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Caivan (Jock River) Limited Partnership c/o
Barrhaven Conservancy Development Corporation
2934 Baseline Road, Suite 302
Ottawa, Ontario
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Attention: **Mr. Daniel Rokin**

Subject: **Landfill Impact Assessment**
3285 and 3305 Borrisokane Road
Ottawa, Ontario

Dear Sir,

Further to your request, Paterson Group (Paterson) has prepared a Landfill Impact Assessment for the aforementioned property, to assess potential impacts from the City of Ottawa's Trail Road Waste Facility Landfill Site, in support of the proposed municipal Site Plan Application.

1.0 Background Information

The subject parcel of land, currently referred to as 3285 and 3305 Borrisokane Road, is situated on the east side of Borrisokane Road, approximately 75m north of the Jock River and approximately 240m south of Strandherd Drive. The subject lands are zoned as a Residential Third Density Zone (R3YY) and Open Space and Leisure Zone (O1) and are approximately 15.25 hectares in size.

The active Trail Road Waste Facility Landfill Site (referred to herein as the 'Trail Site' or 'Trail Road Landfill') is currently owned and operated by the City of Ottawa, is located further south-southwest of the subject lands, southwest of Highway No.416. More specifically, the footprint of the landfill is approximately 1.7 km south of the subject lands at its closest point, while the associated dewatering pond within the landfill site boundary, is situated approximately 1.1 km southwest of the subject lands.

Given the subject lands are within 3 km of the landfill, a landfill impact assessment was completed. This study is to demonstrate that the Trail Site will not have adverse affects on the proposed residential subdivision.

The former Nepean Landfill is situated to the east-southeast of the Trail Road landfill, approximately 2.3km southwest of the subject lands. Given the Trail Road landfill is currently active and is in closer proximity to the subject lands, the Trail Road landfill is the primary focus of this assessment.

2.0 2021 Environmental Monitoring and Operating Report

As part of this assessment Paterson reviewed the 2019, 2020 and 2021 Trail Road Landfill Site Monitoring and Operating Report prepared by Dillon Consulting for the City of Ottawa. The findings of the more recent 2021 report are discussed below; no significant differences in monitoring results were noted in 2021 from the 2019 and 2020 reports.

The more recent 2022 and 2023 operating and monitoring reports requested from the City of Ottawa were not available for review at the time this report was issued. Based on a review of the previous reports, no significant changes are expected to have been identified during the more recent monitoring events.

The following summarizes highlighted key points regarding the groundwater flow and leachate plumes outlined in the 2021 report:

- Groundwater was monitored at various levels in the subsoil units and within various zones and locations including down-gradient of the landfill. No significant change in groundwater flow patterns were observed.

- From a hydrogeology perspective, groundwater flow in the shallow aquifer was generally northwards from the northern portion of the Trail Site (shallow aquifer was not present across the southern portion of the landfill). Groundwater flow in the deep aquifer was highly influenced by the Dewatering Pond located to the north of Cambrian Road, with the groundwater tending to flow in a northwesterly direction.

- Based on the analytical results, weak to moderate leachate impacts were present in the shallow aquifer, predominately within the Cedar Forest, in the northeast section of the Trail Site. The leading side of this plume was dilute, and it was estimated that the plume has migrated approximately 300 m north of the landfill footprint.

- The shallow groundwater plume was contained within the landfill property, although some encroachment of leachate affected groundwater may have occurred within the

Highway 416 right-of-way adjacent to the east of the landfill. Dillon stated that the impacts were likely associated with the landfill expansion in this area, representing a temporary condition.

Leachate loading was expected to diminish with placement of the Final Cover System (Stage 1 in 2016, Stage 2 in 2020, and the eastern portion of Stage 3 in 2021).

- Leachate influenced groundwater identified within the deep aquifer was also reported to be contained within the landfill property in the downgradient flow direction (i.e. towards the Dewatering Pond, located to the north of the landfill). Some impacts above the Reasonable Use Criteria were noted to the south and east of the site, along Trail Road, however, these impacts were expected to be mitigated once the Final Cover System was completed.

- The bedrock aquifer beneath the landfill site was reported to not have been impacted by leachate.

- The proposed 2022 Environmental Monitoring Program was stated to be the same as the 2021 program, with some modifications, including supplemental sampling and the recommended installation of an additional deep aquifer monitoring well on Borrisokane Road.

3.0 Landfill Impact Assessment

3.1 Existing Waste Disposal Facility

The Trail Site is operated and maintained in accordance with the Certificate of Approval issued by the Ontario Ministry of the Environment, Conservation and Parks (MECP):

- Solid, non-hazardous municipal waste which includes wastes generated by residential, commercial, and industrial sectors, and contaminated fill; and
- Dewatered, digested, and lime stabilized sewages from the Robert O. Pickard Environmental Centre.

Composting of leaf and yard material was previously performed at the Trail Site, within the future Stage 5 expansion area. In 2016, the leaf and yard waste composting facility began operating at 4377 Barnsdale Road, located to the south of the Trail Site.

A separation distance of approximately 1.1 km exists between the southern portion of the subject lands and the northern portion of the future Trail Road Landfill Stage 5 area and the Trail Site property boundary.

Currently, the Trail Site (Stages 1 to 4) is approximately 1.7 km south of the subject lands. In 2005, the waste facility obtained approval for the expansion of the Trail Site for an estimated 10 to 40 years. Based on the 2021 report, the estimated remaining life of the Trail Site would be 14 to 16 years. However, this value is said to be dependent on future waste generation and diversion rates.

3.2 Local Geology

The Trail Site and surrounding lands are situated on a northwest-southeast trending ridge of glacially deposited sand and gravel. A deep sand and gravel aquifer is present beneath the entire site, while a shallow sand aquifer is present above a discontinuous clay layer, which has an influence over the local hydrogeology and therefore landfill leachate and groundwater influences in the area (i.e. high attenuation capacity). Bedrock in the area consists of limestone.

According to the Geological Survey of Canada website on the Urban Geology of the National Capital Area, overburden soils in the area of the subject lands are reported to consist of clay and silt with a drift thickness ranging from 10 to 15 m. Bedrock in the area of the subject lands is reported to consist of interbedded dolostone and sandstone of the Oxford Formation.

Based on Geotechnical Investigations completed by Paterson for the subject lands, during the interim of 2017 through 2022, the site stratigraphy generally consists of topsoil underlain by a silty clay deposit. However, near the southeastern portion of the site, a glacial till deposit was encountered underlying the silty clay at depths varying from 3.7 to 6.3m below grade; the glacial till was observed to consist of grey silty sand with some gravel and occasional cobbles and boulders. The findings of the Geotechnical Investigations generally confirm the reported geology.

3.3 Surface Runoff

Surface runoff from the east side (Stages 1 and 2) of the Trail Road Landfill drains to rip-rap swales along the sides of the active and capped landfill areas. A stormwater by-pass is present at the northeastern corner of Stage 1, which collects overland runoff, ultimately ending up in the stormwater management pond (northeastern corner of the site). Surface runoff from the west side (Stages 3 and 4) of the Trail Road Landfill is directed towards a ditch just north of these Stages, towards Cambrian Road, and then to the east, towards the stormwater management pond.

From the stormwater management pond, surface water flows to the east, under Highway 416, where it then flows in a northerly direction through roadside ditches along Borrisokane Road, finally ending up in the Jock River.

Dillon stated monitoring was completed at stations within the drainage area at the northeastern corner of the Trail Site, at downstream locations along the drainage path to the Jock River, and within the Jock River.

Surface water runoff from the Trail Road Landfill does not appear to have adverse effects on surface water receptors, as parameter concentrations (if detected) were below Canadian Water Quality Guideline (CWQG) and/or Provincial Water Quality Objective (PWQO) standards, except for total phosphorus and occasional iron, phenol and chloride concentrations. It is noted that elevated total phosphorus concentrations have been observed off-site in areas uninfluenced by the landfill site.

Surface water monitoring is performed yearly to assess surface water flow and quality of the landfill. Based on the findings of the 2021 report surface runoff is not considered to have the potential to negatively affect the subject lands.

3.4 Local Groundwater Flow

According to the 2021 report, groundwater on the eastern side of the Trail Site (Stages 1 and 2) in the shallow aquifer flows in a northerly direction, into Cedar Forest. Groundwater flow in the deep aquifer is highly influenced by the Dewatering Pond located to the north of Cambrian Road, with the groundwater tending to flow in a northwesterly direction.

3.5 Hydrogeological Review

The infiltration of rainwater into the landfill and decomposing waste creates a liquid called leachate which, if not managed properly, has the potential to impact groundwater in the vicinity of a landfill. In assessing the potential for groundwater contamination by leachate, the local geology and hydrology, approved engineering controls, and continued groundwater monitoring programs were considered.

As noted previously, shallow groundwater flow at the Trail Site is in a northerly direction, upgradient relative to the subject lands. Despite its upgradient orientation, leachate produced at the Trail Site is not considered to have the potential to impact the subject lands given the presence of the Jock River south of the subject lands and flowing east towards the Rideau River, the low permeability of the deep clay deposit beneath the area of the subject lands, the separation distance from the Trail Site and the groundwater monitoring results obtained during the 2021 monitoring program (further discussed in Section 3.10).

According to the 2021 monitoring program, deep groundwater flow beneath the Trail Site is cross-gradient relative to the subject lands; based on the cross-gradient orientation, separation distance and analytical test results obtained during the 2021 monitoring program, the potential for leachate impacts in the deep aquifer beneath the subject lands is considered to be negligible.

Based on 2021 monitoring, no leachate affects were identified in bedrock aquifer beneath the Trail Site.

3.6 Engineering Controls

Engineered controls include a clay and geomembrane bottom liner and a leachate collection and removal system on the western side of the landfill footprint (Stages 3 and 4). Leachate is collected from the western-central portion of the landfill (Stage 3) using a gravity drainage system, which is directed to a collector manhole. In the westernmost portion of the landfill (Stage 4), the collected leachate is mechanically pumped to the manhole.

As of 2021, the collected leachate is pre-treated at the Trail Site to achieve compliance with the Sewer Use discharge permit, allowing leachate to be sent to the Robert O. Pickard Environmental Centre (ROPEC).

It should be noted that the eastern side of the landfill footprint (Stages 1 and 2) were engineered as natural attenuation fill areas, so no leachate is collected from the eastern portion of the landfill. Leachate from Stages 1 and 2 is said to decrease with the installation of a new geomembrane and the completion of the Final Cover System.

Up to three times per year, water level measurements and sampling of 80 monitoring wells for chemical analysis of several common leachate indicator parameter occurs. Additionally, surface water samples near the Trail Site, including the Jock River, are obtained. Groundwater and surface water samples are collected and analyzed to assess the extent of potential landfill impacts.

Additionally, a trigger monitoring program was established and implemented at the Trail Road Landfill Site during the landfill expansion process such that discharging groundwater should not affect surface water to the point where unacceptable surface water quality would result off-site.

3.7 Ground Settlement

Based on the separation distance of 1.1 km between the subject lands and Trail Landfill property limits, settlement of the existing ground surface across the subject lands is not expected to occur as a result of the landfilling activities.

3.8 Visual Impact

Based on the separation distance of 1.1 km between the subject lands and Trail Landfill property, potential visual impact from the Trail Road Landfill on the subject lands is not expected.

3.9 Air Quality, Dust, Odour, and Noise

Based on the separation distance of 1.7 km between the subject lands and Trail Landfill footprint, potential air quality, dust, odour, and noise impacts on the subject lands due to the Trail Road Landfill are not anticipated.

3.10 Contaminated Soil and Groundwater

For this landfill impact assessment, the results from the wells below were chosen to be discussed due to their northern and down-gradient orientation with respect to the landfill.

Shallow Aquifer Monitoring Wells

Based on analytical testing completed as part of the 2021 monitoring program, a concentration of toluene just above laboratory detection limits was present in the spring sample from the shallow aquifer Monitoring Well M75-2 (situated north of Cambrian Road, adjacent to the east boundary of the dewatering pond). The toluene concentration detected was 0.6 ug/L, which is well below MECP Table 3 concentration of 18,000 ug/L. It should also be noted that this detection is considered anomalous, as VOCs have not been detected in MW75-2 since 2013. Additionally, all VOC parameters were non-detect in the subsequent fall 2021 sample. Leachate indicator parameters were similar to the median reference concentrations. The groundwater at this location was not considered to have been impaired by landfill leachate.

Upper/Mid Deep Monitoring Wells

Upper/mid deep Monitoring Wells M120-1 and M184-1 and lower deep Monitoring Wells M97-1 and M104-1, situated along the central portion of the northernmost section of the site, north and northeast of the dewatering pond, were also sampled as part of the 2021 monitoring program.

No VOC concentrations were present in these wells during the 2021 sampling events, other than a toluene concentration equal to the detection limit (0.3 ug/L) in M104-1 taken during the summer. VOCs were non-detect in the subsequent 2021 M104-1 samples.

Leachate indicator parameters were similar to the median reference concentrations in M184-1 and M104-1, with the exception of elevated chloride concentrations in MW104-1. In MW120-1, leachate indicator parameters were generally similar to reference concentrations, however some parameters were slightly elevated relative to the median reference concentrations (but stable). M97-1 had several indicator parameters that were elevated (but generally stable) when compared to the median reference concentrations. In all cases, the 2021 Dillon report concluded that no water quality impairments were expected at the locations of all four wells.

Additionally, as described in the 2021 report section, leachate impacts in the shallow aquifer groundwater plume and deep aquifer are said to be contained within the landfill property, specifically in the downgradient direction (direction of the subject lands).

Based on the information contained in the 2021 monitoring report and the separation distance, contamination of soil and groundwater at the subject lands are not expected to occur as a result of the Trail Road Landfill.

3.11 Landfill Gas

In 2006, a landfill gas to energy plant was built on-site, and commissioned during early 2007. Since then, the infrastructure has undergone substantial upgrades, including the installation of new vertical landfill gas extraction wells, upgrades to existing wells across the Trail Road Landfill Site, and the installation of a gas perimeter collection system (2018, commissioned during April 2019, completed during April 2020, and continued in a phased approach in 2021).

Landfill gas concentrations measured outside the landfill gas perimeter collection system, and closer to the property lines, were non-detect, or minimal. Concentrations complied with the Certificate of Approval. A reduction in methane concentrations was noticed in 2021, post-upgrades. No gas migration was detected beyond the landfill gas perimeter collection system. In other words, no gas migration was detected beyond the property boundary.

Further improvements to the efficiency of the landfill gas collection system are anticipated once the Final Cover System is completed (Stage 1 completed in 2016, Stage 2 in 2020, and the eastern portion of Stage 3 in 2021). As a result, the overall vacuum exerted on the landfill by the extraction wells is increased.

Based on the separation distance of 1.1 km between the subject lands and Trail Landfill property, as well as the engineered controls mitigating the spread of landfill gas, impacts on the subject lands due to the Trail Road Landfill are not anticipated.

4.0 Conclusion

Based on a review of the available Trail Road Landfill Monitoring and Operating reports (2019 through 2021) and the separation distance between the landfill and the subject lands, it is our opinion that the Trail Road Waste Facility Landfill Site will not have any adverse effects on the subject lands and proposed residential subdivision, nor will the landfill pose any risks to human health and safety.

5.0 Statement of Limitations

The recommendations provided in this report are in accordance with our present understanding of the project.

The present report applies only to the project described in this document. Use of this report for purposes other than those described herein or by person(s) other than Caivan (Jock River) Limited Partnership c/o Barrhaven Conservancy Development Corporation is not authorized without review by Paterson for the applicability of our recommendations to the alternative use of this report.

Paterson Group Inc.

Karyn Munch, P.Eng., Q.P.ESA