KINGSTON SOLAR LP
SOL-LUCE KINGSTON
SOLAR PV ENERGY PROJECT

CONSTRUCTION PLAN REPORT

Submitted to:

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Submitted by:

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REV.	DATE	DETAILS OR PURPOSE OF REVISION	PREPARED	CHECKED	APPROVED
A	08/12/11	Issued for client review			
B	07/05/12	Issued for client review			
0	08/05/12	Issued for use			
1	14/09/2012	Issued for use			

EXECUTIVE SUMMARY

The Sol-luce Kingston Solar PV Energy Project ("the Project") is being planned by Kingston Solar LP (the “Proponent”). The Proponent proposes to develop a solar facility with a maximum name plate capacity of approximately 100 MW AC (megawatts of alternating current). The Project sites are to be located to the north and south of Unity Road and south of Mud Lake Road in the City of Kingston and Loyalist Township in Eastern Ontario. The *Project Description Report* has been prepared under the requirements of the Renewable Energy Approvals (REA) process as outlined in *Ontario Regulation 359/09* and is being made available for agency, Aboriginal and public review and comment.

The *Construction Plan Report* provides a description of all activities to occur during the construction and installation phase of the project, as well as the potential environmental effects from construction activities and proposed mitigation and monitoring measures. Environmental impacts are described as they relate to the project location and lands within 300 m of the Project components.

The construction phase of any major project such as this has the potential for adverse effects on the environment.Key activities during the construction phase include: clearing, grading, installing the access road, trenching of underground electrical cables, installing foundations, transporting materials, and assembling, erecting and wiring of the solar arrays. To minimize the potential for environmental effects during the construction phase, the contractor will be made aware of the environmental management commitments that have been made and need to be met. An Environmental Effects Monitoring Plan (EEMP) for the construction period is included in Section 4.0 of the *Construction Plan Report*. Site construction activities leading up to project operation are anticipated to take approximately 15 months. No special housing, healthcare, or food facilities will be required as part of the project’s activities. The *Construction Plan Report* provides details of specific construction activities, the materials and equipment used, and the location and duration of the activity.

In general, the building materials consist of concrete, wood, aggregate, and metal. To the extent possible, these materials will be procured from local and/or regional sources where they are available in sufficient quality and quantity, at competitive prices. Excavation and fill requirements will likely be balanced to avoid importing material from off site. Hazardous materials used during construction would include fuels and lubricants that will be on-site for use in equipment and vehicles. Any temporary work areas will be demarcated to ensure construction vehicles and personnel stay within the allocated areas.

Sufficient fieldwork and data collection was performed to assist in the determination of potential construction effects to environmental and social features. Various mitigation measures to manage these potential effects have been identified. Significant adverse effects from construction activity to the natural and social environment will be avoided through careful facility layout planning, the application of appropriate mitigation measures, and adherence to all regulatory requirements.

The proposed Project is a low-profile and non-obtrusive use. Once constructed, the Project will have no moving parts and produce no significant off-site noise, no harmful emissions or any other form of waste product. Inverters will be placed on concrete pad foundations. The arrays will be spaced in order to avoid shading on the panels and a resulting decrease in electrical output. Due to the spacing between rows, it is anticipated that small native vegetation will be grown beneath and between the rows.

The *Natural Heritage Assessment and Environmental Impact Study* (*NHA/EIS) Report* identified the boundaries and assessed the significance of natural features occurring partially or wholly within 120 m of the Project Location.

By way of a Records Review, information was gathered about the Study Area to identify known or potential natural features occurring within 120 m of the Project Location. Natural features include woodlands, wetlands, protected lands (provincial and national parks, or ANSIs), and wildlife habitat. Site Investigation confirmed the presence and boundaries of natural features reported in the Records Review which occurred within 120 m of the Project Location.

An Evaluation of Significance was conducted for each natural feature confirmed through the Site Investigation. Significant features were indentified based upon current designation by the MNR, or by comparing the results of habitat quality studies of the feature to evaluation criteria provided or approved by the MNR. Significant natural features identified within 120 m of the Project Location included wetlands, woodlands, and wildlife habitat.

The EIS identified and assessed potential negative environmental effects of the Project on natural features. The EIS further identified mitigation measures described in the Environmental Effects Monitoring Plan and Construction Plans to address any negative environmental effects.

Collector lines and access roads are expected to be constructed near or across seven watercourses within the Project Location. The construction of collector lines and access roads are will not result in any negative environmental effects with the mitigation measures described in this report and the Sol-luce Kingston Solar PV Energy Project *Water Assessment and Water Body Report* (under separate cover).

The overall conclusion of the *Construction Plan Report* is that this project can be constructed without any significant adverse residual effects to the natural or social environment.

There are net benefits of this project resulting from an increased municipal tax base for the City of Kingston and Loyalist Township, increased employment opportunities, especially during the construction stage, and the generation of clean, renewable electricity from solar power.

For more information on the Project, please refer to the documents listed in Section 1.0 of the *Construction Plan Report*. These additional reports are provided as part of a completed

submission package to the MOE and were prepared in accordance with Ontario Regulation 359/09.

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1.0 INTRODUCTION

Kingston Solar LP (hereinafter referred to as the "Proponent") intends to design and construct up to 100 MWac (megawatts of alternating current) solar power development in Eastern Ontario located in the City of Kingston and Loyalist Township (Figures 1-1 and 1-2). The renewable energy facility is to be known as the "Sol-luce Kingston Solar PV Energy Project" (hereinafter referred to as "the Project") and will be rated as a Class 3 solar facility. The Project will require a Renewable Energy Approval (REA) as per Ontario Regulation *O.Reg. 359/09* under Part V.0.1 of the *Ontario Environmental Protection Act*.

The development of the Project will help the Province of Ontario meet its goal of increasing the proportion of electricity generated from renewable sources. If approved, this facility would use photovoltaic (PV) technology to convert solar energy into electricity. Power generated by the Project will be fed into the provincial grid via a substation located adjacent to the Hydro One Networks Inc. (HONI) transmission line which crosses the study area.

This *Construction Plan Report* will be submitted to the Ministry of the Environment as required under the Renewable Energy Approvals (REA) process as outlined in *Ontario Regulation 359/09* and will be made available for public review and comment.

Other reports included in the submission package include:

- Project Description Report;
- Design and Operations Report;
- Noise Study Report (appended to the Design and Operations Report);
- Decommissioning Plan Report;
- *Natural Heritage Assessment and Environmental Impact Study (NHA/EIS) Report* (Records Review Report, Site Investigation Report, Evaluation of Significance Report, Environmental Impact Study Report);
- *Water Assessment and Water Body Report* (Records Review Report, Site Investigation Report);
- Stage 1 and 2 Archaeological Assessment; and
- Cultural Heritage Assessment Report.

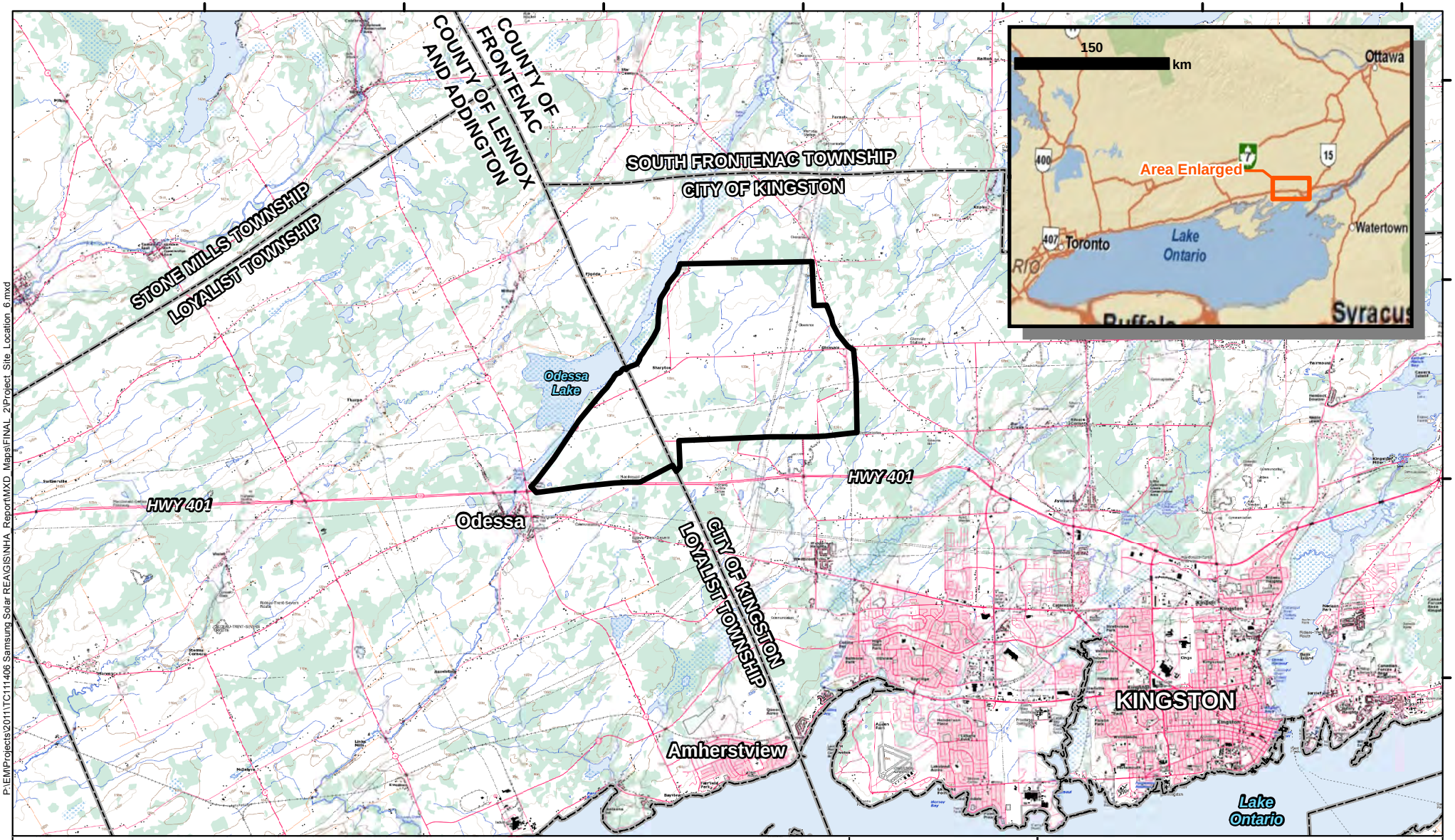
The Proponent has received a contract from the Ontario Power Authority (OPA) for the purchase of electricity generated by photovoltaic solar panels from the solar facility through the Province's Feed-in-Tariff (FIT) program (enabled by the *Green Energy and Green Economy*

Act). For the proponent contact information, refer to the *Project Description Report* submitted as part of this package.

The Project will consist of:

- Multiple sites consisting of arrays of Photovoltaic (PV) panels, with the cumulative capacity to generate up to 100 MW of power located as shown in Figure 1-2;
- Arrays mounted to aluminum or galvanized steel racking anchored to the ground or foundations;
- PV arrays grouped in blocks of approximately 1 MW and connected to an inverter station to convert the incoming power from direct current (DC) to alternating current (AC);
- A transformer at the inverter station that will transform the outgoing AC power to 34.5 kilovolts (kV);
- Underground and/or overhead collector lines to transmit power from the Project to the substation via the municipal road right-of-way. The collector line is estimated to be approximately 33 km in length;
- Transformers to transform the power to 230 kV for interconnection to the adjacent HONI transmission line;
- A maintenance and control building to be located at the substation site for operations and maintenance use; and
- Security fencing around Project site.

Figure 1-1 provides the geographical location of the proposed Project within the City of Kingston and Loyalist Township. The Project sites are located to the north and south of Unity Road and to the south of Mud Lake Road. It is noted that “Project Location” refers to the land proposed to locate all project components. Figure 1-2 shows the Project location, as defined in Ontario Regulation 359/09, as the land proposed to locate all project components. Project components, including solar panels and electrical facilities such as inverters, transformers, substation and electrical lines, will be located on private land or municipally owned right-of-ways. The total land parcel within the project boundary is approximately 261 ha.



LEGEND

- Project Area
- Municipal / County Boundary

NOTES:
- Background topographic DRG map extracted from Geogratis.ca, 1:50k NTS

Datum: NAD83
Projection: UTM Zone 18N

0 2 4 8 12 16 20 Kilometres

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SOL-LUCE KINGSTON SOLAR PV ENERGY PROJECT

Regional Study Area

PROJECT Nº: TC121402	**FIGURE: 1-1**
SCALE: 1:135,000	DATE: September 2012

363000 364000 365000 366000 367000 368000 369000 370000 371000 372000 373000

4910000 4909000 4908000 4907000 4906000 4905000

Florida
Wilton
Odessa Lake
Quabbin Rd.
Unity Rd.
Howes Rd.
Mud Lake Rd. N.
Transmission Lines
Glenvale Creek
Westbrook Rd.
TransCanada Natural Gas Pipeline
Highway 33
Camp
Glenvale Station
Communication
Millhaven Creek
Wilton Road Dam
Freeway
Highway 401
Highway Service Centre
147m 151m 150m 143m 130m 136m 124m 144m 137m 127m 140m

P:\EMProjects\2011\TC111406 Samsung Solar REA\GIS\NHA_Report\MXD_Maps\FINAL_4\ProjectLayout_Overview_7.mxd

LEGEND

Layout Features

- Property Area that is Potentially Eligible for Development
- Development Area (Solar Panels)
- Inverter Station
- Collector Line (Overhead)
- Collector Line (Underground)
- Access Road
- Substation Location
- Operations and Maintenance Building
- Laydown Area
- Project Location, 120 m Setback Investigation Area *

Other Features

- TransCanada Natural Gas Pipeline ROW (Approx.)
- Transmission Lines
- Waterbody (LIO-MNR)

Watercourse/Waterbody (LIO-MNR)

- Intermittent (CRCA-warm water stream)
- Permanent (CRCA-warm water stream)

NOTES:
- Background topographic DRG map extracted from Geogratis.ca, 1:50k NTS, Natural Resources Canada
- Watercourse and Waterbody data extracted from Land Information Ontario, Ministry of Natural Resources, 2011
- Watercourse classification provided by Cataraqui Region Conservation Authority (CRCA) watercourse data, 2011
* Investigation area includes the 120m buffer from the proposed fenceline for development sites, overhead and underground collector lines and access roads (Site Plan April 20, 2012)

Datum: NAD83
Projection: UTM Zone 18N

0 1 2 4 6 8 Kilometres

N W E S

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SOL-LUCE KINGSTON SOLAR PV ENERGY PROJECT

Project Location

PROJECT N°: TC121402 | **FIGURE: 1-2**

SCALE: 1:27,000 | DATE: September 2012

1.1 Overview

The Proponent retained AMEC Environment & Infrastructure, a Division of AMEC Americas Limited (AMEC) to assist in the preparation of studies and reports in support of a Renewable Energy Approval (REA) application for the Project. This *Construction Plan Report* has been prepared in accordance with Item 1, Table 1 of O.Reg. 359/09 and the Ministry of the Environment's (MOE's) *"Technical Guide to Renewable Energy Approvals – Chapter 5: Guidance for Preparing the Construction Plan Report"* (MOE 2011, 2012). Revisions to the Renewable Energy Approval (REA) regulation (O.Reg. 359/09) and the Technical Guide for Renewable Energy Approvals (Technical Guide, 2012) are currently under review and this *Construction Plan Report* has been prepared with consideration of the proposed regulations and revised Technical Guide.

This *Construction Plan Report* provides a description of all activities to occur during the construction and installation phase of the project, as well as the potential environmental effects from construction activities and proposed mitigation and monitoring measures. Environmental impacts are described as they relate to the project location and lands within 300 m of the project components.

1.2 The Proponent

Kingston Solar LP (the "Proponent") is coordinating and managing the approvals process for the Project. The Proponent's office and contact information are as follows:

Full Name of Company:	Kingston Solar LP
Address:	55 Standish Court, 9th Floor Mississauga, Ontario L5R 4B2
Telephone:	905-501-5658
Fax:	905-285-1852 (1-855-359-2342)
Prime Contact:	A. José De Armas
Email:	solucekingston@samsungrenewableenergy.ca

AMEC is the consultant responsible for the preparation of REA-related reports for the Project. The contact at AMEC is:

Full Name of Company:	AMEC Environment & Infrastructure, a Division of AMEC Americas Limited (AMEC)
Prime Contact:	Rob Young
Address:	160 Traders Blvd. E., Unit 110 Mississauga, Ontario L4Z 3K7
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Fax:	905-568-1686
Email:	rob.young@amec.com

1.3 Regulatory Requirements

The Proponent retained AMEC Americas to assist in the preparation of studies and reports in support of a Renewable Energy Approval (REA) application for the Project. The REA application is a requirement under Ontario Regulation 359/09 - Renewable Energy Approvals under Part V.0.1 of the *Environmental Protection Act* (O.Reg. 359/09). The Project is designated as a Class 3 solar facility as defined by Section 4 of O.Reg. 359/09.

This Report has been prepared in accordance with Item 1, Table 1 of O.Reg. 359/09 and the Ministry of the Environment's (MOE's) *"Technical Guide to Renewable Energy Approvals – Chapter 5: Guidance for preparing the Construction Plan Report"* (MOE 2011). O.Reg. 359/09 sets out specific content requirements for the *Construction Plan Report* as provided in the MOE's *Checklist for Requirements under O.Reg. 359/09*, which has been included as a supplement to the REA application for the Project.

2.0 CONSTRUCTION PLAN REPORT REQUIREMENTS

Ontario Regulation 359/09 ("Regulation") sets out specific content requirements for the *Construction Plan Report* as provided in Table 2-1.

Table 2-1: Construction Plan Report Requirements per Ontario Regulation 359/09

Requirement: Set out a description of the following in respect of the renewable energy project:		**Section of this Report**
1.	Details of any construction or installation activities.	3
2.	The location and timing of any construction or installation activities for the duration of the construction or installation.	3 Figures 1-1 & 1-2
3.	Any negative environmental effects that may result from construction or installation activities	4
4.	Mitigation measures in respect of any negative environmental effects	4

The supplementary guidance document "*Technical Guide to Renewable Energy Approvals – Chapter 5: Guidance for preparing the Construction Plan Report*" (MOE 2011), further elaborates on the contents of the report as indicated in Table 2-2.

Table 2-2: Construction Plan Report Requirements per Technical Guide to Renewable Energy Approvals – Chapter 5

Requirement per Technical Guide to Renewable Energy Approvals	**Section of this Report**
Description of construction and installation activities:	3
• Materials brought on site	
• Construction equipment used	
• Timing and operational plans	
• Temporary uses of land	
• Temporary water taking	
• Materials generated at or transported from the Project Location	
Description of negative impacts:	4
• Dust and noise emissions	
• Destruction of vegetation	
• Impacts to water resources	
• Spills	
• Impacts on cultural heritage	
• Impacts on roads and traffic	
Mitigation measures	4
Environmental monitoring	5

This *Construction Plan Report* describes the potential environmental effects that may occur during the construction phase and mitigation methods to minimize those effects.

3.0 DESCRIPTION OF CONSTRUCTION AND INSTALLATION ACTIVITIES

3.1 Overview

The construction phase may have the potential for adverse effects on the environment. Key activities during the construction phase include: clearing, grading, installing access roads, trenching of underground electrical cables, installing foundations, transporting materials, and assembling, erecting and wiring of the solar arrays. To minimize the potential for environmental effects during the construction phase, the contractor will be made aware of the environmental management commitments that have been made and need to be met. A Construction Environmental Effects Monitoring Plan (CEEMP) for the construction period is included in Section 5 of this report.

The Project will be located on multiple sites in the City of Kingston and Loyalist Township. The solar sites comprise of arrays of solar photovoltaic panels, with the cumulative capacity to generate up to 100 MW AC of power. The Project's General Arrangement Drawing showing all solar sites as well as individual Solar Site Layouts are provided in **Appendix A**.

Each solar PV panel will be mounted on structural aluminum or galvanized steel racks arranged in rows. Each rack is fixed in position, facing south and angled 28 – 35 degrees to the horizon. Racks will be anchored to the ground or foundations depending on location. The solar arrays are arranged in predominantly 1 MW blocks with each block terminating at an inverter station to convert the DC power to AC power and step up the voltage to 34.5 kV. To prevent unauthorized access, the entire perimeter of each solar site will be fenced.

The outgoing power would leave the site via underground or overhead cables, depending on site conditions, which would follow the municipal road allowance to the substation.

The various 34.5 kV circuits from the solar sites will be connected into the substation to step-up the voltage to 230 kV (nominal), which is the operating voltage of the adjacent HONI transmission line. The site would include an adjacent switchyard to interconnect with the provincial power grid that will be operated by HONI. The substation will be the base for operations of the solar facilities and would include an operations and maintenance building.

The Project construction will be managed from a central location. This will be used for project management trailers, equipment laydown and parking for the duration of the construction work, after which all contractor facilities will be removed.

For each of the above components the construction activities would include:

- Site preparation;
- Installation of solar sites;
- Installation of collector lines along municipal road allowance;

- Installation of substation including operations and maintenance building; and
- Site clean-up and restoration.

Construction would normally be completed during daytime hours; however, there could be requirements for extended hours during major concrete pours or other installations that cannot be interrupted.

Site construction activities leading up to project operation are anticipated to take approximately 15 months. No special housing, healthcare, or food facilities will be required as part of the project's activities. The following sections provide details of specific construction activities, the materials and equipment used, and the location and duration of the activity. In general, the building materials consist of concrete, wood, aggregate, and metal. To the extent possible, these materials will be procured from local and/or regional sources where they are available in sufficient quality and quantity, at competitive prices. Excavation and fill requirements will likely be balanced to avoid importing off site material. Hazardous materials used during construction would include fuels and lubricants that will be on-site for use in equipment and vehicles. There are no known hazardous by-products of the solar energy generation process itself. Any temporary work areas will be demarcated to ensure construction vehicles and personnel stay within the allocated areas.

Details of construction materials that will be brought on-site and construction equipment to be used are provided in Sections 3.8 and 3.9, respectively.

3.2 Site Preparation

3.2.1 Site Survey and Geotechnical Surveys

Environmental studies and surveys have been conducted on foot, at a site/area specific level. Stage 1 and 2 archaeological surveys have been completed and reports prepared and submitted to the Ontario Ministry of Tourism, Culture and Sport (MTCS).

Preliminary geotechnical work was completed to obtain general subsurface information within the Project area. Additional geotechnical surveys will be completed to augment the existing information for the detailed design of the Project.

Prior to construction, a registered Ontario Land Surveyor (or equivalent) will survey the solar sites, and substation site to layout the buildable area, which includes the footprint of the facility components, access roads, collection lines, plus any temporary work and storage locations. The construction area will be staked and temporary fencing installed. All construction and installation activities will be conducted within this designated area.

3.2.2 Site Clearing, Ground Levelling and Grading

Prior to commencing site clearing and grading, erosion and sedimentation control measures will be installed at runoff pathways to protect surface waters during the construction activities.

Natural features requiring protection will be marked and silt fencing installed as required, and any trees that are to be protected would have temporary fencing placed around them. These measures will be installed where required on each site and would remain in place for the duration of the construction. The Contractor will be required to inspect and maintain the erosion controls.

Some of the sites contain brush, hedgerows and several scattered trees, which will be removed as part of the construction phase. Details of tree and hedgerow removals are provided in the *Natural Heritage Assessment and Environmental Impact Study (NHA/EIS) Report* submitted for MNR approval. Wood residuals may be chipped for erosion control or left on-site for habitat.

Site grading would occur for the construction of access roads, temporary facilities, staging areas, inverter stations and the substation. Excavations will be completed for foundations, and trenches for electrical cables.

Topsoil will be carefully removed and stockpiled in designated areas in consultation with the landowner. The topsoil would remain on site and will be used for site restoration following completion of construction activities. During temporary stockpiling, topsoil will be protected to minimize soil erosion by wind and rain.

Grading is expected to be minimal, and will be done in such a manner to maintain the general drainage patterns of the site while creating appropriate slopes for the safe construction and operation of the solar facility.

One of the solar sites in the project area will be allocated by the Contractor for the Project management trailers, equipment laydown and parking for the duration of the construction work, after which all temporary facilities will be removed. An area of the substation site would also be allocated for construction trailers and laydown for construction at that site.

3.2.3 Surface Water Runoff

A Stormwater Management (SWM) Plan (**Appendix B**) was developed for runoff control from the Project. The objective of the SWM Plan is to control stormwater runoff from the Project, specifically to ensure that surface water quality would meet discharge guidelines, and to manage surface water quantity (i.e., runoff peak flow rates) discharging from each of the Project sites.

The surface water quantity objective of the SWM Plan is to maintain minimal change in peak flows discharging from the Project site for post-development versus pre-development conditions, up to and including the 100 year return period design event. Hydrologic modelling was completed to estimate peak flows for these two conditions from the development of the Project. The results from the two scenarios were compared to evaluate the impact of the development on stormwater drainage and the need for quantity control.

The SWM concluded that, based on the results of hydrologic modelling, the computed increases in peak flows from the Project (substation and solar sites) will be negligible and therefore "quantity" control would be unnecessary. Therefore, the focus of the SWM Plan is stormwater "quality" control.

To achieve "quality" control, grassed filter strips will be used to improve the quality of stormwater runoff by using biological and chemical processes in soils and vegetation to filter out constituents. The grassed filter strips improve the quality of stormwater runoff by using biological and chemical processes in soils and vegetation to filter out constituents. They function by slowing runoff velocities and filtering out sediment and other contaminants, and providing some infiltration into underlying soils. Filter strips were originally used as an agricultural treatment practice, and have more recently evolved into an urban practice.

For the solar sites areas under and within a minimum distance of 6 m of the array blocks will be seeded with "pasture" grass varieties. The proposed plantings over a 6 m flow length will act as grassed filter strips to provide effective stormwater runoff quality control.

3.3 Installation of Perimeter Fences

To protect the public during construction activities, as well as to prevent trespassing and vandalism, a minimum 1.8 m chain link fence will be erected around the perimeter of the Project location with a gate on the access road from Unity Road.

The fence will be a steel chain link fence and installation will require the use of skid steer and auger. The fencing materials will be transported to the site. The vehicles will access the site via proposed access roads which will be located off of Unity Road and Mud Lake Road. The fence will be approximately 34 km in length and erected after the site has been graded and before any further construction. The location of the perimeter fence is located on the Site Plan contained within the *Design and Operations Report*.

3.4 Installation of Solar Components

The construction phase of the complete Project would last approximately 15 months. Key components that will be constructed or erected on the solar sites include:

- Installation of security fencing access roads;
- Concrete pads for inverter stations and footings as necessary for solar panel racks;
- Installation of PV panels and racks;
- Power cabling between PV panels and inverter stations; and
- Installation of preassembled inverter stations.

Construction would typically be completed during regular working hours in accordance with the City of Kingston's noise By-Law No. 2004-52, and Loyalist Township's noise By-Law No. 2011-6. However, there could be requirements for extended hours during major concrete

pours or other installations that cannot be interrupted. The sequence of construction is described below.

3.4.1 Civil Works

Gravel access roads will be installed from the edge of the municipal road to within the solar panel sites. Refer to **Appendix A** for drawings showing the layout and typical access road construction. Gravel access roads will be approximately 6 m wide and 23 km in length. These roads initially permit access by construction vehicles but will be required throughout the life of the Project for maintenance purposes. The roads will be constructed by removing and stockpiling topsoil, then building the roadbed using local granular material. The design would allow drainage of rainwater using lateral drains where appropriate. Access permits will be required from the municipality for the entry from municipal roads. Lanes between the solar arrays would not be paved, but allowed to re-vegetate.

Some of the access roads would need to cross watercourses. During the Project planning and site layout, the crossing of streams and drainage swales was avoided where feasible. Nevertheless, a number of stream crossings will be required as identified in the *Water Assessment and Water Body Report*. Culverts will be installed at each of the water crossings. Culverts may be placed on geotextile material and will be countersunk a minimum of 10% of culvert diameter; they would then be backfilled with gravel to match the final grade of the access road. Permits will be required from the Cataraqui Region Conservation Authority (CRCA) for each of the water crossings. All installation activities would conform to *Ontario Provincial Standard Specification 421 (OPSS) – Construction Specification for Pipe Culvert Installation in Open Cut*.

DC power cables from the PV arrays will be placed in trenches alongside the access road and backfilled or placed overhead. Where cables cross permanent water courses, these will be either directionally drilled beneath the stream bed or installed overhead, as appropriate and in consultation with the CRCA.

Concrete pads will be poured for each of the inverter stations. In addition, concrete foundations will be poured for attachment of solar panel racking in locations of poor soil conditions. The concrete will be delivered by truck from a local supplier.

Security fencing will be erected around the site perimeter prior to start-up. This would consist of 1.8 m high chain link fencing with barbed wire. Manual lockable gates will be supplied at all entrance locations.

3.4.2 Solar Panel and Inverter Station Installation

The Project would include approximately 426,000 solar PV panels, arranged in predominantly 1 MW blocks consisting of approximately 4,260 PV panels. Each block would report to an Inverter Station. The PV panels will be mounted on racks to be assembled on site and anchored

to the ground. The type of anchor would vary depending on the soil conditions within the site. This could be a steel post, ground screw or concrete foundation.

Each row of PV panels will be connected together in series forming a string, and the DC power will be brought to an inverter station via underground or overhead cabling. The inverter station will be delivered to site by truck as a preassembled unit including the inverters, a transformer and ancillary equipment such as switches. The inverter station will be anchored to a concrete slab. Electrical connections will be made within the inverter station and the outgoing AC power would leave the site by underground collector lines or overhead on utility poles.

A small crane will be used on-site for the lifting of the panels, racks and inverter station into position.

Prior to start-up, all systems will be commissioned to ensure correct operation and to adjust the operating parameters to optimize performance. Acceptance testing will be completed on the equipment to ensure that it meets the engineering specifications. Operating staff will be trained on equipment control and operation. This phase will be conducted in the presence of engineers and technical specialists representing the owner, contractor and major equipment suppliers.

3.5 Installation of Collector Lines along Municipal Road Allowance

The 34.5 kV power lines leaving each solar site would follow the road allowance and be installed either underground or overhead.

Underground cables will be installed in trenches between the property line and the travelled portion of the roadway within the road allowance. Trenches will be excavated using backhoes or tracked excavators for placement of the cables. The cables will be bedded in sand and the trench will be backfilled with the excavated material. Warning tape will be installed along the whole length of the underground cables, approximately 300 mm above the cables. If the installation of underground cables requires them to be installed by use of directional drilling to cross roads or other obstacles, they will be installed in conduits. Streams would either be crossed using directional drilling or the cables will be carried overhead on utility poles, as necessary.

Overhead power lines will be placed on existing poles where possible. Existing poles that cannot accommodate the additional power lines will be replaced with new poles and the existing cables will be transferred. New poles will be installed using linemen trucks with mounted augers. Where trimming of vegetation is required within the road allowance, it will be completed in accordance with Municipal and/or HONI requirements. Following installation of poles and hardware the new cabling will be strung to complete the connection to the substation.

3.6 Installation of Substation including the Operations and Maintenance Building

The construction of the substation facility including the operations and maintenance building would last approximately ten months. Key components that will be constructed would include:

- Security fencing;
- Site access roads;
- Footings for buildings;
- Operations and maintenance building;
- Substation switchgear and control building;
- Concrete pads and transformer pits;
- Grounding grid;
- Transformers and switchgear;
- Metering, monitoring and control equipment;
- Stormwater collection and discharge infrastructure; and
- Grid interconnection (by HONI).

3.6.1 Civil Works

Site and access roads will be prepared by excavation of surface soils. Topsoil from site development will be stockpiled for reuse on-site. Excavations will be completed for the equipment and building foundations and for underground utilities such as electrical conduits. Any excess soil will be used as fill for the Project or spread on site. Gravel fill will be added as necessary to allow construction equipment access.

Concrete construction would include the installation of the footings for the operations building, equipment pad and supports and the placement of concrete transformer pits. Excavations will be backfilled using construction fill and excavated materials. Following the major civil works, the site will be underlain by a grounding grid for connection of the electrical equipment and then backfilled with a surface layer of gravel to meet the site plan design.

The operations building will be erected and a septic tank system will be installed to service the building for sanitary purposes. Water will be supplied either by an on-site well or by tanker truck from a municipal supply. The volume of water used will be less than 1,500 L/day. Bottled water will be supplied for drinking purposes.

A chain link security fence will be installed around the perimeter of the substation site.

3.6.2 Equipment Installation and Grid Interconnection

Major equipment consisting of transformers and switchgear will be installed on concrete pads and footings. Circuits from the solar sites will be connected into the substation to step-up the voltage to 230 kV (nominal) to match the operating voltage of the adjacent HONI transmission line.

Upon completion of the installation of the electrical equipment the substation will be connected to the provincial grid via the switchyard. The design and construction of the switchyard will be completed by HONI.

Prior to start-up, all systems will be commissioned to ensure correct operation and to adjust the operating parameters to optimize performance. Acceptance testing will be completed on the equipment to ensure that it meets the engineering specifications. Operating staff will be trained on equipment control and operation. This phase is conducted in the presence of engineers and technical specialists representing the owner, contractor and major equipment suppliers.

All construction and installation activities will take place during normal working hours in accordance with the City of Kingston's noise By-Law No. 2004-52, and Loyalist Township's noise By-Law No. 2011-6.

3.7 Site Clean-up and Restoration

The clean-up of the construction site is the final construction activity to be conducted. The clean-up crew would pick up debris and remove surplus materials and equipment. Areas temporarily used to accommodate the construction will be restored to a condition acceptable to the land owner. Plantings or re-vegetation for erosion control will be installed in accordance with the site plan.

3.8 Materials Brought on Site

Approximate quantities of major equipment and supplies required to complete the Project are estimated as follows:

Type of Material to be Used	Quantity
Concrete	~2,000 m^3
Gravel	~130,000 tonnes
Inverter	~200 units
Solar panels and racking	~ 426,000 units
Transformer (substation)	1 unit
Security fence – 1.8 m chain link with 0.3 m barbed wire	~34 km
CSP Culvert – 600 mm dia. x 20 m long	~35
Collector lines (34.5 kV)	~33 km
DC cabling on solar sites	~1,500 km

In addition to the main components of the works supplementary materials would include:

- Electrical hardware (switches, controls, junction boxes etc);
- Concrete reinforcing steel and formwork;
- Building hardware (operations building); and
- Septic tank and well system (operations building).

A Traffic Management Plan will be developed in consultation with the Construction Contractor, the City of Kingston, and Loyalist Township to deal with specific traffic planning issues including the management of traffic and the delivery of materials. The Traffic Management Plan would include details on routing of trucks, the use of signage, road closures, speed restrictions, and

load restrictions. The plan will be developed during the detailed design phase, once the construction contracts have been awarded

3.9 Construction Equipment Used

The equipment expected to be used during the construction phase is provided below, based on similar projects. The final selection will be confirmed by the Construction Contractor.

Construction Equipment Type/Description	Quantity
Bulldozers for land clearing and access gravel placement	10
Wheeled loaders	8
Hydraulic backhoes	8
Tractor backhoes for excavations/backfill and loading	8
Graders for road construction and gravel placement	2
Rollers for compaction	5
Cranes for unloading and placement of equipment	4
Dump trucks for moving topsoil and excavated materials	6
Lineman trucks for installation of collector lines	4
Diesel generators/compressors	8

3.10 Timing and Operational Plans

Construction would last approximately 15 months. The proposed schedule will be to commence construction in the first half of 2013 with completion in 2014 as shown in Table 3-1. Upon award of the construction contract, the selected contractor will be required to provide an updated schedule.

Table 3-1: Proposed Construction Schedule

Construction Activity	Estimated Timing *
Site preparation	Q2/2013 – Q3/2013
Installation of solar sites	Q2/2013 – Q2/2014
Installation of collector lines along municipal road allowance	Q3/2013 – Q1/2014
Installation of substation including operations and maintenance building	Q2/2013 – Q2/2014
Site clean-up and restoration	Q1/2014 – Q4/2014

***** Q2/2013 = 2nd quarter of 2013 (April-June)

All construction and installation activities will take place during normal working hours and in accordance with the City of Kingston's noise By-Law No. 2004-52, and Loyalist Township's noise By-Law No. 2011-6.

3.11 Temporary Uses of Land

Temporary facilities will be provided during the construction phase that will be removed at the completion of the work. A central site will be selected by the Contractor for overall Project management and laydown. The area will be used for construction offices, parking, equipment, and materials storage. Contractor trailers will be brought to each solar site as they are developed for storage of materials. The sites would also be serviced with portable toilets. An

area of the substation site would also be used for contractor trailers and storage in relation to work conducted at that site.

At the completion of the work all temporary facilities will be removed and the site restored as per Section 3.7.

3.12 Temporary Water Taking

There will be no required use of water resources (groundwater or surface water) during construction. The project also does not require deep excavations for foundations that would involve extensive dewatering. A mitigation plan will be in place to prevent stormwater runoff from entering open excavations (see Section 4.3.2). Should dewatering be required it will be of short duration and limited quantity due to the relatively small footprint of the panel foundations. Dewatering, if required, is not expected to exceed a rate of 50,000 L/day.

3.13 Materials Generated at or Transported from the Project Location

Minor quantities of waste materials will be generated from the construction activities as excavated soils will be reused on site and there are no demolition activities associated with the development of the Project. Typical wastes would include recyclable materials such as packaging, pallets and scrap metal (electrical cabling). Quantities of non-hazardous wastes and domestic wastes will be removed to a licensed landfill (approximately 4 m^3/week). Minor amounts of hazardous wastes will be generated from construction equipment maintenance, and this will be stored in a secure area awaiting removal by a licensed waste contractor.

Waste materials that will be generated during construction will be temporarily stored on-site and would require reuse, recycling, and/or disposal at an appropriate MOE-approved off-site facility. Prior to commencing construction the Contractor would complete a waste assessment in accordance with *A Guide to Waste Audits and Waste Reduction Work Plans for Construction & Demolition Project*s, as required under Ontario Regulation 102/94. All wastes will be managed in accordance with *Ontario Regulation 347, General – Waste Management* (O.Reg. 347) and with reference to *Ontario Provincial Standard Specification 180 - General Specification For The Management of Excess Materials* (OPSS 180). Waste generated at the construction site will be managed to minimize environmental impacts by:

- Using materials effectively;
- Using, where practical, the principle of reduce, reuse and recycle;
- Informing workers of the risks associated with mismanagement of waste; and
- Selecting appropriate disposal methods where reuse and recycling is not possible.

Soils from excavations will be retained for use on-site. Excess materials generated during the course of construction excavations of soil will be handled in accordance with the MOE's *Protocol for the Management of Excess Materials in Road Construction and Maintenance*. Excess excavated soils may be reused elsewhere on the property with landowner permission.

Solid waste, garbage, trash and debris should only be deposited in the bins designated for pick up. The location of the bins will be selected based on the work in progress. No hazardous waste will be placed into the bins for solid waste, garbage, trash and debris. All hazardous waste will be placed in a secure area to prevent spills. All waste will be removed by a waste contractor that is licensed to accept the wastes. The following waste management activities will be observed:

- Recyclable materials should be stored separately for recycling;
- There will be no burning of waste generated at the site;
- There will be no on-site disposal of wastes at site;
- Domestic waste from site offices including food waste should be stored in closed steel containers for removal and disposal;
- Non-recyclable non-hazardous construction waste should be removed from site on an as required basis for disposal at an approved waste disposal site;
- Hazardous wastes will be stored in a secure area in labelled containers;
- Liquid wastes such as oils and lubricants should be stored in a labelled tank or drum for disposal or recycle; and
- All wastes will be removed by hauler appropriately licensed to manage the wastes.

The cement provider will be responsible for ensuring that wash water from the cleaning of cement truck drums is disposed of in a sewage works designed for that purpose and approved under Section 53.(1) of the *Ontario Water Resources Act*, or under Part 8 of the *Building Code Act.*

3.14 Remediation and Clean-up of Work Areas

After all major construction activities are complete, work areas will be remediated and, with the exception of permanent structures, returned to their pre-construction condition. All debris and surplus materials brought to the site will be removed.

Trucks will be used to remove all non-permanent equipment from the project location, along with any debris. The truck(s) will access the site via the permanent access roads located off of Unity Road and Mud Lake Road. The majority of site clean-up works will occur prior to site landscaping.

3.15 Site Landscaping

Landscaping with low maintenance grass species will occur within the Project Location. Vegetation that could be planted may include a seed mix that provides foraging and breeding habitat for a variety of wildlife that frequents the City of Kingston and Loyalist Township. The selected vegetation would need to grow to low heights only so that the panels are not blocked and shaded.

Landscaping is the final construction activity at the Sol-luce Kingston Solar PV Energy Project. It is anticipated that no heavy machinery or equipment will be required for the planting. Final planting is to be determined in consultation with the Ministry of Natural Resources(MNR). Ongoing landscape maintenance is addressed in the *Design and Operations Report*.

4.0 POTENTIAL NEGATIVE ENVIRONMENTAL EFFECTS AND PROPOSED MITIGATION MEASURES

O.Reg. 359/09 requires that any adverse environmental effects that may result from construction or installation activities be described within 300 m of those activities (known as the zone of investigation). This section describes the potential effects, mitigation measures (if required) and net effects that may result from construction or installation activities within the zone of investigation.

The need, assessment, and selection of protection and mitigation measures discussed in the following sections have been predicated on the hierarchical principles of:

- Avoidance – the elimination of adverse environmental effects by siting, construction scheduling, and design considerations;

- Minimization – reduction or control of adverse environmental effects through project modifications or implementation of protection and mitigation measures; and

- Compensation – enhancement or rehabilitation of affected areas.

The application of these principles has greatly reduced the potential for adverse environmental effects from the Project as demonstrated in the following subsections.

Where net effects remain, they are characterized as either positive or adverse. Positive net effects were not assessed. Adverse net effects were assessed utilizing the following nine descriptors, as applicable:

- Direction: the degree to which an effect may be positive or adverse;
- Duration: the period of time until the element returns to baseline conditions;
- Ecological/Social Context: the nature of the area in which the effect may occur;
- Frequency: the number of times that an effect may occur;
- Magnitude: the degree to which an effect may occur;
- Permanence: the degree to which an effect would not return to baseline conditions;
- Probability: the likelihood that an effect may occur;
- Reversibility: the likelihood that an element would recover from an effect; and
- Spatial Extent: the area within which an effect may occur.

The key performance objective for each of the features discussed below is avoiding and/or minimizing potential effects (through the use of appropriate mitigation measures) to the features throughout the construction phase of the Project. The proposed mitigation measures would assist in achieving this performance objective.

Project construction has the potential to affect the local natural and socio-economic environments. This section examines the interactions between the project activities and the

environment (natural and social). For each component of the environment, the following is described:

1. **Existing Conditions** – describes the potentially affected environmental feature.

2. **Potential Effects** – describes the potential effects, both positive and negative, to the environmental features that may occur as a result of the project.

3. **Mitigation Measures** – Recommends specific mitigative measures that will be implemented to minimize any potential negative effect of the project on environmental features.

4. **Residual Effects** – describes any remaining residual effects after mitigative measures are implemented.

As part of the construction program, good site practices and procedures will be implemented to further reduce the environmental effects as identified in this *Construction Plan Report*. These practices will include specifications and protocols regarding management of excavated material, stormwater runoff and sediment control, dust control, soil compaction control, natural heritage resources, and cultural resources.

Staff and contractors will be made aware of the environmental commitments contained in this report to ensure the commitments are implemented. To reduce the risk of negative environmental impacts the construction stage will be aimed at minimizing the duration of work.

The following sections present the potential negative environmental effects and proposed mitigation measures associated with the Project.

4.1 Cultural Heritage and Archaeological Resources

4.1.1 Protected Properties and Cultural Heritage Resources

In accordance with O.Reg. 359/09, a *Cultural Heritage Assessment Report* was completed for the Project, and is included under separate cover as part of the REA application.

Existing Conditions

As a result of consultation with designating authorities under the *Ontario Heritage Act*, none of the Project properties constitute protected properties under Ontario Regulation 350/09. The *Cultural Heritage Assessment Report* concluded that while all the properties exhibit varying degrees of association with the historical theme of land settlement and related agricultural activity, (namely they are remnant agricultural fields in a larger contextual rural landscape) and possess some contextual value due to historical linkages with their surroundings, none are of sufficient cultural heritage value or interest that would warrant not-developing these lands for solar energy installations.

Potential Effects

As construction activities would not occur on properties containing cultural heritage features, no direct adverse effects on protected properties and heritage resources are anticipated during construction.

Mitigation Measures

Impacts to heritage resources may be short in duration and experienced during construction only or during the post construction phase. The *Cultural Heritage Assessment Report* provided general recommendations consisting of screening along roadways comprising traditional fencing and vegetative plantings in keeping with examples found in the general area. For additional information refer to the *Cultural Heritage Assessment Report*.

Residual Effects

With the implementation of proposed mitigation measures, no adverse effects on protected properties and heritage resources are anticipated during construction of the Project.

4.1.2 Archaeological Resources

Potential Effects

As part of the Renewable Energy Approval Application, Stage 1 and 2 Archaeological Assessments (AAs) were completed on all lands directly affected by construction and/or operations activities during 2011 and 2012. Reports have been submitted to the Ministry of Tourism, Culture and Sport (MTCS). The Proponent has received written acknowledgement that the field work completed in 2011 and associated reports were carried out in accordance with the Standards and Guidelines for Consultant Archaeologists. The Proponent is expecting written acknowledgement for 2012 fieldwork and reports in June 2012.

Where required, Stage 3 and 4 Archaeological Assessments will be conducted prior to construction of the Project. As the presence of archaeological resources is sensitive information, the Province does not recommend public release of the location of these sites in order to protect the resource. (Refer to MOE "*Technical Guide to Renewable Energy Approvals"* (MOE 2011, 2012).

Although the studies and follow-up investigations would define the artefacts of archaeological interest within the areas of the Project lands, there could be a potential to discover additional artefacts during the construction stage.

Mitigation Measures

The following steps will be taken by the Contractor should archaeological materials be encountered during excavation and construction activities:

a) All construction/excavation activities in the vicinity of the find will be stopped immediately;

b) The Site Engineer and Construction Manager will be advised by the Contractor;

c) MTCS and a licensed archaeologist will be contacted to investigate;

d) The appropriate aboriginal communities will be contacted; and

e) No activities in that area would resume until the site had been investigated and cleared by MTCS.

In the event that human remains are encountered or suspected of being encountered before or during construction, all work in the vicinity of the find would stop immediately. Notification would then be made to the Ontario Provincial Police or local police who would conduct a site investigation. The MTCS, affected Aboriginal communities, and the Registrar of Cemeteries, Cemeteries Regulation Unit, Ministry of Small Business and Consumer Services would also be notified.

Residual Effects

By following the procedures recommended above no adverse residual effects on archaeological resources are anticipated during construction of the Project.

4.2 Natural Heritage Resources

Details on natural heritage existing conditions and the potential for effects to these features are described in the *Natural Heritage Assessment and Environmental Impact Study (NHA/EIS) Report*. The following provides a summary of existing conditions, potential effects, and proposed mitigation measures. Figure 1-2 shows the location of natural features in proximity to the project location.

Existing Conditions

In accordance with O.Reg. 359/09, a *Natural Heritage Assessment and Environmental Impact Study (NHA/EIS) Report* was completed for the Project and is included under separate cover as part of the REA application. The *NHA/EIS Report* identified the boundaries and assessed the significance of natural features occurring partially or wholly within 120 m of the Project Location. The *NHA/EIS Report* considers the potential effects and mitigation measures for both the regulated and unregulated natural features.

Some of the sites contain brush, hedgerows and several scattered trees, which will be removed as part of the development. The removal of vegetation by clearing and grading of the site is described in Section 3.2 above. Clearing of vegetation has the potential to impair surface water quality through increased erosion from the sites. The removal of vegetation also exposes soils and has the potential to affect air quality through increasing air-borne dust particles.

By way of a Records Review, information was gathered about the Study Area to identify known or potential natural features occurring within 120 m of the Project Location. Natural features include woodlands, wetlands, protected lands (provincial and national parks, or ANSIs), and wildlife habitat. Site Investigation confirmed the presence and boundaries of natural features reported in the Records Review which occurred within 120 m of the Project Location (see Figure 1-2). Woodlands, wetlands, mammals, reptiles, amphibians, migratory and breeding birds, and species at risk were considered through these investigations. Studies concluded that Project lands provided habitat for a variety of wildlife communities including habitat for declining species.

An Evaluation of Significance was conducted for each natural feature confirmed through the Site Investigation. Significant features were indentified based upon current designation by the MNR, or by comparing the results of habitat quality studies of the feature to evaluation criteria provided or approved by the MNR. Significant natural features identified within 120 m of the Project Location included wetlands, woodlands, and wildlife habitat. These features are summarized below. For additional details see the *NHA/EIS Report* provided under separate cover.

Potential Effects

Wildlife and Wildlife Habitat

Disturbance to wildlife may occur during construction of the solar arrays, access roads, and electrical transmission components resulting from local vegetation removal, increased human activity, increased traffic, noise and dust.

Clearing required for construction of Project components will remove 66.2 ha of vegetation consisting largely of regenerating agricultural lands with lesser amounts of woodland and hedgerow. Agricultural and unused open country account for 58% of the Study Area (as defined in the *NHA/EIS Report*) and as a result, 240.5 ha of unused or fallow agricultural land will be utilized. Wetlands not provincially significant will account for approximately 0.34 ha of vegetation removed. The total area of vegetation cleared within natural features will represent a very small proportion of the natural features provided both within the Project Location, and the Study Area.

Disturbance effects experienced during construction are expected to be short-term in duration and spatially limited to active construction zones and their immediate vicinity. Wildlife mortality is possible during construction and decommissioning, particularly with respect to the increase likelihood of road kill, due to increased traffic on local roadways. Limited wildlife mortality is expected to occur directly as a result of construction or decommissioning of solar arrays, access roads, fencing, transmission lines, or inverter stations.

Woodlands and Wetlands

Though the majority of project components will be located outside of woodland boundaries, a total of 8.1 ha of woodland habitat will be cleared of all vegetation to accommodate project components.

Project components not requiring vegetation removal will also occur within 120 m of woodlands. Potential impacts and mitigation measures are detailed in the *NHA/EIS Report*.

Two of fourteen wetlands occurring within 120 m of the Project Location are located within the boundary of the Project. Both wetlands are contained entirely within an agricultural field. Consequently, a total of 0.34 ha of wetlands will be cleared for construction of project components. Project components (e.g., solar panels, access roads and corresponding buried collector lines) not requiring vegetation removal will also occur within 120 m of wetlands.

Disturbance to woodland and wetland features is expected to lessen during the operation of the Project since vehicular traffic, human activity, and ground disturbance will be greatly reduced as compared to construction or decommissioning phases. The potential for accidental spills of harmful fluids is minimal during the operation of the Project as there will be no major equipment required during routine maintenance of the Project. It is also anticipated that dust created from Project activities during operation will be minimal.

Mitigation Measures

Wildlife and Wildlife Habitat

There is potential for disturbance to wildlife as a result of construction activities such as clearing of vegetation and increased traffic. Discussion between the MNR, the Proponent and relevant agencies has been on-going to address and provide mitigation strategies for negative impacts the Project may have on significant wildlife habitat or species of conservation concern. Potential effects and mitigation measures associated with endangered and threatened species are being addressed as part of a separate process in cooperation with the Ministry of Natural Resources (MNR).

The *NHA/EIS Report* submitted for MNR approval includes environmental impact statements including mitigation measures for areas of vegetation removal. The following general mitigation measures will apply:

- Delineate construction area with stakes and flagging, construct silt barrier around periphery of the buildable areas and maintain appropriate distance from trees on edge of woodland (tree removal within woodland area shall not be permitted);

- Maintain vehicles and equipment in good repair, equipped with emission controls, as applicable. Construction equipment will be stored and secured in areas using site silt fencing and stored in an area not subject to water erosion;

- Where the separation distance between significant natural heritage features and the Project site perimeter is 30 m or less, the significant natural feature will be well demarcated such that all construction activities and personnel are excluded from these areas and sufficient buffers are provided to minimize any disturbance to existing vegetation around the Project site perimeter (excluding potential tree pruning requirements);

- After PV panels have been installed, temporary construction areas such as the laydown and storage areas will be restored to pre-existing conditions as soon as practical; and

- The mitigation measures will be installed where required on each site and would remain in place for the duration of the construction.

Further details about potential negative environmental effects on natural heritage features and proposed mitigation measures described in the Environmental Effects Monitoring Plan and Construction Plans to address these effects are available in the *Natural Heritage Assessment and Environmental Impact Study (NHA/EIS) Report*.

Woodlands and Wetlands

A setback of 30 m of Project infrastructure from wetlands will be observed when possible to avoid disruption of wetland function and net loss of wetland area. Some disturbance to other wetland habitat occurring within 120 m of the Project Location may result due to increases to local traffic, human activity, and dust. Potential impacts and mitigation measures are detailed in the *NHA/EIS Report*. These disturbances are expected to be short-term in duration and spatially limited to the construction zones and their immediate vicinity.

During construction, vehicles and construction equipment requiring fuel, lubricating oils, or other industrial fluids will be present on site. Accidental spills of harmful fluids associated with construction or decommissioning have the potential to filter into wetland features and may have a negative environmental impact. It is anticipated that with the implementation of best management practices, any potential effects from an accidental spill would be short term in nature and have negligible negative environmental effects.

Where woodland habitat removal is required, the following mitigation measures should be implemented:

- Tree pruning or removal will be minimized to the greatest extent possible;

- To the extent practical, pruning will be avoided during leaf fall, typically between September to November;

- As appropriate and prior to construction, the limits of woodland habitat removal will be marked in the field. The Construction Contractor would ensure that no construction disturbance occurs beyond the marked limits; and

- To the extent practical, woodland habitat removal will be completed prior to or after the breeding season for migratory birds (May 1 to July 31). Should this be required during the breeding bird season, prior to construction, surveys will be undertaken to identify the presence/absence of nesting birds. If a nest is located, a designated buffer will be marked off within which no construction activity will be allowed while the nest is active. The radius of the buffer width ranges from 5 - 60 m depending on the species. Buffer widths are based on the species sensitivity and on buffer width recommendations of Environment Canada.

Further details about potential negative environmental effects on natural heritage features and proposed mitigation measures described in the Environmental Effects Monitoring Plan and Construction Plans to address these effects are available in the *Natural Heritage Assessment and Environmental Impact Study (NHA/EIS) Report*.

Residual Effects

Due to the abundance of similar habitat features in surrounding areas and lands adjacent to the Project Location, it is anticipated that the Project will have no residual effect on wildlife populations in the area. Efforts have been made to preserve habitat or greatest ecological significance to wildlife guilds residing in the Project Location and will result in the conservation of habitat of declining species.

When possible, setbacks from wetlands and mitigation measures for infrastructure within 30 m of wetlands will ensure that there is no disruption of wetland function and no net loss of wetland area.

4.3 Water Bodies and Aquatic Resources

4.3.1 Surface Water, Fish and Fish Habitat

Details on surface water bodies (e.g., lakes, watercourses) within 120 m of the Project Location and the potential for effects to these features are described in detail in the *Water Assessment and Water Body Report* (refer to *Design and Operations Report* **Appendix C**). This includes information obtained during the records review and site investigations.

A fish habitat assessment was conducted to determine the quality of fish habitat within 120 m of the Project Location. This assessment was carried out according to criteria established by the MNR (1994) on levels of protection required for proposed developments in and around lakes and watercourse. This assessment was also used to characterize watercourses according to Fisheries and Oceans Canada (DFO) fish habitat types. Details related to the site investigations are provided in the *Water Assessment and Water Body Report*.

The following provides a summary of existing conditions and potential effects.

Existing Conditions

The Project is not anticipated to require significant alteration to surface water runoff, or to involve the storage of surface water. The access roads will not impact stormwater flow as culverts will be installed where required.

Based on the current Project layout, in-water work would potentially affect fish or fish habitat, or areas that contain fish habitat or contribute indirectly to fish habitat, at seven locations which include:

- Glenvale Creek Tributary 2 at P14-B3;
- Glenvale Creek Tributary 2b at P5-A;
- Glenvale Creek Tributary 2c at P6A-4;
- Millhaven Creek Tributary 2a at P23-Northern-1;
- Millhaven Creek Tributary 2b at P23-B-2;
- Property 20 Drainage at P19; and
- South of Property 4 Leased Area Drainage & Pond.

The general construction-related impacts of the Project on water features located with 120 m of the Project Location could include:

- Soil erosion and movement during construction;
- Short-term increase in turbidity from runoff; and
- Water quality and habitat effects.

Potential Effects

Construction activities would have the potential to impair surface water quality through the increased erosion from the site due to clearing vegetation and excavation of soils. The result can be increased levels of particulate in the stormwater runoff. While this potential adverse effect is common to most construction sites, best management practices have been developed to mitigate the effects. Some access roads and power lines would require crossing of a watercourse and have the potential to affect fish or fish habitat if not properly managed.

Potential effects to water bodies and fish habitat resulting from the Project relate to three general activities as follows:

- Solar Panel Installation:
  - Increase in watercourse turbidity.

- Culvert and Access Road Construction:
  - Disturbance to aquatic biota and habitat during installation;
  - Permanent enclosure of portions of a watercourse;
  - Loss of bed material within the length of the culvert; and
  - Changes to riparian vegetation within road allowance.

- Overhead and Underground Collector Lines Installation:
  - Erosion and sedimentation from site disturbance and dewatering;
  - Collapse of the punch or bore hold under the stream;
  - Disturbance of riparian vegetation can reduce cover, shade and thermal regimes and food production areas; and
  - Machinery fording the stream can disturb bottom and bank substrates, disrupt sensitive fish life stages and introduce deleterious substances (i.e., equipment is not properly maintained).

General Mitigation Measures

General mitigation measures for construction activities near a watercourse include:

- All in-water work would be completed within MNR timing windows to protect local fish populations during their spawning and egg incubation periods. A typical construction timing window for warm water streams in MNR's Kingston District is July 1 to March 15; however, the DFO timing window for this region for spring spawning fish as inhabit the watercourses in the Project location is July 15 to March 15 as it applies to projects completed using DFO Operational Statements;

- All materials and equipment used for the purpose of site preparation and Project construction would be operated and stored in a manner that prevents any deleterious substance (e.g., petroleum products, silt, etc.) from entering the water:
  - Any stockpiled materials should be stored and stabilized away from the water;
  - Refuelling and maintenance of construction equipment should occur a minimum of 100 m from a water body;
  - As appropriate, spills will be reported to the MOE Spills Action Centre;
  - Any part of equipment entering the water should be free of fluid leaks and externally cleaned/degreased to prevent any deleterious substance from entering the water; and
  - Only clean material, free of fine particulate matter should be placed in the water.

- Sediment and erosion control measures will be implemented prior to construction and maintained during the construction phase to prevent entry of sediment into the water:
  - Silt fencing and/or barriers will be used along all construction areas adjacent to natural areas;
  - No equipment would be permitted to enter any natural areas beyond the silt fencing during construction;

- All sediment and erosion control measures will be inspected at least weekly and during and immediately following rainfall events to ensure that they are functioning properly and are maintained and/or upgraded as required;
- Topsoil stockpiles will be sufficiently distant from watercourses to preclude sediment inputs due to erosion of stored soil materials;
- If the sediment and erosion control measures are not functioning properly, no further work would occur until the sediment and/or erosion problem is addressed;
- All disturbed areas of the construction site will be stabilized immediately and re-vegetated as soon as conditions allow; and
- Sediment and erosion control measures would be left in place until all areas of the construction site have been stabilized.

Mitigation Measures for Solar Panel Installation

To minimize watercourse turbidity due to solar panel installations, refer to the general mitigation measures included above.

Mitigation Measures for New Culvert Crossings

Culverts will be required at watercourse crossings at access roads and for conveyance at specific locations within the Project Location for storm water management. Culverts must be sized according to hydrologic requirements of the watercourse or conveyance feature which will be determined during the detailed design and permit application stage. It is possible that other technical requirements may influence culvert size and materials.

Where fish habitat is present, culverts must be installed such that fish passage is maintained. Where a watercourse provides indirect habitat, the culvert must continue to convey flow to downstream areas.

An Environmental Monitor (or designate) would be on-site during construction of watercourse crossings to ensure compliance with specifications and site plans. In particular, the Construction Contractor would ensure that pre-construction preparation is completed prior to commencement of in-stream work and that bank, bed, and floodplain conditions are restored to pre-construction conditions following completion of any construction activities.

Specific methods for culvert installation will be dependent on culvert type, size and construction season. If a temporary access road is required, the *DFO Operational Statement for Temporary Stream Crossings* can be used. This Operational Statement includes details for mitigation measures. In addition to the mitigation outlined in this report, further requirements may apply as a condition of permits obtained from the CRCA.

Under flowing water conditions, water must be pumped around the work area in order to install a culvert. The following steps outline how a site can be isolated for culvert construction:

- Coffer dams (e.g., aqua-dams, sand bags, concrete blocks, steel or wood wall, clean rip rap, sheet pile or other appropriate designs) can be used to separate the in-water work site from flowing water;

- If rip rap or sand bags are used, clean, washed material would be used to build the berm. The berm face would consist of clean, washed granular material that is adequately sized (i.e., moderate sized rip rap and not sand or gravel) to hold the berm in place during construction. Material to build the berms would not be taken from below the high water mark;

- Coffer dams would be designed to accommodate any expected high flows of the watercourse during the construction period;

- Before starting construction, fish would be salvaged from behind the coffer dam and returned to an area immediately upstream of the isolated area. Salvage operations must consist of techniques that successfully target the species and size classes of fish that inhabit the watercourse reach;

- Accumulated sediment would be removed (ensuring that the original bed of the watercourse is not excavated) from behind the coffer dam before its removal;

- The original channel bottom gradient and substrate would be restored after coffer dam removal;

- Water from dewatered areas would be treated or diverted into a vegetated area or settling basin to remove suspended solids and prevent sediment and other deleterious substances from entering the watercourse;

- Coffer dams would be removed in a downstream to upstream sequence to allow gradual re-introduction of water to the dewatered area and prevent excessive suspension of silt or other bed material;

- Pump intakes would be sized and adequately screened to prevent debris blockage and fish mortality (refer to the *DFO Freshwater Intake End-of-Pipe Fish Screen Guidelines*);

- The pumping system would be sized to accommodate any expected high flows of the watercourse during the construction period. Back-up pumps would be kept on site in case of pump failure;

- The pump would be discharged to a grassed area to allow water to re-enter the watercourse only after it has been filtered through vegetation to prevent silt deposition. If no suitable areas exist, a filter bag would be place on the outlet to filter the water prior to re-entry into the watercourse;

- Work would not be completed during flood stage flows or during times when heavy precipitation is occurring or is expected; and

- The work must be carried out in such a way as to prevent sediment or debris from entering natural watercourses as outlined in a Sediment Control Plan.

Mitigation Measures for Overhead Collector Lines

The *DFO Ontario Operational Statement Habitat Management Program: Overhead Line Construction* provides measures to protect fish and fish habitat when undertaking this construction of this type. Although construction of overhead lines (as required) does not typically require any in-water works, riparian habitat is sensitive to disturbance from overhead line construction. Riparian vegetation occurs adjacent to watercourses and directly contributes to fish habitat by providing shade (thermal refuge), cover, and provides allochthanous habitat and food inputs.

Mitigation Measures for Underground Collector Lines

Crossing techniques that may be employed for installation of a buried collector line include: 1) punch or bore, 2) high pressure directional drilling, 3) dry open-cut crossing and 4) isolated open-cut crossing, in order of preference by DFO for the protection of fish and fish habitat. DFO Operational Statements for each of these methods are included in the *Water Assessment and Water Body Report* (refer to *Design and Operations Report* **Appendix C**).

A summary of mitigation measures for Dry Open-Cut crossings and Isolated Open-Cut crossings is provided below:

Dry Open-Cut (Dry Watercourses)

- Crossings would be undertaken on days when precipitation is not expected;

- The tracked excavator would be working in the dry when excavating a trench;

- Temporary topsoil stockpiles would be located away from watercourses to preclude sediment inputs due to erosion of stored soil materials;

- Water crossings would be backfilled with substrate material that is consistent with the existing substrate size and texture and would remain in/under the crossing;

- The water crossing bed and bank areas would be rehabilitated to pre-excavation condition; and

- Materials such as sand bags, straw bales, geotextile filters, and/or pumps would be readily available on-site so that the crossing can be completed in the dry in case of unexpected stream flow.

Isolated Open-Cut (Dam and Pump Crossings)

Mitigation measures to employ for a low flow watercourse include:

- Where an open cut crossing is not possible, in-stream work would be completed in the dry by de-watering the work area and diverting and/or pumping flows around cofferdams placed at the limits of the work area;
- To the extent practicable, crossings would take place on days when precipitation is not expected;
- To the extent practicable, crossings would take place on days when precipitation is not expected;
- Existing stream flows shall be maintained downstream of the de-watered work area without interruption, during all stages of the work;
- Fish, if present, shall be removed from the work area prior to de-watering and released alive immediately upstream;
- Flow dissipaters and/or filter bags, or equivalent, would be placed at water discharge points to prevent erosion and sediment release;
- Sediment laden dewatering discharge can be pumped to a temporary settling basin well away from the watercourse and allowed to settle and/or filter through the riparian vegetation before re-entering the watercourse downstream of the construction area;
- As conditions warrant the work area would be stabilized against the impacts of high flow events at the end of each workday;
- Work in the channel and floodplain will be suspended and the work area stabilized when there is a high probability of a convective rainfall event and during warm winter periods when there is a high likelihood of significant snowmelt runoff;
- Silt or debris that has accumulated around the temporary cofferdams would be removed prior to their withdrawal; and
- If greater than 50,000 L/day is to be taken from the dewatering area, a Permit to Take Water may be required. However, this is not anticipated to be necessary.

Residual Effects

With the proper implementation of the procedures recommended above no adverse residual effects on water bodies and fish habitat are anticipated during construction of the Project.

4.3.2 Groundwater Effects (Impacts Related to Water-Takings)

Potential Effects

No potential effect on local wells has been predicted as the Project does not require deep excavations for foundations that would involve extensive dewatering during construction. The Project is located in an area of shallow overburden with rock outcrops. Should there be a requirement for dewatering during placement of footings the duration will be short and the rate will be less than 50,000 L/day.

Some materials, such as fuel and other fluids associated with construction equipment have the potential for discharge to the environment through accidental spills and thus infiltrate groundwater supplies.

Mitigation Measures

It is unlikely that quantities of water withdrawn during the course of excavations will exceed the threshold for the MOE's requirement for a Temporary Permit to Take Water (i.e., >50,000 L/day). Therefore, it is not anticipated that the construction of the Project would adversely affect groundwater quality, quantity, or movement. Any water pumped from excavated areas will be directed away from natural features and not directly into wetlands.

General mitigation measures include:

- The perimeter of excavations should be graded to prevent surface runoff from entering;
- Before dewatering, any oil (free product) on the water will be completely removed or contained in the excavation through the use of sorbent booms; keeping the pump intake hose submerged and directing the discharge to a filter bag or hay bale structure;
- Water pumped from an excavation would not be discharged directly to a watercourse or wetland and must be filtered through vegetation or by the use of a filter bag on the end of the discharge hose (or temporarily stored in appropriate-sized settlement ponds). Water entering watercourses should not have a TSS concentration exceeding 25 mg/L.;
- Only nonwoven fabric filter bags will be used for dewatering; and
- The Contractor would dispose the filter bags in an approved landfill.

In the event that well water quality or quantity is disturbed as a result of construction, a temporary potable water supply will be provided until corrective measures are taken and would comply with MOE's *Guideline B-9: Resolution of Groundwater Interference Problems*.

In terms of accidental spills or releases to the environment, undesirable materials on-site are limited to fuel, lubricating oils, and other fluids associated with solar facility construction equipment. Large quantities of these materials would not be stored at the Project site and do not represent a significant potential adverse effect on the groundwater in the event of accidental spills. As per s.13 of the *Environmental Protection Act*, all spills that could potentially have an adverse environmental effect, are outside the normal course of events, or are in excess of the prescribed regulatory levels will be reported to the MOE's Spills Action Centre.

A Construction Emergency Response and Communications Plan will be developed by the Construction Contractor and/or the Proponent and would include protocols for the proper handling of material spills and associated procedures to be undertaken in the event of a spill. See Section 5.0 for more information on the Emergency Response and Communications Plan.

Residual Effects

With the implementation of good construction practices mentioned above, it is anticipated that any potential effects will be short term in nature and have little to no effect on groundwater quality, quantity or movement.

4.4 Air Quality - Exhaust and Dust Emissions

4.4.1 Air Quality – Exhaust Emissions

Potential Effects

Construction activities rely on the use of a wide range of mobile equipment, such as dump trucks. The engine exhaust from these vehicles, especially from those operating on diesel fuel, represent a source of particulate and other emissions (e.g., sulphur dioxide, nitrogen oxide, volatile organic compounds, polycyclic aromatic hydrocarbons, and carbon dioxide) from the construction-site. Traffic delays also result in increased exhaust emissions from vehicles traveling slowly through construction zones. The delivery of materials such as concrete to construction-sites can also generate emissions, especially for sites that are relatively far from material manufacturers.

Mitigation Measures

To reduce emissions from equipment and vehicles, several mitigation measures will be employed:

- Multi-passenger vehicles should be utilized to the extent practical;
- Company and construction personnel should avoid idling of vehicles when not necessary for construction activities;
- Equipment and vehicles should be turned off when not in use unless required for construction activities and/or effective operation;
- Equipment and vehicles should be maintained in good working order with functioning mufflers and emission control systems as available;
- All vehicles should be fitted with catalytic converters as required;
- All construction equipment and vehicles should meet the emissions requirements of the MOE and/or MTO;
- As appropriate, records of vehicle maintenance should be retained and made available for periodic review by the Construction Contractor; and
- All vehicles identified through the monitoring program that fail to meet the minimum emission standards will be repaired immediately or replaced as soon as practicable.

A Construction Traffic Management Plan will be developed by the Construction Contractor and would include protocols for the management of traffic and for the delivery of materials to the construction-site.

Residual Effects

The application of the recommended mitigation measures during construction should limit air emissions to the work areas and limit the magnitude of combustion emissions. As a result, any adverse net effects to air quality from air exhaust emissions are anticipated to be short-term in duration and highly localized.

4.4.2 Air Quality – Dust Emissions

Potential Effects

Air quality effects will be primarily due to particulate matter (dust emissions) from overburden disturbances during excavation and backfill, soils exposure and stockpiling, and placement of gravel on access roads.

During dry conditions, dust may be generated from the work sites and access roads. This may have a detrimental impact on the local environment, construction safety or integrity, and may also cause disruption to the normal activities of nearby residences. The mitigation includes best management practices which are common to the construction industry.

Mitigation Measures

The following procedures will be implemented to ensure the potential impacts from dust are minimized:

- Apply dust suppressants such as water, or calcium chloride dust suppressant on the work sites as required (calcium chloride should not be used on agricultural fields);
- Maintain adequate control of dust at sites that are in close proximity to residences;
- Enforce low speed limits for trucks on site as appropriate;
- Re-vegetate exposed soils as soon as possible;
- As appropriate, protect stockpiles of friable material with a barrier or windscreen and in the event of dry conditions and dust;
- Consult with local road authorities prior to application of dust suppressants on public access roads; and
- Ensure dust generation is monitored and controlled in areas of sensitive land use.

Residual Effects

The above mitigation measures are consistent with good construction practice and should limit dust emissions to the work area. The potential for adverse effects will be short term and localized.

4.5 Noise

Potential Effects

During construction, noise from construction equipment and trucks hauling materials to site could become a nuisance to nearby residents.

Mitigation Measures

The following procedures will be implemented to ensure potential impacts from construction are minimized.

- Equipment and vehicles will be maintained in good working condition to limit engine noise;

- Company and construction personnel should avoid idling of vehicles when not necessary for construction activities;

- The Contractor will be required to use noise abatement equipment, in good working order, on all heavy machinery used on the Project; and

- All construction and installation activities would take place in accordance with the City of Kingston's noise By-Law No. 2004-52, and Loyalist Township's noise By-Law No. 2011-6.

Residual Effects

The above mitigation measures are consistent with good construction practice and should limit noise emissions to the vicinity of the work area. The potential for adverse effects will be short term and localized. It is anticipated that the effects of noise from construction equipment will be minimal.

4.6 Fuel Spills

Potential Effects

The potential exists for spills during any construction activity. The most probable type of spill will be from refuelling of major construction equipment that cannot readily leave the site. This refuelling will be completed from service vehicles. The potential effects of a spill could be the contamination of soils, groundwater or surface water.

Mitigation Measures

By implementing proper handling of fuels and lubricants during construction, the likelihood of accidental events that result in adverse effects to the environment will be prevented or greatly reduced. The following procedures will be implemented to prevent spills:

- All trucks or other road vehicles should be refuelled and maintained off site, where practicable;

- Refuelling and lubrication of other construction equipment should not be allowed within 30 m of a waterway, wetland, or drainage systems;

- Regular inspections of hydraulic and fuel systems on machinery should be done, and leaks should be repaired immediately upon detection or the equipment removed from site;

- Spill kits containing absorbent materials should be kept on hand; and

- Implement best management practices and develop an emergency spill response plan.

In terms of accidental spills or releases to the environment, standard containment facilities and emergency response materials will be maintained on-site as required. Refuelling, equipment maintenance, and other potentially contaminating activities would occur in designated areas, and as appropriate spills will be reported immediately to the MOE Spills Action Centre.

Residual Effects

As the work would not involve the storage or use of bulk chemicals or fuels, a potential spill will be of small volume and the effects localized. With implementation of the above mitigation measures the probability of a spill occurring will be low.

4.7 Public Health and Safety

Potential Effects

There is potential for increased construction-related road traffic and unauthorized access of the public to the Project's construction sites. Unexpected accidents and malfunctions such as fires and spills also pose a risk to public health and safety.

Recreational uses of land adjacent to the Project Sites may also pose a safety risk due to presence of large construction equipment on-site during construction period.

Mitigation Measures

A detailed Traffic Management Plan and a detailed Emergency Response Plan will be developed in consultation with the City of Kingston and Loyalist Township and implemented by the Construction Contractor. The Traffic Management Plan will cover all necessary information such as haul routes, signage, detours, etc.

Security fencing and gates will be present at all construction sites and land access to the sites will be restricted to authorized personnel only. Regular inspection will be made during construction phase of the Project to ensure perimeter fencing and gates are intact and adequately maintained.

The Emergency Response Plan will include a plan for the proper handling of spills during a spill event. The plan would also include key contact information for emergency service providers, a description of the chain of communications and how information will be disseminated between the Proponent and/or the Contractor and the relevant responders. The plan would also indicate how the Proponent and/or the Contractor would contact (via phone or in-person) Project stakeholders who may be directly impacted by an emergency so that the appropriate actions can be taken to protect stakeholders health and safety.

Residual Effects

With application of the above mitigation measures, and adherence to safety procedures and policies, the risk to public health and safety from construction of the Project will be minimal.

4.8 Land Use, Resources and Infrastructure

Potential Effects

Agricultural Lands and Soils

A small section of the Project is located within the City of Kingston's Prime Agricultural Land Use Zoning (City of Kingston Official Plan, 2012). Temporary loss of agricultural land will occur for the duration of the project. Mitigation measures will ensure no impact to surrounding land uses.

It is not anticipated that contaminated soils will be encountered during construction; however, if contaminated soil is encountered during the course of excavations, the contaminated material will be disposed of in accordance with the appropriate provincial legislation, such as *Ontario Regulation 347, the General – Waste Management Regulation*.

Provincial Plan, Policies and Recreational Uses

There are no areas protected under provincial plans and policies within 120 m of the Project Location. Recreational uses will not be permitted on lands required during construction phase of the Project as it would be unsafe for public due to the large construction equipment on-site. The construction of the Project will not result in the creation of access to previously inaccessible areas as the Project is located in areas already cleared for agricultural uses.

Mineral, Aggregate and Petroleum Resources

Environmental effects from the Project on aggregate resources, landfill sites, petroleum wells, or forest resources are not anticipated. The Project will not require the creation of a new pit or quarry and as such a license of permit under the *Aggregate Resources Act* will not be sought.

Local Roads and Traffic

There is potential for an increase in traffic during construction on roadways within the Project Area due to commuting workforce, the transport of Project components, construction machinery, equipment and supplies, and to remove excess materials and waste from the Project Area. Truck trips will be noticeably reduced after the access roads and solar panels have been installed and the Project components are on-site. The increase in traffic may result in short-term, localized disturbance to traffic patterns, increase in traffic volume, and create potential traffic safety hazards. The use of local roads by the construction equipment also has the potential to affect the road bed/condition.

Mitigation Measures

Agricultural Lands and Soils

The solar facility will be constructed on lands with low agricultural potential. O.Reg. 359/09 and the Feed-in-Tariff (FIT) program clearly state that any solar project with a Contract Capacity greater than 100 kW cannot be located (built) in Canadian Land Inventory (CLI) Class 1 Lands, CLI Class 2 Lands or CLI Class 3 Lands that have not been designated as Class 3 Available Lands. Therefore the proponent is not allowed to build on agricultural lands of these classifications in neither City of Kingston nor Loyalist Township. Although not required by O.Reg. 359/09, the Proponent has taken the initiative to further minimize development on City of Kingston zoned Prime Agricultural Lands in response to community input and preservation of wildlife habitat while balancing its obligations to the province of Ontario which is to produce 100 MW AC of power.

Construction activities will be restricted to the delineated construction areas and following the completion of construction, as appropriate, temporary workspaces will be graded and de-compacted (if required), the topsoil replaced, and the area left as close to pre-existing condition as possible.

If contaminated soil is encountered during the course of excavations, the contaminated material will be disposed of in accordance with the appropriate provincial legislation, such as *Ontario Regulation 347, the General – Waste Management Regulation*.

Provincial Plan, Policies and Recreational Uses

Recreational uses will not be permitted on lands required during the construction phase as it would be unsafe for recreational users due to the large construction equipment on-site. As such, there are no mitigation measures required.

Mineral, Aggregate and Petroleum Resources

As no potential effects are anticipated to existing mineral or aggregate resources, no mitigation measures are necessary.

Local Roads and Traffic

The Construction Contractor would implement a Traffic Management Plan to identify and deal with specific traffic planning issues including the management of traffic and the delivery of materials. The Traffic Management Plan will be developed in consultation with the City of Kingston and Loyalist Township and would include consideration of:

- Routing of trucks;
- Seasonal load limits on local roads;
- Access to sites;

- Signage and traffic control (flagmen);
- Detours or lane closures; and
- Construction parking.

The roads will be inspected before commencement of construction to determine condition and a post construction assessment will be completed to determine changes. The roads will be returned to their preconstruction condition. The roads would also be monitored after heavy rain events during the construction period and road repairs made if required. This would include new access points and roadside drain crossings. Detailed plans or agreements regarding maintenance and/or repairs of the local roads damaged during construction will be developed with the City of Kingston and Loyalist Township.

Residual Effects

There are no anticipated residual effects related to land use, resources and infrastructure as a result of construction of the Project. Truck traffic would increase on some roads during panel and other component deliveries, but will be restricted to predetermined routes and times to the greatest extent possible. Road safety is not expected to be an issue during the construction phase; however, the potential for accidents along the haul routes and on-site cannot be totally avoided. The Project's effect on the rural community during construction, including the suspension of recreational uses and some disturbance to adjacent land uses, will be temporary and will be minimized through the implementation of good site practices, and good communication with the community.

Table 4-1 below provides an overall summary of the potential construction effects and proposed mitigation measures.

Table 4-1: Overall Summary of Potential Construction Effects and Proposed Mitigation Measures

Environmental Component	Sources of Negative Effects	Potential Negative Effect	Mitigation Measures	Residual Negative Effect
Heritage & Archaeological Resources	• Excavation required for installation of the facility.	• Potential disturbance of archaeological resources during Project construction/installation; and • Although the studies and follow-up investigations would define the artefacts of archaeological interest within the areas of the Project lands, there could be a potential to discover additional artefacts during the construction stage.	• Stage 1 & 2 Archaeological Assessments (AAs) have been completed on all Project lands. Additional Stage 3 and 4 AAs would be completed as necessary prior to construction; • The Project does not involve the removal or alteration of protected properties, heritage buildings or structures; • Electrical collector line works are proposed to occur predominantly within existing, previously disturbed road right-of-ways, thus reducing the potential for encountering previously undisturbed archaeological materials during collector line construction; • The following steps will be taken by the Contractor should archaeological materials be encountered during excavation and construction activities: a) All construction/excavation activities in the vicinity of the find will be stopped immediately; b) The Site Engineer and Construction Manager will be advised by the Contractor; c) A Ministry of Tourism, Culture, and Sport and a licensed archaeologist will be contacted to investigate; d) The appropriate aboriginal communities will be contacted; and e) No activities in that area would resume until the site had been investigated and cleared by the Ministry of Tourism, Culture, and Sport.	By following the procedures recommended above no adverse residual effects on archaeological resources are anticipated during construction of the Project.
Natural Heritage Resources A. Wildlife and wildlife habitat	• Changes in site topography, placement of Project components, ditches, etc.; and • Construction and installation activities	• Installation of the solar panels in existing agricultural fields would impact bird species and wildlife that use agricultural fields for foraging and protection; however, the impact would be localized (restricted only to the fields in which the solar panels are constructed); • Grassland breeding birds may avoid nesting in the vicinity of solar panels and may move to other nearby habitat. There was a lack of staging habitat for shorebirds and waterfowl within the study area; therefore, the potential for impacts to these birds is minimal; • Due to the lack of topographic features at the study site that would concentrate raptors, and the small number of raptors observed onsite, there is limited potential for raptor mortality as a result of the Project. However, wintering and migrating Bald Eagles have been observed. The installation of new electrical generation and electrical transmission infrastructure may have the potential to affect Bald Eagles;	• The primary mitigation measure employed to reduce impacts to significant specialized wildlife habitat and their functions was avoidance where possible; • Modifications to the layout were made to avoid placing the Project in features identified as significant through the Site Investigation and Evaluation of Significance for this Project; • Micro-siting decisions made during the final development of the Project layout considered minimizing impacts to significant specialized wildlife habitat; • It is anticipated that land gaps occurring between distinct blocks of solar panels will provide sufficient passage for larger mammals unable to pass through the fence to be installed around the solar area. Smaller wildlife such as small mammals, amphibians, reptiles, and insects will be able to pass through the fence and cross the solar bocks; • Traffic volumes, both during construction and post-construction maintenance, are anticipated to be low and would not constitute a significant threat to mammals, reptiles and amphibians; • The post-construction periods and lack of noise disturbance would generally allow for the re-establishment of these habitat types;	The net residual effects on raptor area and the birds that use them are expected to be low to minimal with the implementation of these mitigation plans and periodic monitoring and inspection of standard site control measures. Due to the abundance of similar habitat features in surrounding areas and lands adjacent to the Project Location, it is anticipated that the Project will have no residual effect on wildlife populations in the area. Efforts have been made to preserve habitat or greatest ecological significance to wildlife guilds residing in the Project Location and will result
		• Habitat loss due to the construction of access roads adjacent to woodland and thicket or in grassland habitats may result in some limited effects to wildlife; and • Potential effects may result from construction and access road crossings of existing drainage features,	• Where tree trimming is required such as along the collector line routing (as determined during the construction phase), the following mitigation measures should be implemented: a) Tree pruning will be minimized to the greatest extent possible; b) To the extent practical, pruning will be avoided during leaf fall, typically between September to November; c) As appropriate and prior to construction, the limits of tree pruning	in the conservation of habitat of declining species.

Environmental Component	Sources of Negative Effects	Potential Negative Effect	Mitigation Measures	Residual Negative Effect
		which may represent amphibian habitat.	will be marked in the field. The Construction Contractor would ensure that no construction disturbance occurs beyond the marked limits; and d) To the extent practical, tree pruning will be completed prior to or after the breeding season for migratory birds (May 1st to July 31st). Should pruning be required during the breeding bird season, prior to construction, surveys will be undertaken to identify the presence/absence of nesting birds. If a nest is located, a designated buffer will be marked off within which no construction activity will be allowed while the nest is active. The radius of the buffer width ranges from 5 - 60 m depending on the species. Buffer widths are based on the species sensitivity and on buffer width recommendations of Environment Canada.	
B. Woodlands and Wetlands		• Removal of 8.1 ha of woodlands to accommodate Project components during construction; • Removal of 0.34 ha of wetlands for construction of Project components; and • Accidental spills of harmful fluids associated with routine maintenance of the Project have the potential to filter into woodland and wetland features and may have a negative environmental impact.	• A setback of 30 m of Project infrastructure from wetlands will be observed when possible to avoid disruption of wetland function and net loss of wetland area. Some disturbance to other wetland habitat occurring within 120 m of the Project Location may result due to increases to local traffic, human activity, and dust. Potential impacts and mitigation measures are detailed in the NHA/EIS Report. These disturbances are expected to be short-term in duration and spatially limited to the construction zones and their immediate vicinity; • Disturbance to woodland and wetland features is expected to lessen during operation of the Project since vehicular traffic, human activity, and ground disturbance will be greatly reduced as compared to construction or decommissioning phases; • It is anticipated that with the implementation of best management practices, any potential effects from an accidental spill would be short term in nature and have negligible negative environmental effects. It is also anticipated that dust created from Project activities during operation will be minimal; • The following general mitigation methods will apply for areas of vegetation removal: a) Delineate construction area with stakes and flagging, construct silt barrier around periphery of the buildable areas and maintain appropriate distance from trees on edge of woodland (tree removal within woodland area shall not be permitted); b) Maintain vehicles and equipment in good repair, equipped with emission controls, as applicable. Construction equipment will be stored and secured in areas using site silt fencing and stored in an area not subject to water erosion; c) Where the separation distance between significant natural heritage features and the Project site perimeter is 30 m or less, the significant natural feature will be well demarcated such that all construction activities and personnel are excluded from these areas and sufficient buffers are provided to minimize any disturbance to existing vegetation around the Project site perimeter (excluding potential tree pruning requirements); d) After PV panels have been installed, temporary construction areas such as the laydown and storage areas will be restored to pre-existing conditions as soon as practical; and e) The mitigation measures will be installed where required on each site and would remain in place for the duration of the	When possible, setbacks from wetlands and mitigation measures for infrastructure within 30 m of wetlands will ensure that there is no disruption of wetland function and no net loss of wetland area.

Environmental Component	Sources of Negative Effects	Potential Negative Effect	Mitigation Measures	Residual Negative Effect
			construction.	
Water Bodies A. Surface water, Fish and Fish Habitat	• Solar panel installation.	• Increase in watercourse turbidity.	To minimize watercourse turbidity, the following general mitigation measures should be applied: • All in-water work would be completed within MNR timing windows to protect local fish populations during their spawning and egg incubation periods. A typical construction timing window for warm water streams in MNR's Kingston District is July 1 to March 15; however, the DFO timing window for this region for spring spawning fish as inhabit the watercourses in the Project location is July 15 to March 15 as it applies to projects completed using DFO Operational Statements; • All materials and equipment used for the purpose of site preparation and Project construction would be operated and stored in a manner that prevents any deleterious substance (e.g., petroleum products, silt, etc.) from entering the water: o Any stockpiled materials should be stored and stabilized away from the water; o Refuelling and maintenance of construction equipment should occur a minimum of 100 m from a water body; o As appropriate, spills will be reported to the MOE Spills Action Centre; o Any part of equipment entering the water should be free of fluid leaks and externally cleaned/degreased to prevent any deleterious substance from entering the water; and o Only clean material, free of fine particulate matter should be placed in the water. • Sediment and erosion control measures will be implemented prior to construction and maintained during the construction phase to prevent entry of sediment into the water:	With the proper implementation of the procedures recommended above no adverse residual effects on water bodies and fish habitat are anticipated during construction of the Project.
	• Culvert and access road construction.	• Disturbance to aquatic biota and habitat during installation; • Permanent enclosure of portions of a watercourse; • Loss of bed material within the length of the culvert; and	o Silt fencing and/or barriers will be used along all construction areas adjacent to natural areas; o No equipment would be permitted to enter any natural areas beyond the silt fencing during construction; o All sediment and erosion control measures will be inspected at least weekly and during and immediately following rainfall events to ensure that they are functioning properly and are maintained and/or upgraded as required; o Temporary topsoil stockpiles will be located away from watercourses to preclude sediment inputs due to erosion of stored soil materials; o If the sediment and erosion control measures are not functioning properly, no further work would occur until the sediment and/or erosion problem is addressed; o All disturbed areas of the construction site will be stabilized immediately and re-vegetated as soon as conditions allow; and Sediment and erosion control measures would be left in place until all areas of the construction site have been stabilized. • Culverts will be required at watercourse crossings at access roads and for conveyance at specific locations within the Project Location for storm water management. Culverts must be sized according to hydrologic requirements of the watercourse or conveyance feature which will be determined during the detailed design and permit	

Environmental Component	Sources of Negative Effects	Potential Negative Effect	Mitigation Measures	Residual Negative Effect
		• Changes to riparian vegetation within road allowance.	application stage. It is possible that other technical requirements may influence culvert size and materials; • Where fish habitat is present, culverts must be installed such that fish passage is maintained. Where a watercourse provides indirect habitat, the culvert must continue to convey flow to downstream areas; • An Environmental Monitor (or designate) should be on-site during construction of watercourse crossings to ensure compliance with specifications and site plans. In particular, the Construction Contractor would ensure that pre-construction preparation is completed prior to commencement of in-stream work and that bank, bed, and floodplain conditions are restored to pre-construction conditions following completion of any construction activities; • Specific methods for culvert installation will be dependent on culvert type, size and construction season. If a temporary access road is required, the DFO Operational Statement for Temporary Stream Crossings can be used (Appendix E), provided the specific conditions can be met. This Operational Statement includes details for mitigation measures; • Under flowing water conditions, water must be pumped around the work area in order to install a culvert. The following steps outline how a site can be isolated for culvert construction: o Coffer dams (e.g., aqua-dams, sand bags, concrete blocks, steel or wood wall, clean rip-rap, sheet pile or other appropriate designs) can be used to separate the in-water work site from flowing water; o If rip rap or sand bags are used, clean, washed material should be used to build the berm. The berm face should consist of clean, washed granular material that is adequately sized (i.e., moderate sized rip rap and not sand or gravel) to hold the berm in place during construction. Material to build the berms should not be taken from below the high water mark; o Coffer dams should be designed to accommodate any expected high flows of the watercourse during the construction period; o Before starting construction, fish should be salvaged from behind the coffer dam and returned to an area immediately upstream of the isolated area. Salvage operations must consist of techniques that successfully target the species and size classes of fish that inhabit the watercourse reach; o Accumulated sediment should be removed (ensuring that the original bed of the watercourse is not excavated) from behind the coffer dam before its removal; o The original channel bottom gradient and substrate should be restored after coffer dam removal; o Water from dewatered areas should be treated or diverted into a vegetated area or settling basin to remove suspended solids and prevent sediment and other deleterious substances from entering the watercourse; o Coffer dams should be removed in a downstream to upstream sequence to allow gradual re-introduction of water to the dewatered area and prevent excessive suspension of silt or other bed material;	

Environmental Component	Sources of Negative Effects	Potential Negative Effect	Mitigation Measures	Residual Negative Effect
			o Pump intakes should be sized and adequately screened to prevent debris blockage and fish mortality (refer to the DFO Freshwater Intake End-of-Pipe Fish Screen Guidelines); o The pumping system should be sized to accommodate any expected high flows of the watercourse during the construction period. Back-up pumps should be kept on site in case of pump failure; o The pump should be discharged to a grassed area to allow water to re-enter the watercourse only after it has been filtered through vegetation to prevent silt deposition. If no suitable areas exist, a filter bag should be place on the outlet to filter the water prior to re-entry into the watercourse; o Work should not be completed during flood stage flows or during times when heavy precipitation is occurring or is expected; and o The work must be carried out in such a way as to prevent sediment or debris from entering natural watercourses as outlined in a Sediment Control Plan.	
	• Overhead and underground collector lines installation.	• Erosion and sedimentation from site disturbance and dewatering; • Collapse of the punch or bore hold under the stream; • Disturbance of riparian vegetation can reduce cover, shade and thermal regimes and food production areas; and • Machinery fording the stream can disturb bottom and bank substrates, disrupt sensitive fish life stages and introduce deleterious substances (i.e., equipment is not properly maintained).	Mitigation Measures for Overhead Collector Lines: • The DFO Ontario Operational Statement Habitat Management Program: Overhead Line Construction is provided in the *Water Assessment and Water Body Report (***Appendix C** of the *Design and Operations Report).* This Operational Statement provides measures to protect fish and fish habitat when undertaking this construction of this type; and • Although construction of overhead lines (as required) does not typically require any in-water works, riparian habitat is sensitive to disturbance from overhead line construction. Riparian vegetation occurs adjacent to watercourses and directly contributes to fish habitat by providing shade (thermal refuge), cover, and provides allochthanous habitat and food inputs. Mitigation Measures for Underground Collector Lines: • Crossing techniques that may be employed for installation of a buried collector line include: 1) punch or bore, 2) high pressure directional drilling, 3) dry open-cut crossing and 4) isolated open-cut crossing, in order of preference by DFO for the protection of fish and fish habitat. DFO Operational Statements for each of these methods are included in *Water Assessment and Water Body (***Appendix C** of the *Design and Operations Report);* • A summary of mitigation measures for Dry Open-Cut crossings and Isolated Open-Cut crossings is provided below: o Crossings should be undertaken on days when precipitation is not expected; o The tracked excavator should be working in the dry when excavating a trench; o Topsoil stockpiles should be located away from watercourses to preclude sediment inputs due to erosion of stored soil materials; o Water crossings should be backfilled with substrate material that is consistent with the existing substrate size and texture and would remain in/under the crossing; o The water crossing bed and bank areas should be rehabilitated to	

Environmental Component	Sources of Negative Effects	Potential Negative Effect	Mitigation Measures	Residual Negative Effect
			pre-excavation condition; and o Materials such as sand bags, straw bales, geotextile filters, and/or pumps should be readily available on-site so that the crossing can be completed in the dry in case of unexpected stream flow. Mitigation measures to employ for a low flow watercourse include: • Where an open cut crossing is not possible, in-stream work shall be completed in the dry by de-watering the work area and diverting and/or pumping flows around cofferdams placed at the limits of the work area.	
B. Groundwater		• No potential effect on local wells has been predicted as the Project does not require deep excavations for foundations that would involve extensive dewatering during construction. The Project is located in an area of shallow overburden with rock outcrops. Should there be a requirement for dewatering during placement of footings the duration will be short and the rate will be less than 50,000 L/day; and • Some materials, such as fuel and other fluids associated with construction equipment have the potential for discharge to the environment through accidental spills and thus infiltrate groundwater supplies.	• To the extent practicable, crossings should take place on days when precipitation is not expected; • Existing stream flows shall be maintained downstream of the de-watered work area without interruption, during all stages of the work; • Fish, if present, shall be removed from the work area prior to de-watering and released alive immediately upstream; • Flow dissipaters and/or filter bags, or equivalent, shall be placed at water discharge points to prevent erosion and sediment release; • Sediment laden dewatering discharge can be pumped to a temporary settling basin well away from the watercourse and allowed to settle and/or filter through the riparian vegetation before re-entering the watercourse downstream of the construction area; • As conditions warrant the work area shall be stabilized against the impacts of high flow events at the end of each workday; • Work in the channel and floodplain shall be suspended and the work area stabilized when there is a high probability of a convective rainfall event and during warm winter periods when there is a high likelihood of significant snowmelt runoff; • Silt or debris that has accumulated around the temporary cofferdams shall be removed prior to their withdrawal • It is unlikely that quantities of water withdrawn during the course of excavations will exceed the threshold for the MOE's requirement for a Temporary Permit to Take Water (i.e., >50,000 L/day). Therefore, it is not anticipated that the construction of the Project would adversely affect groundwater quality, quantity, or movement. Any water pumped from excavated areas will be directed away from natural features and not directly into wetlands. General mitigation measures include: o The perimeter of excavations should be graded to prevent surface runoff from entering; o Before dewatering, any oil (free product) on the water will be completely removed or contained in the excavation through the use of sorbent booms; keeping the pump intake hose submerged and directing the discharge to a filter bag or hay bale structure; o Water pumped from an excavation would not be discharged directly to a watercourse or wetland and must be filtered through vegetation or by the use of a filter bag on the end of the discharge hose (or temporarily stored in appropriate-sized settlement ponds). Water entering watercourses should not have a TSS concentration exceeding 25 mg/L;	With the implementation of good construction practices mentioned above, it is anticipated that any potential effects will be short term in nature and have little to no effect on groundwater quality, quantity or movement.

Environmental Component	Sources of Negative Effects	Potential Negative Effect	Mitigation Measures	Residual Negative Effect
			o Only nonwoven fabric filter bags will be used for dewatering; and o The Contractor would dispose the filter bags in an approved landfill. • In the event that well water quality or quantity is disturbed as a result of construction, a temporary potable water supply will be provided until corrective measures are taken and would comply with MOE's Guideline B-9: Resolution of Groundwater Interference Problems; • In terms of accidental spills or releases to the environment, undesirable materials on-site are limited to fuel, lubricating oils, and other fluids associated with solar facility construction. Large quantities of these materials would not be stored at the Project site and do not represent a significant potential adverse effect on the groundwater in the event of accidental spills. As per s.13 of the Environmental Protection Act, all spills that could potentially have an adverse environmental effect, are outside the normal course of events, or are in excess of the prescribed regulatory levels will be reported to the MOE's Spills Action Centre; and • A Construction Emergency Response and Communications Plan will be developed by the Construction Contractor and/or the Proponent and would include protocols for the proper handling of material spills and associated procedures to be undertaken in the event of a spill. See Section 5.0 for more information on the Emergency Response and Communications Plan.	
Air Emissions (Exhaust, Dust)	• Construction related activities (e.g., excavation, grading); and • Use of heavy equipment and vehicles during construction and operations.	• Construction activities rely on the use of a wide range of mobile equipment, such as dump trucks. The engine exhaust from these vehicles, especially from those operating on diesel fuel, represent a source of particulate and other emissions (e.g., sulphur dioxide, nitrogen oxide, volatile organic compounds, polycyclic aromatic hydrocarbons, and carbon dioxide) from the construction-site. Traffic delays also result in increased exhaust emissions from vehicles traveling slowly through construction zones.	To reduce emissions from equipment and vehicles, several mitigation measures should be employed: • Multi-passenger vehicles should be utilized to the extent possible; • Company and construction personnel should avoid idling of vehicles when not necessary for construction activities; • Equipment and vehicles should be turned off when not in use unless required for construction activities and/or effective operation; • Equipment and vehicles should be maintained in good working order with functioning mufflers and emission control systems as available; • All vehicles should be fitted with catalytic converters as required; • All construction equipment and vehicles should meet the emissions requirements of the MOE and/or MTO; • As appropriate, records of vehicle maintenance should be retained and made available for periodic review by the Construction Contractor; and • All vehicles identified through the monitoring program that fail to meet the minimum emission standards will be repaired immediately or replaced as soon as practicable. The following procedures will be implemented to ensure the potential impacts from dust are minimized: • Apply dust suppressants such as water, or calcium chloride dust suppressant on the work sites as required (calcium chloride should not be used on agricultural fields); • Maintain adequate control of dust at sites that are in close proximity to residences;	The application of the recommended mitigation measures during construction should limit air emissions to the work areas and limit the magnitude of combustion emissions. As a result, any adverse net effects to air quality from exhaust emissions are anticipated to be short-term in duration and highly localized.
			• Enforce low speed limits for trucks on site as appropriate; • Re-vegetate exposed soils as soon as possible; • As appropriate, protect stockpiles of friable material with a barrier or	These mitigation measures are consistent with good construction practice and

Environmental Component	Sources of Negative Effects	Potential Negative Effect	Mitigation Measures	Residual Negative Effect
		The delivery of materials such as concrete to construction-sites can also generate emissions, especially for sites that are relatively far from material manufacturers.	windscreen and in the event of dry conditions and dust; • Consult with local road authorities prior to application of dust suppressants on public access roads; and • Ensure dust generation is monitored and controlled in areas of sensitive land use. • A Construction Traffic Management Plan will be developed by the Construction Contractor and would include protocols for the management of traffic and for the delivery of materials to the construction-site.	should limit dust emissions to the work area. The potential for adverse effects from dust will be short term and localized.
Noise	• Construction equipment and trucks.	During construction, noise from construction equipment and trucks hauling materials to site could become a nuisance to nearby residents.	The following procedures will be implemented to ensure potential impacts from construction are minimized. • Equipment and vehicles will be maintained in good working condition to limit engine noise; • Company and construction personnel should avoid idling of vehicles when not necessary for construction activities; • The Contractor will be required to use noise abatement equipment, in good working order, on all heavy machinery used on the Project; and • All construction and installation activities would take place during normal working hours and in accordance with the City of Kingston's noise By-Law No. 2004-52, and Loyalist Township's noise By-Law No. 2011-6.	The above mitigation measures are consistent with good construction practice and should limit noise emissions to the vicinity of the work area. The potential for adverse effects will be short term and localized.
Land Use & Resources	• Installation of facility.	• Potential effects are related to the temporary change in use from agricultural to renewable energy development on lands used during construction; • Potential effects on soils; and • Potential to encounter contaminated soil during excavations.	• The solar facility will be constructed on lands with low agricultural potential. O.Reg. 359/09 and the Feed-in-Tariff (FIT) program clearly state that any solar project with a Contract Capacity greater than 100 kW cannot be located (built) in Canadian Land Inventory (CLI) Class 1 Lands, CLI Class 2 Lands or CLI Class 3 Lands that have not been designated as Class 3 Available Lands. Therefore the proponent is not allowed to build on agricultural lands of these classifications in neither City of Kingston nor Loyalist Township. A small section of the Project is located within the City of Kingston's Prime Agricultural Land Use Zoning (City of Kingston Official Plan, 2012). Although not required by O.Reg. 359/09, the Proponent has taken the initiative to further minimize development on City of Kingston zoned Prime Agricultural Lands in response to community input and preservation of wildlife habitat while balancing its obligations to the province of Ontario which is to produce 100 MW AC of power. • Construction activities will be restricted to the delineated construction areas and following the completion of construction, as appropriate, temporary workspaces will be graded and de-compacted (if required), the topsoil replaced, and the area left as close to pre-existing condition as possible. • If contaminated soil is encountered during the course of excavations, the contaminated material will be disposed of in accordance with the appropriate provincial legislation, such as Ontario Regulation 347, the General – Waste Management Regulation.	There are no anticipated residual effects related to land use and resources as a result of construction of the Project. The Project's effect on the rural community during construction, including the suspension of recreational uses and some disturbance to adjacent land uses, will be temporary and will be minimized through the implementation of good site practices, and good communication with the community.
Provincial, Municipal and Local Infrastructure	• Construction activities.	• Potential effects on local roads infrastructure from construction traffic. • Effects of connection into provincial electrical grid.	• The Proponent would complete road conditions surveys before and after construction in consultation with the appropriate local municipality to monitor potential to damage municipal roads and provide repairs; • The Proponent will be providing technical reports to the Independent	No long term residual effects are anticipated.

Environmental Component	Sources of Negative Effects	Potential Negative Effect	Mitigation Measures	Residual Negative Effect
			Electricity System Operator and HONI for approval of the effects of the solar operation on the provincial power grid;	
Public Health & Safety	• Construction activities.	• There is potential for increased construction-related road traffic and unauthorized access of the public to the Project's construction sites. Unexpected accidents and malfunctions such as fires and spills also pose a risk to public health and safety; and. • Recreational uses of land adjacent to the Project Sites may also pose a safety risk due to presence of large construction equipment on-site during construction period.	• A detailed Traffic Management Plan and a detailed Emergency Response Plan will be developed in consultation with the City of Kingston and Loyalist Township and implemented by the Construction Contractor. The Traffic Management Plan will cover all necessary information such as haul routes, signage, detours, etc.; • Security fencing and gates will be present at all construction sites and land access to the sites will be restricted to authorized personnel only. Regular inspection will be made during construction phase of the Project to ensure perimeter fencing and gates are intact and adequately maintained; and • The Emergency Response Plan will include a plan for the proper handling of spills during a spill event. The plan would also include key contact information for emergency service providers, a description of the chain of communications and how information will be disseminated between the Proponent and/or the Contractor and the relevant responders. The plan would also indicate how the Proponent and/or the Contractor would contact (via phone or in-person) Project stakeholders who may be directly impacted by an emergency so that the appropriate actions can be taken to protect stakeholders health and safety.	With application of the above mitigation measures, and adherence to safety procedures and policies, the risk to public health and safety from construction of the Project will be minimal.
Areas Protected under Provincial Plan & Policies	• The Project altering the ecological functions of a specific land use plan.	• The Project site is not within area of the Greenbelt Plan, the Oak Ridges Moraine Conservation Plan Area, the Niagara Escarpment Plan Area or the Lake Simcoe Watershed Plan Area Greenbelt Plan. No impacts are expected to occur to areas protected under provincial plans and policies.	• No mitigation measures needed as no negative impacts are expected.	None.

5.0 CONSTRUCTION ENVIRONMENTAL MANAGEMENT PLAN

The Proponent, in consultation with the Construction Contractor, would prepare a Construction Environmental Management Plan (CEMP) prior to the initiation of any substantive on-site works. The CEMP is not a requirement of O.Reg. 359/09. The CEMP will be the controlling plan for all construction activities, and will be designed to minimize potential adverse environmental effects, while enhancing the Project's benefits. The CEMP will be based on the environmental effects and mitigation measures identified in this report, and related reports to be submitted as part of the REA application. As part of the construction program, site practices and procedures will be implemented to further reduce the environmental effects identified in this report and supporting studies. These practices may include specifications regarding disposal of excavated material, sediment control, dust control, and soil compaction control. The Proponent staff and contractors will be made aware of the environmental commitments contained in this report and supporting studies to ensure the commitments are implemented.

The Project CEMP would include procedures and plans based on regulatory requirements and accepted site practices and as appropriate would include the following plans:

- *Traffic Management Plan*: the Construction Contractor and/or the major component manufacturers would assist in the development and implementation of this plan, which would contain strategies governing movement of materials and personnel to, from, and within the workspace areas; management of connection points between access roads and public roads; transport of abnormal loads; road/lane closure strategies, control of any upgrading/modification road works; and/or dust suppression and vehicle emission controls.

- *Hazardous Waste Management Plan:* to outline the procedures for proper identification, storage, handling, transport, and disposal of hazardous waste. In addition, the procedures would outline specific requirements for personnel training, emergency response, product review and approval, and record keeping.

- *Non-Hazardous Waste Management Plan:* to establish alternative procedures for the management and disposal of non-hazardous waste such as used lubricants, used drums, and general waste with specific provisions for reuse and recycling of waste materials.

- *Health and Safety Plan*: the Construction Contractor would prepare this plan considering both public and occupational health and safety issues. This may include protecting the public from equipment and construction areas by posting warning signs, use of personal protective equipment, accident reporting, equipment operation, and confined space entry.

- *Construction Plan*: The Proponent would develop construction specifications that would form part of the construction contract. These specifications would detail the specific

techniques and procedures to be followed to implement the mitigation recommendations contained in this report and supporting reports and studies.

- *Emergency Response and Communications Plan*: the Construction Contractor and/or the Proponent would include a plan for the proper handling of material spills and associated procedures to be undertaken during a spill event. The plan would also specify containment and clean-up materials and their storage locations. The plan would include general procedures for personnel training. As appropriate, the plan may cover response actions to high winds, fire preparedness, evacuation procedures, and medical emergencies. This plan will be developed in consultation with local emergency services personnel to determine the extent of emergency response resources and response actions of those involved. The plan would include key contact information for emergency service providers, a description of the chain of communications and how information will be disseminated between the Proponent and/or the Construction Contractor and the relevant responders.

- *Wildfire Prevention and Preparedness Plan*: the Construction Contractor and/or the Proponent may develop a plan for forest fire prevention and preparedness in accordance with MNR and municipal requirements (if required). This plan may be developed with input from the municipalities to determine the extent of emergency response resources and response actions of those involved. If required, the plan will be finalized and provided to the MNR and municipalities prior to construction and would include information on the following:
  - Fire hazard assessment – identification of fuel sources at the Project site including gasoline, oils/lubricant, and debris from clearing activities;
  - Risk assessment of ignition;
  - Ignition prevention measures – dependent on the results of the risk assessment;
  - Fire preparedness plan – including a suppression plan which would require input from the municipalities to determine the extent of emergency response resources and response actions (the fire preparedness plan would also be incorporated in the Emergency Response Plan for evacuation purposes); and
  - Fire protection – maintenance and other measures to protect the Project and public from wildfire threats.

- *Training Plan*: as appropriate, this would involve the training/informing of construction personnel on the unique features of the above plans prior to construction.

- *Complaint Response Protocol*: the Proponent would continue its pre-construction contact with Project stakeholders during construction and through the initial period of operation as long as this seems an effective two-way channel for communication. The Proponent and/or the Construction Contractor may consider developing and implementing a *Complaint Response Protocol:* for the construction phase to address any reasonable concern from the public. This protocol would likely provide a telephone number for contact for the Proponent. Any telephone number provided to the public for reporting of

complaints should be equipped with a voice message system. The Proponent would endeavour to respond to messages within 48 hours. All reasonable commercial efforts should be made to take appropriate action as a result of actual concerns as soon as practicable. Should such a protocol be developed, the Proponent would consider posting it on the Project website (www.samsungrenewableenergy.com) and/or providing it directly to the City of Kingston and Loyalist Township and the MOE.

The Proponent would provide overall direction and assume responsibility for the development and implementation of these plans.

6.0 CONSTRUCTION ENVIRONMENTAL EFFECTS MONITORING PLAN

The Construction Contractor will be the primary party responsible for the implementation of Construction Environmental Effects Monitoring Plan measures. Implementation of these measures will be undertaken in compliance with applicable municipal, provincial, and federal standards and guidelines. The following subsections outline the key monitoring activities to be implemented based on the potential effects and mitigation measures identified in the previous sections.

Additional environmental effects monitoring will take place during the operation of the Project and may consist of similar monitoring activities as described below. The Environmental Effects Monitoring Plan for the operation of the Project is provided in the *Design and Operations Report* and should be referenced for a complete description of the monitoring efforts and contingency measures that will be implemented.

General Construction Requirements

The following section describes the key monitoring activities that will be undertaken by the Proponent. Highlights of the monitoring program include:

- Construction Contractor would monitor and carry out periodic audits to ensure the adequacy of the environmental protection measures completed for this project and the recommended mitigation measures.

- The Construction Contractor will be required to use dust suppressants or water to prevent dust emissions from excavations or placement of materials.

- Monitoring would include ensuring that site restoration meets applicable standards and that landowners are satisfied.

- Construction Contractor would ensure that only required areas are cleared of vegetation and that lands outside of the construction areas are not disturbed (see section below for procedures regarding clearing activities with regards to nesting birds.).

- Any replanted and reclaimed areas will be inspected one year after their planting to ensure that they are established.

6.1 Terrestrial Habitats

Methodologies

Construction activities that have the potential to affect terrestrial flora and fauna include vegetation clearing and disturbance, accidental spills and/or leaks, and waste disposal as described previously Monitoring of these activities is necessary to ensure sensitive terrestrial flora and fauna are protected.

Vegetation clearing activities will be conducted under constant observation and monitoring of the Construction Contractor to ensure that vegetation is cleared only from designated areas. Areas outside the designated construction-sites shall not be disturbed.

Monitoring will be required following the unlikely event of contamination from an accidental spill or leak. Contaminated soils will be removed and replaced as appropriate. All such activities would follow procedures outlined in the Emergency Response Plan for the CEMP (see Section 5.0).

As appropriate, records of waste generation and hauling will be maintained and checked for compliance.

Birds

The Contractor would adhere to the restriction on vegetation clearing during the bird breeding season as per the Migratory Bird Act. Prior to any clearing during the period of May 1 to July 23 (open areas) and May 9 – July 23 (forested areas), a qualified biologist would undertake fieldwork in the areas to be cleared to confirm the presence/absence of active bird nests. If active bird nests are identified; these areas shall be avoided until after the nest has been vacated.

Performance Objectives/Additional Actions

Provided mitigation measures outlined in Section 4.0 are implemented, and monitoring as outlined above occurs, it is anticipated that environmental disturbance would have been contained and that no additional monitoring actions will be required.

6.2 Aquatic Habitat/Surface Water

Methodologies

Monitoring activities relating to aquatic habitat will be confirmed through the permitting process with the CRCA. The monitoring of aquatic habitat would occur at different levels. During construction, the designated Environmental Inspector would ensure that watercourses are being crossed in an appropriate manner and that committed mitigation measures (e.g., erosion/ sediment control) are being implemented and are effective. Some water quality sampling may be undertaken to ensure the effectiveness of the implemented measures. Weather conditions will be monitored to ensure that watercourses are being crossed at appropriate times so as to avoid in-water works during high flow events as much as possible.

Performance Objectives/Additional Actions

Site rehabilitation measures such as vegetation plantings in the riparian zone and fish habitat compensation measures (if required) will be monitored to ensure that they have been

implemented correctly and inspected after the following year spring melt period. Corrective action will be taken should the rehabilitation works not be effective.

All culverts would also be inspected on a frequent basis during construction to ensure that they are conveying water flow and not resulting in upstream flooding.

Additionally, compensation strategies and/or permits from Fisheries and Oceans Canada and/or the CRCA, as applicable, would likely include conditions of approval such as construction and post-construction monitoring. All such strategies and/or permits will be obtained prior to construction, and all such conditions and requirements will be implemented.

6.3 Air Quality and Dust

Methodologies

During the construction period, there will be the potential for disturbance effects such as noise and dust. Standard construction practices would minimize these effects as much as possible. Kingston Solar LP would post a contact number on the construction sites should residents wish to voice a complaint regarding the construction process and/or to obtain more information. Kingston Solar LP would respond promptly to these calls and address the problem.

Performance Objectives/Additional Actions

As appropriate, records of vehicle maintenance will be retained and made available for periodic review by the Construction Contractor. All vehicles identified through the monitoring program that fail to meet the minimum emission standards will be repaired immediately or replaced as soon as practicable from the construction area.

The Construction Contractor would monitor to ensure that temporary topsoil storage piles are stabilized with appropriate means.

6.4 Roads

Methodologies

The use of local roads by the construction equipment has the potential to affect the road bed/condition. The roads will be inspected before commencement of construction to determine condition and a post construction assessment will be completed to determine changes. The roads will be returned to their preconstruction condition. The roads would also be monitored after heavy rain events during the construction period and road repairs made if required. This would include new access points and roadside drain crossings.

Performance Objectives/Additional Actions

If adverse impacts are noted during the above post-construction monitoring, appropriate remediation measures will be developed as per applicable agreements. As appropriate, affected

road substrate will be repaired and roadside ditches and drains will be re-vegetated. Additional follow-up monitoring will be conducted, as per applicable agreements, until adverse impacts are no longer evident.

7.0 TIMING OF CONSTRUCTION ACTIVITIES

Construction of the project is anticipated to take approximately 15 months to complete. The exact calendar dates of construction activities are yet to be determined and will be based on the timing of the REA approval.

8.0 CONCLUSIONS

This *Construction Plan Report* has been completed to fulfill regulatory requirements as mandated by the provincial government for the development of the Project. This report is consistent with the provisions of Ontario Regulation 359/09 for a Class 3 solar facility as set out by the *Green Energy Act (2009)*. Sufficient fieldwork and data collection was performed to assist in the determination of potential construction effects to environmental and social features. Various mitigation measures to manage these potential effects have been identified.

Adverse effects from construction activity to the natural and social environment have been avoided through careful facility layout planning, the application of appropriate mitigation measures, and adherence to all regulatory requirements. No Provincially Significant Wetlands, ANSIs or associated wildlife habitat will be displaced or disrupted as all solar facility infrastructure is located well away from these features and appropriate mitigation measures implemented. Impacts from the construction of the solar facility on aquatic resources are expected to be minimal. Construction of the solar facility in includes works within the defined jurisdiction of the CRCA. Consequently, permits under Ontario Regulation 158/6 will be required.

There are no Provincial Parks or Conservation Reserves in proximity to the project location. The local Planning Authority has not designated Provincially Significant Valleyland, Woodland or Significant Wildlife Habitat on the site or within 120 m of project components.

The overall conclusion of this Construction Plan Report is that this project can be constructed without any significant adverse residual effects to the natural or social environment.

There are net benefits of this project resulting from an increased municipal tax base for the City of Kingston and Loyalist Township, increased number of employment opportunities, especially during the construction stage, and the generation of clean, renewable electricity from solar power.

For more information on the Project, please refer to the documents listed in Section 1.0 of this report. These additional reports are provided as part of a completed submission package to the MOE and were prepared in accordance with Ontario Regulation 359/09.

AMEC has completed this report for the exclusive use of Kingston Solar LP for specific application to the Sol-luce Kingston Solar PV Energy Project. The work has been completed in accordance with Item 1, Table 1 of Ontario Regulation 359/09, and the guidance document — *"Technical Guide to Renewable Energy Approvals: Chapter 5 – Guidance for Preparing the Construction Plan Report"* (MOE 2011, 2012).

Sincerely,
AMEC Environment & Infrastructure
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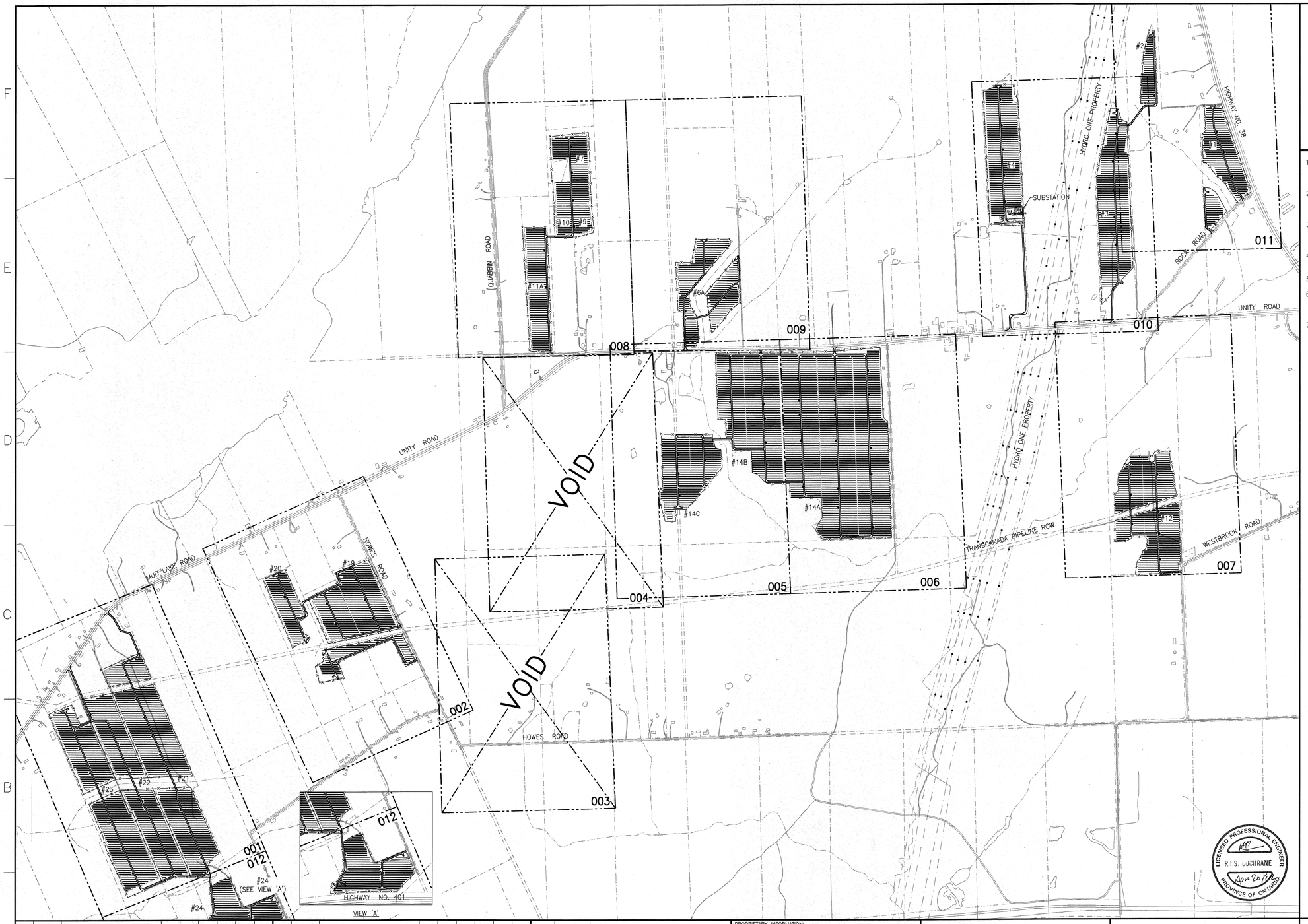
APPENDIX A

SITE LAYOUTS



NOTES

1. BASE FILE PROPERTY LIMITS ARE APPROXIMATE ONLY AND ARE BASED ON AVAILABLE MAPPING AND MUNICIPAL DRAWINGS.
2. DEVELOPMENT AREA BOUNDARIES ARE BASED ON PRELIMINARY CONSTRAINTS AND ARE SUBJECT TO FINALIZATION OF REA STUDY.
3. PANEL SETBACK FROM PROPERTY LINES ASSUMED AT 10M FOR ACCESS AND MAINTENANCE.
4. MAIN ACCESS ROAD LAYOUT IS BASED ON 9.1M LONG MAINTENANCE VEHICLE.
5. UTM ZONE 18 N CSRS PROJECTION
6. ALL DRAWING SHEET REFERENCES SHOWN REFER TO DRAWING NOS. 168335-0002-LYD-0001-001 TO 011.
7. ALL FENCE AND GATE LOCATIONS ARE CONCEPTUAL AND SUBJECT TO FINAL ROAD AND PANEL LAYOUTS.

PROPERTY	AC POWER CAPACITY (MW)
1	3
1/2	1
3	5.5
4	4.5
5	–
6A	3
6B	–
7/9/10	3.5
11A	2.5
11B	–
12	6.5
13	–
14A	21
14B	8
14C	4
15	–
16	–
17	–
18	–
19	5
20	1
19/20	1
21	9
22	5.5
23	6.5
24	3
TOTAL	93.5

PRELIMINARY

0m 100 200 300 400 500
1:10000

LICENSED PROFESSIONAL ENGINEER
R.I.S. COCHRANE
Apr 20/12
PROVINCE OF ONTARIO

REV	DDMMMYY	REVISION / ISSUE DESCRIPTION	DRN	CHK	APP	APP	APP	APP
4	20APR12	RE-ISSUED FOR USE	SZ	RC	DJ			
3	18APR12	RE-ISSUED FOR USE	SZ	RC	DJ			
2	15FEB12	RE-ISSUED FOR USE	SZ	RC	SC			
1	01FEB12	RE-ISSUED FOR USE	SZ	RC	SC			
0	15DEC11	ISSUED FOR USE	SZ	RC	MP	SC		
D	08DEC11	ISSUED FOR CLIENT REVIEW	SZ	RC		SC		
C	30NOV11	ISSUED FOR CLIENT REVIEW	SZ	RC		SC		
B	14OCT11	ISSUED FOR CLIENT REVIEW	SZ	RC	MP	SC		
A	14OCT11	ISSUED FOR SQUAD CHECK	SZ	RC	MP	SC		

STAMP/SEAL

CONCEPTUAL DRAWING ONLY NOT TO BE USED FOR CONSTRUCTION

CLIENT PROJECT MGR. | DEPARTMENT MGR. | PROJECT MGR.

PROJECT PHASE: PRELIMINARY

PROJECT NO.: 168335 | ACTIVITY NO.:

SCALE: 1:10000 | PACKAGE CODE:

	BY	DDMMMYY
DSN	IB/RC	14OCT11
DRN	SZ	14OCT11
CHK	MP	14OCT11
APP	SC	14OCT11

KINGSTON SOLAR LP

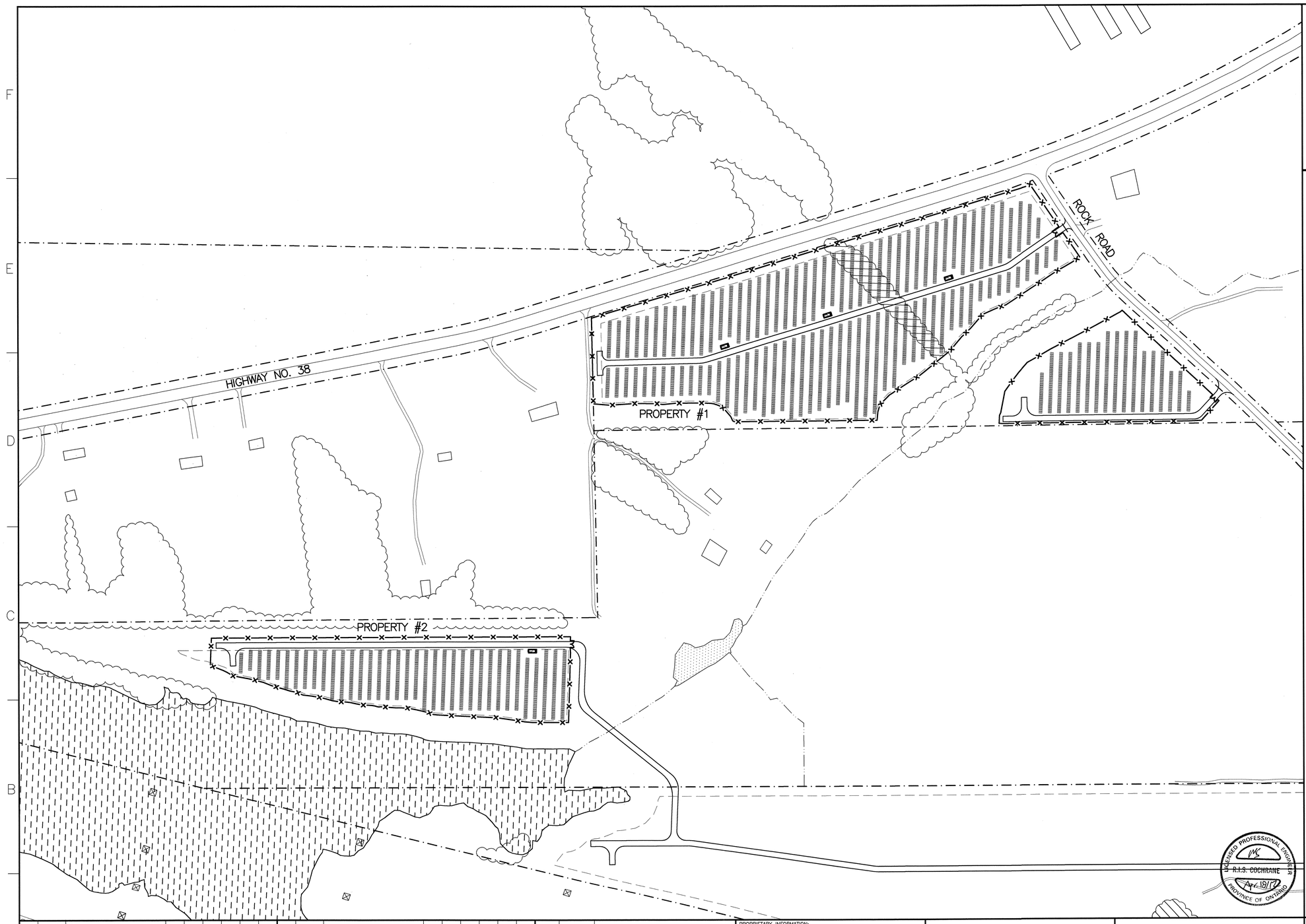
AREA:

SUBJECT: SOL-LUCE KINGSTON ENERGY PROJECT GENERAL ARRANGEMENTS

CLIENT DWG. NO.:

DRAWING NO.: 168335-0002-121-GAD-0001-001 | REV.: 4

PLOTTED: 20-Apr-12 2:07 PM USER: SHAHBAZIAN, RAZMIK
SAVED: 20-Apr-12 2:05 PM



NOTES

1. REFER TO GENERAL NOTES SEE DRAWING 168335-0002-121-GAD-0001-001
2. REFER TO DRAWING 168335-0002-141-LYD-0002-011 FOR ELECTRICAL COLLECTOR LINE LAYOUT

PROPERTY	AC POWER CAPACITY (MW)
1	3
1/2	1
TOTAL	4

LEGEND

EXISTING:

- PROPERTY LINE
- WOODLAND AREA
- BUILDING
- HYDRO ONE TOWER
- POND/WATER BODY
- WETLAND
- WATERCOURSE/DITCH

PROPOSED:

- 1MW INVERTER STATION
- SOLAR PANEL TABLE (5X4 PANELS)
- DEVELOPMENT BOUNDARY
- ACCESS ROAD
- 2-3.65m WIDE SWING GATES
- SECURITY FENCE
- WOODLAND/SHRUBLAND TO BE REMOVED

PRELIMINARY

0m 20 40 60 80 100
1:2000

REV	DDMMMYY	REVISION / ISSUE DESCRIPTION	DRN	CHK	APP	APP	APP	APP
3	18APR12	RE-ISSUED FOR USE	SZ	RC	MP	SC		
2	15FEB12	RE-ISSUED FOR USE	SZ	RC	MP	SC		
1	01FEB12	RE-ISSUED FOR USE	SZ	RC	SC			
0	15DEC11	ISSUED FOR USE	SZ	RC	MP	SC		
D	08DEC11	ISSUED FOR CLIENT REVIEW	SZ	RC		SC		
C	30NOV11	ISSUED FOR CLIENT REVIEW	SZ	RC		SC		
B	17OCT11	ISSUED FOR CLIENT REVIEW	SZ	RC	MP	SC		
A	14OCT11	ISSUED FOR SQUAD CHECK	SZ	RC	MP	SC		

STAMP/SEAL

CONCEPTUAL DRAWING ONLY NOT TO BE USED FOR CONSTRUCTION

R.I.S. COCHRANE — Apr. 19/12 — LICENSED PROFESSIONAL ENGINEER — PROVINCE OF ONTARIO

CLIENT PROJECT MGR. | DEPARTMENT MGR. | PROJECT MGR.

PROJECT PHASE: PRELIMINARY

PROJECT NO.: 168335 | ACTIVITY NO.:

SCALE: 1:2000 | PACKAGE CODE:

	BY	DDMMMYY
DSN	IB/RC	14OCT11
DRN	SZ	14OCT11
CHK	MP	14OCT11
APP	SC	14OCT11

KINGSTON SOLAR LP

AREA:

SUBJECT: SOL-LUCE KINGSTON ENERGY PROJECT SITE LAYOUT PROPERTIES #1 & #2

CLIENT DWG. NO.:

DRAWING NO.: 168335-0002-121-LYD-0001-011 | REV.: 3

PLOTTED: 18-Apr-12 11:51 AM USER: ZHU, SOPHIE
SAVED: 18-Apr-12 9:41 AM

PROPERTY #3

HYDRO ONE PROPERTY

UNITY ROAD

SUBSTATION

PROPERTY #4

OPERATION AND
MAINTENANCE BUILDING

NOTES

1. REFER TO GENERAL NOTES SEE DRAWING 168335-0002-121-GAD-0001-001
2. REFER TO DRAWING 168335-0002-141-LYD-0002-010 FOR ELECTRICAL COLLECTOR LINE LAYOUT

PROPERTY	AC POWER CAPACITY (MW)
3	5.5
4	4.5
TOTAL	10

LEGEND

EXISTING:

- PROPERTY LINE
- WOODLAND AREA
- BUILDING
- HYDRO ONE TOWER
- POND/WATER BODY
- WETLAND
- WATERCOURSE/DITCH

PROPOSED:

- 1MW INVERTER STATION
- SOLAR PANEL TABLE (5X4 PANELS)
- DEVELOPMENT BOUNDARY
- ACCESS ROAD
- 2-3.65m WIDE SWING GATES
- SECURITY FENCE
- WOODLAND/SHRUBLAND TO BE REMOVED

PRELIMINARY

0m 20 40 60 80 100
1:2000

LICENSED PROFESSIONAL ENGINEER
R.I.S. COCHRANE
Apr 18/12
PROVINCE OF ONTARIO

REV	DDMMMYY	REVISION / ISSUE DESCRIPTION	DRN	CHK	APP	APP	APP	APP
3	18APR12	RE-ISSUED FOR USE	SZ	RC				
2	15FEB12	RE-ISSUED FOR USE	SZ	RC				
1	01FEB12	RE-ISSUED FOR USE	SZ	RC				
0	15DEC11	ISSUED FOR USE	SZ	RC	MP	SC		
D	08DEC11	ISSUED FOR CLIENT REVIEW	SZ	RC		SC		
C	30NOV11	ISSUED FOR CLIENT REVIEW	SZ	RC		SC		
B	17OCT11	ISSUED FOR CLIENT REVIEW	SZ	RC	MP	SC		
A	14OCT11	ISSUED FOR SQUAD CHECK	SZ	RC	MP	SC		

STAMP/SEAL

CONCEPTUAL DRAWING ONLY NOT TO BE USED FOR CONSTRUCTION

CLIENT PROJECT MGR. DEPARTMENT MGR. PROJECT MGR.

PROJECT PHASE: PRELIMINARY

PROJECT NO.: 168335

ACTIVITY NO.:

SCALE: 1:2000

PACKAGE CODE:

	BY	DDMMMYY
DSN	IB/RC	14OCT11
DRN	SZ	14OCT11
CHK	MP	14OCT11
APP	SC	14OCT11

KINGSTON SOLAR LP

AREA:

SUBJECT: SOL-LUCE KINGSTON ENERGY PROJECT SITE LAYOUT
PROPERTIES #3 & #4

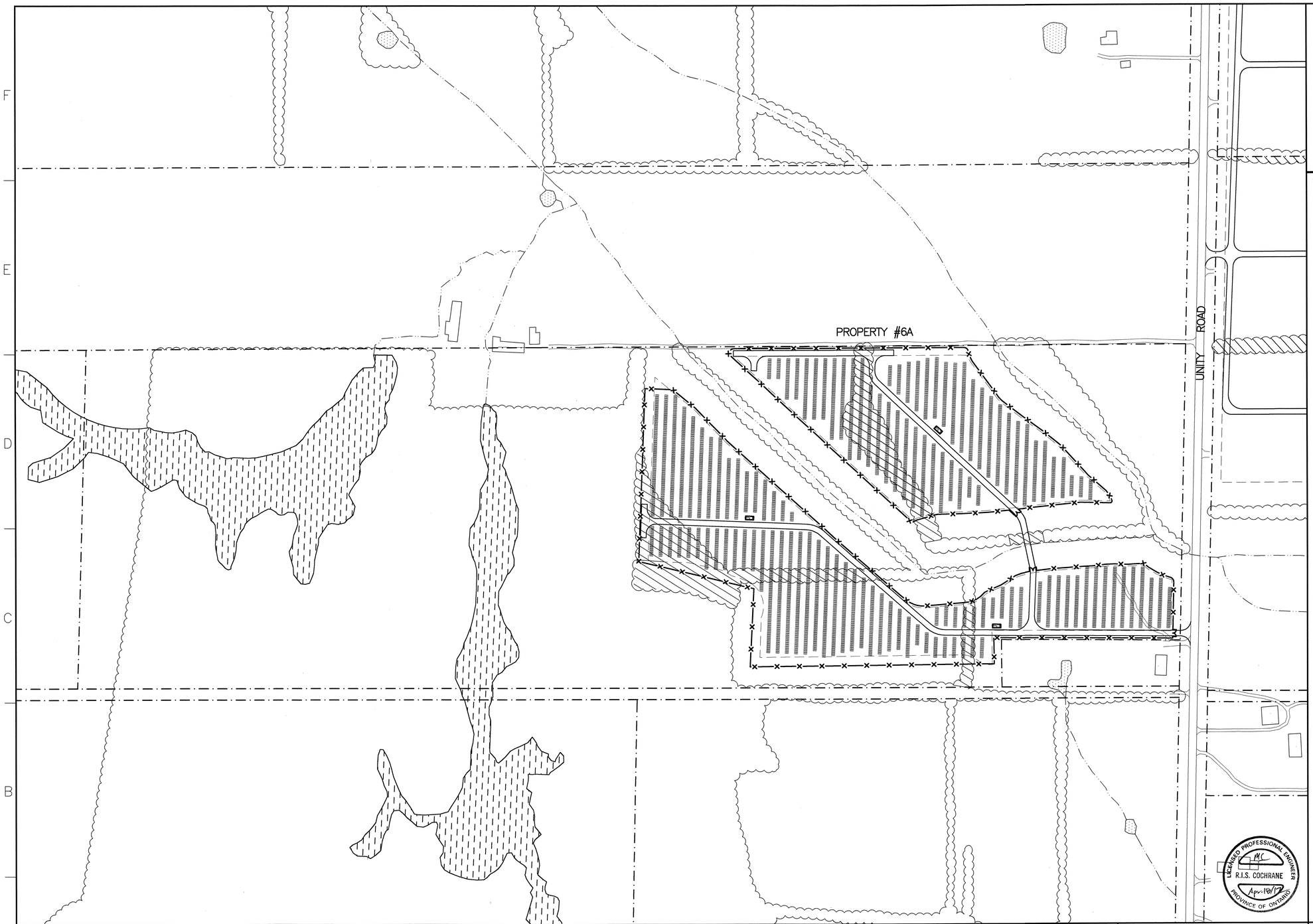
CLIENT DWG. NO.:

DRAWING NO.: 168335-0002-121-LYD-0001-010

REV.: 3

amec

SAVED: 18-Apr-12 3:47 PM PLOTTED: 18-Apr-12 3:47 PM USER: SHAHBAZIAN, RAZMIK



NOTES

1. REFER TO GENERAL NOTES SEE DRAWING 168335-0002-121-GAD-0001-001
2. REFER TO DRAWING 168335-0002-141-LYD-0002-009 FOR ELECTRICAL COLLECTOR LINE LAYOUT

PROPERTY	AC POWER CAPACITY (MW)
6A	3
TOTAL	3

LEGEND

EXISTING:

- PROPERTY LINE
- WOODLAND AREA
- BUILDING
- HYDRO ONE TOWER
- POND/WATER BODY
- WETLAND
- WATERCOURSE/DITCH

PROPOSED:

- 1MW INVERTER STATION
- SOLAR PANEL TABLE (5X4 PANELS)
- DEVELOPMENT BOUNDARY
- ACCESS ROAD
- 2-3.65m WIDE SWING GATES
- SECURITY FENCE
- WOODLAND/SHRUBLAND TO BE REMOVED

PRELIMINARY

0m 20 40 60 80 100
1:2000

LICENSED PROFESSIONAL ENGINEER
R.I.S. COCHRANE
PROVINCE OF ONTARIO

REV	DDMMMYY	REVISION / ISSUE DESCRIPTION	DRN	CHK	APP	APP	APP	APP
			SZ	RC	MP			
3	18APR12	RE-ISSUED FOR USE	SZ	RC	MP	SC		
2	15FEB12	RE-ISSUED FOR USE	SZ	RC		SC		
1	01FEB12	RE-ISSUED FOR USE	SZ	RC		SC		
0	15DEC11	ISSUED FOR USE	SZ	RC	MP	SC		
D	08DEC11	ISSUED FOR CLIENT REVIEW	SZ	RC		SC		
C	30NOV11	ISSUED FOR CLIENT REVIEW	SZ	RC		SC		
B	17OCT11	ISSUED FOR CLIENT REVIEW	SZ	RC	MP	SC		
A	14OCT11	ISSUED FOR SQUAD CHECK	SZ	RC	MP	SC		

STAMP/SEAL

CONCEPTUAL DRAWING ONLY NOT TO BE USED FOR CONSTRUCTION

CLIENT PROJECT MGR. DEPARTMENT MGR. PROJECT MGR.

PROJECT PHASE: PRELIMINARY

PROJECT NO.: 168335

ACTIVITY NO.:

SCALE: 1:2000

PACKAGE CODE:

	BY	DDMMMYY
DSN	IB/RC	14OCT11
DRN	SZ	14OCT11
CHK	MP	14OCT11
APP	SC	14OCT11

KINGSTON SOLAR LP

AREA:

SUBJECT: SOL-LUCE KINGSTON ENERGY PROJECT SITE LAYOUT PROPERTY #6A

amec

CLIENT DWG. NO.:

DRAWING NO.: 168335-0002-121-LYD-0001-009

REV.: 3

PLOTTED: 18-Apr-12 2:15 PM USER: SHAHBAZIAN, RAZMIK
SAVED: 18-Apr-12 1:03 PM
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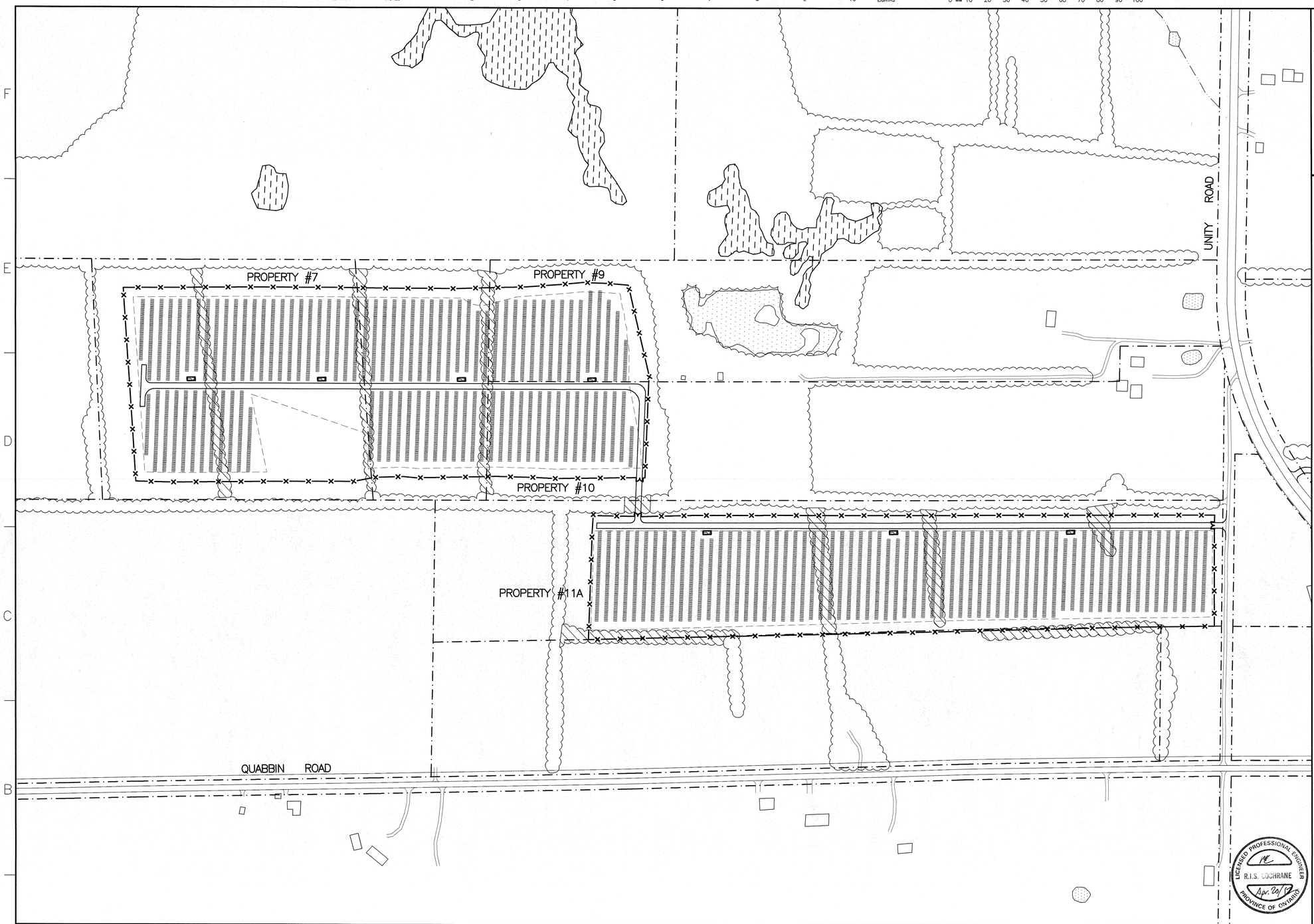


NOTES

1. REFER TO GENERAL NOTES SEE DRAWING 168335-0002-121-GAD-0001-001
2. REFER TO DRAWING 168335-0002-141-LYD-0002-008 FOR ELECTRICAL COLLECTOR LINE LAYOUT

PROPERTY	AC POWER CAPACITY (MW)
7/9/10	3.5
11A	2.5
TOTAL	6

LEGEND

EXISTING:

- PROPERTY LINE
- WOODLAND AREA
- BUILDING
- HYDRO ONE TOWER
- POND/WATER BODY
- WETLAND
- WATERCOURSE/DITCH

PROPOSED:

- 1MW INVERTER STATION
- SOLAR PANEL TABLE (5X4 PANELS)
- DEVELOPMENT BOUNDARY
- ACCESS ROAD
- 2-3.65m WIDE SWING GATES
- SECURITY FENCE
- WOODLAND/SHRUBLAND TO BE REMOVED

PRELIMINARY

0m 20 40 60 80 100
1:2000

LICENSED PROFESSIONAL ENGINEER
R.I.S. COCHRANE
Apr. 20/12
PROVINCE OF ONTARIO

REV	DDMMYY	REVISION / ISSUE DESCRIPTION	DRN	CHK	APP	APP	APP	APP
4	20APR12	RE-ISSUED FOR USE	SZ	RC	DJ			
3	18APR12	RE-ISSUED FOR USE	SZ	RC	DJ			
2	15FEB12	RE-ISSUED FOR USE	SZ	RC	SC			
1	01FEB12	RE-ISSUED FOR USE	SZ	RC	SC			
0	15DEC11	ISSUED FOR USE	SZ	RC	MP	SC		
D	08DEC11	ISSUED FOR CLIENT REVIEW	SZ	RC		SC		
C	30NOV11	ISSUED FOR CLIENT REVIEW	SZ	RC		SC		
B	17OCT11	ISSUED FOR CLIENT REVIEW	SZ	RC	MP	SC		
A	14OCT11	ISSUED FOR SQUAD CHECK	SZ	RC	MP	SC		

STAMP/SEAL

CONCEPTUAL DRAWING ONLY NOT TO BE USED FOR CONSTRUCTION

CLIENT PROJECT MGR.	DEPARTMENT MGR.	PROJECT MGR.

PROJECT PHASE: PRELIMINARY

PROJECT NO.	ACTIVITY NO.
168335	

SCALE	PACKAGE CODE
1:2000	

	BY	DDMMYY
DSN	IB/RC	14OCT11
DRN	SZ	14OCT11
CHK	MP	14OCT11
APP	SC	14OCT11

KINGSTON SOLAR LP

AREA

SUBJECT: SOL-LUCE KINGSTON ENERGY PROJECT SITE LAYOUT PROPERTIES #7 #9 #10 #11A

CLIENT DWG. NO.

DRAWING NO. 168335-0002-121-LYD-0001-008

REV. 4

SAVED: 20-Apr-12 10:44 AM PLOTTED: 20-Apr-12 10:45 AM USER: SHAHBAZIAN, RAZMIK

NOTES

1. REFER TO GENERAL NOTES SEE DRAWING 168335-0002-121-GAD-0001-001
2. REFER TO DRAWING 168335-0002-141-LYD-0002-007 FOR ELECTRICAL COLLECTOR LINE LAYOUT

PROPERTY	AC POWER CAPACITY (MW)
12	6.5
TOTAL	6.5

LEGEND

EXISTING:

- PROPERTY LINE
- WOODLAND AREA
- BUILDING
- HYDRO ONE TOWER
- POND/WATER BODY
- WETLAND
- WATERCOURSE/DITCH

PROPOSED:

- 1MW INVERTER STATION
- SOLAR PANEL TABLE (5X4 PANELS)
- DEVELOPMENT BOUNDARY
- ACCESS ROAD
- 2-3.65m WIDE SWING GATES
- SECURITY FENCE
- WOODLAND/SHRUBLAND TO BE REMOVED

PRELIMINARY

0m 20 40 60 80 100
1:2000

LICENSED PROFESSIONAL ENGINEER R.I.S. COCHRANE Apr 18/12 PROVINCE OF ONTARIO

REV	DDMMMYY	REVISION / ISSUE DESCRIPTION	DRN	CHK	APP	APP	APP
3	18APR12	RE-ISSUED FOR USE	SZ	RC	MP	SC	
2	15FEB12	RE-ISSUED FOR USE	SZ	RC	SC		
1	01FEB12	RE-ISSUED FOR USE	SZ	RC	SC		
0	15DEC11	ISSUED FOR USE	SZ	RC	MP	SC	
D	08DEC11	ISSUED FOR CLIENT REVIEW	SZ	RC		SC	
C	30NOV11	ISSUED FOR CLIENT REVIEW	SZ	RC		SC	
B	17OCT11	ISSUED FOR CLIENT REVIEW	SZ	RC	MP	SC	
A	14OCT11	ISSUED FOR SQUAD CHECK	SZ	RC	MP	SC	

STAMP/SEAL

CONCEPTUAL DRAWING ONLY NOT TO BE USED FOR CONSTRUCTION

CLIENT PROJECT MGR. | DEPARTMENT MGR. | PROJECT MGR.

PROJECT PHASE: PRELIMINARY

PROJECT NO.: 168335 | ACTIVITY NO.:

SCALE: 1:2000 | PACKAGE CODE:

	BY	DDMMMYY
DSN	IB/RC	14OCT11
DRN	SZ	14OCT11
CHK	MP	14OCT11
APP	SC	14OCT11

KINGSTON SOLAR LP

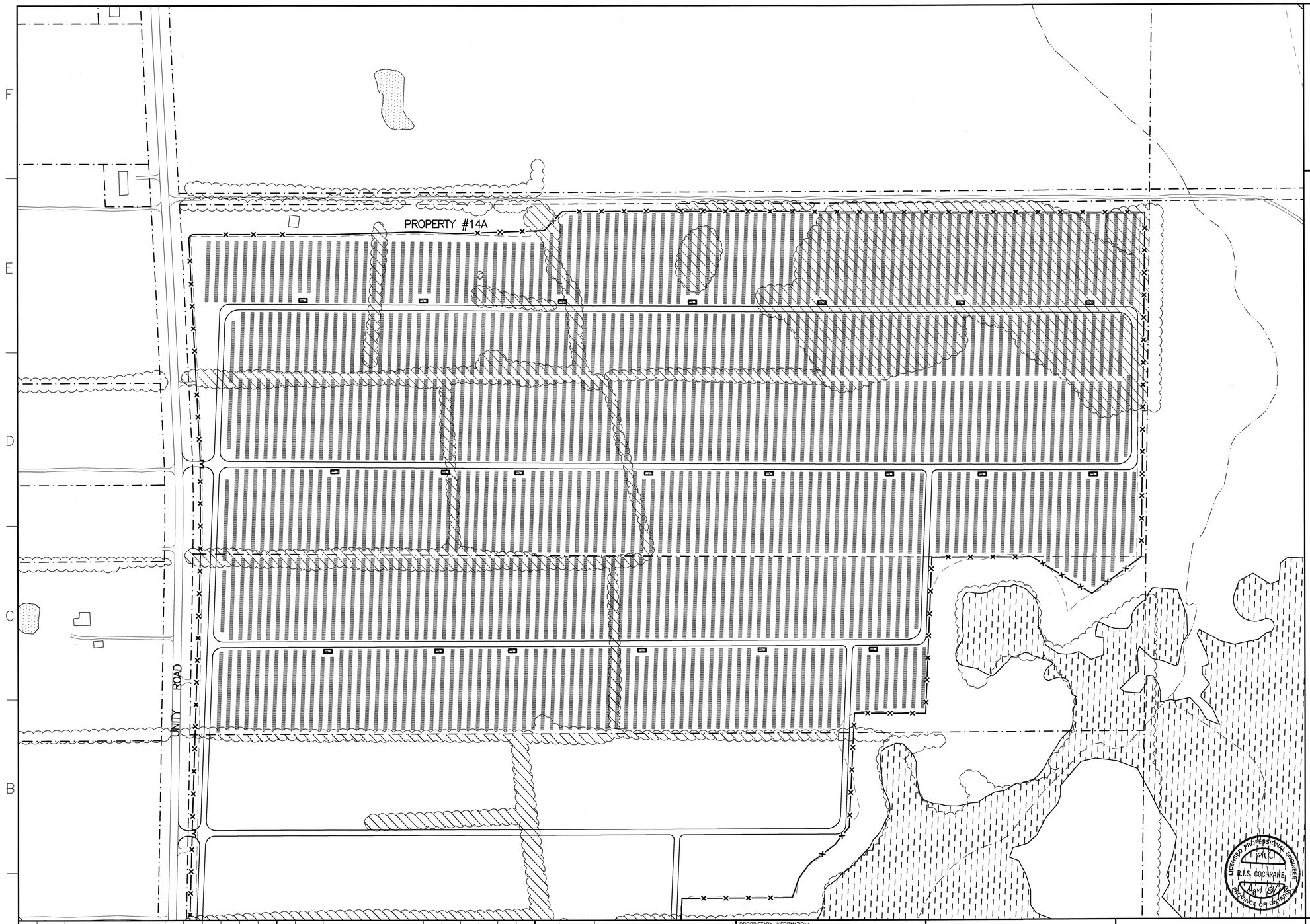
AREA:

SUBJECT: SOL-LUCE KINGSTON ENERGY PROJECT SITE LAYOUT PROPERTY #12

CLIENT DWG. NO.:

DRAWING NO.: 168335-0002-121-LYD-0001-007 | REV.: 3

PLOTTED: 18-Apr-12 3:01 PM USER: SHAHBAZIAN, RAZMIK
SAVED: 18-Apr-12 3:01 PM



NOTES

1. REFER TO GENERAL NOTES SEE DRAWING 168335-0002-121-GAD-0001-001
2. REFER TO DRAWING 168335-0002-141-LYD-0002-006 FOR ELECTRICAL COLLECTOR LINE LAYOUT

PROPERTY	AC POWER CAPACITY (MW)
14A	21
TOTAL	21

LEGEND

EXISTING:

- PROPERTY LINE
- WOODLAND AREA
- BUILDING
- HYDRO ONE TOWER
- POND/WATER BODY
- WETLAND
- WATERCOURSE/DITCH

PROPOSED:

- 1MW INVERTER STATION
- SOLAR PANEL TABLE (5X4 PANELS)
- DEVELOPMENT BOUNDARY
- ACCESS ROAD
- 2-3.65m WIDE SWING GATES
- SECURITY FENCE
- WOODLAND/SHRUBLAND TO BE REMOVED

PRELIMINARY

0m 20 40 60 80 100
1:2000

LICENSED PROFESSIONAL ENGINEER
R.I.S. COCHRANE
APR 12/11
PROVINCE OF ONTARIO

REV	DDMMMYY	REVISION / ISSUE DESCRIPTION	DRN	CHK	APP	APP	APP
3	18APR12	RE-ISSUED FOR USE	SZ	RC			
2	15FEB12	RE-ISSUED FOR USE	SZ	RC	SC		
1	01FEB12	RE-ISSUED FOR USE	SZ	RC	SC		
0	15DEC11	ISSUED FOR USE	SZ	RC	MP	SC	
D	08DEC11	ISSUED FOR CLIENT REVIEW	SZ	RC		SC	
C	30NOV11	ISSUED FOR CLIENT REVIEW	SZ	RC		SC	
B	17OCT11	ISSUED FOR CLIENT REVIEW	SZ	RC	MP	SC	
A	14OCT11	ISSUED FOR SQUAD CHECK	SZ	RC	MP	SC	

STAMP/SEAL

CONCEPTUAL DRAWING ONLY NOT TO BE USED FOR CONSTRUCTION

CLIENT PROJECT MGR. | DEPARTMENT MGR. | PROJECT MGR.

PROJECT PHASE: PRELIMINARY

PROJECT NO.: 168335 | ACTIVITY NO.:

SCALE: 1:2000 | PACKAGE CODE:

	BY	DDMMMYY
DSN	IB/RC	14OCT11
DRN	SZ	14OCT11
CHK	MP	14OCT11
APP	SC	14OCT11

KINGSTON SOLAR LP

AREA

SUBJECT: SOL-LUCE KINGSTON ENERGY PROJECT SITE LAYOUT
PROPERTY #14A

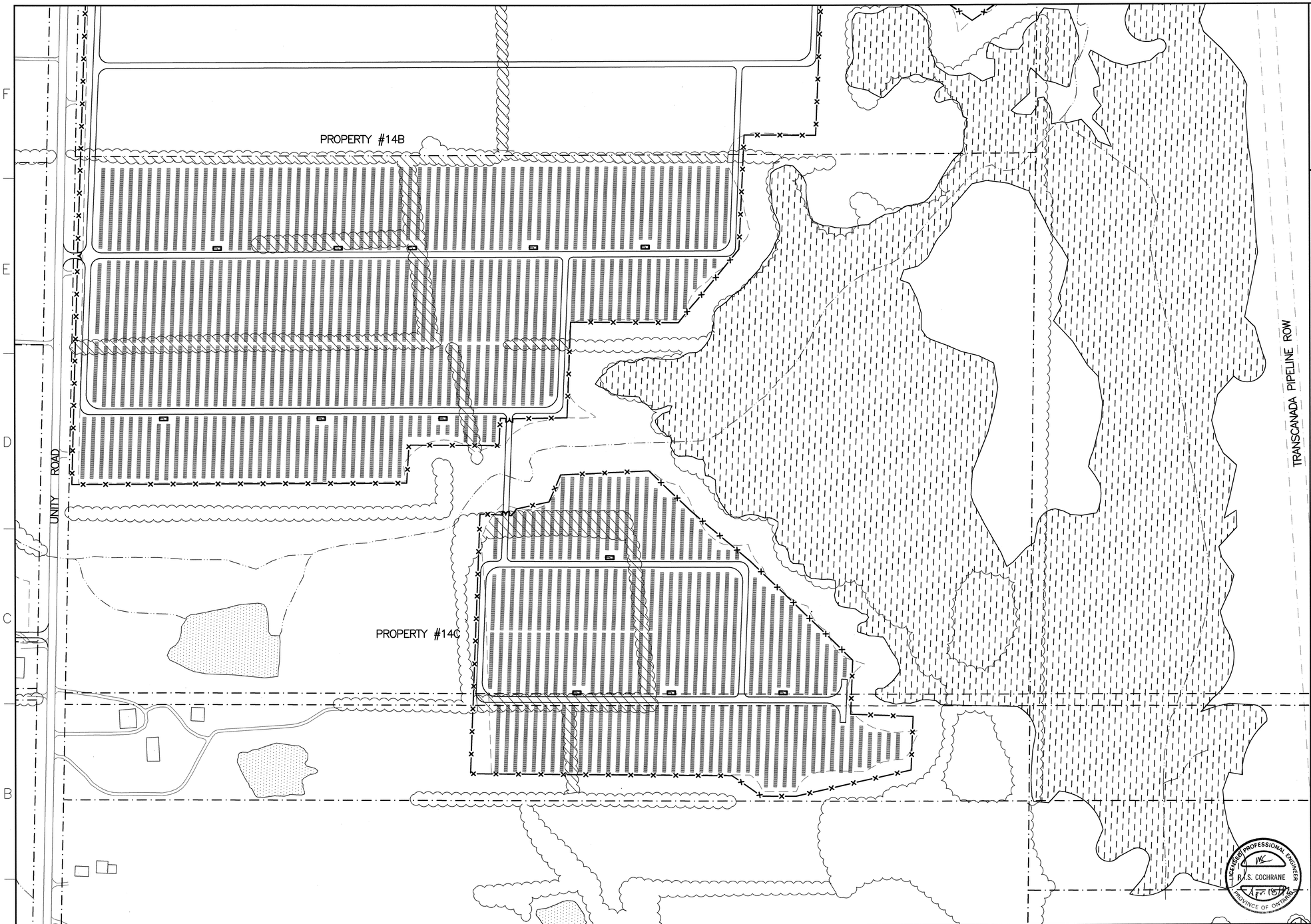
amec

CLIENT DWG. NO.

DRAWING NO.: 168335-0002-121-LYD-0001-006

REV.: 3

PLOTTED: 18-Apr-12 2:08 PM USER: SHAHBAZIAN, RAZMIK
SAVED: 18-Apr-12 11:40 AM



NOTES

1. REFER TO GENERAL NOTES SEE DRAWING 168335-0002-121-GAD-0001-001
2. REFER TO DRAWING 168335-0002-141-LYD-0002-005 FOR ELECTRICAL COLLECTOR LINE LAYOUT

PROPERTY	AC POWER CAPACITY (MW)
14B	8
14C	4
TOTAL	12

LEGEND

EXISTING:

- PROPERTY LINE
- WOODLAND AREA
- BUILDING
- HYDRO ONE TOWER
- POND/WATER BODY
- WETLAND
- WATERCOURSE/DITCH

PROPOSED:

- 1MW INVERTER STATION
- SOLAR PANEL TABLE (5X4 PANELS)
- DEVELOPMENT BOUNDARY
- ACCESS ROAD
- 2-3.65m WIDE SWING GATES
- SECURITY FENCE
- WOODLAND/SHRUBLAND TO BE REMOVED

PRELIMINARY

0m 20 40 60 80 100
1:2000

LICENSED PROFESSIONAL ENGINEER
R.S. COCHRANE
APR 18/12
PROVINCE OF ONTARIO

REV	DDMMMYY	REVISION / ISSUE DESCRIPTION	DRN	CHK	APP	APP	APP	APP
3	18APR12	RE-ISSUED FOR USE	SZ	RC	MP			SC
2	15FEB12	RE-ISSUED FOR USE	SZ	RC				SC
1	01FEB12	RE-ISSUED FOR USE	SZ	RC				SC
0	15DEC11	ISSUED FOR USE	SZ	RC	MP			SC
D	08DEC11	ISSUED FOR CLIENT REVIEW	SZ	RC				SC
C	30NOV11	ISSUED FOR CLIENT REVIEW	SZ	RC				SC
B	17OCT11	ISSUED FOR CLIENT REVIEW	SZ	RC	MP			SC
A	14OCT11	ISSUED FOR SQUAD CHECK	SZ	RC	MP			SC

STAMP/SEAL

CONCEPTUAL DRAWING ONLY NOT TO BE USED FOR CONSTRUCTION

CLIENT PROJECT MGR. | DEPARTMENT MGR. | PROJECT MGR.

PROJECT PHASE: PRELIMINARY

PROJECT NO.: 168335 | ACTIVITY NO.:

SCALE: 1:2000 | PACKAGE CODE:

	BY	DDMMMYY
DSN	IB/RC	14OCT11
DRN	SZ	14OCT11
CHK	MP	14OCT11
APP	SC	14OCT11

KINGSTON SOLAR LP

AREA

SUBJECT: SOL-LUCE KINGSTON ENERGY PROJECT SITE LAYOUT PROPERTIES #14B & #14C

amec

CLIENT DWG. NO.

DRAWING NO.: 168335-0002-121-LYD-0001-005 | REV.: 3

SAVED: 18-Apr-12 3:40 PM | PLOTTED: 18-Apr-12 3:41 PM | USER: SHAHBAZIAN, RAZMIK

I:\CAD\CIVIL\MXD\168335\0002\121-LYD-0001-005.DWG

NOTES

1. REFER TO GENERAL NOTES SEE DRAWING 168335-0002-121-GAD-0001-001
2. REFER TO DRAWING 168335-0002-141-LYD-0002-002 FOR ELECTRICAL COLLECTOR LINE LAYOUT

PROPERTY	AC POWER CAPACITY (MW)
19	5
20	1
19/20	1
TOTAL	7

LEGEND

EXISTING:

- PROPERTY LINE
- WOODLAND AREA
- BUILDING
- HYDRO ONE TOWER
- POND/WATER BODY
- WETLAND
- WATERCOURSE/DITCH

PROPOSED:

- 1MW INVERTER STATION
- SOLAR PANEL TABLE (5X4 PANELS)
- DEVELOPMENT BOUNDARY
- ACCESS ROAD
- 2-3.65m WIDE SWING GATES
- SECURITY FENCE
- WOODLAND/SHRUBLAND TO BE REMOVED

PRELIMINARY

0m 20 40 60 80 100
1:2000

LICENSED PROFESSIONAL ENGINEER
R.I.S. COCHRANE
Apr 18/12
PROVINCE OF ONTARIO

REV	DDMMMYY	REVISION / ISSUE DESCRIPTION	DRN	CHK	APP	APP	APP	APP
3	18APR12	RE-ISSUED FOR USE	SZ	RC	RC			
2	15FEB12	RE-ISSUED FOR USE	SZ	RC	SC			
1	01FEB12	RE-ISSUED FOR USE	SZ	RC	SC			
0	15DEC11	ISSUED FOR USE	SZ	RC	MP	SC		
D	08DEC11	ISSUED FOR CLIENT REVIEW	SZ	RC		SC		
C	30NOV11	ISSUED FOR CLIENT REVIEW	SZ	RC		SC		
B	17OCT11	ISSUED FOR CLIENT REVIEW	SZ	RC	MP	SC		
A	14OCT11	ISSUED FOR SQUAD CHECK	SZ	RC	MP	SC		

STAMP/SEAL

CONCEPTUAL DRAWING ONLY NOT TO BE USED FOR CONSTRUCTION

CLIENT PROJECT MGR. | DEPARTMENT MGR. | PROJECT MGR.

PROJECT PHASE: PRELIMINARY

PROJECT NO.: 168335 | ACTIVITY NO.: | SCALE: 1:2000 | PACKAGE CODE:

	BY	DDMMMYY
DSN	IB/RC	14OCT11
DRN	SZ	14OCT11
CHK	MP	14OCT11
APP	SC	14OCT11

KINGSTON SOLAR LP

AREA:

SUBJECT: SOL-LUCE KINGSTON ENERGY PROJECT SITE LAYOUT PROPERTIES #19 & #20

CLIENT DWG. NO.:

DRAWING NO.: 168335-0002-121-LYD-0001-002 | REV.: 3

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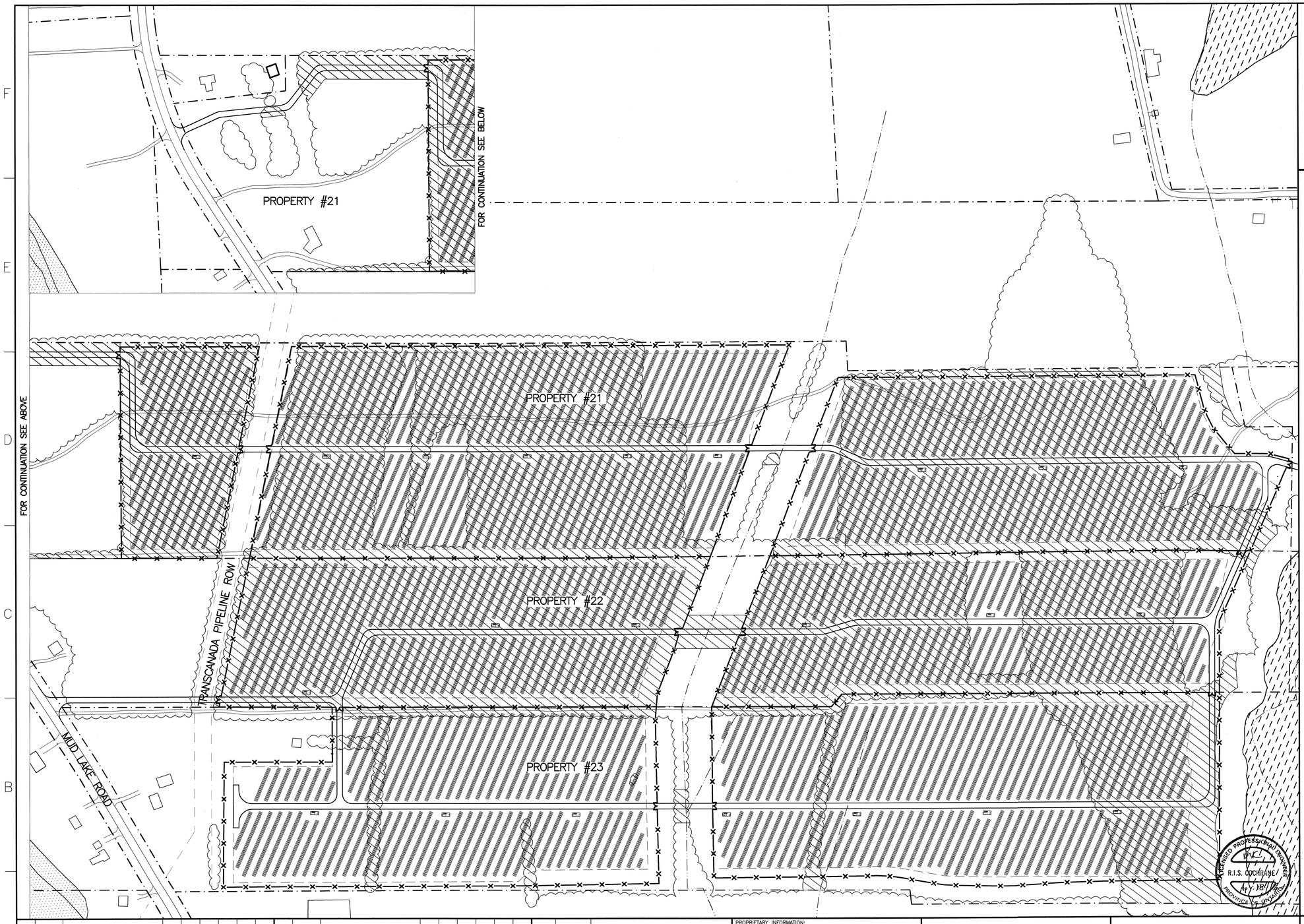

NOTES

1. REFER TO GENERAL NOTES SEE DRAWING 168335-0002-121-GAD-0001-001
2. REFER TO DRAWING 168335-0002-141-LYD-0002-001 FOR ELECTRICAL COLLECTOR LINE LAYOUT

PROPERTY	AC POWER CAPACITY (MW)
21	9
22	5.5
23	6.5
TOTAL	21

LEGEND

EXISTING:

- PROPERTY LINE
- WOODLAND AREA
- BUILDING
- HYDRO ONE TOWER
- POND/WATER BODY
- WETLAND
- WATERCOURSE/DITCH

PROPOSED:

- 1MW INVERTER STATION
- SOLAR PANEL TABLE (5X4 PANELS)
- DEVELOPMENT BOUNDARY
- ACCESS ROAD
- 2-3.65m WIDE SWING GATES
- SECURITY FENCE
- WOODLAND/SHRUBLAND TO BE REMOVED

PRELIMINARY

0m 20 40 60 80 100
1:2000

LICENSED PROFESSIONAL ENGINEER R.I.S. COCHRANE PROVINCE OF ONTARIO

REV	DDMMMYY	REVISION / ISSUE DESCRIPTION	DRN	CHK	APP	APP	APP	APP
3	18APR12	RE-ISSUED FOR USE	SZ	RC	MP			
2	15FEB12	RE-ISSUED FOR USE	SZ	RC	SC			
1	01FEB12	RE-ISSUED FOR USE	SZ	RC	SC			
0	15DEC11	ISSUED FOR USE	SZ	RC	MP	SC		
0	08DEC11	ISSUED FOR CLIENT REVIEW	SZ	RC		SC		
C	30NOV11	ISSUED FOR CLIENT REVIEW	SZ	RC		SC		
B	17OCT11	ISSUED FOR CLIENT REVIEW	SZ	RC	MP	SC		
A	14OCT11	ISSUED FOR SQUAD CHECK	SZ	RC	MP	SC		

STAMP/SEAL

CONCEPTUAL DRAWING ONLY NOT TO BE USED FOR CONSTRUCTION

CLIENT PROJECT MGR. | DEPARTMENT MGR. | PROJECT MGR.

PROJECT PHASE: PRELIMINARY

PROJECT NO.: 168335 | ACTIVITY NO. | SCALE: 1:2000 | PACKAGE CODE

	BY	DDMMMYY
DSN	IB/RC	14OCT11
DRN	SZ	14OCT11
CHK	MP	14OCT11
APP	SC	14OCT11

KINGSTON SOLAR LP

AREA

SUBJECT: SOL-LUCE KINGSTON ENERGY PROJECT SITE LAYOUT PROPERTIES #21, #22 & #23

amec

CLIENT DWG. NO.

DRAWING NO.: 168335-0002-121-LYD-0001-001 | REV.: 3

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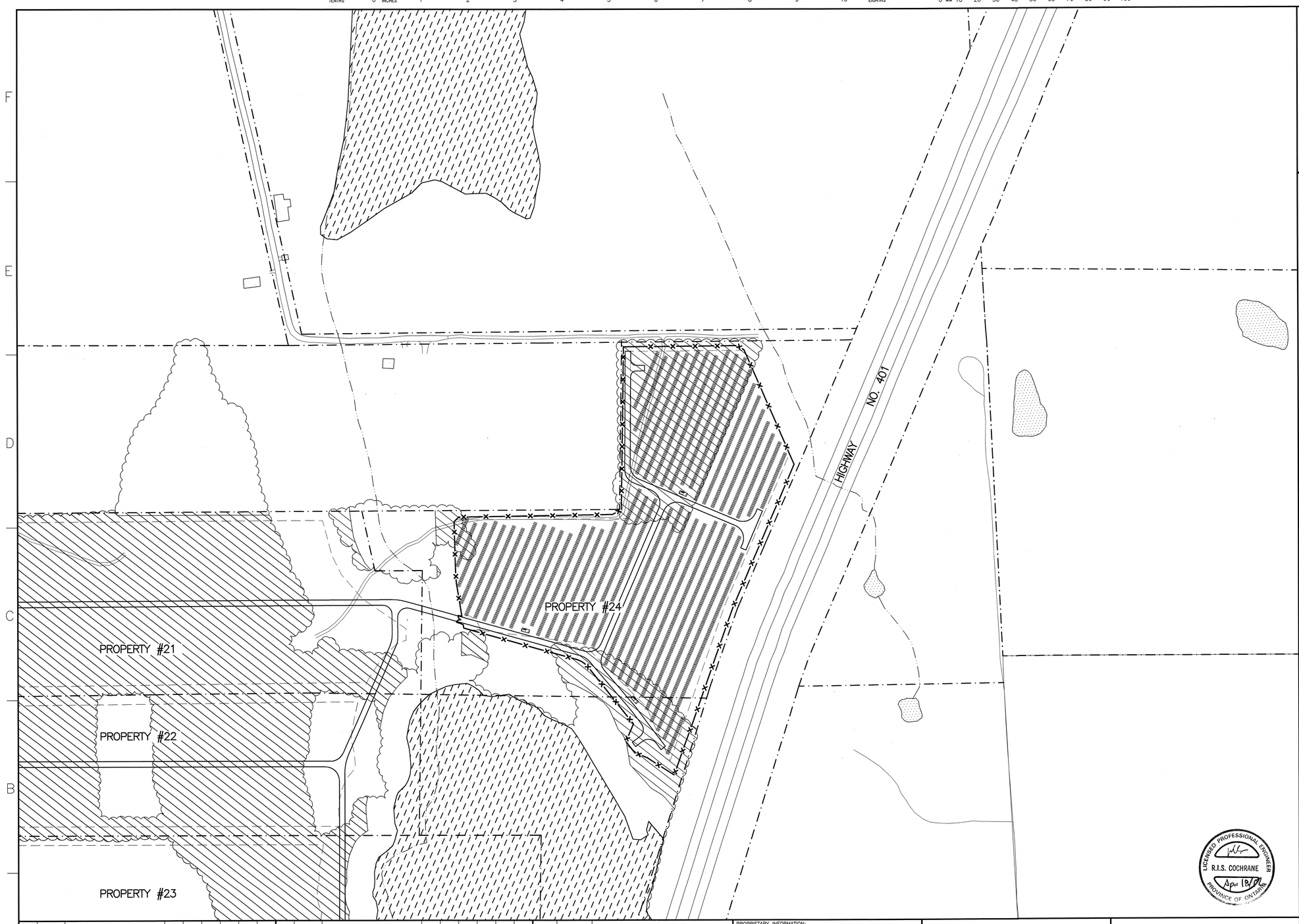

NOTES

1. REFER TO GENERAL NOTES SEE DRAWING 168335-0002-121-GAD-0001-001
2. REFER TO DRAWING 168335-0002-141-LYD-0002-012 FOR ELECTRICAL COLLECTOR LINE LAYOUT

PROPERTY	AC POWER CAPACITY (MW)
24	3
TOTAL	3

LEGEND

EXISTING:

- PROPERTY LINE
- WOODLAND AREA
- BUILDING
- HYDRO ONE TOWER
- POND/WATER BODY
- WETLAND
- WATERCOURSE/DITCH

PROPOSED:

- 1MW INVERTER STATION
- SOLAR PANEL TABLE (5X4 PANELS)
- DEVELOPMENT BOUNDARY
- ACCESS ROAD
- 2-3.65m WIDE SWING GATES
- SECURITY FENCE
- WOODLAND/SHRUBLAND TO BE REMOVED

PRELIMINARY

0m 20 40 60 80 100
1:2000

LICENSED PROFESSIONAL ENGINEER
R.I.S. COCHRANE
PROVINCE OF ONTARIO

REV	DDMMMYY	REVISION / ISSUE DESCRIPTION	DRN	CHK	APP	APP	APP	APP
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0	16FEB12	ISSUED FOR USE	SZ	RC	MP	SC		
B	01FEB12	ISSUED FOR CLIENT REVIEW	SZ	RC	MP	SC		
A	14FEB12	ISSUED FOR SQUAD CHECK	SZ	RC	MP	SC		

STAMP/SEAL

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CLIENT PROJECT MGR. DEPARTMENT MGR. PROJECT MGR.

PROJECT PHASE: PRELIMINARY

PROJECT NO.: 168335

ACTIVITY NO.:

SCALE: 1:2000

PACKAGE CODE:

	BY	DDMMMYY
DSN	IB/RC	14OCT11
DRN	SZ	14OCT11
CHK	MP	14OCT11
APP	SC	14OCT11

KINGSTON SOLAR LP

AREA:

SUBJECT: SOL-LUCE KINGSTON ENERGY PROJECT SITE LAYOUT PROPERTY #24

CLIENT DWG. NO.:

DRAWING NO.: 168335-0002-121-LYD-0001-012

REV.: 1

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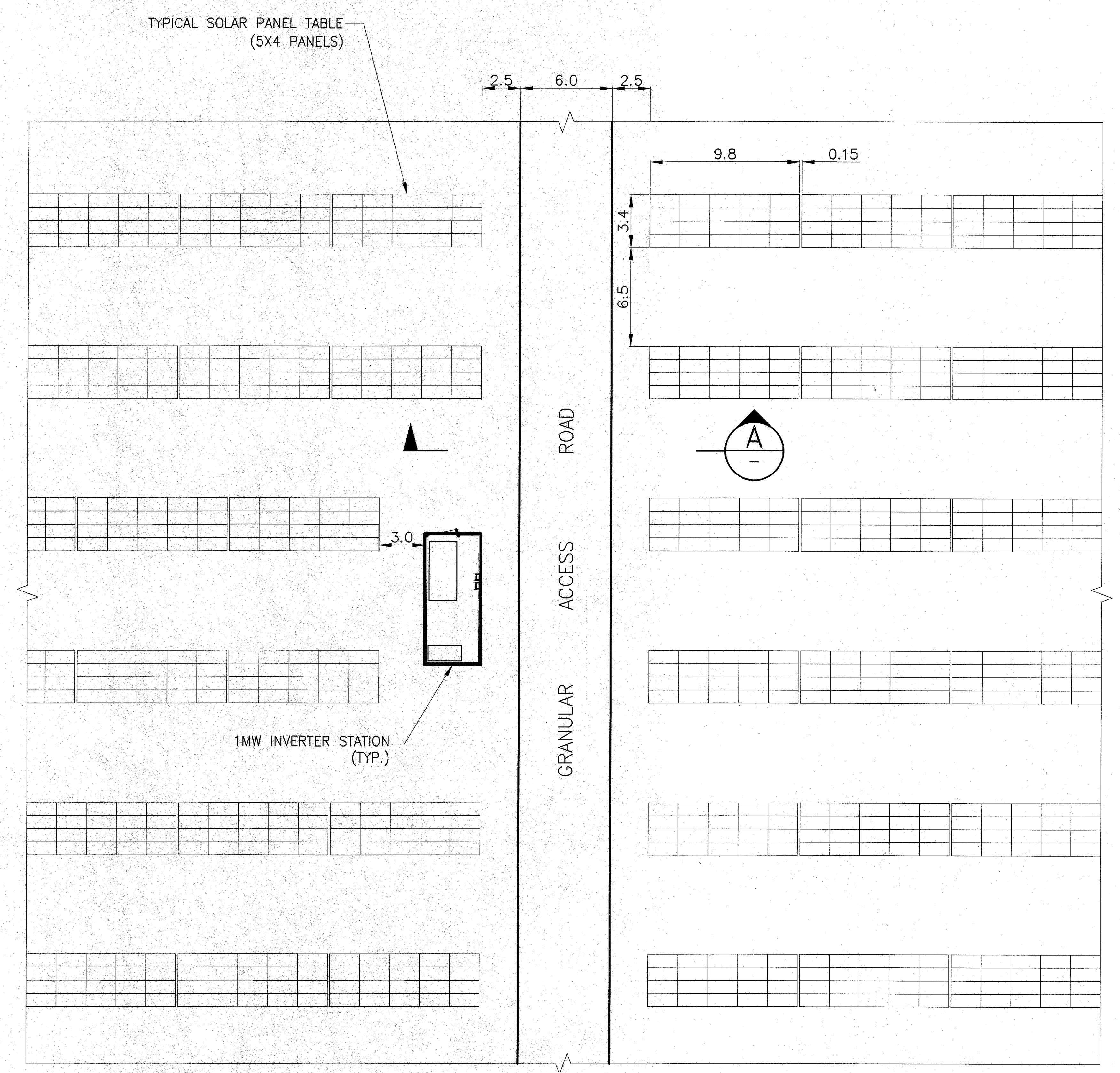
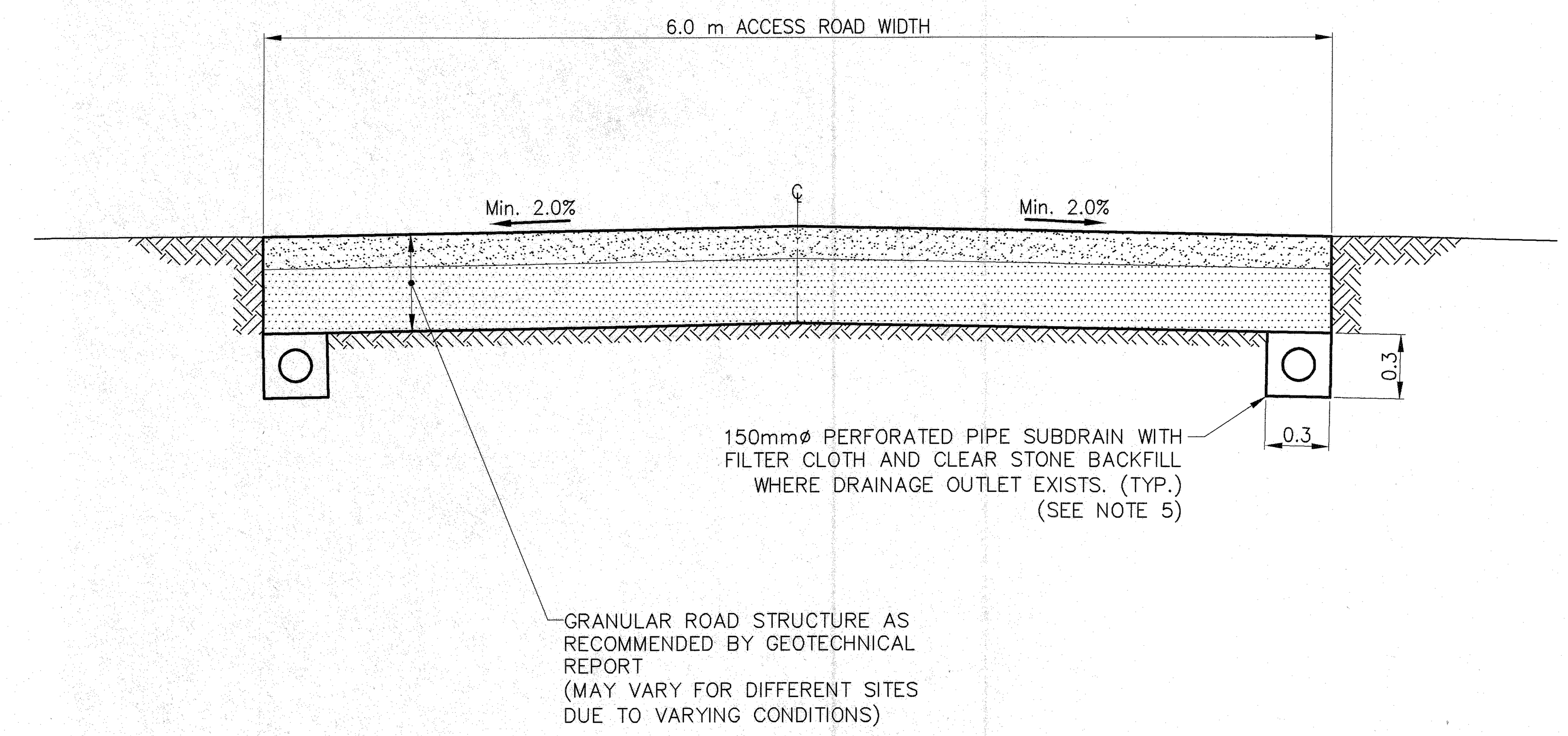
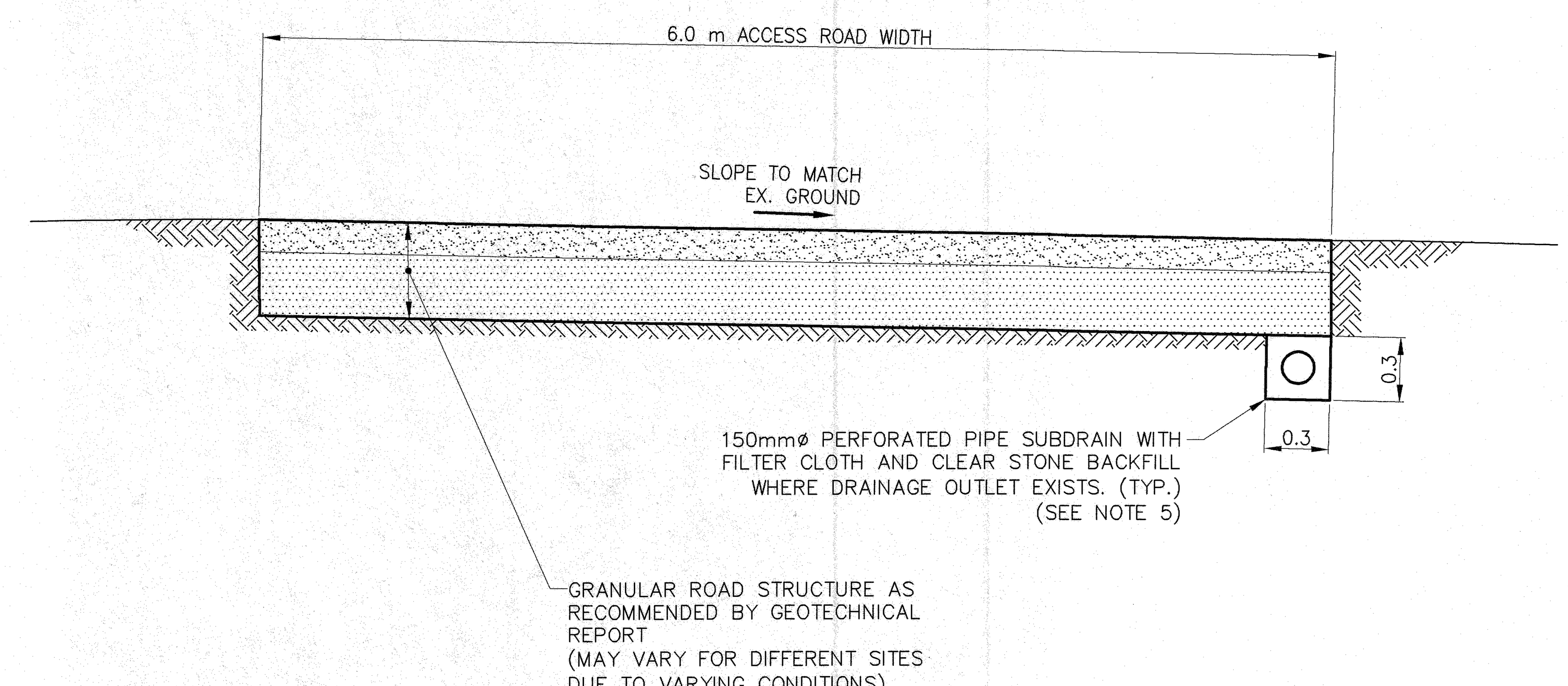
SAVED: 18-Apr-12 5:06 PM



TYPICAL ACCESS ROAD AND PANELS LAYOUT DETAIL
N.T.S.



A TYPICAL ACCESS ROAD CROSS-SECTION
CONDITION 1 – TWO WAY CROSS-FALL
N.T.S.



A TYPICAL ACCESS ROAD CROSS-SECTION
CONDITION 2 – ONE WAY CROSS-FALL
N.T.S.

NOTES

1. TYPICAL CROSS-SECTIONS ARE CONCEPTUAL ONLY AND SHALL BE SUBJECT TO CONFIRMATION OF CONDITIONS AT EACH SITE AND DETAILED DESIGN.
2. THE USE OF TYPICAL CROSS-SECTION CONDITION 1 OR CONDITION 2 SHALL BE DEPENDANT ON THE SPECIFIC TOPOGRAPHY AND GRADING / DRAINAGE DESIGN FOR EACH SITE.
3. GRANULAR PAVEMENT STRUCTURE MATERIAL AND DETAILS FOR EACH SITE SHALL BE DETERMINED BASED ON THE RECOMMENDATIONS OF THE GEOTECHNICAL REPORT.
4. ALL DIMENSIONS SHOWN ON THIS DRAWING ARE IN METERS, UNLESS NOTED OTHERWISE.
5. PERFORATED PIPE SUBDRAIN TO BE UTILIZED ONLY IN AREAS WHERE A DRAINAGE OUTLET EXISTS. IN OTHER AREAS THE GRANULAR PAVEMENT STRUCTURE MAY HAVE TO BE INCREASED ACCORDINGLY.

LICENSED PROFESSIONAL ENGINEER
R.I.S. COCHRANE
Feb.17/12
PROVINCE OF ONTARIO

PRELIMINARY

REV	DDMMMYY	REVISION / ISSUE DESCRIPTION	DRN	CHK	APP	APP	APP	APP
0	15FEB12	ISSUED FOR USE	SZ	RC	SC			
C	06JAN12	ISSUED FOR REVIEW	SZ	RC	MP	SC		
B	26OCT11	ISSUED FOR REVIEW	SZ	RC	MP	SC		
A	25OCT11	ISSUED FOR SQUAD CHECK	SZ	RC	MP	SC		

STAMP/SEAL

CONCEPTUAL DRAWING ONLY
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CLIENT PROJECT MGR. | DEPARTMENT MGR. | PROJECT MGR.

PROJECT PHASE: PRELIMINARY

KINGSTON SOLAR LP

AREA

amec

PROJECT NO.	ACTIVITY NO.		BY	DDMMMYY
168335		DSN	RC	18OCT11
		DRN	SZ	20OCT11
SCALE	PACKAGE CODE	CHK	JJ	24OCT11
N.T.S.		APP	SC	24OCT11

SUBJECT: SOL-LUCE KINGSTON ENERGY PROJECT
TYPICAL CIVIL DETAILS
AND CROSS-SECTIONS

CLIENT DWG. NO.

DRAWING NO.: 168335-0002-121-DTL-0101-001 REV. 0

SAVED: 16-Feb-12 9:29 AM PLOTTED: 16-Feb-12 9:31 AM USER: ZHU, SOPHIE

APPENDIX B

STORMWATER MANAGEMENT PLAN (SWMP)

KINGSTON SOLAR LP
SOL-LUCE KINGSTON
SOLAR PV ENERGY PROJECT

STORMWATER MANAGEMENT PLAN

Submitted to:

Kingston Solar LP
55 Standish Court, 9th Floor
Mississauga, Ontario
L5R 4B2

Submitted by:

AMEC Environment & Infrastructure
a Division of AMEC Americas Limited
160 Traders Blvd. E., Suite 110
Mississauga, Ontario
L4Z 3K7

September 2012

TC111406
168335-0002-160-RPT-0021

IMPORTANT NOTICE

This Document was prepared exclusively for Kingston Solar LP, (the "Proponent") by AMEC Americas Limited. The quality of information contained herein is consistent with the level of effort involved in AMEC services and based on: i) information available at the time of preparation, ii) data supplied by outside sources, and iii) the assumptions, conditions and qualifications set forth in this document. This document is intended to be used by the Proponent only, subject to the terms and conditions of its contract with AMEC. Any other use of, or reliance upon this document by any third party for any other purpose will be at that party's sole risk.

REV.	DATE	DETAILS OR PURPOSE OF REVISION	PREPARED	CHECKED	APPROVED
A	24/11/2011	Issued for client review			
B	4/5/2012	Issued for client review			
0	8/5/2012	Issued for Use			
1	18/9/2012	Issued for REA Application			

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1.0 INTRODUCTION

Kingston Solar LP (hereinafter referred to as "Proponent") proposes to develop a solar facility with a maximum name plate capacity of approximately 100 MW AC (megawatts of alternating current) in Eastern Ontario located in the City of Kingston and Loyalist Township. If approved, this facility would use photovoltaic (PV) technology to convert solar energy into electricity. Power generated by the proposed facility would be fed into the provincial grid via a substation located adjacent to the Hydro One Networks Inc. (HONI) transmission line which crosses the study area. The output of the solar PV Project will be collected and connected to an electrical substation capable of transforming the power from distribution voltage to a transmission voltage of 230 kV.

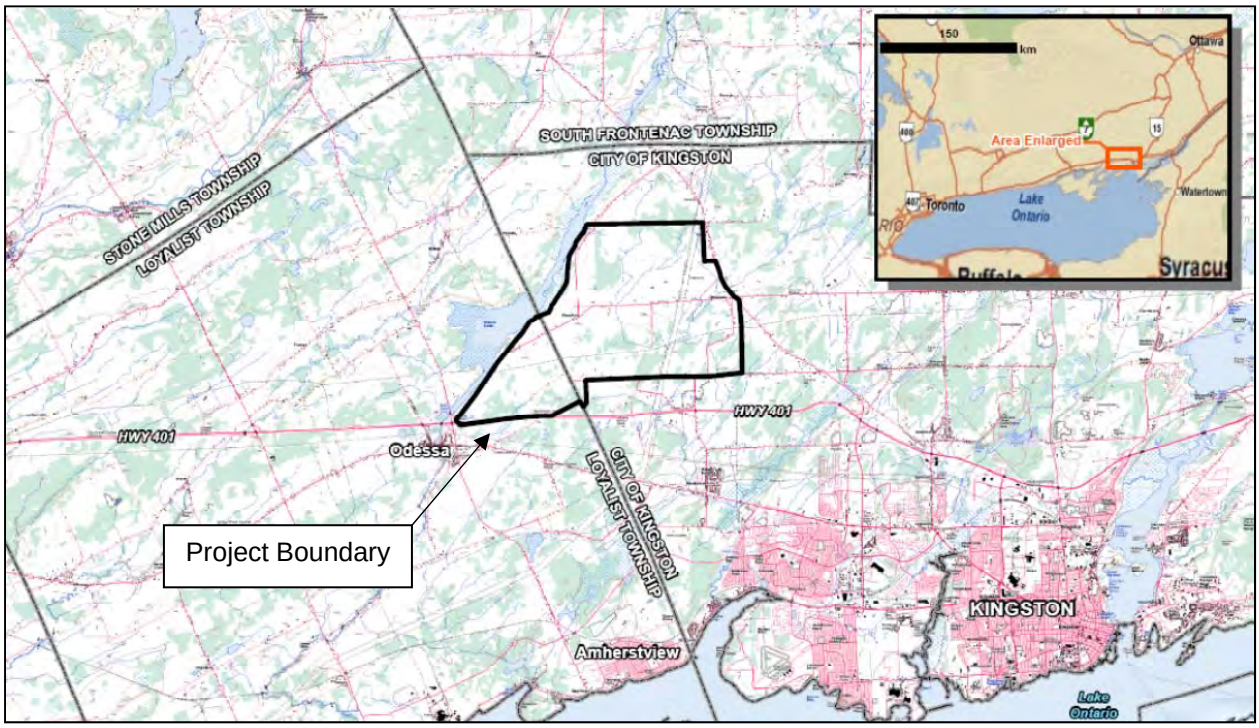
The proposed facility is to be known as the "Sol-luce Kingston Solar PV Energy Project" (hereinafter referred to as "the Project"). The Project is designated as a Class 3 solar facility in accordance with the definition in Section 4 of O.Reg. 359/09. The development of the Project would help the Province of Ontario meet its goal of increasing the proportion of electricity generated from renewable energy sources.

The Project is proposed in the City of Kingston and Loyalist Township and is generally bounded by a northing of 4910430 (NAD 83 UTM), Highway 38 to the east, Millhaven Creek and Odessa Lake to the west and Highway 401 to the south (Figures 1-1 and 1-2).

The basic components of the Project include fixed ground mounted photovoltaic panels (crystalline solar cells) located on sections of privately owned, leased lands within the Project Location, which covers an area of approximately 261 ha.

The Project Location includes all land and buildings/structures associated with the Project. This includes structures such as solar panels, access roads, and power distribution lines as well as any temporary construction zones surrounding access roads (constructible areas) which will be required during the construction of the Project. This also includes the corridors surrounding infrastructure such as access roads in which the final infrastructure may be located.

Figure 1-1: Project Boundary, Regional Context



The Project would consist of:

- Multiple sites consisting of arrays of photovoltaic (PV) modules or panels, with the cumulative capacity to generate up to 100 MW AC of power located as shown in Figure 1-3;

- The arrays would be mounted to aluminum or galvanized racking anchored to the ground or foundations;

- The PV arrays would be grouped in blocks of approximately 1 MW and connected to an inverter station to convert the incoming power from direct current (DC) to alternating current (AC). A transformer at the inverter station will transform the outgoing AC power to 34.5 kilovolts (kV);

- Power from solar sites would be transmitted by underground and/or overhead collector lines to the substation via the municipal road right-of-way;

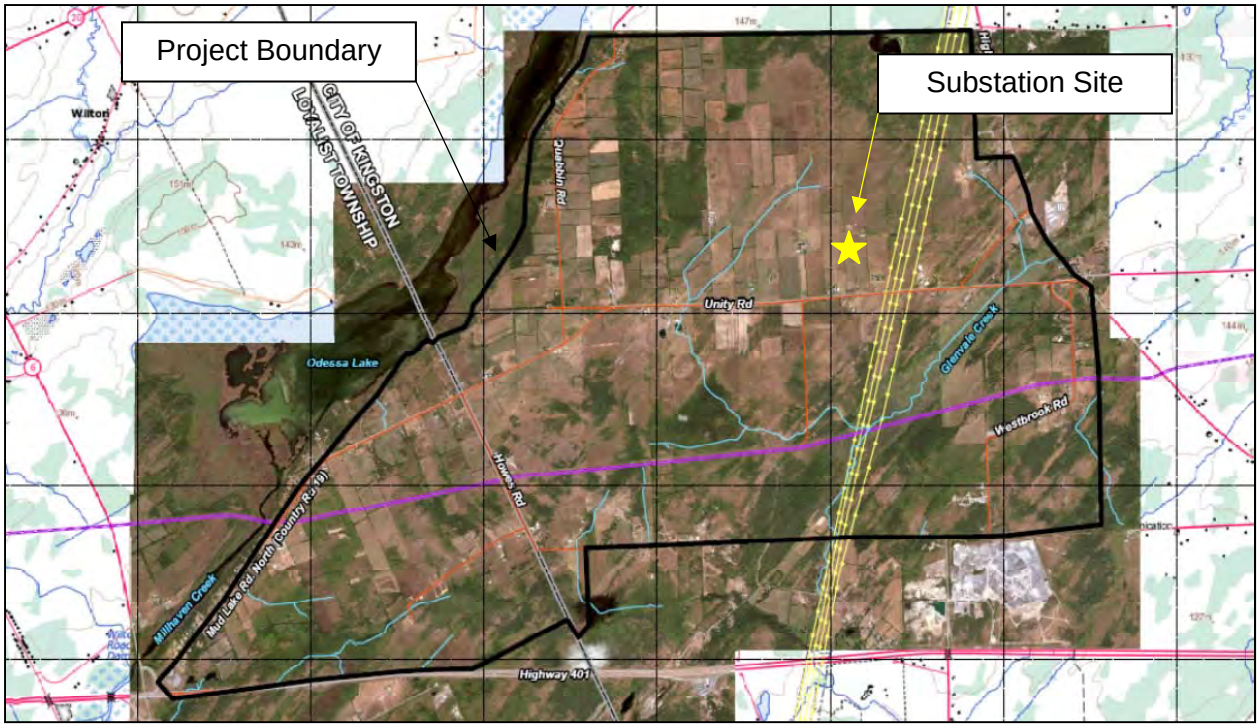
- At the substation, transformers would transform the power to 230 kV for interconnection to the adjacent Hydro One Networks Inc. (HONI) transmission line. The collector line is estimated to be approximately 33 km in length;

- A maintenance and control building would be located at the substation site for operations and maintenance use; and

- All Project sites will be surrounded by security fencing.

For additional details of the Project reference can be made to the *Project Description Report*.

Figure 1-2: Project Boundary, Local Context



The Proponent will provide for the design, construction, operation, and decommissioning of the Project. The proposed schedule is to commence construction in the first half of 2013 with completion in 2014. The lifespan of the Project is 20 years following which it would be decommissioned.

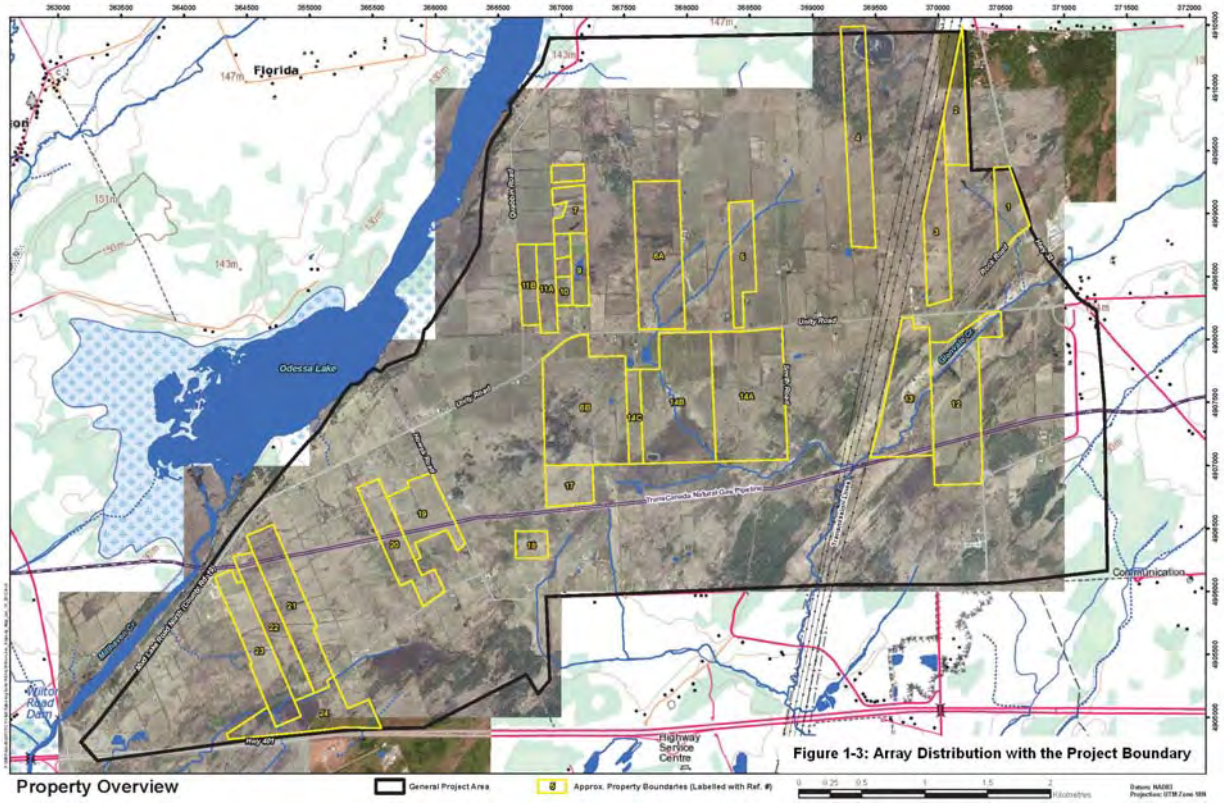
The Stormwater Management (SWM) Plan will address storm runoff from solar panel arrays within the Project boundary and the substation/switchyard. The Project boundary lies wholly within the jurisdiction of the Cataraqui Region Conservation Authority (CRCA).

This report summarizes the development of the concept SWM Plan for the Project.

1.1 Array Location

The solar arrays are distributed within the Project boundary (Figure 1-3) across 19 properties.

Figure 1-3: Array Distribution with the Project Boundary

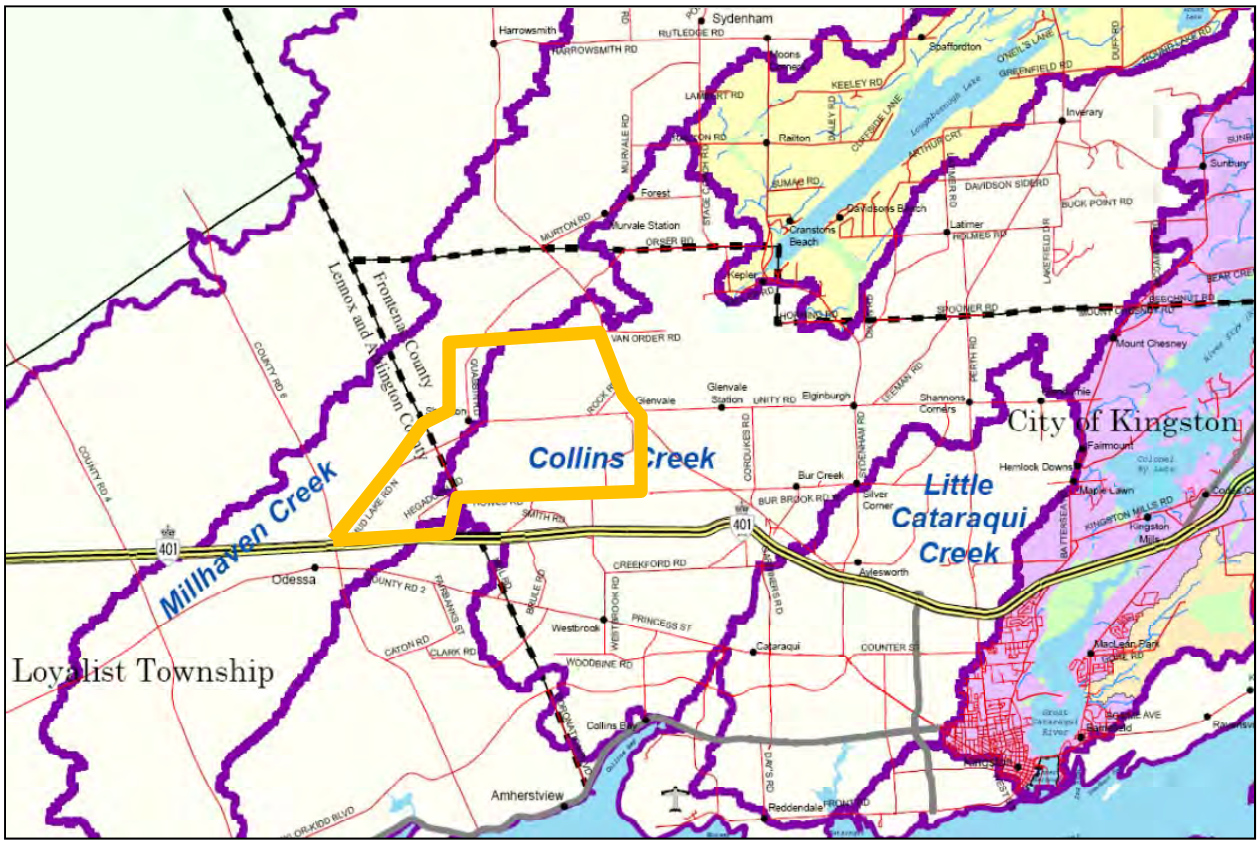


As illustrated in Figure 1-4, the Project boundary spans three subwatersheds within the jurisdiction of the CRCA, namely, the drainage areas associated with Millhaven Creek, Collins Creek and Parrot's Creek (from CRCA, 2011, Map 2-2). These three watersheds drain to Lake Ontario directly.

Some considerations regarding stormwater management planning for the Properties include construction associated with installation of the arrays. The installation will occur on existing ground (i.e., existing topography will be maintained) to the extent possible, and following construction, the site will be seeded to stabilize areas disturbed from construction activities.

As such, although the solar panels are an impervious surface, the underlying soils and topography will change from pre-development conditions. Rain water flowing off the solar panels will fall to the existing ground surface, runoff will travel an unchanged path therefore maintaining the opportunity to infiltrate in a manner equalling pre-development. Areas to be covered by solar arrays are not considered to change in terms of their runoff potential between pre-development and post-development because only minimal hard surfaces (access roads) will be constructed for this development and a vegetated buffer will be maintained between the arrays and the boundary of a Property.

Figure 1-4: Project Boundary with Respect to CRCA Drainage Areas



Note: the background image was taken from Figure 1-16a of the Cataraqui Source Protection Area, Amended Proposed Assessment Report, June 2011.

The following information is relevant for the properties which make up the Project:

- The Project is located within the area known as the Limestone Plain (from Map 2-1 [CRCA, 2011]);
- The bedrock geology underlying the Project is generally comprised of the Gull River Palaeozoic Formation (from Map 2-3 [CRCA, 2011]);
- The surficial geology underlying the Project is substantially comprised of the Palaeozoic Bedrock Drift Complex with some small elements of Fine Textured Glaciolacustrine (from Map 2-4 [CRCA, 2011]);
- The till soils overlying the Precambrian Shield are generally thin within the Project boundary. The soil materials along the southern border of Frontenac County consist of stone free clay deposits broken in places by numerous outcroppings of Precambrian rock. (Gillespie et al, 1966);

- Surficial soils within the Project boundary are generally characterized as loams (from Map 1-5a [CRCA, 2011]) of the Farmington, Guerin, Bondhead, Lyons and Lindsey complexes (Gillespie et al, 1963 and 1966). These complexes are described as well drained (Farmington), imperfectly drained (Guerin) and poorly drained (Lyons, Lindsey) (Gillespie et al, 1963 and 1966);

- The dominant surficial soils are the Farmington, Guerin and Lindsey complexes representing 64%, 15% and 15%, respectively, of the area covered by the Project boundary;

- Overburden thickness across the Project boundary is generally less than 0.9 m (from Map 1-13 [CRCA, 2011]);

- The general drainage pattern within the Project boundary southwesterly;

- Land cover is a mix of agriculture, forest and swamp within the Project boundary (from Map 1-14 [CRCA, 2011]);

- No water control structures are located within the Project boundary (from Map 2-9 [CRCA, 2011]);

- No streamflow gauging stations are located within the Project boundary (from Map 3-1 [CRCA, 2011]);

- The Millhaven Creek and Collins Creek watersheds are considered to be under “Significant” surface water stress while the Parrot’s Creek watershed is considered to be under “Moderate” surface water stress (from Map 3-3 [CRCA, 2011]);

- The Millhaven Creek watershed is considered to be under “Low” groundwater stress while the Parrot’s Creek and Collin’s Creek watersheds are considered to be under “Significant” and “Moderate” ground water stress, respectively (from Map 3-4 [CRCA, 2011]);

- No surface water intake protection zones or wellhead protection areas are located within (wholly or partially) the Project boundary (from Map 4-1 [CRCA, 2011]);

- The underlying aquifer across virtually the entire area encompassing the Project boundary is considered “Highly Vulnerable” (from Map 5-1e [CRCA, 2011]);

- Some areas within the Project boundary are considered to be “Significant” groundwater recharge areas (from Map 5-7 [CRCA, 2011]); and,

- No tile drains have been identified (to date) on any of the Properties.

1.2 Substation Development

The substation facility would be located approximately ½ km west of the intersection of Unity Road and Rock Road and approximately ½ km north of Unity Road (Figures 1-2 and 1-5). The substation would house the switchyard, control, protection, communication and metering system required to support the operation of the substation. The substation would have a foot print of approximately 1.5 ha. The site would include a switchyard to interconnect with the provincial power grid operated by HONI. The site would be largely covered with gravel, and underlain by a grounding grid. The substation site would be surrounded by a chain-link fence equipped with a locked vehicle gate to allow for maintenance access for security (for layout of the substation (Figure 1-6).

The substation is a component of the proposed development on Property #4. Property #4 covers a total area of about 13.5 ha, of which, the area proposed for the substation is about 1.5 ha.

Of particular interest in regards to the development of the SWM Plan for the substation is the proposed transformer containment pit system. A general outline of this system is provided below:

- A “double containment system” will be implemented for transformers at the substation. In addition to the “first stage” of containment, namely the transformer enclosures (conservator, tank, etc.), a “second stage” of containment will be in the form of a transformer containment pit system;

- The stormwater containment area for the transformer will have a minimum volume equal to the volume of transformer oil plus the volume equivalent to providing a minimum 24-hour duration, 25-year return storm capacity for the stormwater drainage area around the transformer under normal operating conditions;

- The containment facility will have a freeboard of 0.25 m approximately 0.30 m above grade, and an impervious floor, stoned filled and walls of reinforced concrete with an impervious plastic liner with sloped floors leading to an oil control device;

- Drainage from the transformer pit would be removed by either manually or automatically operating a sump pump to discharge the liquid. In either case, an oil/grease sensor would be mounted on the pump to detect any oil/grease in the liquid. If oil/grease is detected, the liquid would be removed from site via a licensed waste hauler and the source of the leakage would be identified. If no oil/grease is detected in the liquid, discharge would be via the stormwater collection system; and,

- A clean stormwater outlet draining from the containment facility.

Figure 1-5: Proposed Substation Location

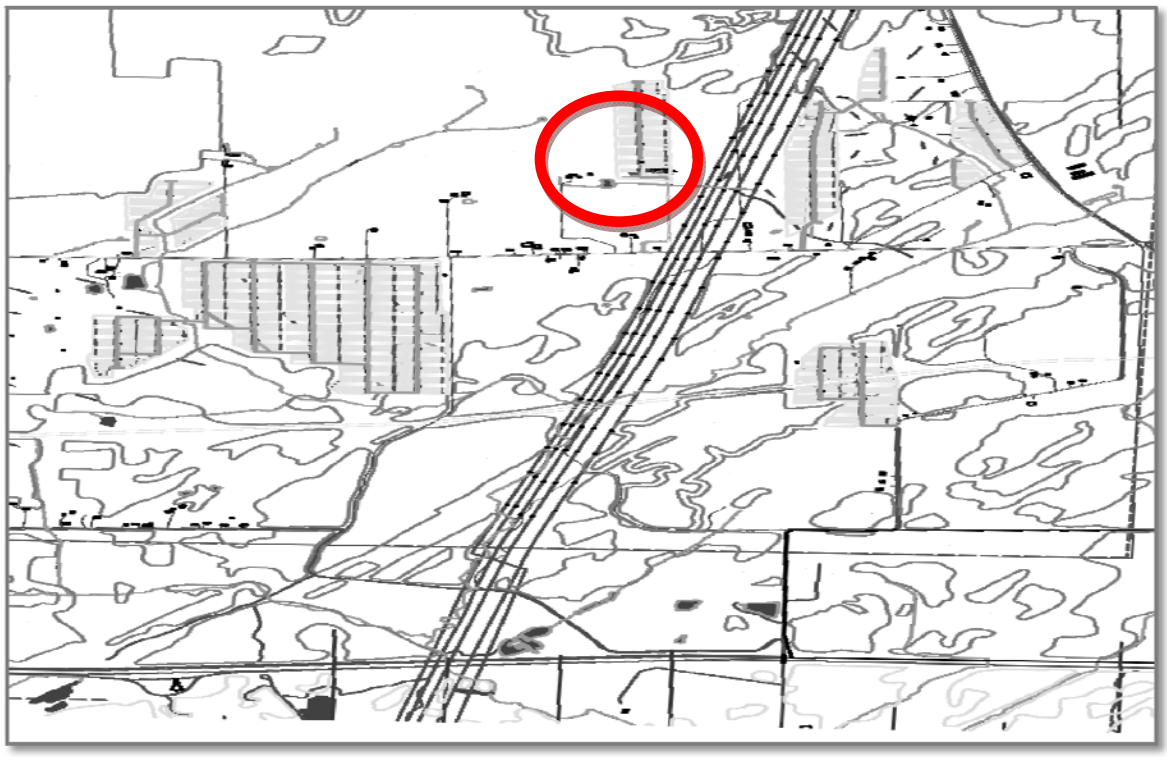
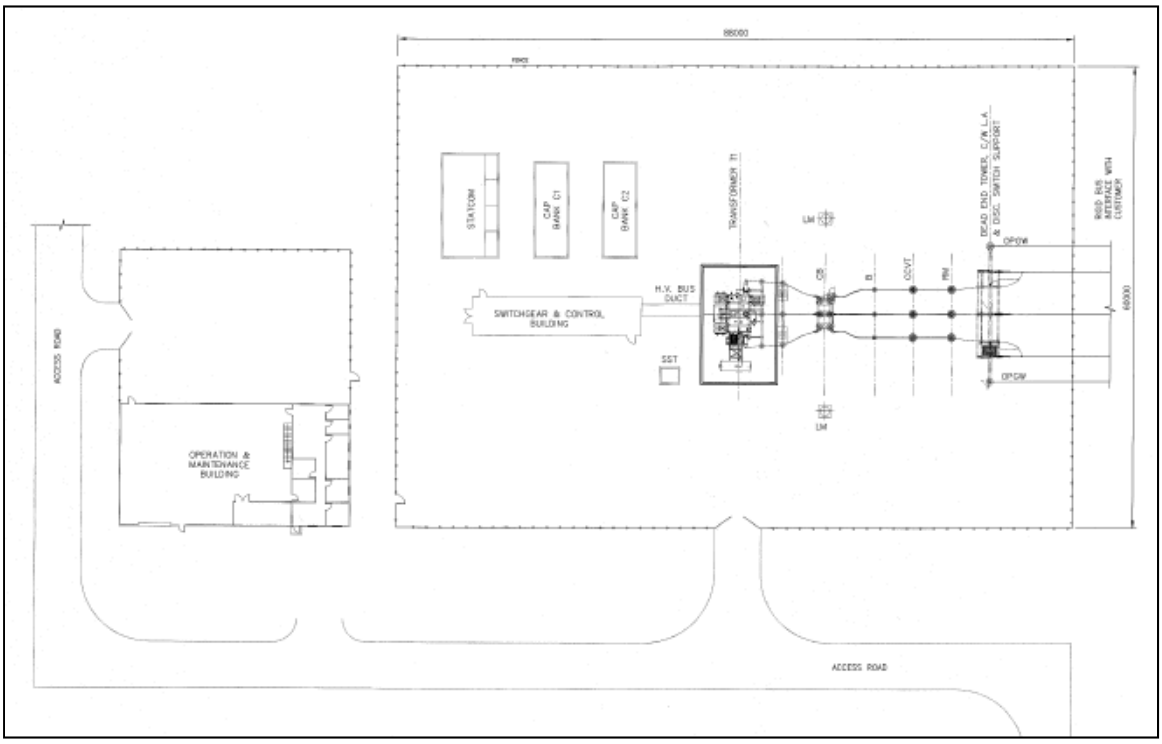


Figure 1-6: Proposed Substation Layout



1.3 Stormwater Management Plan Overview

The objective of a SWM Plan is to control stormwater runoff from the Site, specifically to ensure that surface water quality meet discharge guidelines, and to manage surface water quantity (i.e., runoff peak flow rates) discharging from a development site.

The surface water quantity objective of the SWM Plan is to maintain no increase in peak flows discharging from a development site for post-development versus pre-development conditions, up to and including the 100 year return period design event. Hydrologic modelling was completed to estimate peak flows for these two conditions from the Project. The results from the two scenarios were compared to evaluate the impact of the development on stormwater drainage and the need for quantity control.

The SWM Plan has been designed in compliance with the "*Stormwater Management Planning and Design Manual*" (MOE, 2003) and CRCA guidelines. The overall SWM Plan incorporates the following requirements:

- The quality control aspect of the SWM Plan has been designed based in consideration of the enhanced protection level of treatment; and
- The Ministry of Natural Resources (MNR) *Flood Plain Management in Ontario, Technical Guidelines* (MNR, 1988) indicate the Site is located within Regulatory Flood Zone 2. As such, the 100 year (Regulatory Storm) was used as the extreme design rainfall event for this Site.

2.0 HYDROLOGIC MODELLING

Single event hydrologic modelling has been used to obtain quantitative estimates of stormwater runoff rates and volumes for pre-development and post-development conditions for the Project.

2.1 Model Selection

The surface runoff has been calculated using the computer model Visual OTTHYMO v2.0 (VO2). OTTHYMO is a hydrologic management model that has been used for watershed studies, sub-watershed studies, master drainage plans, functional stormwater management plans, site plans, and stormwater management pond design. VO2 is the second version of the INTERHYMO – OTTHYMO hydrologic modelling tool designed for Microsoft Windows OS. VO2 has been accepted by the Ministry of the Environment (MOE), the Ministry of Natural Resources (MNR), the Ministry of Transportation (MTO), the Ministry of Municipal Affairs and Housing (MMAH), the Association of Conservation Authorities of Ontario, and most municipal governments, as a valid hydrologic simulation program.

2.2 Design Storms

Precipitation data from the Atmospheric Environment Services' in the form of an Intensity Duration Frequency (IDF) relationship is required to develop the design storms for use in this assessment. A number of possible gauges are available in proximity to the Project, namely:

Table 2-1: Rainfall Gauging Stations in Proximity to the Site

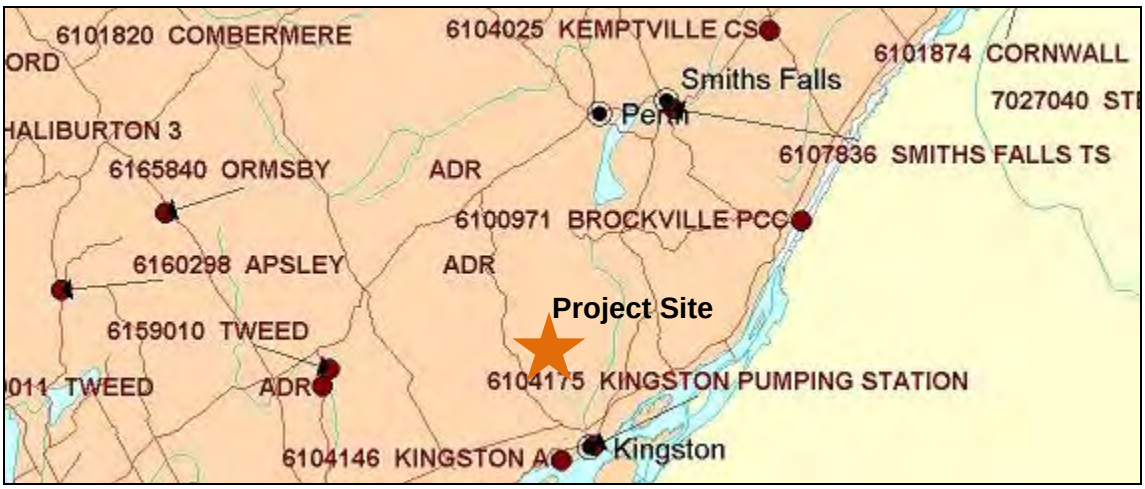
Location	Gauge #	Distance from Site[1] (km)
Kingston Airport	6104146	12.3
Kingston Pumping Station	6104175	16.0
Tweed	6159010	54.7
Brockville PCC	6100971	82.9

Notes: To approximately the centroid of the Project boundary

Table 2-2: Return Period Rainfall Totals for Selected Gauges in Southeastern Ontario

Return Period	24 Hour Rainfall Totals (mm)	
	Kingston Airport	Kingston Pumping Station
2 year	41.5	47.2
5 year	54.3	60.6
10 year	62.8	69.6
25 year	73.5	80.9
50 year	81.5	89.2
100 year	89.4	97.5
Period of Record	17 years	60 years

Figure 2-1: Rainfall Gauges in Southwestern Ontario with IDF Data



The Project lies within similar distances of two gauging stations (Kingston Airport, Kingston Pumping Station), with the Kingston Airport gauge being marginally closer. A comparison of the design events provided in Table 2-2, indicates rainfall totals only marginally higher for the Kingston Pumping Station location. As such, and in consideration of the period of record from the two stations, the Kingston Pumping Station rainfall data has been selected for use in this assessment (Table 2-3).

Design storms with return periods of 2, 5, 10, 25, 50, and 100-years were developed and used to determine design hydrographs to enable evaluation of the total runoff from the site.

The MNR *Flood Plain Management in Ontario, Technical Guidelines* indicates the site is located within Regulatory Flood Zone 2. As such, the 100 year design storm was used as the Regional (extreme) design rainfall event for this site.

A critical duration assessment was completed to determine the critical rainfall design event for this assessment. The critical design event was taken to be that which produced the highest peak flows. The Atmospheric Environment Service (AES) 1 hr and 12 hr storm distributions were evaluated as for design storms due to the applicability of the AES distribution in Ontario (Watt, 1989). Further, given the limited durations available with the AES distribution, the Soil Conservation Service (SCS) Type II 6, 12, and 24 hour storm distributions were also evaluated. A time increment of five minutes was selected for all design storms.

Table 2-3: Total Rainfall Depth

Event	Event Depth (mm) by Duration			
	1 hour	6 hour	12 hour	24 hour
2 year	20.8	35.0	41.2	47.2
5 year	27.8	46.5	54.9	60.6
10 year	32.5	54.1	63.9	69.6
25 year	38.3	63.7	75.4	80.9
50 year	42.7	70.8	83.9	89.2
100 year	47.0	77.9	92.3	97.5

Notes: Data for Environment Canada weather station at Kingston Pumping Station (#6104175)

2.3 Hydrologic Modelling Input Data and Results

2.3.1 Substation Development

The following information is relevant to the development of the pre-development and post-development hydrologic simulation models for the proposed development Substation site.

- The substation is located on Property #4;
- The area proposed for the substation covers about 1.5 ha;
- Based on the substation layout, the development will be dominated by gravels under post development conditions representing about 41% of the developed lands. A pervious runoff curve number (CN) value of 84 has been applied for stormwater management modelling purposes recognizing activity at the site which will result in minor compaction and reduction in infiltration capacity across portions of the Site. An imperviousness of 13% of the total developed area (post-development) has been modeled with a CN value of 98. About 46% of the substation site footprint remains in a pre-development condition for modelling purposes;
- The substation will be constructed on a gravel pad underlain by a grounding grid. ;
- Gravel roads constructed as part of the development of the substation site will be at grade (i.e., not elevated);
- The substation development area drains to a drainage feature (as defined from Ontario Base Mapping) located about 50 m south of the southern boundary of Property #4;

- Surficial soils underlying the substation development area are generally comprised of Lyons loams, classified as Hydrologic Soil Group C[1];

- A base CN number of 79 was used for pervious areas for modelling purposes;

- For post development modelling, the rainfall on the solar panel will fall onto pervious ground and travel overland to the receiving water. As a result, the stormwater runoff from the solar panel arrays is considered to be clean; and

- Time of concentration was computed using the Hathaway equation. Overland flow length was abstracted from available topographic mapping (Ontario Base Maps) and Site plans.

The development of pre-development and post-development hydrologic models took into account the two primary considerations, previously noted, for the substation/array development on Property #4, namely:

The construction associated with installation of the solar panels will be on existing ground and the existing topography will be maintained to the extent reasonably and practically possible, and;

The solar panels are an impervious surface, however, the underlying soils and topography will not have changed from pre-development conditions. Rain water flowing off the solar panels will fall to the existing ground surface, runoff will travel an un-changed path therefore maintaining the opportunity to infiltrate in a manner equalling pre-development. Therefore, areas to be covered by solar panels are not considered to change in terms of their runoff potential between pre-development and post-development.

The substation will be housed on a gravel pad. The gravel pad is typically constructed with a minimum depth of 0.15 m or 6 inches on the upslope side of the substation development. The native material underlying the gravel pad is typically graded to provide a consistent slope for runoff. The grading of the native material results in some compaction of the soils reducing infiltration capacity (this effect is represented in the hydrologic modelling by an increase in CN number for the gravel pad areas of the development). The gravel pad is constructed with minimal surface grade to an approximate maximum depth of about 1 m. The typical specification used for the gravel material used for pad construction is crushed stone having a minimum size of 19 mm (or about 1 inch) with minimal fines. The purpose of the gravel pad is to avoid surface runoff ponding in the substation area. A result of the gravel pad, as constructed, is attenuation of stormwater runoff from the substation area although this effect cannot be effectively represented in the modelling.

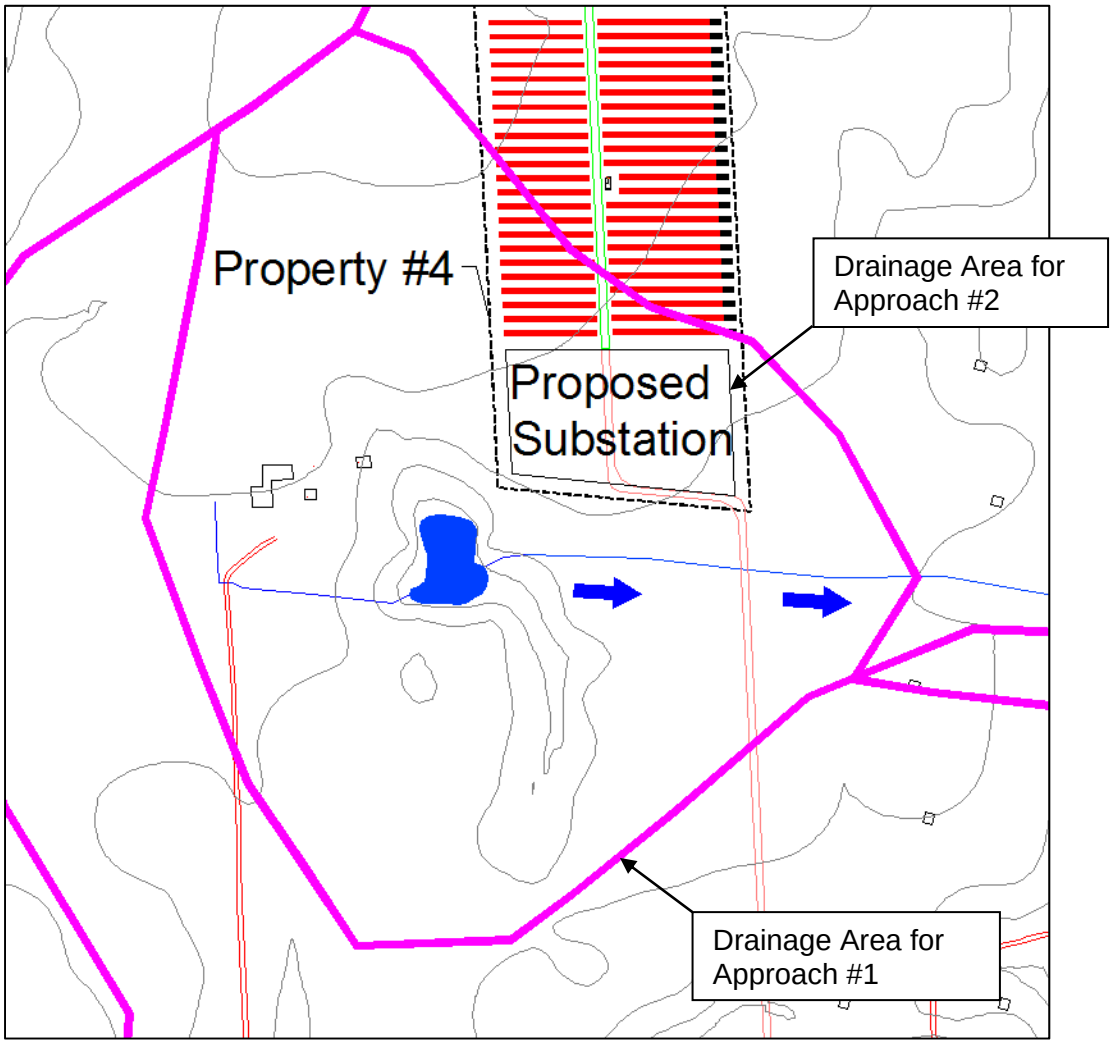
[1] Via http://66.212.167.150/LICO/CDSI_Potential_Mapping_Project.htm

Given the distributed nature of the proposed Project, two modelling approaches have been used to quantify the potential impact of development. Firstly (Approach #1), pre- and post-development models were constructed based on topographically defined drainage patterns to a location a distance downstream sufficient so that the upstream catchment area encompassed a Property. Secondly (Approach #2), pre- and post-development models were constructed based only on the development footprint to an arbitrary outlet, as in the case of the substation.

The pre- and post-development subcatchment model (Approach #1) encompassing the south draining portion of Property #4, including the substation, is illustrated in Figure 2-2. The subcatchment model based on Approach #2 is simply the 1.5 ha footprint of the substation.

Subcatchment parameterization, for both the pre-development and post-development conditions and both modelling Approaches, is outlined in Tables 2-4.

Figure 2-2: Pre- and Post-Development Subcatchment Model - Substation



The computed peak flows from the critical duration analysis are provided in Table 2-5. The results indicate that the 12 hour duration rainfall event is critical for the drainage area associated with the substation. This result is consistent for both modelling approaches and both rainfall distributions (AES and SCS) analyzed. The CRCA stormwater planning guidelines indicate a preference for the AES rainfall distribution, therefore, the 12 hour AES distribution will be used for further modelling analysis for SWM planning for this Project.

The pre- and post-development computed peak flows for the substation site are provided in Table 2-6.

Table 2-4: Catchment Parameterization

Catchment #	Area (ha)	Impervious Area (ha)	Imperviousness (%)	CN (AMC II)	Tp (hr)
Approach #1					
Pre	21.5	0	0	79	0.99
Post	21.5	0.2	1.1	79.3	0.98
Approach #2					
Pre	1.5	0	0	79	0.23
Post	1.5	0.2	13.3	83.6	0.20

Notes:
1. Tp Time to Peak
2. AMC Antecedent Moisture Condition
3. Imperviousness as a percentage of total catchment area

Table 2-5: Critical Duration Analysis Results

100 year Design Rainfall Event Duration	Peak Flow (m^3/s) at Outlet from Site			
	Approach #1		Approach #2	
	Pre	Post	Pre	Post
AES 1 hour	0.507	0.517	0.097	0.122
AES 12 hour	0.618	0.625	0.055	0.062
SCS Type II 6 hour	0.902	0.917	0.182	0.231
SCS Type II 12 hour	1.015	1.032	0.205	0.251
SCS Type II 24 hour	0.950	0.966	0.189	0.229

Notes:
Due to the very small computed flows, the peak flows have been documented above to three decimal places as a means of illustrating computed changes from pre-development to post-development. This level of detail is provided for information purposes only and should not be construed as an indication of the accuracy of the simulation model computations.

Table 2-6: Pre- and Post-Development Peak Flows – Substation

Design Rainfall Event (AES 12 hr)	Peak Flow (m^3/s) at Outlet from Site							
	Approach #1				Approach #2			
	Pre	Post	% Change	Absolute Change	Pre	Post	% Change	Absolute Change
2	0.157	0.160	1.9%	0.003	0.013	0.016	23.1%	0.003
5	0.263	0.267	1.5%	0.004	0.024	0.028	16.7%	0.004
10	0.341	0.346	1.5%	0.005	0.031	0.036	16.1%	0.005
25	0.448	0.454	1.3%	0.006	0.040	0.046	15.0%	0.006
50	0.532	0.538	1.1%	0.006	0.047	0.054	14.9%	0.007
100	0.618	0.625	1.1%	0.007	0.055	0.062	12.7%	0.007

Notes:
Due to the very small computed flows, the peak flows have been documented above to three decimal places as a means of illustrating computed changes from pre-development to post-development. This level of detail is provided for information purposes only and should not be construed as an indication of the accuracy of the simulation model computations.

As illustrated in Figure 2-2, the outlet of the drainage area associated with Approach #1 lies about 100 m downstream from the southern boundary of the substation development footprint. At this location increases in computed peak flows are less than 2% for all of the design rainfall events assessed. Absolute increases in computed peak flows are negligible.

The computed increases in peak flows associated with Approach #2 are significantly greater with larger percentage increases computed for the more frequent events with decreasing change from pre- to post-development through to the 100 year event. However, the absolute changes in computed peak flows are also negligible. Further, the influence of any change in computed peak flows is dissipated within the 100 m distance between the presumed outlet from the substation development footprint and the discharge point for the drainage area associated with Approach #1.

It is therefore concluded that the changes in computed peak flows demonstrate that the substation development has negligible impact on the nature of stormwater runoff from the proposed development.

2.3.2 Property/Array Developments

As noted previously, the array locations are distributed within the Project Location across 19 properties.

The following information is relevant to the development of the pre-development and post-development hydrologic simulation models for the proposed Property developments:

- Gravel roads constructed as part of the development of the substation site will be at grade (i.e., not elevated);

- Surficial soils within the Project developments have been defined based on Map 1-5a from [CRCA, 2011]. The associated hydrologic soil classification is based on available soil mapping for the area (Gillespie et al, 1963 and 1966) and information available at Land Improvement Contractors of Ontario website[2]; and,

- Time of concentration was computed using the Hathaway equation. Overland flow length was abstracted from available topographic mapping (Ontario Base Maps) and Site plans.

The development of pre-development and post-development hydrologic models took into account the two primary considerations, previously noted, for the array development on the Properties, namely:

- The construction associated with installation of the solar panel arrays will be on existing ground and the existing topography will be maintained to the extent reasonably and practically possible, and;

- The solar panels are an impervious surface, however, the underlying soils and topography will not have changed from pre-development conditions. Rain water flowing off the solar panels will fall to the existing ground surface, runoff will travel an un-changed path therefore maintaining the opportunity to infiltrate in a manner equalling pre-development. Therefore, areas to be covered by solar panel arrays are not considered to change in terms of their runoff potential between pre-development and post-development.

Given the distributed nature of the proposed Project, the two previously noted modelling approaches (Approach #1 and Approach #2) have been used to quantify the potential impact of the array developments.

A number of the Properties were evaluated for pre-development and post-development conditions, namely Properties 1, 2, 3, 4, 11, 14, 20, 21, 22, 23, and 24. These Properties were selected for specific hydrologic evaluation as they represent a varied range of change from pre-development and post-development. The full results of this modelling analysis, with drainage boundary illustrations, are provided in **Appendix A**. The average percentage change in computed peak flows is 1.06% using Approach #1 and 3.3% using Approach #2.

The subcatchment parameterization associated with all of the drainage areas associated with the Property developments is provided in **Appendix B**.

The results of the evaluations for these Properties are considered to be reflective of the anticipated results across the remaining Properties which were not specifically assessed with hydrologic modelling.

[2] Available at http://66.212.167.150/LICO/CDSI_Potential_Mapping_Project.htm

It is therefore concluded that the changes in computed peak flows, as indicated above, demonstrate that the array developments have negligible impact on the nature of stormwater runoff from the proposed development of the Properties.

2.4 Stormwater Management Plan

Based on the results of the hydrologic modelling, ”quantity” control is not considered necessary for this SWM Plan. Therefore, the focus of the SWM Plan becomes stormwater ”quality” control.

Grassed filter strips are a low-cost Best Management Practice (BMP) designed to improve the quality of stormwater runoff by using biological and chemical processes in soils and vegetation to filter out constituents. They function by slowing runoff velocities and filtering out sediment and other pollutants, and providing some infiltration into underlying soils. Filter strips were originally used as an agricultural treatment practice, and have more recently evolved into an urban practice.

As noted previously, after construction, the site for areas under and within the panel arrays blocks will be seeded with ‘pasture’ grass varieties. These plantings will essentially act as grassed filter strips for the site. The proposed plantings over a 10 m flow length will provide effective stormwater runoff quality control given the minimal contributing impervious area.

Also noted previously was the implementation of a “double containment system” for transformers at the site which will be an integral component of the quality control aspect of the SWM Plan.

3.0 MAINTENANCE AND MONITORING PROGRAM

The SWM works will be owned, maintained and monitored by the Proponent.

3.1 Maintenance

Proper maintenance is required for maximum filter-strip effectiveness. The maintenance requirements for the grass filter strips within this development will be based on information provided in MOE (2003). The following minimal maintenance items are recommended:

- Inspect the filter strip frequently, especially after intense rainfall events and runoff events of long duration. Small breaks in the sod and small erosion channels quickly become large problems;
- Minimize the development of erosion channels within the filter. Even small channels may allow much of the runoff from the field to bypass the filter. These areas should be repaired and reseeded immediately to help ensure proper flow of runoff through the filter;
- Reseed or inter-seed bare areas of the filter. Since it may be difficult to re-establish vegetation in an established filter strip, the use of mulch or sod can help to reduce some problems;
- Mow and remove hay as required to maintain moderate vegetation height;
- Soil test periodically and apply soil amendments according to test results and recommendations; and
- Control trees, brush, noxious weeds, and Canada thistle in the filter using either mechanical or other means.

3.2 Monitoring

Monitoring will consist of visual inspections of the vegetated areas adjacent to drainage ditches. The monitoring program will include regular inspections of the erosion and sediment control features described in the following section.

4.0 EROSION AND SEDIMENT CONTROL PROGRAM

Erosion and sedimentation are naturally occurring processes that involve particle detachment, sediment transport and deposition of soil particles. Construction activities commonly alter the landscapes where they are located, exacerbating these natural processes.

The transport of sediment overland and deposition into surrounding natural areas, including watercourses, woodlots, and wetlands as well as adjacent private lands, needs to be prevented. The erosion and sediment control measures described in this section are focused on the features of the SWM Plan only. The erosion and sediment control plan for the entire site, as documented in the Construction Plan Report, should be compliant with the MOE design manual (2003).

To minimize the potential operation and environmental impacts, the grass filter areas should be inspected frequently to identify any erosion areas and make timely repairs to the grade.

5.0 CONCLUSIONS

This Report demonstrates that the proposed conditions for the substation and array development, a component of the Project, satisfy the requirements for stormwater management established by MOE (2003), the CRCA, and the proposed changes to O.Reg. 359/09 and the proposed revisions to the Technical Guide. It has been demonstrated that the required targets will be met as follows:

Hydrological modelling completed for this assessment indicates no significant changes between pre-development condition and post-development stormwater runoff peak flow conditions. Therefore, quantity control of stormwater runoff is not considered to be a requirement of this SWM Plan. Further, no impacts to downstream flood conditions are anticipated.

As no significant changes between pre-development condition and post-development stormwater runoff peak flow conditions are anticipated, the recommended stormwater management plan focuses on stormwater runoff quality control. Pasture grass varieties, which will substantially cover the Site after construction, will provide water quality control through filtering (in a similar manner to grassed filter strips) for stormwater runoff from the Site.

A “double containment system” will be implemented for transformers at the substation proposed as a component of this Project. In addition to the “first stage” of containment, namely the transformer enclosures (conservator, tank, etc.), a “second stage” of containment will be in the form of a transformer containment pit system.

A preliminary Stormwater Management facility maintenance and monitoring strategy, based on the stormwater management plan, has also been provided.

A preliminary Stormwater Management facilities erosion and sedimentation control strategy, based on the stormwater management plan, has also been provided.

Sincerely,
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APPENDIX A

HYDROLOGY MODELLING OUTPUT - PROPERTIES

Property #1 Characteristics

	Approach #1	Approach #2
Property	1	
Property Area	8.66	
Road Area	0.508	
% Impervious	2.55	5.87
Longest Flow Path (m)	400	494.6
Slope (%)	1.40	1.40
CN (Existing)	81.0	81.8
Tp(hr)	0.36	0.42
CN (Post-Development)	81.4	82.7
Tp(hr)	0.36	0.40

Property #1 Peak Flow Rates (m^3/s)

Approach #1

Property	1			
Storm Duration	Existing	Proposed	Absolute Change	% Change
2	0.192	0.196	0.004	2.08
5	0.323	0.329	0.006	1.86
10	0.417	0.442	0.025	6.00
25	0.544	0.553	0.009	1.65
50	0.642	0.651	0.009	1.40
100	0.741	0.751	0.01	1.35

Approach #2

Property	1			
Storm Duration	Existing	Proposed	Absolute Change	% Change
2	0.085	0.089	0.004	4.71
5	0.141	0.147	0.006	4.26
10	0.183	0.19	0.007	3.83
25	0.238	0.247	0.009	3.78
50	0.281	0.29	0.009	3.20
100	0.324	0.334	0.01	3.09

Property #2 Characteristics

	Approach #1	Approach #2
Property	2	
Property Area	2.25	
Road Area	0.327	
% Impervious	0.42	14.5
Longest Flow Path (m)	1100	357.1
Slope (%)	0.20	1.40
CN (Existing)	74.0	76.3
Tp(hr)	2.65	0.38
CN (Post-Development)	74.1	79.4
Tp(hr)	2.64	0.35

Property #2 Peak Flow Rates (m^3/s)

Approach #1

Property	2			
Storm Duration	Existing	Proposed	Absolute Change	% Change
2	0.346	0.347	0.001	0.29
5	0.587	0.59	0.003	0.51
10	0.765	0.769	0.004	0.52
25	1.011	1.015	0.004	0.40
50	1.203	1.208	0.005	0.42
100	1.4	1.406	0.006	0.43

Approach #2

Property	2			
Storm Duration	Existing	Proposed	Absolute Change	% Change
2	0.018	0.02	0.002	11.11
5	0.03	0.035	0.005	16.67
10	0.04	0.045	0.005	12.50
25	0.053	0.059	0.006	11.32
50	0.063	0.069	0.006	9.52
100	0.073	0.08	0.007	9.59

Property #3 Characteristics

	Approach 1	Approach 2	Approach 1	Approach 2	Approach 1	Approach 2
Property	3a		3b		3c	
Property Area	2.88		10.34		1.60	
Road Area	0.271		0.538		0.00	
% Impervious	2.49	9.41	2.13	5.20	0.00	0.00
Longest Flow Path (m)	579.5	128.3	822.6	787.6	436	272.1
Slope (%)	0.89	1.17	1.32	1.02	0.01	0.37
CN (Existing)	81.0	82.0	81.0	81.9	84.5	81.0
Tp(hr)	0.61	0.15	0.66	0.71	4.08	0.52
CN (Post-Development)	81.4	83.5	81.4	82.7	84.5	81.0
Tp(hr)	0.60	0.15	0.65	0.69	4.08	0.52

Property #3 Peak Flow Rates (m^3/s)

Approach #1

Property	3a				3b				3c			
Storm Duration	Existing	Proposed	Absolute Change	% Change	Existing	Proposed	Absolute Change	% Change	Existing	Proposed	Absolute Change	% Change
2	0.095	0.097	0.002	2.11	0.216	0.22	0.004	1.85	0.194	0.194	0	0.00
5	0.161	0.164	0.003	1.86	0.365	0.372	0.007	1.92	0.315	0.315	0	0.00
10	0.209	0.213	0.004	1.91	0.475	0.482	0.007	1.47	0.4	0.4	0	0.00
25	0.274	0.279	0.005	1.82	0.623	0.632	0.009	1.44	0.514	0.515	0.001	0.19
50	0.325	0.33	0.005	1.54	0.737	0.747	0.01	1.36	0.601	0.602	0.001	0.17
100	0.377	0.383	0.006	1.59	0.854	0.866	0.012	1.41	0.689	0.69	0.001	0.15

Approach #2

Property	3a				3b				3c			
Storm Duration	Existing	Proposed	Absolute Change	% Change	Existing	Proposed	Absolute Change	% Change	Existing	Proposed	Absolute Change	% Change
2	0.03	0.032	0.002	6.67	0.091	0.095	0.004	4.40	0.014	0.014	0	0.00
5	0.049	0.052	0.003	6.12	0.153	0.159	0.006	3.92	0.025	0.025	0	0.00
10	0.063	0.065	0.002	3.17	0.198	0.205	0.007	3.54	0.032	0.032	0	0.00
25	0.081	0.084	0.003	3.70	0.259	0.268	0.009	3.47	0.042	0.042	0	0.00
50	0.095	0.098	0.003	3.16	0.307	0.317	0.01	3.26	0.049	0.049	0	0.00
100	0.109	0.112	0.003	2.75	0.355	0.365	0.01	2.82	0.057	0.057	0	0.00

Property #4 Characteristics

	Approach 1	Approach 2	Approach 1	Approach 2	Approach 1	Approach 2
Property	4a		4b		4c	
Property Area	3.07		7.53		1.75	
Road Area	0.14		0.24		0.34	
% Impervious	0.87	4.43	0.62	3.13	4.98	19.26
Longest Flow Path (m)	428.9	315.4	947.7	558.5	348.7	322.9
Slope (%)	0.64	0.54	0.48	0.47	0.72	0.68
CN (Existing)	85.7	84.3	84.5	88.3	88.0	88.2
Tp(hr)	0.48	0.43	1.10	0.63	0.35	0.34
CN (Post-Development)	85.8	84.9	84.6	88.6	88.5	90.1
Tp(hr)	0.48	0.42	1.09	0.63	0.35	0.31

Property #4 Peak Flow Rates (m^3/s)

Approach #1

Property	4a				4b				4c			
Storm Duration	Existing	Proposed	Absolute Change	% Change	Existing	Proposed	Absolute Change	% Change	Existing	Proposed	Absolute Change	% Change
2	0.179	0.18	0.001	0.56	0.345	0.346	0.001	0.29	0.091	0.092	0.001	1.10
5	0.293	0.295	0.002	0.68	0.561	0.563	0.002	0.36	0.146	0.149	0.003	2.05
10	0.373	0.375	0.002	0.54	0.717	0.72	0.003	0.42	0.183	0.187	0.004	2.19
25	0.479	0.481	0.002	0.42	0.926	0.929	0.003	0.32	0.232	0.236	0.004	1.72
50	0.561	0.563	0.002	0.36	1.087	1.09	0.003	0.28	0.269	0.273	0.00	1.49
100	0.643	0.645	0.002	0.31	1.249	1.253	0.004	0.32	0.305	0.309	0.00	1.31

Approach #2

Property	4a				4b				4c			
Storm Duration	Existing	Proposed	Absolute Change	% Change	Existing	Proposed	Absolute Change	% Change	Existing	Proposed	Absolute Change	% Change
2	0.034	0.035	0.001	2.94	0.093	0.095	0.002	2.15	0.024	0.027	0.003	12.50
5	0.055	0.057	0.002	3.64	0.15	0.152	0.002	1.33	0.038	0.042	0.004	10.53
10	0.071	0.073	0.002	2.82	0.19	0.192	0.002	1.05	0.048	0.052	0.004	8.33
25	0.091	0.094	0.003	3.30	0.242	0.245	0.003	1.24	0.061	0.065	0.004	6.56
50	0.107	0.11	0.003	2.80	0.282	0.285	0.003	1.06	0.07	0.074	0.004	5.71
100	0.123	0.126	0.003	2.44	0.321	0.325	0.004	1.25	0.079	0.084	0.005	6.33

Property #8 Characteristics

	Approach #1	Approach #2
Property	8b	
Property Area	1.940	
Road Area	0.110	
% Impervious	2.21	5.67
Longest Flow Path (m)	476.5	155.0
Slope (%)	0.54	0.64
CN (Existing)	81.0	82.3
Tp(hr)	0.67	0.24
CN (Post-Development)	81.4	83.2
Tp(hr)	0.66	0.23

Property #8 Peak Flow Rates (m^3/s)

Approach #1

Property	8b			
Storm Duration	Existing	Proposed	Absolute Change	% Change
2	0.042	0.043	0.001	2.38
5	0.072	0.073	0.001	1.39
10	0.093	0.095	0.002	2.15
25	0.122	0.125	0.003	2.46
50	0.145	0.147	0.002	1.38
100	0.168	0.171	0.003	1.79

Approach #2

Property	8b			
Storm Duration	Existing	Proposed	Absolute Change	% Change
2	0.021	0.022	0.001	4.76
5	0.0334	0.036	0.0026	7.78
10	0.044	0.045	0.001	2.27
25	0.057	0.058	0.001	1.75
50	0.067	0.068	0.001	1.49
100	0.076	0.078	0.002	2.63

Property #11 Characteristics

	Approach #1	Approach #2
Property	11a	
Property Area	0.433	
Road Area	0	
% Impervious	0	0
Longest Flow Path (m)	354.7	634.0
Slope (%)	1.97	1.26
CN (Existing)	81.4	82.6
Tp(hr)	0.27	0.52
CN (Post-Development)	81.4	82.6
Tp(hr)	0.27	0.52

Property #11 Peak Flow Rates (m^3/s)

Approach #1

Property	11a			
Storm Duration	Existing	Proposed	Absolute Change	% Change
2	0.129	0.129	0	0.00
5	0.215	0.215	0	0.00
10	0.276	0.276	0	0.00
25	0.358	0.358	0	0.00
50	0.421	0.421	0	0.00
100	0.484	0.484	0	0.00

Approach #2

Property	11a			
Storm Duration	Existing	Proposed	Absolute Change	% Change
2	0.004	0.004	0	0.00
5	0.007	0.007	0	0.00
10	0.009	0.009	0	0.00
25	0.012	0.012	0	0.00
50	0.014	0.014	0	0.00
100	0.016	0.016	0	0.00

Property #14 Characteristics

	Approach 1	Approach 2	Approach 1	Approach 2	Approach 1	Approach 2
Property	14AB-a		14AB-b		14C-b	
Property Area	67.14		3.33		0.525	
Road Area	3.27		0.21		0	
% Impervious	3.56	4.87	1.76	6.27	0	0
Longest Flow Path (m)	1452.6	1140.9	903.1	774.4	1227.7	113.9
Slope (%)	0.63	0.56	0.34	0.42	0.68	0.26
CN (Existing)	86.8	85.6	86.8	89.2	86.8	89.8
Tp(hr)	0.48	1.13	0.45	0.84	0.40	0.22
CN (Post-Development)	87.2	86.2	87.0	89.8	86.8	89.8
Tp(hr)	0.47	1.10	0.45	0.82	0.40	0.22

Property #14 Peak Flow Rates (m^3/s)

Approach #1

Property	14AB-a				14AB-b				14C-b			
Storm Duration	Existing	Proposed	Absolute Change	% Change	Existing	Proposed	Absolute Change	% Change	Existing	Proposed	Absolute Change	% Change
2	1.11	1.136	0.026	2.34	0.145	0.147	0.002	1.38	0.804	0.804	0	0.00
5	1.799	1.833	0.034	1.89	0.235	0.237	0.002	0.85	1.305	1.305	0	0.00
10	2.278	2.317	0.039	1.71	0.298	0.301	0.003	1.01	1.654	1.654	0	0.00
25	2.918	2.967	0.049	1.68	0.382	0.385	0.003	0.79	2.113	2.113	0	0.00
50	3.406	3.457	0.051	1.50	0.445	0.448	0.003	0.67	2.459	2.459	0	0.00
100	3.893	3.947	0.054	1.39	0.508	0.514	0.006	1.18	2.804	2.805	0.001	0.04

Approach #2

Property	14AB-a				14AB-b				14C-b			
Storm Duration	Existing	Proposed	Absolute Change	% Change	Existing	Proposed	Absolute Change	% Change	Existing	Proposed	Absolute Change	% Change
2	0.633	0.654	0.021	3.32	0.04	0.042	0.002	5.00	0.008	0.008	0	0.00
5	1.024	1.055	0.031	3.03	0.064	0.066	0.002	3.13	0.012	0.012	0	0.00
10	1.302	1.339	0.037	2.84	0.081	0.083	0.002	2.47	0.015	0.015	0	0.00
25	1.674	1.72	0.046	2.75	0.103	0.106	0.003	2.91	0.019	0.019	0	0.00
50	1.961	2.011	0.05	2.55	0.12	0.123	0.003	2.50	0.022	0.022	0	0.00
100	2.25	2.304	0.054	2.40	0.137	0.14	0.003	2.19	0.025	0.025	0	0.00

Property #20 Characteristics

	Approach #1	Approach #2
Property	20c	
Property Area	0.137	
Road Area	0.06	
% Impervious	2.67	314.6
Longest Flow Path (m)	733.8	59.0
Slope (%)	0.27	0.85
CN (Existing)	86.8	86.3
Tp(hr)	0.17	0.08
CN (Post-Development)	87.1	91.1
Tp(hr)	0.17	0.06

Property #20 Peak Flow Rates (m^3/s)

Approach #1

Property	20c			
Storm Duration	Existing	Proposed	Absolute Change	% Change
2	0.027	0.027	0.00	0
5	0.043	0.043	0.00	0
10	0.054	0.054	0.00	0
25	0.069	0.069	0.00	0
50	0.08	0.08	0.00	0
100	0.09	0.09	0.00	0

Approach #2

Property	20c			
Storm Duration	Existing	Proposed	Absolute Change	% Change
2	0.001	0.001	0.00	0
5	0.002	0.002	0.00	0
10	0.002	0.002	0.00	0
25	0.003	0.003	0.00	0
50	0.003	0.003	0.00	0
100	0.004	0.004	0.00	0

Property #22 Characteristics

	Approach 1	Approach 2	Approach 1	Approach 2
Property	22a		22b	
Property Area	1.45		3.58	
Road Area	0.16		0.19	
% Impervious	2.62	13.3	4.90	7.28
Longest Flow Path (m)	377.3	270.3	210.7	221.2
Slope (%)	0.47	0.19	0.50	0.14
CN (Existing)	86.8	87.1	86.8	81.8
Tp(hr)	0.19	0.59	0.11	0.70
CN (Post-Development)	87.4	88.3	87.3	82.7
Tp(hr)	0.18	0.56	0.11	0.68

Property #22 Peak Flow Rates (m^3/s)

Approach #1

Property	22a				22b			
Storm Duration	Existing	Proposed	Absolute Change	% Change	Existing	Proposed	Absolute Change	% Change
2	0.082	0.084	0.002	2.44	0.046	0.047	0.001	2.17
5	0.13	0.133	0.003	2.31	0.073	0.073	0	0.00
10	0.163	0.166	0.003	1.84	0.091	0.091	0	0.00
25	0.205	0.209	0.004	1.95	0.115	0.115	0	0.00
50	0.238	0.241	0.003	1.26	0.132	0.132	0	0.00
100	0.27	0.273	0.003	1.11	0.15	0.15	0	0.00

Approach #2

Property	22a				22b			
Storm Duration	Existing	Proposed	Absolute Change	% Change	Existing	Proposed	Absolute Change	% Change
2	0.017	0.018	0.001	5.88	0.031	0.003	0.002	6.45
5	0.028	0.029	0.001	3.57	0.053	0.055	0.002	3.77
10	0.035	0.035	0.002	5.71	0.068	0.071	0.003	4.41
25	0.045	0.045	0.002	4.44	0.09	0.093	0.003	3.33
50	0.053	0.053	0.002	3.77	0.106	0.11	0.004	3.77
100	0.06	0.06	0.003	5.00	0.123	0.126	0.003	2.44

Property #23 Characteristics

	Approach 1	Approach 2	Approach 1	Approach 2
Property	23A-b		23A-c	
Property Area	4.46		2.85	
Road Area	0.22		0.12	
% Impervious	2.24	2.62	2.82	4.31
Longest Flow Path (m)	209.3	217.2	382.4	199.1
Slope (%)	0.48	0.18	0.26	0.25
CN (Existing)	86.8	83.9	86.8	81.7
Tp(hr)	0.19	0.55	0.16	0.48
CN (Post-Development)	87.0	84.3	87.1	82.5
Tp(hr)	0.19	0.55	0.16	0.47

Property #23 Peak Flow Rates (m^3/s)

Approach #1

Property	23A-b				23A-c			
Storm Duration	Existing	Proposed	Absolute Change	% Change	Existing	Proposed	Absolute Change	% Change
2	0.129	0.131	0.002	1.55	0.054	0.055	0.001	1.85
5	0.205	0.207	0.002	0.98	0.085	0.086	0.001	1.18
10	0.257	0.259	0.002	0.78	0.107	0.108	0.001	0.93
25	0.324	0.327	0.003	0.93	0.135	0.136	0.001	0.74
50	0.375	0.378	0.003	0.80	0.156	0.157	0.001	0.64
100	0.426	0.428	0.002	0.47	0.177	0.178	0.001	0.56

Approach #2

Property	23A-b				23A-c			
Storm Duration	Existing	Proposed	Absolute Change	% Change	Existing	Proposed	Absolute Change	% Change
2	0.045	0.047	0.002	4.44	0.027	0.028	0.001	3.7
5	0.076	0.078	0.002	2.63	0.046	0.047	0.001	2.17
10	0.097	0.1	0.003	3.09	0.059	0.061	0.002	3.39
25	0.126	0.13	0.004	3.17	0.077	0.079	0.002	2.60
50	0.149	0.152	0.003	2.01	0.09	0.093	0.003	3.33
100	0.171	0.175	0.004	2.34	0.105	0.107	0.002	1.90

APPENDIX B

SUBCATCHMENT PARAMETERIZATION

Table 1: Summary of Hydrologic Paramaters for Modelling Approach #1

Property	Catchment Area (ha)	Area of Proposed Access Road for Arrays (ha)	Average Distance to Outlet (m)	CN (Existing conditions)	Tp Existing Conditions (hr)	% Impervious	CN (Proposed Conditions)	Tp Proposed Condtions (hr)
1	19.93	0.51	82.00	81.0	0.36	2.55	81.4	0.36
2	77.73	0.33	117.00	74.0	2.65	0.42	74.1	2.64
3a	10.89	0.27	247.00	81.0	0.61	2.49	81.4	0.60
3b	25.20	0.54	113.00	81.0	0.66	2.13	81.4	0.65
3c	38.18	0.00	326.00	84.5	4.08	0.00	84.5	4.08
4a	15.63	0.14	175.00	85.7	0.48	0.87	85.8	0.48
4b	38.18	0.24	213.00	84.5	1.10	0.62	84.6	1.09
4c	6.77	0.34	300.00	88.0	0.35	4.98	88.5	0.35
6A-a	65.01	0.75	39.54	76.2	1.59	1.16	76.5	1.58
6A-b	15.79	0.00	34.95	82.6	0.09	0.00	82.6	0.09
7a	20.30	0.14	192.28	81.0	0.27	0.70	81.1	0.27
7b	18.80	0.11	338.50	72.4	0.66	0.56	72.5	0.65
8a	4.09	0.06	75.36	67.0	0.57	1.47	67.5	0.56
8b	4.97	0.11	142.80	81.0	0.67	2.21	81.4	0.66
11a	12.65	0.00	200.47	81.4	0.27	0.00	81.4	0.27
11b	31.75	0.41	260.02	81.4	0.71	1.28	81.6	0.71
12	68.31	0.88	283.89	88.0	0.89	1.28	88.1	0.88
14AB-a	91.80	3.27	164.35	86.8	0.48	3.56	87.2	0.47
14AB-b	11.89	0.21	84.49	86.8	0.45	1.76	86.9	0.45
14C-a	29.11	0.72	274.33	86.8	0.49	2.46	87.0	0.49
14C-b	64.90	0.00	160.32	86.8	0.40	0.00	86.8	0.40
19a	9.24	0.22	210.12	86.8	0.22	2.34	87.0	0.21
19b	10.64	0.29	155.50	86.8	0.23	2.72	87.1	0.23
20a	43.54	0.95	269.63	86.8	0.27	2.18	87.0	0.27
20b	13.84	0.18	323.40	86.8	0.20	1.28	86.9	0.20
20c	2.10	0.06	110.58	86.8	0.17	2.67	87.1	0.17
21a	20.54	0.43	108.65	86.8	0.34	2.10	87.0	0.34
21b	9.83	0.12	21.69	86.8	0.22	1.25	86.9	0.22
21c	6.72	0.16	40.57	86.8	0.23	2.31	87.0	0.23
21d	7.53	0.29	182.20	86.8	0.18	3.88	87.2	0.18
22a	6.18	0.16	117.81	86.8	0.19	2.62	87.0	0.19
22b	3.92	0.19	23.73	86.8	0.11	4.90	87.3	0.11
22c	3.88	0.26	22.00	86.8	0.14	6.73	87.5	0.13
22d	17.76	0.34	200.00	86.8	0.10	1.90	86.8	0.10
23A-a	7.21	0.05	112.98	86.8	0.09	0.75	86.8	0.09
23A-b	9.74	0.22	160.74	86.8	0.19	2.24	87.0	0.19
23A-c	4.14	0.12	36.09	86.8	0.16	2.82	87.1	0.16
23B	5.29	0.12	165.00	86.8	0.20	2.32	87.0	0.19
23C-a	5.78	0.02	180.98	86.8	0.24	0.40	86.8	0.24
23C-b	17.76	0.27	222.10	86.8	0.11	1.52	86.9	0.11
24a	17.76	0.33	222.00	86.8	0.10	1.83	86.9	0.10
24b	67.15	0.24	100.00	86.8	0.10	0.35	86.8	0.10

Table 2: Summary of Hydrologic Paramaters for Modelling Approach #2

Property	Area of Property (ha)	Area of Proposed Access Road for Arrays (ha)	CN (Existing conditions)	Tp Existing Conditions (hr)	% Impervious	CN (Proposed Conditions)	Tp Proposed Condtions (hr)
1	8.66	0.51	81.8	0.42	5.87	82.7	0.40
2	2.25	0.33	76.3	0.38	14.53	79.4	0.35
3a	2.88	0.27	82.0	0.15	9.41	83.5	0.15
3b	10.34	0.54	81.9	0.71	5.20	82.7	0.69
3c	1.60	0.00	81.0	0.52	0.00	81.0	0.52
4a	3.07	0.14	84.3	0.43	4.43	84.9	0.42
4b	7.53	0.24	88.3	0.63	3.13	88.6	0.63
4c	1.75	0.34	88.2	0.34	19.26	90.1	0.31
6A-a	14.51	0.75	83.2	0.53	5.19	83.9	0.52
6A-b	0.94	0.00	85.7	0.42	0.00	85.7	0.42
7a	1.54	0.14	85.4	0.21	9.31	86.5	0.20
7b	3.15	0.11	81.0	0.33	3.36	81.6	0.32
8a	2.02	0.06	68.5	0.24	2.98	69.4	0.24
8b	1.94	0.11	82.3	0.24	5.67	83.2	0.23
11a	0.43	0.00	82.6	0.52	0.00	82.6	0.52
11b	5.60	0.41	82.1	0.24	7.27	83.2	0.23
12	17.10	0.88	88.0	0.27	5.12	88.5	0.27
14AB-a	67.14	3.27	85.6	1.13	4.87	86.2	1.10
14AB-b	3.33	0.21	89.2	0.84	6.27	89.8	0.82
14C-a	10.57	0.72	89.0	0.67	6.77	89.6	0.66
14C-b	0.53	0.00	89.8	0.22	0.00	89.8	0.22
19a	1.36	0.22	85.9	0.50	15.88	87.8	0.46
19b	2.55	0.29	84.4	0.73	11.33	85.9	0.69
20a	14.08	0.95	85.0	0.76	6.74	85.9	0.74
20b	3.33	0.18	84.5	0.31	5.31	85.2	0.30
20c	0.14	0.06	86.3	0.08	40.88	91.1	0.07
21a	5.93	0.43	81.7	1.10	2.84	82.2	1.08
21b	4.34	0.12	81.6	0.69	2.84	82.1	0.68
21c	4.85	0.16	81.9	0.50	3.20	82.4	0.49
21d	8.08	0.29	82.1	0.48	3.62	82.7	0.47
22a	1.45	0.16	87.1	0.59	11.20	88.3	0.56
22b	3.58	0.19	81.8	0.70	5.36	82.6	0.68
22c	5.56	0.26	82.4	0.29	4.69	83.1	0.28
22d	4.94	0.34	82.1	0.52	6.92	82.8	0.50
23A-a	0.42	0.05	82.3	0.34	12.80	84.3	0.32
23A-b	4.46	0.22	83.9	0.55	4.89	84.6	0.54
23A-c	2.85	0.12	81.7	0.48	4.10	82.4	0.47
23B	3.19	0.12	80.1	0.15	3.85	80.8	0.14
23C-a	0.71	0.02	81.9	0.35	3.25	82.4	0.34
23C-b	6.12	0.27	82.1	0.53	4.41	82.8	0.52
24a	5.17	0.33	82.1	0.52	6.30	82.9	0.50
24b	3.22	0.24	82.1	0.19	7.40	83.3	0.18

APPENDIX C

HYDROLOGY MODELLING OUTPUT - SUBSTATION

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================================================================================
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       V    V   I    SSSSS  U   U    A    L
       V    V   I    SS     U   U   A A   L
        V  V    I     SS    U   U  AAAAA  L
        V  V    I      SS   U   U  A   A  L
         VV     I    SSSSS  UUUUU  A   A  LLLLL

        OOO   TTTTT  TTTTT  H   H  Y   Y  M   M   OOO    TM
       O   O    T      T    H   H   Y Y   MM MM  O   O
       O   O    T      T    H   H    Y    M   M  O   O

        OOO     T      T    H   H    Y    M   M   OOO
```


***** D E T A I L E D O U T P U T *****

Input filename: C:\Program Files\Visual OTTHYMO 2.2.4\voin.dat

Output filename: C:\AMEC\Projects\Samsung - SWM Plan\Hydrology\Samsung Wind 001\Substation Only - Pre to Post Analysis.out
Summary filename: C:\AMEC\Projects\Samsung - SWM Plan\Hydrology\Samsung Wind 001\Substation Only - Pre to Post Analysis.sum

DATE: 11/2/2011 TIME: 8:36:18 PM

USER:

COMMENTS: _____

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  ***************************
  ** SIMULATION NUMBER:   1 **
  ***************************

--------------------
| MASS STORM       |    Filename: C:\AMEC\Projects\Samsung -
|                  |              SWM Plan\Hydrology\AES 12h-60min.mst
| Ptotal= 41.20 mm |    Comments: AES 12 HR MASS CURVE
--------------------
                       Duration of storm    = 11.00 hrs
                       Mass curve time step = 60.00 min
                       New Storm time step  =  6.00 min

                TIME    RAIN |  TIME    RAIN |  TIME    RAIN |  TIME    RAIN
                 hrs   mm/hr |   hrs   mm/hr |   hrs   mm/hr |   hrs   mm/hr
                 .10     .62 |  2.90    9.19 |  5.70    3.79 |  8.50     .21
                 .20    1.24 |  3.00    9.06 |  5.80    3.63 |  8.60     .16
                 .30    1.85 |  3.10    8.73 |  5.90    3.46 |  8.70     .12
                 .40    2.47 |  3.20    8.40 |  6.00    3.30 |  8.80     .08
```

.50	3.09	3.30	8.08	6.10	3.09	8.90	.04
.60	3.71	3.40	7.75	6.20	2.88	9.00	.00
.70	4.33	3.50	7.42	6.30	2.68	9.10	.00
.80	4.94	3.60	7.09	6.40	2.47	9.20	.00
.90	5.56	3.70	6.76	6.50	2.27	9.30	.00
1.00	6.18	3.80	6.43	6.60	2.06	9.40	.00
1.10	6.59	3.90	6.10	6.70	1.85	9.50	.00
1.20	7.00	4.00	5.77	6.80	1.65	9.60	.00
1.30	7.42	4.10	5.69	6.90	1.44	9.70	.00
1.40	7.83	4.20	5.60	7.00	1.24	9.80	.00
1.50	8.24	4.30	5.52	7.10	1.15	9.90	.00
1.60	8.65	4.40	5.44	7.20	1.07	10.00	.00
1.70	9.06	4.50	5.36	7.30	.99	10.10	.00
1.80	9.48	4.60	5.27	7.40	.91	10.20	.00
1.90	9.89	4.70	5.19	7.50	.82	10.30	.00
2.00	10.30	4.80	5.11	7.60	.74	10.40	.00
2.10	10.18	4.90	5.03	7.70	.66	10.50	.00
2.20	10.05	5.00	4.94	7.80	.58	10.60	.00
2.30	9.93	5.10	4.78	7.90	.49	10.70	.00
2.40	9.81	5.20	4.61	8.00	.41	10.80	.00
2.50	9.68	5.30	4.45	8.10	.37	10.90	.00
2.60	9.56	5.40	4.28	8.20	.33	11.00	.00
2.70	9.43	5.50	4.12	8.30	.29		
2.80	9.31	5.60	3.96	8.40	.25		

CALIB			
NASHYD (0001)	Area (ha)= 21.50	Curve Number (CN)= 79.0	
ID= 1 DT= 5.0 min	Ia (mm)= 5.00	# of Linear Res.(N)= 3.00	
	U.H. Tp(hrs)= .99		

NOTE: RAINFALL WAS TRANSFORMED TO 5.0 MIN. TIME STEP.

---- TRANSFORMED HYETOGRAPH ----

TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr
.083	.62	2.833	9.26	5.583	3.96	8.33	.27
.167	1.11	2.917	9.16	5.667	3.82	8.42	.24
.250	1.61	3.000	9.06	5.750	3.69	8.50	.21
.333	2.10	3.083	8.73	5.833	3.56	8.58	.16
.417	2.60	3.167	8.47	5.917	3.43	8.67	.13
.500	3.09	3.250	8.21	6.000	3.30	8.75	.10
.583	3.71	3.333	7.94	6.083	3.09	8.83	.07
.667	4.20	3.417	7.68	6.167	2.93	8.92	.03
.750	4.70	3.500	7.42	6.250	2.76	9.00	.00
.833	5.19	3.583	7.09	6.333	2.60	9.08	.00
.917	5.69	3.667	6.82	6.417	2.43	9.17	.00
1.000	6.18	3.750	6.56	6.500	2.27	9.25	.00
1.083	6.59	3.833	6.30	6.583	2.06	9.33	.00
1.167	6.92	3.917	6.03	6.667	1.90	9.42	.00
1.250	7.25	4.000	5.77	6.750	1.73	9.50	.00
1.333	7.58	4.083	5.69	6.833	1.57	9.58	.00
1.417	7.91	4.167	5.62	6.917	1.40	9.67	.00
1.500	8.24	4.250	5.55	7.000	1.24	9.75	.00
1.583	8.65	4.333	5.49	7.083	1.15	9.83	.00
1.667	8.98	4.417	5.42	7.167	1.09	9.92	.00
1.750	9.31	4.500	5.36	7.250	1.02	10.00	.00
1.833	9.64	4.583	5.27	7.333	.96	10.08	.00
1.917	9.97	4.667	5.21	7.417	.89	10.17	.00
2.000	10.30	4.750	5.14	7.500	.82	10.25	.00
2.083	10.18	4.833	5.08	7.583	.74	10.33	.00

2.167	10.08	4.917	5.01	7.667	.68	10.42	.00
2.250	9.98	5.000	4.94	7.750	.61	10.50	.00
2.333	9.88	5.083	4.78	7.833	.54	10.58	.00
2.417	9.78	5.167	4.65	7.917	.48	10.67	.00
2.500	9.68	5.250	4.52	8.000	.41	10.75	.00
2.583	9.56	5.333	4.38	8.083	.37	10.83	.00
2.667	9.46	5.417	4.25	8.167	.34	10.92	.00
2.750	9.36	5.500	4.12	8.250	.30	11.00	.00

Unit Hyd Qpeak (cms)= .829

PEAK FLOW (cms)= .157 (i)
TIME TO PEAK (hrs)= 5.000
RUNOFF VOLUME (mm)= 12.634
TOTAL RAINFALL (mm)= 41.200
RUNOFF COEFFICIENT = .307

(i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

CALIB					
NASHYD (0002)	Area	(ha)=	21.50	Curve Number	(CN)= 79.3
ID= 1 DT= 5.0 min	Ia	(mm)=	5.00	# of Linear Res.	(N)= 3.00
	U.H. Tp	(hrs)=	.98		

Unit Hyd Qpeak (cms)= .838

PEAK FLOW (cms)= .160 (i)
TIME TO PEAK (hrs)= 5.000
RUNOFF VOLUME (mm)= 12.784
TOTAL RAINFALL (mm)= 41.200
RUNOFF COEFFICIENT = .310

(i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

CALIB					
NASHYD (0003)	Area	(ha)=	1.50	Curve Number	(CN)= 79.0
ID= 1 DT= 5.0 min	Ia	(mm)=	5.00	# of Linear Res.	(N)= 3.00
	U.H. Tp	(hrs)=	.23		

Unit Hyd Qpeak (cms)= .249

PEAK FLOW (cms)= .013 (i)
TIME TO PEAK (hrs)= 3.417
RUNOFF VOLUME (mm)= 12.620
TOTAL RAINFALL (mm)= 41.200
RUNOFF COEFFICIENT = .306

(i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

CALIB					
NASHYD (0004)	Area	(ha)=	1.50	Curve Number	(CN)= 83.6
ID= 1 DT= 5.0 min	Ia	(mm)=	5.00	# of Linear Res.	(N)= 3.00
	U.H. Tp	(hrs)=	.20		

Unit Hyd Qpeak (cms)= .286

PEAK FLOW (cms)= .016 (i)

2.167	10.08	4.917	5.01	7.667	.68	10.42	.00
2.250	9.98	5.000	4.94	7.750	.61	10.50	.00
2.333	9.88	5.083	4.78	7.833	.54	10.58	.00
2.417	9.78	5.167	4.65	7.917	.48	10.67	.00
2.500	9.68	5.250	4.52	8.000	.41	10.75	.00
2.583	9.56	5.333	4.38	8.083	.37	10.83	.00
2.667	9.46	5.417	4.25	8.167	.34	10.92	.00
2.750	9.36	5.500	4.12	8.250	.30	11.00	.00

Unit Hyd Qpeak (cms)= .829

PEAK FLOW (cms)= .157 (i)
TIME TO PEAK (hrs)= 5.000
RUNOFF VOLUME (mm)= 12.634
TOTAL RAINFALL (mm)= 41.200
RUNOFF COEFFICIENT = .307

(i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

CALIB					
NASHYD (0002)	Area	(ha)=	21.50	Curve Number	(CN)= 79.3
ID= 1 DT= 5.0 min	Ia	(mm)=	5.00	# of Linear Res.	(N)= 3.00
	U.H. Tp	(hrs)=	.98		

Unit Hyd Qpeak (cms)= .838

PEAK FLOW (cms)= .160 (i)
TIME TO PEAK (hrs)= 5.000
RUNOFF VOLUME (mm)= 12.784
TOTAL RAINFALL (mm)= 41.200
RUNOFF COEFFICIENT = .310

(i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

CALIB					
NASHYD (0003)	Area	(ha)=	1.50	Curve Number	(CN)= 79.0
ID= 1 DT= 5.0 min	Ia	(mm)=	5.00	# of Linear Res.	(N)= 3.00
	U.H. Tp	(hrs)=	.23		

Unit Hyd Qpeak (cms)= .249

PEAK FLOW (cms)= .013 (i)
TIME TO PEAK (hrs)= 3.417
RUNOFF VOLUME (mm)= 12.620
TOTAL RAINFALL (mm)= 41.200
RUNOFF COEFFICIENT = .306

(i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

CALIB					
NASHYD (0004)	Area	(ha)=	1.50	Curve Number	(CN)= 83.6
ID= 1 DT= 5.0 min	Ia	(mm)=	5.00	# of Linear Res.	(N)= 3.00
	U.H. Tp	(hrs)=	.20		

Unit Hyd Qpeak (cms)= .286

PEAK FLOW (cms)= .016 (i)

TIME TO PEAK (hrs)= 3.333
RUNOFF VOLUME (mm)= 15.203
TOTAL RAINFALL (mm)= 41.200
RUNOFF COEFFICIENT = .369

(i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

****
** SIMULATION NUMBER: 2 **
****

MASS STORM Ptotal= 54.90 mm	Filename: C:\AMEC\Projects\Samsung - SWM Plan\Hydrology\AES 12h-60min.mst Comments: AES 12 HR MASS CURVE

Duration of storm = 11.00 hrs
Mass curve time step = 60.00 min

TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr
1.00	8.24	4.00	7.69	7.00	1.65	10.00	.00
2.00	13.73	5.00	6.59	8.00	.55	11.00	.00
3.00	12.08	6.00	4.39	9.00	.00		

CALIB NASHYD (0001) ID= 1 DT= 5.0 min	Area (ha)= 21.50 Curve Number (CN)= 79.0 Ia (mm)= 5.00 # of Linear Res.(N)= 3.00 U.H. Tp(hrs)= .99

NOTE: RAINFALL WAS TRANSFORMED TO 5.0 MIN. TIME STEP.

---- TRANSFORMED HYETOGRAPH ----

TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr
.083	8.24	2.833	12.08	5.583	4.39	8.33	.00
.167	8.24	2.917	12.08	5.667	4.39	8.42	.00
.250	8.24	3.000	12.08	5.750	4.39	8.50	.00
.333	8.24	3.083	7.69	5.833	4.39	8.58	.00
.417	8.24	3.167	7.69	5.917	4.39	8.67	.00
.500	8.24	3.250	7.69	6.000	4.39	8.75	.00
.583	8.24	3.333	7.69	6.083	1.65	8.83	.00
.667	8.24	3.417	7.69	6.167	1.65	8.92	.00
.750	8.24	3.500	7.69	6.250	1.65	9.00	.00
.833	8.24	3.583	7.69	6.333	1.65	9.08	.00
.917	8.24	3.667	7.69	6.417	1.65	9.17	.00
1.000	8.24	3.750	7.69	6.500	1.65	9.25	.00
1.083	13.72	3.833	7.69	6.583	1.65	9.33	.00
1.167	13.73	3.917	7.69	6.667	1.65	9.42	.00
1.250	13.73	4.000	7.69	6.750	1.65	9.50	.00
1.333	13.73	4.083	6.59	6.833	1.65	9.58	.00
1.417	13.73	4.167	6.59	6.917	1.65	9.67	.00
1.500	13.73	4.250	6.59	7.000	1.65	9.75	.00
1.583	13.73	4.333	6.59	7.083	.55	9.83	.00
1.667	13.73	4.417	6.59	7.167	.55	9.92	.00
1.750	13.73	4.500	6.59	7.250	.55	10.00	.00
1.833	13.73	4.583	6.59	7.333	.55	10.08	.00
1.917	13.73	4.667	6.59	7.417	.55	10.17	.00
2.000	13.72	4.750	6.59	7.500	.55	10.25	.00

2.083	12.08	4.833	6.59	7.583	.55	10.33	.00
2.167	12.08	4.917	6.59	7.667	.55	10.42	.00
2.250	12.08	5.000	6.59	7.750	.55	10.50	.00
2.333	12.08	5.083	4.39	7.833	.55	10.58	.00
2.417	12.08	5.167	4.39	7.917	.55	10.67	.00
2.500	12.08	5.250	4.39	8.000	.55	10.75	.00
2.583	12.08	5.333	4.39	8.083	.00	10.83	.00
2.667	12.08	5.417	4.39	8.167	.00	10.92	.00
2.750	12.08	5.500	4.39	8.250	.00	11.00	.00

Unit Hyd Qpeak (cms)= .829

PEAK FLOW (cms)= .263 (i)
TIME TO PEAK (hrs)= 4.250
RUNOFF VOLUME (mm)= 21.206
TOTAL RAINFALL (mm)= 54.900
RUNOFF COEFFICIENT = .386

(i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

CALIB NASHYD (0002) ID= 1 DT= 5.0 min	Area (ha)= 21.50	Curve Number (CN)= 79.3
	Ia (mm)= 5.00	# of Linear Res.(N)= 3.00
	U.H. Tp(hrs)= .98	

Unit Hyd Qpeak (cms)= .838

PEAK FLOW (cms)= .267 (i)
TIME TO PEAK (hrs)= 4.167
RUNOFF VOLUME (mm)= 21.428
TOTAL RAINFALL (mm)= 54.900
RUNOFF COEFFICIENT = .390

(i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

CALIB NASHYD (0003) ID= 1 DT= 5.0 min	Area (ha)= 1.50	Curve Number (CN)= 79.0
	Ia (mm)= 5.00	# of Linear Res.(N)= 3.00
	U.H. Tp(hrs)= .23	

Unit Hyd Qpeak (cms)= .249

PEAK FLOW (cms)= .024 (i)
TIME TO PEAK (hrs)= 3.000
RUNOFF VOLUME (mm)= 21.182
TOTAL RAINFALL (mm)= 54.900
RUNOFF COEFFICIENT = .386

(i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

CALIB NASHYD (0004) ID= 1 DT= 5.0 min	Area (ha)= 1.50	Curve Number (CN)= 83.6
	Ia (mm)= 5.00	# of Linear Res.(N)= 3.00
	U.H. Tp(hrs)= .20	

Unit Hyd Qpeak (cms)= .286

PEAK FLOW (cms)= .028 (i)
TIME TO PEAK (hrs)= 3.000
RUNOFF VOLUME (mm)= 24.920
TOTAL RAINFALL (mm)= 54.900
RUNOFF COEFFICIENT = .454

(i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

****
** SIMULATION NUMBER: 3 **
****

MASS STORM	Filename: C:\AMEC\Projects\Samsung - SWM Plan\Hydrology\AES 12h-60min.mst
Ptotal= 63.90 mm	Comments: AES 12 HR MASS CURVE

Duration of storm = 11.00 hrs
Mass curve time step = 60.00 min

TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr
1.00	9.59	4.00	8.95	7.00	1.92	10.00	.00
2.00	15.97	5.00	7.67	8.00	.64	11.00	.00
3.00	14.06	6.00	5.11	9.00	.00		

CALIB NASHYD (0001) ID= 1 DT= 5.0 min	Area (ha)= 21.50	Curve Number (CN)= 79.0
	Ia (mm)= 5.00	# of Linear Res.(N)= 3.00
	U.H. Tp(hrs)= .99	

NOTE: RAINFALL WAS TRANSFORMED TO 5.0 MIN. TIME STEP.

---- TRANSFORMED HYETOGRAPH ----

TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr
.083	9.59	2.833	14.06	5.583	5.11	8.33	.00
.167	9.59	2.917	14.06	5.667	5.11	8.42	.00
.250	9.59	3.000	14.06	5.750	5.11	8.50	.00
.333	9.59	3.083	8.95	5.833	5.11	8.58	.00
.417	9.59	3.167	8.95	5.917	5.11	8.67	.00
.500	9.59	3.250	8.95	6.000	5.11	8.75	.00
.583	9.59	3.333	8.95	6.083	1.92	8.83	.00
.667	9.59	3.417	8.95	6.167	1.92	8.92	.00
.750	9.59	3.500	8.95	6.250	1.92	9.00	.00
.833	9.59	3.583	8.95	6.333	1.92	9.08	.00
.917	9.59	3.667	8.95	6.417	1.92	9.17	.00
1.000	9.59	3.750	8.95	6.500	1.92	9.25	.00
1.083	15.97	3.833	8.95	6.583	1.92	9.33	.00
1.167	15.97	3.917	8.95	6.667	1.92	9.42	.00
1.250	15.97	4.000	8.95	6.750	1.92	9.50	.00
1.333	15.97	4.083	7.67	6.833	1.92	9.58	.00
1.417	15.97	4.167	7.67	6.917	1.92	9.67	.00
1.500	15.97	4.250	7.67	7.000	1.92	9.75	.00
1.583	15.97	4.333	7.67	7.083	.64	9.83	.00
1.667	15.97	4.417	7.67	7.167	.64	9.92	.00
1.750	15.97	4.500	7.67	7.250	.64	10.00	.00
1.833	15.97	4.583	7.67	7.333	.64	10.08	.00
1.917	15.97	4.667	7.67	7.417	.64	10.17	.00

2.000	15.97	4.750	7.67	7.500	.64	10.25	.00
2.083	14.06	4.833	7.67	7.583	.64	10.33	.00
2.167	14.06	4.917	7.67	7.667	.64	10.42	.00
2.250	14.06	5.000	7.67	7.750	.64	10.50	.00
2.333	14.06	5.083	5.11	7.833	.64	10.58	.00
2.417	14.06	5.167	5.11	7.917	.64	10.67	.00
2.500	14.06	5.250	5.11	8.000	.64	10.75	.00
2.583	14.06	5.333	5.11	8.083	.00	10.83	.00
2.667	14.06	5.417	5.11	8.167	.00	10.92	.00
2.750	14.06	5.500	5.11	8.250	.00	11.00	.00

Unit Hyd Qpeak (cms)= .829

PEAK FLOW (cms)= .341 (i)
TIME TO PEAK (hrs)= 4.167
RUNOFF VOLUME (mm)= 27.442
TOTAL RAINFALL (mm)= 63.900
RUNOFF COEFFICIENT = .429

(i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

CALIB					
NASHYD (0002)	Area	(ha)=	21.50	Curve Number (CN)=	79.3
ID= 1 DT= 5.0 min	Ia	(mm)=	5.00	# of Linear Res.(N)=	3.00
	U.H. Tp(hrs)=		.98		

Unit Hyd Qpeak (cms)= .838

PEAK FLOW (cms)= .346 (i)
TIME TO PEAK (hrs)= 4.083
RUNOFF VOLUME (mm)= 27.709
TOTAL RAINFALL (mm)= 63.900
RUNOFF COEFFICIENT = .434

(i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

CALIB					
NASHYD (0003)	Area	(ha)=	1.50	Curve Number (CN)=	79.0
ID= 1 DT= 5.0 min	Ia	(mm)=	5.00	# of Linear Res.(N)=	3.00
	U.H. Tp(hrs)=		.23		

Unit Hyd Qpeak (cms)= .249

PEAK FLOW (cms)= .031 (i)
TIME TO PEAK (hrs)= 3.000
RUNOFF VOLUME (mm)= 27.412
TOTAL RAINFALL (mm)= 63.900
RUNOFF COEFFICIENT = .429

(i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

CALIB					
NASHYD (0004)	Area	(ha)=	1.50	Curve Number (CN)=	83.6
ID= 1 DT= 5.0 min	Ia	(mm)=	5.00	# of Linear Res.(N)=	3.00
	U.H. Tp(hrs)=		.20		

Unit Hyd Qpeak (cms)= .286

PEAK FLOW (cms)= .036 (i)
TIME TO PEAK (hrs)= 3.000
RUNOFF VOLUME (mm)= 31.846
TOTAL RAINFALL (mm)= 63.900
RUNOFF COEFFICIENT = .498

(i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

****
** SIMULATION NUMBER: 4 **
****

MASS STORM	Filename: C:\AMEC\Projects\Samsung - SWM Plan\Hydrology\AES 12h-60min.mst
Ptotal= 75.40 mm	Comments: AES 12 HR MASS CURVE

Duration of storm = 11.00 hrs
Mass curve time step = 60.00 min

TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr
1.00	11.31	4.00	10.56	7.00	2.26	10.00	.00
2.00	18.85	5.00	9.05	8.00	.75	11.00	.00
3.00	16.59	6.00	6.03	9.00	.00		

CALIB NASHYD (0001) ID= 1 DT= 5.0 min	Area (ha)= 21.50	Curve Number (CN)= 79.0
	Ia (mm)= 5.00	# of Linear Res.(N)= 3.00
	U.H. Tp(hrs)= .99	

NOTE: RAINFALL WAS TRANSFORMED TO 5.0 MIN. TIME STEP.

---- TRANSFORMED HYETOGRAPH ----

TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr
.083	11.31	2.833	16.59	5.583	6.03	8.33	.00
.167	11.31	2.917	16.59	5.667	6.03	8.42	.00
.250	11.31	3.000	16.59	5.750	6.03	8.50	.00
.333	11.31	3.083	10.56	5.833	6.03	8.58	.00
.417	11.31	3.167	10.56	5.917	6.03	8.67	.00
.500	11.31	3.250	10.56	6.000	6.03	8.75	.00
.583	11.31	3.333	10.56	6.083	2.26	8.83	.00
.667	11.31	3.417	10.56	6.167	2.26	8.92	.00
.750	11.31	3.500	10.56	6.250	2.26	9.00	.00
.833	11.31	3.583	10.56	6.333	2.26	9.08	.00
.917	11.31	3.667	10.56	6.417	2.26	9.17	.00
1.000	11.31	3.750	10.56	6.500	2.26	9.25	.00
1.083	18.85	3.833	10.56	6.583	2.26	9.33	.00
1.167	18.85	3.917	10.56	6.667	2.26	9.42	.00
1.250	18.85	4.000	10.56	6.750	2.26	9.50	.00
1.333	18.85	4.083	9.05	6.833	2.26	9.58	.00
1.417	18.85	4.167	9.05	6.917	2.26	9.67	.00
1.500	18.85	4.250	9.05	7.000	2.26	9.75	.00
1.583	18.85	4.333	9.05	7.083	.75	9.83	.00
1.667	18.85	4.417	9.05	7.167	.75	9.92	.00
1.750	18.85	4.500	9.05	7.250	.75	10.00	.00
1.833	18.85	4.583	9.05	7.333	.75	10.08	.00

1.917	18.85	4.667	9.05	7.417	.75	10.17	.00
2.000	18.85	4.750	9.05	7.500	.75	10.25	.00
2.083	16.59	4.833	9.05	7.583	.75	10.33	.00
2.167	16.59	4.917	9.05	7.667	.75	10.42	.00
2.250	16.59	5.000	9.05	7.750	.75	10.50	.00
2.333	16.59	5.083	6.03	7.833	.75	10.58	.00
2.417	16.59	5.167	6.03	7.917	.75	10.67	.00
2.500	16.59	5.250	6.03	8.000	.75	10.75	.00
2.583	16.59	5.333	6.03	8.083	.00	10.83	.00
2.667	16.59	5.417	6.03	8.167	.00	10.92	.00
2.750	16.59	5.500	6.03	8.250	.00	11.00	.00

Unit Hyd Qpeak (cms)= .829

PEAK FLOW (cms)= .448 (i)
TIME TO PEAK (hrs)= 4.000
RUNOFF VOLUME (mm)= 35.935
TOTAL RAINFALL (mm)= 75.400
RUNOFF COEFFICIENT = .477

(i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

CALIB NASHYD (0002)	ID= 1 DT= 5.0 min	Area (ha)= 21.50	Curve Number (CN)= 79.3	Ia (mm)= 5.00	# of Linear Res.(N)= 3.00	U.H. Tp(hrs)= .98

Unit Hyd Qpeak (cms)= .838

PEAK FLOW (cms)= .454 (i)
TIME TO PEAK (hrs)= 4.000
RUNOFF VOLUME (mm)= 36.255
TOTAL RAINFALL (mm)= 75.400
RUNOFF COEFFICIENT = .481

(i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

CALIB NASHYD (0003)	ID= 1 DT= 5.0 min	Area (ha)= 1.50	Curve Number (CN)= 79.0	Ia (mm)= 5.00	# of Linear Res.(N)= 3.00	U.H. Tp(hrs)= .23

Unit Hyd Qpeak (cms)= .249

PEAK FLOW (cms)= .040 (i)
TIME TO PEAK (hrs)= 3.000
RUNOFF VOLUME (mm)= 35.895
TOTAL RAINFALL (mm)= 75.400
RUNOFF COEFFICIENT = .476

(i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

CALIB NASHYD (0004)	ID= 1 DT= 5.0 min	Area (ha)= 1.50	Curve Number (CN)= 83.6	Ia (mm)= 5.00	# of Linear Res.(N)= 3.00	U.H. Tp(hrs)= .20

Unit Hyd Qpeak (cms)= .286

PEAK FLOW (cms)= .046 (i)
TIME TO PEAK (hrs)= 3.000
RUNOFF VOLUME (mm)= 41.144
TOTAL RAINFALL (mm)= 75.400
RUNOFF COEFFICIENT = .546

(i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

****
** SIMULATION NUMBER: 5 **
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MASS STORM	Filename: C:\AMEC\Projects\Samsung - SWM Plan\Hydrology\AES 12h-60min.mst
Ptotal= 83.90 mm	Comments: AES 12 HR MASS CURVE

Duration of storm = 11.00 hrs
Mass curve time step = 60.00 min

TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr
1.00	12.59	4.00	11.75	7.00	2.52	10.00	.00
2.00	20.98	5.00	10.07	8.00	.84	11.00	.00
3.00	18.46	6.00	6.71	9.00	.00		

CALIB NASHYD (0001) ID= 1 DT= 5.0 min	Area (ha)= 21.50	Curve Number (CN)= 79.0
	Ia (mm)= 5.00	# of Linear Res.(N)= 3.00
	U.H. Tp(hrs)= .99	

NOTE: RAINFALL WAS TRANSFORMED TO 5.0 MIN. TIME STEP.

---- TRANSFORMED HYETOGRAPH ----

TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr
.083	12.59	2.833	18.46	5.583	6.71	8.33	.00
.167	12.59	2.917	18.46	5.667	6.71	8.42	.00
.250	12.59	3.000	18.46	5.750	6.71	8.50	.00
.333	12.59	3.083	11.75	5.833	6.71	8.58	.00
.417	12.59	3.167	11.75	5.917	6.71	8.67	.00
.500	12.59	3.250	11.75	6.000	6.71	8.75	.00
.583	12.59	3.333	11.75	6.083	2.52	8.83	.00
.667	12.59	3.417	11.75	6.167	2.52	8.92	.00
.750	12.59	3.500	11.75	6.250	2.52	9.00	.00
.833	12.59	3.583	11.75	6.333	2.52	9.08	.00
.917	12.59	3.667	11.75	6.417	2.52	9.17	.00
1.000	12.59	3.750	11.75	6.500	2.52	9.25	.00
1.083	20.97	3.833	11.75	6.583	2.52	9.33	.00
1.167	20.98	3.917	11.75	6.667	2.52	9.42	.00
1.250	20.98	4.000	11.75	6.750	2.52	9.50	.00
1.333	20.98	4.083	10.07	6.833	2.52	9.58	.00
1.417	20.98	4.167	10.07	6.917	2.52	9.67	.00
1.500	20.98	4.250	10.07	7.000	2.52	9.75	.00
1.583	20.98	4.333	10.07	7.083	.84	9.83	.00
1.667	20.98	4.417	10.07	7.167	.84	9.92	.00
1.750	20.98	4.500	10.07	7.250	.84	10.00	.00

1.833	20.98	4.583	10.07	7.333	.84	10.08	.00
1.917	20.98	4.667	10.07	7.417	.84	10.17	.00
2.000	20.97	4.750	10.07	7.500	.84	10.25	.00
2.083	18.46	4.833	10.07	7.583	.84	10.33	.00
2.167	18.46	4.917	10.07	7.667	.84	10.42	.00
2.250	18.46	5.000	10.07	7.750	.84	10.50	.00
2.333	18.46	5.083	6.71	7.833	.84	10.58	.00
2.417	18.46	5.167	6.71	7.917	.84	10.67	.00
2.500	18.46	5.250	6.71	8.000	.84	10.75	.00
2.583	18.46	5.333	6.71	8.083	.00	10.83	.00
2.667	18.46	5.417	6.71	8.167	.00	10.92	.00
2.750	18.46	5.500	6.71	8.250	.00	11.00	.00

Unit Hyd Qpeak (cms)= .829

PEAK FLOW (cms)= .532 (i)
TIME TO PEAK (hrs)= 3.917
RUNOFF VOLUME (mm)= 42.516
TOTAL RAINFALL (mm)= 83.900
RUNOFF COEFFICIENT = .507

(i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

CALIB			
NASHYD (0002)	Area (ha)= 21.50	Curve Number (CN)= 79.3
ID= 1 DT= 5.0 min	Ia (mm)= 5.00	# of Linear Res.(N)= 3.00
	U.H. Tp(hrs)= .98	

Unit Hyd Qpeak (cms)= .838

PEAK FLOW (cms)= .538 (i)
TIME TO PEAK (hrs)= 3.917
RUNOFF VOLUME (mm)= 42.872
TOTAL RAINFALL (mm)= 83.900
RUNOFF COEFFICIENT = .511

(i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

CALIB			
NASHYD (0003)	Area (ha)= 1.50	Curve Number (CN)= 79.0
ID= 1 DT= 5.0 min	Ia (mm)= 5.00	# of Linear Res.(N)= 3.00
	U.H. Tp(hrs)= .23	

Unit Hyd Qpeak (cms)= .249

PEAK FLOW (cms)= .047 (i)
TIME TO PEAK (hrs)= 3.000
RUNOFF VOLUME (mm)= 42.469
TOTAL RAINFALL (mm)= 83.900
RUNOFF COEFFICIENT = .506

(i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

CALIB			
NASHYD (0004)	Area (ha)= 1.50	Curve Number (CN)= 83.6
ID= 1 DT= 5.0 min	Ia (mm)= 5.00	# of Linear Res.(N)= 3.00
	U.H. Tp(hrs)= .20	

Unit Hyd Qpeak (cms)= .286

PEAK FLOW (cms)= .054 (i)
TIME TO PEAK (hrs)= 3.000
RUNOFF VOLUME (mm)= 48.267
TOTAL RAINFALL (mm)= 83.900
RUNOFF COEFFICIENT = .575

(i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

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** SIMULATION NUMBER: 6 **
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MASS STORM	Filename: C:\AMEC\Projects\Samsung - SWM Plan\Hydrology\AES 12h-60min.mst
Ptotal= 92.30 mm	Comments: AES 12 HR MASS CURVE

Duration of storm = 11.00 hrs
Mass curve time step = 60.00 min

TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr
1.00	13.85	4.00	12.92	7.00	2.77	10.00	.00
2.00	23.08	5.00	11.08	8.00	.92	11.00	.00
3.00	20.31	6.00	7.38	9.00	.00		

CALIB NASHYD (0001) ID= 1 DT= 5.0 min	Area (ha)= 21.50	Curve Number (CN)= 79.0
	Ia (mm)= 5.00	# of Linear Res.(N)= 3.00
	U.H. Tp(hrs)= .99	

NOTE: RAINFALL WAS TRANSFORMED TO 5.0 MIN. TIME STEP.

---- TRANSFORMED HYETOGRAPH ----

TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr	TIME hrs	RAIN mm/hr
.083	13.85	2.833	20.31	5.583	7.38	8.33	.00
.167	13.85	2.917	20.31	5.667	7.38	8.42	.00
.250	13.85	3.000	20.31	5.750	7.38	8.50	.00
.333	13.85	3.083	12.92	5.833	7.38	8.58	.00
.417	13.85	3.167	12.92	5.917	7.38	8.67	.00
.500	13.85	3.250	12.92	6.000	7.38	8.75	.00
.583	13.85	3.333	12.92	6.083	2.77	8.83	.00
.667	13.85	3.417	12.92	6.167	2.77	8.92	.00
.750	13.85	3.500	12.92	6.250	2.77	9.00	.00
.833	13.85	3.583	12.92	6.333	2.77	9.08	.00
.917	13.85	3.667	12.92	6.417	2.77	9.17	.00
1.000	13.85	3.750	12.92	6.500	2.77	9.25	.00
1.083	23.07	3.833	12.92	6.583	2.77	9.33	.00
1.167	23.08	3.917	12.92	6.667	2.77	9.42	.00
1.250	23.08	4.000	12.92	6.750	2.77	9.50	.00
1.333	23.08	4.083	11.08	6.833	2.77	9.58	.00
1.417	23.08	4.167	11.08	6.917	2.77	9.67	.00
1.500	23.08	4.250	11.08	7.000	2.77	9.75	.00
1.583	23.08	4.333	11.08	7.083	.92	9.83	.00
1.667	23.08	4.417	11.08	7.167	.92	9.92	.00

1.750	23.08	4.500	11.08	7.250	.92	10.00	.00
1.833	23.08	4.583	11.08	7.333	.92	10.08	.00
1.917	23.08	4.667	11.08	7.417	.92	10.17	.00
2.000	23.07	4.750	11.08	7.500	.92	10.25	.00
2.083	20.31	4.833	11.08	7.583	.92	10.33	.00
2.167	20.31	4.917	11.08	7.667	.92	10.42	.00
2.250	20.31	5.000	11.08	7.750	.92	10.50	.00
2.333	20.31	5.083	7.38	7.833	.92	10.58	.00
2.417	20.31	5.167	7.38	7.917	.92	10.67	.00
2.500	20.31	5.250	7.38	8.000	.92	10.75	.00
2.583	20.31	5.333	7.38	8.083	.00	10.83	.00
2.667	20.31	5.417	7.38	8.167	.00	10.92	.00
2.750	20.31	5.500	7.38	8.250	.00	11.00	.00

Unit Hyd Qpeak (cms)= .829

PEAK FLOW (cms)= .618 (i)
TIME TO PEAK (hrs)= 3.917
RUNOFF VOLUME (mm)= 49.227
TOTAL RAINFALL (mm)= 92.300
RUNOFF COEFFICIENT = .533

(i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

CALIB					
NASHYD (0002)	Area	(ha)=	21.50	Curve Number (CN)=	79.3
ID= 1 DT= 5.0 min	Ia	(mm)=	5.00	# of Linear Res.(N)=	3.00
	U.H. Tp(hrs)=		.98		

Unit Hyd Qpeak (cms)= .838

PEAK FLOW (cms)= .625 (i)
TIME TO PEAK (hrs)= 3.833
RUNOFF VOLUME (mm)= 49.617
TOTAL RAINFALL (mm)= 92.300
RUNOFF COEFFICIENT = .538

(i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

CALIB					
NASHYD (0003)	Area	(ha)=	1.50	Curve Number (CN)=	79.0
ID= 1 DT= 5.0 min	Ia	(mm)=	5.00	# of Linear Res.(N)=	3.00
	U.H. Tp(hrs)=		.23		

Unit Hyd Qpeak (cms)= .249

PEAK FLOW (cms)= .055 (i)
TIME TO PEAK (hrs)= 3.000
RUNOFF VOLUME (mm)= 49.173
TOTAL RAINFALL (mm)= 92.300
RUNOFF COEFFICIENT = .533

(i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

CALIB					
NASHYD (0004)	Area	(ha)=	1.50	Curve Number (CN)=	83.6
ID= 1 DT= 5.0 min	Ia	(mm)=	5.00	# of Linear Res.(N)=	3.00

---------- U.H. Tp(hrs)= .20

Unit Hyd Qpeak (cms)= .286

PEAK FLOW (cms)= .062 (i)
TIME TO PEAK (hrs)= 3.000
RUNOFF VOLUME (mm)= 55.472
TOTAL RAINFALL (mm)= 92.300
RUNOFF COEFFICIENT = .601

(i) PEAK FLOW DOES NOT INCLUDE BASEFLOW IF ANY.

FINISH

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