Kootenai River Habitat Restoration Project Master Plan

Chapter 4 – Habitat Action Implementation Scenarios

Kootenai Tribe of Idaho
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Chapter 4: Table of Contents

4 Habitat Action Implementation Scenarios 4-1

4.1 Overview 4-1

4.2 Approach to Determining Spatial Extents of Habitat Actions 4-2

4.2.1 Limiting Factors Data Used To Support Spatial Extent of Habitat Actions 4-2

4.2.2 Restoration Suitability Analysis in Meander Reach Floodplain 4-7

4.2.3 Other Analyses Used To Support Spatial Extent of Restoration Treatments 4-17

4.3 Implementation Scenarios 4-17

4.3.1 Braided Reach 1 Implementation Scenarios 4-18

4.3.2 Braided Reach 2 Implementation Scenarios 4-20

4.3.3 Straight Reach Implementation Scenarios 4-23

4.3.4 Meander Reaches Implementation Scenarios 4-26

4.4 Implementation Sequencing 4-30

4.4.1 Example of minimum implementation scenario 4-31

4.4.2 Example of moderate implementation scenario 4-31

4.4.3 Example of maximum implementation scenario 4-32

4.5 Summary 4-34

Chapter 4: Figures

Figure 4-1. BEHI ratings in the Braided and Straight Reaches. 4-5

Figure 4-2. Channel depths throughout the project area (30,000 cfs) at bankfull discharge. 4-5

Figure 4-3. Channel velocities throughout the project area (30,000 cfs) at bankfull discharge. 4-6

Figure 4-4. Distribution of riffle and pool habitat throughout the project reaches (30,000 cfs). 4-6

Figure 4-5. Areas with greater than 50% hydric component within a soil map unit. 4-8

Figure 4-6. Floodplain elevation categories related to potential plant hydroperiod regimes. River stage is based on a water-surface elevation of 1754 at Porthill. 4-10

Figure 4-7. Native vegetation cover types (enhancement) and other cover types (restoration). 4-12

Figure 4-8. Public/ conservation lands and private lands in the project reaches. 4-14

Figure 4-9. Floodplain restoration suitability analysis results for areas outside levees. 4-16

Figure 4-10. Conceptual implementation timeline related to minimum, moderate, and maximum implementation scenarios. 4-34

Chapter 4: Tables

Table 4-1. Summary of available limiting factors data for instream habitat by reach. 4-4

Table 4-2. Groupings of land cover types into categories to support floodplain restoration suitability analysis. 4-11

Table 4-3. Floodplain restoration suitability categories and associated attributes. 4-15

Table 4-4. Braided Reach 1 criteria for minimum, moderate and maximum implementation scenarios. 4-19

Table 4-5. Braided Reach 1 restoration treatment quantities by implementation scenario. 4-20

Table 4-6. Braided Reach 2 criteria for minimum, moderate and maximum implementation scenarios. 4-22

Table 4-7. Braided Reach 2 restoration treatment quantities by implementation scenario. 4-23

Table 4-8. Straight Reach criteria for minimum, moderate, and maximum implementation scenarios. 4-25

Table 4-9. Straight Reach restoration treatment quantities by implementation scenario. 4-26

Table 4-10. Meander Reach 1 and 2 criteria for minimum, moderate, and maximum implementation scenarios. 4-28

Table 4-11. Meander Reach 1 restoration treatment quantities by implementation scenario. 4-29
Table 4-12. Meander Reach 2 restoration treatment quantities by implementation scenario. 4-30

4 Habitat Action Implementation Scenarios

Chapter 4 describes a range of conceptual implementation scenarios that quantify varying levels of restoration effort. Implementation scenarios, as defined for this Master Plan, are the spatial application of a habitat action. To develop implementation scenarios, data about limiting factors and other natural resource components were used to create maps that illustrate a range of spatial extents for which a habitat action could be applied to address the limiting factors in that reach using a specific set of criteria.

This chapter presents a synthesis of information from chapters 2 and 3. Chapter 2 describes the Kootenai subbasin and identifies specific limiting factors relative to morphology, riparian vegetation, and aquatic habitat. Chapter 2 also identifies river and floodplain management constraints. Chapter 3 includes descriptions of restoration strategies and treatments that were selected to address the limiting factors, and also includes an analysis of the capacity of each restoration treatment to address specific limiting factors. As described in Chapter 3, restoration treatments are combined to form a habitat action for each project reach. This chapter synthesizes information from chapters 2 and 3 by presenting implementation scenarios, which are spatial applications of habitat actions.

4.1 Overview

Habitat actions are applied to each reach by analyzing the spatial extent of limiting factors and other available spatial data about existing resources. Some limiting factors, such as those related to flow velocity and channel depth, have been mapped using bathymetry and hydraulic models, as described in Section 2.4. This makes it possible to identify areas in the river channel where velocity and depth result in unsuitable habitat based on accepted thresholds such as those identified in the Libby Dam BiOp for Kootenai sturgeon (USFWS 2006, clarified in 2008). Other limiting factors, such as the lack of sufficient areas with hydroperiod suitable to support wetland vegetation, can be inferred based on presence of drainage infrastructure, agricultural land use, and scarcity of hydrophytic vegetation in the floodplain. Spatial data about some of these factors exist as GIS layers and were combined as a restoration suitability analysis to identify areas that have a high potential for restoration.

This chapter includes a discussion about how available data were used to develop criteria to guide where habitat actions would be applied within each reach. For each reach, a minimum, moderate and maximum habitat action implementation scenario is described. This range of scenarios was selected because it makes it possible to provide a conceptual illustration of the degree of changes that may result from restoration and the range of estimated costs that would be associated with different levels of effort.

It is important to understand that the implementation scenarios presented in this chapter do not represent recommended sets of restoration treatments; rather, they are ways to illustrate low, medium and high levels of effort that can be translated into costs to help with program planning, development of a funding strategy, and other related activities. In addition, describing the minimum, moderate, and maximum ranges in terms of which limiting factors each scenario

would address makes it possible to understand ecological trade-offs related to choosing one level of effort over another.

The implementation scenarios described in this chapter provide an illustration of possible approaches to addressing the complex and interrelated factors limiting naturally self-sustaining populations of Kootenai sturgeon and other aquatic focal species. When specific restoration projects are selected and designed in subsequent phases of the Kootenai River Habitat Restoration Project, they will likely include mixes (or portions) of the implementation scenarios described in this Chapter.

4.2 Approach to Determining Spatial Extents of Habitat Actions

Within the Braided Reaches and Straight Reach, the spatial extent of habitat actions was determined by hydraulic and morphological limiting factors such as flow velocity, channel depth and bank erosion. Within these reaches, it is possible to increase both depth and velocity by excavating and dredging the channel and constructing floodplain surfaces.

Within the Meander Reaches, it is less feasible to address channel morphology (and related hydraulic and sediment-transport components) through direct restoration treatments due to the Meander Reaches' much larger scale, combined with the greater influence of constraints including levees, land ownership considerations, and the Kootenay Lake backwater effect. Therefore, in the Meander Reaches, the spatial extent of habitat actions is guided mainly by their ability to address floodplain connection, lack of specific instream habitat, bank instability, lack of nutrient inputs to the river, and lack of riparian vegetation and wetlands. In addition, other natural resource and land ownership data sets were used to determine the spatial extent of floodplain restoration in the Meander Reaches.

4.2.1 Limiting Factors Data Used To Support Spatial Extent of Habitat Actions

Habitat limiting factors are discussed in detail in Chapter 2; these limiting factors were linked to long-term, cumulative changes to the ecosystem that have occurred based on river management, land management and development within the project area. Data are available for a subset of these limiting factors in a spatial format that makes it possible to identify where limiting factors are present within different reaches. Methods and sources for each different type of data are described in Chapter 2. Table 4-1 below summarizes the presence of this subset of limiting factors by reach.

Within the Braided Reaches and Straight Reach, the majority of the channel is characterized by altered morphology, resulting in significant areas of low velocities and shallow depths. As described in Section 2.4, and appendices A, B and E, this altered channel morphology in combination with bank erosion has changed the available sediment supply within these reaches, and reduced the availability of sediment storage areas. Availability of sediment storage areas was considered, but not quantified when evaluating the spatial extent of habitat actions in the Braided Reaches for this Master Plan. Depending on the volume of sediment delivered to the Braided Reaches over time, an equivalent volume of floodplain storage areas can be constructed to offset the gradual decrease in sediment-transport capacity as the river flows downstream.

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Quantification of sediment storage needs and the extent of habitat action implementation required to address this need will be evaluated during later design phases. This information, combined with information from other sections of this Master Plan describing how the upstream reaches affect downstream reaches, was used to help identify the spatial extent of restoration treatments that should be implemented in each reach in order to meet project goals and objectives. In areas selected for channel reconstruction, information about pool spacing and the relationship between pools and riffles was used to support the extent of restoration treatments related to instream habitat such as woody debris and substrate placement.

Streambanks with extreme, high and moderate Bank Erosion Hazard Index (BEHI) ratings are also present in all reaches. This information was used to determine the spatial extent of restoration treatments that address bank erosion. Related to BEHI, streambanks without vegetation or with sparse vegetation are also present in all reaches and this information was used to determine the extent of restoration treatments that address the lack of bank revegetation.

Examples of data related to BEHI, channel depth, flow velocity and instream habitat are shown on the following pages in Figures 4-1, 4-2, 4-3 and 4-4 respectively.

Table 4-1. Summary of available limiting factors data for instream habitat by reach.

Criteria		Braided Reach 1		Braided Reach 2		Straight Reach		Meander Reach 1		Meander Reach 2	
		Units	%	Units	%	Units	%	Units	%	Units	%
Velocity	less than 3.3 ft/s	661	3.2%	6,517	39.0%	4,221	72.6%	51,148	100.0%	N/A	N/A
Depth (at 30,000 cfs)	less than 16 ft	12370	59.9%	8,000	47.9%	0	0.0%	0	0.0%	N/A	N/A
	between 16 ft and 23 ft	5,609	27.2%	7,847	47.0%	2,412	41.5%	97	0.2%	N/A	N/A
	Greater than 23 ft	2,658	12.9%	851	5.1%	3,405	58.5%	51,051	99.8%	N/A	N/A
BEHI	Moderate (ft)	25,522	43.6%	9,976	22.7%	6,465	55.4%	53,420	53.2%	98,317	25.4%
	High (ft)	9,175	15.7%	7,034	16.0%	3,082	26.4%	20,629	20.5%	154,045	39.9%
	Extreme (ft)	7,138	12.2%	12,050	27.4%	398	3.4%	10,456	10.4%	78,071	20.2%
Pool Frequency	Average pool spacing (ft)	4,126	--	8,342	--	5,824	--	7,304	--	14,432	--
Number of Pools	Each	5	--	2	--	1	--	7	--	13	--
Pool Length	Length (ft)	8,897	43.1%	1,678	10.1%	3,307	56.8%	18,636	36.5%	67,209	35.8%
Riffle Length	Length (ft)	11,736	56.9%	15,006	89.9%	2,517	43.2%	32,492	63.5%	120,402	64.2%
Bank Vegetation	None (ft)	9,216	19.4%	18,991	60.1%	3,151	27.1%	25,039	26.4%	204,134	59.7%
	Sparse (ft)	31,602	66.4%	9,204	29.1%	8,189	70.3%	45,755	48.3%	110,465	32.3%

* N/A – data output from modeling is not available for Meander Reach 2.

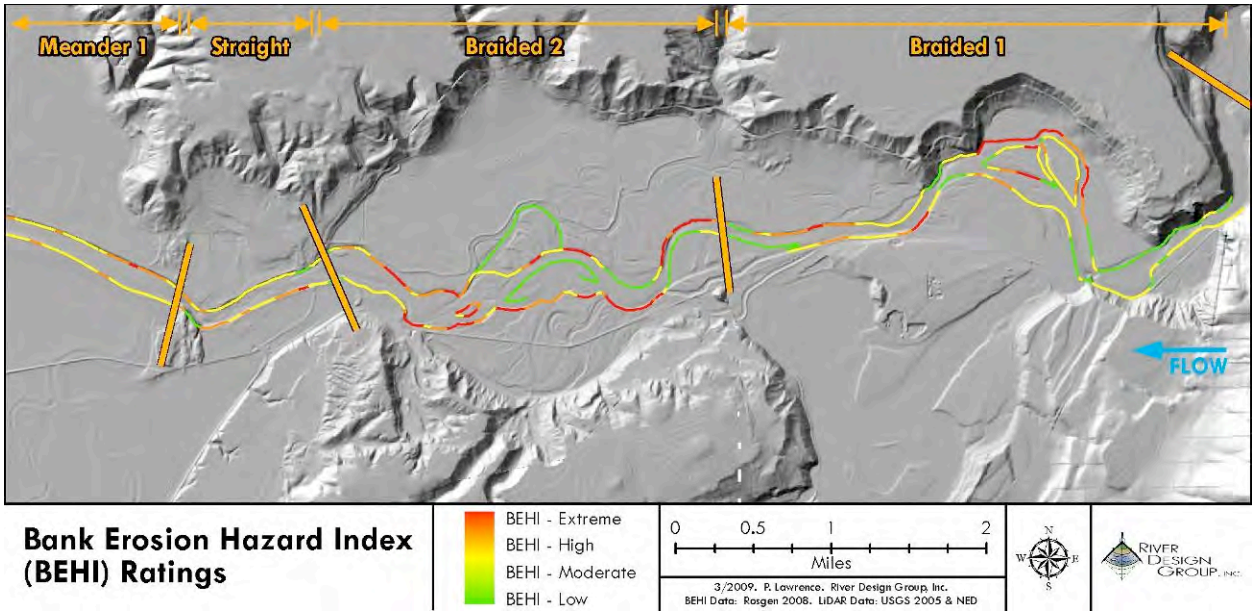

Figure 4-1. BEHI ratings in the Braided and Straight Reaches.

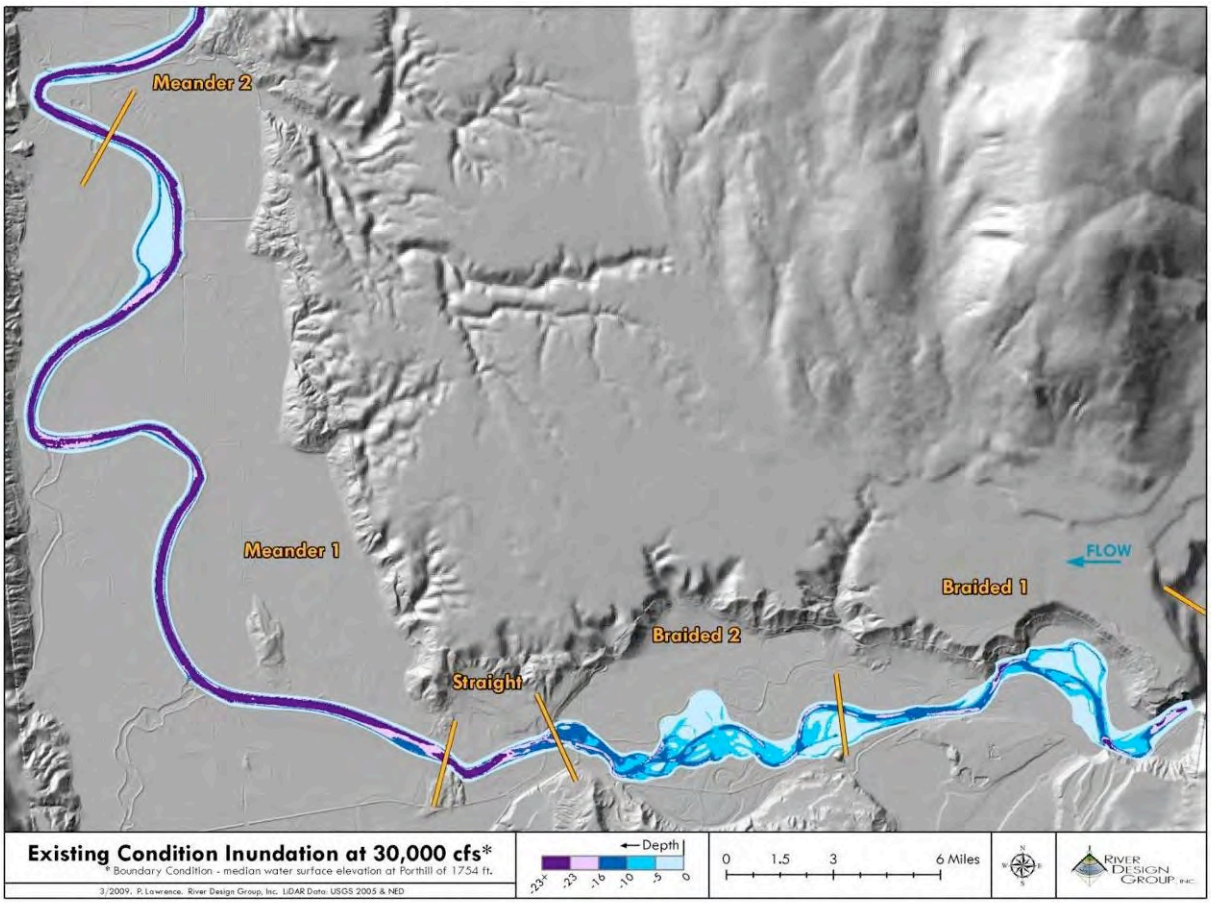

Figure 4-2. Channel depths throughout the project area (30,000 cfs) at bankfull discharge.

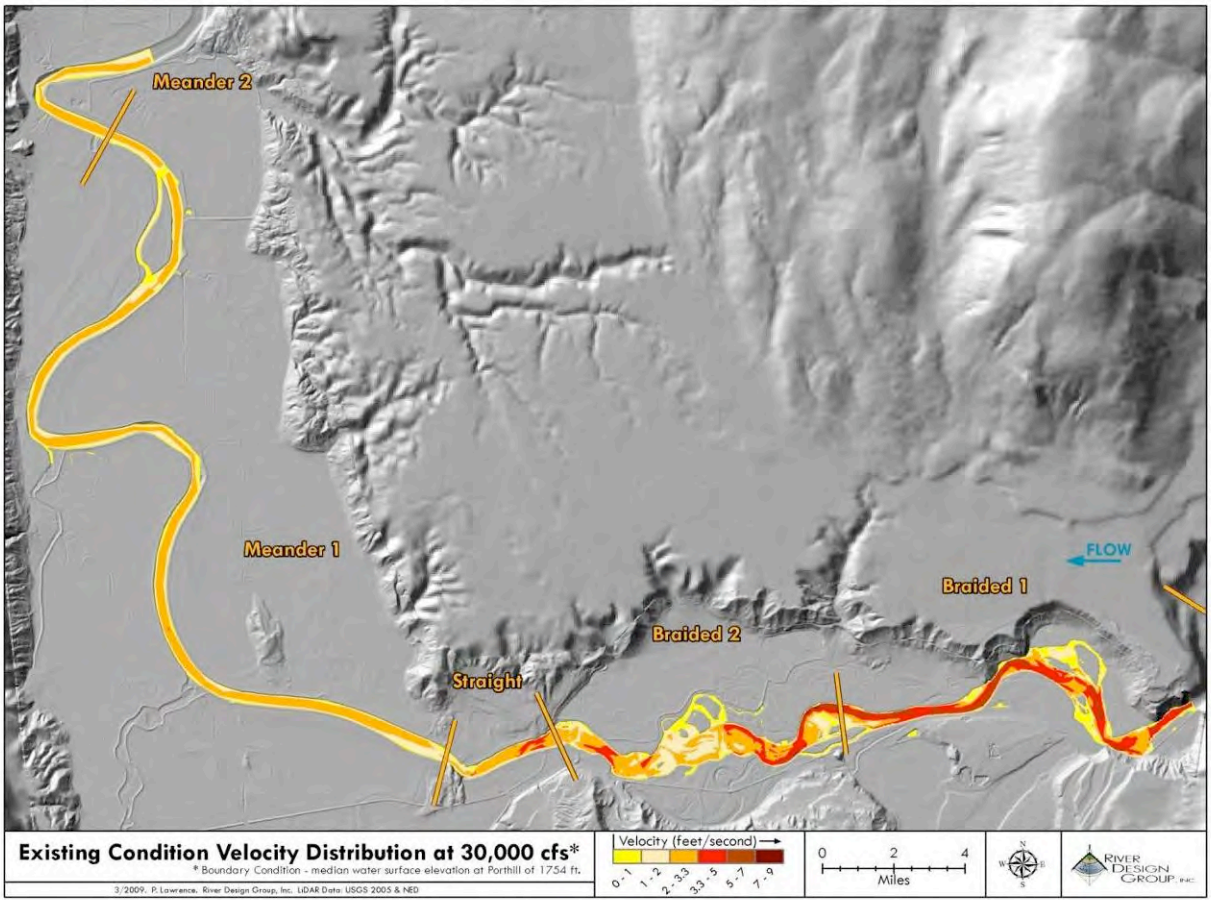

Figure 4-3. Channel velocities throughout the project area (30,000 cfs) at bankfull discharge.

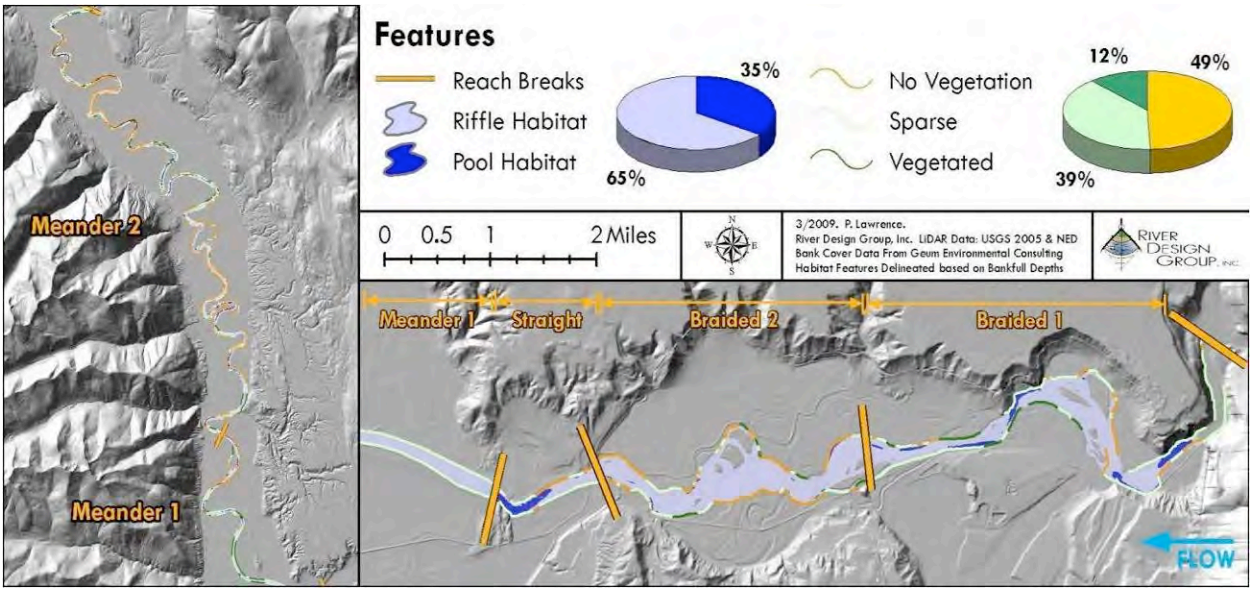

Figure 4-4. Distribution of riffle and pool habitat throughout the project reaches (30,000 cfs).

4.2.2 Restoration Suitability Analysis in Meander Reach Floodplain

In addition to data describing limiting factors, additional data sources were used to identify restoration opportunities in the Meander Reach floodplain. These data sources included:

- Floodplain elevation relative to river stage at 30,000 cfs;
- NRCS mapped hydric soils;
- Land cover classes, including vegetation, agricultural lands, water and substrate; and
- Broad land ownership and conservation status categories.

These data sources were combined into a restoration suitability analysis to identify broad restoration suitability classes within the floodplain in areas outside the levees. For the purpose of this Master Plan, a suitability analysis is defined as a tool for combining geographic information layers based on relevant thresholds to identify areas with combinations of attributes that are meaningful in a floodplain restoration context. To help identify areas where floodplain restoration treatments would be most likely to accomplish project objectives, existing spatial data sets related to soils, elevation, vegetation cover and land ownership or conservation status were compiled and classified based on attributes that indicate relative potential for either riparian and wetland restoration or native vegetation enhancement. A description of these data layers and how they were incorporated into the suitability analysis is provided in the following section.

Hydric Soils

Hydric soils indicate wetland and riparian restoration potential because they are, "saturated or inundated long enough during the growing season to support the growth and reproduction of hydrophytic vegetation (USDA 2007)." The presence of hydric soils typically indicates the historical presence of wetlands, or sufficient hydroperiod to support riparian vegetation.

Hydric soils information was obtained through the USDA's Natural Resources Conservation Service (NRCS) soil data mart (http://soildatamart.nrcs.usda.gov/). This data provides physical and chemical properties for soil survey areas which are rendered in a geographic information layer as unique polygons. These polygons can be sorted or selected by any attribute for which data exists in the NRCS data mart.

For the purposes of this suitability analysis, soils are considered hydric if greater than 50% of the soils within a soil map unit are defined as such. Soil map units defined as non-hydric may include smaller areas of hydric soils (USDA 2006), and thus have potential for restoration, but would require examination on a case by case basis. Hydric soil map units are considered a higher potential for riparian and wetland restoration compared with non-hydric soil map units. Figure 4-5 shows hydric soils in the floodplain.

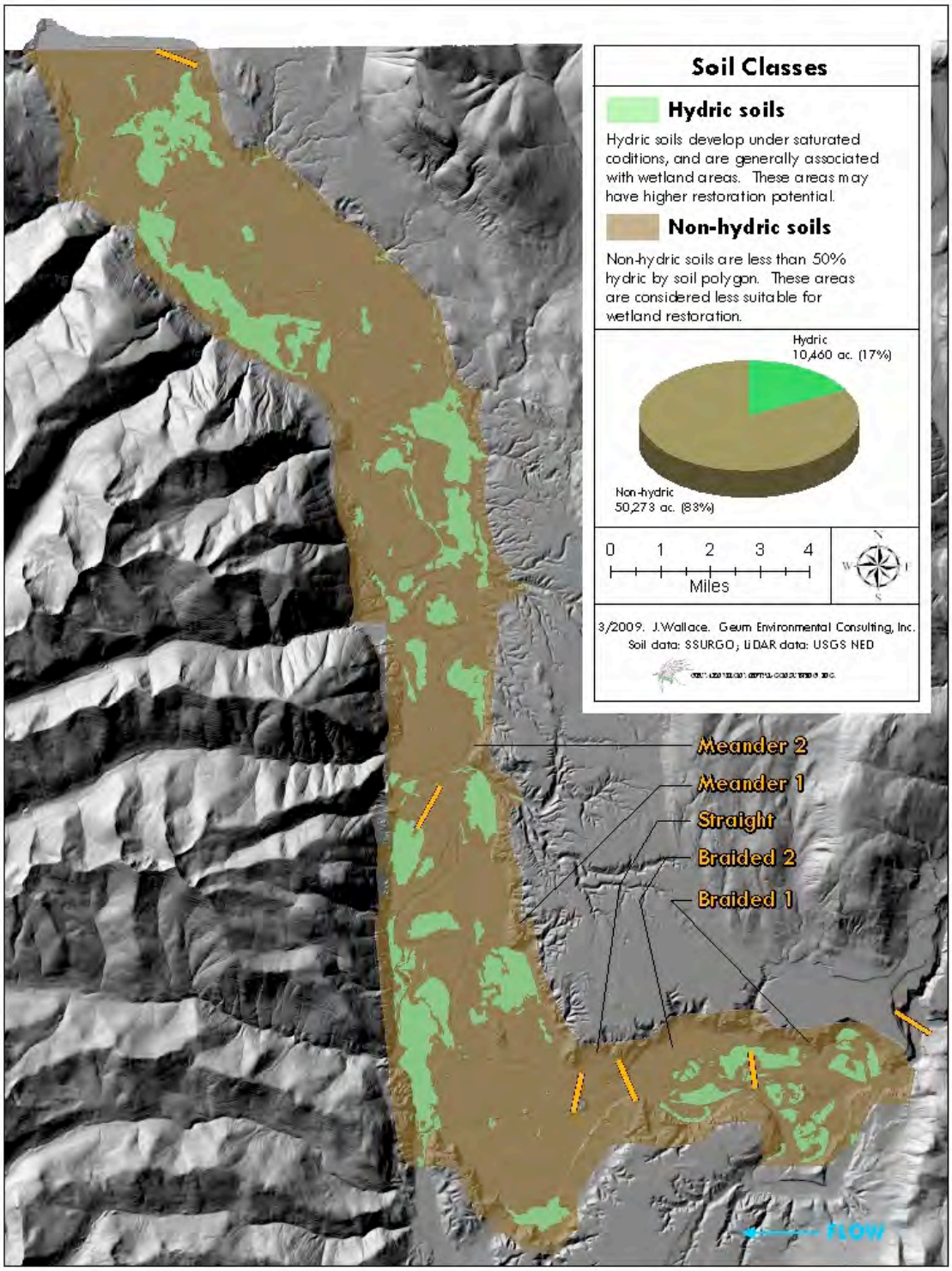

Figure 4-5. Areas with greater than 50% hydric component within a soil map unit.

Relative Elevation

Establishing and maintaining functional floodplain processes requires seasonal surface connection between the river and floodplain. For the Kootenai River, as discussed in previous sections, the average peak flows is estimated to be 30,000 cfs. In order to identify the areas which could potentially be accessed by these flows, elevation layers for both the floodplain surface and the surface of the channel at 30,000 cfs were compared.

A plane representing the elevation of the water-surface at 30,000 cfs stage (approximate river stage at peak flow) was interpolated at 10,000 ft intervals along the channel, using channel slope data, resulting in a total of 28 points from which to base the surface interpolation. Subtracting the existing floodplain elevations from the estimated 30,000 cfs surface produced a new surface, representing the estimated floodplain elevation relative to the 30,000 cfs river stage. These data reflect areas with elevations lower than 30,000 cfs flow as negative values (Figure 4-6).

For purposes of determining floodplain restoration potential, the new surface was separated into three categories linked to coarse estimates of plant community types each category could support: 1) above 30,000 cfs stage (estimated to have potential for upland vegetation); 2) zero to three feet below 30,000 cfs stage (estimated to have potential for riparian woody vegetation such as cottonwoods and willows); and 3) three to six feet below 30,000 cfs stage (estimated to have potential for hydrophytic vegetation and therefore wetlands). Figure 4-6 shows elevation categories related to potential plant hydroperiod regimes.

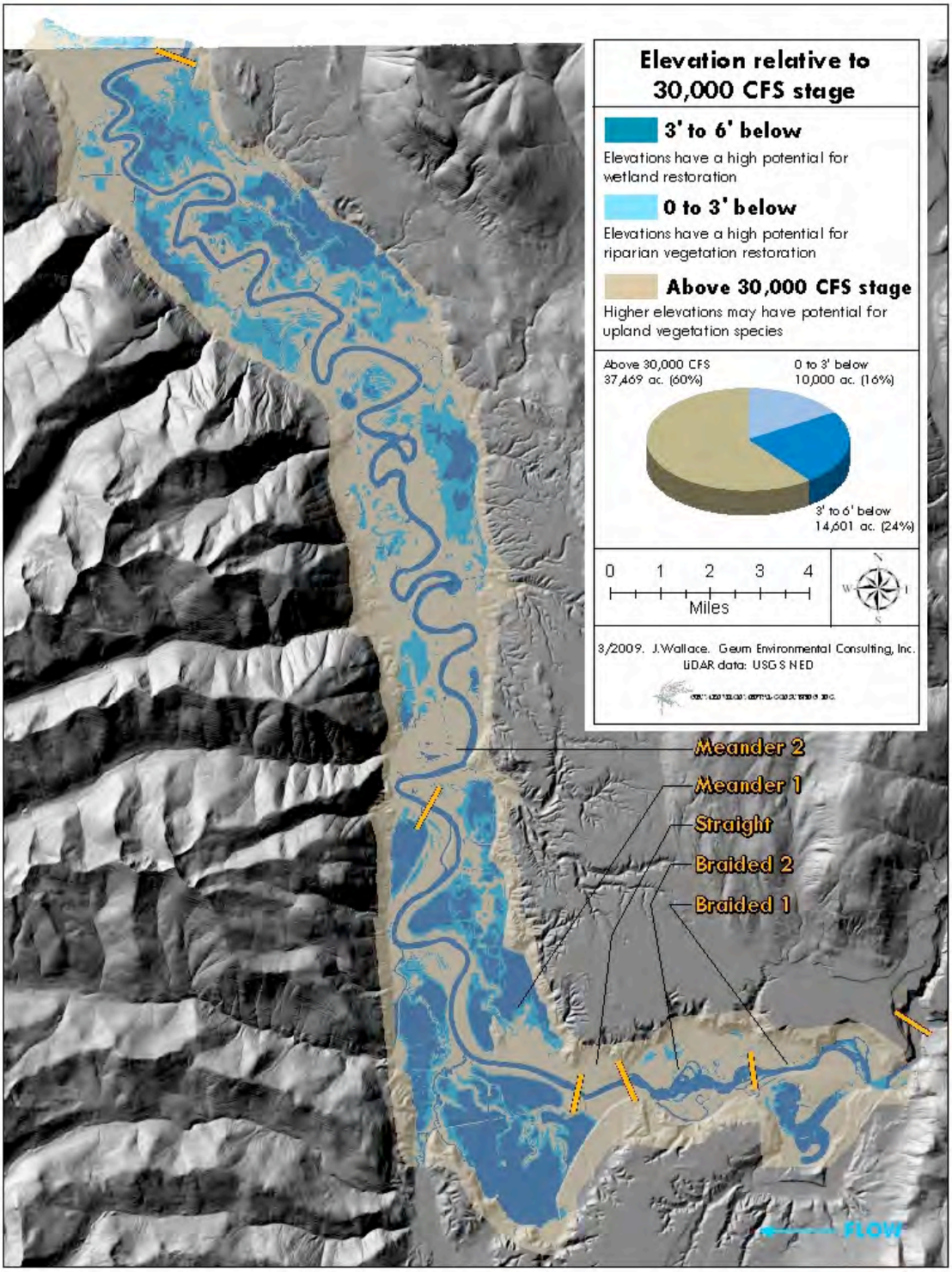

Figure 4-6. Floodplain elevation categories related to potential plant hydroperiod regimes. River stage is based on a water-surface elevation of 1754 at Porthill.

Land Cover

The Kootenai Tribe has developed a land cover classification of the Kootenai River floodplain using a combination of spectral information and aerial photo interpretation. This classification identifies ten vegetation cover types, which were then grouped into three broader categories relating to restoration potential. Standing water and exposed depositional areas were categorized as 'water'. If the cover type included substantial existing native vegetation, it was categorized as having 'enhancement' potential (i.e., a desired plant community is already present). All other cover types were identified as having 'restoration' potential (i.e., the potential to be converted to a desired plant community that would help meet project objectives). Table 4-2 shows how the original land cover types were grouped to support the suitability analysis. Figure 4-7 shows restoration and enhancement classes based on these groupings of cover types.

Table 4-2. Groupings of land cover types into categories to support floodplain restoration suitability analysis.

Enhancement	Restoration	Water
▪ Broadleaf forest ▪ Conifer forest ▪ Riparian vegetation Emergent vegetation	▪ Barren ▪ Foothills grassland ▪ Disturbed grassland ▪ Agricultural	▪ Water ▪ Streamside gravel

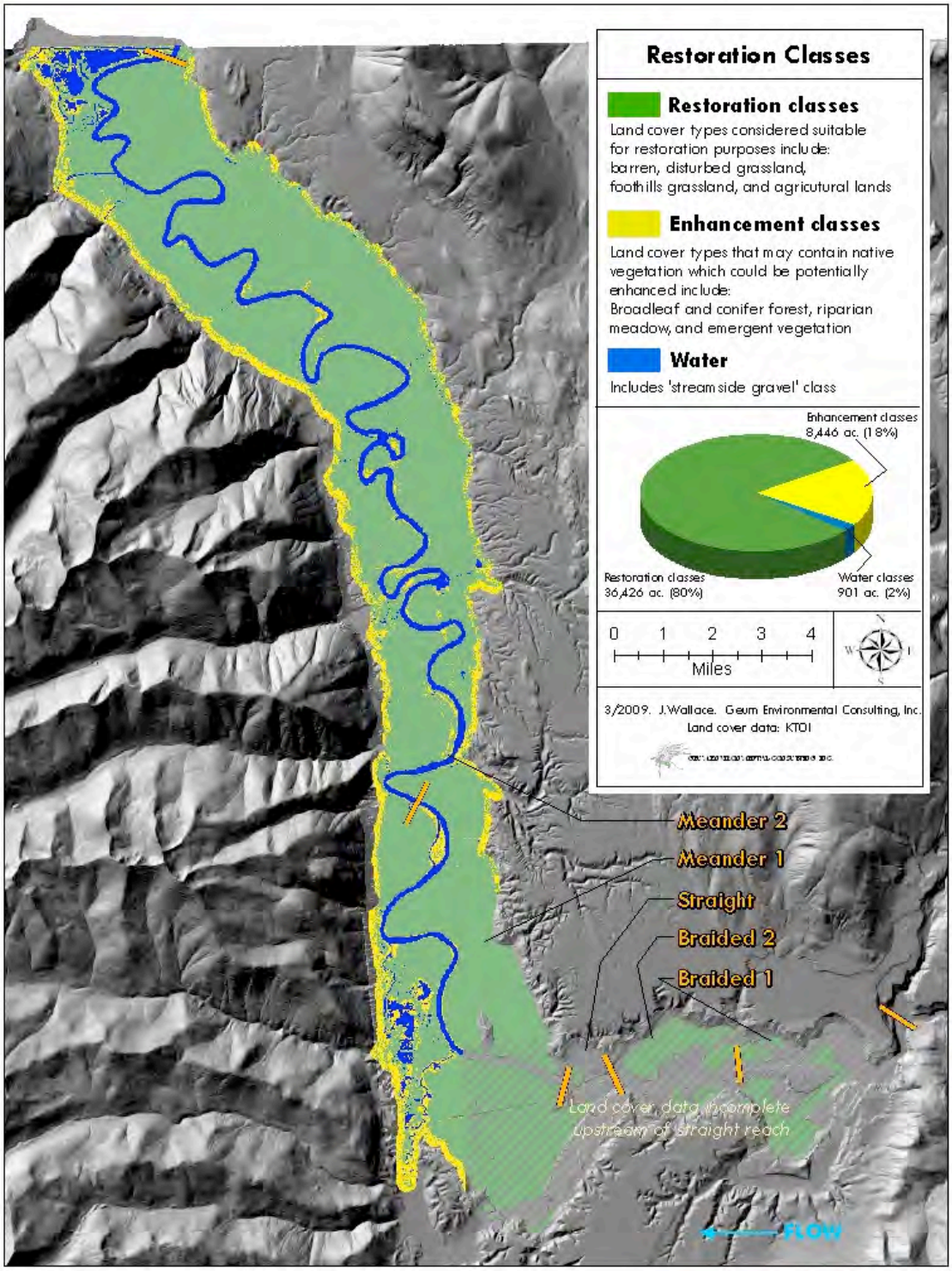

Figure 4-7. Native vegetation cover types (enhancement) and other cover types (restoration).

Ownership

Although land ownership does not have a direct ecological impact on restoration potential, the availability of lands for restoration purposes may depend on whether the land is publicly or privately owned. For this reason, land ownership does not influence the restoration suitability potential of an area in this analysis, but is included as a distinction between restoration suitability classes.

Land parcel data for this project was obtained from Boundary County public records. County, state, or federal government lands, or parcels identified as conservation lands through ownership or trust, are classified together as public/conservation lands. Lands owned by the Kootenai Tribe, or designated as U.S. Indian lands are classified as tribal land. All remaining lands are classified as private. Figure 4-8 shows the distribution of these lands in the project reaches.

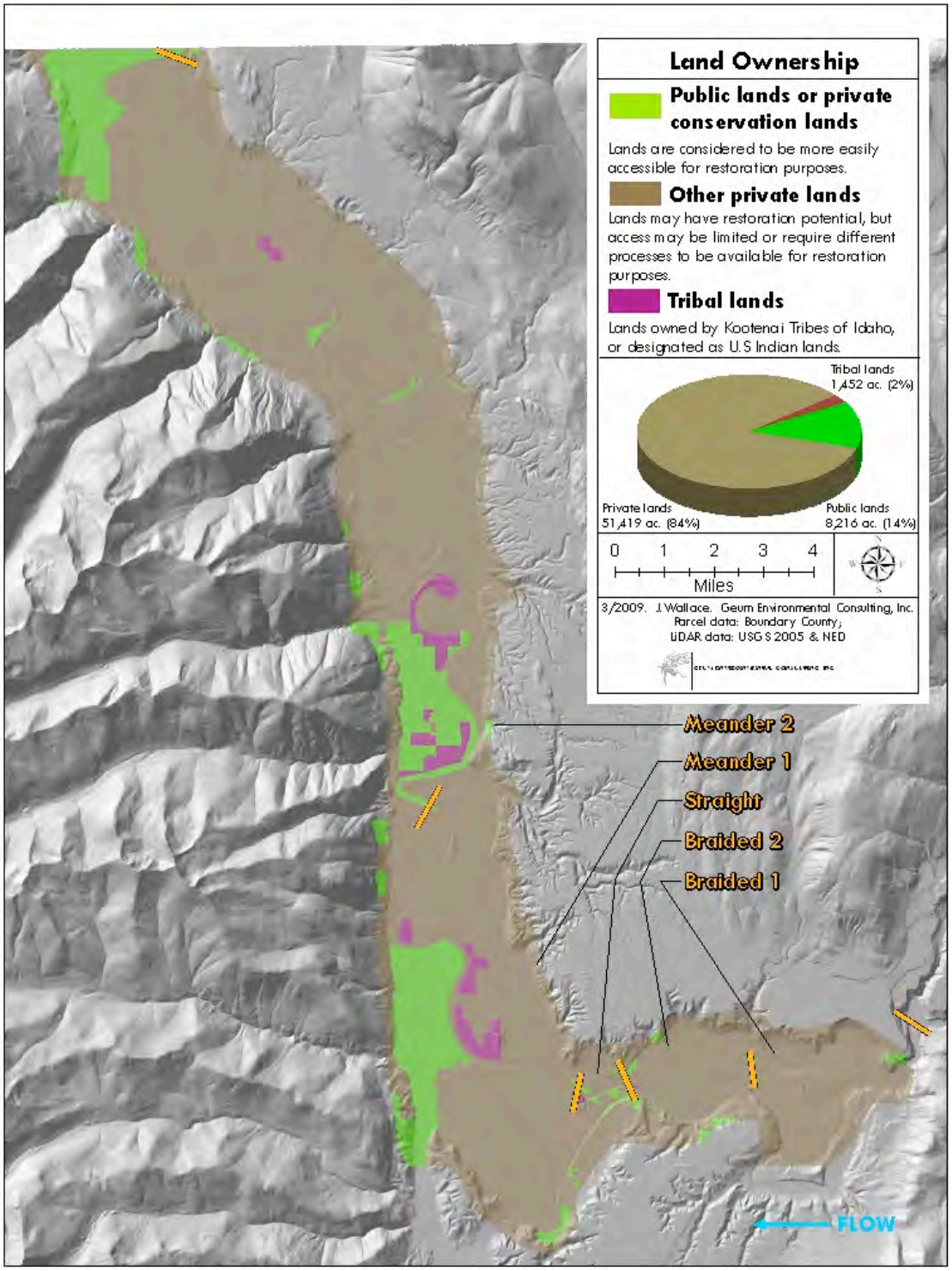

Figure 4-8. Public/ conservation lands and private lands in the project reaches.

Suitability Analysis Results

Suitability classes are differentiated initially by whether the land is publicly owned (or otherwise managed for conservation) versus privately owned. Within these two categories, areas are classified as having either high or moderate restoration potential based on the presence or absence of hydric soils. As described above, the distinction between suitability for wetland and riparian vegetation communities is based on relative elevation data. Areas that have pre-existing native vegetation cover types are classified as 'enhancement' areas because they could potentially be protected or enhanced as part of this project. Enhancement areas are also distinguished as being on either public or private lands. Restoration potential classes are summarized in Table 4-3, and the results of the floodplain restoration suitability analysis are shown in Figure 4-9.

Table 4-3. Floodplain restoration suitability categories and associated attributes.

Restoration Classes	Public or Conservation lands	Private Lands	0 to 3 ft below 30,000 cfs stage	3 to 6 ft below 30,000 cfs stage	Hydric soils	Agricultural or other non-native cover types	Native vegetation cover types
High Riparian Restoration Potential	X		X		X	X	
		X					
High Wetland Restoration Potential	X			X	X	X	
		X					
Moderate Riparian Restoration Potential	X		X			X	
		X					
Moderate Wetland Restoration Potential	X			X		X	
		X					
Enhancement							X

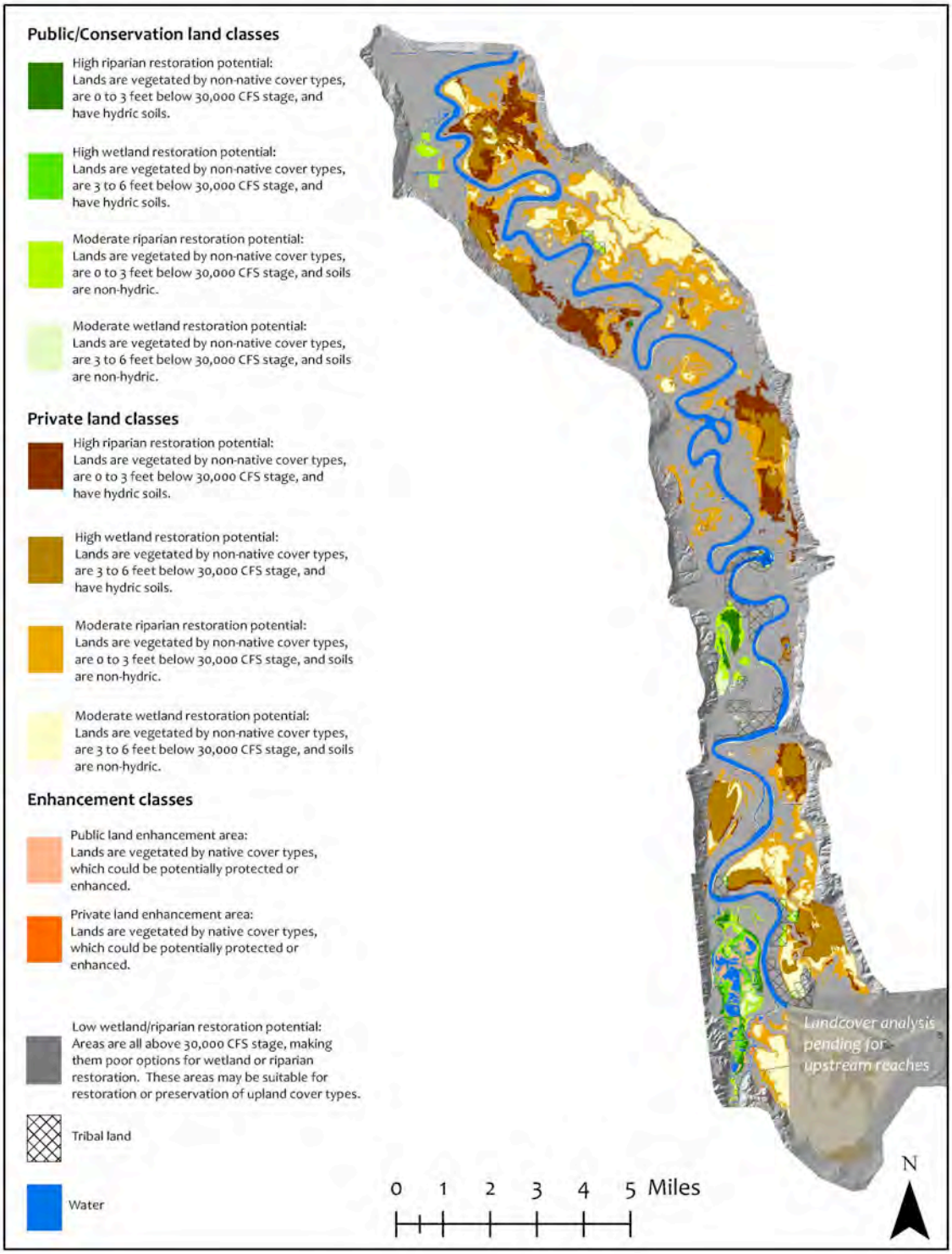

Figure 4-9. Floodplain restoration suitability analysis results for areas outside levees.

4.2.3 Other Analyses Used To Support Spatial Extent of Restoration Treatments

In addition to limiting factors data and other data used to support the floodplain suitability analysis, two additional analyses were completed to develop spatial extents of habitat actions. A conceptual channel was compared to the existing channel to estimate cuts and fills in the Braided Reaches and Straight Reach. Within the levees in the Meander Reaches, areas were identified where floodplain areas could be excavated adjacent to the channel. These analyses are described below.

4.2.3.1 Channel and Floodplain Cuts and Fills in Braided and Straight Reaches

To estimate volumes of material that might be excavated resulting from construction of a conceptual channel, a three-dimensional surface representing a simple, conceptual channel design was compared to the existing land surface and bathymetry using GIS raster analysis tools. Similarly, volumes of fill necessary to construct a floodplain were estimated by estimating the area of existing channel that would need to be filled based on the conceptual channel, and then using GIS to calculate the amount of material needed to fill from existing ground and bathymetry to the elevation associated with river stage at 30,000 cfs (an approximate constructed floodplain surface elevation). Secondary channel lengths were estimated along the conceptual channel quantify the restoration treatment related to secondary channels in the Braided Reach.

4.2.3.2 Floodplain Excavation within Levees

While levees follow the channel very closely in most areas within the Meander Reaches, there are some areas where levees cut between meanders, leaving large areas of land between the river and the levee on the inside of meander bends. Most of these areas are high relative to the peak flow river stage elevation (see Figure 2-2 in Section 2.2), and would require excavation to create surfaces that could support riparian or wetland vegetation. To quantify floodplain excavation adjacent to the river, areas within the levees were digitized in GIS, facilitating area calculations of potentially suitable surfaces. The existing ground elevation of these areas was compared to the elevation at 30,000 cfs river stage to estimate excavation volume for potential floodplain surfaces. To distinguish between moderate and maximum implementation scenarios, a median value of approximately 14,000 cubic yards of excavation per acre was selected. The moderate scenario includes identified floodplain excavation areas where excavation is less than 14,000 cubic yards per acres, while the maximum implementation scenario includes all identified floodplain excavation areas.

4.3 Implementation Scenarios

Based on limiting factors data, results of the floodplain restoration suitability analysis, and other methods described above, criteria were developed for each reach that represent a minimum, moderate and maximum restoration implementation scenario. Criteria are described by reach in this section, and restoration treatments are quantified for each implementation scenario by reach.

4.3.1 Braided Reach 1 Implementation Scenarios

While Braided Reach 1 has areas of flow velocities less than 3.3 ft/sec and shallow depths, these hydraulic components, combined with information about bank vegetation (Table 4-1) show that Braided Reach 1 is in a less impaired condition than Braided Reach 2 and the Straight Reach. For this reason, channel and floodplain reconstruction for the entire reach is only included as part of the maximum implementation scenario. The rationale for this is that the entire length of Braided Reach 1 must be reconstructed to address yet-to-be quantified sediment storage needs that would improve the likelihood of restoration success in downstream reaches. The moderate implementation scenario includes channel and floodplain reconstruction between RM 158 and 159 where extreme BEHI ratings and low velocities and depths are most concentrated. The amount of channel and floodplain reconstruction included as part of the moderate implementation scenario would also accommodate sediment storage needs, but to a lesser degree if future analyses indicate such actions do not contribute to restoration success in downstream reaches. Under these scenarios, quantities of cut and fill for channel and floodplain reconstruction are balanced, because it is probably neither feasible nor desirable to import or export large volumes of material to or from the project area.

Under the maximum implementation scenario, banks with extreme, high and moderate BEHI ratings would be treated; under the moderate scenario, banks with extreme and high BEHI ratings would be treated; and under the minimum scenario, only banks with extreme BEHI ratings would be treated. Quantities for instream structures are based on typical spacing of common structure types, like large wood placement, flow redirective structures, and alluvium (i.e., coarse bed material), that might be included as part of channel designs. For purposes of developing implementation scenarios, large wood would be located at specific sites throughout the project area including meander bends, areas of bank erosion or where new floodplain surfaces are to be stabilized. Placed alluvium would be located at the downstream end of pools. Instream structures and all other treatments would be implemented in conjunction with channel and floodplain reconstruction.

Under all scenarios, Libby Dam flow management and Kootenay Lake level management would be considered as part of subsequent design phases. Most of the length of Braided Reach 1 is not affected by the Kootenay Lake backwater, but flow depths and velocities (and other factors like floodplain connection) are limited at some times of the year by flow regulation at Libby Dam. For the purpose of developing these implementation scenarios, average peak flows were assumed to be 30,000 cfs. However, during the design process, different design flows will be evaluated in terms of additional benefits to habitat and in terms of feasibility related to existing Libby Dam operation, public safety and other factors. Restoration work associated with bank structures and channel and floodplain construction would require coordinating with landowners and infrastructure owners (e.g., railroad). Criteria for where this type of coordination would need to occur are linked to criteria for where those respective treatments would be implemented in the reach. Criteria are displayed in Table 4-4, which includes all restoration treatments that are part of the Braided Reach 1 habitat action.

Table 4-4. Braided Reach 1 criteria for minimum, moderate and maximum implementation scenarios.

Treatment	Restoration Treatment Explanation	Minimum Scenario	Moderate Scenario	Maximum Scenario
BR-A	Excavate and/or dredge the river to modify the channel geometry	None	Areas where velocity is less than 3.3 ft/s or depth is less than 16.5 ft/s (between RM 158 and 159)	Areas where velocity is less than 3.3 ft/s or depth is less than 23 feet
BR-B	Construct floodplain surfaces	No sediment storage needed	Portion of reach needed for sediment storage (between RM 158 and 159)	Entire reach needed for sediment storage
BR-C	Construct and/or enhance wetlands	None	Areas of floodplain construction	Areas of floodplain construction
BR-D	Construct and/or enhance secondary channels	None	Areas of floodplain reconstruction	Areas of floodplain reconstruction
BR-E	Revegetate the floodplain	None	Areas of floodplain reconstruction	Areas of floodplain reconstruction
BR-F	Install bank structures (bank structures, bioengineering)	BEHI = Extreme	Areas of channel reconstruction and BEHI = Extreme and High	Areas of channel reconstruction and BEHI=Extreme, High and Moderate
BR-G	Install instream structures (habitat, river training, grade control)	None	Areas of channel reconstruction (between RM 158 and 159)	Areas of channel reconstruction
KR-A	Manage the discharge from Libby Dam	To be determined	To be determined	To be determined
KR-B	Manage the backwater from Kootenay Lake	No backwater effect in this reach	No backwater effect in this reach	No backwater effect in this reach
KR-C	Manage land use practices	Coordinate with landowners where bank structures (BR-F) apply	Coordinate with landowners where bank structures (BR-F) apply and for river and floodplain work between RM 158 and 159	Coordinate with landowners where bank structures (BR-F) apply And with all landowners for river and floodplain work
KR-D	Manage for impacts from or to infrastructure	Coordinate with infrastructure owners where bank structures (BR-F) apply	Coordinate with infrastructure owners where bank structures (BR-F) apply and for river and floodplain work between RM 158 and 159	Coordinate with infrastructure owners where bank structures (BR-F) apply and for river and floodplain work in entire reach

Based on implementation scenario criteria for Braided Reach 1, Table 4-5 shows quantities of each restoration treatment that would result from minimum, moderate and maximum scenarios.

Table 4-5. Braided Reach 1 restoration treatment quantities by implementation scenario.					
Treatment	**Restoration Treatment Explanation**	**Unit**	**Min**	**Mod**	**Max**
BR-A	Excavate and/or dredge the river to modify the channel geometry	Ft	0	5,280	20,630
		Cu yds (cut)	0	527,063	1,723,682
BR-B	Construct floodplain surfaces	Acres	0	71	115
		Cu yds (fill)	0	527,063	1,723,682
BR-C	Construct and/or enhance wetlands	Acres	0	36	55
BR-D	Construct and/or enhance secondary channels	Ft	0	10,072	13,135
BR-E	Revegetate the floodplain	Acres	0	71	115
BR-F	Install bank structures (bank structures, bioengineering)	Ft	7,138	16,313	41,835
BR-G	Install instream structures (habitat, river training, grade control)	Units	0	10	35
KR-A to KR-D	Project-scale management treatments	These treatments will be applied as needed and quantified if necessary in later design phases.			

4.3.2 Braided Reach 2 Implementation Scenarios

Braided Reach 2 has been identified (see Section 2.4) as the most significant sediment source in the project area, accounting for approximately 43% of banks that have either extreme or high BEHI ratings. In addition, 90% of Braided Reach 2 has depths less than 16 feet and velocities less than 3.3 feet per second. Pools represent less than 10% of instream habitat within Braided Reach 2. Based on limiting factors mapping, unsuitable instream habitat is distributed throughout the reach. Moreover, based on preliminary sediment-transport analyses (Appendix B), it is likely that the entire floodplain area of Braided Reach 2 would be needed to store sediment delivered to the reach. For these reasons, channel and floodplain reconstruction for the entire reach is included as part of all three implementation scenarios. The analyses completed in support of this Master Plan suggest that for ecosystem restoration to be successful under any scenario, it is necessary to restore the entire length of Braided Reach 2. Under all scenarios, quantities of cut and fill for channel and floodplain reconstruction are balanced, because it is probably neither feasible nor desirable to import or export large volumes of material to or from the project area.

As with Braided Reach 1 and all other reaches, under the maximum implementation scenario, banks with extreme, high and moderate BEHI ratings would be treated; under the moderate scenario, banks with extreme and high BEHI ratings would be treated; and under the minimum scenario, only banks with extreme BEHI ratings would be treated. Quantities for instream structures are based on typical spacing of common structure types, like large wood placement, flow redirective structures, and alluvium, that might be included as part of channel designs. For

purposes of developing conceptual implementation scenarios, the spacing of large wood and flow redirective structures is assumed to be one bankfull width between structures on outer meander bends, while placed alluvium would be located at the downstream end of pools. Instream structures and all other treatments would be implemented in conjunction with channel and floodplain reconstruction.

Under all scenarios, Libby Dam flow management and Kootenay Lake level management would be considered as part of subsequent design phases. The entire length of Braided Reach 2 is affected by the Kootenay Lake backwater during some part of each year, and flow depths and velocities (and other factors like floodplain connection) are limited at some times of the year by flow regulation at Libby Dam. As in Braided Reach 1, for the purpose of developing these implementation scenarios, average peak flows were assumed to be 30,000 cfs at a backwater elevation of 1754 feet at Porthill. However, during the design process, different design flows and backwater elevations will be evaluated in terms of additional benefits to habitat and in terms of feasibility related to existing Libby Dam operation, public safety and other factors. Restoration work associated with bank structures and channel and floodplain construction would require coordinating with landowners and infrastructure owners (railroad, highway, levees, pumping station). This type of coordination would need to occur throughout Braided Reach 2 because all three implementation scenarios include channel and floodplain reconstruction throughout the entire reach. Criteria are displayed in Table 4-6, which includes all restoration treatments that are part of the Braided Reach 2 habitat action.

Table 4-6. Braided Reach 2 criteria for minimum, moderate and maximum implementation scenarios.

Treatment	Restoration Treatment Explanation	Minimum Scenario	Moderate Scenario	Maximum Scenario
BR-A	Excavate and/or dredge the river to modify the channel geometry	Percentage of pool habitat less than 40%	Areas where velocity is less than 3.3 ft/s or depth is less than 16.5 ft/s	Areas where velocity is less than 3.3 ft/s or depth is less than 23 feet
BR-B	Construct floodplain surfaces	Entire reach needed for sediment storage	Entire reach needed for sediment storage	Entire reach needed for sediment storage
BR-C	Construct and/or enhance wetlands	Areas of floodplain construction	Areas of floodplain construction	Areas of floodplain construction
BR-D	Construct and/or enhance secondary channels	Areas of floodplain reconstruction	Areas of floodplain reconstruction	Areas of floodplain reconstruction
BR-E	Revegetate the floodplain	Areas of floodplain reconstruction	Areas of floodplain reconstruction	Areas of floodplain reconstruction
BR-F	Install bank structures (bank protection, bioengineering)	Areas of channel reconstruction	Areas of channel reconstruction	Areas of channel reconstruction
BR-G	Install instream structures (habitat, river training, grade control)	Areas of channel reconstruction	Areas of channel reconstruction (between RM 158 and 159)	Areas of channel reconstruction
KR-A	Manage the discharge from Libby Dam	To be determined	To be determined	To be determined
KR-B	Manage the backwater from Kootenay Lake	To be determined	To be determined	To be determined
KR-C	Manage land use practices	Coordinate with landowners where bank structures (BR-F) apply and with all landowners for river and floodplain work	Coordinate with landowners where bank structures (BR-F) apply and with all landowners for river and floodplain work	Coordinate with landowners where bank structures (BR-F) apply and with all landowners for river and floodplain work
KR-D	Manage for impacts from or to infrastructure	Coordinate with infrastructure owners where bank structures (BR-F) apply and with all infrastructure owners for river and floodplain work	Coordinate with infrastructure owners where bank structures (BR-F) apply and with all infrastructure owners for river and floodplain work	Coordinate with infrastructure owners where bank structures (BR-F) apply and with all infrastructure owners for river and floodplain work

Based on implementation scenario criteria for Braided Reach 2, Table 4-7 shows quantities of each restoration treatment that would result from minimum, moderate and maximum scenarios.

Table 4-7. Braided Reach 2 restoration treatment quantities by implementation scenario.

Treatment	Restoration Treatment Explanation	Unit	Min	Mod	Max
BR-A	Excavate and/or dredge the river to modify the channel geometry	Ft	16,669	16,669	16,669
		cu yds (cut)	1,527,334	1,527,334	1,527,334
BR-B	Construct floodplain surfaces	Acres	253	253	253
		cu yds (fill)	1,527,334	1,527,334	1,527,334
BR-C	Construct and/or enhance wetlands	Acres	133	133	133
BR-D	Construct and/or enhance secondary channels	Ft	13,688	13,688	13,688
BR-E	Revegetate the floodplain	Acres	253	253	253
BR-F	Install bank structures (bank protection, bioengineering)	Ft	12,050	19,083	29,059
BR-G	Install instream structures (habitat, river training, grade control)	Units	47	47	47
KR-A to KR-D	Project-scale management treatments	These treatments will be applied as needed and quantified if necessary in later design phases.			

4.3.3 Straight Reach Implementation Scenarios

The Straight Reach has been identified (see Section 2.4) as the reach where sediment generated from the upper Kootenai subbasin, and from within the project area, is transported through to the Meander Reaches and known Kootenai sturgeon spawning locations.

Channel reconstruction or installation of structures in the Straight Reach, combined with creating backwater areas where sediment can be deposited, would allow some of the sediment load to be intercepted before reaching the Meander Reaches.

Significant portions of the Straight Reach have depths and velocities that do not meet habitat suitability criteria for Kootenai sturgeon as identified in the Libby Dam BiOp. For this reason, channel and floodplain reconstruction for the entire length of the Straight Reach is included as part of the maximum implementation scenario because this would result in depths of 23 feet identified in the clarified Libby Dam BiOp (2008) throughout the reach.

For the moderate scenario, the large pool near Ambush Rock at the lower end of the reach would not be reconstructed, resulting in approximately half of the reach being excavated and dredged. For the minimum scenario, the channel would not be dredged or excavated, but structures would be used to concentrate flows toward the center of the channel, result in some natural deepening of the channel. These structures would also be included as part of the maximum and moderate scenarios because they would help maintain the constructed channels.

As with all other reaches, under the maximum implementation scenario, banks with extreme, high and moderate BEHI ratings would be treated; under the moderate scenario, banks with extreme and high BEHI ratings would be treated; and under the minimum scenario, only banks with extreme BEHI ratings would be treated.

As described above, instream habitat structures in the Straight Reach would focus on directing the thalweg to concentrate flows, increase velocity, increase complexity, and promote channel scour for enhancing habitat in smaller pools. Large wood placement, placed alluvium, and flow redirective structures would promote sediment sorting and fine sediment would deposit in lower velocity channel margins. Large wood would be off-set from each other on both sides of the channel through the Straight Reach. All other treatments would be implemented in conjunction with channel and floodplain reconstruction.

Under all scenarios, Libby Dam flow management and Kootenay Lake level management would be considered as part of subsequent design phases. The entire length of the Straight Reach is affected by the Kootenay Lake backwater during some part of each year, and flow depths and velocities (and other factors like floodplain connection) are limited at some times of the year by flow regulation at Libby Dam. As in the Braided Reaches, for the purpose of developing these implementation scenarios and related conceptual channel dimensions, average peak flows were assumed to be 30,000 cfs at a backwater elevation of 1754 feet at Porthill. However, during the design process, different design flows and backwater elevations will be evaluated in terms of potential additional benefits to habitat and in terms of feasibility related to existing Libby Dam operation, public safety and other factors.

Restoration work associated with bank structures and channel and floodplain construction would require coordinating with landowners and infrastructure owners (city of Bonners Ferry, highway, levees). This type of coordination would need to occur throughout the Straight Reach because all three implementation scenarios include channel and floodplain reconstruction throughout the entire reach. Criteria are displayed in Table 4-8, which includes all restoration treatments that are part of the Straight Reach habitat action.

Table 4-8. Straight Reach criteria for minimum, moderate, and maximum implementation scenarios.

Treatment	Restoration Treatment Explanation	Minimum Scenario	Moderate Scenario	Maximum Scenario
SR-A	Excavate and/or dredge the river to modify the channel geometry	Percentage of pool habitat less than 40%	Areas where velocity is less than 3.3 ft/s or depth is less than 16.5 ft/s	Areas where velocity is less than 3.3 ft/s or depth is less than 23 feet
SR-B	Revegetate the riparian corridor and establish a riparian buffer	Bank vegetation = None	Bank Vegetation = None or Sparse	Bank Vegetation = None or Sparse
SR-C	Install bank structures (bank protection, bioengineering)	BEHI = Extreme	BEHI = Extreme and High and areas of channel reconstruction	Areas of channel reconstruction
SR-D	Install instream structures (habitat, river training, grade control)	Areas of channel reconstruction and unsuitable substrate	Areas of channel reconstruction and unsuitable substrate	Areas of channel reconstruction and unsuitable substrate
KR-A	Manage the discharge from Libby Dam	To be determined	To be determined	To be determined
KR-B	Manage the backwater from Kootenay Lake	To be determined	To be determined	To be determined
KR-C	Manage land use practices	Coordinate with landowners where bank structures (BR-F) apply and with all landowners for river and floodplain work	Coordinate with landowners where bank structures (BR-F) apply and with all landowners for river and floodplain work	Coordinate with landowners where bank structures (BR-F) apply and with all landowners for river and floodplain work
KR-D	Manage for impacts from or to infrastructure	Coordinate with infrastructure owners where bank structures (BR-F) apply and with all infrastructure owners for river and floodplain work	Coordinate with infrastructure owners where bank structures (BR-F) apply and with all infrastructure owners for river and floodplain work	Coordinate with infrastructure owners where bank structures (BR-F) apply and with all infrastructure owners for river and floodplain work

Based on implementation scenario criteria for the Straight Reach, Table 4-9 shows quantities of each restoration treatment that would result from minimum, moderate and maximum scenarios.

Table 4-9. Straight Reach restoration treatment quantities by implementation scenario.					
Treatment	**Restoration Treatment Explanation**	**Unit**	**Min**	**Mod**	**Max**
SR-A	Excavate and/or dredge the river to modify the channel geometry	Ft	5,821	5,821	5,821
		Cu yds (cut)	0	218,356	436,713
SR-B	Revegetate the riparian corridor and establish a riparian buffer	Ft	0	3,151	11,340
SR-C	Install bank structures (bank protection, bioengineering)	Ft	398	3,480	9,944
SR-D	Install instream structures (habitat, river training, grade control)	Units	10	10	10
KR-A to KR-D	Project-scale management treatments	These treatments will be applied as needed and quantified if necessary in later design phases.			

4.3.4 Meander Reaches Implementation Scenarios

Criteria for Meander Reach 1 and Meander Reach 2 are the same, so this discussion addresses both reaches. Channel morphology within the Meander Reaches has been impacted by river and floodplain management as described in Section 2, but due to constraints related to levees, flood control, land ownership, scale and the Kootenay Lake backwater effects, it appears at this conceptual stage of design that channel reconstruction may not be feasible in these reaches. Therefore, none of the implementation scenarios include channel reconstruction. However, during the subsequent design phases it may become evident that some channel work is necessary and feasible in some portions of the Meander Reaches.

While channel work in the Meander Reaches is not included as part of these implementation scenarios, some areas of floodplain excavation are included between the channel and existing levees. No floodplain excavation is included as part of the minimum implementation scenario. When identifying floodplain areas that could be excavated to the 30,000 cfs river stage elevation, volumes of excavation and acres were calculated for each identified area as described above in Section 4.2.2.3. One logical way to compare these areas was to evaluate the volume of material required to create one acre of excavated floodplain surface. Based on this evaluation, 14,000 cubic yards per acre was identified as the approximate median value. To differentiate between the moderate and maximum implementation scenarios for floodplain excavation, all areas where excavation would be less than 14,000 cubic yards per acre were included as part of the moderate implementation scenario. The maximum scenario included all identified floodplain excavation areas.

These same floodplain excavation areas were used as areas for determining floodplain revegetation potential adjacent to the river, and were combined with data about bank vegetation. For the moderate implementation scenario, lengths of bank with no vegetation would be vegetated, and for the maximum implementation scenario, lengths of bank with no vegetation and sparse vegetation would be vegetated. As with all other reaches, under the

maximum implementation scenario, banks with extreme, high and moderate BEHI ratings would be treated; under the moderate scenario, banks with extreme and high BEHI ratings would be treated; and under the minimum scenario, only banks with extreme BEHI ratings would be treated.

Outside of the levees, riparian and wetland restoration is linked to the restoration suitability analysis described above in Section 4.2.2.1. Under the minimum scenario, no areas outside the levees would be restored; under the moderate scenario, high restoration suitability areas would be restored; and under the maximum scenario, high and moderate suitability areas would be restored. Secondary channels would be constructed or enhanced to connect suitable restoration areas to the main channel. Under the minimum scenario, no secondary channels would be constructed; under the moderate scenario, secondary channels would connect high restoration suitability areas to the river; and under the maximum scenario, secondary channels would connect high and moderate restoration suitability areas to the channel.

Proposed instream structures in the Meander Reaches include placement of large wood and alluvium (i.e., coarse bed material). Quantities for instream structures are based on typical spacing of common structure types that might be included as part of channel designs. For purposes of developing these implementation scenarios, the spacing for large wood is assumed to be one bankfull width between structures on outer meander bends. Large wood is proposed for tributary confluences in the Meander Reaches. Because most tributaries join the Kootenai River at a meander bend, additional large wood would be placed where tributaries join the main river along a straight section of the Meander Reaches. Coarse bed material treatments are proposed for the Shorty's Island portion of the reach as Kootenai sturgeon are known to spawn in this area. Potential treatment locations include the mile of river downstream from Ambush Rock and the two river miles through Shorty's Island. Instream structures and all other treatments would be implemented in conjunction with floodplain reconstruction actions or independently depending on floodplain treatment locations.

Under the minimum scenario, no instream structures would be placed in the Meander Reaches. Under the moderate scenario, instream structures such as alluvium capable of providing interstitial spaces < 3mm wide to accommodate protected sturgeon embryo incubation would be placed at documented spawning sites in Meander Reach 1. No wood would be placed in the Meander Reaches under the moderate scenario. Under the maximum scenario, alluvium would be placed at documented spawning sites in Meander Reach 1, and large wood would be placed at tributary confluences and at outside meander bends in Meander Reach 1 and Meander Reach 2.

Under all scenarios, Libby Dam flow management and Kootenay Lake level management would be considered as part of subsequent design phases. Kootenay Lake backwater affects the entire length of the Meander Reaches during most of each year. Combined with the levee system which confines rising water, the Kootenay Lake backwater effect results in several feet of water level fluctuation throughout the year. This results in early life stages of some riparian plant species such as cottonwood seedlings being submerged during the growing season at inappropriate times relative to their ecological adaptations. Flow depths and velocities are affected at some times of the year in the Meander Reaches by flow regulation at Libby Dam. Restoration work associated with bank structures, floodplain construction, riparian and wetland restoration and tributaries would require coordinating with landowners and infrastructure owners. Criteria for where this type of coordination would need to occur are tied to criteria for particular restoration treatments.

These criteria are displayed in Table 4-10, which includes all restoration treatments that are part of the Meander Reaches habitat action.

Table 4-10. Meander Reach 1 and 2 criteria for minimum, moderate, and maximum implementation scenarios.

Treatment	Restoration Treatment Explanation	Minimum Scenario	Moderate Scenario	Maximum Scenario
MR-A	Excavate and/or dredge the river to modify the channel geometry	None	Pending design	Pending design
MR-B	Excavate floodplain adjacent to the river	None	Surfaces inside levees where excavation < 14,000 cu yds/ acre	All identified surfaces inside levees
MR-C	Construct and/or enhance riparian areas and wetlands adjacent to the river	None	Surfaces inside levees where excavation < 14,000 cu yds/ acre	All identified surfaces inside levees
MR-D	Construct and/or enhance riparian areas and wetlands behind levees and connect to the river	None	Floodplain restoration suitability = High	Floodplain restoration suitability = High and Moderate
MR-E	Construct or enhance secondary channels adjacent to the river	None	Surfaces inside levees where excavation < 14,000 cu yds/ acre	All identified surfaces inside levees
MR-F	Construct or enhance secondary channels behind levees and connect to the river	None	Connect high restoration suitability areas to main channel	Connect high and moderate restoration suitability areas to main channel
MR-G	Revegetate the floodplain adjacent to the river	None	Surfaces inside levees where excavation < 14,000 cu yds/ acre Bank vegetation = None	All identified surfaces inside levees Bank vegetation = None or Sparse
MR-H	Install bank structures	BEHI = Extreme	BEHI = Extreme and High	BEHI = Extreme, High and Moderate
MR-I	Install instream structures	None	At documented spawning sites in Meander Reach 1	At documented spawning sites in Meander Reach 1, at tributary confluences, and at outside meander bends
MR-J	Tributary restoration	None	Remove barriers	Remove barriers Restore streams
KR-A	Manage the discharge from Libby Dam	To be determined	To be determined	To be determined
KR-B	Manage the backwater from Kootenay Lake	To be determined	To be determined	To be determined
KR-C	Manage land use practices	Coordinate with landowners where bank structures (BR-F) apply	Coordinate with landowners where bank structures (BR-F) apply and with all landowners for instream structure, tributary and	Coordinate with landowners where bank structures (BR-F) apply and with all landowners for instream structure, tributary and

Table 4-10. Meander Reach 1 and 2 criteria for minimum, moderate, and maximum implementation scenarios.				
Treatment	**Restoration Treatment Explanation**	**Minimum Scenario**	**Moderate Scenario**	**Maximum Scenario**
			floodplain work	floodplain work
KR-D	Manage for impacts from or to infrastructure	Coordinate with infrastructure owners where bank structures (BR-F) apply	Coordinate with infrastructure owners where bank structures (BR-F) apply and with all infrastructure owners for instream structure, tributary and floodplain work	Coordinate with infrastructure owners where bank structures (BR-F) apply and with all infrastructure owners for instream structure, tributary and floodplain work

Based on implementation scenario criteria for the Meander Reaches, Table 4-11 shows quantities of each restoration treatment that would result from minimum, moderate and maximum scenarios. No floodplain excavation is included in Meander Reach 1 because no significant areas are present within the levees.

Table 4-11. Meander Reach 1 restoration treatment quantities by implementation scenario.					
Treatment	**Restoration Treatment Explanation**	**Unit**	**Min**	**Mod**	**Max**
MR-A	Excavate and/or dredge the river to modify the channel geometry	Ft	0	TBD	TBD
MR-B	Excavate floodplain adjacent to the river	Acres	0	0	0
		Cu yds (cut)	0	0	0
MR-C	Construct and/or enhance wetlands adjacent to the river	Acres	0	0	0
MR-D	Construct and/or enhance wetlands behind levees and connect to the river	Acres	0	2,242	7,844
MR-E	Construct or enhance secondary channels adjacent to the river	Ft	0	0	0
MR-F	Construct or enhance secondary channels behind levees and connect to the river	Ft	0	30,350	39,172
		Cu yds	0	76,445	117,893
MR-G	Revegetate the floodplain adjacent to the river	Ft	0	25,039	70,794
		Acres	0	0	0
MR-H	Install bank structures	Ft	10,456	31,085	84,504
MR-I	Install instream structures	Units	0	15	35
MR-J	Tributary restoration	Barriers	0	3	3
		Ft	0	0	34,102
KR-A to KR-D	Project-scale management treatments	These treatments will be applied as needed and quantified if necessary in later design phases.			

Based on implementation scenario criteria for the Meander Reaches, Table 4-12 shows quantities of each restoration treatment that would result from minimum, moderate and maximum scenarios.

Table 4-12. Meander Reach 2 restoration treatment quantities by implementation scenario.

Treatment	Restoration Treatment Explanation	Unit	Min	Mod	Max
MR-A	Excavate and/or dredge the river to modify the channel geometry	Ft	0	TBD	TBD
MR-B	Excavate floodplain adjacent to the river	Acres	0	767	1,396
		cu yds (cut)	0	7,930,550	17,259,190
MR-C	Construct and/or enhance wetlands adjacent to the river	Acres	0	TBD	TBD
MR-D	Construct and/or enhance wetlands behind levees and connect to the river	Acres	0	3,690	10,456
MR-E	Construct or enhance secondary channels adjacent to the river	Ft	0	TBD	TBD
MR-F	Construct or enhance secondary channels behind levees and connect to the river	Ft	0	57,137	161,490
		cu yds (cut)	0	170,340	1,051,925
MR-G	Revegetate the floodplain adjacent to the river	Ft	0	204,134	314,599
		Acres	0	767	1,396
MR-H	Install bank structures	Ft	78,071	232,116	330,433
MR-I	Install instream structures	Units	0	0	126
MR-J	Tributary restoration	Barriers	0	13	13
		Ft	0	0	58,839
KR-A to KR-D	Project-scale management treatments	These treatments will be applied as needed and quantified if necessary in later design phases.			

4.4 Implementation Sequencing

The implementation scenarios described above are intended to present an illustration of a range of potential levels of restoration effort that represent spatial applications of habitat actions. These implementation scenarios are the basis for the development of cost estimates presented in Chapter 7. Actual Kootenai River Habitat Restoration Project implementation will be guided by designs that will be developed beginning in 2009. The following section describes in concept how the Kootenai River Habitat Restoration Project will be sequenced over time in terms of the reaches and restoration treatments described in these implementation scenarios.

Because the project area is large, because of funding limitations, and because of the Tribe's desire to implement the project within an adaptive management framework, the Kootenai Tribe anticipates that the restoration project will be completed in several sequences over a multi-year period. Kootenai River habitat restoration work will most likely begin at the upstream end of the

project area and generally proceed downstream. Most likely, restoration would be implemented in an order similar to that described on the following page, depending on which implementation scenario (or combination of pieces of implementation scenarios) is selected.

4.4.1 Example of minimum implementation scenario

The minimum implementation scenario encompasses the following:

- Braided Reach 1 – installation of bank structures and revegetation treatments in areas of extreme bank erosion;
- Braided Reach 2 – channel and floodplain reconstruction in the entire reach (along with other treatments that comprise the BR2 Habitat Action);
- Straight Reach – installation of bank structures and revegetation treatments in areas of extreme bank erosion; and
- Meander Reaches – installation of bank structures and revegetation treatments in areas of extreme bank erosion.

Work would likely proceed in the following order:

1. Bank structures and revegetation work in Braided Reach 1 would be implemented first to reduce sediment inputs into downstream reaches.
2. Channel and floodplain reconstruction in Braided Reach 2 would be phased over at least two years and implemented from upstream to downstream.
3. Bank structures and revegetation work would be integrated with channel and floodplain reconstruction in Braided Reach 2, so some of this work would occur as part of channel and floodplain construction, while other aspects focused on vegetation would be timed relative to plant dormancy and other biological considerations.
4. Bank structures and revegetation in the Straight Reach would be implemented following work in Braided Reach 2, however, it would be possible to implement work in this reach independently of other reaches due to the low risk of the channel shifting within the confined and armored reach.
5. Bank structures and related revegetation work in the Meander Reaches would be implemented on an opportunistic basis as agreements are reached with particular landowners. In general, this work in the Meander Reaches would probably occur after Braided and Straight reach work is substantially under way.

4.4.2 Example of moderate implementation scenario

The moderate implementation scenario encompasses the following:

- Braided Reach 1 – installation of bank structures and revegetation treatments in areas of extreme and high bank erosion, and channel and floodplain reconstruction (along with other treatments that comprise the BR1 Habitat Action) between RM 158 and 159;
- Braided Reach 2 – channel and floodplain reconstruction in the entire reach (along with other treatments that comprise the BR2 Habitat Action);

- Straight Reach – installation of bank structures and revegetation treatments in areas of extreme and high bank erosion and installation of instream structures in the upper half the reach (the lower half encompasses the deep pool at Ambush Rock); and
- Meander Reaches – installation of bank structures and revegetation treatments in areas of extreme and high bank erosion, floodplain excavation and revegetation inside the levees, instream habitat structure placement, floodplain restoration outside of the levees and removal of fish passage barriers on tributaries.

Work would likely proceed in the following order:

1. Bank structures and revegetation work, combined with channel and floodplain reconstruction between RM 158 and 159, in Braided Reach 1 would be implemented first to reduce sediment inputs into downstream reaches.
2. Channel and floodplain reconstruction in Braided Reach 2 would be phased over at least two years and implemented from upstream to downstream.
3. Bank structures and revegetation work would be integrated with channel and floodplain reconstruction in Braided Reach 2, so some of this work would occur as part of channel and floodplain construction, while other aspects focused on vegetation would be timed relative to plant dormancy and other biological considerations.
4. Structures and revegetation in the Straight Reach would be implemented following work in Braided Reach 2; however, it would be possible to implement work in this reach independently of other reaches due to the low risk of the channel shifting within the confined and armored reach.
5. Bank structures and related revegetation work in the Meander Reaches would be implemented on an opportunistic basis as agreements are reached with particular landowners. In general, this work in the Meander Reaches would probably occur after Braided and Straight reach work is substantially under way.
6. Other Meander Reach work inside the levees (e.g., floodplain excavation, instream structures) has the potential to be affected by sedimentation from upstream river work, so it would be started after Braided and Straight Reach channel and floodplain work is completed.
7. Floodplain restoration outside the levees would be implemented on an opportunistic basis as agreements are reached with particular landowners and other entities. This work would not be affected by upstream river work, so could be started at any time.
8. Removal of fish barriers along tributary streams is also independent of other river work, and could be implemented at any time.

4.4.3 Example of maximum implementation scenario

The maximum implementation scenario encompasses the following:

- Braided Reach 1 – channel and floodplain reconstruction (along with other treatments that comprise the BR1 Habitat Action) in the entire reach;
- Braided Reach 2 – channel and floodplain reconstruction in the entire reach (along with other treatments that comprise the BR2 Habitat Action);
- Straight Reach – channel and floodplain reconstruction in entire reach; and

- Meander Reaches – installation of bank structures and revegetation treatments in areas of extreme, high and moderate bank erosion; floodplain excavation and revegetation inside the levees; instream habitat structure placement; floodplain restoration outside of the levees; removal of fish passage barriers on tributaries and restoration of tributaries on the floodplain.

Work would likely proceed in the following order:

1. Channel and floodplain reconstruction throughout Braided Reach 1 would be implemented first to reduce sediment inputs into downstream reaches. This work would probably be phased over at least two years.
2. Channel and floodplain reconstruction in Braided Reach 2 would be phased over at least two years and implemented from upstream to downstream.
3. Bank structures and revegetation work would be integrated with channel and floodplain reconstruction in Braided Reach 2, so some of this work would occur as part of channel and floodplain construction, while other aspects focused on vegetation would be timed relative to plant dormancy and other biological considerations. Because channel work in these reaches would not occur until after Braided Reach 1 channel work is complete, some bank structures and revegetation work might be completed before channel work as a way to limit sediment inputs from Braided Reach 2.
4. Channel reconstruction in the Straight Reach would be implemented following work in Braided Reach 2 and would be phased over one or more years.
5. Bank structures and related revegetation work in the Meander Reaches would be implemented on an opportunistic basis as agreements are reached with particular landowners. In general, this work in the Meander Reaches would probably occur after Braided and Straight reach work is substantially under way. However, under the maximum scenario, some of the extreme and high BEHI rating banks might be restored while Braided and Straight Reach work is in progress.
6. Other Meander Reach work inside the levees (floodplain excavation, instream structures) has the potential to be affected by sedimentation from upstream river work, so it would be started after Braided Reaches and Straight Reach channel and floodplain work is completed, but this would be determined during the design process.
7. Floodplain restoration outside the levees would be implemented on an opportunistic basis as agreements are reached with particular landowners and other entities. This work would not be affected by upstream river work and could be started at any time.
8. Removal of fish barriers and channel restoration along tributary streams is also independent of other river work, so this work could be implemented at any time.

The above implementation sequencing discussion is conceptual and actual sequencing will be determined during the preliminary and final design phases as described in Chapter 9. The conceptual sequencing also helps to develop a conceptual timeline (Figure 4-10) that can be used to estimate time-sensitive elements of the costs such as economy of scale, cost escalation, and funding strategy.

As previously noted, the Kootenai River Habitat Restoration Project will likely take a number of years to complete the work. This will result in various restoration phases being implemented in

different reaches at different times. Funding availability and environmental compliance schedules will also influence implementation sequencing. This chapter has provided a basic rationale for identifying where work should occur and when. Subsequent design phases will consider specific actions and sequencing in greater detail with the recognition that the Kootenai River Habitat Restoration Project is a single endeavor with component parts that are all inter-linked and inter-dependent.

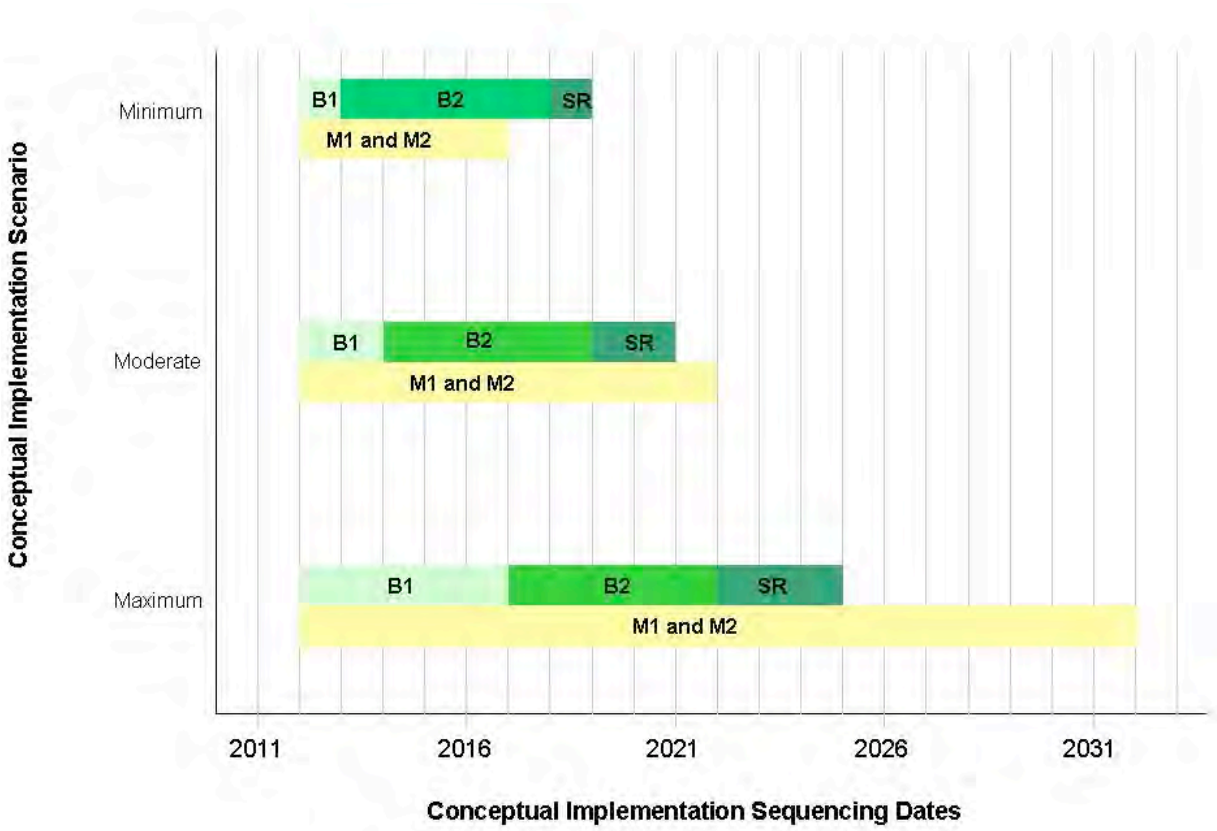

Figure 4-10. Conceptual implementation timeline related to minimum, moderate, and maximum implementation scenarios.

4.5 Summary

Implementation scenarios are spatial applications of habitat actions that link information about limiting factors and other resources to restoration treatments that have been proven to overcome those limiting factors in similar river systems. Implementation scenarios can be used for several purposes, including:

- Describing in a conceptual manner where restoration work is likely to happen in the project reach;
- Helping to identify a range of implementation costs that are tied to particular levels of effort at different locations (costs are described in Chapter 7) and helping to frame an appropriate funding strategy;

- Illustrating in a general way increased benefits to habitat and trade offs (including costs) associated with different levels of restoration effort;
- Describing a range of alternatives for evaluating potential restoration work relative to environmental compliance and permitting at a programmatic level; and
- Communicating the Kootenai River Habitat Restoration Project's scope and nature to the public and other stakeholders.

These implementation scenarios set the stage for design by providing a framework for identifying where restoration work should be completed. To make sure restoration work is achieving the purposes and goals described in this Master Plan, this restoration project will be designed and implemented in an adaptive manner. Just as data about limiting factors and other resources make it possible to develop meaningful implementation scenarios at a conceptual level, increasingly targeted data will be collected and analyzed to support the next phases of project design and implementation. Once portions of the project have been completed, these areas will be monitored to evaluate the degree to which restoration treatments are overcoming habitat limiting factors. These monitoring data will be fed back into the decision-making process and used to modify already-implemented portions of the Kootenai River Habitat Restoration Project if necessary, and to inform designs for future portions of the project. The following chapter describes the Adaptive Management and Monitoring program that will support the Kootenai River Habitat Restoration Project.