Colorado Emergency Watershed Protection (EWP) Program
Sponsored by the Colorado Water Conservation Board (CWCB)
Administered by the Natural Resources Conservation Service (NRCS)
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CWCB Flood Recovery: Project Monitoring

The Colorado Water Conservation Board (CWCB) is supporting an effort to monitor the long-term effectiveness of flood recovery projects across the Front Range. Although project monitoring is not part of the Colorado EWP Program, many EWP projects will be included in the CWCB's effort.

This fact sheet presents information on the CWCB's long-term flood recovery monitoring program approach, objectives, and methods, and provides general project monitoring guidance to watershed coalitions and local sponsors.

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An Opportunity to Learn

The 2013 Colorado Front Range flood recovery effort is unprecedented in size and scope, spanning multiple watersheds and communities. Using a watershed-based approach, more than 100 restoration projects were conceived and built within five years of the disaster. Primary project goals included (1) reducing hazards and protecting life, safety, and property; and (2) enhancing the health and resilience of watersheds and stream corridors. The CWCB recognizes this effort as a rare opportunity to study the long-term effectiveness of flood recovery projects and to advance the science of stream restoration by evaluating the effectiveness of traditional and innovative rehabilitation techniques. This monitoring will also help to identify areas in need of adaptive management so that remedial activities can be initiated early on.

The objectives of the CWCB monitoring program may be different from the goals of a watershed group to monitor the success of flood recovery projects within their watershed as they relate to specific project goals or other watershed concerns (e.g., water quality, fisheries). Coalitions are invited and encouraged to meet with the CWCB to discuss project- or watershed-specific monitoring plans and strategies. The remainder of this document discusses methods specific to the CWCB's monitoring effort, but these may be used for coalition-specific monitoring as well.

Baseline Data

The initial phase of the CWCB monitoring effort is to collect baseline data. These data describe the initial "as-built" condition just after a project has been completed. As-built data are compiled from project completion reports and from repeatable surveys conducted onsite by professional stream and riparian scientists. The CWCB is collecting and organizing this information for future monitoring efforts by the CWCB, watershed coalitions, or others wishing to study the geomorphic and ecological response to flood recovery and stream restoration treatments. Stream surveys are designed to be repeatable and empirical so that important parameters can be tracked in the future to document changes and trends. Survey methods will be documented and made available in a forthcoming report.

Potential Uses of Monitoring Data

- demonstrate improvements at the site, corridor, and watershed scales
- compare effectiveness of unique design approaches, treatment types, and construction techniques
- inform adaptive management activities on individual project reaches
- answer future research questions

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Baseline Data Sources and Surveys

- **Aerial imagery**: Publicly available images or aerial photos collected in the field for qualitative comparison
- **Photo points**: Ground photos from monumented locations that can be repeated for qualitative comparison
- **Cross-section surveys**: Monumented station-elevation surveys across the floodplain and stream channel for quantitative analysis
- **Longitudinal profile surveys**: Station-elevation longitudinal surveys along the stream channel for quantitative analysis
- **Topographic surveys**: Topographic map generated from surveyed points, photogrammetry, and/or LiDAR data
- **Vegetation transects**: Monumented transects for measuring vegetation cover by species and/or functional guild for quantitative and qualitative comparison
- **Vegetation mapping**: Aerial mapping of riparian zone by vegetation type for quantitative and qualitative comparison
- **Micro-topography surveys**: Detailed topographic survey to map fine-scale topography
- **Facet delineation/mapping**: In-stream aquatic habitat type delineation based on velocity and depth
- **Pool area quantification/mapping**: Aerial map of pools meeting specific depth or residual depth criteria
- **Pebble counts**: Stream substrate classification for observing and quantifying changes in sediment distribution
- **Test banks**: Monumented streambank locations for measuring lateral accretion using bank pins and/or profiles
- **Wood counts**: Quantitative counts of large wood and woody material in the channel and/or on the floodplain

Monitoring Stream Health

The CWCB will use baseline and future monitoring data to understand stream health trends and to evaluate the goal of enhancing watersheds and stream corridors. Application of the Colorado Stream Health Assessment Framework (COSHAF), a Colorado-specific tool that uses the 11 variables listed below to evaluate the key factors that determine the health and resilience of a stream reach, helps to ensure that all relevant aspects of stream health are considered, and serves as a guide for determining which monitoring parameters are most relevant. The process begins with a baseline health assessment. Upward or downward trends in stream health factors may then be tracked using selected parameters, indicators, and observations made during future monitoring efforts. A list of suggested monitoring parameters will be developed for each important health variable at priority monitoring sites.

Some projects will also be assessed using the **Stream Visual Assessment Protocol (SVAP2)**, a qualitative rapid assessment tool developed by the Natural Resource Conservation Service (NRCS) that has been adapted for Colorado streams.

Stream Health Assessment Framework		
watershed	**Flow Regime**	Amount and timing of water supply.
	Sediment Regime	Amount, timing, and type of sediment supply.
	Water Quality	Physicochemical properties of water.
	Landscape	Buffer capacity and aquatic and terrestrial habitat connectivity.
reach	**Floodplain Connectivity**	Frequency, extent, and duration of floodplain saturation or inundation.
	Riparian Condition	Riparian habitat condition, including vegetation structure and diversity.
	Organic Materials	Supply of wood and detritius to the reach.
	Morphology	Reach morphology including stream evolutionary state, planform, dimension, and profile.
	Stability	Ability of the reach to maintain form via resistance, dynamic equilibrium, and resilience.
	Physical Structure	Physical habitat including water depth, velocity, structural components, and substrate.
	Biotic Structure	Community and trophic structure of the organisms that inhabit the reach.

Monitoring Tiers and Timeline

CWCB will prioritize projects for baseline data collection using three tiers:

- **Tier 0** – Design and as-built data will be compiled (~20 projects).
- **Tier 1** – Design and as-built data will be compiled, evaluated, and used for reconnaissance-level baseline stream health assessments (~30 projects).
- **Tier 2** – Design and as-built data will be compiled and evaluated, and additional field surveys will be conducted for routine-level baseline stream health and SVAP2 assessments. These sites will be equipped for repeated field surveys and long-term professional monitoring (~30 projects).

Seeking a diversity of Tier 2 projects, CWCB categorized each of the flood recovery projects based on watershed, geomorphic setting, stream type, funding source(s), design team approach, site access and accessibility, and other factors. In several cases, adjacent projects showcasing different techniques or methods were classified as Tier 2 for comparison purposes.

Site setup and baseline data collection for Tier 2 projects occurred in fall 2017 (October) or will occur in spring/summer 2018 (April-July). Future field surveys will be scheduled as needed on an annual or less-than-annual basis (as funding allows).

Tier 2 (High Priority) Long-Term Monitoring Projects (DRAFT-SUBJECT TO CHANGE)			
Name	**Watershed**	**Funding Source**	**Baseline Monitoring/ Site Setup**
Jasper Lake	Big Thompson	EWP/DR Implementation/DR Planning/SB-179	Spring 2018
North Fork	Big Thompson	EWP	10/4/2017
West Drake	Big Thompson	EWP/DR Implementation	?
Glen Haven - West Creek	Big Thompson	EWP	10/24/2017
Glen Haven - Fox Creek	Big Thompson	EWP	10/24/2017
Area 2	Coal Creek	EWP/DR Implementation	10/3/2017
Elkhorn	Estes Valley	EWP/DR Implementation/DR Planning	Spring 2018
River's Edge	Estes Valley	EWP/DR Implementation	Spring 2018
Morten Reach	Estes Valley	EWP/DR Implementation	10/25/2017
Hydroplant	Estes Valley	SB-179/DR Infrastructure	10/25/2017
Cheley Camp	Estes Valley	DR Implementation/DR Planning	10/23/2017
Upper Fish Reach 4 (BDAs)	Estes Valley	EWP/SB-179	10/23/2017
Wagon Wheel Gap	Fourmile Canyon Creek	EWP/DR Planning/SB-179	Spring 2018
Ingram Gulch	Fourmile	EWP/DR Implementation/DR Planning	Spring 2018
Wall Street	Fourmile	EWP/DR Implementation/DR Planning	Spring 2018
Reach 3b	Lefthand	DR Implementation	10/17/2017
Beilins-Hock	Lefthand	EWP/SB-179	Spring 2018
Ranch Property	Lefthand	EWP/DR Implementation	10/6/2017
Streamcrest/Lefthand CD	Lefthand	EWP/DR Implementation	10/16/2017
83rd Street Bridge	Little Thompson	EWP/DR Implementation	10/5/2017
Stagecoach Trail (Blue Mtn)	Little Thompson	EWP/DR Implementation/DR Planning	Spring 2018
Latham Diversion	Middle South Platte	DR Implementation/DR Planning	?
Highway 60	Middle South Platte	EWP	Spring 2018
Hall Ranch/Triangle	Saint Vrain	EWP/DR Planning/SB-179	Spring 2018
Lyons Rehabilitation Project	Saint Vrain	DR Infrastructure	Spring 2018

Other Monitoring Questions

Monitoring data collected by the CWCB will also become useful for tracking geomorphic responses. Channel and floodplain stability, migration, erosion, lateral accretion, scour, and deposition are not only important as stream health processes, but also are critical for evaluating the Colorado EWP Program goal of protecting life, safety, and property. Some projects were planned and developed with their own list of explicit goals and objectives, and all projects are built with specific expectations of landowners, partners, sponsors, and other stakeholders.

Watershed coordinators and other local sponsors are encouraged to articulate explicit or implicit project goals and expectations on a site-by-site or watershed basis, to critically evaluate project effectiveness based on these objectives, and to initiate and implement adaptive management activities where necessary. The CWCB monitoring program aims to support these efforts and can be a valuable source of data to supplement citizen science and other targeted monitoring and evaluation programs. We appreciate the cooperation of private landowners, watershed coalitions, and local project sponsors in helping us to achieve these goals.