APPENDIX 1-A

POPULATION PROJECTIONS AND DEVELOPMENT OF UNIT RATES TECHNICAL MEMORANDUM

CITY OF GREATER SUDBURY WATER AND WASTEWATER MASTER PLAN

TECHNICAL MEMORANDUM POPULATION PROJECTIONS AND DEVELOPMENT OF UNIT RATES

CITY OF GREATER SUDBURY

DRAFT

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1 INTRODUCTION

The City of Greater Sudbury (CGS) retained WSP to undertake a Water and Wastewater Master Plan. The purpose of the Master Plan project is to establish servicing strategies for water and wastewater infrastructure for the core urban areas and surrounding communities in the City for the next 20 years, as part of the five-year review of the City's Official Plan. The Master Plan will identify potential projects to address the servicing needs for planned growth within the City. It is being conducted in accordance with the requirements set out in the Municipal Class Environmental Assessment (Class EA) document (June 2000 as amended in 2007, 2011, and 2015).

This Technical Memorandum documents the population projections and the water and wastewater unit rates and design criteria that will be used to assess the existing systems and the planning of the future system requirements.

2 POPULATION PROJECTIONS

Population forecasts were developed for growth to 2041 and to Ultimate Buildout utilizing the City's current land use designations, vacant land inventory, planning data to 2041 and Ultimate Buildout, and data from the Draft Growth Outlook to 2036 (Hemson Consulting Ltd., 2013), as well as supplementary household creation projection sheets from Hemson (2014).

The population projections corresponding to the various communities in the City are summarized below. Populations to 2041 were obtained from Hemson's supplementary household creation projections. Populations to Ultimate Buildout were estimated using the City's vacant land inventory and application of a residential density of 2.18 people per unit. Populations for the Lively and Walden Wastewater Systems were determined through discussion with City staff and Hemson.

To facilitate infrastructure capital investment planning, projections were broken down into five-year intervals.

The population projection for Valley East to Ultimate Buildout includes growth associated with the Valley East Urban Expansion Reserve.

To facilitate the analysis, the population data for each community was grouped to correspond to the existing water and wastewater systems. As noted in both the Water and Wastewater Baseline Review Reports (WSP, 2015 and 2014 respectively), there are six distinct water systems, while there are 13 distinct wastewater systems. The population data provided in Hemson's supplementary sheets was analyzed to determine the existing and forecasted service populations for each water system and for each wastewater system. The existing and forecasted population for each water system is included in Table 2-1. The population data for each existing wastewater system is included in Table 2-2. It should be noted that the total population for the water systems might be different than the total population for wastewater system in each growth scenario. This variation can be attributed to the fact that not all households being serviced by municipal water are being serviced by municipal wastewater, and vice versa.

Table 2-1 Population Projections by Water System

WATER SYSTEM	2011	2016	2021	2026	2031	2036	2041	ULTIMATE
Dowling	1,773	1,837	1,903	1,965	1,997	2,017	2,016	3,721
Falconbridge	707	724	743	759	769	775	776	855
Onaping-Levack	2,112	2,123	2,135	2,146	2,154	2,159	2,159	2,477
Sudbury (incl. Garson)	94,868	95,826	97,059	98,330	99,056	99,506	99,450	126,663
Valley (incl. Capreol)	36,382	37,235	38,142	38,965	39,451	39,737	39,764	57,641
Vermilion	10,359	10,845	11,303	11,686	11,912	12,050	12,085	19,400

Table 2-2 Population Projections by Wastewater System

WASTEWATER SYSTEM	2011	2016	2021	2026	2031	2036	2041	ULTIMATE
Sudbury (incl. Garson)	91,243	92,182	93,391	94,640	95,352	95,795	95,739	121,886
Copper Cliff	2,696	2,703	2,713	2,724	2,729	2,737	2,736	2,772

WASTEWATER SYSTEM	2011	2016	2021	2026	2031	2036	2041	ULTIMATE
Onaping-Levack	2,112	2,123	2,135	2,146	2,154	2,159	2,159	2,477
Dowling	1,773	1,837	1,903	1,965	1,997	2,017	2,016	3,721
Lively	2,197	2,348	2,491	2,607	2,676	2,716	2,728	5,154
Walden	5,178	5,501	5,804	6,059	6,209	6,299	6,324	11,177
Azilda	4,449	4,624	4,807	4,959	5,050	5,099	5,103	8,361
Chelmsford	7,400	7,517	7,639	7,763	7,838	7,886	7,891	11,008
Coniston	2,225	2,242	2,260	2,277	2,287	2,293	2,294	3,298
Falconbridge	707	724	743	759	769	775	776	855
Wahnapitae	1,397	1,402	1,408	1,413	1,416	1,418	1,418	1,479
Capreol	3,392	3,396	3,412	3,435	3,447	3,456	3,450	4,716
Valley East	19,119	19,644	20,219	20,728	21,028	21,205	21,231	31,469

3 PHASING OF FUTURE GROWTH

The Official Plan (City of Greater Sudbury, 2006) identifies areas within the City designated for residential and Industrial, Commercial and Institutional (ICI) development. The City also provided GIS information identifying vacant lands within the settlement boundaries as Draft Approved Lots, Legal Lots of Record, or Designated Developable Lands.

The timing of the various developments was defined, in consultation with the City's Planning Department, based on population projections for individual development areas and the overall forecasted growth populations for the various communities for the period between 2016 and Ultimate Buildout. Data provided by the City was used to determine the number of projected residential dwelling units corresponding to the various development areas. The person-per-unit values suggested in Hemson's supplementary sheets were used to determine the population equivalents for each of the development areas.

The projected phasing of development areas in the City was determined using the following methodology:

- Lands that are subject of a draft plan of subdivision or condominium were assumed to develop first. Draft approved subdivisions were assigned a proportional share of the projected household growth based on the number of proposed units in the draft plan.
- Legal lots of record were assumed to be location of 20% of future household growth.
- Designated developable lands were assumed to account for 20% of the projected 20 year household growth. This was based on a 10 year average duration from draft approval to first issuance of building permits.

It should be noted that some communities have an oversupply of vacant land, while others are undersupplied. In cases where there is an oversupply of land, vacant lands that were near existing developed areas and existing services were assumed to develop first, in accordance with the Phasing Policies of the City's Official Plan.

The assumed phasing for each community is shown in the maps contained in **Exhibit 1**.

4 WATER SYSTEMS

As part of the scope of the Master Plan a review of the design criteria included in the City's Engineering Design Manual (City of Greater Sudbury, 2012) - henceforth referred to as the City's Engineering Design Manual - was conducted. The sections below present a comparison of the design criteria used by the City and those recommended by the Ministry of Environment and Climate Change (MOECC) guidelines (MOECC, 2008). Furthermore, the sections below present the results of an analysis of water demand data conducted to determine unit water demand criteria. Based on the results of the analysis and comparison with other municipalities, recommendations are provided on the design criteria used in the Master Plan.

4.1 HISTORICAL WATER CONSUMPTION ANALYSIS

Table 4-1 presents historical water production data for the period of 2009 to 2013 as provided by the City of Greater Sudbury. It should be noted that production data does not correspond exactly to consumption data (obtained from water meters), as it also includes unbilled and unaccounted for water. Unbilled water includes water that is used to prevent water connections (municipal side) from freezing, and is considered authorized. Unaccounted for water includes water that is lost through leakage in the distribution system or through losses due to malfunctioning meters.

For each community, the residential and Industrial, Commercial, and Institutional (ICI) water consumption was split to determine the ratio of residential to total consumption using 2012 billing data. This was done by sorting the billing data based on customer name and manually selecting businesses (ICI users). Then, the annual consumption for ICI users was totalled and subtracted from the total annual consumption for all users to obtain the residential portion of annual consumption. The residential portion was then divided by the total to obtain the residential ratio. This ratio was used to estimate the amount of historical water flow that was used by residential users (by multiplying the ratio by the average day flow), which was then used to estimate the historical residential demand by dividing the historical residential flow by the total existing population.

Historical average day and maximum day flows were estimated for the various systems and the corresponding peaking factors were determined.

The Vermilion water system is supplied by the Vale Vermilion Water Treatment Plant, which also supplies Vale's own operations. The data available includes the volume of water treated at the plant (provided by Vale) as well as the volume billed to City customers from the City's meter records. The volume of treated water supplied to the City, and the maximum day and peak hour water demands by the City was not available. This means that the average day demand and the maximum day peaking factor in Vermilion could not be determined.

Historical unit consumption rates were calculated from the data (flow and population) provided for 2009 to 2013. The data sheets and calculations are provided in **Appendix A**. Combined residential/employment as well as residential-only unit rates were calculated.

The residential unit rates were estimated by determining the proportion of water used by residential users relative to the total water billed, multiplying by the total water produced, and dividing by the service population. For example, in Sudbury, approximately 74% of the water billed was to residential users. Therefore, the amount of water used annually by residential users in 2013 was 0.74 x 42,827 m^3/d = 31,692 m^3/d. This value was then divided by the service population in Sudbury (94,868) to obtain the residential unit rate of 334 L/cap/day for 2013.

The combined unit rates were obtained by dividing the total water production values (includes residential and ICI) by the total service population.

The residential unit consumption rates and the combined residential/ICI rates for the various communities are shown below in Table 4-1.

Table 4-1 Historical Average Consumption Unit Rates: Water

		AVERAGE UNIT CONSUMPTION RATES (L/CAP/DAY)				
COMMUNITY	RATE TYPE	2009	2010	2011	2012	2013
Dowling	Combined	221	225	214	215	206
	Residential	181	184	175	176	169
Falconbridge	Combined	1,641	1,636	1,635	1,444	1,497
	Residential	308	307	307	271	281
Onaping-Levack	Combined	609	720	952	799	963
	Residential	263	310	410	344	415
Sudbury	Combined	455	458	465	445	451
	Residential	337	339	344	329	334
Valley	Combined	Data not available	275	278	277	279
	Residential		239	241	241	242
Vermilion	Combined	Data not available				
	Residential					

In Dowling and Falconbridge, unit rates have gradually been declining since 2009. Usage rates in Sudbury and Valley have generally been steady, while the usage rate in Onaping-Levack has increased over the past five years.

Water usage in Onaping-Levack has been increasing since 2009. This could be because of additional water use in the winter. The City has indicated that some water connections, particularly in Onaping-Levack, freeze during the winter and some residents have been requested by the City to continuously run a small flow through their taps to prevent freezing. Based on anecdotal evidence through discussions with City staff, it seems that some residents have assumed that more water is better, and other residents who do not need to run water, have assumed that they should. These misunderstandings have led to further water use in the winter. In addition, the City runs water at the Fraser Lift Station in the winter to prevent freezing of the forcemain.

The historical maximum day and peak hour factors are summarized in Table 4-2 and Table 4-3 respectively.

Table 4-2 Historical Maximum Day Factors: Water

	MAXIMUM DAY FACTORS				
COMMUNITY	2009	2010	2011	2012	2013
Dowling	2.24	2.51	3.18	2.90	4.59
Falconbridge	2.58	1.82	1.68	1.66	2.84
Onaping-Levack	1.94	1.62	1.45	2.08	1.42
Sudbury	1.26	1.33	1.17	1.34	1.39
Valley	Data not available	1.76	1.31	1.39	1.40
Vermilion	Data not available				

All of the historical maximum day factors are reasonable, except Dowling which had a high maximum day factor in 2013. On reviewing the data further, data from 2013 for Dowling was atypical and should be considered an outlier.

Table 4-3 Historical Peak Hour Factors: Water

	PEAK HOUR FACTORS		
COMMUNITY	2011	2012	2013
Dowling	7.11	9.47	14.19
Falconbridge	2.24	2.51	3.47
Onaping-Levack	2.46	3.27	2.61
Sudbury	1.48	1.58	1.52
Valley	1.88	1.80	2.18
Vermilion	Data not available		

All of the peak hour factors are reasonable, except for Dowling. The historical peak hour factors in Dowling are very high compared to the remaining communities in Greater Sudbury, and the lowest value is almost double the peak hour factor suggested in the MOECC Guidelines (3.75 for a population of 1001 to 2000). Upon more detailed review of the raw historical peak hour data, it appears that the Dowling system does not operate as a direct-pumped system and relies on supplying the system from the elevated tank. The hourly flow data indicates that the pumps generally run only for a few hours each day, likely to fill the elevated tank. At these times, the pumps run at high flows, producing an artificially high peak hour. As such, the historical peak hour factors in Dowling should be disregarded.

4.2 CITY OF GREATER SUDBURY WATER DEMAND CRITERIA

The City's Engineering Design Manual does not define unit water demand rates. Rather, it makes reference to MOECC Guidelines for water consumption rates. The City's Engineering Design Manual does, however, define unit rates for wastewater generation on a community-by-community basis, which could be used as water demand criteria assuming a one-to-one correspondence between water and wastewater flows (i.e. all of the water consumed becomes sewage). Typically, water demand is higher than wastewater demand, with about 60-80% of water becoming wastewater. However, in Greater Sudbury, the wastewater rate is higher than water. As such, it is more appropriate to use a one-to-one correspondence.

The City's Engineering Design Manual indicates that non-residential water demands, namely ICI demands, should be based on historical records where available and does not provide an alternate approach in the absence of historical data.

Residential unit water demand criteria are shown in Table 4-4.

Table 4-4 Unit Water Generation Rates per CGS' Manual for Engineering Consultants

WATER SYSTEM	COMMUNITY	UNIT WATER DEMAND (L/CAP/DAY)
Dowling	Dowling	360
Falconbridge	Falconbridge	410
Onaping-Levack	Levack	410
	Onaping	410
Sudbury	Sudbury	410
	Garson	360
	Coniston	410

WATER SYSTEM	COMMUNITY	UNIT WATER DEMAND (L/CAP/DAY)
	Wahnapitae	Not Listed
Valley	Azilda	360
	Capreol	500
	Chelmsford	360
	Valley East	360
Vermilion	Copper Cliff	500
	Lively	410
	Walden	450
	Mikkola	360

The City's Engineering Design Manual also defines peaking factors to be used when designing infrastructure for the various communities. The maximum day and peak hour factors in use at the City are shown in Table 4-5.

Table 4-5 City Standard Peaking Factors

WATER SYSTEM	COMMUNITY	MAXIMUM DAY FACTOR	PEAK HOUR FACTOR
Dowling	Dowling	2.50	3.75
Falconbridge	Falconbridge	2.75	4.13
Onaping-Levack	Levack	2.50	3.75
	Onaping	3.75	4.13
Sudbury	Sudbury	1.65	2.48
	Garson	2.00	3.0
	Coniston	2.25	3.38
	Wahnapitae	2.50	3.75
Valley	Azilda	2.70	1.8
	Capreol	2.00	3.0
	Chelmsford	1.80	2.7
	Valley East	1.80	2.7
Vermilion	Copper Cliff	2.25	3.38
	Lively	2.00	3.00
	Mikkola	2.00	3.00
	Walden	2.00	3.00

4.3 MOECC WATER DEMAND CRITERIA

The MOECC Guidelines for Drinking Water Systems (MOECC, 2008) list values ranging from 270 to 450 L/cap/day as typical for domestic (residential) demand projections. However, MOECC Guidelines recommend using water records wherever possible to determine per capita consumption values.

The MOECC Guidelines also recommend using existing data to determine maximum day and peak hour factors for system design, but provide peaking factors to be used in the absence of reliable data. These peaking factors are based on the service population of the water system. The corresponding peaking factors for the various communities within the City are shown in Table 4-6.

Table 4-6 MOECC Guidelines Peaking Factors

COMMUNITY	2011 POPULATION	MAX DAY FACTOR	PEAK HOUR FACTOR
Sudbury (incl. Sudbury, Garson, Coniston, and Wahnapitae)	94,868	1.65	2.48
Onaping-Levack	2,112	2.25	3.38
Dowling	1,773	2.50	3.75
Vermilion (incl. Copper Cliff, Lively, Walden, Naughton, and Whitefish)	10,359	1.90	2.85
Valley (incl. Valley East, Capreol, Azilda, Chelmsford)	36,382	1.80	2.70
Falconbridge	707	2.75	4.13

For commercial and institutional users, in the absence of historical data, the MOECC recommends using an average demand value of 28 m^3/ha/d. For industrial users, the MOECC lists average flow values ranging from 35 (light industry) to 55 m^3/ha/d (heavy industry).

MOECC Guidelines do not specify peaking factors for commercial and institutional users, recommending rather that a fixture-unit approach be used for every commercial and institutional building. Values of two to four times the average rate are cited for industrial users.

4.4 RECOMMENDED WATER DEMAND CRITERIA

In the City of Greater Sudbury, projected unit rates were assumed to be consistent with historical water consumption. In communities where historical demand was generally consistent or declining, the average was used for the future rate. In communities where the demand was increasing, the historical maximum was used. This methodology is considered conservative for master planning purposes.

There is no firm consensus on how climate change may influence water consumption rates; however, climate change can be expected to produce extremes in weather from heavy rainfall to dry or drought like conditions. These conditions would impact the need for irrigation (lawn watering) which can amount to about one-third of the unit consumption rate in the summer. The City of Greater Sudbury has an Outdoor Watering Bylaw with restrictions in effect from June 1 to the end of September. The bylaw permits lawn watering on alternate days of the month and sets fines for non-compliance. The City should continue to enforce and monitor this program.

The projected water consumption rates along with maximum day and peak hour factors have been determined based on historical data from 2009 to 2013 for each community and presented in Table 4-7.

For ICI water demand, historical data should not be used as a predictor of future consumption or in the development of ICI unit rates. Demand among ICI users depends on the end user's process and industry-specific water needs, and cannot be based on historical consumption for a different user. For the Master Plan, it is recommended to continue to use the ICI peak unit rates in the City's design guidelines, which coincide with those in the MOECC Guidelines:

— Institutional: 28 m^3/ha/d
— Commercial: 28 m^3/ha/d
— Industrial: 35 m^3/ha/d (assumed to be light industrial)

A discussion for each community follows.

4.4.1 DOWLING

For Dowling, historical data from 2013 was not used since it was considerably higher than previous years. The average day demand in 2013 was slightly lower than previous years, but the maximum day flow was much higher than that for previous years. The maximum day and peak hour factors were considered outliers and were omitted from the analysis.

The remaining historical data was used to determine the recommended unit rate and peaking factors. The unit rate and maximum day factors were an average of the data. As indicated previously, the historical peak hour factors in Dowling were very high compared to the remaining communities in Greater Sudbury, and suggested in the MOECC Guidelines (3.75 for a population of 1001 to 2000). Because of the operating method in Dowling, it is recommended that the City disregard the historical peak hour factor for Dowling and use that recommended in the MOE Guidelines (3.75) instead.

4.4.2 FALCONBRIDGE

Rates and peaking factors in Falconbridge are generally in line with MOECC guidelines for a community of this size. The maximum historical rate, average maximum day factor, maximum peak hour factors were used for future rates.

4.4.3 ONAPING-LEVACK

As discussed previously, water demands in Onaping-Levack have increased since 2009. However, the maximum day and peak hour factors are generally consistent with previous years. The unit rate from 2009 to 2013 has generally increased since 2009, but does not show a consistent pattern. As such, the average from 2009 to 2013 was used to determine the unit rate for future growth. The average historical maximum day and the highest peak hour factors were used for the future rates.

4.4.4 SUDBURY

The unit consumption for Sudbury was within the MOECC guideline values at 344 L/cap/d. This value was the historical maximum from 2009 to 2013, although average day demand was generally consistent between 2009 and 2013. The maximum day factor between the specified time frame showed some variability (between 1.17 and 1.39), with no clear upward or downward trend with time. As such, the highest maximum day factor, occurring in 2013, was used. The peak hour factors were generally consistent between 2011 and 2013, but showed some slight variability. As such, the historical maximum, occurring in 2012, was used.

4.4.5 VALLEY

For the Valley water system, the average historical values were used for the unit rate and maximum day factor, whereas the historical maximum value for the peak hour factor was used. The unit rate was consistent between 2010 and 2013, ranging from 239 to 242 L/cap/day. The maximum day factor was highest in 2010 at 1.76, but between 1.31 and 1.40 for 2011 to 2013. The average value was used. The peak hour factor ranged from 1.80 and 2.18 and so the highest value was used to be conservative.

4.4.6 VERMILION

Municipal demand data for the Vermilion system was not available and so peaking factors from the MOE Design Guidelines for Drinking Water Systems (2008) were used.

4.5 SENSITIVITY ANALYSIS

A sensitivity analysis was completed to assess the impact of variability of the unit rates and peaking factors. Additional details and the outcome of each analysis are summarized in **Appendix A-1** for each system.

4.6 SUMMARY

Unit consumption water rates and peaking factors have been determined for each water system based on historical records. City data regarding water usage was not available for the Vermilion water system, and so it is recommended to use the corresponding values from the *MOECC Guidelines*. It is also recommended that the City meter water entering the Vermilion system in order to better monitor consumption and adjust rates in the future, if needed.

Table 4-7 Recommended Domestic Water Consumption Unit Rates (L/cap/day)

SERVICE AREA	RECOMMENDED UNIT RATE (L/CAP/DAY)	RECOMMENDED MAXIMUM DAY FACTOR	RECOMMENDED PEAK HOUR FACTOR
Dowling	200	2.71	3.75
Falconbridge	300	2.12	3.47
Onaping-Levack	350	1.70	3.27
Sudbury	350	1.39	1.58
Valley	250	1.46	2.18
Vermilion	250	1.90	2.85

5 WASTEWATER SYSTEMS

As part of the scope of the Master Plan a review of the design criteria included in the City's Engineering Design Manual was conducted to recommend rates for use in the sewer model development to support the Master Plan. The sections below present a comparison of the design criteria used by the City, those recommended by the MOECC guidelines (MOECC, 2008), and others used by other municipalities across the province. Furthermore, the sections below present the results of an analysis of wastewater demand data conducted to determine unit wastewater demand criteria. Based on the results of the analysis and comparison with other municipalities recommendations are provided on the design criteria to be used for the current Master Plan.

5.1 HISTORICAL WATER GENERATION ANALYSIS

Historical wastewater generation data obtained from 2009 to 2013 Annual Wastewater Reports (City of Greater Sudbury, 2009-2013) was reviewed for each community to determine the residential unit rates and make recommendations for updates to the City's Engineering Design Manual. The historical data was also used to determine the maximum day factors. Table 5-1 summarizes the findings for each community, excluding those with lagoon treatment. In addition, Garson was included with Sudbury, and Copper Cliff was excluded because historical data was not available. Residential rates were estimated using the approximate share of residential water demand from billing records, while combined rates were based on the total usage divided by the residential population.

The residential unit rates were estimated by determining the proportion of water used by residential users relative to the total water billed, multiplying by the total water produced, and dividing by the service population. For example, for Sudbury (excluding Coniston), approximately 73% of the water billed was to residential users. It was assumed that this value corresponded to the same ratio of wastewater residential demand. Therefore, the amount of wastewater produced annually by residential users in 2013 was 0.73 x 65,033 m^3/d = 47,690 m^3/d. This value was then divided by the service population in Sudbury (91,246) to obtain the residential unit rate of 523 L/cap/day for 2013.

The combined unit rates were obtained by dividing the total wastewater generation values by the total service population. It should be noted that the corresponding per capita rate includes both residential and ICI generation.

Table 5-1 Historical Unit Generation Rates: Wastewater

		HISTORICAL AVERAGE UNIT GENERATION RATES (L/CAP/DAY)				
COMMUNITY	RATE TYPE	2009	2010	2011	2012	2013
Azilda	Combined	663	479	372	349	485
	Residential	529	382	297	278	387
Capreol	Combined	827	542	798	680	704
	Residential	718	471	693	591	611
Chelmsford	Combined	642	502	525	501	639
	Residential	508	397	416	396	505
Coniston	Combined	586	398	441	418	557
	Residential	471	320	355	337	448
Dowling	Combined	1147	987	1041	1036	1157
	Residential	938	807	852	847	946
Falconbridge	Combined	354	339	373	342	346
	Residential	66	64	70	64	65

		HISTORICAL AVERAGE UNIT GENERATION RATES (L/CAP/DAY)				
COMMUNITY	RATE TYPE	2009	2010	2011	2012	2013
Levack	Combined	408	362	378	291	372
	Residential	176	156	163	126	160
Lively	Combined	520	420	467	514	771
	Residential	400	323	359	395	593
Walden	Combined	768	595	629	641	821
	Residential	591	457	484	492	631
Sudbury (incl. Garson)	Combined	713	605	638	616	709
	Residential	523	443	468	452	520
Valley East	Combined	361	259	258	239	299
	Residential	311	224	223	206	258
Wahnapitae	Combined	946	633	405	398	493
	Residential	775	518	331	326	404

Garson was included with the analysis for Sudbury since the Garson Lagoon is only used for seasonal retention and managing peaks, with flow going to the Sudbury WWTP when suitable.

For comparison, wastewater demand is typically about 60-80% of water demand for a given community. However, in Greater Sudbury this is generally not the case and can be attributed to high levels of background inflow and infiltration during dry weather flow. In addition, the water and wastewater system boundaries differ for some communities, meaning that the comparison between communities is approximate and inaccurate.

Historical maximum day peaking factors are summarized in Table 5-2. Historical instantaneous peak flows were not available, and so historical peaking factors were not reviewed. In addition, maximum day demand was not available for communities with lagoon treatment, namely Capreol and Wahnapitae.

Table 5-2 Wastewater Generation Factors

	MAXIMUM DAY FACTORS				
COMMUNITY	2009	2010	2011	2012	2013
Azilda	4.34	5.71	6.91	3.61	6.08
Chelmsford	3.77	5.95	3.71	2.48	3.85
Coniston	2.90	2.74	3.69	4.28	4.74
Dowling	1.97	1.82	1.59	1.44	2.12
Falconbridge	1.37	2.33	2.38	3.16	2.03
Levack	2.73	4.25	2.38	2.97	3.66
Lively	2.50	5.62	3.82	4.63	3.67
Walden	2.92	3.28	3.44	3.83	3.36
Sudbury	3.51	4.20	4.44	3.19	3.98
Valley East	3.35	1.28	2.93	1.88	3.99

For some communities, the historical maximum day factor shows variation for the 2009-2013 time period, but no consistent trend upward or downward. For example, for Azilda, the factor ranges from 3.61 in 2012 to 6.91 in 2011. This may indicate that maximum day wastewater generation is weather-dependent and that the system has substantial levels of inflow and infiltration.

5.2 CITY OF GREATER SUDBURY UNIT WASTEWATER GENERATION CRITERIA

Table 5-3 summarizes the values used for unit wastewater generation rates for both existing and future conditions, as listed in the City's Engineering Design Manual.

Table 5-3 City Manual Wastewater Unit Generation Rates and Units of Peak Extraneous Flow

COMMUNITY	UNIT WASTEWATER GENERATION (L/CAP/DAY)	UNITS OF PEAK EXTRANEOUS FLOW (L/HA/DAY)		
		EXISTING DEVELOPMENTS		NEW DEVELOPMENTS
Azilda	360	22,450		22,450
Capreol	500	33,700		33,700
Chelmsford	360	33,700		33,700
Coniston	410	33,700		33,700
Copper Cliff	500	22,450		33,700
Dowling	360	33,700		33,700
Falconbridge	410	33,700		33,700
Garson	360	11,250		11,250
Levack	410	22,450		22,450
Lively	410	33,700		33,700
Mikkola	360	33,700		33,700
Onaping	410	33,700		33,700
Sudbury	410	33,740 over 40 ha	44,900 under 40 ha	17,280
Valley East	360	33,700		33,700
Walden	450	18,050		18,050

As summarized in the table above, unit generation rates and peak extraneous flow vary by community. Unit generation rates vary between 360 and 500 L/cap/day and are within the ranges recommended in the MOECC Guidelines (discussed further in the following section), with exception of Capreol and Copper Cliff. Capreol and Copper Cliff rates exceed the maximum value in the typical range indicated in the MOECC Guidelines (450 L/cap/day).

For ICI users, the requirements in the City's Engineering Design Manual match the *MOECC Guidelines for Sewage Works* (MOECC, 2008) recommendations, summarized in the following section.

5.3 MOECC UNIT WASTEWATER GENERATION CRITERIA

For residential servicing, the *MOECC Guidelines* (MOECC, 2008) recommend estimating the average and peak residential wastewater flows, as well as peak extraneous flows using historical data when available. The Guidelines recommend calculating peak residential wastewater flow using either the Harmon or Babbitt formula to determine the peaking factor, with a minimum of 2.0. In the absence of historical data, the Guidelines indicate that average daily domestic flows of 225 to 450 L/cap/day are typical for residential areas.

For ICI users, in the absence of reliable data, the Guidelines list common rates for different users such as shopping centres, hospitals, and schools. It is suggested that peaking factors are used, similar to the water demand, for a certain establishment. A minimum average allowance of 28 m^3/ha/d is recommended for commercial and tourist areas. No recommendations are made for industrial areas since water use varies by industry and process.

The unit wastewater generation rates used historically in the City of Greater Sudbury for the design and assessment of treatment facilities and collection systems are generally within the range of values indicated in the *MOECC Guidelines*, except for Copper Cliff and Capreol.

5.4 RECOMMENDED WASTEWATER GENERATION CRITERIA

The following tables present the recommended residential unit generation rates and maximum day peaking factors.

Table 5-4 Recommended Residential Unit Rates by Community

COMMUNITY	RESIDENTIAL FLOW UNIT RATE (L/CAP/DAY)
Azilda	400
Capreol	650
Chelmsford	450
Coniston	400
Copper Cliff	500
Dowling	900
Falconbridge	400
Garson	Included with Sudbury
Levack	200
Lively	450
Walden	450
Sudbury	500
Valley East	250
Wahnapitae	500

The average residential unit rates for all communities, except for Copper Cliff, were based on historical data. Historical data was not available for Copper Cliff and the City's current standard of 500 L/cap/day was used instead.

Table 5-5 Recommended Maximum Day Factor by Community

COMMUNITY	MAXIMUM DAY FACTOR
Azilda	5.76
Capreol	2.69
Chelmsford	3.95
Coniston	3.67
Copper Cliff	4.05
Dowling	1.79
Falconbridge	2.25
Garson	Included with Sudbury
Levack	3.20
Lively	4.05
Sudbury	3.86
Valley East	2.69
Wahnapitae	3.67
Walden	3.36

Similarly, most peaking factors were based on historical data, except Capreol, Copper Cliff, and Wahnapitae. For these systems, the peak flows were estimated by assuming the same factor as nearby communities. For Capreol, the value for Valley East was used, Copper Cliff was matched with Lively, and Wahnapitae was matched with Coniston.

In general, the residential unit rates and maximum day factors vary widely by community. For the unit rates, values vary from 200 L/cap/day in Levack up to 900 L/cap/day in Dowling. The maximum day factors range from 1.79 in Dowling up to 5.76 in Azilda.

For ICI wastewater generation, historical data should not be used as a predictor of future consumption or in the development of ICI unit rates. Demand among ICI users depends on the end user's process and industry-specific wastewater being generated, and cannot be based on historical generation for a different user. For the Master Plan it is recommended to use the ICI peak unit rates indicated in the City's Engineering Design Manual as a conservative estimate:

- Institutional: 28 m^3/ha/d
- Commercial: 28 m^3/ha/d
- Industrial: 35 m^3/ha/d (assumed to be light industrial)

Typically, approximately 60-80% of water usage leads to wastewater generation. However, in this case, communities throughout Greater Sudbury have higher wastewater unit rates compared to water, and a one to one correspondence is more suitable.

Although several communities in the City have high levels of inflow and infiltration, it is assumed that new developments will be leak-tight and use more advanced technologies compared to existing areas. Therefore, the City's peak value of 35 m^3/ha/d for most communities is deemed suitable for future use. To obtain an average extraneous flow rate, a peaking factor of three was assumed, for an average extraneous flow of 7.5 m^3/ha/day. Several communities had lower peak values in the City's Engineering Design Manual; this value was used for these respective communities.

5.5 SENSITIVITY ANALYSIS

A sensitivity analysis was completed to assess the impact of variability of the unit rates and peaking factors. Additional details and the outcome of each analysis are summarized in **Appendix B-2** for each system.

5.6 SUMMARY

Unit consumption wastewater rates and peaking factors have been determined for each wastewater system based on historical records. The recommended rates for use in the Master Plan are summarized in Table 5-6.

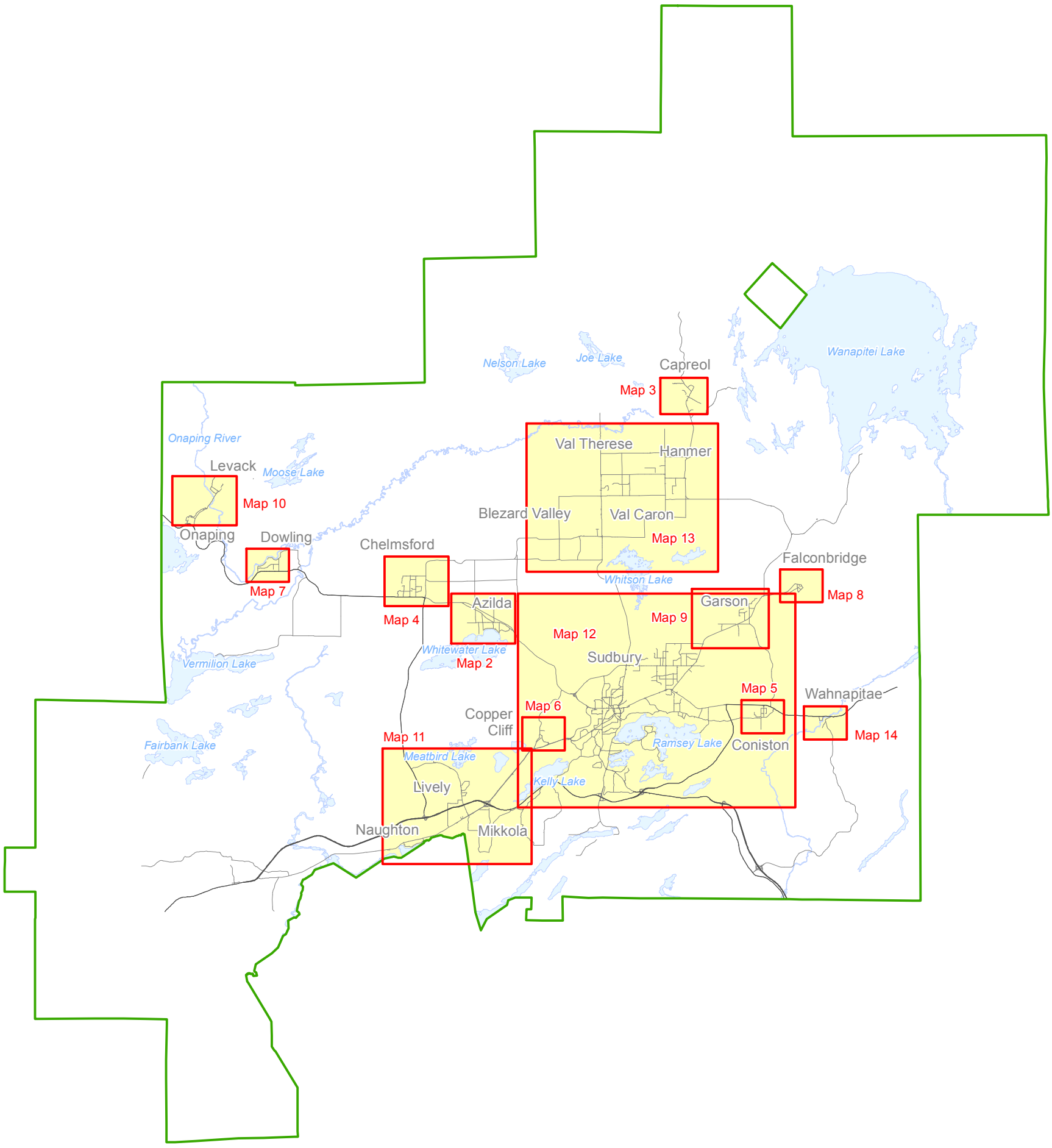
Table 5-6 Recommended Domestic Wastewater Generation Unit Rates (L/cap/day)

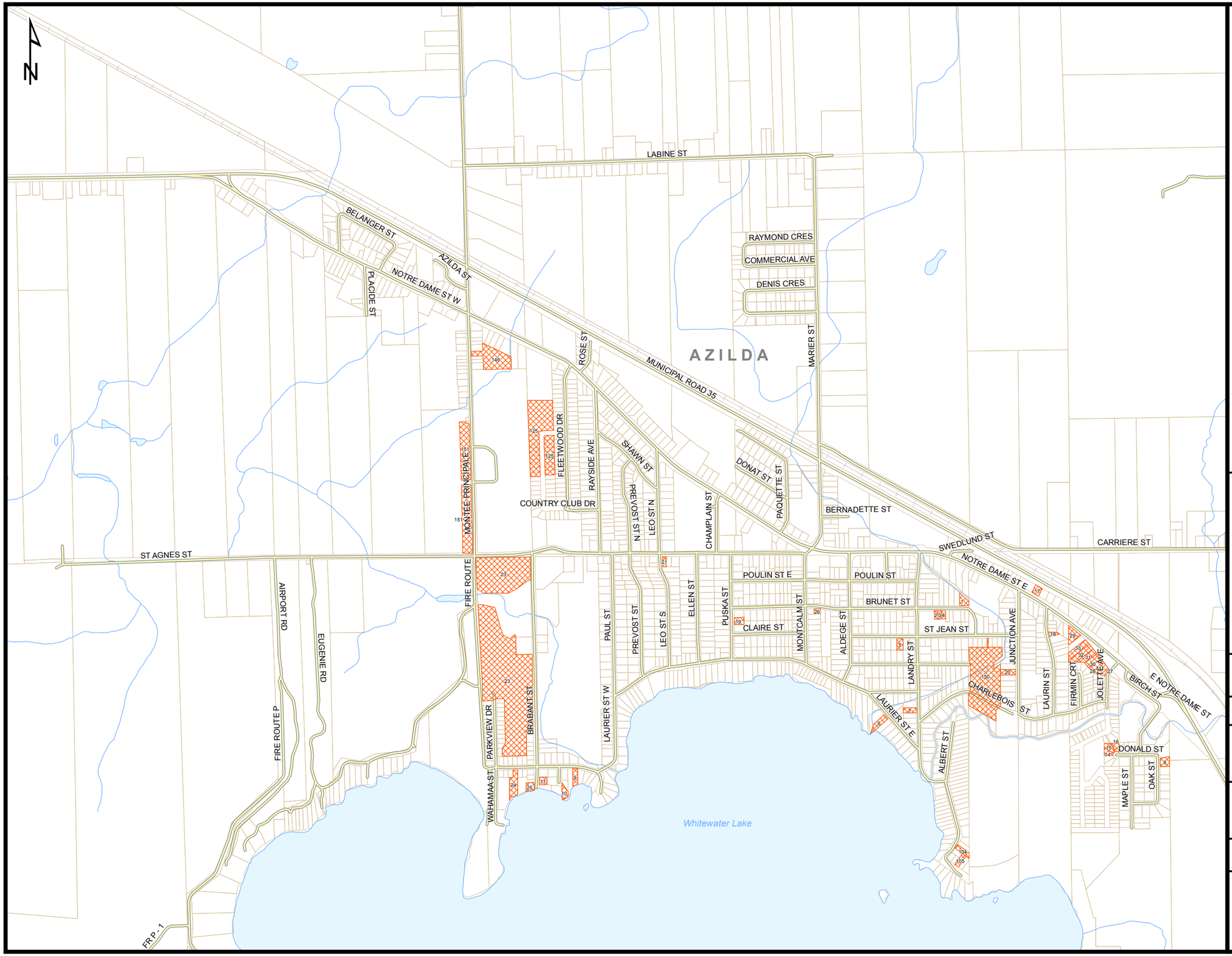
SERVICE AREA	RECOMMENDED RESIDENTIAL UNIT RATE (L/CAP/DAY)	RECOMMENDED MAXIMUM DAY FACTOR
Azilda	400	5.76
Capreol	650	2.69
Chelmsford	450	3.95
Coniston	400	3.67
Copper Cliff	500	4.05
Dowling	900	1.79
Falconbridge	400	2.25
Garson	Included with Sudbury	
Levack	200	3.20
Lively	450	4.05
Walden	450	3.36
Sudbury	500	3.86
Valley East	250	2.69
Wahnapitae	500	3.67

EXHIBIT

1 PHASING MAPS

Map 1
Vacant Land Development
Key Map





Legend

- Road
- Railway
- Watercourse
- Waterbody
- Parcel
- ICI Development (2011 - 2016)
- Residential Development (2011 - 2016)



Sudbury Greater | Grand

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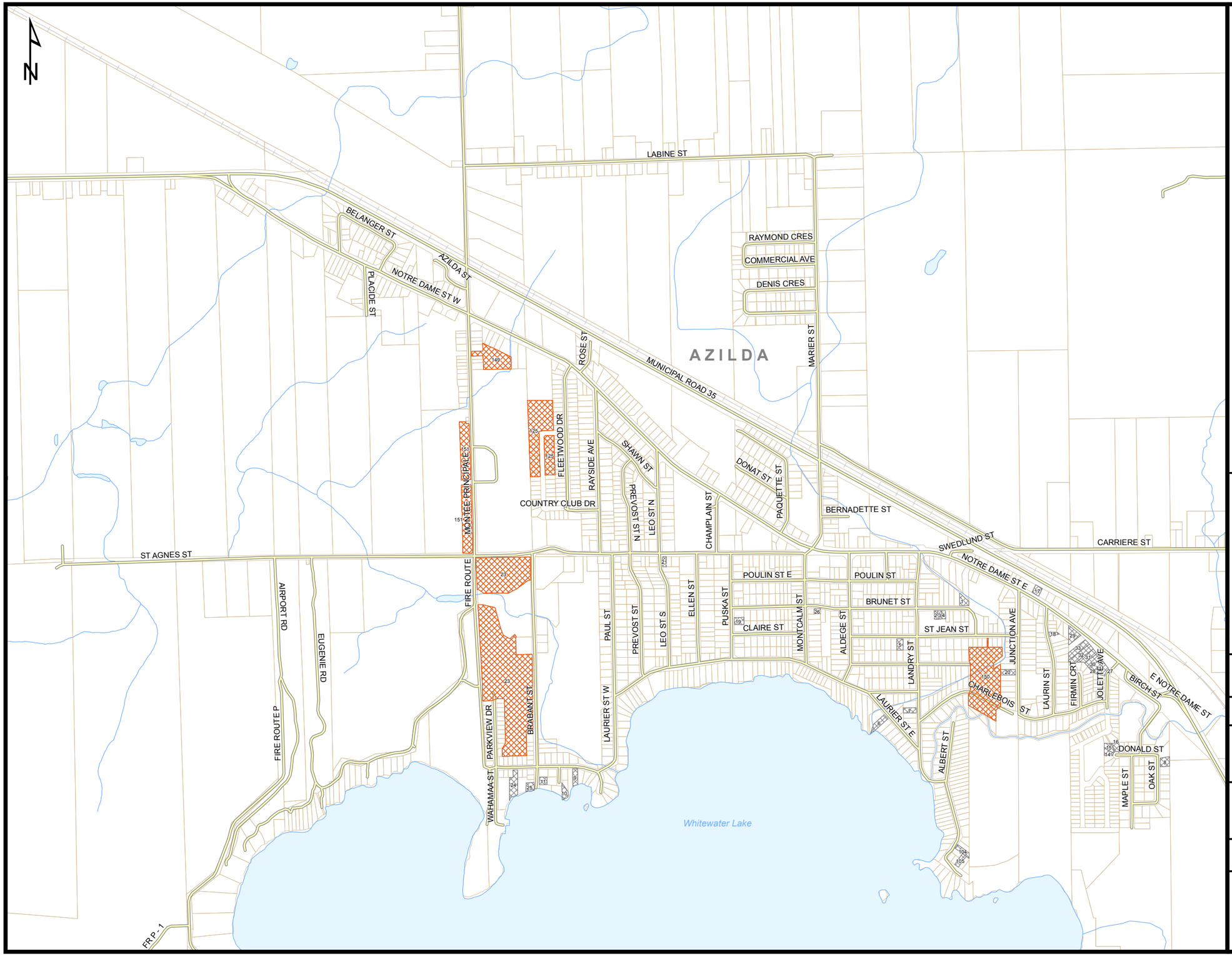
Sudbury Water and Wastewater Master Plan

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Map 2

Azilda
Vacant Land Development
(2011 - 2016)



Legend

- Road
- Railway
- Watercourse
- Waterbody
- Parcel
- ICI Development (2016 - 2021)
- Residential Development (2016 - 2021)
- ICI Development (2011 - 2016)
- Residential Development (2011 - 2016)



Sudbury Greater | Grand

WSP

Project No. 121-23026-00

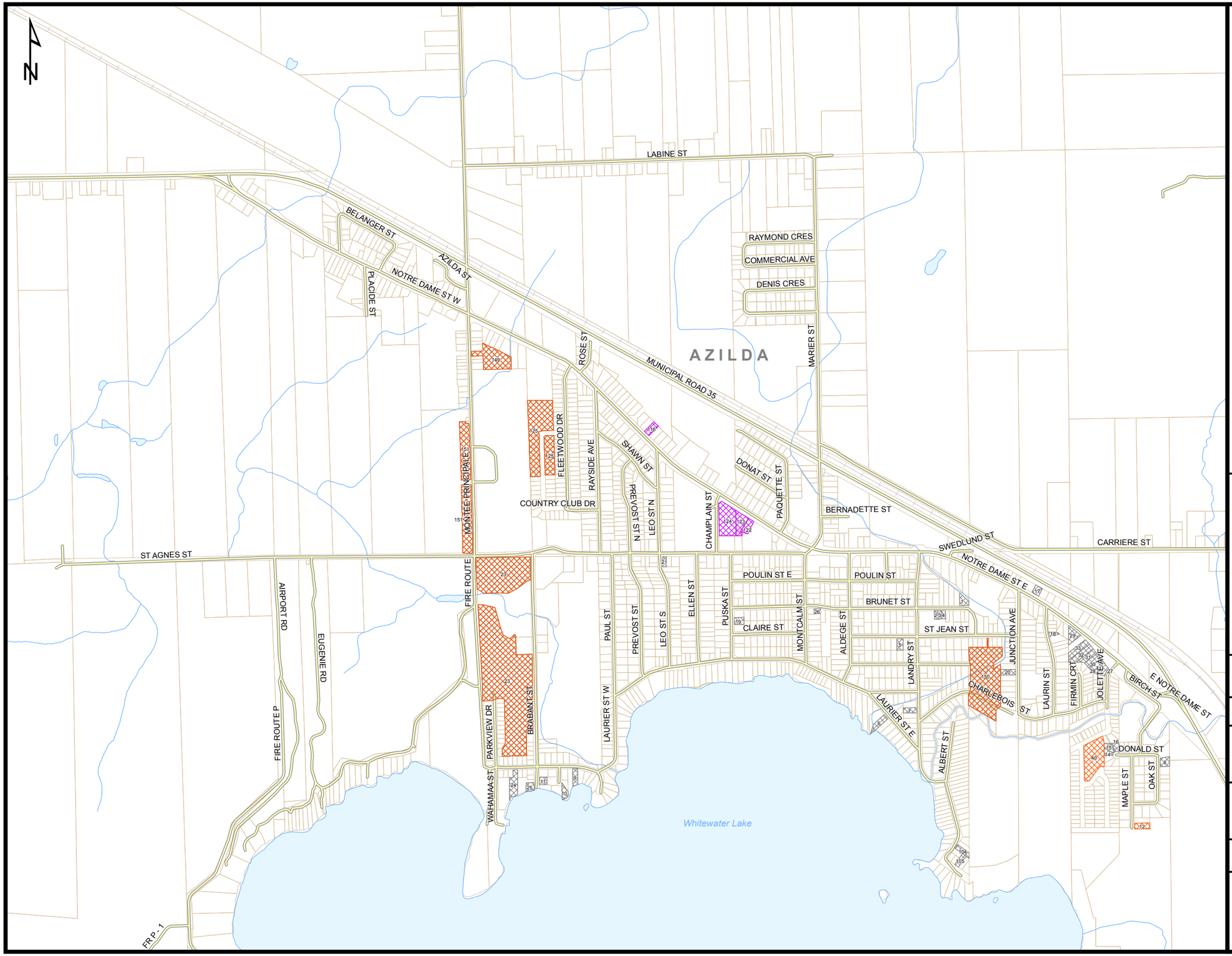
Sudbury Water and Wastewater Master Plan

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Map 2

Azilda
Vacant Land Development
(2016 - 2021)



Legend

- Road
- Railway
- Watercourse
- Waterbody
- Parcel
- ICI Development (2021 - 2026)
- Residential Development (2021 - 2026)
- ICI Development (2011 - 2021)
- Residential Development (2011 - 2021)



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Project No. 121-23026-00

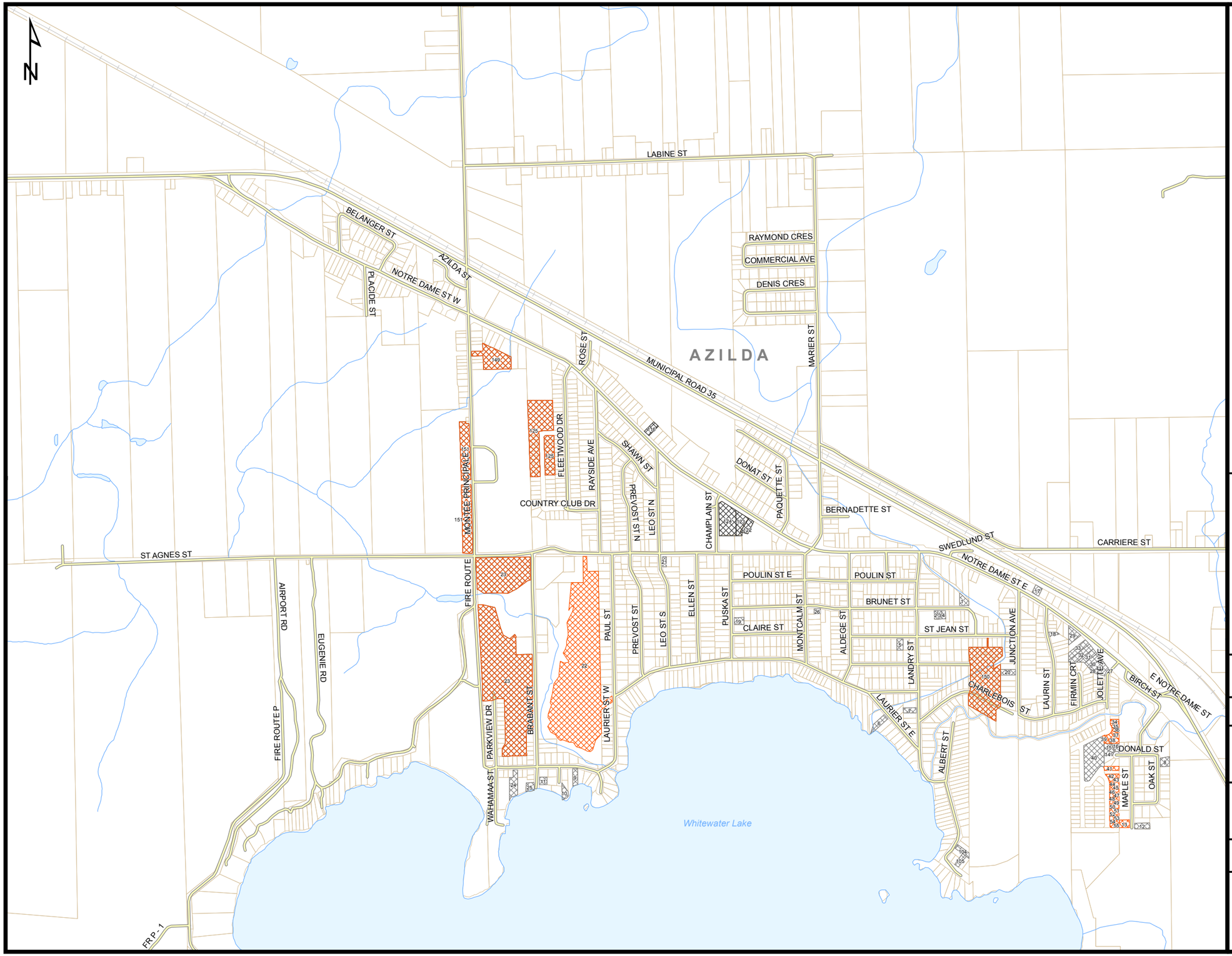
Sudbury Water and Wastewater Master Plan

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Map 2

Azilda
Vacant Land Development
(2021 - 2026)



Legend

- Road
- Railway
- Watercourse
- Waterbody
- Parcel
- ICI Development (2026 - 2031)
- Residential Development (2026 - 2031)
- ICI Development (2011 - 2026)
- Residential Development (2011 - 2026)



Sudbury | WSP

Project No. 121-23026-00

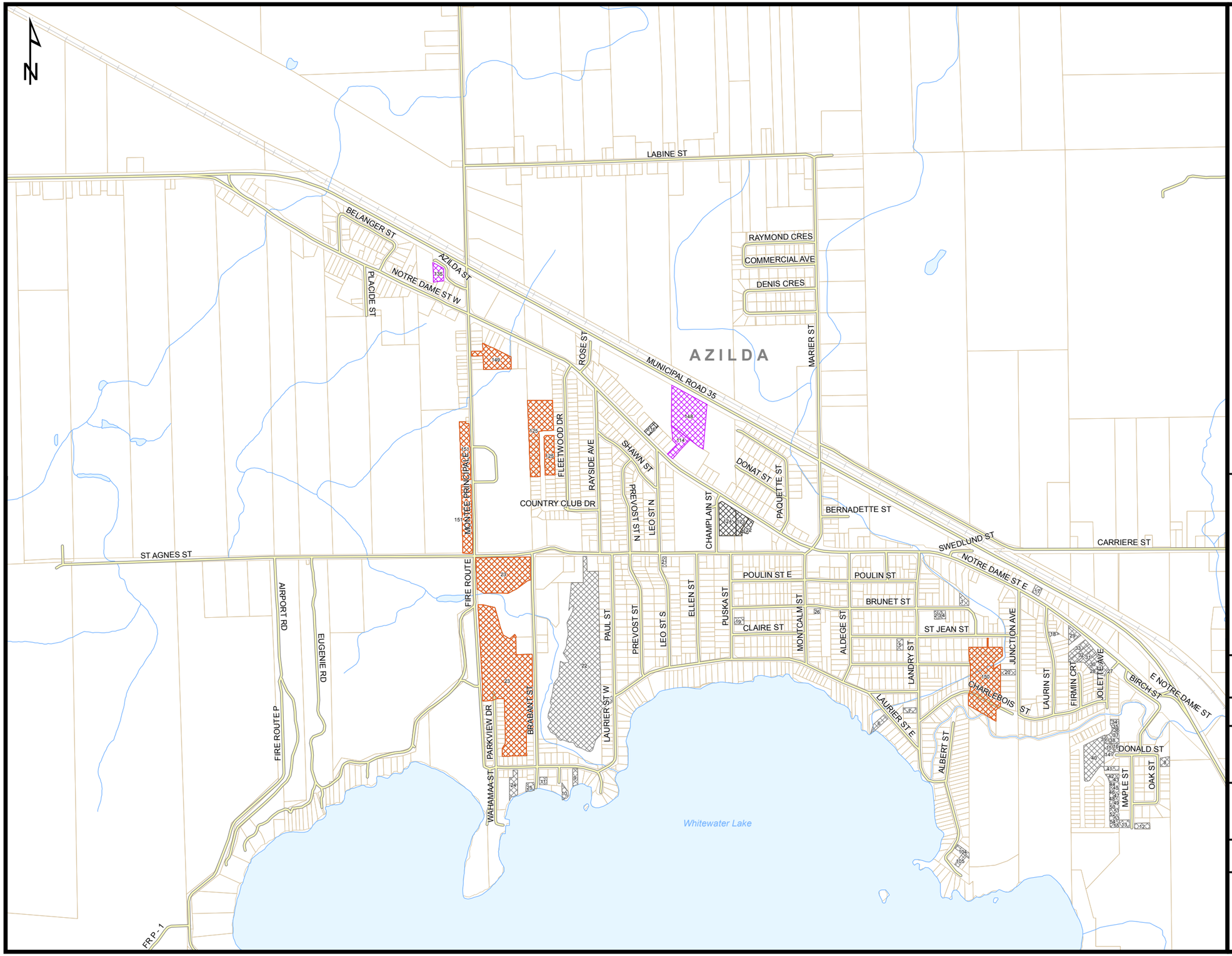
Sudbury Water and Wastewater Master Plan

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Map 2

Azilda
Vacant Land Development
(2026 - 2031)



Legend

- Road
- Railway
- Watercourse
- Waterbody
- Parcel
- ICI Development (2031 - 2036)
- Residential Development (2031 - 2036)
- ICI Development (2011 - 2031)
- Residential Development (2011 - 2031)



Sudbury | WSP

Project No. 121-23026-00

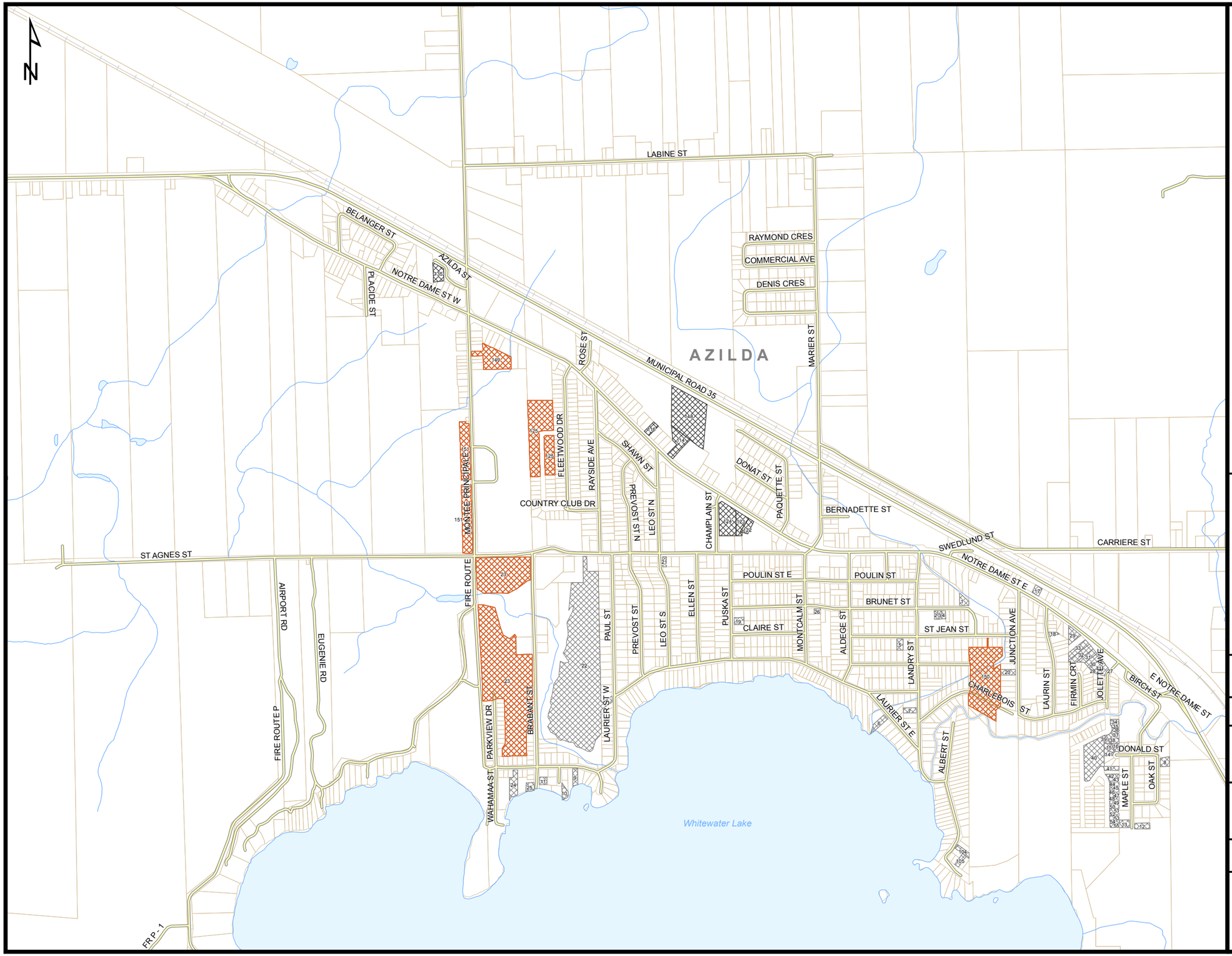
Sudbury Water and Wastewater Master Plan

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Map 2

Azilda
Vacant Land Development
(2031 - 2036)



Legend

- Road
- Railway
- Watercourse
- Waterbody
- Parcel
- ICI Development (2036 - 2041)
- Residential Development (2036 - 2041)
- ICI Development (2011 - 2036)
- Residential Development (2011 - 2036)



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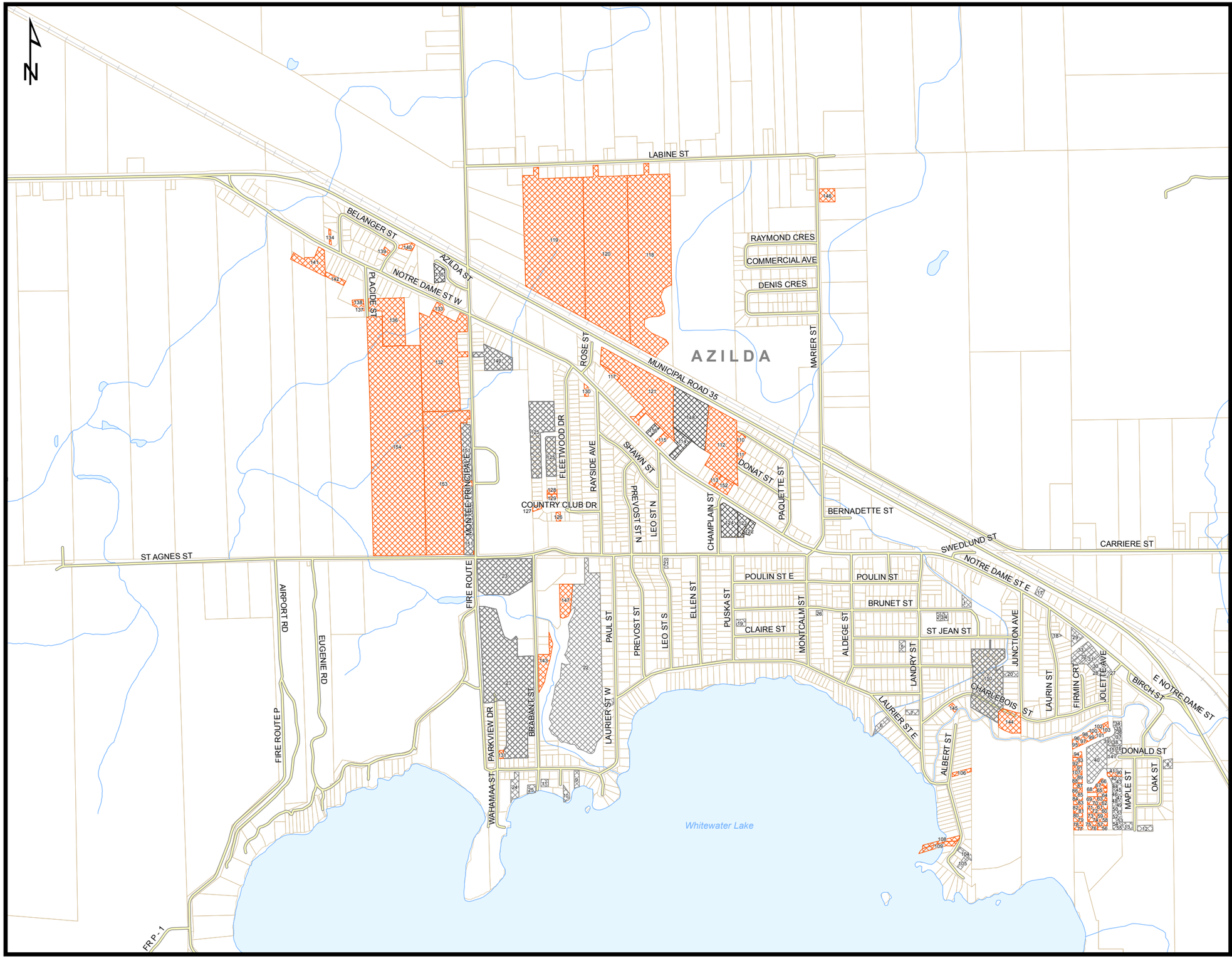
Sudbury Water and Wastewater Master Plan

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Map 2

Azilda
Vacant Land Development
(2036 - 2041)



Legend

- Road
- Railway
- Watercourse
- Waterbody
- Parcel
- ICI Development (2041 - Ultimate)
- Residential Development (2041 - Ultimate)
- ICI Development (2011 - 2041)
- Residential Development (2011 - 2041)



Sudbury Greater | Grand

WSP

Project No. 121-23026-00

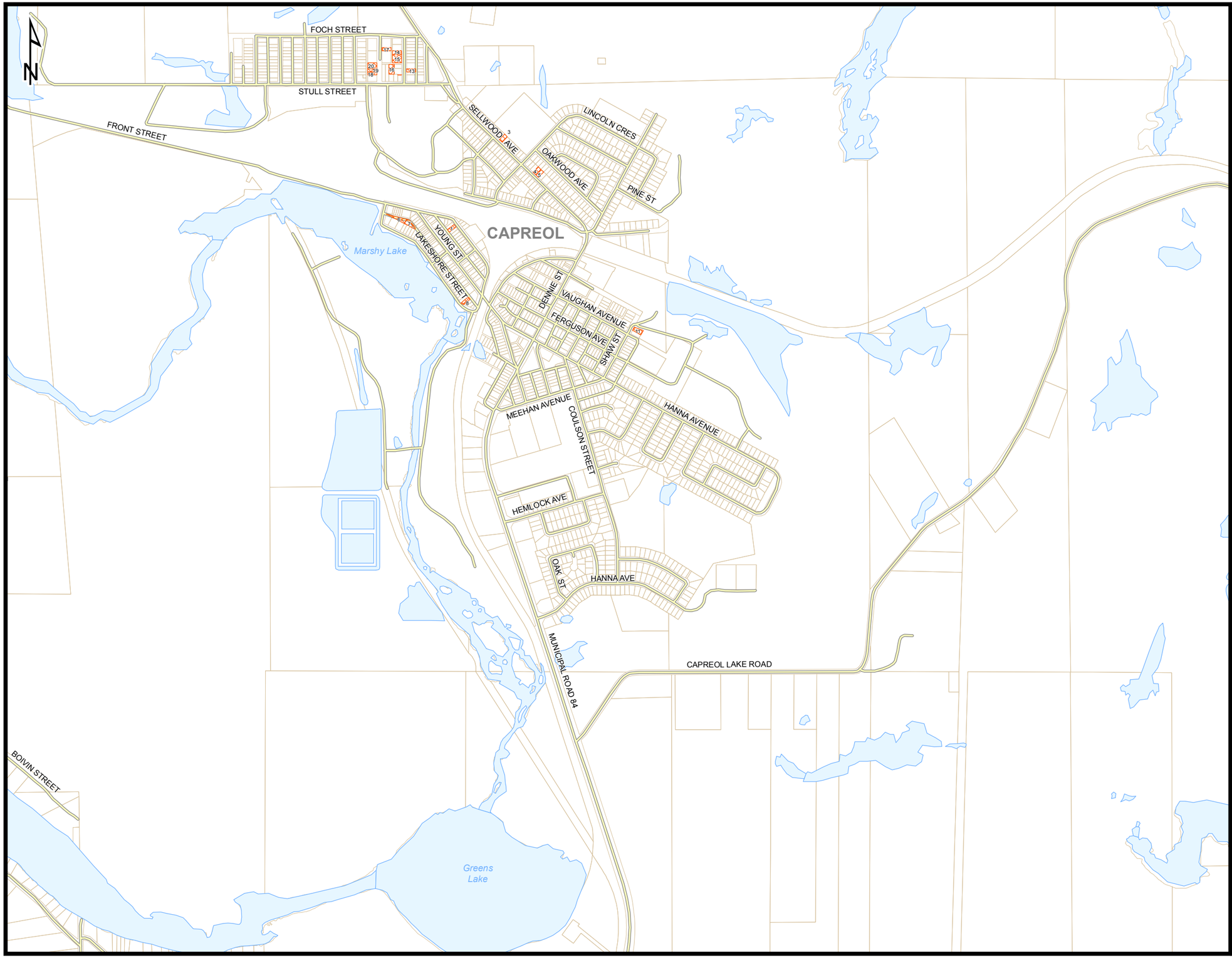
Sudbury Water and Wastewater Master Plan

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Map 2

Azilda
Vacant Land Development
(2041 - Ultimate)



Legend

- Road
- Waterbody
- Parcel
- ICI Development (2011 - 2016)
- Residential Development (2011 - 2016)



Project No. 121-23026-00

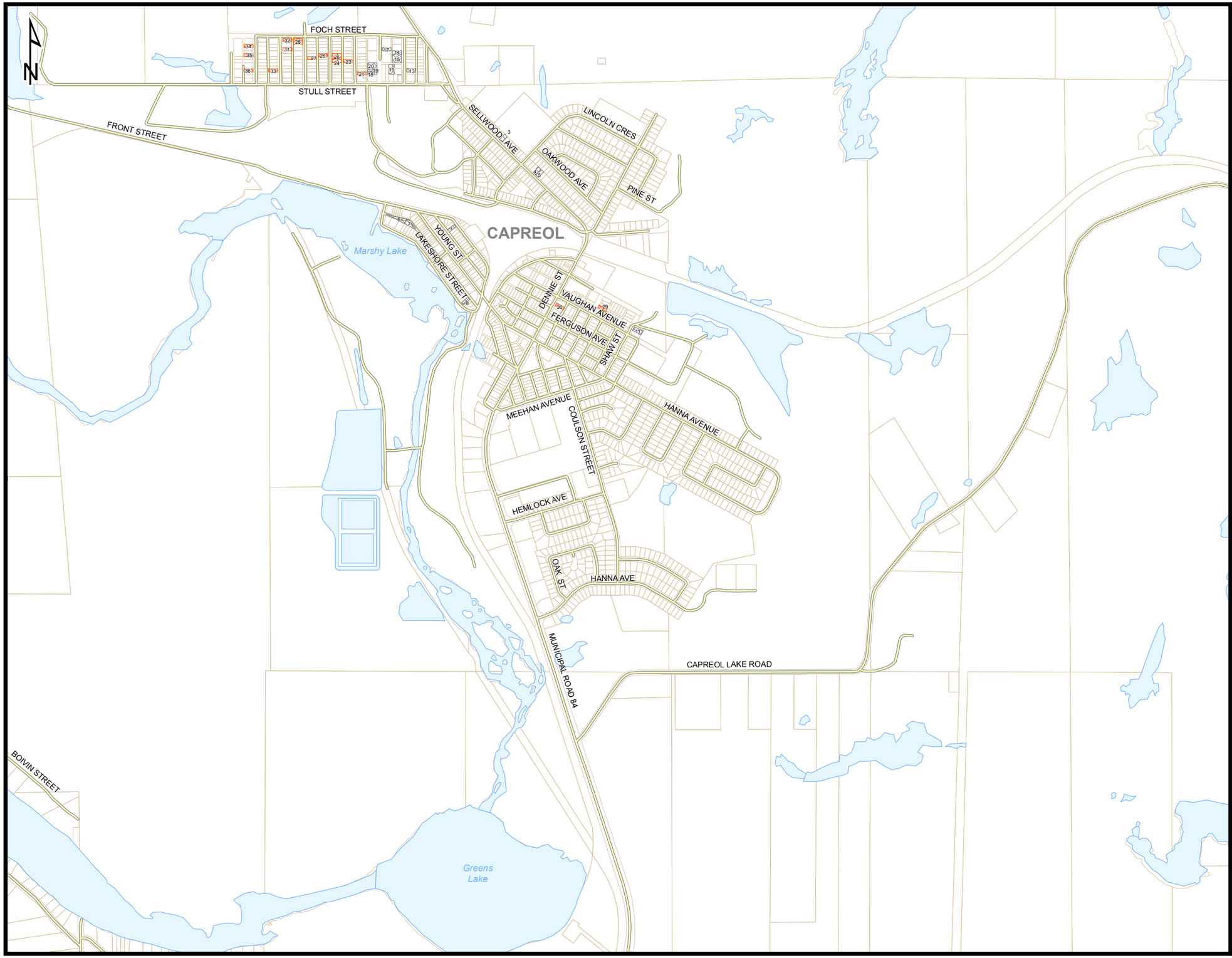
Sudbury Water and Wastewater Master Plan

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Map 3

Capreol Vacant Land Development (2011 - 2016)



Legend

- Road
- Waterbody
- Parcel
- ICI Development (2016 - 2021)
- Residential Development (2016 - 2021)
- ICI Development (2011 - 2016)
- Residential Development (2011 - 2016)



Sudbury | Greater | Grand

WSP

Project No. 121-23026-00

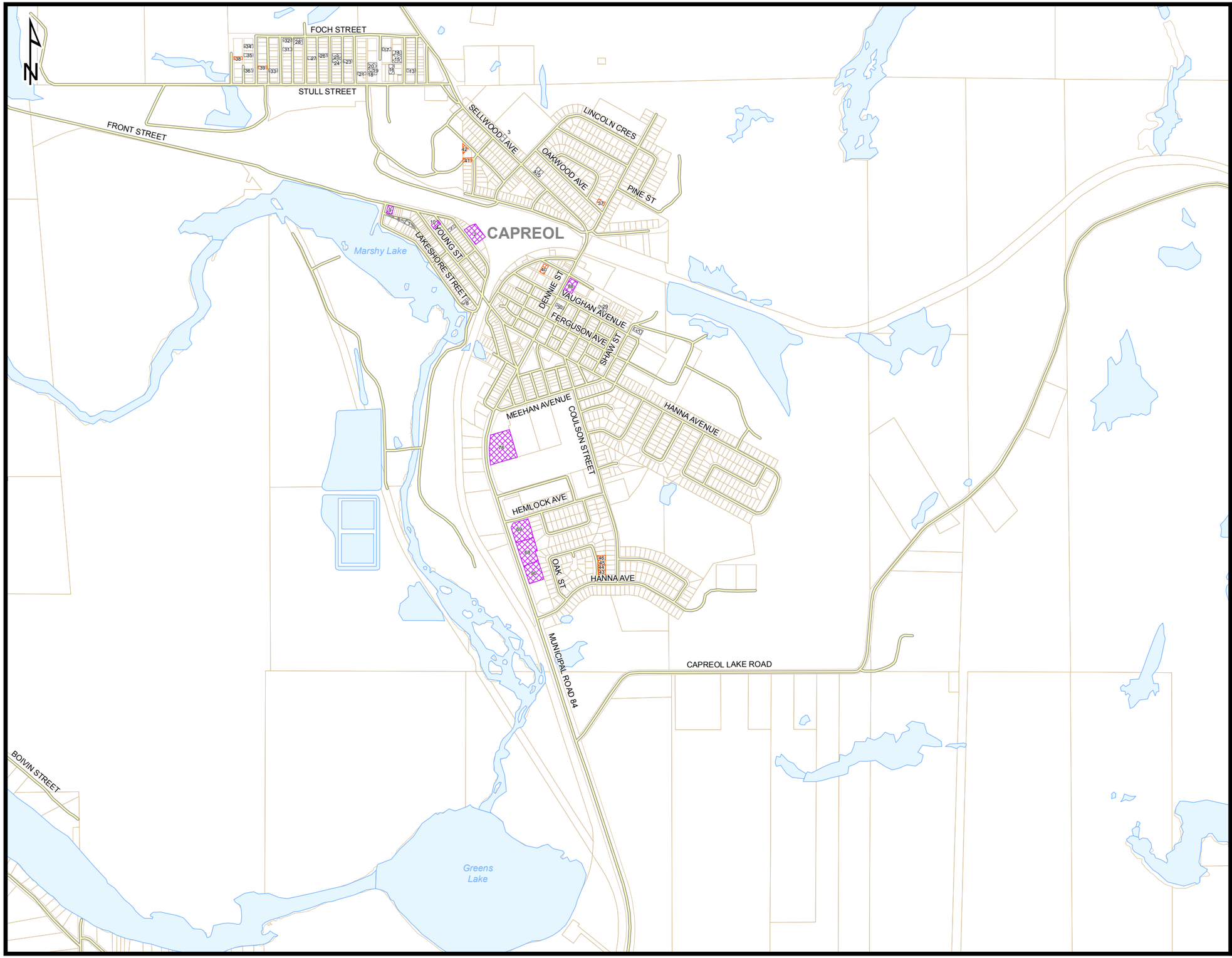
Sudbury Water and Wastewater Master Plan

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Map 3

Capreol
Vacant Land Development
(2016 - 2021)



Legend

- Road
- Waterbody
- Parcel
- ICI Development (2021 - 2026)
- Residential Development (2021 - 2026)
- ICI Development (2011 - 2021)
- Residential Development (2011 - 2021)



Sudbury | WSP

Project No. 121-23026-00

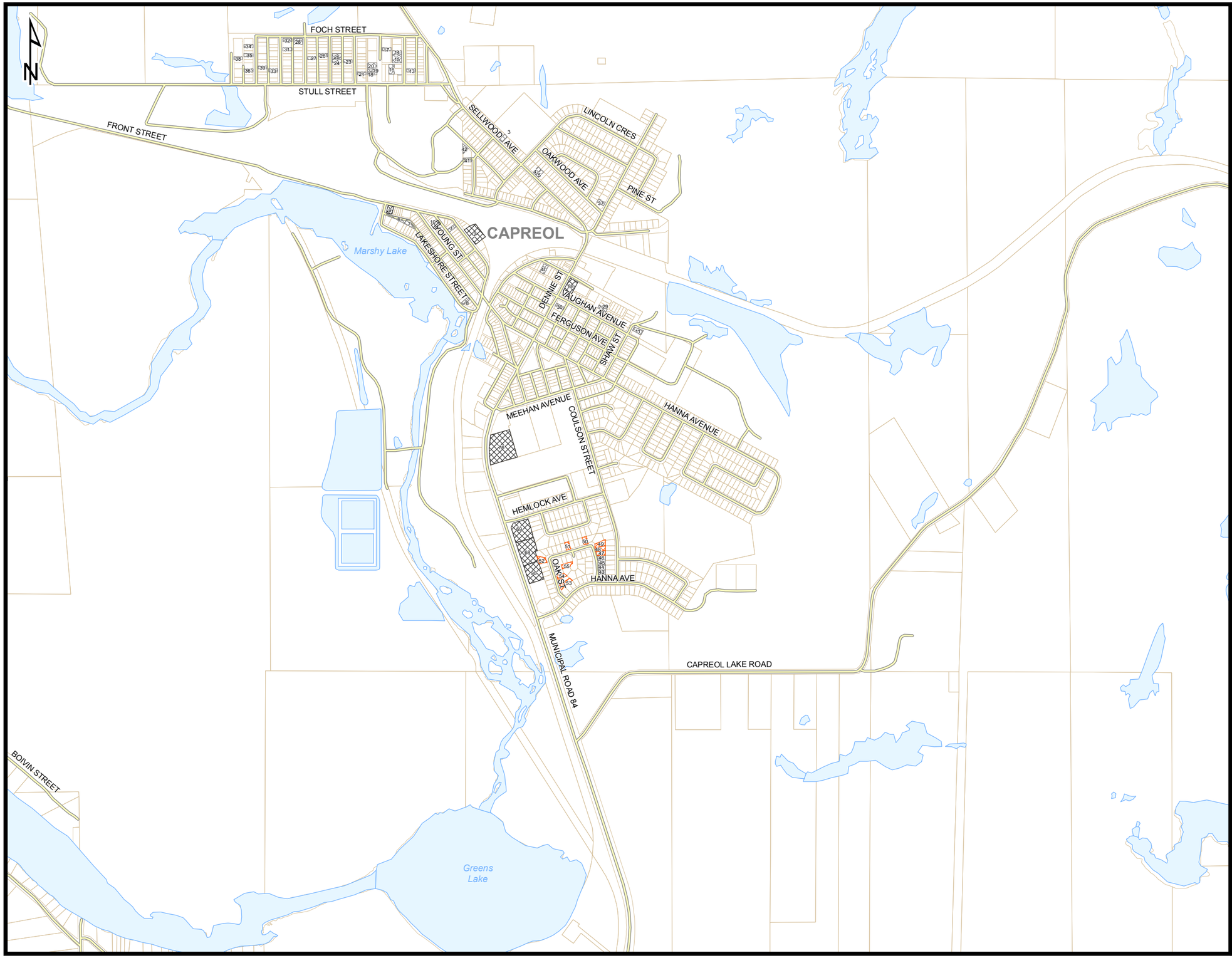
Sudbury Water and Wastewater Master Plan

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Map 3

Capreol Vacant Land Development (2021 - 2026)



Legend

- Road
- Waterbody
- Parcel
- ICI Development (2026 - 2031)
- Residential Development (2026 - 2031)
- ICI Development (2011 - 2026)
- Residential Development (2011 - 2026)



Sudbury | WSP

Project No. 121-23026-00

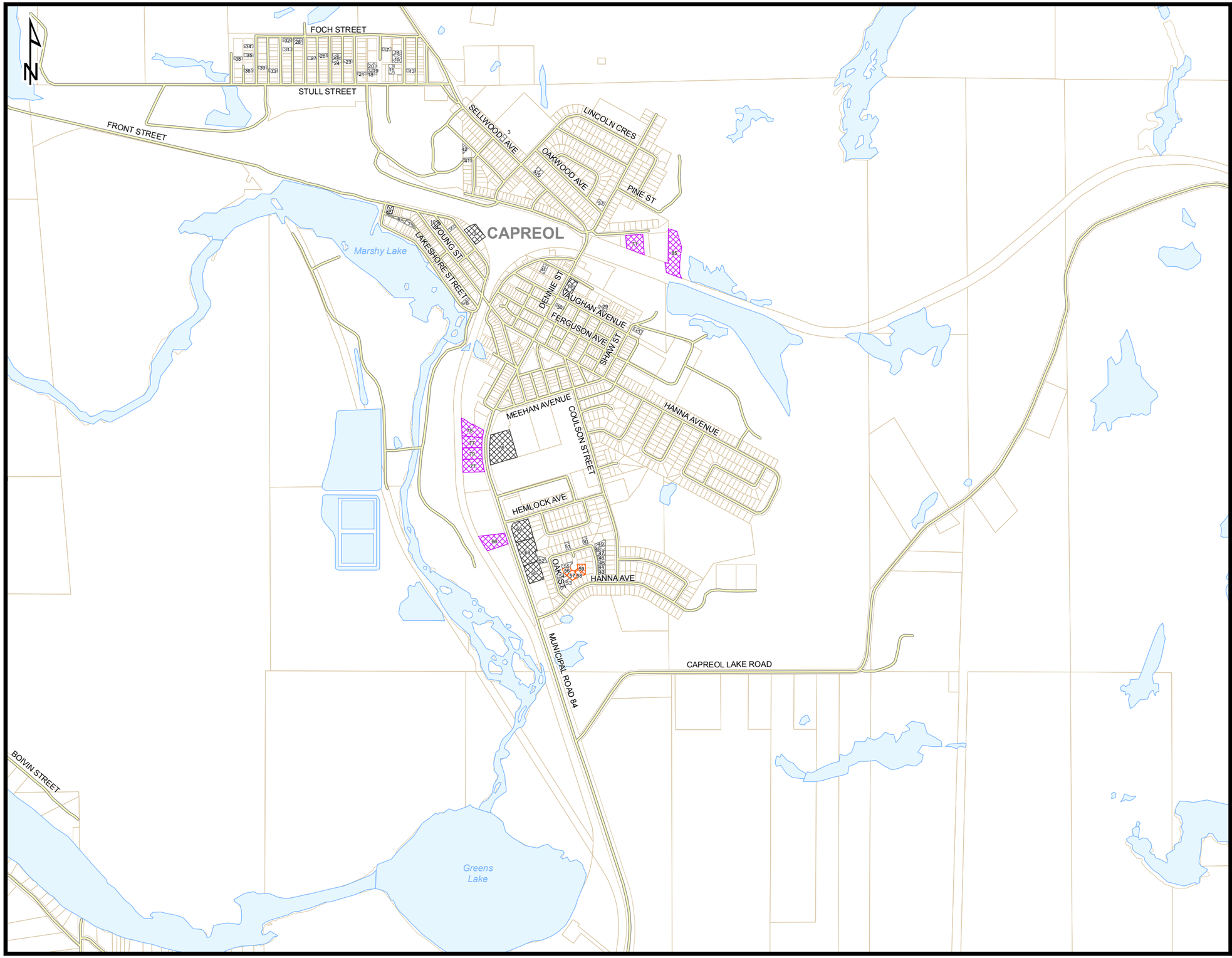
Sudbury Water and Wastewater Master Plan

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Map 3

Capreol
Vacant Land Development
(2026 - 2031)



Legend

- Road
- Waterbody
- Parcel
- ICI Development (2031 - 2036)
- Residential Development (2031 - 2036)
- ICI Development (2011 - 2031)
- Residential Development (2011 - 2031)



Sudbury | WSP

Project No. 121-23026-00

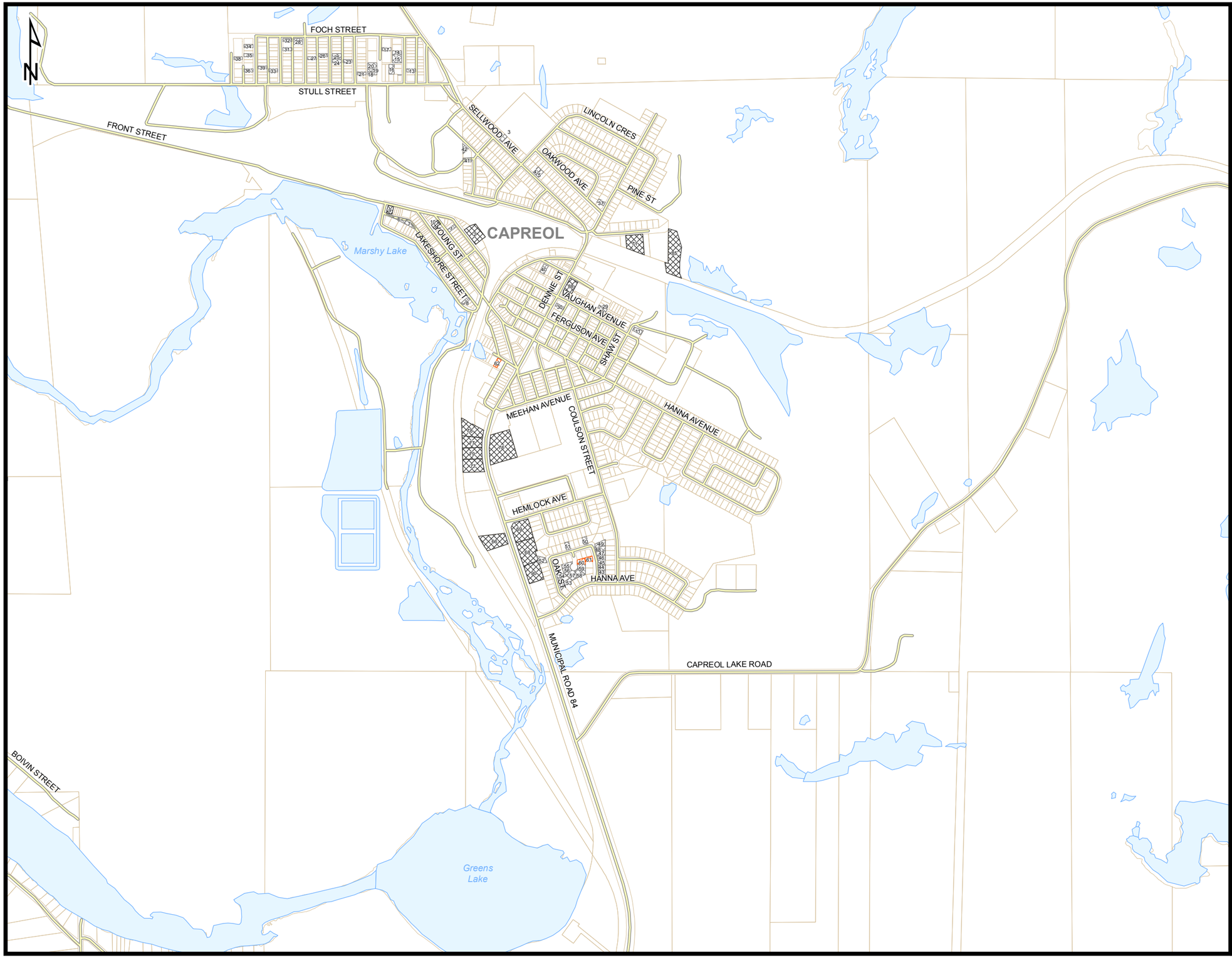
Sudbury Water and Wastewater Master Plan

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Map 3

Capreol
Vacant Land Development
(2031 - 2036)



Legend

- Road
- Waterbody
- Parcel
- ICI Development (2036 - 2041)
- Residential Development (2036 - 2041)
- ICI Development (2011 - 2036)
- Residential Development (2011 - 2036)



Sudbury | WSP

Project No. 121-23026-00

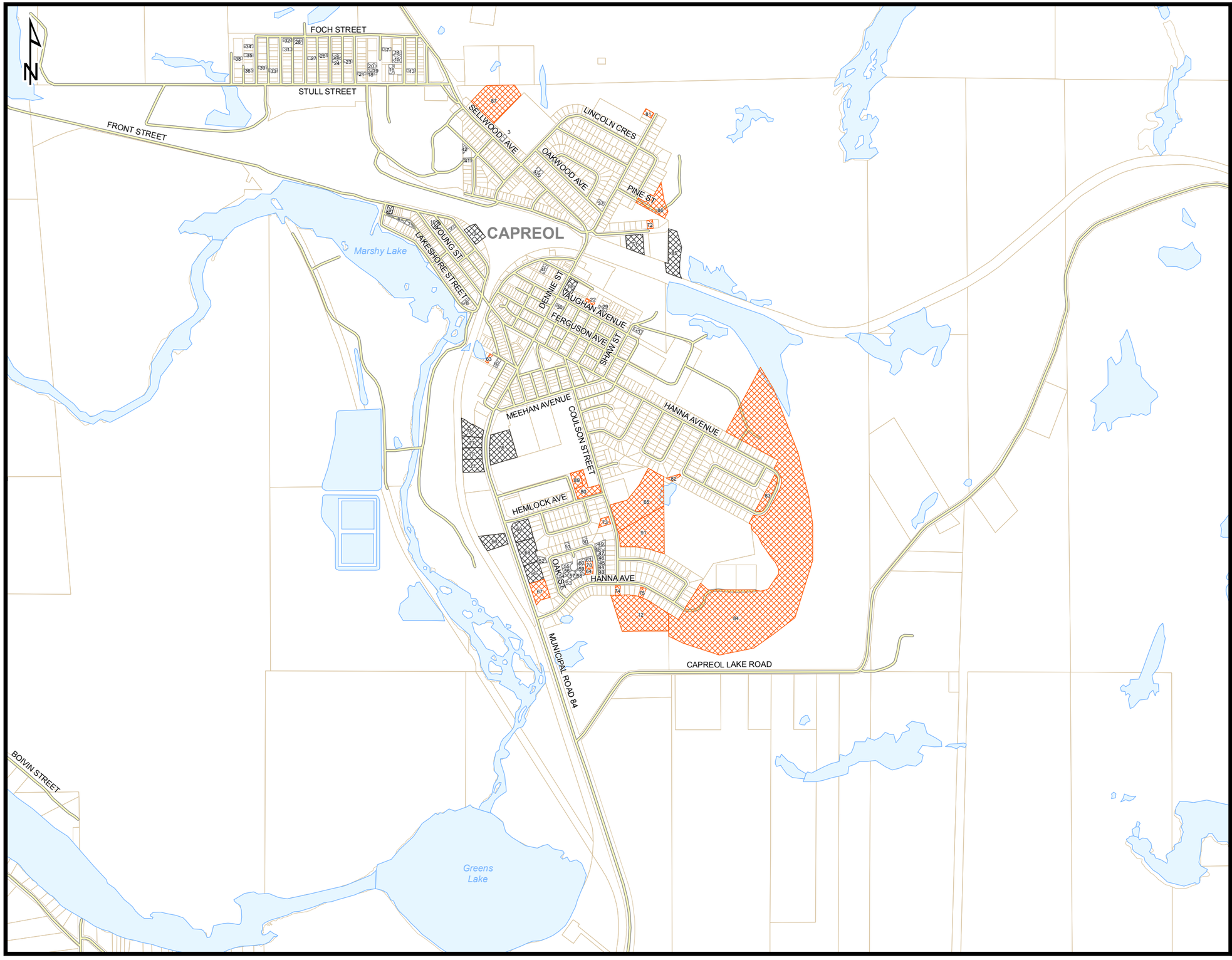
Sudbury Water and Wastewater Master Plan

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Map 3

Capreol
Vacant Land Development
(2036 - 2041)



Legend

- Road
- Waterbody
- Parcel
- ICI Development (2041 - Ultimate)
- Residential Development (2041 - Ultimate)
- ICI Development (2011 - 2041)
- Residential Development (2011 - 2041)



Sudbury | Greater | Grand

WSP

Project No. 121-23026-00

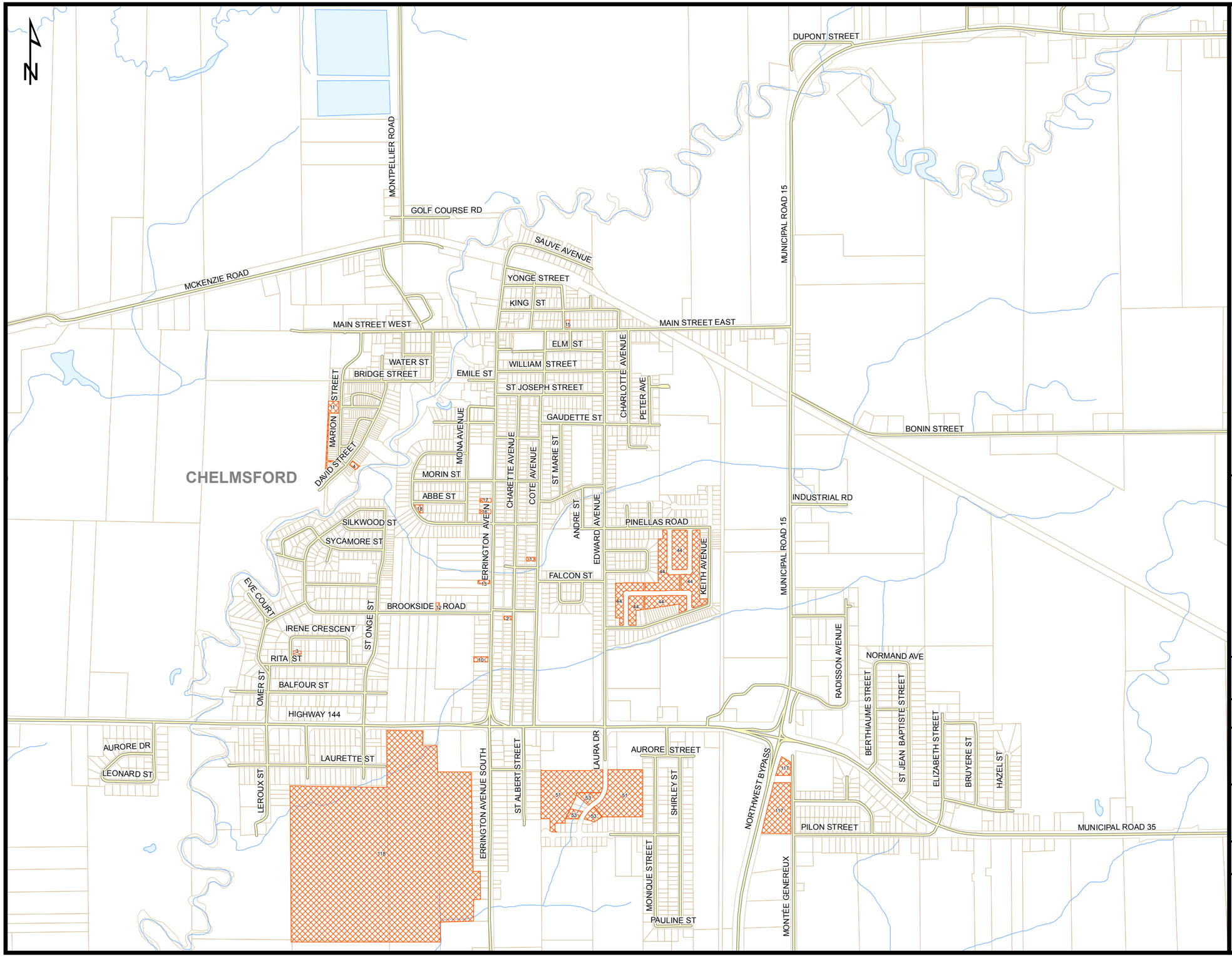
Sudbury Water and Wastewater Master Plan

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Map 3

Capreol
Vacant Land Development
(2041 - Ultimate)



Legend

- Road
- Watercourse
- Waterbody
- Parcel
- ICI Development (2011 - 2016)
- Residential Development (2011 - 2016)



Project No. 121-23026-00

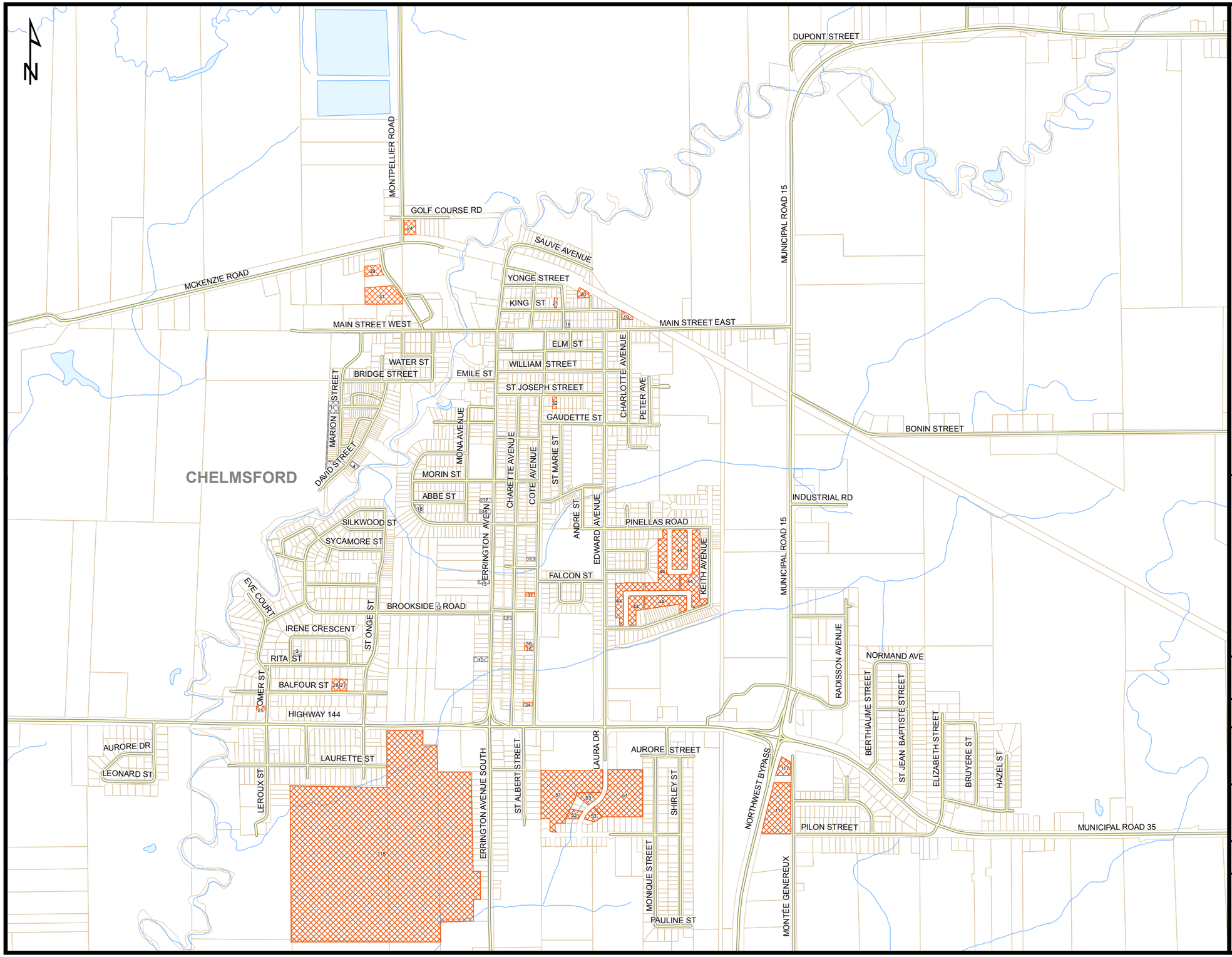
Sudbury Water and Wastewater Master Plan

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Map 4

Chelmsford
Vacant Land Development
(2011 - 2016)



Legend

- Road
- Watercourse
- Waterbody
- Parcel
- ICI Development (2016 - 2021)
- Residential Development (2016 - 2021)
- ICI Development (2011 - 2016)
- Residential Development (2011 - 2016)



Sudbury | WSP

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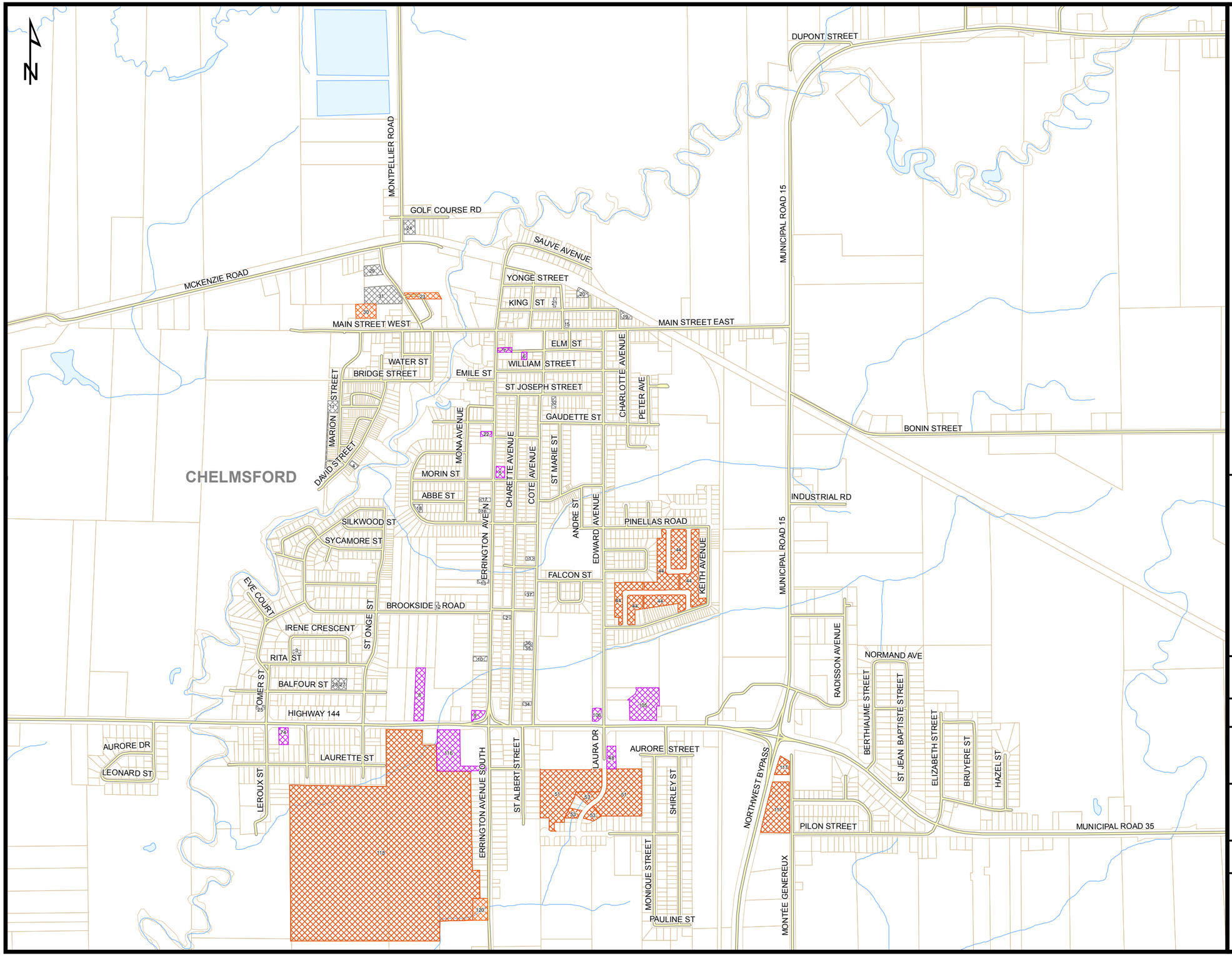
Sudbury Water and Wastewater Master Plan

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Map 4

Chelmsford
Vacant Land Development
(2016 - 2021)



Legend

- Road
- Watercourse
- Waterbody
- Parcel
- ICI Development (2021 - 2026)
- Residential Development (2021 - 2026)
- ICI Development (2011 - 2021)
- Residential Development (2011 - 2021)



Project No. 121-23026-00

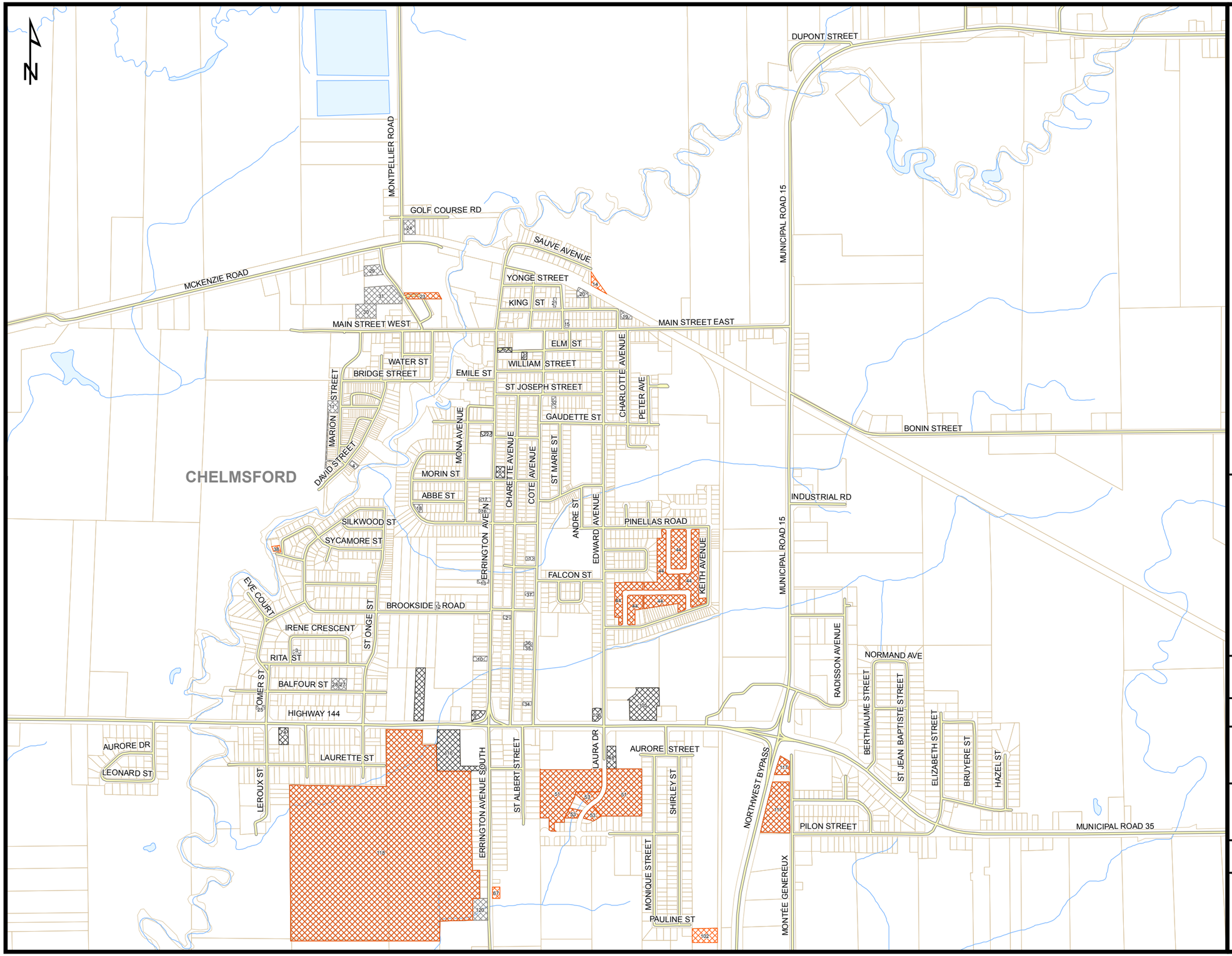
Sudbury Water and Wastewater Master Plan

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Map 4

Chelmsford
Vacant Land Development
(2021 - 2026)



Legend

- Road
- Watercourse
- Waterbody
- Parcel
- ICI Development (2026 - 2031)
- Residential Development (2026 - 2031)
- ICI Development (2011 - 2026)
- Residential Development (2011 - 2026)



Sudbury | WSP

Project No. 121-23026-00

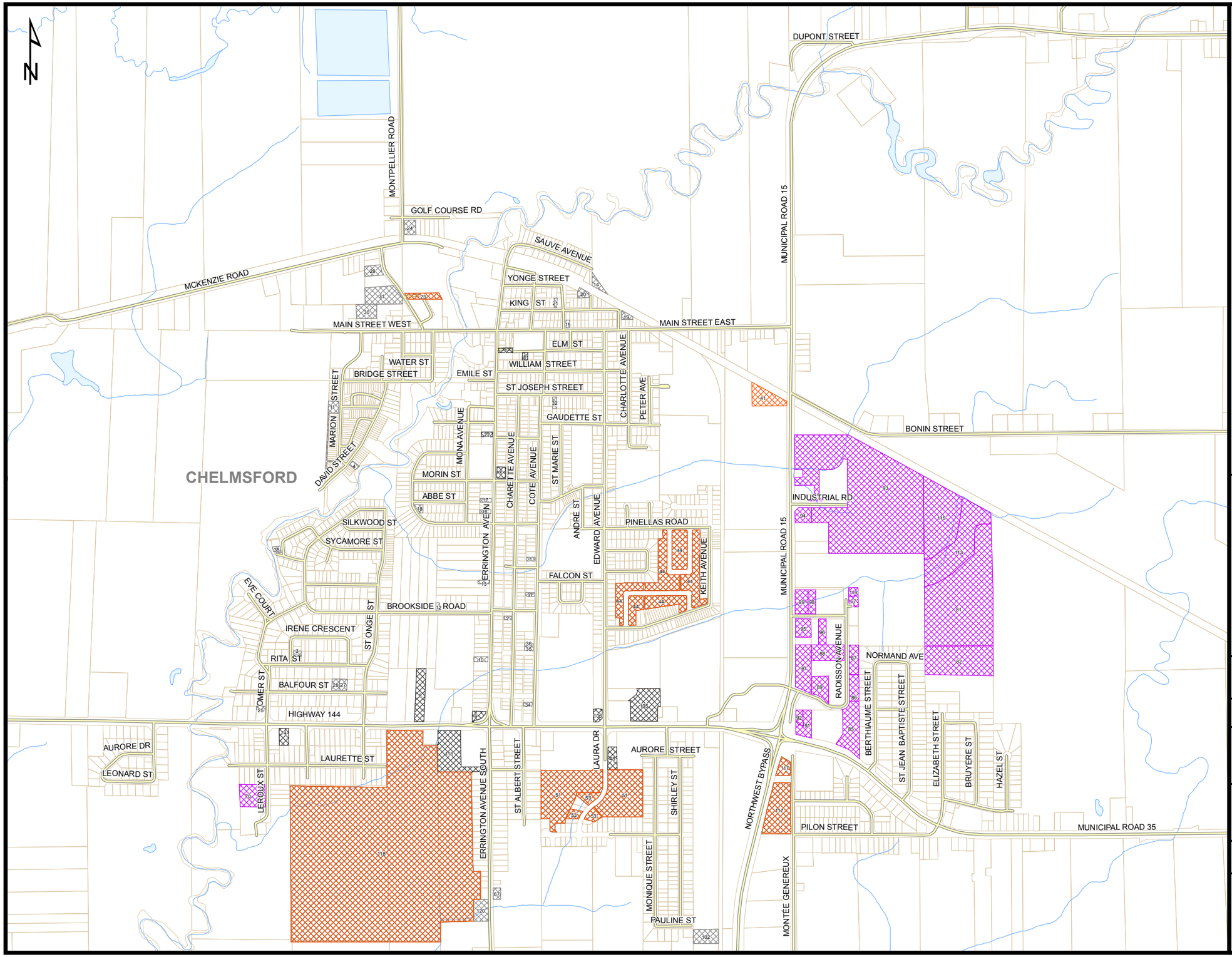
Sudbury Water and Wastewater Master Plan

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Map 4

Chelmsford
Vacant Land Development
(2026 - 2031)



Legend

- Road
- Watercourse
- Waterbody
- Parcel
- ICI Development (2031 - 2036)
- Residential Development (2031 - 2036)
- ICI Development (2011 - 2031)
- Residential Development (2011 - 2031)



Sudbury | WSP

Project No. 121-23026-00

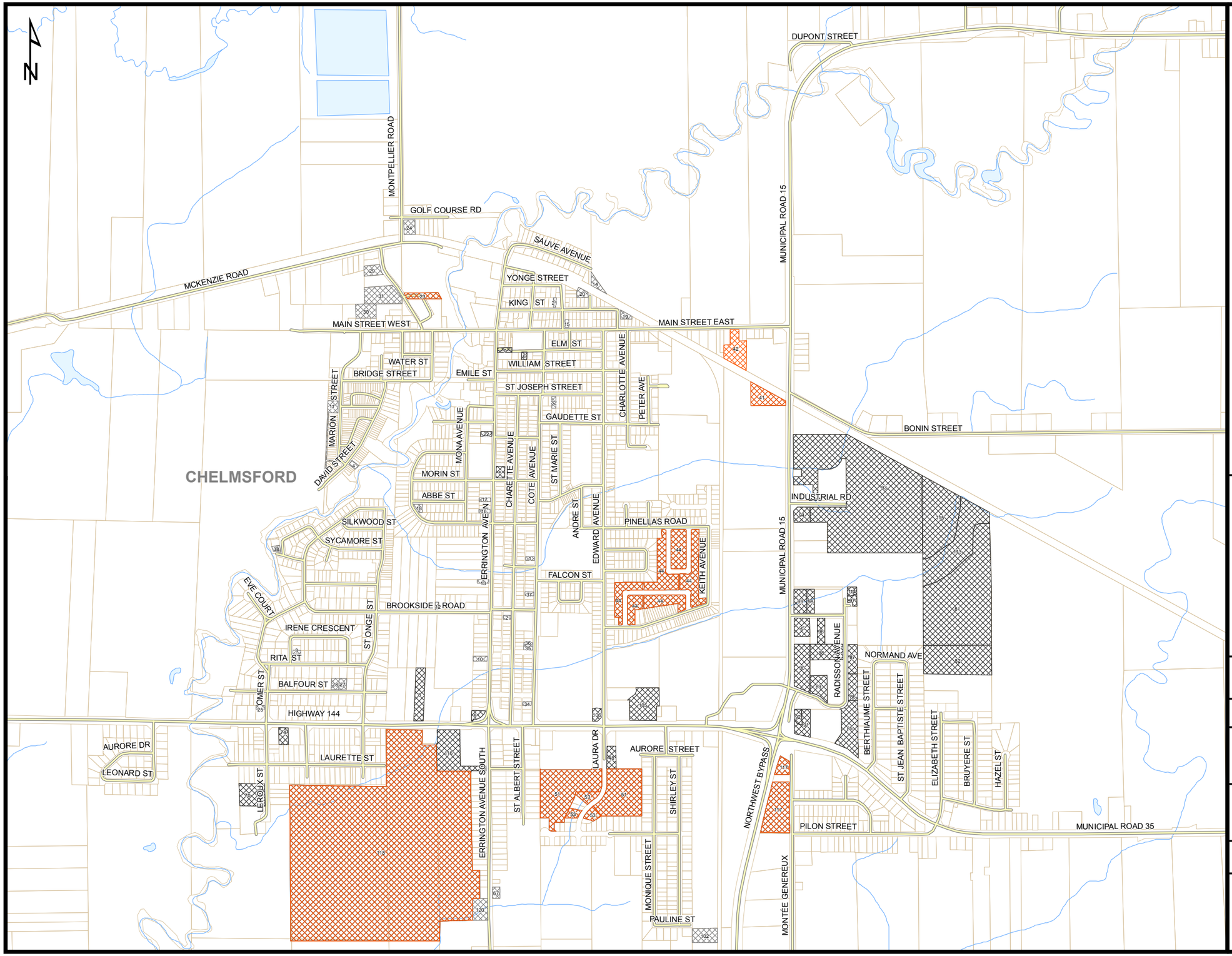
Sudbury Water and Wastewater Master Plan

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Map 4

Chelmsford
Vacant Land Development
(2031 - 2036)



Legend

- Road
- Watercourse
- Waterbody
- Parcel
- ICI Development (2036 - 2041)
- Residential Development (2036 - 2041)
- ICI Development (2011 - 2036)
- Residential Development (2011 - 2036)



Sudbury | WSP

Project No. 121-23026-00

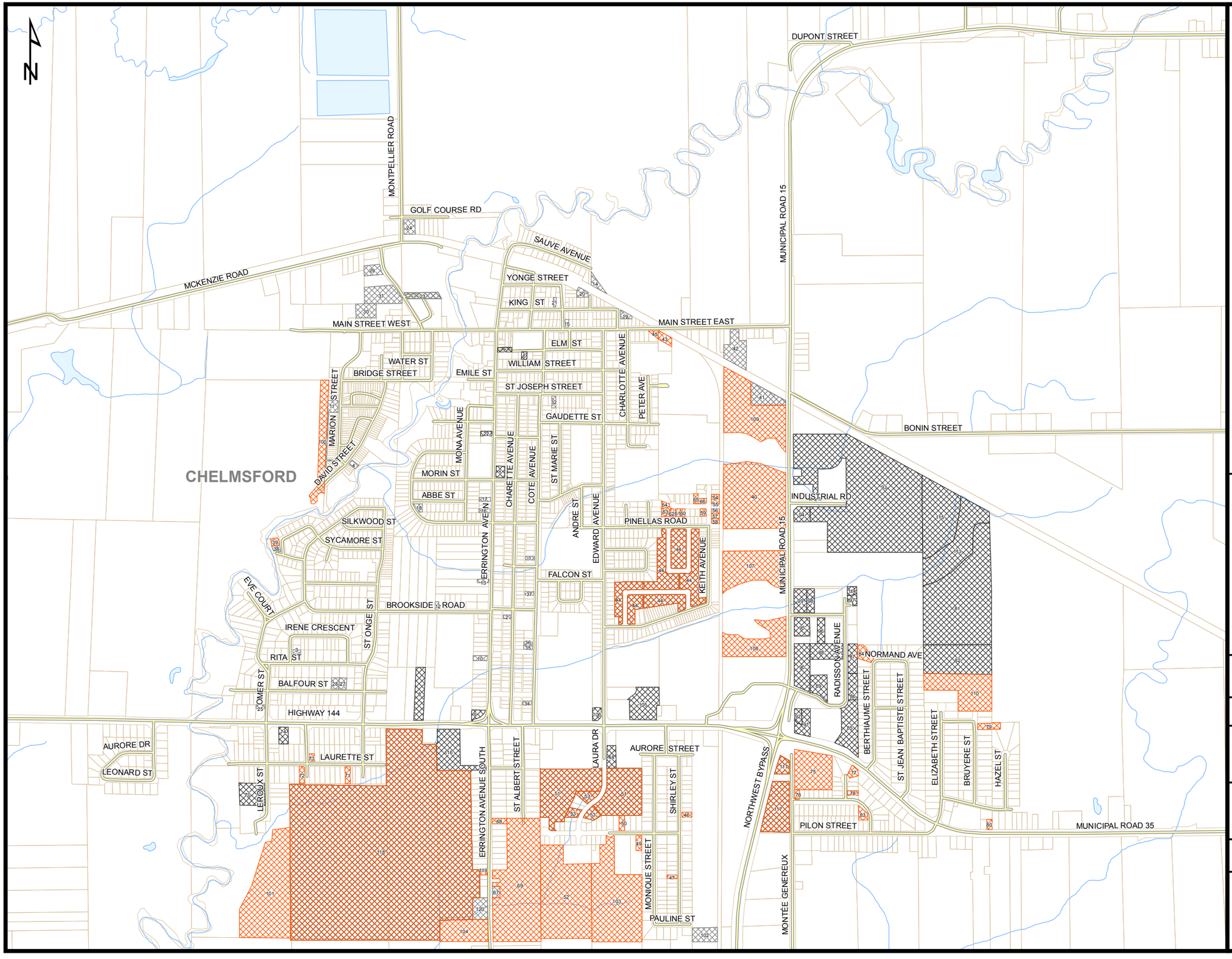
Sudbury Water and Wastewater Master Plan

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Map 4

Chelmsford
Vacant Land Development
(2036 - 2041)



Legend

- Road
- Watercourse
- Waterbody
- Parcel
- ICI Development (2041 - Ultimate)
- Residential Development (2041 - Ultimate)
- ICI Development (2011 - 2041)
- Residential Development (2011 - 2041)



Project No. 121-23026-00

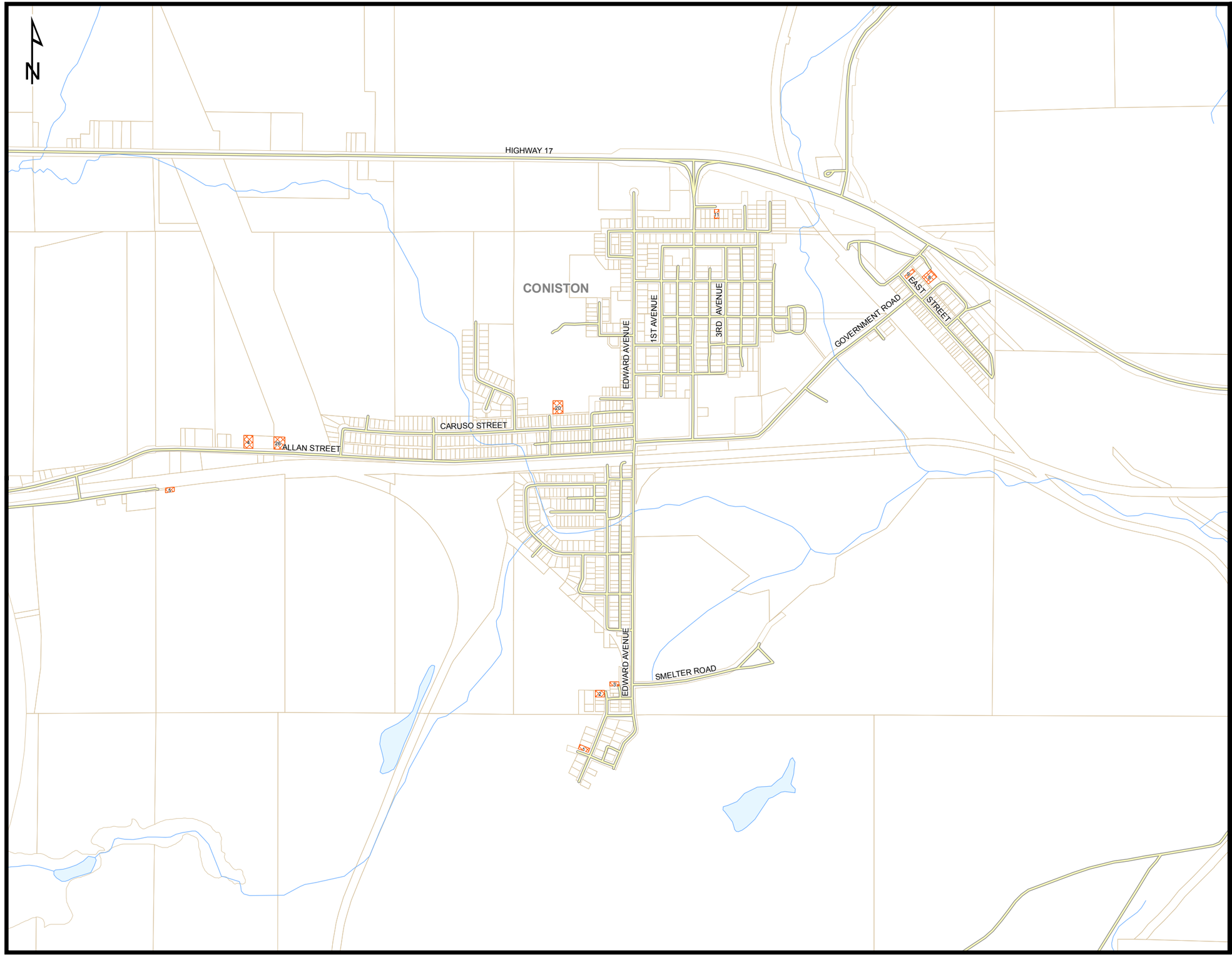
Sudbury Water and Wastewater Master Plan

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Map 4

Chelmsford
Vacant Land Development
(2041 - Ultimate)



Legend

- Road
- Watercourse
- Waterbody
- Parcel
- ICI Development (2011 - 2016)
- Residential Development (2011 - 2016)



Project No. 121-23026-00

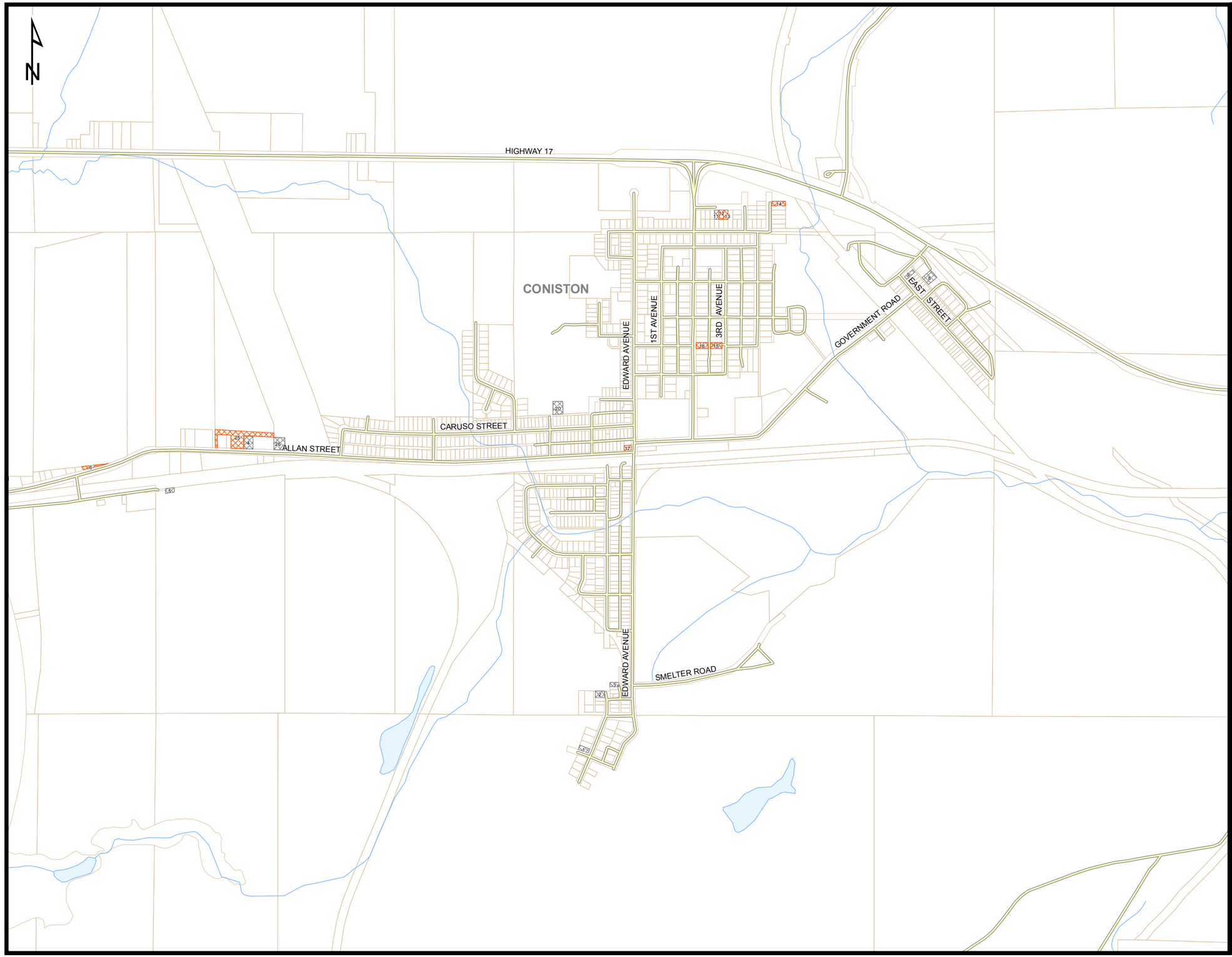
Sudbury Water and Wastewater Master Plan

0 100 200 300 400 500 m

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Map 5

Coniston Vacant Land Development (2011 - 2016)



Legend

- Road
- Watercourse
- Waterbody
- Parcel
- ICI Development (2016 - 2021)
- Residential Development (2016 - 2021)
- ICI Development (2011 - 2016)
- Residential Development (2011 - 2016)



Sudbury | WSP

Project No. 121-23026-00

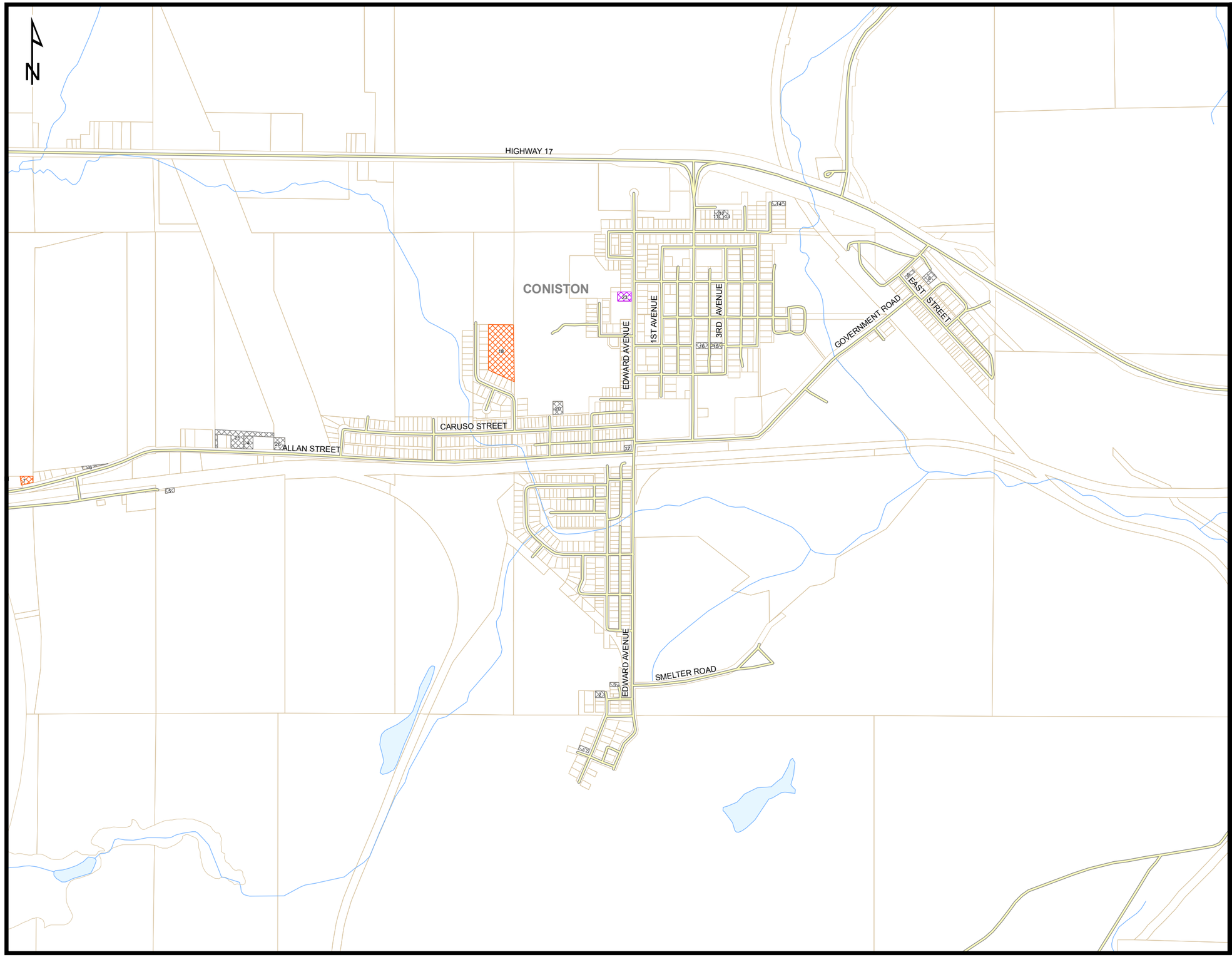
Sudbury Water and Wastewater Master Plan

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Map 5

Coniston
Vacant Land Development (2016 - 2021)



Legend

- Road
- Watercourse
- Waterbody
- Parcel
- ICI Development (2021 - 2026)
- Residential Development (2021 - 2026)
- ICI Development (2011 - 2021)
- Residential Development (2011 - 2021)



Sudbury | WSP

Project No. 121-23026-00

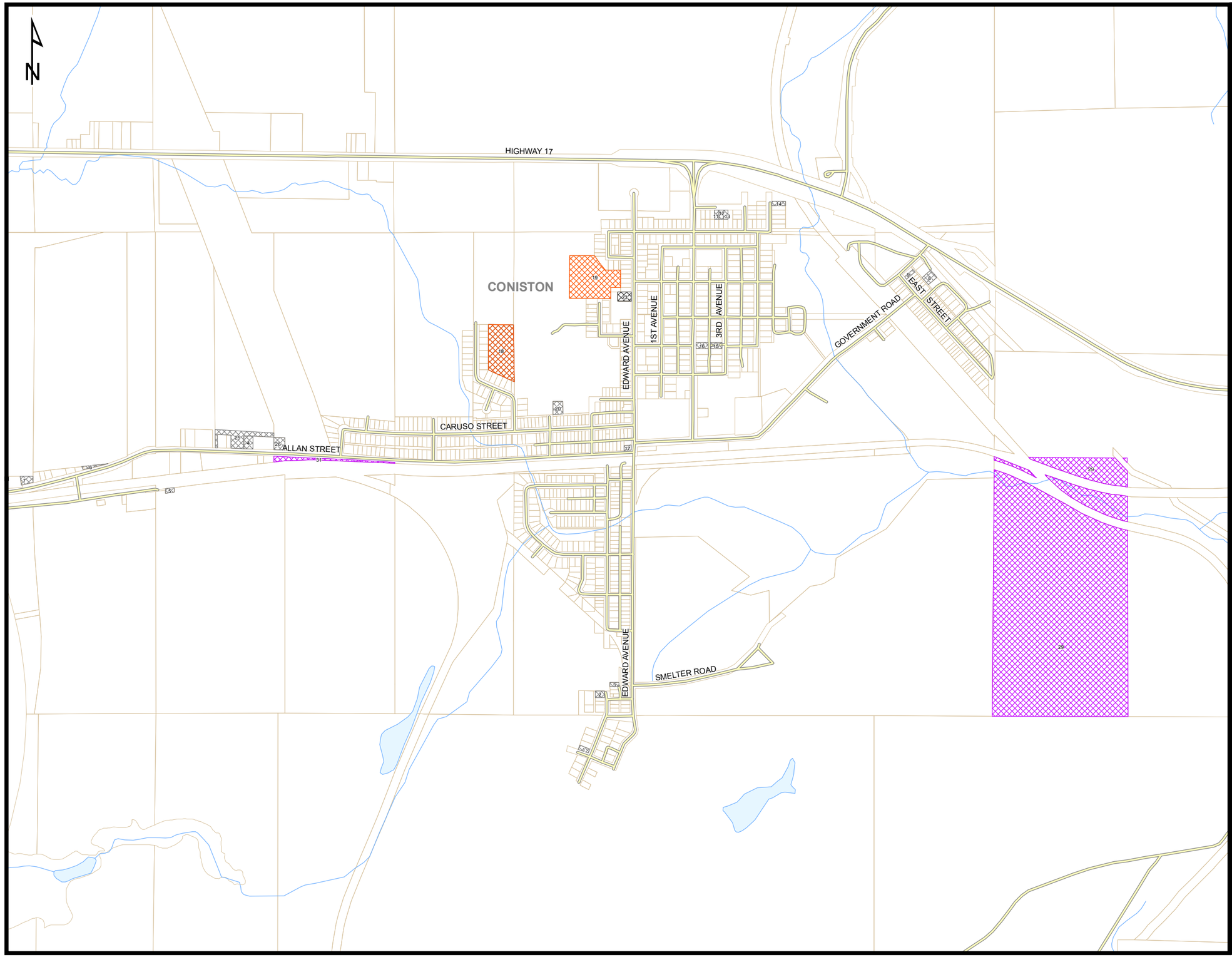
Sudbury Water and Wastewater Master Plan

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Map 5

Coniston
Vacant Land Development
(2021 - 2026)



Legend

- Road
- Watercourse
- Waterbody
- Parcel
- ICI Development (2031 - 2036)
- Residential Development (2031 - 2036)
- ICI Development (2011 - 2031)
- Residential Development (2011 - 2031)



Project No. 121-23026-00

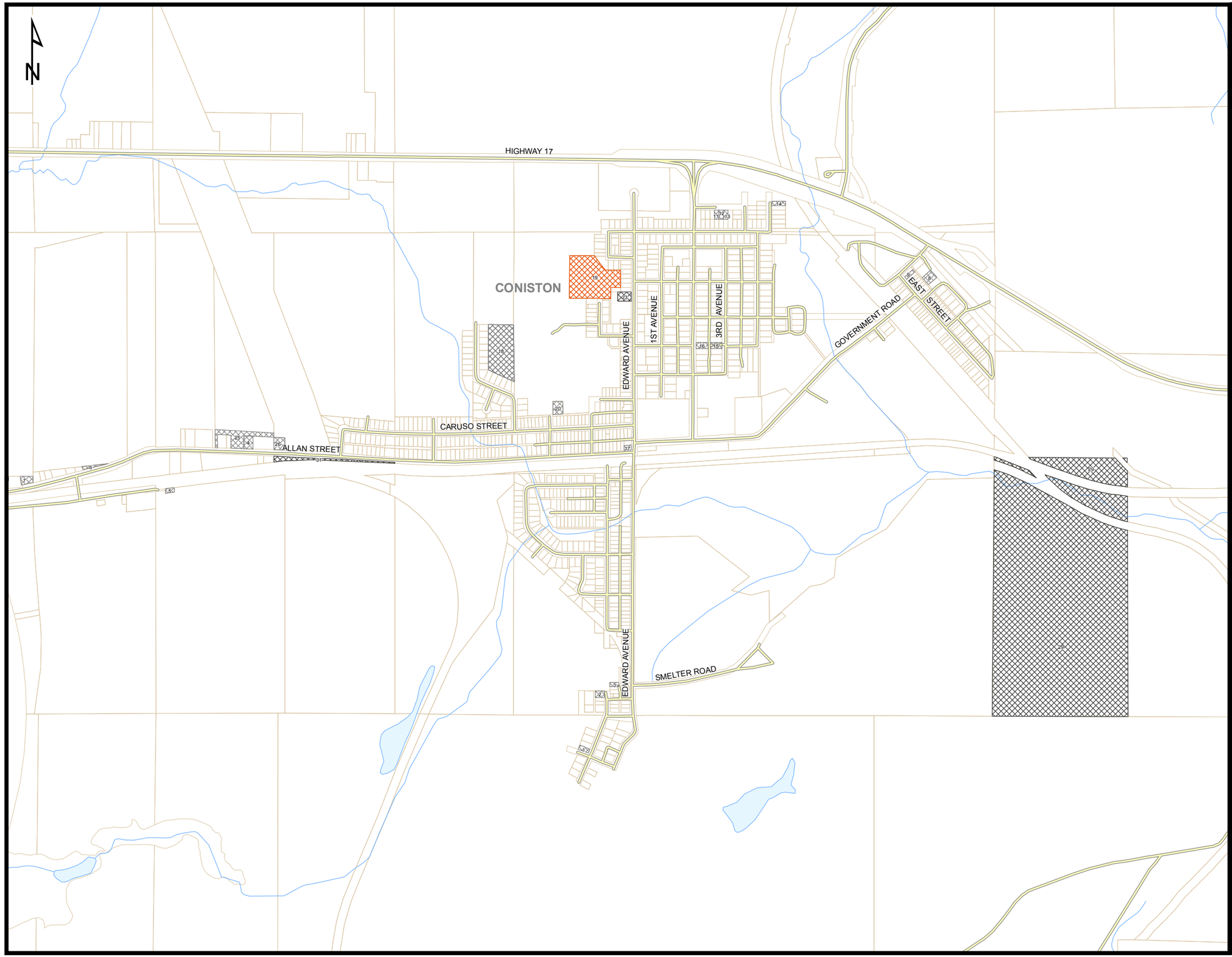
Sudbury Water and Wastewater Master Plan

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Map 5

Coniston Vacant Land Development (2031 - 2036)



Legend

- Road
- Watercourse
- Waterbody
- Parcel
- ICI Development (2036 - 2041)
- Residential Development (2036 - 2041)
- ICI Development (2011 - 2036)
- Residential Development (2011 - 2036)



Project No. 121-23026-00

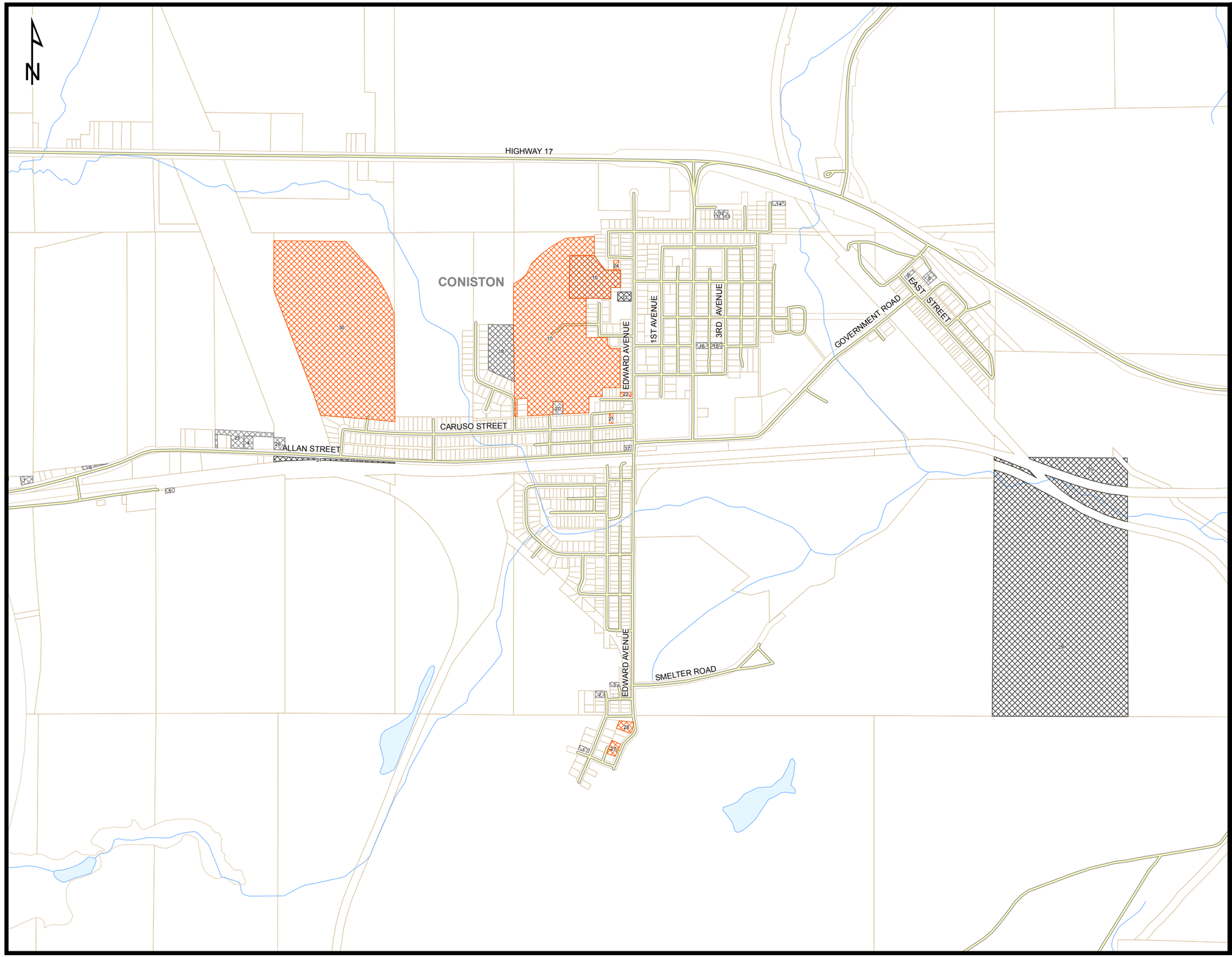
Sudbury Water and Wastewater Master Plan

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Map 5

Coniston Vacant Land Development (2036 - 2041)



Legend

- Road
- Watercourse
- Waterbody
- Parcel
- ICI Development (2041 - Ultimate)
- Residential Development (2041 - Ultimate)
- ICI Development (2011 - 2041)
- Residential Development (2011 - 2041)



Project No. 121-23026-00

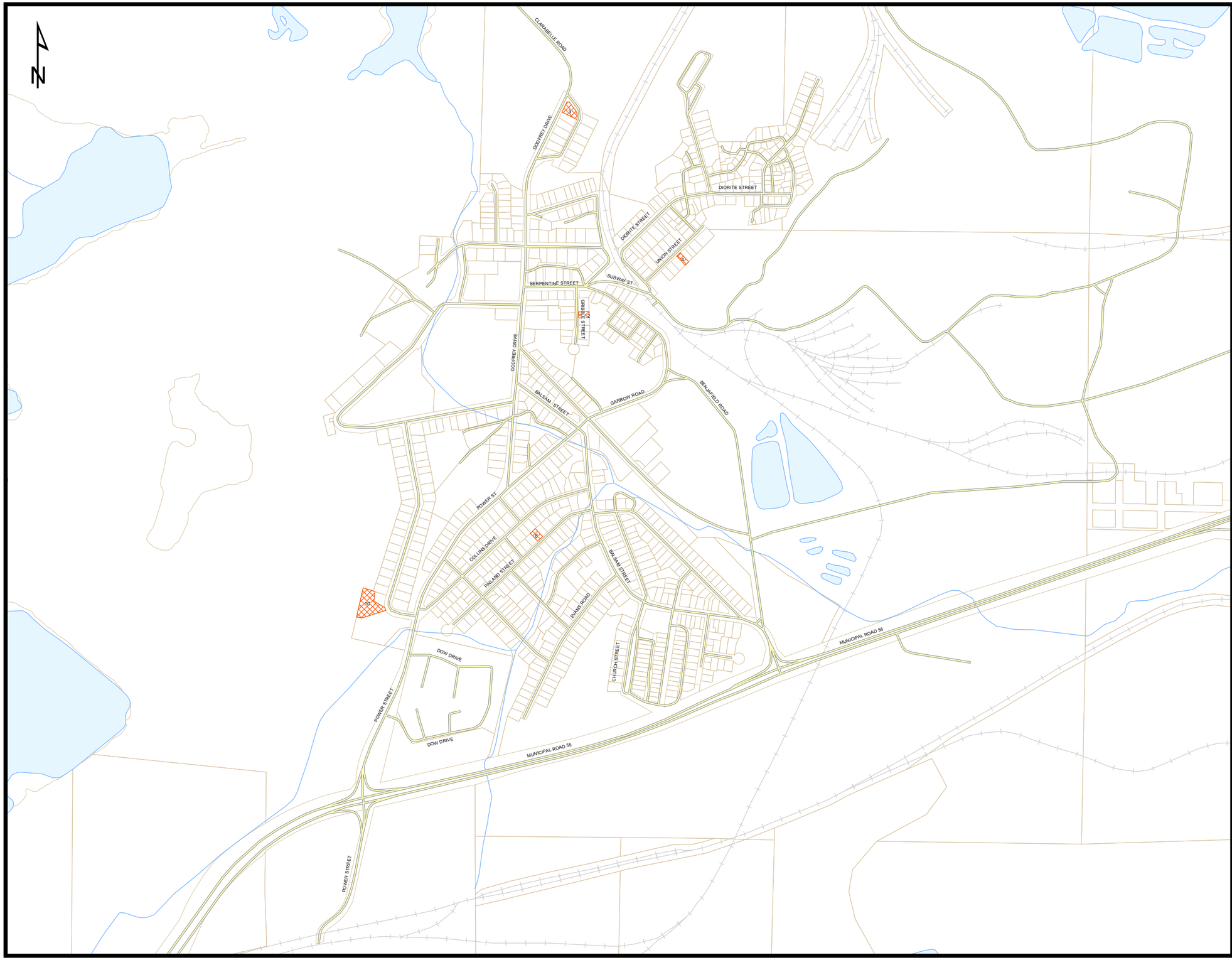
Sudbury Water and Wastewater Master Plan

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Map 5

Coniston
Vacant Land Development
(2041 - Ultimate)



Legend

- Road
- Railway
- Watercourse
- Waterbody
- Parcel
- ICI Development (2011 - 2016)
- Residential Development (2011 - 2016)



Sudbury | WSP

Project No. 121-23026-00

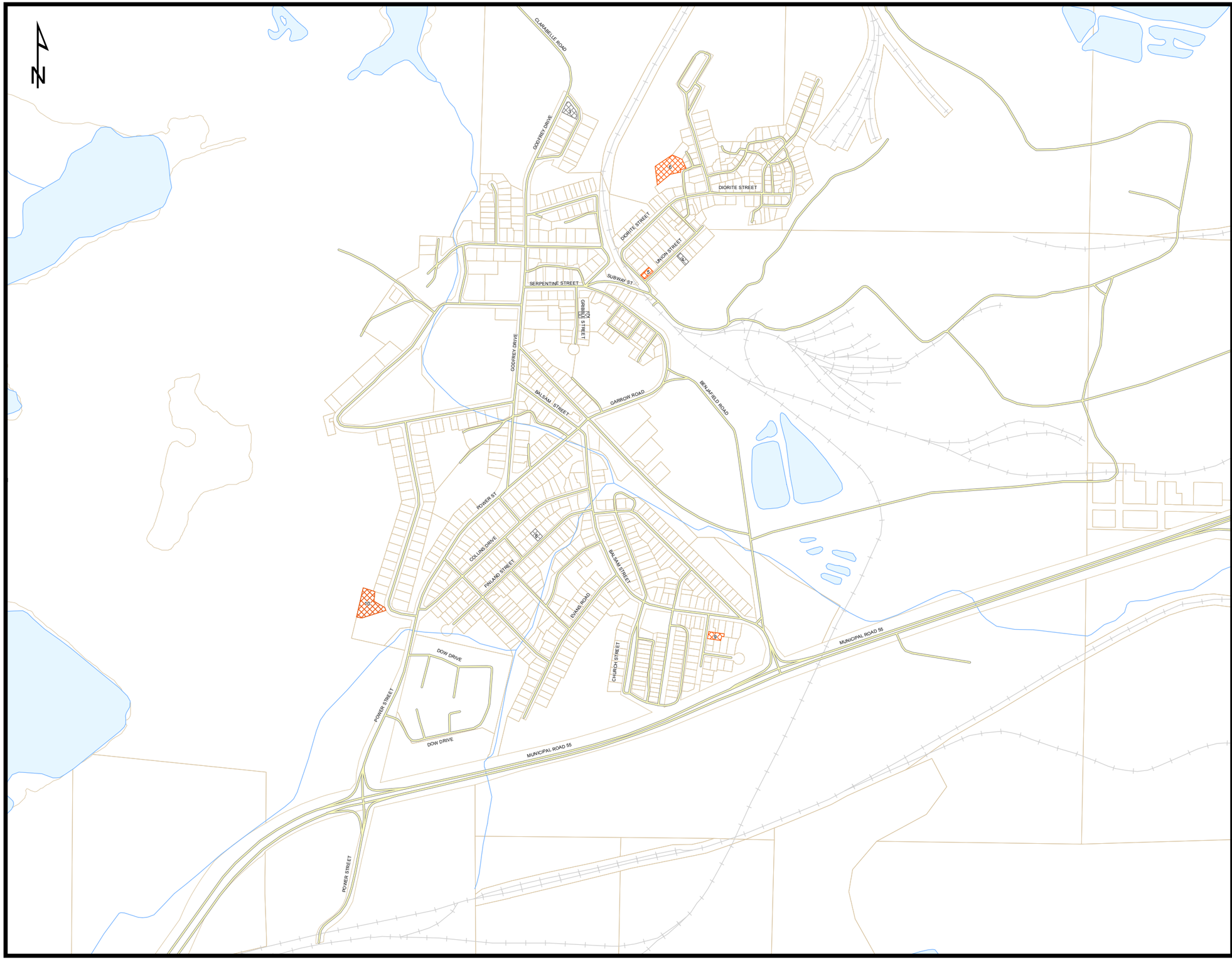
Sudbury Water and Wastewater Master Plan

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1:10,000

Map 6

Copper Cliff Vacant Land Development (2011 - 2016)



Legend

- Road
- Railway
- Watercourse
- Waterbody
- Parcel
- ICI Development (2016 - 2021)
- Residential Development (2016 - 2021)
- ICI Development (2011 - 2016)
- Residential Development (2011 - 2016)



Sudbury | Greater | Grand

WSP

Project No. 121-23026-00

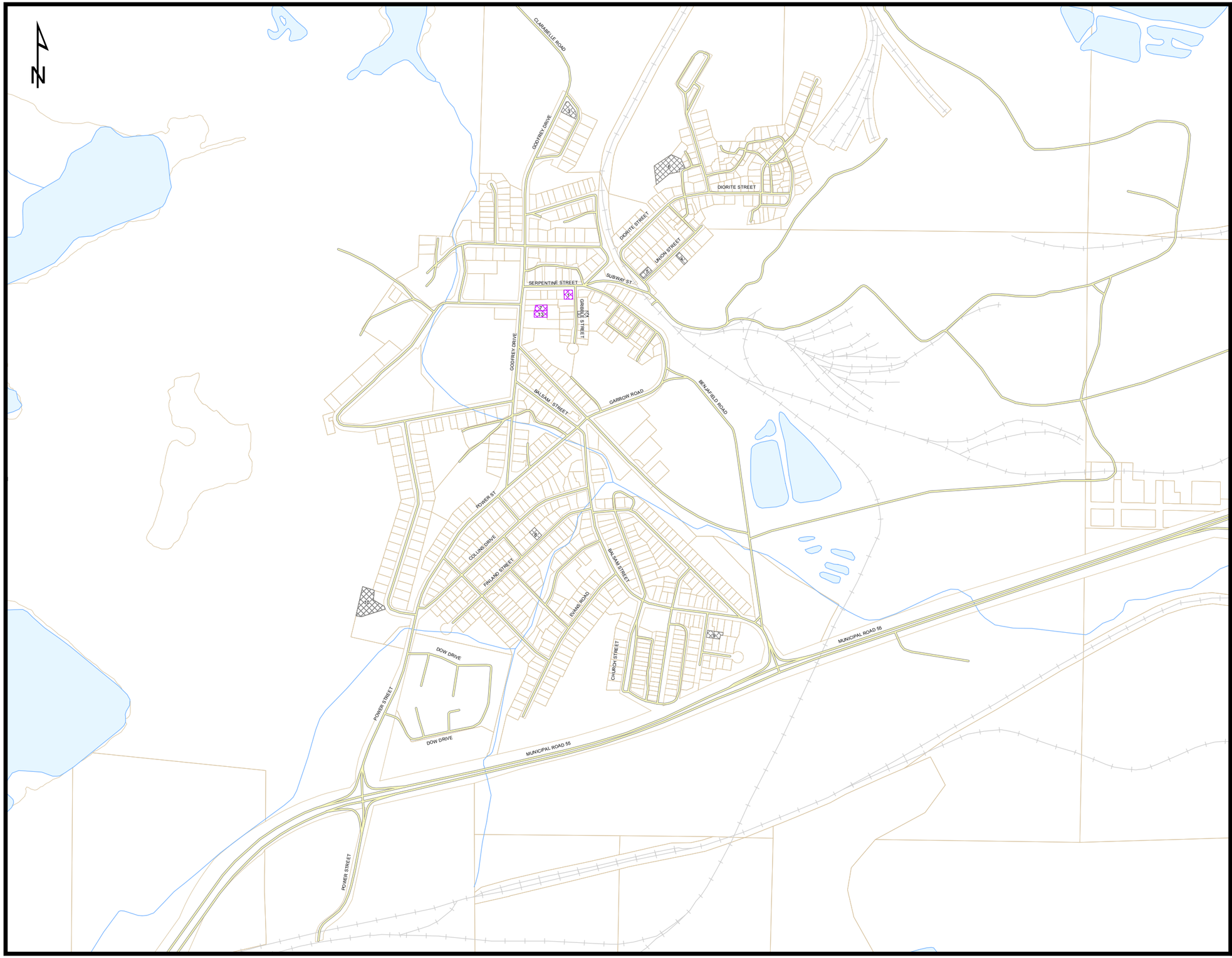
Sudbury Water and Wastewater Master Plan

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Map 6

Copper Cliff Vacant Land Development (2016 - 2021)



Legend

- Road
- Railway
- Watercourse
- Waterbody
- Parcel
- ICI Development (2021 - 2026)
- Residential Development (2021 - 2026)
- ICI Development (2011 - 2021)
- Residential Development (2011 - 2021)



Sudbury | WSP

Project No. 121-23026-00

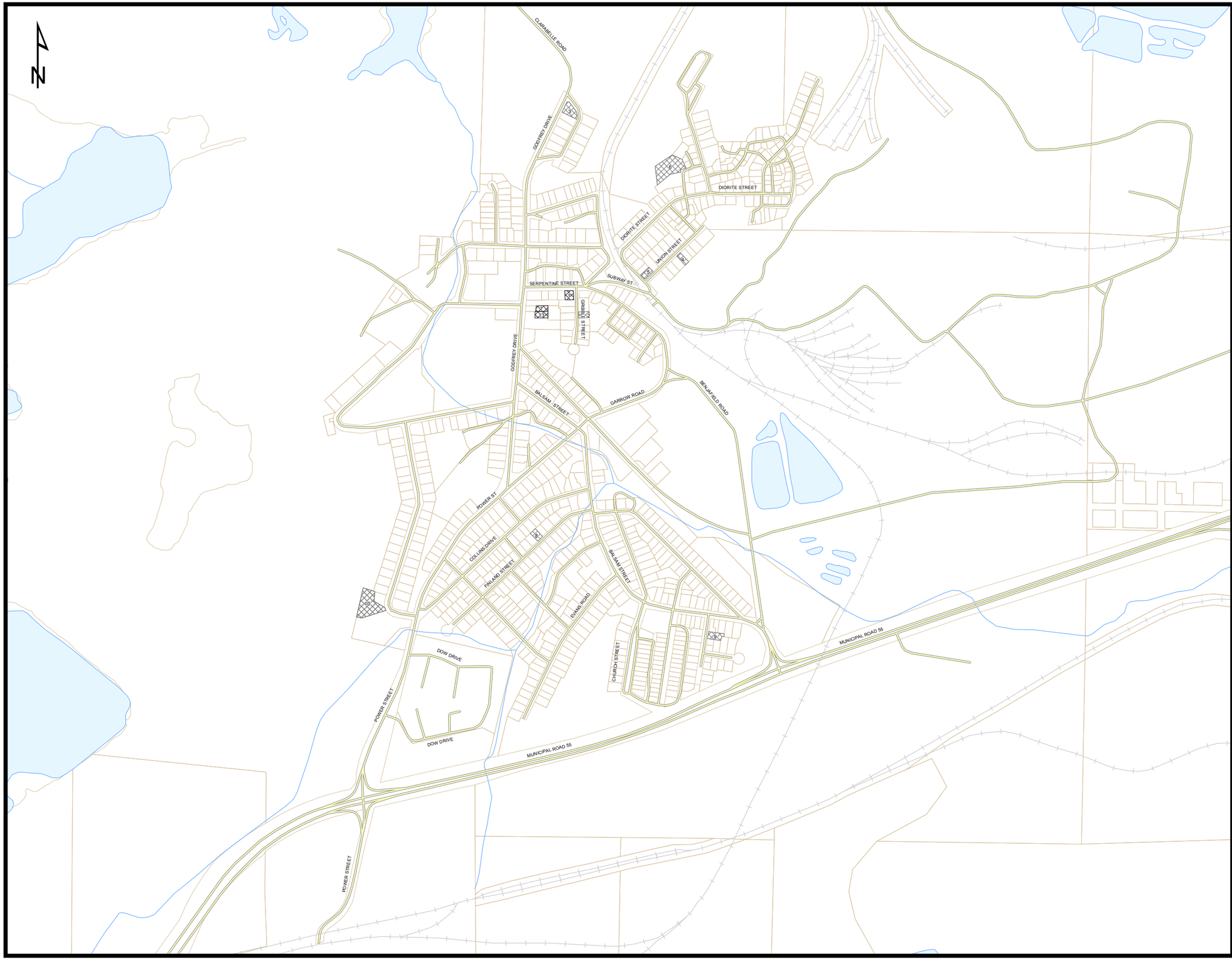
Sudbury Water and Wastewater Master Plan

0 100 200 300 400 500 m

1:10,000

Map 6

Copper Cliff Vacant Land Development (2021 - 2026)



Legend

- Road
- Railway
- Watercourse
- Waterbody
- Parcel
- ICI Development (2026 - 2031)
- Residential Development (2026 - 2031)
- ICI Development (2011 - 2026)
- Residential Development (2011 - 2026)



Sudbury | Greater | Grand

WSP

Project No. 121-23026-00

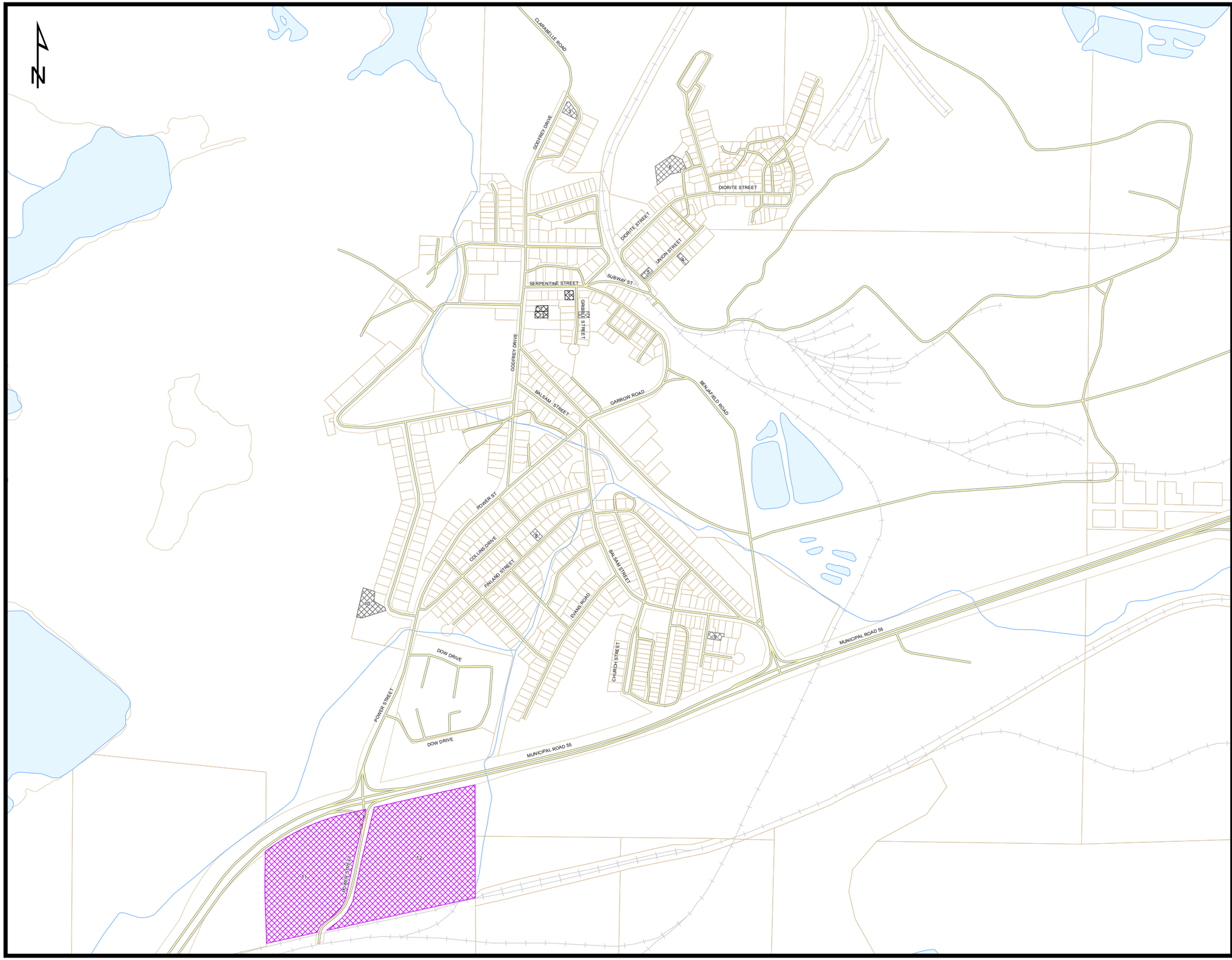
Sudbury Water and Wastewater Master Plan

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1:10,000

Map 6

Copper Cliff Vacant Land Development (2026 - 2031)



Legend

- Road
- Railway
- Watercourse
- Waterbody
- Parcel
- ICI Development (2031 - 2036)
- Residential Development (2031 - 2036)
- ICI Development (2011 - 2031)
- Residential Development (2011 - 2031)



Sudbury | WSP

Project No. 121-23026-00

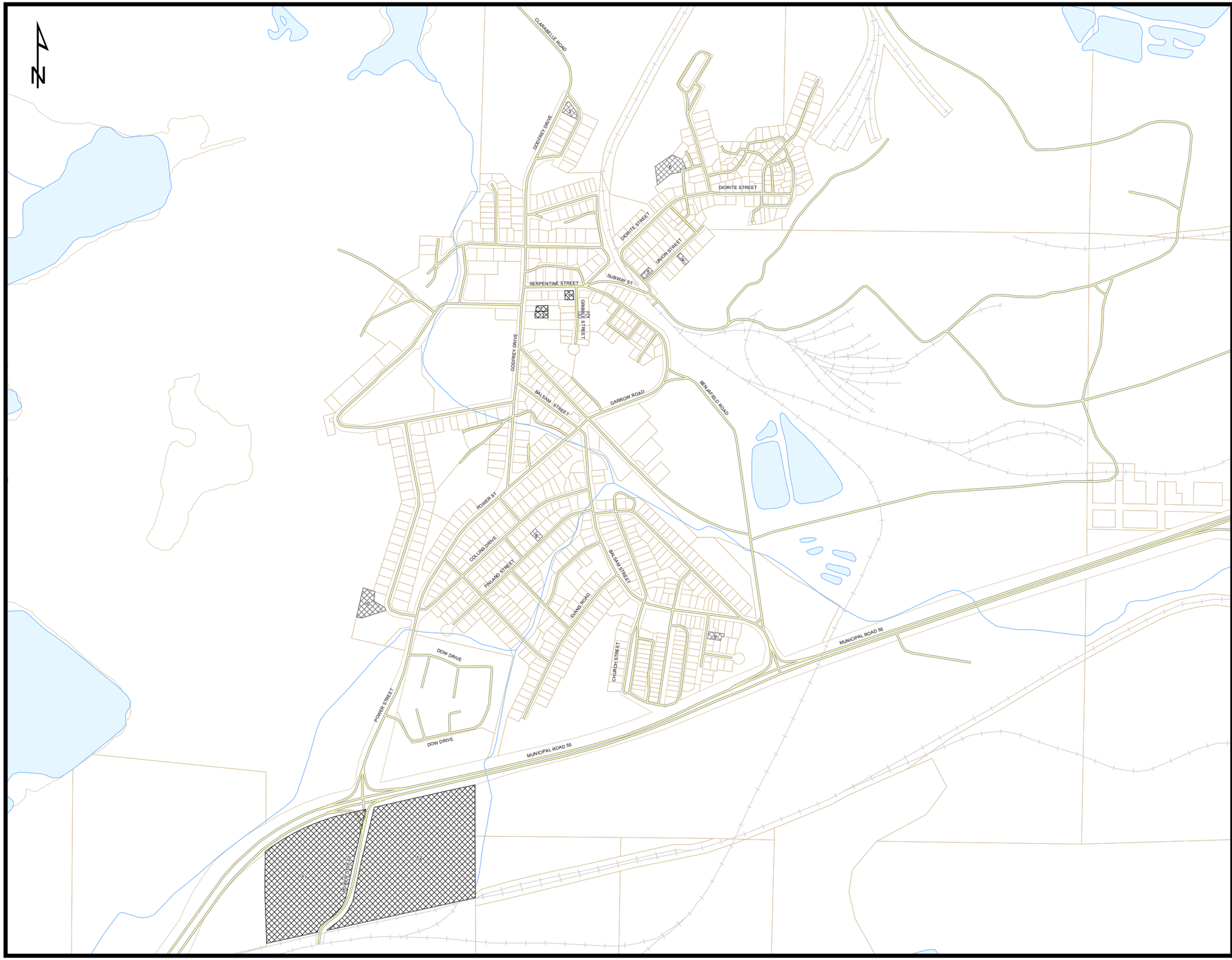
Sudbury Water and Wastewater Master Plan

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1:10,000

Map 6

Copper Cliff
Vacant Land Development
(2031 - 2036)



Legend

- Road
- Railway
- Watercourse
- Waterbody
- Parcel
- ICI Development (2036 - 2041)
- Residential Development (2036 - 2041)
- ICI Development (2011 - 2036)
- Residential Development (2011 - 2036)



Sudbury | WSP

Project No. 121-23026-00

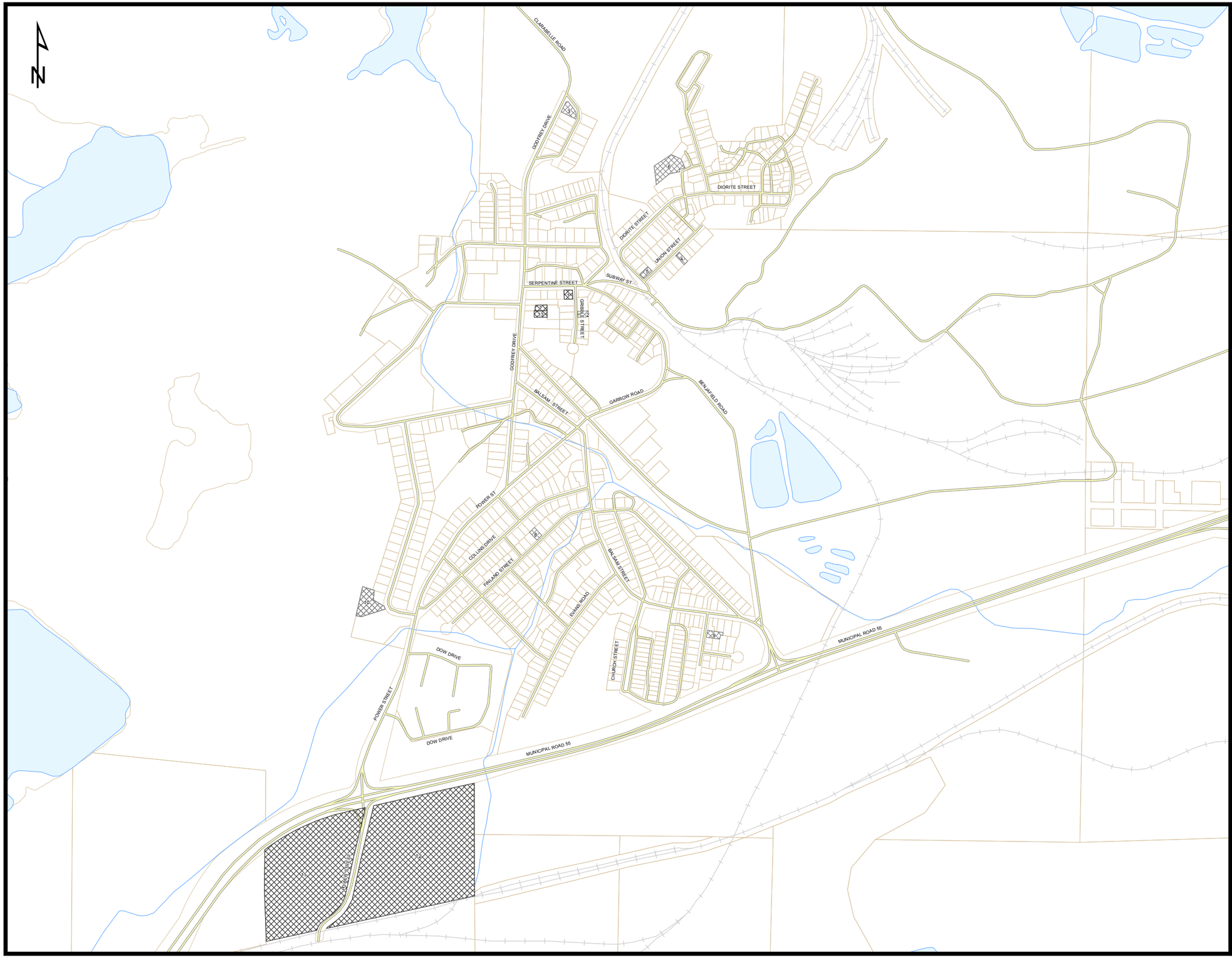
Sudbury Water and Wastewater Master Plan

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Map 6

Copper Cliff Vacant Land Development (2036 - 2041)



Legend

- Road
- Railway
- Watercourse
- Waterbody
- Parcel
- ICI Development (2041 - Ultimate)
- Residential Development (2041 - Ultimate)
- ICI Development (2011 - 2041)
- Residential Development (2011 - 2041)



Project No. 121-23026-00

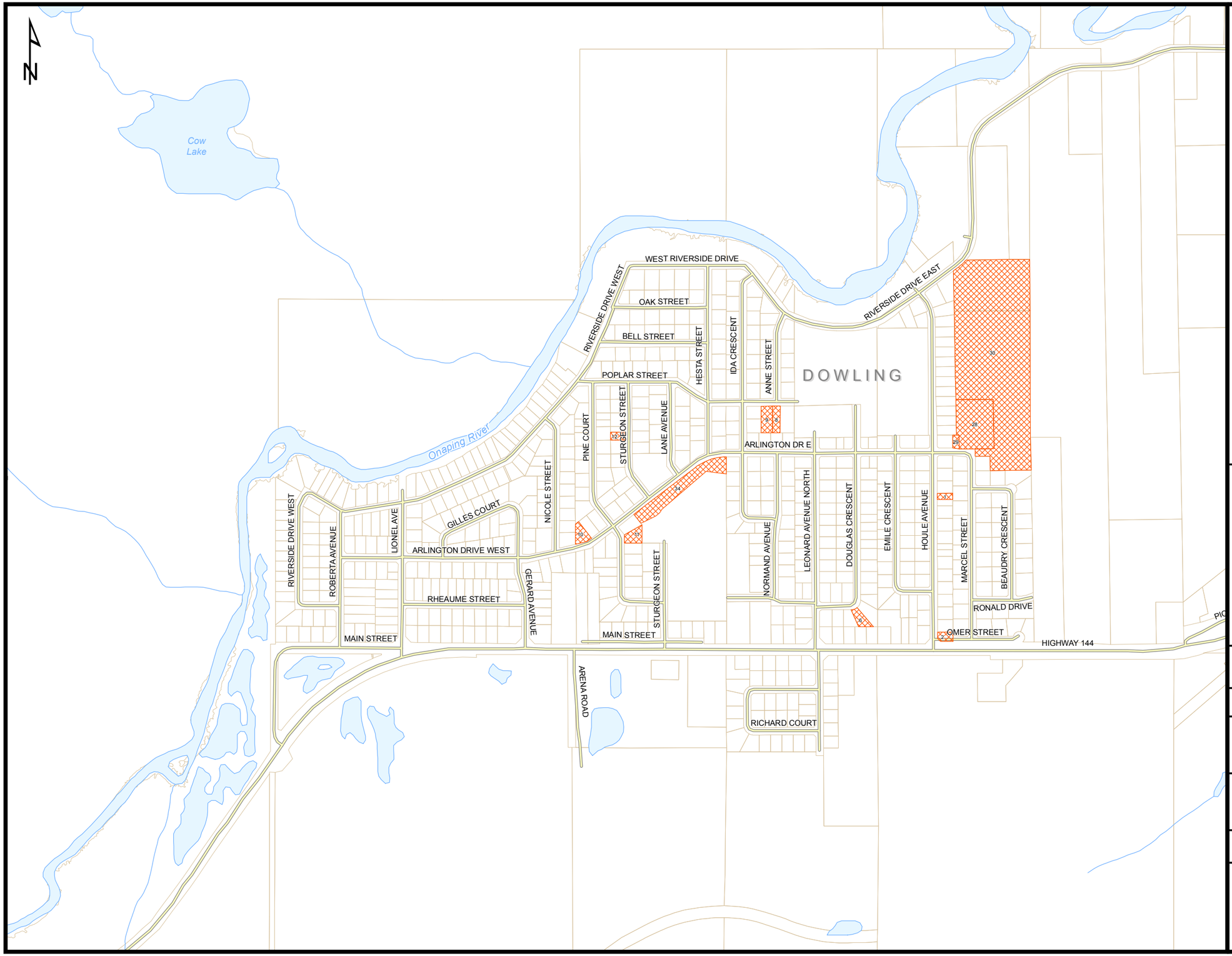
Sudbury Water and Wastewater Master Plan

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Map 6

Copper Cliff Vacant Land Development (2041 - Ultimate)



Legend

- Road
- Watercourse
- Waterbody
- Parcel
- ICI Development (2011 - 2016)
- Residential Development (2011 - 2016)



Project No. 121-23026-00

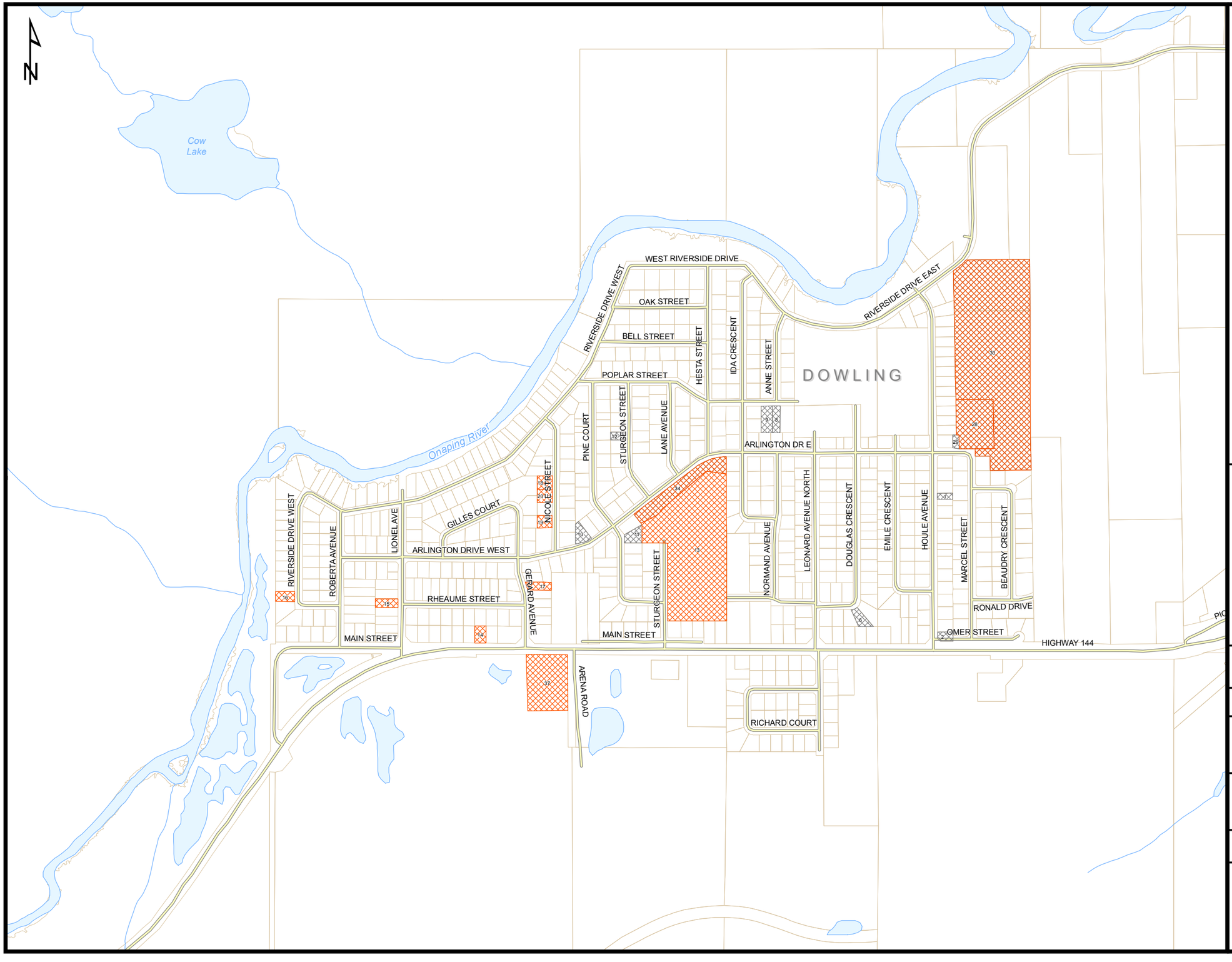
Sudbury Water and Wastewater Master Plan

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1:10,000

Map 7

Dowling Vacant Land Development (2011 - 2016)



Legend

- Road
- Watercourse
- Waterbody
- Parcel
- ICI Development (2016 - 2021)
- Residential Development (2016 - 2021)
- ICI Development (2011 - 2016)
- Residential Development (2011 - 2016)



Sudbury | Greater Grand

WSP

Project No. 121-23026-00

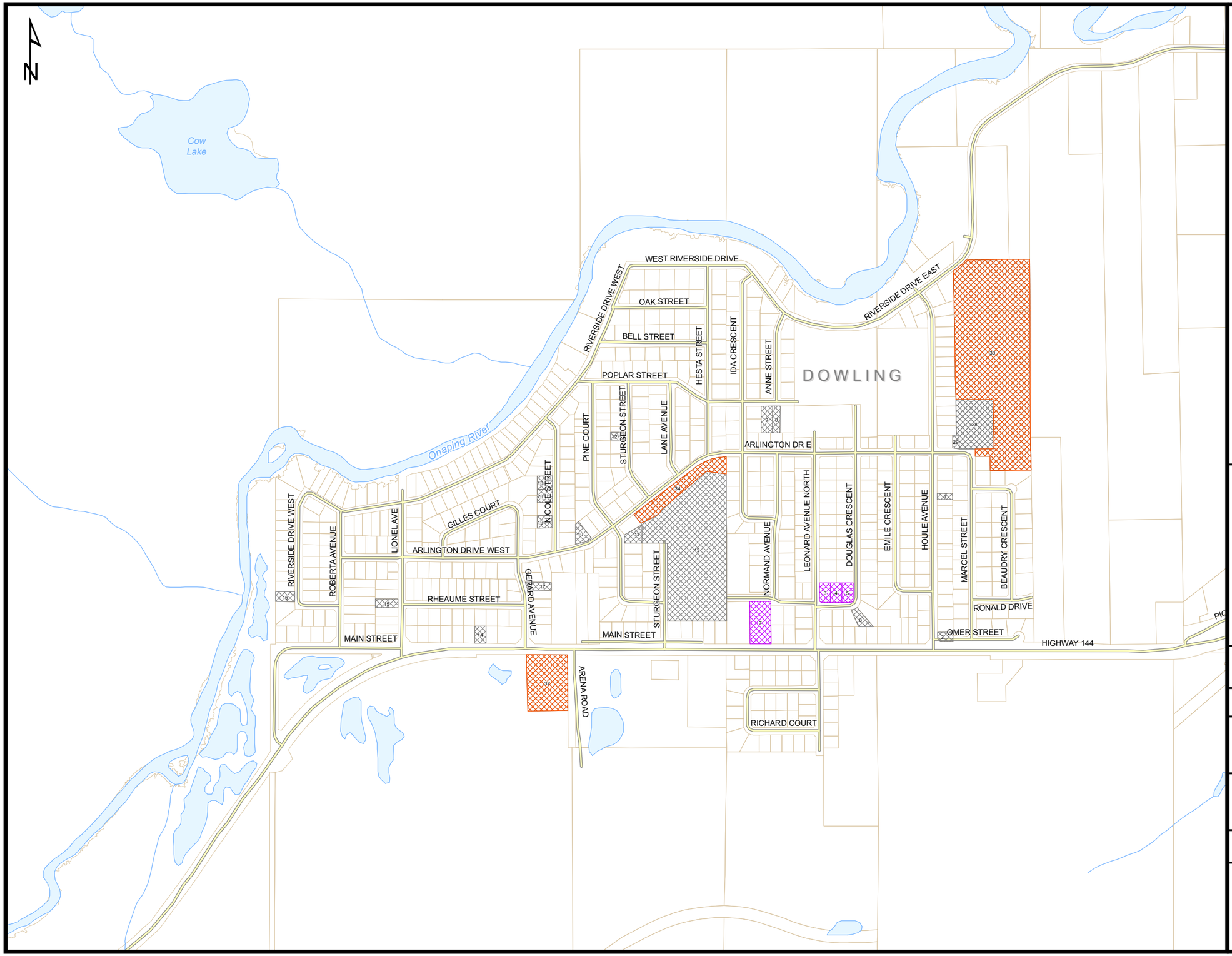
Sudbury Water and Wastewater Master Plan

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1:10,000

Map 7

Dowling Vacant Land Development (2016 - 2021)



Legend

- Road
- Watercourse
- Waterbody
- Parcel
- ICI Development (2021 - 2026)
- Residential Development (2021 - 2026)
- ICI Development (2011 - 2021)
- Residential Development (2011 - 2021)



Sudbury | Greater | Grand

WSP

Project No. 121-23026-00

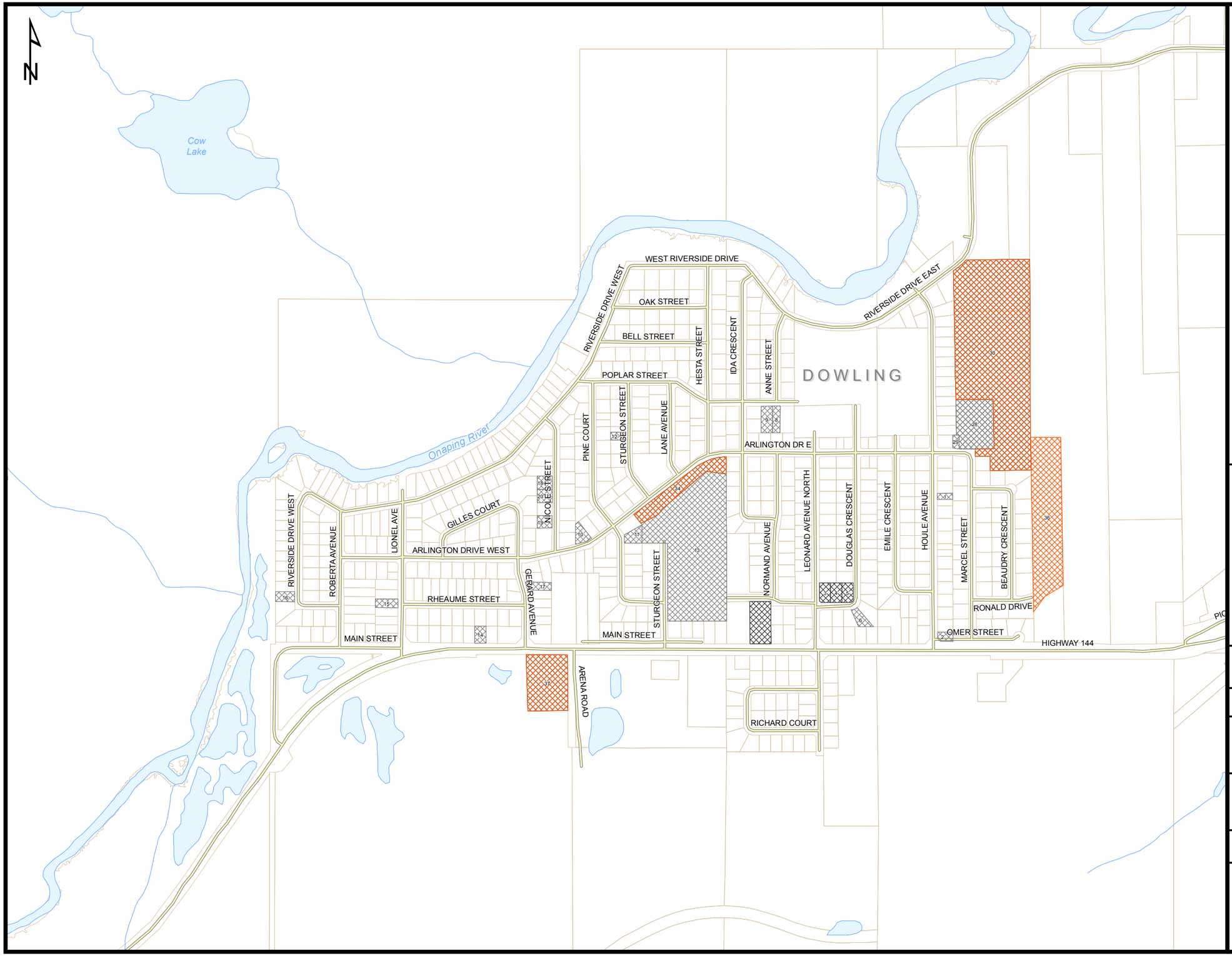
Sudbury Water and Wastewater Master Plan

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1:10,000

Map 7

Dowling
Vacant Land Development
(2021 - 2026)



Legend

- Road
- Watercourse
- Waterbody
- Parcel
- ICI Development (2026 - 2031)
- Residential Development (2026 - 2031)
- ICI Development (2011 - 2026)
- Residential Development (2011 - 2026)



Sudbury | Greater | Grand

WSP

Project No. 121-23026-00

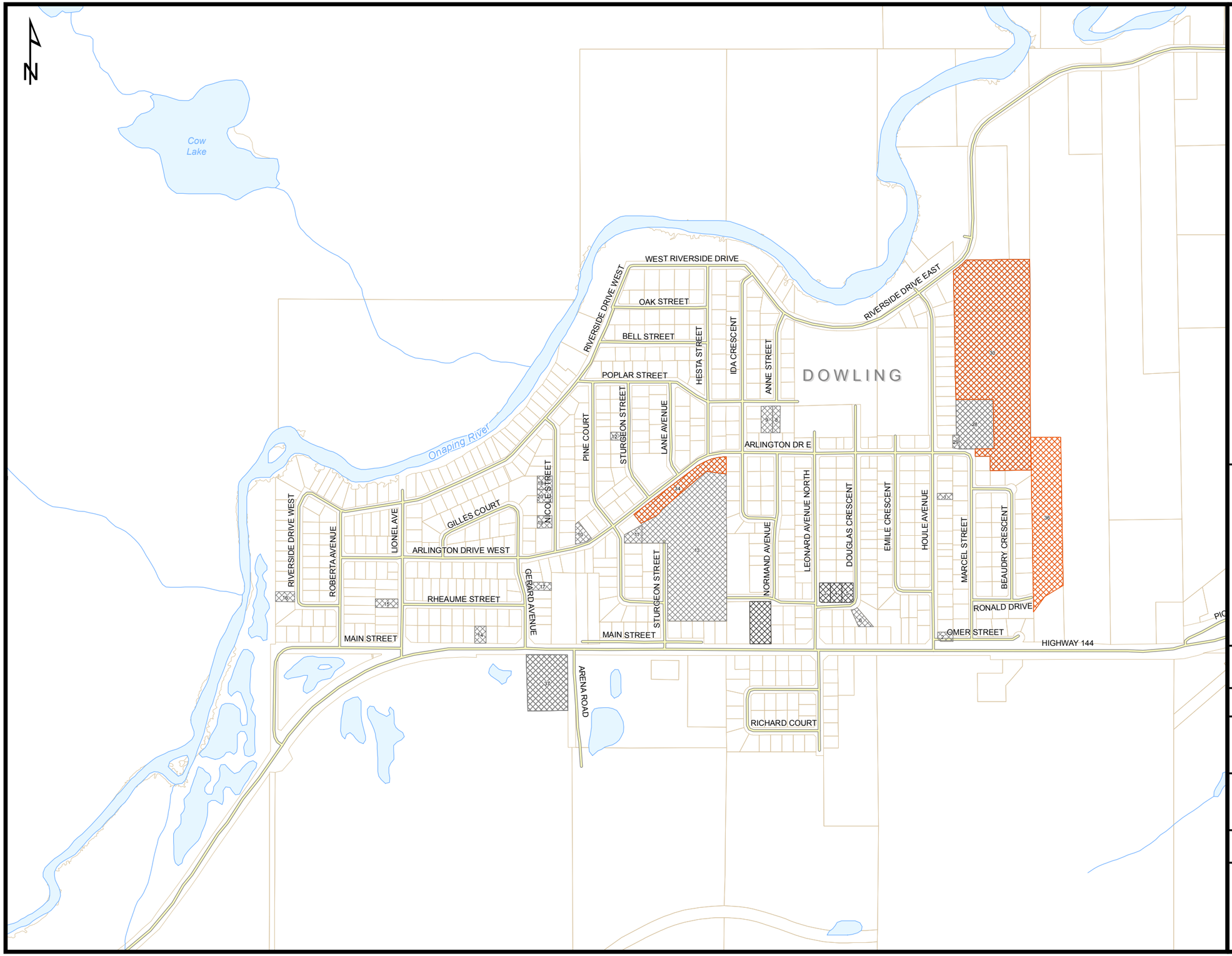
Sudbury Water and Wastewater Master Plan

0 100 200 300 400 500 m

1:10,000

Map 7

Dowling Vacant Land Development (2026 - 2031)



Legend

- Road
- Watercourse
- Waterbody
- Parcel
- ICI Development (2031 - 2036)
- Residential Development (2031 - 2036)
- ICI Development (2011 - 2031)
- Residential Development (2011 - 2031)



Project No. 121-23026-00

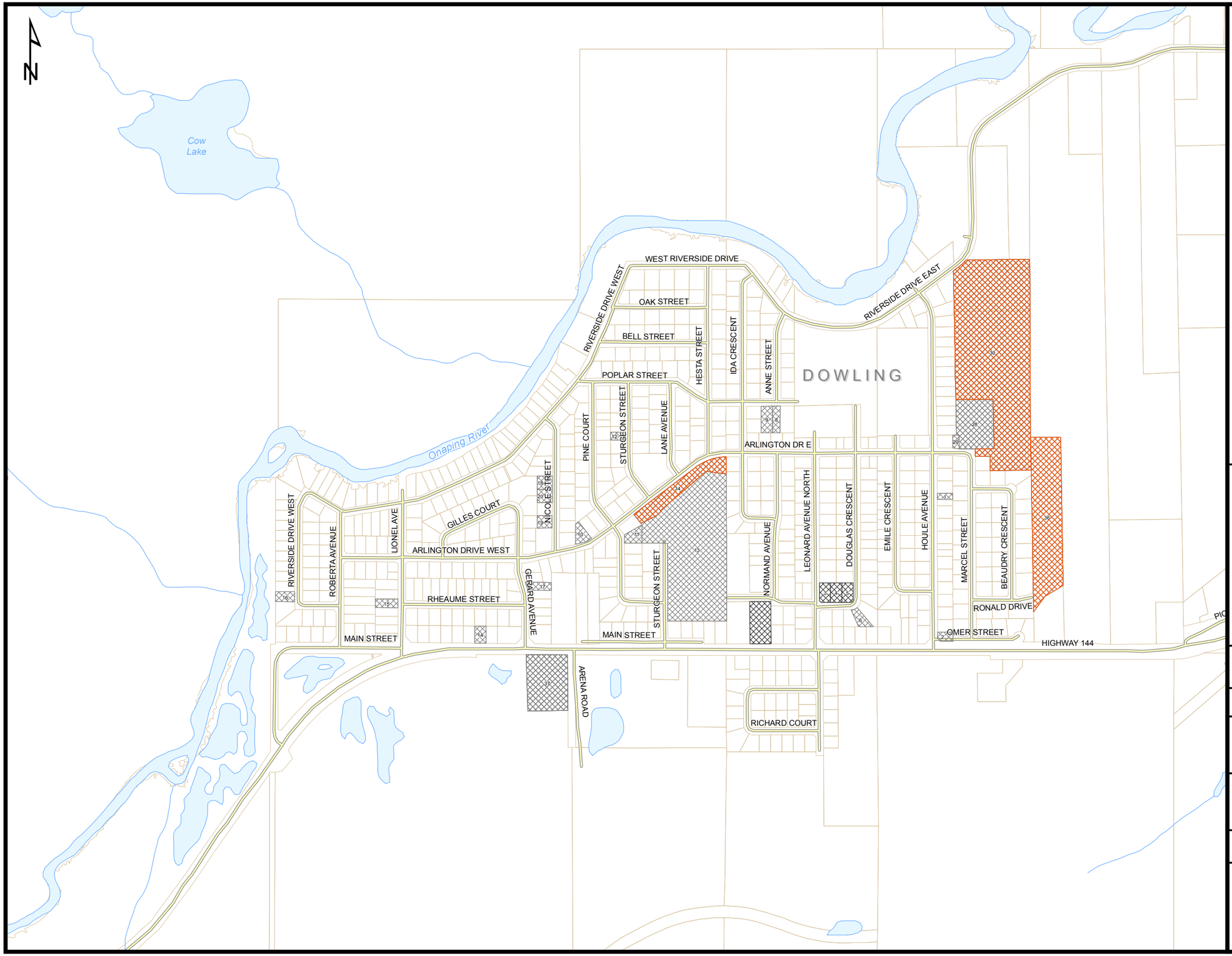
Sudbury Water and Wastewater Master Plan

0 100 200 300 400 500 m

1:10,000

Map 7

Dowling
Vacant Land Development
(2031 - 2036)



Legend

- Road
- Watercourse
- Waterbody
- Parcel
- ICI Development (2036 - 2041)
- Residential Development (2036 - 2041)
- ICI Development (2011 - 2036)
- Residential Development (2011 - 2036)



Sudbury | Greater | Grand

WSP

Project No. 121-23026-00

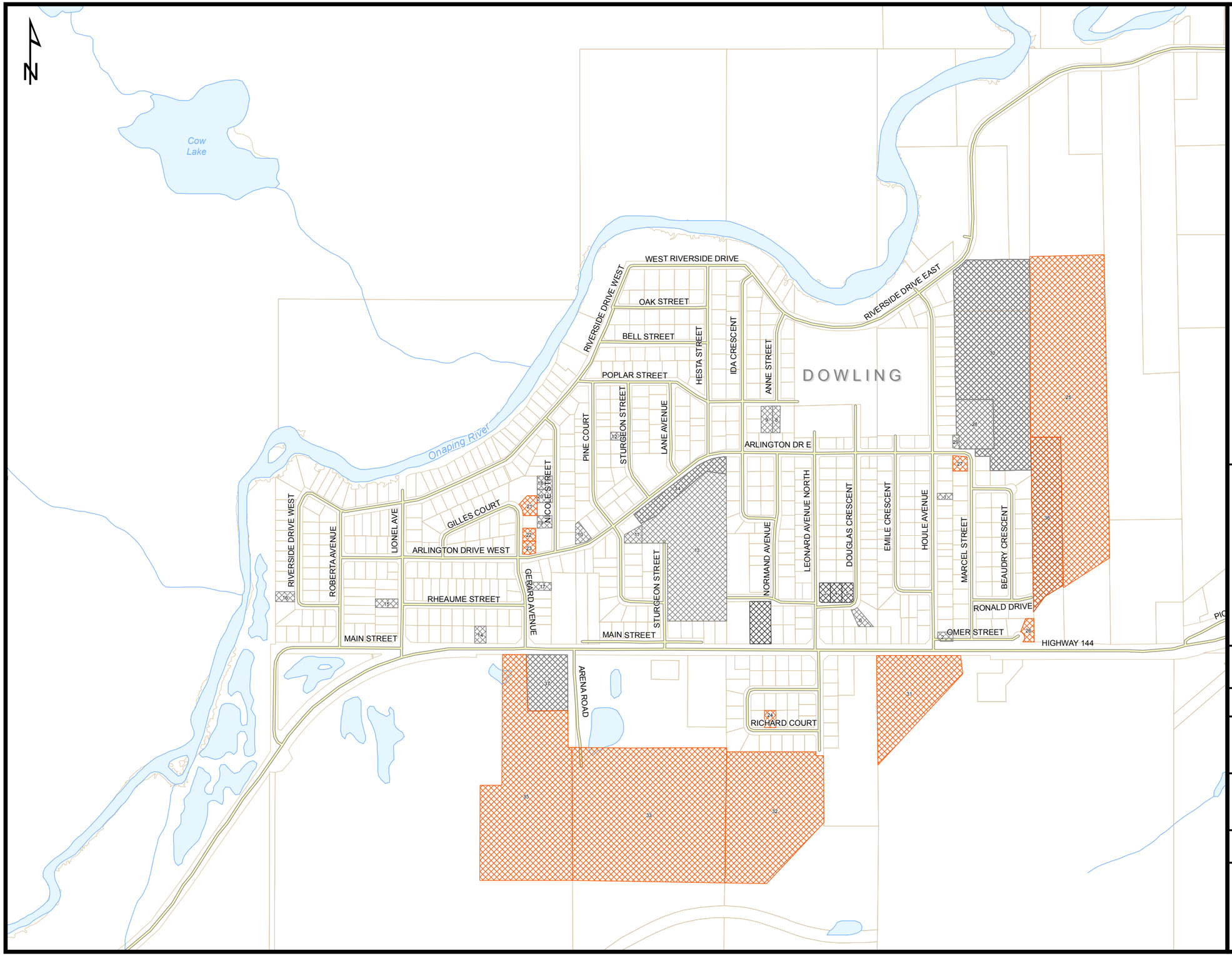
Sudbury Water and Wastewater Master Plan

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Map 7

Dowling
Vacant Land Development
(2036 - 2041)



Legend

- Road
- Watercourse
- Waterbody
- Parcel
- ICI Development (2041 - Ultimate)
- Residential Development (2041 - Ultimate)
- ICI Development (2011 - 2041)
- Residential Development (2011 - 2041)



Project No. 121-23026-00

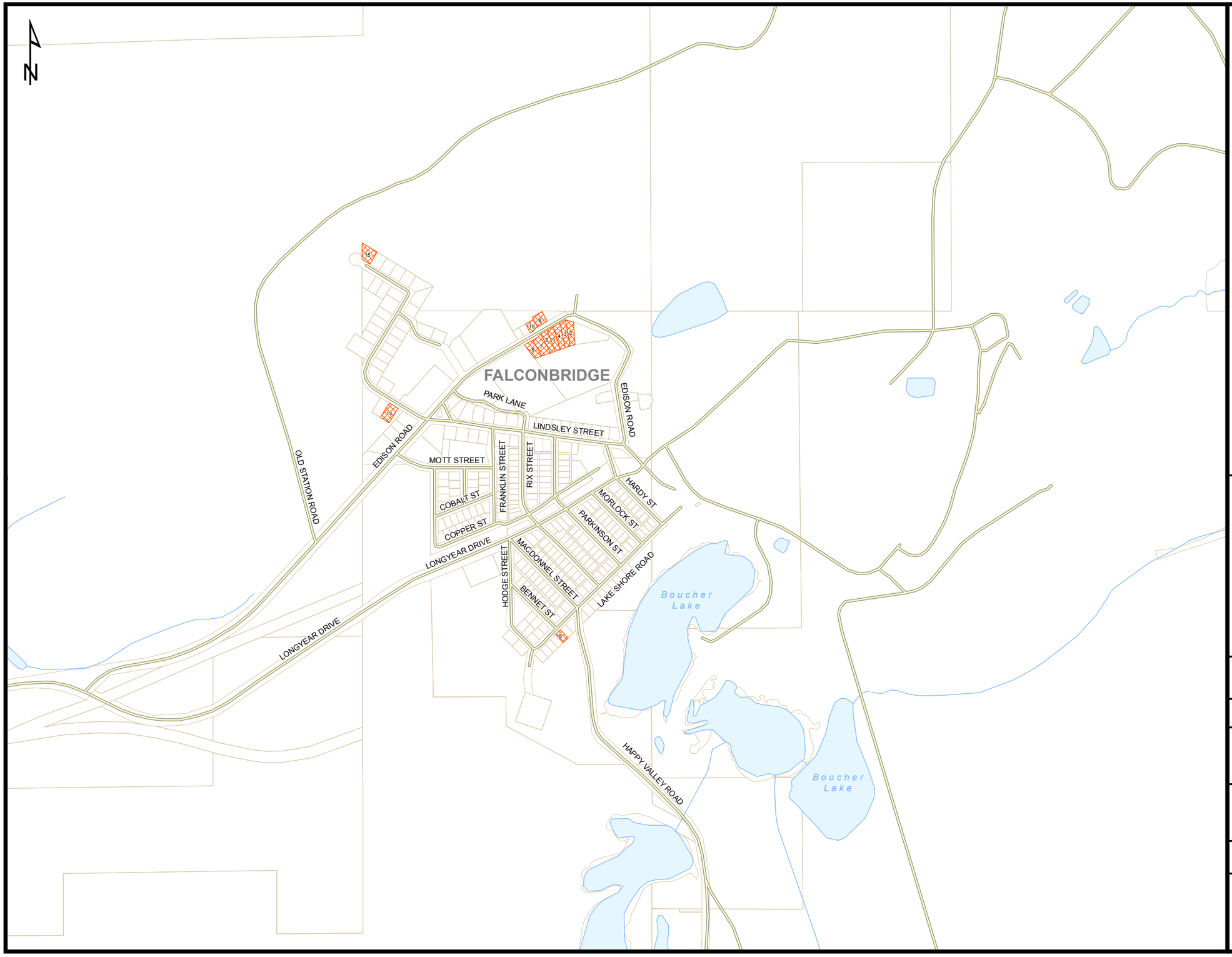
Sudbury Water and Wastewater Master Plan

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Map 7

Dowling
Vacant Land Development
(2041 - Ultimate)



Legend

- Road
- Waterbody
- Watercourse
- Parcel
- ICI Development (2011 - 2016)
- Residential Development (2011 - 2016)



Project No. 121-23026-00

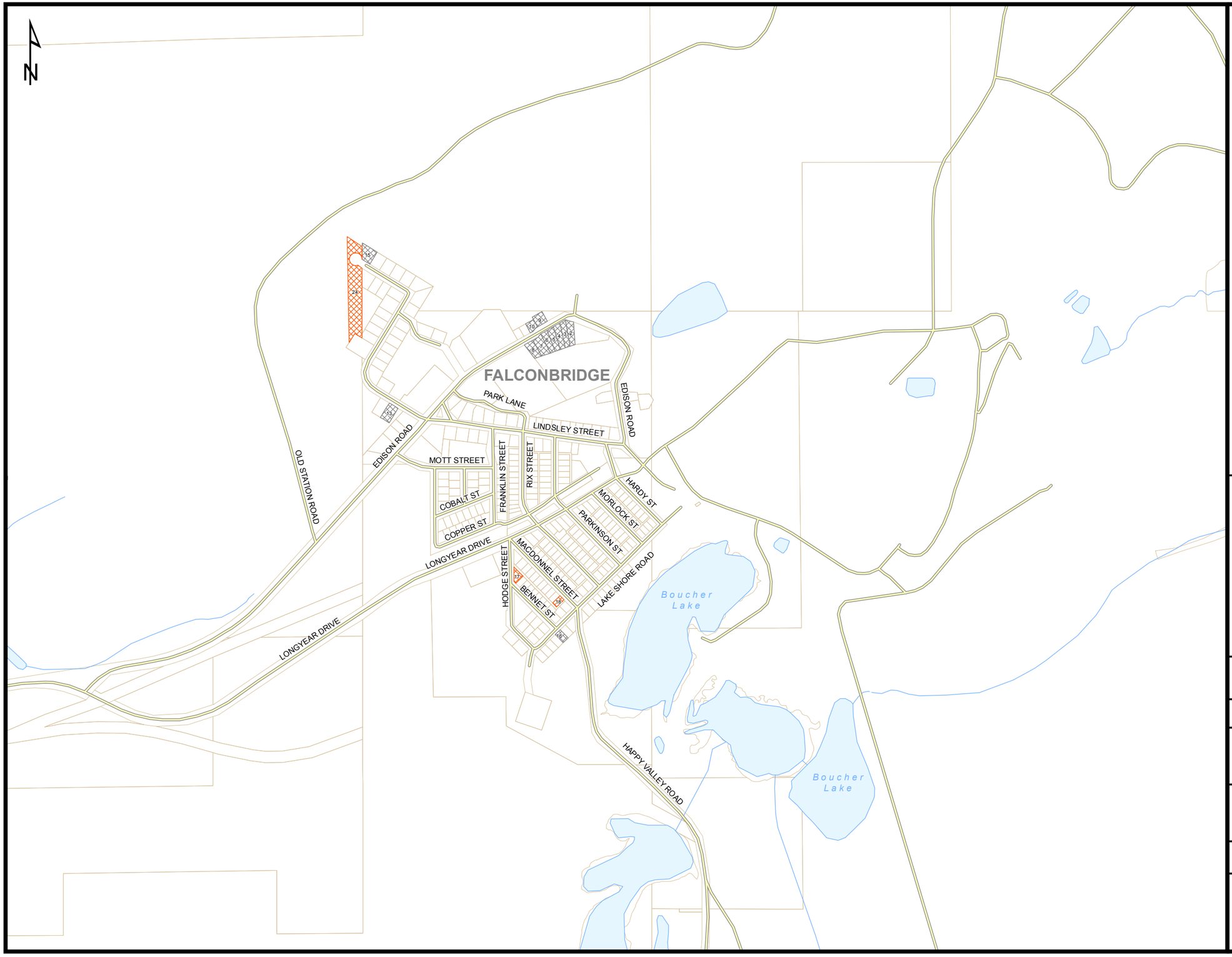
Sudbury Water and Wastewater Master Plan

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1:10,000

Map 8

Falconbridge
Vacant Land Development
(2011 - 2016)



Legend

- Road
- Waterbody
- Watercourse
- Parcel
- ICI Development (2016 - 2021)
- Residential Development (2016 - 2021)
- ICI Development (2011 - 2016)
- Residential Development (2011 - 2016)



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Project No. 121-23026-00

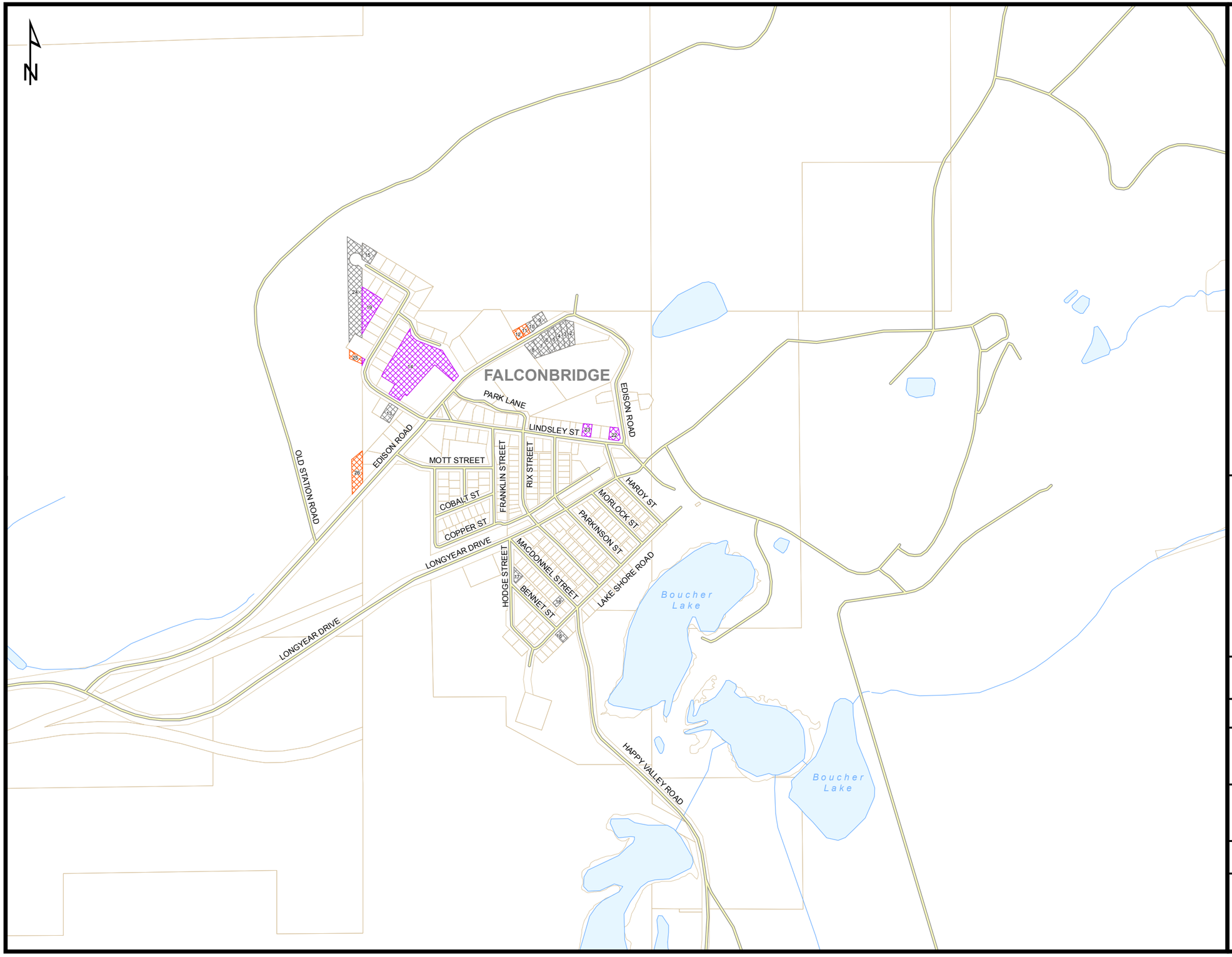
Sudbury Water and Wastewater Master Plan

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Map 8

Falconbridge
Vacant Land Development
(2016 - 2021)



Legend

- Road
- Waterbody
- Watercourse
- Parcel
- ICI Development (2021 - 2026)
- Residential Development (2021 - 2026)
- ICI Development (2011 - 2021)
- Residential Development (2011 - 2021)



Project No. 121-23026-00

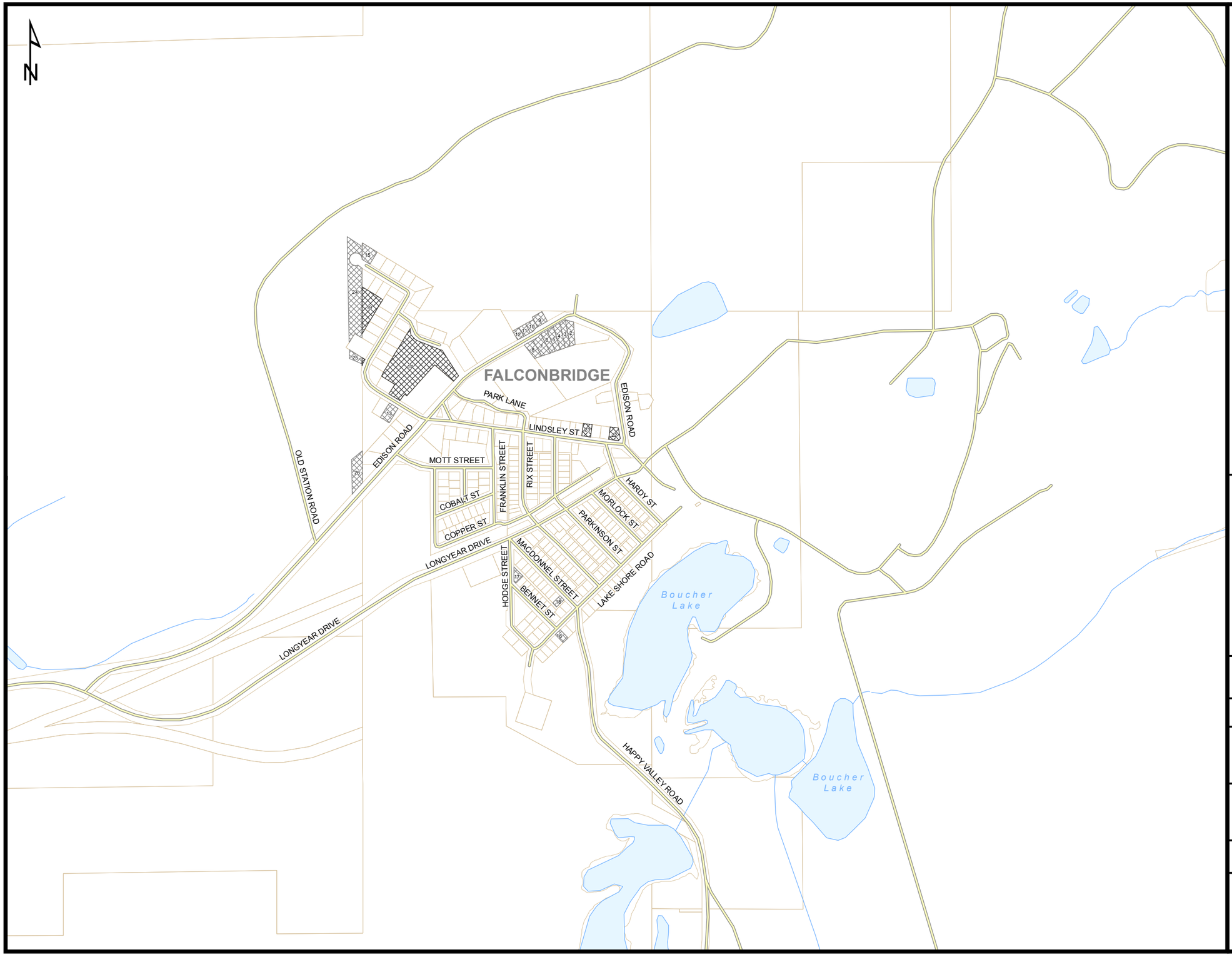
Sudbury Water and Wastewater Master Plan

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1:10,000

Map 8

Falconbridge
Vacant Land Development
(2021 - 2026)



Legend

- Road
- Waterbody
- Watercourse
- Parcel
- ICI Development (2026 - 2031)
- Residential Development (2026 - 2031)
- ICI Development (2011 - 2026)
- Residential Development (2011 - 2026)



Project No. 121-23026-00

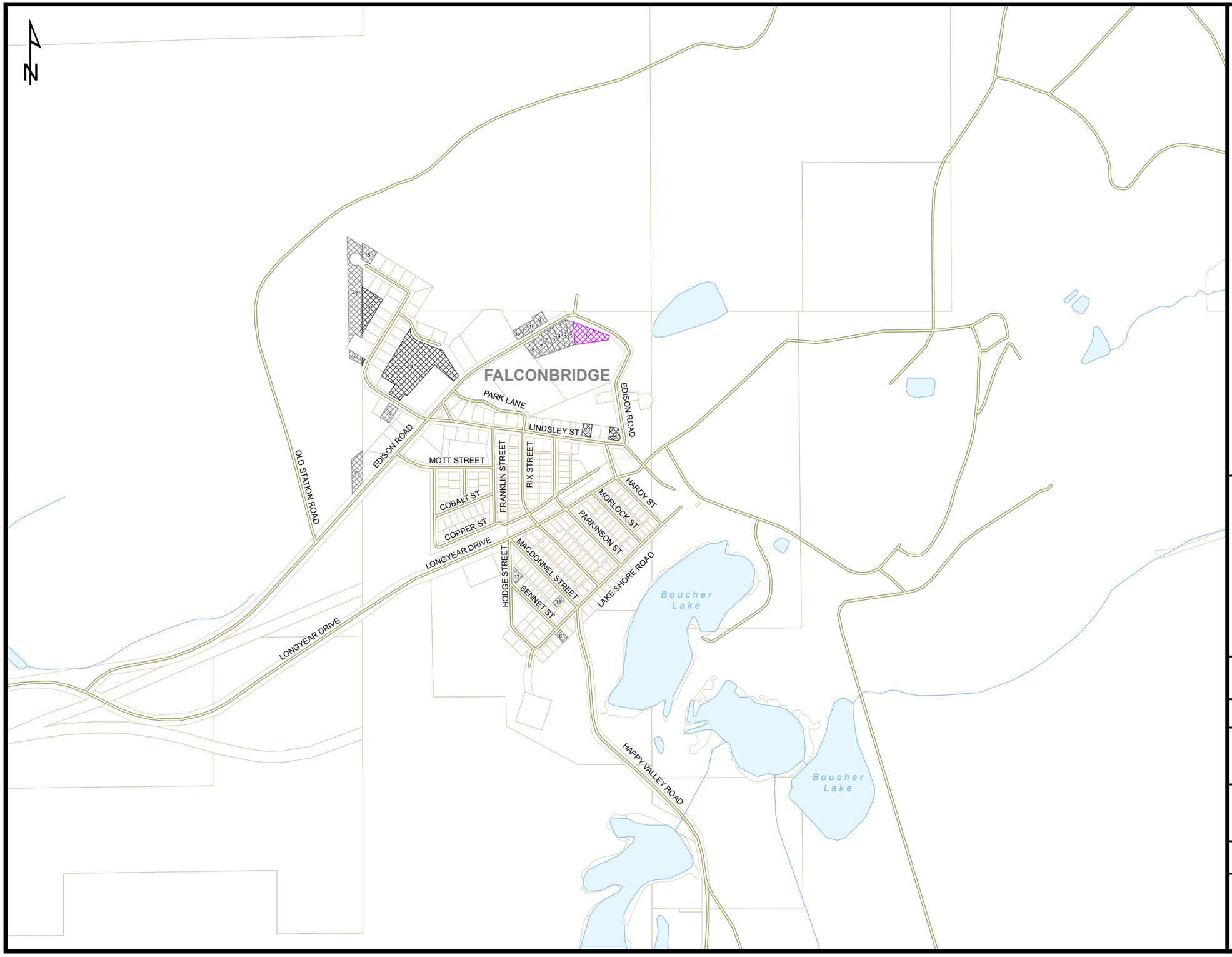
Sudbury Water and Wastewater Master Plan

0 100 200 300 400 500 m

1:10,000

Map 8

Falconbridge
Vacant Land Development
(2026 - 2031)



Legend

- Road
- Waterbody
- Watercourse
- Parcel
- ICI Development (2031 - 2036)
- Residential Development (2031 - 2036)
- ICI Development (2011 - 2031)
- Residential Development (2011 - 2031)



Project No. 121-23026-00

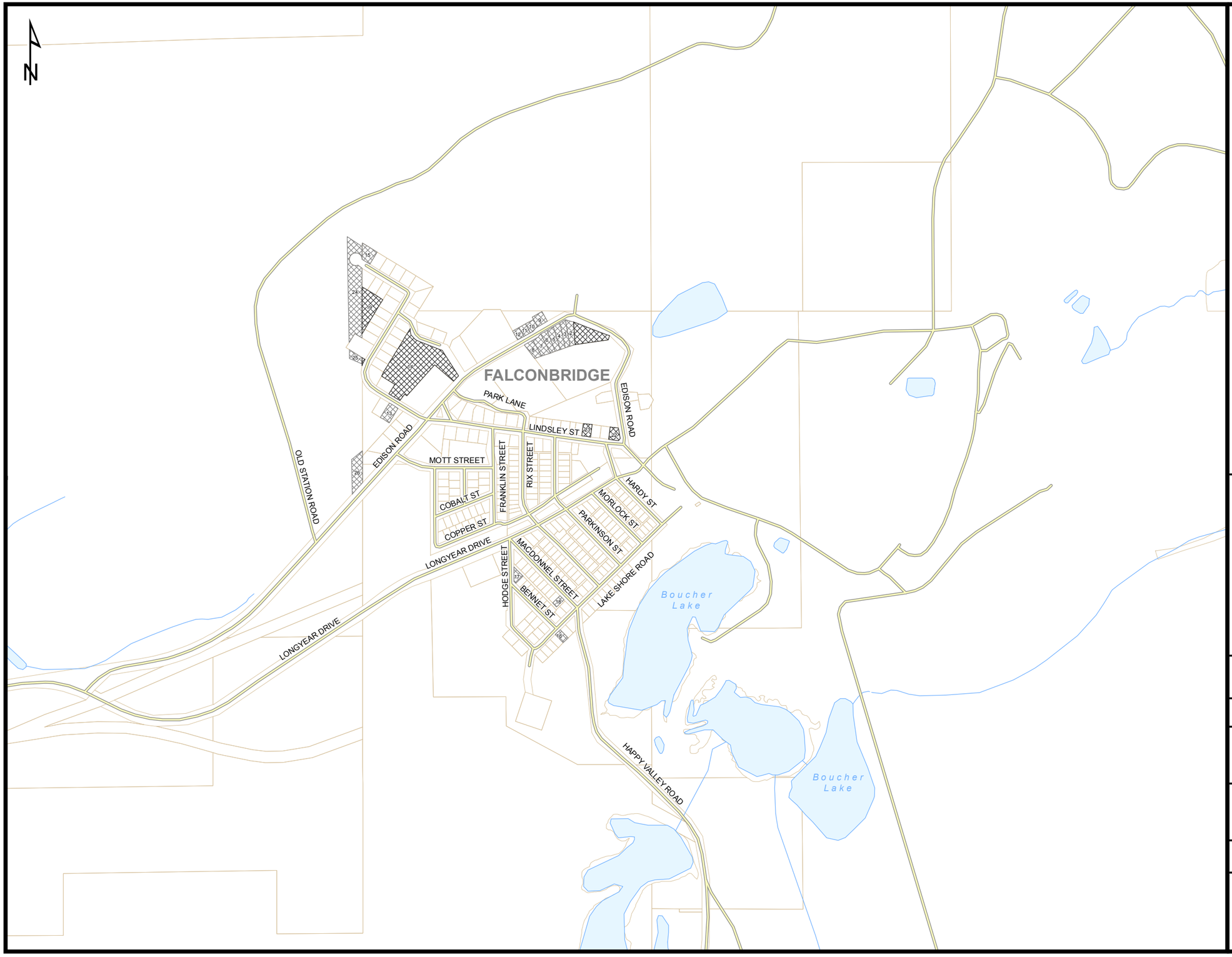
Sudbury Water and Wastewater Master Plan

0 100 200 300 400 500 m

1:10,000

Map 8

Falconbridge
Vacant Land Development
(2031 - 2036)



Legend

- Road
- Waterbody
- Watercourse
- Parcel
- ICI Development (2036 - 2041)
- Residential Development (2036 - 2041)
- ICI Development (2011 - 2036)
- Residential Development (2011 - 2036)



Project No. 121-23026-00

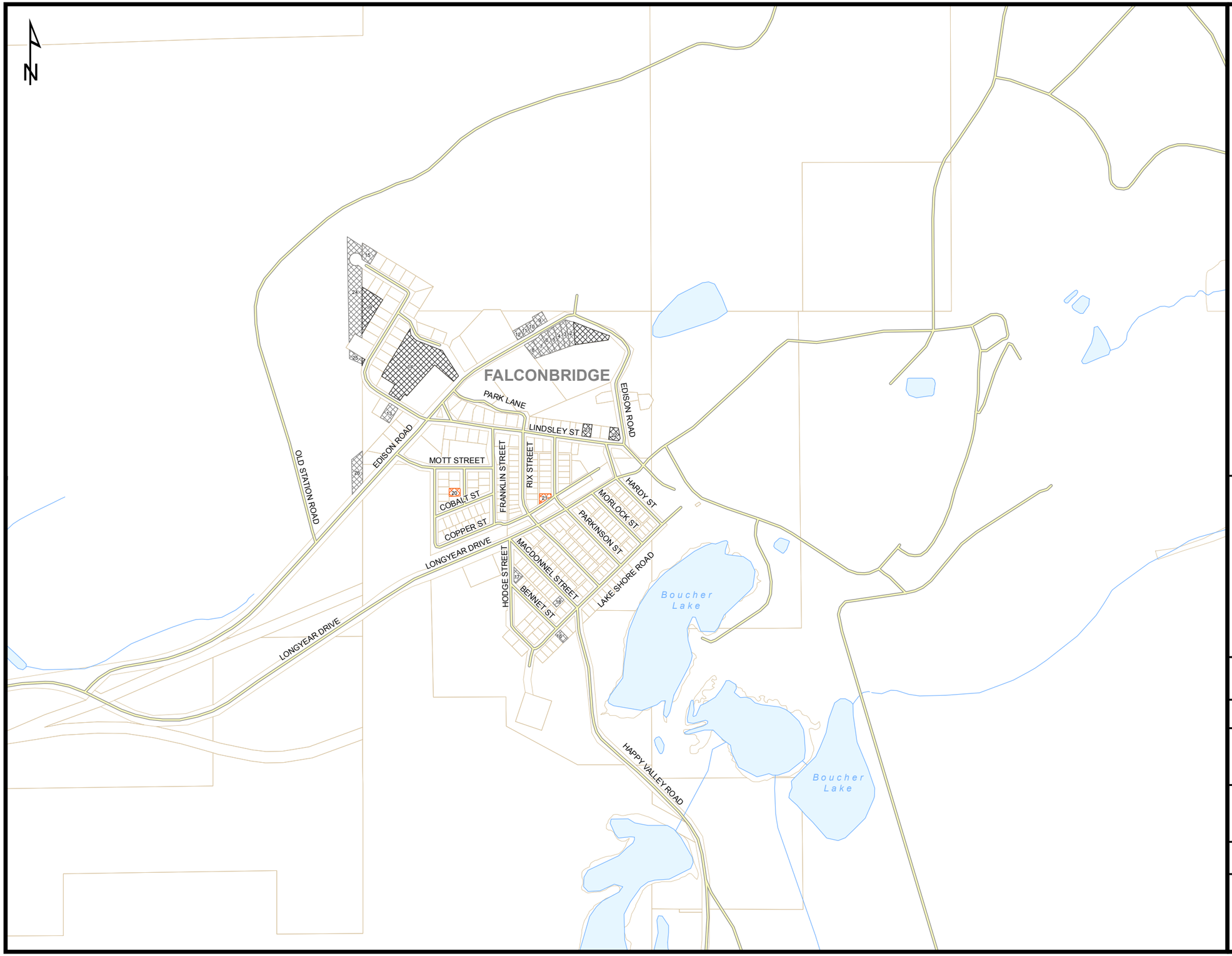
Sudbury Water and Wastewater Master Plan

0 100 200 300 400 500 m

1:10,000

Map 8

Falconbridge
Vacant Land Development
(2036 - 2041)



Legend

- Road
- Waterbody
- Watercourse
- Parcel
- ICI Development (2041 - Ultimate)
- Residential Development (2041 - Ultimate)
- ICI Development (2011 - 2041)
- Residential Development (2011 - 2041)



Project No. 121-23026-00

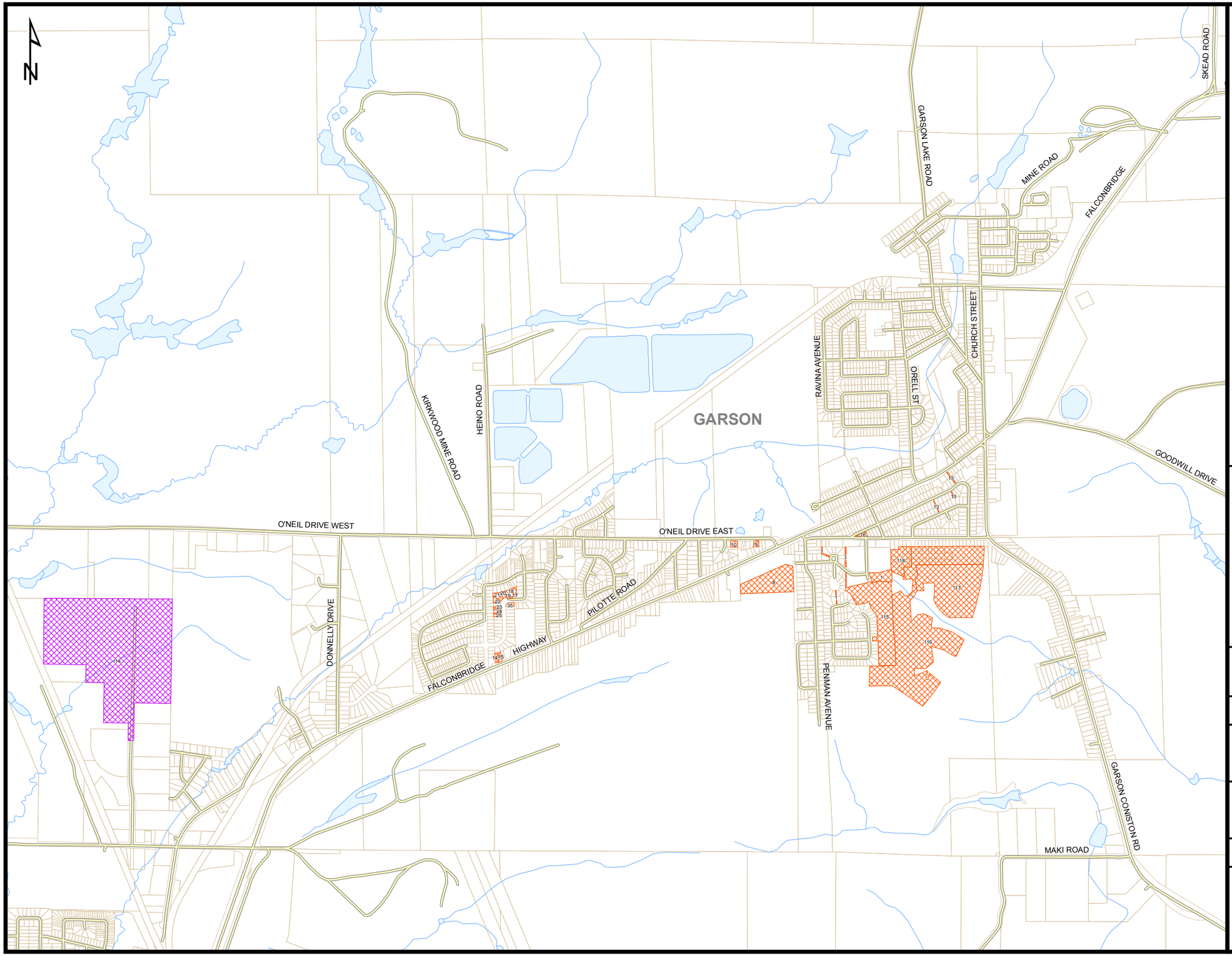
Sudbury Water and Wastewater Master Plan

0 100 200 300 400 500 m

1:10,000

Map 8

Falconbridge
Vacant Land Development
(2041 - Ultimate)



Legend

- Road
- Watercourse
- Waterbody
- Parcel
- ICI Development (2011 - 2016)
- Residential Development (2011 - 2016)



Project No. 121-23026-00

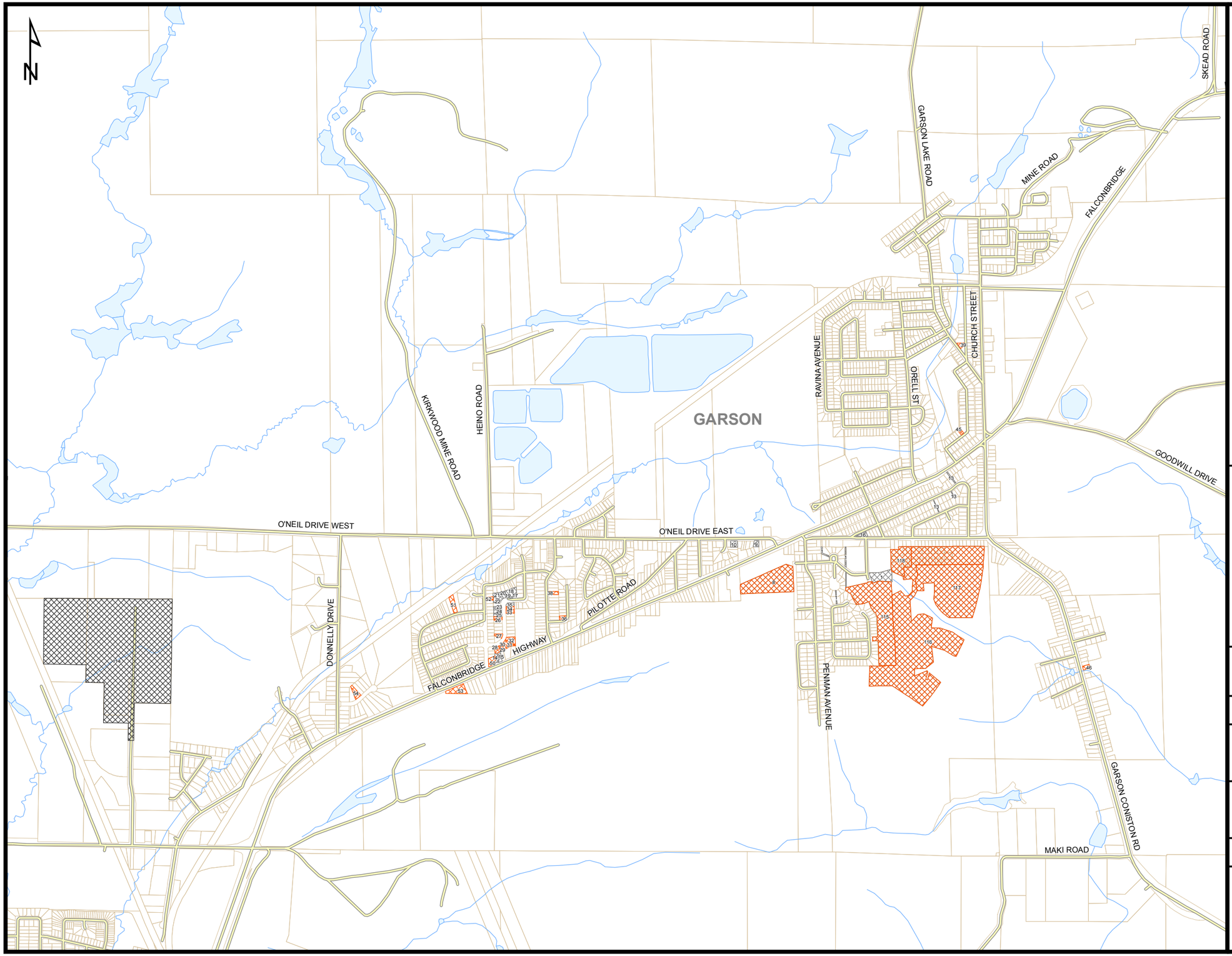
Sudbury Water and Wastewater Master Plan

0 200 400 600 800 1,000 m

1:18,000

Map 9

Garson
Vacant Land Development (2011 - 2016)



Legend

- Road
- Watercourse
- Waterbody
- Parcel
- ICI Development (2016 - 2021)
- Residential Development (2016 - 2021)
- ICI Development (2011 - 2016)
- Residential Development (2011 - 2016)



Project No. 121-23026-00

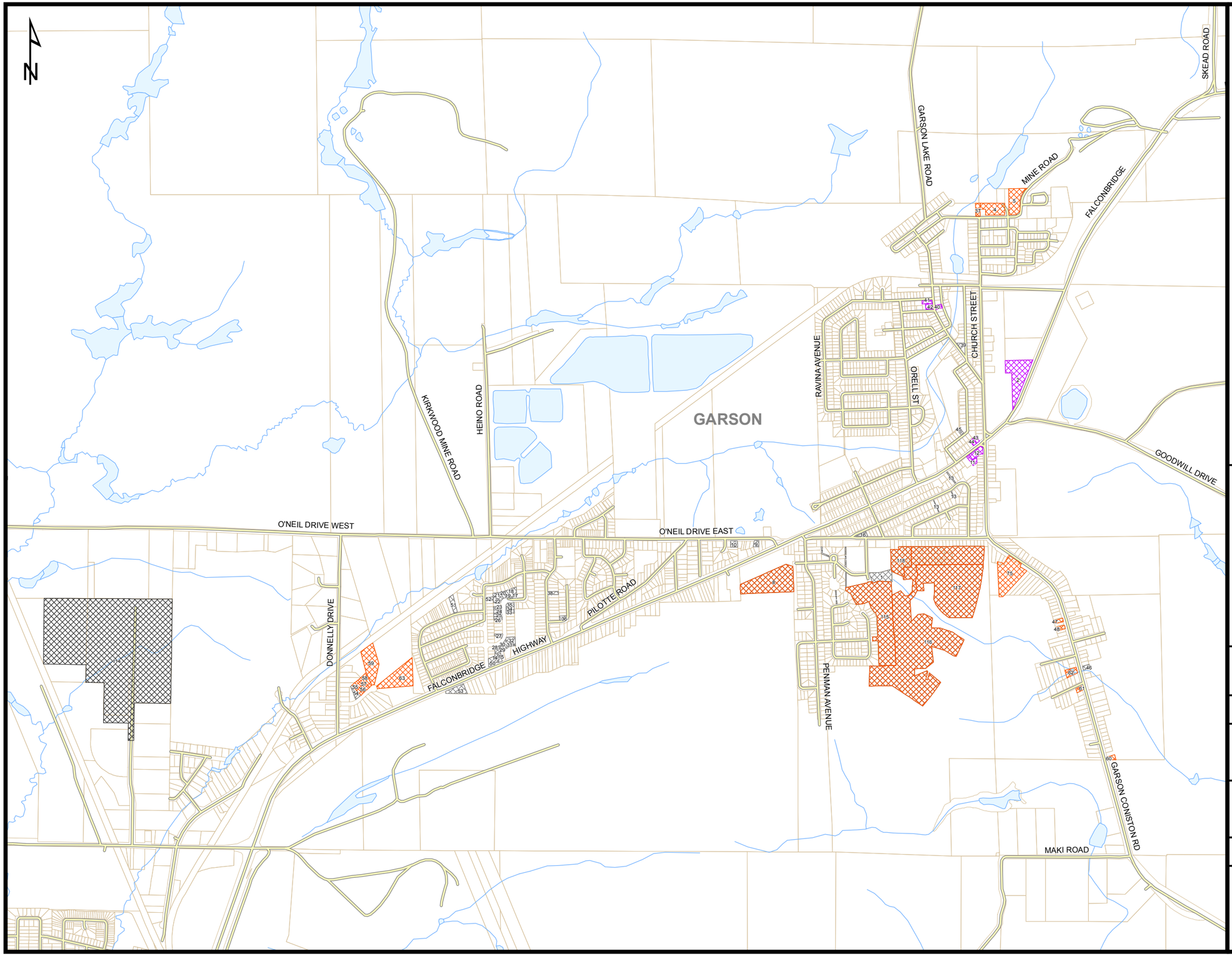
Sudbury Water and Wastewater Master Plan

0 200 400 600 800 1,000 m

1:18,000

Map 9

Garson
Vacant Land Development (2016 - 2021)



Legend

- Road
- Watercourse
- Waterbody
- Parcel
- ICI Development (2021 - 2026)
- Residential Development (2021 - 2026)
- ICI Development (2011 - 2021)
- Residential Development (2011 - 2021)



Project No. 121-23026-00

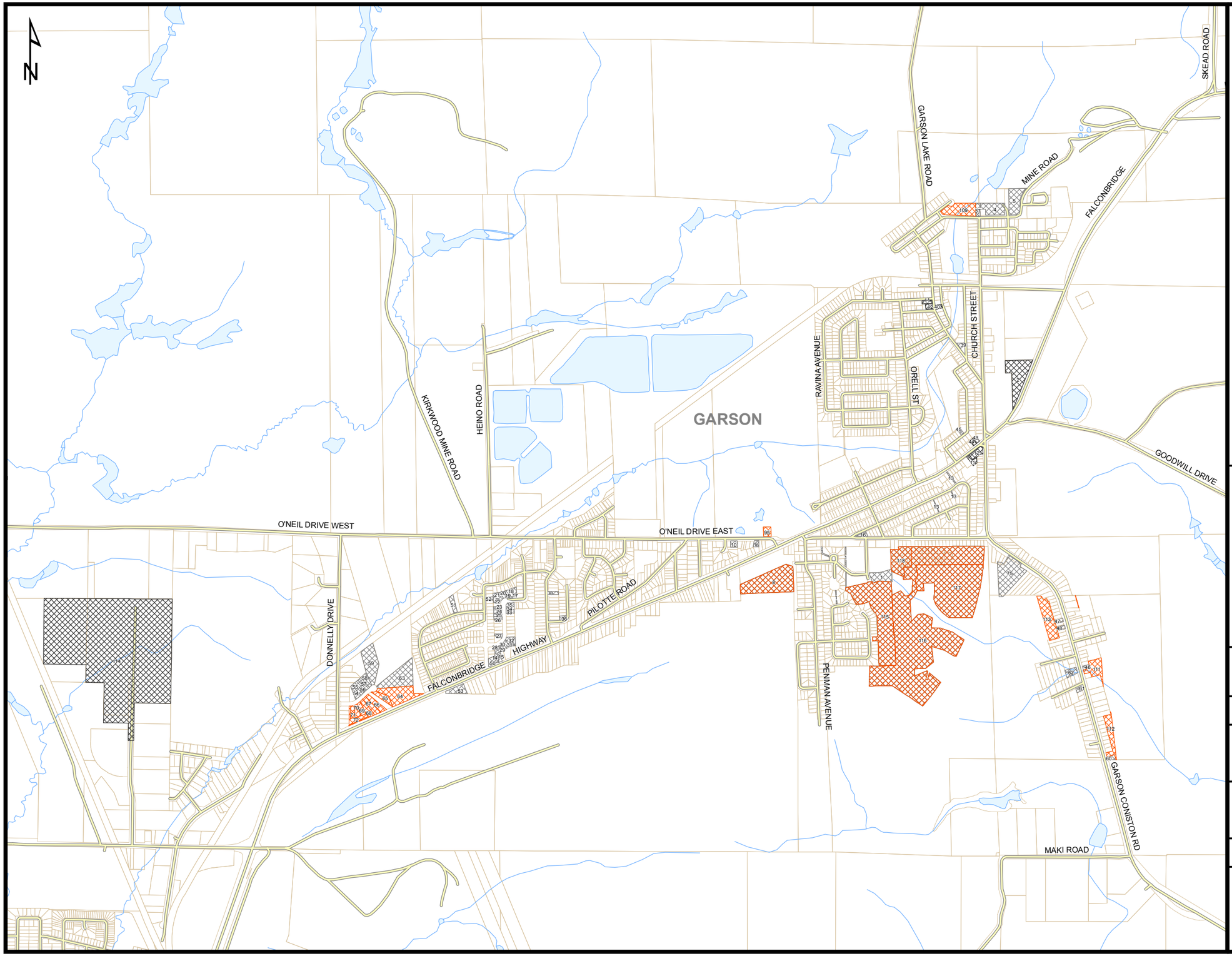
Sudbury Water and Wastewater Master Plan

0 200 400 600 800 1,000 m

1:18,000

Map 9

Garson Vacant Land Development (2021 - 2026)



Legend

- Road
- Watercourse
- Waterbody
- Parcel
- ICI Development (2026 - 2031)
- Residential Development (2026 - 2031)
- ICI Development (2011 - 2026)
- Residential Development (2011 - 2026)



Project No. 121-23026-00

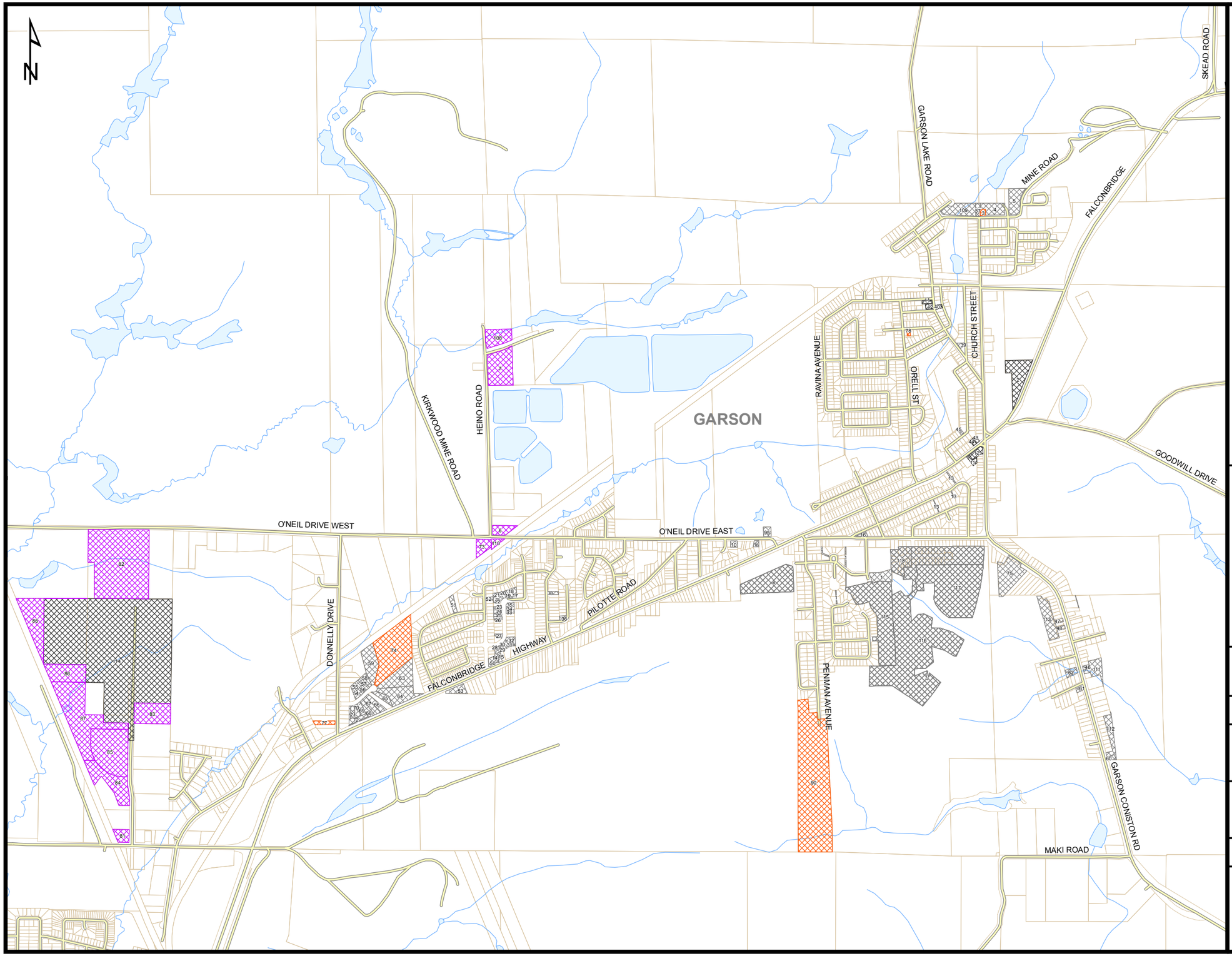
Sudbury Water and Wastewater Master Plan

0 200 400 600 800 1,000 m

1:18,000

Map 9

Garson Vacant Land Development (2026 - 2031)



Legend

- Road
- Watercourse
- Waterbody
- Parcel
- ICI Development (2031 - 2036)
- Residential Development (2031 - 2036)
- ICI Development (2011 - 2031)
- Residential Development (2011 - 2031)



Project No. 121-23026-00

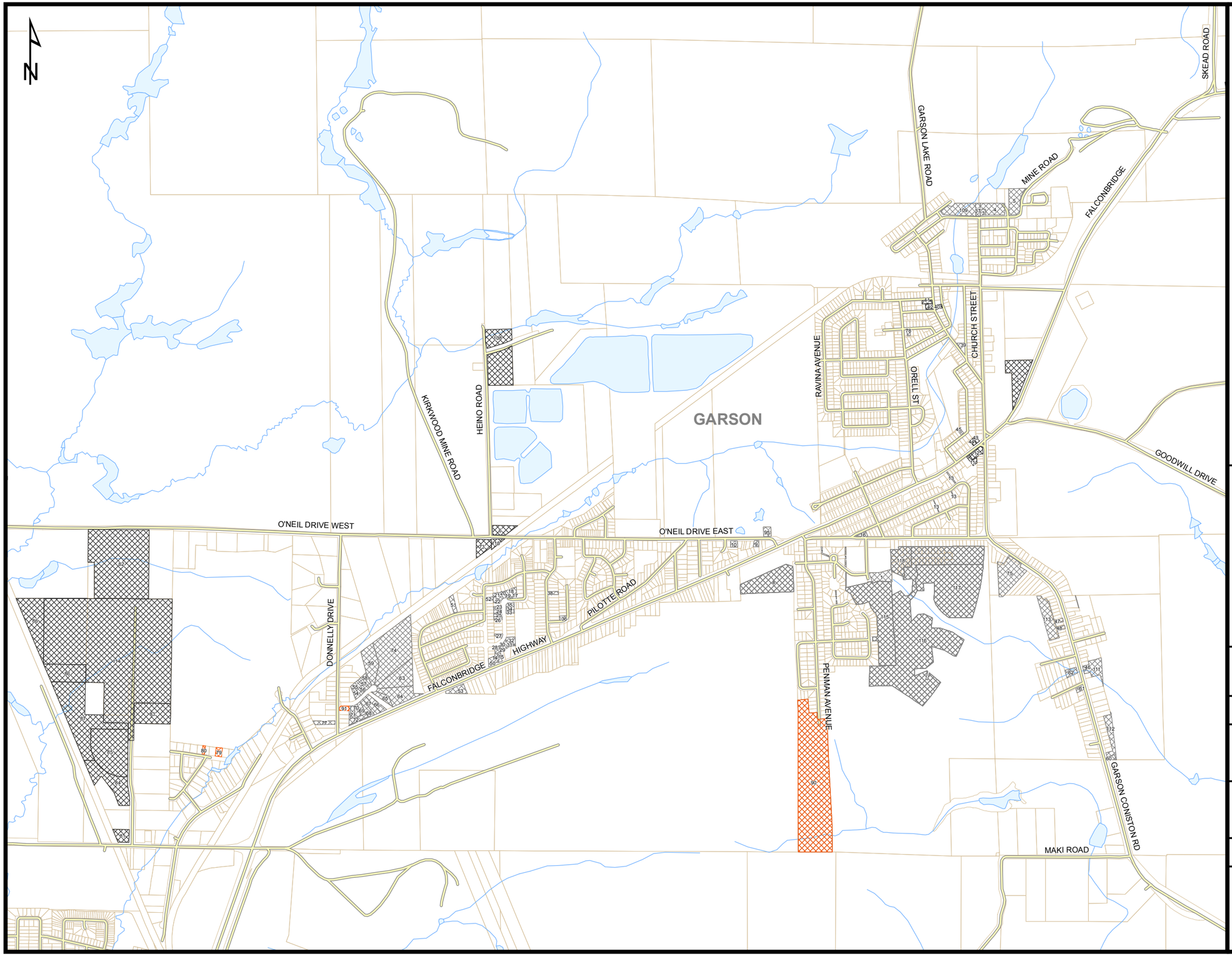
Sudbury Water and Wastewater Master Plan

0 200 400 600 800 1,000 m

1:18,000

Map 9

Garson
Vacant Land Development
(2031 - 2036)



Legend

- Road
- Watercourse
- Waterbody
- Parcel
- ICI Development (2036 - 2041)
- Residential Development (2036 - 2041)
- ICI Development (2011 - 2036)
- Residential Development (2011 - 2036)



Project No. 121-23026-00

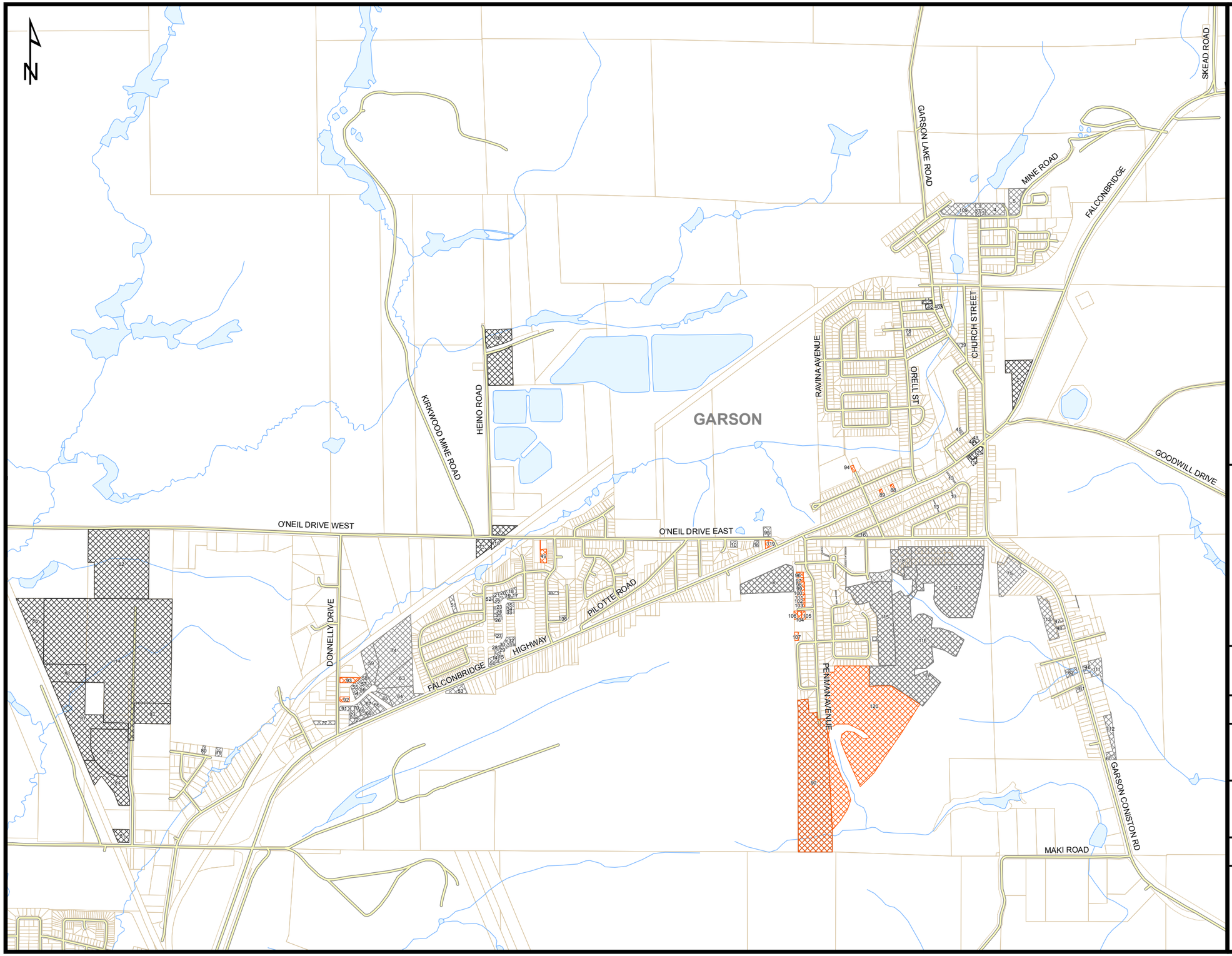
Sudbury Water and Wastewater Master Plan

0 200 400 600 800 1,000 m

1:18,000

Map 9

Garson
Vacant Land Development
(2036 - 2041)



Legend

- Road
- Watercourse
- Waterbody
- Parcel
- ICI Development (2041 - Ultimate)
- Residential Development (2041 - Ultimate)
- ICI Development (2011 - 2041)
- Residential Development (2011 - 2041)



Project No. 121-23026-00

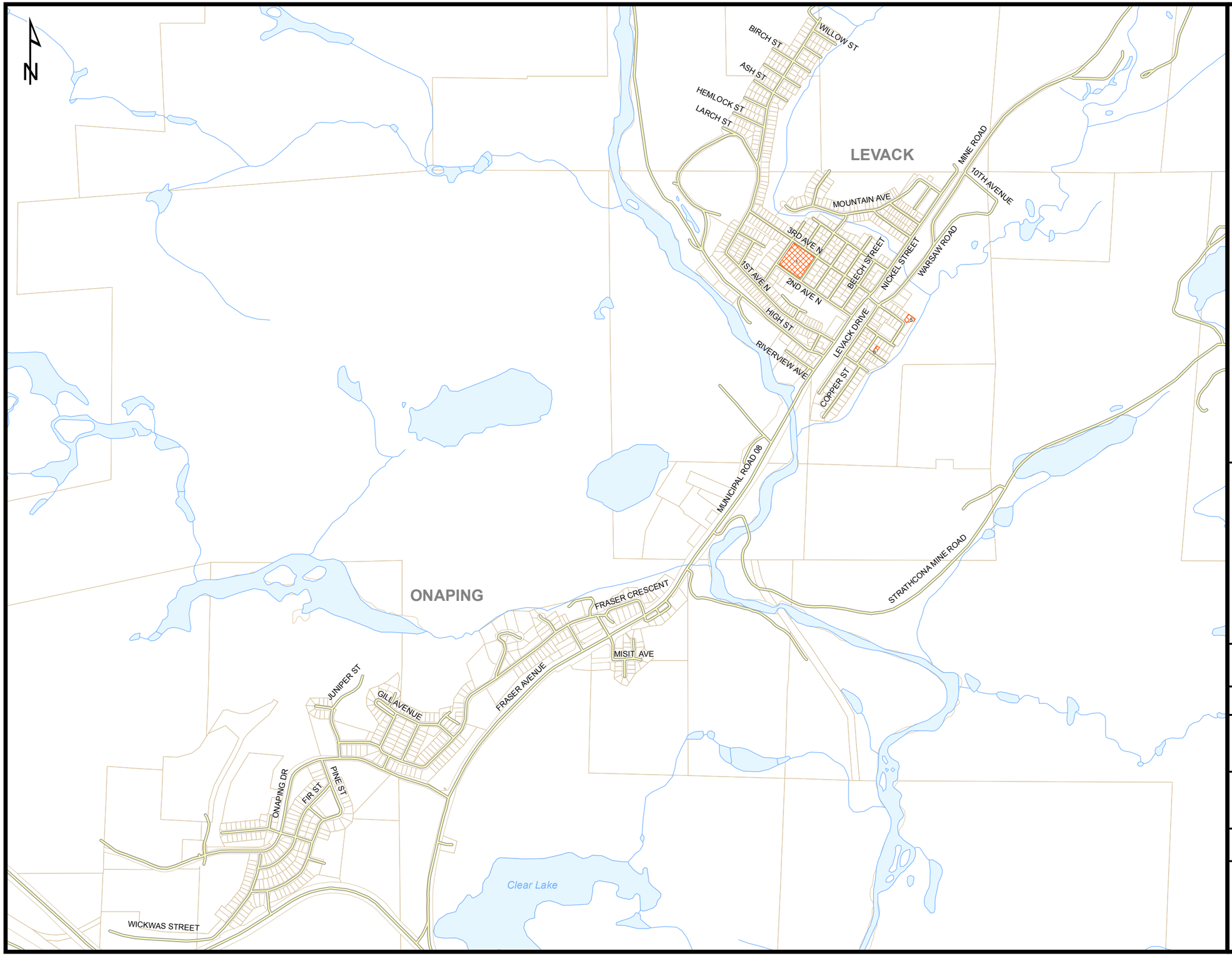
Sudbury Water and Wastewater Master Plan

0 200 400 600 800 1,000 m

1:18,000

Map 9

Garson
Vacant Land Development
(2041 - Ultimate)



Legend

- Road
- Watercourse
- Waterbody
- Parcel
- ICI Development (2011 - 2016)
- Residential Development (2011 - 2016)



Project No. 121-23026-00

Sudbury Water and Wastewater Master Plan

0 150 300 450 600 750 m

1:15,500

Map 10

Levack
Vacant Land Development (2011 - 2016)

N

LEVACK

ONAPING

BIRCH ST
WILLOW ST
ASH ST
HEMLOCK ST
LARCH ST
MOUNTAIN AVE
3RD AVE N
1ST AVE N
2ND AVE N
BEECH STREET
NICKEL STREET
WARSAW ROAD
MINE ROAD
10TH AVENUE
HIGH ST
RIVERVIEW AVE
LEVACK DRIVE
COPPER ST
MUNICIPAL ROAD 08
STRATHCONA MINE ROAD
FRASER CRESCENT
MISIT AVE
FRASER AVENUE
JUNIPER ST
GILL AVENUE
ONAPING DR
FIR ST
PINE ST
WICKWAS STREET
Clear Lake

Legend

- Road
- Watercourse
- Waterbody
- Parcel
- ICI Development (2016 - 2021)
- Residential Development (2016 - 2021)
- ICI Development (2011 - 2016)
- Residential Development (2011 - 2016)



Sudbury | Greater | Grand

WSP

Project No. 121-23026-00

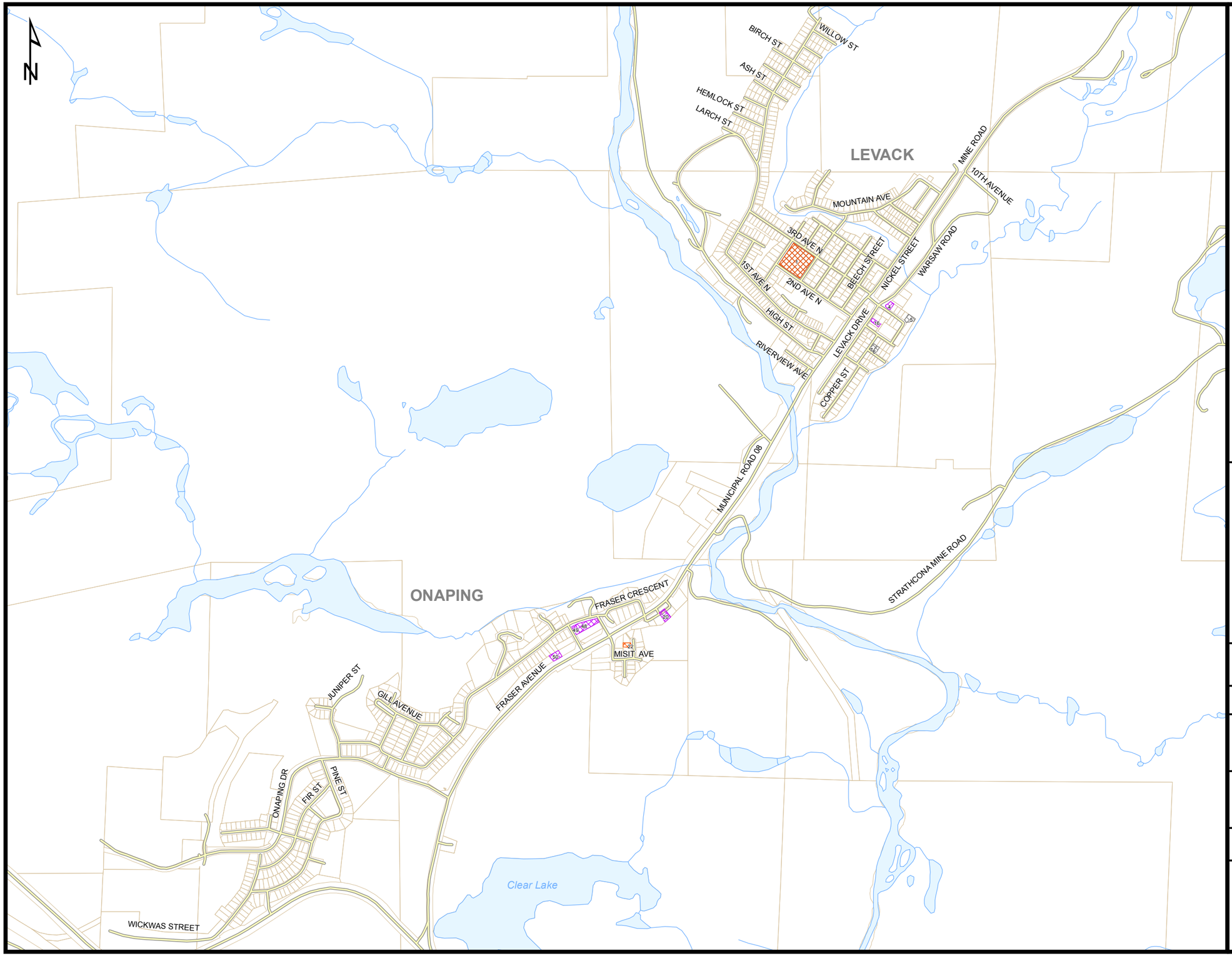
Sudbury Water and Wastewater Master Plan

0 150 300 450 600 750 m

1:15,500

Map 10

Levack
Vacant Land Development
(2016 - 2021)



Legend

- Road
- Watercourse
- Waterbody
- Parcel
- ICI Development (2021 - 2026)
- Residential Development (2021 - 2026)
- ICI Development (2011 - 2021)
- Residential Development (2011 - 2021)



Sudbury | Greater | Grand

WSP

Project No. 121-23026-00

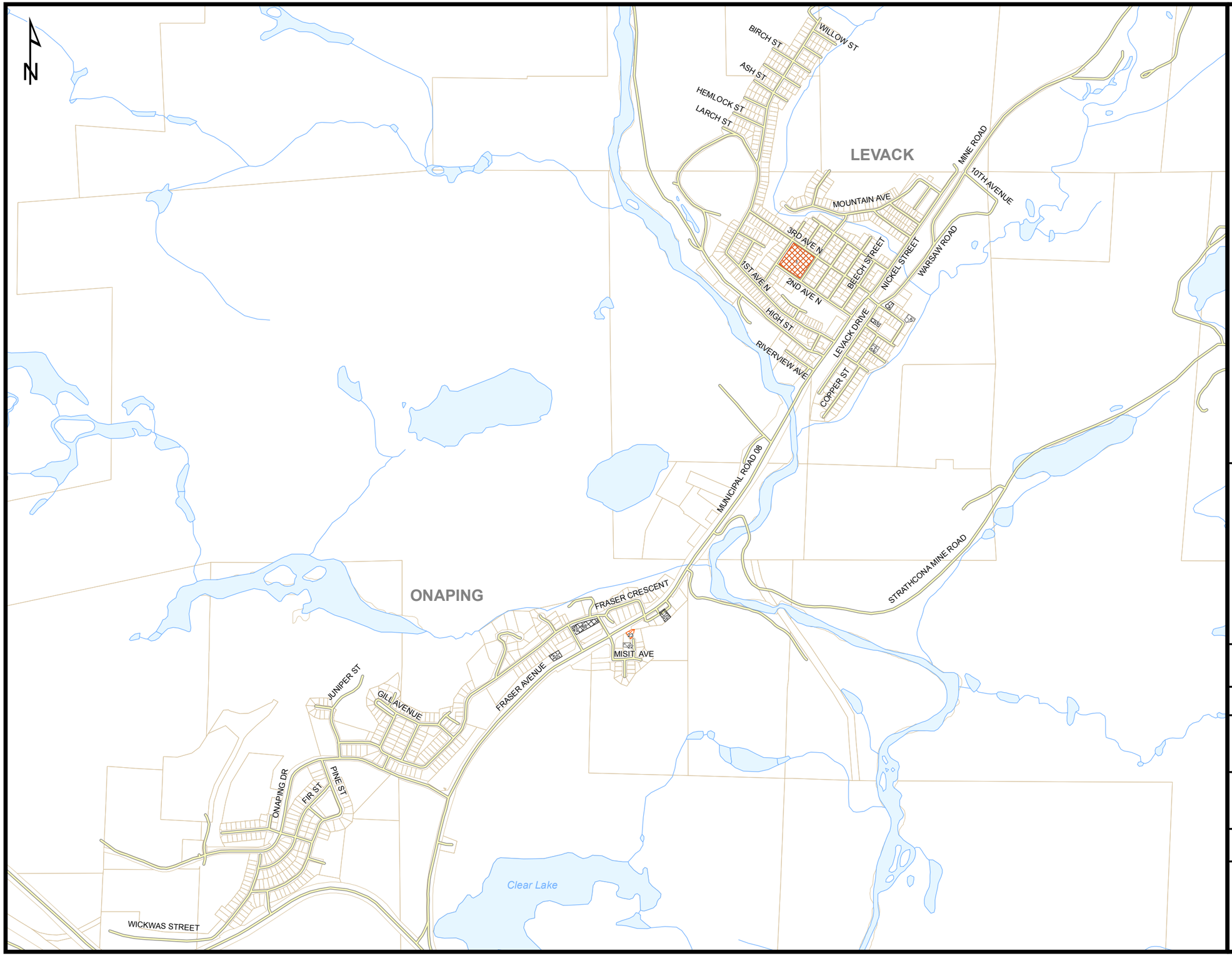
Sudbury Water and Wastewater Master Plan

0 150 300 450 600 750 m

1:15,500

Map 10

Levack
Vacant Land Development
(2021 - 2026)



Legend

- Road
- Watercourse
- Waterbody
- Parcel
- ICI Development (2026 - 2031)
- Residential Development (2026 - 2031)
- ICI Development (2011 - 2026)
- Residential Development (2011 - 2026)



Project No. 121-23026-00

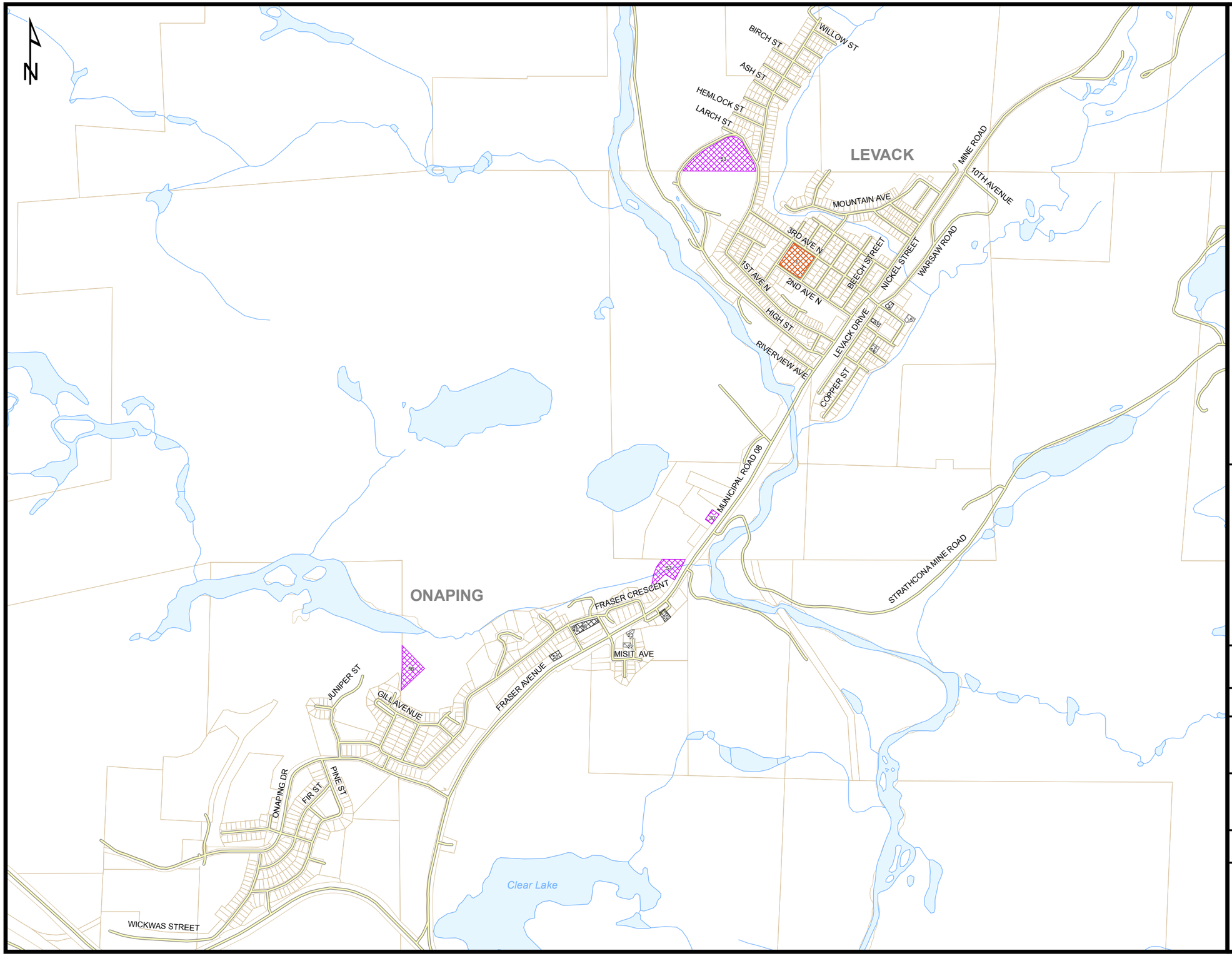
Sudbury Water and Wastewater Master Plan

0 150 300 450 600 750 m

1:15,500

Map 10

Levack
Vacant Land Development
(2026 - 2031)



Legend

- Road
- Watercourse
- Waterbody
- Parcel
- ICI Development (2031 - 2036)
- Residential Development (2031 - 2036)
- ICI Development (2011 - 2031)
- Residential Development (2011 - 2031)



Sudbury | WSP

Project No. 121-23026-00

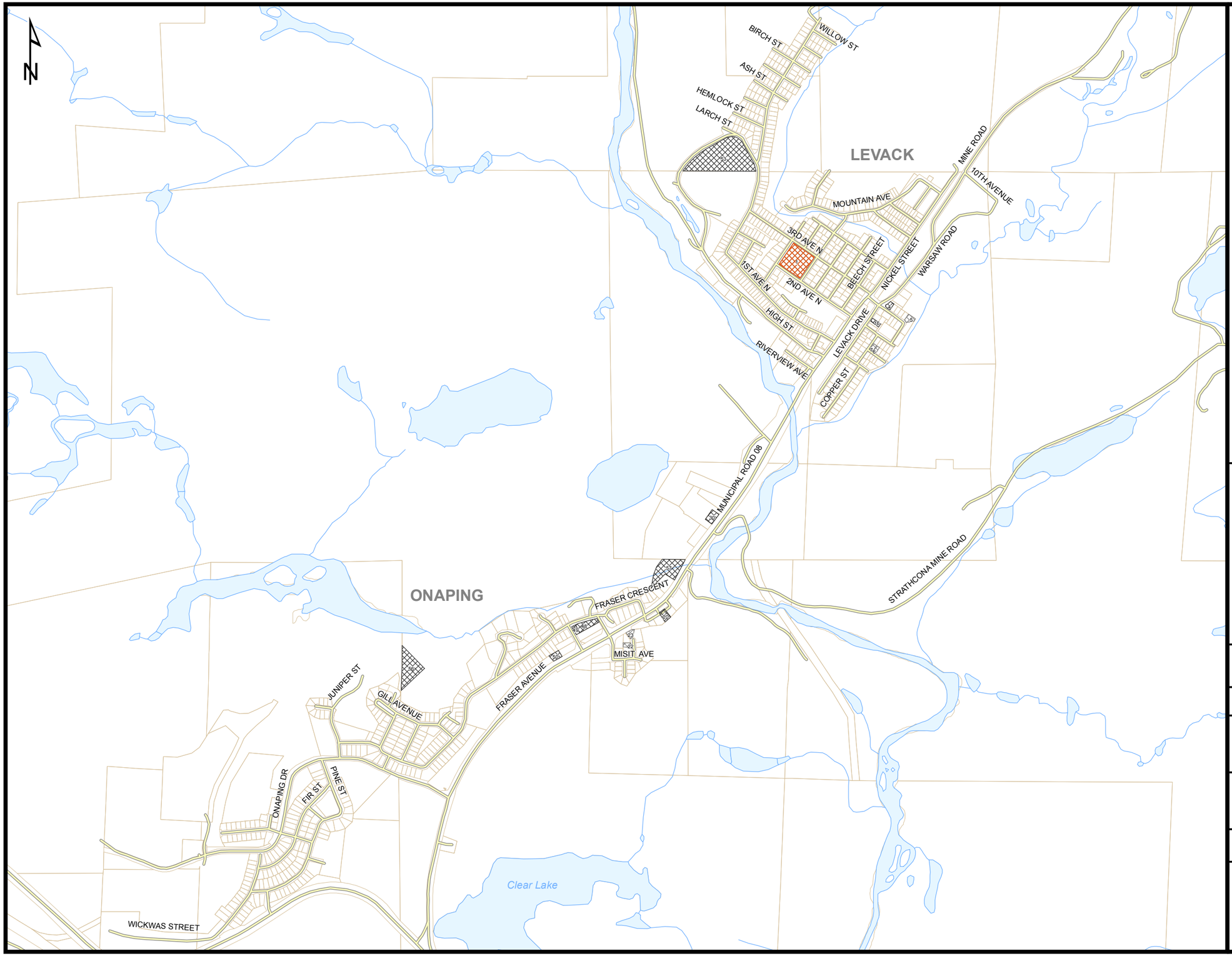
Sudbury Water and Wastewater Master Plan

0 150 300 450 600 750 m

1:15,500

Map 10

Levack
Vacant Land Development
(2031 - 2036)



Legend

- Road
- Watercourse
- Waterbody
- Parcel
- ICI Development (2036 - 2041)
- Residential Development (2036 - 2041)
- ICI Development (2011 - 2036)
- Residential Development (2011 - 2036)



Project No. 121-23026-00

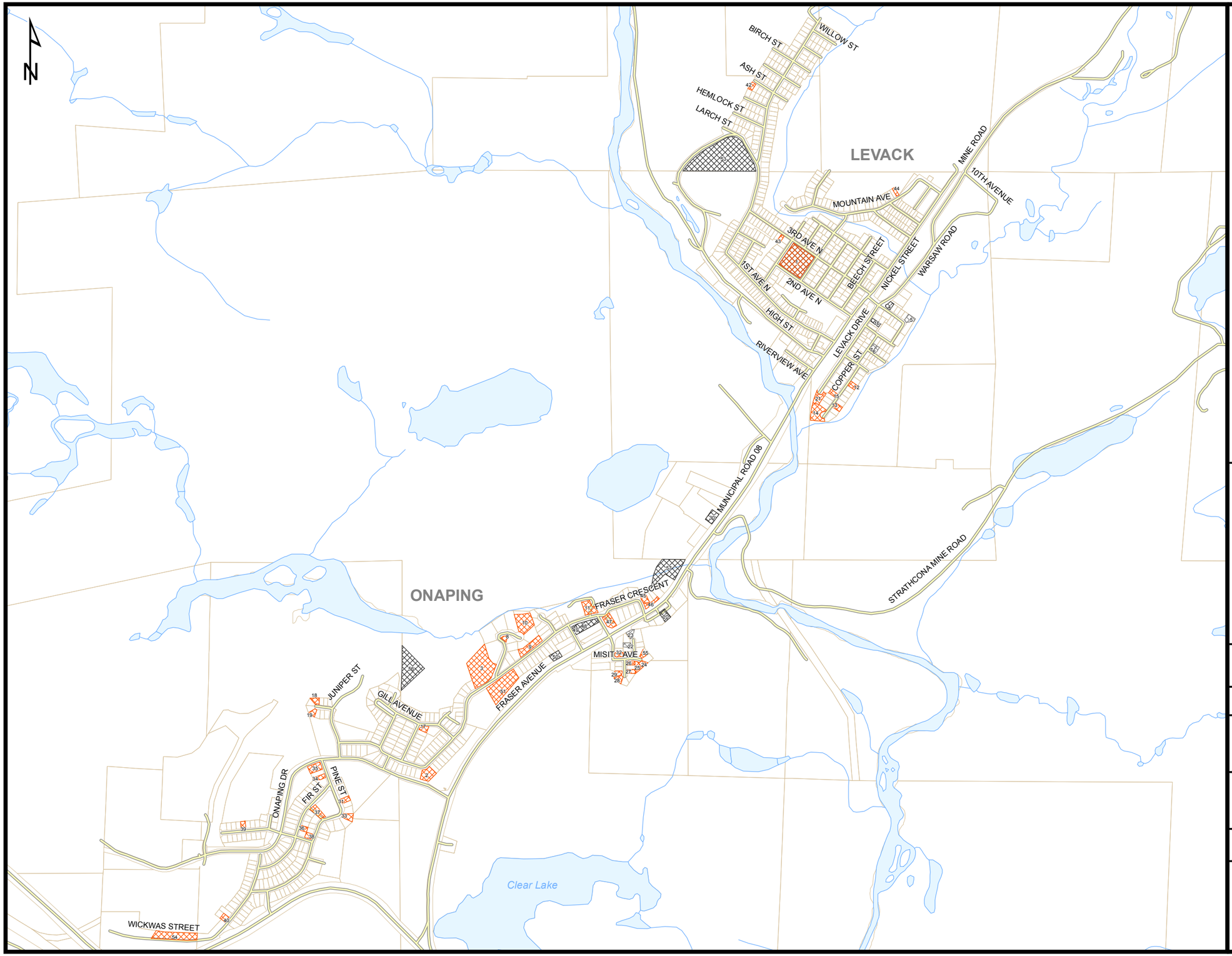
Sudbury Water and Wastewater Master Plan

0 150 300 450 600 750 m

1:15,500

Map 10

Levack
Vacant Land Development
(2036 - 2041)



Legend

- Road
- Watercourse
- Waterbody
- Parcel
- ICI Development (2041 - Ultimate)
- Residential Development (2041 - Ultimate)
- ICI Development (2011 - 2041)
- Residential Development (2011 - 2041)



Sudbury | WSP

Project No. 121-23026-00

Sudbury Water and Wastewater Master Plan

0 150 300 450 600 750 m

1:15,500

Map 10

Levack
Vacant Land Development
(2041 - Ultimate)

N

SEPPALA RD
MAIN STREET
OLD CREIGHTON RD
10TH AVE
9TH AVE
C STREET
4TH AVE
ANDERSON DR
NIEMI RD
HILL RD
WHITE ROAD
HIGHWAY 17
ANSON DRIVE
SANTALA RD
OLD SCOT ROAD
SERVICE ROAD
JACOB STREET
STOS ROAD
MELTON AVE
MUNICIPAL ROAD 55
Mud Lake
Simon Lake
RESERVE RD
MIKKOLA
BLACK LAKE ROAD
BLACK LAKE ROAD
KANTOLA ROAD
FINNWOODS ROAD
MOKAM LANDING RD
LLOYD ST
SHORT ST
HILLCREST DRIVE
BRIAN STREET
FIELD STREET
MUNICIPAL ROAD 55
COLUMBUS COURT
DUHAMEL RD
MAGALL ST
CRAWFORD DR
FIELDING ROAD
NORDIN ROAD

Legend

- Road
- Watercourse
- Waterbody
- Parcel
- ICI Development (2011 - 2016)
- Residential Development (2011 - 2016)

Project No. 121-23026-00

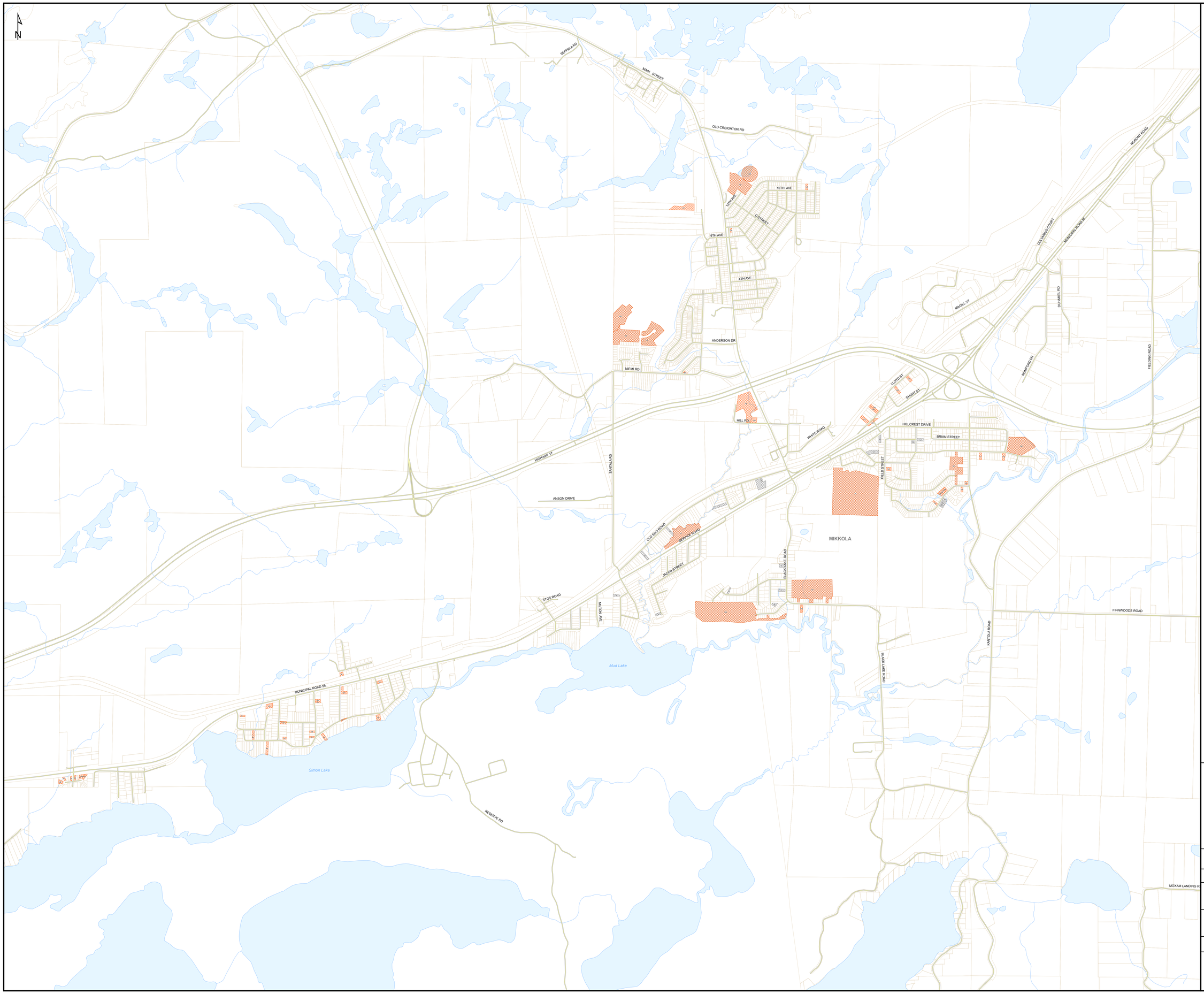
Sudbury Water and Wastewater Master Plan

0 500 1,000 m

1:10,000

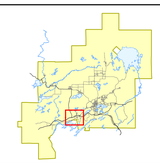
Map 11

Lively / Walden
Vacant Land Development
(2011 - 2016)



Legend

- Road
- Watercourse
- Waterbody
- Parcel
- ICI Development (2016 - 2021)
- Residential Development (2016 - 2021)
- ICI Development (2011 - 2016)
- Residential Development (2011 - 2016)



Project No. 121-23026-00

Sudbury Water and Wastewater Master Plan

0 500 1,000 m

1:10,000

Map 11

Lively / Walden
Vacant Land Development
(2016 - 2021)

N

SEPPALA RD
MAIN STREET
OLD CREIGHTON RD
10TH AVE
9TH AVE
C STREET
4TH AVE
ANDERSON DR
NIEMI RD
HILL RD
WHITE ROAD
LLOYD ST
SHORT ST
HILLCREST DRIVE
BRIAN STREET
FIELD STREET
MACGILL ST
COLUMBUS COURT
MUNICIPAL ROAD 55
NORONT ROAD
DUHAMEL RD
MANFORT DR
FIELDING ROAD
HIGHWAY 17
SANTALA RD
ANSON DRIVE
OLD SOO ROAD
SERVICE ROAD
JACOB STREET
STOS ROAD
MILTON AVE
MIKKOLA
BLACK LAKE ROAD
FINNWOODS ROAD
KANTOLA ROAD
BLACK LAKE ROAD
MOXAM LANDING RD
Mud Lake
Simon Lake
RESERVE RD

Legend

- Road
- Watercourse
- Waterbody
- Parcel
- ICI Development (2021 - 2026)
- Residential Development (2021 - 2026)
- ICI Development (2011 - 2021)
- Residential Development (2011 - 2021)

Project No. 121-23026-00

Sudbury Water and Wastewater Master Plan

0 500 1,000 m

1:10,000

Map 11

Lively / Walden
Vacant Land Development
(2021 - 2026)

N

SEPPALA RD
MAIN STREET
OLD CREIGHTON RD
10TH AVE
9TH AVE
C STREET
4TH AVE
ANDERSON DR
NIEMI RD
HILL RD
WHITE ROAD
LLOYD ST
SHORT ST
HILLCREST DRIVE
BRIAN STREET
FIELD STREET
MACALL ST
COLUMBUS COURT
MUNICIPAL ROAD 55
NORDIN ROAD
DUHAMEL RD
RAMSFORT DR
FIELDING ROAD
HIGHWAY 17
SANTALA RD
ANSON DRIVE
OLD SUDBURY ROAD
SERVICE ROAD
JACOB STREET
STOS ROAD
MILTON AVE
MIKKOLA
BLACK LAKE ROAD
FINNWOODS ROAD
KANTOLA ROAD
MUNICIPAL ROAD 55
Mud Lake
Simon Lake
RESERVE RD
MOXAM LANDING RD

Legend

- Road
- Watercourse
- Waterbody
- Parcel
- ICI Development (2026 - 2031)
- Residential Development (2026 - 2031)
- ICI Development (2011 - 2026)
- Residential Development (2011 - 2026)

Project No. 121-23026-00

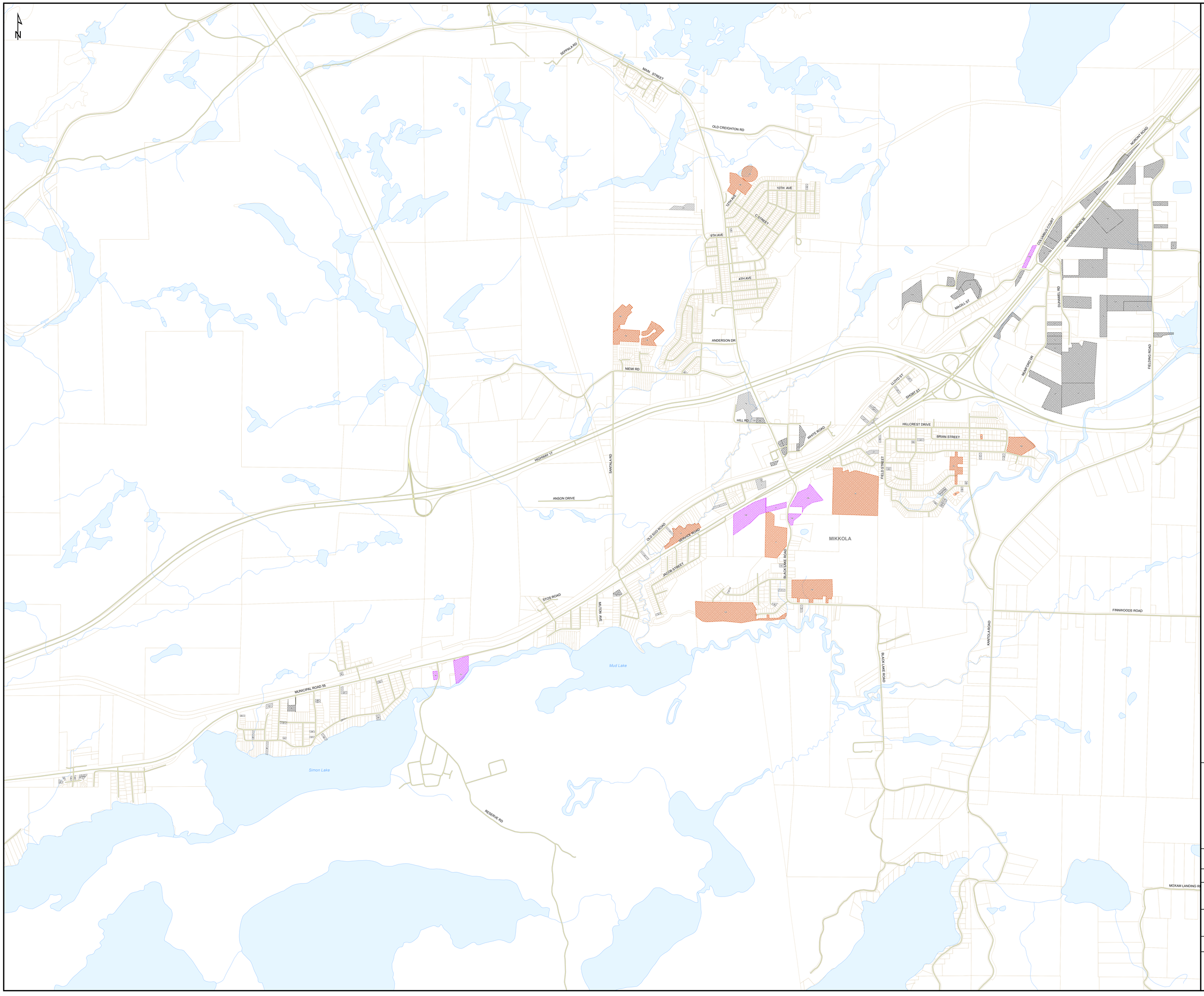
Sudbury Water and Wastewater Master Plan

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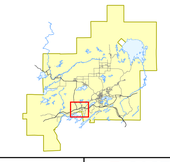
Map 11

Lively / Walden
Vacant Land Development
(2026 - 2031)



Legend

- Road
- Watercourse
- Waterbody
- Parcel
- ICI Development (2031 - 2036)
- Residential Development (2031 - 2036)
- ICI Development (2011 - 2031)
- Residential Development (2011 - 2031)



Project No. 121-23026-00

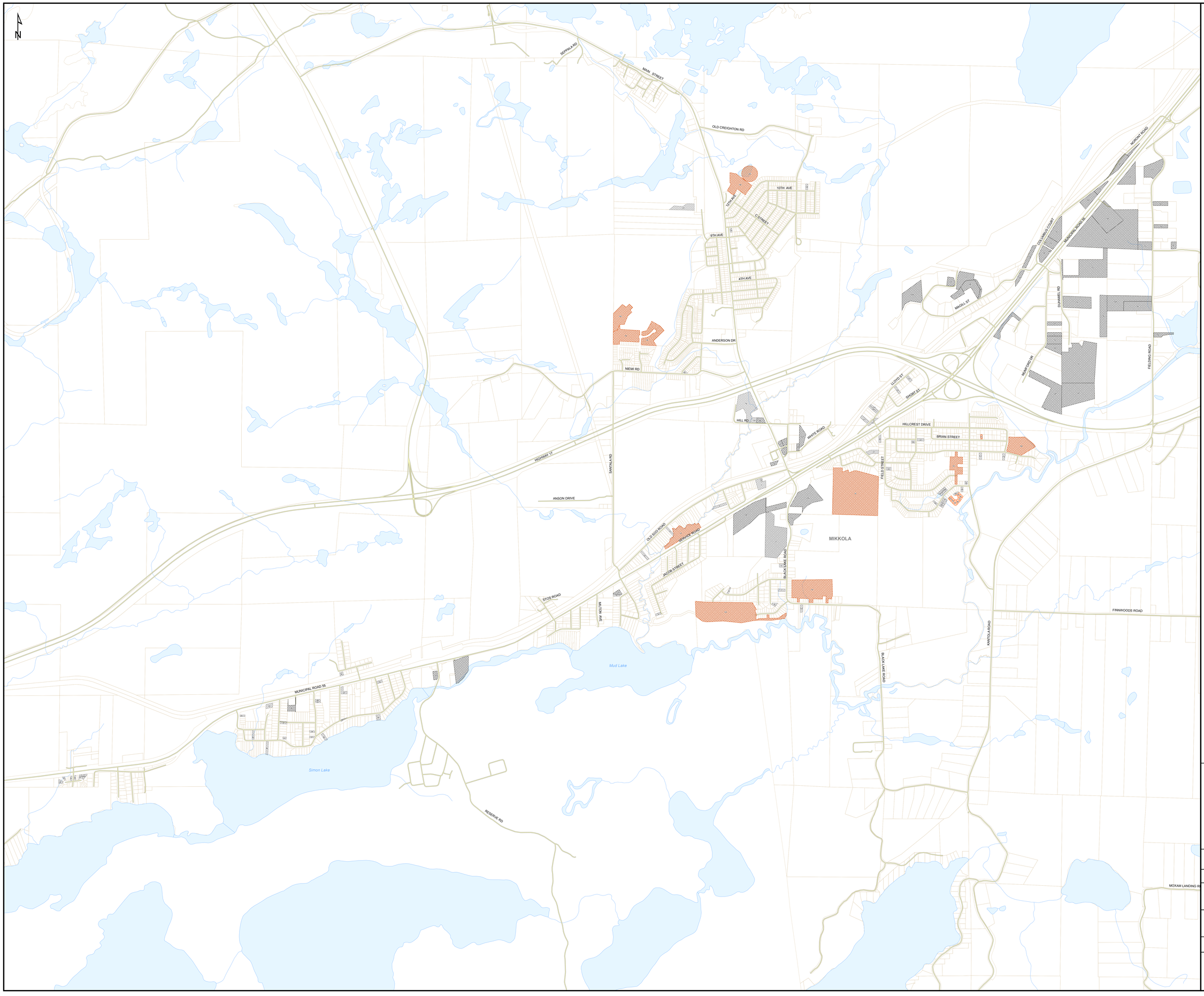
Sudbury Water and Wastewater Master Plan

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1:10,000

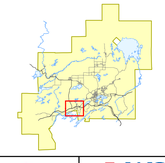
Map 11

Lively / Walden
Vacant Land Development
(2031 - 2036)



Legend

- Road
- Watercourse
- Waterbody
- Parcel
- ICI Development (2036 - 2041)
- Residential Development (2036 - 2041)
- ICI Development (2011 - 2036)
- Residential Development (2011 - 2036)



Project No. 121-23026-00

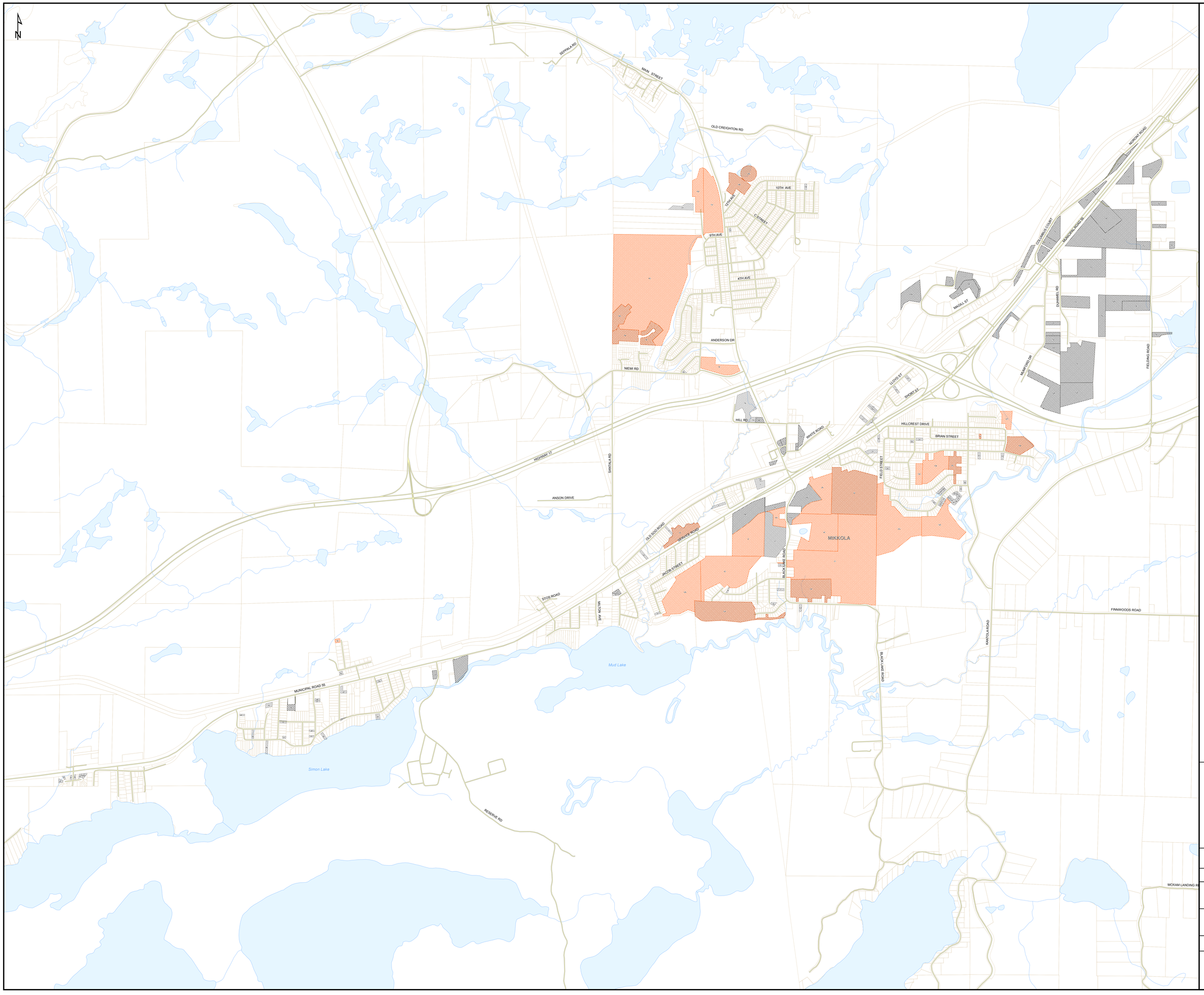
Sudbury Water and Wastewater Master Plan

0 500 1,000 m

1:10,000

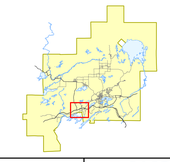
Map 11

Lively / Walden
Vacant Land Development
(2036 - 2041)



Legend

- Road
- Watercourse
- Waterbody
- Parcel
- ICI Development (2041 - Ultimate)
- Residential Development (2041 - Ultimate)
- ICI Development (2011 - 2041)
- Residential Development (2011 - 2041)



Project No. 121-23026-00

Sudbury Water and Wastewater Master Plan

0 500 1,000 m

1:10,000

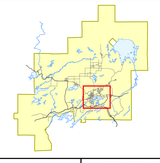
Map 11

Lively / Walden
Vacant Land Development
(2041 - Ultimate)

N

Legend

- Road
- Railway
- Watercourse
- Waterbody
- Parcel
- ICI Development (2011 - 2016)
- Residential Development (2011 - 2016)



Sudbury | WSP

Project No. 121-23026-00

Sudbury Water and Wastewater Master Plan

0 500 1,000 Meters

1:15,000

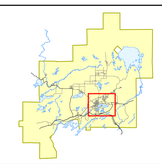
Map 12

Sudbury
Vacant Land Development
(2011 - 2016)

N

Legend

- Road
- Railway
- Watercourse
- Waterbody
- Parcel
- ICI Development (2016 - 2021)
- Residential Development (2016 - 2021)
- ICI Development (2011 - 2016)
- Residential Development (2011 - 2016)



Sudbury | WSP

Project No. 121-23026-00

Sudbury Water and Wastewater Master Plan

0 500 1,000 Meters

1:15,000

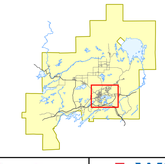
Map 12

Sudbury
Vacant Land Development
(2016 - 2021)

N

Legend

- Road
- Railway
- Watercourse
- Waterbody
- Parcel
- ICI Development (2021 - 2026)
- Residential Development (2021 - 2026)
- ICI Development (2011 - 2021)
- Residential Development (2011 - 2021)



Sudbury (Greater Group) | WSP

Project No. 121-23026-00

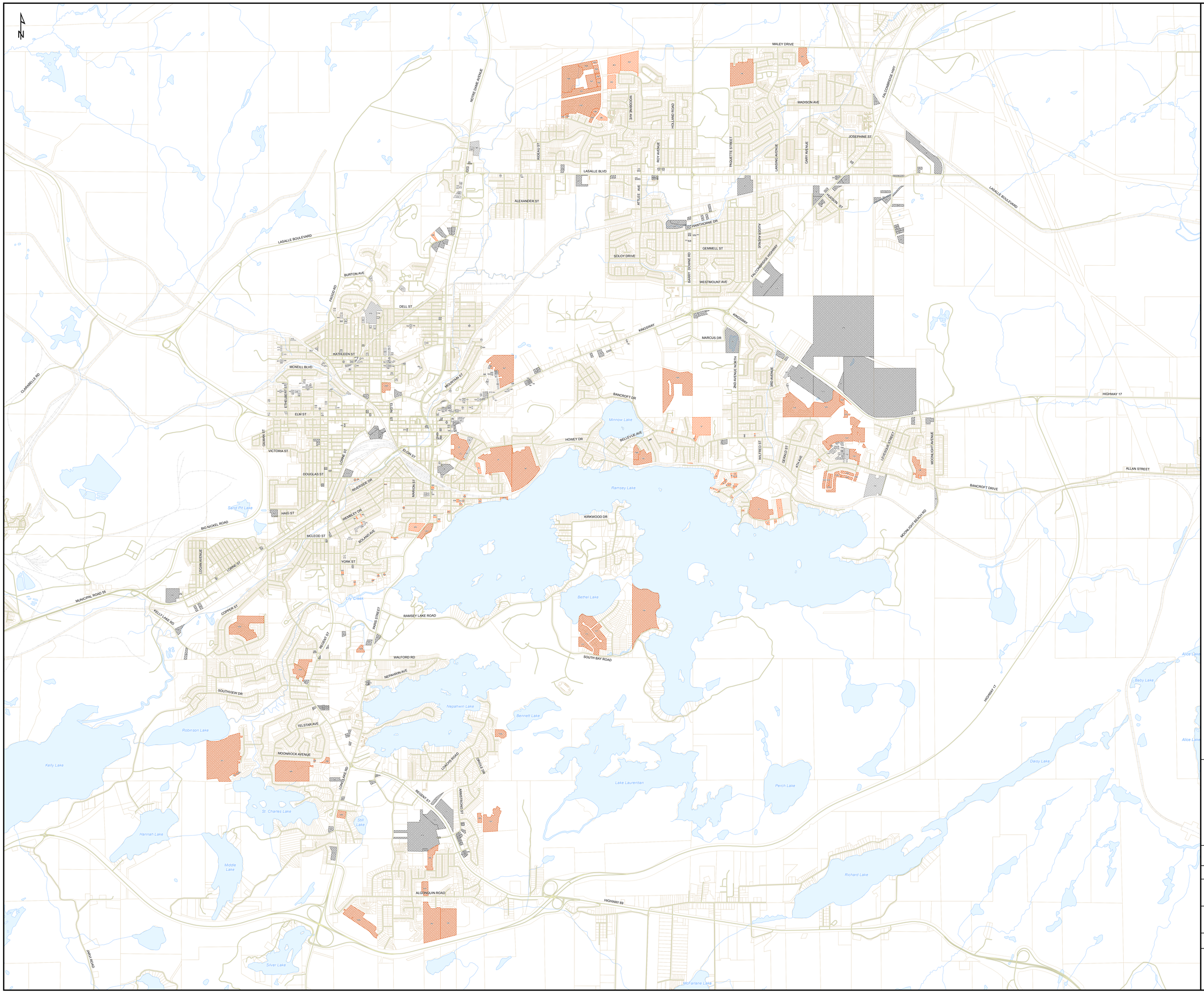
Sudbury Water and Wastewater Master Plan

0 500 1,000 Meters

1:15,000

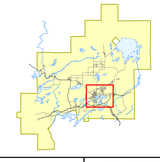
Map 12

Sudbury Vacant Land Development (2021 - 2026)



Legend

- Road
- Railway
- Watercourse
- Waterbody
- Parcel
- ICI Development (2026 - 2031)
- Residential Development (2026 - 2031)
- ICI Development (2011 - 2026)
- Residential Development (2011 - 2026)



Project No. 121-23026-00

Sudbury Water and Wastewater Master Plan

0 500 1,000 Meters

1:15,000

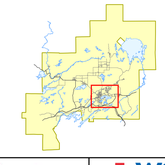
Map 12

Sudbury
Vacant Land Development
(2026 - 2031)

N

Legend

- Road
- Railway
- Watercourse
- Waterbody
- Parcel
- ICI Development (2031 - 2036)
- Residential Development (2031 - 2036)
- ICI Development (2011 - 2031)
- Residential Development (2011 - 2031)



Sudbury | WSP

Project No. 121-23026-00

Sudbury Water and Wastewater Master Plan

0 500 1,000 Meters

1:15,000

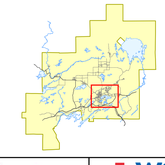
Map 12

Sudbury
Vacant Land Development
(2031 - 2036)

N

Legend

- Road
- Railway
- Watercourse
- Waterbody
- Parcel
- ICI Development (2036 - 2041)
- Residential Development (2036 - 2041)
- ICI Development (2011 - 2036)
- Residential Development (2011 - 2036)



Sudbury (Greater Sudbury) | WSP

Project No. 121-23026-00

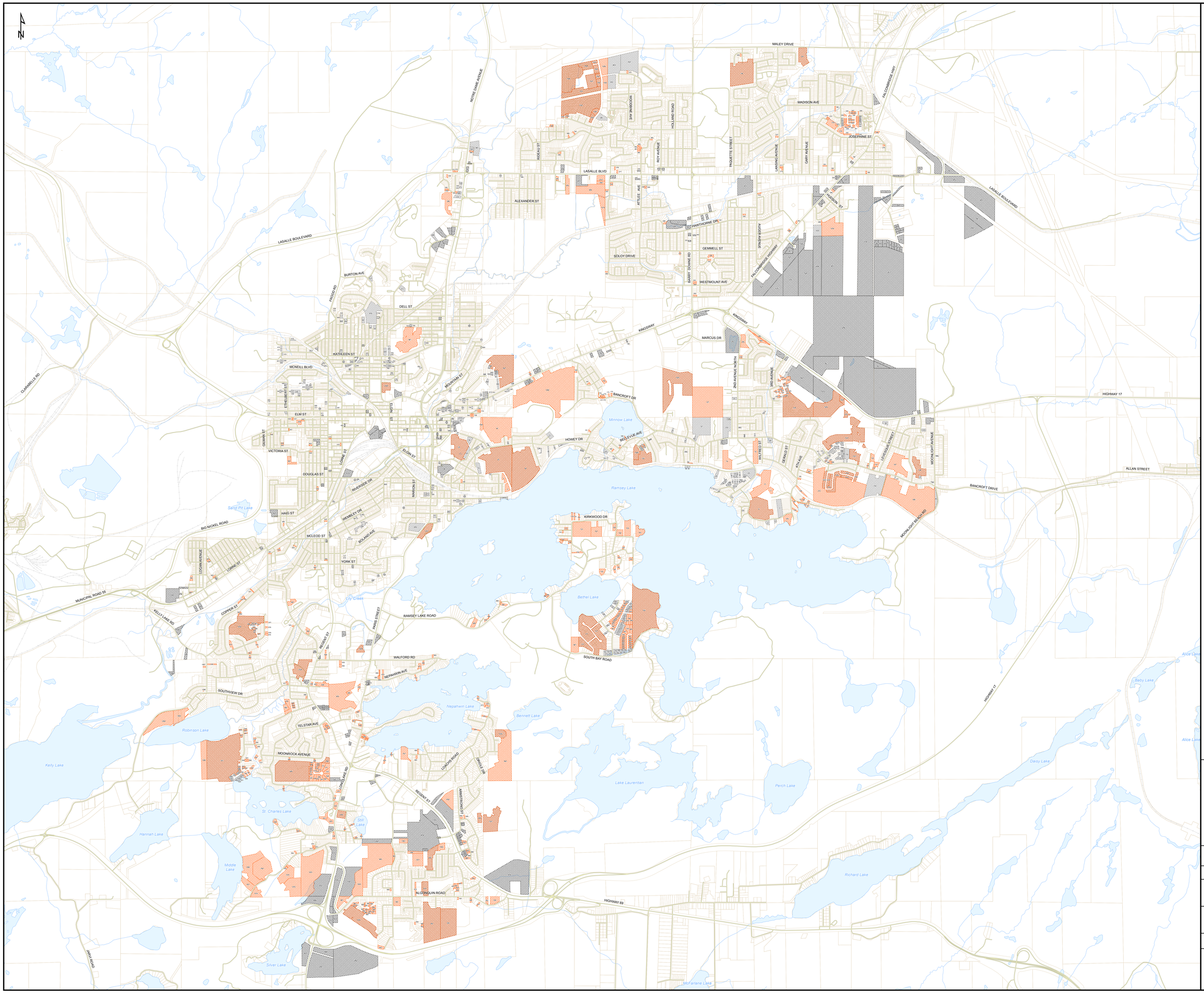
Sudbury Water and Wastewater Master Plan

0 500 1,000 Meters

1:15,000

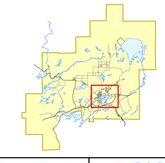
Map 12

Sudbury Vacant Land Development (2036 - 2041)



Legend

- Road
- Railway
- Watercourse
- Waterbody
- Parcel
- ICI Development (2041 - Ultimate)
- Residential Development (2041 - Ultimate)
- ICI Development (2011 - 2041)
- Residential Development (2011 - 2041)



Project No. 121-23026-00

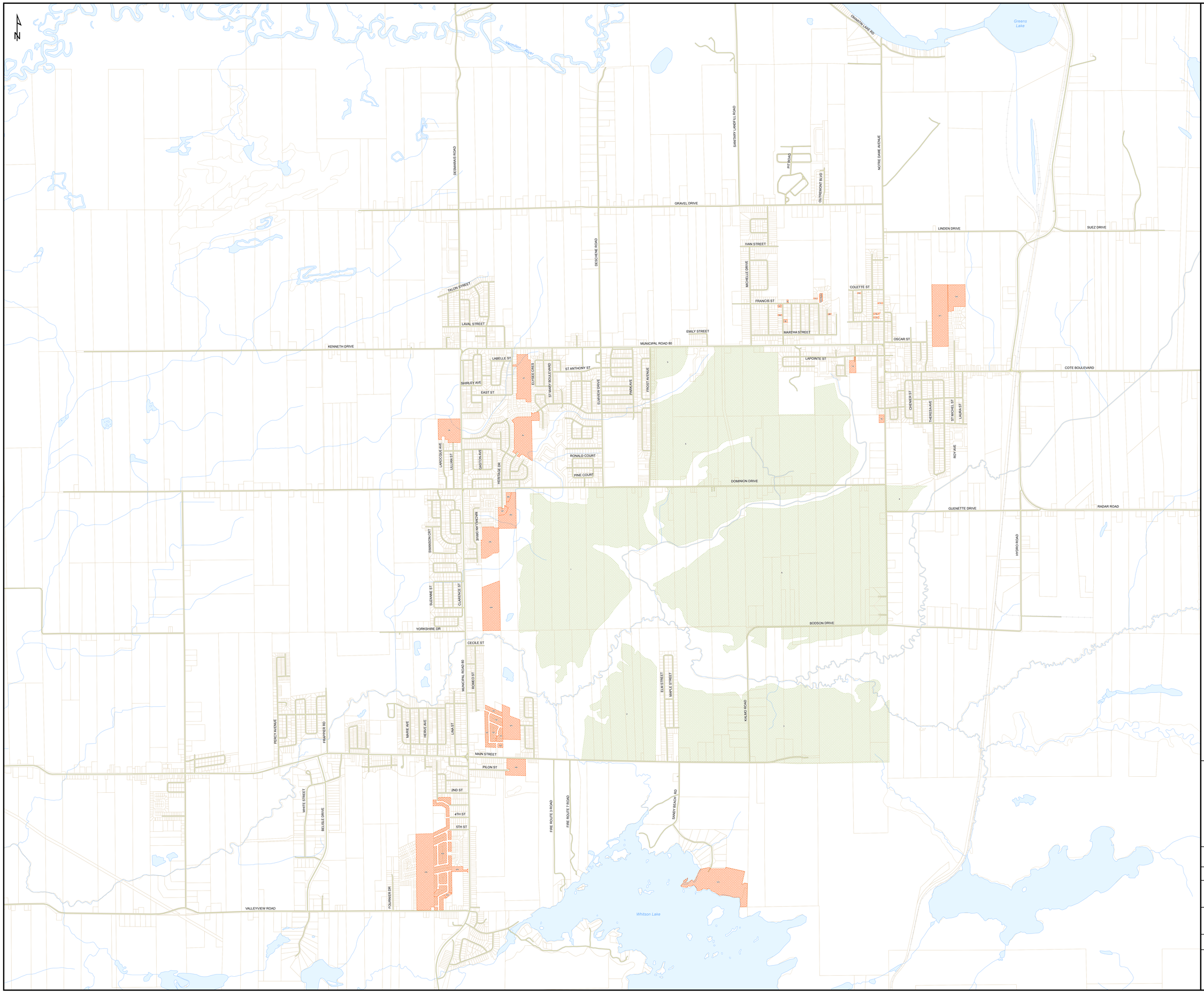
Sudbury Water and Wastewater Master Plan

0 500 1,000 Meters

1:15,000

Map 12

Sudbury Vacant Land Development (2041 - Ultimate)



Legend

- Road
- Railway
- Watercourse
- Waterbody
- Parcel
- Urban Expansion Reserve
- ICI Development (2011 - 2016)
- Residential Development (2011 - 2016)



Sudbury | WSP

Project No. 121-23026-00

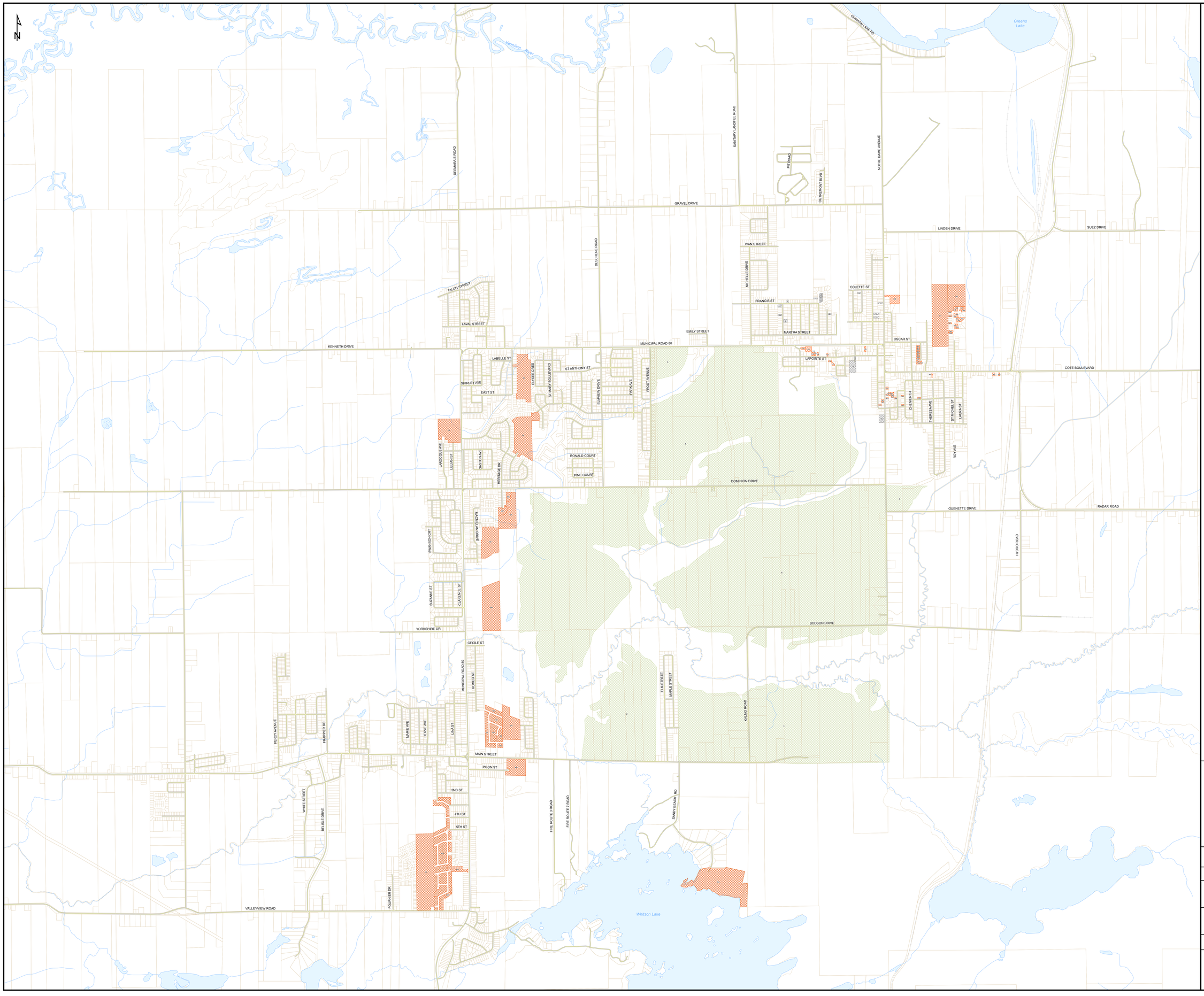
Sudbury Water and Wastewater Master Plan

0 500 1,000 m

1:13,000

Map 13

Valley East
Vacant Land Development
(2011 - 2016)



Legend

- Road
- Railway
- Watercourse
- Waterbody
- Parcel
- Urban Expansion Reserve
- ICI Development (2016 - 2021)
- Residential Development (2016 - 2021)
- ICI Development (2011 - 2016)
- Residential Development (2011 - 2016)



Sudbury | WSP

Project No. 121-23026-00

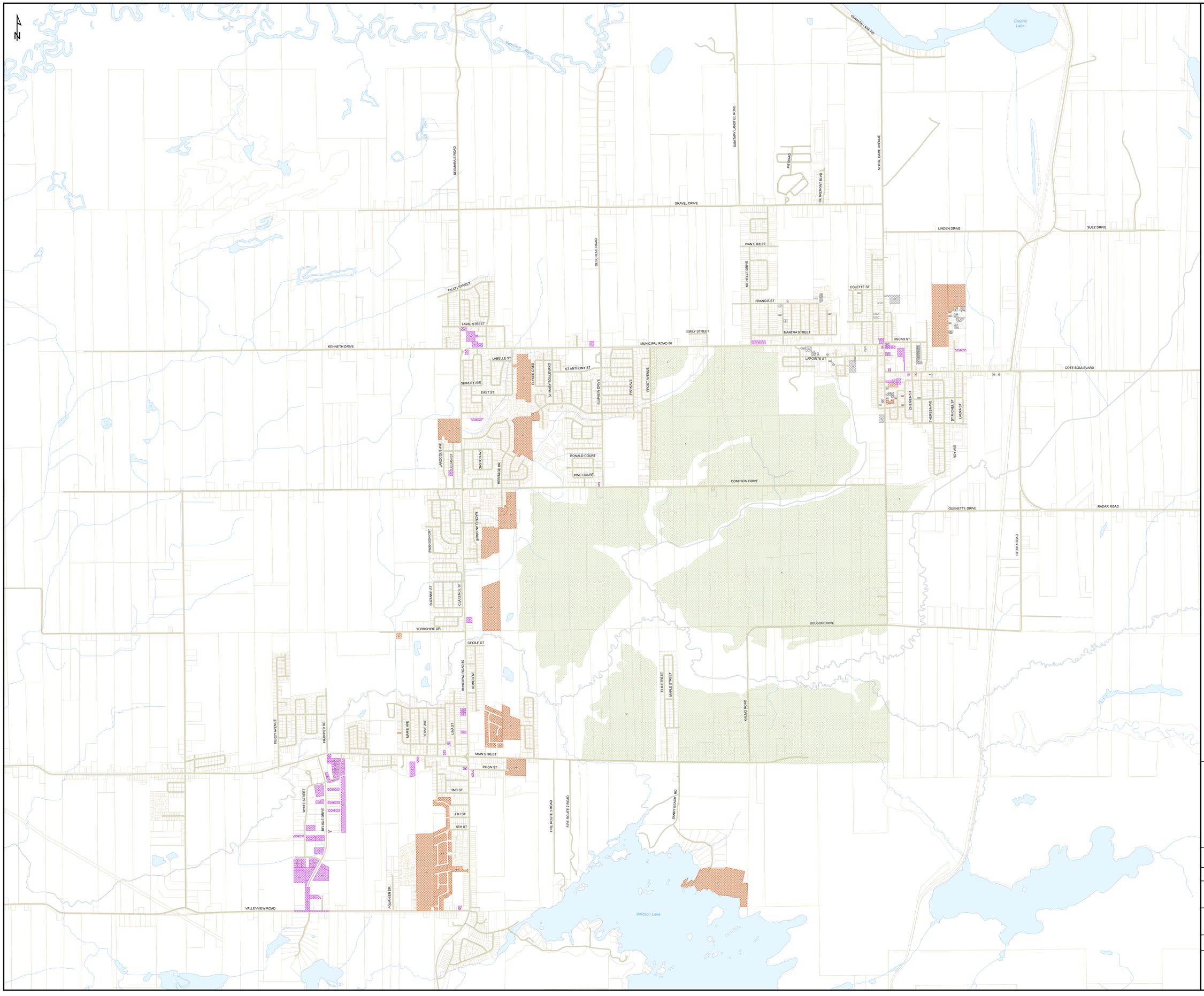
Sudbury Water and Wastewater Master Plan

0 500 1,000 m

1:13,000

Map 13

Valley East
Vacant Land Development
(2016 - 2021)



Legend

- Road
- Railway
- Watercourse
- Waterbody
- Parcel
- Urban Expansion Reserve
- ICI Development (2021 - 2026)
- Residential Development (2021 - 2026)
- ICI Development (2011 - 2021)
- Residential Development (2011 - 2021)



Sudbury | WSP

Project No. 121-23026-00

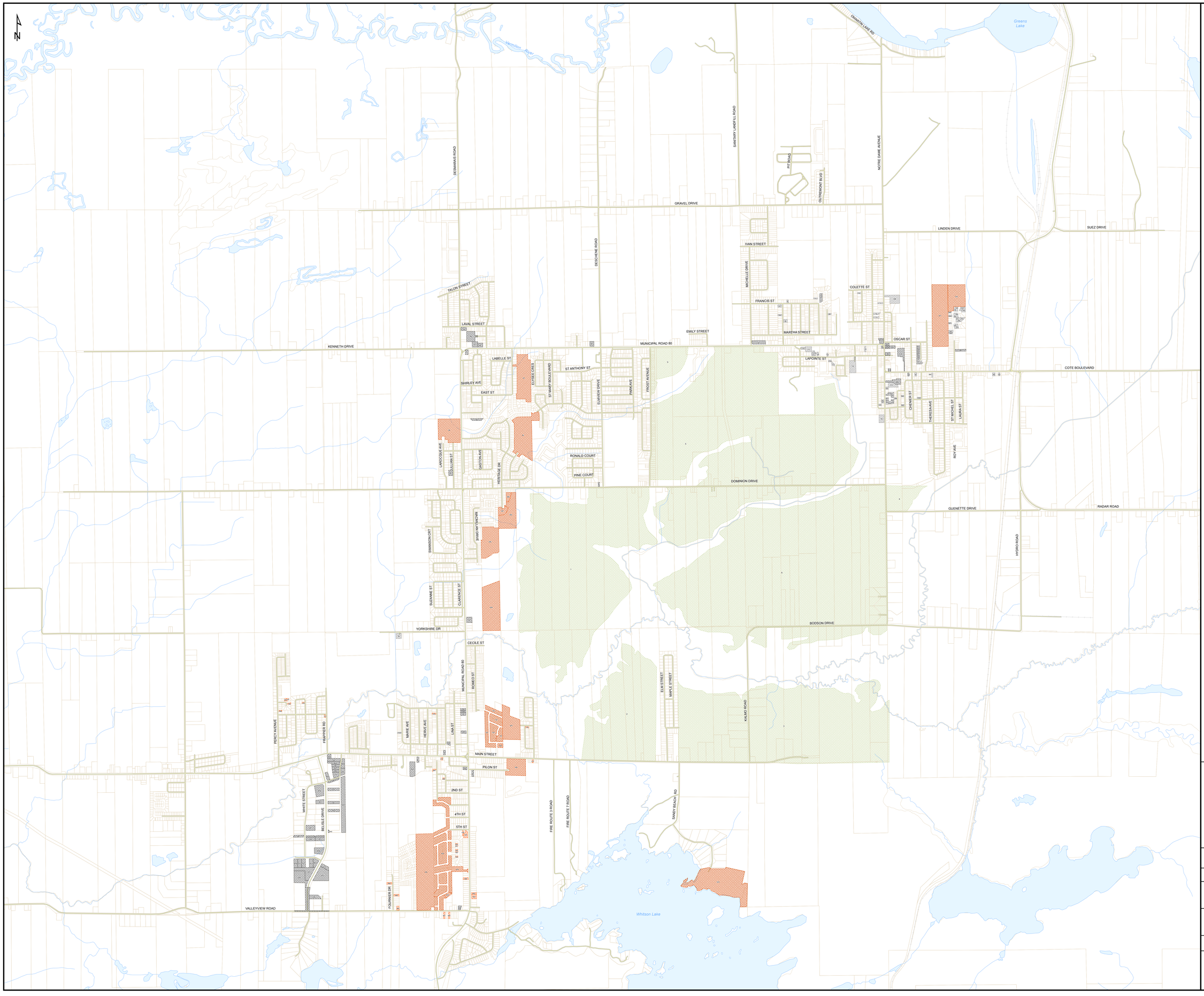
Sudbury Water and Wastewater Master Plan

0 500 1,000 m

1:13,000

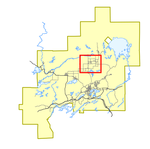
Map 13

Valley East
Vacant Land Development
(2021 - 2026)



Legend

- Road
- Railway
- Watercourse
- Waterbody
- Parcel
- Urban Expansion Reserve
- ICI Development (2026 - 2031)
- Residential Development (2026 - 2031)
- ICI Development (2011 - 2026)
- Residential Development (2011 - 2026)



Sudbury | WSP

Project No. 121-23026-00

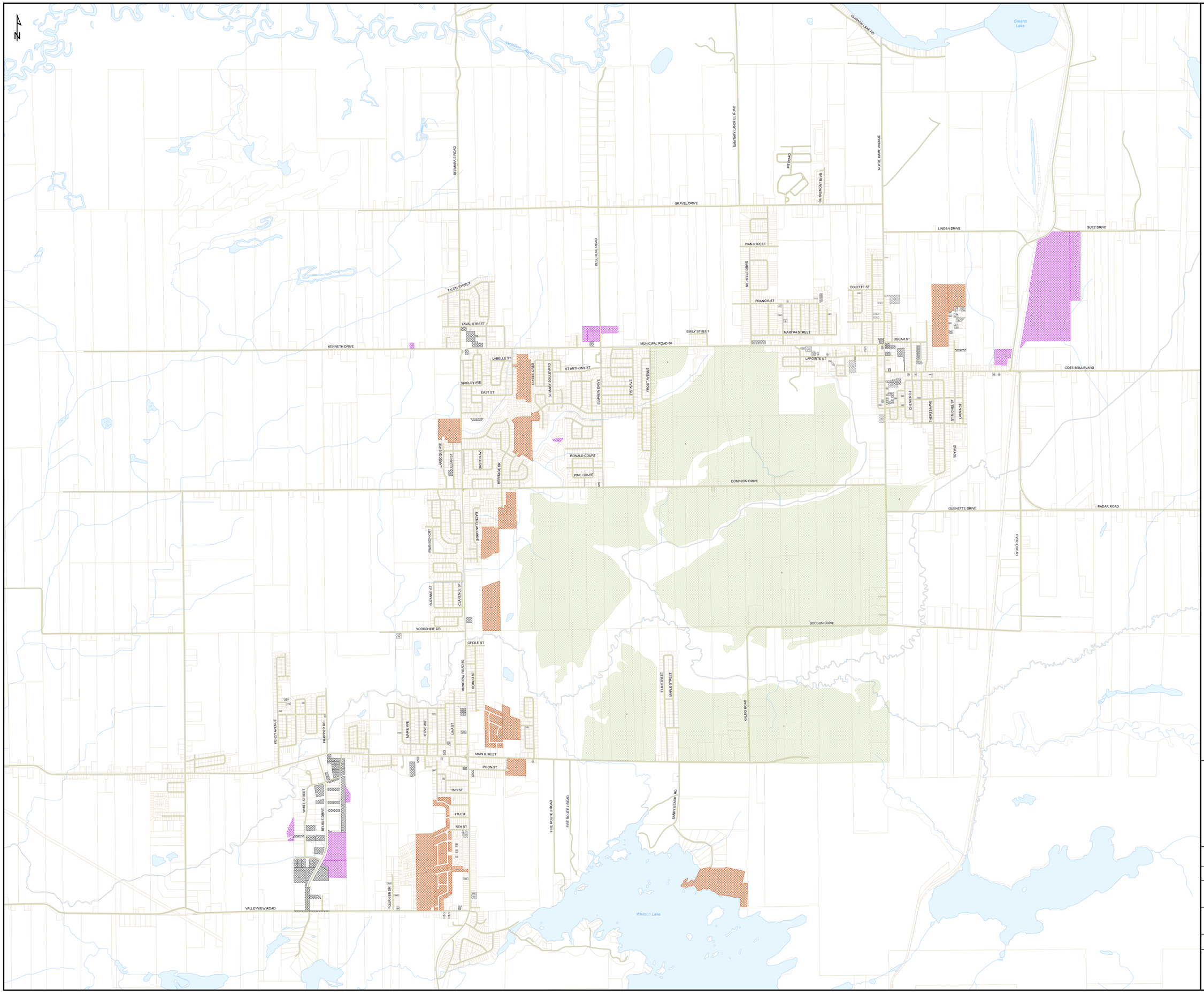
Sudbury Water and Wastewater Master Plan

0 500 1,000 m

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Map 13

Valley East
Vacant Land Development
(2026 - 2031)



Legend

- Road
- Railway
- Watercourse
- Waterbody
- Parcel
- Urban Expansion Reserve
- ICI Development (2031 - 2036)
- Residential Development (2031 - 2036)
- ICI Development (2011 - 2031)
- Residential Development (2011 - 2031)



Sudbury | WSP

Project No. 121-23026-00

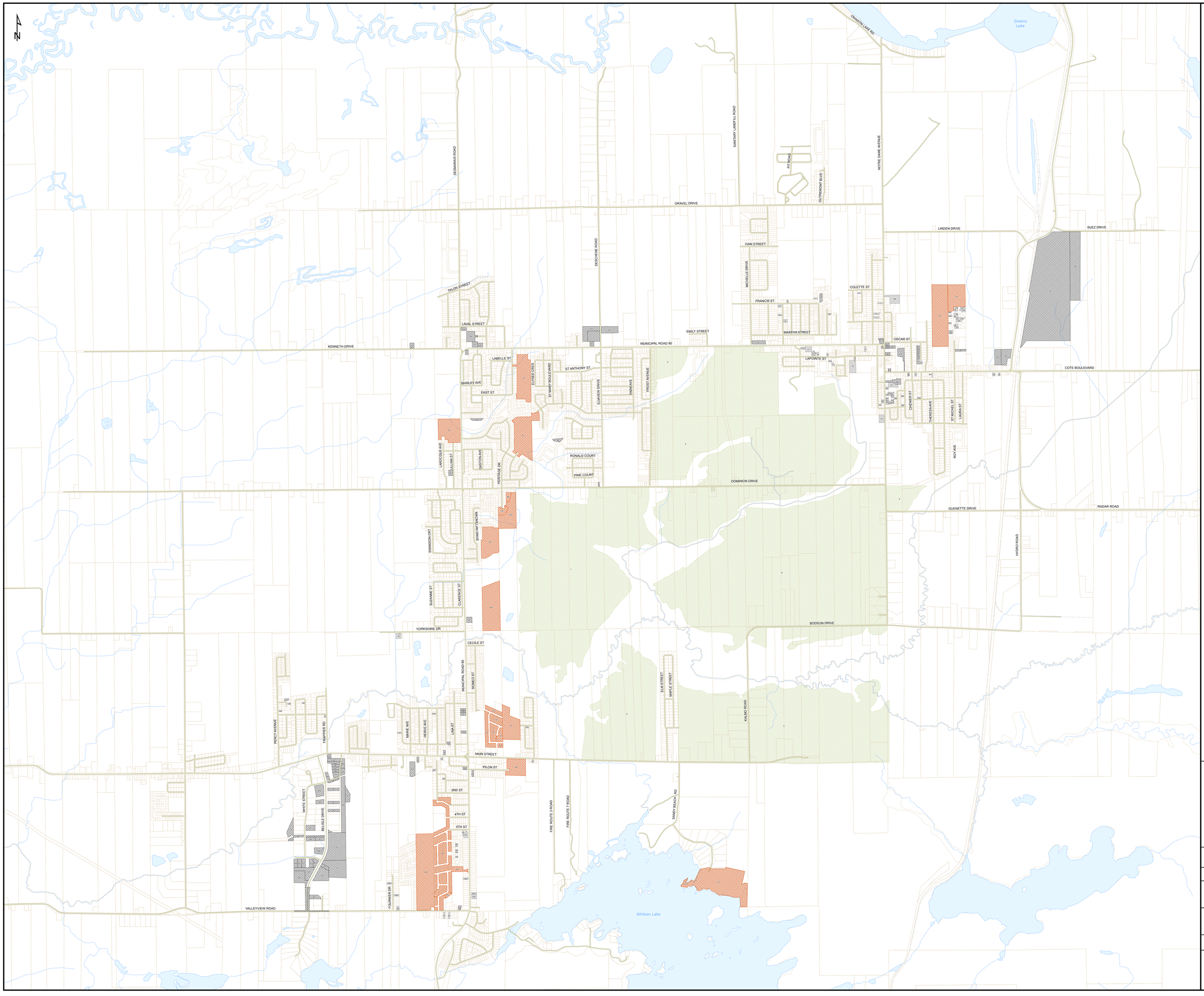
Sudbury Water and Wastewater Master Plan

0 500 1,000 m

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Map 13

Valley East
Vacant Land Development
(2031 - 2036)



Legend

- Road
- Railway
- Watercourse
- Waterbody
- Parcel
- Urban Expansion Reserve
- ICI Development (2036 - 2041)
- Residential Development (2036 - 2041)
- ICI Development (2011 - 2036)
- Residential Development (2011 - 2036)



Sudbury | WSP

Project No. 121-23026-00

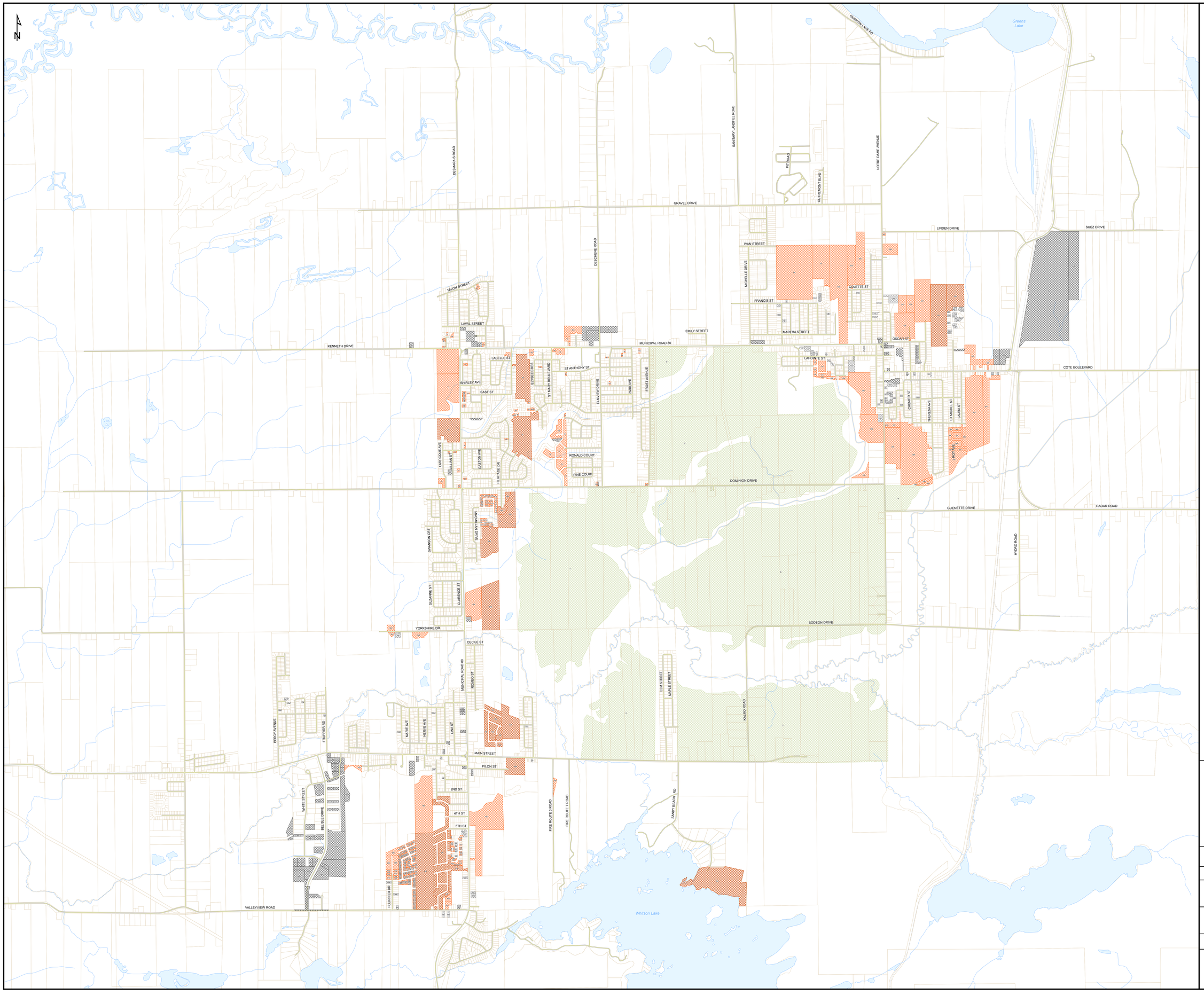
Sudbury Water and Wastewater Master Plan

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Map 13

Valley East
Vacant Land Development
(2036 - 2041)



Legend

- Road
- Railway
- Watercourse
- Waterbody
- Parcel
- Urban Expansion Reserve
- ICI Development (2041 - Ultimate)
- Residential Development (2041 - Ultimate)
- ICI Development (2011 - 2041)
- Residential Development (2011 - 2041)



Sudbury | WSP

Project No. 121-23026-00

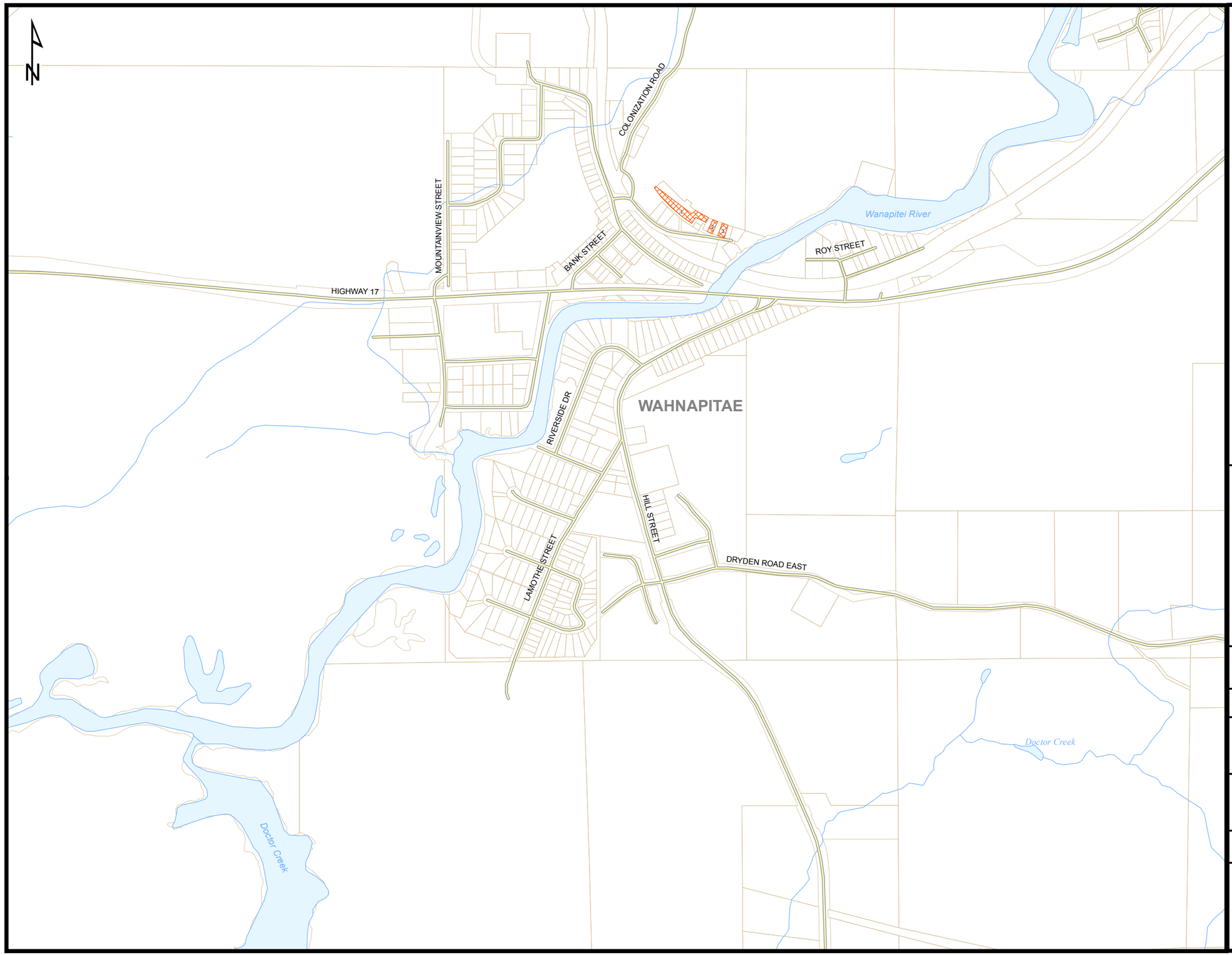
Sudbury Water and Wastewater Master Plan

0 500 1,000 m

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Map 13

Valley East
Vacant Land Development
(2041 - Ultimate)



Legend

- Road
- Watercourse
- Waterbody
- Parcel
- ICI Development (2011 - 2016)
- Residential Development (2011 - 2016)



Project No. 121-23026-00

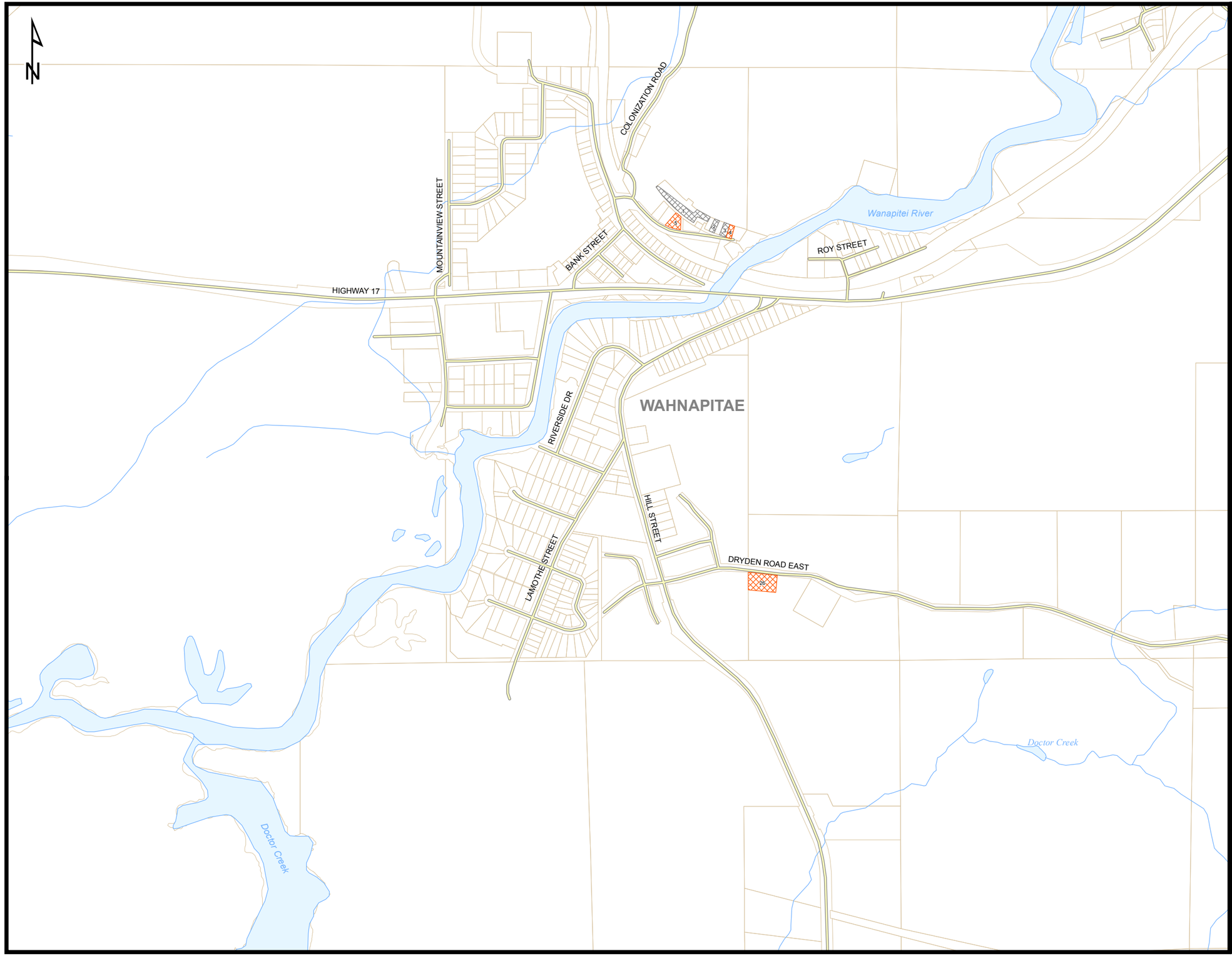
Sudbury Water and Wastewater Master Plan

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Map 14

Wahnapitae
Vacant Land Development
(2011 - 2016)



Legend

- Road
- Watercourse
- Waterbody
- Parcel
- ICI Development (2016 - 2021)
- Residential Development (2016 - 2021)
- ICI Development (2011 - 2016)
- Residential Development (2011 - 2016)



Project No. 121-23026-00

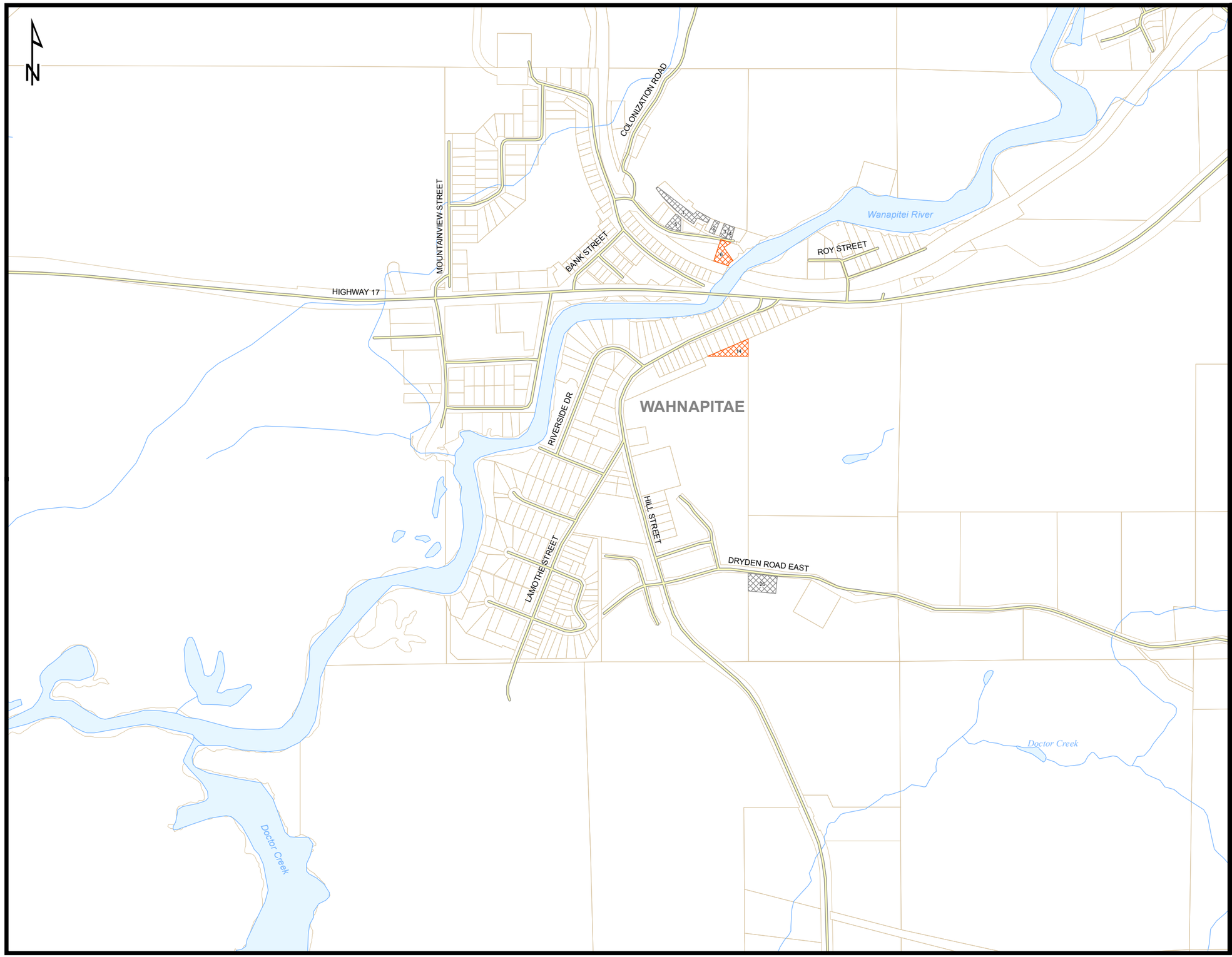
Sudbury Water and Wastewater Master Plan

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Map 14

Wahnapitae Vacant Land Development (2016 - 2021)



Legend

- Road
- Watercourse
- Waterbody
- Parcel
- ICI Development (2021 - 2026)
- Residential Development (2021 - 2026)
- ICI Development (2011 - 2021)
- Residential Development (2011 - 2021)



Project No. 121-23026-00

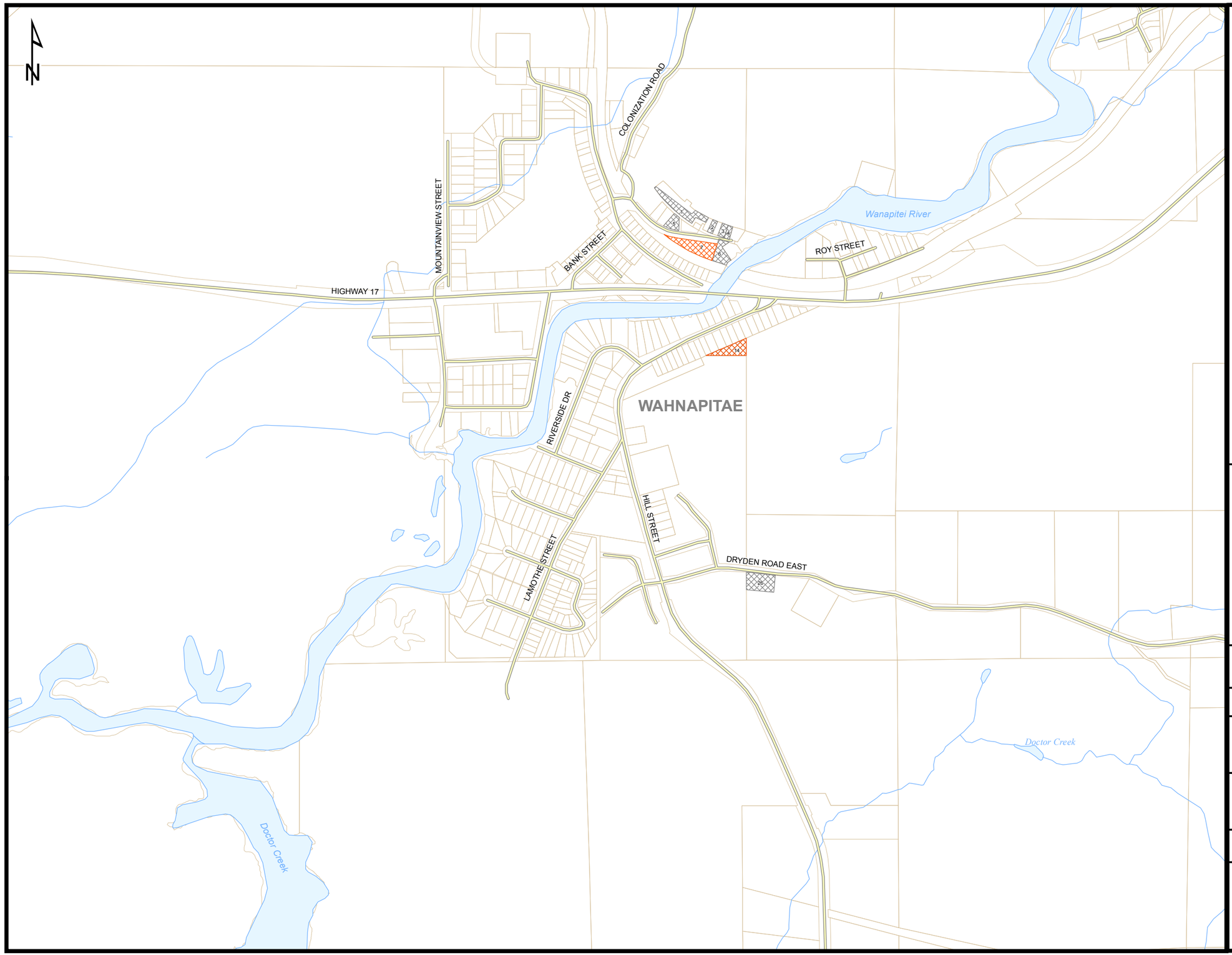
Sudbury Water and Wastewater Master Plan

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Map 14

Wahnapitae
Vacant Land Development
(2021 - 2026)



Legend

- Road
- Watercourse
- Waterbody
- Parcel
- ICI Development (2026 - 2031)
- Residential Development (2026 - 2031)
- ICI Development (2011 - 2026)
- Residential Development (2011 - 2026)



Project No. 121-23026-00

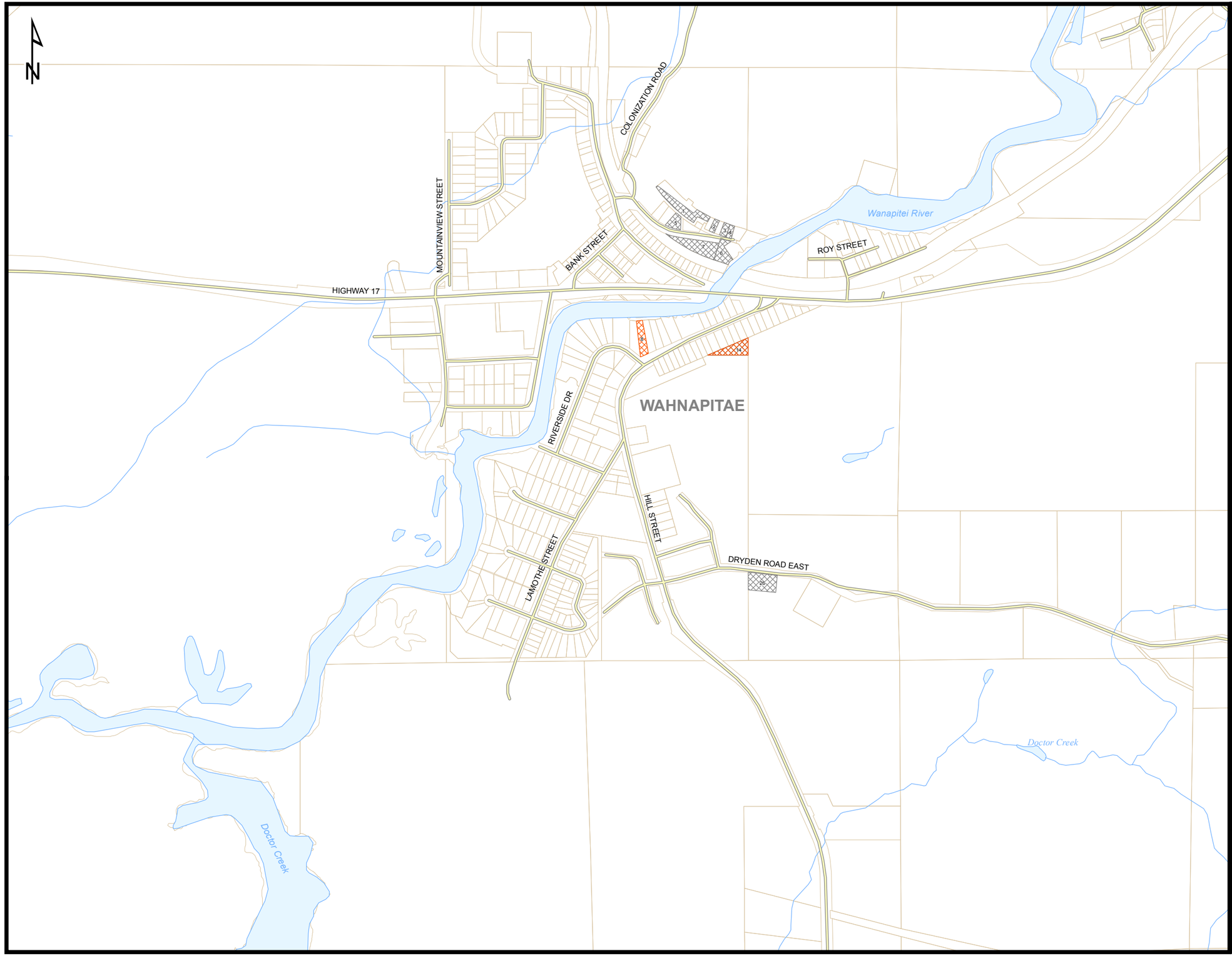
Sudbury Water and Wastewater Master Plan

0 100 200 300 400 500 m

1:10,000

Map 14

Wahnapitae Vacant Land Development (2026 - 2031)



Legend

- Road
- Watercourse
- Waterbody
- Parcel
- ICI Development (2031 - 2036)
- Residential Development (2031 - 2036)
- ICI Development (2011 - 2031)
- Residential Development (2011 - 2031)



Project No. 121-23026-00

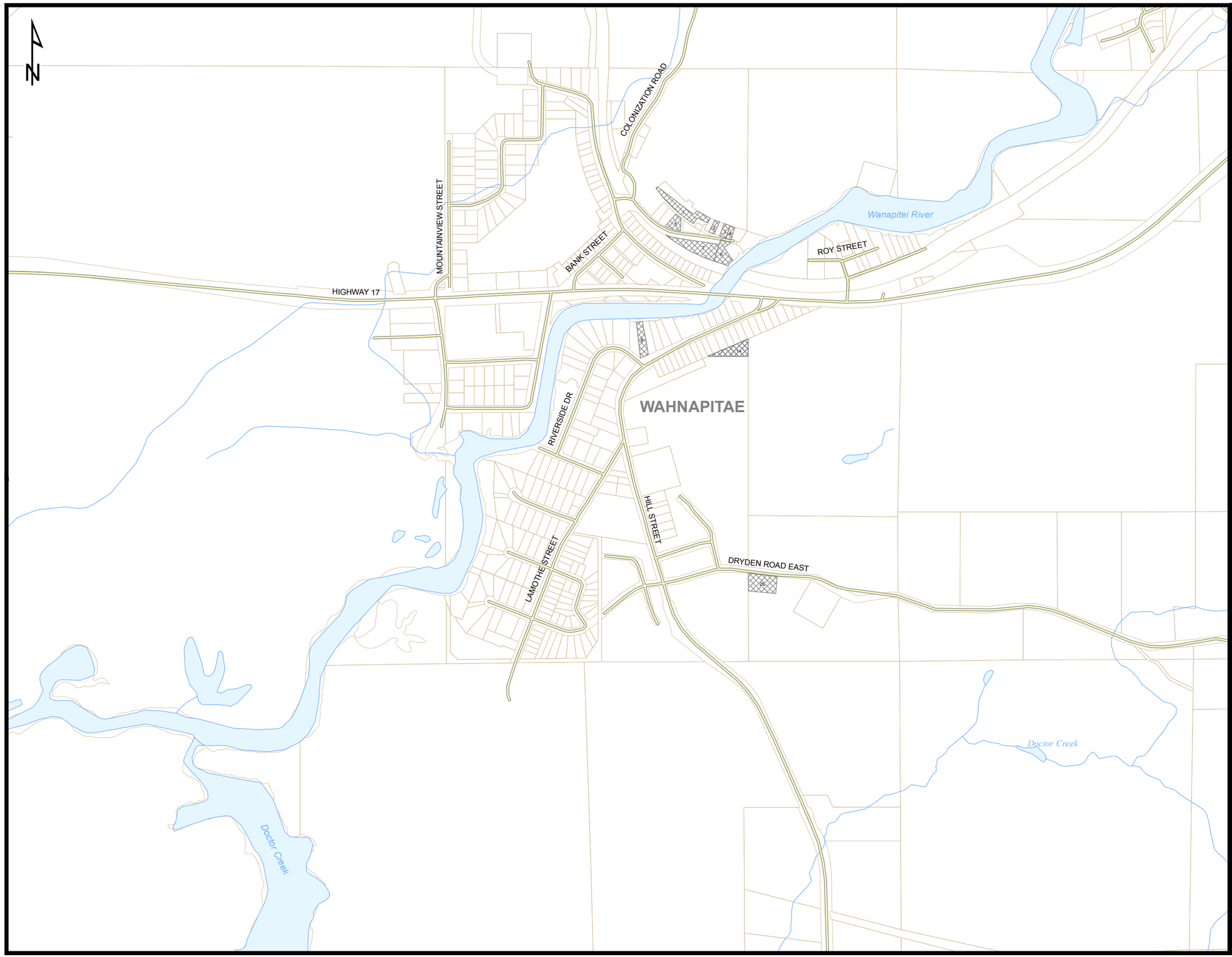
Sudbury Water and Wastewater Master Plan

0 100 200 300 400 500 m

1:10,000

Map 14

Wahnapitae Vacant Land Development (2031 - 2036)



Legend

- Road
- Watercourse
- Waterbody
- Parcel
- ICI Development (2036 - 2041)
- Residential Development (2036 - 2041)
- ICI Development (2011 - 2036)
- Residential Development (2011 - 2036)



Project No. 121-23026-00

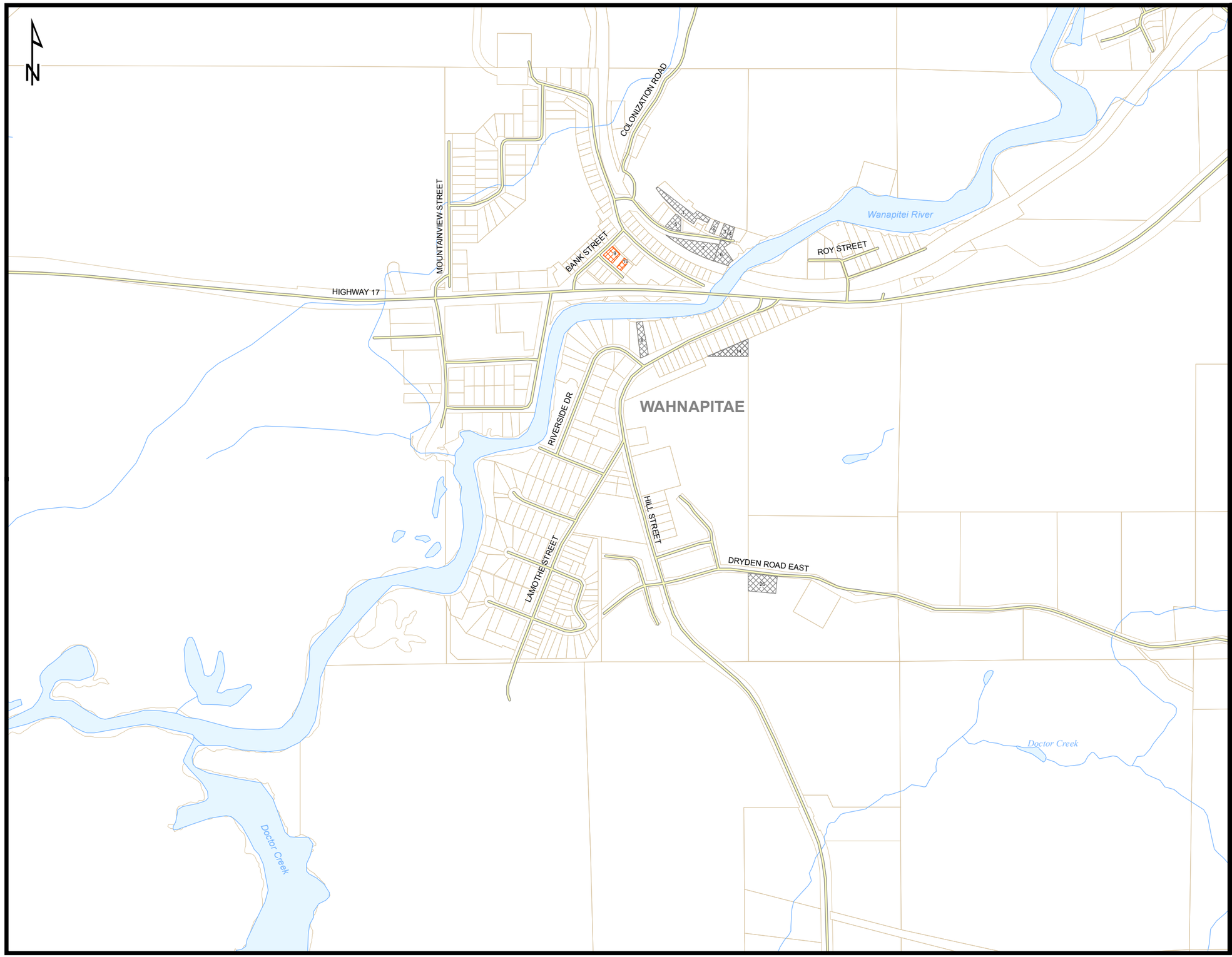
Sudbury Water and Wastewater Master Plan

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Map 14

Wahnapitae
Vacant Land Development
(2036 - 2041)



Legend

- Road
- Watercourse
- Waterbody
- Parcel
- ICI Development (2041 - Ultimate)
- Residential Development (2041 - Ultimate)
- ICI Development (2011 - 2041)
- Residential Development (2011 - 2041)



Project No. 121-23026-00

Sudbury Water and Wastewater Master Plan

0 100 200 300 400 500 m

1:10,000

Map 14

Wahnapitae Vacant Land Development (2041 - Ultimate)

APPENDIX

A SYSTEM SUMMARY SHEETS

A-1 WATER SYSTEMS

DATA ANALYSIS

Omitted - Outlier

		2009	2010	2011	2012	2013	Summary	Design Criterion	Comments
Average Day Flow	m^3/d	392	399	379	382	366	388	**388**	From Water Historical Production data. The daily production values for each facility was added together to determine the total daily production. 2013 was excluded from the set since the year was unusually dry and resulted in atypical demands.
Max Day Flow	m^3/d	875	1,003	1,207	1,108	1,680	1,048	**1,048**	The maximum value of the sum of water production for each facility was used. 2013 was excluded from the set since the year was unusually dry and resulted in atypical demands.
Max Day Factor		**2.24**	**2.51**	**3.18**	**2.90**	**4.59**	2.71	**2.71**	MOE Guidelines recommend a value of 2.50 for populations between 1,001 and 2,000. The maximum value over the past five years was 4.59, which was higher than previous years. Because there is no clear trend, it is suggested to adopt the maximum. 2013 was excluded from the set since the year was unusually dry and resulted in atypical demands.
Peak Hour (L/s)	**L/s**	Not Available		31	42	60	N/A		Peak values were available only for 2011-2013. 2013 was excluded from the set since the year was unusually dry and resulted in atypical demands.
Peak Hour (m^3/d)	m^3/d			2,696	3,616	5,191	N/A		
Peak Hour Factor				**7.11**	**9.47**	**14.19**	8.29	**3.75**	MOE Guidelines recommend a value of 3.75 for populations between 1,001 and 2,000. The historical peak hour data is artificially high since the City operates Dowling Wells to fill the storage tank, and not necessarily just to direct-pump into the system. The hourly data shows that the pumps are only run for a few hours each day. Therefore, this data should not be used to calculate a peaking factor

	2016	2021	2026	2031	2036	2041	Ultimate	
Population (Existing Areas)	1,773	1,773	1,773	1,773	1,773	1,773	1,773	From data provided by Hemson grouped by water system.
Population Growth	64	130	193	225	244	244	1,949	
Total Population	1,837	1,903	1,965	1,997	2,017	2,016	3,721	From data provided by Hemson grouped by water system.
Residential Growth Area (ha)	12.96	9.01	0.00	3.44	0.00	0.00	53.10	From City's GIS database. 2036 and 2041 areas are included with 2031.
Residential Growth Area (ha) - Cumulative	12.96	21.97	21.97	25.41	25.41	25.41	78.51	
Institutional Growth Area (ha)	0.00	0.00	0.47	0.00	0.00	0.00	0.00	
Institutional Growth Area (ha) - Cumulative	0.00	0.00	0.47	0.47	0.47	0.47	0.47	From City's GIS database.
Commercial Growth Area (ha)	0.00	0.00	0.64	0.00	0.00	0.00	0.00	
Commercial Growth Area (ha) - Cumulative	0.00	0.00	0.64	0.64	0.64	0.64	0.64	From City's GIS database.
Industrial Growth Area (ha)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
Industrial Growth Area (ha) - Cumulative	0.00	0.00	0.00	0.00	0.00	0.00	0.00	From City's GIS database.
ICI (ha) - Cumulative	**0.00**	**0.00**	**1.11**	**1.11**	**1.11**	**1.11**	**1.11**	Sum of Institutional, Commercial and Industrial areas
Total Growth Area (ha) - Cumulative	**12.96**	**21.97**	**23.08**	**26.52**	**26.52**	**26.52**	**79.62**	

Ratio of Residential to Total Water Billed	0.82	0.82	0.82	0.82	0.82	0.818		Estimated amount of water consumption related to ICI based on metering data and obtained ratio of residential to total consumption.
Residential Flow (m^3/d)	320	326	310	312	299	314		Calculated based on ratio of residential consumption to total consumption.
Ratio of ICI to Total Water Billed	0.18 71	0.18 73	0.18 69	0.18 70	0.18 67	0.182 70		
Per Capita Residential Demand (m^3/cap/day)	0.181	0.184	0.175	0.176	0.169	0.177	**0.200**	Took average over 2009 to 2013 period, and rounded up.
Average Institutional Flow Unit Rate (m^3/ha/d)							**28.0**	*MOE Guidelines recommend a value of 28 m^3/ha/d.*
Average Commercial Flow Unit Rate (m^3/ha/d)							**28.0**	*MOE Guidelines recommend a value of 28 m^3/ha/d.*
Average Industrial Flow Unit Rate (m^3/ha/d)							**35.0**	*MOE Guidelines recommend a value of 35 m^3/ha/d for light industry and 55 m^3/ha/d for heavy industry.*

	2016	2021	2026	2031	2036	2041	Ultimate
Average Residential and ICI Flows (m^3/d) - Existing	**388**	**388**	**388**	**388**	**388**	**388**	**388**
Average Residential Flows (m^3/d) - Growth	**13**	**26**	**39**	**45**	**49**	**49**	**390**
Average Residential Flows (m^3/d) - Total	**401**	**414**	**427**	**433**	**437**	**437**	**778**
Average Institutional Flow (m^3/d)	**0**	**0**	**13**	**13**	**13**	**13**	**13**
Average Commercial Flow (m^3/d)	**0**	**0**	**18**	**18**	**18**	**18**	**18**
Average Industrial Flow (m^3/d)	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Average ICI Flow (m^3/d)	**0**	**0**	**31**	**31**	**31**	**31**	**31**
Average Day Flow (m^3/d)	**401**	**414**	**458**	**464**	**468**	**468**	**809**
Max Day Flow (m^3/d)	**1,085**	**1,121**	**1,239**	**1,257**	**1,267**	**1,267**	**2,190**
Peak Hour Flow (m^3/d)	**1,503**	**1,553**	**1,716**	**1,740**	**1,755**	**1,754**	**3,033**

ALTERNATIVE CALCULATION METHOD

Per Capita Demand (m^3/cap/day)	0.221	0.225	0.214	0.215	0.206	0.216
Max Day Factor						4.59
Peak Hour Factor						3.75

If ICI is not considered explicitly and demand is divided by total population.
The historical per capita consumption is applied for future development.

	2016	2021	2026	2031	2036	2041	Ultimate
Average Day Flow (m^3/d)	397	412	425	432	436	436	805
Max Day Flow (m^3/d)	1,824	1,890	1,952	1,984	2,003	2,003	3,696
Peak Hour Flow (m^3/d)	1,490	1,544	1,595	1,621	1,636	1,636	3,020

SENSITIVITY ANALYSIS

Analyze sensitivity of forecasted average day flows to unit rate

	Unit Rate (m^3/cap/d)	Average Day Flow (m^3/d) 2016	2021	2026	2031	2036	2041	Ultimate
Using a consolidated per capita flow		397	412	425	432	436	436	805
Using estimated average	0.200	401	414	458	464	468	468	809
City Standards	0.41	414	441	498	511	519	519	1218

Analyze sensitivity of forecasted flows to max day peaking factor

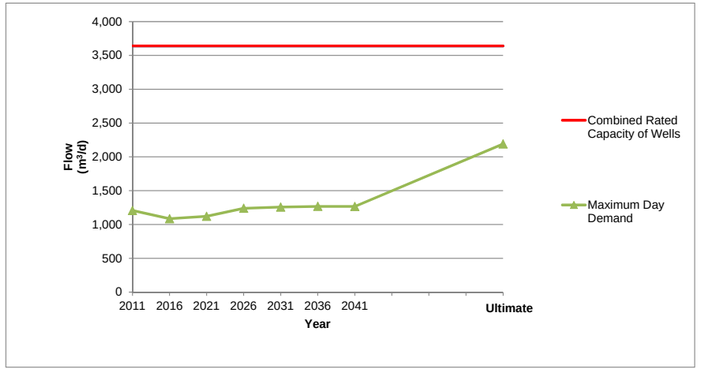
	Max Day Peaking Factor	Max Day Flow (m^3/d) 2016	2021	2026	2031	2036	2041	Ultimate
2009-2013 average of peaking factors	3.08	1,236	1,277	1,412	1,431	1,443	1,443	2,495
2012 peaking factor (maximum historical)	4.59	1,085	1,121	1,239	1,257	1,267	1,267	2,190
MOE Guidelines	2.50	1002	1035	1144	1160	1170	1170	2022

Analyze sensitivity of forecasted flows to peak hour factor

	Peak Hour Peaking Factor	Peak Hour (m^3/d) 2016	2021	2026	2031	2036	2041	Ultimate
MOE Guidelines	3.75	1,503	1,553	1,716	1,740	1,755	1,754	3,033

CAPACITY CHECK

	2011	2016	2021	2026	2031	2036	2041	Ultimate
Combined Rated Capacity of Wells	3,640	3,640	3,640	3,640	3,640	3,640	3,640	3,640
Actual Capacity of Wells	3,640	3,640	3,640	3,640	3,640	3,640	3,640	3,640
Maximum Day Demand	1,207	1,085	1,121	1,239	1,257	1,267	1,267	2,190
Peak Hour Demand		1,503	1,553	1,716	1,740	1,755	1,754	3,033



STORAGE REQUIREMENTS

Storage Available		
Elevated Tank (m^3)	907	Calculated from operating levels.
Total Storage (m^3)	907	
Maximum Fire flow Requirements (L/s)	150	
Fire Duration (hrs)	2	
Minimum Fire Flow Requirement for Residential Areas (L/s)	75	From CGS Engineering Design Manual
Fire Duration (hrs)	1.75	From Fire Underwriters Survey Requirements corresponding to 75 L/s

MOE A + B + C Calculation is not applicable because there is available pumping capacity.

DATA ANALYSIS

	2009	2010	2011	2012	2013	Summary	Design Criterion	Comments
Average Day Flow (m^3/d)	1,161	1,157	1,156	1,021	1,058	1,111	**1,111**	From Water Historical Production data. The daily production values for each facility were added together to determine the total daily production.
Max Day Flow (m^3/d)	2,995	2,107	1,945	1,701	3,005	2,350	**2,350**	
Max Day Factor	**2.58**	**1.82**	**1.68**	**1.66**	**2.84**	2.12	**2.12**	MOE Guidelines recommend a value of 2.75 for populations between 500 and 1,000. This is in line with the historical maximum.
Peak Hour (L/s)	Not Available		29.9	29.7	42.5			Peak values were available only for 2011-2013.
Peak Hour (m^3/d)			2,584	2,562	3,670	2,939		
Peak Hour Factor			**2.24**	**2.51**	**3.47**	2.74	**3.47**	MOE Guidelines recommend a value of 4.13 for populations between 500 and 1,000. However, the historical maximum was higher than other historical values, and so this value was adopted.

	2016	2021	2026	2031	2036	2041	Ultimate	Comments
Population (Existing Areas)	707	707	707	707	707	707	707	From data provided by Hemson grouped by water system.
Population Growth	17	35	52	62	68	69	148	
Total Population	724	743	759	769	775	776	855	From data provided by Hemson grouped by water system.
Residential Growth Area (ha)	0.48	0.67	0.37	0.33	0.86	0.00	0.00	From City's GIS database. 2041 and Ultimate areas are included with 2036.
Residential Growth Area (ha) - Cumulative	0.5	1.1	1.5	1.8	2.7	2.7	2.7	
Institutional Growth Area (ha)	0.0	0.0	1.70	0.0	0.33	0.0	0.0	
Institutional Growth Area (ha) - Cumulative	0.0	0.0	1.70	1.70	2.03	2.03	2.03	From City's GIS database.
Commercial Growth Area (ha)	0.0	0.0	0.17	0.0	0.0	0.0	0.0	
Commercial Growth Area (ha) - Cumulative	0.0	0.0	0.17	0.17	0.17	0.17	0.17	From City's GIS database.
Industrial Growth Area (ha)	0.0	0.0	0.36	0.0	0.0	0.0	0.0	
Industrial Growth Area (ha) - Cumulative	0.0	0.0	0.36	0.36	0.36	0.36	0.36	From City's GIS database.
ICI (ha) - Cumulative	**0.00**	**0.00**	**2.24**	**2.24**	**2.57**	**2.57**	**2.57**	Sum of Institutional, Commercial and Industrial areas
Total Growth Area (ha) - Cumulative	**0.5**	**1.1**	**3.7**	**4.1**	**5.3**	**5.3**	**5.3**	

	2009	2010	2011	2012	2013	Summary	Design Criterion	Comments
Ratio of Residential to Total Water Billed	0.19	0.19	0.19	0.19	0.19	0.19		Estimated amount of water consumption related to ICI based on metering data and obtained ratio of residential to total consumption.
Residential Flow (m^3/d)	218	217	217	192	199	209		Calculated based on ratio of residential consumption to total consumption.
Ratio of ICI to Total Water Billed	0.81	0.81	0.81	0.81	0.81	0.812		
	942	939	939	829	859	902		
Per Capita Residential Demand (m^3/cap/day)	0.308	0.307	0.307	0.271	0.281	0.295	**0.300**	Took average over 2009 to 2013 period. The trend is generally consistent.
Average Institutional Flow Unit Rate (m^3/ha/d)							**28.0**	*MOE Guidelines recommend a value of 28 m^3/ha/d.*
Average Commercial Flow Unit Rate (m^3/ha/d)							**28.0**	*MOE Guidelines recommend a value of 28 m^3/ha/d.*
Average Industrial Flow Unit Rate (m^3/ha/d)							**35.0**	*MOE Guidelines recommend a value of 35 m^3/ha/d for light industry and 55 m^3/ha/d for heavy industry.*

	2016	2021	2026	2031	2036	2041	Ultimate
Average Residential and ICI Flows (m^3/d) - Existing	1,111	1,111	1,111	1,111	1,111	1,111	1,111
Average Residential Flows (m^3/d) - Growth	5	11	16	19	20	21	44
Average Residential Flows (m^3/d) - Total	1,116	1,121	1,126	1,129	1,131	1,131	1,155
Average Institutional Flow (m^3/d)	0	0	48	48	57	57	57
Average Commercial Flow (m^3/d)	0	0	5	5	5	5	5
Average Industrial Flow (m^3/d)	0	0	13	13	13	13	13
Average ICI Flow (m^3/d)	0	0	65	65	74	74	74
Average Day Flow (m^3/d)	1,116	1,121	1,191	1,194	1,205	1,206	1,229
Max Day Flow (m^3/d)	2,365	2,377	2,526	2,532	2,556	2,556	2,606
Peak Hour Flow (m^3/d)	3,869	3,888	4,132	4,142	4,180	4,181	4,263

ALTERNATIVE CALCULATION METHOD This method does not distinguish between Residential and ICI water consumption.

	2009	2010	2011	2012	2013	Summary	Design Criterion	Comments
Per Capita Demand (m^3/cap/day)	**1.641**	**1.636**	**1.635**	**1.444**	**1.497**		**1.570**	*If ICI is not considered explicitly and demand is divided by total population. The historical per capita consumption is applied for future development.*
Max Day Factor							**2.84**	
Peak Hour Factor							**3.47**	

	2016	2021	2026	2031	2036	2041	Ultimate
Average Day Flow (m^3/d)	1,137	1,166	1,193	1,208	1,218	1,219	1,343
Max Day Flow (m^3/d)	3,229	3,311	3,386	3,431	3,457	3,460	3,812
Peak Hour Flow (m^3/d)	3,943	4,044	4,136	4,190	4,222	4,226	4,656

SENSITIVITY ANALYSIS

Analyze sensitivity of forecasted average day flows to unit rate

		Average Day Flow (m^3/d)						
	Unit Rate (m^3/cap/d)	2016	2021	2026	2031	2036	2041	Ultimate
Using a consolidated per capita flow	1.570	1,137	1,166	1,193	1,208	1,218	1,219	1,343
Using estimated average	0.300	1,116	1,121	1,191	1,194	1,205	1,206	1,229
City Standards	0.41	1,118	1,125	1,197	1,201	1,213	1,213	1,246

Analyze sensitivity of forecasted flows to max day peaking factor

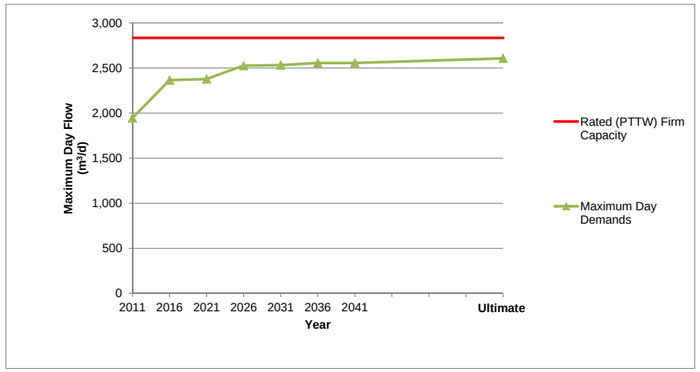
		Max Day Flow (m^3/d)						
	Max Day Peaking Factor	2016	2021	2026	2031	2036	2041	Ultimate
2009-2013 average of peaking factors	2.12	2,363	2,374	2,523	2,529	2,553	2,553	2,603
Maximum historical max day factor	2.84	2,365	2,377	2,526	2,532	2,556	2,556	2,606
MOE Guidelines	1.65	1841	1850	1966	1971	1989	1989	2028

Analyze sensitivity of forecasted flows to peak hour factor

		Peak Hour (m^3/d)						
	Peak Hour Peaking Factor	2016	2021	2026	2031	2036	2041	Ultimate
Using historical highest peak factor	3.47	3,869	3,888	4,132	4,142	4,180	4,181	4,263
Using average of historical peaking factors	2.74	3,054	3,069	3,261	3,269	3,300	3,300	3,365
MOE Guidelines	2.48	2,767	2,781	2,955	2,962	2,990	2,990	3,049

CAPACITY CHECK

	2011	2016	2021	2026	2031	2036	2041	Ultimate
Rated (PTTW) Firm Capacity	2,834 4,251	2,834	2,834	2,834	2,834	2,834	2,834	2,834
Maximum Day Demands	1,945	2,365	2,377	2,526	2,532	2,556	2,556	2,606
Peak Hour Demands	2,584	3,869	3,888	4,132	4,142	4,180	4,181	4,263

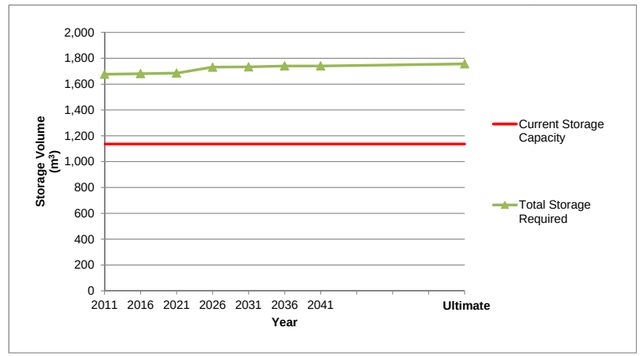


STORAGE REQUIREMENTS

Storage Available			
Elevated Tank (m^3)	1,136	(Useable Volume)	From DWWP 016-201 (September 13, 2011)
Total Storage (m^3)	1,136		
Maximum Fire flow Requirements (L/s) - Existing Network	150		
Maximum Fire flow Requirements (L/s) - Future (starting in 2021)	150		
Fire Duration (hrs)	2		
Minimum Fire Flow Requirement for Residential Areas (L/s)	75		From CGS Engineering Design Manual
Fire Duration (hrs)	1.75		From Fire Underwriters Survey Requirements corresponding to 75 L/s

	Max Day Demand (m^3/d)	Required Fire Flow (m^3/d)	Max Day + Fire (m^3/d)	Peak Hour (m^3/d)	A - Fire Storage (m^3)	B - Equalization Storage (m^3)	C - Emergency Storage (m^3)	A + B + C = Storage Required (m^3)	Storage Available (m^3)	Deficit (m^3)
2011	1,044	12,960	14,004	2,939	1,080	261	335.3	1,676	1,136	540
2016	1,059	12,960	14,019	3,869	1,080	265	336.2	1,681	1,136	545
2021	1,071	12,960	14,031	3,888	1,080	268	336.9	1,685	1,136	549
2026	1,220	12,960	14,180	4,132	1,080	305	346.2	1,731	1,136	595
2031	1,226	12,960	14,186	4,142	1,080	307	346.6	1,733	1,136	597
2036	1,250	12,960	14,210	4,180	1,080	312	348.1	1,741	1,136	605
2041	1,250	12,960	14,210	4,181	1,080	313	348.1	1,741	1,136	605
Ultimate	1,300	12,960	14,260	4,263	1,080	325	351.3	1,756	1,136	620

Residential Max Day (Base Year) = 1044 m3/day
ICI Max Day (Base Year) = 1306 m3/day
*future ICI development is all within network, not assumed to be extension of existing ICI users



DATA ANALYSIS

	2009	2010	2011	2012	2013	Summary	Design Criterion	Comments
Average Day Flow (m^3/d)	1,287	1,521	2,010	1,687	2,033	1,708	**1,708**	From Water Historical Production data. The daily production values for Wells 3, 4 and 5 were added together to determine the total daily production.
Max Day Flow (m^3/d)	2,501	2,459	2,906	3,511	2,886	2,853	**2,853**	The maximum value of the sum of water production for Wells 3, 4 and 5 was used.
Max Day Factor	**1.94**	**1.62**	**1.45**	**2.08**	**1.42**	1.70	**1.70**	MOE Guidelines recommend a value of 2.25 for populations between 2,001 and 3,000. The maximum value over the past five years was 2.08. This value was adopted.
Peak Hour (L/s)			57	64	61			Peak values were available only for 2011-2013.
Peak Hour (m^3/d)	Not Available		4,952	5,515	5,308	5,259		
Peak Hour Factor			**2.46**	**3.27**	**2.61**	2.78	**3.27**	MOE Guidelines recommend a value of 3.38 for populations between 2,001 and 3,000. The maximum value over the past five years was 3.27. This value was adopted.

	2016	2021	2026	2031	2036	2041	Ultimate	
Population (Existing Areas)	2,112	2,112	2,112	2,112	2,112	2,112	2,112	From data provided by Hemson grouped by water system.
Population Growth	11	23	34	42	47	47	365	
Total Population	2,123	2,135	2,146	2,154	2,159	2,159	2,477	From data provided by Hemson grouped by water system.
Residential Growth Area (ha)	1.25	0.05	0.07	0.08	4.64	0.00	6.76	From City's GIS database.
Residential Growth Area (ha) - Cumulative	1.25	1.30	1.37	1.45	6.09	6.09	12.85	
Institutional Growth Area (ha)	0.00	0.00	0.00	0.00	2.78	0.00	0.00	
Institutional Growth Area (ha) - Cumulative	0.00	0.00	0.00	0.00	2.78	2.78	2.78	From City's GIS database.
Commercial Growth Area (ha)	0.00	0.00	0.71	0.00	0.00	0.00	0.00	
Commercial Growth Area (ha) - Cumulative	0.00	0.00	0.71	0.71	0.71	0.71	0.71	From City's GIS database.
Industrial Growth Area (ha)	0.00	0.00	0.00	0.00	1.86	0.00	0.00	
Industrial Growth Area (ha) - Cumulative	0.00	0.00	0.00	0.00	1.86	1.86	1.86	From City's GIS database.
ICI (ha) - Cumulative	**0.00**	**0.00**	**0.71**	**0.71**	**5.35**	**5.35**	**5.35**	Sum of Institutional, Commercial and Industrial areas
Total Growth Area (ha) - Cumulative	**1.25**	**1.30**	**2.08**	**2.16**	**11.44**	**11.44**	**18.20**	

Ratio of Residential to Total Water Billed	0.43	0.43	0.43	0.43	0.43	0.431		Estimated amount of water consumption related to ICI based on metering data and obtained ratio of residential to total consumption.
Residential Flow (m^3/d)	555	656	866	727	876	736		Calculated based on ratio of residential consumption to total consumption.
Ratio of ICI to Total Water Billed	0.57	0.57	0.57	0.57	0.57	0.569		
	732	865	1143	960	1157	971		
Per Capita Residential Demand (m^3/cap/day)	0.263	0.310	0.410	0.344	0.415	0.348	**0.350**	Took average over 2009 to 2013 period. CGS Engineering Design Manual does not include a value for average per capita water consumption. However, it includes a value of 410 L/cap/day for per capita wastewater generation.
Average Institutional Flow Unit Rate (m^3/ha/d)							**28.0**	*MOE Guidelines recommend a value of 28 m3/ha/d.*
Average Commercial Flow Unit Rate (m^3/ha/d)							**28.0**	*MOE Guidelines recommend a value of 28 m3/ha/d.*
Average Industrial Flow Unit Rate (m^3/ha/d)							**35.0**	*MOE Guidelines recommend a value of 35 m3/ha/d for light industry and 55 m3/ha/d for heavy industry.*

	2016	2021	2026	2031	2036	2041	Ultimate
Average Residential and ICI Flows (m^3/d) - Existing	1,708	1,708	1,708	1,708	1,708	1,708	1,708
Average Residential Flows (m^3/d) - Growth	4	8	12	15	16	16	128
Average Residential Flows (m^3/d) - Total	1,712	1,716	1,719	1,722	1,724	1,724	1,835
Average Institutional Flow (m^3/d)	0	0	0	0	78	78	78
Average Commercial Flow (m^3/d)	0	0	20	20	20	20	20
Average Industrial Flow (m^3/d)	0	0	0	0	65	65	65
Average ICI Flow (m^3/d)	0	0	20	20	163	163	163
Average Day Flow (m^3/d)	1,712	1,716	1,739	1,742	1,887	1,887	1,998
Max Day Flow (m^3/d)	2,910	2,917	2,957	2,962	3,208	3,208	3,397
Peak Hour Flow (m^3/d)	5,596	5,609	5,687	5,696	6,169	6,169	6,533

ALTERNATIVE CALCULATION METHOD

Per Capita Demand (m^3/cap/day)	**0.609**	**0.720**	**0.952**	**0.799**	**0.963**		**0.808**	*If ICI is not considered explicitly and demand is divided by total population. The historical per capita consumption is applied for future development.*
Max Day Factor							**2.08**	
Peak Hour Factor							**3.27**	

	2016	2021	2026	2031	2036	2041	Ultimate
Average Day Flow (m^3/d)	1,717	1,726	1,735	1,742	1,745	1,745	2,002
Max Day Flow (m^3/d)	3,573	3,593	3,612	3,625	3,633	3,633	4,168
Peak Hour Flow (m^3/d)	5,613	5,644	5,673	5,694	5,707	5,707	6,547

SENSITIVITY ANALYSIS

Analyze sensitivity of forecasted average day flows to unit rate

		Average Day Flow (m^3/d)						
	Unit Rate (m^3/cap/d)	2016	2021	2026	2031	2036	2041	Ultimate
Using a consolidated per capita flow		1,717	1,726	1,735	1,742	1,745	1,745	2,002
Using estimated average	0.350	1,712	1,716	1,739	1,742	1,887	1,887	1,998
City Standards	0.41	1712	1717	1741	1745	1890	1890	2020

Analyze sensitivity of forecasted flows to max day peaking factor

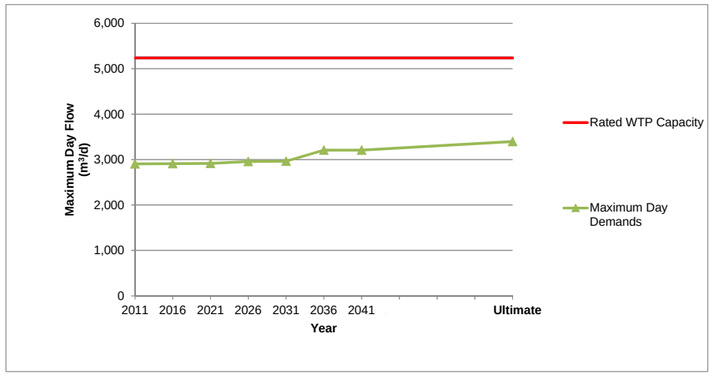
		Max Day Flow (m^3/d)						
	Max Day Peaking Factor	2016	2021	2026	2031	2036	2041	Ultimate
2009-2013 average of peaking factors	1.70	2,912	2,919	2,959	2,964	3,210	3,210	3,399
2012 peaking factor (maximum historical)	2.08	2,910	2,917	2,957	2,962	3,208	3,208	3,397
MOE Guidelines	2.25	3851	3860	3914	3920	4245	4245	4496

Analyze sensitivity of forecasted flows to peak hour factor

		Peak Hour (m^3/d)						
	Peak Hour Peaking Factor	2016	2021	2026	2031	2036	2041	Ultimate
Using historical peak factor	3.27	5,596	5,609	5,687	5,696	6,169	6,169	6,533
MOE Guidelines	3.38	5785	5799	5879	5889	6377	6377	6753

CAPACITY CHECK

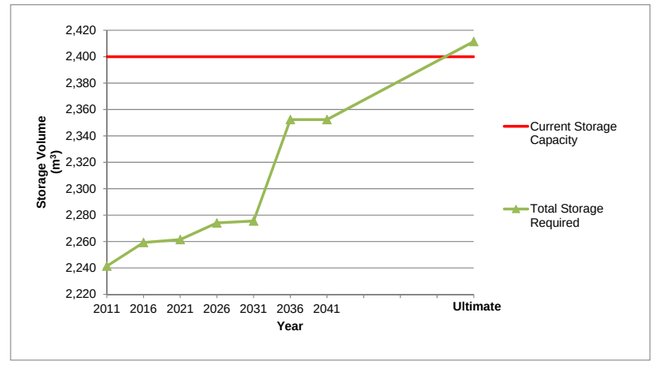
	2011	2016	2021	2026	2031	2036	2041	Ultimate
Rated WTP Capacity	5,237	5,237	5,237	5,237	5,237	5,237	5,237	5,237
Actual WTP Capacity	5,237	5,237	5,237	5,237	5,237	5,237	5,237	5,237
Maximum Day Demands	2,906	2,910	2,917	2,957	2,962	3,208	3,208	3,397
Peak Hour Demands	4,952	5,596	5,609	5,687	5,696	6,169	6,169	6,533



STORAGE REQUIREMENTS

Storage Available		
Elevated Tank (m^3)	2,400	From DWWP 016-202 (September 13, 2011)
Total Storage (m^3)	2,400	
Maximum Fire flow requirements (L/s)	150	
Fire Duration (hrs)	2	
Minimum Fire Flow Requirement for Residential Areas (L/s)	75	From CGS Engineering Design Manual
Fire Duration (hrs)	1.75	From Fire Underwriters Survey Requirements corresponding to 75 L/s

	Max Day Demand (m^3/d)	Required Fire Flow (m^3/d)	Max Day + Fire (m^3/d)	Peak Hour (m^3/d)	A - Fire Storage (m^3)	B - Equalization Storage (m^3)	C - Emergency Storage (m^3)	A + B + C = Storage Required (m^3)	Storage Available (m^3)	Deficit (m^3)
2011	2,853	12,960	15,813	5,259	1,080	713	448	2,241	2,400	0
2016	2,910	12,960	15,870	5,596	1,080	727	452	2,259	2,400	0
2021	2,917	12,960	15,877	5,609	1,080	729	452	2,261	2,400	0
2026	2,957	12,960	15,917	5,687	1,080	739	455	2,274	2,400	0
2031	2,962	12,960	15,922	5,696	1,080	740	455	2,276	2,400	0
2036	3,208	12,960	16,168	6,169	1,080	802	470	2,352	2,400	0
2041	3,208	12,960	16,168	6,169	1,080	802	470	2,352	2,400	0
Ultimate	3,397	12,960	16,357	6,533	1,080	849	482	2,411	2,400	11



Sudbury - Water Demand Forecasts 5/11/2017

(Includes: Sudbury, Coniston, and Wahnapitae)

DATA ANALYSIS

	2009	2010	2011	2012	2013	Average	Design Criterion	Comments
Average Day Flow (m^3/d)	43,153	43,411	44,150	42,189	42,827	43,146	**44,150**	From Water Historical Production data. The daily production values for each facility were added together to determine the total daily production.
Max Day Flow (m^3/d)	54,554	57,592	51,558	56,391	59,601	55,939	**59,601**	
Max Day Factor	**1.26**	**1.33**	**1.17**	**1.34**	**1.39**	1.30	**1.39**	MOE Guidelines recommend a value of 1.65 for populations between 75,000 and 150,000. The maximum value over the past five years was 1.39, which is generally consistent with previous years.
Peak Hour (L/s)	Not Available		757	772	754			Peak values were available only for 2011-2013.
Peak Hour (m^3/d)			65,443	66,705	65,135	65,761	**66,705**	
Peak Hour Factor			**1.48**	**1.58**	**1.52**	1.53	**1.58**	MOE Guidelines recommend a value of 2.48 for populations between 75,000 and 150,000. The maximum value over the past five years was 1.58, which is generally consistent with previous years.

	2016	2021	2026	2031	2036	2041	Ultimate	Comments
Population (Existing Areas)	94,868	94,868	94,868	94,868	94,868	94,868	94,868	From data provided by Hemson grouped by water system.
Population Growth	958	2,191	3,462	4,188	4,639	4,583	31,796	
Total Population	95,826	97,059	98,330	99,056	99,506	99,450	126,663	From data provided by Hemson grouped by water system.
Residential Growth Area (ha)	10.2	8.4	16.3	28.3	11.1	10.1	345.7	From City's GIS database. 2036 and 2041 areas are included with 2031.
Residential Growth Area (ha) - Cumulative	10.2	18.6	34.9	63.2	74.3	84.4	430.1	
Institutional Growth Area (ha)	0.0	0.0	8.11	0.0	0.0	0.0	0.0	
Institutional Growth Area (ha) - Cumulative	0.0	0.0	8.11	8.11	8.11	8.11	8.11	From City's GIS database.
Commercial Growth Area (ha)	0.0	0.0	23.1	0.0	76.8	0.0	0.0	
Commercial Growth Area (ha) - Cumulative	0.0	0.0	23.09	23.09	99.93	99.93	99.93	From City's GIS database.
Industrial Growth Area (ha)	171.5	0.0	70.96	0.0	208.1	0.0	0.0	
Industrial Growth Area (ha) - Cumulative	171.5	171.5	242.4	242.4	450.5	450.5	450.5	From City's GIS database.
ICI (ha) - Cumulative	**171.5**	**171.5**	**273.6**	**273.6**	**558.5**	**558.5**	**558.5**	Sum of Institutional, Commercial and Industrial areas
Total Growth Area (ha) - Cumulative	**181.7**	**190.1**	**308.6**	**336.9**	**632.9**	**643.0**	**988.7**	

Ratio of Residential to Total Water Billed	0.74	0.74	0.74	0.74	0.74	0.74		Estimated amount of water consumption related to ICI based on metering data and obtained ratio of residential to total consumption.
Residential Flow (m^3/d)	31933	32124	32671	31220	31692	31,928		Calculated based on ratio of residential consumption to total consumption.
Ratio of ICI to Total Water Billed	0.26	0.26	0.26	0.26	0.26	0.260		
	11220	11287	11479	10969	11135	11,218		
Per Capita Residential Demand (m^3/cap/day)	0.337	0.339	0.344	0.329	0.334	0.337	**0.350**	Took average over 2009 to 2013 period. The trend is generally consistent.
Average Institutional Flow Unit Rate (m^3/ha/d)							**28.0**	*MOE Guidelines recommend a value of 28 m^3/ha/d.*
Average Commercial Flow Unit Rate (m^3/ha/d)							**28.0**	*MOE Guidelines recommend a value of 28 m^3/ha/d.*
Average Industrial Flow Unit Rate (m^3/ha/d)							**35.0**	*MOE Guidelines recommend a value of 35 m^3/ha/d for light industry and 55 m^3/ha/d for heavy industry.*

	2016	2021	2026	2031	2036	2041	Ultimate
Average Residential and ICI Flows (m^3/d) - Existing	44,150	44,150	44,150	44,150	44,150	44,150	44,150
Average Residential Flows (m^3/d) - Growth	335	767	1,212	1,466	1,624	1,604	11,128
Average Residential Flows (m^3/d) - Total	44,485	44,916	45,361	45,615	45,773	45,753	55,278
Average Institutional Flow (m^3/d)	0	0	227	227	227	227	227
Average Commercial Flow (m^3/d)	0	0	647	647	2798	2798	2798
Average Industrial Flow (m^3/d)	6,001	6,001	8,485	8,485	15,768	15,768	15,768
Average ICI Flow (m^3/d)	6,001	6,001	9,358	9,358	18,793	18,793	18,793
Average Day Flow (m^3/d)	50,486	50,918	54,720	54,974	64,566	64,546	74,071
Max Day Flow (m^3/d)	70,259	70,860	76,151	76,505	89,853	89,826	103,081
Peak Hour Flow (m^3/d)	79,823	80,506	86,517	86,919	102,085	102,054	117,113

ALTERNATIVE CALCULATION METHOD This method does not distinguish between Residential and ICI water consumption.

Per Capita Demand (m^3/cap/day)	**0.455**	**0.458**	**0.465**	**0.445**	**0.451**	**0.455**	**0.455**	*If ICI is not considered explicitly and demand is divided by total population.*
Max Day Factor							**1.39**	*The historical per capita consumption is applied for future development.*
Peak Hour Factor							**1.58**	

	2016	2021	2026	2031	2036	2041	Ultimate
Average Day Flow (m^3/d)	43,582	44,143	44,721	45,051	45,256	45,230	57,607
Max Day Flow (m^3/d)	60,651	61,431	62,236	62,695	62,980	62,945	80,169
Peak Hour Flow (m^3/d)	68,907	69,794	70,708	71,230	71,554	71,514	91,082

SENSITIVITY ANALYSIS

Analyze sensitivity of forecasted average day flows to unit rate

	Unit Rate (m^3/cap/d)	Average Day Flow (m^3/d) 2016	2021	2026	2031	2036	2041	Ultimate
Using a consolidated per capita flow	0.455	43,582	44,143	44,721	45,051	45,256	45,230	57,607
Using estimated average	0.350	50,486	50,918	54,720	54,974	64,566	64,546	74,071
City Standards	0.41	50,543	51,049	54,927	55,225	64,844	64,821	75,978

Analyze sensitivity of forecasted flows to max day peaking factor

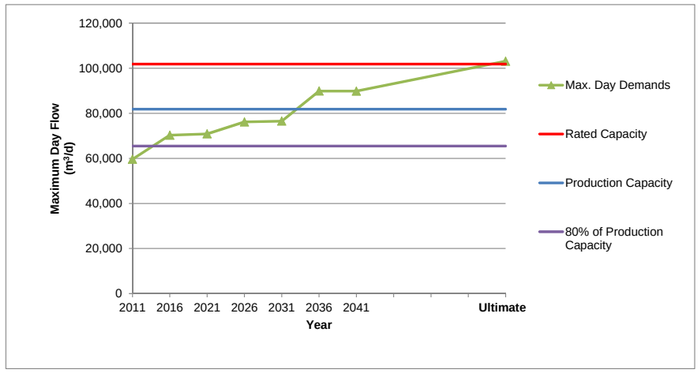
	Max Day Peaking Factor	Max Day Flow (m^3/d) 2016	2021	2026	2031	2036	2041	Ultimate
2009-2013 average of peaking factors	1.30	65,500	66,060	70,992	71,322	83,766	83,741	96,098
Maximum historical max day factor	1.39	70,259	70,860	76,151	76,505	89,853	89,826	103,081
MOE Guidelines	1.65	83,302	84,014	90,287	90,706	106,533	106,501	122,217

Analyze sensitivity of forecasted flows to peak hour factor

	Peak Hour Peaking Factor	Peak Hour (m^3/d) 2016	2021	2026	2031	2036	2041	Ultimate
Using historical highest peak factor	1.58	79,823	80,506	86,517	86,919	102,085	102,054	117,113
Using average of historical peaking factors	1.53	77,147	77,807	83,617	84,005	98,662	98,633	113,187
MOE Guidelines	2.48	125,205	126,276	135,704	136,335	160,123	160,074	183,695

CAPACITY CHECK

	2011	2016	2021	2026	2031	2036	2041	Ultimate
Rated Capacity	101,827	101,827	101,827	101,827	101,827	101,827	101,827	101,827
Production Capacity	81,813	81,813	81,813	81,813	81,813	81,813	81,813	81,813
Max. Day Demands	59,601	70,259	70,860	76,151	76,505	89,853	89,826	103,081
Peak Hour Demands	65,443	79,823	80,506	86,517	86,919	102,085	102,054	117,113
80% of Production Capacity	65,450	65,450	65,450	65,450	65,450	65,450	65,450	65,450



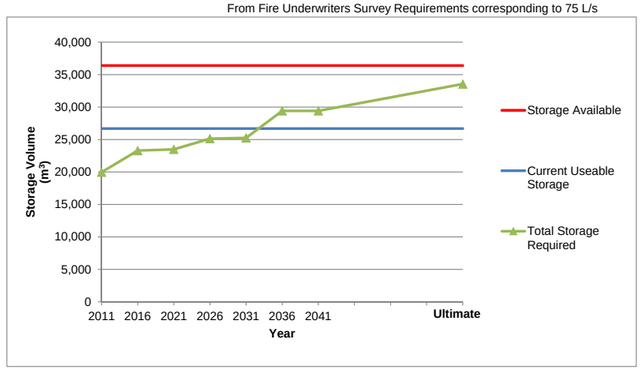
STORAGE REQUIREMENTS

Storage Available

Total Available Storage (m^3)	36,400	From DWWP 016-206, Issue 2 (November 3, 2011)
Total Storage (m^3)	26,700	Usable volume — Estimated from City's typical highest operating level
Maximum Fire flow Requirements (L/s)	150	
Fire Duration (hrs)	2	
Minimum Fire Flow Requirement for Residential Areas (L/s)	75	From CGS Engineering Design Manual
Fire Duration (hrs)	1.75	From Fire Underwriters Survey Requirements corresponding to 75 L/s

	Max Day Demand (m^3/d)	Required Fire Flow (m^3/d)	Max Day + Fire (m^3/d)	Peak Hour (m^3/d)	A - Fire Storage (m^3)	B - Equalization Storage (m^3)	C - Emergency Storage (m^3)	A + B + C = Storage Required (m^3)	Current Useable Storage (m^3)	Deficit (m^3)*
2011	59,601	12,960	72,561	65,761	1,080	14,900	3995.1	19,975	26,700	0
2016	70,259	12,960	83,219	79,823	1,080	17,565	4661.2	23,306	26,700	0
2021	70,860	12,960	83,820	80,506	1,080	17,715	4698.7	23,494	26,700	0
2026	76,151	12,960	89,111	86,517	1,080	19,038	5029.4	25,147	26,700	0
2031	76,505	12,960	89,465	86,919	1,080	19,126	5051.5	25,258	26,700	0
2036	89,853	12,960	102,813	102,085	1,080	22,463	5885.8	29,429	26,700	2,729
2041	89,826	12,960	102,786	102,054	1,080	22,457	5884.1	29,421	26,700	2,721
Ultimate	103,081	12,960	116,041	117,113	1,080	25,770	6712.6	33,563	26,700	6,863

* Deficit is calculated against the current useable storage, not the total available storage in Sudbury.



Valley - Water Demand Forecasts 5/11/2017

(Includes: Valley East, Capreol, Azilda, and Chelmsford)

DATA ANALYSIS

	2009	2010	2011	2012	2013	Summary	Design Criterion	Comments
Average Day Flow (m^3/d)	Not Available	9,999	10,114	10,080	10,135	10,082	**10,082**	From Water Historical Production data. The daily production values for each facility were added together to determine the total daily production.
Max Day Flow (m^3/d)		17,601	13,201	14,055	14,182	14,760	**14,760**	
Max Day Factor		**1.76**	**1.31**	**1.39**	**1.40**	1.46	**1.46**	MOE Guidelines recommend a value of 1.80 for populations between 25,001 and 50,000. This is in line with the historical maximum, and so the historical maximum was adopted.
Peak Hour (L/s)	Not Available		220.0	210.5	255.8			Peak values were available only for 2011-2013.
Peak Hour (m^3/d)			19,007	18,189	22,105	19,767		
Peak Hour Factor			**1.88**	**1.80**	**2.18**	1.95	**2.18**	MOE Guidelines recommend a value of 2.70 for populations between 25,001 and 50,000. However, the historical maximum was consistently lower than 2.70 and so the historical maximum was adopted.

	2016	2021	2026	2031	2036	2041	Ultimate	
Population (Existing Areas)	36,382	36,382	36,382	36,382	36,382	36,382	36,382	From data provided by Hemson grouped by water system.
Population Growth	853	1,760	2,583	3,069	3,355	3,382	21,259	
Total Population	37,235	38,142	38,965	39,451	39,737	39,764	57,641	From data provided by Hemson grouped by water system.
Residential Growth Area (ha)	83.34	9.73	4.62	16.51	1.16	1.17	436.12	From City's GIS database. 2036 and 2041 areas are included with 2031.
Residential Growth Area (ha) - Cumulative	83.34	93.07	97.69	114.20	115.36	116.53	552.65	
Institutional Growth Area (ha)	0.00	0.00	6.60	0.00	0.00	0.00	0.00	
Institutional Growth Area (ha) - Cumulative	0.00	0.00	6.60	6.60	6.60	6.60	6.60	From City's GIS database.
Commercial Growth Area (ha)	0.00	0.00	13.62	0.00	8.71	0.00	0.00	
Commercial Growth Area (ha) - Cumulative	0.00	0.00	13.62	13.62	22.33	22.33	22.33	From City's GIS database.
Industrial Growth Area (ha)	0.00	0.00	23.02	0.00	131.07	0.00	0.00	
Industrial Growth Area (ha) - Cumulative	0.00	0.00	23.02	23.02	154.09	154.09	154.09	From City's GIS database.
ICI (ha) - Cumulative	**0.00**	**0.00**	**43.24**	**43.24**	**183.02**	**183.02**	**183.02**	Sum of Institutional, Commercial and Industrial areas
Total Growth Area (ha) - Cumulative	**83.34**	**93.07**	**140.93**	**157.44**	**298.38**	**299.55**	**735.67**	

Ratio of Residential to Total Water Billed	0.87	0.87	0.87	0.87	0.87		Estimated amount of water consumption related to ICI based on metering data and obtained ratio of residential to total consumption.
Residential Flow (m^3/d)	8683	8782	8753	8800	8,754		Calculated based on ratio of residential consumption to total consumption.
Ratio of ICI to Total Water Billed	0.13	0.13	0.13	0.13	0.132		
	1317	1332	1327	1335	1,328		
Per Capita Residential Demand (m^3/cap/day)	0.239	0.241	0.241	0.242	0.241	**0.250**	Took average over 2009 to 2013 period. The trend is generally consistent.
Average Institutional Flow Unit Rate (m^3/ha/d)						**28.0**	*MOE Guidelines recommend a value of 28 m^3/ha/d.*
Average Commercial Flow Unit Rate (m^3/ha/d)						**28.0**	*MOE Guidelines recommend a value of 28 m^3/ha/d.*
Average Industrial Flow Unit Rate (m^3/ha/d)						**35.0**	*MOE Guidelines recommend a value of 35 m^3/ha/d for light industry and 55 m^3/ha/d for heavy industry.*

	2016	2021	2026	2031	2036	2041	Ultimate
Average Residential and ICI Flows (m^3/d) - Existing	**10,082**	**10,082**	**10,082**	**10,082**	**10,082**	**10,082**	**10,082**
Average Residential Flows (m^3/d) - Growth	**213**	**440**	**646**	**767**	**839**	**846**	**5,315**
Average Residential Flows (m^3/d) - Total	**10,295**	**10,522**	**10,728**	**10,849**	**10,921**	**10,928**	**15,397**
Average Institutional Flow (m^3/d)	**0**	**0**	**185**	**185**	**185**	**185**	**185**
Average Commercial Flow (m^3/d)	**0**	**0**	**381**	**381**	**625**	**625**	**625**
Average Industrial Flow (m^3/d)	**0**	**0**	**806**	**806**	**5,393**	**5,393**	**5,393**
Average ICI Flow (m^3/d)	**0**	**0**	**1,372**	**1,372**	**6,203**	**6,203**	**6,203**
Average Day Flow (m^3/d)	**10,295**	**10,522**	**12,100**	**12,221**	**17,124**	**17,131**	**21,600**
Max Day Flow (m^3/d)	**15,031**	**15,362**	**17,665**	**17,843**	**25,001**	**25,011**	**31,536**
Peak Hour Flow (m^3/d)	**22,456**	**22,950**	**26,391**	**26,656**	**37,350**	**37,365**	**47,113**

ALTERNATIVE CALCULATION METHOD This method does not distinguish between Residential and ICI water consumption.

Per Capita Demand (m^3/cap/day)	**0.275**	**0.278**	**0.277**	**0.279**	**0.277**	*If ICI is not considered explicitly and demand is divided by total population. The historical per capita consumption is applied for future development.*
Max Day Factor					**1.76**	
Peak Hour Factor					**2.18**	

	2016	2021	2026	2031	2036	2041	Ultimate
Average Day Flow (m^3/d)	**10,318**	**10,570**	**10,798**	**10,933**	**11,012**	**11,019**	**15,973**
Max Day Flow (m^3/d)	**18,163**	**18,605**	**19,007**	**19,244**	**19,383**	**19,397**	**28,117**
Peak Hour Flow (m^3/d)	**22,506**	**23,054**	**23,552**	**23,846**	**24,018**	**24,035**	**34,840**

SENSITIVITY ANALYSIS

Analyze sensitivity of forecasted average day flows to unit rate

		Average Day Flow (m^3/d)						
	Unit Rate (m^3/cap/d)	2016	2021	2026	2031	2036	2041	Ultimate
Using a consolidated per capita flow	0.277	10,318	10,570	10,798	10,933	11,012	11,019	15,973
Using estimated average	0.250	10,295	10,522	12,100	12,221	17,124	17,131	21,600
City Standards	0.41	10,432	10,804	12,513	12,712	17,661	17,672	25,002

Analyze sensitivity of forecasted flows to max day peaking factor

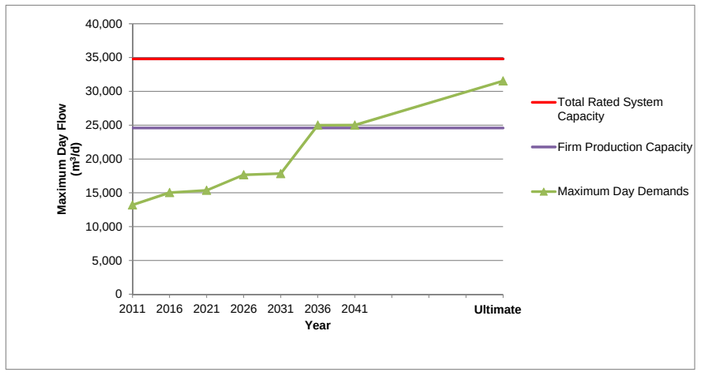
		Max Day Flow (m^3/d)						
	Max Day Peaking Factor	2016	2021	2026	2031	2036	2041	Ultimate
2009-2013 average of peaking factors	1.46	15,081	15,413	17,724	17,902	25,083	25,093	31,640
Maximum historical max day factor	1.76	15,031	15,362	17,665	17,843	25,001	25,011	31,536
MOE Guidelines	1.65	16987	17361	19964	20165	28254	28266	35640

Analyze sensitivity of forecasted flows to peak hour factor

		Peak Hour (m^3/d)						
	Peak Hour Peaking Factor	2016	2021	2026	2031	2036	2041	Ultimate
Using historical highest peak factor	2.18	22,456	22,950	26,391	26,656	37,350	37,365	47,113
Using average of historical peaking factors	1.95	20,127	20,570	23,655	23,892	33,477	33,490	42,228
MOE Guidelines	2.48	25,532	26,094	30,007	30,309	42,467	42,484	53,568

CAPACITY CHECK

	2011	2016	2021	2026	2031	2036	2041	Ultimate
Total Rated System Capacity	34,796	34,796	34,796	34,796	34,796	34,796	34,796	34,796
Firm Production Capacity	24,579	24,579	24,579	24,579	24,579	24,579	24,579	24,579
Maximum Day Demands	13,201	15,031	15,362	17,665	17,843	25,001	25,011	31,536
Peak Hour Demands	19,007	22,456	22,950	26,391	26,656	37,350	37,365	47,113



STORAGE REQUIREMENTS

Storage Available	
Val Caron Elevated Tank (m^3)	5,274
Azilda Elevated Tank (m^3)	4,524
Chelmsford Elevated Tank (m^3)	1,353
Total Storage (m^3)	**11,151**
Maximum Fire flow Requirements (L/s)	150
Fire Duration (hrs)	2
Minimum Fire Flow Requirement for Residential Areas (L/s)	75
Fire Duration (hrs)	1.75

	Max Day Demand (m^3/d)	Required Fire Flow (m^3/d)	Max Day + Fire (m^3/d)	Peak Hour (m^3/d)	A - Fire Storage (m^3)	B - Equalization Storage (m^3)	C - Emergency Storage (m^3)	A + B + C = Storage Required (m^3)	Storage Available (m^3)	Deficit (m^3)
2011	14,760	12,960	27,720	19,767	1,080	3,690	1192	5,962	11,151	0
2016	15,031	12,960	27,991	22,456	1,080	3,758	1209	6,047	11,151	0
2021	15,362	12,960	28,322	22,950	1,080	3,841	1230	6,151	11,151	0
2026	17,665	12,960	30,625	26,391	1,080	4,416	1374	6,870	11,151	0
2031	17,843	12,960	30,803	26,656	1,080	4,461	1385	6,926	11,151	0
2036	25,001	12,960	37,961	37,350	1,080	6,250	1833	9,163	11,151	0
2041	25,011	12,960	37,971	37,365	1,080	6,253	1833	9,166	11,151	0
Ultimate	31,536	12,960	44,496	47,113	1,080	7,884	2241	11,205	11,151	54

Total Rated System Capacity is the sum of the capacity of all wells (per DWWP)

Firm Production Capacity is the sum of the production capacity of all wells, less the one largest. See Baseline Review Report

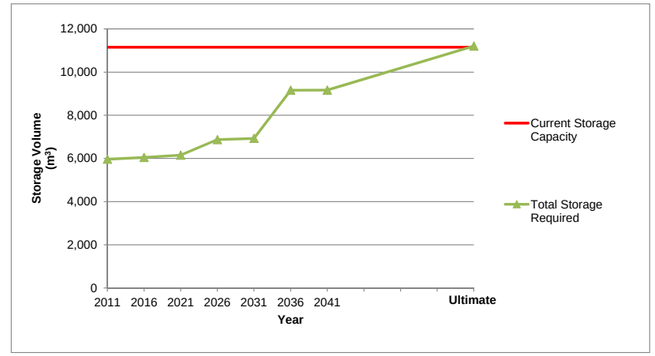
From DWWP 016-205, Issue 2 (November 1, 2011)

From DWWP 016-205, Issue 2 (November 1, 2011)

From DWWP 016-205, Issue 2 (November 1, 2011)

From CGS Engineering Design Manual

From Fire Underwriters Survey Requirements corresponding to 75 L/s



Vermilion - Water Demand Forecasts 5/11/2017

(Includes: Copper Cliff, Lively, Walden, Naughton, Whitefish)

DATA ANALYSIS

	2009	2010	2011	2012	2013	Summary	Design Criterion	Comments
Average Day Flow (m^3/d)				3,227			**4,059**	Production data is not available. These values are from the 2012 billing data. Average existing flows were estimated using historical billing records for 2012 and multiplied with an unbilled water rate. The billed water rates do not account for any leakage or unmetered water in the system.
Max Day Flow (m^3/d)							**7,712**	Data is not available. Estimated using the estimate average day demand (based on billing data) and the max day factor from the MOE Guidelines.
Max Day Factor							**1.90**	MOE Guidelines recommend a value of 1.90 for populations between 10,001 and 25,000. In the absence of historical production data, this value was adopted.
Peak Hour (L/s)			Not Available					Data is not available.
Peak Hour (m^3/d)							**11,569**	
Peak Hour Factor							**2.85**	MOE Guidelines recommend a value of 2.85 for populations between 10,001 and 25,000. In the absence of historical production data, this value was adopted.

	2016	2021	2026	2031	2036	2041	Ultimate	
Population (Existing Areas)	10,359	10,359	10,359	10,359	10,359	10,359	10,359	From data provided by Hemson grouped by water system.
Population Growth	486	944	1,327	1,553	1,691	1,726	9,041	
Total Population	10,845	11,303	11,686	11,912	12,050	12,085	19,400	From data provided by Hemson grouped by water system.
Residential Growth Area (ha)	3.5	8.9	5.7	1.6	0.1	0.7	178.7	From City's GIS database.
Residential Growth Area (ha) - Cumulative	3.5	12.4	18.1	19.7	19.7	20.4	199.1	
Institutional Growth Area (ha)	0.0	0.0	1.12	0.00	0.85	0.0	0.0	
Institutional Growth Area (ha) - Cumulative	0.0	0.0	1.12	1.12	1.97	1.97	1.97	From City's GIS database.
Commercial Growth Area (ha)	0.0	0.0	1.7	0.0	8.2	0.0	0.0	
Commercial Growth Area (ha) - Cumulative	0.0	0.0	1.66	1.66	9.87	9.87	9.87	From City's GIS database.
Industrial Growth Area - Walden Industrial Area - Total Undeveloped and Unserviced Land (ha)	0.0	0.0	72.0	0.0	0.0	0.0	0.0	
Industrial Growth Area - Walden Industrial Area - 20% (ha)	0.0	0.0	14.4	0.0	0.0	0.0	0.0	
Industrial Growth Area - Walden Industrial Area - 80% (ha)	0.0	0.0	57.6	0.0	0.0	0.0	0.0	
Industrial Growth Area - Walden Industrial Area - Total Developed and Unserviced Land (ha)	0.0	0.0	0.0	100.0	0.0	0.0	0.0	
Industrial Growth Area - Balance of Industrial Area (ha)	0.0	0.0	2.4	0.0	18.93	0.0	0.0	
Industrial Growth Area (ha)*	0.0	0.0	74.4	100.0	18.93	0.0	0.0	
Industrial Growth Area (ha) - Walden 20% Cumulative	0.0	0.0	14.4	14.4	14.4	14.4	14.4	
Industrial Growth Area (ha) - Walden 80% Cumulative	0.0	0.0	57.6	57.6	57.6	57.6	57.6	
Industrial Growth Area (ha) - Developed and Unserviced Land (ha) Cumulative	0.0	0.0	0.0	100.0	100.0	100.0	100.0	
Industrial Growth Area (ha) - Balance Cumulative	0.0	0.0	2.4	2.4	21.3	21.3	21.3	
Industrial Growth Area (ha) - Cumulative	0.0	0.0	74.4	174.4	193.3	193.3	193.3	From City's GIS database.
**Includes 100 ha of land that is currently developed but not serviced (to be serviced by 2031)*								
	0.0	0.0	77.2	100.0	28.0	0.0	0.0	
ICI (ha) - Cumulative	**0.0**	**0.0**	**77.2**	**177.2**	**205.2**	**205.2**	**205.2**	Sum of Institutional, Commercial and Industrial areas
Total Growth Area (ha) - Cumulative	**3.5**	**12.4**	**95.3**	**196.8**	**224.9**	**225.6**	**404.3**	

Ratio of Residential to Total Water Billed	0.80	0.80	0.80	0.80	0.80	0.80		Estimated amount of water consumption related to ICI based on metering data and obtained ratio of residential to total consumption.
Residential Flow (m^3/d)				2581				Calculated based on ratio of residential consumption to total consumption.
Ratio of ICI to Total Water Billed	0.20	0.20	0.20	0.20	0.20	0.200		
				646				
Per Capita Residential Demand (m^3/cap/day)				0.249		0.249	**0.250**	Average day demand from production data was not available. The historical demand was estimated using the approximate amount of water billed per capita per day in 2012. The MOE suggests using between 0.27 and 0.45 m^3/cap/d. Therefore, 0.27 m3/cap/d was adopted in this case since it would accould for slight variation in historical production values, compared to billing data.
Unbilled Rate							**25.8%**	Rates determined for the Vermilion Water System were based on billed water rates, which do not account for any leakage or unmetered water in the network. The average day rates were therefore multiplied by this unbilled water rate.
Average Institutional Flow Unit Rate (m^3/ha/d)							**28.0**	*MOE Guidelines recommend a value of 28 m^3/ha/d.*
Average Commercial Flow Unit Rate (m^3/ha/d)							**28.0**	*MOE Guidelines recommend a value of 28 m^3/ha/d.*
Average Industrial Flow Unit Rate - Balance of Industrial Lands (m^3/ha/d)							**35.0**	*MOE Guidelines recommend a value of 35 m^3/ha/d for light industry and 55 m^3/ha/d for heavy industry.*
Average Industrial Flow Unit Rate - Walden 20% (m^3/ha/d)							**35.0**	
Average Industrial Flow Unit Rate - Walden 80% (m^3/ha/d)							**3.0**	
Average Industrial Flow Unit Rate - Currently Developed but Unserviced Area (m^3/ha/d)							**3.0**	

	2016	2021	2026	2031	2036	2041	Ultimate
Average Residential and ICI Flows (m^3/d) - Existing	4,059	4,059	4,059	4,059	4,059	4,059	4,059
Average Residential Flows (m^3/d) - Growth	153	297	417	488	532	543	2,843
Average Residential Flows (m^3/d) - Total	4,212	4,356	4,476	4,548	4,591	4,602	6,903
Average Institutional Flow (m^3/d)	0	0	31	31	55	55	55
Average Commercial Flow (m^3/d)	0	0	46	46	276	276	276
Average Industrial Flow - Walden Industrial Park - 20% (m^3/d)	0	0	504	504	504	504	504
Average Industrial Flow - Walden Industrial Park - 80% (m^3/d)	0	0	173	173	173	173	173
Average Industrial Flow - Walden Industrial Park - Currently Developed but Locally Serviced Area (m^3/d)	0	0	0	300	300	300	300
Average Industrial Flow - Balance of Industrial Area (m^3/d)	0	0	84	84	747	747	747
Average ICI Flow (m^3/d)	0	0	839	1,139	2,055	2,055	2,055
Average Day Flow (m^3/d)	4,212	4,356	5,315	5,686	6,646	6,657	8,957
Max Day Flow (m^3/d)	8,003	8,276	10,098	10,804	12,627	12,648	17,019
Peak Hour Flow (m^3/d)	12,004	12,414	15,148	16,206	18,941	18,972	25,529

Average existing flows were estimated using historical billing records for 2012 and therefore multiplied with an unbilled water rate. The billed water rates do not account for any leakage or unmetered water in the system.

Average existing flows were estimated using historical billing records for 2012 and therefore multiplied with an unbilled water rate. The billed water rates do not account for any leakage or unmetered water in the system.

ALTERNATIVE CALCULATION METHOD This method does not distinguish between Residential and ICI water consumption.

Per Capita Demand (m^3/cap/day)	0.000	0.000	0.000	0.392	0.000	0.392	0.392
Max Day Factor							1.90
Peak Hour Factor							2.85

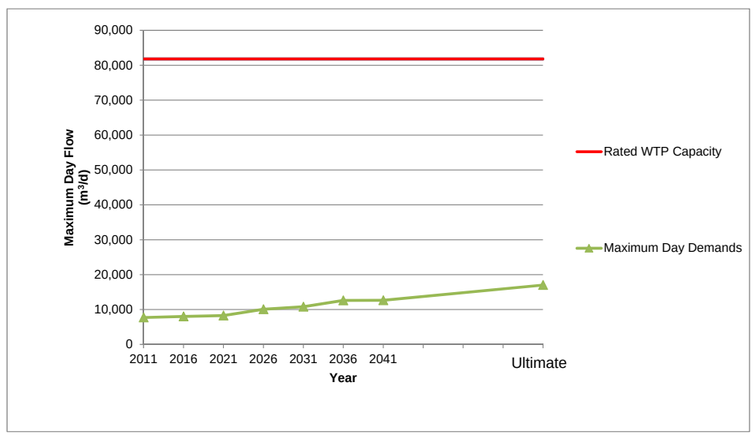
If ICI is not considered explicitly and demand is divided by total population.
The historical per capita consumption is applied for future development.

	2016	2021	2026	2031	2036	2041	Ultimate
Average Day Flow (m^3/d)	4,249	4,429	4,579	4,668	4,722	4,735	7,602
Max Day Flow (m^3/d)	8,074	8,415	8,700	8,868	8,971	8,997	14,443
Peak Hour Flow (m^3/d)	12,111	12,622	13,050	13,303	13,457	13,496	21,665

SENSITIVITY ANALYSIS Not applicable - limited data available.

CAPACITY CHECK Note: The Vermilion WTP is owned by Vale and is used by Vale operations. Vale's use is not included in the demands.

	2011	2016	2021	2026	2031	2036	2041	Ultimate
Rated WTP Capacity	81,800	81,800	81,800	81,800	81,800	81,800	81,800	81,800
Actual WTP Capacity	81,800	81,800	81,800	81,800	81,800	81,800	81,800	81,800
Maximum Day Demands	7,712	8,003	8,276	10,098	10,804	12,627	12,648	17,019
Peak Hour Demands	11,569	12,004	12,414	15,148	16,206	18,941	18,972	25,529



STORAGE REQUIREMENTS

Storage Available	
Standpipe Volume (m^3)	4,732
Total Effective Storage (m^3)*	2,662
Maximum Fire flow Requirements (L/s)	150
Fire Duration (hrs)	2
Minimum Fire Flow Requirement for Residential Areas (L/s)	75
Fire Duration (hrs)	1.75

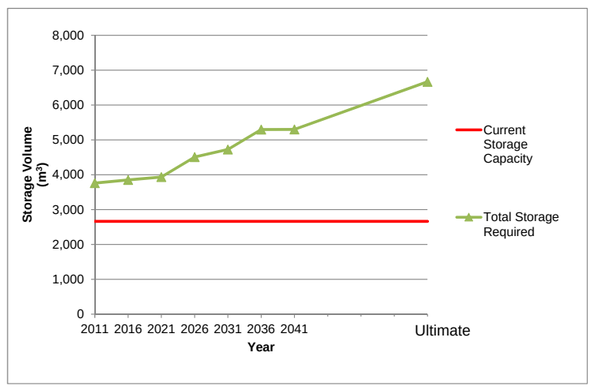
From DWWP 016-204, Issue 2 (November 3, 2011) for Walden tank
In addition, Vale's Copper Cliff tank would provide some protection, but the volume available for City use cannot be confirmed.

Historical Maximum Day and Peak Hour Demands are not available for 2011, but are estimated using billing data and MOE Design Guidelines Max Day and Peaking Factors.

Total effective storage is based on a LWL and HWL of 308.61m and 320.34m respectively and a raidus of 8.5m, per the engineering drawings for the Walden Standpipe (by Horton CBI Limited).

From CGS Engineering Design Manual
From Fire Underwriters Survey Requirements corresponding to 75 L/s

	Max Day Demand (m^3/d)	Required Fire Flow (m^3/d)	Max Day + Fire (m^3/d)	Peak Hour (m^3/d)	A - Fire Storage (m^3)	B - Equalization Storage (m^3)	C - Emergency Storage (m^3)	A + B + C = Storage Required (m^3)	Storage Available (m^3)	Deficit (m^3)
2011	7,712	12,960	20,672	11,569	1,080	1,928	752.0	3,760	2,662	1,098
2016	8,003	12,960	20,963	12,004	1,080	2,001	770.2	3,851	2,662	1,188
2021	8,276	12,960	21,236	12,414	1,080	2,069	787.3	3,936	2,662	1,274
2026	10,098	12,960	23,058	15,148	1,080	2,525	901.2	4,506	2,662	1,843
2031	10,804	12,960	23,764	16,206	1,080	2,701	945.2	4,726	2,662	2,064
2036	12,627	12,960	25,587	18,941	1,080	3,157	1059.2	5,296	2,662	2,633
2041	12,648	12,960	25,608	18,972	1,080	3,162	1060.5	5,302	2,662	2,640
Ultimate	17,019	12,960	29,979	25,529	1,080	4,255	1333.7	6,668	2,662	4,006



A-2 WASTEWATER SYSTEMS

Azilda - Wastewater Flow Forecasts

		2009	2010	2011	2012	2013	Summary	Design Criterion	Comments
Average Day Flow	**(m^3/d)**	2,948	2,129	1,657	1,553	2,160	2,089	**2,089**	From Annual Reports
Max Day Flow	**(m^3/d)**	12,806	12,160	11,446	5,606	13,126	12,385	**12,385**	From Annual Reports; the average assumes that the 2012 data is an outlier and is omitted from the analysis.
Max Day Factor		**4.34**	**5.71**	**6.91**	**3.61**	**6.08**	**5.76**	**5.76**	Calculated - Max Day Flow divided by Average Day Flow. 2012 data was omitted since the Maximum Day Flow was much lower than the remaining years.
Peak Flow	**(m^3/d)**	Not Available						**0**	Peak hour flows were not available
Peak Flow	**(L/s)**							**0**	

	2016	2021	2026	2031	2036	2041	Ultimate Buildout
Population (Existing Areas)	4,449	4,449	4,449	4,449	4,449	4,449	4,449
Population (Growth Areas)	175	358	510	601	650	654	3,912
Total Population	4624	4807	4959	5050	5099	5103	8361
Residential (ha)	19.37	19.37	20.61	32.81	32.81	32.81	117.72
Institutional (ha)							
Commercial (ha)			1.44	1.44	1.44	1.44	1.44
Industrial (ha)					3.16	3.16	3.16
ICI (ha)	**0.00**	**0.00**	**1.44**	**1.44**	**4.60**	**4.60**	**4.60**
Total (ha)	**19.37**	**19.37**	**22.05**	**34.25**	**37.41**	**37.41**	**122.32**

Total Population (Hemson)
ICI development areas were assigned to planning years based on the stage of the application. Draft Approved were assigned to 2016, Legal Lots of Record to 2026, and Designated Developable to 2036.
Areas are cumulative and carry from the development year, all the way through to Ultimate Buildout

Ratio of Residential to Total Customers	0.80	0.80	0.80	0.80	0.80	0.80		This ratio is based on Water Billing Records for the area and is an approximation of the residential portion of demand.
Residential Share of Average Day Demand (m^3/d)	2351	1698	1322	1239	1723	1667		
Residential Flow Unit Rate (m^3/cap/d)	0.529	0.382	0.297	0.278	0.387	0.375	**0.400**	
Average Institutional Flow Unit Rate (m^3/ha/d)							**28.0**	CGS design standards do not suggest average rates for institutional and commercial, but require that rates be developed based on usage. In this case, water demands rates were used and assume a conservative 1:1 ratio of water to sewage.
Average Commercial Flow Unit Rate (m^3/ha/d)							**28.0**	CGS design standards do not suggest average rates for institutional and commercial, but require that rates be developed based on usage. In this case, water demands rates were used and assume a conservative 1:1 ratio of water to sewage.
Average Industrial Flow Unit Rate (m^3/ha/d)							**35.0**	CGS design standards average rate for light industrial of 35 m^3/ha/d.
Average Extraneous Flow Unit Rate (m^3/ha/d)							**7.48**	From CGS Design Standards, peak rate for new developments divided by an assumed peaking factor of 3. This factor would be applied only to new developments, which are assumed to be leak-tight, and have minimal extraneous flow.

	2016	2021	2026	2031	2036	2041	Ultimate Buildout	
Average Residential Flows (m^3/d) - Existing	**2,089**	**2,089**	**2,089**	**2,089**	**2,089**	**2,089**	**2,089**	This includes all contribution from existing ICI and infiltration. The base flow was assumed to be the average day flow to the plant for the 2011-2013 period.
Average Residential Flows (m^3/d)	**70**	**143**	**204**	**241**	**260**	**262**	**1,565**	Obtained by multiplying the projected population growth by the unit rate.
Average Institutional Flow (m^3/d)	**0**	**0**	**0**	**0**	**0**	**0**	**0**	Institutional growth area multiplied by unit flow rate.
Average Commercial Flow (m^3/d)	**0**	**0**	**40**	**40**	**40**	**40**	**40**	Commercial growth area multiplied by unit flow rate.
Average Industrial Flow (m^3/d)	**0**	**0**	**0**	**0**	**111**	**111**	**111**	Industrial growth area multiplied by unit flow rate.
Average Extraneous Flow (m^3/day)	**145**	**145**	**165**	**256**	**280**	**280**	**915**	
Average Day Flow (m^3/d)	**2,304**	**2,378**	**2,499**	**2,627**	**2,780**	**2,782**	**4,720**	
Max Day Flow (m^3/d)	**13,273**	**13,695**	**14,393**	**15,129**	**16,014**	**16,024**	**27,189**	

ALTERNATIVE CALCULATION METHOD

Per Capita Flow (m3/cap/day)	0.663	0.479	0.372	0.349	0.485	0.470	0.470
Average Day Flow (m^3/d)							
Max Day Flow (m^3/d)							

2016	2021	2026	2031	2036	2041	Ultimate Buildout
2171.625	2257.521913	2329.042	2371.826	2394.484	2396.692	3926.41819
12,509	13,003	13,415	13,662	13,792	13,805	22,616

Comments

Multiplying the total population by the consolidated per capita flow factor.

SENSITIVITY ANALYSIS

Analyze sensitivity of forecasted flows to unit rate

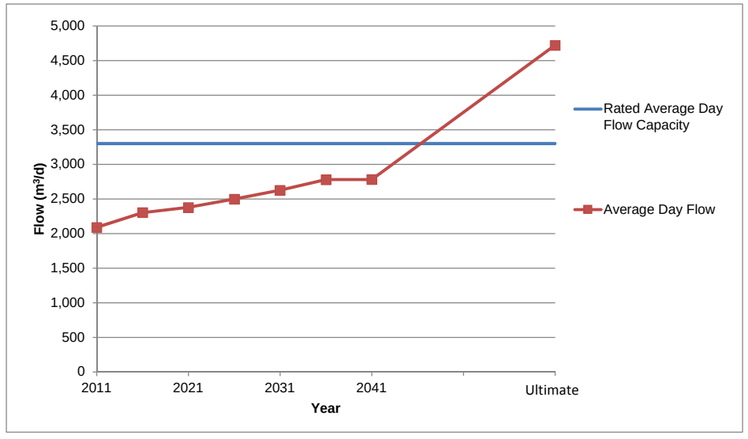
		Average Day Flow (m^3/d)						Ultimate Buildout
	Unit Rate (m^3/cap/d)	**2016**	**2021**	**2026**	**2031**	**2036**	**2041**	**2061**
Base Scenario - Residential Historical Maximum	0.375	2,304	2,378	2,499	2,627	2,780	2,782	4,720
Combined Historical Maximum	0.470	2,317	2,402	2,534	2,668	2,825	2,828	4,993
City Standards	0.360	2,297	2,363	2,478	2,603	2,754	2,756	4,564

Analyze sensitivity of forecasted flows to max day factor

		Max Day Flow (m^3/d)						Ultimate Buildout
	Max Day Peaking Factor	**2016**	**2021**	**2026**	**2031**	**2036**	**2041**	**2061**
Base Scenario - Historical Max	5.58	12,850	13,258	13,935	14,647	15,503	15,514	26,323
Historical Average	6.91	13,273	13,695	14,393	15,129	16,014	16,024	27,189

CAPACITY CHECK

								Ultimate Buildout
	2011	**2016**	**2021**	**2026**	**2031**	**2036**	**2041**	**2061**
Rated Average Day Flow Capacity (m^3/d)	3,300	3,300	3,300	3,300	3,300	3,300	3,300	3,300
Average Day Flow (m^3/d)	2,089	2,304	2,378	2,499	2,627	2,780	2,782	4,720
Maximum Day Flow (m^3/d)	12,385	13,273	13,695	14,393	15,129	16,014	16,024	27,189



Capreol - Wastewater Flow Forecasts

		2009	2010	2011	2012	2013	Summary	Design Criterion	Comments
Average Day Flow	**(m^3/d)**	2,805	1,840	2,708	2,308	2,387	2,410	**2,410**	From Annual Reports
Max Day Flow	**(m^3/d)**	Not Available						**6,473**	Estimated by multiplying the estimated maximum day factor to the historical average day flow.
Max Day Factor								**2.69**	
Peak Flow	**(m^3/d)**							**0**	Peak hour flows were not available
Peak Flow	**(L/s)**							**0**	
Peak Flow Factor								**0**	

	2016	2021	2026	2031	2036	2041	Ultimate Buildout	Comments
Population (Existing Areas)	3,392	3,392	3,392	3,392	3,392	3,392	3,392	
Population (Growth Areas)	4	20	43	55	64	58	1,324	
Total Population	3396	3412	3435	3447	3456	3450	4716	Total Population (Hemson)
Residential (ha)	0.97	1.73	2.27	2.89	3.24	3.43	39.69	ICI development areas were assigned to planning years based on the stage of the application. Draft Approved were assigned to 2016, Legal Lots of Record to 2026, and Designated Developable to 2036.
Institutional (ha)			0.36	0.36	0.36	0.36	0.36	
Commercial (ha)			3.18	3.18	3.71	3.71	3.71	
Industrial (ha)					2.94	2.94	2.94	Areas are cumulative and carry from the development year, all the way through to Ultimate Buildout
ICI (ha)	0.00	0.00	3.54	3.54	7.01	7.01	7.01	
Total (ha)	0.97	1.73	5.81	6.43	10.25	10.44	46.70	

		2009	2010	2011	2012	2013	Summary	Design Criterion	Comments
Ratio of Residential to Total Customers		0.87	0.87	0.87	0.87	0.87	0.87		This ratio is based on Water Billing Records for the area and is an approximation of the residential portion of demand.
Residential Share of Average Day Demand	**(m^3/d)**	2437	1598	2352	2005	2073	2093		
Residential Flow Unit Rate	**(m^3/cap/d)**	0.718	0.471	0.693	0.591	0.611	0.617	**0.650**	
Average Institutional Flow Unit Rate	**(m^3/ha/d)**							**28.0**	CGS design standards do not suggest average rates for institutional and commercial, but require that rates be developed based on usage. In this case, water demands rates were used and assume a conservative 1:1 ratio of water to sewage.
Average Commercial Flow Unit Rate	**(m^3/ha/d)**							**28.0**	CGS design standards do not suggest average rates for institutional and commercial, but require that rates be developed based on usage. In this case, water demands rates were used and assume a conservative 1:1 ratio of water to sewage.
Average Industrial Flow Unit Rate	**(m^3/ha/d)**							**35.0**	CGS design standards average rate for light industrial of 35 m^3/ha/d.
Average Extraneous Flow Unit Rate	**(m^3/ha/d)**							**11.23**	From CGS Design Standards, peak rate for new developments divided by an assumed peaking factor of 3. This factor would be applied only to new developments, which are assumed to be leak-tight, and have minimal extraneous flow.

	2016	2021	2026	2031	2036	2041	Ultimate Buildout	Comments
Average Residential Flows (m^3/d) - Existing	2,410	2,410	2,410	2,410	2,410	2,410	2,410	This includes all contribution from existing ICI and infiltration. The base flow was assumed to be the average day flow to the plant for the 2011-2013 period.
Average Residential Flows (m^3/d)	2	13	28	36	41	38	861	Obtained by multiplying the projected population growth by the unit rate.
Average Institutional Flow (m^3/d)	0	0	10	10	10	10	10	Institutional growth area multiplied by unit flow rate.
Average Commercial Flow (m^3/d)	0	0	89	89	104	104	104	Commercial growth area multiplied by unit flow rate.
Average Industrial Flow (m^3/d)	0	0	0	0	103	103	103	Industrial growth area multiplied by unit flow rate.
Average Extraneous Flow (m^3/day)	11	19	65	72	115	117	525	
Average Day Flow (m^3/d)	2,423	2,442	2,602	2,617	2,783	2,782	4,012	
Max Day Flow (m^3/d)	6,509	6,561	6,990	7,030	7,476	7,473	10,778	

ALTERNATIVE CALCULATION METHOD

	2016	2021	2026	2031	2036	2041	Ultimate Buildout
Per Capita Flow (m3/cap/day)	0.827	0.542	0.798	0.680	0.704	0.710	0.710
Average Day Flow (m^3/d)	2412	2424	2440	2449	2455	2451	3350
Max Day Flow (m^3/d)	6,481	6,512	6,556	6,579	6,595	6,585	9,001

Comments

Multiplying the total population by the consolidated per capita flow factor.

SENSITIVITY ANALYSIS

Analyze sensitivity of forecasted flows to unit rate

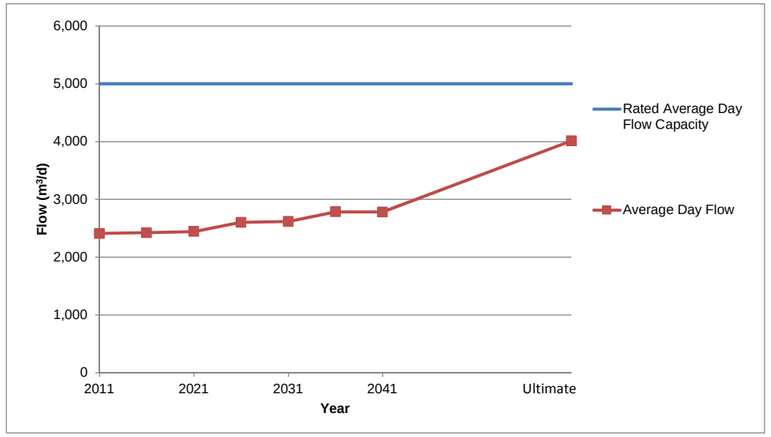
		Average Day Flow (m^3/d)						Ultimate Buildout
	Unit Rate (m^3/cap/d)	2016	2021	2026	2031	2036	2041	2061
Base Scenario - Residential Historical Maximum	0.617	2,423	2,442	2,602	2,617	2,783	2,782	4,012
Combined Historical Maximum	0.710	2,423	2,443	2,605	2,620	2,787	2,785	4,092
City Standards	0.500	2,422	2,439	2,596	2,609	2,773	2,773	3,813

Analyze sensitivity of forecasted flows to max day factor

		Max Day Flow (m^3/d)							Ultimate Buildout
	Max Day Peaking Factor	2016	2021	2026	2031	2036	2041	2061
Base Scenario - Historical Max	Not Available							
Historical Average	0.00	6,509	6,561	6,990	7,030	7,476	7,473	10,778

CAPACITY CHECK

	2011	2016	2021	2026	2031	2036	2041	Ultimate Buildout 2061
Rated Average Day Flow Capacity (m^3/d)	5,000	5,000	5,000	5,000	5,000	5,000	5,000	5,000
Average Day Flow (m^3/d)	2,410	2,423	2,442	2,602	2,617	2,783	2,782	4,012
Maximum Day Flow (m^3/d)	6,473	6,509	6,561	6,990	7,030	7,476	7,473	10,778



Chelmsford - Wastewater Flow Forecasts

		2009	2010	2011	2012	2013	Summary	Design Criterion
Average Day Flow	**(m^3/d)**	4,753	3,712	3,888	3,704	4,729	4,157	**4,157**
Max Day Flow	**(m^3/d)**	17,896	22,090	14,440	9,200	18,210	16,367	**16,367**
Max Day Factor		**3.77**	**5.95**	**3.71**	**2.48**	**3.85**	**3.95**	**3.95**
Peak Flow	**(m^3/d)**							**0**
Peak Flow	**(L/s)**			Not Available				**0**
Peak Flow Factor								

	2016	2021	2026	2031	2036	2041	Ultimate Buildout
Population (Existing Areas)	7,400	7,400	7,400	7,400	7,400	7,400	7,400
Population (Growth Areas)	117	239	363	438	486	491	3,608
Total Population	7517	7639	7763	7838	7886	7891	11008
Residential (ha)	60.00	62.46	63.81	64.78	65.59	66.57	123.52
Institutional (ha)			1.60	1.60	1.60	1.60	1.60
Commercial (ha)			3.75	3.75	3.75	3.75	3.75
Industrial (ha)					45.85	45.85	45.85
ICI (ha)	**0.00**	**0.00**	**5.35**	**5.35**	**51.20**	**51.20**	**51.20**
Total (ha)	**60.00**	**62.46**	**69.16**	**70.13**	**116.79**	**117.77**	**174.72**

Ratio of Residential to Total Customers	0.79	0.79	0.79	0.79	0.79	0.79		
Residential Share of Average Day Demand (m^3/d)	3759	2936	3075	2929	3740	3288		
Residential Flow Unit Rate (m^3/cap/d)	0.508	0.397	0.416	0.396	0.505	0.444	**0.450**	
Average Institutional Flow Unit Rate (m^3/ha/d)							**28.0**	
Average Commercial Flow Unit Rate (m^3/ha/d)							**28.0**	
Average Industrial Flow Unit Rate (m^3/ha/d)							**35.0**	
Average Extraneous Flow Unit Rate (m^3/ha/d)							**11.23**	

	2016	2021	2026	2031	2036	2041	Ultimate Buildout
Average Residential Flows (m^3/d) - Existing	**4,157**	**4,157**	**4,157**	**4,157**	**4,157**	**4,157**	**4,157**
Average Residential Flows (m^3/d)	**53**	**107**	**163**	**197**	**219**	**221**	**1,623**
Average Institutional Flow (m^3/d)	**0**	**0**	**45**	**45**	**45**	**45**	**45**
Average Commercial Flow (m^3/d)	**0**	**0**	**105**	**105**	**105**	**105**	**105**
Average Industrial Flow (m^3/d)	**0**	**0**	**0**	**0**	**1,605**	**1,605**	**1,605**
Average Extraneous Flow (m^3/day)	**674**	**702**	**777**	**788**	**1,312**	**1,323**	**1,963**
Average Day Flow (m^3/d)	**4,884**	**4,966**	**5,247**	**5,292**	**7,442**	**7,456**	**9,498**
Max Day Flow (m^3/d)	**19,305**	**19,631**	**20,742**	**20,918**	**29,419**	**29,471**	**37,545**

Comments

From Annual Reports
From Annual Reports
Calculated - Max Day Flow divided by Average Day Flow
Peak hour flows were not available

Total Population (Hemson)
ICI development areas were assigned to planning years based on the stage of the application. Draft Approved were assigned to 2016, Legal Lots of Record to 2026, and Designated Developable to 2036.
Areas are cumulative and carry from the development year, all the way through to Ultimate Buildout

This ratio is based on Water Billing Records for the area and is an approximation of the residential portion of demand.

CGS design standards do not suggest average rates for institutional and commercial, but require that rates be developed based on usage. In this case, water demands rates were used and assume a conservative 1:1 ratio of water to sewage.
CGS design standards do not suggest average rates for institutional and commercial, but require that rates be developed based on usage. In this case, water demands rates were used and assume a conservative 1:1 ratio of water to sewage.
CGS design standards average rate for light industrial of 35 m^3/ha/d.
From CGS Design Standards, peak rate for new developments divided by an assumed peaking factor of 3. This factor would be applied only to new developments, which are assumed to be leak-tight, and have minimal extraneous flow.

This includes all contribution from existing ICI and infiltration. The base flow was assumed to be the average day flow to the plant for the 2011-2013 period.
Obtained by multiplying the projected population growth by the unit rate.
Institutional growth area multiplied by unit flow rate.
Commercial growth area multiplied by unit flow rate.
Industrial growth area multiplied by unit flow rate.

ALTERNATIVE CALCULATION METHOD

Per Capita Flow (m3/cap/day)	0.642	0.502	0.525	0.501	0.639	0.562	0.562
Average Day Flow (m^3/d)							
Max Day Flow (m^3/d)							
Peak Flow (m^3/d)							
Peak Flow (L/s)							
REMINDERS:							

2016	2021	2026	2031	2036	2041	Ultimate Buildout
4222.775	4291.276901	4361.277	4403.151	4430.257	4432.898	6183.958276
16,692	16,963	17,240	17,405	17,513	17,523	24,445
0	0	0	0	0	0	0
0.0	0.0	0.0	0.0	0.0	0.0	0.0

Comments

Multiplying the total population by the consolidated per capita flow factor.

Multiplying the average flow X the peak hour factor.

SENSITIVITY ANALYSIS

Analyze sensitivity of forecasted flows to unit rate

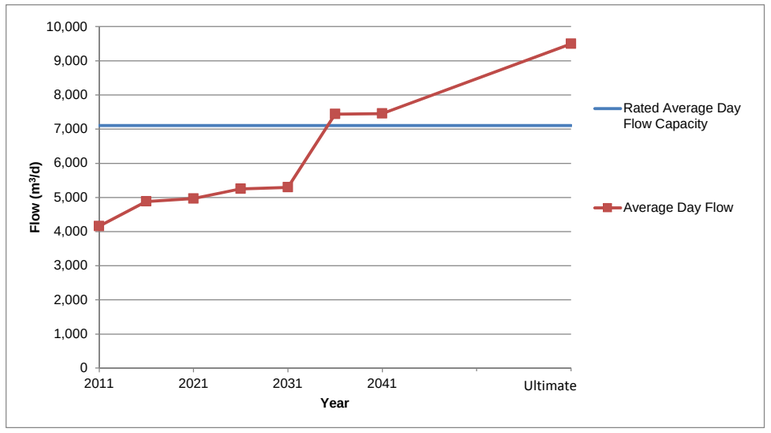
		Average Day Flow (m^3/d)						Ultimate Buildout
	Unit Rate (m^3/cap/d)	2016	2021	2026	2031	2036	2041	2061
Base Scenario - Residential Historical Maximum	0.444	4,884	4,966	5,247	5,292	7,442	7,456	9,498
Combined Historical Maximum	0.562	4,897	4,993	5,288	5,341	7,497	7,510	9,901
City Standards	0.360	4,873	4,945	5,215	5,252	7,399	7,411	9,173

Analyze sensitivity of forecasted flows to max day factor

		Max Day Flow (m^3/d)						Ultimate Buildout
	Max Day Peaking Factor	2016	2021	2026	2031	2036	2041	2061
Base Scenario - Historical Max	4.00	19,534	19,864	20,989	21,167	29,769	29,821	37,990
Historical Average	5.95	19,305	19,631	20,742	20,918	29,419	29,471	37,545

CAPACITY CHECK

								Ultimate Buildout
	2011	2016	2021	2026	2031	2036	2041	2061
Rated WPCP ADF Capacity (m^3/d)	7,100	7,100	7,100	7,100	7,100	7,100	7,100	7,100
Average Day Flow (m^3/d)	4,157	4,884	4,966	5,247	5,292	7,442	7,456	9,498
Maximum Day Flow (m^3/d)	16,367	19,305	19,631	20,742	20,918	29,419	29,471	37,545



Coniston - Wastewater Flow Forecasts

		2009	2010	2011	2012	2013	Summary	Design Criterion	Comments
Average Day Flow	**(m^3/d)**	1,303	885	981	931	1,239	1,068	**1,068**	From Annual Reports
Max Day Flow	**(m^3/d)**	3,777	2,424	3,618	3,986	5,875	3,936	**3,936**	From Annual Reports
Max Day Factor		**2.90**	**2.74**	**3.69**	**4.28**	**4.74**	**3.67**	**3.67**	Calculated - Max Day Flow divided by Average Day Flow
Peak Flow	**(m^3/d)**							**0**	Peak hour flows were not available
Peak Flow	**(L/s)**				Not Available			**0**	
Peak Flow Factor									

	2016	2021	2026	2031	2036	2041	Ultimate Buildout	
Population (Existing Areas)	2,225	2,225	2,225	2,225	2,225	2,225	2,225	
Population (Growth Areas)	17	35	52	62	68	69	1,073	
Total Population	2242	2260	2277	2287	2293	2294	3298	Total Population (Hemson)
Residential (ha)	0.85	1.78	3.34	3.34	5.33	5.33	38.79	ICI development areas were assigned to planning years based on the stage of the application. Draft Approved were assigned to 2016, Legal Lots of Record to 2026, and Designated Developable to 2036.
Institutional (ha)			0.14	0.14	0.14	0.14	0.14	
Commercial (ha)								
Industrial (ha)					36.36	36.36	36.36	
ICI (ha)	**0.00**	**0.00**	**0.14**	**0.14**	**36.50**	**36.50**	**36.50**	Areas are cumulative and carry from the development year, all the way through to Ultimate Buildout
Total (ha)	**0.85**	**1.78**	**3.48**	**3.48**	**41.83**	**41.83**	**75.29**	

Ratio of Residential to Total Customers	0.80	0.80	0.80	0.80	0.80	0.80		This ratio is based on Water Billing Records for the area and is an approximation of the residential portion of demand.
Residential Share of Average Day Demand (m^3/d)	1049	712	790	749	997	859		
Residential Flow Unit Rate (m^3/cap/d)	0.471	0.320	0.355	0.337	0.448	0.386	**0.400**	
Average Institutional Flow Unit Rate (m^3/ha/d)							**28.0**	CGS design standards do not suggest average rates for institutional and commercial, but require that rates be developed based on usage. In this case, water demands rates were used and assume a conservative 1:1 ratio of water to sewage.
Average Commercial Flow Unit Rate (m^3/ha/d)							**28.0**	CGS design standards do not suggest average rates for institutional and commercial, but require that rates be developed based on usage. In this case, water demands rates were used and assume a conservative 1:1 ratio of water to sewage.
Average Industrial Flow Unit Rate (m^3/ha/d)							**35.0**	CGS design standards average rate for light industrial of 35 m^3/ha/d.
Average Extraneous Flow Unit Rate (m^3/ha/d)							**11.23**	From CGS Design Standards, peak rate for new developments divided by an assumed peaking factor of 3. This factor would be applied only to new developments, which are assumed to be leak-tight, and have minimal extraneous flow.

	2016	2021	2026	2031	2036	2041	Ultimate Buildout	
Average Residential Flows (m^3/d) - Existing	**1,068**	**1,068**	**1,068**	**1,068**	**1,068**	**1,068**	**1,068**	This includes all contribution from existing ICI and infiltration. The base flow was assumed to be the average day flow to the plant for the 2011-2013 period.
Average Residential Flows (m^3/d)	**7**	**14**	**21**	**25**	**27**	**27**	**429**	Obtained by multiplying the projected population growth by the unit rate.
Average Institutional Flow (m^3/d)	**0**	**0**	**4**	**4**	**4**	**4**	**4**	Institutional growth area multiplied by unit flow rate.
Average Commercial Flow (m^3/d)	**0**	**0**	**0**	**0**	**0**	**0**	**0**	Commercial growth area multiplied by unit flow rate.
Average Industrial Flow (m^3/d)	**0**	**0**	**0**	**0**	**1,273**	**1,273**	**1,273**	Industrial growth area multiplied by unit flow rate.
Average Extraneous Flow (m^3/day)	**10**	**20**	**39**	**39**	**470**	**470**	**846**	
Average Day Flow (m^3/d)	**1,084**	**1,102**	**1,132**	**1,136**	**2,841**	**2,842**	**3,619**	
Max Day Flow (m^3/d)	**3,978**	**4,044**	**4,153**	**4,168**	**10,428**	**10,428**	**13,282**	

ALTERNATIVE CALCULATION METHOD

Per Capita Flow (m3/cap/day)	0.586	0.398	0.441	0.418	0.557	0.480	0.480
Average Day Flow (m^3/d)	1075.905	1084.800403	1092.861	1097.664	1100.492	1100.789	1582.864439
Max Day Flow (m^3/d)	3,948	3,981	4,011	4,028	4,039	4,040	5,809

2016	2021	2026	2031	2036	2041	Ultimate Buildout

Comments

Multiplying the total population by the consolidated per capita flow factor.

SENSITIVITY ANALYSIS

Analyze sensitivity of forecasted flows to unit rate

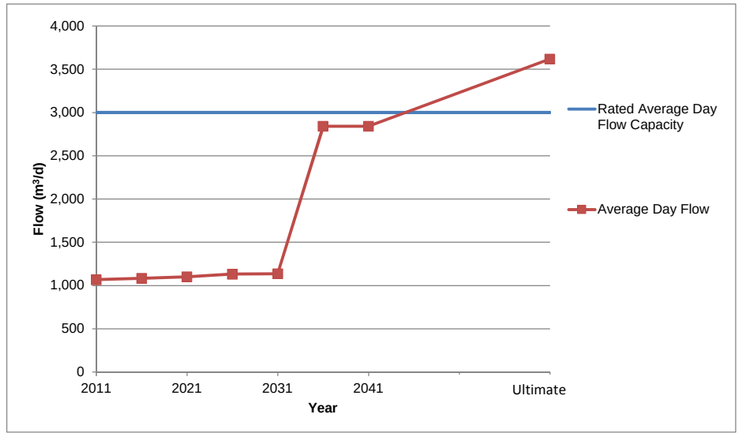
		Average Day Flow (m^3/d)						Ultimate Buildout
	Unit Rate (m^3/cap/d)	**2016**	**2021**	**2026**	**2031**	**2036**	**2041**	**2061**
Base Scenario - Residential Historical Maximum	0.386	1,084	1,102	1,132	1,136	2,841	2,842	3,619
Combined Historical Maximum	0.480	1,085	1,105	1,136	1,141	2,847	2,847	3,705
City Standards	0.410	1,084	1,102	1,132	1,136	2,842	2,842	3,630

Analyze sensitivity of forecasted flows to max day factor

		Max Day Flow (m^3/d)						Ultimate Buildout
	Max Day Peaking Factor	**2016**	**2021**	**2026**	**2031**	**2036**	**2041**	**2061**
Base Scenario - Historical Max	3.86	4,187	4,256	4,371	4,387	10,975	10,976	13,980
Historical Average	4.74	3,978	4,044	4,153	4,168	10,428	10,428	13,282

CAPACITY CHECK

								Ultimate Buildout
	2011	**2016**	**2021**	**2026**	**2031**	**2036**	**2041**	**2061**
Rated WPCP ADF Capacity (m^3/d)	3,000	3,000	3,000	3,000	3,000	3,000	3,000	3,000
Average Day Flow (m^3/d)	1,068	1,084	1,102	1,132	1,136	2,841	2,842	3,619
Maximum Day Flow (m^3/d)	3,936	3,978	4,044	4,153	4,168	10,428	10,428	13,282



Copper Cliff - Wastewater Flow Forecasts

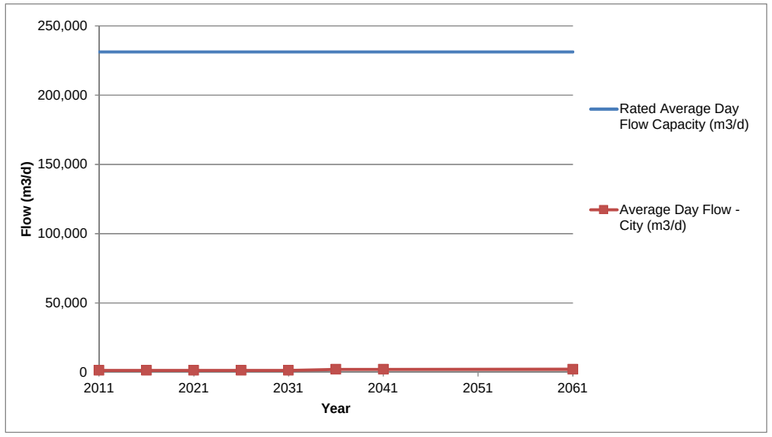
		2009	2010	2011	2012	2013	Summary	Design Criterion	Comments
Average Day Flow	**(m^3/d)**							**1,348**	Historical Flow data was not available. The existing design flow was estimated using the existing population and a design unit flow rate.
Max Day Flow	**(m^3/d)**							**5,460**	Historical Flow data was not available. The max day flow was estimated by multiplying the average day flow by the max day factor.
Max Day Factor				Not Available				**4.05**	Historical Flow data was not available. Value for nearby Lively was used.
Peak Flow	**(m^3/d)**							**0**	Historical Flow data was not available.
Peak Flow	**(L/s)**							**0**	

	2016	2021	2026	2031	2036	2041	Ultimate Buildout	Comments
Population (Existing Areas)	2,696	2,696	2,696	2,696	2,696	2,696	2,696	
Population (Growth Areas)	7	17	27	33	41	39	76	
Total Population	2703	2713	2724	2729	2737	2736	2772	Total Population (Hemson)
Residential (ha)	0.59	1.05	1.05	1.05	1.05	1.05	1.05	ICI development areas were assigned to planning years based on the stage of the application. Draft Approved were assigned to 2016, Legal Lots of Record to 2026, and Designated Developable to 2036.
Institutional (ha)								
Commercial (ha)			0.16	0.16	0.16	0.16	0.16	
Industrial (ha)					15.74	15.74	15.74	
ICI (ha)	**0.00**	**0.00**	**0.16**	**0.16**	**15.90**	**15.90**	**15.90**	Areas are cumulative and carry from the development year, all the way through to Ultimate Buildout
Total (ha)	**0.59**	**1.05**	**1.21**	**1.21**	**16.95**	**16.95**	**16.95**	

								Comments
Ratio of Residential to Total Customers	0.84	0.84	0.84	0.84	0.84	0.84		This ratio is based on Water Billing Records for the area and is an approximation of the residential portion of demand.
Residential Share of Average Day Demand (m^3/d)			Not Available					
Residential Flow Unit Rate (m^3/cap/d)							**0.500**	
Average Institutional Flow Unit Rate (m^3/ha/d)							**28.0**	CGS design standards do not suggest average rates for institutional and commercial, but require that rates be developed based on usage. In this case, water demands rates were used and assume a conservative 1:1 ratio of water to sewage.
Average Commercial Flow Unit Rate (m^3/ha/d)							**28.0**	
Average Industrial Flow Unit Rate (m^3/ha/d)							**35.0**	CGS design standards average rate for light industrial of 35 m^3/ha/d.
Average Extraneous Flow Unit Rate (m^3/ha/d)							**11.23**	From CGS Design Standards, peak rate for new developments divided by an assumed peaking factor of 3. This factor would be applied only to new developments, which are assumed to be leak-tight, and have minimal extraneous flow.

	2016	2021	2026	2031	2036	2041	Ultimate Buildout	Comments
Average Residential Flows (m^3/d) - Existing	1,348	1,348	1,348	1,348	1,348	1,348	1,348	This includes all contribution from existing ICI and infiltration. The base flow was assumed to be the average day flow to the plant for the 2011-2013 period.
Average Residential Flows (m^3/d)	4	8	14	17	20	20	38	Obtained by multiplying the projected population growth by the unit rate.
Average Institutional Flow (m^3/d)	0	0	0	0	0	0	0	Institutional growth area multiplied by unit flow rate.
Average Commercial Flow (m^3/d)	0	0	4	4	4	4	4	Commercial growth area multiplied by unit flow rate.
Average Industrial Flow (m^3/d)	0	0	0	0	551	551	551	Industrial growth area multiplied by unit flow rate.
Average Extraneous Flow (m^3/day)	7	12	14	14	190	190	190	
Average Day Flow (m^3/d)	1,358	1,368	1,380	1,383	2,114	2,114	2,132	
Max Day Flow (m^3/d)	5,501	5,542	5,588	5,600	8,563	8,560	8,633	

CAPACITY CHECK								Ultimate Buildout
	2011	2016	2021	2026	2031	2036	2041	2061
Rated Average Day Flow Capacity (m^3/d)	231,360	231,360	231,360	231,360	231,360	231,360	231,360	231,360
Average Day Flow - City (m^3/d)	1,348	1,358	1,368	1,380	1,383	2,114	2,114	2,132
Maximum Day Flow - City (m^3/d)	5,460	5,501	5,542	5,588	5,600	8,563	8,560	8,633



Dowling - Wastewater Flow Forecasts

		2009	2010	2011	2012	2013	Summary	Design Criterion	Comments
Average Day Flow	**(m^3/d)**	2,033	1,749	1,846	1,837	2,051	1,903	**1,903**	From Annual Reports
Max Day Flow	**(m^3/d)**	4,000	3,180	2,940	2,650	4,338	3,422	**3,422**	From Annual Reports
Max Day Factor		**1.97**	**1.82**	**1.59**	**1.44**	**2.12**	**1.79**	**1.79**	Calculated - Max Day Flow divided by Average Day Flow
Peak Flow	**(m^3/d)**							**0**	Peak hour flows were not available
Peak Flow	**(L/s)**			Not Available				**0**	
Peak Flow Factor									

	2016	2021	2026	2031	2036	2041	Ultimate Buildout	
Population (Existing Areas)	1,773	1,773	1,773	1,773	1,773	1,773	1,773	
Population (Growth Areas)	64	130	193	225	244	244	1,949	
Total Population	1837	1903	1965	1997	2017	2016	3721	Total Population (Hemson)
Residential Growth Area (ha)	12.96	9.01	0.00	3.44	0.00	0.00	53.10	
Residential Growth Area (ha) - Cumulative	12.96	21.97	21.97	25.41	25.41	25.41	78.51	
Institutional Growth Area (ha)	0.00	0.00	0.47	0.00	0.00	0.00	0.00	
Institutional Growth Area (ha) - Cumulative	0.00	0.00	0.47	0.47	0.47	0.47	0.47	ICI development areas were assigned to planning years based on the stage of the application. Draft Approved were assigned to 2016, Legal Lots of Record to 2026, and Designated Developable to 2036. Areas are cumulative and carry from the development year, all the way through to Ultimate Buildout
Commercial Growth Area (ha)	0.00	0.00	0.64	0.00	0.00	0.00	0.00	
Commercial Growth Area (ha) - Cumulative	0.00	0.00	0.64	0.64	0.64	0.64	0.64	
Industrial Growth Area (ha)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
Industrial Growth Area (ha) - Cumulative	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
ICI (ha) - Cumulative	**0.00**	**0.00**	**1.11**	**1.11**	**1.11**	**1.11**	**1.11**	
Total Growth Area (ha) - Cumulative	**12.96**	**21.97**	**23.08**	**26.52**	**26.52**	**26.52**	**79.62**	

Ratio of Residential to Total Customers	0.82	0.82	0.82	0.82	0.82	0.82		This ratio is based on Water Billing Records for the area and is an approximation of the residential portion of demand.
Residential Share of Average Day Demand (m^3/d)	1662	1430	1510	1502	1677	1556		Institutional growth area multiplied by unit flow rate.
Residential Flow Unit Rate (m^3/cap/d)	0.938	0.807	0.852	0.847	0.946	0.878	**0.900**	Commercial growth area multiplied by unit flow rate.
Average Institutional Flow Unit Rate (m^3/ha/d)							**28.0**	Industrial growth area multiplied by unit flow rate.
Average Commercial Flow Unit Rate (m^3/ha/d)							**28.0**	CGS design standards do not suggest average rates for institutional and commercial, but require that rates be developed based on usage. In this case, water demands rates were used and assume a conservative 1:1 ratio of water to sewage.
Average Industrial Flow Unit Rate (m^3/ha/d)							**35.0**	CGS design standards average rate for light industrial of 35 m^3/ha/d.
Average Extraneous Flow Unit Rate (m^3/ha/d)							**11.23**	From CGS Design Standards, peak rate for new developments divided by an assumed peaking factor of 3. This factor would be applied only to new developments, which are assumed to be leak-tight, and have minimal extraneous flow.

	2016	2021	2026	2031	2036	2041	Ultimate Buildout	
Average Residential Flows (m^3/d) - Existing	**1,903**	**1,903**	**1,903**	**1,903**	**1,903**	**1,903**	**1,903**	This includes all contribution from existing ICI and infiltration. The base flow was assumed to be the average day flow to the plant for the 2011-2013 period.
Average Residential Flows (m^3/d)	**58**	**117**	**173**	**202**	**220**	**220**	**1,754**	Obtained by multiplying the projected population growth by the unit rate.
Average Institutional Flow (m^3/d)	**0**	**0**	**13**	**13**	**13**	**13**	**13**	
Average Commercial Flow (m^3/d)	**0**	**0**	**18**	**18**	**18**	**18**	**18**	
Average Industrial Flow (m^3/d)	**0**	**0**	**0**	**0**	**0**	**0**	**0**	Multiplying the total population by the consolidated per capita flow factor.
Average Extraneous Flow (m^3/d	**146**	**247**	**259**	**298**	**298**	**298**	**894**	
Average Day Flow (m^3/d)	**2,106**	**2,267**	**2,367**	**2,435**	**2,452**	**2,452**	**4,582**	
Max Day Flow (m^3/d)	**3,765**	**4,052**	**4,230**	**4,351**	**4,382**	**4,382**	**8,190**	

ALTERNATIVE CALCULATION METHOD

Per Capita Flow (m^3/cap/day)	1.147	0.987	1.041	1.036	1.157	1.074	1.074
Average Day Flow (m^3/d)	1972	2043	2110	2145	2165	2165	3995
Max Day Flow (m^3/d)	3,524	3,651	3,771	3,833	3,870	3,869	7,141

2016	2021	2026	2031	2036	2041	Ultimate Buildout

Comments

Multiplying the total population X the consolidated per capita flow factor.

SENSITIVITY ANALYSIS

Analyze sensitivity of forecasted flows to unit rate

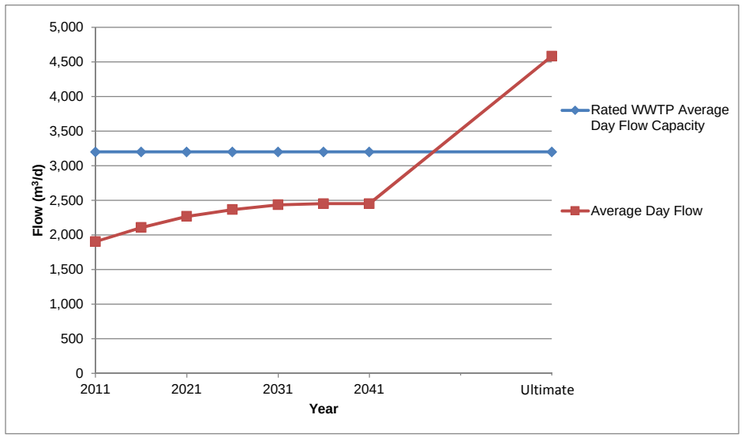
		Average Day Flow (m^3/d)						Ultimate Buildout
	Unit Rate (m^3/cap/d)	2016	2021	2026	2031	2036	2041	2061
Base Scenario - Residential Historical Maximum	0.878	2,106	2,267	2,367	2,435	2,452	2,452	4,582
Combined Historical Maximum	1.074	2,117	2,290	2,400	2,474	2,494	2,494	4,921
City Standards	0.360	2,072	2,197	2,263	2,313	2,320	2,320	3,530

Analyze sensitivity of forecasted flows to max day factor

		Max Day Flow (m^3/d)						Ultimate Buildout
	Max Day Peaking Factor	2016	2021	2026	2031	2036	2041	2061
Base Scenario - Historical Max	1.74	3,670	3,950	4,124	4,241	4,271	4,271	7,983
Historical Average	2.12	3,765	4,052	4,230	4,351	4,382	4,382	8,190

CAPACITY CHECK

								Ultimate Buildout
	2011	2016	2021	2026	2031	2036	2041	2061
Rated WWTP ADF Capacity (m^3/d)	3,200	3,200	3,200	3,200	3,200	3,200	3,200	3,200
Average Day Flow (m^3/d)	1,903	2,106	2,267	2,367	2,435	2,452	2,452	4,582



Falconbridge - Wastewater Flow Forecasts

		2009	2010	2011	2012	2013	Summary	Design Criterion	2016	2021	2026	2031	2036	2041	Ultimate Buildout	Comments
Average Day Flow	**(m^3/d)**	250	240	264	242	245	248	**248**								From Annual Reports
Max Day Flow	**(m^3/d)**	342	558	629	765	497	558	**558**								From Annual Reports
Max Day Factor		**1.37**	**2.33**	**2.38**	**3.16**	**2.03**	**2.25**	**2.25**								Calculated - Max Day Flow divided by Average Day Flow
Peak Flow	**(m^3/d)**	Not Available						**0**								Peak hour flows were not available
Peak Flow	**(L/s)**							**0**								
Peak Flow Factor																
Population (Existing Areas)		**707**	**707**	**707**	**707**	**707**	**707**	**707**	707	707	707	707	707	707	707	
Population (Growth Areas)									17	35	52	62	68	69	148	
Total Population									724	743	759	769	775	776	855	Total Population (Hemson)
Residential (ha)									1.24	2.20	2.64	2.64	2.64	2.64	2.76	ICI development areas were assigned to planning years based on the stage of the application. Draft Approved were assigned to 2016, Legal Lots of Record to 2026, and Designated Developable to 2036. Areas are cumulative and carry from the development year, all the way through to Ultimate Buildout
Institutional (ha)											1.70	1.70	2.03	2.03	2.03	
Commercial (ha)											0.17	0.17	0.17	0.17	0.17	
Industrial (ha)											0.36	0.36	0.36	0.36	0.36	
ICI (ha)									**0.00**	**0.00**	**2.23**	**2.23**	**2.56**	**2.56**	**2.56**	
Total (ha)									**1.24**	**2.20**	**4.87**	**4.87**	**5.20**	**5.20**	**5.32**	
Ratio of Residential to Total Customers		0.19	0.19	0.19	0.19	0.19	0.19									This ratio is based on Water Billing Records for the area and is an approximation of the residential portion of demand.
Residential Share of Average Day Demand	**(m^3/d)**	47	45	50	45	46	47									
Residential Flow Unit Rate (m^3/cap/d)		0.066	0.064	0.070	0.064	0.065	0.066	**0.400**								
Average Institutional Flow Unit Rate (m^3/ha/d)								**28.0**								CGS design standards do not suggest average rates for institutional and commercial, but require that rates be developed based on usage. In this case, water demands rates were used and assume a conservative 1:1 ratio of water to sewage.
Average Commercial Flow Unit Rate (m^3/ha/d)								**28.0**								CGS design standards do not suggest average rates for institutional and commercial, but require that rates be developed based on usage. In this case, water demands rates were used and assume a conservative 1:1 ratio of water to sewage.
Average Industrial Flow Unit Rate (m^3/ha/d)								**35.0**								CGS design standards average rate for light industrial of 35 m^3/ha/d. From CGS Design Standards, peak rate for new developments divided by an assumed peaking factor of 3. This factor would be applied only to new developments, which are assumed to be leak-tight, and have minimal extraneous flow.
Average Extraneous Flow Unit Rate (m^3/ha/d)								**11.23**								

	2016	2021	2026	2031	2036	2041	Ultimate Buildout	
Average Residential Flows (m^3/d) - Existing	**248**	**248**	**248**	**248**	**248**	**248**	**248**	This includes all contribution from existing ICI and infiltration. The base flow was assumed to be the average day flow to the plant for the 2011-2013 period.
Average Residential Flows (m^3/d)	**7**	**14**	**21**	**25**	**27**	**27**	**59**	Obtained by multiplying the projected population growth by the unit rate.
Average Institutional Flow (m^3/d)	**0**	**0**	**48**	**48**	**57**	**57**	**57**	Institutional growth area multiplied by unit flow rate.
Average Commercial Flow (m^3/d)	**0**	**0**	**5**	**5**	**5**	**5**	**5**	Commercial growth area multiplied by unit flow rate.
Average Industrial Flow (m^3/d)	**0**	**0**	**13**	**13**	**13**	**13**	**13**	Industrial growth area multiplied by unit flow rate.
Average Extraneous Flow (m^3/day)	**14**	**25**	**55**	**55**	**58**	**58**	**60**	
Average Day Flow (m^3/d)	**269**	**287**	**389**	**393**	**408**	**408**	**441**	
Max Day Flow (m^3/d)	**606**	**647**	**876**	**885**	**919**	**920**	**994**	

ALTERNATIVE CALCULATION METHOD

Per Capita Flow (m3/cap/day)	0.354	0.339	0.373	0.342	0.346	0.351	0.351
Average Day Flow (m^3/d)	254	261	267	270	272	272	300
Max Day Flow (m^3/d)	573	587	601	608	613	614	676

2016	2021	2026	2031	2036	2041	Ultimate Buildout

Comments

Multiplying the total population by the consolidated per capita flow factor.

SENSITIVITY ANALYSIS

Analyze sensitivity of forecasted flows to unit rate

		Average Day Flow (m^3/d)						Ultimate Buildout
	Unit Rate (m^3/cap/d)	**2016**	**2021**	**2026**	**2031**	**2036**	**2041**	**2061**
Base Scenario - Residential Historical Maximum	0.066	263	275	371	372	385	385	392
Combined Historical Maximum	0.351	268	285	386	390	405	405	434
City Standards	0.410	269	287	389	393	409	409	443
Base Scenario - Average of MOE Guidelines Typical Range	0.400	269	287	389	393	408	408	441

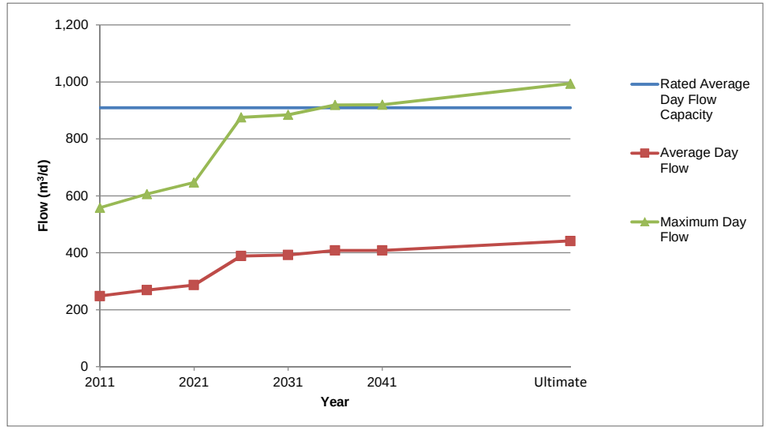
Analyze sensitivity of forecasted flows to max day factor

		Max Day Flow (m^3/d)						Ultimate Buildout
	Max Day Peaking Factor	**2016**	**2021**	**2026**	**2031**	**2036**	**2041**	**2061**
Base Scenario - Historical Max	2.47	665	710	962	972	1,010	1,010	1,092
Historical Average	3.16	606	647	876	885	919	920	994

CAPACITY CHECK

								Ultimate Buildout
	2011	**2016**	**2021**	**2026**	**2031**	**2036**	**2041**	**2061**
Rated WPCP ADF Capacity (m^3/d)	909	909	909	909	909	909	909	909
Average Day Flow (m^3/d)	248	269	287	389	393	408	408	441
Maximum Day Flow (m^3/d)	558	606	647	876	885	919	920	994

From C of A (1979), assuming imperial gallons



Levack - Wastewater Flow Forecasts

		2009	2010	2011	2012	2013	Summary	Design Criterion	Comments
Average Day Flow	**(m^3/d)**	862	765	799	615	786	765	**765**	From Annual Reports
Max Day Flow	**(m^3/d)**	2,353	3,251	1,901	1,828	2,879	2,442	**2,442**	From Annual Reports
Max Day Factor		**2.73**	**4.25**	**2.38**	**2.97**	**3.66**	**3.20**	**3.20**	Calculated - Max Day Flow divided by Average Day Flow
Peak Flow	**(m^3/d)**							**0**	Peak hour flows were not available
Peak Flow	**(L/s)**			Not Available				**0**	
Peak Flow Factor									

	2016	2021	2026	2031	2036	2041	Ultimate Buildout	Comments
Population (Existing Areas)	2,112	2,112	2,112	2,112	2,112	2,112	2,112	
Population (Growth Areas)	11	23	34	42	47	47	365	
Total Population	2123	2135	2146	2154	2159	2159	2477	Total Population (Hemson)
Residential (ha)	1.25	1.30	2.07	2.15	6.79	6.79	13.55	ICI development areas were assigned to planning years based on the stage of the application. Draft Approved were assigned to 2016, Legal Lots of Record to 2026, and Designated Developable to 2036. Areas are cumulative and carry from the development year, all the way through to Ultimate Buildout
Institutional (ha)					2.78	2.78	2.78	
Commercial (ha)			0.71	0.71	0.71	0.71	0.71	
Industrial (ha)					1.86	1.86	1.86	
ICI (ha)	**0.00**	**0.00**	**0.71**	**0.71**	**5.35**	**5.35**	**5.35**	
Total (ha)	**1.25**	**1.30**	**2.78**	**2.86**	**12.14**	**12.14**	**18.90**	

Ratio of Residential to Total Customers	0.43	0.43	0.43	0.43	0.43	0.43		This ratio is based on Water Billing Records for the area and is an approximation of the residential portion of demand.
Residential Share of Average Day Demand (m^3/d)	372	330	344	265	339	330		
Residential Flow Unit Rate (m^3/cap/d)	0.176	0.156	0.163	0.126	0.160	0.156	**0.200**	
Average Institutional Flow Unit Rate (m^3/ha/d)							**28.0**	CGS design standards do not suggest average rates for institutional and commercial, but require that rates be developed based on usage. In this case, water demands rates were used and assume a conservative 1:1 ratio of water to sewage.
Average Commercial Flow Unit Rate (m^3/ha/d)							**28.0**	CGS design standards do not suggest average rates for institutional and commercial, but require that rates be developed based on usage. In this case, water demands rates were used and assume a conservative 1:1 ratio of water to sewage.
Average Industrial Flow Unit Rate (m^3/ha/d)							**35.0**	CGS design standards average rate for light industrial of 35 m^3/ha/d.
Average Extraneous Flow Unit Rate (m^3/ha/d)							**7.48**	From CGS Design Standards, peak rate for new developments divided by an assumed peaking factor of 3. This factor would be applied only to new developments, which are assumed to be leak-tight, and have minimal extraneous flow.

	2016	2021	2026	2031	2036	2041	Ultimate Buildout	Comments
Average Residential Flows (m^3/d) - Existing	**765**	**765**	**765**	**765**	**765**	**765**	**765**	This includes all contribution from existing ICI and infiltration. The base flow was assumed to be the average day flow to the plant for the 2011-2013 period.
Average Residential Flows (m^3/d)	**2**	**5**	**7**	**8**	**9**	**9**	**73**	Obtained by multiplying the projected population growth by the unit rate.
Average Institutional Flow (m^3/d)	**0**	**0**	**0**	**0**	**78**	**78**	**78**	Institutional growth area multiplied by unit flow rate.
Average Commercial Flow (m^3/d)	**0**	**0**	**20**	**20**	**20**	**20**	**20**	Commercial growth area multiplied by unit flow rate.
Average Industrial Flow (m^3/d)	**0**	**0**	**0**	**0**	**65**	**65**	**65**	Industrial growth area multiplied by unit flow rate.
Average Extraneous Flow (m^3/day)	**9**	**10**	**21**	**21**	**91**	**91**	**141**	
Average Day Flow (m^3/d)	**777**	**780**	**813**	**815**	**1,028**	**1,028**	**1,143**	
Max Day Flow (m^3/d)	**2,485**	**2,494**	**2,600**	**2,607**	**3,290**	**3,290**	**3,655**	

ALTERNATIVE CALCULATION METHOD

Per Capita Flow (m3/cap/day)	0.408	0.362	0.378	0.291	0.372	0.362	0.362

	2016	2021	2026	2031	2036	2041	Ultimate Buildout
Average Day Flow (m^3/d)	769	774	778	781	782	782	898
Max Day Flow (m^3/d)	2,461	2,475	2,488	2,497	2,503	2,503	2,871

Comments

Multiplying the total population by the consolidated per capita flow factor.

SENSITIVITY ANALYSIS

Analyze sensitivity of forecasted flows to unit rate

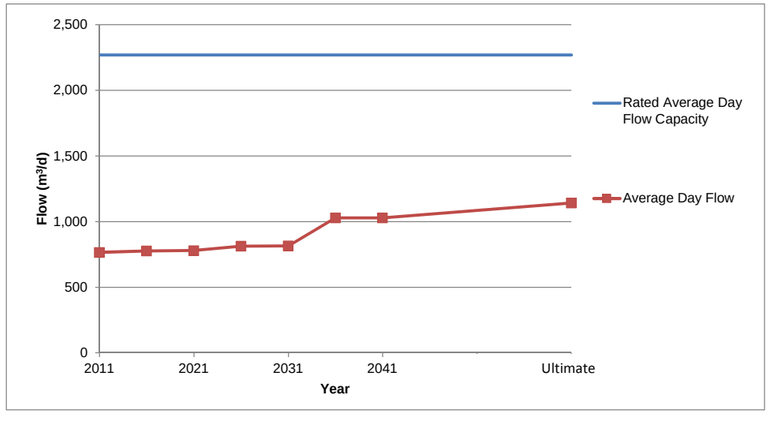
		Average Day Flow (m^3/d)						Ultimate Buildout
	Unit Rate ($m^3/cap/d$)	**2016**	**2021**	**2026**	**2031**	**2036**	**2041**	**2061**
Base Scenario - Residential Historical Maximum	0.156	777	780	813	815	1,028	1,028	1,143
Combined Historical Maximum	0.362	779	783	818	822	1,036	1,036	1,202
City Standards	0.410	779	785	820	824	1,038	1,038	1,219

Analyze sensitivity of forecasted flows to max day factor

		Max Day Flow (m^3/d)							Ultimate Buildout
	Max Day Peaking Factor	**2016**	**2021**	**2026**	**2031**	**2036**	**2041**	**2061**
Base Scenario - Historical Max	3.32	2,577	2,586	2,696	2,703	3,410	3,410	3,789
Historical Average	4.25	2,485	2,494	2,600	2,607	3,290	3,290	3,655

CAPACITY CHECK

								Ultimate Buildout
	2011	**2016**	**2021**	**2026**	**2031**	**2036**	**2041**	**2061**
Rated WPCP ADF Capacity (m^3/d)	2,270	2,270	2,270	2,270	2,270	2,270	2,270	2,270
WPCP Peak Capacity (m^3/d)	5,675	5,675	5,675	5,675	5,675	5,675	5,675	5,675
Average Day Flow (m^3/d)	765	777	780	813	815	1,028	1,028	1,143
Maximum Day Flow (m^3/d)	2,442	2,485	2,494	2,600	2,607	3,290	3,290	3,655



Lively - Wastewater Flow Forecasts

(Lively WWTP Service Area)

		2009	2010	2011	2012	2013	Summary	Design Criterion	Comments
Average Day Flow	**(m^3/d)**	1,143	923	1,025	1,129	1,693	1,183	**1,183**	From Annual Reports
Max Day Flow	**(m^3/d)**	2,860	5,190	3,912	5,227	6,207	4,679	**4,679**	From Annual Reports
Max Day Factor		**2.50**	**5.62**	**3.82**	**4.63**	**3.67**	**4.05**	**4.05**	Calculated - Max Day Flow divided by Average Day Flow
Peak Flow	**(m^3/d)**							**0**	Peak hour flows were not available
Peak Flow	**(L/s)**			Not Available				**0**	
Peak Flow Factor									

	2016	2021	2026	2031	2036	2041	Ultimate Buildout	
Population (Existing Areas)	2,197	2,197	2,197	2,197	2,197	2,197	2,197	
Population (Growth Areas)	152	294	410	479	520	531	2,957	
Total Population	2348	2491	2607	2676	2716	2728	5154	Total Population (Hemson)
Residential (ha)	9.46	9.46	70.50	70.50	70.50	70.50	70.50	
Institutional (ha)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
Commercial (ha)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	No ICI development is expected within the Lively WWTP catchment area.
Industrial (ha)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
ICI (ha)	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	
Total (ha)	**9.46**	**9.46**	**70.50**	**70.50**	**70.50**	**70.50**	**70.50**	

Ratio of Residential to Total Customers	0.77	0.77	0.77	0.77	0.77	0.77		This ratio is based on Water Billing Records for the area and is an approximation of the residential portion of demand.
Residential Share of Average Day Demand (m^3/d)	879	710	788	868	1302	909		
Residential Flow Unit Rate (m^3/cap/d)	0.400	0.323	0.359	0.395	0.593	0.414	**0.450**	
Average Institutional Flow Unit Rate (m^3/ha/d)							**28.0**	CGS design standards do not suggest average rates for institutional and commercial, but require that rates be developed based on usage. In this case, water demands rates were used and assume a conservative 1:1 ratio of water to sewage.
Average Commercial Flow Unit Rate (m^3/ha/d)							**28.0**	CGS design standards do not suggest average rates for institutional and commercial, but require that rates be developed based on usage. In this case, water demands rates were used and assume a conservative 1:1 ratio of water to sewage.
Average Industrial Flow Unit Rate (m^3/ha/d)							**35.0**	CGS design standards average rate for light industrial of 35 m^3/ha/d.
Average Extraneous Flow Unit Rate (m^3/ha/d)							**11.23**	From CGS Design Standards, peak rate for new developments divided by an assumed peaking factor of 3. This factor would be applied only to new developments, which are assumed to be leak-tight, and have minimal extraneous flow.

	2016	2021	2026	2031	2036	2041	Ultimate Buildout	
Average Residential Flows (m^3/d) - Existing	1,183	1,183	1,183	1,183	1,183	1,183	1,183	This includes all contribution from existing ICI and infiltration. The base flow was assumed to be the average day flow to the plant for the 2011-2013 period.
Average Residential Flows (m^3/d)	68	132	185	216	234	239	1,331	Obtained by multiplying the projected population growth by the unit rate.
Average Institutional Flow (m^3/d)	0	0	0	0	0	0	0	Institutional growth area multiplied by unit flow rate.
Average Commercial Flow (m^3/d)	0	0	0	0	0	0	0	Commercial growth area multiplied by unit flow rate.
Average Industrial Flow (m^3/d)	0	0	0	0	0	0	0	Industrial growth area multiplied by unit flow rate.
Average Extraneous Flow (m^3/day)	106	106	792	792	792	792	792	
Average Day Flow (m^3/d)	1,357	1,421	2,159	2,190	2,208	2,214	3,305	
Max Day Flow (m^3/d)	5,493	5,753	8,739	8,865	8,939	8,960	13,379	

ALTERNATIVE CALCULATION METHOD

Per Capita Flow (m3/cap/day)	0.520	0.420	0.467	0.514	0.771	0.538	0.538
Average Day Flow (m^3/d)	1264	1341	1404	1440	1462	1469	2775
Max Day Flow (m^3/d)	5,117	5,428	5,681	5,830	5,919	5,944	11,231

2016	2021	2026	2031	2036	2041	Ultimate Buildout

Comments

Multiplying the total population by the consolidated per capita flow factor.

SENSITIVITY ANALYSIS

Analyze sensitivity of forecasted flows to unit rate

		Average Day Flow (m^3/d)						Ultimate Buildout
	Unit Rate (m^3/cap/d)	**2016**	**2021**	**2026**	**2031**	**2036**	**2041**	**2061**
Base Scenario - Residential Historical Maximum	0.414	1,357	1,421	2,159	2,190	2,208	2,214	3,305
Combined Historical Maximum	0.538	1,370	1,447	2,195	2,232	2,254	2,260	3,567
City Standards for Lively	0.410	1,351	1,410	2,143	2,171	2,188	2,192	3,187
City Standards for Walden	0.450	1,357	1,421	2,159	2,190	2,208	2,214	3,305

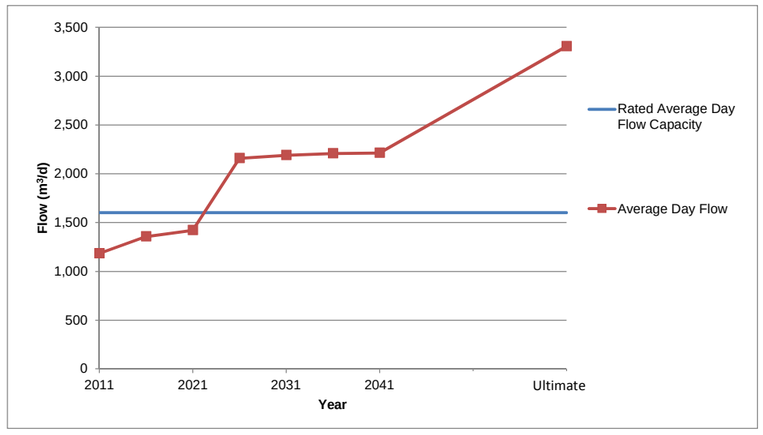
Analyze sensitivity of forecasted flows to max day factor

		Max Day Flow (m^3/d)						Ultimate Buildout
	Max Day Peaking Factor	**2016**	**2021**	**2026**	**2031**	**2036**	**2041**	**2061**
Base Scenario - Historical Max	4.43	6,017	6,302	9,574	9,711	9,792	9,815	14,656
Historical Average	5.62	5,493	5,753	8,739	8,865	8,939	8,960	13,379

CAPACITY CHECK

								Ultimate Buildout
	2011	**2016**	**2021**	**2026**	**2031**	**2036**	**2041**	**2061**
Rated WPCP ADF Capacity (m^3/d)	1,600	1,600	1,600	1,600	1,600	1,600	1,600	1,600
WPCP Peak Capacity (m^3/d)	3,000	3,000	3,000	3,000	3,000	3,000	3,000	3,000
Average Day Flow (m^3/d)	1,183	1,357	1,421	2,159	2,190	2,208	2,214	3,305
Maximum Day Flow (m^3/d)	4,679	5,493	5,753	8,739	8,865	8,939	8,960	13,379

Proposed capacity for the Walden WWTP from Lively/Walden Class EA ESR, page 75



Walden - Wastewater Flow Forecasts

(Walden WWTP Service Area)

		2009	2010	2011	2012	2013	Summary	Design Criterion	Comments
Average Day Flow	**(m^3/d)**	3,979	3,079	3,258	3,317	4,252	3,577	**3,577**	From Annual Reports
Max Day Flow	**(m^3/d)**	11,610	10,106	11,199	12,693	14,273	11,976	**11,976**	From Annual Reports
Max Day Factor		**2.92**	**3.28**	**3.44**	**3.83**	**3.36**	**3.36**	**3.36**	Calculated - Max Day Flow divided by Average Day Flow
Peak Flow	**(m^3/d)**							**0**	Peak hour flows were not available
Peak Flow	**(L/s)**			Not Available				**0**	
Peak Flow Factor									

	2016	2021	2026	2031	2036	2041	Ultimate Buildout	
Population (Existing Areas)	5,178	5,178	5,178	5,178	5,178	5,178	5,178	
Population (Growth Areas)	322	626	880	1,031	1,120	1,146	5,998	
Total Population	5,501	5,804	6,059	6,209	6,299	6,324	11,177	Total Population (Hemson)
Residential (ha)	72.60	76.50	141.90	143.10	144.34	144.34	269.24	ICI development areas were assigned to planning years based on the stage of the application. Draft Approved were assigned to 2016, Legal Lots of Record to 2026, and Designated Developable to 2036. Areas are cumulative and carry from the development year, all the way through to Ultimate Buildout
Institutional (ha)	0.00	0.00	1.12	0.00	0.85	0.00	0.00	
Institutional Cummulative (ha)	0.00	0.00	1.12	1.12	1.97	1.97	1.97	
Commercial (ha)	0.00	0.00	1.50	0.00	8.21	0.00	0.00	
Commercial Cummulative (ha)	0.00	0.00	1.50	1.50	9.71	9.71	9.71	
Industrial - Walden Industrial Area - Total Undeveloped and Unserviced Land (ha)	0.00	0.00	72.0	0.0	0.0	0.0	0.0	
Industrial - Walden Industrial Area - 20% (ha)	0.00	0.00	14.4	0.0	0.0	0.0	0.0	
Industrial - Walden Industrial Area - 80% (ha)	0.00	0.00	57.6	0.0	0.0	0.0	0.0	
Industrial - Walden Industrial Area - Total Developed and Unserviced Land (ha)	0.00	0.00	0.0	100.0	0.0	0.0	0.0	
Industrial - Balance of Industrial Area (ha)	0.00	0.00	2.4	0.0	3.2	0.0	0.0	
Total Industrial (ha)*	0.00	0.00	74.41	100.00	3.19	0.00	0.00	
Industrial Cummulative - Walden Industrial Area - Total Undeveloped and Unserviced Land (ha)	0.0	0.0	72.0	72.0	72.0	72.0	72.0	
Industrial Cummulative - Walden Industrial Area - 20% (ha)	0.0	0.0	14.4	14.4	14.4	14.4	14.4	
Industrial Cummulative - Walden Industrial Area - 80% (ha)	0.0	0.0	57.6	57.6	57.6	57.6	57.6	
Industrial Cummulative - Balance of Industrial Area (ha)	0.0	0.0	2.4	2.4	5.6	5.6	5.6	
Industrial Growth Area (ha) - Cumulative	0.0	0.0	74.4	174.4	177.6	177.6	177.6	
**Includes 100 ha of land that is currently developed but not serviced (to be serviced by 2031)*								
ICI Cummulative (ha)	**0.00**	**0.00**	**77.03**	**177.03**	**189.28**	**189.28**	**189.28**	
Total Cummulative (ha)	**72.60**	**76.50**	**218.93**	**320.13**	**333.62**	**333.62**	**458.52**	

Ratio of Residential to Total Customers	0.77	0.77	0.77	0.77	0.77	0.77			This ratio is based on Water Billing Records for the area and is an approximation of the residential portion of demand.
Residential Share of Average Day Demand (m^3/d)	3059	2367	2505	2550	3269	2750			
Residential Flow Unit Rate (m^3/cap/d)	0.591	0.457	0.484	0.492	0.631	0.531	**0.450**		
Average Institutional Flow Unit Rate (m^3/ha/d)							**28.0**		CGS design standards do not suggest average rates for institutional and commercial, but require that rates be developed based on usage. In this case, water demands rates were used and assume a conservative 1:1 ratio of water to sewage.
Average Commercial Flow Unit Rate (m^3/ha/d)							**28.0**		CGS design standards do not suggest average rates for institutional and commercial, but require that rates be developed based on usage. In this case, water demands rates were used and assume a conservative 1:1 ratio of water to sewage.
Average Industrial Flow Unit Rate - Balance of Industrial Lands (m^3/ha/d)							**35.0**		CGS design standards average rate for light industrial of 35 m^3/ha/d.
Average Industrial Flow Unit Rate - Walden 20% (m^3/ha/d)							**35.0**		
Average Industrial Flow Unit Rate - Walden 80% (m^3/ha/d)							**3.0**		
Average Industrial Flow Unit Rate - Currently Developed but Unserviced Area (m^3/ha/d)							**3.0**		
Average Extraneous Flow Unit Rate (m^3/ha/d)							**6.02**		From CGS Design Standards, peak rate for new developments divided by an assumed peaking factor of 3. This factor would be applied only to new developments, which are assumed to be leak-tight, and have minimal extraneous flow.

	2016	2021	2026	2031	2036	2041	Ultimate Buildout	
Average Residential Flows (m^3/d) - Existing	**3,577**	**3,577**	**3,577**	**3,577**	**3,577**	**3,577**	**3,577**	This includes all contribution from existing ICI and infiltration. The base flow was assumed to be the average day flow to the plant for the 2011-2013 period.
Average Residential Flows (m^3/d)	**145**	**282**	**396**	**464**	**504**	**515**	**2,699**	Obtained by multiplying the projected population growth by the unit rate.
Average Institutional Flow (m^3/d)	**0**	**0**	**31**	**0**	**24**	**0**	**0**	Institutional growth area multiplied by unit flow rate.
Average Commercial Flow (m^3/d)	**0**	**0**	**42**	**0**	**230**	**0**	**0**	Commercial growth area multiplied by unit flow rate.

Average Industrial Flow - Walden Industrial Park - 20% (m^3/d)	0	0	504	504	504	504	504
Average Industrial Flow - Walden Industrial Park - 80% (m^3/d)	0	0	173	173	173	173	173
Average Industrial Flow - Walden Industrial Park - Currently Developed but Locally Serviced Area (m^3/d)	0	0	0	300	300	300	300
Average Industrial Flow - Balance of Industrial Area (m^3/d)	0	0	84	84	196	196	196
Average Extraneous Flow (m^3/day)	437	460	1,317	1,926	2,007	2,007	2,759
Average Day Flow (m^3/d)	4,159	4,319	6,125	7,028	7,515	7,273	10,208
Max Day Flow (m^3/d)	13,991	14,530	20,605	23,644	25,282	24,466	34,341

Industrial growth area multiplied by unit flow rate.

ALTERNATIVE CALCULATION METHOD

Per Capita Flow (m3/cap/day)	0.768	0.595	0.629	0.641	0.821	0.691	0.691
Average Day Flow (m^3/d)							
Max Day Flow (m^3/d)							

2016	2021	2026	2031	2036	2041	Ultimate Buildout
3800	4009	4185	4289	4351	4368	7720
12,782	13,489	14,080	14,430	14,637	14,696	25,972

Comments

Multiplying the total population by the consolidated per capita flow factor.

SENSITIVITY ANALYSIS

Analyze sensitivity of forecasted flows to unit rate

		Average Day Flow (m^3/d)						Ultimate Buildout
	Unit Rate (m^3/cap/d)	**2016**	**2021**	**2026**	**2031**	**2036**	**2041**	**2061**
Base Scenario - Residential Historical Maximum	0.531	4,159	4,319	6,125	7,028	7,515	7,273	10,208
Combined Historical Maximum	0.691	4,236	4,470	6,337	7,276	7,785	7,548	11,652
City Standards for Lively	0.410	4,146	4,294	6,090	6,987	7,470	7,227	9,968
City Standards for Walden	0.450	4,159	4,319	6,125	7,028	7,515	7,273	10,208

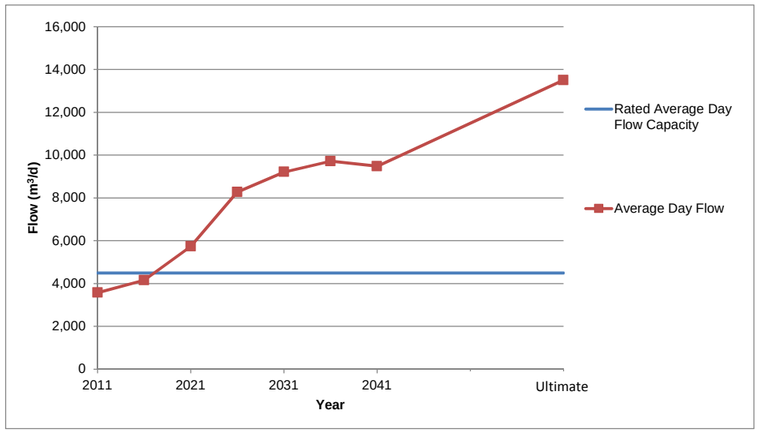
Analyze sensitivity of forecasted flows to max day factor

		Max Day Flow (m^3/d)							Ultimate Buildout
	Max Day Peaking Factor	**2016**	**2021**	**2026**	**2031**	**2036**	**2041**	**2061**
Base Scenario - Historical Max	3.48	14,455	15,012	21,289	24,429	26,120	25,278	35,480
Historical Average	3.83	13,991	14,530	20,605	23,644	25,282	24,466	34,341

CAPACITY CHECK

								Ultimate Buildout
	2011	**2016**	**2021**	**2026**	**2031**	**2036**	**2041**	**2061**
Rated WPCP ADF Capacity (m^3/d)	4,500	4,500	4,500	4,500	4,500	4,500	4,500	4,500
WPCP Peak Capacity (m^3/d)	8,000	8,000	8,000	8,000	8,000	8,000	8,000	8,000
Average Day Flow (m^3/d) - Walden	3,577	4,159	4,319	6,125	7,028	7,515	7,273	10,208
Average Day Flow (m3/d) - Lively			1,421	2,159	2,190	2,208	2,214	3,305
Total Average Day Flow To Walden WWTP	3,577	4,159	5,740	8,284	9,218	9,723	9,486	13,513
Maximum Day Flow (m^3/d) - Walden	11,976	13,991	14,530	20,605	23,644	25,282	24,466	34,341

Proposed capacity for the Walden WWTP from Lively/Walden Class EA ESR, page 75



Sudbury (incl. Garson) - Wastewater Flow Forecasts

		2009	2010	2011	2012	2013	Summary	Design Criterion	Comments
Average Day Flow	**(m^3/d)**	65,033	55,181	58,207	56,233	64,710	59,873	**59,873**	From Annual Reports
Max Day Flow	**(m^3/d)**	228,500	231,700	258,400	179,200	257,300	231,020	**231,020**	From Annual Reports
Max Day Factor		**3.51**	**4.20**	**4.44**	**3.19**	**3.98**	**3.86**	**3.86**	Calculated - Max Day Flow divided by Average Day Flow
Peak Flow	**(m^3/d)**	Not Available							Peak hour flows were not available
Peak Flow	**(L/s)**								
Peak Flow Factor									

2016	2021	2026	2031	2036	2041	Ultimate Buildout	
Population (Existing Areas)	**91,246**	**91,246**	**91,246**	**91,246**	**91,246**	**91,246**	**91,246**	All populations includes Garson
Population (Growth Areas)	936	2,145	3,394	4,107	4,550	4,493	30,641	
Total Population	92182	93391	94640	95352	95795	95739	121886	Total Population (Hemson)
Residential (ha)	39.27	47.94	68.66	102.51	125.88	135.96	466.44	ICI development areas were assigned to planning years based on the stage of the application. Draft Approved were assigned to 2016, Legal Lots of Record to 2026, and Designated Developable to 2036.
Institutional (ha)	0.00	0.00	9.54	9.54	9.54	9.54	9.54	
Commercial (ha)	0.00	0.00	23.09	23.09	99.93	99.93	99.93	
Industrial (ha)	146.32	146.32	217.28	217.28	388.99	388.99	388.99	Areas are cumulative and carry from the development year, all the way through to Ultimate Buildout
ICI (ha)	**146.32**	**146.32**	**249.91**	**249.91**	**498.46**	**498.46**	**498.46**	
	185.59	**194.26**	**318.57**	**352.42**	**624.34**	**634.42**	**964.90**	

Ratio of Residential to Total Customers	0.73	0.73	0.73	0.73	0.73	0.73		This ratio is based on Water Billing Records for the area and is an approximation of the residential portion of demand.
Residential Share of Average Day Demand (m^3/d)	47690	40466	42685	41237	47453	43906		
Residential Flow Unit Rate (m^3/cap/d)	0.523	0.443	0.468	0.452	0.520	0.481	**0.500**	
Average Institutional Flow Unit Rate (m^3/ha/d)							**28.0**	CGS design standards do not suggest average rates for institutional and commercial, but require that rates be developed based on usage. In this case, water demands rates were used and assume a conservative 1:1 ratio of water to sewage.
Average Commercial Flow Unit Rate (m^3/ha/d)							**28.0**	CGS design standards do not suggest average rates for institutional and commercial, but require that rates be developed based on usage. In this case, water demands rates were used and assume a conservative 1:1 ratio of water to sewage.
Average Industrial Flow Unit Rate (m^3/ha/d)							**35.0**	CGS design standards average rate for light industrial of 35 m^3/ha/d.
Average Extraneous Flow Unit Rate (m^3/ha/d)							**5.76**	From CGS Design Standards, peak rate for new developments divided by an assumed peaking factor of 3. This factor would be applied only to new developments, which are assumed to be leak-tight, and have minimal extraneous flow.

2016	2021	2026	2031	2036	2041	Ultimate Buildout	
Average Residential Flows (m^3/d) - Existing	**59,873**	**59,873**	**59,873**	**59,873**	**59,873**	**59,873**	**59,873**	This includes all contribution from existing ICI and infiltration. The base flow was assumed to be the average day flow to the plant for the 2011-2013 period.
Average Residential Flows (m^3/d)	**468**	**1,072**	**1,697**	**2,053**	**2,275**	**2,246**	**15,320**	Obtained by multiplying the projected population growth by the unit rate.
Average Institutional Flow (m^3/d)	**0**	**0**	**267**	**267**	**267**	**267**	**267**	Institutional growth area multiplied by unit flow rate.
Average Commercial Flow (m^3/d)	**0**	**0**	**647**	**647**	**2,798**	**2,798**	**2,798**	Commercial growth area multiplied by unit flow rate.
Average Industrial Flow (m^3/d)	**5,121**	**5,121**	**7,605**	**7,605**	**13,615**	**13,615**	**13,615**	Industrial growth area multiplied by unit flow rate.
Average Extraneous Flow (m^3/day)	**1,069**	**1,119**	**1,835**	**2,030**	**3,596**	**3,654**	**5,558**	
Average Day Flow (m^3/d)	**66,531**	**67,185**	**71,923**	**72,474**	**82,424**	**82,453**	**97,431**	
Max Day Flow (m^3/d)	**257,006**	**259,534**	**277,836**	**279,966**	**318,399**	**318,513**	**376,371**	

ALTERNATIVE CALCULATION METHOD

Per Capita Flow (m^3/cap/day)	0.713	0.605	0.638	0.616	0.709	0.656	0.656
Average Day Flow (m^3/d)	60487	61280	62100	62567	62858	62821	79978
Max Day Flow (m^3/d)	233,659	236,723	239,888	241,695	242,818	242,674	308,952

2016	2021	2026	2031	2036	2041	Ultimate Buildout

Comments

Multiplying the total population by the consolidated per capita flow factor.

SENSITIVITY ANALYSIS

Analyze sensitivity of forecasted flows to unit rate

		Average Day Flow (m^3/d)						Ultimate Buildout
	Unit Rate (m^3/cap/d)	2016	2021	2026	2031	2036	2041	2061
Base Scenario - Residential Historical Maximum	0.500	66,531	67,185	71,923	72,474	82,424	82,453	97,431
Combined Historical Maximum	0.656	66,677	67,520	72,453	73,116	83,134	83,155	102,216
City Standards	0.410	66,447	66,992	71,618	72,105	82,014	82,049	94,673

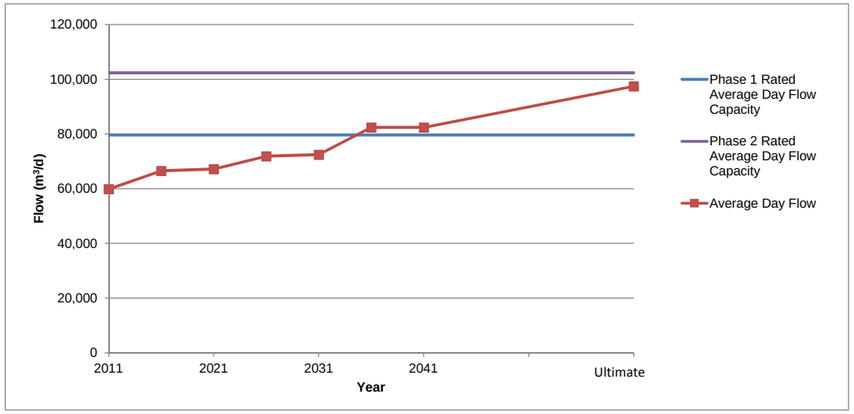
Analyze sensitivity of forecasted flows to max day factor

		Max Day Flow (m^3/d)						Ultimate Buildout
	Max Day Peaking Factor	2016	2021	2026	2031	2036	2041	2061
Base Scenario - Historical Max	3.86	257,006	259,534	277,836	279,966	318,399	318,513	376,371
Historical Average	3.86	257,006	259,534	277,836	279,966	318,399	318,513	376,371

CAPACITY CHECK

								Ultimate Buildout
	2011	2016	2021	2026	2031	2036	2041	2061
Rated WPCP ADF Capacity (m^3/d)	79,625	79,625	79,625	79,625	79,625	79,625	79,625	79,625
Average Day Flow (m^3/d)	59,873	66,531	67,185	71,923	72,474	82,424	82,453	97,431
Maximum Day Flow (m^3/d)	231,020	257,006	259,534	277,836	279,966	318,399	318,513	376,371
Phase 2 WPCP ADF Capacity (m^3/d)	102,375	102,375	102,375	102,375	102,375	102,375	102,375	102,375

Capacity



Valley East - Wastewater Flow Forecasts

		2009	2010	2011	2012	2013	Summary	Design Criterion	Comments
Average Day Flow	**(m^3/d)**	6,893	4,958	4,928	4,566	5,724	5,414	**5,414**	From Annual Reports
Max Day Flow	**(m^3/d)**	23,060	6,370	14,450	8,580	22,844	15,061	**15,061**	From Annual Reports
Max Day Factor		**3.35**	**1.28**	**2.93**	**1.88**	**3.99**	**2.69**	**2.69**	Calculated - Max Day Flow divided by Average Day Flow
Peak Flow	**(m^3/d)**							**0**	Peak hour flows were not available
Peak Flow	**(L/s)**				Not Available			**0**	
Peak Flow Factor									

2016	2021	2026	2031	2036	2041	Ultimate Buildout	
19,119	19,119	19,119	19,119	19,119	19,119	19,119	
526	1,100	1,609	1,910	2,086	2,113	12,350	
19644	20219	20728	21028	21205	21231	31469	Total Population (Hemson)
3.00	9.51	11.00	13.72	13.72	13.72	271.72	ICI development areas were assigned to planning years based on the stage of the application. Draft Approved were assigned to 2016, Legal Lots of Record to 2026, and Designated Developable to 2036.
		4.64	4.64	4.64	4.64	4.64	
		5.25	5.25	13.43	13.43	13.43	Areas are cumulative and carry from the development year, all the way through to Ultimate Buildout
		23.02	23.02	102.14	102.14	102.14	
0.00	**0.00**	**32.91**	**32.91**	**120.21**	**120.21**	**120.21**	
3.00	**9.51**	**43.91**	**46.63**	**133.93**	**133.93**	**391.93**	

		2009	2010	2011	2012	2013	Summary	Design Criterion	Comments
Population (Existing Areas)		**19,119**	**19,119**	**19,119**	**19,119**	**19,119**	**19,119**	**19,119**	
Population (Growth Areas)									
Total Population									
Residential (ha)									
Institutional (ha)									
Commercial (ha)									
Industrial (ha)									
ICI (ha)									
Total (ha)									
Ratio of Residential to Total Customers		0.86	0.86	0.86	0.86	0.86	0.86		This ratio is based on Water Billing Records for the area and is an approximation of the residential portion of demand.
Residential Share of Average Day Demand	**(m^3/d)**	5951	4281	4255	3942	4942	4674		
Residential Flow Unit Rate	**(m^3/cap/d)**	0.311	0.224	0.223	0.206	0.258	0.244	**0.250**	
Average Institutional Flow Unit Rate	**(m^3/ha/d)**							**28.0**	CGS design standards do not suggest average rates for institutional and commercial, but require that rates be developed based on usage. In this case, water demands rates were used and assume a conservative 1:1 ratio of water to sewage.
Average Commercial Flow Unit Rate	**(m^3/ha/d)**							**28.0**	CGS design standards do not suggest average rates for institutional and commercial, but require that rates be developed based on usage. In this case, water demands rates were used and assume a conservative 1:1 ratio of water to sewage.
Average Industrial Flow Unit Rate	**(m^3/ha/d)**							**35.0**	CGS design standards average rate for light industrial of 35 m^3/ha/d.
Average Extraneous Flow Unit Rate	**(m^3/ha/d)**							**11.23**	From CGS Design Standards, peak rate for new developments divided by an assumed peaking factor of 3. This factor would be applied only to new developments, which are assumed to be leak-tight, and have minimal extraneous flow.

2016	2021	2026	2031	2036	2041	Ultimate Buildout	
5,414	**5,414**	**5,414**	**5,414**	**5,414**	**5,414**	**5,414**	This includes all contribution from existing ICI and infiltration. The base flow was assumed to be the average day flow to the plant for the 2011-2013 period.
131	**275**	**402**	**477**	**522**	**528**	**3,088**	Obtained by multiplying the projected population growth by the unit rate.
0	**0**	**130**	**130**	**130**	**130**	**130**	Institutional growth area multiplied by unit flow rate.
0	**0**	**147**	**147**	**376**	**376**	**376**	Commercial growth area multiplied by unit flow rate.
0	**0**	**806**	**806**	**3,575**	**3,575**	**3,575**	Industrial growth area multiplied by unit flow rate.
34	**107**	**493**	**524**	**1,504**	**1,504**	**4,403**	
5,579	**5,796**	**7,392**	**7,498**	**11,521**	**11,527**	**16,985**	
14,988	**15,570**	**19,858**	**20,142**	**30,950**	**30,968**	**45,630**	

Average Residential Flows	**(m^3/d) - Existing**
Average Residential Flows	**(m^3/d)**
Average Institutional Flow	**(m^3/d)**
Average Commercial Flow	**(m^3/d)**
Average Industrial Flow	**(m^3/d)**
Average Extraneous Flow	**(m^3/day)**
Average Day Flow	**(m^3/d)**
Max Day Flow	**(m^3/d)**

ALTERNATIVE CALCULATION METHOD

Per Capita Flow (m3/cap/day)	0.361	0.259	0.258	0.239	0.299	0.283	0.283

	2016	2021	2026	2031	2036	2041	Ultimate Buildout
Average Day Flow (m^3/d)	5563	5725	5869	5955	6005	6012	8911
Max Day Flow (m^3/d)	14,944	15,381	15,768	15,997	16,131	16,151	23,939

Comments

Multiplying the total population by the consolidated per capita flow factor.

SENSITIVITY ANALYSIS

Analyze sensitivity of forecasted flows to unit rate

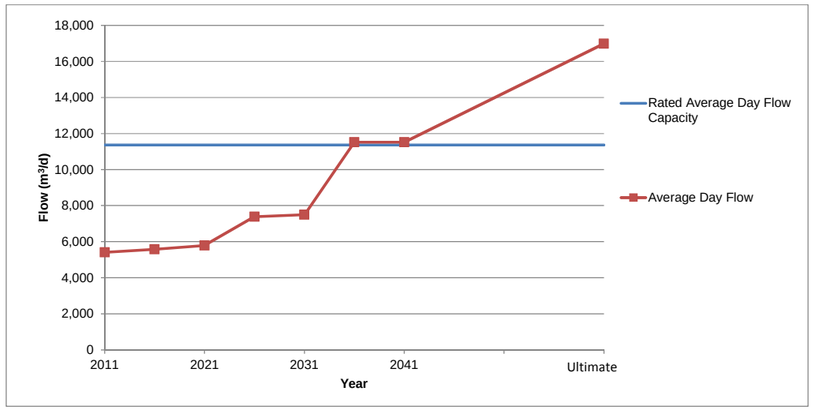
		Average Day Flow (m^3/d)						Ultimate Buildout
	Unit Rate ($m^3/cap/d$)	**2016**	**2021**	**2026**	**2031**	**2036**	**2041**	**2061**
Base Scenario - Residential Historical Maximum	0.244	5,579	5,796	7,392	7,498	11,521	11,527	16,985
Combined Historical Maximum	0.283	5,596	5,832	7,445	7,561	11,590	11,597	17,394
City Standards	0.360	5,637	5,917	7,569	7,708	11,750	11,760	18,343

Analyze sensitivity of forecasted flows to max day factor

		Max Day Flow (m^3/d)						Ultimate Buildout
	Max Day Peaking Factor	**2016**	**2021**	**2026**	**2031**	**2036**	**2041**	**2061**
Base Scenario - Historical Max	2.52	14,069	14,615	18,641	18,907	29,053	29,069	42,832
Historical Average	3.99	14,988	15,570	19,858	20,142	30,950	30,968	45,630

CAPACITY CHECK

								Ultimate Buildout
	2011	**2016**	**2021**	**2026**	**2031**	**2036**	**2041**	**2061**
Rated WPCP ADF Capacity (m^3/d)	11,365	11,365	11,365	11,365	11,365	11,365	11,365	11,365
Average Day Flow (m^3/d)	5,414	5,579	5,796	7,392	7,498	11,521	11,527	16,985
Maximum Day Flow (m^3/d)	15,061	14,988	15,570	19,858	20,142	30,950	30,968	45,630



Wahnapitae - Wastewater Flow Forecasts

		2009	2010	2011	2012	2013	Summary	Design Criterion	Comments
Average Day Flow	**(m^3/d)**	1,321	884	565	556	689	832	**832**	From Annual Reports
Max Day Flow	**(m^3/d)**	Not Available						**3,051**	This was estimated by multiplying the average day demand by the estimated maximum day factor.
Max Day Factor								**3.67**	This was estimated using the factor for nearby Coniston
Peak Flow	**(m^3/d)**							**0**	Peak hour flows were not available
Peak Flow	**(L/s)**							**0**	
Peak Flow Factor									

	2016	2021	2026	2031	2036	2041	Ultimate Buildout	
Population (Existing Areas)	1,397	1,397	1,397	1,397	1,397	1,397	1,397	
Population (Growth Areas)	5	11	16	19	21	21	82	
Total Population	1402	1408	1413	1416	1418	1418	1479	Total Population (Hemson)
Residential (ha)	0.41	0.93	1.38	1.76	1.94	1.94	2.09	ICI development areas were assigned to planning years based on the stage of the application. Draft Approved were assigned to 2016, Legal Lots of Record to 2026, and Designated Developable to 2036.
Institutional (ha)								
Commercial (ha)								
Industrial (ha)								
ICI (ha)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	Areas are cumulative and carry from the development year, all the way through to Ultimate Buildout
Total (ha)	0.41	0.93	1.38	1.76	1.94	1.94	2.09	

Ratio of Residential to Total Customers	0.82	0.82	0.82	0.82	0.82	0.82		This ratio is based on Water Billing Records for the area and is an approximation of the residential portion of demand.
Residential Share of Average Day Demand (m^3/d)	1082	724	463	455	564	681		
Residential Flow Unit Rate (m^3/cap/d)	0.775	0.518	0.331	0.326	0.404	0.471	**0.500**	
Average Institutional Flow Unit Rate (m^3/ha/d)							**28.0**	CGS design standards do not suggest average rates for institutional and commercial, but require that rates be developed based on usage. In this case, water demands rates were used and assume a conservative 1:1 ratio of water to sewage.
Average Commercial Flow Unit Rate (m^3/ha/d)							**28.0**	CGS design standards do not suggest average rates for institutional and commercial, but require that rates be developed based on usage. In this case, water demands rates were used and assume a conservative 1:1 ratio of water to sewage.
Average Industrial Flow Unit Rate (m^3/ha/d)							**35.0**	CGS design standards average rate for light industrial of 35 m^3/ha/d.
Average Extraneous Flow Unit Rate (m^3/ha/d)							**11.23**	The CGS design standards do not have an extraneous flow value for this community. The value for nearby Coniston was used instead. From CGS Design Standards, peak rate for new developments divided by an assumed peaking factor of 3. This factor would be applied only to new developments, which are assumed to be leak-tight, and have minimal extraneous flow.

	2016	2021	2026	2031	2036	2041	Ultimate Buildout	
Average Residential Flows (m^3/d) - Existing	832	832	832	832	832	832	832	This includes all contribution from existing ICI and infiltration. The base flow was assumed to be the average day flow to the plant for the 2011-2013 period.
Average Residential Flows (m^3/d)	3	5	8	10	10	11	41	Obtained by multiplying the projected population growth by the unit rate.
Average Institutional Flow (m^3/d)	0	0	0	0	0	0	0	Institutional growth area multiplied by unit flow rate.
Average Commercial Flow (m^3/d)	0	0	0	0	0	0	0	Commercial growth area multiplied by unit flow rate.
Average Industrial Flow (m^3/d)	0	0	0	0	0	0	0	Industrial growth area multiplied by unit flow rate.
Average Extraneous Flow (m^3/day)	5	10	16	20	22	22	23	
Average Day Flow (m^3/d)	839	847	855	861	864	864	896	
Max Day Flow (m^3/d)	3,078	3,110	3,138	3,159	3,170	3,170	3,288	

ALTERNATIVE CALCULATION METHOD

	2016	2021	2026	2031	2036	2041	Ultimate Buildout
Per Capita Flow (m3/cap/day)	0.946	0.633	0.405	0.398	0.493	0.575	0.575
Average Day Flow (m^3/d)	806	809	812	814	815	815	850
Max Day Flow (m^3/d)	2,958	2,970	2,981	2,987	2,991	2,991	3,119

Comments

Multiplying the total population by the consolidated per capita flow factor.

SENSITIVITY ANALYSIS

Analyze sensitivity of forecasted flows to unit rate

	Unit Rate (m^3/cap/d)	Average Day Flow (m^3/d) 2016	2021	2026	2031	2036	2041	Ultimate Buildout 2061
Base Scenario - MOE Guidelines Lower Limit of Typical Values	0.225	839	847	855	861	864	864	896
Combined Historical Maximum	0.575	839	848	856	862	865	865	902
Residential Hsitorical Maximum	0.471	839	847	855	860	863	863	893
City Standards	Not Provided							

Analyze sensitivity of forecasted flows to max day factor

	Max Day Peaking Factor	Max Day Flow (m^3/d) 2016	2021	2026	2031	2036	2041	Ultimate Buildout 2061
Base Scenario - Historical Max	Data Not Available							
Historical Average	Data Not Available							

CAPACITY CHECK

	2011	2016	2021	2026	2031	2036	2041	Ultimate Buildout 2061
Rated Average Day Flow Capacity (m^3/d)	1,246	1,246	1,246	1,246	1,246	1,246	1,246	1,246
Average Day Flow (m^3/d)	832	839	847	855	861	864	864	896
Maximum Day Flow (m^3/d)	3,051	3,078	3,110	3,138	3,159	3,170	3,170	3,288

From C of A (2011)

