# Chatham-Kent/Lambton/Sarnia Region Scoping Assessment Outcome Report

December 30, 2021

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# 1. Introduction

This Scoping Assessment Outcome Report is part of the Ontario Energy Board's (OEB or Board) regional planning process. The Board endorsed the Planning Process Working Group's Report to the Board in May 2013 and formalized the regional planning process and timelines through changes to the Transmission System Code and Distribution System Code in August 2013.

The first cycle of the regional planning process for the Chatham-Kent/Lambton/Sarnia region was completed in June 2017. The Needs Assessment is the first step in the regional planning process and was completed in June 2016, which identified one need at Kent TS, but that no further regional coordination was required. Subsequently, both the Regional Infrastructure Plan (RIP) and Local Planning Report (June 2017) concluded that there was sufficient transfer capability on the distribution system to alleviate the Kent TS transformer and so no further action was needed.

The new cycle of the regional planning process for the Chatham-Kent/Lambton/Sarnia region started in August 2021. The Study Team led by Hydro One Transmission finalized the Needs Assessment on September 30, 2021, which identified some needs that may require further regional coordination. A Scoping Assessment was then undertaken by the Study Team, led by the IESO, that m reviewed the nature and timing of all the known needs in the region to determine the most appropriate planning approach. It also considered past or ongoing initiatives in the region.

The Scoping Assessment considers three potential planning approaches for the region (or sub-regions, if applicable), including: an Integrated Regional Resource Plan (IRRP) – where both wires and non-wires options have potential to address needs; a Regional Infrastructure Plan (RIP) – which considers wires-only options; or a Local Plan undertaken by the transmitter and affected local distribution company – where no further regional coordination is needed.

This Scoping Assessment Report:

- Lists the needs requiring more comprehensive planning, as identified in the Needs Assessment report;
- Reassesses the areas that need to be studied and the geographic grouping of the needs (if required);
- Determines the appropriate regional planning approach and scope where a need for regional coordination or more comprehensive planning is identified;
- Establishes a terms of reference for an IRRP and/or wires planning, if required; and
- Establishes the composition of the Technical Working Group, if required.

# 2. Study Team

The Scoping Assessment was carried out with the following participants:

- Bluewater Power Inc.
- Entegrus
- Hydro One Networks Inc. (Distribution)
- Hydro One Networks Inc. (Transmission)
- Independent Electricity System Operator (IESO)

# 3. Categories of Needs, Analysis, and Results

## 3.1 Overview of the Region

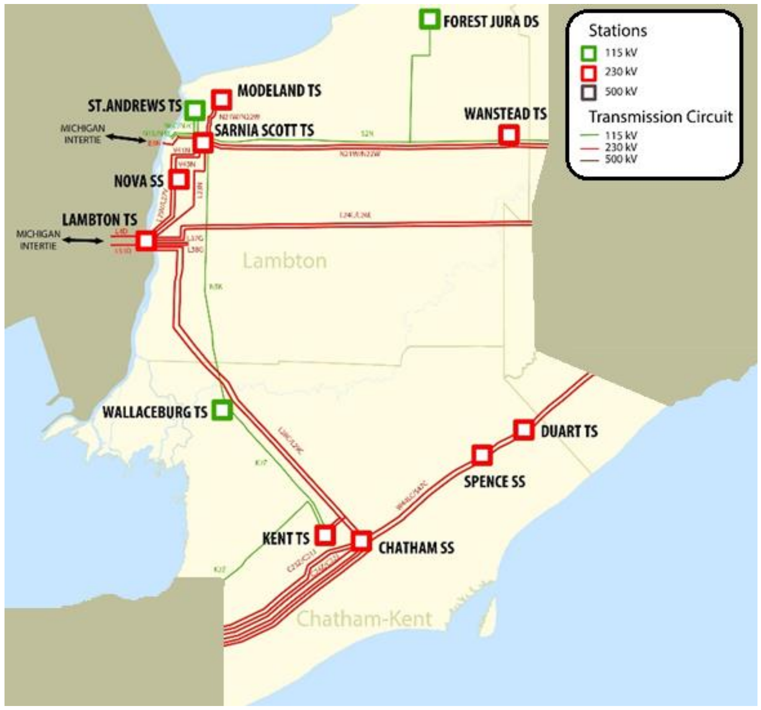
The Chatham-Kent/Lambton/Sarnia region is located west of London and east of Essex County, and includes the municipalities of Lambton Shores and Chatham-Kent, as well as the townships of Petrolia, Plympton-Wyoming, Brooke-Alvinston, Dawn-Euphemia, Enniskillen, St. Clair, Warwick, and Villages of Oil Springs and Point Edward. Portions of Huron County (Municipality of South Huron) and Elgin County (Municipality of West Elgin) are also included in the region. For electricity planning purposes, the planning region is defined by electricity infrastructure boundaries, not municipal boundaries.

This region also has a number of First Nations and Métis Nation of Ontario (MNO) councils, including:

- Indigenous communities including Aamjiwnaang First Nation, Bkejwanong (Walpole Island) First Nation, Caldwell First Nation, Chippewas of Kettle and Stony Point, Chippewas of the Thames First Nation, Mississaugas of the Credit, Moravian of the Thames, Nawash First Nation, Saugeen First Nation and Six Nations of the Grand River (Elected Council and Haundenosaunee Confederacy Chiefs Council/ Haundenosaunee Development Institute); and
- Métis Nation of Ontario communities including MNO Thames Bluewater Métis Council (London) and MNO Windsor-Essex-Kent Métis Council.

An overview of the Chatham-Kent/Lambton/Sarnia region and the location of the electrical infrastructure is shown in Figure 3-1. This region is summer-peaking (i.e., electricity demand is highest during the summer months), however forecast agricultural load growth in the Municipality of Chatham-Kent is winter-peaking.

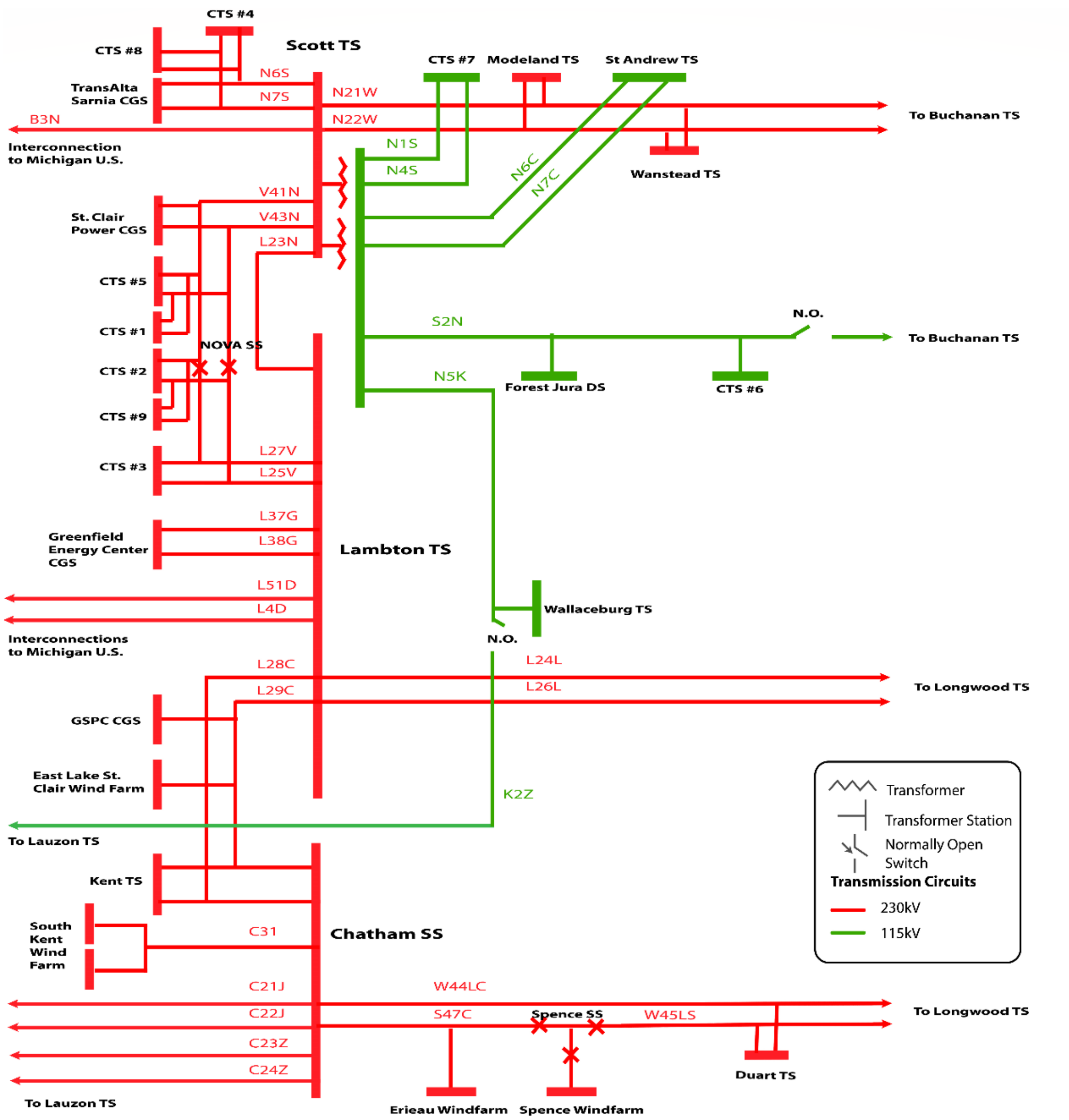
**Figure 3-1 | Overview of the Chatham-Kent/Lambton/Sarnia Region**




The region is currently supplied from a network of 115 kV and 230 kV transmission lines and stations, from the western edge of the City of London, to the City of Sarnia in the northwest, and the Municipality of Chatham-Kent in the southwest. The bulk of supply is transmitted from the 230 kV circuits between Lambton TS, Scott TS, and Chatham SS in the area, connected to the broader provincial system through Longwood TS and Buchanan TS in the east (N21W, N22W, L24L, L26L, W44LC and W45LS). It is also connected to the Windsor-Essex region in the west through 230 kV circuits at Chatham. There is a significant amount of supply resources in Sarnia-Lambton, strategically located near the Dawn gas supply hub, as well as three of the four interconnections between Ontario and Michigan (B3N, L4D and L51D). This area also includes large petro-chemical industrial loads in Sarnia-Lambton, much of which are interdependent with the combined heat and power generators.

An overview of the electrical infrastructure that currently supplies the region is provided in the single line diagram in Figure 3-2.

## Figure 3-2 | Electricity Infrastructure in the Chatham-Kent/Lambton/Sarnia Region




The following transmission infrastructure falls within this region's boundaries:

- 115 kV Transformer stations: St. Andrews TS, Wallaceburg TS, Forest Jura DS
- 115/230 kV Transformer stations: Scott TS
- 230 kV Transformer or Switching stations: Lambton TS, Duart TS, Modeland TS, Wanstead TS, Kent TS, Chatham SS
- 9 customer-owned stations

- 115 kV transmission circuits: N1S/N4S, N6C/N7C, S2N, N5K, K2Z[1]
- 230 kV transmission circuits: N6S/N7S, V41N, V43N, L23N, L25V, L27V, L37G, L38G, L28C, L29C, C31, W44LC, W45LS, S47C, L24L, L26L, N21W, N22W

## 3.2 Background of the Previous Planning Process

The regional planning process was formalized by the OEB in August 2013. To prioritize and manage the process, Ontario was organized into 21 regions based on electricity infrastructure boundaries; each of which were assigned to one of three groups based on urgency of need, where Group 1 Regions were being reviewed first. The Chatham-Kent/Lambton/Sarnia region was part of the Group 3 planning regions.

In June 2016, Hydro One Transmission published the first Needs Assessment report for the Chatham-Kent/Lambton/Sarnia region. The scope of the report included a review of system capability, reliability assessments, and asset sustainment timelines for the region. The report identified one need that did not require further regional coordination, a transformer capacity need at Kent TS. In June 2017, Hydro One Transmission published a Local Planning Report, with the Regional Infrastructure Plan (RIP) subsequently finalized in August 2017, which concluded that there was sufficient transfer capability on the distribution system to alleviate the Kent TS transformer and so no further action was required.

This current, second regional planning cycle started with the Needs Assessment report published by Hydro One Transmission in September 2021. The needs identified in the Needs Assessment report form the basis of the analysis for this Scoping Assessment and are discussed in further detail in Section 3.3.

## 3.3 Needs Identified

Hydro One Transmission's Needs Assessment provided an update on needs identified in the previous planning cycle and the implementation of projects recommended to address them. Furthermore, it identified new needs in the Chatham-Kent/Lambton/Sarnia region based on the most up-to-date sustainment plans and a new 10-year demand forecast. A summary of the current projects and plans underway to respond to existing needs, plus the new needs, are outlined below.

### 3.3.1 Projects and Plans Underway

The Needs Assessment report lists the needs identified from the previous planning cycle, and provides an update on the status of project implementation, summarized in Table 3-1 below. These projects provide a basis for future assessments and should be accounted for in this planning cycle.

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[1] Note, this circuit is also part of the Windsor-Essex region.

**Table 3-1 | Needs Identified in the Previous Cycle and Implementation Plan Update**

| Need | Solution and Timing |
|---|---|
| Thermal overload on Kent TS transformer T3, for the loss of T4 | No further action; sufficient transfer capability on the distribution system to alleviate the Kent TS transformer |
| Wanstead TS | In 2018, Wanstead TS was refurbished with 50/66/83 MVA transformers, and its supply was upgraded from a single 115 kV connection to a double 230 kV connection |
| Chatham TS capacitor SC1 | In 2020, end-of-life the capacitor SC1 and associated breaker were replaced |

Between cycles, a number of additional end-of-life activities were identified in the area. Table 3-2 below summarizes the activities and provides an update on the status of project implementation.

**Table 3-2 | End-of-Life Needs Identified Between Cycles and Implementation Plans**

| Need | Solution and Timing |
|---|---|
| Kent TS transformer T1 | In 2020, Kent TS T1 was replaced on demand due to transformer failure |

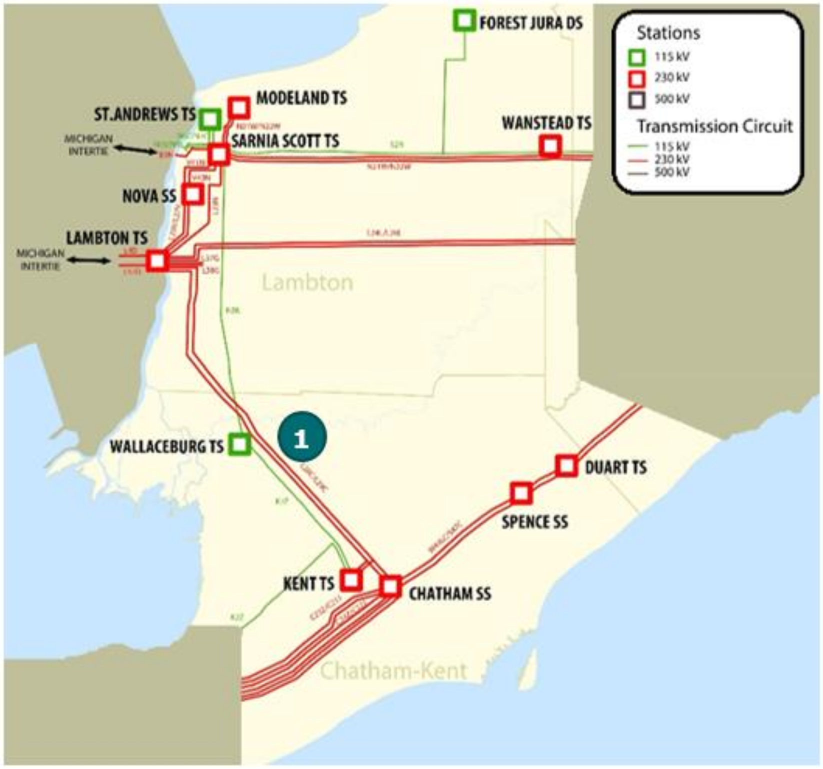
### 3.3.2 Needs to be Addressed in the Current Planning Cycle

The Needs Assessment identified new or updated needs in the Chatham-Kent/Lambton/Sarnia region using the 10-year station-level non-coincident demand forecast provided by the local distribution companies (LDCs), updated end-of-life asset condition information from Hydro One Transmission, as well as the conservation and demand management (CDM) and distributed generation (DG) forecast provided by the IESO. During the Scoping Assessment process, additional end-of-life needs were identified for various 115 kV and 230 kV circuits in the Sarnia-Lambton area. Table 3-3 below outlines these regional needs and their timing. The location of the capacity need is highlighted in Figure 3-3, the end-of-life needs can be identified by their station or circuit labels.

**Table 3-3 | Updated Regional Needs Identified**

| Need # | Station/Circuit | Description of Need |
|---|---|---|
| 1 | Wallaceburg TS | Immediate summer and Winter station capacity need. |
| 2 | Lambton TS interconnection transformers T7/T8 | Lambton TS 600 MVA voltage regulating transformers T7/T8 will be replaced with a single 1,000 MVA series voltage regulating transformer in 2023 |
| 3 | Lambton TS transformers T5/T6 | Like-for-like replacement, to be completed in 2023 |
| 4 | Scott TS transformer T5 | Like-for-like replacement, to be completed in 2024 |
| 5 | St Andrews TS transformers T3/T4 | Like-for-similar replacement with 50/66/83 MVA transformers, to be completed in 2025 |
| 6 | Kent TS transformer T2 | Like-for-similar replacement with 50/66/83 MVA transformers, to be completed in 2027 |
| 7 | N1S/N4S | Like-for-similar replacement of circuit section from Sarnia Scott TS to Vidal JCT, to be completed in 2027 |
| 8 | N6S/N7S | Like-for-similar replacement of circuit section from Sarnia Scott TS to St Andrews, to be completed in 2027 |
| 9 | S2N | Like-for-similar replacement of circuit section from Sarnia Scott TS to Adelaide JCT, to be completed in 2025 |
| 10 | N5K | Like-for-similar replacement of circuit section from Sarnia Scott TS to Kent TS, to be completed in 2027 |
| 11 | N21W/N22W | Like-for-similar replacement of circuit section from Sarnia Scott TS to Buchanan TS, to be completed in 2021 |

**Figure 3-3 | Geographic Location of Capacity Need to be Addressed in the Current Planning Cycle**




In 2019, Hydro One Distribution identified potential agricultural load growth in the Municipality of Chatham-Kent, specifically in the community of Dresden. A separate study team[2] was formed to evaluate the Dresden load connection requests. That study[3] found that the optimal location of a new supply station (referred to in this report as Dresden TS) would be in the vicinity of the existing Wallaceburg TS, connected to the Lambton-to-Chatham 230 kV corridor. At that time, it was identified that additional load connections would result in bulk transfer violations, and a recommendation was deferred until after the IESO's bulk plan for the area was finalized. On September 23, 2021, the IESO issued a bulk plan for the West of London area, Need for Bulk System Reinforcements West of London[4], which recommended a Lambton-to-Chatham reinforcement to be in-service by 2028. Through the course of that plan, it was identified that a new station (Dresden TS) is required to accommodate the agricultural load growth in Chatham-Kent, connected to the recommended new Lambton-to-Chatham circuits. To facilitate load connections ahead of the bulk

[2] Led by the IESO, consisting of Entegrus and Hydro One Transmission and Distribution.

[3] Refer to Appendix 3 for the 2020 Dresden Supply Connection Study.

[4] https://www.ieso.ca/-/media/Files/IESO/Document-Library/regional-planning/southwest-ontario/WOL_Bulk_Report_Final_20210923.ashx

reinforcement in 2028, interim measures may be required such as generation dispatch, and remedial action schemes.

In addition, the Needs Assessment identified that St Andrews TS, Kent TS and Forest Jura DS are approaching station capacity. However, end-of-life sustainment projects are planned which will address the needs identified.

Furthermore, through targeted engagement, communities and stakeholders in the region have identified that there may be additional load growth in the broader region due to economic development, in particular in the Chatham and Sarnia-Lambton areas. This potential growth is mainly attributed to vehicle electrification, development of a hydrogen hub in Sarnia-Lambton, as well as residential and industrial growth. However, it was noted that details of the magnitude and timing of this growth are uncertain.

### 3.3.3 Analysis of Needs

The Study Team has discussed the needs in the Chatham-Kent/Lambton/Sarnia region and potential planning approaches to address them.

The station capacity need at Dresden is driven by forecast agricultural load growth, for which a wires option has been identified as required. Though the optimal connection for that supply station should be the proposed bulk reinforcement along the Lambton-to-Chatham corridor, this will not be in-service until 2028, so near-term measures will be needed to address the requested load connections starting in 2022. Since this has been assessed in recent studies including the West of London bulk plan and the Dresden Load Connection Study (included in Appendix 3), the results of which can be leveraged to explore interim solutions in parallel with the required supply station connection process in order to expedite this load.

There is limited capacity available at existing stations to accommodate the Dresden capacity need (129 MW need). There is the potential for up to 10 MW of capacity at Wallaceburg TS, which is the closest existing station. Kent TS is the next closest station, which may have up to 40 MW of available capacity in the near-term. However, depending on the location of the new loads, this may require buildout of distribution lines approximately 20 km in length to connect to Kent TS. Even with these distribution connections, an 80 MW capacity need remains, which will require a new supply station. While the connection lines for this station has been determined through previous studies, there may be opportunities to integrate this with the Lambton-to-Chatham lines underdevelopment, depending on the location and staging of that project. There may also be ways to temporarily connect loads to the existing infrastructure at a lower level of reliability. However, the ultimate connection of new loads in this area must be to the new Lambton-to-Chatham circuits to ensure reliable long-term supply to the new loads and maintain the required supply capacity to the Chatham-Kent and Windsor-Essex areas outlined in the West of London bulk study. Thus, further wires planning is required to finalise details of interim supply at a lower level of reliability and transition the ultimate connection to the new Lambton-to-Chatham lines underdevelopment. This would be best assessed through a Resource Infrastructure Plan, led by Hydro One Transmission, which approach would also more closely align assessment timelines with the capacity need date.

Aside from this capacity need, it may be premature to conduct comprehensive regional planning for the Sarnia-Lambton sub-region at this time, as the details of potential economic development plans are still in flux. However, there is value in exploring the effects of other local development projects once more information is finalized – whether they are related to specific industries, economic development plans (i.e., potential hydrogen hub in Sarnia-Lambton, greenhouse facilities[5]), or community energy plans and targets. Depending on when further details about these anticipated local developments are solidified, the Working Group will assess the value of leveraging the recently completed Needs Assessment and Scoping Assessment from this cycle or if enough time has passed to necessitate formally triggering the next cycle of planning early, as required.

**Recommendation:** The Dresden capacity need has been assessed in recent studies including the West of London bulk plan, the results of which can be leveraged to explore interim solutions in parallel with the required supply station connection process in order to expedite this load. Thus, wires planning through a RIP led by Hydro One Transmission is recommended to address the needs in the Chatham-Kent sub-region.[6]

Moreover, although there are no needs in the Sarnia-Lambton sub-region currently forecast to arise in the mid-term (5 to 10 years out), the Working Group will continue monitor growth in the region and re-evaluate these needs periodically, in order to trigger further regional planning for the Sarnia-Lambton sub-region as required.

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[5] The IESO commissioned the Greenhouse Energy Profile Study in 2019 to assess potential energy use in the indoor agriculture sector across five regions – of which Chatham-Kent was one.

[6] A Terms of Reference for the Chatham-Kent sub-region RIP is provided in Appendix 2. This will be incorporated into Hydro One Transmission's Terms of Reference for the Chatham-Kent/Lambton/Sarnia RIP.

# 4. Conclusion and Next Steps

The Scoping Assessment concludes that wires planning led by Hydro One Transmission is required to address the capacity need in the Chatham-Kent sub-region, through a Regional Infrastructure Plan. The Working Group will explore interim measures to expedite the Dresden load connections in parallel with wires development.

The Working Group will continue to monitor load growth in this region and re-evaluate these needs periodically, in order to trigger further assessments for the Sarnia-Lambton sub-region as required.

# Appendix 1 – List of Acronyms

| Acronym | Definition |
| --- | --- |
| CDM | Conservation and Demand Management |
| DESN | Dual Element Spot Network |
| DG | Distributed Generation |
| DS | Distribution Station |
| EOL | End-of-Life, end of life |
| GIS | Gas Insulated Switchgear |
| GS | Generating Station |
| IESO | Independent Electricity System Operator |
| IRRP | Integrated Regional Resource Plan |
| JCT | Junction |
| kV | kilovolt |
| LDC | Local Distribution Company |
| LTR | Limited Time Rating |

| Acronym | Definition |
|---|---|
| MNO | Métis Nation of Ontario |
| MTS | Municipal Transformer Station |
| MVA | Megavolt ampere |
| MVar | Megavolt ampere reactive |
| MW | Megawatt |
| NERC | North American Electric Reliability Corporation |
| NPCC | Northeast Power Coordinating Council |
| OEB | Ontario Energy Board |
| ORTAC | Ontario Resource and Transmission Assessment Criteria |
| PSS\E | Power System Simulator for Engineering |
| RIP | Regional Infrastructure Plan |
| SC | Static Capacitor |
| SIA | System Impact Assessment |
| SS | Switching Station |
| TS | Transformer Station |

# Appendix 2 – Regional Infrastructure Planning – Scope for Chatham-Kent Sub-Region

## 1. Introduction and Background

These Terms of Reference establish the objectives, scope, key assumptions, roles and responsibilities, activities, deliverables, and timelines for the Chatham-Kent sub-region capacity needs to be addressed in the Chatham-Kent/Lambton/Sarnia Regional Infrastructure Plan (RIP).

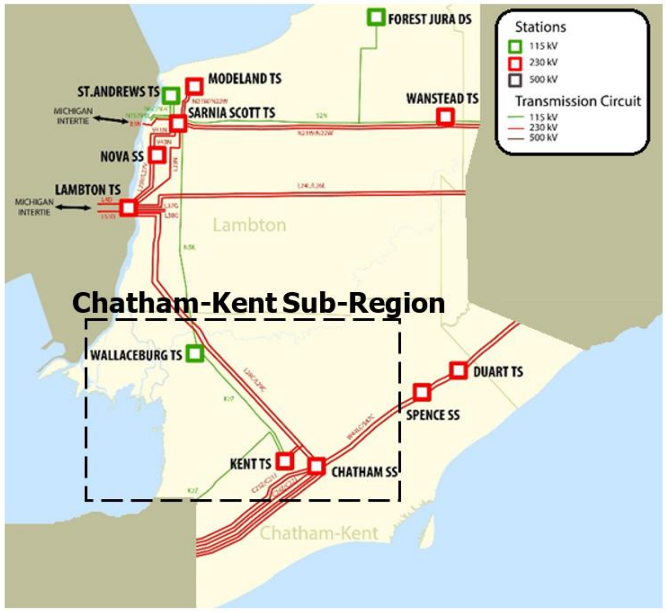
Based on the forecast demand growth within this sub-region and limits on the capability of the transmission capacity supplying the area, and the urgent timelines for load connection requests, a regional infrastructure planning approach is recommended.

The scope of the Chatham-Kent sub-region established through this document will be incorporated into the broader Terms of Reference for the Chatham-Kent/Lambton/Sarnia Region RIP, which will be subsequently developed by Hydro One Transmission.

### Chatham-Kent/Lambton/Sarnia Region

The Chatham-Kent sub-region is currently summer-peaking, however forecast agricultural load growth in the Dresden area will make the sub-region winter-peaking. It is primarily supplied by 230 kV circuits from Lambton TS in the north to Chatham SS (L28C and L29C) and from Longwood TS in the east to Chatham SS (W44LC/S47C and W45LS). The approximate geographical boundaries of the sub-region are shown in Figure A2-1.

## Figure A2-1 | Overview of the Chatham-Kent/Lambton/Sarnia Region

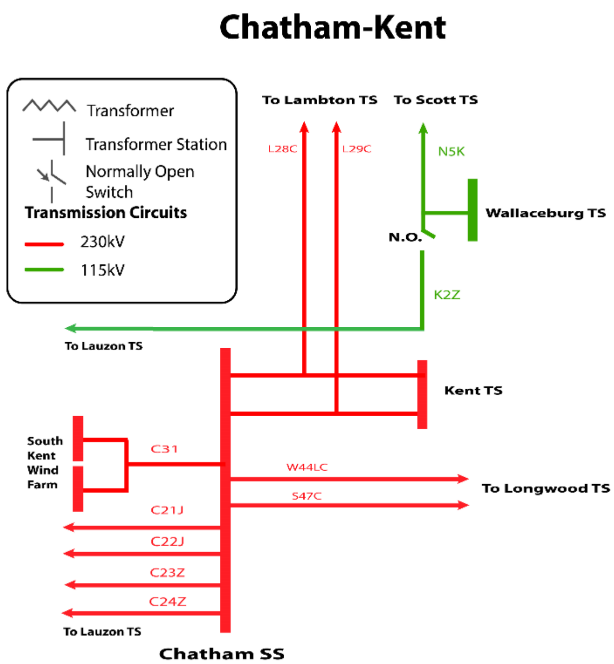



The region is located west of Elgin County and east of Essex County, and includes the municipalities of Chatham-Kent. For electricity planning purposes, the planning region is defined by electricity infrastructure boundaries, not municipal boundaries.

### Chatham-Kent Sub-Region Electricity System

The electricity system supplying the Chatham-Kent/Lambton/Sarnia region is shown in Figure A2-2.

**Figure A2-2 | Chatham-Kent Sub-Region Electricity System**




This RIP will address regional needs in the Chatham-Kent sub-region. Specifically, the following existing infrastructure is included in the scope of this study:

- 115 kV Transformer stations: Wallaceburg TS
- 115/230 kV Transformer stations: Scott TS
- 230 kV Transformer stations: Lambton TS, Duart TS, Modeland TS, Wanstead TS,
- 9 customer-owned stations
- 115 kV transmission circuits: N5K, K2Z
- 230 kV transmission circuits: L28C, L29C, C31, W45LS, S47C/W44LC.

It will also consider the integration of regional needs with transmission reinforcements underdevelopment in the area, specifically the Lambton-to-Chatham double circuit 230 kV lines which are expected in-service by 2028.

## 2. Scope

As identified in the Scoping Assessment, Hydro One Transmission will lead a joint initiative involving Hydro One Distribution, Entegrus, and the IESO, to initiate and undertake the wires planning work for the Chatham-Kent sub-region. The scope of this study is to develop alternatives to address the 129 MW winter capacity need at Wallaceburg TS. Recently completed studies, including the 2021 West of London bulk plan[7], determined that the optimal connection for a new supply station to address this capacity need should be along the Lambton-to-Chatham reinforcement currently under development. Since these circuits will not be in-service until 2028, so near-term measures will be needed to address the immediate load connection requests.

The RIP will explore ways to facilitate early connection of loads ahead of the Lambton-to-Chatham circuits in 2028, such as by temporarily connecting loads to the existing infrastructure at a lower level of reliability. However, the ultimate connection of new loads in this area must be to the new Lambton-to-Chatham circuits to ensure reliable long-term supply to the new loads and maintain the required supply capacity to the Chatham-Kent and Windsor-Essex areas outlined in the West of London bulk study.

The plan will also integrate forecast electricity demand growth, conservation and demand management in the area with transmission and distribution system capability, end-of-life of major facilities in the area, relevant community plans, any relevant bulk system developments, and generation uptake.

The Chatham-Kent RIP will:

- Prepare a 10-year electricity demand forecast for the appropriate stations and reaffirm needs over this timeframe;
- Examine the load meeting capability and reliability of the existing transmission system supplying the Chatham-Kent sub-region, taking into account facility ratings and performance of transmission elements, transformers, local generation, and other facilities such as reactive power devices;
- Establish feasible wires alternatives to address the needs of the Chatham-Kent sub-region, which integrates these alternatives with supply from transmission reinforcements underdevelopment in the area, specifically the Lambton-to-Chatham double circuit 230 kV lines; and
- Develop a flexible and comprehensive wires plan for the Chatham-Kent sub-region.

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[7] https://www.ieso.ca/-/media/Files/IESO/Document-Library/regional-planning/southwest-ontario/WOL_Bulk_Report_Final_20210923.ashx

## 3. Technical Working Group

The core Technical Working Group will consist of planning representatives from the following organizations:

- Hydro One Networks Inc. (Transmission) *(Team Lead for RIP)*
- Hydro One Networks Inc. (Distribution)
- Entegrus
- Independent Electricity System Operator

## 4. Activities, Timeline, and Primary Accountability

| **Activity** | **Lead Responsibility** | **Deliverable(s)** | **Timeframe** |
|---|---|---|---|
| Trigger start of wires planning | Hydro One Transmission | | Q1 2022 |
| Review and reaffirm load forecast for Chatham-Kent sub-region | LDCs | Station-level annual load forecast for Chatham-Kent sub-region | Q1 2022 |
| Review and reaffirm CDM and DG for study period | IESO | | Q1 2022 |
| Perform relevant system studies to identify supply capabilities | LDCs | Load transfer capabilities under normal and emergency conditions | Q1 2022 |
| Perform relevant system studies to identify supply capabilities | Hydro One Transmission | | Q1 2022 |
| Develop options to address needs | Study Team | Develop flexible planning options for forecast | Q1 –Q2 2022 |
| Technical comparison and evaluation | Study Team | | Q2 2022 |
| Complete Study Report | Hydro One Transmission | Regional Infrastructure Plan report | Q2 2022 |

# Appendix 3 – Dresden Load Connection Study

**Written: Feb 28, 2020**[8]

## 1. Executive Summary

This study is intended to examine supply solutions to address the capacity need in the community of Dresden, in particular the 100 MW of firm load requests for 2021/2022. In addition to the firm load requests, 100-200 MW of load growth is projected within the next 3-5 years, based on anticipated demand from the recently completed Chatham-Kent Rural Pipeline Expansion. Consideration was given to solutions that could supply the total projected load.

This study is required to expedite supply for a near-term load requirement and to ensure that the connection point will not adversely affect the bulk transmission system. The next planning cycle is to commence in Q1 2020, however the schedule to complete a Needs Assessment and Integrated Regional Resource Plan (IRRP) would not meet the urgent timeline for the initial load requests. Further, recent load growth in the Kingsville-Leamington area have indicated a need for bulk reinforcements west of London. Given the location of this Dresden load, the connection point selected could impact the nature and timing of the bulk transmission reinforcement required.

The scope of this study was limited to Dresden load supply, in order to complete the following:

- Establish the load requirements in detail;
- Evaluate potential connection points; and
- Identify both local or bulk issues and benefits.

Analysis of available options was conducted based on providing:

- An economically feasible option for the customer(s) who would bear the costs;
- A viable timeline to meet the imminent capacity needs; and
- A system that leaves the bulk options open until a study can be completed to determine the most appropriate bulk reinforcement option.

Given the information at hand, the most feasible approach to address the Dresden load capacity need is to build a DESN station along the Lambton-to-Chatham corridor to supply the firm load growth. This option was selected for the following reasons:

[8] Note, this study was completed prior to the start of the 2021 West of London bulk study and Chatham-Kent/Lambton/Sarnia regional planning. It is included here for reference, but results and conclusions do not reflect subsequent updates and recommendations.

- It is the minimum set of infrastructure that meets the firm capacity need with no stranded assets, regardless of the bulk reinforcement;
- It enables further load growth both in the Dresden area and the Chatham-Kent area; and
- It is the least-cost option that would enable customers to be connected promptly.

Concentrating near-term capacity expansion in the Wallaceburg and surrounding area serves the dual purpose of serving new load growth in the Dresden area, as well as alleviating capacity at Kent TS. This would facilitate further growth in the Chatham-Kent area, particularly in the Dresden area and south of Chatham proper where there have been indications of further growth. In addition, it does not preclude any bulk reinforcement option. However, prior to bulk reinforcement, any load additions to this path would require similar interim measures to the Kingsville-Leamington loads, with a corresponding lower level of reliability. This comes with an added risk to project timelines since the exemption approval required to implement interim measures is contingent on the completion of the west of London bulk plan.

Critical to addressing this reliability concern will be establishing a bulk transmission reinforcement plan. A bulk study will be dependent on the Chatham-Kent/Lambton Sarnia region Needs Assessment to establish a forecast for the entire region. The Needs Assessment is scheduled for this year, and the bulk study for this region will by necessity occur in parallel.

Thus, there are two potential routes depending on the customer(s) level of risk tolerance:

- Proceed with the design and build work for a DESN on the L28C/L29C circuits, with the caveat that the final connection is contingent on the publication of a west of London bulk study and accompanying recommendation for addressing bulk system needs – Not recommended;
- Incorporate the connection of this load in the west of London bulk study and re-evaluate the connection of this load as part of regional planning - Recommended.

If a connection and corresponding System Impact Assessment (SIA) is pursued ahead of the bulk study and regional coordination, this would be subject to the following risks:

- Risk to load security, resulting from the interim measures.
- Risk to timelines, since the approval for the use of interim measures is contingent on the completion of a bulk reinforcement plan, which will take time to complete and coordinate with the Chatham-Kent/Lambton/Sarnia regional plan.
- Risk to approval of the use of interim measures, which also take into account any costs that may be imposed, as may be seen in the market solution to supply new loads in this thermally limited area. New loads would require similar interim measures and exemptions as loads currently connecting in the Leamington area.

# 2. Introduction

## 2.1 Purpose

The purpose of this Planning Study report is to document the results of power system analysis studies used to determine the planned performance of defined options to supply the near-term Dresden load forecast. The results of this Planning Study will be used in the development of needs and planning recommendations for the Chatham-Kent/Lambton/Sarnia Needs Assessment and Integrated Regional Resource Plan (IRRP), as well as the west of London bulk study.

## 2.3 Scope

This study is limited to identifying near-term wires-only options for the Dresden load growth. Given the urgent timelines for connecting the firm load, the scope of the study was limited to load connection options; not a complete regional study.

The results of this study will feed into the Chatham-Kent/Lambton/Sarnia regional planning, which may expand on this study and consider potential wires and/or non-wires options for the entire region.

The IRRP and bulk study for the Windsor-Essex region was completed in 2019, triggered primarily by the unprecedented load growth in the Kingsville-Leamington area. These studies indicated that there may be a need for bulk reinforcements west of London. The location of Dresden relative to transmission supply paths connecting to the Windsor-Essex region suggest that the connection point selected in this study could result in an impact to the nature and timing of bulk transmission reinforcement required. Therefore, bulk impacts and upstream limitations for each screened option are identified at a high-level in this study. However, a separate bulk study will examine further wires and/or non-wires options to address the bulk reinforcements required. The timing of that bulk study will depend on regional planning to develop a load forecast for the entire region.

For practical purposes, the forecast developed for this study is limited to the next 10 years, with emphasis on the next five years.

## 2.4 Load Connection Needs

The load forecast for this area was developed based on discussions with various stakeholders, including Hydro One Distribution, Entegrus, the Municipality of Chatham-Kent, Enbridge Gas, and Ontario Greenhouse Vegetable Growers.

The load forecast is comprised of two parts: (i) the firm load forecast based on load connection requests received, and (ii) projected load growth based on natural gas utilization for greenhouses.

Over the last year, Hydro One Distribution received two connection requests in the Dresden area for new and expanded greenhouse facilities. This amounts to approximately 100 MW of load growth by 2021/2022, which is the firm load forecast at this time.

In November 2019, Enbridge completed the construction of a new gas pipeline in the area; the Chatham-Kent Rural Pipeline Expansion. This pipeline which runs from Dover Centre east through Tupperville and Dresden, provides 30,000 $m^3$/hr of natural gas capacity, or the equivalent of 350 acres of greenhouses. Since the Municipality of Chatham-Kent indicated that there are no water or wastewater supply concerns that would delay the development of this area, the impact of natural gas utilization projections was incorporated into the projected near- to mid-term electricity demand forecasts. The projected load forecast is an additional 100-200 MW of growth.

During the Windsor-Essex IRRP, a near-term capacity need was identified in Chatham-Kent, which exceeded the capacity of Kent TS. Due to the urgency and proximity of the load to the Windsor-Essex region, this need was incorporated into the recently completed Windsor-Essex IRRP. As a result of economic influences, the recommended station build in the area was not implemented, however there still remains the potential for load growth.

To be prudent, the focus of this study will be to address the firm load forecast. Options will be evaluated to ensure that capacity for future growth is enabled and investments are not stranded. As such, when connection requests are received the next stage of distribution or transmission investment can be easily triggered.

# 3. Study Methodology

To determine the feasible set of options, the following methodology was used:

- Options specification: A comprehensive set of wires only options to supply the Dresden capacity need was developed in collaboration with Hydro One Transmission, Hydro One Distribution, and Entegrus.
- Options screening: A preliminary assessment was conducted to prioritize the list of options, prior to a full technical assessment. This included high-level time and cost estimates to screen options that could not meet the need timeframe or were prohibitively expensive for the customer(s). Conservation areas and land impacted by First Nation treaties or reserves were considered when determining the feasibility of the options. Options that were electrically similar were combined into a single option, to expedite the technical assessment.
- Technical assessment: An analysis of the regional and bulk system impact of the prioritized set of options was performed, including conducting thermal and voltage analyses based on the scenarios and assumptions outlined in the next section.

# 4. Scenarios and Assumptions

## 4.1 Scenarios Assessed

The following scenarios were selected for analysis to establish the performance of the identified options relative to recognized planning standards and criteria as referenced in section 4.4.

**Table A3-1 | Description of Credible Scenarios**

| Scenario Name | Scenario Type | Scenario Description |
|---|---|---|
| Scenario 1 | Winter peak, low load growth, median generation, no intertie transfer on J5D, no local generation | Winter peak low scenario |
| Scenario 2 | Winter peak, high load growth, median generation, no intertie transfer on J5D, no local generation | Winter peak high scenario |

A summer case was considered but it was determined that peak demands and the most limiting contingency for this study occur during the winter. Refer to section 4.3.2 for details on the load forecasts.

## 4.2 Options Assessed

The following potential options were selected for analysis relative to the scenarios in section 4.1.

**Table A3-2: Description of Options**

| Option | Scenario Description |
|---|---|
| Option 1 | Supply from a new DESN station directly connected to the Chatham x Lambton 230 kV circuits (L28C/L29C) |
| Option 2 | Supply from a 230-kV double circuit tap connection to a new DESN station at Dresden via the 230-kV transmission lines L28C/L29C from Lambton TS to Chatham SS |
| Option 3 | Supply from a 230-kV double circuit tap connection to a new DESN station at Dresden via the 230-kV double circuit transmission lines L24L/L26L from Longwood TS to Lambton TS |
| Option 4 | Supply from a 230-kV double circuit tap connection to a new DESN station at Dresden via the 230-kV transmission lines W44LC/S47C from Buchanan TS/Spence SS to Chatham SS |

| Option | Scenario Description |
|---|---|
| Option 5 | Supply from a new double circuit tap connection to a new DESN station at Dresden from Chatham SS |
| Option 6 | Supply from a new double 230 kV circuit from Lambton TS to new DESN station at Dresden to Chatham SS |
| Option 7 | Supply to a new DESN station at Dresden from N5K circuit from Sarnia TS to Wallaceburg TS converted from 115 kV to a 230 kV circuit |
| Option 8 | Supply from upsized transformers at Wallaceburg TS |
| Option 9 | Supply from Duart TS through distribution feeders |

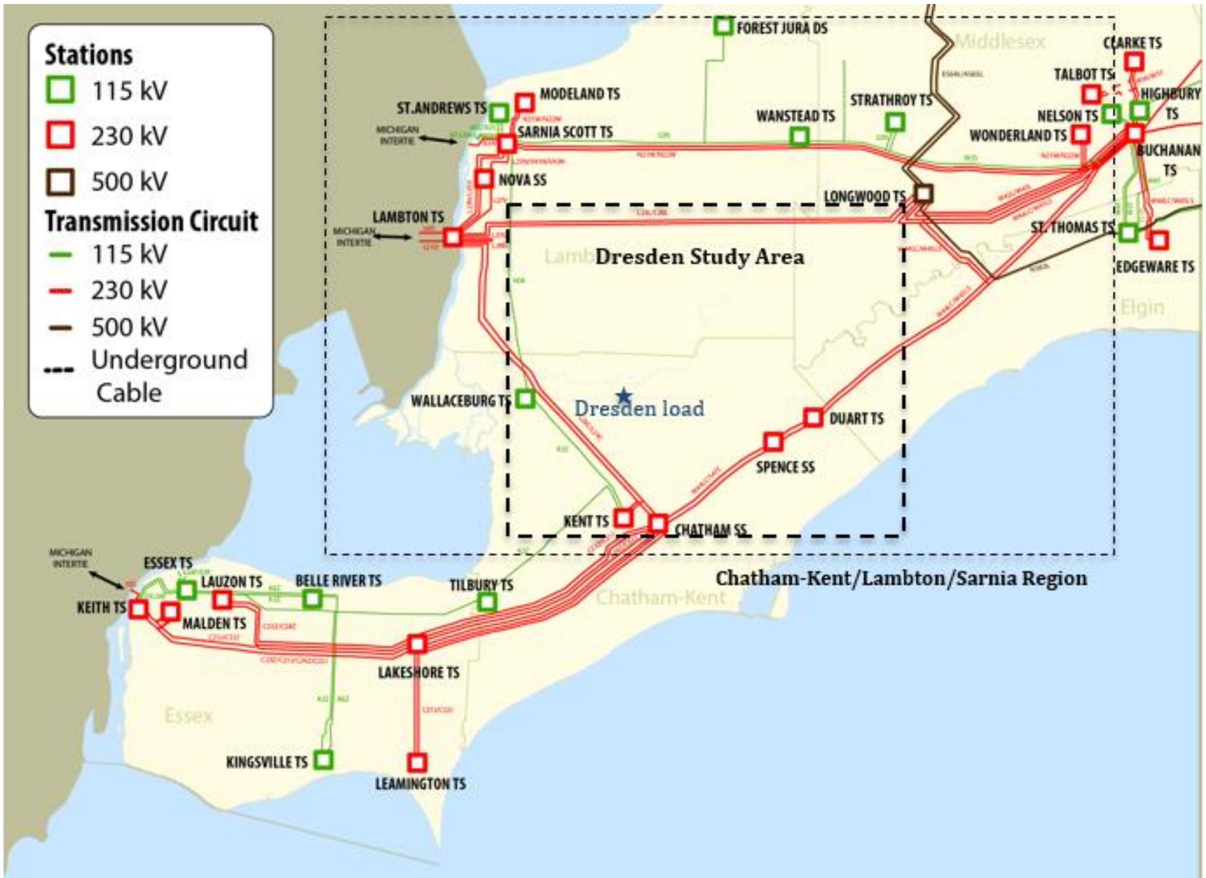
## 4.3 Study Area Assumptions

### 4.3.1 Study Area Transmission Configuration

The community of Dresden area is within the Chatham-Kent/Lambton/Sarnia region, which includes the municipality of Chatham-Kent, as well as the townships of Dawn-Euphemia, Enniskillen, St. Clair, and Villages of Oil Springs. The area is bordered by London to the east, Windsor-Essex to the south west, and the remainder of the Chatham-Kent/Lambton/Sarnia region to the north.

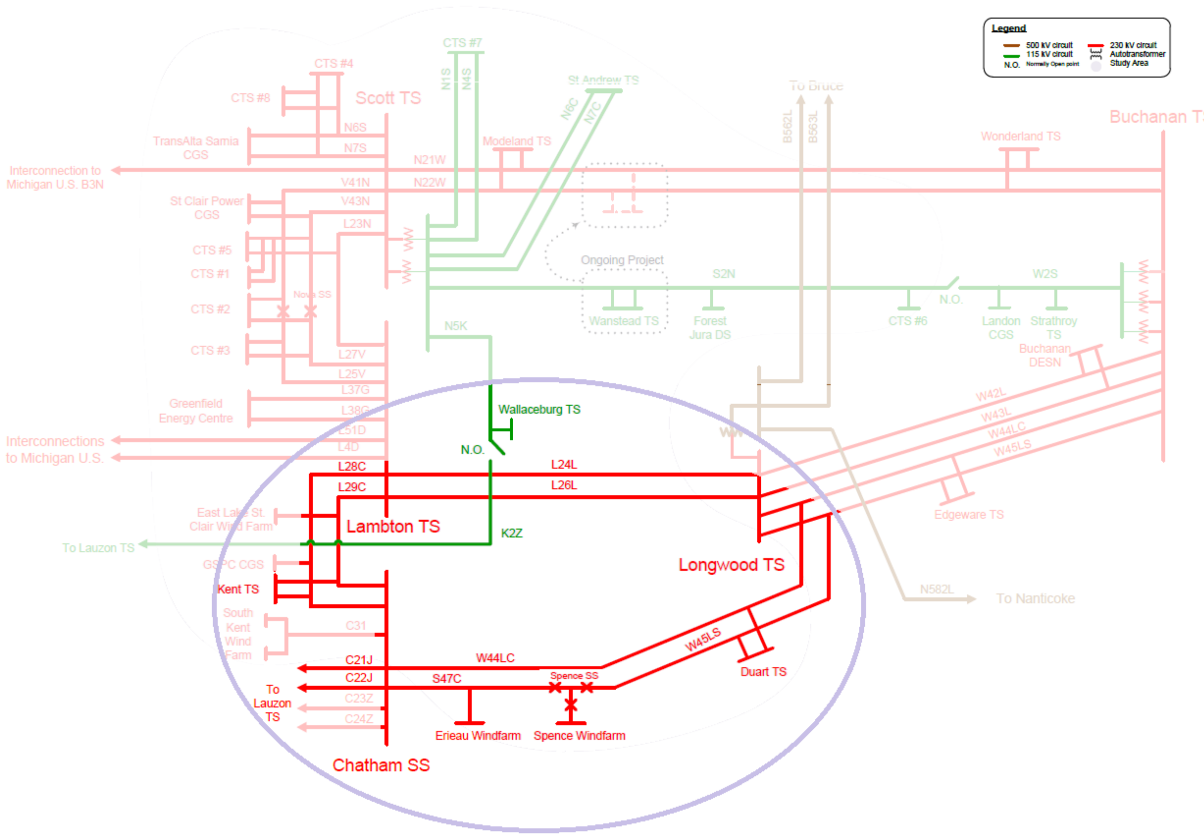
The approximate geographical boundaries of the sub-region are shown in Figure A3-1 within the broader Chatham-Kent/Lambton/Sarnia region and southwestern Ontario.

**Figure A3-1: The Dresden Study area and Chatham-Kent/Lambton/Sarnia Region**




This study focused on the Dresden electrical area, which includes the load and generation connected to circuits L24L, L26L, L29C, L28C, W44LC, and S47C, as illustrated in Figure A3-2.

**Figure A3-2: Single Line Diagram of Electricity System Supplying the Dresden Study Area**




## 4.3.2 Study Area Load

The closest existing supply station to Dresden is Wallaceburg TS, where there is 14 MW of capacity remaining, partially fulfilling the connection requests received by Hydro One Distribution. Options were considered to meet load forecast requirements, less the remaining Wallaceburg TS capacity.

The load for the study area is based on the following assumptions:

- 100 MW of connection requests within the study area to form the firm near-term study area load by 2022;
- Greenhouse utilization of Chatham-Kent gas pipeline capacity form the projected mid-term study area load from 2022-2030. Low and high forecasts were developed based on vegetable and cannabis greenhouse load respectively;
- Supply for 1,000 MW of load growth west of Chatham, this includes the Leamington DESN loads, transmission-connected customers at Leamington, and Lakeshore DESN loads (approximately equivalent to a 1,500 MW West of Chatham transfer); and

- A power factor of 0.95 is assumed for new greenhouse loads at Leamington, Lakeshore and Dresden based on historic performance.

Study area loads for each scenario described in section 4.1 are detailed in Tables A3-3 and A3-4 below.

**Table A3-1: Study Area Loads (MW) – Scenario 1**

| Station | Year 0 | Year 2 | Year 4 | Year 6 | Year 8 | Year 10 |
|---|---|---|---|---|---|---|
| Wallaceburg TS | 41.4 | 141.1 | 172.0 | 233.5 | 249.2 | 249.3 |
| Kent TS | 137.2 | 137.7 | 138.1 | 138.6 | 139.0 | 139.2 |

**Table A3-2: Study Area Loads (MW) – Scenario 2**

| Station | Year 0 | Year 2 | Year 4 | Year 6 | Year 8 | Year 10 |
|---|---|---|---|---|---|---|
| Wallaceburg TS | 41.4 | 141.1 | 202.7 | 325.6 | 341.3 | 341.4 |
| Kent TS | 137.2 | 137.7 | 138.1 | 138.6 | 139.0 | 139.2 |

Note: Red values indicate that the loading exceeds the existing station capacity

### 4.3.3 Study Area Generation

Ontario resources within the Chatham-Kent/Lambton/Sarnia region consist of over 2,500 MW of installed gas generation in Sarnia-Lambton, and approximately 440 MW of renewable resources.

Additional injections into the area can come from the following:

- L4D/L51D from Michigan via Lambton TS;
- B3N from Michigan via Scott TS; and
- J5D from Michigan via Keith TS.

Supply for the study area was based on the following assumptions:

- Median winter on peak generation supply for top 10 percentile of load hours;
- No intertie exchange on J5D;
- Median intertie exchange on B3N, L4D, and L51D; and
- No post-contingency intertie control.

### 4.3.4 Study Area Automatic Switching, Special Protection Systems, and Remedial Action Schemes – Windsor Area Overload Protection and Load Rejection Scheme

**Table A3-5: Study Area Automatic Switching, Special Protection Systems, and Remedial Action Schemes – Windsor Area Overload Protection and Load Rejection Scheme**

| Event | Action |
|---|---|
| Events that result in the loss of one or two of the 230 kV circuits /transformers at Lauzon TS | Reject loads at Kingsville TS, Belle River, Tilbury West and/or capacitors at Kingsville, Lauzon |
| Events that result in the loss of one or two of select 115 kV circuits and capacitors from Keith TS and Lauzon TS | Reject loads at Kingsville TS, Belle River, Tilbury West and/or capacitors at Kingsville |
| Supply to circuits K2Z/K6Z both decline to a voltage level of 106 kV or less | Reject the loads at Kingsville TS |
| Events that result in the loss of one or two of select 115 kV or 230 kV circuits from Keith TS | Reject generation at Brighton Beach, East Windsor, Keith autotransformers, loads at Keith, and/or capacitors at Keith, or select capacitors at Essex |

**Table A3-6: Study Area Automatic Switching, Special Protection Systems, and Remedial Action Schemes – Leamington Load Rejection Scheme**

| Event | Action |
|---|---|
| Events that result in the loss of one or two of the 230 kV circuits west from Chatham SS or Brighton Beach generation | Reject loads at Leamington TS and/or loads directly connected to the tap line to Leamington TS |
| Events that result in sustained low voltages at Leamington TS and/or loads directly connected to the tap line to Leamington TS | Reject loads at Leamington TS and/or loads directly connected to the tap line to Leamington TS |
| Events that result in sustained over-voltages at Leamington TS and/or loads directly connected to the tap line to Leamington TS | Trip capacitors at Leamington TS and/or reject the loads directly connected to the tap line to Leamington TS |

## 4.4 Planning Criteria

This study applies planning criteria in accordance with planning events and performance as detailed by:

- North American Electric Reliability Corporation ("NERC") TPL-001 "Transmission System Planning Performance Requirements" ("TPL-001"),
- Northeast Power Coordinating Council ("NPCC") Regional Reliability Reference Directory #1 "Design and Operation of the Bulk Power System ("Directory #1"), and
- IESO Ontario Resource and Transmission Assessment Criteria ("ORTAC").

# 5. Study Results

## 5.1 Options Screening

The following table summarizes the option screening analysis. A detailed analysis is provided in the subsequent subsections.

Options were considered to supply the Dresden load, after exhausting all the available capacity on the current system.

**Table A3-7: Option Screening Summary**

| Option | Costs[9] ($M) | Timeframe [10] (years) | Load Enabled[11] (MW) | Other Benefits/ Ramifications | Proceed to Technical Assessment |
|---|---|---|---|---|---|
| Option 1 | 60 | 3-5 | 200 | • Can serve nearby loads<br>• Takes away from ability to supply Windsor-Essex loads; advances bulk reinforcement need | Yes |
| Option 2 | 70 | 6-8 | 200 (500) | • Electrically similar to Option 1 | No |
| Option 3 | 110 | 6-8 | 200 (500) | • Furthest supply point from load | No |
| Option 4 | 95 | 6-8 | 200 (500) | • Some existing capacity available | Yes |
| Option 5 | 95 | 6-8 | 200 (500) | • Utilizes existing railway corridor | No |
| Option 6 | 180 | 6-8 | 200 (500) | • Utilizes existing railway corridor<br>• Facilitates generation supply<br>• Potential bulk system benefit | No |
| Option 7 | 125 | 5-7 | 200 | • Utilized existing right-of-way<br>• Circuit reaching end of life<br>• Facilitates generation supply | No |

[9] Costs in Table A2-7 estimate both distribution and transmission costs to connect the load enabled (MW) amount specified. Values are in 2019 Canadian dollars.

[10] Time estimates are based on requirements for Environmental Approval, Section 92 approval, land acquisition, and recent estimates provided for projects in the area.

[11] The load enabled in brackets refers to the additional load that can be further enabled with an accompanying transmission and/or distribution cost, as applicable.

| | | | | | |
|---|---|---|---|---|---|
| Option 8 | 75 | 5-7 | To be determined | • Voltage, outage and GIS equipment limits | Yes |
| Option 9 | 120 | 3-5 | 200 | • Voltage and reliability limits, river/rail/First Nation land crossing | No |

### 5.1.1 Option 1: DESN on L28C/L29C

This would require a new DESN directly connected to the existing L28C/L29C circuits between Wallaceburg and Dover Centre Township to the south. Distribution feeders could be used to serve the dual purpose of connecting the Dresden loads, as well as providing an alternate supply for some northern loads currently fed from Kent TS. This second purpose would benefit the Chatham-Kent area more broadly, by relieving the fully loaded Kent TS and thus facilitating development south of Chatham proper. To that end, the DESN station may be sized to supply future growth with marginal incremental cost.

Load added to this path would take away from the ability to supply load in the Windsor-Essex region, since this path is thermally limited post-contingency. However, this option is the least-cost option that meets the timeline for the firm load increase within a reasonable timeframe. A technical assessment is required to determine the exact impact this option would have before a bulk reinforcement could be implemented.

### 5.1.2 Option 2: Tap onto L28C/L29C

This option is electrically similar to Option 1, since it has the same supply source and thus the same impact on the system's ability to serve the Windsor-Essex loads. The primary difference between the two options is the approximately 10 km of a double 230-kV circuit tap connection from the station to the L28C/L29C circuits, where Option 1 would instead use distribution feeders between the station and the loads. The tap connection for this option would result in slightly higher costs and a longer execution timeline. Thus, this option will be evaluated as Option 1.

### 5.1.3 Option 3: Tap onto L24L/L26L

This would require a 230-kV double circuit tap connection, of approximately 25 km from the existing L24L/L26L circuits to the Dresden area. This option would bypass the current bulk system concerns. However, it would require a significant expenditure to construct the long tap line, which would be approximately equivalent to a new circuit, without contributing towards a potential bulk solution. Since this option does not provide any additional system benefit, the total cost would have to be borne by the triggering customer(s). In addition, the timeline for this option does not meet the near-term timeframe for firm or projected load forecasts. Thus, this option was not considered for further assessment.

### 5.1.4 Option 4: Tap onto W44LC/S47C

There is some existing capacity available on this path, wherein more load can be added before having a detrimental impact on the bulk system, i.e. supply to Windsor-Essex. While this option is more expensive and does not meet the forecast timelines, for the purposes of limiting the bulk impact, a technical assessment is recommended to determine the amount of load that could be supplied and other impacts.

### 5.1.5 Option 5: New double circuit from Chatham SS to new Dresden DESN

This option is electrically similar to Option 1, since it would have the same impact on the bulk system, i.e. the ability to serve Windsor-Essex loads. There is an existing railway corridor between Chatham and Dresden, which could expedite the implementation of this option. However, this corridor would still need to be procured. Overall, Option 1 would be more cost-effective and faster to implement. Thus, this option was not considered for further assessment at this time.

### 5.1.6 Option 6: New double circuit from Chatham SS to Lambton TS

This would require a 230-kV double circuit, of approximately 50 km from Chatham SS to a new Dresden TS to Lambton TS. The cost for the tap connection and DESN would be approximately $180M. While this option might provide some system benefit by facilitating Lambton/Sarnia generation, it would necessitate that the west of London bulk reinforcement be along this corridor. The West of London bulk study is not far enough along to conclude that this reinforcement would be optimal for the region. In addition, the timeline does not meet the load projections even with the potential utilization of the existing railway corridor. Thus, this option was not considered for further assessment, however should be considered in the west of London bulk study.

### 5.1.7 Option 7: Tap onto converted N5K

This option would require four parts:

- The conversion of the existing 115 kV circuit N5K from Scott TS to Kent TS into a 230-kV circuit, for a length of approximately 60 km;
- A 230-kV tap connection, of approximately 1.5 km from the converted N5K to either the L28C or L29C circuit;
- The conversion of Wallaceburg TS from a 115 kV to a 230 kV station; and
- A new DESN station on the 230 kV circuits between Wallaceburg and Dover Centre Township.

In terms of the bulk impact, this would facilitate the flow of Sarnia/Scott generation to supply the growing greenhouse loads in Dresden and the Windsor-Essex region. This option would take advantage of the sustainment savings from replacing the N5K circuit, which is reaching end of life by 2025, and also expedite the timeline by utilizing the existing right of way. However, the transformers at Wallaceburg TS were replaced in 2014, which could result in stranded assets were they to be replaced in such quick succession. Overall, the timing and substantive costs for this option are prohibitive solely for a load connection solution and so this option was not considered for further assessment. However, this option does present bulk system benefits, and so should be further considered in the West of London bulk study.

### 5.1.8 Option 8: Upsized Wallaceburg TS

Since the existing capacity at Wallaceburg TS is fully committed, more capacity could be provided by upsizing the station transformers from 25/42 MVA to 50/83 MVA. The transformers at Wallaceburg TS were replaced in 2014, which could result in stranded assets were they to be replaced in such quick succession. However, Hydro One Transmission has the ability to repurpose the equipment elsewhere on the system. As a further measure, an interim scheme could be set up to fully utilize the transformer capacity with a lower level of reliability, by rejecting load above the transformer station capacity following a contingency.

Aside from the transformer upsizing, the following would also be required:

- Upgrades to the gas insulated switchgear (GIS) on the low voltage yard;
- Addition of low voltage capacitors;
- Reconductoring of N5K; and
- Expansion of the distribution system to connect the new loads.

Wallaceburg TS, being at the end of a single radial 115 kV circuit, is sensitive to low voltage concerns which would be the limiting factor for how much additional capacity would be feasible from this option. The potential capacity may be further limited by the minimum voltages required to be maintained during outage conditions, when Wallaceburg load is transferred to S2N, or Tilbury load is transferred to N5K. However, this is a low-cost solution with the closest timeline match, and so this option should be considered through a technical assessment.

### 5.1.9 Option 9: Supply from Duart TS

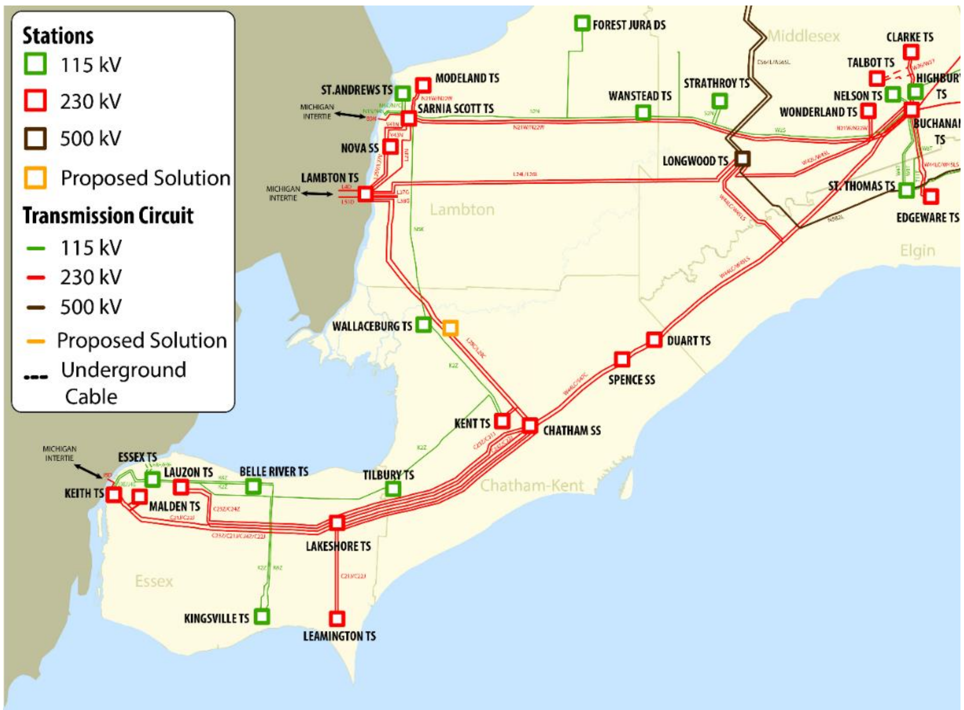
After Wallaceburg TS, Duart TS is the next closest supply station to the Dresden area. There is existing capacity at Duart TS which could be used to supply Dresden through approximately 40 km of distribution feeders. There are three main issues resulting from the long length of distribution feeders. Firstly, the loads would be subject to poor reliability, since the probability of customer interruptions is proportional to distribution length. Secondly, long feeders would result in low voltage concerns, requiring multiple voltage regulators and the expansion of the low voltage yard at Duart TS to compensate for this. Finally, the direct path from Duart TS to Dresden would go through rivers, railways and First Nations land, which would impact the route lengths, easements, and ability to secure right of ways. Based on the technical concerns and high cost, this option was not considered for further assessment.

## 5.2 Technical Assessment

### 5.2.1 Option 1: DESN on L28C/L29C

A representation of this option is depicted in Figure A3-3 below, location assumptions were made for study purposes, but if recommended the final design would be subject to standard approval processes.

#### Figure A3-3: Diagram of Option 1, DESN on L28C/L29C




A thermal assessment indicates that any additional loading on the L28C/L29C circuits would result in an almost 1:1 reduction in load served in the Windsor-Essex region. This would exacerbate the existing limiting contingency and the need for bulk reinforcement.

Currently, under the load projections for the Leamington area itself irrespective of the new Dresden loads, for an outage to either L28C or L29C, the next double contingency (W44LC/S47C) could overload the remaining circuit. In addition, under certain resource dispatch conditions with all elements in service, the loss of L28C or L29C would result in thermal overloads on the remaining LxC circuit. Any new loads added to the Dresden area with this option would exacerbate those issues. Thus, in order to facilitate the connection of load prior to a bulk reinforcement being in place, any new load added to this path would need to be rejected following a contingency. This interim scheme would result in a lower level of reliability. This would be in violation of ORTAC load security requirements, and thus would need an exemption until a bulk reinforcement is in place to alleviate this violation. Given that the area is defined as part of the bulk power system, NPCC requirements prevent the scheme from being used with all elements in service. So a further exemption from NPCC would be required until a bulk reinforcement is in place. There is more risk involved in this process, given the larger group of stakeholders potentially affected. Both exemptions would be contingent on the publication of a bulk reinforcement plan. This would be the outcome of the west of London bulk study, which is targeted to be complete by the end of this year.

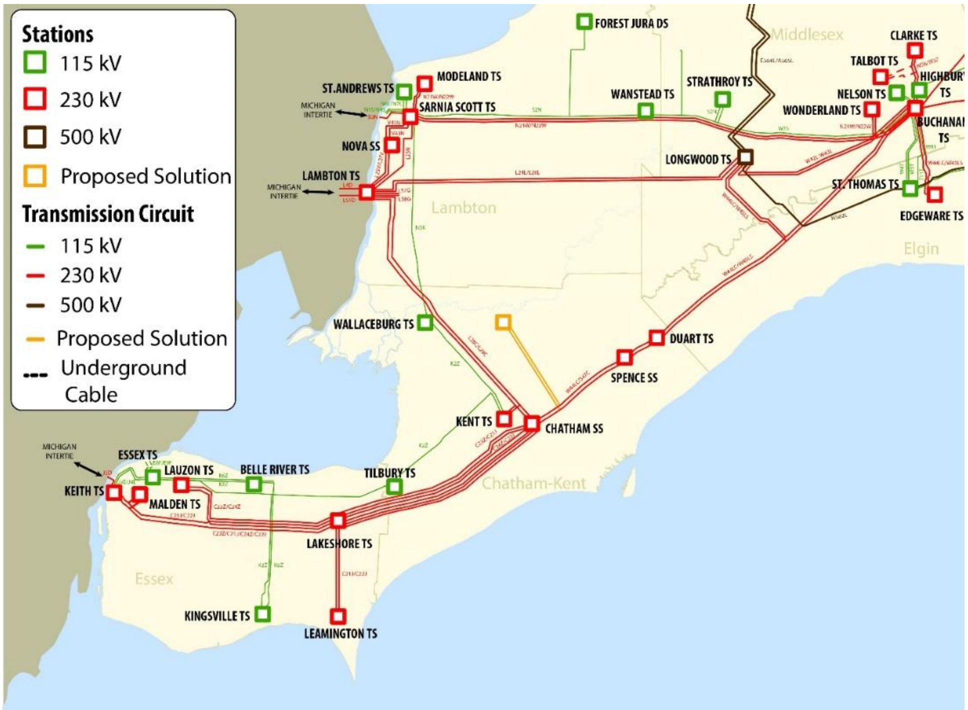
However, this is the least-cost option that would meet the firm load forecast within a reasonable timeframe. This option offers three main advantages. First, it requires the minimum set of infrastructure to meet the firm load forecast, with no stranded assets regardless of the ultimate bulk reinforcement. If further load projections are realized in the Dresden area, this investment could accommodate double the firm load forecast, and would not preclude any bulk reinforcements. Alternatively, if load growth were to fall short of projections this option would not result in stranded assets of tap lines or upgraded equipment, as would be the case with other options considered. Secondly, concentrating near-term capacity expansion in this area serves the dual purpose of serving new load growth in Dresden, as well as alleviating capacity at Kent TS. This would facilitate further growth in Chatham-Kent, particularly in Dresden and south of Chatham proper where there have been indications of further growth. Finally, this option is both the fastest and the least-cost solution that would enable customers to be connected promptly.

Overall, despite the interim lower level of reliability and risk of delay dependent on the bulk study, this option is technically feasible. Given the added benefits detailed above, it would be a reasonable solution.

### 5.2.2 Option 4: Tap onto W44LC/S47C

A representation of this option is depicted in Figure A3-4 below, location assumptions were made for study purposes, but if recommended the final design and routing would be subject to standard approval processes.

**Figure A3-4: Diagram of Option 4, Tap onto W44LC/S47C**




Currently, the most limiting contingency in the area is the loss of the W44LC/W45LS double contingency, which would cause the L28C/L29C circuits to exceed their short-term emergency ratings. The addition of load on W44LC/S47C would result in the new load being on a single supply from Chatham (on S47C) following the loss of W44LC/W45LS double contingency. This would add to the pre-existing L28C/L29C thermal limitation and offer no advantages to Option 1 and would require the added expense of building a new 20 km double 230 kV tap.

Given the additional cost and lead time, this option has no advantages to Option 1 and thus is not preferred.

### Option 4 Variation A: Tap onto W44LC/W45LS with 230 kV tap Connection

In order to alleviate the issue identified above, the connection point along the corridor must be east of Spence SS so that the new station does not remain on single supply from Chatham TS after a W44LC/W45LS contingency. As long as the additional load on W44LC/W45LS does not result in the limiting contingency becoming thermal overloads on the W44LC/W45LS circuits for the loss of the L28C/L29C circuits, this option does exacerbate the bulk system limitation. A thermal assessment indicates that even with an additional 200 MW of load tapped on W44LC/W45LS plus Duart TS fully loaded to 200 MW, there were no post contingency thermal violations. Table A3-8 shows the post-contingency loading of the most stressed circuit sections following an L28C/L29C contingency.

### Table A3-8: Thermal Assessment Results (L28C/L29C N-2 Post Contingency Loading)

| Circuit Section | Loading [% of STE Rating] |
|---|---|
| W44LC Cowal Junction to Dresden Tap/Duart TS | 93% |
| W45LS Cowal Junction to Dresden Tap/Duart TS | 93% |

Note that with this 200 MW additional load at Dresden supplied from a radial tap, post-contingency flow on J5D increased to approximately 360 MW eastward into Ontario, from the original 0 MW pre-contingency flow. This flow is approaching the J5D thermal limit; additional load connected to the W44LC/W45LS circuits above this level is not recommended.

There may also be local voltage issues at the end of the radial tap circuits depending on how much load is connected and the reactive compensation deployed. For example, Table A3-9 shows the post-contingency voltages at the new DESN located at the end of the radial tap following a L28C/L29C contingency. The study assumed a 21.6 MVar capacitor bank at both low voltage buses. The low voltage buses are very close to violating the 10% post-contingency voltage change criteria.

### Table A3-9: New Dresden Area TS Post L28C/L29C N-2 Contingency Voltages

| Bus | Pre-Cont. Voltage | Post Cont. Voltage | % Change | Max Post-Cont. Voltage | Min Post-Cont Voltage |
|---|---|---|---|---|---|
| High voltage Bus 1 | 233 | 214.7 | 8% | 250 | 207 |
| High voltage Bus 2 | 233 | 214.8 | 8% | 250 | 207 |
| Low voltage Bus 1 | 27.5 | 25.0 | 9% | 30.9 | 24.3 |
| Low voltage Bus 2 | 27.5 | 25.0 | 9% | 30.9 | 24.3 |

This option would supply the new load without interim measures, resulting in a load security and restoration level consistent with the rest of the Ontario system. While this option would not have a detrimental impact on the bulk system, there is a significant cost and time associated with it. In addition, the investment in the tap connection would not serve as part of a bulk reinforcement solution since it does not connect to a central transmission hub, like Chatham SS. Thus, this is a feasible option, however the benefit of a reliable load connection at this stage (as opposed to post-bulk reinforcement) and risk of project delay dependent on the bulk study completion must be balanced with the cost to the customer.

### Option 4 Variation B: Tap onto W44LC/W45LS with Distribution Connection

Another variation of this option would be to build a DESN directly on the W44LC/W45LS circuits at the location were the tap line in Variation A begins, i.e. east of Spence SS. Instead of the 230 kV tap connection, distribution feeders could be used to connect to the Dresden load. Duart TS is less than 10 km east of Spence SS and has available capacity currently at the station. Thus, to build another station between Spence SS and Duart TS is redundant. For reasons explained in Section 5.1.9, supplying the new load from Duart TS is not feasible.

### 5.2.3 Option 8: Upsized Wallaceburg TS

A steady state voltage assessment found that more than 60 MW load at Wallaceburg TS would result in a voltage depression at Wallaceburg TS. This is the equivalent of an additional 20 MW of load from the current station winter peak and equivalent to the current station winter capacity. Thus, no additional load can be enabled through this option beyond the existing capacity of the station that has been allocated to Hydro One Distribution. A summary of the post-contingency voltages is provided in Table A3-10.

**Table A3-10: Voltage Assessment Study Results – All Elements In-service**

| Bus | Loading [MW] | Voltage [kV] | Maximum Continuous Voltage [kV] | Minimum Continuous Voltage [kV] |
|---|---|---|---|---|
| Wallaceburg | 41 | 119 | 127 | 113 |
| Wallaceburg | 50 | 117 | 127 | 113 |
| Wallaceburg | 60 | 113 | 127 | 113 |
| Wallaceburg | 70 | 111 | 127 | 113 |

According to the current System Control Order, under a N5K outage condition a maximum of 30 MW of load can be maintained at Wallaceburg TS when supplied from K2Z. Similarly, when Tilbury West DS load is transferred to N5K the maximum allowable loading on N5K is 50 MW. Outages will need to be planned for off-peak timeframes when load is below this level, subject to a detailed assessment of the particular configuration at the time.

**Option 8 Variation A: Autotransformers connecting N5K to Kent TS**

Another variation of this option considered upsizing Wallaceburg TS and connecting the 115 kV circuit N5K to Kent TS through autotransformers. This would provide additional voltage support via Kent TS. Pre-contingency, the amount of load that could be added to this path is approximately 140 MW before hitting both the thermal limit of N5K and low voltage limit at Wallaceburg TS as show in Table A3-11. However, this configuration causes N5K to become an 115 kV parallel path to the L28C/L29C circuits. The L28C/L29C circuits are already the thermally limiting element for the West of Chatham transfer capability. Under a 1,500 MW West of Chatham flow condition, after the loss of W44LC/W45LS, N5K is thermally overloaded with only 30 MW of load at Wallaceburg TS, as shown in Table A3-12.

**Table A3-11: Thermal and Voltage Study Results (Pre-Contingency)**

| Bus | Loading [MW] | Voltage [kV] | N5K Thermal Loading [% Cont. Rating] | Maximum Continuous Voltage [kV] | Minimum Continuous Voltage [kV] |
|---|---|---|---|---|---|
| Wallaceburg | 130 | 114.3 | 93% | 127 | 113 |
| Wallaceburg | 135 | 113.8 | 96% | 127 | 113 |
| Wallaceburg | 140 | 113.1 | 98% | 127 | 113 |
| Wallaceburg | 145 | 112.6 | 100% | 127 | 113 |

**Table A3-12: Thermal and Voltage Study Results (Post W44LC/W45LS Contingency)**

| Bus | Loading [MW] | Voltage [kV] | N5K Thermal Loading [% STE Rating] | Maximum Continuous Voltage [kV] | Minimum Continuous Voltage [kV] |
|---|---|---|---|---|---|
| Wallaceburg | 30 MW | 113.4 | 98% | 127 | 113 |
| Wallaceburg | 35 MW | 113.3 | 100% | 127 | 113 |
| Wallaceburg | 40 MW | 113.2 | 101% | 127 | 113 |

This variation increases the cost by $12M bringing the total cost of this option to $87M. Due to the thermal limitations created by the parallel 115 kV path, load supply beyond 40 MW is not possible. Thus, this variation is not feasible.

**Option 8 Variation B: Additional Capacitors at Wallaceburg TS**

In order to compensate for the low voltage concerns, another variation that was considered was the installation of a high voltage capacitor at Wallaceburg TS. Typical commercially available high voltage capacitors range from 96 – 210 MVar. Based on study results, switching in even a 50 MVar high voltage capacitor would violate the 4% steady state change criteria of the delivery point bus, as stipulated in ORTAC Sec 4.3. This would also exceed the upper voltage limit of the Wallaceburg low voltage bus. Thus the addition of a high voltage capacitor and an associated bus at Wallaceburg TS is not a feasible option.

An alternate would be to add low voltage capacitors at Wallaceburg TS. This would eliminate the reactive element switching change violation. It was found that the addition of every 10 MVar of reactive power would enable the supply of an additional 10 MW of load at Wallaceburg TS, with a corresponding $1.5M per capacitor.

However, there is a limit to the number of low voltage capacitors that can be added to Wallaceburg TS. The current station configuration of Wallaceburg has no available space for another element or bus and the station itself it surrounded by a road to the north, and residential houses and farmland in the other directions. The cost for land procurement, station expansion, and bus construction would further increase the cost and timeline of this option. Thus this option is not feasible.

## 6. Conclusions and Recommendations

In consultation with the transmitter and distributor, nine options were considered to supply the firm load forecast for Dresden. Feasibility screening of available options was conducted based on providing:

- An economically feasible option for the customer(s) who would bear the costs;
- A viable timeline to meet the imminent capacity needs; and
- A system that leaves the bulk options open until a study can be completed to determine the most appropriate bulk reinforcement option.

Of the options considered, the following three were selected for further technical assessment:

- Option 1: DESN on L28C/L29C
- Option 4: Tap onto W44LC/S47C
- Option 8: Upsize Wallaceburg TS

Option 1 is the most feasible approach to address the Dresden load capacity need for the following reasons:

- It is the minimum set of infrastructure that meets the firm capacity need with no stranded assets, regardless of the bulk reinforcement;
- It enables further load growth in the area and in the Chatham-Kent area; and
- It is the least-cost option that would enable customers to be connected promptly.

However, prior to bulk reinforcement, any load additions to this path would require similar interim measures to the Kingsville-Leamington loads, with a corresponding lower level of reliability. Further, there is the added risk to project approvals and timelines since an exemption approval would be required to implement interim measures, which is contingent on the having a west of London bulk plan public as evidence of how the exemption would be remedied.

Option 4 is not preferred since it would not be timely or cost-effective. In order to avoid the bulk issue, the optimal location for load on this path would be east of Spence SS, such that the load is shed by configuration following a contingency. This would bypass the bulk problem, however, in order to do so, a lengthy 20 km tap line would be required, solely for the purposes of this load connection. This would not help the bulk transmission system or form part of a bulk reinforcement option, and once bulk reinforcements are in-place, this would be a stranded asset. The other alternative would be to use distribution feeders instead of the tap connection, however this would result in voltage concerns and low reliability due to the feeder length required.

Option 8 is not preferred since it cannot feasibly supply the firm load forecast. This option would bypass the bulk system concerns, however it would require significant upgrades to Wallaceburg equipment, the connecting circuit, and procurement and expansion of the station property itself. Beyond that, circuit upgrades or conversion of the circuit and station to 230 kV is a potential bulk reinforcement option, which would strand the majority of these costs.

Another alternative would be to defer the choice of a connection point until after the west of London bulk study is complete. There is the possibility that the recommendations from the bulk study could result in a better and more integrated connection point not assessed or even within the realm of this study scope. This would also support the approval of the connection point, rather than being contingent on future study results as with option 1.

Overall, there are two potential routes depending on the level of risk tolerance:

- Proceed with the design and build work for a DESN on the L28C/L29C circuits, with the caveat that the final connection is contingent on the publication of a west of London bulk study and accompanying recommendation for addressing bulk system needs – Not recommended;
- Incorporate the connection of this load in the west of London bulk study and re-evaluate the connection of this load as part of the bulk study - Recommended.

Proceeding with a connection and corresponding System Impact Assessment (SIA) ahead of the bulk study and regional coordination, this would be subject to the following risks:

- **Risk to load security:** Prior to a bulk reinforcement, interim measures will be required which will result in a lower level of reliability.
- **Risk to timelines:** The use of these interim measures will require a temporary exemption from ORTAC criteria and NPCC's criteria. Approval is contingent on a plan detailing the manner and time within which the exemption applicant will become compliant. A plan would require bulk reinforcement, which would be developed through the west of London bulk study. This study is on-going, but is interconnected with the Chatham-Kent/Lambton/Sarnia regional planning process, so timelines are not firm.
- **Risk to approval:** Interim measures will also take into account any costs that may be imposed on the IESO or on other market participants if the exemption were granted. Prior to a bulk reinforcement, the market solution to supply new loads in this area while respecting thermal limitations may result in higher market costs. New loads would require similar interim measures and exemptions as loads currently connecting in the Leamington area.

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