

# THE CLARK FORK RIVER REACH A REMEDIATION AND RESTORATION PROJECT

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May, 2017

The logo for CDM Smith, featuring the letters "CDM" stacked above "Smith" in a bold, white, sans-serif font on a dark blue background.A horizontal decorative bar consisting of a green vertical bar on the left, a section with a blue water bubble texture, and three solid blue rectangular blocks of varying shades. Below this bar is the text "WATER + ENVIRONMENT + TRANSPORTATION + ENERGY + FACILITIES".

WATER + ENVIRONMENT + TRANSPORTATION + ENERGY + FACILITIES

# The Clark Fork River Reach A Remediation and Restoration Project

- Project Background
- Design Approach
- Construction Status
- Results to Date (monitoring)

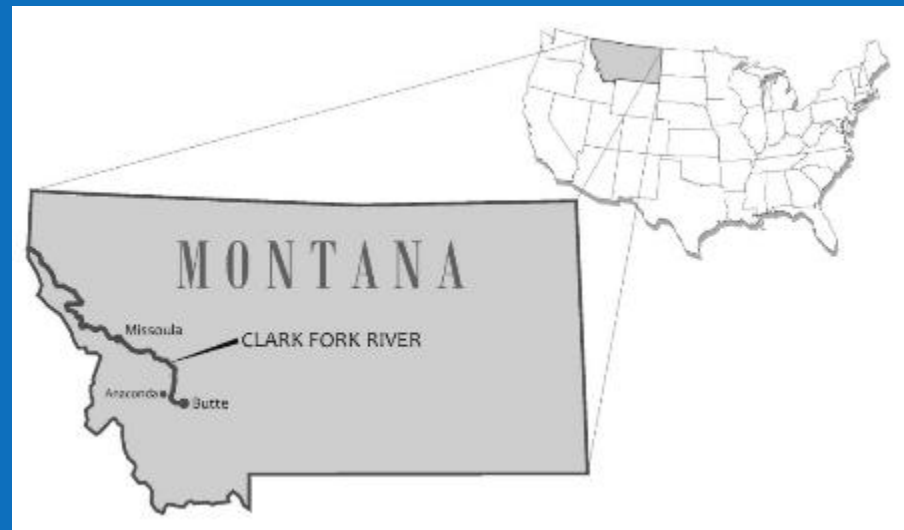


# Introduction

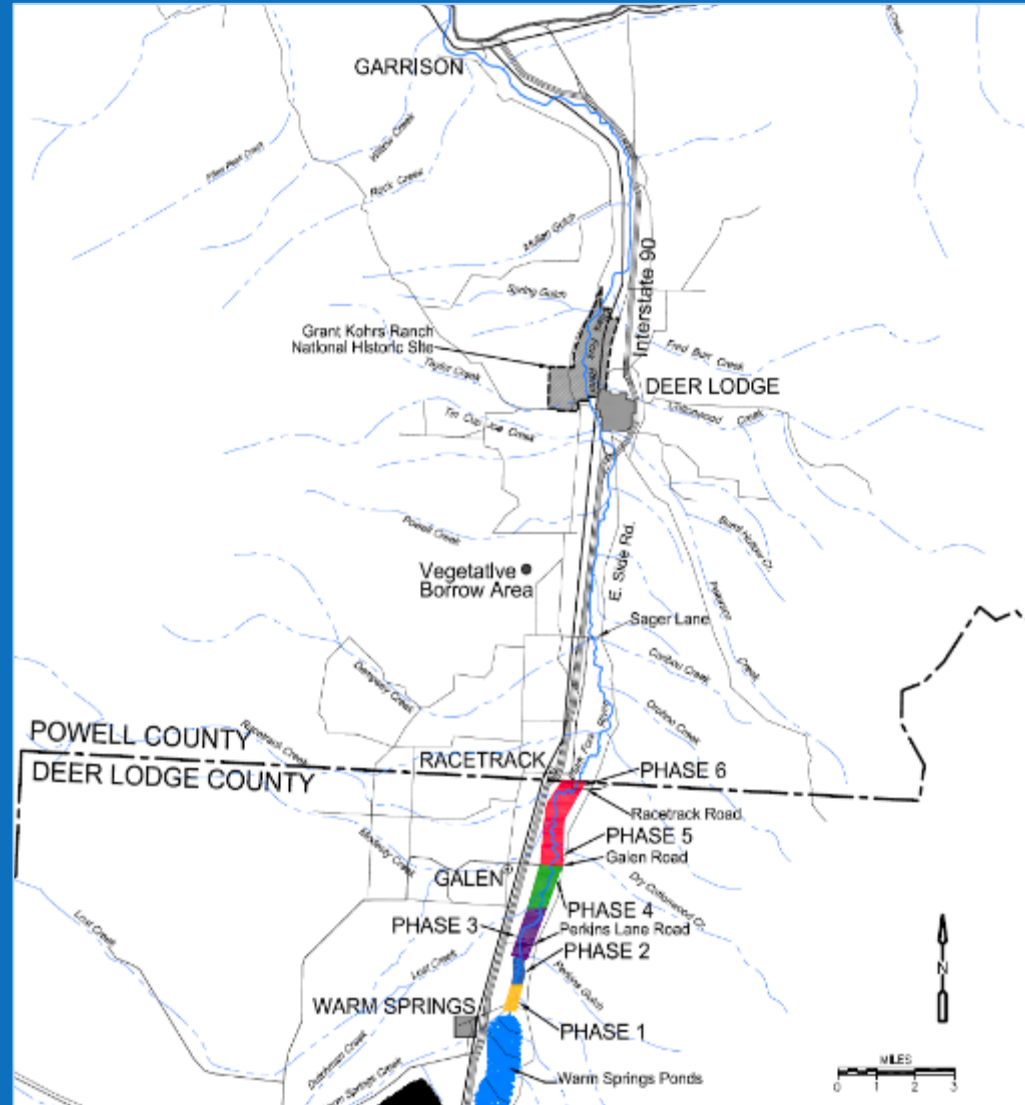
- Clients
  - Montana Department of Environmental Quality
  - Montana Department of Justice
  - Department of Interior – Grant Kohrs Ranch
  - Environmental Protection Agency - Oversight
- Engineers
  - CDM Smith
  - TetraTech
  - TerraGraphics
  - Dowl
- Other Consultants
  - Applied Geomorphology - Geomorphology
  - Geum Environmental Consulting – Vegetation Design
  - RESPEC - Monitoring

# Site Background

- Upper Clark Fork River Operable Unit
  - Part of the largest complex of Superfund Sites in the USA
  - Mine waste contamination from historic mining in the Butte - Anaconda region
  - Sites were listed in the early 1980s
  - Some sites are partially or largely remediated
  - Upper Clark Fork River remediation began in 2013
  - A 15 year remediation effort



# Project Location



# Project Objectives

- Remove tailings and contaminated soils from the floodplain
- Stabilize contaminated, eroding streambanks
- Reestablish vegetation appropriate to land use
- Meet applicable surface water and groundwater standards



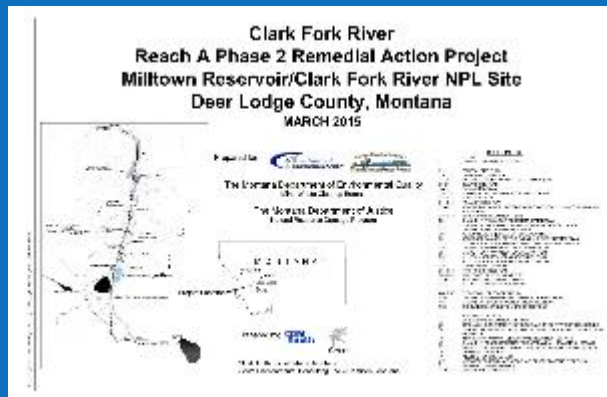
# Regulatory Guidance

- Record of Decision (2004)
- This is primarily a remediation project
- Restoration by DEQ is limited to what is necessary to produce a functioning stream and floodplain
- Additional restoration conducted by the Natural Resource Damage Program (Department of Justice)



# Magnitude of Project

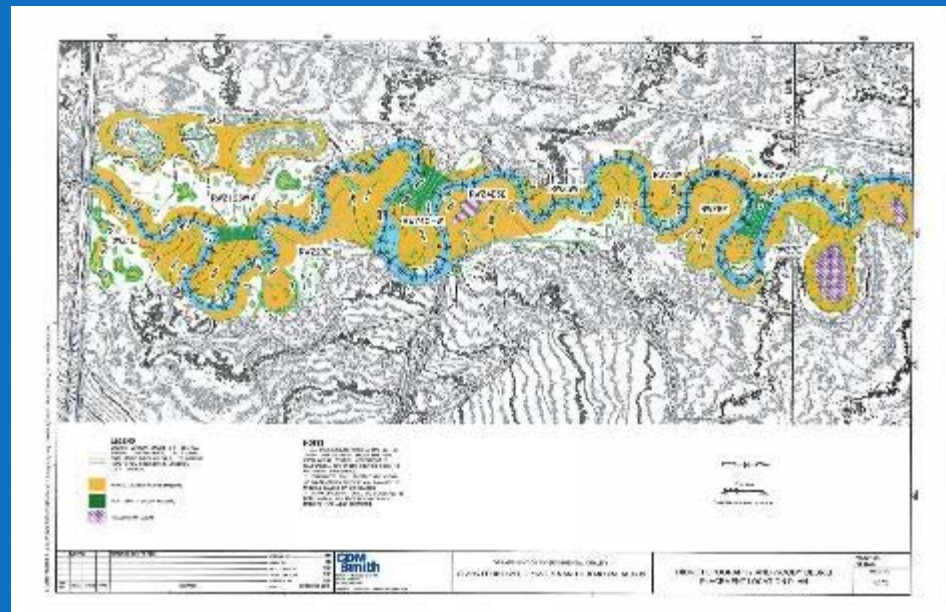
- 45 river miles between Warm Springs and Garrison
- Tailings removal volume on the order of 5,000,000 cy
- 15-year time frame for project
- Estimated cost of \$137,000,000 (net present value 2013 dollars)
- Need for a coordinated design approach





# Overview of Design Process

- Set remedial strategies based on project objectives
- Develop appropriate design criteria
- Develop design elements
- Present design for review by landowners, clients and Technical Review Committee
  - Landowner Plans
  - Preliminary Design
  - Draft Final Design
  - Bid Package



# Remedial Design Strategies

- Tailings – Remove and dispose at central repository
- Where feasible, reconnect the floodplain and river subject to landowner constraints
- Reinforce floodplain areas subject to higher risk of erosion
- Preserve well vegetated streambanks that have low risk of accelerated erosion
- Stabilize actively eroding streambanks with bioengineered treatments



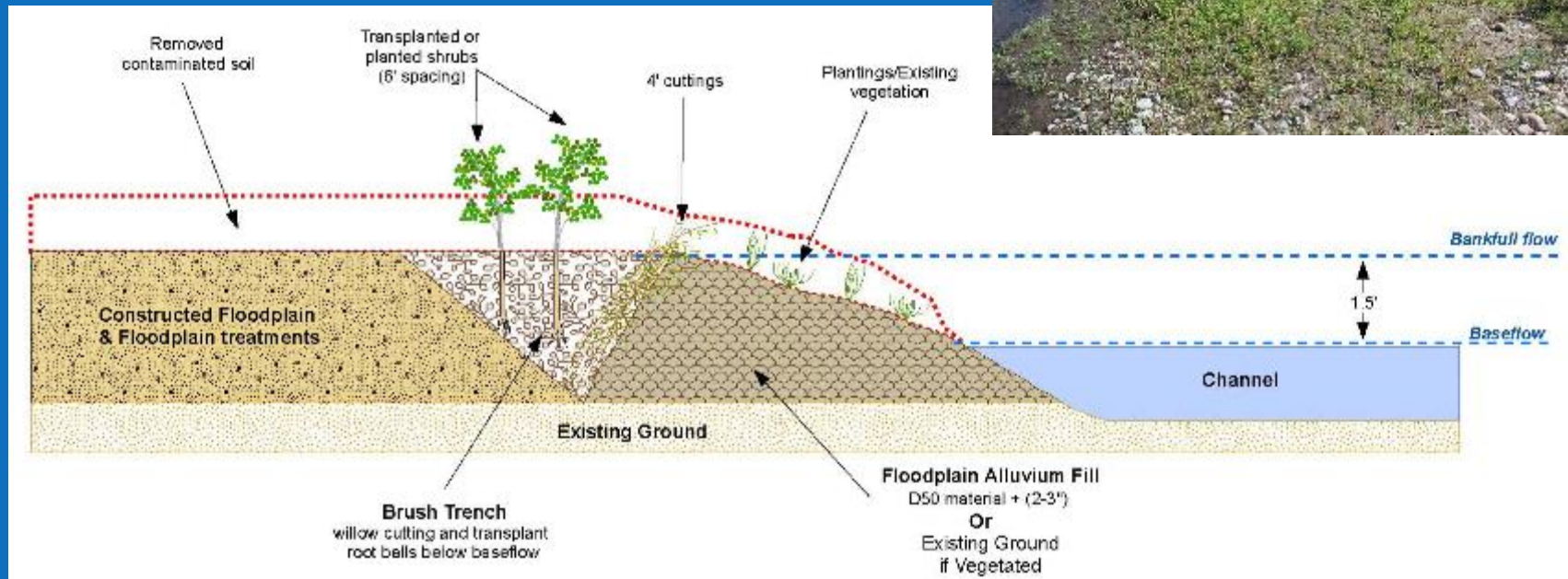
# Typical Existing Banks



# Preserve Vegetation



# Brush Trench Bank Treatment

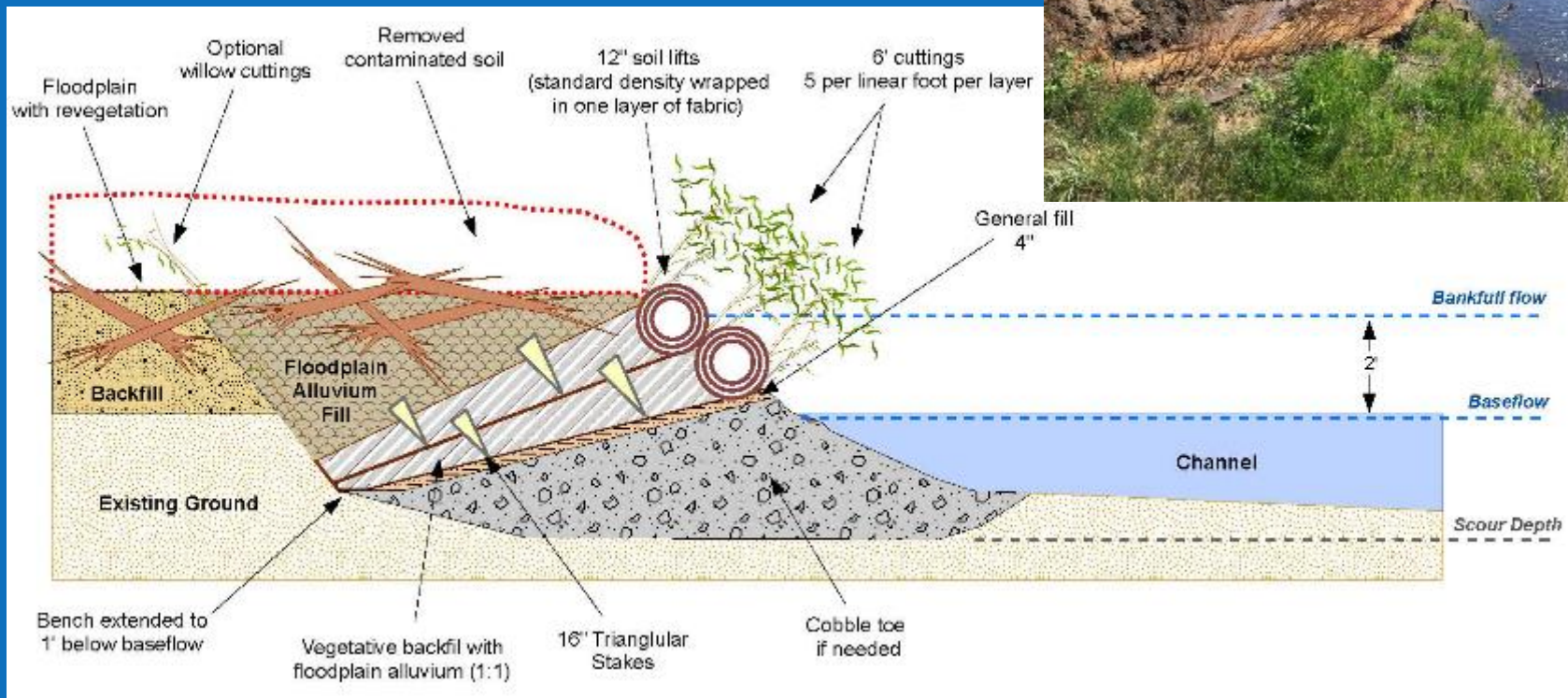


Drawing by Geum Environmental Consulting, Inc.

# Brush Matrix Bank



# Double Vegetated Soil Lift



Drawing by Geum Environmental Consulting, Inc

# Double Vegetated Soil Lifts Installed





# CONSTRUCTION TO DATE

- Four phases of 22 constructed

Project	Year Completed	Removal Area (acres)	Tailings (cy)	Stream Length (mi)
Phase 1	2014	64	332,000	1.3
Phase 2	2016	131	472,000	1.9
Phases 5 & 6	2016	136	539,000	4.5
Totals to Date	-	331	1,343,000	7.7



# Phases 1 and 2



# Tailings Removal



# Tailings Dewatering

- Trenches or wellpoints
- Sediment ponds for settling solids
- Discharge to river after treatment



# Tailings Dewatering



# Alluvium Borrow Area



# Backfill Materials



# Bank Layout





# Monitoring Program

- Perform Qualitative Rapid Assessments (QRA) for vegetation and geomorphology
- Objectives:
  - Evaluate a project phase to see if it is trending towards meeting goals and objectives
  - Determine effectiveness of required monitoring
  - Identify maintenance actions.
- Monitor geomorphology first year, monitor vegetation first and second years.
- After initial monitoring, geomorphic and vegetation monitoring occurs on year 5 and continuing at 5-year intervals.

# Monitoring Program

- Monitoring instituted at Phase 1 in 2015 and 2016 although some monitoring was also conducted in 2014
- Monitoring at Phases 5 and 6 began in 2016 for geomorphology with limited vegetation monitoring primarily in Phase 5.



# Phase 1 Geomorphic Evaluation – 2015 & 2016 QRA

- Conducted by Applied Geomorphology and RESPEC
- Channel Stability – largely stable
- Floodplain stability – No designed floodplain channels creating elevated avulsion risk
- Floodplain Elevation – Clear evidence of floodplain inundation with wood mobilization and fine sediment deposition.



# Phase 1 Geomorphic Evaluation – 2015 & 2016 QRA

- Out-of-bank flow in 2014 caused small avulsion paths across one meander tab.
- Banks heights are design approximately to the height of the two year recurrence flood event.
- Flow in 2014 was about 40 cfs higher than 2-year recurrence event.



# Phase 1 Geomorphic Evaluation

- Erosion due in part due to design and construction variance.
- Avulsion paths were backfilled and planted, upstream bank was elevated.



# Phase 1 Geomorphic Evaluation

- Some slumping of Double Vegetated Soil Lifts but none requiring maintenance
- Fabric used for Double Vegetated Soil Lifts (high strength woven coir) is disintegrating faster than expected but not a concern as long as willows are establishing.
- Willow growth is generally very robust in stream banks.



# Phase 1 Vegetation Evaluation 2015 & 2016

- Conducted by Geum and RESPEC
- Canopy Cover Woody Vegetation on Streambanks – trending towards 40% cover (5-year goal)
- Canopy Cover Woody Vegetation on Floodplain – Trending towards 30% cover (5-year goal)



# Phase 1 Vegetation Evaluation 2015 & 2016

- Herbaceous Vegetation on Floodplain – Majority of plots meet 20% cover by year 1; trending towards 5-year performance goal of 80% cover.
- Planted Woody Vegetation Survival – Majority meet 80% survival in year 1 but fell below 80% in year 2; however, overall canopy cover is increasing.





# Phase 1 Vegetation Evaluation 2015 & 2016

- Herbaceous plantings are meeting goals.
- Browse protection is helping woody plant establishment but is not entirely effective
- Complete wildlife exclosures are most effective.
- Also recommend installation of browse protectors in outer bank planting units of Phase 1.
- Recommended repairing exclosures and browse protectors.

# Phase 5 Vegetation Evaluation 2016

- Canopy Cover of Woody Cover on Streambanks – 42% of plots are meeting 5-year goal of 40% cover.
- Woody Vegetation survival – 71% of plots meeting 80% cover (5-year goal).
- Incomplete evaluation of floodplain cover for woody vegetation and herbaceous plants.



# Monitoring Summary

Related Monitoring Plan Metrics	Phase 1		Phases 5 and 6
	2015	2016	
	(Year 2)	(Year 3)	(Year 1 <sup>1</sup> )
<b>GEOMORPHOLOGY</b>			
<b>Channel Stability</b>			
Channel dimensions			
Slope and Sinuosity			
Bedform complexity			
Bank erosion and channel migration			
<b>Floodplain stability and secondary channel stability<sup>2</sup></b>			
<b>Floodplain connectivity<sup>2</sup></b>			
<b>VEGETATION</b>			
<b>Canopy cover woody vegetation on streambanks</b>			
<b>Canopy cover floodplain woody vegetation</b>			
<b>Canopy cover of herbaceous vegetation</b>			
<b>Woody vegetation survival</b>			

Table from *Qualitative Rapid Assessment 2015-2016 Status Report*, Geum and Applied Geomorphology, 2017

# Summary

- The Clark Fork River project is a large-scale river and floodplain remediation project with restoration components
- Described the design approach
- Presented a summary of construction completed
- Presented monitoring results
- Project approach is on track to meet most remedial and restoration objectives.



# Project Success - A Renewed River

