EIE Corporation

Cedar Shore Estates 589 King Street West, Cobourg

SWM Design Report

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C14-0011

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1. INTRODUCTION AND STUDY AREA

The owners of 589 King Street West in Cobourg (Site), EIE Corporation (EIE), and its' development team, are planning to undertake a residential re-development of the site. "Cedar Shore Estates" includes re-development of the site to establish:

- fourteen (14) single family residential properties,
- one (1) new residential property on which the existing heritage house and detached coach house will remain in their current location and orientation,
- one (1) public park along the south frontage of Lake Ontario,
- 3.4m road widening along the north frontage of King Street West,
- two (2) twenty metre (20.0m) wide municipal road and servicing corridors (identified as Street "A" and Street "B", respectively) with site triangles and widenings at intersecting roadways and cul-de-sac terminations.

The Property, historically known as "The Cedars" is situated in the west end of the Town of Cobourg, south of King Street and west of Maher Street. The north boundary of the property has 132 m frontage on King Street West and abuts Lake Ontario along its south boundary. Immediately east are the rear yards of single family residential properties which front Maher Street and immediately west is a single family property with similar characteristics as the subject lot.

The Canadian Pacific Railway (CPR) is located 50 m north of the site on the opposite side of King Street. The railway is situated on an embankment and crosses Burnham Street with a grade separation. North of the CPR is the Canadian National Railway (CNR) situated at grade, with a level crossing of Burnham Street.

The "bluff" frontage along Lake Ontario is generally stable with a grade variation of approximately 5 metres from water level to land plateau. The toe of the bluff is stabilized with 2 visible rows of large limestone armour stones, and smaller limestone backfill with geotextile founded on bedrock. Above the armouring toe stones is a vegetated (trees and grass) embankment (approx. 1:1 slope).

The subject property is generally rectangular in shape and approximately 3.12 ha (7.7 acres) in area excluding 'water-lot' portions of the property. An existing heritage house (est. 1882) and a detached coach house are the primary structures on the property. Access to the property is from King Street via a single gravel/paved entrance that runs north-south through the eastern part of the site.

The objective of this SWM Design Report is to outline the background information, applicable design criteria and provide a recommended stormwater management concept for the Cedar Shores development application, including temporary erosion/sediment control. The plan identifies the proposed SWM concept including stormsewers, overland flow channels, and oil-grit separator.

2. STORMWATER MANAGEMENT OBJECTIVES

2.1 Pre-consultation

Subsequent to a number of pre-consultation meetings with Town of Cobourg/Municipal Development Review Team (DRT) a First (1st) Submission for Zoning Amendment and Draft Plan of Subdivision for Cedar Shore Estates, 589 King Street West, Town of Cobourg was submitted in November, 2015 by RFA Planning Consultant Inc. on behalf of the proponent.

The Town of Cobourg Planning Department circulated the application including supporting studies and reports to the DRT and external agencies for review and comment.

The DRT's comments were received by the proponent in early February, 2016. A significant component of the DRT comments require clarification regarding the site's approach to Storm Water Management (SWM). In particular, the implementation of Low Impact Development (LID) SWM approaches and the request for additional plans and calculations to comply with the requirements of the Ganaraska Region Conservation Authority's (GRCA) Technical and Engineering Guidelines for Stormwater Management Submissions, December 2014. It should be noted that given the recent release of this guideline and use/reference by the DRT, the materials submitted in November, 2015 were prepared without knowing the guidelines were available, until provided to CIMA+ in January, 2016 by GRCA Staff.

This report is prepared in support of the detailed design and includes revisions, supplementary information and clarification of the materials submitted as part of the 1st Submission which relate to stormwater management concept plan presented in the Functional Servicing and Stormwater Report, September, 2015 prepared by CIMA+. This information has been incorporated as part of the detailed design and engineering submission processes in accordance with the Draft Term of Conditions.

CIMA+ has screened all of the DRT comments received, and included in Appendix A of this report a table summarizing only the DRT comments which pertain to the aforementioned SWM and/or LID clarifications.

For the DRT's consideration, on behalf of the proponent, CIMA+ has prepared a response to each comment received as summarized in Table 1 in Appendix A, and detailed herein.

2.2 Functional Design Criteria, Approach and Methodology

Development of the existing site to create new residential dwellings requires Stormwater Management facilities for the "neighbourhood" and individual lots. Conceptually, minor storm flows will be conveyed along the proposed Road Allowances of Street "A", Street "B" and through the Public Park utilizing combinations of overland flow systems (i.e. swales, grading) and piped flow (i.e. 300mm to 525mm dia. storm sewers) to formalize drainage conveyance.

Minor storm conveyance systems will be designed utilizing quantity calculations in accordance with the Town of Cobourg Design Criteria, with the following parameters:

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- Pervious surfaces will be preserved (or reinstated), where possible, to reduce the site's Stormwater quantity control requirements, utilizing an estimated Run-off co-efficient (C) of 0.34 for the entire site.
- Time of Concentration (Tc) = 15 minutes at the head of the system
- Stormsewer design calculations are based on the Yarnell 1:5 year frequency i=2464 / Tc+16
- Hydraulic Grade Line (HGL) calculations are based the Yarnell 1:25 year frequency i=4318/ Tc+27
- Area (A) determined by the contributing external areas, as mapped
- Flows (Q) determined by the Rational Formula Q = 2.78 (AiC)
- Pipe Roughness Co-efficient (n) = 0.013 for all concrete pipe sizes
- Pipe Velocity (V) = 1.0/n x R2/3 x S1/2 for all circular pipes
- Pipe Flow (Q) = VA

All storm sewers and swales will have a minimum slope gradient of 0.5% and 1.0%, respectively. Implementation of maintenance holes, spaced as appropriate, will provide for access of each section of storm sewer. Implementation of catchbasin/ditch inlet structures, located as appropriate, will provide for drainage inlets to the minor storm sewer system from overland patterns.

Major storm (i.e. greater than 5 year return period) conveyance systems will parallel the minor storm conveyances within public corridors with the primary objective maintaining consistent gradient; limiting low points where possible to encourage positive overland flow patterns.

Minor and Major storm patterns will utilize a single new outlet to Lake Ontario along the site's frontage. Due to the variation in elevation from the site's plateau to the shoreline (5 metres +/-) an outlet/transition structure will be required to convey/outlet storm drainage (minor and major) in a manner that controls velocity and mitigates against erosion.

Given the dynamic nature of Lake Ontario's water surface elevations, wave uprush and beach conditions have been considered when establishing the storm sewer outfall's configuration and extent. In this regard the minimum desirable elevation was determined to be 75.50m to reduce effects and instances of backwatering and erosive forces from Lake Ontario. It is noted that the 100-year flood level is 76m (MNR 1988). Alterations of the existing shoreline at the outlet location will be required to facilitate the outfall's construction.

An "Enhanced" Level of Protection for Stormwater quality (MOE Stormwater Management Planning and Design Manual, March 2003) will be achieved utilizing an Oil/Grit Separator (i.e. "Hydrogaurd" by CIL, or equivalent) will provide "end of pipe" water quality treatment towards the east limit of Street "B"; at an accessible and maintainable location.

Individual lot services (i.e. one per lot) with a minimum size of 150mm will provide storm service to each new property. In conjunction with the Naturalized areas on the west and east boundaries of the site, rear yard storm inlets connected to the storm sewers are anticipated to service the low lying areas during larger rainfall events.

All Stormwater management details have been designed in keeping with standards and guidelines provided by the Town of Cobourg, Ontario Provincial Standard Specification and Drawings (OPSS &

OPSD), Ganaraska Region Conservation Authority (GRCA) and Ministry of Environment & Climate Change (MOECC).

2.3 Low Impact Development Screening

During the project's pre-consultation with Town of Cobourg and GRCA Staff, the use of low impact development (LID) SWM strategies was encouraged to minimize the footprint of SWM facilities, minimize disruption to existing topography (i.e. vegetation) and make use of non-invasive SWM techniques to develop a "treatment train". This is generally re-emphasized by Ganaraska Region Conservation Authority's (GRCA) Technical and Engineering Guidelines for Stormwater Management Submissions, December 2014 which provide the following recommendation:

> *"strongly encouraged that more than one treatment system be used for a project by using a treatment train approach. A combination of source, conveyance, end-of-pipe facilities, and low impact development practices shall be considered to meet the water quantity, quality, and erosion design criteria."*

It is noted that the GRCA reference the Credit Valley Conservation/Toronto Region Conservation (CVC/TRCA) Low Impact Development Stormwater Management Planning and Design Guide, Version 1.0 (2010) within their guidelines. The CVC/TRCA guide identifies a number of LID strategies, which are generally categorized under one of the following categories:

a) "Low Impact Development Practices" which include approaches such as siting and layout of development, reducing impervious areas and using natural drainage systems.

b) "Structural Low Impact Development Practices" which include approaches such as Rainwater Harvesting, Green Roofs, Roof Downspout Disconnection, Soakaways, Infiltration Trenches and Chambers, Bioretention, Vegetated Filter Strips, Permeable Pavement, Enhanced Grass Swales, Dry Swales and Perforated Pipe Systems.

The Low Impact Development Storm Water Management locations shown on the materials included the November, 2015 Submission can generally be categorized into two (2) definable locations, as described below:

a) Rear Yard Natural/Undisturbed Areas; which are conceptually located to encourage the maintenance of the existing topography, making use of depression storages and natural drainage patterns in these localized areas. **Please note** that for clarity, the identifier of ***"LID"*** for the rear yard areas has been amended by this memorandum to identify these areas as ***"Natural/Undisturbed areas"***. The existing topography in these sensitive areas was deemed particularly critical to maintain high/very high value vegetation, maintain physical/sightline buffers to/from existing adjacent residential units, and generally preserve/incorporate the unique and historical features of the existing property into the development.

With these criteria deemed critical to the success of any new development and the small size of the subject Natural/Undisturbed areas (with little to no upstream tributary drainage areas) the concept for stormwater management in these areas is to minimize the establishment of formal

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drainage patterns (i.e. swales or storm sewers) for smaller storm events; rather encouraging infiltration and/or formalizing low flow swales through these areas. To accommodate larger storm events rear yard storm sewer inlets are proposed. The location and elevation of these rear yard inlets will be a critical component of the detailed design to ensure the success of the Natural/Undisturbed areas and minimize localized flooding concerns for the adjacent existing properties and proposed new properties.

These Natural/Undisturbed areas are located at the upstream/outer boundaries of the site's drainage area, and provide "lot level" storm water treatment at the first available opportunity to introduce a "treatment train" along the conveyance of the site's stormwater.

It should be noted that the preservation of these Natural/Undisturbed (and the approach to drainage and SWM within them) has not reduced the Storm Water Quality or Quantity design criteria used for the site. The post-development drainage areas and run-off co-efficients which size the storm sewers and the formal "end-of-pipe" water quality device (i.e. "Hydroguard" by CIL, or equivalent) include these Natural/Undisturbed areas, without exception or alteration/reduction of criteria.

b) Right of Way LID's; which are conceptually located in boulevard areas of the Street "A" and Street "B" right of ways at locations which are deemed suitable without obstruction or impact to sightlines, services or entrances.

The concept was for LID's in these areas to utilize enhanced grass swales, bioswales etc. to provide water quality treatment of sub-catchment areas (where possible) prior to their entry into the storm sewer network. This introduced intermediate locations of treatment along the conveyance of the site's stormwater; thereby reducing reliance on the formalized "end-of pipe" storm water quality treatment.

However, upon further review, and through pre-consultation with the Town of Cobourg, in February 2017, the use of a bio-swales in the boulevard was deemed to be an ineffective strategy for provided additional water quality benefits due to the low permeability of the soils and relatively shallow depth to groundwater, and not supported by the Town of Cobourg Public Works Department.

The approach to implementation of small and localized naturalized areas in conjunction with formal storm water facilitates is generally emphasized by the following exert from the Preliminary Geotechnical Investigation Report, prepared by Golder Associates.

"The low permeability soils and relatively shallow depth to groundwater are not well suited to Low Impact Development (LID) measures such as infiltration galleries, soakaway pits etc., but may be feasible for small or localized areas. LID measure focused on run-off filtration, quality improvement with some minor infiltration enhancement (natural areas, vegetated strips, swales etc.) would be of greater benefit at the site. Given the low infiltration potential and shallow water table these features would need to be designed with proper drainage controls such that water during storm events can overflow/drain to traditional storm water system. LIDs at the Site should be used to complement not replace traditional storm water facilities with minor and major conveyance capabilities."

Detailed design for the stormwater management system is further described in Section 3.4 and will be constructed in a manner that respects existing Town standards and maintenance practices. The detailed design submission does not include bio-swale features in the boulevard as they are not supported by of the Town of Cobourg Public Works Department due to the shallow depth to groundwater and low permeability of the soils.

3. STORMWATER MANAGEMENT DETAILED DESIGN

3.1 Pre-development Conditions

The existing storm drainage systems/patterns within and surrounding the site have been represented on the Pre-Development Drainage Plan (Appendix B), as generally described below:

- roadside ditches along the north and south sides of the King Street, providing right of way drainage; generally flowing east to west, with ultimate connection to an unnamed drainage course, west of the site
- unorganized overland drainage patterns within the area north of King Street, generally sheeting east to west in the direction of an unnamed drainage course, west of the site
- existing storm sewer systems along Maher Street and Monk Street provide right of way and adjacent property drainage; generally flowing in a southerly and easterly direction with ultimate outlet to Lake Ontario at a location south of Monk Street, approximately 45 metres east of Burnham Street;
- unorganized overland drainage patterns of the properties west of the site, generally sheeting north to south, in the direction of Lake Ontario. Given the overall flat nature of the site and this area it is likely these areas west of the site receive overland flows from the unorganized drainage along the western portions of the site

With the exception of the potential sheet flow along the west limit (noted above) the pre-development site's storm drainage patterns are considered relatively "stand-alone". The site consists of unorganized overland drainage patterns, generally sheeting from north-east corner to south-west corner, in the direction of Lake Ontario with an estimated run-off co-efficient of 0.20.

It is noted under Appendix C of the Ganaraska Region Conservation Authority's (GRCA) Technical and Engineering Guidelines for Stormwater Management Submissions, December 2014 that suggested run-off co-efficients vary between 0.08 and 0.35 for Woodland, Flat (≤ 5% Slope) dependant on soil texture. Given the site's very flat (0.6%±) and vegetated nature, a pre-development run-off co-efficient of 0.20 is considered appropriate.

3.2 Post-development Minor Storm System

The post-development site consists of 14 new Single-Detached Low Density Residential lots ranging from 1119.1m^2 (0.28 acres) to 1736.1m^2 (0.42 acres) and one existing Single-Detached Low Density Residential lot of 4157.0 m^2 (1.03 acres). Generally, each proposed lot is fitted with a living quarters, driveway, garage and covered porch facilities. The existing heritage house lot is fitted with a living

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quarter's detached coach house, driveway (revised) and a covered porch. In addition to the residential lots, the site includes Street "A" & Street "B" right of ways and public park areas which include asphalt/concrete roadways, cul-de-sacs, driveway aprons, sidewalk and multi-use pathway facilities.

Given the low site slope, proposed lot size (particularly in comparison to the residential land uses immediately east of the site) and a detailed review of the pervious/impervious surfaces (yielding a 40% impervious/60% pervious divide), the initial minor drainage run-off co-efficient value of 0.35 is considered appropriate. However, a revised run-off co-efficient (from 0.35 to 0.45) has now been utilized and represented on the post-development minor system drainage plan and proposed storm sewer calculations attached in Appendix C. The increased run-off co-efficient results in slightly increased post-development flows, requiring larger pipe sizes (i.e. 450mm to 525mm).

This is generally re-emphasized under section 7.3 of the Ganaraska Region Conservation Authority's (GRCA) Technical and Engineering Guidelines for Stormwater Management Submissions, December 2014 where suggested the run-off co-efficient for Single Family Residential is 0.45 and Appendix C of the Guideline which suggests run-off co-efficients vary between 0.32 and 0.40 for Low Density Residential (1/3-3/4 acre lot), dependant on lot size.

The proposed storm drainage system is provided on figure STM-2 in Appendix 'C' including storm sewer sizing and 25-year hydraulic grade line calculations, in accordance with the Town of Cobourg design criteria.

3.3 Post-development Major Storm System

In general, Major storm conveyance systems will parallel the minor storm sewers within public corridors with the primary objective of maintaining consistent gradient; limiting low points where possible to encourage positive overland flow patterns.

Major storm event run-off co-efficients have been represented on the pre-development and post-development major system drainage plans and calculations attached in Appendix B and Appendix C. To account for a decrease in the perviousness during major storms the run-off co-efficients for the 1:25, 1:50 and 1:100 year storms, have been adjusted in keeping with the Ganaraska Region Conservation Authority's (GRCA) Technical and Engineering Guidelines for Stormwater Management Submissions, December 2014, as follows:

- 25-year event – add 10%
- 50-year event – add 20%
- 100-year event – add 25%

Major storm conveyances will utilize a single new outlet to Lake Ontario along the site's frontage, with the exception of a minor area of rear and side yard drainage from lots 1 – 3, 5 and 6 (areas P1 and P3 on the post-development major drainage plan) which will continue to drain to the outlet along the west property boundary, but at a reduced rate as shown in the table, below. It should be noted that given the size, and generally flat and vegetated nature of these rear yard areas, the total flows originating from these areas (even during larger storm events) are very minor and are expected to be captured by the catch-basins and will only spill for unforeseen or emergency situations. Capture rates for the rear yard catch basin is calculated using MTO Design Chart 4.20 and is provided in Appendix C. A detailed grading plan is provided in Appendix D.

Event	Estimated Pre-Development Overland Flow (m^3/s) directed to adjacent west property (A2, A3, A4)	Estimated Post-Development Overland Flow (m^3/s) directed to adjacent west property (P1, P3)	Estimated Post-Development Overland Flow (m^3/s) directed to adjacent west property less 1:5 event (24 l/s)
2-year	0.055 (55 l/s)	0.000 (0 l/s)	0.000 (0 l/s)
5-year	0.070 (70 l/s)	0.000 (0 l/s)	0.000 (0 l/s)
10-year	0.081 (81 l/s)	0.027 (27 l/s)	0.003 (3 l/s)
25-year	0.104 (104 l/s)	0.034 (34 l/s)	0.010 (10 l/s)
50-year	0.133 (133 l/s)	0.044 (44 l/s)	0.020 (20 l/s)
100-year	0.149 (149 l/s)	0.051 (51 l/s)	0.027 (27 l/s)

Grading and drainage patterns of the **front and side yards** of all proposed lots will direct overland flows towards the public right of ways and open spaces which include King Street, Street ‘A’, Street ‘B’, and the Public Park. This includes roofs and driveways being directed to the roadways with exception to the heritage home.

To minimize the impacts to the existing topography in the **rear yards,** as discussed in Section 2, these areas will require the use of adjacent properties to facilitate major overland flows (i.e. greater than 5 year return period), as summarized below.

- Major flows originating from rear yards of **lots 1, 2, 3, and 5** will maintain their southerly and westerly direction, utilizing the property immediately to the west of the site. However, it should be noted that the site’s development and subsequent re-grading will reduce the overall pre-development area utilizing this drainage pattern; reducing the pre-development area of 1.84 ha (A2, A3, A4 on figure STM-1) to an estimated 0.40 ha (P1 and P3 on figure STM-3).
- Major flows originating from the rear yards of **lots 10, 11, 12, 13, 14, 15** will maintain the southerly and easterly direction utilizing a rear yard vegetated swale, preliminarily sized as a 300mm bottom width, 150mm depth with 3:1 side slopes at a minimum of 1.0% slope to convey the 1:100 storm event of area P2 on figure STM-3.
- Major flows originating from the rear yards of **lots 4, 6, 7, 8 and 9** (existing heritage home) will maintain the southerly direction towards Lake Ontario via the Public Park.

The surfaces of the major storm conveyance systems will primarily be asphalt within the roadways and grassed swales. Where the major storm systems deviate from the roadways, grass surfaces are proposed sufficient to mitigate erosive forces.

The overland flow route, adjacent to the multi-use pathway, is a 0.9m wide grassed swale with a minimum 300mm depth with 3:1 side slopes at a minimum of 1.0% slope. This flow will convey the 1:100 event of area P2 and P4 on figure STM-3. The overland will be fully captured by a DICB (with approximately 0.25m of freeboard) and the armourstone spillway will be for unforeseen or emergency situations (i.e. clogged catchbasin). The last segment of the stormsewer has been enlarged for conveyance of the 1:100 storm event. Details of these conveyance calculations and inlet capacity calculations are provided under Appendix C. To assess the overland flow route a runoff coefficient of 0.6 for the road/front yards and 0.2 for backyards is used in comparison to a blended 0.45 coefficient (which was used for the minor system assessment). This ensured that the swales in backyards were not oversized, minimizing grading impacts by reducing the required depth of the swales.

To maintain an element of conservatism the sizing of these major storm conveyances has not been adjusted by the 1:5 year event, as suggested by the following under section 7.5 the Ganaraska Region Conservation Authority's (GRCA) Technical and Engineering Guidelines for Stormwater Management Submissions, December 2014:

"The major flow shall not be less than the difference between the 100-year design flow and the 5-year design flow, calculated as follows: $Q_{major} = Q_{100year} – Q_{5year}$*."*

Further, the 25-year to 100-year flows have applied runoff coefficient adjustment as noted in section 3.3 for assessment of the major system.

3.4 Storm Water Quality Control

An "Enhanced" Level of Protection for Stormwater quality (MOE Stormwater Management Planning and Design Manual, March 2003) will be achieved for the site by utilizing an Oil/Grit Separator (i.e. "Hydrogaurd" by CIL, or equivalent) towards the east limit of Street "B"; at an accessible and maintainable location. A detailed sizing of Hydroguard model suitable for the site, with primary design objective of 80% Total Suspended Solids (TSS) removal efficiency and treating a minimum of 90% of the annual run-off, is calculated in Appendix E. As the sizing simulation shows, an HG 5 (1500mm diameter) would meet the MOE requirements. However, in order to reduce the depth of the unit to avoid conflict with bedrock, a larger diameter structure is proposed with a reduced sump depth. The proposed hydrodynamic oil grit separator is an HG8 with a 2.4m inner diameter, sump depth of 130mm, and depth of 1.2m from the invert to the bottom of the unit. The unit will provide 88% TSS removal and a 99% net annual volume treated. The unit will provide 0.58m^3 of sediment volume (based on 130mm sump depth), and will require cleanout every 2 years based on an annual captured solids of 0.29 m^3. The maintenance manual is attached in Appendix E.

3.5 Storm Water Quantity Control

The site is located immediately upstream of Lake Ontario waterbody, with all drainage areas (pre and post development) contributing directly to Lake Ontario; with no intermediate (watercourse) receivers. There is no existing (or proposed) infrastructure/landforms downstream of the site which could potentially be damaged or altered by uncontrolled minor and major storm runoff. As such, the only anticipated downstream impacts are directly at the minor/major system outlets to Lake Ontario. Due to the variation in elevation from the site's plateau to the shoreline (5 metres +/-) an outlet/transition structure will be constructed to convey/outlet storm drainage (minor and major) in a manner that controls velocity and mitigates against erosion. The surfaces at these locations will be reinforced to mitigate erosive forces. Reinforcement is anticipated to utilize hard surface materials such as rock protection, armour stone and/or enhanced vegetated surfaces, details of which are identified in the plan and profile drawings attached in Appendix F.

Given the nature and scale of Lake Ontario in comparison the site, the post-development conditions are not anticipated to significantly alter or adversely impact the water surface elevations of the receiving waterbody of Lake Ontario. On this basis, it has been determined that a detailed review of the site's pre-development, post-development (uncontrolled), and post-development (controlled) is not applicable. Furthermore, a review of permissible release rate, required on-site storage, methods of runoff attenuation and measures to minimize downstream erosion impacts are not applicable.

This is generally re-emphasized under Table 3.1 Water Quantity Control Requirements of the Ganaraska Region Conservation Authority's (GRCA) Technical and Engineering Guidelines for Stormwater Management Submissions, December 2014:

Subwatershed	***Flood Control Criteria***	***References & Notes***
North Lake Ontario shoreline	*Quantity control not required for small developments draining directly to Lake Ontario provided this does not cause adverse downstream flooding*	*Lake Ontario Shoreline Management Plan (1992)*

For the purposes of context, the following evaluation of the pre-development to post-development conditions has been prepared. It should be noted that given the location and topography of the site, the pre-development overland flow does not concentrate, until reaching Lake Ontario.

Based on pre-development slopes and the estimated run-off coefficient of 0.20 time of concentrations were estimated using the Airport method for sub catchment areas A1 (29.6 minutes), A2 (15.0 minutes), A3 (22.2 minutes) and A4 (21.2 minutes). Pre-Development flows for the 2yr through 100yr events were estimated using the rational method utilizing rainfall intensities calculated by the Yarnell formula. The Estimated Pre-Development flows reaching Lake Ontario for each event are summarized in the table, below, and compared to the post-development 5-year, 25-year and 100-year hydrology flows based on calculations presented in Appendix C.

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Event	Estimated Pre-Development Overland Flow (m^3/s) (A1, A2, A3, A4)	Estimated Post-Development Storm Sewer Uncontrolled Flow (m^3/s) (A2, A4)
2-year	0.085 (85 l/s)	
5-year	0.109 (109 l/s)	0.249 (249 l/s)
10-year	0.125 (125 l/s)	
25-year	0.163 (163 l/s)	0.364 (364 l/s)
50-year	0.209 (209 l/s)	
100-year	0.236 (236 l/s)	0.524 (524 l/s)

4. TEMPORARY SEDIMENT AND EROSION CONTROL

Site Access from King Street West to permit construction, will utilize the servicing corridors of Street "A" and Street "B".

Temporary sedimentation and erosion control devices will be implemented prior to the initiation of any construction activity on the site. Measures that will be implemented include maintaining vegetative buffers, sediment control fencing, check dams and catch basin sediment traps. The Erosion and Sediment Control Drawing as presented in Appendix D, includes a sediment control pond in Lot 8.

The total drainage area to be exposed during construction is anticipated to be approximately 2.6 ha. The Greater Golden Horseshoe Area Conservation Authority, Erosion & Sediment Control Guidelines for Urban Construction, December 2006, recommends implementing sediment control ponds for drainage areas exceeding 2 ha. The guidelines require a Permanent Pool and Active Pool with 125m^3/ha ea; which equates to 325m^3 for the Cedars site. The proposed ESC pond provides 490m^3 of active storage and 370m^3 of permanent pool storage. A 2" submersible pump with a capacity of 4 L/s will drawdown the ESC pond in 24 to 48 hrs.

All erosion and sediment control details are designed in keeping with standards and guidelines provided by Town of Cobourg, Ontario Provincial Standard Specification and Drawings (OPSS & OPSD), Ganaraska Region Conservation Authority (GRCA) and Ministry of Environment & Climate Change (MOECC).

5. CONCLUSION

The purpose of this SWM Design Report is to outline the background information, applicable design criteria and provide detailed design details for the recommended stormwater management concept for the Cedar Shores development application. The plan identifies the proposed SWM concept including stormsewers, overland flow channels, an oil-grit separator, and naturalized areas. Based on local standards and analysis carried out as a part of this detailed design, it was determined the site can be serviced as represented on the Plan and Profile Drawings (available in Appendix F) and as summarized below:

- Two (2) urbanized roadways; Street “A” connecting to King Street West and Street “B” terminating with cul-de-sac ends
- 1.5m sidewalks within the corridors of Street “A” and Street “B”. 3.0m Multi Use Pathway through the public park, 1.5m sidewalk on the south side of King Street West between Maher Street and Street “A”
- 300mm to 525mm diameter gravity storm sewers within the corridors of Street “A”, Street “B” and Public Park to convey minor storm flows. Overland drainage patterns paralleling the minor storm sewers to covey the major storm flows. Establishment of a new outlet to Lake Ontario. Provision of individual lot services and localized rear yard inlets.
- “Lot Level” storm water quality treatment through implementation of naturalized areas.
- “End of Pipe” storm water quality treatment though implementation of an “Oil/Grit Separator” towards the east limit of Street “B”.
- Adequate erosion and sedimentation control provided during construction including mud mat, sediment control fencing, check dams and catch basin sediment traps.
- Construction access via King Street West.

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APPENDIX A
DEVELOPMENT REVIEW TEAM (DRT) RESPONSE

DRAFT PLAN OF SUBDIVISION DRT COMMENTS

1st Submission, Zoning Amendment and Draft Plan of Subdivision for Cedar Shores Estates (589 King Street West) RFA Planning Consultant Inc.		
	Comments *(Development Review Team - DRT)*	**Response** *(CIMA+)*
B. ENGINEERING DEPARTMENT *Barry Thrasher, Deputy Director of Public Works* *or Neil Stewart, EIT* *at 905-372-9971.*	2. While Storm Water matters are deferred to the GRCA, the Engineering Department is has concerns with the locations of the LID facility. The detailed design shall demonstrate that the LID will not negatively impact the existing properties to the east, nor the proposed houses on the west side of the proposed road.	Refer to section 2 of the SWM Design Report for details. *Please note that for clarity, the identifier of "LID" for the rear yard areas has been amended to identify these areas as "Natural/Undisturbed areas".*
D. PARKS DEPARTMENT *Rory Quigley, Arborist* *at 905-372-4555.*	2. Forestry has some serious concerns with the proposed location of the 'Storm Water Management LID Areas' shown in the proposed development. How will long term health of the trees in these areas and adjacent to them be protected and preserved?	Refer to section 2 of the SWM Design Report for details. *Please note that for clarity, the identifier of "LID" for the rear yard areas has been amended to identify these areas as "Natural/Undisturbed areas".*
G. GANARASKA REGION CONSERVATION AUTHORITY *Greg Wells, Manager Planning and Regulations* *at 905-885-8173.*	With respect to the stormwater management report, we would recommend the consultant refer to the GRCA's December 2014 "Technical and Engineering Guidelines for Stormwater Management Submissions" for the next submission. The following items should be provided or corrected:	Acknowledged.
	1. The proposed design includes possible low-impact development stormwater treatment. In order to determine whether these types of features are suitable for the development, soils information derived from recent soils and/or hydrogeological studies should be provided. If neither are available, soils maps or other reliable data may be used. Copies of the soils reports and maps should be included in the appendix.	Refer to section 2 of the SWM Design Report for details. *Please note that for clarity, the identifier of "LID" for the rear yard areas has been amended by the February 16, 2016 Memo to identify these areas as "Natural/Undisturbed areas".*
	2. Calculations of pre-development runoff should be included. Discussion needs to include: a. Calculation of permissible release rate and required on-site storage b. Methods of runoff attenuation and on-site storage c. Measures to minimize downstream erosion impacts	Refer section 3.1 of the SWM Design Report for details.
	3. Two separate drainage area plans are required: pre-development and post-development. All drainage area plans need to include: a.Source of topographic information (i.e. provincial OBMs, municipal GIS, local survey), date of information (survey date, LiDAR flight date), and benchmark (if applicable) b. Property limits c. Watercourse (if applicable) d. Top of bank locations (if applicable) e. Regulatory flood line (if applicable)	Refer to Appendix B and C for details.
	4. In addition to the items listed in bullet #5, the pre-development drainage area plan should include: a. Contours at 0.5m increments, extending to a suitable distance beyond the property limits to support off-site drainage patterns b. Overland flow paths c. The outlet of any tributary storm sewer network d. Watercourses, swales, and ponds e. Catchment areas (tagged with ID#, area size, and C value)	Refer to Appendix B for details.
	5. In addition to the items listed in bullet #5, the post-development drainage area plan should include: a. Underlying draft plan layout (with lot, block, easement, and road pattern) b. The major flow route c. Conceptual minor system layout d. All SWM facilities	Refer to Appendix C for details.
	6. The runoff coefficients do not match what is listed in the "Technical and Engineering Guidelines for Stormwater Management Submissions". Calculations will need to be revised for the next submission.	Refer section 3.2 of the SWM Design Report for details.
	7. A table comparing peak flow rates for pre-development, post-development uncontrolled, and post-development controlled should be included, if required.	Refer section 3.3 of the SWM Design Report for details.
	8. A rough grading plan is required to show the proposed grades at key locations, to support the proposed major flow route(s).	Refer to Appendix D for details.
	9. The report focuses only on minor flow. The report should include a discussion on major flow treatment options.	Refer section 3.3 of the SWM Design Report for details.
	10. It is noted that all LID controls will be on private property. It is recommended the consultant discuss with Public Works staff whether this option will be acceptable to the Town.	Refer to section 2 of the SWM Design Report for details. *Please note that for clarity, the identifier of "LID" for the rear yard areas has been amended by the February 16, 2016 Memo to identify these areas as "Natural/Undisturbed areas".*

APPENDIX B
PRE-DEVELOPMENT FIGURES AND CALCULATIONS

FIGURE STM-1 PRE-DEVELOPMENT DRAINAGE PLAN
PRE-DEVELOPMENT HYDROLOGY CALCULATIONS

LEGEND

- EXISTING STORM MAINT. HOLE
- EXISTING CATCHBASIN
- EXISTING DOUBLE CATCHBASIN
- EXISTING STORM SEWER
- EXISTING DITCH/SWALE
- LIMIT OF OFFICIAL PLAN ENVIRONMENTAL CONSTRAINT DESIGNATION
- EXISTING STORM DRAINAGE AREA
- PRE-DEVELOPMENT PROPERTY FABRIC
- EXISTING OVERLAND FLOW PATTERN

ID No. — RUNOFF COEFFICIENT — AREA (ha)

Topographic Information obtained from Municipal GIS data and Local Survey
- 2013 SCOOP orthographic photography provided by Town of Cobourg (April, 2014)
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- Existing Underground Services a composite of best available record drawings, municipal mapping and topographic survey (May, 2014)
- All elevations are Geodetic CGVD 28.

CLIENT:
EIE CORPORATION

PROJECT NAME:
CEDAR SHORE ESTATES

SHEET TITLE:
STORMWATER DRAINAGE PLAN

SUB TITILE:
PRE-DEVELOPMENT DRAINAGE PLAN

SCALE:
0 5 10 20 30 40 50
metres
1:1,500

PROJECT No: C14-0011		CLIENT FILE No: ---
DRAFTER: D. CAMPBELL	DESIGNER P. CAMPBELL	DRAWING No: **STM-1**
APPROVER P. CAMPBELL	APPROVER W. McCRAE	
DATE: 3/8/2016		SHEET No: 1 of 1

LEGEND

- EXISTING STORM MAINT. HOLE
- EXISTING CATCHBASIN
- EXISTING DOUBLE CATCHBASIN
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CLIENT:
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PROJECT NAME:
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STORMWATER DRAINAGE PLAN

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SCALE:
0 5 10 20 30 40 50
metres
1:1,500

PROJECT No: **C14-0011**	CLIENT FILE No: ---
DRAFTER: D. CAMPBELL / DESIGNER P. CAMPBELL	DRAWING No: **STM-1**
APPROVER P. CAMPBELL / APPROVER W. McCRAE	
DATE: 3/8/2016	SHEET No: 1 of 1

PRE-DEVELOPMENT HYDROLOGY

CEDAR SHORE ESTATES

589 King Street West, Cobourg
File: C14-0011
Submission: SWM Design Report

Project : Cedar Shore Estates
Project No. : C14-0011

Prepared by: PDC
Checked by: RDC
Date: 16-Feb-16
Various Yarnell Storm Event

Location	A Area (ha)	R Runoff Coeff.	2.78AR	Accum. 2.78AR	Time of Conc. (min)	Design Return Period	Rainfall (mm/hr)	Q Peak Flow (l/s)	Pipe Diam. (mm)	Slope (%)	Length (m)	Capacity (l/s)	Capacity at Critical Slope	Capacity Problem	Velocity (m/s)	Time in Section (min)	Total Time (min)	Remarks
A1	1.28	0.20	0.712	0.712	29.56	"1:2"	41.78	30									29.56	Outlets to Lake Ontario
A2	0.46	0.20	0.256	0.256	15.00	"1:2"	63.50	16									15.00	Conveyed by West Adjacent Property, then Lake Ontario
A3	0.80	0.20	0.445	0.445	22.19	"1:2"	50.53	22									22.19	Conveyed by West Adjacent Property, then Lake Ontario
A4	0.58	0.20	0.322	0.322	21.24	"1:2"	51.93	17									21.24	Conveyed by West Adjacent Property, then Lake Ontario
Total (1:2)								**85**										
A1	1.28	0.20	0.712	0.712	29.56	"1:5"	54.08	38									29.56	Outlets to Lake Ontario
A2	0.46	0.20	0.256	0.256	15.00	"1:5"	79.48	20									15.00	Conveyed by West Adjacent Property, then Lake Ontario
A3	0.80	0.20	0.445	0.445	22.19	"1:5"	64.52	29									22.19	Conveyed by West Adjacent Property, then Lake Ontario
A4	0.58	0.20	0.322	0.322	21.24	"1:5"	66.17	21									21.24	Conveyed by West Adjacent Property, then Lake Ontario
Total (1:5)								**109**										
A1	1.28	0.20	0.712	0.712	29.56	"1:10"	61.88	44									29.56	Outlets to Lake Ontario
A2	0.46	0.20	0.256	0.256	15.00	"1:10"	90.94	23									15.00	Conveyed by West Adjacent Property, then Lake Ontario
A3	0.80	0.20	0.445	0.445	22.19	"1:10"	73.82	33									22.19	Conveyed by West Adjacent Property, then Lake Ontario
A4	0.58	0.20	0.322	0.322	21.24	"1:10"	75.70	24									21.24	Conveyed by West Adjacent Property, then Lake Ontario
Total (1:10)								**125**										
A1	1.28	0.22	0.783	0.783	29.56	"1:25"	76.34	60									29.56	Outlets to Lake Ontario
A2	0.46	0.22	0.281	0.281	15.00	"1:25"	102.81	29									15.00	Conveyed by West Adjacent Property, then Lake Ontario
A3	0.80	0.22	0.489	0.489	22.19	"1:25"	87.79	43									22.19	Conveyed by West Adjacent Property, then Lake Ontario
A4	0.58	0.22	0.355	0.355	21.24	"1:25"	89.51	32									21.24	Conveyed by West Adjacent Property, then Lake Ontario
Total (1:25)								**163**										
A1	1.28	0.24	0.854	0.854	29.56	"1:50"	88.69	76									29.56	Outlets to Lake Ontario
A2	0.46	0.24	0.307	0.307	15.00	"1:50"	121.79	37									15.00	Conveyed by West Adjacent Property, then Lake Ontario
A3	0.80	0.24	0.534	0.534	22.19	"1:50"	102.84	55									22.19	Conveyed by West Adjacent Property, then Lake Ontario
A4	0.58	0.24	0.387	0.387	21.24	"1:50"	105.00	41									21.24	Conveyed by West Adjacent Property, then Lake Ontario
Total (1:50)								**209**										
A1	1.28	0.25	0.890	0.890	29.56	"1:100"	97.08	86									29.56	Outlets to Lake Ontario
A2	0.46	0.25	0.320	0.320	15.00	"1:100"	129.95	42									15.00	Conveyed by West Adjacent Property, then Lake Ontario
A3	0.80	0.25	0.556	0.556	22.19	"1:100"	111.34	62									22.19	Conveyed by West Adjacent Property, then Lake Ontario
A4	0.58	0.25	0.403	0.403	21.24	"1:100"	113.49	46									21.24	Conveyed by West Adjacent Property, then Lake Ontario
Total (1:100)								**236**										

Date	Submission
2-Mar-17	SWM Design Report - 1st Submission
6-Dec-17	SWM Design Report - 2nd Submission

APPENDIX C
POST-DEVELOPMENT FIGURES AND CALCULATIONS

FIGURE STM-2 POST-DEVELOPMENT MINOR DRAINAGE PLAN
POST-DEVELOPMENT MINOR HYDROLOGY CALCULATIONS

FIGURE STM-3 POST-DEVELOPMENT MAJOR DRAINAGE PLAN
POST-DEVELOPMENT MAJOR HYDROLOGY CALCULATIONS

INLET CAPACITY CALCULATIONS
OVERLAND FLOW CALCULATIONS

LEGEND

- PROPOSED STORM CATCH BASIN
- PROPOSED STORM DOUBLE CATCH BASIN
- PROPOSED STORM OIL/GRIT SEPARATOR
- PROPOSED STORM MAINT. HOLE
- PROPOSED STORM WATER QUALITY DEVICE
- EXISTING STORM MAINT. HOLE
- EXISTING CATCHBASIN
- EXISTING DOUBLE CATCHBASIN
- PROPOSED SWALE
- PROPOSED STORM SEWER
- EXISTING DITCH/SWALE
- EXISTING STORM SEWER
- LIMIT OF OFFICIAL PLAN ENVIRONMENTAL CONSTRAINT DESIGNATION
- PROPOSED SUB-DIVISION PROPERTY FABRIC
- PROPOSED EDGE OF CURB
- APPROXIMATE BUILDING FOOTPRINT
- PROPOSED SIDEWALK
- PROPOSED SITE
- EXISTING STORM DRAINAGE AREA
- NATURALIZED AREAS
- PROPOSED MAJOR OVERLAND FLOW PATTERN
- EXISTING OVERLAND FLOW PATTERN

ID No. — RUNOFF COEFFICIENT — AREA (ha)

Topographic Information obtained from Municipal GIS data and Local Survey
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- All elevations are Geodetic CGVD 28.

CIMA+

CLIENT: **EIE CORPORATION**

PROJECT NAME: CEDAR SHORE ESTATES

SHEET TITLE: **STORMWATER DRAINAGE PLAN**

SUB TITILE: **POST-DEVELOPMENT MINOR DRAINAGE PLAN**

SCALE: 0 5 10 20 30 40 50 metres 1:1,500

PROJECT No: C14-0011	CLIENT FILE No: ---
DRAFTER: S. ELLIOTT / DESIGNER P. CAMPBELL	DRAWING No: STM-2
APPROVER P. CAMPBELL / APPROVER ---	
DATE: 11/7/2017	SHEET No: 1 of 1

CEDAR SHORE ESTATES, 589 KING STREET WEST
STORM SEWER DESIGN SHEET

Client Name	EIE Corporation
Project No.	C14-0011
Date:	6-Dec-17
Submission:	2nd SUBMISSION
Prepared For:	Detail Design SWM Report
Prepared By:	RC
Checked By:	PT

Notes:

1 Indicates a User Input
2 15 Minute Entry Time
3 5yr Design Storm
4 5yr: I = 2464 / (T + 16)
5 n = 0.013

Street	U/S MH	D/S MH	A Area (ha)	R Runoff Coeff.	2.78AR	Accum. 2.78AR	Time of Conc. (min)	Rainfall (mm/hr)	Q Peak Flow (l/s)	Pipe Diameter (mm)	Design Slope (%)	Length (m)	Capacity (l/s)	Capacity (%)	Velocity (m/s)	Time in Section (min)	Total Time (min)	Remarks
	51	6	0.13	0.45	0.163	0.163	15.00	79.48	13	300	1.00	17.1	101	13%	1.38	0.21	15.21	
Street "A"	6	5	0.33	0.45	0.413	0.575	15.21	78.96	45	300	1.00	40.0	101	45%	1.38	0.48	15.69	
	52	5	0.26	0.45	0.325	0.325	15.00	79.48	30	300	1.00	46.7	101	30%	1.38	0.56	15.56	
	53	5	0.25	0.45	0.313	0.313	15.00	79.48	30	300	1.00	49.2	101	30%	1.38	0.59	15.59	
Street "A"	5	4	0.24	0.45	0.300	1.514	15.69	77.76	118	375	0.75	44.5	158	74%	1.39	0.53	16.22	
	54	8	0.15	0.45	0.188	0.188	15.00	79.48	20	300	1.00	32.2	101	20%	1.38	0.39	15.39	
	8	4				0.188	16.22	76.47	20	300	1.00	8.5	101	20%	1.38	0.10	16.32	
Street "A"	4	3	0.23	0.45	0.288	1.989	16.32	76.23	152	450	0.50	60.2	210	72%	1.28	0.78	17.11	
Street "B"	7	3	0.24	0.45	0.300	0.300	15.00	79.48	24	300	0.50	38.5	71	33%	0.98	0.66	15.66	
Street "B"	3	2	0.40	0.45	0.500	2.790	17.11	74.42	208	525	0.50	43.0	317	65%	1.42	0.50	17.61	
	58	2	0.14	0.45	0.175	0.175	15.00	79.48	15	300	1.00	10.0	101	15%	1.38	0.12	15.12	
Walkway	2	HG8				2.965	17.61	73.31	217	525	0.50	9.9	317	69%	1.42	0.12	17.73	
Walkway	HG8	1				2.965	17.73	73.05	217	525	0.50	55.0	317	68%	1.42	0.65	18.37	
Public Park	1	Outfall	0.40	0.45	0.500	3.465	18.37	71.68	248	675	0.50	18.4	620	40%	1.68	0.18	18.56	
								100-yr	522	675	0.50	19.0	620	84%	1.68	0.19		

Runoff Coefficients

0.20	Parks-Cemeteries-Playground	0.75	Schools & Churches
0.45	Single Family Residential	0.75	Industrial Areas
0.60	Semi-Detached Residential	0.90	Commercial Areas
0.75	Townhouses	0.90	Heavily Developed Areas
0.75	High Density Residential		

Date	Submission
2-Mar-17	SWM Design Report - 1st Submission
6-Dec-17	SWM Design Report - 2nd Submission

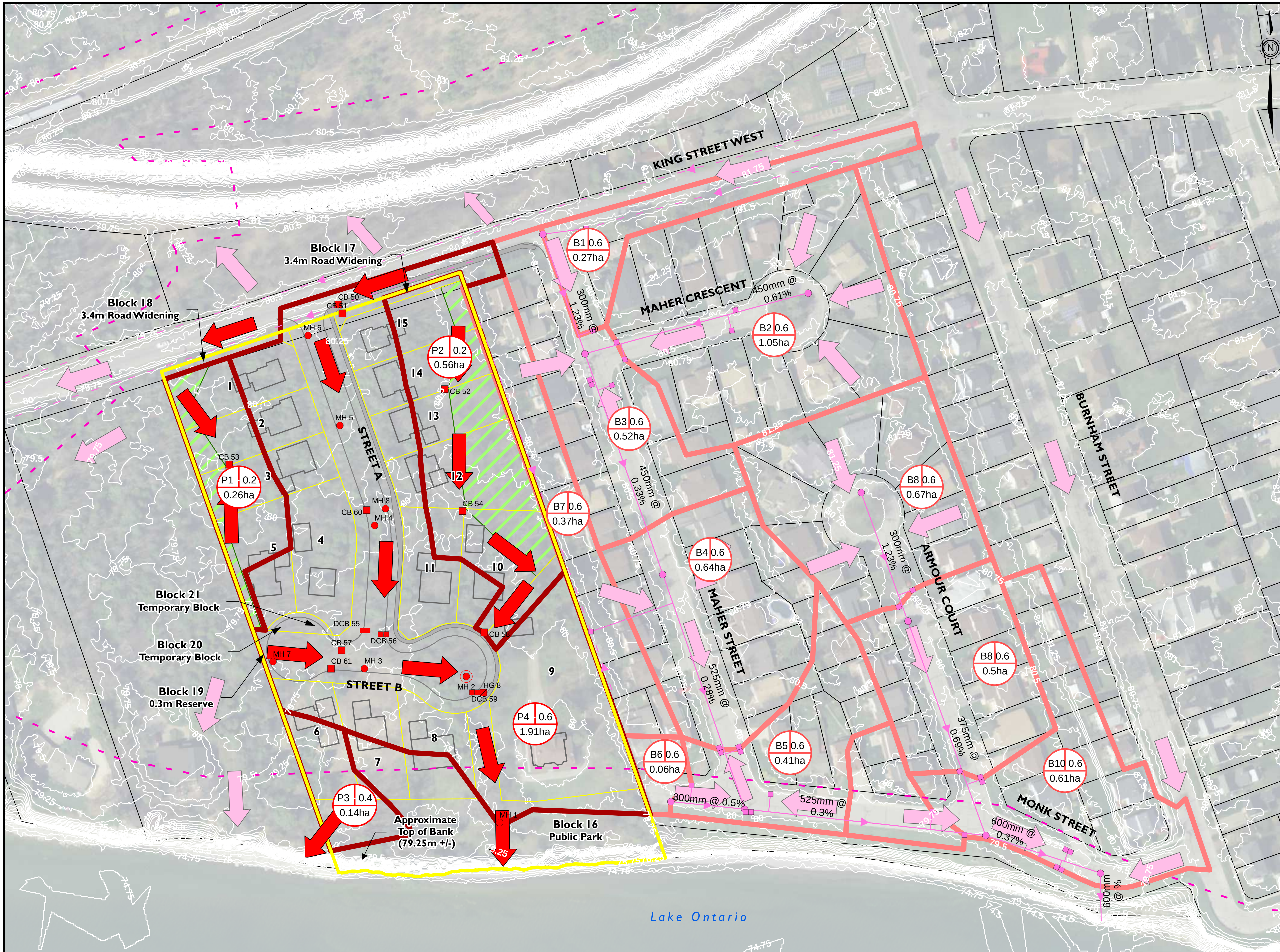
CEDAR SHORE ESTATES, 589 KING STREET WEST
HYDRAULIC GRADELINE DESIGN SHEET

Client Name: EIE Corporation
Project No.: C14-0011
Date: 6-Dec-17
Submission: 2nd SUBMISSION

Prepared For: Detail Design SWM Report
Prepared By: RC
Checked By: PT

Notes:
1 Indicates a User Input
2 15 Minute Entry Time
3 25yr Design Storm
4 25yr: I = 4318 / (T + 27)
5 Bend Loss (hb)
6 Transition Loss (ht)
7 Head Loss (he)
8 Starting WL is downstream Obvert
9 Note: The resultant HGL is the greater of the obvert and the calculated HGL.

			PROPOSED PIPE									PIPE LOSSES					MANHOLE LOSSES at D/S MH						HGL Elevation		EGL Elevation		Surcharge	
STREET NAME	D/S MH	U/S MH	Bend Angle in D/S MH	Box Culvert? (Y/N)	Size mm	Length m	Slope %	Lower Inv. m	Upper Inv. m	Lower Obv. m	Upper Obv. m	25 yr Flow cms	Pipe Capacity cms	Pipe Capacity %	Frict'n Slope %	Frict'n Loss m	Vi in m/s	Vo out m/s	$v_i^2/2g$ m	hb $kv_o^2/2g$ m	ht $v_o^2/2g - v_i^2/2g$ m	he D/S MH m	Lower m	Upper m	Lower m	Upper m	Lower m	Upper m
Public Park	Outfall	1	0	N	675	18.4	0.50	75.600	75.692	76.286	76.378	0.522	0.620	84.2%	0.35	0.065	1.41	1.68	0.102	0.014	0.042	0.056	76.286	76.378	76.328	76.453	0.00	0.00
Walkway	1	HG8	15	N	525	55.0	0.50	75.900	76.175	76.433	76.708	0.286	0.317	90.2%	0.41	0.224	1.28	1.41	0.084	0.010	0.018	0.028	76.433	76.708	76.463	76.741	0.00	0.00
Walkway	HG8	2	45	N	525	9.9	0.50	76.250	76.300	76.783	76.833	0.287	0.317	90.5%	0.41	0.041	1.28	1.28	0.084	0.025	0.000	0.025	76.783	76.833	76.766	76.908	0.00	0.00
Street "B"	2	3	45	N	525	43.0	0.50	76.375	76.590	76.908	77.123	0.273	0.317	86.1%	0.37	0.159	1.22	1.28	0.076	0.025	0.008	0.033	76.908	77.123	76.933	77.144	0.00	0.00
Street "B"	3	7	0	N	300	38.5	0.50	76.830	77.023	77.135	77.327	0.031	0.071	43.3%	0.09	0.036	0.42	1.22	0.009	0.008	0.067	0.075	77.142	77.327	77.151	77.188	0.01	0.00
Street "A"	3	4	90	N	450	60.2	0.50	76.680	76.981	77.137	77.438	0.198	0.210	94.3%	0.44	0.267	1.21	1.22	0.074	0.061	0.002	0.063	77.137	77.438	77.205	77.479	0.00	0.00
Street "A"	4	5	45	N	375	44.5	0.75	77.060	77.394	77.441	77.775	0.153	0.158	96.7%	0.70	0.312	1.34	1.21	0.092	0.022	-0.018	0.005	77.441	77.775	77.501	77.845	0.00	0.00
Street "A"	5	6	0	N	300	40.0	1.00	77.520	77.920	77.825	78.225	0.059	0.101	58.4%	0.34	0.136	0.81	1.34	0.033	0.009	0.059	0.068	77.825	78.225	77.854	77.994	0.00	0.00



LEGEND

- PROPOSED STORM CATCH BASIN
- PROPOSED STORM DOUBLE CATCH BASIN
- PROPOSED STORM OIL/GRIT SEPARATOR
- PROPOSED STORM MAINT. HOLE
- PROPOSED STORM WATER QUALITY DEVICE
- EXISTING STORM MAINT. HOLE
- EXISTING CATCHBASIN
- EXISTING DOUBLE CATCHBASIN
- EXISTING DITCH/SWALE
- EXISTING STORM SEWER
- LIMIT OF OFFICAIL PLAN ENVIRONMENTAL CONSTRAINT DESIGNATION
- PROPOSED SUB-DIVISION PROPERTY FABRIC
- PROPOSED EDGE OF CURB
- APPROXIMATE BUILDING FOOTPRINT
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- PROPOSED MAJOR DRAINAGE AREA
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- NATURALIZED AREAS
- PROPOSED MAJOR OVERLAND FLOW PATTERN
- EXISTING OVERLAND FLOW PATTERN

ID No. RUNOFF COEFFICIENT AREA (ha)

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CIMA+

CLIENT: EIE CORPORATION

PROJECT NAME: CEDAR SHORE ESTATES

SHEET TITLE: STORMWATER DRAINAGE PLAN

SUB TITILE: POST-DEVELOPMENT MAJOR DRAINAGE PLAN

SCALE: 0 5 10 20 30 40 50 metres 1:1,500

PROJECT No: C14-0011	CLIENT FILE No: ---
DRAFTER: S. ELLIOTT / DESIGNER P. CAMPBELL	DRAWING No: STM-3
APPROVER P. CAMPBELL / APPROVER W. McCRAE	
DATE: 11/7/2017	SHEET No: 1 of 1

CEDAR SHORE ESTATES - EAST SWALE MAJOR FLOW (1:100)

TRAPAZOIDAL SWALE SIZE CALCULATIONS USING MANNING'S EQUATION

INCOMING FLOW =	0.051	m^3/s	(1:100 Year Storm Flow for Area P2 - Post Development Major Drainage)
MANNING COEF, n =	0.033	From HEC-RAS 4.1 Reference Manual Table 3-1 - Earth, Grass, Some Weeds	
BOTTOM WIDTH =	0.300	m	
SWALE SLOPE =	0.0100	m/m	
INITIAL DEPTH =	0.050	m	
DEPTH INCREMENT =	0.050	m	

589 King Street West, Cobourg
File: C14-0011
2nd Submission: SWM Design Report

Left Slope =	3	(H:V)			
Right Slope =	3	(H:V)			
Area	Perimeter	Flow	Velocity		Depth
(m^2)	(m)	(m^3/s)	(m/s)		(m)
0.023	0.616	0.008	0.334		0.050
0.060	0.932	0.029	0.487		0.100
0.113	1.249	0.069	0.609	X	0.150
0.180	1.565	0.129	0.717	X	0.200
0.263	1.881	0.214	0.815	X	0.250
0.360	2.197	0.327	0.907	X	0.300
0.473	2.514	0.470	0.994	X	0.350
0.600	2.830	0.646	1.077	X	0.400
0.743	3.146	0.859	1.157	X	0.450
0.900	3.462	1.111	1.234	X	0.500
1.073	3.779	1.404	1.309	X	0.550
1.260	4.095	1.740	1.381	X	0.600
1.463	4.411	2.123	1.452	X	0.650
1.680	4.727	2.554	1.520	X	0.700
1.913	5.043	3.036	1.588	X	0.750
2.160	5.360	3.571	1.653	X	0.800
2.423	5.676	4.161	1.718	X	0.850
2.700	5.992	4.809	1.781	X	0.900
2.993	6.308	5.516	1.843	X	0.950
3.300	6.625	6.284	1.904	X	1.000
3.623	6.941	7.116	1.964	X	1.050
3.960	7.257	8.013	2.024	X	1.100
4.313	7.573	8.978	2.082	X	1.150

CEDAR SHORE ESTATES - PUBLIC PARKLAND GRASSED DEPRESSION OVERLAND MAJOR FLOW (1:100)

TRAPAZOIDAL SWALE SIZE CALCULATIONS USING MANNING'S EQUATION

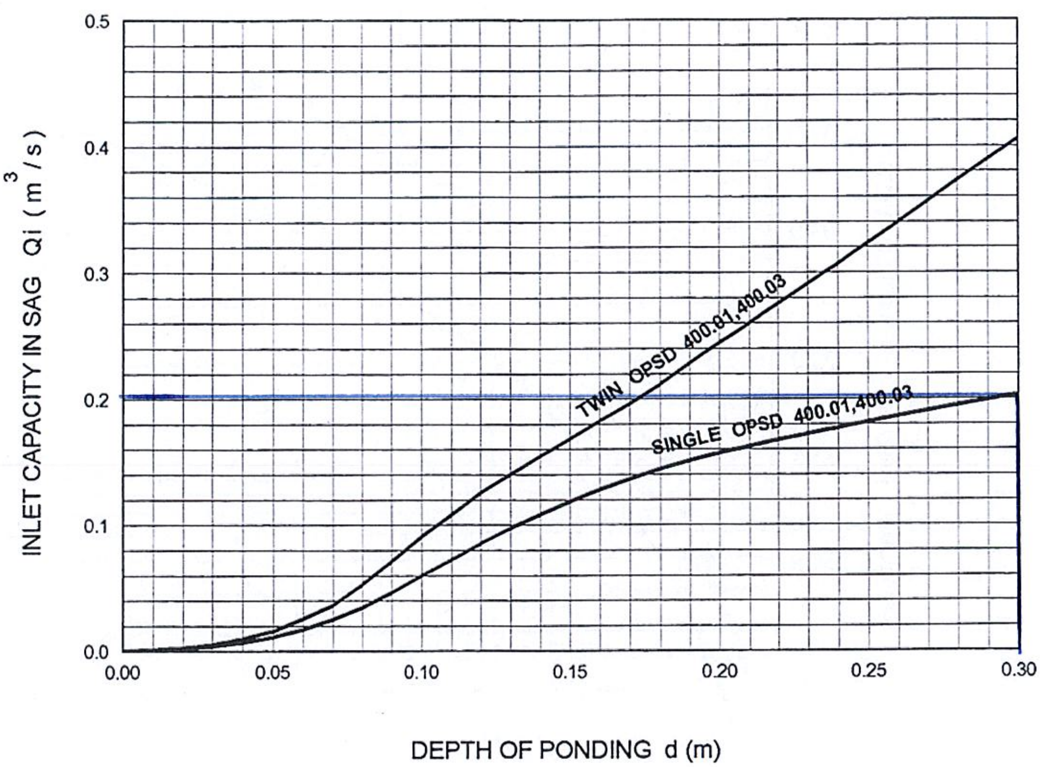
CEDAR SHORE ESTATES

589 King Street West, Cobourg
File: C14-0011
2nd Submission: SWM Design Report

INCOMING FLOW =	0.524	m^3/s	(1:100 Year Storm Flow for Area P4+P2 - Post Development Major Drainage)
MANNING COEF, n =	0.033	From HEC-RAS 4.1 Reference Manual Table 3-1 - Earth, Grass, Some Weeds	
BOTTOM WIDTH =	0.900	m	
SWALE SLOPE =	0.0100	m/m	
INITIAL DEPTH =	0.050	m	
DEPTH INCREMENT =	0.050	m	

Left Slope =	3	(H:V)			
Right Slope =	3	(H:V)			
Area	Perimeter	Flow	Velocity		Depth
(m^2)	(m)	(m^3/s)	(m/s)		(m)
0.053	1.216	0.020	0.373		0.050
0.120	1.532	0.067	0.555		0.100
0.203	1.849	0.140	0.694		0.150
0.300	2.165	0.243	0.811		0.200
0.413	2.481	0.378	0.916		0.250
0.540	2.797	0.547	1.012	X	0.300
0.683	3.114	0.752	1.102	X	0.350
0.840	3.430	0.996	1.186	X	0.400
1.013	3.746	1.283	1.267	X	0.450
1.200	4.062	1.613	1.344	X	0.500
1.403	4.379	1.990	1.419	X	0.550
1.620	4.695	2.415	1.491	X	0.600
1.853	5.011	2.892	1.561	X	0.650
2.100	5.327	3.421	1.629	X	0.700
2.363	5.643	4.006	1.696	X	0.750
2.640	5.960	4.649	1.761	X	0.800
2.933	6.276	5.351	1.825	X	0.850
3.240	6.592	6.115	1.887	X	0.900
3.563	6.908	6.942	1.949	X	0.950
3.900	7.225	7.835	2.009	X	1.000
4.253	7.541	8.796	2.068	X	1.050
4.620	7.857	9.826	2.127	X	1.100
5.003	8.173	10.928	2.184	X	1.150

Design Chart 4.19: Inlet Capacity at Road Sag



$Q_i\,(m^3/s) = 0.2\,m^3/s$

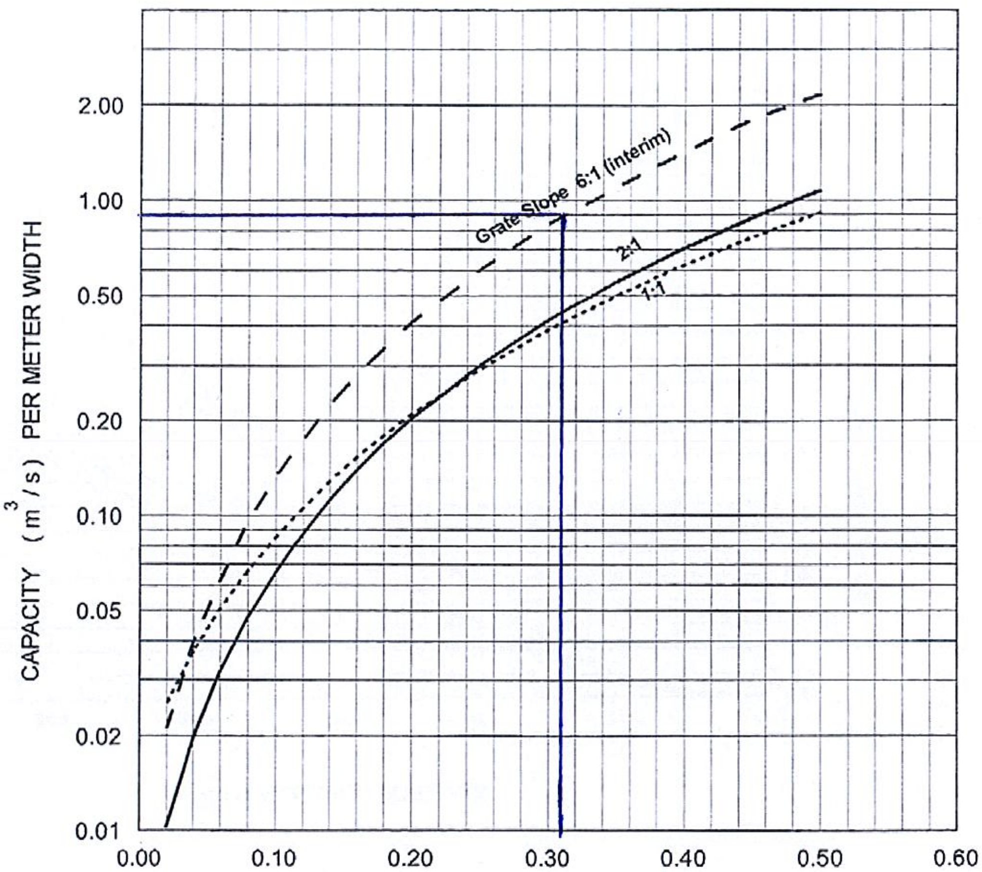
@ 50% Blockage 100 L/s

$Q_c\,(m^3/s) =$ 101 L/s for 300mm @ 1.0%.

$Q_{100yr} =$ 30 L/s.

∴ CB inlet & sewer capacity > Q_{100yr} ✓

Design Chart 4.20: Ditch Inlet Capacity



Notes:

1. Curves apply to grate Type 403.01, but may be used for straight - bar inlets without significant loss of accuracy.

2. Capacities given by curves are for unobstructed grates only. For design use working capacity ≯ 0.5 x unobstructed capacity.

3. Capacities of grates operating in high velocity flows are less than indicated.

$Q_{cap} = 1.2\text{m} \times 0.9\text{m}^3/\text{s}/\text{m} = 1.08\text{m}^3/\text{s}$

Q_{cap} @ 50% Blockage $= 0.54\text{m}^3/\text{s}$

$\therefore Q_{100yr} = 0.524\text{m}^3/\text{s} < Q_{cap}$. ✓

Flow depth = 0.31m; depth provided 0.58m. ~0.25m freeboard.

APPENDIX D
PROPOSED GRADING PLAN & ESC PLAN

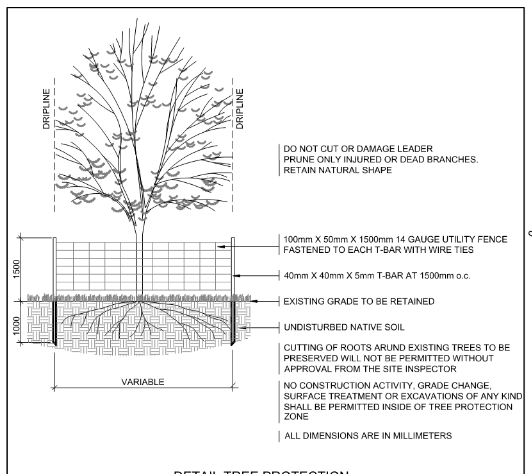
GRADING AND ESC PLAN DRAWINGS G-1 TO ESC-1

STAGING:

1. INSTALL MUD MAT, SEDIMENT FENCE AND TREE PROTECTION FENCE PRIOR TO ANY CLEARING, GRUBBING, GRADING OR EXCAVATION.
2. COMPLETE STAGE ONE CLEARING AND GRUBBING AS SHOWN.
3. CONSTRUCT TEMPORARY SWALES, SEDIMENT POND AND ROCK CHECK DAMS AS PER OPSD 219.210.
4. COMPLETE STAGE 2 CLEARING AND GRUBBING.
5. INSTALL STORM OUTFALL AND OIL GRIT SEPARATOR (HG8) EARLY IN CONSTRUCTION. OUTFALL IS TO BE RESTORED UPON COMPLETION.
6. AT THE COMPLETION OF ROADWAY AND STORM SEWER CONSTRUCTION CATCH BASIN FILTERS ARE TO BE INSTALLED AT ALL DITCH INLETS AND CATCH BASINS. THESE CB FILTERS ARE TO REMAIN OPERATIONAL DURING CONSTRUCTION PERIOD, UNTIL THE LOTS HAVE BEEN SODDED.

ENVIRONMENTAL NOTES:

1. NO CONSTRUCTION EQUIPMENT OR ACTIVITY SHALL PROCEED BEYOND THE LIMITS OF THE SEDIMENT CONTROL FENCE.
2. ALL SEDIMENT AND EROSION CONTROL MEASURES SHALL BE LEFT IN PLACE UNTIL ALL DISTURBED AREAS HAVE STABILIZED.
3. EROSION AND SEDIMENT CONTROL SHALL BE INSPECTED ON A REGULAR BASIS AND IMMEDIATELY AFTER RAINFALL EVENTS TO ENSURE THEY ARE FUNCTIONING PROPERLY AND ARE MAINTAINED AND/OR UPGRADED AS REQUIRED.
4. ACCUMULATED SEDIMENT SHALL BE REMOVED FROM ALL ESC MEASURES AT THE DIRECTION OF THE CONTRACT ADMINISTRATOR OR AFTER EACH RAINFALL EVENT.
5. ALL TREE CLEARING TO OCCUR WITHIN TIMING WINDOW (AUGUST 15 TO MARCH 31)



DETAIL TREE PROTECTION

N.T.S.

Tree Protection Signs:

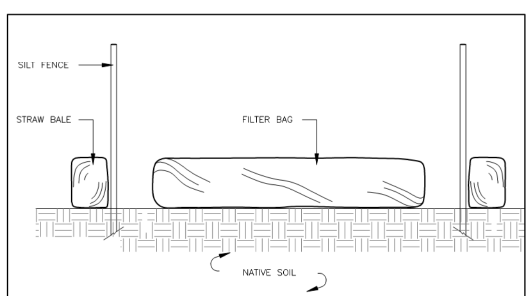
Tree protection signs shall be installed on the Tree Protection Fence. Sign must be 40cm x 60cm, installed on the fence with a maximum spacing of 25m. Sign shall read as follows:

Tree Protection Zone (TPZ)

All construction related activities, including grade alteration, excavation, soil compaction, any materials or equipment storage, disposal of liquid and vehicular traffic are NOT permitted within this TPZ.

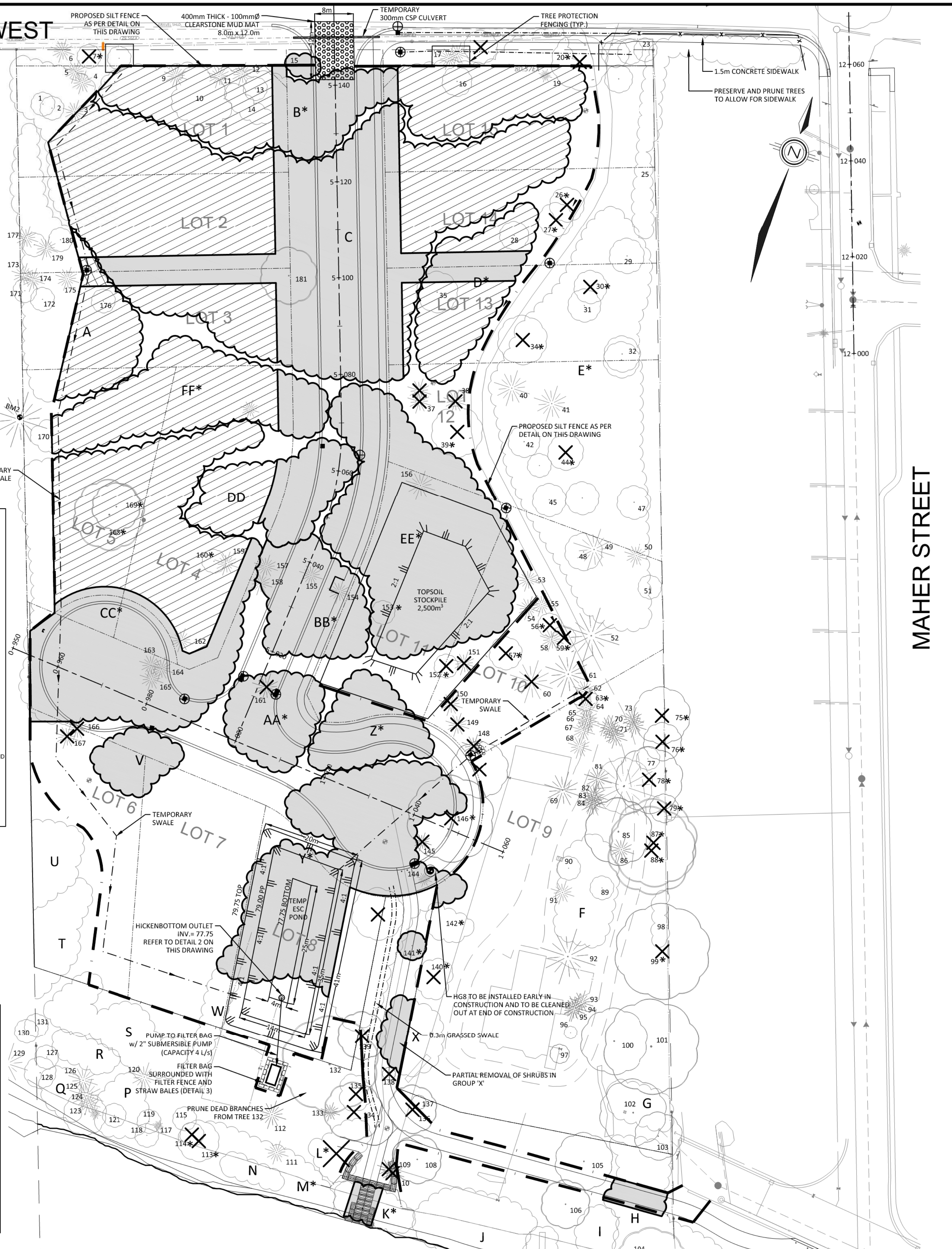
This tree protection barrier must remain in good condition and must not be removed or altered without authorization of Town of Cobourg, Parks Department - Forestry Section.

Concerns or inquiries regarding this TPZ can be directed to: 905-372-1005



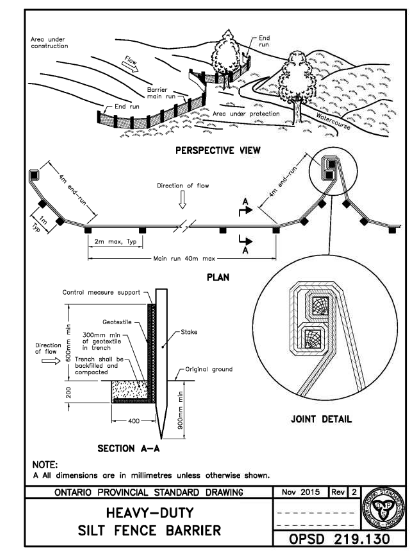
DETAIL 3:
SECTION FILTER BAG

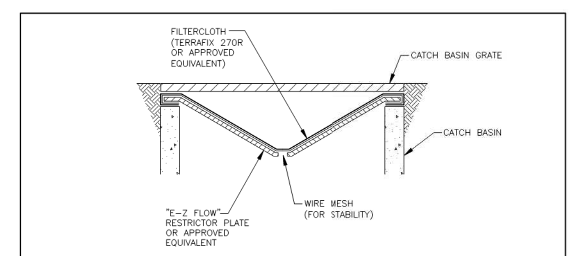
N.T.S.



LEGEND

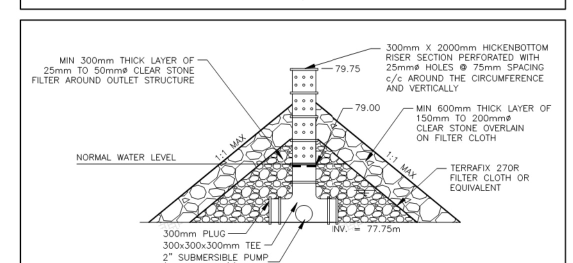
- PROPERTY LINE
- TREE PROTECTION FENCING OPSD 220.010
- TREE PROTECTION FENCING OPSD 220.010 WITH SILT FENCE OPSD 219.130
- CATCHBASIN FILTER BUFFER SEE DETAIL 1
- ROCK CHECK DAM
- MUD MAT
- HICKENBOTTOM SEE DETAIL 2
- EXISTING TREE/TREE GROUP TO REMAIN
- STAGE 1 CLEARING AND GRUBBING
- STAGE 2 CLEARING AND GRUBBING
- TREE REMOVAL STAGE 1
- EXISTING ASH TREE TO BE REMOVED STAGE 1
- GROUP OF TREES STAGE 1 (ASH TREES WITHIN GROUP TO BE REMOVED)
- TEMPORARY SWALE





CATCHBASIN FILTER DETAIL 1

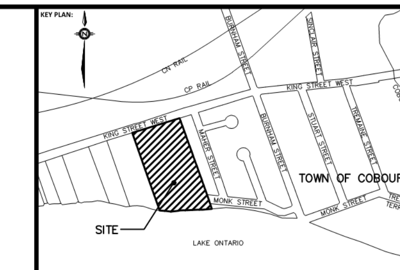
N.T.S.



HICKENBOTTOM OUTLET STRUCTURE DETAIL 2

N.T.S.

KEY PLAN:



BENCHMARK:

BM 2 80.681

TOP OF SPIKE IN EAST FACE OF 0.4m CEDAR.

BM 3 81.305

TOP OF SOUTH HUB OF HYDRANT ON THE NORTH SIDE OF KING ST.W. APPROXIMATELY 24m WEST OF HYDRO POLE MARKED S4-60.

CIMA+
Partners in excellence
55 King Street East
Bowmanville ON L1C 1N4
Phone: 905 697-4464
Fax: 905 697-0443
www.cima.ca

CLIENT:

EIE CORPORATION

PROJECT NAME:

CEDAR SHORE ESTATES

STAMPS:

R. D. CRESSMAN 100150917 06-Dec-2017 PROVINCE OF ONTARIO — DESIGNED BY

W. G. McCRAE Dec 8, 2017 PROVINCE OF ONTARIO — APPROVED BY

No.	Date	Description	By
3.	12/08/2017	ISSUED FOR 2ND SUBMISSION	RC
2.	05/17/2017	ISSUED FOR 1ST SUBMISSION	RC
1.	01/25/2017	PRE-CONSULTATION MEETING	RC

SHEET TITLE:

EROSION, SEDIMENT CONTROL, TREE REMOVAL & TREE PRESERVATION PLAN

DISCIPLINE: INFRASTRUCTURE

SCALE: HORIZONTAL : 1:500

PROJECT No: C14-0011	CLIENT File No:
DRAFTER: K. ALLEN / DESIGNER: P. MERRETT	DRAWING No: ESC
APPROVER: R. CRESSMAN / APPROVER: W. McCRAE	
DATE: JULY 16, 2015	SHEET No: 3 of 19

LEGEND

81.40	FINISHED FLOOR ELEVATION
78.50	MINIMUM BASEMENT ELEVATION
× 81.22	PROPOSED ELEVATION
×80.88EX	EXISTING ELEVATION
	NATURALIZED AREA
	REAR YARD SWALE
F	FRONT DRAINAGE
S/D	SPLIT DRAINAGE
B/S	BACK SPLIT
W/O	WALKOUT

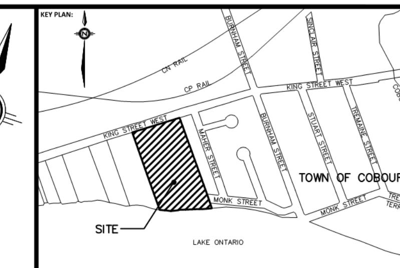
ALL ROOF DRAINS TO DISCHARGE TO GRASSED AREAS AND MUST BE DIRECTED TO ROADWAY

THE MINIMUM DRIVEWAY LENGTH FROM PROPERTY LINE TO THE FACE OF BUILDING IS 6.0m

NO FOUNDATION DRAINS CAN BE CONNECTED TO REAR YARD SEWER

FOUNDATION DRAINS TO BE CONNECTED TO MAIN SEWER ONLY, AS SHOWN ON PLAN AND PROFILE DRAWINGS

KEY PLAN:



BENCHMARK:

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www.cima.ca

CLIENT:

EIE CORPORATION

PROJECT NAME:

CEDAR SHORE ESTATES

STAMPS:

LICENSED PROFESSIONAL ENGINEER R. D. CRESSMAN 100150917 06-Dec-2017 PROVINCE OF ONTARIO

DESIGNED BY

LICENSED PROFESSIONAL ENGINEER W. G. McCRAE Dec 8, 2017 PROVINCE OF ONTARIO

APPROVED BY

No.	Date	Description	By
3.	12/08/2017	ISSUED FOR 2ND SUBMISSION	RC
2.	05/17/2017	ISSUED FOR 1ST SUBMISSION	RC
1.	01/25/2017	PRE-CONSULTATION MEETING	RC

SHEET TITLE:

GRADING PLAN

DISCIPLINE:

INFRASTRUCTURE

SCALE:

HORIZONTAL : 1:500

PROJECT No: C14-0011	CLIENT File No:
DRAFTER: K.ALLEN	DESIGNER: P. MERRETT
APPROVER: R.CRESSMAN	APPROVER: W. McCRAE
DRAWING No: G-1	
DATE: DECEMBER 13, 2016	SHEET No: 4 of 19

APPENDIX E
STORMWATER MANAGEMENT CALCULATIONS

HYDROGUARD OIL GRIT SEPARATOR SIZING
HYDROGAURD MAINTENANCE MANUAL

Canadian Infrastructure Products

Hydroguard Separator Design Summary

King St West Village Development
EIE Corporation
Cobourg, Ontario

Prepared for:
CIMA

September 1, 2016

Introduction

A Hydroguard separator is proposed to provide stormwater quality for the King Street West Village Development in Cobourg. It was sized using Hydroguard's continuous simulation sizing program to meet the MOE's "Enhanced Protection" criteria capturing a minimum of 80% of the annual TSS load and treating a minimum of 90% of the annual run-off. The sizing program has been calibrated to independent lab testing conducted on a full scale Hydroguard unit. The sizing program is available at http://www.hydroworks.com/hydroguard.html#. Hydroguard is a Canadian technology.

The Hydroguard separator proposed for this project was sized to capture a PSD consistent with the MOE's 1994 Stormwater Management Guidelines. A detailed breakdown of the PSD is below.

Particle Size Distribution (PSD)

µm	%
20	20
60	20
150	20
400	20
2000	20

As the sizing simulation shows on page 9, an HG 5 (1500mm diameter) would meet the MOE requirements. In order to reduce the depth of the unit to avoid conflict with bedrock, a larger diameter structure is proposed with a reduced depth.

Drainage Data

Drainage Area Size (ha)	Imperviousness (%)	Hydroguard Unit Proposed	Annual TSS Removal	Net Annual Volume Treated
2.36 ha	35	***HG 8m****	88%	99%

the modified HG 8 unit has a sump depth of 1300mm. See drawing on page 11

Hydroguard Dimensions and Capacities

Table 1. Hydroguard Separator Dimensions for this project

Model	Structure Inside Diam. (SID) (mm)	NJDEP Certified Flow Rate (l/s)	Sediment Depth Requiring Maintenance (litres)	Oil/Floating Trash Volume* [litres]	Permanent Pool Wet Volume* (litres)
HG 8	2400	91	350mm (1,580)	1730	5,881

-Sediment and oil storage volumes can be easily modified for increased capacity

The values in Table 1 are a guideline. The internal baffles are customized for each project depending on pipe diameter, slope, and the depth of inlet pipe below grade. Accordingly, the values of sediment storage and oil storage can be expected to vary slightly from project to project.

Hydroguard Operation

The Hydroguard (HG) separator is unique since it treats both high and low flows in one device, but maintains separate flow paths for low and high flows. Accordingly, high flows do not scour out the fines that are settled in the low flow path since they are treated in a separate area of the device as shown in Figure 1.

The Hydroworks HG separator consists of three chambers:

1. an inner chamber that treats low or normal flows
2. a middle chamber that treats high flows
3. an outlet chamber where water is discharged to the downstream storm system

The water leaving the inner chamber continues into the middle chamber, again at a tangent to the wall of the structure. The water is then conveyed through an outlet baffle wall (high and low baffle). This enhances the collection of any floatables or suspended solids not removed by the inner chamber. Water flowing through the baffles then enters the outlet chamber and is discharged into the downstream storm drain.

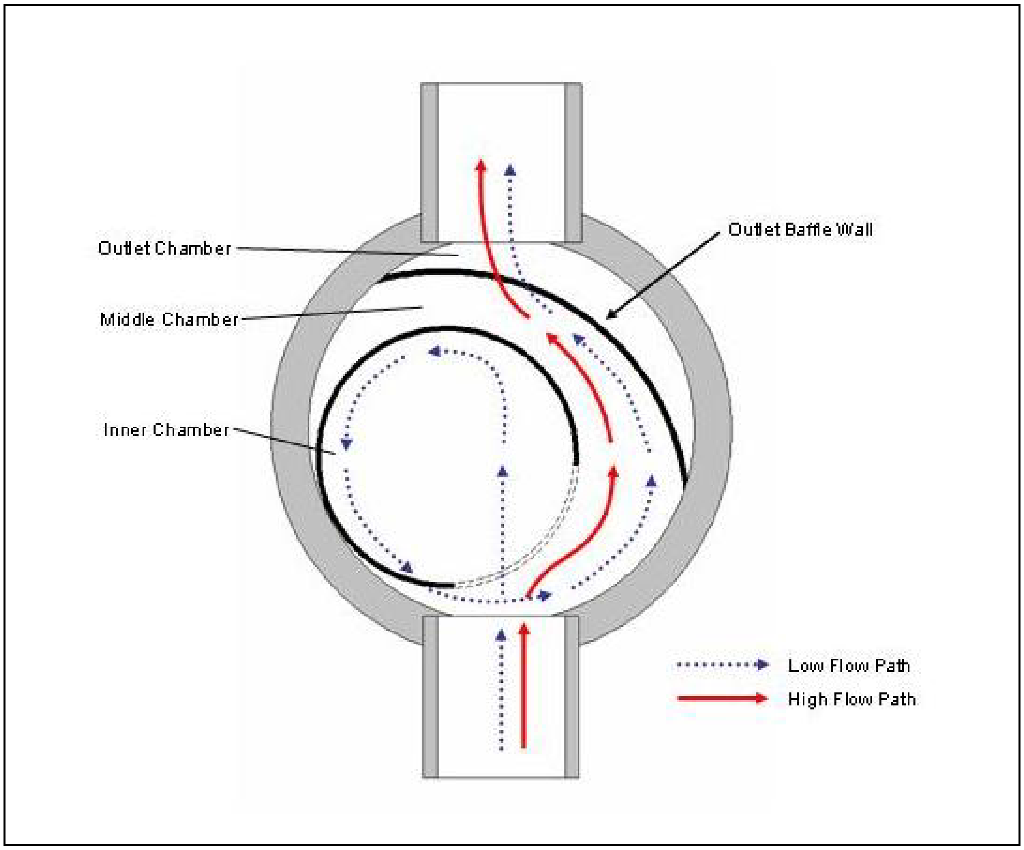


Figure 1. Hydroworks HG Operation – Plan View

During high flows, the flow rate entering the inner chamber is restricted by the size of the inlet opening to the inner chamber. This restriction of flow rate into the inner chamber prevents scour and re-suspension of solids from the inner chamber during periods of high flow. High flows are conveyed directly into the middle chamber where they receive treatment for floatables and solids via the baffle system. This treatment of the higher flow rates is important since trash and heavier solids are typically conveyed during periods of higher flow rates.

The Hydroworks HG separator is revolutionary since it incorporates low and high flow treatment in one device while maintaining separate low and high flow paths to prevent the scour and re-suspension of fines.

Figure 2 is a profile view of Hydroworks HG separator showing the flow patterns for low and high flows.

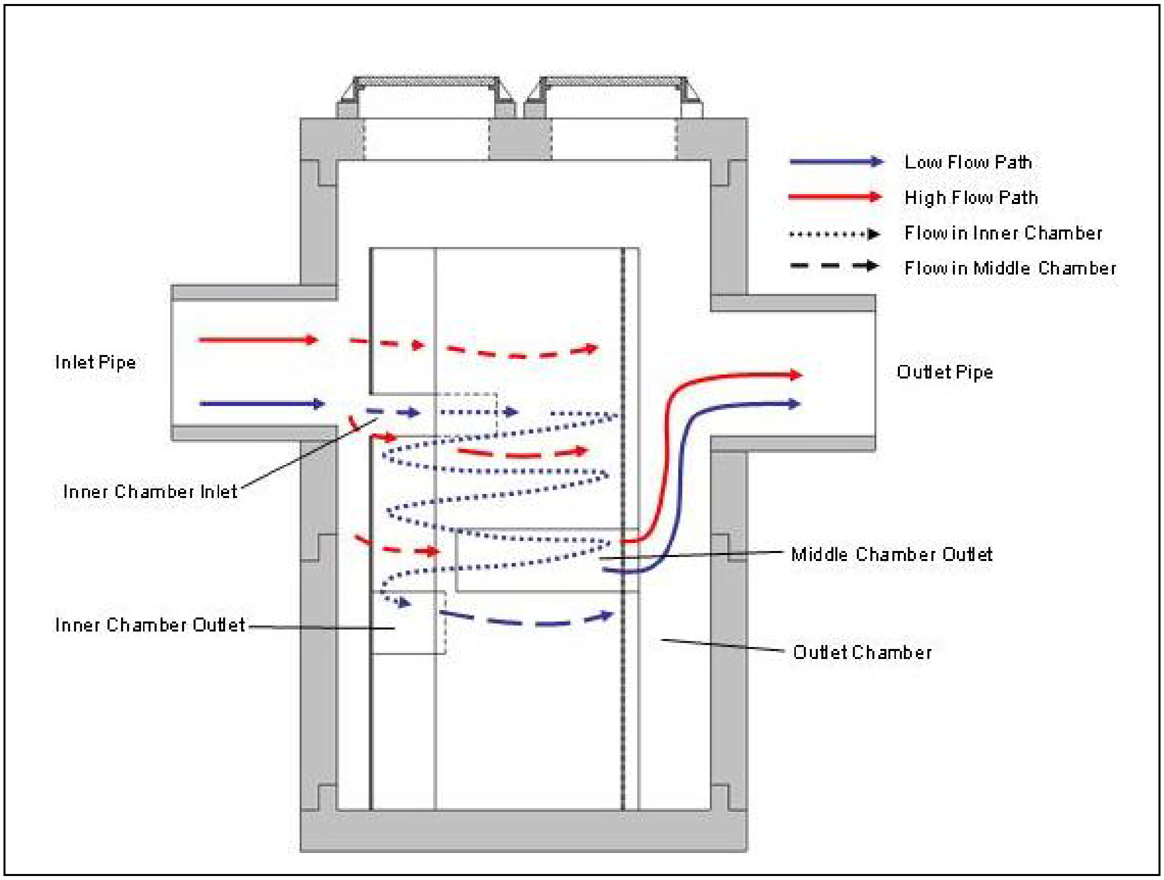


Figure 2. Hydroworks HG Operation – Profile View

Construction Materials

The inner chamber and outlet baffle are made out of a copolymer plastic. The shell of the structure is pre-cast concrete made to OPS specifications. All municipalities readily accept pre-cast concrete since it has the following advantages:

- Made from standard maintenance hole components
- Long service life
- Ease of installation (less dependent on backfill (contractor proficiency) for structural integrity)
- Concrete structures are designed for both anti-buoyancy and traffic loading without any field requirements (such as structural loading slabs in traffic areas and anti-buoyancy slabs to prevent groundwater uplift).
- Low maintenance requirements

Headloss

Any water quality system implemented in a storm drain network will create headloss in the system. In general, depending on the configuration of the by-pass, systems designed to treat high flows or all of the flow will have a higher headloss impact on the storm drain network than systems that by-pass high flows.

The headloss created by the HG separator was measured in an independent laboratory (Alden Research Laboratory) for a full scale HG6. The K value ($h = K\ v^2/(2g)$) for headloss calculations was determined to be 1.09 for full pipe flow. Hydroworks recommends using a K value of 1.6 for all flows (free flow, full pipe, pressure flow) to be conservative.

TSS Removal Calculations for the Specified System

Hydroworks sizes separators based on continuous modeling of rainfall, runoff, TSS buildup, TSS washoff, TSS settling and TSS transport through the system.

The continuous simulation model is based on SWMM 4.4. The model uses the buildup and washoff models directly from SWMM. Settling was calculated using the washoff load and flow rate from SWMM each timestep (5 minutes) and laboratory settling (Alden 2008) for dynamic (flowing water) and Cheng's equation for quiescent (inter-event) time periods with the specified particle size distribution.

TSS removal calculations in the sizing program are based on the Hydroguard being a completely mixed reactor vessel. The removal calculations solve a first order differential equation for the concentration of solids in the tank at any time. The first order differential equation is for continuity of mass.

$$C'V = QC_i - QC_t - r_cV$$

C' = the change in concentration of solids in the tank with time
Q = flow rate through the tank
C_i = solids concentration in the influent to the tank
C_t = solids concentration in the tank
V = tank volume
r_c = reduction in solids in the tank (theoretical (Stokes law) settling or laboratory performance curve

Continuous simulation provides the most accurate way of estimating performance possible since it takes into account:

- The effect of flow rate (detention time) on settling
- Back to back storms
- Pollutant buildup and washoff
- Inter-event settling.

The independent laboratory testing (Alden Research Laboratory, 2008) conducted on the Hydroguard using the NJDEP particle size distribution is provided in Figure 3.

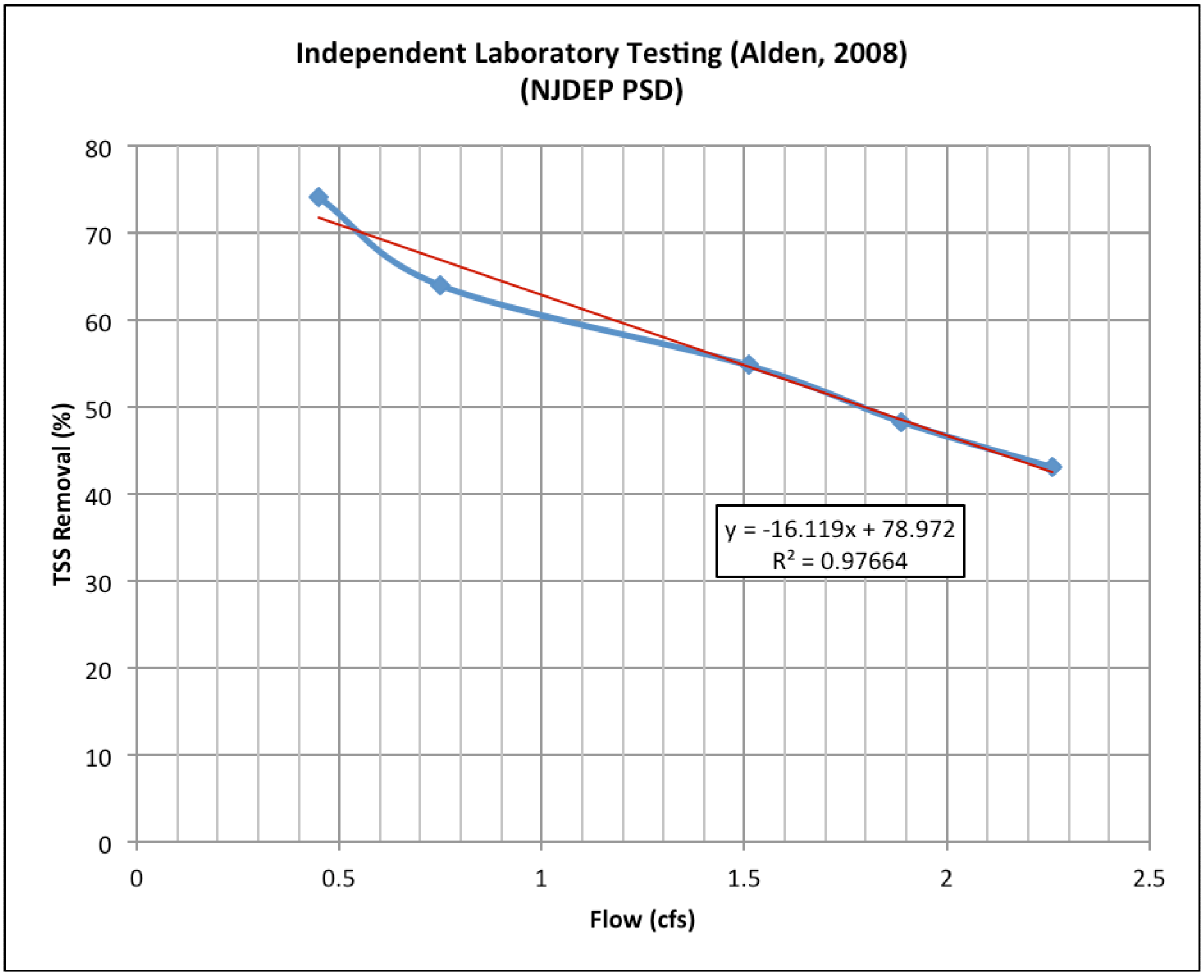


Figure 3. Independent Laboratory Results (Alden, 208)

Figure 4 shows the NJDEP particle size distribution tested by Alden on the HG6.

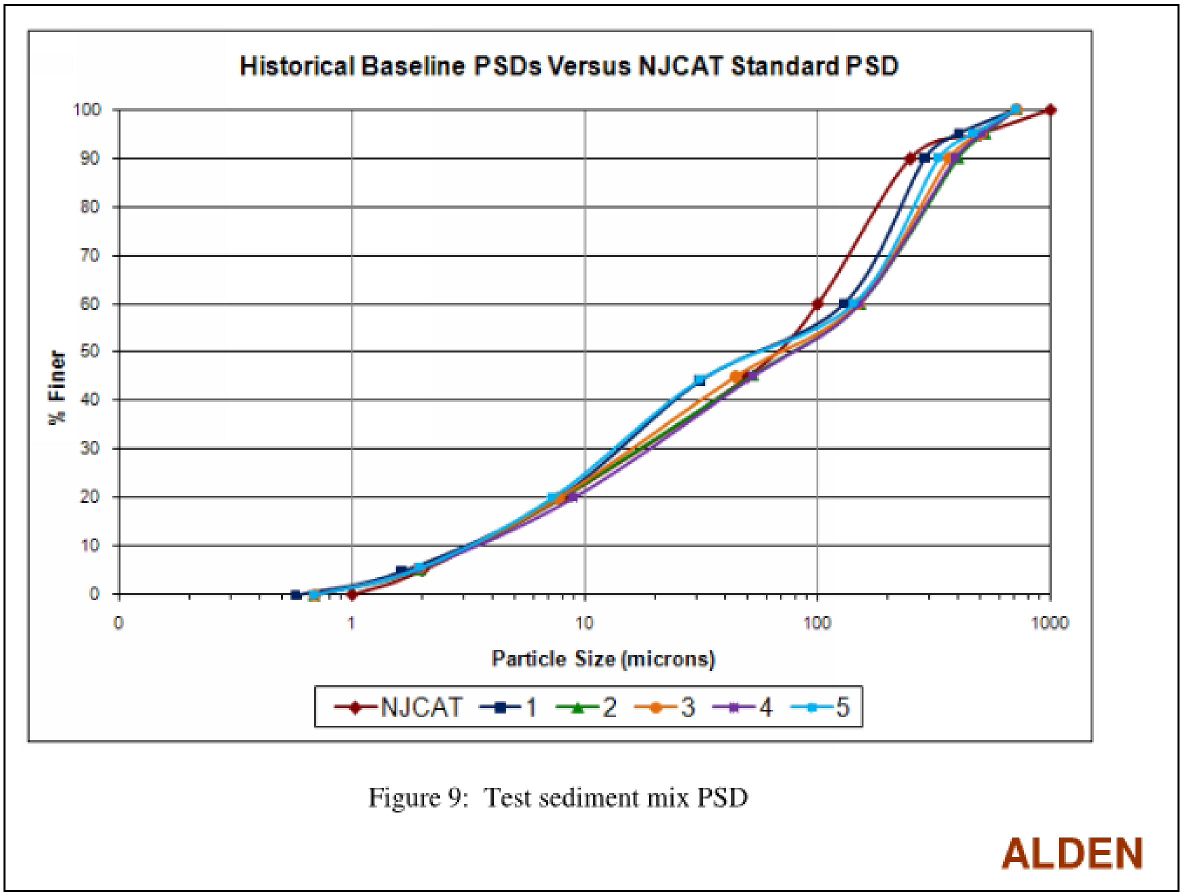


Figure 4. Independent Testing Particle Size Distribution

The model uses the Peclet Number to calculate TSS removal based on the independent laboratory testing. The Peclet number has been used as a dimensionless scaling number for sediment deposition in lakes (Dhamotharan, et. Al. 1981). Others have suggested its use for scaling of TSS removal results for hydrodynamic separators (Dhanak, 2008, Gulliver, Guo and Wu, 2008).

The Peclet number is the ratio of convection (convective settling) to diffusion (turbulence keeping particles in suspension). The Peclet number (Equation 1) varies with the size of separator, particle size of TSS, and flow rate.

$$Pe = V_s\, h\, d / Q \qquad \text{Equation 1}$$

Where Pe = Peclet number
Vs = settling velocity
h = depth of separator sump
d = separator diameter
Q = flow rate

A particle will be removed in the separator if the Peclet number is equal to, or greater than, the Peclet number calculated for removal of that particle based on the independent laboratory results. Based on the NJDEP PSD in Figure 4, the TSS removal in Figure 3, and the dimensions of the tested HG 6, critical Peclet Numbers can be calculated for each particle size in Figure 4 (critical Peclet number is the Peclet Number above which the particle is removed). A critical Peclet Number curve was then developed and input to the model (Figure 5).

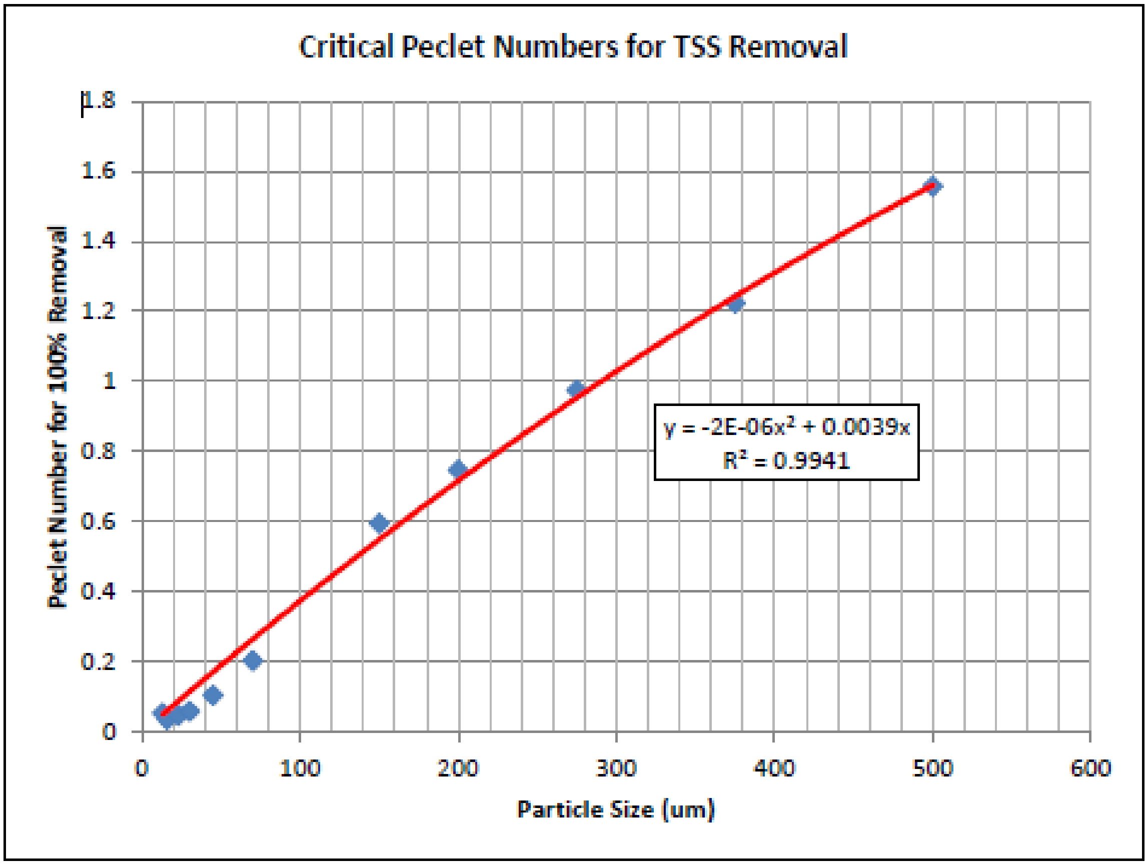


Figure 5. Critical Peclet Number Curve

At each timestep the Peclet Number is calculated for every flow and every Hydroworks separator for each particle size in the design particle size distribution. The calculated Peclet Number is then compared to the Critical Peclet Number to determine if the particle is removed at that timestep or not (removed if the calculated Peclet Number is greater than the Critical Peclet Number and not removed if less than the Critical Peclet Number). These calculations are done for the entire rainfall record to determine an overall TSS removal percentage.

Hydroworks added a Peclet routine to the USEPA SWMM model to determine TSS removal based on the Peclet number calibrated to the independent laboratory testing completed by Alden Research Laboratory in Holden, MA in 2008. A paper describing the Peclet sizing model is available as well as the independent laboratory testing completed by Alden Labs. Figure 6 shows the calibrated model results compared to the independent laboratory testing results from Alden Labs for a Hydroguard HG6 based on the NJDEP (NJCAT) particle size distribution used by Alden for testing purposes.

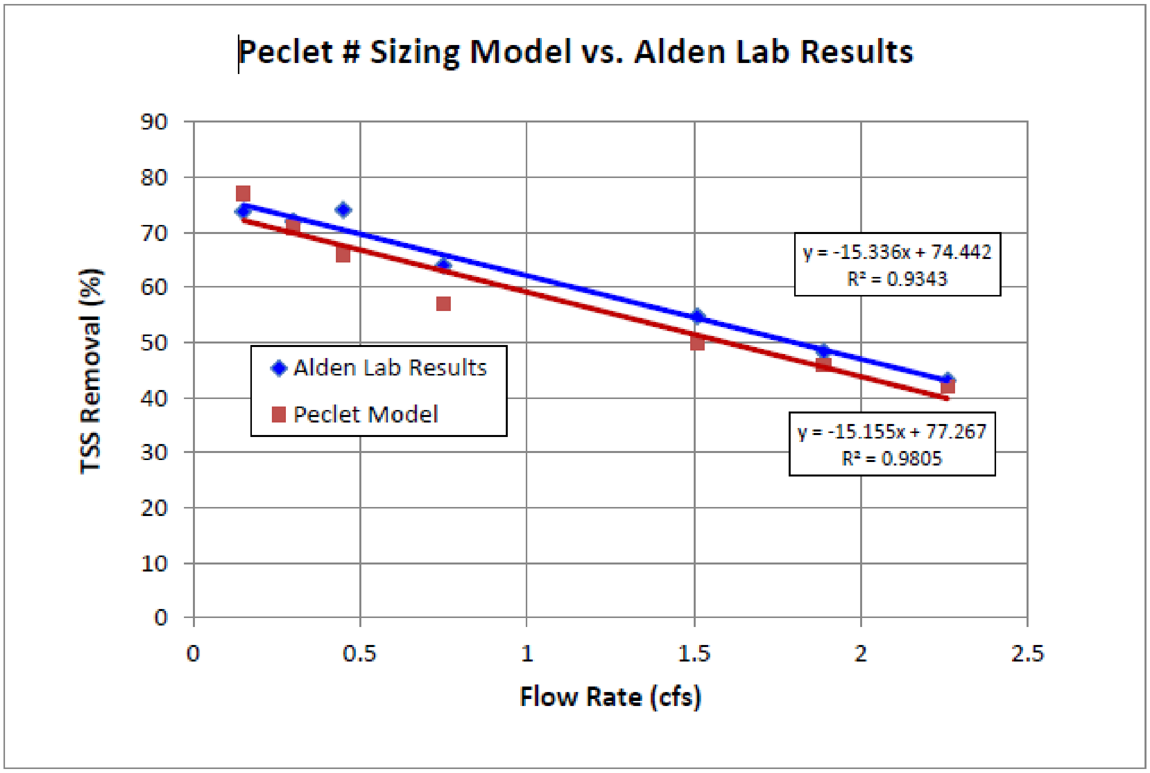
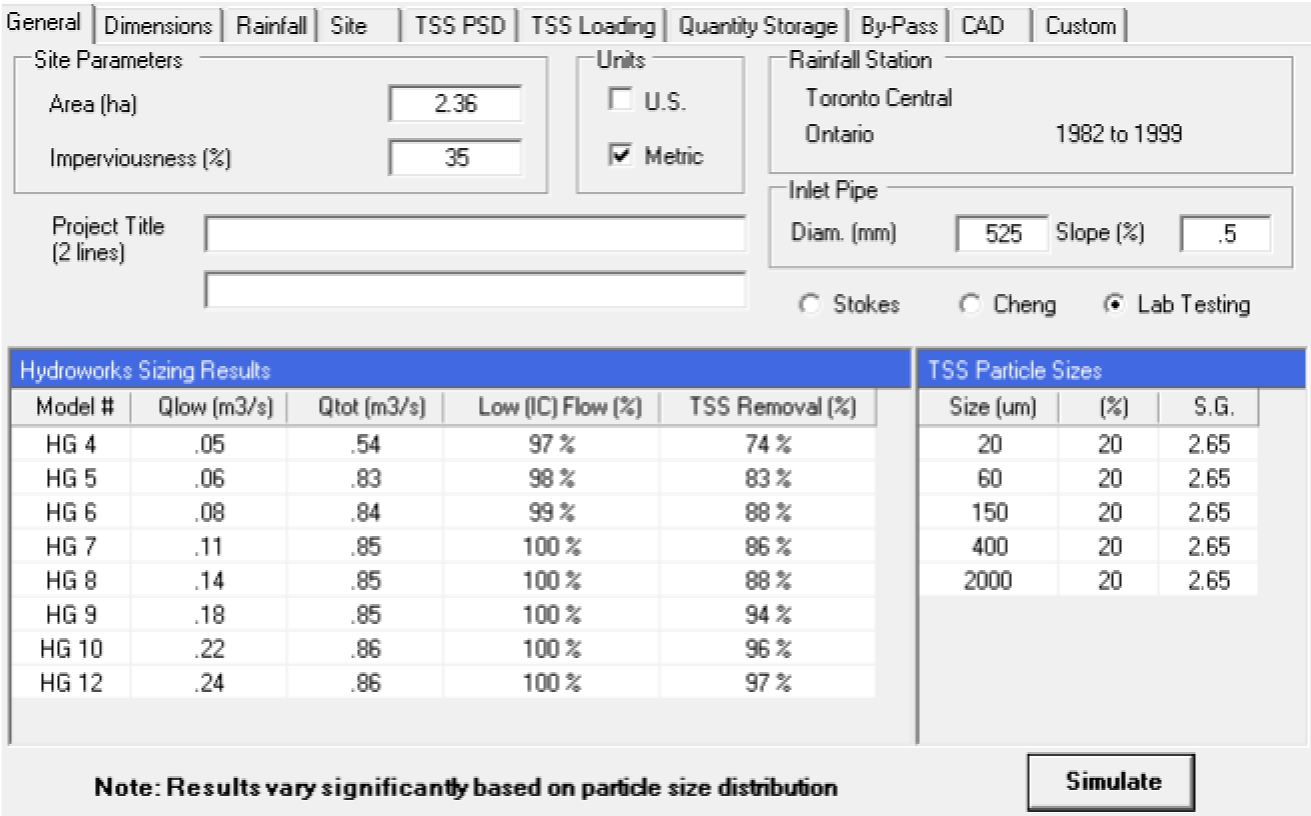


Figure 6. Independent Laboratory TSS Removal Performance versus Peclet Sizing Model

The use of the Peclet Number allows Hydroworks to size the Hydroguard based on any particle size and design storm or local hydrology.

<u>Sizing Results</u>

A summary of the sizing simulation is provided below.
A Hydroguard HG 8m separator will capture 88% of the annual TSS load for a particle size distribution (PSD) consistent with the MOE's 1994 Stormwater Management Guidelines. A breakdown of the PSD is in the sizing summary below.



Model #	Qlow (m3/s)	Qtot (m3/s)	Low (IC) Flow (%)	TSS Removal (%)
HG 4	.05	.54	97 %	74 %
HG 5	.06	.83	98 %	83 %
HG 6	.08	.84	99 %	88 %
HG 7	.11	.85	100 %	86 %
HG 8	.14	.85	100 %	88 %
HG 9	.18	.85	100 %	94 %
HG 10	.22	.86	100 %	96 %
HG 12	.24	.86	100 %	97 %

Size (um)	(%)	S.G.
20	20	2.65
60	20	2.65
150	20	2.65
400	20	2.65
2000	20	2.65

Maintenance Requirements

Based on data from the National Stormwater Quality Database in the U.S., *(http://rpitt.eng.ua.edu/Publications/Stormwater%20Characteristics/NSQD%20EPA.pdf).*
The average concentration of TSS in stormwater run-off was 125 mg/litre, regardless of land use. Therefore the estimated annual captured solids load will be:

Unit	Recommended Sediment Depth for Maintenance	Estimated Annual captured Solids
HG 8	350mm (1.58m^3)	0.29m^3

The maintenance manual is available at http://www.hydroworks.com/hgmaintenance.pdf
A post-installation inspection and 2 annual inspections are included with every Hydroguard unit.

Approvals

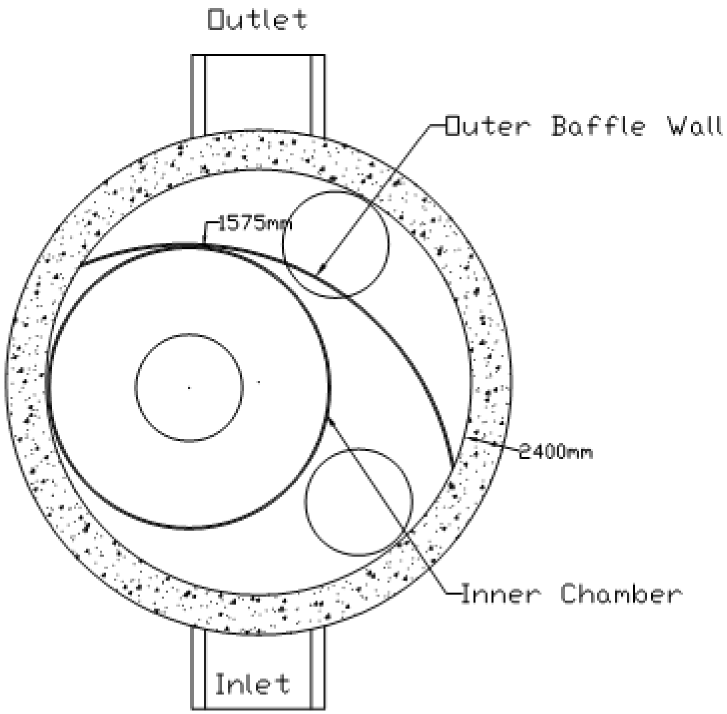
Hydroguard has received the MOE's NETE Certification and been approved for use in Ontario by the Ontario Provincial Standards-Product Management Committee. It is NJCAT verified and NJDEP certified.

Contacts

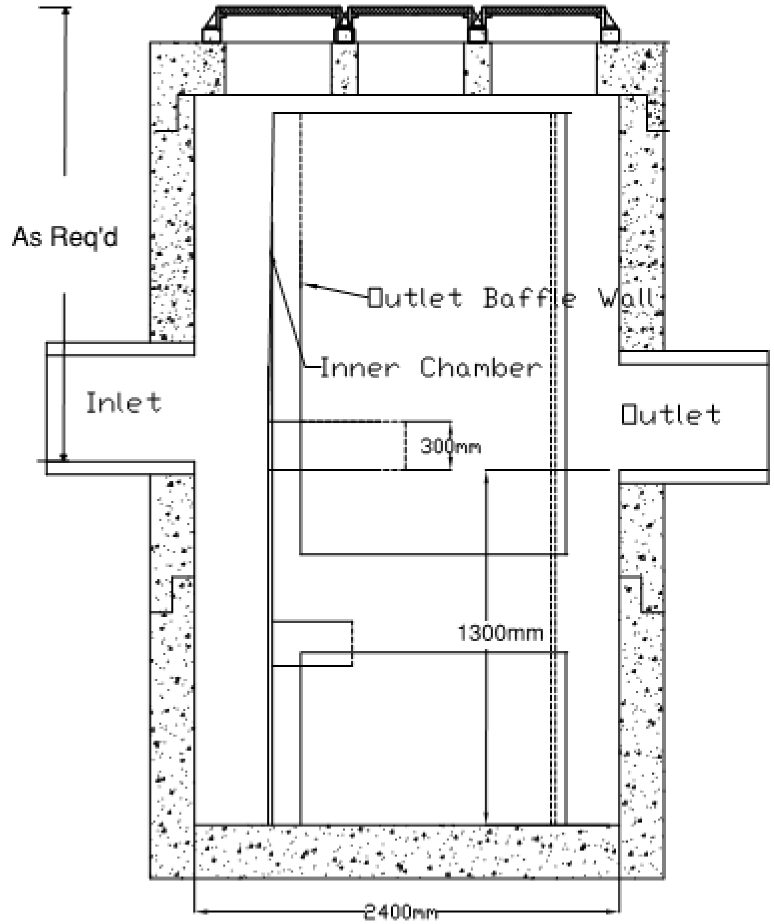
Hydroguard units are 100% Canadian. They are manufactured by Con Cast Pipe (Guelph, Ontario) and DeCast Ltd (Utopia, Ontario). Please call CIP @ (519) 212-9161 with any questions or visit our website at www.c-i-p.ca.

APPENDIX 1

CAD Drawing



Plan



Profile

Permanent Pool Volume = 5,881 litres
The Hydroguard must be cleaned after the construction period if it is used as a sediment and erosion control measure
The Hydroguard should be inspected once per year for stabilized sites
Inspection will determine the maintenance frequency (annual maintenance or once every two years typical for stabilized sites)
Sites with unstable conditions (exposed soil or materials storage) will require more frequent inspection and maintenance

Canadian Infrastructure Products
44 Spooner Crescent, Cambridge, Ontario N1t 1X3
(519) 212-9161 www.c-i-p.ca

Hydroworks, LLC
50 S. 21st St., Kenilworth, NJ 07033
Phone: 888-290-7900 Fax: 888-783-7271
Web: www.hydroworks.com

Can Patent No. 2,536,300

U.S. Patent No. 6,951,619

Hydroworks HG8 (2400mmØ)
PROJECT: King St West Village
LOCATION: Cobourg, Ontario
DATE: September 1, 2016

Hydroworks

Hydroworks® Hydroguard

Maintenance Manual

Version 1.3

Introduction

The Hydroguard is a state of the art hydrodynamic separator. Hydrodynamic separators remove solids, debris and lighter than water (oil, trash, floating debris) pollutants from stormwater. Hydrodynamic separators and other water quality measures are mandated by regulatory agencies (Town/City, State, Federal Government) to protect storm water quality from pollution generated by urban development (traffic, people) as part of new development permitting requirements.

As storm water treatment structures fill up with pollutants they become less and less effective in removing new pollution. Therefore it is important that storm water treatment structures be maintained on a regular basis to ensure that they are operating at optimum performance. The Hydroguard is no different in this regard and this manual has been assembled to provide the owner/operator with the necessary information to inspect and coordinate maintenance of their Hydroguard.

Hydroworks® HG Operation

The Hydroworks HG separator is unique since it treats both high and low flows in one device, but maintains separate flow paths for low and high flows. Accordingly, high flows do not scour out the fines that are settled in the low flow path since they are treated in a separate area of the device as shown in Figure 1.

The HG separator consists of three chambers:

1. an inner chamber that treats low or normal flows
2. a middle chamber that treats high flows
3. an outlet chamber where water is discharged to the downstream storm system

Under normal or low flows, water enters the middle chamber and is conveyed into the inner chamber by momentum. Since the inner chamber is offset to one side of the structure the water strikes the wall of the inner chamber at a tangent creating a vortex within the inner chamber. The vortex motion forces solids and floatables to the middle of the inner chamber. The water spirals down the inner chamber to the outlet of the inner chamber which is located below the inlet of the inner chamber and adjacent to the wall of the structure but above the floor of the structure. Floatables are trapped since the outlet of the inner chamber is submerged. The design maximizes the retention of settled solids since solids are forced to the center of the inner chamber by the vortex motion of water while the outlet of the inner chamber draws water from the wall of the inner chamber.

The water leaving the inner chamber continues into the middle chamber, again at a tangent to the wall of the structure. The water is then conveyed through an outlet baffle wall (high and low baffle). This enhances the collection of any floatables or solids not removed by the inner chamber. Water flowing through the baffles then enters the outlet chamber and is discharged into the downstream storm drain.

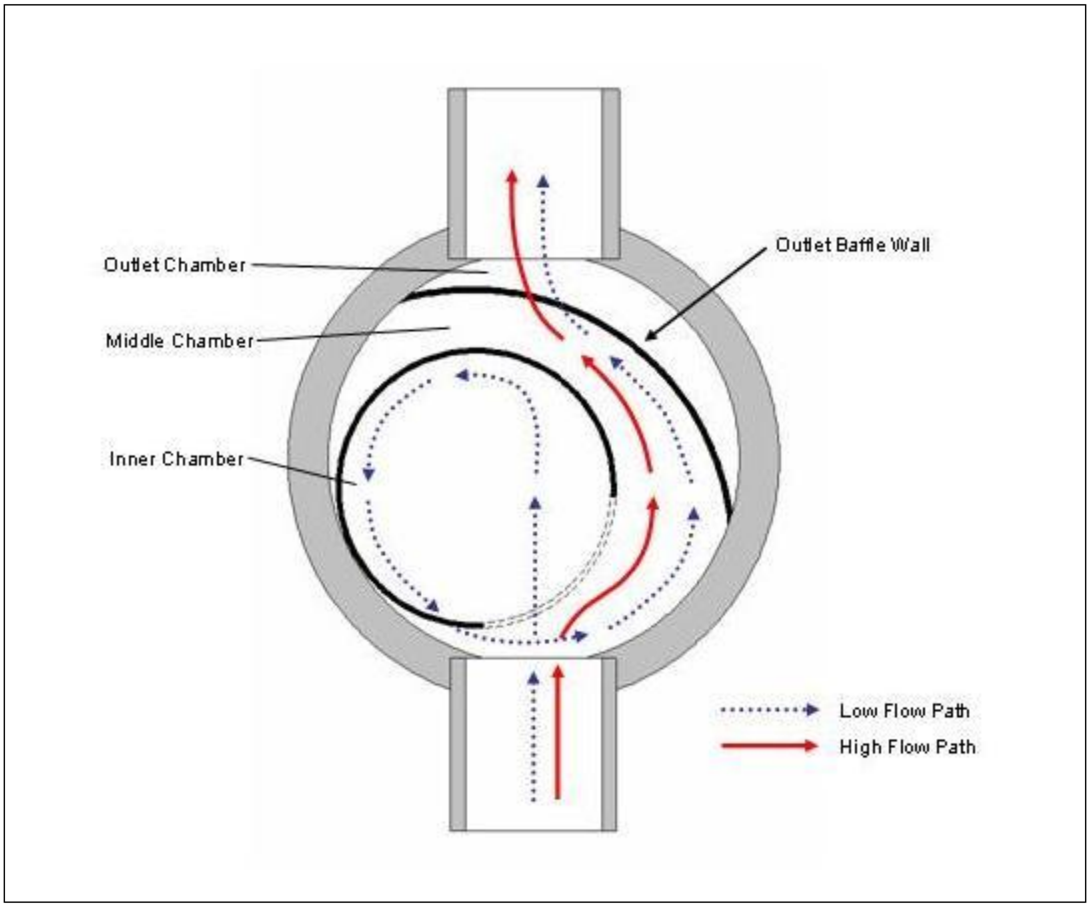


Figure 1. Hydroworks HG Operation – Plan View

During high flows, the flow rate entering the inner chamber is restricted by the size of the inlet opening to the inner chamber. This restriction of flow rate into the inner chamber prevents scour and re-suspension of solids from the inner chamber during periods of high flow. This is important since fines, which are typically considered highly polluted, are conveyed during low/normal flows.

The excess flow is conveyed directly into the middle chamber where it receives treatment for floatables and solids via the baffle system. This treatment of the higher flow rates is important since trash and heavier solids are typically conveyed during periods of higher flow rates. The Hydroworks HG separator is revolutionary since it incorporates low and high flow treatment in one device while maintaining separate low and high flow paths to prevent the scour and re-suspension of fines.

Figure 2 is a profile view of the HG separator showing the flow patterns for low and high flows.

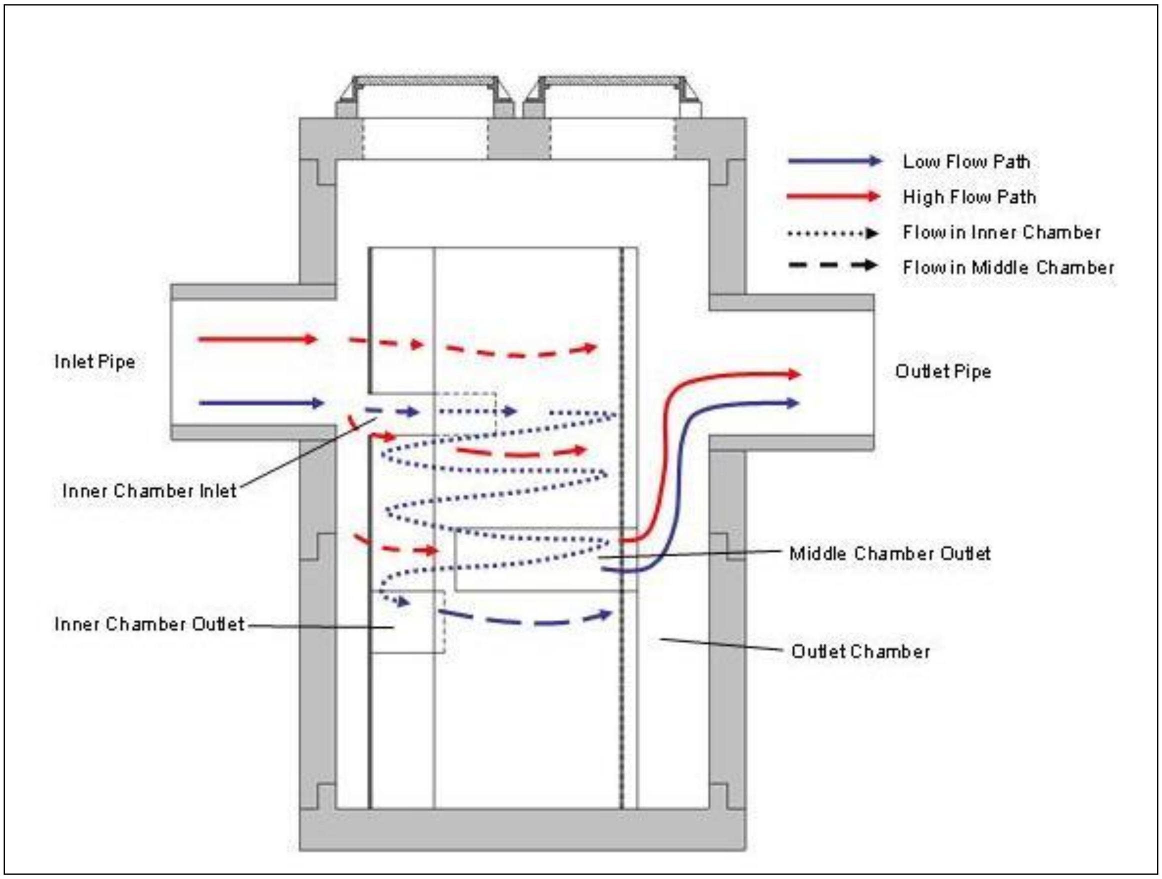
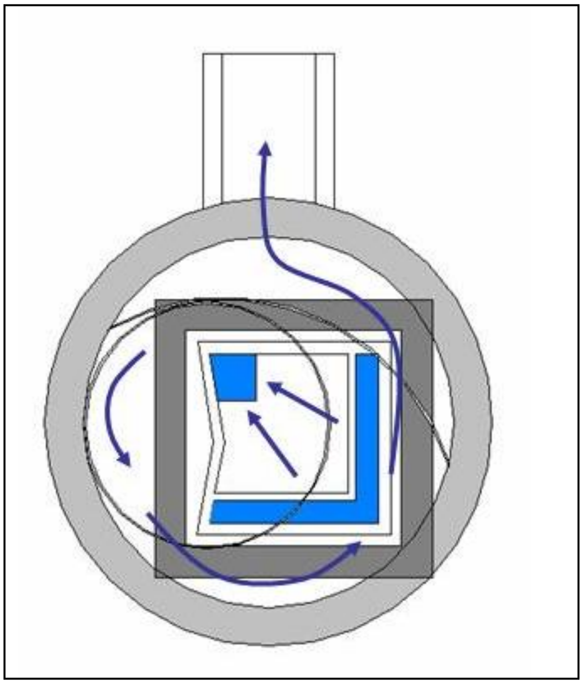


Figure 2. Hydroworks HG Operation – Profile View

The HG 4i is an inlet version of the HG 4 separator. There is a catch-basin grate on top of the HG 4i. Water flows directly into the inner chamber of the HG 4i through the catch-basin grate on top of the structure. The grate is oversized to allow maintenance of the entire structure. A funnel that sits underneath the grate on the top cap of the concrete itself directs the water into the inner chamber during normal flows and the middle chamber during high flows. Figures 3 and 4 show the flow paths for the HG 4i separator.

The inlet funnel is sloped towards the corner inlet and hence the wall of the inner chamber. Water moves in a circular direction in the inner chamber since water enters tangentially along the wall of the inner chamber due to the sloping funnel.

Water continues moving in a circular motion (vortex) through the rest of the structure (through the middle chamber and baffle wall) until it is discharged from the separator.



During periods of peak flow the water will back up from the corner inlet and overflow into two side overflow troughs which discharge directly into the middle chamber. These overflow troughs are covered from the surface such that water cannot directly fall through them (i.e. water must back up to enter the overflow troughs).

Accordingly this funnel provides the same separate flow paths for low and high flow as the other Hydroguard separators.

The whole funnel is removed for inspection and cleaning providing.

Figure 3. Hydroworks Hydroguard HG 4i Normal Flow Path

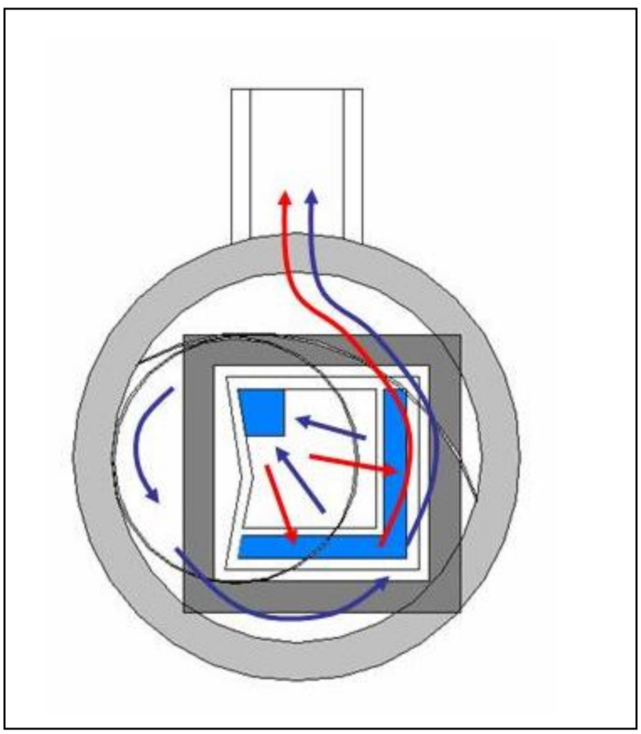


Figure 4. Hydroworks Hydroguard HG 4i Peak Flow Path

Inspection

Procedure

Although all parts of the Hydroguard should be inspected, inspection and maintenance should focus on the inner and middle chambers since this is where the pollutants (floatable and sinking) will accumulate.

Floatables

A visual inspection can be conducted for floatables by removing the covers and looking down into the separator. Multiple covers are provided on Hydroworks HG units to access all areas of the separator (The HG 4 may have a single larger 32” (800mm) cover due to the lack of space for multiple 24” (600mm) covers).

TSS/Sediment

Inspection for TSS build-up can be conducted using a Sludge Judge®, Core Pro®, AccuSludge® or equivalent sampling device that allows the measurement of the depth of TSS/sediment in the unit. These devices typically have a ball valve at the bottom of the tube that allows water and TSS to flow into the tube when lowering the tube into the unit. Once the unit touches the bottom of the device, it is quickly pulled upward such that the water and TSS in the tube forces the ball valve closed allowing the user to see a full core of water/TSS in the unit. The unit should be inspected for TSS through each of the access covers. Several readings (2 or 3) should be made at each access cover to ensure that an accurate TSS depth measurement is recorded.

Frequency

Construction Period

The HG separator should be inspected every two weeks and after every large storm (over 0.5” (12.5 mm) of rain) during the construction period.

Post-Construction Period

The Hydroworks HG separator should be inspected once per year for normal stabilized sites (grassed or paved areas). If the unit is subject to oil spills or runoff from unstabilized (storage piles, exposed soils) areas the HG separator should be inspected more frequently (4 times per year). An initial annual inspection will indicate the required future frequency of maintenance if the unit was maintained after the construction period.

Reporting

Reports should be prepared as part of each inspection and include the following information:

1. Date of inspection
2. GPS coordinates of Hydroworks unit
3. Time since last rainfall
4. Date of last inspection
5. Installation deficiencies (missing parts, incorrect installation of parts)
6. Structural deficiencies (concrete cracks, broken parts)
7. Operational deficiencies (leaks, blockages)
8. Presence of oil sheen or depth of oil layer
9. Estimate of depth/volume of floatables (trash, leaves) captured
10. Sediment depth measured
11. Recommendations for any repairs and/or maintenance for the unit
12. Estimation of time before maintenance is required if not required at time of inspection

A sample inspection checklist is provided at the end of this manual.

Maintenance

Procedure

The Hydroworks HG unit is typically maintained using a vactor truck or clam shell bucket. There are numerous companies that can maintain the HG separator. Envirocalm, LLC, an affiliate company of Hydroworks offers inspection and maintenance services and can inspect and maintain the HG separator. (www.envirocalm.com).

Disposal of the contents of the separator depend on local requirements. Maintenance of a Hydroworks HG unit will typically take 1 to 2 hours.

Frequency

Construction Period

A HG separator can fill with construction sediment quickly during the construction period. The construction sediment will have a much coarser particle size distribution than the suspended solids during the post-development period. Accordingly, scour is not so much of a concern during the construction period compared to the separator filling up with solids. The Hydroguard must be maintained during the construction period when the depth of TSS/sediment reaches 27" (675 mm). This represents 75% of the maximum sediment storage capacity. It must also be maintained during the construction period if there is an appreciable depth of oil in the unit (more than a sheen) or if floatables other than oil cover over 50% of the open water surface on the inlet side of the outlet baffle wall.

The HG separator should be maintained at the end of the construction period, prior to utilization for the post-construction period.

Post-Construction Period

The Hydroguard was independently tested by Alden Research Laboratory in 2008. A HG6 was tested for scour with initial sediment loads of 4.6 ft^3 and 9.3 ft^3. The results from these tests were almost identical. Therefore, the 9.3 ft^3 sediment load was used as 50% of the maximum sediment depth for maintenance in the calculation of the maintenance interval for the HG6 separator based on the NJDEP maintenance interval equation.

Maintenance Interval (months) = 3.565 x (Sediment Storage) / (MTFR x TSS Removal)

Maintenance Interval (HG6) = 3.565 x 9.3 / (1.67x 0.55) = 36 months

All values (flow, sediment storage) can be scaled by the surface area making the sediment depths and maintenance intervals equal for all separators.

The separator was loaded with the sediment in the inner chamber and middle chamber with the majority of sediment (80%) located in the inner chamber. The inner chamber for area represents approximately 44% of the separator surface area. The inner chamber is 4 ft (1200 mm) in diameter in the HG6. Therefore the 50% sediment depth for the HG6 in the inner chamber would be:

9.3 ft^3 x 0.80 / (3.14 x 4 ft^2) x 12 in/ft = 7.1 inches (175 mm)

Accordingly the 100% sediment volume would represent 14.2” (350 mm) of sediment depth in the inner chamber.

The HG separator must be maintained if there is an appreciable depth of oil in the unit (more than a sheen) or if floatables other than oil cover over 50% of the open water surface on the inlet side of the outlet baffle wall. It should also be maintained once the accumulated TSS/sediment depths are greater than 14” (350 mm) in the inner chamber. For typical stabilized post-construction sites (parking lots, streets) it is anticipated that maintenance will be required annually or once every two years. More frequent or less frequent maintenance will be required depending on individual site conditions (traffic use, stabilization, storage piles, etc.). The long term maintenance frequency can be established based on the maintenance requirements during the first several years of operation if site conditions do not change.

Hydroworks

HYDROGUARD INSPECTION SHEET

Date ______________________________

Date of Last Inspection ______________________________

Site ______________________________

City ______________________________

State ______________________________

Owner ______________________________

GPS Coordinates ______________________________

Date of last rainfall ______________________________

Site Characteristics	**Yes**	**No**
Soil erosion evident	☐	☐
Exposed material storage on site	☐	☐
Large exposure to leaf litter (lots of trees)	☐	☐
High traffic (vehicle) area	☐	☐

Hydroguard	**Yes**	**No**
Incorrect access orientation	☐ ***	☐
Obstructions in the inlet or outlet	☐ *	☐
Missing internal components	☐ **	☐
Improperly installed internal components	☐ **	☐
Improperly installed inlet or outlet pipes	☐ ***	☐
Internal component damage (cracked, broken, loose pieces)	☐ **	☐
Floating debris in the separator (oil, leaves, trash)	☐	☐
Large debris visible in the separator	☐ *	☐
Concrete cracks/deficiencies	☐ ***	☐
Exposed rebar	☐ **	☐
Water seepage (water level not at outlet pipe invert)	☐ ***	☐
Water level depth below outlet pipe invert ________“		

Routine Measurements

Floating debris depth	**< 0.5” (13mm)**	☐	**>0.5” 13mm)**	☐*
Floating debris coverage	**< 25% of surface area**	☐	**> 25% surface area**	☐ *
Sludge depth	**< 14” (350mm)**	☐	**> 14” (350mm)**	☐ *

Other Comments: ____

____

____

* Maintenance required

** Repairs required

*** Further investigation is required

Please call Hydroworks at 888-290-7900 or email us at support@hydroworks.com if you have any questions regarding the Inspection Checklist. Please fax a copy of the completed checklist to Hydroworks at 888-783-7271 for our records.

Hydroworks® Hydroguard

One Year Limited Warranty

Hydroworks, LLC warrants, to the purchaser and subsequent owner(s) during the warranty period subject to the terms and conditions hereof, the Hydroworks Hydroguard to be free from defects in material and workmanship under normal use and service, when properly installed, used, inspected and maintained in accordance with Hydroworks written instructions, for the period of the warranty. The standard warranty period is 1 year.

The warranty period begins once the separator has been manufactured and is available for delivery. Any components determined to be defective, either by failure or by inspection, in material and workmanship will be repaired, replaced or remanufactured at Hydroworks' option provided, however, that by doing so Hydroworks, LLC will not be obligated to replace an entire insert or concrete section, or the complete unit. This warranty does not cover shipping charges, damages, labor, any costs incurred to obtain access to the unit, any costs to repair/replace any surface treatment/cover after repair/replacement, or other charges that may occur due to product failure, repair or replacement.

This warranty does not apply to any material that has been disassembled or modified without prior approval of Hydroworks, LLC, that has been subjected to misuse, misapplication, neglect, alteration, accident or act of God, or that has not been installed, inspected, operated or maintained in accordance with Hydroworks, LLC instructions and is in lieu of all other warranties expressed or implied. Hydroworks, LLC does not authorize any representative or other person to expand or otherwise modify this limited warranty.

The owner shall provide Hydroworks, LLC with written notice of any alleged defect in material or workmanship including a detailed description of the alleged defect upon discovery of the defect. Hydroworks, LLC should be contacted at 50 S 21st St., Kenilworth, NJ 07033 or any other address as supplied by Hydroworks, LLC. (888-290-7900).

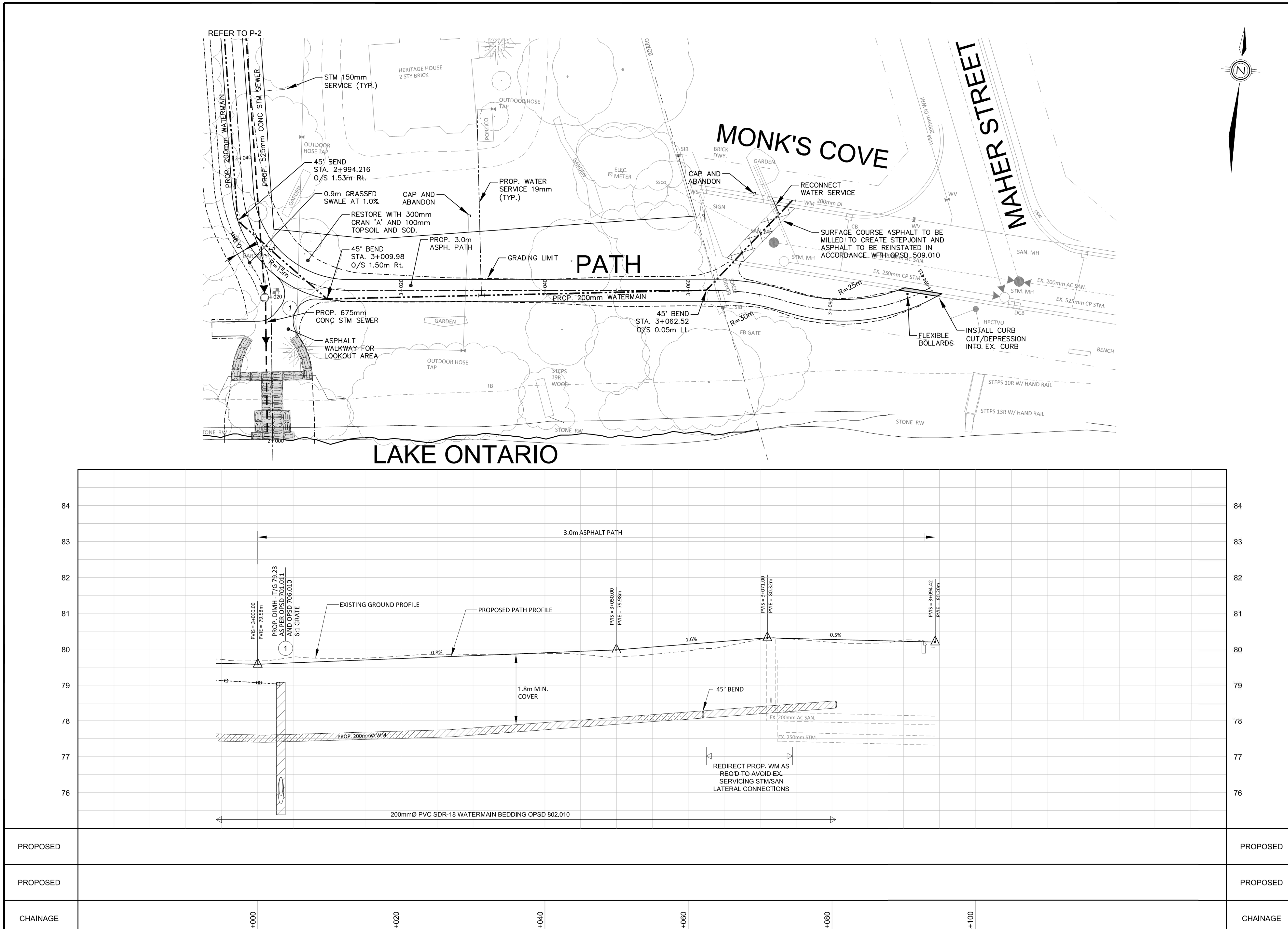
This limited warranty is exclusive. There are no other warranties, express or implied, or merchantability or fitness for a particular purpose and none shall be created whether under the uniform commercial code, custom or usage in the industry or the course of dealings between the parties. Hydroworks, LLC will replace any goods that are defective under this warranty as the sole and exclusive remedy for breach of this warranty.

Subject to the foregoing, all conditions, warranties, terms, undertakings or liabilities (including liability as to negligence), expressed or implied, and howsoever arising, as to the condition, suitability, fitness, safety, or title to the Hydroworks Hydroguard are hereby negated and excluded and Hydroworks, LLC gives and makes no such representation, warranty or undertaking except as expressly set forth herein. Under no circumstances shall Hydroworks, LLC be liable to the Purchaser or to any third party for product liability claims; claims arising from the design, shipment, or installation of the Hydroguard, or the cost of other goods or services related to the purchase and installation of the Hydroguard. For this Limited Warranty to apply, the Hydroguard must be installed in accordance with all site conditions required by state and local codes; all other applicable laws; and Hydroworks' written installation instructions.

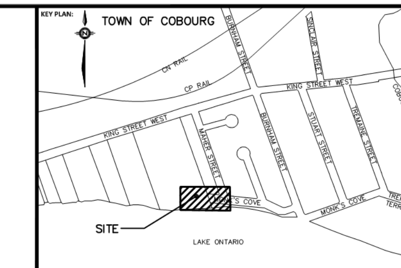
Hydroworks, LLC expressly disclaims liability for special, consequential or incidental damages (even if it has been advised of the possibility of the same) or breach of expressed or implied warranty. Hydroworks, LLC shall not be liable for penalties or liquidated damages, including loss of production and profits; labor and materials; overhead costs; or other loss or expense incurred by the purchaser or any third party. Specifically excluded from limited warranty coverage are damages to the Hydroguard arising from ordinary wear and tear; alteration, accident, misuse, abuse or neglect; improper maintenance, failure of the product due to improper installation of the concrete sections or improper sizing; or any other event not caused by Hydroworks, LLC. This limited warranty represents Hydroworks' sole liability to the purchaser for claims related to the Hydroguard, whether the claim is based upon contract, tort, or other legal basis.

APPENDIX F
PLAN AND PROFILE DRAWINGS

PLAN AND PROFILE DRAWINGS P1 TO P7



KEY PLAN:



BENCHMARK:

BM 2 80.681
TOP OF SPIKE IN EAST FACE OF 0.4m CEDAR.

BM 3 81.305
TOP OF SOUTH HUB OF HYDRANT ON THE NORTH SIDE OF KING ST.W. APPROXIMATELY 24m WEST OF HYDRO POLE MARKED S4-60.

CIMA+
Partners in excellence
55 King Street East
Bowmanville ON L1C 1N4
Phone: 905 697-4464
Fax: 905 697-0443
www.cima.ca

CLIENT:

EIE CORPORATION

PROJECT NAME:

CEDAR SHORE ESTATES

STAMPS:

LICENSED PROFESSIONAL ENGINEER
R. D. CRESSMAN
100150917
PROVINCE OF ONTARIO
DESIGNED BY

LICENSED PROFESSIONAL ENGINEER
W. G. McCRAE
PROVINCE OF ONTARIO
APPROVED BY

No.	Date	Description	By
3.	12/08/2017	ISSUED FOR 2ND SUBMISSION	RC
2.	05/17/2017	ISSUED FOR 1ST SUBMISSION	RC
1.	01/25/2017	PRE-CONSULTATION MEETING	RC

SHEET TITLE:

PROPOSED PLAN AND PROFILE PATH

DISCIPLINE:

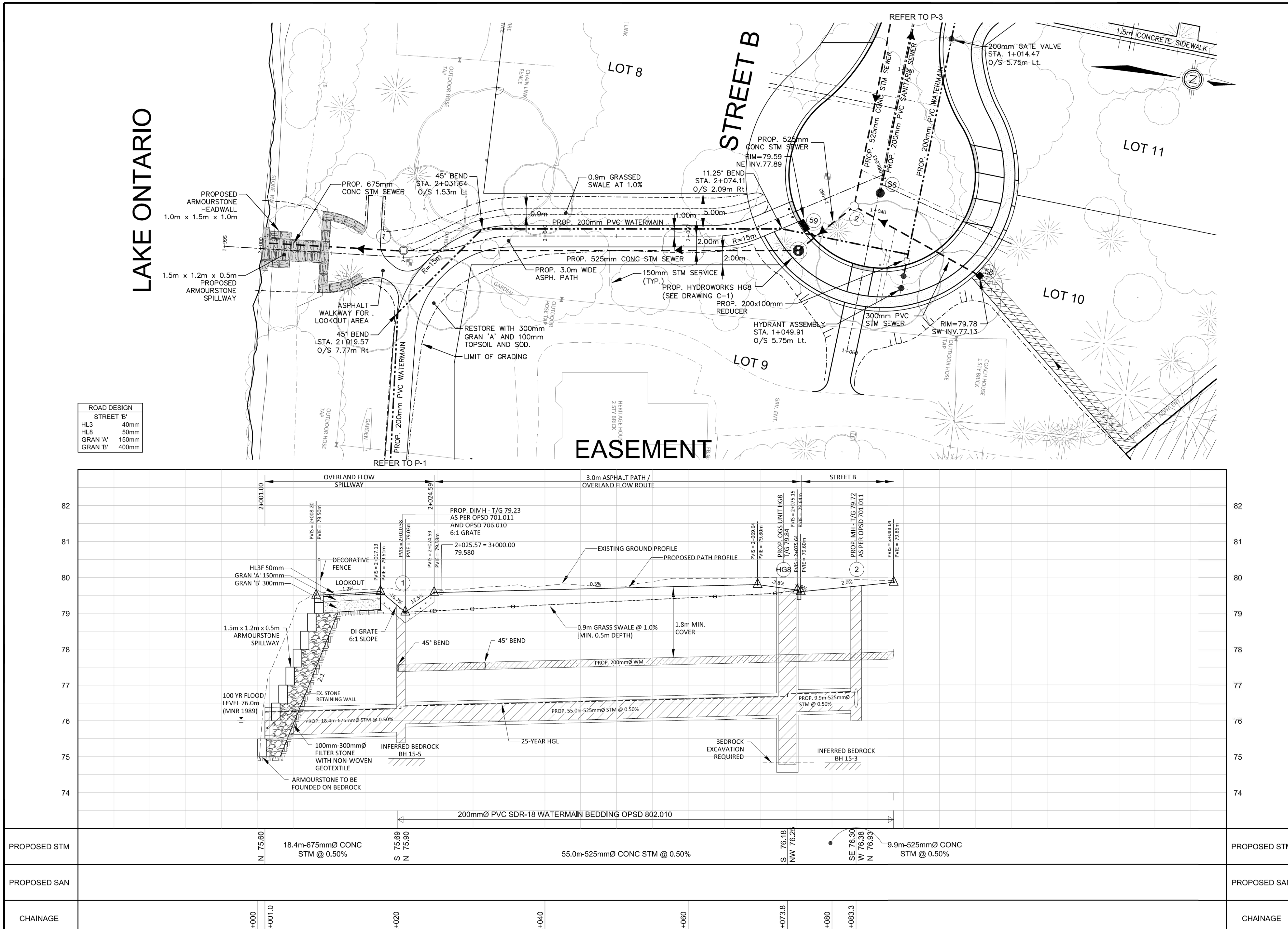
INFRASTRUCTURE

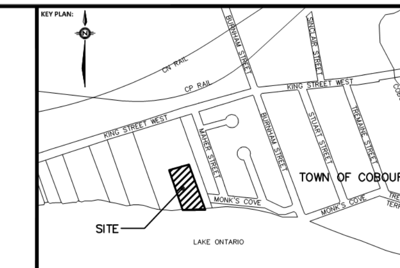
SCALE:

HORIZONTAL : 1:250

VERTICAL : 1:50

PROJECT No: C14-0011	CLIENT File No:
DRAFTER: K.ALLEN	DESIGNER: P. MERRETT
APPROVER: R. CRESSMAN	APPROVER: W. McCRAE
DRAWING No:	P-1
DATE: JULY 16, 2015	SHEET No: 5 of 19





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Phone: 905 697-4464
Fax: 905 697-0443
www.cima.ca

CLIENT:
EIE CORPORATION

PROJECT NAME:
CEDAR SHORE ESTATES

STAMPS:
LICENSED PROFESSIONAL ENGINEER R. D. CRESSMAN 100150917 PROVINCE OF ONTARIO
LICENSED PROFESSIONAL ENGINEER W. G. McCRAE PROVINCE OF ONTARIO
DESIGNED BY
APPROVED BY

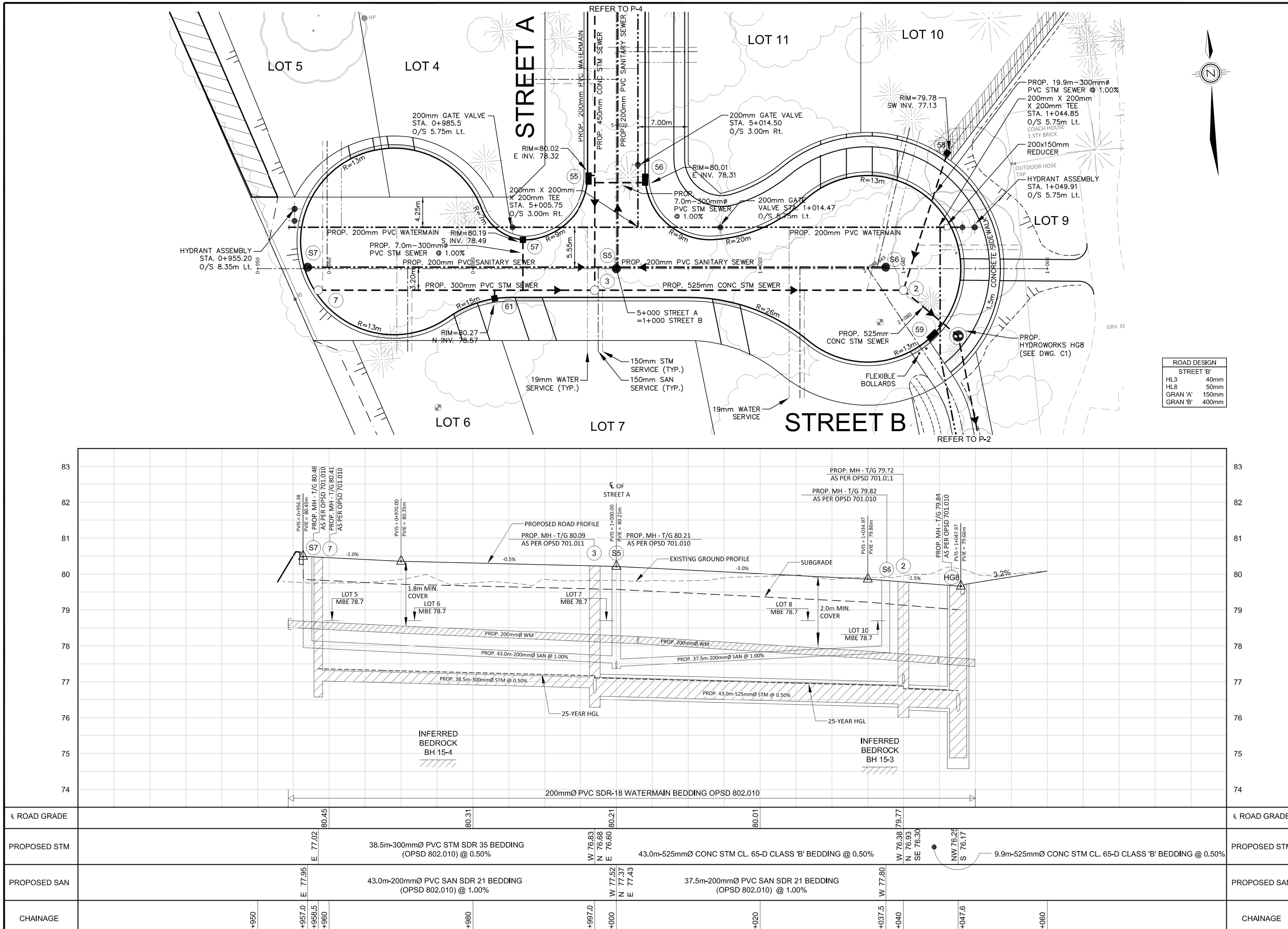
No.	Date	Description	By
3.	12/08/2017	ISSUED FOR 2ND SUBMISSION	RC
2.	05/17/2017	ISSUED FOR 1ST SUBMISSION	RC
1.	01/25/2017	PRE-CONSULTATION MEETING	RC

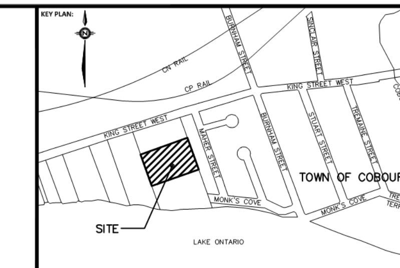
SHEET TITLE:
PROPOSED PLAN AND PROFILE EASEMENT

DISCIPLINE:
INFRASTRUCTURE

SCALE:
HORIZONTAL : 1:250
VERTICAL : 1:50

PROJECT No: C14-0011	CLIENT File No:
DRAFTER: K.ALLEN	DESIGNER: P. MERRETT
APPROVER: R. CRESSMAN	APPROVER: W. McCRAE
DRAWING No: P-2	
DATE: JULY 16, 2015	SHEET No: 6 of 19





BENCHMARK:

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TOP OF SPIKE IN EAST FACE OF 0.4m CEDAR.

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www.cima.ca

CLIENT:

EIE CORPORATION

PROJECT NAME:

CEDAR SHORE ESTATES

STAMPS:

LICENSED PROFESSIONAL ENGINEER R. D. CRESSMAN 100150917 PROVINCE OF ONTARIO

LICENSED PROFESSIONAL ENGINEER W. G. McCRAE PROVINCE OF ONTARIO

DESIGNED BY / APPROVED BY

No.	Date	Description	By
3.	12/08/2017	ISSUED FOR 2ND SUBMISSION	RC
2.	05/17/2017	ISSUED FOR 1ST SUBMISSION	RC
1.	01/25/2017	PRE-CONSULTATION MEETING	RC

SHEET TITLE:

PROPOSED PLAN AND PROFILE STREET B

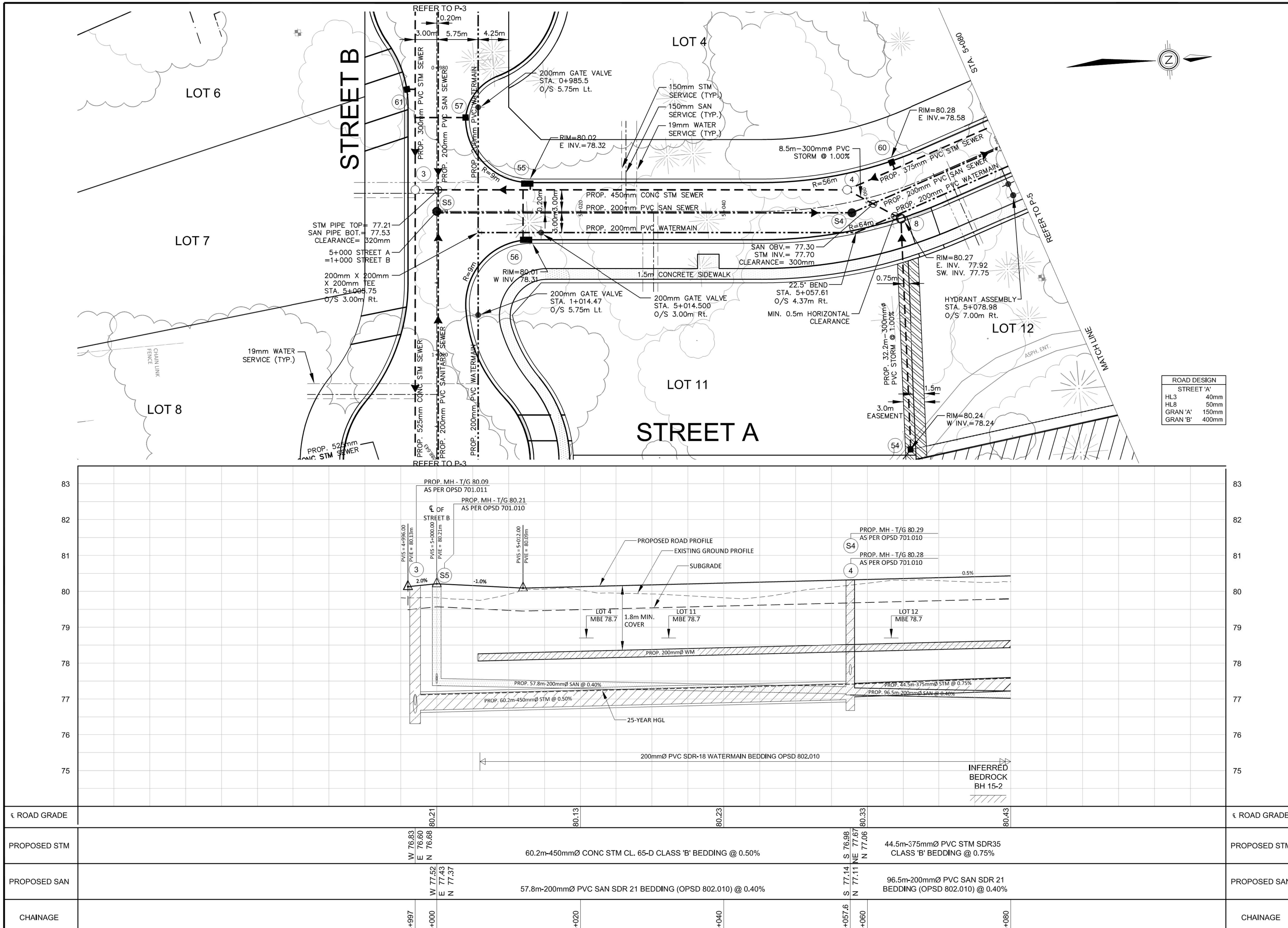
FROM STA.: 0+950 TO STA.: 1+060

DISCIPLINE:

INFRASTRUCTURE

SCALE:
HORIZONTAL : 1:250
VERTICAL : 1:50

PROJECT No: C14-0011
CLIENT File No:
DRAFTER: K.ALLEN
DESIGNER: P. MERRETT
APPROVER: R. CRESSMAN
APPROVER: W. McCRAE
DATE: JULY 16, 2015
DRAWING No: P-3
SHEET No: 7 of 19



KEY PLAN: TOWN OF COBOURG — SITE — LAKE ONTARIO

BENCHMARK:

BM 2 80.681
TOP OF SPIKE IN EAST FACE OF 0.4m CEDAR.

BM 3 81.305
TOP OF SOUTH HUB OF HYDRANT ON THE NORTH SIDE OF KING ST.W. APPROXIMATELY 24m WEST OF HYDRO POLE MARKED S4-60.

CIMA+ Partners in excellence
55 King Street East
Bowmanville ON L1C 1N4
Phone: 905 697-4464
Fax: 905 697-0443
www.cima.ca

CLIENT: EIE CORPORATION

PROJECT NAME: CEDAR SHORE ESTATES

STAMPS: LICENSED PROFESSIONAL ENGINEER R. D. CRESSMAN 100150917 PROVINCE OF ONTARIO — DESIGNED BY; LICENSED PROFESSIONAL ENGINEER W. G. McCRAE PROVINCE OF ONTARIO — APPROVED BY

No.	Date	Description	By
3.	12/08/2017	ISSUED FOR 2ND SUBMISSION	RC
2.	05/17/2017	ISSUED FOR 1ST SUBMISSION	RC
1.	01/25/2017	PRE-CONSULTATION MEETING	RC

SHEET TITLE:

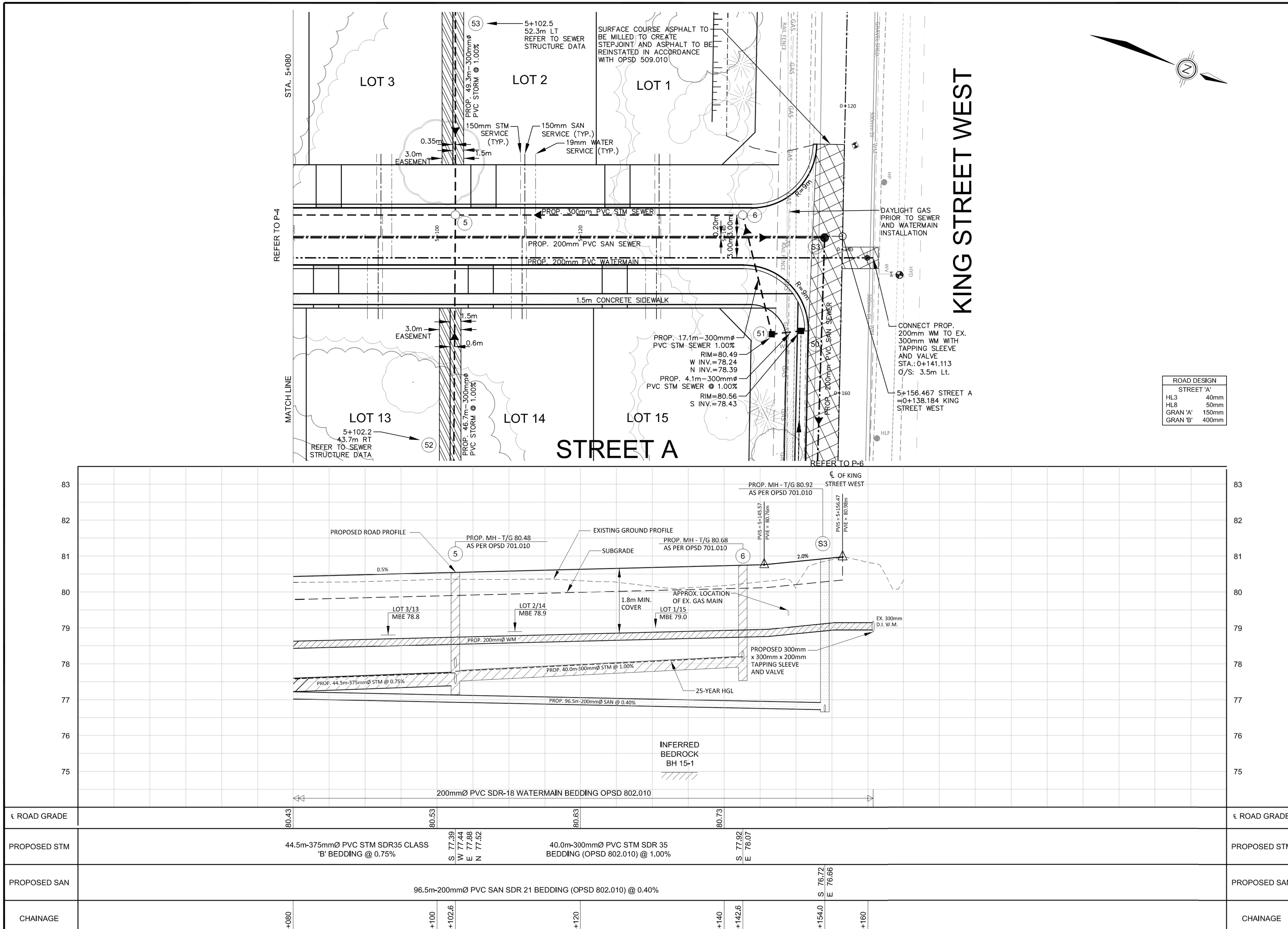
PROPOSED PLAN AND PROFILE STREET A

FROM STA.: 5+000 TO STA.: 5+080

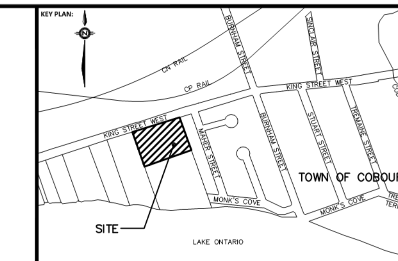
DISCIPLINE: INFRASTRUCTURE

SCALE: HORIZONTAL : 1:250 VERTICAL : 1:50

PROJECT No: C14-0011	CLIENT File No:
DRAFTER: K. ALLEN	DESIGNER: P. MERRETT
APPROVER: R. CRESSMAN	APPROVER: W. McCRAE
DRAWING No:	P-4
DATE: JULY 16, 2015	SHEET No: 8 of 19



KEY PLAN:



BENCHMARK:

BM 2 — 80.681
TOP OF SPIKE IN EAST FACE OF 0.4m CEDAR.

BM 3 — 81.305
TOP OF SOUTH HUB OF HYDRANT ON THE NORTH SIDE OF KING ST.W. APPROXIMATELY 24m WEST OF HYDRO POLE MARKED S4-60.

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CLIENT:

EIE CORPORATION

PROJECT NAME:

CEDAR SHORE ESTATES

STAMPS:

LICENSED PROFESSIONAL ENGINEER R. D. CRESSMAN 100150917 PROVINCE OF ONTARIO — DESIGNED BY

LICENSED PROFESSIONAL ENGINEER W. G. McCRAE PROVINCE OF ONTARIO — APPROVED BY

No.	Date	Description	By
3.	12/08/2017	ISSUED FOR 2ND SUBMISSION	RC
2.	05/17/2017	ISSUED FOR 1ST SUBMISSION	RC
1.	01/25/2017	PRE-CONSULTATION MEETING	RC

SHEET TITLE:

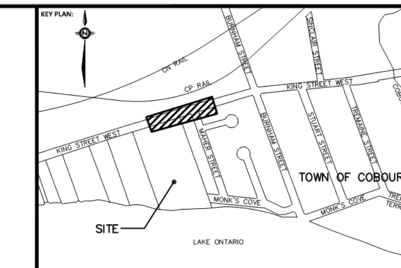
PROPOSED PLAN AND PROFILE STREET A

FROM STA.: 5+080 TO STA.: 5+156.67

DISCIPLINE: INFRASTRUCTURE

SCALE:
HORIZONTAL : 1:250
VERTICAL : 1:50

PROJECT No: C14-0011	CLIENT File No:
DRAFTER: K.ALLEN	DESIGNER: P. MERRETT
APPROVER: R. CRESSMAN	APPROVER: W. McCRAE
DRAWING No: P-5	
DATE: JULY 16, 2015	SHEET No: 9 of 19



BENCHMARK:

BM 2 TOP OF SPIKE IN EAST FACE OF 0.4m CEDAR.	80.681
BM 3 TOP OF SOUTH HUB OF HYDRANT ON THE NORTH SIDE OF KING ST.W. APPROXIMATELY 24m WEST OF HYDRO POLE MARKED S4-60.	81.305

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CLIENT:
EIE CORPORATION

PROJECT NAME:
CEDAR SHORE ESTATES

STAMPS:
LICENSED PROFESSIONAL ENGINEER R. D. CRESSMAN 100150917 PROVINCE OF ONTARIO
LICENSED PROFESSIONAL ENGINEER W. G. McCRAE PROVINCE OF ONTARIO
DESIGNED BY
APPROVED BY

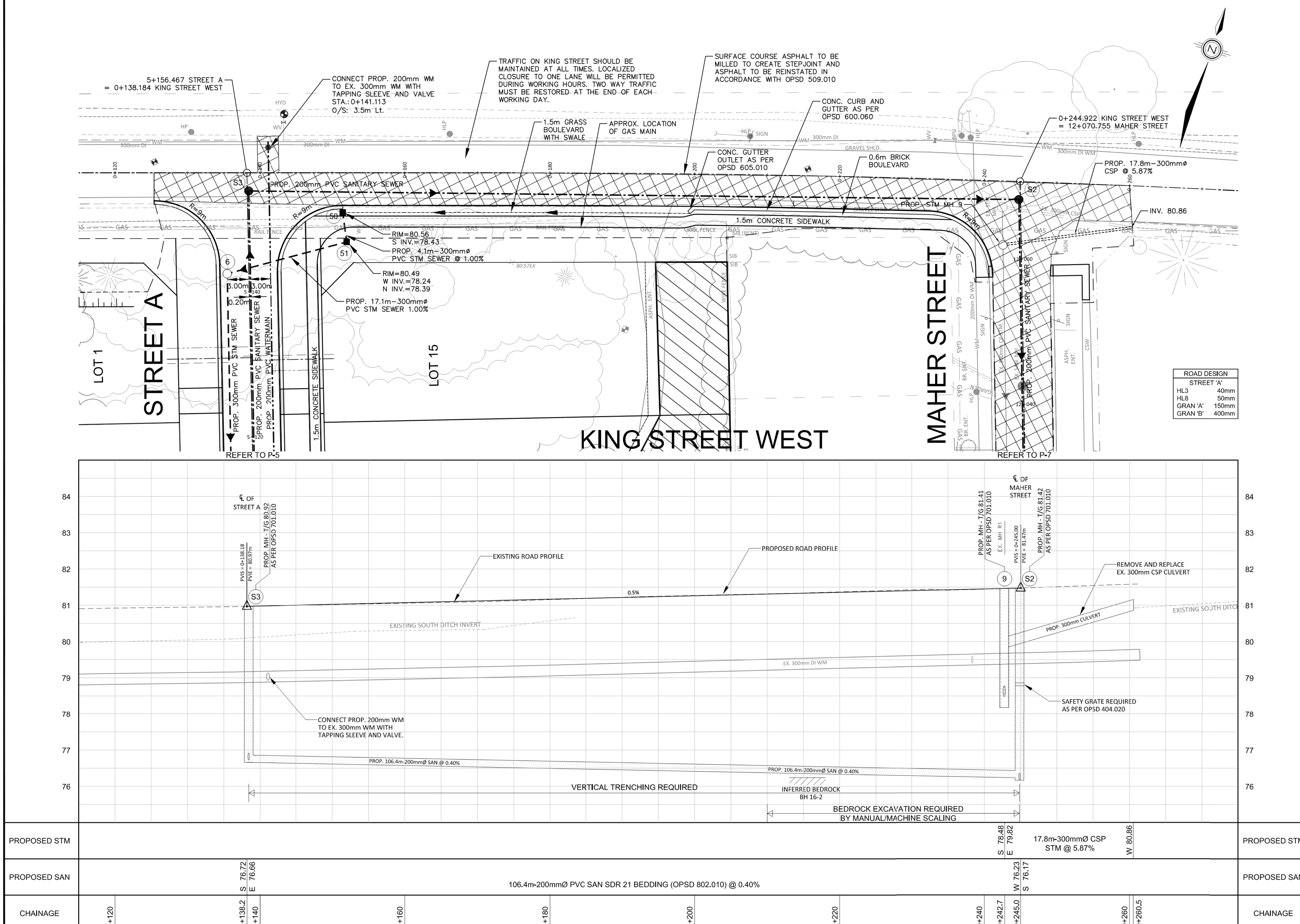
No.	Date	Description	By
3.	12/08/2017	ISSUED FOR 2ND SUBMISSION	RC
2.	05/17/2017	ISSUED FOR 1ST SUBMISSION	RC
1.	01/25/2017	PRE-CONSULTATION MEETING	RC

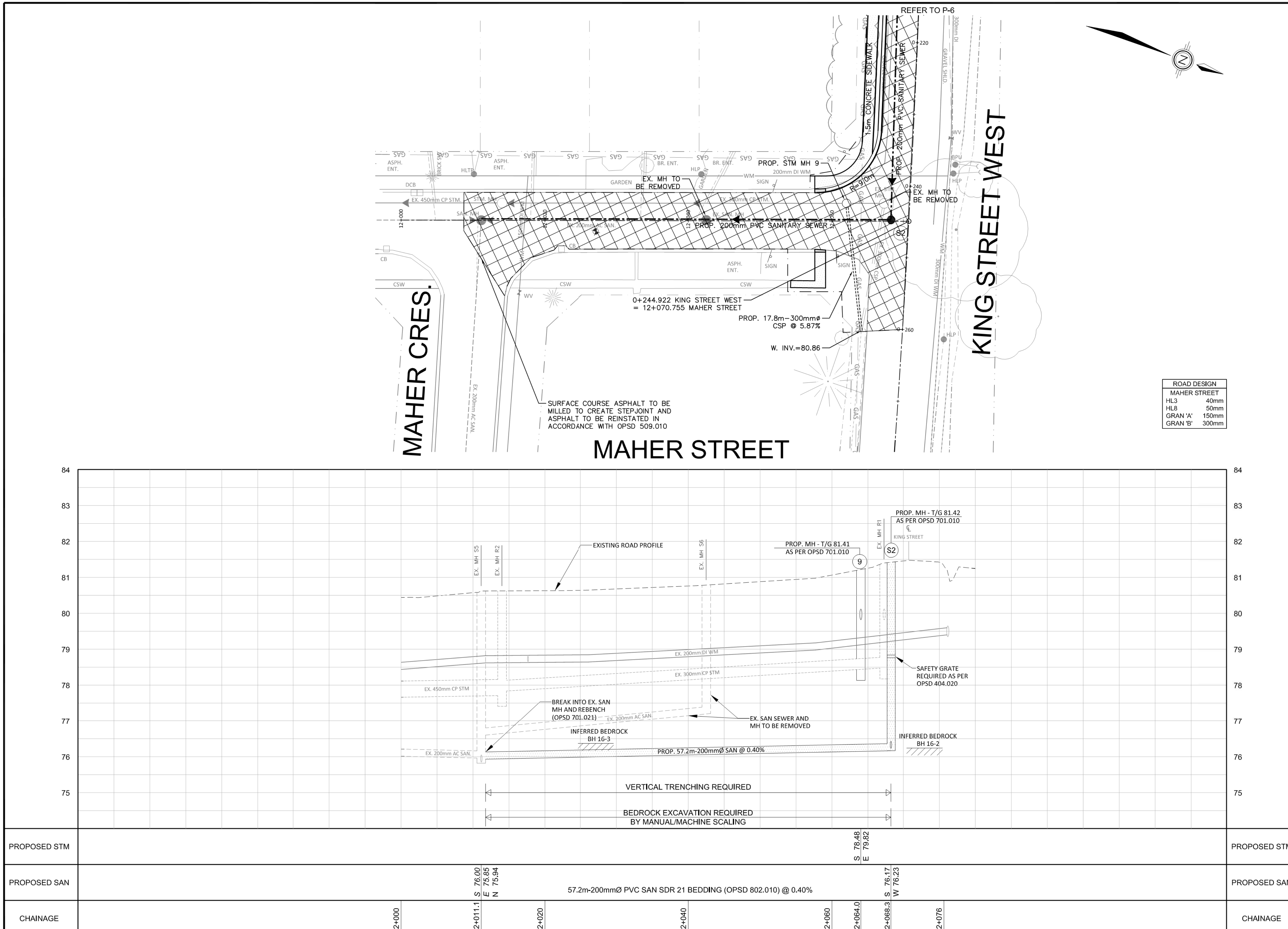
SHEET TITLE:
PROPOSED PLAN AND PROFILE
KING STREET WEST
FROM STA.: 0+120 TO STA.: 0+260

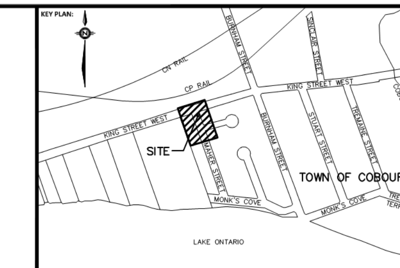
DISCIPLINE:
INFRASTRUCTURE

SCALE:
HORIZONTAL : 1:250
VERTICAL : 1:50

PROJECT No: C14-0011
CLIENT File No:
DRAFTER: K.ALLEN
DESIGNER: P. MERRETT
DRAWING No: P-6
APPROVER: R. CRESSMAN
APPROVER: W. McCRAE
DATE: JULY 16, 2015
SHEET No: 10 of 19







BENCHMARK:

BM 2 TOP OF SPIKE IN EAST FACE OF 0.4m CEDAR.	**80.681**
BM 3 TOP OF SOUTH HUB OF HYDRANT ON THE NORTH SIDE OF KING ST.W. APPROXIMATELY 24m WEST OF HYDRO POLE MARKED S4-60.	**81.305**

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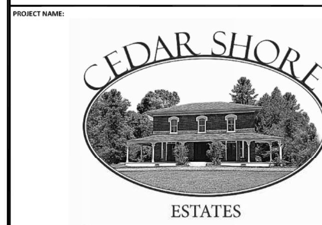
CLIENT:

EIE CORPORATION

PROJECT NAME:



STAMPS:

LICENSED PROFESSIONAL ENGINEER R. D. CRESSMAN 100150917 PROVINCE OF ONTARIO — DESIGNED BY

LICENSED PROFESSIONAL ENGINEER W. G. McCRAE PROVINCE OF ONTARIO — APPROVED BY

No.	Date	Description	By
3.	12/08/2017	ISSUED FOR 2ND SUBMISSION	RC
2.	05/17/2017	ISSUED FOR 1ST SUBMISSION	RC
1.	01/25/2017	PRE-CONSULTATION MEETING	RC

SHEET TITLE:

PROPOSED PLAN AND PROFILE MAHER STREET

FROM STA.: 12+000 TO STA.: 12+076

DISCIPLINE: INFRASTRUCTURE

SCALE: HORIZONTAL : 1:250 VERTICAL : 1:50

PROJECT No: C14-0011	CLIENT File No:
DRAFTER: K.ALLEN	DESIGNER: P. MERRETT
APPROVER: R. CRESSMAN	APPROVER: W. McCRAE
DRAWING No:	P-7
DATE: JULY 16, 2015	SHEET No: 11 of 19

55 King Street East
Bowmanville, Ontario
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