TETRA TECH EBA

OQM | Organizational Quality Management Program

FEASIBILITY REVIEW OF CROSSINGS ALTERNATIVES UNDER AIRPORT ROAD, CORAL HARBOUR

PRESENTED TO

Kivalliq Region, Community and Government Services - Government of Nunavut

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CONSULTING ENGINEERS & SCIENTISTS · www.eba.ca

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LIMITATIONS OF REPORT

This report and its contents are intended for the sole use of the Government of Nunavut and its agents. Tetra Tech EBA Inc. (Tetra Tech) does not accept any responsibility for the accuracy of any of the data, the analysis, or the recommendations contained or referenced in the report when the report is used or relied upon by any Party other than the Government of Nunavut, or for any Project other than the proposed remediation at the subject site. Any such unauthorized use of this report is at the sole risk of the user. Use of this report is subject to the terms and conditions stated in Tetra Tech's Services Agreement. Tetra Tech's General Conditions are provided in Appendix C of this report.

1.0 INTRODUCTION

This report was produced to provide the Community and Government Services (CGS) of the Government of Nunavut a document identifying a preferred solution designed to address the washouts caused by the Post River along Airport Road in Coral Harbour, NU. This Feasibility Review was completed to highlight the possible approaches and develop a cost estimate allowing the CGS to secure the required funding.

Tetra Tech EBA Inc. (operating as Tetra Tech) was initially hired by the CGS in November 2012 to prepare a report specifying remediation options for the culvert crossings near the fuel farm facility. The impetus behind this project was a road washout which had occurred in June of 2012, closing the Airport Road for approximately one week and also causing damage to the supports of the fuel line feeding the Hamlet (See Figures 1-1 and 1-2). The Hamlet of Coral Harbour reported that the road washout and flooding had occurred four times over the previous six or seven years and requested assistance to repair the damage and improve the drainage system to prevent this from happening again.

Figure 1-1. June 2012 Washout

Figure 1-2. June 2012 Impact on Fuel Line

This Feasibility Review is based on Tetra Tech's work to date including a hydrologic/hydraulic analysis, a site visit (June 2013), a site survey, and the testing of the materials forming the road embankment (See Appendixes A, B, and C). Conclusions from the previous work completed by Tetra Tech included the following:

- The Post River, which crosses Airport Road, has a watershed area of approximately 281 km^2. The regional hydrologic analysis determined a 100-year flood flow of 94.2 m^3/s. Peak flows occur during freshet, generally mid to late June.
- Based on the hydraulic model developed for the site and anecdotal information provided by the locals, the capacity of the existing system is limited to be approximately 44 m^3/s. This corresponds to a 2-year return period. Capacity of the system will need to be increased in order to accommodate the 100-year event.
- Ponding on the upstream side of Airport Road occurs in three main basins: west, central, and east. The west and east basins drain smaller watersheds (less than 5 km^2 each). The central basin conveys the majority of the flow from the Post River watershed (the remaining 270 km^2). During periods of high flow, the central basin overflows into the east basin, overwhelming the existing east basin culvert crossings adjacent to the fuel farm (Crossing 9, 9a, and 10). This event is likely the reason for previous washouts at the fuel farm location.
- Monitoring equipment installed in the eastern and central basin recorded water levels throughout the summer of 2013. At times, the water elevation difference between the two basins exceeded 1.4 m; with water levels peaking in the central basin at 6.59 meters above sea level (masl). Survey information reveals that the centreline of the road is at 7.00 masl at the lowest point of the central basin. Based on this information, it is concluded that at some stage, between 6.59 m and 7.00 m, water begins to flow over the divide between the central basin and the eastern basin. The elevation of 6.8 m was established as the critical level beyond which the eastern basin is affected by the raising water levels.
- The recommended upgrades should shift to the central basin for the following reasons:
  - The fuel farm and the gas station are located within the eastern basin. Shifting the upgrades to the central basin protects these facilities and shifts the main flows away from the fuel line connecting the fuel farm to the hamlet of Coral Harbour.
  - Shifting the upgrades to the central basin protects, not only the eastern section of the road, but also the central basin road embankment. Centralising the upgrades within the central basin protects a longer section of the road and reduces the depth of the ponding water north of Airport Road.
- The road embankment material is well-graded and can achieve a maximum dry density of 2,120 kg/m^3 at 100% compaction. However, this material is free draining and, during freshet, is likely to allow water to seep through the roadway. This process weakens the roadway stability. Any improvements proposed for Airport Road should consider limiting the depth of ponding water upstream the road embankment.

The Feasibility Review examines four primary Approaches CGS could consider when addressing the current drainage issues along Airport Road. These are as follows:

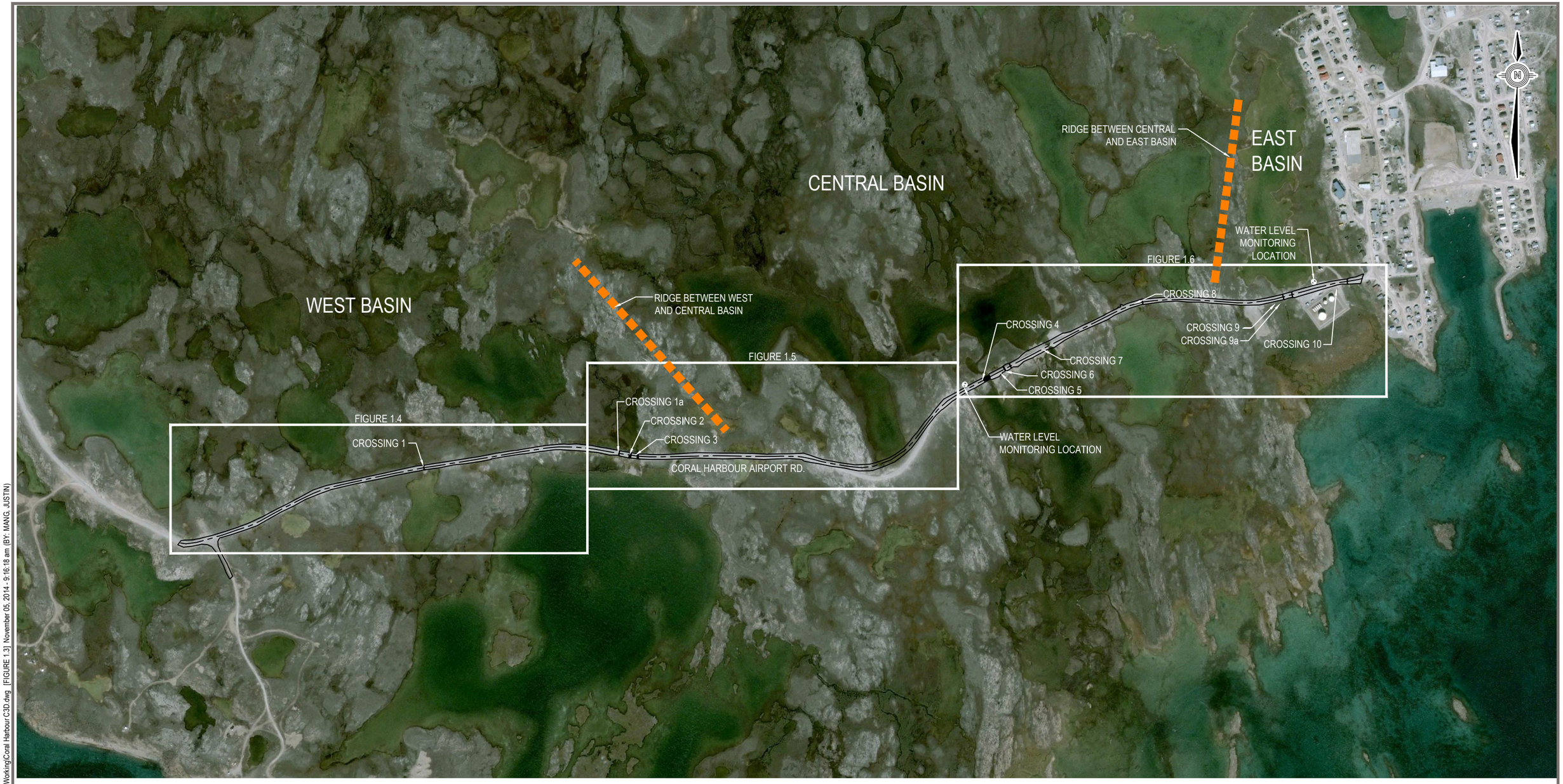
- **Approach 1 – Maintain Existing System:** Leave the Airport Community Road drainage system in its current configuration, performing repairs as failures take place.
- **Approach 2 – Augment Existing Capacity of the System:** Replace Crossing 4 with a new crossing able to increase the system's overall capacity to match the 100-year peak flow of 94.2 m^3/s. This assumes the existing bridge at crossing 7 will remain an integral component of the drainage system.

- **Approach 3 – Replace Existing System with One Crossing:** Construct a new crossing that is able to convey the entire 100-year peak flow of 94.2 m^3/s and remove all the existing crossings including the eight culverts at Crossing 4 and the bridge at Crossing 7.
- **Approach 4 – Replace Existing System with Two Crossings:** Construct two new crossings that are able to convey the entire 100-year peak flow of 94.2 m^3/s and remove/replace the existing crossings.

For each Approach, we identified a series of Alternative implementation strategies for consideration. The Feasibility Review includes a detailed examination of each Approach and Alternatives, including:

- A description of each Approach with a discussion of the risks involved.
- A description of each design Alternative and evaluation based on a range of design criteria.
- A recommended Approach and implementation strategy.

A site map detailing the location of each crossing is included in Figures 1-3, 1-4, 1-5, and 1-6.



Q:\Vancouver\Transportation\C311\C31103153-01 - Coral Harbour Nunavut\Working\Coral Harbour C3D.dwg [FIGURE 1.3] November 05, 2014 - 9:16:18 am (BY: MANG, JUSTIN)

SITE PLAN

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SCALE 1:10,000

100 0 100 200 400m

NOTES

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CLIENT

Nunavut

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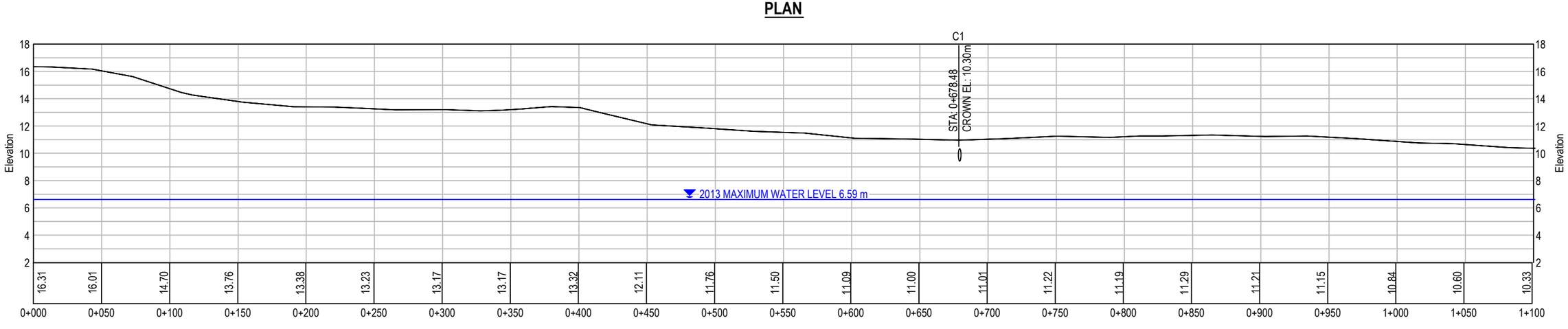
AIRPORT ROAD DRAINAGE REHABILITATION
CORAL HARBOUR, NU

SITE PLAN

PROJECT NO.	DWN	CKD	REV
C31103153-01	JDM	DM	0
OFFICE: VANC	DATE: November 5, 2013		

Figure 1.3

PLAN



PROFILE

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LEGEND

NOTES
PROFILE VIEWS ARE EXAGGERATED BY 10 TIMES VERTICALLY.

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SCALE 1:3000
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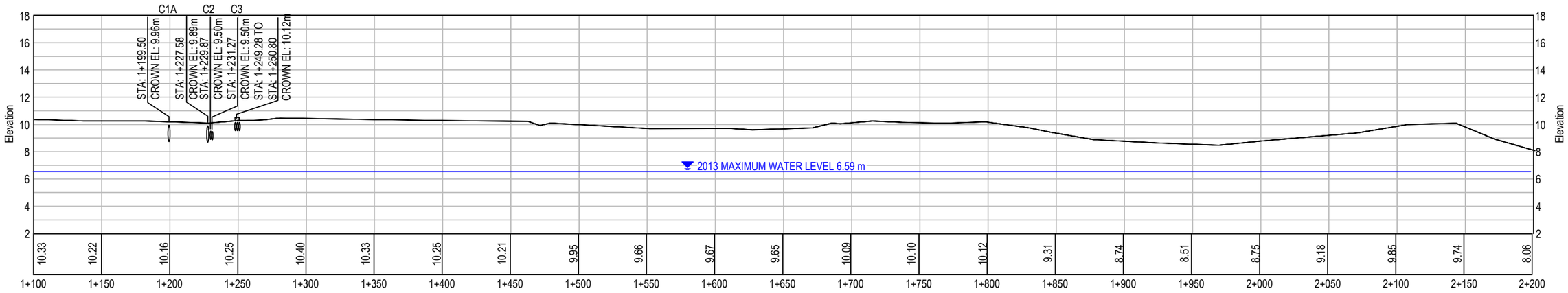
PLAN AND PROFILE
STATION 0+000 - STATION 1+100

PROJECT NO.	DWN	CKD	REV
C31103153-01	JDM	DM	0

OFFICE: VANC
DATE: November 5, 2013

Figure 1.4

PLAN



PROFILE

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STATION 1+100 - STATION 2+200

PROJECT NO.	DWN	CKD	REV
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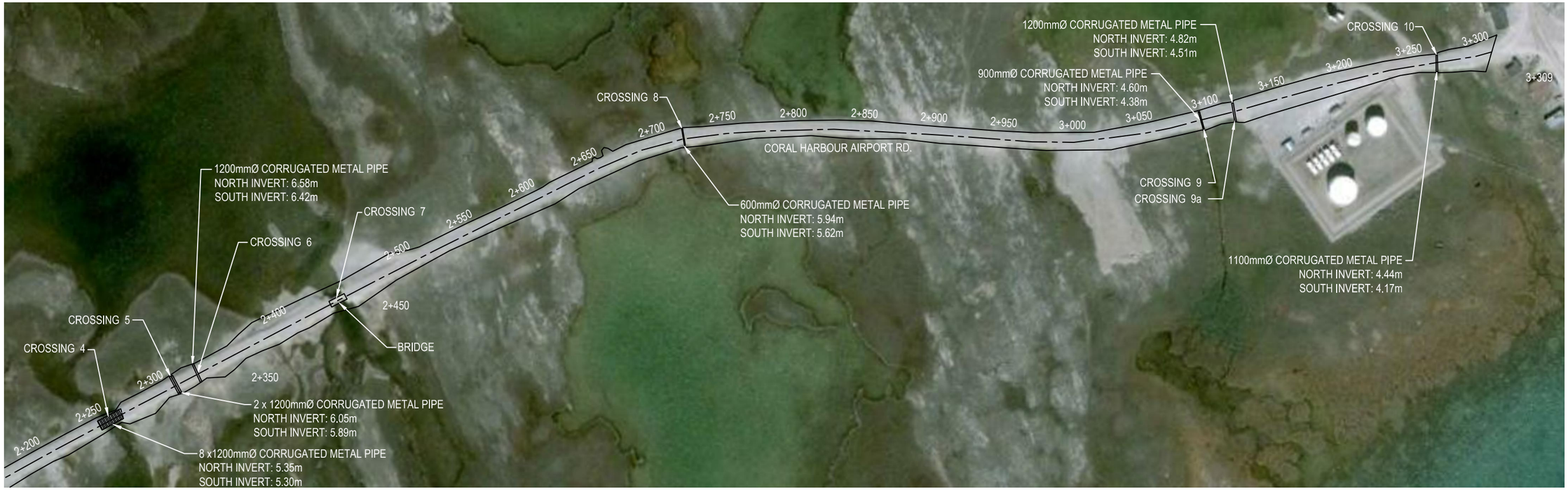
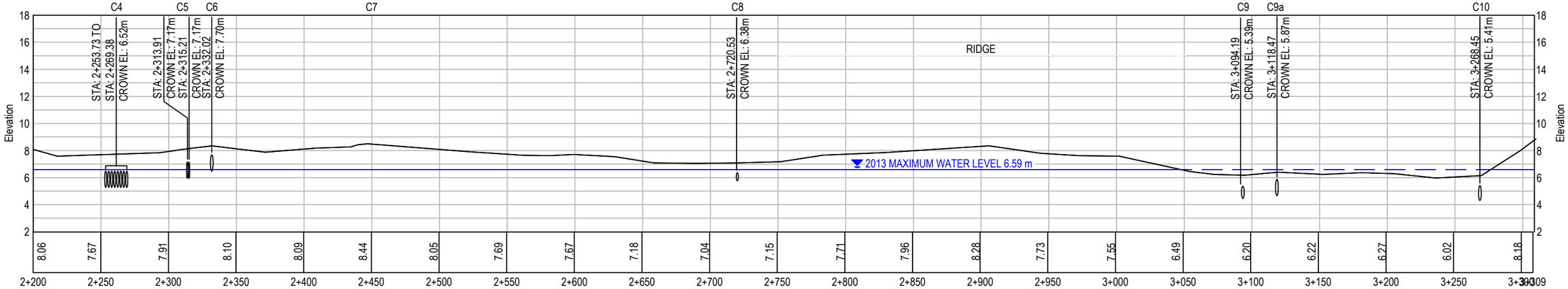
DATE: November 5, 2013

Figure 1.5



PLAN



PROFILE

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LEGEND

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PLAN AND PROFILE
STATION 2+200 - STATION 3+308

PROJECT NO.	DWN	CKD	REV
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OFFICE: VANC
DATE: November 5, 2013

Figure 1.6

Q:\Vancouver\Transportation\C311\C31103153-01 - Coral Harbour Nunavut\Working\Coral Harbour C3D.dwg [FIGURE 1.6] November 05, 2014 - 9:17:08 am (BY: MANG, JUSTIN)

2.0 CONDITION OF EXISTING CROSSING STRUCTURES

The site assessment in June 2013 took place during freshet; as such, it was not possible to complete a review of the conditions of the existing infrastructure in time for the 2013 Technical Memorandum. Once flows subsided, Tetra Tech was able to obtain a series of photographs allowing the development of the enclosed recommendations. Photographs of the crossings were collected by Mr. Charlie Saviakjuk from Coral Harbour. Tetra Tech has noted the following concerns regarding the infrastructure at the two major crossing locations, Crossing 4 and Crossing 7.

2.1 Crossing 4

Crossing 4 is located in the central basin and consists of eight corrugated metal culverts. Based on the photographs provided (Figures 2-1 to 2-4), it appears that the culverts at Crossing 4 are nearing the end of their operational life. The lower portions (inverts) of the culverts are rusted out. The culverts also appear to be damaged and warped, which is indicative of reduced structural strength.

Figure 2-1: Culvert Crossing 4

Figure 2-2: Culvert Crossing 4

Figure 2-3: Culvert Crossing 4

Figure 2-4: Culvert Crossing 4

Although the eight culverts at Crossing 4 may be able to convey water over the next few years, it would be more cost effective to consider the replacement of the eight culverts with a new structure. All the approaches presented in this report include the replacement of these culverts as integral to the proposed improvements.

2.2 Crossing 7 (Bridge)

Crossing 7 is located in the central basin. Based on the pictures and comments provided by Mr. Saviakjuk, the bridge was built in the early 1980s. Tetra Tech was partially able to confirm this information when an attempt was made to contact the company who had supplied the original girders, TRI-Northern Steel Ltd. Based on information provided by other competitors, TRI-Northern has been out of business for several decades. Tetra Tech is unable to fully assess the condition of the bridge without a site visit or as-built drawings. However, some deterioration of the rock gabion baskets forming the abutments of the bridge were observed (Figures 2-5 to 2-7). As detailed in the pictures, the rock gabions have started to “fall” into the river and are no longer vertical. It was noticed that some of the wire links are also broken suggesting it may be time to consider the replacement/repair of the abutments.

Figure 2-5: Bridge Crossing 7

Figure 2-6: Bridge Crossing 7

Figure 2-7: Bridge Crossing 7 – Gabions

Although showing some signs of deterioration, the superstructure of this bridge still has several years of service life available. It should be noted that the bridge deck was recently replaced (2010). Service life of the entire crossing could be extended by completing remediation work on both of the bridge's abutments. Approach 2 was developed to include the remediation and continued use of this bridge. Approaches 3 and 4 include the removal of this bridge crossing and the replacement with one or two new structures respectively.

3.0 FEASIBILITY REVIEW

The CGS requires a Feasibility Review intended to highlight a preferred Approach. Tetra Tech has accomplished this task by first reviewing a set of approaches suggesting which crossings should be upgraded, followed by the selection of the Alternatives defining the type of structure to be used at the subject crossing. Sections 3.1 through 3.4 include a detailed analysis of each Alternative and overall Approaches, including:

- A description of each Approach with a discussion of the risks involved (Section 3.1).
- A brief description of each Alternative (Section 3.2).
- A description of the selection criteria used in evaluating the various Alternatives (Section 3.3).
- The presentation of the proposed Approach/Alternative combinations with a Class D cost estimate (Tables 3.1 and 3.2).
- The recommendation of favourable Approaches and Alternatives (Section 3.4).

3.1 Description of the Approaches

Four separate Approaches were considered during this feasibility review. The first highlights the "Do Nothing" approach. All the other Approaches present a series of improvements at several crossings along Airport Road and

are meant to highlight the strategy which should be adopted to increase the capacity of the entire system to meet the 100-year event.

3.1.1 Approach 1: Maintain Existing System (Status Quo)

The first Approach considered leaving the Airport Community Road drainage system in its current configuration, performing repairs as failures take place. This would entail replacing only the three culverts at Crossing 9, 9a and 10 near the fuel farm facility. By selecting this Approach and replacing only these culverts, the CGS would be forced to continue with the regular repairs of the existing system, which is capable of conveying only a 2-year return event before overtopping Airport Road. It is expected that this solution will lead to continued overtopping of the road and subsequent washouts. Each washout would preclude access to the Airport and the Hamlet. Based on our understanding, once the washout takes place, it takes at least two weeks before the road can be reinstated, cutting off the community from the Airport.

Although considering this Approach is not an option, given the impact it might have on medical evacuations and the fuel line feeding the Hamlet, it was explored to provide context and a cost comparison supporting the decision to upgrade the system capacity.

When a culvert is washed out, a new culvert must be purchased to replace the damaged one. That again delays the reinstatement of the road unless a spare culvert is made available to the Hamlet for the emergency repairs.

Based on previous invoices and local unit prices we have received from Sudliq Construction, we estimate that the cost of replacing a culvert and repairing the roadway after a washout is approximately $75,000. Over the duration of 75 years, the period of time selected for evaluating lifecycle costs across all Approaches/Alternatives, performing repairs to the Airport Road every two years equates to a net present cost in excess of $2,800,000.

Approach 1 is illustrated in Figure 3-1.