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Water Servicing Strategy

LAGOON CITY/BRECHIN AND SOUTH RAMARA WATER SYSTEMS

Township of Ramara

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Document Contents

1	Introduction	1
1.1	Project Description and Objectives	1
1.2	Background Information.....	1
2	Lagoon City and Brechin Assessment.....	2
2.1	Lagoon City WTP Capacity	2
2.2	Historical Water Demands.....	3
2.3	WTP Residual Capacity	4
2.4	WTP Production and Raw Water Quality	4
2.5	Storage Capacity	5
2.6	Projected Growth	5
2.7	Lagoon City/Brechin Servicing Alternatives	7
3	South Ramara Assessment.....	10
3.1	South Ramara WTP rated Capacity	10
3.2	Historical Water Demands.....	10
3.3	WTP Residual Capacity	11
3.4	Storage Capacity	12
3.5	Servicing Needs	12
3.6	South Ramara Servicing Alternatives	12
4	Summary.....	14
4.1	Recommendations	14



Tables

Table 1: Lagoon City WTP Process and Pumping Rated Capacities.....	2
Table 2: Lagoon City WTP Historical Flows	3
Table 3: Lagoon City WTP Residual Capacity in 2023	4
Table 4: Projected Growth in Lagoon City and Brechin	5
Table 5: Servicing Alternatives for Lagoon City/Brechin	9
Table 6: South Ramara WTP Process and Pumping Rated Capacities.....	10
Table 7: South Ramara WTP Historical Flows	11
Table 8: South Ramara WTP Residual Capacity.....	12
Table 9: Servicing Alternatives for South Ramara	13

Figures

Figure 1: Lagoon City & Brechin Servicing Alternative 1.....	16
Figure 2: Lagoon City & Brechin Servicing Alternative 2.....	17
Figure 3: Lagoon City & Brechin Servicing Alternative 3.....	18
Figure 4: South Ramara Servicing Alternative 1	19
Figure 5: South Ramara Servicing Alternative 2	20

Appendices

Appendix A: Lagoon City & Brechin Calculations
Appendix B: South Ramara Calculations



1 Introduction

1.1 PROJECT DESCRIPTION AND OBJECTIVES

Tatham Engineering Limited (Tatham) was retained by the Township of Ramara (Township) to conduct a water servicing strategy study to assess the feasibility and costs of expanding the water service areas of the Lagoon City/Brechin and South Ramara municipal drinking water systems.

Expansion of the service areas for the Lagoon City/Brechin and South Ramara water systems is being considered to service new development and currently unserved homes and to increase the number of water customers, thereby reducing per capita operating costs. The water servicing study considered if and how the water systems could be extended to service currently unserved and undeveloped lands in Brechin, in the corridor between Brechin and Lagoon City, and on the lakeshore between Lagoon City and South Ramara.

This report presents the following:

- assessment of the available residual capacities at the Brechin and Lagoon City (Lagoon City) water treatment plant (WTP) and at the South Ramara WTP; and
- assessment of servicing alternatives with and without WTP expansions.

1.2 BACKGROUND INFORMATION

The following documents were referenced in the preparation of this report:

- Brechin and Lagoon City Drinking Water System Annual Water Reports, Ontario Clean Water Agency (OCWA).
- South Ramara Drinking Water System Annual Water Reports, OCWA.
- Brechin and Lagoon City Drinking Water System Drinking Water Works Permit (DWWP).
- South Ramara Drinking Water System DWWP.
- Lagoon City/Brechin Water Works Engineer's Report, C. C. Tatham and Associates Ltd., May 2001.
- Heritage Farms Water Works Engineer's Report, C. C. Tatham and Associates Ltd., May 2001.
- South Ramara Water Works Upgrades and Expansion Design Brief, C. C. Tatham and Associates Ltd., December 2003.



2 Lagoon City and Brechin Assessment

2.1 LAGOON CITY WTP CAPACITY

The rated capacity of the Lagoon City WTP is 4,000 m³/day (Maximum Day Demand). The rated capacities and descriptions of the WTP process and pumping components are summarized in Table 1. A detailed list is provided in Appendix A.

The WTP's production capacity is decreased during periods when the raw water quality deteriorates. This is discussed further in Section 2.4.

Table 1: Lagoon City WTP Process and Pumping Rated Capacities

	TOTAL RATED CAPACITY	DESCRIPTION
Raw Water Intake	4,000 m ³ /day (PTTW)	485 m of 300 mm diameter pipe
Low Lift Pumping ¹	4,058 m ³ /day	3 pumps, one pump rated at 2,435 m ³ /day, and two pumps rated at 2,029 m ³ /day each, all at 10.4 m TDH
Flocculation Tanks ²	50.8 m ³	4 spiral flow flocculation tanks each 12.7 m ³
Filtration	4,000 m ³ /day	2 filter-absorber units
Filter Backwash Pumping	7,514 m ³ /day	Single 7,514 m ³ /day backwash pump at 9.1 m TDH
High Lift Pumping ¹	9,353 m ³ /day	5 pumps, one pump rated at 1,944 m ³ /day, one pump rated at 1,145 m ³ /day, one pump rated at 1,728 m ³ /day, and two pumps rated at 4,536 m ³ /day each, all at 70 m TDH
Clearwell ³	1,091 m ³ (965 m ³)	Clearwell located beneath the WTP
Emergency Power	175 kW	Diesel engine generator with 2,775 L fuel tank

1. Total rated capacity for pumps is the total rated capacity of all pumps with the largest pump out of service.

2. Total rated capacity for tanks is the total volume of all units.

3. Clearwell capacity consists of chlorine contact volume (965 m³) plus HLP operating volume (126 m³).

4. Information obtained from the Brechin and Lagoon City DWS DWWP.



2.2 HISTORICAL WATER DEMANDS

A summary of historical water demands is provided in Table 2. The most recent five-year Average Day Demand (ADD) was 722 m³/day, corresponding to a per capita consumption of 272 L/p/day. The Maximum Day Demand (MDD) in the past five years was 1,798 m³/day.

Populations for Lagoon City and Brechin were determined using population densities of 2 ppu and 2.6 ppu respectively, and assuming there has been no population growth in Lagoon City from 2012 to 2021 and steady growth in Brechin. As per the 2023 Annual Report, the estimated current (2023) population is 406 in Brechin and 2,264 in Lagoon City.

Table 2: Lagoon City WTP Historical Flows

YEAR	ADD (m ³ /day)	MDD (m ³ /day)	MAXIMUM DAY FACTOR	POPULATION (BRECHIN AND LAGOON CITY)	AVERAGE CONSUMPTION (L/p/day)
2012	732	1,247	1.70	2,593	282
2013	770	1,411	1.83	2,596	297
2014	783	1,239	1.58	2,596	302
2015	781	1,670	2.14	2,604	300
2016	837	1,546	1.85	2,611	321
2017	699	1,207	1.73	2,624	266
2018	870	1,829	2.10	2,635	330
2019	893	1,798	2.01	2,637	339
2020	676	1,333	1.97	2,650	255
2021	684	1,090	1.59	2,650	258
2022	719	1,246	1.73	2,664	270
2023	636	1,072	1.69	2,670	238
5 Year Avg/Max	722	1,798	2.01	-	272



2.3 WTP RESIDUAL CAPACITY

Table 3 presents the residual capacity of the Lagoon City WTP for the current and allocated populations. Calculations are provided in Appendix A.

In 2023, the WTP had a residual capacity of 2,202 m³/day (MDD). As per the 2023 Annual report, an additional population of 205 (79 additional units at 2.6 ppu) has been allocated to the WTP. Using the historical per capita water consumption of 272 L/p/day and maximum day factor of 2.01, this additional population will utilize 112 m³/day of capacity.

Therefore, the residual unallocated capacity of the WTP is 2,090 m³/day, which is equivalent to approximately 1,460 residential units at 2.6 ppu.

Table 3: Lagoon City WTP Residual Capacity in 2023

	POPULATION	MDD (m ³ /day)	WTP RESIDUAL CAPACITY (m ³ /day)
Existing	2,670	1,798	2,202
Additional Allocation	205	112	- 112
Total Allocated	2,875	1,910	2,090

2.4 WTP PRODUCTION AND RAW WATER QUALITY

The Lagoon City WTP has periodically experienced high raw water turbidity events that have reduced its treated water production capacity. These high turbidity events typically occurred in the winter or spring when temperatures rose quickly and there was a major thaw that caused significant runoff to the lake from the canals and streams. The high raw water turbidity required the WTP filters to be backwashed at a higher frequency to meet the treated water quality requirements. This reduced filtration time and utilized more treated water for backwashing, which reduced the WTP daily production rate. The most recent high turbidity event occurred between December 24, 2022, and January 14, 2023, due to a winter thaw. Raw water turbidity spiked to 40 NTU. The capacity of both filters was reduced by about 75% for two weeks. Treated water production was reduced significantly. Although water demands were met, the required water levels in the WTP clearwell and Brechin standpipe were difficult to maintain.

WTP operation and production capacity during high turbidity events will need to be investigated and addressed to ensure a reliable supply of treated water and maintain the available WTP residual capacity for service extensions. Optimization of the pre-treatment and the filtration systems and review of operational practices are required to mitigate the effects of occasional



deterioration in raw water quality. Review and costing of WTP optimization measures are outside the scope of this study.

2.5 STORAGE CAPACITY

The Lagoon City drinking water system has two treated water storage facilities: the in-ground clearwell at the WTP and the Brechin standpipe. The WTP clearwell provides a storage volume of 965 m³ for chlorine contact time, and the Brechin standpipe has a storage volume of 945 m³, for a total storage capacity of 1,910 m³.

Using the storage calculation in the MECP Design Guidelines for Drinking Water Systems (2008), the existing water storage tanks are adequate to provide fire protection, equalization, and emergency storage for a population of approximately 3,520.

There is therefore adequate storage for the existing allocated population and an additional population of 645, which corresponds to approximately 248 units at 2.6 ppu.

2.6 PROJECTED GROWTH

Through discussion with Township staff, the projected population growth was determined to consist of the developments listed below, and as shown on Figure 3. The projected growth population is 7,355, as summarized in Table 4.

Table 4: Projected Growth in Lagoon City and Brechin

DEVELOPMENT LANDS	GROSS AREA (ha)	RESIDENTIAL OR EQUIVALENT UNITS	EQUIVALENT POPULATION
Lagoon City Vacant Lands – Paradise Blvd	4	80	160
Vacant Lands South of Lagoon City STP	3	60	120
Lakeshore Drive to Concession Road 3	14.9	90	180
OPA 17 Addition	59	1,328	3,453
Northwest Subdivision	15	338	879
Brechin Subdivision	27	550	1,430
Ramara Road 47 Commercial	9.23	65	169
2175 Highway 12 Commercial	2.64	19	49
Ramara Industrial Park	18.21	128	333
2312 Concession Road 4	11.2	224	582
Totals	164.18	2,882	7,355



Unless otherwise specified the following assumptions were used:

- Residential unit density of 30 units per hectare of net area.
- 25% of the gross land area of each site is undevelopable.
- Using a commercial/industrial water consumption rate of 10 m³/ha/day and a MDD for future residential units of 1,424 L/unit/day, each gross hectare of commercial/industrial land is equivalent to 7 residential units.
- Populations are based on densities of 2.0 ppu for Lagoon City and 2.6 ppu for Brechin.

Lagoon City Vacant Lands

Vacant serviced residential lands within the Lagoon City service area consisting of:

- Paradise Boulevard lots: 80 units on approximately 4 ha; and
- Development area south of Lagoon City STP: 60 units on approximately 3 ha.

Lakeshore Drive South to Concession Road 3

Approximately 14.9 ha area consisting of:

- 22 vacant residential lots; and
- 68 existing unserviced homes.

OPA 17 Addition

The OPA 17 Addition consists of approximately 59 ha immediately north of Ramara Road 47 and west of the CN railway. Part of the Lagoon City/Brechin service area, and created as part of a land-swap, the site is assumed to consist of:

- 44.25 ha of developable land (75% of 59 ha); for
- 1,328 residential units.

Northwest Subdivision

The Northwest Subdivision is an approximately 15 ha parcel located in the northwest corner of the Brechin planning area. The site is assumed to consist of:

- 11.25 ha of developable land (75% of 15 ha); for
- 338 residential units.



Brechin Subdivision

The Brechin Subdivision covers approximately 27 ha at 2123 Concession Road 4, within the Brechin planning area. The site is assumed to consist of 550 residential units.

Ramara Road 47 Commercial

The Ramara Road 47 commercial area consists of several lots located in the triangular area bounded by Ramara Road 47, Highway 12, and the CN Railway. The lots and the approximate gross area of each lot are as follows:

- Brechin Park (2.53 ha)
- 3251 Ramara Road 47 (1.92 ha)
- 2226 Highway 12 (0.41 ha)
- Vacant lot south of 2202 Highway 12 (4.37 ha).

The total combined gross area is approximately 9.23 ha, equivalent to 65 residential units.

2175 Highway 12 Commercial

2175 Highway 12 has an approximate gross area of 2.64 ha, equivalent to 19 residential units.

Ramara Industrial Park

The Ramara Industrial Park is in the southern part of the Brechin planning area. The total gross area of the vacant lots within the Park is approximately 18.21 ha, equivalent to 128 residential units.

2312 Concession Road 4

2132 Concession Road 4 has an approximate gross area of 11.2 ha, equivalent to 224 residential units.

2.7 LAGOON CITY/BRECHIN SERVICING ALTERNATIVES

Three servicing alternatives for the Lagoon City/Brechin servicing area are presented below and on Figures 1, 2, and 3. The servicing alternatives were developed to show how much of the projected growth could be serviced by the residual capacity of the existing WTP and storage infrastructure, and to identify when expansions will be required.

- Alternative 1 presents the servicing of growth using the available capacity of the existing WTP and storage infrastructure.



- Alternative 2 shows the additional growth that could be serviced by increasing only the water storage volume.
- Alternative 3 presents the servicing of all projected growth if both the WTP and storage facilities are expanded.

Alternative 1 – Growth Serviced with Existing WTP and Existing Storage

The available treated water storage capacity in the Brechin standpipe and WTP clearwell limits the growth that could be accommodated with the existing water infrastructure. The existing storage volume is sufficient for an additional population of 645, which is equivalent to 248 additional residential units at 2.6 ppu (9% of the total projected growth). The storage calculation is based on providing a fire flow of 38 L/s for 2 hours, which was the design basis for the WTP clearwell and Brechin standpipe.

The residual storage capacity equivalent of 248 units could be utilized by the vacant serviced residential lands within Lagoon City (140 units), the Lakeshore Drive service extension (90 units), plus an additional 18 units.

An additional 248 units would increase the existing and allocated MDD by 353 m³/day, to 2,263 m³/day, which is approximately 56% of the WTP rated capacity.

Alternative 1a – Growth Serviced with WTP Clearwell Upgrades

The Lagoon City WTP could be upgraded to increase the portion of the clearwell volume that is available for storage. This would be achieved by adding baffles in the clearwell, which would increase the effective chlorine contact time and thus reduce the required dedicated chlorine contact volume. This clearwell upgrade would increase the available equalization/fire storage by 386 m³, which would be sufficient to increase the number of additional units from 248 units (Alternative 1 above) to 348 units.

Alternative 2 – Growth Serviced with Additional Storage and No WTP Expansion

The residual capacity of the Lagoon City WTP (2,090 m³/day) could service an additional population of up to 3,796 (1,460 additional residential units at 2.6 ppu) if additional treated water storage was built to match. As the existing storage volume can accommodate an additional population of 645, storage would need to be expanded to service a further 3,151 persons.

This alternative would require the construction of a 2,500 m³ standpipe(s), assuming a required fire flow of 164 L/s for 3 hours to meet current MECP Guidelines for the serviced population. This standpipe volume could be reduced to 2,100 m³ if the existing STP clearwell was retrofitted with baffles.



If storage infrastructure was expanded to match the WTP capacity, the water system could service the vacant serviced residential lands within Lagoon City (140 units at 2.0 ppu), the Lakeshore Drive service extension (90 units at 2.0 ppu), plus an additional 1,283 units at 2.6 ppu (52% of the total projected growth), for a total of 1,513 units.

Alternative 3 - Service All Projected Growth with WTP Expansion and Additional Storage

Development of Lagoon City and Brechin to full build-out (growth of 2,882 units) will require additional WTP capacity (1,900 m³/day expansion), addition of baffles in the WTP clearwell, and additional treated water storage (3,400 m³).

The WTP site, located just south of the navigation channel into Lagoon City, is constrained by the channel to the north and privately-owned resort lands to the south. Space for an expansion is available on the site to the east of the existing WTP building. Further study is required to determine the extent and feasibility of a WTP expansion. Cost for expansion of the WTP is expected to be in the order of \$10 million.

Table 5 presents high level capital cost estimates for the water treatment and storage infrastructure for each alternative. The costs to extend the distribution system are not included.

Table 5: Servicing Alternatives for Lagoon City/Brechin

ALTERNATIVE	NEW UNITS SERVICED	OPINION OF PROBABLE COSTS FOR SYSTEM UPGRADES ¹
1 - Growth serviced with existing WTP and storage	248	None
1a - Growth serviced with existing WTP with clearwell upgrades	348	\$150,000 for adding baffles in clearwell
2 - Growth serviced with additional storage and no WTP expansion	1,513	\$2.5M for 2,500 m ³ standpipe
3 - Service all projected growth with WTP expansion and additional storage	2,882	\$3.5M for 3,400 m ³ standpipe \$10M for 1,900 m ³ /day WTP expansion

1. Excluding cost of extending distribution system if needed



3 South Ramara Assessment

3.1 SOUTH RAMARA WTP RATED CAPACITY

The rated capacity of the South Ramara WTP is 387 m³/day (MDD). The capacity of the WTP process and pumping components, based on the DWWP and Operations and Maintenance Manual, is summarized in Table 6. A detailed list is provided in Appendix B.

Table 6: South Ramara WTP Process and Pumping Rated Capacities

	TOTAL RATED CAPACITY	DESCRIPTION
Raw Water Intake	387 m ³ /day (PTTW)	80 m of 150 mm diameter pipe
Low Lift Pumping ¹	543 m ³ /day	2 pumps both rated at 543 m ³ /day at 18.9 m TDH
Package Treatment Units	387 m ³ /day	2 packages each consisting of 1 flocculation tank, 1 settling tank and 1 media filter
Filter Backwash Pumping	387 m ³ /day	2 backwash pumps, one for each filter
High Lift Pumping ¹	708 m ³ /day	2 pumps (duty/standby) each rated at 708 m ³ /day at a TDH of 28.1 m
Clearwell ²	170 m ³ (117 m ³)	2 above ground concrete treated water clearwells, Tank 1 (67 m ³) and Tank 2 (103 m ³)
Emergency Power	47 kW	1 propane generator

1. Total rated capacity is the total rated capacity of all pumps with the largest pump out of service.
2. Clearwell capacity consists of chlorine contact time volume (37 m³), backwash water (16 m³), and equalization storage (117 m³).

3.2 HISTORICAL WATER DEMANDS

The historical water demands from the 2023 Annual Report are summarized in Table 7. The five-year average ADD was 52 m³/day, corresponding to a per capita consumption of 164 L/p/day. The MDD in the past five years was 175 m³/day.

The serviced population for South Ramara was determined by applying a population density of 2.6 ppu to the number of service connections presented in the 2023 Annual Report. The estimated 2023 population is 343.



Table 7: South Ramara WTP Historical Flows

YEAR	ADD (m ³ /day)	MDD (m ³ /day)	MAXIMUM DAY FACTOR	POPULATION	AVERAGE CONSUMPTION (L/p/day)
2012	50	136	2.72	257	194
2013	52	98	1.88	260	200
2014	59	181	3.07	260	227
2015	51	124	2.43	265	192
2016	54	148	2.74	270	200
2017	41	104	2.57	270	150
2018	42	111	2.66	276	151
2019	47	135	2.88	296	158
2020	58	175	3.01	299	195
2021	53	128	2.42	299	177
2022	52	124	2.38	343	152
2023	48	97	2.02	343	140
5 Year Avg/Max	52	175	3.01	-	164

3.3 WTP RESIDUAL CAPACITY

As shown in Table 8, the residual capacity of the South Ramara WTP for the current population is 212 m³/day. There are no operational concerns that would limit the available capacity at the South Ramara WTP.

The Township has advised that an additional 23 vacant lots have been allocated WTP capacity, corresponding to an additional population of 60 persons (23 units at 2.6 ppu), which will utilize 30 m³/day of capacity, assuming a per capita consumption rate of 164 L/p/day and a maximum day factor of 3.01.

Therefore, the residual unallocated capacity of the South Ramara WTP is 182 m³/day, which is equivalent to approximately 142 additional units at 2.6 ppu. Calculations are provided in Appendix B.



Table 8: South Ramara WTP Residual Capacity

	POPULATION	MDD (m ³ /day)	WTP RESIDUAL CAPACITY (m ³ /day)
Existing	343	175	212
Additional Allocation	60	30	- 30
Total Allocated	403	205	182

3.4 STORAGE CAPACITY

The South Ramara drinking water system has two above-ground storage tanks at the WTP. The tanks provide a total storage volume of 170 m³. As specified in the South Ramara Water Works Design Brief (December 2003), the storage volume was not designed to provide fire protection or for lawn watering uses.

Using the storage calculation in the MECP Design Guidelines for Drinking Water Systems (2008), the existing water storage volume is adequate for a population of approximately 679.

There is therefore adequate storage for an additional population of 335, which corresponds to 129 units at 2.6 ppu.

3.5 SERVICING NEEDS

Based on correspondence with the Township, there are no planned developments in South Ramara, only infill.

The Township is considering extending the water distribution system along Lakeshore Drive to Concession Road 1, which would mean servicing a total of existing 176 unserviced homes and vacant lots in South Ramara, if capacity was available at the South Ramara WTP.

3.6 SOUTH RAMARA SERVICING ALTERNATIVES

Two servicing alternatives for the South Ramara servicing area are presented below and on Figures 4 and 5. The alternative figures were developed to show the water system extension that could be serviced by the residual capacity of the existing WTP and storage infrastructure, and to identify when expansions will be required.

- Alternative 1 presents the servicing for the number of additional homes that can be accommodated by the existing WTP and storage infrastructure.
- Alternative 2 involves a water distribution system extension along Lakeshore Drive and additional storage.

Table 9 summarizes the alternatives and their preliminary estimated cost.



Alternative 1 – Water System Extension Serviced with Existing WTP and Storage

The treated water storage volume at the South Ramara WTP is the limiting factor. The existing facilities are adequate to accommodate 129 additional residential units. Therefore, the 23 vacant lots, plus an additional 106 units on an extension of the water distribution system, could be serviced without expanding the WTP or storage capacity.

Alternative 2 – Extend Service Along Lakeshore Drive with Additional Storage

The residual capacity of the South Ramara WTP (212 m³/day) could service up to 165 homes if additional treated water storage was built to match. This would require 22 m³ of additional storage to service 36 more homes than alternative 1.

Extending the water distribution system along Lakeshore Drive to Concession Road 1 would service an additional 11 homes, for a total of 176 lots. The required water servicing capacity would exceed the South Ramara WTP capacity by 14 m³/day (4%) and require 28 m³ (16%) of additional storage. It would service 47 more homes than Alternative 1.

Expansion of the WTP to service only 11 additional homes is not easily justifiable. The WTP site at 3001 Suntrac Drive is constrained by existing homes on all sides. Increasing the storage volume on the site would be difficult to implement due to the size and shape of the property and the location of the building on the property. Further study is required to determine if adding storage on site is feasible.

Table 9: Servicing Alternatives for South Ramara

ALTERNATIVE	NEW UNITS SERVICED	UPGRADES REQUIRED	ESTIMATED COST
1 – Extension Serviced with Existing WTP and Storage	129	4,350 m of watermain and services	\$2.8M (\$22k per lot)
2 – Extension along Lakeshore Serviced with Additional Storage	165	4,920 m of watermain and services 22 m ³ storage tank	\$3.2M ¹ (\$19k per lot)

1. Excludes the cost of an additional storage tank.



4 Summary

The residual capacities of the Lagoon City WTP and South Ramara WTP were assessed to determine the infrastructure expansions needed to extend municipal water service to unserved and undeveloped lands in Brechin, Lagoon City, and on the lakeshore between Lagoon City and South Ramara.

In Lagoon City:

- An expansion of the WTP and additional standpipe(s) would be required to service all the projected developments in Lagoon City and Brechin (2,882 units).
- Up to 1,513 units can be serviced by the existing WTP if a standpipe(s) is added to provide sufficient treated water storage.
- Up to 248 units can be serviced with the existing water system infrastructure, including the serviced vacant lots in Lagoon City and the extension of the water system along Lakeshore Drive. The number of additional units that can be serviced is increased to 348 units if membrane baffles are added in the WTP clearwell.
- Service extensions beyond the Lakeshore Drive extension require that the issues with seasonal reduced treated water production at the Lagoon City WTP be addressed through operational and/or capital upgrades.

In South Ramara:

- Treated water storage is sufficient to accommodate the 23 vacant lots and approximately 106 additional units.
- The WTP has enough residual capacity to service 165 units, if a tank is added to provide sufficient treated water storage.

4.1 RECOMMENDATIONS

The extent and feasibility of expanding the WTP in Lagoon City and adding storage in South Ramara will need to be determined. Ideally, planning and design of WTP and storage expansions should be initiated prior to reaching 80% of capacity.

The proposed service extensions would not add enough new users to justify expansion of the South Ramara WTP.



In the short term, it is recommended that the Township complete the following:

- Review the Lagoon City WTP's existing pre-treatment and filtration systems and operational practices to address seasonal reduced treated water production.
- Design upgrades at the Lagoon City WTP to increase the clearwell volume available for equalization storage by improving the effective chlorine contact time, and any recommended pre-treatment and filtration system upgrades.
- Evaluate alternative sites and designs for additional treated water storage in the Lagoon City/Brechin water system and at the South Ramara WTP.



FIGURE 1:
LAGOON CITY & BRECHIN WATER SERVICING - ALTERNATIVE 1

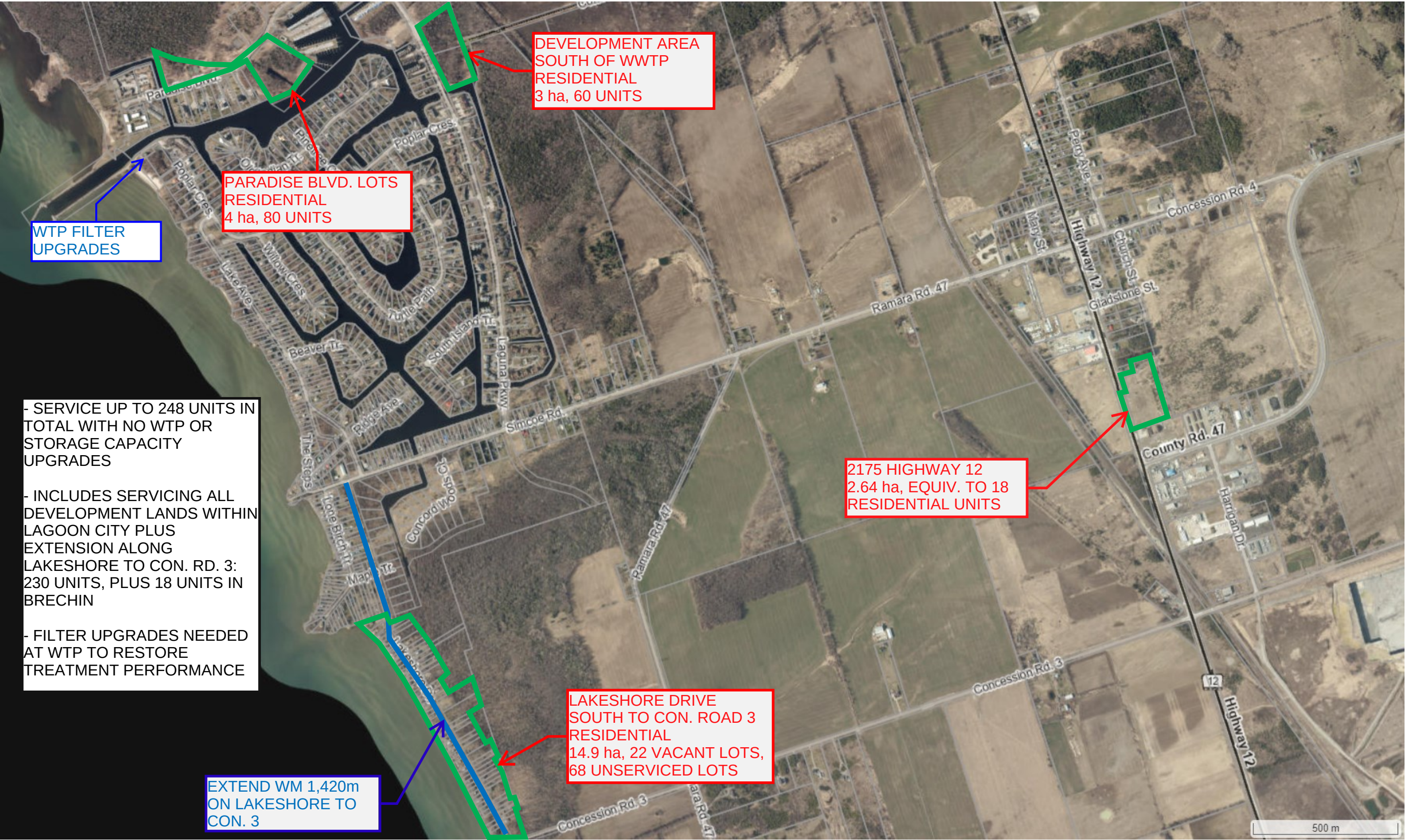


FIGURE 2:
LAGOON CITY & BRECHIN WATER SERVICING - ALTERNATIVE 2

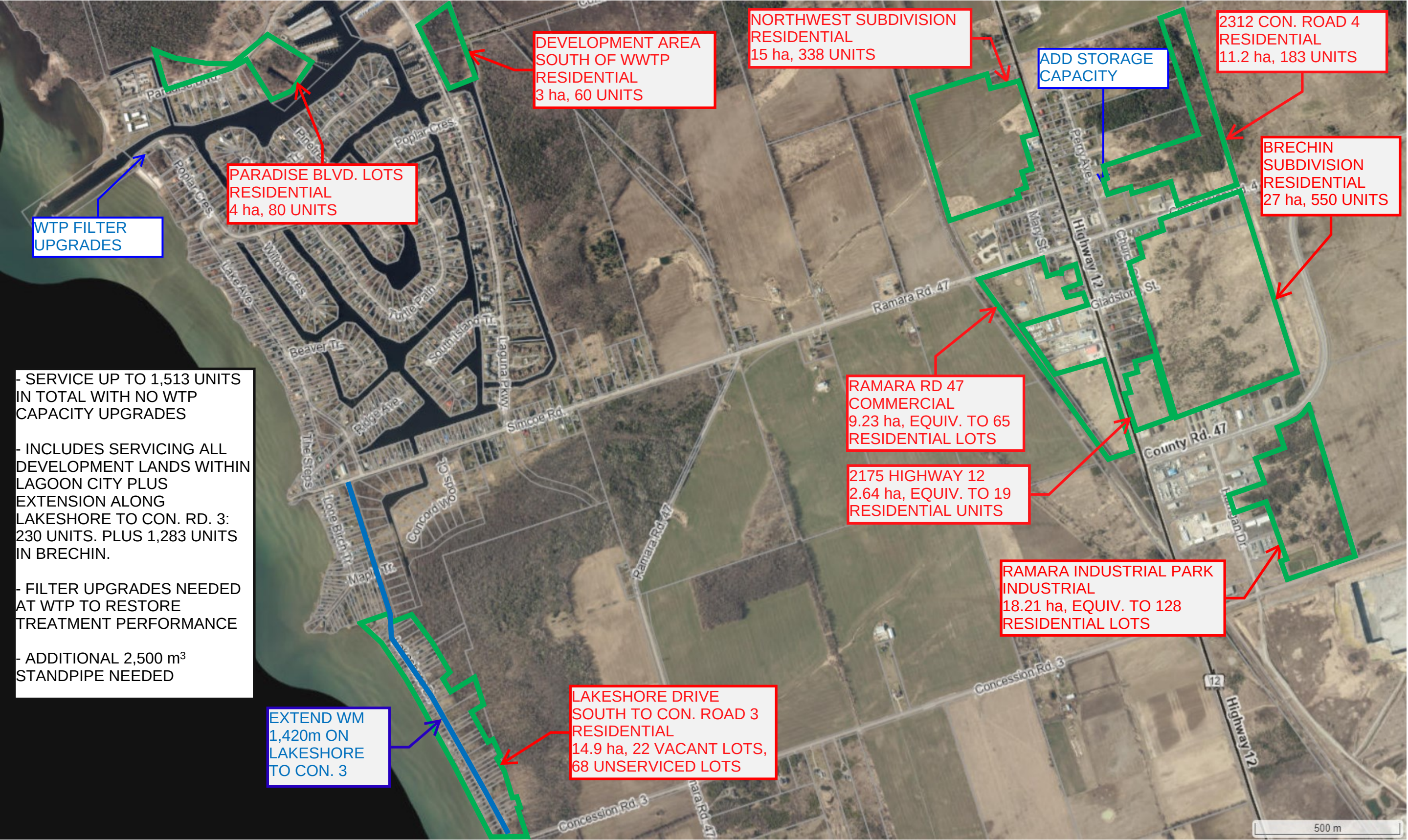


FIGURE 3:
LAGOON CITY & BRECHIN WATER SERVICING - ALTERNATIVE 3

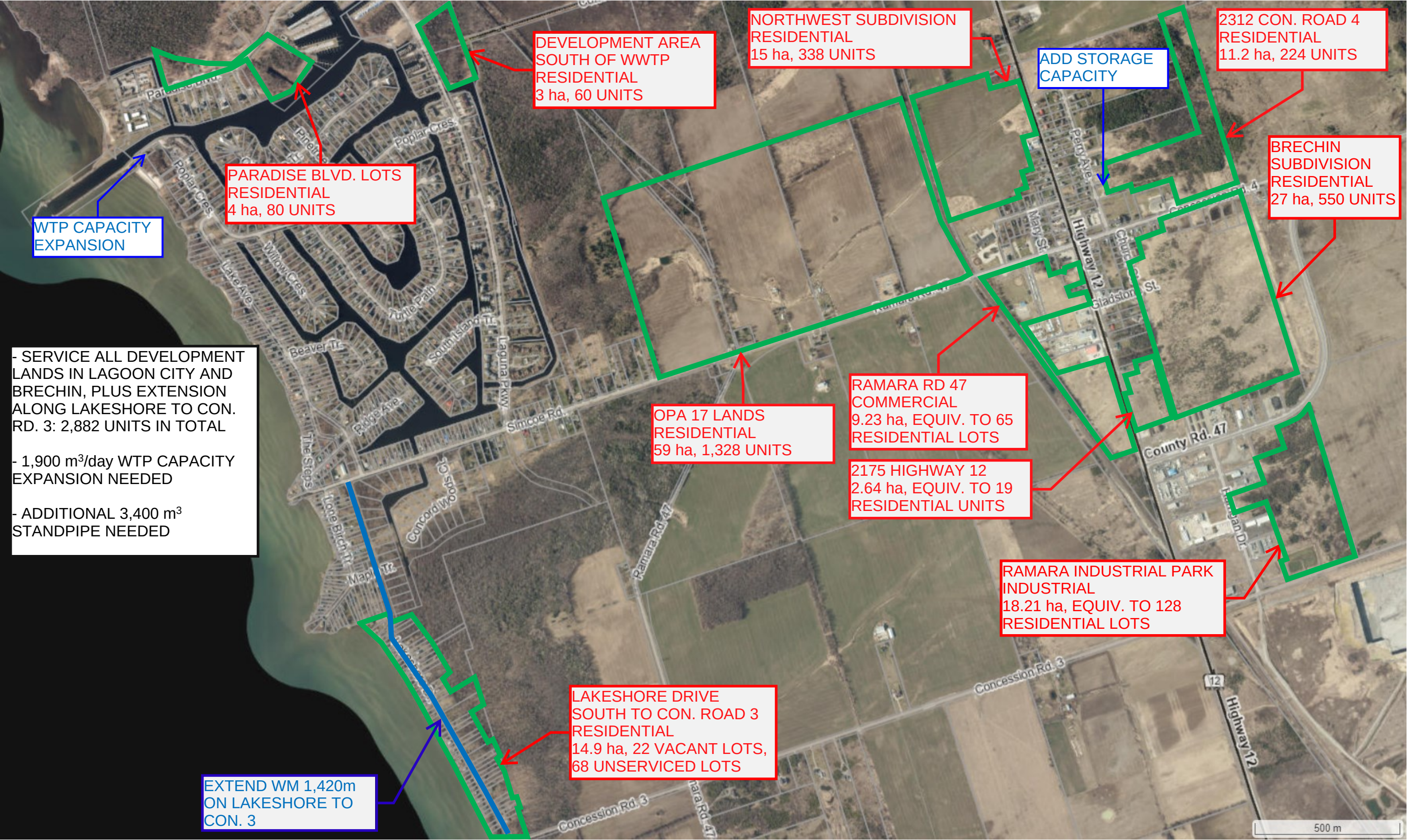


FIGURE 4:
SOUTH RAMARA - SERVICING ALTERNATIVE 1

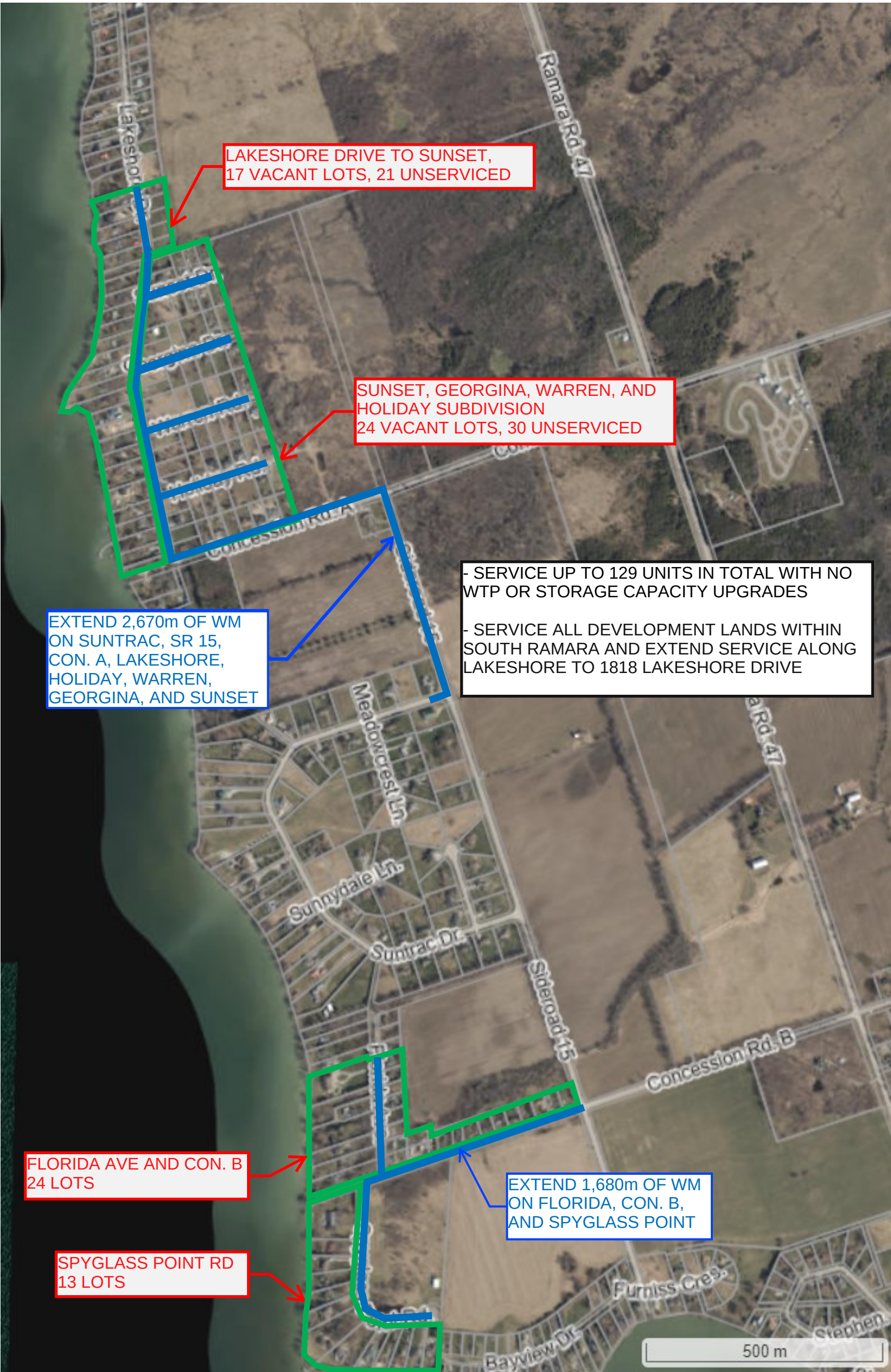


FIGURE 5:
SOUTH RAMARA - SERVICING ALTERNATIVE 2



Appendix A: Lagoon City & Brechin Calculations

PROJECT	Ramara Water Servicing Strategy	FILE	322926	
		DATE	9/5/2024	
SUBJECT	Residual WTP Capacity - Lagoon City & Brechin	NAME	EP/JRC	
		PAGE	1	OF 3

1. Summary of Historical Flow Data

- From the 2023 Brechin and Lagoon City Drinking Water System Annual Water Report:
 - Populations are based on population density of 2.0 ppu for Lagoon City and 2.6 ppu for Brechin.

Year	Average Daily Demand (ADD) (m ³ /day)	Maximum Daily Demand (MDD) (m ³ /day)	Maximum Day Factor (MDF)	Population*			Average Per Capita Consumption (L/p/day)
				Brechin	Lagoon City	Total	
2012	732	1,247	1.70	343	2,250	2,593	282
2013	770	1,411	1.83	346	2,250	2,596	297
2014	783	1,239	1.58	346	2,250	2,596	302
2015	781	1,670	2.14	354	2,250	2,604	300
2016	837	1,546	1.85	361	2,250	2,611	321
2017	699	1,207	1.73	374	2,250	2,624	266
2018	870	1,829	2.10	385	2,250	2,635	330
2019	893	1,798	2.01	387	2,250	2,637	339
2020	676	1,333	1.97	400	2,250	2,650	255
2021	684	1,090	1.59	400	2,250	2,650	258
2022	719	1,246	1.73	400	2,264	2,664	270
2023	636	1,072	1.69	406	2,264	2,670	238
5 Year Average / Max	722	1,798	2.01	-	-	-	272

*Assuming there has been no population growth in Lagoon City from 2012 to 2021 (1,125 single family dwellings), 1132 single family dwellings in Lagoon City in 2022 and 2023, and steady population growth in Brechin.

2. WTP Residual Capacity

- Lagoon City WTP rated capacity: 4,000 m³/day

	Population**	Average Per Capita Consumption (L/p/day)*	ADD* (m ³ /day)	MDF*	MDD (m ³ /day)	Residual WTP Capacity (m ³ /day)
Existing	2,670	-	722	-	1,798	2,202
Additional	205	272	56	2.01	112	
Allocated	2,875	-	777	-	1,910	2,090

*Per capita consumption, ADD, MDD, and MDF are based on the 5-year average/max value.

**Populations are based on 2.0 for Lagoon City and 2.6 ppu for Brechin for 1,288 existing connections and 1,367 allocated connections.

MDD for future residential units is estimated to be:

$$272 \text{ L/p/day} \times 2.01 \text{ MDF} \times 2.6 \text{ ppu} = 1,423.7 \text{ L/unit/day}$$

There is currently 2,202 m³/day of remaining WTP capacity with the ex. connected population of 2,670

This is equivalent to approximately 1,540 additional units.

There is currently 2,090 m³/day of remaining WTP capacity with the allocated population of 2,875

This is equivalent to approximately 1,460 additional units.

PROJECT	Ramara Water Servicing Strategy	FILE	322926	
		DATE	9/5/2024	
SUBJECT	Residual WTP Capacity - Lagoon City & Brechin	NAME	EP/JRC	
		PAGE	2	OF 3

3. Existing Capacity of WTP Process and Pumping Components

- From the DWWP Issue 5:

Water Treatment Plant

- Rated Capacity: 4,000 m³/day.

Raw Water Intake

- 485 m of 300 mm pipe. Capacity is 4,000 m³/day from the PTTW.

Low Lift Pumping Station

- Three (3) vertical turbine low lift pumps;
 - One (1) rated at 2,435 m³/day at 10.4 m TDH.
 - Two (2) rated at 2,029 m³/day at 10.4 m TDH each.

Flocculation Tanks

- Four (4) flocculation tanks, each with a capacity of 12.7 m³.

Filtration

- Two (2) filter-absorber units, each with a surface area of 7.1 m².
- Design Capacity: 4,000 m³/day.

Filter Backwash System

- One (1) backwash pump rated at 7,514 m³/day at 9.1 m TDH, with a backwash rate of 44 m/hr.

High Lift Pumping Station

- One (1) submersible high lift pump and four (4) vertical turbine pumps;
 - One (1) submersible high lift pump rated at 1,944 m³/day at 70 m TDH.
 - One (1) vertical turbine pump rated at 1,145 m³/day at 70 m TDH.
 - One (1) vertical turbine pump rated at 1,728 m³/day at 70 m TDH.
 - Two (2) vertical turbine pumps rated at 4,536 m³/day at 70 m TDH each.

Emergency Power

- One 175 kW standby-by diesel engine generator set.
- One 2,775 L above ground fuel storage tank.

4. Existing Storage Capacity

On-Site Storage (WTP Clearwell)

- Volume: 1,091 m³. Volume available for chlorine contact time: 965 m³. (O&M Manual 4.2.8.3)

Elevated Storage Tank (Water Reservoir) with Baffle factor 0.3

- Volume: 945 m³.

Total Treated Water Storage Volume: 1,910 m³.

PROJECT	Ramara Water Servicing Strategy	FILE	322926
		DATE	9/5/2024
SUBJECT	Residual WTP Capacity - Lagoon City & Brechin	NAME	EP/JRC
		PAGE	3 OF 3

5. Required Storage Capacity for Fire Protection

- From the 2008 MECP Design Guidelines for Drinking Water Systems Section 8.4.2:
 - Equivalent Population: $2,875 + 645 = 3,520$
 - 3,520 is the approximate population needed to reach maximum capacity of existing storage volume.
 - Minimum fire flow requirement is: 38 L/s .
With a fire flow duration of: 2.0 hrs .
 - Maximum Day Demand (for Equivalent Population : 3,520)

$$\text{MDD} = 272 \text{ L/p/day} \times 3,520 \text{ p} \times 2.01 = 1,927 \text{ m}^3/\text{day}$$

Total Treated Water Storage Requirement = A + B + C

For Allocated Pop.

		2,875 persons	3,520 persons
For the populations of:			
A = Fire Storage	=	274 m^3	274 m^3
B = Equalization Storage (25% of Maximum Day Demand)	=	478 m^3	482 m^3
C = Emergency Storage (25% of A + B)	=	188 m^3	189 m^3
Total Water Storage Requirement		939 m^3	944 m^3

6. Storage Capacity Assessment

- There is spare capacity of 6.0 m^3 in the Brechin water tower, which is equivalent to approximately 645 persons or 248 units assuming a population density of 2.6 ppu.
- Fire flow is less than current standards based on population as per MECP Design Guidelines table 8-1.

17-Jan-25 Considering storage in clearwell

If Baffle factor increase 0.5 by adding baffles in clearwell:

$$\text{CT} = 125$$

$$\text{C} = 1.2 \text{ mg/L}$$

$$\text{T} = 104 \text{ min}$$

$$\text{BF} = 0.5$$

$$\text{Te} = 208 \text{ min}$$

$$\text{V} = 4000 \text{ m}^3/\text{d} \times 208 \text{ min} / 1440 \text{ min/c} = 579 \text{ m}^3 \text{ instead of } 965 \text{ m}^3$$

Available volume for storage is increase 386 m^3

Assuming remainder of storage is for WTP uses.

260 persons 100 units

$$\text{MDD: } 142.4 \text{ m}^3/\text{day}$$

$$\text{Fire storage } 273.6 \text{ assuming } 38 \text{ L/s}$$

$$\text{Equalization } 35.6$$

$$\text{Emergency } 77.3$$

$$\underline{\quad\quad\quad} 386 \text{ m}^3$$

Appendix B: South Ramara Calculations

PROJECT	Ramara Water Servicing Strategy	FILE	322926
		DATE	9/5/2024
SUBJECT	Residual WTP Capacity - South Ramara	NAME	EP/JRC
		PAGE	1 OF 3

1. Summary of Historical Flow Data

- From the 2023 South Ramara Drinking Water System Annual Water Report:
 - Populations are based on population density of 2.6 ppu.

Year	Average Daily Demand (ADD) (m ³ /day)	Maximum Daily Demand (MDD) (m ³ /day)	Maximum Day Factor (MDF)	Population	Average Per Capita Consumption (L/p/day)
2012	50	136	2.72	257	194
2013	52	98	1.88	260	200
2014	59	181	3.07	260	227
2015	51	124	2.43	265	192
2016	54	148	2.74	270	200
2017	41	104	2.57	270	150
2018	42	111	2.66	276	151
2019	47	135	2.88	296	158
2020	58	175	3.01	299	195
2021	53	128	2.42	299	177
2022	52	124	2.38	343	152
2023	48	97	2.02	343	140
5 Year Average / Max	52	175	3.01	-	164

2. System Residual Capacity

- South Ramara WTP rated capacity: 387 m³/day

	Population**	Average Per Capita Consumption (L/p/day)*	ADD* (m ³ /day)	MDF*	MDD (m ³ /day)	Residual WTP Capacity (m ³ /day)
Existing	343	-	52	-	175	212
Additional	60	164	10	3.01	30	
Allocated	403	-	61	-	205	182

*Per capita consumption, ADD, MDD, and MDF are based on the 5-year average/max value.

**Populations are based on 2.6 ppu for 132 existing connections and 155 allocated connections.

MDD for future residential units is estimated to be:

$$164 \text{ L/p/day} \times 3.01 \text{ MDF} \times 2.6 \text{ ppu} = 1,284 \text{ L/unit/day}$$

There is currently 212 m³/day of remaining WTP capacity with the ex. connected population of 343

This is equivalent to approximately 165 additional units.

There is currently 182 m³/day of remaining WTP capacity with the allocated population of 403

This is equivalent to approximately 142 additional units.

PROJECT	Ramara Water Servicing Strategy	FILE	322926	
		DATE	9/5/2024	
SUBJECT	Residual WTP Capacity - South Ramara	NAME	EP/JRC	
		PAGE	2	OF 3

3. Existing Capacity of WTP Process and Pumping Components

- From the DWWP Issue 4:

Water Treatment Plant

- Rated Capacity: 387 m³/day.

Raw Water Intake

- 80 m of 150 mm pipe. Capacity is 387 m³/day from the PTTW.

Low Lift Pumping Station

- Two (2) submersible pumps rated at 6.29 L/s (543 m³/day) at 18.9 m TDH each.

Package Treatment Units

- Each consist of flocc tank, settling tank, and media filtration.
- Capacity of each treatment train is 387 m³/day.

Filter Backwash System

- Two (2) backwash pumps one for each filter.

High Lift Pumping Station

- Two (2) high lift pumps (one duty, one standby) rated at 8.19 L/s (708 m³/day) at 28.1 m TDH each.

Emergency Power

- One 47 kW propane generator for backup power supply.

4. Existing Storage Capacity

On-Site Storage (WTP Clearwell)

- Two (2) above ground concrete treated water clearwells;
 - Volume of Tank 1: 66.8 m³.
 - Volume of Tank 2: 103 m³.

Total storage volume: 170 m³.

5. Required Storage Capacity

- The South Ramara water system is not designed to provide fire protection.
- From the 2008 MECP Design Guidelines for Drinking Water Systems Section 8.4.5: Treated Water Storage Required is equal to the Average Day Demand for systems serving fewer than 500 people.
- From the December 2003 Design Brief, additional storage is required for chlorine contact time and process water.
- 500 is the approximate population needed to reach maximum capacity of existing storage volume.
- For the populations of:

		343 persons	500 persons
Average Day Demand	=	52 m ³	82 m ³
Chlorine Contact Time	=	37 m ³	37 m ³
Process Water (filter backwash)	=	16 m ³	16 m ³
Total Treated Water Storage Requirement		105 m ³	135 m ³

PROJECT	Ramara Water Servicing Strategy	FILE	322926
		DATE	9/5/2024
SUBJECT	Residual WTP Capacity - South Ramara	NAME	EP/JRC
		PAGE	3 OF 3

6. Storage Capacity Assessment

- There is spare capacity of 65 m^3 , which could service more than 157 additional people.
- From the 2008 MECP Design Guidelines for Drinking Water Systems Section 8.4.3: Treated Water Storage Required for systems with population greater than 500 and not providing fire protection is equal to 25% of MDD plus 40% of ADD:

- For a total population of: 679 equivalent to 129 additional units:

	Units	Population	ADD Per Capita (L/p/day)	ADD (m^3/day)	MDF	MDD (m^3/day)	Residual WTP Capacity (m^3/day)
Existing	132	343	-	52	-	175	212
Projected	129	335	164	55	3.01	166	-
Total	261	679	-	107	-	341	46

- Equalization storage required is: $0.25 \times 341 + 0.4 \times 107 = 128 \text{ m}^3$
- Chlorine contact time requirements as per the MECP Procedure for Disinfection of Drinking Water:
 - Free chlorine residual: 1.2 mg/L
 - Required CT: 52
 - $T_{10} = 52 / 0.0 = 43.3 \text{ min}$
 - Baffling Factor (avg.): 0.5
 - Hydraulic retention time: 86.6 min
 - Peak Factor 4.13 *MECP Design Guidelines Table 3-1*
 - Peak demand: $441 \text{ m}^3/\text{day} = 0.306 \text{ m}^3/\text{min}$
 - Minimum volume: 27 m^3
- Process water requirements for filter backwashing and other in-plant needs are estimated to be 16 m^3
- Total treated water storage required is: $128 + 27 + 16 = 170 \text{ m}^3$
- Total existing storage volume: 170 m^3 .
- Additional treated water storage volume required: **0 m^3 .**
- Therefore, 335 additional people, equivalent to 129 additional units at 2.6 ppu, can be serviced by the existing WTP and storage tanks.