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MINISTRY OF THE ENVIRONMENT AND CLIMATE CHANGE

Status of the Hauled Sewage Industry & Costing Toward the Development of Environmental Standards for Hauled Sewage in Ontario

Hauled Sewage Costing Summary Report (DRAFT)

May 2017 – 16-4730

May 12, 2017

Standards Development Branch
Ontario Ministry of the Environment and Climate Change
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Attention: Ms. Shelly Bonte-Gelock

Hauled Sewage Costing Summary Report

Dillon Consulting Limited (Dillon) is pleased to submit our draft hauled sewage costing report, in support of the overall project regarding the Status of Hauled Sewage Industry and Costing toward the Development of Environmental Standards for Hauled Sewage in Ontario.

Sincerely,

DILLON CONSULTING LIMITED

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References

Acronyms, Abbreviations, Definitions

– B –

Biochemcial Oxygen Demand (BOD_5), 5-day carbonaceous biochemical oxygen demand

-– C –

conventional activated sludge (CAS), a wastewater treatment process employing aerated tanks and suspended biomass to achieve the removal of BOD_5. The CAS process may also remove nitrogen and other wastewater nutrient.

CCME, Canadian Council of Ministers of the Environment

– D –

dissemination block (DB), an area bounded on all sides by roads and/or boundaries of standard geographic areas. The dissemination block is the smallest geographic area for which population and dwelling counts are disseminated. Dissemination blocks cover all the territory of Canada.

Dewatering Trench, A simple septage management structure consisting of a shallow trench for collection of septage solids and ground infiltration of liquid.

– E –

***eff**luent, sanitary sewage that has passed through a treatment unit*

ECCC - Environment and Climate Change Canada

– G –

Geotube, a water-permeable membrane constructed as a long tube capable of providing dewatering of high-solids wastewater residuals

– H –

hauled sewage,(also known as Septage) sanitary sewage that,

a) *domestic waste that is human body waste, toilet or other bathroom waste, waste from other showers or tubs, liquid or water borne culinary or sink waste or laundry waste, and*
b) *other waste that is suitable for storage, treatment or disposal in a sewage system regulated under Part 8 of Division B of Ontario Regulation 332/12 (Building Code) made under the Building Code Act, 1992, if the waste is not fully disposed of at the site where it is produced, other than,*

i. waste that is,(A) from a sewage works that is subject to an environmental compliance approval, and(B) conveyed, by a sewer that is subject to an environmental compliance approval, away from the site where it is produced,

ii. waste in a vehicle sewage holding tank, or

iii. Greenhouse Nutrient Feedwater.

hauled sewage system, works, installations, equipment, operations and land used in connection with the collection, handling, treatment, transportation, storage, processing and disposal of hauled sewage, as regulated under the Environmental Protection Act.

holding tank, a tank designed to retain all sanitary sewage discharged into it and requiring periodic emptying.

– L –

Lagoon, *A wastewater process consisting of a large basin (earthen or membrane lined) which provides treatment through passive oxygen transfer through the liquid surface, mechanical aerators or fine bubble aeration system.*

leaching bed, an absorption system constructed as absorption trenches or as a filter bed, located wholly in ground or raised or partly raised above ground, as required by local conditions, to which effluent from a treatment unit is applied for treatment and disposal and that is composed of,

(a) the soil, *as defined in Part 8 of Division B,* leaching bed fill *or other filter media that is contained between the surface on which the* sanitary sewage *is applied and the bottom of the bed,*
(b) the distribution pipe *and the stone or gravel layer in which the* distribution pipe *is located, and*
(c) the backfill above the distribution pipe, *including the topsoil and sodding or other anti-erosion measure, and the side slopes of any portion elevated above the natural ground elevation.*

– M –

MOECC, Ontario Ministry of the Environment and Climate Change

MPAC, Municipal Property Assessment Corporation

– N –

NASM, Non-Agricultural Source Material is treated and recycled material from non-agricultural sources, such as sewage biosolids that is applied to agricultural land to provide a beneficial use. NASM does not include compost that meets the standards for Category AA or A outlined in Part II of the Ontario Compost Quality Standards. NASM does not include untreated septage or commercial fertilizers. The regulation, under the Nutrient Management Act, 2002, provides the rules for the storage, *sampling, analysis and land application of NASM. NASM is classified under one of three categories. Category 3 consists of pulp and paper biosolids, paunch manure and sewage biosolids.*

– O –

– P –

population density, number of persons per square kilometre

– R –

residential occupancy, an occupancy in which sleeping accommodation is provided to residents who are not harboured for the purpose of receiving special care or treatment and are not involuntarily detained.

rural area (RA), include all territory lying outside population centres (POPCTRs). Taken together, population centres and rural areas cover all of Canada.

– S –

sanitary sewer, sanitary sewer means a sewer that conveys sewage.

septic tank, a watertight vault in which sanitary sewage *is collected for the purpose of removing scum, grease and solids from the liquid without the addition of air and in which solids settling and anaerobic digestion of the* sanitary sewage *takes place.*

sewage system, "(1) *All* sewage systems *shall be classed as one of the following under the Ontario Building Code, 2012:*

- *(a) Class 1 — a chemical toilet, an incinerating toilet, a recirculating toilet, a self contained portable toilet and all forms of privy including a* portable privy*, an* earth pit privy*, a* pail privy*, a* privy vault *and a composting toilet system,*
- *(b) Class 2 – a* greywater system,
- *(c) Class 3 – a cesspool,*
- *(d) Class 4 – a* leaching bed *system, or*
- *(e) Class 5 – a system that requires or uses a* holding tank *for the retention of* hauled sewage *at the site where it is produced prior to its collection by a* hauled sewage system*.*

– T –

treatment unit, a device that, when designed, installed and operated in accordance with its design specifications, provides a specific degree of sanitary sewage treatment to reduce the contaminant load from that of sanitary sewage to a given effluent quality.

Total Kjeldahl Nitrogen: The total concentration of organic nitrogen and ammonia in wastewater.

– U –

Upper Tier Municipality, a municipality of which two or more lower-tier municipalities form part for municipal purposes

Uncommitted reserve capacity, represents the remaining hydraulic capacity at a sewage or water treatment plant, in accordance with MOECC Procedure D-5-1 (Formerly Appendix A): Calculating and Reporting Uncommitted Reserve Capacity at Sewage and Water Treatment Plants, dated March 1995, by subtracting the sum of current average day flow and flow associated with approved development from the hydraulic design capacity of a plant

– W –

WWTP, Waste Water Treatment Plant

Executive Summary

In 2016, the Ministry of the Environment and Climate Change (MOECC) initiated the hauled sewage policy and program review and is examining options for addressing the environmental impacts and human health concerns related to management. Options that may be considered by the MOECC include the development of regulations, standards and/or guidance for the location, engineering design, operation and monitoring of a number of hauled sewage management alternatives. Dillon Consulting Limited (Dillon) has been engaged to gather data, estimate the quantity of hauled sewage that requires management, and estimate the cost of management alternatives in order to support the policy and program review.

Hauled sewage, commonly referred to as septage, is the waste material removed from holding tanks, and septic systems. As of the date of this report, the MOECC regulates the transport and land application of untreated hauled sewage in Ontario through the Environmental Protection Act. Hauled sewage is most commonly treated at municipal sewage treatment facilities; however dedicated processes are also available. Treated hauled sewage that is applied to agricultural land for crop benefit may be managed in accordance with the requirements of the Nutrient Management Act.

There are two main objectives to be addressed by this costing summary report:

- Develop estimates of the capital cost to handle hauled sewage across Ontario including treatment at sewage treatment plants (STPs), treatment at a dedicated facility prior to land application, and management using dewatering trenches.

- Consider the annual operating and maintenance cost to transport, handle and treat hauled sewage ($\$/m^3\cdot$year) based on the destinations considered. The available capacity at municipal sewage treatment plants that could be allocated to accepting / treating hauled sewage was reviewed and assessed.

The previous hauled sewage data gathering report by Dillon, dated March 2017 and quantification report by Dillon dated March 2017 provided the basis for the development of hauled sewage costs presented in this report. The centre of the best estimate range from the quantification portion of this project is used to support costing which includes approximately 920,000 m^3/year and 3,040,000 m^3/year of material from septic and holding tanks, respectively. Material from septic tanks is much more concentrated, and although it represents less than 25% of the estimated volume of hauled sewage, it represents more than 90% of the contaminant loading when it is managed using STPs. Future growth to the 2036 planning horizon is estimated to add 5% more hauled sewage (on an organic mass load basis). A corresponding increase of 5% above current cost estimates, expressed in 2017 dollars, can be considered for future hauled sewage quantity; however this modest increase is well within the uncertainty of estimates provided. Uncertainty surrounding the quantity of hauled sewage has the potential to meaningfully affect estimated costs.

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The allocation of hauled sewage among management approaches is developed using information collected from hauler surveys, and information provided by the MOECC district offices. The allocation of hauled sewage to management practices is a key area of uncertainty in terms of the real costs that may be experienced after a policy change.

This report provides a high-level overview of the considerations and methods used to develop opinions of probable costs for treatment of hauled sewage in the province. Capital and operating costs represent a range of probable costs for implementation of upgrades, understanding that there may be significant variation in the type of treatment processes required at individual locations. An opinion of probable capital cost was estimated for implementing sewage treatment plant infrastructure based upon conservative assumptions regarding the infrastructure required, particularly for maximum unit costs. Treatment technology, biosolids management and the need for tertiary treatment may vary by location and affect the cost range. The estimates are considered most reliable at the provincial level, and MPAC region or site specific considerations that may influence process configuration are considered at a high level; however detailed assessment of every MPAC Region is beyond the scope of this province wide assessment. Further detailed design effort is required to estimate the probable cost of upgrades for individual facilities.

The range of costs presented in this report provides a breadth of potential treatment process options that may be considered in managing hauled sewage in Ontario. The ranges of cost in this report represent the uncertainty with respect to the envisioned number, configuration, and complexity of treatment systems that may be implemented for the management of hauled sewage. The ranges presented do not represent the accuracy of probable cost estimates, which are considered order of magnitude only, relying on the level of information for concept design at or below the detail typical for Class V, Level 1, Class D Cost Estimates (+/-40%).

The probable cost of implementing STP capacity, in the form of mechanical treatment processes, for the total quantity of hauled sewage in Ontario is estimated to be between $1,090,000,000 and $1,455,000,000. The maximum cost range includes the value of existing STPs treatment capacity currently consumed by hauled sewage (approximately 2,200,000 m^3/year), and the additional cost of new infrastructure for treatment of hauled sewage currently applied to land (approximately 1,700,000 m^3/year). It is acknowledged that lagoon systems are not appropriate for all small systems; however the minimum cost for implementing treatment using lagoons for small systems is $744,000,000.

A more moderate estimate of cost is represented by the cost to treat only the quantity of hauled sewage currently estimated to be applied to land. For this estimate new mechanical treatment processes at STPs are estimated to be between $566,000,000 and $788,000,000. The minimum cost for this scenario considering the potential use of lagoons for small systems is $390,000,000. The actual cost of new infrastructure may be reduced where uncommitted hydraulic reserve capacity can be allocated to hauled sewage that is currently applied to land.

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These estimates assume a distributed approach to the use of STP treatment capacity based upon the value of limiting trucking distances and mitigating risk to treatment processes by limited the percentage of treatment capacity dedicated to hauled sewage at any one STP. Distributing treatment tends to provide a higher estimated cost due to an increased number of receiving stations required, and relatively higher cost per m^3 of capacity by including more smaller STPs.

Material collected from holding tanks represents more than 75% of the estimated volume of hauled sewage, but less than 10% of the contaminant load, and is considered to be best managed through STPs. Material collected from septic tanks represents less than 25% of the volume of hauled sewage, but is much more concentrated and may be more cost effectively managed through a dedicated process that would generate a NASM quality material for agricultural use. The cost associated with dedicated alkaline stabilization processes is estimated to be on the order of $85,000,000 to $200,000,000 for all septic tank material in the province, and $39,000,000 to $92,000,000 for the material currently estimated to be applied to land. Use of dewatering trenches is likely to be limited to remote areas of the province and in limited appropriate situations is likely to represent a cost effective management option. A potential change in policy that would ban land application of untreated hauled waste is anticipated to be most cost effectively implemented by providing flexibility for municipalities and sewage industry service providers to select from a range of management options.

1.0 Background

In 2016, the Ministry of the Environment and Climate Change (MOECC) initiated the hauled sewage policy and program review and is examining options for addressing the environmental impacts and human health concerns related to management. Options that may be considered by the MOECC include the development of regulations, standards and/or guidance for the location, engineering design, operation and monitoring of a number of hauled sewage management alternatives. Dillon Consulting Limited (Dillon) has been engaged to gather data, estimate the quantity of hauled sewage that requires management, and estimate the cost of management alternatives in order to support the policy and program review.

Hauled sewage, commonly referred to as septage, is the waste material removed from holding tanks, and septic systems. As of the date of this report, the MOECC regulates the transport and land application of untreated hauled sewage in Ontario through the Environmental Protection Act. Hauled sewage is most commonly co-treated at municipal sewage treatment plants (STPs); however dedicated processes are also available. Treated hauled sewage that is applied to agricultural land for crop benefit may be managed in accordance with the requirements of the Nutrient Management Act.

In 2002, the government of Ontario committed to a ban on land application of untreated hauled sewage, and released a proposed five-year strategy for public consultation. Based upon the feedback during consultation in 2002-2003 along with further analysis, the proposed province-wide ban has not yet been implemented. The primary reason for this was insufficient information to demonstrate adequate treatment capacity at municipal sewage treatment plants (STPs) and other dedicated hauled sewage treatment facilities. In 2008 the MOECC developed a set of Draft Guidelines for public consultation to provide additional details related to hauled sewage management alternatives.

This report builds on earlier data gathering and quantification exercises to identify costs associated with hauled sewage. The costs considered include capital costs associated with expansion or use of existing STPs, increases in operating and maintenance costs associated with additional wastewater loads and management of residuals, as well as dedicated hauled sewage management approaches such as treatment facilities that generate non-agricultural source material (NASM) quality soil amendment, or dewatering trenches.

The cost summary is considered for each Municipal Property Assessment Corporation (MPAC) region, based on the unit cost of suitable treatment the quantity of hauled sewage generated in each region. Data is not available to permit the analysis of treatment facilities and costs at the subregion or dissemination block level. A description of the locations of the individual MPAC regions, and their demographics is presented in the Hauled Sewage Quantification and Destination Report (Quantification Report) prepared as part of this study.

2.0 Objectives

The purpose of this report is to provide a high-level province-wide assessment of probable cost for the diversion of untreated hauled sewage to appropriate facilities for management. There are two main objectives to be addressed by this costing summary report:

- Develop estimates of the capital cost to handle hauled sewage across Ontario including treatment at sewage treatment plants (STPs), treatment at a dedicated facility prior to land application, and management using dewatering trenches.
- Consider the annual operating and maintenance cost to transport, handle and treat hauled sewage ($/m^{3}·year) based on the destinations considered. The available capacity at municipal sewage treatment plants that could be allocated to accepting / treating hauled sewage was reviewed and assessed.

3.0 Quantity Quality and Destination of Hauled Waste

A key aspect of hauled sewage management is the quantity and quality of material that requires management. The cost is also substantially affected by the type of management selected. Background related to these aspects that affects estimates of probable cost are presented in this section.

3.1 Waste Quality

The accumulated material in septic tanks is high in solids and high strength in terms of a number of other quality parameters relative to typical sewage. The quantity of this material is minimal in terms of STP hydraulic capacity, while the contaminant loading may be substantial. In contrast, the quality of hauled sewage from holding tanks is anticipated to be similar to conventional sewage collected by sewers. A review of the variability of quality of hauled sewage from septic tanks and holding tanks is beyond the scope of this study.

The MOECC Design Guidelines for Sewage Works (2008) contain quality ranges for both septage and typical sanitary sewage. Hauled sewage from septic tanks is assumed to be equal to the "average" quality referenced by the MOECC, while hauled sewage from holding tanks is assumed to be equivalent to typical medium-strength domestic sewage. Waste quality of these two sources is summarized below in Table 3-1.

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Table 3-1: Hauled Sewage Quality (MOECC, 2008)

Parameter	Septic Tank Material Quality (mg/L)	Conventional Sewage / Holding Tank Waste Quality (mg/L)	Ratio of Septic Tank Material to Conventional Sewage
Total Solids (TS)	40,000	720	55:1
Total Volatile Solids (TVS)	25,000	360	69:1
Total Suspended Solids (TSS)	15,000	210	71:1
Volatile Suspended Solids (VSS)	10,000	160	62:1
Biochemical Oxygen Demand (BOD_5)	7,000	190	37:1
Chemical Oxygen Demand (COD)	15,000	430	35:1
Total Kjeldahl Nitrogen (TKN)	700	40	17:1
Total Ammonia Nitrogen (TAN)	150	25	6:1
Total Phosphorous (TP)	250	7	36:1
Alkalinity	1,000	90	11:1
Oils and Grease	8,000	90	89:1
pH	6.0 s.u.	NA	NA

As shown in Table 3-1 above, septic tank material is substantially higher strength than holding tank waste. For the purposes of this evaluation the relative concentration of BOD_5, TKN, ammonia and TP are considered the most pertinent contaminants influencing treatment process sizing to protect effluent quality. The ratio of BOD and TP in septage to conventional sewage is approximately 37:1, while the TKN and ammonia are less than 17:1. Accordingly, the contaminant load associated with septic tank material is assumed to consume an "equivalent" STP rated capacity of 37 times conventional sewage or holding tank waste, corresponding to the ratio of BOD_5 concentrations in these two waste sources. The solids ratios are even higher than the BOD ratio selected. The additional mass of solids is not anticipated to create a risk to effluent quality, or require an increase in the size of solids separation unit processes (e.g. clarifiers), and therefore the additional solids load is only considered in terms of additional quantity of biosolids for management.

A province wide blended wastewater quality has been estimated, considering the relative volumetric total contributions of septic tank and holding tank waste to the total volume of hauled sewage estimated for the province. Blended quality, with BOD_5 concentrations approximately 9 times that of typical sewage, is summarized below in Table 3-2.

Table 3-2: Combined Hauled Sewage Estimated Quality

Parameter	Average Hauled Sewage Quality
Total Solids (TS)	9,800 mg/L
Total Volatile Solids (TVS)	6,100 mg/L
Total Suspended Solids (TSS)	3,600 mg/L
Volatile Suspended Solids (VSS)	2,400 mg/L
Biochemical Oxygen Demand (BOD_5)	1,800 mg/L
Chemical Oxygen Demand (COD)	3,800 mg/L
Total Kjeldahl Nitrogen (TKN)	200 mg/L
Total Ammonia Nitrogen (TAN)	55 mg/L
Total Phosphorous (TP)	60 mg/L
Alkalinity	300 mg/L
Oils and Grease	1,900 mg/L

The hauled sewage quality within each MPAC region varies substantially depending on the relative contributions of septic tank and holding tank waste to total hauled sewage production. In regions with little to no holding tank waste production, the quality of hauled sewage will more closely resemble that of septic tank waste, as presented in Table 3-1.

3.2 Waste Quantity

Waste quantities and population data were established as part of the Quantification Report for each of the 27 MPAC regions in Ontario. Waste quantity was estimated using a number of sources of data including:

- Census population data
- Estimates of the fraction of dwellings serviced by sanitary sewers and those serviced by private systems generating hauled sewage based primarily on the Municipal Water and Wastewater Survey data from 2009
- Estimation of approximate pump-out frequency of private systems.

For the purposes of this report, it is assumed that a private system pump out frequency of 4-years is required. This represents the median frequency identified in the Quantification Report. Holding tank waste generation was also estimated assuming the median of the range presented in the Quantification Report. Total current hauled sewage generation by MPAC region is summarized below in Table 3-3. Total hauled sewage volume is expressed both in terms of the actual volume of hauled sewage estimated for septic and holding tank waste, and as equivalent STP rated capacity representing the contaminant mass load from septic systems as cubic metres of standard strength sewage equivalent.

The relative proportion of septic and holding tank waste generated in each MPAC region is considered in determining the corresponding total standard sewage equivalent volume.

Table 3-3: Hauled Waste Generation Summary

MPAC Region	Region Description	Septic Tank Waste Generation (m^3/year)	Septic Tank Waste Generation (Equivalent STP Rated Capacity m^3/year)	Holding Tank Waste Generation (m^3/year)	Total Hauled Sewage Volume (m^3/year)	Total Hauled Sewage Volume (Equivalent STP Rated Capacity m^3/year)	Total Hauled Sewage Volume (Equivalent STP Rated Capacity m^3/day)
1	Prescott, Russel, Stormont Dundas and Glengarry Counties	44,000	1,620,000	20,700	65,000	1,640,000	4,500
2	Lanark, Leeds and Grenville Counties	44,500	1,640,000	854,250	899,000	2,490,000	6,800
3	Regional Municipality of the City of Ottawa	43,000	1,580,000	-	43,000	1,580,000	4,300
4	Renfrew County	28,000	1,030,000	9,900	38,000	1,040,000	2,800
5	Frontenac, Lennox and Addington Counties	30,000	1,110,000	52,450	82,000	1,160,000	3,200
6	Hastings, Northumberland, City of Prince Edward Counties	56,000	2,060,000	127,150	183,000	2,190,000	6,000
7	Peterborough County, Kawartha Lakes County	70,500	2,600,000	9,950	80,000	2,610,000	7,200
9	City of Toronto	-	-	-	-	-	-
13	Regional Municipality of Durham	19,000	700,000	-	19,000	700,000	1,900
14	Regional Municipality of York	36,500	1,340,000	99,100	136,000	1,440,000	3,900
15	Regional Municipalities of Halton and Peel	19,000	700,000	-	19,000	700,000	1,900
16	Simcoe County	70,500	2,600,000	15,600	86,000	2,610,000	7,200

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MPAC Region	Region Description	Septic Tank Waste Generation (m^3/year)	Septic Tank Waste Generation (Equivalent STP Rated Capacity m^3/year)	Holding Tank Waste Generation (m^3/year)	Total Hauled Sewage Volume (m^3/year)	Total Hauled Sewage Volume (Equivalent STP Rated Capacity m^3/year)	Total Hauled Sewage Volume (Equivalent STP Rated Capacity m^3/day)
17	District Municipality of Muskoka	-	-	-	-	-	-
18	Regional Municipality of Niagara	40,000	1,470,000	-	40,000	1,470,000	4,000
19	Regional Municipality of Hamilton	25,000	920,000	-	25,000	920,000	2,500
20	City of Brantford, Brant, Haldimand and Norfolk Counties	31,000	1,140,000	1,195,000	1,226,000	2,340,000	6,400
21	Regional Municipality of Waterloo, The Counties of Dufferin and Wellington, and the City of Guelph	52,500	1,930,000	-	53,000	1,930,000	5,300
23	Elgin, Middlesex and Oxford Counties	55,500	2,040,000	7,300	63,000	2,050,000	5,600
24	Huron and Perth Counties	26,500	980,000	38,500	65,000	1,010,000	2,800
25	Bruce and Grey Counties	53,000	1,950,000	70,200	123,000	2,020,000	5,500
26	Municipality of Chatham-Kent, Lambton County	36,500	1,340,000	-	37,000	1,340,000	3,700
27	Essex County	31,000	1,140,000	6,100	37,000	1,150,000	3,200
28	Territorial Districts of Nipissing and Parry Sound	30,500	1,120,000	400	31,000	1,120,000	3,100
29	Territorial Districts of Cochrane and Timiskaming	15,500	570,000	-	16,000	570,000	1,600
30	Regional Municipality of Sudbury and the Territorial Districts of Sudbury and Manitoulin	15,500	570,000	485,750	501,000	1,060,000	2,900

MPAC Region	Region Description	Septic Tank Waste Generation (m^3/year)	Septic Tank Waste Generation (Equivalent STP Rated Capacity m^3/year)	Holding Tank Waste Generation (m^3/year)	Total Hauled Sewage Volume (m^3/year)	Total Hauled Sewage Volume (Equivalent STP Rated Capacity m^3/year)	Total Hauled Sewage Volume (Equivalent STP Rated Capacity m^3/day)
31	Territorial District of Algoma	14,500	530,000	39,400	54,000	570,000	1,600
32	Territorial District of Kenora, Rainy River and Thunder Bay	28,000	1,030,000	15,950	44,000	1,050,000	2,900
Total	Yearly Total (m^3/year)	920,000	33,700,000	3,040,000	3,965,000	36,800,000	100,800

The centre of the best estimate range is used to support costing which includes approximately 920,000 m^3/year and 3,040,000 m^3/year of material from septic and holding tanks, respectively. Table 3-3 shows that material from septic tanks is estimated to represent less than 25% of the volume of hauled sewage but over 90% of contaminant loading expressed as rated capacity. The total estimated rated capacity required to manage all hauled sewage at STPs is 100,800 m^3/day, which is on the order of 1% of the rated capacity identified as part of this project in the province.

3.3 Destinations of Hauled Waste

The destination of hauled sewage was characterized as part of the Quantification Report by MPAC Region by considering input from the stakeholder surveys as well as MOECC input. The MOECC input was based upon a review of Environmental Compliance Approval information, and input from District offices.

ECAs related to hauled sewage management sites are issued primarily by district offices (estimated to be 90%), with some issued by Environmental Approvals Branch (EAB) estimated to be about 10%. The conditions, requirements, and duration of ECAs vary based upon the age of the approval. It is common for new district approvals to have a two year duration, and therefore the total number of approvals changes with time. It is estimated that between 350, and 375 sites are approved to manage hauled sewage; however it is also known that not all approvals are actively used. The approvals may include: land application, storage, dewatering trenches, exfiltration lagoons, lagoons with surface water discharge, and processing. Less than five ECAs from EAB were identified with processing technology such as digestion, which supports the assumption that the majority of hauled sewage is currently applied to land without treatment. Storage is common as part of ECAs issued by EAB, 27 of 35 records include storage. The capacity identified as part of ECAs for land application and other management sites varies substantially. New district office approvals commonly provide a maximum land application rate. Actual application rates are less than the permitted maximum and are likely to vary substantially; however a number of newer ECAs were identified with a maximum application rate of 15 L / m^2 / week. Based upon the order of magnitude application rate information available, the total capacity for approved land application is difficult to quantify; however it is anticipated to be many times the quantity of hauled sewage generated. The ECA information available supports survey data responses, and District office survey information which suggests that the most common management practices for hauled sewage are currently land application of untreated hauled sewage, and STP disposal at or upstream of the headworks. Approvals also suggest that dewatering trenches and exfiltration lagoons provide a meaningful portion of management for northern and remote communities. Other alternatives for treatment prior to land application that appear to be implemented less commonly include:

- Management directly through the solids digestion / processing at STPs;
- Management at dedicated anaerobic digestion facilities;
- Geotextile tube dewatering and storage / stabilization to NASM quality;
- Alkaline stabilization to Non-Agricultural Source Material (NASM) quality; or

- Other proprietary technology for stabilization to Non-Agricultural Source Material (NASM) or fertilizer quality

It is anticipated that a change in policy that would ban or discourage land application of untreated hauled sewage will cause a shift to management at STPs with conventional sewage, or dedicated treatment to NASM quality material for management within the restrictions of the Nutrient Management Act (NMA). Dewatering trenches would also be considered for remote locations. This report is focused on opinions of probable cost for STP treatment capacity, dedicated alkaline stabilization as a representative example of treatment to NASM quality, and dewatering trenches. The current breakdown of management between STPs, land application, and dewatering trench has not been characterized with certainty. Survey information collected as part of this project, MOECC estimates provided by district offices, and a proposed estimate for cost estimation are summarized in Dillon's Quantification Report as part of this project. The survey data collected from haulers included a relatively low response rate, including some MPAC regions without any responses from haulers. The experience of MOECC district offices is considered more likely to represent the best estimate even through it is acknowledged that individual experiences may bias the MOECC district office data as well. It is also noted that hauler responses show delivery to STPs at a higher rate for most MPAC Regions than the MOECC data, and given that no data was required to support hauler responses, it may indicate that haulers anticipate this is the preferred alternative, and are more willing to respond where management to STPs forms a substantial portion of operations. The estimated percentage for each management approach in each MPAC region carried for costing based upon the data available is presented as follows:

- MOECC District Office estimates are taken where they were presented as single percentage estimates;
- In cases where MOECC District Office presented as a range, the end of the range that best agrees with hauler survey response data was selected; and
- Where the MOECC District office estimate was presented as greater than or less than a value, and no hauler data was available, the numerical percentage presented by the MOECC was used to represent the MPAC Region.

The rules used to generate the estimates used for this costing report allow a consistent approach to using information, but they do not necessarily provide insight into management practices. The allocation of hauled sewage among management approaches is a key area of uncertainty in terms of the real costs that may be experienced after a policy change. The current allocation used for cost estimates is provided in Table 3-4. Changes in allocation in the future were not developed for this project; however banning the land application of untreated hauled sewage would require reallocation of a substantial portion of hauled sewage to an alternate management approach.

Table 3-4: Summary of Allocation of Hauled Sewage Quantity by Management Approach for each MPAC Region

MPAC Region	Hauler Survey				MOECC District Office Estimates			Estimate used for Costing		
	Hauler Survey Response Code	STP	Land Application	Dewatering Trench/ Exfiltration Lagoon	STP	Land Application	Dewatering Trench/ Exfiltration Lagoon	STP	Land Application	Dewatering Trench/ Exfiltration Lagoon
1	1	20%	80%	0%	60%	40%	0%	60%	40%	0%
	8	0%	100%	0%						
	10	0%	100%	0%						
	23	100%	0%	0%						
	24	100%	0%	0%						
	28	<1%	90%	>9%						
	Average Response	<37%	62%	>2%						
2	7	100%	0%	0%	50%	50%	0%	50%	50%	0%
	11	25%	75%	0%						
	20	100%	0%	0%						
	23	100%	0%	0%						
	24	100%	0%	0%						
	Average Response	85%	15%	0%						
3	1	20%	80%	0%	40 to 50%	50 to 60%	0%	50%	50%	0%
	2	100%	0%	0%						
	11	25%	75%	0%						
	23	100%	0%	0%						
	24	100%	0%	0%						
	Average Response	69%	31%	0%						

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MPAC Region	Hauler Survey				MOECC District Office Estimates			Estimate used for Costing		
	Hauler Survey Response Code	STP	Land Application	Dewatering Trench/ Exfiltration Lagoon	STP	Land Application	Dewatering Trench/ Exfiltration Lagoon	STP	Land Application	Dewatering Trench/ Exfiltration Lagoon
4	11	25%	75%	0%	40-50%	50-60%	0%	40%	60%	0%
	Average Response	25%	75%	0%						
5	7	100%	0%	0%	50%	50%	0%	50%	50%	0%
	11	25%	75%	0%						
	Average Response	63%	38%	0%						
6	7	100%	0%	0%	50%	50%	0%	50%	50%	0%
	Average Response	100%	0%	0%						
7	15	8%	92%	0%	<25%	>70%	<5%	25%	70%	5%
	17	40%	60%	0%						
	Average Response	24%	76%	0%						
9	1	20%	80%	0%	100%	0%	0%	100%	0%	0%
	14	100%	0%	0%						
	Average Response	60%	40%	0%						
13	14	100%	0%	0%	>50%	<50%	0%	50%	50%	0%
	15	8%	92%	0%						
	17	40%	60%	0%						
	Average Response	49%	51%	0%						

MPAC Region	Hauler Survey				MOECC District Office Estimates			Estimate used for Costing		
	Hauler Survey Response Code	STP	Land Application	Dewatering Trench/ Exfiltration Lagoon	STP	Land Application	Dewatering Trench/ Exfiltration Lagoon	STP	Land Application	Dewatering Trench/ Exfiltration Lagoon
14	14	100%	0%	0%	>50%	<50%	0%	50%	50%	0%
	15	100%	0%	0%						
	Average Response	100%	0%	0%						
15	4	100%	0%	0%	100%	0%	0%	100%	0%	0%
	13	100%	0%	0%						
	14	100%	0%	0%						
	Average Response	100%	0%	0%						
16	9	100%	0%	0%	40%	60%	0%	40%	60%	0%
	14	100%	0%	0%						
	22	0%	100%	0%						
	25	100%	0%	0%						
	Average Response	75%	25%	0%						
17	25	100%	0%	0%	40%	60%	0%	40%	60%	0%
	26	100%	0%	0%						
	Average Response	100%	0%	0%						
18	14	100%	0%	0%	100%	0%	0%	100%	0%	0%
	Average Response	100%	0%	0%						

MPAC Region	Hauler Survey				MOECC District Office Estimates			Estimate used for Costing		
	Hauler Survey Response Code	STP	Land Application	Dewatering Trench/ Exfiltration Lagoon	STP	Land Application	Dewatering Trench/ Exfiltration Lagoon	STP	Land Application	Dewatering Trench/ Exfiltration Lagoon
19	4	100%	0%	0%	>50%	<50%	0%	50%	50%	0%
	14	100%	0%	0%						
	Average Response	100%	0%	0%						
20	14	100%	0%	0%	>50%	<50%	0%	50%	50%	0%
	Average Response	100%	0%	0%						
21	3	20%	80%	0%	>50%	<50%	0%	50%	50%	0%
	9	100%	0%	0%						
	12	100%	0%	0%						
	14	100%	0%	0%						
	Average Response	80%	20%	0%						
23	-	-	-	-	90%	10%	0%	90%	10%	0%
	Average Response	-	-	-						
24	12	100%	0%	0%	<25%	>75%	0%	25%	75%	0%
	Average Response	100%	0%	0%						
25	9	100%	0%	0%	10%	90%	0%	10%	90%	0%
	12	100%	0%	0%						
	14	100%	0%	0%						
	18	100%	0%	0%						
	Average Response	100%	0%	0%						

MPAC Region	Hauler Survey				MOECC District Office Estimates			Estimate used for Costing		
	Hauler Survey Response Code	STP	Land Application	Dewatering Trench/ Exfiltration Lagoon	STP	Land Application	Dewatering Trench/ Exfiltration Lagoon	STP	Land Application	Dewatering Trench/ Exfiltration Lagoon
26	27	100%	0%	0%	<25%	>75%	0%	25%	75%	0%
	Average Response	100%	0%	0%						
27	21	100%	0%	0%	>50%	<50%	0%	50%	50%	0%
	27	100%	0%	0%						
	Average Response	100%	0%	0%						
28	19	100%	0%	0%	50%?	25%?	25%?	50%	25%	25%
	25	100%	0%	0%						
	Average Response	100%	0%	0%						
29	5	6%	93%	1%	<15%	<5%	>80%	15%	5%	80%
	Average Response	6%	93%	1%						
30	-	-	-	-	50 to 70%	0%	30 to 50%	50%	0%	50%
	Average Response	-	-	-						
31	6	100%	0%	0%	50%	0%	50%	50%	0%	50%
	19	100%	0%	0%						
	Average Response	100%	0%	0%						
32	-	-	-	-	1% to <50%	0%	>50% to 99%	50%	0%	50%
	Average Response	-	-	-						
Total		78%	22%	0%				51%	40%	10%

After a change in policy, it may be difficult or undesirable to mandate, or control the management approach selected by private system owners or sewage industry service providers. Management of hauled sewage at STPs is the most common alternative to untreated land application now, and may be the preferred choice of private system owners or haulers after a policy change. It is prudent to consider the potential impact of managing all hauled sewage at municipal STPs by adding hauled sewage to the conventional sewage. As presented in Table 3-1, hauled sewage from septic systems is typically much more concentrated than conventional sewage, while holding tank waste is considered likely to be similar to the quality of conventional sewage. Material collected from septic tanks may impact the biological treatment process, and at high loading rates may lead to process upsets, and / or impact effluent quality. Experience suggests that up to 2% of STP rated volumetric capacity can be dedicated to hauled sewage while protecting the biological system and effluent quality. It is considered likely that this experience is based upon a blend of septic and holding tank waste. Based upon the contaminant load from the estimated province wide average blended combination of septic and holding tank waste, adding 2% hauled sewage by volume may consume up to 20% of STP organic treatment capacity, and 2% septic tank waste could consume up to 75% of STP organic treatment capacity of a treatment plant. In order to assess the potential cost of treatment on a loading basis, the hauled sewage generated in each MPAC region is presented in terms of equivalent STP rated capacity, and as a percentage of total treatment capacity in Table 3-5.

Table 3-5: Total Number of Facilities, Total STP Rated Capacity, Hauled Sewage Quantity, and Fraction of Total Capacity by MPAC Region

MPAC Region	Region Description	Total Facilities	Total Treatment Capacity (m^3/d)	Hauled Sewage Quantity (Equivalent STP rated capacity m^3/d)[1]	Hauled Sewage Loading as a Fraction of Total Capacity[2]
1	Prescott, Russel, Stormont Dundas and Glengarry Counties	33	113,724	4,500	4.0%
2	Lanark, Leeds and Grenville Counties	13	86,255	6,800	7.9%
3	Regional Municipality of the City of Ottawa	2	545,153	4,300	0.8%
4	Renfrew County	10	51,097	2,800	5.5%
5	Frontenac, Lennox and Addington Counties	6	128,596	3,200	2.5%
6	Hastings, Northumberland, City of Prince Edward Counties	23	567,844	6,000	1.1%

MPAC Region	Region Description	Total Facilities	Total Treatment Capacity (m^3/d)	Hauled Sewage Quantity (Equivalent STP rated capacity m^3/d)[1]	Hauled Sewage Loading as a Fraction of Total Capacity[2]
7	Peterborough County, Kawartha Lakes County	14	103,774	7,200	6.9%
9	City of Toronto	5	1,544,367	-	0.0%
13	Regional Municipality of Durham	13	542,281	1,900	0.4%
14	Regional Municipality of York	17	32,670	3,900	12%
15	Regional Municipalities of Halton and Peel	10	776,687	1,900	0.2%
16	Simcoe County	27	201,091	7,200	3.6%
17	District Municipality of Muskoka	18	19,604	-	0.0%
18	Regional Municipality of Niagara	23	316,039	4,000	1.3%
19	Regional Municipality of Hamilton	3	429,920	2,500	0.6%
20	City of Brantford, Brant, Haldimand and Norfolk Counties	16	136,802	6,400	4.7%
21	Regional Municipality of Waterloo, The Counties of Dufferin and Wellington, and the City of Guelph	31	361,855	5,300	1.5%
23	Elgin, Middlesex and Oxford Counties	39	384,609	5,600	1.5%
24	Huron and Perth Counties	18	75,185	2,800	3.7%
25	Bruce and Grey Counties	26	82,812	5,500	6.6%
26	Municipality of Chatham-Kent, Lambton County	28	141,952	3,700	2.6%
27	Essex County	23	281,957	3,200	1.1%
28	Territorial Districts of Nipissing and Parry Sound	13	76,880	3,100	4.0%
29	Territorial Districts of Cochrane and Timiskaming	43	106,098	1,600	1.5%

MPAC Region	Region Description	Total Facilities	Total Treatment Capacity (m^3/d)	Hauled Sewage Quantity (Equivalent STP rated capacity m^3/d)[1]	Hauled Sewage Loading as a Fraction of Total Capacity[2]
30	Regional Municipality of Sudbury and the Territorial Districts of Sudbury and Manitoulin	25	136,452	2,900	2.1%
31	Territorial District of Algoma	17	104,423	1,600	1.5%
32	Territorial District of Kenora, Rainy River and Thunder Bay	30	159,772	2,900	1.8%
Total		523	7,507,897	100,800	1.3%

[1]Hauled waste expressed as an equivalent volume of standard sewage.
[2]Relative percentage of hauled sewage estimated to be generated of total treatment capacity in the MPAC region presented as equivalent STP rated capacity accounting for the increased load associated with septic tank material.

Table 3-5 indicates that all MPAC regions contain sufficient treatment capacity to accommodate locally produced hauled sewage without exceeding a 20% load increase. Only in one region, The Region of York, does hauled waste exceed 10% of available capacity. Consequently, it is anticipated that only a fraction of existing facilities within each region will be required to accept hauled sewage while protecting STPs and the environment. The actual number of facilities upgraded will depend on a number of factors including size and distribution of treatment capacity relative to hauled sewage generation. It is worth noting that the estimates provided in Table 3-5 are presented on an annual average basis, and do not account for seasonal or daily variations in hauled sewage delivered to STPs. The estimates also do not account for relative distance from private systems to individual STPs, receiving facilities already available at STPs, or preferential delivery of hauled sewage to individual STPs. All of these factors may tend to increase the quantity of hauled sewage at individual STPs, and present additional risks to treatment facilities. The analysis of quantity compared with treatment capacity is intended as a high level measure of potential risk, and does not replace detailed evaluation of STP hauled sewage receiving infrastructure needs required for each MPAC Region and individual facilities.

4.0 Treatment Approach

Wastewater processes with sizing dependent on organic or nutrient mass loading (e.g. aeration and biosolids handling) are the unit processes most affected by hauled sewage. The required available plant capacity to treat hauled sewage may need to consider relative strength, as a small volume of concentrated hauled sewage may consume a larger fraction of plant design capacity. Potential modifications to liquid and biosolids treatment requirements are summarized in this section based upon the treatment approach selected.

4.1 Wastewater Treatment

For wastewater treatment processes, system complexity and required effluent quality are anticipated to affect the type and cost of infrastructure changes to manage hauled sewage.

Mechanical Treatment

It is envisioned that hauled sewage will be treated with conventional sewage from sanitary sewers through the allocation of treatment capacity at existing STPs, or through allocation of a portion of new STP capacity construction implemented at new and existing STPs. Major process components anticipated at every facility include:

- Hauled sewage receiving infrastructure: A standard-sized receiving station providing hauler logging/tracking, grinding and screening, with a small building enclosure prior to treatment is assumed for each facility.
- Flow equalization: Tankage to accumulate hauled sewage received to mitigate the effect of shock loads to the treatment process as trucked waste is received at the facility. Controlled pumping of material from an equalization basin will maintain a more consistent process load and reduce the likelihood of upset conditions
- Biological treatment process: A suspended growth conventional activated sludge (CAS) biological process is considered representative of the majority of mechanical treatment plants in Ontario. Design refinements specific to each site are not considered for the high level costs presented here, but would be necessary to determine sizing for new infrastructure at individual facilities.

For some facilities that have stringent effluent quality limits, effluent filtration is anticipated to be required.

- Tertiary treatment for total phosphorous removal in the form of deep bed sand filtration following chemical addition is considered as part of the high end of the cost estimate. TP from septic tank materials is higher strength that conventional sewage, and it is anticipated that future trends in total phosphorous effluent limits will make tertiary treatment necessary at an increasing number of facilities in the future.

Information collected from STP surveys showed that existing hauled sewage receiving stations are not as complex as the typical station described above. The most common approach is an access point such as a manhole within the existing collection system, at a pump station, or at the headworks of the STP. The more robust receiving station with equalization tank described above is considered prudent to include in the cost estimate for hauled sewage management, because it aligns with MOECC design guidance (MOECC, 2008), and as the quantity of hauled sewage received increases, the potential need for spill containment, odour mitigation, and controlled addition of hauled sewage into the treatment system becomes more important.

Lagoon Treatment

The cost of treatment is considered for an aerated lagoon or facultative lagoon system. Lagoons represent treatment systems in rural or remote areas, or may be considered as a low-cost alternative for treatment where existing mechanical facilities are not available. A continuous discharge process has been developed for this assessment for aerated lagoons, while facultative lagoons are assumed to be intermittent discharge with 6-month retention time. Major process components for a lagoon system are anticipated to include:

- Hauled sewage receiving infrastructure: A standard-sized septage receiving station providing hauler logging/tracking, grinding and screening prior to treatment for each facility;
- Aerated lagoon (if included): A lagoon with diffused aeration for BOD removal; and
- Facultative/polishing lagoon: An un-aerated lagoon cell providing temporary storage and treatment of remaining BOD loading.

In order to meet the wastewater systems effluent regulation (WSER) for ammonia, it is anticipated that some systems will require a nitrifying filter.

- Nitrifying filters (e.g. below grade attached-growth aerated systems or intermittent sand filters).

Remote/Low Capacity Treatment

Areas within the province with very low population densities, or areas where private sewage systems are not within reasonable hauling distances of STPs, and agricultural demand for NASM is limited may consider alternative forms of septage management. Dewatering trench structures, which contain solids and allow for infiltration of liquid within a confined area are likely to be considered. The cost of dewatering trenches has been estimated following the size and configuration guidelines set out in the *Draft Guide to Disposal of Septage in Dewatering Trenches (MOECC, 2008).*

Treatment to NASM quality for use in Agriculture

There are a number of technologies that may be considered to generate a NASM quality material, including geotextile dewatering containers (e.g. Geotubes®), alkaline stabilization, and various vendor technologies designed to reduce pathogens. For the purpose of the costs presented in this report, an alkaline stabilization process is considered representative to achieve pathogen reduction necessary for land application of hauled sewage as a NASM product. Alkaline stabilization systems that would align with the *Draft Guide to Alkaline Stabilization of Domestic Septage* (MOECC, 2008) would include in-vessel treatment providing a minimum of 30 minutes of contact time at pH 12, with a further 1-day curing tank and lagoon based storage of treated material for up to six months prior to land application.

4.2 Biosolids Treatment

The solids and organic loading from high-strength hauled sewage may generate a substantial quantity of biosolids requiring management. Considerations include the need to stabilize residuals for appropriate use in accordance with best-practices guidelines. A level of treatment consistent with production of a biosolids product meeting NASM requirements has been used for this assessment. The following processing options have been considered:

- Aerobic digestion with management of digested biosolids as a liquid material
- Anaerobic digestion with management of digested biosolids as a liquid material
- Anaerobic digestion with dewatering of digested material to a solid cake

The costs of offsite management, storage and land application are highly variable and may be highly dependent on local conditions. A range of cost for biosolids management is presented based on the estimated quantity of total and volatile solids associated with hauled sewage, anticipated reduction in volatile solids through treatment, and publicly available management cost per tonne of biosolids.

4.3 Identification of Treatment needs

The quantity of hauled sewage estimated by MPAC region is currently managed either through treatment with conventional sewage at STPs, application to land, or in some MPAC regions using dewatering trenches. Characterizing the number, type, and rated capacity of STPs in Ontario provides context for the likely type of treatment system that may require upgrades.

4.3.1 Existing Treatment Capacity

Information on existing treatment facilities within the province has been provided through MOECC records. The distribution of treatment facilities by using rated capacity categories that align with previous effort for the MOECC is summarized below in Table 4-1.

Table 4-1: Existing Treatment Facility Summary

Rated Capacity, r, m^3/d	Total Facilities	Mechanical Facilities	Lagoon Facilities	Total Rated Capacity (m^3/d)	Median Overall Facility Size (m^3/d)	Median Mechanical Facility Size (m^3/d)	Median Lagoon Size
**reported as "0" or not reported	44	38	6	NA	NA	NA	NA
r <460	138	81	58	20,612	112	60	207
460≤ r <2,300	183	101	86	212,212	1,063	1,158	981

Rated Capacity, r, m^3/d	Total Facilities	Mechanical Facilities	Lagoon Facilities	Total Rated Capacity (m^3/d)	Median Overall Facility Size (m^3/d)	Median Mechanical Facility Size (m^3/d)	Median Lagoon Size
2,300≤ r <4,600	68	55	13	227,594	3,184	3,300	3,180
4,600≤ r <13,800	60	53	7	466,587	6,817	6,817	5,797
13,800≤ r ≤46,000	41	41	0	983,355	21,997	21,997	NA
r >46,000	32	32	0	5,163,017	80,713	80,713	NA

The number of treatment facilities is greater for the smaller size categories, while the majority of rated capacity in the province is delivered by facilities in the higher capacity categories. Survey information was collected as part of this project to characterize the current quantity of hauled sewage received by existing STPs within the province; however the response rate does not allow reliable quantities by rated capacity of STP to be reported (by MPAC region and province wide).

It is known that a portion of existing treatment facilities receive hauled sewage as part of their normal operations. Additional facilities may also be capable of receiving hauled sewage by allocating uncommitted reserve capacity for treatment. Information regarding the uncommitted hydraulic reserve capacity is not required to be reported to the MOECC for all STPs, and the information available for the province is not aggregated centrally such that reliable assumptions could be developed for allocation of uncommitted hydraulic reserve capacity to hauled sewage treatment. Survey information also suggests that hauled sewage is not consistently considered for STP design, and therefore uncommitted hydraulic reserve capacity is typically intended to be allocated to new serviced developments within communities. It is considered prudent to include the cost of building new treatment infrastructure to manage the total quantity of hauled sewage such that the value of existing treatment capacity allocated is characterized, and the potential cost of new infrastructure is considered.

4.3.2 New Facility Size Requirements

An estimate was developed for the approximate physical size of treatment works required to manage the hauled sewage quantity within each MPAC region. This order-of-magnitude sizing considers the approximate quantity of suspended growth aeration tank volume for mechanical systems, or the lagoon volume required to accommodate the BOD_5 mass loading associated with each MPAC region. An estimate of the equivalent quantity of STP rated capacity requirement for each MPAC region is presented in Table 3-5. The number of treatment facilities that require receiving stations to limit the percentage of treatment capacity dedicated at any one STP is estimated by dividing the total capacity required by 20% of the median facility size in each MPAC Region. The number of facilities estimated, the median size of facility, and additional biological treatment capacity required at each facility are presented in Table 4-2.

Table 4-2: Estimated Additional STP Capacity Requirements

MPAC Region	Region Description	Estimated Number of Facilities Requiring Receiving Stations and Treatment Upgrades	Median Facility Size with MPAC Region (m^3/d)	Additional Aeration Volume Required Per facility[1] (*total volume*) m^3	Facultative Lagoon Area required per-facility[2] (*total*) Ha
1	Prescott, Russel, Stormont Dundas and Glengarry Counties	22	1,058	129 (*2,848*)	1.8 (*38.8*)
2	Lanark, Leeds and Grenville Counties	8	4,329	541 (*4,327*)	7.4 (*59*)
3	Regional Municipality of the City of Ottawa	1	272,576	2,749 (*2749*)	37.5 (*37.5*)
4	Renfrew County	7	2,052	258 (*1807*)	3.5 (*24.6*)
5	Frontenac, Lennox and Addington Counties	3	7,745	670 (*2009*)	9.1 (*27.4*)
6	Hastings, Northumberland, City of Prince Edward Counties	17	1,823	224 (*3801*)	3.0 (*51.8*)
7	Peterborough County, Kawartha Lakes County	29	1,261	156 (*4524*)	2.1 (*61.7*)
9	City of Toronto	-	345,998	NA	-
13	Regional Municipality of Durham	2	6,821	607 (*1215*)	8.3 (*16.6*)
14	Regional Municipality of York	7	2,874	358 (*2505*)	4.9 (*34.2*)
15	Regional Municipalities of Halton and Peel	1	39,768	1,215 (*1215*)	16.6 (*16.6*)
16	Simcoe County	16	2255	283 (*4534*)	3.9 (*61.8*)
17	District Municipality of Muskoka	-	544		-

MPAC Region	Region Description	Estimated Number of Facilities Requiring Receiving Stations and Treatment Upgrades	Median Facility Size with MPAC Region (m^3/d)	Additional Aeration Volume Required Per facility[1] (*total volume*) m^3	Facultative Lagoon Area required per-facility[2] (*total*) Ha
18	Regional Municipality of Niagara	2	16606	1,279 (*2557*)	17.4 (*34.9*)
19	Regional Municipality of Hamilton	1	18,300	1,598 (21.8)	21.8 (21.8)-
20	City of Brantford, Brant, Haldimand and Norfolk Counties	13	2467	312 (*4055*)	4.3 (*55.3*)
21	Regional Municipality of Waterloo, The Counties of Dufferin and Wellington, and the City of Guelph	12	2376	280 (*3356*)	3.8 (*45.8*)
23	Elgin, Middlesex and Oxford Counties	32	899	111 (*3561*)	1.5 (*48.6*)
24	Huron and Perth Counties	8	1901	220 (*1761*)	3.0 (*24*)
25	Bruce and Grey Counties	14	2004	251 (*3510*)	3.4 (*47.9*)
26	Municipality of Chatham-Kent, Lambton County	18	1067	130 (*2333*)	1.8 (*31.8*)
27	Essex County	9	1814	221 (*1992*)	3.0 (*27.2*)
28	Territorial Districts of Nipissing and Parry Sound	21	765	93 (*1950*)	1.3 (*26.6*)
29	Territorial Districts of Cochrane and Timiskaming	13	618	76 (*991*)	1.0 (*13.5*)
30	Regional Municipality of Sudbury and the Territorial Districts of Sudbury and Manitoulin	10	1598	183 (*1834*)	2.5 (*25*)
31	Territorial District of Algoma	7	1149	142 (*995*)	1.9 (*13.6*)

MPAC Region	Region Description	Estimated Number of Facilities Requiring Receiving Stations and Treatment Upgrades	Median Facility Size with MPAC Region (m^3/d)	Additional Aeration Volume Required Per facility[1] (*total volume*) m^3	Facultative Lagoon Area required per-facility[2] (*total*) Ha
32	Territorial District of Kenora, Rainy River and Thunder Bay	9	1668	202 (*1818*)	2.8 (*24.8*)

[1]approximate aeration volume assuming an activated sludge facility with a mixed liquor suspended solids concentration of 3,000 mg/L and a BOD load to biomass (F:M) ratio of $0.1d^{-1}$. Other design parameters are assumed not to be limiting.
[2]approximate facultative lagoon area assuming organic load-limited sizing and an average load of 22 kd/(ha*d) (MOECC, 2008). Note that additional sizes are based on organic load only and do not consider additional long-term storage volume required for semi-annual batch discharge.

The total amount of new treatment capacity is presented as new mechanical treatment plant capacity and the equivalent area of lagoons that would be required. Only one or the other would be required to deliver the required treatment capacity. The equivalent area of lagoons is presented in part to show that if all hauled sewage were managed through lagoons the area required is likely not feasible, and therefore lagoons can contribute only a portion of the treatment capacity. The treatment capacity required ranged from 0.2 – 12% of the rated capacity available in each MPAC region, which suggests that existing treatment capacity could be allocated, or expanded to accommodate up to 20% hauled sewage treated with conventional sewage.

5.0 Cost Review

This section is focused on developing an opinion of probable cost for new infrastructure that is anticipated in the event that policy is changed such that land application of untreated hauled sewage is not an option. There are two main ways in which costs may be observed:

- Private system owner costs for the transport and disposal of hauled sewage by contractors; and
- The incremental capital and operating costs associated with constructing and operating hauled sewage management infrastructure.

5.1 User Cost Information

Owners of private systems engage sewage industry service providers to haul the contents of septic and holding tanks. The cost to these users is highly variable. In general the cost structure for sewage industry service providers is considered to be a function of:

- Equipment (primarily trucks with ancillary equipment);
- Labour;
- Distance traveled (e.g. fuel and vehicle depreciation); and
- Disposal cost.

The cost of disposal is either related to the service providers' private site (maintaining approvals, application equipment, storage facilities etc.), or a tipping fee at a treatment system (most often municipal STPs).

Municipalities and STPs were asked to provide tipping fees required at STPs for hauled sewage as part of survey data collection. A summary of the responses from municipalities and STP operations teams are presented separately in Table 5-1.

Table 5-1: Summary of Survey Responses Regarding Tip Fees at STPs

Survey Source	Minimum tip fee reported ($/m3)	Maximum tip fee reported ($/m3)	Average tip fee reported ($/m3)	Median tip fee reported ($/m3)
Municipal[1,2]	1.83	35.83	15.13	13.10
STP	1.40	76.00	19.02	17.50

1 - There were three survey responses greater than maximum presented that appear to be reported with incorrect units.

2 – There were also two responses less than the minimum reported that were two orders of magnitude lower, and are considered likely to be a per Litre cost.

Information provided in terms of cost per load is not included in the data presented in Table 5-1. Due to the variable volume of a load, the information on per load basis is not directly comparable to the information in Table 5-1. The range of cost per load reported in the STP survey was $35 - $200. The average and median tip fees per load were $110.62 and $96.00, respectively. For a load consisting of a single average private septic system (4.5 m^3) the load rates are reported to be above the median per m^3 cost, while for a full truck load (~20m^3), the load rate would be on the low end of the per m^3 cost range.

Some respondents reported higher tip fees for septic tank waste compared with holding tank waste, and one respondent reported charging double for loads from outside the municipal boundary. All respondents that reported an industrial tip fee, reported that it was the same as the residential fee per volume.

The Hauler survey requested information about the cost to private system owners. Only 14 of 31 Haulers that responded were willing to provide cost information, and the level of detail provided varied widely. Haulers reported costs in a variety of ways, and each business had different methods of accounting for volume of hauled sewage, septage or holding tank material, residential or commercial customers. The overall range for a pump out for residential systems was $160 - $480 per septic tank, and $185 - $230 for holding tanks. In general, distance travelled was either included in the price, or a certain distance was included in the price, and a rate per kilometer was added to the base price. Winter pump-out also tended to increase the cost.

It is worth noting that the Haulers who responded to the survey reported delivering hauled sewage to STPs at a higher rate than other sources of information (primarily MOECC district office experience) would suggest. It is important to keep in mind that the information provided by haulers is likely more representative of management through STPs rather than land application or other approaches. The data collected did not allow a cost differentiation to be made between land application, dewatering trench management and delivery to STPs.

It is anticipated that investment in infrastructure at STPs, or by haulers to process hauled waste to NASM quality will be reflected in the cost charged for tip fees, and ultimately experienced by private system owners. There is pressure for municipalities to set fees for wastewater services that reflect full cost recovery, but it is clear that the lower end of existing tip fees do not reflect cost recovery.

Transportation can affect the cost to private system owners in two main ways:

1. Transportation additional distance increases cost on a per kilometer basis for variable costs such as fuel; and
2. Increases in transportation distant tends to reduce the total number of loads a hauler can collect per time (daily / annually), which distributes fixed business costs over fewer customers, and increases total cost to private system owners

Although probable cost increases to private system owners cannot be characterized in detail based upon the information available for this project, it is worth noting that if a policy change tends to lead to centralized management of hauled sewage and increased transportation distances, the cost to private system owners will tend to increase.

5.2 Treatment Capital Costing

Capital costs have been estimated for treatment of hauled sewage, accounting for the full estimated quantity of hauled sewage in Ontario. This total includes material that may already be managed at STPs. An incremental construction unit cost ($\$/(m^3/d)$ capacity) has been estimated for mechanical STPs and lagoons corresponding to the median facility size within each flow capacity bracket identified in Table 4-1. It is assumed that the incremental cost of hauled sewage treatment is appropriate for both for the addition of new capacity at existing facilities, and for the construction of new facilities. Capital costs associated with treatment to NASM quality through alkaline treatment and dewatering trenches have also been estimated for comparison.

Treatment for conventional wastewater effluent quality meeting a minimum standard of the national *Wastewater Systems Effluent Regulations* (WSER) (SOR/2012-139) under the fisheries act is assumed, with the additional cost of tertiary treatment to meet enhanced discharge quality provided separately. The uncertainty related to the level of treatment required is reflected in the ranges of cost estimated.

The CapdetWorks costing package has been used to develop a cost for hauled sewage treatment per m^3 for construction, assuming standard 2017 unit prices. Regional variations may apply to the cost of constructing systems, particularly those located in remote areas of the province; however the cost per m^3 for each technology of size range presented has not been adjusted between MPAC regions.
Core capital cost items include:

- Inlet septage receiving infrastructure: Cost of a standard septage receiving station providing hauler logging/tracking, grinding and screening prior to treatment.
- Flow equalization
- Biological treatment
- Biosolids treatment
- Chemical addition for phosphorous removal and effluent filtration

Capital costing has been developed with the following assumptions:

- Hauled sewage will be blended with typical sewage upstream of the treatment process. Blending will produce a combined waste stream with an organic strength not more than 20% greater than existing wastewater and will allow a conventional treatment process to be implemented
- Treatment capacity to accommodate hauled sewage will be added to the existing rated capacity (See Table 3-5). The probably capital cost of expansion is presented for facilities that may presently have uncommitted hydraulic reserve capacity assuming that hauled sewage would otherwise displace future capacity for servicing new development in the community.
- Facility expansion will consist of construction of a parallel treatment process containing all core wastewater and solids process units.
- The organic loading to the existing facility will remain constant. Maintaining a consistent organic load will require “de-rating” the hydraulic capacity of the existing facility. With a 20% increase in blended waste strength, the existing facility hydraulic loading will decrease by approximately 19%.
- The new parallel process will receive the excess blended inlet flow, which will be approximately 19% of the original facility hydraulic capacity. The size of this new parallel process will depend on a number of factors, including existing wastewater strength, and the average strength of the received hauled waste.

- For each size range, the median existing facility size has been identified and new treatment capacity (19% of the existing median facility size) has been identified. This assumed capacity is used to size and cost the new capital construction.
- Management of hauled sewage through Remote/Low Capacity Treatment (e.g. dewatering trenches) or through alkaline stabilization will occur without blending with other wastewater streams and at locations independent of existing municipal wastewater treatment infrastructure.
- Final effluent disinfection and outfall structures are assumed to be common to existing and new treatment capacity. No new costs for hauled sewage treatment are assigned to these items, because the hydraulic load is not anticipated to substantially change these unit processes.

It is acknowledged that this represents a conservative costing approach, as many facilities may presently accommodate hauled sewage, or be able to do so at minimal costs. In some cases, the cost of targeted capital improvements at specific facilities (e.g. increases to blower or aeration tank size) may be accommodated at less cost than the construction of a new treatment train if sufficient capacity reserve in other process units is available to treat hauled waste.

Costing estimates are presented for six STP size ranges in Table 5-2 to 5-4 below. These size ranges represent the initial rated capacity of an existing treatment facility (lagoon or mechanical treatment plant). The process cost represents the cost of receiving and treating hauled sewage for BOD removal to a secondary level effluent quality. The cost of tertiary treatment for TP and solids removal process units is provided separately, because it would not be required for all facilities. Total cost for the system (e.g. a mechanical process with secondary level treatment, tertiary filtration and solids digestion) is represented by the sum of the relevant unit costs.

5.2.1 Mechanical Treatment

Incremental costs for a mechanical STP are shown below in Table 5-2. The following design assumptions were made in pricing the mechanical STP process:

- Each upgraded facility would be equipped with a hauled sewage receiving system providing monitoring/access control, grinding and screening for protection of the downstream biological process, and flow equalization with adjustable feed rate to the treatment process.
- Biological process tanks are sized with sufficient volume to provide BOD removal and nitrification, with a food to biomass ratio of 0.1. This sizing represents the assumption that ammonia discharge limits will be relevant for the majority of facilities in the province for the considered planning horizon.
- Biological treatment consists of concrete aeration tanks, secondary clarifiers, blowers (with associated process buildings) and pumps.

Table 5-2: Mechanical STP Capital Unit Costing Summary

Facility Size Range (m^3/day)	<460[1]	460-2,300	2,300-4,600	4,600-13,800	13,800-46,000	>46,000
Median Additional Treatment Volume Required Per Facility[2]	11.5m3/d	220m3/d	630m3/d	1300m3/d	4,200m3/d	15,300m3/d
Biological Treatment Process Cost ($/($m^3$/d) capacity)						
· Mechanical Treatment Process Cost	$45,000	$11,000	$5,600	$3,900	$2,400	$1,700
Tertiary Treatment Cost ($/($m^3$/d) capacity)						
· Deep-bed Sand Filter (Mechanical Treatment)[3]	$4,000	$1,200	$900	$700	$400	$300
Biosolids Management Unit Cost ($/($m^3$/d) capacity)						
· Aerobic Digestion	$2,800	$900	$400	$200	$120	$100
· Anaerobic Digestion	$10,000	$3,300	$1,200	$600	$300	$200
· Anaerobic Digestion with Dewatering	$13,000	$4,200	$1,600	$1,100	$900	$600
Total Unit Cost Range ($/($m^3$/d))	$45,000 - $62,000	$11,000 - $16,400	$5,600 - $8,100	$3,900 - $5,700	$2,400 - $3,700	$1,700 – $2,600
Total Capital Cost Range (median sized facility)[4]	$520,000 – $710,000	$2.4M - $3.6M	$3.5M- $5.1M	$5.1M – $7.4M	$10.1M – $15.5M	$26M – $40M

[1]Process configuration for very small treatment volumes may differ from larger facilities. Pricing for this size range has been estimated using a non-linear exponential scaling factor of 0.63. Budgeting for systems of this size may be best accomplished in coordination with suppliers of similarly sized packaged systems.
[2]Based upon 20% increase in treatment capacity for the median sized facility rated capacity
[3]Deep bed sand filters for tertiary treatment cost estimated using implementation project experience rather than CapdetWorks.
[4]Capital cost ranges from construction of a simple secondary level biological process with no filtration or solids processing to construction of a mechanical treatment system with anaerobic digestion and dewatering, and deep bed filtration. Total costs correspond to the median indicated treatment volumes.

The minimum assumed capital cost includes:

- Mechanical treatment
- No tertiary filtration (assuming less stringent receiver requirements)
- Aerobic digestion of biosolids with offsite management as liquid

The maximum assumed capital cost includes:

- Mechanical treatment
- Tertiary filtration (assuming stringent effluent receiver requirements)
- Anaerobic biosolids digestion with dewatering

The cost range for the smallest capacity mechanical plants is much higher per m^3 of capacity. This occurs mainly because a robust receiving station becomes a substantial portion of the total cost when hauled sewage treatment is less than 20% of the rated capacity. It is not likely that hauled sewage receiving at very small mechanical STPs will provide the most cost effective management and therefore it is considered unlikely that this cost range is relevant. Therefore the estimate of probable cost range is $1,700 – $16,400 per m^3/day of rated capacity. It should also be noted that the largest facility sizes are relatively rare, particularly in areas with substantial hauled waste generation.

5.2.2 Lagoon Treatment

Costs in this section represent estimates of the range of construction costs for two types of lagoon processes:

1. A facultative lagoon with no aeration and sufficient volume to provide 6-months of storage for seasonal discharge.
2. An aerated lagoon process consisting of an aerated cell followed by a facultative cell. The envisioned process would generate effluent of sufficient quality to permit continuous discharge. Storage capacity has not been included to allow storage of treated effluent for a 6-month period between periodic lagoon discharge events.

An estimate of the additional cost of an aerated below grade nitrifying filter process has been provided separately to show the potential increase in capital to meet more stringent ammonia discharge limits. Digestion process infrastructure for biosolids management has not been included, as the majority of solids generated through treatment processing would be dealt with through a periodic lagoon de-sludging.

The following design assumptions were made in pricing the lagoon STP process:

- Each upgraded facility would be equipped with a hauled sewage receiving system providing monitoring/access control, grinding and screening for protection of the downstream biological process, and flow equalization.
- The aerated lagoon process includes a facultative storage lagoon, with cost estimated based upon the MOECC BOD surface loading limit of 22kg/(ha*d), without consideration for the BOD removal anticipated in the first aerated facultative lagoon cell.
- The facultative lagoon process cost is estimated assuming a maximum 22kg/(ha*d) organic load and 6-months of storage, assuming a 1.8m liquid depth and a permanent liquid level of 0.6m.

- Land acquisition costs for lagoon construction are considered due to the size of this process and likelihood that construction may occur separately from existing works. A cost of $10,000 per acre is assumed based on standard Ontario agricultural land prices.
- Nitrifying filter cost is based on relative hydraulic loading of each facility size range. Cost of this system is influenced by residual ammonia concentration and effluent quality requirements and may be refined during design of individual facilities.

Lagoon treatment costing is summarized below in Table 5-3. Note that the largest two STP rated capacity size ranges are not presented in the table, because lagoons are typically implemented for lower rated capacity and there were no existing systems identified in these categories.

Table 5-3: Lagoon STP Capital Costing Summary

Facility Size Range (m^3/day)	<460[1]	460-2,300	2,300-4,600
Median Additional Treatment Volume Required	21.3 m3/d	200 m3/d	600 m3/d
· Facultative Lagoon Process Cost	$25,000	$7,800	$4,600
· Aerated Lagoon Treatment Process Cost	$28,000	$9,300	$4,700
Tertiary Treatment Cost			
· Nitrifying Filter (Lagoon)	$9,000	$3,800	$2,500
Total Unit Cost Range ($/($m^3$/d))	$25,000 – $37,000	$7,800 – $13,000	$4,600 – $7,200
Total Capital Cost Range (median sized facility)[4]	$530,000 - $790,000	$1.6M – $2.7M	$2.8M – $4.3M

The cost range for the smallest capacity lagoons is much higher per m^3 of capacity. This occurs mainly because a robust receiving station becomes a substantial portion of the total cost when hauled sewage treatment is less than 20% of the rated capacity. A less complex receiving station may be acceptable for small lagoon systems assuming that direct addition of hauled sewage will not upset the biological treatment process, and given the retention time involved, effluent quality is much less sensitive to the hauled sewage addition rate. The receiving station requirements may ultimately be driven by odour management and setbacks from odour receptors. Very small and very large systems are not considered likely to be implemented and therefore the range of probable costs is estimated to be $4,600 – $13,000 / m^3 of lagoon rated capacity.

5.2.3 Alkaline Stabilization

Alkaline stabilization costing is summarized below in Table 5-4. Costs represent the construction of a stand-alone system for treatment of the septage component of hauled waste without blending with typical wastewater. It is assumed that the alkaline-stabilized product is suitable for land application as a NASM without further digestion or processing. The median treatment volumes are identified corresponding to the volume of blended hauled sewage (mix of septic and holding tank material) used for mechanical or lagoon treatment within three facility size ranges considered practical for construction of a process of this type, corresponding to the capacity to receive approximately 3 to 35 11,000L trucks per day. Alkaline stabilization of smaller volumes through a centralized process is assumed to be less practical or cost effective. Similarly very large facilities are unlikely as the cost of hauling is expected to be impractical.

Alkaline stabilization is not anticipated to be directly associated with existing facilities. Volumes presented represent the actual quantities of septage, not the equivalent construction of new STP for blended waste. Cost estimates are based upon the following configuration:

- A hauled sewage receiving system providing monitoring/access control, grinding and screening for protection of the downstream biological process, and flow equalization;
- An allowance for the cost of tankage to receive, process and cure hauled sewage as described in Section 4.1;
- Cost allowance for lime storage and support systems; and
- Product storage provided in a lagoon with a 6-month holding capacity to accommodate agricultural use of NASM.

Table 5-4: Alkaline Stabilization Capital Costing Summary

Assumed Treatment Capacity (m^3/day)	4,600-13,800	13,800-46,000	>46,000
Median Treatment Volume Required	35 m3/d	110 m3/d	410 m3/d
· Chemical Stabilization Process Cost[1] ($/(m3/d) capacity)	$56,000	$34,000	$20,000
Total Capital Cost[2] (median sized facility)	$2.0M	$3.8M	$8.3M

[1]Cost per m^3/d of raw hauled waste, without dilution with municipal sewage.

The range of probable cost estimated to implement these facilities is \$20,000 – \$56,000 per m^3/day capacity. It is worth noting that the capital costs per m^3 of material treated for this approach appear high in comparison to construction of new capacity for more dilute blended wastewater at an STP.; however the cost of the system is not very sensitive to the strength of material, and is therefore much better suited to managing concentrated septic tank material. Although, holding tank waste or low strength material could be managed through the system, the much lower nutrient and organic matter content would provide less benefit for use in agriculture. The best way to observe the difference between STP management and dedicated treatment to NASM is in the total cost of management summary provided in subsequent sections.

5.2.4 Dewatering Trenches

Dewatering trench costs were estimated following design assumptions set out in the 2008 MOECC *Draft Guide to Disposal of Septage in Dewatering Trenches.* Costing estimates for this alternative were developed based upon the following configuration:

- Dewatering trench systems would be installed in regions with favourable soil conditions, with a minimum permeability of 10 min/cm, allowing for the maximum recommended septage application rate;
- Siting will not impact ground water quality as prescribed by the "reasonable use" criteria assessed on a site specific basis;
- Trenches would be the maximum recommended physical dimension of 75m length, 3m width and 1m depth, with minimal separation between trenches;
- No additional land area purchase would be required for down gradient contaminant attenuation;
- Necessary screening of hauled sewage to remove foreign objects prior to application to trenches would be provided by haulers and is not captured in capital costs.
- Capital costs for construction of a dewatering trench consist of land acquisition and trench excavation. Unit costs for treatment are not influenced by the total volume of material handled at each site, and would be limited by the guidance related to configuration of trenches and reasonable use of groundwater.
- The 2015 Manitoba cost per acre of agricultural land ($1750/acre) (Statistics Canada, 2017) has been selected as representative cost for areas (particularly northern Ontario) where trenches are most likely to be constructed.

The capital cost of a dewatering trench for excavation costs only with land available at no cost (e.g. crown land or existing municipal property is $2,400/($m^3$/d) capacity is represents the lowest probable cost of implementation. The additional cost of land acquisition for the trench and immediate surrounding buffer area, without consideration of the area required for groundwater attenuation is $2,650/($m^3$/d). The size of the attenuation zone requires site specific inputs related to the reasonable use of groundwater, and is difficult to estimate for a generalized scenario. Conservative assumptions required to attenuate for example 1 m^3/d of full strength septic tank material to a background nitrate concentration of 2.5mg/L may require as much as 63 acres of attenuation area. The cost of owning the most conservative attenuation zone would be prohibitive, and therefore the cost of owning the attenuation zone has not been included in the estimates provided. The cost of hydrogeological assessment and other site specific evaluation required to determine the attenuation zone is also considered highly site specific, and has not been developed in detail for this report. Overall, the cost of infrastructure is very low, but the overall cost of protection of groundwater may be substantial for this approach.

Dewatering trenches presents the simplest approach, with the least investment; however it is considered likely to be challenging to site these facilities in many portions of the province in order to allow for the required setbacks and attenuation zones. It is considered probable that they are only relevant for MPAC Regions 28 – 32. They are most likely relevant for areas where management through STPs is not feasible due to trucking distances. Material accumulated in trenches may be excavated and used as a NASM, where holding time provide pathogen reduction to CP2 standards; however it is considered likely that dewatering trenches are most useful in areas with limited agricultural demand for nutrients, where the approach would represent disposal.

5.3 O&M Costing

Costs have been estimated at a high level for each of the treatment processes and sizes based on Dillon's professional experience, available unit costs and typical costing metrics generated through the CaptdetWorks costing tool. We have excluded the cost of operator labour from this estimate as many hauled sewage processes co-located with existing works may use existing site staff to operate additional treatment capacity at negligible incremental cost. Costs are expressed as $/year per m^3/d of additional treatment capacity constructed. We have considered the minimum and maximum costs for a potentially viable treatment process within the range of technologies considered as part of this exercise

O&M Costs may encompass a number of items including:

- Electricity demand for equipment (assuming a cost of $0.1/kWh)
- Chemical cost (e.g. alum for phosphorous removal)
- Annual allowance for maintenance labour cost,
- Equipment replacement costs (based on the cost of replacement divided by a standard equipment replacement frequency)
- Sludge management cost (sludge hauling and disposal).

Operating costs were developed with a number of assumptions including:

- Electricity costs of $0.1/kWh
- Chemical costs consisting primarily of polymer for dewatering processes or alum for phosphorous removal and filtration
- Sludge disposal may be performed following practices appropriate for management of NASM.

The cost of biosolids management is considered primarily from facilities operating an activated sludge process, disposing stabilized digested sludge or dewatered cake. Disposal costs for lime stabilized material may differ. Lagoon biosolids disposal is considered as the desludging/disposal frequency (once per 10-20 years) is dependent on lagoon loading and operation, and contractor fees for bulk sludge removal.

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Table 5-5: Operating and Maintenance Unit Cost Summary

Facility Size Range (m^3/day)	<460	460-2,300	2,300-4,600	4,600-13,800	13,800-46,000	>46,000
Median Treatment Volume Required	21.3m3/d	200m3/d	600m3/d	1300m3/d	4,200m3/d	15,300m3/d
Operating Costs ($/($m^3$/d capacity)/year)[5]						
Core Process						
· Activated Sludge Process	$4,800	$1,200	$500	$320	$200	$150
· Facultative Lagoon Process	$2,200	$440	$210	$150	$90	$50
· Aerated Lagoon Process	$3,100	$810	$330	$200	$140	$100
· Chemical Stabilization Process[4]				$1,200	$1,100	$1000
Biosolids management Process						
· Aerobic Digestion	$790	$340	$130	$70	$40	$30
· Anaerobic Digestion	$1,000	$420	$150	$50	$50	$45
· Anearobic Digestion with Dewatering[1]	$1,200	$520	$200	$130	$100	$70
Tertiary Treatment						
· Filtration alum demand[2]	$4	$4	$4	$4	$4	$4
Biosolids Disposal						
· Land Application of Dewatered Biosolids[3]	$10-25	$10-25	$10-25	$10-25	$10-25	$10-25
Total Operating Cost Range ($/$m^3$/d capacity) per year	$2200-$6000	$450-$1800	$230-$720	$160-$1200	$100-$1100	$60-$1000

[1]Dewatering costs include polymer demand.

[2]Alum demand is estimated assuming an 0.5mg/L average total phosphorous limit. This value is applicable to addition to a CAS process ahead of tertiary filters, or applicable to lagoons which may add alum to a storage chamber. Unit costs are constant as dosage is proportional to flow at fixed concentration.

[3]Based on modeled sludge production and a disposal cost of $92 – $135 per wet tonne based on a municipal reference for land application of dewatered sludge cake, and examples of lagoon desludging events. Cost range is dependent on relative volume per dry tonne, and has the potential to vary outside the range presented for individual cases.

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[4]Based on treatment of un-blended hauled waste. Corresponding volumes are identified in Table 5-4
[5]Operating costs exclude labour for operation. It is assumed existing facility operators may operate additional treatment capacity at nominal cost.

The range of operating costs presented in Table 5-5 reflect the range of operating costs for biological treatments, and potential biosolids or tertiary treatment add-on processes.

The minimum assumed operating cost includes:

- Operation of a facultative lagoon system
- Land disposal of biosolids from de-sludging (low end cost)

The maximum assumed operating cost includes:

- Operation of an activated sludge treatment process
- Anaerobic digestion with dewatering
- Tertiary filtration
- Land disposal of dewatered biosolids (high end cost)

At the higher capacity ranges the cost of operating a chemical stabilization process is greater on a per-unit volume basis than conventional treatment.

5.4 STP Capital and Operating Cost Estimates

Total costs have been estimated based upon 100% of the hauled sewage quantity estimated being treated at 282 upgraded facilities, as identified in Table 4-2. As described above the number of facilities is estimated based upon limiting the treatment capacity allocated to hauled sewage on a mass loading basis to less than 20% of the STP rated capacity. The number of facilities included for each MPAC region is used to estimate the number of receiving stations, based on the median size of treatment facility presently constructed within the MPAC region. The range of sizes of facilities within each size range within individual MPAC regions is shown for reference. Total costs are estimated based on the median size of facility present in each MPAC region, the corresponding unit cost range to upgrade a median-sized facility, and the number of upgraded facilities required. Overall costs are presented as a range indicating variability in overall costs between different treatment process alternatives and possible biosolids and tertiary treatment processes.

The costs presented in Table 5-7 represent the required capital cost range for construction of new capacity for the total quantity of hauled sewage estimated for the province, or construction of capacity to accommodate the quantity that is currently managed through land application. The *Hauled Sewage Quantification and Destination Summary Report*, presents estimates of the quantity of hauled sewage managed through STPs, dewatering trenches and land application. The estimated percentage of hauled sewage that is managed using land application is presented for each MPAC region in Table 5-6. The range of costs estimated to manage hauled sewage using STP infrastructure is presented in Table 5-7. Low end costs are represented by simple mechanical treatment with aerobic digestion. High end costs are represented by more sophisticated mechanical treatment including tertiary filtration and anaerobic digestion.

Table 5-6: Overall Facility Upgrades Summary

MPAC Region	Number of STPs						Median Size of existing STPs in MPAC Region (m^3/d)	Facilities of Median Size Requiring Upgrades[1]	Percentage of Hauled Sewage Volume Currently Estimated to be managed using land application	Estimated Number of Median-Sized Facility Upgrades Required for Land-Applied Hauled Waste Only
	<460	460 - 2,300	2,300 - 4,600	4,600 - 13,800	13,800 - 46,000	>46,000				
1	7	18	3	4	0	1	1,045	22	60%	9
2	3	1	4	2	3	0	4,329	8	50%	4
3	1	0	0	0	0	1	272,576	1	50%	1
4	0	6	0	3	1	0	2,052	7	40%	5
5	1	0	1	2	1	1	7,745	3	50%	2
6	2	11	1	5	3	2	1,823	17	50%	9
7	3	8	1	0	1	1	1,261	29	50%	15
9	1	0	0	0	1	3	219,000	-	100%	
13	1	2	4	2	2	2	4,553	2	50%	1
14	10	3	3	0	1	0	-	7	50%	4
15	1	0	1	2	1	5	39,768	1	100%	0
16	4	11	1	5	5	1	2,255	16	40%	10
17	8	5	4	0	0	0	285	-	40%	-
18	12	2	0	2	3	4	441	2	100%	0
19	0	0	1	0	1	1	18,300	1	50%	1

MPAC Region	Number of STPs						Median Size of existing STPs in MPAC Region (m^3/d)	Facilities of Median Size Requiring Upgrades[1]	Percentage of Hauled Sewage Volume Currently Estimated to be managed using land application	Estimated Number of Median-Sized Facility Upgrades Required for Land-Applied Hauled Waste Only
20	2	6	2	4	1	1	2,467	13	50%	7
21	9	9	5	2	3	3	1,469	12	80%	3
23	11	16	2	3	6	1	825	32	90%	4
24	2	8	4	3	1	0	1,896	8	25%	6
25	7	9	4	5	1	0	1,677	14	10%	13
26	5	13	7	1	1	1	1,067	18	25%	14
27	6	7	4	3	2	1	1,814	9	50%	5
28	5	5	0	2	0	1	683	21	75%	6
29	20	14	2	6	1	0	527	13	95%	1
30	4	11	6	3	0	1	1,244	10	100%	0
31	7	5	2	0	2	1	1,063	7	100%	0
32	6	13	7	2	1	1	1,499	9	100%	0
Total	138	183	69	61	42	33		282		120

[1]Actual number of upgraded facilities may differ, particularly for MPAC regions where the majority of facilities will require upgrades.

[2]Capital costing assuming the cost of upgrading the number of required facilities at the unit cost per m^3 of additional capacity for the median sized facility within the MPAC region. Facilities may include stand-alone systems processing un-blended hauled waste such as alkaline stabilization or dewatering trenches not associated with existing treatment infrastructure.

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Table 5-7: Costing Summary

MPAC Region	Description of MPAC Region	Total Cost (Least Cost Management Alternative)	Total Cost (Greatest Cost Management Alternative)	Total Cost (Least Cost Management Alternative)	Total Cost (Greatest Cost Management Alternative)
		Upgrades to All Receiving Facilities		Upgrades to New Receiving Facilities Only	
1	Prescott, Russel, Stormont Dundas and Glengarry Counties	$58,000,000	$79,000,000	$24,000,000	$32,000,000
2	Lanark, Leeds and Grenville Counties	$42,000,000	$57,000,000	$21,000,000	$28,000,000
3	Regional Municipality of the City of Ottawa	$131,000,000	$135,000,000	$93,000,000	$135,000,000
4	Renfrew County	$35,000,000	$49,000,000	$25,000,000	$35,000,000
5	Frontenac, Lennox and Addington Counties	$11,000,000	$16,000,000	$7,000,000	$11,000,000
6	Hastings, Northumberland, City of Prince Edward Counties	$77,000,000	$105,000,000	$41,000,000	$56,000,000
7	Peterborough County, Kawartha Lakes County	$90,000,000	$124,000,000	$65,000,000	$90,000,000
9	City of Toronto		$0	$0	$0
13	Regional Municipality of Durham	$7,000,000	$10,000,000	$3,000,000	$5,000,000
14	Regional Municipality of York	$24,000,000	$33,000,000	$14,000,000	$19,000,000
15	Regional Municipalities of Halton and Peel	$14,000,000	$20,000,000	$0	$0
16	Simcoe County	$89,000,000	$123,000,000	$56,000,000	$77,000,000
17	District Municipality of Muskoka	$0	$0	$0	$0
18	Regional Municipality of Niagara	$11,000,000	$16,000,000	$0	$0
19	Regional Municipality of Hamilton	$6,000,000	$9,000,000	$6,000,000	$9,000,000
20	City of Brantford, Brant, Haldimand and Norfolk Counties	$39,000,000	$52,000,000	$21,000,000	$28,000,000
21	Regional Municipality of Waterloo, The Counties of Dufferin and Wellington, and	$35,000,000	$47,000,000	$17,000,000	$23,000,000

MPAC Region	Description of MPAC Region	Total Cost (Least Cost Management Alternative)	Total Cost (Greatest Cost Management Alternative)	Total Cost (Least Cost Management Alternative)	Total Cost (Greatest Cost Management Alternative)
	the City of Guelph				
23	Elgin, Middlesex and Oxford Counties	$71,000,000	$98,000,000	$9,000,000	$12,000,000
24	Huron and Perth Counties	$38,000,000	$52,000,000	$28,000,000	$39,000,000
25	Bruce and Grey Counties	$69,000,000	$95,000,000	$64,000,000	$89,000,000
26	Municipality of Chatham-Kent, Lambton County	$47,000,000	$65,000,000	$37,000,000	$51,000,000
27	Essex County	$40,000,000	$56,000,000	$22,000,000	$31,000,000
28	Territorial Districts of Nipissing and Parry Sound	$40,000,000	$55,000,000	$11,000,000	$16,000,000
29	Territorial Districts of Cochrane and Timiskaming	$20,000,000	$27,000,000	$2,000,000	$2,000,000
30	Regional Municipality of Sudbury and the Territorial Districts of Sudbury and Manitoulin	$39,000,000	$54,000,000	$0	$0
31	Territorial District of Algoma	$20,000,000	$27,000,000	$0	$0
32	Territorial District of Kenora, Rainy River and Thunder Bay	$37,000,000	$51,000,000	$0	$0
Total		$1,090,000,000	$1,455,000,000	$566,000,000	$788,000,000

[1]Actual number of upgraded facilities may differ, particularly for MPAC regions where the majority of facilities will require upgrades.

[2]Capital costing assuming the cost of upgrading the number of required facilities at the unit cost per m^3 of additional capacity for the median sized facility within the MPAC region. Facilities may include stand-alone systems processing un-blended hauled waste such as alkaline stabilization or dewatering trenches not associated with existing treatment infrastructure.

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Costs in Table 5-7 represent a conservative estimate based upon mechanical STP treatment for all hauled waste. This is assumed to be the predominant technology available to manage hauled waste in the province. Lagoon treatment may also be available for consideration, particularly in areas where lower capacity facilities are common. The least cost alternative, considering lagoons for facilities within the sizing range identified in Table 5-3 is $744,000,000 for upgrades to all facilities and $390,000,000 for new receiving facilities only.

Separately we have considered the cost of managing septage through dedicated alkaline stabilization facilities producing a NASM product for land application. New alkaline stabilization infrastructure would not necessarily be co-located with existing treatment facilities. New facilities may be constructed in a range of sizes. We have assumed that lime stabilization processes would be constructed with capacities of approximately 35m^3 to 410m^3, accepting approximately 3 to 35 11,000L trucks per day. Cost ranges represent the variability in anticipated per-unit capital costs depending on the size of the individual facilities constructed. Costs for each MPAC region are summarized below in Table 5-8. Costs are provided for management of all septic tank material and, and septic tank material estimated to be currently managed through un-treated land application.

The remaining quantity of hauled sewage not treated through alkaline stabilization will consist of holding tank material at a concentration approximately equal to conventional sewage. Additional capacity requirements to treat this material, approximately 8,300m^3/d total, is very small relative to the existing province-wide installed treatment capacity and it is assumed this material may be handled at less than 10 % of the estimate provided for management through STPs.

Table 5-8: Summary of Cost for Alkaline Stabilization as Primary Management Approach

MPAC Region	Treatment of All Septic Tank Material		Treatment of Septic Tank Material Currently Land Applied	
1	$4,100,000	$9,700,000	$1,600,000	$3,900,000
2	$4,100,000	$9,800,000	$2,100,000	$4,900,000
3	$4,000,000	$9,400,000	$2,000,000	$4,700,000
4	$2,600,000	$6,100,000	$1,600,000	$3,700,000
5	$2,800,000	$6,600,000	$1,400,000	$3,300,000
6	$5,200,000	$12,300,000	$2,600,000	$6,100,000
7	$6,500,000	$15,500,000	$4,600,000	$10,800,000
9	$0	$0	$0	$0
13	$1,800,000	$4,200,000	$900,000	$2,100,000
14	$3,400,000	$8,000,000	$1,700,000	$4,000,000
15	$1,800,000	$4,200,000	$0	$0

MPAC Region	Treatment of All Septic Tank Material		Treatment of Septic Tank Material Currently Land Applied	
16	$6,500,000	$15,500,000	$3,900,000	$9,300,000
17	$0	$0	$0	$0
18	$3,700,000	$8,800,000	$0	$0
19	$2,300,000	$5,500,000	$1,200,000	$2,700,000
20	$2,900,000	$6,800,000	$1,400,000	$3,400,000
21	$4,800,000	$11,500,000	$2,400,000	$5,800,000
23	$5,100,000	$12,200,000	$500,000	$1,200,000
24	$2,400,000	$5,800,000	$1,800,000	$4,400,000
25	$4,900,000	$11,600,000	$4,400,000	$10,500,000
26	$3,400,000	$8,000,000	$2,500,000	$6,000,000
27	$2,900,000	$6,800,000	$1,400,000	$3,400,000
28	$2,800,000	$6,700,000	$700,000	$1,700,000
29	$1,400,000	$3,400,000	$100,000	$200,000
30	$1,400,000	$3,400,000	$0	$0
31	$1,300,000	$3,200,000	$0	$0
32	$2,600,000	$6,100,000	$0	$0
Total	$85,000,000	$200,000,000	$39,000,000	$92,000,000

6.0 Summary and Conclusions

This report provides a high-level overview of the considerations and methods used to develop opinions of probable costs for treatment of hauled sewage in the province. Capital and operating costs presented represent a range of probable costs for implementation of upgrades, understanding that there may be significant variation in the type of treatment processes required in individual locations. Further detailed design effort is required to estimate the probable cost of upgrades for individual facilities.

The range of probable capital cost and operating costs in order to manage Hauled sewage is presented in Table 6-1:

Table 6-1: Summary of Cost per Unit Treatment Capacity for Hauled Sewage Management Alternatives

Management Alternative	Min	Max
Estimated capital cost of additional lagoon capacity ($/M^3/day rated capacity)	$3000	$13,000
Estimated operating cost for lagoon treatment ($/m^3/year)	$150	$3,810
Estimated capital cost of additional Mechanical STP capacity ($/M^3/day rated capacity)	$1700	$16,400
Estimated operating cost for mechanical STP treatment ($/m^3/year)	$150	$9,020
Estimated capital cost of alkaline stabilization to NASM quality ($/m^3/day capacity)	$20,000	$70,000
Estimated operating cost of alkaline stabilization to NASM quality ($/m^3/year)	$1,000	$2,200
Estimated capital cost of dewatering trenches ($/m^3/day capacity)	$2,400 – $2650	Unclear
Estimated operating cost of dewatering trenches ($/m^3/year)	$10	$25

* Operating costs for STP and lagoon systems do not reflect cost of staffing. It is assumed staff would be shared with the existing facility.

The opinion of probable capital cost estimated for implementing sewage treatment plant infrastructure is based upon either prudent or conservative assumptions regarding the infrastructure required. The quantity of hauled sewage that requires management estimated for this report is based upon the centre of the best estimate range from the quantification portion of this project. The probable cost of implementing STP capacity for the full amount of hauled sewage in Ontario is estimated to be between

$1,090,000,000 and $1,455,000,000. This estimate assumes full recovery of treatment capital costs, including for facilities where hauled waste presently consumes a portion of treatment capacity. Rated capacity at these facilities is assumed to be intended for serviced development, and all new infrastructure would eventually be required to manage hauled sewage. Assuming that new infrastructure is only required for the quantity of hauled sewage estimated to be applied to land without treatment, the probable cost of new STP infrastructure is estimated to be between $566,000,000 and $788,000,000. The low end cost estimates assuming lagoon treatment may be considered for applicable plant size ranges is $744,000,000 for upgrades to all facilities and $390,000,000 for new receiving facilities only.

Material collected from holding tanks is considered best managed through STPs, while material collected from septic tanks is much more concentrated and represents hauled sewage that may be more efficiently and cost effectively managed through a dedicated process that would generate a NASM quality material for agricultural use. The cost associated with dedicated alkaline stabilization processes is estimated to be on the order to $85,000,000 to $200,000,000 for all septic tank material in the province, and $39,000,000 to $92,000,000 for material currently estimated to be applied to land. Use of dewatering trenches is likely to be limited to remote areas of the province and in limited appropriate situations is likely to represent a cost effective management option.

A potential change in policy that would ban land application of untreated hauled waste is anticipated to be most cost effectively implemented by providing flexibility for municipalities and sewage industry service providers to select from a range of management options.

References

Ministry of the Environment and Climate Change (MOECC). 2008. Design Guidelines for Sewage Works 2008. Available Online: https://www.ontario.ca/document/design-guidelines-sewage-works. Last Accessed: March 15, 2017

Ministry of Environment and Climate Change (MOECC). 2008. Draft Guide to Disposal of Septage in Dewatering Trenches

Ministry of Environment and Climate Change (MOECC). 2008. Draft Guide to Alkaline Stabilization of Domestic Septage

XCG Consultants Ltd. "Capability of Municipal Sewage Treatment Plants to Co-Treat Septage and Landfill Leachates." Oakville, 2004.

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