

The Calgary Airport Authority

Parallel Runway Project

Volume V – Item 3

Surface Water and Aquatic Resources

Baseline Report

The bottom half of the page features a large, vertical gradient background transitioning from orange on the left to purple on the right. The word 'Report' is written in a large, white, sans-serif font on the left side of this gradient.

Report

The Calgary Airport Authority

**Parallel Runway Project
Volume V – Item 3
Surface Water and Aquatic Resources
Baseline Report**

Prepared by:

AECOM

2540 Kensington Road NW
Calgary, AB, Canada T2N 3S3
www.aecom.com

403 270 9200 tel
403 270 0399 fax

Project Number:

60114017

Date:

June 2010

April 14, 2010

Project Number: 60114017

Peter Rudolf
Director Airfield Development
Calgary Airport Authority
2000 Airport Road N.E.
Calgary, AB
T2E 6WS

Dear Peter:

**Re: Baseline Study – Surface Water and Aquatic Resources
Comprehensive Study Environmental Assessment
Parallel Runway Project 16L-34R - Runway Development Program**

This report presents the results of the baseline study for Surface Water and Aquatic Resources conducted by AECOM Canada Ltd. for the Parallel Runway Project 16L-34R and connecting taxiways to be constructed at the Calgary International Airport in Alberta.

The report is part of the Comprehensive Study – Environmental Assessment and forms part of Volume V of that study.

If you have any questions concerning this report, please contact the undersigned at (403) 717-3498.

Sincerely,
AECOM Canada Ltd.



Barry Hawkins Project Manager
barry.hawkins@rwy-yyc.com

TJ:
Encl.
cc: File

Acronyms

Abbreviation	Full text
ASRD	Alberta Sustainable Resource Development
The Authority	Calgary Airport Authority
BOD	Biological Oxygen Demand
BRBC	Bow River Basin Council
BTEX	Benzene, Toluene, Ethylbenzene, Xylene
CEAA	Canadian Environmental Assessment Act
CCME	Canadian Council of Ministers of the Environment
COD	Chemical Oxygen Demand
COSEWIC	Committee on the Status of Endangered Wildlife in Canada
CS	Comprehensive Study
EA	Environmental Assessment
FWMIS	Alberta Environment Fisheries & Wildlife Management Information System
LSA	Local Study Area
PHC	Petroleum Hydrocarbons
PRP	Parallel Runway Project
RSA	Regional Study Area
SARA	Species at Risk Act
TSS	Total Suspended Solids
VC	Valued Component
YYC	Calgary International Airport

Executive Summary

This Surface Water and Aquatic Resources Baseline Report forms part of a Comprehensive Study for the Parallel Runway Project at Calgary International Airport. The Comprehensive Study was prepared as part of an environmental assessment and approval process initiated by the Calgary Airport Authority.

There are no lakes or streams within the local study area. All surface runoff exiting Calgary International Airport property is discharged either directly or via the City's stormwater system into Nose Creek, a fish-bearing watercourse. Nose Creek is considered to be a highly impacted watercourse throughout most of its length. The creek exhibits poor water quality as a direct result of the high loading of contaminants such as suspended solids and nutrients from the surrounding basin, particularly in upstream and upslope areas outside of the Local Study Area and Regional Study Area.

A stormwater drainage management plan was developed in 2000 and updated in 2003 for the entire Calgary International Airport campus including the Parallel Runway Project lands. Currently, there is little development or runoff within the Local Study Area. Within the Regional Study Area, runoff comes from the existing Calgary International Airport facilities and operations, and from other commercial and residential developments in the area. The design criterion for all discharges that are allowed into Nose Creek from the Authority's storm management system is 2.6 L/s/ha peak flow for the 1:100 year event. The stormwater drainage system for the Parallel Runway Project will meet these criteria.

The most widely handled and managed product within Calgary International Airport is the de-icing compound glycol that is a potential surface water contaminant. Recovered glycol is either sent to the City of Calgary treatment plant or is stored in a retention pond and treated to the appropriate guideline before release into the stormwater system. Several spills of glycol have occurred in the past, but these were mitigated internally and none were detected to have exited Calgary International Airport property and entered surface waters.

There have been two recorded exceedences of the water quality objective for glycol which originated from within the South Corner Catchment area. Both exceedences were detected by the Authority's stormwater monitoring program during routine sampling and detected in one of the stormwater drain. One occurrence in February 2008 was the result of de-icing activities during an extreme snow fall followed by a period of extremely warm weather. The second, in April 2008, was related to improper operation of stormwater infrastructure. Modifications to the glycol management program by the relevant Calgary International Airport operator have resolved the issue which has been confirmed by subsequent monitoring results.

Table of Contents

Acronyms

Executive Summary

	page
1. Introduction	1
1.1 Project Objectives	2
2. Study Area	2
2.1 Local Study Area	2
2.2 Regional Study Area	2
3. Valued Components	5
3.1 Surface Water Quantity	5
3.2 Surface Water Quality	6
4. Methods	7
5. Existing Conditions	8
5.1 Overview	8
5.2 Water Quantity	9
5.3 Water Quality	13
6. References	17
7. Personal Communications	18

Statement of Qualifications and Limitations

Figures

Figure 1	Local and Regional Study Areas.....	3
Figure 2	Surface Water Features.....	4
Figure 3	Water Sampling Sites.....	10
Figure 4	Catchments, Ponds and Drainage Paths.....	11

List of Tables

Table 1	Identification of Surface Water Issues and Valued Components	5
Table 2	Fish Species of Nose Creek (FWMIS 2009).....	8
Table 3	Summary of Field Data 2008	15
Table 4	Airport Water Quality Objectives for-end-of Pipe Discharges (Transport Canada Airports Group 1995).....	15
Appendix A	Nose Creek and West Nose Creek Water Quality 2009	

1. Introduction

The Surface Water and Aquatic Resources Baseline Report form part of and provide background documentation and support to a Comprehensive Study (CS) that is being prepared for the Parallel Runway Project (PRP) at the Calgary International Airport (YYC). The CS is being prepared as part of an environmental assessment (EA) and approval process mounted by the Calgary Airport Authority (the Authority). The process being followed by YYC EA shadows the process that would be followed under the *Canadian Environmental Assessment Act* (CEAA).

The PRP consists of the following components:

- A 4,267 m x 60 m runway (14,000 ft x 200 ft)
- Associated taxiways
- A perimeter road with security fencing
- Grading of workspace to the east of the proposed runway
- Visual navigation aids
- Electronic navigation aids
- A maintenance building
- A field electric centre
- Changes to airside/groundside roads necessitated by construction of the runway
- Closure of Barlow Trail between 48 Avenue and Airport Road
- A taxiway underpass (designated Taxiway J Underpass) servicing the airport's cargo area for airport service vehicles to pass under one of the taxiways
- Utility services to the runway including some changes to the airfield storm drainage system
- A taxiway underpass (designated Taxiway F Underpass)

Further details regarding the process and project can be found in Volume II, Chapter 5 of the CS.

As part of the CS, a series of baseline studies have been undertaken to describe the biophysical, socio-economic, and cultural resource conditions within the Local Study Area (LSA) and Regional Study Area (RSA) that surround YYC. In total, 13 baseline studies have been undertaken:

- Soils and Terrain
- Vegetation
- Surface Water and Aquatics Resources
- Wildlife & Wildlife Habitat
- Groundwater
- Transportation
- Land Use
- Noise
- Climate & Greenhouse Gases
- Air Quality
- Cultural Resources
- Socio-economics
- Human Health

The results of each of the baseline studies were documented in stand-alone technical reports such as this one. In each case, a draft was prepared and made available for public, stakeholder, and government agency comment. The final baseline conditions will be summarized in each individual assessment chapter (Volume III), with each of the stand-alone technical reports becoming an appendix to the CS.

Surface water was included as a component in the CS because of its importance to environmental health, the public, and because the PRP could potentially affect it. For the purposes of this baseline report, surface water has been described based on its characteristics with respect to: water quantity and water quality. The surface water baseline study documents the existing condition of surface water from the perspective of water quantity and quality within the LSA and RSA prior to the development of the PRP. The report will also address how these existing conditions have affected discharge water quantity and quality and, by extension, aquatic life and human health in the receiving environment.

1.1 Project Objectives

The objectives of the baseline study were to identify the primary surface water valued components (VCs) and to summarize existing data for these components within the LSA and RSA. The baseline information includes data from the existing YYC operations, as well as from within the immediate receiving environment (Nose Creek and the lands encompassing the LSA). It will be used to complete an environmental effects assessment on the VCs from various activities associated with construction and operation of the PRP.

2. Study Area

2.1 Local Study Area

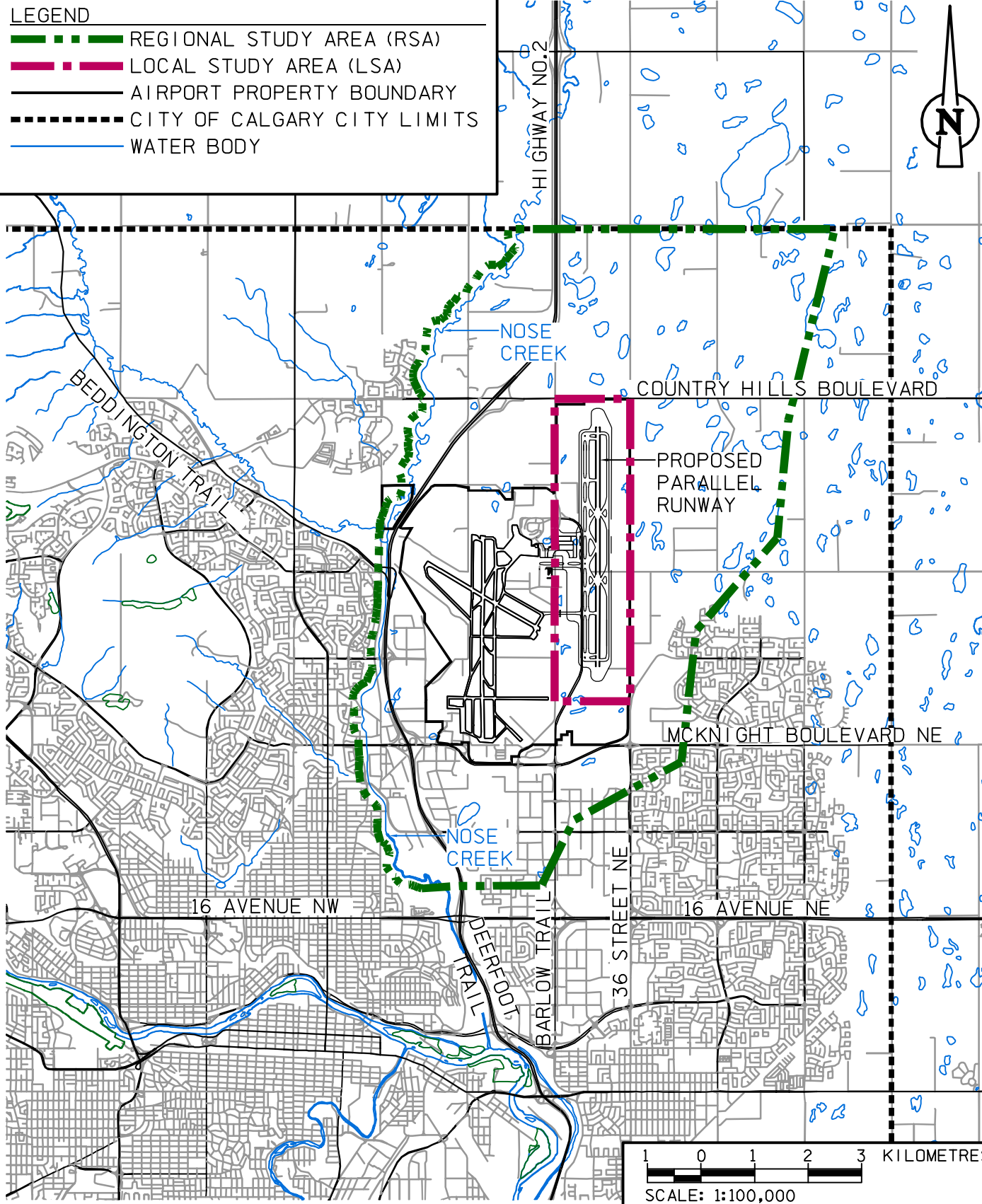
The LSA that has been defined for the baseline includes the actual physical footprint of the PRP. The LSA encompasses the lands that are bounded by 36 Street NE to its east, Deerfoot Trail to its west, Country Hills Boulevard to its north, and McKnight Boulevard to its south (Figure 1).

Ecologically, the LSA is located within the Foothills Fescue Natural sub-region of Alberta. The sub-region is dominated by shortgrass prairie with few naturally treed areas. The LSA is interspersed with permanent and ephemeral pothole sloughs or wetlands. Current land uses within the LSA are agricultural with a scattering of residential acreages and light industrial activities and development parks. The land uses within the area that the PRP would occupy consist primarily of agricultural crop fields in the northern portion and livestock pastures in the southern portion. East of 36 Street NE, land use changes from agricultural to mixed light industrial. A golf course abuts the southern boundary of the LSA (see Volume V, Item 7 of the CS). There are no permanent rivers, streams or lakes within the LSA. There are, however, as noted, a number of ephemeral or seasonal wetland areas or sloughs. There are no active storm runoff control features within the LSA. However, Pond K which is shown in the study area has been constructed in anticipation of the PRP to assist in runoff control during the project's construction period.

2.2 Regional Study Area

The RSA includes the drainage basin around the LSA, which includes a 12 km portion of Nose Creek, drainage control structures that are associated with the existing YYC operations such as storm retention ponds and internal storm runoff conveyance systems, discharge locations, holding ponds, and other such structures (Figure 1). The drainage basin that encapsulates the RSA as defined by local hydrology and topography is shown in Figure 2. Nose Creek receives treated stormwater that is discharged from the existing YYC at a number of locations which are shown on Figure 2. The main tributary to Nose Creek is West Nose Creek which flows into the main creek from the west near Deerfoot Trail at the RSA's western boundary. West Nose Creek does not receive any surface water discharge from the RSA or YYC facilities.

ISS/REV: A
 YYC FILE NAME: 09c16c321_RX.dwg
 Saved By: DAUK, ERIN
 PLOT: 2010/04/14 9:22:07 AM
 A SIZE 8.5" x 11" (215.9mm x 279.4mm)



YYC CALGARY AIRPORT AUTHORITY

The Calgary Airport Authority
 Runway Development Program
 Parallel Runway Project

AECOM

Local and Regional Study Areas

Figure 1

THIS DRAWING, IN ALL FORMS, ELECTRONIC OR HARD COPY, IS THE EXCLUSIVE PROPERTY OF THE CALGARY AIRPORT AUTHORITY AND MUST NOT BE REPRODUCED WITHOUT WRITTEN PERMISSION.

Existing land uses within the RSA consist of facilities associated with YYC and its operations, agricultural, commercial buildings, light industrial parks, golf courses, some scattered residential housing, and associated roadways. Highway 2 (Deerfoot Trail) runs parallel and on the west side of YYC property. Nose Creek and its floodplain are separated from YYC by Deerfoot Trail on the east and by the benchlands and escarpment of the creek to its west. There are numerous developments, both residential and commercial located on these upslope areas adjacent to the Nose Creek valley.

3. Valued Components

VCs are surrogate measures of the general environment that are used to assist in focusing an EA; they can include measures related to species (diversity, numbers, presence/absence), information about habitats and habitat availability measures that are considered to be unique to an area, are valued by the public, play an important role in maintaining environmental health, and are measureable. VCs to be effective should be final recipients of effects from a project activity and must be clearly linked to project activities. For the purposes of the Surface Water Baseline study, water quantity and water quality were chosen as VCs. Water quantity and water quality have the potential to be adversely affected by activities related to the development of the PRP. In Table 1, the effects matrix for surface water as they relate to these two VCs and the PRP are shown. In order for the selected VCs to be used effectively, a baseline of data should exist from which to measure any expected or anticipated changes that may relate to the project. For both of the selected VCs, the required data bases are available. Fish and fish habitat were not selected as appropriate VCs because neither is present or available within the LSA. Both fish and fish habitat are present in portions of the RSA, in for example, Nose Creek; however, selected VCs are capable of acting as a surrogate to determine whether or not effects on these receptors are likely to occur as a result of the PRP. Further, if such effects are projected as being likely to occur, mitigation controls to reduce, minimize or eliminate such effects from occurring will be directed at water quality and quantity control measures.

Table 1 Identification of Surface Water Issues and Valued Components

Issue/Effect	VC	Data or Information	General Project Component or Activity
Degradation of aquatic habitat in Nose Creek (stream incising, sedimentation) from increased surface water discharge from project area	Surface water quantity	Drainage management plan including designed peak runoff, baseline fish, and fish habitat in Nose Creek study area	Construction and operation of runway, stormwater retention capacity
Reduced water quality to Nose Creek from release of hazardous materials and construction/operation of site runoff	Surface water quality	Drainage management plan, baseline water quality from stormwater runoff, and baseline water quality of Nose Creek. Baseline fish and fish habitat in Nose Creek study area.	Construction and operation of runway, plane de-icing, hazardous materials releases, stormwater retention

3.1 Surface Water Quantity

There is a high potential for changes to water quantity or discharge from within the RSA as a direct result of proposed developments within the LSA without mitigation. The primary reason for the increase in potential for changes in this VC is directly related to the increase in hard surface runoff volume that can be anticipated as a result of the PRP. The magnitude and timing of increased discharge volume that could result from the development of the PRP could result in detrimental effects to the receiving environment in Nose Creek. These effects could result from increases in peak flows and their timing. Uncontrolled and more frequent peak flow periods related to storm or snow melt events could also lead to an increased quantity of contaminants being carried by the discharges and being subsequently released

into the receiving environments. The area of the LSA where the PRP project is to be developed is poorly drained as evidenced by the number of ephemeral sloughs present. There are also no creeks or streams to which surface water can be directed. The surface hardening that will result from runway construction and other infrastructure developments will decrease the ability of the area to store and absorb precipitation, which could result in increases to peak runoff. If the anticipated increase in runoff volume is transmitted to Nose Creek by means of storm drainage discharge, increasing stream flow peaks could also occur. Without mitigation, increased flows could cause bank degradation and increased sedimentation in the stream with resulting effects on the life stages or life requisites of fish resident in Nose Creek such as spawning, spawning success, habitat availability, and quality.

3.2 Surface Water Quality

Water quality was selected as a VC (Table 1) because it is a critical component and index of the health of the receiving environment. Further, water quality is directly linked to the aquatic ecosystem, the type and numbers of fish, the quality of fish habitat, the abundance and diversity of aquatic organisms such as benthic invertebrates, and by extension to wildlife, livestock and humans. Water quality has a high potential to be negatively affected by the development of the PRP unless mitigation and control measures are not in place to prevent its degradation. Water quality is easily measured in a replicable manner and YYC has collected and continues to collect information on this VC so that the airport's historical effects can be determined and the effects of the PRP on water quality can be predicted in a reliable and rigorous manner.

Changes to water quality are measured by comparing the concentrations of specific chemicals, or the condition of certain non-chemical and chemical parameters such as Dissolved Oxygen, pH, temperature, Total Suspended Solids (TSS), and Biochemical Oxygen Demand (BOD), at the time of sampling to Canadian Council of Ministers of the Environment (CCME) guidelines or site-specific objectives. It is important to know what baseline water quality conditions are and if baseline conditions exceeded CCME guidelines historically. If such exceedences did occur, in what parameter, by how much, and for how long become the questions that require answering followed by the corrective responses that define the necessary mitigation.

Without site specific mitigation and control, the concentrations of a variety of water quality parameters can be altered and influenced by activities related to the construction, operation, and closure phases of development projects such as the PRP.

Natural water quality is determined by climate, geology and landscape, and can usually be altered as a result of anthropogenic activities. The PRP has the potential during its construction and operations stages to increase loading of TSS, metals, hydrocarbons, and other chemicals to the receiving environment through stormwater drainage. Increased loading levels for these types of parameters could be derived from exposed cuts, road/runway surfaces, and airport operations (de-icing, spills). Increased metal concentration in the receiving environment may have toxic effects on aquatic organisms.

The total load of suspended/dissolved matter, nutrients, and metals that is discharged into a receiving water body and the effect this may have on the aquatic environment (e.g., alteration of pH, alkalinity, or hardness) is dependent upon basin size. Larger basins are able to distribute inputs by means of dilution; for example, over a large surface area, sediments are deposited while the smaller basins cannot achieve this. Therefore, smaller basins are more susceptible to chemical and loading fluxes and will, as a result, be affected for a longer period of time and from an ecological point of view more substantively. Within the RSA and the LSA, the drainage basin that comprises Nose Creek is not considered to be large; similarly,

the ponds that have been retained within the study areas are small. The ponds are, in fact, primarily storm retention ponds and operate as a series of flow through basins which considerably increases their ability to treat stormwater inflows in an effective manner such that the further downstream the pond, the better the water quality should be. The use of nitrogen (N) and phosphorus (P) as fertilizers may be incorporated into operational activities associated with the PRP (e.g., grounds maintenance). This has the potential to introduce an excess of nitrogen (N) or phosphorous (P) into receiving surface water or groundwater. The ratios of the different forms of N and P particularly in surface water can adversely affect the total productivity of aquatic ecosystems. While typically excess phosphorous is implicated in surface water eutrophication, an excess of nitrogen in the system can also contribute to increased productivity if the natural balance of N:P is upset. Increased productivity particularly by various forms of algae and their subsequent decay can lead to severe oxygen depletion in receiving water which, in turn, can potentially make the aquatic environment less healthy or unable to support a diverse fauna.

4. Methods

The baseline study for the project was completed by reviewing the relevant literature and data bases that have been generated for the lands within the LSA and RSA. These information sources included the data gathered in support of the operations of the existing airport such as water quality data bases, storm management plans and system design. The primary sources of information reviewed were:

- Strategic Environmental Assessment of the Calgary International Airport 2004 Master Plan (Jacques Whitford Limited/Axys 2006)
- The Calgary Airport Authority Parallel Runway 16L-34R Engineering and Construction Feasibility Study (UMA Engineering 2007)
- Stormwater Management Master Plan Update, 2003 (UMA Engineering 2003)
- Nose Creek Watershed Management Plan (Palliser Environmental Services 2008)
- Water Quality data collected by YYC since 1980
- Fish and Wildlife Management Information System (FWMIS 2009)
- Maps of the project development and stormwater drainage plan by UMA Engineering Ltd.
- Reference maps
- Regulatory documents
- Other literature sources

The baseline study includes a description of the drainage management plan for existing YYC operations. The existing storm and wastewater management plans provide the basis for storm and runoff management that will be associated with the PRP. In fact, pre-planned and built facilities that will only be functionally incorporated into the YYC storm management system are already present within the LSA. In order to put these management features into context and to comprehend how the entire storm management system will work in the future, the existing system first had to be understood and explained in this baseline report.

5. Existing Conditions

5.1 Overview

There are no permanent lakes or streams within the LSA. There are, however, several seasonal wetlands within the LSA and adjacent to it that contain standing water during some parts of the year. The soils in the LSA drain poorly and the area has extremely low relief which accounts for the presence of the pothole sloughs. At present, the LSA is vegetated by grasses and has a very limited amount of impervious surface. The four lanes of Barlow Trail and two lanes of McCall Way NE are essentially the only significant hard surfaces within the LSA that would be capable of generating runoff. Currently, both roadways drain to vegetated swales and are not connected into any storm drainage system. Precipitation that accumulates within the LSA during storm events infiltrates and is absorbed into the ground and only tends to accumulate to any degree in the wetland areas that are present.

The only watercourse within the RSA is Nose Creek. Nose Creek is a tortuous meandering watercourse that is down slope of the LSA. It is approximately 75 km long and flows into the Bow River approximately 7 km downstream of the RSA.

Table 2 indicates the fish species that occur within Nose Creek according to the Alberta Environment Fisheries and Wildlife Management Information System (FWMIS 2009) database.

Table 2 Fish Species of Nose Creek (FWMIS 2009)

Common Name	Species
Longnose sucker	<i>Catostomus catostomus</i>
White sucker	<i>C. commersoni</i>
Brook stickleback	<i>Culaea inconstans</i>
Lake chub	<i>Couesius plumbeus</i>
Longnose dace	<i>Rhinichthys cataractae</i>
Fathead minnow	<i>Pimephales promelas</i>

Brook stickleback and fathead minnows are fish species that are considered tolerant of environmental extremes such as low pH and dissolved oxygen concentrations, and high water temperatures (Scott and Crossman 1998, Nelson and Paetz 1992). The two species are frequently found together and in habitat in which most other fish species could not survive (Nelson and Paetz 1992). Although none of the fish species resident in Nose Creek are provincially or federally listed as either rare or threatened (ASRD 2005, COSEWIC 2009, SARA 2009), they could still be affected by changes in water quantity and quality. The fish species listed are considered either coarse or forage species and none are of commercial, recreational or sporting importance.

Under the Alberta Environment, Calgary Management Area Codes of Practice Map (Alberta Environment, 2006), Nose Creek is classified as a class D watercourse. A Class D watercourse has no restricted activity period for in-stream works in recognition of its lack of susceptibility to harm of either resident fish or habitat. A class D watercourse may be defined under the code of practice as having a low sensitivity to habitat change and one containing fish of low sensitivity to environmental degradation. Under the code, the definition of fish species reflects the definition used under the Federal *Fisheries Act*.

5.2 Water Quantity

The lands within LSA contribute runoff waters to the North East, Central East and South East catchment areas as shown on Figure 3. Partially as a result of the low relief topography within all of these catchments here is very little natural surface runoff. The majority of the surface within the LSA is also vegetated primarily with grasses which tend to reduce the potential for runoff to be generated and to increase the land's potential for infiltration and internal absorption. In comparison to paved or otherwise hardened surfaces, grassed areas reduce runoff potential from close to 90% of inflow precipitation to approximately 30%. The most significant source of runoff within the LSA at present would be generated by runoff from the four lanes of Barlow Trail which is currently the major access route to the airport and McCall Way NE which is a two lane service road that runs parallel to the current YYC operational area. Runoff that is generated during storm events from these two arterials is currently handled by vegetated swales and ditches, and is not connected into any storm system.

Most precipitation stays within the LSA and is absorbed or infiltrates into the ground. Evapotranspiration is another major route for water removal during the growing season. The North East catchment area of the LSA is currently partly developed as a light industrial area. A storm retention pond, Pond J, is located in this area and is connected to Pond A which is part of the YYC storm management system. Discharge from Pond A is directed to a storm outfall on Nose Creek. Pond K within the Central East Catchment area of the LSA is connected to Pond M within YYC and forms part of the storm management system. Pond K was pre-built to anticipate the need for storm retention within the LSA as the PRP project is built out in the future. The South East Corner Catchment area of the LSA is occupied by a golf course within which are a number of ponds. These ponds are interconnected and discharge towards the south. The collected discharge from the golf course runs along McKnight Boulevard to the west where it eventually enters Nose Creek.

The stormwater ponds within the YYC lands are generally incompatible for nesting or feeding resources for waterfowl. The ponds are typically built with steep rip-rap sides or other bank treatment and support bird wires to mitigate potential bird hazards. These designs are in place to reduce the use of ponds by waterfowl or migratory birds in meeting the Authority's responsibility to provide safe operation for aircraft.

All discharges to Nose Creek from the airport or through YYC storm drainage systems are regulated by YYC under agreement as specified in the Nose Creek Watershed Water Management Plan (Palliser 2008) and volumes are cumulatively not allowed to exceed 2.6 L/s/ha.

The existing storm infrastructure for both the LSA and RSA are shown in Figure 3. Within the RSA, there are numerous sources of runoff from the existing YYC and surrounding developments both upslope and down slope of the LSA. All developed lands surrounding the LSA have stormwater management systems that direct stormwater into the City of Calgary stormwater system. Some overland surface runoff is expected from non-developed lands until these lands are developed and they are incorporated into the City's stormwater system.

A stormwater management plan was developed for YYC in 2000 and updated in 2003. The plan divided the airport lands into 12 major catchments, including three in the LSA. For the purposes of the baseline overview, all of the major catchment areas located within the LSA and RSA will be discussed (Figure 4). There is no direct flow data for water volume exiting YYC. The Authority's 2003 Stormwater Management Master Plan Update (UMA 2003) established a drainage design criterion of 2.6 L/s/ha for the 1:100 year event, which is the permissible maximum release rate to Nose Creek as outlined in the Nose Creek Watershed Water Management Plan (Palliser 2008). All drainage areas were designed to this criterion. The discharge into Nose Creek is controlled by a large 5 foot butterfly valve and a spilling well is located at the actual discharge point to reduce erosion and sedimentation.

The infrastructure that is in place to handle storm runoff and other water runoff that is handled in the YYC system is shown in Figure 3. The details of how each of these systems is interconnected are discussed in the following text which also details which of these systems discharges to Nose Creek either directly or by means of City sewer systems.

In anticipation of the PRP, the LSA was divided into three catchment areas in 2007 (UMA 2007). These are North East, Central East, and South East. The PRP 16L34R will be located within the LSA in the North East and Central East catchments, while the taxiway and other facilities required to support this runway will be situated in the Central East catchment. Within each of these two catchment areas, a storage facility was developed and constructed (e.g., Pond K) to retain and control the release of runoff during early phases of construction.

The Barlow North Tradepark development is located within the North East catchment and is, therefore, included in the LSA. Stormwater from this development area is currently directed to Pond J, which empties into a series of storm sewer pipes before entering Nose Creek near Airport Trail. The remainder of the North East catchment is undeveloped.

The Central East catchment is mostly undeveloped and primarily used for agricultural purposes. This catchment slopes gently from north to south, and it is expected that very little surface runoff currently exits the catchment. Pond K has been constructed in the Central East catchment, and water from the pond enters Pond M, which exits YYC to the City of Calgary's stormwater system at exit point 2B.

The South East Corner catchment is located south of the PRP footprint and outside of the LSA but within the RSA. Drainage within this catchment is collected by a series of small ponds that empty into a stormwater drain that empties into McCall Lake, which then empties into Nose Creek.

Within the RSA and the existing YYC lands, there are nine drainage catchments; however, the four that will be discussed are: the North Central, Central, South Central, and South Corner catchments. Drainage from each of these catchments is directed to stormwater retention ponds before being released into the stormwater system. The fire mock-up facility is located within the Central catchment, and drainage from this facility goes through a filtration system before entering the stormwater system at exit point 2B.

Runoff from the North Central catchment drains into two Groundside ponds (non-glycol contaminated water) and one Airside pond (Pond A) for residual glycol contaminated water storage and treatment. De-icing occurs at the gates in the North Central catchment (Apron II), Apron VII, and on the apron in the South Central Catchment. After de-icing, glycol is captured using vacuum trucks and is taken to the glycol dump station near Pond A (North Retention Pond). Glycol from the dump station is either sent to the City of Calgary's treatment plant or to Pond A for treatment using an aeration system before being released to the stormwater system.

Water from the two Groundside ponds and Pond A enters the City of Calgary's stormwater system and joins the stormwater from the North East catchment (from the LSA).

There are stormwater retention ponds associated with most of the stormwater outlets exiting YYC property. Associated with each pond is a control gate at the outlet that can be used to control the exit of stormwater from YYC property if necessary.

Within the RSA, but outside of YYC property, all surface water runoff goes to Nose Creek. Other inputs to Nose Creek within the RSA come from residential and industrial developments and transportation corridors (Highway 2) via overland flow (for those that don't tie into the existing City of Calgary stormwater sewer system).

5.3 Water Quality

Within the RSA, potential water quality contamination sources and issues were identified by Jacques Whitford (2006) and included the potential release of fuels and glycol into the stormwater system. The presence of petroleum hydrocarbons (PHC) including benzene, toluene, ethylbenzene, and xylene (BTEX) was also indicated from sampling at some groundwater monitoring sites within airport lands (Jacques Whitford 2006), which may also indicate that these potentially toxic hydrocarbons are also contained in storm runoff waters. No fertilizer is used on YYC property; however, a herbicide application program is undertaken each year (Gary Kindrat, YYC Environmental Department, personal communication).

The Authority has had a surface water quality sampling program since 1982. The most recent monitoring data from the sites indicated on Figure 3 are shown in Table 3. Sample points 8 and 9 are old sample points which are identified on Figure 3, but are not part of the monthly sampling routine in recent history.

The surface water quality objectives to which the Authority adheres to are shown in Table 4. Where there is more than one objective for a parameter, the more stringent one applies.

The parameters listed in Tables 3 and 4 coincide with the testing that is completed by the Authority under its surface water monitoring program. The testing parameter list for the various survey sites is adjusted according to the types of expected or potential contaminants that occur at the specific location. The primary parameter list monitored and sampled at all end of pipe locations is; BOD, Glycol, Chemical Oxygen Demand (COD), TSS, pH, and oil and grease. The frequency of monitoring that the Authority follows is also indicated. Where the concentrations of parameters are bolded, this indicates that an exceedence, or concentration greater than the guideline or objective, has been recorded. In addition, the water in Pond A is tested for heavy metals and BTEX along with a suite of inorganic and organic parameters.

Suspended sediment is usually measured as TSS and is typically the most significant contaminant of concern in stormwater being released to surface water. The CCME guideline that the Authority follows for short term (e.g., 24 hr) total suspended sediment exposure due to anthropogenic activities is 25 mg/L when background is less than 250 mg/L, and 10% when background is greater than 250 mg/L. For longer durations, CCME guidelines state that the maximum average increase is 5 mg/L (inputs lasting for 48 hours to 30 days).

Within the RSA, water is sampled on a monthly basis at all stormwater retention pond outlets. The same sampling protocol is followed for Pond A prior to allowing its waters to be released into the stormwater system (Figure 3). No stormwater is released from Pond A, which discharges to Nose Creek, unless its water quality meets the surface water objectives. If water quality parameters at the end-of-pipe sample locations exceed these objectives, then the exceedences are reported to Environment Canada and Alberta Environment. There have been two recorded exceedences of the water quality objective for glycol which originated from within the South Corner Catchment. Both exceedences were detected by the Authority's stormwater monitoring program during routine sampling in one of the stormwater drains (Gary Kindrat, personal communication). One occurrence in February 2008 was the result of de-icing activities during an extreme snowfall followed by a period of extremely warm weather. The second in April 2008 was related to improper operation of stormwater infrastructure. In both cases, investigations were conducted followed by implementing corrective actions and/or procedures. (Gary Kindrat, personal communication). While other types of spills have occurred on YYC property which had the potential to cause contaminants to enter the systems, no other water quality exceedences have been recorded at end-of-pipe sample and discharge locations for water leaving YYC property (Gary Kindrat, YYC Environmental Department, personal communication).

Peak de-icing activity and, therefore, glycol use at YYC takes place between November and March. The current glycol management strategy followed by YYC operations calls for de-icing fluids to be captured from de-icing locations and taken to the glycol dump station. Some glycol could, however, enter Pond A from melt water generated from contaminated snow that is taken to the glycol dirty snow dump, which is a segregated area adjacent to the glycol dump station. Because of the potential risk that this could pose to stormwater quality on discharge, there are no fluid releases from Pond A to the stormwater system during the winter months.

In the lower reaches of Nose Creek, many water quality parameters regularly exceed CCME and Alberta Surface Water Quality Objectives (BRBC 2008b). Some of the parameters that regularly exceed or do not meet minimum standards include the concentrations of dissolved oxygen, nitrate, total ammonia, total phosphorus, and TSS. The Bow River Basin Council (BRBC 2005) rated the water quality in Nose Creek as poor, based on data collected between 1991 and 2001. Data was collected from Nose Creek in 2009 raw data is included in Appendix A. The Bow Basin Watershed Management Plan (BRBC 2008a) states that the water quality objectives for Nose Creek are to provide surface water quality that is appropriate for irrigation use, safe for livestock watering and protected from excessive algal and/or macrophyte growth. The goals of the management plan state that Nose Creek should become capable of maintaining the existing cool-water aquatic ecosystem (fish and benthic invertebrates) presumably without any further degradation occurring.

Bichel *et al* (2009) completed invertebrate sampling at five locations within Nose Creek. Their results indicated that reaches of Nose Creek adjacent to urban areas, such as those sections of the creek within Airdrie and the Calgary city limits, show low benthic invertebrate diversity. In addition, the benthic invertebrate diversity decreased closer to the mouth. This has been attributed to poor water quality and frequent water level fluctuations resulting from various anthropogenic inputs into the watershed.

The Authority has completed water quality sampling at the Nose Creek stormwater outlet near Airport Trail (site 5) from 1999 to 2002 with no chemical exceedences noted for the measured parameters. A summary of these data is provided in Table 3. The water quality objectives for end of pipe discharges to surface water which means to Nose Creek that are authorized for YYC (Transport Canada 1995) are shown in Table 4.

The only permit the Authority holds for any water release/pumping is to the City of Calgary for when the Authority diverts glycol contaminated water to the City's wastewater treatment plant during the glycol application season. No permit is required when the Authority releases to Nose Creek from the glycol pond; however, a number of calls are made to inform the City and Alberta Environment of an impending release complete with results of back to back water quality analysis of the glycol pond water for their records. This is done every time the Authority releases to Nose Creek from the glycol pond.

Table 3 Summary of Field Data 2008

Field Data 2008								
Station Number	Date	BOD mg/l	Glycol mg/l	COD mg/l	pH	TOC mg/l	TSS mg/l	TPH/OG mg/l
1a	24-Oct-2008	154	<10	630	7.6	73	20	0.20
	26-Nov-2008	3210	1120	4000	7.7	1250	32	1.40
	17-Dec-2008	12600	71300	100000	7.5	28400	186	33.30
2a	17-Sep-2008	<2		22.00	8.10	5.00	23.00	<0.2
	24-Oct-2008	4.00	<10	21.00	7.80			<0.2
	27-Nov-2008	2.00	<10	21.00	8.2	9.00	12.00	<0.2
2b	17-Sep-2008	<2		32.00	8.20	11.00	9.00	<0.2
	24-Oct-2008	3.00	<10	42.00	7.40	15.00	2.00	<0.2
	27-Nov-2008	No Flow	No Flow	No Flow	No Flow	No Flow	No Flow	No Flow
3	19-Jun-2008	19.00		63.00	7.60	27.00	10.00	<0.2
	24-Jul-2008	<0.2		38	8	2	1	<0.2
	17-Sep-2008	>2		28.00	8.40	8.00	20.00	<0.2
4c	17-Sep-2008	>2		25	7.9	5.00	13.0	<0.2
	24-Oct-2008	2.00	<10	22.00	7.40	8.00	6.00	<0.2
	27-Nov-2008	4	<10	26	8.2	9.00	6.0	<0.2
5 (upstream)	25-Aug-2009	9.8			8.4		32	
5 (downstream)	25-Aug-2009	8.9			8.4		10	
6	08-Apr-2008	92	<10	208	8.2	73	19	0.20
	09-May-2008	17.00	10.00	68.00	8.00	23.00	43.00	0.20
	19-Jun-2008	4.00		12.00	7.70	7.00	8.00	0.20

Table 4 Airport Water Quality Objectives for-end-of Pipe Discharges (Transport Canada Airports Group 1995)

Parameter	End of Pipe ^{1,2} (Environment Canada)	Protection of Freshwater Aquatic Life ³ (CCME)	Drinking Water ³ (CCME)
Field Measurements			
Dissolved Oxygen	-	5-9.5 mg/L	-
Temperature	Not to alter ambient temp by more than 1°C	-	-
General Characteristics			
pH	6-9	6.5-9	6.5-8.5
Total Suspended Solids	25 mg/L	Variable (depends on background levels- see text)	-
Biochemical Oxygen Demand	20 m/L (5 day)	-	-
Chemical Oxygen Demand	-	-	-
Volatile Organics			
Phenols	0.020 mg/L	0.001 mg/L	0.002 mg/L
BTEX	-	0.3 mg/L	-
Volatile Organics (total)	-	variable	-
Other Organics			
Total Glycols	100 mg/L	-	-
Ethylene Glycol	-	3 mg/L	-
Propylene Glycol	-	74 mg/L	-
Diethyl Glycol	-	31 mg/L	-

Parameter	End of Pipe ^{1,2} (Environment Canada)	Protection of Freshwater Aquatic Life ³ (CCME)	Drinking Water ³ (CCME)
Total Petroleum Hydrocarbons	-	-	-
Oil and Grease	15 mg/L	-	-
Fecal Coliform Bacteria	40/100 ml	100/100 ml	-
<i>E. coli</i> Bacteria	-	200/100 ml	-
Total Organic Carbon	-	-	-
Inorganics (non-metals)			
Ammonia	-	1.37-2.2 mg/L	-
Nitrite	-	0.06 mg/L	4.5 mg/L
Nitrate	-	-	45 mg/L
Total Phosphorus	1.0 mg/L	-	-
Fluoride (total)	-	-	1.5 mg/L
Cyanide (total)	-	-	0.2 mg/L
Cyanide (free)	-	0.05 mg/L	0.025 mg/L
Arsenic	-	0.05 mg/L	0.025 mg/L
Metals			
Aluminum	-	0.005-0.1 mg/L	-
Antimony	-	-	-
Barium	-	-	1.0 mg/L
Boron	-	-	5.0 mg/L
Cadmium	-	0.0002-0.0018 mg/L	0.005 mg/L
Chromium (total)	-	0.002-0.02 mg/L	0.05 mg/L
Cobalt	-	none	-
Copper	-	0.002-0.004 mg/L	≤1.0 mg/L
Iron	-	0.3 mg/L	≤0.3 mg/L
Lead	-	0.001-0.007 mg/L	0.01 mg/L
Manganese	-	-	≤0.05 mg/L
Mercury	-	0.0001 mg/L	0.001 mg/L
Molybdenum	-	-	-
Nickel	-	0.025-0.15 mg/L	-
Selenium	-	0.001	0.01
Silica	-	-	-
Silver	-	0.0001 mg/L	-
Tin	-	-	-
Vanadium	-	-	-
Zinc	-	0.03 mg/L	5 mg/L

¹ Environment Canada (1976)² CEPA (1994)³ CCME (1994)

6. References

Alberta Environment. 2006: Code of Practice 1:525,000 Calgary Management Area Map. Queen's Printer. Edmonton, Alberta.

Alberta Sustainable Resource Development (ASRD). 2005. The General Status of Alberta Wild Species. January 2005, Draft. Edmonton, AB.

Bow River Basin Council. 2005. The 2005 Report on the State of the Bow River Basin. *Bow River Basin Council*, Chapter 6.

Bow River Basin Council. 2008a. Bow Basin Watershed - Water Quality Objectives and Indicators. Prepared by the Bow Basin Watershed Management Plan Technical Committee for the Steering Committee. Accessed at: <http://www.brbc.ab.ca/pdfs/080509Final%20BBWMP%20TC%20March%2014,%202008.pdf>.

Bow River Basin Council. 2008b. Bow Basin Watershed Management Plan. Phase I - Water Quality. Prepared by the Bow Basin Watershed Management Plan Technical Committee for the Steering Committee. Accessed at: http://www.brbc.ab.ca/pdfs/091104-BBWMP%20ICdocument%20v1.0%20Sept%2010_final_.pdf.

Canadian Council of Ministers of the Environment (CCME). 1999. Total particulate matter. Canadian water quality guidelines for the protection of aquatic life. Canadian Environmental Quality Guidelines. Canadian Council of Ministers of the Environment, 1999. 13 pp.

CCME. 1994. Canadian Water Quality Guidelines (1994). Canadian Environmental Quality Guidelines. Canadian Council of Ministers of the Environment, Winnipeg, MB.

Canadian Environmental Protection Act (CEPA). 1994. Guidelines for Glycol Releases from Canadian Airports.

Committee on the status of endangered wildlife in Canada. (COSEWIC) 2009. Committee on the Status of Endangered Wildlife in Canada. Access at: http://www.cosewic.gc.ca/eng/sct0/rpt/rpt_csar_e.cfm [accessed 02 November, 2009].

Bichel, M. Head, B. O'Shea, and D. Principalli. 2009. Nose Creek Invertebrate Water Quality Assessment. Final report prepared for ENSC502 course by A. Accessed at: <http://wcmprod2.ucalgary.ca/ensc/node/68>.

Environment Canada. 1976. Guidelines for Effluent Quality and Wastewater Treatment at Federal Establishments. Environment Canada. Report EPS-1-3C-76-1.

FWMIS. 2009. Sustainable Resources Development Fish and Wildlife Management Information System. Accessed at: http://xnet.env.gov.ab.ca/imf/imf.jsp?site=fw_mis_pub.

Jacques Whitford. 2006. Strategic Environmental Assessment of the Calgary International Airport 2004 Master Plan. Prepared for the Calgary Airport Authority by Jacques Whitford, Calgary, Alberta. 177 pp + Appendices.

Nelson, J.S., M. Paetz. 1992. The Fishes of Alberta. The University of Alberta Press. Edmonton, AB.

Palliser Environmental Services Ltd. (Palliser). 2008. Nose Creek Watershed Water Management Plan. Prepared for the Nose Creek Watershed Partnership. Prepared by Palliser Environmental Services Ltd. Mossleigh, Alberta.

Species at Risk Public Registry. 2009. Accessed at: <http://www.sararegistry.gc.ca> Accessed 5 May, 2009.

Scott, W.B. and E.J. Crossman. 1998. Freshwater fishes of Canada. Galt House Publications Ltd., Oakville, Ontario. 966pp.

Transport Canada Airports Group. 1995. Environment and Support Services Airport Water Quality Manual. Report TP12233.

UMA. 2007. The Calgary Airport Authority Parallel Runway 16L-34R Engineering and Construction Feasibility Study. Prepared for the Calgary Airport Authority by UMA Engineering, Edmonton, Alberta.

UMA. 2003. Stormwater Management Master Plan Update, 2003. Prepared for the Calgary Airport Authority by UMA Engineering, Edmonton, Alberta.

7. Personal Communications

Gary Kindrat, YYC Environment. Personal communication 18 November, 2009.

Statement of Qualifications and Limitations

The attached Report (the “Report”) has been prepared by AECOM Canada Ltd. (“Consultant”) for the benefit of the client (“Client”) in accordance with the agreement between Consultant and Client, including the scope of work detailed therein (the “Agreement”).

The information, data, recommendations and conclusions contained in the Report:

- are subject to the scope, schedule, and other constraints and limitations in the Agreement and the qualifications contained in the Report (the “Limitations”)
- represent Consultant’s professional judgement in light of the Limitations and industry standards for the preparation of similar reports
- may be based on information provided to Consultant which has not been independently verified
- have not been updated since the date of issuance of the Report and their accuracy is limited to the time period and circumstances in which they were collected, processed, made or issued
- must be read as a whole and sections thereof should not be read out of such context
- were prepared for the specific purposes described in the Report and the Agreement
- in the case of subsurface, environmental or geotechnical conditions, may be based on limited testing and on the assumption that such conditions are uniform and not variable either geographically or over time

Unless expressly stated to the contrary in the Report or the Agreement, Consultant:

- shall not be responsible for any events or circumstances that may have occurred since the date on which the Report was prepared or for any inaccuracies contained in information that was provided to Consultant
- agrees that the Report represents its professional judgement as described above for the specific purpose described in the Report and the Agreement, but Consultant makes no other representations with respect to the Report or any part thereof
- in the case of subsurface, environmental or geotechnical conditions, is not responsible for variability in such conditions geographically or over time

The Report is to be treated as confidential and may not be used or relied upon by third parties, except:

- as agreed by Consultant and Client
- as required by-law
- for use by governmental reviewing agencies

Any use of this Report is subject to this Statement of Qualifications and Limitations. Any damages arising from improper use of the Report or parts thereof shall be borne by the party making such use.

This Statement of Qualifications and Limitations is attached to and forms part of the Report.

Appendix A

Nose Creek and West Nose
Creek Water Quality 2009
(Palliser Environmental Services
Ltd. 2009 and City of Calgary)

Nose Creek and West Nose Creek Water Quality 2009

(Palliser Environmental Services Ltd. 2009 and City of Calgary)

Description	Date	Discharge	Temperature	DO	pH	EC	FC	TP	TDP	TDS	TSS	E. Coli	Notes
NC U/S Crossfield	21-Jul-09	0.000											No flow
NC D/S Crossfield	21-Jul-09	0.000	16.1	7.23	8.36	1048	2300	0.205	0.134	684	11		
NC U/S Airdrie	21-Jul-09	0.000											No flow
NC D/S Airdrie	21-Jul-09	0.047	22.5	15.20	9.30	885	62	0.096	0.026	570	18		
NC U/S WNC	21-Jul-09	0.174	24.6	14.01	8.49	1059	169	0.099	0.018	677	31		
WNC @ Bighill Springs Rd.	21-Jul-09	0.009	20.0	13.45	8.71	855	340	0.100	0.071	563	10		
NC U/S Crossfield	31-Aug-09	0.000											No flow
NC D/S Crossfield	31-Aug-09	0.000											No flow
NC U/S Airdrie	31-Aug-09	0.000											No flow
NC D/S Airdrie	31-Aug-09	0.003	20.5	14.91	8.96	979	16	0.089	0.018	585	17		
NC U/S WNC	31-Aug-09	0.051	14.3	5.44	8.33	1380	400	0.068	0.024	886	15		
WNC @ Bighill Springs Rd.	31-Aug-09	0.010	15.2	10.96	8.86	929	123	0.062	0.039	594	6		
NC U/S Crossfield	29-Sep-09	0.000											No flow
NC D/S Crossfield	29-Sep-09	0.000											No flow
NC U/S Airdrie	29-Sep-09	0.000											No flow
NC D/S Airdrie	29-Sep-09	0.000	10.7	13.52	8.89	1125	52	0.067	0.026	765	17		
NC U/S WNC	29-Sep-09	0.020	7.6	8.40	8.65	1230	222	0.075	0.031	729	18		
WNC @ Bighill Springs Rd.	29-Sep-09	0.008	8.2	11.06	8.74	984	11	0.092	0.016	650	13		
NC U/S Crossfield	30-Oct-09	0.000											No flow
NC D/S Crossfield	30-Oct-09	0.000											No flow
NC U/S Airdrie	30-Oct-09	0.103	0.9	11.27	8.67	1545	38	2.760	2.600	1037	4		
NC D/S Airdrie	30-Oct-09	0.110	3.6	11.47	8.90	1104	9	0.119	0.014	726	36		
NC U/S WNC	30-Oct-09	0.160	1.5	11.99	8.87	1277	66	0.068	0.014	806	18		
WNC @ Bighill Springs Rd.	30-Oct-09	0.020	2.2	15.95	8.72	1040	16	0.043	0.019	666	9		
Nose Creek at the Mouth	19-Jan-09		0.7	13.18	8.04	1514		0.091	0.036		25	>2419	
Nose Creek at the Mouth	10-Feb-09		0.4	11.70	8.09	988		0.116	0.050		38	1732.9	
Nose Creek at the Mouth	16-Mar-09		0.5	12.24	7.91	841		0.313	0.203		65	755.5	
Nose Creek at the Mouth	13-Apr-09		6.3	9.34	7.96	600		0.459	0.220		145	40.8	
Nose Creek at the Mouth	11-May-09		12.2	10.05	8.55	1136		0.157	0.026		50	686.7	
Nose Creek at the Mouth	8-Jun-09		11.9	9.49	8.43	1213		0.148	0.038		32	1986.3	

Description	Date	Discharge	Temperature	DO	pH	EC	FC	TP	TDP	TDS	TSS	E. Coli	Notes
Nose Creek at the Mouth	6-Jul-09		18.0	1.64	7.66	1007		0.126	0.019		14	547.5	
Nose Creek at the Mouth	4-Aug-09		14.7	6.25	8.04	427		0.289	0.030		221	>2419	
Nose Creek at the Mouth	31-Aug-09		12.9	8.06	8.32	948		0.073	0.023		21	135.4	
Nose Creek at the Mouth	28-Sep-09		9.6	7.90	8.37	1312		0.060	0.012		12	133.6	
Nose Creek at the Mouth	26-Oct-09		4.5	10.51	8.27	1167		0.078	0.015		21	>2419	
Nose Creek at the Mouth	23-Nov-09		1.3	10.40	8.33	1243		0.090	0.044		10	2419.6	
Nose Creek at 15 St	19-Jan-09		0.3	3.49	7.74	1710		0.104	0.075		9	52	
Nose Creek at 15 St	10-Feb-09		1.1	3.40	7.81	2101		0.080	0.053		5	16	
Nose Creek at 15 St	16-Mar-09		1.3	11.34	8.03	1878		0.247	0.197		7	101.7	
Nose Creek at 15 St	13-Apr-09		6.8	8.31	7.85	520		0.483	0.289		114	2	
Nose Creek at 15 St	11-May-09		12.9	9.55	8.65	1183		0.250	0.055		61	9.7	
Nose Creek at 15 St	8-Jun-09		10.8	9.71	8.28	917		0.218	0.075		34	224.7	
Nose Creek at 15 St	6-Jul-09		18.6	5.90	8.64	1443		0.247	0.132		44	365.4	
Nose Creek at 15 St	4-Aug-09		13.9	5.33	8.03	511		0.276	0.040		113	2419.6	
Nose Creek at 15 St	31-Aug-09		14.7	6.56	8.77	1111		0.108	0.028		28	435.2	
Nose Creek at 15 St	28-Sep-09		7.3	8.27	8.63	1430		0.116	0.019		43	111.2	
Nose Creek at 15 St	26-Oct-09		2.4	11.18	8.43	1112		0.056	0.019		14	34.5	
Nose Creek at 15 St	23-Nov-09		0.8	12.80	8.55	1560		0.666	0.474		11	1	
West Nose Creek at Mouth	6-Jul-09		16.1	7.39	8.08	956		0.063	0.020		29	290.9	
West Nose Creek at Mouth	4-Aug-09		14.3	6.81	7.99	323		0.389	0.061		262	>2419	
West Nose Creek at Mouth	31-Aug-09		16.8	6.10	8.33	999		0.025	0.009		20	307.6	
West Nose Creek at Mouth	28-Sep-09		7.2	9.17	8.44	1070		0.026	0.004		10	50.4	
West Nose Creek at Mouth	26-Oct-09		3.8	11.25	8.41	964		0.036	0.013		17	42.8	
West Nose Creek at Mtn View Rd	19-Jan-09		0.4	14.24	8.16	860		0.131	0.026		68	>2419	
West Nose Creek at Mtn View Rd	10-Feb-09		0.8	12.00	8.27	479		0.087	0.025		65	25.9	
West Nose Creek at Mtn View Rd	16-Mar-09		0.9	12.38	8.10	782		0.247	0.188		33	127.4	
West Nose Creek at Mtn View Rd	13-Apr-09		3.6	10.00	8.01	506		0.459	0.220		89	14.5	
West Nose Creek at Mtn View Rd	11-May-09		10.0	12.09	8.46	838		0.045	0.016		5	74.9	
West Nose Creek at Mtn View Rd	8-Jun-09		8.6	11.30	8.43	927		0.055	0.016		9	166.4	
West Nose Creek at Mtn View Rd	6-Jul-09		16.4	7.93	8.22	802		0.040	0.025		6	613.1	
West Nose Creek at Mtn View Rd	4-Aug-09		14.4	6.55	8.18	734		0.049	0.024		6	1119.9	
West Nose Creek at Mtn View Rd	31-Aug-09		12.9	7.46	8.38	733		0.025	0.014		4	816.4	
West Nose Creek at Mtn View Rd	28-Sep-09		5.6	8.49	8.36	792		0.038	0.011		31	307.6	
West Nose Creek at Mtn View Rd	26-Oct-09		2.3	11.70	8.40	848		0.044	0.015		32	2419.6	
West Nose Creek at Mtn View Rd	23-Nov-09		0.8	9.87	8.20	504		0.037	0.011		22	38.8	