6.2 Groundwater Quality and Quantity

Groundwater investigations were undertaken by Golder Associates Ltd. in 2001/2003 and then again in 2009 **(Table 6-3)**. The complete series of reports, including borehole logs and analysis is available upon request to the City of Ottawa. In 2001/2003 twenty-five standpipes were installed in the silty clay or glacial till along the Carp River floodplain and in granite gneiss bedrock of the South March Highlands. In 2009 a further nine monitoring wells were installed.

6.2.1 Current Baseline Conditions

In 2001/2003, where the standpipes were installed in silty clay or glacial till along the Carp River floodplain, the groundwater ranged from 0.2 m above the ground surface to approximately 1.8 m below the existing ground surface. In standpipes installed in granite gneiss bedrock of the South March Highlands, the groundwater levels were measured at approximately 0.1 to 5.3 m below the ground surface.

During the 2009 investigation, in standpipes installed in silty clay or glacial till, the groundwater levels ranged from 0.03 m to approximately 4.0 m below the existing ground surface. Where the standpipes were installed in granite gneiss bedrock, the groundwater levels ranged from 0.2 m to 9.1 m below ground surface.

During wet times of the year, when groundwater levels are expected to be higher, it is possible that groundwater could reach ground elevation at borehole locations within the Shirley's Brook tributary (see Borehole No. 09-27; 00-48). At Borehole No. 00-55, located in PSW #2 where there was a proposed SWM #4B Facility, groundwater levels reached 0.2 m below ground elevation.

During the spring melt and extremely wet events it is likely that groundwater discharge contributes to the water levels of the PSW#2 wetland. In areas of the alignment where drainage culverts are proposed, groundwater levels ranged from 0.03 m to 4.0 m below ground surface. Culvert installations, especially in the area of Borehole No. 09-3 will need to consider groundwater elevations when excavating to install the culverts.

No water wells were listed in the 2009 geotechnical report provided by Golder Associates. However, two dug wells have been found where historical farm sites (O'Brien Farm in Part A and Wilson Farm in Part B) have been identified. At one time potable water was obtained here, but no longer.

Table 6-3 – Observed Groundwater Elevations

Borehole No.	Observed Groundwater Elevations - 2009											
	Station	Ground Elevation	APRIL 23		MAY 20		MAY26		JULY 2		JULY 13	
			Elevation	W.L	Elevation	W.L	Elevation	W.L	Elevation	W.L	Elevation	W.L
09-3	12+250	92.76	92.73	-0.03	92.70	-0.06	-		92.52	-0.24	-	
09-5	12+400	93.06	92.21	-0.85	92.99	-0.07	-		92.53	-0.53	-	
09-6	12+500	93.05	89.57	-3.48	91.58	-1.47	-		92.65	-0.4	-	
09-7	12+600	93.22	91.74	-1.48	92.47	-0.75	-		92.33	-0.89	-	
09-9	WEST OF 12+600	92.77	92.27	-0.50	92.05	-0.72	-		91.94	-0.83	-	
09-11	12+800	93.02	92.96	-0.06	92.70	-0.32	-		92.60	-0.42	-	
09-14	13+100	93.18	90.64	-2.54	91.92	-1.26	-		92.40	-0.78	-	
09-17	SOUTH OF 13+400	92.11	-	-	88.15	-3.96	-		90.71	-1.4	90.88	*-1.23*
09-19	SOUTHWEST OF 14+000	102.16	102.30	-0.14	101.36	-0.8	-		100.42	-1.74	-	
09-22	EAST OF 14+400	107.29	-	-	-	-	106.65	-0.64	106.39	-0.9	106.59	*-0.7*
09-23	NORTHWEST OF 14+300	107.52	-	-	-	-	107.37	-0.15	107.09	-0.43	107.19	*-0.33*
09-27	SOUTHWEST OF 14+600	101.51	-	-	-	-	98.76	-2.75	101.11	-0.4	101.27	*-0.24*
09-30	EAST OF 15+800	108.94	-	-	-	-	106.51	-2.43	106.14	-2.8	106.29	*-2.65*
00-44	14+450	109.47	-	-	-	-	-		-		100.39	*-9.08*
00-48	14+550	101.52	-	-	-	-	101.30	0.22	101.12	-0.4	100.91	*-0.61*
00-55	SWM 4B	102.31	-	-	-	-	-		-		102.11	*-0.2*
00-57	15+050	109.88	-	-	-	-	-		-		104.66	*-5.22*
00-63	15+400	110.32	-	-	-	-	-		-		105.12	*-5.20*
00-67	15+800	109.88	-	-	-	-	107.10	-2.78	106.83	3.05	106.95	*-2.93*
00-69S	16+000	103.46	-	-	-	-	101.86	-1.6	100.26	3.2	100.24	*-3.22*
00-69D	*16+000*	*103.46*	-	-	-	-	*101.96*	*-1.5*	*100.26*	*3.2*	*100.21*	*-3.25*

NOTE: W.L. = Water Level Elevation
Values for 2009 were obtained by using the elevation at ground surface of the borehole and subtracting the observed groundwater elevation.

6.2.2 Effects Assessment

Groundwater will require dewatering when the excavations for below grade structures encounter porous bedrock or seams of sand that liberate water. Calculations by Golders has indicated that while installing storm sewers, upwards of 30 m^3 per day can be expected from the porous bedrock. This water will need to be removed so the storm sewers can be constructed properly in dry conditions.

Layers of silty sand and sandy silt are expected to be encountered in the floodplain cut / wetland restoration areas on the west side of the Carp River. This a fortunate occurrence as this will ensure the wetlands remain wet year round, and can provide permanent wet habitats to the target amphibian species.

Construction Measures

The two encountered wells will be properly decommissioned where they fall upon the alignment under Ontario Regulation 143/2. There are therefore no effects expected to impact potable groundwater resources as a result of the Terry Fox Drive new road construction.

Cut excavations on the floodplain east of the Carp River will need to manage the flow of water into the excavations. Generally, the excavations for the deeper pools should be conducted as quickly and completely as possible, without giving the basins a chance to collect water. Water entering the excavations may be left intact, however if removal is necessary, the water will need to be treated and returned to the river at a turbidity level change of not greater than 20 NTU. Measurements are to be taken at the source, prior to mixing and measured against the daily background levels in the Carp River. Daily turbidity levels in the Carp River and in Shirley's Brook are to be measured and logged by the Environmental Monitor along with the daily rainfall amounts.

During construction, when dewatering of groundwater is necessary to maintain dry working conditions, clean water will be kept separated from dirty water. Clean water will be generally directed to the receiving stream while dirty water will be clarified to remove the suspended sediments before discharge.

Interim Measures

Other than the short, interim diversion of East Shirley's Brook near Stn, 15+000 there are no other interim measures relating to surface water on the Terry Fox Drive project.

Operational Measures

During operations, there is the potential for contamination of surface waters and indirectly the groundwater system through the use of salt and other de-icing materials. Once dissolved in water, there is no readily available treatment options for brackish (salty) water in road runoff.

6.2.3 Assessment of Significance

Table 6-4 provides a summary of the roadway effects on groundwater quality and quantity and the corresponding mitigation strategies.

Table 6-4 – Summary of Effects on Groundwater Quality and Quantity

Project Interaction	Potential Effects	Mitigative Factor and Measure	Significance Criteria*	Assessment of Significance
Construction				
Site Preparation, and Construction of storm sewers	• Source of potable water contaminated; • Discharge to creeks and wetlands affected; • Large amounts may overwhelm smaller creeks.	• Groundwater not currently used or forecast to be used for potable water within the future urban areas. No mitigation proposed; • Roadway bed fill in creek valleys and wetlands will be shot rock with large interstitial spaces to allow seepage to continue unabated; • Permit to Take Water required from MOE; • PSW #2 to remain flooded and will recharge the local area; • Decommissioning two dug water wells within the ROW.	• Nature of Effect – *negative, direct;* • Magnitude – *Moderate;* • Spatial Extent - *Local;* • Duration - *Short-term, intermittent;* • Frequency - *Mod-High* ; • Permanence – *Temporary*; • Ecological Context – *Local to downstream.*	Not significant with mitigation.
Preloading in Floodplain	• Squeeze water from underlying clay – no longer able to be recharged. Water table remains static.	• Clay plain currently recharges very slowly; • preload surcharging to include wick drains to reduce the time by speeding settlement; • Granular layer to remain and will act as French drain to non-paved surfaces and help support baseflow in the Carp River.	• Nature of Effect – *neutral, direct;* • Magnitude – *Low* • Spatial Extent - *Local;* • Duration - *6 months;* • Frequency - *Once, two locations;* • Permanence – *Temporary;* • Ecological Context – *None.*	Neutral effect. No significant impact with mitigation.
Floodplain Cut and Restoration	• Fine grained clays can effect the Carp River; • Groundwater intrusion into cut basins; • Spring flood flows can knock over light duty silt fencing.	• Ring cut area in heavy duty sediment fencing with pipes every 50 m to allow water in and out; • Groundwater intrusion is a positive benefit to the wetland but will need to be managed during construction.	• Nature of Effect – *positive, direct;* • Magnitude – *Moderate;* • Spatial Extent - *Local;* • Duration - *Short-term, intermittent;* • Frequency - *Low*; • Permanence – *Temporary;* • Ecological Context – *Local.*	No significant impacts with mitigation. Positive benefit to local Carp River ecosystem.
Operations				
Road De-icing	• Dissolved salt and sand will contaminate surface	• Ottawa follows existing salt application guidelines that stringently limit the amount of salt in roadway	• Nature of Effect – *Negative, indirect;* • Magnitude – *Moderate*	No significant impact with mitigation and the regular use of Best