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Cut and Run:

EPA Betrays Another Montana Town

A Tale of Butte, the Largest Superfund Site in the United States

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About This Report

Cut and Run is an account of the largest Superfund site in the nation and how the U.S. Environmental Protection Agency has pre-determined its fate. Written by a group of professionals who have worked extensively with mine waste characterization and reclamation in western Montana, this white paper tells the story of an emerging decision to let tons of contaminated mine tailings sit on the headwaters of the Clark Fork and Columbia River. Rather than remove the tailings, and the source of contamination, EPA has decided, based on very limited information, to allow the wastes to clean themselves over geologic time.

The geologists, hydrologists, hydrogeologists, soil scientists, and engineers who put ***Cut and Run*** together have raised serious concerns regarding several aspects of the Proposed Butte Priority Soils preferred alternative. This white paper critiques the reasoning behind the decision to leave the tailings in place and the long-term consequences of that decision.

This PEER white paper is an attempt to explain the abdication of responsibility behind the proposed "Technical Impracticability" waiver. The white paper also recommends that EPA order further study as to the extent of contamination and the removal of accessible tailings and other mine wastes as the next step for truly rehabilitating the site and the city of Butte.

In order to avoid detracting from the message, the messengers behind this report have chosen to remain anonymous. As all the material cited within is on the public record, they believe that the facts presented speak for themselves.

PEER is proud to assist conscientious public servants who have dedicated their careers to the protection of our country's resources and the faithful execution of our environmental laws.

Jeff Ruch
PEER Executive Director

EXECUTIVE SUMMARY

The U.S. Environmental Protection Agency is prepared to walk away from the nation's largest Superfund site. More precisely, EPA is prepared to allow the responsible party, Atlantic Richfield Company (now British Petroleum/ARCO), to walk away without fully cleaning up the site.

As a result, millions of cubic yards of mine tailings, smelting slag and other wastes will drain in perpetuity into the headwaters of the Clark Fork and Columbia Rivers. And the City/County of Butte-Silver Bow will be relegated into an industrial waste heap with dim economic prospects for recovery.

EPA is poised to make a formal finding of "Technical Impracticability" that the tailings cannot be removed and that the aquifer on which is sits must therefore be sacrificed. But, contrary to its own procedures, EPA is making this Technical Impracticability finding without proper characterization of the tailings and without knowing how fast the contaminant plume is growing.

The Butte Priority Soils Operable Unit site is a 5 square mile area that includes the historic city of Butte, the second largest National Historic Landmark District in the United States. The Butte Priority Soils Operable Unit lies in the upper Silver Bow Creek valley, immediately west of the continental divide.

EPA's lack of careful characterization not only violates its own guidelines but common sense as well:

- ***Public Health Threat Looming.*** Leaving wastes in place, especially when it is in contact with groundwater, does not protect human health and the environment in the headwaters of the Clark Fork River;

- ***Environmentally Counterproductive.*** EPA's plan to leave the wastes in place jeopardizes all the reclamation work performed below. A poor job anywhere along the entire complex puts all the work below that point at some level of risk of recontamination or failure; and

- ***Economically Devastating.*** Deferring cleanup indefinitely will be an impediment to the economic future and growth of Butte.

In ***Cut and Run,*** geologists, hydrologists, hydrogeologists, soil scientists, and engineers who have worked extensively with mine waste characterization and reclamation in western Montana, critique the reasoning behind the decision to leave the tailings in place and the long-term consequences of that decision. In this paper, these professionals lay out the case for removing the source of contamination, tons of mine tailings sitting on the headwaters of the Clark Fork and Columbia River. This white paper strongly recommends that EPA order the removal of the tailings as the next step for truly rehabilitating the site and the city of Butte.

Above: 1906 photograph of the Parrott Smelter and tailings. The southern flank of the Butte hill can be seen to the left of the smelter.
Below: 2004 photograph from near the same spot. The constructed French drain along the Metro Storm Drain is in the foreground. Note the City/County shop complex in the background is constructed on fill material over the Parrott Tailings in the center of the photograph. Compare the

mountains on the horizon for a perspective on the landscape changes. The active mining area around the Berkeley Pit is seen on the left side of the photograph.

I. Welcome to Butte

Butte, Montana was the site of metal mining beginning in 1864, and continuing to the present day. The mines—more than 200 at one time—hummed 24 hours a day, and Butte, dubbed "the Richest Hill on Earth," fueled the industrial revolution, national electrification, and two world wars by supplying gold, silver, and copper from its colossal mines.

Past practices of mining and ore processing lead to contamination of soil, surface water, and groundwater in the community and in the stream system downstream. The Anaconda Company was responsible for all of the mining in Butte. Atlantic Richfield Company (now British Petroleum/ARCO) acquired Anaconda in the late 1970's and has been named the major Principal Responsible Party for the sites. In this way, the Butte area is lucky to have a major corporation responsible for its cleanup, and indeed, ARCO has made significant progress in remediation for some portions of the site.

Superfund, or the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), provides federal authority to respond to releases or threatened releases of hazardous substances to protect public health or the environment. The area around Butte was designated as a Superfund site in 1983. In subsequent years a number of operable units were separated and individual Remedial Investigations, Feasibility Studies, and Records of Decisions were to be written for each unit.

The Butte Priority Soils Operable Unit site is a 5 square mile area that includes the historic city of Butte, the second largest National Historic Landmark District in the United States. The Butte Priority Soils OU lies in the upper Silver Bow Creek valley, immediately west of the continental divide at an elevation ranging from approximately 5,400 to 6,400 feet. It is centered on the Butte Hill and urban Uptown Butte.

Mountains bound the upper Silver Bow Creek valley on the east, south, and north with elevations reaching 10,000 feet. Two primary streams drain the valley: Blacktail Creek and Silver Bow Creek. Silver Bow Creek has received many millions of cubic yards of mine tailings, slag from smelting operations, and other waste materials. The creek is literally the headwaters of the Clark Fork and Columbia rivers.

The Butte Superfund site is very large, the largest in the country. It is also a very complex site. This paper focuses on the Metro Storm Drain (MSD), the historic upper portion of Silver Bow Creek, including the Parrott Tailings subarea. The MSD received mine waste from the Parrott and other historic smelters. Mining waste in the area is the source of the most highly contaminated groundwater plume remaining in the system. The site itself received waste rock fill material decades ago, and now is the site of one road and the City/County Shop complex (see inset).

The Butte Priority Soils Operable Unit includes:

1) **The Parrott Tailings-Metro Storm Drain contamination**:
   a. Mine and ore-processing waste deposited along Silver Bow Creek channel in the center of the city of Butte.

   b. An associated plume of highly contaminated groundwater is centered on the tailings. Copper, zinc, arsenic, and cadmium concentrations are many orders of magnitude higher than health and/or aquatic standards. The dimensions and movement of the plume are poorly constrained by data.

2) Clark Mill-Butte Reduction works:
   a. Mine and ore-processing waste deposited along Silver Bow Creek channel in the center of the city of Butte.

   b. The area has largely been cleaned up under a Phase 1-Time Critical Removal Action (TCRA) (~1992-1996).

3) Mine waste dumps

a. Minimally processed dumps left from mining operations in the historic town.

b. Nonresidential areas are now mostly vacant lots or open-space areas, most have been recontoured, capped with 18" or more of soil, and revegetated under TCRAs.

b. Residential contaminated soils exist in yards. Where the soils were tested and exceeded action levels for arsenic and lead they were partially or fully removed, capped, and revegetated under TCRAs.

4) Railroad beds

a. Rail beds through town were sites of significant contamination.

b. Most have been capped and revegetated under TCRAs.

5) Indoor Dust and Mining related dust deposited in homes.

a. Indoor dust has been sampled in some homes; cleanups mostly involve lead paint abatement (not statutorily related to Superfund liability, but included anyway).

b. Mining related dust has recently been tested in the structure of homes. It occurs in attics, in walls, between floors, and in basements and crawl spaces. Little testing or removal has been done. The health effects of the dust (some samples have significant As , Pb, and Hg concentrations) are poorly known.

6) Surface water

a. Storm water and base flow runoff from the area is a significant concern.

b. Base flow will be treated.

c. Shallow groundwater at the base of the hill is captured and treated.

d. Storm water will generally be discharged after some sediment is allowed to settle.

II. Technical Impractibility: Cleanup on a Geologic Timetable

The EPA and its contractors carried out very little study of the Metro Storm Drain (MSD) site between 1991 and 2004. The Remedial Investigation and Feasibility Study were so incomplete that the EPA was required to do a "Focused Feasibility Study" (FFS) of the MSD, completed in February 2004 (1).

EPA's proposed plan for the Priority Soils site was released December 20, 2004 (2). It was based on consideration of a number of other documents prepared between 1991 and 2004. The last Record of Decision for the Butte area is in the process of being written; the public comment period for EPA's Proposed Plan for the Butte Priority Soils Operable Unit (BPSOU) ended on March 21, 2005.

Just after public comment period closed, it became known that EPA and ARCO have been working together since before January 2005 on a TI (Technical Impractibility) waiver for the Parrott Tailings. This TI waiver means leaving the waste material responsible for the plume of contaminated groundwater in place in perpetuity. As a result, the aquifer will be written off for beneficial uses. Documents circulated between EPA and ARCO (3) make it clear that EPA believes the water contamination cannot be reduced to meet standards. They propose installing a groundwater capture and treat system that will need to operate in perpetuity. Nowhere have they proposed to reduce the threats to human health or the environment by partial or full removal of the sources of contamination.

Of course, it is completely inappropriate for EPA to be working towards a TI waiver while purportedly going through the public process of selecting a preferred alternative because of the six alternatives, three of which involve significant removal. This breach of good faith is compounded by the fact that EPA does not have the data to show it is impractible to solve the contamination problem.

EPA and its chosen consultant (CDM) have failed at its mission to characterize the Metro Storm Drain portion of the operable unit and therefore do not understand the likely impacts and limitations of proposed remediation attempts:

Tailings Not Competently Characterized

EPA's plan says that the aquifer has been characterized, using "over 200 wells and soil borings". This is misleading because:

1. The median depth of wells used is about 30 ft,
2. Only one well exceeds 200 ft in depth, and
3. Soil borings were typically very shallow.

This work is not appropriate for characterization of the aquifer. The upper surface is characterized; the aquifer is not.

The alluvial aquifer in the valley is developed in deeper sediments that are inappropriately assumed to be highly heterogeneous, apparently because the stratigraphy has not been worked out in the Remedial Investigation or Focused Feasibility Study for the MSD; the predominance of fine-grained units in the shallow wells has been inappropriately confused with the deeper wells, which show a more coarse-grained nature. The aquifer has not been characterized, as alluded to in the RI or FFS.

The simple fact that the parent material for alluvium in the valley is quartz monzonite suggests that the aquifer should be more homolithic than heterolithic; there are no source areas that produce large volumes of clays. The nearest exposure of correlative sediment is the >150 ft of section exposed on the southwest wall of the Continental Pit. The unconsolidated sediments there and in the Berkeley Pit rest on weathered bedrock along an unconformity that probably is the paleo-valley of the former Silver Bow Creek. The section is composed almost entirely of sand and gravel derived from the quartz monzonite. A number of paleosols can be mapped across the exposures. The soils are a fine-grained facies, but are a minor part of the relatively coarse-grained section. Comparing this exposure to other alluvial/fluvial aquifers (e.g. Fort Union, Judith River, or Kootenai formations of Montana, Holocene sediments of the Atlantic or Gulf coastal plains), this aquifer is more homogeneous than heterogeneous.

The CDM report hypothesizes that the “past flow system” affects current hydrochemistry of the groundwater. It is important to substantiate this claim with data and geochemical modeling; otherwise, such statements are purely hypothetical. Because the majority of wells are not drilled into the primary aquifer, even basic hydrogeologic information such as flow direction, groundwater velocity, and contaminant source areas are not well characterized.

Although the contaminated soils include acid-generating materials—groundwater samples show pHs as low as 2.5—nowhere in the FFS or PP is there a discussion of the effects of low pH on the geochemistry of the aquifer system. The possibility of increasing the pH of the plume of groundwater is not discussed in the documents. Possible effects of removing the acid-generating materials from the site are neither mentioned nor discussed.

In summary, with respect to characterization, it should be apparent that prior to selecting a Preferred Alternative there are considerable unresolved issues that merit additional work to accurately characterize the aquifer.

Contaminant Plume is Not Defined

There is little reliable evidence on the rates of groundwater flow in the Parrott Tailings area. The maps of contaminant plumes in the FFS are clearly wrong based on new wells installed in 2004, which indicate that groundwater movement was underestimated. Aquifer tests are basically limited to about a dozen slug tests; most of which were performed in finer-grained sediments that are shallow in the flow system. The single “pump test” relied on so heavily in the

FFS had an observation well located in a much shallower, finer grained unit. Not surprisingly, there was little response in the tighter shallower unit, biasing the results of the test.

The FFS did not use standard scientific reasoning, such as multiple working hypotheses, in its evaluation of the sources of contamination to the MSD. For instance, the document concluded without analysis that the contamination seen discharging to the lower MSD came from the North Side and Diggings East Tailings. The FFS did not evaluate the Parrott Tailings as a likely source for the contamination, as was suggested in earlier EPA documents and shown to be the case based on the results of the 2004 drilling program.

There are important disagreements regarding both the mobility of metals in the MSD area, the hydraulic conductivity values of the aquifer, as well as the vertical extent of the contaminated plume. The analysis of the groundwater flow pattern and contaminant transport presented in the CDM report is inadequate for the purpose of remedial alternative selection, given the magnitude of the contamination present.

New monitoring wells installed by MBMG in 2004 (4) indicate the possibility of overlooked contamination at the intermediate depth of the aquifer. This observation, which significantly affects understanding of the groundwater regime and contaminant receptors, needs to be confirmed by installing more monitoring wells at the locations recommended through future modeling efforts.

The technical approach used in the CDM report does not comply with advanced technologies and methods of groundwater modeling. 3-D groundwater flow modeling incorporating geochemical modeling should be considered indispensable for an analysis of this scope and importance.

Importance of Adsorption – Desorption is Unproven

EPA's determination that the restoration of the contaminated alluvial aquifer is not feasible or technically practicable is based on no data collected from this operable unit. Vertical and horizontal delineation of the contaminant plume and thorough characterization of aquifer materials is standard practice, and was not carried out. The CDM FFS and EPA documents and presentations repeatedly allude to the processes and importance of absorption – desorption mechanisms in contamination in aquifer materials. However, because of inadequate characterization of the aquifer and the lack of sample collection and analysis by the EPA or its contractors, no data has been put forward to test their hypotheses. Such an important conclusion should be made only after a reasonable effort is expended to test the hypothesis. It is surprising to realize that no wells were drilled and no lithologic samples were collected between the release of the RI in 1991 and the FFS in 2004.

Column leach tests should be performed on samples so that conclusions can be made that are representative of the entire aquifer system. The preliminary column test experiments in the MBMG document (4) indicates similar retardation factors for metals as used in the CDM

document. Because the MBMG column study did not have replicates, we would caution the end user not to rely on these tests to draw conclusions. The column test experiment does, however, suggest that metals desorb relatively rapidly. Assuming similar values for desorption and adsorption coefficients, the rapid desorption seems to be contrary to the observed (CDM) lack of plume mobility.

There is evidence collected during the removal at the Clark Tailings and Lower Area One that the aquifer began to clean up in a few months during dewatering and excavation. These data should be evaluated as they directly relate to conditions near the MSD. A modeling effort could utilize these data to predict cleanup of the aquifer for no further removal, partial removal and complete removal scenarios.

Water Levels and Water Balance are Unaccounted For

Well hydrographs show that water levels have fluctuated by many feet between the wet years of 1996-97 and during the present drought. Yearly fluctuations about a foot to feet are the norm. These cycles show that significant quantities of water are moving away from the Parrott Tailings site–no other explanation is tenable. Discharge from the french drain was anticipated by Arco to be similar to stream flow in the MSD prior to any construction---about 40 gpm. Discharge from the French drain was about 500 gpm on March 21, 2005, and by early July it had decreased to about 400 gpm. Considering that we are in a multi-year drought, how will discharge change when we return to a wetter climate? The lack of understanding of how groundwater and surface water interact within the french drain is another indication of the need for a numerical groundwater flow model. Not only will a model help answer the question of French drain discharge during wetter period, but also a more important question of whether all of the flow is being captured.

III. Pay No Attention to These Rules: Wavier Violates EPA's own Guidance

Technical Impracticability waivers are important for sites that cannot be cleaned up. For example, the EPA quite rightly, executed a Technical Impracticability waiver for the Berkeley Pit operable unit in the Butte area. This excavation, one by one and one half miles wide and 1600 feet deep, is simply impracticable to restore. Additionally, it is the sump for contaminated groundwater in much of the underground mining area in Butte.

EPA regulations require that proposed alternatives to select a remedy for a Superfund site must be preceded by a remedial investigation/ feasibility study (RI/FS) considering all possibilities. The purpose of the RI is the gathering of information to characterize the site in order to assist in the evaluation of effective remedial alternatives. The main purpose of the FS is to evaluate the remedial alternatives to aid the agency decision-maker in the selection of an appropriate remedy. An alternative that does not meet applicable or relevant and appropriate requirements (ARARs) under federal or state environmental or facility siting laws may be selected in some cases (waiver). For example, when based on an analysis of relevant information available, compliance with a requirement is considered technically impracticable from engineering prospective. The community and the public are to be involved in various stages of the process to reach a decision about a particular site, which would include the decision concerning the Technical Impracticality waiver."

It is troubling that a Technical Impracticability waiver is being considered for the Butte Priority Soils Operable Unit given that EPA's own Superfund guidance declares that:

> "Decisions regarding the technical practicability of ground-water restoration must be based on a thorough characterization of the physical and chemical aspects of the site."
>
> "A demonstration that ground-water restoration is technically impracticable generally should be accompanied by a demonstration that contamination sources have been, or will be identified and removed or treated to the extent practicable." (Guidance for Evaluating the Technical Impracticability of Ground-Water Restoration, p.13, http://www.epa.gov/superfund/resources/gwdocs/techimp.htm)

The recent Montana Bureau of Mines and Geology report (Open-File Report 507) (4) shows that:

> 1) The source of groundwater contamination (Parrott Tailings) at this site has not been accurately defined/delineated,
> 2) The horizontal and vertical extent of groundwater contamination has not been accurately defined,
> 3) The original conceptual model/understanding of the site's hydrogeologic framework is flawed.

How can EPA be in a position to state that “adequate documentation” exists to consider, much less approve, a Technical Impracticability waiver for the Butte Priority Soils Operable Unit?

The basic data needed to answer the fundamental questions (e.g. what is the nature and extent of contamination? What are the physical hydraulic characteristics of the site? What are the pathways of contaminant migration?) have not been obtained. The data, or lack thereof, speak for itself, namely that EPA is not following its own guidelines.

Inadequate data and a flawed understanding of the site characteristics will lead to a defective remedy. EPA needs to get back to the basics on this site. A good place to start is with its own guidance documents:

> *"The objective of the RI/FS process is not the unobtainable goal of removing all uncertainty, but rather to gather information sufficient to support an informed risk management decision regarding which remedy appears to be most appropriate for a given site." (1-3)*
>
> *"The final objective of the field investigations is to characterize the nature and extent of contamination such that informed decisions can be made as to the level of risk presented by the site and the appropriate type(s) of remedial response." (3-13)*
>
> *"In general, the RI/FS must obtain data to define source areas of contamination, the potential pathways of migration, and the potential receptors and associated exposure pathways (1-4)"*
>
> *"Data on the physical characteristics of the site and surrounding areas should be collected to the extent necessary to define potential transport pathways and receptor populations and to provide sufficient engineering data for development and screening of remedial action alternatives."*

Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA, EPA/540/G-89/004, OSWER Directive 9355.3-01, October 1988
http://www.epa.gov/superfund/resources/remedy/pdf/540g-89004-s.pdf

> *"Source removal and remediation may be difficult even where source locations are known. The appropriate level of effort for source removal and remediation must be evaluated on a site-specific basis, considering the degree of risk reduction and any other potential benefits that would result from such action.* ***Even partial removal*** *of contamination sources can greatly reduce the long-term reliance on both active and passive ground-water remediation." (p. 13)* [emphasis added]

Guidance for Evaluating the Technical Impracticability of Ground-Water Restoration
http://www.epa.gov/superfund/resources/gwdocs/techimp.htm
Directive 9234.2-25, September 1993

IV. The Case For Removing the Tailings

It is apparent there are important unanswered questions regarding both contaminant transfer rates and the associated complex geochemistry. There is considerable uncertainty and even more debate between the EPA's and the State's scientists about the degree to which groundwater would be cleaned if tailings were removed. The bottom line is this: there simply is not enough information to decide if it is prudent to walk away from the groundwater aquifer.

Unless there is a better understanding of the existing pathway and a way to isolate these tailings from groundwater sources, removal of all of the Parrott Tailings is the only way to protect human health and the environment.

Removal of the Parrott Tailings waste material would at the least assure that the aquifer might clean itself up over some measurable unit of time. While groundwater will need to be captured and treated as a necessary interim step, removing the accessible tailings from the MSD area will undoubtedly make the groundwater cleaner to a large extent, and cleaner water, even if it does not completely meet standards, is preferable to treatment "in perpetuity."

Leaving wastes in place, especially when it is in contact with groundwater, does not protect human health and the environment in the headwaters of the Clark Fork River. Left where they are, the wastes are susceptible to unforeseen events, such as catastrophic storm events or equipment malfunctions in the engineered recovery system. The groundwater is so highly contaminated that even small, unforeseen releases could cause significant health and environmental damage.

Compromising Downstream Cleanups

EPA's plan to leave the wastes in place jeopardizes all the reclamation work performed below. A poor job anywhere along the entire complex puts all the work below that point at some level of risk of recontamination or failure.

EPA proposes to capture and treat contaminated groundwater by the use of a french drain constructed parallel to the valley gradient. The use of such a system is a bit confounding, since most contaminant capture systems utilize systems perpendicular to the direction of transport. There are no data to demonstrate how effective the capture system will be, but even minor inefficiencies will likely result in concentrations of heavy metals in Silver Bow Creek toxic to aquatic life. Poor decision making at this stage of the Superfund process would compromise the completed cleanups along Silver Bow Creek.

These risks also strongly argue for a conclusion that EPA's preferred alternative is not protective of the environment, as required by CERCLA.

Economic Development Concerns

Leaving waste in place may hinder economic development and the future of Butte. A remedy that leaves waste in place ignores the social and economic consequences. The economic well being of Butte depends on a clean environment and the ability to attract people and businesses to the area.

The economic importance of implementing a cleanup alternative that accurately characterizes mine wastes and addresses the potential impacts not only to human health and the environment but also to the economy was most recently illustrated when Bi-Mart backed out of the purchase and construction of a $1.3 million store in Anaconda in mid March 2005. Bi-Mart cancelled the sale agreement of the East Yards lots because of unforeseen beryllium contamination on the Superfund land. Bi-Mart asked for reimbursement of money they spent on "unexpected costs" related to the discovery of the contamination on the 7.6-acre parcel. Bi-Mart felt the county should pick up the tab because the county represented to Bi-Mart that "the property was a remediated Superfund site". Butte can expect similar impacts to their economy if there is not an adequate understanding of the impacts from mine wastes to groundwater and surface water.

The inadequacy of the site characterization done on this site by the EPA prior to the proposed sale of this property to Bi-Mart emphasizes the importance of adequately characterizing the Butte Priority Soils OU using the best available technology. This has not been done to date. Decisions are being made without having a sufficient understanding of the extent and volume of wastes as well as their contribution to groundwater and surface water pathways.

Any type of cleanup, other than the best available technology that removes wastes from their pathways, will leave Butte with an economy and economic growth potential that is unacceptable to its citizens. To save money by accepting a preferred alternative that leaves waste in place to contaminate surface or groundwater at the expense of public health and economic development will not help promote Butte and future economic development. It will leave Butte with a stigma of potential toxicity that will only hinder economic investment in the community.

Precautionary Principle Points Toward Removal

Removal of accessible material and material under the county shops (Alternative 5b in the Focused Feasibility Study) is a reasonable solution that is likely to solve the groundwater contamination problems permanently. Removal of the Parrott Tailings waste material would allow the possibility that the aquifer could clean itself up over some measurable unit of time. Leaving both the contaminated and the acid-generating material in place assures the aquifer will remain contaminated

A Final Recommendation

The lack of defendable scientific work on the MSD area speaks to the lack of scientific oversight. We suggest that the EPA appoint an independent group of scientists that will advise EPA and its contractors, and attempt to rectify competing opinions on site characteristics and implementation of cleanup options. Such a group could be made up of local and regional experts on hydrogeology, contaminant transfer, and site remediation.

References:

(1) CDM, February 2004, Phase II Remedial Investigations/Feasibility Study, Final Feasibility Study Report – Appendix E.

(2) USEPA, Superfund Program Cleanup Proposal, Butte Priority Soils Operable Unit: http://www.epa.gov/Region8/superfund/sites/mt/FinalBPSOUProposedPlan.pdf

(3) Butte Priority Soils Operable Unit Silver Bow Creek/Butte Area Superfund Site Preliminary Draft Technical Memorandum- For Review Only Groundwater Technical Impracticability Evaluation for Butte Priority Soils Operable Unit, Atlantic Richfield Company, December 22, 2004

(4) Montana Bureau of Mines and Geology 2004. Open-File Report 507 entitled "Summary of Investigations, Upper Silver Bow Creek. http://www.mbmg.mtech.edu/sbcitation.asp?cit1=MBMG&cit2=507&

(5) WET, July 2004. Technical Review Comments For: Focused Feasibility Study of the Metro Storm Drain; CDM, February 2004 & Upper Silver Bow Creek Investigations; MBMG, June 2004.