

4. Implementation Plan

This section identifies the Industrial Area rehabilitation program work packages, presents a probable schedule and a cost opinion to complete the rehabilitation program. Anticipated construction impacts and mitigation measures are identified, as well as health hazards and the details of an Environmental and Community Health Protection Plan (ECHPP).

4.1 Identification of Work Packages

The work packages identified for the Industrial Area rehabilitation program are listed in Table 4.1.

TABLE 4.1
IDENTIFICATION OF INDUSTRIAL AREA WORK PACKAGES

Package ID	Industrial Area Work Package Description
IA-WP#1	Site Preparation
IA-WP#2	Demolition of Buildings/Tanks and Resizing/Consolidation of Ruins
IA-WP#3	Riverbank Reconstruction
IA-WP#4	Consolidation of Wastes
IA-WP#5	Simple Earth (Clay) Cap Placement
IA-WP#6	Engineered Cover Placement
IA-WP#7	Groundwater Interceptor Well Network
IA-WP#8	Site Revegetation
IA-OMM#1	Operation, Maintenance, and Monitoring (OMM)

In Section 4.2, the work packages have been subdivided into tasks and subtasks and reorganized for ease of implementation. The order of the tasks and subtasks is provided in Section 4.4.

4.2 Sequencing of Work Packages

Closure of the Industrial Area is best accomplished in stages that focus on minimizing impacts to the environment while completing the project in an efficient and logical manner. Construction activities are subdivided into a five-year work program with an operation, maintenance, and monitoring (OMM) program that extends into the foreseeable future. The sequencing of the work package tasks by year of implementation is listed in Table 4.2 below. In general, the work packages would be completed in the order listed in Table 4.2; however, the opportunity exists for some of the work packages and their subtasks to be completed concurrently to expedite the work program or to extend the work program to meet annual budget constraints. The schedule in Section 4.4 identifies the complete breakdown of each work package, including tasks and subtasks.

TABLE 4.2
YEARLY SEQUENCE OF INDUSTRIAL AREA WORK PACKAGE TASKS

Task ID	Tasks Description	Details
Year 1 – Site Preparation and Demolition		
IA-WP#1.1	Site Preparation	Site setup, construct decontamination pad, and site access routes
IA-WP#2.1	Demolition of Buildings and Tanks	Demolish existing buildings and tanks
IA-WP#2.2	Resizing and Consolidation of Ruins	Consolidate ruins
Year 2 – Riverbank Reconstruction		
IA-WP#1.2	Site Preparation	Site setup, grub trees/vegetation in cover and riverbank areas, decommission well adjacent to riverbank and wells in Year 2 cover areas
IA-WP#6.1	Clay Berm Around Perimeter of Equalization Pond	Construct a clay berm around the equalization pond
IA-WP#3	Riverbank Reconstruction	Excavate and consolidate riverbank wastes, reconstruct riverbank, and transfer slag from Area Z to G
IA-WP#6.2	Clay Cover over Riverbank Wastes	Place the initial lower clay layer to limit exposure to consolidated wastes until the engineered cover is fully completed
Year 3 – North Industrial Area Rehabilitation		
IA-WP#1.3	Site Preparation	Site setup, grub trees/vegetation in cover and North Industrial Areas, decommission wells in North Industrial Area and Year 3 cover areas, install New Westerly Creek 500 m culvert extension to Mine Area
IA-WP#4.1	Consolidation of North Industrial Area Wastes	Consolidate wastes from Areas N, O, P, R, Q, S, Y, X, W, U, V, and T. Transfer slag from Areas H and M to R, Areas M, E, and I to Q, and Areas I and G to V
IA-WP#6.3	Clay Cover over North Industrial Area Wastes	Cover Areas D, C, B and the north half of Areas F and E
IA-WP#5.1	Simple Earth (Clay) Cap Placement in North Industrial Area	Place a simple earth (clay) cap over Areas N, O, R, Q, V, and T
Year 4 – South Industrial Area Rehabilitation		
IA-WP#1.4	Site Preparation	Site setup, grub trees/vegetation in cover and South Industrial Areas, decommission wells in South Industrial Area and Year 4 cover areas
IA-WP#4.2	Consolidation of South Industrial Area Wastes	Consolidate wastes from Areas K, J, L, M, G, I, and H. Transfer slag from Area G to K
IA-WP#6.4	Clay Cover over South Industrial Area Wastes	Cover the south half of Areas E and F
IA-WP#6.5	Placement of Remaining Layers of Engineered Cover	Place the GCL over the initial clay layer, then complete the engineered cover with 25 cm of sand, 30 cm of clay, 35 cm of silty clay loam and 15 cm of silty loam topsoil
IA-WP#5.2	Simple Earth (Clay) Cap Placement in South Industrial Area	Place a simple earth (clay) cap over Areas K, M, G, I, and H
Year 5 – Groundwater Interceptor Well Network and Revegetation		
IA-WP#7	Groundwater Interceptor Well Network	Install a 500-m horizontal well screen, eight vertical pressure relief wells and 360 m water conveyance pipe
IA-WP#8	Site Revegetation	Revegetate the Industrial Area with grasses and shrubs, and poplar trees in the engineered cover
Annual – Site Operation, Maintenance, and Monitoring		
IA-OMM#1	OMM	Existing and future OMM of the ATP, groundwater collection system, simple earth (clay) caps, engineered cover, riverbank, and groundwater interceptor well network

4.3 Anticipated Construction Impacts and Mitigation Measures

Table 4.3 identifies the main anticipated construction impacts and potential mitigation measures to minimize the effect of these impacts.

TABLE 4.3
ANTICIPATED CONSTRUCTION IMPACTS AND MITIGATIVE MEASURES

Construction Impacts	Mitigation Measures
Clearing and grubbing of trees and shrubs during site preparation	Altered areas should be revegetated with native species. If possible, minimize cutting trees larger than 100 mm diameter.
Suspended particulates in air from heavy equipment/vehicles adversely affecting air quality	Dust suppression methods will be utilized on an "as needed" basis.
Vegetation removal for temporary road construction or existing road upgrades to accommodate heavy vehicles	Roads not required for the future OMM of the site will be excavated, backfilled with appropriate material and revegetated to blend in with existing cover/cap requirements.
Suspended sediment in surface water	Diversion dams/trenches, and geotextile silt fencing will be used to isolate surface water flows from active excavation areas. Sediment settling/retention ponds may be required.
Low-level radiation protection during excavation and transport of low-level radioactive slag	Low-level radiation exposure is not expected to exceed public dose limits and the action levels identified in the H&S Plan (CH2M HILL, January 2002). Implementation of simple dose limiting procedures described in the H&S plan will serve to minimize this exposure. No internal low-level radiation hazards expected.
Low-level radiation protection during excavation and transport of low-level radioactive tailings	Low-level radiation exposure is not expected to exceed public dose limits and the action levels identified in the H&S Plan (CH2M HILL, January 2002). Implementation of simple dose limiting procedures described in the H&S plan will serve to minimize this exposure. Dust suppression may be necessary under dry conditions. Controls to prevent contamination spread must be in effect, including monitoring equipment and personnel prior to leaving the active work area.

4.4 Implementation Schedule

Following acceptance of the final cleanup plan by the existing liaison committees, the public, and regulatory bodies, tender packages will be developed with the Management Board Secretariat, Shared Services Bureau (SSB) in such a way that it will be possible to issue a call for tenders for implementation of the work packages shortly after the delivery of the necessary permits and approvals.

The integrated cleanup plan will prioritize site-wide rehabilitation work packages based on the ability of an individual work package to lower contaminant loading rates, eliminate public health and environmental hazards, and facilitate the implementation of work packages in a logical manner.

The schedule has been arranged in a linear format and has not been assumed to run concurrently. Work programs are anticipated to commence in early April and extend as late as November. It is not anticipated that the work will be conducted in the winter months of

December to March. The contractor work plan will need to outline mitigating steps to be taken in order to minimize anticipated weather delays in the early and late months of the work periods. The scheduled operational periods of the year allow for sufficient slack time to account for deleterious weather conditions and other delays, and to allow for integration into the overall site-wide implementation schedule.

The rehabilitation program schedule is provided in Table 4.4 and spans a five-year period to complete the following main tasks in the time frames provided:

- Year 1 – Site Preparation and Demolition (Duration: 60 days)
- Year 2 – Riverbank Reconstruction (Duration: 47 days)
- Year 3 – North Industrial Area Rehabilitation (Duration: 102 days)
- Year 4 – South Industrial Area Rehabilitation (Duration: 125 days)
- Year 5 – Groundwater Interceptor Well Network and Revegetation (Duration: 100 days)

The work program will first address buildings, ruins and other structures that may impede the waste consolidation process. The riverbank reconstruction process must be completed before the waste consolidation work programs, as access routes to the riverbank will be limited when operations commence in the North and South Industrial Areas.

The rehabilitation of the North Industrial Area was sequenced prior to the South Industrial Area due to the required movement of slag materials from the South Industrial Area and to facilitate the continued operation of the groundwater collection and treatment system. As wastes in the North and South Industrial Areas are excavated and consolidated, the slag stockpiled in the Industrial Area will be used as backfill to within 65 cm of the proposed ground surface as shown in SEC-2 in Figure 3-8. It is anticipated that the slag on the site can be used to backfill most of the Industrial Area where excavations will extend deeper than 65 cm. The primary locations designated for slag backfill are Areas R, Q, V, and K. The sequencing of the South Industrial Area rehabilitation program is planned to allow for the transfer of slag into the considerable excavation anticipated in Area K. When the areas are backfilled to 65 cm bgs, simple earth (clay) caps will be applied to the North and South Industrial Areas.

During years two to four, the wastes generated while rehabilitating the riverbank and the areas north and south of the engineered cover will be mounded in the central Industrial Area. As the wastes are mounded, a 50-cm clay cover will be progressively placed over the mound to minimize exposure to the wastes between construction seasons. When the mound is complete, the remaining layers of the engineered cover will be applied. This will allow for protection from the wastes, while integrating flexibility into the consolidation process in the event that significantly more wastes are identified and require the clay-covered mound to be reworked to accommodate them.

The GIWN will be installed west of the WCA following the completion of the engineered cover, so as to not impede the consolidation and cover placement process.

Following the placement of the topsoil layer on the engineered cover, the cover will be vegetated with grass, shrubs and poplar trees. Simple earth (clay) caps, SEC-1, SEC-2, and SEC-3, will be vegetated with grass and shrubs. SEC-4 under the main entrance to the site will be asphalted or remain a gravel surface.

If required, the rehabilitation program could be condensed to three years as shown in Table 4.5.

ID	Task Name	Duration	Start	Finish	Predecessors	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32
0	Table 4.4 - Industrial Area 5-Year Construction Schedule	125 days	Mon 04/02/07	Tue 11/06/07		[Summary bar]																															
1	YEAR 1 - Site Preparation and Demolition	60 days	Mon 04/02/07	Fri 07/13/07		[Task bar]																															
2	IA-WP#1.1 - Year 1 Site Preparation	15 days	Mon 04/02/07	Thu 04/26/07		[Task bar]																															
3	1.1.1 - Setup	5 days	Mon 04/02/07	Tue 04/10/07		[Task bar]																															
4	1.1.2 - Decontamination Pad	5 days	Tue 04/10/07	Wed 04/18/07	3	[Task bar]																															
5	1.1.3 - Access Routes	5 days	Wed 04/18/07	Thu 04/26/07	4	[Task bar]																															
6	IA-WP#2.1 - Demolition of Buildings and Tanks	30 days	Thu 04/26/07	Tue 06/19/07		[Task bar]																															
15	IA-WP#2.2 - Resizing and Consolidation of Ruins	15 days	Tue 06/19/07	Fri 07/13/07		[Task bar]																															
25	YEAR 2 - Riverbank Reconstruction	47 days	Mon 04/02/07	Thu 06/21/07		[Task bar]																															
26	IA-WP#1.2 - Year 2 Site Preparation	6 days	Mon 04/02/07	Wed 04/11/07		[Task bar]																															
30	IA-WP#6.1 - Clay Berm Around Perimeter of Equalization Pond - 20 m/day	20 days	Tue 04/03/07	Tue 05/08/07	27	[Task bar]																															
31	IA-WP#3 - Riverbank Reconstruction	41 days	Wed 04/11/07	Thu 06/21/07		[Task bar]																															
42	IA-WP#6.2 - 50 cm Clay Cover over Riverbank Wastes - 600 m2/day	5 days	Tue 06/05/07	Wed 06/13/07	40	[Task bar]																															
43	YEAR 3 - North Industrial Area Rehabilitation	101.5 days	Mon 04/02/07	Tue 09/25/07		[Task bar]																															
44	IA-WP#1.3 - Year 3 Site Preparation	32 days	Mon 04/02/07	Fri 05/25/07		[Task bar]																															
45	1.3.1 - Setup	1 day	Mon 04/02/07	Tue 04/03/07		[Task bar]																															
46	1.3.2 - Grubbing Trees and Vegetation in Cover and North Industrial Areas	9 days	Tue 04/03/07	Wed 04/18/07	45	[Task bar]																															
47	1.3.3 - Well Decommissioning in North Industrial Area and Year 3 Cover Areas	1 day	Wed 04/18/07	Thu 04/19/07	46	[Task bar]																															
48	1.3.4 - New Westerly Creek 500 m Culvert Extension	15 days	Tue 05/01/07	Fri 05/25/07	50	[Task bar]																															
49	IA-WP#4.1 - Consolidation of North Industrial Area Wastes - 1300 m3/day	78 days	Thu 04/19/07	Tue 09/04/07		[Task bar]																															
69	IA-WP#6.3 - 50 cm Clay Cover over NIA Wastes - 1000 m2/day	81.5 days	Tue 05/01/07	Thu 09/20/07		[Task bar]																															
75	IA-WP#5.1 - Simple Earth Cap Placement - 1000 m2/day	78.5 days	Thu 05/10/07	Tue 09/25/07		[Task bar]																															
82	YEAR 4 - South Industrial Area Rehabilitation	125 days	Mon 04/02/07	Tue 11/06/07		[Task bar]																															
83	IA-WP#1.4 - Year 4 Site Preparation	11 days	Mon 04/02/07	Thu 04/19/07		[Task bar]																															
87	IA-WP#4.2 - Consolidation of South Industrial Area Wastes - 1300 m3/day	56 days	Thu 04/19/07	Thu 07/26/07		[Task bar]																															
96	IA-WP#6.4 - 50 cm Clay Cover over SIA Wastes - 1000 m2/day	17 days	Thu 07/26/07	Fri 08/24/07		[Task bar]																															
99	IA-WP#6.5 - Place Remaining Layers of Engineered Cover	41 days	Mon 08/27/07	Tue 11/06/07		[Task bar]																															
104	IA-WP#5.2 - Simple Earth Cap Placement - 1000 m2/day	28 days	Fri 06/22/07	Fri 08/10/07		[Task bar]																															
110	YEAR 5 - GIWN & Revegetation	100 days	Mon 04/02/07	Fri 09/21/07		[Task bar]																															
111	IA-WP#7 - Groundwater Interceptor Well Network	100 days	Mon 04/02/07	Fri 09/21/07		[Task bar]																															
112	IA-WP#8 - Site Revegetation	30 days	Mon 04/02/07	Wed 05/23/07		[Task bar]																															

Project: Table 4.4 - Industrial Area 5-Year Construction Schedule Date: Thu 11/04/04	Task		Progress		Summary		External Tasks		Deadline	
	Split		Milestone		Project Summary		External Milestone			

ID	Task Name	Duration	Start	Finish	Predecessors	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28
0	Table 4.5 - Industrial Area 3-Year Construction Schedule	108.5 days	Mon 04/02/07	Mon 10/08/07		[Gantt bar for Table 4.5 - Industrial Area 3-Year Construction Schedule]																											
1	YEAR 1 - Site Preparation and Demolition	101 days	Mon 04/02/07	Tue 09/25/07		[Gantt bar for YEAR 1 - Site Preparation and Demolition]																											
2	IA-WP#1.1 - Year 1 Site Preparation	55 days	Mon 04/02/07	Thu 07/05/07		[Gantt bar for IA-WP#1.1 - Year 1 Site Preparation]																											
9	IA-WP#6.1 - Clay Berm Around Perimeter of Equalization Pond - 20 m/day	20 days	Thu 04/26/07	Thu 05/31/07	5	[Gantt bar for IA-WP#6.1 - Clay Berm Around Perimeter of Equalization Pond - 20 m/day]																											
10	IA-WP#2.1 - Demolition of Buildings and Tanks	30 days	Thu 05/31/07	Tue 07/24/07		[Gantt bar for IA-WP#2.1 - Demolition of Buildings and Tanks]																											
19	IA-WP#2.2 - Resizing and Consolidation of Ruins	15 days	Tue 07/24/07	Fri 08/17/07		[Gantt bar for IA-WP#2.2 - Resizing and Consolidation of Ruins]																											
29	IA-WP#3 - Riverbank Reconstruction	41 days	Thu 07/05/07	Fri 09/14/07		[Gantt bar for IA-WP#3 - Riverbank Reconstruction]																											
40	IA-WP#6.2 - 50 cm Clay Cover over Riverbank Wastes - 600 m2/day	5 days	Mon 09/17/07	Tue 09/25/07	39	[Gantt bar for IA-WP#6.2 - 50 cm Clay Cover over Riverbank Wastes - 600 m2/day]																											
41	YEAR 2 - Waste Consolidation and Simple Earth Cap	108.5 days	Mon 04/02/07	Mon 10/08/07		[Gantt bar for YEAR 2 - Waste Consolidation and Simple Earth Cap]																											
42	IA-WP#1.2 - Year 2 Site Preparation	1 day	Mon 04/02/07	Tue 04/03/07		[Gantt bar for IA-WP#1.2 - Year 2 Site Preparation]																											
44	CREW 1	101 days	Tue 04/03/07	Wed 09/26/07		[Gantt bar for CREW 1]																											
45	IA-WP#4.1 - Consolidation of Industrial Area Wastes - 1300 m3/day	40 days	Tue 04/03/07	Tue 06/12/07		[Gantt bar for IA-WP#4.1 - Consolidation of Industrial Area Wastes - 1300 m3/day]																											
52	IA-WP#6.3/6.4 - 50 cm Clay Cover over Wastes - 1000 m2/day	61 days	Tue 06/12/07	Wed 09/26/07		[Gantt bar for IA-WP#6.3/6.4 - 50 cm Clay Cover over Wastes - 1000 m2/day]																											
58	CREW 2	107.5 days	Tue 04/03/07	Mon 10/08/07		[Gantt bar for CREW 2]																											
59	IA-WP#4.2 - Crew 2 Consolidation of Industrial Area Wastes - 1300 m3/day	87 days	Tue 04/03/07	Fri 08/31/07		[Gantt bar for IA-WP#4.2 - Crew 2 Consolidation of Industrial Area Wastes - 1300 m3/day]																											
80	IA-WP#5.1 - Simple Earth Cap Placement - 1000 m2/day	20.5 days	Mon 09/03/07	Mon 10/08/07		[Gantt bar for IA-WP#5.1 - Simple Earth Cap Placement - 1000 m2/day]																											
84	CREW 3	98 days	Mon 04/16/07	Wed 10/03/07		[Gantt bar for CREW 3]																											
85	IA-WP#5.1 - Simple Earth Cap Placement - 1000 m2/day	98 days	Mon 04/16/07	Wed 10/03/07		[Gantt bar for IA-WP#5.1 - Simple Earth Cap Placement - 1000 m2/day]																											
95	YEAR 3 - Cover, GIWN & Revegetation	101 days	Mon 04/02/07	Tue 09/25/07		[Gantt bar for YEAR 3 - Cover, GIWN & Revegetation]																											
96	IA-WP#1.3 - Year 3 Site Preparation	3 days	Mon 04/02/07	Thu 04/05/07		[Gantt bar for IA-WP#1.3 - Year 3 Site Preparation]																											
99	IA-WP#6.5 - Place Remaining Layers of Engineered Cover	41 days	Thu 04/05/07	Fri 06/15/07		[Gantt bar for IA-WP#6.5 - Place Remaining Layers of Engineered Cover]																											
104	IA-WP#8 - Site Revegetation	30 days	Thu 05/03/07	Tue 06/26/07	103FF+5 days	[Gantt bar for IA-WP#8 - Site Revegetation]																											
105	IA-WP#7 - Groundwater Interceptor Well Network	100 days	Tue 04/03/07	Tue 09/25/07	97	[Gantt bar for IA-WP#7 - Groundwater Interceptor Well Network]																											

Project: Table 4.5 - Industrial Area 3-Year Construction Schedule Date: Thu 11/04/04	Task		Progress		Summary		External Tasks		Deadline	
	Split		Milestone		Project Summary		External Milestone			

The condensed program would require several crews working simultaneously:

- Demolishing buildings, consolidating ruins and reconstructing the riverbank in Year 1
- Consolidating wastes and covering with a 50-cm clay cover and placing simple earth (clay) caps in the North and South Industrial Areas during Year 2
- Completing the engineered cover and installing the GIWN concurrent with vegetating the Industrial Area with grass and poplar trees on the engineered cover in Year 3

4.5 Cost Opinion for Each Work Package

The estimated cost of each work package listed in Table 4.1, including a 15 percent contingency for capital costs, and overhead, bonds, and insurance costs, is provided in Table 4.6.

TABLE 4.6
WORK PACKAGE COSTS

Work Package Identification #	Description	Estimated Cost* (2004 dollars)
Capital Cost Items		
IA-WP#1	Site Preparation	\$818,237
IA-WP#2	Demolition	\$481,478
IA-WP#3	Riverbank Reconstruction	\$831,012
IA-WP#4	Consolidation of Wastes	\$913,535
IA-WP#5	Simple Earth (Clay) Cap	\$4,025,504
IA-WP#6	Engineered Cover	\$3,459,446
IA-WP#7	Groundwater Interceptor Well Network	\$2,785,212
IA-WP#8	Site Revegetation	\$253,595
Total Capital Costs		\$13,568,019
Operation, Maintenance, and Monitoring Cost Items (Annual)		
IA-OMM#1		
1.1	Arsenic Treatment Plant Operations	\$577,371
1.2	Sludge Disposal (assuming 550 tonnes/year)	\$177,131
1.3	Site Maintenance and Monitoring	\$146,408
1.4	Groundwater Interceptor Well Network OMM	\$26,468
Total Annual (Weighted) OMM Costs		\$927,377
Net Present Value of OMM Costs (includes remote location fees and overhead)		\$12,123,471**
Net Present Value of Capital and OMM Costs		\$25,691,490

*All costs have been developed using 2004 pricing and do not include an escalation factor.

**Net Present Value (NPV) of Annual OMM Costs using an effective interest rate of 5 percent, and a planning horizon of 20 years.

The net present value (NPV) costs presented above are the sum of the capital cost and the net present value of the OMM costs for 20 years following the completion of work. The annual weighted OMM costs have been transformed to a net present value assuming an effective interest rate of 5 percent and a planning horizon of 20 years. The effective interest rate includes inflationary effects. It should be noted that OMM efforts and costs will likely be required beyond the 20-year horizon. The 20-year period was selected based on the assumption that it is a reasonable period for budgetary planning purposes.

As shown above, the estimated capital cost of the Closure Plan is \$13,568,019 with annual weighted OMM costs of \$927,377. The costs provided do not include engineering consulting fees, except for the OMM budgets. The net present value of the Closure Plan is \$25,691,490. The costs presented in the above table include overhead, remote location costs, federal Goods and Services Tax (GST), a 15 percent contingency for the capital costs, a 5 percent contingency for the OMM costs, and the cost of various construction bonds and insurance associated with the work. With the exception, GST was not applied to the cost for the ATP operations, which will continue to be conducted by OCWA. The costs presented are expected to have accuracy on the order of +/-25 percent.

As noted in Section 3.4.1, consolidation, grading, and covering/capping of the Industrial Area will affect existing pumping stations, inspection holes, monitoring wells, and the overland forcemain from the Tuttle Shaft. The pumping stations, inspection holes, and wells will require modification to extend these to the new final grade. The existing forcemain from the Tuttle Shaft will be replaced with a new above ground pipeline as detailed and costed in the Mine Area Closure Plan. The capital cost to undertake the other modifications in the Industrial Area are not included in Table 4.6 since related evaluation and design is beyond the scope of this Closure Plan. The modifications required for the existing pumping stations, inspection holes, and monitoring wells will be addressed as part of the final design.

As noted in Section 3.5.5 and shown in Figure 3-15, future flows to the ATP will likely decrease to approximately 198 m³/day. However the cost opinion for the ATP operations (Table 4.6) is conservatively based on the current annual cost resulting from the current treatment rate of approximately 274 m³/day.

The capital cost of the GIWN (Table 4.6) was based on the current understanding of groundwater flow in the bedrock at the site and will be refined following further hydrogeological field investigations and groundwater flow modelling proposed to be completed in 2004.

The capital cost of the GIWN (Table 4.6), consisting of a horizontal well in bedrock, vertical pressure relief wells and vertical access shafts (see Section 3.5.2), may potentially be reduced if future modelling and design work identifies a similar but more cost-effective approach. For example, construction of a horizontal tunnel instead of a horizontal well may be more cost effective, since vertical shafts are not needed to allow the connection of the vertical wells to the horizontal well (The vertical pressure relief wells could be drilled directly through the constructed tunnel). However, as described in Section 3.5.2, the construction of vertical shafts, as part of the horizontal well solution, provides the opportunity for future access, if desired, for monitoring and more refined operation of the horizontal well.

Also, as noted in Section 3.4.1, depending on the data obtained during the upcoming hydrogeological field investigation, additional modelling should also include evaluation of a horizontal well constructed entirely in the overburden, in conjunction with vertical pressure relief wells constructed in the bedrock, to determine if effective groundwater flow control can be achieved. Depending on the results of these evaluations, this may potentially lead to a more cost-effective GIWN than the cost opinion presented in Table 4.6 (based on a horizontal well in bedrock and vertical pressure relief wells to completely dewater the surficial deposits beneath the WCA).

A detailed breakdown of the estimated costs associated with each work package tasks and subtasks is provided in Appendix B. The costing in Appendix B is based on the cost opinion originally expressed in the Industrial Area Rehabilitation Alternatives report (CH2M HILL, December 2003a), which has been modified and completed to the preliminary design level, with the exception of the costing for the GIWN which has been completed to the conceptual design level.

Costs are itemized into unit, estimated quantity, unit price, and total categories. Each work package is subdivided into tasks and subtasks, coinciding with a planned schedule. The unit costs include labour, equipment rates, fuel, and materials. Unit costs have been based on prices acquired from regional contractors where available. If a regional contractor was not available a suitable alternate was determined, taking into consideration mobilization and demobilization costs. Delivery of materials to Deloro was included in the rates.

Site preparation will include access road rehabilitation, office trailers, decontamination trailers, a decontamination pad, and grubbing of trees and vegetation to expose the wastes and soils prior to excavation.

The cost estimates for the demolition phase were based on site visits and photographs taken during prior site investigations. The lump sum prices have been determined on the number of machine hours that would be necessary to complete the work. A site visit with a demolition expert for budgetary purposes would be necessary to more accurately estimate the actual costs.

Unit rates of excavation were determined based on hourly costs of machines and pre-determined work-rates for the machinery. Budgets are entirely dependent on the volume of material to be excavated and compacted, not the time required to complete the work.

The unit rates for the supply of engineered cover and simple earth (clay) cap materials, in particular the clay, is based on currently available resource information. Prior to the implementation of the construction program, the cost of these materials will be refined.

Table 4.7 summarizes the costs of work package tasks in the order of their year of completion.

TABLE 4.7
YEARLY PROJECT COST AND IMPLEMENTATION PLAN

Package I.D.	Work Package Description	Estimated Cost
Year 1 – Site Preparation and Demolition		
IA-WP#1.1	Site Preparation	\$ 231,544
IA-WP#2.1	Demolition of Buildings and Tanks	\$ 237,341
IA-WP#2.2	Resizing and Consolidation of Ruins	\$ 244,136
Year 1 Capital Costs		\$ 713,022
Year 2 – Riverbank Reconstruction		
IA-WP#1.2	Site Preparation	\$ 63,513
IA-WP#6.1	Clay Berm Around Perimeter of Equalization Pond	\$ 80,934
IA-WP#3	Riverbank Reconstruction	\$ 831,012
IA-WP#6.2	50 cm Clay Cover over Riverbank Wastes	\$ 95,735
Year 2 Capital Costs		\$ 1,071,194
Year 3 – North Industrial Area Rehabilitation		
IA-WP#1.3	Site Preparation, including the NWC 500 m Culvert Extension	\$ 397,146
IA-WP#4.1	Consolidation of North Industrial Area Wastes	\$ 507,988
IA-WP#6.3	50 cm Clay Cover over North Industrial Area Wastes	\$ 758,449
IA-WP#5.1	Simple Earth (Clay) Cap Placement in North Industrial Area	\$ 2,089,588
Year 3 Capital Costs		\$ 3,753,170
Year 4 – South Industrial Area Rehabilitation		
IA-WP#1.4	Site Preparation	\$ 126,034
IA-WP#4.2	Consolidation of South Industrial Area Wastes	\$ 405,548
IA-WP#6.4	50 cm Clay Cover over South Industrial Area Wastes	\$ 318,182
IA-WP#6.5	Placement of Remaining Layers of Engineered Cover	\$ 2,191,159
IA-WP#5.2	Simple Earth (Clay) Cap Placement in South Industrial Area	\$ 1,950,904
Year 4 Capital Costs		\$ 4,991,826
Year 5 – Groundwater Interceptor Well Network and Revegetation		
IA-WP#7	Groundwater Interceptor Well Network	\$ 2,785,212
IA-WP#8	Site Revegetation	\$ 253,595
Year 5 Capital Costs		\$ 3,038,807
TOTAL CAPITAL COSTS		\$ 13,568,019

4.6 Health Hazard Assessment

A document entitled *Deloro Mine Rehabilitation Project – General Health and Safety Plan (GHASP), Final Report* (CH2M HILL, January 2002) has been developed to identify the main hazards and to provide a basis for the health and safety protocols.

The GHASP identifies the following health hazards associated with the Deloro Mine Site that could be encountered while undertaking site inspections, site investigations, and remedial cleanup:

- Arsenic and arsenic compounds, other metals, and silica
- Radiological hazards
- Heat and cold stress
- Buried utilities
- General physical (safety) hazards
- Biological hazards
- Chemicals existing at or brought onto site

The GHASP outlines and describes appropriate procedures and protocols to effectively deal with the above hazards associated with the Deloro Mine Site. The GHASP addresses hazard evaluation and control procedures and protocols (including action levels), personal protective equipment to be used, air monitoring protocols and specifications, decontamination procedures and protocols, spill containment procedures, confined space entry procedures, emergency response plans, and emergency contacts.

Addenda to the GHASP will address hazards associated with specific work packages identified in this and the other three Closure Plans.

Radiological hazards result from low-level radioactive slag and some tailings-like material in the Industrial Area, and sediments in the onsite Young's Creek Area contaminated by radium and uranium tailings eroded from the Tailings Area. The slag represents an external hazard from low-level radiation fields, whereas the tailings-like material and sediments represent both external hazards due to low-level radiation fields and internal hazards from potential ingestion and/or inhalation during the handling activities. Although ambient low-level radiation fields in most of the work areas are expected to be below 1 $\mu\text{Sv/h}$, standard low-level radiation protection procedures as described in the GHASP will be employed to minimize doses to workers during the various remediation activities. Routine low-level radiation field monitoring will be used to identify those areas in which low-level radiation protection procedures must be implemented. Contamination control procedures will also be implemented as described in the GHASP. Decontamination procedures are outlined in Section 4.7.4 of this Closure Plan.

4.7 Environmental and Community Health Protection Plan

Potential receptors that could be affected by the cleanup of the Deloro Mine Site include workers involved in the site cleanup, residents in the Village of Deloro, residents and cottagers along the Moira River downstream of the site, and vehicular traffic along Highway 7 near Young's Creek (in the case of impacted materials to be transported onsite from offsite Young's Creek across Highway 7). The following ECHPP identifies potential risks associated with the cleanup of the site and recommends appropriate mitigation measures. Protection of workers involved in the site cleanup was addressed in Section 4.6.

The disturbance of potentially contaminated materials during remedial activities and the possible loss of contaminants from the work area depend to a high degree on the remedial methods and related physical activities undertaken during site rehabilitation. Since the

transport of contaminants is most easily controlled at the source, the remedial activities selected for the site have been chosen based on the ability to minimize and control the disturbance, spread and loss of contaminants from the work area. Additional actions can be taken to further limit the spread and loss of contaminants from the work area and potentially offsite. These include measures to control dust, noise, odours, surface water runoff, surface water run-on, and erosion, as well as the use of appropriate equipment and personnel decontamination procedures. Each of these measures, which are discussed briefly below, will be undertaken prior to and during implementation of the remedial activities. Odour control is not discussed since it is not expected to be of concern during implementation of remedial activities at the Deloro site.

It should be noted that this overview provides some of the key aspects associated with the mitigation and monitoring of potential offsite impacts resulting from remedial activities at the Deloro site. The finalized details and procedures will be included in the contract documents and specifications associated with the rehabilitation of the Deloro site, and the execution plans proposed by the remedial contractors who are selected to complete the cleanup work.

4.7.1 Dust Control and Air Monitoring

Effective dust control at sites undergoing remediation is best addressed via the development, establishment, implementation and enforcement of a fugitive particulate emission control program. The development and implementation of such a program is generally the responsibility of the remedial contractor and is required to be reviewed and approved by the owner and/or the consultant. The fugitive particulate emission control program includes a description of the procedures relating to the handling of materials, air monitoring and dust control, and is documented in the contractor's execution plan for the site remedial activities. The remedial contractor is required to take all precautions necessary to minimize and control the generation of dust and under no circumstances will unacceptable levels of dust be permitted to be generated and/or transported offsite.

Key aspects of a fugitive particulate emission control program include:

- Carrying out remedial activities that involve disturbance of material, such as excavation, during good weather conditions in order to minimize the loss of materials by wind.
- Movement of materials directly to their designated location, rather than handling several times, in order to minimize the generation of dust (i.e. multiple handling tends to break materials into smaller and smaller pieces which are more likely to be entrained by wind).
- Ensuring adequate equipment and personnel are available at the site at all times to immediately clean up any spilled material, whether it be of a small or large amount.
- An inspection program to monitor the condition of onsite and offsite roads, materials piles, vehicles, etc.
- The use of tarps to cover materials which are likely to generate dust.
- The use of dust suppressants to control dust associated with roadways, work area, stockpiles and other possible sources. Materials used to assist in dust suppression might include water, calcium chloride or latex binders. The frequency of application of dust suppressants is generally on an as-needed basis.

- Regrading of unpaved roads, as required, to keep silt content below 10 percent, and the sweeping of paved roads.
- The use of tarps on trucks used to transport materials onsite and offsite.
- In the case of the Deloro site cleanup, air monitoring both upwind and downwind of the site will be carried out in order to confirm that dust control measures are effective, and to ensure that any potential offsite air quality impacts caused by remedial operations are minimized. Monitoring should be carried out for dustfall and total suspended particulate (TSP). Monitoring for arsenic and other selected metals should also be considered. Although in the handling of low-level radioactive tailings, low-level radioactive contaminants may become airborne, the expected levels will be considerably less restrictive than those for arsenic at similar TSP concentrations.
- The frequency of monitoring and location of monitoring stations at the Deloro site will be determined following the development of the final integrated cleanup plan, and the review of the contractor's execution plan, the proposed remedial activities and meteorological conditions. Typically, TSP is measured using standard high-volume samplers and a daily (24-hour) average determined. Depending on the size of the site, samplers are typically located at four upwind/downwind perimeter sites during each work day. Their location is subject to change based on the location of remedial activities, but they are generally placed at the furthest possible distance downwind of the site within the property line. Standard dustfall jars are used to obtain dustfall measurements, which are typically determined based on a 30-day integrated measurement of dustfall loadings at four perimeter locations.
- Meteorological measurements (wind speed and direction) may also be required to be carried out in conjunction with the air monitoring program. Typically, hourly and daily average wind speed and direction at one localized site could be required during site activities.
- The MOE Ambient Air Quality Criteria (AAQC) for dustfall is 7 g/m² (30-day AAQC) and for TSP is 120 µg/m³ (24-hr AAQC). The AAQC for TSP and dustfall were determined with nuisance effects being the limiting factor. Health effects are not a concern until TSP levels are several times higher than defined by the AAQC, unless elevated concentrations of arsenic and/or other metals are present in the dust. Levels in excess of these criteria, on the basis of property line monitoring results, are considered unacceptable. In instances where background or upwind concentrations exceed these criteria, additional contribution to the parameter is also normally considered unacceptable.
- Monitoring of ambient air quality prior to initiation of remedial activities at the Deloro site is recommended and should be carried out on several occasions and under a variety of conditions in order to establish background air quality both onsite and offsite.

4.7.2 Noise Control

While noise is expected to be generated at the Deloro site during cleanup as a result of mobile sources such as truck and vehicular traffic, as well as equipment sources such as excavators, bulldozers, compactors, generators, pumps and air compressors, conformation with regulatory requirements is not expected to be a major problem. The development and implementation of a noise monitoring and control program is generally the responsibility of

the remedial contractor and is required to be reviewed and approved by the owner and/or the consultant prior to initiation of any site work. The contractor is usually required to provide written details of the noise monitoring and control program in their execution plan to ensure that local requirements are met.

Typical aspects of a noise monitoring and control program include:

- The contractor will be required to take all precautions necessary to minimize noise and under no circumstances will unacceptable levels of noise be permitted to impact offsite residents/property owners.
- The contractor is to conduct all work using appropriate construction methods and equipment so that noise emanating from the site remains at acceptable levels.
- The contractor is required to obtain approval from the owner and/or consultant prior to conducting any site activities between the hours of 6:00 p.m. and 7:00 a.m.
- The contractor will be required to undertake noise monitoring if deemed necessary.
- MOE noise guidelines for landfill operations suggest that a criterion of 50 dBA during the hours of 7:00 a.m. and 7:00 p.m. should be established for the closest residential location. A similar guideline may be suitable for the cleanup activities at the Deloro site.

4.7.3 Surface Water Protection

The control of surface water is required in order to minimize the contact of water with potentially contaminated materials and thus reduce the generation of contaminated water. This can be achieved through the control of surface water runoff from the work area, as well as the control of surface water run-on into the work area. Surface water is also required to be controlled in order to minimize erosion and prevent the offsite transport of potentially contaminated water and sediment to Young's Creek and the Moira River. Specific details relating to the control of surface water will be dependent on the final engineering designs for the cleanup of the site.

The development and implementation of a work area surface water control program is generally the responsibility of the remedial contractor and is required to be reviewed and approved by the owner and/or the consultant. Generally, the remedial contractor is required to take all precautions necessary to minimize the generation of sediment and potentially contaminated surface water and may be required to collect and treat any such water.

Key aspects of a work area surface water control program include:

- The use of geotextile silt fencing, sand bags and/or straw bales to reduce sediment transport.
- The construction of surface water diversions, comprised of swales and sumps or clay berms, to re-direct and/or collect surface water runoff and run-on.
- The collection and treatment of all potentially contaminated water, including water used to decontaminate equipment, surface water and water generated from the dewatering of excavations.
- In the case of the Deloro site cleanup, surface runoff characteristics (e.g. quantity, quality, and direction of flow) of the site should be assessed prior to initiation of

remedial activities. Additionally, an assessment of the quality of water in existing site drainage ditches and channels, including those that result in both run-on and runoff, standing water and natural water (e.g. any adjacent natural streams, wetland areas, and the Moira River) should be undertaken prior to remedial activities (if not addressed through current site monitoring). The water quality assessment should include the sampling and analysis of water for total suspended solids, arsenic, and metals.

- Once a decision on the activities planned for the Deloro site is made, a site-wide surface water quality monitoring program should be developed for implementation during the cleanup.

4.7.4 Decontamination Procedures

In order to prevent the transfer of contaminants from the work area, all equipment, materials, and supplies that come into contact with potentially contaminated materials must be decontaminated prior to removal from the work area. The development and implementation of equipment decontamination procedures is generally the responsibility of the remedial contractor and is required to be reviewed and approved by the owner and/or the consultant. The remedial contractor is required to take all precautions necessary to minimize the transfer of contaminated materials from the work area. Under no circumstances is the transfer of non-decontaminated equipment and materials from the work area permitted.

The key aspects of a decontamination program include:

- Decontamination of equipment and materials that have come into contact with potentially contaminated materials, completed by the contractor prior to the removal of equipment and materials from the work area.
- Equipment decontamination using water or steam facilities to decontaminate tracks, sprockets, tires, axles, buckets, and trailers used in the transport of materials.

CH2M HILL has prepared a conceptual design for a decontamination facility to be constructed and operated by the remedial contractors.

4.7.5 Emergency Response and Preparedness

CH2M HILL will develop a site-specific emergency procedures plan including requirements and information relating to emergency contacts, directions to the nearest hospital, spill and fire control, emergency communications, emergency response such as for a spill or fire, medical emergency procedures, notification, and reporting. All site contractors will be expected to be familiar with and implement the site-specific emergency procedures plan as required. Much of this information is already contained in the GHASP (CH2M HILL, January 2002).

4.7.6 Associated Considerations and Activities

Several issues associated with the mitigation of offsite impacts include:

- As previously noted, CH2M HILL will develop a site TERP to outline procedures and protocols for addressing vehicular accidents and spills of hazardous and non-hazardous materials. Procedural controls will limit the speed of vehicles and determine safe routes.

- The development and implementation of specific work practices associated with contamination, decontamination, and clean work zones.
- In addition to the existing perimeter fencing, the development and implementation of a site security plan including aspects such as additional fencing of work areas, warning/caution signs, security patrols, control of site staff and visitors, etc.
- The use of a qualified environmental contractor who is experienced in similar types of projects, has a good safety and environmental record, and whose employees are experienced and qualified.

4.8 Other Operational Procedures

In order to prevent the spread of contamination during the excavation of the low-level radioactive tailings-like material, the approximately 1,200-m² area will be surrounded by a berm, constructed to contain any contamination during rainfall events. The highest levels of radium contamination, located in the eastern portion of the old lagoon, likely represent only two or three truckloads. Procedural controls will ensure that this material is not excavated during precipitation events.

Since the low-level radioactive constituents in the low-level radioactive slag are immobile, low-level radioactive releases from this waste are not likely to occur during rainfall events.

5. Operation and Maintenance Requirements

The operations and maintenance requirements are addressed in Section 5, while the monitoring requirements are addressed in Section 6. Collectively, these requirements are referred to as operations, maintenance and monitoring (OMM).

A detailed OMM plan and manual should be established for the Industrial Area following the implementation of the rehabilitation measures. OMM of the rehabilitation measures will be required to ensure that they remain in good working order.

OMM efforts under the recommended alternative would be associated primarily with the ongoing operation of the ATP and groundwater collection and treatment system currently maintained by OCWA, the operation of the GIWN and the periodic maintenance of the poplar trees, simple earth (clay) caps, engineered cover, GIWN, surface water drainage ditches, riverbank and perimeter fence.

Monitoring programs to identify the need for maintenance are discussed in Section 6.

5.1 Arsenic Treatment Plant

The ATP and associated infrastructure is presently maintained by OCWA on behalf of the MOE. It is anticipated that OCWA will continue to manage the system into the foreseeable future.

5.2 Groundwater Collection and Treatment System

The overland conveyance system for the pumping stations and the GIWN may require periodic flushing and cleaning. Pipe integrity testing by regular pressure testing will be required. Regular pump maintenance, such as routine seals replacement, will be as specified by the pump manufacturer.

Routine maintenance of erosion on the equalization pond berm will also be required.

5.3 Poplar Trees

In the short-term (first three years), maintenance requirements will include watering of planted/treed areas as required to maintain plantation health, replacing plants as needed, checking for tree health, and addressing rodent activity (beaver and vole controls). Mowing between tree rows will reduce competition among the trees and expose rodents to predators. These activities will help to ensure that the freshly vegetated areas have a low mortality rate and that vegetation density increases to the required level.

5.4 Simple Earth (Clay) Caps and Engineered Cover

Periodic maintenance of the simple earth (clay) caps and engineered cover will be required to repair erosion damage and areas of vegetative stress.

Drainage ditches graded into the simple earth (clay) caps or engineered cover will require routine maintenance to protect against erosion.

5.5 Riverbank

The reconstructed riverbank may require maintenance following storm events that damage the rip/rap along the shoreline. Additional features to prevent the erosion of the riverbank at the outfall of the horizontal well conveyance pipe may be required.

5.6 Perimeter Fencing

A maintenance program to inspect and maintain the integrity of the perimeter fence will address the following activities on a semi-annual basis:

- Removal of dead trees that may otherwise collapse and damage the perimeter fence
- Removal of beaver dams, which are causing surface water control problems, including follow-up inspections to ensure they are not reconstructed
- Routine inspections to identify any other problems in regards to the fence integrity including identification of missing or damaged signs

The MNR should be contacted in the event large mammals become trapped inside the perimeter fence, to determine a suitable course of action.

6. Monitoring Program

A comprehensive monitoring plan will be required to evaluate the effectiveness of the cleanup measures and to identify the need for maintenance tasks discussed in Section 5. The physical and chemical stability, water quality, and biological features in the Industrial Area will be monitored in phases during two site rehabilitation time frames:

- Construction Phase
- OMM Phase

Monitoring may occur daily, weekly, or monthly or at other specified intervals. It is anticipated that sampling frequency will be gradually reduced as monitoring programs confirm the effectiveness of the rehabilitation measures in reducing the flux of arsenic migrating to the Moira River.

The results of monitoring during construction activities should be documented in a Site Closure Report. During the OMM phase, annual reports should be prepared that document the results of monitoring activities for that year, discuss past trends in the data, and forecast trends for the future. The overall effectiveness of the cleanup measures will be examined in the annual reports.

Various components associated with the monitoring program are described in detail below.

6.1 Physical Stability

Physical stability monitoring will be required for the three phases of site rehabilitation. A description of the monitoring programs for each phase is discussed below.

6.1.1 Monitoring Programs during the Construction Phase

Following design specifications during the construction phase will enhance the physical stability of site features. The following activities will require monitoring during the construction phase:

- Selection and characterization of suitable soils for the engineered cover, simple earth (clay) caps and backfill
- Placement, compaction and grading of consolidated wastes, layers of engineered covers, simple earth (clay) caps, and the reconstructed riverbank
- Placement of the rip/rap along the reconstructed riverbank
- Installation of the geosynthetic clay liner within the engineered cover and SEC-4
- Installation of the geotextile filter within the reconstructed riverbank, SEC-2 and SEC-3
- North extension of the culvert in New Westerly Creek
- Installation of the GIWN
- Revegetation of the Industrial Area with poplar trees and grasses

6.1.2 Monitoring Programs during the OMM Phase

Following the construction phase, monitoring the physical stability of existing and newly constructed site features in the Industrial Area will be required as part of the ongoing OMM phase. Table 6.1 lists the physical stability monitoring required during OMM.

TABLE 6.1
PHYSICAL STABILITY MONITORING DURING THE OMM PHASE

Site Security
<ul style="list-style-type: none">• Examine the condition of the site fence, gates, gate locks, and signage
Surface Water Drainage Ditches
<ul style="list-style-type: none">• Inspect ditches for: erosion especially on steep sections and downstream of confluence points; accumulation of sediment, ice, and debris that can result in blockages; beaver activity
New Westerly Creek and Culvert
<ul style="list-style-type: none">• Inspect the NWC for: erosion especially downstream of the outfall; if possible, for internal deformation of culvert; accumulation of sediment, ice, and debris at the inlet and outfall of the culvert that can result in blockages; beaver activity
Engineered Cover and Simple Earth (Clay) Caps
<ul style="list-style-type: none">• Inspect for: slope stability; tension cracks at the crest of slopes; signs of new or ongoing slope failure; gully and wind erosion; vegetation cover growth, stress, and stability; seepage along the side slopes; seepage stains; alluvial fans at the base of slopes; piping; bulging of slopes; and sloughing of crest• Measure liner leakage (i.e. infiltration) using Time Domain Reflectometry (TDR) probes or equivalent• Survey and/or instrument if critical-rates of slope movement or settlement are reached• Sample seeps for metals and arsenic• Periodic low-level radiation field surveys of the engineered cover and simple earth (clay) caps over low-level radioactive slag can give an indication of the cap/cover integrity. A low-level radiation survey near significant cracks may identify unshielded low-level radiation fields• Inspect collector pipes in SEC-4, if possible, for internal deformation and blockages
Groundwater Collection and Treatment System
<ul style="list-style-type: none">• Equalization pond: routine OMM by OCWA; visually inspect the pond and surrounding berm for erosion, cracks, burrowing animals (e.g. gopher holes, fox den); test pond for leakage to water table• ATP: routine OMM by OCWA• Piping, manholes, and pumps: routine OMM by OCWA• Groundwater interceptor well network: routine OMM of flows and piping by OCWA; inspect horizontal and pressure relief well integrity and repair damaged wells; properly decommission damaged or unused wells

Monitoring frequency will vary from feature to feature. Elements of the groundwater collection and treatment system may require daily or weekly physical stability monitoring by OCWA. However, most site features will require monthly to semi-annual monitoring for the first five years following implementation of the Industrial Area rehabilitation measures. Following the initial five years, monitoring frequency could be reduced to annual, provided that the results do not identify adverse impacts to surface water quality.

6.2 Chemical Stability and Water Quality

The current monitoring program (surface water, groundwater, pumping system, ATP inlet and outlet) will be extended to monitor the effectiveness of the site rehabilitation measures.

6.2.1 Existing Monitoring Programs

An extensive monitoring program is currently conducted by OCWA to monitor the quality of surface water, groundwater and ATP effluent at the Deloro site. The existing sampling protocols discussed below were provided by OCWA in January 2004 (OCWA, January 2004).

Arsenic Treatment Plant

The raw influent and final effluent from the ATP is analyzed for arsenic daily when the ATP is operating.

Pumping Stations

Groundwater samples are collected monthly from the six pumping stations (PS#1 to PS#6) and the two groundwater inspection holes and tested for aluminum, arsenic, cobalt, copper, lead, mercury, molybdenum, nickel, and zinc.

Groundwater Monitoring Program

Groundwater within the Industrial Area has been sampled on a regular basis since 1988. Presently, there are 68 monitoring wells in the Industrial Area, which are sampled quarterly.

The 44 GA- and GR- series of monitoring wells are analyzed for aluminum, arsenic, cobalt, copper, lead, mercury, molybdenum, nickel, zinc, pH, conductivity, and height.

The 24 MW-97, MW-98, and 97-TL series of monitoring wells with piezometer tubes are analyzed for height, temperature, pH, dissolved oxygen, conductivity, redox (EMF), total cyanide, ICP, and hydride metals.

The 98-6t series of monitoring wells with piezometer tubes are monitored for height only.

Several of the wells are no longer operational, while others are occasionally dry.

Surface Water Monitoring Network

The Moira River monitoring network, shown in Figure 3-14, comprises 20 sampling stations on the Moira River, New Westerly Creek and Young's Creek that provide information on surface water quality upstream, downstream, and within the site boundary.

There are 12 sampling stations listed in Table 6.2 which are adjacent to the Industrial Area. All 12 stations are sampled weekly and analyzed for aluminum, arsenic, and nickel, with additional analyses for cobalt and copper at stations Stn 6, DM 6, DM7/Highway 7 and Gatling Shaft. The Gatling Shaft and DM 6 are also analyzed for lead, molybdenum, and zinc. All the stations are sampled monthly for mercury and quarterly for aluminum, arsenic, cobalt, copper, mercury, molybdenum, nickel, lead, and zinc. In addition, the Moira River at Highway 7 is analyzed for arsenic with a 28-day sampler that is repeated every 28 days.

TABLE 6.2
MOIRA RIVER MONITORING NETWORK

Station	Location
Stn 1	Station 1 is located on the river upstream of the Deloro site
Gatling	Samples are collected from the Gatling Shaft runoff to the river
Stn 2	Station 2 is located at the river between the Gatling and Tuttle Shaft stations
Tuttle	Samples are collected from the Tuttle Shaft runoff to the river
Stn 3	Station 3 is located downstream of the Tuttle Shaft and above the falls east of the boarding house ruins
Stn 4	Station 4 is located immediately upstream of the weir south of the mine site bridge
DM 6	Samples are collected from the runoff west of the concrete west tailings dam wall
Stn 320	Samples are collected from the runoff through the old equalization pond and dump
NWC	Samples are collected from the New Westerly Creek runoff to the river
Stn 5	Station 5 is located approximately 100 m downstream of the NWC station
Stn 6	Station 6 is located approximately 200 m downstream of Station 5
Hwy7/DM7	Highway 7 and the Moira River represents the downstream point for the Moira River; DM7 represents the upstream Moira River point for Young's Creek contribution

6.2.2 Monitoring Programs during the Construction Phase

With the following modifications, the current monitoring program (surface water, groundwater, pumping system, ATP inlet and outlet) will be extended into the construction phase to monitor the impacts of construction activities during the site rehabilitation.

Arsenic Treatment Plant

During construction, the raw influent and final effluent from the ATP will continue to be analyzed for arsenic daily when the ATP is operating.

Pumping Stations

During construction, the groundwater samples will continue to be collected monthly from the six pumping stations (PS#1 to PS#6) and the two groundwater inspection holes and tested for aluminum, arsenic, cobalt, copper, lead, mercury, molybdenum, nickel, and zinc.

Occasional interruption in pumping, and therefore sampling, is anticipated during modifications to the stations.

Groundwater Monitoring Program

Most, if not all, of the existing 68 monitoring wells will be decommissioned during the rehabilitation program. However, wells will only be decommissioned when the presence of the wells interfere with the excavation or consolidation activities, which will be completed over several years.

Therefore, during construction, the 68 monitoring wells in the Industrial Area will continue to be sampled quarterly for the parameters listed in Section 6.2.1, until the wells are decommissioned.

Surface Water Monitoring Network

The 12 sampling stations listed in Table 6.2 will continue to be sampled weekly/monthly/quarterly and analyzed for the parameters listed in Section 6.2.1. The Moira River at Highway 7 will continue to be analyzed for arsenic with a 28-day sampler.

However, during periods of active excavation work in the Industrial Area (e.g. waste consolidation, cover/cap placement, riverbank reconstruction), surface water samples should be collected daily from Stations No. 3, 4, 9, 320, New Westerly Creek, and temporary stormwater retention ponds and analyzed for arsenic, metals, and suspended solids. The results should be compared to surface water concentrations of upstream sampling Stations No. 1 and 2, the PWQOs, and historical pre-excavation concentrations to assess the effectiveness of the surface water protection measures.

Sediment Monitoring Program

During construction, monitoring of sediment quality will be required to assess the impacts during excavation and consolidation activities on the Moira River.

Prior to, during, and following the riverbank reconstruction activities, sediment quality in the river should also be monitored to assess whether additional controls are required to limit the effect of construction activities on the Moira River.

Sediment samples should be analyzed for arsenic and metals.

6.2.3 Monitoring Programs during the OMM Phase

It is expected that groundwater extraction and treatment will probably not vary in the short term and that significant arsenic loading to the Moira River will persist until the new hydrogeological regime is established. Future monitoring of ATP influent and effluent, surface water, groundwater, and sediment quality at selected locations will evaluate the effectiveness of the recommended alternative following implementation.

Monitoring programs will identify trends:

- To determine the short- and long-term effects of the rehabilitation program on the Moira River water and sediment quality
- In groundwater quality and water table elevations in the Industrial Area after implementation of the GIWN and infiltration reduction measures
- In the quality and quantity of the influent treated by the ATP to assess the effects of the rehabilitation program, the ATP treatment efficiency, and the ability of the ATP to treat decreased influent volumes

The current monitoring program (surface water, groundwater, pumping system, ATP inlet and outlet) will be continued into the post-rehabilitation OMM phase for five years to monitor the effects of rehabilitation measures. Following the initial five years, monitoring frequency of pumping stations could be reduced to quarterly and the surface water and groundwater could be reduced to semi-annual or annual, provided that the results do not identify adverse impacts to surface water quality.

Arsenic Treatment Plant

During OMM, the raw influent and final effluent from the ATP will continue to be analyzed for arsenic daily when the ATP is operating.

Pumping Stations

During OMM, the groundwater samples will continue to be collected monthly from the six pumping stations (PS#1 to PS#6) and the two groundwater inspection holes and tested for aluminum, arsenic, cobalt, copper, lead, mercury, molybdenum, nickel, and zinc.

Groundwater Monitoring Program

During OMM, the remaining or replaced monitoring wells in the Industrial Area will continue to be sampled quarterly for the parameters listed in Section 6.2.1.

The groundwater at the outfall of the horizontal well conveyance pipe will be sampled monthly for the first year and quarterly thereafter, and analyzed for arsenic to monitor the effect of the GIWN. The analysis of other parameters may be re-evaluated in the future.

The water levels in the pressure relief wells will be monitored monthly for the first year and quarterly thereafter.

Groundwater seeps that may originate from the WCA will be analyzed monthly for arsenic and metals, and mitigation measures implemented if the water is contaminated.

Surface Water Monitoring Network

The 12 sampling stations listed in Table 6.2 will continue to be sampled weekly/monthly/quarterly and analyzed for the parameters listed in Section 6.2.1. The Moira River at Highway 7 will continue to be analyzed for arsenic with a 28-day sampler.

6.3 Biomonitoring

Biomonitoring will be undertaken in areas where natural environmental restoration measures are planned. This includes the revegetation of the west Moira River bank, and the capped and covered areas within the Industrial Area. The biomonitoring program will be undertaken during the first growing season following the construction of each remediated area, and annually thereafter for a total of five years. Biomonitoring will then be conducted once every five years over a twenty-year period, and then every ten years thereafter.

Visual inspections will also be conducted for the remedial work proposed along the west bank of the Moira River. These inspections will help to ensure that stream bank stability is not compromised and that the restoration measures implemented, including the installation of any bioengineering structures (e.g. root wads, fascines), are functioning as designed.

Qualified field personnel will evaluate the success of herbaceous vegetation (e.g. grasses, wildflowers, etc.) seeding and woody plantings in the capped areas. Plant health/condition will be monitored and woody-planted materials, such as shrubs and trees that are determined to be inadequate or dead will be replaced. Native colonizing species of shrubs and trees that germinate and grow in these areas will also be documented.

To further support the goals and objectives of the Industrial Area Closure Plan, the monitoring program may include the collection of plants (leaves and/or stems) from the capped and covered areas during the growing season and prior to senescence. The concentration of arsenic and metals of concern in these plant tissue samples could be chemically determined. Trends could be identified and comparisons to benchmark, toxicological and site data could be conducted to ensure that the goals of the Industrial Area Closure Plan are being met.

Wildlife use, including direct sightings or signs such as tracks and scat in the Industrial Area, should be documented and recorded on a site map, as one of the goals of the Industrial Area Closure Plan is to improve the quality and increase the quantity of wildlife habitat. Wildlife observations could be documented by qualified field personnel while undertaking the other investigations and thus, would be completed with the same frequency and over the same period of time.

6.4 Site Management

It is anticipated that the proposed rehabilitation alternative will achieve the expected conditions and uses in the long-term. As part of a long-term site management program, it is anticipated that the following measures will be implemented or maintained:

- Fencing exists on the perimeter of the Deloro Mine Site and access is restricted to authorized personnel
- Signage exists on the perimeter fence as well as at the north and south approaches along the Moira River
- The MOE will retain ownership and control of the site for the foreseeable future
- Site conditions will be registered on title at the conclusion of the cleanup coincident with the issuance of a Record of Site Condition (RSC)

The mitigation measures outlined in Section 7 will be addressed in the event that design malfunctions and/or accidents occur.

