ADAPTIVE MANAGEMENT OF
LEFT HAND CREEK WATERSHED

Restoration Site Monitoring Methods

Developed by:

LEFTHAND WATERSHED OVERSIGHT GROUP
6800 Nimbus Road, Longmont CO 80503 (office)
P.O. Box 1074, Niwot, CO 80544-0210 (mailing)
303.530.4200 | www.lwog.org

LEFTHAND WATERSHED
oversight group

Restoration Site Monitoring Methods Introduction

The purpose of these methods is to monitor Left Hand Creek Watershed's trajectory towards resilience following completion of more than ten flood recovery restoration projects in an adaptive management context. The protocols were developed as part of Lefthand Watershed Oversight Group's adaptive management plan and includes methods for quantitative and qualitative monitoring of parameters associated with key watershed functions.

Lefthand Watershed Oversight Group's plan is described in detail in our guide – Building Watershed Resilience through Adaptive Management. In summary, we developed a model (see Figure 1) to conceptualize the status of key watershed functions that are tied to watershed resilience in the past, present, and potential future of Left Hand Creek Watershed. A key aspect of this model is the conceptualized future of Lefthand Creek Watershed, which represents the goals of our restoration projects and how we envision a heathier and more resilient Left Hand Creek Watershed.

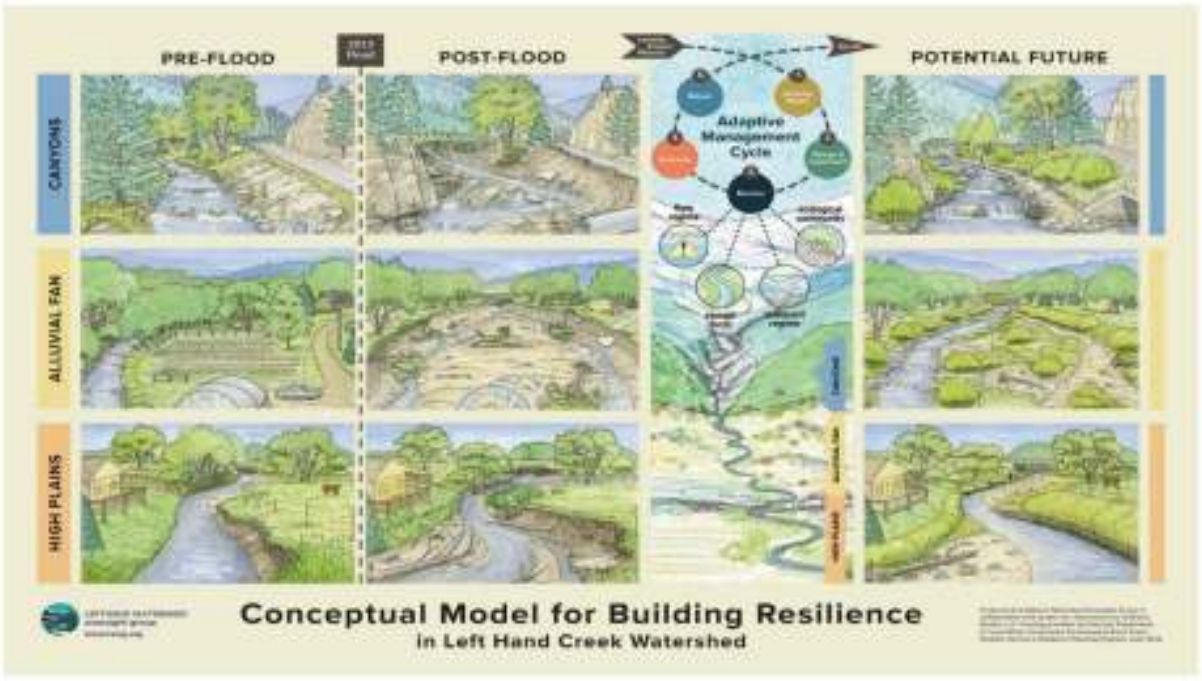

Figure 1: *The conceptualized status of Left Hand Creek Watershed is shown on nine drawn panels arranged by watershed zone and time. The adaptive management cycle is drawn between the post-flood and potential future scenarios, indicating that adaptive management began after the 2013 flood. Restoration goals are presented in the potential future panels. Key watershed functions tie directly to the monitoring step of the adaptive management cycle, indicating that these parameters are measured to track the trajectory of the restoration efforts.*

Based on this model, we developed a Monitoring and Assessment Framework (MAF) for tracking the watershed's trajectory towards resilience. The complete MAF is included on the following page. In summary, the MAF identifies parameters that should be measured to assess the status of key watershed functions and links those parameters to smaller-scale restoration questions which contribute to tracking

our trajectory towards a heathier and more resilient Left Hand Creek Watershed. For each parameter, the MAF provides information about specific data that needs to be collected as well as required analysis and frequency of data collection.

Key elements of the MAF that are directly tied to adaptive management are performance standards and management triggers. These factors are also inherently tied to data analysis and interpretation because they indicate an expected range or trend of acceptable performance for each parameter and when a management action becomes necessary.

Monitoring Methods Instructions

Selecting and using appropriate monitoring methods requires a careful review of the MAF to establish a plan for data collection that's related to specific project goals and objectives. A summary of steps is provided to help guide users to the appropriate monitoring method for their intended purpose:

1. **Restoration Questions:** Review of the MAF should begin with a review of restoration questions to determine how they related to a bigger-picture restoration goal. In our case this is watershed health and resilience, as illustrated in the conceptual model.

2. **Parameters:** After relevant restoration questions are identified, parameters should be selected based on resources available (e.g. monitoring personnel or monitoring frequency required).

3. **Monitoring Method:** After restoration questions and parameters are selected, relevant monitoring methods (as noted in the MAF) should be reviewed and selected. All monitoring methods noted in the MAF are provided in the index below.

Data and information collected using these monitoring methods ties back directly to performance standards and management triggers, and ultimately the overall adaptive management plan. The MAF provides performance standards and management triggers based on the best, currently available information. Information in these columns will be updated and changed as more data is collected and analyzed. Column metrics may shift from more qualitative tracking of trends to quantitative measurements. These metrics should always be review, modified, and updated to reflect specific project needs and unique circumstances.

As monitoring data is collected and new information is learned, our understanding of systems may change or unexpected events may occur, requiring adjustments to our management strategies and even overall goals. In this way, data collected informs the overall adaptive management plan.

LEFTHAND WATERSHED oversight group

Index to Form/Methods

	Method	Included in this Document?	Timing	Purpose/Additional Information	Page
Qualitative rapid assessment of restoration sites	Monitoring Assessment Framework	Included	Before selecting methods	Select appropriate forms and methods for monitoring	4
	Restoration Site Information Form	Included	Preliminary to monitoring. One time.	Site overview summary for project/reach design	5
	Restoration Site Monitoring Form Instructions	Included	Review before monitoring	Review for Site Monitoring Forms	6
	Restoration Site Monitoring Form	Included	-- Annually at high flow -- Annually at post high flow	Use for specific monitoring at restoration sites. Pair with SVAP monitoring.	9
	Photo Monitoring Form	Included	-- Annually at high flow -- Annually at post high flow	Used for reach-wide monitoring and LWOG selected monitoring	14
	Stream Visual Assessment Protocol (SVAP)	Not Included	Annually at post high flow	Pair with site monitoring form for comprehensive assessment and comparison with existing data.	
Robust quantitative assessment to be used as resources permit	Cross-Sectional Profile	Not Included	Annually at post high flow	See CWCB SOP	
	Long Profile	Not Included	Annually at post high flow	See CWCB SOP	
	Vegetation Survey	Not Included	Annually at post high flow	See CWCB EWP Protocol with added species level data	
	Sediment Survey	Not Included	Annually at post-high flow	See CWCB EWP Protocol	
	Benthic Macro-Invertebrate (BMI)	Not Included	• Once pre-restoration • Post restoration every 2-3 years	See Colorado WQCD Protocol	

LEFTHAND WATERSHED
oversight group

Monitoring and Assessment Framework

The MAF described in the introduction is included on the following page. Below is a key describing each column in the MAF. The MAF is updated and modified as new information becomes available.

- **Watershed Function:** Large scale ecosystem properties and processes which influence watershed health and resilience. We have used four: Flow Regime, Stream Form, Sediment Regime and Ecological Community.
- **Category:** Smaller scale ecosystem properties and processes which influence watershed health and resilience, and tie directly to specific watershed functions.
- **Monitoring Parameter:** Specific aspects of the watershed function which will be directly monitored and assessed.
- **Monitoring Method Description:** Reference to monitoring methods that should be used. Each method is provided in this document. Includes occasional description of what information the monitoring method will provide.
- **Location:** The number of recommended monitoring locations.
- **Performance Standard:** The metric or guidance that dictates normal operation of the monitoring parameter. This may include general trends, scales, or ideal values.
- **Management Trigger:** The result or value (collected from monitoring) that will cause a management action, or a change in normal procedures. When monitoring is conducted parameters outside of the "normal" range may trigger a response. A larger deviation from normal may trigger further management responses.
- **Suggested Management Actions:** Typical actions or techniques that can be implemented in response to the findings from monitoring or when management actions are triggered. This fits in the "adjust" step of the adaptive management cycle, where further action is based on evaluations from data collection.
- **Monitoring Personnel:** The level of effort for monitoring in the field can vary dramatically, from requiring scientific or engineering expertise to community-based monitoring.
- **The monitoring personnel is divided into three categories:**
    - Community: requires the least amount of experience
    - Technical: requires some technical subject matter knowledge
    - Professional: requires advanced subject matter knowledge
- **Monitoring Frequency:** The frequency with which monitoring is recommended to be conducted.

LEFTHAND WATERSHED oversight group

Monitoring and Assessment Framework

	Key Questions	Category	Monitoring Parameters	Monitoring Method Description	Monitoring Frequency	Location	Performance Standard	Management Trigger	Suggested Management Actions	Monitoring Personnel
Flow Regime										
	Are there adequate flushing flows to reduce vegetation enroachment and to maintain pool depths?	Flow Regime	Stream stage and flow (and relate to surveyed cross sections, embeddedness, and riparian conditon)	Characterization of the timing and magnitude of flows. Includes analysis of flow in relation to recurrence interval and percent of time exceeded.	Continuous (every 15 minutes to 1 hour)	Several locations as appropriate to represent longitudinal variation in flow from upstream to downstream.	Flushing flows occur with enough frequency that encroachment of vegetation is not occurring. Overbank flows are sufficient to support floodplain vegetation. Low flows are sufficient to support fish passage. Additional standards to be determined as part of the Stream Management Plan and fish passage study.	Significant dry up points, vegetation encroaches into channel, hydrograph too flashy. Additional triggers to be determined as part of the Stream Management Plan and fish passage study.	- Flow augmentation (per Stream Management Plan recommendation) - Active management of encroaching vegetation - Watershed management to encourage infiltration if warranted	2 - Technical or Professional
	Is channel and floodplain conveying flows per the design?	Floodplain Connectivity	Width of river at a given recurrence interval (pin flag method) (and relate to surveyed cross sections, and species distribution in floodplain.)	Observe and record width of floodplain flows over several years to determine floodplain width in relation to flows and corresponding stages compared to design.	Observe floodplain flow during sporadic high flows	At surveyed cross sections and selected additional important locations in the floodplain.	Width of floodplain at a given recurrence interval is appropriate for the landscape location.	Width of floodplain at a given recurrence interval is inappropriate for the landscape location.	- Reconfigure channel to reconnect floodplain - Create floodplain benching - Reestablishment of wetland hydrology - Continue observations of riparian condition	2 - Technical
Stream Form and Function										
	What channel dimensions within each watershed zone lead to the highest functioning sites? (Help build database to inform future restoration projects.)	Channel Dimension	Channel and floodplain dimensions (and relate to flow and ecological community) .	CWCB SOP for X-section monitoring. Relate to ecological measurements below.	Annually	At least 3 locations per watershed zone representing the variety of channel forms including pools, riffles, runs, and bends. Select locations where conveyance and/or vegetaion composition is important.	No evidence of excessive instability, incision, over-widening, scour, or deposition over time. Channel dimensions are appropriate for the flow regime and trending in appropriate direction when evaluating in context of the channel evolution model.	Dimensions are not appropriate for the flow regime and trending in appropriate direction compared to channel evolution model. Evidence of excessive instability, incision, over-widening, scour, or deposition.	- Improve channel geometry - Address incision, instability or sedimentation	2 - Technical
	Are the installed features functioning as intended? --- *Are brush trenches trapping sediment and creating micro-topography as intended?* - --- *Is there diversity and complexity present in stream form and riffle-pool sequence?*	Planform / Lateral Stability	Bank and channel cross section condition	Primarily photo monitoring, SVAP (bank condition) and facies mapping. Can include cross sections as appropriate or as budget allows.	Annually	Adjacent to assets at risk or features of interest.	Stressors may be present but patterns of deposition, scour, and migration appear to be mostly natural. Lateral migration and bank erosion are minimal in areas of concern (e.g. adjacent to structures). SVAP score for bank condition improves or stays same year after year.	Excessive deposition, scour, migration, or bank erosion are detected. SVAP score for bank condition is <5, or goes down 2 points or more in one year.	- Investigate stream form changes upstream - Structural Bank Protection or stabilization - Livestock fencing - Address instability - Reduce bank erosion - Increase riparian vegetation	2 - Technical
		Long Profile / Vertical Stability	Channel (long profile) condition	Primarily photo monitoring and facies mapping and SVAP Channel Condition score. Can include long profile as appropriate or as budget allows. SVAP score for channel condition and pools. Carry a GPS unit while surveying the longitudinal profile along the thalweg will provide information needed to map the thalweg.	Annually or Every 2 years	In areas where conveyance or pool depth or sedimentation is a particular concern.	No evidence of excessive incision or sedimentation in pools over time. SVAP score for channel condition and pools improves or stays same year after year.	Significant deposition, scour, incision, or headcutting. Pool habitat reduced significantly. SVAP score for channel condition and pools is <5, or goes down 2 points or more in a category in one year.	- Install Grade Control structures - Structural Bank Protection - Investigate local gradient impacts - Livestock fencing - Revegetate riparian zone - Reconfigure/regrade banks	2 - Technical
		Instream Structures and Features	Installed features functional score	Photo monitoring using CWCB SOP; Feature-Function checklist.	Annually	At selected structures or features in the study reach. Aim to get good representation of all features installed.	Features functioning as intended (see check list)	Features not functioning as intended.	- Varies depending on feature.	1 -Community
	Are there adequate flushing flows to maintain pool depths?	Streambed Composition and Function	Embeddedness Score and Streambed composition	Wolman's pebble count, SVAP embeddedness score.	Annually or every 2 years.	At selected cross sections (or nearest downstream riffle if x-section is not on riffle).	Embeddedness <=20% (for cobble/gravel streams). Pebble counts do not show a consistent multi-year trend toward increasing proportions of fine sediment.	Embeddedness >= 30% (for cobble/gravel streams)	- Install Large Woody Structures - Investigate and address sources of fine sediment/sand - adjust channel dimensions - Construct Pool Riffle sequence	1 - Community

LEFTHAND WATERSHED oversight group

Monitoring and Assessment Framework

Sediment Regime										
	Where are the main sediment source locations in the watershed? (NOT a project specific question)	Sediment from Watershed	Map of sediment sources	Trace turbidity sources (this will tell us if there's a problem first), assess extent of bare or disturbed areas, and identify erosion in tributaries if there's a problem identified	Annually during storm events	Watershed-wide	No significant sources of sediment are detected.	Areas are contributing significant sediment into the watershed.	- Terracing - Revegetation - Post Fire restoration -Sediment Basins -Fencing of livestock	2 - Technical
	Are banks in our project area contributing to sediment in the water column?	Sediment from Banks	Bank condition, water turbidity	Cross sections and visual assessment, as budget allows grab samples during storm events up and downstream of project site of concern. Erosion pins as appropriate. Use CWCB SOP.	Annually	Areas where bank stablity is a concern.	Channel banks in normal or stable condition with vegetation and little bare soil	Significant or excessive erosion	- Increase riparian vegetation - Install livestock fencing - Draft bank stabilization projects - Inspect upstream sources of instability (channelization, increased stream power) -Add instream structures to dissipate energy	1 - Community or Technical
	Are there adequate flushing flows to transport sediment?	Sediment Transport Continuity	Sediment accumulation	Photo monitoring using CWCB SOP. Review longitudinal profiles to assess whether a channel structure is blocking the flow of sediment at certain locations.	Annually	Areas of concern.	No signs of significant deposition or scour. Impediments to sediment transport exist, but they are not significant.	Major impediments to sediment transport exist causing significant deposition and/or significant scour exists within stream reach.	-Remove blockage and seek ways to improve sediment transport	1 - Community or Technical
Ecological Community										
	Is the floodplain functioning as indended? --- *Are brush trenches trapping moisture and increasing native plant diversity?* --- *Is the site maintaining or improving habitat diversity and quantity year to year?*	Riparian Condition	Quantity and quality of riparian habitat, percent bare ground, species composition, and percent non-natives.	Use same plot collection methodology as CWCB's monitoring team, but collect species-specific data instead. Partner with university member to assess key quesitons in more depth.	Annually	At least 3 locations per watershed zone representing the variety of floodplain types, include variety of features such as brush trenches and wood installations, include areas where conveyence is a concern.	Trending in the general direction of more native species. Wetland species present in floodplain. Bare ground is reduced except in areas that are geomorphically appropriate. Age class distribution is geomorphically appropriate.	Significant encroachment by trees into the channel is occurring. Significant bare ground on banks. Significant presence of invasive plant species. Absence of wetland species in floodplain.	- Invasive species management strategy - Fencing sensitive areas - Planting - Grazing/ burrowing animal management - Reduce barren ground/exposed soil - Reestablish of wetland hydrology - Active management of encroaching trees	3 - Professional
		Habitat Condition	SVAP Score	Assess the quality and quantity of instream habitat using the Stream Visual Assessment protocol (SVAP).	Annually	Throughout study reach.	SVAP score stays the same or increases each year.	SVAP score <5, or goes down 2 points or more in a category in one year.	- Install Instream Structures and habitat features - Revegetation -Weed Removal -Increase instream habitat structure -Bank stabilization -Side Channel and Off Channel Habitat	1 - Community
		Biotic Structure	Presence of benthic macroinvertebrates, algae, macrophytes, and fish.	Assess abundance and diversity of aquatic plants and animal communities. The species list for benthic macroinvertebrates can be used to calculate the Index of Biological Integrity (IBI) score, which can be used to quantitatively relate the aquatic habitat score of the stream to those of others.	Fish & Wildlife presence (opportunistically). BMI every two or three years.	Throughout study reach.	Distribution, age structure, overall biomass, and functional guilds are appropriately represented. IBI Score compares favorably to similar streams and is trending higher with time.	Macroinvertebrates: Exotic invasions, severely limited feeding guilds, IBI scores that are low or trending lower. Algae: Healthy periphyton community absent from streambed rocks. Aquatic macrophytes: Characteristic plant cover is absent, or plant cover is dominated by invasive aquatic macrophytes. Shading of stream channel by trees is minimal. Animals and Fish: Typical species severely limited, exotic infestations, keystone species absent.	- Revegetate - Increase shade - instream habitat (e.g. large wood, boulders). - Prohibit Further Channelization - Improve connectivity of quality habitat - Maintain healthy riparian plant communities - Wetland creation	2 - Technical or Professional
	Is the revegetation effort meeting warrenty/EWP requirements?	Plant Survival	Counts of dead installed plants.	Count dead plants at revegetation sites	Annually	All sites	Meets EWP requirements per contract.	Does not meet EWP requirements.	Replant	1 - Community
	Is the site maintaining or improving water quality year to year? (NOT restoration project site specific)	Water Quality	A variety of observed and measured physical, chemical, and microbiological parameters. Examples are listed in appendix.	Water quality pertains to physical, chemical, and microbiological characteristics of the water. These characteristics are important determinants of stream function for aquatic habitat, and for serving as a source of drinking and irrigation water. Local governments are interested in ensuring that the stream provides these functions, and that water quality improvement is sufficient to remove the stream from the State's list of impaired waters.	Variable: monthly, quarterly, annually	Currently at 7 primary sampling locations in the mountain reaches, representing various degrees of influence from mining sites. Could expand to the plains.	The stream's water quality does not significantly limit its ability to perform the functions of providing aquatic habitat and serving as a source of drinking water and irrigation water. Key water quality parameters included in the TMDL for the creek are trending toward levels that will allow removal of the creek from the list of impaired waters in a reasonable time.	The stream's water quality does significantly limit its ability to perform the functions of providing aquatic habitat and serving as a source of drinking water and irrigation water. Key water quality parameters included in the TMDL for the creek are not trending toward levels that will allow removal of the creek from the list of impaired waters in a reasonable time.	- Chemical Management Plans - Investigate upstream sources of pollutant (water quality/ pollution investigation) - Wetland creation - Runoff management - Public Education Programs - Debris (trash) removal	2 - Technical

LEFTHAND WATERSHED
oversight group

Restoration Site Information Form

This form provides general site information and restoration methods. (Fill out once per project.)

Site/Selected Reach Name: _____

Existing Data Source

Organization/ Agency: _____

Form/ Method: _____

Position in Watershed: ☐Canyons ☐Alluvial Fan ☐High Plains

Restoration Methods

Seeding Method: ☐1-2 zones ☐3-4 zones ☐Other _____

Top Soil Added: ☐Yes ☐No ☐Other _____

Geotextile Type: ☐Coir Fabric ☐Wood Chips ☐Wood Straw ☐None

Irrigation: ☐Yes ☐No ☐Other _____

River System Information

Adjacent Restoration Projects: ☐Upstream ☐Downstream ☐None

Fish Passage Barriers: ☐Upstream ☐Downstream ☐None

Diversion Structures: ☐Upstream ☐Downstream ☐None

Stakeholder Information

Number of Private Landowners: _____

Public Land Agencies: _____

LEFTHAND WATERSHED
oversight group

Restoration Site Monitoring Form Instructions

Location

A. **Watershed**: Indicate the watershed of your project/reach location.

B. **Zone:** Indicate the Front Range watershed zone of the project/reach. Selections include: canyons, alluvial fan (foothills), and plains.

C. **Project/Selected Reach**: Restoration monitoring reaches will likely be defined by project areas. For large project sites with poor vantage points, a recommended reach length is 20 times annual high flow (bankfull) channel width. Reach selection should be representative of the project. Additionally, reach selection may include considerations for continuous long profiles (a central vantage point) and riffle/pool sequences.

Photo Monitoring

Photo monitoring will be used to evaluate stream form and function over time. Photo points will be tracked and recorded by use of GPS coordinates and oriented by azimuth. The Colorado Water Conservation Board (CWCB) Standard Operating Procedures (SOP) will be used for set up and monitoring. These selected photo points are based on reach wide observations specific to monitoring parameters and selected LWOG from monitoring locations. LWOG form photo monitoring may be used to track site specific restoration features or problem areas (i.e. flow monitoring, encroachment, head cutting, bare ground, actively eroding banks). The photo monitoring will be used to record photo points for each site.

Flow Monitoring

The location of flow monitoring surveys will be representative of the entire reach and revisited during high and post-high flow surveys. Channel flow and width measurements will be recorded and represented by monitored by a selected photo point. During high flow surveys, take photo at monitoring point and use pin flags to mark water line. Come back at lower flows to measure width when safe to do so.

Reach-Wide Observations

Reach-wide observations and photo monitoring are representative of the entire reach. Specific areas of concern should be assigned photo points and described on the site-specific photo monitoring form.

A. **Floodplain Connectivity**

   a. During high and post-high flow survey, observe for evidence of floodplain activation. The floodplain is defined by riparian and upland area extending beyond the zone of channel forming discharge (annual high streamflow). This area can be identified by a

change in vegetation (bare rock to established riparian; herbaceous to woody), change in topography (change in slope of bank), or change in deposition (difference in particle size deposited by channel flow versus substrate without frequent deposition).

b. Observe the floodplain for signs of activation:

i. Disturbance/ erosion: sediment transport or scour in the floodplain

ii. Deposition: deposition of finer substrate in the floodplain

iii. New large wood: comparison to past visits at site

iv. Rack lines, small wood: deposition of organic material in the floodplain; rack lines formed as water levels recede off the floodplain

v. Moisture: soil is visibly moist in the floodplain

vi. Wetland vegetation: presence of herbaceous wetland vegetation in the floodplain

vii. Photo monitoring: incorporate these observations in photo monitoring points, or create a LWOG-specific photo point and record on photo monitoring form

B. Sedimentation/ Transport

a. During the post-high flow survey, identify the deepest pool in sample reach. Record total number of pools within reach and measure the water depth of deepest pool. *If the selected reach incorporates cross sectional and long profile surveys, use these assessment tools to record depth of deepest pool (cross section) and numbers of pools and riffles (long profile).*

b. Observe all pools in channel and determine if pool size is maintained annually. This assessment will be assisted by a site- specific LWOG photo point of pool size and substrate.

Photo monitoring: assign a single, representative pool an additional photo point and record on photo monitoring form. This photo(s) will show pool size and substrate. Compare annual observations of the selected LWOG_pool photo point to determine changes in deposition and pool size.

c. Observe the entire reach for signs of head cutting. Head cutting is an abrupt vertical drop in the form of a steep riffle or waterfall often resulting in a pool.

Photo monitoring: assign a photo point to pools with evidence of head cutting and record on photo monitoring form. Compare annual observations of head cutting to determine in-channel migration.

d. Observe water clarity in water upstream and downstream of observed reach.

C. Bank Condition

a. During high flow and post-high flow surveys, observe entire reach for active bank instability at elevations beyond the annual high flow (bankfull) channel. Indicate the type(s) of observed bank instability:

i. Channel migration: erosion specific to upper bank failure including slumping and toe erosion.

ii. Exposed banks: vegetation gaps for greater than 30% of one bank exposing fine, alluvial sediment or high deposition on banks leaving riparian area beyond the annual high flow (bankfull) channel sensitive to erosion.

iii. Erosion: evidence of active erosion adjacent to the channel including run off from elevated banks, scour along channel that erodes beyond stabilizing structures (i.e. roots, boulders). Eroded areas spanning three times the average bank height is of concern.

Photo monitoring: incorporate these observations in photo monitoring points, or create a LWOG-specific photo point and record on photo monitoring form.

D. Encroachment

a. During post-high flow survey, observe entire reach for evidence of encroachment by herbaceous or woody vegetation. Encroachment is establishment of riparian vegetation within the annual high flow (bankfull) channel. Rate the extent of encroachment by herbaceous or woody vegetation for the entire reach low, medium, or high.

Photo: incorporate these observations in photo monitoring points, or create a LWOG-specific photo point and record on photo monitoring form.

E. Invasive Plants

a. During high flow and post-high flow surveys, observe entire reach for extent of invasive species. Additionally, record the intensity of management for removing invasive species for the specific site.

Photo: incorporate these observations in photo monitoring points, or create a LWOG-specific photo point and record on photo monitoring form.

F. Wildlife Observations

a. During high flow and post-high flow surveys, observe entire reach for signs of sights of wildlife including scat and tracks.

G. Trash

a. During high flow and post-high flow surveys, observe entire reach for any types of trash.

H. Feature Function Check List

a. During the preliminary assessment, identify and record all implemented features specific to the project area or selected reach. Each feature should also match with intended function(s). During **high flow and post-high flow surveys**, features will be photo monitored and assessed for functional performance based on each structure's intended function.

LEFTHAND WATERSHED
oversight group

LWOG Restoration Site Monitoring Form

Name(s): _____ **Date/Time:**_____

Location:

Watershed:_____

Zone:_____

Project/Selected Reach: _____

Desktop: In the office, record flow and corresponding stage from nearest flow meter, if applicable.

_____

Photo Monitoring:

Photo monitoring is a reach wide monitoring of site-specific channel form and restoration feature observations. Additional LWOG photo points may be assigned for flow monitoring and reach wide observations specific to this monitoring form. See photo monitoring instructions for detail and CWCB SOP.

Flow Monitoring:

Select location that is representative of reach and can be replicated for high and post-high flow surveys and photo monitoring

1. What flow are you observing?

☐ Dry ☐ No moving water

☐ Low flow ☐ Bankfull full

☐ Floodplain or overflow channel activated

Photo monitoring (LWOG_flow)
ID _____
GPS _____
Azimuth _____

2. What is the width of the wetted channel? _____

Use pin flags to mark high points during high flow events and come back to measure when safe.

Reach-wide Observations:

A. Floodplain Connectivity

Is there evidence that the floodplain has been recently activated? ☐ Yes ☐ No

If yes: ☐ Disturbance/ erosion ☐ Rack lines, small wood

☐ Deposition ☐ Moisture

☐ New large wood ☐ Wetland vegetation

Photo (optional)
ID _____
GPS _____
_____

LEFTHAND WATERSHED
oversight group

B. Sedimentation/ Transport

1. Record total number of pools_____ and water depth of deepest pool_____

2. Is there evidence of deposition in pools? ☐ Yes ☐ No

select a photo point for a pool representative of reach and compare deposition annually by photo monitoring

Photo monitoring (LWOG_pool)
ID _____
GPS _____
_____

3. Is there evidence of head-cutting ☐ Yes ☐ No

Photo (optional)
ID _____
GPS _____
_____

4. Is the downstream water of the reach ☐ more ☐ less ☐ equally as turbid than the upstream?

C. Bank Condition

Is there evidence of significant bank instability? ☐ Yes ☐ No

Photo (optional)
ID _____
GPS _____
_____

If yes: ☐ Channel migration (upper bank failure/erosion, toe erosion)

☐ Exposed banks (vegetation gaps >30% of bank, high deposition on bank)

☐ Erosion (upper bank run off, scour, eroded area 3X avg. bank height)

D. Encroachment

Is there encroachment of woody vegetation ☐ Yes ☐ No and/or herbaceous vegetation ☐ Yes ☐ No into the channel, below the top of the bank?

If yes and woody riparian:

Photo monitoring (LWOG_encroachment)
ID _____
GPS _____
Azimuth _____

☐ High (occurs frequently, dense)

☐ Medium (occurs sporadically, dense or sparse)

☐ Low (occurs in isolated locations, sparse)

If yes and herbaceous riparian:

☐ High (occurs frequently, dense)

☐ Medium (occurs sporadically, dense or sparse)

☐ Low (occurs in isolated locations, sparse)

LEFTHAND WATERSHED
oversight group

E. Invasive Plants

1. Are invasives managed at this site?

☐ High (> annually) ☐ Medium (annually) ☐ Low (< annually) ☐ No

2. What is the extent of invasives?

☐ High (> 50%) ☐ Medium (20%-50%) ☐ Low (<20%)

Photo (optional)
ID _____
GPS _____
_____

F. Wildlife Observations

Is there evidence of wildlife (scat, tracks, visual)?

☐No ☐Fish ☐Frogs ☐Birds ☐Waterfowl ☐Mammal ☐Pollinators ☐Other_____

G. Did you see trash or other non-natural material along the creek?

☐ No ☐ Garbage ☐ Treated Lumber ☐ Other _____

LEFTHAND WATERSHED
oversight group

H. Feature-Function Check List:

**List features specific to site. Use Feature-Function Key to reference intended functions provided by each feature. For each feature, indicate if each intended function is met by recording "1" or not met by recording "0" in the appropriate intended function columns. Surveyed total out of expected score (all relevant functions are met) is to be calculated and recorded on far right hand column. See example.*

		INTENDED FUNCTION													
		Turbulence/Aeration	Reduce Velocity/ Dissipate Energy	Capture Sediment	Capture Organic Material	Stabilize Bank	Stabilize Grade	Protect Infrastructure	Create Pools	Floodplain Connectivity	Establish Vegetation	Provide Slow Moving Water	Provide Cover	Direct Flow	**Total**
FEATURE	Example: Floodplain Large Wood			**1**	**0**						**1**		**1**		**3/4**

LEFTHAND WATERSHED oversight group

Feature-Function Key:

To be used as a reference for the Feature Function Check List. Each "X**" indicates a function intended to be met by specific features.*

		INTENDED FUNCTION												
		Turbulence/Aeration	Reduce Velocity/ Dissipate Energy	Capture Sediment	Capture Organic Material	Stabilize Bank	Stabilize Grade	Protect Infrastructure	Create Pools	Floodplain Connectivity	Establish Vegetation	Provide Slow Moving Water	Provide Cover	Direct Flow
FEATURE	Geotextile					X					X			
	Habitat Wood (Multiple, pool)		X	X	X	X			X				X	X
	Habitat Wood (Single, Pool)		X	X	X	X			X				X	
	Habitat Wood (Riffle)												X	
	Large Wood Revetment		X			X			X				X	X
	Boulder-Willow Toe					X					X		X	
	Floodplain Large Wood			X	X						X		X	
	Log/Boulder Vane					X								X
	J- Hook		X	X		X			X					X
	Willow Revetment			X		X					X		X	
	Step/Pool	X				X	X		X					
	Beaver Dam Analogue		X	X	X		X		X			X		
	In-stream Boulder/Cluster	X	X						X					
	Cascade/Riffle	X					X			X		X		
	Boulder/Log Toe					X		X						
	Brush Trench		X	X	X						X			
	Side Channel		X	X	X					X				
	Backwater Pool		X	X	X					X				
	Off-Set Rip Rap							X						
	Soil Lift					X								

LEFTHAND WATERSHED
oversight group

Photo Monitoring Supplemental Form

Name(s): _____ **Date/Time:**_____

Watershed:_____

Zone:_____

Project/Selected Reach: _____

Site_PhotoPoint	Azimuth	Date	GPS location UTM or lat./long.	Comments
Ex: 81st_PP1	80	9/17/18		Left bank, US, use for LWOG_Flow, Photo 1
81st_LWOG_Encroachment	52	9/17/18		Left bank, DS, Photo 2