FARO MINE CLOSURE

Infrastructure Support Assessment

Prepared for:

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Energy, Mines and Resources
Assessment and Abandoned Mines Branch

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1.0 Introduction

This report provides a general overview and assessment of infrastructure which will be required to support the Faro Mine Closure Project. Consideration of the support infrastructure is required to inform the eventual implementation strategy and intended to assist in decision making. The infrastructure support components that were addressed in this study include road access (territorial roads and access road to the mine site) , accommodation (available housing and municipal servicing infrastructure in Faro) and electrical power (power supply and onsite infrastructure). Where possible, estimated costs for upgrading of various items in the support infrastructure have also been provided. Due to the overview nature of this study, the cost estimates should be considered as Class D estimates at best, and intended to provide a rough order of magnitude of the final costs that could be expected.

2.0 Study Methods

The methods used in the preparation of this report included the following:

- **Research and Data Compilation** – This included reviews of various reports and documents relating to the mine closure project including work completed by SRK Consulting, Independent Peer Review Panel, plus other reports and information provided by the Faro Project Management Team (FPMT). Meetings with the FPMT were also held to review the study scope and obtain input and understanding of the closure project.
- **Field Trip to Faro** – In January, 2008 I travelled to Faro with Bill Slater, Technical Manager with the Faro Mine Closure. The field trip included a tour of the mine site area, photo documentation, and meetings with various people including Mike Bryson, Manager of Operations at the site to obtain input for the study. Included was a tour of the community and review of the available housing with Faro's CAO, Hermann Minderlein and input on the municipal servicing infrastructure from Mark Vaino, Public Works Superintendent. Murry Hampton, Manager of Faro Real Estate provided valuable input on condition and numbers of available dwelling units in Faro.
- **Report Preparation** – During the course of the assessment work, additional input was received from a variety of sources including reports and personal communication with government personnel and other individuals. Assessments of the existing roads, housing and power infrastructures were carried out and cost estimates prepared for upgrades that were identified as being required.

3.0 INFRASTRUCTURE SUPPORT ASSESSMENTS

3.1 ROAD ACCESS

The following section addresses the roadway network to the minesite in terms of its adequacy to support the remediation work. This includes the Territorial Highway network, which will be used to haul heavy equipment and materials to Faro from various locations. It also addresses the access road to the minesite and the road from the Robert Campbell Highway into Faro.

Territorial Highways

Some of the territorial highway system will be subjected to additional wear and tear from heavy traffic, particularly along the Klondike and Campbell Highway link to Skagway for hauling fuel and possibly large quantities of lime for treatment of tailings water. If Tailings Alternative #1 is selected as part of the remediation work, an estimated 1,066 tonnes of lime will be required in treating the water before it is pumped into the Faro pit. The types of vehicles that will be used to haul these materials are not known at this time. Nor do we know the weights and quantities that may be hauled on the vehicles.

However, under the *Territorial Highways Act*, *Bulk Commodity Haul Regulations* are enforced if the yearly tonnage of commodity that is hauled is greater than 7,500 tonnes. "Bulk commodity haul" means the movement of a bulk commodity by one or more oversized or overweight vehicles on a regular or continuing basis between locations as specified in a permit allowing for the haul on an approved bulk haul route. Permit fees are levied on the basis of $0.01 per tonne-kilometre in excess of legal gross vehicle weight (GVW), calculated from the origin to final destination of the haul route. As an example, the most recent ore-haul from Faro operated under these regulations, as did the haul from Sa Dena Hes. North 60 Petroleum currently has a bulk haul permit to haul fuel on certain routes and Lynden Transportation has a bulk haul permit for the Minto Mine copper ore haul. As such, these regulations could come into play, depending on how materials are hauled to the site.

Regarding the road link from the Campbell Highway to Faro, the Bulk Commodity Haul Regulations would also apply. In the opinion of YG Highways maintenance personnel, the road is in good condition and should be adequate for any hauling work required for the remediation work. Also, from discussions with the YG Highways and Public Works, the Pelly River bridge is considered to be in good condition and adequate for legal loads.

The road from the Campbell Highway to Faro is scheduled for upgrading within the next two years. This will include reshaping, granular surfacing and chip sealing.

In summary, it appears that the territorial road network will be adequate to handle the additional loads and traffic associated with the remediation work. There should not be any direct costs to the closure project in terms of road maintenance or upgrades to the roads other than potential fees levied under the *Bulk Commodity Haul Regulations.*

Access Road to Minesite

The access road from Faro to the minesite is approximately 21.4 km in length. A general assessment of the road was carried out during the site visit and input on the road condition and maintenance practices was obtained from the Acting Foreman of the Drury Creek Maintenance facility.

In general, the access road is in fair condition and is graded every year by YG Maintenance. However, there are some areas where road settlement has occurred over the years that should be upgraded (see photos). The acting foreman indicated that some drainage control work is required including a culvert replacement and a new culvert installation. Glaciation has been causing problems in some areas which can be alleviated to some extent with excavation work along the sides of the road.

During the site visit, a hanging culvert was noted at the Rose Creek Crossing (Km. 9.8), which is a barrier to fish passage. If this section of the creek is found to be fish habitat, then the culvert should be replaced with one which allows for fish passage.

Based on a preliminary review, the following upgrades have been identified, and recommended to be carried out prior to the start up of remediation work:

- Haul, place and compact pit run in various low spots where road settlement has occurred
- Ditch excavation and drainage work to help alleviate glaciation problems
- Replace one culvert and install one new culvert.
- Reconstruct culvert crossing at Rose Creek if necessary
- Reshape and grade the entire roadway

The cost for this work is estimated at $100,000 to $125,000.

It is also recommended that the entire road be resurfaced with a 75-mm lift of road crush or base course material prior to the start of the remediation work. According to YG maintenance personnel, the last time the road was resurfaced was in 1992, and much of this material has been lost into the ditches from road grading work over the years. Resurfacing would improve the road structure and driving surface as well as extend the time between upgrades and maintenance.

The cost for the resurfacing is estimated at $200,000 to $250,000.

3.2 ACCOMMODATION IN FARO

From studies completed to date on the closure alternatives, it appears that the project could require between 650 and 1,210 man years' employment input, depending on the selected option. The length of time to complete the closure will again depend on the option which is finally selected. Initial estimates assume a time period of 7 – 8 years. However, if Alternative #2, which completely relocates the tailings to the Faro Pit, is chosen, this portion of the work may require 10 – 15 years to complete.

For the purpose of this assessment, it is assumed that the community of Faro may need to accommodate this workforce for a period of 7 – 15 years, probably at varying numbers throughout the closure operation. Based on the above, following are estimates of the manpower that could be required at any one time:

Total Man Years	Workers Required in Faro during Closure Operation Period		
	7 years	10 years	15 years*
650	93	65	43
1,210	173	121	81

** This long-term requirement is only for the tailings relocation*

The actual number of workers that will be employed in the closure operation and living in Faro is estimated to be between 65 and 173. Considering that most of the workers may relocate to Faro with their families during this period, the population in the community could increase by 400 or more persons, depending on family size and number of single workers.

Currently, there are about 375 people living in Faro and during the closure operation the population could double, depending on the workforce required.

For the purpose of this assessment, it is assumed that as many as 173 housing units may be required during the restoration period of 7 years.

During the years when the mine was operational, the community infrastructure supported a population of 1,500 or more. In 1977, when Cyprus Anvil operated the mine, the population was recorded at 1,519. Since the mine last shut down in 1998, when Anvil Range Mining Corporation was placed into receivership, a large portion of the housing is now empty and unused. From discussions with Mr. Hampton of Faro Real Estate Limited, it is estimated that about 200 units are currently available for sale or occupancy at this time. This includes detached homes, duplexes, 4-plexes, 6-plexes and apartment complexes. Since the vacant units have been unmaintained for 10 years, upgrades will be required before they can be reoccupied. From discussions with the CAO of Faro, Mr. Minderlein, and Mr. Hampton, as well as an inspection of a sampling of homes, the required upgrades would generally include the following:

- new furnaces
- new water tanks
- painting
- floor cladding
- exterior finishes and cladding

There were few structural problems noted in the buildings. The foundations generally consist of concrete footings and walls, and for the most part appear to remain stable. Although Faro is in a discontinuous permafrost area, most of the housing has not been adversely affected by soil settlement over the years. Since the townsite has been disturbed for many years due to roads and housing development, further melting of permafrost and settlement is unlikely to occur. (See photos.)

Detached homes are selling for $50,000 - $95,000 each, depending on the condition of the unit. Duplexes are selling for $22,000 to $25,000 each. There are about 37 detached units empty at this time. In addition to the empty housing units, there are about 40 empty lots which are available for purchase and new construction. Renovation costs are estimated at $20,000 - $40,000 per unit.

From the assessment, it appears that there will be ample opportunities in Faro for housing workers and their families, including apartments, duplexes, detached homes, and new houses available to subdivision lots.

However, there will not be a need for the additional housing for another 5 years when the remediation work is intended to begin. During this time, there may be some ongoing deterioration in the empty units, which could increase the costs for renovation and upgrading to some extent. However, as long as the units are kept secure and closed from the weather, deterioration of structural components is unlikely to occur.

It is assumed that most of the workforce required during the remediation work will be living in Faro. However, some workers living in Ross River may also be employed in the closure project. As such, there may be a need for an organized and regular shuttle bus system between Ross River and the minesite to transport workers.

3.3 WATER AND SEWER INFRASTRUCTURE

Water System

The town draws its water from three shallow groundwater wells located on the lower bench close to the Pelly River. The well pumps deliver water through a 200-mm (8-in.) dia. supply pipeline to Pumphouse No. 3 on the upper bench of the town. The water is chlorinated at Pumphouse No. 3 and delivered to two steel storage tanks beside the pumphouse. Water is drawn from the tanks and pumped into the distribution system. Watermain pressures in the lower bench are regulated by a pressure-reducing valve.

Pumphouse No. 4 contains booster pumps which increase flows and pressures for the 80/81 subdivision at the east end of the town, and also delivers water to an in-ground concrete reservoir at an upper elevation which provides fire protection, system pressures and storage backup for the community.

The water distribution system in Faro consists mostly of insulated HDPE (high density polyethylene) pipe, but also contains some D.I. (ductile iron), PVC (polyvinyl chloride), AC (asbestos cement) and some original wood stave pipe. The distribution piping system is not designed to circulate water back to the main pumphouses, and must reply on consumption and bleeding of water during the winter in order to protect water and sewer mains from freezing. The exception to this is the lower bench, which can recirculate water back to Pumphouse No. 3. Some sections of the watermain have been valved off and decommissioned where there is no housing occupancy.

In 1998, the Town installed 220 thermostatically controlled bleeders (TCBs) in an initiative to reduce water consumption from bleeding. This device is designed to bleed water only when the service water temperature reaches a set low temperature and shuts off when the temperature reaches a pre-set higher level.

With low population levels, some sections of the town watermains have dead ends.

From discussions with Mr. Mark Vainio, Public Works Superintendent, during the site visit, the water supply and distribution system is generally in good condition. Some of the watermain sections, which are of old wood-stave construction, are slated for replacement in 2008. Other improvements are planned as part of ongoing upgrading and maintenance. One section of watermain on the lower bench has been closed off because some of the houses along that street are unoccupied. If these housing units were to be re-occupied, there would be an additional cost to replace this line since it is wood-stave.

The cost for the watermain replacement is estimated at $80,000 - $100,000.

Sewage System

The sewer system in the community collects all sewage from serviced lots and pumps it to a sewage lagoon located west of the community. The collection system was designed for a fully developed community and as such is not operating at full capacity. According to the works superintendent, there are no issues with the collection or treatment systems at this time, and any increased housing would not result in any operational problems.

3.4 POWER SUPPLY

The following section addresses the electrical power support requirements for the remediation work, as well the post closure requirements. It includes estimations of the power requirements and a general assessment of the condition of the current power support infrastructure.

Electrical Power Requirements

Electrical power requirements will be substantial for supporting the remediation work and to a lesser extent, during the post closure period. Following is an example of the power demands for various items of infrastructure for the first option presented in the "Options for Closure of the Faro Mine Complex" Report:

FARO MINE AREA – RECOMMENDED OPTION (MINIMUM COVER)

- Faro Pit:
  - Water treatment – Pump: to pump from pit to treatment plant
  - Heat tracing

- Zone II Pit:
  - Water Management: 1 – 90 m. deep well with submersible pump
  - Heat tracing

- ETA Tailings:
  - Slurry pumping system (tailings to Faro Pit)

  - Lime Treatment

  - Groundwater collection System to Plant:
    - 5 – 20m wells with submersible pumps
    - Heat tracing
    - Pumping station

- Groundwater:
  - Northfork Rose Creek Collection System to Plant:
    - Groundwater wells: 5 – 20m wells with submersible pumps
    - Pumping station
    - Heat tracing
  - S Cluster Collection System to Plant:
    - Pumping well: 1 – 20m pumping well with submersible pump
    - Monitoring well: 2 – 15m wells with submersible pumps
    - Heat tracing

Similar types of activities requiring electrical power are noted for the Rose Creek Valley options and for the Vangorda/Grum Mine Area options. SRK Consulting provided a rough estimate of power requirements considering the remedial option that included complete relocation of the Rose Creek Tailings. From these figures, maximum monthly and daily maximum figures were generated and presented as follows:

1. **Faro**
   - Upgrade Faro Creek Diversion – closure consumption of 399 MWh due to possible hydraulic monitoring of ETA tailings (occurs over 1 summer season – 4 month period is assumed)
     Monthly max.: 100 MWh
   - Post Closure – Groundwater collection and water treatment plant operation. Annual power requirement is 3,282 MWh
     Monthly max: 274 MWh.
   - Total daily max: 13 MWh

2. **Rose Creek Tailings**
   - Complete Relocation of tailings – highest consumption option. Total closure consumption of 154,629 MWh due to hydraulic monitoring of tailings over 15 summer seasons.
     Monthly max.: 2,577 MWh
   - Post Closure – due to groundwater collection and water treatment plant operation. Annual power requirement is 4,961 MWh.
     Monthly max.: 413 MWh.
   - Total daily max.: 100 MWh

3. **Vangorda/Grum**
   - Backfill Vangorda Pit – This is the option with the highest electrical consumption and includes pumping out Vangorda Pit. The closure consumption over two years is 3,546

MWh.
Monthly max.: 443 MWh

- Post Closure – Groundwater collection and water treatment plant operation. Annual power requirement is estimated at 1,902 MWh.
  Monthly max.: 88 MWh.
- Total daily max.: 18 MWh

4. **Camp, office, Shops etc**.
   - Monthly max.: 30 MWh (estimate)
   - Total daily max.: 1 MWh.

From the above, the estimated maximum total monthly power demand could be in the range of 3,925 MWh or a daily maximum demand of about 130 MWh. This requires an energy supply of approximately 5.5 MW. For comparison, it is noted that the original supply infrastructure was capable of delivering 25 MW when the mine was operating.

Support Infrastructure

Power is supplied to the mine site by Yukon Energy Corporation (YEC) through a 138,000 Volt power line from Faro. The power line is owned and maintained by YEC. From discussions with YEC personnel it was learned that the line is generally in good condition, requiring annual maintenance including occasional replacement of cross arms, insulators and poles. With continued maintenance, the power line is expected to be adequate to supply the needs for the remediation work as well as ongoing needs in the post closure period. There are no direct costs to the FMC project for any upgrading or maintenance to the supply infrastructure. The electrical demands for the closure work fit well with the supply available from YEC having surplus demands to handle the higher electrical load during the summer period and lower supplies available during winter when the winter load is also low.
If upgrades are required to the substations at the mine site, the contractor would be responsible to pay for the new equipment, however there would be a utility contribution from YEC.
It is recommended that the FMC Team initiate discussions with YEC so that they can begin forecast load planning for the closure and post closure period.

Regarding the infrastructure at the mine site, input was obtained from the site electrician who is responsible for maintaining the electrical systems at the mine site as well as other persons familiar with the systems. The original equipment was installed in the late 1960's and various problems with the current equipment and systems were reported and are outlined as follows:

- Much of the equipment is outdated (ie. breakers etc.) and parts are no longer available. Overload relays are obsolete.
- There is no consistency with the make of equipment and materials which has been installed by various contractors over the years. As such, they are not compatible with each other which results in inefficient maintenance (ie. parts replacement)
- Some of the equipment installed over the years is of inferior quality.
- System components are deteriorating (ie. corrosion problems).
- High maintenance is required on old equipment.

In addition, if the tailings relocation option is selected, there will be a requirement for a new power supply line. Also, a new substation with transfers and switchgear was identified as being required.
Based on a general overview of the infrastructure at the mine site it is apparent that there are a number of problems and deficiencies in the current systems and that electrical upgrades will be required to support the remediation work and post closure operations. The costs for the electrical upgrade work is likely to be significant. However, in order to estimate these costs, a detailed electrical engineering assessment of the existing infrastructure will be necessary.
It is recommended that the assessment identify the electrical upgrade work and associated costs which will meet the needs of the closure project and post closure operations, and that they be designed to be operated and maintained efficiently over the long term.

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Appendix A

Photographs

Photo 1 – Access road from Faro to mine site showing typical road settlement.

Photo 2 – Access Road. and typical road settlement.

Photo 3 – Perched culvert at Rose Creek crossing.

Photo 4 – Other end of perched culvert.

Photo 5 – Typical unoccupied duplex.

Photo 6 – Typical unoccupied row housing.

Photo 8 – Unoccupied apartment.

Photo 9 – Single family units.

Photo 10 – Unoccupied 6 plex.

Photo 11 – Haul Road between Faro Mine and Vangorda/Grum site.

Photo 12 – Overburden dump at Vangorda/Grum site.

Photo 13 – Vangorda Pit.

Appendix B

Information Sources

REFERENCES

Bulk Commodity Haul Regulations – Territorial Highways Act. O.I.C. 1994/174

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PERSONAL COMMUNICATION

Amin Abdullah, Manager, Bridges, Transportation Engineering, Yukon Government

Andy Blattmann, Building Maintenance Worker, Yukon Government, Faro

Bill Slater, Technical Manager, Faro Mine Closure, Planning and Information Office

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Hector Campbell, Director of Resources Planning and Regulatory Affairs, Yukon Energy Corporation

Hermann Minderlein, Chief Administrative Officer, Town of Faro.

John Bowness, A/Foreman, Drury Creek Maintenance Camp, Yukon Government.

Mark Vaino, Public Works Superintendent, Town of Faro

Murray Hampton, Manager, Faro Real Estate Limited.

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