GREATER LONDON SUB-REGION INTEGRATED REGIONAL RESOURCE PLAN - APPENDICES

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Greater London Sub-region IRRP

Appendix A: Demand Forecast

A.1 Gross Demand Forecast

Table A-1 and A-2 shows the gross demand forecast provide by LDCs. The gross demand forecast reflects existing customer connection requests as well as load projections based on municipal and regional plans for the area.

London Hydro developed gross demand forecast considering macro-economic conditions and growth projections provided by the City of London for population growth and residential, commercial, institutional and industrial development.

All gross forecasts provided by the LDCs assumed median weather conditions and a power factor of 0.9.[1]

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[1] The assumed power factor is a conservative assumption used for forecasting and need identification purposes.

Table A-1: LDC Gross Station Forecasts – London Hydro

Station/DESN	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034
Buchanan TS	127	144	146	145	147	148	150	151	153	154	155	156	158	164	166	168	169	171	172
Clarke TS	95	96	97	98	99	93	94	95	96	97	92	93	94	95	96	97	98	99	100
Highbury TS	88	88	89	83	84	91	92	93	93	94	100	100	101	101	102	103	104	105	105
Nelson TS	16	17	15	52	58	59	60	61	62	63	64	65	66	67	68	69	75	77	78
Talbot TS	273	277	282	258	254	256	263	265	267	269	278	280	283	285	288	296	298	301	304
Wonderland TS	104	90	92	90	92	94	90	92	94	96	90	92	94	91	93	95	92	94	96

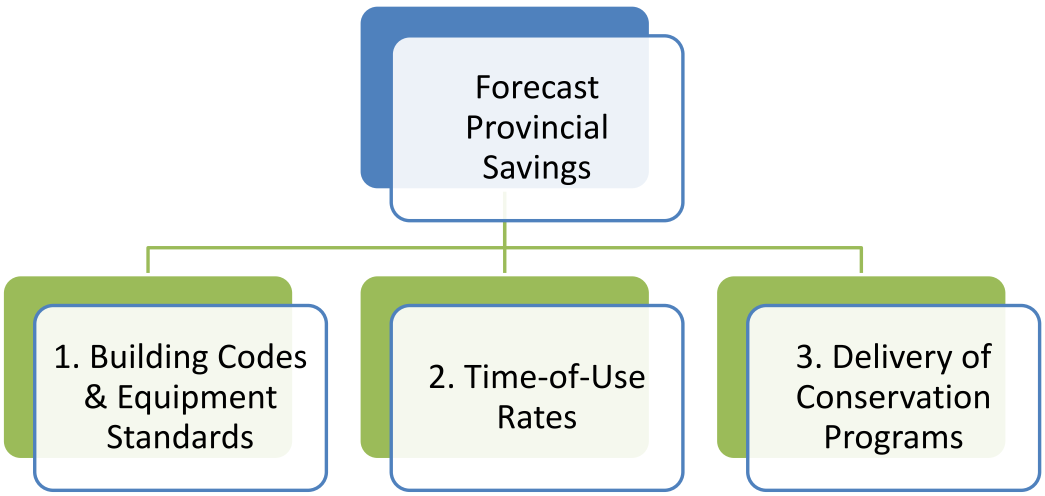
Table A-2: LDC Gross Station Forecasts –Hydro One Distribution

Station/DESN	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034
Buchanan TS	15	15	15	16	16	16	16	16	16	16	17	17	17	17	17	17	17	18	18
Clarke TS	14	14	14	14	14	14	15	15	15	15	15	15	15	16	16	16	16	16	16
Highbury TS	8	8	8	8	8	8	8	9	9	9	9	9	9	9	9	9	9	9	9
Wonderland TS	9	9	9	9	9	9	9	9	9	9	10	10	10	10	10	10	10	10	10

A.2 Conservation Forecast

Conservation savings were separated into the three main categories shown in Figure 1 below. The impacts of the savings for each category were allocated according to the forecast residential, commercial, and industrial gross demand. This appendix provides additional breakdowns of the conservation savings estimates for the Greater London Sub-region.

Figure 1: Conservation Savings Categories



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

The forecast peak demand savings from CDM programs is shown in Table A-3 below.

Table A-3: Peak Demand (MW) Savings by TS from 2013 LTEP Conservation Targets

Station/DESN	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034
Buchanan TS	2.5	3.6	5.1	6.4	8.1	8.7	9.6	10.2	10.8	11.4	12.1	13.9	14.6	15.7	17.3	18.6	18.7	18.7	18.5
Clarke TS	2	2	3	4	5	6	7	7	7	8	8	8	8	10	10	11	11	11	11
Highbury TS	2	2	3	4	4	5	5	6	7	7	8	8	9	9	10	11	11	11	11
Nelson TS	0.5	0.7	1.1	1.6	1.6	1.9	2.2	2.4	2.8	3.1	3.7	4.5	5.2	5.9	6.9	7.8	8.4	8.6	8.6
Talbot TS	5	7	10	13	14	15	17	18	19	21	23	25	27	29	32	35	35	35	35
Wonderland TS	2	2	3	4	5	5	6	7	8	9	9	9	10	10	11	12	12	12	12

A.3 Expected Peak Demand Contribution of Contracted Distributed Generation

The installed capacity of contracted DG is adjusted to reflect the expected power output at the time of local area peak, based on resource-specific peak capacity contribution values. The expected peak demand contribution of contracted DG in the Greater London Sub-region is show in Table A-4.

TableA-4: Peak Demand: Expected Peak Demand Contribution from Contracted Distributed Generation (MW)

Station/DESN	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034
Buchanan TS	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8
Clarke TS	2.3	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
Highbury TS	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
Nelson TS	0	0	0	0	14.9	14.9	14.9	14.9	14.9	14.9	14.9	14.9	14.9	14.9	14.9	14.9	14.9	14.9	14.9
Talbot TS	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
Wonderland TS	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6

A.4 Planning Forecast Scenarios

The planning forecast takes the gross forecast data provided by the LDCs, accounts for the demand impacts of conservation and DG, outlined in Section 5.4 Conservation Assumed in the Forecast, and Section 5.5 Distributed Generation Assumed in the Forecast, respectively, and adjusts for the impact of extreme weather conditions. Extreme weather correction is done using Hydro One's correction factor of 6% between median and extreme weather conditions. Table A-5 shows the Planning Demand Forecasts for individual Transformer Stations.

Table A-5: Peak Demand Planning Forecast for the Greater London Sub-region (MW)

Station/DESN	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034
Buchanan TS	147	165	164	163	164	165	166	167	167	168	169	169	170	176	176	177	178	180	182
Clarke TS	111	111	112	112	112	106	106	107	107	108	104	104	105	106	106	107	108	109	110
Highbury TS	96	96	96	89	89	97	97	97	98	98	103	103	104	104	104	104	105	106	107
Nelson TS	17	17	15	53	45	45	46	47	48	48	49	49	50	50	50	51	57	58	59
Talbot TS	284	287	288	260	256	256	261	262	263	264	272	272	273	273	273	278	281	284	287
Wonderland TS	118	102	102	100	102	103	99	100	101	103	97	98	99	96	97	98	95	97	99

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Appendix B: Needs Assessment

Appendix B provides background information, the methodology and data used to assess need and options in the Greater London Sub-region IRRP.

A.5 Background Information about Nelson TS reconfiguration

The first stage in the regional planning process, the Needs Assessment report, was issued on April 3, 2015. A number of needs were identified for the Greater London Sub-region that required further review as part of the scoping process. Additionally, Nelson TS in this sub-region was also identified to be at end-of-life and discussions were underway between Hydro One and London Hydro on the reconfiguration details for the station. Nelson TS is one of the main stations in downtown London that receives supply from the transmission system at 115 kV and is currently connected to the local distribution system at 13.8 kV. The remaining stations providing supply to this sub-region are at a voltage of 27.6 kV on the distribution side. A different voltage level made the load transfers to and from Nelson TS difficult for load balancing or during emergency conditions.

However, by the time the Scoping Assessment was issued, London Hydro and Hydro One had come to a commercial agreement for the rebuild of Nelson TS to 27.6 kV instead of the end-of-life 13.8 kV for the low voltage supply. With this reconfiguration, the entire London area distribution voltage will be at one level introducing a higher level of flexibility to the local distribution system for various scenarios. London Hydro is now able to balance load across all their stations, potentially deferring the need for new capacity. Additionally, in the event of loss of transmission supply to one part of the distribution system, the entire distribution system in the city can be leveraged to help restore supply to customers.

A.6 Relevant Excerpts from the Ontario Resource and Transmission Assessment Criteria (ORTAC)

Section 7.2 in ORTAC is quoted below for reference:

7.2 Load Restoration Criteria

The IESO has established load restoration criteria for high voltage supply to a transmission customer. The load restoration criteria below are established so that satisfying the restoration times below will lead to an acceptable set of facilities consistent with the amount of load affected.

The transmission system must be planned such that, following design criteria contingencies on the transmission system, affected loads can be restored within the restoration times listed below:

a. All load must be restored within approximately 8 hours.

b. When the amount of load interrupted is greater than 150 MW, the amount of load in excess of 150 MW must be restored within approximately 4 hours.

c. When the amount of load interrupted is greater than 250 MW, the amount of load in excess of 250 MW must be restored within 30 minutes.

These approximate restoration times are intended for locations that are near staffed centres. In more remote locations, restoration times should be commensurate with travel times and accessibility.

A.7 Load Restoration for Clarke/Talbot Sub-system

The Clarke/Talbot pockets in North London are supplied by the 230 kV circuits W36/37 that emanate from Buchanan TS. The supply to Talbot TS is provided by two underground cables tapped off from the main overhead W36/37 circuits that run to Clarke TS. These two stations combined supply almost 50% of the London Hydro demand. The 20-year forecast projects the population in the service territories of Clarke TS and Talbot TS to grow by 55,500 to 256,300 and the adjusted peak demand to grow by 35 MW from 379 MW to 404 MW total peak demand.

Both Clarke TS and Talbot TS supply a mix of customer types, residential, institutional, commercial, and industrial with estimates of customer type broken down in the table below:

Station	Commercial	Industrial	Residential	Unallocated[2]
Clarke TS	18%	28%	27%	27%
Talbot TS	30%	1%	46%	23%
Total	24%	14.5%	36.5%	25%

Both stations supply critical customers such as hospitals, waste treatment facilities, water pumping facilities, nursing homes, and the Sun Canadian Pipeline (a provincially mandated high priority facility). Although most hospitals have some generating capability, it is limited to essential services.

The two loss of supply scenarios that have the most impact to the W36/37 load pocket are loss of the overhead supply from Buchanan TS, and loss of the cabled section of W36/37. Under the loss of overhead supply from Buchanan TS, supply to both Clarke TS and Talbot TS would be lost. While in the event of double cable outage, supply to Talbot TS would be lost.

An outage of the W36 and W37 overhead transmission lines could cause significant outages. It is expected that most of the critical customers supplied by Clarke and Talbot TS could be restored in the event of a major W36/W37 outage through feeder level load transfers to adjacent

[2] Unallocated load represents MPAC data that could not be matched to London Hydro's customer database, and hence, may be either industrial or commercial load.

stations. It is important to note that the feeder capacity margins are not static and will reduce as the 20-year projected load growth at the transformer stations materializes. Hence, the amount of load that can be restored using the distribution system in the event of a double element loss of supply to Clarke TS and Talbot TS will reduce over time. Nevertheless, it is important to not lose sight of the fact that these analyses are based on peak load conditions which typically last 2-3 hours in a day for a couple of days in the year. This means that in reality, more capacity can be to be available on feeders after the system rides through the peak day events, hence, more services could potentially be restored.

The overall performance of the W36/W37 is fairly good. Based on Hydro One's information, the circuits perform at or better than the performance of HONI's average 230 kV circuit performance. With regards to the cable portions in particular, Hydro One indicated that only one instance of cable problem was observed over the past 25 years. That was a cable leak which was repaired in under 100 minutes.

The restoration ability in this sub-region will be boosted by the addition of the new Nelson TS in 2019 as well as distribution solutions recommended in this IRRP.