• Hamlet of Kugaaruk

Dam Safety Review

Type of Document
Final

Project Name
Dam Safety Review
Sewage Lagoon
Kugaaruk, Nunavut

Project Number
OTT-00219538-A0

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Date Submitted
November 14, 2014

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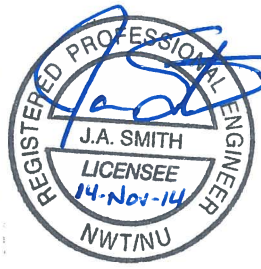

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Executive Summary

A dam safety review of the sewage lagoon in the Hamlet of Kugaaruk, Nunavut was undertaken. This work was authorized by the Hamlet of Kugaaruk.

The review comprised of a review of the available documentation, site visit, interviews with Hamlet staff, and preparation of a report documenting the findings and recommendations.

The existing sewage lagoon comprises of two cells and utilizes the wetland downstream as part of overall sewage treatment. It is understood that the existing sewage lagoon was constructed in 2007 at the same location as the previous sewage lagoon. The previous lagoon was of a similar layout; however, it was too small to meet the growing demands of the community and too permeable (designed with exfiltration berms) to meet the environmental regulations for discharge even after feeding through the wetland. The existing sewage lagoon is understood to contain an impermeable liner within the berms and discharges from the main cell into the smaller downstream cell, where it then overtops the downstream berm and feeds into the wetland at a controlled rate during the growing season.

In addition to the dam safety review, measurements of the sludge blanket thickness were obtained at select locations to provide a basis for further evaluating when sludge removal/clean out may be required.

The geotechnical review of the existing sewage lagoon did not reveal any signs of seepage, slope instability or erosion. An issue related to the discharge pipe has resulted in the Hamlet staff discharging from the upper cell to the lower cell using a sump pump and hose laid over the west berm. It is recommended that the discharge pipe be brought back online such that discharge and subsequent overtopping of the downstream berm can be carried out at a continuous controlled rate.

Based on our measurements it is estimated that the sludge blanket at the time of our visit was about 0.3 m thick. Based on Section 3.2.3.2 of the Operation Manual for the facility (prepared by Dillon and dated October 6, 2009), a sludge blanket thickness of 0.5 m indicates that the sludge should be removed from the lagoon. Therefore, based on this criterion it does not appear that sludge cleanout is required at this time.

Based on accumulation rates to date, it is recommended that the sludge blanket thickness be re-evaluated in the summer of 2016 to determine if cleanout is required.

The above and other related considerations have been discussed in greater detail in the report.

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1 Introduction

A representative of **exp** Services Inc. (**exp**) visited the Hamlet of Kugaaruk, Nunavut (Figure 1) from July 27, 2014 to July 30, 2014. The purpose of the visit was to undertake a geotechnical dam safety review of the water retaining structures. A geotechnical review of the raw sewage discharge point and associated access road was also undertaken. Representative measurements of the thickness of the sludge in the lagoon were obtained. The dam safety review is intended to satisfy one of the requirements of the Nunavut Water Board for the upcoming renewal of the Hamlet's Water Licence. The sludge blanket thickness measurements were undertaken to determine when clean out of the lagoon may be required.

The existing sewage lagoon is located south of the community and is accessed by an approximately 1.3 km long roadway (Figure 2). The existing sewage lagoon comprises of two cells and utilizes the wetland downstream as part of overall sewage treatment. The general layout of the lagoon is shown on the appended Photo 1.

It is understood that the existing sewage lagoon was constructed in 2007 at the same location as the previous sewage lagoon. The previous lagoon was of a similar layout; however, it was too small to meet the growing demands of the community and too permeable (designed with exfiltration berms) to meet the environmental regulations for discharge even after feeding through the wetland. The existing sewage lagoon is understood to contain an impermeable liner within the berms and discharges the effluent from the main cell into the smaller downstream cell. The effluent overtops the downstream berm and feeds into the wetland at a controlled rate during the growing season.

2 Review of Available Information

2.1 Review of Lagoon Record Drawings

Record drawings of the existing sewage lagoon prepared by Dillon Consulting Limited (Dillon) and dated December 2009 were made available and were reviewed. The record drawings included sewage lagoon plan and cross-sections. However, details on the berm construction were not available at the time of this report. It is understood however that the berms were constructed using locally available silty sand and gravel with a layer of coarse Armour stone rip rap covering the slopes for erosion protection. A continuous near vertical synthetic liner was installed in the core of the berms and anchored into sound bedrock via key trench and low permeability backfill/grout.

The topography of the site slopes down from east to west towards the ocean and primarily consists of exposed bedrock outcrops. The upper cell takes advantage of the local topography with exposed bedrock providing containment along the entire east side of the cell. Three berms form the remainder of the upper cell, with the north and south berms terminating against exposed bedrock at their east end. The crest elevation of the berms that form the upper cell is Elevation 28.0 m. The base of the upper cell varies from Elevation 22.0 m to 23.0 m approximately. The upstream and downstream slopes of the upper cell berms are 3 Horizontal:1 Vertical (3H:1V). The maximum berm height of the upper cell is about 11 m (west berm, between the upper and lower cells).

The lower cell also takes advantage of the local terrain and consists of one berm (west berm) running from north to south and terminates against exposed bedrock at either end. The lower cell berm is about 2 m high. The top of the lower cell berm is at Elevation 19.0 m and the berm side slopes are 2H: 1V.

2.1.1 Lagoon Drainage Outfall Pipe (Discharge Pipe)

A 300 mm diameter High Density Polyethylene (HDPE) discharge pipe has been provided close to the bottom of the upper cell of the lagoon leading to a manhole located in the centre of its west berm. From the manhole, the discharge pipe leads to the lower cell. An operating valve has been installed in the manhole located on the west berm of the upper cell.

2.1.2 Spillway

A spillway has been provided near the mid-length of the west berm of the upper cell and outlets down the rip rap slope into the lower cell. This spillway consists of a 2000 mm wide rip rap covered trench.

2.1.3 Discharge Flume

The discharge flume comprises of two half sections of heavy duty polyethylene (PE) pipe which accept raw sewage at the truck turnaround pad and discharge to the upper cell.

2.1.4 Lagoon Road

The road on top of the berms is 5 m wide, at Elevation 28.0 m and accessed from the northeast corner.

2.1.5 Access Road to Lagoon

Record drawings of the access road were not available, as this road has been in place for many years, providing access to the previous lagoon and the solid waste site, which is also located in this area.

3 Site Review

A visual review of the lagoon and access road was undertaken. It revealed the following:

1.) At the time of the visit, any signs of seepage, slope instability or erosion of the berms of the lagoon were not observed. The berms of the lagoon appeared to be in general accordance with the record drawings and were in good condition.

2.) The three berms of the upper cell are approximately 5 m wide at the top, with upstream and downstream slopes of 3H:1V. The top of the berms are exposed silty sand and gravel fill and the slopes of the berm have been provided with enough rip rap that the silty sand and gravel core is not visible. The toes of the berms are predominantly founded on exposed bedrock. See appended Photos 2 and 3.

3.) The core of the lower cell berm was not visible since rip rap has been placed over the entire berm surface; however, a synthetic liner was observed beneath the Armour stone on the upstream slope.

4.) The emergency overflow weir was also observed to be in general accordance with the record drawings and was in good condition.

5.) A generator was positioned atop the west berm between the upper and lower cell. The generator was not operational during our time onsite; however, it was hooked up to a sump pump that was installed below the effluent surface in the upper cell and connected to a hose that extended over the top of the berm and down the downstream slope to the lower cell. See appended Photo 4.

6.) The lower cell was partially filled with effluent. Decanting of the effluent by overtopping the lower cell berm into the wetlands was not observed during our visit. See appended Photos 5 and 6.

7.) The access road from the community to the sewage lagoon is wide enough for two way traffic and has no obvious issues related to grades, turn radius or visibility. Some minor erosion was noted across the road at various locations; however, no major channels were present at the time or our visit.

8.) The truck turn around pad surface was in good condition, the slope of the pad was covered in rip rap and the discharge flumes were in good condition. See appended Photo 7.

4 Sludge Blanket Thickness

Measurements of the sludge blanket thickness were obtained at select locations as part of our assessment. The measurements were obtained to provide a basis for evaluating when clean out of the lagoon may be required. The approximate locations of the measurements are shown on the attached Figure 3.

Based on our measurements it is estimated that the sludge blanket at the time of our visit was about 0.3 m thick. Section 3.2.3.2 of the Operation Manual for the facility (prepared by Dillon and dated October 6, 2009), indicates that the sludge should be removed from the lagoon when it reaches a thickness of 0.5 m. Therefore, it is considered that sludge cleanout is not required at this time.

Based on accumulation rates to date, it is recommended that the sludge blanket thickness be re-evaluated in the summer of 2016 to determine if cleanout is required.

5 Interview with Staff

Informal interviews held with Hamlet of Kugaaruk staff resulted in no major issues being identified regarding the performance of the lagoon. The Senior Administrative Officer (SAO) did indicate that the heat tracer of the discharge pipe was not operational when he took over the office and the valve had frozen shut. Therefore, the Hamlet staff had been using the sump pump and hose to discharge the effluent as outlined above.

The SAO reported that the required maintenance to bring the heat tracer back into operation had been carried out. However, local staff members were still discharging the effluent from the upper cell to the lower cell using the sump pump. To our knowledge it has not been confirmed that the valve is now operational.

6 Remedial Measures

It is recommended that the discharge pipe be brought back into operation. The discharge pipe is part of the original design and is intended to provide a constant flow of effluent from the upper cell to the lower cell during the seasonal decanting process.

7 Consequences of Dam Failure

Failure of dam would result in uncontrolled discharge of the effluent to the wetlands and ocean. This may result in eutrophication of the wetlands/near shore ocean waters, which may adversely impact aquatic life, e.g. fish habitat, etc. There are no other developments or local trails that we are aware of located downhill of the lagoon. As such, there is no danger to humans in case of failure of the berms of the lagoon.

8 Conclusions

Based on our review of the design drawings and site conditions, it is our opinion that the existing sewage lagoon is safe from a geotechnical and dam safety perspective for continual operation.

Figures

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scale 1:15,000 km	CLIENT: HAMLET OF KUGAARUK, NU	project no. OTT-00219538-A0
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drawn by M.N.		

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drawn by M.N.		

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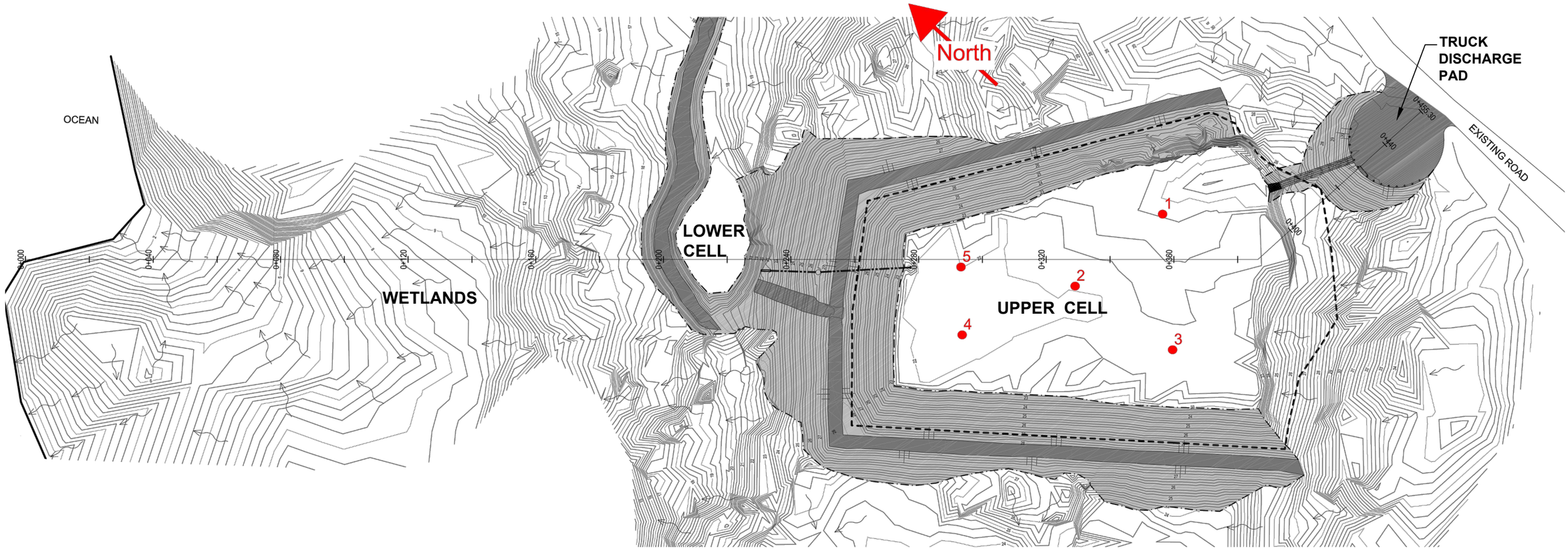

LEGEND

3 SLUDGE THICKNESS MEASUREMENT LOCATION

0 10m 25m 50m

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drawn by M.N.		

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Appendix A: Photos

Photograph No. 1
Overview of existing sewage lagoon
(looking east)

Photograph No. 2
Exposed bedrock providing containment along the east side of the upper cell.
(standing at the southeast corner, looking north)

Photograph No. 3
Crest view of south berm; typical top of berm view
(standing at the southeast corner, looking west)

Photograph No. 4
Generator and sump pump setup used to discharge effluent from upper cell to lower cell
(standing near northwest corner of upper cell, looking south)

Photograph No. 5
Downstream slope of west berm of upper cell and view of lower cell.
(standing near northwest corner of lower cell, looking southeast)

Photograph No. 6
Wetland downslope of Cell #2 of existing sewage lagoon
(standing near northwest corner of lower cell, looking southwest)

Photograph No. 7
Truck atop turn around pad discharging raw sewage down discharge flume
(standing on north berm, looking east)

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