APPENDIX 5

STORM DRAINAGE DESIGN BRIEF

Village of Alton

Main Street North

and Queen Street West

Storm Drainage Design Brief

July 12, 2021

Prepared for:

TOWN OF CALEDON

Village of Alton

Main Street North and Queen Street West

Storm Drainage Design Brief

Town of Caledon

RVA 184339

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STORM DRAINAGE DESIGN BRIEF

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1.0 INTRODUCTION

1.1 Project Description

R.V. Anderson Associates Limited (RVA) was retained by the Town of Caledon (the Town) to undertake a 'Schedule C' Class Environmental Assessment (EA) followed by design developed to 30% detail for Main Street North and Queen Street West (Figure 1). The project involves reconstructing the road and implementing streetscaping and beautification to revitalize the area in accordance with the Town of Caledon's Six Village Community Improvement Plan, Peel Region's Road Characterization Study, and project stakeholder design input.

Both Main Street North and Queen Street West are two-lane hard-surfaced, rural roadways. On Main Street, roadside ditches and culverts are the primary controls used to convey drainage from the roadway and adjacent lands. Along the west end of Queen Street, runoff is conveyed in roadside ditches (Mississauga Road to Osprey Mills Drive), while runoff east of Osprey Mills Drive to Main Street is conveyed via the existing semi-mountable curb and gutter and storm sewers systems which outlet to Alton Mill Pond and Shaw's Creek.

This design brief outlines the proposed storm drainage system consisting of storm sewers, catchbasins, oil grit separators (OGS) and ditches for Main Street North and Queen Street West. The design follows the recommendations of the CVC Stormwater Management Criteria Version, 2012.

1.2 Project Background

The project area (shown in Figure 1 below) includes approximately 1.9 km of Main Street north of Queen Street and approximately 1.4 km of Queen Street between Main Street and Mississauga Road. The project area lies within the Shaw's Creek watershed. Shaw's Creek is a tributary to the Credit River and flows from west to east within the study area. The proposed project falls within the regulation limits of the Credit Valley Conservation Authority (CVC).

Current land uses in the study catchments are primarily mixed low density residential and natural areas.

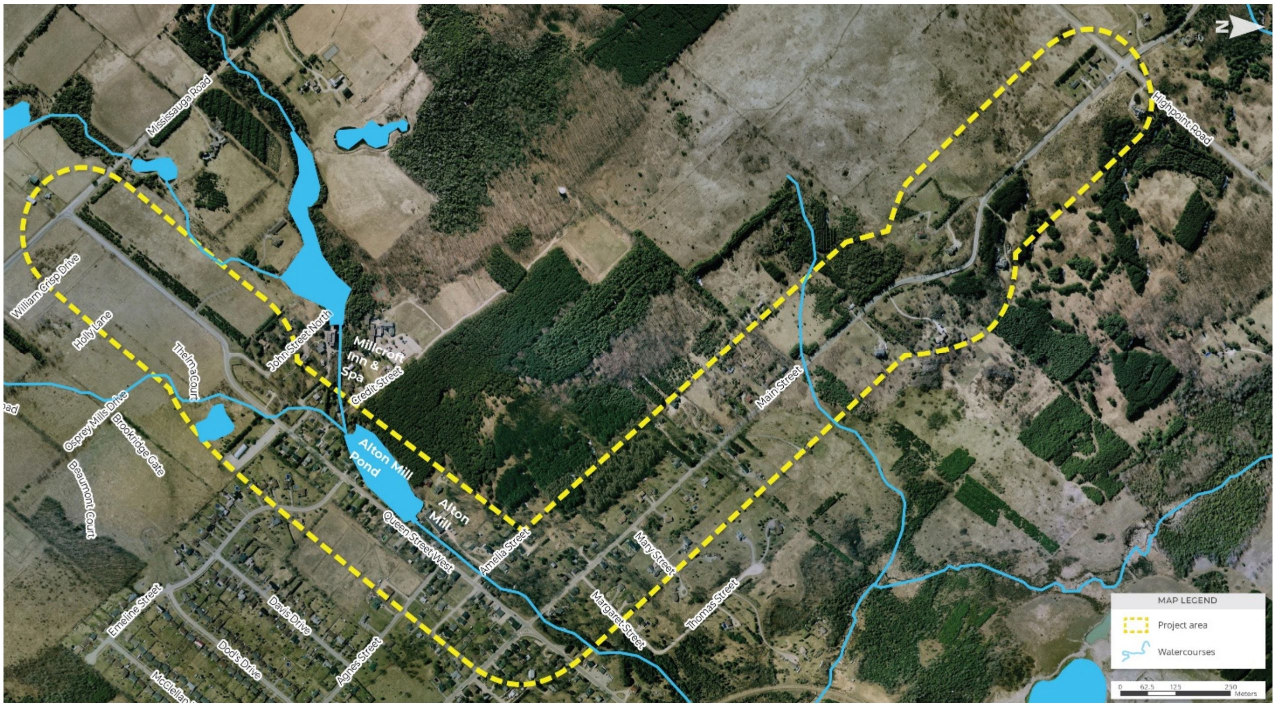


Figure 1: Project Area

Permits and approvals necessary to complete the undertaking may include CVC, Ministry of Natural Resources and Forestry (MNRF), Ministry of the Environment and Climate Change (MOECC), Ministry of Tourism, Culture and Sport (MTCS), Town of Caledon and utilities.

The following reports were utilized as the basis for the stormwater management design:

- *CVC Stormwater Management Criteria Version, 2012*
- *Ontario Ministry of the Environment (MOECC) Stormwater Management Planning and Design Manual, 2003*
- *LID Implementation Process for Regional Road Right-Of-Ways, 2014*
- *Development Standards, Policies & Guidelines, Town of Caledon, 2009*
- *Alton Village Storm Drainage Study Drainage Study Report Phase 1 Part 2, GHD, 2017*

1.3 Purpose

The purpose of this report is to provide a stormwater management strategy that will identify and address impacts related to the proposed road reconstruction. This report will also address and incorporate concerns from stakeholders and regulatory agencies.

The previous Alton Village Drainage Study Report Phase 1 – Part 1 and 2 (R.J. Burnside, 2014) identified the low points and flood concerns along Queen Street and Main Street and suggested potential solutions. Other drainage issues such as unidentified culverts, poorly defined swales and reduced water quality in the Alton Mill pond as a result of drainage from the Alton Estates and the new subdivision were identified and considered in the stormwater designs for Main Street North and Queen Street West.

Under proposed conditions, Main Street and Queen Street will remain 2 lane roads with minimal impact to levels of imperviousness and peak runoff rates. North of Mary Street will be maintained as a rural cross-section, and semi-urban cross-section around the S-curve, as there is no related growth for this area. These indicate that the primary objectives of the storm water design should be to provide adequate conveyance capacity while maintaining existing peak runoff rates and improving runoff quality within the project right-of-way.

Proposed storm sewers will be designed to convey the 10-year storm. Post development flows will be controlled to pre-development levels for the 2, 5, 10, 25, 50, and 100-year storms, where required/feasible. Ministry of Environment, Conservation and Parks (MECP) guidelines require that infiltration be provided for the runoff within the contract limits. With the majority of the road upgrades being performed within tight corridors of existing roads and close to the Alton Mill Pond, this level of infiltration is not easily achieved. As such, efforts are made to promote infiltration and a degree of stormwater filtration in enhanced grass swales. Additional quality control will be provided via a treatment train approach, including inlet sediment controls and Oil-Grit Separators (OGS) units. The treatment target is 80% Total Suspended Solids (TSS) removal and 90% runoff treatment for the project area, excluding external drainage.

2.0 EXISTING SITE CONDITIONS CHARACTERIZATION

2.1 Tributary Areas, Outlets, and Drainage Patterns

Subcatchments were delineated based on existing storm sewer locations, LiDAR data, local survey information, and aerial mapping. The overall drainage direction is from southwest to northeast along Queen Street and across Main Street, with all runoff directed toward the Alton Mill Pond and Shaw's Creek.

Existing drainage is conveyed via ditches along each side of Main Street within the rural section north of Mary Street. Small culverts (each 450 mm CSP) at STA 8+500 and STA 9+200 collect the drainage from these ditches and the upland areas and outlet to the northeast. On the northeast side of Main Street runoff follows drainage paths for 600 m to 900 m prior to discharging to a tributary of Shaw's Creek.

Runoff from Main Street, south of Highpoint Sideroad at STA 9+300 drains via roadside ditches towards a small wetland on Margaret Street prior to discharging to Shaw's Creek at the northeast end of the street. It should be noted that diches along Margaret Street do not have gradient to Shaw's Creek, and this wetland is an isolated depression. Immediately upstream of the Margaret Street wetland is a 750 mm diameter PVC culvert that crosses Main Street and collects runoff from approximately 27 hectares, the majority of which is undeveloped land west of Main Street. The road drainage around this culvert crossing has been noted as a location of recent flooding. The wetland also has a history of flooding and has been identified as an area of concern. Runoff from Main Street south of Margaret Street is directed overland through ditches toward Shaw's Creek, approximately 200m downstream of the Main Street Bridge.

Queen Street is already serviced by storm sewers between Osprey Mills Drive and Main Street. The majority of these storm sewers have sufficient conveyance capacity and will be extended to capture runoff as needed. One section (east of Emeline to Agnes street), however will need to be replaced to provide adequate capacity. All existing outfalls at James Street, Emeline Street, Agnes Street, Amelia Street and at the Shaw's Creek Bridge at Queen Street are adequately sized and will not be replaced.

In general, the existing infrastructure appears to have adequate capacity for the design storms and can accommodate the proposed design changes. Further investigation is required to determine the structural state of the existing culverts and infrastructure. It is understood that the City of Caledon will be undertaking a CCTV review of the existing culverts and infrastructure, but this assessment falls outside the scope of this report.

2.2 Condition of Receiving Watercourses

Shaw's Creek is the main watercourse through Credit River Subwatershed 17 and the Village of Alton is the only significant urban area within this catchment. The existing subwatershed land uses are primarily agriculture and natural with small proportions of urban, wet meadow and aggregate land use (Shaw's Creek Subwatershed Study, 2006). Caledon Lake, located in the northern part of the Shaw's Creek subwatershed, controls the drainage characteristics of the upper basin. The basin mostly consists of a continuous rugged relief with marshy areas within its floodplains. Recharge rates in the upper reaches of Shaw's Creek are very high, because of high infiltration soils, and hummocky topography (which directs surface water to the groundwater system).

Alton Mill Pond is an online pond formed by the damming of Shaw's Creek as it flows parallel to Queen Street West. Although the pond supports fish habitat, the dam acts as a barrier preventing fish passage. Reduced water quality in the pond was noted as a result of drainage from the Alton Estates and the new subdivision. Based on a review of the MNRF Natural Heritage Information Centre database, DFO Species at Risk mapping, and correspondence with CVC, no aquatic species at risk occur within the study limits.

2.3 Significant Natural Features

Fisheries, vegetation, watercourses, and wildlife are all environmental features that may be impacted by stormwater runoff.

Shaw's Creek and its tributaries are cold water aquatic communities which support Brook Trout *(Salvelinus fontinalis)*. The subwatershed study also identifies that Brook Trout spawning habitat is present downstream within the vicinity of Queen Street East. Brook Trout are a sensitive species which require clear, cold, well oxygenated water for all life processes, especially spawning. Also, spawning American Brook Lamprey *(Lethenteron appendix)* were observed in the Shaw's Creek tributary. This species prefers Coldwater habitats and is relatively sensitive to pollution and turbidity.

No aquatic species at risk are known to be present in Shaw's Creek or its tributary within the vicinity of the study area.

3.0 STORMWATER OBJECTIVES

3.1 Water Quantity and Flood Control

The objective of stormwater management, for the improvement of Main Street North and Queen Street West, is to develop a plan that will address the following:

- Ensure no increased risk of flooding to downstream properties and/or infrastructure.
- Design proposed sewer to convey 10-year return period storm runoff.
- Control post-development peak flows to pre-development levels or better for 2, 5, 10, 25, 50, and 100-year storm events.
- Where applicable, promote infiltration within the road right-of-way.

3.2 Water Quality, Erosion, and Sediment Control

As per the Guidelines for the Preparation of Stormwater Management Reports in Support of Municipal Class Environmental Assessments, Region of Peel, 2014 and CVC Stormwater Management Criteria 2012, the quality and erosion controls are described below:

- Shaw's Creek
    - Quality Control – Level 1 Enhanced (80% long term TSS removal).
    - Erosion Control – Erosion control should be provided through onsite retention of minimum 5 mm of every rainfall event.

3.3 Water Balance

- Minimum post-development recharge of the first 5 mm for any precipitation event

3.4 Site Constraints

Due to the limited space available within the road right-of-way, conventional SWM facilities such as SWM ponds and some Low Impact Development (LID) features are not feasible options to achieve the SWM objectives set within this report. Expected high groundwater conditions along Alton Millpond and in the lower lying sections of Main Street are also likely to limit the effectiveness of groundwater infiltration in these areas. To meet quality control requirements enhanced swales are proposed at the outlets for the rural section of Main Street. Within the proposed urban section of Main Street and along Queen Street a treatment train including a combination of catch basin shields, and oil grit separators (OGS) will be provided for right-of-way drainage.

3.4.1 Queen Street Outlets

No new outlets are proposed as the five (5) primary Queen Street outfalls between Mississauga Road and Main Street will continue to be used. With development on both sides of Queen Street and limited space, all quantity and quality controls will be implemented within the existing right-of-way using catch basin shields and an OGS unit for the new section of storm sewer.

The existing road right-of-way does not provide enough space to allow for the implementation of additional LID measures such as infiltration trenches or outlet swales. Quality treatment will me limited to normal level of protection provided by the combination of catch basin shields and an OGS unit.

3.4.2 Main Street Rural Outlets

No quantity control measures have been proposed for the rural section outlets along Main Street. The majority of runoff at these outlets is generated by upland wooded and agricultural lands and the proposed road works will only have a small effect on drainage as there is no proposed increase to the number of lanes and minimal change to the level of imperviousness. As such, enhanced grass swales are proposed to capture and convey road runoff while providing the opportunity for infiltration and filtration/treatment prior to discharging at low points. Check dams along the swales will provide energy dissipation along the steeper sections as well as minor peak flow attenuation. It should also be noted that the watercourses at low points are likely intermittent streams, and that runoff will also be treated by downstream natural features before reaching Shaw's Creek.

Due to limited road right of way, and existing grading constraints additional LID features such as infiltration trenches, or larger bioswales are no feasible for the rural section of Main Street. Smaller bio swales are also not recommended due to additional maintenance requirements and anticipated road salting during the winter. Enhanced swales can be improved further via engineered soil layers to improve infiltration, and the necessity of this will depend on local ground water conditions.

3.4.3 Main Street Urban Outlets

The Main Street urban section will be reconstructed with curb, gutter, storm sewers with sections of sidewalk and boulevard. There is little room for controls outside the roadway for larger LIDs for quantity and quality control due to existing utilities. A single infiltration trench is proposed to be connected to the sewer to provide infiltration capacity for the first 5mm of runoff. Quantity control could be provided via superpipe storage, but this is not recommended as it is no required based on existing peak flow level in Shaw's Creek. CVC confirmed that superpipe storage, and quantity control in general is not required for this outlet, beyond providing capture for 5mm runoff to reduce erosion.

4.0 FUTURE DRAINAGE CONDITIONS

4.1 Drainage Patterns

Refer to Drawings in Appendix A

Under proposed conditions, 1.9 km of Main Street North, from High Point Side Road to Queen Street and 1.0 km of Queen Street West from Mississauga Road to Main Street will be reconstructed. There is a recently upgraded section of Queen Street between Osprey Mills Drive and James Street that will not require additional road improvements. The runoff controls for the proposed improvements have been designed to convey the 10-year storm without flooding (minor systems) and match or reduce pre-condition peak flows (major/minor systems) and improve runoff quality on a project-wide basis. Existing drainage patterns throughout the project will be maintained, with minor adjustments to the areas serviced by new storm sewers.

The only change to existing drainage patterns is proposed at the Margaret Street outlet, in the urban section of Main Street North. As stated above, under existing conditions all drainage north of this outlet discharges via a 750mm culvert to an existing swale on the east side of Main Street approximately 60m north of Margaret Street. This swale connects to an existing wetland, and both the wetland and the existing swale and culvert, which are prone to flooding. To alleviate this flooding, the proposed sewer along Main Street will bypass this outlet and convey the road drainage south directly to Shaw's Creek. This proposed change will divert approximately 4 ha of drainage away from the outlet, though approximately 23.5 ha of external area will remain connected to the Margaret Street outlet to provide base flow for the wetland. This external drainage area is primarily composed of wooded lots and large residential properties. Due to existing land cover in this area, the resulting low peak flows will reduce the possibility of flooding within the swale and wetland.

No negative impacts to Shaw's Creek are anticipated from the proposed diversion of 4 ha of drainage from the Main Street Road corridor via the proposed sewer. Based on the existing HEC-RAS model for this section of Shaw's Creek there will be a less than 1% local increase in peak flows as a result of this proposed drainage pattern change. This local increase would occur from the discharge point to approximately 200m downstream. Beyond which there would be no impact to peak flows in Shaw's Creek.

4.2 Outlet Identification

Existing stormwater drainage patterns and outlet locations will be maintained with only one new outlet included in the proposed design. The primary runoff outlets from the project right-of-way are as follow.

Queen Street West

- STA 5+710 James Street: The existing storm sewer outfall is located north of James Street and outside of the project right-of-way. No improvements are planned for this outfall.
- STA 5+910 Queen Street, east of Emeline Street: The existing storm sewer outfall to Alton Mill Pond will be maintained and no new drainage will be directed to this sewer. A new storm sewer will bypass this outfall (and discharge to the existing outfall near Agnes

Street), decreasing the peak flow at this location of recent flooding. Upstream drainage improvements are planned near the bottom of Emeline Street (Alton Village Drainage Study, GHD 2017) and the resulting reduction in runoff to this outfall sewer should help ease flooding.

- STA 6+170 Queen Street, east of Agnes Street: The existing storm sewer outfall to Alton Mill Pond will be maintained with additional storm sewer conveying runoff from Queen Street rather than as major system (surface) drainage.
- STA 6+230 Queen Street, east of Amelia Street: The existing storm sewer outfall to Alton Mill Pond will be maintained and no new drainage will be directed to this sewer.

Main Street North

- STA 8+200 Main Street at High Point Side Road: The existing roadside ditches along Main Street are poorly defined and will be improved as enhanced grass swales. No additional runoff will be added to the swales and they will discharge as they currently do at High Point Side Road.
- STA 8+500 Main Street: The existing roadside ditches along Main Street will be improved as enhanced grass swales. Curb breaks will allow runoff to the ditches in sections where curb and gutter to be installed. No additional runoff will be added to the swales and they will discharge as they currently do near the existing 450 mm CSP culvert (to be replaced with 750 mm diameter).
- STA 9+200 Main Street: The existing roadside ditches along Main Street will be improved as enhanced grass swales. Curb breaks will allow runoff to the ditches in sections where curb and gutter to be installed. No additional runoff will be added to the swales and they will discharge as they currently do near the existing 450 mm CSP culvert (to be replaced with 900 mm diameter).
- STA 9+820 Main Street, west of Nicholas Street: The existing 750 mm diameter culvert will be maintained for the upland (major system) drainage from west of Main Street. This culvert location has experienced past flooding, but flood risks will be greatly reduced by collecting all roadway runoff in a new storm sewer and diverting and discharging it south to Shaw's Creek (near the bridge). The existing culvert has capacity for the 100-year storm, though the downstream channel must be maintained, and free of debris and blockage for the culvert to operate effectively.
- STA 9+970 Main Street: New storm sewer outlet near Shaw's Creek. This storm sewer will divert runoff from Margaret Street and have runoff treated by catchbasin capture devises, and an OGS unit to improve water quality prior to discharge. An infiltration

trench with 35 m^3 of storage is proposed to provide capacity for 5mm runoff from the impervious areas. A plunge pool and flow spreader are proposed for this outlet to mitigate any local erosion. These outlet measures will also reduce the risk of increased erosion within Shaw's Creek due to the proposed change in drainage patterns.

5.0 HYDROLOGIC AND HYDRAULIC MODELING

5.1 Design Storm

The Town of Caledon's IDF curves were used in determining the rainfall values. Rainfall intensity (I, mm/hour) is calculated as follows with T_c representing the time of concentration (minutes):

$$i_{100\,Year} = \frac{4688}{(t_c + 17)}0.9624$$

$$i_{50\,Year} = \frac{3886}{(t_c + 16)}0.9495$$

$$i_{25\,Year} = \frac{3158}{(t_c + 15)}0.9335$$

$$i_{10\,Year} = \frac{2221}{(t_c + 12)}0.9080$$

$$i_{5\,Year} = \frac{1593}{(t_c + 11)}0.8789$$

$$i_{2\,Year} = \frac{1070}{(t_c + 7.85)}0.8759$$

In accordance with the Regio of Peel standards, a T_c of 15 min was used for subcatchments within the right-of-way. Impervious surfaces such as paved areas were assumed to have a runoff coefficient of 0.90. The pervious surfaces such as grass and landscaped areas were assumed to have a runoff coefficient of 0.25. Weighted runoff coefficients were determined for the individual catchment areas (external and internal to the rights-of-way).

5.2 Hydrologic Modeling

Catchment delineations were completed for the pre-development and post-development conditions based on existing and proposed storm infrastructure, contours, and received survey data (shown in Appendix C). Peak flows were calculated for all storm events as per CVC and Region of Peel's criteria (Appendix D) using the PCSWMM software. The 24-hour Chicago storm distribution was used to determine pre-development and post-development flows as recommended by "Guidelines for the Preparation of Stormwater Management Reports in Support of Municipal Class Environmental Assessments", prepared by Hatch Mott MacDonald, 2014.

Tables 1 and 2 below summarize the pre-development and post-development outlet peak flows and runoff volumes.

Table 1 Existing Outlet Peak Flows

Existing			Peak Flow (m3/s)					
Outlet*	Total Area (ha)	Imperv. Area (ha)	2Yr	5Yr	10Yr	25Yr	50Yr	100Yr
Queen Street West								
STA 5+710 James Street	38.74	12.02	0.428	1.222	1.681	2.003	2.227	2.256
STA 5+910 east of Emeline Street	14.64	5.209	1.023	1.563	1.957	2.489	2.921	3.427
STA 6+170 east of Agnes Street	6.757	0.280	0.110	0.285	0.429	0.626	0.783	0.933
STA 6+230 east of Amelia Street	1.668	0.067	0.037	0.106	0.162	0.238	0.297	0.358
STA 6+380 at Main Street	0.145	0.137	0.025	0.035	0.043	0.052	0.059	0.066
Total	61.95	17.713	1.623	3.211	4.272	5.408	6.287	7.040
Main Street North								
STA 8+200 at High Point Side Road	0.628	0.136	0.041	0.086	0.120	0.162	0.194	0.228
STA 8+500 culvert	15.82	0.348	0.089	0.206	0.302	0.453	0.570	0.704
STA 9+200 culvert	23.67	0.336	0.105	0.307	0.460	0.710	0.917	1.153
STA 9+820 culvert near Nicholas	27.44	0.425	0.121	0.362	0.537	0.807	1.011	1.248
STA 9+970 Shaw’s Creek Bridge	0.185	0.092	0.018	0.026	0.034	0.043	0.051	0.059
Total	67.743	1.337	0.374	0.987	1.453	2.175	2.743	3.392

Table 2 Proposed Outlet Peak Flows

Proposed			Peak Flow (m3/s)					
Outlet*	Total Area (ha)	Imperv. Area (ha)	2Yr	5Yr	10Yr	25Yr	50Yr	100Yr
Queen Street West								
STA 5+710 James Street	39.04	12.16	0.495	1.281	1.732	2.032	2.238	2.259
STA 5+910 east of Emeline Street	14.50	5.077	0.996	1.500	1.924	2.445	2.871	3.328
STA 6+170 east of Agnes Street	7.018	0.500	0.156	0.350	0.507	0.723	0.896	1.082
STA 6+230 east of Amelia Street	1.681	0.078	0.039	0.108	0.164	0.240	0.301	0.358
STA 6+380 at Main Street	0.145	0.137	0.026	0.035	0.043	0.052	0.059	0.066
Total	62.384	17.952	1.712	3.274	4.370	5.492	6.365	7.093
Main Street North								
STA 8+200 at High Point Side Road	0.628	0.140	0.053	0.108	0.147	0.191	0.223	0.257
STA 8+500 culvert	15.82	0.400	0.108	0.230	0.304	0.474	0.589	0.728
STA 9+200 culvert	23.67	0.469	0.126	0.307	0.469	0.722	0.922	1.157
STA 9+820 culvert near Nicholas	23.49	0.000	0.043	0.195	0.304	0.492	0.636	0.808
STA 9+970 Shaw’s Creek Bridge	4.14	0.642	0.130	0.278	0.390	0.538	0.657	0.683
Total	67.748	1.651	0.46	1.118	1.614	2.417	3.027	3.633

Queen Street West

Increases to peak flows are expected to be minimal along Queen Street, with a slight increase at the Agnes Street outfall due to the proposed storm sewer bypassing the Emeline Street outfall. The existing storm sewers that discharge to the James Street, Amelia Street and Main Street outfalls will all be maintained as they are with additional lengths of to extend drainage along the improved road segments.

Main Street North

Increases to peak flows are minimal along Main Street. Proposed work will include drainage improvements and better-defined ditches/swales. Due to the steep terrain, turf reinforcement and check dams will be required to dissipate energy and minimize erosion. These check dams will provide minor attenuation to maintain peak runoff rates to existing levels.

In the urban section of Main Street runoff will be reduced to the existing 750 mm culvert and downstream wetland and diverted to Shaw's Creek near the bridge. This new outlet will result in increased discharge along the short section of watercourse between the proposed and existing Margaret Street outfall. Review of the HEC-RAS model of the Main Street bridge indicates that there is adequate capacity through the structure to accommodate this slight flow increase. The HEC-RAS model does not separate the flow within the creek channel, and the same flow is used for the entire reach. Based on this there is no impact within the HEC-RAS model due to the proposed change to the discharge location for the Main Street ROW drainage.

6.0 SWM AND LOW IMPACT DEVELOPMENT FEATURES AND DESIGN

6.1 Evaluation and Selection of Candidate Features

The document titled "LID Implementation Process for Regional Road Right-of-Ways" provided by the Region was utilized to evaluate and select the most applicable LID practice for this project. A thorough review of the available information (i.e. EA report, survey, contour mapping, etc.) was conducted and it was determined that underground storage/infiltration, OGS and permeable pavement units were the only feasible options.

Table 3 below indicates the opportunities and constraints for each of the applicable LID practices relevant to Regional Roads within the Region of Peel. Although Main Street and Queen Street within this project study are Town of Caledon Roads, Region of Peel LID practices are being adopted.

Table 3 – LID Practice Analysis

Project Type	LID Practice	Constraint/Opportunity
Regional Road Works (Urban)	**SWM Pond**	Constraint. - Space is not available within the road ROW. - The adjacent properties within the project area are either farmlands or developed sites. In order to meet the Region's SWM initiative, multiple SWM ponds will be required at each existing outlet. Buying a large amount of property to build SWM ponds is not an economical solution.
	Bio-Retention Facilities	Constraint. - Space is not available within the road ROW - High use of de-icing salts and high splash radius will kill plants, resulting in high future maintenance. - Based on the LID planning and design guide, it does not recommend bio-retention facilities receiving runoffs from high traffic areas where large amounts of de-icing salts are applied.
	Enhanced Grassed Swale	Opportunity/Constraint. - Space is not available within the road ROW along Queen Street, however the rural sections of Main Street are good locations due to the less road corridor. - Based on the LID planning and design guide, it does not recommend bio-retention facilities receiving runoff from high traffic areas where large amounts of de-icing salts are applied (Queen Street sections).

Regional Road Works (Urban)	**Bioswales**	Constraint. - Space is not available within the road ROW - High use of de-icing salts and high splash radius will kill plants. - Based on the LID planning and design guide, it does not recommend bio-retention facilities receiving runoffs from high traffic areas where large amounts of de-icing salts are applied.
	Perforated Pipe	Opportunity/Constraint. - Perforated pipe system could be installed however, without proper pre-treatment, perforated pipes will clog up and the entire system will fail. - Perforated pipes cannot be cleaned properly to remove sediment accumulated. - Very high future maintenance cost, not a good long term solution.
	Permeable Pavement	Opportunity. - Permeable surfaces can be provided at lay-by Parking areas. - Snow plow and de-icing costs are reduced due to rapid snow and ice melt drainage. - Puddling and flooding on parking lots is also reduced. - Potential for earning Canadian Green Building Council LEED sustainable sites credits for reducing stormwater pollution and runoff
	OGS	Opportunity. - OGS units can be used due to their smaller footprint and treatment design flexibility for treatment area size. - OGS units need to be designed as part of a multi component approach to achieve water quality treatment target.
	Superpipe Storage	Opportunity. - Can be used along Queen Street to maintain pre-post peak discharge rates within the road ROW. - CVC has indicated superpipe storage should be avoided

Regional Road Works (Urban)	**Infiltration Trenches**	Opportunity/Constraint. - Underground storage/infiltration arches such as those manufactured by Terrafix, Stormtech or Cultec can be used to detain and infiltrate stormwater. - Can be used underneath pavement, layby parking areas, and permeable paver areas. - High groundwater table along Alton Mill Pond would likely limit the effectiveness of infiltration.

As indicated above, the most feasible LID practices that can be incorporated into the SWM design for Main Street and Queen Street are OGS units, enhanced grass swales and catch basin shields. These features have been incorporated into the stormwater management design.

6.2 Design of Features

For water quality treatment, catchbasin shields will be installed in each catch basin and ditch inlet. An oil grit separator (OGS) will be provided to treat road runoff before it is discharged to the outlet. The OGS units will be sized to provide 80% TSS removal for the contributing drainage areas based on 90% runoff capture, though only 50% TSS removal will be accounted for as per CVC guidelines. The OGS and catchbasin capture devices will achieve approximately 75% TSS removal, or a Normal MECP level of protection. Design details for the proposed OGS units are provided in Appendix E.

7.0 DRAINAGE PLAN AND DESIGN

7.1 Minor System Design

The minor drainage system consists of storm sewers which are sized to accommodate the peaks flows for the 10-year Town of Caledon IDF storms. With Main Street and Queen Street proposed to remain 2 lane roads, there will be minimal increase to the imperviousness and peak runoff rates. Existing storm sewers have adequate conveyance capacity and will be maintained where feasible as part of the new SWM design. OGS units will be installed for quality control at the new storm sewer outlet near the Shaw’s Creek Bridge and on the new storm sewer on Queen Street near the Agnes Street outfall.

7.2 Major System Design

The major drainage system consists of overland flow within the curb and gutter along Queen Street and the urban section of Main Street. The rural sections of Main Street will use enhanced grass swales to provide conveyance while promoting runoff filtration and infiltration. Larger culverts are proposed for the two rural crossings of Main Street where the existing 450 mm CSP pipes were determined to have inadequate capacity. A 600mm Culvert is proposed for the crossing north of the S-curve, and a 900mm culvert is proposed for the crossing south of the S-curve, north of Mary Street.

7.3 Monitoring and Maintenance

The storm drainage systems must be maintained at regular intervals by inspecting and cleaning the following:

- OGS (it is recommended to clean via vacuum truck on regular intervals and immediately after oil, fuel, or other chemical spills).
- Catchbasin shields (it is recommended to clean via vacuum truck as sediment depths reach 300 mm to 600 mm depths in catchbasin sumps).
- Enhanced grass swales (should be checked to maintain vegetation, remove debris after every major storm event and at least twice annually).
- Infiltration trench (should be checked for sediment build up regularly and flushed and vacuumed out once sediment levels exceed 75mm deep).

Inspection and cleaning requirements will have to be monitored closely during the initial period of operation of the storm drainage system to determine an appropriate cleaning schedule.

8.0 APPROVAL AND REVIEW REQUIREMENTS

The drainage and stormwater management report is subjected to review and approval from following regulatory agencies:

- The Regional Municipality of Peel
- The Credit Valley Conservation Authority (CVC)
- Town of Caledon
- Ministry of Natural Resources and Forestry (MNRF)

- Ministry of Environment Conservation and Parks (MECP)
- Public interest groups and stakeholders

9.0 FUTURE DESIGN RECOMMENDATIONS

This stormwater management plan has been prepared in support of the proposed road reconstruction for the Town of Caledon. The plan assesses the potential impacts of the proposed development on stormwater quantity, quality and erosion control measures and presents a stormwater management plan to mitigate these impacts in accordance with the regulatory requirements.

The recommended stormwater management plan consists of the following components:

- New storm sewers along Main Street from STA 9+625 to a new outfall near the Shaw's Creek Bridge. This will improve conveyance and divert road runoff from areas of recent flooding.
- An oil grit separator (Stormceptor Model STC-2000 or approved equivalent) for the new Main Street outfall at the Shaw's Creek Bridge. This will provide water quality control through Total Suspended Solids (TSS) removal.
- Enhanced grass swales will provide runoff quality control for the rural sections of Main Street that will not be serviced by storm sewers. The swales will serve as conveyance, while providing runoff filtration and promoting infiltration.
- Larger culverts will be installed to replace the undersized culverts on Main Street at STA 8+500 and 9+200.
- The existing storm sewer on Queen Street will be extended from Osprey Mills Drive to Mississauga Road with catch basin shield to be installed in the new inlets.
- A new storm sewer will be installed on Queen Street W. south of James Street to the existing outfall across from Agnes Street. This sewer will bypass the Emeline Street outfall, which has had previous flooding concerns.
- An oil grit separator (Stormceptor Model STC-750 or approved equivalent) will be installed on the new storm sewer upstream of the Agnes Street outfall. This will provide water quality control through Total Suspended Solids (TSS) removal.
- Short storm sewer extensions near Amelia Street and Main Street will be installed to improve local drainage by reducing overland flow paths.

- New storm sewers will be designed with sufficient hydraulic capacity (up to 10-year return period storm) to avoid ponding at low lying points.
- An infiltration trench with 35 m3 of storage capacity along the urban section of Main Street.
- A minimum of 75% TSS removal efficiency for an enhanced level of control will be provided at all new outfalls through a treatment train approach consisting of CB shields, OGS.

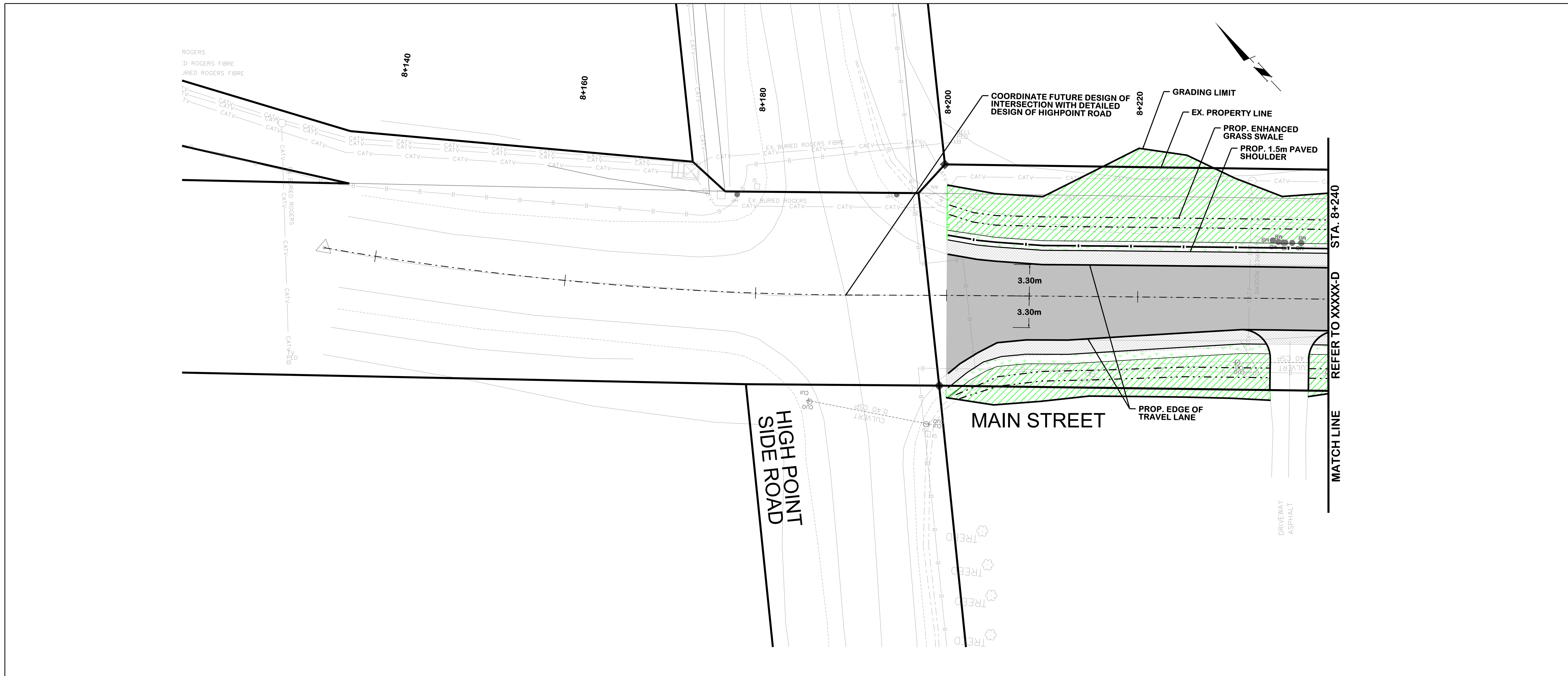
The implementation of the proposed storm drainage systems will control the site's runoff in accordance with the Region of Peel, CVC, and Town of Caledon's stormwater management requirements.

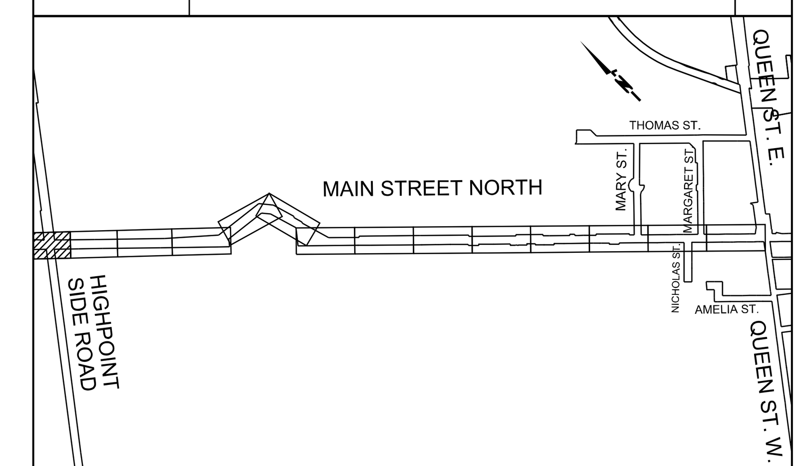
Report prepared by:

R.V. ANDERSON ASSOCIATES LIMITED

APPENDIX A

SWM Drawings





LEGEND:

- PROPOSED ROADWAY PAVEMENT
- PROPOSED IMPRESSED COLORED CONCRETE
- PROPOSED CONCRETE SIDEWALK / CONCRETE BUS PAD
- PROPOSED PAVED SHOULDER
- PROPOSED TOPSOIL AND SOD
- PROPOSED CUT/ FILL
- PROPOSED DITCH LINE
- PROPOSED RETAINING WALL
- EXISTING BELL PLANT
- EXISTING ROGERS PLANT
- EXISTING GAS LINE
- EXISTING WATERMAIN

SERVICE DATA

SERVICE	DATE	INIT.	SERVICE	DATE	INIT.
HYDRO ONE	XXX X, 2019	C.D.B.			
WATERMAINS	AUG 09, 2019	C.D.B.			
GAS MAINS	AUG 06, 2019	C.D.B.			
BELL U/G CABLE	SEP 30, 2019	C.D.B.			
HYDRO U/G CABLE	XXX X, 2019	C.D.B.			
ROGERS PLANT	AUG 12, 2019	C.D.B.			

REVISIONS

DATE	DETAILS	INIT.
NOV 22, 2019	ISSUED FOR PIC REVIEW	J.P.D.
MAR. 12, 2021	30% PRELIMINARY DESIGN	D.J.O.

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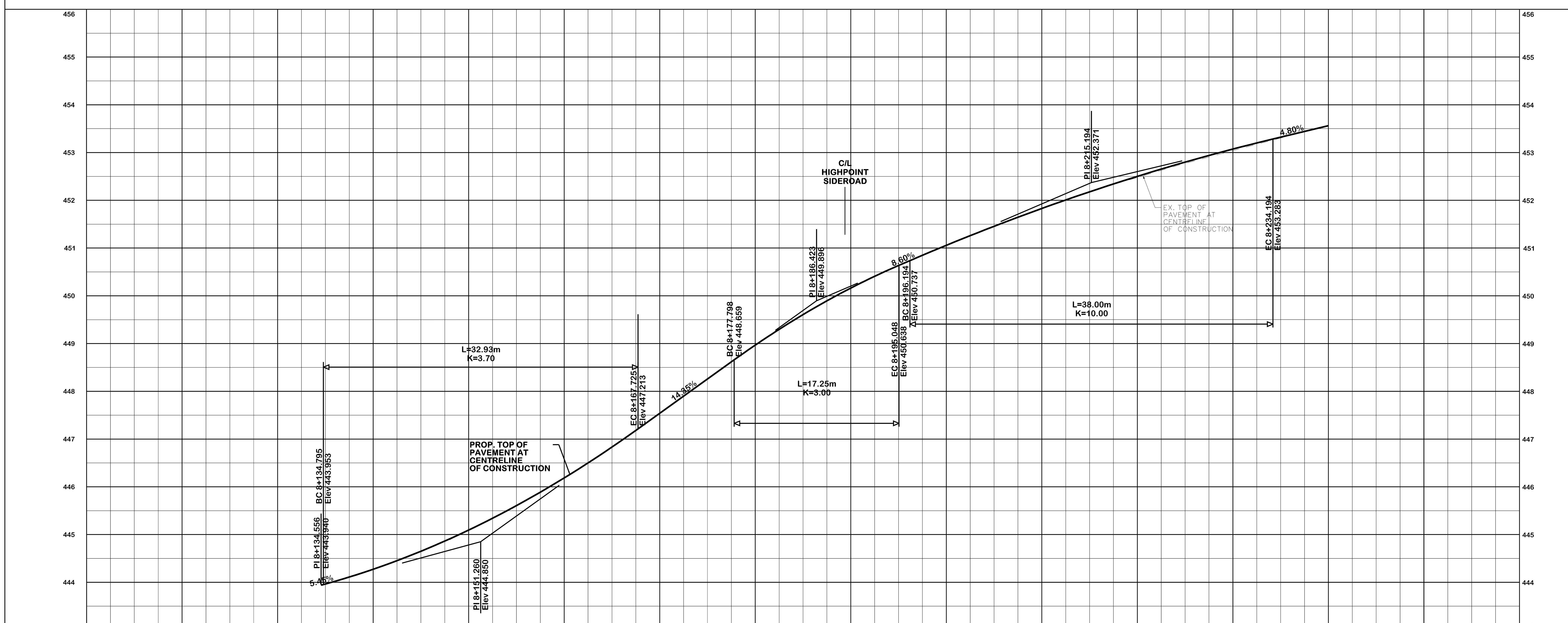

PROP. SWALE ELEV.						
PROP. FINISHED GRADE		445.09	447.53	450.17	451.83	453.04
EX. ROAD ELEV.		445.10	447.54	450.16	451.83	453.08
ROAD CHAINAGE	8+130	8+150	8+170	8+190	8+210	8+230

General Notes

All Driveways Are ASPHALT Unless Otherwise Noted

All Water And Sanitary Service Locations Are Approximate And Must Be Located Accurately In The Field

All Horizontal And Vertical Bends Are In Degrees

All Pipes Size In mm

20C Existing Water Service, Size In mm

WS20 Proposed Water Service, Size In mm

B.M. No. 798475 Elev. 412.263 m
Description
Location Lat. 43-50.8 Long. 80-03.0

The Contractor Is Responsible For Locating And Protecting All Existing Utilities Prior To And During Construction. Location Of Existing Utilities Approximate Only, To Be Verified In Field By Contractor.

Designed by ______ ______ ______ ______ Chkd. ______

Approved by ______ ______ ______ ______ ______

NOTICE TO CONTRACTOR

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CITY OF BRAMPTON WORKS DEPT.
TOWN OF CALEDON WORKS DEPT.
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ENBRIDGE INCORPORATED-GAS DISTRIBUTION
ONTARIO MINISTRY OF TRANSPORTATION
ONTARIO CLEAN WATER AGENCY
HYDRO ONE NETWORKS
ENERSOURCE, HYDRO MISSISSAUGA
HYDRO ONE BRAMPTON

CABLE TELEVISION/FIBREOPTIC PROVIDERS:
BELL CANADA
ENERSOURCE TELECOM
HYDRO ONE TELECOM
ROGERS CABLE
ALLSTREAM
PSN (PUBLIC SECTOR NETWORK)
FUTUREWAY (FCI BROADBAND)

10m 0 10 20 30m HORIZONTAL SCALE

1m 0 1 2 3m VERTICAL SCALE

TOWN OF CALEDON

ALTON VILLAGE EA

QUEEN ST. (MISSISSAUGA RD. TO MAIN ST.)
MAIN ST. (QUEEN ST. TO HIGH POINT RD.)

PROPOSED RECONSTRUCTION

STA. TO STA.

CAD Area	X-XX	Area		Project No.	2018-81
Checked by:	H.H.	Drawn by:	M.A.D.		
Date:	MARCH 2021	Sheet:	NC-1 of NC 24	Plan No.	XXXXX-D

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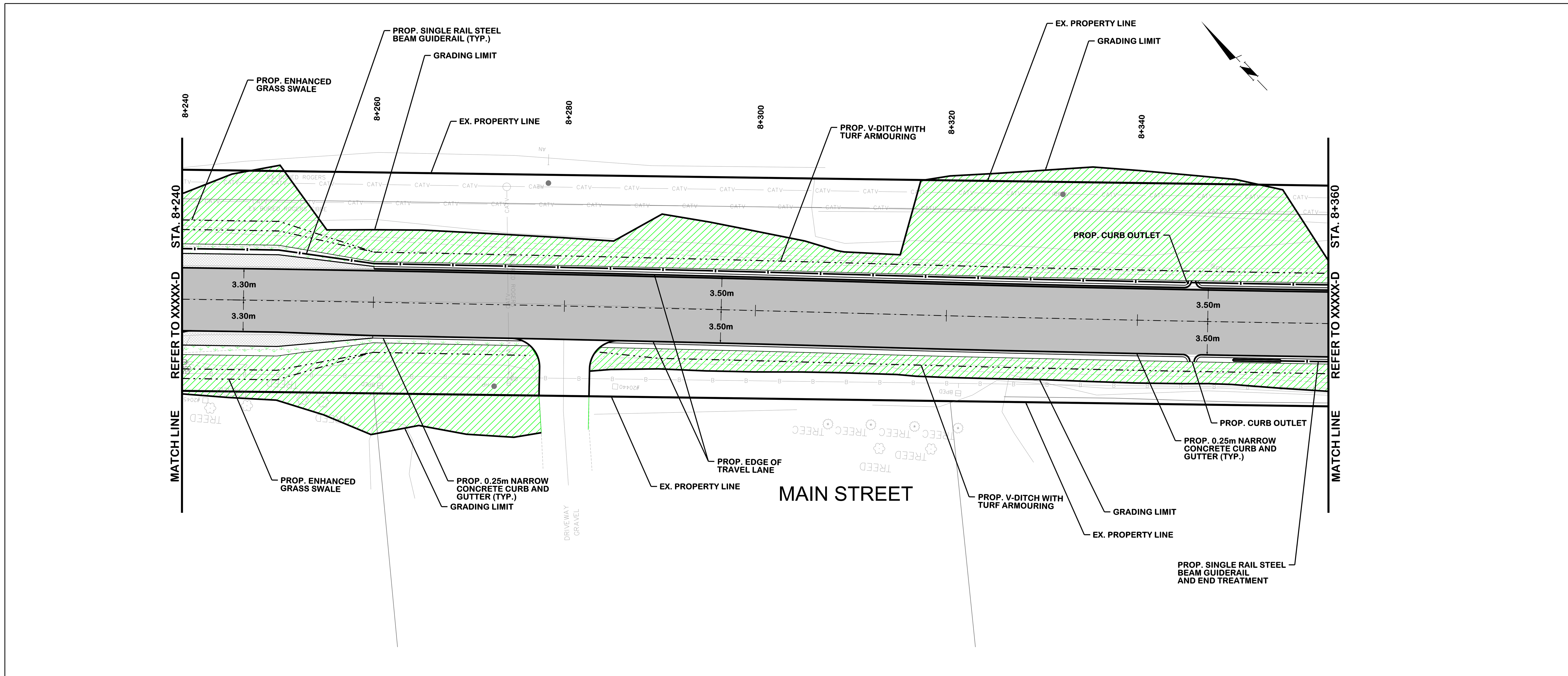

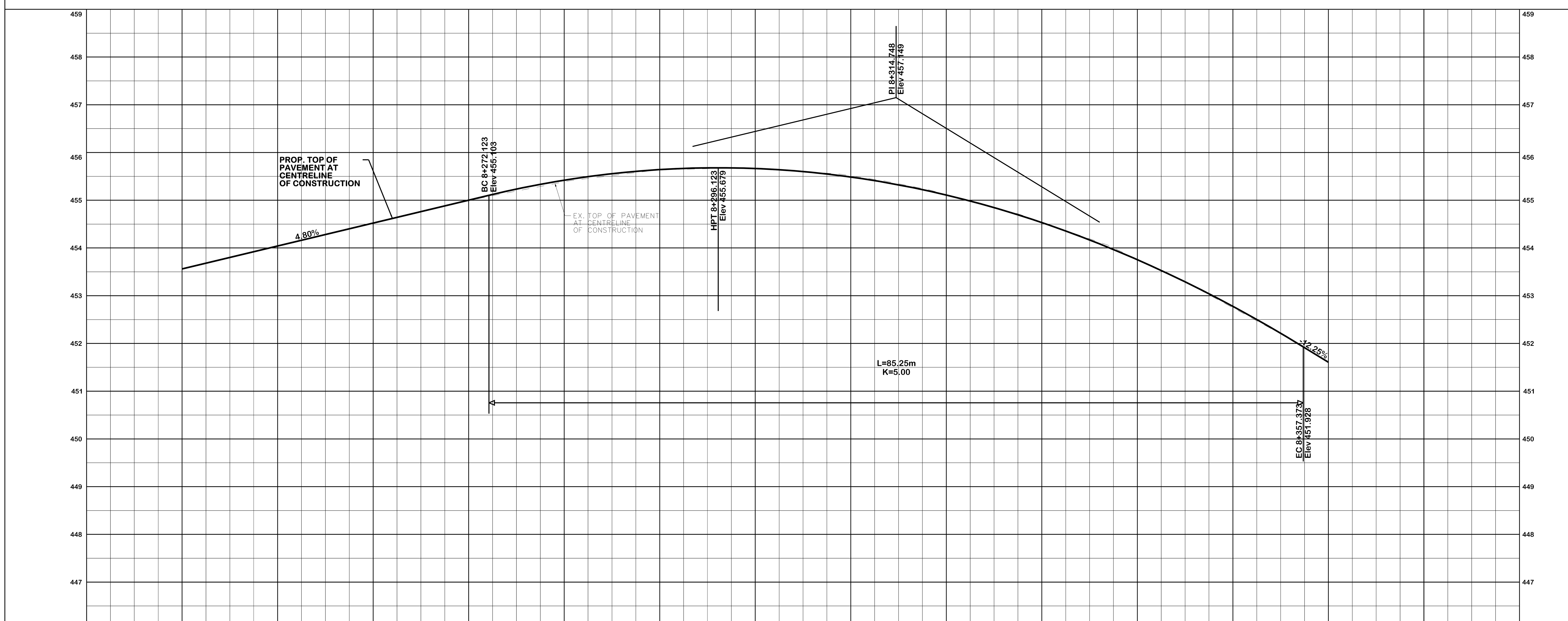

	8+250	8+270	8+290	8+310	8+330	8+350
PROP. SWALE ELEV.						
PROP. FINISHED GRADE	454.05	454.98	455.64	455.51	454.54	452.75
EX. ROAD ELEV.	454.05	455.01	455.65	455.50	454.55	452.79
ROAD CHAINAGE	8+250	8+270	8+290	8+310	8+330	8+350

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GAS MAINS	AUG 06, 2019	C.D.B.			
BELL U/G CABLE	SEP 30, 2019	C.D.B.			
HYDRO U/G CABLE	XXX X, 2019	C.D.B.			
ROGERS PLANT	AUG 12, 2019	C.D.B.			

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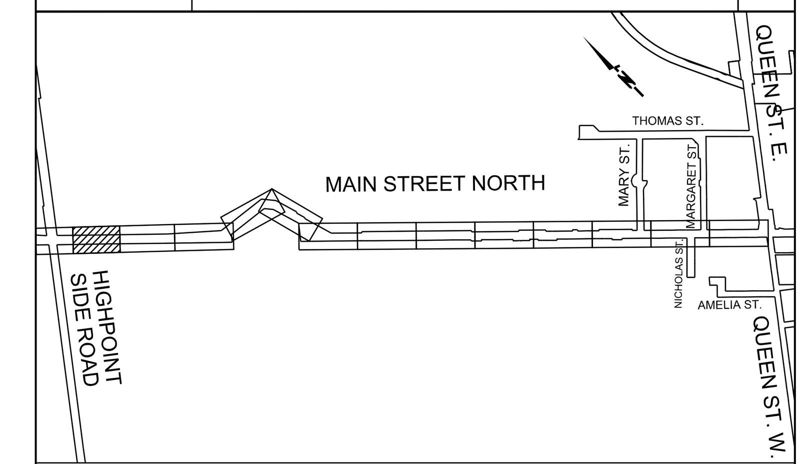

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- PROPOSED PAVED SHOULDER
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- PROPOSED DITCH LINE
- PROPOSED RETAINING WALL
- EXISTING BELL PLANT
- EXISTING ROGERS PLANT
- EXISTING GAS LINE
- EXISTING WATERMAIN

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General Notes

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B.M. No. 798475 Elev. 412.263 m
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Designed by ____ Chkd. ____ Approved by ____

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ONTARIO MINISTRY OF TRANSPORTATION
ONTARIO CLEAN WATER AGENCY
HYDRO ONE NETWORKS
ENERSOURCE, HYDRO MISSISSAUGA
HYDRO ONE BRAMPTON

CABLE TELEVISION/FIBREOPTIC PROVIDERS:
BELL CANADA
ENERSOURCE TELECOM
HYDRO ONE TELECOM
ROGERS CABLE
ALLSTREAM
PSN (PUBLIC SECTOR NETWORK)
FUTUREWAY (FCI BROADBAND)

HORIZONTAL SCALE: 10m 0 10 20 30m
VERTICAL SCALE: 1m 0 1 2 3m

TOWN OF CALEDON

ALTON VILLAGE EA

QUEEN ST. (MISSISSAUGA RD. TO MAIN ST.)
MAIN ST. (QUEEN ST. TO HIGH POINT RD.)

PROPOSED RECONSTRUCTION

STA. TO STA.

CAD Area: X-XX	Area		Project No. 2018-81
Checked by: H.H.	Drawn by: M.A.D.		
Date: MARCH 2021	Sheet: NC-2 of NC 24		Plan No. XXXXX-D

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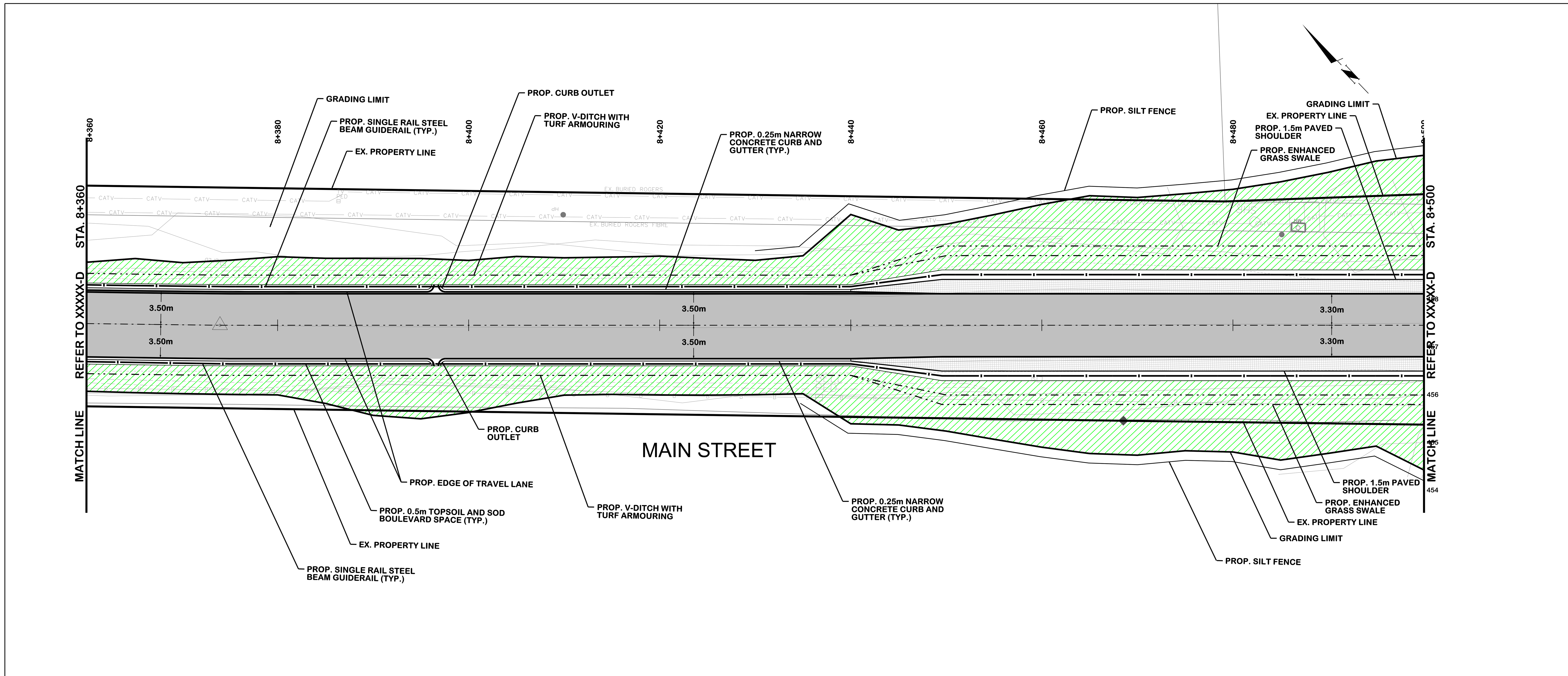

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GAS MAINS	AUG 06, 2019	C.D.B.			
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HYDRO U/G CABLE	XXX X, 2019	C.D.B.			
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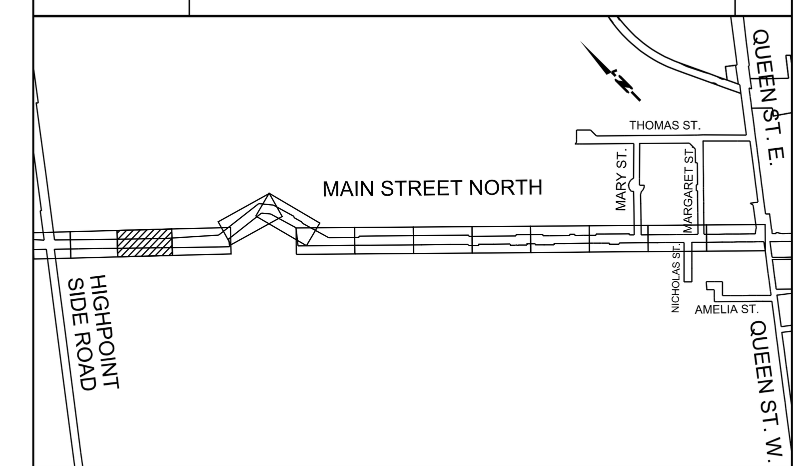

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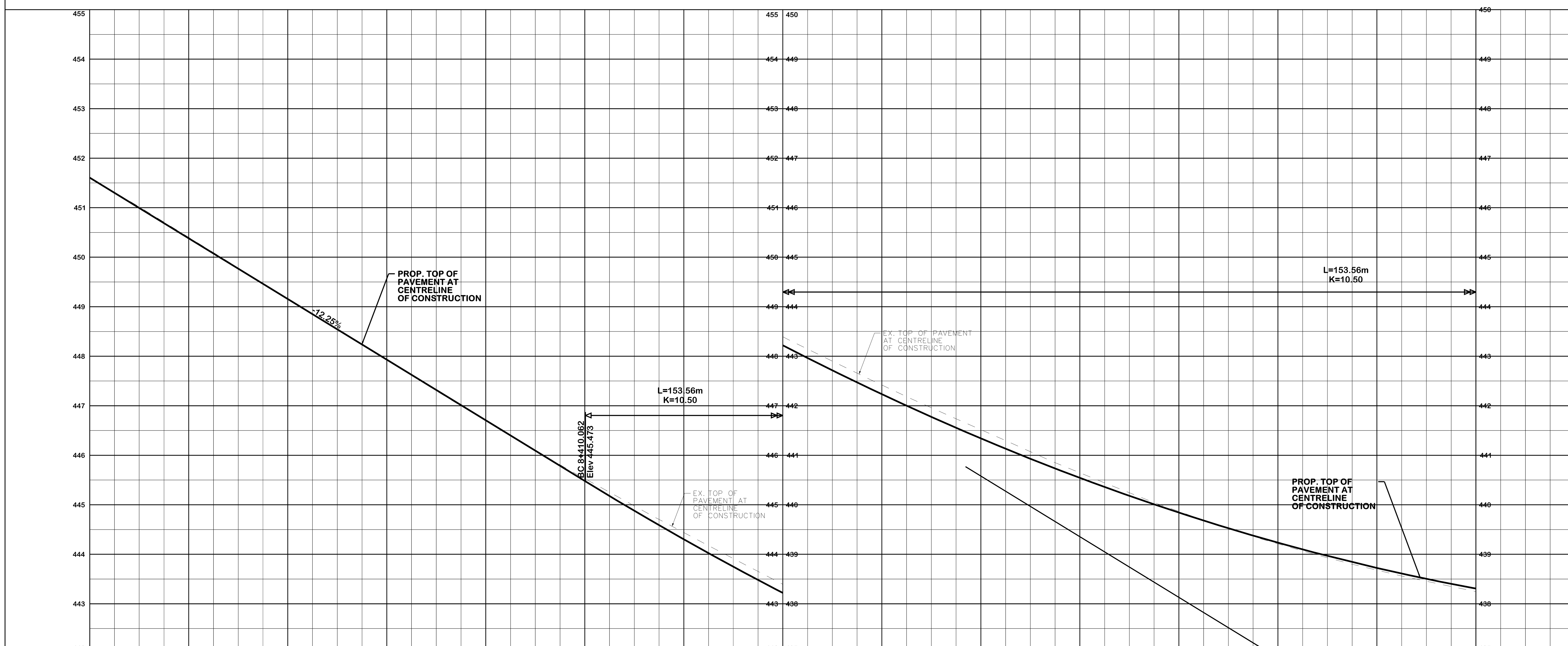

PROP. SWALE ELEV.								
PROP. FINISHED GRADE	450.40	447.92	445.53	443.39	441.52	439.87	438.68	
EX. ROAD ELEV.	450.40	447.94	445.49	443.23	441.35	439.85	438.73	
ROAD CHAINAGE	8+370	8+390	8+410	8+430	8+450	8+470	8+490	

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FUTUREWAY (FCI BROADBAND)

10m 0 10 20 30m HORIZONTAL SCALE
1m 0 1 2 3m VERTICAL SCALE

TOWN OF CALEDON

ALTON VILLAGE EA

QUEEN ST. (MISSISSAUGA RD. TO MAIN ST.)
MAIN ST. (QUEEN ST. TO HIGH POINT RD.)

PROPOSED RECONSTRUCTION

STA. TO STA.

CAD Area	X-XX	Area		Project No.	2018-81
Checked by:	H.H.	Drawn by:	M.A.D.		
Date:	MARCH 2021	Sheet:	NC-3 of NC 24	Plan No.	XXXXX-D

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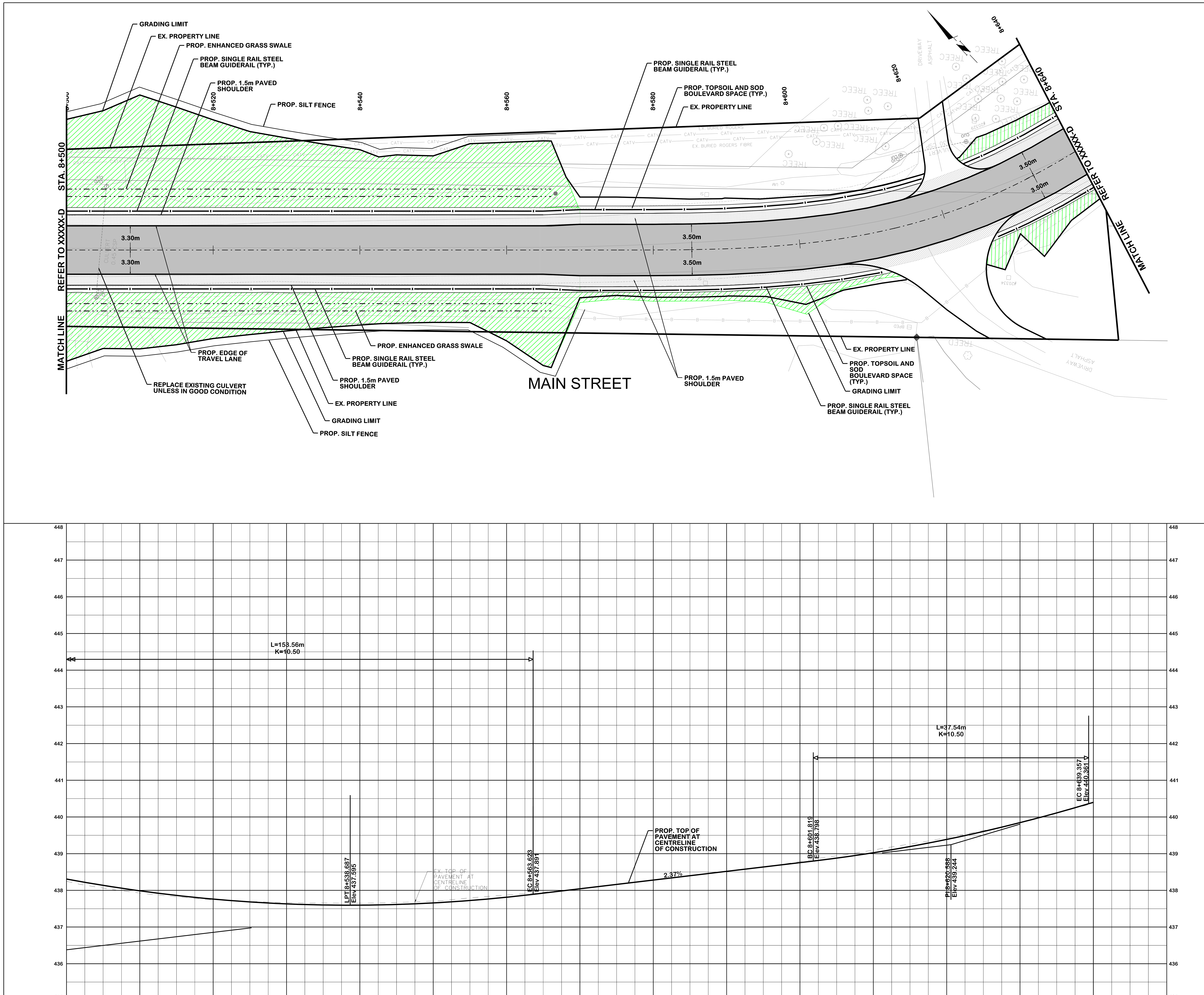

	8+510	8+530	8+550	8+570	8+590	8+610	8+630
PROP. SWALE ELEV.							
PROP. FINISHED GRADE	437.93	437.67	437.71	438.05	438.52	439.10	439.84
EX. ROAD ELEV.	437.99	437.63	437.66	438.04	438.52	439.02	439.85
ROAD CHAINAGE	8+510	8+530	8+550	8+570	8+590	8+610	8+630

SERVICE DATA

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GAS MAINS	AUG 06, 2019	C.D.B.			
BELL U/G CABLE	SEP 30, 2019	C.D.B.			
HYDRO U/G CABLE	XXX X, 2019	C.D.B.			
ROGERS PLANT	AUG 12, 2019	C.D.B.			

REVISIONS

DATE	DETAILS	INIT.
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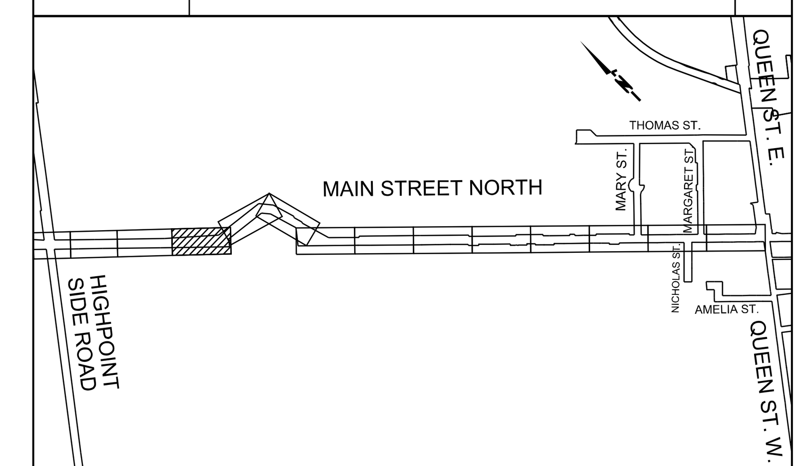

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STA.		TO STA.	
CAD Area: X-XX	Area	Project No.	2018-81
Checked by: H.H.	Drawn by: M.A.D.		
Date: MARCH 2021	Sheet: NC-4 of NC 24	Plan No.	XXXXX-D

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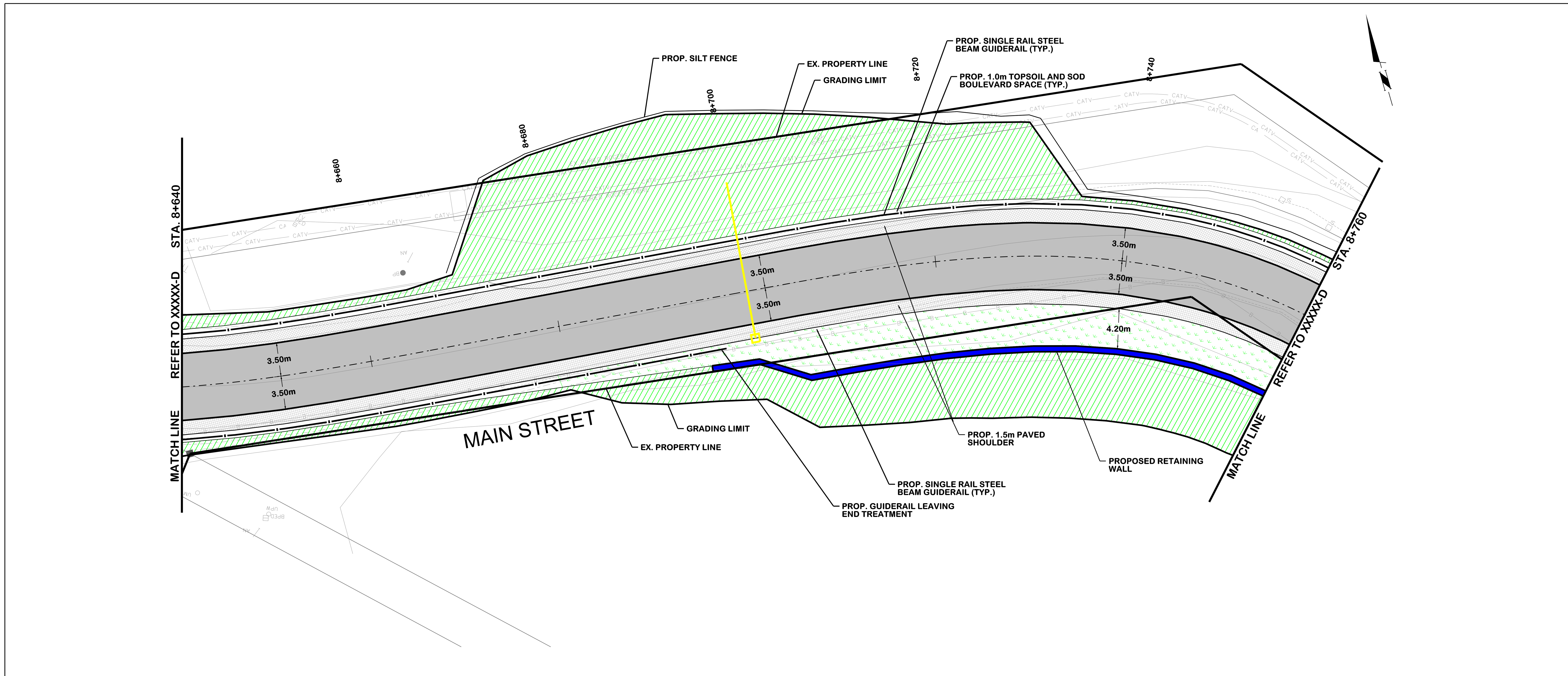

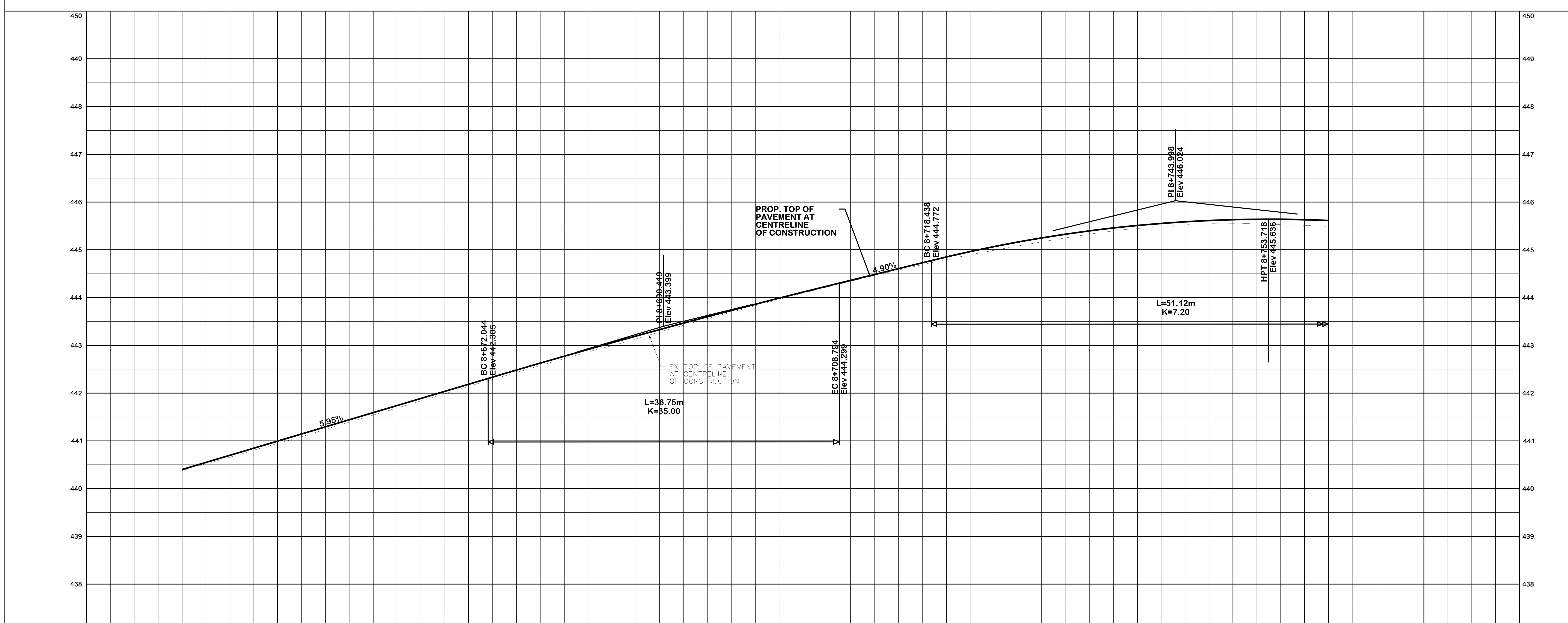

PROP. SWALE ELEV.						
PROP. FINISHED GRADE	440.94	442.14	443.28	444.34	445.16	445.55
EX. ROAD ELEV.	440.99	442.18	443.32	444.35	445.24	445.63
ROAD CHAINAGE	8+650	8+670	8+690	8+710	8+730	8+750

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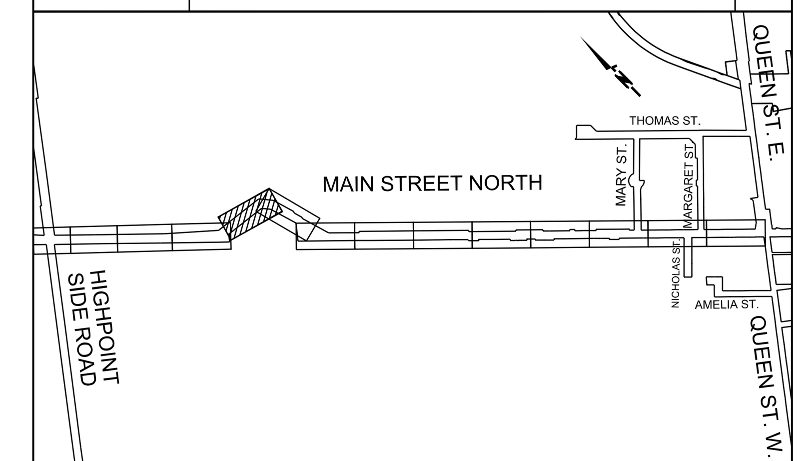

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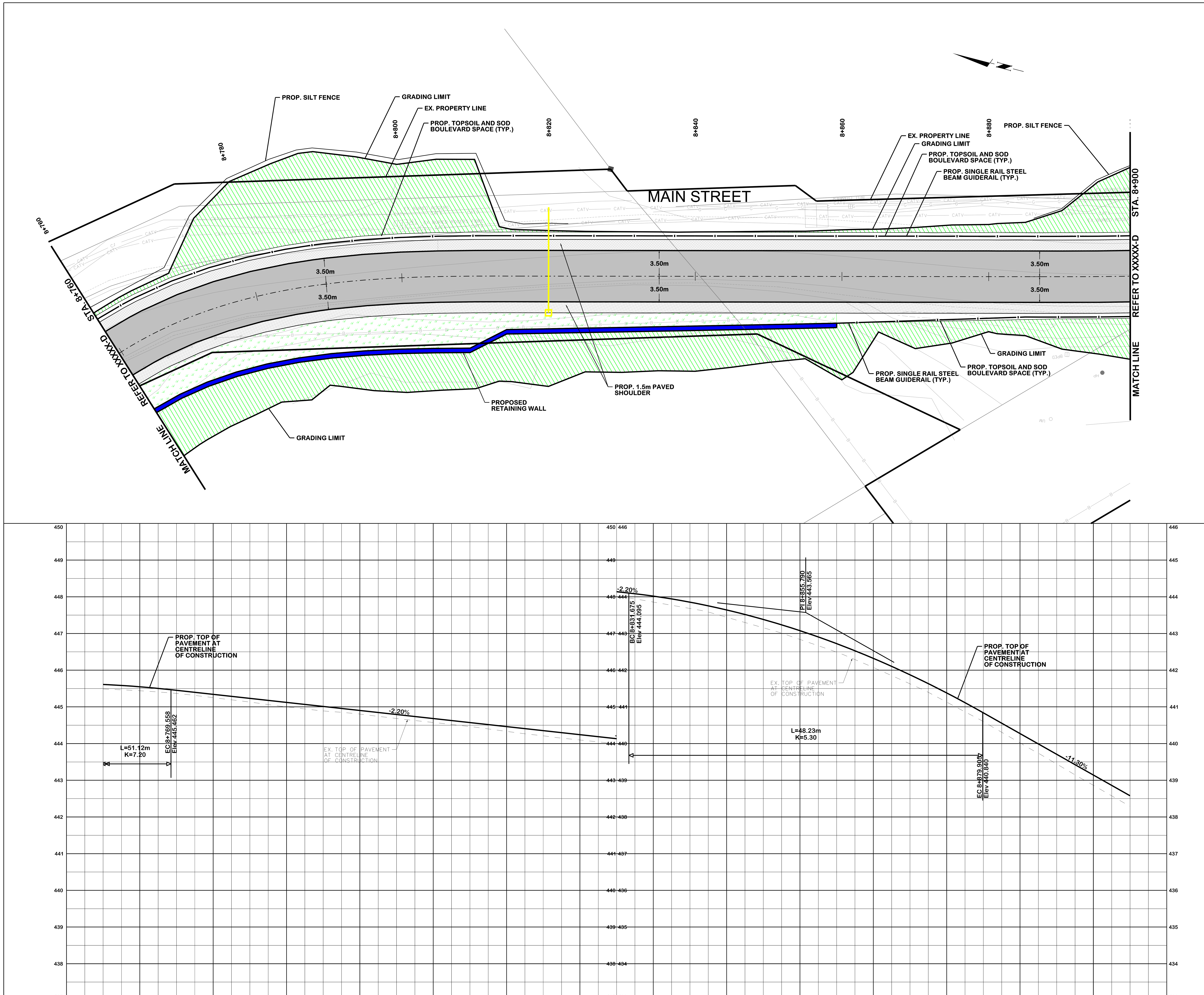


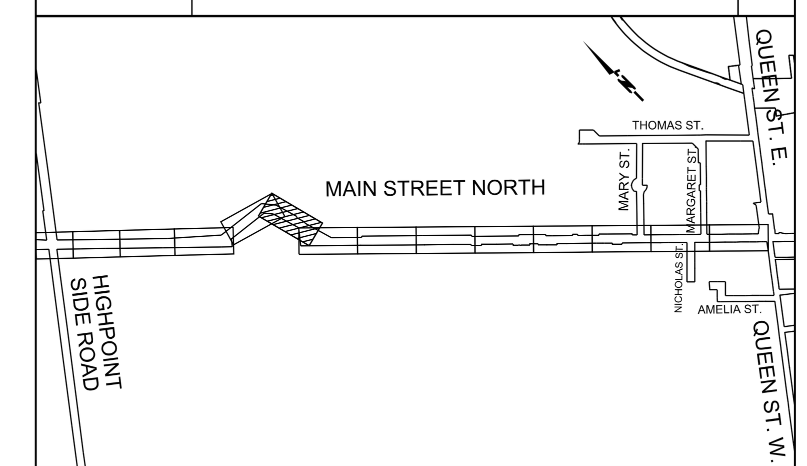
							PROP. SWALE ELEV.
445.37	444.89	444.46	443.99	443.15	441.62	439.43	PROP. FINISHED GRADE
445.46	445.02	444.58	444.13	443.38	441.86	439.70	EX. ROAD ELEV.
8+770	8+790	8+810	8+830	8+850	8+870	8+890	ROAD CHAINAGE

SERVICE DATA

SERVICE	DATE	INIT.	SERVICE	DATE	INIT.
HYDRO ONE	XXX X, 2019	C.D.B.			
WATERMAINS	AUG 09, 2019	C.D.B.			
GAS MAINS	AUG 06, 2019	C.D.B.			
BELL U/G CABLE	SEP 30, 2019	C.D.B.			
HYDRO U/G CABLE	XXX X, 2019	C.D.B.			
ROGERS PLANT	AUG 12, 2019	C.D.B.			

REVISIONS

DATE	DETAILS	INIT.
NOV 22, 2019	ISSUED FOR PIC REVIEW	J.P.D.
MAR. 12, 2021	30% PRELIMINARY DESIGN	D.J.O.



LEGEND:

- PROPOSED ROADWAY PAVEMENT
- PROPOSED IMPRESSED COLORED CONCRETE
- PROPOSED CONCRETE SIDEWALK / CONCRETE BUS PAD
- PROPOSED PAVED SHOULDER
- PROPOSED TOPSOIL AND SOD
- PROPOSED CUT/ FILL
- PROPOSED DITCH LINE
- PROPOSED RETAINING WALL
- EXISTING BELL PLANT
- EXISTING ROGERS PLANT
- EXISTING GAS LINE
- EXISTING WATERMAIN

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General Notes

All Driveways Are ASPHALT Unless Otherwise Noted

All Water And Sanitary Service Locations Are Approximate And Must Be Located Accurately In The Field

All Horizontal And Vertical Bends Are In Degrees

All Pipes Size In mm

20C Existing Water Service, Size In mm

WS20 Proposed Water Service, Size In mm

B.M. No. 798475 Elev. 412.263 m
Description
Location Lat. 43-50.8 Long. 80-03.0

The Contractor Is Responsible For Locating And Protecting All Existing Utilities Prior To And During Construction. Location Of Existing Utilities Approximate Only, To Be Verified In Field By Contractor.

Designed by ____ ____ ____ ____ Chkd. ____

Approved by ____ ____ ____ ____ ____

NOTICE TO CONTRACTOR

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THE REGIONAL MUNICIPALITY OF PEEL
CITY OF MISSISSAUGA WORKS DEPT.
CITY OF BRAMPTON WORKS DEPT.
TOWN OF CALEDON WORKS DEPT.
BELL CANADA
ENBRIDGE INCORPORATED-GAS DISTRIBUTION
ONTARIO MINISTRY OF TRANSPORTATION
ONTARIO CLEAN WATER AGENCY
HYDRO ONE NETWORKS
ENERSOURCE, HYDRO MISSISSAUGA
HYDRO ONE BRAMPTON

CABLE TELEVISION/FIBREOPTIC PROVIDERS:
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ENERSOURCE TELECOM
HYDRO ONE TELECOM
ROGERS CABLE
ALLSTREAM
PSN (PUBLIC SECTOR NETWORK)
FUTUREWAY (FCI BROADBAND)

10m 0 10 20 30m HORIZONTAL SCALE

1m 0 1 2 3m VERTICAL SCALE

TOWN OF CALEDON

ALTON VILLAGE EA

QUEEN ST. (MISSISSAUGA RD. TO MAIN ST.)
MAIN ST. (QUEEN ST. TO HIGH POINT RD.)

PROPOSED RECONSTRUCTION

STA. TO STA.

CAD Area	X-XX	Area		Project No.	2018-81
Checked by:	H.H.	Drawn by:	M.A.D.		
Date:	MARCH 2021	Sheet:	NC-6 of NC 24	Plan No.	XXXXX-D

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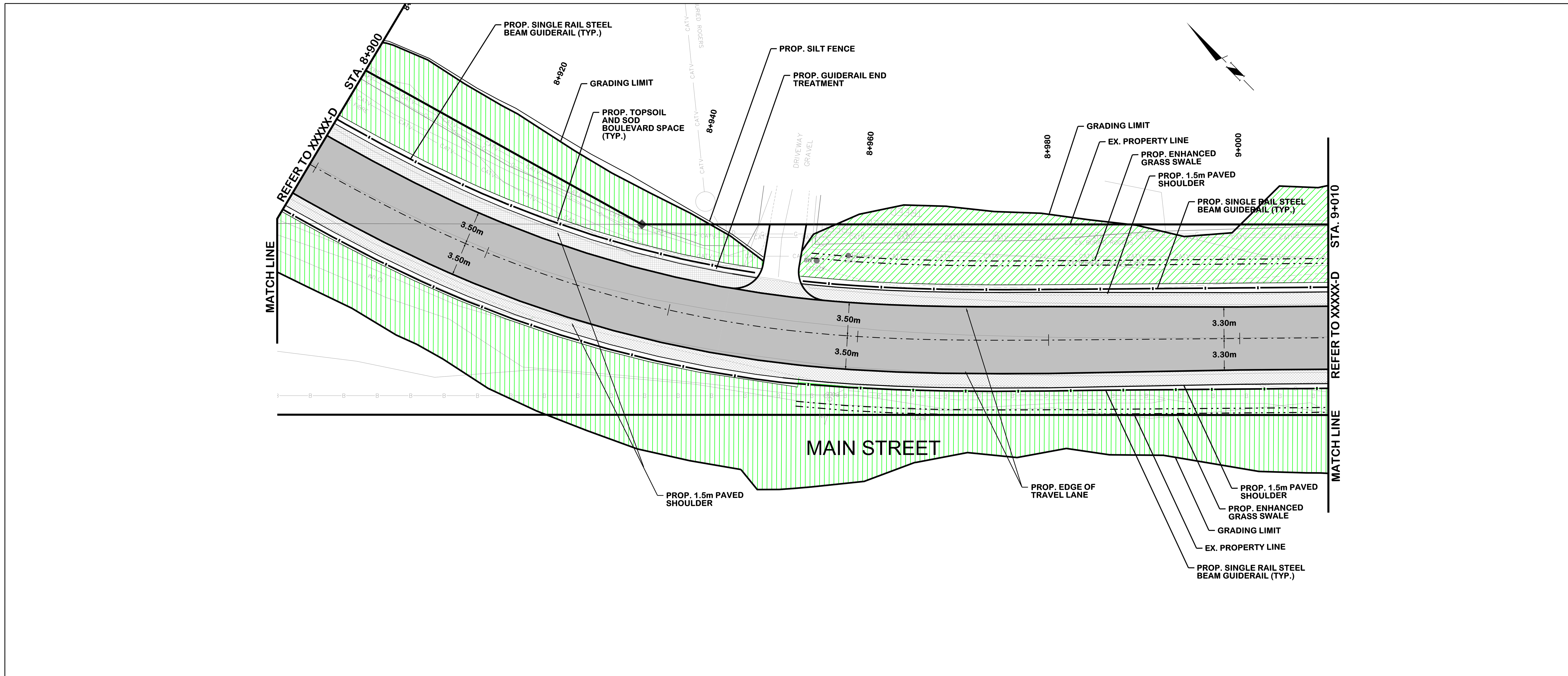
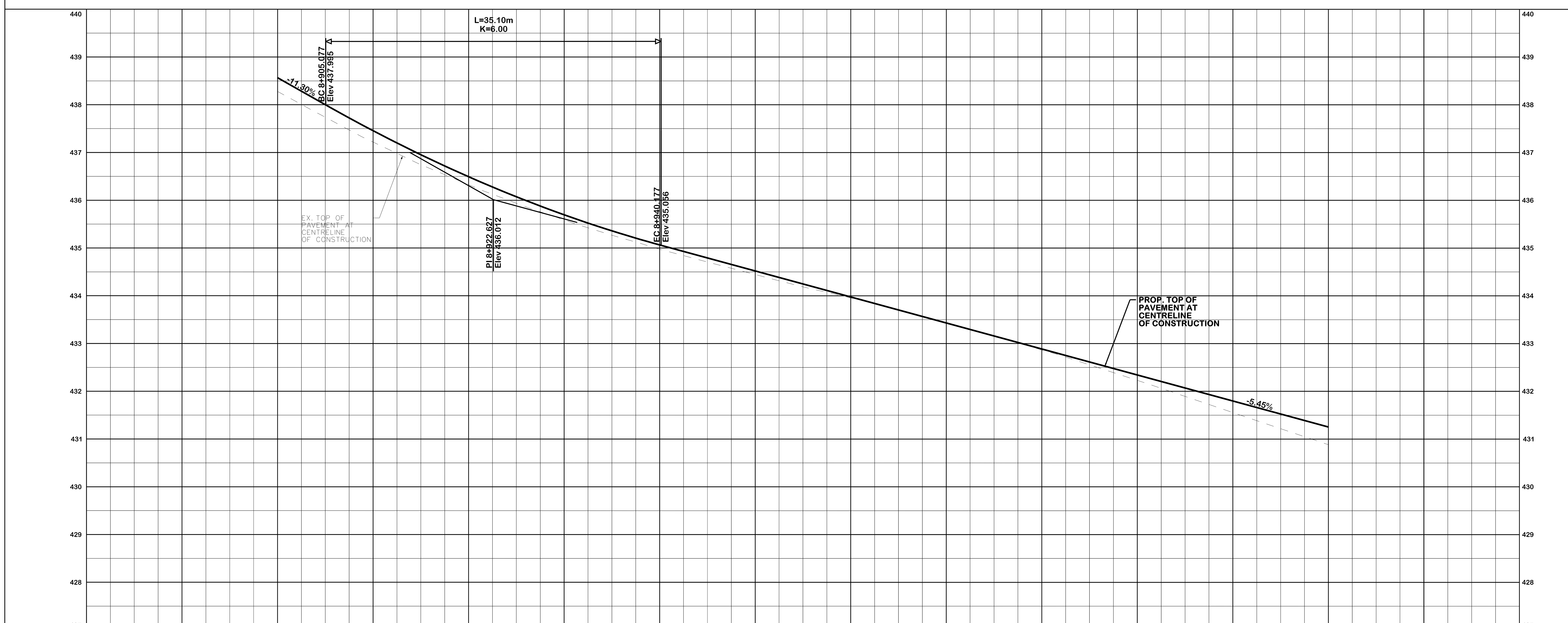




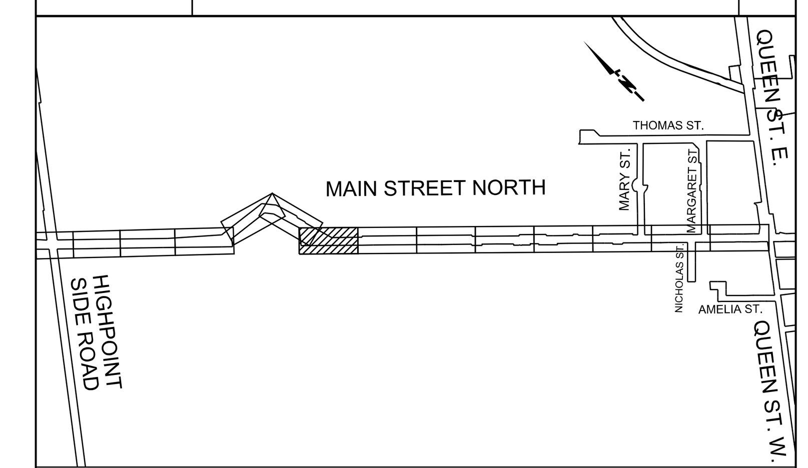
	8+910	8+930	8+950	8+970	8+990
PROP. SWALE ELEV.					
PROP. FINISHED GRADE	437.22	435.59	434.44	433.44	432.23
EX. ROAD ELEV.	437.46	435.71	434.54	433.44	432.35
ROAD CHAINAGE	8+910	8+930	8+950	8+970	8+990

SERVICE DATA

SERVICE	DATE	INIT.	SERVICE	DATE	INIT.
HYDRO ONE	XXX X, 2019	C.D.B.			
WATERMAINS	AUG 09, 2019	C.D.B.			
GAS MAINS	AUG 06, 2019	C.D.B.			
BELL U/G CABLE	SEP 30, 2019	C.D.B.			
HYDRO U/G CABLE	XXX X, 2019	C.D.B.			
ROGERS PLANT	AUG 12, 2019	C.D.B.			

REVISIONS

DATE	DETAILS	INIT.
NOV 22, 2019	ISSUED FOR PIC REVIEW	J.P.D.
MAR. 12, 2021	30% PRELIMINARY DESIGN	D.J.O.



LEGEND:

- PROPOSED ROADWAY PAVEMENT
- PROPOSED IMPRESSED COLORED CONCRETE
- PROPOSED CONCRETE SIDEWALK / CONCRETE BUS PAD
- PROPOSED PAVED SHOULDER
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- PROPOSED DITCH LINE
- PROPOSED RETAINING WALL
- EXISTING BELL PLANT
- EXISTING ROGERS PLANT
- EXISTING GAS LINE
- EXISTING WATERMAIN

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All Pipes Size In mm
20C Existing Water Service, Size In mm
WS20 Proposed Water Service, Size In mm
B.M. No. 798475 Elev. 412.263 m
Description
Location Lat. 43-50.8 Long. 80-03.0
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Designed by ____ ____ ____ ____ Chkd. ____
Approved by ____ ____ ____ ____ ____

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CITY OF MISSISSAUGA WORKS DEPT.
CITY OF BRAMPTON WORKS DEPT.
TOWN OF CALEDON WORKS DEPT.
BELL CANADA
ENBRIDGE INCORPORATED-GAS DISTRIBUTION
ONTARIO MINISTRY OF TRANSPORTATION
ONTARIO CLEAN WATER AGENCY
HYDRO ONE NETWORKS
ENERSOURCE, HYDRO MISSISSAUGA
HYDRO ONE BRAMPTON

CABLE TELEVISION/FIBREOPTIC PROVIDERS:
BELL CANADA
ENERSOURCE TELECOM
HYDRO ONE TELECOM
ROGERS CABLE
ALLSTREAM
PSN (PUBLIC SECTOR NETWORK)
FUTUREWAY (FCI BROADBAND)

10m 0 10 20 30m HORIZONTAL SCALE
1m 0 1 2 3m VERTICAL SCALE

TOWN OF CALEDON

ALTON VILLAGE EA

QUEEN ST. (MISSISSAUGA RD. TO MAIN ST.)
MAIN ST. (QUEEN ST. TO HIGH POINT RD.)

PROPOSED RECONSTRUCTION

STA. TO STA.

CAD Area	X-XX	Area		Project No.	2018-81
Checked by:	H.H.	Drawn by:	M.A.D.		
Date:	MARCH 2021	Sheet:	NC-7 of NC 24	Plan No.	XXXXX-D

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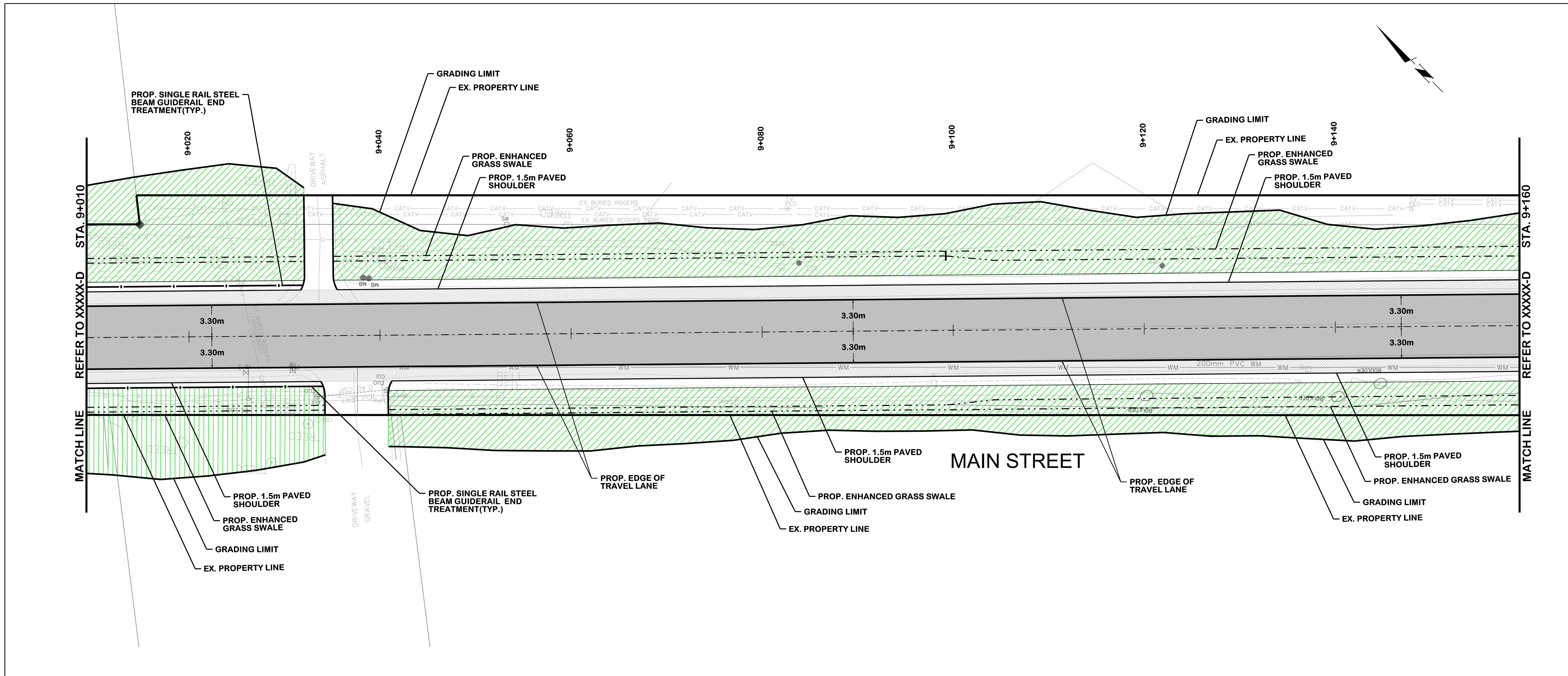
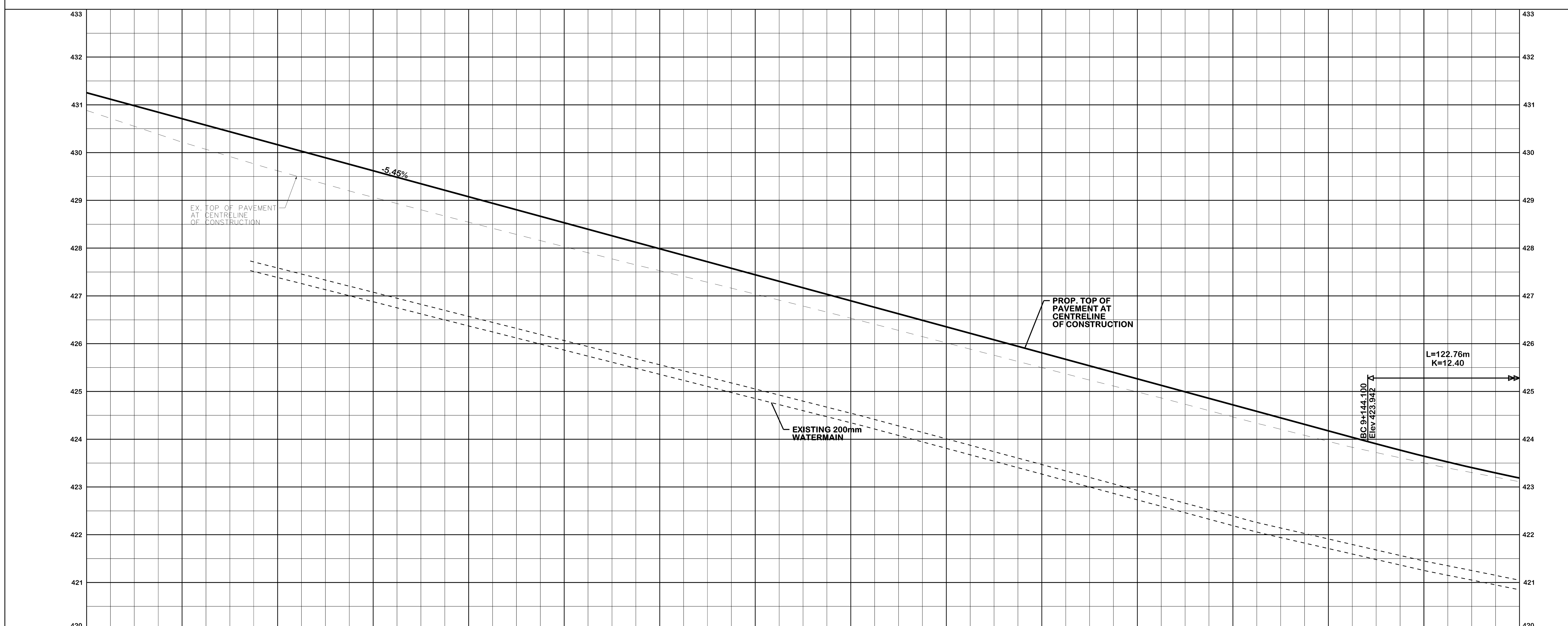




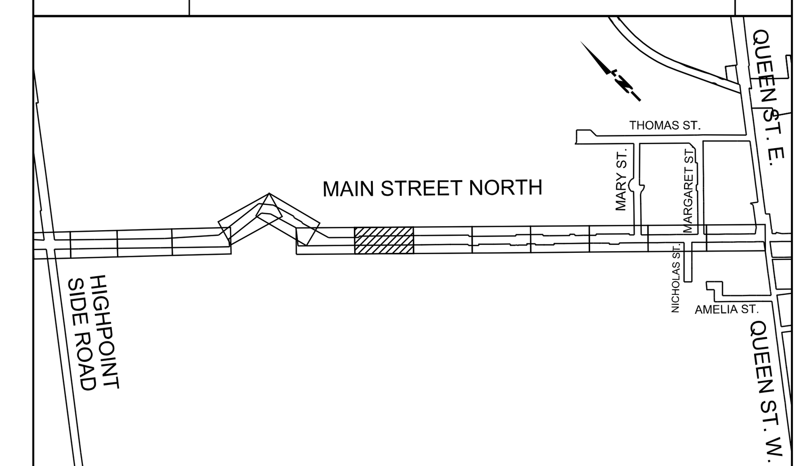
	9+010	9+030	9+050	9+070	9+090	9+110	9+130	9+150
PROP. SWALE ELEV.								
PROP. FINISHED GRADE	430.88	429.62	428.54	427.52	426.53	425.49	424.46	423.49
EX. ROAD ELEV.	431.26	430.17	429.08	427.99	426.90	425.81	424.71	423.64
ROAD CHAINAGE	9+010	9+030	9+050	9+070	9+090	9+110	9+130	9+150

SERVICE DATA

SERVICE	DATE	INIT.	SERVICE	DATE	INIT.
HYDRO ONE	XXX X, 2019	C.D.B.			
WATERMAINS	AUG 09, 2019	C.D.B.			
GAS MAINS	AUG 06, 2019	C.D.B.			
BELL U/G CABLE	SEP 30, 2019	C.D.B.			
HYDRO U/G CABLE	XXX X, 2019	C.D.B.			
ROGERS PLANT	AUG 12, 2019	C.D.B.			

REVISIONS

DATE	DETAILS	INIT.
NOV 22, 2019	ISSUED FOR PIC REVIEW	J.P.D.
MAR. 12, 2021	30% PRELIMINARY DESIGN	D.J.O.



LEGEND:

- PROPOSED ROADWAY PAVEMENT
- PROPOSED IMPRESSED COLORED CONCRETE
- PROPOSED CONCRETE SIDEWALK / CONCRETE BUS PAD
- PROPOSED PAVED SHOULDER
- PROPOSED TOPSOIL AND SOD
- PROPOSED CUT/ FILL
- PROPOSED DITCH LINE
- PROPOSED RETAINING WALL
- EXISTING BELL PLANT
- EXISTING ROGERS PLANT
- EXISTING GAS LINE
- EXISTING WATERMAIN

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General Notes

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All Horizontal and Vertical Bends Are In Degrees
All Pipes Size In mm
20C Existing Water Service, Size In mm
WS20 Proposed Water Service, Size In mm
B.M. No. 798475 Elev. 412.263 m
Description
Location Lat. 43-50.8 Long. 80-03.0
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Designed by ______ Chkd. ______ Approved by ______

NOTICE TO CONTRACTOR

48 HOURS PRIOR TO COMMENCING WORK NOTIFY THE FOLLOWING

THE REGIONAL MUNICIPALITY OF PEEL	CABLE TELEVISION/FIBREOPTIC PROVIDERS:
CITY OF MISSISSAUGA WORKS DEPT.	BELL CANADA
CITY OF BRAMPTON WORKS DEPT.	ENERSOURCE TELECOM
TOWN OF CALEDON WORKS DEPT.	HYDRO ONE TELECOM
BELL CANADA	ROGERS CABLE
ENBRIDGE INCORPORATED-GAS DISTRIBUTION	ALLSTREAM
ONTARIO MINISTRY OF TRANSPORTATION	PSN (PUBLIC SECTOR NETWORK)
ONTARIO CLEAN WATER AGENCY	FUTUREWAY (FCI BROADBAND)
HYDRO ONE NETWORKS	
ENERSOURCE, HYDRO MISSISSAUGA	
HYDRO ONE BRAMPTON	

10m 0 10 20 30m HORIZONTAL SCALE
1m 0 1 2 3m VERTICAL SCALE

TOWN OF CALEDON

ALTON VILLAGE EA

QUEEN ST. (MISSISSAUGA RD. TO MAIN ST.)
MAIN ST. (QUEEN ST. TO HIGH POINT RD.)

PROPOSED RECONSTRUCTION

STA.		TO STA.	
CAD Area: X-XX	Area	Project No. 2018-81	
Checked by: H.H.	Drawn by: M.A.D.		
Date: MARCH 2021	Sheet: NC-8 of NC 24	Plan No. XXXXX-D	

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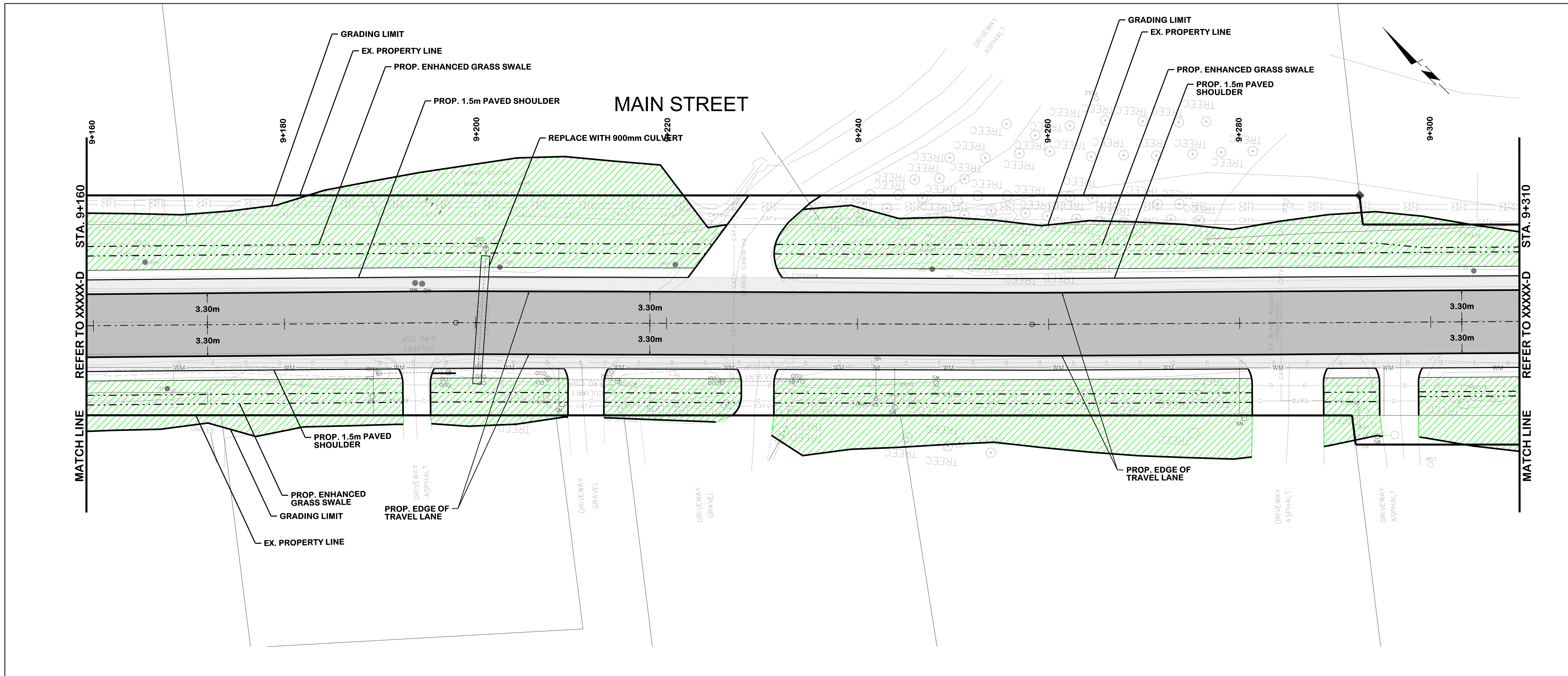
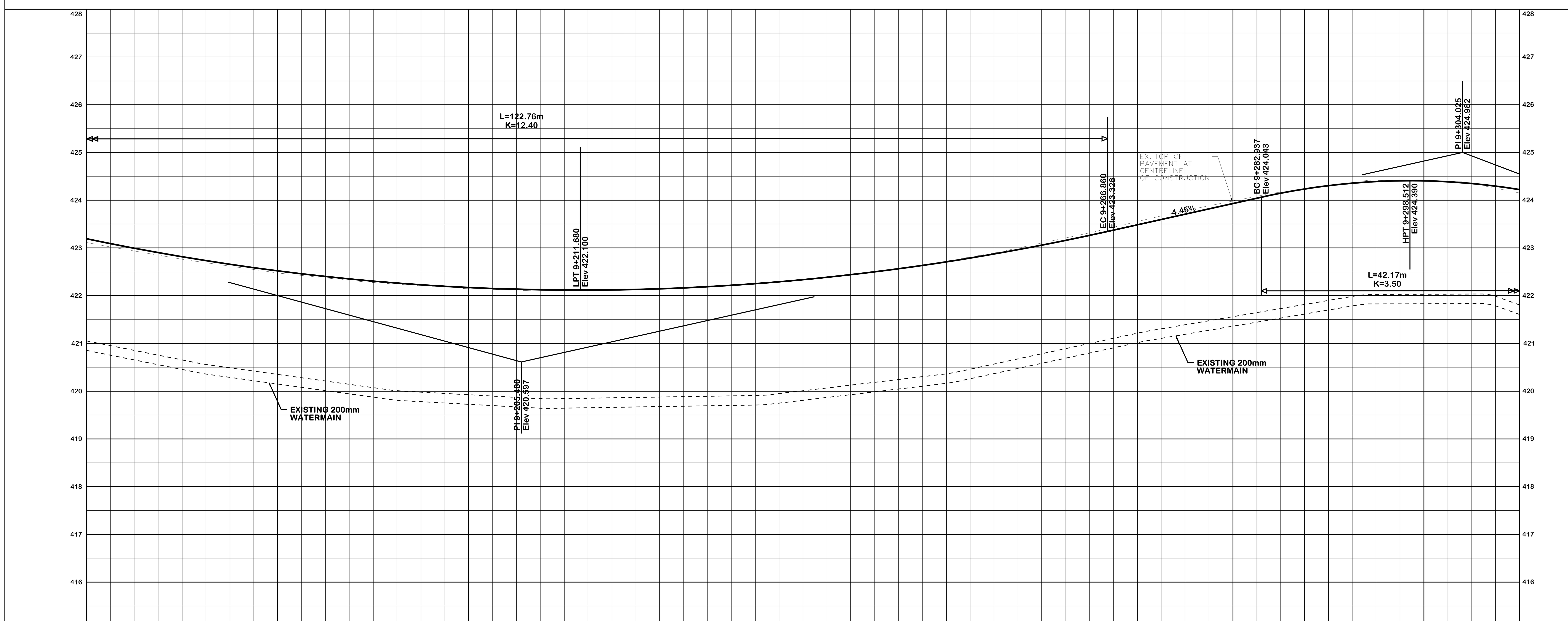




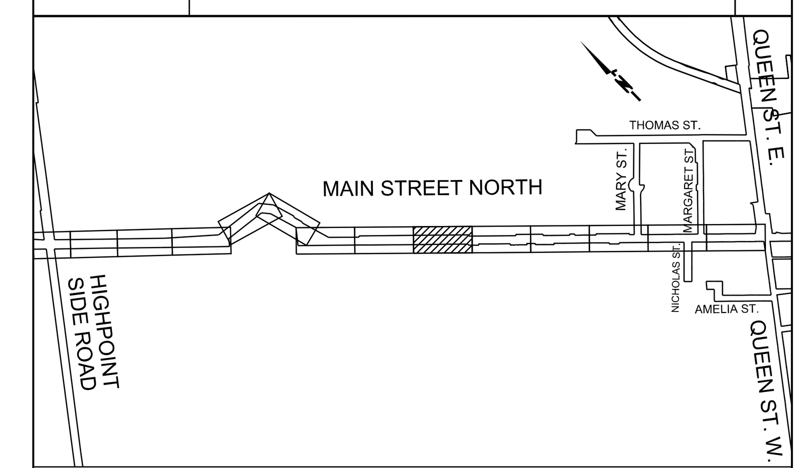
							PROP. SWALE ELEV.
422.75	422.26	422.09	422.25	422.71	423.54	424.29	PROP. FINISHED GRADE
422.80	422.29	422.10	422.23	422.69	423.46	424.28	EX. ROAD ELEV.
9+170	9+190	9+210	9+230	9+250	9+270	9+290	ROAD CHAINAGE

SERVICE DATA

SERVICE	DATE	INIT.	SERVICE	DATE	INIT.
HYDRO ONE	XXX X, 2019	C.D.B.			
WATERMAINS	AUG 09, 2019	C.D.B.			
GAS MAINS	AUG 06, 2019	C.D.B.			
BELL U/G CABLE	SEP 30, 2019	C.D.B.			
HYDRO U/G CABLE	XXX X, 2019	C.D.B.			
ROGERS PLANT	AUG 12, 2019	C.D.B.			

REVISIONS

DATE	DETAILS	INIT.
NOV 22, 2019	ISSUED FOR PIC REVIEW	J.P.D.
MAR. 12, 2021	30% PRELIMINARY DESIGN	D.J.O.



LEGEND:

- PROPOSED ROADWAY PAVEMENT
- PROPOSED IMPRESSED COLORED CONCRETE
- PROPOSED CONCRETE SIDEWALK / CONCRETE BUS PAD
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B.M. No. 798475 Elev. 412.263 m
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HORIZONTAL SCALE 10m 0 10 20 30m
VERTICAL SCALE 1m 0 1 2 3m

TOWN OF CALEDON

ALTON VILLAGE EA

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MAIN ST. (QUEEN ST. TO HIGH POINT RD.)

PROPOSED RECONSTRUCTION

STA. TO STA.

CAD Area	X-XX	Area		Project No.	2018-81
Checked by:	H.H.	Drawn by:	M.A.D.		
Date:	MARCH 2021	Sheet:	NC-9 of NC 24	Plan No.	XXXXX-D

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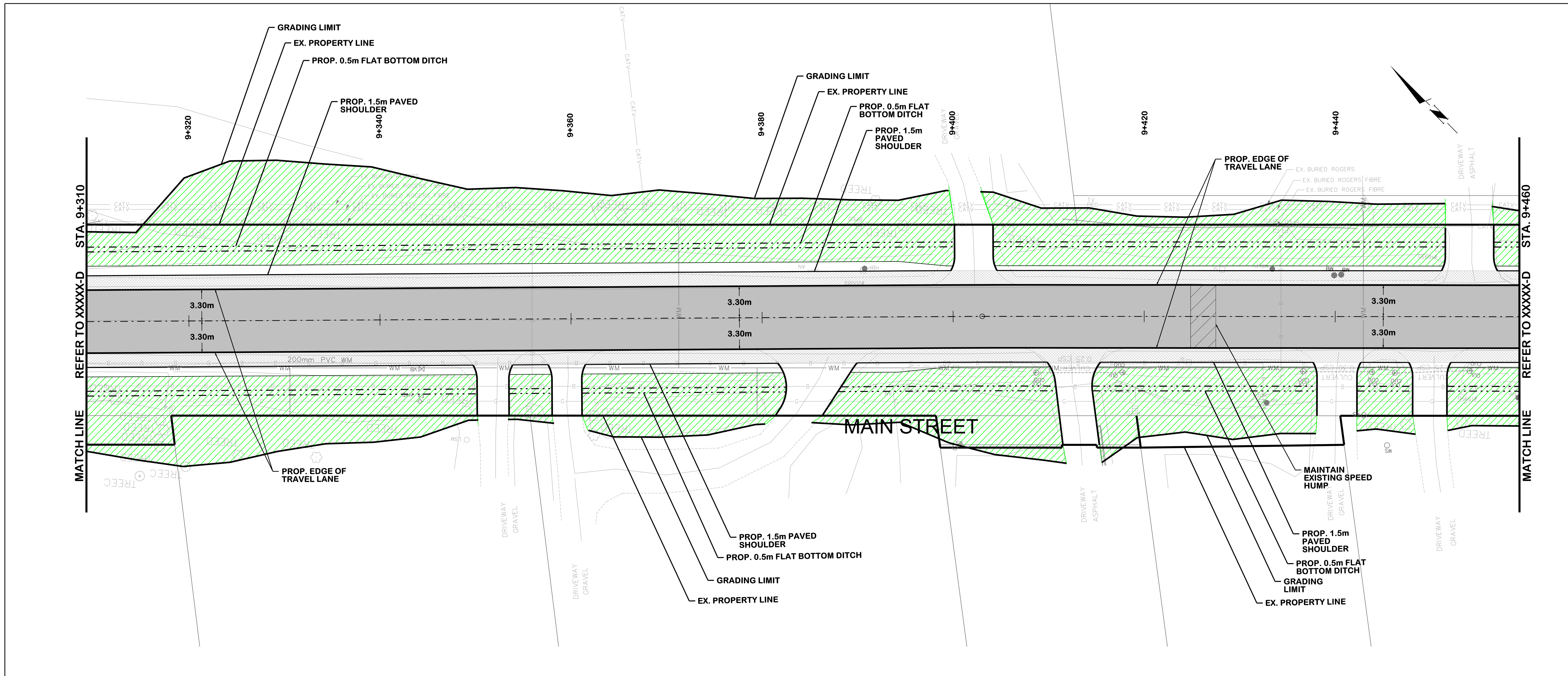

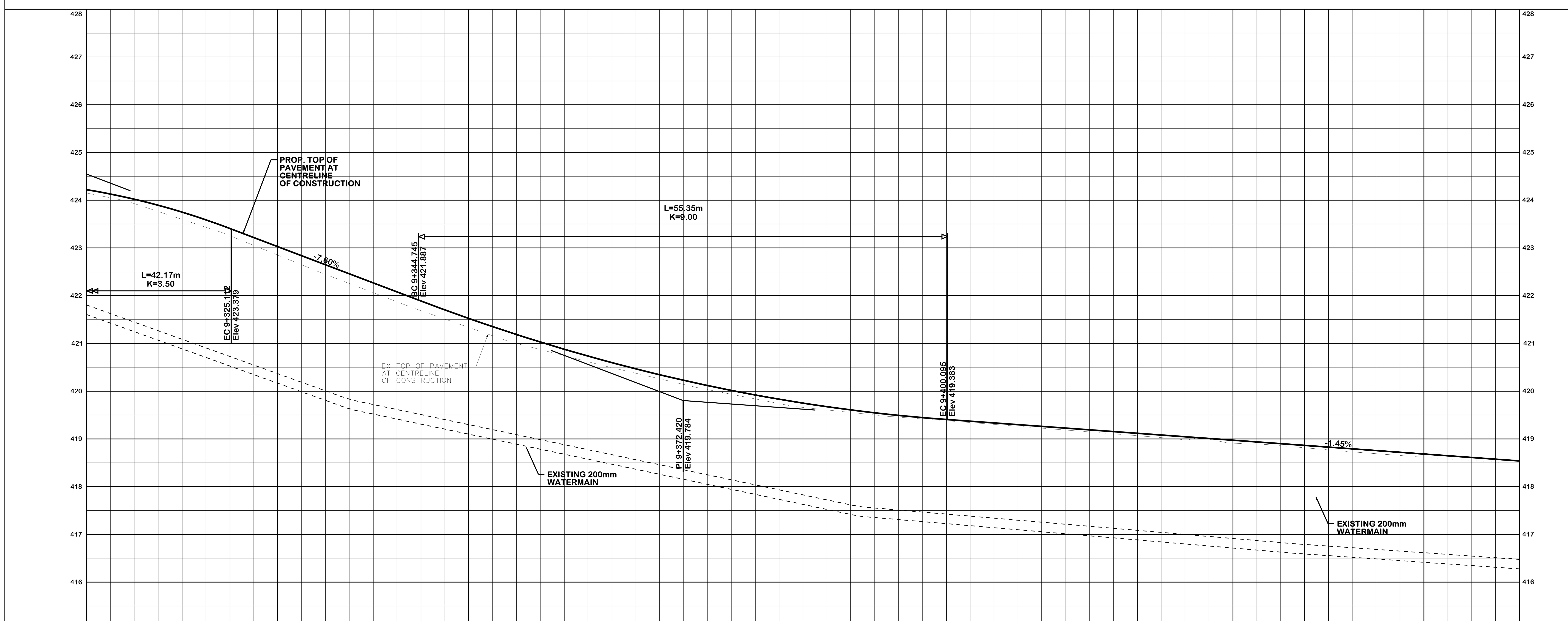

	9+310	9+330	9+350	9+370	9+390	9+410	9+430	9+450
PROP. SWALE ELEV.								
PROP. FINISHED GRADE	424.13	422.83	421.31	420.24	419.53	419.20	418.89	418.59
EX. ROAD ELEV.	424.20	423.01	421.50	420.32	419.57	419.23	418.94	418.65
ROAD CHAINAGE	9+310	9+330	9+350	9+370	9+390	9+410	9+430	9+450

SERVICE DATA

SERVICE	DATE	INIT.	SERVICE	DATE	INIT.
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HYDRO U/G CABLE	XXX X, 2019	C.D.B.			
ROGERS PLANT	AUG 12, 2019	C.D.B.			

REVISIONS

DATE	DETAILS	INIT.
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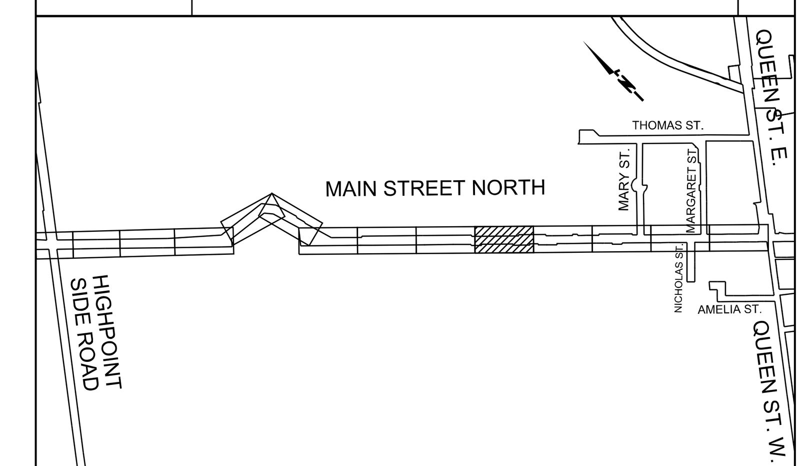

LEGEND:

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Approved by ____ ____ ____ ____ ____

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HORIZONTAL SCALE: 10m 0 10 20 30m

VERTICAL SCALE: 1m 0 1 2 3m

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STA. TO STA.

CAD Area	X-XX	Area		Project No.	2018-81
Checked by:	H.H.	Drawn by:	M.A.D.		
Date:	MARCH 2021	Sheet:	NC-10 of NC 24	Plan No.	XXXXX-D

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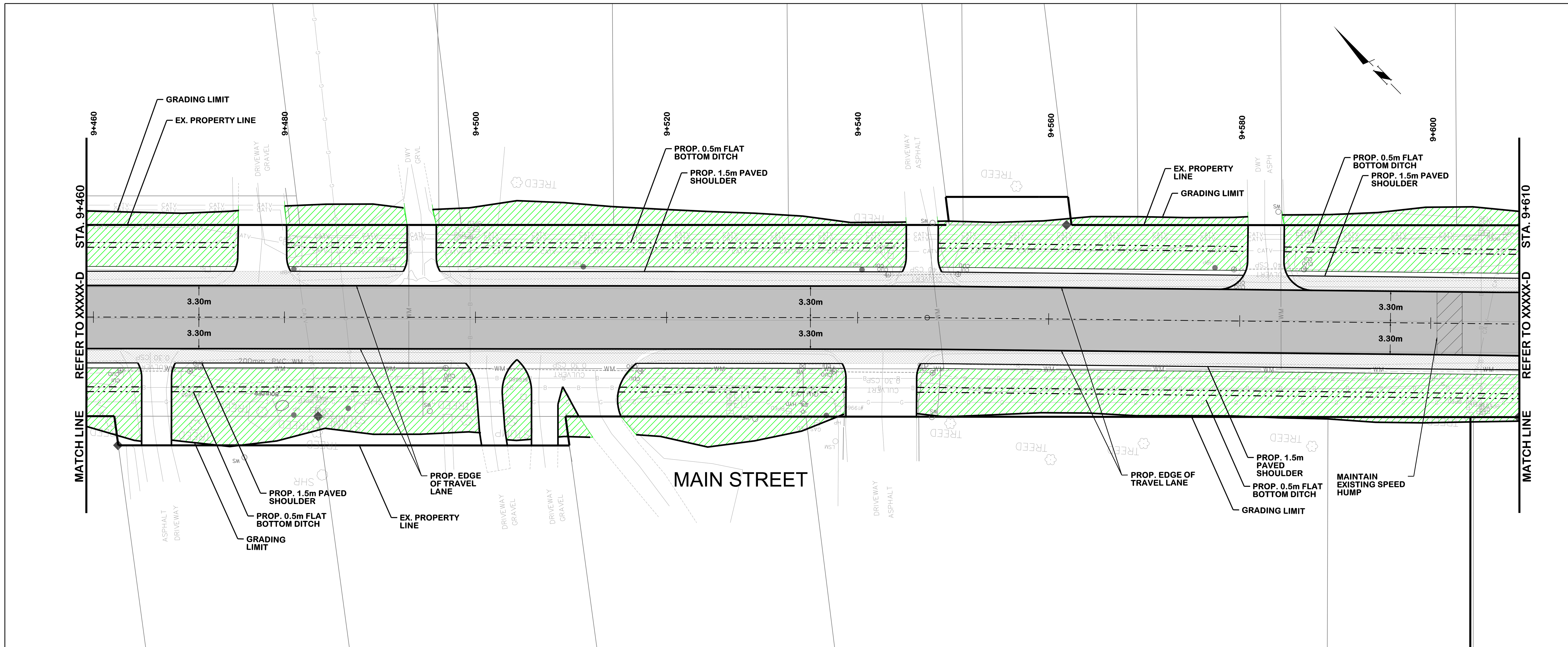

SERVICE DATA

SERVICE	DATE	INIT.	SERVICE	DATE	INIT.
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GAS MAINS	AUG 06, 2019	C.D.B.			
BELL U/G CABLE	SEP 30, 2019	C.D.B.			
HYDRO U/G CABLE	XXX X, 2019	C.D.B.			
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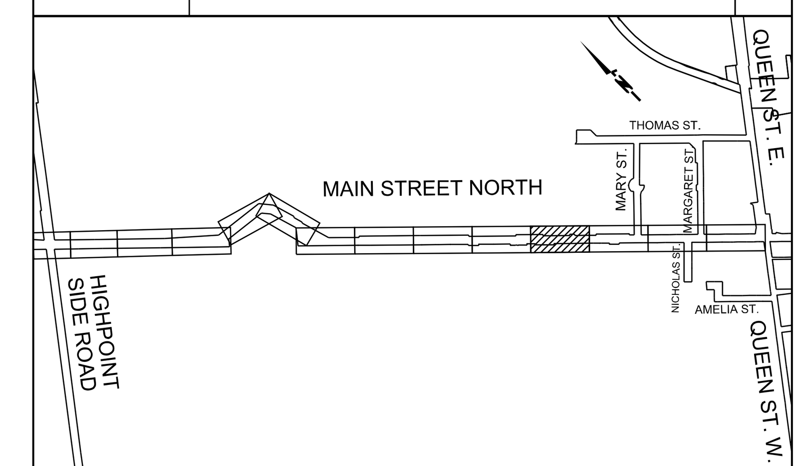

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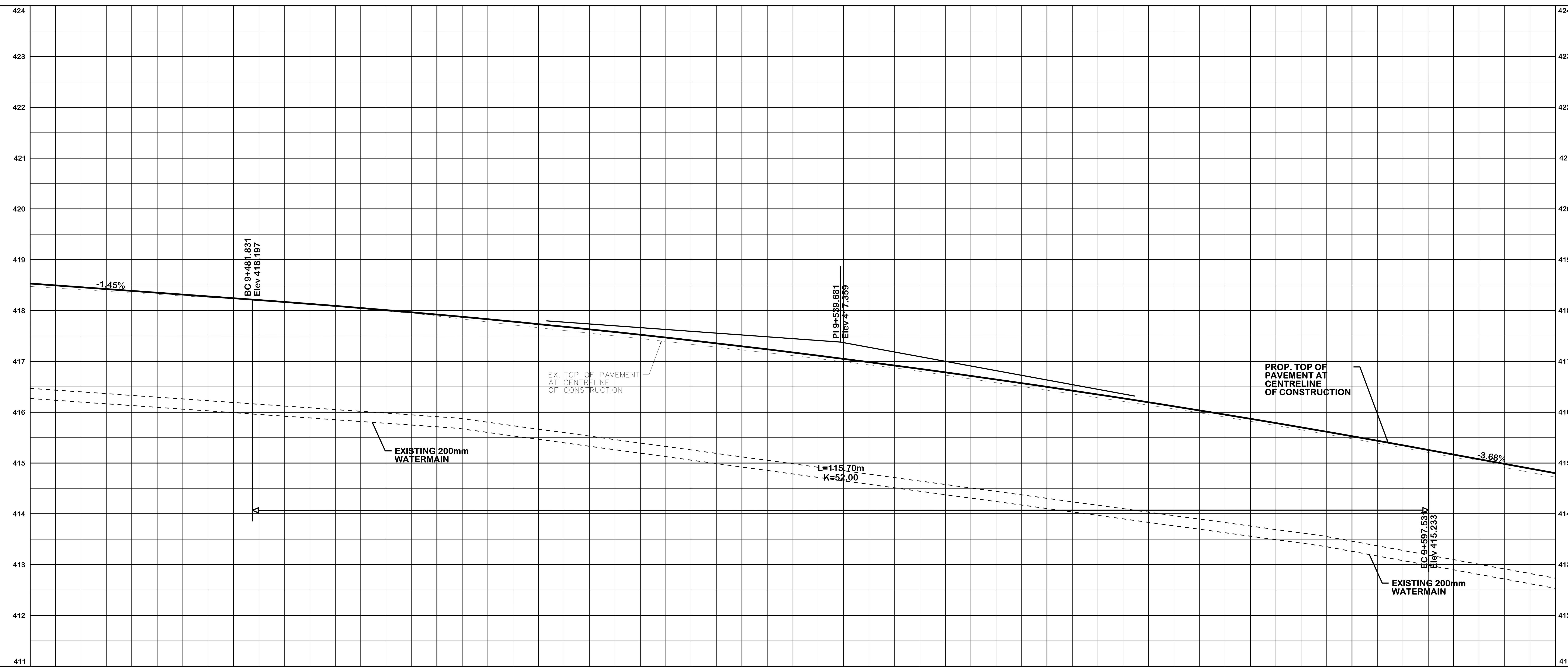

							PROP. SWALE ELEV.
418.33	418.06	417.64	417.20	416.71	416.12	415.45	PROP. FINISHED GRADE
418.36	418.07	417.71	417.27	416.76	416.17	415.50	EX. ROAD ELEV.
9+470	9+490	9+510	9+530	9+550	9+570	9+590	ROAD CHAINAGE

General Notes

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All Water And Sanitary Service Locations Are Approximate And Must Be Located Accurately In The Field

All Horizontal And Vertical Bends Are In Degrees

All Pipes Size In mm

20C Existing Water Service, Size In mm

WS20 Proposed Water Service, Size In mm

B.M. No. 798475 Elev. 412.263 m
Description
Location Lat. 43-50.8 Long. 80-03.0

The Contractor Is Responsible For Locating And Protecting All Existing Utilities Prior To And During Construction. Location Of Existing Utilities Approximate Only, To Be Verified In Field By Contractor.

Designed by ______ ______ ______ ______ Chkd. ______

Approved by ______ ______ ______ ______ ______

NOTICE TO CONTRACTOR

48 HOURS PRIOR TO COMMENCING WORK NOTIFY THE FOLLOWING

THE REGIONAL MUNICIPALITY OF PEEL
CITY OF MISSISSAUGA WORKS DEPT.
CITY OF BRAMPTON WORKS DEPT.
TOWN OF CALEDON WORKS DEPT.
BELL CANADA
ENBRIDGE INCORPORATED-GAS DISTRIBUTION
ONTARIO MINISTRY OF TRANSPORTATION
ONTARIO CLEAN WATER AGENCY
HYDRO ONE NETWORKS
ENERSOURCE, HYDRO MISSISSAUGA
HYDRO ONE BRAMPTON

CABLE TELEVISION/FIBREOPTIC PROVIDERS:
BELL CANADA
ENERSOURCE TELECOM
HYDRO ONE TELECOM
ROGERS CABLE
ALLSTREAM
PSN (PUBLIC SECTOR NETWORK)
FUTUREWAY (FCI BROADBAND)

10m 0 10 20 30m HORIZONTAL SCALE

1m 0 1 2 3m VERTICAL SCALE

TOWN OF CALEDON

ALTON VILLAGE EA

QUEEN ST. (MISSISSAUGA RD. TO MAIN ST.)
MAIN ST. (QUEEN ST. TO HIGH POINT RD.)

PROPOSED RECONSTRUCTION

STA. TO STA.

CAD Area	X-XX	Area		Project No.	2018-81
Checked by:	H.H.	Drawn by:	M.A.D.		
Date:	MARCH 2021	Sheet:	NC-11 of NC 24	Plan No.	XXXXX-D

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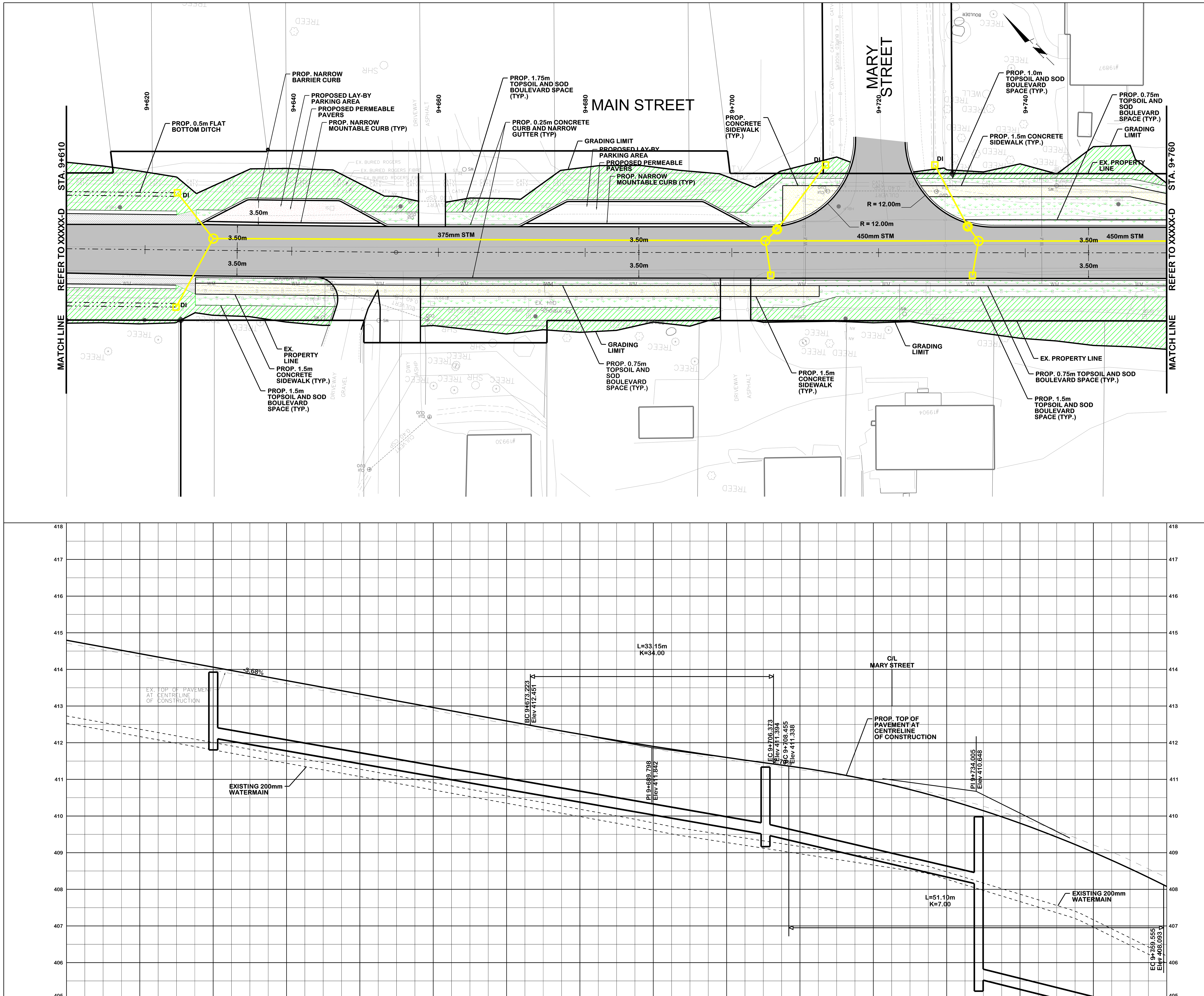


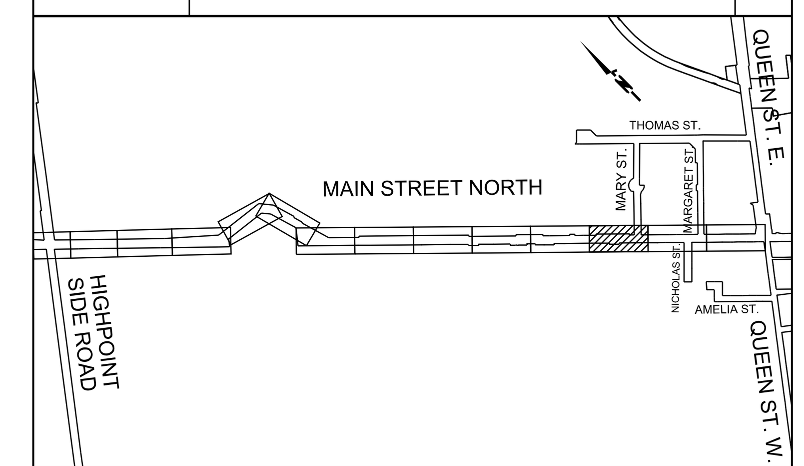
								PROP. SWALE ELEV.
414.70	413.96	413.22	412.50	411.81	411.24	410.50	409.19	PROP. FINISHED GRADE
414.77	414.04	413.30	412.57	411.88	411.30	410.58	409.31	EX. ROAD ELEV.
9+610	9+630	9+650	9+670	9+690	9+710	9+730	9+750	ROAD CHAINAGE

SERVICE DATA

SERVICE	DATE	INIT.	SERVICE	DATE	INIT.
HYDRO ONE	XXX X, 2019	C.D.B.			
WATERMAINS	AUG 09, 2019	C.D.B.			
GAS MAINS	AUG 06, 2019	C.D.B.			
BELL U/G CABLE	SEP 30, 2019	C.D.B.			
HYDRO U/G CABLE	XXX X, 2019	C.D.B.			
ROGERS PLANT	AUG 12, 2019	C.D.B.			

REVISIONS

DATE	DETAILS	INIT.
NOV 22, 2019	ISSUED FOR PIC REVIEW	J.P.D.
MAR. 12, 2021	30% PRELIMINARY DESIGN	D.J.O.



LEGEND:

- PROPOSED ROADWAY PAVEMENT
- PROPOSED IMPRESSED COLORED CONCRETE
- PROPOSED CONCRETE SIDEWALK / CONCRETE BUS PAD
- PROPOSED PAVED SHOULDER
- PROPOSED TOPSOIL AND SOD
- PROPOSED CUT/ FILL
- PROPOSED DITCH LINE
- PROPOSED RETAINING WALL
- EXISTING BELL PLANT
- EXISTING ROGERS PLANT
- EXISTING GAS LINE
- EXISTING WATERMAIN

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10m 0 10 20 30m HORIZONTAL SCALE

1m 0 1 2 3m VERTICAL SCALE

TOWN OF CALEDON

ALTON VILLAGE EA

QUEEN ST. (MISSISSAUGA RD. TO MAIN ST.)
MAIN ST. (QUEEN ST. TO HIGH POINT RD.)

PROPOSED RECONSTRUCTION

STA. **TO STA.**

CAD Area X-XX	Area	Project No. 2018-81	
Checked by: H.H.	Drawn by: M.A.D.		
Date: MARCH 2021	Sheet: NC-12 of NC 24	Plan No. XXXXX-D	

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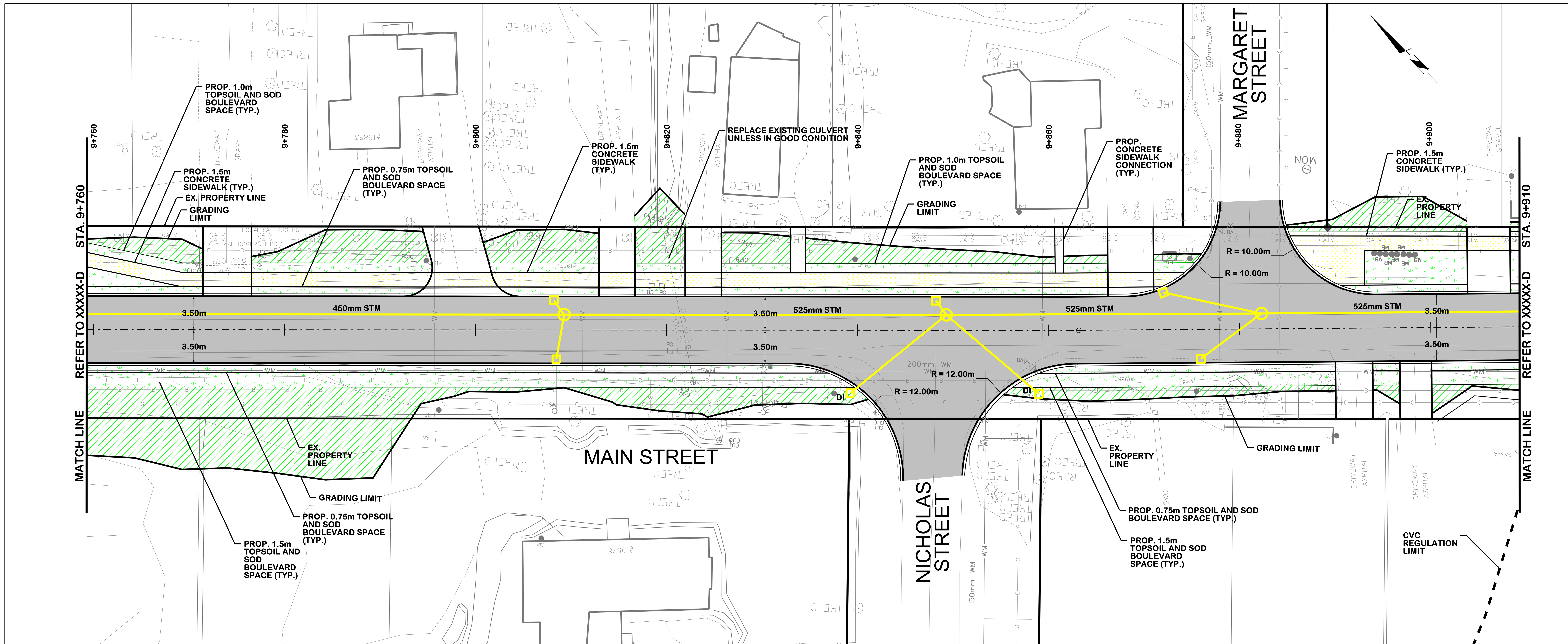

SERVICE DATA

SERVICE	DATE	INIT.	SERVICE	DATE	INIT.
HYDRO ONE	XXX X, 2019	C.D.B.			
WATERMAINS	AUG 09, 2019	C.D.B.			
GAS MAINS	AUG 06, 2019	C.D.B.			
BELL U/G CABLE	SEP 30, 2019	C.D.B.			
HYDRO U/G CABLE	XXX X, 2019	C.D.B.			
ROGERS PLANT	AUG 12, 2019	C.D.B.			

REVISIONS

DATE	DETAILS	INIT.
NOV 22, 2019	ISSUED FOR PIC REVIEW	J.P.D.
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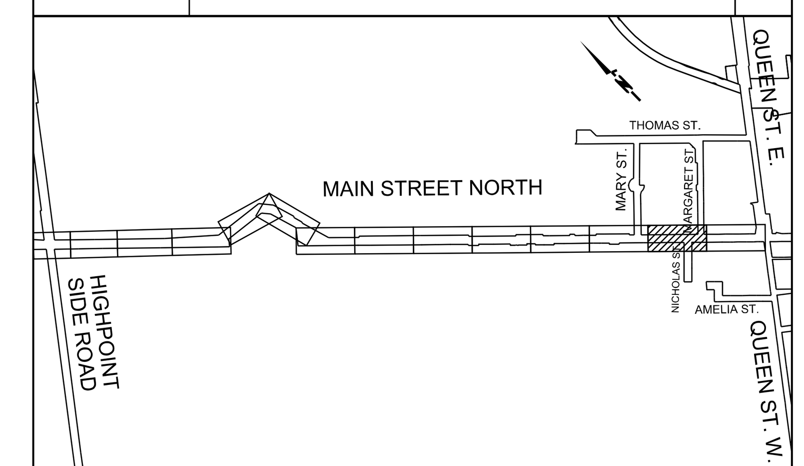

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- EXISTING BELL PLANT
- EXISTING ROGERS PLANT
- EXISTING GAS LINE
- EXISTING WATERMAIN

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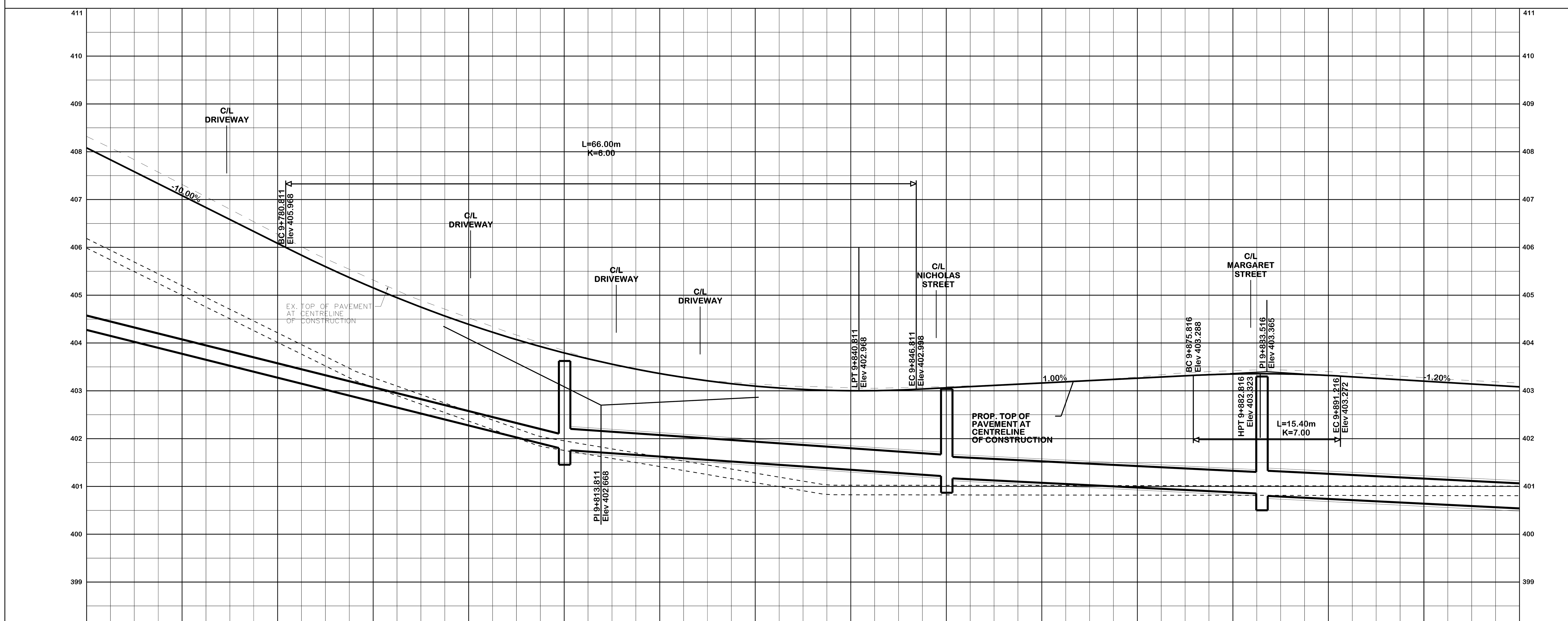

							PROP. SWALE ELEV.
407.28	405.28	403.80	403.11	403.06	403.26	403.36	PROP. FINISHED GRADE
407.47	405.42	403.82	402.89	402.63	402.91	403.19	EX. ROAD ELEV.
9+770	9+790	9+810	9+830	9+850	9+870	9+890	ROAD CHAINAGE

General Notes

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Approved by ______ ______ ______ ______ ______

NOTICE TO CONTRACTOR

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ONTARIO CLEAN WATER AGENCY
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FUTUREWAY (FCI BROADBAND)

10m 0 10 20 30m HORIZONTAL SCALE

1m 0 1 2 3m VERTICAL SCALE

TOWN OF CALEDON

ALTON VILLAGE EA

QUEEN ST. (MISSISSAUGA RD. TO MAIN ST.)
MAIN ST. (QUEEN ST. TO HIGH POINT RD.)

PROPOSED RECONSTRUCTION

STA. **TO STA.**

CAD Area X-XX	Area	Project No. 2018-81	
Checked by: H.H.	Drawn by: M.A.D.	Plan No. XXXXX-D	
Date: MARCH 2021	Sheet: NC-13 of NC 24		

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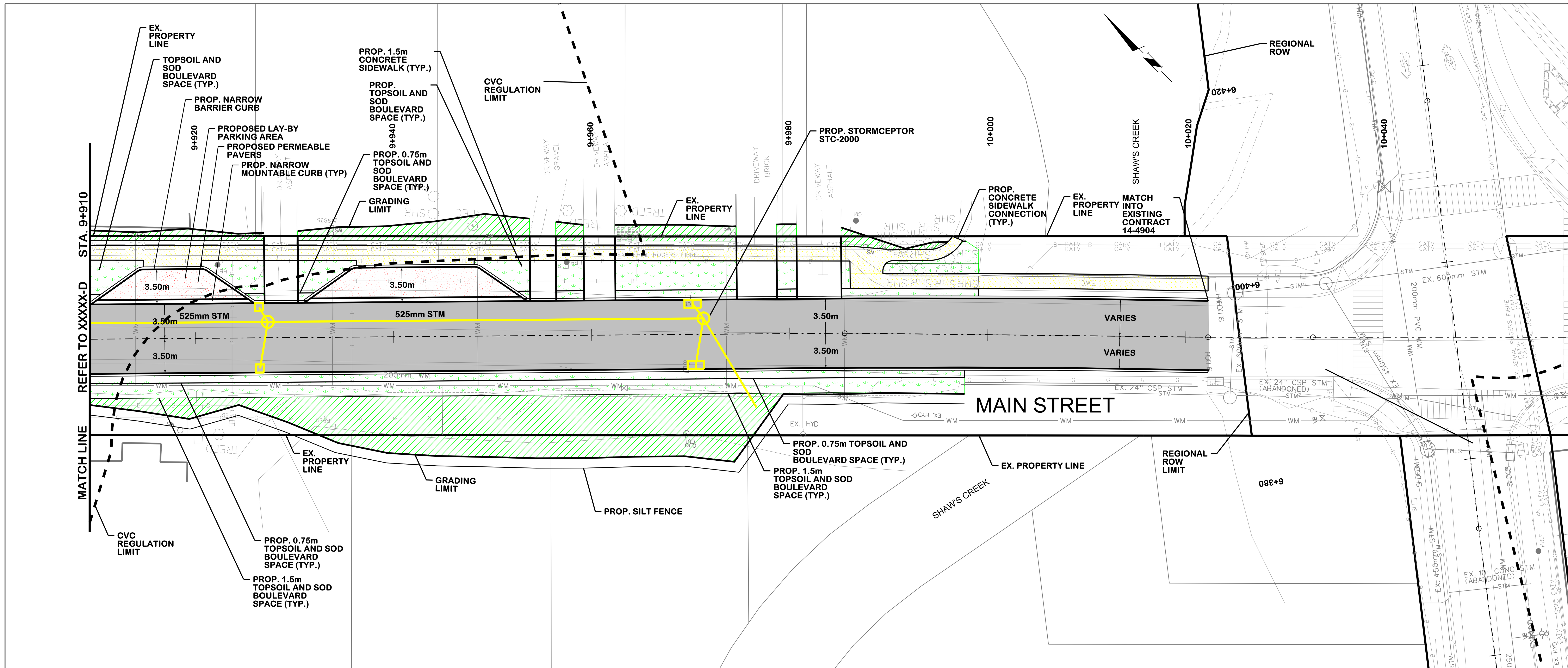

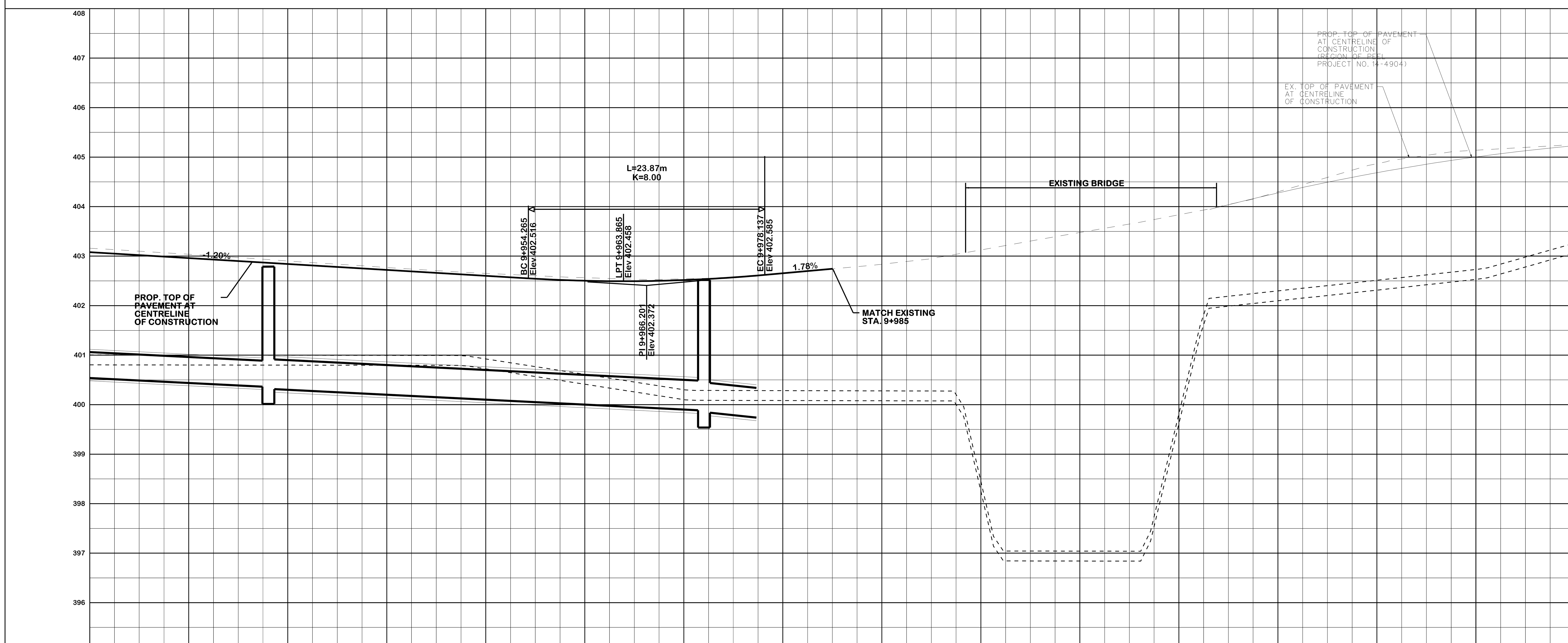

								PROP. SWALE ELEV.
403.13	402.87	402.62	402.51	402.80	403.44	404.26	405.10	PROP. FINISHED GRADE
403.05	402.81	402.57	402.44	402.75	403.36	404.28	405.08	EX. ROAD ELEV.
9+910	9+930	9+950	9+970	9+990	10+010	10+030	10+050	ROAD CHAINAGE

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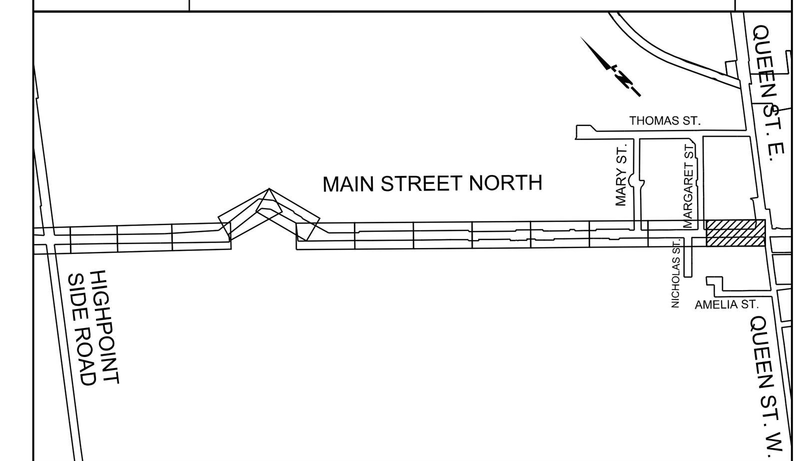
SERVICE DATA

SERVICE	DATE	INIT.	SERVICE	DATE	INIT.
HYDRO ONE	XXX X, 2019	C.D.B.			
WATERMAINS	AUG 09, 2019	C.D.B.			
GAS MAINS	AUG 06, 2019	C.D.B.			
BELL U/G CABLE	SEP 30, 2019	C.D.B.			
HYDRO U/G CABLE	XXX X, 2019	C.D.B.			
ROGERS PLANT	AUG 12, 2019	C.D.B.			

REVISIONS

DATE	DETAILS	INIT.
NOV 22, 2019	ISSUED FOR PIC REVIEW	J.P.D.
MAR. 12, 2021	30% PRELIMINARY DESIGN	D.J.O.



LEGEND:

- PROPOSED ROADWAY PAVEMENT
- PROPOSED IMPRESSED COLORED CONCRETE
- PROPOSED CONCRETE SIDEWALK / CONCRETE BUS PAD
- PROPOSED PAVED SHOULDER
- PROPOSED TOPSOIL AND SOD
- PROPOSED CUT/ FILL
- PROPOSED DITCH LINE
- PROPOSED RETAINING WALL
- EXISTING BELL PLANT
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- EXISTING GAS LINE
- EXISTING WATERMAIN

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General Notes

All Driveways Are ASPHALT Unless Otherwise Noted
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All Horizontal And Vertical Bends Are In Degrees
All Pipes Size In mm
20C Existing Water Service, Size In mm
WS20 Proposed Water Service, Size In mm
B.M. No. 798475 Elev. 412.263 m
Description
Location Lat. 43-50.8 Long. 80-03.0
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Designed by ______ ______ ______ ______ Chkd. ______

Approved by ______ ______ ______ ______ ______

NOTICE TO CONTRACTOR

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ROGERS CABLE
ALLSTREAM
PSN (PUBLIC SECTOR NETWORK)
FUTUREWAY (FCI BROADBAND)

TOWN OF CALEDON

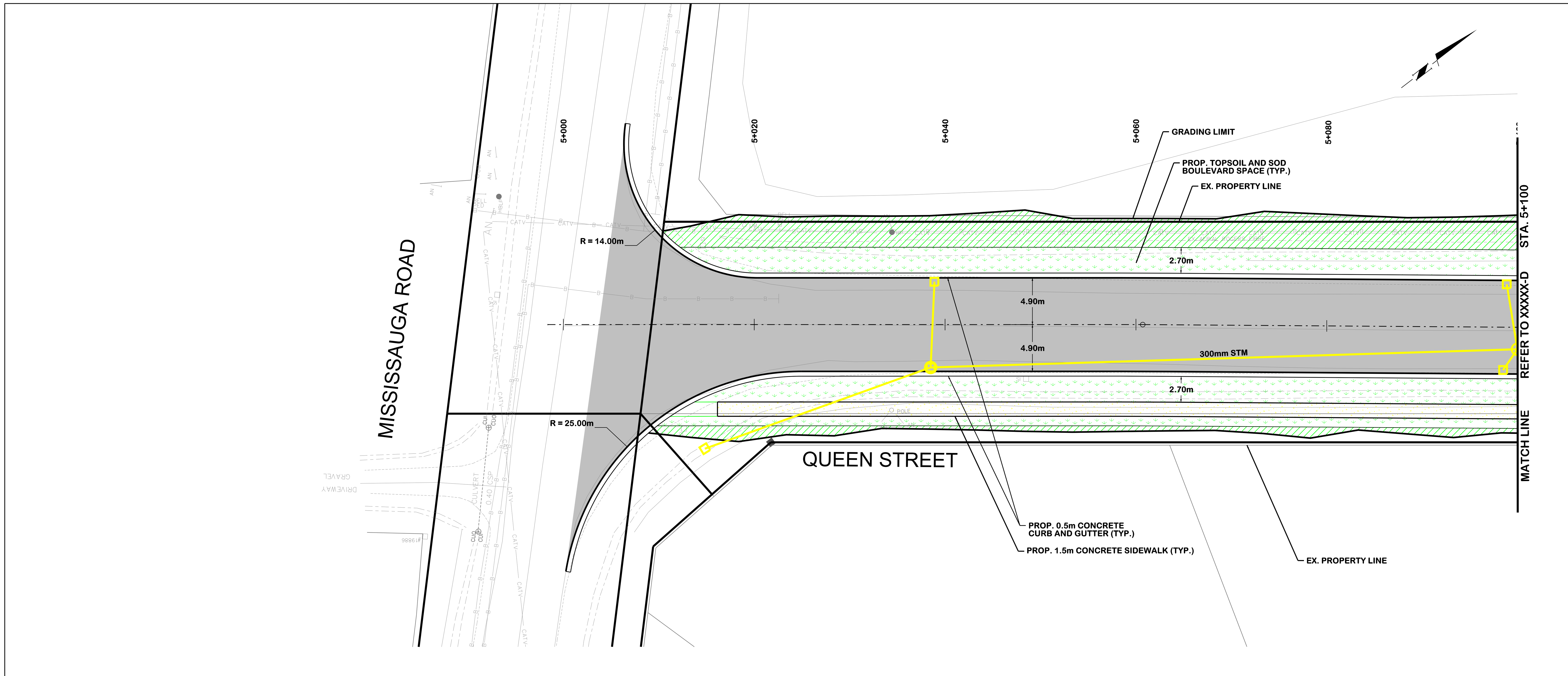
ALTON VILLAGE EA

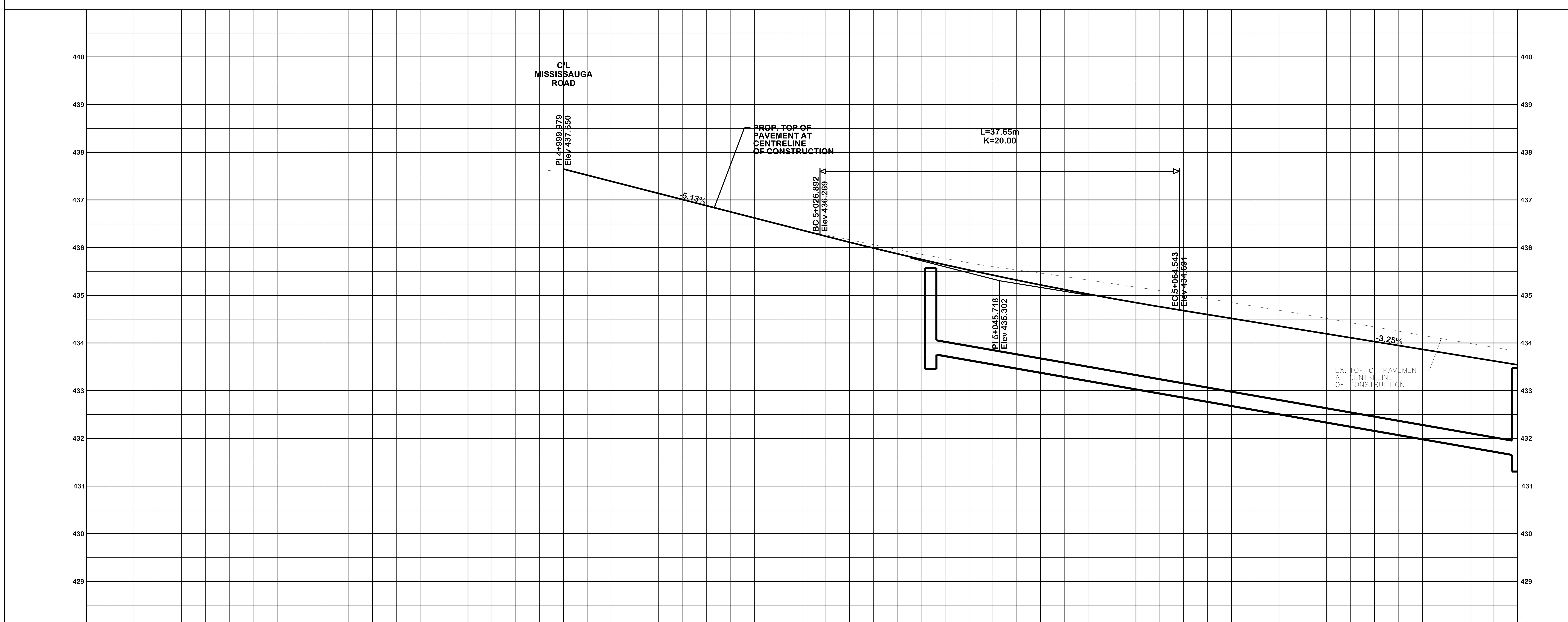
QUEEN ST. (MISSISSAUGA RD. TO MAIN ST.)
MAIN ST. (QUEEN ST. TO HIGH POINT RD.)

PROPOSED RECONSTRUCTION

STA. TO STA.

CAD Area: X-XX	Area	Project No. 2018-81	
Checked by: H.H.	Drawn by: M.A.D.		
Date: MARCH 2021	Sheet: NC-14 of NC 24	Plan No. XXXXX-D	





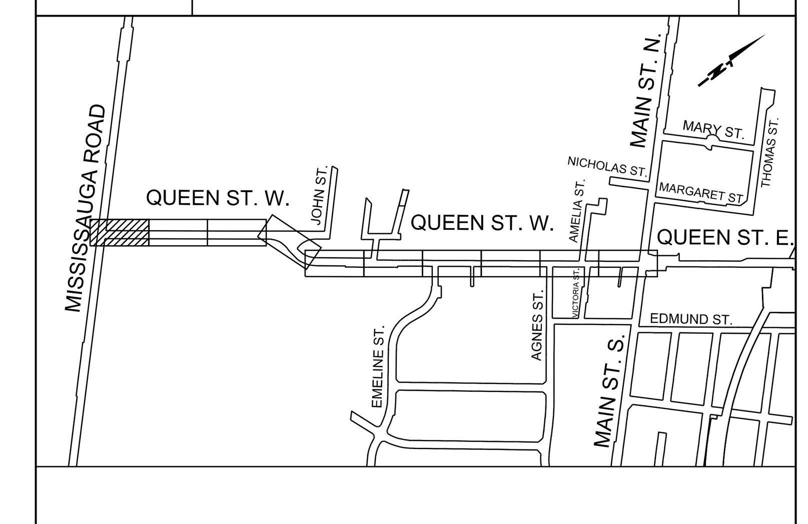
PROP. SWALE ELEV.						
PROP. FINISHED GRADE		437.14	436.16	435.46	434.85	434.16
EX. ROAD ELEV.		437.13	436.16	435.47	434.84	434.21
ROAD CHAINAGE	4+990	5+010	5+030	5+050	5+070	5+090

SERVICE DATA

SERVICE	DATE	INIT.	SERVICE	DATE	INIT.
HYDRO ONE	XXX X, 2019	C.D.B.			
WATERMAINS	AUG 09, 2019	C.D.B.			
GAS MAINS	AUG 06, 2019	C.D.B.			
BELL U/G CABLE	SEP 30, 2019	C.D.B.			
HYDRO U/G CABLE	XXX X, 2019	C.D.B.			
ROGERS PLANT	AUG 12, 2019	C.D.B.			

REVISIONS

DATE	DETAILS	INIT.
NOV 22, 2019	ISSUED FOR PIC REVIEW	J.P.D.
MAR. 12, 2021	30% PRELIMINARY DESIGN	D.J.O.



LEGEND:

- PROPOSED ROADWAY PAVEMENT
- PROPOSED IMPRESSED COLORED CONCRETE
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PROPOSED RECONSTRUCTION

STA. TO STA.

CAD Area	X-XX	Area		Project No.	2018-81
Checked by:	H.H.	Drawn by:	M.A.D.		
Date:	MARCH 2021	Sheet: NC-15 of NC 24		Plan No.	XXXXX-D

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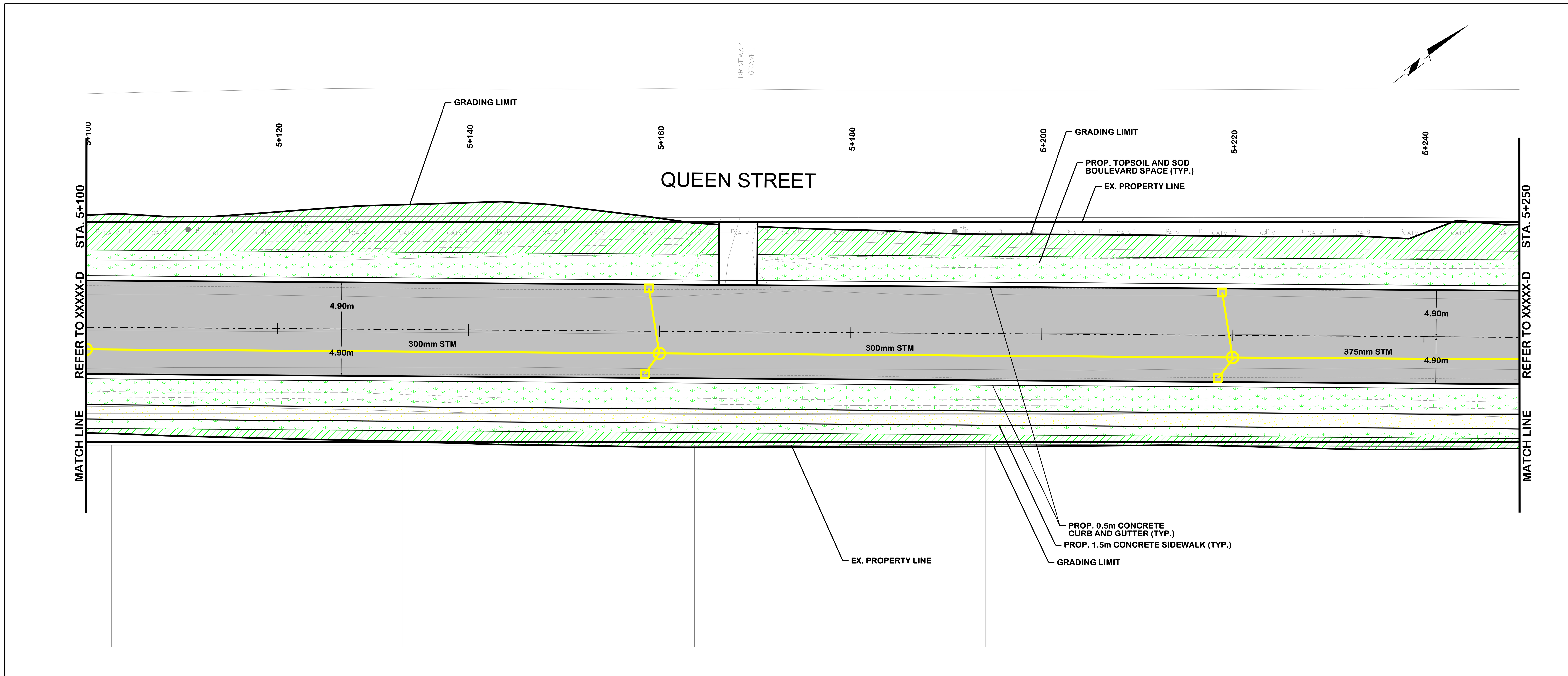

SERVICE DATA

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REVISIONS

DATE	DETAILS	INIT.
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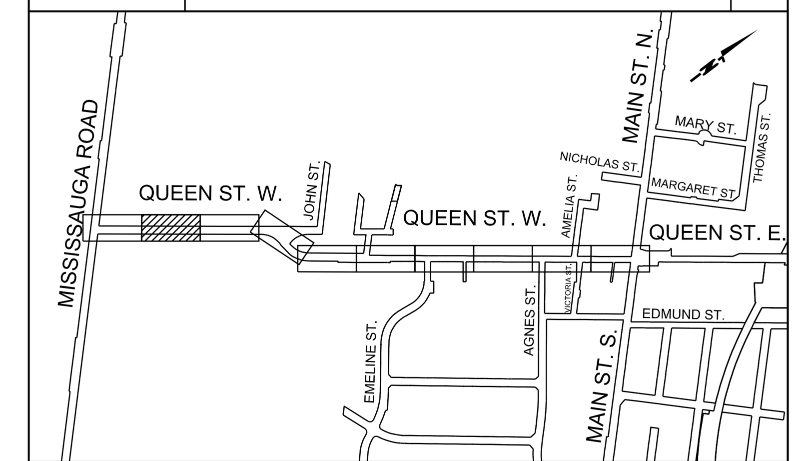

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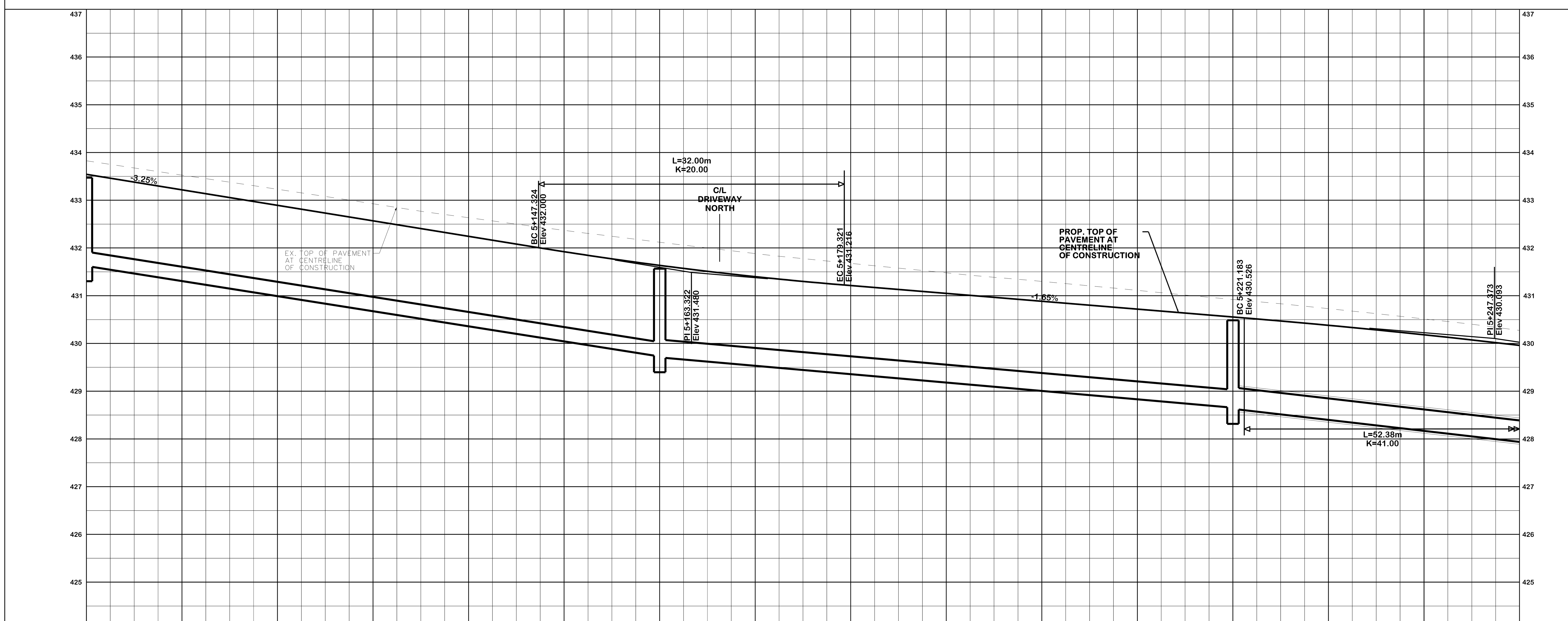

433.52	432.92	432.36	431.88	431.47	431.10	430.72	PROP. SWALE ELEV.
433.58	432.95	432.37	431.89	431.48	431.10	430.72	PROP. FINISHED GRADE
5+110	5+130	5+150	5+170	5+190	5+210	5+230	EX. ROAD ELEV.
							ROAD CHAINAGE

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PROPOSED RECONSTRUCTION

STA.		TO STA.	
CAD Area: X-XX	Area	Project No.	2018-81
Checked by: H.H.	Drawn by: M.A.D.		
Date: MARCH 2021	Sheet: NC-16 of NC 24	Plan No.	XXXXX-D

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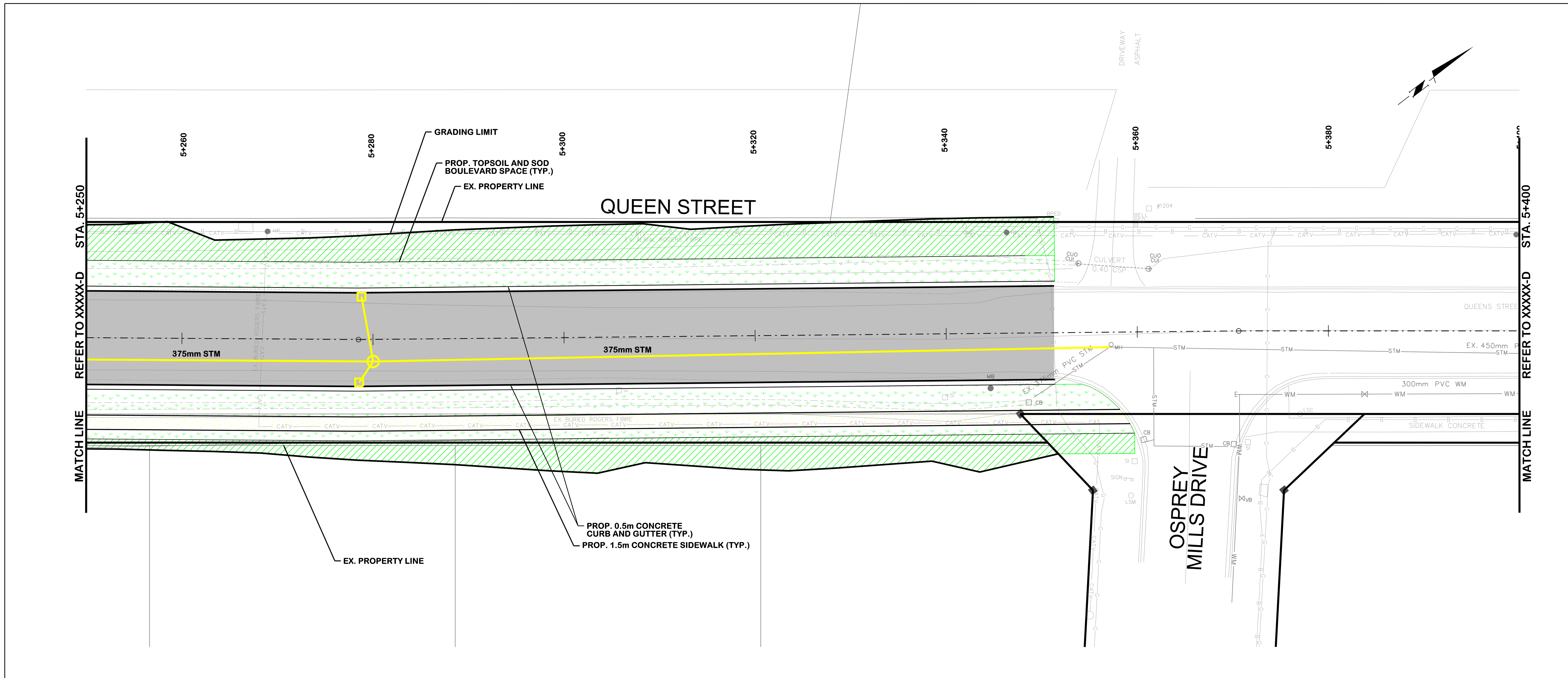
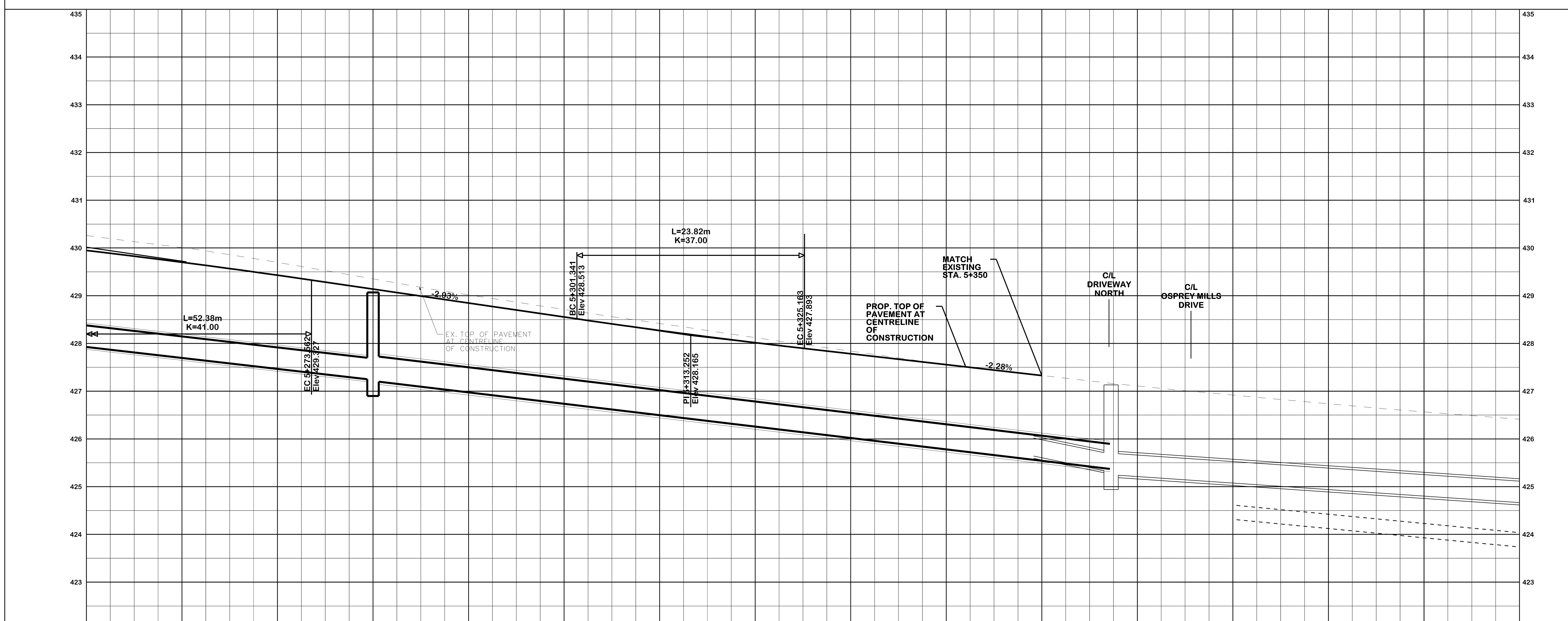




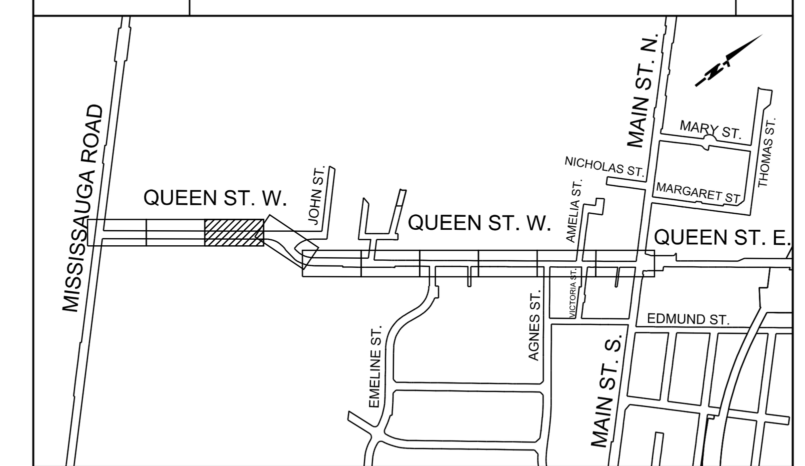
430.26	429.70	429.02	428.42	427.84	427.33	426.91	426.56	PROP. SWALE ELEV.
430.27	429.73	429.14	428.55	427.96	427.37	426.83	426.40	PROP. FINISHED GRADE
5+250	5+270	5+290	5+310	5+330	5+350	5+370	5+390	EX. ROAD ELEV.
								ROAD CHAINAGE

SERVICE DATA

SERVICE	DATE	INIT.	SERVICE	DATE	INIT.
HYDRO ONE	XXX X, 2019	C.D.B.			
WATERMAINS	AUG 09, 2019	C.D.B.			
GAS MAINS	AUG 06, 2019	C.D.B.			
BELL U/G CABLE	SEP 30, 2019	C.D.B.			
HYDRO U/G CABLE	XXX X, 2019	C.D.B.			
ROGERS PLANT	AUG 12, 2019	C.D.B.			

REVISIONS

DATE	DETAILS	INIT.
NOV 22, 2019	ISSUED FOR PIC REVIEW	J.P.D.
MAR. 12, 2021	30% PRELIMINARY DESIGN	D.J.O.



LEGEND:

- PROPOSED ROADWAY PAVEMENT
- PROPOSED IMPRESSED COLORED CONCRETE
- PROPOSED CONCRETE SIDEWALK / CONCRETE BUS PAD
- PROPOSED PAVED SHOULDER
- PROPOSED TOPSOIL AND SOD
- PROPOSED CUT/ FILL
- PROPOSED DITCH LINE
- PROPOSED RETAINING WALL
- EXISTING BELL PLANT
- EXISTING ROGERS PLANT
- EXISTING GAS LINE
- EXISTING WATERMAIN

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General Notes

All Driveways Are ASPHALT Unless Otherwise Noted

All Water And Sanitary Service Locations Are Approximate And Must Be Located Accurately In The Field

All Horizontal And Vertical Bends Are In Degrees

All Pipes Size In mm

20C Existing Water Service, Size In mm

WS20 Proposed Water Service, Size In mm

B.M. No. 798475 Elev. 412.263 m
Description
Location Lat. 43-50.8 Long. 80-03.0

The Contractor Is Responsible For Locating And Protecting All Existing Utilities Prior To And During Construction. Location Of Existing Utilities Approximate Only, To Be Verified In Field By Contractor.

Designed by ______ ______ ______ ______ Chkd. ______

Approved by ______ ______ ______ ______ ______

NOTICE TO CONTRACTOR

48 HOURS PRIOR TO COMMENCING WORK NOTIFY THE FOLLOWING

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CITY OF MISSISSAUGA WORKS DEPT.
CITY OF BRAMPTON WORKS DEPT.
TOWN OF CALEDON WORKS DEPT.
BELL CANADA
ENBRIDGE INCORPORATED-GAS DISTRIBUTION
ONTARIO MINISTRY OF TRANSPORTATION
ONTARIO CLEAN WATER AGENCY
HYDRO ONE NETWORKS
ENERSOURCE, HYDRO MISSISSAUGA
HYDRO ONE BRAMPTON

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BELL CANADA
ENERSOURCE TELECOM
HYDRO ONE TELECOM
ROGERS CABLE
ALLSTREAM
PSN (PUBLIC SECTOR NETWORK)
FUTUREWAY (FCI BROADBAND)

10m 0 10 20 30m HORIZONTAL SCALE

1m 0 1 2 3m VERTICAL SCALE

TOWN OF CALEDON

ALTON VILLAGE EA

QUEEN ST. (MISSISSAUGA RD. TO MAIN ST.)
MAIN ST. (QUEEN ST. TO HIGH POINT RD.)

PROPOSED RECONSTRUCTION

STA. TO STA.

CAD Area X-XX	Area		Project No. 2018-81
Checked by: H.H.	Drawn by: M.A.D.		
Date: MARCH 2021	Sheet: NC-17 of NC 24		Plan No. XXXXX-D

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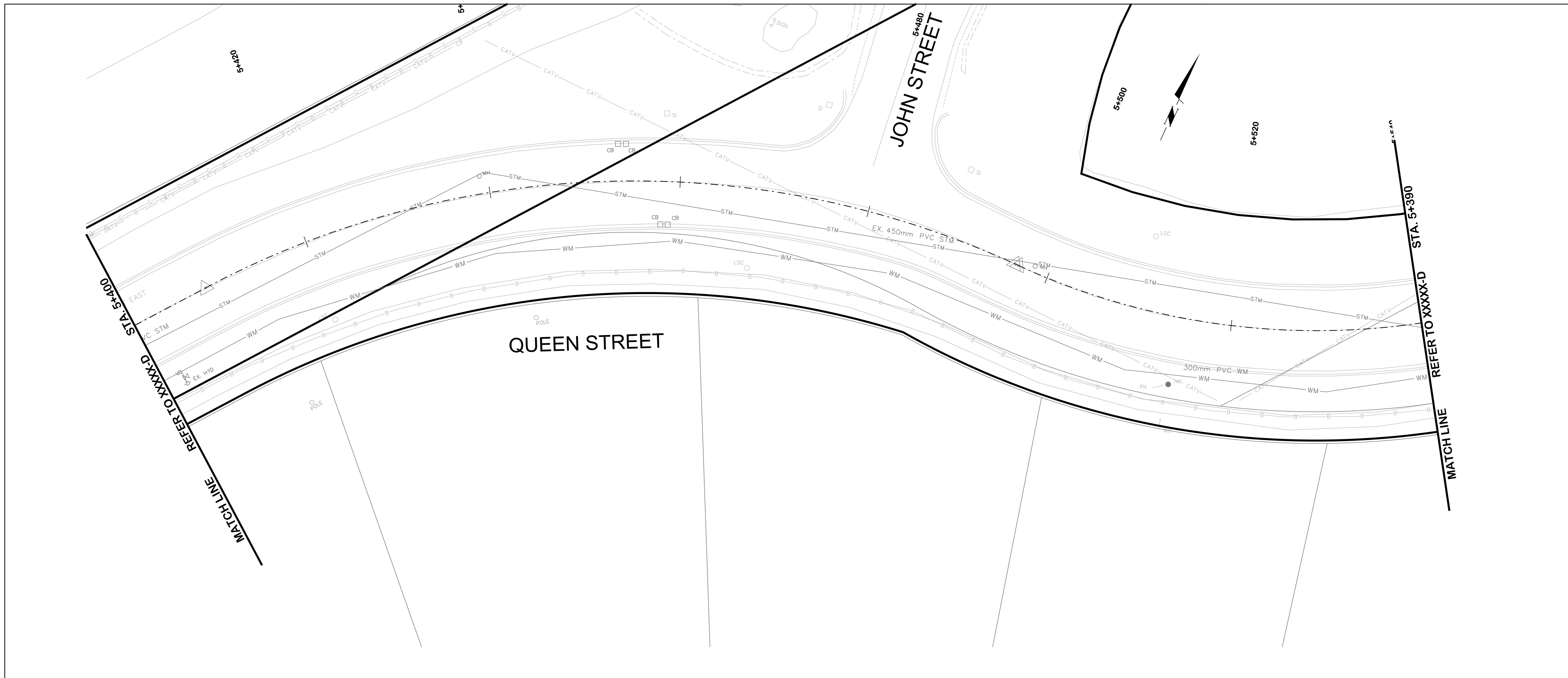
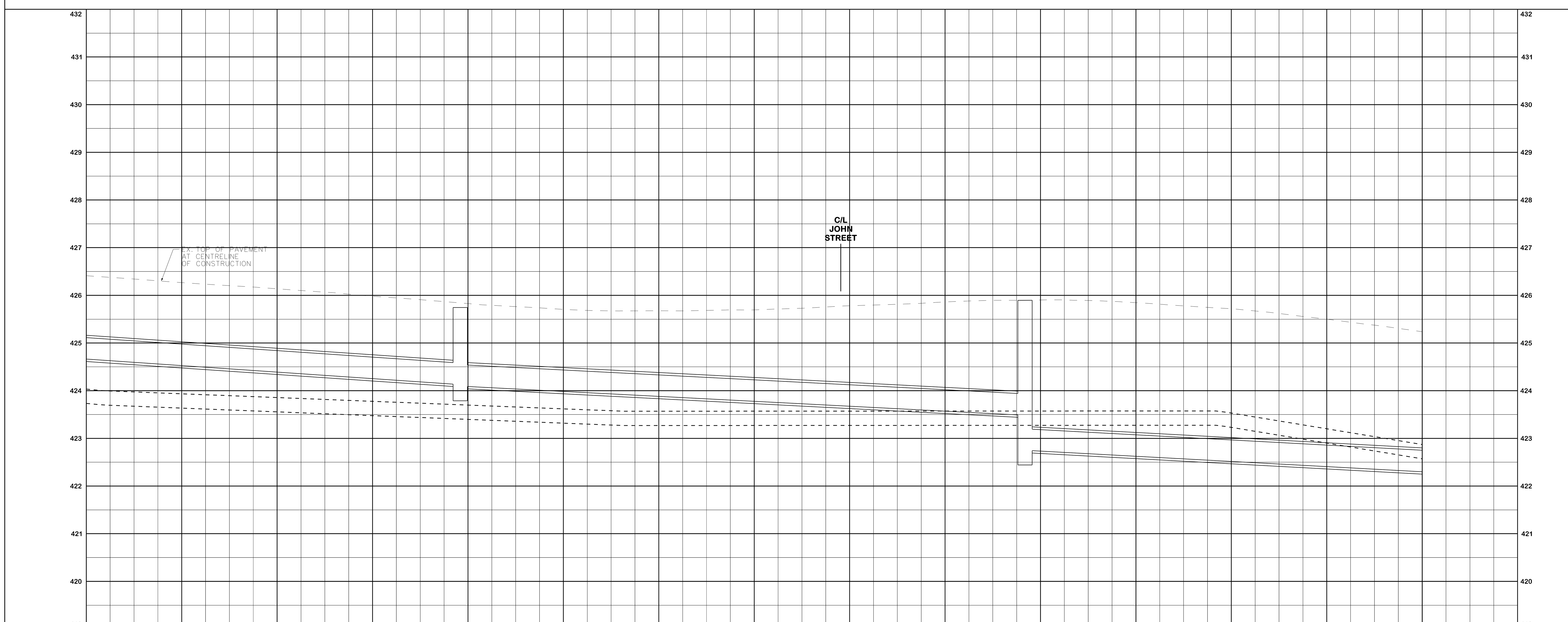




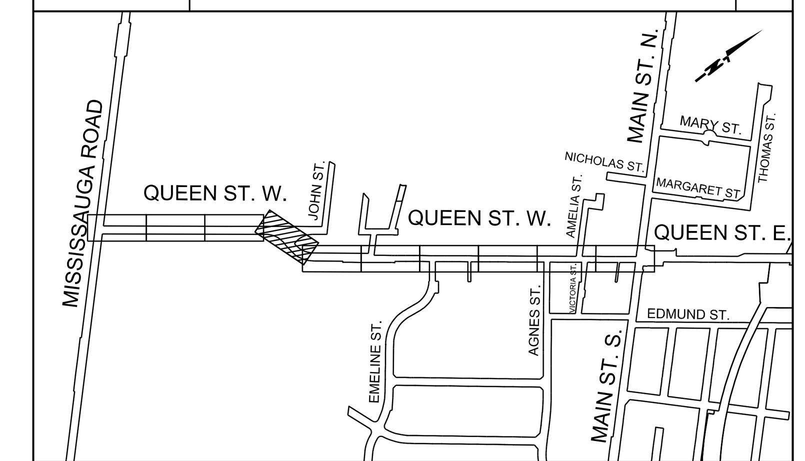
430.26	429.70	429.02	428.42	427.84	427.33	426.91	PROP. SWALE ELEV.
430.27	429.73	429.14	428.55	427.96	427.37	426.83	PROP. FINISHED GRADE
5+250	5+270	5+290	5+310	5+330	5+350	5+370	EX. ROAD ELEV.
							ROAD CHAINAGE

SERVICE DATA

SERVICE	DATE	INIT.	SERVICE	DATE	INIT.
HYDRO ONE	XXX X, 2019	C.D.B.			
WATERMAINS	AUG 09, 2019	C.D.B.			
GAS MAINS	AUG 06, 2019	C.D.B.			
BELL U/G CABLE	SEP 30, 2019	C.D.B.			
HYDRO U/G CABLE	XXX X, 2019	C.D.B.			
ROGERS PLANT	AUG 12, 2019	C.D.B.			

REVISIONS

DATE	DETAILS	INIT.
NOV 22, 2019	ISSUED FOR PIC REVIEW	J.P.D.
MAR. 12, 2021	30% PRELIMINARY DESIGN	D.J.O.



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- PROPOSED RETAINING WALL
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- EXISTING ROGERS PLANT
- EXISTING GAS LINE
- EXISTING WATERMAIN

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General Notes

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Approved by ______ ______ ______ ______ ______

NOTICE TO CONTRACTOR

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ONTARIO CLEAN WATER AGENCY
HYDRO ONE NETWORKS
ENERSOURCE, HYDRO MISSISSAUGA
HYDRO ONE BRAMPTON

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HYDRO ONE TELECOM
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10m 0 10 20 30m HORIZONTAL SCALE

1m 0 1 2 3m VERTICAL SCALE

TOWN OF CALEDON

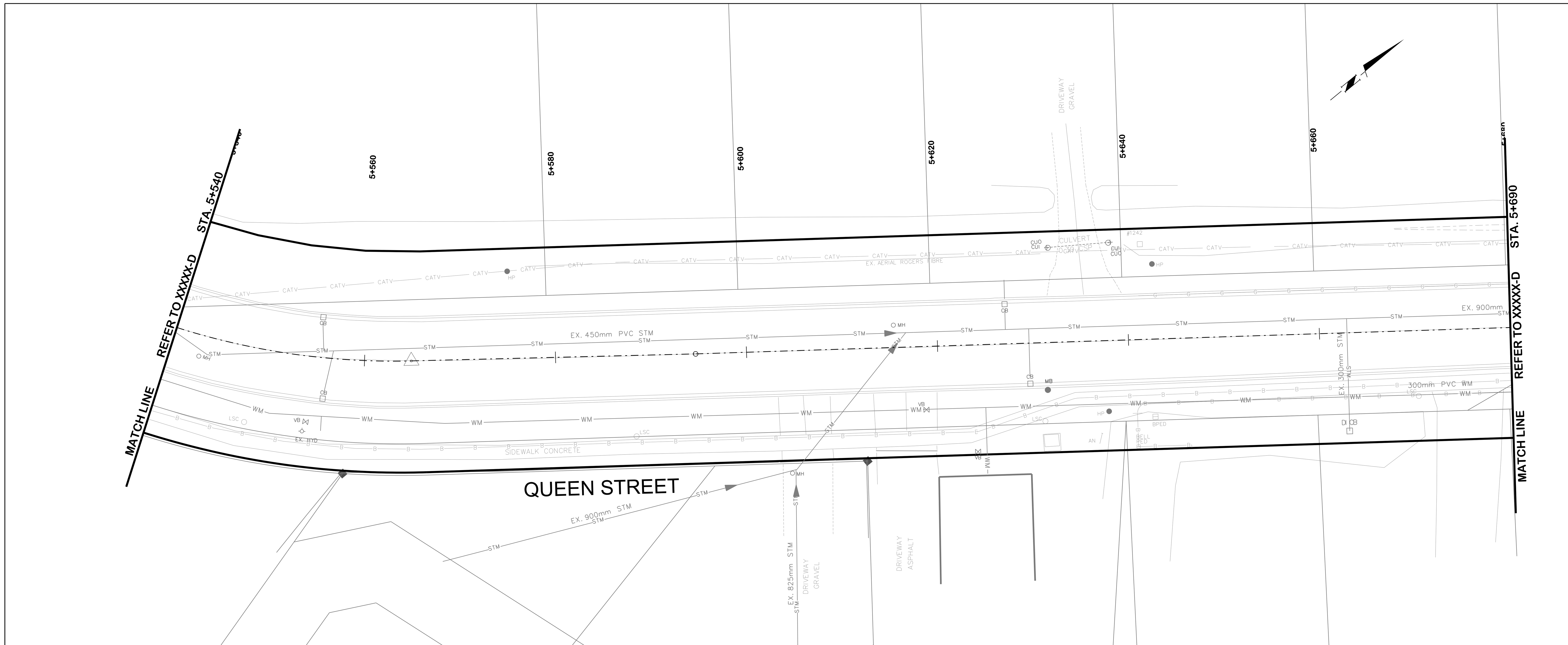
ALTON VILLAGE EA

QUEEN ST. (MISSISSAUGA RD. TO MAIN ST.)
MAIN ST. (QUEEN ST. TO HIGH POINT RD.)

PROPOSED RECONSTRUCTION

STA. **TO STA.**

CAD Area	X-XX	Area		Project No.	2018-81
Checked by:	H.H.	Drawn by:	M.A.D.		
Date:	MARCH 2021	Sheet:	NC-18 of NC 24	Plan No.	XXXXX-D



SERVICE DATA

SERVICE	DATE	INIT.	SERVICE	DATE	INIT.
HYDRO ONE	XXX X, 2019	C.D.B.			
WATERMAINS	AUG 09, 2019	C.D.B.			
GAS MAINS	AUG 06, 2019	C.D.B.			
BELL U/G CABLE	SEP 30, 2019	C.D.B.			
HYDRO U/G CABLE	XXX X, 2019	C.D.B.			
ROGERS PLANT	AUG 12, 2019	C.D.B.			

REVISIONS

DATE	DETAILS	INIT.
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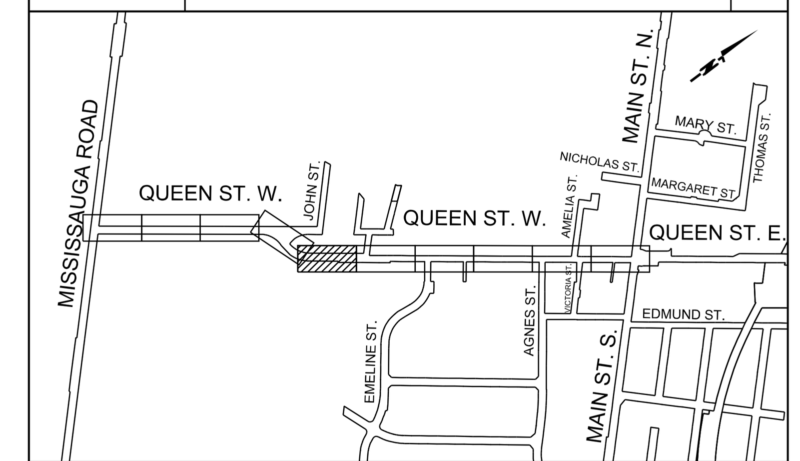

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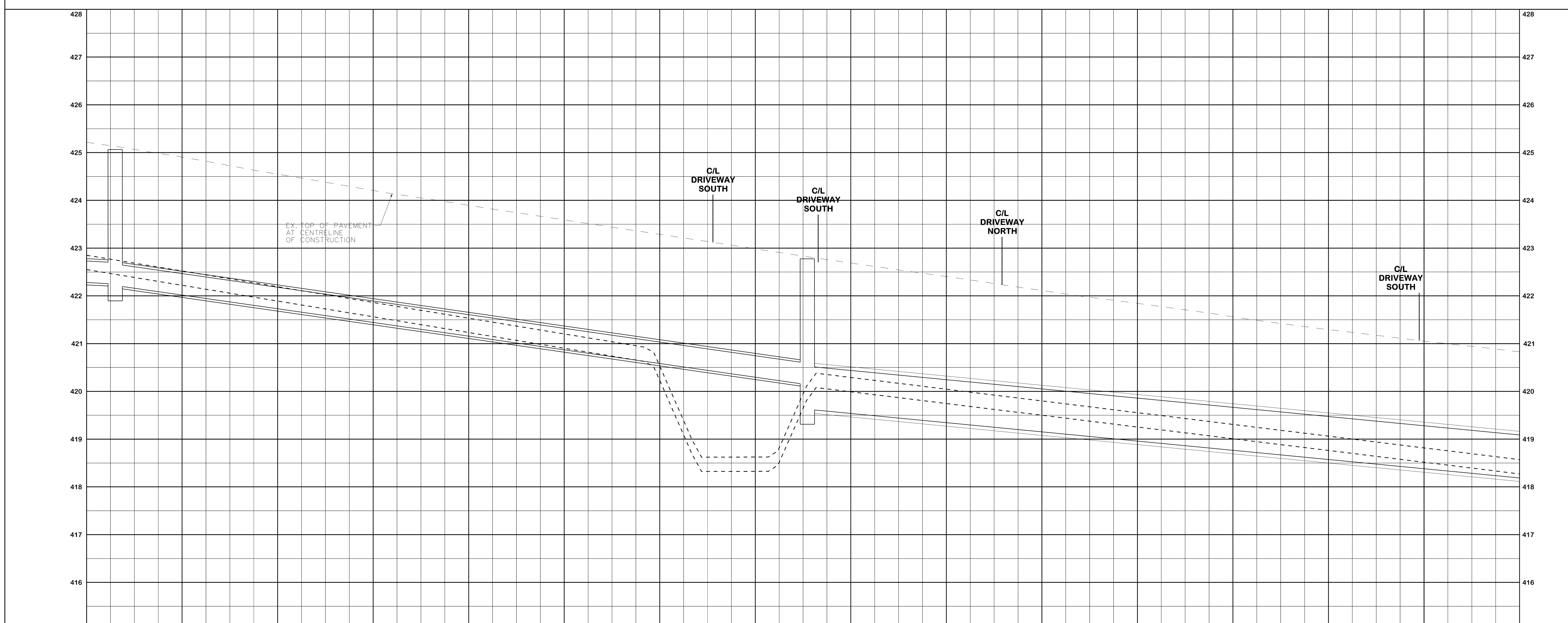
Approved by ______ ______ ______ ______ ______



							PROP. SWALE ELEV.
424.92	424.22	423.60	422.99	422.42	421.85	421.30	PROP. FINISHED GRADE
424.92	424.29	423.66	423.03	422.42	421.85	421.32	EX. ROAD ELEV.
5+550	5+570	5+590	5+610	5+630	5+650	5+670	ROAD CHAINAGE

NOTICE TO CONTRACTOR

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10m 0 10 20 30m HORIZONTAL SCALE

1m 0 1 2 3m VERTICAL SCALE

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ALTON VILLAGE EA

QUEEN ST. (MISSISSAUGA RD. TO MAIN ST.)
MAIN ST. (QUEEN ST. TO HIGH POINT RD.)

PROPOSED RECONSTRUCTION

STA. **TO STA.**

CAD Area X-XX	Area	Project No. 2018-81	
Checked by: H.H.	Drawn by: M.A.D.	Plan No. XXXXX-D	
Date: MARCH 2021	Sheet: NC-19 of NC 24		

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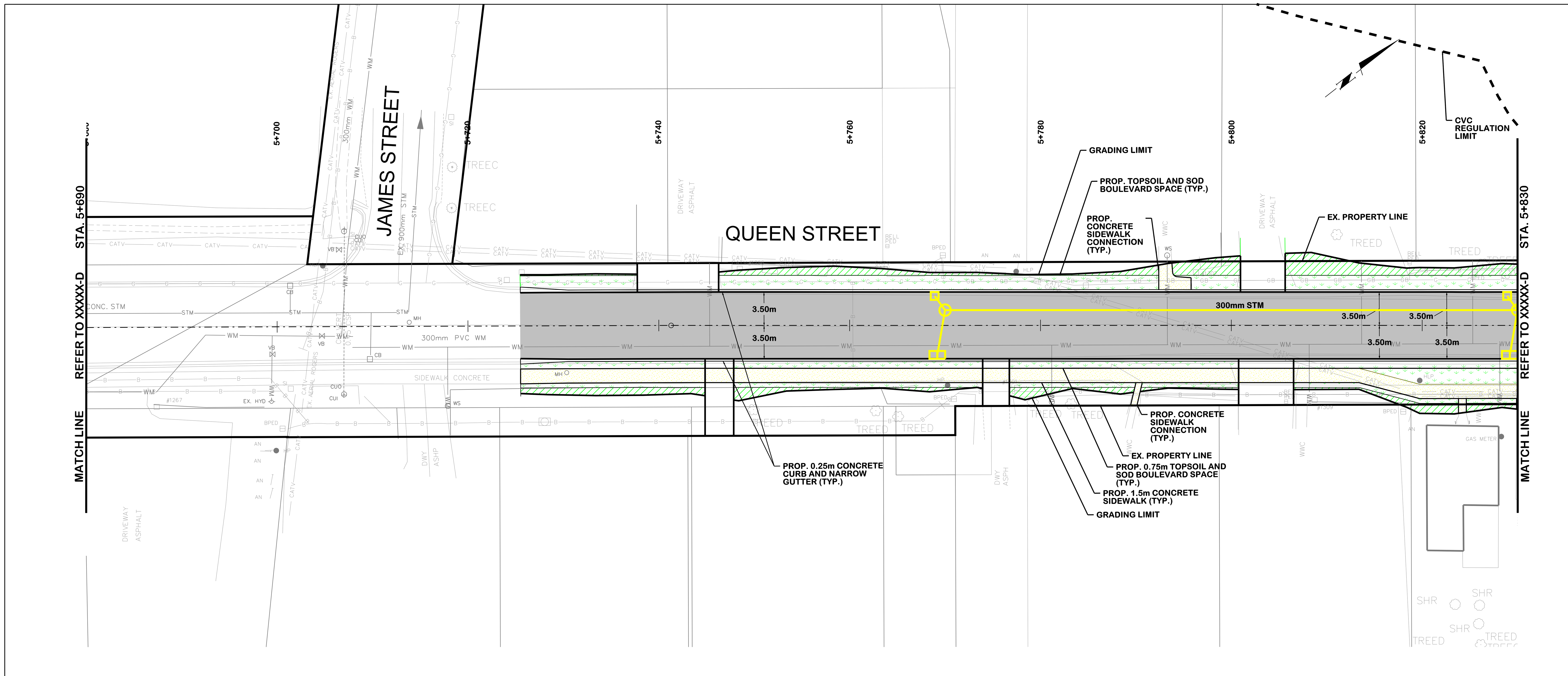
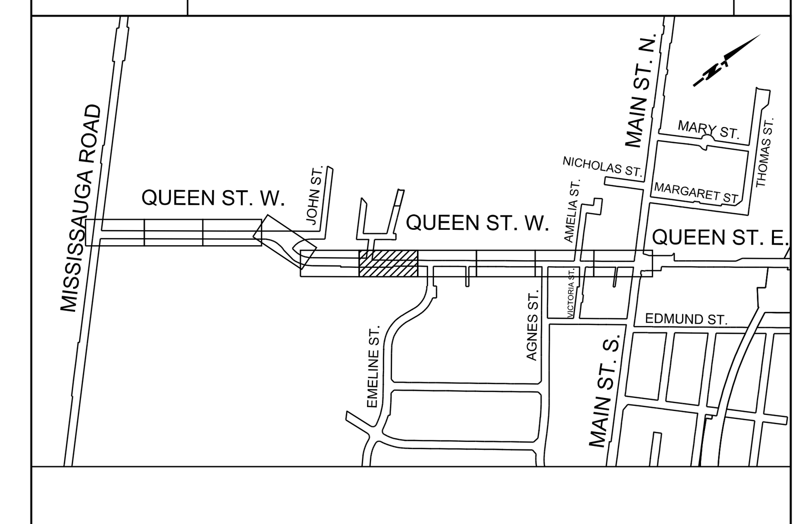


SERVICE DATA					
SERVICE	DATE	INIT.	SERVICE	DATE	INIT.
HYDRO ONE	XXX X, 2019	C.D.B.			
WATERMAINS	AUG 09, 2019	C.D.B.			
GAS MAINS	AUG 06, 2019	C.D.B.			
BELL U/G CABLE	SEP 30, 2019	C.D.B.			
HYDRO U/G CABLE	XXX X, 2019	C.D.B.			
ROGERS PLANT	AUG 12, 2019	C.D.B.			

REVISIONS		
DATE	DETAILS	INIT.
NOV 22, 2019	ISSUED FOR PIC REVIEW	J.P.D.
MAR. 12, 2021	30% PRELIMINARY DESIGN	D.J.O.



LEGEND:

- PROPOSED ROADWAY PAVEMENT
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- PROPOSED PAVED SHOULDER
- PROPOSED TOPSOIL AND SOD
- PROPOSED CUT/ FILL
- PROPOSED DITCH LINE
- PROPOSED RETAINING WALL
- EXISTING BELL PLANT
- EXISTING ROGERS PLANT
- EXISTING GAS LINE
- EXISTING WATERMAIN

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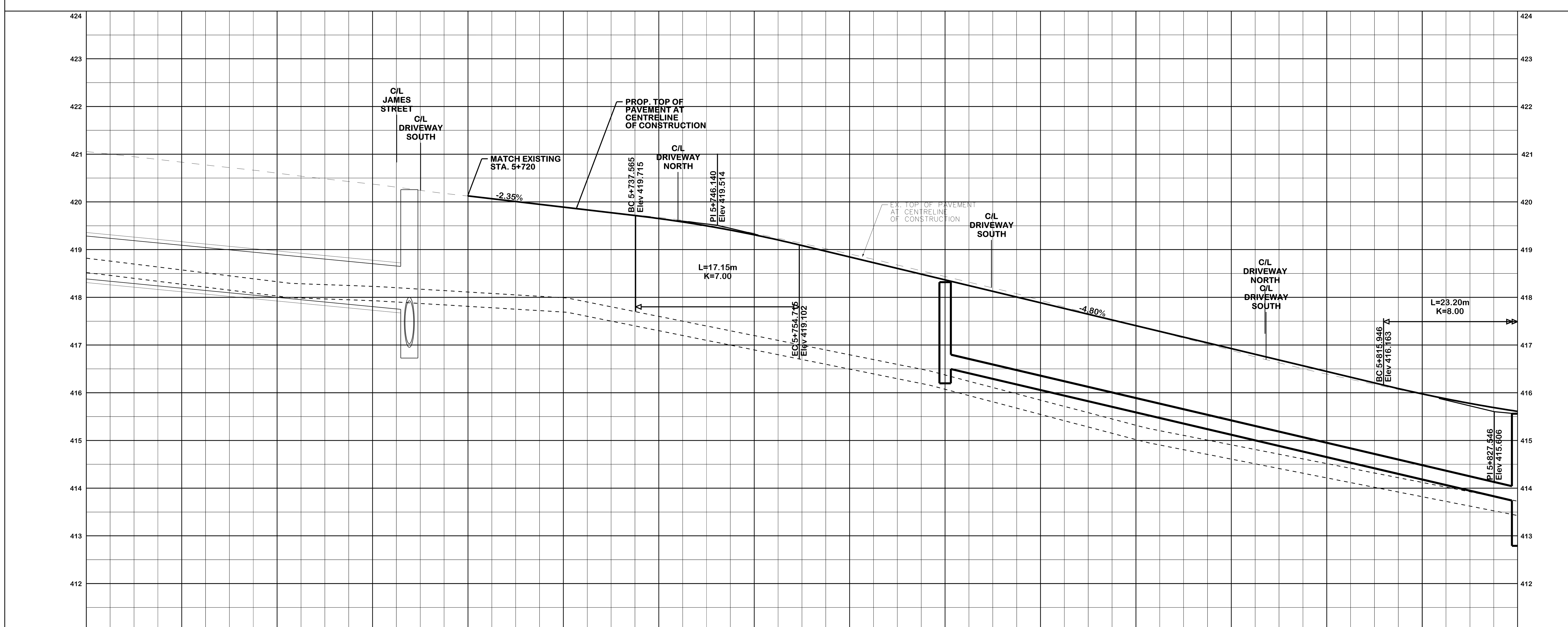

	5+690	5+710	5+730	5+750	5+770	5+790	5+810	
								PROP. SWALE ELEV.
	420.83	420.37	419.89	419.35	418.44	417.41	416.39	PROP. FINISHED GRADE
	420.83	420.36	419.89	419.32	418.37	417.41	416.45	EX. ROAD ELEV.
410	5+690	5+710	5+730	5+750	5+770	5+790	5+810	ROAD CHAINAGE

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ONTARIO CLEAN WATER AGENCY
HYDRO ONE NETWORKS
ENERSOURCE, HYDRO MISSISSAUGA
HYDRO ONE BRAMPTON

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10m 0 10 20 30m HORIZONTAL SCALE

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TOWN OF CALEDON

ALTON VILLAGE EA

QUEEN ST. (MISSISSAUGA RD. TO MAIN ST.)
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PROPOSED RECONSTRUCTION

STA. TO STA.

CAD Area	X-XX	Area		Project No.	2018-81
Checked by:	H.H.	Drawn by:	M.A.D.		
Date:	MARCH 2021	Sheet:	NC-20 of NC 24	Plan No.	XXXXX-D

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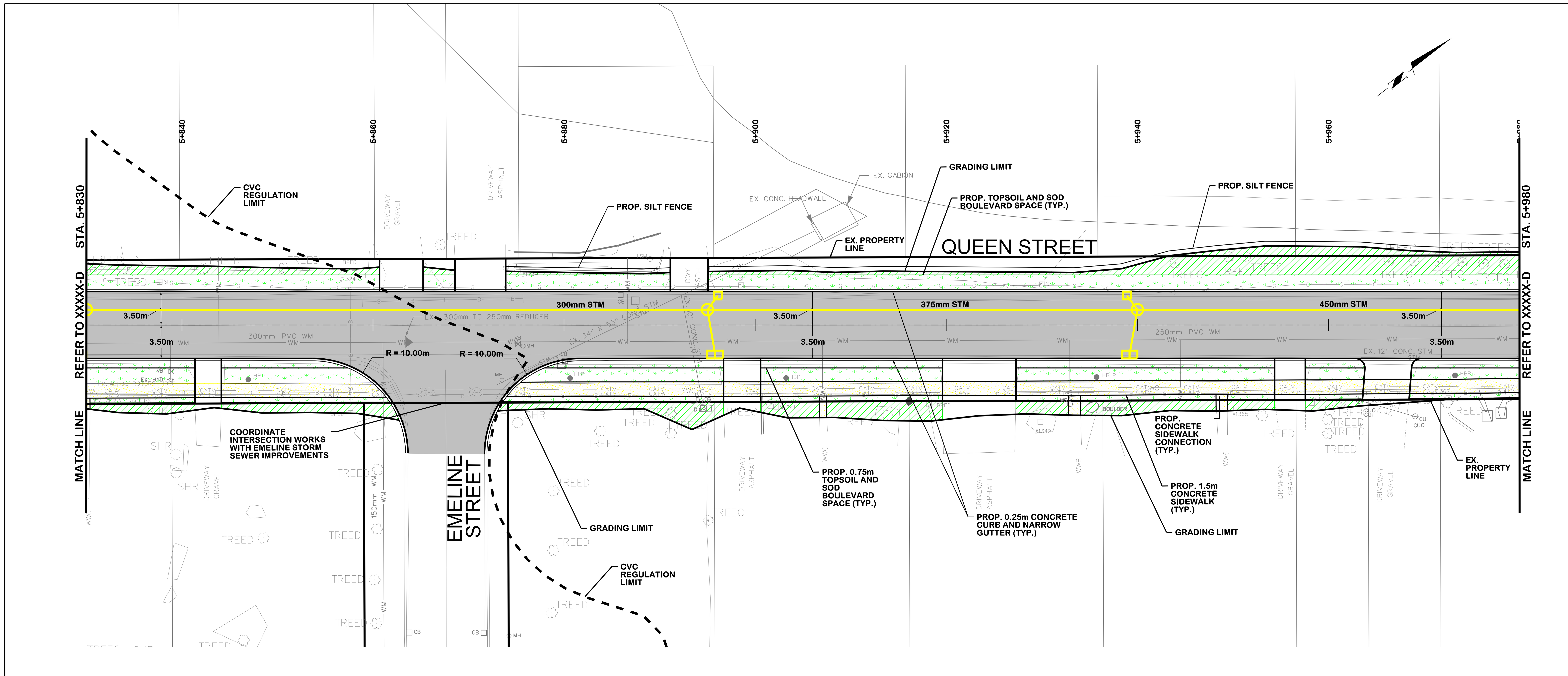

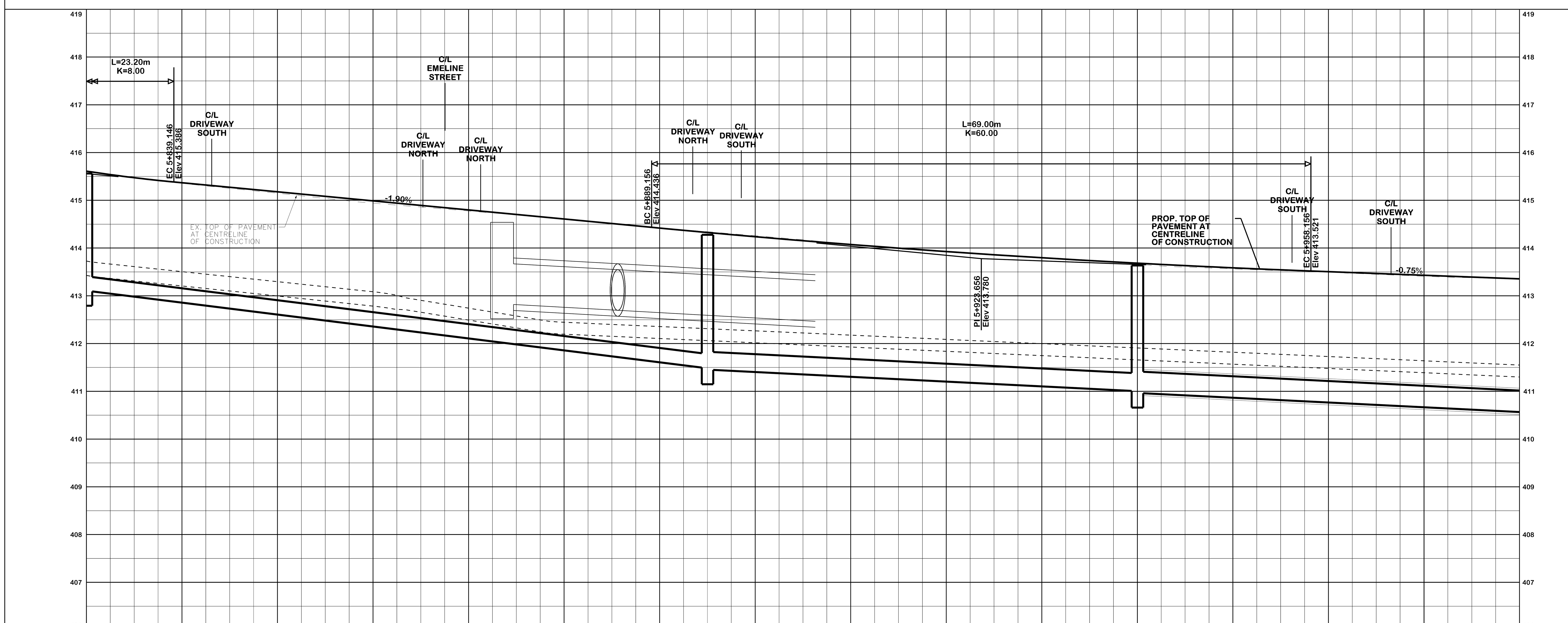

								PROP. SWALE ELEV.
415.61	415.15	414.78	414.43	414.08	413.80	413.56	413.41	PROP. FINISHED GRADE
415.61	415.18	414.80	414.42	414.07	413.79	413.58	413.43	EX. ROAD ELEV.
5+830	5+850	5+870	5+890	5+910	5+930	5+950	5+970	ROAD CHAINAGE

SERVICE DATA

SERVICE	DATE	INIT.	SERVICE	DATE	INIT.
HYDRO ONE	XXX X, 2019	C.D.B.			
WATERMAINS	AUG 09, 2019	C.D.B.			
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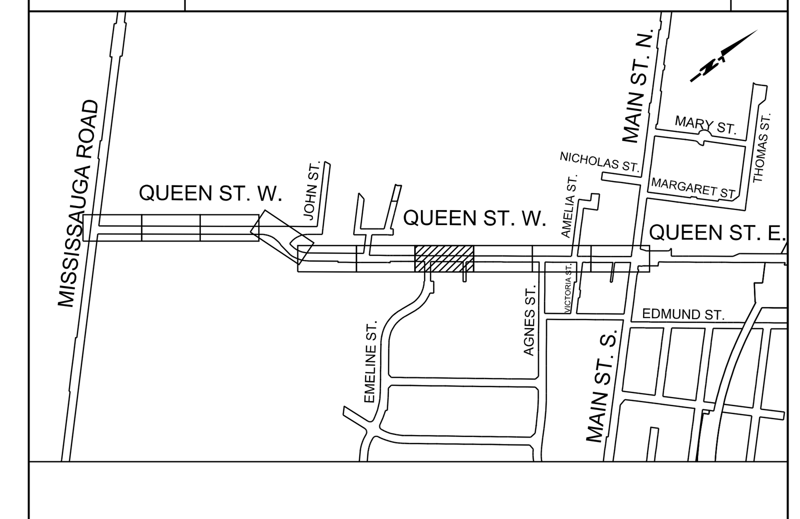
ROGERS PLANT	AUG 12, 2019	C.D.B.			

REVISIONS

DATE	DETAILS	INIT.
NOV 22, 2019	ISSUED FOR PIC REVIEW	J.P.D.
MAR. 12, 2021	30% PRELIMINARY DESIGN	D.J.O.



LEGEND:

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PROPOSED RECONSTRUCTION

STA. **TO STA.**

CAD Area	X-XX	Area		Project No.	2018-81
Checked by:	H.H.	Drawn by:	M.A.D.	Plan No.	XXXXX-D
Date:	MARCH 2021	Sheet:	NC-21 of NC 24		

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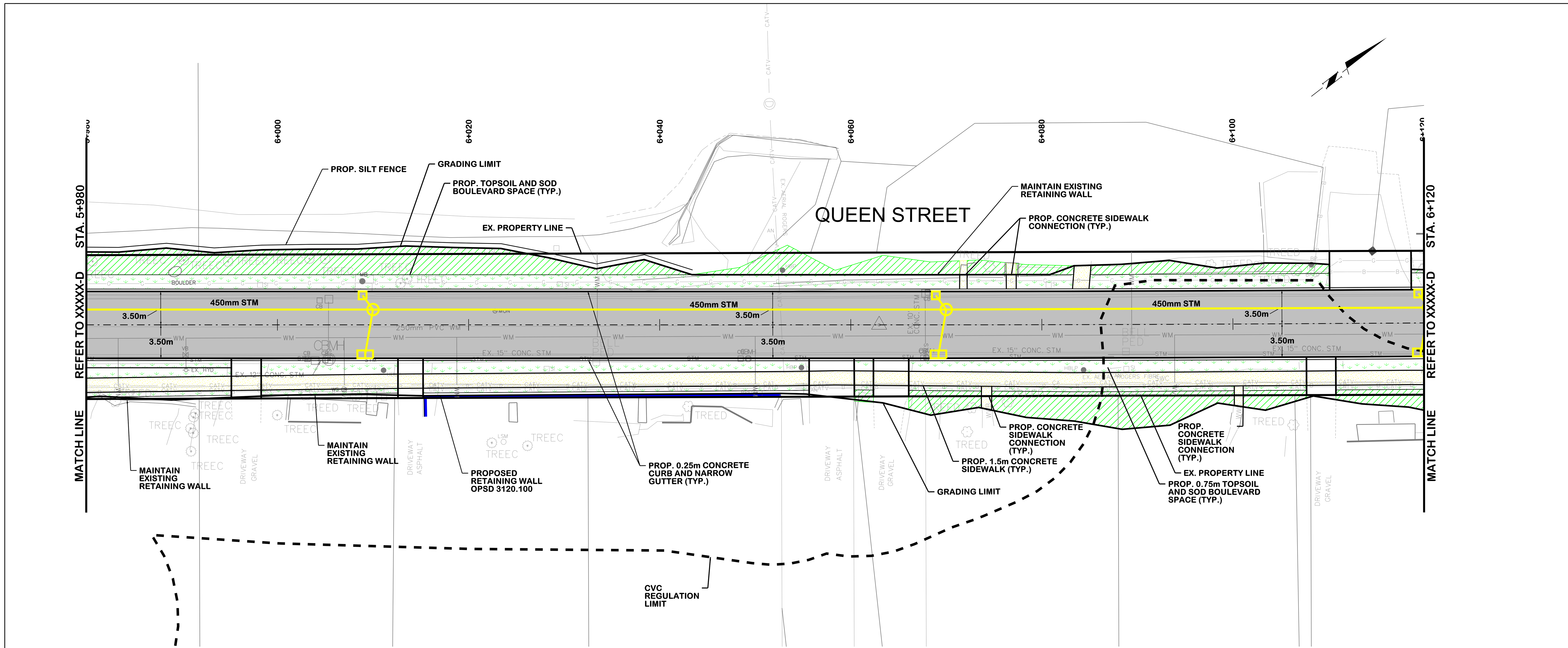

SERVICE DATA

SERVICE	DATE	INIT.	SERVICE	DATE	INIT.
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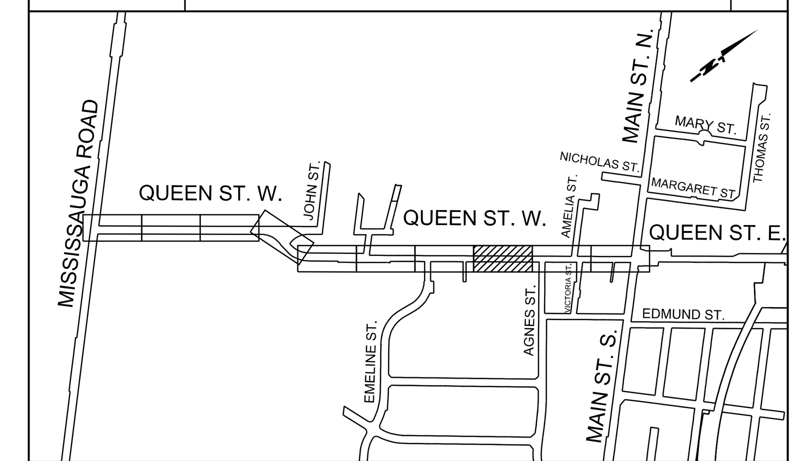

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- EXISTING GAS LINE
- EXISTING WATERMAIN

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General Notes

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All Pipes Size In mm

20C Existing Water Service, Size In mm

WS20 Proposed Water Service, Size In mm

B.M. No. 798475 Elev. 412.263 m
Description
Location Lat. 43-50.8 Long. 80-03.0

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Designed by ______ ______ ______ ______ Chkd. ______

Approved by ______ ______ ______ ______ ______

NOTICE TO CONTRACTOR

48 HOURS PRIOR TO COMMENCING WORK NOTIFY THE FOLLOWING

THE REGIONAL MUNICIPALITY OF PEEL
CITY OF MISSISSAUGA WORKS DEPT.
CITY OF BRAMPTON WORKS DEPT.
TOWN OF CALEDON WORKS DEPT.
BELL CANADA
ENBRIDGE INCORPORATED-GAS DISTRIBUTION
ONTARIO MINISTRY OF TRANSPORTATION
ONTARIO CLEAN WATER AGENCY
HYDRO ONE NETWORKS
ENERSOURCE, HYDRO MISSISSAUGA
HYDRO ONE BRAMPTON

CABLE TELEVISION/FIBREOPTIC PROVIDERS:
BELL CANADA
ENERSOURCE TELECOM
HYDRO ONE TELECOM
ROGERS CABLE
ALLSTREAM
PSN (PUBLIC SECTOR NETWORK)
FUTUREWAY (FCI BROADBAND)

10m 0 10 20 30m HORIZONTAL SCALE

1m 0 1 2 3m VERTICAL SCALE

TOWN OF CALEDON

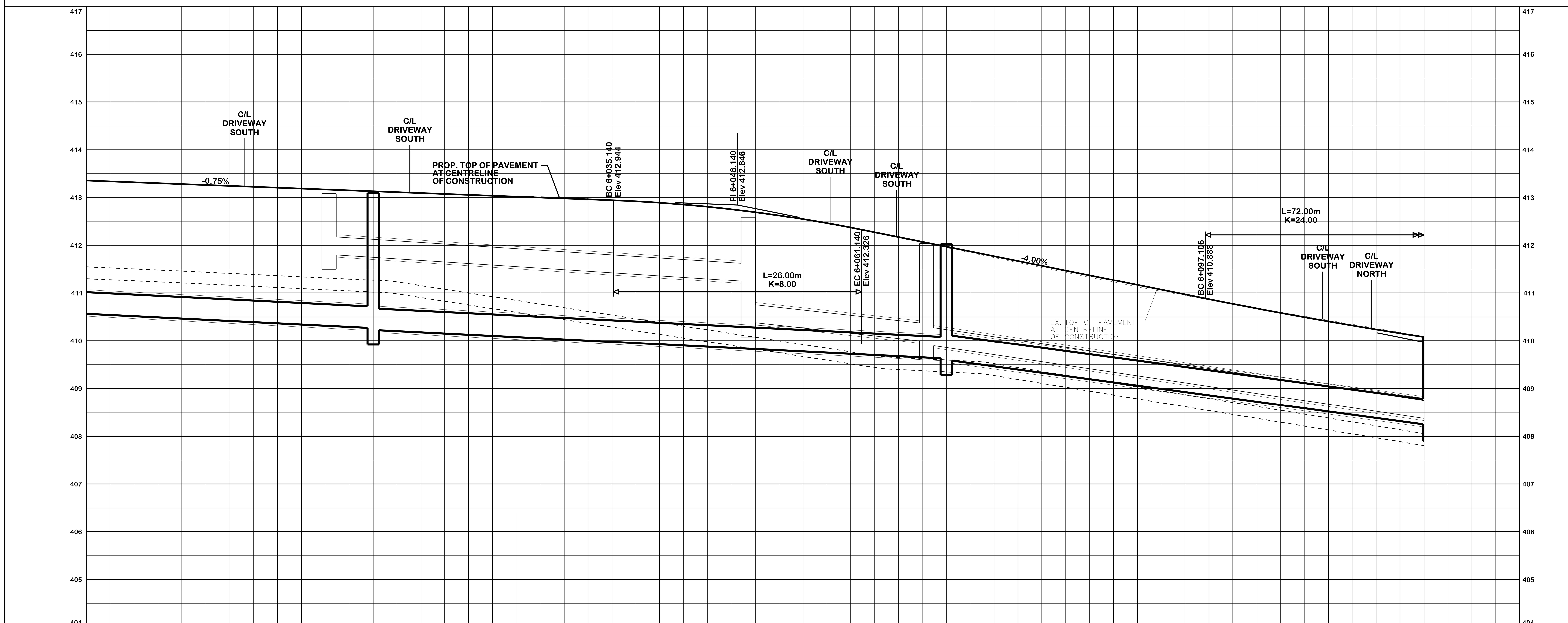
ALTON VILLAGE EA

QUEEN ST. (MISSISSAUGA RD. TO MAIN ST.)
MAIN ST. (QUEEN ST. TO HIGH POINT RD.)

PROPOSED RECONSTRUCTION

STA. **TO STA.**

CAD Area X-XX	Area	Project No. 2018-81	
Checked by: H.H.	Drawn by: M.A.D.	Plan No. XXXXX-D	
Date: MARCH 2021	Sheet: NC-22 of NC 24		



							PROP. SWALE ELEV.
413.28	413.13	413.01	412.70	411.95	411.13	410.43	PROP. FINISHED GRADE
413.29	413.15	413.01	412.70	411.96	411.17	410.40	EX. ROAD ELEV.
5+990	6+010	6+030	6+050	6+070	6+090	6+110	ROAD CHAINAGE

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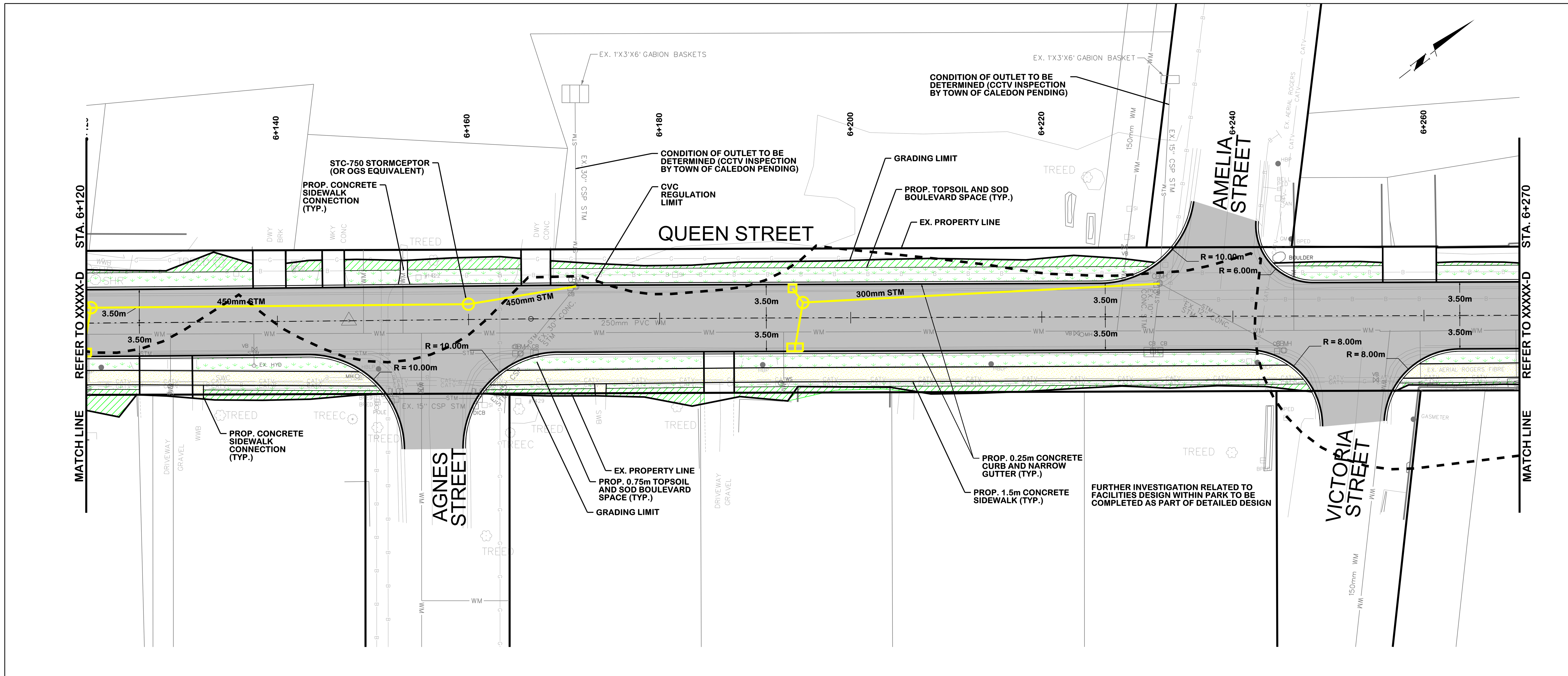

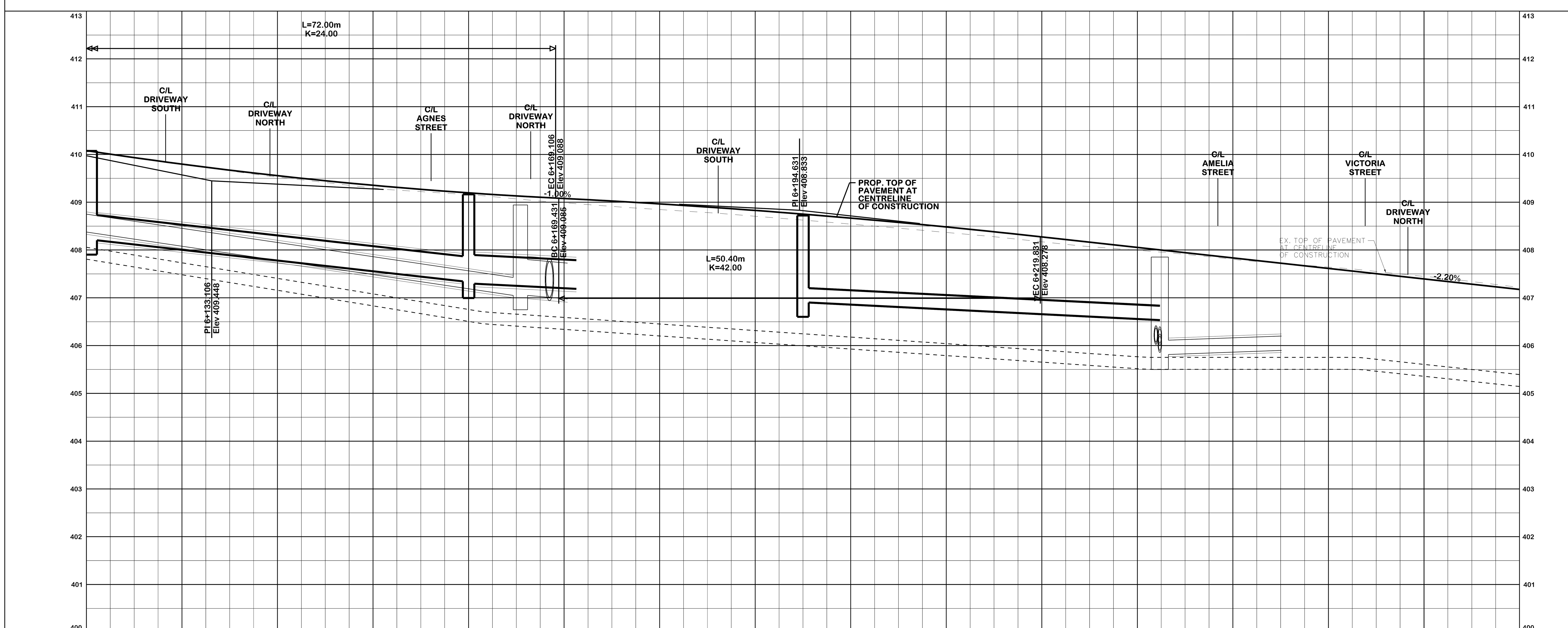

							PROP. SWALE ELEV.
409.79	409.30	408.99	408.71	408.37	407.99	407.64	PROP. FINISHED GRADE
409.78	409.32	409.00	408.70	408.37	408.00	407.61	EX. ROAD ELEV.
6+130	6+150	6+170	6+190	6+210	6+230	6+250	ROAD CHAINAGE

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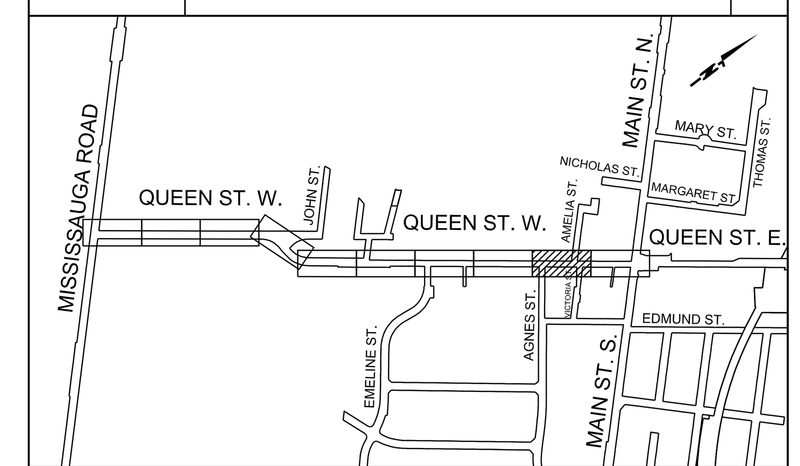
SERVICE DATA

SERVICE	DATE	INIT.	SERVICE	DATE	INIT.
HYDRO ONE	XXX X, 2019	C.D.B.			
WATERMAINS	AUG 09, 2019	C.D.B.			
GAS MAINS	AUG 06, 2019	C.D.B.			
BELL U/G CABLE	SEP 30, 2019	C.D.B.			
HYDRO U/G CABLE	XXX X, 2019	C.D.B.			
ROGERS PLANT	AUG 12, 2019	C.D.B.			

REVISIONS

DATE	DETAILS	INIT.
NOV 22, 2019	ISSUED FOR PIC REVIEW	J.P.D.
MAR. 12, 2021	30% PRELIMINARY DESIGN	D.J.O.



LEGEND:

- PROPOSED ROADWAY PAVEMENT
- PROPOSED IMPRESSED COLORED CONCRETE
- PROPOSED CONCRETE SIDEWALK / CONCRETE BUS PAD
- PROPOSED PAVED SHOULDER
- PROPOSED TOPSOIL AND SOD
- PROPOSED CUT/ FILL
- PROPOSED DITCH LINE
- PROPOSED RETAINING WALL
- EXISTING BELL PLANT
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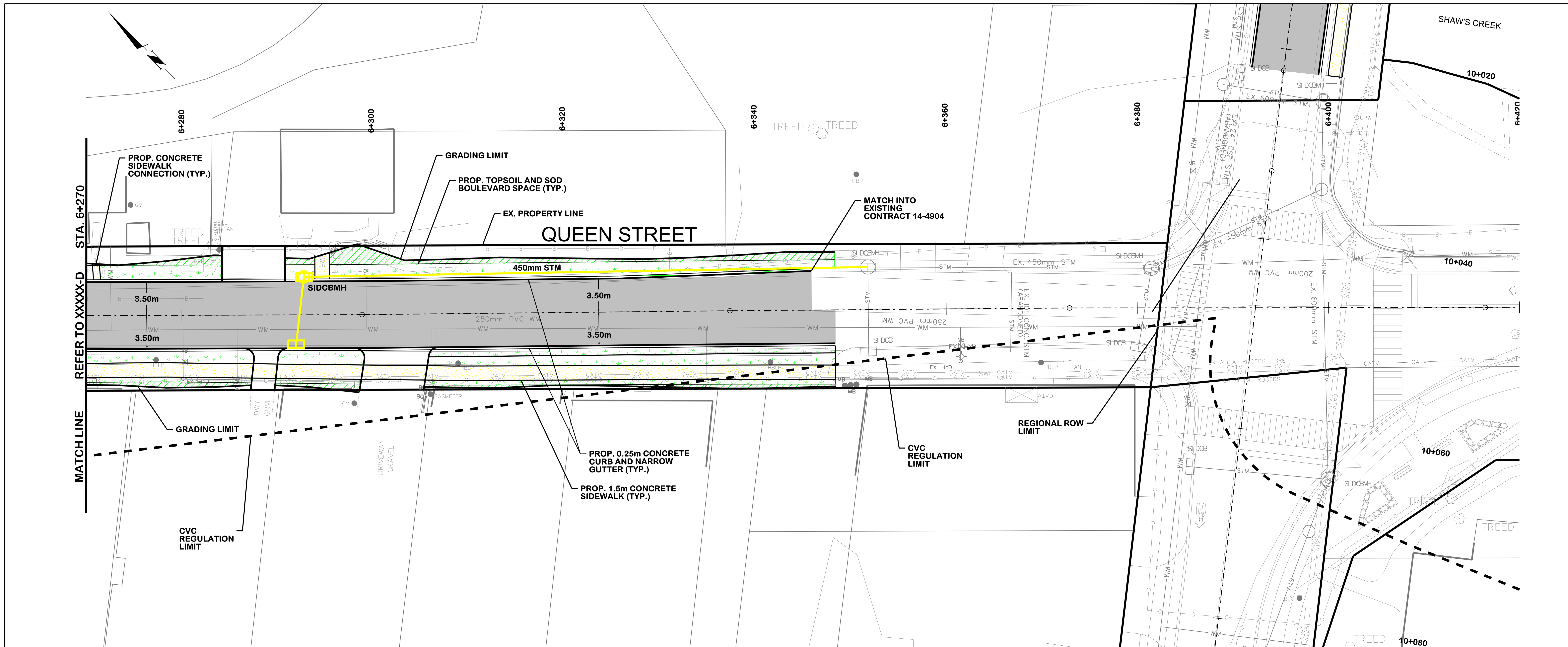
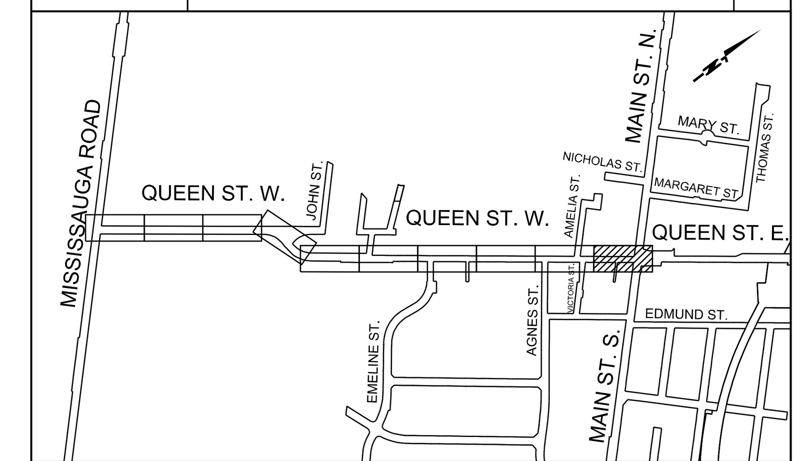
Checked by: H.H.	Drawn by: M.A.D.	
Date: MARCH 2021	Sheet: NC-23 of NC 24	Plan No. XXXXX-D





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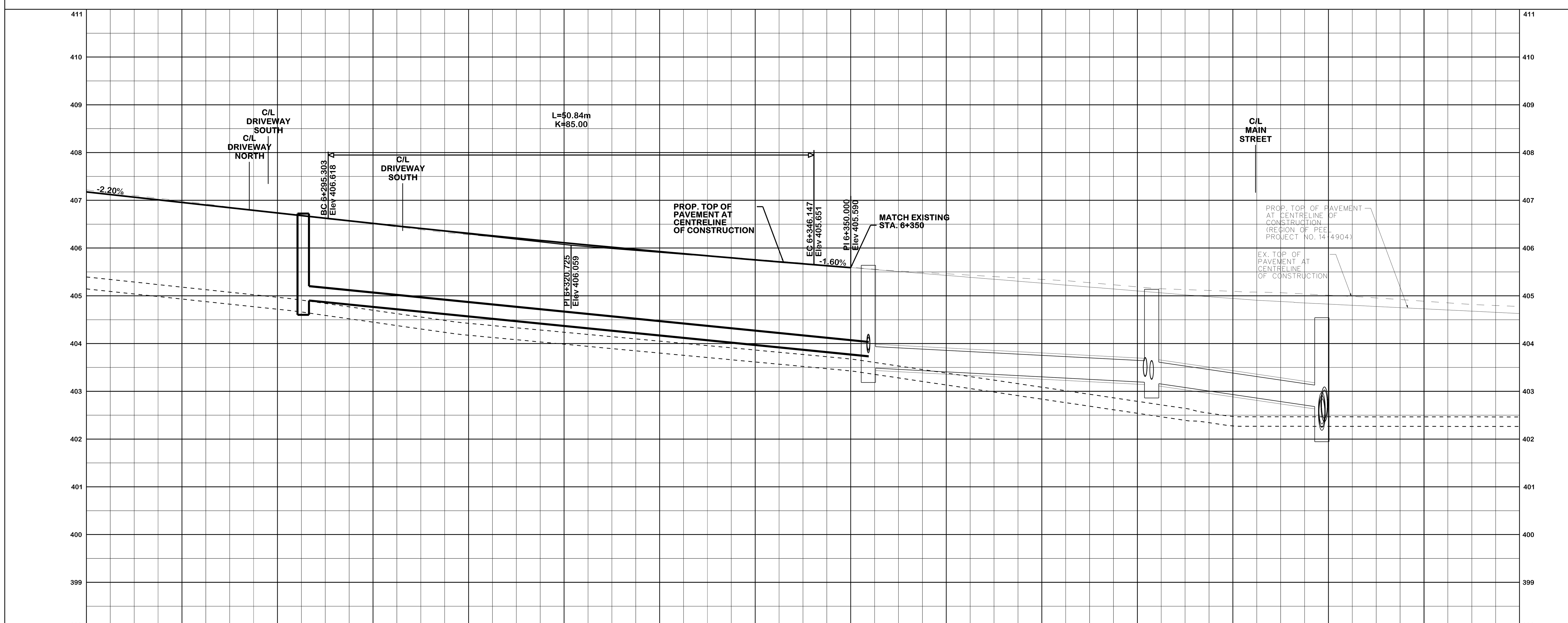

PROP. SWALE ELEV.								
PROP. FINISHED GRADE	407.22	406.73	406.28	405.92	405.60	405.34	405.09	404.89
EX. ROAD ELEV.	407.17	406.73	406.31	405.93	405.60	405.32	405.08	404.87
ROAD CHAINAGE	6+270	6+290	6+310	6+330	6+350	6+370	6+390	6+410

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CAD Area: X-XX	Area	Project No.	2018-81
Checked by: H.H.	Drawn by: M.A.D.		
Date: MARCH 2021	Sheet: NC-24 of NC 24	Plan No.	**XXXXX-D**

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APPENDIX B

Storm Sewer Design Sheet

TOWN OF CALEDON

DEVELOPMENT Main St North and Queen St West

CONSULTANT R.V. Anderson Associates Ltd

MAJOR DRAINAGE AREA Shaws Creek

SHEET No. 1 **OF** 1 **DATE** Feb 2020

DESIGNED BY TAP

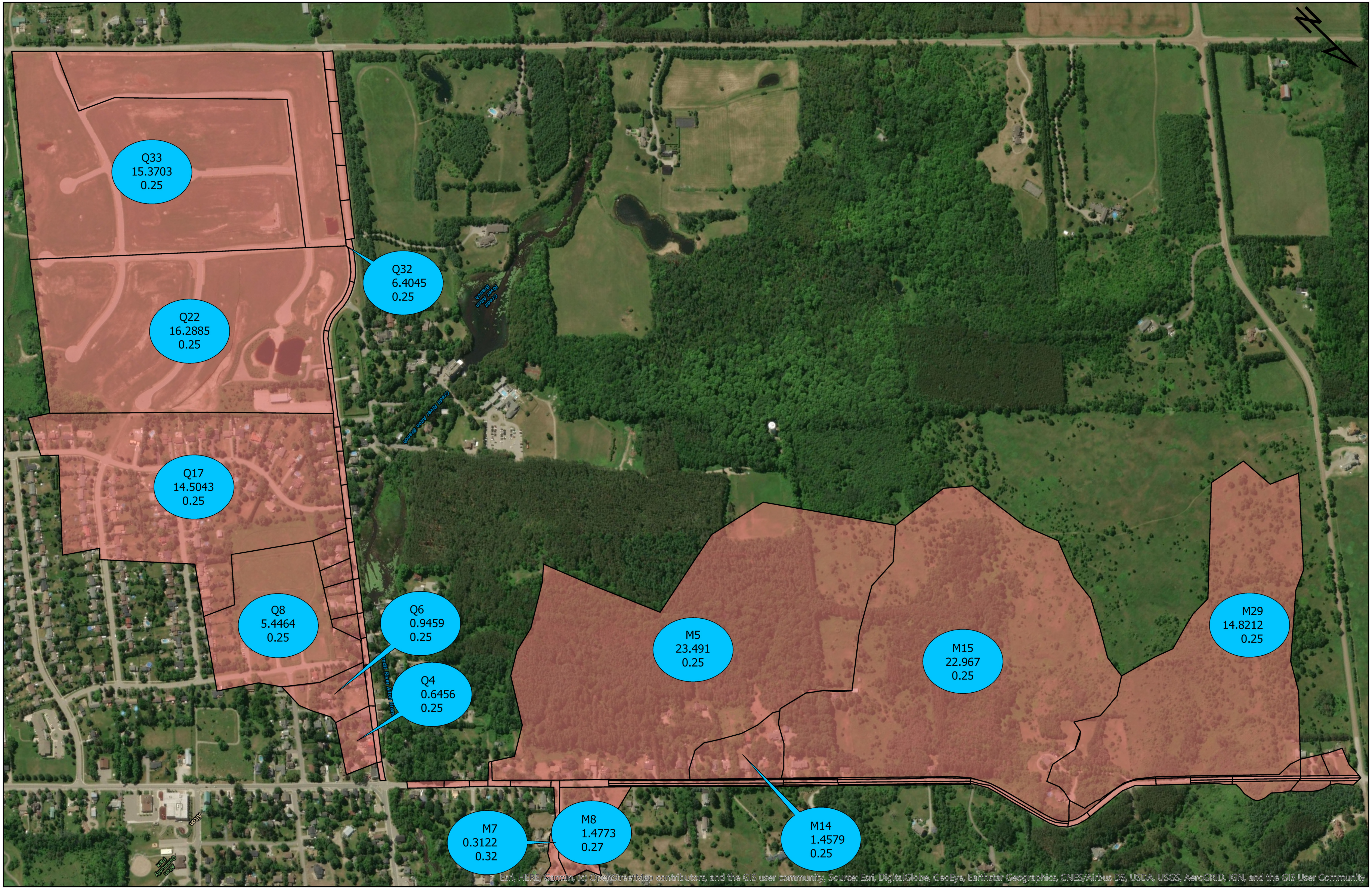
CHECKED BY ______

PUBLIC WORKS AND ENGINEERING DEPARTMENT
STORM DRAINAGE DESIGN CHART
FOR CIRCULAR DRAINS FLOWING FULL

LOCATION					DRAINAGE AREA				RUNOFF				PIPE SELECTION					PROFILE	
	FROM		TO																NOTES / DESCRIPTIONS
STREET	MH No.	Sta.	MH No.	Sta.	A ha.	C	A*C	Cumul. A*C	Cumul. Tc (Ti- __) min	Intensity mm/h	Rational Q m^3/s	PCSWMM Q m3/s	Pipe Length m	Pipe Slope %	Pipe Dia. mm	Actual Capacity (full) m^3/s	Velocity (Average) m/s	Fall in Sewer m	
Queen Street West - Mississauga Road to James Street																			
Queen St W	PROP-STMH-QJ10	5+040	PROP-STMH-QJ9	5+100	0.0652	0.82	0.0535	0.053	15.0	74.7	0.011	0.016	60	2.5	300	0.153	2.163	1.50	Proposed extension of existing storm sewer
Queen St W	PROP-STMH-QJ9	5+100	PROP-STMH-QJ8	5+160	0.1103	0.82	0.0904	0.144	15.5	73.4	0.029	0.044	60	2.5	300	0.153	2.163	1.50	Proposed extension of existing storm sewer
Queen St W	PROP-STMH-QJ8	5+160	PROP-STMH-QJ7	5+220	0.1122	0.82	0.092	0.236	15.9	72.2	0.047	0.071	60	2.5	300	0.153	2.163	1.50	Proposed extension of existing storm sewer
Queen St W	PROP-STMH-QJ7	5+220	PROP-STMH-QJ6	5+280	0.1094	0.82	0.0897	0.326	16.4	71.0	0.064	0.098	60	2.5	375	0.277	2.510	1.50	Proposed extension of existing storm sewer
Queen St W	PROP-STMH-QJ6	5+280	EX-STMH-QJ5	5+355	0.1207	0.82	0.099	0.425	16.8	70.1	0.083	0.127	75	2.5	375	0.277	2.510	1.88	Existing storm sewer
Queen St W	EX-STMH-QJ5	5+355	EX-STMH-QJ4	5+435	6.4040	0.25	1.601	2.026	17.3	68.9	0.387	0.264	80	1.4	450	0.337	2.121	1.12	SWM pond controls inflow from adjacent lands, use modelled flow
Queen St W	EX-STMH-QJ4	5+435	EX-STMH-QJ3A	5+495	0.0750	0.25	0.0188	2.044	17.9	67.4	0.383	0.283	60	1.1	450	0.299	1.880	0.66	SWM pond controls inflow from adjacent lands, use modelled flow
Queen St W	EX-STMH-QJ3A	5+495	EX-STMH-QJ3A	5+545	0.0921	0.25	0.023	2.067	18.4	66.2	0.380	0.283	50	1	450	0.285	1.793	0.50	SWM pond controls inflow from adjacent lands, use modelled flow
Queen St W	EX-STMH-QJ3A	5+545	EX-STMH-QJ2	5+615	31.730	0.25	7.9325	10.000	18.9	65.2	1.812	0.307	70	2.7	900	2.975	4.676	1.89	SWM pond controls inflow from adjacent lands, use modelled flow
Queen St W	EX-STMH-QJ2	5+615	EX-STMH-QJ1	5+715	31.730	0.25	7.9325	17.932	19.2	64.7	3.224	1.728	60	1.9	900	2.495	3.922	1.14	SWM ponds control inflow from adjacent lands, use modelled flow
Queen Street West - James Street to Agnes Street																			
Queen St W	PROP-STMH-QAG-8	5+770	PROP-STMH-QAG-7	5+830	0.0532	0.92	0.0489	0.049	15.0	74.7	0.010	0.016	60	3.6	300	0.183	2.596	2.16	Proposed new storm sewer
Queen St W	PROP-STMH-QAG-7	5+830	PROP-STMH-QAG-6	5+890	0.0754	0.92	0.0694	0.118	15.4	73.6	0.024	0.038	60	3.6	300	0.183	2.596	2.16	Proposed new storm sewer
Queen St W	PROP-STMH-QAG-6	5+890	PROP-STMH-QAG-5	5+940	0.7270	0.92	0.6688	0.787	15.8	72.6	0.159	0.059	50	2.5	375	0.277	2.510	1.25	Proposed new storm sewer
Queen St W	PROP-STMH-QAG-5	5+940	PROP-STMH-QAG-4	6+010	0.4100	0.55	0.2255	1.013	16.1	71.8	0.202	0.125	70	2	450	0.403	2.535	1.40	Proposed new storm sewer
Queen St W	PROP-STMH-QAG-4	6+010	PROP-STMH-QAG-3	6+070	0.2880	0.55	0.1584	1.171	16.6	70.6	0.230	0.176	60	2	450	0.403	2.535	1.20	Proposed new storm sewer
Queen St W	PROP-STMH-QAG-3	6+070	PROP-STMH-QAG-2	6+120	0.4000	0.55	0.22	1.391	17.0	69.6	0.269	0.241	50	2	450	0.403	2.535	1.00	Proposed new storm sewer
Queen St W	PROP-STMH-QAG-2	6+120	OGS	6+160	0.2140	0.55	0.1177	1.509	17.3	68.9	0.289	0.278	40	2	450	0.403	2.535	0.80	Proposed storm sewer into OGS
Queen St W	OGS	6+160	Agnes St Outfall	6+170	0.0505	0.92	0.0465	1.555	17.5	68.2	0.295	0.278	10	1.8	450	0.383	2.405	0.18	Proposed storm sewer from OGS to outfall
Queen Street West - Amelia Street Storm Sewer Extension																			
Queen St W	PROP-STMH-QAM-2	6+190	EX-CBMH-QAM-1	6+230	0.0892	0.92	0.0821	0.082	15.0	74.7	0.017	0.027	30	2.0	300	0.137	1.935	0.60	Proposed extension of existing storm sewer
Queen Street West - Main Street Storm Sewer Extension																			
Queen St W	PROP-DCBMH-QM5	6+290	EX-DCBMH-QM4	6+350	0.0500	0.97	0.0485	0.049	15.0	74.7	0.010	0.015	60	1.9	300	0.133	1.886	1.14	Proposed extension of existing storm sewer
Queen St W	EX-DCBMH-QM4	6+350	EX-DCBMH-QM3	6+380	0.0577	0.97	0.056	0.104	15.5	73.3	0.021	0.033	30	1.2	450	0.312	1.964	0.36	Existing storm sewer
Queen St W	EX-DCBMH-QM3	6+380	EX-STMH-QM2	6+400	0.0338	0.96	0.0324	0.137	15.8	72.6	0.028	0.042	20	0.3	450	0.156	0.982	0.06	Existing storm sewer
Main Street North - Upstream of Mary Street to Shaws Creek																			
Queen St W	PROP-STMH-MAIN-7	9+630	PROP-STMH-MAIN-6	9+705	1.8820	0.25	0.4705	0.471	15.0	74.7	0.098	0.084	75	3.3	375	0.319	2.884	2.48	Proposed new storm sewer
Queen St W	PROP-STMH-MAIN-6	9+705	PROP-STMH-MAIN-5	9+735	1.6030	0.50	0.8015	1.272	15.4	73.5	0.260	0.265	30	3.8	450	0.556	3.494	1.14	Proposed new storm sewer
Queen St W	PROP-STMH-MAIN-5	9+735	PROP-STMH-MAIN-4	9+810	0.3120	0.53	0.1654	1.437	15.6	73.1	0.292	0.307	75	9	450	0.855	5.378	6.75	Proposed new storm sewer
Queen St W	PROP-STMH-MAIN-4	9+810	PROP-STMH-MAIN-3	9+850	0.0930	0.76	0.0707	1.508	15.8	72.5	0.304	0.323	40	0.9	525	0.408	1.885	0.36	Proposed new storm sewer
Queen St W	PROP-STMH-MAIN-3	9+850	PROP-STMH-MAIN-2	9+880	0.1050	0.76	0.0798	1.588	16.2	71.6	0.316	0.336	30	1.1	525	0.451	2.084	0.33	Proposed new storm sewer
Queen St W	PROP-STMH-MAIN-2	9+880	PROP-STMH-MAIN-1	9+925	0.0010	0.76	0.0008	1.589	16.4	71.0	0.313	0.340	45	1.2	525	0.471	2.176	0.54	Proposed new storm sewer
Queen St W	PROP-STMH-MAIN-1	9+925	PROP-OGS-MAIN	9+970	0.0580	0.76	0.0441	1.633	16.7	70.2	0.318	0.348	45	1.3	525	0.490	2.265	0.59	Proposed storm sewer into OGS

APPENDIX C

Modelled Subcatchment Drawings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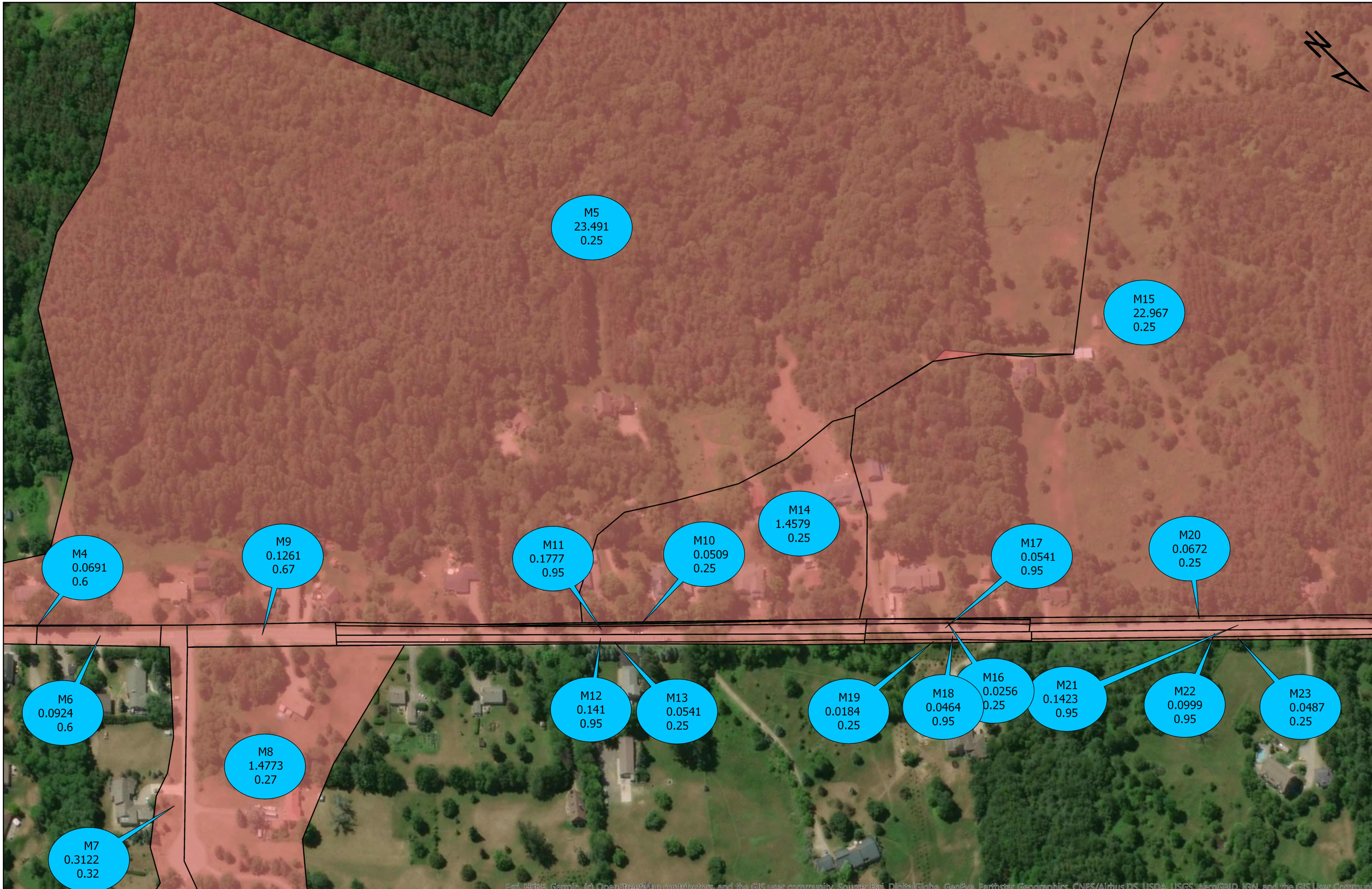
Esri, HERE, Garmin, (c) OpenStreetMap contributors, and the GIS user community, Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community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M10
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M6
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0.32
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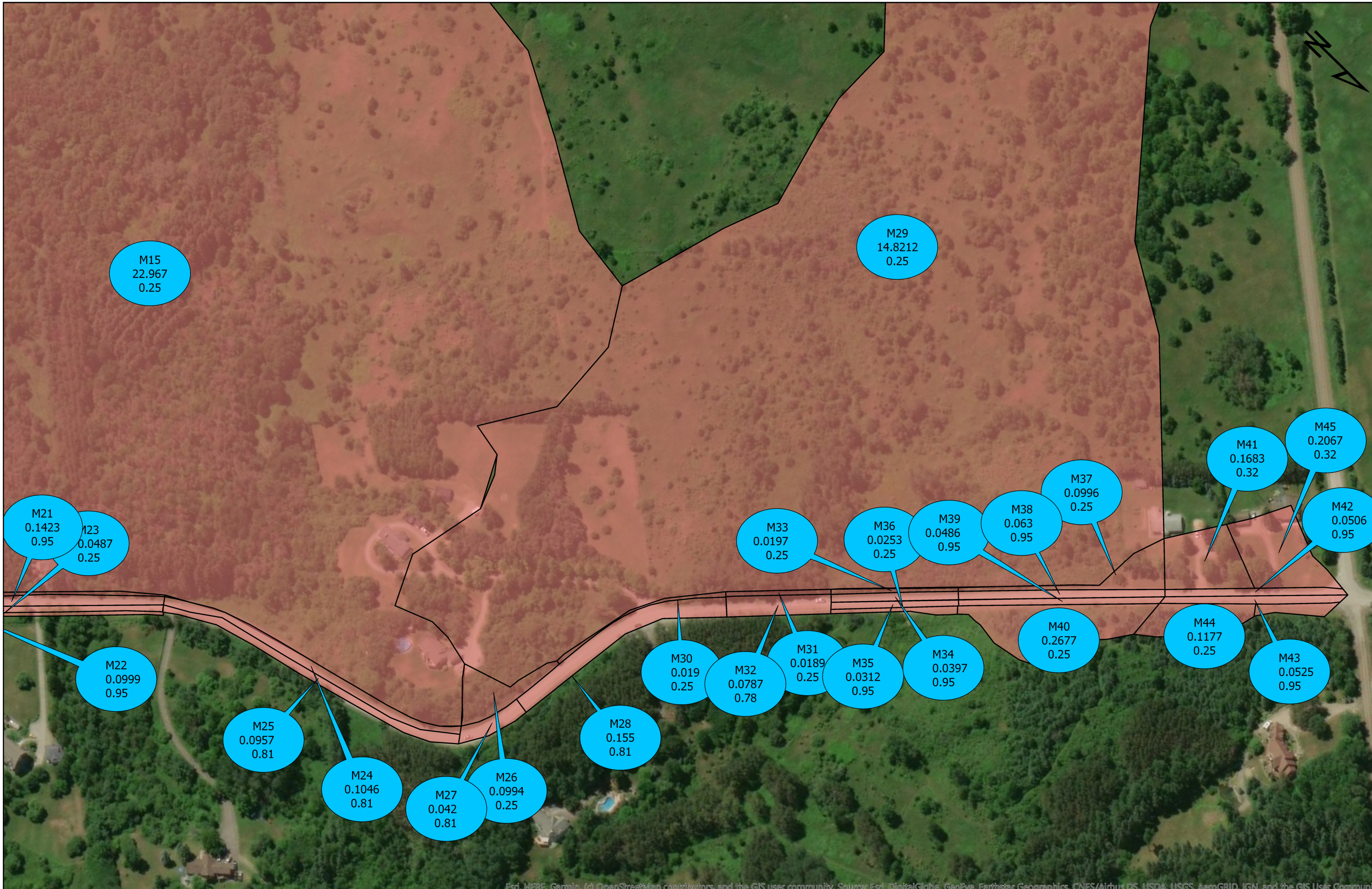

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M38 0.063 0.95
M37 0.0996 0.25
M40 0.2677 0.25
M41 0.1683 0.32
M45 0.2067 0.32
M42 0.0506 0.95
M44 0.1177 0.25
M43 0.0525 0.95
N
Esri, HERE, Garmin, (c) OpenStreetMap contributors, and the GIS user community, Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community


Q31 0.0652 0.71
Q30 0.1103 0.71
Q29 0.1122 0.71
Q28 0.1094 0.71
Q27 0.1207 0.71
Q26 0.1267 0.71
Q25 0.0747 0.91
Q24 0.0921 0.91
Q23 0.0644 0.92
Q21 0.0987 0.91
Q20 0.0532 0.86
Q32 6.4045 0.25
Q33 15.3703 0.25
Q22 16.2885 0.25
Q17 14.5043 0.25
Esri, HERE, Garmin, (c) OpenStreetMap contributors, and the GIS user community, Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

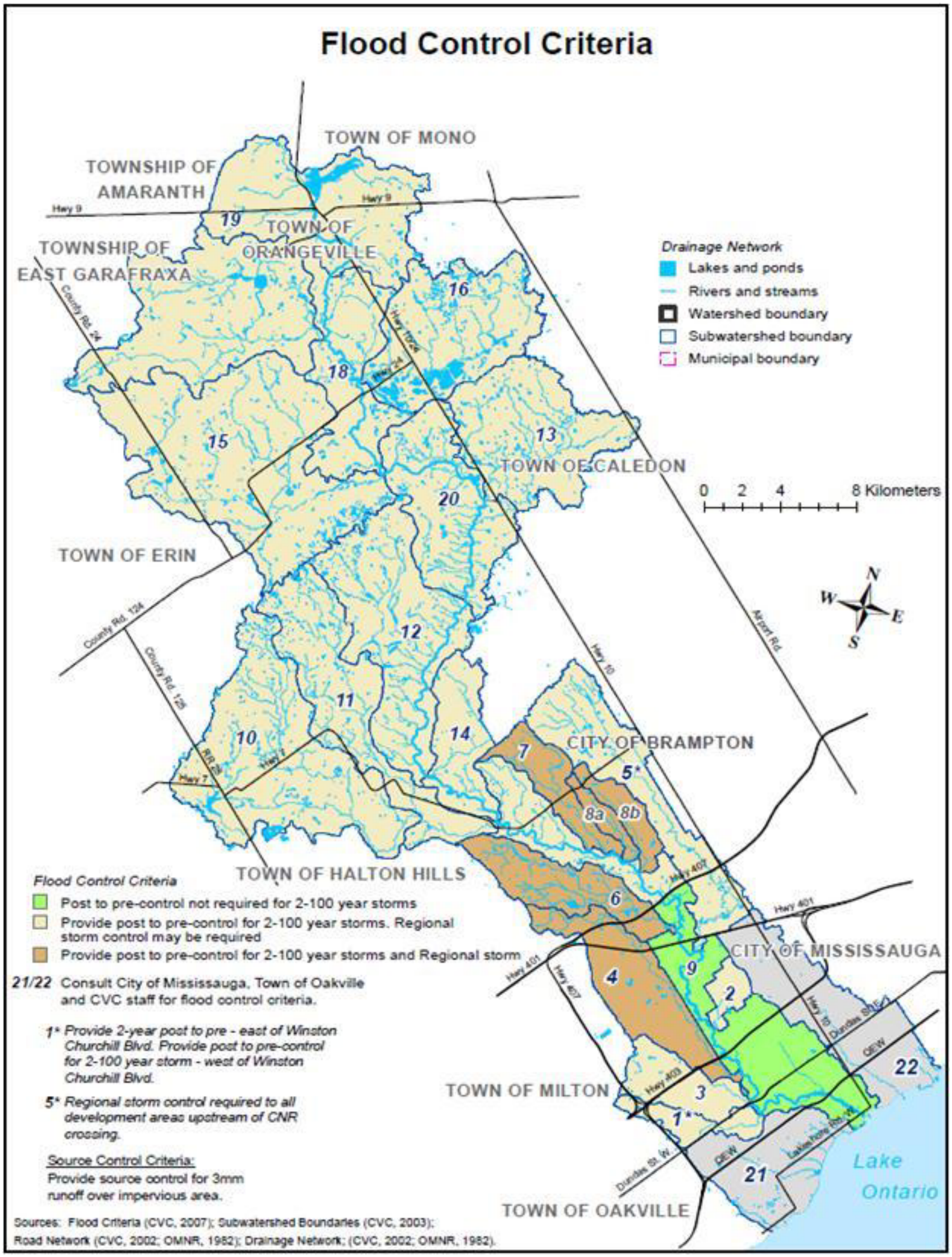

Credit River Alton Branch
M4
0.0691
0.6
M2
0.0582
0.6
M3
0.0375
0.6
M1
0.0887
0.6
Q21
0.0987
0.91
Q20
0.0532
0.86
Q19
0.0754
0.86
Q18
0.0727
0.86
Q13
0.0786
0.86
Q14
0.2094
0.28
Q11
0.0721
0.86
Q10
0.1605
0.28
Q7
0.058
0.86
Q5
0.0892
0.86
Q3
0.0498
0.92
Q2
0.0608
0.92
Q15
0.0508
0.86
Q16
0.3592
0.28
Q12
0.3287
0.28
Q9
0.053
0.86
Q6
0.9459
0.25
Q4
0.6456
0.25
Q1
0.0338
0.91
Q8
5.4464
0.25
Q22
16.2885
0.25
Q17
14.5043
0.25
Esri, HERE, Garmin, (c) OpenStreetMap contributors, and the GIS user community, Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

APPENDIX D

CVC and Region of Peel Stormwater Management Criteria 2012 (Excerpt)

Shaw's Creek Subwatershed

Figure 3-2: CVC Flood Control Criteria



#	Subwatershed Name	Flood Control Criteria	References & Notes
11	Silver Creek	• Provide post to pre control for all storms (i.e. 2,5,10,25,50 & 100 year)	• Hydrologic Model: GAWSER Model- Return period peak flows based on 24 hour SCS Type II distribution • Silver Creek Subwatershed Study updated November, 2003 by CVC, Schroeter & Associates, EWRG, ABL, Jacques Whitford Environmental Ltd., and Waterloo Hydrogeologic Inc.
12	Credit River - Cheltenham to Glen Williams	• Provide post to pre control for all storms (i.e. 2,5,10,25,50 & 100)	• Hydrologic Model: GAWSER Model- Return period peak flows based on 24 hour SCS Type II distribution • Glen Williams Integrated Planning Project - Scoped Subwatershed Plan dated January, 2003 by Dillon Consulting
13	East Credit River	• Provide post to pre control for all storms (i.e. 2,5,10,25,50 & 100 year)	• Hydrologic Model: GAWSER Model- Return period peak flows based on 24 hour SCS Type II distribution • East Credit Subwatershed Study - Subwatershed 13 dated November 2007 by Kidd Consulting
14	Credit River - Glen Williams to Norval	• Provide post to pre control for all storms (i.e. 2,5,10,25,50 & 100 year)	• Hydrologic Model: GAWSER Model- Return period peak flows based on 24 hour SCS Type II distribution
15	West Credit River	• Provide post to pre control for all storms (i.e. 2,5,10,25,50 & 100 year)	• Hydrologic Model: GAWSER Model- Return period peak flows based on 24 hour SCS Type II distribution • Subwatershed Study in Progress (Phase 1 completed); Phase 2 initiated
16	Caledon Creek	• Provide post to pre control for all storms (i.e. 2,5,10,25,50 & 100 year)	• Hydrologic Model: GAWSER Model- Return period peak flows based on 24 hour SCS Type II distribution • Caledon Creek and Credit River Subwatershed Study by CVC, Blackport Hydrogeologic, EWRG, Water System • Analysis & Parish Geomorphic
17	Shaw's Creek	• Provide post to pre control for all storms (i.e. 2,5,10,25,50 & 100 year)	• Hydrologic Model: GAWSER Model- Return period peak flows based on 24 hour SCS Type II distribution • Subwatershed Study in Progress (Phase I completed)
18	Credit River - Melville to Forks of the Credit	• Provide post to pre control for all storms (i.e. 2,5,10,25,50 & 100 year)	• Hydrologic Model: GAWSER Model- Return period peak flows based on 24 hour SCS Type II distribution • Caledon Creek and Credit River Subwatershed Study by CVC, Blackport Hydrogeologic, EWRG, Water System Analysis & Parish Geomorphic
19	Orangeville	• Provide post to pre control for all storms (i.e. 2,5,10,25,50 & 100 year)	• Hydrologic Model: GAWSER Model- Return period peak flows based on 24 hour SCS Type II distribution • Phase I and II completed (update in progress)
20	Credit River - Forks of the Credit to Cheltenham	• Provide post to pre control for all storms (i.e. 2,5,10,25,50 & 100 year)	• Hydrologic Model: GAWSER Model- Return period peak flows based on 24 hour SCS Type II distribution

NOTE: Based on CVC Board direction, additional analysis on recently observed high intensity short duration storms such as Toronto storm on August 19, 2005 may be required. This would allow to appropriately inform decision making taking into consideration the flooding implications of climate change. Consult CVC staff.

For watersheds that drain directly to Lake Ontario, summary of the flood control criteria is provided in **Table 3-2** and **Figure 3-3** illustrates the location of these tributaries.

5. Hydrologic and Hydraulic Modeling

Project Stage – [EA/PD], [DD], unless otherwise noted

This section will describe the methodology and findings of hydrologic and hydraulic analysis for the study area. The Hydrologic and Hydraulic Modelling should include, but is not limited to, the following elements:

5.1 Design Storm

- Use Intensity-Duration-Frequency (IDF) curves stipulated by the applicable Municipality within which the project is located.

- For the hydrologic modeling of the project study area, select appropriate IDF coordinates from applicable municipality as listed in **TABLE 1**:

TABLE 1 – IDF Parameters for Municipalities in the Region of Peel

	City of Brampton		Town of Caledon			City of Mississauga		
IDF Parameter	***a***	***b***	***a***	***b***	***c***	***a***	***b***	***c***
2-year	22.1	0.714	1070	7.85	0.8759	610	4.6	0.78
5-year	29.9	0.701	1593	11	0.8789	820	4.6	0.78
10-year	35.1	0.695	2221	12	0.9080	1010	4.6	0.78
25-year	41.6	0.691	3158	15	0.9335	1160	4.6	0.78
50-year	46.5	0.688	3886	16	0.9495	1300	4.7	0.78
100-year	51.3	0.686	4688	17	0.9624	1450	4.9	0.78

- Use the 5, 10, 25, 50, 100-year return period storm events for water quantity (i.e., peak flow and volume control) estimates.

- Generate and select appropriate design storm hyetographs based on a design storm interval and a storm duration of synthetic storm distributions. Alternatives include:
  - 4-hour Chicago storm distribution – *Recommended* for peak runoff prediction from urban watersheds,
  - 24-hour Chicago storm distribution – *Recommended* for maximum volume storage from urban watersheds, or
  - 24-hour SCS Type II – Developed by the US Soil Conservation Service (SCS) as the applicable storm distribution over most parts of Canada.

- A minimum hydrograph computational time interval of 10 minutes *(5 minutes is recommended).*

- Generate the 25 mm, 4-hr event storm event for quality control design of proposed features.

- Evaluate the impact of a *real/actual* extreme storm events on existing and proposed conditions, which could include the Regional storm (Hurricane Hazel) or extreme observed event (i.e., Toronto Pearson July 8, 2013 rain event).

5.2 Hydrologic Modeling

- Describe the existing and proposed runoff peak flows and volumes for the study area.

- Select and apply the applicable modelling tool. Options include:
  - HYMO-based models – e.g., OTTHYMO, SWMHYMO widely accepted for design situations.
  - SWMM-based Models – e.g., EPA SWMM, PCSWMM, XPSWMM widely accepted for design situations.

- For total catchment areas < 10 ha, use the rational method to estimate runoff peak flows and modified rational method to estimate runoff volumetric storage requirements. *However, hydrologic simulation models based on design storm input with hydrograph analysis are preferred.* **[EA]**

- For total catchment areas > 10 ha, use hydrologic simulation models and:
  - Provide hydrologic *logic* model indicating sub-catchment and routing (i.e., through channels, pipes etc) mechanism to outlets.
  - Tabulate and clearly present applicable sub-catchment areas, and hydrologic catchment parameters (i.e., % imperviousness, hydraulic flow length, slope, calculated time of concentration).
  - Ensure appropriate runoff loss methodology is used in model and documented as per established soil conditions (e.g., SCS Curve Number, Horton's Infiltration Loss, Green-Ampt Method).

- Provide table similar to **TABLE 2** to summarize the outlet peak flows for existing and proposed sites.

TABLE 2 – Sample Hydrology Modeling Summary Table

Pre-/Post development Conditions				
Outlet #	**Total Area Contributing to Outlet**	**10-yr Peak Flow [cms]**	**25-yr Peak Flow [cms]**	**100-yr Peak Flows [cms]**

APPENDIX E

OGS Sizing Design Summary

Stormceptor®

FORTERRA™

Detailed Stormceptor Sizing Report – Main at Bridge

Project Information & Location			
Project Name	Alton Queen and Main	**Project Number**	184339
City	Alton	**State/ Province**	Ontario
Country	Canada	**Date**	12/3/2019
Designer Information		**EOR Information (optional)**	
Name	Troy Poirier	**Name**	
Company	RV Anderson Associates	**Company**	
Phone #	506-455-2888	**Phone #**	
Email	tpoirier@rvanderson.com	**Email**	

Stormwater Treatment Recommendation

The recommended Stormceptor Model(s) which achieve or exceed the user defined water quality objective for each site within the project are listed in the below Sizing Summary table.

Site Name	Main at Bridge
Recommended Stormceptor Model	STC 2000
Target TSS Removal (%)	80.0
TSS Removal (%) Provided	81
PSD	Fine Distribution
Rainfall Station	TORONTO CENTRAL

The recommended Stormceptor model achieves the water quality objectives based on the selected inputs, historical rainfall records and selected particle size distribution.

Stormceptor Sizing Summary		
Stormceptor Model	**% TSS Removal Provided**	**% Runoff Volume Captured Provided**
STC 300	65	79
STC 750	76	89
STC 1000	77	89
STC 1500	78	89
STC 2000	81	93
STC 3000	83	93
STC 4000	86	96
STC 5000	87	96
STC 6000	89	97
STC 9000	92	98
STC 10000	92	98
STC 14000	94	99
StormceptorMAX	Custom	Custom

Stormceptor® FORTERRA™

Stormceptor
The Stormceptor oil and sediment separator is sized to treat stormwater runoff by removing pollutants through gravity separation and flotation. Stormceptor's patented design generates positive TSS removal for each rainfall event, including large storms. Significant levels of pollutants such as heavy metals, free oils and nutrients are prevented from entering natural water resources and the re-suspension of previously captured sediment (scour) does not occur.
Stormceptor provides a high level of TSS removal for small frequent storm events that represent the majority of annual rainfall volume and pollutant load. Positive treatment continues for large infrequent events, however, such events have little impact on the average annual TSS removal as they represent a small percentage of the total runoff volume and pollutant load.

Design Methodology
Stormceptor is sized using PCSWMM for Stormceptor, a continuous simulation model based on US EPA SWMM. The program calculates hydrology using local historical rainfall data and specified site parameters. With US EPA SWMM's precision, every Stormceptor unit is designed to achieve a defined water quality objective. The TSS removal data presented follows US EPA guidelines to reduce the average annual TSS load. The Stormceptor's unit process for TSS removal is settling. The settling model calculates TSS removal by analyzing:
• Site parameters
• Continuous historical rainfall data, including duration, distribution, peaks & inter-event dry periods
• Particle size distribution, and associated settling velocities (Stokes Law, corrected for drag)
• TSS load
• Detention time of the system

Hydrology Analysis

PCSWMM for Stormceptor calculates annual hydrology with the US EPA SWMM and local continuous historical rainfall data. Performance calculations of Stormceptor are based on the average annual removal of TSS for the selected site parameters. The Stormceptor is engineered to capture sediment particles by treating the required average annual runoff volume, ensuring positive removal efficiency is maintained during each rainfall event, and preventing negative removal efficiency (scour).
Smaller recurring storms account for the majority of rainfall events and average annual runoff volume, as observed in the historical rainfall data analyses presented in this section.

Rainfall Station

State/Province	Ontario	**Total Number of Rainfall Events**	2719
Rainfall Station Name	TORONTO CENTRAL	**Total Rainfall (mm)**	13185.4
Station ID #	0100	**Average Annual Rainfall (mm)**	732.5
Coordinates	43°37'N, 79°23'W	**Total Evaporation (mm)**	188.9
Elevation (ft)	328	**Total Infiltration (mm)**	11177.6
Years of Rainfall Data	18	**Total Rainfall that is Runoff (mm)**	1818.9

Notes

• Stormceptor performance estimates are based on simulations using PCSWMM for Stormceptor, which uses the EPA Rainfall and Runoff modules.
• Design estimates listed are only representative of specific project requirements based on total suspended solids (TSS) removal defined by the selected PSD, and based on stable site conditions only, after construction is completed.
• For submerged applications or sites specific to spill control, please contact your local Stormceptor representative for further design assistance.

Drainage Area	
Total Area (ha)	4.2
Imperviousness %	15.00

Up Stream Storage	
Storage (ha-m)	Discharge (cms)
0.000	0.000

Water Quality Objective	
TSS Removal (%)	80.0
Runoff Volume Capture (%)	90.00
Oil Spill Capture Volume (L)	
Peak Conveyed Flow Rate (L/s)	
Water Quality Flow Rate (L/s)	

Up Stream Flow Diversion	
Max. Flow to Stormceptor (cms)	

Design Details	
Stormceptor Inlet Invert Elev (m)	
Stormceptor Outlet Invert Elev (m)	
Stormceptor Rim Elev (m)	
Normal Water Level Elevation (m)	
Pipe Diameter (mm)	
Pipe Material	
Multiple Inlets (Y/N)	No
Grate Inlet (Y/N)	No

Particle Size Distribution (PSD)

Removing the smallest fraction of particulates from runoff ensures the majority of pollutants, such as metals, hydrocarbons and nutrients are captured. The table below identifies the Particle Size Distribution (PSD) that was selected to define TSS removal for the Stormceptor design.

Fine Distribution		
Particle Diameter (microns)	Distribution %	Specific Gravity
20.0	20.0	1.30
60.0	20.0	1.80
150.0	20.0	2.20
400.0	20.0	2.65
2000.0	20.0	2.65

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Site Name	Main at Bridge

Site Details

Drainage Area	
Total Area (ha)	4.2
Imperviousness %	15.00

Surface Characteristics	
Width (m)	410.00
Slope %	2
Impervious Depression Storage (mm)	0.508
Pervious Depression Storage (mm)	5.08
Impervious Manning's n	0.015
Pervious Manning's n	0.25

Maintenance Frequency	
Maintenance Frequency (months) >	12

Infiltration Parameters	
Horton's equation is used to estimate infiltration	
Max. Infiltration Rate (mm/hr)	61.98
Min. Infiltration Rate (mm/hr)	10.16
Decay Rate (1/sec)	0.00055
Regeneration Rate (1/sec)	0.01

Evaporation	
Daily Evaporation Rate (mm/day)	2.54

Dry Weather Flow	
Dry Weather Flow (lps)	0

Winter Months	
Winter Infiltration	0

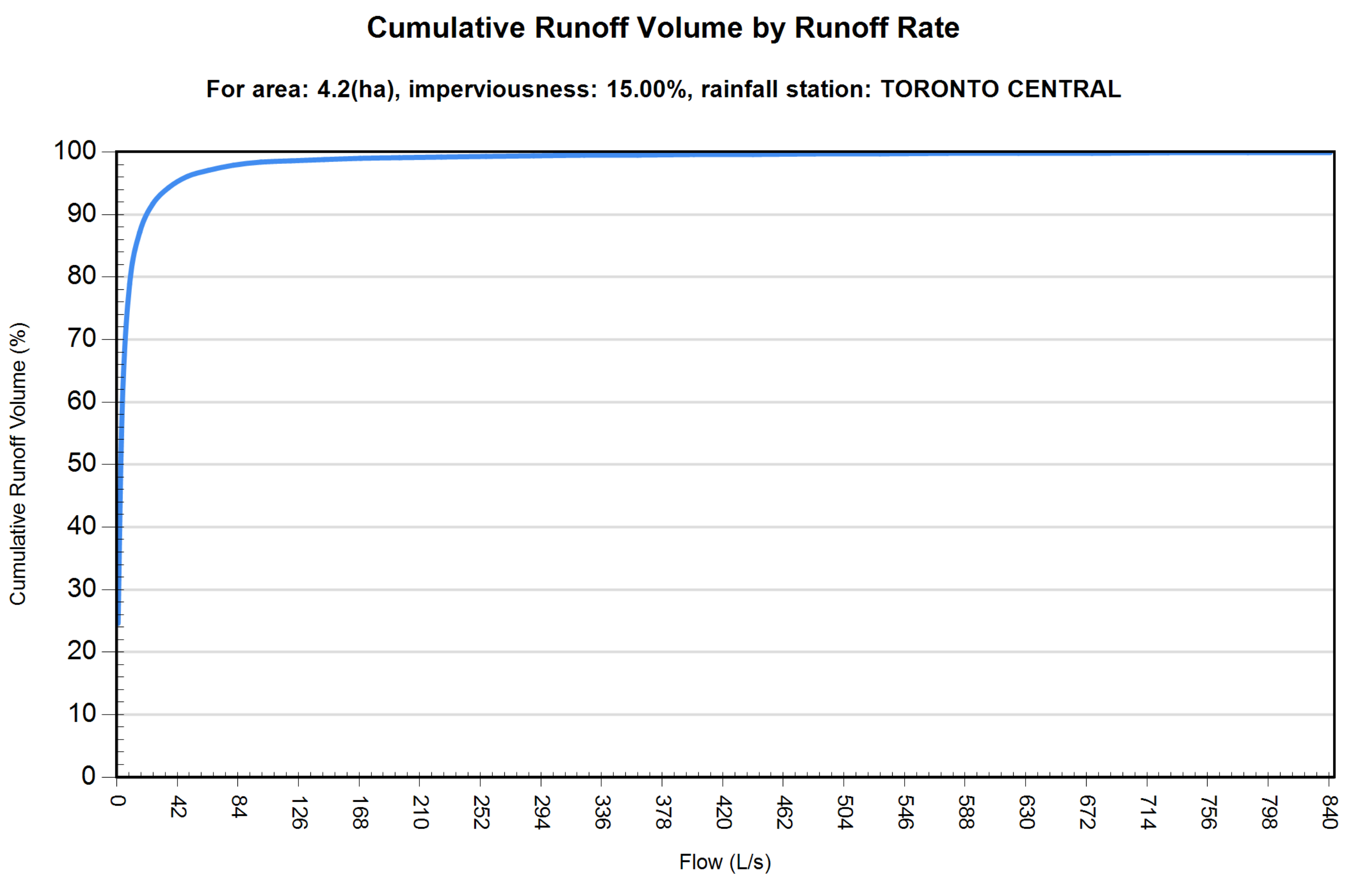
TSS Loading Parameters

TSS Loading Function	

Buildup/Wash-off Parameters	
Target Event Mean Conc. (EMC) mg/L	
Exponential Buildup Power	
Exponential Washoff Exponent	

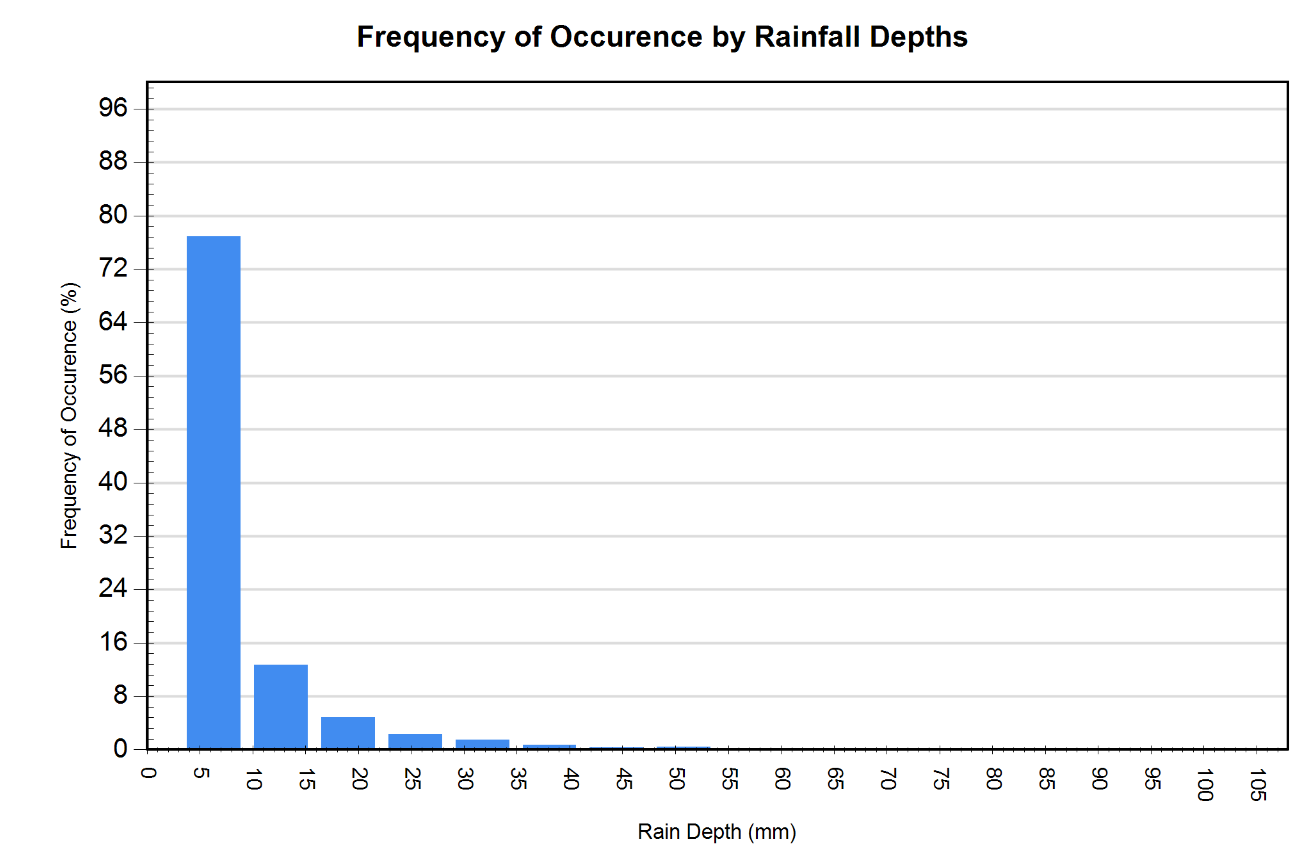
TSS Availability Parameters	
Availability Constant A	
Availability Factor B	
Availability Exponent C	
Min. Particle Size Affected by Availability (micron)	

Cumulative Runoff Volume by Runoff Rate			
Runoff Rate (L/s)	Runoff Volume (m³)	Volume Over (m³)	Cumulative Runoff Volume (%)
1	19030	58227	24.6
4	46418	30841	60.1
9	60990	16268	78.9
16	67400	9857	87.2
25	70826	6432	91.7
36	72892	4366	94.3
49	74209	3049	96.1
64	75046	2212	97.1
81	75611	1647	97.9
100	75994	1264	98.4
121	76201	1057	98.6
144	76335	923	98.8
169	76453	805	99.0
196	76550	708	99.1
225	76636	622	99.2
256	76720	539	99.3
289	76790	468	99.4
324	76847	412	99.5
361	76894	365	99.5
400	76940	318	99.6
441	76985	273	99.6
484	77012	246	99.7
529	77039	219	99.7
576	77067	191	99.8
625	77097	162	99.8
676	77127	131	99.8
729	77159	100	99.9
784	77175	83	99.9
841	77192	66	99.9


Cumulative Runoff Volume by Runoff Rate
For area: 4.2(ha), imperviousness: 15.00%, rainfall station: TORONTO CENTRAL
Cumulative Runoff Volume (%)
100
90
80
70
60
50
40
30
20
10
0
0
42
84
126
168
210
252
294
336
378
420
462
504
546
588
630
672
714
756
798
840
Flow (L/s)

Rainfall Event Analysis

Rainfall Depth (mm)	No. of Events	Percentage of Total Events (%)	Total Volume (mm)	Percentage of Annual Volume (%)
6.35	2091	76.9	3344	25.4
12.70	345	12.7	3201	24.3
19.05	131	4.8	2062	15.6
25.40	63	2.3	1358	10.3
31.75	42	1.5	1185	9.0
38.10	20	0.7	678	5.1
44.45	9	0.3	377	2.9
50.80	11	0.4	521	4.0
57.15	3	0.1	159	1.2
63.50	1	0.0	61	0.5
69.85	0	0.0	0	0.0
76.20	1	0.0	73	0.6
82.55	1	0.0	80	0.6
88.90	1	0.0	85	0.6
95.25	0	0.0	0	0.0
101.60	0	0.0	0	0.0



For Stormceptor Specifications and Drawings Please Visit:
http://www.imbriumsystems.com/technical-specifications

Detailed Stormceptor Sizing Report – Queen near Agnes

Project Information & Location			
Project Name	Alton Queen and Main	**Project Number**	184339
City	Alton	**State/ Province**	Ontario
Country	Canada	**Date**	12/3/2019
Designer Information		**EOR Information (optional)**	
Name	Troy Poirier	**Name**	
Company	RV Anderson Associates	**Company**	
Phone #	506-455-2888	**Phone #**	
Email	tpoirier@rvanderson.com	**Email**	

Stormwater Treatment Recommendation

The recommended Stormceptor Model(s) which achieve or exceed the user defined water quality objective for each site within the project are listed in the below Sizing Summary table.

Site Name	Queen near Agnes
Recommended Stormceptor Model	STC 750
Target TSS Removal (%)	80.0
TSS Removal (%) Provided	82
PSD	Fine Distribution
Rainfall Station	TORONTO CENTRAL

The recommended Stormceptor model achieves the water quality objectives based on the selected inputs, historical rainfall records and selected particle size distribution.

Stormceptor Sizing Summary		
Stormceptor Model	**% TSS Removal Provided**	**% Runoff Volume Captured Provided**
STC 300	73	88
STC 750	82	94
STC 1000	84	94
STC 1500	84	94
STC 2000	87	97
STC 3000	88	97
STC 4000	91	98
STC 5000	91	98
STC 6000	93	99
STC 9000	95	99
STC 10000	95	99
STC 14000	96	99
StormceptorMAX	Custom	Custom

Stormceptor

The Stormceptor oil and sediment separator is sized to treat stormwater runoff by removing pollutants through gravity separation and flotation. Stormceptor's patented design generates positive TSS removal for each rainfall event, including large storms. Significant levels of pollutants such as heavy metals, free oils and nutrients are prevented from entering natural water resources and the re-suspension of previously captured sediment (scour) does not occur.
Stormceptor provides a high level of TSS removal for small frequent storm events that represent the majority of annual rainfall volume and pollutant load. Positive treatment continues for large infrequent events, however, such events have little impact on the average annual TSS removal as they represent a small percentage of the total runoff volume and pollutant load.

Design Methodology

Stormceptor is sized using PCSWMM for Stormceptor, a continuous simulation model based on US EPA SWMM. The program calculates hydrology using local historical rainfall data and specified site parameters. With US EPA SWMM's precision, every Stormceptor unit is designed to achieve a defined water quality objective. The TSS removal data presented follows US EPA guidelines to reduce the average annual TSS load. The Stormceptor's unit process for TSS removal is settling. The settling model calculates TSS removal by analyzing:

- Site parameters
- Continuous historical rainfall data, including duration, distribution, peaks & inter-event dry periods
- Particle size distribution, and associated settling velocities (Stokes Law, corrected for drag)
- TSS load
- Detention time of the system

Hydrology Analysis

PCSWMM for Stormceptor calculates annual hydrology with the US EPA SWMM and local continuous historical rainfall data. Performance calculations of Stormceptor are based on the average annual removal of TSS for the selected site parameters. The Stormceptor is engineered to capture sediment particles by treating the required average annual runoff volume, ensuring positive removal efficiency is maintained during each rainfall event, and preventing negative removal efficiency (scour).
Smaller recurring storms account for the majority of rainfall events and average annual runoff volume, as observed in the historical rainfall data analyses presented in this section.

Rainfall Station

State/Province	Ontario	**Total Number of Rainfall Events**	2719
Rainfall Station Name	TORONTO CENTRAL	**Total Rainfall (mm)**	13185.4
Station ID #	0100	**Average Annual Rainfall (mm)**	732.5
Coordinates	43°37'N, 79°23'W	**Total Evaporation (mm)**	249.1
Elevation (ft)	328	**Total Infiltration (mm)**	10515.1
Years of Rainfall Data	18	**Total Rainfall that is Runoff (mm)**	2421.2

Notes

- Stormceptor performance estimates are based on simulations using PCSWMM for Stormceptor, which uses the EPA Rainfall and Runoff modules.
- Design estimates listed are only representative of specific project requirements based on total suspended solids (TSS) removal defined by the selected PSD, and based on stable site conditions only, after construction is completed.
- For submerged applications or sites specific to spill control, please contact your local Stormceptor representative for further design assistance.

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Drainage Area	
Total Area (ha)	1.679
Imperviousness %	20.00

Up Stream Storage	
Storage (ha-m)	Discharge (cms)
0.000	0.000

Water Quality Objective	
TSS Removal (%)	80.0
Runoff Volume Capture (%)	90.00
Oil Spill Capture Volume (L)	
Peak Conveyed Flow Rate (L/s)	
Water Quality Flow Rate (L/s)	

Up Stream Flow Diversion	
Max. Flow to Stormceptor (cms)	

Design Details	
Stormceptor Inlet Invert Elev (m)	
Stormceptor Outlet Invert Elev (m)	
Stormceptor Rim Elev (m)	
Normal Water Level Elevation (m)	
Pipe Diameter (mm)	375
Pipe Material	PVC - plastic
Multiple Inlets (Y/N)	No
Grate Inlet (Y/N)	No

Particle Size Distribution (PSD)

Removing the smallest fraction of particulates from runoff ensures the majority of pollutants, such as metals, hydrocarbons and nutrients are captured. The table below identifies the Particle Size Distribution (PSD) that was selected to define TSS removal for the Stormceptor design.

Fine Distribution		
Particle Diameter (microns)	Distribution %	Specific Gravity
20.0	20.0	1.30
60.0	20.0	1.80
150.0	20.0	2.20
400.0	20.0	2.65
2000.0	20.0	2.65

Stormceptor® FORTERRA

Site Name	Queen near Agnes

Site Details

Drainage Area	
Total Area (ha)	1.679
Imperviousness %	20.00

Surface Characteristics	
Width (m)	259.00
Slope %	2
Impervious Depression Storage (mm)	0.508
Pervious Depression Storage (mm)	5.08
Impervious Manning's n	0.015
Pervious Manning's n	0.25

Maintenance Frequency	
Maintenance Frequency (months) >	12

Infiltration Parameters	
Horton's equation is used to estimate infiltration	
Max. Infiltration Rate (mm/hr)	61.98
Min. Infiltration Rate (mm/hr)	10.16
Decay Rate (1/sec)	0.00055
Regeneration Rate (1/sec)	0.01

Evaporation	
Daily Evaporation Rate (mm/day)	2.54

Dry Weather Flow	
Dry Weather Flow (lps)	0

Winter Months	
Winter Infiltration	0

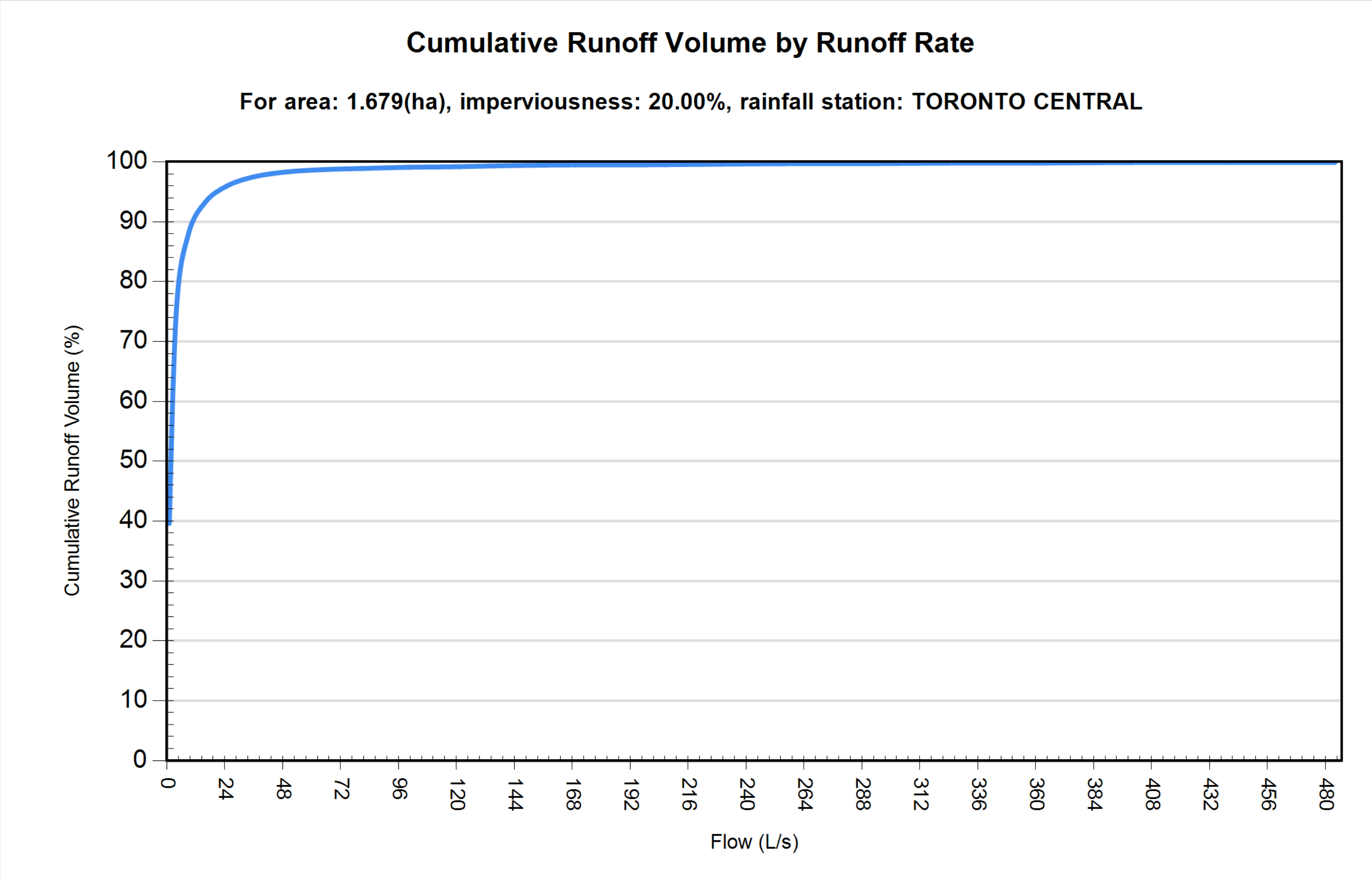
TSS Loading Parameters

TSS Loading Function	

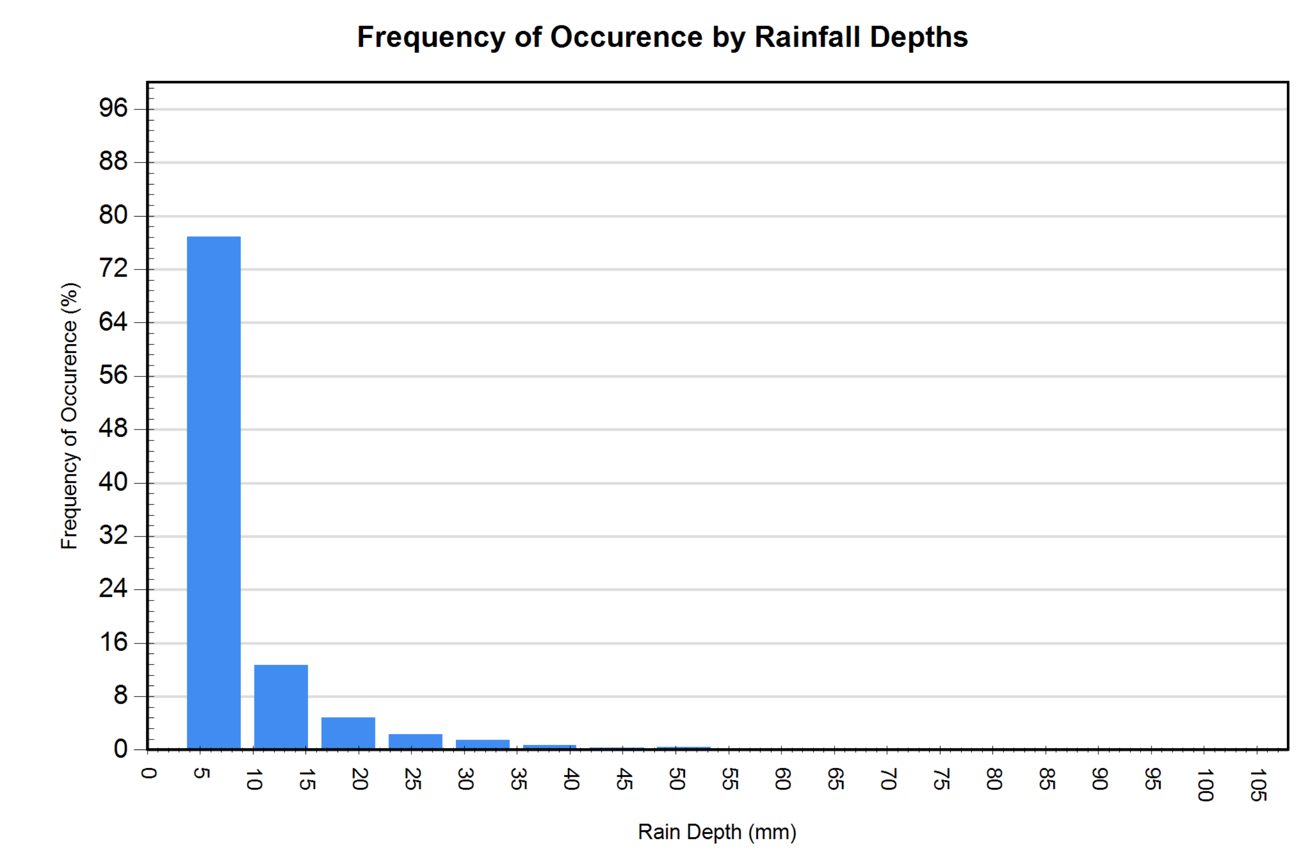
Buildup/Wash-off Parameters	
Target Event Mean Conc. (EMC) mg/L	
Exponential Buildup Power	
Exponential Washoff Exponent	

TSS Availability Parameters	
Availability Constant A	
Availability Factor B	
Availability Exponent C	
Min. Particle Size Affected by Availability (micron)	

Cumulative Runoff Volume by Runoff Rate			
Runoff Rate (L/s)	**Runoff Volume (m³)**	**Volume Over (m³)**	**Cumulative Runoff Volume (%)**
1	16269	24852	39.6
4	31011	10107	75.4
9	36176	4942	88.0
16	38357	2761	93.3
25	39479	1638	96.0
36	40081	1037	97.5
49	40426	691	98.3
64	40600	517	98.7
81	40682	435	98.9
100	40745	372	99.1
121	40801	316	99.2
144	40855	262	99.4
169	40902	215	99.5
196	40932	186	99.5
225	40958	160	99.6
256	40982	136	99.7
289	41001	116	99.7
324	41022	95	99.8
361	41045	73	99.8
400	41068	49	99.9
441	41081	36	99.9
484	41094	24	99.9


Cumulative Runoff Volume by Runoff Rate
For area: 1.679(ha), imperviousness: 20.00%, rainfall station: TORONTO CENTRAL
Cumulative Runoff Volume (%)
100
90
80
70
60
50
40
30
20
10
0
0
24
48
72
96
120
144
168
192
216
240
264
288
312
336
360
384
408
432
456
480
Flow (L/s)

Rainfall Event Analysis				
Rainfall Depth (mm)	No. of Events	Percentage of Total Events (%)	Total Volume (mm)	Percentage of Annual Volume (%)
6.35	2091	76.9	3344	25.4
12.70	345	12.7	3201	24.3
19.05	131	4.8	2062	15.6
25.40	63	2.3	1358	10.3
31.75	42	1.5	1185	9.0
38.10	20	0.7	678	5.1
44.45	9	0.3	377	2.9
50.80	11	0.4	521	4.0
57.15	3	0.1	159	1.2
63.50	1	0.0	61	0.5
69.85	0	0.0	0	0.0
76.20	1	0.0	73	0.6
82.55	1	0.0	80	0.6
88.90	1	0.0	85	0.6
95.25	0	0.0	0	0.0
101.60	0	0.0	0	0.0



For Stormceptor Specifications and Drawings Please Visit:
http://www.imbriumsystems.com/technical-specifications

APPENDIX F

Enhanced Grass Swale Guide (CVC)

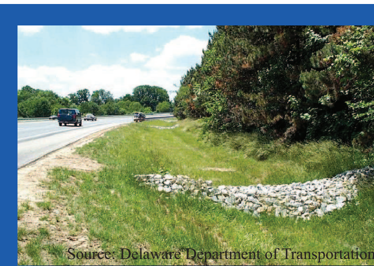
ENHANCED GRASS SWALES

CVC/TRCA LOW IMPACT DEVELOPMENT
PLANNING AND DESIGN GUIDE - FACT SHEET

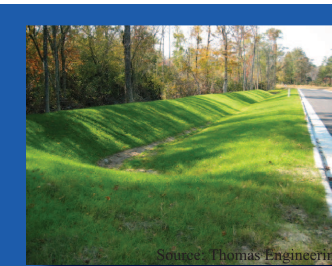
GENERAL DESCRIPTION

Enhanced grass swales are vegetated open channels designed to convey, treat and attenuate stormwater runoff (also referred to as enhanced vegetated swales). Check dams and vegetation in the swale slows the water to allow sedimentation, filtration through the root zone and soil matrix, evapotranspiration, and infiltration into the underlying native soil. Simple grass channels or ditches have long been used for stormwater conveyance, particularly for roadway drainage. Enhanced grass swales incorporate design features such as modified geometry and check dams that improve the contaminant removal and runoff reduction functions of simple grass channel and roadside ditch designs.

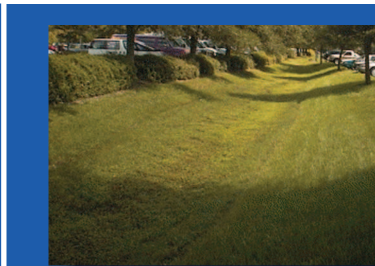
Where development density, topography and depth to water table permit, enhanced grass swales are a preferred alternative to both curb and gutter and storm drains as a stormwater conveyance system. When incorporated into a site design, they can reduce impervious cover, accent the natural landscape, and provide aesthetic benefits.


Source: Delaware Department of Transportation


Source: Seattle Public Utilities


Source: Thomas Engineering


Source: Sue Donaldson




Source: CVC

DESIGN GUIDANCE

GEOMETRY AND SITE LAYOUT

- Shape: Should be designed with a trapezoidal or parabolic cross section. Trapezoidal swales will generally evolve into parabolic swales over time, so the initial trapezoidal cross-section design should be checked for capacity and conveyance assuming it is a parabolic cross-section. Swale length between culverts should be 5 metres or greater.
- Bottom Width: Should be designed with a bottom width between 0.75 and 3.0 metres. Should allow for shallow flows and adequate water quality treatment, while preventing flows from concentrating and creating gullies.
- Longitudinal Slope: Slopes should be between 0.5% and 4%. Check dams should be incorporated on slopes greater than 3%.
- Length: When used to convey and treat road runoff, the length simply parallels the road, and therefore should be equal to, or greater than the contributing roadway length.
- Flow Depth: A maximum flow depth of 100 mm is recommended during a 4 hour, 25 mm Chicago storm event.
- Side Slopes: Should be as flat as possible to aid in providing pretreatment for lateral incoming flows and to maximize the swale filtering surface. Steeper side slopes are likely to have erosion gullying from incoming lateral flows. A maximum slope of 2.5:1 (H:V) is recommended and a 4:1 slope is preferred where space permits.

PRE-TREATMENT

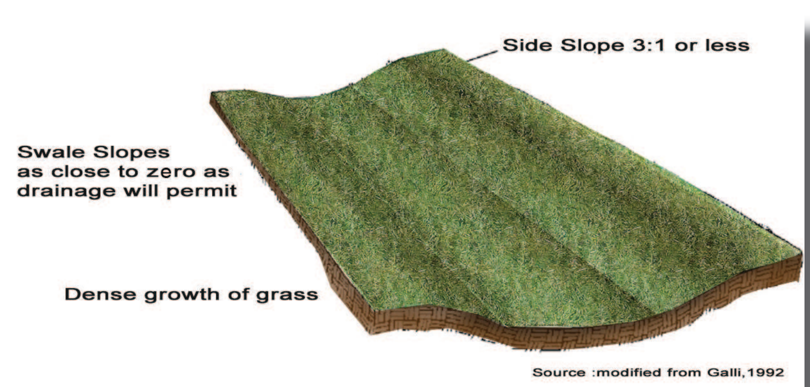
A pea gravel diaphragm located along the top of each bank can be used to provide pretreatment of any runoff entering the swale laterally along its length. Vegetated filter strips or mild side slopes (3:1) also provide pretreatment for any lateral sheet flow entering the swale. Sedimentation forebays at inlets to the swale are also a pretreatment option.

CONVEYANCE AND OVERFLOW

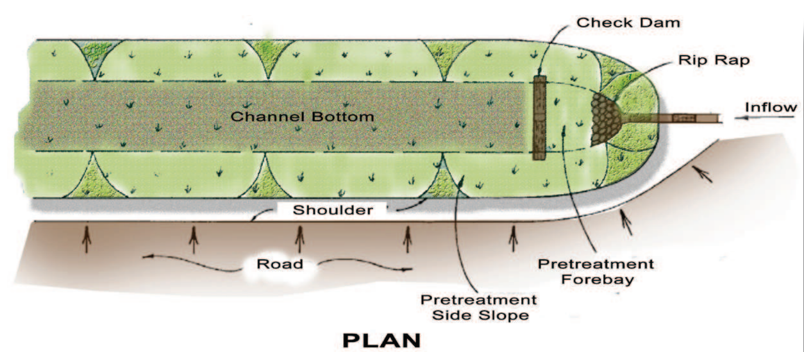
Grass swales must be designed for a maximum velocity of 0.5 m/s or less for the 4 hour 25 mm Chicago storm event. The swale should also convey the locally required design storm (usually the 10 year storm) at non-erosive velocities.

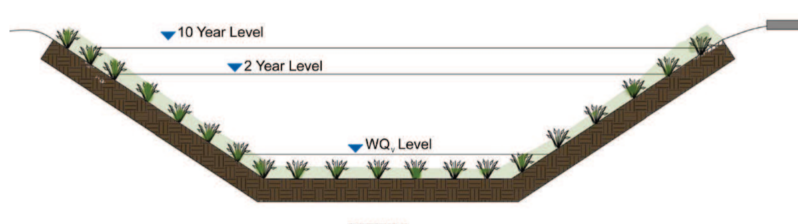
SOIL AMENDMENTS

If soils along the location of the swale are highly compacted, or of such low fertility that vegetation cannot become established, they should be tilled to a depth of 300 mm and amended with compost to achieve an organic content of 8 to 15% by weight or 30 to 40% by volume.



PLAN VIEW OF A GRASS SWALE





PLAN AND PROFILE VIEWS

ABILITY TO MEET SWM OBJECTIVES

BMP	Water Balance Benefit	Water Quality Improvement	Stream Channel Erosion Control Benefit
Enhanced Grass Swale	Partial - depends on soil infiltration rate	Yes, if design velocity is 0.5 m/s or less for a 4 hour, 25 mm Chicago storm	Partial - depends on soil infiltration rate

GENERAL SPECIFICATIONS

Component	Specification	Quantity
Check Dams	Constructed of a non-erosive material such as suitably sized aggregate, wood, gabions, riprap, or concrete. All check dams should be underlain with geotextile filter fabric. Wood used for check dams should consist of pressure treated logs or timbers, or water-resistant tree species such as cedar, hemlock, swamp oak or locust.	Spacing should be based on the longitudinal slope and desired ponding volume.
Gravel Diaphragm	Washed stone between 3 and 10 mm in diameter.	Minimum of 300 mm wide and 600 mm deep.

CONSTRUCTION CONSIDERATIONS

Grass swales should be clearly marked before site work begins to avoid disturbance during construction. No vehicular traffic, except that specifically used to construct the facility, should be allowed within the swale site. Any accumulation of sediment that does occur within the swale must be removed during the final stages of grading to achieve the design cross-section. Final grading and planting should not occur until the adjoining areas draining into the swale are stabilized. Flow should not be diverted into the swale until the banks are stabilized.

Preferably, the swale should be planted in the spring so that the vegetation can become established with minimal irrigation. Installation of erosion control matting or blanketing to stabilize soil during establishment of vegetation is highly recommended. If sod is used, it should be placed with staggered ends and secured by rolling the sod. This helps to prevent gullies.

OPERATION AND MAINTENANCE

Generally, routine maintenance will be the same as for any other landscaped area; weeding, pruning, and litter removal. Grassed swales should be mown at least twice yearly to maintain grass height between 75 and 150 mm. The lightest possible mowing equipment should be used to prevent soil compaction. Routine roadside ditch maintenance practices such as scraping and re-grading should be avoided. Regular watering may be required during the first two years until vegetation is established. Routine inspection is very important to ensure that dense vegetation cover is maintained and inlets and pretreatment devices are free of debris.

For the first two years following construction the swale should be inspected at least quarterly and after every major storm event (> 25 mm). Subsequently, inspections should be conducted in the spring and fall of each year and after major storm events. Inspect for vegetation density (at least 80% coverage), damage by foot or vehicular traffic, accumulation of debris, trash and sediment, and structural damage to pretreatment devices.

Trash and debris should be removed from pretreatment devices and the surface of the swale at least twice annually. Other maintenance activities include weeding, replacing dead vegetation, repairing eroded areas, dethatching and aerating as needed. Remove accumulated sediment on the swale surface when dry and exceeding 25 mm depth.

SITE CONSIDERATIONS

Available Space
Grass swales usually consume about 5 to 15% of their contributing drainage area. A width of at least 2 metres is needed.

Site Topography
Site topography constrains the application of grass swales. Longitudinal slopes between 0.5 and 6% are allowable. This prevents ponding while providing residence time and preventing erosion. On slopes steeper than 3%, check dams should be used.

Drainage Area & Runoff Volume
The conveyance capacity should match the drainage area. Sheet flow to the grass swale is preferable. If drainage areas are greater than 2 hectares, high discharge through the swale may not allow for filtering and infiltration, and may create erosive conditions. Typical ratios of impervious drainage area to treatment facility area range from 5:1 to 10:1.

Soil
Grass swales can be applied on sites with any type of soils.

Pollution Hot Spot Runoff
To protect groundwater from possible contamination, source areas where land uses or human activities have the potential to generate highly contaminated runoff (e.g., vehicle fueling, servicing and demolition areas, outdoor storage and handling areas for hazardous materials and some heavy industry sites) should not be treated by grass swales.

Proximity to Underground Utilities
Utilities running parallel to the grass swale should be offset from the centerline of the swale. Underground utilities below the bottom of the swale are not a problem.

Water Table
The bottom of the swale should be separated from the seasonally high water table or top of bedrock elevation by at least one (1) metre.

Setback from Buildings
Should be located a minimum of four (4) metres from building foundations to prevent water damage.

Toronto and Region Conservation for The Living City
CVC Credit Valley Conservation

FOR FURTHER DETAILS SEE SECTION 4.8 OF THE CVC/TRCA LID SWM GUIDE