Upper Clark Fork Tributaries TMDLs For Sediment, Metals, and Temperature

Draft TMDL Document Public Meeting
Deer Lodge, Montana
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Montana Department of Environmental Quality

What is a TMDL?

- Total Maximum Daily Load is the amount (loading rate) of a pollutant that a water body can receive from all sources and still meet water quality standards.

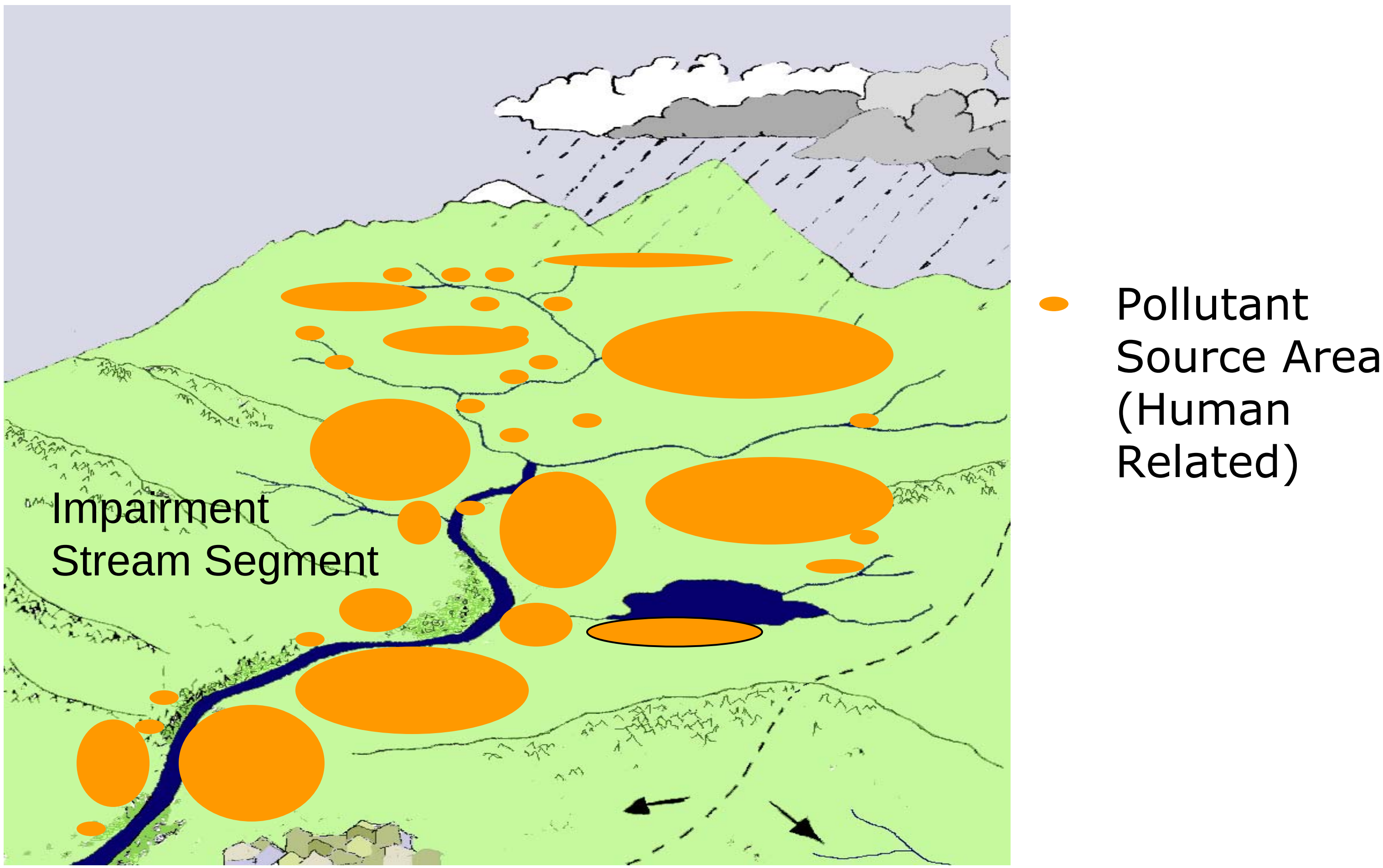
Pollutants

Sediment

Metals

Temperature

A Watershed Approach to Source Assessment



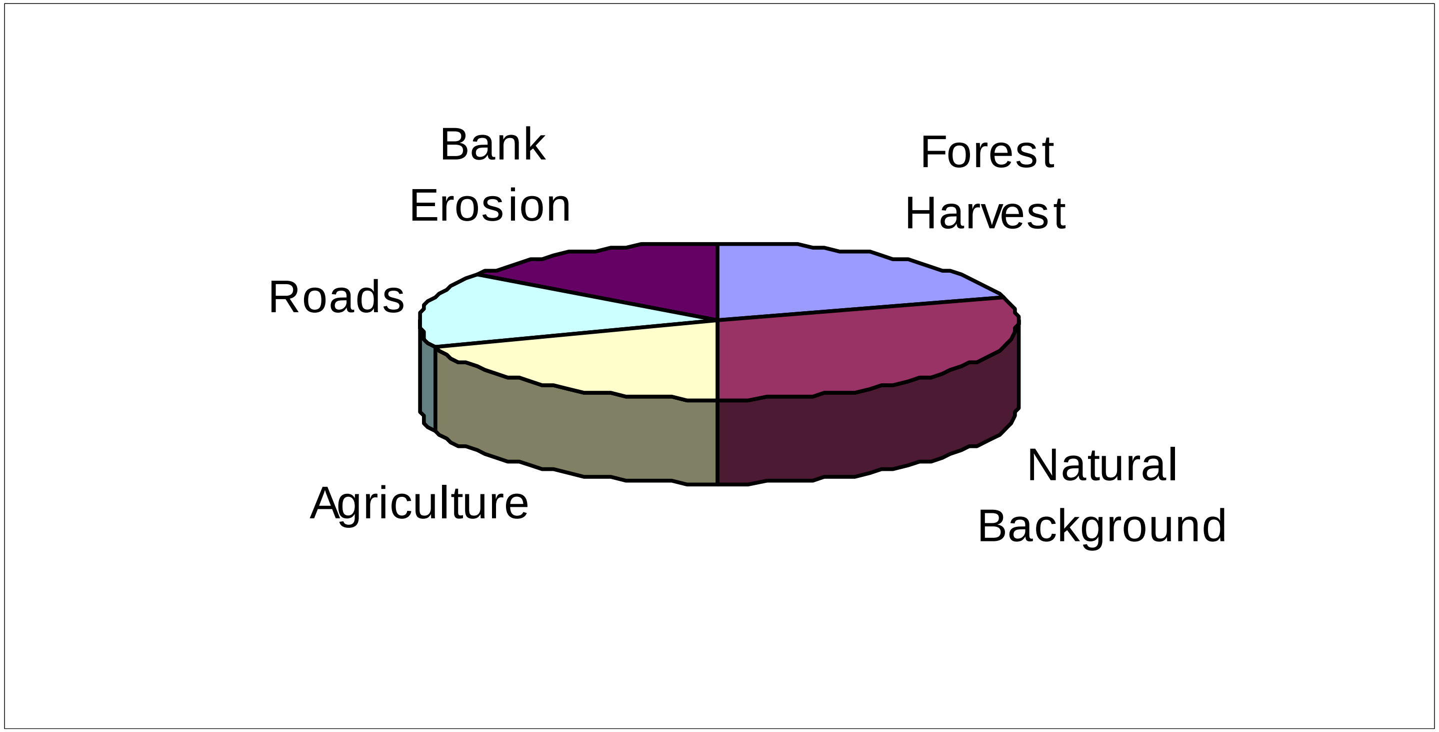
The TMDL Pieces

- TMDL = Load Allocation (LA) + Waste Load Allocation (WLA) + Margin of Safety
- The TMDL (Allowable Load) Must Be Allocated to Sources
- Loads Allocated to All Sources Must Equal Or Be Less Than The TMDL
- Allocations Usually Based on Existing Loading and Opportunity for Reductions Via BMPs, etc.

The TMDL Allocations

The TMDL is the pie.

The allocations are the pieces



Why TMDL?

- The Clean Water Act (CWA) requires assessment of waters
- Per CWA & Montana Law, TMDLs must be developed for those waters with pollutant causes of impairment
- Court Order: The DEQ is under a court order which influences our pace and focus for the TMDLs that get completed.

TMDL Development in Montana (and Everywhere)

- An individual TMDL is developed for each water body segment - pollutant combination
- One stream segment may have multiple TMDLs for different pollutants
- One stream may have multiple segments and therefore have multiple TMDLs for the same pollutant

TMDL Development in Montana

- TMDLs are developed at a watershed scale (TMDL Planning Areas) to address multiple water body impairments

- TMDLs in a planning area are usually combined into one final report (TMDL Document)

Major TMDL Steps

- Define Magnitude and Extent of Pollutant Impacts
- Characterize and Quantify Sources of the Problem (Source Assessment)
- Define Solutions via the TMDL & Associated Allocations

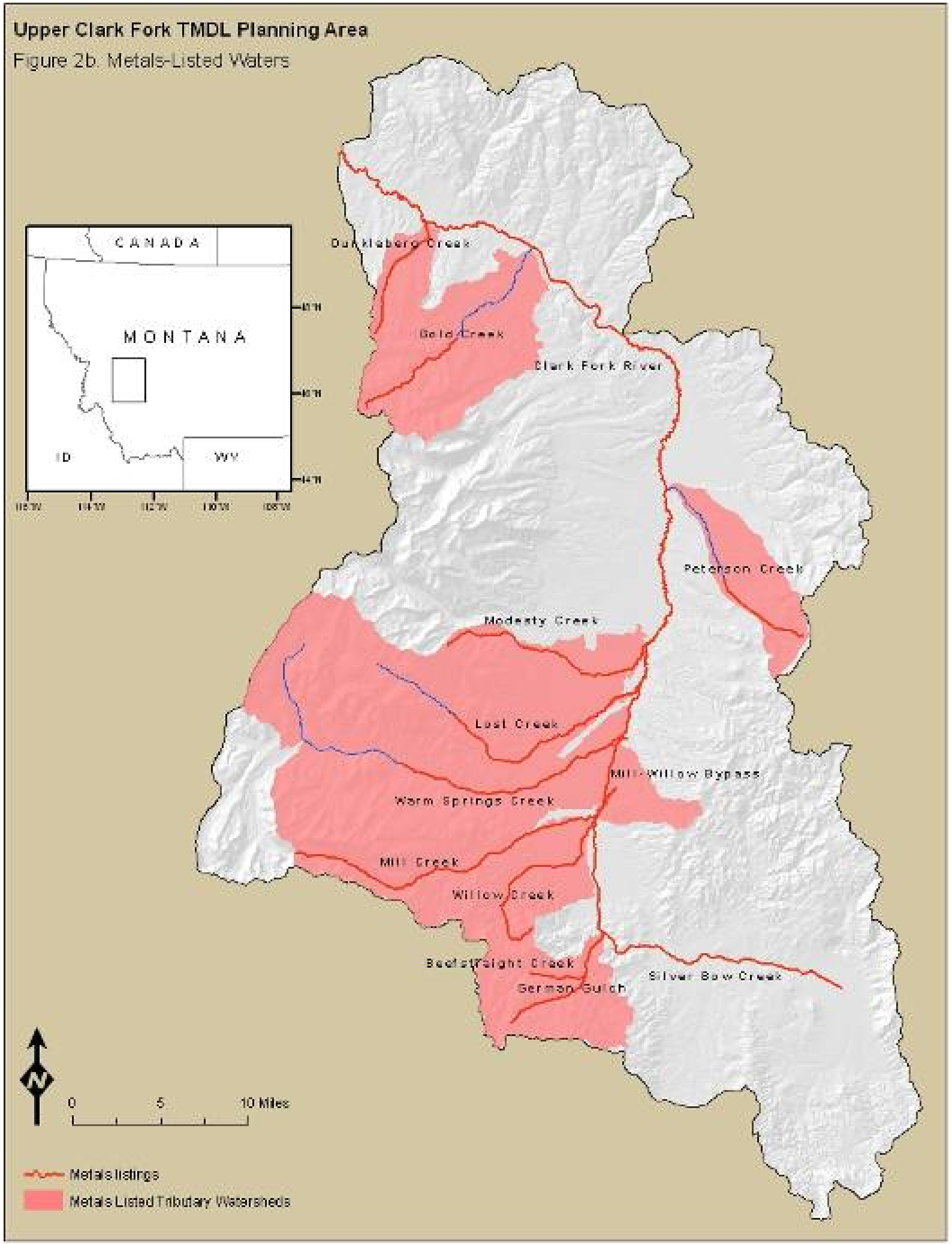
TMDL Components

- Environmental Targets
  - Linked to use support and state water quality standards
  - Used to assess existing and future conditions
- Source Assessment
- TMDL, Allocations and Margin of Safety
- Monitoring Plan
- Framework Restoration Strategy

What Streams Were Draft TMDLs Prepared For?

- **Metals (64)** – Beefstraight, Dunkleberg, Gold, Lost, Mill, Modesty, Peterson, Warm Springs (near Anaconda), and Willow Creeks and German Gulch and Mill-Willow Bypass.
- **Sediment (13)** – Antelope, Brock, Cable, Dempsey, Hoover, Peterson, Tin Cup Joe, Warm Springs (near Phosphate), Willow and Storm Lake Creeks
- **Temperature** – Peterson Creek
- The Little Blackfoot watershed, Mainstem Clark Fork River and Silver Bow Creek TMDLs, as well as all nutrient TMDLs in the Upper Clark Fork will be developed at a later time.

METALS



Upper Clark Fork TMDL Planning Area
Figure 2b. Metals-Listed Waters
CANADA
MONTANA
ID
WY
Dunkleberg Creek
Gold Creek
Clark Fork River
Peterson Creek
Modesty Creek
Lost Creek
Mill-Willow Bypass
Warm Springs Creek
Mill Creek
Willow Creek
Beefstraight Creek
German Gulch
Silver Bow Creek
0
5
10 Miles
Metals listings
Metals Listed Tributary Watersheds

Metals TMDLs

- 64 Metals TMDLs on 16 water body segments:
  - Beefstraight Creek
  - Dunkleberg Creek*
  - German Gulch
  - Gold Creek*
  - Lost Creek
  - Mill Creek*
  - Mill-Willow Bypass
  - Modesty Creek
  - Peterson Creek*
  - Warm Springs Creek
  - Willow Creek*

  - Aluminum
  - Arsenic
  - Cadmium
  - Chromium
  - Copper
  - Cyanide (Beefstraight Creek/German Gulch)
  - Iron
  - Lead
  - Manganese
  - Selenium (German Gulch)
  - Zinc

Metals - Water Quality Targets

- Established state numeric water quality standards are adopted as the water quality targets (Circular DEQ-7)

- Acute and chronic toxicity aquatic life standards are designed to protect aquatic life uses, while the human health standard is designed to protect drinking water uses

- TMDLs are written when either aquatic life or human health standard is exceeded

Metals - Water Quality Targets; Supplemental Indicators

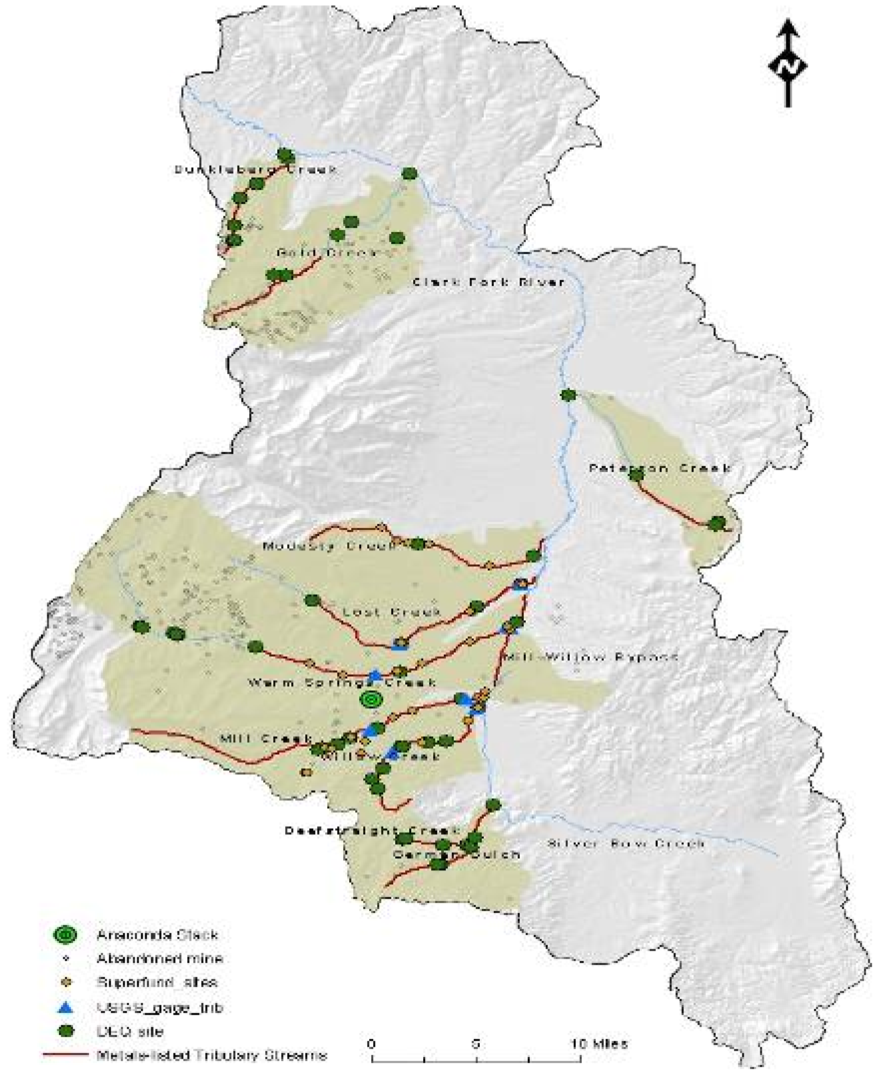
- Sediment Metals Concentrations
  - Narrative standards in Montana’s general water quality prohibitions apply to metals concentrations that are found in stream bottom sediments
  - NOAA has developed metals concentration guidelines for freshwater sediments
  - These are expressed as Probable Effect Levels (PELs)
- No elevated metals concentrations in fish tissue and no organ deformation
- No significant anthropogenic sources

Metals – Potential Sources

- Natural background loading from mineralized geology
- Atmospheric deposition from Anaconda Smelter and other historic smelters
- Abandoned mines, including adit discharge/drainage from abandoned mines and runoff/drainage from abandoned mine tailings
- Upland, in-stream, and floodplain metals deposits from historical mining operations
- Inter-basin transfers (i.e. irrigation)
- Permitted point sources

Metals Source Assessment

- DEQ High Priority/Abandoned Hardrock Mines/Active Hardrock Mines Database
- MBMG Abandoned and Inactive Mine Database
- Permitted and Unpermitted Point Source
  - Discharge Adits
  - Unstable Tailings
  - Floodplain Mining Wastes
  - Industrial Stormwater
- Available Data Review
  - Coarse review of pre-1994 data
  - Analysis of post-1994 data
- Data Collection
  - 2007/2008 High and Low Flow Sampling Events
  - Sediment Metals Data



Metals - TMDLs

- The TMDL represents the maximum amount of each metal that a stream can receive without exceeding water quality standards

- It is a function of the stream’s ability to dilute metals concentrations (i.e. stream flow), and for many metals, the water hardness (which effects toxicity and numeric water quality standard)

TMDL Equation

TMDL = (X)*(Y)*(0.0054)

- TMDL = Total Maximum Daily Load in lbs/day for metal of concern
- X = the chronic aquatic life use criteria (target) with hardness adjustments where applicable in ug/l for metal of concern
- Y = streamflow in cubic feet per second (cfs)
- 0.0054 = conversion factor

Metals – Example TMDL: Lost Creek

TMDL = (target concentration)*(flow)*(0.0054)

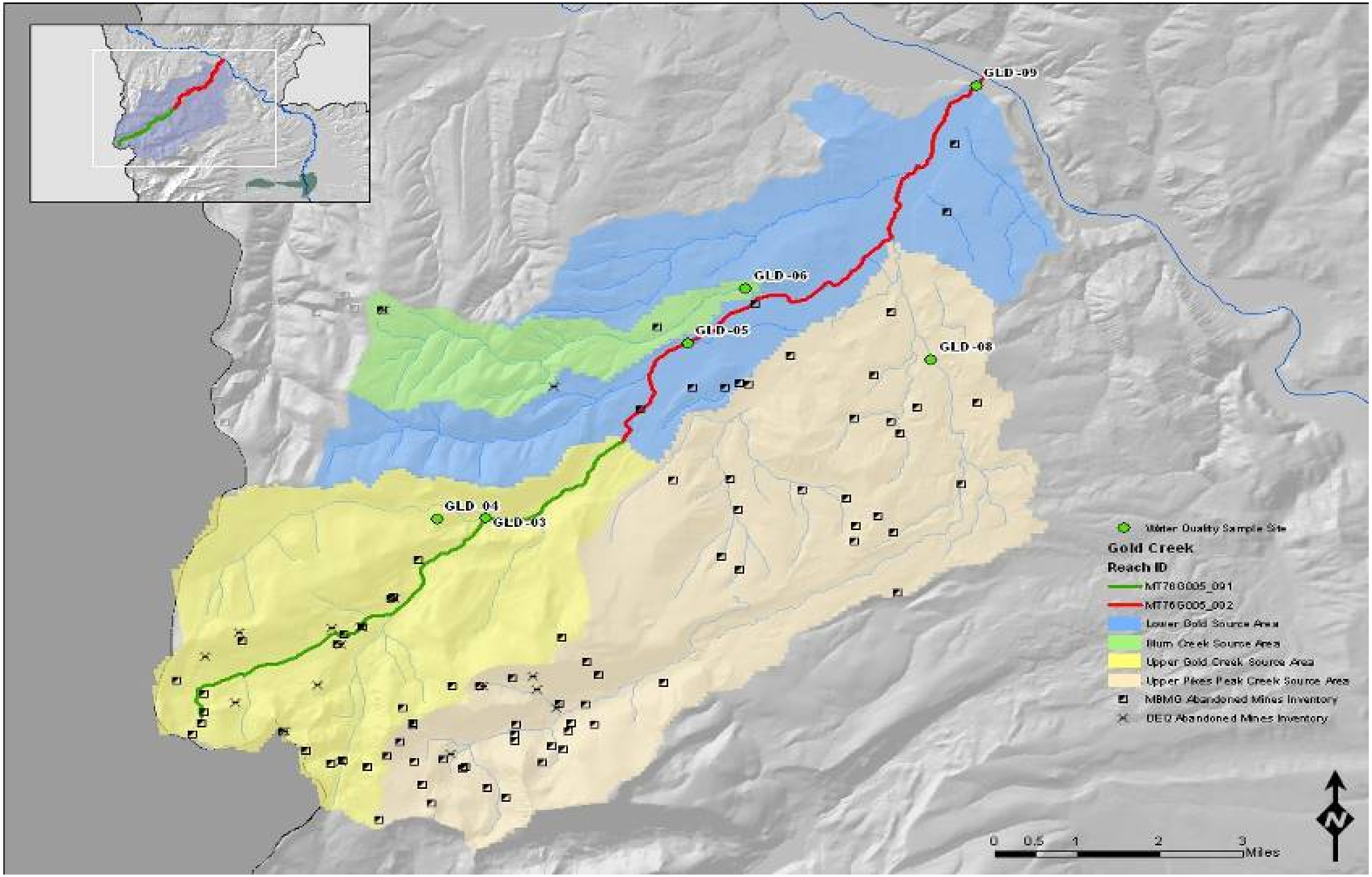
Metal	Target Conc (µg/L)			TMDL (lbs/day)			Percent Load Reduction Based on Sampled Target Exceedance		
	Storm flow	High flow	Low flow	Storm flow	High flow	Low flow	Storm flow	High flow	Low flow
Arsenic	10	10	10	0.036	0.594	0.130	89%	29%	60%
Copper	9.96	8.04	10.12	0.033	0.651	0.053	85%	57%	0%
Lead	3.51	2.55	3.59	0.012	0.207	0.019	64%	9%	0%

Metals Allocations

- Based on source assessment
  - Mining complexes
  - Source areas with numerous sources
  - All mining sources in a watershed or subwatershed
  - Naturally occurring
  - Discrete Source (waste load allocation)

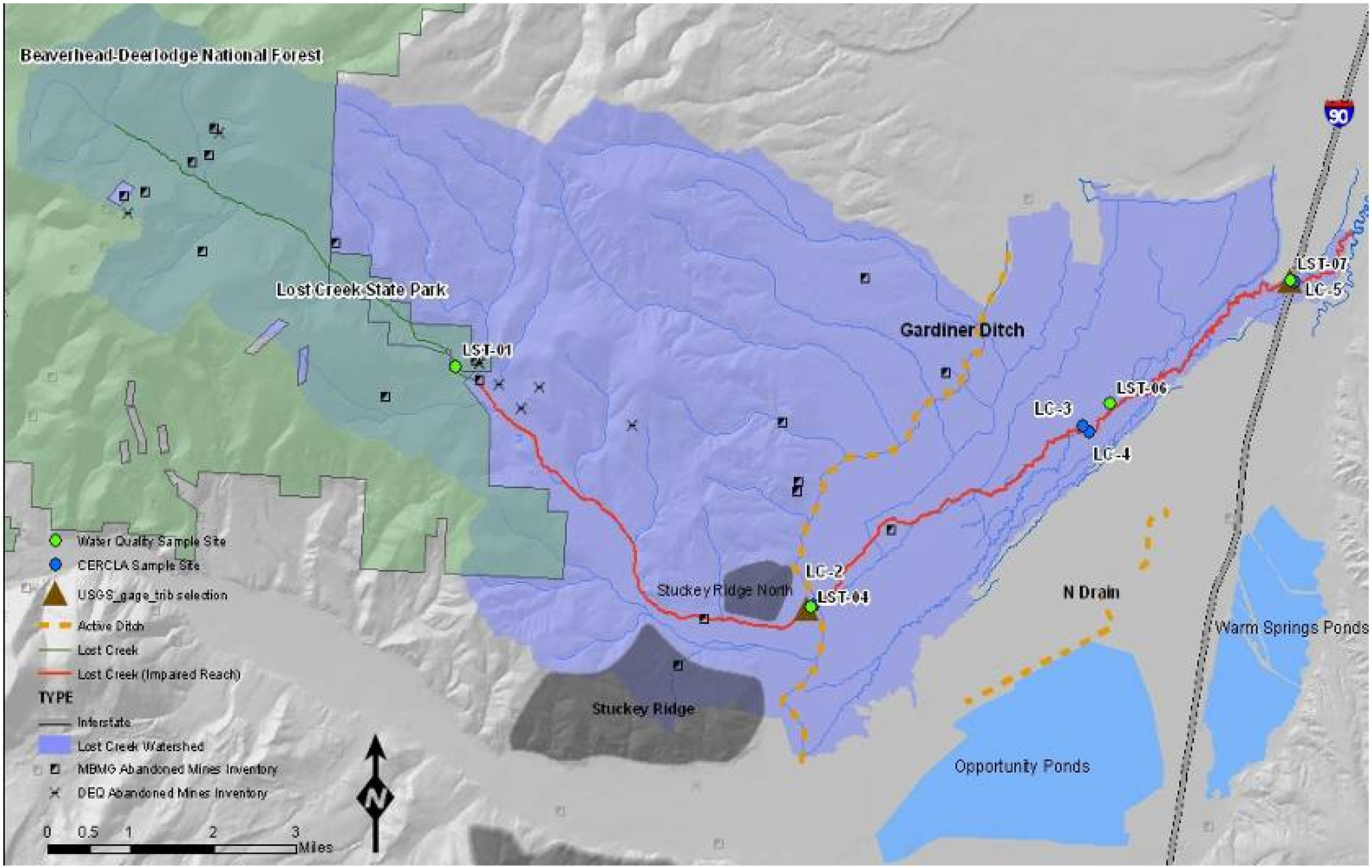
Allocation Example: Source Areas

$$TMDL_{Gold} = LA_{GoldNat} + (WLA_{Blum} + WLA_{PPeak} + WLA_{UppGold} + WLA_{LowGold})$$



Allocation Example: Entire Watershed

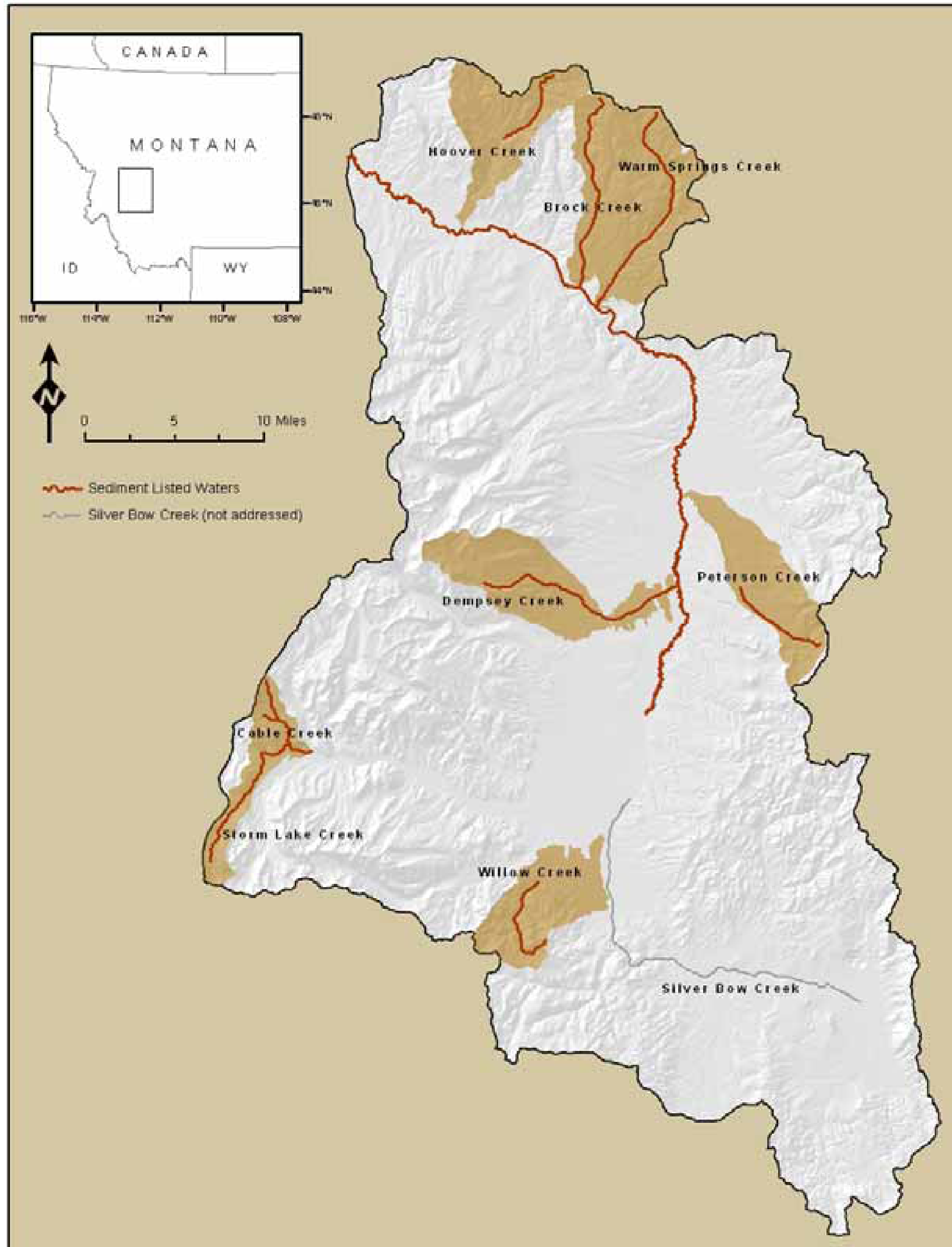
$$TMDL_{Lost} = LA_{Lost} + LA_{LostNat}$$



Metals – Restoration Strategy

- Primarily relies on regulatory mechanisms such as CERCLA (Fed Superfund), AML, and CECRA (State Superfund)
- Grant funding: Upper Clark Fork River Basin, Resource Indemnity Trust/Reclamation and Development Grants Program (RIT/RDGP), and 319

SEDIMENT



CANADA
MONTANA
ID
WY
0
5
10 Miles
Sediment Listed Waters
Silver Bow Creek (not addressed)
Hoover Creek
Warm Springs Creek
Brock Creek
Peterson Creek
Dempsey Creek
Cable Creek
Storm Lake Creek
Willow Creek
Silver Bow Creek

Sediment – Water Quality Targets

- State water quality standards for sediment are ‘narrative’
  - No increases are allowed above naturally occurring concentrations of sediment or suspended sediment, (except as permitted in 75-5-318, MCA), settleable solids, oils, or floating solids, which will or are likely to create a nuisance or render the waters harmful, detrimental, or injurious to public health, recreation, safety, welfare, livestock, wild animals, birds, fish or other wildlife.

Sediment – Water Quality Targets

- To aid in the translation of the narrative standard, water quality targets are developed for a suite of sediment related parameters
- Water quality targets help define the degree of impact from sediment

Upper Clark Fork TPA Sediment and Habitat Targets		
Sediment and Habitat Water Quality Target	**High Gradient Reaches (>2% slope, including Rosgen A and B stream types)**	**Low Gradient Reaches (<2% slope, including Rosgen C and E stream types)**
Morphology		
Width/Depth Ratio	≤15	≥12 - ≤22
Entrenchment	1.4 - 2.2	≥2.2
Substrate Composition		
Pebble Count, % <2mm	≤7	≤10
Pebble Count, % <6mm	≤18	≤23
Pool Habitat		
Residual Pool Depth (feet)	≥0.8	≥1.0
Pool Frequency (per 1000 feet of stream)	≥15	≥12

Sediment – Water Quality Targets; Supplemental Indicators

- Additionally, riparian Greenline provides insight into the condition of streambanks and overall riparian quality which often is associated with factors that may be leading to increased sediment loads and the reduction of habitat
  - 80% or greater shrub cover under most conditions
  - 5% or less bare ground under most conditions

Sediment – Potential Sources

- Natural erosion as a result of climatic and hydrologic processes

- Human Influenced Sediment/Erosion
  - Sediment from roads and road crossings
  - Land use management
    - Grazing Practices
    - Timber Harvest
    - Crop Production
    - Development
  - Bank Erosion
    - Riparian Degradation/Removal
    - Unnatural Flow Fluctuations

Sediment Source Assessment

- 2007 Field Sediment and Habitat Data Collection and Aerial Assessment
  - Bank Erosion (BEHI method)
  - Morphology (cross-section, pool/riffle relationships, pool quantity/quality)
  - Substrate composition
  - Riparian Greenline
- Roads investigation review and aerial assessment of Upper Clark Fork TPA road network
- Upland sediment modeling
- Review of historic data/information, such as NRDP/FWP Fishery Studies, USFS data, etc

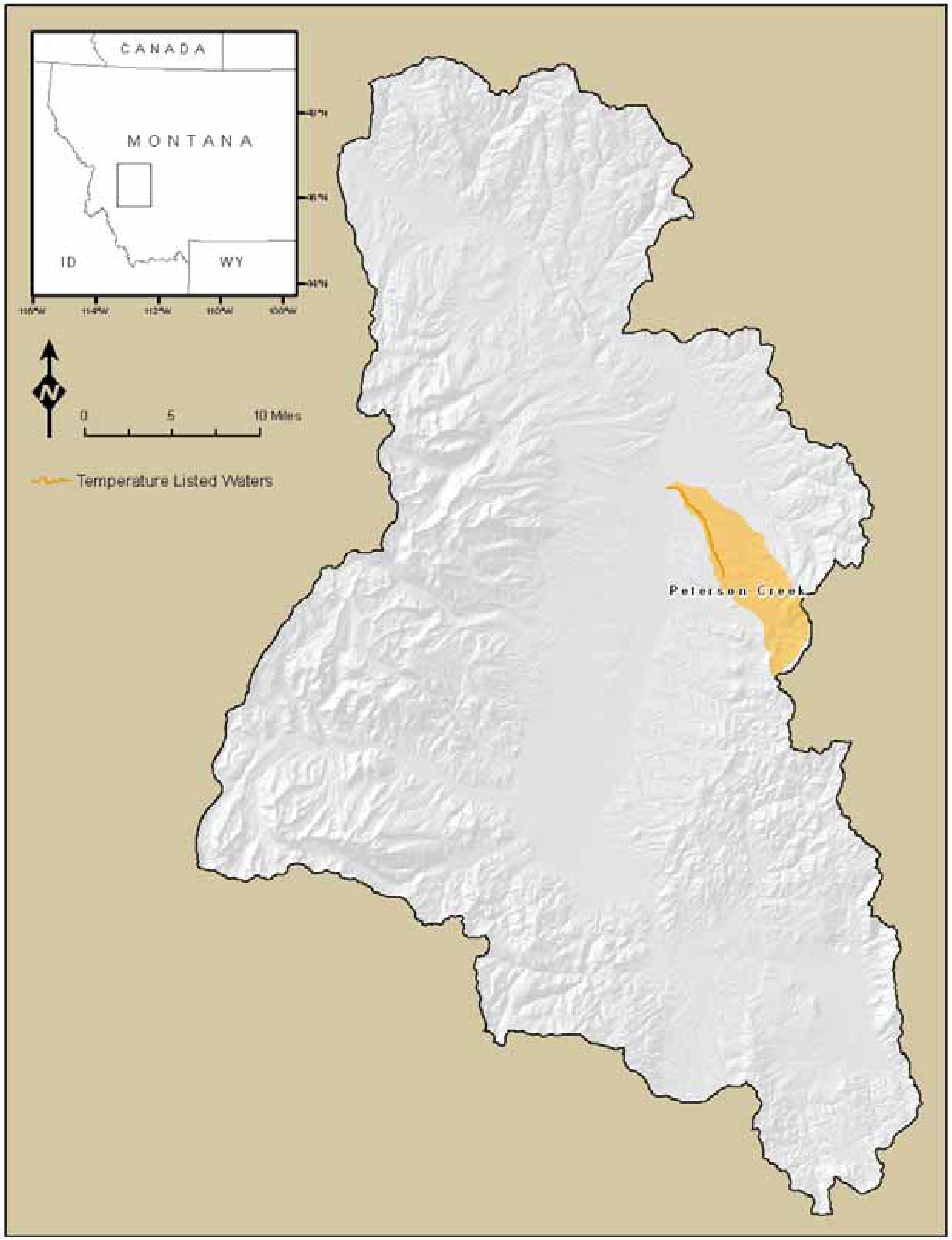
Sediment – TMDLs

- The TMDL for sediment is expressed as the sum of the sediment loads from all sources assuming all reasonable land, soil, and water conservation practices are in place
- The sediment loads are derived from the source assessment

Sediment – Example TMDL and Allocation

Brock Creek Sediment TMDL				
Sources		**Current Estimated Load (Tons/Year)**	**Sediment Load Allocation (Tons/Year)**	**Sediment Load Allocation – Expressed as Percent Reduction**
Roads		54	24	56%
Eroding Banks	Anthropogenically Influenced	519	223	48%
	Natural	100	100	
Upland Erosion	All Land Uses	3238	2234	31%
Total Sediment Load		3911	2581	34%

TEMPERATURE

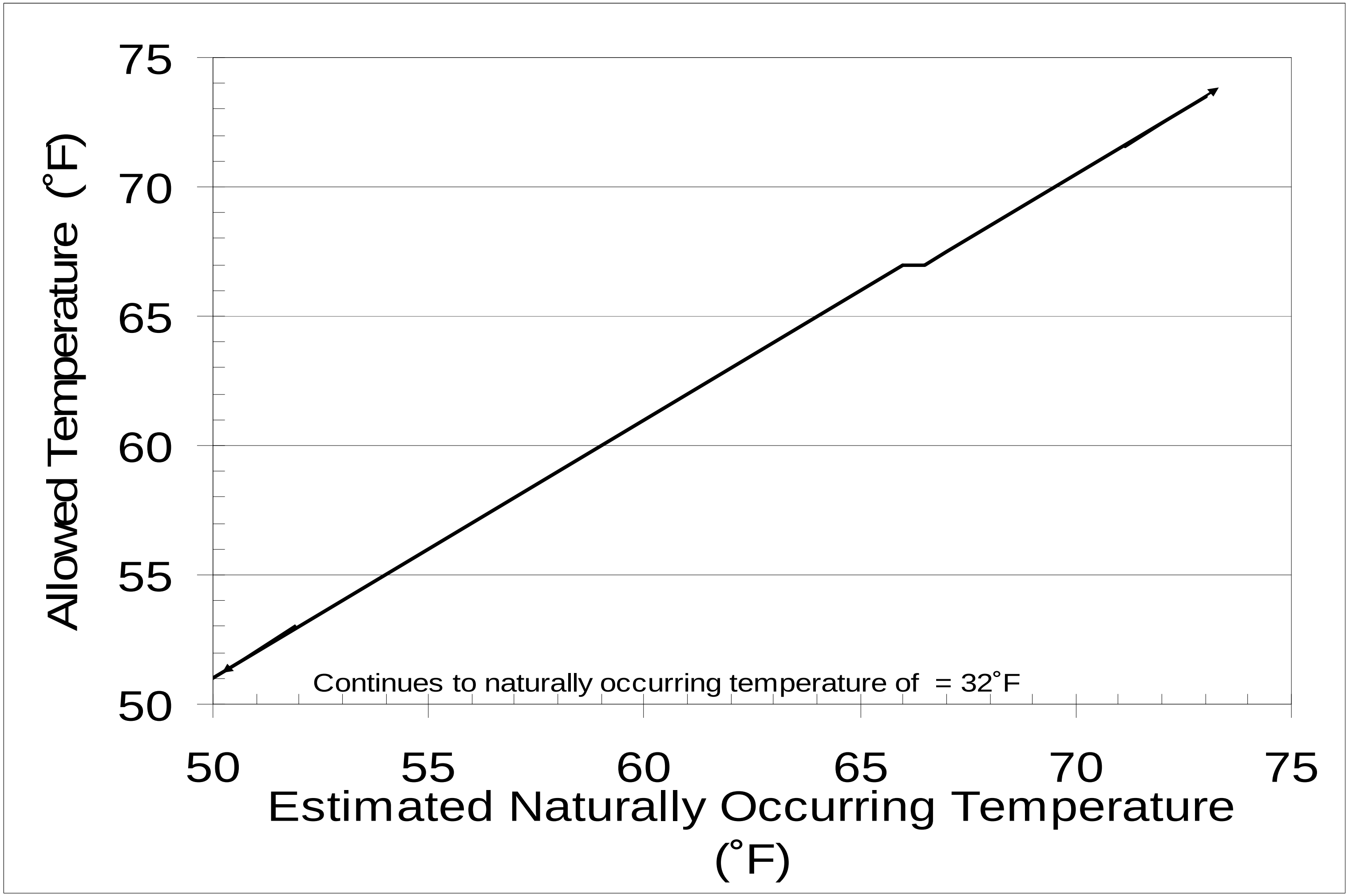


Temperature – Water Quality Targets

- Montana's temperature standards address a maximum allowable increase above "naturally occurring" temperatures

- For Peterson Creek, the maximum allowable temperature increase over naturally occurring temperature is
  - 1°F if the naturally occurring temperature is less than 67°F, and the rate of change cannot exceed 2°F per hour
  - 0.5°F if the naturally occurring temperature is greater than 67°F

Temperature - TMDL

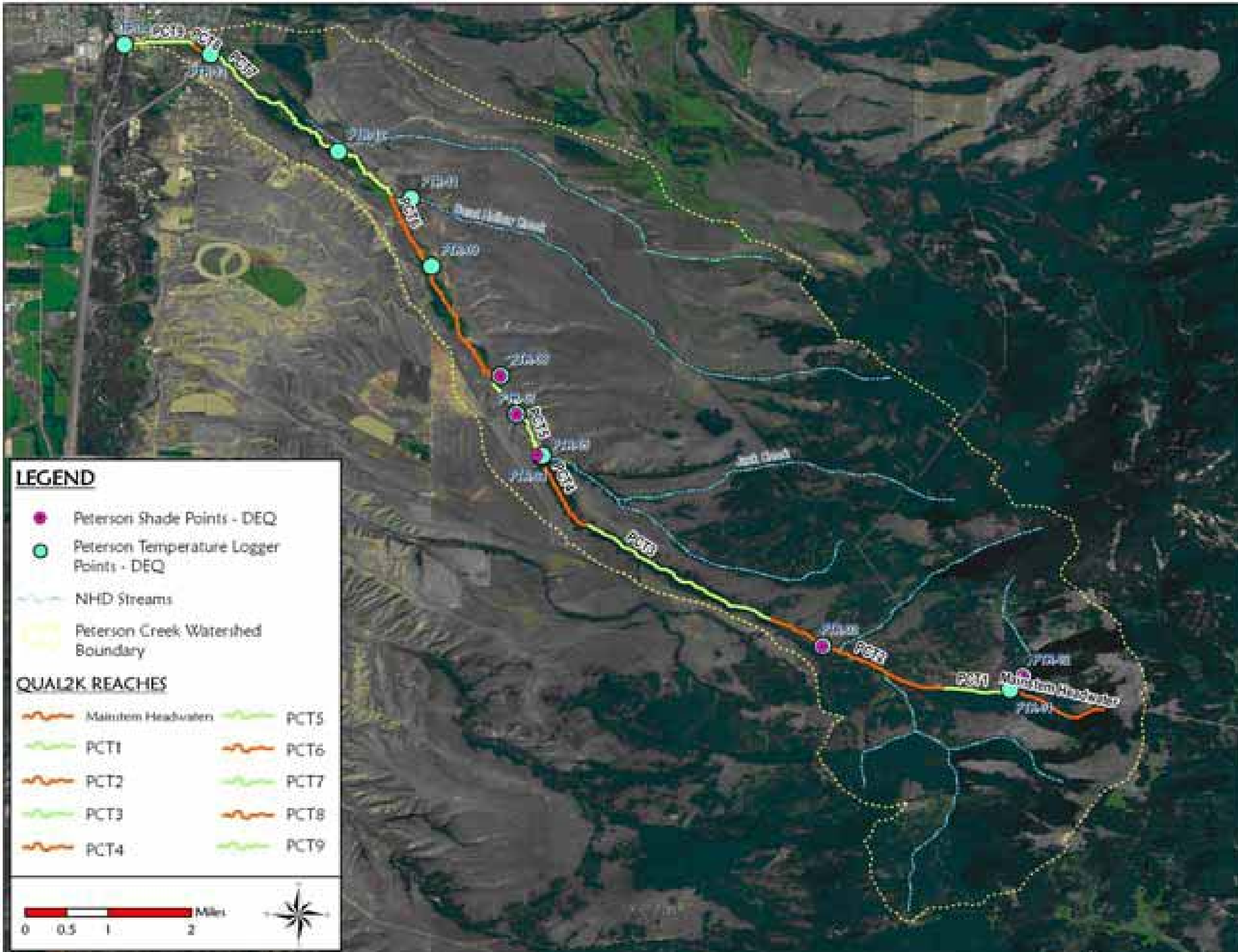


Temperature – Source Assessment

- To determine “naturally occurring” temperature conditions and if temperature increases are the result of anthropogenic activities, a QUAL2K water quality model was applied

- The model incorporated real temperature, flow, and shade information collected in 2007, which was used to calibrate the model to best represent existing conditions

- Additional scenarios were run in the model to represent conditions absent of human influence, as well as potential restoration approaches to determine targeted temperature conditions



LEGEND
Peterson Shade Points - DEQ
Peterson Temperature Logger Points - DEQ
NHD Streams
Peterson Creek Watershed Boundary
QUAL2K REACHES
Mainstem Headwaters
PCT1
PCT2
PCT3
PCT4
PCT5
PCT6
PCT7
PCT8
PCT9
Miles
0
0.5
1
2

Temperature – Source Assessment

- The 'naturally occurring' scenario represents water temperature conditions resulting from the implementation of all reasonable land, soil, and water conservation practices
- The comparison between modeled existing conditions and the naturally occurring scenario provides the basis for the targets, TMDL, and allocation

Temperature – Source Assessment

Peterson Creek Temperatures Relative to Montana's Water Quality Standards.					
Data Logger Site	**Field Measured Data**	**QUAL2K Existing Conditions**	**Departure from Field Data (ºF)**	**QUAL2K Naturally Occurring Scenario**	**Departure from Existing Conditions Model (ºF)**
	Maximum Temperature (ºF)	**Maximum Temperature (ºF)**		**Maximum Temperature (ºF)**	
PTR-01	60.0	63.5	3.53	63.5	0.00
PTR-03	69.4	67.5	-1.89	67.5	0.00
PTR-07	71.0	68.4	-2.54	68.4	0.00
PTR-09	71.9	78.2	6.23	66.9	**-11.21**
PTR-12	72.4	77.3	4.86	67.6	**-9.61**
PTR-13	66.6	73.6	6.97	70.1	**-3.47**
PTR-14	75.8	78.3	2.43	68.6	**-9.72**
Bold text indicates violation of Montana's water quality standard					

Temperature – TMDL

- For temperature TMDLs, because of the dynamic temperature conditions throughout the course of a day, the TMDL is the thermal load, at any instantaneous moment, associated with the stream temperature when in compliance with Montana's water quality standards

- This can be represented by the following equation and graph:
  - $(\Delta-32)*(Q)*(15.7)$ = Instantaneous Thermal Load (ITL)

  Where:
    - Δ = allowed temperature
    - Q = instantaneous discharge in CFS
    - ITL = Allowed thermal load per second in kilocalories per day above waters melting point
    - Conversion factor = 15.7

Temperature – TMDL

- The equation and translation of temperature to an ITL allows for a quantitative expression by which to compare to Montana's state standard and accurately define a thermal load, however in practical terms this is not readily translatable to on-the-ground management or allocation of load among sources

- Therefore, it may also be expressed through surrogates that would result in compliance with state standards

Temperature – TMDL

- As such, the Peterson Creek temperature TMDL is also expressed as:

TMDL for Temperature in Peterson Creek.	
The TMDL equals the resultant thermal load associated with stream temperature when all conditions below are met:	
Source Type	**Load Allocation (surrogate)**
Agricultural activities and other land uses that could impact riparian health and resultant shade provided by the riparian or near stream vegetation.	Peterson Creek between Jack Creek and mouth: the thermal load that can reach the stream when there is an average daily shade of 85% using a Solar Pathfinder, with specific focus from Jack Creek to Burnt Hollow Creek, and Boulder Road to the mouth.
Agricultural activities or other land uses that could impact Channel width/depth ratio	No measurable increase in thermal loading to the stream from preventable human caused increases in width/depth ratios throughout Peterson Creek. This can be evaluated as any measurable decrease in the average daily shading of a stream reach as measured via the Solar Pathfinder.

Temperature Targets

Targets for Temperature in Peterson Creek.	
Water Quality Targets	**Criteria**
Maximum allowable increase over naturally occurring temperature	For waters classified as B-1, a 1ºF maximum increase above naturally occurring water temperature is allowed within the range of 32ºF to 66ºF; within the naturally occurring range of 66ºF to 66.5ºF, no discharge is allowed which will cause the water temperature to exceed 67ºF; and where the naturally occurring water temperature is 66.5ºF or greater, the maximum allowable increase in water temperature is 0.5ºF.
OR meet ALL of the temperature influencing restoration targets below	
Riparian Shade	Peterson Creek between Jack Creek and mouth: average daily shade 85% as measured using Solar Pathfinder, with specific focus from Jack Creek to Burnt Hollow Creek, and Boulder Road to the mouth.
Channel width/depth ratio	No preventable human caused increases in width/depth ratios throughout Peterson Creek.
Irrigation water management	15% improvement in irrigation efficiency during the warmest months (mid-June through August).
Inflows to stream	No human caused surface water inflow, in single or in combination, will increase temperatures more than ½ ºF.

NEXT STEPS - PRIORITIZATION

- Use information from the TMDL, and other large scale assessment efforts throughout the watershed (Superfund, NRDP, etc) to address water quality issues in an efficient and effective manner.

- The WRC will be developing a Watershed Restoration Plan (WRP) to help with this prioritization.

NEXT STEPS - MONITORING

- Additional monitoring or assessment may be necessary in some cases to further refine and identify restoration needs.
- Monitoring is also an essential component to measure success over time as projects are developed.

NEXT STEPS – IMPLEMENTATION

- Goals:
  - Improve and restore riparian corridors to provide shade, filter sediment, and stabilize eroding banks
  - Improve grazing/agricultural and other land use management practices to reduce pollutant loading while still providing viable and sustainable economic growth
  - Install all appropriate BMPs to road and road crossing networks throughout the Upper Clark Fork watershed
  - Investigate irrigation networks and management and improve summertime flows when/where possible
  - Prevent contaminated sediment and waste rock/ tailings from migrating into adjacent surface waters
  - Reduce or eliminate concentrated runoff and discharges that generate sediment and/or heavy metals contamination to adjacent surface waters and groundwater

NEXT STEPS – ADAPTIVE MANAGEMENT

- Full attainment of targets/TMDLs
- Failure to achieve target attainment due to underperformance or ineffectiveness of restoration actions. The target may or may not be modified based on additional information, but additional restoration will be needed.
- Failure to achieve target attainment, but target attainment is deemed unachievable even though all applicable monitoring and restoration activities have been completed. Under this scenario, site-specific water quality standards and/or the reclassification of the water body may be necessary.

NEXT STEPS

- Development of the Watershed Restoration Plan
- Seek Funding to Implement Projects
- Integration with other watershed priorities and future TMDL development
  - Little Blackfoot watershed
  - Upper Clark Fork Tributaries (nutrient TMDLs)
  - Silver Bow Creek
  - Clark Fork River