TETRA TECH

December 3, 2013 1312940100-LTR-V0004-00

Manitoba Conservation and Water Stewardship
Environmental Approvals Branch
123 Main Street, Suite 160
Winnipeg, MB R3C 1A5

Attention: Mr. Bruce Webb, P.Eng.
Water Development & Control Assessment Officer

Subject **Remediation of Omands Creek Dublin to Saskatchewan Avenues, Development Environmental Assessment Report**

Dear Mr. Webb:

Please find enclosed 5 hard copes (paper) and 1 electronic copy (CD) of the Remediation of Omands Creek, Dublin to Saskatchewan Avenues Development Environmental Assessment Report.

Sincerely

Ryan Wizbicki, P.Eng.
Project Manager

RW/gs

Attachments

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Report to:

MANITOBA CONSERVATION

Remediation of Omands Creek, Dublin to Saskatchewan Avenues Development Environmental Assessment Report

Document No. 1312940100-REP-V0001-00

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REVISION HISTORY

REV. NO	ISSUE DATE	PREPARED BY AND DATE	REVIEWED BY AND DATE	APPROVED BY AND DATE	DESCRIPTION OF REVISION

EXECUTIVE SUMMARY

Background

The City of Winnipeg intends to remediate a portion of Omands Creek, between Dublin Avenue and Saskatchewan Avenue, immediately east of the McCrossen Street right of way and west of the former Dominion Bride Operations yard at 1460 Dublin Avenue in Winnipeg. This section of Omands Creek is an artificial channel constructed to reroute some of the Colony Creek system directly into the Assiniboine River. During the early 1900s, Omands Creek was diverted to its current configuration. Recent environmental site assessments have determined that surface soils along the creek and sediment within Omands Creek are contaminated with metals and PAHs. Geotechnical assessments have also found the creek banks to be unstable to conduct remedial activities.

Project Components

The Omands Creek Remediation Project is comprised of remediation of creek bed and banks sediment and reconstruction of Omands Creek bed and banks. A significant consideration in the design of the reconstruction of Omands Creek following remediation was to enhance habitat and erosion protection through the re-contouring of the stream banks to a more stable configuration, placement of clean fill to bring the channel back to grade, installation of rock structures for aquatic habitat enhancement and erosion protection, and re-vegetation of the banks of Omands Creek.

Document Contents

This EIS has been organized under the following main headings:

Section 1: Introduction – Provides a general overview of the Project, information about the City of Winnipeg, background, the regulatory setting and proposed Project schedule.

Section 2: Project Description – Provides a detailed overview of the Project including the Project setting, components, construction activities, construction schedule and health safety and environment plan.

Section 3: Existing Environment – Provides an overview of existing environmental characteristics of the Project site and surrounding area.

Section 4: Effects Assessment, Mitigation and Monitoring – Describes the environmental assessment approach, potential Project related effects on the physical,

terrestrial, aquatic and human environments, and the significance of those effects. Also describes proposed mitigation measures and monitoring procedures during construction.

Effects Assessment, Mitigation and Monitoring

A details list of the potential environmental effects of the Project during construction is presented in Table E1. Potential effects are listed by type and source and include the mitigation measures.

Significance of Effects

All potential effects are mitigated through preventative measure designed into the Project or have minor residual effects.

Table E.1 Summary of the Environmental Impact Assessment for the Remediation of the Former Dominion Bridge Operations Yard during Construction.

Factor	Potential Effect	Assessment of Effects	Residual Effect
Physical Environment			
Air Quality	Dust and exhaust emissions	Limited, short-term, indistinguishable from adjacent background sources	None
Noise and Vibration	Vibration from construction activities such as heavy equipment operation	Limited, short-term, indistinguishable from adjacent background sources	None
Soil Chemistry and Quality	Spills and fugitive contaminants	Project involves remediation of soil contamination therefore all necessary control and clean-up equipment already at site	Positive and long-term
Hydrogeology	Spills and fugitive contaminants	Project involves remediation of soil contamination therefore all necessary control and clean-up equipment already at site	Positive and long-term
Terrestrial Environment			
Vegetation	Clearing vegetation to access contaminated soils and sediments	Re-vegetate with native species; make site available for community-led habitat enhancements	Positive and long-term
Wildlife and Habitat	Dust and exhaust emissions	Re-vegetate with native species; make site available for community-led habitat enhancements	Positive and long-term
Aquatic Environment			
Surface Hydrology	Isolation of stream to conduct remediation and reconstruction works	Limited and short-term; increased flow capacity	Positive and long-term
Shoreline and Creek bank Stability	Remediation and reconstruction works	Channel is unstable and reconstruction will result in stable channel	Positive and long-term
Surface Water Quality	Spills and fugitive contaminants	Project involves remediation of soil contamination that are a potential source of water quality impacts	Positive and long-term
Sediment Quality	Spills and fugitive contaminants	Project involves remediation of soil contamination	Positive and long-term
Fish and Fish Habitat	Isolation of the channel and remediation and reconstruction works in the channel	Project involves remediation of soil contamination and impacts to water quality; reconstruction will result in a stable channel and additional habitat features will improve habitat heterogeneity at site	Positive and long-term
Human Environment			
Human Health and Safety	Potential interactions with the public during works; worker safety	Site is currently an industrial site and will remain secure until made available to the public; site specific safety plans for work at site; limited to Project activities	None
Existing or Planned Land Use	Site converted to green space with public access	Site converted to green space with public access	Positive and long-term
Aesthetics	Site converted to green space with public access	Site converted to green space with public access	Positive and long-term
Effects of the Environment on the Project			
Climate change	Potential increases in precipitation and therefore flow	Reconstruction will increase flow capacity of the channel	Positive and long-term

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1.0 INTRODUCTION

The City of Winnipeg is conducting remediation activities at the former Dominion Bridge Operations Yard. The Project site, including the reach of Omands Creek running along the west side, has been designated a contaminated site under the Manitoba *Contaminated Sites Remediation Act* and classified as a Class 1 site (high priority for action) under the National Classification System for Contaminated Sites. The upland works, including surface soil remediation and improvements in site drainage, are being conducted as per a Director's Remediation Order issued pursuant to the *Contaminated Sites Remediation Act* (CSRA). As the upland remediation works do not require a Manitoba Environment Act License (EAL) to proceed, the upland works have not been included in the scope of the Environment Act proposal (EAP) (Appendix A) and environmental assessment report (EAR). A receiving facility approval to accept and treat the impacted soils and sediments recovered by the upland and Project works is covered by a separate process and is therefore not included in the scope of the EAP and EAR. The scope of the EAP and EAR is therefore the remediation works proposed for the Omands Creek channel between Dublin and Saskatchewan avenues (the Project).

1.1 PROJECT OVERVIEW

The Project site was subject to two previous environmental site assessments: Wardrop Engineering (1999) and AECOM (2011a). Remedial options were subsequently developed by AECOM (2011b) in consultation with the City of Winnipeg and Manitoba Conservation. Various remediation options were considered and only excavation of contaminated materials and treatment at an approved, offsite facility was considered viable. A "do nothing" approach was not considered as leaving the contaminants in situ did not address the existing risks to human health and safety and the environment.

The proposed Project includes the excavation of bank and streambed materials to a depth of 1 m and removal to an approved, offsite facility for treatment. The stream banks will be re-contoured to provide a stable profile and the streambed will be backfilled with clean material and placement of rock structures within the creek and re-vegetation of the banks to enhance habitat and erosion control. The final bank slope will be completed to a 4 m horizontal to 1 m vertical for increased bank stability. The reduced bank slope will increase the flow capacity of the channel which will reduce water velocities during high-water events and therefore reduce the overall potential for erosion. The reconstruction of the channel will have a beneficial effect on surface hydrology.

1.2 PROJECT SCHEDULE

The upland surface soil remediation works at the Former Dominion Bridge Operations yard began in early November 2013 with completion of this stage of remediation by December 20, 2013. The proposed schedule for the remediation of Omands Creek is to begin in early January 2013 and to be completed by February 28, 2013. Project components requiring approvals or permits will not commence until the necessary approvals and permits have been received.

1.3 PROPONENT

Project Name:	Remediation of the Former Dominion Bridge Operations Yard
Proponent:	City of Winnipeg
Contact:	Tracy Stople 4th Floor, 185 King Street Winnipeg, Manitoba R3B 1J1 Phone: (204) 986-2221 Fax: (204) 986-7311
Environmental Approvals Agent:	Tetra Tech WEI Inc.
Contact (Tetra Tech WEI Inc.):	Ryan Wizbicki 400 - 161 Portage Avenue East Winnipeg, Manitoba R3B 0Y4 Phone: (204) 954-6800 Fax: (204) 988-0546

1.4 REGULATORY FRAMEWORK

The Project will require reviews or permits by federal, provincial, and municipal agencies (Table 1.1).

Table 1. 1 Regulatory Reviews and Permits required for the Omands Creek Project.

Permit/Regulation/Act	Agency	Status
Fisheries Act	Fisheries and Oceans Canada	This submission
Navigable Waters Protection Act	Transport Canada	This submission
Remedial Action Plan	Manitoba Conservation	Approved
Environment Act License	Manitoba Conservation	This submission
Waterway Authorization	Manitoba Infrastructure & Transportation	Submitted
Waterway Permit	City of Winnipeg	Received

1.4.1 *Provincial Environmental Assessment and Permitting*

The Project constitutes a Class 2 development as a water development and control project that will result in alterations to a stream channel which will affect fish habitat (Manitoba *Environment Act*, Classes of Development Regulation 164/88). The Project will therefore require an EAL prior to the initiation of any works. An EAL is issued upon the Minister's acceptance of an EAP proposal and EAR. Under the provincial environmental assessment (EA) process, only the Project components requiring a permit should be included in the EAP and EAR. The scope of provincial EAP and EAR therefore includes only the remediation works in the Omands Creek channel. The upland works are being conducted under a Director's Remediation Order issued pursuant to the CSRA and are therefore not included in the EAP and EAR.

In-channel works include the removal of contaminated soils and sediments therefore the EAL and EAR includes the necessary elements of a remedial action plan (RAP) so that both the physical works and remediation activities can be addressed under an EAL for the Project. A separate approval was given for the receiving facility to accept and treat the impacted soil from the upland works and the in-channel soil and sediments removed by Project works. The receiving facility approval is not included in the scope of the EAP and EAR.

Omands Creek is considered a provincial drain by Manitoba Infrastructure and Transportation. The proposed works will therefore require a Waterway Authorization as per s.14(4) of the Manitoba *Water Resources Administration Act*.

1.4.2 *Federal Environmental Assessment and Permitting*

The Project does not constitute a designated physical activity under the *Canadian Environmental Assessment Act* (Regulations Designating Physical Activities SOR/2012-147) therefore a federal environmental assessment will not be required for the Project.

Amendments to the *Fisheries Act* came into force on 25 November 2013. The coming into force was preceded by a Fisheries Protection Policy Statement released in October 2013. It is anticipated that a review of the Project under the *Fisheries Act* will be conducted by Fisheries and Oceans Canada (DFO). Although the Project proposes to remediate historic contaminants and includes mitigation measures designed to minimize potential effects of the remediation activities on fish, the new amendments and policy statement provide no indication as to whether any authorization under the *Fisheries Act* will be required for the Project to proceed.

The amended *Navigable Waters Protection Act* (NWPA), to be renamed the *Navigation Protection Act* (NPA), will come into force in April 2014. Until then the NWPA remains in force. The NWPA and NPA are administered by Transport Canada – Navigable Waters Protection Program (TC-NWPP) which will make a determination as to the navigability of Omands Creek at the Project and will determine whether an approval is required for the Project to proceed. There are no known navigation uses of Omands Creek at the Project site, the City of Winnipeg owns the land bordering and under Omands Creek, and public access to the creek is restricted by fencing. As proposed, it is not anticipated the Project would require an approval under the NPA.

1.4.3 MUNICIPAL

Any proposed work within 250 feet of Omands Creek is subject to the City of Winnipeg Waterways By-law No.5888/92. This permit was issued 22 October 2013.

1.5 PUBLIC ENGAGEMENT

During the planning phase of the Project, local interest groups were contacted and a Project overview was discussed with them. The City of Winnipeg Naturalist was contacted and the Project scope was discussed including the planned design for restoration of Omands Creek following the remediation works.

The local interest group Friends of Omands Creek was also contacted to discuss the scope of the remediation however upon contacting the group, Tetra Tech was informed that Friends of Omands Creek has not been active for the past couple of years.

No concerns were expressed following the discussion of the project scope with the City of Winnipeg Naturalist or Friends of Omands Creek.

2.0 PROJECT DESCRIPTION

2.1 PROJECT SETTING

2.1.1 OMANDS CREEK

The Omands Creek flows south through a constructed channel runs along the west property line of the Former Dominion Bridge Operations Yard, located at 1460 Dublin Avenue. Omands Creek discharges into the Assiniboine River approximately 3.2 km south of the Project. It is believed that the creek was redirected to the constructed channel in the early 1900s. Prior to redirection Omands Creek discharged east into Colony Creek in what is now downtown Winnipeg. Colony Creek no longer exists. The location of the original, natural Omands Creek channel is a matter of speculation as it has long since been backfilled, developed, and occupied by the developing City of Winnipeg. The stream banks were raised at least once during the Dominion Bridge operations to confine the stream to the channel and prevent flooding of the adjacent property.

2.1.2 HISTORIC CONTAMINATION

A steel manufacturing and fabrication facility was operated at 1460 Dublin Avenue by Dominion Bridge from around 1910 to the mid-1990s. The City of Winnipeg currently owns the site and leases the location to several industrial manufacturing tenants which carry out steel manufacturing and fabrication and chrome plating. The stream bank soil and stream bed sediment are assumed to have been contaminated during the historic steel manufacturing and fabrication operations. ESA results indicate that at least a portion of the fill used to raise the stream banks was contaminated with metals (AECOM 2011a).

2.1.2.1 INVESTIGATIONS

An Environmental Due Diligence Audit was conducted in 1992 and a Phase I Environmental Site Assessment (ESA) was conducted in 1994 (SNC Lavalin Environment 1994) and 1997 (Dames & Moore 1997). More extensive investigations were conducted in 1999 (Phase II and Phase III ESAs; Wardrop 1999), and in 2011 (Phase III ESA; AECOM 2011a). A Remedial Action Plan was developed for the site, including Omands Creek, in 2011 (AECOM 2011b).

2.1.2.2 CONTAMINANTS OF CONCERN

Concentrations of metals and polycyclic aromatic hydrocarbons (PAH) in Omands Creek surface water and sediment exceed the Canadian Council of Ministers of the Environment (CCME) guidelines for the protection of aquatic life (AECOM 2011b). Sample results from upstream and downstream of the Project site indicate that there are potential offsite sources for some of the contaminants (AECOM 2011b). Groundwater loading of metals to the stream is estimated to be less than 2% (AECOM 2011b).

2.1.3 LAND OWNERSHIP AND LAND USE DESIGNATION

The Project site is entirely contained within property owned by the City of Winnipeg. The proposed works and activities are compatible with all permitted land use and zoning restrictions for the property.

2.2 OMANDS CREEK PROJECT COMPONENTS

2.2.1 OVERVIEW AND SCOPE

The proposed remediation project includes the removal of the top 1 m of bank soil and streambed sediment, re-contouring of the stream banks to a more stable configuration, placement of clean fill to bring the channel up to grade, installation of rock structures for aquatic habitat enhancement and erosion protection, and re-vegetation of the banks.

2.2.2 GEOTECHNICAL CONSIDERATIONS

A geotechnical investigation, including a site inspection and slope stability analysis, was conducted by TREK Geotechnical Inc. for the proposed remediation of Omands Creek (Appendix B). The investigation considered excavation of contaminated sediments, removal of the retaining wall, and restoration of the stream channel. The analysis recommended the works be staged in order to maintain stability. The following staging was recommended:

1) East bank cut at IH:IV
2) Excavate channel to depth of 1.0 m
3) Install woven geo-membrane
4) Backfill channel excavation with 0.6 m rockfill
5) Backfill remainder of channel excavation with 0.4 m clay
6) Regrade channel bank slopes to 4H:IV

2.2.3 CONTAMINATED SOIL AND SEDIMENT

Contaminated soils and sediment are expected to be encountered on the east bank of Omands Creek and the creek bed. A remedial action plan (RAP) has been prepared

and submitted to address any contaminated soils within the Project area (Appendix C). The EAR and subsequent Manitoba Environment Act License will address contaminated sediments encountered during the creek works. The purpose of the Environmental Act License and relevant sections of the RAP are only to address contaminated soil and sediment that may be excavated during the Project works and not to remediate any contaminated soil or sediment beyond the excavation limits.

2.2.4 *Miscellaneous Utility Works*

An active natural gas service line crosses Omands Creek (Figure 3.2). The stream bed material has eroded from beneath the service line leaving the service line suspended within the stream water column. Manitoba Hydro has been engaged to lower the service line. The service line will be lowered into a trench below the maximum depth of stream bed excavation.

2.2.5 *Aesthetics and Landscaping*

The remediation of Omands Creek between Dublin Avenue and Saskatchewan Avenue has been designed to enhance the naturalization of the stream channel and stream banks. The installation of rock structures within the creek will enhance the heterogeneity of fish habitat to the extent possible within a channelized stream. It is anticipated that submerged and emergent aquatic macrophytes will colonize the stream bed and wetted margins to provide a more naturalized stream channel. The stream banks will be planted with a native grass and wildflower seed mixture. The City of Winnipeg will make the Omands Creek corridor available to community groups interested in establishing trails and enhancing wildlife habitat through tree plantings.

2.3 Construction Activities

2.3.1 *Preconstruction Activities*

Preconstruction activities include all the activities leading up to the main on-site construction works.

2.3.1.1 *Utilities and Service Providers*

Utilities located in close proximity to the Project included a natural gas service line crossing on Omands Creek and a power distribution line running along the west side of the property. Tetra Tech has initiated proper and ongoing coordination and communication with Manitoba Hydro and other service providers prior to construction and communication will continue throughout the course of the Project.

Tetra Tech's continuing Project site evaluation includes:

- Obtaining underground service plans of existing services for potentially affected areas from utilities or relevant public registries.
- Obtaining information, design, and construction requirements from utility and service providers.
- Confirming alignments as required.
- Identifying crossing locations and potential impacts to both the Project and the utility/service (if any).
- Developing options to avoid, manage, and mitigate potential conflicts.
- Evaluating options with affected utilities and service providers, selecting and finalizing the preferred approaches (e.g. protection, relocation, avoidance), and incorporating feedback from the applicable utilities and service providers.

2.3.1.2 SITE SURVEYS

Initial site surveys were conducted as part of the ESA completed and 2011 and during the preliminary Project design.

2.3.1.3 STAGING

The activities which will occur prior to work beginning are:

- Scheduling of remediation activities will be completed with contractor and businesses currently operating at the site;
- Material stockpile areas adjacent to the Project site (but within the former Dominion Bridge property) will be identified for stockpiling of debris and potentially contaminated materials that are to be excavated within the work area;
- Materials stockpile areas adjacent to the Project site (but within the former Dominion Bridge property) will be identified for stockpiling clean fill and construction materials;
- Estimated remedial excavation extents will be marked.

Construction offices and mobile sanitation facilities established for the upland works will be utilized during the remediation of Omands Creek.

2.3.2 CHANNEL REMEDIATION

Channel works may be conducted using a stepwise approach in approximately 100 m sections. If required for water management or slope stability of each section of the channel will be isolated, stabilized, remediated, and may be rehabilitated before moving on to the next section. Alternatively, if conditions allow, rehabilitation of the creek may

be completed for longer sections or the entire length of the Project site instead of in sections.

2.3.2.1 ISOLATION

Coffer dams constructed of sandbags will be installed at the upstream and downstream ends and the section will be dewatered to the downstream. There is typically no flow in Omands Creek during the winter months; however a pump will be installed upstream of the upstream coffer dam and should any stream flow occur, the water will be pumped around the channel section and discharged downstream.

2.3.2.2 UNLOAD BANKS

The existing creek banks are geotechnically unstable. The banks will be unloaded by cutting back and grading the upper banks to reduce the slope. The banks will be replaced to a flatter slope and final contouring will be conducted after the central channel works have been completed.

2.3.2.3 CHANNEL EXCAVATION

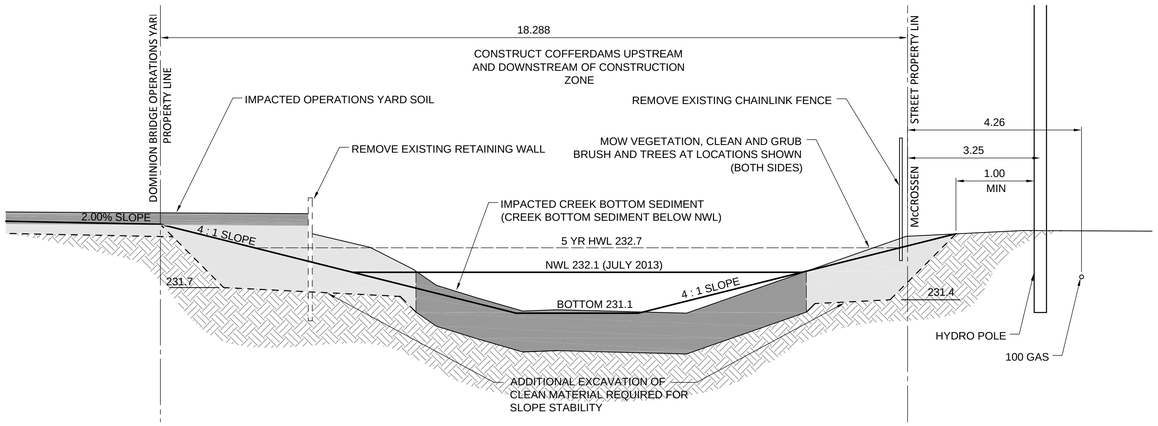
Creek sediments will be excavated from the channel. The excavation will remove sediment to a depth of 1 m from the existing grade. All excavated material will be removed to a contained stockpile area, assessed, and directed to the appropriate disposal/treatment facility.

2.3.2.4 CHANNEL RECONSTRUCTION

A geotextile membrane will be installed within the excavated channel bottom. A 0.6 m layer of 0.15 m minus rock will be placed on top of the membrane to provide scour protection and slope stability (Figure 2.1). A 0.4 m layer of silty clay native soil material will be placed on the rock to bring the channel back up to grade. An alternating series of shallow wing deflectors will be constructed using 0.15 m minus rock. The wing deflects will add habitat and flow complexity while permitting freshet flows to discharge unimpeded (Figure 2.2). Revetments will be installed on the banks opposite to each wing deflector to provide scour protection (Figure 2.2). Riffle silt traps will also be installed within the channel (Figure 2.2). The silt traps will be low-grade and have course rock fill in the centre portion to allow fish passage for small fish at low water levels.

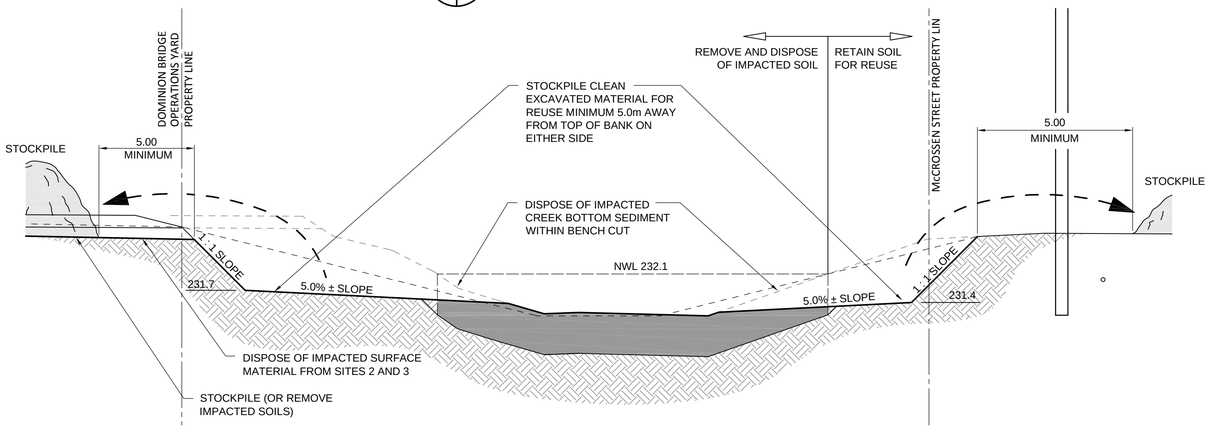
2.3.2.5 REBUILD BANK SLOPES

Final contouring of the bank slopes will be conducted. Silt fencing will be installed at the 1:2 flood waterline to intercept any silt from the work site during the following spring freshet. The silt fencing will be maintained for two years or until vegetation has assumed the sediment and erosion control function.



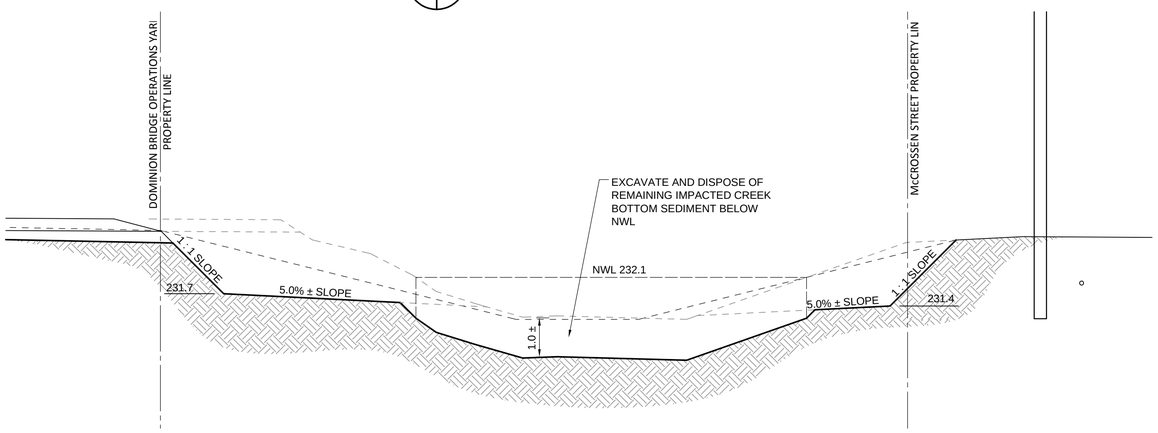
1 C0008 - STAGE 1 - SITE PREP AND DEWATERING

1:75 * CROSS SECTION "D" FROM DWG C0008 SHOWN



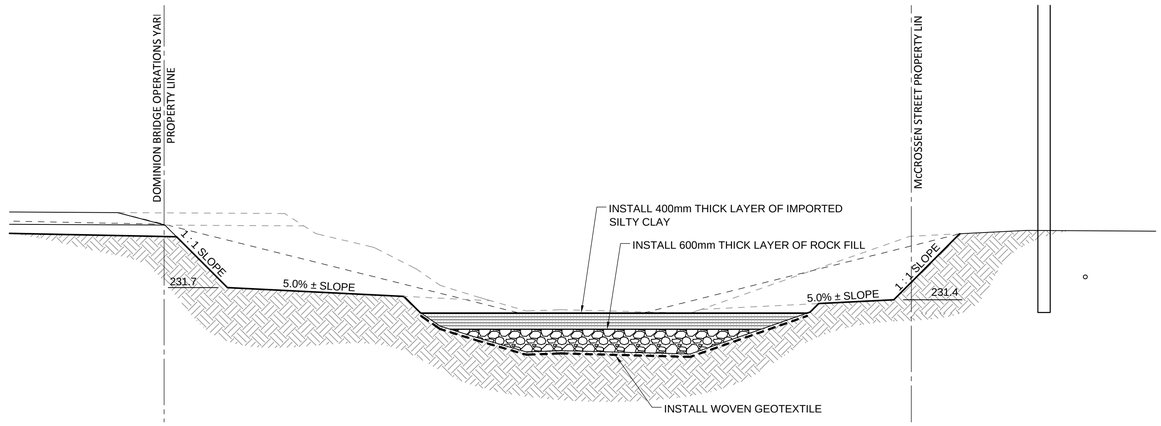
2 - - STAGE 2 - BENCH CUT BANKS

1:75



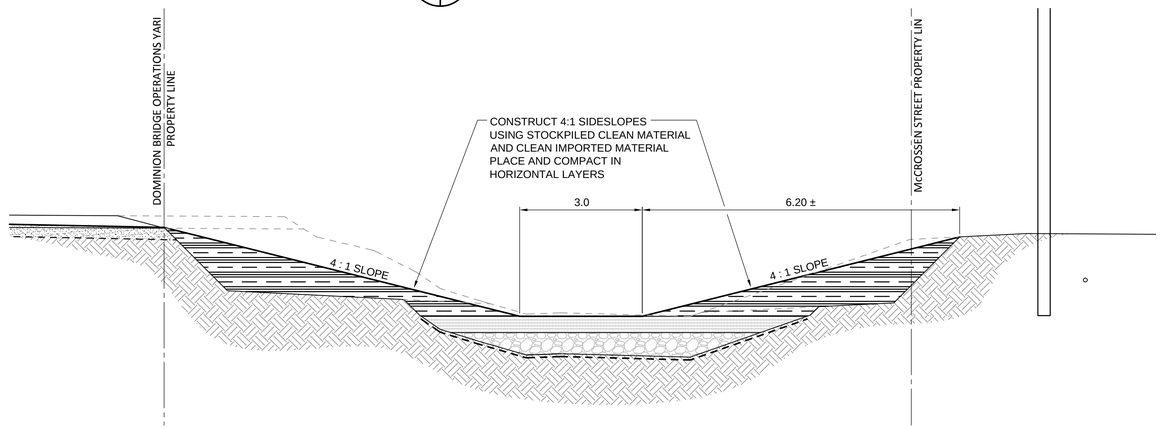
3 - - STAGE 3 - EXCAVATE CREEK BED

1:75



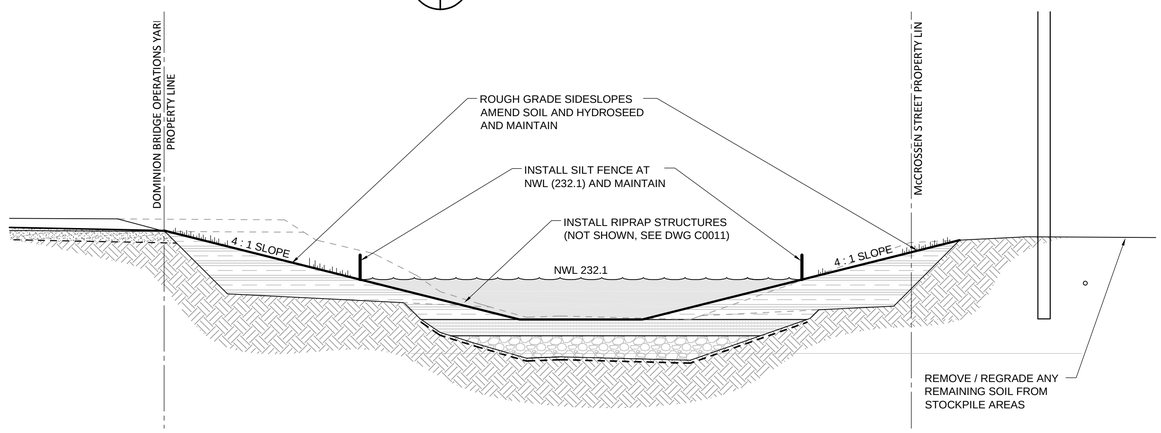
4 - - STAGE 4 - CONSTRUCT CREEK BED

1:75



5 - - STAGE 5 - CONSTRUCT CHANNEL

1:75



6 - - STAGE 6 - VEGATATE & MAINTAIN

1:75

APEGM
Certificate of Authorization
TETRA TECH WEI Inc.
No. 5313 Date: April 30, 2014

LOCATION APPROVED
UNDERGROUND STRUCTURES

SUPV. U/G STRUCTURES COMMITTEE — DATE

NOTE:
LOCATION OF UNDERGROUND STRUCTURES AS SHOWN ARE BASED ON THE BEST INFORMATION AVAILABLE. BUT NO GUARANTEE IS GIVEN THAT ALL EXISTING UTILITIES ARE SHOWN OR THAT THE GIVEN LOCATIONS ARE EXACT. CONFIRMATION OF EXISTENCE AND EXACT LOCATION OF ALL SERVICES MUST BE OBTAINED FROM THE INDIVIDUAL UTILITIES BEFORE PROCEEDING WITH CONSTRUCTION.

B.M. ELEV.

NO.	REVISIONS	DATE	BY
01	ISSUED FOR TENDER	13.09.13	KJM
00	ISSUED FOR 99% REVIEW	13.08.29	BM

TETRA TECH

DESIGNED BY	KJM, KMS	CHECKED BY	RDW
DRAWN BY	TRC	APPROVED BY	GS
HOR. SCALE:	AS NOTED	RELEASED FOR CONSTRUCTION	
VERTICAL:			
DATE	13.08.29	DATE	

PROVINCE OF MANITOBA — K. J. RAE — 2013-09-13 — REGISTERED PROFESSIONAL ENGINEER

CONSULTANT DRAWING NO.
1312940100-DWG-C0010

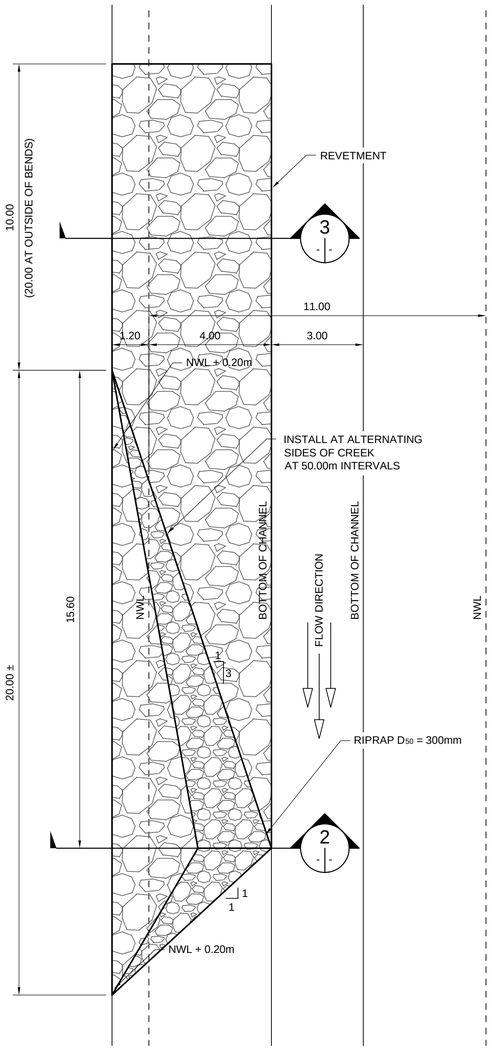
Winnipeg

THE CITY OF WINNIPEG
PLANNING, PROPERTY & DEVELOPMENT DEPARTMENT

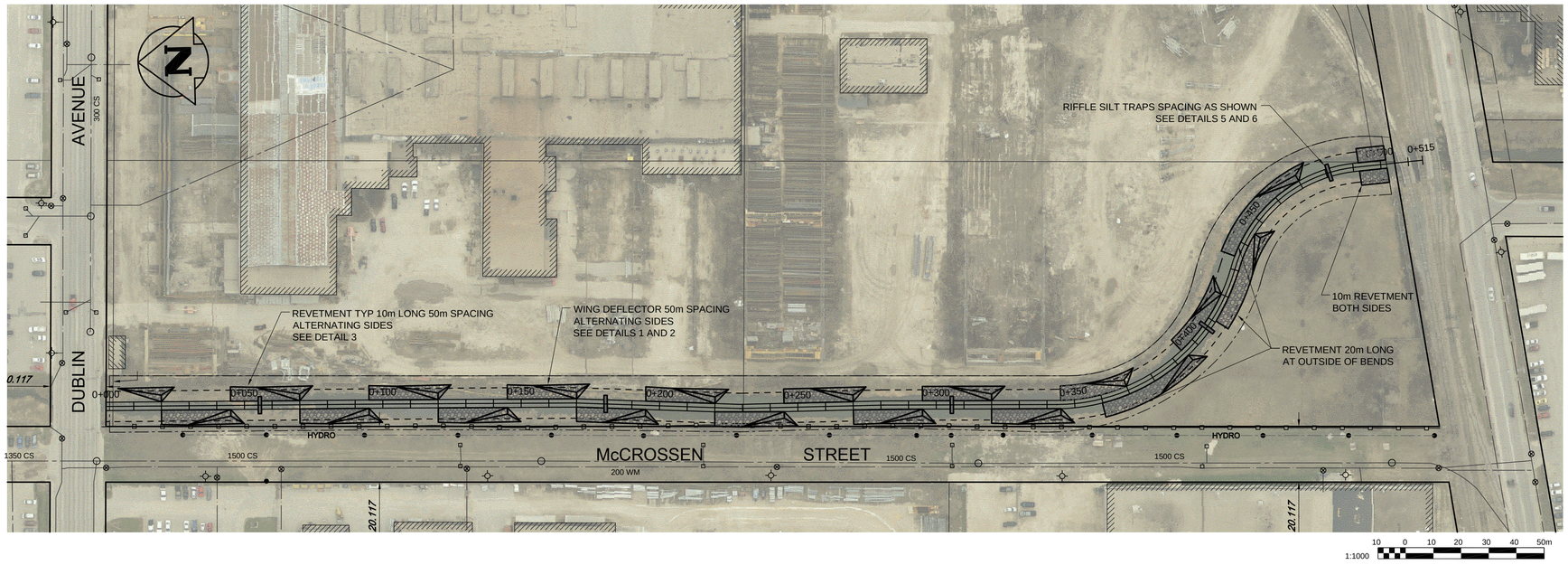
DOMINION BRIDGE REMEDIATION

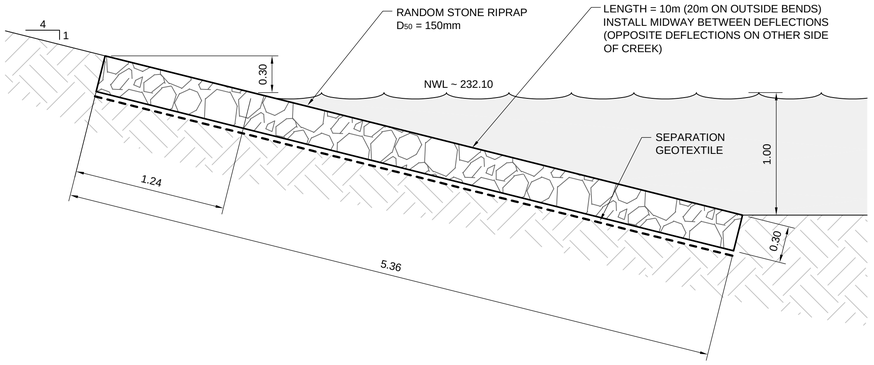
OMANDS CREEK
REMEDIATION CONSTRUCTION SEQUENCE

Figure 2.1
C0010



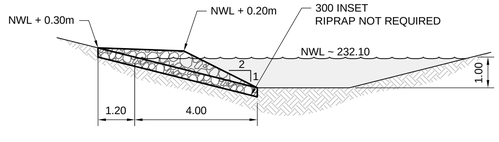
1 WING DEFLECTOR PLAN VIEW
1:100



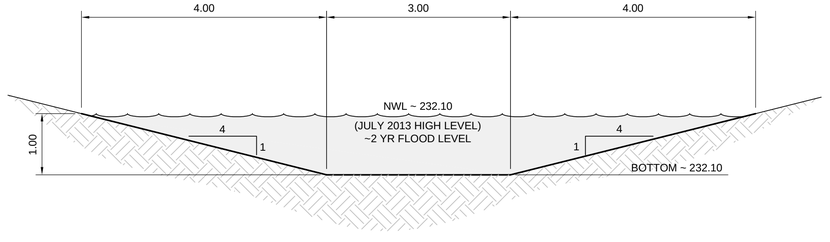


3 CHANNEL REVETMENT SECTION VIEW
H = 1:25 V = 1:25

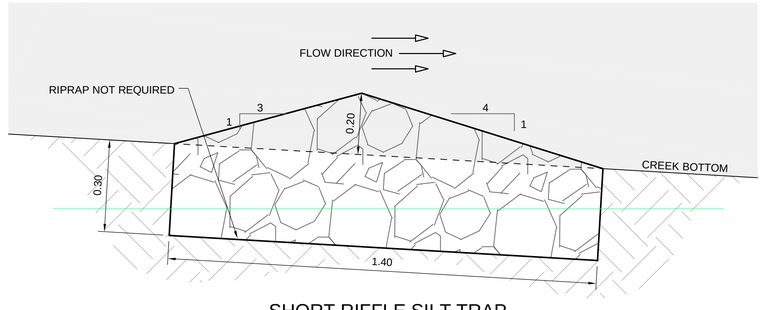
5 SHORT RIFFLE SILT TRAP
SECTION VIEW
H = 1:50 V = 1:50



2 WING DEFLECTOR SECTION VIEW
H = 1:100 V = 1:100



4 TYPICAL CREEK SECTION VIEW
H = 1:50 V = 1:50



6 SHORT RIFFLE SILT TRAP
PROFILE VIEW
H = 1:10 V = 1:10

APEGM
Certificate of Authorization
TETRA TECH WEI Inc.
No. 5313 Date: April 30, 2014

LOCATION APPROVED
UNDERGROUND STRUCTURES

SUPV. U/G STRUCTURES COMMITTEE — DATE

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ELEV.

NO.	REVISIONS	DATE	BY
01	ISSUED FOR TENDER	13.09.13	KJM
00	ISSUED FOR 99% REVIEW	13.08.29	BM

TETRA TECH

DESIGNED BY	KJM	CHECKED BY	RDW
DRAWN BY	TRC	APPROVED BY	GS
HOR. SCALE:	AS NOTED	RELEASED FOR CONSTRUCTION	
VERTICAL:			
DATE	13.08.29	DATE	

PROVINCE OF MANITOBA
K. J. McRAE
2013-09-13
REGISTERED PROFESSIONAL ENGINEER

CONSULTANT DRAWING NO.
1312940100-DWG-C0011

Winnipeg
THE CITY OF WINNIPEG
PLANNING, PROPERTY & DEVELOPMENT DEPARTMENT

DOMINION BRIDGE REMEDIATION

OMANDS CREEK RIPRAP DETAILS

Figure 2.2

C0011

2.3.2.6 RE-VEGETATION

Re-vegetation tasks will be conducted in the summer of 2014. The in-situ soil will be amended with a sand and peat mix rototilled to a depth of 0.1 to 0.15 m into the soil. Native grasses and perennial wild flower species will be hydroseeded. The grass will be periodically mowed until the perennials and wildflowers become established.

2.3.3 CONTAMINATED SOIL AND SEDIMENT

Any contaminated soil or sediment excavated during the Project works will be contained, assessed and disposed. Previous Environmental Site Assessments (Wardrop Engineering, 1999 and AECOM, 2011) provided a detailed map of the degree, extent, and type of contaminants in the soils and sediments within the Project area.

2.3.3.1 SOIL REMEDIAL ACTION PLAN

A Remedial Action Plan (RAP) has been prepared to address the contaminated upland soils encountered within the Project area (Appendix C). The purpose of the RAP is only to address contaminated soil that may be excavated during the Project works and not to remediate any contaminated soil beyond the excavation limits other than where limits are not fully defined. The remedial action consists of the following:

- Excavation of potentially contaminated soil at four upland excavation areas and within the boundaries of Omands Creek between Dublin Avenue and Saskatchewan Avenue;
- Offsite disposal of contaminated soils with concentrations exceeding the applicable Canadian Council of Ministers of the Environment (CCME) guidelines; and
- Backfilling of the excavations to match surficial conditions prior to excavation with clean excavated material and/or imported clean backfill.

2.3.3.2 SEDIMENT REMEDIAL ACTION PLAN

Project Description

The remediation of Omands Creek will comprise the removal by excavation of 1 m of bank soil and stream sediment below the existing grade.

Prior to remediation works, the working area will be isolated with cofferdams or similar structures to manage any potential water inflow or out flow in the work area. These will be constructed up and downstream of the work area using non-erodible material such as sandbags. Any surface water or ice located between the cofferdams will be removed prior to remediation works through either pumping or placement (in the event of surface ice) downstream of the isolated work area. Surface and/or groundwater infiltration into the work area is to be expected. The water will be collected into temporary storage and tested for contaminants of concern (i.e., BTEX and PHC Fractions F1 and F4, PAHs

and/or metals). If the contaminants of concern are below guideline limits then the excavation water may be either discharged downstream of the work area or into the sanitary sewer systems (following approval by Manitoba Conservation and the City of Winnipeg). If the excavation water exceeds guideline limits for contaminants of concern then the water will be directed to a licensed disposal facility (e.g., A-1 Environmental Services).

Restoration of the creek following remediation of the top 1 m of sediment will include backfilling of the Omands Creek excavation through placement of a geotextile membrane on the excavated channel bottom, the placement of a 0.6 m layer of 0.15 m minus rock to provide scour protection and slope stability. A 0.4 m layer of silty clay soil material will be placed on the rock to bring the channel back up to grade. An alternating series of shallow wing deflectors will be constructed using 0.15 m minus rock that will add habitat and flow complexity while permitting freshet flows to discharge unimpeded. Revetments will be installed on the banks opposite to each wing deflector to provide scour protection. Low riffles will be installed to act as sediment traps every 100 m along the length of the creek between Dublin Avenue and Saskatchewan Avenue.

Any sediment that is excavated and determine to be containing concentrations of contaminants of concern above the applicable Canadian Council of Ministers of the Environment guidelines will be disposed offsite.

Site Site Investigations

AECOM (2011) conducted a sediment sampling program in October 2010 as part of the Phase III Environmental Site Assessment. The sampling program consisted of four transects across the stream with surficial sediment grab samples and a deeper sediment sample taken along each transect. The surficial samples recovered from the top 0.05 m of sediment using a Ponar or Ekman dredge while the deeper samples were recovered from the midstream of each transect at depths of 0.30 m to 0.35 m below grade.

In total, sixteen sediment samples were analyzed for total organic matter, dissolved organic carbon, particle size, total metals, PCBs and PAHs. Metals and PAH impacts were identified in the sediment throughout the entire length of the Project site and likely extending beyond the maximum depth of sample collection of 0.35 m below grade. However, contaminants of concern occurred in higher concentrations in the surficial sediments and lower concentrations in deeper sediments indicating contaminants were deposited via surface run-off and/or shallow groundwater rather than deeper groundwater sources.

Off-Site Disposal

Based on the results of the AECOM 2010 investigation, the excavated potentially contaminated sediments will be suitable for disposal at the BFI Prairie Green Landfill located north of Winnipeg off PTH 7.

Equipment Decontamination

Equipment that comes in contact with contaminated sediment will be decontaminated prior to that equipment leaving the site. Loose or visible sediment will be scraped or brushed off the equipment before leaving the site and contained. The equipment will then be pressured washed as needed. Sediment and solids from the decontamination process will be disposed at the BFI Prairie Green Landfill facility.

2.4 CONSTRUCTION SCHEDULE

The Upland remediation works began in November 2013. The remediation of Omands Creek Works, are tentatively scheduled to begin on January 6, 2014 and be completed by February 28, 2014.

2.5 HEALTH, SAFETY AND ENVIRONMENT PLAN

A Site Specific Health and Safety Plan (SSSP) was developed for the upland remediation works. The SSSP will be updated to include the results of the Omands Creek remediation environmental assessment processes.

3.0 EXISTING ENVIRONMENT

3.1 PHYSICAL ENVIRONMENT

3.1.1 CLIMATE

The Project is located in the Winnipeg Ecodistrict of the Lake Manitoba Plain Ecoregion of the Prairies Ecozone. The Winnipeg Ecodistrict belongs to the Grassland Transition Ecoclimatic Region in southern Manitoba. The mid-continental climate is characterized by four seasons with short, hot summers and long, cold winters. Baseline climate data for the regional study area were obtained from the Environment Canada (EC) meteorological station located at the James Armstrong Richardson International Airport in Winnipeg (49° 55.2' N / 97° 13.8' W).

Data were assembled for the 30 year period from 1978 to 2007. Monthly averages (Table 3.1) were calculated from daily data supplied by EC.

Hourly wind data were assembled for the years 2003 to 2007. Monthly averages (Table 3.2) were calculated from hourly data supplied by EC. Windrose Pro Ver 2.3.20 was used to create a windrose plot and determine prevailing wind direction for the region. Mean monthly wind speed varied little over the year, ranging from 14.8 km/hr in July to 19.9 km/hr in April, and mean annual wind speed was 17.8 km/hr. Maximum wind gusts reached 119 km/hr. The prevailing wind direction is primarily from the south and secondarily from the north and northwest in the winter and spring months (Table 3.2; Figure 3.1).

In general, precipitation falls primarily as snow during the winter months, with the greatest snowfalls occurring in November, December and January. Annual average precipitation is 512.4 mm with precipitation peaking in June, July and August (Table 3.1). The most recent rainfall frequency data were available up to the year 1996. Mean 24-hour rainfall intensity was 55.1 mm (Table 3.3; Environment Canada 2010).

Table 3. 1 Summary of historical meteorological data collected at Winnipeg, MB (1978-2007) (calculated from daily data supplied by Environment Canada 2010).

	Units	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Temperature - Mean	°C	-16.8	-13.7	-6.2	4.3	11.7	16.9	19.7	18.6	12.8	5.0	-4.9	-13.3	2.8
Temperature - Mean Min	°C	-21.8	-18.8	-11.2	-2.1	4.6	10.6	13.5	12.0	6.4	-0.5	-9.3	-18.0	-2.9
Temperature - Extreme Min	°C	-41.0	-41.8	-37.4	-26.3	-10.1	-1.0	2.7	0.0	-7.0	-17.0	-34.0	-37.0	-41.8
Temperature - Mean Max	°C	-11.7	-8.6	-1.1	10.7	18.7	23.2	25.9	25.1	19.0	10.5	-0.5	-8.6	8.6
Temperature - Extreme Max	°C	7.3	9.0	17.0	34.3	37.0	37.8	35.9	38.7	38.8	30.5	18.2	9.7	38.8
Rainfall - Total	mm	0.2	2.4	9.3	19.5	55.7	86.4	75.1	76.1	47.4	30.4	6.6	1.5	410.6
Snowfall - Total	cm	22.8	12.8	16.7	10.4	2.7	0.0	0.0	0.0	0.2	4.5	20.3	22.0	112.3
Precipitation - Total	mm	19.4	13.9	24.3	30.2	58.5	86.4	75.1	76.1	47.6	34.8	25.2	20.8	512.4
Wind Gust - Maximum	km/h	106	80	106	104	98	115	109	98	98	119	106	98	119

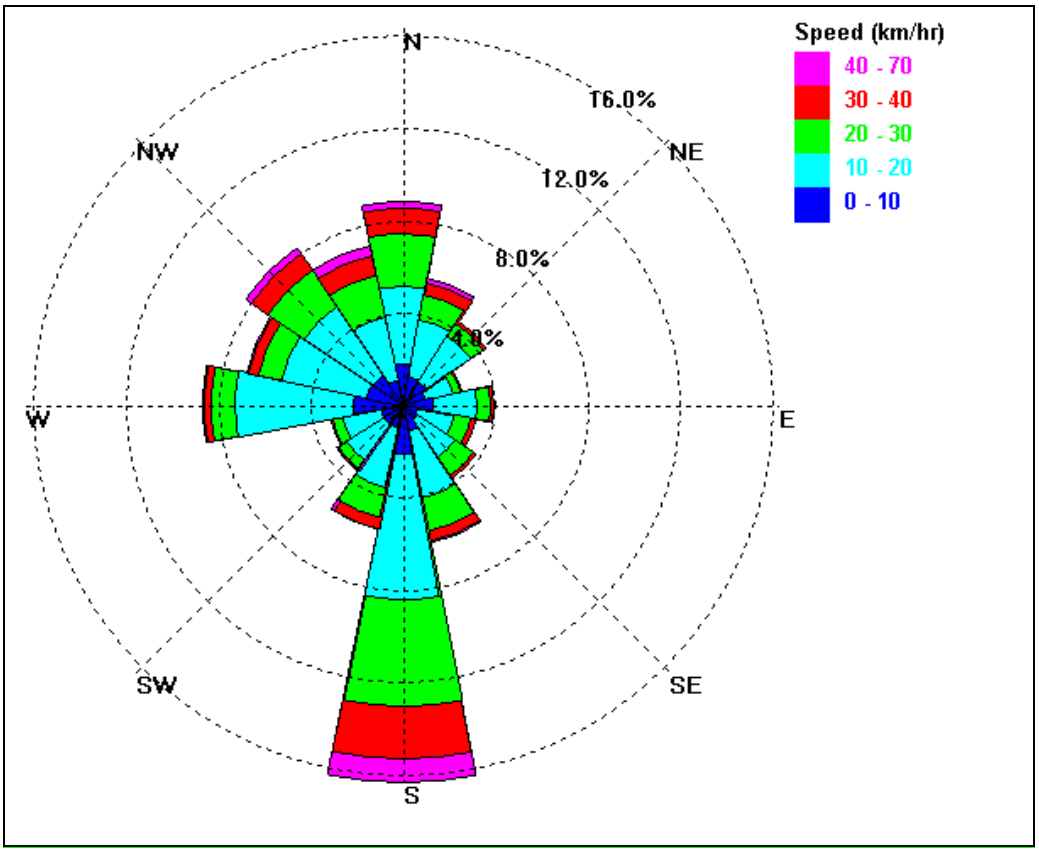
Table 3. 2 Monthly prevailing wind conditions at Winnipeg, MB (2003-2007) (calculated from hourly data supplied by Environment Canada 2010).

	Units	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Wind Speed - Mean	km/hr	18.5	16.7	18.5	19.9	18.9	16.9	14.8	16.6	17.3	18.3	18.5	18.1	17.8
Wind Speed - Mean Max	km/hr	56	59	65	63	59	63	57	65	59	63	63	65	65
Wind Direction		WNW & S	S	S	S & N	N & S	S	S	S	S	S	S	S	S

Table 3. 3 Rainfall intensity (mm) at Winnipeg, MB (1967-1996) (Environment Canada 2010).

Year	5 Min	10 Min	15 Min	30 Min	1H	2H	6H	12H	24H
1967	12.2	24.1	25.9	31.7	33.0	57.9	63.2	63.5	63.5
1968	17.8	24.6	35.3	39.4	39.4	39.4	48.3	61.2	84.3
1969	7.1	10.4	12.7	15.2	21.8	23.4	25.4	39.1	49.3
1970	11.2	20.8	29.0	37.8	41.1	49.8	54.9	60.5	62.2
1971	4.6	6.1	8.4	11.7	14.5	19.8	25.4	29.0	31.0
1972	9.1	16.5	20.3	35.6	35.6	35.8	35.8	35.8	35.8
1973	6.3	10.4	14.5	19.8	29.7	40.4	45.7	45.7	45.7
1974	9.4	16.3	18.8	25.1	28.7	33.0	37.1	38.9	55.4
1975	9.4	14.5	17.8	22.6	27.9	27.9	44.7	53.8	54.4
1976	15.0	15.7	18.0	21.8	22.1	24.1	26.2	33.3	42.7
1977	7.4	12.4	15.2	19.8	21.6	32.5	50.3	57.7	61.7
1978	10.6	17.6	21.6	24.5	28.0	41.7	52.6	52.6	60.4
1979	10.6	19.1	25.4	36.3	39.3	39.8	40.7	40.7	40.7
1980	7.4	8.8	10.4	15.0	19.3	24.5	25.6	26.6	30.5
1981	10.6	12.4	15.9	18.2	24.1	29.0	53.3	53.4	63.0
1982	8.6	13.0	16.2	22.6	22.7	22.7	32.5	34.9	36.8
1983	13.2	17.2	19.3	23.2	28.0	30.9	51.9	52.3	52.3
1984	12.6	19.0	22.8	39.5	56.2	56.9	60.2	69.5	69.7
1985	5.0	7.3	9.3	12.4	18.4	33.1	61.5	84.0	97.4
1986	10.0	11.8	13.9	16.7	18.5	19.7	28.7	35.4	41.6
1987	7.1	9.0	10.4	20.8	24.8	36.6	46.2	57.2	57.3
1988	7.9	15.8	18.5	22.7	34.8	36.9	39.7	49.7	49.7
1989	4.4	7.7	10.4	12.3	14.1	16.2	34.6	41.1	53.5
1990	9.8	12.7	16.2	19.0	22.0	22.0	22.0	22.5	36.9
1991	11.6	16.4	18.0	18.2	19.3	31.2	43.1	43.5	64.0
1992	8.6	10.2	11.2	17.2	18.0	19.3	21.2	25.2	35.6
1993	6.2	12.4	18.6	29.0	41.6	70.1	72.2	78.4	87.4
1994	8.8	13.1	15.4	24.2	32.2	55.5	67.0	68.2	68.2
1995	7.5	9.9	12.0	18.0	23.0	23.4	35.6	44.0	63.9
1996	8.1	16.1	21.9	43.8	58.6	58.6	58.8	58.8	58.8
MEAN	**9.3**	**14.0**	**17.4**	**23.8**	**28.6**	**35.1**	**43.5**	**48.6**	**55.1**
SD	**3.0**	**4.7**	**6.1**	**8.9**	**11.0**	**13.9**	**14.3**	**15.6**	**16.4**

Figure 3. 1 Windrose (2003-2007), Winnipeg, Manitoba



3.1.2 AIR QUALITY

In general, Winnipeg has excellent air quality. The sources of airborne pollutants typically include industrial operations, vehicle and equipment emissions, fires, and other specific activities. Ambient air quality in Winnipeg is continuously monitored by two air quality monitoring stations, located at 65 Ellen Street in downtown Winnipeg (approximately 3.6 km northwest of the Project site) and 229 Scotia Street in a residential area (approximately 7.5 km northeast of the Project site). Data for these stations are collected by Manitoba Conservation (2008) and the National Air Pollution Surveillance (2008).

Maximum short-term (1 to 24-hour averages) and annual mean concentrations of air contaminants for the Winnipeg stations are summarized in Table 3.4. There were no exceedances of Manitoba's Air Quality Objectives for carbon monoxide (CO) or nitrogen dioxide (NO_2). In 2005, there was a single exceedance of the 24 hour Canada Wide Standard for Particulate Matter 2.5 ($PM_{2.5}$). The only parameter that regularly exceeds guideline levels is ground level ozone (O_3) – a product primarily of vehicle emissions.

Table 3. 4 Summary of short-term maximum and annual average observed concentrations of air pollutants at Winnipeg monitoring sites for 2003-2006 (from NAPS 2008).

Pollutant	Period	Station / Year								Manitoba Air Quality Objective - MTL	Manitoba Air Quality Objective - MAL	Manitoba Air Quality Objective - MDL
		Winnipeg NAPS-070118-R Residential				Winnipeg NAPS-070119-C Downtown						
		2003	2004	2005	2006	2003	2004	2005	2006			
CO (ppm)	1 hour	3.3	2.6	2.9	2.0	4.7	3.5	3.4	2.8	-	31	13
	8 hour	2.0	1.47	1.5	1.3	2.4	1.38	1.9	1.4	17	13	5
	24 hour	-	-	0.9	0.8	-	-	1.0	1.2			
	Annual	0.29	0.24	0.2	0.2	0.52	0.36	0.3	0.4	-	-	-
NO_2 (ppb)	1 hour	93	56	64	54	126	99	67	91	530	213	-
	24 hour	36	32.5*	36	32	40	45	40	36	-	106	-
	Annual	9.7	8.6	8	7	14.2	13.3	12	13	-	53	32
NO (ppb)	1 hour	249	242	249	120	312	282	336	240	-	-	-
	24 hour	71.2	70.9*	56	47	80	95.3*	75	67	-	-	-
	Annual	4.4	4.5	5	3	8.9	9.3	8	7	-	-	-
O_3 (ppb)	1 hour	68	57	60	63	70	53	128	63	200	82	50
	8 hour	-	-	56	57	-	-	53	60		65^	
	24 hour	54	42*	48	48	49	38*	46	44	-	-	-
	Annual	22.9	19.9	20	23	20.5	17.4	19	21	-	15	-
$PM_{2.5}$ ($\mu g/m^3$)	1 hour	-	-	53	59	-	-	391	55			
	24 hour	-	-	22	26	-	-	38	24		30•	
	98th percentile (year)	14	13	14	14	14	13	-	15			
	98th percentile (last 3 years)	-	-	14	14	-	-	14	14			
	Annual	-	-	5	5	-	-	5	5			

MDL - the maximum desirable level is the long-term goal for air quality and provides a basis for an anti-degradation policy for unpolluted parts of the country and for the continuing development of pollution control technology

MAL - The maximum acceptable level is intended to provide adequate protection against effects on soil, water, vegetation, materials, animals, visibility, and personal comfort and well-being

MTL - The maximum tolerable level denotes time-based concentrations of air contaminants beyond which, owing to a diminishing margin of safety, appropriate action is required without delay to protect the health of the general population

*24-hour moving average

^Canada-Wide Standard for ozone: 3-year average of the fourth highest daily maximum 8-hour averages

•Canada-Wide Standard for PM2.5: 3-year average of the annual 98th percentile of daily 24-hour averages

3.1.3 SOILS, SEDIMENT AND GEOLOGY

The general stratigraphy in the Winnipeg area consists of a 12 to 15 m layer of Pleistocene drift composed of Lake Agassiz silt and clay overlying a 9 m layer of silty glacial till. The overburden is deposited on Paleozoic carbonate bedrock composed of dolomite and limestone.

The clays are generally low permeability and contain some degree of fracturing. The clays are often intermixed with layers of silt which may be water bearing. The soils are lacustrine in origin having been deposited as lake bottom sediment in the former glacial Lake Agassiz.

The carbonate bedrock is highly fractured and constitutes the principle potable water aquifer in the area. The glacial tills may also contain ground water; however the water quality is less desirable than that of the carbonate bedrock. The tills and limestone are hydraulically connected. Based on the available geological information, the bedrock beneath Omands Creek is part of the Upper Fort Garry member of the Red River formation.

3.1.3.1 CONTAMINATED SOILS AND SEDIMENT

Based on the results of AECOM (2011), the contaminants of concern in the Project area soil and sediment are summarized as follows:

- Maximum naphthalene concentration of 4.3 mg/kg in OC10-3C at 0 m – 0.05 m below grade. Sample location OC10-3C is located approximately 155 m downstream of the Dublin Avenue bridge.
- Maximum benzo(a)pyrene concentration of 4.3 mk/kg in OC10-3C at 0 m – 0.05 m below grade.
- Maximum concentrations of PAHs, Acenapthene, Acenaphthylene, Anthracene, Benzo(a)anthracene, Chrysene, Dibenz(a,h)anthracene, Fluoranthene, Fluorene, 2-Methylnaphthalene, Phenanthrene, and Pyrene of 1.1 mg/kg, 1.5 mg/kg, 2.2 mg/kg, 4.8 mg/kg, 6.0 mg/kg, 0.73 mg/kg, 18 mg/kg, 1.9 mg/kg, 1.2 mg/kg, 20 mg/kg, and 12 mg/kg, respectively in OC10-3C at 0 m – 0.05 m below grade.
- Maximum concentrations of Metals, Arsenic (8.2 mg/kg in OC10-4B at 0 m -0.05 m below grade), Cadmium (1.3 mg/kg in OC10-2A at 0 m – 0.05 m below grade), Total Chromium (51 mg/kg in OC10-3B in 0.3 m – 0.35 m below grade), Copper (48.3 mg/kg in OC10-2B at 0 m – 0.05 m below grade), Lead (165 mg/kg in OC10-5C at 0 m – 0.05 m below grade), and Zinc (5320 mg/kg in OC10-3B at 0 m – 0.05 m below grade).
- PCBs were not detected at concentrations exceeding the applicable sediment quality guidelines.

- Applicable results from the Wardrop (1999) and AECOM (2011) are presented in Table 3.5 and 3.6.

30 0 20 40 60m

1:1500

LEGEND

SEDIMENT SAMPLE

MANITOBA HYDRO NATURAL GAS LINE

NO.	DESCRIPTION

REFERENCE DRAWINGS

NO.	DATE	DESCRIPTION	PREPARED	REVIEW	DESIGN	AUTHORIZE

REVISIONS/ISSUE DRAFTING ENGINEERING

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AUTHORIZED BY: RW DATE: 13.12.03 CLIENT DRAWING NO.

CLIENT
CITY OF WINNIPEG

DRAWING DESCRIPTION
FIGURE 3.2: OMANDS CREEK
SEDIMENT SAMPLE LOCATIONS
1460 DUBLIN AVENUE, WINNIPEG, MB

DESIGNED BY:	RW	DRAWN BY:	SP	DRAWING NO.	REV.
REVIEWED BY:	RW	SCALE:	1:1500	1312940100-SKT-V0004	00

Table 3. 5 Omands Creek Sediment sample laboratory analytical results - PAHs.

Sample ID	OC10-2A	OC10-2B	OC10-2B	OC10-2C	OC10-3A	OC10-3B	OC10-3B	OC10-3C	OC10-4A	OC10-4B	OC10-4B	OC10-4C	OC10-5A	OC10-5B	OC10-5B	OC10-5C	CCME Sediment Quality Quideline ISQG[a]	CCME Sediment Quality Quideline PEL[a]
Sampling Date	7-Oct-10	7-Oct-10	7-Oct-10	7-Oct-10	7-Oct-10	7-Oct-10	7-Oct-10	7-Oct-10	7-Oct-10	7-Oct-10	7-Oct-10	7-Oct-10	7-Oct-10	7-Oct-10	7-Oct-10	7-Oct-10		
Sample Depth (m)	0 - 0.05	0.0 - 0.05	0.3 - 0.35	0.0 - 0.05	0 - 0.05	0.0 - 0.05	0.3 - 0.35	0.0 - 0.05	0 - 0.05	0.0 - 0.05	0.3 - 0.35	0.0 - 0.05	0 - 0.05	0.0 - 0.05	0.3 - 0.35	0.0 - 0.05		
Particle Size >0.075 mm (%)	18.1	22.3	--	15	21.4	37.6	17.9	47.6	7.3	6.8	<0.1	19.2	9.8	18	5.4	13.8		
Particle Size <0.075 mm (%)	81.9	77.7	--	85	78.6	62.4	82.1	52.4	92.7	93.2	100	80.8	90.2	82	94.6	86.2		
Total Organic Carbon(%)	6.4	3.2	--	11.1	6.8	2.7	0.8	2.6	2.1	4.2	0.5	6.3	7.2	2.2	0.6	4.1		
Naphthalene	0.04	0.05	0.036	<0.04	0.02	0.02	0.026	**4.3**	0.029	0.03	0.001	0.032	0.07	0.05	<0.002	0.07	0.0346	**0.391**
2-Methyl Naphthalene	0.03	0.04	0.011	<0.04	0.02	0.02	0.017	**1.2**	0.03	0.03	<0.001	0.028	0.06	0.03	<0.002	0.07	0.0202	**0.201**
Phenanthrene	**0.54**	0.27	0.068	0.24	0.27	0.16	0.61	**20**	0.18	0.31	0.001	0.43	**1.7**	0.15	0.004	0.45	0.0419	**0.515**
Acenaphthylene	<0.03	0.05	0.005	<0.04	0.04	0.01	0.025	**1.5**	0.017	0.02	<0.001	0.028	0.05	0.02	<0.002	0.04	0.00587	**0.128**
Acenaphthene	0.04	0.03	0.03	<0.04	0.03	0.02	0.041	**1.1**	0.016	0.03	<0.001	0.042	**0.22**	0.02	<0.002	0.05	0.00671	**0.0889**
Fluorene	0.08	0.07	0.057	0.04	0.03	0.03	0.055	**1.9**	0.022	0.04	<0.001	0.055	**0.2**	0.04	<0.002	0.07	0.0212	**0.144**
Anthracene	0.11	0.09	0.039	0.09	0.07	0.05	0.14	**2.2**	0.044	0.11	<0.001	0.088	**0.42**	0.05	<0.002	0.12	0.0469	**0.245**
Fluoranthene	<0.8	0.57	0.15	<0.5	0.45	0.33	1.5	**18**	0.29	0.58	<0.001	0.7	1.9	0.35	0.01	0.64	0.111	**2.355**
Pyrene	0.61	0.48	0.14	<0.04	0.37	0.27	**1.2**	**12**	0.23	0.48	<0.001	0.55	**1.6**	0.3	0.007	0.52	0.053	**0.875**
Benzo(a)anthracene	0.22	0.19	0.042	0.15	0.16	0.12	**0.52**	**4.8**	0.13	0.23	<0.001	0.25	**0.71**	0.12	0.002	0.25	0.0317	**0.385**
Chrysene	0.38	0.29	0.053	0.22	0.23	0.14	0.66	**6**	0.14	0.29	0.002	0.33	0.77	0.16	0.005	0.32	0.0571	**0.862**
Benzo(b&j)fluoranthene	0.35	0.2	0.042	0.24	0.19	0.18	0.79	6.4	0.12	0.35	0.006	0.36	0.64	0.16	0.007	0.27	NG	NG
Benzo(k)fluoranthene	0.1	0.15	0.027	0.1	0.14	0.07	0.3	3.6	0.084	0.13	<0.002	0.14	0.47	0.07	0.003	0.19	NG	NG
Benzo(a)pyrene	0.19	0.15	0.03	0.15	0.15	0.12	0.51	**4.3**	0.11	0.27	<0.001	0.24	0.61	0.09	<0.002	0.21	0.0319	**0.782**
Indeno(1,2,3-cd)pyrene	0.16	0.12	0.024	0.13	0.13	0.1	0.39	3.8	0.078	0.24	<0.002	0.21	0.48	0.08	<0.004	0.16	NG	NG
Benzo(g,h,i)perylene	<0.2	0.12	0.021	0.14	0.12	0.11	0.35	2.8	0.069	0.25	<0.002	0.19	0.39	0.08	0.004	0.15	NG	NG

[a] Canadian Council of Ministers of Environment (CCME) Sediment Quality Guidelines (2002) for the Protection of Aquatic Life.

ISQG – Interim Freshwater sediment quality guidelins

PEL – Probably effect levels

0.00671 – results exceed CCME ISQG Guideline

0.00671 – results exceed CCME ISQG and PEL Guideline

NG – No Guideline

Table 3. 6 Omands Creek Sediment sample laboratory analytical results - Metals.

Sample ID	OC10-2A	OC10-2B	OC10-2B	OC10-2C	OC10-3A	OC10-3B	OC10-3B	OC10-3C	OC10-4A	OC10-4B	OC10-4B	OC10-4C	OC10-5A	OC10-5B	OC10-5B	OC10-5C	CCME Sediment Quality Quideline ISQG[a]	CCME Sediment Quality Quideline PEL[a]
Sampling Date	7-Oct-10	7-Oct-10	7-Oct-10	7-Oct-10	7-Oct-10	7-Oct-10	7-Oct-10	7-Oct-10	7-Oct-10	7-Oct-10	7-Oct-10	7-Oct-10	7-Oct-10	7-Oct-10	7-Oct-10	7-Oct-10		
Sample Depth (m)	0 - 0.05	0.0 - 0.05	0.3 - 0.35	0.0 - 0.05	0 - 0.05	0.0 - 0.05	0.3 - 0.35	0.0 - 0.05	0 - 0.05	0.0 - 0.05	0.3 - 0.35	0.0 - 0.05	0 - 0.05	0.0 - 0.05	0.3 - 0.35	0.0 - 0.05		
Aluminum (Al)	17200	15200	18900	17600	18500	13700	22400	8870	20100	17200	20200	17100	17100	15400	21600	16300	NG	NG
Antimony (Sb)	1.1	1.2	0.6	1	0.9	0.7	1	1	1.0	1.3	0.5	1	1	1.2	0.4	1.7	NG	NG
Arsenic (As)	7	5.9	6.7	7.2	5.3	5.5	7.9	5.4	6.2	8.2	11.1	7.3	6.2	6.2	6.5	6.3	5.9	**17**
Barium (Ba)	130	119	191	119	119	114	216	103	142	139	251	116	134	116	217	135	NG	NG
Beryllium (Be)	0.8	0.8	0.8	0.8	0.8	0.6	0.9	0.4	0.8	0.8	1.2	0.8	0.8	0.8	1	0.8	NG	NG
Bismuth (Bi)	0.2	0.2	0.2	0.2	0.2	0.1	0.2	<0.1	0.2	0.2	0.2	0.2	0.2	0.1	0.2	0.2	NG	NG
Cadmium (Cd)	1.3	0.52	0.31	0.66	0.65	0.35	0.43	0.43	0.36	0.62	0.3	0.68	0.7	0.42	0.36	0.7	0.6	**3.5**
Calcium (Ca)	38700	42700	62200	35600	42400	67500	36700	93400	33100	44100	31600	37000	43400	70000	69000	47600	NG	NG
Chromium (Cr), Total	37	33	41	36	37	38	51	39	38	39	42	39	38.0	38	44.0	37	37.3	**90**
Cobalt (Co)	10.1	10.1	13.1	9.4	8.7	10.5	16.7	6.7	10.4	11.1	17.9	9.6	9.9	10.5	14.7	9.1	NG	NG
Copper (Cu)	45.1	48.3	31.3	41.3	40.4	36.9	41.3	34	30.8	41.9	36.2	41.8	41.9	35	33.3	43.0	35.7	**197**
Iron (Fe)	23900	22400	27500	23500	22700	23500	34500	23000	25100	24400	32300	23200	26100	31100	29700	26500	NG	NG
Lead (Pb)	86.2	90.8	40.7	61.7	70.4	**113**	79.8	**107**	74.8	**97**	16.6	78	85.2	83.3	16.8	**165.0**	35	**91.3**
Lithium (Li)	21	19	29	19	20	17	31	11	21	23	27	19	22	21	31	20	NG	NG
Magnesium (Mg)	25000	23600	39400	23100	27600	30300	23000	46100	21200	26600	20400	24400	28800	30600	22600	29100	NG	NG
Manganese (Mn)	357	280	433	324	267	362	803	256	395	308	568	301	322	384	674	347	NG	NG
Mercury (Hg)	0.06	0.06	<0.05	0.05	0.07	<0.05	<0.05	<0.05	<0.05	0.07	<0.05	0.07	0.09	<0.05	<0.05	0.08	0.17	**0.486**
Molybdenum (Mo)	1.4	0.9	0.9	1.9	0.9	1.6	1.2	3.2	0.4	1.5	1.8	1	0.9	1.3	0.6	0.8	NG	NG
Nickel (Ni)	30.4	28.4	38.5	30.1	29.5	34.2	46.1	28.9	31.2	33.7	45.2	29.5	30.7	32.3	44.2	31.1	NG	NG
Phosphorus (P)	877	628	632	921	931	545	653	598	725	722	632	904	1040	598	569	1070	NG	NG
Potassium (K)	4030	3520	4120	4000	3940	2930	4870	2030	4170	3870	4020	3820	3690	3380	4950	3590	NG	NG
Selenium (Se)	1.6	0.9	<0.5	1.3	1.2	<0.5	<0.5	0.8	<0.5	1.3	<0.5	0.6	0.7	<0.5	<0.5	1.2	NG	NG
Silver (Ag)	0.09	0.73	0.11	0.07	0.1	0.09	0.12	0.06	0.07	0.11	0.12	0.08	0.11	0.1	0.13	0.1	NG	NG
Sodium (Na)	408	370	613	608	390	424	702	324	354	431	581	394	498	341	546	928	NG	NG
Strontium (Sr)	53.3	52	69.8	55.4	56.8	65.2	76.2	62.4	60.3	60.6	70.5	49.2	57.9	63.4	97.8	68.4	NG	NG
Thalium (Tl)	0.24	0.22	0.28	0.25	0.26	0.19	0.32	0.14	0.25	0.26	0.31	0.26	0.26	0.22	0.30	0.22	NG	NG
Tin (Sn)	3	6.8	1.5	1.9	1.9	2.2	7.1	2	2.9	2.8	0.9	2.2	2.4	2.9	1.1	4.6	NG	NG
Titanium (Ti)	132	206	345	118	129	202	373	134	163	187	130	166	154	233	237	162	NG	NG
Uranium (U)	3.5	2.4	1.97	4.91	2.97	1.54	1.72	1.55	1.18	3.8	1.77	3.41	2.56	2.32	1.99	2.61	NG	NG
Vanadium (V)	58	49	58	58	56	42	65	33	58	57	63	59	57	48	67	49	NG	NG
Zinc (Sn)	288	223	147	271	**347**	**5320**	**1170**	**3310**	201	**498**	96	**725**	**395**	**287**	128	**376**	123	**315**
Zirconium (Zr)	3.6	5.8	11.8	3.9	4.9	5.2	11.5	1	1.4	6.9	10.1	4.4	4.9	5.8	11.9	2.4	NG	NG

[a] Canadian Council of Ministers of Environment (CCME) Sediment Quality Guidelines (2002) for the Protection of Aquatic Life.
ISQG – Interim Freshwater sediment quality guidelins
PEL – Probably effect levels
0.00671 – results exceed CCME ISQG Guideline
0.00671 **– results exceed CCME ISQG and PEL Guideline**
NG – No Guideline

3.1.4 HYDROGEOLOGY

Bedrock in the Winnipeg region consists of limestones, dolomites, and calcareous shales. Glaciers deposited the layer of till that presently overlies the bedrock in the Winnipeg area. Meltwater from the last retreating glacier formed Glacial Lake Agassiz, and the sediments deposited in the lake formed the Agassiz clay deposits in the Winnipeg area. Weathering of the Agassiz clay deposits, combined with deposition from periodic flooding of the Red and Assiniboine Rivers, resulted in the current surficial deposits, which include the surface soils of the Winnipeg area (Grove and Pupp 1995).

There are three main lithologic units that control the hydrogeologic conditions in the City of Winnipeg (Grove and Pupp 1995).

(1) The upper unit consists of glaciolacustrine clay deposits, with occasional silt horizons, that contain variable shallow 'perched' water table conditions created by infiltration of surface waters.

(2) A complex till zone with intertill sand and gravel deposits underlies the clays at a depth of 15 m to 20 m. The composition of the basal till is highly variable and localized aquifers may exist where the till is predominantly sand and gravel. The bedrock is composed of carbonate and sandstone deposits and occurs at a depth of approximately 20 m to 25 m.

(3) The bedrock aquifers are confined, with the dominant groundwater flow direction towards the centre of the Winnipeg draw down cone near the confluence of the Red and Assiniboine rivers.

Bedrock Aquifers

The major underlying aquifer in the Winnipeg area is the upper 15 m to 30 m fractured zone of the Upper Carbonate Aquifer. The aquifer is somewhat confined by the overburden and underlying lower permeability carbonate bedrock. Transmissivity in the aquifer ranges from 2.9×10^{-4} m^2/s to 2.9×10^{-2} m^2/s (Dillon 2009).

Prior to the development of the aqueduct system which supplies the City of Winnipeg with potable water, the Upper Carbonate Aquifer was an important source of water for both municipal and industrial use. The Upper Carbonate Aquifer remains a potable water source in areas bordering the City (east of the Red River) and for some industrial use within Winnipeg.

The Lower Carbonate Aquifer occurs within fractured networks in the bottom 7.5 m to 15 m of the Red River formation, along the interface of the upper shale unit of the Winnipeg formation. Transmissivities in the aquifer are generally less than 7.0×10^{-5} m^2/s (Dillon 2009). This aquifer is of limited use for potable water supply.

The Winnipeg Formation contains an Upper Sandstone Aquifer, 6 m to 12 m thick, and a Lower Sandstone Aquifer, approximately 3 m thick. Both sandstone aquifers contain

non-potable saline waters. Transmissivities vary from approximately 1.4 x 10^{-3} m^2/s in the Upper Sandstone aquifer to 1.4 x 10^{-4} m^2/s in the Lower Sandstone aquifer. The Pre-Cambrian basement lies beneath this aquifer.

3.1.4.1 CONTAMINATED GROUNDWATER

There have been numerous investigations of the shallow groundwater quality across the Former Dominion Bridge Operations Yard site and along Omands Creek bed (Wardrop 1999 and AECOM 2011). It was determined that shallow groundwater along the creek bank contains concentrations of total metals that exceed CCME guidelines for the Protection of Freshwater Aquatic Life. Particularly the metals Aluminum, Arsenic, Cadmium, Chromium, Copper, Iron, Lead, Nickel, Selenium, Silver and Zinc exceed the applicable guidelines.

3.1.5 NOISE AND VIBRATION

The properties adjacent to the Project site are a mixture of industrial and commercial businesses which generate noise and vibration through business activities and traffic. The area is currently subject to noise and vibration from heavy industry activities on the former Dominion Bridge property to the east, heavy traffic on Dublin Avenue to the north, and traffic on Saskatchewan Avenue to the south. In addition, a Canadian Pacific spur line borders the south of the Project site. The closest residential units are 340 m to the northeast.

3.2 TERRESTRIAL ENVIRONMENT

3.2.1 VEGETATION AND HABITAT

The Project area is a disturbed industrial site. The native vegetation was historically cleared during the construction of the Omands Creek channel and the development of the industrial sites adjacent to the stream channel. A terrestrial vegetation survey was not conducted as part of the Phase III assessment; however, the City of Winnipeg, Naturalist Services conducted a vegetation survey at a similar site located 500 m upstream. Both are highly disturbed meadows adjacent to Omands Creek. At the upstream site (Omands Creek 7, Site 432) 22 plant species comprising a mix of native and introduced species were observed (Table 3.7; City of Winnipeg 2013). The upstream site was classified as Grade D habitat which is defined as having a minimum sensitivity to disturbance due to being a heavily disturbed site where vegetation is dominated by weed species with few native species present (City of Winnipeg 2013). Omands Creek 7 was categorized as Riverbottom Forest habitat however the Project site, a stream diversion without the development of natural plant succession, does not readily fit into any of the five main habitat types that naturally occur in the City of Winnipeg (City of Winnipeg 2013).

Table 3. 7 Vegetation observed at Omands Creek 7, 500 m upstream of the Dominion Bridge Project site (after City of Winnipeg 2013).

Common Name	Species	Genus	Native/Introduced
Manitoba maple	*Acer*	*negundo*	N
Absinthe	*Artemisia*	*absinthium*	I
Showy milkweed	*Asclepias*	*speciosa*	N
Purple milk-vetch	*Astragulus*	*danicus*	
Wild mustard	*Brassica*	*kaber*	I
Smooth brome	*Bromus*	*inermis*	I
Canada thistle	*Cirsium*	*arvense*	I
Hedge bindweed	*Convolvulus*	*sepium*	N
Orchard grass	*Dactylis*	*glomerata*	I
Common horsetail	*Equisetum*	*arvense*	N
Smooth fleabane	*Erigeron*	*glabellus*	N
Rush	*Juncus*	*spp.*	
Silverweed	*Potentilla*	*anserina*	N
Seaside buttercup	*Ranunculus*	*cymbalaria*	N
Curled dock	*Rumex*	*crispus*	I
Chair-maker's rush	*Scirpus*	*americanus*	N
Bur-reed	*Sparganium*	*spp.*	
Dandelion	*Taraxacum*	*officinale*	I
Stinkweed, Field pennycress	*Thlaspi*	*arvense*	I
Common cat-tail	*Typha*	*latifolia*	N
American elm	*Ulmus*	*americana*	N
Stinging nettle	*Urtica*	*dioica*	N

Table 3. 8 Fish species known to occur in Omands Creek.

Common Name	Scientific Name		At Creek Mouth[1]	Project Site[2]	Upstream of Project[1]
	Genus	Species			
Northern Pike	*Esox*	*lucius*		X	X
Quillback	*Carpiodes*	*cyprinus*	X		
Brassy Minnow	*Hybognathus*	*hankinsoni*		X	
Fathead Minnow	*Pimephales*	*promelas*			X
Common Carp	*Cyprinus*	*carpio*			X
White Sucker	*Catostomus*	*commersoni*	X		X
Black Bullhead	*Ameiurus*	*melas*		X	
Brook Stickleback	*Culaea*	*inconstans*	X	X	X
Rock Bass	*Ambloplites*	*rupestris*	X		

[1] Penner (2007)

[2] AECOM (2011a)

3.2.2 WILDLIFE

A wildlife survey was not conducted as part of the Phase III ESA (AECOM 2011); however wildlife observations during the aquatic survey included Raccoon (*Procyon lotor*) footprints observed along creek margins, bird nests, and a duck tunnel on the creek banks. No amphibians were observed. A Red-sided Garter Snake (*Thamnophis sirtalis parietalis*) was captured downstream of the Project site during the aquatic survey. More recently, Muskrat (*Ondatra zibethicus*) trails were observed in the cattails along the creek margins.

3.2.3 TERRESTRIAL SPECIES OF CONCERN

A review conducted by the Manitoba Conservation Data Centre found no records of listed plant species or terrestrial wildlife of concern within the Project site or surrounding area. The Red-sided Garter Snake, found downstream of the Project site, is listed by Manitoba Conservation as G5T5/S4. That is, the subspecies is globally secure throughout its range while widespread, abundant, and secure within the provincial range but with long-term concerns.

3.3 AQUATIC ENVIRONMENT

3.3.1 HYDROLOGY

Omands Creek is part of the Province of Manitoba Water Resources Branch Designation of Drains (DES) Map No. 26, Sturgeon Creek and Associated Watersheds. The creek is a fourth order drain and discharges into the Assiniboine River 3.2 km south of the Project area. The creek originates in the RM of Rosser and drains the east

Colony Creek system. The watershed area at the Project site is approximately 76 km^2. Downstream of the Project area the creek receives treated runoff from the Winnipeg Airport Authority (WAA) de-icing system.

3.3.1.1 REGIONAL FLOOD ESTIMATE

A Water Survey of Canada flow gauging station was formerly operated on Omands Creek approximately 900 m upstream of the Project site between 1978 and 1993 (Station 05MJ007, watershed area 74.8 km^2), and was located at Metro Route 90 (King Edward Street near Dublin Avenue). A new level-only gauging station (05MH013, watershed area 79.8 km^2) has been operating in 2012 and 2013 and is located near Empress Street and Westway, downstream of the Project.

Regional discharge coefficients have been computed by the Province of Manitoba, Water Stewardship for former station 05MJ007 and are directly applicable to the Project site. The coefficients are regularly updated, and the October 2011 version of the coefficients was used. The creek is within Provincial zone 3 with exponent n=0.765.

Local flood flow can be estimated using the regional discharge formula:

$$Q = CA^n$$

Where:

- Q is the estimated flow in cubic metres per second (cms).
- C is a coefficient determined from frequency analysis (October 2011).
- A is the watershed area in km^2 (76 km^2 at the Project site).
- n is a regional exponent equal to 0.765 for this part of the Province.

3.3.1.2 FLOW-DURATION ANALYSIS

Eleven years of seasonal (March through October) average daily flow are available for Water Survey of Canada gauge 05MJ007 for the years 1978, 1983-1988, and 1990-1993.

The flow duration curve for the entire period of record is based on 2695 daily flow values (11 years, March through October). Based on the historic flow record, the flow will be less than 0.3 cms 90% of the time and less than 1.0 cms 95% of the time. Inspection of the daily data from the Water Survey of Canada HYDAT database indicates that Omands Creek exhibits typical ephemeral behavior common to many prairie streams, including high springtime flow due to snowmelt, high summertime flow in response to rainstorms, and long periods with no flow where the creek is reduced to a series of puddles.

The flow hydrograph for station 05MJ007 for the period of Record, the fraction of time that flow falls below a specified value and the flow duration curve can be found in the Tetra Tech memo entitled Omands Creek Hydraulics, September 9, 2013 (Appendix D).

3.3.2 WATER QUALITY

AECOM (2011a) collected water samples for water quality analysis at four locations on Omands Creek at the Project site (Table 3.9 and 3.10). Results were compared to the Canadian Council of Minister of Environment (CCME) Water Quality Guidelines (2007) for the Protection of Freshwater Aquatic Life, where possible. The surface water samples were collected by submerging sample containers completely under the water surface before opening the lid to collect water in the containers. Preservative was added immediately to each sample as required. Water samples collected for dissolved mercury and metals analysis were filtered during collection of samples using a 45 µm filter.

Several dissolved and total metals exceeded CCME guideline values. Dissolved metals that exceed the guidelines included cadmium and selenium while the total metals that exceed the guidelines included aluminum, cadmium, iron, selenium and zinc.

Concentrations of dissolved cadmium exceeded the referenced guidelines by between 1.2 to 11 times the guideline concentrations in samples from OC10-2, OC10-3 and OC10-5. Dissolved selenium exceeded the referenced guidelines by between 1.4 to 1.6 times the guideline concentrations in samples from OC10-2, OC10-3, OC10-4 and OC10-5.

Concentrations of total aluminum, total cadmium, total iron and total selenium exceeded the referenced guidelines by between 1.2 to 18 times the guideline concentrations in samples from OC10-2, OC10-3, OC10-4 and OC10-5. Total zinc concentrations exceeded the referenced guidelines by 2.3 times the guideline concentrations.

1:1500 30 0 20 40 60m

LEGEND

SURFACE WATER SAMPLE

MANITOBA HYDRO NATURAL GAS LINE

NO.	DESCRIPTION

REFERENCE DRAWINGS

NO.	DATE	DESCRIPTION	PREPARED	REVIEW	DESIGN	AUTHORIZE

REVISIONS/ISSUE DRAFTING ENGINEERING

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TETRA TECH

AUTHORIZED BY: RW DATE: 13.12.03 CLIENT DRAWING NO.

CLIENT
CITY OF WINNIPEG

DRAWING DESCRIPTION
FIGURE 3.3: OMANDS CREEK
SURFACE WATER SAMPLE LOCATIONS
1460 DUBLIN AVENUE, WINNIPEG, MB

DESIGNED BY:	DRAWN BY:	DRAWING NO.	REV.
RW	SP	1312940100-SKT-V0005	00
REVIEWED BY: RW	SCALE: 1:1500		

Table 3.9 **Dissolved Metal concentrations in surface water of the Site; 2010. Units are mg/L unless otherwise noted. See Figure 3.3 for sample locations. Data summarized from AECOM (2011a).**

Sample ID	OC10-2	OC10-3	OC10-4	OC10-5	Upstream	Downstream	CCME Freshwater Aquatic Water Qualtiy Guidelines[a]
Sampling Date	**10/7/2010**	**10/7/2010**	**10/7/2010**	**10/7/2010**	**11/7/2013**	**11/7/2013**	
Dissolved Metals							
Aluminum	0.038	0.044	0.052	0.06			.005-0.100 [b]
Antimony	<0.0005	<0.0005	<0.0005	<0.0005			NG
Arsenic	0.0030	0.0030	0.0033	0.0032			0.005
Barium	0.064	0.064	0.062	0.062			NG
Beryllium	<0.0001	<0.0001	<0.0001	<0.0001			NG
Bismuth	<0.001	<0.001	<0.001	<0.001			NG
Boron	0.088	0.087	0.085	0.089			NG
Cadmium	0.00002	0.00019	<0.00001	0.00003			0.000017
Calcium	76.9	75.9	68.4	75	63.9	65.7	NG
Chromium	<0.001	<0.001	<0.001	<0.001			0.0089
Cobalt	<0.0005	<0.0005	<0.00005	<0.0005			NG
Copper	0.0014	0.0015	0.0014	0.0015			0.002-0.004 [c]
Iron	0.066	0.087	0.078	0.0119			0.300
Lead	0.0003	0.0004	0.0003	0.0005			0.001-0.007 [d]
Lithium	0.072	0.072	0.074	0.073			NG
Magnesium	23	23	65.4	24	43.2	45.0	NG
Manganese	0.0634	0.0646	0.02	0.0655			NG
Mercury	<0.00002	<0.00002	<0.00002	<0.00002			0.000026
Molybdenum	0.001	0.001	0.001	0.001			0.073
Nickel	0.003	0.004	0.004	0.004			0.025-0.150 [e]
Potassium	12	12.3	12.4	12	15.1	13.7	NG
Selenium	0.0016	0.0015	0.0015	0.0014			0.0010
Silicon	2.65	2.71	2.62	2.52			NG
Silver	<0.00002	<0.00002	<0.00002	<0.00002			0.0001
Sodium	67	65.3	73.1	65.6	90.6	71.6	NG
Strontium	0.429	0.431	0.394	0.423			NG
Sulphur	67	68	68	69			NG
Thallium	<0.00005	<0.00005	<0.00005	<0.00005			0.0008
Tin	<0.005	<0.005	<0.005	<0.005			NG
Titanium	<0.005	<0.005	<0.005	0.009			NG
Uranium	0.0082	0.0082	0.0075	0.0082			NG
Vanadium	0.006	0.006	0.006	0.006			NG
Zinc	<0.005	0.009	<0.005	0.006			0.030
Zirconium	<0.0005	<0.0005	<0.0005	0.0006			NG

[a] Canadian Council of Ministers of Environment (CCME) Water Quality Guidelines (2007) for the Protection of Freshwater Aquatic Life.

[b] 0.005 mg/L at pH < 6.5; 0.100 at pH > 6.5

[c] 0.002 mg/L at a water hardness of 0-120 mg/L as $CaCO_3$; 0.003 mg/L at a water hardness of 120-180 mg/L as $CaCO_3$; 0.004 mg/L at a water hardness of >180 mg/L as $CaCO_3$

[d] 0.001 mg/L at a water hardness of 0-60-mg.L as CaCO3; 0.002 mg/L at a water hardness of 60-120 mg/L as CaCO3; 0.04 mg/L at a water hardness of 120-180 mg/L as CaCO3; 0.007 mg/L at a water hardness of >180 mg/L as CaCO3

[e] 0.025 mg/L at a water hardness of 0-60 mg/L as CaCO3; 0.065 mg/L at a water hardness of 60-120 mg/L as CaCO3; 0.110 mg/L at a water hardness of 120-180 mg/L as CaCO3; 0.150 mg/L at a water hardness of > 180 mg/L as CaCO3.

Table 3.10 **Total Metal concentrations in surface water of the Site; 2010. Units are mg/L unless otherwise noted. See Figure 3.3 for sample locations. Data summarized from AECOM (2011a).**

Sample ID	OC10-2	OC10-3	OC10-4	OC10-5	CCME Freshwater Aquatic Water Qualtiy Guidelines[a]
Sampling Date	**10/7/2010**	**10/7/2010**	**10/7/2010**	**10/7/2010**	
Total Metals					
Aluminum	0.476	0.839	0.665	0.502	.005-0.100 [b]
Antimony	<0.0005	<0.0005	<0.0005	<0.0005	NG
Arsenic	0.0032	0.0030	0.0034	0.0033	0.005
Barium	0.079	0.076	0.069	0.071	NG
Beryllium	<0.0001	<0.0001	<0.0001	<0.0001	NG
Bismuth	<0.001	<0.001	<0.001	<0.001	NG
Boron	0.104	0.095	0.085	0.095	NG
Cadmium	0.00032	0.00005	0.00002	0.00002	0.000017
Calcium	78.1	73.4	72.0	74.5	NG
Chromium	0.0001	0.002	0.001	<0.001	0.0089
Cobalt	<0.0005	0.0005	<0.0005	<0.0005	NG
Copper	0.0023	0.0035	0.0031	0.0023	0.002-0.004 [c]
Iron	0.555	1.070	0.808	0.598	0.300
Lead	0.0016	0.0038	0.0021	0.0019	0.001-0.007 [d]
Lithium	0.081	0.075	0.073	0.076	NG
Magnesium	30	31	29	22	NG
Manganese	0.0706	0.0649	0.0644	0.0693	NG
Mercury	<0.00002	<0.00002	<0.00002	<0.00002	0.000026
Molybdenum	0.001	0.001	0.001	0.001	0.073
Nickel	0.005	0.005	0.004	0.005	0.025-0.150 [e]
Potassium	13.6	12.5	13.0	13.2	NG
Selenium	0.0017	0.0015	0.0014	0.0015	0.0010
Silicon	3.61	4.33	4.300	3.540	NG
Silver	<0.00002	<0.00002	<0.00002	<0.00002	0.0001
Sodium	75.6	66	68	71.4	NG
Strontium	0.481	0.447	0.406	0.444	NG
Sulphur	72	66	66	75	NG
Thallium	<0.00005	<0.00005	<0.00005	<0.00005	0.0008
Tin	<0.005	<0.005	<0.005	<0.005	NG
Titanium	0.011	0.032	0.026	0.015	NG
Uranium	0.0092	0.0086	0.0080	0.0085	NG
Vanadium	0.007	0.007	0.008	0.008	NG
Zinc	0.017	0.069	0.014	0.012	0.030
Zirconium	0.0008	0.0009	0.0006	0.0006	NG

[a] Canadian Council of Ministers of Environment (CCME) Water Quality Guidelines (2007) for the Protection of Freshwater Aquatic Life.

[b] 0.005 mg/L at pH < 6.5; 0.100 at pH > 6.5

[c] 0.002 mg/L at a water hardness of 0-120 mg/L as $CaCO_3$; 0.003 mg/L at a water hardness of 120-180 mg/L as $CaCO_3$; 0.004 mg/L at a water hardness of >180 mg/L as $CaCO_3$

[d] 0.001 mg/L at a water hardness of 0-60-mg.L as CaCO3; 0.002 mg/L at a water hardness of 60-120 mg/L as CaCO3; 0.04 mg/L at a water hardness of 120-180 mg/L as CaCO3; 0.007 mg/L at a water hardness of >180 mg/L as CaCO3

[e] 0.025 mg/L at a water hardness of 0-60 mg/L as CaCO3; 0.065 mg/L at a water hardness of 60-120 mg/L as CaCO3; 0.110 mg/L at a water hardness of 120-180 mg/L as CaCO3; 0.150 mg/L at a water hardness of > 180 mg/L as CaCO3.

3.3.3 SEDIMENT QUALITY

Surficial sediment (i.e., the upper 0.35 m of sediment) was sampled in 2010 at various locations in Omands Creek at the Project site as well as upstream and downstream (AECOM 2011a). Sample locations are shown in Figure 3.2.

Sixteen sediment samples were collected on October 7 and 8, 2010 from four transects across Omands Creek. The sampling program included the collection of three grab samples from the top 0.05 m of surficial sediment across Omands Creek at four transect sampling locations along the creek using a Ponar or Ekman dredge. Additional samples were also collected to assess the deeper sediments from the midstream sample location of each transect at depths of 0.3 m to 0.35 m below grade.

The majority of polycyclic aromatic hydrocarbons (PAH) occurred at concentrations in excess of the ISQG (Table 3.5). Twelve PAHs occurred at concentrations in excess of the probable effects level (PEL) in sample OC10-3C. Concentrations of various PAHs in sample OC10-3C exceeded the guidelines by anywhere from 25 to 477 times the guideline concentrations. In sample OC10-5A various PAHs ranged from just over guidelines to 40 times greater than guidelines. PAHs Benzo(b/j)fluoranthene, Benzo(g,h,i) perylene, Benzo(k)fluoranthene and Indeno(1,2,3-cd)pyrene were all less than guidelines in both OC10-3C and OC10-5A.

Six metals occurred at concentrations that exceeded the ISQG concentrations (Table 3.6). One and/or two metals occurred at concentrations in excess of the PEL in sample OC10-3A, OC10-3B, OC10-3C, OC10-4B, OC10-4C, OC10-5A, OC10-5B and OC10-5C. Concentrations of lead and/or zinc occurred at concentrations that exceeded the guidelines by anywhere from 2 to 58 times the guideline concentrations.

3.3.4 FISH AND FISH HABITAT

3.3.4.1 FISH HABITAT

Omands Creek was historically diverted south into the Assiniboine River and retains the channel characteristics of a typical confined, excavated agricultural drain. The creek channel exhibits a low sinuosity ratio and low degree of physical habitat heterogeneity. Channel gradient at the Project site is low, 0.025%, and a hydraulic control immediately downstream of the Project site controls water levels throughout most of the reach during low and no flow periods. The low gradient and downstream hydraulic control combine to create a depositional channel. Normal summer water depth in the channel ranges from 0.25 m where the creek enters the property to 1.5 m downstream at the rail crossings while the wetted channel width ranges from 1.0 m upstream to 4.5 m downstream. In dry years the creek has been observed to go dry. Creek bed substrate is composed mainly of fine silt and clays resulting from upstream transport and deposition at the Project site.

The creek banks along most of the channel have an average slope of 2.8:1 and were likely originally constructed with a 3:1 slope but slippage into the channel over the years has reduced slope. A retaining wall and backfill forms a portion of the east bank adjacent to the buildings. The stream banks are fully vegetated with secondary growth that is dominated by grasses with occasional shrubs. A few trees have grown up along the east bank at the downstream end of the Project site. Cattail (*Typha latifolia*) have colonized the entire streambed in the upstream portion of creek and are gradually reduced to the margins of an open channel downstream. Dense beds of submerged macrophytes such as common waterweed (*Elodea candensis*), milfoil (*Myriophyllum* sp.), and pondweed (*Potamogeton* sp.) occur in the open channel (AECOM 2011a).

During normal summer water levels habitat in the upper portion of the creek is a shallow, slow run (uniform flow) or riffle (disturbed water surface) which transitions to a shallow flat (stagnant water). The downstream portion is characterized by a deep flat. Large-body fish migration through the reach likely occurs during higher flows such as spring freshet when the hydraulic control can be passed. AECOM (2011a) concluded that there was no overwintering habitat at the Project site.

The reaches upstream and downstream of the Project site Omands Creek are narrower, shallower and more sinuous (AECOM 2011a). Watercourse substrate in these reaches is more diverse with greater proportions of sand and gravel (AECOM 2011a). These reaches are often reduced to disconnected pools or completely dry late in the summer.

Omands Creek has been designated as Type A habitat (complex habitat, indicator fish species) on Map 062H14 in Fisheries and Oceans Canada 2013 “Fish Habitat Classification for Manitoba Agricultural Watersheds”. At the Project site, Omands Creek is Type B habitat (simple habitat, indicator fish species; AECOM 2011a).

3.3.4.2 FISH COMMUNITY

A fish community survey was conducted in 2010 in the Project area as part of the Phase III environmental site assessment (AECOM 2011a). The soft, deep substrate in the creek channel at the Site was determined to be unsafe therefore electrofishing surveys were conducted immediately upstream and downstream of the Site (AECOM 2011a). The survey covered 468 m with a total fishing time of 1,664 seconds and resulted in the capture of Northern Pike (*Esox lucius*), Brassy Minnow (*Hybognathus hankinsoni*), Black Bullhead (*Ameiurus melas*), and Brook Stickleback (*Culaea inconstans*; AECOM 2011a). The Brassy Minnow result is questionable as this fish species has not previously been captured in Winnipeg or intermediate water bodies between Omands Creek and the Red and Assiniboine tributaries on the Manitoba Escarpment in western Manitoba where they are known to occur (Stewart and Watkinson 2007).

Farther upstream of the Project site, fish community surveys were conducted at several locations within Brookside Cemetery (2.1 km) between 2004 and 2006 using a variety of sampling gear (gill nets, seines, and minnow traps; Penner 2007). Catch-per-unit-effort

was low and resulted in the capture of Northern Pike, White Sucker (*Catostomus commersoni*), Fathead Minnow (*Pimephales promelas*), and Brook Stickleback).

Downstream of the Project site, a fish community survey conducted in 2005 at the confluence with the Assiniboine River (2.6 km) resulted in Quillback (*Carpiodes cyprinus*), White Sucker, and Rock Bass (*Ambloplites rupestris*; Penner 2007).

Observations that Omands Creek at the Project site occasionally goes dry during dry periods (AECOM 2011a) indicates the fish community at the Project undergoes cycles of extirpation and re-colonization. For large-body species, this cycle is likely augmented by poor availability of overwintering habitat in the creek at the Project site. This is consistent with the low densities of large-body species observed upstream. The persistence of large-body species is likely dependent on periodic migrations upstream from the Assiniboine River to sustain the community. This would likely occur during spring migration when water levels in the creek are higher. The species present at the mouth of the creek, such as Quillback and Rock Bass, are likely seasonally migrating residents of the Assiniboine River rather than year-round residents of Omands Creek.

All fish species observed in Omands Creek are either spring or summer spawners.

3.3.4.3 AQUATIC SPECIES OF CONCERN

No aquatic species of concern have been observed in Omands Creek.

3.4 HUMAN ENVIRONMENT

3.4.1 REGIONAL ECONOMY

Manitoba has a well-diversified economy. Major industries include: agri-foods, transportation equipment, resource-based industries, chemicals, machinery and equipment, furniture and building products, paper products, fabricated metal products, plastics, printing, apparel, electronics, information technology and telecommunications, aerospace, farm equipment, hydroelectric generation, life sciences and biotechnology, environmental services, and culture and tourism. Manufacturing is Manitoba's largest industry, accounting for approximately 12% of the province's GDP, followed by the province's primary industries (mining, agriculture and forestry) which account for approximately 7% of the economy (Province of Manitoba 2010). Service industries account for 72% of the GDP. Provincial GDP, employment and import/export statistics for the years 2004 to 2008 are detailed in Table 3.11.

Table 3. 11 Manitoba Economic Characteristics (2004 - 2008).

Economic Indicators	2004	2005	2006	2007	2008
Real GDP (mkt prices) % growth	2.2	2.7	3.9	3.1	2.2
Real GDP per Capita (mkt prices) $	32,009	32,753	33,851	34,627	34,955
Employed (thousands)	577	580	587	597	607
Unemployment Rate (%)	5.3	4.8	4.3	4.4	4.2
CPI, All Items (2002 =100)	104	107	109	111	113
Total Private Investment ($ million)	5,082	5,091	5,811	6,267	7,221
Manufacturing shipments ($ million)	13,262	13,702	14,854	16,111	16,409
Exports ($ million)	9,297	9,301	10,195	12,192	12,830
Imports ($ million)	10,565	11,796	12,426	13,151	15,292

Source: Province of Manitoba 2010

In the Winnipeg Census Metropolitan Area (CMA), healthcare, manufacturing, business and finance, government, transportation, and sales and services are the largest employers. Winnipeg's diverse economy experienced significant growth in recent years and was one of only a few Canadian cities to experience any overall growth in 2009. The unemployment rate in the third quarter of 2009 was 5.1% compared to the national average of 8.2% (Destination Winnipeg 2010).

3.4.2 COMMUNITY AND NEIGHBOURHOOD CHARACTERISTICS

The Project is located in the St. James Industrial neighbourhood of the St. James – Assiniboia neighbourhood cluster. The St. James Industrial neighbourhood is bounded by Notre Dame Avenue to the north, the Canadian Pacific Railway La Riviere rail line to the east, Ellice, Silver and St. Matthews avenues to the south and the James Armstrong Richardson International Airport to the west. There is no demographic information available for the St. James Industrial neighbourhood indicating there are no persons residing in the neighbourhood (City of Winnipeg 2013).

3.4.3 LAND USE

The St. James Industrial neighbourhood is zoned for commercial and industrial developments.

3.4.3.1 EXISTING LAND USE

As part of the former Dominion Bridge property, the Project site is currently zoned for commercial and industrial development.

3.4.3.2 PLANNED LAND USE

The City of Winnipeg intends to subdivide the former Dominion Bridge property and retain the Project site (Omands Creek channel). Following remediation, the City of Winnipeg will maintain the Project site as a green space and make the property available for further enhancements by community groups.

3.4.4 ARCHAEOLOGICAL RESOURCES

Omands Creek at the Project site is not a natural waterway; the current alignment was excavated from native prairie soil in the early 1900s and the spoils were used to create the channel banks. Later modifications were limited to building up the channel banks using available onsite materials. Soon after construction an industrial sites were established along the banks.

Manitoba Tourism, Culture, Sport and Consumer Protection - Historic Resources Branch was confirmed that there are no known or anticipated historical cultural or archaeological resources of significance within 150 m of the Project site.

3.4.5 ABORIGINAL INTERESTS

The City of Winnipeg is located in Treaty No.1, signed in 1871 between the Government of Canada and the Chippewa and Swampy Cree Indian Tribes. The nearest reserve lands are located over 50 km outside the City of Winnipeg (Table 3.12; INAC 2010). There are no known outstanding aboriginal land claims or active traditional use for lands in the Regional Area.

Table 3. 12 Proximity to First Nations Reserves.

Reserve Name	First Nations Band	Distance from Winnipeg (km)	Direction
Broken Head Indian Reserve 4	Brokenhead Ojibway Nation	64	NE
Dakota Plains 6A	Dakota Plains	74	W
Roseau River 2	Roseau River Anishinabe First Nation Government	80	S

Source: Indian and Northern Affairs Canada (INAC) 2010

4.0 EFFECTS ASSESSMENT, MITIGATION, AND MONITORING

4.1 ENVIRONMENTAL ASSESSMENT APPROACH

4.1.1 SCOPE OF PROJECT

The Project includes the remediation of contaminated sediment in Omands Creek west of the Former Dominion Bridge Operations yard. The remediation works include the removal of contaminated bank and stream bed sediment and bank slope stability improvements. The stream bed will be reconstructed with features intended to increase habitat heterogeneity while the stream banks will be planted with grasses and perennials. All Project works were included in the assessment of Project-related effects.

4.1.2 SPATIAL BOUNDARIES

4.1.2.1 PROJECT SITE

The Project site is defined as the area that will be directly disturbed by Project construction and/or operation. The Project site consists of Omands Creek channel and banks between Dublin and Saskatchewan Avenues, immediately west of 1460 Dublin Avenue, the Former Dominion Bridge Operations yard and east of the McCrossen Street right of way in the City of Winnipeg.

4.1.2.2 REGIONAL AREA

4.1.3 TEMPORAL BOUNDARIES

The remediation works are tentatively planned to begin on January 6, 2014 and to be completed by February 28, 2014 followed by the re-vegetation of the creek banks by mid July 2014. The assessment will therefore include the construction period plus the re-vegetation period.

4.1.4 METHODS FOR IDENTIFYING, PREDICTING, AND ASSESSING EFFECTS

The environmental factors considered in the environmental impact assessment are listed in Table 4.1. Environmental effects of the project were identified, predicted or assessed using a stepwise approach. The first step involved characterization of the interaction between the project and environmental components, with respect to the nature of the interaction, the location, duration, and, where appropriate the

magnitude/severity/intensity of the interaction. The reversibility of the interaction also was examined.

Table 4. 1 List of factors to be considered in the Remediation of the Former Dominion Bridge Operations Yard.

Physical Environment	Air Quality
	Noise and Vibration
	Soil Chemistry and Quality
	Hydrogeology
Terrestrial Environment	Vegetation
	Wildlife and Habitat
Aquatic Environment	Surface Hydrology
	Shoreline and Creek bank Stability
	Surface Hydrology
	Surface Water Quality
	Sediment Quality
	Fish and Fish Habitat
Human Environment	Human Health and Safety
	Existing or Planned Land Use
	Aesthetics
Accidental Release of Hazardous Materials	
Effects of the Environment on the Project	Climate change

4.1.4.1 *MITIGATION AND RESIDUAL EFFECTS*

As much as possible, measures to prevent adverse effects have been built into the Project design and proposed construction methods. Mitigation measures were developed for any significant impacts identified during the determination of significance. To the extent possible, positive effects will be enhanced.

Residual impacts were determined by measuring mitigation measures against the predicted Project effects. If present, the severity, extent, and duration of any residual effects were identified.

4.1.4.2 *DETERMINATION OF SIGNIFICANCE*

A determination of the significance of any potential effects of the project on environmental components was conducted after the application of mitigation measures. The mitigation measures to be applied to this project have been integrated into the project design; consequently, it is only the residual effects of the project which require

assessment. The criteria employed in the assessment of effects significance and the associated methods for criteria application are described below.

Assessment of the significance of environmental effects of the Project involved the consideration and evaluation of specific characteristics, or attributes, of the effects. The attributes examined included the magnitude and geographic extent of the effects; the frequency of occurrence of the effects and their duration; the ecological and socio-economic context; the reversibility of the effect, and, the likelihood the effect will occur.

Significance assessment involves the evaluation of each effect attribute against a three-level significance ranking scale:

- Level I - a negligible or limited potential to contribute to an overall significant environmental effect
- Level II – a moderate potential to contribute to an overall significant environmental effect
- Level III - a high potential to contribute to an overall significant environmental effect.

The effects attributes and evaluation criteria for the environmental components identified are defined in Tables 4.2 through 4.4.

An effect defined as significant in this assessment meets both of the following criteria:

- A Level II or III rating is attained for ecological and/or socio-economic context; and,
- A Level II or III rating is attained for all of the attributes involving magnitude/extent, duration and frequency.

A Level I rating for any of the attributes involving magnitude/geographic extent, duration, or frequency; or, if a Level I rating is achieved for both ecological and socio-economic contexts (where applicable), then the effect is considered to be “not significant”.

Effects are also assessed as to their likelihood, recognizing that there is some overlap in the concepts of duration, frequency and likelihood.

4.2 ENVIRONMENTAL ASSESSMENT RESULTS

The environmental assessment results are presented in Table 4.5 while the overall effects of the Project are described in the following sections.

Table 4. 2 Environmental Impact Significance Criteria.

Significance Level	Context		Extent		Frequency	Reversibility	Likelihood of Occurrence
	Ecological	Socio-Economic[1]	Magnitude / Geographic Extent	Duration			
I	No meaningful adverse ecosystem effects – effects within the range of natural variation	No meaningful adverse effects to socioeconomic interests – effects within year to year variation	See Table 7-2 for specific criteria	See Table 7-3 for group specific criteria	Effect expected to occur infrequently, or not at all (i.e., <once per year)	Effect is readily Reversible over a relatively short period (i.e., ≤ period of construction)	Unlikely to occur
II	Adverse effects outside the range of natural variation, but Involving only common species or communities, or affecting resources of limited importance	Adverse effects involve measurable disturbance to local residents or land users, or to community character or services in portions of the study area	See Table 7-2 for specific criteria	See Table 7-3 for group specific criteria	Effect expected to occur intermittently, possibly with some degree of regularity (i.e., <once per month)	Effect is reversible at substantial cost, and/or over long period (i.e., lifespan of project)	Could reasonably be expected to occur
III	Adverse effects involve locally, regionally, or nationally important species, communities, or resources	Adverse effects involve measurable disturbance to livelihoods, Traditional Use activities, community character, or to services throughout the study area	See Table 7-2 for specific criteria	See Table 7-3 for group specific criteria	Effect expected to occur regularly or continuously (i.e., >once per month)	Effect is not reversible	Will occur, or is likely to occur

1 –Limited to consideration of environmentally (biophysical) induced socio-economic effects.

Table 4. 3 Significance Criteria – Magnitude and Geographic Extent.

Component	Factor	Level I	Level II	Level III
Physical Environment	Air Quality	Emissions above background but within applicable federal and provincial regulations and guidelines; or if guidelines exceeded, effects limited to the project footprint	Emissions have the potential to exceed federal or provincial guidelines for areas beyond project footprint, resulting in potential for meaningful adverse environmental effects to resources (land, water, biota) or residents outside the project footprint.	Emissions are likely to exceed federal or provincial guidelines for areas beyond project footprint, resulting in meaningful, and unacceptable adverse environmental effects to resources (land, water, biota or residents outside the project footprint.
	Climate and meteorology	Greenhouse gas emissions of <0.1% of Canada's target CO_2 emission rate reduction of 240 Mt/a	Greenhouse gas emissions of 0.1 to 1.0% of Canada's target CO_2 emission rate reduction of 240 Mt/a	Greenhouse gas emissions of >1.0% of Canada's target CO_2 emission rate reduction of 240 Mt/a
	Water Quality - Surface	Water quality effects in receiving waters within applicable federal and provincial regulations and guidelines; or if guidelines exceeded, no anticipated adverse environment effects beyond any defined mixing zones	Water quality effects in receiving waters exceed applicable federal and provincial regulations and guidelines and have the potential to adversely affect[1] drinking water uses, aquatic life, and/or wildlife, beyond any defined mixing zones	Water quality effects in receiving waters applicable federal and provincial regulations and guidelines are likely to adversely affect[1] drinking water uses, aquatic life, and/or wildlife, beyond any defined mixing zones, likely resulting in an unacceptable effect
	Water Quantity - Surface	Change to creek flows is <15% of seasonal average	Change to creek flows is15 to 25% of seasonal average	Change to creek flows is >25% of seasonal average
	Water Quality - Ground	Water quality effects in receiving waters within applicable federal and provincial regulations and guidelines; or if guidelines exceeded, no anticipated adverse environment effects beyond any defined mixing zones	Water quality effects in receiving waters exceed applicable federal and provincial regulations and guidelines and have the potential to adversely affect drinking water uses, aquatic life, and/or wildlife, beyond any defined mixing zones	Water quality effects in receiving waters applicable federal and provincial regulations and guidelines are likely to adversely affect[1] drinking water uses, aquatic life, and/or wildlife, beyond any defined mixing zones, likely resulting in an unacceptable effect
Biological Environment	Aquatic Environment (aquatic life, fish, and fish habitat)	In water work or structures necessary but no net loss of the productive capacity of fish habitats[1]	In water work or structures necessary resulting in a net loss of the productive capacity of local fish habitat[1]	In water work or structures necessary resulting in a net loss of the productive capacity of regional fish habitat[1]
	Vegetation	Effect considered minor (i.e., only affecting common species or communities), and confined to the project footprint.	Activity has the potential to measurably affect vegetation communities or species outside of the project footprint but effect limited to common species or communities.	Activity is likely to measurably affect vegetation communities or species outside the project footprint and may affect rare or protected species

Table 4.3 Cont'd. Significance Criteria – Magnitude and Geographic Extent.

Component	Factor	Level I	Level II	Level III
	Wildlife and habitat, including: • Amphibians and reptiles • Migratory birds • Furbearers	Effect considered minor, occurring at the level of individuals and not affecting population size to a degree distinguishable from natural variation. Habitat alteration/loss restricted to project footprint.	Activity has the potential to measurably affect population size and/or habitat availability outside the project footprint.	Activity is likely to measurably affect population size and/or and habitat availability outside the project footprint.
Human Environment (changes to resulting from a direct change in the natural environment)	Human health and safety (safety, noise, air quality, aesthetics, recreational use)	Selected parameter changes by <10% from baseline conditions within project study area	Selected parameter changes by 10 to 20% from baseline conditions within project study area	Selected parameter changes by >20% from baseline conditions within project study area
	Heritage/archaeological structures/sites	Heritage/archaeological resources disturbed by the project but are recovered	Heritage/archaeological resources of local importance are disturbed by the project but are not recoverable	Heritage/archaeological resources of regional/national importance are disturbed by the project but are not recoverable

1 - Determined by DFO in consultation with Manitoba Water Stewardship.

Table 4. 4 CEAA Significance Criteria – Duration.

Component	Level I	Level II	Level III
Physical and biological environment	Short-term - Effect not measurable beyond construction period (< 1 year)	Medium-term – Effect likely to persist though first 10 years of project operation	Long-term – Effect likely to persist beyond 10 years of project operation
Human environment (indirect effects resulting from a direct change in the environment)[1]	Short-term - Effect will occur for ≤ 1 year (construction phase)	Medium-term - Effect likely to persist though first 10 years of project operation	Long-term - Effect likely to persist beyond 10 years of project operation

1 - Significance determinations are not provided for non-environmentally induced socio-economic and socio- cultural components.

Table 4. 5 Environmental Assessment Results.

Factor	Potential Effect	Mitigation	Context		Extent					Residual Effects	Determination of Effects	Monitoring/Follow up
			Ecological	Socio-economic	Magnitude	Duration	Frequency	Reversibility	Likelihood			
Physical Environment												
Air Quality	Fugitive dust generated by equipment operation	None	No adverse ecosystem effects Level I	No adverse effects to socio-economic interests Level I	Limited to Project site works Level I	Construction phase Level I	Intermittent Level I	Reversible Level I	Could reasonably be expected to occur Level II	Negligible	Not significant	None
	Exhaust generated by equipment operation	Limit vehicle idling; regular vehicle/equipment maintenance	No adverse ecosystem effects Level I	No adverse effects to socio-economic interests Level I	Not detectible beyond Project site Level I	Construction phase Level I	Regular Level II	Reversible over time Level I	Will occur Level II	Negligible	Not significant	None
Noise and Vibration	Vibration from construction activities such as heavy equipment operation	Investigate and respond to public concerns; adapt work activities to minimize effects	No adverse ecosystem effects Level I	No adverse effects to socio-economic interests Level I	Limited to Project site works Level I	Construction phase Level I	Intermittent Level I	Reversible Level I	Could reasonably be expected to occur Level II	Negligible	Not significant	On-site monitoring
Soil Chemistry and Quality	Reduced soil quality as result of deleterious substance spills	Project involves remediation of soil contamination therefore all necessary control and clean-up equipment already at site	No adverse ecosystem effects Level I	No adverse effects to socio-economic interests Level I	Limited to Project site works Level I	Construction phase Level I	Incidental Level I	Reversible Level I	Could reasonably be expected to occur Level II	Negligable	Not significant	On-site monitoring
	Reduced soil quality as result of fugitive contaminants	Excavated materials will be contained on site, tested, and directed to appropriate off site disposal/treatment; all equipment will be inspected and cleaned prior to leaving site.	No adverse ecosystem effects Level I	No adverse effects to socio-economic interests Level I	Limited to Project site works Level I	Construction phase Level I	Incidental Level I	Reversible Level I	Unlikely to occur Level II	Negligable	Not significant	On-site monitoring
Ground Water	Reduced ground water quality as result of deleterious substance spills	Project involves remediation of soil contamination therefore all necessary control and clean-up equipment already at site	No adverse ecosystem effects Level I	No adverse effects to socio-economic interests Level I	Limited to Project site works Level I	Construction phase Level I	Incidental Level I	Reversible within a short period Level I	Could reasonably be expected to occur Level II	Negligable	Not significant	On-site monitoring
	Reduced ground water quality as result of fugitive contaminants	Excavation to extend below the extent of contaminated materials; use clean material for backfill	No adverse ecosystem effects Level I	No adverse effects to socio-economic interests Level I	Limited to Project site works Level I	Construction phase Level I	Incidental Level I	Reversible within a short period Level I	Unlikely to occur Level I	Negligable	Not significant	On-site monitoring

Table 4. 5 Cont'd. Environmental Assessment Results.

Factor	Potential Effect	Mitigation	Context		Extent					Residual Effects	Determination of Effects	Monitoring/Follow up
			Ecological	Socio-economic	Magnitude	Duration	Frequency	Reversibility	Likelihood			
Terrestrial Environment												
Riparian Vegetation	Vegetation clearing of the Project site to conduct soil and sediment remediation and channel reconstruction	Retain trees, if possible; replant with native species and maintain until established	No adverse ecosystem effects Level I	No adverse effects to socio-economic interests Level I	Limited to Project site Level I	Construction and monitoring phases Level I	Once Level I	Reversible within a short period Level I	Will occur Level III	Negligable	Not significant	On-site monitoring; sediment control measures and re-vegetation works will be regularly monitored until vegetation re-established
Wildlife and Habitat	Vegetation clearing of the Project site to conduct soil and sediment remediation and channel reconstruction	Retain trees, if possible; replant with native species and maintain until established; conduct works outside of nesting season\	No adverse ecosystem effects Level I	No adverse effects to socio-economic interests Level I	Limited to Project site Level I	Construction and monitoring phases Level I	Once Level I	Reversible within a short period Level I	Will occur Level III	Negligable	Not significant	On-site monitoring; sediment control measures and re-vegetation works will be regularly monitored until vegetation re-established
Aquatic Environment												
Stream Bank Stability	Use of heavy equipment along stream banks; loss of vegetation cover	Project involves reconstruction of stream banks to more stable geometry; retain trees, if possible; replant with native species and maintain until established	No adverse ecosystem effects Level I	No adverse effects to socio-economic interests Level I	Limited to Project site Level I	Construction and monitoring phases Level I	Once Level I	Reversible within a short period Level I	Will occur Level III	Negligable	Not significant	On-site monitoring; sediment control measures and re-vegetation works will be regularly monitored until vegetation re-established
Surface Hydrology	Isolation of channel sections will restrict stream flow	Works to be conducted in the winter months when stream flow does not occur	No adverse ecosystem effects Level I	No adverse effects to socio-economic interests Level I	Limited to Project site Level I	Construction and monitoring phases Level I	Once Level I	Reversible Level I	Unlikely to occur Level I	Negligable	Not significant	On-site monitoring
Surface Water Quality	Reduced water quality due to disturbance and transport of contamiants	In-stream works limited to winter months when no flow in stream; isolate work areas with temporary dams; collection and removal of water and sediment to shore for assessment and disposal/treatment	No adverse ecosystem effects Level I	No adverse effects to socio-economic interests Level I	Limited to Project site Level I	Construction and monitoring phases Level I	Incidental Level I	Reversible Level I	Unlikely to occur Level I	Negligable	Not significant	On-site monitoring
	Reduced water quality due to erosion and sediment transport from disturbed areas	In-stream works limited to winter months when no flow in stream; install and maintain sediment and erosion control measures until vegetation cover established	No adverse ecosystem effects Level I	No adverse effects to socio-economic interests Level I	Limited to Project site Level I	Construction and monitoring phases Level I	Incidental Level I	Reversible Level I	Could reasonably be expected to occur Level II	Negligable	Not significant	On-site monitoring; sediment control measures and re-vegetation works will be regularly monitored until vegetation re-established
Sediment Quality	Reduced sediment quality as result of deleterious substance spills	Project involves remediation of soil contamination therefore all necessary control and clean-up equipment already at site	No adverse ecosystem effects Level I	No adverse effects to socio-economic interests Level I	Limited to Project site works Level I	Construction phase Level I	Incidental Level I	Reversible Level I	Unlikely to occur Level I	Negligable	Not significant	On-site monitoring

Table 4. 5 Cont'd. Environmental Assessment Results.

Factor	Potential Effect	Mitigation	Context		Extent					Residual Effects	Determination of Effects	Monitoring/Follow up
			Ecological	Socio-economic	Magnitude	Duration	Frequency	Reversibility	Likelihood			
Fish and Fish Habitat	Disruption of fish passage through Project site by isolation dams	Works scheduled for winter months when no stream flow; complete works prior to spring freshet	No adverse ecosystem effects Level I	No adverse effects to socio-economic interests Level I	Limited to Project site works Level I	Construction phase Level I	Incidental Level I	Reversible Level I	Unlikely to occur Level I	Negligable	Not significant	On-site monitoring
	Disruption of fish habitat through the removal of stream sediments	Conduct works during winter moths when habitat not in use; stream bed reconstructed to grade with clean material	No adverse ecosystem effects Level I	No adverse effects to socio-economic interests Level I	Limited to Project site works Level I	Construction phase Level I	Incidental Level I	Reversible Level I	Unlikely to occur Level I	Negligable	Not significant	On-site monitoring
	Alteration of fish habitat through placement of rock features	Conduct works during winter moths when habitat not in use; stream bed reconstructed to grade with clean material	No adverse ecosystem effects Level I	No adverse effects to socio-economic interests Level I	Limited to Project site works Level I	Construction phase Level I	Incidental Level I	Reversible Level I	Unlikely to occur Level I	Negligable	Not significant	On-site monitoring
Human Environment												
Human Health and Safety	Interactions with site tenants and general public	Project site is fenced to exclude the general public; site tenants informed of works and communications maintained as activities change	No adverse ecosystem effects Level I	No adverse effects to socio-economic interests Level I	Limited to Project site works Level I	Construction phase Level I	Incidental Level I	Reversible Level I	Unlikely to occur Level I	Negligable	Not significant	On-site monitoring
Human Health and Safety	Worker safety	Adherence to Manitoba Workplace Safety and Health guidelines	No adverse ecosystem effects Level I	No adverse effects to socio-economic interests Level I	Limited to Project site works Level I	Construction phase Level I	Incidental Level I	Reversible Level I	Unlikely to occur Level I	Negligable	Not significant	On-site monitoring; inspection by Workplace Safety and Health
Existing or Planned Land Use	Project site will be converted to a green space and no longer available as an industrial site	Minimize the area to be detached and converted to green space	No adverse ecosystem effects Level I	No adverse effects to socio-economic interests Level I	Limited to Project site works Level I	Long-term Level III	Incidental Level I	Reversible Level I	Will occur Level III	Negligable	Not significant	None
Aesthetics and Recreational Use	Project site will be disturbed and unavailable for recreational use during remediation and reconstruction works	Conduct works during the winter when potential use is minimal; re-establish vegetation cover	No adverse ecosystem effects Level I	No adverse effects to socio-economic interests Level I	Limited to Project site works Level I	Construction phase Level I	Incidental Level I	Reversible Level I	Unlikely to occur Level I	Negligable	Not significant	None

4.2.1 PHYSICAL ENVIRONMENT

4.2.1.1 AIR QUALITY

Effects and Mitigation

Potential effects of the Project on air quality include dust emissions from Project activities and exhaust emissions from construction equipment.

Dust may be generated during excavation. Dust emissions will be short-term, limited to the duration of the specific construction phase (i.e., days to weeks), and the spatial extent will be localized to the Project site.

The exhaust emissions from construction equipment will be short-term (limited to the construction phase), the spatial extent will be localized to the Project site, and the incremental contribution to vehicular exhaust emissions at the Project site will be negligible in comparison to the emissions from the daily vehicle traffic adjacent to the Project site.

Residual Effects

Effects of the Project on air quality will be limited to the Project site during the period of restoration and reconstruction.

4.2.1.2 NOISE AND VIBRATION

Effects and Mitigation

Noise and vibration resulting from construction will be limited to daytime hours and the spatial extent will be localized to the Project site. Noise and vibration during the restoration and reconstruction phase of the Project will result from operation of equipment and vehicles on site and activities such as excavation. Any noise and vibrations from the Project are likely to be indistinguishable from normal industrial activities within the neighborhood.

Residual Effects

Any noise or vibration related to Project activities will not extend beyond the duration of the Project works.

4.2.1.3 SOIL CHEMISTRY AND QUALITY

Effects and Mitigation

The Project site soil is contaminated. The excavation and removal of contaminated bank soil and replacement with clean backfill is designed to improve soil chemistry and quality. The potential for liberating contaminated soil through scour and transport downstream will be eliminated. This effect extends beyond the Project site, is long term (permanent), and is beneficial.

Residual Effects

The residual effects will be the replacement of contaminated soil with clean soil and a significant reduction in the risk of flow transportation of contaminated soil downstream. This beneficial effect will extend beyond the duration of the Project.

4.2.1.4 HYDROGEOLOGY

Effects and Mitigation

There is a possible, though not likely, potential for downward migration of contaminated groundwater during the remediation and reconstruction activities. In order to mitigate the risk, the excavation depth is designed to exceed the extent of contamination.

Residual Effects

There are no anticipated residual effects of the Project on groundwater.

4.2.2 TERRESTRIAL ENVIRONMENT

4.2.2.1 VEGETATION

Effects and Mitigation

Existing vegetation will be cleared in order to excavate bank and bed material. Existing vegetation is an unmaintained secondary growth mix of weeds, invasive species, and native species. Existing trees will be maintained, if possible, and cleared areas will be planted with native grasses and perennials. Effects will be limited to the Project site and cleared areas will be re-planted with native species and maintained until established.

Residual Effects

The existing vegetation will be replaced with a more natural mix of native species. This is a beneficial effect.

4.2.2.2 WILDLIFE AND HABITAT

Effects and Mitigation

Terrestrial habitat will be disrupted during the remediation and reconstruction activities. By conducting the activities during the winter disturbance of nesting birds is avoided. Nesting habitat will be disrupted until the vegetation has re-established. Any terrestrial animals using the Project site will be temporarily displaced. Birds and terrestrial animals are expected to colonize the Project site once vegetation has been re-established.

Residual Effects

The removal of contaminated materials and re-vegetation with native plant species will be a net benefit for wildlife and habitat.

4.2.3 AQUATIC ENVIRONMENT

4.2.3.1 STREAM BANK STABILITY

Effects and Mitigation

The existing stream banks are unstable and show slippage into the stream channel. The reduced slopes and added aquatic habitat structures will improve stream bank stability and therefore reduce the risk of bank slippage and erosional events within the stream channel. The Project effects are expected to be beneficial.

Residual Effects

The beneficial effects of improved stream bank stability are expected to extend beyond the duration of the Project.

4.2.3.2 SURFACE HYDROLOGY

Effects and Mitigation

In general, works within a stream channel present the risk of restricted flow and increased erosion during remediation and reconstruction activities. Works will be conducted during the winter when there is no flow so there will be no effect on surface flow.

The reduced bank slopes will increase the flow capacity of the channel which will reduce water velocities during high-water events and therefore reduce the overall potential for erosion. The reconstruction of the channel will have a beneficial effect on surface hydrology.

Residual Effects

The benefits of channel reconstruction to surface hydrology are expected to extend beyond the duration of the Project.

4.2.3.3 SURFACE WATER QUALITY

Effects and Mitigation

There is potential for reduced water quality during the remediation and reconstruction works through the disturbance of contaminated soil and sediment and sedimentation from disturbed areas. The stream channel will be isolated and works will be conducted during the winter when there is no flow in the stream. Sediment and erosion control measures will be installed prior to spring freshet and maintained until the vegetation cover has been established. The controlled removal of contaminated soil and sediment is anticipated to have a net benefit on surface water quality.

Residual Effects

The benefits to surface water quality are expected to extend beyond the duration of the Project.

4.2.3.4 SEDIMENT QUALITY

Effects and Mitigation

The Project site sediment is contaminated. The excavation and removal of contaminated sediment and replacement with clean backfill is designed to improve sediment chemistry and quality. The potential for liberating contaminated sediments through scour and transport downstream will be eliminated. This effect extends beyond the Project site, is long term (permanent), and is beneficial.

Residual Effects

The residual effects will be the replacement of contaminated sediment with clean sediment and a significant reduction in the risk of flow transportation of contaminated sediment downstream. This beneficial effect will extend beyond the duration of the Project.

4.2.3.5 FISH AND FISH HABITAT

Effects and Mitigation

There is a potential for the loss of fish due to construction activities while existing habitat will be removed and the Project site will be unavailable as fish habitat during the remediation and reconstruction activities. The works will be conducted during the winter months when the stream does not support fish. The works will be completed by spring freshet when fish begin seasonal migrations through the Project site. The reconstructed channel will include engineered features designed to provide increased habitat heterogeneity. The increased channel stability and habitat heterogeneity and the removal of contaminated soils and sediments will have a beneficial effect on fish and fish habitat.

Residual Effects

The beneficial effects of the remediation and reconstruction of Omands Creek will extend beyond the duration of the Project.

4.2.4 HUMAN ENVIRONMENT

4.2.4.1 HUMAN HEALTH AND SAFETY

Effects and Mitigation

Safe work conditions will be maintained for all Project personnel during the remediation construction works and the Project has been designed and will be completed with the safety of the Project personnel and current and future site occupants operating businesses at the site in mind. Slope stability of the east bank of Omands Creek will be improved.

Residual Effects

The benefits of improving slope stability of the east bank of Omands Cree will extend beyond the duration of the Project.

4.2.4.2 CONSTRUCTION

Occupational Health and Safety

The City, Tetra Tech and Tri-Core Projects Ltd are dedicated to providing and maintaining a safe and healthy work environment for all personnel throughout the construction and maintenance period of the Project. Occupational health and safety measures include:

- Effective implementation and utilization of Tetra Tech Site Specific Safety Plan and Tri-Core's Safety Plan.
- Effective communication systems including site orientations/training, hazard assessments/control, safe work procedures, and regular tailgate meetings.
- Tri-Core Projects Ltd. currently maintains a valid Certificate of Recognition (COR) recognized in Manitoba confirming that Tri-Core is compliant with Manitoba legislated safety requirements.
- All remediation construction activities will comply with Manitoba's Workplace Safety and Health Act.

Public Health and Safety

Public health and safety measures during the construction phase of the Project include:

- Barriers surrounding remediation areas, if required, will be placed to ensure the employees and customers of the businesses currently operating at the site are aware of the location of open excavations.
- Staging the remediation activities will be completed to minimize the disruption to the businesses operating at the site.
- When not in use, heavy equipment will be secured and parked in a common location on the Project site, as per normal industry standard.

Residual Effects
Construction
There are no anticipated residual effects of the Project on human health and safety during the construction phase.

4.2.4.3 EXISTING OR PLANNED LAND USE

Effects and Mitigation
The Project site is currently within an industrial development and will remain so until the remediation and reconstruction works have been completed. Once the Project site has been detached from the former Dominion Bridge property the Project site will be made

available as a green space. The conversion to a green space is beneficial while having no effect on adjacent land uses.

Utility services could inadvertently be disrupted during the remediation and reconstruction activities. Utility locates have been conducted using information provided by service providers and communications with services providers will be maintained throughout the Project activities to ensure any disruptions to services are minimized. The natural gas service line crossing on Omands Creek that is currently exposed and suspended within the water column will be lowered and re-buried by Manitoba Hydro during the remediation and reconstruction works thus eliminating the need for separate trenching works and the risk of contaminant transport from uncontained works.

Residual Effects

The benefits of converting the Project site to green space will extend beyond the duration of the Project.

4.2.4.4 AESTHETICS AND RECREATIONAL USES

Effects and Mitigation

The Project site will be disturbed during the remediation and reconstruction works. The site is currently a part of an industrial development and therefore not accessible by the general public. Once the remediation and reconstruction works have been completed the site will be made accessible to the general public as a green space and will be available for community group-led green space improvement initiatives.

Residual Effects

The benefits of improved aesthetics and conversion of the Project site to a green space accessible by the general public will extend beyond the duration of the Project.

4.2.5 EFFECT OF THE ENVIRONMENT ON THE PROJECT

4.2.5.1 CLIMATE CHANGE

Effects and Mitigation

Potential effects of climate change include changes to the amount of precipitation and potential stream flow in Omands Creek. The reduction in stream bank slopes will increase the flow capacity of the channel at the Project site which in turn will reduce the potential for channel erosion from higher flows. The habitat features installed during the channel reconstruction will provide scour protection. The removal of contaminated soils and sediments, increased flow capacity, and installation of scour protection will be beneficial.

Residual Effects

The beneficial effects of the remediation and reconstructed of the Omands Creek channel will extend beyond the duration of the Project.

4.2.6 CUMULATIVE EFFECTS

The City of Winnipeg undergoes a constant process of urban maintenance and renewal. The vast majority of these activities do not require an environmental assessment or EAL in order to proceed. The majority of the potential effects, particularly with respect to the human environment, will be indistinguishable from normal urban activities occurring within the Project neighbourhood. Other potential effects such as the remediation of contaminants and reconstruction of the stream channel will have beneficial effects on the human, terrestrial, and aquatic environments that will extend past the duration of the Project.

4.3 MONITORING

4.3.1 SURFACE WATER QUALITY

Water quality will be monitored before, during and after remediation construction activities in the Project area between Dublin Avenue and Saskatchewan Avenue. Surface water samples were collected by AECOM in 2010 and by Tetra Tech in 2013 prior to freeze up. These samples were collected at locations at the upstream and downstream extents of the Project site and at two locations between the Project site extents and analyzed for parameters in Table 3.9 and 3.10.

Water samples will be collected once following remediation construction activities at the upstream and downstream extents of the Project site. Both samples will be compared to the Canadian Council of Ministers of Environment Water Quality Guidelines (2007) for the Protection of Freshwater Aquatic Life. The post remediation downstream water quality will be compare to pre remediation and upstream water quality.

4.3.2 SEDIMENT QUALITY

Sediment quality monitoring within the Project area has been conducted by AECOM in 2010 at the locations shown on Figure 3.2 and Tables 3.5 and 3.6. Sediment quality will be monitored during the remediation construction to assess the sediment quality conditions that will remain in place in Omands Creek and to determine appropriate disposal for the sediment that is remove from the Project site.

4.3.3 SEDIMENT AND EROSION CONTROL MEASURES

Sediment and erosion control measures that will be implemented as part of Omands Creek channel reconstruction will include the placement of a geotextile membrane within the excavated channel which will be covered by an approximately 0.6 m layer of 0.15 m minus rock to provide scour protection and aid in channel stability. A 0.4 m layer of silty clay native soil material will be placed on the rock to replace the texture of the excavated material and to bring the channel back up to grade. An alternating series of shallow wing deflectors and will be constructed using 0.15 m minus

rock. The wing deflectors will add habitat and flow complexity while permitting freshet flows to discharge unimpeded. Revetments will be installed on the banks opposite to each wing deflector to provide scour protection. Riffle silt traps will also be installed within the channel. The silt traps will be low-grade and have course rock fill in the centre portion to allow fish passage for small fish at low water levels.

Final bank slope will be completed at 4 m horizontal to 1 vertical for increased bank stability. Silt fencing will be installed at 1:2 flood waterlines to intercept any silt from the work site during the following spring freshet. The silt fencing will be maintained for two years or until vegetation has assumed the sediment and erosion control function.

Re-vegetation of the banks will be conducted beginning in July 2014. The in-situ soil will be amended with a sand and peat mix rototilled to a depth of 0.1 to 0.15 m into the soil. Native grasses and perennial wild flower species will be hydroseeded. The grass will be periodically mowed until the perennials, such as herbs and wildflowers, become established.

5.0 REFERENCES

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