Section 10

BRINGING IT ALL TOGETHER

LEARNING OBJECTIVES

1. Put the tools that you have learned into practice

1. CASE STUDY

- Put the tools that you have learned into practice

1. CASE STUDY

Use the information provided to calculate the following for each landscape:

1. Peak month landscape water budget calculated using peak month ETo, plant factors, and hydrozone areas
2. Irrigation water requirement for the peak month taking into account effective precipitation and irrigation efficiency
3. Peak month irrigation schedule (upper and lower boundary of minutes per month)
4. Suggest how the peak month irrigation schedule could be used to program a conventional irrigation controller

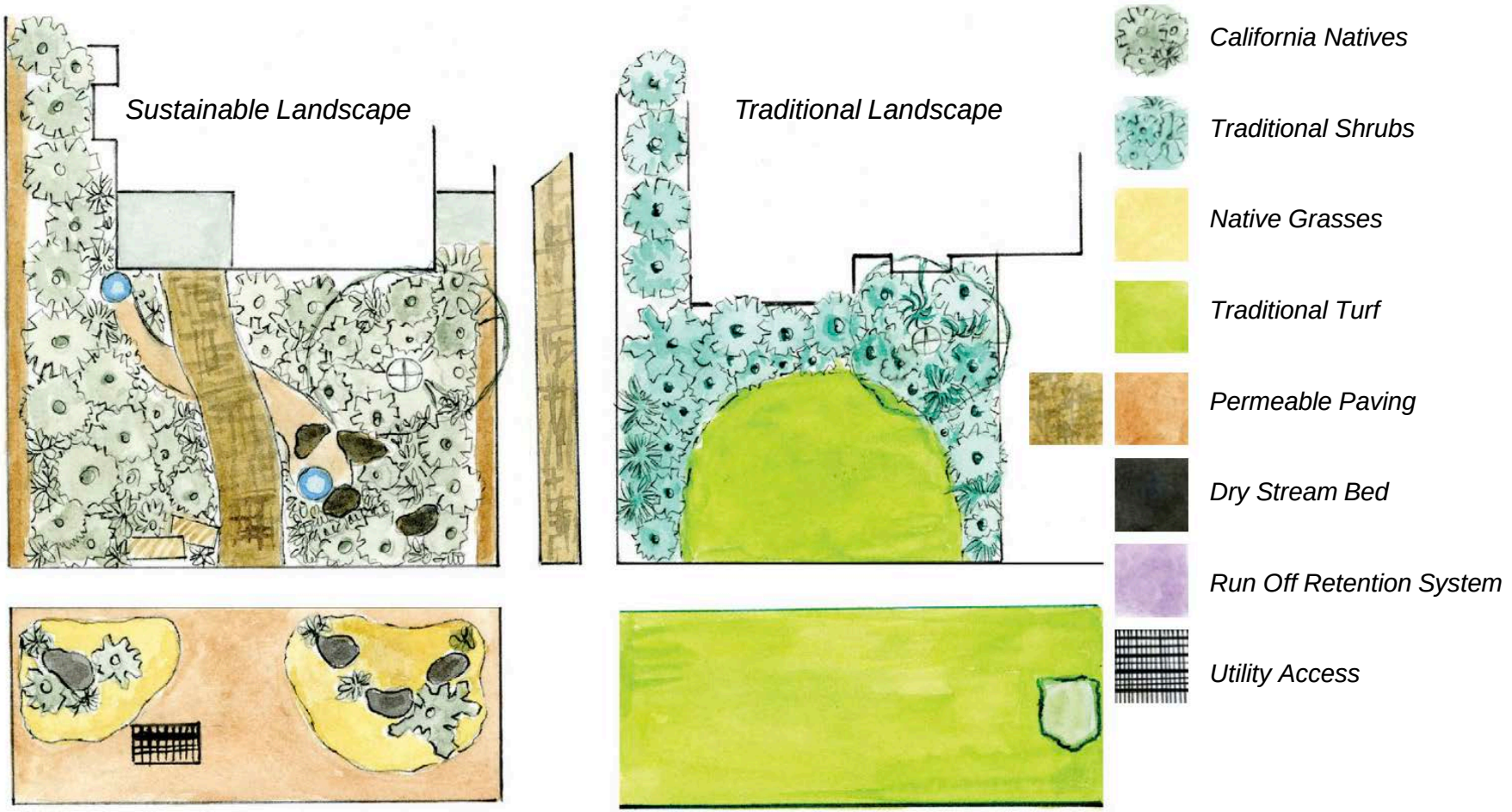
1. CASE STUDY

5. Explain how you would implement a simple program to manage these landscapes to a monthly landscape water budget

6. Extra credit:
   - Using the traditional landscape determine the volume of mulch and compost needed to sheet mulch the two turf zones
     - Assume a 2-inch layer of compost and a 4-inch layer of mulch
   - Using the sustainable landscape:
     - Determine the annual rain catchment potential
     - Determine the annual graywater production potential

1. CASE STUDY

City of Santa Monica garden\garden Project



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1. CASE STUDY: HYDROZONES

Traditional Landscape

Hydrozone	Plant Factor (PF)	Area (sq ft)	ETo (inches)	Precipitation (inches)	DU_{LQ}	PR (in / hr)
Turf – front yard	0.8	845	4.65	0.1	0.6	1.85
Turf – parkway	0.8	320	4.65	0.1	0.6	1.85
Shrubs	0.5	530	4.65	0.1	0.6	1.85

Time to runoff: 5 mins

Sustainable Landscape

Hydrozone	Plant Factor (PF)	Area (sq ft)	ETo (inches)	Precipitation (inches)	DU_{LQ}	PR (in / hr)
Natives–front yard	0.3	950	4.65	0.1	0.9	0.65
Natives–parkway	0.3	100	4.65	0.1	0.9	0.65

Time to runoff: 15 mins

1. CASE STUDY: ETo & PRECIPITATION

Month	ETo (inches)	Precipitation (inches)
January	0.93	3.50
February	1.40	4.30
March	2.48	1.70
April	3.30	0.70
May	4.03	0.40
June	4.50	0.10
July	4.65	0.10
August	4.03	0.10
September	3.30	0.40
October	2.48	0.70
November	1.20	1.70
December	0.62	2.10
Total	**32.92**	**15.80**

1. CASE STUDY: EXTRA CREDIT

Roof area	1,350 sq. ft.
Number of residents	3
Clothes washer average daily per capita water use	9.6 gallons
Shower and bath average daily per capita water use	12.6 gallons

2. PEAK MONTH LANDSCAPE WATER BUDGET SOLUTION

- Peak month landscape water budget calculated using peak month ETo, plant factors, and hydrozone areas

2. PEAK MONTH LANDSCAPE WATER BUDGET

Water Budget = Weather x Plant Type x Area

Water Budget = ETo x PF x LA x 0.62

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2. PEAK MONTH LANDSCAPE WATER BUDGET

Traditional Landscape

Hydrozone	ETo (inches)	Plant Factor (PF)	Area (sq ft)	Water Budget (gallons)
Turf – front yard	4.65	0.8	845	1,949
Turf – parkway	4.65	0.8	320	738
Shrubs	4.65	0.5	530	764
Total			**1,695**	**3,451**

Sustainable Landscape

Hydrozone	ETo (inches)	Plant Factor (PF)	Area (sq ft)	Water Budget (gallons)
Natives - front yard	4.65	0.3	950	822
Natives - parkway	4.65	0.3	100	86
Total			**1,050**	**908**

3. IRRIGATION WATER REQUIREMENT FOR THE PEAK MONTH SOLUTION

- Irrigation water requirement for the peak month taking into account effective precipitation and irrigation efficiency

3. PEAK MONTH IRRIGATION WATER REQUIREMENT

Irrigation Water = [(Weather x Plant Type) – Rain] x Area ÷ Efficiency

Irrigation Water = [(ETo x PF) – EP] x LA ÷ IE x 0.62

3. PEAK MONTH IRRIGATION WATER REQUIREMENT

Traditional Landscape

Hydrozone	ETo (inches)	Plant Factor (PF)	Effective Precipitation (inches)	Area (sq ft)	Irrigation Efficiency	Irrigation Water (gallons)
Turf – front yard	4.65	0.8	0.1 x 0.25	845	0.6	3,226
Turf – parkway	4.65	0.8	0.1 x 0.25	320	0.6	1,222
Shrubs	4.65	0.5	0.1 x 0.25	530	0.6	1,260
Total				**1,695**		**5,708**

Sustainable Landscape

Hydrozone	ETo (inches)	Plant Factor (PF)	Effective Precipitation (inches)	Area (sq ft)	Irrigation Efficiency	Irrigation Water (gallons)
Natives - front yard	4.65	0.3	0.1 x 0.25	950	0.9	897
Natives - parkway	4.65	0.3	0.1 x 0.25	100	0.9	94
Total				**1,050**		**991**

4. PEAK MONTH IRRIGATION SCHEDULE SOLUTION

- Peak month irrigation schedule (upper and lower boundary of minutes per month)

4. PEAK MONTH IRRIGATION SCHEDULE

PWR = ETo x PF

RTM = 1 ÷ [0.4 + (0.6 x DU_{LQ})]

IWR = PWR x RTM

Lower Boundary = (PWR ÷ PR) x 60

Upper Boundary = (IWR ÷ PR) x 60

4. PEAK MONTH IRRIGATION SCHEDULE

Traditional Landscape

Hydrozone	PWR (inches)	RTM	IWR (inches)	Lower Boundary (mins)	Upper Boundary (mins)
Turf – front yard	3.72	1.32	4.91	121	160
Turf – parkway	3.72	1.32	4.91	121	160
Shrubs	2.33	1.32	3.08	76	100

Sustainable Landscape

Hydrozone	PWR (inches)	RTM	IWR (inches)	Lower Boundary (mins)	Upper Boundary (mins)
Natives – front yard	1.40	1.06	1.48	130	137
Natives – parkway	1.40	1.06	1.48	130	137

5. CONTROLLER PROGRAMMING SOLUTION

- Suggest how the peak month irrigation schedule could be used to program a conventional irrigation controller

5. CONTROLLER PROGRAMMING

Traditional Landscape

Hydrozone	Month Run Time (mins)	Week Run Time (mins)	Number of Days to Irrigate	Daily Run Time (mins)	Number of Cycles Per Day
Turf – front yard	144	36	3	4	3
Turf – parkway	144	36	3	4	3
Shrubs	80	20	2	5	2

Sustainable Landscape

Hydrozone	Month Run Time (mins)	Week Run Time (mins)	Number of Days to Irrigate	Daily Run Time (mins)	Number of Cycles Per Day
Natives – front yard	136	34	1	17	2
Natives – parkway	136	34	1	17	2

6. WATER BUDGET PROGRAM SOLUTION

- Explain how you would implement a simple program to manage these landscapes to a monthly landscape water budget

6. WATER BUDGET PROGRAM

- Water budgets shown are the irrigation water requirements based on monthly historical average ETo, precipitation and irrigation efficiency
- More accurate to update the planned budget using actual ETo and precipitation at the end of each month
- The water usage numbers are shown in gallons, when in the real world they would be billed in thousands of gallons or CCF
- Many water providers bill based on a water budget
    - In this case it would be more meaningful to align the water budget calculation with that used by the water provider
- The water usage numbers shown indicate that the traditional landscape has a conventional irrigation controller being updated monthly, whereas the sustainable landscape has a weather based irrigation controller that is watering more closely to the budget

6. WATER BUDGET PROGRAM

- Include water rates and calculate potential cost savings
- Take meter readings at the end of each month to determine actual water usage
- Compare budgeted water usage to actual water usage
- If water usage exceeds the budget find out why and fix the issue

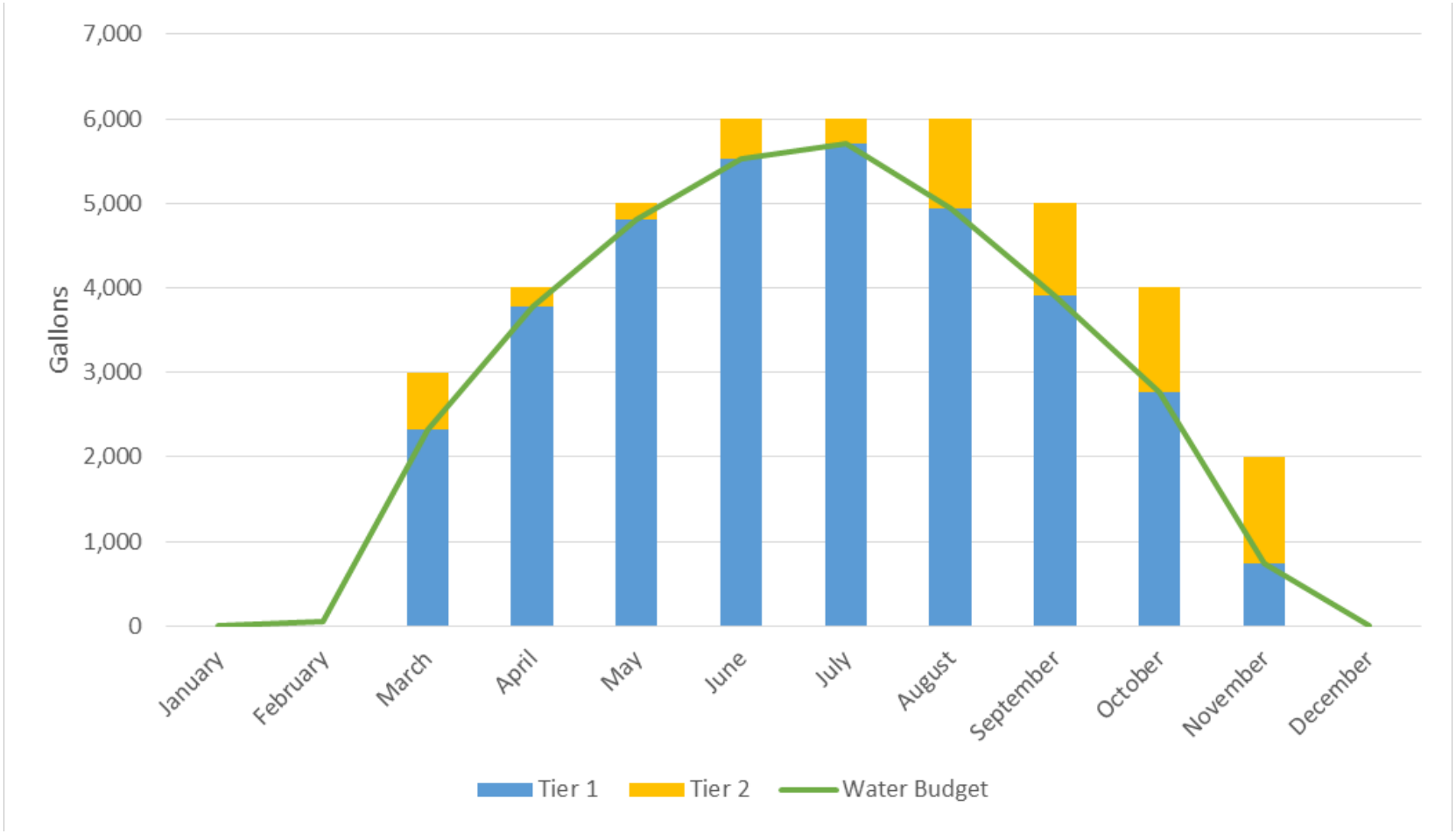
6. WATER BUDGET PROGRAM

Traditional Landscape

Month	Water Budget / Irrigation Water Requirement (gallons)	Assumed Actual Water Usage (gallons)	% Over / Under Budget	Cost of Water ($)	Cost Savings Potential ($)
January	0	0		0	0
February	54	0		0	0
March	2,323	3,000	129%	18	5
April	3,775	4,000	106%	23	2
May	4,810	5,000	104%	28	1
June	5,522	6,000	109%	34	3
July	5,708	6,000	105%	34	2
August	4,941	6,000	121%	35	7
September	3,907	5,000	128%	29	8
October	2,761	4,000	145%	24	9
November	740	2,000	270%	13	9
December	0	0		0	0
Total	**34,541**	**41,000**	**119%**	**237**	**45**

6. WATER BUDGET PROGRAM

Traditional Landscape



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6. WATER BUDGET PROGRAM

Sustainable Landscape

Month	Water Budget / Irrigation Water Requirement (gallons)	Assumed Actual Water Usage (gallons)	% Over / Under Budget	Cost of Water ($)	Cost Savings Potential ($)
January	0	0		0	0
February	0	0		0	0
March	231	500	217%	3	2
April	590	600	102%	3	0
May	802	800	100%	4	0
June	958	1,000	104%	6	0
July	991	1,000	101%	6	0
August	856	900	105%	5	0
September	644	700	109%	4	0
October	412	500	121%	3	1
November	0	0		0	0
December	0	0		0	0
Total	**5,484**	**6,000**	**109%**	**34**	**4**

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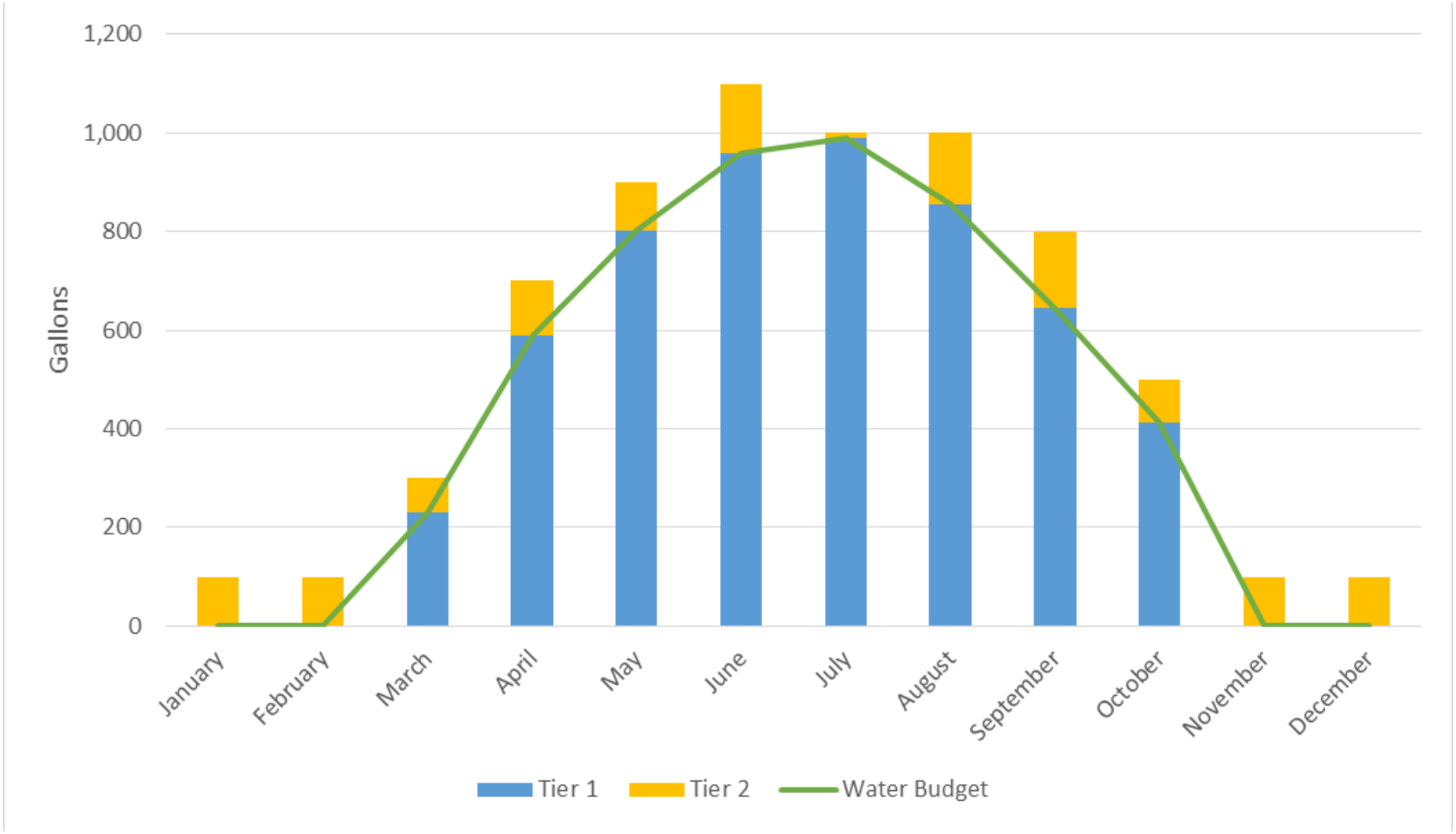
6. WATER BUDGET PROGRAM

Sustainable Landscape



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7. EXTRA CREDIT SOLUTIONS

Using the traditional landscape determine the volume of mulch and compost needed to sheet mulch the two turf zones

- Assume a 2-inch layer of compost and a 4-inch layer of mulch

Using the sustainable landscape:

- Determine the annual rain catchment potential
- Determine the annual graywater production potential

7. EXTRA CREDIT: MULCH & COMPOST

Mulch

Hydrozone	Area (sq ft)	Depth (inches)	Volume (cubic feet)	Volume (cubic yards)
Turf – front yard	845	2	141	5.2
Turf – parkway	320	2	53	2
Total	**1,165**		**194**	**7.2**

Compost

Hydrozone	Area (sq ft)	Depth (inches)	Volume (cubic feet)	Volume (cubic yards)
Turf – front yard	845	4	282	10.4
Turf – parkway	320	4	107	4
Total	**1,165**		**389**	**14.4**

7. EXTRA CREDIT: RAIN CATCHMENT

Rain catchment potential = area in square feet x rainfall in inches x 0.62

Roof Area (sq ft)	Annual Precipitation (inches)	Annual Rain Catchment Potential (gallons)
1,350	15.8	13,225

- The annual rain catchment potential of 13,225 gallons is equal to 241% of the annual water budget of 5,484 gallons
- The landscape itself also receives rainfall
- Precipitation is focused on the winter months when ETo is relatively low
- Directing rainwater into the landscape would ensure that the soil moisture reservoir remains at field capacity into the spring and would help to delay the point at which irrigation is required
- Adding a cistern would go further to reduce the supplemental irrigation requirement

7. EXTRA CREDIT: GRAYWATER

Graywater production potential = average daily per capita water use in gallons x number of residents x 365 days

Fixture	Average Daily Per Capita Water Use (gallons)	Number of Residents	Annual Graywater Production Potential (gallons)
Clothes washer	9.6	3	10,512
Shower and bath	12.6	3	13,797
Total	**22.2**		**24,309**

- Annual graywater production potential of 24,309 gallons is equal to 443% of the annual water budget of 5,484 gallons
- Graywater production occurs throughout the year
- Graywater irrigation techniques are typically relatively crude when compared to an efficient drip irrigation system
- There should be more than enough graywater to irrigate the landscape successfully

8. BRINGING IT ALL TOGETHER REVIEW

8. BRINGING IT ALL TOGETHER REVIEW

1. Know where your water comes from and be aware of local rebate programs
2. Be able to use a water meter for tracking water usage and leak detection
3. Consider landscapes as mini-watersheds that reside within a larger watershed
4. Healthy living soils are the foundation of sustainable landscapes
5. Reference evapotranspiration and climate appropriate plants to determine how much water the landscape needs
6. A water budget is an estimate of how much water is needed to maintain a healthy landscape for a given time period
7. High-efficiency irrigation systems and landscape water management are important components of conserving water supplies
8. Regular maintenance is essential to the proper operation of an efficient irrigation system over time

8. BRINGING IT ALL TOGETHER REVIEW

9. The purpose of an irrigation system audit is to assess how effective an irrigation system is at applying water to a specific hydrozone
10. Irrigation scheduling involves developing a plan for the operation of the irrigation system
11. If used properly, irrigation controllers can efficiently manage the application of irrigation water and provide reliable operation of irrigation systems at any time, day or night