PATERSON GROUP

memorandum

re: **Preliminary Geotechnical Review - Proposed SWMP**
Proposed Residential Development
Cardinal Creek Village South – Ottawa, Ontario

to: Taggart Investments - **Ms. Michelle Taggart** - mtaggart@taggart.ca
to: HP Urban Inc. - **Mr. Peter Hume** - peter.hume@hpurban.ca
to: DSEL - **Mr. Braden Kaminski** - Bkaminski@dsel.ca
date: December 2, 2022
file: PG5201-MEMO.01 Revision 2

Upon your request and authorization, Paterson Group (Paterson) prepared a preliminary geotechnical review of the proposed stormwater management pond (SWMP) to be located at the north side of Cardinal Creek within aforementioned development. This memo should be read in conjunction with Paterson geotechnical Report PG5201-1 Revision 5 dated November 29, 2021.

1.0 Background

Paterson reviewed the conceptual design drawings for the proposed stormwater management pond and emergency spillway prepared by David Schaeffer Engineering Ltd. from a geotechnical perspective. The current conceptual design drawings are attached to the end of this report.

Based on our review of the conceptual drawings, the stormwater management pond is proposed along the central portion of the subject site and to the north of the Cardinal Creek extension running east-west direction. The stormwater management pond is proposed to be located within an agricultural land with a relatively flat surface. The subsurface profile along with the groundwater table is discussed further in the following sections.

The following summarizes our geotechnical recommendations for the construction of the SWMP based on the subsurface profile.

2.0 Proposed Stormwater Management Pond

Based on our review of the available conceptual drawings, the proposed SWMP will consist of the following:

- Pond bottom elevation……80.00 m
- Top of berm elevation……85.00 m
- Permanent water elevation ……82.50 m
- Maximum 100-Year water elevation……84.50 m

The SWMP is proposed to include an emergency spillway, a concrete outlet structure, an outlet drop (MH), a concrete headwall with chute blocks, and an armour stone spillway.

3.0 Subsurface Soil Profile

Generally, the subsoil conditions at the test hole locations within the proposed footprint of the SWMP consists of a layer of topsoil, followed by a very stiff to stiff brown silty clay deposit overlying bedrock. The silty clay deposit was observed to turn into a stiff grey silty clay at a depth of 3 to 4 m below existing grade. The location of the test holes along with the bedrock contours are shown on Drawing PG5201- Test Hole Location Plan, appended to this memorandum as well as the test hole logs.

Groundwater observations were recorded at the time of the field investigation and are noted on the Soil Profile and Test Data Sheets. The groundwater level can also be estimated based on moisture levels and colour of the recovered soil samples. Based on these observations at the test hole locations, the long-term groundwater table is expected at elevations between 82 to 83 m. It should be noted that groundwater levels are subject to seasonal fluctuations. Therefore, the groundwater levels could vary at the time of construction.

4.0 Geotechnical Assessment

From a geotechnical perspective, the construction of the proposed SWMP based on the conceptual drawings provided is acceptable from a geotechnical perspective. The main areas of concern will be:

- the groundwater infiltration rate within the excavation side slopes and along the bottom of the pond.
- the permeability of the subsoil materials.
- recommended footing depth and bearing capacity for the pond outlet footings.
- the stability of the excavation side slopes and protection of the surrounding structures.
- provide design recommendations for the proposed outfall and emergency spillway.

Groundwater Infiltration

The proposed SWMP will be located in an area where water infiltration will be important to manage during the construction phase. Based on the findings from our investigation, water infiltration rates are anticipated to be low to moderate and could be managed using open sumps. Based on the field observations, the long-term groundwater level is expected at a depth of 3.0 m to 4.0 below the original ground surface (elevation of 82 to 83 m).

It is anticipated that silty clay will be encountered at the excavation slopes and the bottom of the bond. However, if glacial till and/or bedrock is encountered along the excavation face and/or the bottom of the pond, a minimum 500 mm thick clay liner may be required depending on the groundwater infiltration observations. The requirement of a clay seal will be determined at the time of excavation to assess the soil type at the bottom of the excavation and the water infiltration observations, once exposed.

Excavation Side Slopes

From a geotechnical perspective, the construction of the proposed SWMP is sufficient. The long-term performance of the subject pond will depend on the stability of its excavation side slopes. Due to the absence of finalized grading, the sidewalls of the pond should be cut back at a 3H:1V to 5H:1V side slope to ensure long term stability is maintained for the service life of the proposed SWMP.

Based on the available drawings and subsoil information within the proposed pond location, the base of the pond is expected to consist of very stiff brown silty clay. Based on the groundwater observations during the geotechnical investigations noted above, it is expected that groundwater infiltrations be encountered at or just below the base of the pond. It should be noted that the existing clay within the base of the pond is acceptable to control groundwater infiltration from a geotechnical perspective. It is recommended that Paterson be contacted during the excavation period to conduct site inspections to verify the groundwater conditions at the time of construction.

If steeper slopes are proposed for the SWMP, additional slope reinforcement system will be required such as erosion control blankets with hydroseeding or Geocells such as Presto GEOWEB or an approved alternative. The recommended slope stabilization system will be dependent on the steepness of the proposed side slopes which can be reviewed upon finalizing the SWMP design drawings.

Bearing Capacity for Concrete Structures

The proposed concrete structures within the SWMP can be founded on an undisturbed stiff to very stiff brown silty clay, stiff grey silty clay, or clean surface-sounded bedrock. The following allowable bearing resistance values are provided for design purposes and should be confirmed in the field prior to pouring concrete footings:

Very stiff to stiff brown silty clay……150 kPa
Stiff to firm grey silty clay .....100 kPa
Inferred glacial till……..150 kPa
Bedrock……..500 kPa

It is recommended that the design of the proposed concrete structures be reviewed from a geotechnical perspective.

Service Roadway Pavement Structure

Topsoil and deleterious fill, such as those containing organic materials, should be stripped from under the service road prior to the placement of the recommended pavement structure. The recommended service roadway pavement structure is presented in Table 1 below.

Table 1 - Recommended Service Road Pavement Structure

Thickness (mm)	Material Description
50	**Wear Course** - HL 3 or Superpave 12.5 Asphaltic Concrete
150	**BASE** - OPSS Granular A Crushed Stone
300	**SUBBASE** - OPSS Granular B Type II
-	**WOVEN GEOTEXTILE –** Terratrack 200 or approved other
SUBGRADE - Either fill, in situ soil or OPSS Granular B Type I or II material placed over in situ soil.	

It is expected that the silty clay subgrade will be significantly rutted during placement of the granular base layers for the proposed pavement structure. Due to the significant amount of vehicle traffic, it is recommended to protect the subgrade surface by means of a woven geotextile liner and/or a biaxial geogrid layer. It may be further required to provide a granular layer below the proposed pavement structure in areas where frequent vehicle turning may lead to significant subgrade disturbance.

Consideration should be taken to utilizing the cow-path technique for the temporary haul road by increasing the thickness of the Granular B Type II at areas where loading is increased, such as truck turning areas.

For the long-term performance of the temporary haul road and service road, heavy wheel loading from construction traffic should be limited until the full design thickness of the temporary haul road is placed and compacted as recommended. It is expected that the temporary haul road will require regular maintenance during the construction process to minimize tire rutting.

It is expected that the upper 100 mm of Granular B Type II used to build-up the temporary haul road will be contaminated during the construction phase. Therefore, the upper contaminated portion of the Granular B Type II layer should be removed before placement of the Granular A crushed stone base layer for the proposed pavement structure.

Minimum Performance Graded (PG) 58-34 asphalt cement should be used for this project. The pavement granular base and subbase should be placed in maximum 300 mm thick lifts and compacted to a minimum of 100% of the material's SPMDD using suitable vibratory equipment.

Pond Outlet and Emergency Spillway Recommendations

Pond Outlet Structure Recommendations

Paterson reviewed the current preliminary design drawings for the SWMP outlet structure (attached to the end of this memo). Based on our review, the proposed concrete headwall and outlet structures will be founded on Stiff grey silty clay and/or inferred glacial till. The bearing resistance values for the proposed structures can be taken from the "bearing capacity for concrete structures" section in the previous page.

The Spillway fronting the pond outlet pipe is proposed to be terraced with armour stone blocks. It is recommended that the armour stone blocks be placed on a sufficient bearing medium. The bearing medium should be cut back in a stepped fashion down to the edge of the Cardinal Creek stream. If bedrock is encountered at the bottom of excavation, bedrock removal may be required to accommodate the stepped subgrade recommended herein. Each step should be cut a minimum 1.2 m horizontally and maximum 0.6 m vertically. If soil is encountered at the steps, a non-woven geotextile liner such as Terrafix 270R or equivalent, should be used to cover the subgrade. The subgrade should be built up to the underside of the armour stone using OPSS Granular A crushed stone or Granular B Type II placed in maximum 300 mm thick loose lifts and compacted to a minimum 98% of the material's SPMDD.

The armour stone blocks should be backfilled with engineered fill such as OPSS Granular A or Granular B Type II compacted to a minimum 95% of the material's SPMDD. The armour stone blocks should be placed staggered in a Piano-key fashion and battered at a minimum 100 mm between rows to enhance the overall global stability of the system. Due to the nature of armour stone blocks, the blocks will be in different sizes and shapes and may form voids between the blocks. Therefore, it is recommended that non-woven geotextile liners such as Terrafix 270R or equivalent, be placed between the armour stone blocks and the backfill material to prevent the loss of the backfill material.

If the bottom concrete headwall is founded over silty clay or glacial till, it is highly recommended that riprap stone be placed against the bottom of the headwall structure to prevent the running water from undermining the headwall footings until the armour stone wall system is constructed. The riprap stone should consist of stone fragmented to maximum size of 400 mm with sharp edges to allow for interlocking between the riprap material.

Emergency Spillway Recommendations

Currently, details of the emergency spillway are not available. However, it is expected that the side slopes of the subject spillway will be cut down to a minimum 3H:1V or flatter. Vegetation will be required to be established immediately after completing the excavation of the side slopes. The recommendations provided under subsection “Excavation Side Slopes” under Section 2 of this report will apply for the construction of the spillway side slopes.

A water flow barrier system may be required to be installed along the bottom of the emergency spill way system consisting of stone dams, equally spaced, to ensure that the water flow is not detrimental to the toe of the side slopes nor the bottom of the spillway. This can be designed once a finalized design of the spillway is available.

Field Inspections

All field work should be reviewed and approved by Paterson at the time of construction. Paterson should be notified upon the commencement of work and establish a schedule for inspections to prevent issues related to slopes from arising.

It should be noted that if winter construction is anticipated, the contractor should take every precaution to prevent frost from migrating below settlement sensitive structures. Additional winter construction recommendations are provided in the site’s geotechnical report.

5.0 Conclusion

Based on our review, the proposed conceptual SWMP design is acceptable from a geotechnical perspective. All work completed during construction should be inspected periodically and approved by Paterson.

Further geotechnical review should be completed by Paterson upon completion of the final design drawings to update the SWMP review memo accordingly. It is also important that Paterson be provided with the spillway and outfall design to ensure the side slopes are designed as per the recommendations provided herein. Additional recommendations may be provided based on the inclination of the spillway/outfall side slopes.

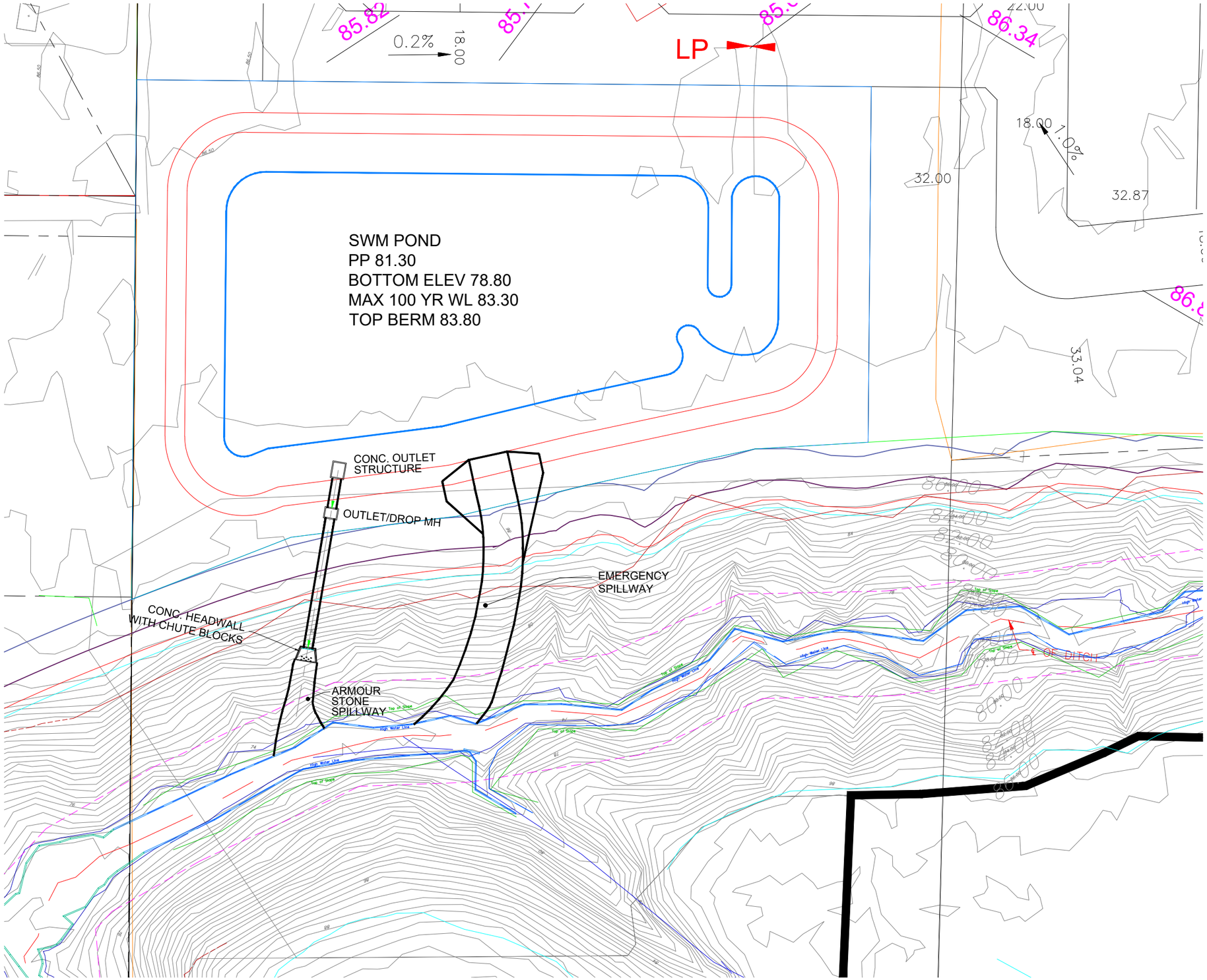
We trust that the current submission meets your requirements.

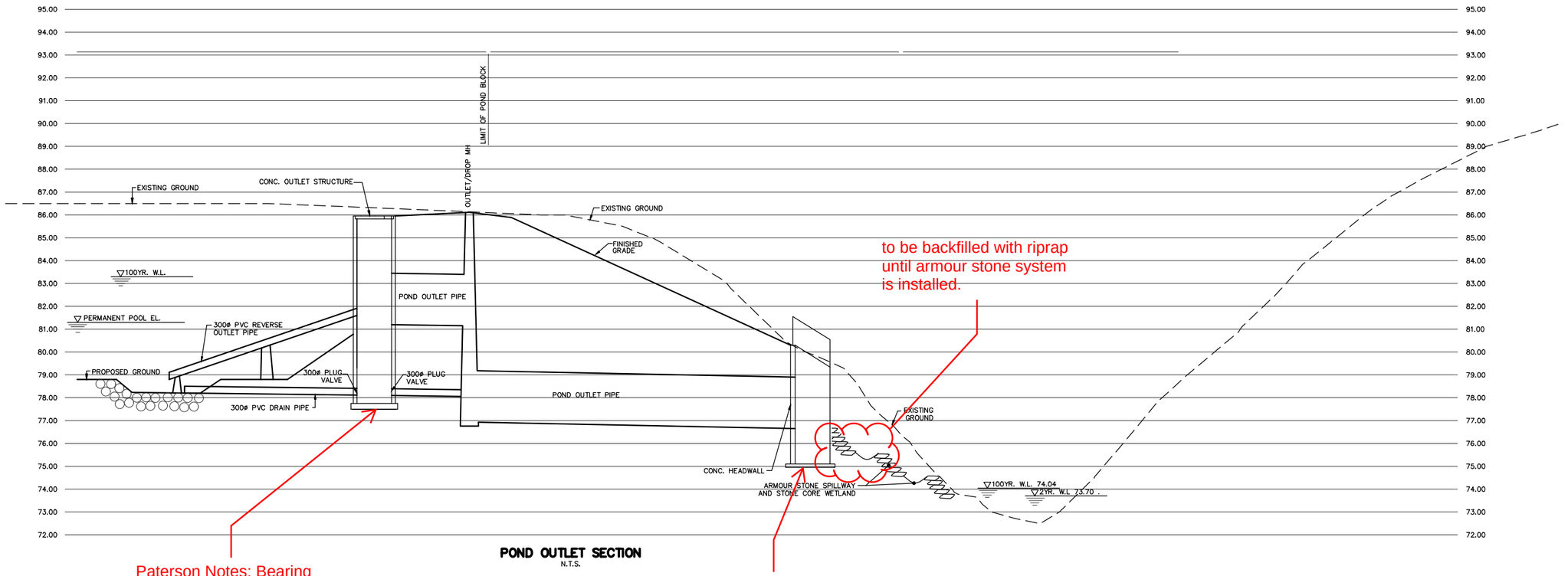
Best Regards,

Paterson Group Inc.

Yashar Ziaeimehr, M.A.Sc.

Faisal I. Abou-Seido, P.Eng.

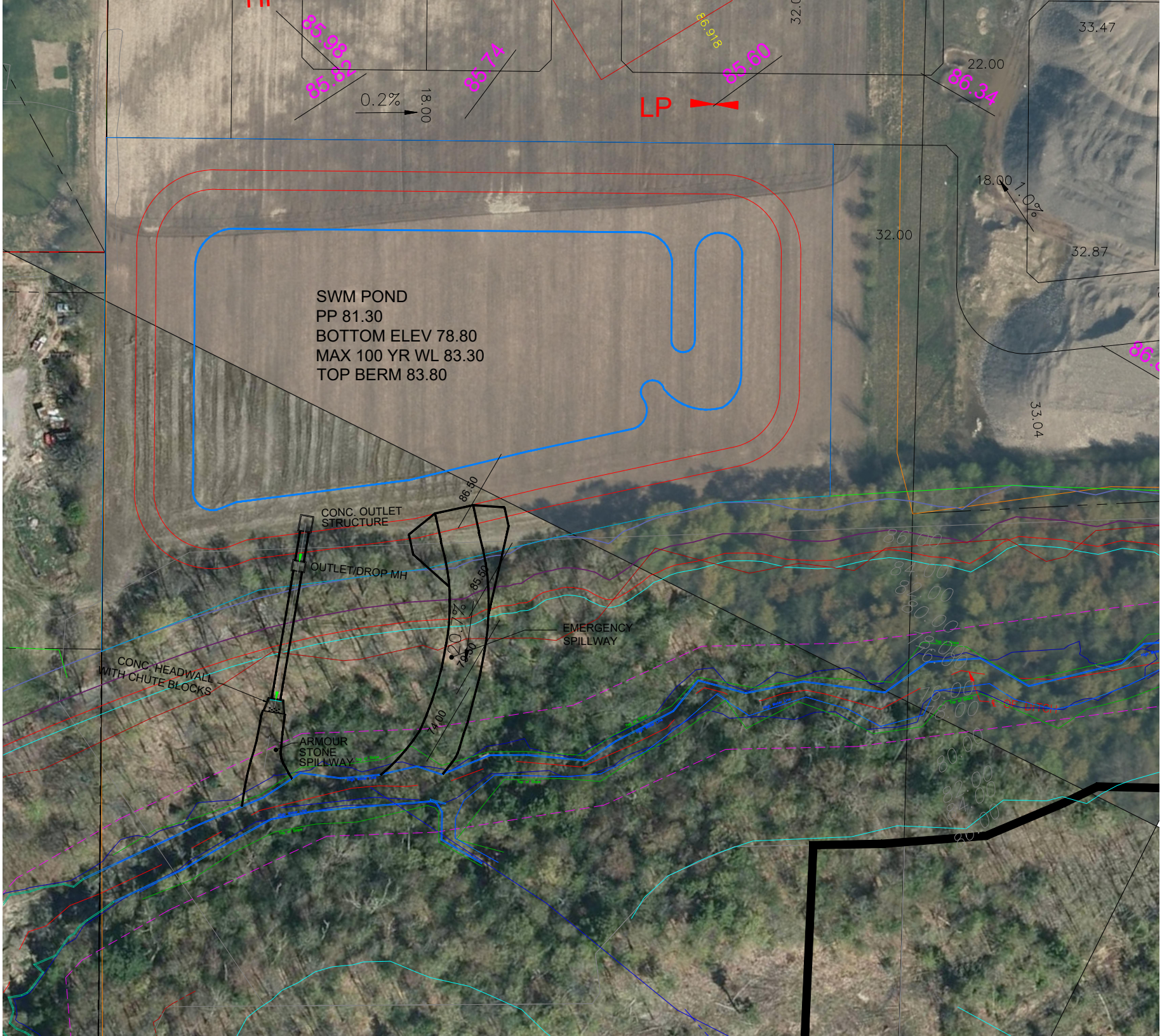

SWM POND
PP 81.30
BOTTOM ELEV 78.80
MAX 100 YR WL 83.30
TOP BERM 83.80
LP
0.2%
18.00
85.82
86.34
18.00
1.0%
32.00
32.87
33.04
CONC. OUTLET STRUCTURE
OUTLET/DROP MH
EMERGENCY SPILLWAY
CONC. HEADWALL WITH CHUTE BLOCKS
ARMOUR STONE SPILLWAY
top of slope
high water line
℄ DF DITCH



POND OUTLET SECTION
N.T.S.

Paterson Notes: Bearing medium expected to be Stiff Grey Silty Clay and/or Glacial till.

Paterson Notes: Bearing medium expected to be glacial till over bedrock and/or bedrock.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ARMOUR STONE SPILLWAY
LP
0.2%
18.00
22.00
33.47
32.00
32.87
33.04
18.00 1.0%
85.98
85.82
85.74
86.34
85.60
86.50
85.50
74.00
20.00