Appendix B

Stormwater Management and Drainage Analysis Memo

PARSONS

DESIGN MEMO

To: Ghaz Mohammad, P. Eng., Senior Project Manager, City of Brampton **Date:** May 12, 2022

From: Mehdi Heidari, PhD, P.Eng. Parsons

Copy: Altaf Hussain, P. Eng., Parsons

Subject: Ken Whillans Drive Extension Environmental Assessment Study
Stormwater Management and Drainage

Introduction

Parsons Inc. was selected by the City of Brampton to prepare a Schedule "B" Municipal Class Environmental Assessment (EA) study for the extension of Ken Whillans Drive, connecting Church Street at the north end to Union Street at the west end. The proposed extension will change some of the perviousness characteristics of the drainage area in the study limit and alter the current drainage pattern and potential storm water run-off volumes and flow rates. The purpose of this Stormwater Management (SWM) memorandum is to characterize the changes in drainage and stormwater run-off associated with the preliminary preferred design alternative for the extension of Ken Whillans Drive and provide stormwater management recommendations for control and treatment of the run-off as may be necessary and feasible.

Background

A preferred alignment (Design Alternative #2C) was selected for the extension of Ken Whillans Drive, resulting in approximately 265m of new road between Church Street and Union Street, opposite the intersection of Union Street and Nelson Street. The proposed alignment passes through areas that are currently either park lands (green, grass) and/or existing driveway access for the YMCA building at 20 Union Street.

The proposed cross-section for the new roadway "shared street" is unique and intended to function primarily as a pedestrian thoroughfare with lay-by parking areas and wide boulevard areas with extensive streetscaping. A typical cross-section of 20m right-of-way (ROW) for the Ken Whillans Drive Extension is shown in **Figure 1**.

FIGURE 1: 20M PROPOSED RIGHT-OF-WAY KEN WHILLANS DRIVE TYPICAL CROSS-SECTION

The pedestrian and furnishing zones, vehicular travel areas and lay-by zones will be paved with concrete permeable pavers. To promote free and obstacle free transitions between the various zones, no curb and gutter are proposed.

Downtown Brampton Flood Protection Environmental Assessment Study

The City of Brampton has recently concluded an Environmental Assessment Study intended to address historic flooding issues in the downtown Brampton area and which will remove the flood risk from 19 hectares of property within a Special Policy Area and allow for new residential land uses in areas north of Wellington Street circa 2033.

Detailed design for the recommended flood protection works is planned for 2022-2023 with construction to occur between 2024-2028. The implementation of the recommended flood protection works is expected to be completed before the Ken Whillans Drive Extension.

As such, the Ken Whillans Drive Extension project is not anticipated to have any impacts on the existing regulated flood limits for the downtown Brampton areas.

Design Criteria

The design criteria for stormwater management control are subject to *TRCA Stormwater Management Guidelines*, and the *City of Brampton's Engineering Design Procedures Manual (2008)*. Parsons also utilized the *Peel Region Stormwater Design Criteria and Procedure Manual*, and *Low Impact Development Stormwater Management Planning and Design Guide (CVCA)* in the preparation of this memorandum. The primary criteria from these documents for a site under 0.5 ha are listed as below:

- Quantity Control – Post Development Run-off controlled to pre-development level, or best efforts;
- Quality Control – Enhanced Level (80% TSS removal), or best efforts for or best efforts;
- 5mm retention – Best effort to retain 5mm rainfall from all surfaces for all storm events on site, and
- Sediment and Erosion Control – contain sediment discharge from site during construction activities.

As indicated in the City of Brampton Design Procedures Manual, the run-off coefficients for various land use are listed below.

Runoff Co-Efficient

Unless otherwise demonstrated the following co-efficients are to be used:

Land Use	Co-Efficient
Parks	0.25
Single and Semi-Detached	0.50
Multiple, Institutional	0.75
Commercial	0.90
Industrial	0.90
Roadways	0.90

The City of Brampton does not reference permeable pavers as a potential land use. As such, we have used the run-off coefficient for permeable pavers as provided in the Peel Region Public Works Stormwater Design Criteria and Procedural manual as shown in Table 1.

TABLE 1: RUNOFF COEFFICIENT FOR DIFFERENT LANDUSES*

Land use	Runoff coefficient
forest and dense wooded areas	0.10–0.25
parks, open space and playgrounds	0.30
single family residential	0.65
semi-detached residential	0.70
townhouse or rowhouse	0.75
apartments or hi-rise residential	0.90
industrial	0.90
commercial	0.90
institutional	0.75
densely built, paved	0.90
asphalt, concrete, roof areas—without green roofs	0.90
Permeable pavements	0.15 to 0.25

* Peel Region – Public works stormwater design criteria and procedural manual

In this memorandum, the run-off coefficient value of 0.25 has been assumed for the permeable pavements.

The Intensity-Duration-Frequency (IDF) curves of City of Brampton were adopted for the storm sewer/drainage assessments and design for the study area, Considering the 5-year peak flow and to be checked for the 100-year return period. IDF parameters for the various return periods are presented in Table 2.

TABLE 2: CITY OF BRAMPTON IDF PARAMETERS

Return Period	A	B	C	i (mm/hr)
City of Brampton				
2	22.1	-	-0.714	79.43
5	29.9	-	-0.701	104.99
10	35.1	-	-0.695	121.93
25	41.6	-	-0.691	143.48
50	46.5	-	-0.688	159.52
100	51.3	-	-0.686	175.36

The Rational Method for run-off calculation was used to determine the peak flow from both existing and proposed sites.

$Q = 2.78CIA$

Where:

Q = Peak Flow Rate (l/s)
C = Run-off Coefficient (see Table 1)
I = Rainfall Intensity (mm/hr), 10-minute time of concentration
104.99 (mm/hr) for 5-year and 175.36 (mm/hr) for 100-year storm events. (See Table 2)
A = Run-off Area (ha)

Existing Conditions

The study area consists of combination of park (open space, grassed areas) and asphalt roadway, as shown in the existing condition- Catchment Drainage area exhibit- **Attachment A**. The existing access roadway for the YMCA is approximately 140m long and with no catch basin structures and as such along the roadway. Although the driveway is curbed, there are curb cuts every +/-10m with the assumed intention of allowing stormwater to drain beyond the curb toward the existing double/single catch basins on side of the driveway which connected to the storm sewer running along the center of the driveway and connecting to an outlet at Union Street,

Each catchment including the lands outside the study area and associated run-off coefficient has been tagged and listed in Table 3 including the flow calculations for 5- and 100-year storm events. The catchments drain to existing catch basins/ditch inlets which eventually discharge to the existing storm sewers in both of Union and Church Street.

TABLE 3: RUNOFF PEAK FLOW AT EXISTING CONDITION

Catchment ID	Area (ha)	Runoff Coefficient	Q -5 year (l/s)	Q -100 year (l/s)
EC 01	0.23	0.84	56.30	94.04
EC 02	0.43	0.34	42.02	70.19
EC 03	0.25	0.65	46.24	77.23
EC 04	1.35	0.37	144.49	241.33
EC 05	0.37	0.90	97.19	162.34
EC 06	0.91	0.69	183.31	306.18
EC 07	0.09	0.34	9.29	15.52
EC 08	0.10	0.25	6.98	11.66
EC 09	0.25	0.67	49.03	81.89
EC 10	0.04	0.79	9.79	16.35
Total			**644.65**	**1076.72**

As such, for the existing conditions the calculated stormwater run-off peak flow rate is 644.65 (l/s) for the 5-year and 1076.72 (l/s) for the 100-year storm events.

Post-Development Conditions

As described previously, the proposed shared street of Ken Whillans Drive Extension is recommended to be constructed utilizing permeable concrete pavers to the furthest extent possible.

The drainage catchment delineation area for the proposed condition has been presented in the exhibit-**Attachment B**. The replacement of the existing asphalt driveway with permeable pavers and the fact that the run-off coefficient of permeable pavers is similar (or potentially lower depending on the type of stone) than grass (park) land uses. The existing drainage inlet structures (as shown on Attachment B) are impacted by the proposed concrete permeable pavers grading and will be removed. As shown on the proposed drainage exhibit, the major drainage flow will be intercepted by the proposed catch basins located at the low-points (i.e., PR.CB 01, PR.CB 02) and will be conveyed to existing storm sewer system. Further detailed information regarding the proposed LID and infiltration system within the Right of Way will be provided in the detailed design stage.

The drainage delineation area has been impacted by the new proposed road layout, therefore the proposed catchments and the generated runoff for 5-year and 100-year storm events have been calculated and the results have been provided in Table 4.

TABLE 4: RUNOFF PEAK FLOW AT PROPOSED CONDITION

Catchment ID	Area (Ha)	Runoff Coefficient	Q -5 year (l/s)	Q -100 year (l/s)
EC 01	0.23	0.84	56.30	94.04
PC 02	0.41	0.34	40.78	68.12
PC 04	1.07	0.37	99.12	165.56
EC 05	0.37	0.90	97.19	162.34
PC 06	1.50	0.69	280.27	468.13
EC 07	0.09	0.34	9.29	15.52
EC 08	0.10	0.25	6.98	11.66
PC 09	0.26	0.67	50.63	84.57
EC 10	0.04	0.79	9.79	16.35
Total			650.36	**1086.27**

As such, for the proposed conditions, the calculated stormwater run-off peak flow rate is 650.3.6 (l/s) and 1086.27 (l/s) for the for 5-year and 100-year storm events, respectively, which is less than 1% increase comparing to the existing condition.

Stormwater Quantity Control

The site of the Ken Whillans Drive Extension falls below the 0.5 (ha) threshold for triggering full TRCA stormwater management requirements. As such, the goal for stormwater management criteria is to achieve a best-efforts approach and attempting to provide quantity and quality control as is practical and feasible.

The goal of quantity control is to restrict the peak storm-water run-off post-construction conditions to less than or equal to the peak flow runoff in the existing conditions. As it has been demonstrated, the proposed Ken Whillans Drive Extension implementation will result in less than 1% increase of flow run-off rates. As such no quantity control measures are required or warranted on this project.

Stormwater Quality Control

Considering the site limitations for the study area, very little can be achieved for stormwater run-off treatment. All proposed runoffs will be drained toward the proposed catch basins which to be connected to the nearest existing storm sewers.

As indicated in Section 4.7 Permeable Pavement, Low Impact Development Stormwater Management Planning and Design Guide (CVC), the Permeable Pavement with subdrain has load reduction of 50% TSS, most metals and hydrocarbons. Considering this shared street adjacent to the park, the rest of TSS will be retained by the grass. Therefore, the proposed shared street development will meet the Enhanced Level (80% TSS removal).

The TRCA SWM criteria target 5mm retention of run-off onsite, through storage, infiltration, evapotranspiration, or water reuse. Due to the small size of the Project area, and permeability of the pavement which has a low runoff coefficient (0.15 to 0.25) along with the subdrains underneath, this improvement along Ken Whillans Drive provides adequate potential to allow the 5 mm rainfall retention in the Project area. It is worth mentioning that the boulevard embankment areas beyond the paved pedestrian zones will be treated with extra depth topsoil (300mm) to promote increased retention from the typical 5mm, up to 8-10 mm.

Conclusions and Recommendations

The preferred shared street alternative of the Ken Whillans Drive Extension between Church Street and Union Street will result in improvement to the traffic and pedestrian access within the study area. Proposed stormwater management targets are met through:

- Proposed conditions peak flow rates are very close to the existing conditions, no storage required, and best efforts are achieved;
- Any existing drainage inlet under the proposed grading will be removed/abandoned and two new catch basins (PR.CB 01 and PR.CB 02) have been proposed to capture the major flows at the low points and convey the drainage flow to the existing sewer system ,and
- The permeable pavement with subdrains and the proposed boulevards will provide adequate rainfall retention to meet the TRCA's onsite rainfall retention criteria.

2022-05-12

Mehdi Heidari, PhD, P.Eng.

Drainage Engineer

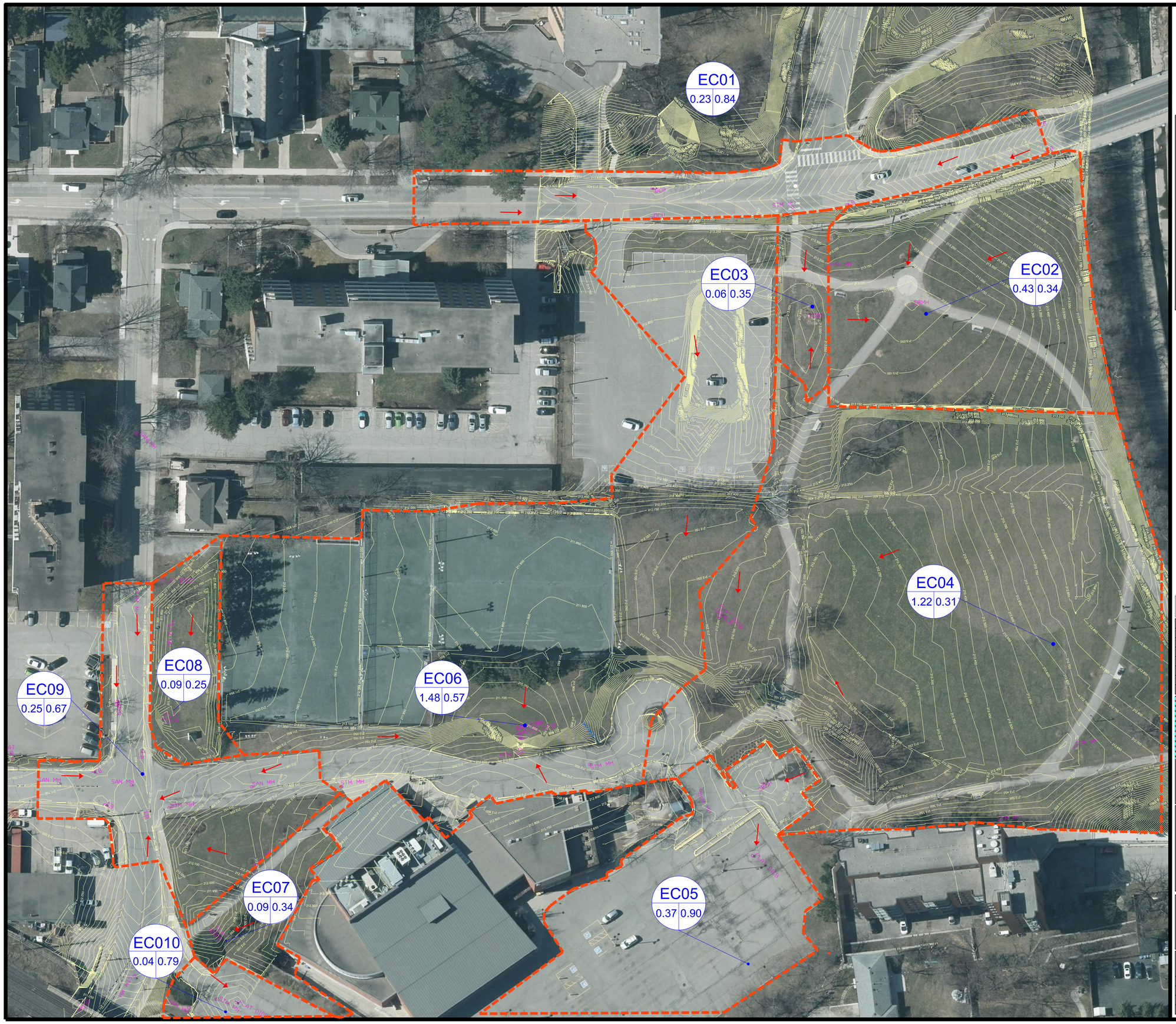
APPENDIX

Attachment A :

Drainage Catchment Area - Existing Condition

Attachment B:

Drainage Catchment Area - Proposed Condition



N

LEGEND

- CATCHMENT BOUNDARY
- SHEET FLOW
- ECXX (A | C) — EXISTING CATCHMENT ANNOTATION
  A : Area (Ha)
  C : Runoff Coefficient
- EXISTING CONTORS

60m 50m 40m 30m 20m 10m 0m 5m 10m

NO.	DATE	REVISIONS	CHECKED
1	MAY 06, 2022	PRELIMINARY REVISION 1	MH

BRAMPTON Flower City
brampton.ca

Public Works & Engineering
Capital Works

DRAFT

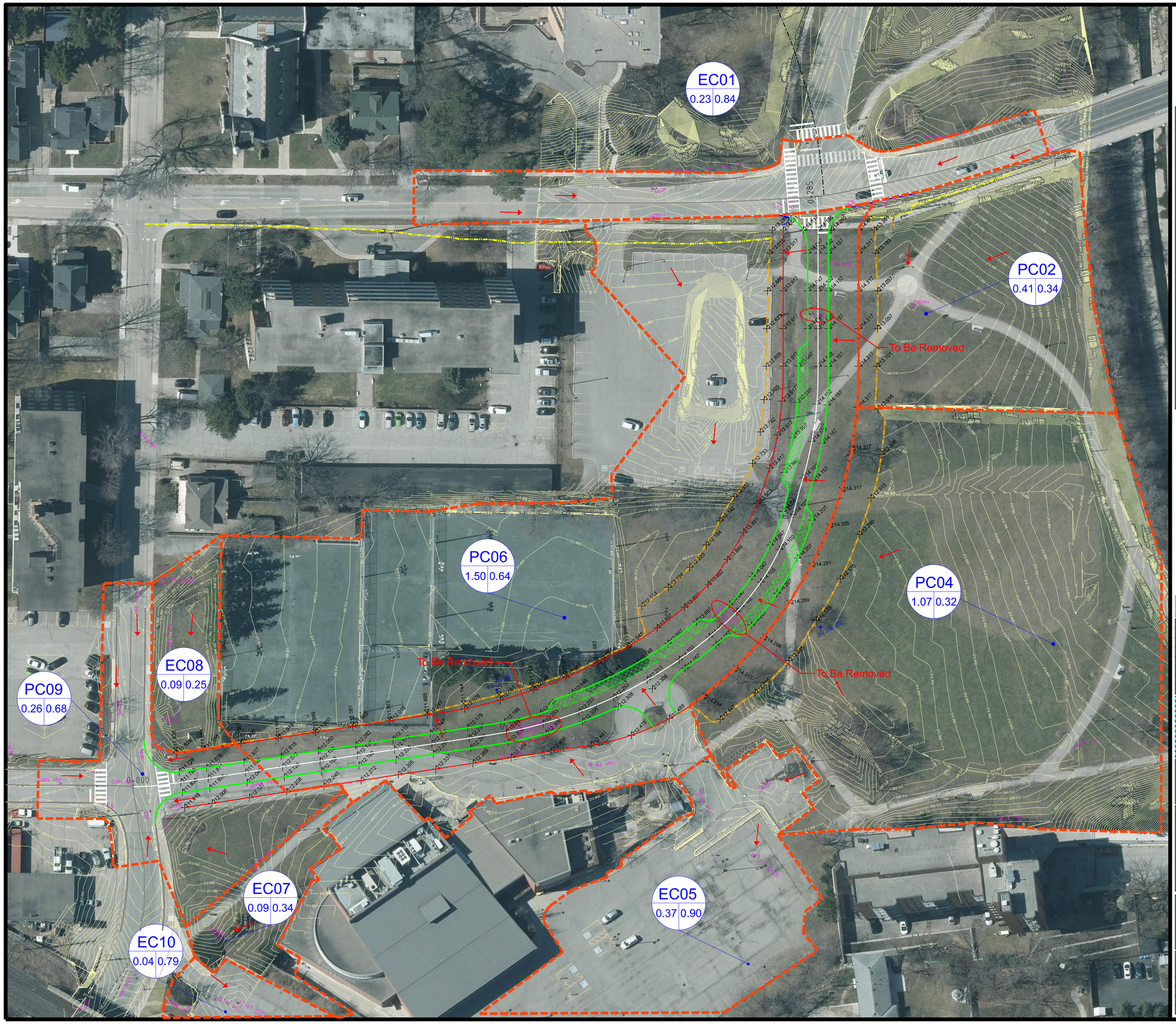
PROJECT DWG. NO.

KEN WHILLANS DRIVE

Drainage Catchment Area
Existing Condition

PROPOSED PRELIMINARY DESIGN

SURVEYED BY:	xxxxxx	DATE:	MAY 06, 2022	FILE NO.	477728
DRAWN BY:	MMB	CHECKED BY:	xxxxxx	DRAWING NO.	SHEET NO.
DESIGNED BY:	AA	CHECKED BY:	xxxxxx	xx-xx-xx	1/1
SCALE:	h 1:500	DATE:	XXXXXX		



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LEGEND

- CATCHMENT BOUNDARY
- SHEET FLOW
- ECXX/P (A / C) — PROPOSED OR EXISTING CATCHMENT AREA ANNOTATION
  A : Area (Ha)
  C :WeightedRunoff Coefficient
- PR.CB — PROPOSED CATCH BASIN
- 2.5m WIDE LAYBY (PARKING AREA)
- PROPOSED RIGHT-OF-WAY
- EDGE OF TRAVEL ZONE
- PROPOSED GRADING LIMIT
- EXISTING CONTORS

60m 50m 40m 30m 20m 10m 0m 5m 10m

NO.	DATE	REVISIONS	CHECKED
1	MAY 06, 2022	PRELIMINARY REVISION 1	MH

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Capital Works

DRAFT

PROJECT DWG. NO.

KEN WHILLANS DRIVE

Drainage Catchment Area
Proposed Condition

PROPOSED PRELIMINARY DESIGN

SURVEYED BY:	xxxxxx	DATE:	MAY 06, 2022	FILE NO.	477728
DRAWN BY:	MMB	CHECKED BY:	xxxxxx	DRAWING NO.	SHEET NO.
DESIGNED BY:	AA	CHECKED BY:	xxxxxx	xx-xx-xx	1/1
SCALE:	h 1:500	DATE:	XXXXXX		