

DESIGNING YOUR RAINWATER CATCHMENT AND STORAGE SYSTEM

**FOR RAINWATER
CATCHMENT
SYSTEMS IN SAIPAN**

By

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WERI

**WATER AND ENVIRONMENTAL RESEARCH INSTITUTE
OF THE WESTERN PACIFIC
UNIVERSITY OF GUAM**

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**These guidelines may only be used for
Saipan**

HOW BIG SHOULD A NEW TANK BE? IS YOUR OLD TANK BIG ENOUGH?

This booklet provides answers to FOUR QUESTIONS:

- What should the water in your storage tank be USED FOR?
- How much water does your family use?
- How BIG of a NEW rainwater storage tank should you get?
- Is your OLD rainwater storage tank BIG enough?

In the home, the SIX MAIN USES OF WATER are:

- Drinking
- Cooking
- Washing dishes
- Bathing
- Washing clothes
- Flushing toilets

Here are some RULES:

- **ALWAYS** use the water in your rainwater storage tank according to a **USE RATE** you have decided on.
- **NEVER** use the water in your rainwater storage tank for bathing.

So, we have almost answered the question "What should the water in your rainwater storage tank be used for?"

THE USE RATE

It is very important to determine how much water your family uses. This is called the use rate. Your family's use rate will help you determine the size of tank your home requires. If you are unable to estimate your family's use rate then you can use the results

of a survey that was made in Saipan in 1999. For example, if your family uses tank water only for drinking cooking and washing dishes the average use rate for Saipan is 4 Gal / Day / Person. Average values for various other uses are shown below.

- **1 Gal / Day / Person:** Only use tank water for drinking and cooking.
- **4 Gal / Day / Person:** Only use tank water for drinking, cooking, and washing dishes.
- **20 Gal / Day / Person:** Only use tank water for drinking, cooking, washing dishes, and toilet flushing **or** washing clothes.
- **30 Gal / Day / Person:** Only use tank water for drinking, cooking, washing dishes, toilet flushing, **and** washing clothes.
- The survey evaluation found that the use rate for bathing was very high. This high use rate rules out the use of rain catchment tanks as a source of bathing water in Saipan.

The intended uses mentioned for each of the rates above are only suggestions. As long as your family's total consumption per person does not exceed the listed use rate value, the tank size will be adequate. Using the water for other needs than specified **may result in an empty tank** especially during the dry seasons.

A computer program was designed to evaluate tank size and use rate combinations that produce the best long term sustainable supply. Computer runs were made using Saipan rainfall values taken from the gage at the International Airport in Saipan from 1954 to 1999.

CHARTS FOR TANK SIZING

The following chart lists the common tank sizes sold locally. Tanks of 1,000 gallons or more are constructed of reinforced concrete. The most common shape is cylindrical, although in some cases oval shapes are available. The 250 and 500-gallon tanks are available in various materials.

Tank Size (gallons)	Cylindrical And Cylindroids		
	Diameter		Height
	Length	Width	
*250	---		---
*500	---		---
1,000	6' 0"		4' 10"
1,500	6' 0"		7' 2"
2,000	8' 0"		5' 4"
2,500	8' 0"		7' 0"
3,000	8' 0"		8' 0"
**3,500	11' 6"	8' 0"	6' 0"
**4,000	11' 6"	8' 0"	7' 0"

* Various sizes and styles available.

** Oval shaped cylinders (cylindroid) Long and short diameters are provided.

Several factors are necessary in order to determine the required tank size. These include: the number of people using water from the tank, how much water they use per day, the roof area, and the extent and condition of the guttering system. All of these factors are necessary in order to determine the optimal tank size for your rainwater catchment system.

Following are four different examples of tank sizing problems that you might encounter. If these examples do not answer the questions you may have concerning design of your rain water catchment system, please contact the Water and Environmental Research Institute of the Western Pacific (WERI) for further information. The e-mail address, telephone, and fax numbers for WERI are provided at the end of this booklet.

SIZING NEW TANKS

Here are the **STEPS** to use if you want to know how **BIG** to make a **NEW** tank.

STEP 1. Measure the **LENGTH** and **WIDTH** of your roof.

STEP 2. Find your **ROOF SIZE**.

Multiply Length times Width.
Roof Size = Length x Width

STEP 3. Select a **ROOF FACTOR**.

If the entire roof has gutters, use **1.0**

If 3/4 of the roof has gutters, use **0.75**

If 1/2 of the roof has gutters, use **0.50**

If 1/4 of the roof has gutters, use **0.25**

STEP 4. Select a **GUTTER FACTOR**.

If your gutter has only a few leaks, use **0.90**

If your gutter has a number of leaks, use **0.75**

If your gutter has a lot of leaks, use **0.60**

STEP 5. Find your **USEABLE ROOF SIZE**.

Multiply Roof Size times Roof Factor times Gutter Factor.

Usable Roof Size = Roof Size x Roof Factor x Gutter Factor

STEP 6. Write down the **NUMBER OF PEOPLE** that live in your home.

STEP 7. Use the **CHARTS** at the back of this booklet to get the size of your **NEW** tank.

EXAMPLE ONE

Your roof is 45 feet in length by 40 feet wide. There are gutters around 3/4 of your roof and they have very few leaks. There are 5 people in your family. How **BIG** should your **NEW** tank be? By following the steps on the previous page, we can fill in the blank spaces below.

Step 1. Length 45 feet
Width 40 feet

Step 2. 45 ft. x 40 ft. = 1800 ft.² Size

Step 3. Roof Factor = 0.75

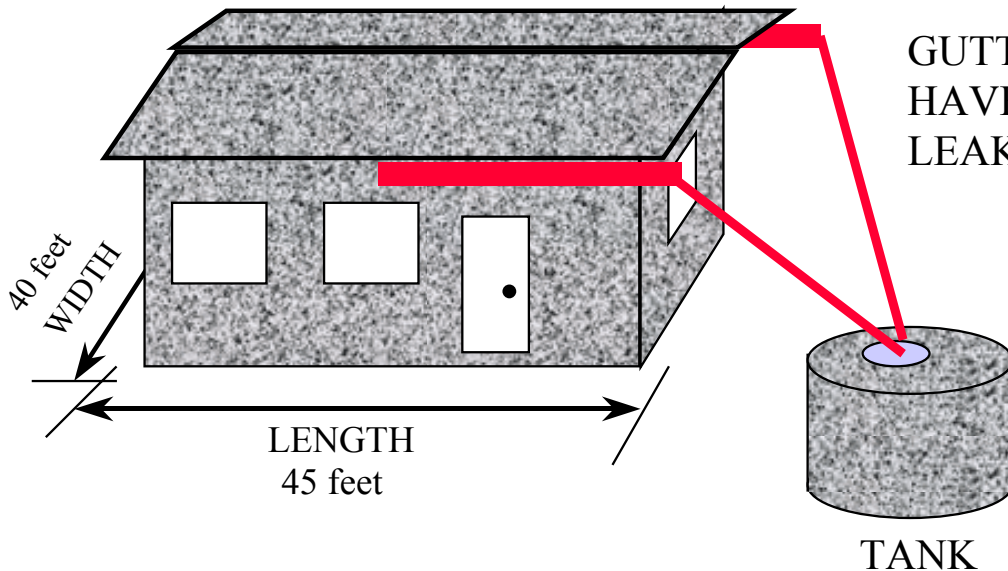
Step 4. Gutter Factor = 0.90

Step 5. $\frac{1800 \text{ ft.}^2}{\text{Roof Size}} \times \frac{0.75}{\text{Roof Factor}} \times \frac{0.90}{\text{Gutter Factor}} = \frac{1215 \text{ ft.}^2}{\text{Useable Roof Size}}$

Step 6. 2 People

3/4 OF ROOF
HAS
GUTTERS

GUTTERS
HAVE FEW
LEAKS



Step 7. Go to the chart table for your useable roof size. Since your roof size is **1215** square feet, you should use the chart labeled "For useable roof size of 1200 to 1400 square feet" which is on page 15. The same chart is shown below for easy reference. Locate the row labeled 2 people in the left-hand column.

FOR USABLE ROOF SIZE OF 1200 TO 1400 SQUARE FEET

PEOPLE	USAGE GALS / DAY / PERSON			
	1	4	20	30
20	1000			
19	1000			
18	1000			
17	500			
16	500			
15	500			
14	500			
13	500	4000		
12	500	3000		
11	500	2500		
10	250	2000		
9	250	2000		
8	250	1500		
7	250	1000		
6	250	1000		
5	250	1000		
4	250	500		
3	250	500		
2	250	250	2000	
1	250	250	1000	1500

TWO PEOPLE →

A 250 gal tank will supply up to **4 gal / day / person.**

A 2000 gal tank could supply up to **20 gal / day / person.**

A use rate of **30 gal / day / person** requires a tank larger than studied in this project.

Color code legend:

ROOF TOO SMALL	250 gal.	500 gal.	1000 gal.	1500 gal.	2000 gal.	2500 gal.	3000 gal.	3500 gal.	4000 gal.
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Step 7.(cont) There are three answers to the question of how BIG your NEW tank should be. First look again at the graph on the previous page. You will see that these answers are represented by four colored boxes to the right of the box that shows the number of people. These colored boxes tell you what size tank you need depending on the USE RATE you have decided on.

For example:

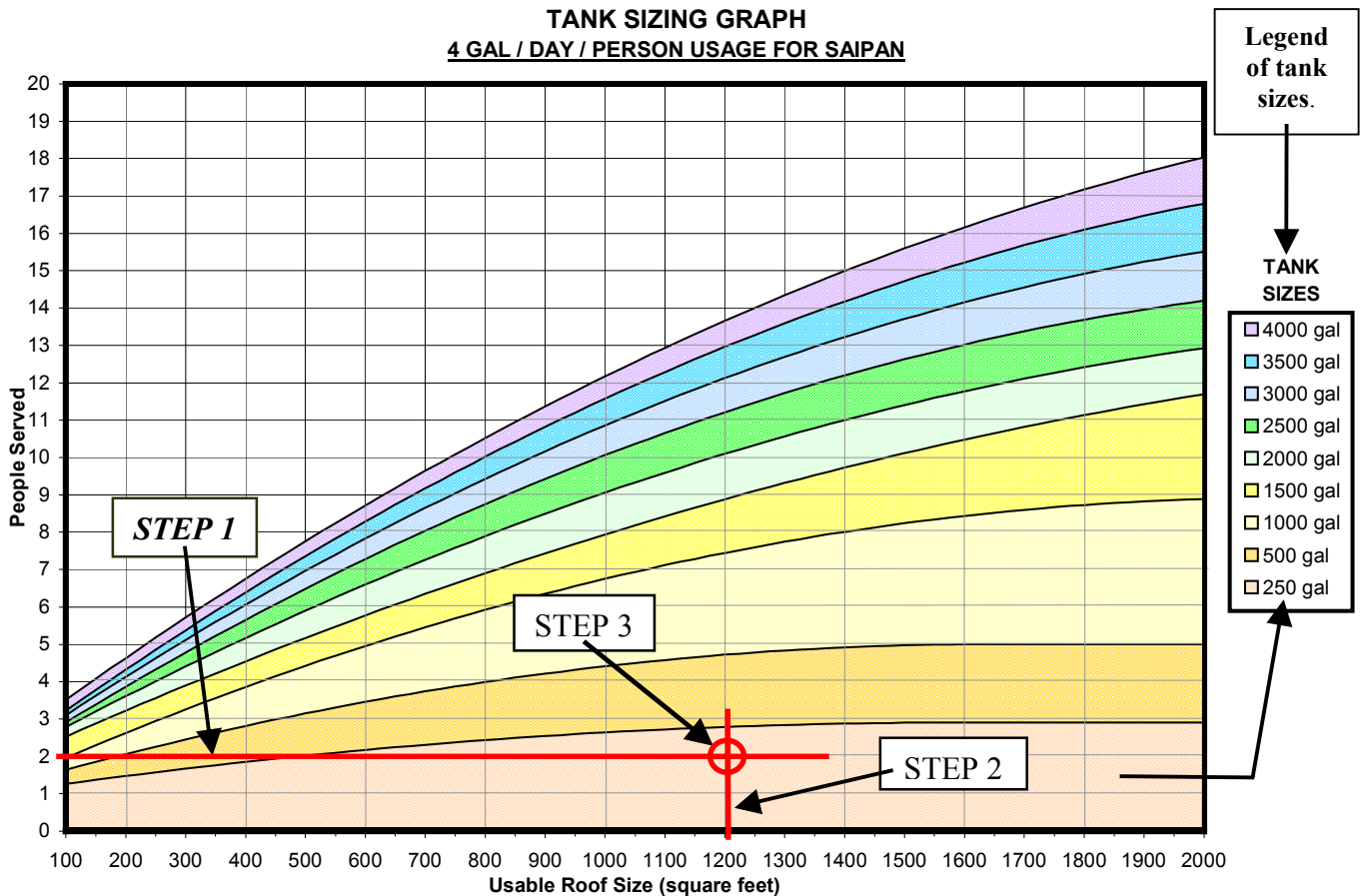
- A 250 gal tank can supply up to **4 gal / day / person**. This **4 gal / day / person** use rate is the normal amount of water used in Saipan for drinking, cooking, and washing dishes.
- A 2000 gal tank can supply up to **20 gal / day / person**. This **20 gal / day / person** use rate is the normal amount of water used in Saipan for drinking, cooking, washing dishes, and laundry **or** toilet flushing.
- For this roof size and number of people, the roof is too small to serve more than **20 gal / day / person**.

Step 7. (cont.) An alternative means of determining your required tank size is to use the graphs shown on pages 18 through 21. An example of using these graphs is shown below. To use these graphs we must first choose our use rate and then go to the corresponding graph for our chosen rate. Our example graph is for a use rate of 4 gal / day / person. This graph can be found on page 19 and is shown below for easy reference:

Step 1. Draw a horizontal line across the graph at a height corresponding to the number of people who are to be served by the tank.

Step 2. Draw a vertical line up from the usable roof size.

Step 3. The intersection of the vertical and horizontal lines falls in a color zone that indicates the required tank size. In our example the tank size required is 250 gallons.



EXAMPLE TWO

Now suppose that your **USABLE** roof size is 1,620 square feet and 10 people are served by your tank. How big should your tank be now?

Since we already know the usable roof size and the number of people, we can go right to the chart to get an answer. Your usable roof size is between 1,600 and 1,800 square feet, so you would choose the chart located on page 16. A copy of part of this chart is shown below. The row labeled 10 people shows that a 250 gal tank will provide 1 gal / day / person and a 1500 gal tank will provide water at a rate of 4 gal / day / person. The roof size is inadequate to provide a dependable supply of more than 4 gal / day / person for 10 people.

FOR USABLE ROOF SIZE OF 1600 TO 1800 SQUARE FEET

	USAGE GALS / DAY / PERSON			
PEOPLE	1	4	20	30
20	1000			
19	1000			
18	500			
17	500			
16	500	4000		
15	500	3500		
14	500	3000		
13	500	3000		
12	500	2500		
11	500	2000		
10 PEOPLE →	10	250	1500	

A 250 gal tank will supply up to **1 gal / day / person.**

A 1500 gal tank will supply up to **4 gal / day / person.**

ROOF TOO SMALL	250 GAL	500 GAL	1000 GAL	1500 GAL	2000 GAL	2500 GAL	3000 GAL	3500 GAL	4000 GAL
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IS THE TANK YOU ALREADY HAVE BIG ENOUGH?

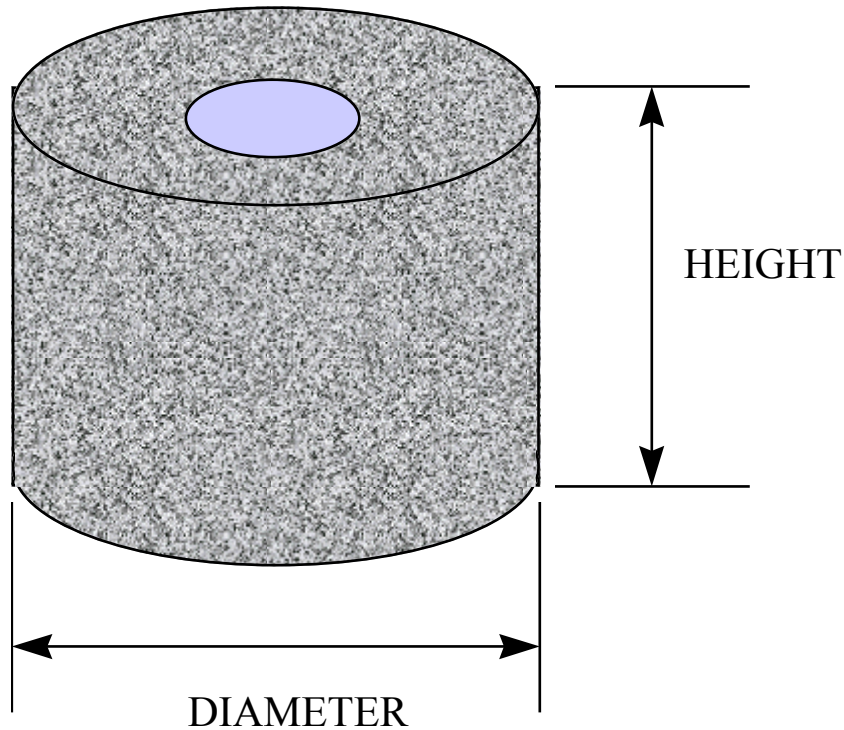
The steps that you should follow if you want to know if your OLD tank is BIG enough are exactly the same as you used to determine the size of a NEW tank except that you will also have to find out the number of gallons of water that your tank will hold. Here's the additional step:

STEP 7. Find the *SIZE* of your tank (in gallons). See the sketch below for a description of the terms used.

Multiply 5.87 times height (ft) times diameter (ft) times diameter (ft).

$$\text{Tank Size} = 5.87 \times \frac{\text{Height(ft)}}{\text{Height(ft)}} \times \frac{\text{Diameter(ft)}}{\text{Diameter(ft)}} \times \frac{\text{Diameter(ft)}}{\text{Diameter(ft)}}$$

You will also have to use the charts in the back of the booklet in a slightly different way. This will be shown in Step 8 on the following page.



RAIN WATER CATCHMENT TANK

EXAMPLE THREE

Your roof is 42 feet long and 47 feet wide. You have gutters around the entire roof but they leak a lot. There are 8 people in your home. Your tank is 9.5 feet in diameter and 6 feet high. How much water can your tank dependably supply to your family?

Step 1. Length = $\frac{42}{}$ feet
Width = $\frac{47}{}$ feet

Step 2. $\frac{42 \text{ ft.}}{\text{Length}} \times \frac{47 \text{ ft.}}{\text{width}} = \frac{1974 \text{ ft.}^2}{\text{roof size}}$

Your answer should be 1,974 square feet.

Step 3. $\frac{1.0}{}$ roof factor

Step 4. $\frac{0.6}{}$ gutter factor

Step 5. $\frac{1974 \text{ ft.}^2}{\text{roof size}} \times \frac{1.0}{\text{roof factor}} \times \frac{0.60}{\text{gutter factor}} = \frac{1184 \text{ ft.}^2}{\text{usable roof size}}$

Your answer should be approximately 1184 square feet.

Step 6. $\frac{8}{}$ people

Step 7. $5.87 \times \frac{6 \text{ ft.}}{\text{height}} \times \frac{9.5 \text{ ft.}}{\text{diameter}} \times \frac{9.5 \text{ ft.}}{\text{diameter}} = \frac{3179 \text{ gal.}}{\text{tank size}}$

Your answer should be approximately 3,179 gallons.

Step 8. Now go to the chart for usable roof sizes between 1,000 and 1,200 square feet and look at the row for 8 people. Find the tank size listed in the farthest right row that is equal to or less than your tank size. In this example the tank size that is nearest to your size is 2000 gallons. This tells us that your tank will supply up to 4 gallons / day / person but is not large enough to meet the next higher use rate of 20 gals / day / person.

EXAMPLE FOUR

Now suppose that you have a usable roof size of 500 square feet, a 1,000-gal tank, and that there are 12 people in your household. How much water can your tank dependably supply?

Look at the chart for usable roof sizes between 400 and 600 square feet and the row of the chart corresponding to 12 people. The chart shows that the tank can supply a maximum dependable supply of 1 gal / day / person.

HAVING TROUBLE??

The authors of this bulletin are hopeful that the procedures, charts and examples will help you in designing a new or evaluating an existing roof rainwater catchment system. If you are having trouble using the charts and examples or if your system does not seem to fit the charts provided, please contact the Commonwealth Utility Corporation (CUC) or contact Dr. Leroy Heitz at the address and numbers listed on the last page of this bulletin.

TANK SIZING TABLES FOR SAIPAN

**FOR USABLE ROOF SIZE
OF 100 TO 200 SQUARE FEET**

PEOPLE	USAGE GALS / DAY / PERSON			
	1	4	20	30
10	2500			
9	2000			
8	1500			
7	1500			
6	1000			
5	500			
4	250			
3	250	3000		
2	250	1500		
1	250	250		

**FOR USABLE ROOF SIZE
OF 200 TO 400 SQUARE FEET**

PEOPLE	USAGE GALS / DAY / PERSON			
	1	4	20	30
19	3500			
18	3000			
17	3000			
16	2500			
15	2500			
14	2500			
13	2000			
12	1500			
11	1500			
10	1000			
9	1000			
8	1000			
7	500			
6	500			
5	250			
4	250	3000		
3	250	1500		
2	250	500		
1	250	250		

ROOF TOO SMALL	250 GAL	500 GAL	1000 GAL	1500 GAL	2000 GAL	2500 GAL	3000 GAL	3500 GAL	4000 GAL
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TANK SIZING TABLES FOR SAIPAN (CONTINUED)

**FOR USABLE ROOF SIZE
OF 400 TO 600 SQUARE FEET**

PEOPLE	USAGE GALS / DAY / PERSON			
	1	4	20	30
20	2500			
19	2000			
18	2000			
17	1500			
16	1500			
15	1000			
14	1000			
13	1000			
12	1000			
11	500			
10	500			
9	500			
8	500			
7	250			
6	250	3000		
5	250	2000		
4	250	1500		
3	250	1000		
2	250	500		
1	250	250	2000	

**FOR USABLE ROOF SIZE
OF 600 TO 800 SQUARE FEET**

PEOPLE	USAGE GALS / DAY / PERSON			
	1	4	20	30
20	1500			
19	1500			
18	1000			
17	1000			
16	1000			
15	1000			
14	500			
13	500			
12	500			
11	500			
10	500			
9	500			
8	250	3500		
7	250	2500		
6	250	2000		
5	250	1000		
4	250	1000		
3	250	500		
2	250	250		
1	250	250	1500	3000

ROOF TOO SMALL	250 GAL	500 GAL	1000 GAL	1500 GAL	2000 GAL	2500 GAL	3000 GAL	3500 GAL	4000 GAL
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TANK SIZING TABLES FOR SAIPAN (CONTINUED)

**FOR USABLE ROOF SIZE
OF 800 TO 1000 SQUARE FEET**

PEOPLE	USAGE GALS / DAY / PERSON			
	1	4	20	30
20	1500			
19	1000			
18	1000			
17	1000			
16	500			
15	500			
14	500			
13	500			
12	500			
11	500			
10	250	4000		
9	250	3000		
8	250	2500		
7	250	2000		
6	250	1500		
5	250	1000		
4	250	1000		
3	250	500		
2	250	250	4000	
1	250	250	1000	2000

**FOR USABLE ROOF SIZE
OF 1000 TO 1200 SQUARE FEET**

PEOPLE	USAGE GALS / DAY / PERSON			
	1	4	20	30
20	1000			
19	1000			
18	1000			
17	500			
16	500			
15	500			
14	500			
13	500			
12	500			
11	500	4000		
10	500	2500		
9	250	2000		
8	250	2000		
7	250	1500		
6	250	1000		
5	250	1000		
4	250	1000		
3	250	500		
2	250	250	2500	
1	250	250	1000	1500

ROOF TOO SMALL	250 GAL	500 GAL	1000 GAL	1500 GAL	2000 GAL	2500 GAL	3000 GAL	3500 GAL	4000 GAL
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TANK SIZING TABLES FOR SAIPAN (CONTINUED)

**FOR USABLE ROOF SIZE
OF 1200 TO 1400 SQUARE FEET**

PEOPLE	USAGE GALS / DAY / PERSON			
	1	4	20	30
20	1000			
19	1000			
18	1000			
17	500			
16	500			
15	500			
14	500			
13	500	4000		
12	500	3000		
11	500	2500		
10	250	2000		
9	250	2000		
8	250	1500		
7	250	1000		
6	250	1000		
5	250	1000		
4	250	500		
3	250	500		
2	250	250	2000	
1	250	250	1000	1500

**FOR USABLE ROOF SIZE
OF 1400 TO 1600 SQUARE FEET**

PEOPLE	USAGE GALS / DAY / PERSON			
	1	4	20	30
20	1000			
19	1000			
18	500			
17	500			
16	500			
15	500	4000		
14	500	3500		
13	500	3000		
12	500	2500		
11	500	2500		
10	250	2000		
9	250	1500		
8	250	1500		
7	250	1000		
6	250	1000		
5	250	1000		
4	250	500		
3	250	500	4000	
2	250	250	2000	4000
1	250	250	1000	1000

ROOF TOO SMALL	250 GAL	500 GAL	1000 GAL	1500 GAL	2000 GAL	2500 GAL	3000 GAL	3500 GAL	4000 GAL
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TANK SIZING TABLES FOR SAIPAN (CONTINUED)

**FOR USABLE ROOF SIZE
OF 1600 TO 1800 SQUARE FEET**

PEOPLE	USAGE GALS / DAY / PERSON			
	1	4	20	30
20	1000			
19	1000			
18	500			
17	500			
16	500	4000		
15	500	3500		
14	500	3000		
13	500	3000		
12	500	2500		
11	500	2000		
10	250	1500		
9	250	1500		
8	250	1000		
7	250	1000		
6	250	1000		
5	250	1000		
4	250	500		
3	250	500	3500	
2	250	250	1500	3500
1	250	250	1000	1000

**FOR USABLE ROOF SIZE
OF 1800 TO 2000 SQUARE FEET**

PEOPLE	USE RATES GALS / DAY / PERSON			
	1	4	20	30
20	1000			
19	1000			
18	500			
17	500	4000		
16	500	3500		
15	500	3500		
14	500	3000		
13	500	2500		
12	500	2000		
11	500	1500		
10	250	1500		
9	250	1500		
8	250	1000		
7	250	1000		
6	250	1000		
5	250	1000		
4	250	500		
3	250	500	3500	
2	250	250	1500	3500
1	250	250	1000	1000

ROOF TOO SMALL	250 GAL	500 GAL	1000 GAL	1500 GAL	2000 GAL	2500 GAL	3000 GAL	3500 GAL	4000 GAL
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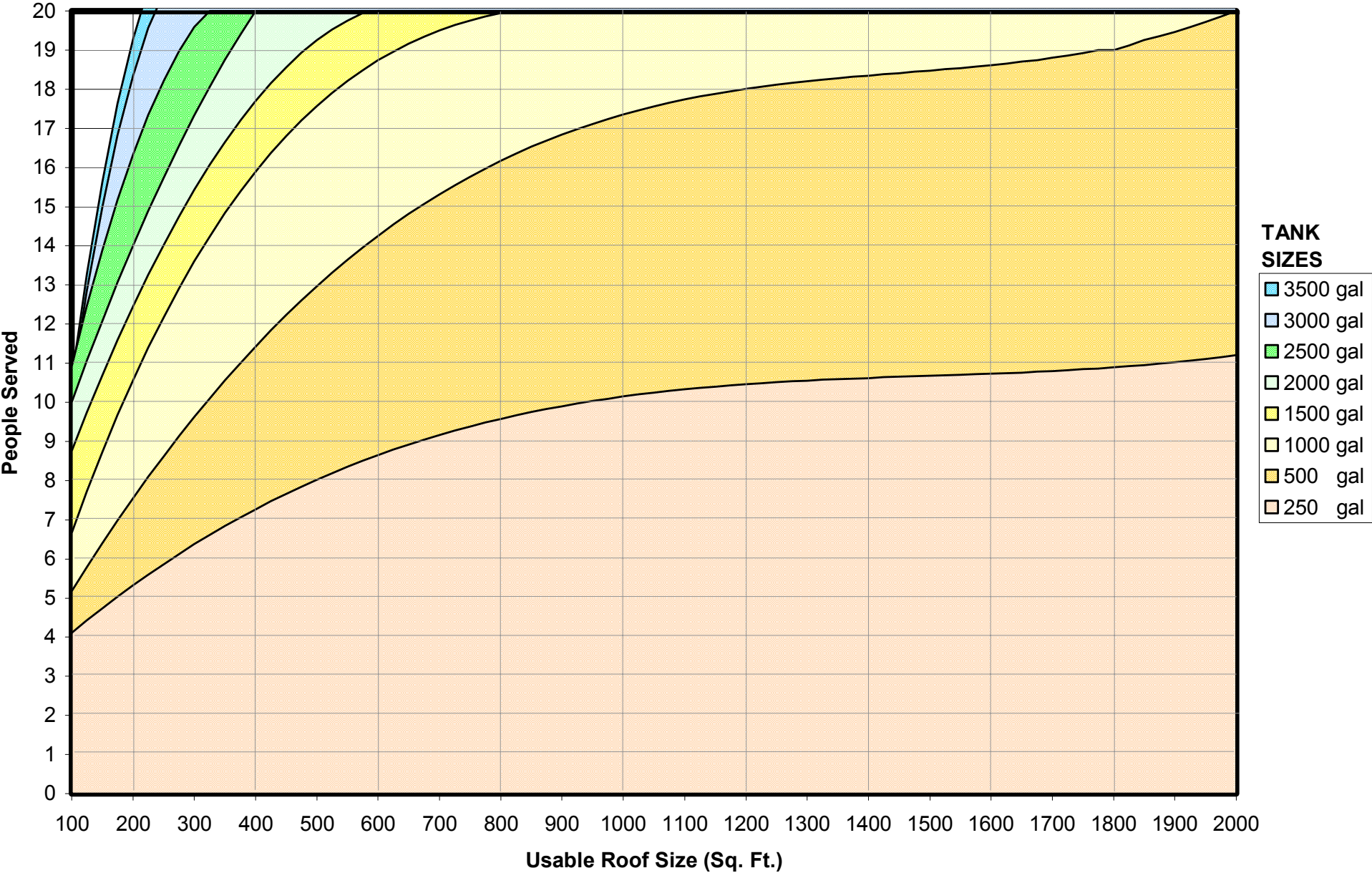
TANK SIZING TABLES FOR SAIPAN (CONTINUED)

FOR USABLE ROOF SIZE
OF 2000 TO 2200 SQUARE FEET

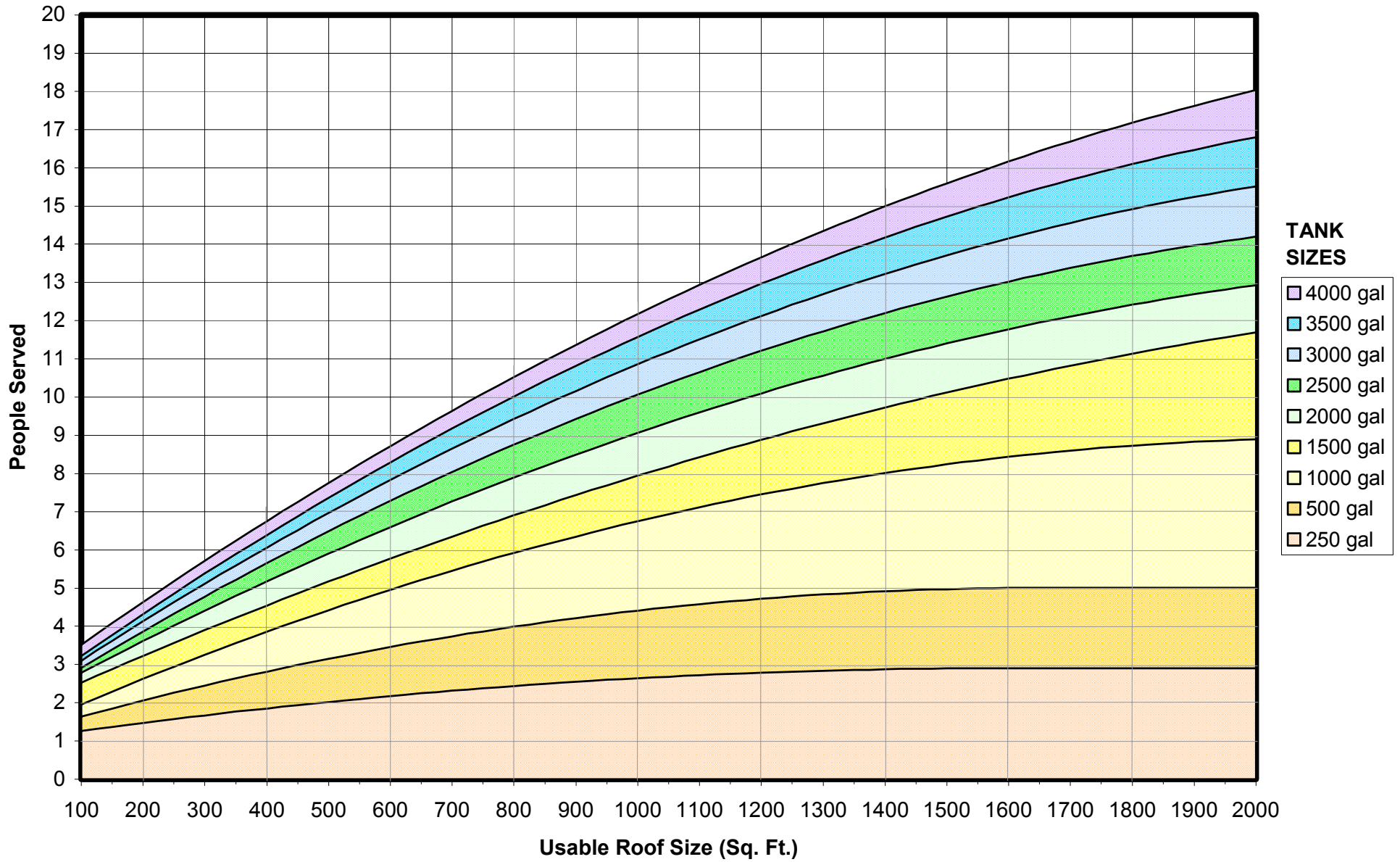
PEOPLE	USAGE GALS / DAY / PERSON			
	1	4	20	30
20	1000			
19	500			
18	500	4000		
17	500	4000		
16	500	3500		
15	500	3000		
14	500	2500		
13	500	2500		
12	500	2000		
11	250	1500		
10	250	1500		
9	250	1500		
8	250	1000		
7	250	1000		
6	250	1000		
5	250	1000		
4	250	500		
3	250	500	3500	
2	250	250	1500	3000
1	250	250	1000	1000

ROOF TOO SMALL	250 GAL	500 GAL	1000 GAL	1500 GAL	2000 GAL	2500 GAL	3000 GAL	3500 GAL	4000 GAL
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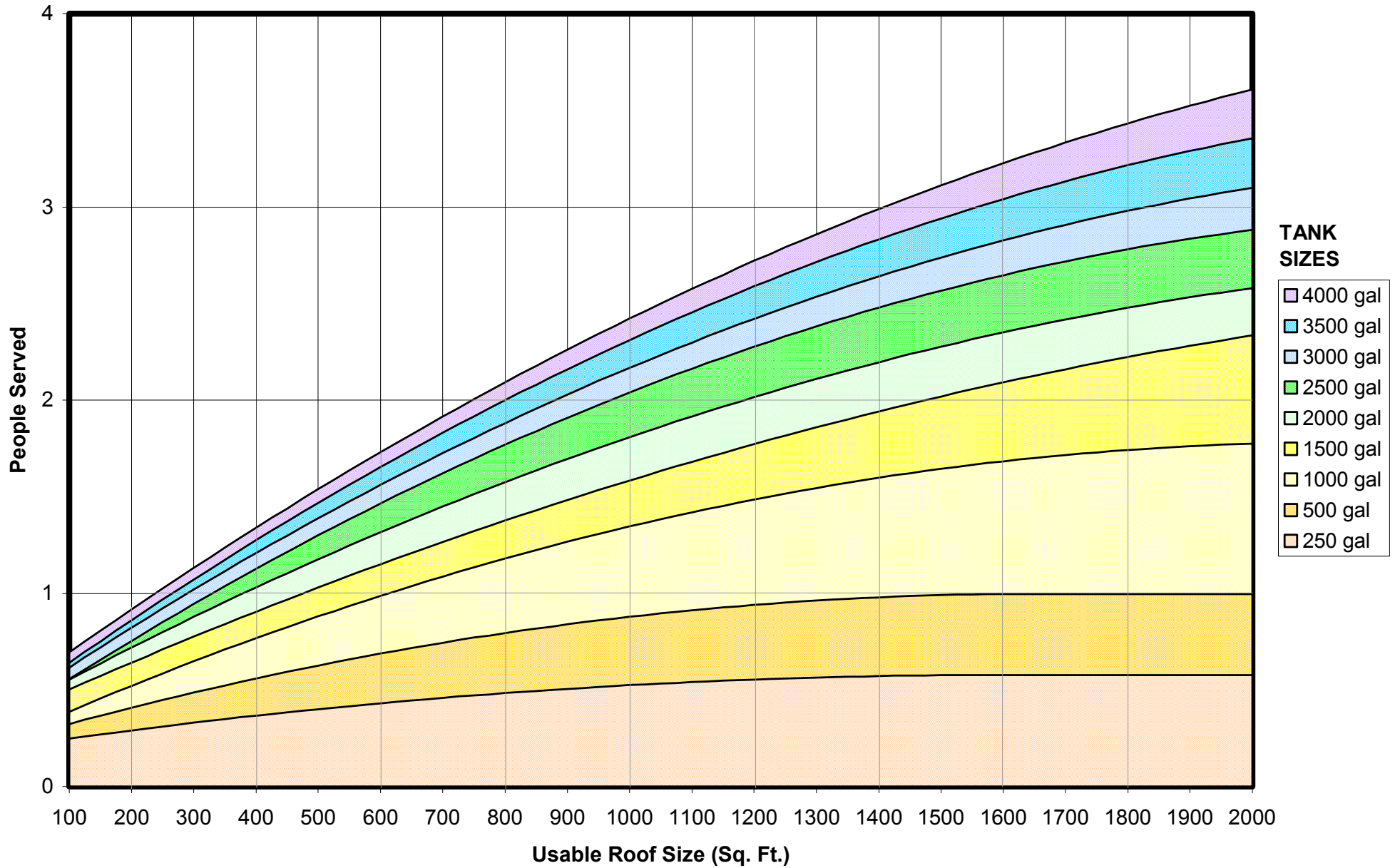
1 GAL / DAY / PERSON USAGE FOR SAIPAN



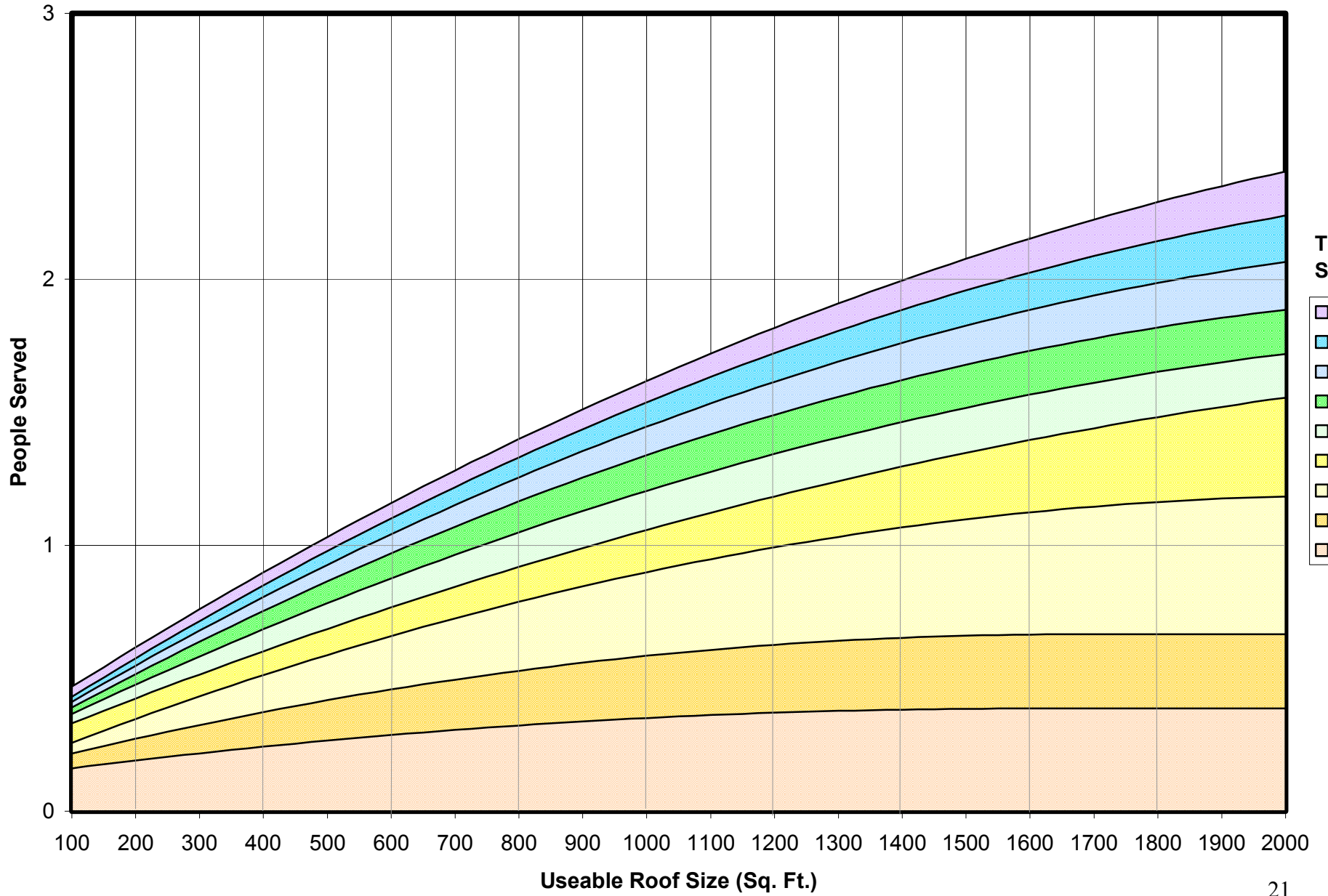
4 GAL / DAY / PERSON USAGE FOR SAIPAN



20 GAL / DAY / PERSON USAGE FOR SAIPAN



30 GAL / DAY / PERSON USAGE FOR SAIPAN



**FOR MORE INFORMATION ON ROOF TOP RAIN WATER CATCHMENT
SYSTEMS**

**CONTACT
THE COMMONWEALTH UTILITY CORPORATION (CUC)**

OR

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ENVIRONMENTAL RESEARCH INSTITUTE
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or visit

<http://www.uog.edu/weri/raincatch/main.htm>

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