CAPITAL PROJECT SUMMARY SHEET

SYSTEM RENEWAL

Project Number:	19A2
Project Name:	Battery Bank Replacement
Start Date:	Jan-19
In-Service Date:	Dec-19

Project Title: Battery Bank Replacement Program

Supporting Reference Material: 2017 Substation Assessment Report

Description: Battery banks installed in substations provide DC power to enable the operation of circuit breakers and relays during a power failure. The batteries are inspected annually and tested once every four years. Battery banks are replaced based on age and condition. This program to replace battery banks will continue 2019 through 2021.

PRIMARY DRIVER: Reliability

OTHER DRIVERS: Safety

CUSTOMERS IMPACTED: 650

OEB CAPITAL REPORTING:

A2 - Battery Bank Replacements

COST ESTIMATE - BY YEAR

	COST	AREA/SCOPE
2012	$15,435	
2013	$11,427	
2014	$11,019	
2015	$12,065	
2016	$13,518	
2017	$11,356	One Substation
2018	$13,000	One Substation
2019	$15,000	One Substation
2020	$15,000	
2021	$15,000	
TOTAL COST ESTIMATE:		$132,820

LH PROJECT DRIVER: REL

LH SECTION # 110

CAPITAL PROJECT SUMMARY SHEET

SYSTEM RENEWAL

Project Number:	19A2
Project Name:	Battery Bank Replacement
Start Date:	Jan-19
In-Service Date:	Dec-19

Project Title: Battery Bank Replacement Program

Risks to Completion & Mitigation Plan:

Risks to completion are minimal. This project is part of a program that has been successfully executed in each of the past five years. The availability of resources (internal labour) is sufficient to complete this project.

EVALUATION OF OUTCOMES:

Efficiency, Customer Value, Reliability	Replacing battery banks enhances the reliability of protection relays, which ensures that faults are addressed in a manner that minimizes customer interruptions.
Safety	Replacing battery banks ensures that DC power will be available to operate feeder protections, which are required to isolate faults.
Cyber-Security, Privacy	Not Applicable
Co-ordination, Interoperability	Not Applicable
Economic Development	Not Applicable
Environmental Benefits	Not Applicable

IMPACT TO O&M COSTS:

Slight reduction by reducing the probability of unplanned failures through planned replacement.

ALTERNATIVES CONSIDERED:

Do nothing; however, this alternative was rejected since it is believed that the costs of unplanned failures outweigh the cost of the program.

LINK TO STRATEGIC PLAN:

Section 6.2.1 - Emphasis on Reliability

CUSTOMER ENGAGEMENT:

Customers were not directly engaged regarding this project, but recent surveys indicate customers value improvements to reliability (refer to DSP Section 3.2.4 Customer Engagement).

CAPITAL PROJECT SUMMARY SHEET

SYSTEM RENEWAL

Project Number:	19A2
Project Name:	Battery Bank Replacement
Start Date:	Jan-19
In-Service Date:	Dec-19

Project Title: Battery Bank Replacement Program

Additional Information:

Not Applicable

Prepared By:	**Ismail Sheikh, P.Eng.** **Systems Engineer**
Approved By:	**William Milroy, P.Eng.** **V.P. Engineering & Operations**

CAPITAL PROJECT SUMMARY SHEET

SYSTEM RENEWAL

Project Number:	19A3
Project Name:	Substation RTU Standardization
Start Date:	Jan-19
In-Service Date:	Dec-19

Project Title: Substation RTU Standarization Program

Supporting Reference Material: 2017 Substation Assessment Report

Description:

London Hydro trialed a number of different substation remote terminal units (RTUs) before selecting a standard design in 2011. Many of the trial RTUs are no longer supported by the manufacturer and London Hydro has insufficient experience or spare components to sustain them.

To ensure that London Hydro is able to continuously support SCADA to enhance system reliability for customers, a new program was developed to replace all unique substation RTUs. From 2019 through 2021 a program of RTU replacements will carry on at various substations.

PRIMARY DRIVER:	Interoperability
OTHER DRIVERS:	Efficiency
	Reliability
	Customer Value
CUSTOMERS IMPACTED:	2
OEB CAPITAL REPORTING:	A11 - Vault and RTU Renewal
LH PROJECT DRIVER:	REL

COST ESTIMATE - BY YEAR

	COST	AREA/SCOPE
2012	$0	
2013	$0	
2014	$0	
2015	$30,000	2 Substations
2016	$38,050	2 Substations
2017	$30,000	2 Substations
2018	$73,900	2 Substations
2019	$80,000	2 Substations
2020	$80,000	2 Substations
2021	$80,000	2 Substations
TOTAL COST ESTIMATE:		$411,950

LH SECTION # 110

CAPITAL PROJECT SUMMARY SHEET

SYSTEM RENEWAL

Project Number:	19A3
Project Name:	Substation RTU Standardization
Start Date:	Jan-19
In-Service Date:	Dec-19

Project Title: Substation RTU Standarization Program

Risks to Completion & Mitigation Plan:

Risks to completion are minimal. This project is part of a program that has been successfully executed in each of the past five years. The availability of resources (internal labour) is sufficient to complete this project.

EVALUATION OF OUTCOMES:

Efficiency, Customer Value, Reliability	Standarizing RTUs generates efficiencies in employee training and spare inventory, while increasing reliability by means of reduced repair times achieved through greater staff familiarity with the equipment.
Safety	Not Applicable
Cyber-Security, Privacy	New equipment
Co-ordination, Interoperability	The RTUs will be secured in accordance with London Hydro's cyber security practices.
Economic Development	Not Applicable
Environmental Benefits	Not Applicable

IMPACT TO O&M COSTS:

Slight reduction as training costs decrease due to equipment standardization.

ALTERNATIVES CONSIDERED:

Do nothing; however, this alternative was rejected since it does not address the need to be able to reliably maintain the SCADA system.

LINK TO STRATEGIC PLAN:

Section 6.2.1 - Emphasis on Reliability

CUSTOMER ENGAGEMENT:

Customers were not directly engaged regarding this project, but recent surveys indicate customers value improvements in reliability (refer to DSP Section 3.2.4 Customer Engagement).

CAPITAL PROJECT SUMMARY SHEET

SYSTEM RENEWAL

Project Number:	19A3
Project Name:	Substation RTU Standardization
Start Date:	Jan-19
In-Service Date:	Dec-19

Project Title: Substation RTU Standarization Program

Additional Information:

Not Applicable

Prepared By:	**Ismail Sheikh, P.Eng.** **Distribution Engineer**
Approved By:	**William Milroy, P.Eng.** **V.P. Engineering & Operations**

CAPITAL PROJECT SUMMARY SHEET

SYSTEM RENEWAL

Project Number:	19A6
Project Name:	Municipal Transformer Station
Start Date:	Jan-19
In-Service Date:	Dec-19

Project Title: Station Conversion Program

Supporting Reference Material:
4.16 kV Conversion Plan - 2018 Update, Plan for Rear Lot to Front Lot Conversion (2018)
Electric Distribution System Asset Sustainment Plan: 2015-2029 (2014)
2017 Substation Assessment Report

Description:

The 4.16kV infrastructure is gradually being phased out due to its limited capacity, inability to serve load growth, and the high system losses associated with it. Priority zones A, B, C, and D have been identified based on a coordinated approach using multiple evaluation factors such as age and condition of assets, reliability and system performance, and operational flexibility.

The Station Conversion Program will require coordination with 4.16 kV overhead and underground conversion projects in Sections B and G.

PRIMARY DRIVER:	Reliability
OTHER DRIVERS:	Safety
	Efficiency
	Customer Value
	Environmental
CUSTOMERS IMPACTED:	Varies

OEB CAPITAL REPORTING:

A4 - Station Refurbish / New

COST ESTIMATE - BY YEAR

	COST	AREA/SCOPE
2012		
2013		
2014		
2015		
2016		
2017		
2018		
2019	$37,000	
2020		
2021		
TOTAL COST ESTIMATE:		$37,000

LH PROJECT DRIVER:	REL
LH SECTION #	110

CAPITAL PROJECT SUMMARY SHEET

SYSTEM RENEWAL

Project Number:	19A6
Project Name:	Municipal Transformer Station
Start Date:	Jan-19
In-Service Date:	Dec-19

Project Title: Station Conversion Program

Risks to Completion & Mitigation Plan: Risks to completion are minimal. The availability of resources (internal labour) is sufficient to complete this project.

EVALUATION OF OUTCOMES:

Efficiency, Customer Value, Reliability	Conversion by zones allows us to offload multiple substations that provide backup to each other during the same time interval, so decommissioning is possible which will reduce system losses and O&M costs.
Safety	Removing aged and degraded high voltage switchgear and transformers improves safety for both the public and staff.
Cyber-Security, Privacy	Not Applicable
Co-ordination, Interoperability	Not Applicable
Economic Development	Not Applicable
Environmental Benefits	Environmental benefits include elimination of deteriorated station transformers, which might have bushings that are leaking oil.

IMPACT TO O&M COSTS:

Reduction in O&M costs are expected by removing aged and degraded switchgear and transformers.

ALTERNATIVES CONSIDERED:

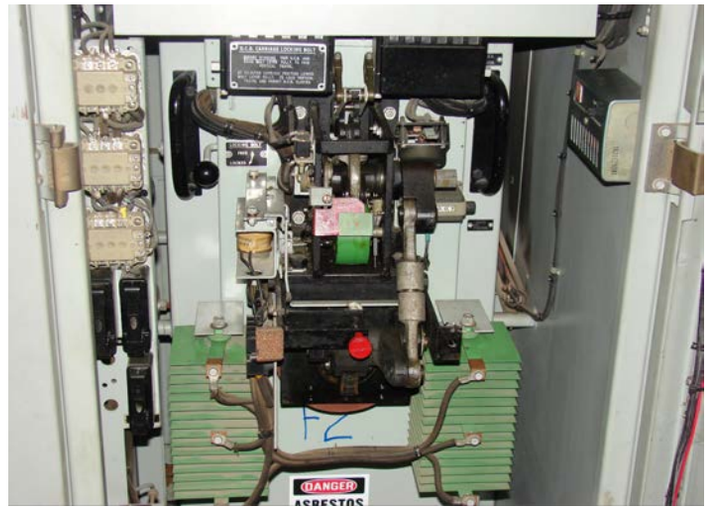
Do nothing; however, this alternative was rejected since it is believed that the safety and environmental costs of failures outweigh the cost of the program.

LINK TO STRATEGIC PLAN:

Section 6.2.1 - Emphasis on Reliability

CUSTOMER ENGAGEMENT:

Customers were not directly engaged regarding this project, but recent surveys indicate customers value improvements to reliability (refer to DSP Section 3.2.4 Customer Engagement).



CAPITAL PROJECT SUMMARY SHEET

SYSTEM RENEWAL

Project Number:	19A6
Project Name:	Municipal Transformer Station
Start Date:	Jan-19
In-Service Date:	Dec-19

Project Title: Station Conversion Program

Additional Information:

Not Applicable

Prepared By:	**Ismail Sheikh, P.Eng.** **Systems Engineer**
Approved By:	**William Milroy, P.Eng.** **V.P. Engineering & Operations**

CAPITAL PROJECT SUMMARY SHEET

SYSTEM RENEWAL

Project Number:	19B1
Project Name:	Cable Silicone Injection
Start Date:	Jan-19
In-Service Date:	Dec-19

Project Title: Silicone Injection of Underground Cable

Supporting Reference Material:
Rehabilitation of Aging Underground Residential Distribution System: Addendum 2018
SPOORE Analysis - Methodology and Outcome
Electric Distribution System Asset Sustainment Plan: 2015-2029 (2014)

Description:

Silicone injection technology increases the lifespan of polymeric cable by adding another 40 years of service. This project covers the rehabilitation of medium-voltage polymeric cable by means of silicone injection in three (3) subdivisions serviced at 27.6kV. The total cable length is estimated to be 11 km; all of the cable is 25+ years old. Subdivisions were selected using SPOORE analysis, which encompasses reliability, safety, risk and aging of the underground cable. The analysis is based on a multi-year performance window which takes into account age and failures of cables and transformers, and the presence of transformer leakers.

The cable length addressed in this budget item is below the target of 46 km per year of rehabilitated cable that is outlined in the Asset Sustainment Plan. The reduction in budget is temporary in order to reallocate resources to address the increased scope and spending in Project 19C3 and 19F5 to accomodate the Dundas Place project. However, there are 11 km of silicone injection that are part of Subdivision Conversion in 19B2, which will satisfy Novinium's requirement of 20 km of injected cable per year to get a lower rate.

Three subdivisions were selected for silicone injection as part of this budget item for a total of 11 km of cable to be rehabilitated.

The rehabilitation will also include anticipated replacement of 15 single-phase padmounted transformers that are deteriorated, leaking, or do not meet today's standard. The new transformers will be equipped with dual load break switches that provide operation flexibility, and are expected to reduce downtime for customers by allowing more effective switching.

PRIMARY DRIVER:	Reliability
OTHER DRIVERS:	Efficiency
	Customer Value
CUSTOMERS IMPACTED:	Approximately 900 Customers

OEB CAPITAL REPORTING:

B1: Silicone Injection of Underground Cable

COST ESTIMATE - BY YEAR

	COST	AREA/SCOPE
2012	$792,460	2 Subdivisions
2013	$1,847,897	5 Subdivisions
2014	$2,297,219	5 Subdivisions
2015	$1,937,060	8 Subdivisions
2016	$2,370,774	4 Subdivisions
2017	$2,553,843	6 Subdivisions
2018	$1,478,225	4 Subdivisions
2019	$725,000	3 Subdivisions
2020	$1,220,000	5 Subdivisions
2021	$3,546,000	5 Subdivisions
TOTAL COST ESTIMATE:		$18,768,478

LH PROJECT DRIVER:	REL	**LH SECTION #**	145

CAPITAL PROJECT SUMMARY SHEET

SYSTEM RENEWAL

Project Number:	19B1
Project Name:	Cable Silicone Injection
Start Date:	Jan-19
In-Service Date:	Dec-19

Project Title: Silicone Injection of Underground Cable

Risks to Completion & Mitigation Plan: Resource availability (internal and contract) is the biggest risk to completion. Mitigation plan includes a multi-year contract with external resources and regular coordination meetings with Engineering and Operations.

EVALUATION OF OUTCOMES:

Efficiency, Customer Value, Reliability	Cable injection has been found to be more economical than cable replacement. Reliability will improve with fewer outages caused by cable failures. Upon completion, customers will receive more reliable service.
Safety	Impact to safety is minimal with a slight decrease in risk to workers handling cables and other equipment.
Cyber-Security, Privacy	Not applicable
Co-ordination, Interoperability	Cable injection is a solution for rejuvenating aging cable that is widely used among utilities.
Economic Development	Improved reliability will contribute to overall attractiveness of London as a place to live and do business.
Environmental Benefits	Silicone injection is an environmentally friendly solution; the treatment compounds are not flammable and do not pose environmental hazards.

IMPACT TO O&M COSTS:

Annual operating and maintenance costs will have a slight reduction due to fewer outages related to cable failures.

ALTERNATIVES CONSIDERED:

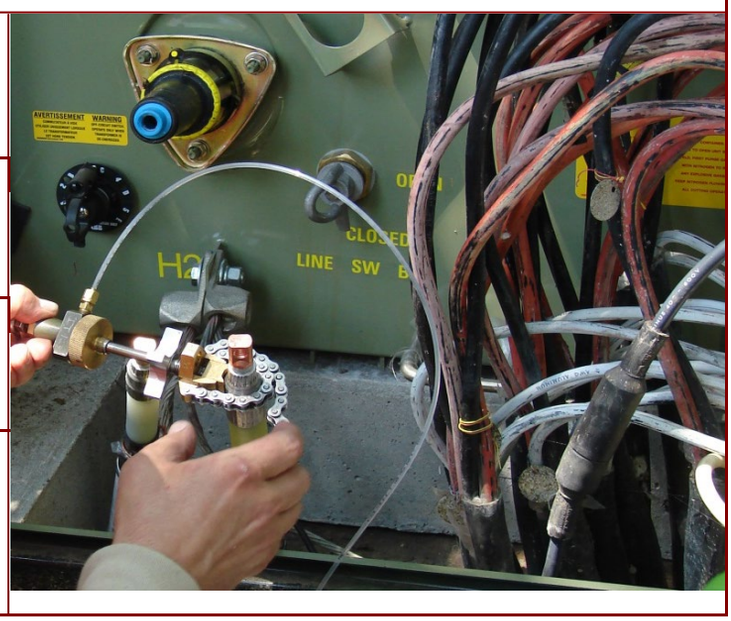
Complete replacement of cables is more expensive, especially if the cables are direct buried and directional boring is required to install ducts.

LINK TO STRATEGIC PLAN:

Section 6.2.1 - Emphasis on Reliability

CUSTOMER ENGAGEMENT:

Customers were not directly contacted regarding this project but recent surveys indicate that customers value improvements in reliability (refer to DSP Section 3.2.4 Customer Engagement).



CAPITAL PROJECT SUMMARY SHEET

SYSTEM RENEWAL

Project Number:	19B1
Project Name:	Cable Silicone Injection
Start Date:	Jan-19
In-Service Date:	Dec-19

Project Title: Silicone Injection of Underground Cable

Additional Information:

1199 Hamilton Rd: 1.7 km, 4 TEs

Oakridge Park West: 4.8 km, 4 TEs

Huntington Meadows: 4.5 km, 7TEs

Prepared By: **Omar Faqhruldin, P.Eng.**
Distribution Engineer

Approved By: **William Milroy, P.Eng.**
Chief Engineer &
V.P. of Operations

CAPITAL PROJECT SUMMARY SHEET

SYSTEM RENEWAL

Project Number:	19B2
Project Name:	Subdivision Rehabilitation
Start Date:	Jan-19
In-Service Date:	Dec-19

Project Title: Subdivision Conversions / Rebuilds with Silicone Injection

Supporting Reference Material:
Rehabilitation of Aging Underground Residential Distribution System: Addendum 2018
SPOORE Analysis - Methodology and Outcome
Electric Distribution System Asset Sustainment Plan: 2015-2029 (2014)

Description:

Subdivision selection is based on comprehensive SPOORE analysis which encompasses elements such as reliability, safety, risk and aging of underground cable. The analysis is based on a multi-year performance window.

New Meadows Phase 1 (4.16 kV Supply)

New Meadows Phase 1 is a subdivision located south of Fanshawe Park Rd. west of Maxwell Crescent and East of North Vernon Ave. Approximately 704 customers are supplied by 11 km of underground primary cable that is 30+ years old. The cable is rated 28 kV but it is energized at 4.16 kV. The cable will be treated with silicone injection and re-energize at 27.6kV. There are thirty nine (39) single-phase padmounted transformers, and five (5) three phase transformers in New Meadows Phase 1; all transformers will be replaced with dual load break switching transformers. In addition, three (3) SEs will be addressed by replacement or elimination.

PRIMARY DRIVER:	Reliability
OTHER DRIVERS:	Efficiency
	Customer Value
CUSTOMERS IMPACTED:	Approximately 700 customers

OEB CAPITAL REPORTING:

B2: Subdivision Conversions / Rebuilds with Silicone Injection

COST ESTIMATE - BY YEAR

	COST	AREA/SCOPE
2012	$2,051,900	3 Subdivisions
2013	$1,830,355	2 Subdivisions
2014	$1,014,866	4 Subdivisions
2015	$1,302,031	1 Subdivision (deferred)
2016	$1,050,862	1 Subdivision
2017	$31,639	--
2018	$70,000	1 Subdivision
2019	$1,964,000	1 Subdivision
2020	$0	-
2021	$900,000	1 Subdivision
TOTAL COST ESTIMATE:		$10,215,653

LH PROJECT DRIVER:	REL	**LH SECTION #**	145

CAPITAL PROJECT SUMMARY SHEET

SYSTEM RENEWAL

Project Number:	19B2
Project Name:	Subdivision Rehabilitation
Start Date:	Jan-19
In-Service Date:	Dec-19

Project Title: Subdivision Conversions / Rebuilds with Silicone Injection

Risks to Completion & Mitigation Plan: Resource availability (internal and contract) is the biggest risk to completion. Mitigation plan includes a multi-year contract with external resources and regular co-ordination meetings with Engineering and Operations.

EVALUATION OF OUTCOMES:

Efficiency, Customer Value, Reliability	Cable replacement is used only to replace the existing 5 kV and 15 kV rated cables and silicone injection is used to rejuvenate the existing 27.6 kV rated cable. By installing new cable/injecting the existing, reliability will improve with fewer outages caused by cable failure. Also, when converted to 27.6 kV, outages will be shorter in duration due to the availability of back up supply for the 27.6 kV. This will result in more reliable service to customers.
Safety	Impact to safety is minimal with a slight decrease in risk to workers handling cables and other equipment.
Cyber-Security, Privacy	Not applicable
Co-ordination, Interoperability	Not applicable
Economic Development	Improved reliability will contribute to overall attractiveness of London as a place to live and do business.
Environmental Benefits	Not applicable

IMPACT TO O&M COSTS:

Annual operating and maintenance costs will have a slight reduction due to fewer outages related to cable failures.

ALTERNATIVES CONSIDERED:

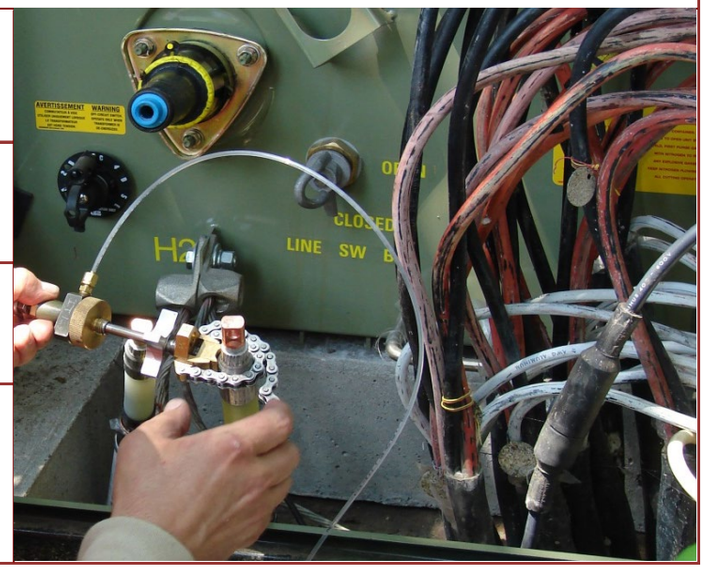
Not applicable

LINK TO STRATEGIC PLAN:

Section 6.2.1 - Emphasis on Reliability

CUSTOMER ENGAGEMENT:

Customers were not directly contacted regarding this project but recent surveys indicate that customers value improvements in reliability (refer to DSP Section 3.2.4 Customer Engagement).



CAPITAL PROJECT SUMMARY SHEET

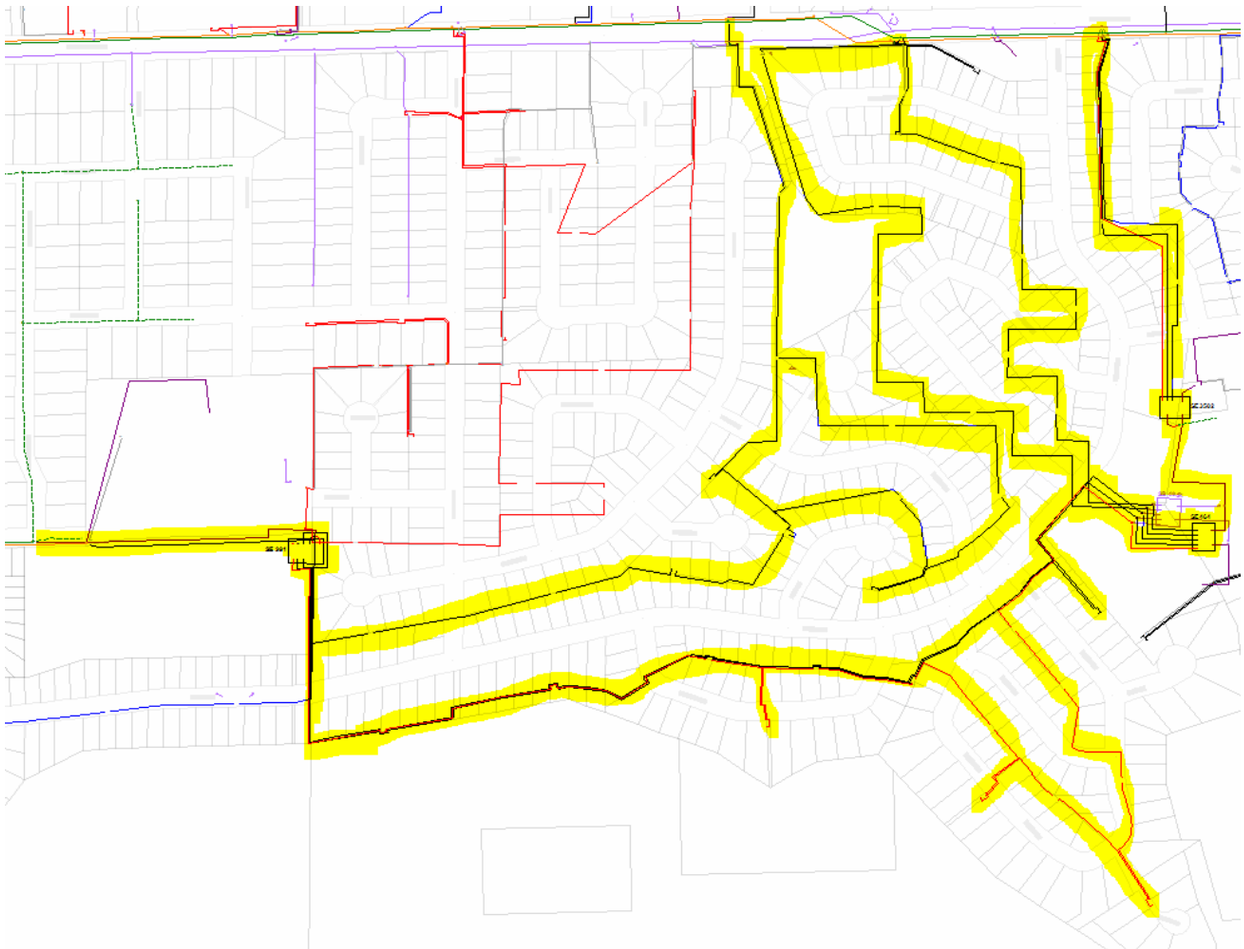
SYSTEM RENEWAL

Project Number:	19B2
Project Name:	Subdivision Rehabilitation
Start Date:	Jan-19
In-Service Date:	Dec-19

Project Title: Subdivision Conversions / Rebuilds with Silicone Injection

Additional Information:

New Meadows Phase 1 (4.16 kV Supply)



Prepared By:	**Omar Faqhruldin, P.Eng.** **Distribution Engineer**
Approved By:	**William Milroy, P.Eng.** **Chief Engineer &** **V.P. of Operations**

CAPITAL PROJECT SUMMARY SHEET
SYSTEM RENEWAL

Project Number:	19B3
Project Name:	Replacement/Removals of SE's
Start Date:	Jan-19
In-Service Date:	Dec-19

Project Title: Replacement of Air Insulated Sectionalizing Enclosures (SEs)

Supporting Reference Material:
Distribution Reliability Report: Performance Review and a New Perspective for In-service 27.6 kV Three-Phase Air Insulated Sectionalizing Enclosures (2006)
Electric Distribution System Asset Sustainment Plan: 2015-2029 (2014)
2017 Quality of Supply Report

Description:

Earlier research and analysis into the failures of air insulated switching enclosures on the 27.6 kV system led to the internal publication of an in-depth report at London Hydro in 2006. The findings and recommendations from that report have helped with targeting the elimination of the most prone-to-failure units. The work conducted over more than ten years has shown a remarkably positive impact in performance and failures have decreased. From the time the higher-risk units started to be changed out (2006) to-date, more than 80% of the units have been addressed either by elimination or replacement with a Load Center (LC).

Although London Hydro's plan is to continue to address, on average, 6-8 SE's every year, the reduction in this budget section is temporary in order to reallocate resources to address the increased scope and spending in Projects 19C3 and 19F5 to accomodate Dundas Place project. London Hydro will return to its 6-8 SE's per year in 2020. At this pace, all of the three-phase SE's remaining in service would be addressed in the following 4-5 years.

PRIMARY DRIVER:	Reliability
OTHER DRIVERS:	Safety
	Customer Value
	Efficiency
CUSTOMERS IMPACTED:	Approximately 100 Customers
OEB CAPITAL REPORTING:	B3 - Replace Air Insulated SE's

COST ESTIMATE - BY YEAR

	COST	AREA/SCOPE
2012	$492,254	10 units
2013	$512,101	9 units
2014	$350,101	6 units
2015	$219,588	2 units
2016	$258,757	11 units
2017	$358,480	4 units
2018	$419,437	1 unit
2019	$152,000	1 units
2020	$636,000	
2021	$99,500	
TOTAL COST ESTIMATE:		$3,498,218

LH PROJECT DRIVER:	REL	**LH SECTION #**	145

CAPITAL PROJECT SUMMARY SHEET

SYSTEM RENEWAL

Project Number:	19B3
Project Name:	Replacement/Removals of SE's
Start Date:	Jan-19
In-Service Date:	Dec-19

Project Title: Replacement of Air Insulated Sectionalizing Enclosures (SEs)

Risks to Completion & Mitigation Plan:

Risks to completion are low. This project is part of a program that has been successfully executed in each of the past ten years. The availability of resources (internal and contract) is sufficient to complete this project.

EVALUATION OF OUTCOMES:

Efficiency, Customer Value, Reliability	The removal or replacement of air-insulated switching enclosures (SE) with Load Centers (LC) will lead to fewer outages caused by SE failures. It is expected that customers will receive a more reliable supply.
Safety	Replacing air-insulated switching enclosures (live-front) with solid dielectric load centers (dead-front) will have a positive impact on the system with a considerable decrease in the risk of flashovers.
Cyber-Security, Privacy	Not applicable
Co-ordination, Interoperability	Load Centers are London Hydro standard for distribution switchgear (200A and 600A).
Economic Development	Improved reliability will contribute to the overall attractiveness of London as a place to live and do business.
Environmental Benefits	Not applicable

IMPACT TO O&M COSTS:

Annual operating and maintenance costs will have a slight reduction due to fewer outages caused by SE failures.

ALTERNATIVES CONSIDERED:

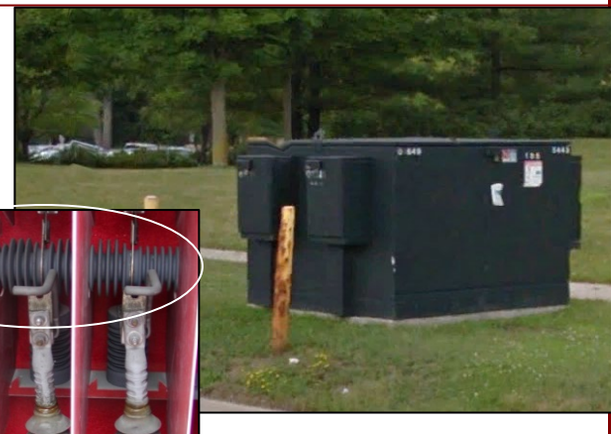
Not applicable

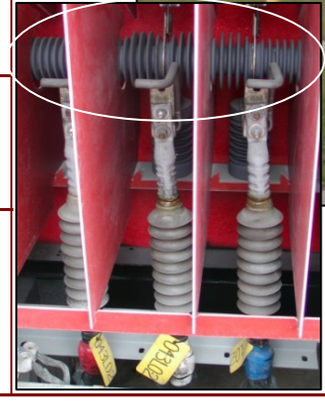
LINK TO STRATEGIC PLAN:

Section 6.2.1 - Emphasis on Reliability

CUSTOMER ENGAGEMENT:

Customers were not directly contacted regarding this project but recent surveys indicate that customers value improvements in reliability (refer to DSP Section 3.2.4 Customer Engagement).





CAPITAL PROJECT SUMMARY SHEET

SYSTEM RENEWAL

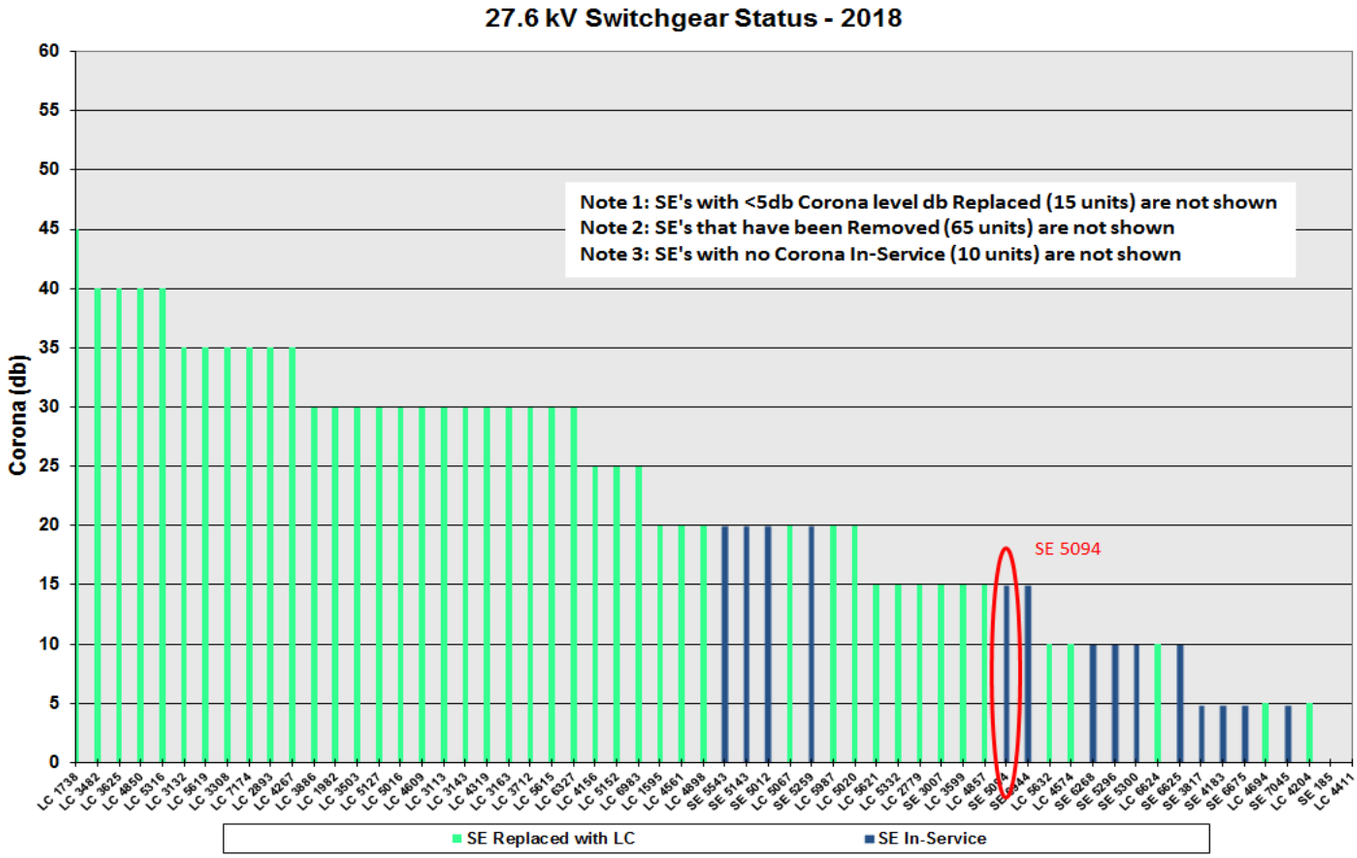
Project Number:	19B3
Project Name:	Replacement/Removals of SE's
Start Date:	Jan-19
In-Service Date:	Dec-19

Project Title: Replacement of Air Insulated Sectionalizing Enclosures (SEs)

Additional Information:

In the last decade London Hydro has addressed three-phase air-insulated switchgear on the 27.6 kV distribution system that were underperforming according to the report issued in 2006. At the end of 2018, of the 148 switching enclosures (SE's) audited at the start of the program, 123 SE's were addressed by removing 64 from the system and replacing 59 with Load Centers (LC's).

This year's budget will address a 200 amp switchgear installed on main feeder SE 5094 by replacing it with a Load Centre.



Prepared By: Omar Faqhruldin, P.Eng.
Distribution Engineer

Approved By: William Milroy, P.Eng.
Chief Engineer &
V.P. of Operations

CAPITAL PROJECT SUMMARY SHEET

SYSTEM RENEWAL

Project Number:	19B4
Project Name:	Transformer Replacement
Start Date:	Jan-19
In-Service Date:	Dec-19

Project Title: Defective/Leaking Transformer Replacements

Supporting Reference Material: Electric Distribution System Asset Sustainment Plan: 2015 to 2029 (2014)
London Hydro Maintenance Inspections

Description:

London Hydro field staff conduct annual audits of padmounted transformers in accordance with the requirements of the Ontario Energy Board. These audits are meant to identify defective or depreciated transformers, as well as transformers which may be weeping oil around the primary and secondary bushings. These matters are usually caused by transformer aging and the degradation of the sealing gaskets, or as a result of rusted bottom cabinets from salty sidewalks.

This project covers the cost to identify and replace fully depreciated and leaking transformers. This budget item also includes funding for the replacement of transformers that have failed in the field and require replacement. This budget item has traditionally also included replacement of polemount units that are leaking or are being found defective in the field throughout the year.

The dollars invested from 2018 through 2021 are in line with the recommendations of the Asset Sustainment Plan to gradually address the aging population of padmounted transformers.

PRIMARY DRIVER:	Environmental
OTHER DRIVERS:	Safety
	Reliability
CUSTOMERS IMPACTED:	Estimated 900-1200
OEB CAPITAL REPORTING	B4 - Replacement of Defective/Leaking Transformers
LH PROJECT DRIVER:	SAF

COST ESTIMATE - BY YEAR

	COST	AREA/SCOPE
2012	$1,047,618	
2013	$892,191	
2014	$737,297	
2015	$1,493,000	
2016	$1,161,332	60-80 units
2017	$866,890	60-80 units
2018	$1,008,000	100+ units
2019	$900,000	80-100 units
2020	$800,000	
2021	$800,000	
TOTAL COST ESTIMATE:		$9,706,328

LH SECTION # 145

CAPITAL PROJECT SUMMARY SHEET

SYSTEM RENEWAL

Project Number:	19B4
Project Name:	Transformer Replacement
Start Date:	Jan-19
In-Service Date:	Dec-19

Project Title: Defective/Leaking Transformer Replacements

Risks to Completion & Mitigation Plan: Resource availability is the biggest risk to completion; London Hydro, if necessary, uses contract resources to address the units in need of replacement in subdivisions.

EVALUATION OF OUTCOMES:

Efficiency, Customer Value, Reliability	Reliability is inherently improved by timely replacement of padmounted transformers that may be on the verge of failure or affecting the environment. This measure is in line with the asset renewal process described by London Hydro in its 15-year Asset Sustainment Plan.
Safety	This item contributes greatly to safety as rusted cabinets (see photo below) which may no longer be tamper proof (and hence, become a hazard to the public and employees for electric contact) are replaced.
Cyber-Security, Privacy	Not applicable
Co-ordination, Interoperability	Discussions with utilities may influence manufacturers to modify the design of transformer cabinets to be more durable to weather, salt and contamination.
Economic Development	Improved reliability will contribute to the overall attractiveness of London as a place to live and do business.
Environmental Benefits	Potentially leaking oil from transformers can contaminate soil or waterways, thus affecting the environment. This measure demonstrates vigilant attention to environmental risks.

IMPACT TO O&M COSTS:

Fewer outages will occur due to transformer failures, with a potential reduction in annual operating and maintenance costs.

ALTERNATIVES CONSIDERED:

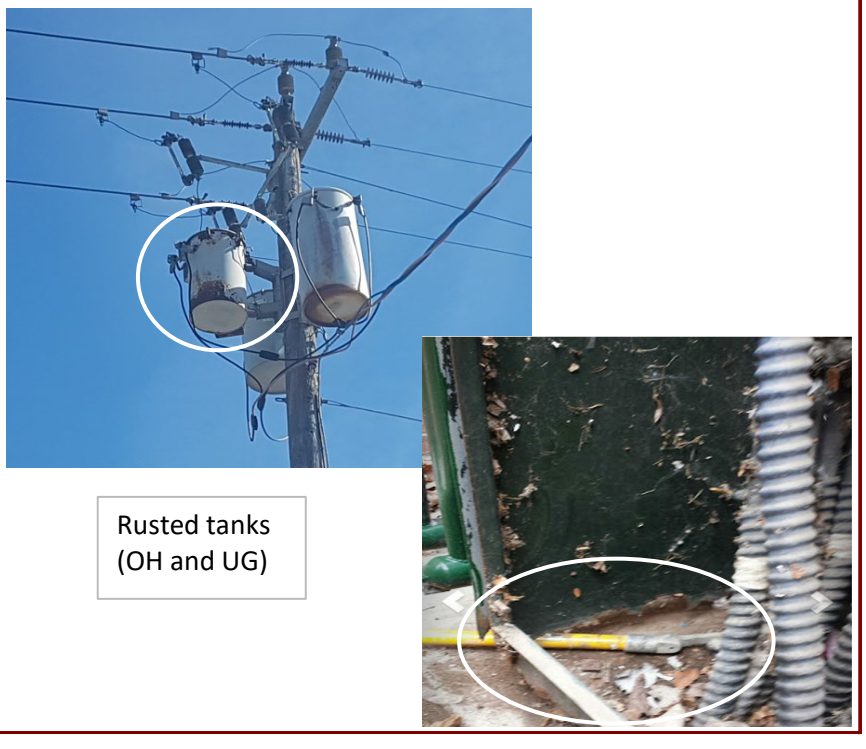
Allowing deteriorated transformers to run to failure can cause additional outages in subdivisions where other components of the system have improved their reliability.

LINK TO STRATEGIC PLAN:

Section 6.2.1 - Emphasis on Reliability and Safety

CUSTOMER ENGAGEMENT:

Customers were not directly contacted for this project but surveys indicate customers value improvements to reliability (refer to DSP Section 3.2.4 Customer Engagement).



Rusted tanks (OH and UG)

CAPITAL PROJECT SUMMARY SHEET

SYSTEM RENEWAL

Project Number:	19B4
Project Name:	Transformer Replacement
Start Date:	Jan-19
In-Service Date:	Dec-19

Project Title: Defective/Leaking Transformer Replacements

Additional Information:

London Hydro performs OEB audits on the condition of all the padmounted transformers in our system every three years. These audits help identify potentially defective/end-of-life or leaking transformers for replacement. London Hydro takes its environmental responsibilities seriously and, as such, continues to invest capital dollars into the identification and removal of these problematic transformers. This budget item also includes funding for the replacement of transformers that have failed in the field or require immediate replacement, prioritized according to audit results.

The cost to replace a typical padmounted transformer ranges between $7,500 and $20,000 depending on the transformer type and size. On average, London Hydro has been replacing approximately 60-80 padmount units per year, in addition to the polemount units that needed to be changed out in emergency. This proposed budget is slightly lower than in previous years; as more budget was allocated to other sections.

Prepared By:	**Omar Faqhruldin, P.Eng.** **Distribution Engineer**
Approved By:	**William Milroy, P.Eng.** **Chief Engineer &** **V.P. of Operations**

CAPITAL PROJECT SUMMARY SHEET SYSTEM RENEWAL

Project Number:	19B5
Project Name:	Secondary Pedestal Replacements
Start Date:	Jan-19
In-Service Date:	Dec-19

Project Title: Replacement of Deteriorated Secondary Pedestals

Supporting Reference Material: Electric Distribution System Asset Sustainment Plan: 2015-2019 (2014)
Annual OEB Field Audits

Description:

London Hydro has a secondary underground distribution system that includes approximately 900 single-phase, low voltage junction pedestals, typically used in residential areas. These pedestals (located in front yard or backyard) house low voltage electrical connections, from one common bus cable to several service cables in order to supply multiple premises. A large majority of these units are in excess of 30-40 years old and are considered to be at the end of life. The outdated metal enclosures are often corroded. It has also been found that the connections and barriers within the existing units are beginning to fail, posing safety risks. Many of the pedestals, however, have not been opened or worked on since the original installation and problems appear when staff have to conduct secondary cable repairs.

This budget item covers the replacement of the most deteriorated units with new non-metalic pedestals. Areas where problems have been experienced in the past, as well as newly discovered units that present safety concerns will be addressed first. This project is supported by the Asset Sustainment Plan that anticipates the need for the secondary system renewal.

PRIMARY DRIVER:	Safety
OTHER DRIVERS:	Reliability
	Customer Value
CUSTOMERS IMPACTED:	Estimated 150
OEB CAPITAL REPORTING:	B7 - Misc. Subdivision Projects

COST ESTIMATE - BY YEAR

	COST	AREA/SCOPE
2012	$33,610	17 Units
2013	$20,456	12 Units
2014	$22,015	12 Units
2015	$25,836	12 Units
2016	$41,719	12 Units
2017	$32,148	10 Units
2018	$26,000	9 Units
2019	$20,000	
2020	$20,000	
2021	$21,000	
TOTAL COST ESTIMATE:		$262,784

LH PROJECT DRIVER:	REL
LH SECTION #	145

CAPITAL PROJECT SUMMARY SHEET SYSTEM RENEWAL

Project Number:	19B5
Project Name:	Secondary Pedestal Replacements
Start Date:	Jan-19
In-Service Date:	Dec-19

Project Title: Replacement of Deteriorated Secondary Pedestals

Risks to Completion & Mitigation Plan: The identification of deteriorated secondary pedestals happens as crews respond to power outages on the secondary system; there is no proactive search to prioritize replacements. This process may result in additional pedestals remaining in the system that could potentially be unsafe. Considering an increase for this budget item in the near future may achieve more of the necessary replacements.

EVALUATION OF OUTCOMES:	
Efficiency, Customer Value, Reliability	Pedestals can be located in the front yard or back yard of residential properties. Deteriorated pedestals often are rusty, crooked or dismantled and in addition to becoming an unsafe electrical enclosure, their failure usually affects more than one household for a longer duration.
Safety	This item contributes greatly to safety as pedestal deterioration can inadvertently expose live conductors to staff and to the public.
Cyber-Security, Privacy	Not applicable
Co-ordination, Interoperability	Not applicable
Economic Development	Improved reliability will contribute to the overall attractiveness of London as a place to live and do business.
Environmental Benefits	There are no direct environmental benefits associated with this program, however, new plastic pedestals (on the right) that replace old metalic units (on the left) could be recycled.

IMPACT TO O&M COSTS:

Fewer power interruptions may occur as a result of eliminating bad pedestals, with a potential reduction in annual operating and maintenance costs.

ALTERNATIVES CONSIDERED:

Allowing deteriorated pedestals to run to failure could increase their life time; however, associated safety concerns lead to replacement sooner rather than later.

LINK TO STRATEGIC PLAN:

Section 6.2.1 - Emphasis on Reliability and Safety

CUSTOMER ENGAGEMENT:

Customers are not directly contacted for this project but surveys indicate customers value improvements to reliability (refer to DSP Section 3.2.4 Customer Engagement).

CAPITAL PROJECT SUMMARY SHEET SYSTEM RENEWAL

Project Number:	19B5
Project Name:	Secondary Pedestal Replacements
Start Date:	Jan-19
In-Service Date:	Dec-19

Project Title: Replacement of Deteriorated Secondary Pedestals

Additional Information:

The underground residential distribution system at London Hydro began to develop in the mid 1960's. With service cables approaching 50-55 years old, associated pedestals of likely the same age are still in service. London Hydro is collecting information on the demographics of the secondary system; future plans may be formulated to begin mass replacement as some services reach end of life. This rebuild process would encompass the elimination of most of the old pedestals, as such, no separate plan is needed to address this aging equipment type.

Prepared By:	**Omar Faqhruldin, P.Eng.** **Distribution Engineer**
Approved By:	**William Milroy, P.Eng.** **Chief Engineer &** **V.P. of Operations**

CAPITAL PROJECT SUMMARY SHEET

SYSTEM RENEWAL

Project Number:	19B6
Project Name:	Vault Rebuilds
Start Date:	Jan-19
In-Service Date:	Dec-19

Project Title: Vault Transformer Replacements

Supporting Reference Material:
Electric Distribution System Asset Sustainment Plan: 2015-2029 (2014)
London Downtown Long-Term 27.6 kV Supply and 13.8 kV Decommissioning Strategy
4.16 kV Aging Infrastructure System Planning Report - 2018 Update (Plan for Rear Lot to Front Lot Conversion)
OEB Audits conducted by field staff

Description:

The Asset Sustainment Report identified various indoor transformer vaults as being in poor condition. These vaults were also inspected by London Hydro staff.

These indoor transformer vaults contain dry-type transformers that are more than forty years old. Our operations staff has identified these locations as having chronic water problems that could result in equipment failure. This budget item will allow for the replacement of these dry-type transformers with padmount or pole mount transformers located outside the vaults. It will also allow for the installation and termination of secondary cables from the new transformation to the new disconnects inside the vaults.

As part of this project, transformer vaults designated as TV 871, located at 1290 Huron St. and TV 1909 at Glen Cairn Arena will be eliminated and the 187kW load will be converted to the 27.6 kV distribution system.

PRIMARY DRIVER:	Safety
OTHER DRIVERS:	Environmental
	Customer Value
CUSTOMERS IMPACTED:	2
OEB CAPITAL REPORTING:	B5 - Rebuild or Convert Vault Areas

COST ESTIMATE - BY YEAR

	COST	AREA/SCOPE
2012	$134,849	6 vaults
2013	$216,173	3 vaults
2014	$91,031	4 vaults
2015	$170,696	5 vaults
2016	$69,589	3 vaults (2 deferred)
2017	$176,364	3 vaults
2018	$30,750	1 vault
2019	$132,600	2 vaults
2020	$174,000	
2021	$288,000	
TOTAL COST ESTIMATE:		$1,484,052

LH PROJECT DRIVER:	SAF	**LH SECTION #**	145

CAPITAL PROJECT SUMMARY SHEET

SYSTEM RENEWAL

Project Number:	19B6
Project Name:	Vault Rebuilds
Start Date:	Jan-19
In-Service Date:	Dec-19

Project Title: Vault Transformer Replacements

Risks to Completion & Mitigation Plan:

Transformer vaults are usually located on customer-owned premises, such as in apartment building basements, school vaults etc; therefore, London Hydro requires permission from the owner to upgrade the service. The mitigation plan is to present the options to the customer and engage the customer in the decision-making process. We will need to ensure the availability of resources to match outage timing dictated by the owner.

EVALUATION OF OUTCOMES:	
Efficiency, Customer Value, Reliability	London Hydro coordinates vault transformer replacements with overhead voltage conversion projects so that the customers are less affected by power interruptions and can further benefit from increased reliability of supply. Removing transformers from customer premises mitigates liability and provides room for the customer.
Safety	Vault transformer replacements achieve the elimination of dry-type transformers, which can be unsafe when maintenance is performed on them since energized components can come in contact with the ground and accumulated water, which also causes corrosion.
Cyber-Security, Privacy	Not applicable
Co-ordination, Interoperability	Co-ordination will be required with customers on whose premises the equipment is found.
Economic Development	Improved reliability will contribute to the overall attractiveness of London as a place in which to live and do business.
Environmental Benefits	Potential environmental benefits include the recycling of the metal components from these old installations.

IMPACT TO O&M COSTS:

Fewer outages can be expected after the supply systems are upgraded to current standards and, hence, annual operating and maintenance costs may be reduced.

ALTERNATIVES CONSIDERED:

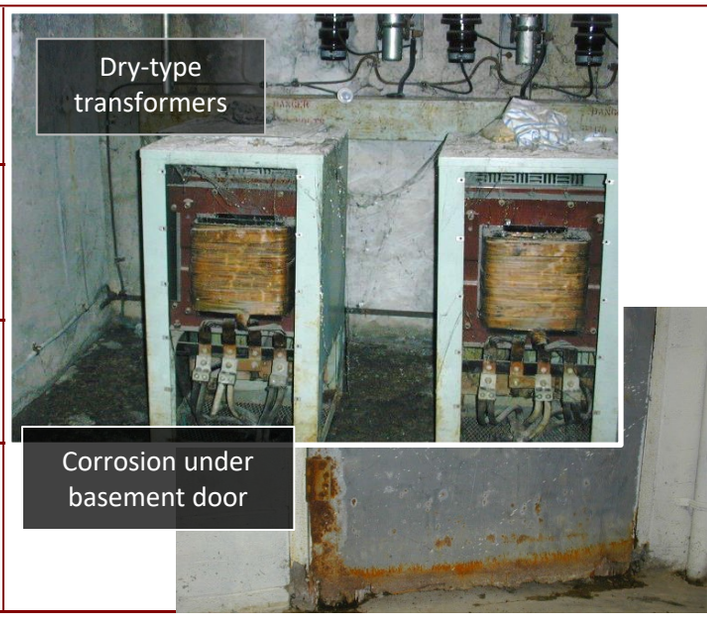
Leave transformers in service; however, this option is not acceptable as they have reached their end of life and can no longer be properly and safely maintained.

LINK TO STRATEGIC PLAN:

Section 6.2.1 - Emphasis on Reliability and Safety

CUSTOMER ENGAGEMENT:

London Hydro initiates contact with the owner to explain work and explore viable options for vault replacement. London Hydro co-ordinates service interruptions, site restoration and overall scheduling.



CAPITAL PROJECT SUMMARY SHEET

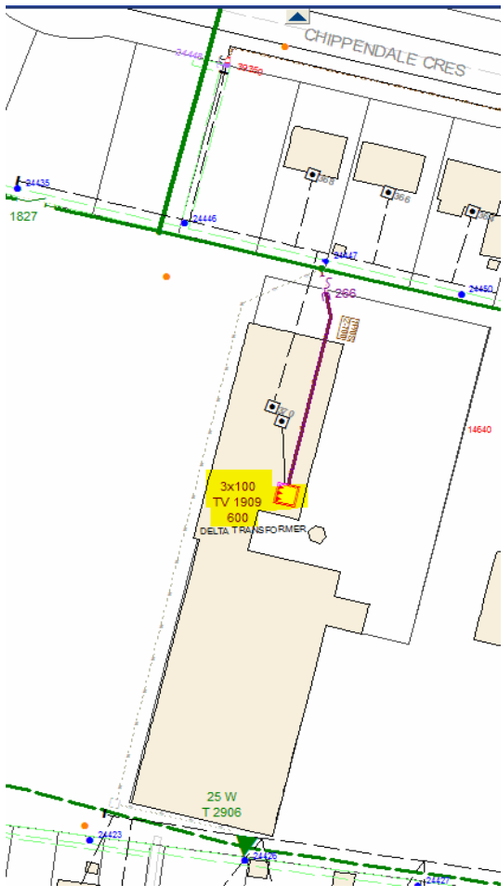
SYSTEM RENEWAL

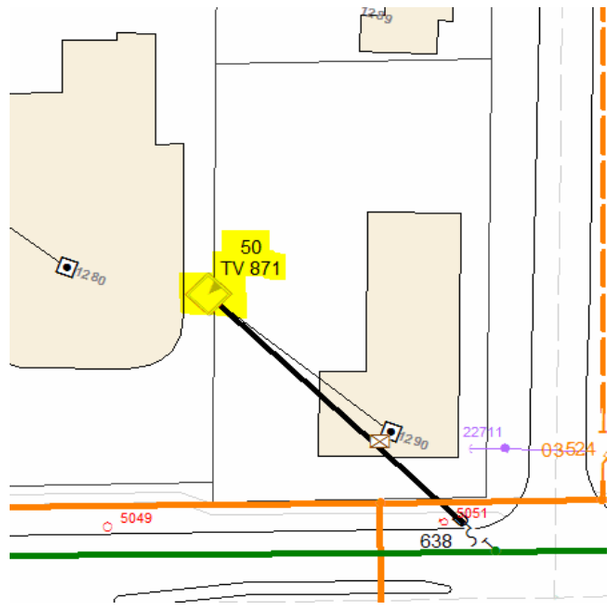
Project Number:	19B6
Project Name:	Vault Rebuilds
Start Date:	Jan-19
In-Service Date:	Dec-19

Project Title: Vault Transformer Replacements

Additional Information:

The highlighted segments show transformer vault TV 871 at 1290 Huron St. and TV 1909 at Glen Cairn Arena, supplied off the existing overhead 4.16 kV distribution system.
This project will coordinate with the rebuilding and conversion of the surrounding overhead distribution under Projects 19B9 and 19G5.





Prepared By: Omar Faqhruldin, P.Eng.
Distribution Engineer

Approved By: William Milroy, P.Eng.
Chief Engineer &
V.P. of Operations

CAPITAL PROJECT SUMMARY SHEET

SYSTEM SERVICE

Project Number:	19B7
Project Name:	Backup Supply Installation
Start Date:	Jan-19
In-Service Date:	Dec-19

Project Title: Installation of Backup Supply

Supporting Reference Material:

1) 2017 Quality of Supply Report.
2) Single-Phase Radial Supplies in Residential Subdivisions

Description:

London Hydro has started to experience outages in the residential underground subdivisions that were serviced in the past via a radial underground system. This configuration leaves London Hydro's control room operators with no options to restore power quickly during outages resulting from equipment failure.

This budget item provides for additional supply in one of those subdividsions thereby providing our operators with an alternate source from which they can restore power. This work will greatly improve the speed at which power can be restored to these areas and enhance the reliability of supply.

PRIMARY DRIVER:	Customer Value
OTHER DRIVERS:	Reliability
CUSTOMERS IMPACTED:	64
OEB CAPITAL REPORTING	
B8 - Backup Supply & Fault Indicators	
LH PROJECT DRIVER:	REL

COST ESTIMATE - BY YEAR

	COST	AREA/SCOPE
2012	$94,421	
2013	$44,325	
2014	$40,547	
2015	$171,253	
2016	$40,072	
2017	$70,040	
2018	$96,600	
2019	$55,000	1 Subdivision
2020	$0	
2021	$0	
TOTAL COST ESTIMATE:	$612,258	

LH SECTION # 145

CAPITAL PROJECT SUMMARY SHEET

SYSTEM SERVICE

Project Number:	19B7
Project Name:	Backup Supply Installation
Start Date:	Jan-19
In-Service Date:	Dec-19

Project Title: Installation of Backup Supply

Risks to Completion & Mitigation Plan:

Risk to completion is low. This project is part of a program that has been successfully executed in each of the past six years. The availability of resources (internal and contract) is sufficient to complete this project.

EVALUATION OF OUTCOMES:

Efficiency, Customer Value, Reliability	Backup supply provides the opportunity for quicker power restoration in the event of a permanent fault in the underground system with minimum impact on the customers' load. This provides increased reliability for home owners and minimizes power interruptions.
Safety	There is no direct implication to safety from this program
Cyber-Security, Privacy	Not applicable
Co-ordination, Interoperability	Not applicable
Economic Development	Improved reliability will contribute to the overall attractiveness of London as a place to live and do business
Environmental Benefits	There is no direct environmental benefit. However, shorter power restoration reduces crews' time in the field and hence, reduced emissions from operating trucks.

IMPACT TO O&M COSTS:

Fewer power interruptions have the potential for a reduction in annual operating and maintenance costs.

ALTERNATIVES CONSIDERED:

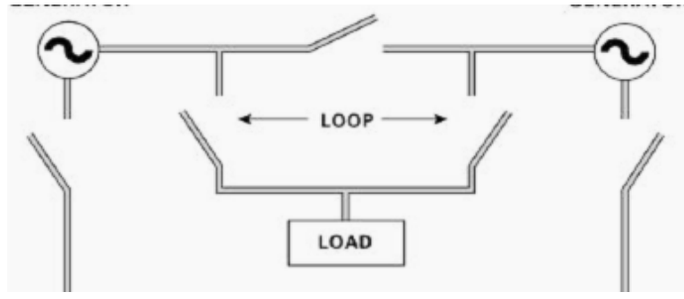
Customers can be supplied by radials but most faults in the underground system are permanent and repairs can last for extended periods of time during which customers may experience long power outages unless backup supply is in place.

LINK TO STRATEGIC PLAN:

Section 6.2.1 - Emphasis on Reliability and Safety

CUSTOMER ENGAGEMENT:

Customers are not directly contacted for this project but surveys indicate customers value imrpovements to reliability (refer to DSP Section 3.2.4 Customer Engagement).



CAPITAL PROJECT SUMMARY SHEET

SYSTEM SERVICE

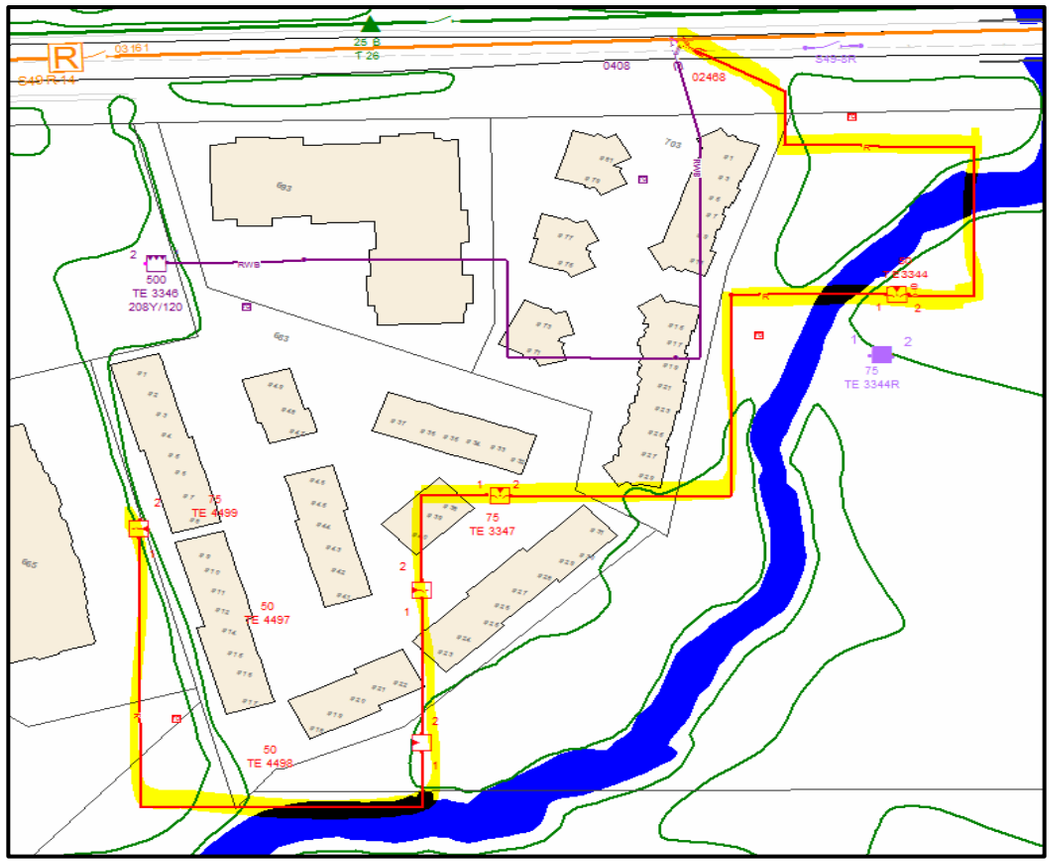
Project Number:	19B7
Project Name:	Backup Supply Installation
Start Date:	Jan-19
In-Service Date:	Dec-19

Project Title: Installation of Backup Supply

Additional Information:

The red phase (highlighted yellow) is 38 years old and has five single phase transformers. If a cable fault occurs on this radial, 64 residential customers will experience a long duration outage.

The scope of this project is to bring in another red phase supply to close the loop, which will mitigate the above risk by having a backup supply.



Prepared By: Omar Faqhruldin, P.Eng.
Distribution Engineer

Approved By: William Milroy, P.Eng.
Chief Engineer &
V.P. of Operations

CAPITAL PROJECT SUMMARY SHEET

SYSTEM SERVICE

Project Number:	19B8
Project Name:	Fault Indicator Installations
Start Date:	Jan-19
In-Service Date:	Dec-19

Project Title: Installation of Fault Indication in Padmounted Transformers

Supporting Reference Material: 2017 Quality of Supply Report

Description:

Determining the location of faulted equipment on underground residential distribution systems can result in extended outage duration in the absence of fault indication devices. In areas where transformers do not have fault indicators, crews must search for visible failure signs inside each transformer and, if there are none, the cable between every two transformers must be tested to determine the location of the fault.

Modern fault indication technology allows for a quick assessment, without inspecting every transformer from the inside, in order to determine the location of a faulted segment and then isolate it. The power can be restored to the affected customers in a much shorter timeframe, relying on the indication provided by the transformers that "saw" fault current.

This item includes the installation of approximately 75 fault indicators in various subdivisions.There are a small number of transformers where fault indicators are already present; this project will provide fault indication at every transformer location, thus shortening the troubleshooting time for the crews and the outage duration for the customers in these subdivisions.

PRIMARY DRIVER: Modern	Efficiency
OTHER DRIVERS:	Reliability
	Customer Value
CUSTOMERS IMPACTED:	Estimated 1200
OEB CAPITAL REPORTING:	B8 - Backup Supply & Fault Indicators
LH PROJECT DRIVER:	REL

COST ESTIMATE - BY YEAR

	COST	AREA/SCOPE
2012	$14,902	
2013	$17,316	
2014	$12,102	48 units
2015	$12,000	48 units
2016	$15,036	56 units
2017	$16,235	65 units
2018	$28,500	57 units
2019	$22,000	75 Units
2020	$20,000	
2021	$21,000	
TOTAL COST ESTIMATE:		$179,091

LH SECTION # 145

CAPITAL PROJECT SUMMARY SHEET

SYSTEM SERVICE

Project Number:	19B8
Project Name:	Fault Indicator Installations
Start Date:	Jan-19
In-Service Date:	Dec-19

Project Title: Installation of Fault Indication in Padmounted Transformers

Risks to Completion & Mitigation Plan:

Risk to completion is low. This project is part of a program that has been successfully executed in each of the past ten years. The availability of resources (internal labour) is sufficient to complete this project.

EVALUATION OF OUTCOMES:

Efficiency, Customer Value, Reliability	Shorter outages are achieved when fault indication is present in the underground distribution system. Older transformers can benefit from being retrofitted with fault indication. Select areas are covered based on subdivision performance and rehabilitation plans.
Safety	No direct impact for safety but locating a fault by patrolling the main road without accessing every transformer case exerts less physical effort.
Cyber-Security, Privacy	Not applicable
Co-ordination, Interoperability	Not applicable
Economic Development	Improved reliability will contribute to overall attractiveness of London as a place to live and do business.
Environmental Benefits	There are no direct environmental benefits. However, shorter troubleshooting time can result in operating the trucks for shorter durations, hence gas emissions are reduced.

IMPACT TO O&M COSTS:

Annual operating and maintenance costs will have a slight reduction due to reduced crew time spent responding to an outage.

ALTERNATIVES CONSIDERED:

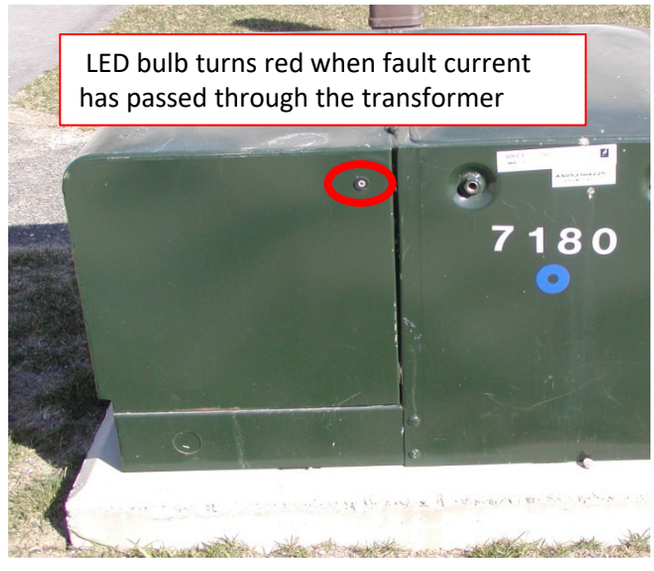
Newer transformers with fault indication are currently installed in areas where the infrastructure is rebuilt/converted.

LINK TO STRATEGIC PLAN:

Section 6.2.1 - Emphasis on Reliability and Safety

CUSTOMER ENGAGEMENT:

Customers are not directly contacted for this project type but surveys indicate customers value improvements to reliability (refer to DSP Section 3.2.4 Customer Engagement).



CAPITAL PROJECT SUMMARY SHEET

SYSTEM SERVICE

Project Number:	19B8
Project Name:	Fault Indicator Installations
Start Date:	Jan-19
In-Service Date:	Dec-19

Project Title: Installation of Fault Indication in Padmounted Transformers

Additional Information:

Installation of transformer fault indication in areas with lengthy and complex circuit arrangements has the ability to decrease both outage duration and the cost of repairs. The average underground residential subdivision supplies 16 transformers on a feeder loop. These loops are segmented into two radial sections of up to eight transformers to lessen the impact of an outage to fewer customers affected. Through the installation of fault indication it was found that the average time required to locate a fault could be reduced by 1.25 hours, saving up to 50% of the troubleshooting time.

Prepared By:	**Omar Faqhurldin, P.Eng.** **Distribution Engineer**
Approved By:	**William Milroy, P.Eng.** **Chief Engineer &** **V.P. of Operations**

CAPITAL PROJECT SUMMARY SHEET SYSTEM RENEWAL

Project Number:	19B9
Project Name:	Zone B Underground Conversion
Start Date:	Jan-19
In-Service Date:	Dec-19

Project Title: 4.16kV Underground Conversions

Supporting Reference Material:
4.16 kV Aging Infrastructure System Planning Report (2015)
4.16 kV Conversion Plan - 2018 Update, Plan for Rear Lot to Front Lot Conversion (2018)
Electric Distribution System Asset Sustainment Plan: 2015-2029 (2014)

Description:
The 4.16kV infrastructure is gradually being phased out due to its limited capacity, inability to serve load growth, and the high system losses associated with it. Priority zones A, B, C, and D have been identified based on a coordinated approach using multiple evaluation factors such as age and condition of assets, reliability and system performance, and operational flexibility. In addition, the proposed rebuilds replace deteriorating infrastructure meeting the criteria outlined in the Asset Sustainment Plan Report.

This work is in coordination with neighbouring 4.16 kV overhead conversions under Project 19G5.

PRIMARY DRIVER:	Reliability
OTHER DRIVERS:	Efficiency
	Customer Value
	Safety
CUSTOMERS IMPACTED:	600
OEB CAPITAL REPORTING:	B6 - Underground Conversions

COST ESTIMATE - BY YEAR

	COST	AREA/SCOPE
2012	$103,296	3 TV's
2013	$400,236	9 TV's
2014	$328,092	2 TV's, 5 TE's & 1 SUB
2015	$431,033	2 TV's & 7 TE's
2016	$49,450	7 TE's / 0.81 km primary
2017	$55,363	7 TE's/ 1.08 km primary
2018	$112,200	5 TEs / 0.51 km primary
2019	$1,225,000	4 subdivisions
2020	$327,000	
2021	$448,000	
TOTAL COST ESTIMATE:		$3,479,670

LH PROJECT DRIVER:	REL	**LH SECTION #**	145

CAPITAL PROJECT SUMMARY SHEET SYSTEM RENEWAL

Project Number:	19B9
Project Name:	Zone B Underground Conversion
Start Date:	Jan-19
In-Service Date:	Dec-19

Project Title: 4.16kV Underground Conversions

Risks to Completion & Mitigation Plan:

Risk to completion is low. Resources must be secured to co-ordinate timing with the overhead line conversion projects under Project 19G5. This project is part of a program that has been successfully executed in each of the past six years. The availability of resources (internal and contract) is sufficient to complete this project.

EVALUATION OF OUTCOMES:	
Efficiency, Customer Value, Reliability	Voltage conversion by zones is intended to off load multiple substations that provide backup to each other during the same time interval, so decommissioning is made possible without jeopardizing the ability to reliably supply these customers. Underground and overhead work is also co-ordinated for the most optimal system reconfiguration.
Safety	Removing high voltage overhead lines from residential backyards improves safety for both the public and staff. Safety of the public and staff is also improved through voltage conversion of loads supplied by old overhead plant since some in-service installations are substandard, such as positek fused transformers and open bus.
Cyber-Security, Privacy	Not applicable
Co-ordination, Interoperability	Co-ordination is required with overhead line projects in Section 19G5. New underground plant placement will be co-ordinated with other utilities.
Economic Development	Improved reliability will contribute to the overall attractiveness of London as a place in which to live and do business.
Environmental Benefits	Environmental benefits include elimination of deteriorated polemount transformers, which have the potential to leak oil.

IMPACT TO O&M COSTS:

Fewer outages can be expected as the supply changes to the new 27.6kV system, resulting in a reduction in annual operating and maintenance costs.

ALTERNATIVES CONSIDERED:

Leave plant in service; however, this option is not acceptable as the plant has reached its end of life and can no longer be properly and safely maintained

LINK TO STRATEGIC PLAN:

Section 6.2.1 - Emphasis on Reliability

CUSTOMER ENGAGEMENT:

Property owners are contacted to discuss pole relocations, new routing of underground cables, restoration, etc. Customers are provided with utility contact names after high level notifications regarding project scope are sent out.

CAPITAL PROJECT SUMMARY SHEET

SYSTEM RENEWAL

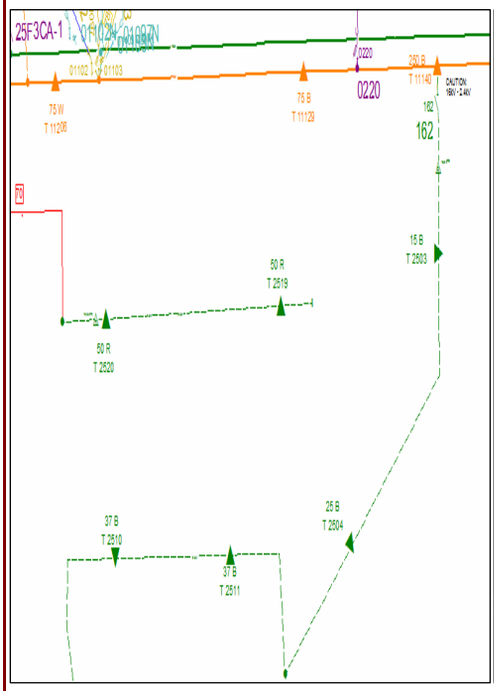
Project Number:	19B9
Project Name:	Zone B Underground Conversion
Start Date:	Jan-19
In-Service Date:	Dec-19

Project Title: 4.16kV Underground Conversions

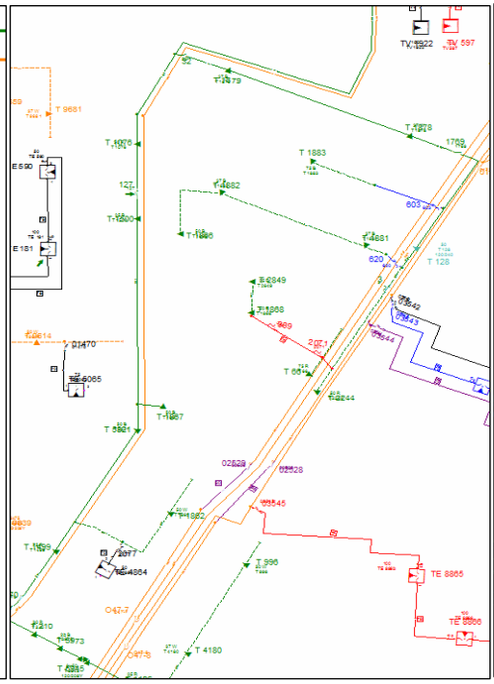
Additional Information:

The initiatives outlined in the "4.16 kV Conversion Plan: Plan for Rear Lot to Front Lot Conversion, 2018" require converting all 4.16 kV within Zone B, C, and D. As discussed in the report, there are many operating, safety, reliability and customer service issues related to maintaining the existing aging rear lot systems and therefor London Hydro will be converting these systems to front lot systems. There are two methods that will be utilized in this conversion: Hybrid conversion or full front lot underground conversion. In the hybrid conversion, the primary conductors from existing overhead rear lot distribution will be relocated to underground front lot distribution while the secondary distribution system continues to remain in rear lot. In the full front lot underground conversion, both the primary and secondary distribution system from existing overhead rear lot will be relocated to underground front lot.

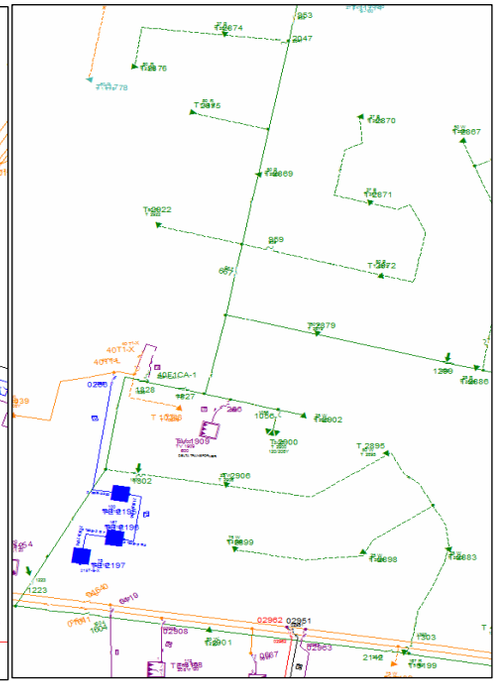
The listed areas below show the scope of areas that will be address by either the hybrid or the full underground conversion. These areas coordinate with the overhead distribution being converted under Project 19G5.



Old Oak Park Phase 1



Fairmount Phase 2



Glen Cairn Phase 2

Prepared By:	**Omar Faqhruldin, P.Eng.** **Distribution Engineer**
Approved By:	**William Milroy, P.Eng.** **Chief Engineer &** **V.P. of Operations**

CAPITAL PROJECT SUMMARY SHEET
SYSTEM RENEWAL

Project Number:	19B10
Project Name:	13.8 kV Underground Conversion
Start Date:	Jan-19
In-Service Date:	Dec-19

Project Title: 13.8 kV Underground Conversions of Non-Network Load and Customer Owned Substations

Supporting Reference Material: London Downtown - 13.8 kV/27.6 kV Nelson TS - 5 Year Plan
Downtown Intensification Board Presentation (2016)

Description:

The initiatives outlined in the "London Downtown - 13.8 kV/27.6 kV Nelson TS - 5 Year Plan" require converting the load on the 13.8 kV non-network system. In addition, the proposed voltage conversion area also requires the conversion of customer owned substations (CS).

The budget section includes work at the following locations:
- CS 356 - 300 Wellington Road (Post Office) - Coordinate with Project 19C2
- CS 339 - 205 York Street (VIA Rail) - Coordinate with Project 19G4
- CS 286 - 100 Dundas Place (Bell building) - move to network system
- CS 337 - 155 Kent Street (Richmond Court Apartments) - Coordinate with Project 19G4
- NT 84 - 383 Richmond Street (Royal Bank Building)
- Single-phase loop along Wellington Road between Bathurst Street and South Street containing 8 TEs and 1 SE (the Wellington "Gateway") - Coordinate with Projects 19C2 & 19G4
- Kent Street underground loop containing 5 TEs - Coordinate with Project 19G4

It is anticipated that 4,060 kW of load will be converted from 13.8 kV distribution to 27.6 kV distribution. Projects and associated costs in this section vary annually based on timing of customer conversion schedules and related 13.8 kV supply system conversions. The planned completion of the entire program is 2020.

In addition to the above scopes, 2019 will involve extensive design and coordination to plan for the 2020 conversions of CS 220 (Labatt) and CS 264 (City Centre). This may include some preliminary installation of infrastructure to support the conversion of the substations.

PRIMARY DRIVER:	Reliability
OTHER DRIVERS:	Customer Value
	Econ. Dev.
CUSTOMERS IMPACTED:	180
OEB CAPITAL REPORTING:	B6 - Underground Conversions

COST ESTIMATE - BY YEAR

	COST	AREA/SCOPE
2012	$0	
2013	$0	
2014	$0	
2015	$299,310	6 TE's & 1 SE
2016	$803,314	14 TE's
2017	$741,551	5 TE's
2018	$1,228,910	3 CS, 7 TEs & 4 SEs
2019	$1,783,000	4 CSs, 3 SE's, 1 NT
2020	$971,000	2 CS + 1 TE
2021	$0	
TOTAL COST ESTIMATE:		$5,827,085

LH PROJECT DRIVER:	REL	**LH SECTION #**	145

CAPITAL PROJECT SUMMARY SHEET

SYSTEM RENEWAL

Project Number:	19B10
Project Name:	13.8 kV Underground Conversion
Start Date:	Jan-19
In-Service Date:	Dec-19

Project Title: 13.8 kV Underground Conversions of Non-Network Load and Customer Owned Substations

Risks to Completion & Mitigation Plan:

Risks to completion are anticipated to be low. Availability of resources to match timing with the overhead line conversion projects will be addressed by securing resources (internal or contract) in advance. The only other risk that could potentially affect this project is getting approval from an owner to convert the customer's station, in which case we would install a step down transformer at a suitable location and leave the customer's service on 13.8 kV.

EVALUATION OF OUTCOMES:	
Efficiency, Customer Value, Reliability	Downtown's load serviced at 13.8kV is being converted to 27.6 kV by co-ordinating the overhead portion with the underground work. At the same time, the current 27.6 kV supply to the city core will be connected through new station ties connecting to existing commercial load, as well as future developments in the most reliable way. Efficiency is gained by eliminating multiple cables energized at multiple voltages, and instead running only one 27.6 kV voltage system.
Safety	There are no direct safety issues associated with this project. However, obsolete customer-owned equipment is replaced with a more accessible and safer to operate automated system, such as load centres.
Cyber-Security, Privacy	Not applicable
Co-ordination, Interoperability	Various projects co-ordinate with other 13.8kV conversions (19C2 & 19G4) and will require co-ordination with property owners.
Economic Development	Modern and reliable supply systems in the downtown core will encourage the development of new businesses, and thereby contribute to making London a prosperous city.
Environmental Benefits	The City of London is considering rapid transit in the years to come, a new advanced, green transportation system that will move through a revitalized downtown. London Hydro's enhanced electric supply will be able to accomodate all the new load emerging from this initiative.

IMPACT TO O&M COSTS:

The modern and enhanced power supply in the downtown core energized at only 27.6 kV, coupled with a backup supply provided by new feeder ties, should contribute to decreased operating and maintenance costs throughout the year.

ALTERNATIVES CONSIDERED:

The non-network 13.8kV supply from the Nelson transformer station will no longer be available after 2020 since Hydro One is rebuilding the station. Transferring load to the 27.6kV via stepdown transformation; capacity and reliability, however, could be at risk with downtown expansion.

LINK TO STRATEGIC PLAN:

Section 6.2.1 - Emphasis on Reliability

CUSTOMER ENGAGEMENT:

Planned collaboration with buidling and property owners, as well as early stage involvement of customers is essential to the success of these projects. Engineering and Operations staff ensure proper communications at every stage.

Richmond St. opposite Kent St.

CAPITAL PROJECT SUMMARY SHEET

SYSTEM RENEWAL

Project Number:	19B10
Project Name:	13.8 kV Underground Conversion
Start Date:	Jan-19
In-Service Date:	Dec-19

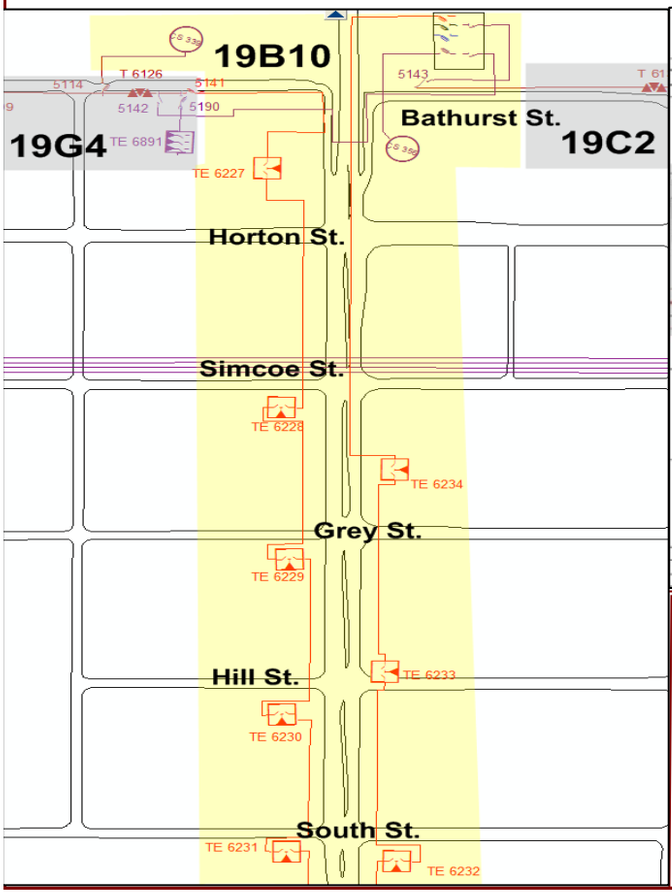
Project Title: 13.8 kV Underground Conversions of Non-Network Load and Customer Owned Substations

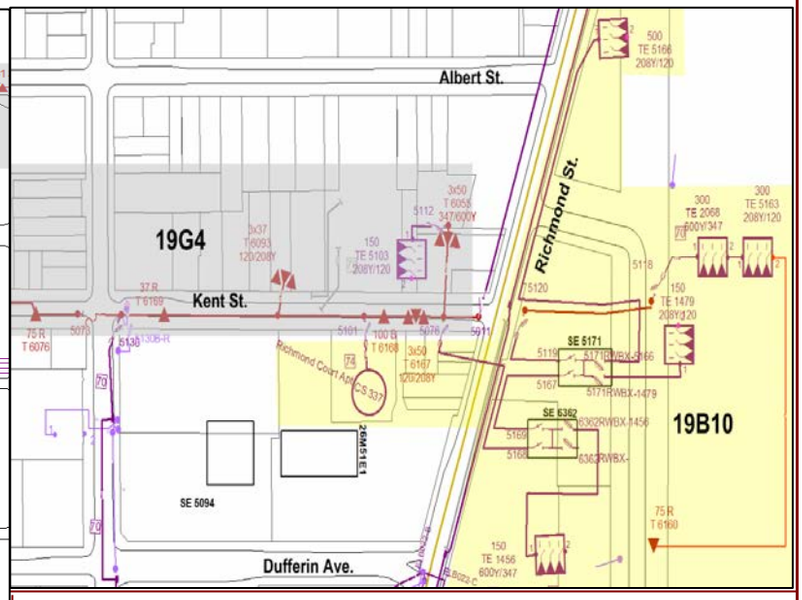
Additional Information:

The initiatives outlined in the London Downtown - 13.8 kV/27.6 kV Nelson TS - 5 Year Plan report require converting all 13.8 kV load by year 2020 when Hydro One eliminates the only transformer station supplying this voltage. Converting the downtown load from 13.8 kV distribution, that had only one supply source, to the 27.6 kV distribution system, that has multiple supply sources, ensures a more reliable system to the city of London's core area and also aids in optimizing switching and load transferring amongst the other 27.6 kV stations.

Some of the benefits of the conversion work include:

- Eliminate three primary switchgear enclosures which pose maintence and liability issues
- Completion of the Wellington Gateway. 2018 addressed the 3-phase scope. The 2019 scope will convert the 1-phase load (8 TEs in total). See yellow outlined area in image below left.
- Conversion of a submersible transformer to London Hydro's newly created switchable vault transformer (NT 84). This scope was deferred from 2018.
- Convert Kent St. area by reconfiguring the distribution to loop five 3-phase TEs that will permit the elminatation of a downtown 3-phase pole line crossing a parking lot and into Victoria Park. See yellow outlined area in image below right.





Prepared By: **Rodney Doyle, P.Eng.**
Senior Distribution Engineer

Approved By: **William Milroy, P.Eng.**
Chief Engineer &
V.P. of Operations

CAPITAL PROJECT SUMMARY SHEET

SYSTEM RENEWAL

Project Number:	19B11
Project Name:	Switchable Tx Outage Restore
Start Date:	Jan-19
In-Service Date:	Dec-19

Project Title: Adding Switchable Padmounted Transformers for Residential Supply

Supporting Reference Material:

1) 2017 Quality of Supply Report
2) Live-Front Transformer Replacement Program

Description:

Determining the location of faulted equipment on underground residential distribution systems, depending on how many fault indicators exist on a circuit, will affect the outage time for all the customers interrupted due to the fault. More so, if switchable padmounted transformers are not present, isolating a fault location can involve multiple operations and longer outage time for customers who could otherwise be restored sooner. In areas where older transformers do not permit isolating themselves from a loop one at a time, crews must isolate entire strings of transformers (from riser to open point) in order to isolate the faulted transformer or cable section and re-energize the healthy portion of the circuit.

Modern switchable transformers have two medium-voltage switches that permit the unit to be isolated upstream or downstream or completely removed from the loop before lifting the elbows. This new budget item aims to replace some of the live-front transformers or older non-switchable units that do not have this flexibility built in. By deploying more switchable padmounted transformers in subdivisions, the power can be restored to some of the unaffected customers in a much shorter duration.

It is anticipated that five (5) units will be installed in place of existing live-front transformers. This practice will continue with the goal of eliminating at least all live-front transformers, which also pose a safety hazard when operated due to the exposed energized components.

PRIMARY DRIVER: Modern	Reliability
OTHER DRIVERS:	Efficiency
	Customer Value
	Safety
CUSTOMERS IMPACTED:	Estimated 100
OEB CAPITAL REPORTING:	B7 -Misc. Subdivision Projects

COST ESTIMATE - BY YEAR

	COST	AREA/SCOPE
2012		
2013		
2014		
2015		
2016		
2017		
2018	$38,499	1 Subdivision
2019	$50,000	1 Subdivision
2020		
2021		
TOTAL COST ESTIMATE:		$88,499

LH PROJECT DRIVER:	REL
LH SECTION #	145

CAPITAL PROJECT SUMMARY SHEET

SYSTEM SERVICE

Project Number:	19B11
Project Name:	Switchable Tx Outage Restore
Start Date:	Jan-19
In-Service Date:	Dec-19

Project Title: Adding Switchable Padmounted Transformers for Residential Supply

Risks to Completion & Mitigation Plan:

Risk to completion is low. Although this is a newly added project, the availability of resources (internal labour) is adequate to complete the work.

EVALUATION OF OUTCOMES:

Efficiency, Customer Value, Reliability	Shorter outages are achieved when fault indication is present in the underground distribution system. Switchable transformers present this feature by means of a "signaling light" and they can also be switched out from a circuit one at a time due to the two switching elements installed (referred to as "dash 1" and "dash 2").
Safety	The impact on safety is exercized by removing live-front units from service and replacing them with switchable transformers.
Cyber-Security, Privacy	Not applicable
Co-ordination, Interoperability	Not applicable
Economic Development	Improved reliability will contribute to overall attractiveness of London as a place to live and do business.
Environmental Benefits	There are no direct environmental benefits. However, shorter troubleshooting time can result in operating the trucks for shorter durations, hence gas emissions are reduced.

IMPACT TO O&M COSTS:

Annual operating and maintenance costs will have a slight reduction due to reduced crew time spent responding to an outage.

ALTERNATIVES CONSIDERED:

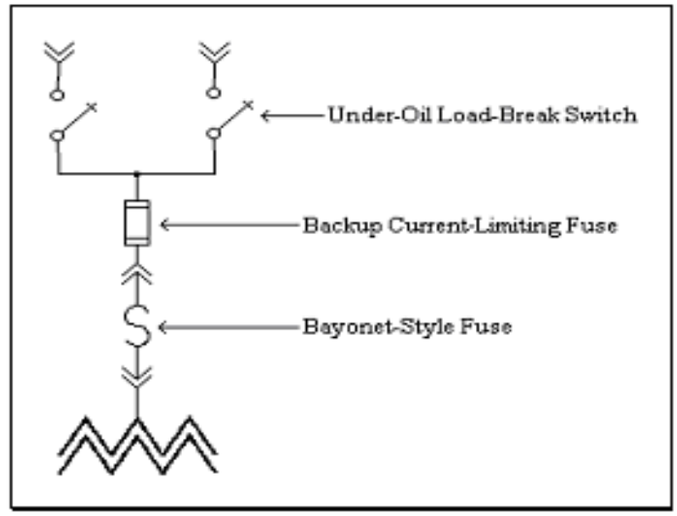
Newer switchable transformers are currently installed in areas where the infrastructure is rebuilt/converted.

LINK TO STRATEGIC PLAN:

Section 6.2.1 - Emphasis on Reliability and Safety

CUSTOMER ENGAGEMENT:

Customers are not directly contacted for this project type but surveys indicate customers value improvements in reliability (refer to DSP Section 3.2.4 Customer Engagement).



Internal Electrical Arrangement of Fusing and Switching Elements

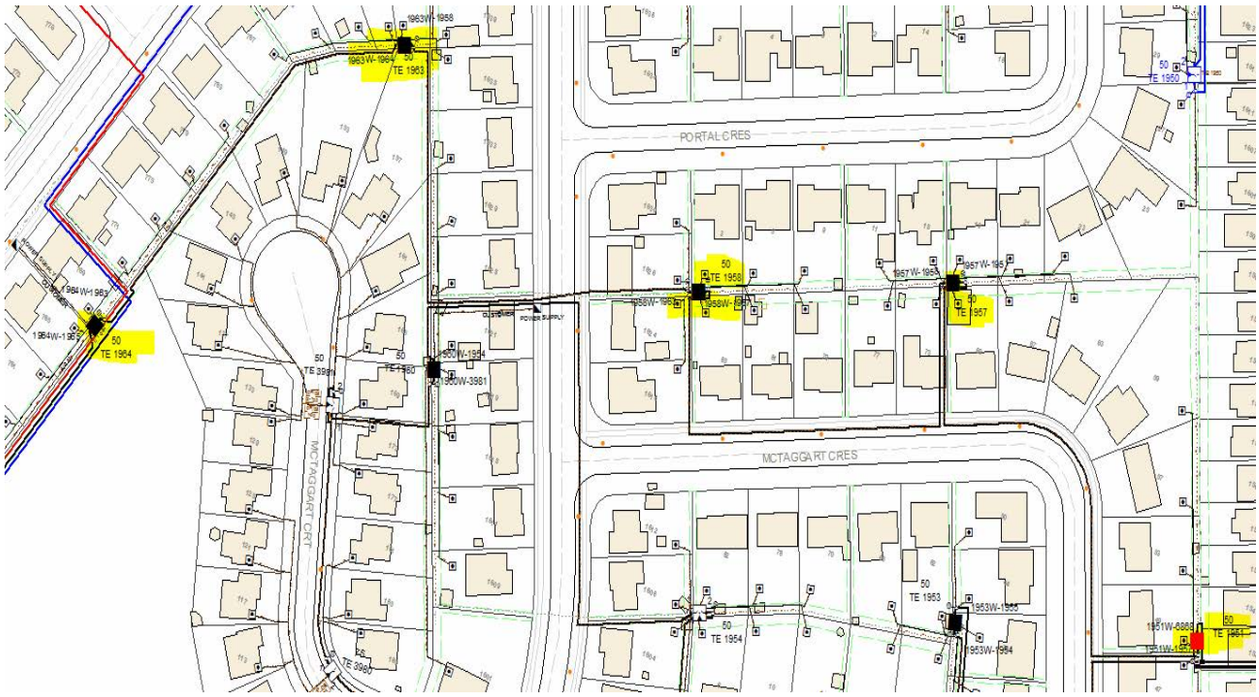
CAPITAL PROJECT SUMMARY SHEET SYSTEM RENEWAL

Project Number:	19B11
Project Name:	Switchable Tx Outage Restore
Start Date:	Jan-19
In-Service Date:	Dec-19

Project Title: Adding Switchable Padmounted Transformers for Residential Supply

Additional Information:

Installation of switchable transformers in subdivisions allows for faster fault restoration. Once a fault has been identified, the fault location can be isolated quickly while using switchable transformers, and more customers can be restored sooner. Below is a map that shows the transformers that were selected for replacement next year (in yellow). All the units are live-front transformers and by replacing them with switchable transformers, sectionalizing will become possible.



Prepared By: **Omar Faqhruldin, P.Eng.**
Distribution Engineer

Approved By: **William Milroy, P.Eng.**
Chief Engineer &
V.P. of Operations

CAPITAL PROJECT SUMMARY SHEET SYSTEM RENEWAL

Project Number:	19B12
Project Name:	Restore Time for Radial Customers
Start Date:	Jan-19
In-Service Date:	Dec-19

Project Title: Restoration Improvements for Multiunit Radial Customers

Supporting Reference Material: 2017 Quality of Supply Report

Description:

London Hydro has iexperienced increased outages on older underground cable supplying multi-unit radial customers (e.g. commercial developments, apartment buildings). When the cable is not ducted or no available spare duct exists, outage times tend to be very long (up to 8 hours or higher) becase the fault needs to be located and fixed before re-energization.

This budget item provides for additional civil work to improve the speed at which power can be restored to these customers and enhance the reliability of supply by installing new spare duct.

PRIMARY DRIVER:	Reliability
OTHER DRIVERS:	Customer Value
CUSTOMERS IMPACTED:	Various

OEB CAPITAL REPORTING

B8 - Backup Supply & Fault Indicators

COST ESTIMATE - BY YEAR

	COST	AREA/SCOPE
2012		
2013		
2014		
2015		
2016		
2017		
2018	$51,100	
2019	$52,000	6 Locations
2020		
2021		
TOTAL COST ESTIMATE:		$103,100

LH PROJECT DRIVER:	REL
LH SECTION #	145

CAPITAL PROJECT SUMMARY SHEET
SYSTEM SERVICE

Project Number:	19B12
Project Name:	Restore Time for Radial Customers
Start Date:	Jan-19
In-Service Date:	Dec-19

Project Title: Restoration Improvements for Multiunit Radial Customers

Risks to Completion & Mitigation Plan:

Risk to completion is low. Although this is a newly added project, the availability of resources (internal labour) is adequate to complete the work.

EVALUATION OF OUTCOMES:	
Efficiency, Customer Value, Reliability	Spare ducts for radially fed customers provide the opportunity for quicker power restoration by pulling new cable in the event of a permanent fault in the underground system, which takes longer to repair. This is also a program that can facilitate the next step of asset renewal when these type of aged cables will be due for replacement.
Safety	There is no direct implication to safety from this program
Cyber-Security, Privacy	Not applicable
Co-ordination, Interoperability	Not applicable
Economic Development	Improved reliability will contribute to the overall attractiveness of London as a place to live and do business
Environmental Benefits	There is no direct environmental benefit. However, shorter power restoration reduces crew time spent in the field and hence, reduced emissions from operating trucks.

IMPACT TO O&M COSTS:

Fewer power interruptions have the potential for a reduction in annual operating and maintenance costs.

ALTERNATIVES CONSIDERED:

Customers can be supplied by radials but most faults in the underground system are permanent and repairs can last extended periods of time during which customers can experience long power outages unless failed cable can easily be replaced by new cable.

LINK TO STRATEGIC PLAN:

Section 6.2.1 - Emphasis on Reliability and Safety

CUSTOMER ENGAGEMENT:

Customers are not directly contacted for this project but surveys indicate customers value improvements in reliability (refer to DSP Section 3.2.4 Customer Engagement).

CAPITAL PROJECT SUMMARY SHEET SYSTEM RENEWAL

Project Number:	19B12
Project Name:	Restore Time for Radial Customers
Start Date:	Jan-19
In-Service Date:	Dec-19

Project Title: Restoration Improvements for Multiunit Radial Customers

Additional Information:

This item will target larger multiunit radial customers where the underground supply is direct buried, which can significantly prolong the duration of an outage when having to repair the faulted cable. By providing a spare duct, restoration time can be improved as the underground crews have a means to replace the cable instead of locating the fault, digging up and splicing the phase that faulted. Our GIS system will be used to create a report of locations where cable is aged (25+ years old), is a radial feed to a multiunit appartment building, and is direct buried. The selection will be made based on performance over the last few years for radial underground customers where risk of cable failure is higher.

The locations within this project include: 312 Commiccioners Rd, 2030 Meadowgate Blvd, 433 King St, 1255 and 1275 Killaly, 1671 Jalna Blvd. and 1067 Wellington Rd.

Prepared By:	**Omar Faqhruldin, P.Eng.** **Distribution Engineer**
Approved By:	**William Milroy, P.Eng.** **Chief Engineer &** **V.P. of Operations**

CAPITAL PROJECT SUMMARY SHEET

SYSTEM RENEWAL

Project Number:	19C1
Project Name:	27.6 kV Supply to Core
Start Date:	Jan-19
In-Service Date:	Dec-19

Project Title: Main Feeder supply

Supporting Reference Material:

London Downtown Long Term 27.6 kV Supply and 13.8 kV Decommissioning Strategy
London Downtown - 13.8 kV/27.6 kV Nelson TS - 5 Year Plan
Analysis of Downtown Intensification: Ring Bus Utilization (2017)
QSI: Monthly Reliability Performance Overview - August 2017
North West Supply Capacity Study (2018)
METSCO Energy Solutions TanD & PD Maintenance Test on Feeders 26M47 and 26M48

Description:

London Downtown is presently supplied mainly through the older 13.8 kV Non-Network via Nelson Transformer Station (TS). Nelson TS was a double DESN with the T1/T2 supplying the 3-wire Network system, and the T3/T4 supplying the 4-wire Non-Network system. Hydro One is rebuilding the T1/T2 DESN to 27.6 kV standards and this new supply is expected to be in service by December 2018 while the T3/T4 DESN will be eliminated by end of 2020.

In preparation for the new 27.6 kV Nelson TS in-service date, the downtown feeder project intends to install one (1) new 27.6 kV circuit from the new Nelson TS to supply the downtown and offload Talbot TS. This feeder is planned to connect London District Energy's (LDE) new 20 MW generator contingent upon their Connection Impact Study (CIA).

The new Nelson 27.6 kV supply to the downtown core will provide many benefits:
- increase adequacy and security of supply;
- enable the connection of distributed generation in the core;
- assist with voltage conversion of the 4-wire Non-Network system load to 27.6 kV, in preparation for the T3/T4 DESN phase out

In addition, the 26M47 egress cable replacement project will address the 26M47 cable from Talbot TS. This cable, although 28 years old, has had numerous faults and it needs replacing, based on cable diagnostic testing and recent inspections revealing indication of excessive heating. This project impacts over 1400 customers.

Furthermore, to address growth and increased electrical demand in the Northwest, the Northwest feeder project intends to install a new 27.6kV circuit from Talbot TS. This project also involves multiple Northwest feeder reconfigurations, to offload feeders and bring supply diversity to the Northwest. The new feeder build will also support 4kV conversions and replacement of degraded assets. This project impacts over 6000 customers.

PRIMARY DRIVER:	Reliability
OTHER DRIVERS:	Safety
	Customer Value
	Econ. Dev.
CUSTOMERS IMPACTED:	10,000+

OEB CAPITAL REPORTING:

C4 - Backup Supply/ Structure Installation

COST ESTIMATE - BY YEAR

	COST	AREA/SCOPE
2012		
2013	$1,124,173	
2014	$319,016	
2015	$153,939	
2016	$1,145,424	
2017	$3,442,000	
2018	$1,231,915	
2019	$2,441,000	
2020	$0	
2021	$0	
TOTAL COST ESTIMATE:		$9,857,467

LH PROJECT DRIVER:	RNF
LH SECTION #	140

CAPITAL PROJECT SUMMARY SHEET

SYSTEM RENEWAL

Project Number:	19C1
Project Name:	27.6 kV Supply to Core
Start Date:	Jan-19
In-Service Date:	Dec-19

Project Title: Main Feeder supply

Risks to Completion & Mitigation Plan:

Risks that could potentially affect this project significantly include unknown underground conditions such as collapsed ducts and unforeseen City of London projects. If these situations arise, alternative routes will have to be re-evaluated.

EVALUATION OF OUTCOMES:

Efficiency, Customer Value, Reliability	The new feeders from Nelson and Talbot TS will increase system reliability and reduce customer outage durations during system contingency scenarios. As well, the additional feeders permit the renewal and upgrade of old deteriorated electrical infrastructure, supply diversity, improve operational flexibility during contingency scenarios, and support new growth.
Safety	Not Applicable
Cyber-Security, Privacy	Not Applicable
Co-ordination, Interoperability	This project will permit the interconnection of Nelson TS and Talbot TS for increased reliability and operational flexibility during contingencies.
Economic Development	Additional capacity to support generation, economic development initiatives of the City of London, and its intensification plans as outlined in the City's London Plan.
Environmental Benefits	Penetration of 27.6 kV supply to the core facilitates the removal of aging infrastructure containing lead.

IMPACT TO O&M COSTS:

Reduction in O&M costs expected as the new feeders facilitate renewal of old infrastructure that were failing or degraded.

ALTERNATIVES CONSIDERED:

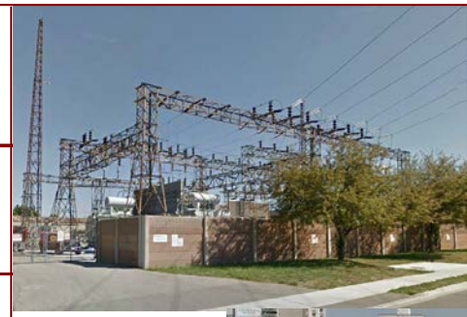
Do nothing; however, this alternative was rejected due to the risk it would pose to supply capacity and reliability.

LINK TO STRATEGIC PLAN:

Section 6.2.1 - Emphasis on Reliability

CUSTOMER ENGAGEMENT:

Customers were not directly engaged regarding this project, but recent surveys indicate customers value improvements to reliability (refer to DSP Section 3.2.4 Customer Engagement).



Nelson TS
New feeders to downtown to offload Talbot TS

Sub 11
Supplies downtown currently from Talbot TS

CAPITAL PROJECT SUMMARY SHEET

SYSTEM RENEWAL

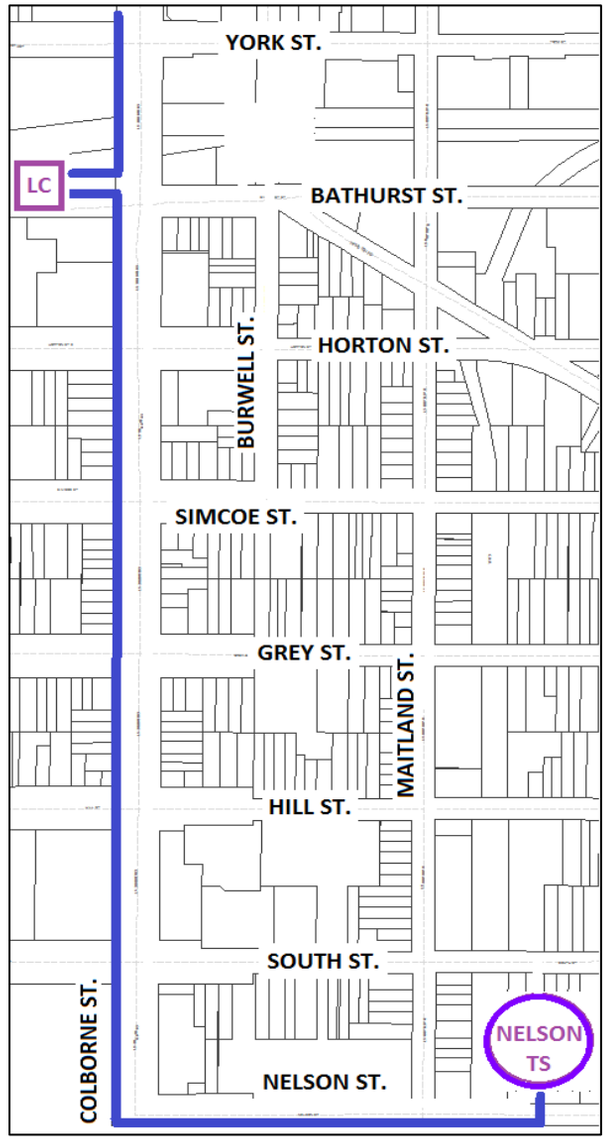
Project Number:	19C1
Project Name:	27.6 kV Supply to Core
Start Date:	Jan-19
In-Service Date:	Dec-19

Project Title: Main Feeder supply

Additional Information:

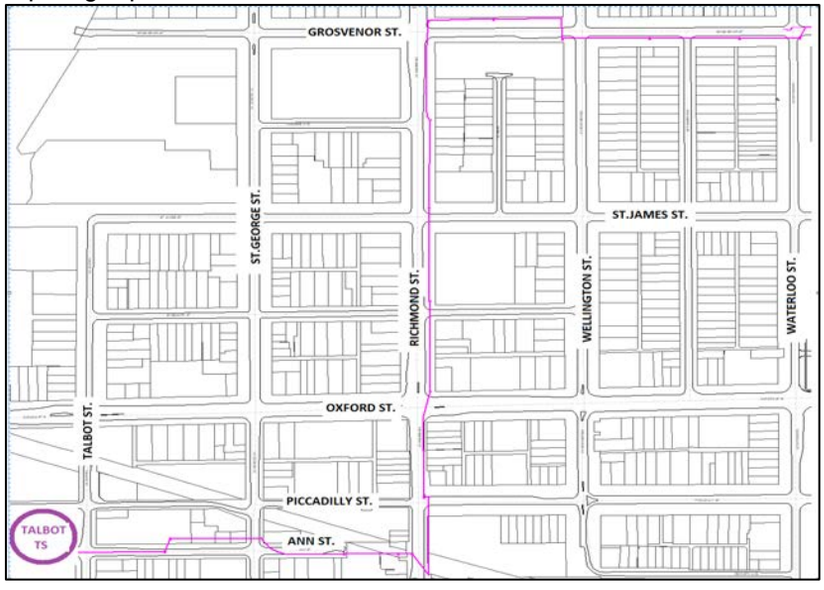
New 27.6 kV Nelson TS Feeder 13M26

The new feeder routing illustrated to the right supplies a load centre to connect London District Energy's generation and continues north to offload Talbot TS 26M48 feeder. This will permit the 26M48 feeder to backup the 26M51 feeder; both feeders will supply non-network downtown loads.



26M47 Cable Egress Replacement:

Its route highlighted below amounts to approximately 3 km. The cable was originally installed in 1990 and has faulted seven times in the last 10 years. Recent inspections indicate evidence of excessive heating. Engineers have deemed this cable to have reached the end of its useful service life; thus, requiring replacement.



Prepared By: Adrian Lattanzio, P.Eng.
Distribution Engineer

Approved By: William Milroy, P.Eng.
V.P. of Eng. & Operations

CAPITAL PROJECT SUMMARY SHEET

SYSTEM RENEWAL

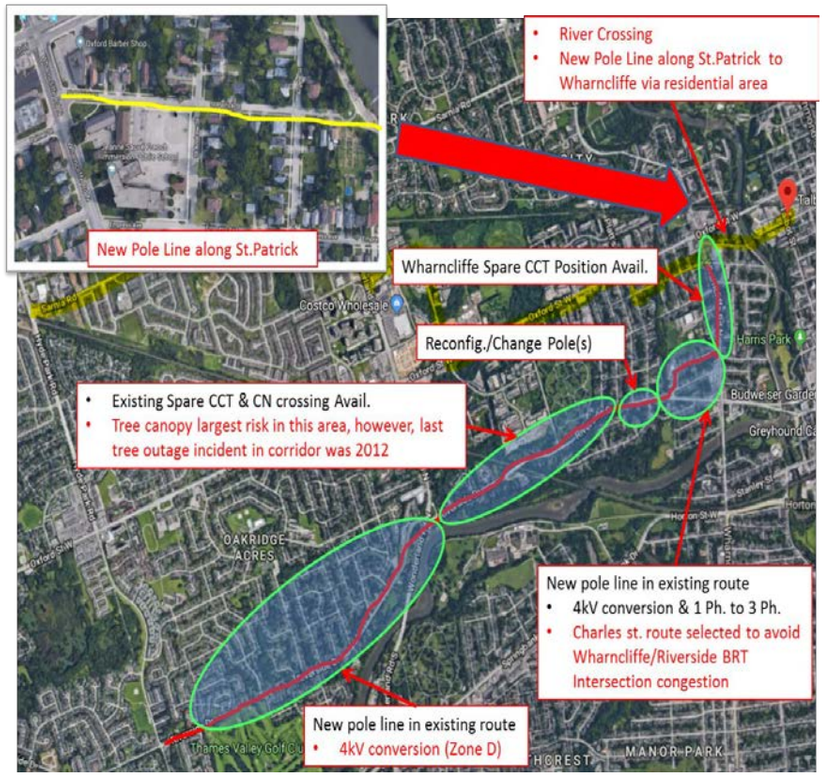
Project Number:	19C1
Project Name:	27.6 kV Supply to Core
Start Date:	Jan-19
In-Service Date:	Dec-19

Project Title: Main Feeder supply

Additional Information Continued:

New 27.6kV Talbot TS feeder build, 26M23, and supporting reconfigurations:

The build of 26M23 will include a river crossing, new pole line(s), and/or replace/reconfigure existing, in small sections, but the majority will take advantage of existing spare positions. This new feeder will support offloading the Northwest feeders, and 4kV conversions of degraded assets proposed in Zone D.



Prepared By: Adrian Lattanzio, P.Eng.
Distribution Engineer

Approved By: William Milroy, P.Eng.
V.P. of Eng. & Operations

CAPITAL PROJECT SUMMARY SHEET SYSTEM RENEWAL

Project Number:	19C2
Project Name:	13.8 kV Conversion Main Feeders
Start Date:	Jan-19
In-Service Date:	Dec-19

Project Title: 13.8 kV Conversion of Main Feeders

Supporting Reference Material: London Downtown - 13.8 kV/27.6 kV Nelson TS - 5 Year Plan
Downtown Intensification Board Presentation (2016)

Description:

A multi-year voltage conversion of 13.8 kV loads to 27.6 kV will facilitate the removal of aging distribution infrastructure, as well as address the long term strategic plans described in the London Downtown - 13.8 kV/27.6 kV Nelson TS - 5 Year Plan report which recommends the conversion of the non-network downtown core to 27.6 kV supply.

The work proposed is the final phase of a multi-year strategic plan to resupply non-network 13.8 kV loads at 27.6 kV supply. There is one transformer bank (3x167 kVA) that will remain on the 13.8 kV since the 8K6 feeder needs to be maintained to provide backup for the 2K15 feeder until large customers such as Labatt's and City Centre are converted to the 27.6 kV system. This will be the remaining non-network overhead load on the 13.8kV once all projects under this budget item are completed. This work is also co-ordinated with other plans that will address the age and condition of the existing 13.8 kV Nelson TS supply from Hydro One.

Some of this work will require coordination with neighbouring 13.8 kV underground conversions under Project 19B10 and coordination with neighbouring 13.8 kV overhead feeder conversions under Project 19G4.

PRIMARY DRIVER:	Reliability
OTHER DRIVERS:	Efficiency
	Econ. Dev.
CUSTOMERS IMPACTED:	Various
OEB CAPITAL REPORTING:	C3 - Conversions

COST ESTIMATE - BY YEAR

	COST	AREA/SCOPE
2012	$0	
2013	$0	
2014	$545,748	
2015	$470,000	
2016	$667,000	1,400 kW Converted
2017	$472,200	2,092 kW Converted
2018	$783,750	1,896 kW Converted
2019	$40,000	300 kW Planned
2020	$30,000	501 kW Planned
2021	$0	
TOTAL COST ESTIMATE:		$3,008,698

LH PROJECT DRIVER:	RNF	**LH SECTION #**	140

CAPITAL PROJECT SUMMARY SHEET SYSTEM RENEWAL

Project Number:	19C2
Project Name:	13.8 kV Conversion Main Feeders
Start Date:	Jan-19
In-Service Date:	Dec-19

Project Title: 13.8 kV Conversion of Main Feeders

Risks to Completion & Mitigation Plan: Availability of resources to match timing with the 13.8 kV underground plant conversion projects; mitigation plan is close co-ordination with the overhead line projects and securing resources (internal or contract) to ensure completion.

EVALUATION OF OUTCOMES:

Efficiency, Customer Value, Reliability	The conversion of the main 13.8 kV non-network feeders will be completed according to the multi-year plan to off load Nelson TS. In following the plan, the non-network load will gradually be switched over to the much more reliable 27.6 kV system, with increased alternatives for backup during contingencies. Older infrastucture will also be eliminated in co-ordination with voltage conversion of the loads supplied by the 13.8 kV overhead system.
Safety	In converting 13.8 kV main feeders, any depreciated plant, such as poles, will be eliminated from the system, increasing safety overall.
Cyber-Security, Privacy	Not applicable
Co-ordination, Interoperability	Concurrent with executing the negotiated Connection Cost Recovery Agreement (CCRA) with Hydro One for the upgrade of Nelson TS, London Hydro was engaged with the IESO, the OPA, and Hydro One on the OEB's Regional Planning Process (RPP).
Economic Development	Improved reliability will contribute to overall attractiveness of London as a place in which to live and do business
Environmental Benefits	There are no direct environmental benefits associated with this project; some material (e,g., wire) may be recycled in the process.

IMPACT TO O&M COSTS:

Annual operating and maintenance costs may be reduced due to fewer outages related to a newly converted system.

ALTERNATIVES CONSIDERED:

Voltage conversion of all 13.8 kV non-network load must be completed by 2020. An evaluation of the challenges encountered in this project leaves as an option some temporary supply via step-down transformation at selected locations where load still needs to be supplied at 13.8 kV.

LINK TO STRATEGIC PLAN:

Section 6.2.1 - Emphasis on Reliability

CUSTOMER ENGAGEMENT:

At the design stage, when changing the physical layout of the distribution system, property owners may be invited to discuss placement options of poles, potential new routing, etc.

CAPITAL PROJECT SUMMARY SHEET

SYSTEM RENEWAL

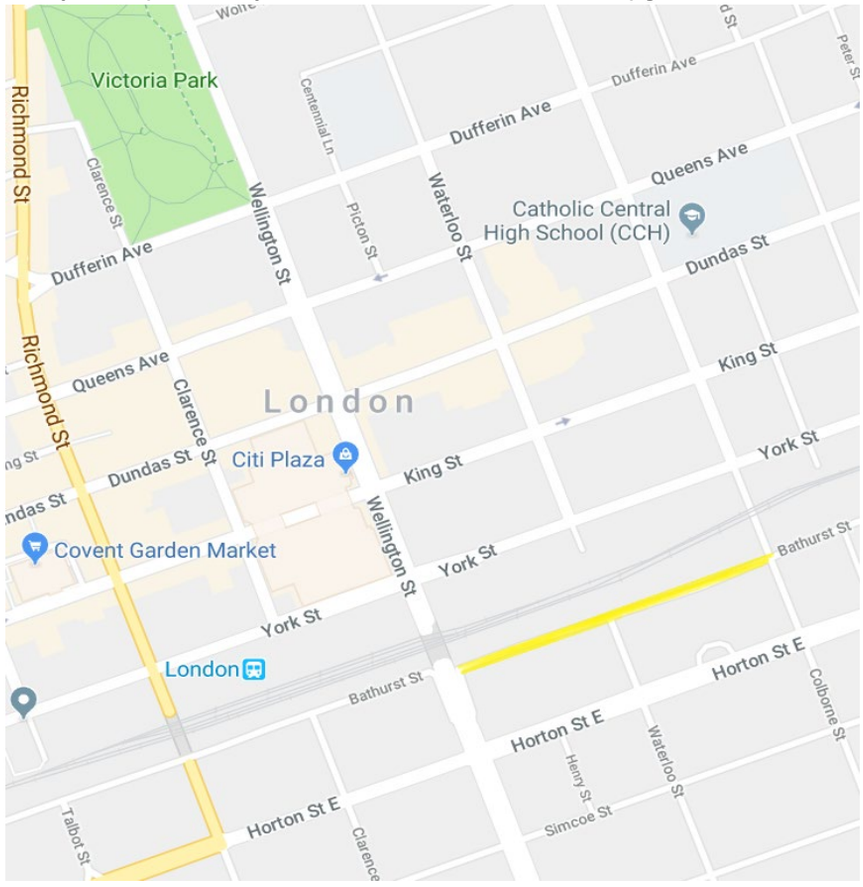
Project Number:	19C2
Project Name:	13.8 kV Conversion Main Feeders
Start Date:	Jan-19
In-Service Date:	Dec-19

Project Title: 13.8 kV Conversion of Main Feeders

Additional Information:

The initiatives outlined in the London Downtown - 13.8 kV/27.6 kV Nelson TS - 5 Year Plan report require converting all 13.8 kV load by year 2020 when Hydro One eliminates the only transformer station supplying this voltage. Converting the downtown from 13.8 kV distribution, that had only one supply source, to the 27.6 kV distribution system, that has multiple supply sources, ensures a more reliable system to London's core area and also aids in optimizing switching and load transfering amongst the other 27.6 kV stations.

Under this project item it is anticipated that approximately 300 kW of 13.8 kV load will be converted to the 27.6 kV distribution system. The general project area covers the overhead plant as illustrated below (in yellow). Upon successful conversion of the planned load, it is anticipated there will be an additional 501 kW of 13.8 kV main feeder load (one transformer bank) which will be converted in early 2020 prior to Hydro One's transformer station upgrade.



Prepared By: **Sunny Patel, P.Eng.**
Distribution Engineer

Approved By: **William Milroy, P.Eng.**
Chief Engineer &
V.P. of Operations

CAPITAL PROJECT SUMMARY SHEET

SYSTEM RENEWAL

Project Number:	19C3
Project Name:	Civil Structure Installation
Start Date:	Jan-19
In-Service Date:	Dec-19

Project Title: Installation of Civil Structure

Supporting Reference Material:
City of London: The London Plan (2016)
Electric Distribution System Asset Sustainment Plan: 2015-2029 (2014)
High Voltage Design Report for Dundas Flex Street (2017)
Summary Report of Structures Inventory: Maintenance Holes & Network Transformer Vaults (2012)

Description:

The City of London will be conducting extensive civil infrastructure rehabilitation along the following streets in 2019:

1) Dundas Street: from east of Richmond Street to Wellington Road. Known as Dundas Place Phase 2
2) York Street: from Talbot Street to Clarence Street
3) Talbot Street: from King Street to York Street

In conjunction with the City's projects, London Hydro will replace most of its existing concrete encased duct and maintenance hole systems, whose audits revealed the structural integrity is at, or nearing, the end of its usefull lifespan.

In collaboration with Project 19F5, London Hydro will rebuild and modernize the existing electrical distribution system along Dundas Street to a 27.6 kV system and in collaboration with Project 19F3 the York Street and Talbot Street projects will replace existing structure and reroute existing cables. The installation of these civil infrastructures will also permit London Hydro to install future main feeder circuits and provide the City's Core with the 27.6 kV supply.

PRIMARY DRIVER:	Co-ordination
OTHER DRIVERS:	Efficiency
	Reliability
	Econ. Dev.
	Environmental
CUSTOMERS IMPACTED:	Various
OEB CAPITAL REPORTING:	C4 - Backup Supply / Structure Installation
LH PROJECT DRIVER:	RNF

COST ESTIMATE - BY YEAR

	COST	AREA/SCOPE
2012	$0	
2013	$0	
2014	$1,005,000	
2015	$1,835,000	
2016	$690,000	
2017	$1,600,000	
2018	$4,208,496	
2019	$4,704,000	
2020	$200,000	
2021	$1,200,000	
TOTAL COST ESTIMATE:		$15,442,496

LH SECTION # 141

CAPITAL PROJECT SUMMARY SHEET

SYSTEM RENEWAL

Project Number:	19C3
Project Name:	Civil Structure Installation
Start Date:	Jan-19
In-Service Date:	Dec-19

Project Title: Installation of Civil Structure

Risks to Completion & Mitigation Plan: Availability of resources to match timing dictated by the City; mitigation plan is close co-ordination with the City to ensure schedules are compatible and to secure resources (contract) in a joint tender with the City. These are very complex projects that require much planning and design time; mitigation plans are to press the City to commit to the projects at least one year in advance to provide sufficient time for planning and design.

EVALUATION OF OUTCOMES:	
Efficiency, Customer Value, Reliability	These projects involve the replacement of the old duct and maintenance holes and electrical equipment that are nearing the end of useful life with new duct structure and maintenance holes, modernized electrical equipment and 27.6 kV feeders. Efficiency is gained by removing multiple cables supplied by various systems and installing and operating only 27.6 kV feeders.
Safety	The safety component relies on the fact that new maintenance holes will provide a safer environment for our employees to access and perform work.
Cyber-Security, Privacy	Not applicable
Co-ordination, Interoperability	Projects are co-ordinated with the City of London and other utilities to minimize costs and for efficient completion of civil infrastructure installations.
Economic Development	Additional capacity in the core supports the economic development initiatives of the City of London and its intensification plans as outlined in the City's London Plan.
Environmental Benefits	Environmental benefits are related to future new cable installations that will allow London Hydro to eliminate lead cable present in the downtown supply system.

IMPACT TO O&M COSTS:

New civil infrastructure installations permit London Hydro to find new routes for underground supply cable, which can free up and allow decomissioning of other old structures that would otherwise require maintenance to remain in service.

ALTERNATIVES CONSIDERED:

London Hydro can commit to projects related to civil infrastructure installation on its own, using its own contractors at the time when projects evolve. This is a much more costly option than co-ordinating with the City.

LINK TO STRATEGIC PLAN:

Section 6.2.1 - Emphasis on Reliability

CUSTOMER ENGAGEMENT:

Multiple parties are involved in discussion throughout this project, in co-ordination with the City of London, property owners, commercial customers and other parties affected (e.g. other utilities).

CAPITAL PROJECT SUMMARY SHEET

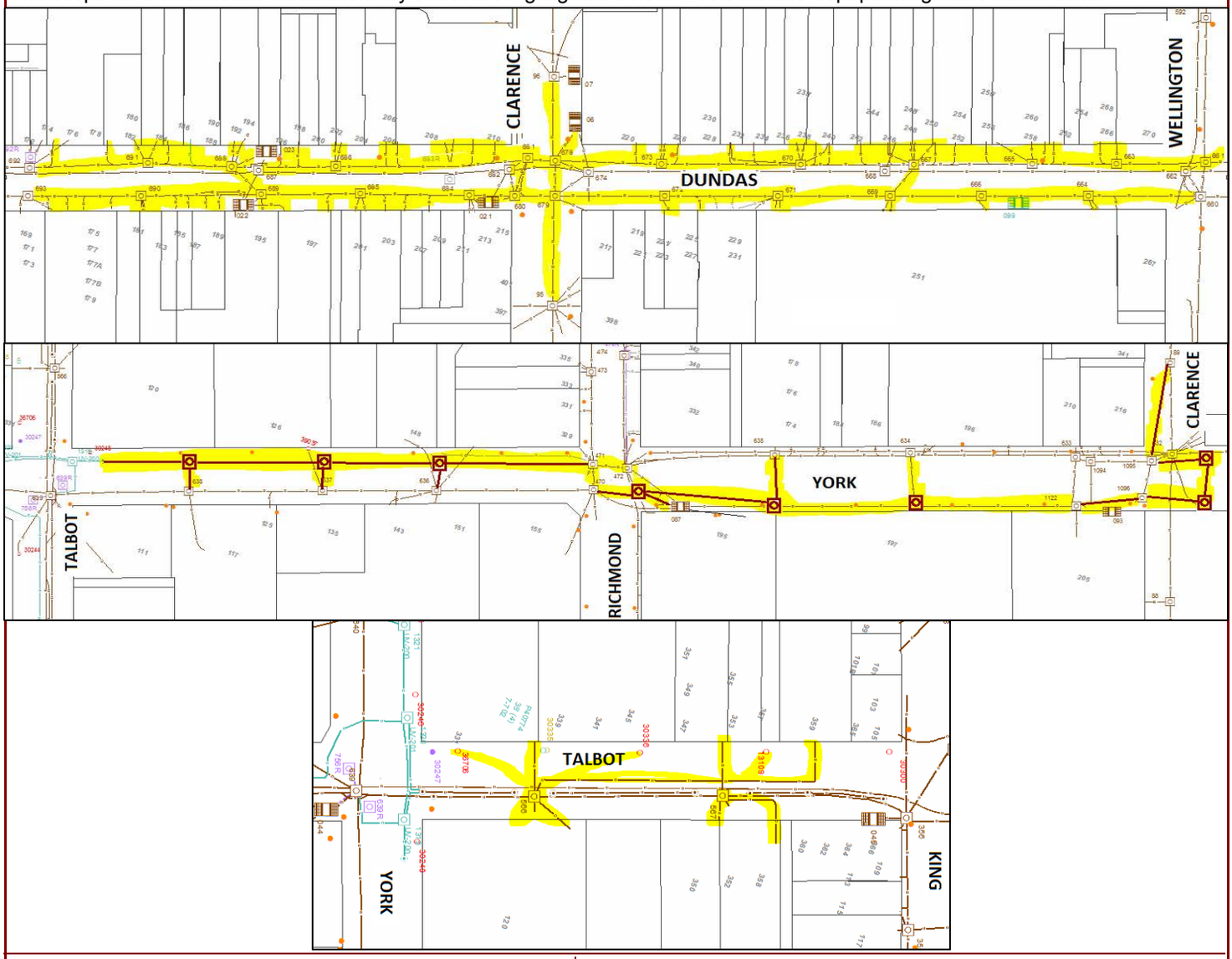
SYSTEM RENEWAL

Project Number:	19C3
Project Name:	Civil Structure Installation
Start Date:	Jan-19
In-Service Date:	Dec-19

Project Title: Installation of Civil Structure

Additional Information:

The scope for civil structure installations by street are highlighted below. Costs include depopulating cable from vaults.



Prepared By: Rodney Doyle, P.Eng.
Senior Distribution Engineer

Approved By: William Milroy, P.Eng.
Chief Engineer &
V.P. of Operations

CAPITAL PROJECT SUMMARY SHEET

SYSTEM RENEWAL

Project Number:	19C4
Project Name:	New Main Feeder Ties
Start Date:	Jan-19
In-Service Date:	Dec-19

Project Title: New 27.6 kV Main Feeder Ties

Supporting Reference Material:
London Area Regional Infrastructure Plan (2017)
Electric Distribution System Asset Sustainment Plan: 2015-2029 (2014)
Northwest Supply Capacity Study (2018)

Description:

Significant residential and commercial development in the city's Northwest end has resulted in load growth exceeding reliable operating limits on the existing distribution feeders.

This project involves reconfiguring 26M56 and 26M14 feeders to balance loads within design limits. In addition, 26M14 will provide supply diversity to the Northwest to improve reliability.

PRIMARY DRIVER:	Reliability
OTHER DRIVERS:	Efficiency
	Customer Value
	Econ. Dev.
CUSTOMERS IMPACTED:	6,000+
OEB CAPITAL REPORTING:	C3 - Conversions

COST ESTIMATE - BY YEAR

	COST	AREA/SCOPE
2012	$0	
2013	$0	
2014	$0	
2015	$776,043	
2016	$1,623,919	685kW converted
2017	$85,576	
2018	$74,210	1 Project
2019	$155,000	2 Projects
2020	$650,000	
2021	$2,100,000	
TOTAL COST ESTIMATE:		$5,464,748

LH PROJECT DRIVER:	RNF	**LH SECTION #**	140

CAPITAL PROJECT SUMMARY SHEET

SYSTEM RENEWAL

Project Number:	19C4
Project Name:	New Main Feeder Ties
Start Date:	Jan-19
In-Service Date:	Dec-19

Project Title: New 27.6 kV Main Feeder Ties

Risks to Completion & Mitigation Plan:

Risks to completion are limited. The availability of resources (internal and contractor) is sufficient to complete this project.

EVALUATION OF OUTCOMES:

Efficiency, Customer Value, Reliability	Customers will benefit from the additional capacity and reliable supply to support load growth and increase operational flexibility under system contingencies.
Safety	Not applicable
Cyber-Security, Privacy	Not applicable
Co-ordination, Interoperability	Not applicable
Economic Development	Additional capacity and improved reliability will contribute to overall attractiveness of London as a place in which to live and do business.
Environmental Benefits	Not applicable

IMPACT TO O&M COSTS:

Remain the same or increase marginally due to supply diversity with feeders orginating from two different DESNs

ALTERNATIVES CONSIDERED:

Do nothing, however this alternative was rejected since the existing distribution system is operating at the edge of its reliable limits due to increased loads as a result of the commercial and residential development experienced in the Northwest.

LINK TO STRATEGIC PLAN:

Section 6.2.1 - Emphasis on Reliability

CUSTOMER ENGAGEMENT:

Customers were not directly engaged regarding this project, but recent surveys indicate customers value improvements to reliability (refer to DSP Section 3.2.4 Customer Engagement).

CAPITAL PROJECT SUMMARY SHEET

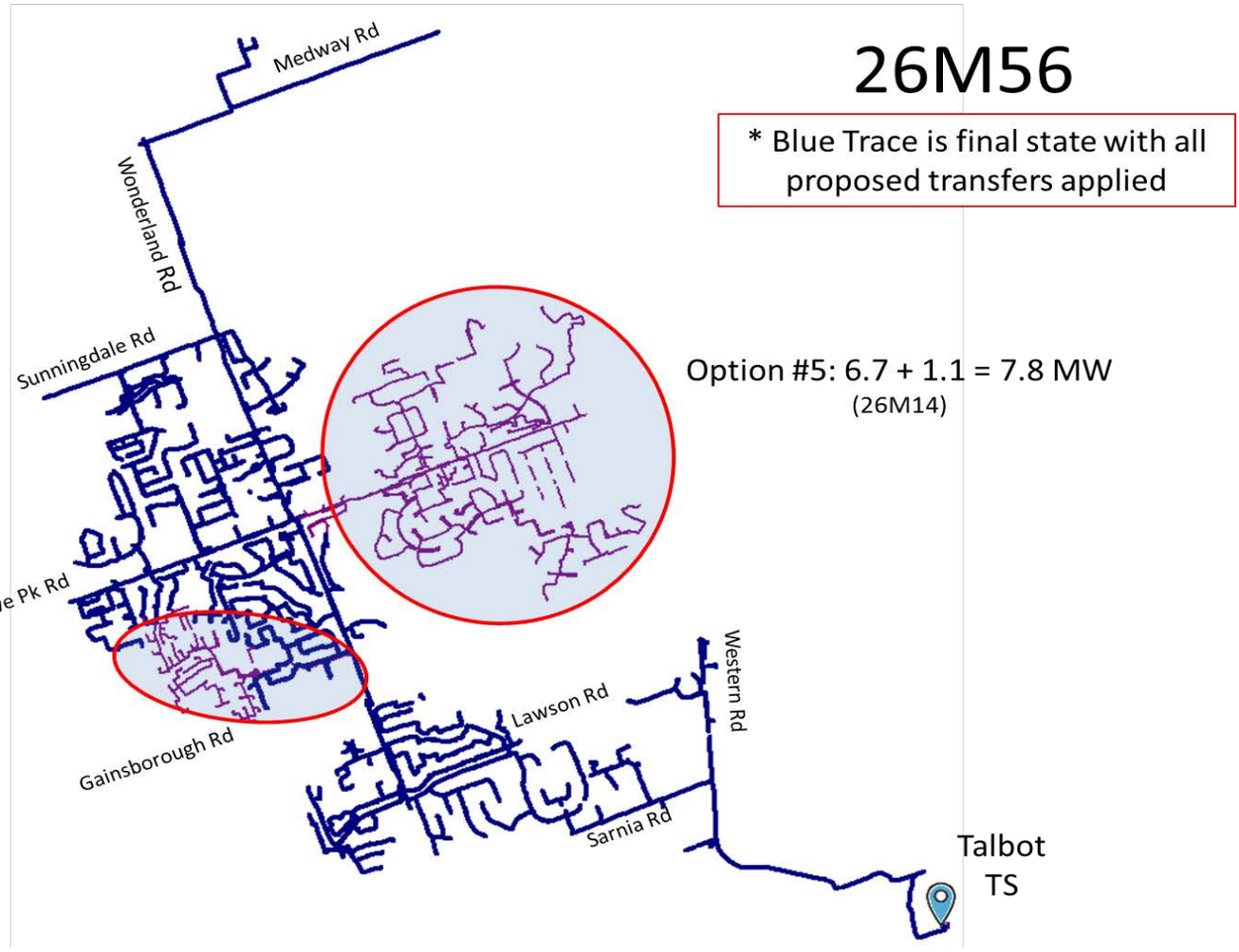
SYSTEM RENEWAL

Project Number:	19C4
Project Name:	New Main Feeder Ties
Start Date:	Jan-19
In-Service Date:	Dec-19

Project Title: New 27.6 kV Main Feeder Ties

Additional Information:

This reconfiguration will facilitate better balance loading and improve reliability. Reference image below for load pockets to be transferred to 26M14.



Prepared By:	**Adrian Lattanzio, P.Eng.** **Distribution Engineer**
Approved By:	**William Milroy, P.Eng.** **V.P. of Eng. & Operations**

CAPITAL PROJECT SUMMARY SHEET SYSTEM ACCESS

Project Number:	19D1
Project Name:	City of London (Road Authority) Relocations
Start Date:	Jan-19
In-Service Date:	Dec-19

Project Title: City of London (Road Authority) Relocations

Supporting Reference Material:
Infrastructure Replacement List (2014-2023), City of London
2014 Transportation Development Charge - Background Study, City of London (May 2014)
2030 Transportation Master Plan - SmartMoves (May 2013)
Public Service Works on Highways Act

Description:

This project involves the relocation of London Hydro Infrastructure located on the road allowance. These relocations are initiated by the Road Authority (City of London) and are necessary in order to accommodate planned modifications to the roadway.

The terms and conditions under which these relocations occur are specified in the Public Service Works on Highways Act enacted by the Provincial Government. The Act gives a Road Authority the power to ensure that all operating corporations entitled to the use of the road allowance cooperate with the Road Authority to execute any required modifications to the profile of the road allowance in a timely manner. The Act states that an Operating Corporation (London Hydro Inc.) must modify or relocate their plant on the road allowance to accommodate the Road Authority's improvements or alterations within a specified time period. The Act also outlines the mechanism for the apportionment of costs for these required works. Typically the Operating Corporation is permitted to recover 50% of the labour and vehicle costs from the Road Authority.

PRIMARY DRIVER:	Co-ordination
OTHER DRIVERS:	Econ. Dev.
	Customer Value
	Safety
CUSTOMERS IMPACTED:	Various
OEB CAPITAL REPORTING	D1 - City Road Authority Relocates
LH PROJECT DRIVER:	COL

COST ESTIMATE - BY YEAR

	COST	AREA/SCOPE
2012	$1,589,553	
2013	$991,465	
2014	$1,928,812	
2015	$1,520,000	
2016	$3,025,000	
2017	$3,066,121	
2018	$1,739,165	
2019	$1,550,000	
2020	$1,670,000	
2021	$730,000	
TOTAL COST ESTIMATE:		$17,810,116

LH SECTION # 133

CAPITAL PROJECT SUMMARY SHEET

SYSTEM ACCESS

Project Number:	19D1
Project Name:	City of London (Road Authority) Relocations
Start Date:	Jan-19
In-Service Date:	Dec-19

Project Title: City of London (Road Authority) Relocations

Risks to Completion & Mitigation Plan: Availability of resources to match timing dictated by the City of London; mitigation plan is close co-ordination with the City to ensure schedules are compatible; some projects may require new infrastructure to be designed, ordered, constructed; mitigation plan is to push the City to commit to projects at least one year in advance to provide ample lead time for planning.

EVALUATION OF OUTCOMES:

Efficiency, Customer Value, Reliability	Past projects have demonstrated it is most efficient to build new infrastructure at the new location, rather than attempt relocating the existing infrastructure; this results in newer infrastructure which will be more reliable.
Safety	Renewed infrastructure and new design standards improve the safety of the distribution system
Cyber-Security, Privacy	Not Applicable
Co-ordination, Interoperability	Significant co-ordination is required with the municipality and other utilities; where possible, a single contractor is used to install civil works
Economic Development	Municipal road widenings are part of the City's overall economic development plan to enhance growth, and this project supports that plan.
Environmental Benefits	Not Applicable

IMPACT TO O&M COSTS:

Annual operating and maintenance costs may be reduced since newly installed infrastructure will experience fewer outages.

ALTERNATIVES CONSIDERED:

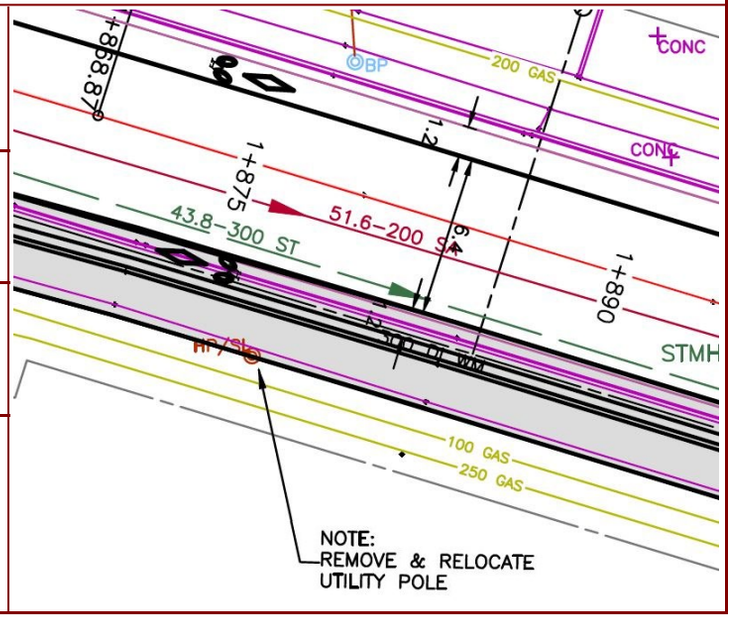
In most cases there are no alternatives; if possible, design alternatives that reduce impact to utility plant are considered.

LINK TO STRATEGIC PLAN:

6.2.1 - Emphasis on Reliability - Growth

CUSTOMER ENGAGEMENT:

The City of London leads customer interaction on road widening projects; London Hydro initiates contact with customers to explain the driver for hydro work, potential service interruptions, surface restoration responsibilities, and overall schedule.



CAPITAL PROJECT SUMMARY SHEET

SYSTEM ACCESS

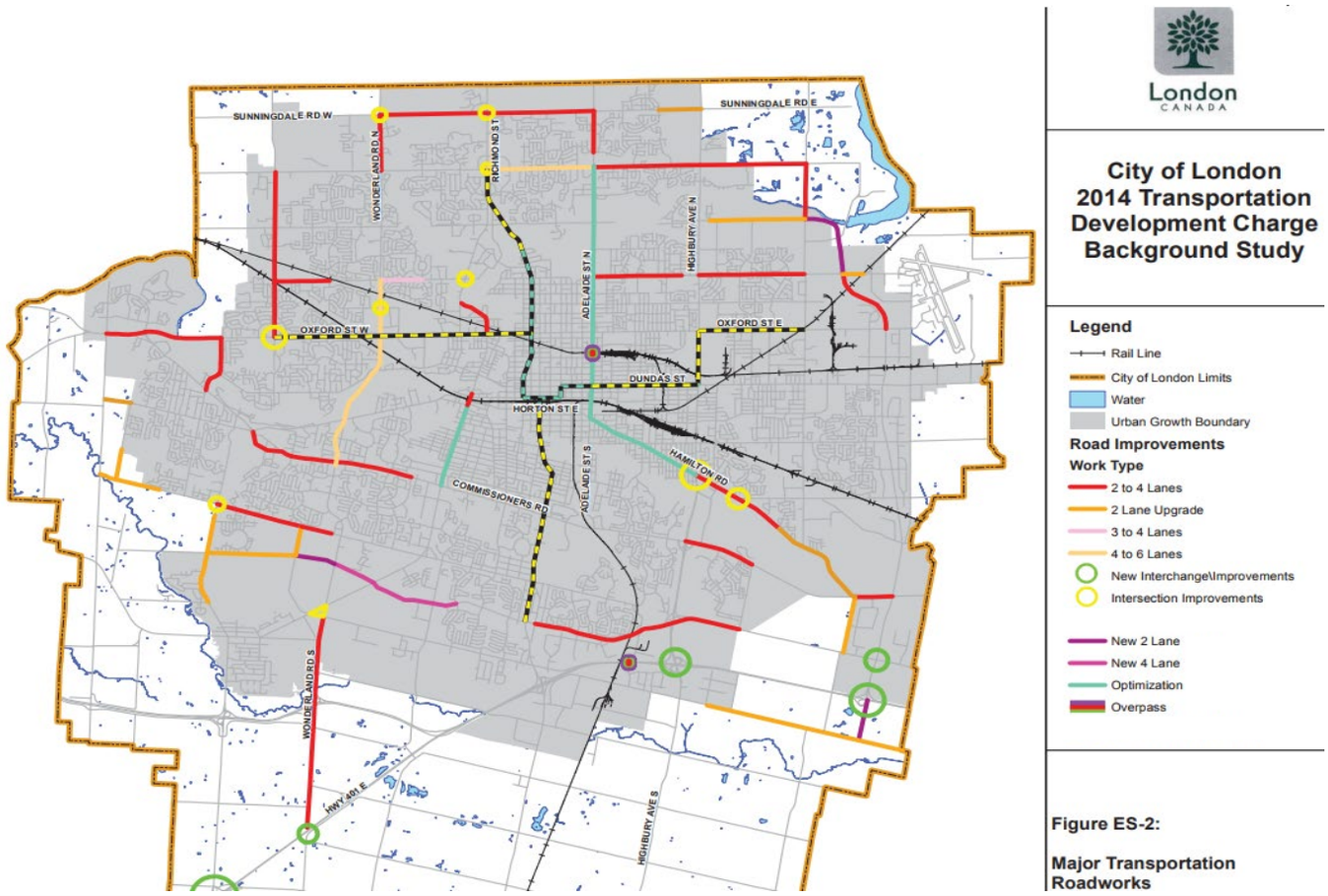
Project Number:	19D1
Project Name:	City of London (Road Authority) Relocations
Start Date:	Jan-19
In-Service Date:	Dec-19

Project Title: City of London (Road Authority) Relocations

Additional Information:

The city works are externally driven and mostly attributed to growth. The City of London is following a multi-year plan to meet the City's growing transportation needs and new developments. Working in collaboration with the City and other utilities, infrastructure assets are relocated in advance of city works, typically one to two years ahead of time.

The 2019 budget for this section is estimated to address utility relocations due to City plans, which are outlined in documents such as: "2030 Transportation Master Plan - Smart Moves (May 2013)" and "2014 Transportation Development Charge Background Study, City of London (May 2014)".



Prepared By:	**Sunny Patel, P.Eng.** **Distribution Engineer**
Approved By:	**William Milroy, P.Eng.** **Chief Engineer &** **V.P. of Operations**

CAPITAL PROJECT SUMMARY SHEET

SYSTEM ACCESS

Project Number:	19E1
Project Name:	Expansions and Relocations
Start Date:	Jan-19
In-Service Date:	Dec-19

Project Title: Developer Driven Distribution Circuits Expansions and Relocations

Supporting Reference Material: London Hydro Conditions of Service

Description:

This budget item includes extension of the existing high voltage overhead and/or underground distribution system in order to accommodate new customer developments as they are added to London's service area. This budget item includes all costs associated with the construction of these extensions.

At present time, there is one confirmed expansion that started in 2018 and is expected to continue into 2019 which involves a 27.6kV overhead line extension to service a proposed commercial development on Wellington Road, South of Glanworth Drive. For 2019, this project has been allotted a budget of $300,000 which is the estimated carryover. The remaining $200,000 is allocated for expansions and relocations that have yet to be determined by various developers.

This item also includes the relocation of existing London Hydro plant for accommodating new developments within the city limits. These relocations are required when items such as new proposed driveways and turn lanes for new developments are in conflict with the existing hydro plant. This budget item includes all costs associated with the relocation.

PRIMARY DRIVER:	Customer Value
OTHER DRIVERS:	Econ. Dev.
CUSTOMERS IMPACTED:	Various

OEB CAPITAL REPORTING

E1 - Developer Expansions and Relocations

COST ESTIMATE - BY YEAR

	COST	AREA/SCOPE
2012	$474,285	
2013	$721,224	
2014	$346,785	
2015	$461,286	
2016	$683,035	
2017	$901,549	
2018	$1,709,000	
2019	$500,000	
2020	$1,300,800	
2021	$200,000	
TOTAL COST ESTIMATE:		$7,297,964

LH PROJECT DRIVER:	DEV	**LH SECTION #**	131

CAPITAL PROJECT SUMMARY SHEET SYSTEM ACCESS

Project Number:	19E1
Project Name:	Expansions and Relocations
Start Date:	Jan-19
In-Service Date:	Dec-19

Project Title: Developer Driven Distribution Circuit Expansions and Relocations

Risks to Completion & Mitigation Plan: Availability of resources to match timing required by the developer; mitigation plan is close coordination with the developer and securing resources (internal or contract) to ensure completion.

EVALUATION OF OUTCOMES:

Efficiency, Customer Value, Reliability	Expansion for new developments within the city of London reinforces the distribution system and often represents opportunities to reconfigure infrastructure and increase automation, which enhances the reliability of the power supply to customers.
Safety	There are no direct implications to safety as a result of this project
Cyber-Security, Privacy	Not Applicable
Co-ordination, Interoperability	London Hydro responds to customers' requests for service or relocation of plant to support new developments.
Economic Development	Adequate supply capacity supports the economic development initiatives in the city of London and the intensification plans outlined in the City's London Plan.
Environmental Benefits	There are no direct environmental benefits associated with this project.

IMPACT TO O&M COSTS:

Not Applicable

ALTERNATIVES CONSIDERED:

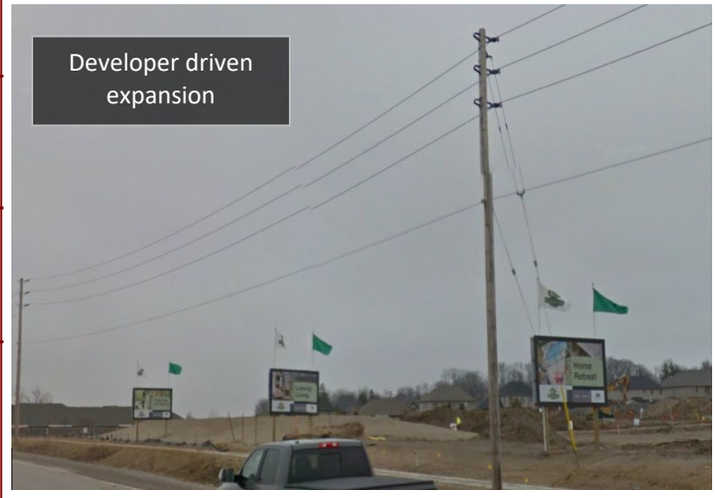
Customer development added to London Hydro's service area must be supplied with service upon request.

LINK TO STRATEGIC PLAN:

6.2.1 - Emphasis on Reliability - Growth

CUSTOMER ENGAGEMENT:

This project is a direct result of customer applications to receive service in territories where London Hydro lacks the infrastructure. Customers make decisions on the type of expansion (overhead or underground) required.



CAPITAL PROJECT SUMMARY SHEET

SYSTEM ACCESS

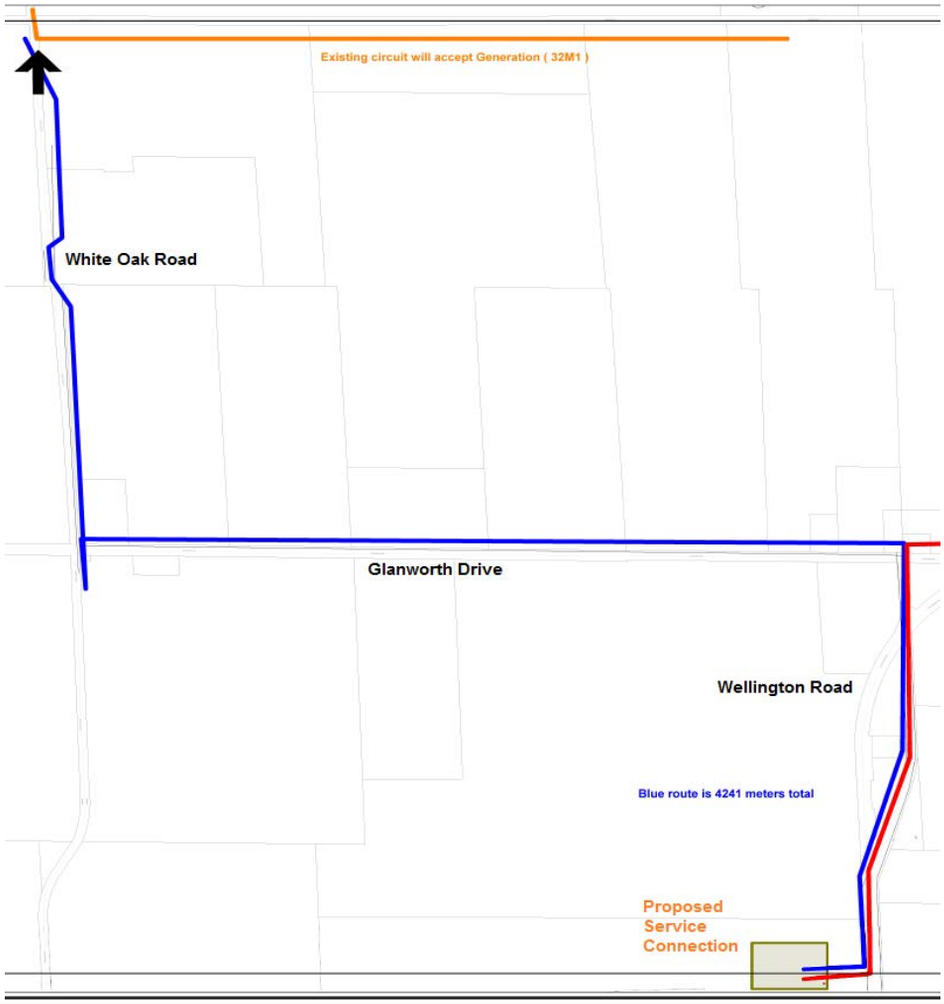
Project Number:	19E1
Project Name:	Expansions and Relocations
Start Date:	Jan-19
In-Service Date:	Dec-19

Project Title: Developer Driven Distribution Circuits Expansions and Relocations

Additional Information:

This project involves the installation and/or modification of electrical equipment that is used in supplying customers' installations. It also includes the work associated with upgrading existing installations. The London Hydro Conditions of Service details how capital contributions are assessed for these installations.

The known overhead line build expansion project to be carried over from 2018 is shown geographically below.



Prepared By: Sunny Patel, P.Eng.
Distribution Engineer

Approved By: William Milroy, P.Eng.
V.P. Engineering
& Operations

CAPITAL PROJECT SUMMARY SHEET

SYSTEM ACCESS

Project Number:	19E2
Project Name:	Secondary Service Upgrades
Start Date:	Jan-19
In-Service Date:	Dec-19

Project Title: Residential Secondary Service Upgrades

Supporting Reference Material: London Hydro Conditions of Service: Service Upgrades - Residential (Sec.2.2.4 & Appendix B)

Description: This budget item is for the replacement of existing overhead low voltage service conductors with larger capacity conductors. These connections are typically required when customers increase their electrical service demands. This budget item includes all costs associated with these basic service upgrades. For an upgrade to a service level higher than the basic connection, London Hydro may charge a reasonable fee for the portion of the upgrade beyond basic service.

PRIMARY DRIVER:	Customer Value
OTHER DRIVERS:	Econ. Dev.
CUSTOMERS IMPACTED:	Various

OEB CAPITAL REPORTING:

E2 - Residential Secondary Service Upgrade

COST ESTIMATE - BY YEAR

	COST	AREA/SCOPE
2012	$340,484	
2013	$314,266	
2014	$342,587	
2015	$395,395	
2016	$445,300	various
2017	$390,944	various
2018	$363,000	various
2019	$370,000	
2020	$377,000	
2021	$384,000	
TOTAL COST ESTIMATE:		$3,722,976

LH PROJECT DRIVER:	DEV	**LH SECTION #**	131

CAPITAL PROJECT SUMMARY SHEET SYSTEM ACCESS

Project Number:	19E2
Project Name:	Secondary Service Upgrades
Start Date:	Jan-19
In-Service Date:	Dec-19

Project Title: Residential Secondary Service Upgrades

Risks to Completion & Mitigation Plan:

Risks to completion are minimal. This project is part of a program that is successfully executed each year. The availability of resources (internal labour) is sufficient to complete this project.

EVALUATION OF OUTCOMES:

Efficiency, Customer Value, Reliability	Replacement of aged and undersized secondary services is supported by the Asset Sustainment Plan, which recommends that assets reaching end of life should be replaced before affecting reliability or jeopardizing safety.
Safety	Upgrading substandard or inadequate residential electric service contributes to overall improvements in safety.
Cyber-Security, Privacy	Not Applicable
Co-ordination, Interoperability	Not Applicable
Economic Development	Improved service will contribute to the overall attractiveness of London as a place in which to live and do business.
Environmental Benefits	There are no direct environmental benefits associated with this work.

IMPACT TO O&M COSTS:

Fewer outages may be experienced on the secondary system when older installations are upgraded, resulting in lower operating and maintenance costs.

ALTERNATIVES CONSIDERED:

The Distribution System Code requires every LDC to provide basic electric service to all residential customers. These upgrades bring all installations up to current standards.

LINK TO STRATEGIC PLAN:

6.2.1 - Emphasis on Reliability - Asset Management

CUSTOMER ENGAGEMENT:

Upgrades to residential secondary services are initiated by customers; London Hydro upgrades the infrastructure in response to the customer request.

CAPITAL PROJECT SUMMARY SHEET

SYSTEM ACCESS

Project Number:	19E2
Project Name:	Secondary Service Upgrades
Start Date:	Jan-19
In-Service Date:	Dec-19

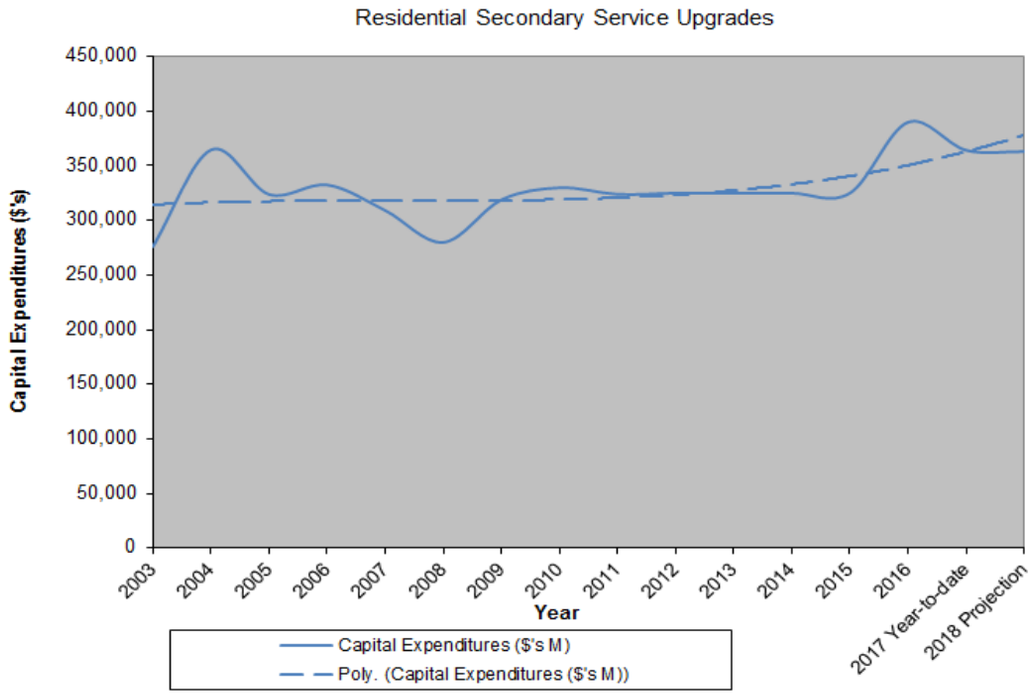
Project Title: Residential Secondary Service Upgrades

Additional Information:

This project involves the replacement of overhead low voltage electrical services to residential dwellings. There is no charge from London Hydro to the customers for these upgrades as they are part of London Hydro's basic connection for overhead residential customers as defined in the Distribution System Code.

These upgrades are initiated by customers that require an increase to their electrical service size. These requests may be due to issues such as the addition of new load in their home or due to an insurance company requiring the service to be upgraded to a minimal size and configuration.

From a budgeting perspective, the annual expenditures are estimated based on past history. A graph is provided below which illustrates the level of required expenditures within London Hydro's service territory between 2003 and 2017.



Prepared By: **Sunny Patel, P.Eng.**
Distribution Engineer

Approved By: **William Milroy, P.Eng.**
V.P. Engineering
& Operations

CAPITAL PROJECT SUMMARY SHEET

SYSTEM ACCESS

Project Number:	19E3
Project Name:	Residential Underground Servicing
Start Date:	Jan-19
In-Service Date:	Dec-19

Project Title: New Single Family Residential Underground Distribution

Supporting Reference Material:
Housing Market Outlook Reports (2018)
London Hydro Conditions of Service

Description:
This item involves the installation of single family residential underground distribution systems to provide service as needed to developers.

It is noted that market conditions can create large fluctuations in expenditures from year to year. This item is solely dependent on market conditions. This section will contain several different projects of varying magnitude depending on customer requirements.

PRIMARY DRIVER:	Customer Value
OTHER DRIVERS:	Econ. Dev.
CUSTOMERS IMPACTED:	Various
OEB CAPITAL REPORTING:	E3 - Single Family Residential UG
LH PROJECT DRIVER:	DEV

COST ESTIMATE - BY YEAR

	COST	AREA/SCOPE
2012	$2,480,430	
2013	$1,513,249	
2014	$2,881,332	
2015	$2,340,507	
2016	$2,896,629	
2017	$4,760,309	
2018	$5,103,916	
2019	$2,520,000	
2020	$1,470,000	
2021	$1,494,000	
TOTAL COST ESTIMATE:	$27,460,372	

LH SECTION # 142

CAPITAL PROJECT SUMMARY SHEET

SYSTEM ACCESS

Project Number:	19E3
Project Name:	Residential Underground Servicing
Start Date:	Jan-19
In-Service Date:	Dec-19

Project Title: New Single Family Residential Underground Distribution

Risks to Completion & Mitigation Plan: Resource availability to match customer's requested service date is the biggest risk to completion. Mitigation plan includes close co-ordination between engineering and operations staff to determine the projects that need to be completed by external resources and secure the external resources (contractor) well in advance of the requested project start date

EVALUATION OF OUTCOMES:	
Efficiency, Customer Value, Reliability	With the economic growth expected in the City of London, new developments will be built. London Hydro utilizes these opportunities to expand the underground distribution system infrastructure, reconfigure the system, and increase automation, which will provide the customers with reliable power supply.
Safety	There is no direct implication to safety as a result of this project.
Cyber-Security, Privacy	Not applicable
Co-ordination, Interoperability	London Hydro responds to developer requests for new services to support new developments in the City of London.
Economic Development	London is growing and new residential subdivisions will be built to accomodate the growth. London Hydro will ensure that adequate supply capacity supports the economic development initiatives in the City of London and its growth plans as outlined in the City's "The London Plan".
Environmental Benefits	There are no direct environmental benefits as a result of this project.

IMPACT TO O&M COSTS:

Not applicable

ALTERNATIVES CONSIDERED:

There is no alternative consideration; new houses added to London Hydro's with service area must be supplied with service upon request.

LINK TO STRATEGIC PLAN:

6.2.1 - Emphasis on Reliability - Growth

CUSTOMER ENGAGEMENT:

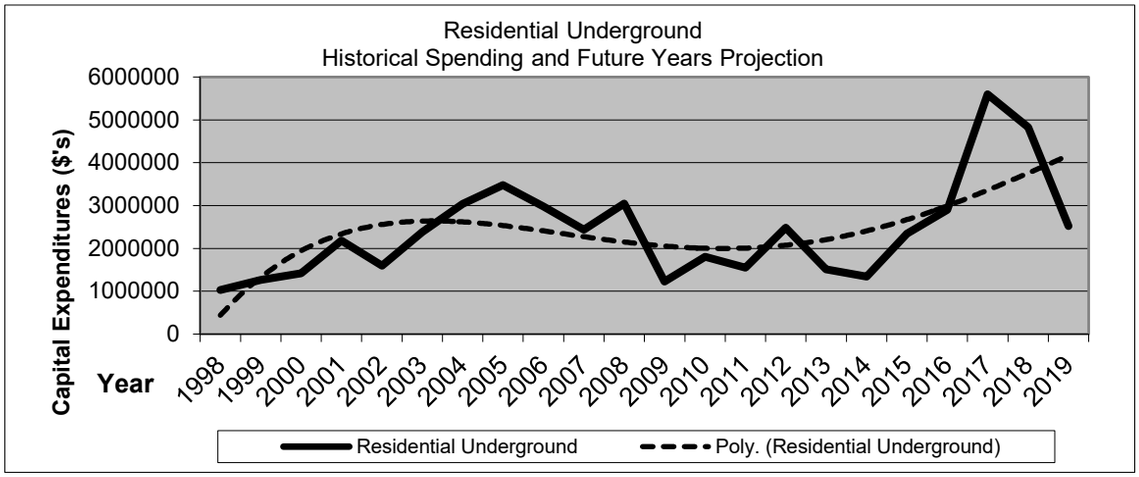
This project is a direct result of customer applications to install services in new subdivision developments where London Hydro lacks the underground infrastructure. This project is closely co-ordinated with the customer and developers.

CAPITAL PROJECT SUMMARY SHEET

SYSTEM ACCESS

Project Number:	19E3
Project Name:	Residential Underground Servicing
Start Date:	Jan-19
In-Service Date:	Dec-19

Project Title: New Single Family Residential Underground Distribution



The graph to the left shows historical and projected spending in the residential underground budget section (including downward trending 2019 year-end forecast).

ONTARIO HOUSING STARTS: YEAR TO YEAR COMPARISON

Metropolitan Area	JAN - AUG 2017	JAN - AUG 2018	%	INCREASE/DECREASE
Barrie	971	1,292	33%	↑
Belleville	380	400	5%	↑
Brantford	344	444	29%	↑
Guelph	546	716	31%	↑
Hamilton	1,852	2,517	36%	↑
Kingston	491	503	2%	↑
Kitchener area	2,328	2,184	-6%	↓
London	2,581	1,847	-28%	↓

Data from the Ontario Home Builders Association shows downward trend

The map to the left shows active planning and subdivision applications as of October 2018.

Prepared By: **Rick Stainthorpe CET, PMP**
Director Logistics & Operations Support

Approved By: **William Milroy, P.Eng.**
V.P. Engineering & Operations

CAPITAL PROJECT SUMMARY SHEET

SYSTEM ACCESS

Project Number:	19E4
Project Name:	Multi-Housing Servicing
Start Date:	Jan-19
In-Service Date:	Dec-19

Project Title: New Multi-Housing Underground Distribution

Supporting Reference Material:
Housing Market Outlook Reports (2018)
London Hydro Conditions of Service

Description:
This item involves the installation of multi-housing (primarily townhouses and condominiums) underground distribution systems to provide service as needed to developers.

This item is solely dependent on market conditions. This section will contain several different projects of varying magnitude depending on customer requirements.

PRIMARY DRIVER:	Customer Value
OTHER DRIVERS:	Econ. Dev.
CUSTOMERS IMPACTED:	Various

OEB CAPITAL REPORTING:

E4 - Multi-Family Residential UG

COST ESTIMATE - BY YEAR

	COST	AREA/SCOPE
2012	$633,113	
2013	$993,045	
2014	$831,460	
2015	$1,867,370	
2016	$1,226,389	
2017	$2,578,480	
2018	$2,043,000	
2019	$1,645,000	
2020	$955,000	
2021	$974,000	
TOTAL COST ESTIMATE:		$13,746,857

LH PROJECT DRIVER:	DEV	**LH SECTION #**	143

CAPITAL PROJECT SUMMARY SHEET
SYSTEM ACCESS

Project Number:	19E4
Project Name:	Multi-Housing Servicing
Start Date:	Jan-19
In-Service Date:	Dec-19

Project Title: New Multi-Housing Underground Distribution

Risks to Completion & Mitigation Plan: Resource availability to match customer's requested service date is the biggest risk to completion. Mitigation plan includes close co-ordination between engineering and operations staff to determine the projects that need to be completed by external resources and secure the external resources (contractor) well in advance of the requested project start date.

EVALUATION OF OUTCOMES:	
Efficiency, Customer Value, Reliability	With the economic growth expected in the City of London, new developments will be built. London Hydro utilizes these opportunities to expand the underground distribution system infrastructure, reconfigure the system, and increase automation, which will provide the customers with reliable power supply.
Safety	There is no direct implication to safety as a result of this project.
Cyber-Security, Privacy	Not applicable
Co-ordination, Interoperability	London Hydro responds to developer's requests for new services to support new developments in the City of London.
Economic Development	London is growing and new multi-housing projects will be developed; London Hydro will ensure that adequate supply capacity supports the economic development initiatives in the City of London and its growth plans as outlined in the City's "The London Plan" plan.
Environmental Benefits	There are no direct environmental benefits as a result of this project.

IMPACT TO O&M COSTS:

Not applicable

ALTERNATIVES CONSIDERED:

There is no alternative consideration; new multi-housing developments added to London Hydro's service area must be supplied service upon request.

LINK TO STRATEGIC PLAN:

6.2.1 - Emphasis on Reliability - Growth

CUSTOMER ENGAGEMENT:

This project is a direct result of customer applications to install services in new subdivision developments where London Hydro lacks the underground infrastructure. This project is closely co-ordinated with the customer and developers.

CAPITAL PROJECT SUMMARY SHEET

SYSTEM ACCESS

Project Number:	19E4
Project Name:	Multi-Housing Servicing
Start Date:	Jan-19
In-Service Date:	Dec-19

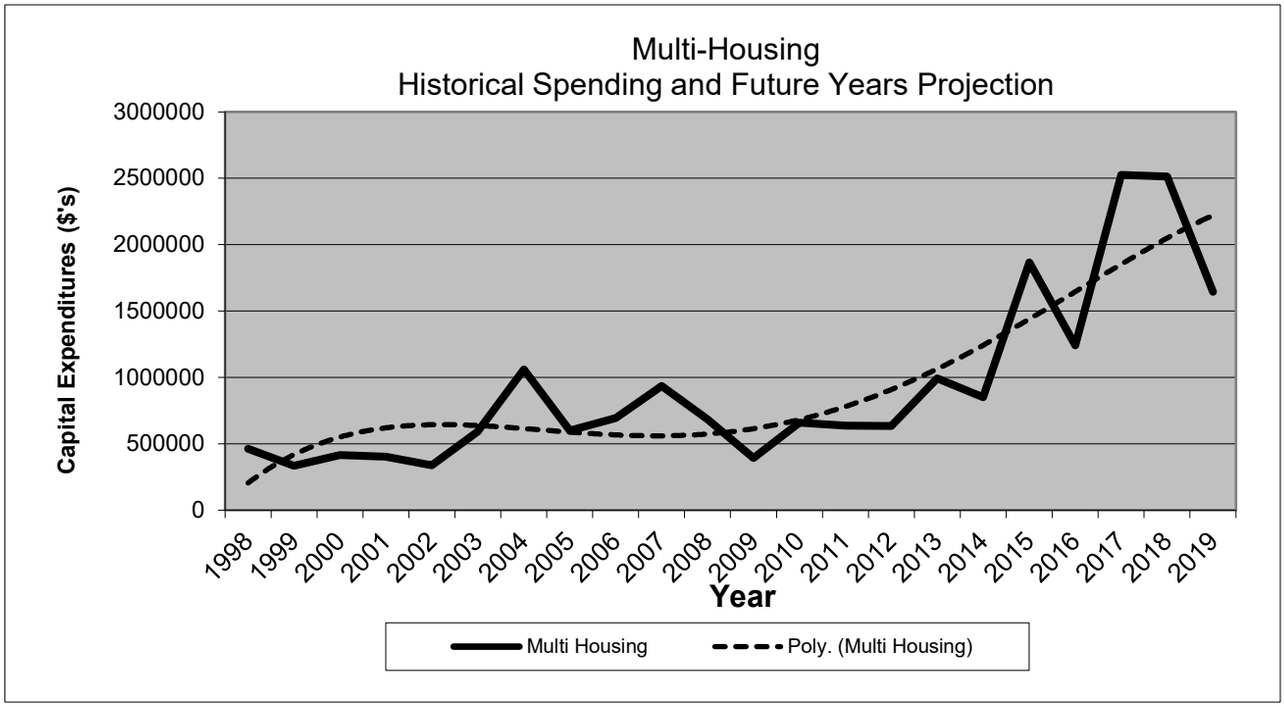
Project Title: New Multi-Housing Underground Distribution

Additional Information:

The "London Hydro Conditions of Service" document details how capital contributions are assessed for these installations.

From a budgeting perspective, the annual expenditures are estimated based on a number of factors including: past history, City of London development forecasts, market reviews including Canada Mortgage and Housing Corporation, and customer inquiries. Examples of the various documents created and reviewed are shown. This information is updated each year and the forecasts and budgets are adjusted accordingly.

This collection of information is part of a larger library that is used in the preparation of the 25 year load forecast.



The graph above shows historical and projected spending in the multi-housing budget section (with a forecast trending downward for 2019 year-end)

Prepared By:	**Rick Stainthorpe CET, PMP** **Director Logistics & Operations Support**
Approved By:	**William Milroy, P.Eng.** **Chief Engineer & V.P. of Operations**

CAPITAL PROJECT SUMMARY SHEET

SYSTEM ACCESS

Project Number:	19E5
Project Name:	Commercial Distribution
Start Date:	Jan-19
In-Service Date:	Dec-19

Project Title: New Commercial Distribution Services

Supporting Reference Material:
London Hydro Conditions of Service
City of London: The London Plan

Description:
This item is for the installation of commercial overhead and underground distribution systems to provide service as required by customers. This item is solely based on market conditions.

This budget is based on past historical expenditure patterns and past history, City of London development forecasts, market reviews, and customer inquiries.

PRIMARY DRIVER:	Customer Value
OTHER DRIVERS:	Econ. Dev.
CUSTOMERS IMPACTED:	Various
OEB CAPITAL REPORTING:	E5 - Commercial Distribution Services
LH PROJECT DRIVER:	DEV

COST ESTIMATE - BY YEAR

	COST	AREA/SCOPE
2012	$2,439,282	
2013	$2,310,586	
2014	$2,044,678	
2015	$1,900,000	
2016	$1,940,000	
2017	$2,830,198	
2018	$2,139,823	
2019	$3,045,000	
2020	$2,070,000	
2021	$2,111,000	
TOTAL COST ESTIMATE:		$22,830,567

LH SECTION # 144

CAPITAL PROJECT SUMMARY SHEET

SYSTEM ACCESS

Project Number:	19E5
Project Name:	Commercial Distribution
Start Date:	Jan-19
In-Service Date:	Dec-19

Project Title: New Commercial Distribution Services

Risks to Completion & Mitigation Plan: Resource availability to match customers' requested service dates is the biggest risk to completion. Mitigation plan includes close co-ordination between engineering and operations staff to determine the projects that need to be completed by external resources and secure the external resources (contractor) well in advance of the requested project service date.

EVALUATION OF OUTCOMES:	
Efficiency, Customer Value, Reliability	With the economic growth expected in the City of London, new commercial and industrial projects will be developed requiring London Hydro to expand its overhead/underground infrastructure. This expansion will reinforce the distribution system and offers opportunities for reconfiguration and increased automation, which provide the customers with reliable power supply.
Safety	There is no direct implication to safety as a result of this project.
Cyber-Security, Privacy	Not applicable
Co-ordination, Interoperability	London Hydro co-ordinates with and responds to customer requests for new installations or modification to current installations.
Economic Development	Commercial and industrial customers play a big role in the economic growth of the City of London. London Hydro will ensure that adequate supply capacity supports the economic development initiatives in the City of London and its growth plans as outlined in the City's "The London Plan" plan.
Environmental Benefits	There are no direct environmental benefits as a result of this project.

IMPACT TO O&M COSTS:

Not applicable

ALTERNATIVES CONSIDERED:

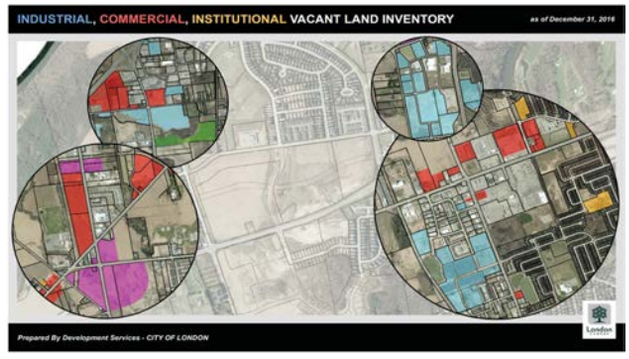
There is no alternative consideration; new commercial and industrial customers added to London Hydro's service area must be supplied service upon request.

LINK TO STRATEGIC PLAN:

6.2.1 - Emphasis on Reliability - Growth

CUSTOMER ENGAGEMENT:

This project is a direct result of customer applications to install services in proposed commercial and industrial locations. This project is closely co-ordinated with the customer and for developers.



CAPITAL PROJECT SUMMARY SHEET

SYSTEM ACCESS

Project Number:	19E5
Project Name:	Commercial Distribution
Start Date:	Jan-19
In-Service Date:	Dec-19

Project Title: New Commercial Distribution Services

Additional Information:

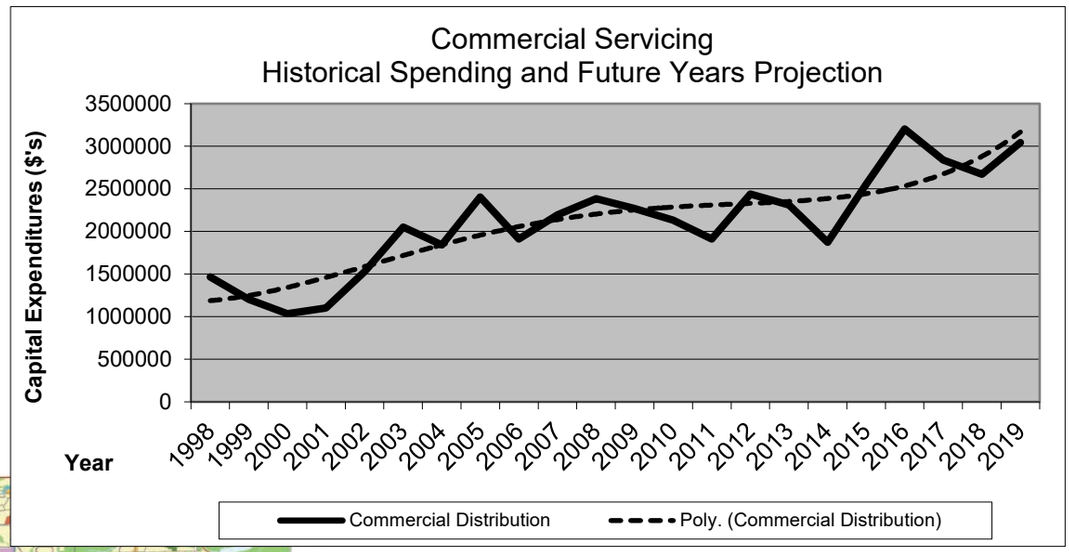
This project involves the installation and/or modification of electrical equipment that is used to supply commercial (including apartments) and industrial customers' installations. It also includes the work associated with upgrading existing installations to meet the demands and requirements for the new loads.

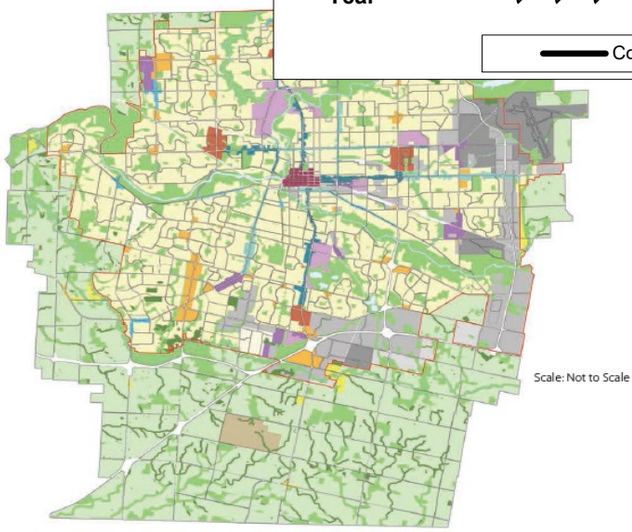
The "London Hydro Conditions of Service" document outlines how capital contributions are calculated for these installations.

From a budgeting perspective, the annual expenditures are estimated based on a number of factors including past history, City of London development forecasts, market reviews, and customer inquiries. Examples of the various documents created and reviewed are shown. This information is updated each year and the forecasts and budgets are adjusted accordingly.

This collection of information is part of a larger library that is used in the preparation of the 25 year load forecast.

The graph to the right shows historical spending in New Commercial Servicing plus 2019 projection trending upwards from the previous year due to pending large commercial projects.





Prepared By: **Rick Stainthorpe CET, PMP**
Director Logistics & Operations Support

Approved By: **William Milroy, P.Eng.**
Chief Engineer & V.P. of Operations

CAPITAL PROJECT SUMMARY SHEET

SYSTEM RENEWAL

Project Number:	19F1
Project Name:	Network Vaults/ Manholes /Transformer Replacements
Start Date:	Jan-19
In-Service Date:	Dec-19

Project Title: Network Vaults / Manholes / Transformer Replacements

Supporting Reference Material:
Summary Report of Structures Inventory: Maintenance Holes & Network Transformer Vaults (2012)
Electric Distribution System Asset Sustainment Plan: 2015-2029 (2014)
High Voltage Design Report for Dundas Flex Street (2017)

Description:

This item involves the design and installation of structural entities such as concrete manholes, vaults, roof slabs and steel vault grating, as well as replacement of network transformers, protectors and other electrical components associated with the structure replacement.

In 2012, London Hydro conducted an extensive inspection of the civil structures on its distribution system. London Hydro retained four engineering consultants to complete inspection and assess the condition of the below grade structures: network transformer vaults and maintenance holes. The total number of inspected structures consisted of 32 network transformer vaults and 553 maintenance holes. The report summarized the following items: inventory breakdown, structure condition ratings, inventory replacement cost value, recommendations for next inspection cycle and anticipated life expectancy.

Each year, we select manholes and vaults for inspection based on two criteria. One is the re-inspect year recommended by engineering consultants. In 2017, we started taking structural rating into consideration as the 2nd criteria because a large number of structures were due for a default 5-year inspection. We postponed the inspection for those structures in good condition. In addition, for the never-inspected population, we selected the structures based on their age. By 2017, we finished the inspection for all manholes and vaults from this group which were 50 years old. We have been replacing manholes and roof slabs since the report was published and we are up to date with replacements to 2018.

In 2019, London Hydro will replace various maintenance hole (MH) roofslabs, repair walls to MHs and vaults, and rebuild at least one MH and/or vault. London Hydro will also replace network transformers and their relays as part of 13.8 kV conversion that coordinates with the City of London's Dundas St. project.

PRIMARY DRIVER:	Safety
OTHER DRIVERS:	Reliability
	Efficiency
CUSTOMERS IMPACTED:	Various
OEB CAPITAL REPORTING:	F1- Replacements of Network Vaults/ Manholes /Transformers
LH PROJECT DRIVER:	SAF

COST ESTIMATE - BY YEAR

	COST	AREA/SCOPE
2012	$904,397	13 Projects
2013	$555,280	9 Projects
2014	$1,297,346	9 Projects
2015	$1,500,000	12 Projects
2016	$1,000,000	10 Projects
2017	$1,581,189	12 Projects
2018	$897,883	10 Projects
2019	$1,648,000	11 Projects
2020	$1,050,000	
2021	$1,050,000	
TOTAL COST ESTIMATE:	$11,484,095	

LH SECTION # 141

CAPITAL PROJECT SUMMARY SHEET SYSTEM RENEWAL

Project Number:	19F1
Project Name:	Network Vaults/ Manholes /Transformer Replacements
Start Date:	Jan-19
In-Service Date:	Dec-19

Project Title: Network Vaults / Manholes / Transformer Replacements

Risks to Completion & Mitigation Plan: Resource availability is the biggest risk to completion. Mitigation plan includes close co-ordination between engineering and operations staff to determine the projects that need to be completed by external resources and secure the external resources (contractor) well in advance of the project start date.

EVALUATION OF OUTCOMES:	
Efficiency, Customer Value, Reliability	The network system housed by the duct and maintenance hole system downtown is gradually being reshaped, with sections of cable abandoned due to reduced loads, and some structures are being retired when redundant. Network transformers are often refurbished when work takes place in the vault housing them, or completely eliminated according to customer needs identified by system planning.
Safety	Working safely in below grade structures is a high priority at London Hydro. This project ensures that operators continue to be able to use confined spaces to conduct work in a very safe manner.
Cyber-Security, Privacy	Not applicable
Co-ordination, Interoperability	Not applicable
Economic Development	Maintaining the infrastructure in the downtown core supports economic development as London Hydro continues to support emerging loads in the most reliable way.
Environmental Benefits	Environmental benefits that are a direct result of this project include the elimination of segments of paper-insulated-lead-covered (PILC) cable which has become obsolete at London Hydro due to safety and environmental concerns.

IMPACT TO O&M COSTS:

A slight reduction in the operating and maintenance costs can be realized as a result of renewing this type of infrastructure.

ALTERNATIVES CONSIDERED:

London Hydro engineers do not have in-house expertise regarding civil work. Civil engineering consultants have been contracted to advise on the state of this infrastructure and have made recommendations that need to be followed.

LINK TO STRATEGIC PLAN:

6.2.1 - Emphasis on Reliability

CUSTOMER ENGAGEMENT:

London Hydro engages City of London and businesses that are directly affected when such large scope reconstruction projects take place.

CAPITAL PROJECT SUMMARY SHEET SYSTEM RENEWAL

Project Number:	19F1
Project Name:	Network Vaults/ Manholes /Transformer Replacements
Start Date:	Jan-19
In-Service Date:	Dec-19

Project Title: Network Vaults / Manholes / Transformer Replacements

Additional Information:

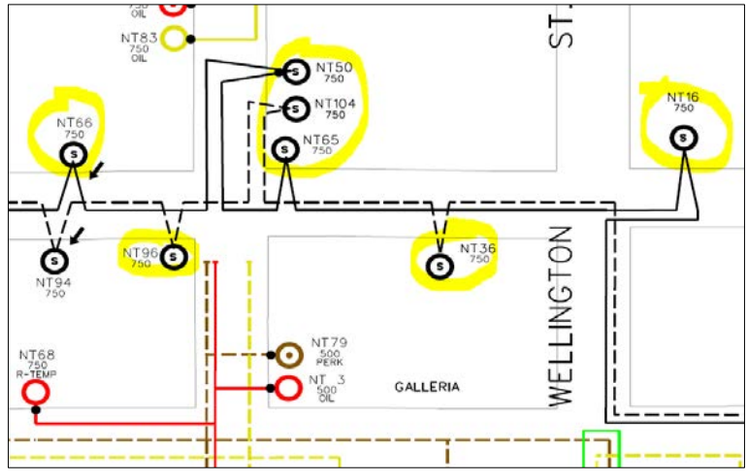
London Hydro owns a large number of older maintenance holes (MH) and vaults, a few of them dating from the early 1920's. The condition assessment performed on this infrastructure indicates some structures are no longer safe to be in use. This item will resolve safety and reliability issues resulting from these inspections and is in compliance with the Asset Sustainment Plan.

This budget item also includes the cost for replacing the electrical components associated with the structure replacements. Complete reconstruction is very complex and can reach exorbitant costs. Therefore, London Hydro's approach is to re-inspect civil structures as appropriate and perform remedial work, prioritizing replacements only if necessary and in co-ordination with other work on the network.

Based on London Hydro's 2017 structural audit, the following is proposed for 2019 construction:
- Roof slab replacements for MHs: 24, 40, 149, 330, 347, 356, 432, 676, 677, 769, and 873.
- Wall repairs to MH 126, 149, 270, 432 and vault 021.
- Rebuild MH 558 and vault 084. Option may include performing remedy work to delay replacement.
- Abandon MHs 70, 217, 255, 314, 438 and 454
- Other remedial or replacement work requiring immediate attention from latest ongoing inspections.

In addition to the above works, this budget section will also cover the installation of seven new network transformers (NTs 66, 96, 95, 104, 50, 16, and 36) related to Dundas Place project. These new 27.6kV network transformers will replace the older 13.8kV network transformers, which will assist in decommissioning of the 13.8 kV Nelson transformer station in 2020, and will help modernize our city's core electrical supply.

The image to the right shows Dundas Place Phase 2 final system configuration with the planned Network Transformer (NT) replacements highlighted in yellow.



-

Prepared By: **Rodney Doyle, P.Eng.**
Senior Distribution Engineer

Approved By: **William Milroy, P.Eng.**
Chief Engineer &
V.P. of Operations

CAPITAL PROJECT SUMMARY SHEET

SYSTEM RENEWAL

Project Number:	19F2
Project Name:	Primary & Secondary Cable Replacement
Start Date:	Jan-19
In-Service Date:	Dec-19

Project Title: Primary & Seconday Cable Replacement

Supporting Reference Material: Electric Distribution System Asset Sustainment Plan: 2015-2029 (2014)

Description: London Hydro utilizes approximately 9,500 km of total primary cable (3,400 km in circuit length) in its distribution system and 22 km of low-voltage main secondary cable in the downtown service territory. Although London Hydro is continuously assessing and replacing cables through capital projects, some cables fail unexpectedly and require immediate replacement. This project provides funding to replace such cables.

PRIMARY DRIVER:	Reliability
OTHER DRIVERS:	Efficiency
CUSTOMERS IMPACTED:	Various

OEB CAPITAL REPORTING:

F2 - Replacement of Primary& Secondary Cables

COST ESTIMATE - BY YEAR

	COST	AREA/SCOPE
2012	$462,053	
2013	$199,082	
2014	$384,081	
2015	$50,095	
2016	$147,985	
2017	$266,879	
2018	$399,030	projected costs
2019	$300,000	
2020	$380,000	
2021	$380,000	
TOTAL COST ESTIMATE:		$2,969,205

LH PROJECT DRIVER:	REL	**LH SECTION #**	150

CAPITAL PROJECT SUMMARY SHEET

SYSTEM RENEWAL

Project Number:	19F2
Project Name:	Primary & Secondary Cable Replacement
Start Date:	Jan-19
In-Service Date:	Dec-19

Project Title: Primary & Seconday Cable Replacement

Risks to Completion & Mitigation Plan: The risks to completion are minimal. An inventory of spare material is maintained based on historical experience and labour allocation is prioritized based on the operational risk associated with cable failures.

EVALUATION OF OUTCOMES:

Efficiency, Customer Value, Reliability	Replacing failed cables ensures that customers receive a reliable supply of electricity.
Safety	Not Applicable
Cyber-Security, Privacy	Not Applicable
Co-ordination, Interoperability	Not Applicable
Economic Development	Not Applicable
Environmental Benefits	The failed cables being replaced often contain lead, while the new cables do not contain lead.

IMPACT TO O&M COSTS:

There may be a slight reduction due to the reduced labour required to splice modern polymer-based cables.

ALTERNATIVES CONSIDERED:

Do nothing, however this alternative was rejected due to the risk it would pose to supply reliability.

LINK TO STRATEGIC PLAN:

Section 6.2.1 - Emphasis on Reliability

CUSTOMER ENGAGEMENT:

Customers were not directly engaged regarding this project, but recent surveys indicate customers value improvements to reliability (refer to DSP Section 3.2.4 Customer Engagement).

CAPITAL PROJECT SUMMARY SHEET

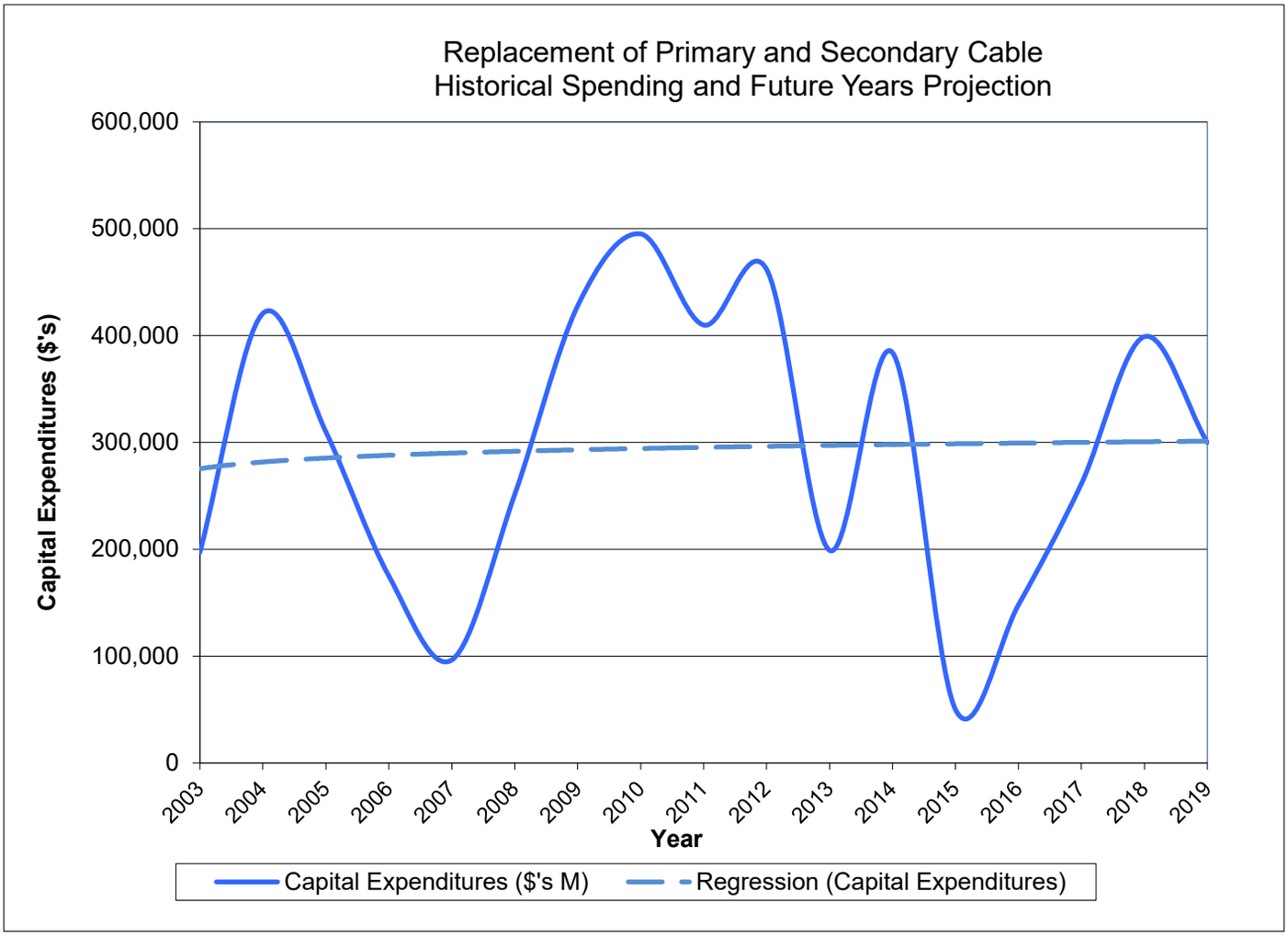
SYSTEM RENEWAL

Project Number:	19F2
Project Name:	Primary & Secondary Cable Replacement
Start Date:	Jan-19
In-Service Date:	Dec-19

Project Title: Primary & Seconday Cable Replacement

Additional Information:

A historical trend was used to estimate the required level of funding for future failure replacements. The graph below illustrates that historical expenditures have been as high as $500,000 and as low as $100,000.
For year 2019 we budgeted $300,000.



Prepared By: **Rodney Doyle, P.Eng.**
Senior Distribution Engineer

Approved By: **William Milroy, P.Eng.**
Chief Engineer &
V.P. of Operations

CAPITAL PROJECT SUMMARY SHEET

SYSTEM RENEWAL

Project Number:	19F3
Project Name:	Maintenance Hole Cable Rebuilds
Start Date:	Jan-19
In-Service Date:	Dec-19

Project Title: Maintenance Hole Cable Rebuilds

Supporting Reference Material: Electric Distribution System Asset Sustainment Plan: 2015-2029 (2014)

Description:

Portions of London's downtown core are supplied from the 13.8 kV network system by an extensive low voltage network grid stepping down via network transformers. The network has traditionally been supplied by PILC (paper insulated lead cable). The primary cables and the low voltage network grid cables are installed in a common duct and manhole system that has become very crowded over the past fifty years. This item includes replacement of lead primary cables with new EPR insulated flat strap cables (lead free alternative cable), replacement of secondary cables, and reconfiguration of cables within crowded manholes that are difficult to work in. By doing this work we will eliminate unused cables, clear up hazards and make space available for future cable installations.

This budget will also cover the installation of cable protecting fuses in the mains of the low voltage grid to reduce the high fault energies released when a fault occurs. These fuse elements limit the fault energy and so, they decrease the probability of catastrophic failures substantially.

Much of this scope's objectives will be covered in the special project code 19F5 for Dundas Place. Remaining scope will be covered under this project code, 19F3, through coordination of City of London's remaining civil infrastructure rehabilitation in the city's core area, York Street from Colborne Street to Thames River (phased over 3 years starting last year), and Talbot St. from King Street to York St. In conjunction with the City of London's projects, London Hydro is replacing most of the civil structures (refer to Project 19C3). As a consequence, the associated electrical distribution within these structures will require replacement. The new electrical system will be converted to the 27.6 kV system, with the exception of Talbot Street section, which will support the decommissioning of the 13.8 kV Nelson transformer station in 2020, and will help modernize our city's core electrical supply.

PRIMARY DRIVER: Safety

OTHER DRIVERS: Reliability; Efficiency

CUSTOMERS IMPACTED: No Direct Impact to Customers

OEB CAPITAL REPORTING:

F4 - Manintenance Hole Cable Rebuilds/Fuse Install

COST ESTIMATE - BY YEAR

	COST	AREA/SCOPE
2012	$145,750	
2013	$239,326	
2014	$142,461	
2015	$150,000	
2016	$617,965	
2017	$128,535	
2018	$2,226,616	
2019	$475,000	
2020	$200,000	
2021	$150,000	
TOTAL COST ESTIMATE:		$4,475,653

LH PROJECT DRIVER: SAF

LH SECTION # 150

CAPITAL PROJECT SUMMARY SHEET

SYSTEM RENEWAL

Project Number:	19F3
Project Name:	Maintenance Hole Cable Rebuilds
Start Date:	Jan-19
In-Service Date:	Dec-19

Project Title: Maintenance Hole Cable Rebuilds

Risks to Completion & Mitigation Plan:

Availability of resources to match timing dictated by the City; mitigation plan is close co-ordination with the City to ensure schedules are compatible and to secure resources (contract) in a joint tender with the City if desirable. These projects can be very complex requiring much planning and design time; mitigation plan is to press the City to commit to the project and provide design details as far in advance as possible to provide sufficient time for planning and design.

EVALUATION OF OUTCOMES:

Efficiency, Customer Value, Reliability	Cable rebuilds are usually planned when a civil component of the maintenance hole is in decent condition and cables need to be rebuilt to enable safe access and work. Old primary and secondary cables are replaced with new cables and also re-routed along the maintenance hole walls. New installations will increase overall system reliability. In addition, unused cables are eliminated making space for future installations.
Safety	Many of the hazards associated with confined spaces are eliminated during cable rebuilds; also adding protection in the low voltage secondaries increases safety and prevents catastrophic failures.
Cyber-Security, Privacy	Not applicable
Co-ordination, Interoperability	Co-ordination with the City and customers is necessary when cable rebuild work happens, in order to properly regulate the traffic and to co-ordinate outages.
Economic Development	Not Applicable
Environmental Benefits	Lead cable elimination is very beneficial to the environment as this material is a designated substance and has been found to be potentially harmful.

IMPACT TO O&M COSTS:

Maintenance costs may be reduced when cables in maintenance holes are rebuilt since, during outages, accessibility is improved and the work may take less time.

ALTERNATIVES CONSIDERED:

The possibility exists to leave these maintenance hole cables untouched but the complexity of the system can become problematic with the need to pull new cable in place of the old lead cable.

LINK TO STRATEGIC PLAN:

6.2.1 - Emphasis on Reliability - Asset Management

CUSTOMER ENGAGEMENT:

London Hydro engages City of London and businesses that are directly affected when such large scope reconstruction projects take place.

Cable congestion inside manhole

CAPITAL PROJECT SUMMARY SHEET

SYSTEM RENEWAL

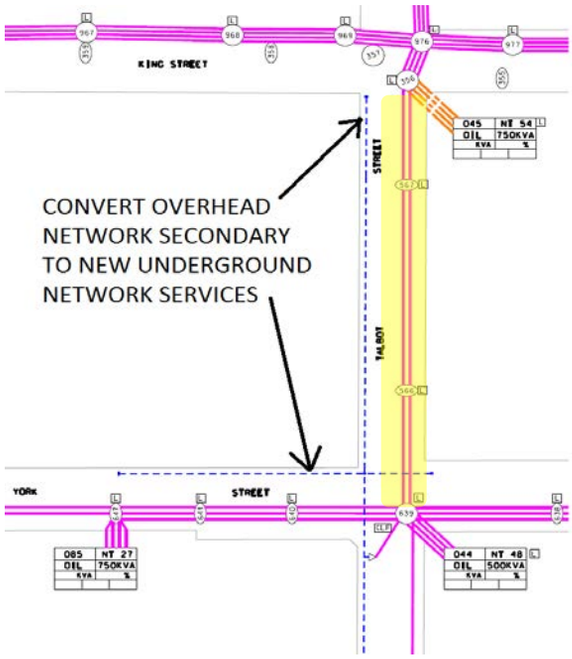
Project Number:	19F3
Project Name:	Maintenance Hole Cable Rebuilds
Start Date:	Jan-19
In-Service Date:	Dec-19

Project Title: Maintenance Hole Cable Rebuilds

Additional Information:

The duct and maintenance hole system in the downtown contains approximately 40 km of primary 13.8 kV network and non-network feeder cables, in addition to approximately 22 km of copper secondary main feeder cables of the low voltage network grid. The system also houses 27.6 kV feeder cables. London Hydro has installed approximately 3,000 cable protecting fuses on the low voltage network grid system over the last several years to address the safety issues that are inherent in a closed loop system of this design.

The electrical work proposed for 2019 associated with maintenance hole rebuilds coordinates with London Hydro's replacement of aging civil structure under Project 19C3. It comes as a consequence of the City of London's reconstruction of:
1) Talbot Street between York Street and King Street.
2) York Street between Thames River to Talbot Street (started in 2018)



The image to the left illustrates the removal of overhead network secondary by taking advantage of The City of London's excavation work in the area (highlighted yellow) and converting the services to underground.

Prepared By:	**Rodney Doyle, P.Eng.** **Senior Distribution Engineer**
Approved By:	**William Milroy, P.Eng.** **Chief Engineer &** **V.P. of Operations**

CAPITAL PROJECT SUMMARY SHEET

SYSTEM RENEWAL

Project Number:	19F4
Project Name:	Explosion-Limiting MH Covers
Start Date:	Jan-19
In-Service Date:	Dec-19

Project Title: Explosion-Limiting Maintenance Hole Cover Installations

Supporting Reference Material: Technical Risk Assessment - Manholes and Vaults, AESI, 2013

Description:

Explosions in manholes are low probability/high impact events. The energy released in a major manhole explosion can launch an 80 kilogram cast-iron manhole cover 15 meters or more. Such explosions are typically caused by the ignition of combustible gases that accumulate in manholes due to overheating cable insulation, or non-London Hydro sources such as natural gas leaks and dumped chemicals. It may also be possible for high-current arcs to cause manhole explosions when combustible gases are not present.

To reduce the potential impact of manhole explosions, London Hydro, over the past couple of years, has installed manhole covers designed to provide a controlled release of pressure during explosions. By latching the manhole cover to the manhole frame and designing exhaust ports into the bottom of the cover, explosion-limiting manhole covers lift only a few inches during an explosion and create an air-dam that limits the force of the explosion.

Recently, it was discovered that the first generation of explosion-limiting manhole covers were seizing, causing field crews difficulty opening and accessing manholes. The issue may be attributed to the units not being suitable for our climate. Late in 2018, the manufacturer agreed to supply 27 newer versions free of charge for London Hydro to install and re-evaluate. For 2019, London Hydro reduced the scope so we can evaluate the newer version of the explosion-limiting manhole cover and work with the manufacturer to either develop an exchange program to replace existing units or simply order new units.

PRIMARY DRIVER: Safety

OTHER DRIVERS:

CUSTOMERS IMPACTED:

OEB CAPITAL REPORTING:

F4 - Maintenance Hole Cable Rebuilds/Fuse Install

COST ESTIMATE - BY YEAR

	COST	AREA/SCOPE
2012	$0	
2013	$0	
2014	$0	
2015	$0	
2016	$100,000	80 Covers
2017	$100,000	80 Covers
2018	$20,410	20 Covers
2019	$25,000	20 Covers
2020	$25,000	20 Covers
2021	$25,000	20 Covers
TOTAL COST ESTIMATE:		$295,410

LH PROJECT DRIVER: SAF

LH SECTION # 150

CAPITAL PROJECT SUMMARY SHEET SYSTEM RENEWAL

Project Number:	19F4
Project Name:	Explosion-Limiting MH Covers
Start Date:	Jan-19
In-Service Date:	Dec-19

Project Title: Explosion-Limiting Maintenance Hole Cover Installations

Risks to Completion & Mitigation Plan: The risks to completion for this project are minimal. A materials standard has been approved by the Standards department and minimal labour is required to install the new covers.

EVALUATION OF OUTCOMES:

Efficiency, Customer Value, Reliability	Not Applicable
Safety	In the event of an explosion inside a manhole, public safety will be enhanced.
Cyber-Security, Privacy	Not Applicable
Co-ordination, Interoperability	Not Applicable
Economic Development	Not Applicable
Environmental Benefits	Not Applicable

IMPACT TO O&M COSTS:

Not Applicable

ALTERNATIVES CONSIDERED:

Do nothing, however this alternative was rejected because it does not enhance public safety.

LINK TO STRATEGIC PLAN:

6.2.1 - Emphasis on Reliability

CUSTOMER ENGAGEMENT

Customers were not directly engaged regarding this project, but recent surveys indicate customers value improvements to safety (refer to DSP Section 3.2.4 Customer Engagement).

CAPITAL PROJECT SUMMARY SHEET SYSTEM RENEWAL

Project Number:	19F4
Project Name:	Explosion-Limiting MH Covers
Start Date:	Jan-19
In-Service Date:	Dec-19

Project Title: Explosion-Limiting Maintenance Hole Cover Installations

Additional Information:

Not Applicable

Prepared By:	**Rod Doyle, P.Eng.** **Distribution Engineer**
Approved By:	**William Milroy, P.Eng.** **Chief Engineer &** **V.P. of Operations**

CAPITAL PROJECT SUMMARY SHEET

SYSTEM RENEWAL

Project Number:	19F5
Project Name:	Replacement of Primary and Secondary Cables
Start Date:	Jan-19
In-Service Date:	Dec-19

Project Title: Dundas Place - Electrical Work

Supporting Reference Material:
Electric Distribution System Asset Sustainment Plan: 2015-2029 (2014)
Downtown Secondary Network & 27.6kV / 13.8kV Ring Supply Study (2016)
Analysis of Downtown Intensification: Ring Bus Utilization (2017)
High Voltage Design Report for Dundas Flex Street (2017)

Description:

London's downtown core is largely supplied from the 13.8 kV network system by an extensive low voltage grid network stepped down via network transformers. The primary network feeders have traditionally used PILC (paper insulated lead covered) cables. The primary cables and the low voltage grid network cables are installed in a common duct and manhole system that has become very crowded over the past fifty years. This item includes replacement of lead primary cables with new EPR insulated flat strap cables (lead free alternative cable), replacement of secondary cables, some of which contain lead and asbestos, and reconfiguration of cables within crowded maintenance holes that are difficult to work in. By doing this work, London Hydro will eliminate unused cables, clear up hazards, and make space available to work safely and install future cables.

This budget will also cover the installation of cable protecting fuses in the mains of the low voltage grid network to reduce the high fault energies released when a fault occurs. These fuse elements limit fault energy thereby decreasing the probability of catastrophic failures substantially.

In conjunction with the City of London's projects, London Hydro is replacing most of the civil structures (refer to Project 19C3). As a consequence, the associated electrical distribution within these structures will require replacement. The new primary network supply will be converted to the 27.6 kV system; this will support the decommissioning of the 13.8 kV Nelson transformer station in 2020, and will help modernize our city's core electrical supply.

The scope under this project number also encompasses make-ready work to reconfigure the network system to enable the depopulation of the civil structures for the cable replacement and conversion work to take place.

PRIMARY DRIVER: Reliability

OTHER DRIVERS: Efficiency, Safety, Environmental, Econ. Dev.

CUSTOMERS IMPACTED:

OEB CAPITAL REPORTING:

F2 - Replacement of Primary & Secondary Cables

COST ESTIMATE - BY YEAR

	COST	AREA/SCOPE
2012		
2013		
2014		
2015		
2016		
2017		
2018	$44,469	City Hall & Centennial Hall
2019	$3,100,000	Dundas Place
2020		
2021		
TOTAL COST ESTIMATE:		$3,144,469

LH PROJECT DRIVER: SAF

LH SECTION # 150

CAPITAL PROJECT SUMMARY SHEET

SYSTEM RENEWAL

Project Number:	19F5
Project Name:	Replacement of Primary and Secondary Cables
Start Date:	Jan-19
In-Service Date:	Dec-19

Project Title: Dundas Place - Electrical Work

Risks to Completion & Mitigation Plan:

Availability of resources to match timing dictated by the City; mitigation plan is close co-ordination with the City to ensure schedules are compatible and to secure resources (contract) in a joint tender with the City. This is a very complex project that requires much planning and design time; mitigation plan is to press the City to commit to the project at least one year in advance to provide sufficient time for planning and design.

EVALUATION OF OUTCOMES:	
Efficiency, Customer Value, Reliability	Old primary and secondary cables are replaced with new cables and are also re-routed along the maintenance hole walls. New installations will increase overall system reliability. In addition, unused cables are eliminated making space for future installations. Efficiencies are gained when coordinating the cable replacement in conjunction with the civil structure replacements under the City of London's Dundas Place project.
Safety	Many of the hazards associated with confined spaces are eliminated during cable rebuilds; also adding protection in the low voltage secondaries increases safety and prevents catastrophic failures.
Cyber-Security, Privacy	Not applicable
Co-ordination, Interoperability	Co-ordination with the City and customers is necessary when cable rebuild work happens in order to properly regulate the traffic and to co-ordinate outages.
Economic Development	Not Applicable
Environmental Benefits	Lead cable elimination is very beneficial to the environment as this material is a designated substance and has been found to be potentially harmful.

IMPACT TO O&M COSTS:

Maintenance costs may be reduced when cables in maintenance holes are rebuilt since newer cables are less prone to fail, during outages accessibility is improved, and the work may take less time.

ALTERNATIVES CONSIDERED:

Do nothing is not an option since all civil structures (ducts and manholes) will be removed as part of Dundas Place and therefore installation of new cables is necessary.

LINK TO STRATEGIC PLAN:

6.2.1 - Emphasis on Reliability - Asset Management

CUSTOMER ENGAGEMENT:

London Hydro engages City of London and businesses that are directly affected when such large scope reconstruction projects take place.

Cable congestion inside manhole

CAPITAL PROJECT SUMMARY SHEET

SYSTEM RENEWAL

Project Number:	19F5
Project Name:	Replacement of Primary and Secondary Cables
Start Date:	Jan-19
In-Service Date:	Dec-19

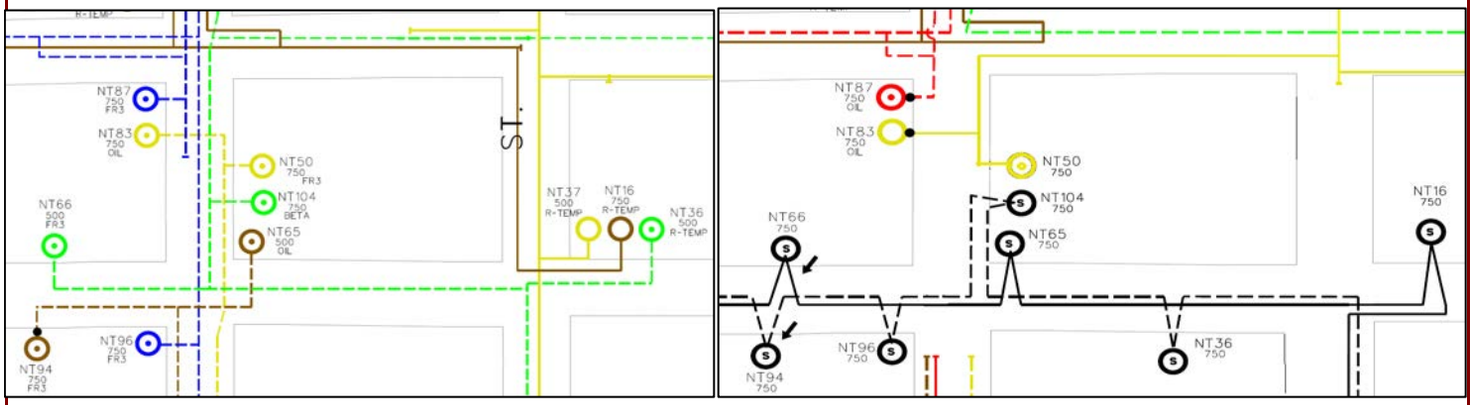
Project Title: Dundas Place - Electrical Work

Additional Information:

The duct and maintenance hole system in the downtown contains approximately 40 km of primary 13.8 kV network and non-network feeder cables, in addition to approximately 22 km of copper secondary main feeder cables of the low voltage network grid. The system also houses 27.6 kV feeder cables.

The electrical work proposed for 2019 is associated with London Hydro's replacement of aging civil structure under Project 19C3 and is strictly related to the Dundas Place project. It comes as a consequence of the City of London's reconstruction of Dundas Street between Richmond Street to Wellington Road, known as Dundas Place Phase 2.

Below images show the before and after network circuit reconfiguration and voltage converison within Dundas Place Phase 2 project.



The image on the left shows the current 13.8 kV network system along Dundas Street (between Richmond St. and Wellington Rd.)
The image on the right shows the reconfigured system serviced at 27.6 kV shown in black.

Prepared By:	**Rodney Doyle, P.Eng.** **Senior Distribution Engineer**
Approved By:	**William Milroy, P.Eng.** **Chief Engineer &** **V.P. of Operations**

CAPITAL PROJECT SUMMARY SHEET

SYSTEM RENEWAL

Project Number:	19G1
Project Name:	Pole Replacement
Start Date:	Jan-19
In-Service Date:	Dec-19

Project Title: Replacement of Deteriorated Poles

Supporting Reference Material:
Annual Sound and Bore Pole Test Results
Electric Distribution System Asset Sustainment Plan: 2015-2030 (2014)

Description:

Each year London Hydro tests an average of 3,000-4,000 London Hydro owned poles. As a result of these pole tests, an average of 30 poles are recommended for treatment or replacement each year. London Hydro has completed testing all poles identified as being in poor or fair condition, as well as all poles identified to have been in-service for 20+ years.

The testing involves performing a visual check of the pole and its equipment, hammering the pole to listen for hollow sounds (referred to as "sound test"), as well as obtaining a core material sample from the base of the pole when required.

This capital project is intended to cover the costs of replacing depreciated poles recommended for treatment/replacement - approximately 50 poles can be replaced with this budget. The increased budget is in anticipation of receiving more poles recommended for replacement due to an above average 5000 poles tested in the 2018 program.

PRIMARY DRIVER:	Safety
OTHER DRIVERS:	Reliability
CUSTOMERS IMPACTED:	Various
OEB CAPITAL REPORTING:	G1 - Poles - Fully Depreciated or Fire Risk
LH PROJECT DRIVER:	SAF

COST ESTIMATE - BY YEAR

	COST	AREA/SCOPE
2012	$354,585	various
2013	$267,987	various
2014	$250,393	various
2015	$482,980	various
2016	$347,053	various
2017	$555,988	various
2018	$394,375	various
2019	$400,000	various
2020	$300,000	various
2021	$300,000	various
TOTAL COST ESTIMATE:	$3,653,361	

LH SECTION # 132

CAPITAL PROJECT SUMMARY SHEET

SYSTEM RENEWAL

Project Number:	19G1
Project Name:	Pole Replacement
Start Date:	Jan-19
In-Service Date:	Dec-19

Project Title: Replacement of Deteriorated Poles

Risks to Completion & Mitigation Plan:

Risks to completion are minimal. This project is part of a program that is successfully executed each year. The availability of resources (internal and contractor) is sufficient to complete this project.

EVALUATION OF OUTCOMES:

Efficiency, Customer Value, Reliability	This project has a direct impact on safety and system reliability. Replacing depreciated poles will protect expensive assets (e.g.,. transformers and switches) supported by the poles as well as reduce the risk of experiencing power outages; hence, adding value to customers.
Safety	This program is aimed at replacing fully depreciated poles; fully depreciated poles are at high risk of failure especially during heavy storm conditions.
Cyber-Security, Privacy	Not applicable
Co-ordination, Interoperability	Limited co-ordination required; most poles are replaced like-for-like without affecting adjacent pole lines and/or projects. Transfer of third party attachments requires some co-ordination with the asset owner.
Economic Development	Limited impact
Environmental Benefits	Not applicable

IMPACT TO O&M COSTS:

Depreciated poles typically support older distribution assets. Upgrading these poles will address these depreciated assets as well; hence, reducing unplanned outages and O&M costs.

ALTERNATIVES CONSIDERED:

Limited consideration; poles that are deemed fully depreciated via poles testing must be replaced immediately.

LINK TO STRATEGIC PLAN:

6.2.1 - Emphasis on Reliability

CUSTOMER ENGAGEMENT:

Limited engagement with customer is required as most poles are replaced like-for-like.

CAPITAL PROJECT SUMMARY SHEET

SYSTEM RENEWAL

Project Number:	19G1
Project Name:	Pole Replacement
Start Date:	Jan-19
In-Service Date:	Dec-19

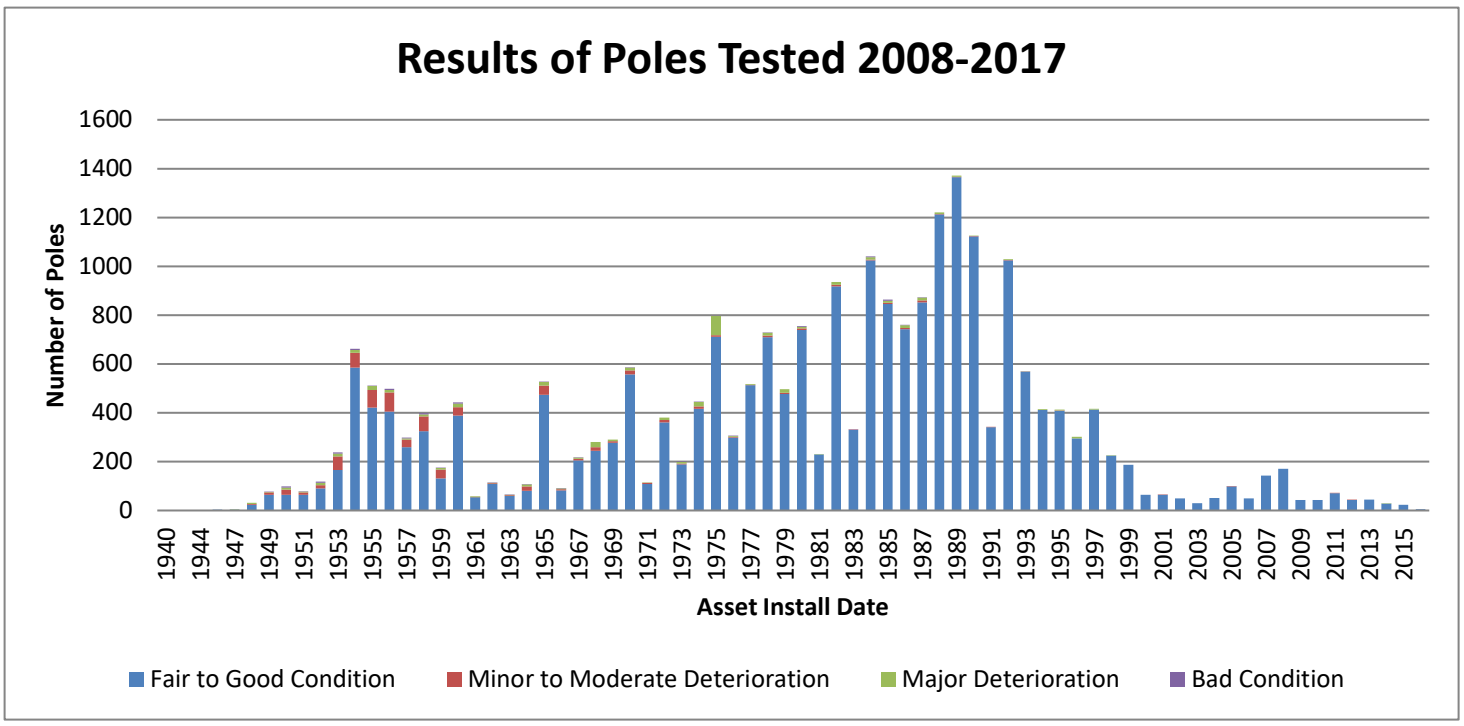
Project Title: Replacement of Deteriorated Poles

Additional Information:

This project involves replacement of the deteriorating wooden poles that are tested and recommended for replacement.

London Hydro's system contains over 26,500 London Hydro owned poles. Approximately 98% of the poles on London Hydro's system are made of wood. In 1998, London Hydro introduced the pole testing program as part of our condition based assessment. All poles that are older than 20 years are tested every 5 years. Pole testing is done on an annual basis and capital budgeting is based on historical expenditure.

The graph below summarizes the condition of poles tested between the years 2008-2017. Based on past testing results, about 1% of poles tested required immediate replacement - that is approximately an average of 30 poles per year. The graph test data also shows that there are poles that have been in-service for over 50 years (estimated time span for useful life) and are not yet fully depreciated. Depending on the pole test results, these older poles are tested more frequently, as a due diligence, and to maximize their in-service lifespan. Standard CAN/CSA 22.3 requires all wood poles with 60% (or less) strength remaining to be reinforced or replaced.



Prepared By: Sunny Patel, P.Eng.
Distribution Engineer

Approved By: William Milroy, P.Eng.
V.P. Engineering
& Operations

CAPITAL PROJECT SUMMARY SHEET SYSTEM RENEWAL

Project Number:	19G2
Project Name:	Pole Fire Mitigation
Start Date:	Jan-19
In-Service Date:	Dec-19

Project Title: Replacement of Poles Susceptible to Pole Fires

Supporting Reference Material:
Mitigating Pole Fires on London Hydro's Distribution System Report
Electric Distribution System Asset Sustainment Plan: 2015-2029 (2014)

Description:

Pole fires occur in specific older types of overhead construction with wood crossarms and pin type insulators. In these types of construction, leakage current tracks over deteriorated insulators and becomes concentrated in places where bolts and steel brackets interface with the wood resulting in fires.

Several years ago London Hydro instituted the pole fire replacement program and to-date has completed 87% of the projects.

The areas designated for replacement consist of the plant built more that 40 years ago and identified in the above reports as requiring replacement. This plant consists of outdated and aged materials and construction techniques that are more prone to failure than those used today.

This budget item will rebuild the pole line along Springbank Drive, from Wharncliffe Road to Horton Street West, and Johnston St. In addition, the railway crossing on Industrial Road, North of Osler Street, will be addressed by this item as the poles adjacent to the tracks are currently susceptible to fires.

PRIMARY DRIVER:	Reliability
OTHER DRIVERS:	Safety
CUSTOMERS IMPACTED:	Various
OEB CAPITAL REPORTING:	G1 - Poles - Fully Depreciated or Fire Risk
LH PROJECT DRIVER:	REL

COST ESTIMATE - BY YEAR

	COST	AREA/SCOPE
2012	$512,737	
2013	$306,730	
2014	$389,177	
2015	$64,499	
2016	$129,799	1 Street
2017	$106,017	2 Streets
2018	$103,035	2 Streets
2019	$110,000	2 Streets
2020	$120,000	1 Street
2021	$0	
TOTAL COST ESTIMATE:	$1,841,994	

LH SECTION # 132

CAPITAL PROJECT SUMMARY SHEET SYSTEM RENEWAL

Project Number:	19G2
Project Name:	Pole Fire Mitigation
Start Date:	Jan-19
In-Service Date:	Dec-19

Project Title: Replacement of Poles Susceptible to Pole Fires

Risks to Completion & Mitigation Plan:

Risk to completion is low. This project is part of a program that has been successfully executed each year since 2001. The availability of resources (internal and contract) is sufficient to complete this project

EVALUATION OF OUTCOMES:

Efficiency, Customer Value, Reliability	By replacing poles that were identified as being at risk of pole fires, London Hydro reinforces the overhead system infrastructure providing increased reliablity, while eliminating outdated plant and reconfiguring the distribution system to supply customers more efficiently.
Safety	Safety increases when configurations that are susceptible to fire are eliminated from the system by removing possible hazardous conditions associated with pole fires.
Cyber-Security, Privacy	Not applicable
Co-ordination, Interoperability	Minimum co-ordination is required to transfer 3rd party attachments owned by other utilities that share our poles.
Economic Development	Improved reliablity will contribute to the overall attractiveness of London as a place in which to live and do business.
Environmental Benefits	Not applicable

IMPACT TO O&M COSTS:

Fewer outages may be experienced after eliminating pole fire risks, hence reducing overall operating and maintenance costs.

ALTERNATIVES CONSIDERED:

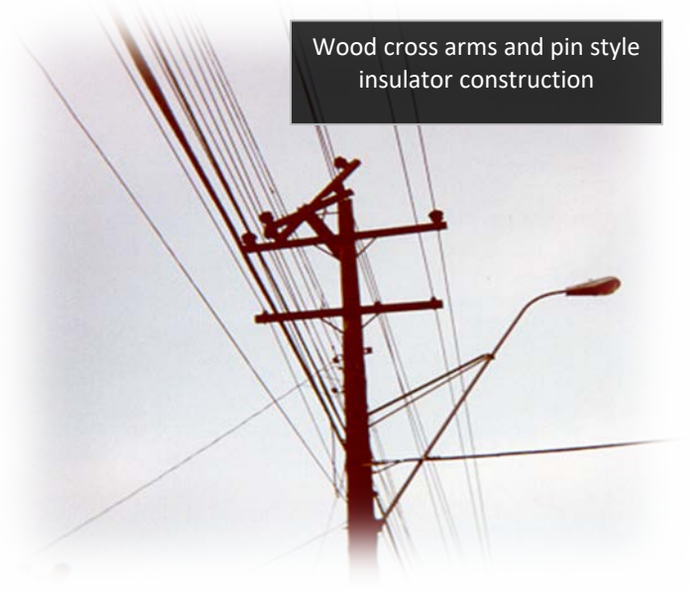
Deferring these pole replacements until they reach end of life is an option; however, risk factors affecting safety and reliability warrant their replacement as per this program's time line.

LINK TO STRATEGIC PLAN:

Section 6.2.1 - Emphasis on Reliability

CUSTOMER ENGAGEMENT:

Customers were not directly contacted regarding this project but recent surveys indicate that customers value improvements in reliability (refer to DSP Section 3.2.4 Customer Engagement).



Wood cross arms and pin style insulator construction

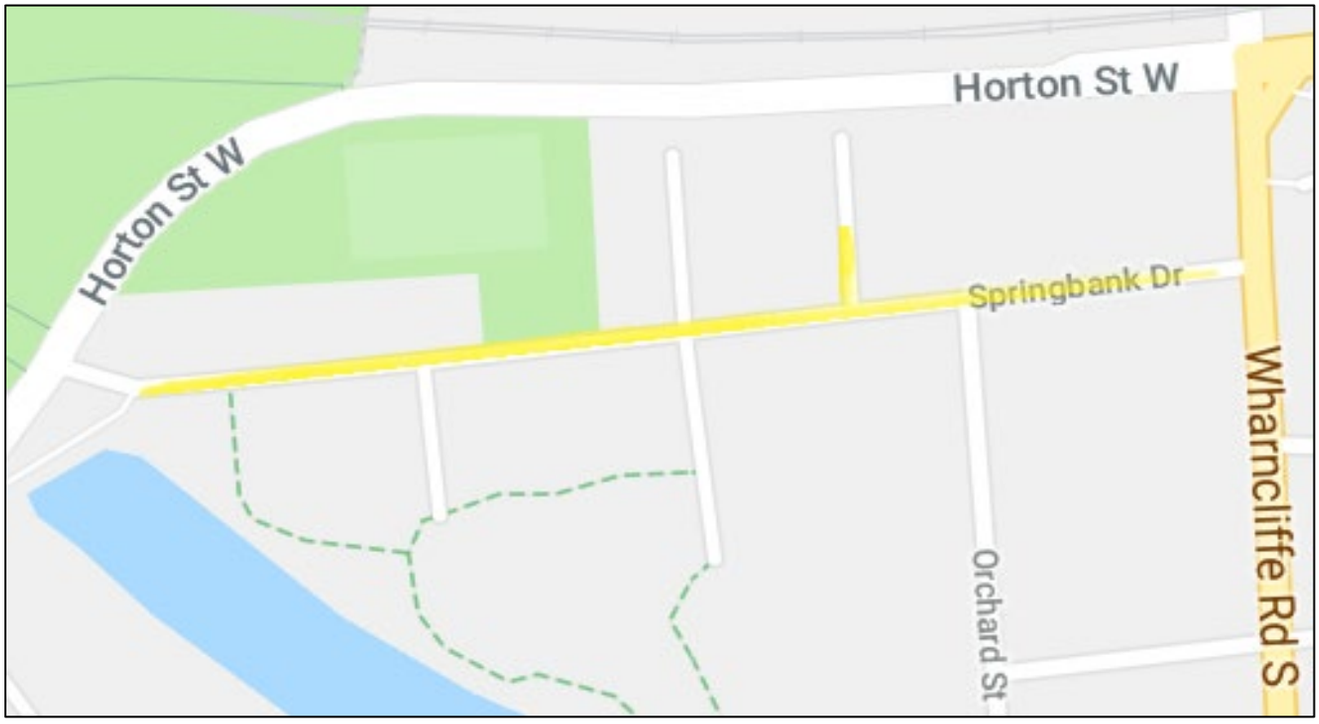
CAPITAL PROJECT SUMMARY SHEET SYSTEM RENEWAL

Project Number:	19G2
Project Name:	Pole Fire Mitigation
Start Date:	Jan-19
In-Service Date:	Dec-19

Project Title: Replacement of Poles Susceptible to Pole Fires

Additional Information:

The general project area for this year is shown below with the streets planned for rebuild highlighted in yellow. The replacement program will continue on an annual basis until the time that all pole fire prone poles are replaced.



Prepared By:	**Sunny Patel, P.Eng.** **Distribution Engineer**
Approved By:	**William Milroy, P.Eng.** **V.P. Engineering & Operations**

CAPITAL PROJECT SUMMARY SHEET

SYSTEM RENEWAL

Project Number:	19G3
Project Name:	Rebuild Depreciated Areas
Start Date:	Jan-19
In-Service Date:	Dec-19

Project Title: Rebuild of Fully Depreciated Overhead Areas - Delta Service Conversions

Supporting Reference Material:
4.16 kV Aging Infrastructure System Planning Report - 2018 Update (Plan for Rear Lot to Front Lot Conversion)
Asset Sustainment Plan - Electrical Distribution System: 2015-2029 (2014)
ESA - Distributor Flash Notice - Phase 2: "3-Phase, 3-Wire, Solidly-Grounded Wye Customer Services Corrective Action Proposal"

Description:

The above reports have identified various parts of the system in this area as being in poor condition. The deficiencies related to the age of the equipment may adversely impact the reliability of supply as well as public and employee safety. The poles and associated hardware are approximately 50 years old. Many of the transformers in the area are operating in excess of their capacity due to load which has been added by customers over the years (i.e. air-conditioning and other appliances). These reports confirm we must continue to replace aging plant.

In 2019, the rebuild of fully depreciated overhead areas will be primarily addressed by projects under sections G1, G2 and G5. Due to the allocation of budget to the Dundas Place external project, there will be no large projects addressed under this budget item. The focus for rebuilding depreciated plant in 2019 will be on Delta Service Conversions.

According to ESA - Distributor Flash Notice - Phase 2: "3-Phase, 3-Wire, Solidly-Grounded Wye Customer Services Corrective Action Proposal", LDCs are to eliminate electrical configurations of concern from their service territories. For instance, a high risk is encountered when a delta service is fed by a grounded supply. London Hydro has identified eighteen (18) locations that are used as delta services which are supplied by grounded Wye transformers and no neutral is available at the metering point. In 2019, up to nine (9) services will be addressed with this budget item.

PRIMARY DRIVER:	Reliability
OTHER DRIVERS:	Safety
	Customer Value
CUSTOMERS IMPACTED:	9
OEB CAPITAL REPORTING:	G3 - Rebuild Fully Depreciated OH Areas
LH PROJECT DRIVER:	REL

COST ESTIMATE - BY YEAR

	COST	AREA/SCOPE
2012	$1,966,200	
2013	$424,644	
2014	$194,253	
2015	$253,351	
2016	$433,353	22 poles, 268kW
2017	$260,000	28 poles, 217kW
2018	$116,060	
2019	$50,000	9 locations
2020	$50,000	9 locations
2021	$4,859,500	
TOTAL COST ESTIMATE:		$8,607,361

LH SECTION # 132

CAPITAL PROJECT SUMMARY SHEET

SYSTEM RENEWAL

Project Number:	19G3
Project Name:	Rebuild Depreciated Areas
Start Date:	Jan-19
In-Service Date:	Dec-19

Project Title: Rebuild of Fully Depreciated Overhead Areas - Delta Service Conversions

Risks to Completion & Mitigation Plan: Availability of resources and co-ordination of the potential outages may slow down the progress of these projects; the mitigation plan is to closely monitor projects' progress and secure external resources (contractor), if required. Close coordination is necessary with contractor working on customer service upgrades and ESA.

EVALUATION OF OUTCOMES:

Efficiency, Customer Value, Reliability	A robust and secure overhead distribution system will improve the overall system operation by ensuring the reliable distribution of power to customers and by reducing outages that can be avoided.
Safety	Safety is the number one factor considered in addressing overhead system weaknesses since live contact can occur when equipment fails.
Cyber-Security, Privacy	Not applicable
Co-ordination, Interoperability	Certain practices and standards have been adopted by multiple utilities in the province through the exchange of performance standards, expertise, and the availability of new certified equipment and technologies (e.g., ungrounded wye supply).
Economic Development	Improved reliability will contribute to the overall attractiveness of London as a place in which to live and do business.
Environmental Benefits	Not applicable

IMPACT TO O&M COSTS:

Fewer outages due to faults on the overhead system may result in a slight reduction in annual operating and maintenance costs.

ALTERNATIVES CONSIDERED:

Equipment at risk can remain in service but could compromise performance and increase safety risks.

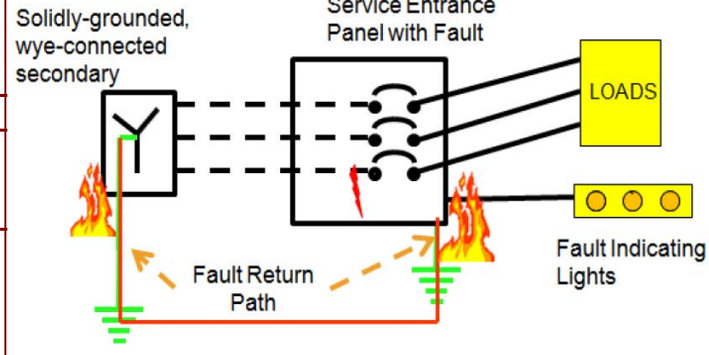
LINK TO STRATEGIC PLAN:

6.2.1 - Emphasis on Reliability

CUSTOMER ENGAGEMENT:

This project is a direct result of customer applications to upgrade services in proposed commercial and industrial locations. This project is closely co-ordinated with the customer and the Electrical Safety Authority (ESA).

CONFIGURATION OF CONCERN
SCHEMATIC: POTENTIAL FAILURE MODE



CAPITAL PROJECT SUMMARY SHEET SYSTEM RENEWAL

Project Number:	19G3
Project Name:	Rebuild Depreciated Areas
Start Date:	Jan-19
In-Service Date:	Dec-19

Project Title: Rebuild of Fully Depreciated Overhead Areas - Delta Service Conversions

Additional Information:

Ungrounded distribution systems are used in industrial installations due to their ability to provide continuous service with a ground fault on one phase. Since the system is ungrounded, the occurrence of the first ground fault will not cause an overcurrent protective device to operate. A single phase failure does not cause high current to flow because the current is limited by the capacitance of the other two phases. However, with one phase and ground at zero potential the voltages in other phases are increased to the system phase-to-phase voltage, and the line to ground voltage rises by 73% which stresses the insulation of cables and other equipment connected to the system. It is common practice to run a faulted, ungrounded system until it is convenient to shut down for repairs.

To ensure the risks are mitigated, a delta ungrounded supply (3 phase, 3 wire) can be converted to a wye grounded supply (3 phase, 4 wire). Generally the customer has no immediate need for supply from a grounded system and they do not need to increase their capacity. However, the Ontario Electrical Safety Code (Rule 10-204) requires that the new 3 phase, 4 wire system be connected to a grounding conductor at each individual service. In most cases, there will be no system grounded conductor (neutral) run to each consumer's service and no neutral conductor installed as part of the existing delta connected consumer's service.

Prepared By:	**Sunny Patel, P.Eng.**
Approved By:	**Bill Milroy, P.Eng.** **V.P. Engineering & Operations**

CAPITAL PROJECT SUMMARY SHEET

SYSTEM RENEWAL

Project Number:	19G4
Project Name:	13.8 kV Overhead Conversion
Start Date:	Jan-19
In-Service Date:	Dec-19

Project Title: 13.8 kV Overhead Conversions

Supporting Reference Material: London Downtown - 13.8 kV/27.6 kV Nelson TS - 5 Year Plan
Downtown Intensification Board Presentation (2016)

Description:

A multi-year voltage conversion of 13.8 kV loads to 27.6 kV will facilitate the removal of aging distribution infrastructure, as well as address the long term strategic plans described in the London Downtown - 13.8 kV/27.6 kV Nelson TS - 5 Year Plan report which recommends the conversion of the non-network downtown core to 27.6 kV supply.

The work proposed is the final phase of a multi-year strategic plan to resupply non-network 13.8 kV loads at 27.6 kV supply. This work is also co-ordinated with other plans that will address the age and condition of the existing 13.8 kV Nelson TS supply from Hydro One.

Some of this work will require coordination with neighbouring 13.8 kV underground conversions under Project 19B10 and coordination with neighbouring 13.8 kV overhead feeder conversions under Project 19C2.

PRIMARY DRIVER:	Reliability
OTHER DRIVERS:	Efficiency
	Customer Value
	Safety
	Econ. Dev.
CUSTOMERS IMPACTED:	Various
OEB CAPITAL REPORTING:	G5 - Overhead Voltage Conversion

COST ESTIMATE - BY YEAR

	COST	AREA/SCOPE
2012		
2013		
2014		
2015	$568,217	
2016	$402,216	917kW Converted
2017	$241,520	1,213kW Converted
2018	$233,720	820kW Converted
2019	$553,000	1391kW Planned
2020	$0	
2021	$0	
TOTAL COST ESTIMATE:		$1,998,673

LH PROJECT DRIVER:	RNF	**LH SECTION #**	132

CAPITAL PROJECT SUMMARY SHEET SYSTEM RENEWAL

Project Number:	19G4
Project Name:	13.8 kV Overhead Conversion
Start Date:	Jan-19
In-Service Date:	Dec-19

Project Title: 13.8 kV Overhead Conversions

Risks to Completion & Mitigation Plan:

Availability of resources to match timing with the overhead line and underground projects under Projects 18C2 and 18B10; mitigation plan is close co-ordination with these projects and securing resources (internal or contract) to ensure completion.

EVALUATION OF OUTCOMES:

Efficiency, Customer Value, Reliability	In accordance with the multi-year plan to off load Nelson TS, the non-network load currently supplied at 13.8 kV will gradually be switched over to the much more reliable 27.6 kV system, with increased alternatives for backup during contingencies. Older infrastucture may also be addressed during voltage conversion of 13.8 kV overhead lateral circuits. This project is coordinated with conversion of related underground 13.8 kV loads.
Safety	In converting 13.8 kV overhead plant, any depreciated equipment such as poles will be eliminated from the system, increasing overall safety.
Cyber-Security, Privacy	Not applicable
Co-ordination, Interoperability	Not applicable
Economic Development	Improved reliability will contribute to overall attractiveness of London as a place in which to live and do business.
Environmental Benefits	There are no direct environmental benefits associated with this project; some material (e,g., wire) may be recycled in the process.

IMPACT TO O&M COSTS:

Annual operating and maintenance costs may be reduced due to possibly fewer outages on newer infrastructure.

ALTERNATIVES CONSIDERED:

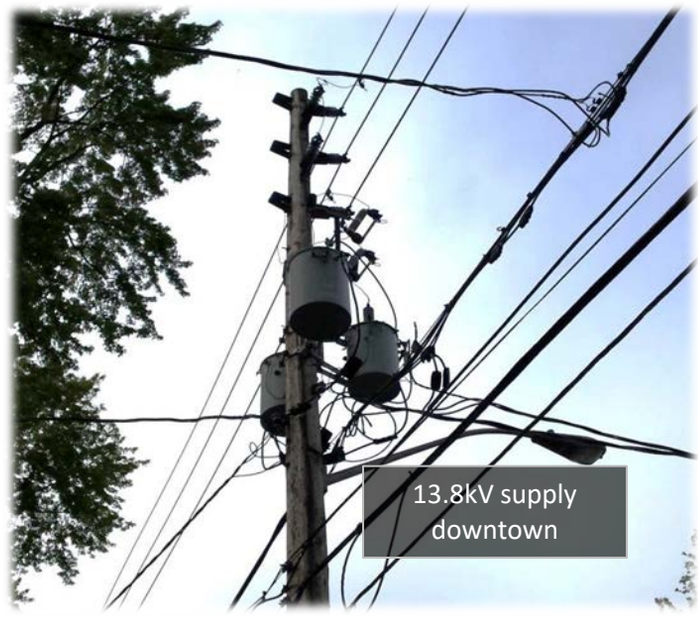
Voltage conversion of all 13.8 kV non-network load must be completed by 2020. An evaluation of the challenges encountered in this project leaves as an option some temporary supply via step-down transformation at selected locations where load still needs to be supplied at 13.8 kV.

LINK TO STRATEGIC PLAN:

Section 6.2.1 - Emphasis on Reliability

CUSTOMER ENGAGEMENT:

At the design stage, when changing the physical layout of the distribution system, property owners may be invited to discuss placement options of poles, potential new routing, etc.



CAPITAL PROJECT SUMMARY SHEET

SYSTEM RENEWAL

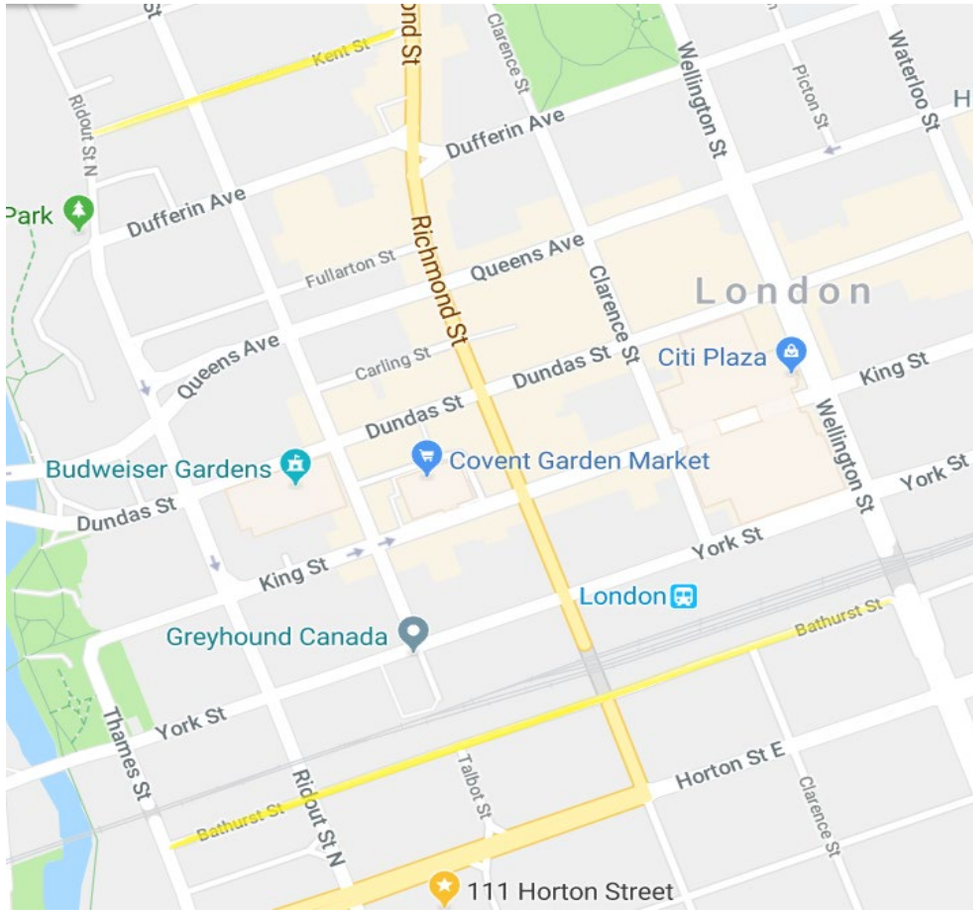
Project Number:	19G4
Project Name:	13.8 kV Overhead Conversion
Start Date:	Jan-19
In-Service Date:	Dec-19

Project Title: 13.8 kV Overhead Conversions

Additional Information:

The initiatives outlined in the London Downtown - 13.8 kV/27.6 kV Nelson TS - 5 Year Plan report require converting all 13.8 kV load by year 2020 when Hydro One eliminates the only transformer station supplying this voltage. Converting the downtown from 13.8 kV distribution, that had only one supply source, to the 27.6 kV distribution system, that has multiple supply sources, ensures a more reliable system in the City of London's core area and also aids in optimizing switching and load transferring amongst the other 27.6 kV stations.

Under this project it is anticipated that approximately 1391 kW of 13.8 kV load will be converted to the 27.6 kV distribution system. The general project area is shown below with the streets planned for load conversion highlighted in yellow.



Prepared By:	**Sunny Patel, P.Eng.** **Distribution Engineer**
Approved By:	**Bill Milroy, P.Eng.** **V.P. Engineering & Operations**

CAPITAL PROJECT SUMMARY SHEET

SYSTEM RENEWAL

Project Number:	19G5
Project Name:	Zone B Overhead Conversion
Start Date:	Jan-19
In-Service Date:	Dec-19

Project Title: 4.16kV Overhead Conversions

Supporting Reference Material:
4.16 kV Conversion Plan - 2018 Update, Plan for Rear Lot to Front Lot Conversion (2018)
Electric Distribution System Asset Sustainment Plan: 2015-2029 (2014)

Description:

The 4.16kV infrastructure is gradually being phased out due to its limited capacity, inability to serve load growth, and the high system losses associated with it. Priority zones A, B, C, and D have been identified based on a coordinated approach using multiple evaluation factors such as age and condition of assets, reliability and system performance, and operational flexibility. In addition, the proposed rebuilds replace deteriorating infrastructure meeting the criteria outlined in the Asset Sustainment Plan Report.

Some of this work will require coordination with neighbouring 4.16 kV underground conversions under Project 19B9 and coordination with transformer vault replacements under Project 18B6. As well, coordination with section A will be required to decommission Substation 92 under project 19A6 as part of the conversion work.

PRIMARY DRIVER:	Reliability
OTHER DRIVERS:	Efficiency
	Customer Value
	Safety
CUSTOMERS IMPACTED:	600
OEB CAPITAL REPORTING:	G5 - Overhead Voltage Conversion
LH PROJECT DRIVER:	REL

COST ESTIMATE - BY YEAR

	COST	AREA/SCOPE
2012	$800,399	
2013	$2,968,682	
2014	$3,075,859	
2015	$2,550,000	
2016	$2,525,000	1,583 kW Converted
2017	$2,965,000	1,238 kW Converted
2018	$2,272,380	1,864 kW Converted
2019	$2,392,000	1,548 kW Planned
2020	$4,501,200	
2021	$575,300	
TOTAL COST ESTIMATE:		$24,625,820

LH SECTION # 132

CAPITAL PROJECT SUMMARY SHEET SYSTEM RENEWAL

Project Number:	19G5
Project Name:	Zone B Overhead Conversion
Start Date:	Jan-19
In-Service Date:	Dec-19

Project Title: 4.16kV Overhead Conversions

Risks to Completion & Mitigation Plan:

Risk to completion is low. Resources must be secured to coordinate timing with underground conversion projects under Project 19B9. This project is part of a program that has been successfully executed in each of the past six years. The availability of resources (internal and contract) is sufficient to complete this project.

EVALUATION OF OUTCOMES:

Efficiency, Customer Value, Reliability	Conversion by zones allows us to offload multiple substations that provide backup to each other during the same time interval, so decommissioning is possible without jeopardizing the ability to reliably supply these customers.
Safety	Removing high voltage overhead lines from residential backyards improves safety for both the public and staff. Safety of the public and staff is also improved throughout voltage conversion of loads supplied by old overhead plant since some in-service installations are substandard, such as positek fused transformers and open bus (see picture below).
Cyber-Security, Privacy	Not applicable
Co-ordination, Interoperability	Not applicable
Economic Development	Improved reliability will contribute to the overall attractiveness of London as a place in which to live and do business.
Environmental Benefits	Environmental benefits include elimination of deteriorated polemount transformers, which might have bushings that are leaking oil.

IMPACT TO O&M COSTS:

Fewer outages can be expected as the supply changes to the 27.6 kV new supply system, leading to a potential decrease in annual operating and maintenance costs.

ALTERNATIVES CONSIDERED:

Some of the overhead infrastructure installed on the 4.16 kV is as old as 60 years and has passed end of life. Rebuilding it at 4.16 kV would deviate from the 4 kV plan of converting overhead areas by zone, which is necessary in order to offload old 4.16 kV substations that would otherwise also need to be rebuilt.

LINK TO STRATEGIC PLAN:

Section 6.2.1 - Emphasis on Reliability

CUSTOMER ENGAGEMENT:

Customers that may be affected are contacted for discussion regarding pole relocations, anchoring, ground restoration, etc. Utility contact names are provided to customers who may have concerns.

CAPITAL PROJECT SUMMARY SHEET

SYSTEM RENEWAL

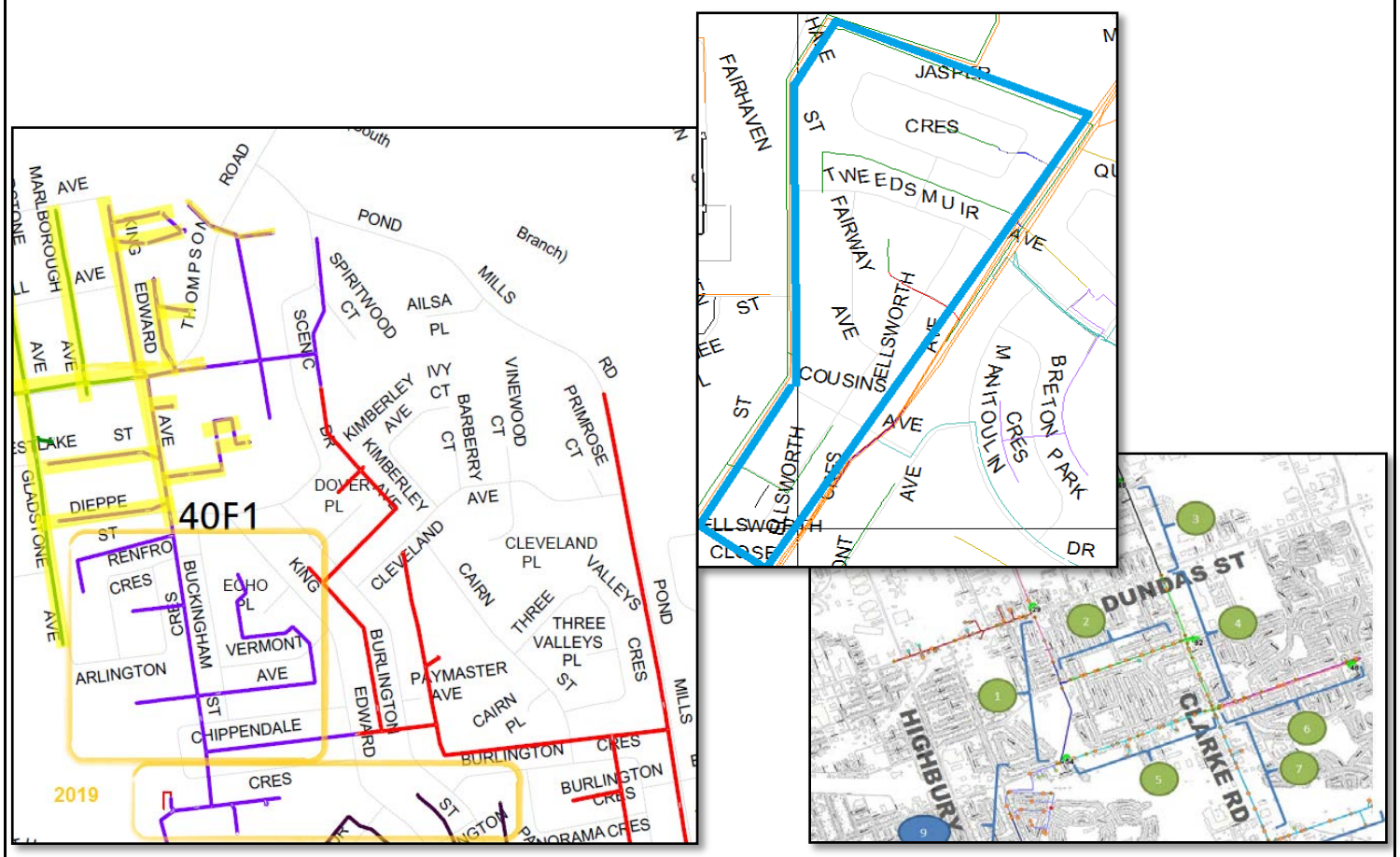
Project Number:	19G5
Project Name:	Zone B Overhead Conversion
Start Date:	Jan-19
In-Service Date:	In-Service Date:

Project Title: 4.16kV Overhead Conversions

Additional Information:

The initiatives outlined in the 4.16 kV Aging Infrastructure System Planning Report require converting all 4.16 kV within identified Zones. In addition, the proposed voltage conversion areas require rebuilding and converting deteriorating underground systems and transformer vaults; thus, meeting the criteria outlined in the Asset Sustainment Plan Report. The deficiencies related to the age of the equipment may adversely impact the reliability of supply as well as public and employee safety since some of the transformers are located in confined spaces within the customer's building.

Under this project it is anticipated that approximately 1,548 kW of 4.16 kV load from Zones B, C and D will be converted to the 27.6 kV distribution system. The general project areas are shown below.



Prepared By: Sunny Patel, P.Eng.
Distribution Engineer

Approved By: Bill Milroy, P.Eng.
V.P. Engineering
& Operations

CAPITAL PROJECT SUMMARY SHEET

SYSTEM RENEWAL

Project Number:	19G6, 19G7, 19G8, 19G14
Project Name:	Overhead System Safety Enhancements
Start Date:	Jan-19
In-Service Date:	Dec-19

Project Title: Replacement of Automatic Splices, Replacement of Porcelain Insulators, Replacement of Porcelain Fused Cutouts and Installation of Copper-Clad Steel (CCS) Grounds

Supporting Reference Material:
Reliability Incident Report - August 2013, Automatic Splice Failure;
Kinectrics Reports: Forensic Analysis of Canadian Porcelain Line Post Insulators (2014);
AESI Report: Copper-Clad Steel - An Alternative for Copper Grounding Conductors
ESA Mitigation of Pole Top Fires Best Practice

Description:

Safety has been recognized to be at risk when energized conductors come in contact with the ground or other equipment. Multiple incidents of conductor breakage occurring in the past in an automatic splice suggests that these non-standard aerial connectors may not be very secure and, therefore, are unsafe. Ongoing system audits identify locations of such splices. This budget item deals with ensuring the mechanical strength in the overhead lines by addressing risk from using these automatic splices.

Up to 1,034 porcelain line post insulators were replaced in 2018, as a result of a system wide program of eliminating this equipment from many manufacturers, which over time has exhibited extremely poor reliability. Small probability/ high impact events on overbuild lines have had consequences, therefore, elimination of these porcelain insulators is a priority. This budget item will deal with additional porcelain insulators installed on the 27.6 kV system across the city, as a measure of enhancing safety on the aerial system.

In 2019, the replacement of porcelain fused cutouts will be a new item introduced to prevent a possible pole fire risk caused by leakage current that may occur due to the characteristics of the porcelain material.

An additional element essential to the safe and reliable operation of a distribution system is proper grounding. The integrity of the grounding system has been compromised over time as grounding conductors have been stolen or cut at the base of the poles. The new standard copper-clad steel conductor adopted by London Hydro as replacement for traditional copper grounds makes it possible for crews to re-establish lasting system grounding connections. Several grids will be selected for grounding repairs in this budget item.

PRIMARY DRIVER:	Safety
OTHER DRIVERS:	Reliability
	Customer Value
	Econ. Dev.
CUSTOMERS IMPACTED:	Various
OEB CAPITAL REPORTING:	G2 - Arrestor/Insulator/Other
LH PROJECT DRIVER:	SAF

COST ESTIMATE - BY YEAR

	COST	AREA/SCOPE
2012	$130,729	various grids
2013	$72,056	various grids
2014	$772,265	various grids
2015	$950,000	various grids
2016	$880,000	various grids
2017	$281,258	various grids
2018	$411,695	various grids
2019	$335,000	various grids
2020	$285,000	various grids
2021	$235,000	various grids
TOTAL COST ESTIMATE:	$4,353,003	

LH SECTION # 132

CAPITAL PROJECT SUMMARY SHEET

SYSTEM RENEWAL

Project Number:	19G6, 19G7, 19G8, 19G14
Project Name:	Overhead System Safety Enhancements
Start Date:	Jan-19
In-Service Date:	Dec-19

Project Title: Replacement of Automatic Splices, Replacement of Porcelain Insulators, Replacement of Porcelain Fused Cutouts and Installation of Copper-Clad Steel (CCS) Grounds

Risks to Completion & Mitigation Plan: Availability of resources and co-ordination of the potential outages may slow down the progress of these projects; the mitigation plan is to closely monitor projects' progress and secure external resources (contractor), if required.

EVALUATION OF OUTCOMES:

Efficiency, Customer Value, Reliability	A robust and secure overhead distribution system will improve the overall system operation by ensuring the reliable distribution of power to customers and by reducing outages that can be avoided.
Safety	Safety is the number one factor considered in addressing overhead system weaknesses since live contact can occur when equipment fails.
Cyber-Security, Privacy	Not applicable
Co-ordination, Interoperability	Certain practices and standards have been adopted by multiple utilities in the province through the exchange of performance standards, expertise, and the availability of new certified equipment and technologies (e.g., copperclad conductor).
Economic Development	Improved reliability will contribute to the overall attractiveness of London as a place in which to live and do business.
Environmental Benefits	Not applicable

IMPACT TO O&M COSTS:

Fewer outages due to faults on the overhead system may result in a slight reduction in annual operating and maintenance costs.

ALTERNATIVES CONSIDERED:

Equipment at risk can remain in service but could compromise performance and increase safety risks.

LINK TO STRATEGIC PLAN:

6.2.1 - Emphasis on Reliability

CUSTOMER ENGAGEMENT:

Customers were not directly contacted regarding this project but recent surveys indicate customers value improvements in reliability (refer to DSP Section 3.2.4 Customer Engagement).

CAPITAL PROJECT SUMMARY SHEET

SYSTEM RENEWAL

Project Number:	19G6, 19G7, 19G8, 19G14
Project Name:	Overhead System Safety Enhancements
Start Date:	Jan-19
In-Service Date:	Dec-19

Project Title: Replacement of Automatic Splices, Replacement of Porcelain Insulators, Replacement of Porcelain Fused Cutouts and Installation of Copper-Clad Steel (CCS) Grounds

Additional Information:

Outages resulting from the failure of a component on the overhead system usually result in the interruption of power on an entire feeder, which supplies, on average, several thousand customers. While automated equipment exists in the system to detect and isolate the faulted segment, the necessary repairs can still create prolonged outages, depending on the damage. The following equipment types will be addressed in this budget item.

1) Certain risks can arise when an automated splice installed on a main 600 amp circuit fails and the conductor breaks inside the splice. Such splices have been identified on segments of circuits and will be replaced under this budget item. As more are identified, risks will be mitigated, prioritized by location or grid.

2) Failed porcelain insulators installed on the main circuits have proven to create dangerous situations wherein their breakage can cause separate phases to swing onto one another or make contact with the ground. All the remaining porcelain insulators installed on the 27.6 kV system are being located through audits and replacements will be staged over the next several years.

3) Similar to porcelain insulators, failed porcelain cutout switches have also proven to create dangerous situations wherein their breakage can cause live primary to make contact with other equipment or the ground. Porcelain cutout switches installed on the 27.6 kV system are being located through audits and their replacement will be staged over the next several years.

4) Installation of the new standard copper-clad steel ground conductors will continue in the city where grounding at poles has been compromised. This budget item covers the installation of new grounds at approximately 240 poles.

Prepared By:	**Sunny Patel, P.Eng.** **Distribution Engineer**
Approved By:	**William Milroy, P.Eng.** **Chief Engineer &** **V.P. of Operations**

CAPITAL PROJECT SUMMARY SHEET SYSTEM RENEWAL

Project Number:	19G9
Project Name:	Firon Switch Replacement
Start Date:	Jan-19
In-Service Date:	Dec-19

Project Title: Clamshell Connector and Firon Switch Replacements

Supporting Reference Material: N/A

Description:

Clamshell connectors (Figure 1) originally supplied with legacy overhead switches are prone to overheating from corrosion initiated by contact between dissimilar metals. The heating and cooling at these points of corrosion lead to failure of the connector. A system-wide audit was performed to produce a list of clamshell connector locations for replacement. These mechanical-style connectors will be replaced with 2-hole aluminum compression lugs (Figure 2) to reduce corrosion and heating, thereby improving safety and system reliability.

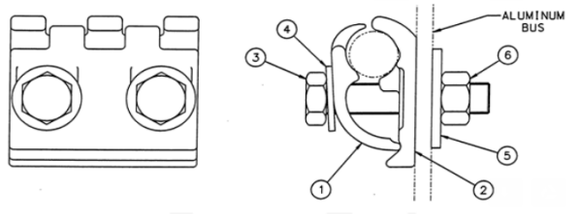


Figure 1 - Clamshell Connectors

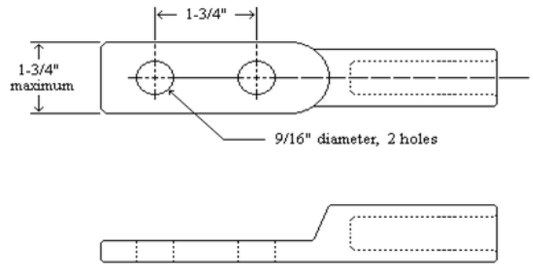


Figure 2 – Two-Hole Compression Lugs

PRIMARY DRIVER:	Safety
OTHER DRIVERS:	Reliability
	Efficiency
	Customer Value
CUSTOMERS IMPACTED:	Various

OEB CAPITAL REPORTING:

G2 - Arrestor/Insulator/Other

COST ESTIMATE - BY YEAR

	COST	AREA/SCOPE
2018	$96,511	35 locations
2019	$50,000	25 locations
2020	$50,000	25 locations

TOTAL COST ESTIMATE: $196,511

LH PROJECT DRIVER:	SAF
LH SECTION #	132

CAPITAL PROJECT SUMMARY SHEET SYSTEM RENEWAL

Project Number:	19G9
Project Name:	Firon Switch Replacement
Start Date:	Jan-19
In-Service Date:	Dec-19

Project Title: Clamshell Connector and Firon Switch Replacements

Risks to Completion & Mitigation Plan: Availability of resources to complete installations can slow down these enhancements. Priority is given to projects that can impact safety and reliabillity the most according to customer impact.

EVALUATION OF OUTCOMES:

Efficiency, Customer Value, Reliability	A robust and secure overhead distribution system will improve the overall system operation by reliably distributing power to customers and reducing the duration of unplanned outages.
Safety	The proactive removal of defective equipment from the overhead distribution system will lower risk to both powerline workers and the general public.
Cyber-Security, Privacy	Not applicable
Co-ordination, Interoperability	Certain practices and standards have been adopted by multiple utilities in the province through the exchange of performance standards, expertise, and the availability of new certified equipment and technologies (e.g., two-hole compression lugs).
Economic Development	Improved reliability will contribute to overall attractiveness of London as a place to live and do business.
Environmental Benefits	No direct environmental benefits come from this project type.

IMPACT TO O&M COSTS:
Fewer outages due to faults on the overhead system may result in a slight reduction in annual operating and maintenance costs.

ALTERNATIVES CONSIDERED:
Equipment at risk can remain in service but could compromise performance and increase safety risks.

LINK TO STRATEGIC PLAN:
Section 6.2.1 - Emphasis on Reliability

CUSTOMER ENGAGEMENT:
Customers were not directly contacted regarding this project but recent surveys indicate that customers value improvements in reliability (refer to DSP Section 3.2.4 Customer Engagement).

CAPITAL PROJECT SUMMARY SHEET SYSTEM RENEWAL

Project Number:	19G9
Project Name:	Firon Switch Replacement
Start Date:	Jan-19
In-Service Date:	Dec-19

Project Title: Clamshell Connector and Firon Switch Replacements

Additional Information:

Not Applicable.

Prepared By:	**Sunny Patel, P.Eng.** **Distribution Engineer**
Approved By:	**William Milroy, P.Eng.** **Chief Engineer &** **V.P. of Operations**

CAPITAL PROJECT SUMMARY SHEET SYSTEM RENEWAL

Project Number:	19G13
Project Name:	Load Break/Sectionalizing Switches
Start Date:	Jan-19
In-Service Date:	Dec-19

Project Title: Load Break/Sectionalizing Switch Installations

Supporting Reference Material: Sectionalizing Switch Placement - May 2018

Description:

Outages resulting from failure of a component on the overhead system usually result in the interruption of power on an entire feeder. While automated equipment exists in the system to detect and isolate the faulted segment, the necessary repairs can still create prolonged outages. Sectionalizing switches will serve to reduce the duration of customer interruptions during such outage events by improving operational flexibility.

A system wide reliability analysis was performed to establish optimal placement for new sectionalizing switches. The selection criteria addressed historical feeder performance and customer segmentation to reduce the system average interruption duration index (SAIDI).

PRIMARY DRIVER:	Safety
OTHER DRIVERS:	Efficiency
	Customer Value
	Reliability
CUSTOMERS IMPACTED:	Various
OEB CAPITAL REPORTING:	G2 - Arrestor/Insulator/Other
LH PROJECT DRIVER:	SAF

COST ESTIMATE - BY YEAR

	COST	AREA/SCOPE
2018	$30,500	5 locations
2019	$30,000	5 locations
2020	$30,000	5 locations

TOTAL COST ESTIMATE: $90,500

LH SECTION # 132

CAPITAL PROJECT SUMMARY SHEET SYSTEM RENEWAL

Project Number:	19G13
Project Name:	Overhead System Safety Enhancements
Start Date:	Load Break/Sectionalizing Switche
In-Service Date:	Dec-19

Project Title: Load Break/Sectionalizing Switch Installations

Risks to Completion & Mitigation Plan: Availability of resources to complete installations can slow down these enhancements. Priority is given to projects that can impact safety and reliabillity the most according to customer impact.

EVALUATION OF OUTCOMES:

Efficiency, Customer Value, Reliability	A robust and secure overhead distribution system will improve the overall system operation by reliably distributing power to customers and reducing the duration of unplanned outages.
Safety	Ease of installation reduces the probability of malfunction due to workmanship and the double insulator design provides a more controlled workspace.
Cyber-Security, Privacy	Not applicable
Co-ordination, Interoperability	Sectionalizing switches co-ordinate well with fault-interrupting devices such as breakers and reclosers. Once a fault has been interrupted, a sectionalizing switch may be leveraged to isolate a faulted segment to facilitate the restoration of unfaulted customers.
Economic Development	Improved reliability will contribute to overall attractiveness of London as a place to live and do business.
Environmental Benefits	No direct environmental benefits come from this project type.

IMPACT TO O&M COSTS:

Improved operational flexibility may provide a slight reduction in annual operating and maintenance costs by reducing the travel time between switching operations.

ALTERNATIVES CONSIDERED:

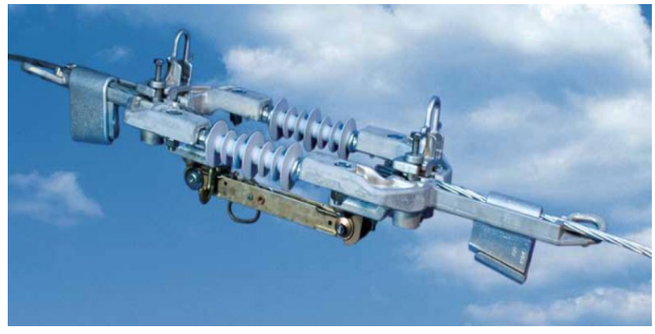
Pole mounted load break switches were considered as an alternative, but did not provide the same installation flexibility.

LINK TO STRATEGIC PLAN:

Section 6.2.1 - Emphasis on Reliability

CUSTOMER ENGAGEMENT:

Customers were not directly contacted regarding this project but recent surveys indicate that customers value improvements in reliability (refer to DSP Section 3.2.4 Customer Engagement).



CAPITAL PROJECT SUMMARY SHEET

SYSTEM RENEWAL

Project Number:	19G13
Project Name:	Overhead System Safety Enhancements
Start Date:	Load Break/Sectionalizing Switche
In-Service Date:	Dec-19

Project Title: Load Break/Sectionalizing Switch Installations

Additional Information:

Not Applicable.

Prepared By:	**Sunny Patel, P.Eng.** **Distribution Engineer**
Approved By:	**William Milroy, P.Eng.** **Chief Engineer &** **V.P. of Operations**

SAF

CAPITAL PROJECT SUMMARY SHEET SYSTEM SERVICE

Project Number:	19H1
Project Name:	Recloser Installations
Start Date:	Jan-19
In-Service Date:	Dec-19

Project Title: Recloser Installation Program

Supporting Reference Material:
Use of Reclosers on London Hydro's Electrical System, 2003
2017 Quality of Supply Report
Feeder Segmentation Proposals, 2015

Description:
The installation of SCADA-controlled switches or reclosers reduces the duration and frequency of outages that customers experience. London Hydro has installed approximately 160 SCADA-controlled devices and plans to continue installing reclosers until all customers have been sectionalized into groups of approximately 1000.

In 2019, four new reclosers will be installed at locations that enhance system segmentation as well as support ORTAC planning requirements.

PRIMARY DRIVER:	Reliability
OTHER DRIVERS:	Efficiency
CUSTOMERS IMPACTED:	Various
OEB CAPITAL REPORTING:	H1 - Recloser Installations
LH PROJECT DRIVER:	REL

COST ESTIMATE - BY YEAR

	COST	AREA/SCOPE
2012	$173,246	3 Locations
2013	$184,026	3 Locations
2014	$236,482	5 Locations
2015	$195,000	4 Locations
2016	$133,200	3 Locations
2017	$230,135	5 Locations
2018	$309,355	4 Locations
2019	$260,000	4 Locations
2020	$195,000	3 Locations
2021	$195,000	3 Locations
TOTAL COST ESTIMATE:		$2,111,444

LH SECTION # 250

CAPITAL PROJECT SUMMARY SHEET SYSTEM SERVICE

Project Number:	19H1
Project Name:	Recloser Installations
Start Date:	Jan-19
In-Service Date:	Dec-19

Project Title: Recloser Installation Program

Risks to Completion & Mitigation Plan: The risks to completion are minimal. This project is part of a program that has been successfully executed in each of the past five years.

EVALUATION OF OUTCOMES:

Efficiency, Customer Value, Reliability	By increasing the segmentation of the distribution system, customers will experience fewer faults and crews will be able to find faults more expediently.
Safety	Not Applicable
Cyber-Security, Privacy	The remote terminal units will be secured in accordance with London Hydro's cyber security practices.
Co-ordination, Interoperability	Not Applicable
Economic Development	Improved reliability will contribute to the overall attractiveness of London as a place to live and to conduct business.
Environmental Benefits	Not Applicable

IMPACT TO O&M COSTS:

Operating costs related to finding faults will be reduced, while maintenance costs will increase due to the additional assets.

ALTERNATIVES CONSIDERED:

Do nothing, however this alternative was rejected because it will not enhance the reliability of supply provided to customers.

LINK TO STRATEGIC PLAN:

Section 6.2.1 - Emphasis on Reliability

CUSTOMER ENGAGEMENT:

Customers were not directly engaged regarding this project, but recent surveys indicate customers value improvements in reliability (refer to DSP Section 3.2.4 Customer Engagement).

CAPITAL PROJECT SUMMARY SHEET SYSTEM SERVICE

Project Number:	19H1
Project Name:	Recloser Installations
Start Date:	Jan-19
In-Service Date:	Dec-19

Project Title: Recloser Installation Program

Additional Information:

Not Applicable

Prepared By:	**Hassan El-Madhoun, P.Eng.** **Operations Engineer**
Approved By:	**William Milroy, P.Eng.** **Chief Engineer &** **V.P. of Operations**

CAPITAL PROJECT SUMMARY SHEET
SYSTEM SERVICE

Project Number:	19H2, 19H3, 19H4, 19H5
Project Name:	SCADA Enhancements
Start Date:	Jan-19
In-Service Date:	Dec-19

Project Title: SCADA Enhancements

Supporting Reference Material: Electric Distribution System Asset Sustainment Plan: 2015-2029 (2014)

Description:

A reliable SCADA system is required to efficiently monitor and control the distribution system. The SCADA projects will enhance components of the system that are either technically obsolete or inefficient to maintain. Specifically, the projects will increase the reliability of remote terminal units (RTUs), modernize communications protocols and mediums, secure data against cyber threats, and develop system intelligence tools that enable automation.

This project will be the initial investment for a Power Quality Monitoring system, which will enable engineering and operations to do things such as (but not limited to), predict equipment damage before catastrophic failure, troubleshoot protection and control failures, locate faults more quickly, and reduce outage time.

PRIMARY DRIVER:	Inoperability
OTHER DRIVERS:	Cyber Security
	Reliability
CUSTOMERS IMPACTED:	

OEB CAPITAL REPORTING:

H2/H3 - RTU Replacement Program
H4 - SCADA
H5 - Power Quality

COST ESTIMATE - BY YEAR

	COST	AREA/SCOPE
2012	$150,000	
2013	$240,000	
2014	$360,000	
2015	$300,000	
2016	$280,000	SCADA
2017	$289,424	SCADA
2018	$318,800	SCADA
2019	$655,000	SCADA
2020	$300,000	SCADA
2021	$280,000	SCADA
TOTAL COST ESTIMATE:		$3,173,224

LH PROJECT DRIVER:	REL	**LH SECTION #**	250

CAPITAL PROJECT SUMMARY SHEET SYSTEM SERVICE

Project Number:	19H2, 19H3, 19H4, 19H5
Project Name:	SCADA Enhancements
Start Date:	Jan-19
In-Service Date:	Dec-19

Project Title: SCADA Enhancements

Risks to Completion & Mitigation Plan:

The risks to completion are minimal. Most of the SCADA enhancement projects are part of programs that have successfully been completed in previous years. Should project requirements exceed internal capabilities, working relationships with external resources have been established.

EVALUATION OF OUTCOMES:

Efficiency, Customer Value, Reliability	A modern, secure and robust SCADA system will improve the overall system operation by reliably providing real-time data to the Control Centre and historical data for engineering analysis.
Safety	Increased central visibility will improve London Hydro's ability to expendiently respond to developing emergency situations.
Cyber-Security, Privacy	Modern equipment will enhance London Hydro's ability to prevent the electrical supply from being compromised by cyber attacks.
Co-ordination, Interoperability	The technology employed will be selected to adhere to industry standards and provide the functionality required for future initiatives.
Economic Development	Not Applicable
Environmental Benefits	Not Applicable

IMPACT TO O&M COSTS:

Proactively replacing components identified as being at risk of failure will reduce operating and maintenance costs by reducing the number of emergency repairs.

ALTERNATIVES CONSIDERED:

An evaluation of different technologies (eg. wired vs. radio) and vendors was conducted to determine the optimal investments.

LINK TO STRATEGIC PLAN:

Section 6.2.1 - Emphasis on Reliability

CUSTOMER ENGAGEMENT:

Customers were not directly engaged regarding this project, but recent surveys indicate customers value improvements in reliability (refer to DSP Section 3.2.4 Customer Engagement).

CAPITAL PROJECT SUMMARY SHEET SYSTEM SERVICE

Project Number:	19H2, 19H3, 19H4, 19H5
Project Name:	SCADA Enhancements
Start Date:	Jan-19
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Project Title: SCADA Enhancements

Additional Information:

H2 - Serial communications equipment is used throughout London Hydro's SCADA system. However, serial technology has reached technical obsolescence and many of the equipment manufacturers no longer provide product support. To address this change in communications technology London Hydro has developed a program to replace end-of-life serial communications equipment with Ethernet-capable communications equipment. In addition to replacing end-of-life equipment, this program will also advance the decommissioning of leased-lines, thereby reducing monthly communications rental costs.

H3 - DART Remote Terminal Units (RTU) were installed to monitor and control 70 line switches and 2 substations. The RTUs employ circuit-board technology that is now obsolete, requiring expensive batch orders of circuit boards to maintain. Since the switches that the DARTs control have remaining useful lives in excess of 25 years, a replacement RTU was required. To address this challenge London Hydro identified a replacement RTU, developed by Virelec in conjunction with Power Stream and Oakville Hydro, that uses equipment already employed to monitor and control London Hydro's substations and FITs. The program, which began in 2012, will replace all DART RTUs by the end of 2020, assuming that their rate of failure does not increase.

H4 - London Hydro’s SCADA system was designed during an era when cyber security was a relatively unknown term. As a result, many of the legacy devices employed by the SCADA system have limited security functions. To address this weakness London Hydro has developed a multi-faceted SCADA Cyber Security program. In coordination with the Asset Sustainment plan, legacy SCADA assets will be replaced with modern devices designed to ensure industrial security. To eliminate opportunities for remote security breaches, SCADA communications will be transferred from publicly accessible networks to privately controlled networks whenever it is economically efficient. This transfer will increase both the length of fibre optic cable employed for operational functions and the volume of traffic on London Hydro’s licensed radio frequencies. Where it is economically inefficient to isolate SCADA communications from public networks, efforts will be directed toward enhanced network segregation and encryption.

H5 - For decades utilities have utilized faulted circuit indicators to efficiently locate and isolate faults. As a result of advancements in wireless technology, this information can now be provided to Control Room Operators in real-time using Line Status Sensors. In addition to fault indication, the line sensors also provide real-time load information. This new technology represents an economical alternative to installing SCADA-controlled switches to provide greater visibility into the distribution system. Power Quality monitoring tools will also be implemented to assist in analyzing the system's behaviors under normal and fault scenarios.

Prepared By:	**Hassan El-Madhoun, P.Eng.** **Operations Engineer**
Approved By:	**William Milroy, P.Eng.** **Chief Engineer &** **V.P. of Operations**

CAPITAL PROJECT SUMMARY SHEET
SYSTEM SERVICE

Project Number:	19H12
Project Name:	SCADA
Start Date:	Jan-19
In-Service Date:	Mar-22

Project Title: Microgrid Control (West 5)

Supporting Reference Material: Natural Resources Canada (NRCAN) Smart Grid Submission

Description:

The smart microgrid project will demonstrate the integration of smart grid systems and design including, grid monitoring and automation, data management and communication, new metering methodologies, demand management, electric vehicle (EV) integration, microgrids, energy storage and Distributed Energy Resource Management (DERM). West 5 is a 70-acre multi-use development located on the western edge of the city of London, Ontario (in the growing Riverbend area), with many sustainable and “high tech” features, soon to be the largest Net-zero Energy community in Canada.

This project will include London Hydro's investment in London Hydro grid assets such as high voltage distribution automation devices and associated monitoring, protections and controls.

The project is proposed to be constructed over a 3 - 4 year period in partnership with Sifton Properties and S2E Technologies Inc.

This project is contingent on receiving funding from NRCAN's Smart Grid Fund. The terms of the funding from NRCAN are in the final stages of evaluation at this time.

PRIMARY DRIVER:	Interoperability
OTHER DRIVERS:	Reliability
	Econ. Dev.
	Environmental
CUSTOMERS IMPACTED:	West 5 Development Area
OEB CAPITAL REPORTING:	H11 - Grid Automation

COST ESTIMATE - BY YEAR

	COST	AREA/SCOPE
2012		
2013		
2014		
2015		
2016		
2017		
2018		
2019	$90,000	SCADA
2020	$180,000	SCADA
2021	$90,000	SCADA
TOTAL COST ESTIMATE:		$360,000

LH PROJECT DRIVER:	Interoperability
LH SECTION #	250

CAPITAL PROJECT SUMMARY SHEET SYSTEM SERVICE

Project Number:	19H12
Project Name:	SCADA Enhancements
Start Date:	Jan-19
In-Service Date:	Mar-22

Project Title: Microgrid Control (West 5)

Risks to Completion & Mitigation Plan: This project is contingent on receiving funding from the NRCAN Smart Grid Fund and executing mutually acceptable agreements with Sifton Propoerties and S2E Technologies Inc. The risk to London Hydro will be mitigated by restricting project expenditures until all approvals and agreements are executed and received.

EVALUATION OF OUTCOMES:

Efficiency, Customer Value, Reliability	This project will enhance grid reliability to the West 5 develoment.
Safety	New processes will be developed to ensure safe maintence and operation of this smart grid technology.
Cyber-Security, Privacy	The project will be designed to maintain high levels of cyber-security with respect to SCADA control and monitoring.
Co-ordination, Interoperability	This project will provide greater visibility and control of the grids operation.
Economic Development	This project will provide opportunity for employment in the smart grid related industries in London.
Environmental Benefits	This project will enable increased penetration of clean renewable generation.

IMPACT TO O&M COSTS:

This project will serve as a learning experience to determine the ongoing impacts to maintain a microgrid system.

ALTERNATIVES CONSIDERED:

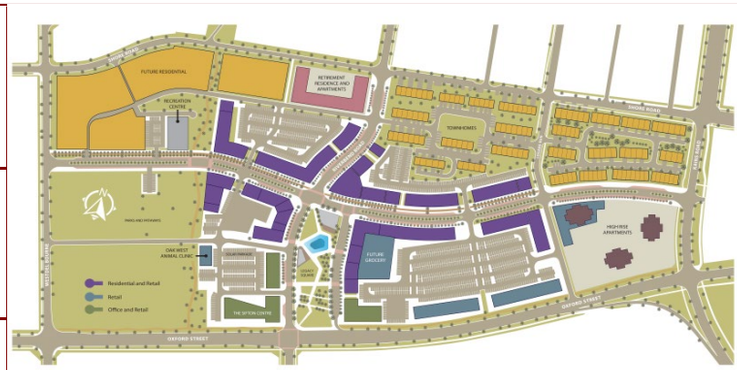
This project is an alternative to the typical non-automated subdivision design strategy.

LINK TO STRATEGIC PLAN:

This project is aligned Customer Care, Reliability, Leadership and Techology.

CUSTOMER ENGAGEMENT:

London Hydro is directly engaged with Sifton Properties which is the customer involved.



CAPITAL PROJECT SUMMARY SHEET SYSTEM SERVICE

Project Number:	19H12
Project Name:	SCADA Enhancements
Start Date:	Jan-19
In-Service Date:	Mar-22

Project Title: Microgrid Control (West 5)

Additional Information:

Not Applicable

Prepared By:	**Allan Van Damme, P.Eng.** **Director of Operations**
Approved By:	**William Milroy, P.Eng.** **V.P. of Engineering & Operations**