EVALUATION OF RETAINED PROCESS OPTIONS FOR SURFACE WATER [a]
Secondary Screening of Technologies and Process Options

General Response Action	Remedial Technology	Process Option	Description of Process Option	Effectiveness [b]	Implementability [c]	Cost [d]
No Action	None	None	No action would be taken and operation of the existing water treatment plant (WTP) would cease, including collection of contaminated seep water. The contaminated area would remain in its existing condition or worsen overtime.	Not Applicable (NA) Consideration required by the NCP.	NA Consideration required by the NCP.	No Cost
No Further Action	None	None	No new action would be taken; however the existing WTP would continue to operate and be repaired; however significant upgrades would not be made.	Existing collection and treatment system is effective at reducing the volume of surface water in Pit 3 and Pit 4 and meeting existing surface water discharge criteria. However, WTP effluent has high levels of SO_4.	Existing WTP may be approaching the end of its practical life cycle.	Low Capital Medium O&M
Institutional Controls	Land Use Controls	Deed/Zoning Restrictions	Use of on-site surface water would be restricted through legally binding requirements on property such as deed and zoning restrictions. Restrictions would be used to prevent use or transfer of property without notification of limitations on the use of the property.	Potentially effective in preventing human contact with contaminated surface water at the site, but would not provide protection to the environment or surface water located off-site.	Legal requirements which are readily implemented.	Low Capital Low O&M
	Access Restrictions	Physical Restrictions (Fencing and Posted Warnings)	Fences, berms, and warning signs would be used to control access to on-site areas with contaminated surface water.	Effective in limiting direct exposure to humans with contaminated media. Long term effectiveness depends on future O&M. Would not protect the environment.	Readily Implemented.	Low Capital Low O&M

EVALUATION OF RETAINED PROCESS OPTIONS FOR SURFACE WATER [a]
Secondary Screening of Technologies and Process Options

General Response Action	Remedial Technology	Process Option	Description of Process Option	Effectiveness [b]	Implementability [c]	Cost [d]
Institutional Controls (continued)	Community Awareness	Information and Education Programs	Community information and educational programs would be undertaken to enhance awareness of potential hazards and remedies.	Potentially effective in reducing human contact with surface water, but would not protect the environment.	Readily Implemented.	Low Capital Low O&M
Monitoring	None	Long-term Surface Water Monitoring	Periodic monitoring for COCs in surface water.	Effective in documenting surface water quality, but does not reduce exposure to contaminated surface water.	Readily Implemented.	Low Capital Medium O&M
		Monitored Natural Attenuation	Concentrations of COCs in surface water would be allowed to equilibrate through natural in-situ processes such as dilution, adsorption, and chemical reactions. Monitoring would be done to demonstrate reductions in contaminant concentrations.	Limited effectiveness for inorganics and radionuclides. However, some reduction in COC loadings may occur in combination with source depletion/control, natural adsorption, and flushing processes. Monitoring would be necessary to evaluate effectiveness.	Readily Implemented.	Medium Capital Medium O&M
Containment	Surface Water Controls	Grading	Contouring and installation of swales to promote surface water runoff and reduce erosion and infiltration of surface water into contaminated material.	Somewhat effective at reducing infiltration of surface water into acid mine drainage (AMD) generating materials and reducing erosion of contaminated materials.	Readily Implemented.	Medium Capital Medium O&M
		Revegetation	Revegetate surfaces of recontoured land and ditches to reduce erosion and the amount of solids in runoff. A growth medium would be placed where existing surface can not support vegetation.	Effective in reducing infiltration of surface water into AMD generating materials, and COC loadings from contaminated materials to surface water.	May be difficult to establish vegetation in existing surface materials. Adequate supply of topsoil may not be readily available.	Low Capital Low O&M

EVALUATION OF RETAINED PROCESS OPTIONS FOR SURFACE WATER [a]
Secondary Screening of Technologies and Process Options

General Response Action	Remedial Technology	Process Option	Description of Process Option	Effectiveness [b]	Implementability [c]	Cost [d]
Containment (continued)	Surface Water Controls (continued)	Channelization	Surface water flowing through contaminated material in existing ditches would be controlled by installation of constructed channels. Existing drainages would be straightened, lined, and have energy dissipaters installed to isolate surface water from contaminated sediments. Only considered for drainages.	Would reduce erosion and the transport of COCs from the site via surface water. Effective in reducing infiltration of surface water into AMD generating materials.	Readily implemented, but more complex to install than other surface water control measures.	Medium Capital Low O&M
		Diversion Ditches	Surface water run-on from areas up slope of contaminated materials would be captured in ditches and diverted away from contaminated material.	Effective at reducing infiltration of surface water into AMD generating materials.	Readily Implemented.	Medium Capital Low O&M
		Relocation	Physically relocate existing surface water drainages around and away from contaminated materials. Only considered for drainages.	Effective at reducing infiltration of surface water into AMD generating materials and transport of COCs.	May be difficult to implement with existing topography. New route must have proper slope.	High Capital Low O&M
		Backfill (Partial or Full)	Open pits would be backfilled with clean materials to reduce exposure to surface water. Fill materials may be from on-site borrow sources. Only considered for Pit 3 and Pit 4.	Effective in reducing human and animal contact with COCs and decreasing physical hazards.	Sufficient clean material for backfill may not be readily available.	Very High Capital Low O&M
		Biostabilization	Stabilization would be performed using vegetation, rocks, wood debris, and other materials to reduce erosion and suspended solids in run-off. Not considered for Pit 3 and Pit 4.	Effective at reducing COC loadings from contaminated materials to surface water. Adaptive management may be needed to provide long-term effectiveness.	Readily Implemented.	Low Capital Medium O&M

EVALUATION OF RETAINED PROCESS OPTIONS FOR SURFACE WATER [a]
Secondary Screening of Technologies and Process Options

General Response Action	Remedial Technology	Process Option	Description of Process Option	Effectiveness [b]	Implementability [c]	Cost [d]
Containment (continued)	Surface Water Controls (continued)	Sedimentation Dams/Traps	Sedimentation dams and traps would be constructed to capture and contain solids in the runoff to control downstream transport. Only considered for drainages.	Effective in reducing transport of mine-affected surface materials via surface water by decreasing suspended solids in the run-off prior to release into streams or other accessible areas.	Readily Implemented.	Low Capital Medium O&M
		Passive Collection	Passive collection of surface water and/or seeps into ponds or other structures. Water collected would be routing to a water treatment plant.	Effective means of collecting surface water and seeps and reducing transport of COCs.	May be difficult with existing site topography to route water to a treatment plant without using a pump.	Medium Capital Medium O&M
	Physical Barriers	Hydraulic Isolation	Line surface water bodies with clay or a geomembrane to reduce contact between clean surface water and contaminated surface materials or reduce infiltration of contaminated surface water.	Effective at reducing infiltration of surface water into AMD generating materials and transport of COCs to surface water. Likely disruptive to aquatic habitat and organisms.	Readily Implemented.	Medium Capital Low O&M
Removal	Dewatering	Complete Dewatering	Ongoing removal of contaminated surface water from pits, ponds, and/or drainages to prevent accumulation of surface water. Water would be routed to a treatment plant for processing.	Effective in reducing human exposure to surface water and infiltration of surface water into AMD generating materials. Would create hydraulic sink to capture contaminated groundwater; however, contaminated sediments would be exposed.	Readily Implemented. May be difficult to operate dewatering and treatment system during winter months.	Medium Capital High O&M

EVALUATION OF RETAINED PROCESS OPTIONS FOR SURFACE WATER [a]
Secondary Screening of Technologies and Process Options

General Response Action	Remedial Technology	Process Option	Description of Process Option	Effectiveness [b]	Implementability [c]	Cost [d]
Removal (continued)	Dewatering (continued)	Partial Dewatering	Actively extract water to maintain water level near the pit bottom. Pit sediment would remain submerged. Water would be routed to a treatment plant for processing. Considered for Pit 3 and Pit 4.	Effective in reducing the volume of surface water present in the pits and would create hydraulic sink to capture contaminated groundwater and surface water. Contaminated sediments would remain under water.	Readily Implemented. Currently being used at the site.	Medium Capital Medium O&M
		Gravity Drain	Surface water in the pits would be limited to a specific elevation using a gravity drain (surface or subsurface) and routed to a treatment plant for processing, as needed. Could also be used for routing clean water into a drainage stream. Considered for Pit 3 and Pit 4.	Effective at reducing infiltration of surface water into AMD generating materials.	May be difficult to obtain proper slope with existing site topography and be susceptible to plugging.	High Capital Low O&M
		Seep Collection	Water discharging from seeps would be collected and routed to a treatment plant for processing.	Effective at reducing transport of COCs.	Readily Implemented. Proven technology currently being used at the site.	Medium Capital Medium O&M
Treatment	Continue Operating Existing WTP [e]	Chemical Precipitation	Active water treatment would continue using the existing water treatment plant without modification. Sludge generated during treatment would continue to be disposed off-site at the Ford Mill until closure or at a new disposal site.	Existing collection and treatment system is effective at reducing the volume of surface water in the Pit 3 and Pit 4 and meeting existing surface water discharge criteria. However, WTP effluent has high levels of SO_4.	Existing WTP may be approaching the end of its practical life cycle.	Low Capital Medium O&M

EVALUATION OF RETAINED PROCESS OPTIONS FOR SURFACE WATER [a]
Secondary Screening of Technologies and Process Options

General Response Action	Remedial Technology	Process Option	Description of Process Option	Effectiveness [b]	Implementability [c]	Cost [d]
Treatment (continued)	Ex-Situ Physical/Chemical [e]	See evaluation for groundwater (Table 2-8)				
	In-Situ Physical/Chemical	Neutralization/ Precipitation	Adjustment of surface water pH. Soluble metal salts would be converted to insoluble salts that will precipitate. Typically performed with liming agents like limestone or hydrated lime, but the use of other alkalis is technically feasible. Not considered for use at seeps or drainages.	Addition of lime is potentially effective at increasing the pH of surface water and reducing loadings of COCs to groundwater. Complete mixing may be difficult to achieve.	Materials readily available and easy to use.	Medium Capital Medium O&M
		Reactive Bags {NOT RETAINED}	Bags of reactive material would be placed in the surface water so that flow past the reactive materials reduces COC concentrations. Considered for drainages.	Potentially effective at reducing loadings of COCs from surface water to groundwater.	Innovative technology that has not been demonstrated.	Medium Capital Low O&M
		Passive Reactive Barrier (PRB) Wall	Contaminated surface water would be funneled through chemically or biologically reactive materials to reduce concentrations of COCs.	Potentially effective for reducing loadings of COCs at parts of the site where surface water could be reasonably routed to through the PRB. Effectiveness would need to be determined through bench and/or pilot scale testing.	Readily Implemented. However, construction may be complicated if more than one reactive medium is needed. Operational lifetime is unclear.	High Capital Low O&M

EVALUATION OF RETAINED PROCESS OPTIONS FOR SURFACE WATER [a]
Secondary Screening of Technologies and Process Options

General Response Action	Remedial Technology	Process Option	Description of Process Option	Effectiveness [b]	Implementability [c]	Cost [d]
Treatment (continued)	Ex-Situ Biological Treatment	See evaluation for groundwater (Table 2-8)				
	In-Situ Biological Treatment	In-situ Bacterial Reduction	Introduction of bacteria and/or nutrients (carbon source) to promote naturally occurring bacteria to create reducing conditions, which promote the immobilization of metals. Retained for Pit 3 and Pit 4.	Potentially effective at reducing loadings of COCs from surface water into groundwater. Effectiveness would need to be determined through bench-scale testing.	Not proven or developed to full scale. May be difficult to maintain optimal conditions for bacteria with changing subsurface conditions.	Medium Capital Medium O&M
		In-situ Biological Oxidation and Reduction	Addition of organic matter to water to precipitate some metals. Retained for Pit 3 and Pit 4.	Effectiveness would need to be determined through bench-scale testing.	Difficult to maintain optimal conditions.	Medium Capital Medium O&M
Surface Water Discharge	On-Site Discharge of Treated Water	See evaluation for groundwater (Table 2-8)				

EVALUATION OF RETAINED PROCESS OPTIONS
FOR SURFACE WATER [a]
Secondary Screening of Technologies and Process Options

{NOT RETAINED} with shading denotes remedial technology process option that will not be carried forward for additional evaluation.

[a] Surface Water includes seeps, water in open pits, ponded water, and affected drainages.
[b] Effectiveness rates the technical effectiveness of the process to achieve the remedial action objectives for the medium of concern.
[c] Implementability is based on technical and administrative factors that affect the ability to implement the process.
[d] Costs are based on professional judgment and are relative to process options presented under a specific remedial technology type.
[e] Residuals produced during ex-situ physical/chemical treatment of water will likely be managed using one of the off-site disposal process options presented on Table 2-1. Disposal of residuals will depend on the treatment alternative selected. In addition, the residuals may go through additional treatment or waste minimization process prior to final disposal.

Notes: 1) Multiple response actions and remedial technologies may be combined to develop effective alternatives for surface water.

2) Process options retained for additional evaluation may not be applicable to all locations of the site or conditions present at the site.

3) Some technologies presented in this table are applicable to still water, but not flowing water.

4) Based on the NCP, consolidation/containment remedial technologies are preferred for contaminated material with large volumes and low concentration levels. Smaller volumes of material with higher concentrations are more suited for treatment.

5) If needed, treatability testing could be performed during the remedial design phase.