



MEMORANDUM

January 4, 2018

TO: Emily Tieu
Senior Environmental Officer
Ottawa District Office
Eastern Region

FROM: Obai Mohammed
Hydrogeologist
Technical Support Section
Eastern Region

RE: 2016 Annual Monitoring Report – Miller's Road Waste Disposal Site (WDS)
Lot 6, Concession 13, Geographic Township of Buchanan
Township of Deep River, County of Renfrew
Environmental Compliance Approval (ECA) Number A413106

Purpose

I have reviewed the 2016 Annual Monitoring Report (AMR) for Miller's Road Waste Disposal Site (WDS) prepared by Jp2g Consultants Inc. (Jp2g) on behalf of The Corporation of the Town of Deep River and dated May 2017. The current review is limited to hydrogeological aspects of the report. I offer the following comments for your consideration:

Summary

- Reasonable Use Guideline B-7 applies to all operating waste disposal sites and those closed after 1986. Thus, Guideline B-7 applies to Miller's Road WDS.
- The site is in compliance with Guideline B-7 as determined by the Reasonable Use Concept (RUC) assessment at monitoring wells 96-1S, 96-1D, 95-3S and 95-3D.
- An approximately 14 hectare parcel of land immediately to the west of the landfill site was purchased and registered on title as a Contaminant Attenuation Zone (CAZ).
- Iron and manganese concentrations exceeded the RUC values, however they are deemed to be at natural concentrations and not as a result of landfilling activities. No increasing trends for manganese and iron concentrations have been observed over time. All other Leachate Indicator Parameters (LIP) concentrations were found to be low as part of the regulatory assessment.
- Iron and manganese should be included in the RUC and trigger assessments in future monitoring activities, for any future leachate-related impacts that may occur.
- The direction of groundwater from the site is determined to be south east towards Maskinonge Lake. Groundwater mounding under the landfilling area is causing some radial flow in the vicinity of Area 2 towards the west.

- The leachate impact is measured by elevated inorganic concentrations (alkalinity, hardness, calcium, chloride, TDS, DOC and selected metals). Groundwater leaving the site from Area 4 (southeast) will be contained with the CAZ in this direction. Any groundwater impacts migrating to the southeast would likely discharge to surface water, and therefore the intent of Guideline B-7 in this direction is met.
- Impact west of Area 2 is also characterized by elevated organic parameters in the groundwater. The vertical impact in this direction is restricted to the deeper groundwater. The horizontal extent of impact measures as far as monitoring well 95-4 but not as far as wells 95-3 and 96-1.
- The water quality from wells located further to the west from the site (95-3, 95-5 and 96-1S and 96-1D) is characterized by low levels of inorganic parameters and organic parameters below detections limits. The groundwater at these locations is not impacted by the Waste Disposal Site.
- Organic sampling did not reveal any exceedances of ODWS with the exception of vinyl chloride at monitors 07-3D and 95-6, consistent with historical results. Vinyl chloride was not revealed outside of monitors 07-3D and 95-6 and therefore is not migrating off-site.
- None of the sampled residential wells exceeded ODWS/OG for the LIP concentrations. The landfill therefore is not influencing the water quality of the residential wells. It is recommend to include the residential wells on a 3 year basis with the next sampling scheduled for 2018. I support this recommendation.
- Continued ground and surface water monitoring is recommended as per the amended Certificate of Approval A413106 dated April 4, 2014. Future monitoring reports should include a discussion to understand groundwater – surface water interaction.

Environmental Compliance Approval

The Deep River (Miller's Road) waste disposal site (the site) operates under ECA A413106 issued in April, 1980 and most recently amended April, 2014. The site is licensed for the use and operation of a 4.5 hectare landfill within a total area of 8.55 hectares. Additional 14.14 hectares has been registered on title as Contaminant Attenuation Zone (CAZ) establishing a total site area of 22.69 hectares. The landfill operates as a naturally attenuating site. The site is used entirely for the disposal of construction and demolition waste and it is understood that no radioactive waste is disposed at the site. The site does not contain engineered control systems and therefore is considered a natural attenuating landfill site.

Site Description

The site is located on Lot 6, Concession 13, Township of Deep River east of Highway 17 along Miller's Side Road. The site is presently leased by the Town of Deep River from Canadian Nuclear Laboratories (CNL) formerly Atomic Energy of Canada Limited (AECL). The waste disposal site is made up of four areas comprising a total area of 8.55 hectares. Landfilling within Areas 1 and 2 (3.22 hectares) has been cleared and used for waste disposal. The northerly portions of Areas 3 and 4 (5.33 hectares) are approximately 5 meters lower in elevation than Areas 1 and 2 and are heavily wooded. A site plan that includes the location of all monitoring wells is provided in Figure 2 and the CAZ is shown in Figure 3.

The site is located within the Maskinonge Lake Basin. The basin drains to Maskinonge Lake, which in turn drains via Chalk Lake to the Ottawa River. Surface water features in the vicinity of the site include an un-named "Landfill Creek" that is located approximately 100 meters south east of the site and Spring Creek that originates west of the site and passes by the site to the south. The site is characterized by relatively flat terrain.

The drainage from the site flows mostly south-southeast towards Maskinonge Lake. There are no land use concerns or water users observed downstream of the site. Currently, the nearby residences are located up gradient (approximately 500 meters) of the waste disposal site and potential impact on these water supplies is not anticipated. It also is expected that Spring Creek will act as a hydraulic boundary to any leachate migrating southwestward according to Jp2g.

Geology

Jp2g determined the geology to be as follows:

- Till with gravelly sand and silt in Areas 2, 3 and 4 with till thickness ranging from 0 to 1.75 m;
- Fine-grained sand with trace silt in Areas 1 and 2 and extending south to Spring Creek with thickness generally greater than 10.7 m; and,
- Precambrian felsic metasedimentary bedrock with depth to bedrock ranging from 0 meters at the surface to approximately 30 meters.

Hydrogeology

Jp2g determined the hydrogeological conditions to be as follows:

- Groundwater flow in the overburden is influenced by underlying bedrock topography and is predominantly to the east and southeast;
- Groundwater flow in the vicinity of Area 2 flows southwest under a low hydraulic gradient possibly related to groundwater mounding in this area;
- Local groundwater flow from the north of Area 3 is north towards a wetland;
- The groundwater flow leaving the southern portion of Area 4 flows immediately to the southeast and eventually to Maskinonge Lake;
- Hydraulic conductivity values range between 1.3×10^{-2} to 6.95×10^{-5} cm/s;
- Historical horizontal gradients reported in previous AMRs ranged from 0.001 in Area 2 to 0.02 in Areas 3 and 4. The higher gradient values are reportedly influenced by the dipping bedrock surface and topography;
- Vertical gradients are variable across the site as shown in Table 3 of the report; and,
- The average linear velocity is 2 m/year south of the landfill and 0.06 m/year southwest from the western property line.

Background Groundwater Quality

Background groundwater quality has been monitored at monitoring wells 91-2 and 95-5, located south and northwest of the site, respectively, and are considered representative of background water quality. The 2016 chemical analysis from these wells indicates that all parameters concentrations are less than Ontario Drinking Water Standards (ODWS), and no impacts from landfilling activities are detected.

Leachate

Wells 95-6 and 07-3D were used to characterize leachate conditions. Both monitors typically reveal the highest concentrations and are deemed to be representative of leachate parameter concentrations. Monitoring well 95-6 is located in the immediate down gradient flow path from the fill area of the site at the south end and monitoring well 07-3D is located along the northwest property line of Area 2. Table 6 outlines the 2016 range of leachate concentrations from monitoring wells 95-6 and 07-3D.

In 2016, elevated concentrations of alkalinity, boron, barium, calcium, hardness, iron, potassium, magnesium, manganese, sodium and TDS were observed compared to concentrations measured in background wells and these serve as leachate indicator parameters (LIP) at the site. Concentrations above ODWS were observed for iron, manganese, DOC, and TDS at both leachate monitors during the 2016 monitoring year.

Volatile organic compounds (VOCs) analysis results indicated that only vinyl chloride (VC) concentrations have exceeded the ODWS at both leachate monitors in 2016, consistent with previous years. VC was not present at other locations revealed in the assessment outside of monitoring wells 07-3D and 95-6 and therefore is not migrating off-site.

Downgradient Groundwater Quality

On-site downgradient monitoring wells

The downgradient groundwater quality is monitored at the site by monitoring wells 91-5, 96-3, 85-C, 88-2S, 88-2D, 85-D and 85-Y. Their locations are provided on Figure 9. All of these wells are located between the licensed fill area and the perimeter of the buffer zone. Monitoring wells 88-2S, 88-2D, 85-Y and 85-D are located in the immediate downgradient flow path from Area 4 in an area of steep hydraulic gradient. Monitoring well 91-5 is located along the western perimeter of the site within an area of a low hydraulic gradient. Monitoring wells 85-C and 96-3 are located along the southern perimeter of the waste disposal site and are considered to be in the direction of groundwater flow originating from the southwest corner of Area 1. During the 2016 monitoring events, samples were collected from the following monitoring locations: 91-5S, 91-5D, and 96-3. Table 7 outlines concentrations from monitoring wells that are greater than ODWS and reflective of Leachate impacts.

Minor leachate impact is recognized along the western property line at monitoring station 91-5D. Impact at this location is characterized by elevated levels of chloride and sodium greater than background levels. Iron and manganese concentrations were found to be at levels greater than background and ODWS at monitor 91-5D location. The shallow setting, 91-5S, reveals hardness to exceed background values and the iron concentration was found to be exceeding the ODWS. As the chloride values at 91-5S are in-line with background values it is interpreted that this location does not reveal impact from the waste site. Iron and manganese values at monitor 91-5 were attributed by Jp2g to the overburden geology in the area, despite that none of both compounds were found to be exceeding the ODWS at the background monitors in 2016. The historical trends of selected chemical concentrations from monitors 91-5D and 96-3 do not reveal any increasing trends in concentrations.

Off-site downgradient monitoring wells

Groundwater samples collected from monitors 07-2S, 07-2D, located southeast of Area 1 within the CAZ to the south, in an area with a steep hydraulic gradient, revealed concentrations of iron and manganese that are greater than ODWS. TDS concentration was exceeding the ODWS at monitor 07-2D during the fall 2016 sampling event. Monitoring wells 07-2S and 07-2D have also been compared to Provincial Water Quality Objectives (PWQOs) to determine the potential for contaminants to reach the Landfill Creek from the groundwater in the vicinity of monitoring well 07-2S and 07-2D. The results indicate iron and barium at both shallow and deep settings, and boron at the deep setting exceeded the PWQOs.

Jp2g noted that barium and iron exist in the historical background concentrations and therefore are poor parameters in assessing landfill impact. I disagree with this statement since barium is found recently and historically in background monitors at concentrations lower by one order of magnitude than barium concentrations measured in 2016 at monitors 07-2S and 07-2D. Further, boron is revealed to exist at levels above PWQOs at this location. The presence of boron in the deep setting indicate impact from the landfill site in the deep overburden aquifer. It is recommended by Jp2g that water quality from monitoring wells 07-2S and 07-2D continue to be compared to PWQOs to assess any potential impacts groundwater migrating from the landfill may have on the local surface water environment. I support this recommendation.

Groundwater samples collected from monitors 95-3S, 95-3D, 95-4S, 95-4D, 96-1D, 96-1S, 07-FS, 07-FD, 08-1S and 08-1D, located to the west within the CAZ, revealed that the major component of off-site leachate impact is focussed in the vicinity of monitoring wells 07-3, 07-F and to a lesser extent 08-1 and 95-4. Similar to the groundwater south of the site the deeper groundwater on balance reveals parameters with the higher chemical concentrations. Chemical concentrations dissipate rapidly moving west from the site as evidenced by the low chemical concentrations in the other monitoring wells that are located on the property recently purchased by the municipality (95-3 and 96-1). The groundwater quality at monitoring wells located to the west within the CAZ does not reveal any increasing trends in concentrations with the exception of slight increasing trends in chloride and conductivity concentrations at monitoring well 95-4D, and alkalinity, hardness, calcium and barium concentrations at monitoring well 08-1S.

Residential monitoring wells

Condition 14 of the ECA requires that groundwater supply wells in the vicinity of the site are sampled. The last sampling event was completed during the 2015 program at four (4) residential wells along Millers Road near the landfill site. The location of the supply wells is not shown within the site plan. The results of the residential groundwater sampling are shown in Table 10. None of the sampled residential wells LIP concentrations exceeded ODWS. Residential sampling in 2015 included the analysis of benzene, 1,4-dichlorobenzene, dichloromethane, toluene and vinyl chloride. All parameters revealed concentrations that were less than ODWS.

It is interpreted that the landfill is not impacting residential wells water quality, thus sampling was not included in the 2016 monitoring program. It is recommend to include the residential wells on a 3 year basis with the next sampling scheduled for 2018. I concur with this.

Regulatory Evaluation

Guideline B-7 applies to operating waste disposal sites and those closed after 1986. Therefore, Guideline B-7 applies to Miller's Road WDS. The parameters used in this assessment of Guideline B-7 include: alkalinity, boron, barium, chloride, DOC, sodium, iron, manganese, VC and TDS. Jp2g compares the calculated Reasonable Use Concept (RUC) concentrations of the aforesaid parameters to the groundwater quality results at monitoring wells located along or beyond the western landfill boundary and included: 07-3S, 07-3D, 07-FS, 07-FD, 91-5S, 91-5D, 95-3S, 95-3D, 95-4S, 95-4D, 95-5, 96-1S and 96-1D. Impacts to the groundwater quality in the southeast downgradient direction will be contained within the contaminant attenuation zone, hence, wells to the south and south east are not considered in the RUC assessment. Any groundwater impacts migrating to the southeast would likely discharge to surface water, and therefore the intent of Guideline B-7 in this direction is met. All parameters concentrations were less than the RUC except for manganese and iron during spring monitoring event at monitoring well 96-1D. The report noted the presence of naturally occurring manganese and iron throughout the area. No increasing trends for manganese and iron concentrations have been observed over time. Due to the low values of all other LIP concentrations, and the stability of manganese and iron concentrations over time since 2012, Jp2g attributed manganese and iron concentrations to the local area mineralogy, and accordingly concluded that the site is interpreted to be compliant with Guideline B-7. I concur with this conclusion.

Groundwater – Surface water Interaction

Vertical hydraulic gradients exist variably across the site as shown in Table 3. The report did not discuss the groundwater – surface water interaction, and as such it is unknown if potentially impacted groundwater could discharge to surface. Future monitoring reports should include a discussion to understand groundwater – surface water interaction. A number of surface water features are located near the landfill site. These include Landfill Creek, Spring Creek, and Maskinonge Lake to the southeast and a wetland to the northeast and downgradient of Area 3. There is potential for surface water impact due to surface water runoff and groundwater discharge. Results from monitoring wells 07-2S and 07-2D (located north of Landfill Creek) indicate a potential groundwater pathway for these contaminants to reach Landfill Creek.

An MOECC Surface Water Scientist should continue to be consulted with respect to surface water management at this site.

Trigger Mechanisms and Contingency Plans

The groundwater trigger mechanism indicates that if the concentration of any parameter used in the assessment of Guideline B-7 (i.e. alkalinity, boron, barium, chloride, DOC, sodium, iron, manganese, VC and TDS) exceeds the calculated RUC along the western limit of the designated CAZ area (96-1S and D and 95-3S and D) over four (4) consecutive groundwater monitoring events, a contingency plan would be activated. A trigger mechanism is not required south east of the site as the property is comprised of restricted federal lands (i.e. Canadian Nuclear Laboratory property) and the MOECC has indicated that contaminants will be maintained within the CAZ in this direction. The contingency plan involves conducting additional sampling and investigation to determine the source and extent of impacts, and to identify an acceptable mitigation/remediation program, should one be required. The specifics of the contingency plan will be dependent on the nature and extent of the impact. I concur with the proposed trigger mechanisms and contingency plan proposed.

Jp2g recommended that iron and manganese be removed as trigger values in the compliance assessment. I do not agree with this recommendation. Iron and manganese were reported exceeding the ODWS at monitors 07-2S and 07-2D, located southeast of Area 1 within the CAZ to the south, compared to their background concentrations. I recommend to continue monitoring iron and manganese as trigger values, for any future leachate-related impacts that may occur.

Landfill Gas

Methane was not detected in any of the monitored wells or the on-site attendants shed during the 2016 monitoring events. The onsite risks associated with landfill gas associated with this site are beyond the scope of my review. Landfill gas monitoring should continue to be conducted, and the need for landfill gas mitigation should continue to be assessed and discussed in future monitoring reports.

Groundwater Monitoring Program

The approved monitoring program under the ECA dated April 4, 2014 is based on the supporting documentation for the Expansion Application, Section 7.0 of the Design and Operations Report, Jp2g letter dated January 8, 2014 and ECA Condition 7.6 (2). No changes are proposed for the approved groundwater monitoring program. Groundwater monitoring should be continued on a semi-annual basis (summer and fall), as part of the regular monitoring program at the site.

A handwritten signature in black ink, appearing to read 'Obai', with a stylized flourish extending to the right.

Obai Mohammed, P.Eng.
OYM/ob

- ec: Greg Faaren
Peter Taylor
Lauren Forrester
Tara Macdonald
- c: File GW RE DE 01 02 C13 (Miller's Road WDS)
OM/IDS# 2404-AS8K6V