habitat.

The project objectives to address the problems are:

- Stabilize two naturally occurring large wood depositional areas that were recruited in the December 2015 flood event on mid channel gravel bars with apex log jams,
- Stabilize and increase off channel habitat by adding apex log jam and increasing complexity with large wood to improve rearing habitat,
- Stabilize banks with bank structures and improve channel migration processes by the stabilization of the higher elevation eroding terrace,

- Increase floodplain connectivity with two apex bar log jams and two opposing bank structures at two locations to displace water onto the adjacent floodplain,
- Increase available spawning gravel and increase pool depths with apex bar and bank structures by sorting and retaining gravels in two pool tail crests and creating constriction flow scour in two pools.

GOAL:
Enhance the quality of fish habitat in the Lewis River by:

- Improving habitat complexity and diversity in the side channel using LWM
- Providing refugia during winter flows for juvenile salmonids.
- Providing rearing opportunities for juvenile salmonids during summer months.
- Providing increased spawning opportunities for adult salmonids.

The project objectives are consistent with the Aquatic Fund objectives.
Objective 1: *Benefit fish recovery throughout the North Fork Lewis River, with priority to federal ESA-listed species.*
This project will contribute to the recovery of these species by increasing the amount and quality of rearing pools in side channels. In addition, additional spawning areas will be associated with the log complexes.

Objective 2: *Support the reintroduction of anadromous fish throughout the basin.*
Juvenile anadromous salmonids will have consistent quality rearing and refugia when this project is complete, promoting juvenile survival and directly contributing to the Spring Chinook and coho salmon, and steelhead trout reintroduction efforts.

Objective 3: *Enhance fish habitat in the Lewis River Basin-, with priority given to the North Fork Lewis River.*
This project is located in the North Fork Lewis River Basin, Lewis River Reach 21. It is well documented that coho salmon juveniles prefer slow water habitats with large wood components and Chinook salmon prefer mainstem spawning habitat. This project restores and creates additional spawning area in the mainstem channel and higher quality slow water habitat in adjacent side channels.

Three of the six 'High' Rated Multi-Species Priority Restoration Needs for Lewis River 21 listed in the Lower Columbia Fish Recovery Board's SalmonPORT will be addressed in this project

1) Floodplain function and channel migration processes
2) Off Channel & side channel habitat
3) Stream channel habitat structure & bank stability.

Ronni and Timm (2016) reviewed existing habitat and environmental assessment data for spring Chinook, coho and winter steelhead and conducted a limiting factor analysis to identify limiting habitat and life stages. Similar to the LCFRB Plan, summer rearing habitat was identified to be limited in the stream systems above Swift Dam. Ronni and Timm emphasized estimating suitable rearing habitat (littoral zone, <3m deep) in the reservoir, and changing the depth criteria by one or two meters had a large influence in determining if spawning habitat would be limiting. Sediment

load in Lewis 21 reach was the factor affecting summer rearing for all three species. Sediment load was also affecting winter rearing habitat for steelhead in this reach. High quantities of fine sediments (21.9 % fines) from surface [erosion], mass wasting and roads were estimated using Fullerton et al. (2006; 2010a, b).

Five major categories of restoration actions for the goal of improving summer and winter rearing were listed within the 25 priority reaches identified and then adopted by the ACC. For Lewis River 21, large wood placement was recommended along with road restoration to improve summer and winter rearing.

D. J. Warren & Associates, Inc. (2016) used the EDT model to generate habitat limiting factors and reach restoration analysis. The EDT model determined habitat factors that limited salmon and steelhead production based on the differences in habitat inputs between current and historical conditions. Historical conditions were defined by functioning Level 3 Survival Factors. Using this methodology, Lewis 21 has key habitat identified as the limiting factor. Key habitat is defined as '*The relative quantity of the primary habitat types(s) utilized by the focus species during a life stage; quantity is expressed as percent of wetted surface area of the stream channel*'.

The short term benefits of the project will be the immediate juvenile refuge from high flow events in the side channel, floodplain, and large wood structure habitats during the first winter months. Several high flow channels are present in the lower elevation floodplain area on the north side of the channel that would be reactivated at lower flows than current channel conditions will allow and would inundate approximately thirty two acres of floodplain habitat from the top of the project reach downstream. Longer term benefits will include deeper pools maintained by high flow scour, increased spawning gravel habitat from gravel sorting by the added channel roughness and a reduction in channel shear stress at high flows by inundating the adjacent floodplain to the north.

Other benefits that could be considered both short and long term outcomes would be the reduction in sediment inputs and the stabilization of the eroding bank/terrace. This would also encourage other natural processes such as channel migration to occur on the adjacent lower elevation floodplain.

6. Tasks

Task 1: NEPA and required permits.

1) Field work for this NEPA document would be accomplished during the fall and winter of 2017/18 and a final decision memo to proceed with the project to be signed by March 2018 that would include Lewis River Phase I. The project would be implemented July 2019.
2) Instream restoration activities are covered under a Memorandum of Understanding (MOU) with the Washington Department of Fish and Wildlife HPA permit, a regional US Army Corps of Engineers RGP-8 permit, and an ARBO II programmatic consultation with the USFWS and NOAA.

3) The Forest Service is the landowner and project sponsor, and the District Ranger is supportive of this project.

Task 2: Project Design.

1) Finalize project design and project preparation details. Preliminary designs were completed during in 2017.
2) Surveys will be done to develop project specific elevations for excavation and final structure designs. This includes longitudinal profile and cross-sectional information that will be used as designs are finalized.
3) A 35 acre Peppercat timber sale unit is set aside to use for fish habitat restoration activities over the next ten years. An area within this stand will be designated for harvest operations for this project. Additional material may be acquired from PacifiCorp Swift Reservoir Cleaning operations.

Task 3: Project Implementation

1) Develop equipment, logging, and instream implementation through a Request for Quotation using a time and equipment contract.
2) Qualified USFS personnel will administer the contract to ensure project specifications are met.

Task 4: Monitoring

1) Perform baseline monitoring. This monitoring will occur prior to project implementation and include a longitudinal profile, cross-sections, pebble counts, and photo-documentation. Mount St. Helens Institute (MSHI) will provide two interns to perform the monitoring under supervision and training from the Forest Service.
2) Monitoring will occur following project implementation and will continue on an annual basis for several years following project completion. MSHI will provide two interns and volunteers for this portion of the work under supervision by the USFS
3) A monitoring report will be written each year following project implementation for three years. MSHI will provide raw data in excel format, provide analysis of data and will complete the report with USFS assistance.

7. Methods

Project designs to achieve these goals and objectives are to provide roughness in the form of four large wood structures within 1300 feet (0.25 miles) of river channel using 300 pieces of large wood from a USFS harvest unit and 10-12 whole trees (NEPA pending) from the immediate riparian area. Large wood would also be added to the lower energy side channels to promote and maintain pool scour, high and low flow juvenile refugia, and spawning gravel sorting for spring Chinook, coho and steelhead. Wood added to the side channels would be anchored or buried in a manner to be retained at high flows.

Two apex jams would each occupy approximately 30 feet of cross-sectional area and two bank structures that would be constructed opposing the apex bar structures would occupy approximately 18 feet of cross-sectional area (figures 1 and 2). Both structures would be

built to exceed the eroding terrace bank height to the south of the channel which would be approximately 13 feet above the channel thalweg (figure 3, 4 and 5). This would provide an additional two feet of structure height from the top elevation of the highest floodplain surface and be approximately seven feet higher than the lower elevation floodplain to the north.

Material will consist of naturally recruited wood on the gravel bar, imported Douglas fir (12-14" DBH) from a harvest unit, and either cedar or Douglas fir (less than or equal to 36" DBH) from the immediate riparian area or from the PacifiCorp Swift Reservoir spring forebay cleanout.

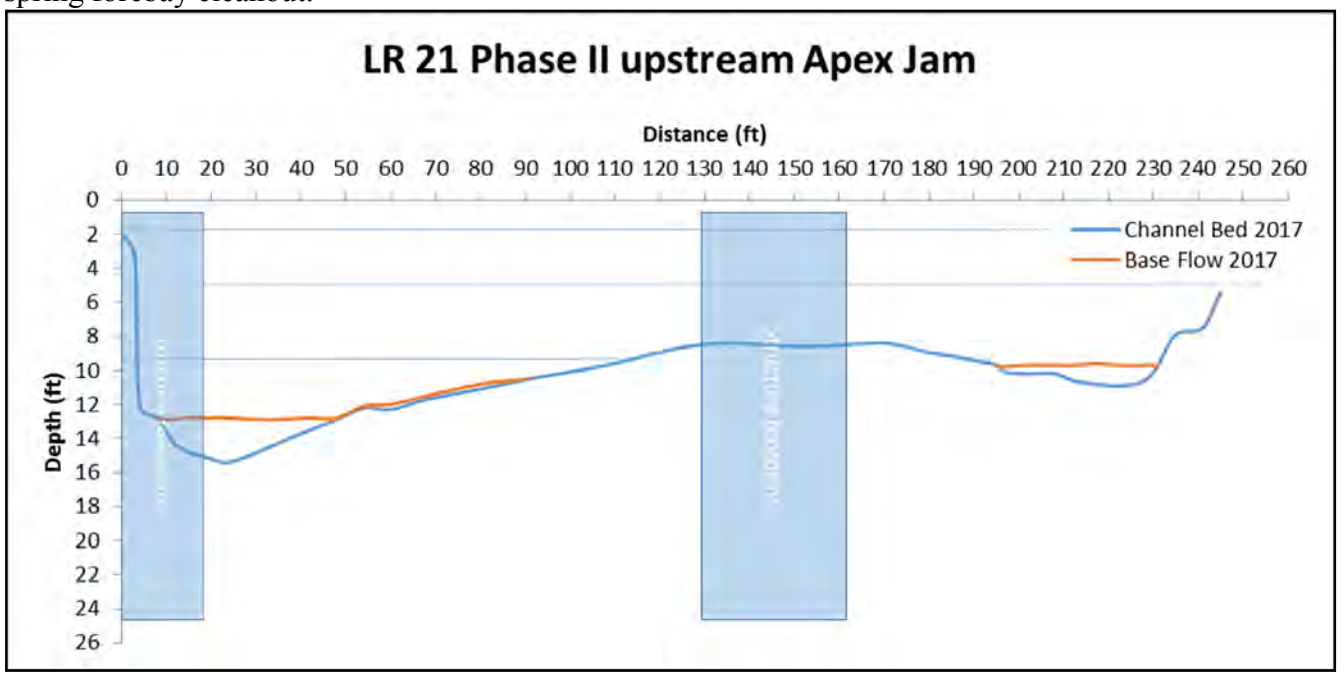

Figure 1. Cross section of upstream apex and bank structure noting structure footprint, design discharges, and bankfull width.

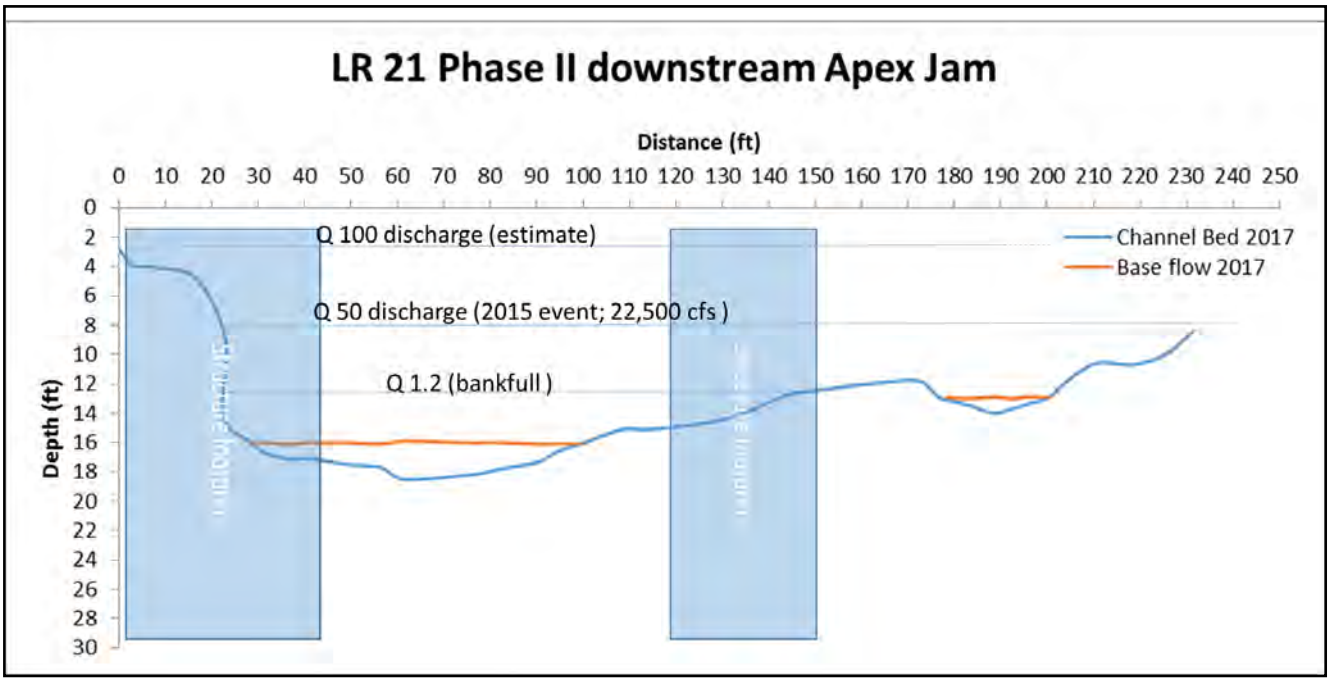

Figure 2. Cross section of downstream apex and bank structure noting structure footprint, design discharges, and bankfull width.

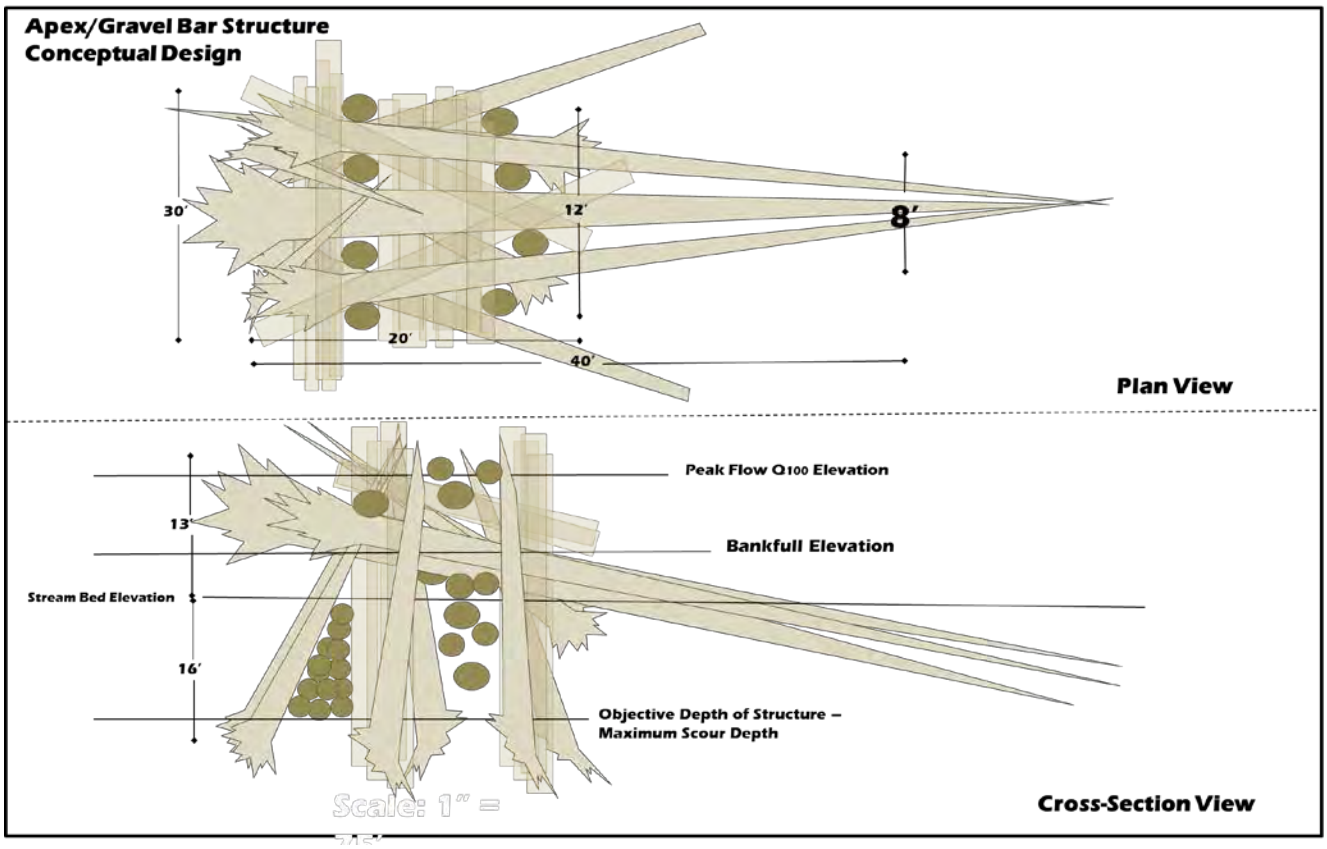

Figure 3. Conceptual apex/gravel bar structure showing proposed structure heights, widths, and scour depths.

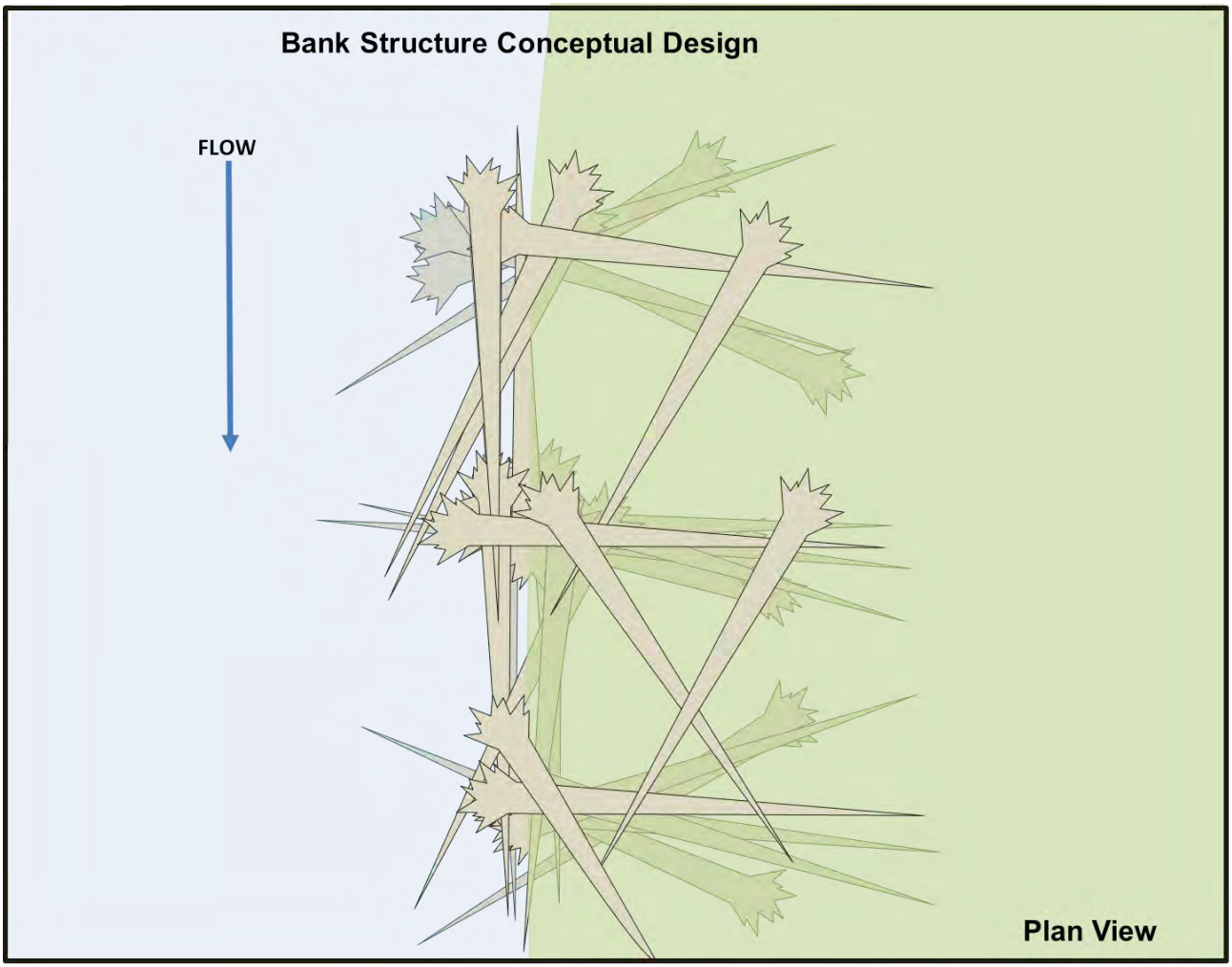

Figure 4. Conceptual plan view design of proposed bank structure key member placement.

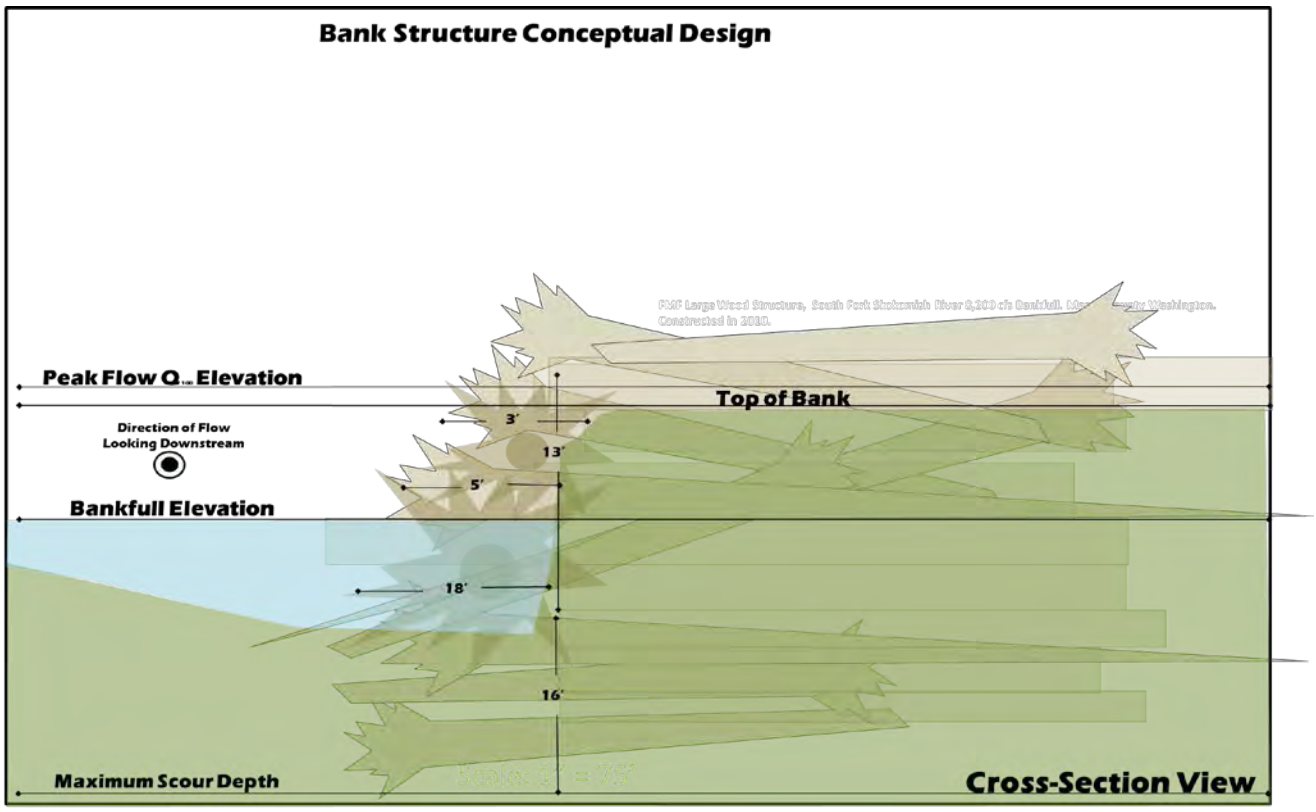

Figure 5. Conceptual bank structure showing proposed structure height, scour depth, and projection into the channel.

Best Management Practices (BMP's) for the Lewis River 21 Phase II project are implemented by the sponsoring agency (USFS) individual resource analyses requirements by fisheries, hydrology, botany, archeology, recreation, soils, and wildlife. Additionally, a Memorandum of Understanding (MOU) with the Washington Department of Fish and Wildlife HPA permit, a regional US Army Corps of Engineers RGP-8 permit, and an ARBO II programmatic consultation with the USFWS and NOAA further describes BMP's to be implemented.

The permits issued to the USFS to conduct aquatic restoration ensure that minimal resource damage will occur when implementing instream projects. Examples include worksite isolation to minimize instream turbidity or erosion control measures that limit sediment delivery to the waterbody.

The short term benefits will be the immediate juvenile refuge from high flow events in the side channel, floodplain, and large wood structure habitats during the first winter months. Several high flow channels are present in the lower elevation floodplain area on the north side of the channel that would be reactivated at lower flows than current channel conditions will allow and would inundate approximately thirty two acres of floodplain habitat from the top of the project reach downstream. Longer term benefits will include deeper pools maintained by high flow scour, increased spawning gravel habitat from gravel sorting by the added channel roughness and a reduction in channel shear stress at high flows by inundating the adjacent floodplain to the north.

Other benefits that could be considered both short and long term outcomes would be the reduction in sediment inputs and the stabilization of the eroding bank/terrace. This would also encourage other natural processes such as channel migration to occur on the adjacent lower elevation floodplain.

8. Specific Work Products

Deliverable 1: Contract submission to the agencies contracting department for the Lewis River 21 Phase II project will be completed the first week of March, 2019 and obligated to a qualified contractor by May 1, 2019.

Deliverable 2: Tree harvest on USFS land will begin during the last week of June and will be completed and hauled to the project site for instream project implementation prior to the instream work window (July 15-Aug 15). Instream work will be completed within the instream work window. All work will be completed by October 15, 2019.

Deliverable 2: A project completion report that includes project narrative, financial information, description of project successes and lessons learned, and photo documentation of the completed project will be submitted to the ACC by the January meeting 2020.

Deliverable 3: Monitoring Reports will be submitted to the ACC as described in Section 6 Task 4.

9. Project Duration

Project duration will be from September 2018 through December 2021.

The on the ground activities will start in late June 2019 with harvest and haul of the trees from USFS Peppercat 35 unit.

Task 1: NEPA and required permits will be completed by March 2018.
Task 2: Project Design will be completed by March 2019.
Task 3: Project Implementation will be completed by October 15, 2019
Task 4: Monitoring will be completed by December 2021.
Task 5: Project closeout site visit would occur during June of 2020 or to be determined by the ACC.

10. Permits and Authorizations

Resource surveys have been completed for the Phase II project area and NEPA will be completed March 2018. Further scoping involving a wildlife biologist, fisheries biologist and recreation staff will occur in the fall of 2018 and spring of 2019 to identify final tree tipping selection and expected Lewis River trail disturbance from implementation and

side channel development through natural and mechanical processes associated with the project.

Permitting and BMP requirements are covered under a Memorandum of Understanding (MOU) with the Washington Department of Fish and Wildlife HPA permit, a regional US Army Corps of Engineers RGP-8 permit, and an ARBO II programmatic consultation with the USFWS and NOAA.

11. Matching Funds and In-kind Contributions

Table 1. Matching funds and in-kind contributions for the Lewis River 21 Phase II restoration project.

Partner	Contribution	Funds
Forest Service	Project development, Contracting, Permitting, Monitoring	$28,000 In-kind
Materials from USFS	Trees with rootwads	$150,000 In-kind
Mt. St. Helens Institute	Monitoring	$3,000 In-kind

12. Peer Review of Proposed Project

USFS Region 6 Restoration Assistance Team (RAT) reviewed the Lewis River 21 project area on November 2, 2017. RAT project review contact information: Paul Powers, 541-433-3236. The Review is attached in Appendix C.

13. Budget

Table 2. 2019 Lewis River 21 Phase II proposed budget.

2019 Lewis River 21 Phase II proposed budget	**NEPA**	**Final designs**	**Project Mgmt**	**Construction**	**Monitoring/Labor /Reporting/Coord.**
Personnel Costs					
FS - Zone Team or Contract	$5,000 (ACC)				
FS –Fish Bio and Hydrologist*		$8,000 (IK) $8,000 (ACC)			
FS - Fish Bio and Bio technician*			$5,000 (IK) $5,000 (ACC)		$1,000 (IK) $1,000 (ACC)
FS - Contract administrator *				$10,000 (IK) $10,000 (ACC)	
FS - Contract Specialist*				$2,000 (IK)	
Mt St. Helens Institute					$3,000 (IK)
Mt. St. Helens Institute Community Education					$3,000 (ACC)
Travel			$1,000 (IK) $1,000 (ACC)		
Materials					
Forest Service 300 Pieces of LWM with rootwads				$150,000 (IK)	
Contract Payables					
Helicopter Contract				$90,000 (ACC)	
Excavator Contract				$25,000 (ACC)	
Logging and hauling of trees				$30, 000 (ACC)	
Materials and Supplies			$1,000(IK)		
Total ACC Funds $178,000	**$5,000**	**$8,000**	**$6,000**	**$155,000**	**$4,000**
Total FS Funds $178,000		*$8,000*	*$7,000*	*$162,000*	*$1,000*
Total Partner Funds $3,000					*$3,000*
Project Total $359,000					
*FS personnel estimated as $400/day.					

Table 3. 2019 Lewis River 21 Phase II Expanded Budget.

Item	Personnel	Estimated Days/units*	Cost Per Unit	Total*
NEPA Environmental Assessment required by Federal Law	Fish Biologist Wildlife Biologist Recreation	4 3 5	$400 per day per person	$5,000 (ACC)
Final Designs	Fish Biologist Hydrologist Fish Technician	20 2 18	$400 per day per person	$8,000 (IK) $8,000 (ACC)
Project Management	Fish Biologist Fish Technician	15 10	$400 per day per person	$5,000 (IK) $5,000 (ACC)
Travel	½ ton PU	Fleet Cost 2000 miles	$500 $0.75/mile	$1,000 (IK) $1,000 (ACC)
Construction	Contract Administration/Prep Helicopter contract Logging and Haul contract	55	$400 per day per person	$12,000 (IK) $10,000 (ACC) $90,000 (ACC) $30,000(ACC) $25,000 (ACC)
Materials & Supplies	Field Equipment, Notebooks, Misc Supplies			$1,000 (IK)
Trees with rootwads		300		$150,000 (IK)
Monitoring *MSHI* FS Monitoring Training	Supervisor Assistant Fisheries Technician	20 5	$300 per day per person $400/day	$3,000 (IK) $3,000 (ACC) $1,000 (IK) $1,000 (ACC)
Total				**$359,000**

14. Photo Documentation (*Per National Marine Fisheries Service's Biological Opinion for Relicensing of the Lewis River Hydroelectric Projects – August 27, 2007*):

Photo documentation will be collected by photo point locations marked by rebar and identified with latitude and longitude. To provide a similar pre and post photographic view, azimuths will be included. Each photo will be labeled with a date, time, project name, photographer's name, and documentation of the subject activity. Both close up and panoramic views will be included.

Photo documentation will be included in the completion report provided to the ACC in January 2020.

15. **Insurance. All qualifying applicants shall comply with PacifiCorp's insurance requirements set forth in Appendix A. The policy limits are deemed sufficient by PacifiCorp for project activities involving significant risk, including placement of large woody debris in navigable waterways, and are presumed to be sufficient for all activities likely to be funded under this Full Proposal Form. Should applicant's insurance program not meet these requirements, bid pricing should include any additional costs applicant would incur to comply with these requirements.**

Appendix A
Insurance Requirements
(Risk Mgmt to evaluate risk by project and report needed insurance limits to Lewis River Project Coordinator)

1. INSURANCE

Without limiting any liabilities or any other obligations of [CONTRACTOR], [CONTRACTOR] shall, prior to commencing the Project, secure and continuously carry with insurers having an A.M. Best Insurance Reports rating of A-:VII or better the following insurance coverage:

1.1 Workers' Compensation. [CONTRACTOR] shall comply with all applicable Workers' Compensation Laws and shall furnish proof thereof satisfactory to PacifiCorp prior to commencing the Project.

All Workers' Compensation policies shall contain provisions that the insurance companies will have no right of recovery or subrogation against PacifiCorp, its parent, divisions, affiliates, subsidiary companies, co-lessees, or co-venturers, agents, directors, officers, employees, servants, and insurers, it being the intention of the parties that the insurance as effected shall protect all parties.

1.2 Employers' Liability. Insurance with a minimum single limit of $1,000,000 each accident, $1,000,000 disease each employee, and $1,000,000 disease policy limit.

1.3 Commercial General Liability. The most recently approved ISO policy, or its equivalent, written on an occurrence basis, with limits not less than $1,000,000 per occurrence/ $2,000,000 general aggregate (on a per location and/or per job basis) bodily injury (with no exclusions applicable to injuries sustained by volunteers working or participating in the Project) and property damage, including the following coverages:

a. Premises and operations coverage
b. Independent contractor's coverage
c. Contractual liability
d. Products and completed operations coverage
e. Coverage for explosion, collapse, and underground property damage
f. Broad form property damage liability
g. Personal and advertising injury liability, with the contractual exclusion removed
h. Sudden and accidental pollution liability, if appropriate
i. Watercraft liability, either included or insured under a separate policy

1.4 Business Automobile Liability. The most recently approved ISO policy, or its equivalent, with a minimum single limit of $1,000,000 each accident for bodily injury and property damage including sudden and accidental pollution liability, with respect to [CONTRACTOR]'s vehicles whether owned, hired or non-owned, assigned to or used in the performance of the Project.

1.5 Umbrella Liability. Insurance with a minimum limit of $4,000,000 each occurrence/aggregate where applicable to be provided on a following form basis in excess of the coverages and limits required in Employers' Liability insurance, Commercial General Liability insurance and Business Automobile Liability insurance above. [CONTRACTOR] shall notify PacifiCorp, if at any time their minimum umbrella limit is not available during the term of this Agreement, and will purchase additional limits, if requested by PacifiCorp.

In addition to the requirements stated above any and all parties providing underground locate, engineering, design, or soil sample testing services including [CONTRACTOR], subcontractor and all other independent contractors shall be required to provide the followings insurance:

Professional Liability: [CONTRACTOR] (or its contractors) shall maintain Professional Liability insurance covering damages arising out of negligent acts, errors or omissions committed by [CONTRACTOR] (or its contractors) in the performance of this Agreement, with a liability limit of not less than $1,000,000 each claim. [CONTRACTOR] (or its subcontractors of any tier) shall maintain this policy for a minimum of two (2) years after completion of the work or shall arrange for a two (2) year extended discovery (tail) provision if the policy is not renewed. The intent of this policy is to provide coverage for claims arising out of the performance of work or services contracted or permitted under this Agreement and caused by any error, omission for which the [CONTRACTOR] its subcontractor or other independent contractor is held liable.

Except for Workers' Compensation insurance, the policies required herein shall include provisions or endorsements naming PacifiCorp, its affiliates, officers, directors, agents, and employees as additional insureds.

To the extent of [CONTRACTOR]'s negligent acts or omission, all policies required by this Agreement shall include provisions that such insurance is primary insurance with respect to the interests of PacifiCorp and that any other insurance maintained by PacifiCorp is excess and not contributory insurance with the insurance required hereunder, provisions that the policy contain a cross liability or severability of interest clause or endorsement, and that [CONTRACTOR] shall notify PacifiCorp immediately upon receipt of notice of cancellation, and shall provide proof of replacement insurance prior to the effective date of cancellation. No required insurance policies, except Workers' Compensation, shall contain any provisions prohibiting waivers of subrogation. Unless prohibited by applicable law, all required insurance policies shall contain provisions that the insurer will have no right of recovery or subrogation against PacifiCorp, its parent, affiliates, subsidiary companies, co-lessees, agents, directors,

officers, employees, servants, and insurers, it being the intention of the Parties that the insurance as effected shall protect all parties.

A certificate in a form satisfactory to PacifiCorp certifying to the issuance of such insurance shall be furnished to PacifiCorp prior to commencement of the Project by [CONTRACTOR] or its volunteers or contractors. If requested, [CONTRACTOR] shall provide a copy of each insurance policy, certified as a true copy by an authorized representative of the issuing insurance company, to PacifiCorp.

[CONTRACTOR] shall require subcontractors who perform work at the Project to carry liability insurance (auto, commercial general liability and excess) workers' compensation/ employers' or stop gap liability and professional liability (as required) insurance commensurate with their respective scopes of work. [CONTRACTOR] shall remain responsible for any claims, lawsuits, losses and expenses including defense costs that exceed any of its subcontractors' insurance limits or for uninsured claims or losses.

PacifiCorp does not represent that the insurance coverage's specified herein (whether in scope of coverage or amounts of coverage) are adequate to protect the obligations [CONTRACTOR], and [CONTRACTOR] shall be solely responsible for any deficiencies thereof.

Appendix B
Questions asked from USFS Lewis River 21 Phase II Pre-Proposal

WDFW- Written questions for USDA Forest Service, Lewis River 21 Phase II

1) The Lewis River Reach 21 was selected from the Lewis River Aquatic Fund Priority Reaches (2016 version) and is ranked as a LCFRB tier 2 reach. For spring Chinook, the reach was ranked as 11th with key habitat listed as the primary reach limiting factor. Other higher ranked LCFRB tier 1 reaches such as Lewis River 18 and 19 had a reach rank of 1 and 7, respectively, for spring Chinook. Lewis River 21 reach was selected as its life history use is spawning, rearing, and migration for spring Chinook whereas Lewis River Reach 17 and 18 life history use for spring Chinook is holding, rearing, and migration.

2) The Little Creek restoration project at the upstream boundary of the Lewis 21 Reach has had restoration work completed in 2014. Chinook have recently been observed spawning in this tributary during a 2017 fall site visit.

Cowlitz Tribe- Written questions for USDA Forest Service, Lewis River 21 Phase II

1) Using the Washington State Department of forestry Hydraulics Overview and the USGS Pier-Scour Equation Evaluation for Coarse Bed Streams, the Colorado State University/HEC 18 Jones pier scour equation was selected to use for the apex jam scour calculations. This equation was selected because it has been found to be reliable in estimating pier scour depths, when compared to field data measurements, than several other existing equations. This is due to the correction factor (K4) that accounts for scour hole armoring in a gravel bed that the other sand bed equations lack (WADNR 2004, USSG 2004).

$$d/y_1=2.0K_1K_2K_3K_4\ (b/\ y_1)^{0.65}Fr^{0.43}$$

Where:

y_1=1m (depth of water upstream of obstruction)

b=10.0m (width of obstruction)

Fr=0.55 (Froude number)

K_1=0.9 (correction factor)

K_2=1.0 (correction factor)

K_3=1.1 (correction factor)

K_4=0.7 (correction factor)

Peak flow estimate for the project area were obtained from USSG gage (#14216000) and verified using USSG StreamStats to obtain discharge estimates. Froude number was obtained be using discharge and cross sectional mean depth at Q50 discharge. Resulting scour depths calculated for the apex jams are 15.7-16 feet. If those depths cannot be reached during project implementation, adjustments to the structure widths can be made to accommodate the onsite conditions.

2) A timber stand and wildlife assessment made by the district silviculturist and wildlife biologist, respectively, have approved the tipping of trees under the ARBO II NOAA and USFWS programmatic consultation. As such, full length trees, equal to or less than 36", will be obtained from the immediate riparian areas and will be used to increase structure durability.

LCFRB- Written questions for USDA Forest Service, Lewis River 21 Phase II

1) The project site functionally relates to Lewis River Phase I by tying the bottom end of Phase II floodplain into a knickpoint at the confluence of the Lewis River and the Rush Creek alluvial fan Phase I project.
2) It is a project goal to maintain and capture wood at the Phase II project site to provide habitat complexity and channel roughness to activate side channels. Current mainstem channel conditions are incised from historic elevations and the side channels on river right floodplain are being activated at high flows (>50 year events). It is the project goal to activate these side channel between base and bankfull flows (1.2 year events).

Appendix B
Peer Review of USFS Lewis River 21 Phase II

REGION 6 RESTORATION ASSISTANCE TEAM (RAT)

Regional Assistance Team Report for Lewis River Reach 21 Phase II, Gifford Pinchot National Forest

November, 2017

File Code: 2600 **Date:** November 9, 2017

Subject: November 2, 2017 R6 Restoration Assistance Team (RAT) Field Reconnaissance of the Lewis River Reach 21 Phase II Project on the Gifford Pinchot National Forest

To: Ruth Tracey, Greg Robertson

Cc: Scott Peets, Jim Capurso, Brian Staab, Paul Powers, Cari Press

We would like to thank the Gifford Pinchot National Forest for the opportunity to visit this impressive landscape and provide input on an exciting project. The RAT was hosted by Ruth Tracy, Greg Robertson and Bryce Michaelis, the visit was made by Paul Powers, Fisheries Biologist from the Deschutes National. This report documents our observations in the field and recommendations for the project area.

Observations

Lewis River

We reviewed Lewis River 21 Phase II on the Lewis River near the confluence with Rush Creek. The stated goals of the project are to increase habitat complexity, retain alluvial contributions from Rush Creek, and improve flow interaction with relic channels on river right of the Lewis River near the confluence with Rush Creek through the addition of large woody material. Proposed large wood additions would include whole length trees acquired from adjacent riparian stands (greater than 36" DBH) as well as approximately 200 pieces of greater than 12" dbh material. Large wood would be assembled into bar/island formation jams as well as bank jams. The objective being the displacement of flow volume from the main stem Lewis River and thereby activation of relic flow paths on river right (looking downstream).

As we walked down Rush Creek to the confluence with the Lewis River (downstream end of Lewis River 21), it was immediately apparent that the Lewis River had incised over the past several decades and become largely disconnected from the historic surfaces (Fig. 1). This was visible in the surface on river right across from the Rush confluence where the USFS had recognized the need to reconnect relic channels (Fig. 2). Indicators of incision include abrupt hydraulic jumps from tributaries to the mainstem river (Fig. 3), large substrate sizes in the bed, and simple habitats within the mainstem channels (Fig. 4). Some mid-channel bars with young alders have formed and some wood has been deposited on these (Fig. 5).

Figure 1. Typical level of disconnect between the Lewis River and the left bank terrace.

Figure 2. Right bank floodplain feature that is the target area for activation of relic flow paths.

Figure 3. Plunge of approximately six feet from Rush Creek alluvial fan to the Lewis River.

Figure 4. Downstream extent of proposed LWD additions to the Lewis River.

Figure 5. Mid-channel bars developing with young alder growth within Lewis River Reach 21.

Back at the office, we looked at the LiDAR surface of this reach. From the LiDAR data numerous relic channels are visible in the project area and upstream of the project area on both river right and left in the disconnected floodplain (Fig. 6). To evaluate the level of separation between the Lewis River and adjacent flow paths and floodplain surfaces, a newly developed method of comparing relative elevations was used called the PowerSlope. Using the valley centerline, raw elevations from the 2016 LiDAR set were used and a third order polynomial equation was generated (best fit line), which is the best fit trend line describing the valley slope (Fig. 7).

Using the PowerSlope, we can evaluate the surfaces found within the valley relative to this trendline. This information can be mapped using the Relative Elevation Model (REM), also recently developed for this purpose. The REM is color coded to show how much existing surfaces are above or below the PowerSlope. Elevations that match the PowerSlope are blue, elevations above the PowerSlope are warm colors, and elevations below the PowerSlope are shades of pink (Fig. 8).

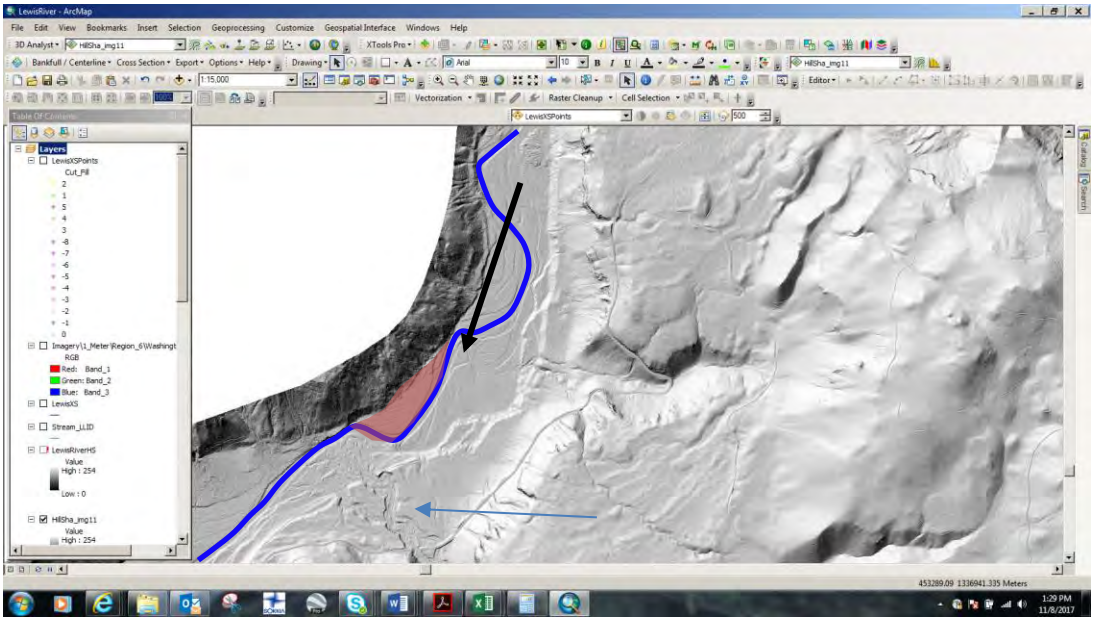

Figure 6. Hillshade LiDAR with main stem Lewis River depicted with blue line, Rush Creek at arrow and target surface/channels for wetting with the proposed project.

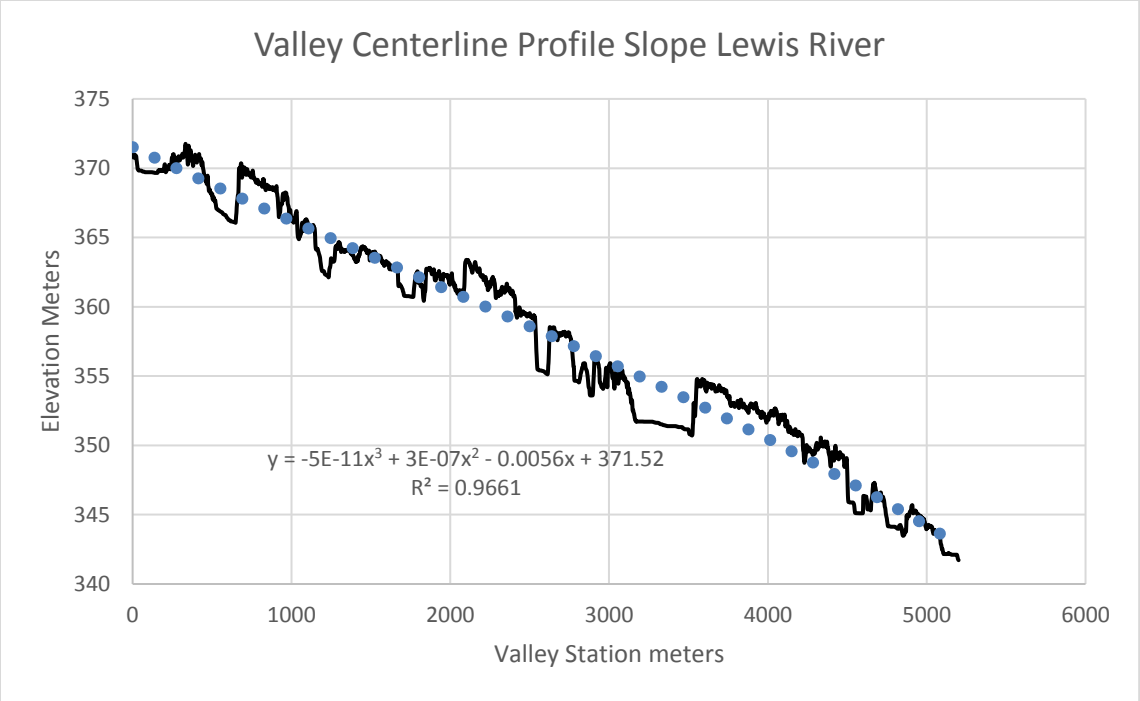

Figure 7. PowerSlope equation developed for the project reach review along the Lewis River.

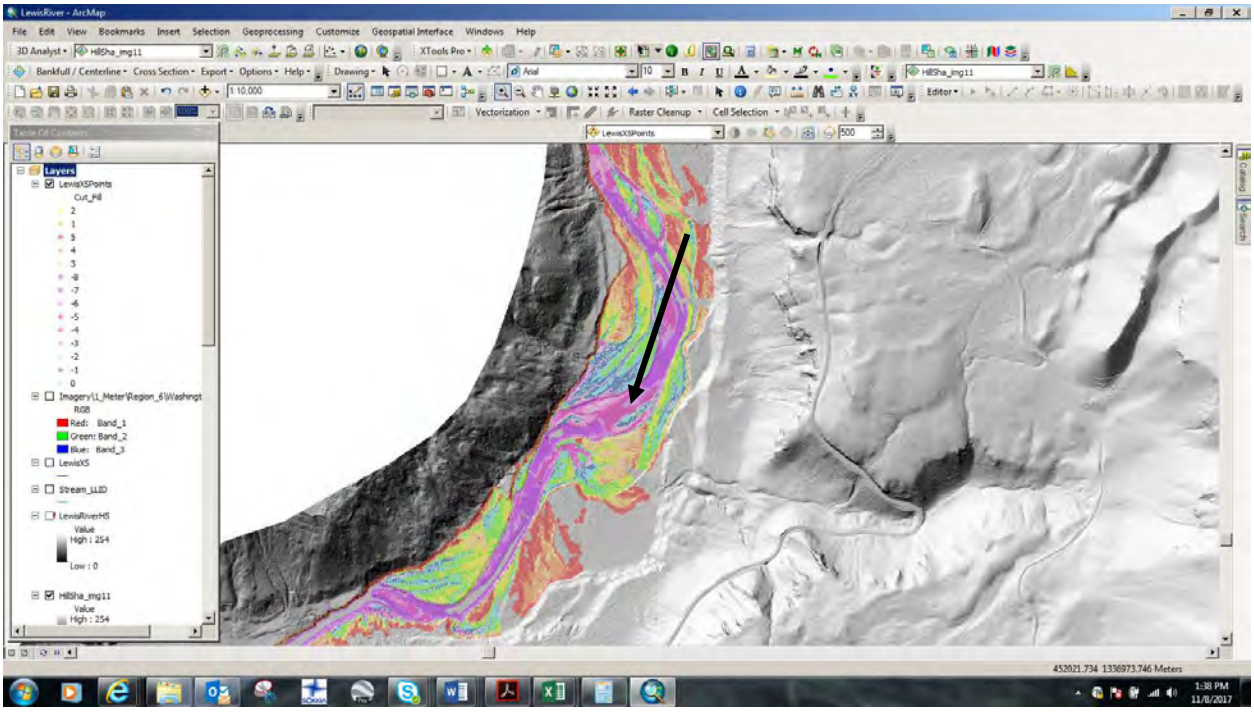

Figure 8. Relative Elevation Model map of the Lewis River Project Valley. Legend for color codes is displayed in the GIS table of contents at the left.

Evaluating elevations along the Lewis River relative to the valley slope shows both the level of incision of the river, as well as, how much lift would be required to activate the relic channels on the disconnected floodplains in the project reach and upstream. While the existing relic channel elevations generally sit at or two feet below the PowerSlope elevation, the water surface of the Lewis River Reach 21 is up to seven feet lower than the PowerSlope elevation. Furthermore, a berm-type feature that blocks the entrance to the relic channels is one to three feet above the PowerSlope elevation (Fig. 9). Therefore, the bed of the Lewis River would have to be significantly aggraded to restore perennial connection to these channels, as well as, the physical blockage of flow into these channels would have to be removed. This can also be seen when looking at a simple valley cross section through this area (Fig. 10).

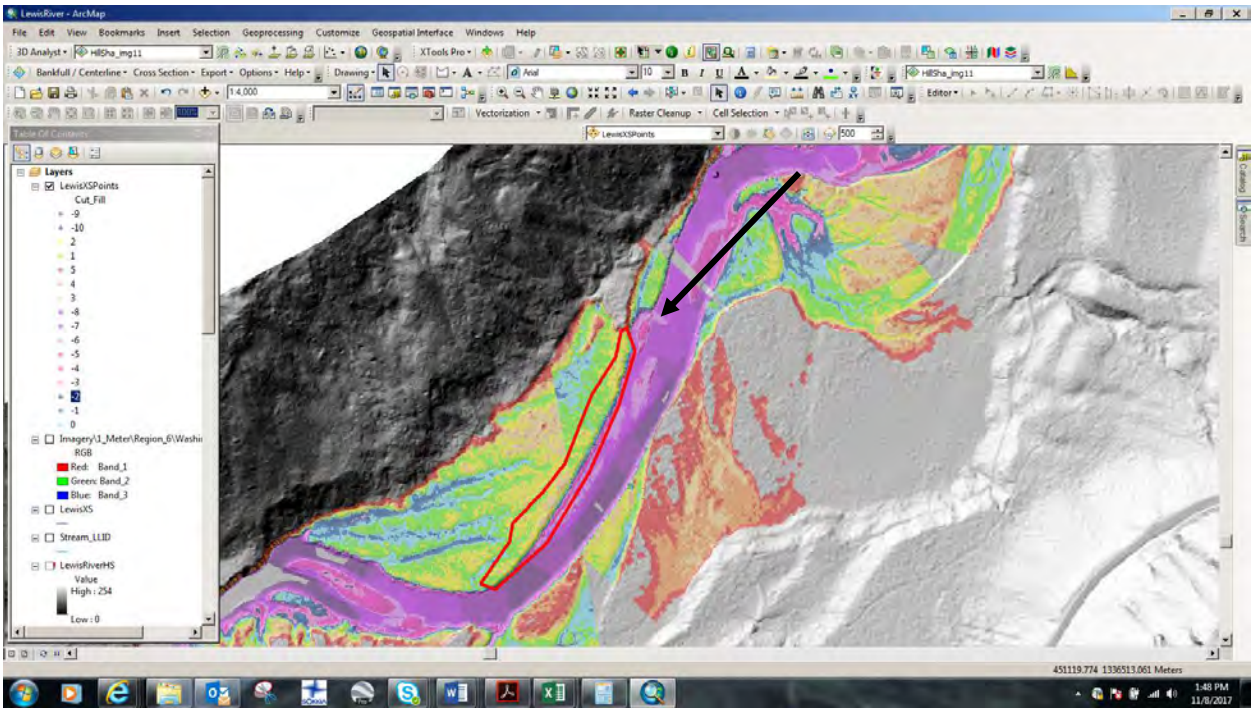

Figure 9. Zoom in showing the material blocking access to the relic channels on river right (area within red box).

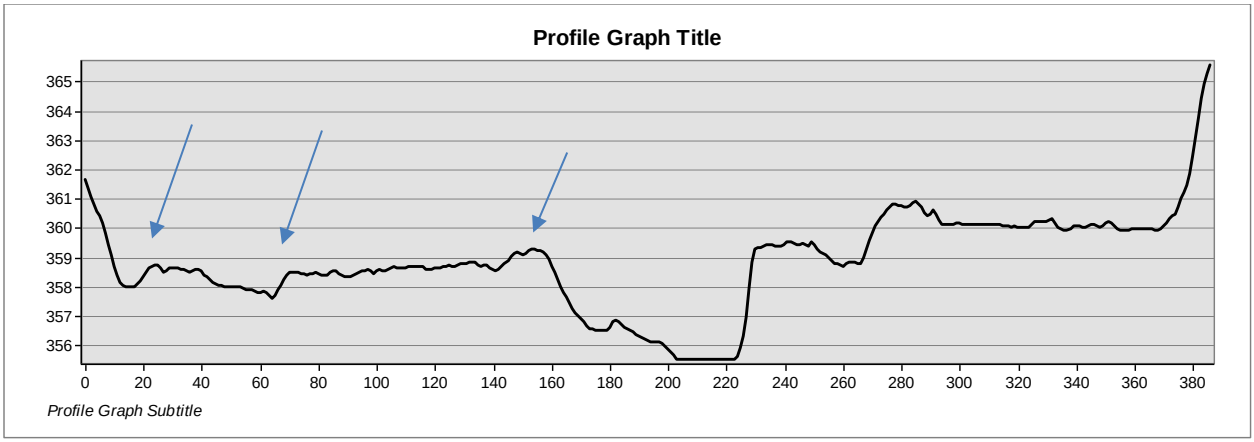

Figure 10. Valley cross section depicting the elevation of target channels (meters) at approximate stations of 15 and 60 meters as well as berm feature at station 160 meters, and the water surface of the Lewis River at 200-225 meters. X and Y axis depicted in meters.

The Lewis River in the project reach is in an unconfined depositional valley and has been converted into a transport reach by incision and disconnection from its historic surfaces. The Lewis River Reach 21 appears to be incised several feet below a fully connected valley floor when evaluating based on the Channel Evolution Model developed by Cluer and Thorne (2013), can be represented as being at Stage 3 (Fig. 11). Connection to the historic and seasonally wetted channels on the floodplain surface would be representative of Stage 0. Achievement of this condition would require several feet of lift within the Lewis River. If this were to occur, the Lewis River valley could expect all the biological and geomorphic benefits associated with a stream at Stage 0 (Fig. 12).

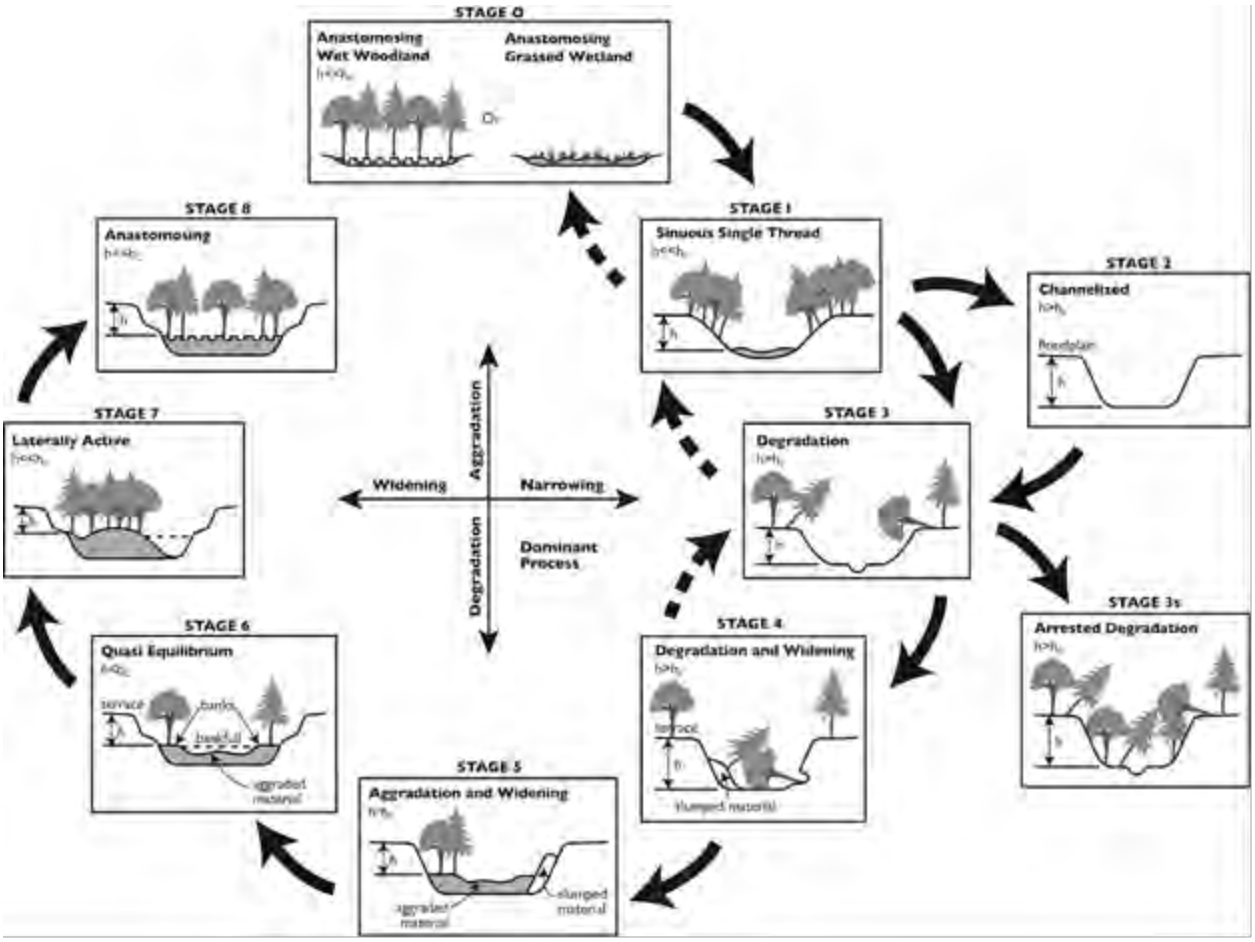

Figure 11. Stream Evolution Model (SEM) developed by Cluer and Thorne 2013.

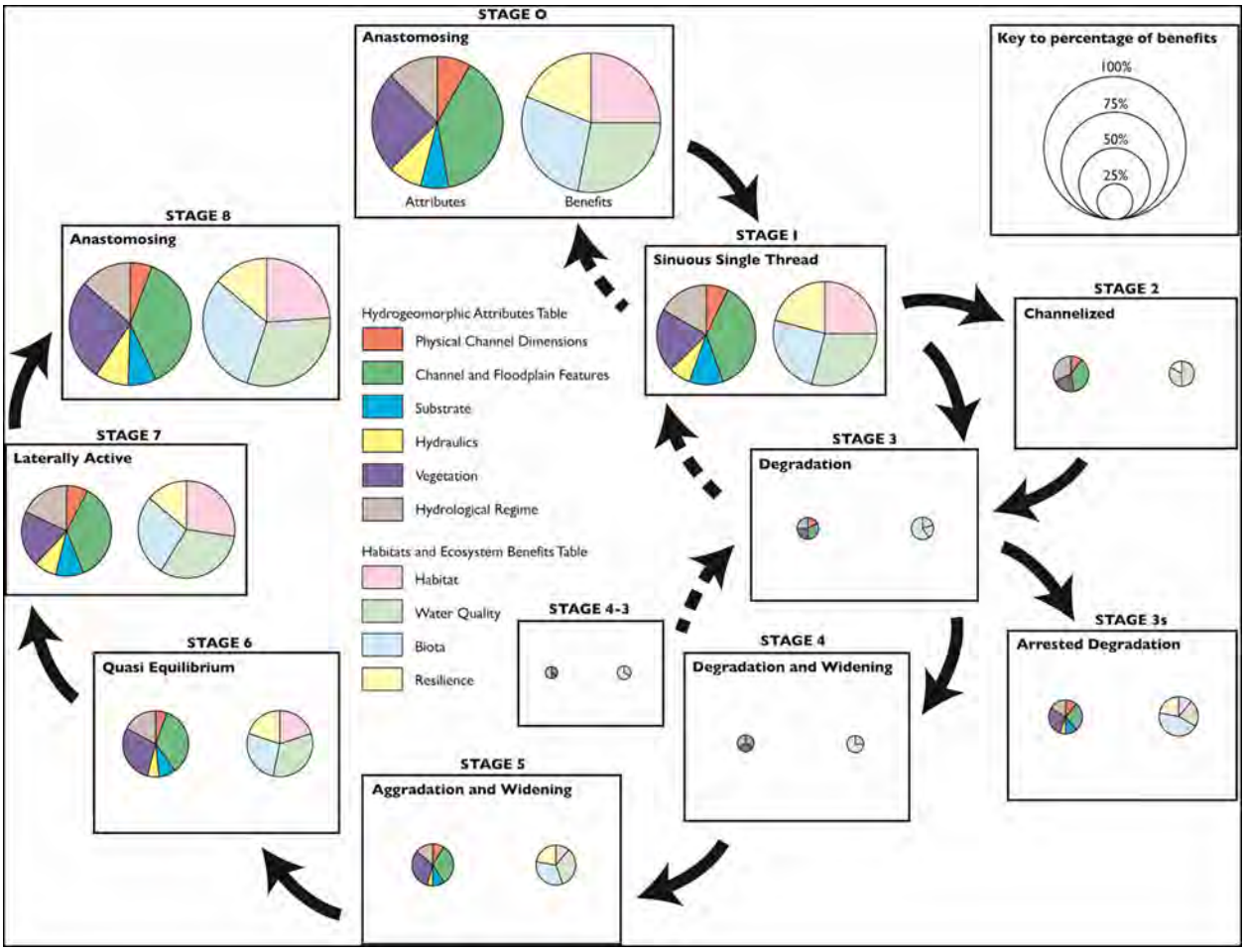

Figure 12. Cluer and Thorne schematic showing the hydrogeomorphic and habitat benefits associated with each stage of the SEM (2013).

Recommendations

We think that the project as proposed would improve connectivity to disconnected surfaces and channels as well as provide some much needed habitat complexity within Lewis River Reach 21. The proposed placement of LWD with the addition of key members (up to 36 inch dbh) would provide the roughness needed to displace some amount of water volume and seasonally wet, to some extent, disconnected channels on river right. The proposed construction technique has proven effective at displacing flow, promoting pool formation and promoting the deposition of alluvial substrates around and behind the structure.

We do not advocate that modelling scour depths provide more accuracy than field measurements. A bedrock controlled scour pool exists in the middle of this project area and measured as 8 feet residual depth. We suggest actual measurements such as the scour pool at this location are the most accurate predictors of maximum scour pool depth.

Given the track record of the proposed approach as well as the practitioners involved in the project development, it seems highly likely that the proposed project would be effective at improving mainstem Lewis River habitat including pool formation and deposition of alluvial substrates as well as improving connectivity with the disconnected historic surfaces.

We also recommend maximizing the extent and duration of the connectivity initiated with this proposed project by suggesting additional projects to move the Lewis River to Stage 0. If we presume that the historic conditions found within the valley of the Lewis River resembled the illustration in figure x, and that the current conditions resemble the illustration in figure y, then the degree of departure from historic conditions can be established and a larger scale recovery plan developed. Given that the Lewis River is currently at Stage 3 and resembles the conditions depicted in Figure x, the amount of time needed to reach Stage 0 without direct intervention could be decades or centuries.

Figure 13. Rendering of historic depositional valleys within the Pacific Northwest, Hogervorst, 2016.

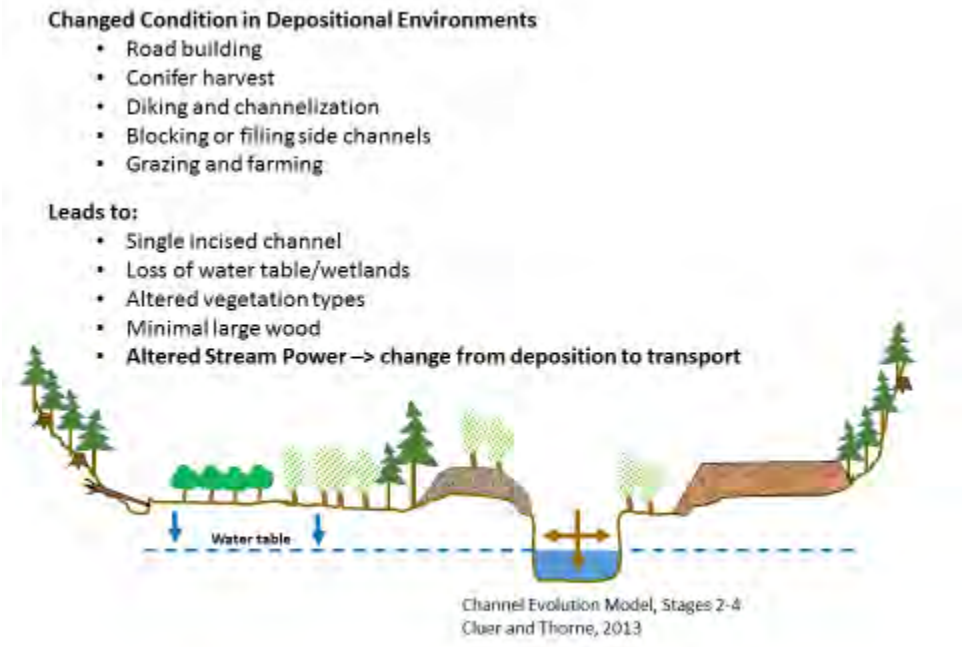

Figure 14. Rendering depicting current conditions within degraded river valleys of the Pacific Northwest. Hogervorst, 2016.

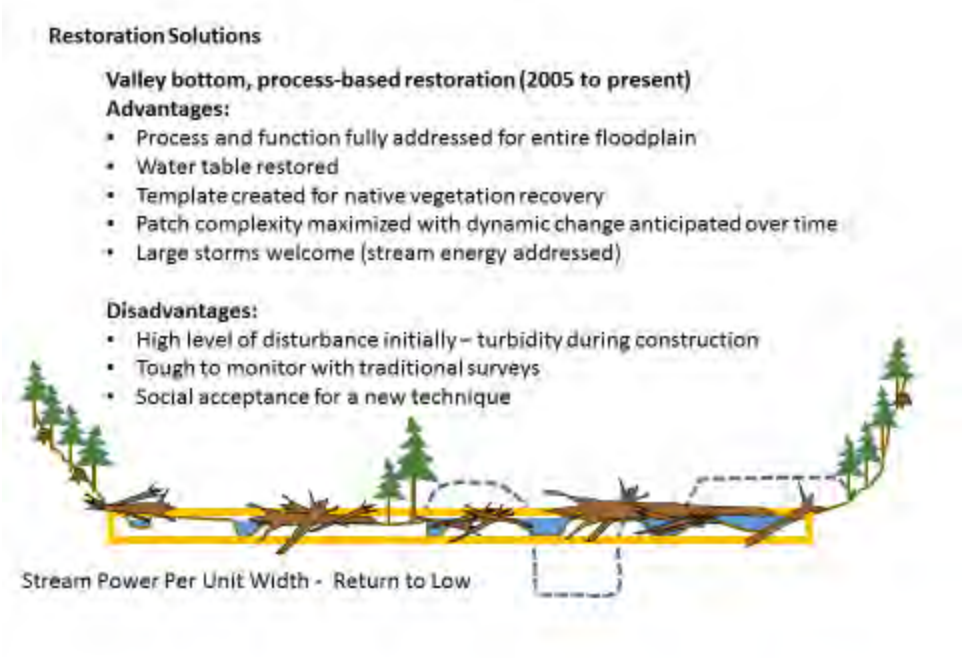

Figure 15. Illustration depicting pre-project surface (blue dashed line) and the constructed new surface which includes multiple flow paths, large wood jams and an elevated alluvial aquifer. Hogervorst, 2016.

Specifically, we recommend aggrading the Lewis River to the PowerSlope elevation. Reconnecting the adjacent valley floor surface by aggrading the bed and removing floodplain and relic channel constrictions significantly reduces unit stream power allowing gravels and silts to deposit on the bed and floodplain. To maintain this elevation, the river should be aggraded at least 2 meander bends upstream or further (extends into Lewis River Reach 22) to allow the river to release its energy on the larger floodplain surfaces. Immediately downstream of the Rush Creek confluence, the Lewis River has cut down to bedrock and this is a good area to develop as a grade tie in location. Reinforcing this grade control with large wood structure is recommended which we understand is planned for in the Lewis River 21 Phase I project scheduled for implementation in the summer of 2018.

If the Stage 0 approach depicted in the Channel Evolution Model developed by Cluer and Thorne (2013) is something the Gifford Pinchot NF would like to pursue further, we would be happy to work with you to better understand the REM and expand the restoration of Lewis River Reach 21 and 22. To better understand the historic condition, it might be helpful to obtain historic aerial images of the project area (although the incision may have happened prior to the earliest photos) (to obtain historic images: https://earthexplorer.usgs.gov/). Also, it may be useful to load the REM pdf map of the Lewis River on your tablet to field verify the relic channels and floodplain constrictions.

We greatly enjoyed our time exploring this project area both in the field and in the office. If the Forest has any questions on our recommendations or has need for additional help during design or implementation, please feel free to contact us.

References:

Cluer B. and C. Thorne. 2013. A stream evolution model integrating habitat and ecosystem benefits. River Research and Applications 30: 135-154.

Sincerely,

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