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Appendix D

Supplementary Information in Support of Alternative 3A

Appendix D

November 2022

1.0 Introduction

Government Review Team (GRT) comments on the August 2021 EA raised several concerns regarding preferred Alternative 3 particularly the proximity to, and the potential impacts of the Cement Kiln Dust (CKD) Pile on the relocated watercourse. To address these concerns, the Town re-engaged with St. Marys Cement (SMC) to discuss the watercourse relocation and how far onto SMC lands it might extend. SMC undertook further review and indicated that encroachment onto their lands would not be possible without affecting their Aggregate Resources Act license. Reflecting on both the comments on the August 2021 EA and the limitations with respect to SMC lands, the study team revisited the preferred Alternative 3. The team was challenged to determine if refinements to the preferred alternative could minimize the need to relocate the watercourse while maintaining the target capacity of the preferred alternative and its attributes. To this end, the team identified a refinement to the preferred alternative, Alternative 3A. The new Alternative 3A was incorporated and assessed as part of the alternative methods evaluation and ultimately chosen as the preferred Alternative Method (see Vol. I, Section 7).

This appendix details the conceptual design of Alternative 3A.

2.0 Description of Alternative 3A

The key characteristics of Alternative 3A are provided in Table 1, below.

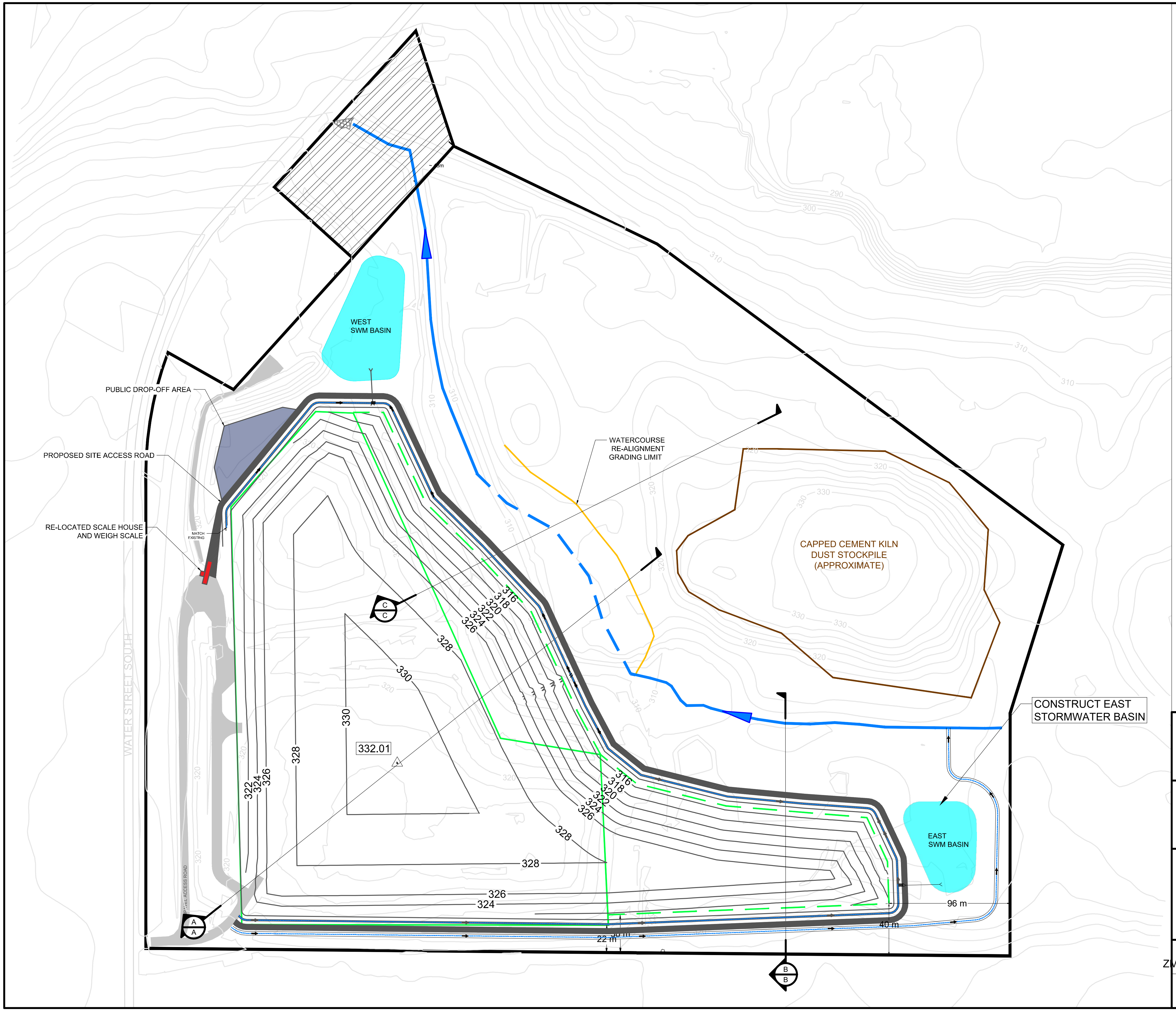
Table 1: Key Characteristics of Alternative 3A

Alternative 3A: A Combination of Vertical and Horizontal Expansion with Watercourse Re-Alignment	
Description	Expand the landfill vertically, above the existing landfill footprint and horizontally to the north and east of the existing landfill footprint. Realign a small portion of the watercourse.
Total Footprint	117,000 m^2
Total New Disposal Volume	709,000 m^3 (40 years)
Highest Final Peak	331 masl
Changes to Watercourse	The watercourse through the site needs a small (±230 metres) realignment.
Changes to Ancillary Facilities	• Scale and scale house to be relocated. New public drop-off area required. • Existing stormwater ponds A and B to be replaced with larger ponds in a new location. • New internal and external ditching required around new waste footprint. • New access road and perimeter road required for waste trucks and site maintenance.

November 2022

The information in Table 1, above, has been incorporated into Vol. I Table 7.1 to allow the comparative evaluation of Alternative Methods. Vol. I, Section 8 describes the preferred Alternative 3A in greater detail to address many of the comments raised by the Government Review Team (GRT). It can be summarized as a combination of a vertical and horizontal expansion of the existing landfill site. Key points of the conceptual design, shown on Figure D-1, are:

- The expansion will operate in a similar fashion as the existing landfill site.
- The landfill property remains 37 hectares. The expansion adds 3.2 hectares to the site's existing 8.0 hectare waste footprint, resulting is a total waste footprint of 11.2 hectares.
- The expansion must provide 708,000 m^3 of additional capacity (Alternative 3A provides 709,000 m^3). This includes 73,050 m^3 of volume approved through interim ECA's, resulting in 634,950 m^3 of new capacity to address the remaining 40-year Planning Period requirements through December 31, 2056 (see Vol I Section 3.1.3.8).
- Vertical expansion consists of Cells 1 and 2 above and between the existing Phase I and Phase II/III waste footprints.
- Horizontal expansion consists of Cells 3 and 4. These extend the existing waste footprints to the east.
    - To accommodate the horizontal expansion, an approximately 230 m portion in the middle section of the on-site watercourse will be realigned. This is discussed in more detail in Section 2.1.
- For the ultimate build out, a new access road, running from the scale clockwise around the perimeter of the waste footprint, will allow two-way traffic for the segment from the scale to the East Stormwater Management Basin (aka SWM Basin or Pond). It will continue as a single lane road from the pond joining with the existing site access road on the west limit of Phase II/III.
    - The two-lane road will allow waste vehicles to access the tipping face.
    - The one-lane road is meant for site inspections, maintenance and staff access. Waste vehicles will not normally travel on the one-lane road.
- Both existing stormwater management basins will be removed, replaced by two new stormwater management basins to be located at the perimeter of the existing and expanded waste footprint.
    - Runoff originating from within the waste footprint will be directed to an internal ditch system. These ditches convey surface water into the West and East basins for treatment. The basins will discharge to the existing watercourse
    - Runoff originating from lands external to the landfill site will be intercepted by a separate ditch, conveying runoff around and away from the waste footprint before discharging directly to the existing watercourse.



LEGEND

━━	PROPERTY LINE
──	APPROXIMATE CKD PILE COVER LIMIT
— —	PROPOSED WATERCOURSE ALIGNMENT
──	EXISTING REFUSE LIMIT
— —	EXPANSION REFUSE LIMIT
──	EXISTING CONDITIONS CONTOURS (1m)
──	PROPOSED WASTE CONTOURS (2m)
A	CROSS-SECTION LABEL
▨	RIGHT-OF-WAY AND SEWER EASEMENT
🟦	PROPOSED STORMWATER BASIN (APPROXIMATE)
332.01 △	APPROXIMATE PEAK OF WASTE (masl)
➔	STORMWATER FLOW DIRECTION

N

0 60 120 180 240

Metres

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Figure Title

ALTERNATIVE METHOD 3A

PROPOSED FINAL REFUSE CONTOURS

Drawn	Checked	Date	Figure No.
ZM	JH	JUNE 2022	D-1
Scale		Project No.	
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File:Shared Work Areas (\\pops)\ E:\032339 - St. Marys Waste\CIVIL\04_MiscDwg\032339 Figure 8-2 and 8-5.dwg Date Plotted: June 10, 2022 - 1:17 PM

- The site's groundwater resources will be protected by:
  - Using the site's native clays as a landfill liner, limiting leachate[1] infiltration into the groundwater.
  - Installing a leachate collection system across the new waste footprint, like that of Phase II/III. The leachate collection system will use 'lateral' collection pipes surrounded by gravel like a French drain at regular intervals across the base of the footprint. These 'lateral' pipes will drain to a perimeter 'header' pipe.
- Leachate collected from Phase I, Phase II/III and the new waste footprint will be directed to the site's existing leachate sewer. This connects to the Town's sanitary sewer system at Water Street S., which ultimately takes the leachate to the St. Marys Waste Water Treatment Plant (WWTP) for treatment.
- The site buffer is at least 30 m wide. The buffer allows adequate space for vehicle usage, operations and activities which ensure there is no operation negatively impacting areas outside of this buffer zone.

2.1 Watercourse Realignment

Preferred alternative 3A is premised on retaining most of the approximately 790 m long watercourse, between the east property line and Water Street North, which bisects the site in its present location. There will be a realignment of an approximate 230 m reach within the middle of the site. The proposed realignment is shown on Figure D-2.

The realigned watercourse is designed to provide a 20 m buffer from the toe of the CKD pile embankment to the edge of the realignment grading (top-of-bank). As a contingency, this buffer could include a CKD surface water interception swale and monitoring pond.

The realigned watercourse has been designed to match the existing watercourse, assuming:

- 20 m (approximate) buffer to CKD pile
- 50 m to 60 m wide corridor, including:
  - 3:1 embankments,
  - 15 m (approximate) wide watercourse bottom, and
  - 2.5 m to 3.0 m wide riparian channel.

Some minor adjustments to this design may be made to align with natural channel design principles. Additional improvements to the remaining sections of the watercourse through the landfill property will be made, including the addition of channel substrates, installation of habitat features and bank stabilization, where required. All new and remaining riparian areas will be naturalized with trees, shrub and grass plantings.

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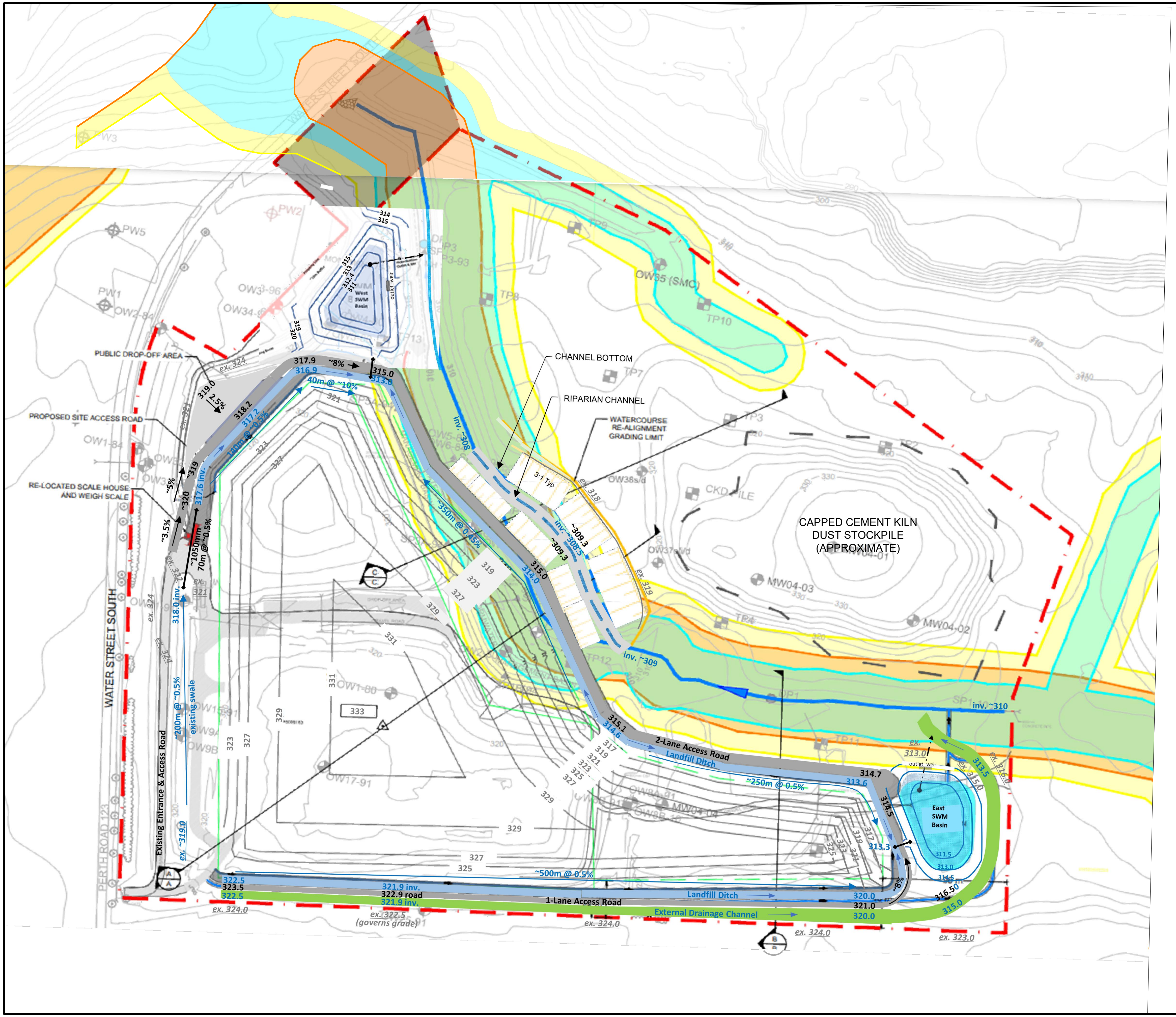
[1] Leachate is contaminated groundwater generated from landfilled waste mixing with groundwater, rainwater and/or snow melt. Contaminants in the waste are extracted much like a coffee percolator. Water drips into coffee grinds (waste) creating the coffee (leachate).



LEGEND

🟥	PROPERTY LINE
—	EXISTING WATERCOURSE
—	PROPOSED WATERCOURSE ALIGNMENT
—	EXISTING REFUSE LIMIT
— —	EXPANSION REFUSE LIMIT
—	EXISTING CONDITIONS CONTOURS (1m)
◐ ??	MONITORING/OBSERVATION WELL
▨ ??	TESTPIT
Ⓐ	CROSS-SECTION LABEL
🟩	EXTERNAL DRAINAGE CHANNEL
▬	ACCESS ROAD
🟦	LANDFILL DITCH

UPPER THAMES RIVER CONSERVATION AUTHORITY REGULATED AREAS

🟨	REGULATION LIMIT 2021
🟧	EROSION HAZARD LIMIT
🟦	FLOODING HAZARD LIMIT

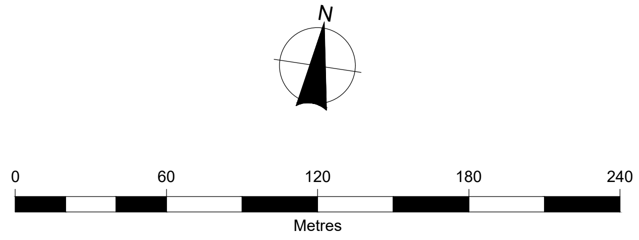


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Figure Title

ALTERNATIVE METHOD 3A

PROPOSED GRADING AND SITE PLAN

Drawn	Checked	Date	Figure No.
DB	DB	JUNE 2022	**D-2**
Scale		Project No.	
1:3,000		300032339	

File:Shared Work Areas (\\pops)\ E:\032339 - St. Marys Waste\CIVIL\04_MiscDwg\032339 Figure 8-6.dwg Date Plotted: June 9, 2022 - 7:23 PM

The realigned section will be constructed in stages. Most of the realigned watercourse can be constructed in the dry by not making connections at the upstream and downstream ends. Once the banks are vegetated and stabilized, the downstream connection will be made. Any wildlife within the existing channel will be salvaged and relocated. The upstream connection will then be made and the existing channel closed off. No in-water work will occur during June and July.

It is expected that the realignment construction will begin during the operation of Cell 1 and be completed before excavation of Cell 3 begins.

2.1 Construction Activities

Site construction activities would likely include one or more of each of the following equipment: excavator, wheel tractor scraper, bulldozer, construction truck, and a compactor, along with vehicles arriving for on-site delivery of materials. Construction will occur in relatively short bursts (likely two-three months at a time) and will occur while landfill operations are on-going.

Construction is required to prepare for each cell's operation (except Cell 1) and for site closure at the end of the planning period. Construction of Cell 2 features will precede in parallel with Cell 1 operation. Similarly, Cell 3 construction will occur during operation of Cell 2 and Cell 4 construction will occur when Cell 3 is in operation. Closure cover (aka, Final Cover) will be applied progressively to the site and completed following receipt of the last load of waste.

We are also anticipating some minor post-closure construction efforts will occur. These will be focused on small areas of the site to address settlement, cover erosion or desiccation, or repairing a leachate seep. These activities normally take less than a day to address.

3.0 Supplemental Data Collection and Effects Assessment

3.1 Atmosphere

3.1.1 Air Quality

3.1.1.1 Baseline Data Collection & Evaluation

No additional data collection was required to support the assessment of Alternative 3A with respect to air quality.

3.1.1.2 Supplemental Information for Section 7.4.1 Evaluation of Alternatives

Air emissions from Alternative 3A are expected to be similar or better than emissions produced by Alternative 3. The additional height of Alternative 3A would result in slightly better air quality (lower emissions from the landfill) due to dispersion. As a result, Alternative 3A was not specifically modeled. The model considers the effect at the property line and at sensitive receptors off property. As a result, the maximum ground level concentration can be at one location for one scenario and a different location for another scenario. The footprint of the landfill in Alternative 3A is the same distance to the western property line where sensitive receptors are located as Alternative 3. The model also considers the final landfill height. The maximum concentration of air contaminants occurs at ground level. With increasing height, there is greater dispersion and, therefore, lower concentrations of contaminants in the air. Alternative 3A will have a final landfill height that is higher than Alternative 3. Therefore, relative to Alternative 3, Alternative 3A can be expected to have slightly lower concentrations of air contaminants. For the purposes of the evaluation, the differences are expected to be minimal and are considered negligible.

3.1.1.3 Supplemental Information for Table 9.1 Effects, Mitigation, and Net Effects

No additional information was required to assess the effects documented in Table 9.1. No additional mitigation was required and there are no monitoring requirements beyond those already proposed in Vol. I, Section 11.

3.1.2 Odour

3.1.2.1 Baseline Data Collection & Evaluation

No additional data collection was required to support the assessment of Alternative 3A with respect to odour.

3.1.2.2 Supplemental Information for Section 7.4.2 Evaluation of Alternatives

Odours emissions are expected to be like Alternative 3 as the proximity of the landfill footprint to sensitive receptors is the same for both alternatives 3 and 3A. the additional height of Alternative 3A may result in slightly lower odour emissions due to dispersion. As a result, Alternative 3A was not modeled. As with the air quality evaluation, the differences between Alternative 3 and Alternative 3A are expected to be minimal and are considered negligible.

3.1.2.3 Supplemental Information for Table 9.1 Effects, Mitigation, and Net Effects

No additional information was required to assess the effects documented in Table 9.1. No additional mitigation was required and there are no monitoring requirements beyond those already proposed in Vol. I, Section 11. A commitment has been made to re-model odour during detailed design.

3.1.3 Noise

3.1.3.1 Baseline Data Collection & Evaluation

No additional data collection was required to support the assessment of Alternative 3A with respect to noise.

3.1.3.2 Supplemental Information for Section 7.4.3 Evaluation of Alternatives

Noise emissions are expected to be like Alternative 3 as the proximity of the landfill footprint to sensitive receptors is the same for both alternatives and the noise sources are unchanged. As a result, Alternative 3A was not modelled.

3.1.3.3 Supplemental Information for Table 9.1 Effects, Mitigation, and Net Effects

No additional information was required to assess the effects documented in Table 9.1. No additional mitigation was required and there are no monitoring requirements beyond those already proposed in Vol. 1 Section 11.

3.2 Hydrogeology

3.2.1 Baseline Data Collection & Evaluation

GRT comments on the August 2021 EA identified concerns regarding preferred Alternative 3's proximity to, and the potential impacts of, the Cement Kiln Dust (CKD) Pile on the relocated watercourse. Alternative 3A was subsequently developed to realign a small portion (approximately 230 m) of the watercourse rather than relocating it entirely (as with Alternative 3). However, to address the GRT comments, additional baseline data collection was undertaken to better understand hydrogeologic conditions in the vicinity of the realigned watercourse and the potential risks associated with the proximity to the CKD pile.

In April 2022, field investigations were initiated to:

- Characterize subsurface soil and groundwater conditions both along the watercourse realignment and between the Cement Kiln Dust (CKD) pile and the watercourse realignment.
- Assess the likelihood of encountering CKD material along the proposed route for the realignment and identify if leachate from CKD pile may impact the watercourse.
- Assess the likelihood of encountering the “sand and silt” seam (i.e., meltwater deposits) either along the realignment or between the CKD pile and the realignment.
- Assess the potential for groundwater recharge/discharge conditions between the watercourse and the CKD pile.
- Assess whether the sand and silt seam (meltwater deposits) represent a groundwater migration pathway between the CKD pile and the watercourse realignment.
- Assess current soil characteristics, groundwater levels, groundwater quality between the CKD pile and the watercourse and historical surface water quality in the watercourse prior to construction to establish baseline conditions.

- Incorporate the sentry wells into the updated Environmental Monitoring Program once the MECP approves the proposed expansion and an ECA is secured. The Sentry wells will assess changes in water quality between the CKD pile and the watercourse and provide a means of predicting future impacts of the CKD pile on the watercourse realignment.

- Identify triggers and develop a contingency plan and response actions.

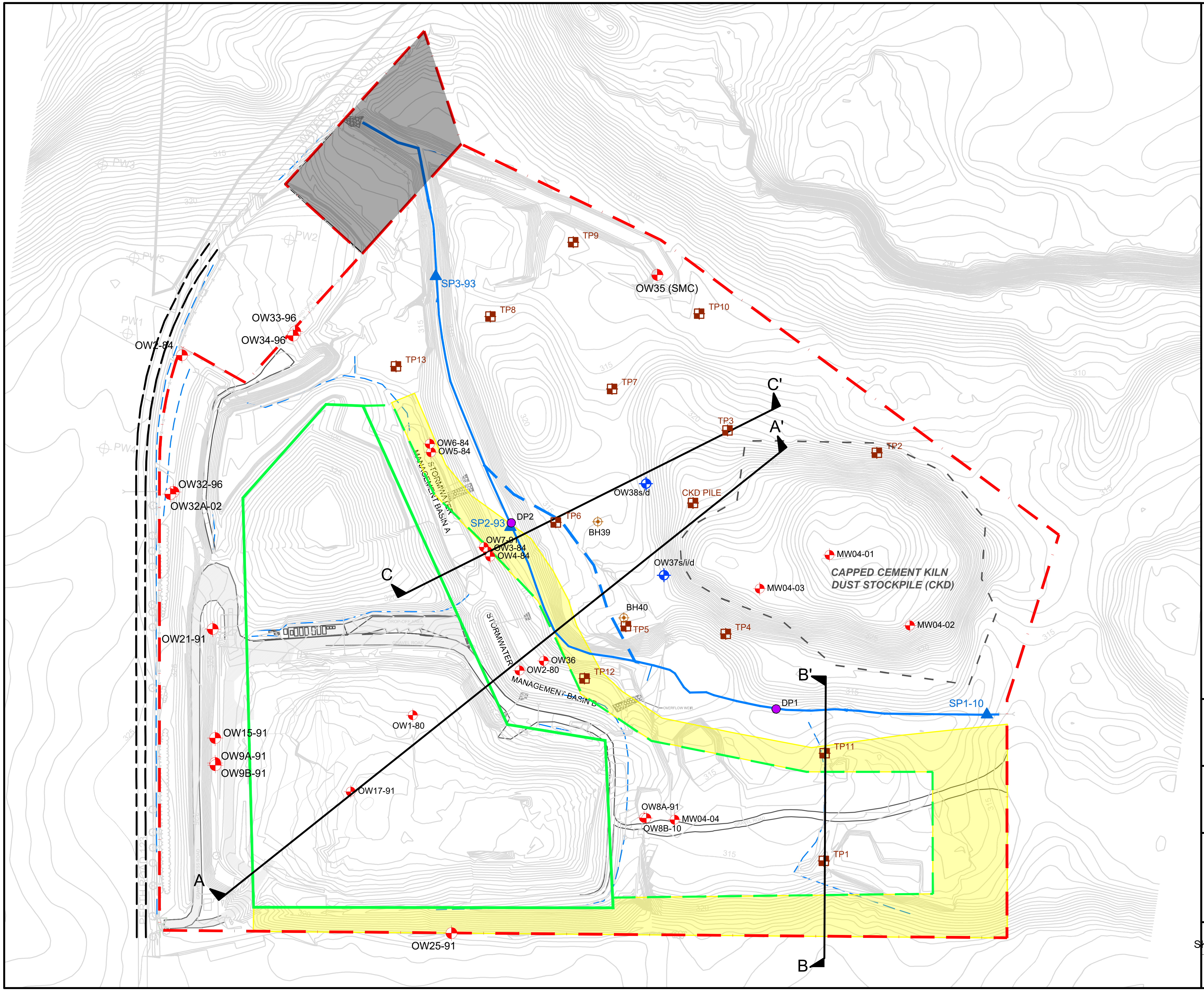
3.2.1.1 Borehole and Monitoring Well Installations

Five monitoring wells and two boreholes were installed between April 8 and 12, 2022. The locations are presented in Figure D-3 (Plan view) and the Cross Sections A-A’ and C-C’ (Figure D-4 and Figure D-5). Borehole logs are presented in Attachment A.

Soil (colour, texture, inferred origin [native versus fill/waste/CKD], depth, moisture, etc.) and groundwater conditions encountered at the time of drilling were documented and used to determine drilling depth and well installation details. Continuous split spoon soil samples were retrieved from each drilling location. Standard penetration tests (blow counts) were recorded for each split spoon. Representative soil samples were collected and submitted for laboratory analysis of grain size distribution, moisture content, and CKD related soil quality parameters (pH, sulphate, chloride, potassium, and sodium). The grain size distribution and moisture content results are presented in Attachment B. Laboratory Soil quality results are provided in Attachment C.

Monitoring wells were installed in separate holes at MW37 and MW38 using 52 mm (2 inch) diameter, Schedule 40, PVC slotted 1.5 metre (m) screen and riser pipe. Silica sand was placed around and at least 30 cm above the well screen, then the annulus was backfilled with bentonite grout/pellets and secured with a monument style above ground steel casing.

On April 22, 2022, the new well locations and elevations were surveyed. The location, ground surface elevation and top of pipe elevation were surveyed at each borehole/monitoring well location to tie in the wells and water level data to the existing well monitoring network. A summary is presented in Table 2, below.



LEGEND

🟥	PROPERTY LINE
- -	APPROXIMATE CKD PILE COVER LIMIT
🟦	EXISTING WATERCOURSE
🟦	PROPOSED WATERCOURSE ALIGNMENT
🟩	EXISTING REFUSE LIMIT
🟩	EXPANSION REFUSE LIMIT
🟨	PERIMETER INFRASTRUCTURE
—	EXISTING CONDITIONS CONTOURS
—	PROPOSED WASTE CONTOURS
⊕	MONITORING WELL (RJB, 2022)
⊕	MONITORING/OBSERVATION WELL
▣	TESTPIT
▲	SURFACE WATER SAMPLING LOCATION
⊕	BOREHOLE (RJB, 2022)
●	DRIVE POINT PIEZOMETER
A A'	CROSS-SECTION LABEL
▨	RIGHT-OF-WAY AND SEWER EASEMENT

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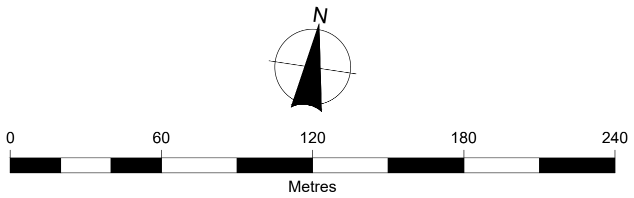

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TOWN OF ST. MARYS

Figure Title

ALTERNATIVE METHOD 3A HYDROGEOLOGICAL CONSIDERATIONS

PLAN VIEW

Drawn	Checked	Date	Figure No.
SK	KH	MAY 2022	D-3
Scale		Project No.	
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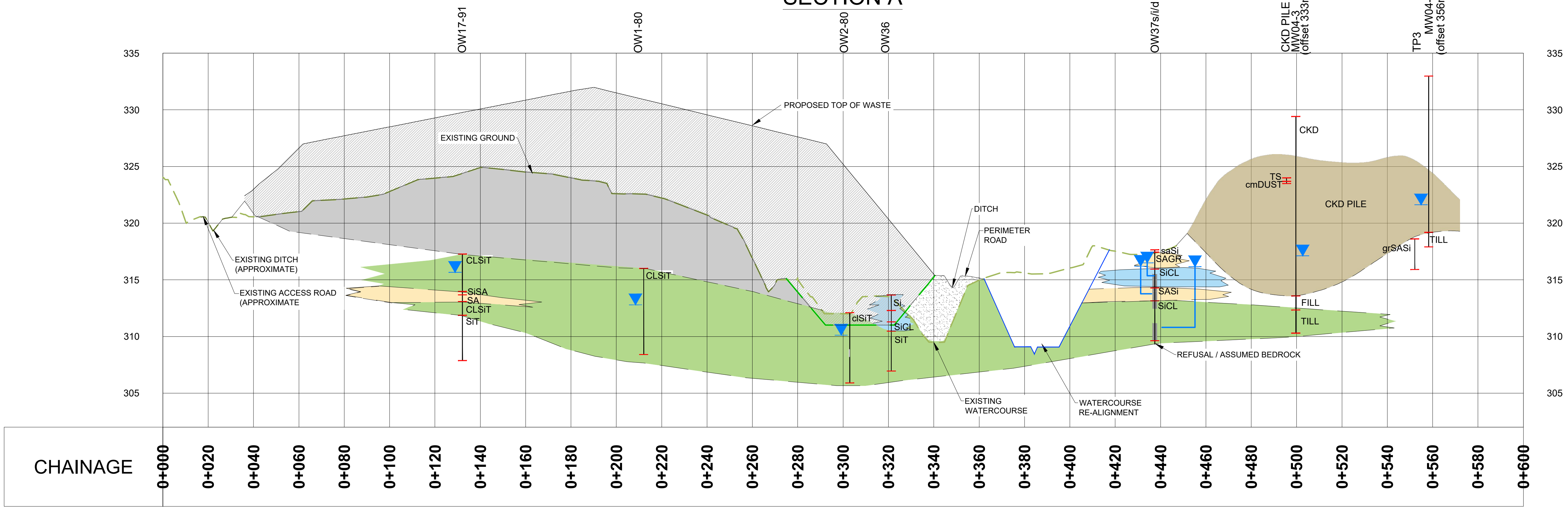
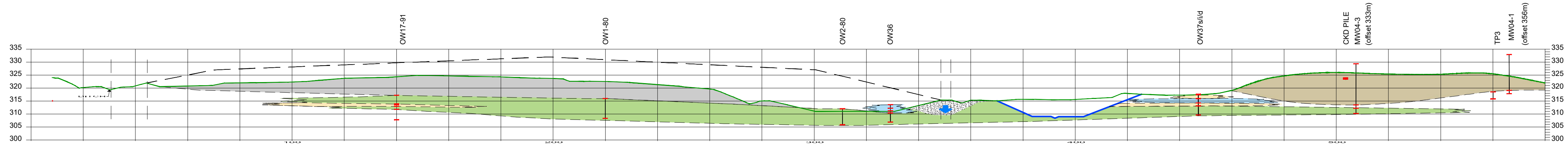
SECTION A





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TOWN OF ST. MARYS

Figure Title

ALTERNATIVE METHOD 3A

CROSS SECTION A-A

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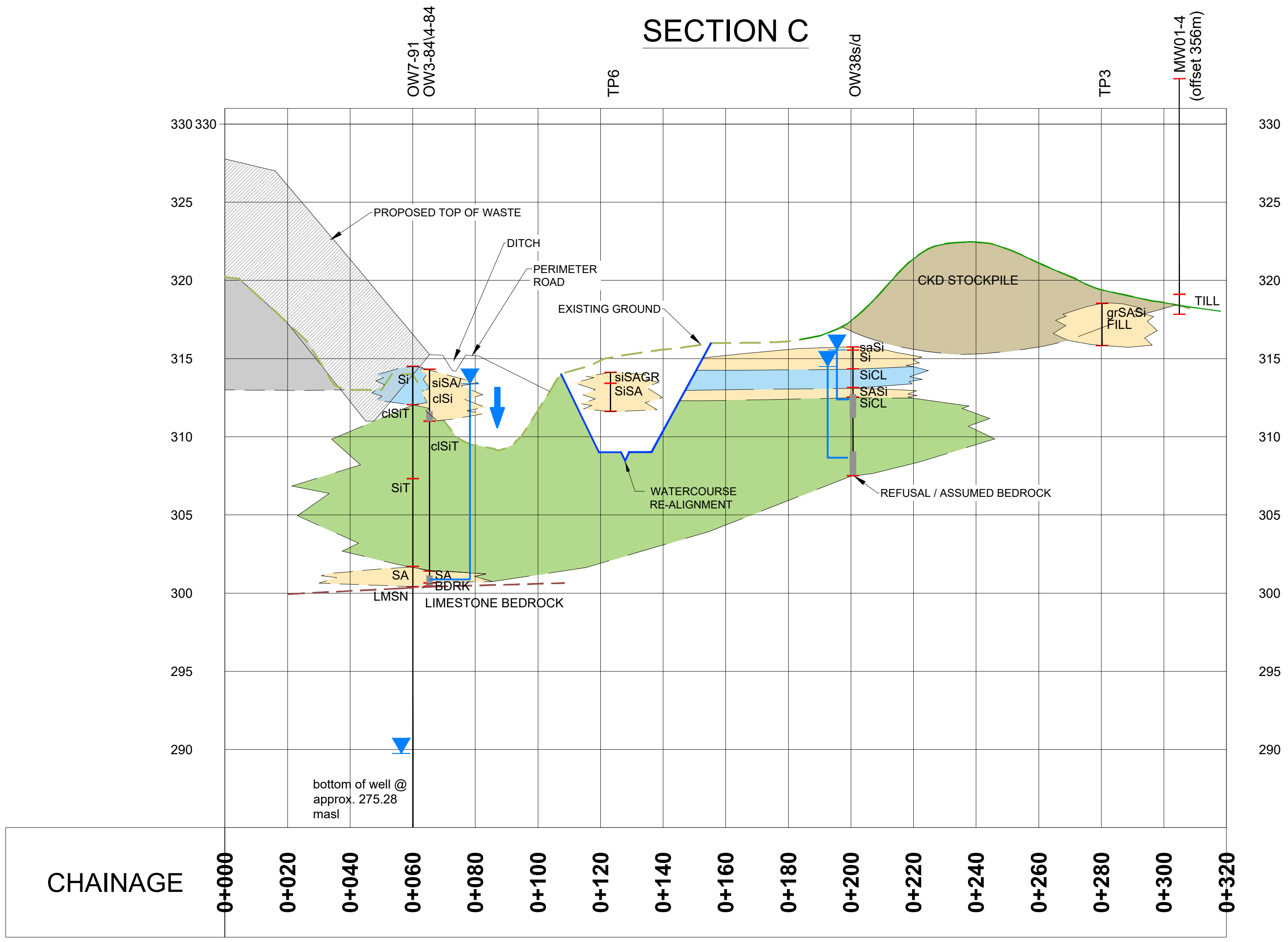
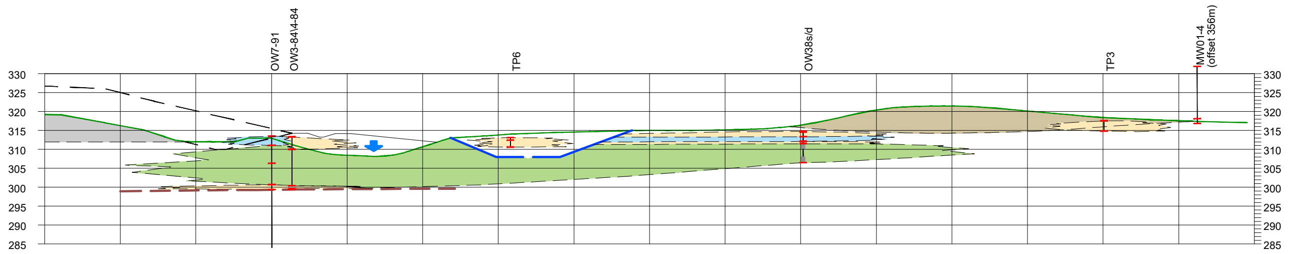
SECTION C





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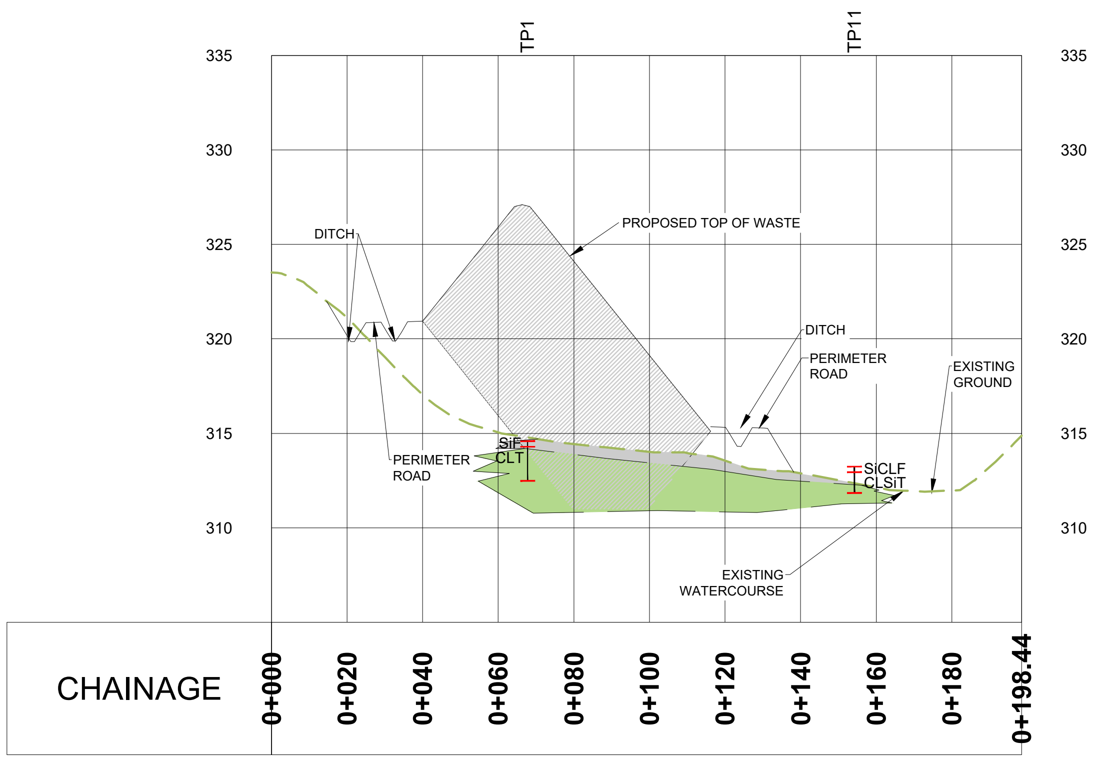

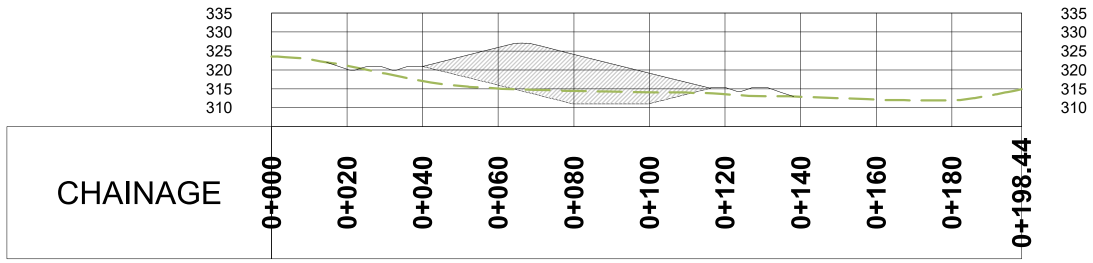

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TOWN OF ST. MARYS

Figure Title

ALTERNATIVE METHOD 3A

CROSS SECTIONS B & C

Drawn	Checked	Date	Figure No.
ZM	JH	MAY 2022	**D-5**
Scale		Project No.	
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November 2022

Table 2: Monitoring Well and Borehole Details

Elevations (masl)	MW37S-22	MW37I-22	MW37D-22	MW38S-22	MW38D-22	BH39-22	BH40-22
	(MW37S)	(MW37I)	(MW37D)	(MW38S)	(MW38-D)	(BH39)	(BH40)
Easting	-	-	487 561	-	487 537	487 501	487 536
Northing	-	-	4 787 234	-	4 787 307	4 787 258	4 787 155
Ground Surface	317.18	317.27	317.17	315.81	315.83	320.37	318.25
Top of Casing	318.26	318.30	318.24	316.95	316.95	--	--
Top of Screen	315.21	313.72	310.62	312.76	309.33	--	--
Bottom of Screen	313.69	312.20	309.10	311.24	307.81	--	--

Notes: masl – metres above sea level

- The wells were numbered in sequence with other site wells and given the postscript “-22” to indicate the year drilled to be consistent with other site wells. (NB: Well Name with and without the postscript are used interchangeably throughout this document (i.e., “MW38S-22” is the same as “MW38S”. Relative well depths: “S” – shallow, “I” – intermediate, “D” – deep.
- Elevations are in metres above sea level (m asl) and have been tied to site surveyed elevations.
- Well coordinates are in NAD83, Zone 17T.
- Monitoring wells were not installed at BH39 and BH40.
- Monitoring well details for all previously installed wells are presented in Attachment B.

3.2.1.2 Well Development

On April 11, 2022, water levels were recorded at the newly installed wells relative to the top of well casing. MW37S was observed to be dry, so on April 12, 2022, MW37I was installed to observe shallow groundwater at the MW37 well nest. The wells were developed by purging up to ten well volumes to remove sediment from the well screen and sand pack. If the well was pumped dry prior to reaching ten well volumes a second purge was attempted after three hours. Well development data is presented below in Table 3.

Table 3: Well Purging Details

Well ID	Date	Water Level (m btop)	Total Depth (m btop)	Calculated Purge (L)	1st Purge (L)	2nd Purge (L)
MW37S	11-Apr-22	Dry	4.57	-	-	-
MW37I	12-Apr-22	3.86	6.11	45	45	-
MW37D	11-Apr-22	2.04	9.11	140	28	28
MW38S	11-Apr-22	2.47	5.72	65	65	-
MW38D	11-Apr-22	2.11	9.11	140	25	8

m btoc – metres below top of pipe; L – litres

[1] When the well went dry during the 1st purge a 2nd purge was attempted after 3 hours.

3.2.1.3 In-Situ Hydraulic Conductivity Testing

In-situ hydraulic conductivity testing (rising head/falling head slug testing) was also completed on the new wells. The hydraulic conductivity in the deep wells (MW37D and MW38D) was too low to conduct a rising and falling head test during the time on site. As such, only the falling head slug test was completed. The results are presented in Attachment D and summarized in Table 4 below.

Table 4: Hydraulic Conductivity Summary

Well ID	Soil Unit	Hydraulic Conductivity (K) (m/s)	Notes
MW37S	Silt and Clay (Till)	‘--	Not tested, well dry/insufficient water
MW37I	Sand and Silt	$3.0x10^{-6}$ $6.3x10^{-6}$	In Situ Falling Head In Situ Rising Head →Geometric Mean: $4.3x10^{-6}$
MW37D	Silt and Clay (Till)	$5.4x10^{-7}$	In Situ Falling Head
MW37D	Silt and Clay (Till)	$1x10^{-10}$	Geometric mean from other on-site wells screened in the Till Recovery too slow to complete In Situ rising head test which is consistent with previous low K estimates
MW38S	Sand and Silt/Silt & Clay	$7.1x10^{-6}$ $4.1x10^{-6}$	In Situ Falling Head In Situ Rising Head →Geometric Mean: $5.4x10^{-6}$
MW38D	Silt and Clay (Till)	$1x10^{-10}$	Geometric mean from other on-site wells screened in the Till Recovery too slow to complete In Situ testing which is consistent with previous low K estimates

Notes:
Previous test results were summarized in Table 4.6 of the EA Hydrogeological Study (Volume III, Appendix C).

3.2.1.4 Soil Quality

A series of soil samples were collected at each drilling location. The samples were typically collected at the screened interval to correlate the soil quality with the groundwater quality in the monitoring wells. Given that there was no evidence of CKD related materials or evidence of CKD impacts to the soil at any of the drilling locations, no other soil samples were collected or submitted for chemical analysis. The results are summarized below in Table 5.

Table 5: Soil Quality Summary

Location	Distance to CKD	Depth	Soil Description	pH	Sulphate	Chloride	Sodium	Potassium
	(m)	(m bgl)			µg/g	µg/g	µg/g	µg/g
BH37	**20**	**3.35**	**Sand & Silt**	7.75	70	5	185	1300
		7.62	**Till**	7.71	116	38	244	2590
BH38	**50**	**2.74**	**Sand & Silt**	7.65	127	48	228	2600
		8.23	**Till**	7.74	109	21	275	3880
BH39	**70**	**3.35**	**Till**	7.28	210	3	252	2900
		6.40	**Till**	7.35	68	3	238	2490

Location	**Distance to CKD**	**Depth**	**Soil Description**	**pH**	**Sulphate**	**Chloride**	**Sodium**	**Potassium**
	(m)	**(m bgl)**			**µg/g**	**µg/g**	**µg/g**	**µg/g**
		7.92	**Till**	7.48	100	3	276	3120
BH40	**62**	**3.35**	**Silt & Sand**	7.39	23	<2	254	3760
		4.88	**Silt**	7.42	70	2	173	1200
		7.01	**Till**	7.42	330	166	411	4660

Notes:
Distance to CKD is based on inferred limit shown on Figure D-3
m =metres; bgl = below ground level, µg/g microgram per gram

The primary mechanism for soil at the watercourse realignment to be impacted by CKD, would be if CKD waste had been placed within the watercourse realignment (i.e., beyond the limit of CKD waste presented in Figure D-3). The borehole logs, and soil quality results indicate there are no CKD materials in the soil or near the watercourse realignment.

The more permeable sand and silt seam (meltwater deposits) within the site stratigraphy is the most likely preferential pathway for CKD impacts to migrate via groundwater toward the watercourse realignment.

The pH of each soil sample was near neutral suggesting that CKD related impacts are not evident in the soil at the four borehole locations. There is no obvious correlation of soil chemistry between: the proximity of each borehole relative to the CKD pile; the position of the borehole relative to groundwater flow from the CKD pile (Figure D-6); the depth at which the sample was collected; or the relative permeability of the soil unit (as detailed in Section 3.2.1.3).

3.2.1.5 Groundwater Flow

Water levels were recorded on several occasions at monitoring wells located near the watercourse realignment. Water level data is presented below in Table 6.

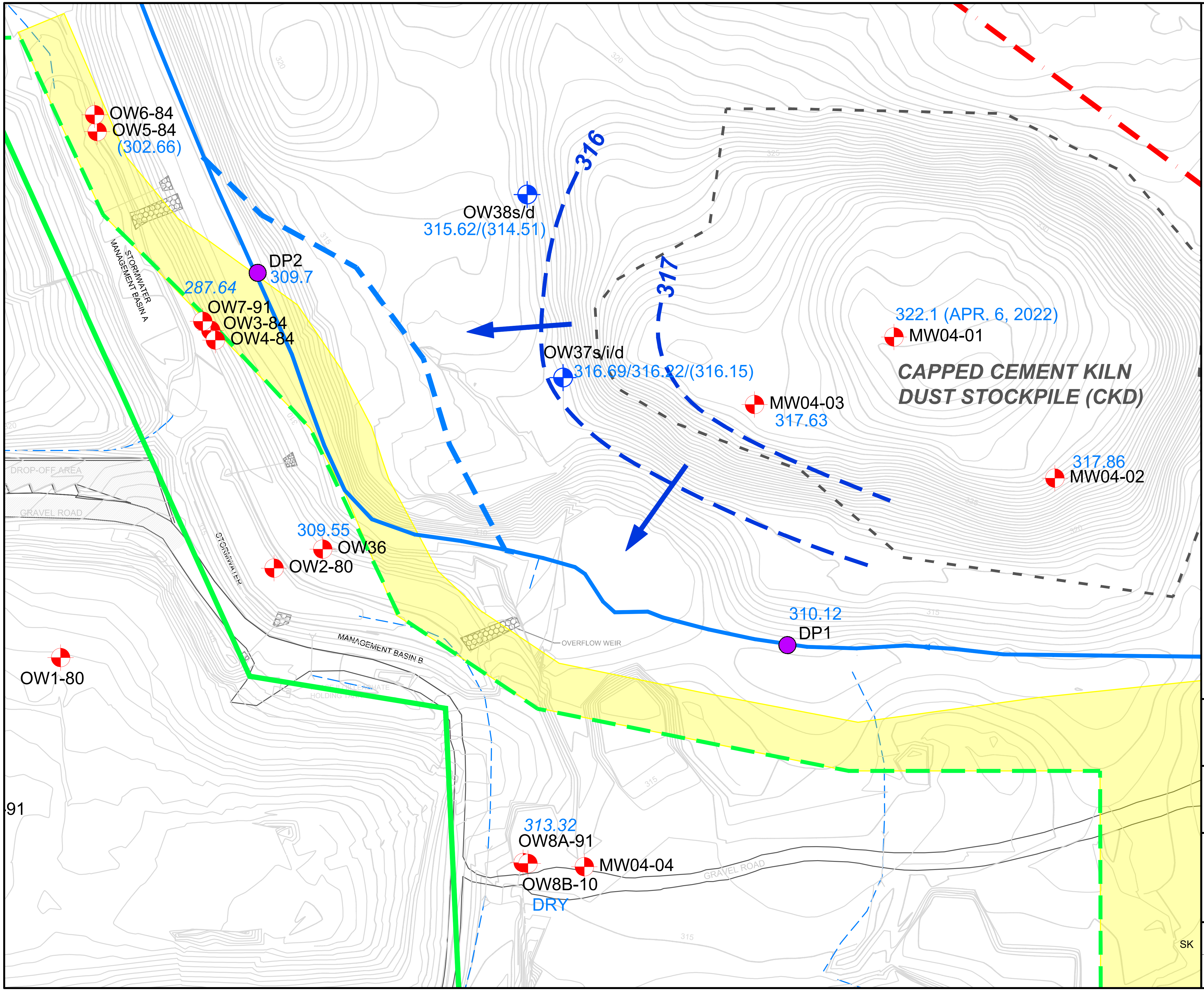
Table 6: Groundwater Elevations

Dates (2022)	**MW37 S**	**MW37I**	**MW37 D**	**MW38 S**	**MW38 D**	**MW04-01**	**MW04-02**	**MW04-03**
		Groundwater Elevation (metres above sea level)						
April 11	Dry		316.20	314.48	314.84	-	-	-
April 12	Dry	314.44	315.46	315.15	308.10	322.10	317.72	317.45
April 22	316.04	316.06	316.11	315.46	310.03	-	-	-
May 6	316.69	316.22	316.15	315.62	314.51	-	317.86	317.63

Notes: The water levels at MW38S continue to rise. Non-static conditions possible.
– Not Measured

The water levels collected on May 6, 2022, approximately two weeks after development, sampling, testing, and purging, are assumed to best reflect static water level conditions. On

May 6, 2022, the water levels in the deeper wells are lower than those in the shallower wells indicating downward flow in the subsurface.



LEGEND

🟥	PROPERTY LINE
	APPROXIMATE CKD PILE COVER LIMIT
	EXISTING WATERCOURSE
	PROPOSED WATERCOURSE ALIGNMENT
🟩	EXISTING REFUSE LIMIT
	EXPANSION REFUSE LIMIT
🟨	PERIMETER INFRASTRUCTURE
	EXISTING CONDITIONS CONTOURS
	PROPOSED WASTE CONTOURS
⊕	MONITORING WELL (RJB, 2022)
⊕	MONITORING/OBSERVATION WELL
●	DRIVE POINT PIEZOMETER
316.69	MEASURED WATER LEVEL - MAY 2022 (SHALLOW WELL)
(316.69)	MEASURED WATER LEVEL - MAY 2022 (DEEP WELL)
316.69	MEASURED WATER LEVEL - MAY 2022 (BEDROCK WELL)
	INTERPRETED GROUNDWATER CONTOUR (masl)
←	INTERPRETED GROUNDWATER FLOW DIRECTION

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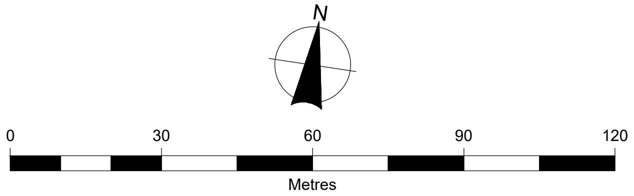

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Figure Title

ALTERNATIVE METHOD 3A
HYDROGEOLOGICAL CONSIDERATIONS
GROUNDWATER LEVEL

Drawn	Checked	Date	Figure No.
	KH	MAY 2022	**D-6**
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The shallow water levels in the vicinity of the watercourse realignment are presented in Figure D-6. The groundwater levels in all monitoring wells between the CKD pile and the watercourse realignment are higher than the base of the watercourse. It is therefore possible that a hydraulic connection exists between the CKD pile and watercourse realignment. As such groundwater could preferentially migrate through the more permeable soils (i.e., sand and silt meltwater deposits) towards the watercourse realignment.

No CKD impacts to the existing watercourse have been detected to date (2020 Monitoring Report by GM BluePlan Engineering, 2021).

The existing riparian channel within the watercourse is closest to the CKD pile near the site’s east property limit, over a length of approximately 110 m. The area between the watercourse top-of-bank and the toe of the CKD pile embankment is less than approximately 20 m and the watercourse’s riparian channel is another 10 m, or so, further away. West of testpit 4 (TP4 on Figure D-2), the narrowest overbank distance is approximately 10 m, whereas the riparian channel is approximately 60 m away from the toe of the CKD pile embankment.

The watercourse realignment will have an overbank distance to the CKD pile of no less than 20 m and the riparian channel another 30 m away (~50 m total).

Based on a lateral groundwater velocity of 20 m/year between the CKD Pile and the existing watercourse (assuming a lateral gradient of 0.04 m/m (from MW04-01 to OW37) and a typical hydraulic conductivity of a sand and silt seam of 5 x10^{-6} m/s), it is estimated that groundwater borne impacts from the CKD pile could take less than 10 years to reach even the furthest portions of the existing watercourse.

The CKD pile was present sometime prior to 1978 therefore CKD waste has had the potential to impact the environment for more than 30 years. Based on a groundwater velocity of 20 m/year, any potential groundwater impacts derived from the CKD pile should have already reached the existing watercourse.

3.2.1.6 Groundwater Quality

Groundwater quality samples were collected at OW37I-22, OW37D-22 and OW38S-22 and the existing wells drilled into the CKD pile (i.e., MW04-01 and MW04-03). Prior to sample collection MW37S, MW38D and MW04-02 were observed to have insufficient water to facilitate sample collection. Samples were not collected at these locations. The samples were analyzed for parameters consistent with the current monitoring program and 2019 sampling of the CKD pile wells to establish baseline conditions and compare the groundwater chemistry of the existing wells with the new wells. The data is presented below in Table 7 and Table 8. Laboratory Certificates of Analysis are presented in Attachment C.

OW2-84 is the background well used to assess landfill site impacts on groundwater. The values presented for OW2-84 represent average concentrations[2]. The data presented in the Table 7 and Table 8 demonstrates a difference in water quality between the groundwater downgradient of the CKD pile and background groundwater conditions. The concentrations of various parameters including hardness, conductivity, alkalinity, chloride, sulphate, calcium, sodium, manganese, and magnesium are higher than background at OW38S, OW37I and OW337D downgradient of the CKD pile.

It is inferred that groundwater downgradient of the CKD pile been mildly impacted by CKD waste. Continued monitoring will assess whether groundwater chemistry is stable or changes over time. More groundwater quality data is required at these locations to determine long term trends.

---

[2] Burnside has electronic water quality data up to 2018. Including more current data is not expected to significantly change the overall interpretation. The values shown in Tables 6 and 7 are for comparative purposes only.

Table 7: General Groundwater Quality

Inorganics	PWQO	Location	OW2	MW04-01	MW04-03	OW37D-22	OW37I-22	OW38S-22
		Units	Background	CKD (Centre)	CKD (SW Corner)	Till	Sand & Silt	Sand & Silt / Silt & Clay
pH	6.5-8.5	mg/L	7.89	9.84	7.91	7.59	7.62	7.32
Conductivity		uS/cm	321	37800	5110	1740	1590	1900
Alkalinity		mg/L CaCO^3	161	5500	648	426	414	643
C-Hardness		mg/L CaCO^3	141	172.0	410	1030	893	1020
DOC		mg/L	2.2	86.3	20.9	2.7	2.4	9.7
Bromide		mg/L	-	<2.8	<0.28	2.19	1.83	3.09
Chloride		mg/L	3.71	3370	356	167	141	244
Fluoride		mg/L	-	<1.3	<0.13	<0.05	<0.05	<0.05
Nitrate		N mg/L	0.2	<3.6	<0.36	<0.07	<0.05	<0.07
Nitrite		N mg/L	<0.05	<2.7	<0.27	<0.05	<0.05	<0.05
TKN		N mg/L	0.2	31.0	3.2	0.31	0.17	0.53
Phosphate		mg/L	-	67.70	<0.65	<0.13	<0.10	<0.13
Sulphate		mg/L	20.6	11700	1380	476	374	171
Phenols	0.001	mg/L	<0.001	0.08	0.04	0.036	0.041	0.069
TDS		mg/L	-	39000	4250	1380	1150	1210
Bicarbonate (as CaCO3)		mg/L CaCO^3	-	3350	648	426	414	643
Carbonate (as CaCO3)		mg/L CaCO^3	-	2150	<5	<5	<5	<5
Cl:Na Ratio			0.2	2.6	4.9	3.6	5.4	5

Notes: PWQO – Provincial Water Quality Objectives.
PWQOs apply to surface water quality not groundwater quality. The values are shown for general comparison and assessment purposes only. Shaded values exceed the PWQO

November 2022

Table 8: General Groundwater Chemistry

Inorganics	**PWQO**	**Units**	**OW2**	**MW04-01**	**MW04-03**	**OW37D-22**	**OW37I-22**	**OW38S-22**
			Background	**CKD Centre**	**CKD SW Corner**	**Till**	**Sand & Silt**	**Sand & Silt / Silt & Clay**
					Metals			
Aluminum	0.075	mg/L	-	1.15	0.028	0.052	0.044	0.075
Antimony	0.020	mg/L	-	<0.002	<0.001	<0.001	<0.001	<0.001
Arsenic	0.1	mg/L	-	0.0220	0.0010	0.003	0.004	<0.001
Barium		mg/L	-	0.0400	0.0470	0.109	0.05	0.067
Beryllium	1.1	mg/L	-	<0.0010	<0.0005	<0.0005	<0.0005	<0.0005
Bismuth		mg/L	-	<0.004	<0.002	<0.002	<0.002	<0.002
Boron	0.2	mg/L		0.05	0.02	0.061	0.052	0.036
Cadmium	0.0002	mg/L		0.00370	0.00010	<0.0001	<0.0001	<0.0001
Calcium		mg/L		69.00	148	221	208	255
Chromium	0.00089	mg/L		0.0270	*<0.002*	<0.002	<0.002	<0.002
Cobalt	0.0009	mg/L		0.00250	0.0006	0.0007	0.0013	0.0023
Copper	0.005	mg/L		0.009	<0.001	0.001	<0.001	0.001
Iron	0.3	mg/L		1.860	7.9	0.142	0.783	0.045
Lead	0.025	mg/L		0.312	<0.0005	<0.0005	<0.0005	<0.0005
Magnesium		mg/L		<5	9.9	116	90.8	94
Manganese		mg/L		0.209	0.475	0.109	0.172	0.667
Mercury	0.0002	mg/L		<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Molybdenum	0.04	mg/L		0.550	0.365	0.006	0.003	<0.002
Nickel	0.025	mg/L		0.054	0.005	0.002	0.002	0.006
Phosphorus		mg/L		0.48	<0.02	<0.02	<0.02	<0.02
Potassium		mg/L		11400	1160	7.85	5.19	5.83
Selenium	0.1	mg/L		0.037	0.007	<0.001	0.003	0.006
Silicon		mg/L		23	3.79	10.6	10.1	7.88
Silver	0.0001	mg/L		<0.0002	0.0002	<0.0001	<0.0001	0.0002

Inorganics	PWQO	Units	OW2	MW04-01	MW04-03	OW37D-22	OW37I-22	OW38S-22
			Background	CKD Centre	CKD SW Corner	Till	Sand & Silt	Sand & Silt / Silt & Clay
Sodium		mg/L		1280	73	46.5	26.3	48.4
Strontium		mg/L		0.1280	0.399	1.79	0.735	0.925
Thallium		mg/L		0.0018	<0.0003	<0.0003	<0.0003	<0.0003
Tin		mg/L		<0.004	<0.002	<0.002	<0.002	<0.002
Titanium		mg/L		0.05700	0.007	0.013	0.007	<0.002
Uranium	0.005	mg/L		0.01490	0.00080	0.0034	0.0028	0.0037
Vanadium	0.006	mg/L		0.018	0.002	<0.002	<0.002	<0.002
Zinc	0.03	mg/L		0.048	<0.005	<0.005	<0.005	<0.005
PAHs								
Phenanthrene	0.03	µg/L		0.11	<0.10	0.11	0.11	<0.10
Chrysene	0.0001	µg/L		0.11	*<0.10*	*<0.10*	*<0.10*	*<0.10*
Benzo(b)fluoranthene		µg/L		0.11	<0.10	<0.10	<0.10	<0.10
Benzo(k)fluoranthene	0.0002	µg/L		0.11	*<0.10*	*<0.10*	*<0.10*	*<0.10*

Notes: Other PAHs and PCBs were not detected in the groundwater quality sample collected. Refer to Attachment C for details. PWQO – Provincial Water Quality Objectives. PWQOs apply to surface water quality not groundwater quality. The values are shown for general comparison and assessment purposes only. Laboratory detection limits that exceed PWQO are underlined. Shaded values exceed the PWQO; B/G = background wells used for landfill site monitoring

3.2.1.7 Bedrock Surface

Auger refusal was noted during drilling at OW37, OW38 and OW40 which is inferred to represent the bedrock surface. Bedrock was encountered at the elevations summarized in Table 9 below.

Table 9: Inferred Bedrock Surface Elevation

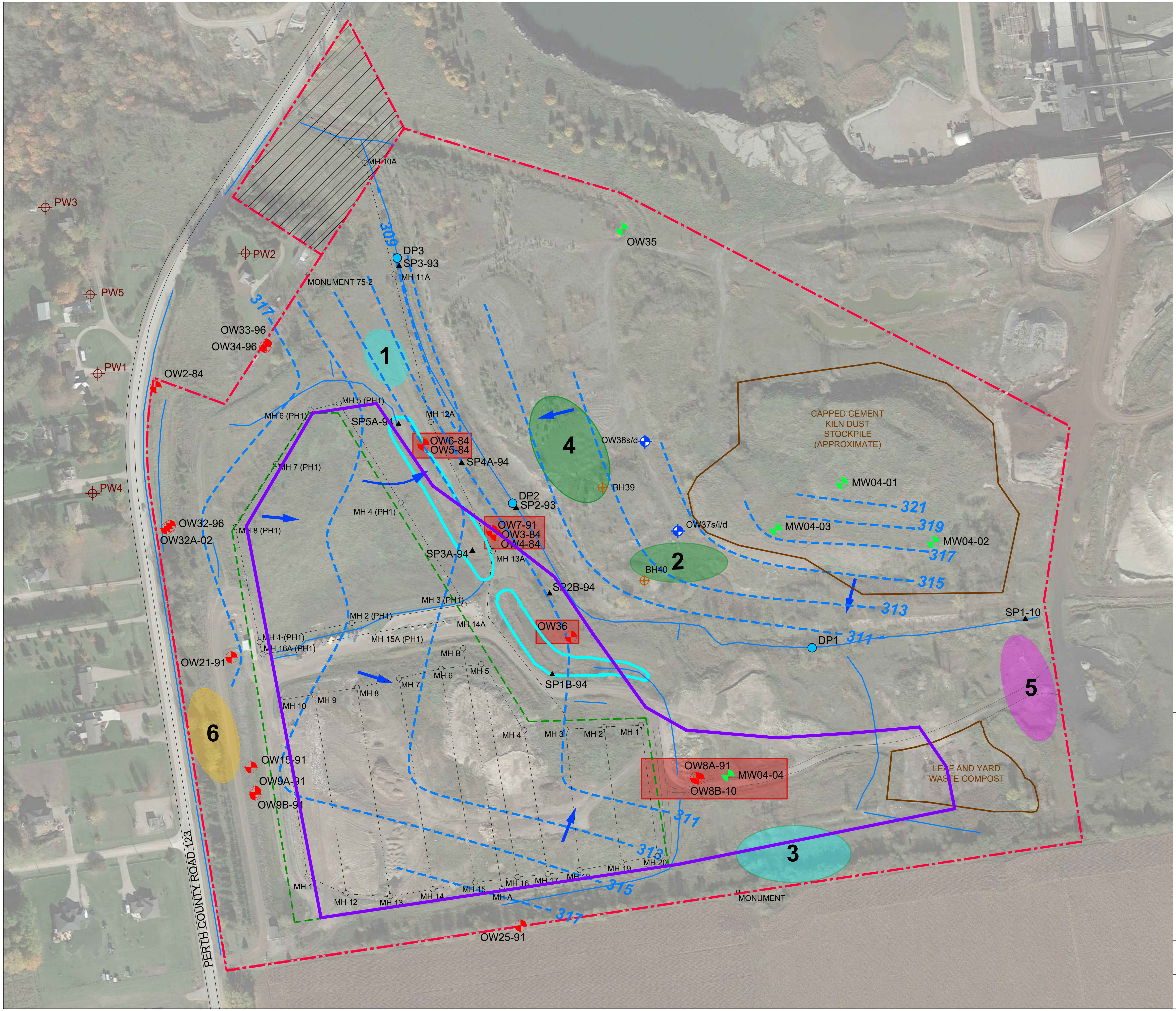
Location	Auger Refusal
OW37-22	309.15
OW38-22	307.60
BH39-22	No refusal @ 312.14
BH40-22	310.23

The bedrock surface was contoured as part of a previous hydrogeological study as shown in Figure D-7. The subsurface information collected at OW37, OW38, BH39 and BH40 has been included for consideration as part of Watercourse Relocation design.

3.2.1.8 Groundwater Impacts

Building on the 2020 Hydrogeological Study (Volume III, Appendix C), the additional baseline data was evaluated. Based on the evaluation, it is unlikely that CKD pile impacts will be detected in the watercourse realignment despite a portion being relocated closer to the CKD pile, if current groundwater conditions persist. The data collected as part of this evaluation supports this interpretation, which is also consistent with the 2020 Burnside study, based on the following evidence:

- The sand and silt seam that was encountered at MW37, MW38 and BH40 was not detected at BH39 demonstrating that the unit thins near the watercourse as interpreted in 2020. As such, only a portion of the watercourse realignment is likely to encounter the sand and silt seam during excavation.
- The sand and silt seam ($K = 5x10^{-6}$ m/s) is orders of magnitude more permeable than the till (K ranges from $1x10^{-10}$ m/s up to $5.4x10^{-7}$ m/s) as detailed in Table 4. Groundwater from the CKD pile would preferentially migrate through the sand and silt seam toward the existing watercourse and watercourse realignment. Groundwater would migrate much more slowly through the lower permeable till.
- On the landfill side of the watercourse the meltwater deposits are typically dry based on conditions at OW3-84/OW4-84. It is interpreted that the leachate collection system is locally under draining the meltwater deposits. On the CKD pile side of the watercourse, the meltwater deposits are saturated with water levels at OW37 and OW38 above the bottom of the existing watercourse and watercourse realignment.
- If CKD related impacts on the existing watercourse were to occur then, they theoretically should have occurred already based on the age of the CKD pile, and the estimated groundwater flow rates between the CKD pile and the watercourse.



LEGEND

PROPERTY BOUNDARY
LIMIT OF REFUSE DISPOSAL
WATERCOURSE
LEACHATE COLLECTION SYSTEM
STORM WATER MANAGEMENT BASIN
LANDFILL OBSERVATION WELL
EA MONITORING WELL
PRIVATE DOMESTIC WELL (APPROXIMATE LOCATION)
▲ SURFACE WATER MONITORING LOCATION
● DRIVE POINT PIEZOMETER
▨ RIGHT OF WAY AND SEWER EASEMENT
ALTERNATIVE 3A FOOTPRINT
INTERPRETED GROUNDWATER CONTOUR - masl (Based on April 2017 water levels in overburden wells)
INTERPRETED GROUNDWATER FLOW DIRECTION
🟥 EXISTING MONITORING WELLS TO BE DECOMMISSIONED
WELLS INSTALLED IN 2022 IN AREAS 2 AND 4 (NO ADDITIONAL WELL NEEDED AT THIS TIME)
PROPOSED AREA FOR FUTURE MONITORING WELLS (IF REQUIRED)
PROPOSED AREA FOR FUTURE WELL NESTS
PROPOSED AREA FOR FUTURE SHALLOW WATER TABLE WELLS

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BURNSIDE

Client / Report

TOWN OF ST. MARYS

ENVIRONMENTAL ASSESSMENT
HYDROGEOLOGICAL STUDY

Figure Title

PROPOSED AREAS FOR NEW OVERBURDEN MONITORING WELLS

Drawn	Checked	Date	Figure No.
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- CKD impacts to soil in the vicinity of the watercourse were not detected based on field observations and soil sampling data collected at the four borehole locations (i.e., soil samples had a near neutral pH and there was no physical evidence of CKD waste at BH39 or BH40).
- CKD impacts on the watercourse chemistry have not been detected to date indicating that the sand and silt seam does not currently represent a direct pathway between the CDK pile and the existing watercourse. It is also reasonable to assume, based on the information collected to date, that a direct hydraulic connection might not be present between the CKD waste and the watercourse realignment. Continued groundwater monitoring at OW37, OW38, MW04-01 and MOW04-03 in conjunction with routine landfill sampling will facilitate prediction of the potential for CKD impacted groundwater to reach the watercourse in the future.
- Groundwater quality at MW37I, MW37D, and MW38S suggest mild CKD impacts between the CKD pile and the watercourse realignment, however, there isn’t a clear relationship between sample depth, soil unit screened, or proximity to the CKD waste.

3.2.1.9 Reasonable Use Guideline (RUG)

Calculations were completed to evaluate compliance with the Ministry’s Reasonable Use Guideline (RUG) for an expanded site under Alternative 3. The calculations are expected to remain valid for Alternative 3A.

The primary direction of landfill leachate migration and groundwater movement is expected to be downward, through the till, to the bedrock aquifer. The existing landfill footprint has an established leachate collection system. This same leachate collection system design is expected for the expansion footprint. As with the existing system, it should capture most of the leachate generated at the site. However, to illustrate the worst-case scenario, the maximum leachate volume that could be transmitted through the till to the bedrock has been calculated based on site permeability and vertical gradients.

Chloride was the contaminant considered since it is a conservative parameter. It migrates at the rate of groundwater flow, is not altered by biological degradation or oxidation/reduction and is not adsorbed by the soil. The background and leachate chloride concentrations for the site were determined from historical monitoring data.

Based on historical monitoring data, the bedrock chloride RUG is approximately 130 mg/L. The bedrock chloride concentration calculated for Alternative 3 (and similar for 3A) is 31 mg/L; significantly below the RUG. Our calculations assume leachate dilution does not occur within the overburden, only within the bedrock aquifer. Furthermore, this is the concentration below the landfill footprint. Some additional dilution will occur between the landfill footprint and the site boundary. Therefore, the actual chloride concentration in the bedrock aquifer is expected to be less, meaning the proposed landfill expansion is expected to meet the RUG. The detailed calculations were included in Appendix J of the Hydrogeology Study.

3.2.1.10 Impacts from Surface Drainage

If surface drainage from the CKD pile were to contact CKD waste, it could theoretically carry contaminants toward the realigned watercourse. Based on the soil conditions encountered at MW37, MW38, BH39 and BH40, it is unlikely that CKD waste will be disturbed by construction of the realignment. It is also unlikely that surface water would contact the CKD waste as it is currently covered and vegetated. Though an MECP concern, monitoring of the existing watercourse indicates the CKD pile, and the landfill are not currently impacting surface water quality. This monitoring shows that surface water is not a significant pathway for the transportation of CKD impacts to the watercourse realignment.

A surface water interception swale and sampling pond could be added to the Alternative 3A design as a contingency to address the MECP's concern that CKD-impacted surface water runoff may be discharging contaminants into the watercourse.

3.2.1.11 Investigation Findings:

The data collected as part of the April 2022 site investigations between the CKD Pile and the watercourse realignment suggests the following:

- A sand and silt seam (i.e., meltwater deposit) is present beneath portions of the watercourse realignment.
- A sand and silt seam (i.e., meltwater deposit) is present between the CKD pile and the watercourse realignment.
- Localized groundwater levels are above the bottom of the proposed watercourse realignment thus making it possible for groundwater beneath the CKD pile to enter the watercourse.
- CKD waste has impacted downgradient groundwater quality at OW37 and OW38 although the concentrations are significantly less downgradient of the CKD pile demonstrating that subsurface movement of impacted groundwater is limited and or localized.

The sentry wells will serve to predict the potential for CKD pile groundwater impacts to affect surface water quality in the future before they occur.

According to Section 4.1.2 of MECP's *"Guide on Aspects of Hydrogeological Assessment for New and Expanding Landfilling Sites (DRAFT V.9), March 2022"*, "A [Landfill] site can be considered suitable if:

I. Possible impacts can be naturally attenuated or controlled with the support of engineering designs, to prevent off-site impacts;

II. Groundwater movement and flow patterns are predictable to support the implementation of an effective monitoring program to facilitate early detection of potential impacts to the groundwater and or surface water; and

III. Implementing viable contingency measures are feasible in the event of unforeseen failure.

The hydrogeological investigations completed at the St. Mary's Landfill Site demonstrate that the Site is considered suitable per the draft guideline based on the following:

I. Possible impacts to groundwater can be attenuated or controlled with the existing and future expansion of the leachate collection system.

II. Groundwater flow and groundwater-surface water interaction along the watercourse realignment is understood. Monitoring wells are in place along the perimeter of the landfill to predict future off-site impacts. Monitoring wells are also in place between the watercourse realignment and both the existing landfill footprint and the CKD pile to predict future impacts on the watercourse realignment.

III. General contingency measures are presented herein for consideration and implementation in the event of unforeseen failure of the proposed landfill design.

3.2.2 Supplemental Information for Section 7.5 Evaluation of Alternatives

Review of the historical hydrogeological data (Vol. III, App. C) combined with the 2022 baseline data (Section 3.2.1) provides a clear understanding of the potential effects and pathways for groundwater contamination for all Alternatives. With this, the groundwater quality indicators were revised and combined to better articulate the risks to groundwater associated with the alternatives and, specifically, the risks associated with the proximity of the CKD pile. The updated indicators synthesize the information and data measured by the previous indicators. Thus, the updated indicators are better measures of the potential risks and impacts from each alternative while maintaining the intent of the original indicators.

Indicator 1: Risk of increasing leachate generation and strength:

Alternatives 3 and 3A, with moderately sized waste footprints (116,000 m^2 and 117,000 m^2 respectively), are likely to generate the same quantity of leachate. Alternatives 2 and 5 have larger waste footprints and are therefore expected to generate more leachate.

For Alternatives 3, 3A and 5 new waste is to be placed above the existing Phase I and Phase II/III footprints, potentially increasing leachate strength compared to existing conditions. The waste loading (i.e., m^3 of capacity per hectare of waste footprint) is shown for the alternatives in Table 10.

Table 10: Waste Loading of Alternatives

	Do Nothing	Alt 2	Alt 3	Alt 3A	Alt 5
Approved Capacity (m^3)	453,050				
Expansion Capacity (m^3)	0	634,950			
Total Capacity (m^3)	453,050	1,088,000			
Area (ha)	8.0	15.0	11.6	11.7	14.1
Waste Loading (m^3/ha)	56,631	72,533	93,793	92,991	77,163

Per Table 10, Alternatives 3 and 3A have the highest waste loading, though with less than 1% difference between them they are essentially equal. Alternative 2 has the lowest waste loading while Alternative 5 is the second lowest for the expansion options. However, as all alternatives have a waste loading of less than 98,500 m^3/ha, the lowest value in Table 2 of O.Reg. 232/98, used for the single liner design option at a background chloride concentration of zero milligrams per litre (0 mg/L), none of the alternatives are expected to result in significant leachate strength concerns.

Indicator 2: Risk of impacting groundwater quality:

Alternatives 2 and 3 will relocate the watercourse to the north side of the CKD Pile. The relocation increases the risk of CKD leachate impacts on the watercourse. Alternative 3A instead realigns a small (~230 m) section of the watercourse to provide additional waste footprint and achieve the Planning Period disposal capacity. This small realignment will not be as close to the CKD Pile as the relocation required for Alternatives 2 and 3. Alternative 3A is therefore less likely to create a conduit for CKD leachate to enter a meltwater deposit and move through the groundwater.

Further, the 2022 baseline data (Section 3.2.1) and historic data (Vol. III, App. C) indicates that CKD Pile impacts on the watercourse relocation envisioned for Alternative 3A can be monitored. Potential mitigation measures are available to address future effects (see Section 3.2.4.2).

Indicator 3: Risk of altering groundwater flow:

Alternatives 2 and 3 will require relocation of the watercourse. Shallow groundwater currently flowing toward the existing watercourse will be disrupted by this change, though the effects on shallow groundwater are not known.

Alternative 3A will have a short section of the watercourse realigned and the topography around the watercourse will change slightly. Based on the historic and 2022 baseline data, we anticipate changes to shallow groundwater flow will be imperceptible.

There is no change to the watercourse or the topography surrounding the watercourse under Alternative 5. As a result, no changes to shallow groundwater flow are expected.

Additional Mitigation

No changes to mitigation were required for Alternatives 2, 3 or 5 because of the 2022 baseline data evaluation completed for Alternative 3A.

Although not currently required, mitigation measures for Alternative 3A may be needed as part of the watercourse realignment design and construction, or they may be added later based on updated monitoring. Potential measures include:

- Add to or improve the cover materials and vegetation above the CKD Pile.
- Excavation/removal of the buried CKD material or sand and silt seam pathway, backfilling with a clayey material (likely available on-Site).
- Over excavating some or the entire realignment and installing a liner – either recompacted clay or a geosynthetic.
- Installing a French drain between the CKD Pile and the watercourse realignment, directing the CKD impacted groundwater to the Site's leachate collection system, a holding tank, or a containment pond (lined, dedicated for this purpose).

Net Effects

The post-mitigation risks to groundwater associated with Alternatives 2, 3 and 5 remain as described in the Hydrogeology Assessment (Vol. III, App. C). The risk associated with Alternative 3A is relatively minor and can be reduced significantly with appropriate design elements, such as:

- Add to or improve the cover materials and vegetation above the CKD Pile.
- Excavation/removal of the buried CKD material or sand/silt seam pathway, backfilling with a clayey material (likely available on-Site).
- Over excavating some or the entire realignment and installing a liner – either recompacted clay or a geosynthetic.
- Installing a French drain between the CKD Pile and the watercourse realignment, directing the CKD impacted groundwater to the Site's leachate collection system.

As above, these are design elements may also be used as mitigation (post-construction contingency) measures.

3.2.3 Supplemental Information for Table 9.1 Effects, Mitigation, and Net Effects

The 2022 baseline data evaluation completed for Alternative 3A determined one additional mitigation measure. This mitigation measure is provided as a contingency. Should CKD effects be observed in the realigned watercourse through the updated Annual Monitoring Program, measures to separate the watercourse from the CKD will be required as outlined in the 'Additional Mitigation' section above.

3.2.4 Proposed Monitoring Program

The current monitoring program was developed by CRA in 1992 and was revised in April 2009. Under the 2009 program, groundwater and surface water are monitored twice annually in the spring and fall. The 2009 program included a list of monitoring wells, residential water supply wells, leachate wells, and surface water stations and their respective monitoring requirements.

The updated Monitoring Program is based on the existing program and incorporates changes to address GRT comments on the August 2021 EA and recent discussions with respect to Alternative 3A. The updated monitoring program will be implemented upon Environmental Protection Act approval of the landfill expansion and the commencement of fill operations. The program also considers the following MECP documents that have come into effect since 1992, when the original monitoring program was developed:

- *Landfilling Sites, Ontario Regulation 232/98;*
- *Landfill Standards: A Guidelines on the Regulatory and Approval Requirements for New or Expanding Landfill Sites, January 2021, Schedule 5: Groundwater, Leachate and Surface Water Monitoring Parameters;*
- *Monitoring and Reporting for Waste Disposal Sites, Groundwater and Surface water, Technical Guidance Document, MOE, November 2010; and*
- *Guide on Aspects of Hydrogeological Assessment for New and Expanding Landfilling Sites, DRAFT (V.9), March 2022.*

We have also considered the six areas within the site where additional monitoring wells were recommended in the Hydrogeology Report (Vol. III, Appendix C). These are shown on Figure D-7.

- Shallow water table monitoring wells are recommended in Areas 1,2, and 3;
- Nested water table and bedrock wells are recommended in Areas 4 and 5; and,
- A provision to install replacement wells in Area 6 following construction (i.e., if OW9A-91, OW9B-91, OW15-91, and OW21-91 need to be replaced).

Each nest will include at a minimum one shallow water table well and a bedrock well. In addition, high permeability water bearing seams (meltwater deposits) encountered should also be screened with a monitoring well.

The wells installed during 2022 partly fulfill the needs for new wells as outlined in Table 11.

Table 11: Proposed Monitoring Well Locations

Area	Proposed	Current Status (Wells Installed in 2022/Future Replacements)
1	Water Table	Future replacement
2	Water Table	MW37S-22 MW37D-22(@ overburden bedrock contact)

Area	Proposed	Current Status (Wells Installed in 2022/Future Replacements)
3	Water Table	Future replacement
4	Water Table Bedrock	MW38S-22 MW38I-22 MW38D-22 (@ overburden bedrock contact)
5	Water Table Bedrock	Future replacement Future replacement
6 Provisional	Water Table Bedrock	Future replacement Future replacement

Eventually nine wells need to be decommissioned as they are within the expansion footprint. These include: OW3-84, OW4-84, OW5-84, OW6-84, OW7-91, OW8A-91, OW8B-91, MW04-04, and OW36.

Table 12 provides a list of sampling efforts required at each monitoring location recommended in this proposed monitoring program.

Table 12: Ground & Surface Water Monitoring Program Summary

Groundwater Monitoring Wells		
Station	**Water Level**	**Water Quality**
OW2-84 (Background O/B)	WL	GWQ
OW8A-91	WL	GWQ
OW8B-10	WL	GWQ
OW9A-91[3]	WL	GWQ
OW9B-91[3]	WL	GWQ
OW15-91[3]	WL	GWQ
OW21-91[3]	WL	GWQ
OW25-91 (Background O/B)	WL	GWQ
OW32-96	WL	GWQ
OW33-96 (P/L)[4]	WL	GWQ
OW34-96 (P/L)[4]	WL	GWQ
OW32A-02 (P/L)[4]	WL	GWQ
OW37S-22[1]	WL	GWQ
OW37I-22[1]	WL	GWQ
OW37D-22[1]	WL	GWQ
OW38S-22[1]	WL	GWQ
OW38D-22[1]	WL	GWQ
MHB	WL	GWQ
Surface Water Stations		
Station	**Flow (F), Water level (WL)**	**Water Quality**
SP1-10 (upstream)	WLF	SWQ

Groundwater Monitoring Wells		
SP2-93 (midstream)[3]	WLF	SWQ
SP3-93 (downstream)	WLF, FLOW	SWQ
West SWM Basin[2,5]		
Inlet	WLF	SWQ
Outlet	WLF	SWQ
East SWM Basin[2,5]		
Inlet	WL	SWQ
Outlet	WL	SWQ
Leachate Manholes[6]		
MH1 (Phase I)	WL	LQ
MH3 (Phase II/III)	WL	LQ

Notes:

1. OW3-84, OW4-84, OW5-84, OW6-84, OW7-91, and OW36 will be decommissioned and replaced by OW37S, OW37I-22, OW37D-22, OW38S-22, and OW38D-22. OW37S-22 and OW38D may have insufficient water to collect a sample)
2. Record observations of sedimentation build up in Basin
3. SP2-93, OB9A-91, OW9B-91, OW15-91 and OW21-91 might have to be decommissioned to facilitate site construction. (Replacement wells proposed in Area 6 (Figure D-7).
4. Located along property limit (P/L) for Reasonable Use Assessment
5. SWM Basins A&B will continue to be monitored until they are replaced by West and East SWM Basins.
6. Monitoring of noted leachate manholes will be discontinued and replaced with new monitoring locations when the landfill expansion's leachate collection system is constructed and operating

O/B – Overburden; WL= Water level; WLF= water level and or flow conditions; GWQ = Groundwater Quality – Schedule 5; SWQ = Surface Water Quality; LQ = Leachate Quality; Flow = Flow Measurement
It is recommended that at least two duplicate water quality samples be collected for blind laboratory analysis (Approximately 1 duplicate should be collected for every 10 samples submitted to the Laboratory for analysis).

General site conditions should be documented during each site visit including, but not limited to, condition of landfill cover, erosion, leachate seeps, blown litter, odours, conditions of each monitoring location, and wells needing repair.

Table 13: Water Quality Parameters

Sample Type	Schedule 5 Parameters	Special considerations
Groundwater Monitoring Wells (GWQ)	Column 2: Indicator List for Groundwater plus: total phosphorus, hardness, manganese, potassium, bicarbonate and carbonate	Schedule 5: Column 1: Comprehensive list for Groundwater plus hardness, bicarbonate and carbonate at OW37S, OW37I, OW37D, OW38S, OW38D, MHB, OW2-84 and OW25-91
Surface Water Stations (SWQ)	Column 4: Indicator List for Surface Water plus: boron, hardness, magnesium, manganese, sodium, calcium,	

Sample Type	Schedule 5 Parameters	Special considerations
	potassium, bicarbonate and carbonate	
Leachate wells	Column 2: Indicator List for Leachate, plus: total phosphorus, hardness, manganese, potassium, bicarbonate and carbonate	

Notes:

- A copy of MECP (January 2012) Landfill Standards, Schedule 5 groundwater and surface water quality parameters is provided in Attachment E with additions noted above based on the following:
- Potassium was added as an indicator for CKD pile contaminants.
- Total Phosphorus, hardness, boron, and manganese are current landfill indicators (2021 Monitoring Report, GM BluePlan, 2022).
- Magnesium, sodium, calcium, bicarbonate and carbonate were added to facilitate analysis using trilinear plots (Piper plots).

3.2.4.1 Adaptive Management Triggers

Adaptive Management or Contingency plans are emplaced to address potential impacts that may occur but are unlikely to happen. This section provides triggers and procedures, to be incorporated into the post EA Design and Operations Plan, for use during emergencies as well as planned responses if site design and environmental control measures do not function as anticipated.

It is recommended that non-emergency measures be implemented only after a review of background information and site performance indicators to provide the best solution to potential impacts that may arise. The engineering contingency measures described below in Section 4.2.2 are generic and address a wide variety of issues. A situation specific issue may be more suitably addressed by a specific response measure. Therefore, all measures, beyond those of a routine maintenance nature, are to be reviewed by the MECP before implementation to ensure maintaining compliance with the ECA. The following sections outline the measures that should be taken if one or more of these situations occur at the site.

Contingency triggers are developed to determine when action is required. The contingency triggers for the site are based on both concentration trigger values for chloride and evaluating concentration trends for site specific indicator parameters while taking into consideration Provincial Water Quality Objectives (PWQO) and Ontario Drinking Water Quality Standards (ODWQS). The indicator parameters for the site are presented in Table 14 and recommended for monitoring to determine if changes in water quality (i.e., trends or trigger exceedances) demonstrate a deterioration in water quality or predict a future landfill or CKD pile effect on groundwater or surface water quality. The trends and triggers for these indicator parameters will be evaluated as part of the updated annual monitoring required by both the EA and the ECA. The monitoring and contingency program might need minor adjustments once detailed design is completed; however, the overall intent and evaluation process is not expected to change.

Table 14: Points of Compliance and Indicator Parameters

Location	Chloride Trigger	Trend Analysis	Notes
Assessment for Landfill Impacts			
Reasonable Use Boundary/Compliance wells OW32-96, OW32A-02, OW33-96, OW34-96, and OW35	Chloride (100 mg/L)	Alkalinity Conductivity DOC Sulphate, hardness, TKN, manganese and boron	Sodium : chloride, sodium : calcium, and chloride : sulphate ratios will be reviewed in the future to determine if they can demonstrate landfill related impacts. Time versus concentration trends to be assessed for all indicator parameters while taking PWQOs and ODWQS and Reasonable Use target concentrations into consideration.
Sentry Wells: OW9A-091, OW9B-91, OW15-91		Chloride, Alkalinity, conductivity, DOC, sulphate, hardness, TKN, manganese and boron	
Background Wells: OW2-84, OW25-91		Chloride, Alkalinity, conductivity, DOC, sulphate, hardness, TKN, manganese and boron	
Surface water: SP3-93 (downstream)		Potassium, sulphate, alkalinity, conductivity, DOC, hardness, manganese, TKN and boron	Time versus concentration trends to be assessed for all indicator parameters while taking into consideration PWQO concentrations and trends comparing upstream (SP1-10) versus downstream (SP3-93) conditions.

Location	Chloride Trigger	Trend Analysis	Notes
Sentry Wells for Potential CKD Impacts on Watercourse			
OW37S-22 OW37I-22 OW37D-22 OW38S-22 OW38D-22		Potassium Alkalinity Conductivity DOC Sulphate (Establish base line for all indicators (minimum 4 results), assess for increasing trend for 4 consecutive results - evaluate potential for future impact on surface water quality.)	Sodium:chloride, sodium: calcium, and chloride : sulphate ratio will be reviewed in the future to determine if they can demonstrate CKD related impacts.

Notes: OW9A-091, OW9B-91, OW15-91 might need to be decommissioned and replaced to facilitate construction.

Chloride Trigger:

Groundwater: The D&O (CRA 1992) identified a trigger of 100 mg/L for chloride at the property limit. Chloride is a good indicator of landfill related impacts but can be influenced by road salting and in this case, the CKD pile. As such, other indicators including conductivity, alkalinity sulphate, DOC, potassium, and a few metals will also be used to assess long term trends even if background concentrations are near the Reasonable Use Guideline (RUG) value (e.g., DOC) or no RUG value exists (e.g., alkalinity).

Surface Water: Surface water impacts have not been detected (GM BluePlan, 2022) and there are currently no site-specific surface water triggers. A PWQO value does not exist for chloride however the Canadian Water Quality Guidelines (CWQG) present a surface water criterion of 128 mg/L for chloride. The historical range for chloride is between 13 mg/L and 887 mg/L at the upstream station SP1-10 (i.e., elevated chloride is attributed to off site upstream contributions) therefore a concentration above 128 mg/L does not necessarily reflect a site related impact on the watercourse. Downstream surface water (SP3-93) quality will be compared to upstream surface water ((SP1-10) quality to assess on site contribution of chloride to the watercourse.

CKD Pile Sentry Wells: It is expected that ground water quality at the sentry wells would have to deteriorate significantly before a CKD related effect could be detected in surface water. A chloride trigger is not recommended for the sentry wells positioned between the CKD pile and the watercourse based on the following rationale:

- The sentry wells are not a point of compliance yet provide early warning for potential future impacts on the watercourse which will be evaluated based on water quality trends in the sentry wells in conjunction with a comparison of upstream (SP1-10) and downstream (SP3-93) surface water quality in the watercourse as noted above.

- The Ontario Drinking Water Quality Aesthetic Objective (ODWQ – AO) for chloride is 250 mg/L,
- The chloride concentrations at OW37I-22, OW37D-22 and OW38-S are already almost 250 mg/L (244 mg/L at OW38S-22, see Table 7) yet the watercourse is not currently impacted by the CKD Pile (or the landfill), and,
- Groundwater flow contributions from the CKD pile to the watercourse are minimal.

Trend Analysis

If the chloride trigger is activated at a point of compliance, the required action will depend on the nature of the result and concentration trend analysis for the other indicators. If an exceedance of a trigger concentration or an increasing concentration trend emerges during annual monitoring, the next two routine monitoring results obtained at that location will be reviewed to confirm the validity of the suspect concentration or trend. If the exceedance or trend is confirmed by the next two routine monitoring results to reflect a potential impact, action will be required.

Assessing water quality impacts on the watercourse will rely on indicator parameter data trends at the sentry wells and a comparison of surface water quality in the watercourse between upstream (SP1-10) and downstream (SP3-93) stations. Once baseline conditions are established (minimum of 4 samples), the following will be considered:

- If an unacceptable increasing trend for an indicator parameter is identified in a sentry well:
  - Other parameter trends will be assessed both in the sentry wells and watercourse monitoring locations to confirm or refute the trend, and
  - Water quality between upstream and downstream surface water stations will be compared to determine whether indicator concentrations and trends are similar or different between stations to assess contaminant loading on the watercourse.
- If an unacceptable increasing trend is identified in the watercourse:
  - Concentration trends will be assessed both in the sentry wells and watercourse monitoring locations to confirm or refute the trend, and,
  - Water quality between upstream (SP1-10) and downstream (SP3-93) surface water stations will be compared to determine whether indicator concentrations and trends are similar or different between stations to assess contaminant loading on the watercourse.

The trends and triggers for indicator parameters outlined above will be evaluated to recommend if contingency measures are needed. The recommendation(s) will be included as an “Opinion Section” in both the annual monitoring report and associated cover letter, for submission to the MECP. If more immediate action is required, the Town will submit an interim letter report.

The goal is to submit a remedial action plan with mitigation measures to the MECP for review and comment within one month of identifying an increasing trend as outlined above. It will be carried out upon approval from the MECP and could include the following, depending on the situation:

Adaptive Management Measures - Groundwater:

- Install and test boundary well(s) downgradient of the affected sentry well(s).
- Review current site operations to determine if there is any probable cause for the increase and if any operational changes could reduce the impact through reduction of leachate production.
- Review data to determine the probability of off-site contamination and an assess the need develop a contaminant attenuation zone.
- Review the updated annual monitoring program and recommend changes. Any new boundary wells would become part of the updated annual monitoring program and triggers would be set for these wells. If the trigger levels are exceeded or unacceptable increasing trends are identified at the new boundary wells, and there is potential for off-site impacts, additional actions will be required. The exact nature of those actions would depend on impacts identified and where they are occurring and could include items outlined in the following sections.

Adaptive Management Measures - Surface Water:

- Review current site operations to determine if there is any probable cause for the increase and if any operational changes could reduce the impact through surface water controls such as ditches, swales, berms, grading, seeding, cover enhancement.
- Review the updated annual monitoring program and recommend changes. New surface water quality monitoring points would become part of the updated annual monitoring program and triggers would be set for these locations. If the trigger levels are exceeded at the new locations, and there is potential for off-site impacts, additional actions will be required. The exact nature of those actions would depend on impacts identified and where they are occurring and could include items outlined in the following sections.

3.2.4.2 Adaptive Management Responses

When the triggers are exceeded, an Adaptive Management response may be required. The following sections outline discuss a variety of potential strategies to provide guidance in the event that effects are detected.

Potential Effect Identified: Landfill Leachate Migration in Groundwater (Overburden)

The leachate collection system installed beneath Phase II/III collects leachate beneath the waste reducing the potential for contaminants to migrate into the overburden, more specifically the meltwater deposits.

A deeper collection pipe was also installed in the meltwater deposits beneath the leachate collection system between MHA and MHB (maintenance hole A and B). The deeper pipe has no outlet. It was installed as a contingency to collect leachate entering the meltwater deposits. Water in the deeper pipe can be pumped out from MHB when leachate contaminants are detected (i.e., not meeting Provincial Water Quality Objectives). Otherwise, overflow from MHB is allowed to discharge to the surface water system that flows to Basin B. Water quality samples are collected at MHB to assess changes and potential impacts beneath the Phase II/III leachate collection system the waste. This provides a level of protection that contaminants won't exceed the trigger levels at the property boundary.

Other options include:

- Establish an offsite Contaminant Attenuation Zone (CAZ), such as the road allowance or other lands located to the west of the site.
- Install poplars or other hardy trees on completed portions of the site, which tend to stabilize the surface, increase evapotranspiration and uptake leachate impacted groundwater which reduces the leachate generated from the site; and/or,
- Install a cut-off trench, with leachate interception and recirculation back into the landfill. If monitoring beyond the control feature indicates leachate migration, then purge wells would be installed along the landfill side of the cut off feature to dewater the meltwater deposits. The quality of purge water would determine whether the water would be discharged to the leachate collection system or the surface water Basin.

Potential Effect Identified: Leachate migration in the Bedrock Aquifer

If monitoring indicates leachate migration into the bedrock, then purge wells could be installed downgradient of the plume. The quality of contamination in the purge water would determine whether the water would be discharged to the leachate collection system or a surface water Basin.

Potential Effect Identified: Leachate Mounding and Seepage

Leachate seeps would be corrected by excavating the soil cover and waste in the vicinity of the seep and placing a granular material (e.g., clear washed stone) to create a hydraulic connection between the perched layer and the collection system. Leachate seeps due to the failure of the leachate collection system can be corrected by flushing the lines and removing restrictions in the pipe. If flushing is unsuccessful, purge wells could be installed through to the base of the waste. The leachate could be pumped to a holding tank to alleviate pressure and leachate mounding on the landfill side slopes. Alternatively, the leachate could be transferred and held in a clay-lined, temporary dry surface water storage pond to facilitate eventual management and disposal.

The District Manager of the MECP must be notified within 1 week of a leachate breakout.

Potential Effect Identified: Groundwater Impacts from CKD pile

Groundwater impacts from the CKD pile could be addressed as follows:

- Continued groundwater quality monitoring between the CKD pile and the watercourse realignment will be critical to assessing water quality trends, changes in the subsurface conditions and predicting future CKD impacts on the watercourse.
- The concentration of many parameters in the groundwater within CKD pile have declined since monitoring began in 2004. Continued monitoring of the groundwater quality at MW04-01 and MW04-03 screened within the CKD pile will assess whether source concentrations will continue to decline.
- Groundwater levels and water quality monitoring at OW37, OW38, MW04-01 and MW04-03 should be incorporated into the routine monitoring program. A contingency plan and trigger mechanism must be established to determine when confirmation sampling and remedial action are required.

Although not currently required, mitigation measures may be needed as part of the watercourse realignment design and construction, or they may be added later based on monitoring. Potential measures include:

- Add to or improve the cover materials and vegetation above the CKD Pile.
- Excavation/removal of the buried CKD material or sand and silt seam pathway, backfilling with a clayey material (likely available on-Site).
- Over excavating some or the entire realignment and installing a liner – either recompacted clay or a geosynthetic.
- Installing a French drain between the CKD Pile and the watercourse realignment, directing the CKD impacted groundwater to the Site’s leachate collection system, a holding tank, or a containment pond (lined, dedicated for this purpose).

Potential Effect Identified: Surface Water Impacts from CKD pile

The monitoring well network, and site drainage systems are designed to prevent and predict impacts to surface water. Should CKD contaminants be detected in the sample collection pond, then mitigation measures can be implemented. These may include or combine:

- Extend or improve the cover materials and vegetation above the CKD Pile.
- Additional local grading.
- Enhance the swale with vegetation to provide additional treatment.
- Modify the sampling pond to provide additional treatment.
- Adding an outlet control to the sampling pond, allowing surface water to accumulate but not discharge. The water could then be sampled, and if contaminated, disposed (potentially directed to the leachate collection system) rather than released into the watercourse.

Potential Effect Identified: Presence of High Levels of Landfill Gas

Historically, there has been no landfill gas monitoring at the Site. Further, there was no monitoring completed as part of this field investigation. We assume landfill gas migration will remain an insignificant issue at the Site, particularly given its predominantly clay/silt till nature. However, contingency measures can be put into place should landfill gas issues arise. These include:

- If low combustible gas levels are suspected or complaints regarding odours are received:
    - A landfill monitoring program can be initiated.
    - Consideration will be given to installing a passive gas venting system consisting of perforated gas collection piping in appropriate locations.
- If high levels of combustible gas are suspected, then the need to install an active gas collection system will be considered.

3.2.5 Baseline Data Collection & Evaluation

A preliminary site design was prepared to support the Alternative 3A landfill expansion, providing supplemental information on:

- Limits of Landfill expansion
- Perimeter access roads and ditches
- Stormwater Management Basins
- Realignment of Landfill Tributary
- External channel

Existing topographic mapping was used to measure drainage areas, establish site grades, and identify the locations of the access roads, ditches, and stormwater management basins. These are shown on Figure D-2.

Preliminary hydrotechnical calculations confirmed the sizes of the drainage facilities exceed capacity for both the 1:250-year storm and an enhanced level of water quality control.

The cross-section of the realigned watercourse is based upon that which now exists within this reach of the watercourse.

Although the watercourse seems stable within the landfill site, monitoring for erosion problems should be done annually and particularly after large runoff events. Repairs are to be made should any erosion threaten the integrity of the channel embankments.

Interactions between CKD and the surface water quality in the watercourse are not expected. However, if the updated monitoring program (Section 3.2.4) detects impacts from CKD in the realigned watercourse, measures to mitigate these impacts will be required. Contingency plans are provided with the updated monitoring program.

3.2.5.1 Surface Water Quality

The Annual Operations & Monitoring Report (2021) was reviewed to assess site surface water impacts and impacts from the CKD Pile. This effort was focussed mainly on determining the potential impacts of the CKD Pile on the watercourse. Further, as part of the evaluation described in Section 3.2, the Alternative 3A watercourse realignment was evaluated to determine if there was a potential for groundwater effects that would reach the surface (i.e., the watercourse).

Relative to surface water monitoring for the existing landfill site:

- **CKD Pile**: No CKD effects to the existing surface water quality in watercourse have been detected to date.
- **Basin A**: Fluctuating chloride concentrations are consistent with a closed site. The water quality appears to be influenced by surface sources such as salt and organics rather than landfill leachate. Based on the similarity to water quality within the on-site water course, no impacts to surface water resources are expected due to discharges from Basin A.
- **Basin B**: The water quality at Basin B does not appear to be influenced by landfill leachate. Exceedances of the PWQO are attributed to salting and/or naturally occurring conditions, including off-site influence from agricultural fields.

This additional information is consistent with historical surface water monitoring. There have been no changes since preparation of the Hydrogeological Assessment (Volume III, Appendix C).

Surface water quality sampling was not undertaken as part of the April 2022 field investigations given that ongoing ECA compliance monitoring includes surface water quality sampling along the watercourse. The results are presented in the 2021 Monitoring report by GM BluePlan (March 2022). Relevant information is summarized below and time versus concentration plots for chloride and hardness are attached (Attachment F):

Table 15: Surface Water Quality Summary

Parameter	PWQO / (APV)	SP1-10 Upstream		SP2-93 Midstream		SP3-93 Downstream	
		Jun-21	Nov-21	Jun-21	Nov-21	Jun-21	Nov-21
Calcium		15.9	161	29.2	93.6	42.4	95.9
Chloride	(180)	*415*	10.9	*356*	48.5	*349*	49.1
Hardness		108	506	152	300	190	307
Phenols		0.003	**0.009**	0.002	**0.011**	<0.001	**0.014**
Magnesium		16.7	25.3	19.1	16.10	20.5	0.02
TDS		816	328	902	428	908	386
BOD5		<2	19	2	<2	<2	<2
Ammonia		0.12	0.11	0.02	<0.02	0.02	<0.02
Un-Ionized Ammonia	20	0.758	0.001	0.276	<0.001	0.020	<0.001
Iron	0.3	0.265	**21.8**	**0.650**	0.157	**0.922**	0.159
Manganese		0.055	3.11	0.063	0.022	0.171	0.020

Parameter	PWQO / (APV)	SP1-10 Upstream		SP2-93 Midstream		SP3-93 Downstream	
		Jun-21	**Nov-21**	**Jun-21**	**Nov-21**	**Jun-21**	**Nov-21**
Alkalinity		194	294	186	271	211	270
Sodium		154	2.85	146	29.7	145	30.6
Nitrate		<0.07	0.33	<0.07	2.81	<0.07	2.83
Nitrite		<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Phosphorous	0.03	**0.19**	**1.33**	**0.12**	**0.07**	**0.14**	**0.07**
TSS	-	<10	324	21	<10	11	<10

Notes:
1. All parameters are in mg/L except for conductivity (μS/cm) and unionized ammonia is in μg/L
2. Data provided via email, David Blake to Kim Hawkes, June 27, 2020, 3:29 PM).
3. Parameters such as sulphate, potassium, and DOC were not tabulated in the GM BluePlan report.
4. PWQO – Provincial Water Quality Objectives, AVP – Aquatic Protection Value (in brackets)

The water quality results in Table 15 and the time versus concentration plots in Attachment F demonstrate similarity between the upstream and downstream stations for the parameters tested. It is not possible to comment further relative to other CKD related indicators, such as potassium, given that results were not documented in the 2021 Monitoring Report or included in the 2021 data.

3.2.5.2 Surface Water Quantity

No additional data collection was required to support the assessment of Alternative 3A with respect to surface water quantity.

3.3 Surface Water

3.3.1 Supplemental Information for Section 7.6 Evaluation of Alternatives

3.3.1.1 Surface Water Quality

Indicator 1: Risk of contaminated runoff reaching surface water:

No new risks or effects are anticipated due to Alternative 3A.

Indicator 2: Risk of leachate from seeps reaching surface water:

Alternative 3A is expected to present a slightly higher risk of leachate seeps than Alternative 3 due to being about four metres taller.

Indicator 3: Risk of leachate from CKD pile reaching surface water:

There is a lower risk of CKD effects reaching the watercourse with Alternative 3A as the watercourse realignment is minor and farther from the CKD pile compared to Alternatives 2 and 3.

Indicator 4: Risk of on-site surface water quality impacting Thames River:

The watercourse realignment for Alternative 3A is minor and farther from the CKD pile compared to Alternatives 2 and 3. This lowers the risk of water quality impacts on the Thames River.

Net Effects

Alternative 3A represents a low to moderate risk of effects to surface water and Alternatives 2, 3 and 5 are high risk due to their potential interactions with the CKD pile. All other potential effects can be adequately mitigated.

Additional Mitigation

As discussed in Section 3.2.1, there are no indications that the CKD pile is influencing surface water quality or will influence surface water quality following Alternative 3A watercourse realignment. Contingency measures have been proposed (Section 3.2.4.2) should impacts be detected by the updated monitoring program.

3.3.1.2 Surface Water Quantity

No changes to surface water quantity are expected due to the expansion of the landfill site under any of the Alternatives. The overall length of the watercourse also remains roughly the same under any of the Alternatives. The differences merely relate to the amount of the watercourse that is realigned, under Alternative 3A, or relocated, under Alternatives 2 and 3. Alternative 5 does not modify the existing watercourse.

3.3.2 Supplemental Information for Table 9.1 Effects, Mitigation, and Net Effects

No additional information was required to assess the effects documented in Table 9.1. No additional mitigation was required and there are no monitoring requirements beyond those already proposed in Vol. 1 Section 11 (and above, in Section 3.2.4).

3.4 Ecology

3.4.1 Baseline Data Collection & Evaluation

No additional data collection was required to support the assessment of Alternative 3A with respect to ecology.

3.4.2 Supplemental Information for Section 7.7 Evaluation of Alternatives

The conceptual design footprint of Alternative 3A was reviewed for terrestrial and aquatic ecological impacts. The review found:

3.4.2.1 Terrestrial Ecology

- No concerns for SAR or wildlife.
- The realignment is proposed within a MEGM3 (dry-fresh graminoid meadow) vegetation community that encompasses the landfill site on the east side of the existing drain. The realignment is located well outside the area identified as terrestrial crayfish habitat (Significant Wildlife Habitat) and is also outside of the grassland areas that were identified as confirmed nesting and foraging habitat for Eastern Meadowlark (Threatened under the ESA). Eastern Meadowlark prefer sites that feature moderately tall grass with abundant litter cover, a high proportion of grass cover, low proportion of shrub and woody vegetation and low percent cover of bare ground. The vegetation structure of the MEGM3 in this location is comprised of a higher percentage of trees and shrubs, poor soil conditions with a high percent of bare ground compared to the area where Eastern Meadowlark was recorded during breeding bird surveys (i.e., capped cement kiln dust stockpile). This area of the landfill is highly disturbed from historic operations. No records of any species of concern or SWH were identified in this location during surveys. Therefore, we do not anticipate impacts to SWH or SAR should the watercourse be realigned in this location.
- Perimeter facilities on southern property limit will require tree cutting. Approvals must be confirmed, including breeding bird avoidance requirements. Habitat restoration/compensation may also be required.

3.4.2.2 Aquatic Ecology

- There are no SAR in the watercourse on the landfill property.
- The watercourse realignment of Alternative 3A is preferred over the relocation for Alternatives 2 and 3 as less watercourse adjustment is required and there is a lower potential for interactions with the CKD Pile.
- As with all of the Alternatives, contaminants or sediments from the watercourse could move downstream and impact the Thames River and the aquatic species inhabiting the river.
- Must review Fisheries Act implications upon detailed design.

3.4.3 Supplemental Information for Table 9.1 Effects, Mitigation, and Net Effects

No additional information was required to assess the effects documented in Table 9.1. No additional mitigation was required and there are no monitoring requirements beyond those already proposed in Vol. 1 Section 11.

3.5 Impacts to Cultural Heritage Resources

3.5.1 Built Heritage and Cultural Heritage Landscapes

3.5.1.1 Baseline Data Collection & Evaluation

No additional data collection was required to support the assessment of Alternative 3A with respect to cultural heritage resources.

3.5.1.2 Supplemental Information for Section 7.8.1 Evaluation of Alternatives

No cultural heritage resources were identified within the property limit of the St. Marys Landfill. As a result, moving the waste footprint and the watercourse realignment are not going to impact any on-site cultural heritage resources.

There does not appear to be a visual connection between the property and any of the Alternatives that would indirectly affect the off-site heritage residence. This will be confirmed in an updated Cultural Heritage Resources Assessment (CHRA) to be prepared during the detailed design phase of the project.

Similarly, there will be no direct effects to any Cultural Heritage Landscapes (CHLs), according to the CHRA (Vol. 3, Appendix E) as the viewscape is not expected to change significantly with any of the Alternatives. The trees along the southern boundary of the landfill property will need to be removed for Alternative 3A. These trees will remain in place with all remaining Alternatives. The effect of this removal on the landscape is very minimal as these trees only provide a visual block from the agricultural field to the south. They are not integral to blocking the view from Water St. S. It is noted that overall, the trees are on the slope of the former quarry and therefore provide a relatively low and minimally effective visual blockage. Indirect effects to CHLs are not expected but will be confirmed in an updated CHRA to be prepared during the detailed design phase of the project.

Alternative 3A is equally preferred with the other expansion alternatives.

3.5.1.3 Supplemental Information for Table 9.1 Effects, Mitigation, and Net Effects

No additional information was required to assess the effects documented in Table 9.1. No additional mitigation was required and there are no monitoring requirements beyond those already proposed in Vol. 1 Section 11.

3.5.2 Archaeological Resources

3.5.2.1 Baseline Data Collection & Evaluation

No additional archaeological assessment was completed for Alternative 3A.

3.5.2.2 Supplemental Information for Section 7.8.2 Evaluation of Alternatives

The Stage 1 Archaeological Assessment (Volume III, Appendix F) concluded that the entire On-Site Study Area has been documented to not retain archaeological potential and that these lands do not require further archaeological assessment.

3.5.2.3 Supplemental Information for Table 9.1 Effects, Mitigation, and Net Effects

No additional information was required to assess the effects documented in Table 9.1. No additional mitigation was required and there are no monitoring requirements beyond those already proposed in Vol. 1 Section 11.

3.6 Traffic

3.6.1 Baseline Data Collection & Evaluation

No additional data was collected to evaluate Alternative 3A. The same site staff and users would be anticipated to arrive at the site regardless of the Alternative selected (except the Do Nothing Alternative).

3.6.2 Supplemental Information for Section 7.9 Evaluation of Alternatives

There are no anticipated changes to traffic due to Alternative 3A.

3.6.3 Table 9.1 Effects, Mitigation, Net Effects, and Monitoring Requirements

No additional information was required to assess the effects documented in Table 9.1. No additional mitigation was required and there are no monitoring requirements beyond those already proposed in Vol. 1 Section 11.

3.7 Land Use

The following applies equally to Sensitive Land Use and Aggregate Resources as discussed in Section 7.10.

3.7.1 Baseline Data Collection & Evaluation

No additional data was collected to evaluate Alternative 3A. The land use information contained in Volume III, Appendix G, the Socio-Economic Impact Assessment, remains relevant to Alternative 3A.

3.7.2 Supplemental Information for Section 7.10 Evaluation of Alternatives

The existing landfill and vacant, former extraction lands are the only uses currently present in the On-Site Study Area. Alternative 3A is like Alternative 3 with respect to land use evaluation.

3.7.3 Supplemental Information for Table 9.1 Effects, Mitigation, and Net Effects

No additional information was required to assess the effects documented in Table 9.1. No additional mitigation was required and there are no monitoring requirements beyond those already proposed in Vol. 1 Section 11.

3.8 Socio-economic Conditions

3.8.1 Financial Factors

3.8.1.1 Baseline Data Collection & Evaluation

The financial evaluation of Alternatives has been updated considering the cost of expanding and operating the landfill site. The Town's costs for waste collection and transportation to the landfill have not been considered. The updated cost estimate is presented in Table 15.

A 20% market factor allowance has been applied to the cost estimate. This accounts for unforeseen market factors that have been occurring due to changes in trade deals, tariffs, the COVID-19 pandemic, product shortages, skilled trades labour shortages, etc.

3.8.2 Supplemental Information for Section 7.11.1 Evaluation of Alternatives

Alternative 3A has a similar footprint to Alternative 3. This means that the new LCS, perimeter roads, perimeter ditching and new SWM basins are like Alternative 3 (i.e., larger than existing conditions but smaller than Alternatives 2 and 5). The watercourse only requires realignment for this Alternative, which is less work, and therefore lower cost than the relocation in Alternatives 2 and 3. No work is required on SMC lands and therefore there will be no costs associated with property acquisition or easement (not shown on Table 15). There are additional earthworks required on the south and north sides of the waste footprint to prepare for the internal perimeter ditch, perimeter road and the external ditch. The scale, scale house and public drop-off area will need to be relocated for Alternatives 3, 3A and 5. Closure of the site under Alternative 3A will be much like Alternative 3 though less expensive than Alternatives 2 and 5.

3.8.3 Supplemental Information for Table 9.1 Effects, Mitigation, and Net Effects

No additional information was required to assess the effects documented in Table 9.1. No additional mitigation was required and there are no monitoring requirements beyond those already proposed in Vol. 1 Section 11.

Table 16: Capital & Operating Costs of Alternatives

Item No.	Description	Alternative 2	Alternative 3	Alternative 3A	Alternative 5
A1	Mobilization	$479,000	$512,000	$444,000	$535,000
A2	Earthworks	$3,238,000	$3,303,000	$2,981,000	$3,849,000
A3	Landscaping	$170,000	$162,000	$162,000	$162,000
A4	Road Development	$698,000	$680,000	$550,000	$1,024,000
A5	Stormwater Management	$288,000	$249,000	$117,000	$270,000
A6	Electrical Services	$97,000	$97,000	$97,000	$97,000
A7	Monitoring Well Installation	$100,000	$100,000	$100,000	$117,000
A8	Public Drop Off Infrastructure	$0	$484,000	$484,000	$484,000
A9	Creek Realignment/Relocation Efforts	$610,000	$610,000	$219,000	$11,000
A10	Design and Reporting	$852,000	$852,000	$852,000	$852,000
A11	Contract Administration & Construction Inspection	$776,000	$776,000	$776,000	$776,000
A12	Contingency (10%)	$683,000	$732,000	$634,000	$765,000
Subtotal - Landfill Construction:		$6,829,000	$7,313,000	$6,338,000	$7,642,000
B1	Closure Construction	$757,000	$586,000	$591,000	$712,000
B2	Contract Administration & Construction Inspection	$76,000	$59,000	$60,000	$72,000
B3	Contingency (10%)	$84,000	$65,000	$66,000	$79,000
Subtotal - Landfill Closure Cover:		$833,000	$645,000	$651,000	$784,000
CAPITAL COSTS (Present Value)		**$7,662,000**	**$7,958,000**	**$6,989,000**	**$8,426,000**
C1	Cell Operation Efforts	$211,000	$211,000	$211,000	$211,000
C2	Equipment and Equipment Maintenance	$195,000	$195,000	$195,000	$195,000
C3	Environmental Monitoring	$34,000	$34,000	$34,000	$41,000
C4	LCS Maintenance and Leachate Disposal	$43,000	$37,000	$34,000	$39,000
C5	Contingency (10%)	$49,000	$48,000	$48,000	$49,000
Operations Costs (Annually):		$532,000	$525,000	$522,000	$535,000
LIFETIME OPERATIONS COST (Present Value)		**$14,554,000**	**$14,362,000**	**$14,280,000**	**$14,636,000**
D1	Post Closure Care Requirements	$77,000	$74,000	$73,000	$75,000
D2	Contingency (10%)	$8,000	$8,000	$8,000	$8,000
Post Closure Care (Future Annual Cost):		$85,000	$82,000	$81,000	$83,000
POST CLOSURE CARE (Present Value)		**$5,135,000**	**$4,953,000**	**$4,893,000**	**$5,014,000**
TOTAL COST (Present Value)		**$27,351,000**	**$27,273,000**	**$26,162,000**	**$28,076,000**

3.8.4 Social Impacts

3.8.4.1 Baseline Data Collection & Evaluation

No additional data collection was required to support the assessment of Alternative 3A with respect to social impacts.

3.8.4.1 Supplemental Information for Section 7.11.2 Evaluation of Alternatives

Social impacts for Alternative 3A are like those of all other expansion Alternatives as all sensitive receptors are in the same location relative to the landfill operation.

3.8.4.1 Supplemental Information for Table 9.1 Effects, Mitigation, and Net Effects

No additional information was required to assess the effects documented in Table 9.1. No additional mitigation was required and there are no monitoring requirements beyond those already proposed in Vol. 1 Section 11.

3.9 Indigenous Communities

3.9.1 Baseline Data Collection & Evaluation

No additional data collection was required to support the assessment of Alternative 3A with respect to social impacts.

3.9.2 Supplemental Information for Section 7.12 Evaluation of Alternatives

There is potential for the Thames River to be affected, as described in this appendix, Section 3.3.2.1 (Surface Water Quality) and Section 3.4.2.2 (Aquatic Ecology).

In summary, surface water from the site eventually drains to the Thames River. Existing landfill operations show no measurable impact on water quality exiting the landfill property, and therefore no impact on water quality in the Thames River.

With the landfill expansion, the risk of contamination is higher for Alternatives 2, 3 and 5 than for Alternative 3A. This is because there is a higher chance of interactions with the CKD material due to the watercourse relocation in Alternatives 2 and 3 and a higher chance of CKD material interactions from landfilling above the CKD pile in Alternative 5. With Alternative 3A, the watercourse realignment is minor and kept farther from the CKD pile compared to the relocation required for Alternatives 2 and 3.

In addition, there are aquatic species at risk in the Thames River. The Thames River will not be directly affected; however, contaminants or sediments from the watercourse could move downstream and impact the Thames River and the aquatics species inhabiting it.

3.9.3 Supplemental Information for Table 9.1 Effects, Mitigation, and Net Effects

No additional information was required to assess the effects documented in Table 9.1. No additional mitigation was required and there are no monitoring requirements beyond those already proposed in Vol. 1 Section 11.

BURNSIDE

[The Difference is our People]

Attachment A

Borehole Logs

LOG OF DRILLING OPERATIONS

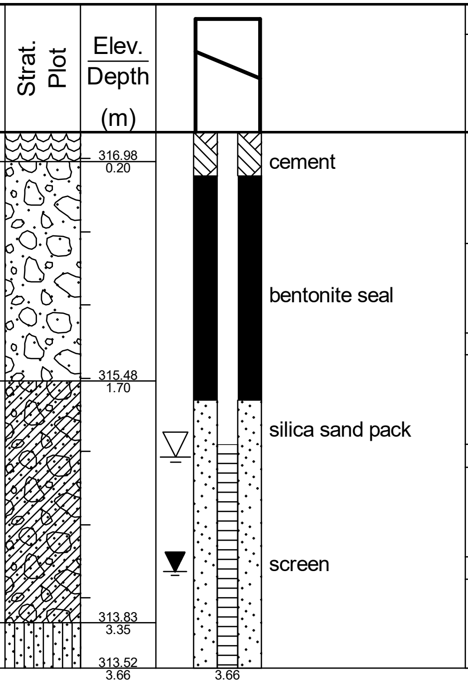
OW37S-22

R.J. Burnside & Associates Limited
449 Josephine St., Wingham, ON N0G 2W0
telephone (519) 357-1521 fax (519) 357-1521

Page 1 of 1

Client: **Town of St. Marys**	Project Name: **St. Marys Landfill**	Logged by: **A. Maenza**
Project No.: **300032339.0000**	Location: **St. Marys**	Ground (m amsl): **317.18**
Drilling Co.: **Direct Environmental Drilling**	Date Started: **4/11/2022**	Static Water Level Depth (m): **2.22**
Drilling Method: **Hollow Stem Auger**	Date Completed: **4/11/2022**	Sand Pack Depth (m) : **1.83 - 3.66**

Depth Scale (ft) (m)	Stratigraphic Description Surface Elevation (m): **317.18**	Elev. Depth (m)
	Dark brown sandy SILT with organic content; massive; soft; saturated [topsoil]	316.98 0.20
1.0 (m) 5.0 (ft)	Light brown silty SAND and GRAVEL, inferred cobbles; massive; compact; non-cohesive; moist	315.48 1.70
2.0 (m) 10.0 (ft) 3.0 (m)	Grey SILT and CLAY, some gravel; massive; firm to soft; cohesive; non-plastic; moist [till] Wet 2.6 m bgs.	313.83 3.35
	Yellow brown SAND and SILT; massive; compact to loose; non-cohesive; saturated	313.52 3.66



SAMPLE Num.	Int.	N.Val.	%Recov.
SS1	☒	50/4	17
SS2	☒	18	83
SS3	☒	7	75
SS4	☒	12	83

Prepared By: **A. Maenza** Checked By: **K. Hawkes** Date Prepared: **4/19/2022**

This borehole log was prepared for hydrogeological and/or environmental purposes and does not necessarily contain information suitable for a geotechnical assessment of the subsurface conditions. Borehole data requires interpretation by R. J. Burnside & Associates Limited personnel before use by others.

LEGEND
- ▼ Water found @ time of drilling
- ▽ Static Water Level - 4/22/2022

MONITORING WELL DATA
Pipe: **51 mm dia. PVC**
Screen: **51 mm dia. PVC #10 slot**

SAMPLE TYPE

AC	Auger Cutting	SS	Split Spoon
CS	Continuous	AR	Air Rotary
RC	Rock Core	WC	Wash Cuttings

LOG OF DRILLING OPERATIONS

OW37I-22

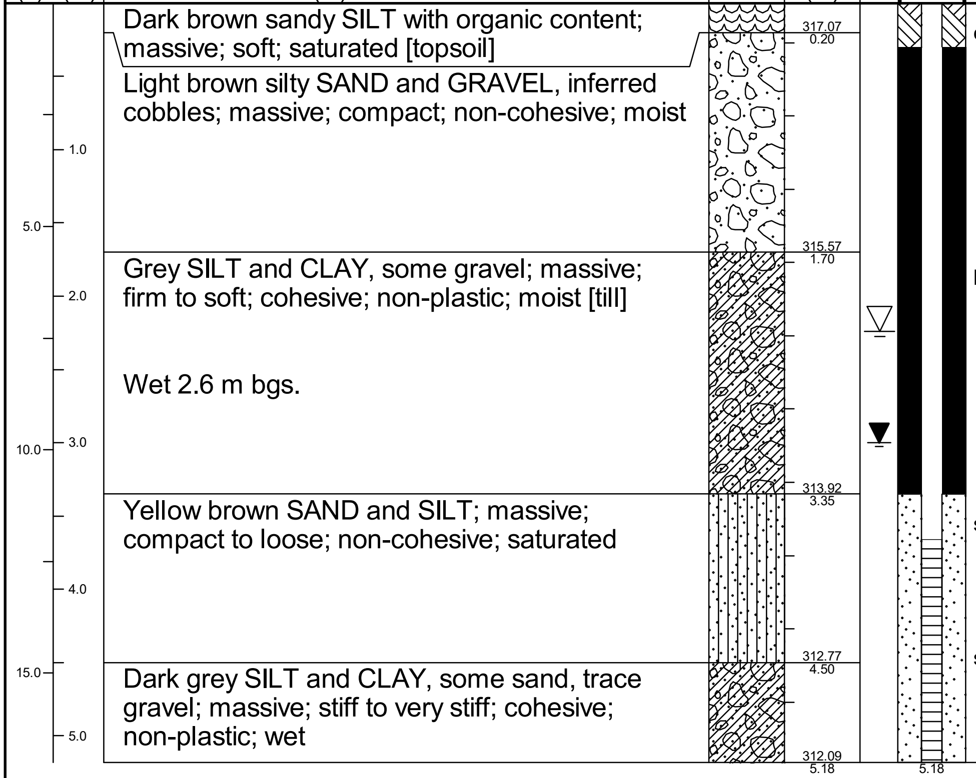
R.J. Burnside & Associates Limited
449 Josephine St., Wingham, ON N0G 2W0
telephone (519) 357-1521 fax (519) 357-1521

Page 1 of 1

Client: **Town of St. Marys**	Project Name: **St. Marys Landfill**	Logged by: **A. Maenza**
Project No.: **300032339.0000**	Location: **St. Marys**	Ground (m amsl): **317.27**
Drilling Co.: **Direct Environmental Drilling**	Date Started: **4/12/2022**	Static Water Level Depth (m): **2.24**
Drilling Method: **Hollow Stem Auger**	Date Completed: **4/12/2022**	Sand Pack Depth (m) : **3.35 - 5.18**

Surface Elevation (m): **317.27**

Stratigraphic Description	Elev. Depth (m)
Dark brown sandy SILT with organic content; massive; soft; saturated [topsoil]	317.07 0.20
Light brown silty SAND and GRAVEL, inferred cobbles; massive; compact; non-cohesive; moist	315.57 1.70
Grey SILT and CLAY, some gravel; massive; firm to soft; cohesive; non-plastic; moist [till] Wet 2.6 m bgs.	313.92 3.35
Yellow brown SAND and SILT; massive; compact to loose; non-cohesive; saturated	312.77 4.50
Dark grey SILT and CLAY, some sand, trace gravel; massive; stiff to very stiff; cohesive; non-plastic; wet	312.09 5.18



SAMPLE Num.	Int.	N.Val.	%Recov.
SS1	☒	50/4	17
SS2	☒	18	83
SS3	☒	7	75
SS4	☒	12	83
SS5	○	27	0
SS6	☒	32	83

Prepared By: **A. Maenza** Checked By: **K. Hawkes** Date Prepared: **4/19/2022**

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LEGEND
▼ Water found @ time of drilling
∇ Static Water Level - 4/22/2022

MONITORING WELL DATA
Pipe: **51 mm dia. PVC**
Screen: **51 mm dia. PVC #10 slot**

SAMPLE TYPE			
AC	Auger Cutting	SS	Split Spoon
CS	Continuous	AR	Air Rotary
RC	Rock Core	WC	Wash Cuttings

LOG OF DRILLING OPERATIONS

OW37D-22

BURNSIDE
R.J. Burnside & Associates Limited
449 Josephine St., Wingham, ON N0G 2W0
telephone (519) 357-1521 fax (519) 357-1521

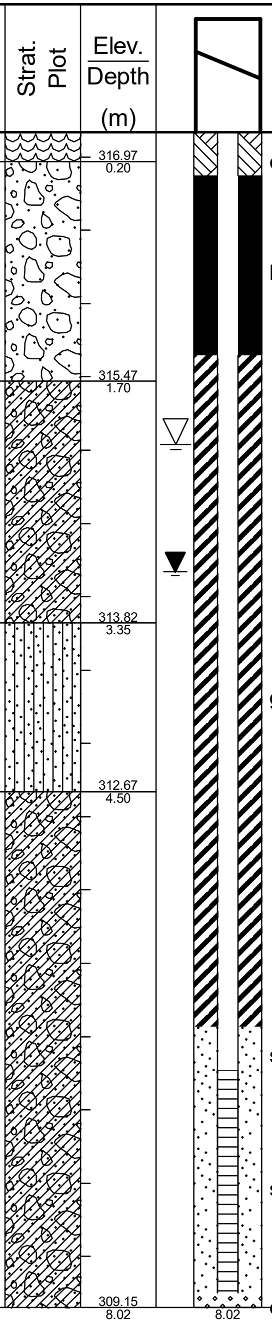
Page 1 of 1

Client: **Town of St. Marys**	Project Name: **St. Marys Landfill**	Logged by: **A. Maenza**
Project No.: **300032339.0000**	Location: **St. Marys**	Ground (m amsl): **317.17**
Drilling Co.: **Direct Environmental Drilling**	Date Started: **4/8/2022**	Static Water Level Depth (m): **2.13**
Drilling Method: **Hollow Stem Auger**	Date Completed: **4/8/2022**	Sand Pack Depth (m) : **6.10 - 7.92**

Surface Elevation (m): **317.17**

Stratigraphic Description	Elev. / Depth (m)
Dark brown sandy SILT with organic content; massive; soft; saturated [topsoil]	316.97 0.20
Light brown silty SAND and GRAVEL, inferred cobbles; massive; compact; non-cohesive; moist	315.47 1.70
Grey SILT and CLAY, some gravel; massive; firm to soft; cohesive; non-plastic; moist [till] Wet 2.6 m bgs.	313.82 3.35
Yellow brown SAND and SILT; massive; compact to loose; non-cohesive; saturated	312.67 4.50
Dark grey SILT and CLAY, some sand. trace gravel; massive; stiff to very stiff; cohesive; non-plastic; wet Saturated 6.9 m bgs.	309.15 8.02

Auger Refusal



SAMPLE Num.	Int.	N.Val.	%Recov.
SS1	☒	50/4	17
SS2	☒	18	83
SS3	☒	7	75
SS4	☒	12	83
SS5	○	27	0
SS6	☒	32	83
SS7	☒	31	100
SS8	☒	40	25
SS9	☒	66	25
SS10	☒	64/10	58

Prepared By: **A. Maenza** Checked By: **K. Hawkes** Date Prepared: **4/19/2022**

This borehole log was prepared for hydrogeological and/or environmental purposes and does not necessarily contain information suitable for a geotechnical assessment of the subsurface conditions. Borehole data requires interpretation by R. J. Burnside & Associates Limited personnel before use by others.

LEGEND
▼ Water found @ time of drilling
▽ Static Water Level - 4/22/2022

MONITORING WELL DATA
Pipe: **51 mm dia. PVC**
Screen: **51 mm dia. PVC #10 slot**

SAMPLE TYPE

AC	◧	Auger Cutting
CS	▯	Continuous
RC	▭	Rock Core
SS	☒	Split Spoon
AR	▯	Air Rotary
WC	▭	Wash Cuttings

LOG OF DRILLING OPERATIONS

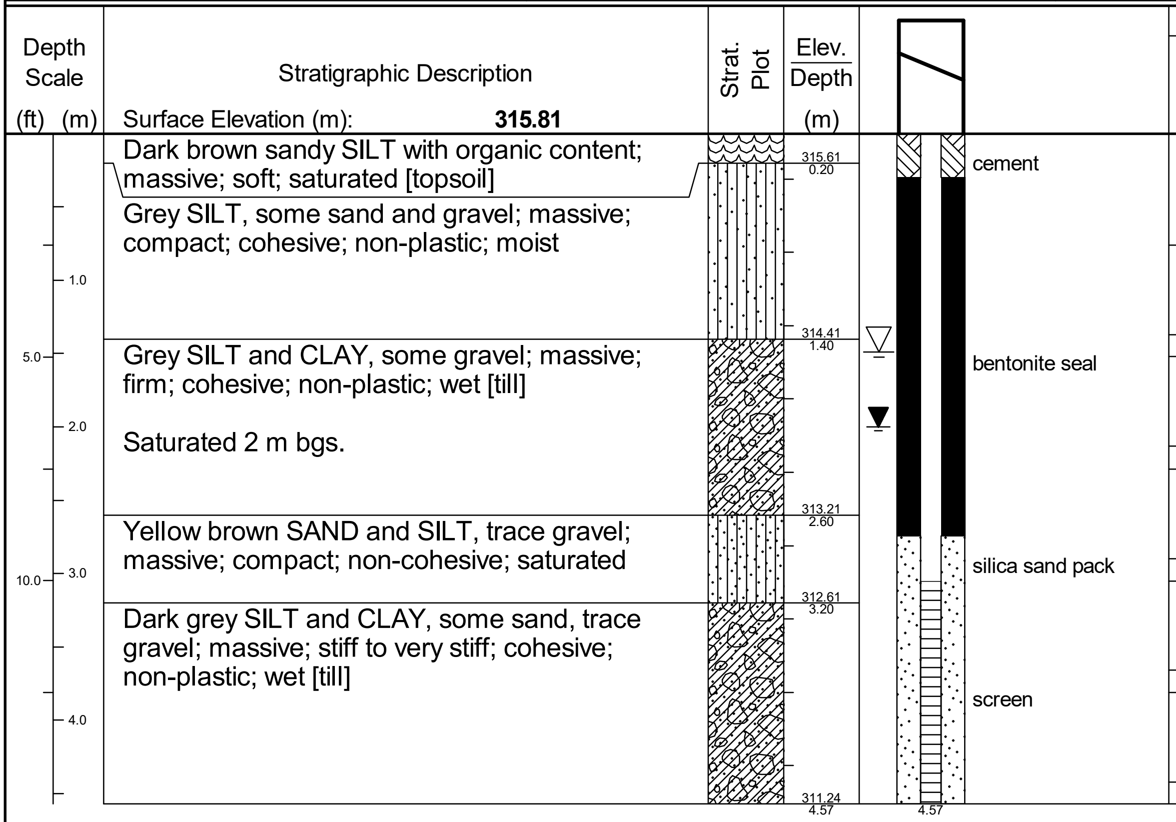
OW38S-22

R.J. Burnside & Associates Limited
449 Josephine St., Wingham, ON N0G 2W0
telephone (519) 357-1521 fax (519) 357-1521

Page 1 of 1

Client: **Town of St. Marys**	Project Name: **St. Marys Landfill**	Logged by: **A. Maenza**
Project No.: **300032339.0000**	Location: **St. Marys**	Ground (m amsl): **315.81**
Drilling Co.: **Direct Environmental Drilling**	Date Started: **4/11/2022**	Static Water Level Depth (m): **1.49**
Drilling Method: **Hollow Stem Auger**	Date Completed: **4/11/2022**	Sand Pack Depth (m) : **2.74 - 4.57**

Stratigraphic Description Surface Elevation (m): **315.81**	Elev. Depth (m)
Dark brown sandy SILT with organic content; massive; soft; saturated [topsoil]	315.61 0.20
Grey SILT, some sand and gravel; massive; compact; cohesive; non-plastic; moist	314.41 1.40
Grey SILT and CLAY, some gravel; massive; firm; cohesive; non-plastic; wet [till] Saturated 2 m bgs.	313.21 2.60
Yellow brown SAND and SILT, trace gravel; massive; compact; non-cohesive; saturated	312.61 3.20
Dark grey SILT and CLAY, some sand, trace gravel; massive; stiff to very stiff; cohesive; non-plastic; wet [till]	311.24 4.57



SAMPLE Num.	Int.	N.Val.	%Recov.
SS1	☒	43	83
SS2	☒	12	63
SS3	☒	24	75
SS4	☒	23	67
SS5	☒	20	92

Prepared By: **A. Maenza** Checked By: **K. Hawkes** Date Prepared: **4/19/2022**

This borehole log was prepared for hydrogeological and/or environmental purposes and does not necessarily contain information suitable for a geotechnical assessment of the subsurface conditions. Borehole data requires interpretation by R. J. Burnside & Associates Limited personnel before use by others.

LEGEND
- ▼ Water found @ time of drilling
- ▽ Static Water Level - 4/22/2022

MONITORING WELL DATA
- Pipe: **51 mm dia. PVC**
- Screen: **51 mm dia. PVC #10 slot**

SAMPLE TYPE

AC	Auger Cutting	SS ☒	Split Spoon
CS	Continuous	AR	Air Rotary
RC	Rock Core	WC	Wash Cuttings

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R.J. Burnside & Associates Limited
449 Josephine St., Wingham, ON N0G 2W0
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LOG OF DRILLING OPERATIONS

OW38D-22

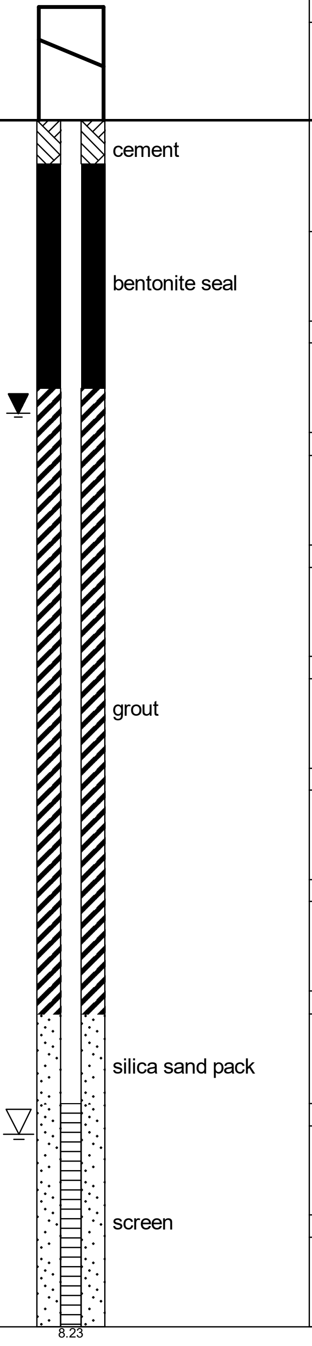
Page 1 of 1

Client: **Town of St. Marys**	Project Name: **St. Marys Landfill**	Logged by: **A. Maenza**
Project No.: **300032339.0000**	Location: **St. Marys**	Ground (m amsl): **315.83**
Drilling Co.: **Direct Environmental Drilling**	Date Started: **4/8/2022**	Static Water Level Depth (m): **6.92**
Drilling Method: **Hollow Stem Auger**	Date Completed: **4/8/2022**	Sand Pack Depth (m) : **6.10 - 8.23**

Surface Elevation (m): **315.83**

Stratigraphic Description	Elev. (m)	Depth (m)
Dark brown sandy SILT with organic content; massive; soft; saturated [topsoil]	315.63	0.20
Grey SILT, some sand and gravel; massive; compact; cohesive; non-plastic; moist	314.43	1.40
Grey SILT and CLAY, some gravel; massive; firm; cohesive; non-plastic; wet [till] Saturated 2 m bgs.	313.23	2.60
Yellow brown SAND and SILT, trace gravel; massive; compact; non-cohesive; saturated	312.63	3.20
Dark grey SILT and CLAY, some sand, trace gravel; massive; stiff to very stiff; cohesive; non-plastic; wet [till] Moist 6.8 m bgs.	307.60	8.23

Auger Refusal



SAMPLE

Num.	Int.	N.Val.	%Recov.
SS1	☒	43	83
SS2	☒	12	63
SS3	☒	24	75
SS4	☒	23	67
SS5	☒	20	92
SS6	☒	17	100
SS7	☒	36	17
SS8	☒	27	83
SS9	☒	31	100
SS10	☒	36	83

Depth Scale (ft) 5.0, 10.0, 15.0, 20.0, 25.0; (m) 1.0, 2.0, 3.0, 4.0, 5.0, 6.0, 7.0, 8.0

Prepared By: **A. Maenza** Checked By: **K. Hawkes** Date Prepared: **4/19/2022**

This borehole log was prepared for hydrogeological and/or environmental purposes and does not necessarily contain information suitable for a geotechnical assessment of the subsurface conditions. Borehole data requires interpretation by R. J. Burnside & Associates Limited personnel before use by others.

LEGEND
▼ Water found @ time of drilling
▽ Static Water Level - 4/22/2022

MONITORING WELL DATA
Pipe: **51 mm dia. PVC**
Screen: **51 mm dia. PVC #10 slot**

SAMPLE TYPE

AC	Auger Cutting	SS	Split Spoon
CS	Continuous	AR	Air Rotary
RC	Rock Core	WC	Wash Cuttings

BURNSIDE

R.J. Burnside & Associates Limited
449 Josephine St., Wingham, ON N0G 2W0
telephone (519) 357-1521 fax (519) 357-1521

LOG OF DRILLING OPERATIONS

BH39-22

Page 1 of 1

Client: **Town of St. Marys**	Project Name: **St. Marys Landfill**	Logged by: **A. Maenza**
Project No.: **300032339.0000**	Location: **St. Marys**	Ground (m amsl): **320.37**
Drilling Co.: **Direct Environmental Drilling**	Date Started: **4/12/2022**	Static Water Level Depth (m): **NA**
Drilling Method: **Hollow Stem Auger**	Date Completed: **4/12/2022**	Sand Pack Depth (m) : **NA**

Surface Elevation (m): **320.37**

Depth (m)	Stratigraphic Description	Elev. / Depth (m)
0.00	Brown/grey SILT and CLAY, some gravel; mottled; massive; firm to soft; cohesive; non-plastic; moist [till]	
	Wet 2.2 m bgs.	
4.50	Grey SILT and CLAY, some gravel; massive; soft; cohesive; non-plastic; saturated [till]	315.87 4.50 ▼
	Stiff and wet 7.6 m bgs.	
8.23		312.14 8.23

Well: 8.23

SAMPLE

Num.	Int.	N.Val.	%Recov.
SS1	☒	7	58
SS2	☒	8	63
SS3	☒	11	75
SS4	☒	6	92
SS5	☒	7	25
SS6	☒	5	58
SS7	☒	9	50
SS8	☒	7	58
SS9	☒	6	83
SS10	☒	29	100

Prepared By: **A. Maenza** Checked By: **K. Hawkes** Date Prepared: **4/19/2022**

This borehole log was prepared for hydrogeological and/or environmental purposes and does not necessarily contain information suitable for a geotechnical assessment of the subsurface conditions. Borehole data requires interpretation by R. J. Burnside & Associates Limited personnel before use by others.

LEGEND
▼ Water found @ time of drilling
▽ Static Water Level -

MONITORING WELL DATA
Pipe:
Screen:

SAMPLE TYPE

AC	◧	Auger Cutting	SS	☒	Split Spoon
CS	▯	Continuous	AR	▯	Air Rotary
RC	▨	Rock Core	WC	▭	Wash Cuttings

LOG OF DRILLING OPERATIONS

BH40-22

R.J. Burnside & Associates Limited
449 Josephine St., Wingham, ON N0G 2W0
telephone (519) 357-1521 fax (519) 357-1521

Page 1 of 1

Client: **Town of St. Marys**	Project Name: **St. Marys Landfill**	Logged by: **A. Maenza**
Project No.: **300032339.0000**	Location: **St. Marys**	Ground (m amsl): **318.25**
Drilling Co.: **Direct Environmental Drilling**	Date Started: **4/12/2022**	Static Water Level Depth (m): **NA**
Drilling Method: **Hollow Stem Auger**	Date Completed: **4/12/2022**	Sand Pack Depth (m) : **NA**

Surface Elevation (m): **318.25**

Elev. Depth (m)	Stratigraphic Description
	Brown/grey SILT and CLAY, some gravel; mottled; massive; firm to stiff; cohesive; non-plastic; moist [till]
316.05 2.20	Yellow brown SILT and SAND, some gravel; massive; firm to stiff; cohesive; non-plastic; moist
313.75 4.50	Grey SILT; massive; firm; cohesive; non-plastic; wet; iron-stained
313.05 5.20	Yellow brown silty SAND; massive; loose; non-cohesive; saturated ▼
312.65 5.60	Dark grey SILT and CLAY, some gravel; massive; stiff to very stiff; cohesive; non-plastic; moist [till]
310.23 8.02	Auger Refusal

8.02

Depth Scale (ft): 5.0, 10.0, 15.0, 20.0, 25.0
Depth Scale (m): 1.0, 2.0, 3.0, 4.0, 5.0, 6.0, 7.0, 8.0

SAMPLE

Num.	Int.	N.Val.	%Recov.
SS1	☒	17	75
SS2	☒	10	67
SS3	☒	6	100
SS4	☒	31	100
SS5	○	30	0
SS6	☒	27	83
SS7	☒	29	83
SS8	☒	16	100
SS9	☒	27	92
SS10	☒	61/10	25

Prepared By: **A. Maenza** Checked By: **K. Hawkes** Date Prepared: **4/19/2022**

This borehole log was prepared for hydrogeological and/or environmental purposes and does not necessarily contain information suitable for a geotechnical assessment of the subsurface conditions. Borehole data requires interpretation by R. J. Burnside & Associates Limited personnel before use by others.

LEGEND
▼ Water found @ time of drilling
▽ Static Water Level -

MONITORING WELL DATA
Pipe:
Screen:

SAMPLE TYPE
AC ◧ Auger Cutting
CS Continuous
RC Rock Core
SS ☒ Split Spoon
AR Air Rotary
WC Wash Cuttings

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Attachment B

Grain Size Distribution

CHUNG & VANDER DOELEN
ENGINEERING LTD.

311 VICTORIA STREET NORTH
KITCHENER / ONTARIO / N2H 5E1
519-742-8979

April 21, 2022
File: M22510

Attn: Alex Maenza
R.J. Burnside & Associates Limited
449 Joesephine Street, PO Box 10
Wingham, ON N0G 2W0

RE: Grain Size Analysis, Atterberg Limits, Moisture Content Test Results
St. Marys Landfill (300032339.0000)

Chung & Vander Doelen Engineering Ltd. (CVD) is pleased to submit the enclosed grain size analysis, atterberg limits, and moisture content test results for the above noted project.

The Atterberg limits test results are as follows:

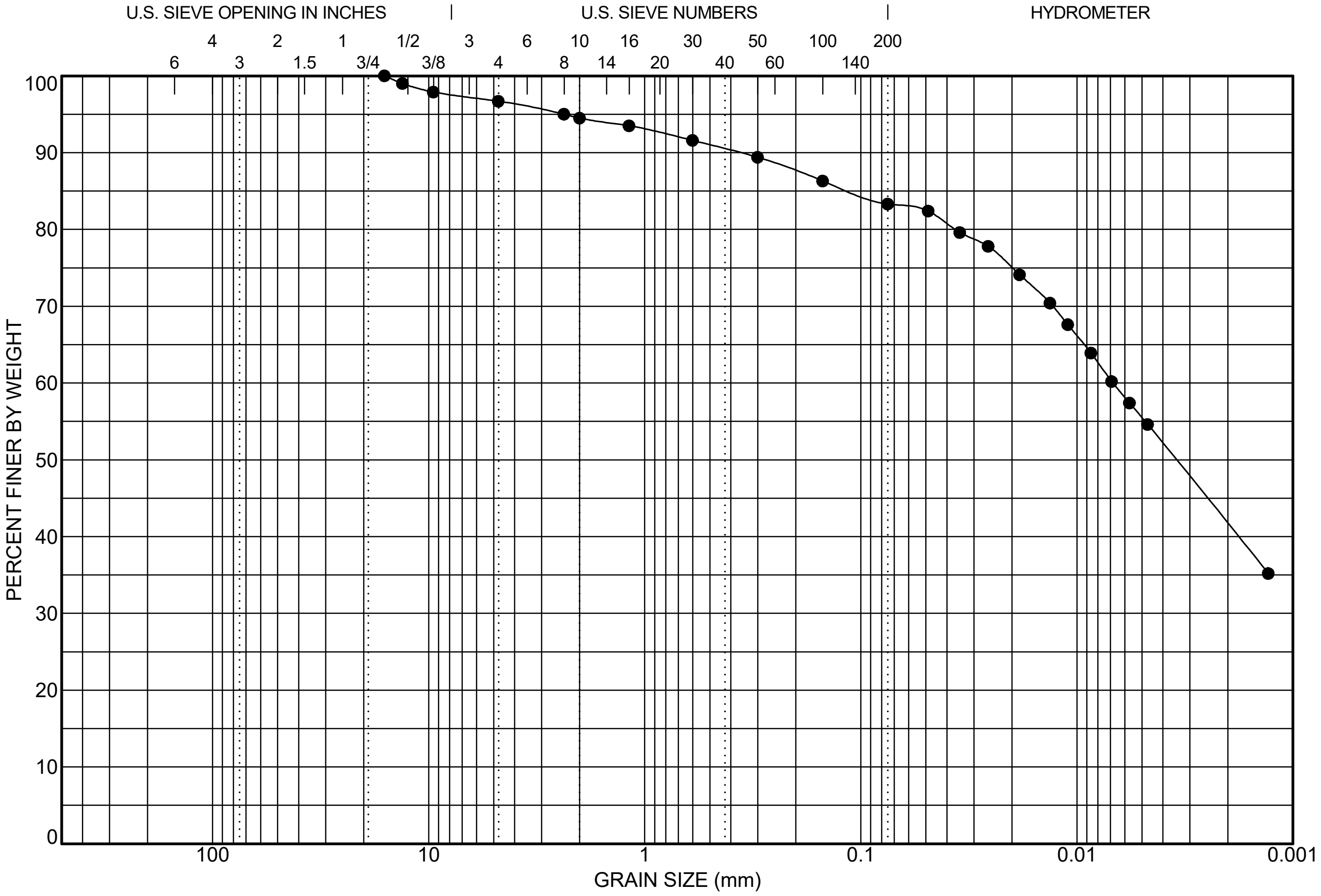
1) Plastic Limit: 18
2) Liquid Limit: 39
3) Plasticity Index: 21

Should you have any questions, please contact our office at your convenience.

Yours truly,
CHUNG & VANDER DOELEN ENGINEERING LTD.

Hugh Arthur
Laboratory Supervisor

Andrew LeDrew, C.E.T., BSS
Team Manager, Inspection & Materials Testing



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

LL	PL	PI	Cc	Cu	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
39	18	21			16	0.007			3.3	13.4	83.3	

Date: Apr. 21 - 2022
Client: R.J. Burnside & Associates Ltd.
Contractor: N/A
Source: MWB OW38
Sampled From: 16 ft
Sample No.: SS6
Date Sampled: Apr. 08 - 2022
Sampled By: Client
Lab No.: 316
Date Tested: Apr. 19 - 2022
Type of Material: Clay and Silt, some Sand, trace Gravel

Sieve Size (mm)	Percent Passing	No Specifications

CHUNG & VANDER DOELEN
ENGINEERING LTD.
311 Victoria Street North
Kitchener, Ontario N2H 5E1
Telephone: 519-742-8979
Fax: 519-742-7739
e-mail: info@cvdengineering.com

GRAIN SIZE DISTRIBUTION

Project: St. Marys Landfill

Location: St. Marys, Ontario

File No.: M22510 (300032339.0000)

Enclosure No.: 1

DM - NO SPECIFICATIONS M22510: ST MARYS LANDFILL GS: APR 21 2022.GPJ LAW LNDN.GDT 22-4-21

CHUNG & VANDER DOELEN
ENGINEERING LTD.

www.cvdengineering.com
(519) 742-8979

Moisture Content Analysis of Soils (ASTM D2216 / LS 701)

PROJECT NO.: M22510 (300032339.0000)
PROJECT: St. Marys Landfill
LOCATION: St. Marys, ON
DATE: Apr 14 2022
TESTED BY: HC
LAB NO. 0318

Borehole/Testpit No.	-	-	-	-	-	-	-	-
Depth	-	-	-	-	-	-	-	-
Container No.	C233	C408	RM504	C380	C96	C196	C433	C235
Wet Soil + Container	100.45	106.29	116.71	99.94	89.48	73.42	105.52	113.90
Dry Soil + Container	95.21	93.84	104.69	86.76	77.76	65.71	93.44	98.63
Weight of Container	10.15	10.15	8.40	10.15	10.15	10.15	10.15	10.15
Weight of Water	5.24	12.45	12.02	13.18	11.72	7.71	12.08	15.27
Weight of Dry Soil	85.06	83.69	96.29	76.61	67.61	55.56	83.29	88.48
MOISTURE CONTENT	6.2%	14.9%	12.5%	17.2%	17.3%	13.9%	14.5%	17.3%

Borehole/Testpit No.	-	-	-	-	-	-	-	-
Depth	-	-	-	-	-	-	-	-
Container No.	C135	C491	X210	C310	X214	C372	C178	C188
Wet Soil + Container	109.58	102.24	110.92	112.35	91.01	144.26	118.61	82.25
Dry Soil + Container	94.78	92.37	97.77	97.84	80.13	129.89	108.19	73.37
Weight of Container	10.15	10.15	10.65	10.15	10.65	10.15	10.15	10.15
Weight of Water	14.80	9.87	13.15	14.51	10.88	14.37	10.42	8.88
Weight of Dry Soil	84.63	82.22	87.12	87.69	69.48	119.74	98.04	63.22
MOISTURE CONTENT	17.5%	12.0%	15.1%	16.5%	15.7%	12.0%	10.6%	14.0%

Borehole/Testpit No.	-	-	-	-	-	-	-	-
Depth	-	-	-	-	-	-	-	-
Container No.	C413	C10	C5	C231	C386	C438	C477	C173
Wet Soil + Container	101.81	104.17	118.52	107.44	102.08	119.10	127.68	129.69
Dry Soil + Container	91.44	92.26	101.24	94.90	91.33	107.31	111.18	116.65
Weight of Container	10.15	10.15	10.15	10.15	10.15	10.15	10.15	10.15
Weight of Water	10.37	11.91	17.28	12.54	10.75	11.79	16.50	13.04
Weight of Dry Soil	81.29	82.11	91.09	84.75	81.18	97.16	101.03	106.50
MOISTURE CONTENT	12.8%	14.5%	19.0%	14.8%	13.2%	12.1%	16.3%	12.2%

Moisture Content Analysis of Soils (ASTM D2216 / LS 701)

PROJECT NO.:	M22510 (300032339.0000)	DATE:	Apr 14 2022
PROJECT:	St. Marys Landfill	TESTED BY:	HC
LOCATION:	St. Marys, ON	LAB NO.	0318

Borehole/Testpit No.	-	-	-	-	-	-	-	-
Depth	-	-	-	-	-	-	-	-
Container No.	C325	C381	C425	C122	C245	X228	C297	C292
Wet Soil + Container	98.37	75.34	120.02	122.91	84.07	116.59	90.09	122.49
Dry Soil + Container	84.05	71.02	105.66	110.19	77.44	100.73	82.11	110.04
Weight of Container	10.15	10.15	10.15	10.15	10.15	10.65	10.15	10.15
Weight of Water	14.32	4.32	14.36	12.72	6.63	15.86	7.98	12.45
Weight of Dry Soil	73.90	60.87	95.51	100.04	67.29	90.08	71.96	99.89
MOISTURE CONTENT	19.4%	7.1%	15.0%	12.7%	9.9%	17.6%	11.1%	12.5%

Borehole/Testpit No.	-	-	-	-	-	-	-	-
Depth	-	-	-	-	-	-	-	-
Container No.	C267	C66	C474	C43	C130	C88	C156	RM270
Wet Soil + Container	86.67	114.31	104.69	116.29	97.27	103.01	109.18	101.86
Dry Soil + Container	75.21	103.99	90.08	100.49	85.53	88.37	94.79	85.44
Weight of Container	10.15	10.15	10.15	10.15	10.15	10.15	10.15	8.40
Weight of Water	11.46	10.32	14.61	15.80	11.74	14.64	14.39	16.42
Weight of Dry Soil	65.06	93.84	79.93	90.34	75.38	78.22	84.64	77.04
MOISTURE CONTENT	17.6%	11.0%	18.3%	17.5%	15.6%	18.7%	17.0%	21.3%

Borehole/Testpit No.	-	-						
Depth	-	-						
Container No.	X237	J126						
Wet Soil + Container	130.24	122.87						
Dry Soil + Container	112.04	109.35						
Weight of Container	10.65	10.65						
Weight of Water	18.20	13.52						
Weight of Dry Soil	101.39	98.70						
MOISTURE CONTENT	18.0%	13.7%						

Attachment C

Soil Quality Results

032339 St. Marys Drilling Program
Soil Moisture Sample Log

MWA - 04/08/2022		
Split Spoon	**Depth**	**Tin ID**
SS1	0.76 - 1.37	C381
SS2A	1.52 - 1.68	C245
SS2B	1.68 - 2.13	C386
SS3	2.29 - 2.90	C491
SS4A	3.05 - 3.35	C380
SS4B	3.35 - 3.66	C5
SS5	3.81 - 4.42	No Recov.
SS6	4.57 - 5.18	C173
SS7	5.33 - 5.94	C66
SS8	6.10 - 6.71	C88
SS9	6.86 - 7.47	C477
SS10	7.62 - 8.02	C292

MWB - 04/08/2022		
Split Spoon	**Depth**	**Tin ID**
SS1	0.76 - 1.37	C233
SS2	1.52 - 2.13	C231
SS3A	2.29 - 2.59	C433
SS3B	2.59 - 2.90	
SS4A	3.05 - 3.20	C425
SS4B	3.20 - 3.65	X237
SS5	3.81 - 4.42	C235
SS6	4.57 - 5.18	C135
SS7	5.33 - 5.94	C156
SS8	6.10 - 6.71	C372
SS9	6.86 - 7.47	C297
SS10	7.62 - 8.23	X214

BHC - 04/12/2022		
Split Spoon	**Depth**	**Tin ID**
SS1	0.76 - 1.37	C188
SS2	1.52 - 2.13	RM504
SS3	2.29 - 2.90	C438
SS4	3.05 - 3.66	C130
SS5	3.81 - 4.42	C96
SS6	4.57 - 5.18	C408
SS7	5.33 - 5.94	J126
SS8	6.10 - 6.71	C122
SS9	6.86 - 7.47	C10
SS10	7.62 - 8.23	RM270

BHD - 04/12/2022		
Split Spoon	**Depth**	**Tin ID**
SS1	0.76 - 1.37	C413
SS2	1.52 - 2.13	X210
SS3	2.29 - 2.90	X228
SS4	3.05 - 3.66	C196
SS5	3.81 - 4.42	No Recov.
SS6	4.57 - 5.18	C43
SS7A	5.33 - 5.64	C474
SS7B	5.64 - 5.94	C178
SS8	6.10 - 6.71	C325
SS9	6.86 - 7.47	C310
SS10	7.62 - 8.02	C267

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Attachment D

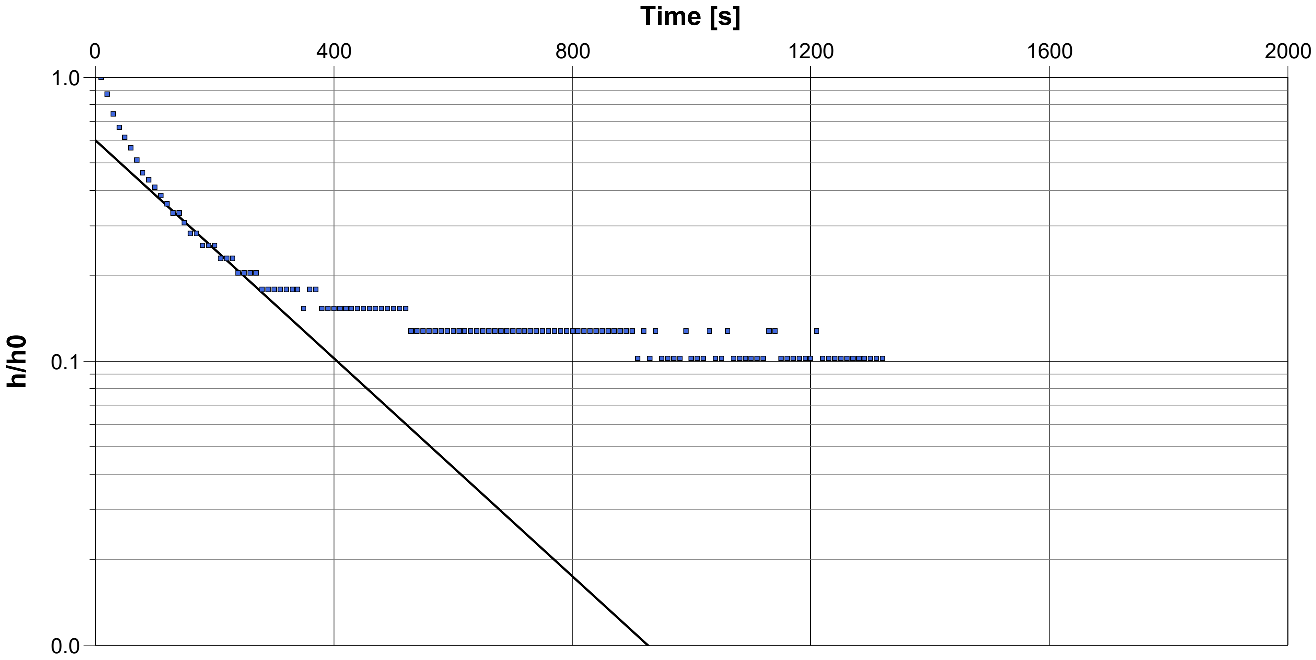
Hydraulic Connectivity Testing

BURNSIDE

Slug Test Analysis Report

Project:	St. Marys Landifll
Number:	30002339
Client:	Town of St. Marys

Location: St. Marys	Slug Test: Falling Head - OW37I	Test Well: OW37I
Test Conducted by: A.M.		Test Date: 4/22/2022
Analysis Performed by: J.D.	Falling Head Slug Test	Analysis Date: 5/3/2022
Aquifer Thickness: 1.20 m		



Calculation using Hvorslev

Observation Well	Hydraulic Conductivity [cm/s]	
OW37I	3.01×10^{-4}	$3.01x10^{-6}$ m/s

Slug Test Analysis Report

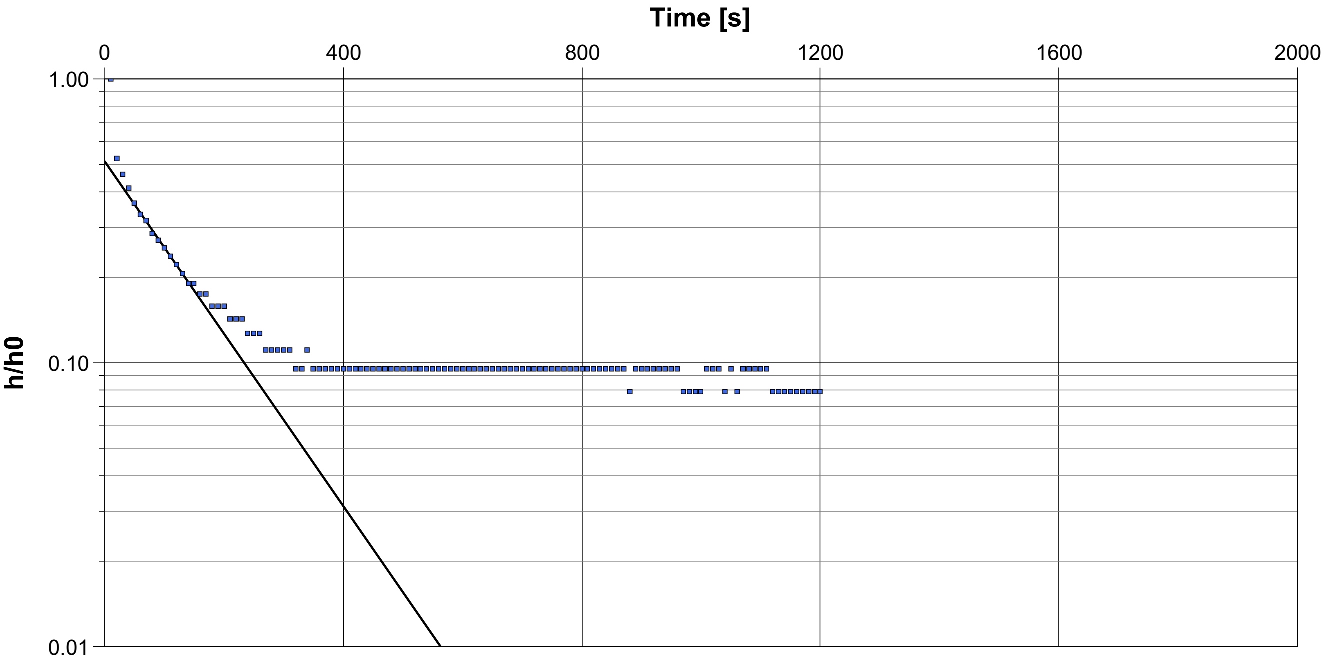
Project: St. Marys Landifll

Number: 30002339

Client: Town of St. Marys

Location: St. Marys	Slug Test: Rising Head - OW37I	Test Well: OW37I
Test Conducted by: A.M.		Test Date: 4/22/2022
Analysis Performed by: J.D.	Rising Head Slug Test	Analysis Date: 5/3/2022

Aquifer Thickness: 1.20 m



Calculation using Hvorslev

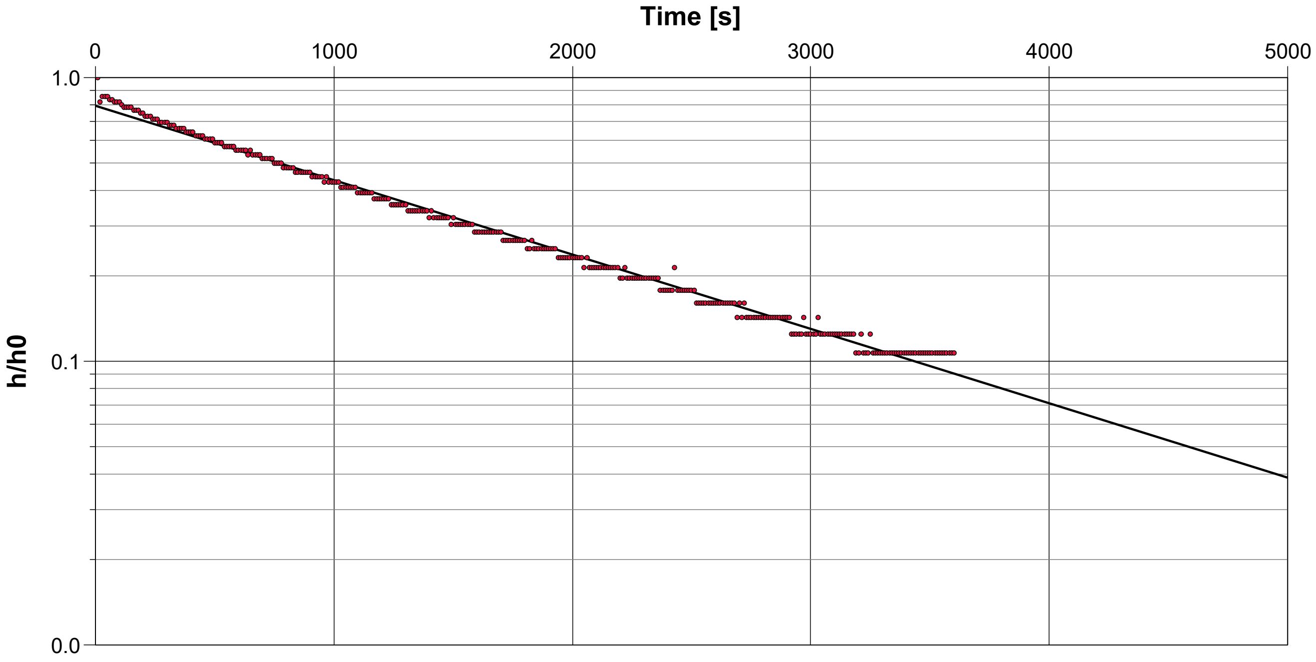
Observation Well	Hydraulic Conductivity [cm/s]	
OW37I	6.27×10^{-4}	$6.27x10^{-6}$ m/s

BURNSIDE

Slug Test Analysis Report

Project:	St. Marys Landifll
Number:	30002339
Client:	Town of St. Marys

Location: St. Marys	Slug Test: Falling Head - OW37D	Test Well: OW37D
Test Conducted by: A.M.		Test Date: 4/22/2022
Analysis Performed by: J.D.	Falling Head Slug Test	Analysis Date: 5/3/2022
Aquifer Thickness: 3.50 m		



Calculation using Hvorslev

Observation Well	Hydraulic Conductivity [cm/s]	
OW37D	5.37×10^{-5}	$5.4x10^{-7}$ m/s

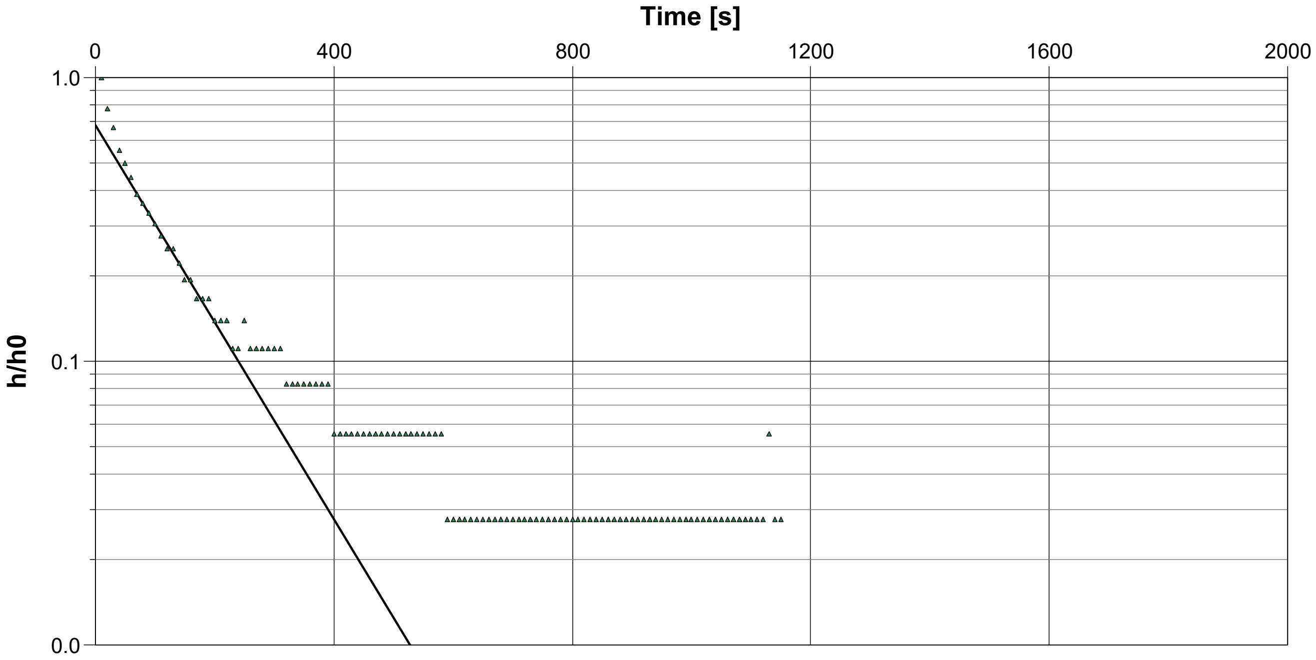
Slug Test Analysis Report

Project: St. Marys Landifll

Number: 30002339

Client: Town of St. Marys

Location: St. Marys	Slug Test: Falling Head - OW38S	Test Well: OW38S
Test Conducted by: A.M.		Test Date: 4/22/2022
Analysis Performed by: J.D.	Falling Head Slug Test	Analysis Date: 5/3/2022
Aquifer Thickness: 0.60 m		

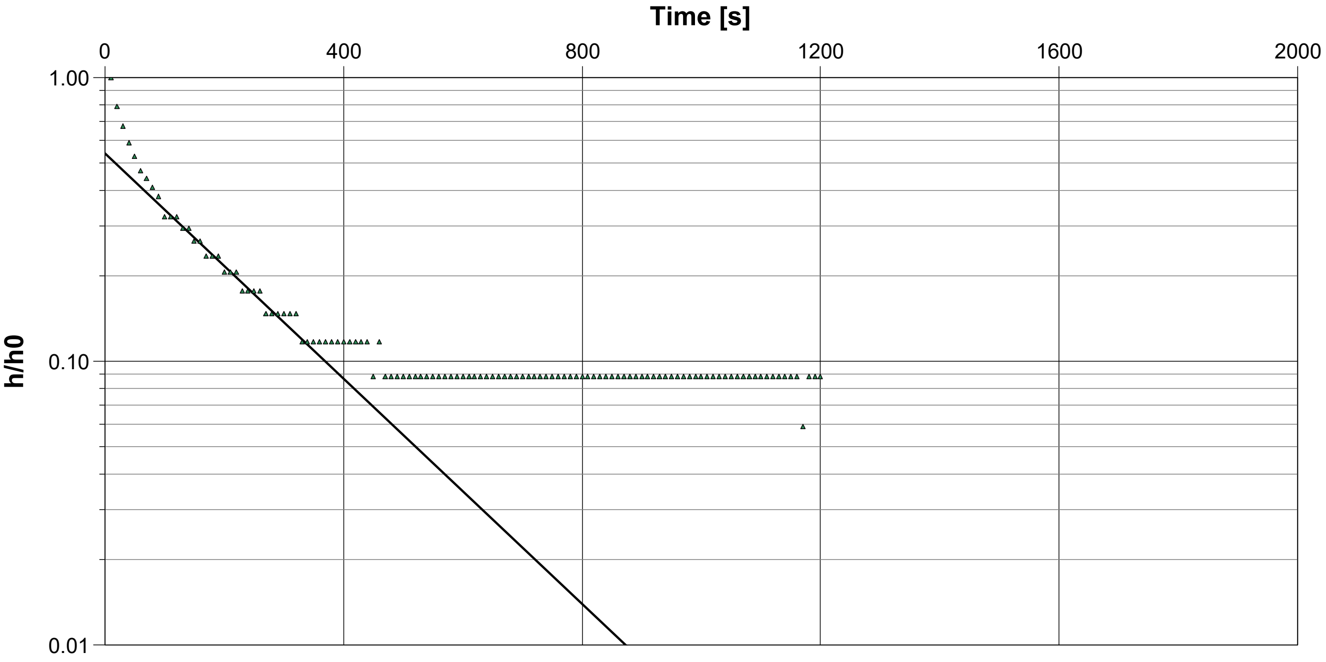


Calculation using Hvorslev

Observation Well	Hydraulic Conductivity [cm/s]	
OW38S	7.10×10^{-4}	$7.1x10^{-6}$ m/s

BURNSIDE	**Slug Test Analysis Report**
	Project: St. Marys Landifll
	Number: 30002339
	Client: Town of St. Marys

Location: St. Marys	Slug Test: Rising Head - OW38S	Test Well: OW38S
Test Conducted by: A.M.		Test Date: 4/22/2022
Analysis Performed by: J.D.	Rising Head Slug Test	Analysis Date: 5/3/2022
Aquifer Thickness: 0.60 m		



Calculation using Hvorslev

Observation Well	Hydraulic Conductivity [cm/s]	
OW38S	4.06 × 10^{-4}	4.1x10^{-6} m/s

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Attachment E

Schedule 5 – Groundwater, Leachate and Surface Water Monitoring Parameters

LANDFILL STANDARDS:

A GUIDELINE ON THE REGULATORY AND APPROVAL REQUIREMENTS FOR NEW OR EXPANDING LANDFILLING SITES

Last Revision Date:

January 2012

Cette publication technique n'est disponible qu'en anglais

PIBS 7792e

SCHEDULE 5
Groundwater, Leachate and Surface Water Monitoring Parameters

Parameter Group	Parameter			
	Column 1	**Column 2**	**Column 3**	**Column 4**
	Comprehensive List for Groundwater and Leachate	**Indicator List For Groundwater and Leachate**	**Comprehensive List for Surface Water**	**Indicator List for Surface Water**
Inorganics				
	Alkalinity	Alkalinity	Alkalinity	Alkalinity
	Ammonia	Ammonia	Ammonia	Ammonia
	Arsenic		Arsenic	
	Barium	Barium	Barium	
	Boron	Boron	Boron	
	Cadmium		Cadmium	
	Calcium	Calcium		
	Chloride	Chloride	Chloride	Chloride
	Chromium		Chromium	
	Conductivity	Conductivity	Conductivity	Conductivity
	Copper		Copper	
	Iron	Iron	Iron	Iron
	Lead		Lead	
	Magnesium	Magnesium		
	Manganese			
	Mercury		Mercury	
	Nitrate	Nitrate	Nitrate	Nitrate
	Nitrite		Nitrite	Nitrite
	Total Kjeldahl Nitrogen		Total Kjeldahl Nitrogen	Total Kjeldahl Nitrogen
	pH	pH	pH	pH
	Tota IPhosphorus		Tota Phosphorus	Total Phosphorus
	Potassium			
	Sodium	Sodium		
	Suspended Solids (Leachate Only)	Suspended Solids (Leachate Only)	Suspended Solids	Suspended Solids
	Total Dissolved Solids	Total Dissolved Solids	Total Dissolved Solids	Total Dissolved Solids
	Sulphate	Sulphate	Sulphate	Sulphate

	Zinc		Zinc	
Volatile Organics				
	Benzene			
	1,4 Dichlorobenzene			
	Dichloromethane			
	Toluene			
	Vinyl Chloride			
Other Organics				
	Biochemical Oxygen Demand (BOD$_5$) (Leachate Only)	Biochemical Oxygen Demand (BOD$_5$) (Leachate Only)	Biochemical Oxygen Demand (BOD$_5$)	Biochemical Oxygen Demand (BOD$_5$)
	Chemical Oxygen Demand	Chemical Oxygen Demand	Chemical Oxygen Demand	Chemical Oxygen Demand
	Dissolved Organic Carbon	Dissolved Organic Carbon		
	Phenol		Phenol	Phenol
Field Parameters				
			Temperature	Temperature
	pH	pH	pH	pH
	Conductivity	Conductivity	Conductivity	Conductivity
			Dissolved Oxygen	Dissolved Oxygen
			Flow	Flow

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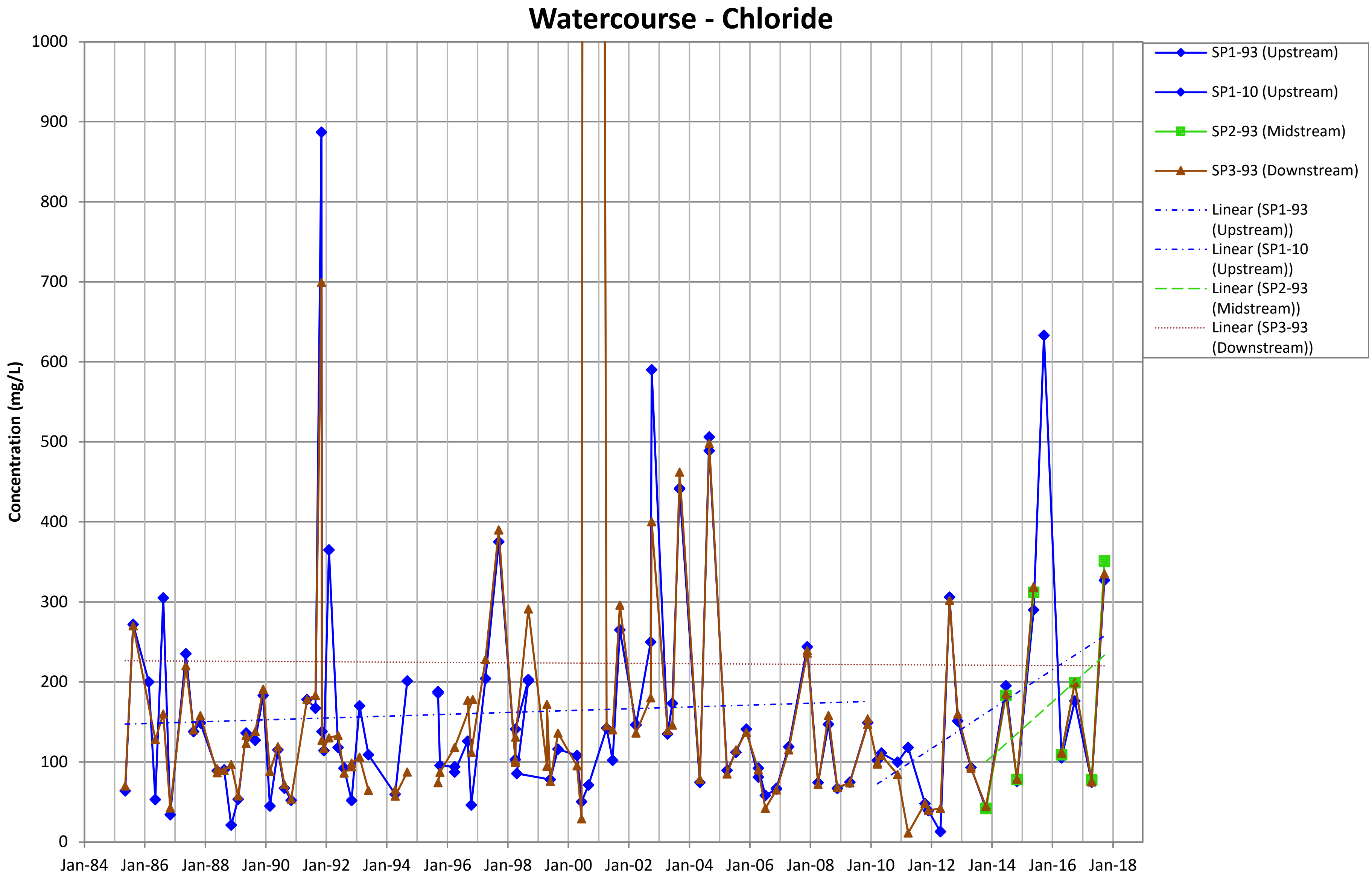
Attachment F

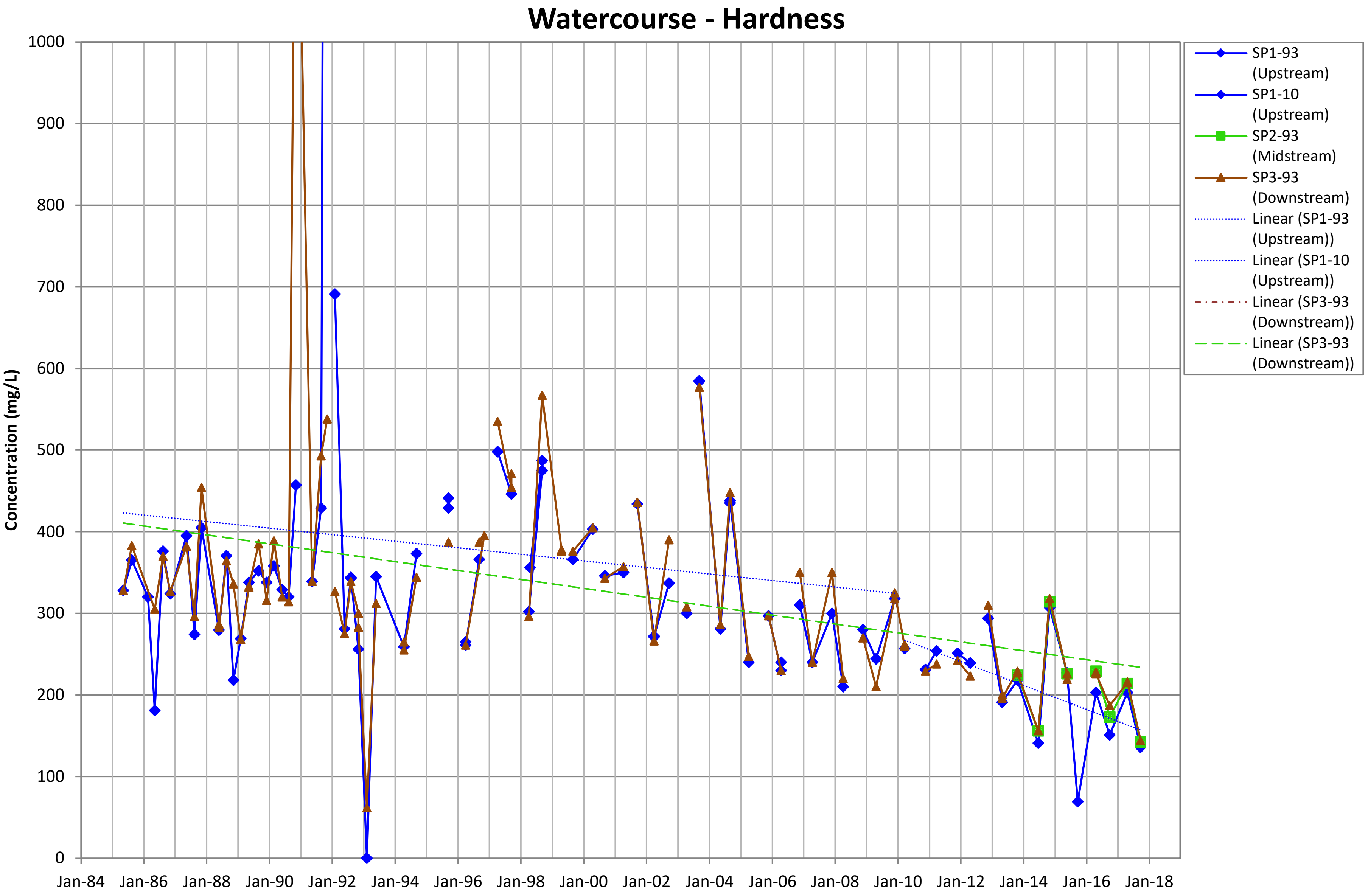
Time vs. Concentration

Attachment F



R.J. Burnside & Associates Limited
File: 2017 AMR SW Quality
Date: 7/7/2022

St. Marys Landfill
Environmental Assessment
300032339



R.J. Burnside & Associates Limited
File: 2017 AMR SW Quality
Date: 7/7/2022

St. Marys Landfill
Environmental Assessment
300032339