Construction Work Plan

WORK PLAN

Tower Arctic LTD.

Contract Number:	15255-00331-07
Project Number:	15255-00331
Tower Arctic Number:	21807
Document Number:	TA-21807-WP-0004
Submitted From:	Tower Arctic LTD.
Submitted To:	Government of Nunavut, Advisian
Date Submitted:	June 15th, 2018

Contents

1.0 Project Description 2
1.1 Working Schedule 2
1.2 Construction Equipment 2
1.3 Work Team 3
2.0 Environnement 3
3.0 Health and Safety 3
4.0 Haul Route Maintenance 3
5.0 Instructions 4
5.1 Access Road (Hauling Route) 4
5.1.1 Blasting (station 5+660 to 5+900) 4
5.1.2 Road construction (station 0+000 to 5+900) 5
5.1.3 Culverts Installation 6
5.1.4 Signage Installation 6
5.2 Quarry Activities 7
5.2.1 Drilling and Blasting 7
5.2.2 Perimeter Safety Fence 7
5.2.3 Cleaning after Blasting 8
5.2.4 Aggregate Materials Crushing/Screening 8
5.2.5 Stockpiling 8
5.3 Construction Site 8
5.3.1 Breakwaters 8
5.3.2 Dredged Channel 12
5.3.3 Laydown and Sealift Ramp Area 14
5.3.4 Sheet Piles Wharf 15
5.3.5 Shoreline Works 18
5.3.6 Pavement 19
6.0 Site Restoration 20
7.0 Wrap up & Demobilization 20

1.0 Project Description

Project is located on the North-West end of the Baffin Island in the hamlet of Pond Inlet. The project consists in building two breakwaters for a steel piles wharf and a small craft harbor. To build those items, a quarry is necessary to provide aggregate materials. The quarry will be located 6 kilometers far from the hamlet. A hauling route will make the link between the construction site and the quarry.

1.1 Working Schedule

In order to meet the tight schedule, Tower Arctic Ltd. will be working day and night shift with all the necessary workers and Staff. After the mobilization in 2018, many works will be done simultaneously. Those works consist in the hauling route construction, quarry mobilization and the construction of the West breakwater. In 2019, the East breakwater, the sheet piles wharf and the East breakwater will be completed.

1.2 Construction Equipment

Tower Arctic Ltd. is planning to use the following equipment to complete the work involved in the tender:

- 1 ea. 800 Excavator with GPS
- 1 ea. 650 Excavator
- 1 ea. 345 Excavator
- 1 ea. D6 Bulldozer
- 1 ea. WA 500 loader
- 5 ea. 740 Articulated Dump Truck
- 2 ea. T40R Drilling Rig
- 6 ea. Light Units¸
- 1 ea. 22T Hamm Compactor

Note that this is only given for information purposes and might change once work starts

Tower Arctic Ltd. will also be planning to install a Fold-Away garage to do maintenance on equipment. This will help the mechanics keep the equipment in working order to avoid long break downs.

1.3 Work Team

During the project, the crew is not supposed to get bigger than eighteen workers per shift. There will be a foreman, a couple of operators and some laborers. To monitor construction works, an engineer will always be on site.

2.0 Environnement

On top of having spill kits in each equipment, Tower Arctic Ltd. will be placing spill kit barrels in certain areas of the job. These barrels contain many spill containment items such as spill pads, bags, small shovel, absorbent socks and absorbent cushions. A Spill Response Plan has been made to prevent and to know how to respond to any kind of accidental spill.

Because of the quarry exploitation, many precautions will be taken to reduce dust spread. In the Quarry Management Plan all of the measures are described in details. For example, water will be use during crushing/screening process and a calcium truck will ensure that traffic on the haul route is almost dust free.

A Spill Response Plan has been made to prevent and to know how to respond to any kind of accidental spill.

3.0 Health and Safety

Tower Arctic Ltd. has the security of its workers at heart. For this reason a complete Health and Safety plan has been written. A copy of this document will be available for consultation at any moment during the construction.

For new workers, Tower Arctic Ltd. has a company orientation in order to inform its employees of its internal policies and safety procedures. The superintendent and the project engineers will also be on site in order to highlight the various risk and hazards involved in this project.

4.0 Haul Route Maintenance

The haul route that will make the link between the quarry and the construction site will be used only by workers and equipment. We will manage with the equipment listed above to ensure that the road surface is acceptable and safe for material transport. A water truck will also be mobilized to help with dust control and if water is required when compacting the aggregate material.

5.0 Instructions

This work plan is divided into work areas. Each work area will have various steps which may be similar from one area to another. In order to meet the short deadline, Tower Arctic Ltd. will be working on different areas at the same time. The schedule will show which areas will be worked on at the same time. Also note, the number of the areas does not indicate the sequence they will be done. The sequencing will be shown in the construction schedule.

The general idea is to work as per the following areas:

- Area 1: Hauling route (from 0+000 at the quarry to 5+900 at the construction site)
- Area 2: Quarry site
- Area 3: Construction site

Note that equipment listed in steps is only for information purposes and might change on site depending on existing conditions.

Mobilization

Tower Arctic Ltd. will start mobilizing required equipment on site according to the sealift dates.

We will have a mechanical team on site to help assemble the equipment as it arrives on site. The garage will also be installed at the beginning of the project to facilitate the maintenance. It will be setup on the contractor's laydown with an arrangement of containers.

5.1 Access Road (Hauling Route)

The hauling route is a 6 km long road that will make the link between the quarry and the construction site. The quarry is located at the 0+000 station and the construction site is located at the 5+900 station. Works will begin at the construction site.

5.1.1 Blasting (station 5+660 to 5+900)

The hauling route is designed to follow as much as possible the existing ground profile. However, there is a need of blasting for the stations mentioned before because the difference in altitude is important and does not allow safe traffic. The blasting will be done in accordance to the Tower Arctic Ltd.'s blasting procedure.

Equipment needed:

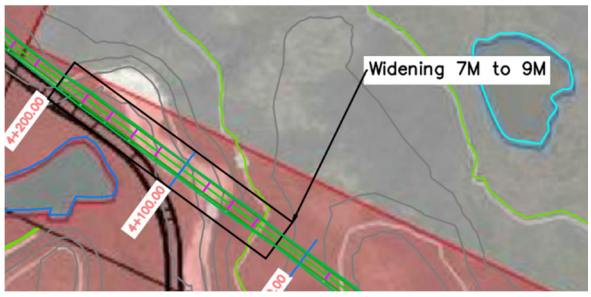
- T40 drilling rig

5.1.2 Road construction (station 0+000 to 5+900)

The blasting that will be done before is going to be reused to make the filling material for the road itself. There will be a lack of approximately 10 000 m^3, to build the road structure, that will come from the quarry. This filling material consists in crushed rock. The road is designed to be 7 meters wide but a couple of 9 m zones are planned to allow trucks to meet. (See Sketch 1)

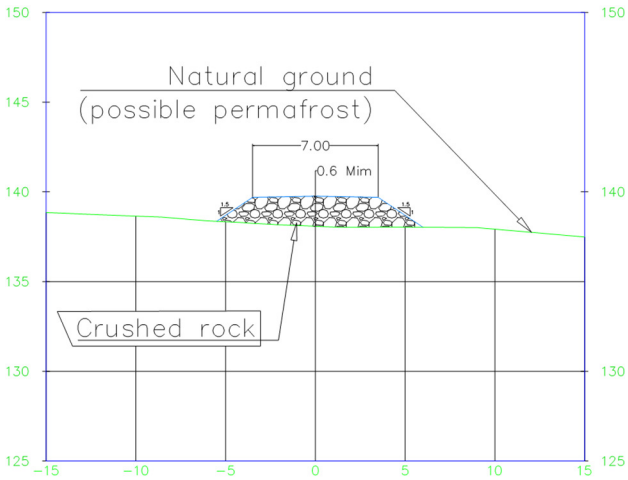
Equipment needed for Road Construction:

- D6 Bulldozer
- WA 500 loader
- 740 articulated dump truck
- 22T Hamm compactor



Sketch 1: Typical Widening

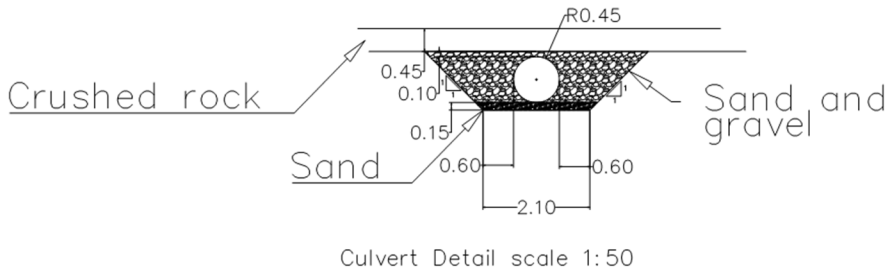
Here is a typical drawing of the hauling route structure (See Sketch 2)



Sketch 2: Typical road structure

5.1.3 Culverts Installation

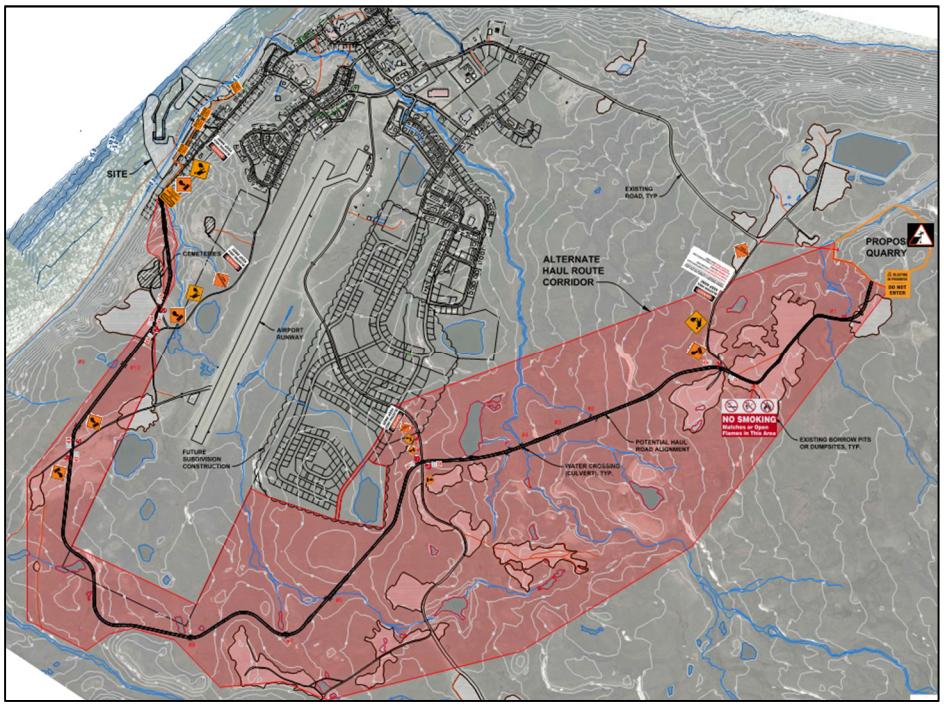
During the road construction, a couple of culverts will be needed at some locations where the road crosses watercourses. The first step is to install sheet piles that will be used to make a pool upstream of the culvert. The water level will come up and will be pumped the other side of the culvert. During this time, the culvert installation will be made according to the suggested detail. (See Sketch 3)



Sketch 3: Culvert Detail

5.1.4 Signage Installation

During the construction of the route, construction signs will be put in place when needed to ensure safety of the community. At the end of the construction, the whole Signage Plan will be in place.



Sketch 4: Signage Plan

5.2 Quarry Activities

5.2.1 Drilling and Blasting

Blasting is an activity that will occur one to two times a day during quarry activities. The blasting procedure will be normalized in the Drilling and Blasting Procedure document and there is a lot of information also in the Quarry Management Plan. Blasting will begin at the south west end of the quarry to finish at the North-East end. (See Sketch 4)

Equipment needed:

- T40 drilling rig

Sketch 5: Example of blasting sequence (Note that this sequence may change on field)

5.2.2 Perimeter Safety Fence

After the beginning of the first blasts, a perimeter safety fence will be needed to ensure public protection from falling. The holes for the fence posts will be drilled with the same equipment as the one that performs the blasting holes.

Equipment needed:

- T40 drilling rig

5.2.3 Cleaning after Blasting

Before doing another blast, cleaning of the site will be necessary. A loader will bring the boulders from blasting to the screener unit. The 650 Excavator will also be used for cleaning and sorting the armour stone. Once the rock face is clean and free from boulders, it will be possible to proceed to another blasting session.

Equipment needed:

- D6 Bulldozer
- WA 500 Loader
- 650 Excavator

5.2.4 Aggregate Materials Crushing/Screening

The quarry will produce all the aggregate materials for the construction site. There is 5 types of filling materials and 4 types of armour stone. The crusher/screener unit will be in charge to produce those types of materials.

Equipment needed:

- Crusher/Screener Unit

5.2.5 Stockpiling

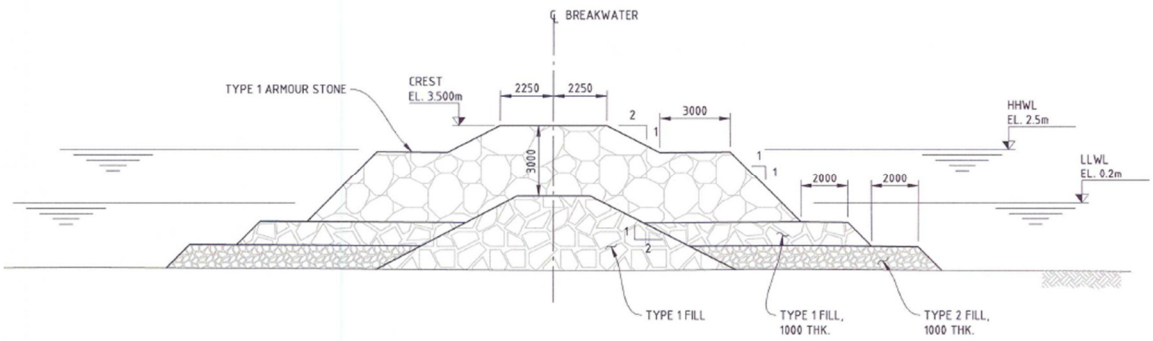
In order to have a sufficient quantity of materials during the works, stockpiling will be made close to the quarry site. We're expecting that stockpiles will remain small during the project because of the high demand at the construction site.

5.3 Construction Site

After the opening of the quarry and the construction of the hauling route, the principal project will begin. This project consist in the construction of a laydown area, leading to the West Breakwater. A sheet piles wharf will take place on it. On the other side there will be the East Breakwater. Between those breakwaters, a small craft harbour will be installed and a channel dredged to give access to the wharf.

5.3.1 Breakwaters

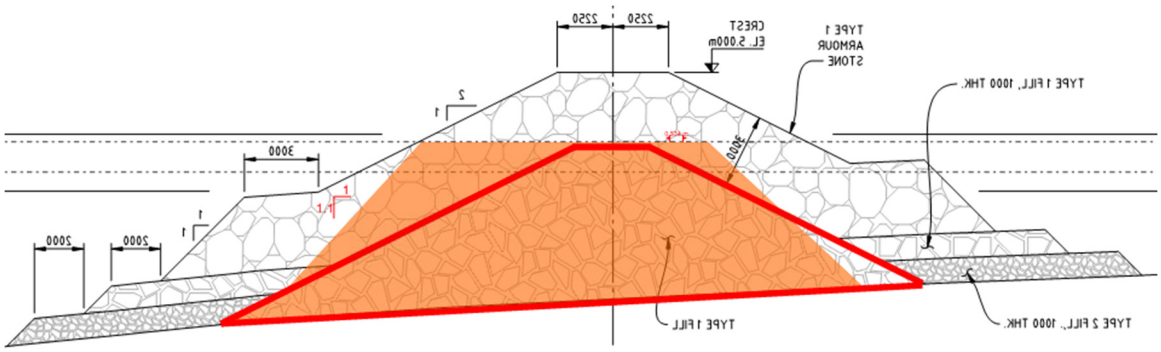
Each breakwater has a similar granular structure. The core is built of Type 1 Fill (4.75mm @ 1200mm) and the covering of the breakwaters consist in a thick layer of Type 1 Armour Stone (1,200mm @ 1,620mm) to prevent erosion. To support the Armour Stone two layers of different materials will be placed on seabed. The layer on top consists in a layer of Type 1 Fill (same as the core) and the bottom layer is a Type 2 Fill (0.075mm @ 150mm). Both of these layers are designed to be a meter thick. (See Sketch 5)



Sketch 6: Typical Section

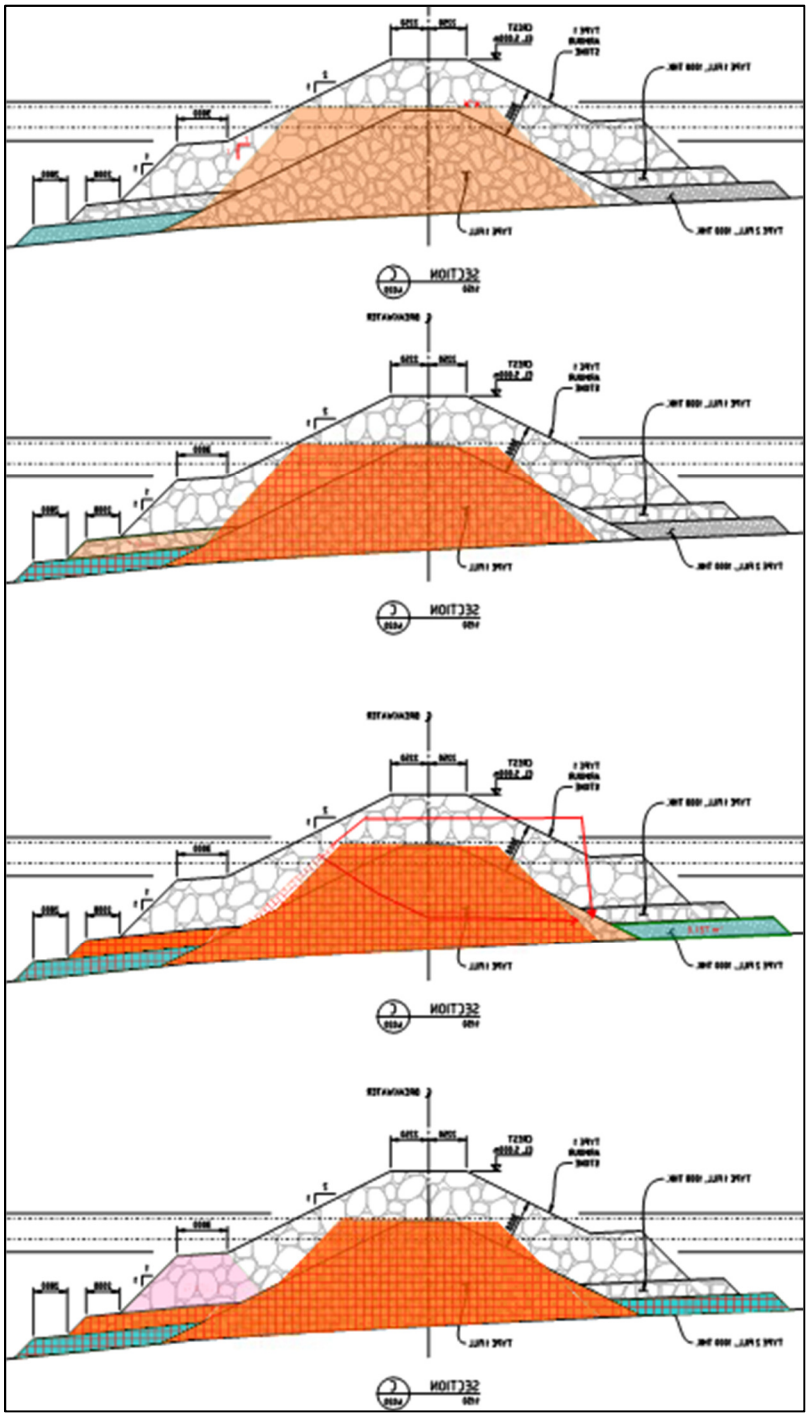
<u>Note that this is the typical section. For the other sections depending on the location please refer to the construction plans.</u>

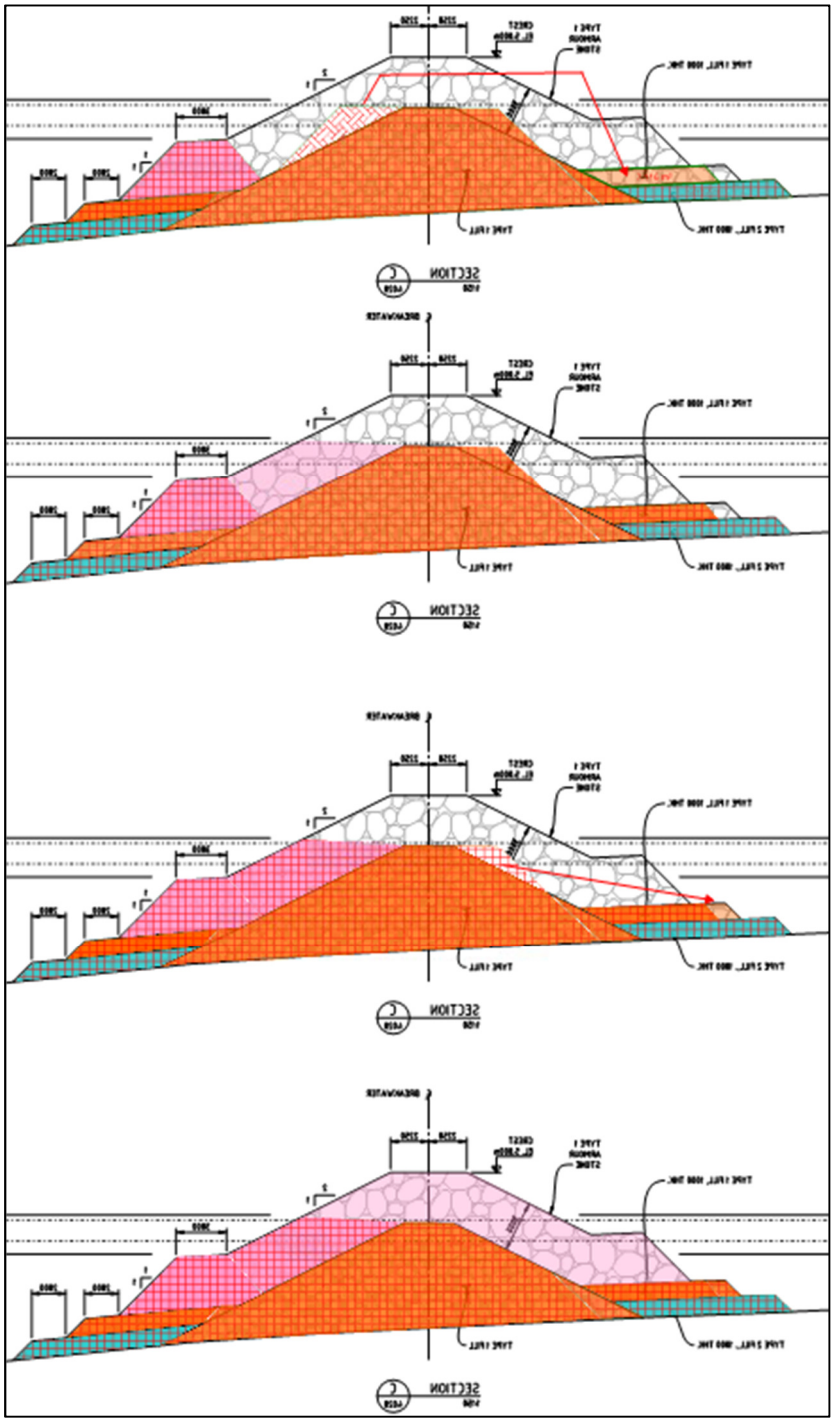
The construction of these aggregate structures will require a minimal amount of equipment. Material will be brought on site by articulated dump truck, then roughly placed with the D6 Bulldozer. With only the use of dozer, the specified slopes wouldn't be respected. For this reason a 345 and an 800 excavator will be used to do the fine placement on breakwaters. To be sure that the thickness of each fill layer is the same as specified, the 800 excavator is equipped with a GPS. To place the two layers supporting the Type 1 Armour Stone, we will build a larger core to be able to reach the extremity of those layers with the excavator (See Sketch 6). Depending on the operations, boulders could be placed with a large clam on a 160T crane or with the 800 excavator.



Sketch 7: Construction Core (orange) / Final Core (red)

Prior to construction we've determined a preliminary construction sequence to be able to meet the tight time schedule. In the drawings, the hatch means that this material have been placed and the pale filling means that this material is getting placed currently. (See Sketch 7)





Sketch 8: Typical Construction Sequence

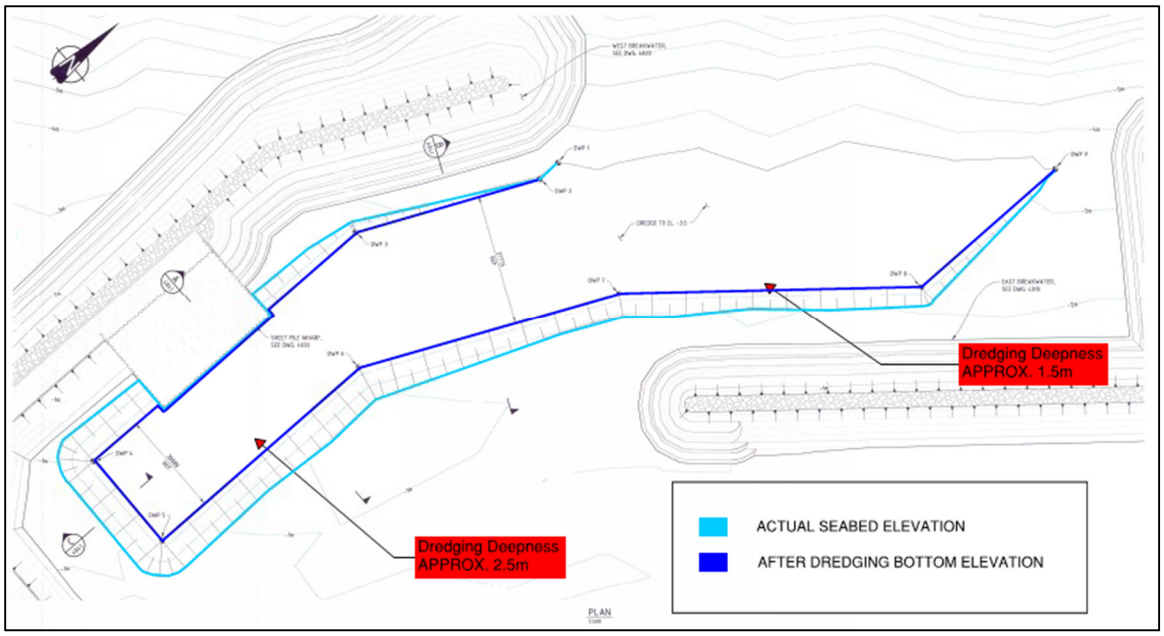
Note that this is the typical section. For the other sections depending on the location please refer to the construction plans.

Equipment needed for Breakwaters Construction

- D6 Bulldozer
- 345 Excavator
- 800 Excavator
- 740 Articulated Dump Trucks
- 160T Crane

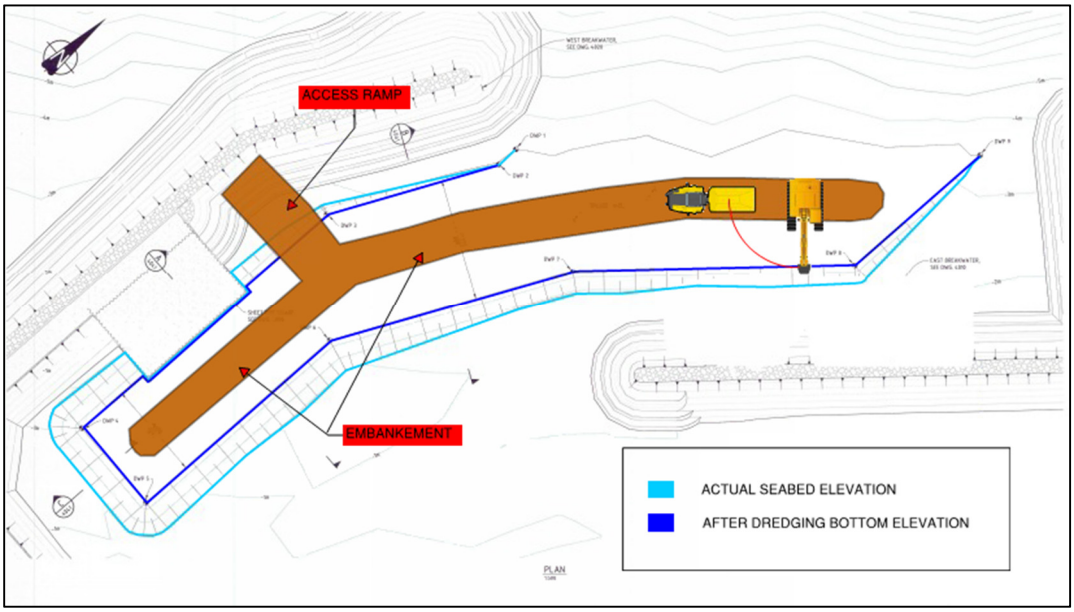
5.3.2 Dredged Channel

For the Pond Inlet Marine Infrastructure project, a dredged channel is necessary to give vessels access, to the sheet piles wharf. The dredging deepness will vary depending on the location. Close to the wharf, 2.5 meters of sediments need to be removed and near the harbor entry (between breakwaters ends), 1.5 meter of material will be removed (See Sketch 8). A good amount of material from dredging will be used to fill the Laydown and Sealift Ramp area (See the appropriate section).



Sketch 9: Access Channel and Berth Pocket

Because of the low depth of dredging, it will be possible to do this operation only with an excavator on embankment. We will build the embankment from the West Breakwater to the end of the dredging channel. Articulated Dump Trucks will circulate on this dam to reach the excavator to exit dredging materials (See Sketch 9). The embankment will be demobilized gradually during the progress of dredging.



Sketch 10: Dredging Procedure

Equipment needed for dredging

- 800 Excavator
- 345 Excavator
- Articulated Dump Trucks

5.3.3 Laydown and Sealift Ramp Area

The Laydown and Sealift Ramp area consists in the wharf approach ramp on the West Breakwater. It's a large platform with Type 1 pavement (See the appropriate section). This platform makes the link between two parts of the West Breakwater. Those two parts will be built before the dredging activity to provide a pool for dredged sediments. The construction method for those two parts is the same as typical breakwater. Before dumping sediments in the pool, a filter fabric (non-woven geotextile) need to be placed on the slope to retain sediments and to prevent contamination of adjacent materials. Those sediments will be compacted with the Hamm 20T compactor according to the construction specifications.

The sealift ramp is only a 1V:10H slope that has a Type 1 Fill core and Type 4 Armour Stone on sides. The pavement on top is a Type 2 Pavement (See the appropriate section) and it consists of a 300mm Type 3 Fill compacted layer. To build the ramp, the D6 bulldozer will spread the materials brought by the 740 Articulated Dump Trucks. The material of the shoulders will be placed using the 345 or the 800 Excavator.

Equipment needed for this area

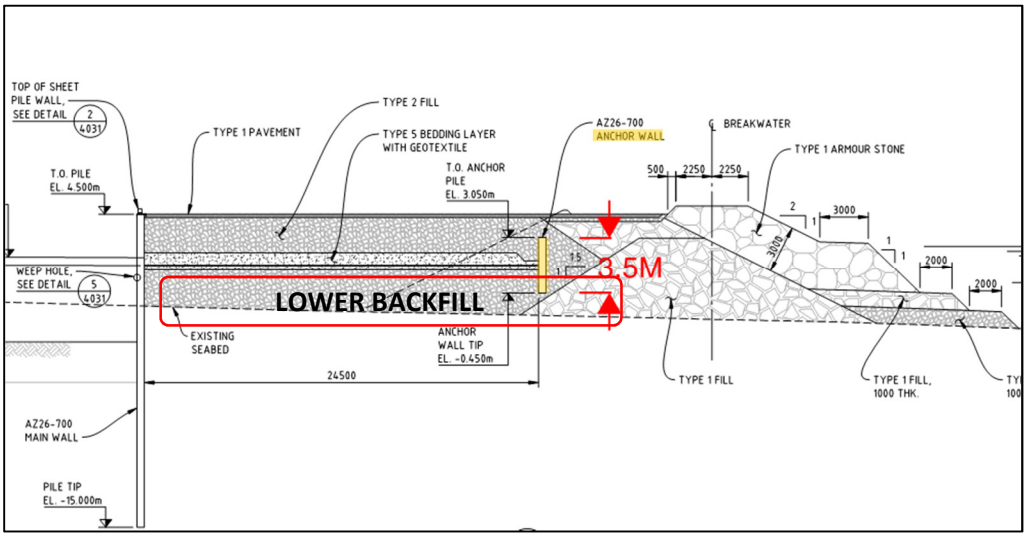
- 800 Excavator
- 345 Excavator
- Articulated Dump Trucks
- Hamm 20T Compactor
- D6 Bulldozer

5.3.4 Sheet Piles Wharf

The sheet piles wharf, on top of the West Breakwater, is a squared structure with tie-rods in both directions. This structure is designed to allow big boats to dock on it.

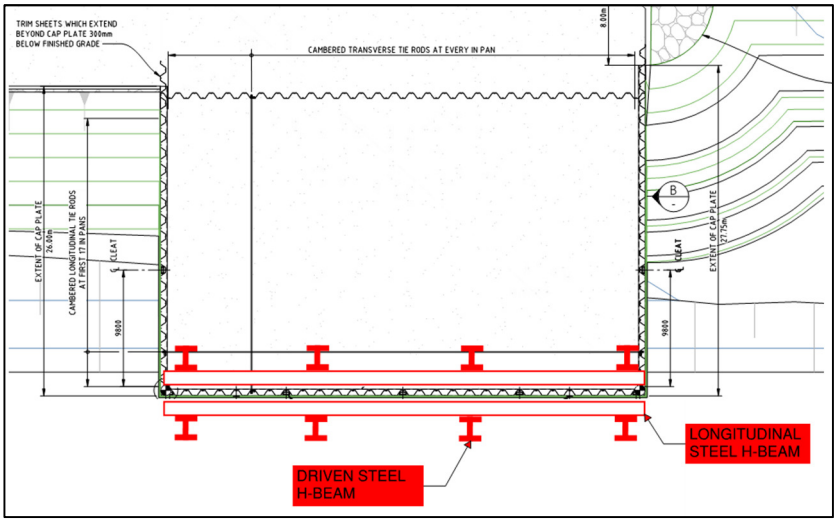
The construction method for this structure includes a lot of steps that need to be followed closely. Here is a list of those steps:

- The first step will be to place the granular backfill under the tie-rods line. This Type 1 Fill material will be placed by the D6 Bulldozer and will be compacted primarily by the crane traffic on top of it.



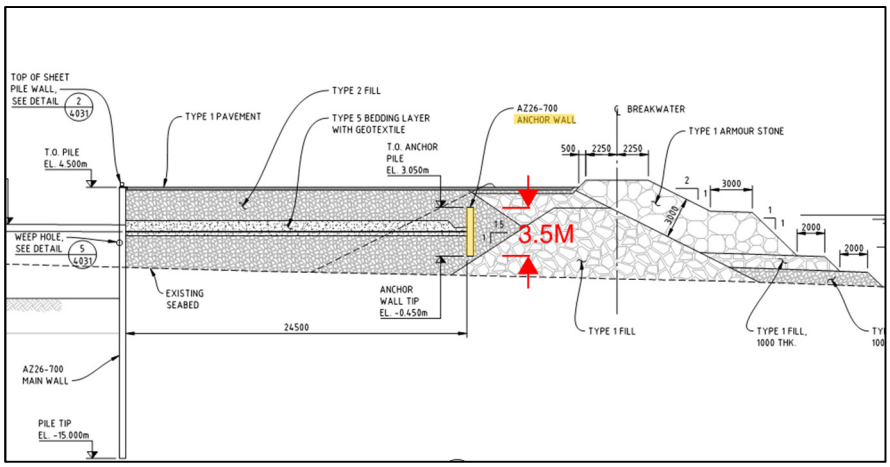
Sketch 11: Lower Backfill

- After the lower backfill completion, sheet piles will be driven, beginning by the wall parallel to the dredged channel and finishing with both sides. A steel beams template (See Sketch 12) will be used to ensure that sheet piles are getting driven straightly. The surveyor will be on site to help maintaining the line and the good elevation of the top end of sheet piles. A vibratory hammer on a crane or an excavator will be used for driving.



Sketch 12: Driving Template

- The third step will be to install the anchor wall for the sheet piles that will be parallel to the vessels. This anchor wall consists on cutted sheet piles (3.5m long) placed at 24.5 meters of the sheet piles wall (See Sketch 10). The anchors will be driven with a vibratory hammer on a crane or an excavator.



Sketch 13: Anchors location

- After the install of anchors and sheet piles, tie-rods will be installed. They will be made of #18 DYWIDAG and some couplers.) Note that the compaction of the zone under the tie-rods, around the tie-rods and on top of the tie-rod need to be done in accordance to the Construction Specifications document, generally with a walk-behind vibratory double drum compactor.

- After the tie-rods installation, we will apply the recommended stress on them for both directions according to the construction specifications.

- Once the tension in tie-rods is correctly adjusted, filling must be completed with the D6 Bulldozer and compaction must be done with a walk-behind compactor.

- Finally, a Type 1 Pavement is required on top of the wharf and must be completed with the D6 Bulldozer and the Hamm 20T compactor.

- Note that the hardware installation on top of sheet piles will not be described in this Construction Work Plan.

Equipment needed for the Sheet Piles Wharf

- 800 Excavator
- 345 Excavator
- Articulated Dump Trucks
- Hamm 20T Compactor

5.3.5 Shoreline Works

The shoreline works consist in all the works close to water excluding both breakwaters, wharf and dredging. Those works include the float pad, the paving of the existing beach and the installation of the security fence close to the shoreline.

- For the construction of the float pad, the D6 Bulldozer will spread materials from the quarry and the Hamm 20T compactor will assure the good level of compaction. The core of this pad is made of Type 1 Fill and the top is made of Type 1 Pavement. To prevent vehicle access to the Small Craft Harbour, big boulders will be placed at the end of the float pad with the 800 Excavator.

- The paving of the existing beach will be simply realised with the D6 Bulldozer and quarry materials. A Type 1 pavement will be made (See the appropriate section).

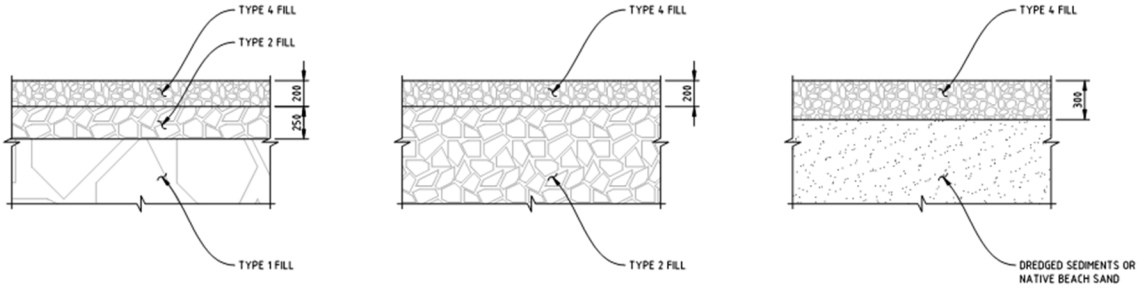
- The security fence is a part of the Traffic Management Plan. The installation method is the same as the quarry safety fence. The drilling rig will be used to drill the post holes and then they will be set in post concrete.

Equipment needed for Shoreline Works

- 800 Excavator
- 345 Excavator
- Articulated Dump Trucks
- Hamm 20T Compactor
- D6 Bulldozer

5.3.6 Pavement

For this project, there is two type of pavement that will made on top of builded structures. The Type 1 Pavement will be used on top of West Breakwater, Laydown Area and on Shoreline. The Type 2 Pavement will only be used for the Sealift Ramp. The main difference is that the Type 1 Pavement top layer is made with thinner aggregate materials (Type 4 Fill) than the Type 2 Pavement top layer (Type 3 Fill). There is three types of Type 1 Pavement depending on the base layer. (See Sketch 13)



Sketch 14: Type 1 Pavement

Placement of materials coming from the quarry will be done by the D6 Bulldozer and the compaction by the Hamm 20T compactor. Each layer will be compacted according to the Construction Specifications document.

Equipment needed for Shoreline Works

- Articulated Dump Trucks
- Hamm 20T Compactor
- D6 Bulldozer

6.0 Site Restoration

At the end of the project a general clean-up of each site will be done. The Quarry site will be closed according to the method in the Quarry Management Plan. For the Hauling route, a final grading will be done and two earth berms placed at the extremities to avoid use by vehicles.

7.0 Wrap up & Demobilization

Tower Arctic Ltd. is planning on finishing work on November 2019. Following the completion, Tower Arctic Ltd. will begin with the demobilization of its equipment. About two weeks will be required to finalize the demobilization. Tower Arctic Ltd. will keep sufficient equipment on site to complete the list of deficiencies.

Also during the demobilization of the equipment, Tower Arctic Ltd. will finalize the as built and calculate the final quantities for payment purposes.