

London Hydro's Role in the Electricity Market

IEEE Women in Engineering
London Hydro Tour Event
April 23, 2013

Jagoda Borovickic, P.Eng.
Cristina Terek, P.Eng.



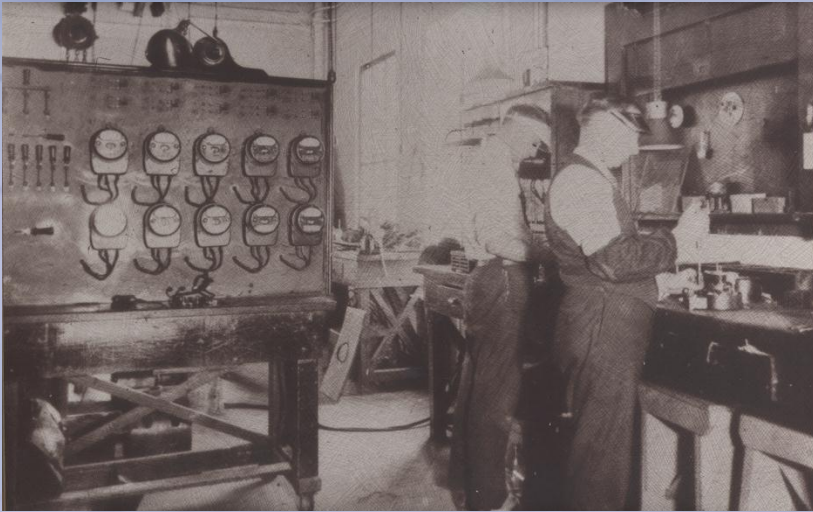
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Agenda

- London Hydro Overview
- London Hydro's Role as a Distributor of Electricity
- Asset Management and Reliability of our System
- Planning, Design and Operation of our System
- Renewable Generation



History of London Hydro



- 1910 – Electricity brought to London
- 1993 – Water, Parks and Recreation transferred to the City
- 2000 – London Hydro incorporated under Ontario Business Corporation Act



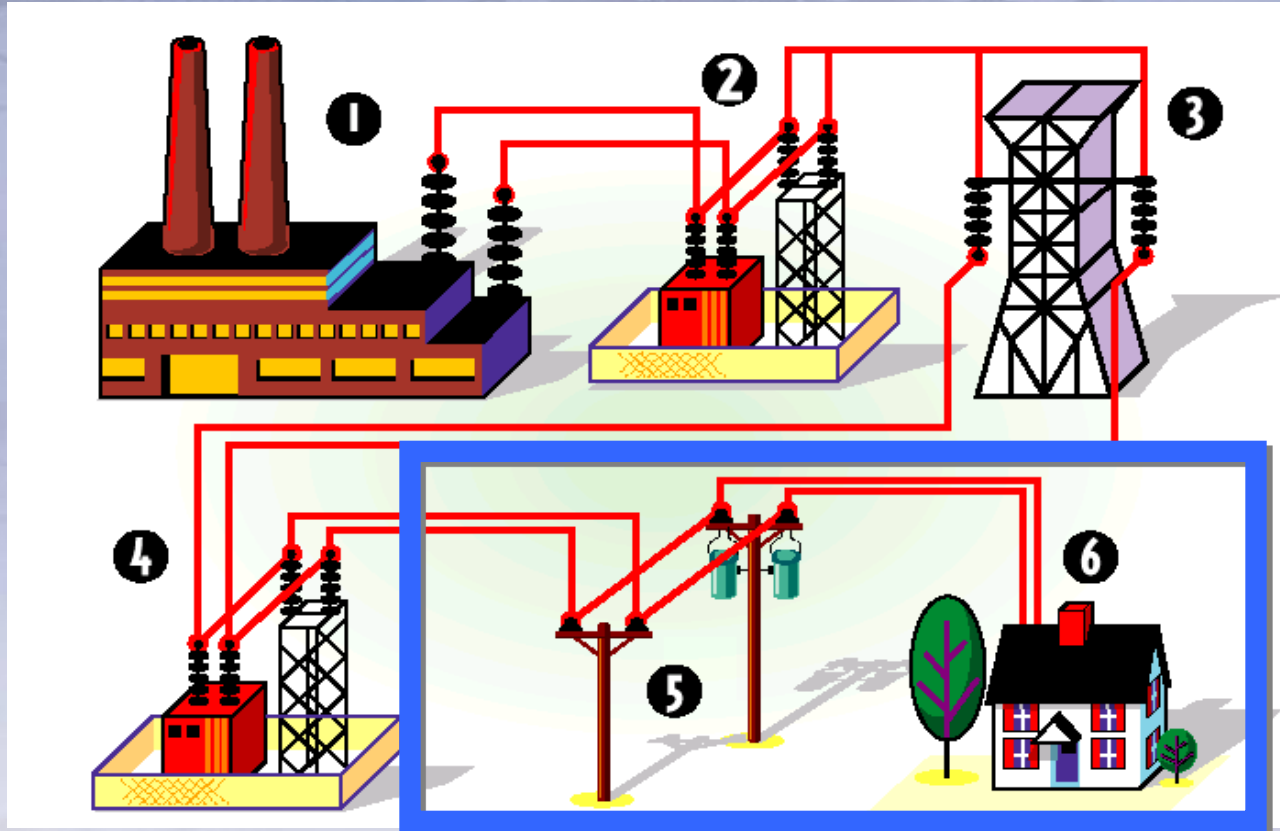
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London Hydro operates in a regulated environment

- Distribution System Code as per the Ontario Energy Board
- Ontario Regulation 22/04 – “Electrical Distribution Safety”
- The Green Energy Act



London Hydro's role in the supply chain



Owned by
London
Hydro



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London Hydro has significant experience and knowledge

- 7th largest out of 80 Ontario utilities
- 280 employees (14 licensed Engineers)
- 148,000 customers
- Record peak demand of 717 MW (in 2011)
- 1,365 km of overhead line circuitry
- 1,480 km of underground cable circuitry
- 39 substations
- 15,200 distribution transformers
- 29,000 distribution poles
- 125 automated switches



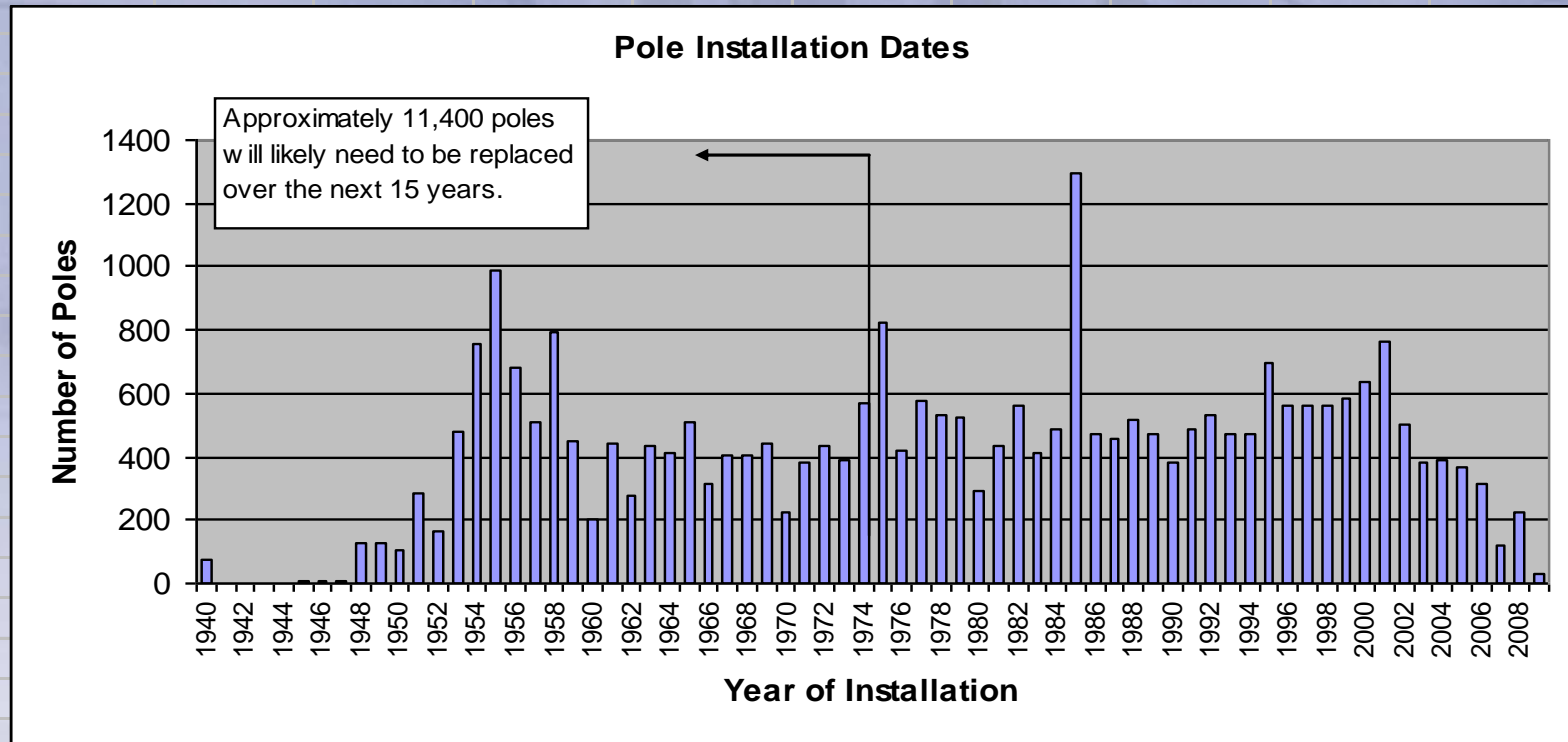
Asset Management

- Items Considered:
 - Age and Life Expectancy
 - Plant Condition
 - Inspection Plan
 - Risk Assessment
 - Maintenance/Refurbishment and Replacement Programs



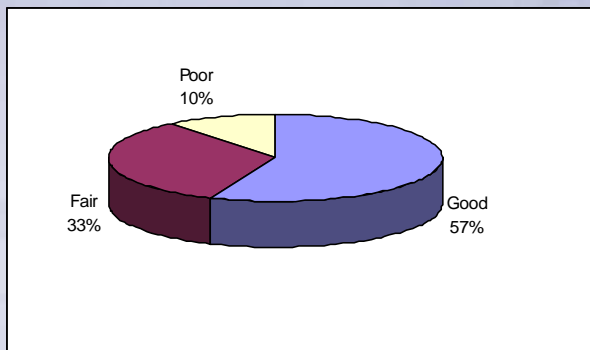
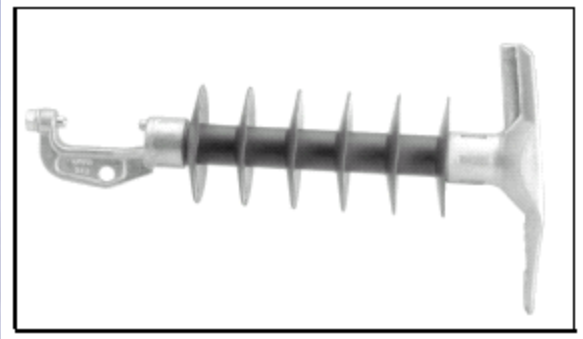
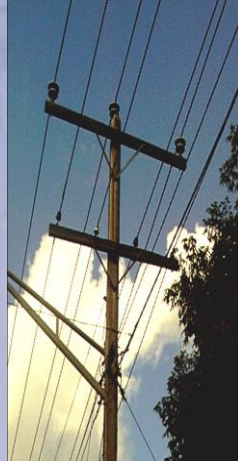
Asset Management

Demographics of Asset



Asset Management

Condition of Asset



Asset Management

Regular Field Inspections and Audits

ENTER NEW OVERHEAD AUDIT Audit#: **toNumber**

Grid#: Location:

Corrective Action Priority
 1-Urgent 2-Timely All OK

Poles
Condition of Pole
Broken
Cracked
Excessive Surface Wear
Needs to be Straightened
Grading Change/Washouts
Insect Damage
Specify

Supports
Crossarms Broken
Rotten
Cracked
Guys Broken
Loose
Unattached
Guy Guard Missing
Strain Insulators Broken
Brace Irons Bent
Missing
Broken
Specify

Pins and Insulators
Pins Wooden
Sunk
Insulators Primary Broken
Secondary Broken
Specify

Hardware and Attachments
Loose or Missing Hardware
Insulators Unattached from Pins
Conductor unattached from Insulators
Insulators Flashed Over
Tie Wires Unraveled
Ground Wires Broken
Ground wire guards Removed/broken
Specify

Transformers/Terminal Poles/Protective Devices
Broken Switch
Arrestor Damaged
Primary Lead Needs Repair
Defective Bushings
Exposed Ground Rod
Nomenclature Missing
Nomenclature Needs Replacing
Device#:
Transformer Mounted on Hangers
Leaking Oil
Rust
Neutral and Ground Connections Broken
Control cabinet damaged
Cable Guard Missing or Broken
Specify

Conductors and Cables
Inadequate Sags
Low Conductor Clearance
Broken/Frayed Conductors
Lashing Wire Broken
Tree Trimming Required
Specify

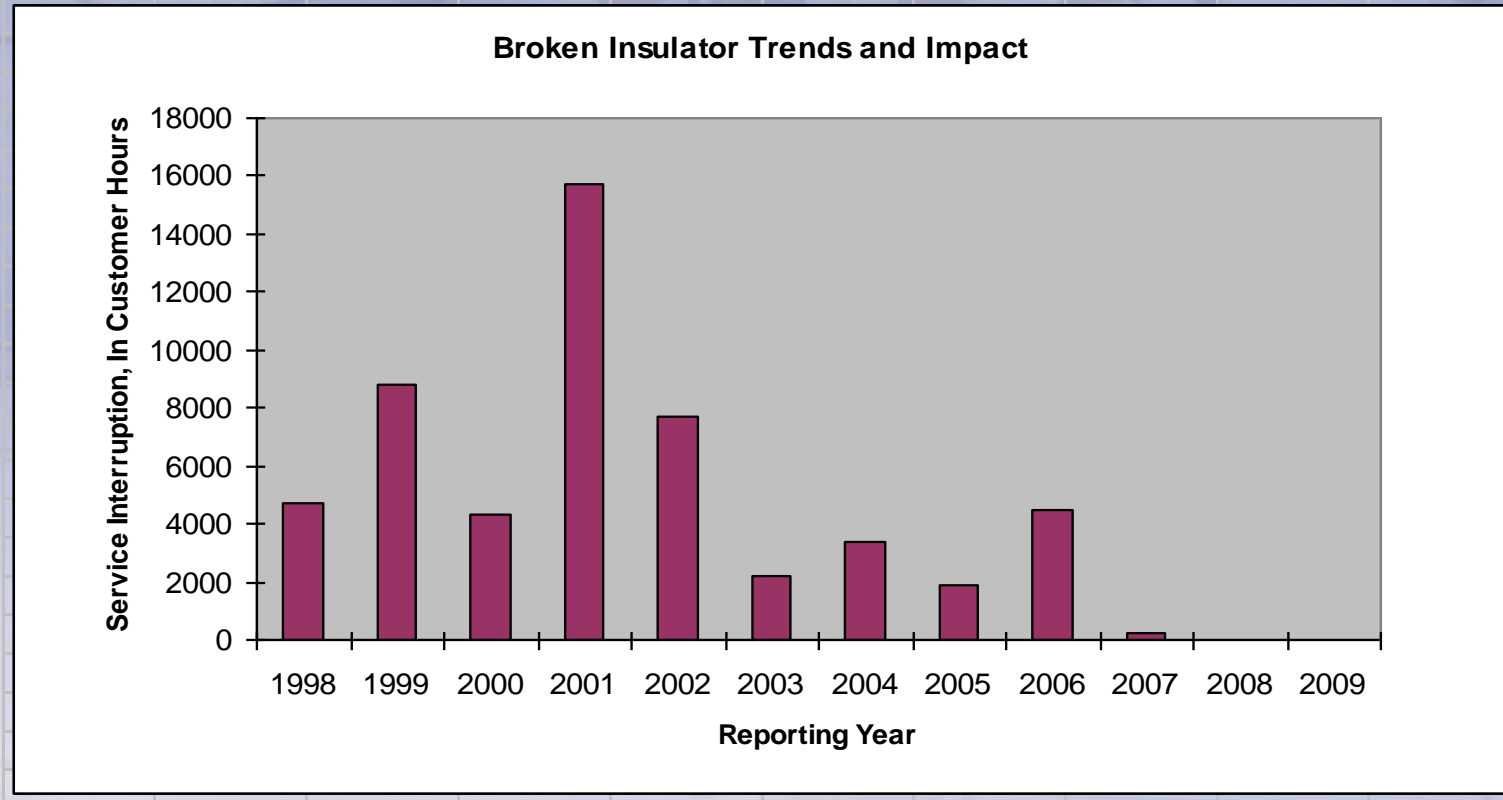
Conclusions
Requires Closer Inspection
Additional Comments

All OK Inspected By: Certificate: Add New

Date: Print Close

Asset Management

Risk Assessment



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Reliability

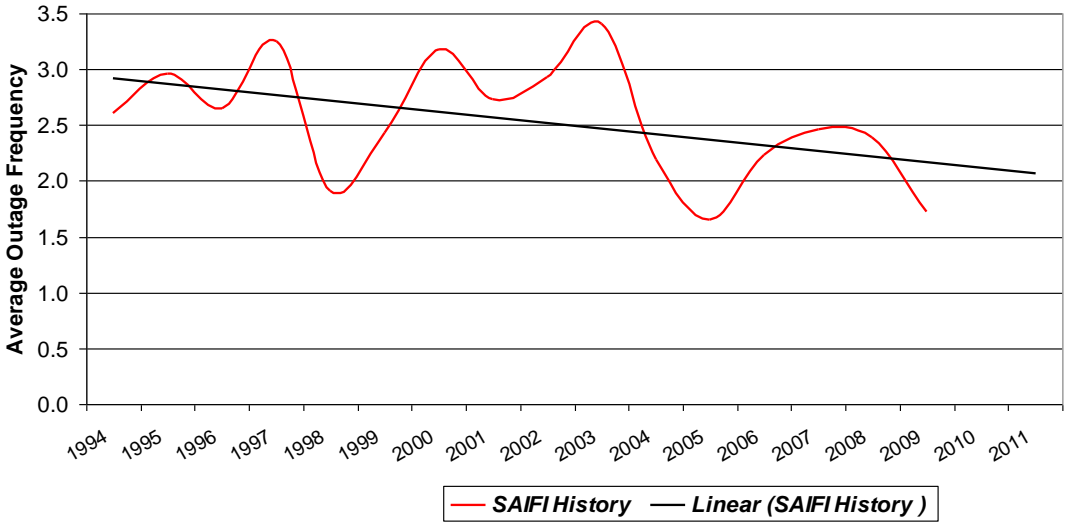
Reliability involves:

- The analysis of outages (“no hydro”)
- Risk assessment
- Problem solving to prevent future occurrences
- Working with manufacturers to make designs more reliable
- Working with third party test facilities



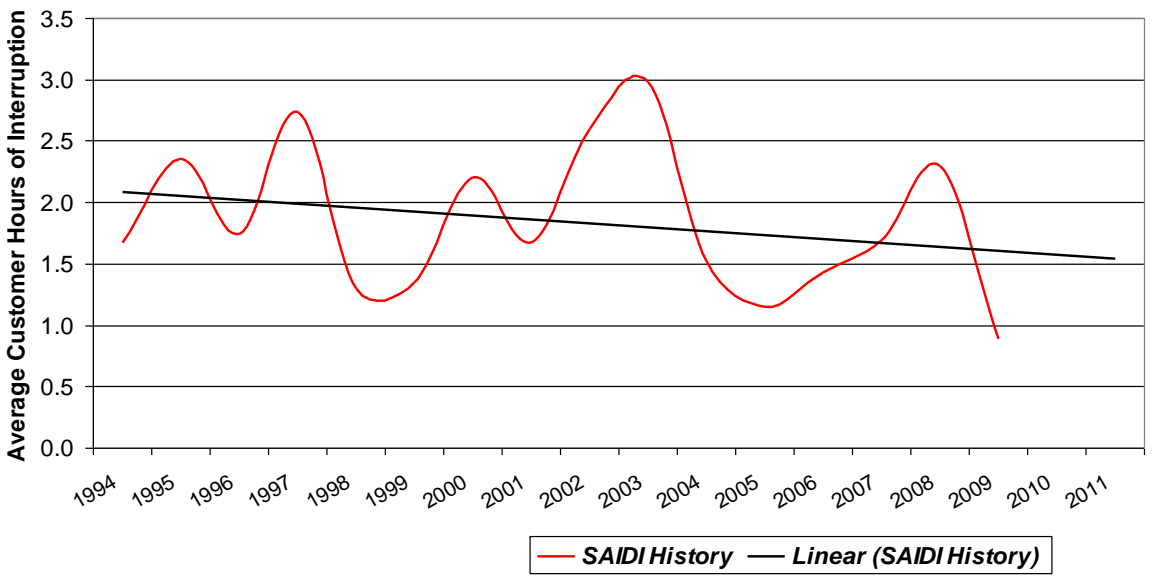
Reliability

**Outage Frequency Performance
SAIFI**



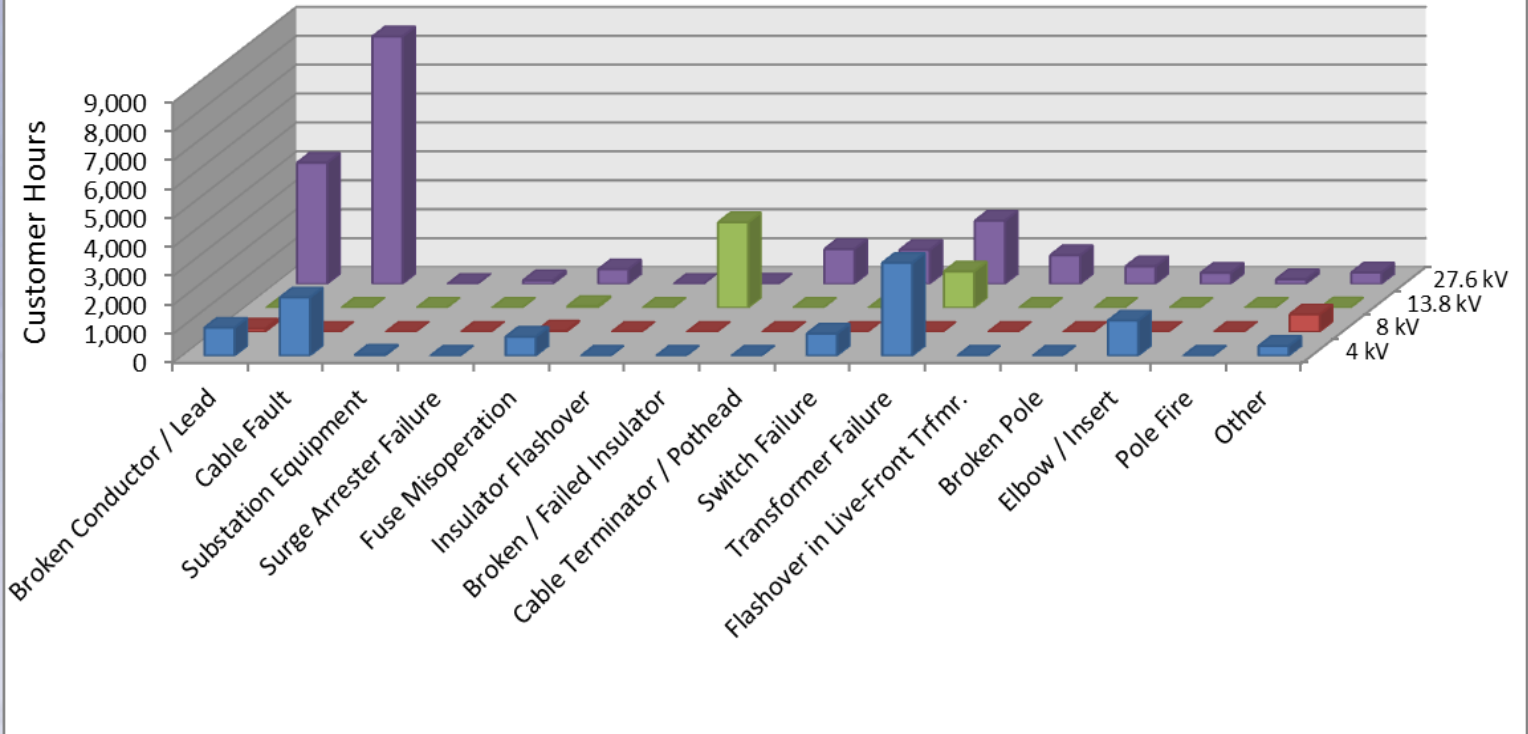
Reliability Performance Analysis

**Outage Duration Performance
SAIDI**



Reliability

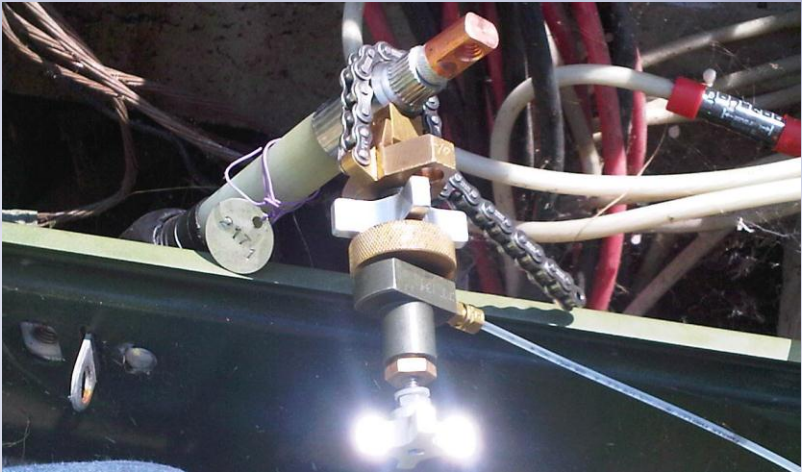
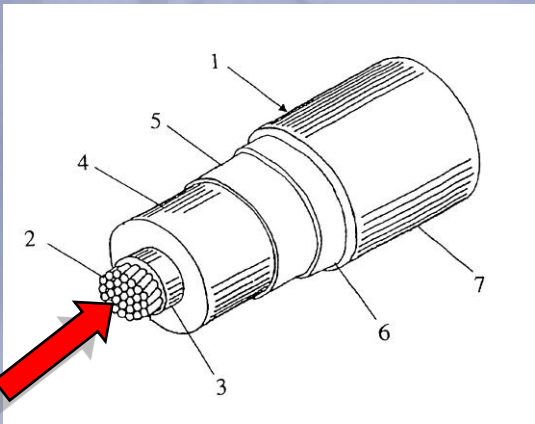
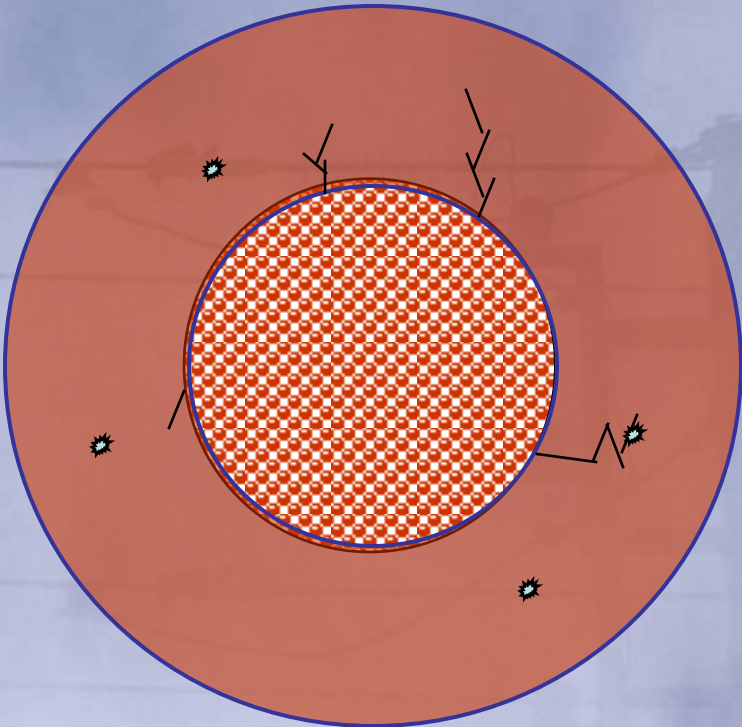
Equipment Related Outages - 2010



Defective
Equipment
Analysis

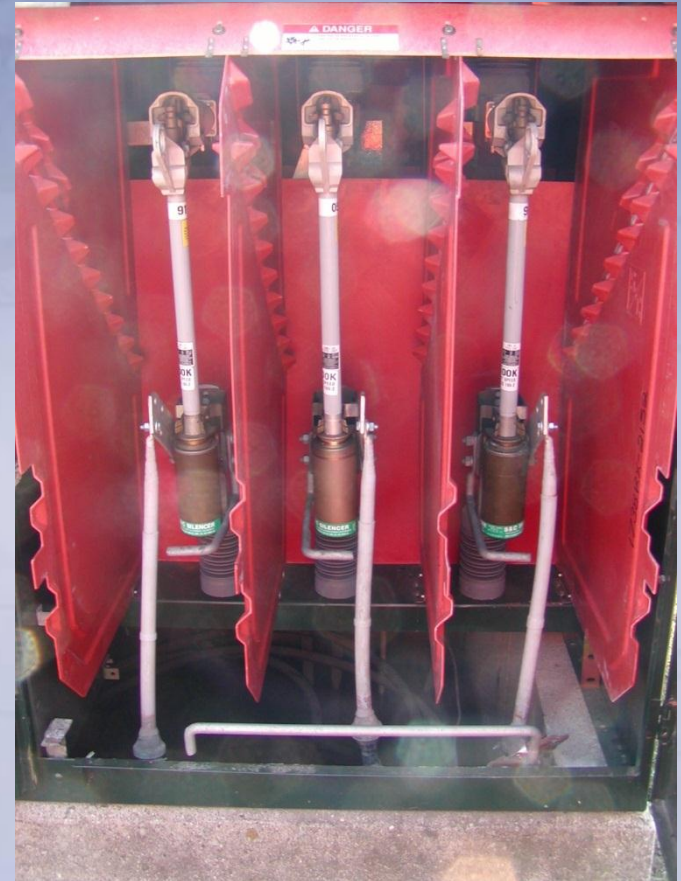
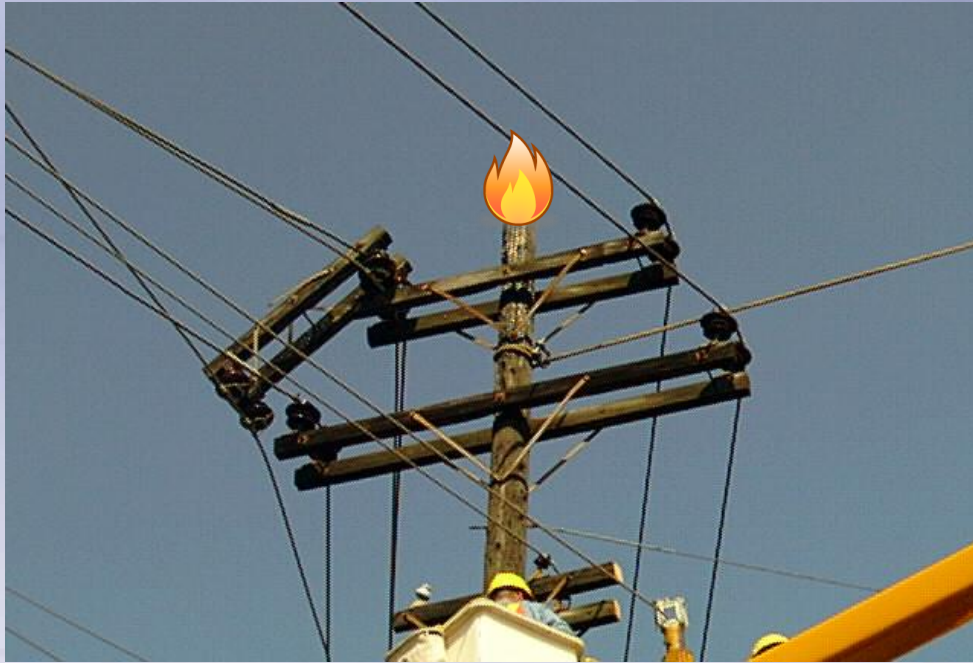


Silicone Injection of Cables



Reliability

Root Cause Analysis

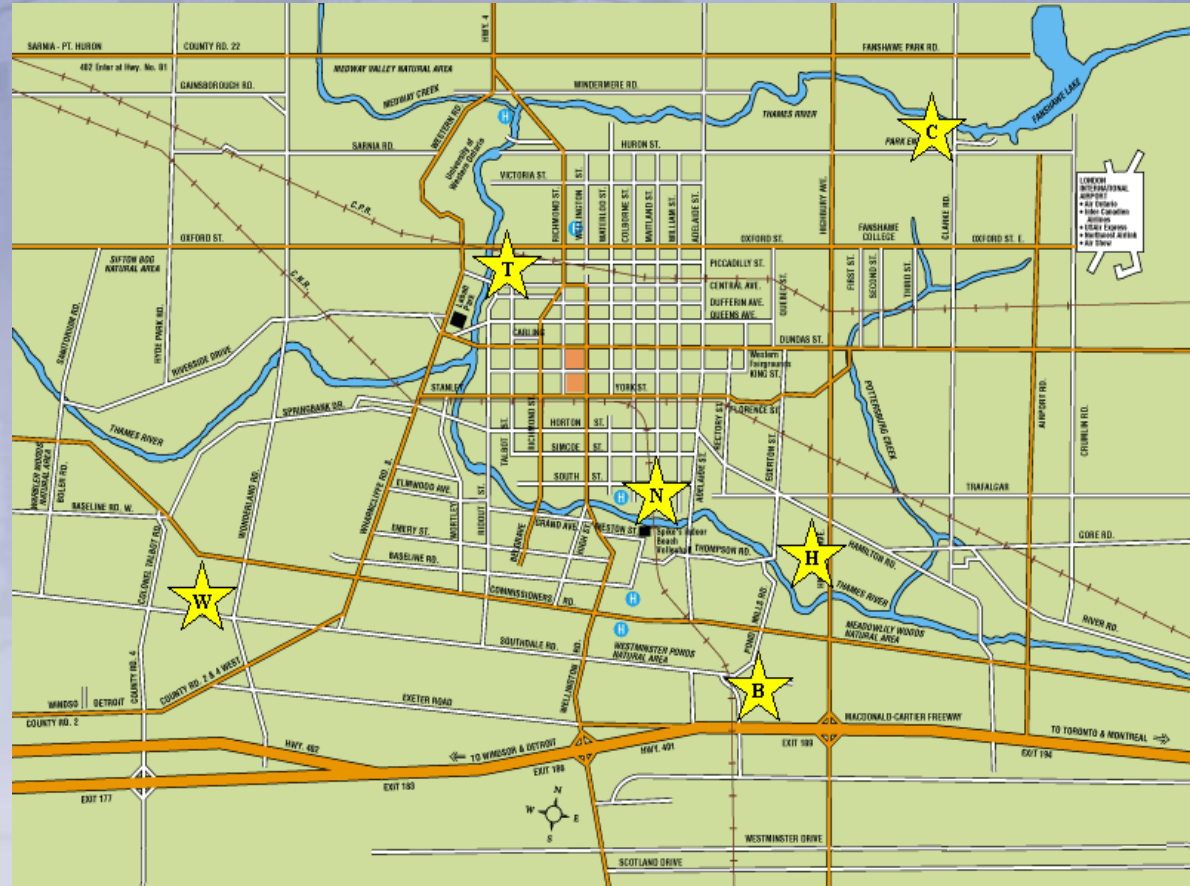


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System Planning

Hydro One Network Inc.
Transformer Stations:

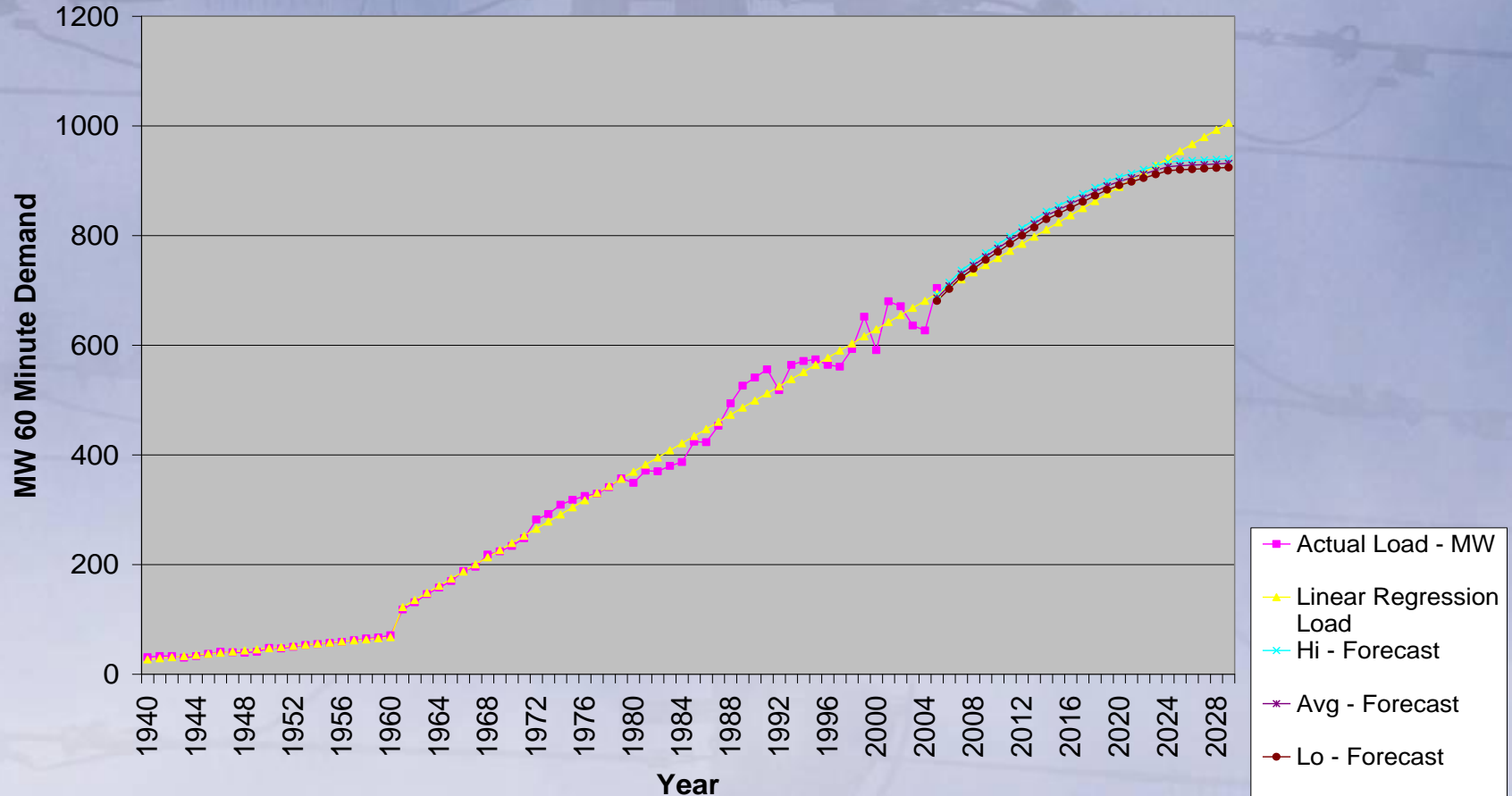
- Buchanan
- Clarke
- Highbury
- Nelson
- Talbot
- Wonderland



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System Planning

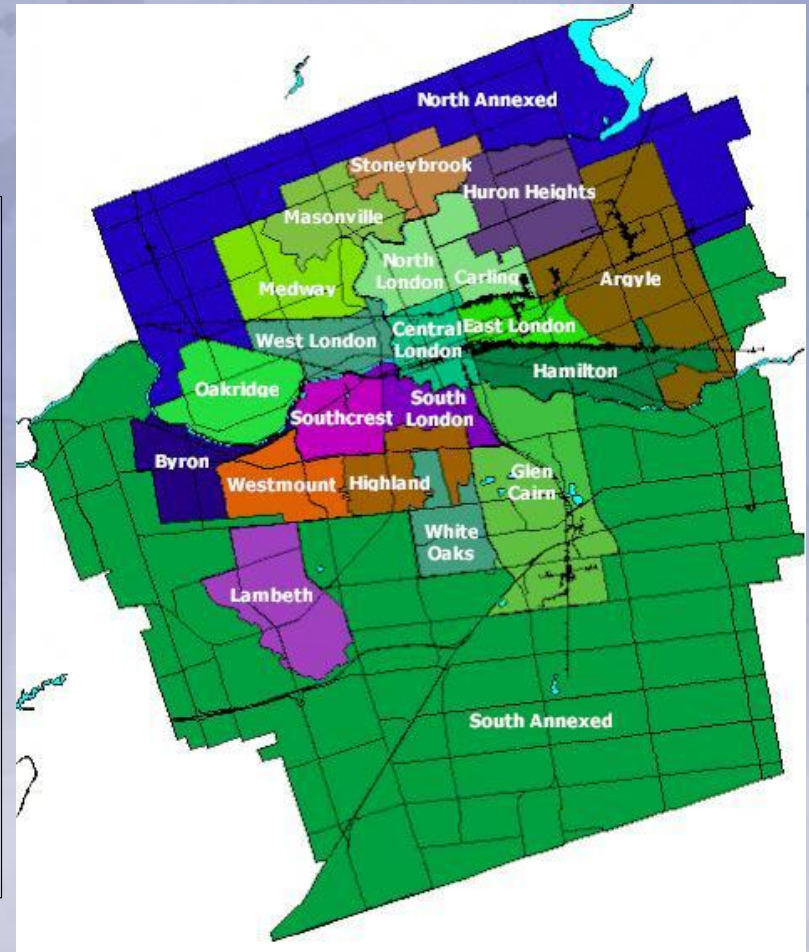
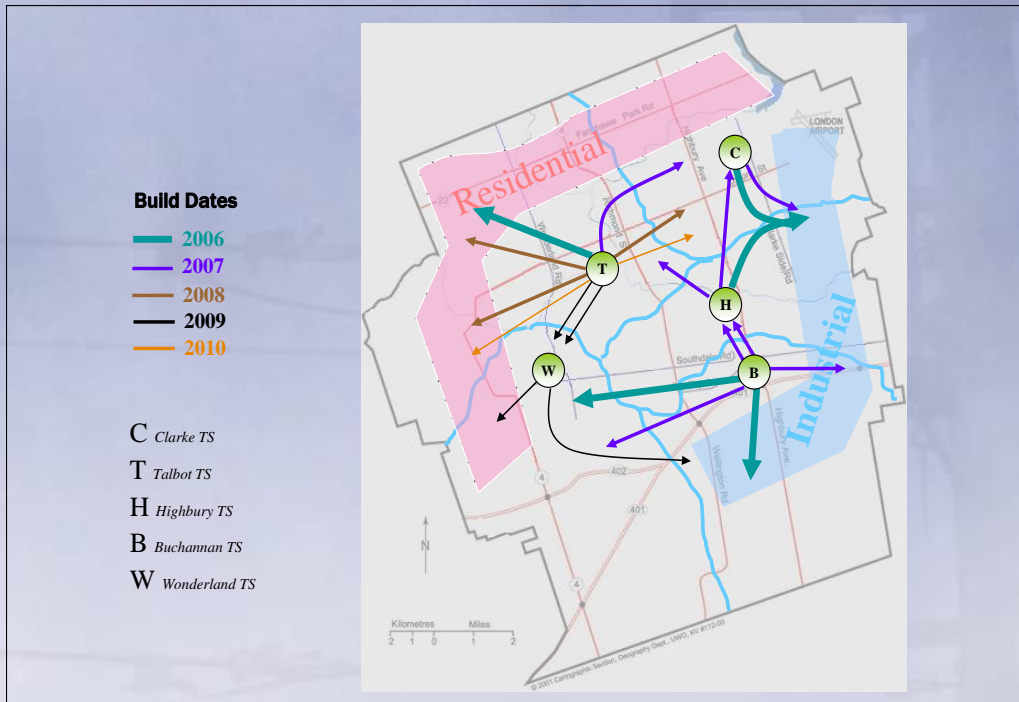
Long Term Projected Load Growth



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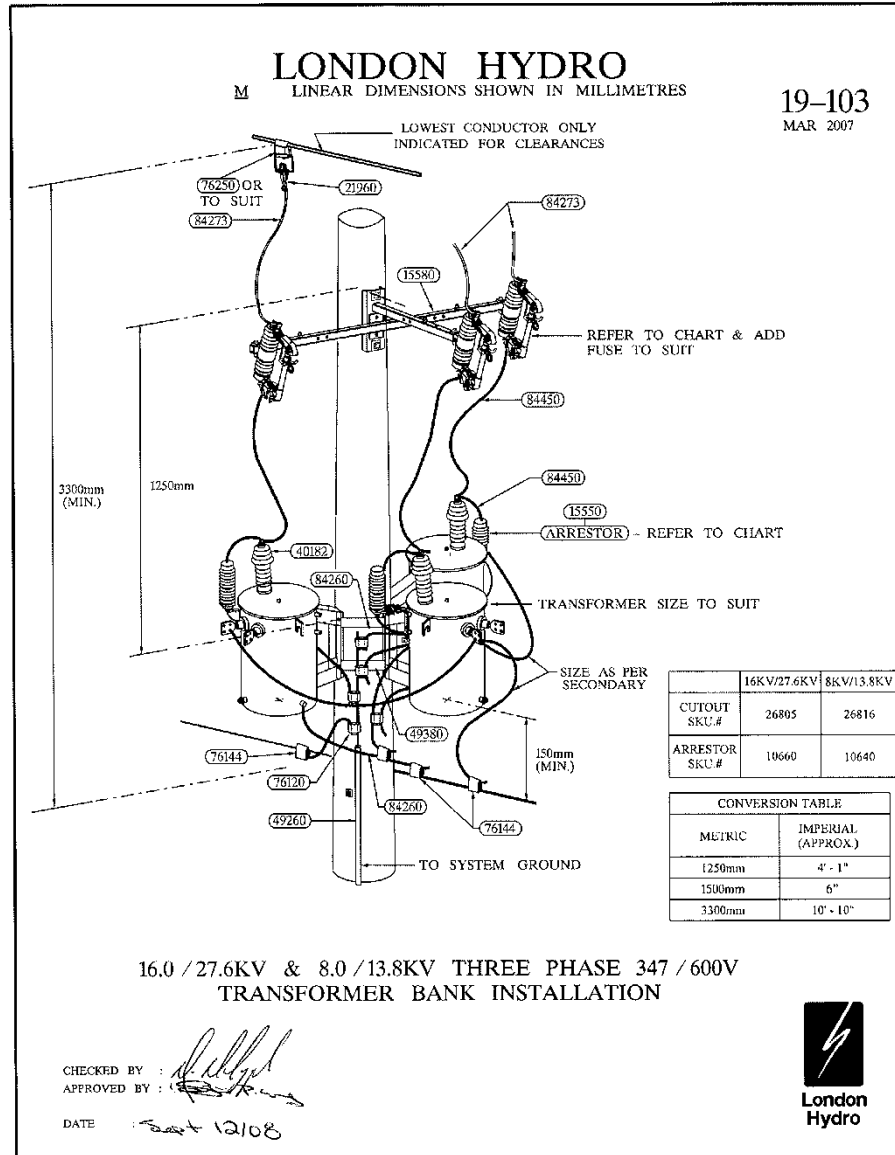
System Planning

Spatial Area Forecasts to determine areas requiring additional capacity



Engineering Design

Construction Standards



Engineering Design

Equipment Specifications

ABB INC. QUEBEC

008/008

08/04 '00 11:20

418 650 2021

765
LIGHTNING ARRESTER SUPPORT
50
H2 NEUTRAL SPADE TERMINAL
240
745
X3
X2
X1
LV SPADE TERMINALS
90
COVER CLAMP ASSEMBLY
LIFTING LUG

HV BUSHING WITH CONNECTOR SUITABLE FOR #8 SOLID TO #2/0 STR. AL. OR CU CABLE
50
PRESSURE RELIEF VALVE
NAMEPLATE STAMPING
TOP OF TANK
1'00
1.30
260
10.35
710
560
550
TAPS CHANGER
REMOVABLE TINNED CU. GROUND STRAPS
740
600
560 INS. DIA.
LOWER HANGER LUG
22 WIDE SLOTS
GROUND CONNECTOR SUITABLE FOR #8 SOLID TO #2/0 STR. AL. OR CU CABLE

POLEMOUNT TYPE ONAN 60Hz 65°C

1 PH.	50 kVA	SERIAL No	
IMPEDANCE AT 65°C	1.7 %	VOL. OF OIL	63 L
6IL	125 kV	TOTAL MASS	380 kg
H.V. 27600GRDY/16000 V X			V
L.V. 120/240 V		NON PCB	

11120044000

POSITIONS	TAPS CHANGER (TC)				
	1	2	3	4	5
	105 %	102.5 %	100 %	97.5 %	95 %

WARNING: OPERATE SWITCH ONLY WHEN TRANSFORMER IS DE-ENERGIZED

P.O. No. _____ DATE _____

SPEC.No. _____ MFR.REF.No. TA0050NNA1A012

ABB QUEBEC, CANADA R01

30
13
64 (2 HOLES #5)

HYDRO ELECTRIC COMMISSION
CITY OF LONDON

DATE April 12/00 APPROVED

P.O. NO. _____ AS SUBMITTED

FILE NO. E-00-011 AS MARKED

Henry Shiel

01	000406	NAMEPLATE WAS 1115204044	A.T.	<i>A.T.</i>
no. date	REVISIONS	DESCRIPTION	BY	APPR

ABB INC. QUEBEC, QC.
TITLE: TRANSFORMER OUTLINE AND NAMEPLATE DRAWING

DRAWN: A.T. DATE: 2000/03/22
ELEC.APP. L.C. DATE: 2000/03/22
MEC.APP. A.T. DATE: 2000/03/22

SCALE: 1-15

No: TA0050NNA1A-012

NOTE:

- ALL STENCILLING IS AS PER "CEA DTWG-01" EXCEPT THE FOLLOWING: THE DISTANCE BETWEEN KVA, HV AND LV (147 ONLY) IS 1.5mm FOR TANK HEIGHT OF 685mm OR LESS.

L'INFORMATION CONTENUE DANS LA PRESENTE EST LA PROPRIETE DE ABB INC. ET REVELER UN CARACTERE CONFIDENTIEL. AUCUNE PARTIE DE CE DROIT NE PEUT ETRE REPRODUITE NI UTILISEE SANS LA PERMISSION FORMELLE DE LA SOCIETE. LES CONTREVENANTS SERONT POURSUIVIS. THE INFORMATION CONTAINED HEREON WHICH IS THE PROPERTY OF ABB INC. MUST BE MAINTAINED IN CONFIDENCE AND NO PORTION OF THE DRAWING MAY BE REPRODUCED OR USED, WITHOUT THE EXPRESS PERMISSION OF THE COMPANY. CONTRAVENTION WILL BE PROSECUTED.

Operation and Maintenance

- Physical Obstacles
- Subsurface unknowns



**London
Hydro**

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Operation and Maintenance

- Difficult locations



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Hydro**

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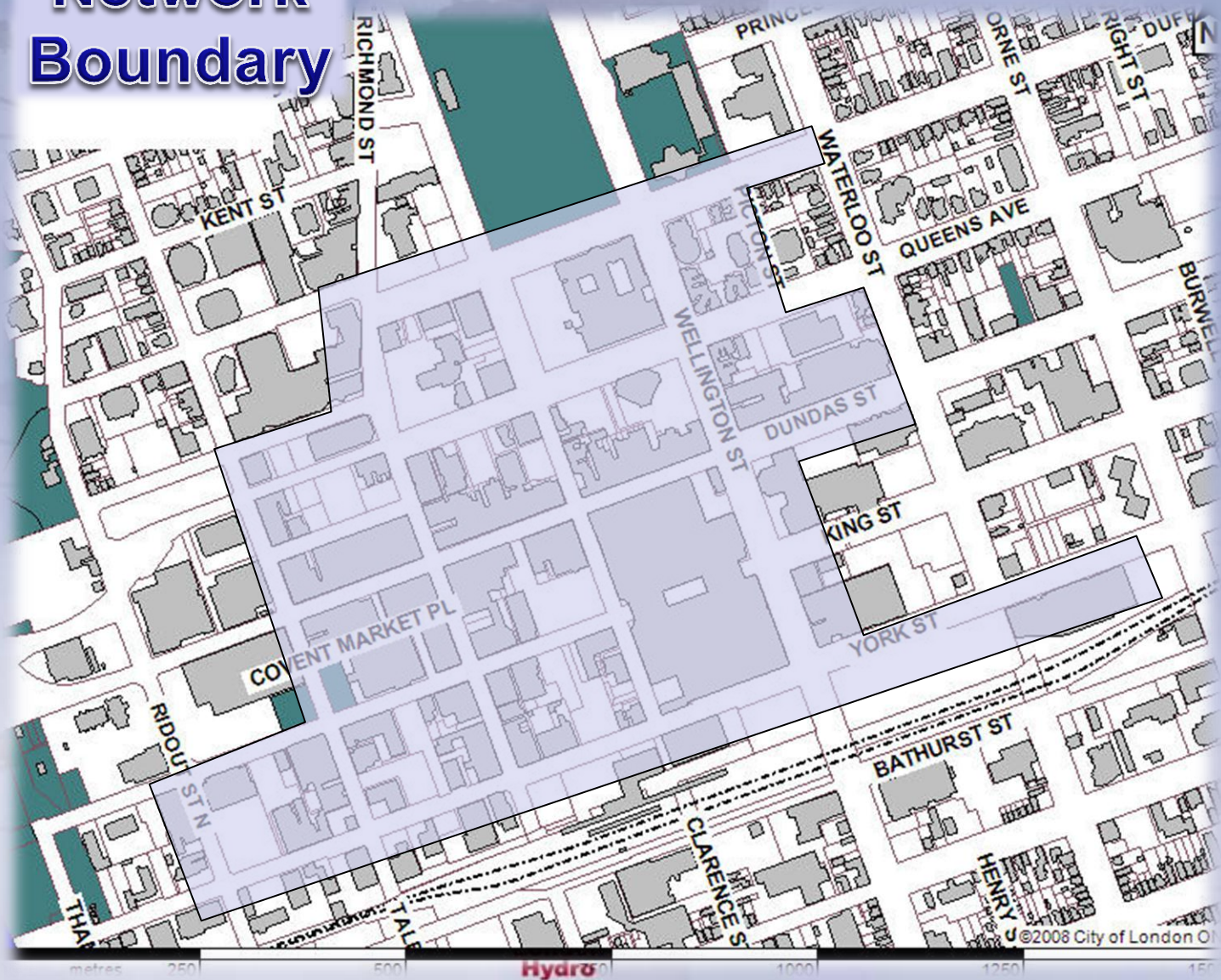
Project Scheduling

Engineering & Operations 2011 Gross Capital Budget

ID	Name	SEC	Notes	Start	Finish	CAP Budget	2011											
							Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov
0	2011 Engineering Projects Capital Schedule			Mon 1/3/11	Fri 12/30/11	\$19,991,000												
1	Infrastructure Projects			Mon 1/2/11	Fri 12/16/11	\$13,987,000												
2	Substation Rebuilds			Mon 2/7/11	Mon 11/7/11	\$935,000												
3	11A1 Downtown Network Supply Upgrade	110		Mon 2/7/11	Fri 6/24/11	\$85,000												
4	11A2 T1-L Switch Replacements	110		Mon 2/7/11	Tue 7/12/11	\$125,000												
5	11A3 Sub 92 Rebuild	110		Mon 2/7/11	Thu 10/13/11	\$650,000												
6	11A4 Sub 97 Conversion Phase 2	110		Mon 6/20/11	Fri 7/8/11	\$25,000												
7	11A5 Sub 49 Animal Contact Protection	110		Mon 2/7/11	Mon 3/14/11	\$15,000												
8	11A6 Substation Transformer Temperature Monitoring	110		Mon 9/20/11	Mon 11/7/11	\$10,000												
9	11A7 Sub 23 Reclosing Relay Replacement	110		Mon 10/10/11	Wed 10/12/11	\$25,000												
10	Subdivisions			Mon 1/24/11	Fri 12/9/11	\$4,245,000												
11	11B1 Silicone Injection of Underground Cable	145		Mon 1/24/11	Fri 12/9/11	\$2,670,000												
12	11B2 Hazelden Park Subdivision Rebuild	145	Replace aging infrastructure	Mon 5/2/11	Fri 7/22/11	\$330,000												
13	11B3 Replacement of Air Insulated Sectionalizing Enclosures	145		Mon 3/7/11	Tue 10/18/11	\$400,000												
14	11B4 Fully Depreciated and Leaking Transformer Replacement	145	Based on OEB Audits	Mon 1/24/11	Fri 10/28/11	\$450,000												
15	11B5 Residential Secondary Pedestal Replacements	145		Mon 3/28/11	Wed 5/11/11	\$25,000												
16	11B6 Vault Transformer Replacements	145		Mon 4/11/11	Mon 8/29/11	\$250,000												
17	11B7 Installation of Underground Backup Supply	145		Mon 4/4/11	Fri 5/27/11	\$110,000												
18	11B8 Installation of Fault Indication on Padmount Transformers	145		Mon 2/7/11	Fri 2/18/11	\$10,000												
19	Main Feeders			Mon 3/28/11	Fri 11/18/11	\$2,190,000												
20	11C1 Ridout St 13.8kV Voltage Conversion	131		Mon 4/4/11	Fri 6/24/11	\$350,000												
21	11C2 26M43 Feeder Construction Phase 1	131		Mon 9/26/11	Fri 11/18/11	\$300,000												
22	11C3 4M15 Feeder Extension	131		Mon 8/8/11	Fri 10/28/11	\$440,000												
23	11C4 Crumlin Rd Feeder Upgrade and 8.32kV Voltage Conversion	131		Mon 3/28/11	Fri 8/12/11	\$860,000												
24	11C5 Sub 26 and 46, 13.8kV Voltage Conversion	131		Mon 5/30/11	Fri 6/5/11	\$240,000												
25	Network			Mon 1/3/11	Fri 12/16/11	\$2,555,000												
26	11F1 Replacement of Network Vaults/Manholes/Transformers	141	Depreciated Plant & Equipment	Mon 3/7/11	Fri 11/11/11	\$1,320,000												
27	11F2 Replacement of Primary and Secondary Cables	150	Emergency & Planned	Mon 1/3/11	Fri 12/16/11	\$350,000												
28	11F3 Eliminate East End Network-Adelaide St. Area	150		Mon 2/21/11	Tue 7/19/11	\$465,000												
29	11F4 Network PILC Replacement	150		Mon 5/30/11	Fri 11/25/11	\$200,000												
30	11F5 Network 208 Voltage Risers	150		Mon 9/5/11	Fri 10/28/11	\$70,000												
31	11F6 Manhole Cable Rebuilds	150		Mon 4/4/11	Mon 10/17/11	\$150,000												
32	Overhead Lines			Mon 1/10/11	Fri 12/9/11	\$3,597,000												
33	11G1 Replacement of Fully Depreciated Poles	132	Poles	Mon 3/28/11	Fri 8/12/11	\$300,000												
34	11G2 Replacement of Poles Susceptible to Pole Fires	132	Poles	Thu 3/3/11	Fri 10/14/11	\$500,000												
35	11G3 Rebuild of Fully Depreciated Overhead Areas	132	Various locations	Mon 1/17/11	Fri 12/9/11	\$2,497,000												
36	11G4 13M15 Overhead Reliability Enhancements	132		Fri 7/1/11	Thu 8/18/11	\$160,000												
37	11G5 26M53 Overhead Reliability Enhancements	132		Mon 1/10/11	Fri 2/18/11	\$110,000												
38	11G6 Removal and Restoration of Overhead Plant	132	External Party Related	Fri 6/10/11	Thu 11/17/11	\$30,000												
39	System Automation			Fri 4/1/11	Fri 12/9/11	\$465,000												
40	11H1 Recloser Installations	250	Various Locations	Thu 9/1/11	Wed 12/7/11	\$320,000												
41	11H2 Network Temperature Monitoring Devices	250		Tue 11/1/11	Mon 11/28/11	\$10,000												
42	11H3 RTU Replacement Program	250		Mon 9/5/11	Fri 10/28/11	\$50,000												
43	11H4 SCADA Communications Enhancement	250		Mon 10/17/11	Fri 12/9/11	\$20,000												
44	11H5 Migration to Digital Radios	250		Fri 4/1/11	Thu 10/13/11	\$65,000												
45	City & Developer Works			Mon 1/10/11	Fri 12/30/11	\$6,004,000												
46	City Works Projects			Mon 1/10/11	Fri 12/16/11	\$500,000												
47	11D1 City of London (Road authority) Relocations	133	Projects City Driven	Mon 1/10/11	Fri 12/16/11	\$500,000												
48	Developer Works Projects			Mon 1/10/11	Fri 12/30/11	\$5,504,000												
49	11E1 Developer Driven Distribution Circuits Expansions and Relocations	131		Mon 1/10/11	Fri 12/30/11	\$830,000												
50	11E2 Residential Secondary Service Upgrades	131	Customer Driven	Mon 1/10/11	Fri 12/30/11	\$324,000												
51	11E3 New Single Family Residential Underground Distribution	142	Developer Driven	Mon 1/10/11	Fri 12/30/11	\$1,600,000												
52	11E4 New Multi-Housing Underground Distribution	143	Developer Driven	Mon 1/10/11	Fri 12/30/11	\$650,000												
53	11E5 New Commercial Distribution Services	144	Developer Driven	Mon 1/10/11	Fri 12/30/11	\$2,100,000												

Downtown Network

Network
Boundary



Downtown Network



Network Customers



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Downtown Network

Network System Facts

20 MW *the peak load*

1100 *the number of customers served*

35,000 + *the number of people whose jobs depend on the network being up and running*



Operational Emergencies

At approximately 3:00 a.m. October 31, 2007 a twelve inch water main broke at the intersection of Dundas and Wellington

6:10 a.m. Sinkhole emerges



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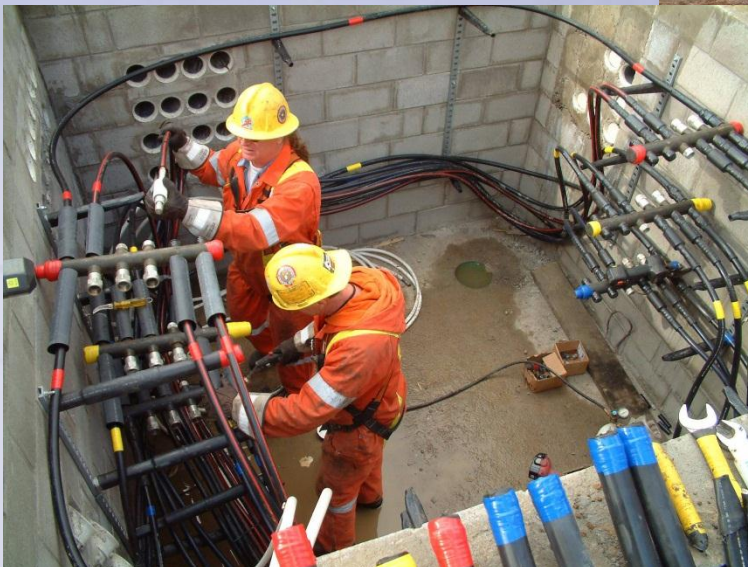
Operational Emergencies

- All 5 Feeders Supplying Downtown affected
- 225 tons of sand, asphalt & debris removed from site



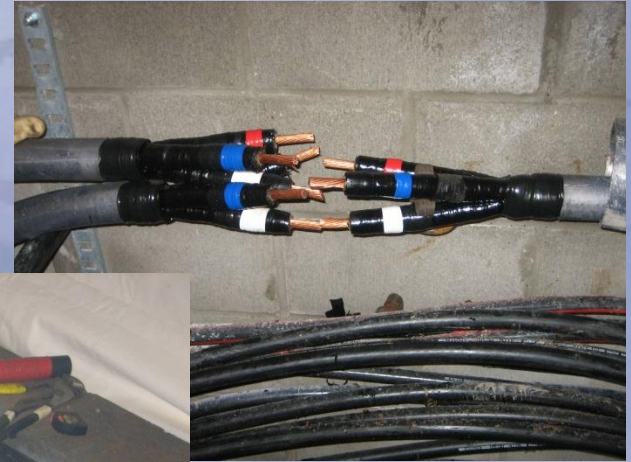
Operational Emergencies

- 1 km of rebar
- 40 Cubic Meters of Concrete
- 2 km of duct
- 200 m of Duct Bank
- 2.7 km of Secondary cables, 250 Connections



Operational Emergencies

- 0.5 km of Primary Cable
- 20 Primary Lead Splices
- 8 hours per splice
- 4 completed in 1 day
- 250 switching operations
- 21 continuous days of work



Broken Pole – Wires Intact



**Pole hit by
Drunk
Driver**

Broken Pole/Wires Down



**Wind
Damage**

**Electrical
And
Physical
Hazard**

Operational Emergencies

Damage on St. James St., London – 1976

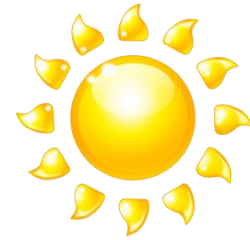


Renewable Generation in London

- Under Net Metering:
 - 5 customers generating up to 20 kW solar power
- Under microFIT:
 - Approx. 125 customers (residential and commercial) up to 1,000 kW
 - Over 70 applications approved for approx. 600 kW more solar power
 - Over 800 applications submitted to OPA in London in total



**ALL MICRO-GENERATION
PROJECTS ARE
SOLAR PV**



Renewable Generation in London

Bio-Gas

Storm Fisher Bio-Gas plant 2.8 MW (SOP-FIT)

- Commercial Operation Day in Sept. 2010

Solar PV

11 FIT solar generators connected for a total of 1.6 MW

- 16 additional connections pending capacity allocation

Water

Fanshawe Dam generating up to 610 kW

- retail embedded generator (*“grandfathered”*)



Renewable generation in Ontario

IESO tracks the renewable generation projects connected to transmission systems (>50 kV):

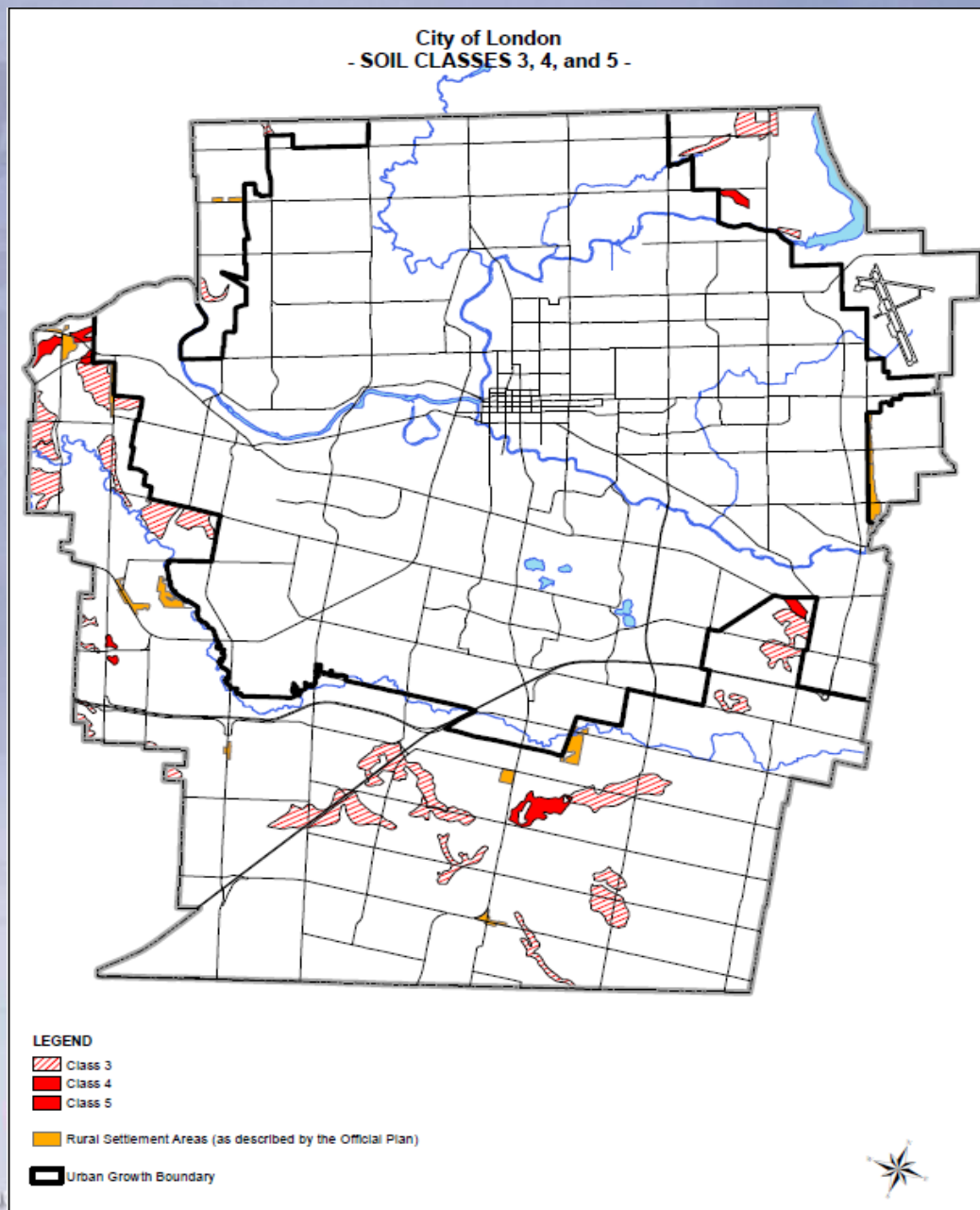
- 1,100 MW wind power connected
- 6,700 MW hydro power connected
- No solar power connected



Solar related opportunities

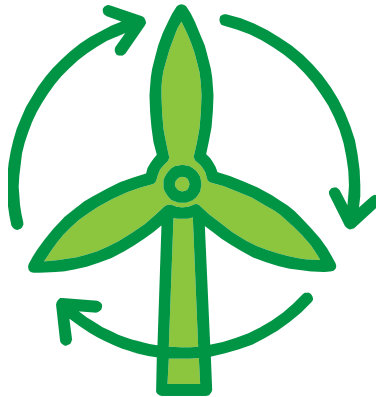
- Non-rooftop > 100 kW only on Class 3 Lands or higher, according to the Ministry of Agriculture
- Scarce areas within C of L where such projects could develop
- Agricultural land in Ontario to be used solely for its purpose
- Real estate availability for ground-mounted solar panels

10 acres → 1 MW



Wind related opportunities

- No wind power generation applicants in London
- OPA encourages wind power generation
- Not reliable for peak shaving
- Great for added renewable energy in Ontario



Questions?



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