6.0 NATURAL ENVIRONMENT – BASELINE CONDITION DESCRIPTION, IMPACT ASSESSMENT AND MITIGATION

6.1 Bedrock Geology, Surficial Geology and Soils

The regional geology of the area has been described in reports and maps by Ontario Geological Survey (1991) and Chapman and Putnam (1984). These background data sources were supplemented by geological information from the Ministry of the Environment (MOE) computerized well record database.

Geotechnical studies of the project area were undertaken in 2001, 2003 and again in the spring of 2009 by Golder Associates Ltd. During the 2001 / 2003 studies, a total of 173 exploratory boreholes were drilled to various depths of up to 8.6 m as part of the preliminary design of the SWM ponds, along the edge of the planned pavement and where structural elements (i.e. culverts) may be installed. During 2009, the fieldwork involved 19 new boreholes along the current alignment near the Carp River ranging to a depth of 4.3 m to 31.0 m in the clay dominated floodplains. A second phase of work along the road alignment in the bedrock dominated areas and the East Shirley's Brook realignment advancing 25 boreholes to a depth of 1.1-7.3 m. Boreholes were progressed to gain information on the capacity of the soils to bear the weight of structures and the roadbed, subsurface conditions, depth of the soil layers, elevation (relative) of the groundwater table, type of overburden, blow count and type of rock strata. Standpipes &/or monitoring wells were sealed into 25 of the earlier boreholes and into another nine of the 2009 holes to allow the periodic monitoring of groundwater elevations.

6.1.1 Current Baseline Conditions

6.1.1.1 Bedrock Geology

Terry Fox Drive crosses two major landforms. The Carp River floodplain is a low lying, relatively flat area of productive farm land, while the South March Highlands are fully forested, rolling outcrops of bedrock with several pockets of wetlands, small drainage watersheds and few areas of arable land.

The complete series of Golder reports, including borehole logs and analysis is available upon request to the City of Ottawa. In the study area, boreholes revealed two types of bedrock in the study area. The first, primarily found south of Station 16+100, is a granite gneiss composed of approximately 78 to 80% silica with oxides of aluminum, iron and potassium as the other major components. The second, found north of Station 16+100, is a primarily metamorphosed sandstone composed of about 98% silica.

In the areas of the road alignment occupied by granite gneiss bedrock, the depth of soil cover may vary sharply over short distances. Bedrock was found exposed at the ground surface; between Stations 13+875 and 16+100 it varies from exposed bedrock at the ground surface to a proven depth of 4.4 metres. The results of rising head testing done in standpipes revealed in situ permeability of approximately $2x10^{-3}$ to $8x10^{-4}$ centimetres per second.

The terrain where the sandstone bedrock is located is marked by gentle slopes and less severe changes in the depth to rock. No exposed sandstone was observed during field surveys. In borehole 00-71 the sandstone bedrock was proven at a depth of about 0.7 metres. Rising head testing in standpipes sealed in sandstone bedrock suggested an in situ permeability of approximately $4x10^{-5}$ centimetres per second.

6.1.1.2 Physiography and Surficial Geology

A detailed overview of the surficial geology of the project area is available in the Golder Associates Ltd. report from 2009, as available from the City. In general, along the alignment there is a layer of topsoil that ranges in thickness from 30 to 510 mm, with an average thickness of 240 mm. In the low-lying wetland areas between Stations 13+300 and 13+450, peat exists at the ground surface ranging in depth from 0.15 to 0.58 m.

Within the Carp River flood plain, localized deposits of silty sand or sandy silt underlie the topsoil and peat. The overburden above the bedrock was found to generally consist of layers of silty sand, sandy silt, sand, gravel and glacial till. The thickness of this overburden ranges in depth from 0.1 to 3.0 m, averaging at approximately 0.6 m. Between Stations 12+100 to 13+700 and Stations 14+500 to 15+000, the topsoil is underlain by a thick deposit of silty clay. The upper portion of this deposit has been weathered to form a stiff grey brown crust that was found to typically be 1.4 to 3.2 m thick.

In higher elevation areas of the route, glacial till overlays the bedrock and consisted of a mixture of gravel and cobble in a matrix of silty sand and sandy silt with traces of clay. Boulders were also encountered within the till. The thickness of the till ranged from 0.1 m to 5.7 m with an average thickness of approximately 1.0 m.

6.1.1.3 Soils

There are at least nine distinct soil types that occur in the study area as well as combinations of these soils (Schut L.W., EA. Wilson, 1977). A short description of the soil types are shown in **Table 6-1**.

Table 6-1 – Soils in the Project Study Area

Soil/Soil Association Name	Description
Anstruther Loamy Sand, Sandy Loam	This soil is the dominant soil type in the area, and occurs in the west portion of the study area, north of Highway 417. It is usually in association with outcrops of bedrock, and is composed of 10 to 50 cm of acidic stony sandy loam, loamy sand or undifferentiated drift material.
Rideau Silty Clay or Clay	Rideau soils are composed of grey to olive grey, heavy clay and are poorly drained and remain saturated for long periods of time.
Jockville Fine Sandy Loam, Loamy Fine Sand or Fine Sand	These soils develop on coarse textured marine or fluvial material. This particular soil type located in the northern central portion of the study area is poorly drained and is very pale brown to greyish brown.
Rockland	Outcrops of Palezoic or Precambrian bedrock exist in the northern portion of the study area and along Highway 417. These areas have either a thin veneer of mineral soil or thick layer of muck soils.
St. Thomas Fine Sand, Loamy Fine Sand or Fine Sandy Loam	This soil type occurs in the northern portion of the study area along Sandhill Road from Herzberg Road to Klondike Road. It is a light coloured, well drained soil found on very gently to gently sloping or undulating topography.
Goulbourn Organics	This soil type occurs in the Kanata North Business Park and consists of 40 to 160 cm of moderately to well composted, black organic material which is underlain by mineral material which may be a sandy loam to clay loam. This soil is also poorly drained.
Dalhousie Silty Clay Loam, Silty Clay or Clay	This soil occur in many places within the study area including at the Highway 417/Eagleson Road intersection and along Shirley's Brook creek at March Road. This soil is a poorly drained, predominantly fine textured, noncalcareous soil.

Soil/Soil Association Name	Description
North Gower Silt Loam, Silty Clay Loam, or Clay Loam	This soil is poorly drained and found on level to nearly level topography. It consists of moderately find textured marine materials over fine textured marine materials, and occurs north of Highway 417 along First Line Road.
Oka Gravelly Sand, Sandy Loam or Loam	This soil occurs south of Highway 417 in the Hazeldean area. It is well drained and occurs on very gently to gently sloping topography.
Anstruther/Dalhousie	This association occurs along the rail line east of Goulbourn Forced Road. The Anstruther loamy sand dominates and the Dalhousie is a silty clay with poor drainage.
North Gower/Dalhousie	This association occurs along both sides of Highway 417 near Katimavik. The North Gower loam has poor drainage as does the Dalhousie silty clay.
Nepean/Queensway	Both soil types are a sandy loam with good drainage. This association occurs east of the Terry Fox/Highway 417 intersection and extends in a south-easterly direction to Highway 7.
Castor/North Gower	This association includes a dominate, poorly drained Castor loam and a poorly drained North Gower loam.

These soils occur singularly or in combination with each other. Typical associations are Anstruther/Dalhousie, North Gower/Dalhousie, Nepean/Queensway and Castor/North Gower. Those soils that are associated with marshland or the larger water courses have not been inventoried as they are alluvial in nature.

6.1.2 Effects Assessment

Construction activities are not expected to adversely affect bedrock, surficial geology or soils. Soils in the majority of the study area are characterized as sandy which may be subject to erosion but the potential for erosion can be minimized with the appropriate mitigation measures (**Storm Water Management: Chapter 7**). Effects on watercourses will be prevented or will be mitigated in accordance with the appropriate guidelines documented in the Sediment and Erosion Control (S&EC) plan developed as part of the detailed design drawings. No planned monitoring is associated with bedrock/soils.

Extensive blasting operations will be required to remove bedrock along the road alignment and the Shirley's Brook realignment to achieve the required design components. Blasting will have the potential to generate noise, dust and percussive effects on people and wildlife. These effects are assessed in the relevant sections below.

Construction Mitigation Measures

A sediment and erosion control plan has been developed for implementation by the contractor during construction. These will be reviewed by the Conservation Authority and become part of their permitting process. A water management program will be in place to ensure soil and silt particles from the excavation, do not impact the downstream watersheds. A full time environmental monitor will be on site daily to check that the silt fences are being maintained and that the prescribed mitigation practices are being met by the contractor(s).

In the area of PSW #4, a sensitive amphibian habitat, blasting will be required within close (70 m) proximity to the wetland edge. A newly listed Species at Risk, the Western Chorus Frog were identified and thought to be breeding in this small wetland. Fractures in the bedrock due to excessive percussive forces could cause the wetland to lose it's ability to contain surface water, resulting in the loss of habitat

and breeding area for several amphibian species. A wildlife passage culvert is being built at this location to avoid roadkill around this feature. The culvert elevations will match the surface of the bedrock, the bottom 300 mm will be filled with native organic soils and log debris to encourage the amphibians to use the passage rather than climbing on the roadway. The contractor will be required to implement a blasting management and reduction plan for work around this wetland and around water to reduce impacts to the natural environment.

A Permit To Take Water (PTTW) from the Ontario Ministry of the Environment will be required for the project. As part of that permitting process, for dewatering of open excavations, the contractor will also need to submit a detailed plan that identifies the pump sizes, duration of pumping, location of discharge, treatment methods to maintain clear water conditions, temperature amelioration if needed and contingency precautions in case of a release of silt. A contingency plan will be implemented to ensure the contractor has on-site extra silt fencing, spills kits and silt containment booms in case of an accidental release of sediment to a watercourse.

Toxic or Hazardous Materials to be Used

Explosives will be used as part of the blasting operations to cut the bedrock as required to meet the necessary sub-grades. Trace residual amounts of nitrates and potentially, toluene if using TNT, will be generated. The residual amounts will depend on the blasting materials used by the contractor and the efficiency of the operation in achieving complete combustion. It is expected that the contractors will require up to two explosives magazines, placed in strategic locations along the right of way and well away from existing residences. All personnel handling the explosives will be licensed in accordance with the federal and provincial guidelines. Any use of explosives around waterbodies shall be in compliance with the federal Guidelines for Use of Explosives in Canadian Fisheries Waters such that the explosives are used as efficiently as practical and that the residues remaining are minimal.

At this time, there are no other known toxic or hazardous materials to be used in the construction of the Project.

Interim Measures

No interim mitigation measures are expected that will affect geology and soils.

Operational Measures

Once the sides slopes of the road embankment have been stabilized with vegetation, there is little ongoing maintenance or measures to be undertaken during the operational period. A warranty period will be expected for the plants, to ensure they grow as desired and control surface erosion of soils. Erosion concerns may arise within a period of 2-3 years post construction as the surrounding landscape recovers from the perturbation and during this period, City staff may need to ensure protection from erosion by periodic inspections and spot repairs.

6.1.3 Assessment of Significance

Table 6-2 provides a summary of the geology/soils effects assessment.

Table 6-2 – Summary of Effects on Bedrock Geology, Surficial Geology and Soils

Project Interaction	Potential Effects	Mitigation Method and Measure	Significance Criteria*	Assessment of Significance
Construction				
Excavation of roadbed - Blasting	• Release of bedrock/soil particles to the downstream watercourses; • Noise and percussive effects of blasting; • Blasting may affect PSW #4, causing loss of water and sensitive amphibian habitat.	• Ensure Sediment and Erosion Control plan is followed during contracting; • Secure Permit to Take Water; • Secure MVC Permit; • Contingency of 1,000 m of silt fencing and silt containment booms; • Reduce magnitude of blasts around PSW #4, PSW #3 and along Shirley's Brook realignment at interface with PSW#2.	• Magnitude – *Low;* • Geographic Extent - *Low;* • Duration - *one season;* • Frequency - *once or twice (second time when additional lanes added for Section 1);* • Permanence – *No;* • Ecological Context – *Local.*	Not significant with mitigation.
Interim Measures				
East Shirley's Brook Realignment	• Blasting around water may kill fish or disturb species at risk; • Wetland portion will generate spoils of organic soil that can be reused.	• Blast management plan to be prepared by Contractor • Remove spoils from wetland and use in rock cut portion where organic supplementation is needed .	• Magnitude – *Mod;* • Geographic Extent - Low - *PSW #1;* • Duration - *one season;* • Frequency - *once;* • Permanence – *Yes;* • Ecological Context – *Local.*	Not significant with mitigation.
Operational Measures				
Regular road maintenance	• Slope failures releasing sediment into watercourses; • Stormwater discharge to unprotected surfaces.	• Reseed vertical erosion scars when they happen; • Maintain runoff patterns, adjust patterns as necessary to minimize erosion.	• Magnitude – *Mod;* • Geographic Extent - *Length of road;* • Duration - *continuous;* • Frequency - *check once or twice annually;* • Permanence – *No;* • Ecological Context – *Local.*	Not significant with mitigation.

** Magnitude High-highly mobile clay soils near a coldwater watercourse; moderate – small particle soils released near warm water watercourse; Low – large particle soils released near degraded or non-sensitive watercourses.*