U.S. ENVIRONMENTAL PROTECTION AGENCY
OFFICE OF INSPECTOR GENERAL

Catalyst for Improving the Environment

Hotline Report

Contaminated Soil Waste Repository at East Mission Flats, Idaho

Report No. 09-P-0162

June 8, 2009



Report Contributors: Eric Lewis
Dan Cox
Tom Reilly
Johnny Ross
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Kimberly Crilly

Abbreviations

BEIPC	Basin Environmental Improvement Project Commission
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
EMF	East Mission Flats
EPA	U.S. Environmental Protection Agency
IDEQ	Idaho Department of Environmental Quality
OIG	Office of Inspector General
ROD	Record of Decision
SVCRC	Silver Valley Community Resource Center

Cover photo: The planned East Mission Flats contaminated soil waste repository location. (Photo taken by OIG staff in May 2008)

U.S. Environmental Protection Agency
Office of Inspector General

09-P-0162
June 8, 2009

At a Glance

Catalyst for Improving the Environment

Why We Did This Review

We conducted this review to determine if the U.S. Environmental Protection Agency (EPA) allowed appropriate community involvement and provided adequate notice when selecting the East Mission Flats (EMF), Idaho, repository location; and included flood controls in repository design to minimize potential for releasing contaminants.

Background

An environmental organization located in Kellogg, Idaho, complained to the Office of Inspector General (OIG) Hotline that EPA did not follow Superfund requirements in designing the repository. The group alleged the public was not notified appropriately of repository plans and did not have an opportunity to provide comments.

For further information, contact our Office of Congressional, Public Affairs and Management at (202) 566-2391.

To view the full report, click on the following link:
www.epa.gov/oig/reports/2009/20090608-09-P-0162.pdf

Contaminated Soil Waste Repository at East Mission Flats, Idaho

What We Found

EPA Region 10 and the Idaho Department of Environmental Quality (IDEQ) provided opportunities for the community to become involved and notified the public when selecting the East Mission Flats repository site location and soliciting comments on the proposed plan, location, and designs.

We found that many physical aspects of flooding have been investigated and considered in the design process. However, we also found that the geochemical aspects and potential for releasing dissolved contaminants had yet to be investigated. The proposed repository site is located in an area that floods annually. Region 10 and IDEQ have not sufficiently analyzed the geochemical conditions that are expected to form near the repository base, the potential for annual flooding to introduce water into the repository, and the possibility that dissolved contaminants will migrate away from the repository. In response to our concerns, Region 10 and IDEQ prepared a draft scope of work for the needed analysis. Much of that work was completed and included in Region 10's response to our draft report. But the work leaves unresolved the amount of water that will be introduced into the repository with flooding and rising groundwater levels.

What We Recommend

We recommended that EPA Region 10 finish analyzing the geochemical and physical conditions that may lead to contaminants dissolving near the repository base; then confirm the adequacy of the repository design to prevent dissolved contaminants from being released under these conditions.

Region 10 concurred with the recommendation and prepared a technical analysis. We acknowledge that the new work is extensive, especially the unsaturated zone modeling. However, the Region's analysis included assumptions, with consequent conclusions, that the OIG believes require technical verification. The Region should address these issues in its 90-day response to the final report. The recommendation will remain open.

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460

OFFICE OF
INSPECTOR GENERAL

June 8, 2009

MEMORANDUM

SUBJECT: Contaminated Soil Waste Repository at East Mission Flats, Idaho
Report No. 09-P-0162

FROM: Wade T. Najjum
Assistant Inspector General
Office of Program Evaluation

TO: Michelle Pirzadeh
Acting Regional Administrator
Region 10

This is our final report on the subject review conducted by the Office of Inspector General (OIG) of the U.S. Environmental Protection Agency (EPA). This report contains findings that describe concerns the OIG has identified and corrective actions the OIG recommends. This report represents the opinion of the OIG and the findings contained in this report do not necessarily represent the final EPA position. Final determinations on matters in this report will be made by EPA managers in accordance with established resolution procedures.

The estimated cost of this report – calculated by multiplying the project's staff days by the applicable daily full cost billing rates in effect at the time – is $418,288.

Action Required

In accordance with EPA Manual 2750, you are required to provide this office with a written response within 90 days of the date of this report. You should include a corrective action plan for agreed-upon actions, including milestone dates. We have no objections to the further release of this report to the public. This report will be available at http://www.epa.gov/oig.

If you or your staff have any questions regarding this report, please contact Eric Lewis at 202-566-2664 or lewis.eric@epa.gov, or Tom Reilly at 202-566-2897 or reilly.tom@epa.gov.

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Purpose

The purpose of this review was to determine whether an OIG Hotline complaint that the Silver Valley Community Resource Center (SVCRC) submitted to the U.S. Environmental Protection Agency (EPA) Office of Inspector General (OIG) had merit.

In conducting this review, we pursued the following questions:

1. Did EPA Region 10 and the Idaho Department of Environmental Quality (IDEQ) allow for appropriate community involvement in selecting the repository site location and providing comments on the proposed plan and repository designs?

2. Did Region 10 and IDEQ provide adequate public notification regarding the waste repository proposed for East Mission Flats (EMF)?

As a result of the community concerns and our own observations, we pursued an additional objective:

3. Did Region 10 and IDEQ incorporate flood controls in the repository design to minimize potential for contaminant release?

Background

SVCRC, an environmental organization located in Kellogg, Idaho, submitted a complaint to the OIG Hotline. SVCRC alleged that EPA did not follow Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) requirements in designing the EMF repository. The repository is located close to the Old Mission National Historic Landmark and State Park near Cataldo, Idaho, in an area that floods every spring. SVCRC alleged the public did not receive appropriate notification of the repository plans and did not have sufficient opportunity to provide comments. Community members were also concerned that contaminants from the repository might migrate from the site during annual flooding.

The EMF repository site (see Figures 1 and 2) encompasses a 23-acre parcel of land about ¾ of a mile west of Cataldo, Idaho. The repository site is 1,500 feet from Old Mission State Park and about 3,000 feet from the Coeur d'Alene River. Interstate 90 separates the site from the park and the river.

Sediments at the repository site are already contaminated. Contamination within the river basin includes source areas of mine and mill sites in the upper South Fork of the Coeur d'Alene River valley and deposits of mining waste on the 100-year floodplain in the lower river valley, west of Cataldo.

The repository will hold about 416,000 cubic yards of soils contaminated with lead, arsenic, and other metals. Remedial actions in the Bunker Hill Mining and Metallurgical

Complex (Bunker Hill) Superfund Site (Operable Unit 3) will generate these soils. In response to public comments on the 30% Design Report, EPA Region 10 and IDEQ reduced the planned height of the repository from 62 feet to 34 feet to eliminate direct sight lines from the park to the top of the repository.

Figure 1. Aerial photo of repository site location.



(Source: Mapquest.com website)

Figure 2. EMF Repository Site – December 2007



(Source: OIG staff photo)

When Congress passed CERCLA, also known as Superfund, in 1980, it incorporated public involvement into the remediation process. Congress intended to ensure that the people whose lives were affected by hazardous wastes and EPA's actions to clean them up would have a say in what happened in their community.

Since then, Congress further strengthened the role of community members through passage of the Superfund Amendments and Reauthorization Act of 1986, and EPA, through its administrative reforms. While EPA retains the final responsibility and authority to decide what will happen at a Superfund site, the Agency must consider community input.

The goal of EPA's Superfund Community Involvement Program under CERCLA is to advocate and strengthen early and meaningful community participation during site cleanups. Superfund community involvement staff strive to keep the community well informed of ongoing and planned activities, encourage and enable community members to get involved, and listen carefully to what the community is saying. EPA's community involvement efforts, through its Community Involvement Plans for specific Superfund sites, fulfill the statutory and regulatory requirements of CERCLA, as well as the intent of the law.

The Community Involvement Plan for Operable Unit 3 of the Bunker Hill Site outlined community involvement goals and proposed avenues such as local newspapers, public meetings, and fact sheets, to provide information to the public.

The Record of Decision (ROD) for Operable Unit 3 directs EPA to initiate a public outreach effort to give citizens and stakeholders an opportunity to comment on the location and design of proposed repositories. This outreach effort was to be concurrent with the technical evaluation of potential repository sites.

Scope and Methodology

We performed work on this assignment from December 2007 through March 2009. We interviewed the complainants, local residents, employees in EPA Region 10 and the Idaho Department of Environmental Quality, representatives of the Coeur d'Alene Tribe, members of the Basin Environmental Improvement Project Commission, and staff from the Center for Justice. We visited the planned repository site in East Mission Flats, Idaho, during May 2008 and observed that the site was inundated with several feet of water. We attended an "open house" conducted by IDEQ and Region 10 in July 2008 to update interested local residents on design plans for the repository. We reviewed site administrative files, community relations files, cleanup planning documents, and the intermediate design reports, referred to as the 30% and 60% Design Reports.

We performed this review in accordance with generally accepted government auditing standards as issued by the Comptroller General of the United States. We limited our review of management controls and compliance to those directly relating to the issues identified in the hotline complaint.

Results of Review

Notification and Community Involvement

Region 10 provided adequate opportunities for public comment on the ROD

Region 10 provided adequate opportunities for the public to comment on the ROD for Operable Unit 3 of the Bunker Hill Superfund site which was issued in September 2002. EPA received more than 3,300 comments on the proposed Basin Cleanup Plan from approximately 1,300 different individuals.[1] EPA extended the comment period twice, for a total of 120 extra days, in response to public requests. Part 3 of the ROD contains the summaries of public comments and the EPA responses.

The Region published a Community Involvement Plan for the Coeur d'Alene Basin and Bunker Hill Superfund site in August 2005. Consistent with the plan, EPA and IDEQ provided information on ongoing cleanup efforts in the Bunker Hill complex through the Basin Environmental Improvement Project Commission (BEIPC)[2], the Citizens Coordinating Council[3], town hall meetings, Internet sites, newspapers, and a door-to-door campaign informing community members of ongoing cleanup efforts.

Region 10 and IDEQ met ROD community involvement requirements in siting the repository

During January and February 2005, EPA and IDEQ representatives went door-to-door to discuss with seven individuals living near the site the potential for siting a repository at East Mission Flats. The IDEQ representative also contacted one individual by phone, left handouts at four residences, and mailed certified letters and handouts to two individuals.

Region 10 and IDEQ also discussed, during a July 2005 town hall meeting which 19 community members attended, the possibility that a repository could be sited at East Mission Flats. At this meeting, the Region and IDEQ indicated that attendees were welcome to provide written or verbal comments regarding the siting of the repository. During an October 2005 town hall meeting, Region 10 again indicated that there was an urgent need to site more repositories in the Coeur d'Alene Basin and asked the Citizens Coordinating Council for help in identifying appropriate locations. The Region also noted that efforts were ongoing to investigate whether a repository could be sited at "Mission Flats."

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[1] *Ombudsman Review of Bunker Hill and Coeur d' Alene Basin Superfund Actions*; OIG Report No. 2004-P-00009, March 24, 2004.

[2] The Coeur d'Alene Basin Environmental Improvement Project Commission (BEIPC) was established when the ROD was issued for Operable Unit 3.

[3] The Citizens Coordinating Council was formed as a sub-group under the BEIPC to provide a mechanism for the community and other interested stakeholders to obtain information on site plans and activities and express their concerns.

In the December 2006 Basin Bulletin, Region 10 published an article indicating that IDEQ had purchased property at East Mission Flats in September 2006 and, jointly with Region 10, was proceeding to design a new repository at that location.

Region 10 and IDEQ met ROD community involvement requirements in designing the repository

In designing the repository, Region 10 and IDEQ adequately addressed the ROD's community input/notification requirements. Region 10, IDEQ, and BEIPC conducted several public meetings where they provided information on the design of the EMF repository. For example, they:

- sponsored a community meeting at the Canyon School in March 2006,
- presented information on the repository at a Citizens Coordinating Council meeting in May 2006,
- made update presentations at Citizens Coordinating Council meetings in February and May 2007,
- provided a public tour of the EMF site in June 2007, and
- held a discussion on the 30% Design Report at the Canyon School in October 2007.

The public was given the opportunity to submit comments on the 30% Design Report between May 16 and July 6, 2007. Among those providing comments on the design were the Coeur d'Alene Tribe, Center for Justice, Idaho Conservation League, SVCRC, and the Lands Council. In response to the public comments received on the 30% Design Report, Region 10 and IDEQ made several changes to the repository design. For example,

- The height was reduced from 62 to 34 feet for a maximum top elevation of 2,165 feet.
- The volume was reduced from about 668,000 to 416,000 cubic yards.
- Perimeter protection will now be installed as soon as the perimeter of the repository is built to an elevation of 2,152 feet. This change was expected to permanently protect the site from erosion due to flooding.
- Temporary protection steps are to be taken to protect the placed soils from eroding while the repository is open.
- The existing gate is to be replaced with a key card for controlled and monitored access to control what materials are disposed of at the repository.

IDEQ and Region 10 also held a community "open house" on July 31, 2008, where the public was invited to review and give suggestions on the executive summary of the 60% Design Report for the EMF repository. The public was given the opportunity to submit written comments through September 8, 2008.

Evaluating the Potential for Contaminant Release

The complainant and other local citizens raised concerns regarding potential release of contaminants from the repository that might result from flooding. The proposed repository will be built on the floodplain of the Coeur d'Alene River. The area is known to flood annually, although the magnitude of that flooding varies year to year. At a minimum, water is expected to cover over half of the lower perimeter of the repository for several weeks during the annual run-off period. When OIG personnel visited in May 2008, the site was under several feet of water (see Figure 3). We reviewed the 30% and 60% Design Reports to determine the degree to which the repository has been designed to prevent contaminants leaving the repository by being eroded or dissolved by flood waters that penetrate the repository and then drain away.

We found that many of the physical aspects of flooding had been considered in the design process. However, we also found that:

- the geochemical and physical conditions that might lead to contaminants dissolving near the repository base had yet to be investigated, and
- the adequacy of the repository design to prevent dissolved contaminant release had yet to be evaluated.

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(Source: OIG staff photo)

Potential Erosion of Repository Waste Materials

The latest repository design included armoring the sides of the repository to protect the repository waste materials from being carried away by flood waters. Compacting the waste materials as the repository is constructed will also make erosion less likely. The design specifications were to prevent erosion of the repository waste materials under the maximum velocity and shear stress expected in a flood of a magnitude estimated to occur once every 100 years. Estimates of stress were made using a numerical model constructed to simulate the hydraulic effects of flooding at the repository site. The construction plan for the armoring was modified to include annual construction stages with the intent of preventing erosion of repository materials throughout the many years that the repository is expected to be open to receive new waste soils.

We found that the design team had considered the potential for erosion of the repository materials, and incorporated into the repository design elements that will lessen the likelihood that erosion will occur under the expected conditions.

Potential Geochemical Mobilization of Contaminants

IDEQ and Region 10 have not evaluated the physical and geochemical changes that will develop within and below the repository because the site floods annually. The 60% Design Report and the October 2008 response to comments received on the report suggest several issues that we detail below.

We found that the October 2008 response dismisses concerns regarding the potential for metals to leach from the repository into the underlying groundwater. The primary argument provided is that the metal concentrations in the underlying groundwater are below drinking water standards, even though the top 2 to 4 feet of soils at the repository site have been contaminated for decades. However, not far from the repository site, where the thickness of contaminated soils is much greater due to historic dredge and dump activities, the groundwater concentrations, according to Appendix B of the 60% Design Report, were more than twice the ecological standard for zinc. As a result, adding over 30 feet of contaminated soils may potentially contaminate the groundwater under and beyond the repository if adequate mitigation steps are not incorporated into the repository design. We also found the argument given did not consider changes in the geochemical conditions that are anticipated to occur within and underneath the repository.

The October 2008 response also reports that the repository cap will practically eliminate infiltration from precipitation into the compacted, contaminated materials. However, this response does not acknowledge that the infiltration cap does not extend down the sides of the repository where the contaminated materials will be capped instead by gravel and other armoring materials. Nor does the response consider that a liner will not be placed at the repository base, even though the groundwater level is known to rise above land surface annually with the flooding. No barriers will be present to prevent flood waters from infiltrating into the repository materials from the side and from underneath.

The metals in the repository materials will be fairly stable, except under the reduced geochemical conditions[4] that are expected to occur near the repository base, according to the 60% Design Report. The report suggests that a geochemical model could be constructed to include the effects of developing a reducing environment near the repository base. This modeling should include adding flood waters into the repository annually.

The 60% Design Report identified that dissolved oxygen concentrations in the groundwater underlying the repository site are already fairly low (less than or equal to 1 milligram per liter). The report does not attempt to explain this condition and does not explore the implications of this oxygen-reduced water rising into the repository during annual flooding. With oxygen concentrations already low, the groundwater may more likely become reduced as it rises into the repository during annual flooding. Reduced geochemical conditions would then promote dissolving metal contaminants and increase the possibility of contaminants migrating.

We concluded that EPA Region 10 and IDEQ have not sufficiently analyzed:

- the reduced geochemical conditions that are expected to form at the repository base,
- the potential for annual inundation by floodwaters to introduce water into the repository that will maintain the reduced conditions, and
- the possibility that dissolved contaminants will migrate away from the repository.

For example, staff calculating the quantity of water that might infiltrate have assumed that inundation by flood waters will be on the order of 5 days, whereas the 60% Design Report indicates annual flooding persisting for several weeks. Laboratory experiments with contaminated soils have been limited to leaching with water similar to precipitation. To understand if contaminants will be mobile under the reduced conditions expected to form near the repository base, the experiments should include leaching experiments under reduced conditions. Region 10 and IDEQ should conduct the analysis needed to understand geochemical conditions that will prevail if the repository base stays saturated. Factors to consider include infiltration of water with annual flooding and settlement beneath the repository. If reduced conditions are predicted to be maintained near the base, Region 10 and IDEQ should modify the repository design to mitigate any unacceptable migration of dissolved contaminants that might result.

In response to OIG concerns, Region 10 and IDEQ prepared a draft scope of work for this analysis. On December 2, 2008, we met with Region 10 and IDEQ to discuss the scope of work and the need for their planned work and results to be reviewed. The reviewer or reviewers should be independent of the design team and qualified to assess that the analysis is technically sound and that the repository will protect human health and the environment.

[4] Reduced geochemical conditions form when the available oxygen has been consumed by biological or abiotic processes.

In its response to our report, dated April 17, 2009, Region 10 described the results of the analysis. We acknowledge that the new work is extensive, especially the unsaturated zone modeling.

Region 10 sent an additional response, dated May 15, 2009, that included a technical review by an EPA research geochemist. The reviewer did not cover work related to physical infiltration of water into the proposed repository.

We have identified several technical issues with the work the Region and IDEQ have conducted that leave unresolved the amount of water that will be introduced into the repository with flooding and rising groundwater levels. Region 10's response memoranda are included in Appendix A. Our comments, describing technical issues that need to be addressed, are in Appendix B.

Recommendation

We recommend that the EPA Regional Administrator, Region 10:

1. Finish analyzing the geochemical and physical conditions that might lead to contaminants dissolving near the repository base; then confirm the adequacy of the repository design to prevent dissolved contaminants from being released under these conditions.

Agency Comment and OIG Evaluation

Region 10 concurred with the recommendation and prepared a technical analysis. However, the Region's analysis included assumptions, with consequent conclusions, that the OIG believes require technical verification. The Region should address these issues in its 90-day response to the final report. The recommendation will remain open.

Status of Recommendation and Potential Monetary Benefits

RECOMMENDATIONS						POTENTIAL MONETARY BENEFITS (in $000s)	
Rec. No.	Page No.	Subject	Status[1]	Action Official	Planned Completion Date	Claimed Amount	Agreed To Amount
1	9	Finish analyzing the geochemical and physical conditions that might lead to contaminants dissolving near the repository base; then confirm the adequacy of the repository design to prevent dissolved contaminants from being released under these conditions.	O	Regional Administrator, Region 10			

[1] O = recommendation is open with agreed-to corrective actions pending
C = recommendation is closed with all agreed-to actions completed
U = recommendation is undecided with resolution efforts in progress

Appendix A

Agency Responses

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 10
1200 Sixth Avenue, Suite 900
Seattle, WA 98101-3140

April 17, 2009

Reply To: Coeur d'Alene Field Office

MEMORANDUM

SUBJECT: OIG Draft Hotline Report – Contaminated Soil Waste Repository at East Mission Flats, Idaho
OIG Assignment No. OCPL-FY08-0002
Dated March 30, 2009

FROM: Daniel D. Opalski, Director
Office of Environmental Cleanup

TO: Eric Lewis,
Product Line Director, Special Reviews
Office of Program Evaluation

This memorandum is in response to your draft hotline report on the Contaminated Soil Waste Repository at East Mission Flats, Idaho. Region 10 would like to thank you for your thorough review of the concerns raised by the complainant and the work performed by EPA and the Idaho Department of Environmental Quality (IDEQ). We feel the report fully endorses the extensive public outreach efforts that both agencies have conducted for this repository site.

We also believe the report's technical recommendation is consistent with our remedial design process and the adaptive management approach we are using for this project and others throughout the Bunker Hill Superfund Site. Below you will find our response to the draft recommendation, a discussion of other technical issues contained within your report, and a recommendation from Region 10 on the content of your report.

Region 10 Response

Region 10 concurs with the report's recommendation and believes that the analyses recommended by OIG have been completed by the IDEQ and incorporated into the East Mission Flats Repository Draft 90% Design Report. As you are aware, the Draft 90% Design Report was not completed at the time the OIG interviews were conducted.

The report is still in draft and is undergoing internal agency review. Once the agency review is complete, IDEQ will provide the Final 90% Design Report to the public.

See **OIG Comment 1** in Appendix B.

The Draft 90% Design Report contains two appendices that provide technical support for the geotechnical and hydrogeologic aspects of the design. We are enclosing copies of Appendix G and Q from the Draft 90% Design Report with this response. Appendix G discusses consolidation of the soils within the footprint of the future repository and Appendix Q addresses multiple geochemistry evaluations. In the interest of brevity, the information contained in this memorandum are summaries of more detailed information contained in appendices G and Q.
The following sections summarize the EPA and IDEQ response to the recommendation in the OIG draft Hotline Report, our response to a request noted in the draft report, and a suggested edit to the background section to provide more detail on the existing environmental conditions at the site. Each issue is identified by the page and paragraph it appears in the OIG report.

Recommendation, Page 9 Paragraph 2

> *Finish analyzing the geochemical and physical conditions that might lead to contaminants dissolving near the repository base; then confirm the adequacy of the repository design to prevent dissolved contaminants from being released under these conditions.*

Response: OIG staff reviewed design documents up to and including the 60% Design Report. At the 60% design phase geochemical and physical conditions that might influence contaminant mobility near the repository base had not been fully addressed. Contaminant mobility is dependant on the presence of water within the repository to saturate waste material and the geochemical behavior of metals in various geochemical regimes. Both aspects of contaminant mobility were evaluated during the 90% Design Report effort. The results of this evaluation are summarized in Appendix Q of the Draft 90% Design Report.

Three pathways of water influx to the repository were assessed for the 90% Design Report: (1) downward vertical migration through the evapotranspiration (ET) cover; (2) lateral infiltration due to contact with flood water; and (3) upward vertical migration from the first water-bearing zone beneath the site. In addition to the water flux modeling, an assessment of the potential for metals leaching from remedial action-derived soil under oxidizing conditions was performed.

See **OIG Comment 2** in Appendix B.

Results of the water influx assessment indicated infiltration through the top surface of the repository will be minimized or eliminated by the construction of an ET

cover. Vertical migration of groundwater upward into the base of the repository will not occur due to the low hydraulic conductivity of the underlying soils and lack of sustained driving hydraulic head. Long-term saturation of the base of the repository due to periodic flood events and the development of reducing conditions are not expected. Lateral infiltration model results estimate inundation by surface water due to periodic flooding will saturate a ring approximately 13 to 16 feet wide and 0.3 to 0.5 feet thick at the perimeter of the repository, less than 0.05% of the total repository volume. EPA and IDEQ believe these are conservative estimates for the extent of saturation. The assumptions used in the lateral infiltration model are listed in Appendix Q. Since reducing conditions within the waste soil mass were not anticipated, an evaluation of metals mobility under reducing conditions was not conducted.

See **OIG Comment 3** in Appendix B.

Leachate generated from the small volume of water that may penetrate the yard waste soil is not expected to contain elevated levels of metals. The surface water will be saturated with oxygen, unlike the sub-oxic water in the first water-bearing zone. Based on column tests approximating oxidizing conditions at the proposed repository, arsenic, cadmium, and lead will not be mobilized and low levels of antimony and zinc will be present. The column tests actually indicate that the existing deposits have the potential to generate more metals than yard waste soil, specifically cadmium and zinc. Cadmium, leached from the existing native deposits, may be in the range of the primary drinking water maximum contaminant level (MCL), and zinc could exceed the secondary drinking water MCL. Because the existing soils generate higher levels of metals than the proposed yard waste, the reduction in infiltration beneath the repository footprint should result in an overall decrease in metals leached to shallow groundwater and an improvement in water quality.

See **OIG Comment 4** in Appendix B.

The repository design is intended to protect human health and the environment from releases due to reasonably foreseeable events and we believe it is adequate based on the results of the referenced studies. Assessment of the design performance is part of the operations and maintenance program established for the site. One goal of the design is to protect groundwater quality. To help achieve that goal the groundwater monitoring program will continue on a regular basis for as least as long as it takes to fill the repository to capacity. Currently that monitoring program is conducted quarterly, but that may be revised as appropriate through adaptive management and other means. In addition, the site will be maintained in perpetuity by the State of Idaho to minimize the potential for release of contaminants from the site to the environment. If the water quality data show a trend of increasing dissolved metals concentrations, the first issue would be to identify the cause of the increase. Once the cause of the increase is identified, an appropriate remedy would be developed and implemented. This management approach is based on realistic site characterization assumptions in an effort

to produce a cost-effective solution to long-term waste soil storage at the East Mission Flats Repository Site.

Third-Party Review Request, Page 9, Paragraph 1

> *. . . we met with Region 10 and IDEQ to discuss the scope of work and the need for the planned work and results to be reviewed. The reviewer . . . should be independent of the design team and qualified to assess that the analysis is technically sound and that the repository will protect human health and the environment.*

Response: A review by an independent third party will be conducted in spring 2009. Comments from the third-party reviewer will be incorporated into the Final 90% Design Report.

See **OIG Comment 5** in Appendix B.

Suggested Edit to the Background section

The selected repository site at EMF is located within the drainage of the South Fork and main stem Coeur D'Alene River. The entire river drainage has been impacted by mine and smelter wastes, including the EMF site and surrounding area. In order to provide a more complete description of the existing environmental conditions at the repository site, the background section on Page 1 should include reference to the pre-existing widespread distribution of metals in soils and groundwater.

See **OIG Comment 6** in Appendix B.

Conclusion

I'd like to close by saying that Region 10 appreciates the work of your staff during the review of the East Mission Flats Repository. We'd like to work with you to finalize your report as soon as possible. At this time, EPA and IDEQ are planning to finalize the repository design in May 2009. Please feel free to contact Bob Phillips if you have any questions regarding this response.

Attachments (2)

cc: Michelle Pirzadeh,
Acting Regional Administrator, Region 10, ORA 140

Dan Opalski,
Director, Office of Environmental Cleanup, ECL 117

Cami Grandinetti

Manager, Cleanup Unit 4, ECL 111

Angela Chung
Team Leader, Coeur d'Alene Basin, ECL 111

Ed Moreen
Project Manager, EPA - Coeur d'Alene Field Office

Bob Phillips
Audit Coordinator, OMP-145

Rob Hanson
Mine Waste Cleanup Program Manager, IDEQ, Boise

Andy Mork
Project Manager, IDEQ, Boise

See **OIG Comment 7** in Appendix B.

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 10
1200 Sixth Avenue, Suite 900
Seattle, WA 98101-3140

OFFICE OF
ENVIRONMENTAL CLEANUP

May 15, 2009

MEMORANDUM

SUBJECT: Supplemental Information for March 30, 2009 Office of Inspector General Draft Hotline Report – Contaminated Soil Waste Repository at East Mission Flats, Idaho
Office of Inspector General Assignment Number: OCPL-FY08-0002

FROM: Daniel D. Opalski, Director
Office of Environmental Cleanup

TO: Eric Lewis, Product Line Director
Special Reviews
Office of Program Evaluation

This letter is in follow-up to my response dated April 13, 2009, in which I indicated that a third party was going to review the geochemical analysis performed for the contaminated soil waste repository at East Mission Flats, Idaho. That review has been performed and a copy of the final memorandum is attached for your information.

With this review, all is in order for completion of the design and the inception of the construction at this site. The Idaho Department of Environmental Quality plans to begin construction as soon as possible and no later than the end of the month. We would appreciate receiving your final report before that time.

Please feel free to contact Bob Phillips at (206) 553-6367 if you have any questions regarding this letter.

Enclosure

cc: Ed Moreen, Project Manager
Environmental Protection Agency - Coeur d'Alene Field Office

Bob Phillips, Audit Coordinator
Environmental Protection Agency

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
NATIONAL RISK MANAGEMENT RESEARCH LABORATORY
GROUND WATER AND ECOSYSTEMS RESTORATION DIVISION
PO BOX 1198 • ADA, OK 74821

May 12, 2009

OFFICE OF
RESEARCH AND DEVELOPMENT

MEMORANDUM

SUBJECT: Review of Appendix Q, East Mission Flats Repository Geochemistry Evaluation, East Mission Flats Repository – Bunker Hill Site (09-R10-001)

FROM: Richard Wilkin, Ph.D., Environmental Geochemist
Subsurface Remediation Branch

TO: Ed Moreen, Coeur d'Alene Field Office
U.S. EPA, Region 10

Per the request for technical assistance, this memo presents a technical review of geochemical issues relating to contaminant behavior in the proposed East Mission Flats (EMF) repository in Kootenai County, Idaho. In particular, this review focuses on the potential for metals contained in waste materials to be leached, mobilized, and to potentially degrade the quality of groundwater underlying the site.

The EMF repository site is located within the Coeur d'Alene River floodplain. The repository footprint is planned to be roughly triangular in shape, covering an area of about 14 acres. The top of the repository will be limited to a maximum elevation of 2165 feet and is designed to rise approximately 32 feet above the existing ground surface. A total of about 445,000 cubic yards of material (yard waste) will be placed in the EMF repository. Wastes will be placed in 6- to 12-inch lifts and compacted to 90% in the interior of the repository and 95% at the perimeter of the repository. It is noteworthy that historical flood events have deposited metals-impacted silt and clay upon the entire site, as the site is covered with a 1 to 4 foot-thick layer of soil that contains elevated concentrations of lead, zinc, arsenic, and cadmium. Below this surface horizon, metals concentrations drop sharply and reflect un-impacted native soils of the area.

Several groundwater monitoring wells have been constructed at the site. These wells have been sampled on a quarterly basis since December 2007. The wells are screened over a depth interval of 10 feet, from 17 to 27 feet below ground surface. Water quality data and water level data have been collected from these wells. To date, results of the monitoring indicate that groundwater underneath the site meets EPA drinking water standards for the suite of metals tested. This is significant given the fact that contaminated soils are present at the land surface.

The potential for groundwater impacts from the placement of metals-impacted soil at the EMF repository has been assessed by evaluating hydrological and geochemical data and by conducting column leach tests to simulate site conditions. The leach tests focused in particular on arsenic, lead, cadmium, copper, and zinc. Based on the results of these tests, the EMF repository is not expected to impact metals concentrations in groundwater beneath the site. The underlying soils have high sorptive capacity and are predicted to remove any mobile metals from the aqueous phase. Because groundwater impacts are unexpected, liners and leachate collection systems are not part of the design.

With respect to the hydrologic assessment, three different water entry pathways were evaluated. These pathways include infiltration of precipitation and snowmelt, migration of rising groundwater through the base of the repository, and lateral migration along the perimeter of the repository from ponded surface water. Minimization of infiltration will rely on surface grading and construction of a cover consisting of clean soil and a planted native grass seed mix. Over the period of monitoring, groundwater levels within the casing of the monitoring wells were found to rise to within about 0.5 feet of land surface. Estimates of water level changes suggest that the saturated zone will not reach the base of the repository. Lateral ingress of water during seasonal high-water events is expected to cause periodic saturation of a very small portion of waste materials at the base of the repository. Less than 0.05% of the total repository volume is expected to experience a moisture increase from lateral infiltration. Overall, lines of evidence suggest that very little water will reach the waste materials and consequently there is an expectation that limited opportunities will become available for geochemical processes to take place that lead to leaching of metals from soil to the aqueous phase with subsequent migration down to the groundwater table.

Geochemical evaluations involved evaluation of distribution coefficients, sequential extraction procedures, synthetic precipitation leach tests, and column testing. Site specific sorption coefficients were not determined. Average values for soil were taken from the survey document published by EPA (2005). Note the Kd values published in this report differ from those published in a more complete 3-volume review published by EPA (1999a,b; 2004). The significance of this is in the fact that Kd values vary widely and are most appropriately determined on a site-by-site basis. Nevertheless, the main conclusion is reasonable that native materials at the EMF site are expected to have a high sorption capacity for metals. The sequential extraction data collected on two samples are especially important, as they provide some indication of the potential mobility of metals under variable geochemical conditions. A significant fraction of the arsenic, cadmium, copper, lead, and zinc in the soils are bound in the Fe/Mn oxide-bound fraction (0.20 to 0.63). This fraction can potentially be leached under reducing conditions. However, it is expected that oxidizing conditions will prevail throughout the repository. The water that does infiltrate the repository is expected to be oxygenated surface water, without the capacity to drive reductive dissolution.

The question as to whether the redox status of water will shift from oxidizing conditions to more reducing conditions is not specifically evaluated with model or laboratory assessments. The issue is of interest because, under iron-reducing conditions, metals associated with Fe and Mn oxides/hydroxides could potentially be mobilized.

Again, as noted above, the sequential extraction tests suggested a significant fraction of metals associated in this bonding environment. It is important to point out that if conditions moved beyond iron-reducing to sulfate-reducing (if sulfate-rich groundwater migrated into the repository), metals would again be strongly partitioned to the solid phase as insoluble metal sulfide clusters and precipitates. Hence there is a narrow window of reduction-oxidation conditions that could develop in conjunction with seepage of water through the repository mass and vadose zone to threaten the quality of the underlying groundwater.

Development of a geochemical model to examine trends as the system moves from oxidizing to reducing would require a significant amount of extra supporting information (e.g., mineralogy, organic carbon concentrations and reactivity, etc.) and would likely yield equivocal results. Likewise establishing lab experimentation to mimic potential changes in reduction-oxidation conditions, would perhaps be more tractable, but would present additional challenges and may ultimately miss conditions that end up developing in the repository. Unfortunately, there is no well-established test that can be performed to evaluate contaminant behavior over variable redox conditions. The primary concern here, however, feeds back to whether or not water is expected to reach the waste soils, from upward, downward, or lateral migration. The analysis presented in the Repository Design documentation suggests that the repository soil mass will not be saturated for prolonged periods of time. These conclusions are based upon a reasonable set of data and model assumptions. Given these conclusions, concerns about the potential for metals mobilization, while not to be discounted, do not warrant additional testing and assessment. It is noted that a groundwater monitoring program is in place to track any changes in groundwater quality through time. A phase of assessment and evaluation of options would be triggered in the event that the monitoring program detected any unanticipated changes in groundwater quality. It is recommended that the monitoring program also track the moisture content in the repository in order to obtain data that can be directly compared with estimates derived during the design phase of the project, and to ensure that stored waste materials stay dry as intended in the repository design.

If you have any questions concerning these comments, please do not hesitate to call me at your convenience (Wilkin: 580-436-8874). I look forward to future interactions with you concerning this and other sites.

References

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See **OIG Comment 8** in Appendix B.

Appendix B

OIG Comments

OIG Comment 1

The OIG has analyzed the new work that Region 10 and IDEQ have conducted and have documented in the memorandum of April 17, 2009, and in the two appendices to the Draft 90% Design Report (Appendices G and Q) that were attached to the memorandum. These appendices to the Draft 90% Design Report are not included in Appendix A due to their length, but are available upon request.

We acknowledge that the new work is extensive, especially the unsaturated zone modeling. However, we have found technical issues in the analyses that prevent the work from meeting the intent of the recommendation. Detailed information on these issues is outlined in other OIG comments that follow.

OIG Comment 2

We agree with Region 10's assessment that water may enter the repository through three potential pathways.

Region 10 notes that contaminant mobility is dependant on "the geochemical behavior of metals in various geochemical regimes." However, the Region only investigated the potential for metal leaching under oxidizing conditions. The Region should also conduct analyses of metals leaching under anoxic conditions. Full saturation is not required for anoxic conditions to form. And yet the Region uses its predictions that most of the repository will be unsaturated as reason for not conducting analyses of metals leaching under anoxic conditions.

Region 10 states that mobility is "dependant on the presence of water within the repository to saturate waste sediments." While we agree that the mobility of dissolved contaminants is greatest when sediments are saturated, dissolved contaminants are mobile to some degree under unsaturated conditions.

We do not believe that Region 10 has presented a decisive argument that groundwater and flood waters will not enter the repository and dissolve the contaminants. As such, Region 10 needs to investigate the possible mobilization of metals under anoxic conditions. (See also OIG Comment 3.)

OIG Comment 3

Water Infiltration. We take issue with the analyses that form the basis for the Region's conclusion that two pathways for water to infiltrate into the repository—rising groundwater through the base of the repository and flood waters flowing laterally into the repository—will introduce minimal water. These analyses were presented in the Region's memorandum and in the Appendices to the Draft 90% Design Report (Appendices G and Q). We do agree with the Region's assessment that the evapotranspiration (ET) cap that will cover the top and upper sides of the repository will minimize the amount of precipitation (rain and snow melt) that enters through the third possible pathway.

Effects of Compaction on Groundwater Rise. The Region's analysis of the potential for groundwater to rise into the repository used groundwater data from well MW-B. These data, along with water level data from the other monitoring wells, were presented in Table 1 of Appendix Q. A vertical seepage velocity consistent with the 8-foot rise in water levels observed between February and June 2008 in well MW-B was calculated. However, when applying that seepage velocity, the Region introduced the effects of settlement and compaction to predict groundwater rise under the repository. The Region concluded that settlement and compaction would reduce the predicted increase in the water level to the degree that no water would be introduced into the repository from rising groundwater. We agree that compaction of the clay materials underlying the repository would cause a decrease in hydraulic conductivity and, therefore, could inhibit the rise in groundwater levels. However, we disagree that a 550 percent decrease in hydraulic conductivity will occur under the entire repository.

Variable Settlement Under the Repository. Figure 11 in Appendix G presented graphically the variable amount of settlement, and thus, the variable amount of decrease in hydraulic conductivity, expected in the clay material underlying the repository. The analysis shows little settlement expected under the outer parts of the repository. Therefore, in these areas, the hydraulic conductivity will not be significantly decreased and water level rises of the magnitude measured in 2008 in wells MW-B and MW-A should be expected to occur with that magnitude of flooding. This rise in groundwater levels would introduce water into the base of the repository.

Clay Layer Under the Repository is Overestimated. We also disagree with the simplified hydrogeologic characterization of the subsurface underlying the repository site that was used in the analysis. As presented in Appendix G, 10 feet of clay is assumed to underlie the entire site. The clay is assumed to be underlaid by 10 feet of gravely sand. This conceptual model is a conservative approach for the geotechnical analysis focused on estimating the amount of settlement that might occur under the repository. However, for estimating the hydraulic effects of the subsurface materials on rising groundwater levels related to annual spring snow melt and flooding, this conceptual model is anything but conservative. It overestimates the amount of clay recorded in the site's geologic logs. Although every log shows some amount of clay, the thickness of that clay varies greatly. At one location the clay is only 1.5 feet thick. The horizon where the clay was logged varies as well. And some logs show more than one interval of clay. This distribution of clay in the logs suggests that the clay is in lenses, as opposed to being in a single continuous layer. Clay is the subsurface material that will undergo the greatest change in its ability to transmit water due to the weight of the repository. The hydraulic transmission properties of silt, sand, and gravel will not change appreciably. The Region's assumptions of a thick and continuous clay layer bias the results of its analysis towards the sediments being overly resistant to water level rises.

Compaction Increases the Hydraulic Gradient. Another issue we have with calculating groundwater rise is with using the same hydraulic gradient resulting from the data collected in well MW-B to calculate seepage velocity through materials compacted by the weight of the repository. The overall energy driving the rise in the water level with flooding will be the same. Therefore, as the hydraulic conductivity decreases with compaction, the upward vertical hydraulic gradient across the sediments that drives the rise in the water level will increase. The hydraulic gradient will not stay the same as the Region assumes in its calculations.

Analysis Needs to Assess Seepage Three-Dimensionally. The seepage velocity calculation treats the rising water level measured in well MW-B as a one-dimensional problem. However, the water level rises in the floodplain sediments in response to complex, dynamic, three-dimensional interactions. New water and energy are added to the subsurface from recharge upgradient, local areal recharge from snowmelt, linear recharge along the river, and areal recharge due to surface water flooding out of the riverbanks and spreading across the flood plain. If the gravely sand deposits being tapped by well MW-B are confined, as claimed in Appendix Q, then the upgradient recharge would be the dominant, if not only, source of water coming in and would be responsible for the rise in the water level. The seepage analysis needs to be three-dimensional. The level of

water rises in well MW-B because of increases in pressures from upgradient, not from below as implied in the one-dimensional analysis used in Appendix Q.

Limited Temporal Data Limits Understanding of the Dynamic System. The Region has little temporal data to understand the dynamic groundwater system that is located so near the base of the planned repository. Water levels now are being measured quarterly in six monitoring wells. But the measurements extend only back to December 2007. In addition, when levels were high and the site was flooded, measurements could not be obtained in some of the wells. This means that there are even less data to understand the groundwater system when water levels are high.

Clay Compaction not Sufficient to Prevent Groundwater Rise. We know from measurements made in June 2008 in wells MW-A and MW-B that water levels rose 7.5 to 8 feet from when previously measured in February 2008. This same rise would have put the water level in wells MW-C and MW-D about 1.5 feet above the ground surface. The actual water level could not be measured in these wells due to flooding. Having the flooding and highest groundwater levels occurring at the same time is consistent with the groundwater and surface waters systems being hydraulically connected. This connection means that the energy of the flood waters as they cascade out of the steep terrain of the upper river basin has the potential of being transmitted through the groundwater system as well as the overbanked river system. The Region's analysis relies on compaction of the clays underlying the repository to provide enough resistance to keep the groundwater from rising into the repository. We remain unconvinced by the Region's analyses that groundwater will not rise into the repository during some, if not all, floods.

Model Needs to Assess Floodwater Retained in Unsaturated Wastes. We conclude from the Region's analysis of lateral infiltration during flooding that substantial floodwater remains in the repository wastes months (90 days) after flooding has receded. The Region used a sophisticated unsaturated model to estimate the third pathway for water entering the repository—infiltration through the sides of the repository during flooded conditions. The Region presents results (Figures 2 and 3 in Appendix C attached to Appendix Q of the draft 90% Design Report) at two different times in the model run: after 75 days of flooding and then after 90 more days of drainage. The Region also presents results from two versions of the model that assume different hydraulic properties for the waste materials within the repository. In Appendix Q, the Region focuses on the small area that is predicted to become fully saturated. However, the results show that the saturation remains above 50 percent throughout the modeled domain. In other words, a lot of water is in the unsaturated wastes. The amount of water retained is not presented, although the model could be used for this calculation. The modeling results do not support an assumption that the repository wastes will eventually dry.

Model Initial Conditions. Transient models, such as the one presented in Appendix Q, require the modeler to assume conditions at the start of the simulation. The modeling results presented show artifacts of the initial saturation condition assumed at the start of the modeled period (Figures 2 and 3 in Appendix C attached to Appendix Q of the draft 90% Design Report). That initial condition is described as 20 percent moisture content by volume. The modeling report does not specify the porosity used in the model. But an effective porosity of 0.25 was used in calculating the rising groundwater. If we assume a similar porosity was used in the unsaturated zone modeling, this means the starting saturation would have been 80 percent. The results show that the saturation remains above 50 percent throughout the modeled domain. The effects of the initial conditions on the results should be investigated and minimized.

Model Did Not Assess All Relevant Flooding Scenarios. Only the 12-year-recurrence interval flood was simulated in the modeling. Floods of greater frequency, such as the 1-year-recurrence interval flood, and of greater magnitude, such as the 100-year-recurrence interval flood against which the repository is being armored, also should be simulated to better understand the amount of water that will enter the repository over the long run.

Model Scenarios Did Not Assess Long-Term Repository Performance. The simulation durations were very short: 75 days of flooding were followed by 90 days of drainage. The simulation should have lasted at least 1 year to fully model the cyclical nature of the flooding at the site. Carrying out a simulation over several flooding cycles would provide insight into the long-term performance of the repository. A longer simulation over several flooding cycles would help to minimize artifacts introduced by the assumed initial conditions.

Model Configuration Assumption. The assumption in the model that the base of the repository is impermeable is conservative considering the short duration of the model simulations presented. However, this assumption would affect model results if multiple flood cycles were simulated. Flux out of the model domain through the seepage faces might be predicted because of the assumption that the base is impermeable. This might result in the model predicting less retention of water within the repository. In addition, flux to the groundwater can never occur with this model assumption.

Model Should Be Used to Fully Assess and Document Repository Performance. In all of these simulations, the amount of water entering and leaving the model domain and the change in water stored within the domain should be documented. For the modeling that has been done, we are presented only a few model results in graphical form. From these graphics, it appears that substantial water is retained. However, the Region has not used the computational power of the model to quantify the water flux and storage.

The Region needs to test model assumptions and fully analyze model results to ensure that the current repository design, as presented in the Draft 90% Design Report, will minimize the floodwaters entering and being retained in the repository wastes.

OIG Comment 4

We disagree with Region 10's conclusion that groundwater will not rise into the repository (see OIG Comment 3). As the memorandum of April 17, 2009 states, the groundwater has low levels of oxygen. We see the continued need for the Region to evaluate the geochemical potential for metals within the repository to be mobilized under anoxic conditions.

OIG Comment 5

Region 10 should proceed with having the work technically reviewed, as the OIG analysis was limited to information contained in the Region's response memorandum and the two draft appendices. For example, the technical reviewer should have access to the full modeling records. Technical review of the hydraulic analyses presented in Appendices G and Q of the Draft 90% Design Report should specifically address the issues the OIG raised in these comments.

OIG Comment 6

Information has been added to the final report describing the extent of contamination in the basin.

OIG Comment 7

Region 10 sent the OIG an additional response on May 18, 2009. The memorandum, dated May 15, 2009, included an independent review of Appendix Q to the 90% Design Report conducted by

EPA's Office of Research and Development, dated May 12, 2009. These two memoranda are included in Appendix A.

OIG Comment 8

Region 10, in its response of April 17, 2009, agreed to have its analysis reviewed by an independent third party. We acknowledge that Dr. Wilkin, in his memorandum of May 12, 2009, has thoroughly reviewed many of the geochemical issues related to contaminant behavior in the proposed repository. However, Dr. Wilkin's review did not include hydrologic issues related to contaminant mobility in the proposed repository. OIG Comment 3 presents a wide range of hydrologic issues that we identified in the attachments to the April 17, 2009, response. As Dr. Wilkin stated in his review, "the primary concern here, however, feeds back to whether or not water is expected to reach the waste soils, from upward, downward, or lateral migration." The Region's April 17, 2009, response included assumptions, with consequent conclusions, that OIG believes require technical verification. The Region should address these issues in its 90-day response to the final report. The recommendation will remain open.

Appendix C

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