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DRAFT Resolute, Nunavut Dump Site Investigation
Hamlet of Resolute, Nunavut

Project No. 003-GNCGS

The Government of Nunavut
Department of Community and Government Services

September 5, 2008

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1 INTRODUCTION

On July 7th, 2008, the Government of Nunavut – Department of Community and Government Services (GN-CGS) commissioned Arktis Solutions Inc. (ASI) to complete a Municipal Dump Site Evaluation & Design at Resolute, Nunavut. The Hamlet of Resolute, Nunavut is located on the south shore of Cornwallis Island approximately 900 km north of the Arctic Circle (refer to Figure 1).

ASI visited Resolute, Nunavut from August 3rd to 9th, 2008 and completed the following activities:

i. Site inspection of the existing Municipal Dump Site (MDS);

ii. Site inspection of the Bulky Metals Dump Site (BMDS);

iii. Site inspection, topographic survey, and preliminary geotechnical investigation of the proposed new Municipal Dump Site;

iv. Visual inspection for waste materials on ground surface as observed from public roadways;

v. Municipal solid waste audit; and,

vi. Interviews with various community members and Hamlet staff regarding waste operations.

The purpose of this report is to summarize the findings from the site investigation.

2 INVESTIGATION AND OBSERVATIONS

Figure 2 provides perspective on infrastructure locations within the vicinity of Resolute, as well as, the approximate locations of waste accumulations that were observed during the site visit. Each waste accumulation area is discussed below. Figure 2 also provides the general location of the proposed MDS, which is located north of the airport. Table 1 provides a summary table of the waste types, site area, and approximate waste volumes; specific details are outlined in the following sections.

Table 1: Summary of Waste Locations at Resolute, NU.

Site Location	General Waste Type	Approximate Site Dimensions (m)	Approximate Waste Volume (m^3)
Existing Municipal Dump Site	Municipal and Commercial	150 x 50 x 6	40,500
Miscellaneous Hamlet Bulky Metals Site	Household and community metal waste	40 x 20 x 1	800
Industrial Bulky Metals Site	Industrial bulky metal waste	150 x 50 x 3	22,500
Bulky Metals Site Adjacent to Airport	Industrial bulky metal waste	30 x 30	Unknown
Large Bulky Metals Site	Industrial bulky metal waste and electrical waste	200 x 20	900
Existing Bulk Metals Disposal Site	Industrial bulky metal waste, electrical waste, and construction debris	150 x 150 x 7	160,000
Shoreline of Resolute Bay	Industrial bulky metal waste	Sporadic waste debris along shoreline	1,000
East shore of Resolute Bay	Military waste		Unknown
Hamlet maintenance garage	Hazardous waste (batteries and oil/grease)		Varies
Burn Waste Pile	Hazardous (incineration ash)	4 x 10 x 3	
Asbestos Pile	Hazardous waste (asbestos)	3 x 10 x 2	

2.1 Existing Waste Locations

2.1.1 Existing Municipal Dump Site

The existing MDS is about 4 km south-west of the community, located at the western tip of Resolute Bay. The site is immediately east of the road to the cemetery and about 0.5 km north of the ocean shoreline. It appears that disposal operations consist of end dumping (area fill) from the existing road elevation onto the adjacent lower elevation ground surface. As well, waste was found to be burned on-site as a means to manage waste volumes. ASI noted no controls for waste disposal, burn pits, site access, safety, or site water management. The site had recently (within 2 weeks of site visit) been covered with about 0.3 m thick, pit run sandy gravel. The MDS had an estimated plan area of about 7500 m^2, is about 5 to 7 m in height, with side slopes of about 1.5H:1V. Figures 3 to 6 provide photographs of the existing MDS.

2.1.2 Miscellaneous Hamlet Bulky Metals Site

At a hamlet industrial lay down area north (within about 500 m) of the Resolute community, bulky metal waste has accumulated. The lay down area is approximately 800 m^2. From discussions with Hamlet staff, this site has been accumulating waste materials since 2007 and appears to contain approximately 800 m^3 of metal waste that consists of various items, including: household appliances, snow mobiles, vehicles, crushed barrels, etc. The crushed barrels were gathered and stacked within a partially bermed area. Waste materials appear to be end dumped at random over the site from an adjacent service road which was found to be partially blocked with the waste materials. As well, ASI noted shallow groundwater seeps passing through the lay down area. Further, the site is open to the public with no controls on dumping and access. Figures 7 to 9 provide photographs of the miscellaneous hamlet bulky metals site.

2.1.3 Industrial Bulky Metals Site

A local general contractor has a site lay down area located adjacent to the community tank farm, approximately 2 km south-west of the community. The site is an approximate 150 m x 50 m area (7,500 m^2) and contains various bulky metals ranging from barrels, vehicles, tanks, pipes, etc. From discussion with the general contractor, some of this bulky waste may need to be disposed of in the proposed bulky metals site. During further discussion with the general contractor, ASI learned that this land is leased for his use.

2.1.4 Bulky Metals Site Adjacent to Airport

West of airport road within the vicinity of the industrial buildings, miscellaneous bulky metals waste was observed to be end dumped over a ridge. The ridge is about 150 m west of airport road and has a drop in topography of about 10 to 20 m. Items appeared to be mainly barrels with miscellaneous metals. It is unknown if there is buried waste along this ridge. Figure 10 and 11 provide photographs of the bulky metals along the ridge. From the surveyed maps provided by the GN, this land is within the airport property.

2.1.5 Large Bulky Metals Site

Large bulky metals, such as industrial vehicles, tanks, and electrical equipment was observed to accumulate at a site north of the airport and about 1 km north of the proposed MDS. About 900 m^3 of metal debris has been lined up (about 200 m long) adjacent to a crevasse, and positioned about 0.5 km from the ocean shoreline. An additional 100 m^3 of waste and potentially buried waste is located about 0.5 km east of this location with some waste material noted to be end dumped into the crevasse. Site access to this location is from a steep road immediately north of the proposed MDS. There are no controls for the disposal of bulky metals in this region. Figure 12 and 13 provide photographs of the bulky metals at this site. From the surveyed maps provided by the GN, this land is within the airport property.

2.1.6 Existing Bulk Metals Disposal Site

The existing BMDS is located approximately 9.5 km, by road, north-west of the community and about 3 km north-west of the Resolute Bay airport. From the surveyed maps provided by the GN, the BMDS is located within airport property. At the south-east corner of the existing MDS, ASI noted a sewage lagoon in use. From discussion with the airport manager, ASI confirmed that the site is within airport property; also, it was noted by the airport manager that the entrance to the existing BMDS, and therefore also the proposed MDS, drifts in with snow and requires regular snow removal.

Waste materials are end dumped from a topographic high (adjacent to the road) over a ridge to a topographic low. The site has been partially covered with granular material, perhaps as a cover, that facilitates driving on the waste mound and end dumping on the leading edge of the waste fill (refer to Figures 14 and 15). The waste within the existing BMDS is approximately 7m high on the leading edge (dumping edge), and about 1m in height from the original ground surface immediately adjacent to the road, with approximate plan dimensions of 150m x 150m. The estimated volume of waste is about 160,000 m^3 and appears to consist of bulk metals, crushed barrels, industrial and commercial waste, construction and demolition materials such as concrete and rebar, snow mobiles, burned materials, electrical equipment, aerials and antennas etc. No controls to what types of waste can be deposited in this area were observed and recently burned waste was evident at the crest of the waste slope. ASI noted that a perimeter berm (about 2 m high) was exposed on the south and south west sides of the waste pile. It is likely the perimeter berm was installed to contain the bulky waste; though, due to continued operation, this berm has been engulfed by waste along the west side of the site and, if present, is completely covered on the north side. Figure 16 to 21 provides photographs around the perimeter of the existing BMDS.

From visual inspection, there was little to no sorting of the waste observed; however, the north edge of the waste deposit contained predominantly crushed barrels with date stamps ranging from 1996 to 2005. Also, there appeared to be no controls for leachate escape or collection. Leachate seeps were noted on the leading edge of the waste deposit that drained to the west into a wet tundra zone (see Figures 22 and 23). From discussion with Hamlet staff, sewage from the adjacent lagoon overflows, yearly, into the south side of the bulky metal pile and down slope, adjacent to the pile.

2.1.7 Other Sites

The following sites were also noted to contain waste products:

i. Adjacent to the shore of Resolute Bay, various large bulky metal items remained and scattered at random within 200 m of the shoreline. Items included parts of boats, barges, corrugated steel, and miscellaneous machinery parts. There is an estimated 1000 m^3 of bulky materials around the Resolute Bay shoreline.

ii. Along the north shore of Resolute Bay, waste and bulky metal waste was day-lighting through the as-placed gravel cover. From discussion with community members, this shore is a location of buried military waste. Figures 24 and 25 provide photographs of Resolute Bay and the buried waste along its shore.

iii. From discussion with Hamlet staff, adjacent to the Hamlet maintenance garage, up to about 12 barrels of waste oils/grease from the garage can be temporarily stored prior to backhauling to southern Canada.

iv. From discussion with Hamlet staff, adjacent to the Hamlet maintenance garage, there is a shed that temporarily houses dispensed vehicle batteries prior to backhauling to southern Canada.

v. Adjacent to the south-east corner of the proposed MDS there is a sign that marks a burn waste pile with dimensions of about 4 m x 10 m x 3 m. From visual inspection, the burn waste is covered with pit run gravel. No attempts were completed to assess cover thickness. No controls or safeguards were provided around the piles to limit site drainage or restrict public access for safety. Figure 26 depicts the burn waste pile and asbestos pile.

vi. Adjacent to the burn waste pile near the south-east corner of the proposed MDS, there is a sign that marks an asbestos pile. The asbestos pile is about 3 m x 10 m x 2 m in size. From visual inspection, the asbestos is covered with pit run gravel. No attempts were completed to assess cover thickness. No controls or safeguards were provided around the piles to limit site drainage or restrict public access for safety. Figure 26 depicts the burn waste pile and asbestos pile.

2.2 Proposed Municipal Dump Site

The proposed MDS location is approximately 75 m north of the existing BMDS. The site has a perimeter fence with an entrance gate located on the south face, east side of the enclosure. A gravel road with ditch provides access through the entrance gates into the enclosed site (see Figure 27). The site has an area of approximately 50,000 m^2.

Generally, the site consists of a higher topographic zone (in the east half of the site; “the eastern zone”) in the vicinity of the entrance gate with a slope of about 1H: 22V, and a zone of steeper grade (in the west half of the site; “the western zone”) with a slope of about 1H: 10V. The dimensions of the site are approximately 285 m x 175 m with an overall elevation change of about 15 m. A ridge of highly fracture bedrock outcrop is located at a topographic elevation of about 60 m, and separates the two zones noted above (see Figure 27). The lowest point within the proposed MDS, located along the west side of the fence is at a topographic elevation of 52 m, while the highest point at the east side of the enclosure is 67

m (refer to Figure 43 for the preliminary topographic drawing). Typical ground cover in the eastern zone ranges from about 1 to 2 m of overburden sandy-gravel material to highly fractured bedrock and boulder size materials (see Figure 28 for representation range in material sizes on site). The western zone of the site consists mainly of highly fractured bedrock to 1 to 2 m of boulder size materials. Figures 29 to 33 show the topographic and surface features of the site from various locations within the proposed MDS.

The galvanized steel chain link fence making up the enclosure for the proposed new MDS consists of twenty-eight (28) 88.9 mm dia. hollow post sections at various spacing, with smaller 66 mm dia. posts between, spaced at approximately 2 m. All posts appear to be drilled and backfilled into the surrounding soils. The top rail and bracing members located adjacent to doors, and in changes of direction along the length of the fence, were found to be 42.9 mm dia. as per drawings. The height of the fence is approximately 1.8 m. The gates providing access to the enclosure consist of two (2) 88.9 mm posts spaced at 1.8 m complete with gate hinges, drop latch and latch catch. Adjacent to the gates there is a pedestrian door between two (2) 88.9 mm posts complete with gate hinges and door latch. The fence installation appeared to be true and was found to be stable. In general, the existing fenced enclosure was found to be in conformance with Dwg. 003 supplied to ASI by the GN; however, the following minor deficiencies were noted (note that test pits around the existing post members were not completed due to the rocky terrain encountered when on site):

i. At the western half of the fenced perimeter (west of the ridge) no bottom wire was in place to hold the chain link tight at the bottom of the fence. The bottom wire was noted in the eastern half of the fence, though the majority of the wire was not tied into the chain link.

ii. The maximum 50 mm spacing between grade and bottom of chain link indicated on the drawing could not be achieved everywhere due to the terrain, resulting in significant localized gapping at the underside of fence (refer to Figure 34).

iii. A vertical bracing member in the pedestrian door was not in place (refer to Figure 35).

iv. Horizontal bracing members adjacent to gate and door shown on the drawing were not in place (refer to Figure 35).

v. Tension bars were found to be deformed (refer to Figure 36).

vi. Disconnected top rail to 88.9 mm posts noted (refer to Figure 36).

vii. Some domed tops for main 88.9 mm dia. post members were missing allowing water into the centre of the posts.

viii. Bent top rail noted (localized; refer to Figure 37).

ix. Disconnected top rail noted (localized; refer to Figure 38).

x. Single top rail to intermediate post connection found to be disconnected (localized; refer to Figure 39)

xi. Chain link short from top rail noted at north side (localized; refer to Figure 40).

xii. Single location where horizontal brace should be added at north-east corner along road (localized; refer to Figure 41).

xiii. Some of the drilled holes for the existing posts were not completely backfilled (refer to Figure 42).

3 ANALYSIS AND DISCUSSION

3.1 Closure of Existing MDS and BMDS

Closure of the existing MDS and BMDS will likely require the following major activities:

i. Regrade the side slopes to be geotechnically stable.

ii. Regrade top of waste pile surface to allow for surface water drainage and minimize pooling.

iii. Divert of surface waters around waste pile location.

iv. Placement of an engineered cover over waste materials to contain waste, control infiltration, and encourage permafrost aggradation into waste pile.

v. Placement of an engineered berm around the perimeter of waste pile to buttress the waste in preparation for cover placement.

vi. Manage leachate from the waste pile, which may involve: collection and storage, monitoring, and treatment.

3.2 Layout of Proposed MDS

The proposed MDS may involve the following major components:

i. Engineered lined and bermed municipal dump area.

ii. Permanent bulky metals disposal storage area.

iii. Temporary storage of bulky metals area.

iv. Engineered lined and bermed hazardous waste storage area.

v. Recyclable storage area.

vi. Site access road and roadway within site area to each waste storage area.

vii. Engineered perimeter berm around permanent bulky metals disposal storage area.

viii. Surface water management structures.

ix. Leachate collection storage, collection, and treatment.

x. Fenced perimeter.

The philosophy of the proposed MDS is to separate and compartmentalize major types of waste. With proper operations, waste separation may encourage backhauling of hazardous waste and recyclables. The site of each waste type storage area is dependent on the amount of waste generated over the lifespan of the facility.

Based on preliminary calculations of waste volumes and considering site characteristics, the proposed MDS may not be of sufficient size. More detailed calculations and layout of the proposed MDS will be completed after discussion with GN-CGS regarding matters discussed in Section 3.3 of this report.

Also, the terrain described above presents several potential challenges to the use of the whole site for a new MDS. Access to the lowest elevation within the western zone would require construction of a road, with a shallower slope than the existing topography. As such, the existing fractured bedrock and boulder sized materials would need to be excavated (the width of a road) and replaced with granular fill materials to achieve adequate sloping for vehicle entrance. In addition, excavation of existing boulder materials may be required at the base of the ridge to facilitate storage of waste materials. In fact, based on the site topography the majority of the proposed MDS may need to be re-graded to make the most use of the full area within the fenced enclosure. Furthermore, to facilitate installation of a perimeter berm, general re-grading of the site perimeter would be required just to facilitate construction access for berm installation.

3.3 Fenced Enclosure

Based on the some of the deficiencies noted within the chain link fence, either the fence has experienced heaving during its current life span, or the deficiencies are a result of installation. Should the proposed site be used to facilitate a new MDS, minor repairs and restoration to the fence would be required as part of a maintenance program to prolong the life span of the fence and to correct deficiencies effecting the ability of the fence to keep people/wildlife from entering the site. Please note that the existing fence will confine movement of construction vehicles within the enclosure during construction of a new MDS, and may further limit the use of the full enclosed area.

3.4 Items for Discussion

Select major issues that the GN-CGS should consider prior to development of engineering and management plans for the existing and proposed waste sites include the following:

i. The land tenure and ownership of the existing BMDS and proposed MDS are not confirmed. Based on information gathered during the site investigation, these sites are within airport land boundaries. If this is the case, it is unclear how the hamlet can position a new MDS on airport lands without airport approval. If it is airport property, it is likely that the airport would not accept the liability associated with a hamlet MDS on airport lands. ASI will require guidance from GN-CGS on how to move forward on this issue.\

ii. Based on historical information, the existing BMDS undergone closure in 1999 by Transport Canada. Additionally, Transport Canada completed an Environmental Site Assessment (ESA) of this location in 1994 and 1999. The ESA documents have been requested from Transport Canada. From discussion with Transport Canada staff (Mike Molinski, personal communication), the responsibility of the existing BMDS lies with Transport Canada. This responsibility stems back to the transfer of the Resolute airport from U.S. ownership to Transport Canada around the 1950s. The relationship, if any, between GN-CGS and Transport Canada's with regards to the existing BMDS care and closure activities is unknown and may impact abandonment and restoration plans for this site. There has been additional waste deposited by third-parties following the 1999 closure that will also need to be considered.

iii. There is no documentation to demonstrate that a site selection study was conducted for the placement of a new MDS. >From discussion with community members, it suggests that no community consultations took place to determine preferred locations. Further, there is no information/documentation that demonstrates that the proposed MDS site is adequate to store waste. Additional details should be sought to assess if the current location has adequate characteristics to be used for a MDS. Consideration should be given to, but not limited to, topography, construction constraints, operation constraints, size with respect to material balance, etc.

iv. Topography of the proposed new MDS may constrict construction. The proposed MDS location is located approximately 200 m north of the existing BMDS. The site has a perimeter fence with an entrance gate located on the south face. A gravel road with ditch provides access to the fence entrance from the vicinity of the existing BMDS. Generally, the site consists of a higher topography zone (in the east half of the site) in the vicinity of the entrance gate, and zone of steeper grade (in the west half of the site). A ridge of highly fracture bedrock outcrop, at a topographic elevation of about 60 m, separates the two zones described above. The elevation drop over the ridge is about 5 to 15 m. Typical ground cover in the eastern half of the site ranges from about 1 to 2 m of overburden sandy-gravel material to highly fractured bedrock and boulder size materials. The western zone of the site consists mainly of highly fractured bedrock to 1 to 2 m of boulder size materials. The topography, partnered with the fractured native material and pre-existing fence structure, may limit

construction output and thus increase construction costs beyond those expected. The function of the MDS is to contain and manage wastes and leachate. A site should be selected to serve these functions in a fashion where capital costs may be minimized if possible.

4 CONCLUSIONS AND RECOMMENDATIONS

4.1 Conclusions

A site investigation of Resolute, NU existing municipal dump site, bulky metals site, and proposed municipal dump site was completed to obtain site specific information regarding site characteristics and current waste management and operations. The information obtained may be used to develop closure plans for the existing municipal dump site and bulky metals site. Further, the information obtained may be used to aid in the design of a new municipal dump and bulky metals disposal site. The objective of this report was to provide the GN-CGS with perspective of the current site conditions and to provide preliminary recommendations for GN-CGS consideration. The decision on recommendations will influence the next steps to be untaken by ASI. ASI welcomes further discussion and direction from the GN-CGS on these matters.

4.2 Recommendations

The following preliminary recommendations are based on the findings from the site investigation:

i. Determine land tenure and ownership for the existing BMDS and proposed MDS.

ii. Determine organization(s) responsible for closure and reclamation of the existing bulky metals sites.

iii. Assess snow accumulation areas within vicinity of the new MDS.

iv. Conduct a site selection study for the new MDS.

v. Provide an engineered controlled location for the disposal of bulky metals waste.

vi. Remove bulky metals from the following locations: industrial bulky metals site; bulky metals site adjacent to airport; large bulky metals site; and shoreline of Resolute Bay. This clean-up effort may reduce the incentive for uncontrolled dumping.

vii. Separate of hazardous materials from bulky waste and municipal waste.

viii. Appropriately dispose of hazardous materials, such as asbestos and burn ash.

ix. Storage of oil/grease, batteries, and other hazardous materials within an engineered lined facility.

x. Stop practices of burning of municipal waste.

xi. Provide a location for controlled burning of acceptable waste products.

xii. Manage site waters at each existing waste locations.

xiii. Assess existing contamination adjacent to waste locations by conducting an environmental site assessment. Where required, install surface and groundwater monitoring locations to measure potential of contamination.

xiv. Engineer a closure design for the existing MDS and BMDS.

xv. Review the 1994 and 1999 ESA documentation from Transport Canada regarding the existing BMDS.

xvi. Complete an updated ESA of the existing BMDS.

5 LIMITATIONS OF LIABILITY

This report has been prepared for the exclusive use of the Government of Nunavut – Department of Government Services for the specific application described in Section 1.0 of this report. It has been prepared for information purposes only. No other warranty is made, either expressed or implied.

6 CLOSURE

We trust that this report meets your present requirements. Please contact the undersigned should there be any questions.

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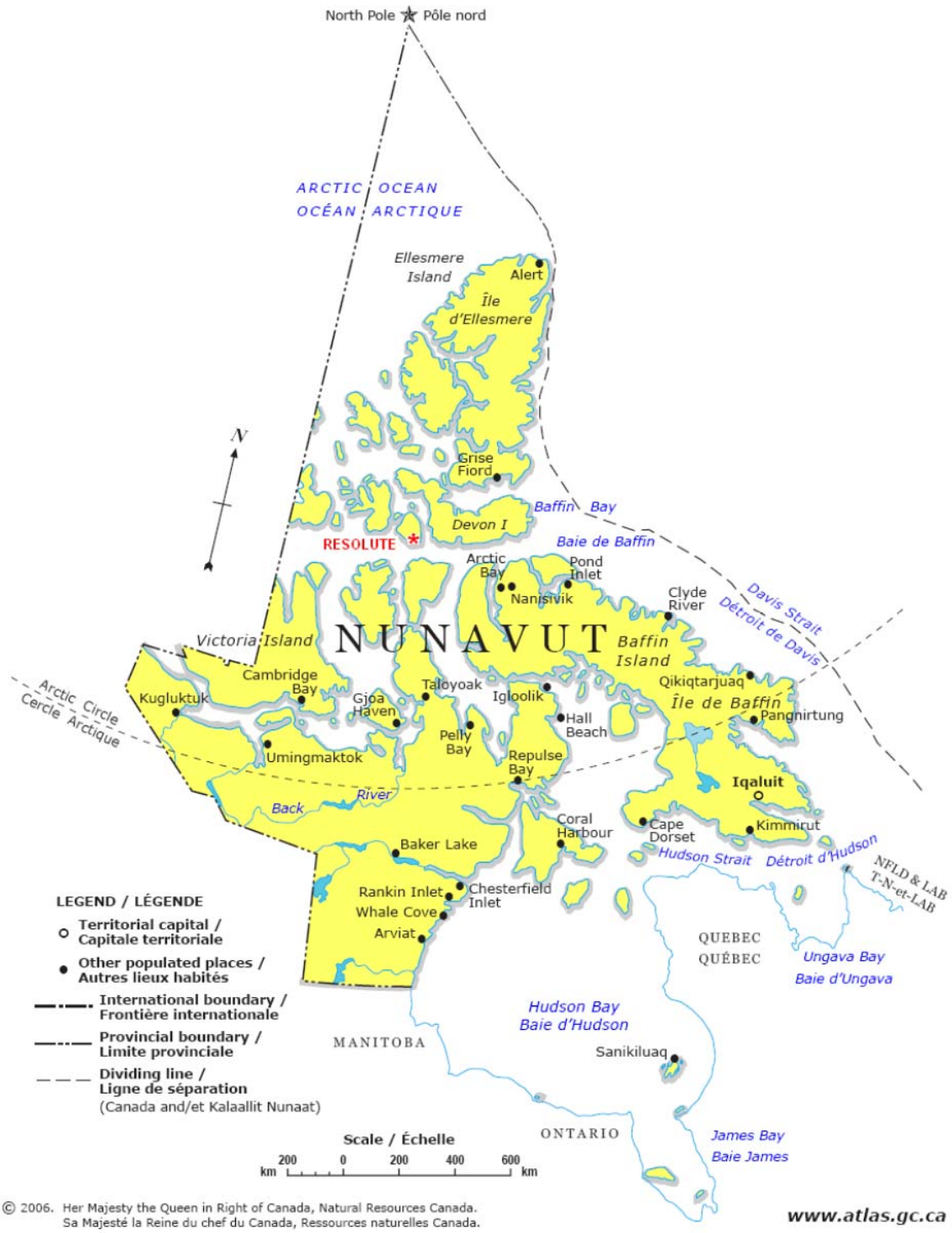

Figure 1: Communities of the Nunavut Territory

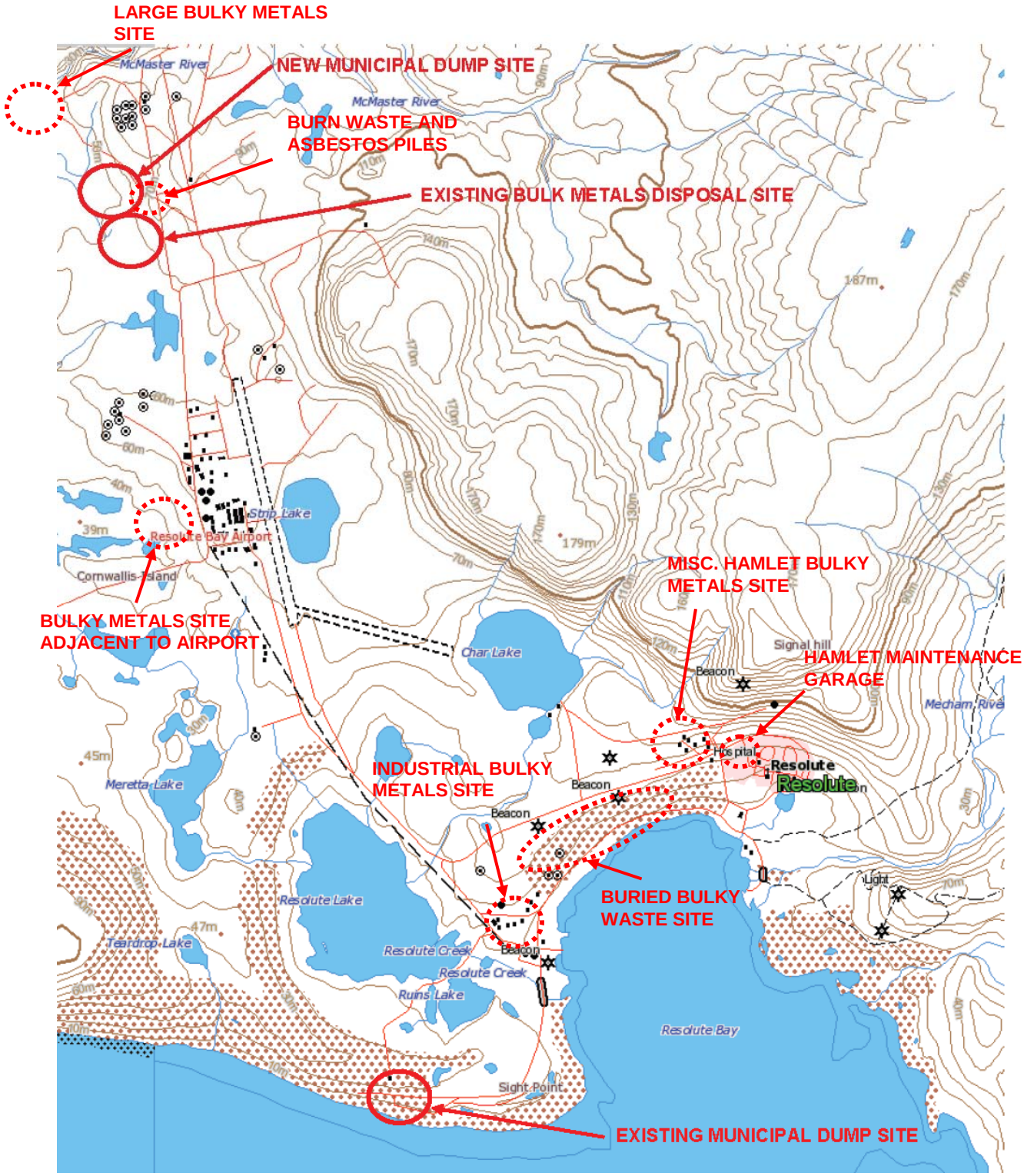

Figure 2: Schematic of infrastructure locations at Resolute, Nunavut.

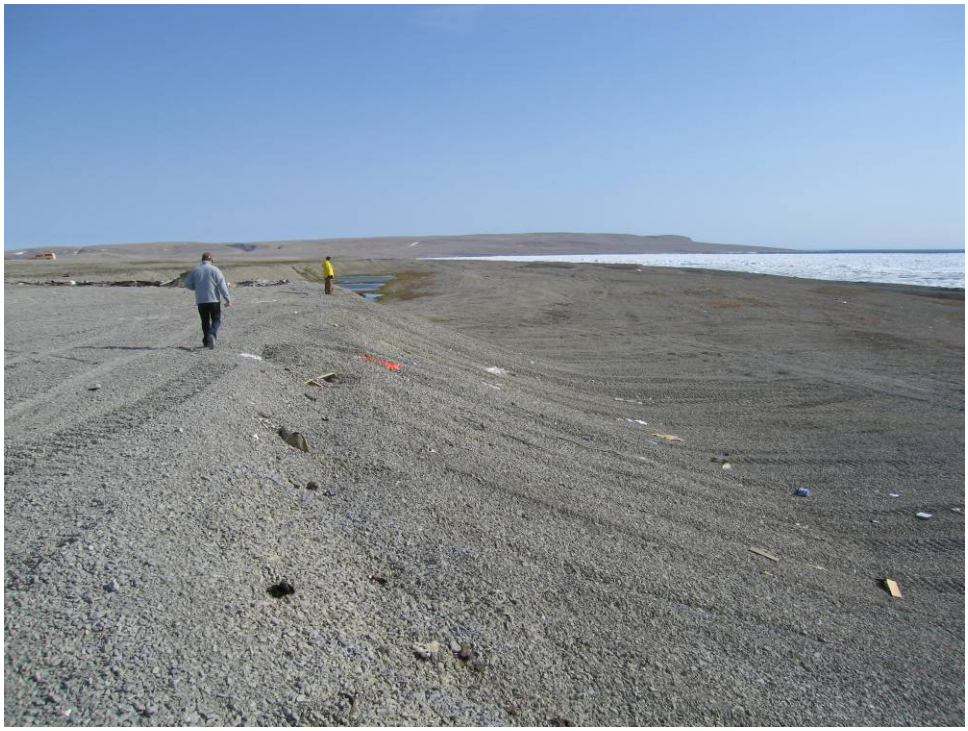

Figure 3: Photograph of recently covered and graded existing municipal dump site from perspective along top of the waste pile. Note recently burned waste piles in the foreground.

Figure 4: Photograph of recently covered and graded existing municipal dump site from perspective at base of waste pile slope.

Figure 5: Photograph of ground surface between existing municipal dump site and ocean from perspective at base of municipal dump site.

Figure 6: Photograph of recently burned waste pile.

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Figure 11: Photograph of bulky metals end dumped over ridge adjacent to airport.

Figure 12: Photograph of large bulky metals site approximately 1 km north of the proposed MDS.

Figure 13: Photograph of large bulky metals site approximately 1 km north of the proposed MDS.

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Figure 15: West view of top cover and leading dump face of existing BMDS.

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Figure 26: Photograph of burn waste (background) and asbestos piles (foreground).

Figure 26: Photograph of proposed MDS entrance gate facing south.

Figure 27: Photograph of ridge within the proposed MDS.

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Figure 31: Eastern view of proposed MSD from south-west fence corner.

Figure 32: North-east view of proposed MDS.

Figure 33: South-east view of the proposed MDS showing tundra-like flat terrain outside of fenced area.

Figure 34: Gapping at base of fence based on terrain.

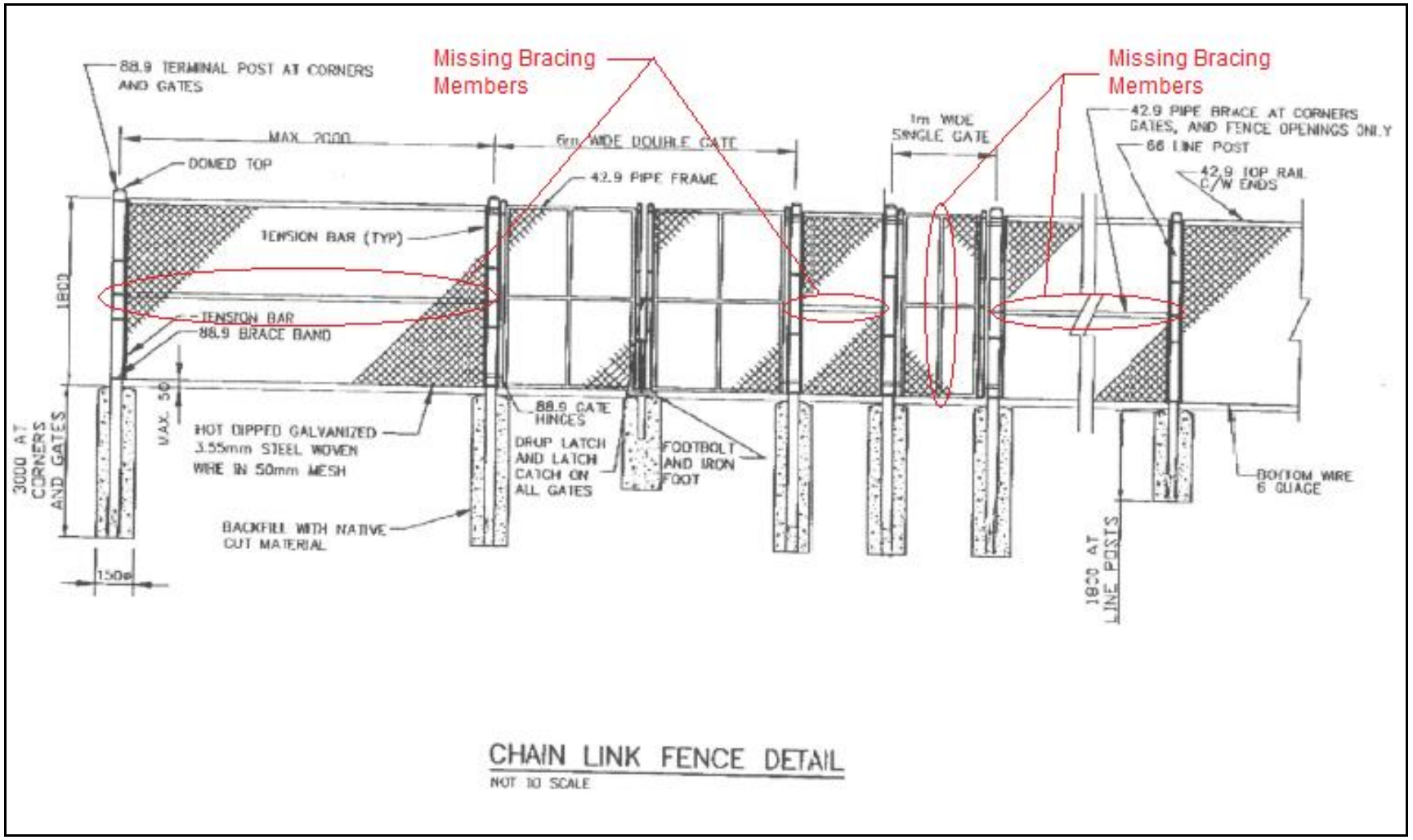

Figure 35: Drawing showing missing bracing members at gates.

Figure 36: Top rail connection, disconnected.

Figure 37: Localized bent top rail.

Figure 38: Localized disconnection of top rail at top rail sleeve.

Figure 39: Disconnect top rail to line post at top of post.

Figure 40: Chain link short from top rail.

Figure 41: Potential location for addition of new bracing member.

Figure 42: Drilled and embedded post lacking backfill to top of hole.

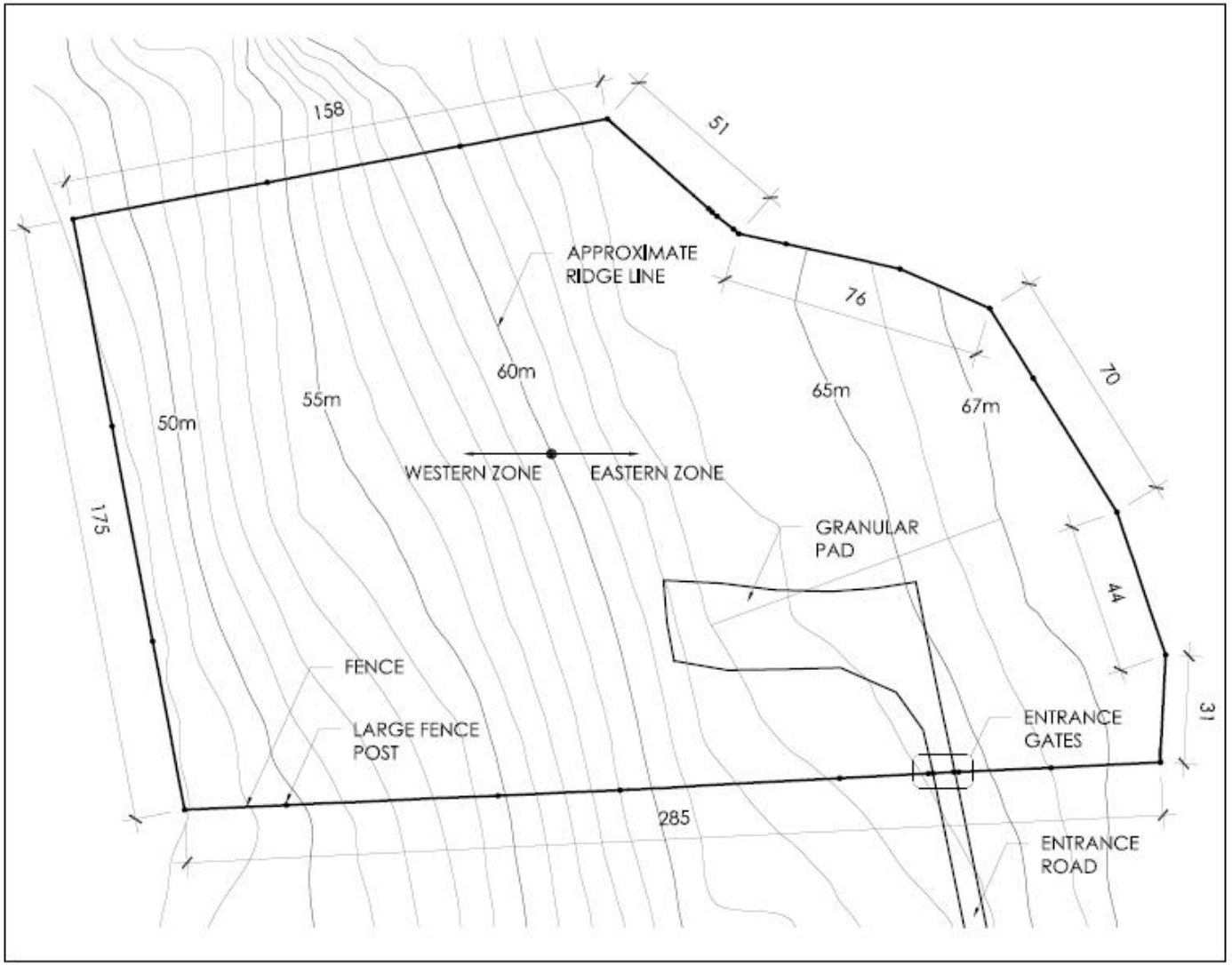

Figure 43: Preliminary Topographic Drawing of the Proposed MDS.