

Task Title:

CalculatingSizeofResidentialSepticSystem_A_A1.2_A2.2_B3.2a_C3.3



Task Title: Calculating the Size of a Residential Septic System

OALCF Cover Sheet – Practitioner Copy

Learner Name: _____

Date Started: _____

Date Completed: _____

Successful Completion: Yes ☐ No ☐

Goal Path: Employment ☐ Apprenticeship ☐

Secondary School ☐ Post Secondary ☐ Independence ☐

Task Description: The learner will make calculations for installing septic systems in rural communities using the Ontario Building Code.

Main Competency/Task Group/Level Indicator:

- Find and Use Information/Read continuous text/A1.2
- Find and Use Information/Interpret documents/A2.2
- Communicate Ideas and Information/Complete and create documents/B3.2a
- Understand and Use Numbers/Use measures/C3.3

Materials Required:

- Pen/pencil and paper and/or digital device
- Printer to print chart used in Task 4 (optional)
- Calculator or digital device with calculator function

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Learner Information

Plumbers must understand the calculations for sizing a septic system in a residential home, including the daily flow rate, the wastewater absorption rate and the size of the tank needed.

Read “Calculating the Size of a Septic System of a Residential Home”.

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Calculating the Size for a Septic System of a Residential Home

How to interpret the code!

The building code can be quite intimidating and confusing. Here is a quick guide to help you with how to design a new system.

All septic systems that are within a single lot and rated to accept a total daily flow rate of <10,000 L must comply with the Ontario Building Code (OBC). The average 3-4 bedroom house is rated at 2,000 L.

All systems must be built according to the OBC regardless of how the residence will be used such as seasonal cottage use or low occupancy numbers. The system must be built to meet the maximum use possibility of the residence in case the property is sold to new owners or changed from seasonal use to a year-round residence.

It is the homeowners' responsibility to contact local governing authorities and acquire the necessary permits associated with the septic system installation or repair.

The following guide has been put together to assist you with meeting *minimum* OBC regulations for residential septic systems. Local governing authorities may have additional by-laws in place requiring additional design requirements.

The two main factors that dictate the size and design of a septic system are the maximum daily flow and soil/site conditions.

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Maximum Daily Flow				
50L per Fixture Unit over 20		Bedrooms over 5	Each 10 sq M of Living Space over 200 sq M	
Full Bathroom (Toilet, shower, sink)	6	500L per additional bedroom	200 sq M to 400 sq M	100L for each 10 sq M over 200 (rounded up)
2 pc Bathroom (toilet, sink)	5			
Shower (stand alone)	1.5			
Floor Drain (basement)	2		400 sq M to 600 sq M	75L/10 sq M (rounded up)
Sink (not included in bathrooms)	1.5			
Garburator	3			
Dishwasher	1.5 (if connected to a sink)		600 sq M and up	50L/10 sq M (rounded up)
Laundry Tub	1.5			
Clothes washer	1.5			

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Step 1: Calculate the maximum daily flow, as per the OBC calculation.

All daily flow calculations start with the number of bedrooms. Most people assume it is based on the number of bathrooms or current occupants, but that is not the case.

The OBC assumes that for every bedroom, 2 people could be living in the residence. Average daily use per person is approximately 275 L, and therefore, the maximum daily flow could be around 500-600 L / bedroom.

OBC Bedroom Rate:

- 1 Bedroom – 750 L
- 2 Bedrooms – 1100 L
- 3 Bedrooms – 1600 L
- 4 Bedrooms – 2000 L
- 5 Bedrooms – 2500 L

(If you are building a home with more than 5 bedrooms, consult a professional)

The OBC refers to the Maximum Daily Flow as “Q” for all calculations.

Calculate the number of fixtures (bathrooms, sinks, etc.) and total living space to determine additional L/day to add to base bedroom rate. The greater of these calculations will need to be added, not both.

Fixtures:

Each fixture has a pre-determined hydraulic load which must be used to calculate daily flow.

For example: a toilet with flush tank has a hydraulic load of 6, a laundry tub has a load of 1.5, a washing machine has a load of 1.5 and a sink has a load of 1.5. Each of these is multiplied by the hydraulic load.

- 2 toilets = $2 \times 6 = 12$
- 1 laundry tub = $1 \times 1.5 = 1.5$
- 1 washing machine = $1 \times 1.5 = 1.5$
- 1 sink = $1 \times 1.5 = 1.5$

Add all of the totals to determine the fixture count.

$$12 + 1.5 + 1.5 + 1.5 = 16.5$$

16.5 is the total fixture count

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If the total fixture count exceeds 20, then 50 L per additional fixture will need to be added to the bedroom base rate (round up for each half).

For example, if your total is 23, then you may have to add 150 L to the bedroom base rate.

Living area (m2) (all living space, excluding basement)

To convert from sq ft to m2 multiply by .092903

If the house living space exceeds the included limit of 200 m2, additional flow will be added to the base rate using the following calculation:

For each 10m2 of living space over 200 m2 to a max of 400 m2, calculate 100 L per 10m2. (rounded up)

(if your house is greater than 400 m2, consult a professional)

Once the living space and fixture count flow rates have been calculated, whichever is greater must be added to the base bedroom rate.

For example:

Calculate the maximum daily flow rate for a 4-bedroom house with 3 full bathrooms, kitchen sink, clothes washer, laundry tub, dishwasher and total living space of 224 m².

Bedroom Rate = 2000 L (4 bedrooms).

The total fixture units for the house will be 23.5

Fixture units $20 + 3.5 = 23.5$

add 50L for each number above 20 $3.5 \times 50 = 175$ (round up) = 200L

The total Living space = 224m²

Living space $200 \text{ m}^2 + 24 \text{ m}^2 = 224 \text{ m}^2$

add 100L for each 10m² above 200m²

$24 \text{ m}^2 \times 100 = 2.4 \times 100 = 240$ (round up) = 300L

The largest daily flow for the living space and fixture count is 300 L which is added to the 2000 L

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The Maximum Daily Flow (Q) will be 2300 L.

Step 2: Soil/Site Conditions

The other factor to be calculated is the rate at which the treated wastewater will be absorbed into the soil.

This is called a "T" time.

"T" time is equal to the number of minutes it takes for the water level to drop per cm in a water filled hole in the receiving soil.

Sandy soil has a common T time of <10 (meaning it took less than 10 minutes for the water level to drop 1 cm in the water filled hole).

Sandy loam soil T time can be 20 or more because the smaller soil particles may slow the rate of absorption.

Clay (worst soil) the T time is generally over 50 because clay particles are so fine and tightly packed.

The most common method of identifying the percolation rate is to send a soil sample to a lab for analysis. The cost associated with a soil analysis ranges from \$200-\$300 for the test, plus the time and labour to dig the hole and deliver the sample.

Another method is to have a professional perform a percolation test on-site. The cost will be comparable to the lab analysis, but results will be known sooner and be much more accurate.

Septic System and Tank Sizing

Daily Flow and "T" time are used to calculate the tank size

The septic tank must be twice* the daily flow (Q), but no less than 3600 L. The tank must also be dual chamber with 2/3 of the volume in the first compartment. The tank size is to provide 24hr retention time of sewage to allow for proper separation of solids.

**If a garburator is installed, the volume must be three times the daily flow.*

Daily Flow = 2300L

Tank Size = $2300 \times 2 = 4600$

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The Tank Size must be 4600L

Each type of system then has a different equation to be used to figure out the size.

For example:

Conventional trench: Total Trench Length = $(Q \times T \text{ time}) / 200$

Above house example would be 2300×10 (sandy soil) = $23000 / 200 = 115$
Meters of total trench length

or

Filter Bed: Total area of Base = $((Q) \times "T" \text{ time}) / 850$

2300×10 (sandy soil) = $23000 / 850 = 27.06 \text{ sq M}$

A filter bed not only needs to meet the basic equation, there must also be enough surface area for the waste water to be absorbed at a rate of 4 L per sq. M, so for 2300L a surface area of 575 sq.M. is required.

If the T time is 50 or greater, conventional trenches cannot be installed. A raised bed or "tertiary" unit will need to be installed instead.

adapted from <http://ontarioseptictank.ca/>

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Work Sheet

Task 1: What is it the responsibility of the homeowner to do before they install or repair a septic system?

Answer:

Task 2: Why is the number of bedrooms used in the calculation of the daily flow rate?

Answer:

Task 3: List the two main factors that determine the size and design of a Septic System?

Answer:

Task 4: What is generally the "T" time for clay?

Answer:

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Task 5: There are 3 residential homes to be built. Use the following information to determine the size of the Septic System required. Use the document "Calculating the Daily Flow for a Septic System of a Residential Home" and use the chart provided to complete the calculations..

a) House 1 • 3 bedrooms • 2 full bathrooms • 1 Clothes washer (Washing Machine) • 1 Laundry tub • 1 Floor Drain • 2400 sq ft. livable space • Sandy soil with an absorption rate of 12	b) House 2 • 2 Bedrooms • 1 full bathroom • 1 Dishwasher • 1 Clothes washer • 1 Laundry Tub • 1 Floor drain • 1150 sq ft. livable space • Loamy soil with an absorption rate of 22	c) House 3 • 4 bedrooms • 3 full bathrooms • 1 1/2 bathroom • 1 dishwasher • 1 Clothes washer • 1 laundry tub • 1 additional sink • 2 floor drains • 3000 sq ft. livable space • Sandy soil with an absorption rate of 10
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DAILY FLOW CHART – House # _____			
Fixture or Device	Number of fixtures within residences	Hydraulic Load, Fixture Units	Totals (Number of fixtures within Residence x Hydraulic Load)
<i>Bathroom group (Toilet, sink, tub)</i>			
Toilet with flush tank		6	
Toilet with direct flush valve		8	
1/2 Bathroom		5	
Kitchen Sink		1.5	
Garburator		3	
Clothes Washer		1.5	
Dishwasher		1	
Laundry Tub		1.5	
Additional Tub		2	
Additional Shower (Stand Alone)		2	
Additional Sink		1.5	
Additional Toilet		4	
Floor Drain		2	
Total Daily Flow			

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DAILY FLOW CHART – House # _____			
Fixture or Device	Number of fixtures within residences	Hydraulic Load, Fixture Units	Totals (Number of fixtures within Residence x Hydraulic Load)
<i>Bathroom group (Toilet, sink, tub)</i>			
Toilet with flush tank		6	
Toilet with direct flush valve		8	
1/2 Bathroom		5	
Kitchen Sink		1.5	
Garburator		3	
Clothes Washer		1.5	
Dishwasher		1	
Laundry Tub		1.5	
Additional Tub		2	
Additional Shower (Stand Alone)		2	
Additional Sink		1.5	
Additional Toilet		4	
Floor Drain		2	
Total Daily Flow			

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DAILY FLOW CHART – House # _____			
Fixture or Device	Number of fixtures within residences	Hydraulic Load, Fixture Units	Totals (Number of fixtures within Residence x Hydraulic Load)
<i>Bathroom group (Toilet, sink, tub)</i>			
Toilet with flush tank		6	
Toilet with direct flush valve		8	
1/2 Bathroom		5	
Kitchen Sink		1.5	
Garburator		3	
Clothes Washer		1.5	
Dishwasher		1	
Laundry Tub		1.5	
Additional Tub		2	
Additional Shower (Stand Alone)		2	
Additional Sink		1.5	
Additional Toilet		4	
Floor Drain		2	
Total Daily Flow			

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Answers

Task 1: What is it the responsibility of the homeowner to do before they install or repair a septic system?

Answer: It is the homeowners' responsibility to contact local governing authorities and acquire the necessary permits associated with the septic system installation or repair.

Task 2: Why is the number of bedrooms used in the calculation of the daily flow rate?

Answer: The OBC assumes that for every bedroom, 2 people could be living in the residence. Average daily use per person is approximately 275 L, and therefore, the maximum daily flow could be around 500-600 L / bedroom.

Task 3: List the two main factors that determine the size and design of a Septic System?

Answer: maximum daily flow, soil and site conditions

Task 4: What is generally the "T" time for clay?

Answer: Generally over 50 minutes (Absorption Rate)

Task 5: There are 3 residential homes to be built. Use the following information to determine the size of the Septic System required. Use the document Calculating the Daily Flow for a Septic System of a Residential Home and use the chart provided to complete the calculations.

Answer: See completed charts that follow.

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DAILY FLOW CHART – House # <u>1</u>			
Fixture or Device	Number of fixtures within residences	Hydraulic Load, Fixture Units	Totals (Number of fixtures within Residence x Hydraulic Load)
<i>Bathroom group (Toilet, sink, tub)</i>			
Toilet with flush tank	2	6	12
Toilet with direct flush valve		8	
1/2 Bathroom		5	
Kitchen Sink		1.5	
Garburator		3	
Clothes Washer	1	1.5	1.5
Dishwasher		1	
Laundry Tub	1	1.5	1.5
Additional Tub		2	
Additional Shower (Stand Alone)		2	
Additional Sink		1.5	
Additional Toilet		4	
Floor Drain	1	2	2
Total Daily Flow			17

Bedrooms - 1600L

Fixtures - 17

Living Space - 2400 sq ft = 222.97 sq. M, $222.97 - 200 = 22.97$, $100 \times 3 = 300$ L

Add the greater of the living space or fixtures to the bedroom total, $1600 + 300 = 1900$ L

1900 L Daily Flow Rate (Q)

Tank size is $1900 \times 2 = 3800$ L

Conventional Trench = $(1900 \times 12) / 200 = 22800 / 200 = 114$ metres

Filter Bed = $(1900 \times 12) / 850 = 22800 / 850 = 26.82$ sq. m

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DAILY FLOW CHART – House # <u>2</u>			
Fixture or Device	Number of fixtures within residences	Hydraulic Load, Fixture Units	Totals (Number of fixtures within Residence x Hydraulic Load)
<i>Bathroom group (Toilet, sink, tub)</i>			
Toilet with flush tank	1	6	6
Toilet with direct flush valve		8	
1/2 Bathroom		5	
Kitchen Sink		1.5	
Garburator		3	
Clothes Washer	1	1.5	1.5
Dishwasher	1	1	1
Laundry Tub	1	1.5	1.5
Additional Tub		2	
Additional Shower (Stand Alone)		2	
Additional Sink		1.5	
Additional Toilet		4	
Floor Drain	1	2	2
Total Daily Flow			12

Bedrooms - 1100 L

Fixtures - 12

Living Space - 1150 sq ft = 106.84 sq. M

No additional Flow

1100 L Daily Flow Rate (Q)

Tank size is $1100 \times 2 = 2200$ L, minimum size tank must be 3600 L

Conventional Trench = $(1100 \times 22) / 200 = 24200 / 200 = 121$ metres

Filter Bed = $(1100 \times 22) / 850 = 24200 / 850 = 28.47$ sq. m

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DAILY FLOW CHART – House # <u>3</u>			
Fixture or Device	Number of fixtures within residences	Hydraulic Load, Fixture Units	Totals (Number of fixtures within Residence x Hydraulic Load)
<i>Bathroom group (Toilet, sink, tub)</i>			
Toilet with flush tank	3	6	18
Toilet with direct flush valve		8	
1/2 Bathroom	1	5	5
Kitchen Sink		1.5	
Garburator		3	
Clothes Washer	1	1.5	1.5
Dishwasher	1	1	1
Laundry Tub	1	1.5	1.5
Additional Tub		2	
Additional Shower (Stand Alone)		2	
Additional Sink	1	1.5	1.5
Additional Toilet		4	
Floor Drain	2	2	4
Total Daily Flow			32.5

Bedrooms - 2000L

Fixtures - $32.5 = 32.5 - 20 = 12.5$, $12.5 \times 50 = 625$ rounded up to 650L

Living Space - 3000 sq ft = 278.71 sq. M, $278.71 - 200 = 78.71$, $100 \times 8 = 800$ L

Add the greater of the living space or fixtures to the bedroom total, $2000 + 800 = 2800$ L

2800L Daily Flow Rate (Q)

Tank size is $2800 \times 2 = 5600$ L

Conventional Trench = $(2800 \times 10) / 200 = 28000 / 200 = 140$ metres

Filter Bed = $(2800 \times 10) / 850 = 28000 / 850 = 32.94$ sq. m

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Performance Descriptors

Levels	Performance Descriptors	Needs Work	Completes task with support from practitioner	Completes task independently
A1.2	scans text to locate information			
	locates multiple pieces of information in simple texts			
	makes connections between sentences and between paragraphs in a single text			
	follows the main events of descriptive, narrative and informational texts			
A2.2	performs limited searches using one or two search criteria			
	extracts information from tables and forms			
	uses layout to locate information			
	makes connections between parts of documents			
	makes low-level inferences			
B3.2a	uses layout to determine where to make entries			
	begins to make some inferences to decide what information is needed, where and how to enter the information			

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Levels	Performance Descriptors	Needs Work	Completes task with support from practitioner	Completes task independently
	makes entries using a limited range of vocabulary			
	follows instructions on documents			
C3.3	calculates using numbers expressed as whole numbers, fractions, decimals, percentages and integers			
	understands and uses formulas for finding the perimeter, area and volume of non-rectangular, composite shapes			
	manages unfamiliar elements (e.g. context, content) to complete tasks			
	chooses and performs required operations; makes inferences to identify required operations			
	selects appropriate steps to solutions from among options			
	interprets, represents and converts measures using whole numbers, decimals, percentages, ratios and fractions			
	organizes and displays numerical information (e.g. graphs, tables)			

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Levels	Performance Descriptors	Needs Work	Completes task with support from practitioner	Completes task independently
	uses strategies to check accuracy (e.g. estimating, using a calculator, repeating a calculation, using the reverse operation)			

This task: Was successfully completed ☐ Needs to be tried again ☐

Learner Comments:

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Instructor (print):

Learner (print):
