CITY OF YELLOWKNIFE

2011 INSPECTION OF DAMS 1, 2 AND 3 ON FIDDLER'S LAKE SEWAGE LAGOON, CONTROL STRUCTURE F9 AND OTHER TRAPPER'S LAKE OUTLET STRUCTURES

REPORT

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1.0 INTRODUCTION

This letter documents the findings of an inspection completed by EBA Engineering Consultants Ltd. operating as EBA, A Tetra Tech Company (EBA), of the dams at the City of Yellowknife's (City's) Fiddler's Lake Sewage Lagoon. Also inspected were three structures controlling the outlets of nearby Trapper's Lake. The purpose of this work was to visually assess the integrity of the dams and provide recommendations for further work if required.

Authorization to proceed with the inspection of Dams 1, 2 and 3 on Fiddler's Lake and Control Structure F9 on Trapper's Lake was provided in e-mail correspondence from the City on August 17, 2011. When EBA determined that additional control structures might be present around Trapper's Lake, the City authorized further investigation via e-mail on September 12, 2011.

EBA has conducted similar inspections in the years 1989, 1994, 1999 through 2005, and 2007 through 2009, for Dams 1, 2, and/or 3, and for Control Structure F9. It is understood that an annual inspection of the dams by a geotechnical engineer is a condition of the water licence.

2.0 SYSTEM DESCRIPTION

There are three dams near the outlet of the Fiddler's Lake Sewage Lagoon. The following briefly describes the dams associated with the lagoon:

- **Dam 1** – is a zoned earth-fill dam, consisting of sand fill, a clay core and a gravel drainage blanket. It is approximately 200 m long and 5 m high. On the southwest end of Dam 1, a concrete control structure, with a stop log weir, controls outflow from Fiddler's Lake. The dam was constructed in 1982.
- **Dam 2** – is a zoned earth-fill dam consisting of sand fill, a clay core, and a gravel drainage blanket. It is approximately 350 m long, 3 m high, and features bedrock outcrops at each abutment. A bedrock outcrop occurs within Dam 2 and has been incorporated into the dam. The dam was constructed in 1982.
- **Dam 3** – was constructed in 1986 using clay fill and is about 150 m long and 1 m high. In 1990 a bagged sewage area was constructed by excavating downstream of Dam 3 and creating disposal cells for the bagged sewage. Subsequent to initial construction, sand was added to the facility as more cells were created. EBA understands that since 2009, bagged sewage has been collected at the landfill. Bagged sewage continues to be disposed of upstream of Dam 3 (e-mail correspondence: W. Alexander, E. Hoeve; June 27-28, 2011).

There are also five control structures influencing water flow along the south end of Trapper's Lake. EBA understands that the intent of these structures is to prevent water from Trapper's Lake from flowing into Fiddler's Lake, and to reroute the flow into the Grace/Kam Lake drainage.

- **Water Control Structure F9** – is a small concrete/earth dam at the southeast end of Trapper's Lake. This structure controls water flowing out of Trapper's Lake, located to the east of Fiddler's Lake. EBA is not aware of any design information for this dam. Our understanding is that this control structure is located on a channel excavated to divert water from Trapper's Lake around the Fiddler's Lake system.

- **Former outlet – South Trapper's Lake** - the former outlet to bypass the Fiddler's Lake drainage was constructed with a shallow swale leading to a small lake near the access road. That drainage path goes to the Grace/Kam Lake drainage. However, high runoff following construction caused the swale to erode into a significant ditch, dropping the water level of Trapper's Lake. The ditch was then backfilled, and replaced with Control Structure F9 (AECOM, 2011 and 2012).
- **Dyke #1** – is located at the southwest corner of Trapper's Lake. This dyke is intended to block the outflow from Trapper's Lake down to Fiddler's Lake.
- **Dyke #2** – is located at about the middle of the south side of Trapper's Lake, and is also intended to block the outflow from Trapper's Lake into Fiddler's Lake.
- **Dyke #3** – is located at the southwest corner of the southeast arm of Trapper's Lake, and is also intended to block the outflow from Trapper's Lake into Fiddler's Lake.

Figure 1 presents a site location plan for reference.

3.0 SCOPE OF WORK

EBA's original scope of work for 2011 was to consist of the following:

- Visually inspect Dam 1;
- Visually inspect Dam 2;
- Visually inspect Dam 3;
- Visually inspect Water Control Structure F9; and
- Prepare a summary letter that documents the findings of the inspections and presents recommendations for ongoing maintenance.

The following items were later added to the scope:

- Locate and visually inspect the other structures suspected to be present along the shore of Trapper's Lake; and
- Add the findings and recommendations for these structures to EBA's summary letter.

4.0 METHODOLOGY

Dams 1, 2 and 3 on Fiddler's Lake, and Control Structure F9 on Trapper's Lake were inspected by Rita Kors-Olthof, P.Eng., and Ed Hoeve, P.Eng., of EBA, on September 1, 2011. This date corresponded with the approximate annual high water level behind the dams, prior to the commencement of decanting on September 6, 2011. The purpose of the inspection was to note possible changes to conditions observed by EBA on the previous visual inspection of each structure and to look for visual evidence of seepage, erosion, presence of sinkholes, and other conditions that might affect the integrity of the dams, as follows:

- For Dams 1 and 2, we compared our findings to EBA's visual findings of September 10, 2009, augmented if/as needed by relevant observations of Dam 1 from the level survey of November 3, 2010.

- For Dam 3, we compared our findings to EBA's visual findings of June 10, 2008. As noted in EBA's email of June 27, 2011 (W. Alexander, E. Hoeve), the dam still appeared to be covered with several generations of unengineered fill, so it was not possible to observe the dam itself.
- In the case of Control Structure F9, the structure was the same as the one observed in previous years (most recently in 2007), and EBA recorded visual observations and compared with previous observations.

EBA then sought information about the purpose of Control Structure F9, and in addition to a brief construction history of the area, received information regarding up to three potential dyke locations along the south shore of Trapper's Lake (AECOM, 2011). We were subsequently able to locate two of the three suspected dyke structures, Dykes 1 and 2, during a field reconnaissance and inspection on October 6, 2011. EBA's field representatives were Rita Kors-Olthof, P.Eng., and Fai Ndofor, P.Eng. Since earlier documentation was not available, EBA carried out a visual inspection so as to create a visual baseline for future observations, and looked for visual evidence of seepage, erosion, presence of sinkholes, and other conditions that might affect the integrity of the structures.

Further information about the possible location of Dyke 3 was obtained this past winter, as well as information regarding the former outlet of Trapper's Lake (AECOM, 2012).

EBA also conducted an air photo review for those structures based on pre-development air photo coverage (1970), coverage dated only a few years after construction (1984), coverage more than 10 years after construction (1994), and compared those findings to more recent imagery from Google Earth (2004) and 2008 ATLAS GIS imagery from Municipal and Community Affairs (MACA, 2012).

5.0 OBSERVATIONS

5.1 Dam 1

Photos 1 to 4 show elements of the dam. Significant observations were:

- The water level was observed at an elevation of 187.03 m and no evidence of a higher water level was visible (Photo 1). It is noted that this water level exceeds the maximum recommended water level (186.6 m) by about 0.4 m.
- A small amount of water seepage was observed between the fractured bedrock and the northeast side of the control structure at the outlet (Photo 2). Such seepage has been observed in past inspections when the lagoon water level is high.
- No signs of erosion on upstream face of dam.
- The upstream face of the dam was obscured by accumulations of vegetation and soil (Photo 3). Further from shore, the vegetative mat appears to be floating.
- No apparent seepage or subsidence was observed during the inspection of the downstream face (Photo 4).

Further observations are presented in Table 1, where they are compared with similar observations from the previous inspection.

5.2 Dam 2

Photos 5 to 9 show elements of the dam. Significant observations were:

- Dam crest width appears to have had no change from 2009 (Photo 5), but a small slot has been made from the road into the upstream face to drain water of a low area in the road (Photo 6).
- No signs of erosion on upstream face of dam.
- The upstream face of the dame was obscured by accumulations of vegetation and soil (Photo 7). Further from shore, the vegetative mat appears to be floating.
- No apparent seepage or subsidence was observed during the inspection of the downstream face, although the terrain downstream tended to be marshy and wet (Photo 8) with at least two areas of ponded water noted (Photo 9).

Further observations are presented in Table 2, where they are compared with similar observations from the previous inspection.

5.3 Dam 3

Photos 10 to 14 show elements of the dam. Significant observations were:

- Dam 3 extends between two large bedrock outcrops and appears stable. Piles of sand are present over the dam (Photo 10).
- EBA is certain that the upstream face of the dam has been covered; it is not clear if the downstream face of the dam is visible. While there are no obvious signs of erosion, the generally well-vegetated surfaces of the present earth structure have localized areas of exposed soil (Photos 10, 11 and 12). Erosion noted at northwest corner of dam/disposal cells is related to periodic surface water flowing off the access road to the downstream side of dam (Photo 13).
- No apparent seepage or subsidence was observed during the inspection of the downstream side of the dam, although the terrain downstream tended to be marshy and wet, with a few areas of ponded water noted below the toe (Photo 14). We recall, however, that laboratory tests on water sampled from downstream of the dam in 2008 suggested either a breach of Dam 3 itself, or a breach of the bagged sewage disposal cells created on top or downstream of the clay core of Dam 3.

Further observations are presented in Table 3, where they are compared with similar observations from the previous inspection.

5.4 Control Structure F9

Photos 15 to 18 show elements of the structure and surrounding terrain. The structure is greatly obscured when the vegetation is in leaf. Significant observations were:

- The concrete east half of the dam is cast onto a local bedrock outcrop. The concrete section is 91 cm thick from upstream to downstream side, and 144 cm long across the top surface, from the vertical west edge at the earth spillway to the east abutment on the bedrock. The earth spillway is possibly also supposed to be concrete but, if so, has overgrown considerably with willow roots and vegetation (Photos 15 and 16).
- The concrete structure appeared to be in good condition, but it was not known if the west section should have consisted of concrete or earth (and hence whether it should be cleaned out, or not).
- Water level was 20 cm below the top of the concrete and 6 cm below the top of the earthen spillway on the upstream side, and 51 cm below the top of the concrete on the downstream side. Photos 17 and 18 present upstream and downstream views at F9.
- No flow was occurring on arrival at the site, with the upstream water level 6 cm below the top of the earth section. Minor chopping of roots (all that could be accomplished with the limited tools on hand), did not reveal more concrete, but allowed a little more water through.

Further observations are presented in Table 4, where they are compared with similar observations from the previous inspection.

5.5 Dyke 1

Photos 19 to 23 show elements of the structure and surrounding terrain. Significant observations were:

- The east and west ends of the dyke abut against local bedrock outcrops (Photos 19 and 20). The west end of the dyke was not reached during the reconnaissance because the dyke was breached and could not be crossed (Photo 19. This breach was located at about a third of the way across the dyke from the east abutment and, on Google Earth (2004) and ATLAS GIS (MACA, 2012, based on 2008 imagery), at least one other breach is visible at slightly less than the one-third point from the west abutment.
- The 1984 air photos indicate that Dyke 1 was created by blading up materials from north of the dyke location, as well as from a borrow area to the west of the south pond (Figure 2). That borrow area is now completely overgrown and is virtually indistinguishable from its surroundings on the 2008 ATLAS GIS imagery. The dyke crest appeared to be more-or-less level shortly after construction, with a slight increase in elevation at the abutments, especially at the east abutment. A relatively steep slope along the crest remains at the east abutment (Photo 20), likely due to this section of the dyke having been protected by being constructed over exposed or near-surface bedrock. It is only because of this well-preserved area that the dyke's location could be field-verified with confidence.
- Based on the view from the south (Photo 21), what remains of the dyke is nearly level, but it appears to have settled so that the dyke crest is just above the water level, or just below. Therefore, it seems probable that there are now more breaches than could be seen on EBA's foot traverse or on the most recent imagery.
- Beavers have been cutting trees in the area (Photo 22), but whether they are helping to keep the dyke intact, or only further inundating it by working downstream, is unknown. It is also possible that the water level at the dyke is higher than it should be, if Control Structure F9 is letting insufficient water through.

- The 1984 air photos suggest a lower water level than the present water level, though this is possibly a seasonal variation. The 1994 air photos indicate a water level in between the 1984 and 2008 water levels, but closer to the 2008 level. Most interesting, the 1970 pre-development air photos indicate a water level in Trapper's Lake comparable to the higher 1994 or 2008 water levels, but there are no obvious large ponds visible in the area in which Dyke 1 would be located a dozen or so years later. This phenomenon suggests the possibility of rapid thaw settlement in the vicinity, as a result of dyke construction.
- The outlet(s) of the south pond (Photo 23) lead down to Fiddler's Lake, forming a bustling stream enroute. EBA traversed the easternmost stream, but due to the width of the south pond, the width of the receiving drainage, and the numerous small ponds and streams within that drainage visible on the 2008 ATLAS GIS imagery, it is highly likely that there are several outlet streams feeding the main stream.

5.6 Dyke 2

Photos 24 to 27 show elements of the structure and surrounding terrain. Significant observations were:

- The east and west ends of the dyke abut on local bedrock outcrops, and there is an intermediate bedrock outcrop as well. Looking east from the west abutment, the dyke is characterized by tall grasses on the untreed sections, and grasses, white birch and willow in treed areas, especially on the downstream side (Figure 2, Photos 24 and 25).
- An outlet stream from Trapper's Lake, via a pond in the lake-side marsh, reaches the toe of the dyke near the west end (Photos 26 and 27). There was no sign of seepage daylighting on the downstream face or at the toe, though there was a pond downstream.
- The 2008 ATLAS GIS imagery indicates that a small stream reaches the upstream side of Dyke 2, but there is no obvious outlet stream.
- The water level of the pond is estimated to be about 0.5 m lower than the water level on the upstream side of the dyke. The dyke crest is about 1 m above the upstream water level and about 1.5 m above the downstream water level.
- The field reconnaissance suggests that the dyke may be performing adequately, and the proximity of bedrock, or near-surface bedrock beneath the dyke may have helped to preserve it.
- The 1984 air photos suggest that material was scraped up from the north and south sides of the dyke to construct it.

5.7 Dyke 3

Dyke 3 has not yet been located in the field, but EBA has now obtained sufficient information for a future field reconnaissance of the site (AECOM, 2012). Significant observations from the air photos and ATLAS GIS include:

- Dyke 3 is a smaller north-south dyke located between bedrock outcrops on the southwest corner of the southeast leg of Trapper's Lake, west of F9 (Figure 3).

- On the 1984 air photos, borrow sources are less obvious at this site, since scrape-marks are not obvious on and alongside the dyke slopes. However, a small area to the west of the dyke appears to have been used for borrow, with a few long strips opened up. It is possible that this dyke was constructed earlier than the others, since there appears to be some vegetation on the lower slopes.
- The 2008 ATLAS GIS imagery shows a small stream entering and leaving the dyke area, suggesting that the dyke may be breached.

5.8 Former Outlet of Trapper's Lake – East of F9

The former outlet of Trapper's Lake has not yet been located in the field (Figure 3). Significant observations from the air photos and ATLAS GIS include:

- Both the former outlet channel, and the newer one that leads to it from F9, are readily visible on the 1984 air photos and on the 2008 ATLAS GIS imagery. The ATLAS GIS imagery suggests that the backfill in the former outlet channel has now settled, and may no longer be effective in blocking drainage (Figure 3).
- The 1994 air photos, which extend further south than the 1984 airphotos, indicate that the ditch continuing south to the road has only intermittent water flow, since it is dry through most of its length in this set of photos.

5.9 Construction Access Trails

The original construction access trails have not yet been investigated in the field. These access trails include, but may not be limited to:

- The trail leading from the sewage lagoon road to F9 and the former outlet;
- Apparent trails leading from the F9 area to Dyke 3, Dyke 2 and finally Dyke 1.

Of these trails, air photo observations suggest the most potential concern with the trail between Dyke 2 and Dyke 1 (Figure 2). Significant observations from the 1984 air photos, Google Earth (2004), ATLAS GIS (MACA, 2012, based on 2008 imagery), and the field reconnaissance include:

- The 1970 pre-development air photos confirm that no apparent cleared trail existed at that time. What appears to be a cleared trail on the 1984 air photos is now possibly a low area which may transport water from the Dyke 2 area, bypassing Dyke 1 (even if it were functional) and allowing water into the drainage downstream of Dyke 1. Sections of the trail appear very dark in colour on Google Earth, which suggests that surface water may now be present, though some of the dark areas may just be shadows.
- Dark areas on the ATLAS GIS imagery (2008) also suggest the possibility of surface water along parts of the trail, although some of these dark areas may also just be shadows. However, at the west end of the area, during the field reconnaissance, EBA encountered a small stream whose origin was not determined, and which may in fact originate along the old trail.
- ATLAS GIS contours suggest that the areas of Dykes 1 and 2 are both at approximately 190 m elevation, and that the trail between the two is at a slightly higher elevation. Although occasional spot

elevations are shown, and are reported to the nearest tenth of a metre, EBA notes that the contours are at 2 m intervals and, hence, are not detailed enough for more than an overview of the area. As well, a slightly higher ground surface elevation along the trail between the two dykes does not preclude the possibility of localized permafrost degradation allowing subsurface flow between the two sites.

6.0 RECOMMENDATIONS

6.1 Recommendations from Previous Inspections

EBA's 2009 annual inspection report for Dams 1 and 2 indicated the following recommendations:

- The water level in the facility should be maintained at or below 186.6 m. This is level with the top of the clay core in Dam 2 measured in 2008, 1.2 m below the lowest point on the crest of Dam 2, and 0.1 m below the originally designed full supply level (FSL). EBA observed that the water level at the time of EBA's 2011 inspection was 187.03 m, about 0.4 m above the recommended water level, and above the top of the clay core in Dam 2.
- Survey the crest of Dam 2 in 2011 to assess for settlement. This recommendation was relaxed from the previous recommendation for an annual survey, because the 2009 survey indicated that no settlement had occurred. The survey remains to be done, presumably in 2012.

EBA's 2008 annual inspection report for Dam 3 indicated the following recommendations:

- Conduct follow-up water quality monitoring (annually) to verify that microbial levels are not on an increasing trend outside of the immediate downstream area;
- Conduct a risk assessment for the impacted area downstream, including the likelihood of on-going impacts;
- Move sewage cells to locations up gradient of the clay core of the dam;
- Upgrade bagged sewage facility to prevent unauthorized disposal and uncontrolled disposal outside of cells;
- Upgrade the disposal facility to allow for larger volume disposal and increase the volume available for bagged sewage disposal;
- Reinforce and raise the height of the clay core in Dam 3;
- Upgrade the dam structure to prevent sewage seepage downstream of the dam;
- Construct a new clay-cored dam downstream (north) of Dam 3 to enclose a larger bagged sewage area; and
- Update operations to prevent public access and provide a central disposal station at the solid-waste facility.

The bagged sewage is now being collected under controlled conditions at the bailing facility, and City staff then disposes of it at Dam 3. However EBA's observations in 2011 indicate that very few of the remaining

recommendations have as yet been carried out. It does not appear that any earthworks have been undertaken.

EBA's 2007 annual inspection report for Control Structure F9 indicated the following recommendations:

- The next inspection of the F9 Control Structure should be scheduled in 2011. EBA carried out this inspection in 2011.

6.2 New Recommendations

EBA's new recommendations are as follows:

- Maintain better control of Fiddler's Lake water elevation, so as not to exceed the maximum recommended water level of 186.6 m.
- Infill the apparent waterbar cut into the top of Dam 2 to restore the integrity of the upstream face. Apply gravel surfacing to the dam crest road so as to fill in the low ponding area, and allow water to drain as sheet flow onto the dam slopes, instead of as concentrated flow at that location.
- Slope the road access at the northwest corner of Dam 3 away from the dam so as to prevent erosion of the downstream face of the fill.
- Apply gravel surfacing as needed to the crests of Dams 1 and 2 so as to maintain positive drainage off the tops of the dams without concentrating water flows.
- Prepare a plan for upgrading of the Dam 3 and bagged sewage disposal facility in accordance with the recommendations provided in 2008.
- Evaluate the performance of water control structures on Trapper's Lake: Dyke 1, Dyke 2, Dyke 3, F9, and former outlet near F9. It could be that water inflow from Trapper's Lake is contributing to the difficulty of limiting the water level in Fiddler's Lake to its recommended maximum. Investigation of these items is proposed for 2012.

7.0 CLOSURE

We trust this report meets your present requirements. If you have any questions or comments, please contact the undersigned.

Sincerely,
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Google Earth, 2012. Imagery from August 18, 2004.

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TABLES

Table 1: Comparison of 2009 and 2011 Observations at Dam 1

Item Observed	September 10, 2009	September 1, 2011
Water Gauge	Water gauge has been replaced. The reference elevation marked on the top of the control structure was 188.179 m as opposed to 188.45 m used in previous inspections.	Reference elevation at 188.18 m.
Relative Reservoir Water Elevation at Dam Outlet (Concrete at top of outlet structure is 188.179m)	At the time of inspection, the top stop log had been removed and water was flowing over the remaining logs; water level was approximately 186.88 m.	Water elevation at 187.03 m (Photo 1).
Observed High Water Mark	187.01 m (187.28 m in 2008 datum).	No higher elevation apparent on gauge (no detritus clinging to gauge).
Seepage Outlet Structure	Small seepage.	A small amount of water seepage was observed between the fractured bedrock and the northeast side of the control structure at the outlet (Photo 2). Although moist mossy areas were observed on the southwest side of the outlet, no seepage was noted there.
Crest Width	The dam crest was gravel surfaced. Crest width at the middle of the dam was about 10 m and tapered to about 5 m at the control structure.	Dam crest was gravel-surfaced. Crest northeast of "No shooting" sign is muddy, occasional potholes on remainder of crest. No changes in crest width.
Upstream Face	No evidence of erosion. Face was heavily vegetated.	No sign of erosion, good vegetative cover. Further from shore, the vegetative mat appears to be floating.
Downstream Face	No evidence of erosion.	No evidence of erosion or seepage (Photo 4).
Downstream Toe	No evidence of seepage observed. Downstream toe of dam was dry.	No evidence of seepage on downstream toe. Although some moist mossy areas were noted at the toe of the downstream face, these appeared to be more likely related to the flat poorly-draining terrain in the meadows and brush at the toe of slope than to possible dam seepage.

Table 2: Comparison of 2009 and 2011 Observations at Dam 2

Item Observed	September 10, 2009	September 1, 2011
Crest Width	Dam crest was gravel surfaced, over about 5 m top width. 8 m top width where blast rock has been placed on downstream side.	No changes in crest width, minor washboarding or potholes (Photo 5). A small slot has been cut down from the crest onto upstream face to help drain low area on road (Photo 6).
Upstream Face	Observed depressions in the upstream face as a result of the removal of organic debris, face remains highly vegetated.	No sign of erosion, good vegetative cover (Photo 7). The ground surface on the upstream side of the dam is not uniformly sloped, possibly due to uneven stripping of the vegetation and organics and/or local low areas between bedrock outcrops along the upstream face.
Downstream Face	No erosion observed.	No erosion observed.
Downstream Toe of Dam	Ponded water was observed at the downstream toe at Station 0+340.	Marshy ground below the downstream toe was common along the east half of the dam (Photo 8), where the terrain is flat, with mixed mossy grassy meadow and brush (alder, larch, birch, willow, poplar). Two areas of ponded water were specifically noted, at about 0+530 on the 2009 survey, and at about 0+335 (Photo 9).
Possible Drainage Downstream of Dam	The water ponded at Station 0+340 had drained away by September 15, 2009.	No follow-up visit was made, but since the week prior to the site visit was characterized by heavy rain, and no flowing water was noted, the ponded water was considered more likely due to poor soil drainage, not dam seepage.

Table 3: Comparison of 2008 and 2011 Observations at Dam 3

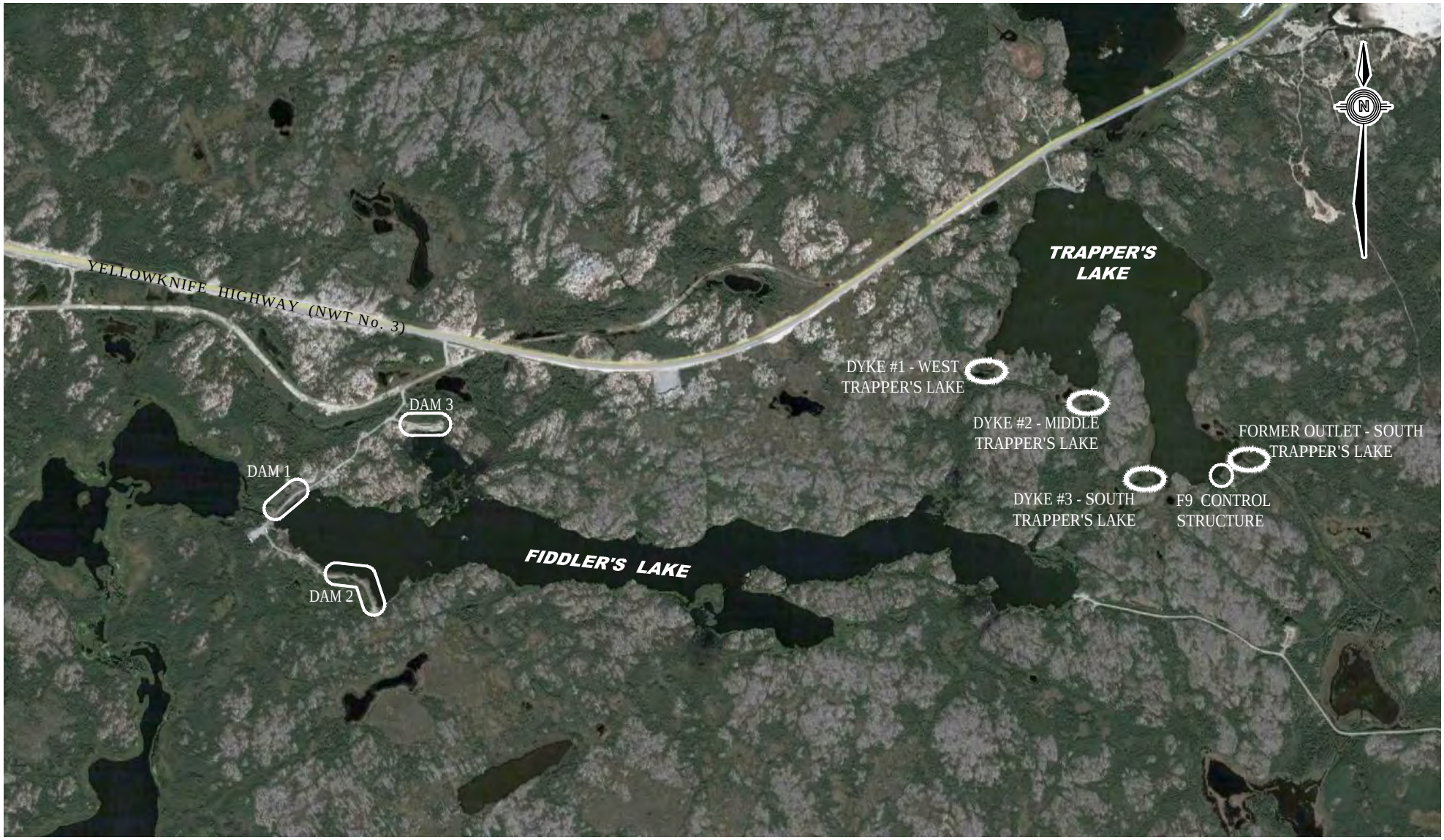
Item Observed	June 10, 2008	September 1, 2011
General Comment	Dam 3 appears to be stable. Cells on top of the dam appear to be downstream of the clay core. Water samples were collected from an existing monitoring well, from ponded water downstream, and from the lagoon upstream of Dam 3. Piles of sand, presumably for future cover, are located on west end of the dam. General debris and garbage found around the site.	Dam 3 extends between two large bedrock outcrops and appears stable. Piles of sand are present on the dam (Photo 10). Debris and garbage appears minor around the site, and is mostly windblown, possibly from the bagged sewage drop-off area in the rock outcrop located to the west.
Upstream Face	Vegetated, no signs of erosion.	Upstream face of the dam is not visible, but area upstream is generally well vegetated, with no signs of erosion.
Downstream Face	Highly vegetated with grasses, no signs of erosion. Two large pits dug into the sand fill.	Highly vegetated with grasses and weeds, no sign of erosion, but ground surface is very rough, especially west half (Photo 11). This area presumed to be part of old downstream bagged sewage disposal cell area reported in 2003. Possibly winter operations resulted in frozen fill placement, or deterioration of bagged materials beneath eventually results in very rough surface. Flat area downstream of east end of dam is sand on the surface, with no apparent ponding or erosion (Photo 12). Water draining off road at west end of dam is causing localized minor erosion of downstream slope (Photo 13).
Seepage or Overtopping	No signs of seepage through dam or overtopping.	No signs of seepage or overtopping noted anywhere along downstream side of dam.
Crest	Clay core is not exposed. Sand generally level, no evidence of subsidence or erosion.	Top of dam generally appears level, except for one unvegetated sand pile.
Water Levels	Fiddler's Lagoon water level is about 15 m from upstream toe. Seasonally-ponded water has collected adjacent to the downstream toe of Dam 3.	Fiddler's Lake water level is about 10 m from the upstream toe at the east end of Dam 3 (further away from toe heading west), although some of this distance is very marshy and likely includes some floating vegetative mats. Ponded water is present intermittently beyond the downstream toe. Areas likely to pond are characterized by grasses and horsetail under the willows (Photo 14). Areas less subject to ponding have wild rose, currant, Labrador tea.

Table 4: Comparison of 2007 and 2011 Observations at Control Structure F9

Item Observed	September 27, 2007	September 1, 2011
Configuration of Structure	The dam was observed to consist of a concrete east half and a lower, apparently earth fill, west half. If the west half is concrete, it is obscured by vegetation. The rational for this design was not known.	The concrete east half of the dam is cast onto a local bedrock outcrop. The concrete section is 91 cm thick from upstream to downstream side, and 144 cm long across the top surface, from the west edge at the earth spillway to the east abutment on the bedrock. The earth spillway is possibly also supposed to be concrete but in that case has overgrown considerably with willow roots and vegetation (Photos 15-16).
Condition of Structure	The observed portions of the dam appeared to be in good condition.	The concrete structure appeared to be in good condition, but it was not known if the west section should have consisted of concrete or earth (and hence whether it should be cleaned out, or not).
Water Levels	The upstream water level was determined to be about 0.2 m below the lowest point in the earth fill section and about 0.3 m below the top of concrete.	Water level was 20 cm below the top of the concrete and 6 cm below the top of the earthen spillway on the upstream side, and 51 cm below the top of the concrete on the downstream side (Photos 17-18).
Water Flow	There was no flow at the time of observation.	No flow was occurring on arrival at the site, with the upstream water level 6 cm below the top of the earth section. Minor chopping of roots (all that could be accomplished with the limited tools on hand), did not reveal more concrete, but allowed a little water through.

FIGURES

\\eba.local\corp\Edmonton\Drafting\DIVISIONS2007\Other Offices\Y141\Y14101405\acad\Y14101405_Figure 1.dwg [FIGURE 1] April 02, 2012 - 11:54:39 am (BY: MARSH, MAUREEN)



0 1 km

Approximate Scale 1: 20 000

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City of Yellowknife

A TETRA TECH COMPANY

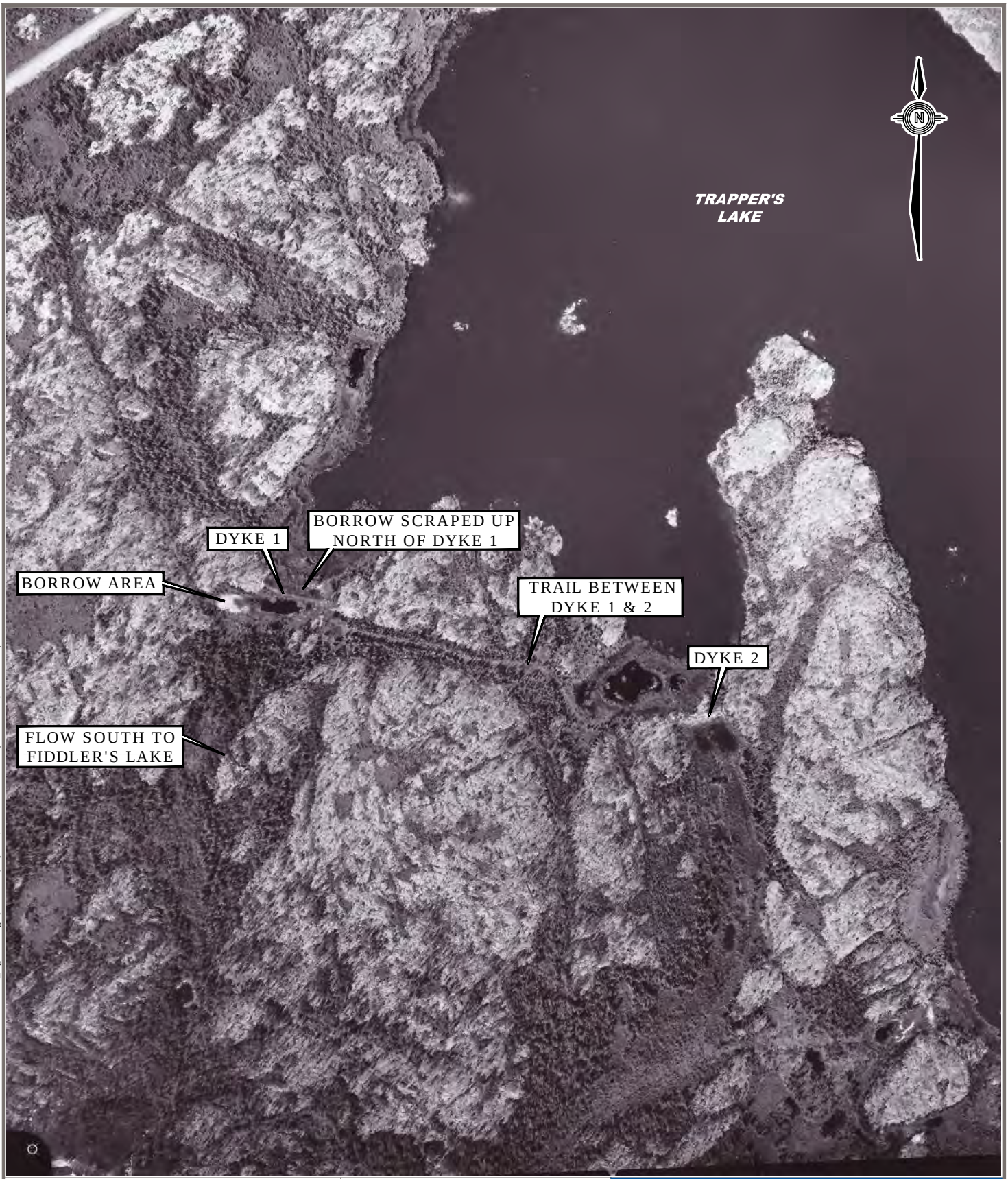
FIDDLER'S LAGOON ANNUAL DAM INPSECTIONS AND TRAPPERS LAKE OUTLET INSPECTION
YELLOWKNIFE, NT

SITE LOCATION PLAN

PROJECT NO.	DWN	CKD	REV
Y14101405	TK/MM	RKO	0

OFFICE	DATE
EDM	April 2012

Figure 1



NOTE:

BASED ON AIR PHOTOS A26546 - 185-188 DATED 1984

0 250

Scale: 1: 5 000 (metres)

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City of Yellowknife

FIDDLER'S LAGOON ANNUAL DAM INPSECTIONS AND TRAPPERS LAKE OUTLET INSPECTION
YELLOWKNIFE, NT

SITE PLAN FOR
DYKES 1 AND 2

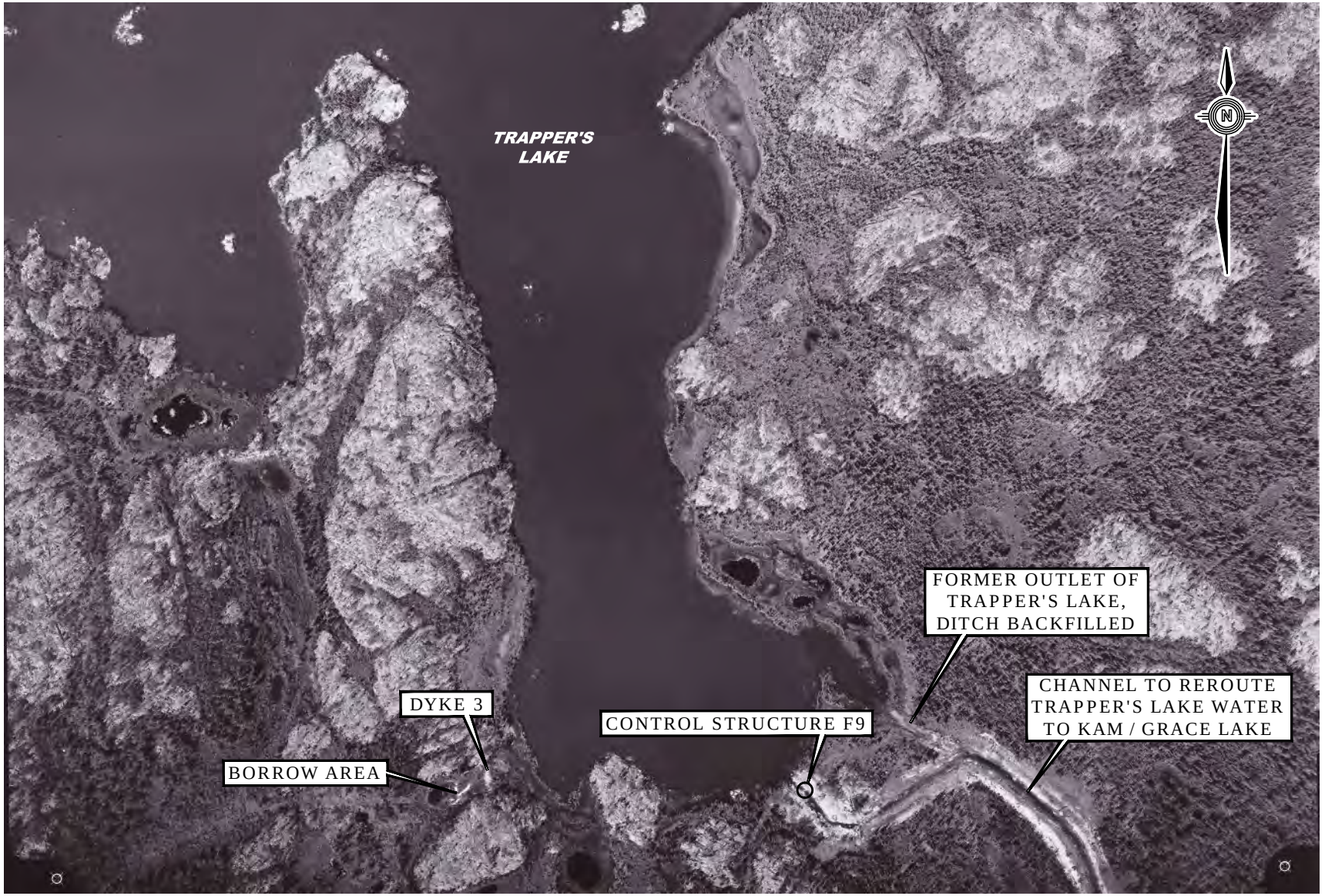
PROJECT NO.	DWN	CKD	REV
Y14101469	MM	RKO	0

OFFICE	DATE
EDM	April 2012

Figure 2

\\eba.local\corp\Edmonton\Drafting\DIVISIONS2007\Other Offices\Y141\Y14101405\acad\Y14101405_Figure 1.dwg [FIGURE 2] April 02, 2012 - 11:47:32 am (BY: MARSH, MAUREEN)

\\eba.local\corp\Edmonton\Drafting\DIVISIONS2007\Other Offices\Y141\Y14101405\acad\Y14101405_Figure 1.dwg [FIGURE 3] April 02, 2012 - 11:49:05 am (BY: MARSH, MAUREEN)



NOTE:

BASED ON AIR PHOTOS A26546 - 185-188 DATED 1984

0 250

Scale: 1: 5 000 (metres)

CLIENT

City of Yellowknife

FIDDLER'S LAGOON ANNUAL DAM INPSECTIONS AND TRAPPERS LAKE OUTLET INSPECTION
YELLOWKNIFE, NT

SITE PLAN FOR DYKE 3,
CONTROL STRUCTURE F9 AND
FORMER OUTLET OF TRAPPER'S LAKE

eba
A TETRA TECH COMPANY

PROJECT NO.	DWN	CKD	REV
Y14101405	MM	RKO	0

OFFICE	DATE
EDM	February 24, 2012

Figure 3

PHOTOGRAPHS

Photo 1	Water level at Dam 1 outlet structure measured at 187.03 m
Photo 2	Seepage from bedrock on northeast side of Dam 1 outlet, downstream side.
Photo 3	Occasional areas of ponded water on upstream face of Dam 1.
Photo 4	Typical downstream face of Dam 1 where riprap is exposed
Photo 5	Crest of Dam 2, looking east from west end. Minor washboarding and potholes
Photo 6	Waterbar (slot) cut into upstream face of Dam 2 to help drain low area on road
Photo 7	Occasional area of ponded water on upstream face of Dam 2.
Photo 8	Typical marshy area downstream of east half of Dam 2.
Photo 9	Ponded water below Dam 2, about 95 m east of west abutment.
Photo 10	Looking east at Dam 3 and bagged sewage disposal area.
Photo 11	Downstream face of Dam 3 is mostly very well vegetated
Photo 12	Exposed sand at east end of Dam 3 on downstream side
Photo 13	Erosion at northwest corner of Dam 3 / bagged sewage disposal area
Photo 14	Downstream of Dam 3 in ponded area. Grasses and horsetail under willows
Photo 15	Control Structure F9, Ed Hoeve standing at transition
Photo 16	Apparent earth spillway at F9 is overgrown with willows and grasses
Photo 17	Looking upstream at Control Structure F9, Ed Hoeve standing on the structure
Photo 18	Looking downstream from F9 along man-made channel.
Photo 19	Looking west along the crest of Dyke 1, which is breached near the east end.
Photo 20	Looking east at the east abutment of Dyke 1, which is preserved due to near-surface bedrock
Photo 21	Looking upstream at Dyke 1 from marshy area downstream of south pond

Photo 1: Water level at Dam 1 outlet structure measured at 187.03 m, about 0.4 m over maximum recommended level.

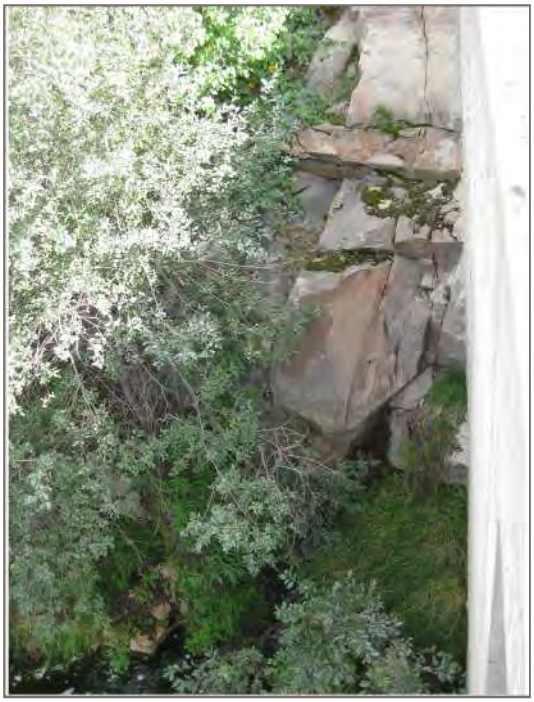


Photo 2: Seepage from bedrock on northeast side of Dam 1 outlet, downstream side.

Photo 3: Typical upstream area of Dam 1.

Photo 4: Typical downstream face of Dam 1 where riprap is exposed. Dam toe is generally very brushy.

Photo 5: Crest of Dam 2, looking east from west end. Minor washboarding and potholes on gravelled surface.

Photo 6: Waterbar (slot) cut into upstream face of Dam 2 to help drain low area on road.

Photo 7: Typical upstream area of Dam 2.

Photo 8: Typical marshy area downstream of east half of Dam 2.

Photo 9: Ponded water below Dam 2, about 95 m east of west abutment.

Photo 10: Looking east at Dam 3 and bagged sewage disposal area.

Photo 11: Downstream area of Dam 3 is mostly very well vegetated.

Photo 12: Exposed sand at east end of Dam 3 on downstream side does not appear to have ponding or erosion.

Photo 13: Erosion at northwest corner of Dam 3 / bagged sewage disposal area, due to water flowing off road access.

Photo 14: Downstream of Dam 3 in ponded area. Grasses and horsetail under willows are diagnostic of periodic wet areas here.

Photo 15: Control Structure F9, Ed Hoeve standing at transition between concrete structure east side and earth spillway west side.

Photo 16: Apparent earth spillway at F9 is overgrown with willows and grasses.

Photo 17: Looking upstream at Control Structure F9, Ed Hoeve standing on the structure. Trapper's Lake in background.

Photo 18: Looking downstream from F9 along man-made channel.

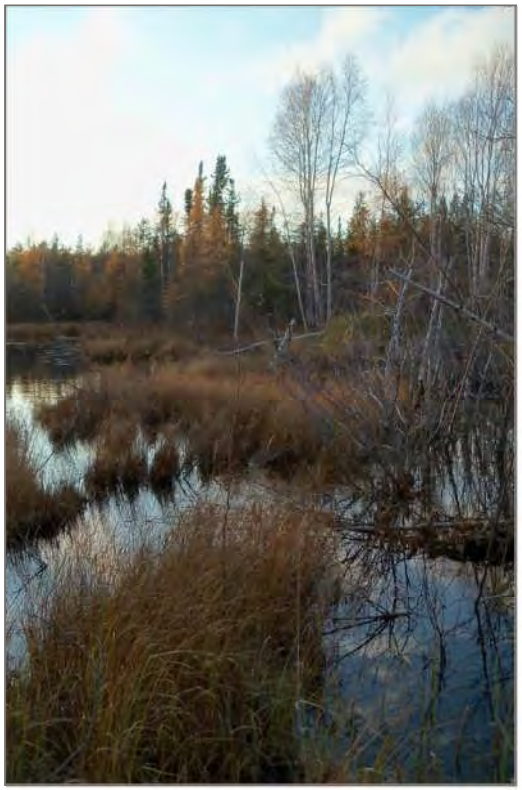


Photo 19: Looking west along the crest of Dyke 1, which is breached near the east end.

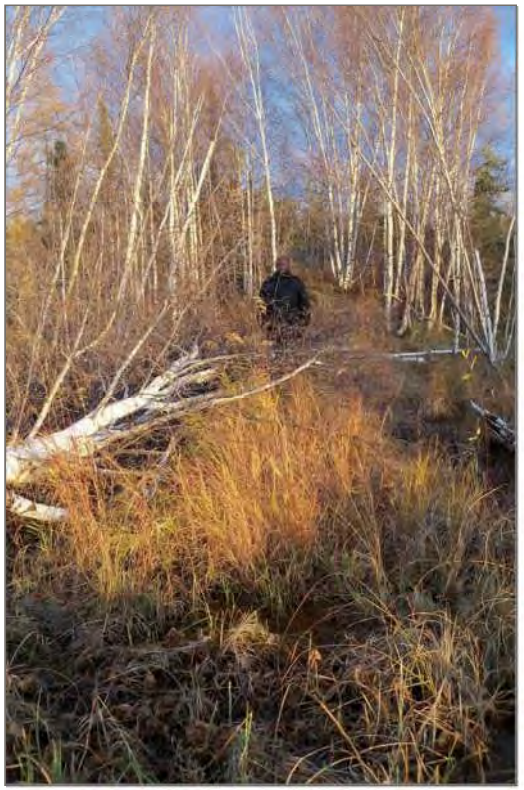


Photo 20: Looking east at the east abutment of Dyke 1, which is preserved due to near-surface bedrock.

Photo 21: Looking upstream at Dyke 1 from marshy area downstream of south pond.

Photo 22: Beavers at work on Dyke 1.

Photo 23: Looking downstream from Dyke 1. South pond flows south into Fiddler's Lake.

Photo 24: Looking east from west abutment of Dyke 2. Disturbed site indicators include grasses, birch and willow.

Photo 25: Looking upstream at well-vegetated downstream face of Dyke 2 near west end.

Photo 26: Looking upstream towards Trapper's Lake from near west end of Dyke 2. Small stream flows from lake through pond in marsh to dyke.

Photo 27: Looking upstream at small stream flowing towards Dyke 2.

APPENDIX A
EBA'S GENERAL CONDITIONS

GENERAL CONDITIONS

GEOTECHNICAL REPORT

This report incorporates and is subject to these “General Conditions”.

1.0 USE OF REPORT AND OWNERSHIP

This geotechnical report pertains to a specific site, a specific development and a specific scope of work. It is not applicable to any other sites nor should it be relied upon for types of development other than that to which it refers. Any variation from the site or development would necessitate a supplementary geotechnical assessment.

This report and the recommendations contained in it are intended for the sole use of EBA’s Client. EBA does not accept any responsibility for the accuracy of any of the data, the analyses or the recommendations contained or referenced in the report when the report is used or relied upon by any party other than EBA’s Client unless otherwise authorized in writing by EBA. Any unauthorized use of the report is at the sole risk of the user.

This report is subject to copyright and shall not be reproduced either wholly or in part without the prior, written permission of EBA. Additional copies of the report, if required, may be obtained upon request.

2.0 ALTERNATE REPORT FORMAT

Where EBA submits both electronic file and hard copy versions of reports, drawings and other project-related documents and deliverables (collectively termed EBA’s instruments of professional service), only the signed and/or sealed versions shall be considered final and legally binding. The original signed and/or sealed version archived by EBA shall be deemed to be the original for the Project.

Both electronic file and hard copy versions of EBA’s instruments of professional service shall not, under any circumstances, no matter who owns or uses them, be altered by any party except EBA. EBA’s instruments of professional service will be used only and exactly as submitted by EBA.

Electronic files submitted by EBA have been prepared and submitted using specific software and hardware systems. EBA makes no representation about the compatibility of these files with the Client’s current or future software and hardware systems.

3.0 ENVIRONMENTAL AND REGULATORY ISSUES

Unless stipulated in the report, EBA has not been retained to investigate, address or consider and has not investigated, addressed or considered any environmental or regulatory issues associated with development on the subject site.

4.0 NATURE AND EXACTNESS OF SOIL AND ROCK DESCRIPTIONS

Classification and identification of soils and rocks are based upon commonly accepted systems and methods employed in professional geotechnical practice. This report contains descriptions of the systems and methods used. Where deviations from the system or method prevail, they are specifically mentioned.

Classification and identification of geological units are judgmental in nature as to both type and condition. EBA does not warrant conditions represented herein as exact, but infers accuracy only to the extent that is common in practice.

Where subsurface conditions encountered during development are different from those described in this report, qualified geotechnical personnel should revisit the site and review recommendations in light of the actual conditions encountered.

5.0 LOGS OF TESTHOLES

The testhole logs are a compilation of conditions and classification of soils and rocks as obtained from field observations and laboratory testing of selected samples. Soil and rock zones have been interpreted. Change from one geological zone to the other, indicated on the logs as a distinct line, can be, in fact, transitional. The extent of transition is interpretive. Any circumstance which requires precise definition of soil or rock zone transition elevations may require further investigation and review.

6.0 STRATIGRAPHIC AND GEOLOGICAL INFORMATION

The stratigraphic and geological information indicated on drawings contained in this report are inferred from logs of test holes and/or soil/rock exposures. Stratigraphy is known only at the locations of the test hole or exposure. Actual geology and stratigraphy between test holes and/or exposures may vary from that shown on these drawings. Natural variations in geological conditions are inherent and are a function of the historic environment. EBA does not represent the conditions illustrated as exact but recognizes that variations will exist. Where knowledge of more precise locations of geological units is necessary, additional investigation and review may be necessary.

7.0 PROTECTION OF EXPOSED GROUND

Excavation and construction operations expose geological materials to climatic elements (freeze/thaw, wet/dry) and/or mechanical disturbance which can cause severe deterioration. Unless otherwise specifically indicated in this report, the walls and floors of excavations must be protected from the elements, particularly moisture, desiccation, frost action and construction traffic.

8.0 SUPPORT OF ADJACENT GROUND AND STRUCTURES

Unless otherwise specifically advised, support of ground and structures adjacent to the anticipated construction and preservation of adjacent ground and structures from the adverse impact of construction activity is required.

9.0 INFLUENCE OF CONSTRUCTION ACTIVITY

There is a direct correlation between construction activity and structural performance of adjacent buildings and other installations. The influence of all anticipated construction activities should be considered by the contractor, owner, architect and prime engineer in consultation with a geotechnical engineer when the final design and construction techniques are known.

10.0 OBSERVATIONS DURING CONSTRUCTION

Because of the nature of geological deposits, the judgmental nature of geotechnical engineering, as well as the potential of adverse circumstances arising from construction activity, observations during site preparation, excavation and construction should be carried out by a geotechnical engineer. These observations may then serve as the basis for confirmation and/or alteration of geotechnical recommendations or design guidelines presented herein.

11.0 DRAINAGE SYSTEMS

Where temporary or permanent drainage systems are installed within or around a structure, the systems which will be installed must protect the structure from loss of ground due to internal erosion and must be designed so as to assure continued performance of the drains. Specific design detail of such systems should be developed or reviewed by the geotechnical engineer. Unless otherwise specified, it is a condition of this report that effective temporary and permanent drainage systems are required and that they must be considered in relation to project purpose and function.

12.0 BEARING CAPACITY

Design bearing capacities, loads and allowable stresses quoted in this report relate to a specific soil or rock type and condition. Construction activity and environmental circumstances can materially change the condition of soil or rock. The elevation at which a soil or rock type occurs is variable. It is a requirement of this report that structural elements be founded in and/or upon geological materials of the type and in the condition assumed. Sufficient observations should be made by qualified geotechnical personnel during construction to assure that the soil and/or rock conditions assumed in this report in fact exist at the site.

13.0 SAMPLES

EBA will retain all soil and rock samples for 30 days after this report is issued. Further storage or transfer of samples can be made at the Client's expense upon written request, otherwise samples will be discarded.

14.0 INFORMATION PROVIDED TO EBA BY OTHERS

During the performance of the work and the preparation of the report, EBA may rely on information provided by persons other than the Client. While EBA endeavours to verify the accuracy of such information when instructed to do so by the Client, EBA accepts no responsibility for the accuracy or the reliability of such information which may affect the report.

From:	Miki Ehrlich
To:	permits@mvlwb.com
Subject:	FW: 2011 LAGOON DAM INSPECTION REPORT
Date:	Wednesday, April 25, 2012 2:55:59 PM
Attachments:	DOCS-#302099-v1-2011_LAGOON_DAM_INSPECTION_REPORT.PDF

Please post to MV2009L3-0007 – Reports and Studies – Inspection
File title: MV2009L3-0007 – Lagoon Dam Inspection Report – Apr17-12
Thanks!

From: Wendy Alexander [mailto:walexander@yellowknife.ca]
Sent: Tuesday, April 17, 2012 4:21 PM
To: 'Miki Ehrlich (mehrlich@mvlwb.com)'
Subject: 2011 LAGOON DAM INSPECTION REPORT

Hi Miki,

Attached is the Lagoon Dam Inspection report for the fall of 2011. The lateness of the submission is due to the inspection of the F9 control structure, which was required to be done in 2011 and forms part of the report. It was determined that several control structures were built around Trapper's Lake in order to alter its drainage path away from the sewage lagoon. The process for locating all of the structures was lengthy and has resulted in the submission of the report later than the 60 day requirement outlined in the water licence.

If you have any questions regarding this report, please let me know.

Regards,

Wendy Alexander, P.Eng.
Municipal Works Engineer
City of Yellowknife
PO Box 580, 4807-52 Street
Yellowknife, NT X1A 2N4
Phone: 867-920-5689