



Cooke City TMDL Implementation Evaluation



Gold Dust

Final

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ACRONYMS

Acronym	Definition
ADB	Assessment Database
DEQ	Department of Environmental Quality (Montana)
EPA	Environmental Protection Agency (US)
GPM	Gallons per Minute
MCA	Montana Code Annotated
MWCB	Mine Waste Cleanup Bureau (DEQ)
TMDL	Total Maximum Daily Load
USDA	United States Department of Agriculture
USFS	United States Forest Service
USGS	United States Geological Survey

EXECUTIVE SUMMARY

The Cooke City TMDL Implementation Evaluation (Evaluation) summarizes efforts that have been made to address the water quality issues described in the document titled *“Water Quality Restoration Plan for the Cooke City TMDL Planning Area,”* (2002) (TMDL document). The TMDL document provides recommendations for restoration and monitoring associated with 40 different pollutant/waterbody combinations. The recommendations are generally associated with one or more of the following: 1) the New World Mining District Response and Restoration Project, 2) the McLaren tailings adjacent to Soda Butte Creek, 3) identification of unknown or uncharacterized pollutant sources within the Montana portion of the watershed(s), and 4) pollutant loading from sources within the Wyoming portion of the watershed(s). TMDL document recommendations associated with the New World Mining District have for the most part, either been implemented or are in the planning stages of being implemented. TMDL document recommendations involving the McLaren tailings have been planned for, and significant implementation has begun, with a projected completion date of October 2015. TMDL document recommendations for source identification/characterization outside of the New World Mining District have not been fully implemented, but in some cases may not be warranted due to an absence of historical mining activity.

This Evaluation does not identify any need for revising the TMDL document. However, the TMDL document itself identifies some instances where additional monitoring and assessment may be necessary in order to rule out the possibility that there may be additional pollutant sources beyond those addressed in the existing TMDL document.

1.0 BACKGROUND

The following impaired waterbodies are included in whole or in part, within the boundaries of the Cooke City TMDL Planning Area:

- Stillwater River
- Clarks Fork River
- Daisy Creek
- Fisher Creek
- Miller Creek
- Soda Butte Creek

Pollutants of concern include the following:

- Copper
- Cadmium
- Lead
- Zinc
- Iron
- Manganese
- Aluminum
- Silver
- pH
- Sediment

The TMDL document indicates that pollutant-related water quality problems in the Cooke City TMDL Planning Area are believed to emanate from five main sources:

- Historical mining within the New World Mining District and immediately surrounding area (including tailings, adit discharges, erosion from surface disturbance and roads).
- The McLaren tailings which were placed in the historic Soda Butte Creek channel.
- Unknown or uncharacterized pollutant sources within the Montana portions of various watersheds (abandoned mines and road/trail networks).
- Unknown or uncharacterized pollutant sources within Wyoming portions of various watersheds (abandoned mines and road/trail networks).
- Natural background sources (highly weathered and/or mineralized rock, copper bogs, groundwater seepage, natural surface erosion due to local topography and climate).

The following excerpts from an early USDA Forest Service project summary document provide the historical context for watershed restoration work in the Cooke City TMDL Planning Area.

“The New World Mining District (District) Response and Restoration Project officially began when the USDA Forest Service submitted an implementation plan to the State of Montana on January 22, 1999. Since that time, the Forest Service has engaged in a number of activities to collate all existing data into a common database, further investigate portions of the District that were not well understood, and prepare engineering designs for proposed cleanup projects.

The District, which includes a mixture of National Forest and private lands, is a historic metals mining area located in the general vicinity of Cooke City, Montana in the Beartooth Mountains. This historic mining district, which is centered northeast of Yellowstone National Park, contains hard rock mining wastes and acid discharges that impact human health and the environment. Human health and environmental issues are related to elevated levels of heavy metals present in mine waste piles, open pits, acidic water discharging from mine openings, and stream sediments. Cleanup work will be challenging in this harsh, mountainous environment due to the severe climate, short construction season, and the relatively large amount of snowfall that the District receives.

The 40 square mile District is located at an elevation that ranges from 7,900 feet to over 10,400 feet above sea level, and is snow-covered for much of the year. Historic mining disturbances affect about 65 acres with the largest disturbances attributed to the McLaren Pit (17 acres) and the McLaren Tailings (11 acres). The Glengarry Adit and the nearby Como Basin are the other major source areas in the District that contribute pollutants to headwater streams.

The District is situated at the headwaters of three river systems that all eventually flow into the Yellowstone River. These rivers include the Clark’s Fork of the Yellowstone, the Stillwater, and the Lamar. The Lamar River flows through Yellowstone Park. The major tributary streams affected by mining disturbances within the District include Daisy, Miller, Fisher, and Soda Butte creeks.

On August 12, 1996, the U.S. government signed a settlement agreement with Crown Butte Mining, Inc. to purchase the mining company’s interest in their District holdings (also referred to as District Property). This transfer of property to the U.S. government effectively ended Crown Butte Mining’s proposed mine development, and provided \$22.5 million to cleanup historic mining impacts in the District. Of the total cleanup funds, up to \$2.5 million was set aside specifically for natural resource damages incurred in the District. In June 1998, the interested parties, which included government agencies, several local and regional environmental groups, and the mining company, signed a consent

decree. The consent decree, which was approved by the U.S. District Court, finalized the terms of the settlement agreement and made available the funds that are being used for site cleanup.” (Maxim Technologies, Inc., 2001).

2.0 TMDL-RECOMMENDED ACTIVITIES

The TMDL document recommends specific restoration activities for addressing pollutants within the Cooke City TMDL Planning Area. These recommendations are summarized by waterbody, below:

Daisy Creek, Fisher Creek, Stillwater River, Miller Creek, Clarks Fork River, Soda Butte Creek

- Implementation of the New World Mining District Response and Restoration Project by the USDA Forest Service. Within the New World Mining District, and potentially some of the adjacent lands, this would potentially entail:
 - Stabilization of solid mine wastes to prevent or reduce erosion of mine wastes into streams.
 - Preparing, filling and capping waste repository sites.
 - Closing adits and shafts.
 - Re-vegetating mining-disturbed areas.
 - Implementation of an adaptive management approach to address unforeseen problems.
- Implementation of the travel plan for the Gallatin National Forest.
- Implementation of an adaptive management approach to characterize sources, develop restoration plans, and adjust TMDL targets for impairments associated with properties outside the New World Mining district.

Clarks Fork River (specific)

- Identification and reclamation of pollutant sources within the Lady of the Lake Creek and Broadwater River drainages.

Soda Butte Creek (specific)

- Restoration of the McLaren Tailings and Mill site.
- Reduction of environmental impacts associated with the Republic Mine and Mill sites along Republic and Woody Creeks.
- Collaboration with Wyoming and with EPA to characterize and address sources of pollutants in streams that flow from Wyoming into Montana.

The TMDL document recommends three types of monitoring activities:

- Monitoring to evaluate target/standards attainment (both short-term and long-term).
- Monitoring to ensure continued functionality of implemented restoration practices (e.g. revegetation monitoring, periodic monitoring of discharges from the under-drains beneath the McLaren pit, road maintenance monitoring, etc).
- Monitoring to identify and characterize any unknown or previously unevaluated pollutant sources (e.g. identification and characterization of pollutant sources in areas outside the boundaries of the New World Mining District, evaluation of pollutant contributions from sources in Wyoming, etc).

3.0 INDICATORS OF PROGRESS

Indicators of progress towards achieving Cooke City TMDL targets generally fall into one of three major categories: 1) Reclamation/Restoration, 2) Monitoring, and 3) Planning.

3.1 RECLAMATION/RESTORATION

The USDA Forest Service has nearly completed the construction phase of the New World Mining District Response and Restoration Project. The Project is designed to reduce or eliminate many of the impacts of historical mining in the Cooke City TMDL Planning Area. Highlights of the Forest Service's work are listed below, categorized by drainage:

Fisher Creek

- 32,000 cubic yards of mine waste rock and mill tailings was removed and placed in a long-term repository. 4.6 acres of the former waste areas was re-vegetated.
- 5,700 cubic yards of waste rock from the Gold Dust adit portal area was removed and placed in a long-term repository.
- The Glengarry adit and the Como Raise were plugged and closed, reducing the Glengarry adit discharge rate to Fisher Creek by 98%.
- The Glengarry Mill Site adit was closed and reclaimed, resulting in an approximately 72% reduction in discharge rate.
- The Gold Dust adit was reclaimed, resulting in an approximately 41% reduction in discharge rate.
- Approximately 7,000 cubic yards of high-sulfide-bearing waste from the Gold Dust adit portal pad waste rock dump was removed and placed in a permanent repository.
- The Lower Tredennic Dump 1 Adit and the Henderson Mountain Dump 7 adit were both closed, and all discharge water is now diverted into infiltration basins.
- Mining waste in the Como Basin was consolidated, and then capped with an impermeable membrane, followed by soil. The cap was later re-vegetated.
- Run-on and runoff controls were implemented at various waste rock dumps in order to prevent erosion and leaching of sediment and metals.
- Various road and drainage improvements have been made or are underway to reduce sediment erosion.

Clarks Fork River

- Adit closure and waste rock removal in the Fisher Creek Drainage, a tributary to the Clarks Fork River (see above for details).

Daisy Creek

- Approximately 70,000 cubic yards of outlying waste rock was consolidated into the McLaren Pit. The Pit was capped with an impermeable membrane, a drainage layer, and a soil cover. The roughly 11-acre cover was seeded with native grasses. Surface run-on and runoff channels were constructed to convey water around and off of the capped wastes. During pit reclamation, four subsurface drains were installed to collect groundwater that enters the pit, and convey it to a pair of runoff channels.

- Boreholes in the McLaren adit were plugged, reducing the adit discharge rate from 13 GPM to 6 GPM. The McLaren adit was then closed, and all remaining discharge was routed to an infiltration basin. Revegetation work has taken place in disturbed areas below the adit.
- Various road and drainage improvements have been made or are underway to reduce sediment erosion.

Stillwater River

- Adit closure and waste rock removal in the Daisy Creek Drainage, a tributary to the Stillwater River (see above for details).
- Various road and drainage improvements have been made or are underway to reduce sediment erosion.

Miller Creek

- Removal of the Black Warrior and the Little Daisy waste rock dumps in the Miller Creek drainage and storage of the rock in a permanent repository. This eliminated 46% of the total volume of waste rock present in the Miller Creek drainage.
- Four small mine waste rock piles that were in contact with Miller Creek were pulled back from the edge of the Creek, re-graded, amended in place with lime, and re-vegetated.
- Closure of the Black Warrior and Little Daisy adits, including removal of waste rock and diversion of all adit discharge into infiltration basins.
- Run-on and runoff controls were implemented at various waste rock dumps in order to prevent erosion and leaching of sediment and metals.
- Various road and drainage improvements have been made or are underway to reduce sediment erosion.

Soda Butte Creek

- Adit closure and waste rock removal/stabilization occurred in the Miller Creek drainage, a tributary to Soda Butte Creek (see above for details).

In addition to the work completed as part of the New World Mining District Response and Restoration Project, several other actions have taken place to reduce pollutant inputs to Soda Butte Creek in particular:

- Approximately 10,200 cubic yards of mine/smelter waste were removed from the McLaren Mill site and the Great Republic Smelter site. These wastes were added to the New World waste repository.
- In 2010, the Montana DEQ Abandoned Mines Section began the process for removing the McLaren tailings and associated mine wastes. The tailings are being mixed with lime to dry the tailings, increase the pH, and reduce the mobility of metals present in the tailings. Groundwater present in the tailings will be pumped and treated in an onsite treatment facility. All mine wastes will be placed in a mine waste repository constructed on a terrace located west of the tailings impoundment. Following the removal of the tailings, approximately 2,000 lineal feet of Soda Butte Creek and Miller Creek will be reconstructed to a naturalistic condition.

3.2 MONITORING

The USDA Forest Service has been conducting extensive, water quality monitoring throughout the Cooke City TMDL Planning Area since approximately 1999. This data collection effort has been focused on

identifying and quantifying pollutant sources/inputs, and on documenting changes in water quality resulting from New World Mining District cleanup operations. The USDA Forest Service has set up an online, publicly available database containing nearly all of the known water quality data collected within the Cooke City TMDL Planning Area (Maxim Technologies, Inc., 2010).

Additional studies have been conducted by the USDA Forest Service, the United States Geological Survey, and the Montana DEQ. These studies have focused on trying to determine the approximate water quality conditions that may have existed in area streams prior to the start of mining operations (aka natural background conditions), and on assessing the potential effectiveness of possible treatment options. The USDA Forest Service has set up a web page with links to the documents containing data and reports of this nature, associated with the New World Mining District Response and Restoration Project: <http://www.maximtechnologies.com/newworld/documents.htm>

The Forest Service has been, and continues to monitor revegetation success and diagnose revegetation problems. This includes a wide variety of data collection methods ranging from plant cover surveys to soil fertility testing. Results are reported in numerous different monitoring reports, accessible via links on the following website: <http://www.maximtechnologies.com/newworld/documents.htm>

Numerous investigations of the McLaren Tailings and discharges to Soda Butte Creek have been performed since the 1950s. A summary of these investigations is provided in a report compiled by the U.S. Geological Survey: *Metal Loading in Soda Butte Creek Upstream of Yellowstone National Park, Montana and Wyoming: A Retrospective Analysis of Previous Research; and Quantification of Metal Loading* (2001). DEQ investigations of the McLaren Tailings have occurred since 1993. Project documents related to the McLaren Tailings reclamation project can be accessed at the following website: <http://deq.mt.gov/AbandonedMines/mclaren.mcp.x>.

The USDA Forest Service has reported the following in a written communication to the Montana DEQ Watershed Protection Section (USDA Forest Service, personal communication 2011):

- “The USFS does not have information to suggest that any reasonably treatable remaining non-point sources in Miller Creek exist.”
- New World Mining District properties in the Lady of the Lake Creek drainage have been assessed for potential pollution sources. No mining-related sources were found during the assessment. Additional properties within the Lady of the Lake Creek drainage include USDA Forest Service property and privately owned land. There are no known historical mining disturbances on any of these properties.
- There are no known historical mining disturbances within the Broadwater River drainage.
- All of the Wyoming land within the Soda Butte Creek drainage lies within the North Absaroka Wilderness. There are no known roads, motorized access, or historical mining impacts within any of this land. However, there was some historical mining in Montana that went right up to the border with Wyoming.

The *Final Site Evaluation Report for the Republic Mine and Mill Site (Pioneer Technical Services, Inc., 2001)* suggests that there is a waste rock dump in the Republic Creek drainage that “may be situated on the Wyoming side of the border”. However, the Report noted that a sample of the waste rock was analyzed and “is not considered a potential acid producer.” The Report concluded, based on sampling and analysis of surface water and sediment, that the Republic Mine and Mill Site was contributing to metals concentrations that were elevated above background conditions, but that it was not causing any exceedances of surface water quality standards.

3.3 PLANNING

Restoration work within the Cooke City TMDL Planning Area has been guided by many different planning documents. These have included engineering reports, work plans, monitoring plans, and environmental assessments. The USDA Forest Service has developed plans for long-term operations and maintenance of New World Mining District reclamation work. Their operations and maintenance plan includes detailed, long-term water quality monitoring plans that will extend monitoring out until at least 2032. The operations and maintenance plan is designed to alert the USDA Forest Service of any reclamation failures, and to help gauge whether or not additional reclamation work is warranted. This plan, when implemented, will offer an additional level of review for ensuring that all reasonable land, soil and water conservation practices have or will be implemented to address pollutants in Daisy Creek, Fisher Creek, and Miller Creek. Planning documents associated with the New World Mining District Response and Restoration Project can be accessed at the following website:
<http://www.maximtechnologies.com/newworld/documents.htm>

The most current planning documents associated with the McLaren Tailings cleanup may be accessed at the following website: <http://deq.mt.gov/AbandonedMines/mclaren.mcp.x>. The evaluation of reclamation alternatives is presented in the *Draft Final Expanded Engineering Evaluation/Cost Analysis for the McLaren Tailings Site (2002)*. Scheduled reclamation activities are described in the *Reclamation Design Report (Pioneer Technical Services, Inc., 2009)*. Additional information may be obtained by contacting John Koerth, Section Supervisor for the Montana DEQ Abandoned Mines Section. Mr. Koerth can be reached at (406) 841-5026 or by email at jkoerth@mt.gov

4.0 RECOMMENDATIONS FOR ADDITIONAL WORK

Suggestions for additional restoration work are outlined below. They represent “suggestions” only. It may be possible to meet TMDL targets and water quality standards by implementing some, all, or none of these activities, or by implementing a different set of actions.

- Implement the *Site-wide, Long-term Operations and Maintenance Plan, New World Mining District Response and Restoration Project (Tetra Tech, 2009)*.
- Finish surface disturbance stabilization work in Fisher and Daisy Creek drainages.
- Continue the adaptive management approach to address erosion issues related to roads, trails, stream crossings, and other land disturbances.
- Complete the McLaren Tailings cleanup project (Montana DEQ).
- Conduct further assessment of sources of water quality impairments within the non-Miller Creek, non-New World Mining District properties in the Soda Butte Creek drainage.
- In 2020, assemble available data and reports, and evaluate progress towards TMDL implementation and meeting TMDL targets in the Stillwater River, Clarks Fork River, Miller Creek, and Soda Butte Creek. Note that 2020 was chosen based on the assumption that it will take several years to realize water quality benefits from recently completed and soon-to-be completed revegetation and road/trail improvements throughout the Cooke City TMDL Planning Area. Once vegetation becomes established and soil disturbances stabilize, it will then take several more years to acquire enough data to accurately determine whether or not TMDL targets are truly being met.
- In 2020, assemble available data and reports, and re-evaluate whether or not all reasonable land, soil and water conservation practices have been implemented to address pollutants within

Daisy Creek and Fisher Creek. Note that 2020 was chosen to provide a reasonable time frame for the discovery of new advances in reclamation and treatment technology. This date also provides time for adequate data collection to determine whether recently completed reclamation efforts will be effective, long term. 2020 allows for completion of a review of all reasonable land, soil and water conservation practices concurrently with the TMDL target achievement review described in the bullet above.

5.0 CONCLUSIONS

The following is a brief summary of conclusions reached as a result of completing the Cooke City TMDL Implementation Evaluation:

- Based on extensive available information, and using best professional judgment, all reasonable land, soil and water conservation practices have been or are in the process of being implemented in the Daisy Creek, Fisher Creek, Miller Creek, and Stillwater River drainages in the Cooke City TMDL Planning Area. Because much of the restoration work has been completed just recently, or is still ongoing, the long-term effects it will have on water quality cannot be accurately determined at this time. Based on current plans for further restoration and monitoring, it would be best to wait until the year 2020 before attempting to evaluate TMDL target attainment in Daisy Creek, Fisher Creek, Miller Creek, and the Stillwater River.
- Some source identification and assessment remains to be completed within the Clarks Fork River and Soda Butte Creek drainages. The results can then be used to make a preliminary estimate of the time and resources required to achieve TMDL targets.
- Significant reclamation/restoration work still needs to be completed to implement the TMDLs for the Soda Butte Creek drainage. The McLaren Tailings restoration project should address many of the pollutant issues in Soda Butte Creek. The McLaren Tailings Reclamation project is scheduled to be completed in October 2015.

Please see **Appendix A – Conclusions Spreadsheet** for a detailed explanation of all of the conclusions reached as a result of completing the Cooke City TMDL Implementation Evaluation.

6.0 SOURCES OF INFORMATION

A wide variety of information sources were consulted during the preparation of the Cooke City TMDL Implementation Evaluation. They included reports, databases, websites, and personal communications. Information was sought from stakeholders. Detailed questions concerning the construction and content of the Cooke City TMDL Implementation Evaluation should be directed to Robert Ray, Section Supervisor, Montana DEQ Watershed Protection Section, (406) 444-5319, or rray@mt.gov

7.0 REFERENCES

- Boughton, Gregory K. 2001. Metal Loading in the Soda Butte Creek Upstream of Yellowstone National Park, Montana and Wyoming: A Retrospective Analysis of Previous Research; and Quantification of Metal Loading, August 1999. Cheyenne, WY: U.S. Geological Survey. Report Water-Resources Investigations Report 01-4170. <http://pubs.usgs.gov/wri/wri014170/>. Accessed 6/13/11 A.D.
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APPENDIX A – CONCLUSIONS SPREADSHEET

Waterbody Pollutant	Conclusion*	Justification/Recommendations																								
Daisy Creek Copper	2	<ul style="list-style-type: none"> - The TMDL document(Yashan, 2002) suggests that all, or nearly all of the metals related impairments could, and would be resolved through implementation of the New World Mining District Response and Restoration Project (see pg 5-3 of the TMDL document). This project is nearly complete, and monitoring results suggest that significant decreases in metals concentrations and loading have occurred (Tetra Tech, 2010). - Extensive studies, using several different methods, have been conducted to help estimate pre-mining water quality conditions. Information from these studies was summarized and described by Tetra Tech in a report for the USDA Forest Service (Tetra Tech, 2009a). - Tetra Tech completed a report in which they provided estimates of pre-mining metals concentrations and then, given current flows, determined what the effect would be on water quality if all existing, post-restoration, anthropogenic metals sources were to be eliminated. Tetra Tech concluded “Loading analyses show even complete removal of all known mine related water sources, including McLaren Pit underdrain flow, would not improve water quality relative to DEQ-7 standards.” (Tetra Tech, 2009a). However, determining which standards apply and whether or not standards are being met is more complicated than a simple comparison to the numeric values found in DEQ-7. The process often involves determining whether or not all reasonable land, soil and water conservation practices have been applied, and whether or not the applied beneficial uses are appropriate for the natural, background conditions in the waterbody. - In April of 2009, Tetra Tech completed a technical memorandum calculating the estimated costs associated with constructing an on-site treatment system to remove metals in one of the main, post-restoration, anthropogenic sources of metals loading to Daisy Creek: the McLaren Pit subsurface drains (Tetra Tech, 2009c). The Technical Memorandum concluded that the cost for construction and maintenance of an adequate treatment system would likely exceed 2 million dollars, and would not result in making significant progress towards achieving desired water quality values. - The USDA Forest Service has in place a long-term operations and maintenance plan for the Daisy and Fisher Creek drainage areas impacted by the New World Mining District. The plan includes commitments for surface water quality monitoring through 2032. It also contains commitments for monitoring, operation and maintenance (through 2032) of the restoration practices that were implemented as part of the New World Mining District Response and Restoration Project. (Tetra Tech, 2009b) - In summary, with respect to metals impairments in Daisy and Fisher Creek: 1) A tremendous amount of restoration work has been completed, eliminating many of the anthropogenic sources of metal loading. 2) Completing restoration work to eliminate all of the remaining anthropogenic sources for metals would be very costly, and is unlikely to result in in-stream metals concentrations that would meet DEQ-7 water quality standards. 3) Plans and commitments are in place to safeguard the current improvements in water quality. 4) Based on extensive, available information, and best professional judgment, all reasonable land, soil and water conservation practices to address metals loading have been, or are being implemented in the Daisy and Fisher Creek drainages. 5) The current water quality meets the statutory definition of “natural” as found in 75-5-306 of the Montana Code Annotated (MCA)(State of Montana, 2009). 6) In the future, changes in the assumptions upon which this conclusion is based could trigger the need for a reevaluation of whether or not “all reasonable land, soil and water conservation practices” are being implemented. 7) Due to the widespread nature of the land disturbance associated with recent restoration efforts, it could take a number of years for water quality in the Daisy and Fisher Creek drainages to adjust and stabilize. Depending upon the results of long-term water quality monitoring, it would be reasonable to evaluate TMDL targets and/or standards attainment for metals in Daisy Creek and Fisher Creek around the year 2020. 																								
Daisy Creek Cadmium			2																							
Daisy Creek Lead					2																					
Daisy Creek Zinc							2																			
Daisy Creek Iron									2																	
Daisy Creek Manganese											2															
Daisy Creek Aluminum													2													
Fisher Creek Copper															2											
Fisher Creek Iron																	2									
Fisher Creek Manganese																			2							
Fisher Creek Aluminum																					2					
Fisher Creek Zinc																							2			
Fisher Creek Cadmium																									2	
Fisher Creek Lead																										
Fisher Creek Silver	2																									
Miller Creek Copper			NA**	<ul style="list-style-type: none"> - The TMDL document identified the following potential metals sources within the Miller Creek drainage: discharges from the Black Warrior adit and possibly other adits, erosion and transport of sediments from mining-disturbed areas, and natural, non-anthropogenic sources. The TMDL document indicated that the majority of higher metals concentrations in Miller Creek have been observed during high-flow conditions. (See Section 4.2.2 of the TMDL document.) - Following completion of the TMDL, the USGS completed and published a detailed, low-flow source assessment for the Miller Creek drainage. The USGS study noted that there was some metals loading associated with the Black Warrior adit and other mining-related sources, but concluded that “Metal loading to Miller Creek during this low-flow study was relatively small and had minor effect on metal concentrations in the mainstem. Substantial differences between mining-related areas and areas influenced by local geology could not be readily determined.” (Cleasby and Nimick, 2002) - As part of the New World Mining District Response and Restoration Project, the USDA Forest Service diverted adit discharges from the Black Warrior and Little Daisy adits into infiltration basins. The USDA Forest Service also moved waste rock from the Black Warrior and Little Daisy adit areas to a permanent waste rock repository. The USDA Forest Service pulled back, re-graded, limed and re-vegetated four waste rock piles that had previously been in contact with Miller Creek. All known, adit-related discharges within the Miller Creek drainage infiltrate to groundwater and do not directly discharge to Miller Creek. (Tetra Tech, 2010) - The USDA Forest Service has indicated that they do not have any information to suggest that there are “any reasonably treatable remaining nonpoint sources in Miller Creek.” (USDA Forest Service, personal communication 2011) - Based on a review of USGS and USDA Forest Service studies, it appears that all point-source discharges of metals to surface waters have been eliminated (Tetra Tech, 2010; Cleasby and Nimick, 2002). - Based on extensive available information, and using best professional judgment, all reasonable land, soil and water conservation practices have been or are in the process of being implemented in the Miller Creek drainage. 																						
Miller Creek Iron					NA**																					
Miller Creek Cadmium							NA**																			
Miller Creek Lead									NA**																	
Miller Creek Manganese											NA**															
Miller Creek Zinc													NA**													
Miller Creek Zinc			NA**																							

Waterbody Pollutant	Conclusion*	Justification/Recommendations
Soda Butte Creek Copper	NA**	<ul style="list-style-type: none"> - Metals impairments in Soda Butte Creek are believed to come from the following sources: Miller Creek (both New World Mining District and other mining related disturbances), the McLaren Tailings area (including the McLaren Mill Site), Soda Butte upstream of the McLaren Tailings Area (but not including Miller Creek), Woody/Republic Creek, Unnamed Creek (in Montana/Wyoming), and a wide array of lesser-known sources (e.g. tributaries, hillsides, Cooke City, in-stream, floodplain, etc). Little is known regarding the relative contributions from each of these sources, though Miller Creek and the McLaren Tailings Area appear to be two of the most significant. (See Section 4.2.3 of the TMDL document.)
Soda Butte Creek Iron		<ul style="list-style-type: none"> - Metals contributions to Soda Butte Creek from Miller Creek are expected to decline as New World Mining District cleanup draws to a close and the associated land disturbance stabilizes. For a complete discussion of efforts to address metals loading in Miller Creek, please see Miller Creek specific conclusions elsewhere in this “Conclusions Spreadsheet”
Soda Butte Creek Manganese		<ul style="list-style-type: none"> - In June of 2010, DEQ began work on a project to address the McLaren tailings. The project includes removing tailings from the historic Soda Butte Creek channel, amending the tailings with lime, operating a temporary construction dewatering and water treatment system, construction of a repository to encapsulate the McLaren tailings and associated mine wastes, and reconstructing portions of Soda Butte Creek and Miller Creek currently covered by the tailings impoundment. The entire project is expected to take 6 years, with the reclamation activities completed by October 2015. (Koerth, John and Tom Henderson, personal communication 3/1/2011)
Soda Butte Creek Lead		<ul style="list-style-type: none"> - Additional monitoring is needed to identify and quantify metals sources in many different tributaries to Soda Butte Creek. In several cases, these tributaries are located wholly or partly in the State of Wyoming. The USDA Forest Service has indicated that the Wyoming portions of these drainages are all located within the North Absaroka Wilderness, and that there is no known historical mining within the Wilderness portions of these drainages (USDA Forest Service, personal communication 2011).
Soda Butte Creek Aluminum		<ul style="list-style-type: none"> - Further source assessment may be needed in the Montana portions of tributaries to Soda Butte Creek. As a practical matter, it may be wise to wait until the effects of the New World Mining District cleanup and the McLaren tailings cleanup are known before engaging in additional source identification and assessment. - Based on the estimated timeline for the McLaren Tailings clean-up and the need for post-cleanup water quality monitoring, Soda Butte Creek should be evaluated for TMDL targets and/or water quality standards attainment around the year 2020. In the mean time, it is not possible to determine exactly when TMDL targets for Soda Butte Creek will be achieved. The only thing certain is that it will take more time.
Daisy Creek Sediment	2	<ul style="list-style-type: none"> - In preparing the TMDL, DEQ modeled sediment load for the Daisy Creek drainage. Modeling suggested that roughly 2/3 of the stream’s sediment load (or 22.7 tons/year) comes from natural sources. The remaining 1/3 (or 11.3 tons/year) comes from roads and mine-related disturbances, in roughly equal proportions. - The New World Mining District Response and Restoration Project has involved large scale surface disturbance in many areas within the Daisy Creek drainage. Disturbance has included road building, road maintenance, road obliteration, mine waste removal, repository construction, and various other projects. The USDA Forest Service has actively reclaimed and re-vegetated much of the disturbed area. The USDA Forest Service currently has a long-term operation and maintenance plan in place that includes vegetation monitoring and specifies some of the conditions under which remedial action would take place to prevent excessive erosion (Tetra Tech, 2009b). - The USDA Forest Service plans to conduct annual macroinvertebrate and periphyton monitoring in Daisy Creek and the Stillwater River during 2012, 2013, and 2014 (Tetra Tech, 2009b). This data may prove valuable in determining if sediment TMDL targets are being met as a result of restoration efforts. - In 2010, the USDA Forest Service awarded a contract for the completion of numerous road erosion prevention projects throughout the New World Mining District and some of the surrounding areas within the Cooke City TMDL Planning Area. The work associated with the contract is scheduled to be completed during the 2011 work season, and will likely result in reduced sediment loading from roads in the Daisy Creek drainage. (Marks, Mary B., personal communication 11/4/2010) - After vegetation planting and seeding, it typically takes a number of years for vegetation to grow to sufficient size to stabilize soil and reach their full potential for erosion prevention. This is especially true in places like the Cooke City TMDL Planning Area, where cold climate and snow cover create an exceptionally short growing season. Depending upon the results of vegetation monitoring, it would be reasonable to evaluate TMDL targets and/or standards attainment in Daisy Creek around the year 2020.
Stillwater River Sediment	2	<ul style="list-style-type: none"> - The TMDL document identifies three main sources of sediment loading to the impaired section of the Stillwater River: 1) sediment from Daisy Creek, 2) sediment from the Lake Abundance road that crosses the bed of the Stillwater below the confluence with Daisy Creek, and 3) natural background sources outside of the Daisy Creek drainage (see Section 2.2.3 of the TMDL document). - Please see conclusions for “Daisy Creek Sediment” for a discussion of progress towards addressing loading from the Daisy Creek drainage. - In 2010, the USDA Forest Service awarded a contract for the completion of numerous road erosion prevention projects throughout the New World Mining District and some of the surrounding areas within the Cooke City TMDL Planning Area. This included funds for addressing erosion issues on the Lake Abundance road outside of the Daisy Creek drainage. The Lake Abundance road was identified in the TMDL document as a potential sediment source for the impaired section of the Stillwater River. The work associated with the contract is scheduled to be completed during the 2011 work season. (Marks, Mary B., personal communication 11/4/2010) - The USDA Forest Service plans to conduct annual macroinvertebrate and periphyton monitoring in Daisy Creek and the Stillwater River during 2012, 2013, and 2014 (Tetra Tech, 2009b). This data may prove valuable in determining if sediment TMDL targets are being met as a result of restoration efforts. - After vegetation planting and seeding, it typically takes a number of years for vegetation to grow to sufficient size to stabilize soil and reach their full potential for erosion prevention. This is especially true in places like the Cooke City TMDL Planning Area, where cold climate and snow cover create an exceptionally short growing season. Depending upon the results of vegetation monitoring, it would be reasonable to evaluate TMDL targets and/or standards attainment in the Stillwater River around the year 2020.

Waterbody Pollutant	Conclusion*	Justification/Recommendations
Fisher Creek Sediment	2	<ul style="list-style-type: none"> - The TMDL document identifies two main sources of sediment loading to Fisher Creek: 1) natural background conditions, and 2) road and mining disturbances (see Section 3.2.3 of the TMDL document). - The New World Mining District Response and Restoration Project has involved large scale surface disturbance in many areas within the Fisher Creek drainage. Disturbance has included road building, road maintenance, road obliteration, mine waste removal, and various other projects. The USDA Forest Service has actively reclaimed and re-vegetated much of the disturbed area. The USDA Forest Service currently has a long-term operation and maintenance plan in place that includes vegetation monitoring and specifies some of the conditions under which remedial action would take place to prevent excessive erosion (Tetra Tech, 2009b). - The USDA Forest Service plans to conduct annual macroinvertebrate and periphyton monitoring in Fisher Creek during 2012, 2013, and 2014 (Tetra Tech, 2009b). This data may prove valuable in determining if sediment TMDL targets are being met as a result of restoration efforts. - In 2010, the USDA Forest Service awarded a contract for the completion of numerous road erosion prevention projects throughout the New World Mining District and some of the surrounding areas within the Cooke City TMDL Planning Area. The work associated with the contract is scheduled to be completed during the 2011 work season, and will likely result in reduced sediment loading from roads in the Fisher Creek drainage. (Marks, Mary B., personal communication 11/4/2010) - After vegetation planting and seeding, it typically takes a number of years for vegetation to grow to sufficient size to stabilize soil and reach their full potential for erosion prevention. This is especially true in places like the Cooke City TMDL Planning Area, where cold climate and snow cover create an exceptionally short growing season. Depending upon the results of vegetation monitoring, it would be reasonable to evaluate TMDL targets and/or standards attainment in Fisher Creek around the year 2020.
Stillwater River Copper	2	<ul style="list-style-type: none"> - The TMDL document identifies metals loading from the Daisy Creek drainage as the primary source for metals in the impaired section of the Stillwater River (see Section 2.2 of the TMDL document). - Please see conclusions for “Daisy Creek [metals]” for a discussion of how metals impairments in Daisy Creek will be addressed. - In summary, with respect to metals impairments in Daisy Creek (and hence the Stillwater River): 1) A significant amount of restoration work has been completed, eliminating many of the anthropogenic sources of metal loading. 2) Completing restoration work to eliminate all of the remaining anthropogenic sources for metals would be very costly, and is unlikely to result in in-stream metals concentrations that would meet DEQ-7 water quality standards in Daisy Creek. 3) Plans and commitments are in place to safeguard the current improvements in water quality. 4) Based on extensive, available information, and best professional judgment, all reasonable land, soil and water conservation practices to address metals loading have been, or are being implemented in the Daisy Creek drainage. 5) The current water quality meets the statutory definition of “natural” as found in 75-5-306 of the Montana Code Annotated (MCA)(State of Montana, 2009). 6) In the future, changes in the assumptions upon which this conclusion is based could trigger the need for a reevaluation of whether or not “all reasonable land, soil and water conservation practices” are being implemented. 7) Due to the widespread nature of the land disturbance associated with recent restoration efforts, it could take a number of years for water quality in the Daisy Creek drainage to adjust and stabilize. Depending upon the results of long-term water quality monitoring, it would be reasonable to evaluate TMDL targets and/or standards attainment for metals in the Stillwater River around the year 2020.
Stillwater River Iron		
Stillwater River Manganese		
Daisy Creek, pH	2	<ul style="list-style-type: none"> - The TMDL document identifies acid mine drainage and naturally occurring acid rock drainage as the two main sources of acid in Daisy Creek and Fisher Creek (see Sections 2.2.2 and 3.2.2 of the TMDL document respectively). - The TMDL targets for pH in Daisy Creek and Fisher Creek are based on the assumption that if numeric metals standards are met in Daisy Creek and Fisher Creek, then pH will return to acceptable levels (see Sections 2.3.1 and 3.3.1 of the TMDL document). - As discussed in the conclusions for “Daisy Creek [metals]” and “Fisher Creek [metals]”, a tremendous amount of restoration work has been completed, eliminating many of the anthropogenic sources of metal loading. Completing restoration work to eliminate all of the remaining anthropogenic sources for metals would be very costly, and is unlikely to result in in-stream metals concentrations that would meet DEQ-7 water quality standards. Plans and commitments are in place to safeguard the current improvements in water quality. Based on extensive, available information, and best professional judgment, all reasonable land, soil and water conservation practices to address metals loading have been, or are being implemented in the Daisy and Fisher Creek drainages. The current water quality meets the statutory definition of “natural” as found in 75-5-306 of the Montana Code Annotated (MCA)(State of Montana, 2009). In the future, changes in the assumptions upon which this conclusion is based could trigger the need for a reevaluation of whether or not “all reasonable land, soil and water conservation practices” are being implemented. - Since the pH TMDLs and targets were based on the assumption that the metals reductions would be met, it may be logical to assume that because all reasonable land, soil and water conservation practices have been, or are being implemented to address metals loading in Daisy Creek and Fisher Creek, the same is true for pH impairments. - Due to the widespread nature of the land disturbance associated with recent restoration efforts, it could take a number of years for water quality in the Daisy and Fisher Creek drainages to adjust and stabilize. Depending upon the results of long-term water quality monitoring, it would be reasonable to evaluate TMDL targets and/or standards attainment for pH in Daisy Creek and Fisher Creek at the same time that target and/or standards attainment for metals is evaluated, around the year 2020.
Fisher Creek pH		

Waterbody Pollutant	Conclusion*	Justification/Recommendations
Clarks Fork River Copper	2	<ul style="list-style-type: none"> - The TMDL document states: “Addressing the Fisher Creek metals and pH impairment concerns will address the vast majority of loading to the Clarks Fork River. Nevertheless, there needs to be an assessment and characterization of potentially significant mining sources in the Lady of the Lake Creek and Broadwater River drainages.” (See Section 5.2.2, page 5-4 of the TMDL document.) - New World Mining District properties in the Lady of the Lake Creek drainage have been assessed for potential pollution sources. No mining-related sources were found during the assessment. Additional properties within the Lady of the Lake Creek drainage include USDA Forest Service property and privately owned land. There are no known historical mining disturbances on any of these properties. (USDA Forest Service, personal communication 2011) - There are no known historical mining disturbances within the Broadwater River drainage. (USDA Forest Service, personal communication 2011) - Please see conclusions under “Fisher Creek [metals]” and “Fisher Creek pH” for a discussion of how metals and pH impairment concerns in Fisher Creek have been addressed. - In 2010, the USDA Forest Service awarded a contract for the completion of numerous road erosion prevention projects throughout the New World Mining District and some of the surrounding areas within the Cooke City TMDL Planning Area. The work associated with the contract is scheduled to be completed during the 2011 work season, and will likely result in reduced sediment loading from roads in the Fisher Creek and Clarks Fork River drainages. (Marks, Mary B., personal communication 11/4/2010) - it would be reasonable to evaluate TMDL targets and/or standards attainment within the Clarks Fork River along with targets and/or standards attainment for Fisher Creek in the year 2020.
Clarks Fork River Zinc		
Clarks Fork River Cadmium		
Clarks Fork River Silver		
Clarks Fork River Iron		
Clarks Fork River pH		

*Conclusions are limited to one of the three specific conclusions identified in 75-5-703(9) MCA(State of Montana, 2009). In this column, the three possible conclusions will be denoted by individual numbers as described below:

- 1 – The implementation of a new or improved phase of voluntary reasonable land, soil, and water conservation practice is necessary.
- 2 – Water quality is improving but a specified time is needed for compliance with water quality standards.
- 3 – Revisions to the TMDL are necessary to achieve applicable water quality standards.

**In these instances, the typical three conclusions are superseded by complicating factors in statute, or a lack of sufficient information in order to draw defensible conclusions.

REFERENCES FOR APPENDIX A

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