PICKERING-AJAX-WHITBY SUB-REGION INTEGRATED REGIONAL RESOURCE PLAN

Part of the GTA East Planning Region | June 30, 2016

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Integrated Regional Resource Plan

Pickering-Ajax-Whitby Sub-region

This Integrated Regional Resource Plan ("IRRP") was prepared by the Independent Electricity System Operator ("IESO") pursuant to the terms of its Ontario Energy Board licence, EI-2013-0066.

This IRRP was prepared on behalf of the Pickering-Ajax-Whitby Sub-region Working Group ('the Working Group"), which included the following members:

- Independent Electricity System Operator
- Veridian Connections Inc.
- Whitby Hydro Electric Corporation
- Hydro One Networks Inc. (Distribution)
- Hydro One Networks Inc. (Transmission)

The Working Group assessed the adequacy of electricity supply to customers in the Pickering-Ajax-Whitby Sub-region over a 20-year period beginning in 2015; developed a flexible, comprehensive, integrated plan that considers opportunities for coordination in anticipation of potential demand growth and varying supply conditions in the Pickering-Ajax-Whitby Sub-region; and developed an implementation plan for the recommended options, while maintaining flexibility in order to accommodate changes in key conditions over time.

Working Group members agree with the IRRP's recommendations and support implementation of the plan through the recommended actions. The Pickering-Ajax-Whitby Sub-region Working Group members do not commit to any capital expenditures and must still obtain all necessary regulatory and other approvals to implement recommended actions.

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List of Abbreviations

Abbreviation	Description
CDM or Conservation	Conservation and Demand Management
CFF	Conservation First Framework
DR	Demand Response
DG	Distributed Generation
EA	Environmental Assessment
Hydro One	Hydro One Networks Inc.
IESO	Independent Electricity System Operator
IRRP	Integrated Regional Resource Plan
kV	Kilovolt
kW	Kilowatt
LAC or Committee	Local Advisory Committee
LDC	Local Distribution Company
LMC	Load Meeting Capability
LTEP	Long-Term Energy Plan
LTR	Limited Time Rating
MVA	Megavolt-ampere
MW	Megawatt
NERC	North American Electric Reliability Corporation
NPCC	Northeast Power Coordinating Council
OEB or Board	Ontario Energy Board
OPA	Ontario Power Authority
ORTAC	Ontario Resource and Transmission Assessment Criteria
PPWG	Planning Process Working Group
PPWG Report	Planning Process Working Group Report to the Board
PV	Photovoltaic (solar)
RIP	Regional Infrastructure Plan
SCGT	Single-Cycle Gas Combustion Turbine
TS	Transformer Station
TWh	Terawatt Hours
Veridian	Veridian Connections Inc.
Whitby Hydro	Whitby Hydro Electric Corporation
Working Group	Technical Working Group for Pickering-Ajax-Whitby IRRP

1. Introduction

This Integrated Regional Resource Plan ("IRRP") addresses the electricity needs for the Pickering-Ajax-Whitby Sub-region (the "sub-region") over the next 20 years, from 2015-2034. This report was prepared by the Independent Electricity System Operator ("IESO") on behalf of the Technical Working Group composed of the IESO, Veridian Connections Inc. ("Veridian"), Whitby Hydro Electric Corporation ("Whitby Hydro"), Hydro One Distribution and Hydro One Transmission [1] (the "Working Group").

The sub-region is part of the GTA East planning region ("GTA East Region"). The GTA East Region is within the Region of Durham and extends from Lake Ontario northward to the southern parts of Scugog and Uxbridge, and includes the municipalities of Pickering, Ajax, Whitby, Oshawa and the eastern part of Clarington. The area is supplied by several transformer stations ("TS") fed by the 230 kV transmission system in the area. The local distribution companies ("LDCs") providing services to the GTA East Region include: Hydro One Distribution, Oshawa PUC Networks ("Oshawa PUC"), Veridian and Whitby Hydro.

The sub-region includes the City of Pickering, Town of Ajax, the Town of Whitby and the southern parts of the Townships of Uxbridge and Scugog. The sub-region is currently served by Cherrywood TS 230/44 kV step-down transformers, Whitby TS and a portion of Thornton TS. The scope of this sub-region IRRP also includes consideration of the entire GTA East regional supply for the purposes of restoration analysis. A map of the GTA East Region is provided in Figure 1-1 below.

[1] For the purpose of this report, "Hydro One Transmission" and "Hydro One Distribution" are used to differentiate the transmission and distribution accountabilities of Hydro One Networks Inc., respectively.

Figure 1-1: Map of Region

Source: Data provided by Hydro One Networks Inc.

In Ontario, planning to meet the electrical supply and reliability needs of a large area or region is done through regional electricity planning, a process that was formalized by the Ontario Energy Board ("OEB" or "Board") in 2013. In accordance with the OEB's regional planning process, transmitters, distributers and the IESO are required to carry out regional planning activities for the province's 21 electricity planning regions at least once every five years. The GTA East Region is one of these planning regions.

This IRRP identifies power system capacity and reliability requirements, and coordinates the options to meet customer needs in the sub-region over the next 20 years. Specifically, this IRRP identifies investments for immediate implementation necessary to meet near-term needs in the sub-region, respecting the lead time for development.

This IRRP also identifies planning considerations over the longer term. It does not identify or recommend any specific projects for the longer term at this time but maintains flexibility to meet longer-term needs as they arise by monitoring growth and impacts of conservation and distributed generation ("DG") uptake at area transformer stations.

This report is organized as follows:

- A summary of the recommended plan for the Pickering-Ajax-Whitby Sub-region is provided in Section 2;
- The process and methodology used to develop the plan is discussed in Section 3;
- The context for electricity planning in the Pickering-Ajax-Whitby Sub-region and the study scope are discussed in Section 4;
- Demand forecast scenarios, and conservation and DG assumptions, are described in Section 5;
- Electricity needs in the Pickering-Ajax-Whitby Sub-region are presented in Section 6;
- Alternatives and recommendations for meeting needs are addressed in Section 7;
- Considerations for meeting regional growth needs in the longer term are discussed as in Section 8;
- A summary of engagement carried out to date in developing this IRRP and moving forward is provided in Section 9; and
- A conclusion is provided in Section 10.

2. The Integrated Regional Resource Plan

This IRRP addresses the sub-region's electricity needs over the next two decades, based on application of the IESO's Ontario Resource and Transmission Assessment Criteria ("ORTAC").[2] The IRRP identifies the needs that are forecast to arise in the near term (0-5 years or 2015 through 2020) and medium to long term (6-20 years or 2021 through 2034). The medium to longer term is referred to as the longer-term plan throughout this report as no distinct needs have been identified for the area past the near-term horizon. These two planning horizons are distinguished in the IRRP to reflect the level of commitment required to address needs over these time periods. The plans for both timeframes are coordinated to ensure consistency. The IRRP was developed based on consideration of planning criteria and input received during engagement with local communities and other stakeholders. The planning criterion includes technical feasibility, cost, reliability, and, in the near-term, the IESO sought to maximize the economic use of existing electricity infrastructure.

This IRRP identifies specific projects for implementation in the near- term. This is necessary to ensure that they are in-service in time to address the sub-region's more urgent needs while respecting the lead time for development of the recommended and required infrastructure.

The IRRP also identifies possible longer-term electricity needs and considerations to keep in mind for the next round of planning. In preparation for the longer term, actions are identified to gather information and lay the groundwork for future planning processes. These actions are intended to be completed before the next IRRP cycle so that their results can inform further consideration at that time.

The needs and recommended actions comprising the near-term plan, as well as the long-term plan, are summarized below.

[2] ORTAC Section 7.4 Application of Restoration Criteria - http://www.ieso.ca/Documents/marketAdmin/IMO_REQ_0041_TransmissionAssessmentCriteria.pdf

2.1 Near-Term Plan (Up to 2020)

By 2019, peak summer 27.6 kV electrical demand at Whitby TS is expected to exceed the Limited Time Rating[3] ("LTR") of the transformer that supplies electricity at the 27.6 kV level by 12 MW, increasing to 132 MW by end of the study period in 2034. This increased loading is chiefly influenced by the forecast growth in demand in the greenfield community of Seaton in North Pickering. As the transformation capacity need is triggered by a new growth pocket with no current access to transmission supply, the near-term plan considers options to provide additional 27.6 kV supply to meet the entire capacity need of the new Seaton community.

Near-Term Needs

- Need for additional 27.6 kV transformation capacity to supply growth
- Need to conduct analysis to assess the economic justification for addressing the restoration shortfall for the 30 minute and 4 hour timelines

Currently, a portion of customers supplied from the circuits H24/26C and M29/B23C in the GTA East Region would not be able to be restored within ORTAC timelines for rare failure events at peak times. A restoration shortfall exists for the 30 minute and 4 hour timelines. The 2015 30 minute and 4 hour shortfalls are 49 MW and 64 MW for the H24/26C circuits and 81 MW and 29 MW for the M29/B23C circuits respectively. The near-term plan considers the relative benefit of wires options versus the status quo for the 30 minute and 4 hour restoration timelines for rare double element failure events.

Recommended Actions

1. Build a new 230/27.6 kV station and upgrade an existing 230 kV line

Action is required to provide additional 27.6 kV supply capacity for the sub-region, specifically in proximity to the greenfield community of Seaton. Feeders are currently being built from Whitby TS to the new load centre to provide some additional supply to Seaton, however, the 27.6 kV transformation capacity at Whitby TS is forecast to be exceeded by 2019 and additional 27.6 kV capacity will be required to meet the forecast demand. Based on the analysis, included as Appendix B and summarized in Section 7.1.3, it has been determined that the most economic

[3] LTR determines the capacity of a station to serve load

course of action is to construct a new 230/27.6 kV station and upgrade an existing 230 kV line in the proximity of Seaton by 2018 in order to meet the need for additional capacity in 2019 (hereinafter, this solution is referred to as "Seaton MTS"). An Environmental Assessment ("EA"), which is currently underway, will recommend the preferred site for Seaton MTS. Based on the anticipated needs and lead time required for approvals and construction, it is recommended that Hydro One and Veridian undertake further planning and project development along with approval for implementation of Seaton MTS.

2. **Undertake further restoration analysis and recommend next steps as part of the RIP for the GTA East Region**

Preliminary technical and economic analysis indicates that the cost of addressing the restoration shortfall may be less than the potential cost of prolonged supply interruptions to local electricity customers. This preliminary analysis accounted for the low likelihood of the rare failure event (the simultaneous and prolonged loss of two supply lines serving the area) and assumed the higher end of customer interruption costs.

Based on this preliminary analysis it is recommended that the transmission and distribution companies conduct detailed studies to determine if specific restoration facilities can be justified. These detailed studies should be conducted as part of the Regional Infrastructure Plan ("RIP") for the GTA East Region and should consider outage statistics, associated wires solutions/costs and incremental reliability benefits.

2.2 Longer-Term Plan (2021-2034)

Over the long term, factors such as intensification of established areas, progress on community energy plans, conservation, DG uptake at the transformation station level and the electrification of the transportation sector could affect electrical service for the sub-region. These factors could impact the capacity of the existing electricity supply infrastructure. Near-term actions in order to prepare for the long term will focus on monitoring these factors.

3. Development of the IRRP

3.1 The Regional Planning Process

In Ontario, planning to meet the electricity needs of customers at a regional level is done through regional planning. Regional planning assesses the interrelated needs of a region - defined by common electricity supply infrastructure — over the near, medium and long term and develops a plan to ensure cost-effective and reliable electricity supply. Regional plans consider the existing electricity infrastructure in an area, forecast growth and customer reliability, evaluate options for addressing needs and recommend actions.

Regional planning has been conducted on an as needed basis in Ontario for many years. Most recently, the Ontario Power Authority ("OPA") carried out regional planning activities to address regional electricity supply needs. The OPA conducted joint regional planning studies with distributors, transmitters, the IESO and other stakeholders in regions where a need for coordinated regional planning had been identified.

In the fall of 2012, the Ontario Energy Board ("OEB") convened the Planning Process Working Group ("PPWG") to develop a more structured, transparent and systematic regional planning process. This group was composed of industry stakeholders including electricity agencies, utilities and stakeholders. In May 2013, the PPWG released the Working Group Report to the Board ("PPWG Report"), setting out the new regional planning process. Twenty-one electricity planning regions in the province were identified in the Working Group Report and a phased schedule for completion was outlined. The Board endorsed the Working Group Report and in August 2013 formalized the process timelines through changes to the Transmission System Code and Distribution System Code, as well as through changes to the OPA's licence in October 2013. The OPA licence changes required it to lead a number of aspects of regional planning, including the completion of comprehensive IRRPs. Following the merger of the IESO and the OPA on January 1, 2015, the regional planning responsibilities identified in the OPA's licence were transferred to the IESO.

The regional planning process begins with a Needs Screening process performed by the transmitter, which determines whether there are needs requiring regional coordination. If regional planning is required, the IESO then conducts a Scoping Assessment to determine whether a comprehensive IRRP is required, which considers conservation, generation, transmission and distribution solutions, or whether a "wires" solution is the best option. If the

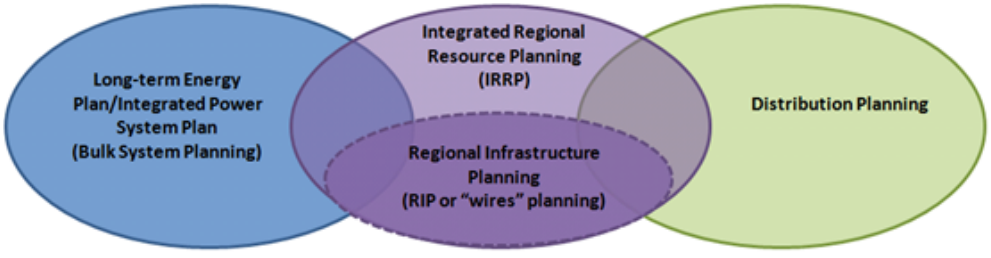
IESO recommends a wires solution, then a transmission- and distribution-focused RIP is developed. The Scoping Assessment process also identifies any sub-regions that require assessment. There may also be regions where infrastructure investments do not require regional coordination and can be planned directly by the distributor and transmitter, outside of the regional planning process. At the conclusion of the Scoping Assessment process, the IESO produces a report that includes the results of the Needs Screening process – identifying whether an IRRP, RIP or no regional coordination is required – and a preliminary Terms of Reference. If an IRRP is recommended, then the IESO is required to complete the IRRP within 18 months. If a RIP is required, the transmitter takes the lead and has six months to complete it following the completion of the IRRP. Both RIPs and IRRPs must be updated at least every five years.

The final IRRPs and RIPs must be posted on the IESO and relevant transmitter websites and can be used as supporting evidence in a rate application or leave to construct. They may also be used by municipalities for planning purposes and by other parties to facilitate a better understanding of local electricity growth and infrastructure requirements.

Regional planning, as shown in Figure 3-1, is just one forms of electricity planning that is undertaken in Ontario. There are three types of electricity planning in Ontario:

- Bulk system planning
- Regional system planning
- Distribution system planning

Figure 3-1: Levels of Electricity System Planning



Bulk System Planning

- 500 kV & 230 kV transmission
- Interconnections
- Inter-area network transfer capability
- System reliability (security and adequacy) to meet NERC, NPCC, ORTAC
- Congestion and system efficiency
- System supply and demand forecasts
- Incorporation of large generation
- Typically medium- and long-term focused

Regional Planning

- 230 kV & 115 kV transmission
- 115/230 kV autotransformers and associated switchyard facilities
- Customer connections
- Load supply stations
- Regional reliability (security and adequacy) to meet NERC, NPCC & ORTAC
- ORTAC local area reliability criteria
- Regional/local area generation & CDM resources
- Typically near- & medium-term focused

Distribution Network Planning

- Transformer stations to connect to the transmission system
- Distribution network planning (e.g. new & modified Dx facilities)
- Distribution system reliability (capacity & security)
- Distribution connected generation & CDM resources
- LDC demand forecasts
- Near- & medium-term focused

Planning at the bulk system level typically considers the 230 kV and 500 kV network. Bulk system planning considers the major transmission facilities and assesses the resources needed to adequately supply the province. Bulk system planning is typically carried out by the IESO in accordance with government policy. Distribution planning, which is carried out by local distribution companies, looks at specific investments on the low voltage, distribution system.

Regional planning can overlap with bulk system planning. For example, overlap can occur at interface points where regional resource options may also address a bulk system issue. Similarly, regional planning can overlap with the distribution planning of LDCs. An example of this is when a distribution solution addresses the needs of the broader local area or region. Therefore, to ensure efficiency and cost effectiveness, it is important for regional planning to be coordinated with both bulk and distribution system planning.

By recognizing the linkages with bulk and distribution system planning and coordinating multiple needs identified within a given region over the long term, the regional planning process provides an integrated assessment of needs. Regional planning aligns near and long-term solutions and allows specific investments recommended in the plan to be understood as part of a larger context. Furthermore, regional planning optimizes ratepayer interests by avoiding piecemeal planning and asset duplication and allows Ontario ratepayers' interests to be represented along with the interests of LDC ratepayers. Where IRRPs are undertaken, they allow an evaluation of the multiple options available to meet needs, including conservation, generation and "wires" solutions. Regional plans also provide greater transparency through engagement in the planning process and by making plans available to the public.

3.2 The IESO's Approach to Regional Planning

IRRPs assess electricity system needs for a region over a 20-year period. The 20-year outlook anticipates long-term trends so that near-term actions are developed within the context of a longer-term view. This enables coordination and consistency with the long-term plan, rather than simply reacting to immediate needs.

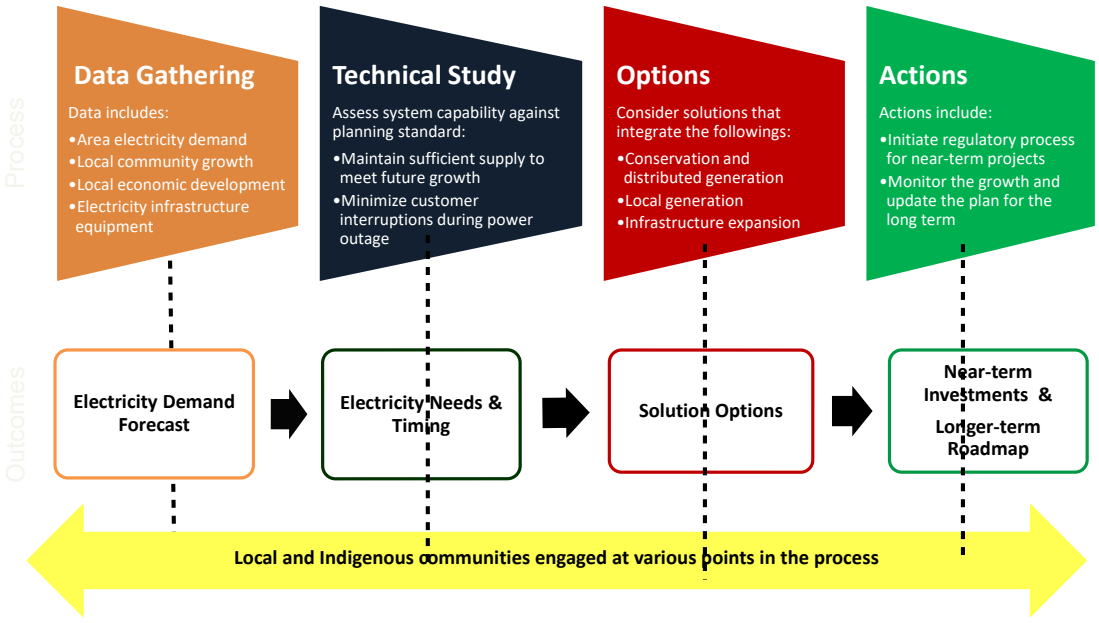
In developing an IRRP, a different approach is taken to developing the plan for the first 10 years of the plan than for the longer-term period of 10-20 years. The plan for the first 10 years is developed based on best available information on demand, conservation and other local developments. Given the long lead time to develop electricity infrastructure, near-term electricity needs require prompt action to enable the specified solutions in a timely manner. By

contrast, the long-term plan is characterized by greater forecast uncertainty and longer development lead time, as such solutions do not need to be committed to immediately. Given the potential for changing conditions and technological development, the IRRP for the long term is more directional, focusing on developing and maintaining the viability of options for the future and continuing to monitor demand forecast scenarios.

In developing an IRRP, the IESO and technical working group (see Figure 3-2 below) carry out a number of steps. These steps include electricity demand forecasts; technical studies to determine electricity needs and the timing of these needs; the development of potential options; and a recommended plan including actions for the near and long term. Throughout this process, engagement is carried out with stakeholders and First Nation and Métis communities who may have an interest in the region. The steps of an IRRP are illustrated in Figure 3-2.

The IRRP report documents the inputs, findings and recommendations developed through the process described above and provides recommended actions for the entities responsible for plan implementation. Where "wires" solutions are included in the plan recommendations, the completion of the IRRP report is the trigger for the transmitter to initiate an RIP process. Other recommendations in the IRRP may include: development of conservation, local generation, or other solutions; community engagement; or information gathering to support future iterations of the regional planning process in the region.

Figure 3-2: Steps in the IRRP Process



3.3 Pickering-Ajax-Whitby Sub-region Working Group and IRRP Development

The initial impetus for the sub-region IRRP was a 2014 Needs Screening report for GTA East. This report was produced by Hydro One Transmission with input from the OPA and IESO, Veridian, Whitby Hydro, Oshawa PUC and Hydro One Distribution. The Needs Screening was carried out to identify any needs which required coordinated regional planning. The Needs Screening Report found that there were needs which potentially required regional coordination, therefore the former OPA conducted a Scoping Assessment process and issued a Scoping Assessment Report in December 2014, in which it identified needs in the Pickering-Ajax-Whitby Sub-region that should be further assessed through an IRRP.

In late 2014 the Working Group was formed to develop a Terms of Reference for the IRRP, gather data, identify near to long-term needs in the sub-region, and develop the near-term recommend actions included in this IRRP.

4. Background and Study Scope

This report presents an IRRP for the Pickering-Ajax-Whitby Sub-region for the 20-year period from 2015 to 2034.

The IRRP planning approach for this sub-region was determined during the GTA East Region Scoping Assessment process. The combination of greenfield growth in North Pickering and supply capacity limitations in the area triggered the need for a coordinated approach by way of an IRRP for the sub-region.

A greenfield community -Seaton is planned to be developed in north Pickering, just north of the Cherrywood TS, within Veridian's service territory. This development is being planned for residential capacity for up to 70, 000 people and 35,000 jobs. Veridian plans to supply this new community load at 27.6 kV. Hydro One and Veridian assessed the station capacity requirements and plans for a proposed new 230/27.6 kV station called "Seaton MTS" prior to the regional planning process for the sub-region. Further assessment of the 27.6 kV supply situation was undertaken as part of this IRRP.

To set the context for this IRRP, the scope of this IRRP and the sub-region's existing electricity system are described in Section 4.1.

4.1 Study Scope

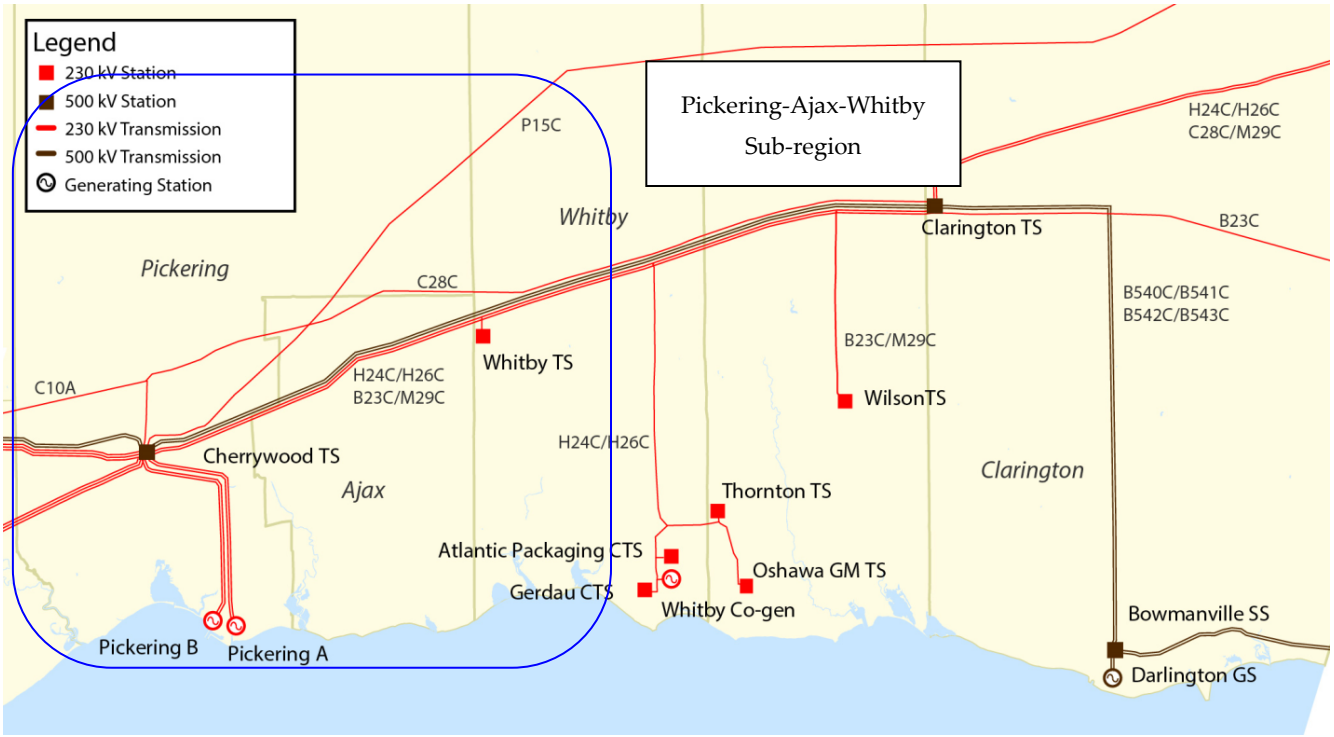
This IRRP recommends options to meet supply needs of the sub-region in the near, and longer term. The plan is a joint initiative involving the Working Group members, the IESO, Veridian, Whitby Hydro, Hydro One Distribution and Hydro One Transmission, and incorporates input from other stakeholders. The plan takes into account forecast electricity demand growth, conservation and demand management ("CDM" or "conservation") in the area, transmission and distribution system capability, relevant community plans, developments on the bulk transmission system, FIT and other generation uptake through province-wide programs.

This IRRP addresses regional needs in the sub-region, including capacity, security, reliability and relevant end-of-life consideration of assets.

The following transmission facilities are included in the plan scope and illustrated in Figure 4-1:

- Stations—Cherrywood TS, Whitby TS
- Transmission circuits—H24/26C and M29/B23C

Figure 4-1: Regional Transmission Facilities



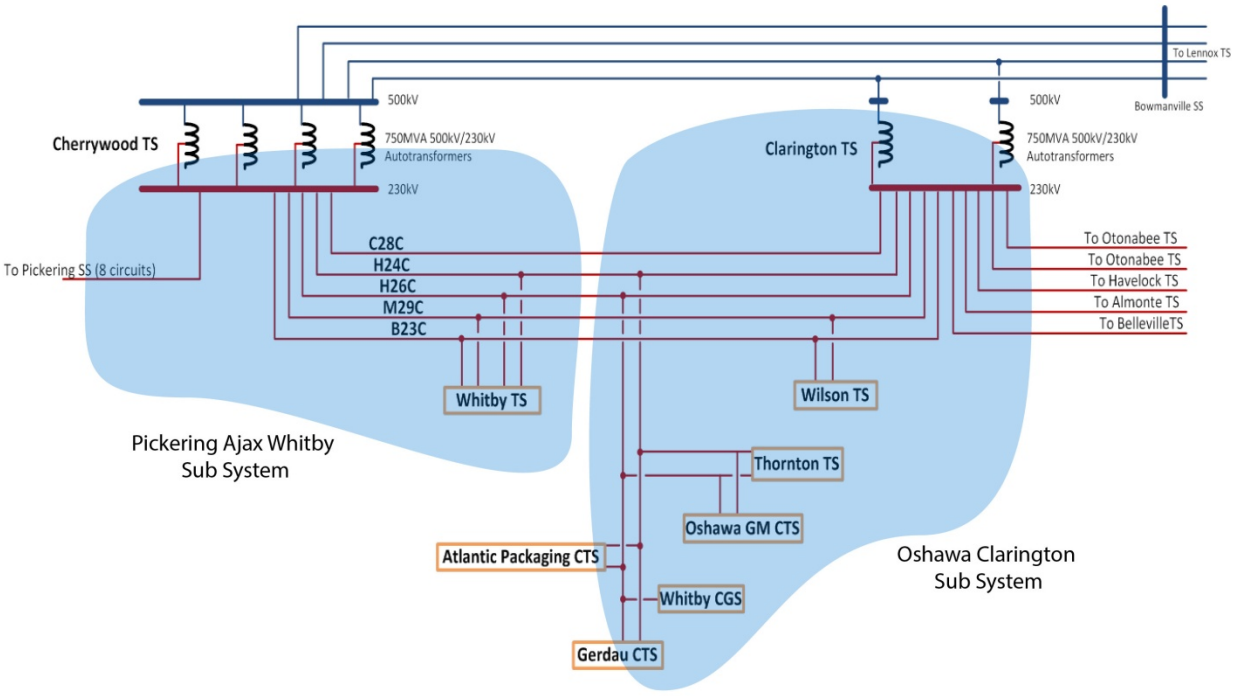
Source: Data provided by Hydro One Networks Inc.
Copyright: Hydro One Networks Inc. [2016].

The IRRP was developed by completing the following steps:

- Preparing a 20-year electricity demand forecast and establishing needs over this timeframe.
- Examining the capacity and reliability of the existing transmission system supplying the sub-region, taking into account facility ratings and performance of transmission elements, transformers, local generation, and other facilities such as reactive power devices. Needs were established by applying ORTAC.
- Establishing feasible integrated alternatives to address needs, including a mix of conservation, generation, transmission and distribution facilities, and other electricity system initiatives.
- Evaluating options using planning criteria which may include: technical feasibility, cost, reliability performance, environmental and social factors.
- Conducting community engagement to obtain local input on options for meeting the needs.
- Developing and communicating findings, conclusions, and recommendations.

Figure 4-2 below shows the electrical configuration of the main stations, supply sources, and transmission assets for the GTA East Region as a single line diagram. Note that the needs analysis includes Clarington TS which is currently under construction and is expected to be in-service for 2018.

Figure 4-2: Electrical Sub-systems



Source: Hydro One Networks Inc.

5. Demand Forecast

This section outlines the forecast of electricity demand for the Pickering-Ajax-Whitby Sub-region. It highlights the assumptions made for peak-demand load forecasts and the contributions of conservation and DG to reducing peak demand. The resulting net demand forecast is used in assessing the electricity needs of the area over the planning horizon.

To evaluate the adequacy of the electricity system, the regional planning process involves measuring the demand observed at each station for the hour of the year when overall demand in the study area is at a maximum. This is called "coincident peak demand" and represents the moment when assets are most stressed and resources most constrained. This differs from a non-coincident peak, which is measured by summing each station's individual peak, regardless of whether the stations' peaks occur at different times of the area's overall peak.

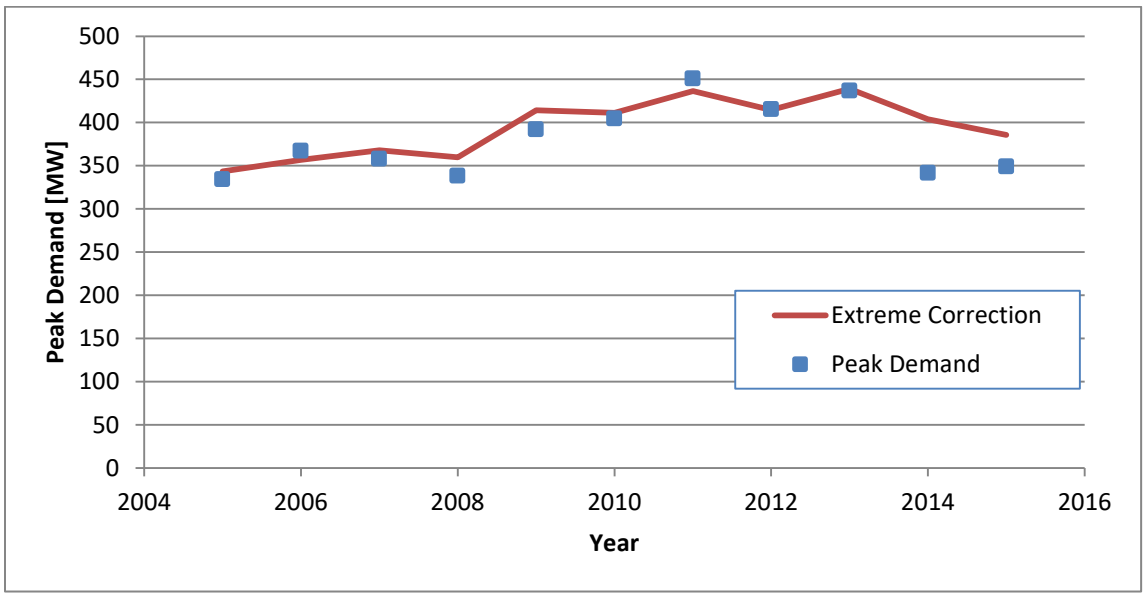
Within the sub-region, the peak loading hour for each year typically occurs in the early-evening of the hottest weekday during the summer. This typically occurs on the same day as the overall provincial peak, but may occur at a different hour in the day. The 2015 regional peak occurred on July 30 at 5:00 pm. Although a large group of industrial customers exists in the GTA East Region, both the regional and sub-regional peak is generally driven by the air conditioning loads of residential and commercial customers. The introduction of the IESO's Industrial Conservation Initiative program in recent years has decreased the overall effect of industrial customer load during peak hours.

Section 5.1 begins by describing the historic electricity demand trends in the sub-region from 2005 to 2015. Section 5.2 describes the demand forecast used in this study and the methodology used to develop it.

5.1 Historical Demand

The sub-region has seen steady demand growth since 2005. The peak demand in this sub-region is heavily driven by weather conditions. Residential and commercial customers combine for approximately 80% of the load in the area and during the summer months, load from air conditioning drives the peak demand. The recent decline in peak demand during 2014 and 2015 can be attributed to the cool summers experienced across the GTA and province-wide. The peak day temperature in 2014 and 2015 averaged 29.4 degrees Celsius, compared to 34.2 degrees Celsius from 2010 to 2013.

Figure 5-1: Historical Peak Demand in Pickering-Ajax-Whitby Sub-region



The red line in Figure 5-1 shows the weather corrected customer demand for the same hour as the actual peak demand. The weather corrected line has been adjusted to reflect the expected behaviour of the load under extreme weather conditions. Correction factors between actual and extreme conditions are produced on a zonal basis by Hydro One, the transmitter in this area.

5.2 Demand Forecast Methodology

For the purpose of this IRRP, a 20-year planning forecast was developed to assess supply and reliability needs at the regional level.

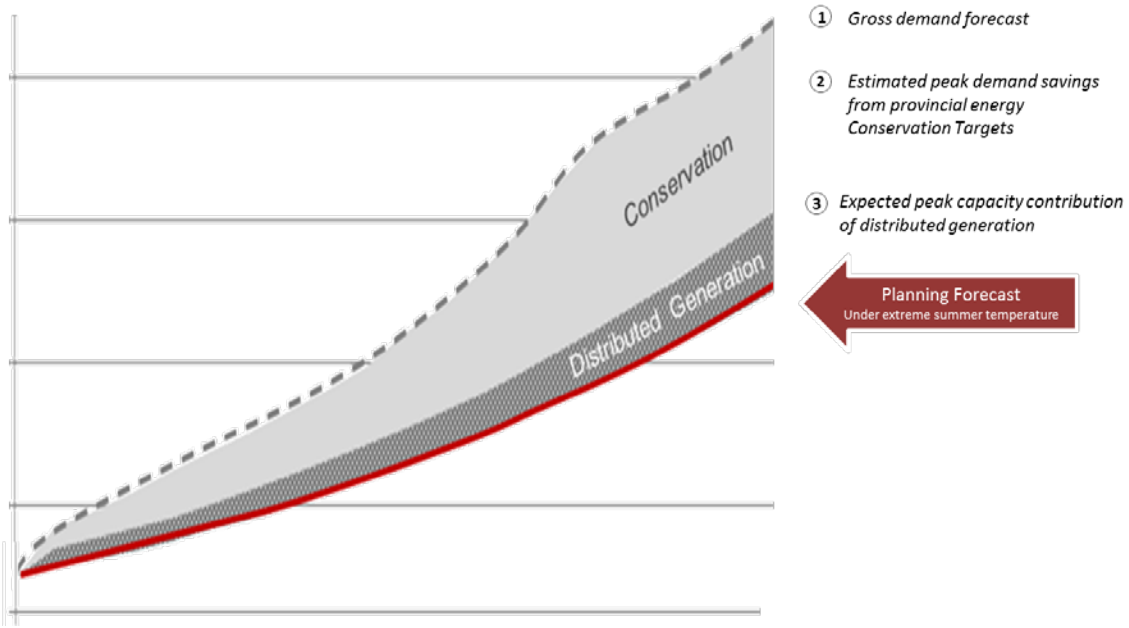
Regional electricity needs are driven by the limits of the infrastructure supplying an area, which is sized to meet peak-demand requirements. Regional planning typically focuses on growth in

regional-coincident peak demand. Energy adequacy is usually not a concern of regional planning, as the region can generally draw upon energy available from the provincial electricity grid, with energy adequacy for the province being planned through a separate process.

The 20-year planning forecast is divided notionally into two timeframes. The near (0-5 years or 2015 through 2020) and medium to long term (6-20 years or 2021 through 2034).

The sub-region's peak demand forecast was developed as shown in Figure 5-2. Gross demand forecasts, assuming normal-year weather conditions, were provided by the LDCs and the transmission-connected customers in the LDCs' service territory. The LDCs' forecasts are based on growth projections included in regional and municipal plans, which in turn reflect the province's Places to Grow policy. These forecasts were then modified to produce a planning forecast - i.e., they were adjusted to reflect the peak demand impacts of provincial conservation targets and DG contracted through provincial programs such as FIT and microFIT, and to reflect extreme weather conditions where necessary. The planning forecast was then used to assess any growth-related electricity needs in the sub-region.

Figure 5-2: Development of Demand Forecast



Using a planning forecast that is net of provincial conservation targets is consistent with the province's Conservation First policy. However, this assumes that the targets will be met and that the targets, which are energy-based, will produce the corresponding local peak demand

impacts. An important aspect of plan implementation will be monitoring the actual peak demand impacts of conservation programs delivered by the local LDCs and, as necessary, adapting the plan.

Additional details related to the development of the demand forecasts are provided in Appendix A.

5.3 Gross Demand Forecast

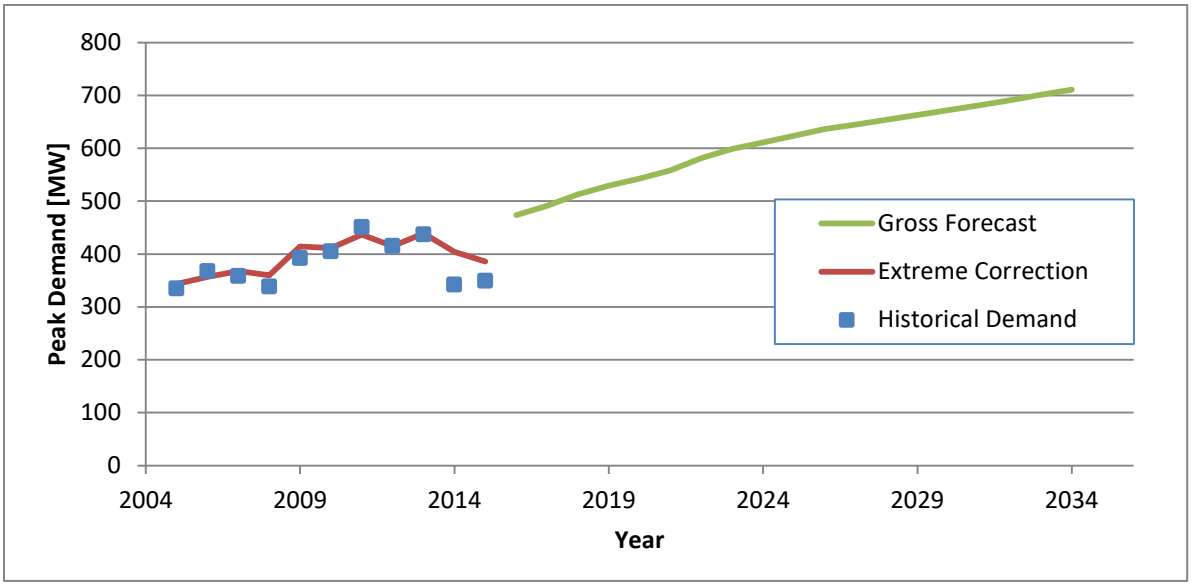
Each participating LDC and transmission-connected customer in the LDCs' service territories prepared gross demand forecasts at the TS level or bus level for multi-bus stations. Gross demand forecasts account for the increases in demand from new or intensified development, but do not account for the impact of new conservation measures such as codes & standards or demand response ("DR") programs. LDCs are only expected to account for changes in consumer demand resulting from efficiency improvements and increasing electricity prices, known as "natural conservation".

Since LDCs have the most direct experience with customers and applicable local growth expectations, their information is considered the most accurate for regional planning purposes. Most LDCs cited alignment with municipal and regional official plans as a primary source for input data. Other common considerations included known connection applications and typical electrical demand intensity for similar customer types.

The graph below shows the gross demand forecast provided by the LDCs[4] for the sub-region, with historical data points for comparison. The demand in the sub-region is serviced by Whitby TS and Cherrywood TS. Whitby TS is split into two DESNs and provides supply at both 27.6 kV and 44.0 kV levels, while Cherrywood TS only provides supply at the 44.0 kV level.

[4] Forecasts are subject to change as population information continues to be updated as part of provincial and local growth plan reviews

Figure 5-3: Sub-region Gross Demand Forecast



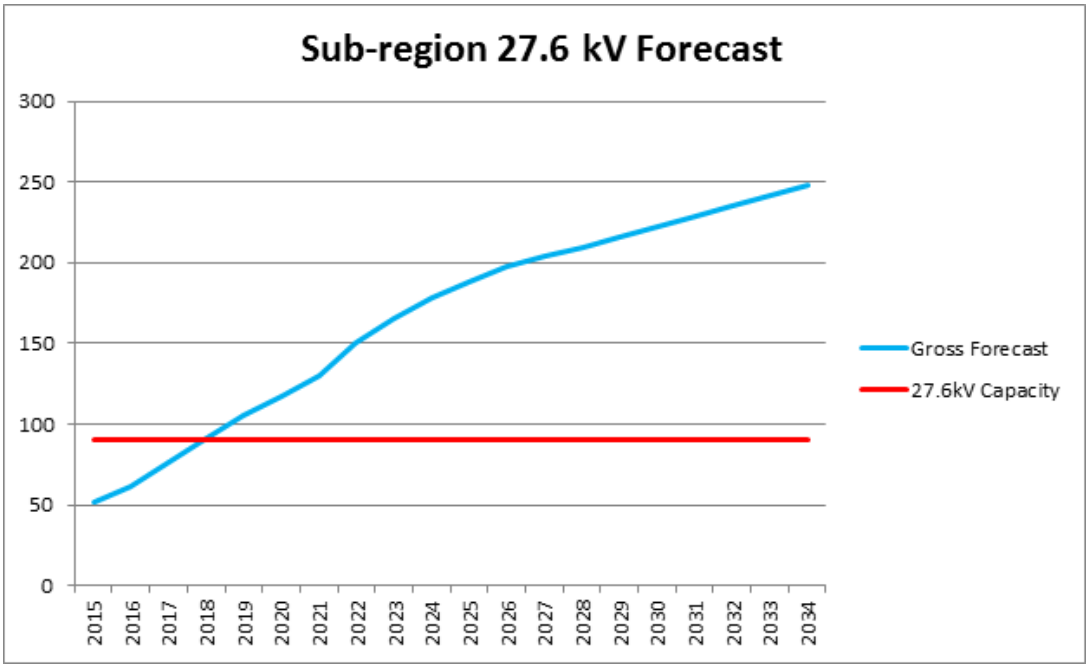
Both the weather corrected peak and historical demand shows that demand in the sub-region has been generally increasing over the past decade, with a slight dip in the most recent year. However, the data for summer of 2014 and 2015 should be regarded as less reliable due to abnormally cool summer conditions. Although an extreme weather correction has been applied in all cases, these methodologies are generally not designed to make such extreme adjustments.

The total annual growth for this area averages 2.3% over the 20-year planning horizon. The highest growth is forecast to occur in the near term (year 0-5) at a rate of 3.7%. The demand growth decreases to 2.8% in the medium term (year 5-10) and further declines to 1.5% for the last 10 years of the planning period.

Demand growth in the sub-region is driven by a series of development projects which include the new community of Seaton, and various intensification projects in Pickering, Ajax and Whitby[5]. The new community of Seaton is envisioned as sustainable urban community[6] and is forecast to account for 22% of the total demand in the sub-region by 2034. The resulting demand of this new development will be initially serviced by available 27.6 kV capacity at Whitby TS, but is expected to exceed station capacity in 2019 as shown in Figure 5-4.

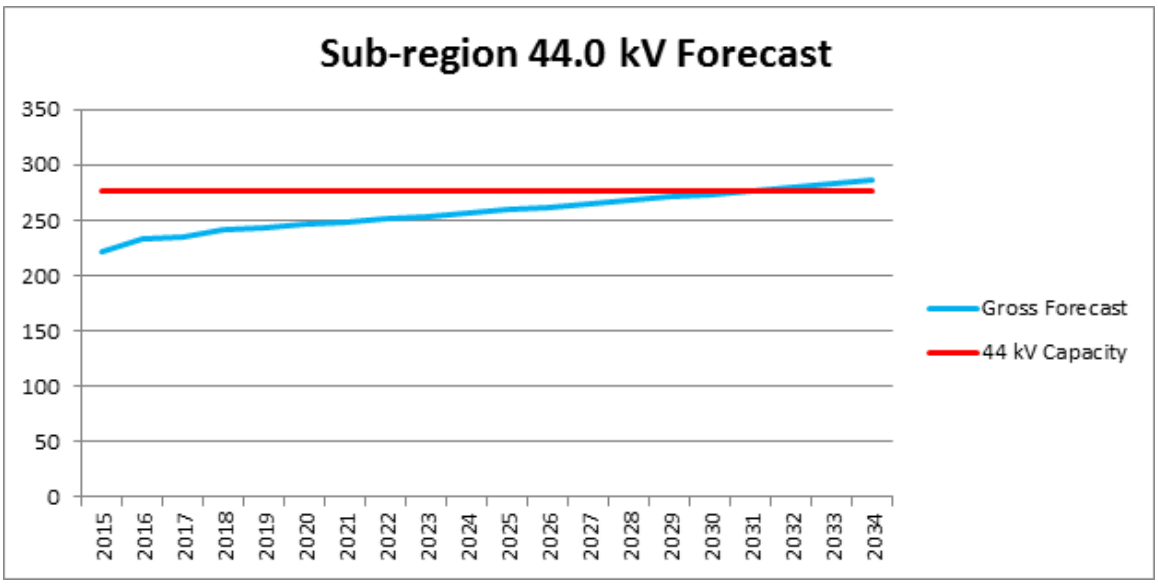
[5] https://www.pickering.ca/en/living/resources/DowntownPickering_FinalVisionDocument_June2013.pdf
https://www.ajax.ca/en/doingbusinessinajax/resources/Planning_Services/Ajax_Official_Plan_Consolidation_Jan_15_2016.pdf
http://www.whitby.ca/en/townhall/resources/pl_opa1-chart_march28_2013.pdf
[6] https://www.pickering.ca/en/cityhall/seatoncommunity.asp

Figure 5-4: Sub-region 27.6 kV Gross Forecast



The 44.0 kV demand in the area is supplied by Whitby TS and Cherrywood TS, and the 44 kV capacity is expected to be sufficient to supply forecast demand into the longer term.

Figure 5-5: Sub-region 44.0 kV Gross Forecast



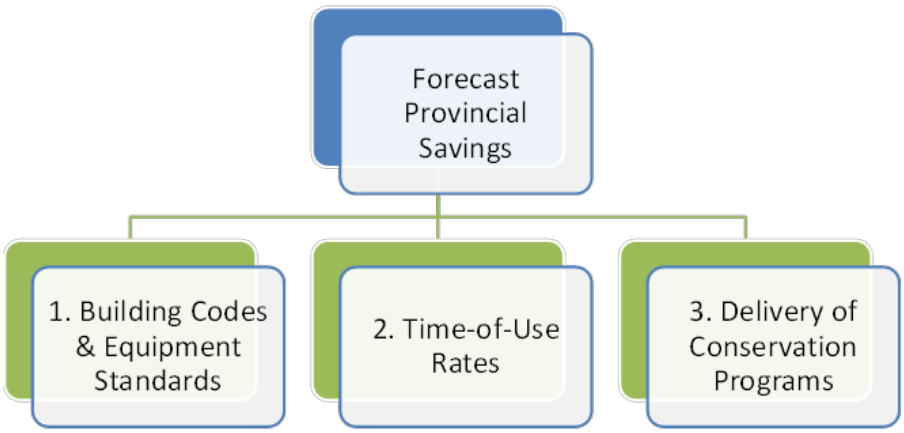
The gross demand forecasts provided by the LDCs, and forecast methodology are provided in Appendix A.

5.4 Conservation Assumed in the Forecast

Conservation is the first resource considered in planning, approval and procurement processes. It plays a key role in maximizing the utilization of existing infrastructure and maintaining reliable supply by keeping demand within equipment capability. Conservation is achieved through a mix of program-related activities, rate structures, and mandated efficiencies from building codes and equipment standards. The conservation savings forecast for the sub-region have been applied to the gross peak demand forecast, along with DG resources (described in Section 5.5), to determine the net peak demand or planning forecast for the sub-region.

In December 2013 the Ministry of Energy released a revised LTEP that outlined a provincial conservation target of 30 terawatt-hours ("TWh") of energy savings by 2032. A portion of this province-wide energy conservation target was allocated to the sub-region, and, as further described below, it was further converted to an estimated peak demand reduction for the sub-region. The expected peak demand savings for the sub-region are shown below in Table 5-1. To estimate the impact of the conservation savings in the area, the forecast provincial savings were divided into three main categories:

Figure 5-6: Categories of Conservation Savings



1. *Savings due to Building Codes & Equipment Standards*
2. *Savings due to Time of Use Rate structures*
3. *Savings due to the delivery of Conservation Programs*

The 2013 LTEP committed to establishing a new 6-year Conservation First Framework ("CFF") beginning in January 2015 to enable the achievement of all cost-effective conservation. In the

near-term, Ontario's LDCs have an aggregate energy reduction target of 7 TWh, as well as individual LDC specific targets. These targets are to be achieved between 2015 and the end of 2020 through LDC conservation programs enabled by the CFF. Each LDC was required to prepare a Conservation and Demand Management ("CDM") plan by May 1, 2015 describing how their target will be achieved. LDCs are also required to provide updates to their CDM plans.

As part of the Conservation First policy, the provincial government has adopted a broad definition of conservation that includes various types of customer action and behind-the-meter generation. This means that conservation includes any programs or mechanisms that reduce the amount of energy consumed from the provincial electricity grid. Conservation initiatives, including behind the meter generation projects and on-site generation, are expected to reduce customers' reliance on the provincial electricity grid and contribute to peak demand savings in the sub-region.

To provide a more regional specific forecast, the impact of the savings for each category were broken down by the residential, commercial and industrial customer sectors. The IESO then worked together with area LDCs to establish a methodology to estimate the electrical demand impacts of the energy targets by the three customer sectors. This provides a better resolution of the forecast conservation, as conservation potential varies by sector due to different energy consumption characteristics and conservation opportunities.

For the sub-region, LDCs were requested to provide their gross demand forecast and provide the breakdown of their demand forecast by sector at each TS based on their knowledge of local customers. For TSs that an LDC cannot provide gross load segmentation for, the IESO and the LDC worked together using best available information and assumptions to derive sectoral gross demand. For example, LDC information found in the OEB's Yearbook of Electricity Distributors[7] was used to help estimate the breakdown of demand. Once sector gross demand at each TS was available, the next step was to estimate peak demand savings for each conservation category: codes and standards, time-of-use rate, and conservation programs. The estimates for each of these categories were done separately due to their unique characteristics and data availability. In general, hourly profiles of IESO's gross forecast and conservation

[7] OEB Yearbook of Electricity Distributors: http://www.ontarioenergyboard.ca/OEB/Industry/Rules+and+Requirements/Reporting+and+Record+Keeping+Requirements/Yearbook+of+Distributors

savings were used to determine the impact that each conservation category has on peak demand. Impacts were estimated for residential, commercial and industrial sectors reflecting that various sectors have different conservation opportunities.

The planning forecast assumes that the targets will be met, and will produce the expected local peak demand impacts. Therefore, an important aspect of plan implementation will be monitoring the actual peak demand impacts of conservation programs delivered by the LDCs.

The table below shows the final estimated conservation peak demand savings, which were applied to the gross demand to create the net forecast for the sub-region.

Table 5-1: Peak Demand Savings from 2013 LTEP Conservation Targets, Select Years

Year	2016	2018	2020	2022	2024	2026	2028	2030	2032	2034
Total East GTA Savings (MW)	33	57	74	92	111	134	154	174	184	185
Sub-region Only Savings (MW)	6	14	24	33	44	55	64	72	77	78

Over the 20-year time period, it is expected that conservation savings for the GTA East planning region will amount to the deferral of one TS the size of Cherrywood TS. For the sub-region the conservations savings over the study period are expected to amount to approximately 40% of the capacity provided by a station similar to Cherrywood TS

Additional conservation forecast details are provided in Appendix A.

5.5 Distributed Generation Assumed in the Forecast

In addition to conservation resources, DG in the Pickering-Ajax-Whitby Sub-region is also anticipated to help offset peak demand requirements at select stations. The introduction of the *Green Energy Act, 2009* and the associated development of Ontario's FIT program, have increased the significance of distributed renewable generation in Ontario. This generation, while intermittent in nature, contributes to meeting the electricity demands of the province.

In developing the planning forecast, after applying the conservation savings to the gross demand forecast as described above, the forecast is further reduced by the expected peak contribution from existing and contracted DG in the area. The effects of projects that were already in-service prior to the base year of the gross demand forecast were not included as they are already embedded in the gross demand forecast which is the starting point for the planning forecast. Potential future DG uptake was not included and is instead considered as an option for meeting identified needs.

Based on the IESO contract list as of August 2015, existing and contracted DG projects are expected to offset an incremental 18 MW of peak demand within the sub-region. The largest project in the sub-region is a renewable biomass generator in Ajax with the capability to generate up to 25 MW, and currently contracted for 18 MW. Other projects in the area are small scale solar projects (<500 kW). Table 5-2 shows the DG by technology that is currently under contract in the sub-region.

Table 5-2: Distributed Generation by Technology in the Pickering-Ajax-Whitby Sub-region

Technology	Contract Capacity [MW]	Capacity Contribution [MW]	Capacity Factor
Solar	2	1	32%
Renewable Biomass	18	17	98%

The capacity contribution for each DG project was calculated by applying a capacity factor based on fuel type to the contracted capacity of each project. The capacity factors used in this study are based on historical data gathered during Ontario's overall system peak.

In the sub-region, all of the DG projects are planned to be connected to Whitby TS to help offset some of the load during peak demand hours. Currently, new DG connection is restricted from connecting to Cherrywood TS due to short circuit ("SC") constraints because of an out-of-service 30 MW landfill gas generation facility. Hydro One is in discussions with the land and facility owner and is seeking legal and regulatory advice on the process for the removal of this allocated capacity. If capacity allocation is removed, the SC restriction can be lifted and new DG can apply to connect to this station.

The following table shows the cumulative DG in the sub-region.

Table 5-3: Cumulative DG used for Planning Forecast

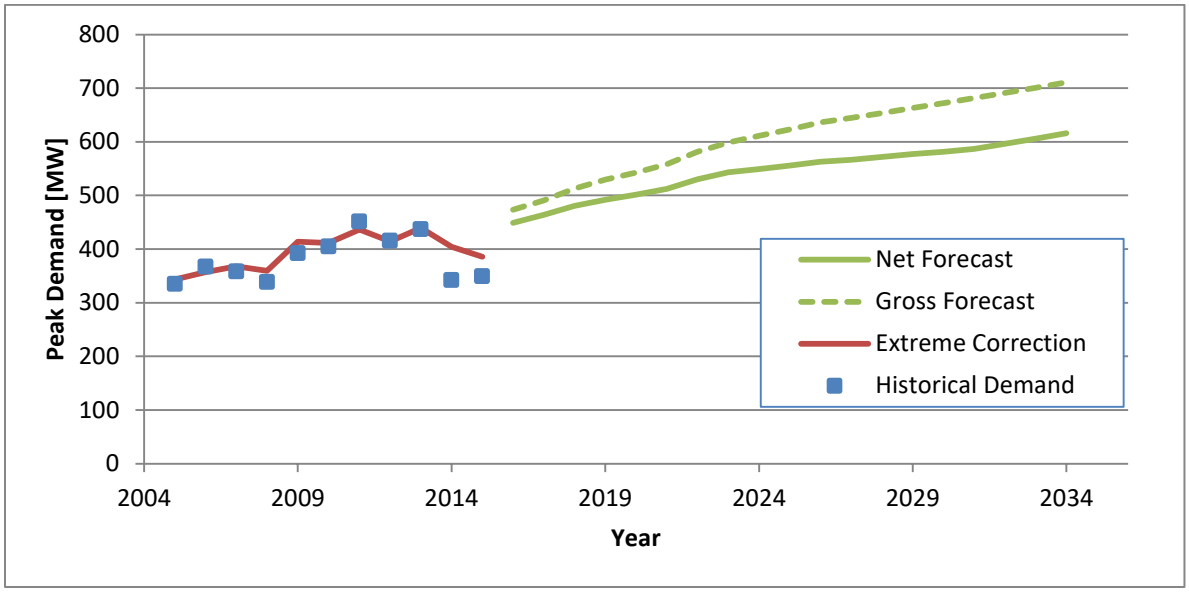
Year	2015	2016	2017	2018	2019	2020	2034
Pickering-Ajax-Whitby [MW]	18	18	18	18	18	18	18

5.6 Planning Forecasts

A 20-year planning forecast was produced based on the LDCs' gross demand forecasts and net of anticipated conservation and DG.

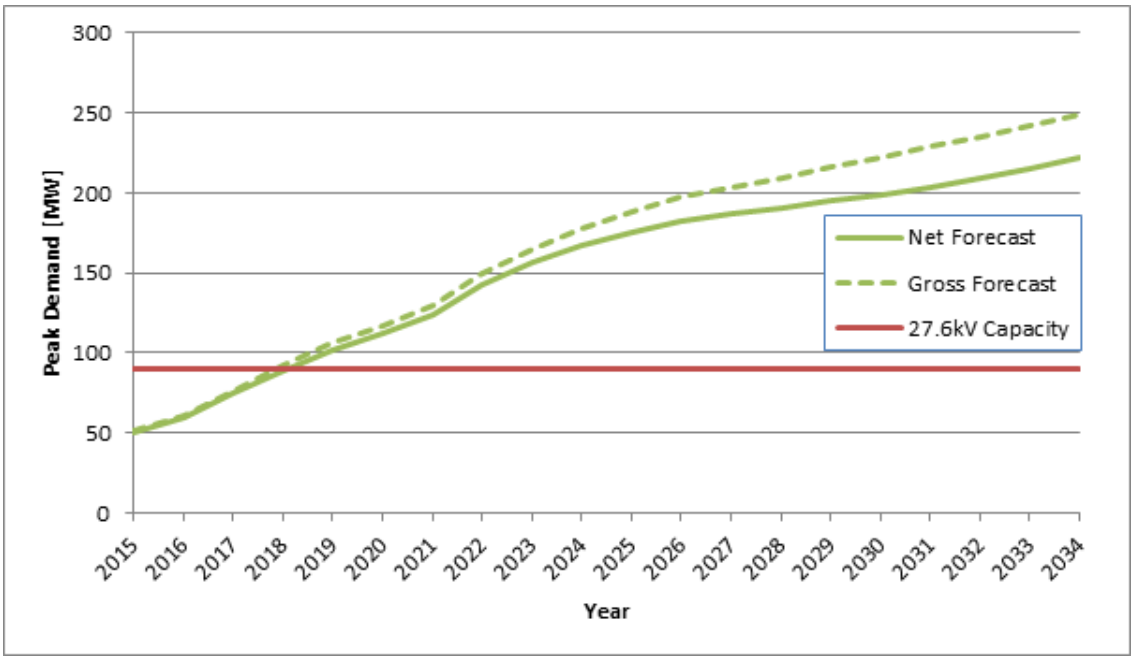
Figure 5-7 illustrates the planning forecast, along with historical demand for the sub-region. The combined effects of DG and conservation are expected to reduce the peak demand in the Pickering-Ajax-Whitby Sub-region by 95 MW by the end of the planning period in 2034. This corresponds to 13% of the overall gross demand in 2034 of 711 MW.

Figure 5-7 Pickering-Ajax-Whitby Sub-region Planning Forecast



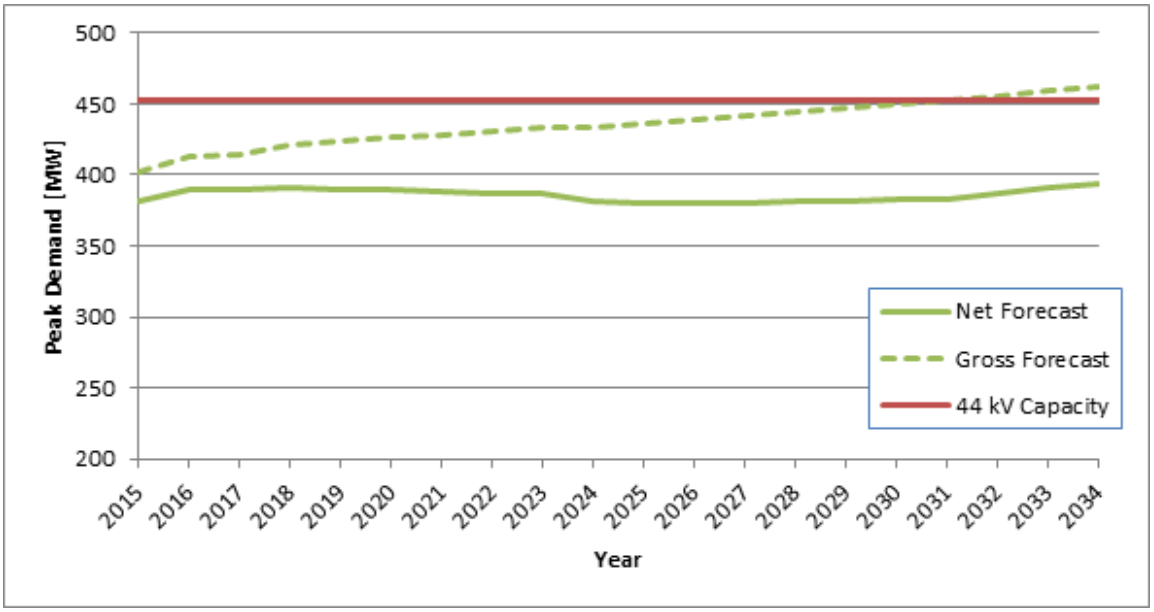
The net 20-year planning forecast for the 27.6 kV load serviced by Whitby TS is shown below in Figure 5-8. By 2034 the combined effects of DG and conservation are expected to decrease the peak demand by 27 MW; this accounts for 11% of the gross demand in 2034.

Figure 5-8 Pickering-Ajax-Whitby Sub-region 27.6 kV Planning Forecast



The net 20-year planning forecast for the 44.0 kV load serviced by Whitby TS and Cherrywood TS is shown in Figure 5-9 below. By 2034 the combined effects of DG and Conservation are expected to decrease the peak demand by 50 MW; these effects account for 15% of the gross demand in 2034.

Figure 5-9 Pickering-Ajax-Whitby Sub-region 44.0 kV Planning Forecast



6. Needs

The Pickering-Ajax-Whitby Sub-region Working Group identified two electricity needs in the near-term, based on the planning forecasts, system capability and application of planning criteria. This section describes the identified needs for the near-term in the sub-region.

6.1 Needs Assessment Methodology

The IESO's ORTAC[8] was applied to assess supply capacity and reliability needs. ORTAC includes criteria related to the assessment of the bulk transmission system, as well as the assessment of local or regional reliability requirements.

The application of these criteria in an area is used to generally identify three broad categories of needs as follows:

- **Transformer Station Capacity** describes the electricity system's ability to deliver power to the local distribution network through the regional transformer stations. This is limited by the 10-day LTR of the step-down transformer stations in the local area. Transformer station capacity need arises when the peak demand at step-down transformer stations in the local area exceeds the combined LTR ratings.
- **Upstream Transmission System Capacity** describes the electricity system's ability to provide continuous supply to a local area. This is limited by the load meeting capability ("LMC") of the transmission line or sub-system and is the maximum demand that can be supplied on a transmission line or sub-system under applicable transmission and generation outage scenarios as prescribed by ORTAC; it is determined through power system simulations analysis (See **Appendix D** for more details). These capacity needs arise when coincident peak demand on a transmission line or sub-system exceeds its LMC.
- **Load Security and Restoration** describes the electricity system's ability to minimize the impacts of potential supply interruptions to customers in the event of a major transmission outage, such as an outage on a double-circuit tower line resulting in the loss of both circuits. Load security describes the amount of load susceptible to supply interruptions in the event of a major transmission outage. Load restoration describes the electricity system's ability to restore power to those affected by a major transmission outage within reasonable timeframes.

[8] http://www.ieso.ca/imoweb/pubs/marketadmin/imo_req_0041_transmissionassessmentcriteria.pdf

6.2 Needs

Two needs were identified in the area which impact the ability to serve local loads:

1. There is a need arising in 2019 for additional 27.6 kV TS capacity to supply new growth.
2. There is a need to conduct detailed analysis to assess the economic justification for addressing a restoration shortfall (MW) that exists in the GTA East Region for rare loss of supply events.

6.2.1 Transformer Station Capacity-27.6 kV

The sub-region is supplied by two stations, Cherrywood TS and Whitby TS. These stations step down the voltage from 230 kV to either the 27.6 kV or 44 kV distribution levels. The Cherrywood TS provides supply at the 44 kV level while Whitby TS provides supply at the 27.6kV and 44 kV levels. Whitby Hydro provides distribution service at the 44 kV level, however Veridian uses both voltage levels to supply its service territory;. Dedicated 27.6 kV feeders from Malvern TS and Sheppard TS also supply the western portion of Veridian's service territory. These two stations are in the eastern part of an adjacent planning region-Metro Toronto.

Figure 6-1 and Figure 6-2 below show the historical and forecast 44 kV peak demand for the study area. Based on the planning forecast, sufficient 44 kV capacity exists to supply current and forecast 44 kV demand in the area until the end of the study period.

Figure 6-1: Planning Forecast for Cherrywood TS 44.0 kV

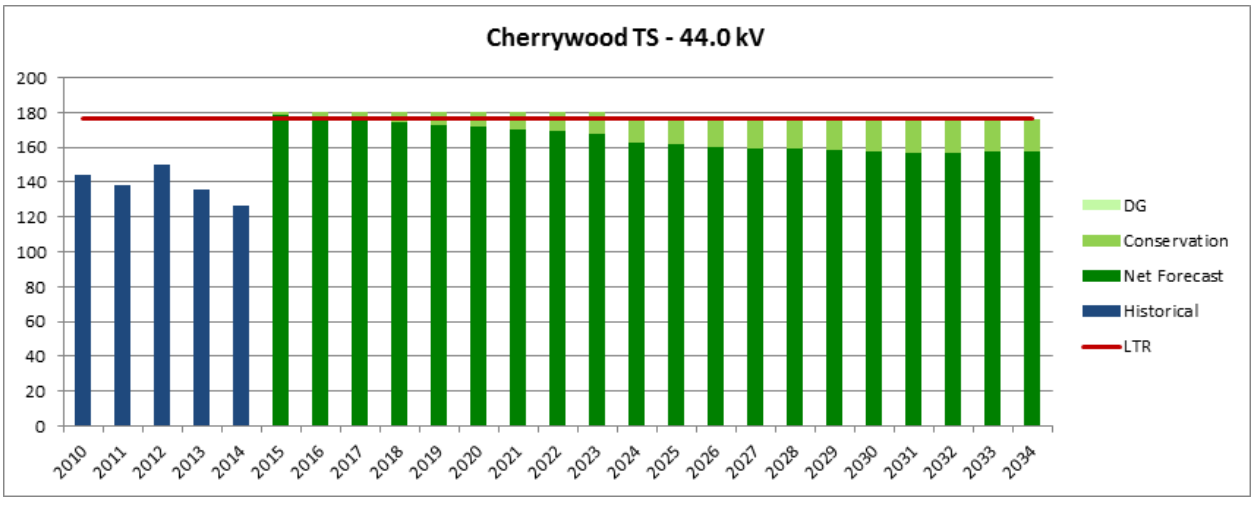


Figure 6-2: Planning Forecast for Whitby TS 44.0 kV

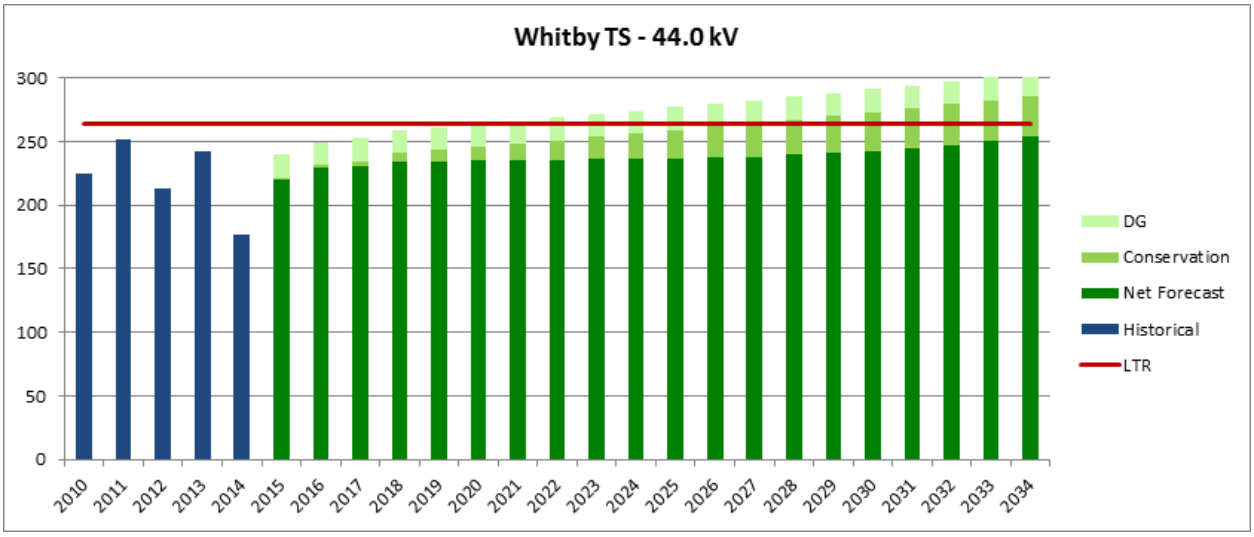
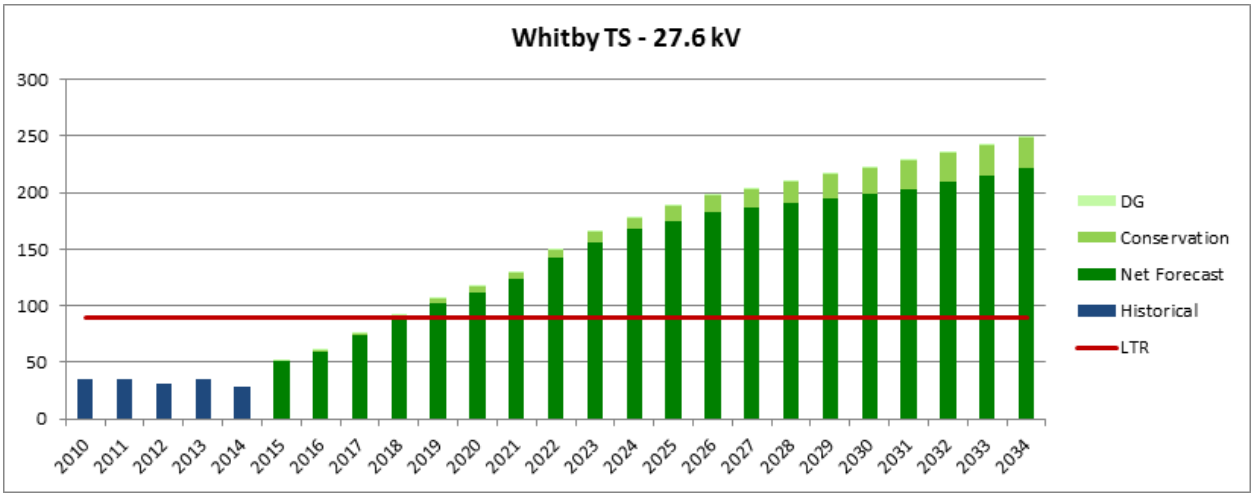


Figure 6-3 below shows the planning forecast for the 27.6 kV demand in the study area. The 27.6 kV demand in the study area is expected to exceed available capacity by 2019.

Figure 6-3: Planning Forecast for Whitby TS 27.6 kV



The 10 year forecast for 27.6 kV demand for the sub-region is shown in Table 6-1 below, with figures shown in red indicating demand levels that exceed the 90 MW transformation capacity limit for the 27.6 kV bus.:

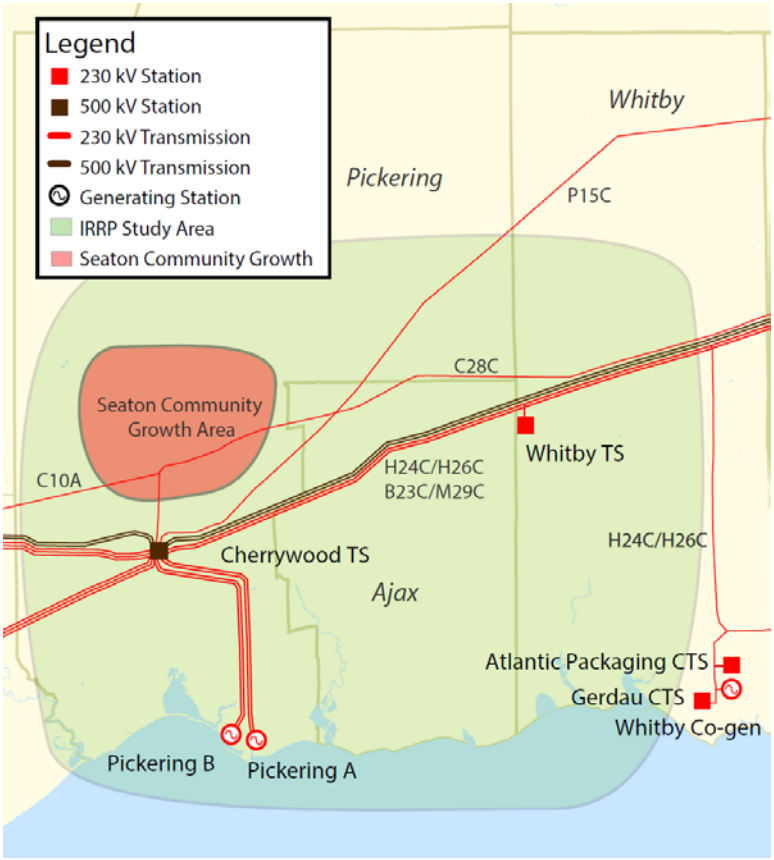
Table 6-1: Sub-region 27.6 kV Planning Forecast from 2015 to 2024

BY bus LTR (MW)	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
90	51	60	74	89	102	112	124	143	156	167

The new community of Seaton in North Pickering accounts for more than 60% of the total 27.6 kV demand by 2034, influencing a transformation capacity shortfall of approximately 12 MW in 2019 and up to 132 MW in 2034.

The location of the greenfield growth due to Seaton relative to the other infrastructure facilities in the area is shown in the figure below (in red). The community of Seaton is just north of Cherrywood TS and west of Whitby TS.

Figure 6-4: Location of Seaton in the Study Area



Source: Data provided by Hydro One Networks Inc. Copyright: Hydro One Networks Inc. [2016].

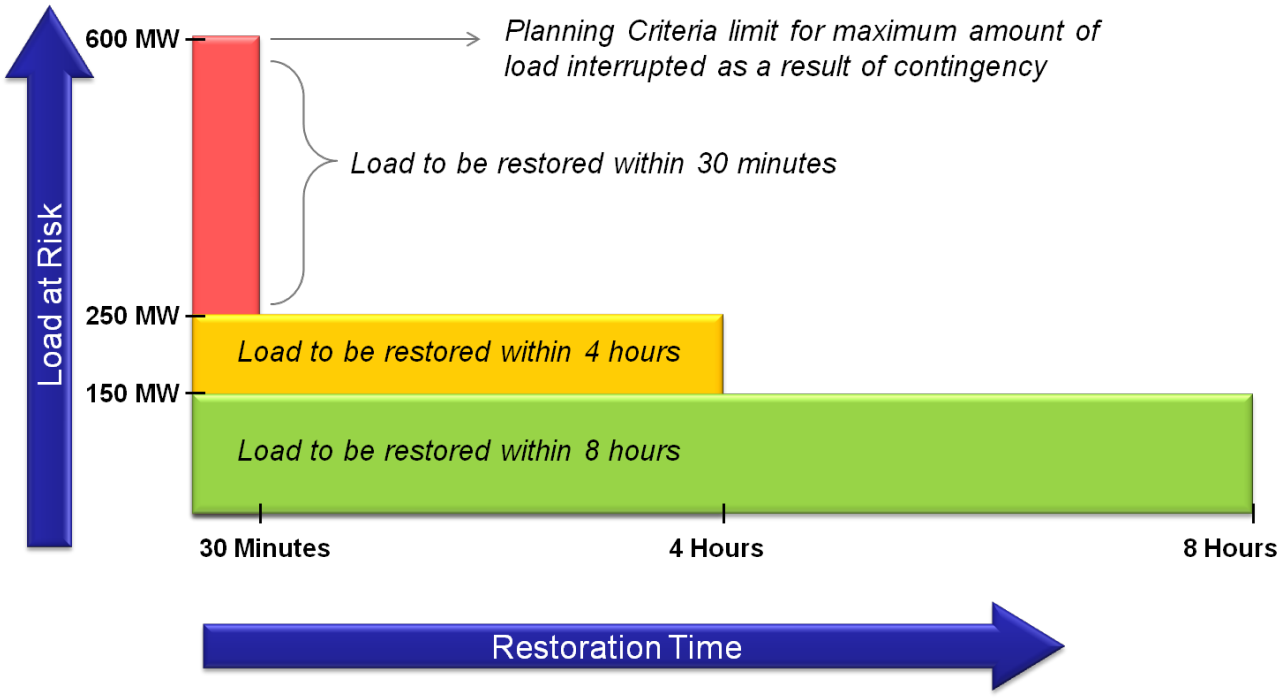
Additional 27.6 kV capacity is required for the sub-region to meet forecast 27.6 kV demand.

6.2.2 Load Restoration

Restoration refers to the ability of the system to restore sufficient amount of load within defined periods of time following the prolonged loss of a major supply source from the transmission system.

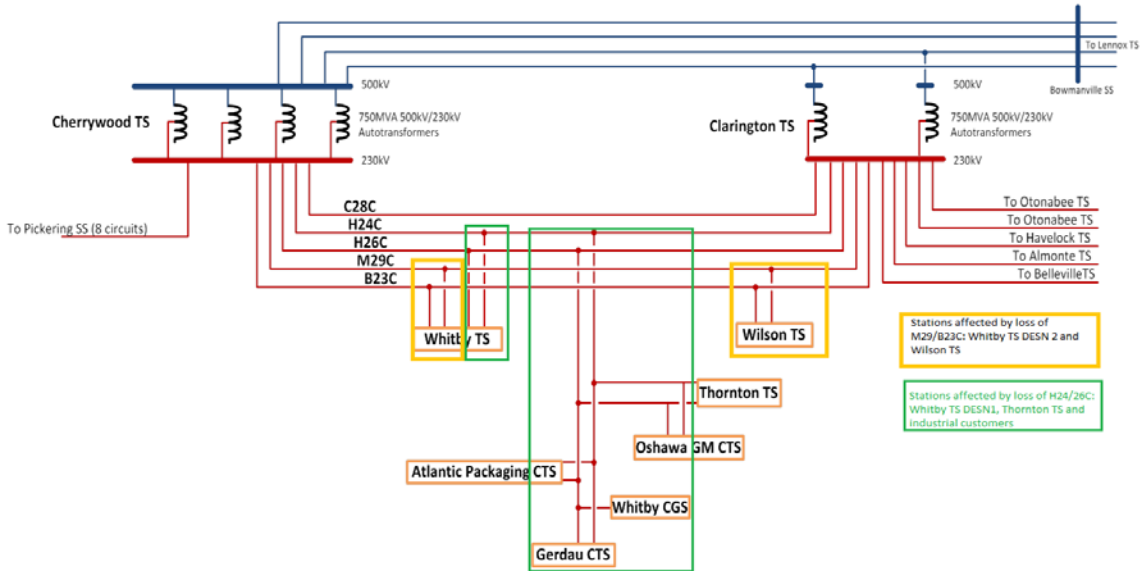
The group of stations and customers supplied from the H24/26C and M29/B23C circuits within the GTA East Region have been identified as being at risk of not meeting restoration levels as defined in ORTAC. ORTAC indicates that, for the loss of two elements, any load in excess of 250 MW should be restored within 30 minutes and any load in excess of 150 MW should be restored within 4 hours. The assessment must also consider restoration of all loads within 8 hours. These restoration levels are summarized in Figure 6-5 below.

Figure 6-5: ORTAC Load Restoration Criteria



The figure below shows the stations and customers served by each of the circuit pairs of H24/26C and M29/B23C.

Figure 6-6: Restoration Pocket for H24/26C and M29/B23C



Source: Hydro One Networks Inc. [2016].

As shown in Figure 6-6 , Whitby TS DESN 1 and the Oshawa radial pocket that includes direct connect customers and Thornton TS are served by the same circuits H24/26C, meaning both are at risk of supply interruption following the simultaneous loss of the pair of circuits. The industrial loads or direct connect customers account for 153 MW of the load supplied by the H24/26C circuits. These industrial loads cannot be restored by the LDCs in the event of an outage as these customers are connected directly to the transmission system.

For the simultaneous loss of the other pair of circuits M29/B23C, the stations Whitby DESN2 and Wilson TS are at risk of supply interruptions.

Table 6-2 below shows the total peak load at risk of interruption for select years, and the 30 minute and 4 hour restoration capability required to meet this criteria for both outages:

Table 6-2: Peak Load at Risk of Interruption for Select Years

Load Pocket	2015 Peak (MW)					2025 Net (MW)				
	Actual Demand	30-Min Restoration	30-Min Restoration Shortfall	4-Hour Restoration	4-Hour Restoration Shortfall	Forecast	30-Min Restoration	30-Min Restoration Shortfal	4-Hour Restoration	4-Hour Restoration Shortfall
M29/B23: Whitby TS DESN2, Wilson TS	436	105	81	257	29	504	105	149	257	97
H24/H26: Including Transmission Connected Customers	356	57	49	142	64	567	57	259	142	275

It is assumed that given the proximity of emergency crews and equipment, all loads would be restored within 8 hours through conventional transmission supply.

Based on discussions with area LDCs, up to 105 MW can be restored through distribution transfers within 30 minutes under the current supply arrangement and 257 MW within 4 hours for customers supplied off the M29/B23C circuits. This leaves a maximum 2015 shortfall of 81 MW after 30 minutes, and 29 MW after 4 hours.

Similarly, for the H24/26C circuits, up to 57 MW can be restored through distribution transfers within 30 minutes under the current supply arrangement and 142 MW within 4 hours for customers supplied off these circuits. This leaves a maximum 2015 shortfall of 49 MW after 30 minutes, and 64 MW after 4 hours.

After taking into account the load transfer capability of LDCs in the area, ORTAC restoration timelines and load levels are currently not met for the 30 minute and 4 hour criteria for both pairs of circuits. According to ORTAC[9], where a restoration need is identified, "transmission customers and transmitters can consider each case separately taking into account the probability of the contingency, frequency of occurrence, length of repair time, the extent of hardship caused and cost. The transmission customer and transmitter may agree on higher or lower levels of reliability for technical, economic, safety and environmental reasons provided the bulk power system adheres to NERC and NPCC standards". For the GTA East Region,

[9] ORTAC Section 7.4 Application of Restoration Criteria - http://www.ieso.ca/documents/marketAdmin/IMO_REQ_0041_TransmissionAssessmentCriteria.pdf

there is a need to assess the economic justification for addressing the restoration shortfall for the 30 minute and 4 hour timelines.

6.3 Needs Summary

Two near-term needs have been identified in the study area, and are summarized in Table 6-3 below.

Table 6-3: Summary of Needs in Pickering-Ajax-Whitby Sub-region

Area	Need	Description	Need Date
North Pickering	Transformation Capacity	Need for additional 27.6 kV transformation capacity to supply growth	2019
GTA East Region	Restoration	Need to conducted analysis to assess the economic justification for addressing the restoration shortfall for the 30 minute and 4 hour timelines	Now

7. Near-Term Plan

This section describes the alternatives considered in developing the near-term plan for the Pickering-Ajax-Whitby Sub-region, provides details of and the rationale for the recommended plan, and outlines an implementation plan. The capacity and restoration needs identified above are discussed in separate sections below.

7.1 Alternatives for Meeting the Near-Term Transformation Capacity Need

In developing the near-term plan for the capacity need in the sub-region, the Working Group considered a range of integrated options. The Working Group specifically considered technical feasibility, cost and consistency with longer-term needs and priorities in the sub-region when evaluating alternatives. Solutions that maximize the use of existing infrastructure were also given priority, where they were determined to be cost effective.

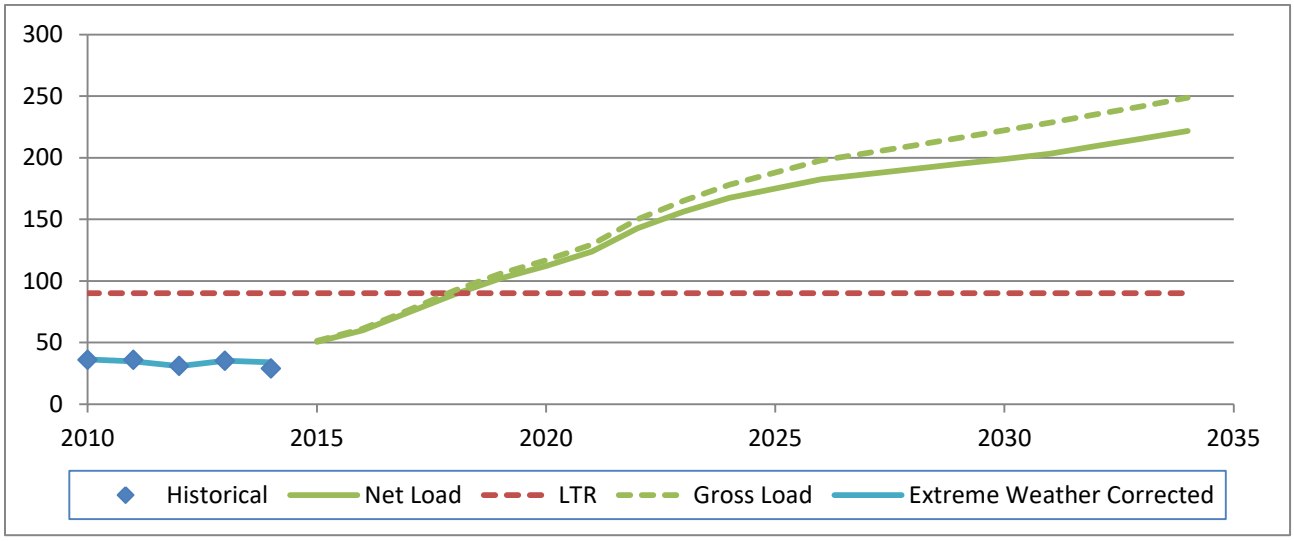
As mentioned previously, the transformation capacity need in the sub-region is mainly influenced by the forecast demand from the Greenfield development of Seaton in north Pickering. This development is being planned for residential capacity for up to 70,000 people and 35,000 jobs. Veridian is also planning to supply this community via 27.6 kV supply.

The following sections detail the alternatives considered. The alternatives are grouped according to three major solution categories: (1) conservation, (2) local generation and (3) transmission and distribution.

7.1.1 Conservation

Conservation was considered as part of the planning forecast, which includes the local peak-demand effects of the provincial conservation targets. Achieving the estimated peak demand reductions associated with the provincial conservation targets does not, however, result in deferring any of the near-term capacity needs. Achieving these conservation targets does however significantly reduce the magnitude of the 27.6 kV transformation capacity required over the long term by 27 MW, from 249 MW to 222 MW by 2034. It also effectively offsets new demand growth at Whitby TS (the only station providing supply at the 27.6 kV level in the sub-region) until 2034. The Whitby TS 27.6 kV load under both the gross and planning load forecasts is shown in Figure 7-1.

Figure 7-1: Effect of Conservation Targets on 27.6 kV Demand in the Sub-region



As explained in Section 5.4 provincial conservation targets are achieved over an entire year, while transmission needs are triggered by peak demand (single highest observation in a year). As a result, in order to reduce, defer, or address transmission capacity needs, conservation programs must have an impact during the hour of peak demand. In the case of this study area this typically means late afternoon on the hottest weekdays of summer.

The peak demand impact shown in the planning forecast represents the Working Group's estimate of how meeting the sub-region's allocation of provincial energy targets will translate into peak demand reductions. There is uncertainty in this estimate, arising both from whether the sub-region is able to meet provincial energy conservation targets and how energy conservation, in fact, translates to corresponding peak demand reductions. As a result, there is a wide range of demand impacts which could be experienced (both higher and lower than forecast).However, higher or lower demand impacts due to conservation achievement are not a significant factor in this sub-region, because 60% of the capacity need is due to greenfield growth in the new community of Seaton. Without this Greenfield growth, it is expected that there would be sufficient 27.6 kV capacity until the end of study period with the achievement of conservation targets for the localized 27.6 kV electrical demand.

7.1.2 Generation

Since the need for LMC in this area stems from residential growth served at the 27.6 kV voltage level, transmission-connected bulk generation is not a viable option. Also, the new Seaton load requires transmission/distribution infrastructure to connect to the existing grid; therefore a bulk generation solution would not avoid the above infrastructure investment.

Standalone local generation could theoretically supply the new community without the need for grid connection; however, without the diverse pool of system resources, the standalone approach would require implementing a portfolio of community based resources, including different types of generation, storage, demand management, transmission, and distribution to meet area needs (capacity, energy, operability) over the entire study period. In order to match the same level of service provided to a grid-connected system and maintain reliable supply to the community, a margin above the base generation requirements is needed to cover planned and forced generation outages. Based on the IESO's understanding of electricity service for the 25 Remote Communities (northern off-grid communities) in Ontario, it is assumed that for a standalone DG option for the Seaton community capacity redundancy would need to be approximately 130% of net-peak demand to provide reliable electricity service in the event of planned or forced generation outages.

The level of local distribution investment required to enable both the standalone option and grid-connected option would be similar in terms of design characteristics and cost. Assuming the standalone portfolio would be a mix of local natural gas generation, renewable generation, and storage, the cost associated with this approach is estimated to be at least three times that of the grid-connected option.

Local small scale generation solutions are better suited to areas with existing wires infrastructure and small incremental resource needs. The potential role of DG to manage long-term growth in the overall study area will be reviewed as part of future regional planning cycles.

7.1.3 Transmission and Distribution

As discussed in the previous sections additional conservation and generation are not feasible options to meet the near-term needs. In parallel with assessing these options, the Working Group developed transmission and distribution options to address the transformation capacity need.

These options provide new or upgraded transmission or distribution system assets, including lines, stations, feeders and related equipment. Solutions of this nature are characterized by high upfront capital costs, but have high reliability over the lifetime of the asset and enable the economic delivery of the incremental capacity and energy requirements from the provincial power system.

As noted previously, Veridian and Hydro One have been monitoring the need for station capacity in this area and given the lead times for development of a new step-down transformer station have initiated EA work for three potential sites to supply the community of Seaton. The preferred site will be determined by this EA process which is currently underway, with results expected in Q1 2017. A new station at any of the three sites will also require an upgrade to the associated 230 kV connecting circuits in the area in order to connect the station to the transmission system; this transmission line upgrade is a necessary feature of all the station alternatives discussed below. For the transformation capacity need, utilization of available station and feeder capacity from proximal stations outside the GTA East Region was also considered as part of the transmission and distribution set of options. Figure 7-2 below shows the relative locations of the infrastructure considered in the alternatives described below.

Figure 7-2: Proposed Station Sites and Related Infrastructure

Source: Data provided by Hydro One Networks Inc.

The alternatives to meet the transformation capacity need can be found in the Appendix B, and are summarized below. There are two main wires solutions that are suitable for addressing the need: 1. Build new feeders from existing stations, which have available capacity, followed by construction of a new step-down station, once the available capacity is utilized, or 2. Build a new step-down station near the load centre by 2019.

1. Build new 27.6 kV feeders from existing stations followed by a new 230 kV to 27.6 kV step-down station and associated 230 kV transmission line reinforcement at the proposed station sites.

Malvern TS and Sheppard TS already provide 27.6 kV supply to Veridian territory and also have a total of 85 MW of surplus 27.6 kV capacity available until the end of the study period. Combinations of building new feeders from these two stations to the Seaton load centre by 2019

were considered, followed by building a new step-down station and associated 230 kV transmission line reinforcement(see reference to three sites below) in order to meet the remaining capacity need.

2. Build a new 230 kV to 27.6 kV step-down transformer station near the Seaton load centre, with associated 230 kV transmission line reinforcement, by 2019. Three sites for the station are being considered within the EA.

Based on a net present value cost comparison, building a new station at Sites 1 or 2 was determined to be the most economic alternative, as shown below.

Table 7-1: Net Present Value of Alternatives

Alternatives	2016 $M
1. Use Malvern TS capacity and then build Seaton TS at Site 1 or 2	93-109
2. Use Malvern TS capacity and build Seaton TS as Site 3 and associated feeders	104-119
3. Use Sheppard TS capacity and then build Seaton TS-1 or 2	73-84
4. Use Sheppard TS capacity and then build Seaton TS-3 and associated feeders	91-102
5. Use Sheppard TS capacity, then use Malvern TS capacity, then build Seaton TS-1 or 2	105-124
6. Use Sheppard TS capacity, then use Malvern TS capacity, then build Seaton TS-3 and associated feeders	113-130
7 Build Seaton TS-1 or 2	60-68
8 Build Seaton TS-3 and associated feeders	94-108

Building a new step-down station at Sites 1 or 2 is the most cost-effective option[10] for meeting the 27.6 kV transformation capacity need in the sub-region. The EA, which is currently underway, will determine the preferred station site. The EA results are expected in Q1 2017.

Should Site 3 be selected through the EA process more detailed technical and economic analysis[11] is require to determine if a new station should be built only versus building feeders from the Malvern or Sheppard stations followed by a new station.

The detailed economic assumptions and methodology used to assess the options are detailed in Appendix B.

7.2 Alternatives for Meeting the Near-Term Restoration Need for the Region

The other major need identified in the area is the shortfall in meeting restoration timelines following the coincident loss of two transmission circuits to the GTA East Region. Although the IRRP is for the sub-region, the restoration analysis considers the entire GTA East Region, because the loss of two circuits impacts supply to the entire GTA East Region. This was acknowledged by the regional participants during the scoping phase of the regional planning process for the GTA East Region. The restoration analysis considers the loss of a pair of 230 kV circuit in the area, either H24/26C or M29/B23C, and the ability to restore load within the ORTAC prescribed timelines.

7.2.1 Conservation

Meeting restoration criteria requires that the faulted elements (line sections) be isolated, such that customer electrical demand can be restored from a reliable line section or an alternate source. Conservation is not a feasible option for addressing these types of needs.

7.2.2 Generation

Generation was ruled out as a feasible option to address restoration needs in the GTA East Region from both a technical and economic perspective, given the number of facilities that would be required and given the surplus generation capacity available in the province.

[10] See Appendix B for details on proposed station Site 3

[11] Further analysis is recommended due to the similar range of costs of the two alternatives-Station at Site 3 or Building feeders from existing stations followed by a station at Site 3

Approximately 93 MW of supply would be required today and 372 MW by 2025 in order to provide back-up in the event of a four hour outage on all four circuits.

Large generation is not a suitable option for addressing restoration needs because multiple facilities are needed in order to address loss of supply along the various line segments. Additionally, these facilities would need to have black start and islanded operation capabilities, a costly generation and system design feature.

Using smaller scale DG was also determined to be infeasible for the same technical and economic reasons as noted above. In order to provide restoration, each of these facilities would also have to be able to supply their local loads in islanded mode. Some high value loads (such as pumping and water purification facilities) are typically developed with onsite gas or diesel generation to ensure they can continue to operate during a power supply outage. While there is benefit to building this type of supply redundancy to ensure restoration capability for some loads, it is impractical on a larger scale to address regional restoration needs.

7.2.3 Transmission and Distribution

Since additional conservation and generation are not feasible options to meet the restoration shortfall, the Working Group considered transmission and distribution options. According to ORTAC[12], where a restoration need is identified, "transmission customers and transmitters can consider each case separately taking into account the probability of the contingency, frequency of occurrence, length of repair time, the extent of hardship caused and cost". Additionally, these parties may also agree on higher or lower levels of reliability for technical, economic, safety and environmental reasons. A preliminary assessment was undertaken to determine high level costs and benefits of transmission and/or distribution options giving consideration to the factors outlined in ORTAC. In carrying out this assessment, the Working Group took into account that many jurisdictions justify costs of this nature by comparing the cost to customers of supply interruption for the low probability/high impact events to the cost of mitigation. These jurisdictions: 1. assess the probability of the failure event occurring; 2. estimate the expected magnitude and duration of outages to customers served by the supply lines; 3. monetize the cost of a supply interruption to the affected customers; and 4. determine the cost of solutions and their impact on supply interruptions to the affected customers. If the cost of meeting the

[12] ORTAC Section 7.4 Application of Restoration Criteria - http://www.ieso.ca/documents/marketAdmin/IMO_REQ_0041_TransmissionAssessmentCriteria.pdf

security and restoration criteria exceeds the expected cost of customer supply interruptions, then it is not considered cost-justified.

The Working Group undertook a preliminary costs/benefit analysis (Appendix C) and concluded that there may be value in mitigating these restoration shortfalls. However a more detailed analysis is required to establish specific solutions and determine if these are cost justified. The GTA East regional participants recommended that this further restoration analysis and recommendations be conducted as part of the RIP to be led by Hydro One in collaboration with the affected LDCs and IESO.

7.3 Recommended Near-Term Plan

The Working Group recommends the actions described below to meet the near-term transformation capacity need in the sub-region, and the restoration need identified for the GTA East Region. Successful implementation of this plan will address the region's electricity needs until the end of the study period in year 2034.

1. Build a new 230/27.6 kV (75/125MVA) step-down station in 2018 and associated circuit upgrade to the new community of Seaton.
2. Undertake detailed restoration analysis and recommend next steps as part of the RIP for the GTA East Region.

7.4 Implementation of Near-Term Plan

To ensure that the near-term electricity needs of the Pickering-Ajax-Whitby Sub-region are addressed, it is important that the near-term plan recommendations be implemented in a timely manner. The specific actions and deliverables associated with the near-term plan are outlined in Table 7-2, along with recommended timing for implementation.

The Pickering-Ajax-Whitby Sub-region Working Group will continue to meet at regular intervals as this IRRP is implemented to monitor developments in the sub-region and to track progress.

Table 7-2: Summary of Needs and Associated Recommendations in the Pickering-Ajax-Whitby Sub-region

Area	Need	Recommendation	Implementation Date
North Pickering	Transformation Capacity	Build a new 230/27.6 kV (175/25MVA) step-down station in 2018 and associated circuit upgrade to provide supply by 2019 to the new community of Seaton.	Veridian and Hydro One to start work on implementing the station and line work as soon as possible
GTA East	Restoration	Undertake further restoration analysis and recommend next steps as part of the RIP for the GTA East Region.	Q3 2016

Veridian and Hydro One are pursuing a combined EA for the proposed station sites and related 230 kV line work. The assessment will determine the preferred site. It is expected to be completed by Q1 2017. Based on the anticipated needs and lead time required for approvals and construction, it is recommended that Veridian complete all work required for implementation of Seaton MTS as soon as possible.

The RIP should be initiated for the GTA East Region upon completion of the IRRP.

The IESO has committed to working with the affected parties to assist with any approval requirements associated with this IRRP.

8. Long-Term Plan

Given the uncertainty in forecasting demand beyond a 10-year timeline, the purpose of the long-term plan is to consider alternate potential demand scenarios in order to facilitate discussions about how the sub-region may need to plan its future electricity supply and to lay the groundwork for the next regional planning cycle. This section describes potential long-term needs, approaches to addressing these needs, and recommended actions.

With the implementation of the proposed new step-down station in North Pickering, the local electricity infrastructure is expected to be capable of reliably supplying the forecast growth in the sub-region over the next two decades. As a result, longer term planning initiatives will focus on monitoring developments associated with factors that could affect longer term electrical service plans for this area. This includes monitoring progress on conservation efforts at the transformer station level.

One of the potential longer term needs identified through discussion with area LDCs is growth in electrical demand exceeding the capacity of existing transmission and distribution infrastructure serving the established areas of Pickering-Ajax-Whitby, including in the lakeshore area. Reviews and updates of Official Plans in this sub-region are expected in the near future. Similar to past Official Plans[13] for the City of Pickering, the lakeshore area is expected to continue to experience intensification through development of high rise multi-unit residential and commercial buildings. Given that this area is south of a major highway-the 401 and approximately 5 km from Cherrywood TS and more than 10 km from Whitby TS, this intensification could drive the need for a new step-down transformer station closer to future growth areas. This new step-down transformer station could be supplied by the transmission lines currently dedicated to delivering bulk power from Pickering GS. When the generation facilities at Pickering GS begin retiring and plans for the site become clearer over the next few years, these transmission lines could be repurposed and used to reliably supply longer term local development.

The provincial growth plan is under review and is expected in late 2016. The plan is expected to consider growth scenarios up to the year 2040. Municipal reviews of growth plans including that of Pickering, Ajax and Whitby will follow the release of the provincial plan and potentially have an impact on the longer term electrical supply for this sub-region. Other initiatives that

[13] https://www.pickering.ca/en/cityhall/resources/op6.pdf

could impact future electricity use are the City of Pickering's corporate energy management plan, the Town of Whitby's sustainability plan and the renewable energy and energy conservation policies in the Town of Ajax Official Plan. Additionally, the upcoming Durham Region Community and Municipal Energy Plans and the projects and initiatives identified by the GTA East Local Advisory Committee could also impact future electricity use. These initiatives will be monitored over the long term (see Section 9).

On a regional and provincial basis, the province's new climate change action plan and the new LTEP is expected to have a significant electrical demand impact through encouraging the electrification of customer end uses and transportation. For instance, the new rail maintenance facility in Whitby is expected to require an incremental demand of 30 MW by 2018 from the regional supply. Such demand requirements are expected to be more frequent in the future as regional transit continues to expand and electrify.

Switching from carbon based fuel sources to electricity to meet provincial or municipal environmental goals are also a factor that could impact the capacity of the existing transmission and distribution systems servicing these developed areas in the longer term.

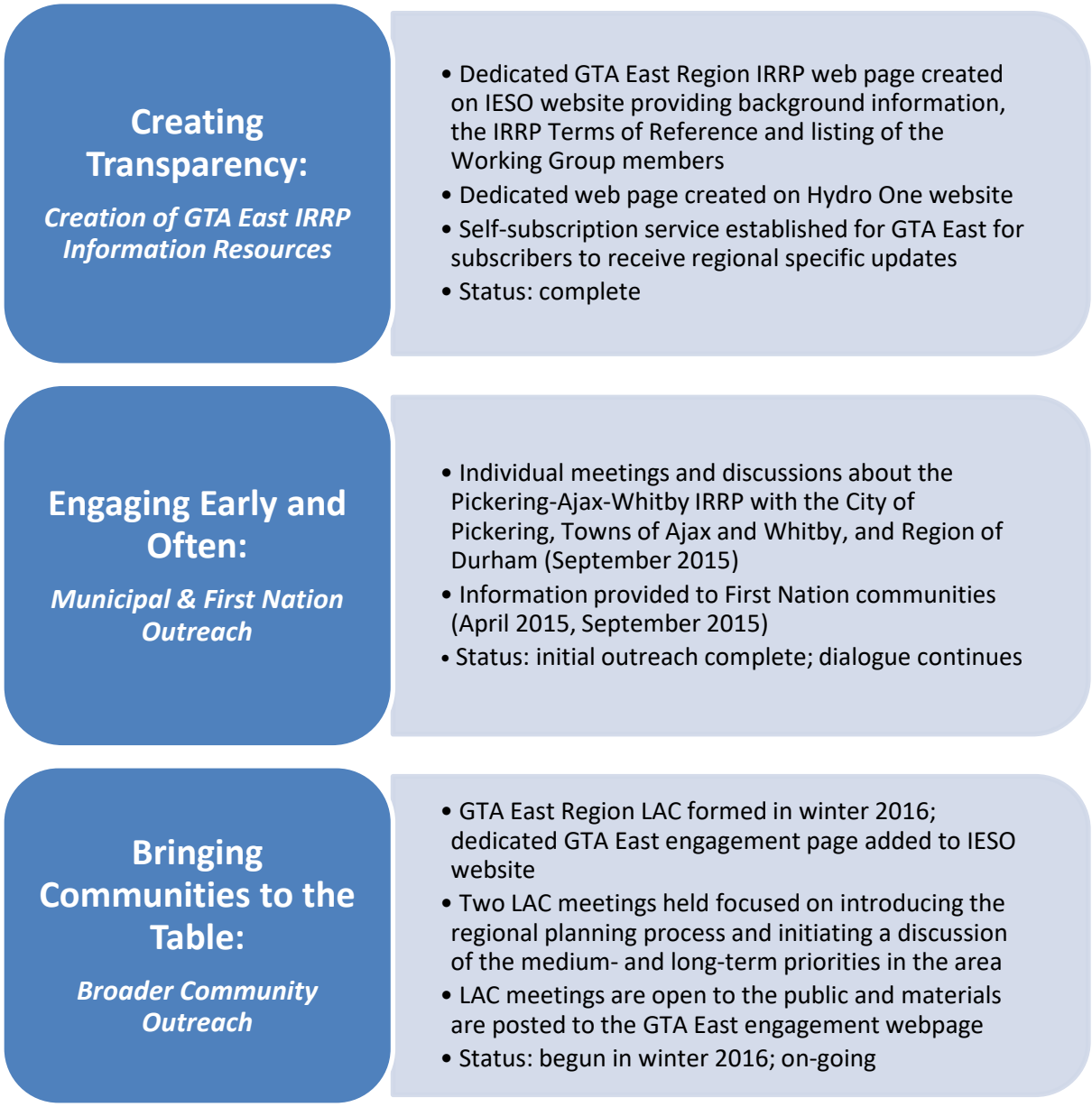
Monitoring of growth in electricity demand and the achievement of conservation and DG targets in the sub-region will be the key components of ongoing electricity planning in this sub-region and the supply situation will be reviewed in subsequent regional planning studies.

9. Community, Aboriginal and Stakeholder Engagement

Community engagement is an important aspect of the regional planning process. Providing opportunities for input in the regional planning process enables the views and preferences of the communities to be considered in the development of the plan, and helps lay the foundation for successful implementation. This section outlines the engagement principles as well as the engagement activities undertaken to date for the Pickering-Ajax-Whitby IRRP and those that will continue to take place to discuss the medium and long-term priorities and initiatives identified by the Local Advisory Committee ("LAC" or "Committee").

A phased community engagement approach was undertaken for the Pickering-Ajax-Whitby IRRP based on the core principles of creating transparency, engaging early and often, and bringing communities to the table. These principles were established as a result of the IESO's outreach with Ontarians in 2013 to determine how to improve the regional planning and siting process, and they now guide IRRP outreach with communities and will ensure this dialogue continues as the plan moves forward.

Figure 9-1: Summary of the Pickering-Ajax-Whitby Sub-region IRRP Community Engagement Process



Creating Transparency

To start the dialogue on the Pickering-Ajax-Whitby IRRP and build transparency in the planning process, a number of information resources were created for the plan. A dedicated web page[14] was created on the IESO website including a map of the regional planning area,

[14] http://www.ieso.ca/Pages/Ontario%27s-Power-System/Regional-Planning/GTA-East/default.aspx

information on why an IRRP was being developed for the Pickering-Ajax-Whitby Sub-region, the IRRP Terms of Reference and a listing of the organizations involved. A dedicated email subscription service was also established for the GTA East planning region where communities and stakeholders could subscribe to receive email updates about the IRRP.

Engaging Early and Often

The first step in the engagement of the GTA East Region IRRP was to provide information to the municipalities and First Nation communities in the planning area.

In September 2015 individual meetings were held with municipal representatives from the City of Pickering, Towns of Ajax and Whitby and Region of Durham. Key topics of discussion included growth trends, discussion of the near-term needs in the sub-region, a review of the identified near-term projects including those that have already begun due to timing requirements, and a discussion of the possible approaches that can be used to address medium- and long-term needs in regional planning. The regional plan was also discussed in the context of the bulk electricity system in the area, more specifically the upcoming closure of the Pickering Nuclear Generating Station ("NGS") , the refurbishment of the Darlington NGS and the construction of the Clarington TS. The presentations and information were well received and formed the foundation for the broader engagement in the development of the Pickering-Ajax-Whitby Sub-region IRRP.

The IESO continues to work with First Nation communities to arrange a joint information session with all Williams Treaty communities and to jointly develop a plan for their engagement in this and other IRRPs moving forward. It is expected that the session will be held in the summer of 2016.

Bringing Communities to the Table

To continue the dialogue on regional planning, a LAC was established for the GTA East Region in winter 2016. The role of a LAC is to provide advice on the development of the regional plan as well as to provide input on broader community engagement. LACs are generally comprised of municipal, Indigenous, environmental, business, sustainability and community representatives. All LAC meetings are open to the public and meeting information is posted on the dedicated engagement webpage, which in this case is the IESO's GTA East engagement web page[15].

[15] http://www.ieso.ca/Pages/Ontario's-Power-System/Regional-Planning/GTA-East/default.aspx

Development of the GTA East LAC was completed through a request for nominations process promoted by the following activities: advertisements in nine local newspapers across Durham Region; localized digital advertising on The Weather Network for a two-week period and promotions through facebook and Twitter; emails sent to municipal representatives across GTA East Region; an e-blast sent to the IESO's GTA East subscribers list which includes over 700 subscribers; and inclusion of the call for nominations in the IESO's weekly Information Bulletin.

Two meetings of the GTA East LAC were held on March 10 and May 4, 2016. At the first LAC meeting, an overview of the regional planning process was presented to the Committee, along with information on the bulk level planning in the area. The Committee was also provided information on the two near-term needs in the Pickering-Ajax-Whitby Sub-region, these being: capacity needs in North Pickering and restoration needs across the entire GTA East Region. Due to the timing of the capacity needs, the Committee was informed that Veridian and Hydro One had already begun the EA process for a new TS and upgraded line in order for these critical pieces of infrastructure to be in-service by their need date of 2019. For the restoration needs, the Committee was presented with an overview of this need and promised additional information at the second LAC meeting once the Working Group undertook additional analysis.

The second meeting of the LAC included an update on the restoration work undertaken by the Working Group and a brainstorming session about the medium- and long-term priorities. For the restoration work, Committee members were informed that, due to the complexity of the required analysis, a Hydro One-led RIP subsequent to the completion of the IRRP will further develop the restoration analysis. For the medium- and long-term priorities, several questions were also posed to the Committee members to generate a group discussion on long-term growth projections and community priorities for inclusion in the plan. This meeting was followed by a two-week comment period for LAC members to provide additional information to inform the long-term portion of the plan. A summary of this discussion and feedback can be found in Appendix D along with the meeting summaries from the GTA East LAC meetings.

Moving forward, engagement will continue on both the near-term projects and the IRRP. For the transformer station and replacement line to meet near-term needs in north Pickering, Veridian and Hydro One will undertake engagement as part of the EA process. For the Pickering-Ajax-Whitby IRRP, the GTA East LAC will be provided with a presentation of the final plan and if requested by LAC members an additional LAC meeting will be held in the fall of 2016 to discuss next steps in the continued development of the long-term priorities.

The IESO is committed to undertaking early and sustained engagement to enhance regional electricity planning. Further information on the IESO's regional planning processes is available on the IESO website[16]. Additional information on outreach activities for the Pickering-Ajax-Whitby IRRP can be found on the GTA East webpage and updates will continue to be sent to all GTA East subscribers.

[16] http://www.ieso.ca/Pages/Participate/Regional-Planning/default.aspx

10. Conclusion

This report documents the IRRP that has been carried out for Pickering-Ajax-Whitby Sub-region. The IRRP identifies electricity needs in the sub-region over the 20-year period from 2015 to 2034, recommends a plan to address near-term needs and identifies actions to monitor long-term developments.

The step-down station solution recommended to meet the near-term need for 27.6 kV transformation capacity in the sub-region is already underway. Veridian and Hydro One have submitted a combined application for an EA of proposed station sites and related 230 kV line work. Results of the EA that is currently underway will determine the preferred station site and are expected in Q1 2017.

In order to further study and analyze the restoration needs and determine a preferred solution it is recommended that a RIP be initiated for the GTA East Region. The RIP is to be led by Hydro One Transmission, and include Veridian, Whitby Hydro, Oshawa PUC, Hydro One Distribution and IESO as Working Group members. It is recommended that this RIP be initiated after the completion of the PAW IRRP in June 2016, with RIP study completion in Q1 2017.

In the longer term, the Pickering-Ajax-Whitby Sub-region Working Group will continue to meet regularly throughout the implementation of the plan to monitor progress and developments in the area and will produce annual update reports that will be posted on the IESO website. Of particular importance, the Working Group will monitor developments focused on the factors described in the long-term section above that could impact electricity infrastructure, along with progress on conservation efforts and DG uptake at the transformer station level.