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Comparative Analysis of Early Action Alternatives

In Section 5, each early action alternative was analyzed independently, without consideration of the other alternatives. In this section, the alternatives are compared, considering effectiveness, implementability, and cost. This comparative analysis identifies the advantages and disadvantages of each alternative relative to the others. Table 6-1 provides a summary of the comparative analysis.

Alternative 1, the No Action Alternative, is not considered for this comparative analysis because it is not protective of human health and the environment. The remaining alternatives are:

1. Alternative 2 – Channelization and Installation of Concrete Cloth Liner along Red Devil Creek
2. Alternative 3 – Installation of Culvert Liner along Red Devil Creek
3. Alternative 4 – Excavation of Actively Eroding Sediment Along Red Devil Creek

6.1 Effectiveness

The subsections below discuss the major components of the effectiveness of the Early Action alternatives.

6.1.1 Overall Protection of Human Health

With the exception of Alternative 1 (No Action), the three early action alternatives all offer varying degrees of protection to human health and the environment to the extent that they prevent tailings from eroding into Red Devil Creek and migrating to the Kuskokwim River. Additionally, upon completion of construction activities, there will be an immediate reduction in the volume of contamination entering the Kuskokwim River for all three of the action alternatives.

The potential short-term risks to the public associated with the alternatives are similar due to the remote location of RDM. BMPs and standard construction practices will be utilized under all alternatives to provide protection of workers implementing the remedy. None of the proposed alternatives will result in contaminant volume reduction. Alternatives 2 and 3 will provide a barrier between contaminated sediment and surface water, reducing exposure pathways identified at the site.

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Alternative 3 will direct and contain the stream flow within the culvert, minimizing the potential for overflow and continued erosion of the tailings areas in the Main Process Area and thus would provide greater protection of human health and the environment than Alternative 2.

The relative ranking of the four alternatives with regard to overall protection of human health (most- to least-effective) is as follows:

1. Alternative 3 – Installation of Culvert Liner Along Red Devil Creek
2. Alternative 2 – Channelization and Installation of Concrete Cloth Liner Along Red Devil Creek
3. Alternative 4 – Excavation of Actively Eroding Sediment Along Red Devil Creek
4. Alternative 1 – No Action

6.1.2 Compliance with ARARs/TBC Materials

Alternatives 2, 3, and 4 can be implemented in compliance with action-specific and location-specific ARARs. A greater number of action- and location-specific ARARs would likely apply to Alternative 4 due to the larger extent of disturbance proposed under this alternative. Each of the action alternatives can be implemented such that it is in compliance with ARARs and will allow for the ARARs to be met in full once a full-scale remedy is implemented.

6.1.3 Long-Term Effectiveness and Permanence

Although long-term effectiveness is a criterion under the EE/CA guidance, it should be noted that the early action alternatives presented in this document were developed to provide an interim remedy to the observed erosion of highly contaminated sediment along Red Devil Creek. The alternatives were not designed to be permanent solutions. Alternatives 2, 3, and 4 would require the same post-implementation activities, such as annual visual inspections and maintenance to ensure the long-term effectiveness. Additionally, the alternatives will require further remedial actions to be performed during the full-scale remedy in order to address the residual sediment contamination along Red Devil Creek. Finally, Alternatives 2 and 3 would require additional removal/demolition activities under the final remedial action.

Of the three early action alternatives, Alternative 4 provides the most long-term effectiveness. Under this alternative, a portion of the Red Devil Creek sediments will be excavated and stockpiled for later disposition. While Alternatives 2 and 3 are similar to one another, Alternative 2 requires more material be excavated and stockpiled. Therefore, Alternative 2 provides more long-term effectiveness than Alternative 3. With Red Devil Creek remaining in its present state, and contaminated sediments continuing to migrate into the Kuskokwim River unabated, Alternative 1, No Action, provides the least amount of long-term effectiveness.

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The relative ranking of the four alternatives with regard to long-term effectiveness (most- to least-effective) is as follows:

1. Alternative 4 – Excavation of Actively Eroding Sediment Along Red Devil Creek
2. Alternative 2 – Channelization and Installation of Concrete Cloth Liner Along Red Devil Creek
3. Alternative 3 – Installation of Culvert Liner Along Red Devil Creek
4. No Action 1 – No Action

6.1.4 Reduction of Toxicity, Mobility, or Volume Through Treatment

Alternatives 2, 3, and 4 do not provide for a reduction in the volume or toxicity of the actively eroding contaminated sediment observed along Red Devil Creek in the Main Processing Area. While treatment is not associated with the reduction, all the early action alternatives will reduce the mobility associated with the actively eroding and migrating tailings within the Main Processing Area. Alternative 4 provides the most reduction in mobility because contaminated sediments are actually removed from the creek and relocated. Both Alternatives 2 and 3 provide a barrier between the surface waters of Red Devil Creek and the sediment. Therefore, they are considered equal under this evaluation criterion. The No Action Alternative does not provide for a reduction of toxicity, mobility, or volume through treatment.

The relative ranking of the four alternatives with regard to reduction of toxicity, mobility, or volume criteria (most- to least-effective) is as follows (most to least reduction):

1. Alternative 4 – Excavation of Actively Eroding Sediment along Red Devil Creek
2. (tie) Alternative 2 – Channelization and Installation of Concrete Cloth Liner along Red Devil Creek
3. (tie) Alternative 3 – Installation of Culvert Liner along Red Devil Creek
4. No Action

6.1.5 Short-Term Effectiveness

No contaminated material is proposed to be transported off site under the proposed RDM Early Action alternatives. Alternative 4 would result in most adverse short-term impacts to construction workers and the environment because a larger quantity of contaminated material would be disturbed during the excavation of Red Devil Creek within the Main Processing Area. However, the potential for such impacts is expected to be minimized by engineering controls and BMPs.

With no work being performed, Alternative 1, No Action, is the most effective in the short term, as no impacts are anticipated. While the installation of the concrete cloth (Alternative 2) is relatively straightforward and does not require excess construction equipment as compared to the installation of a culvert system (Alter-

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native 3), there is more material movement associated with the preparation of the creek bed. Therefore, Alternative 3 provides better short-term effectiveness as compared to Alternative 2.

The relative ranking of the four alternatives with regard to short-term effectiveness (most- to least-effective) is as follows:

1. No Action
2. Alternative 3 – Installation of Culvert Liner along Red Devil Creek
3. Alternative 2 – Channelization and Installation of Concrete Cloth Liner along Red Devil Creek
4. Alternative 4 – Excavation of Actively Eroding Sediment along Red Devil Creek

6.2 Implementability

All three alternatives are implementable using common construction equipment and practices. A major concern that will need to be addressed for each of the early action alternatives will be the coordination to obtain and transport equipment to and from the site. It is anticipated that all three active alternatives can be completed within one construction season, which will coincide with the navigation season of Kuskokwim River.

6.2.1 Technical Feasibility

Alternative 2 (Concrete Cloth Liner) will likely require greater technical considerations when compared to the other alternatives due to installation requirements of the concrete cloth.

Although installation is conducted using common site work construction methods and equipment, significant site preparation and planning will be required prior to placement of the cloth. The cloth can only be applied under dry conditions; otherwise, the liner will prematurely set prior to final placement. Additionally, the material only has a working time of 1 to 2 hours after hydration so modifications are not possible once the material has become wet and begins to set.

Of the three action alternatives, Alternative 4 is the most technically feasible. The work associated with Alternative 4 would not have to be repeated during the future full-scale remedial action. Alternatives 2 and 3 are temporary in nature, and less compatible with future final remedial actions.

While the No Action Alternative would appear to be the most technically feasible alternative, it is not. The focus of the Early Action is to reduce contaminated sediment migration into the Kuskokwim River. Alternative 1 does not address this issue; therefore, it is not technically feasible.

On this basis, the alternatives are ranked as follows for the technical feasibility criterion (most- to least-feasible):

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1. Alternative 4 – Excavation of Actively Eroding Sediment along Red Devil Creek
2. Alternative 3 – Installation of Culvert Liner along Red Devil Creek
3. Alternative 2 – Channelization and Installation of Concrete Cloth Liner along Red Devil Creek
4. Alternative 1 – No Action

6.2.2 Administrative Feasibility

All early action alternatives will require coordination with BLM, EPA, ADEC, ADF&G, and other regulatory authorities to develop mitigation plans to help provide protection of aquatic biota that have been observed within Red Devil Creek prior to the commencement of work. Sources of riprap and fill rock for the gabion toe protection and drop structure under Alternative 4; gabion headwall under Alternative 3; and riprap needed for the dissipation pool as proposed for both Alternatives 2 and 3 will also need to be identified on site, or, alternatively, access agreements for off-site sources will be required prior to initiating construction.

The alternatives are ranked as follows for administrative feasibility (most- to least-feasible based on the extent of disturbance and the quantity of fill/riprap required):

1. Alternative 3 – Installation of Culvert Liner along Red Devil Creek
2. Alternative 2 – Channelization and Installation of Concrete Cloth Liner along Red Devil Creek
3. Alternative 4 – Excavation of Actively Eroding Sediment along Red Devil Creek
4. Alternative 1 – No Action

6.2.3 Availability of Service and Materials

Alternative 2 would require more extensive design work and coordination in obtaining materials (e.g., concrete cloth) than Alternatives 3 and 4. Likewise, Alternative 3 would require more design work and coordination when compared to Alternative 4, as Alternative 4 utilizes readily available equipment and personnel without the need to ship additional materials such as culverts or liners to the site. For all three of the action alternatives, an on-site source of riprap will be required or an easement or access agreement will be needed for any off-site sourced material. With no services or materials needed for its implementation, the No Action Alternative ranks ahead of the three action alternatives.

The alternatives are ranked as follows for availability of service and materials (most- to least-available):

1. Alternative 1 – No Action

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2. Alternative 4 – Excavation of Actively Eroding Sediment along Red Devil Creek
3. Alternative 3 – Installation of Culvert Liner along Red Devil Creek
4. Alternative 2 – Channelization and Installation of Concrete Cloth Liner along Red Devil Creek

6.3 Cost

While an estimate prepared as part of a detailed design will provide a more accurate cost, this is beyond the scope of an EE/CA. In developing the individual cost estimates, there are a number of uncertainties that must be accounted for. There is a considerable amount of site data; however, data gaps associated with the extent of contamination still exist. Additionally, the designs have not been finalized and assumptions and alternative features provided in this EE/CA are conceptual. Therefore, the volume of material to be excavated was increased by 10% to account for unknowns.

Finally, for all of the action alternatives, a 20% contingency factor was added to address potential unknowns that may increase the cost of implementing the individual alternative.

6.3.1 Cost Evaluation

In evaluating the costs of the early action alternatives, there are three components: capital cost, annual post-construction site controls cost, and total project cost.

For the RDM site, the capital costs of the action alternatives are:

1. Alternative 2 – Channelization and Installation of Concrete Liner, \$2,090,000
2. Alternative 3 – Installation of Culvert Liner along Red Devil Creek, \$2,110,000
3. Alternative 4 – Excavation of Actively Eroding Sediment, \$2,140,000

Each alternative will require post-construction site monitoring to assess the effective-ness and integrity of the early action. Additionally, some minor maintenance, such as debris removal, is also anticipated. The present worth annual O&M costs are estimated to be approximately \$23,000 per year for each of the alternatives. A cost summary is provided in Table 6-2.

6.4 Summary of Comparative Analysis

A summary of the comparative analysis for the early action alternatives is presented in Table 6-1.

Table 6-1 Summary of Comparative Analysis, Draft Engineering Evaluation/Cost Analysis, Red Devil Mine

Alternative Description	Qualitative Ranking		Cost
	Effectiveness	Implementability	
Alternative 2 Channelization of Red Devil Creek and Installation of Concrete Liner	MODERATE — Reduces contact between surface water of Red Devil Creek and contaminated sediment observed to be actively eroding. — Would significantly reduce mobility of contaminated sediments; however, volume and toxicity of COCs will not be affected. Contamination will remain in place; excess sediment resulting from excavation will be stored in specified stockpile for further treatment. — ARARs and TBCs will be met.	LOW — Readily implementable based on standard construction practices. — However, substantive requirements must be addressed before implementation such as coordination of shipping large quantities of concrete cloth liner to the site by barge. — Will require significant site preparation in areas of contamination prior to installation. Additional site preparation will be needed during the full-scale removal action as the concrete liner will have to be broken up and removed in order to address contaminated sediment at RDM along the creek.	\$2,090,000
Alternative 3 Installation of Culvert Liner along Red Devil Creek	MODERATE — Reduces contact between surface water of Red Devil Creek and contaminated sediment observed to be actively eroding. — Would significantly reduce mobility of contaminated sediments; however, volume and toxicity of COCs will not be affected. Contamination will remain in place; excess sediment resulting from excavation will be stored in specified stockpile for further treatment. — ARARs and TBCs will be met.	MODERATE — Readily implementable based on standard construction practices. — However, substantive requirements must be addressed before implementation such as coordination of shipping culvert to the site by barge. — Will require additional site preparation during full-scale remedy to remove culvert liner in order to address contaminated sediment at RDM along the creek.	\$2,110,000
Alternative 4 Excavation of Actively Eroding Contaminated Sediment along Red Devil Creek	MODERATE TO HIGH — Removes the potential for contact between surface water of Red Devil Creek and contaminated sediment observed to be actively eroding. — Would significantly reduce mobility of contaminated sediments within the Main Processing Area; however, volume and toxicity of COCs will not be affected. Excavated sediments will be stored on site in specified stockpile for further treatment. — ARARs and TBCs will be met.	HIGH — Readily implementable based on standard construction practices. — No additional materials will be required to be shipped to the site besides equipment to perform earthwork.	\$2,140,000

Key:

ARAR = Applicable or relevant and appropriate requirement.

COC = Contaminant of concern.

TBC = To-be-considered material.

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Table 6-2 Summary of Individual Alternative Costs

Alternative	Total Capital Cost	Yearly O & M Cost	Present Worth O & M Cost	Total Present Worth Cost
1	-	-	-	-
2	\$1,900,000	\$23,000	\$190,000	\$2,090,000
3	\$1,920,000	\$23,000	\$190,000	\$2,110,000
4	\$1,950,000	\$23,000	\$190,000	\$2,140,000

Key:
O&M = Operation and maintenance.