City of Santa Fe

Agenda

CITY CLERK'S OFFICE
DATE 8/4/15 TIME 9:25am
SERVED BY Robert Wood
RECEIVED BY Alicia Martinez

SANTA FE WATER CONSERVATION COMMITTEE MEETING
CITY HALL - 200 LINCOLN AVE.
CITY COUNCILORS' CONFERENCE ROOM
TUESDAY, AUGUST 11, 2015
4:00 PM TO 6:00 PM

1. CALL TO ORDER
2. ROLL CALL
3. APPROVAL OF AGENDA
4. APPROVAL OF CONSENT AGENDA
5. APPROVAL OF MINUTES JULY 14, 2015 - WATER CONSERVATION COMMITTEE MEETING
6. CONSENT ITEMS
7. CONSENT AGENDA
   - A. INFORMATIONAL
     - i. WERS PRESENTATION (Doug Pushard, 40 minutes)

DISCUSSION ITEMS:

8. CLIMATE ACTION TASKFORCE (Councilor Ives, 10 minutes)
9. VACANCIES ON THE CONSERVATION COMMITTEE (Robert Wood, 5 minutes)
10. DIFFERENCES IN SOIL MOISTURE AT CURB CUTS WITH AND WITHOUT RAIN GARDENS INSTALLED AT THE SANTA FE COMMUNITY COLLEGE – (Aaron Kauffman, 15 minutes)

INFORMATIONAL ITEMS:

11. GROUP REPORTS FROM WATER CONSERVATION COMMITTEE INITATIVES: (Councilor Ives, 40 minutes)
    - A. GROUP #5-WATER SYSTEM MAP (10 minutes)
    - B. GROUP #2- WATER CONSERVATION EDUCATION/OUTREACH (10 minutes)
    - C. GROUP #3- WATER CONSERVATION CODES, ORDINANCES & REGULATIONS – LEGISLATIVE UPDATE (10 minutes)
    - D. GROUP #4- REESTABLISH TREND OF NET ANNUAL REDUCTIONS IN PER CAPITA WATER USAGE AND IDENTIFYING LARGE WATER USERS (10 minutes)
    - E. GROUP #1 – TREATED WASTE WATER AS DRINKING WATER SOURCE. (5 Minutes)

MATTERS FROM STAFF:

- Vacancies - Water Conservation Staff & Committee – UPDATE.
- Website and advertising – UPDATE.
- Drought, Monsoon/El Nino, and ESA - UPDATE SUMMARY

MATTERS FROM COMMITTEE:

MATTERS FROM PUBLIC:

NEXT MEETING – THURSDAY, SEPTEMBER 10, 2015:
CAPTIONS: MONDAY, AUGUST 24, 2015 @ 3 PM. PACKET MATERIAL: WEDNESDAY, SEPTEMBER 30, 2015 @ 3 PM.

ITEMS FOR NEXT AGENDA:

ADJOURN.
Persons with disabilities in need of accommodations, contact the City Clerk's office at 955-6520, five (5) working days prior to meeting date.

WATER CONSERVATION COMMITTEE
INDEX
AUGUST 11, 2015

Adjournment and signature	Meeting was adjourned at 5:45 pm	Page 7

SANTA FE WATER CONSERVATION COMMITTEE MEETING
CITY HALL - 200 LINCOLN AVE.
CITY COUNCILORS' CONFERENCE ROOM
TUESDAY, AUGUST 11, 2015
4:00 PM TO 5:45 PM

MINUTES

1. CALL TO ORDER

Councilor Peter Ives, Chair for the Water Conservation Committee called the meeting to order at 4:00 pm in the City Councilors' Conference Room. A quorum is reflected in the roll call.

2. ROLL CALL

Present:
Councilor Peter Ives, Chair
Lisa Randall, Vice Chair
Tim Michael
Grace Perez
Doug Pushard
Giselle Piburn
Bill Roth

Not Present:
Stephen Wiman

Staff Present:
Robert Wood, Water Conservation Specialist Senior

Others Present:
Andy Otto, Santa Fe Watershed
Jim Lodes, Citizen
Bob Kreger, Citizen
Kim Shanahan, SFAHBA
Aaron Kaufman, Southwest Urban Hydrology
David Dunlap, WERS Committee Presenter

3. APPROVAL OF AGENDA

Ms. Randall moved to approve the agenda as presented, second by Ms. Perez, motion carried by unanimous voice vote.

4. APPROVAL OF CONSENT AGENDA

Dispense with Consent Agenda. WERS Presentation to follow.

5. APPROVAL OF MINUTES JULY 14, 2015 - WATER CONSERVATION COMMITTEE MEETING
Corrections:

Page 3: Mr. Woods – should be Mr. Wood

Page 4: b. – 2nd paragraph, 3rd line: councilor – should be councilors
Page 6: Matters from Staff: J.D. ~~Shagrough~~ Sugrue

Matters from the Public: Ms. Piburn was not in attendance at the meeting of July 14, 2015 and she has not received any calls on fluoridation.

Mr. Michael moved to approve the minutes of July 14 2015 as amended, second by Ms. Piburn, motion carried by unanimous voice vote.

6. CONSENT ITEMS

7. CONSENT AGENDA

INFORMATIONAL - WERS PRESENTATION – Doug Pushard
David Dunlap: Presenter – Introduction of Kim Shanahan (Presentation by Power Point) Mr. Dunlap said he believes everyone is comfortable and knows what WERS is, Water Efficiency Rate in store. The first of its kind interactive water conservation tool for both new and existing homes. WERS is spreadsheet based and measures indoor and outdoor water usage to arrive at a store from 0-100 with lower being better. They are capturing data such as the project foot print, indoor fixtures and appliances, faucets, showers, toilets, dishwashers – they are including things such as water treatment, evaporative coolers, humidifier's, shut off valves, which is all in the inside. On the outside they are looking at irrigation, gardening, permeable paving, plant types, plant density, irrigation distribution, retention ponds, and all the methods – all the storm water prevention pollution efforts to keep water on the property.

Mr. Pushard noted this is a performance base vs. a prescriptive based tool and this is important for everyone to understand because it is easy to confuse what is a prescriptive base vs. a performance base.

Mr. Shanahan said it is a predictive performance based.

Mr. Pushard said so what it gives you is like miles per gallon on your car, what the behavior of the house miles per gallon should be under normal occupancy both indoor and outdoor. As Mr. Dunlap has said, there is believe it or not, no tool like this. This is the first of a kind, EPA is a member of the WERS technical team and very supportive because there is no tool like this and they would like to see a tool like this.

Mr. Dunlap said what we have currently that are dictating our water efficiency and conservation efforts within the codes, the city of Santa Fe Green Building Code is based on house square footage and it is a point system that does not correlate to gallons. On the plus side it does represent choices for the homeowners. Ultimately best practices should be encouraged equally and if it is by point's people will tend to gravitate to the lowest cost points. How do I just meet my minimum compliance that may not be the greatest savings opportunities within a home? It may not even be the greatest savings opportunities for the same expense. We also have all of the codes that are part of the Land Use Development Code. 5 to 6 pages worth of prescriptive requirements for storm water retention, runoff, ponding, etc., passive and active water harvesting. Part of the WERS predictive performance path to water conservation can offer is allowing the codes

to be focused on health and safety and have an objective measurement for water conservation goals.

Mr. Wood said he has noticed at times where in the Land Use Code in different sections they contradict themselves especially when it comes to NW quadrant, were you able to account for all that.

Mr. Dunlap said that is a tough job, what we are trying to do is measure and quantifies the things that can be measured and quantified within the site. The sites that were prescriptive were mandatory things allowing the codes to become an overlay to that – saying here is what we think is appropriate in this location but then we say this is what we can objectively quantify.

The Chair asked the question, we call it predictive performance and thoroughly you can evaluate whether a house has the attributes such as low water use, washers, those types of things, those attributes against the points that are allocated. Are we not taking some norm in terms of the use?

Mr. Dunlap said that there are some national agreed upon studies that have been done that document typical occupants nationally in the US; they wash their hands this many times, they flush the toilet this many times, we are using those accepted standards for per occupants in home. We are measuring occupants as a number of bedrooms plus one and then we are using the fixture main factoring standard or what a field verified might test on that fixture in the field as the gallons per minute that goes in to that home.

Chair Ives: In terms of that "normal person" today, is that assessment different in other parts of the country. Is there a variance.

Mr. Dunlap said there isn't a variance because we are making it a national tool and what we expect to find in that if we run 10 case studies in Santa Fe and 10 case studies of similar kinds of homes, similar types of occupancy in Michigan or Florida we would see a much higher score in Michigan or Florida or someplace where conservation is not as ingrained as it is here. That is appropriate; we are already more conservation minded so we should be scoring better. There are ways that we can capture the conservation as being built in to what we are doing now. In terms of the user behavior that would only be measurable by actual metering data.

The Chair stated that the reason we ask was based on the fact that the city is putting in new meters and new billing system that might have a capacity to evaluate household by household. We might be able to gather that information.

Mr. Shanahan said they are looking at this as a micro-tool for each individual house but it can also be looked as a macro tool for jurisdiction.

Mr. Pushard noted that where we do an indoor/outdoor split that is actually a local. That number would be indoor/outdoor split would be very different for Santa Fe even compared to Albuquerque but when you get to Florida or Wisconsin that will be totally different. It is a local number or parameter factored in.

Mr. Dunlap said there is some importance in being able to compare one house from another independently in occupancy. This infrastructure coming in today allows us to

look at those homes with occupancy. Gallons per capita per day is the current number the water utility generates annually and reports to the State Engineer. This is a number that is useful for looking at what an expected 3 or 4% occupancy would be for a home moving forward based on historical information. Unfortunately the hard data that we have currently is just strictly per meter per household so we don't know anything about them automatically by that usage what is going on behind the meter, who is in that house. We don't have indoor vs. outdoor except in some very specific places like in Las Campanas where they have dual meters, they are gathering data for indoor/outdoor split. It would be great to consider having a separate outdoor meeting behind the main meter for the city. These are great tools. We are looking at taking the historical data that we have and comparing some of the test houses that we are running for WERS now and comparing them to the historic data and see where they fall relative to those averages. WERS is built to be a trade off matrix, performance based – the restriction around the tool is total water usage, i.e., the score. One of the great things that allows is within a particular jurisdiction the city or county may decide whether they want to impose mandatory requirements or turf restrictions or types of irrigation, those can all still occur as prescriptive pathways but the WERS can function independently from that.

Screen shots were included in the packet.

(Exhibits Attached – A)

Ms. Lisa Randall assumed the Chairmanship with the exiting of Councilor Ives: 5:15 pm

DISCUSSION ITEMS:

8. CLIMATE ACTION TASKFORCE – COUNCILOR IVES TO REPORT AT NEXT MEETING.

9. VACANCIES ON THE CONSERVATION COMMITTEE
A News Release was issued on July 15, 2015 announcing openings for members to serve on the Water Conservation Committee. The request has been sent out to the City Councilors offering them the opportunity to also make recommendations. Mr. Wood encouraged the members to submit names to the Mayor and Council of any suggested candidates for the committee.

10. DIFFERENCES IN SOIL MOISTURE AT CURB CUTS WITH AND WITHOUT RAIN GARDENS INSTALLED AT THE SANTA FE COMMUNITY COLLEGE – (Aaron Kauffman, 15 minutes)

(Slide presentation was followed by the WCC members) Exhibit B

QUESTIONS:
Do you think you will do further testing at the sites.
Mr. Kauffman said that the equipment is out at the site, there was funding for 9 months. Equipment is very expensive; to look at other soil textures would be an investment. It would be valuable to look at others. At this time there is no additional funding available.

INFORMATIONAL ITEMS:

11. GROUP REPORTS FROM WATER CONSERVATION COMMITTEE INITATIVES:

A. GROUP #5-WATER SYSTEM MAP
No updates. There was a nice article in the New Mexican on the water map.

B. GROUP #2- WATER CONSERVATION EDUCATION/OUTREACH
No Updates.

C. GROUP #3- WATER CONSERVATION CODES, ORDINANCES & REGULATIONS – LEGISLATIVE UPDATE
Updated earlier in the meeting.

D. GROUP #4- REESTABLISH TREND OF NET ANNUAL REDUCTIONS IN PER CAPITA WATER USAGE AND IDENTIFYING LARGE WATER USERS
Mr. Michael asked if we could dissolve this group. This information will be taken back to the chair and listed as an action item for the next meeting to dissolve group #4.

E. GROUP #1 – TREATED WASTE WATER AS DRINKING WATER SOURCE.
No report.

MATTERS FROM STAFF

- Vacancies - Water Conservation Staff & Committee
  - A candidate for the Water Conservation Manager was available and the offer was rejected. The position will be re-advertised.
  - Quita Ortiz has taken a position with the Water Resources Group for career advancement.
  - The Intern will be on board through October, 2015.

The WCC members offered to help in any way possible. Mr. Wood said they will be staffing a booth at the SWAN Park, Mr. Wood will gladly accept any help from the members. The entire park is recycled water other than the drinking water and we need to get the word out. Ms. Randall asked if there is English/Spanish Signage. Mr. Wood will check on this and update at next meeting.

- Website and advertising
  Advertising is still on hold pending administrative direction. This is not creating a problem as most of our advertising is done in April, May and June. Mr. Wood stated that until they have further direction they are not moving forward.

Mr. Pushard suggested that once staff gets direction he would like to have information brought to the WCC members to review the advertising plan for concurrence. In the past this was one of the weak links not being fully aware where the advertising would be placed.

- Drought, Monsoon/El Nino, and ESA
  (Report included in packet)

MATTERS FROM COMMITTEE:
Questions on the Animas River, does it affect the BDD? Mr. Wood said that the BDD is not affected. Mr. Wood said that the awareness has been educational for the public to know that we could be affected at any time.

Mr. Pushard asked for information on the Demand Hardening Study. Mr. Wood will look in to this matter.

MATTERS FROM PUBLIC:
Jim Lodus: Study on Santa Fe River Basin, has that been completed. Mr. Pushard responded that this was an item discussed about 6 months ago and it has gone to the Bureau of Reclamation.

NEXT MEETING – THURSDAY, SEPTEMBER 10, 2015:
Same time, different date in the Land Use Committee Meeting room.

CAPTIONS: MONDAY, AUGUST 24, 2015 @ 3 PM. PACKET MATERIAL: WEDNESDAY, SEPTEMBER 30, 2015 @ 3 PM.

ITEMS FOR NEXT AGENDA:
Dissolution of Group #4

ADJOURN

There being no further business to come before the Water Conservation Committee, the meeting was adjourned at 5:45 pm.

Signature Page:

Councilor Peter Ives, Chair

Lisa Randall, Vice Chair

Fran Lucero, Stenographer

Existing home with EPA upgrades & RW reuse, START HERE

Building Information

New or Existing?	EXISTING	# of bedrooms	3	House footprint in sf	2,000.00
Type	Single Home	# of floors	1	Roof pitch	0.00 in 12
# of units total		ave. floor to floor ht	9	Roof Type	Asphalt <Default>
Sample set size		main HW pipe dia.	0.75	Roof sf	

Climate Information

Average Annual Rain	16.07	MUNICIPAL OVERRIDE: Average Annual Rain	TBD
Average Annual ETO	4.41	MUNICIPAL OVERRIDE: Average Annual ETO	TBD
Average Annual Watering Months	TBD	MUNICIPAL OVERRIDE: Average Annual Watering Months	TBD

Site Information

Lot Size (sf)	16000.00			Maxium Allowable Irrigation Per Code	
Encroachments	200.00			*Please only use one method if required by code, otherwise leave both as zero*	
Under Roof (sf)	2000.00	OR	by %	0%	
Remaining Lot (sf)			by sf	0.00	

Collection / Infiltration / Land Use Worksheet

All Turf (sf)	500.00	Directed Imp. Paving (sf)	0.00
New Softscape (sf)	2,000.00	Remaining Impervious (sf)	0.00
Existing Softscape (sf)		Prohibited Landscape Area (sf)	1,000.00
Water Features (sf)	0.00	Other (sf)	10,300.00
Permeable Paving (sf)	0.00	*must total 100%*	
TOTAL			

Building Code / Green Program Specific Water Use Perscriptive Information

If the Building Code and Green Building Program values are left blank, the WERS Program will be the default.

(Currently, this feature is not active in the pilot program)

WERS Municip Green

Indoor Requirements / Allowances

Start Here | Indoor Use WERS | Capture & Usage | Exterior Use DESIGN | Verification Sun ..

Exhibit A 1

Existing home, Indoor WERS before changes

IU1 Indoor Fixtures and Appliances *** PLEASE DO NOT USE "COPY AND PASTE" ANYWHERE IN THIS TABLE ***

	Fixture or Appliance	Industry Baseline GPF / GPM / GPC /	Existing Units GPF / GPM / GPC /	Prescriptive Path? N — Minimum Prescriptive Path Units GPF / GPM / GPC / etc (Enter as information provided on the "Start Here" tab.)	Proposed Units GPF / GPM / GPC /	Applicable to Project?	Proposed or Actual Daily Use in Gallons	Gallons Saved Over Baseline	Gallons Saved Over Existing	Percent Saved Per Fixture (Baseline vs. Proposed)	Installation or Testing Confirmed?	Notes
A	Toilet (GPF)	1.60	5.00	1.28	5.00	Y					N	
B	Showerhead (GPM)	2.50	2.50	2.00	2.60	Y					N	
C	Lavatory (GPM)	2.20	2.50	1.50	2.60	Y					N	
D	Kitchen Faucet (GPM)	2.20	2.50	2.20	2.60	Y					N	
E	Dishwasher (GPC)	6.50	6.50	4.25	6.60	Y	6.50	0.00	0.00	0.00%	N	
F1	Washer Size in CF		5.00		5.00						N	
F2	Washer WF	9.50	9.50	9.50	9.00	Y	45.00	2.50	0.00	5.26%	N	
G	Water used to reach 100 degrees (GPU)	2.00	2.00	1.50	2.00		0.00	0.00	0.00	0.00%	N	
H	Indoor Water Features in Gallons/Day (See worksheet below)		0.00	N/A	0.00	Y	0.00	0.00	0.00	0.00%	N	
							51.50	2.50	0.00	Total		

AVERAGE Rainwater reuse gal/day credit: 0.00
AVERAGE Greywater reuse gal/day credit: 0.00
AVERAGE Adjusted usage gal/day: 51.50

MINIMUM REQUIRED INDOOR WERS SUBTOTAL: 84

Project INDOOR WERS SUBTOTAL: 128

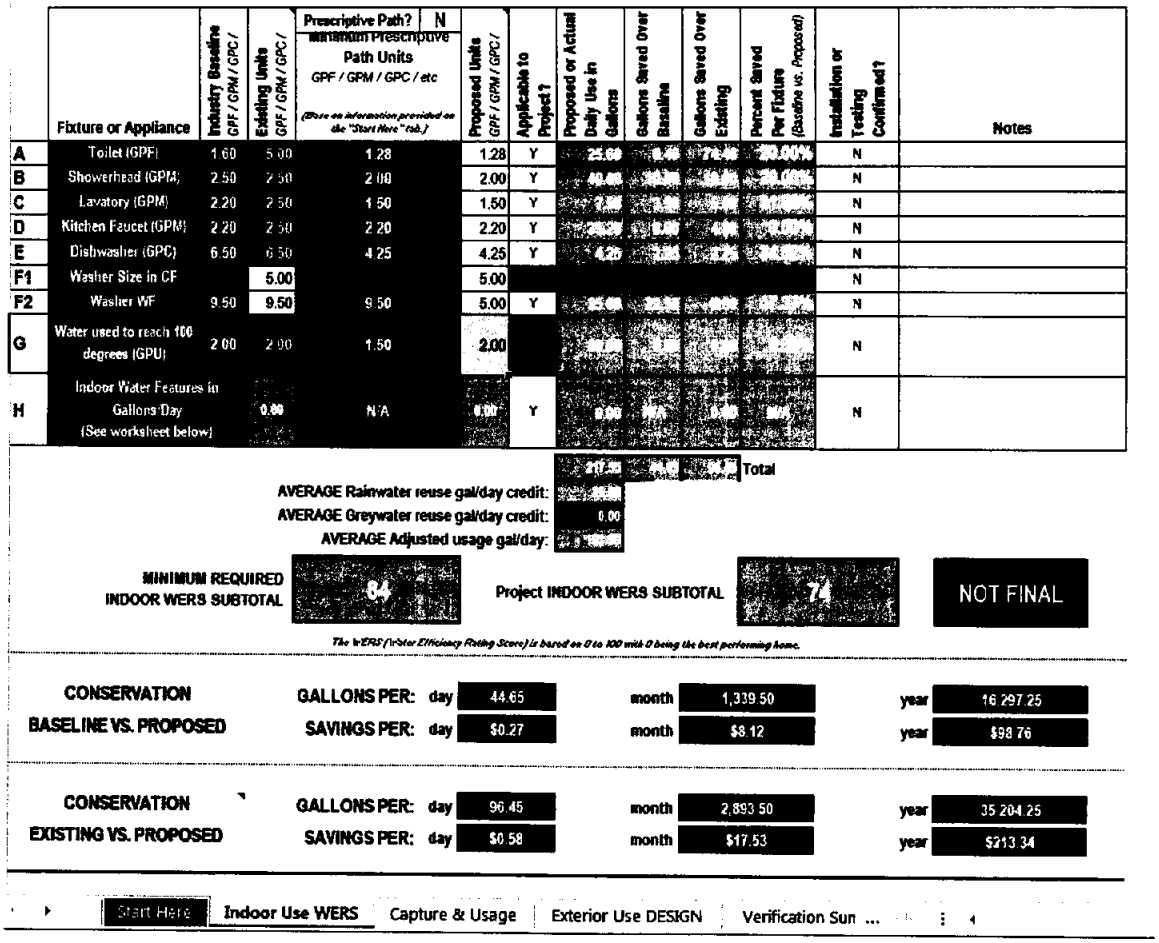
NOT FINAL

The InWERS (Interior Efficiency Rating Score) is based on 0 to 100 with 0 being the best performing home.

CONSERVATION BASELINE VS. PROPOSED	GALLONS PER:	day	2.50	month	75.00	year	912.50
	SAVINGS PER:	day	$0.02	month	$0.45	year	$5.53
CONSERVATION EXISTING VS. PROPOSED	GALLONS PER:	day	NO DATA	month	NO DATA	year	NO DATA
	SAVINGS PER:	day	NO DATA	month	NO DATA	year	NO DATA

Start Here | Indoor Use WERS | Capture & Usage | Exterior Use DESIGN | Verification Sun ...

Existing home with EPA upgrades & RW reuse, Indoor WERS



	Fixture or Appliance	Industry Baseline GPF / GPM / GPC /	Existing Units GPF / GPM / GPC /	Prescriptive Path? N — Minimum Prescriptive Path Units GPF / GPM / GPC / etc (Enter on information provided on the "Start Here" tab.)	Proposed Units GPF / GPM / GPC /	Applicable to Project?	Proposed or Actual Daily Use in Gallons	Gallons Saved Over Baseline	Gallons Saved Over Existing	Percent Saved Per Fixture (Baseline vs. Proposed)	Installation or Testing Confirmed?	Notes
A	Toilet (GPF)	1.60	5.00	1.28	1.28	Y					N	
B	Showerhead (GPM)	2.50	2.50	2.00	2.00	Y					N	
C	Lavatory (GPM)	2.20	2.50	1.50	1.50	Y					N	
D	Kitchen Faucet (GPM)	2.20	2.50	2.20	2.20	Y					N	
E	Dishwasher (GPC)	6.50	6.50	4.25	4.25	Y					N	
F1	Washer Size in CF		5.00		5.00						N	
F2	Washer WF	9.50	9.50	9.50	5.00	Y					N	
G	Water used to reach 100 degrees (GPU)	2.00	2.00	1.50	2.00						N	
H	Indoor Water Features in Gallons/Day (See worksheet below)		0.00	N/A	0.00	Y					N	

Total

AVERAGE Rainwater reuse gal/day credit:

AVERAGE Greywater reuse gal/day credit: 0.00

AVERAGE Adjusted usage gal/day:

MINIMUM REQUIRED INDOOR WERS SUBTOTAL 64

Project INDOOR WERS SUBTOTAL 74

NOT FINAL

The WERS (Water Efficiency Rating Score) is based on 0 to 100 with 0 being the best performing home.

CONSERVATION BASELINE VS. PROPOSED	GALLONS PER: day	44.65	month	1,339.50	year	16,297.25
	SAVINGS PER: day	$0.27	month	$8.12	year	$98.76
CONSERVATION EXISTING VS. PROPOSED	GALLONS PER: day	96.45	month	2,893.50	year	35,204.25
	SAVINGS PER: day	$0.58	month	$17.53	year	$213.34

Start Here | Indoor Use WERS | Capture & Usage | Exterior Use DESIGN | Verification Sun ...

Existing home with EPA upgrades & RW reuse, Exterior design

EU1 Design Parameters

1.1 Area Calculations *(from "Start Here Tab")*

New Softscape (sf) | Water Features (sf) | Total areas available for land / softscape, water feature, or

Existing Softscape (sf) | meable Paving (sf)

1.2 Potential ETO in Inches per Month

Maximum Eto *(for reference only)*

Average Monthly Eto *(for reference only)*

JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1.94	2.30	3.45	5.13	6.52	7.79	7.24	6.19	5.01	3.75	2.32	1.87

1.3 Water Baseline by Month in Gallons Average Monthly Baseline in Gallons *(for reference only)*

JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
2556.37	3589.87	5378.46	8001.36	10156.50	12137.16	11288.29	9647.91	7813.35	5845.62	3612.51	2525.90

1.4 Water Allowance by Month in Gallons

Max Baseline Percentage | ve. Monthly Allowance in Gallons *(for reference only)*

JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC

1.5 Average Rainfall in Inches per Month Average Monthly Rainfall in Inches *(for reference only)*

JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC

1.6 Average Peak ALLOWABLE Monthly Rainfall ve. Peak Monthly Rainfall *(for reference only)*

MAX ALLOWED Peak % | Ave. Peak ALLOWABLE MRF. *(for reference only)*

modified

JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC

EU2 Proposed Design Analysis

(Please note - if using another third-party program for analysis, leave all items in this section as zero and proceed to line 2.2)

2.1 OPTION ONE: Landscape / Water Requirement

Use of the following pull-downs affects the "Average Peak ALLOWABLE Rainfall" percentage.

Y | Rain Sensor present? (10%)

Y | Smart Controller present? (10%)

Please complete the table below with the information that best describes the proposed outdoor design.

Zone	Hydrozone / Area (sf)	Plant / Feature Type & Water Requirement	KL	Irrigation Type	DU/LQ	LWR/A (GPM) Average
1	500.00	Turfgrass - Low	0.6	Rotor	0.7	600.00
2	2000.00	Shrubs - Medium	0.5	Drip/Micro	0.8	2800.00
3	0.00	Permeable Hardscape	0		0	0.00
4	0.00	Pool, Spa, or Water Feature	0.8	No Irrigation	0.000	0.00
5		<select plant / feature type>	0		0	0.00
6		<select plant / feature type>	0		0	0.00
7		<select plant / feature type>	0		0	0.00
8		<select plant / feature type>	0		0	0.00
9		<select plant / feature type>	0		0	0.00
10		<select plant / feature type>	0		0	0.00
11		<select plant / feature type>	0		0	0.00
12		<select plant / feature type>	0		0	0.00
13		<select plant / feature type>	0		0	0.00
14		<select plant / feature type>	0		0	0.00
15		<select plant / feature type>	0		0	0.00
Total Area	2500.00	Landscape / Water Requirement for Site (GPM)				3407.00

All documentation for section 2.1 and installed items above have been verified. (Only to be used by the WERS

<select answer>

2.2 OPTION TWO: Landscape / Water Requirement Via Third-Party Program

2.2 OPTION TWO: Landscape / Water Requirement Via Third-Party Program

OUTDOOR WATER USE CALCULATION PROGRAM

Are calculations being done for this home?	<select answer>
If so, which third-party program is being used?	
If other, please provide the name & URL of the program.	

OUTDOOR WATER USE DESIGN PROFESSIONAL

Design Professional of Record	Name	
	Phone	
	Email	
Program under which the design professional is certified?		
If other, please provide the name & URL of the program.		

OUTDOOR WATER USE REDUCTION

Please enter the information for outdoor water use results from the third-party program used to calculate outdoor water use.

	sf/ area Upon Which Calculations were based
6872.55	Average Water Baseline by Month in Gallons / Month
6872.55	Average Water Allowance Gallons / Month
	AVE. Landscape / Water Required for Site in G/M
90.54%	Average Reduction in Percent Compared to Allowance

All documentation for section 2.2 and installed items within the documentation have been verified. (Only to be used by the WERS Professional) <select answer>

2.3 NON-PERMANENT IRRIGATION AFFIRMATION

Use this section only if there is landscaping but no irrigation for the project.

Xeriscaping? <select answer> Percent of softscape?

Start Here | Indoor Use WERS | Capture & Usage | **Exterior Use DESIGN** | Verificati

2.4 **Water Use Reduction Summary (Sub-Total)** Project is using WERS for calculations

[redacted] Average Reduction (gallons) [redacted] Average Cost Savings / Month

[redacted] Average Reduction (percent) [redacted] Average Cost Savings / Year

EU3 Outdoor Water Reuse

Tied to capture & usage tab

3.1 **Combined Available** *ave gal/ day* [redacted] *ave gal/ month* [redacted] *ave gal/ year* [redacted]

3.2 **Reuse Offset**

[redacted]

Landscape / Water Requirement per Month with offset [redacted]

EU4 Summary After Reuse Analysis

4.1 **Water Use Reduction Summary** Project is using WERS for calculations

4188.55 Average Reduction (gallons) [redacted] Average Cost Savings / Month

[redacted] Average Reduction (percent) [redacted] Average Cost Savings / Year

4.2 **Project OUTDOOR WERS SUBTOTAL**

40 NOT FINAL Without Reuse Offset

[redacted] NOT FINAL With Reuse Offset

Signature Section

Verifier **Date**

Start Here | Indoor Use WERS | Capture & Usage | **Exterior Use DESIGN** | Verificatio

Verification Summary

WERS REPORT

Builder

[redacted]

Verification

[redacted]

Project

1234 HOMEOWNER WAY SANTA FE NM

Report Date: [redacted]

This report is for: [redacted]

*Please complete the information in the white boxes.
*Orange boxes are pulldowns that require responses.
*Purple boxes and grey boxes are also active.
*Cells with a small red triangle have additional guidance provided in a "Hover" box.

WR1 SUMMARY

Indoor Use and Conservation Summary

AVERAGE CONSERVATION BASELINE VS. PROPOSED	GALLONS PER YEAR:	15,065.38
	SAVINGS PER YEAR:	$91.30
AVERAGE CONSERVATION EXISTING VS. PROPOSED	GALLONS PER YEAR:	35,204.25
	SAVINGS PER YEAR:	$213.34

Outdoor Use and Conservation Summary

AVERAGE CONSERVATION ALLOWANCE VS. PROPOSED	GALLONS PER YEAR:	41,585.55
	SAVINGS PER YEAR:	$252.01

Combined Use and Conservation Summary

AVERAGE CONSERVATION BASELINE VS. PROPOSED	GALLONS PER YEAR:	56,650.92
	SAVINGS PER YEAR:	$343.30

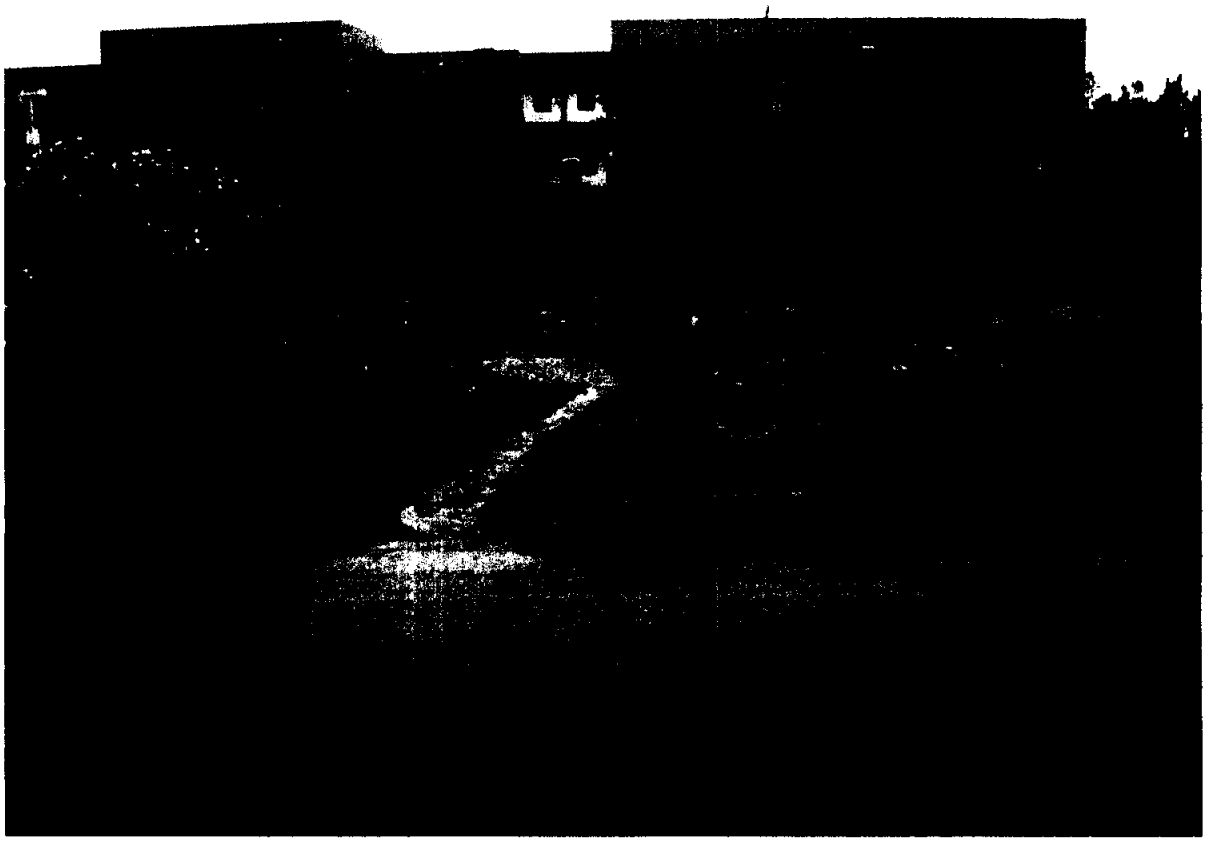
WERS [redacted] NO OFFSETS NOT FINAL WITH OFFSETS [redacted]

The WERS is based on the total water use requirements of the proposed design in comparison to an established baseline. For indoor, the baseline is the EPA Water Act of 1992 for the standard plumbing fixtures. For outdoor, the baseline is 25% of the peak average monthly rainfall deducted from the average monthly ETo for the project site as provided by the EPA.

Stormwater Irrigation: Can Retention Basins Significantly Improve Soil Moisture?

July 2015

Aaron Kauffman, Southwest Urban Hydrology LLC



The following report was completed for the Soil and Water Conservation Commission with funding from the Water Quality Conservation Grant Program. Administrative support and project collaboration was provided by the Santa Fe-Pojoaque SWCD.

Southwest Hydrology

SouthwestUrbanHydrology.com

Abstract

Vegetation planted around rain gardens and bio-retention basins presents an opportunity to remediate stormwater pollutants, diversify habitat, and improve community aesthetics in urban settings. In semi-arid regions where water resources are scarce however, it is unclear whether stormwater captured in these basins is sufficient to sustain plant growth without supplemental irrigation. This study examined whether soil moisture could be significantly improved at parking lot curb cuts with rain gardens compared to curb cuts without rain gardens. Results from nine months of monitoring indicate that average volumetric water content of soils in rain gardens significantly increased at multiple depths over areas without rain gardens. Enhancements in soil moisture in rain gardens could potentially sustain vegetation for extended periods without precipitation and thus reduce the burden on potable and effluent water sources for irrigation in urban settings.

Introduction

During recent years there has been a growing national recognition that shrubs and trees in urban landscapes have both environmental and commercial value. Research has shown that vegetation along streets and parking lots can lower urban temperatures and energy consumption; filter, degrade, and accumulate stormwater contaminants; and positively influence consumer behavior by enhancing aesthetics to building exteriors. Research by the city of Albuquerque Parks Department revealed that for every dollar spent in public tree maintenance, $1.31 in benefits were returned from tree canopy in the form of carbon sequestration, air quality improvements, reduced energy consumption, etc (Vargas et al. 2006). Despite these benefits, adoption of urban forestry by municipalities and commercial developers in the arid Southwest can be hindered by the high costs of irrigation and public concern over potable water use during times of drought. For example, between 2007 and 2012 water use by the city of Santa Fe Parks Division averaged 101.8 million gallons/year while irrigation costs amounted to $1.35 million/year (Santa Fe New Mexican, April 14, 2013).

One potential method to alleviate water consumption could be through the establishment of rain gardens and bio-retention basins that harvest stormwater as passive irrigation for urban forestry projects. Questions remain however, as to whether these basins can supplement vegetation year-round in the absence of irrigation systems.

Objectives

To assess the efficacy of basins at improving passive irrigation for plants, volumetric water content (VWC) was monitored at curb cuts with and without rain gardens at the Santa Fe Community College. Specific research questions addressed included:

- Is VWC in the soil profile significantly different between curb cuts without rain gardens (i.e. controls) and curb cuts with rain gardens (i.e. treatments)?
- Is there a significant difference in VWC at varying depths of the soil profile?
- How does the VWC in the soil profile vary in time?
- How does precipitation drive VWC fluctuations at varying depths and treatments?

Study Area

The Kids' Campus asphalt parking lot at the Santa Fe Community College is approximately 25,000 square feet with seven evenly spaced curb cuts on the western edge that serve as drainage. Historically stormwater was allowed to exit the curb cuts onto mild slopes (less than 5%) with a mixture of native grasses. Soils are generally described as Alire loam which includes a well drained mixture of loams and clay loams in the first 45 inches of a typical profile (USDA: NRCS Web Soil Survey).

In October of 2012 and April 2013 two rain gardens were constructed to harvest stormwater from parking lot curb cuts. The dimensions of the basins are approximately 15'x10'x1' for a maximum catchment volume of 1,122 gallons. Over the course of a year with 12 inches of precipitation and no individual storms exceeding one inch, it is expected that the basins would harvest at least 13,464 gallons of stormwater runoff. Basin bottoms were mulched with three inches of wood chips and planted with grasses tolerant of temporary inundation by water. Basin berms were planted with shrubs and trees including Three-leaf sumac (*Rhus trilbata*), False indigo (*Amorpha fruticosa*), Patmore green ash (*Fraxinus pennsylvanica*) and Honey locust (*Gleditsia triancanthos*). Vegetation selection criteria was based on plants that were drought tolerant, helped improve pollinator habitat, demonstrated ability to remediate common stormwater pollutants, and were native or adapted to the region without being invasive. Supplemental irrigation was not provided to plants during soil moisture monitoring (i.e. August 2014-June 2015).

Field Methods

On August 23, 2014 5-inch diameter holes were augured 13 feet west of four curb cuts draining the Kids' Campus parking lot. Two of the holes were created in undisturbed native grasses (Control) and two were excavated in the bottom of the rain gardens (Treatment). The

holes were augured 30-inches in depth. Decagon 5TM soil moisture probes were installed vertically into each hole 30 inches below the soil surface before four additional probes were installed horizontally into the soil profile at 6, 12, 18, and 24 inches below the soil surface (total of 20 probes) (Figures 1 and 2). The probes below 18 inches were expected to account for soil moisture beyond the influence of evaporation. The probes between 30 inches and the surface were expected to provide estimates of available soil moisture for transpiration. Excavated soil was reinserted into the holes at comparable bulk density prior to disturbance.

Probe cables were threaded through plastic conduit (to prevent mastication by rodents) and attached to metal fence posts approximately 25 inches west of the augured holes (Figures 3 and 4). The cables were connected to Decagon EM50 data loggers that recorded hourly VWC (m^3/m^3) for 715mL of soil volume per probe. An Onset tipping bucket precipitation gauge was also attached to one of the fence posts to record precipitation (in/hour and in/day).

Analytical Methods

Hourly VWC data for each probe was downloaded and organized by depth and treatment. To assess whether treatments and soil depth influenced VWC, a two-way ANOVA with replication was used on data pooled by rain gardens and controls. Two sample T-tests were used to determine statistical differences by treatments and depths. All statistical comparisons were evaluated at the $\alpha = 0.10$ level of significance. In order to examine the influence of precipitation on soil moisture responses and compare diurnal fluctuations by soil depth and season, VWC data was averaged by treatment and charted against daily or hourly precipitation depth.

Results and Discussion

Treatment and Depth

Comparisons of VWC revealed significant differences in soil moisture by treatment ($F(1, 131030) = 109389.6$, $\rho = 0$) and depth ($F(4, 131030) = 7862.9$, $\rho = 0$) (Figure 5). The interaction of treatment and depth also resulted in significant differences in mean VWC ($F(4, 131030) = 14422.3$, $\rho = 0$). Rain gardens improved VWC 11%, 3%, 24%, 10%, and 49% over comparable depths in soils without water catchment basins. While these increases in VWC could lead to improved growing conditions for plants, the changes appeared to be random across the soil profile (Figure 6). It was expected that rain gardens would increase soil moisture by creating more residence time (i.e. ponding) for stormwater to infiltrate the soil surface, but sustaining soil moisture through time was likely a function of organic matter and soil texture. Organic matter from the wood mulch might have influenced VWC at shallow depths where evaporation was

shielded, while differences in water holding capacity by soil textures could have affected VWC throughout the soil profile measured.

According to a Web Soil Survey, Alire loam (i.e. soil at the site) has at least five distinct layers of loam and clay loam textures in the top 45 inches of a typical profile (USDA: NRCS). Assuming soil layers were spatially uniform across the study area, excavating the rain gardens six inches in depth prior to implementing soil moisture probes could have resulted in soil probes being located in disparate soil textures from the control sites (i.e. the rain garden probes inserted 6 inches below the soil surface in basins already excavated 6 inches would lead to that probe being closer to 12 inches deep in control areas). Comparisons of soil moisture probes offset by depth and overlaid on a diagram with typical Alire loam soil profile resulted in more symmetrical VWC lines as seen in Figure 7. Increases in rain garden VWC at 6, 12, 18, and 24 inches in depth over corresponding control depths of 12, 18, 24, and 30 inches amounted to 12%, 8%, 14%, and 47% respectively. It is not clear why VWC diverges rapidly at 24 inches in the rain gardens compared to 30 inches in the controls, however this result is encouraging in the context of vadose zone soil moisture (i.e. groundwater recharge). By maintaining higher moisture in the soil profile, gravitational movement of water to deeper parts of the soil profile could more easily occur.

Fluctuations through Time and Influence of Precipitation

Total precipitation depth measured during the nine month study was 6.23 inches. Precipitation was divided into daily measurements and plotted against hourly VWC averaged between the rain gardens and controls for each depth (Figures 8-12). Chart observations show that soil moisture often spiked with an input of precipitation, however on some occasions the controls did not display a response to precipitation at multiple depths. It is assumed that the concentration of water in rain gardens aided precipitation events as small as 1/100 inch to percolate through the soil profile whereas runoff at control sites did not have the residence time necessary to infiltrate and percolate to depths as shallow as 6 inches.

Spikes in VWC were generally assumed to correspond with saturation of soils. As the VWC dropped and leveled off within a day or two after storms, field capacity (i.e. maximum amount of water a soil texture will hold against gravity) was met. According to Saxton and Rawls (2006) field capacity for loam and clay loam soils is 28% and 36% respectively. Without additional precipitation inputs, evapotranspiration will cause VWC to taper downward towards permanent wilting point (i.e. VWC where plants cannot extract water from the soil). Permanent wilting point (PWP) for loam and clay loam soils is 14% and 22% respectively. Average VWC in the rain gardens and controls did not reach PWP during the 9 months of monitoring (Table 1). By the end of 28 days (March 21st-April 17th) without measurable precipitation however, average VWC in the controls did reach approximately 23% at 6, 12, and 18 inches below the soil surface (Figures 8-10). This represented an 11.9%, 8.9%, and 5.5% decline in VWC during the dry period for the 6, 12, and 18 inch control site depths respectively. Rain garden VWC during the

same dry period only dropped 3.2%, 6.7%, and 1.0% for comparable depths. By April 17th rain garden VWC was 29%, 26%, and 31% at 6, 12, and 18 inches in depth, meaning that plant available water content (i.e. the VWC range between field capacity and PWP) was never in jeopardy of being lost. These results indicate that despite the controls having access to stormwater runoff through curb cuts, the absence of ponding at these sites could limit plant available water content during extended periods without precipitation. This is important to consider with regard to whether curb cuts without basins are sufficient to sustain plants in the absence of potable or effluent irrigation.

Diurnal Fluctuations

One of the primary reasons for sustained VWC in the upper soil profile of the rain gardens could be that wood mulch reduces water loss from evaporation. Diurnal fluctuations in VWC were examined for the first week of each seasonal trimester during the 9 month study (i.e. September 1st-7th, December 1st-7th, and March 1st-7th). Charts plotting hourly precipitation against seasonal VWC for 6 and 12 inches below the soil surface are presented below (Figures 13-18). Observations of diurnal soil moisture fluxes (i.e. waviness of the VWC measurements by day and night) are clear in the top six inches of each season. The diurnal signal of the VWC data becomes less obvious at 12 inches in depth for each season, particularly in the rain garden measurements for September. While the diurnal fluctuations never appear to shift more than 1% for any given 24-hour period, the downward trend of VWC during periods without precipitation is clear. For example, during the first week of September VWC at 6 inches in depth dropped 1.8% in the rain gardens versus 2.9% in the controls. Observational fluctuations in VWC were not evident at depths greater than 18 inches.

Conclusion and Management Implications

There are different methods to assess the value of passive irrigation provided by rain gardens. One important factor to consider is the economic savings associated with the cost of water for irrigation. After exceeding seasonal threshold water consumption quantities and associated delivery charges, the city of Santa Fe charges approximately $0.02/gallon ($21.72/1000 gallons) for water. Based on this value, the rain gardens measured at the Kids' Campus would capture $269.28 of free water from associated runoff during an average year of precipitation (13,464 gallons/year). In contrast, the city irrigates trees in street medians with two 5-gallon emitters twice per week for four hours during establishment and four hours every two weeks as they become older (personal communication). This would amount to $6.40/tree/month and $1.60/tree/month respectively. Once trees are established they are irrigated manually if soil moisture drops below 23% (i.e. the approximate VWC that control sites reached in mid-April during monitoring). These numbers indicate that the potential economic savings in irrigation

costs from rain gardens could be substantial. These savings are less meaningful however, if passive irrigation in basins cannot sustain vegetation in the absence of irrigation systems.

Studies indicate that water consumption by trees will vary depending on species, maturity, growing conditions, and other factors. On a warm (~0.25 inches ET) spring or fall day a mature tree (~100ft^2 of canopy) might use 7.8 to 14.6 gallons of water per day (Table 2). Based on average VWC at the Kids' Campus monitoring site, the 150 ft^2 rain gardens are estimated to hold approximately 821 gallons of water in the 30-inch soil profile (Table 3). This amounts to 124 gallons (0.33 gallons/ft^3 of soil) more than the control sites and 294 gallons (0.79 gallons/ft^3 of soil) above permanent wilting point. Based on these estimates, rain gardens might harbor ~8 to 16 days of extra water in the soil profile over curb cuts without rain gardens and ~20 to 38 days of extra water above permanent wilting point (Table 2). These inferences appear to be corroborated at rain gardens with less mature trees during a dry spell between March 21st and April 17th.

Measurements of VWC provided from September 2014 through May 2015 indicate that rain gardens can significantly improve soil moisture over areas without catchment basins and potentially sustain mature trees in the absence of irrigation systems. It should be noted that precipitation in the first half of 2015, particularly during the month of May, was above normal for the area around Santa Fe and New Mexico in general. Further monitoring of soil moisture during normal and below normal periods of precipitation, as well as during summer months (June through August), is critical to determining the value of rain gardens during periods of plant stress and the height of the growing season.

Figures and Tables

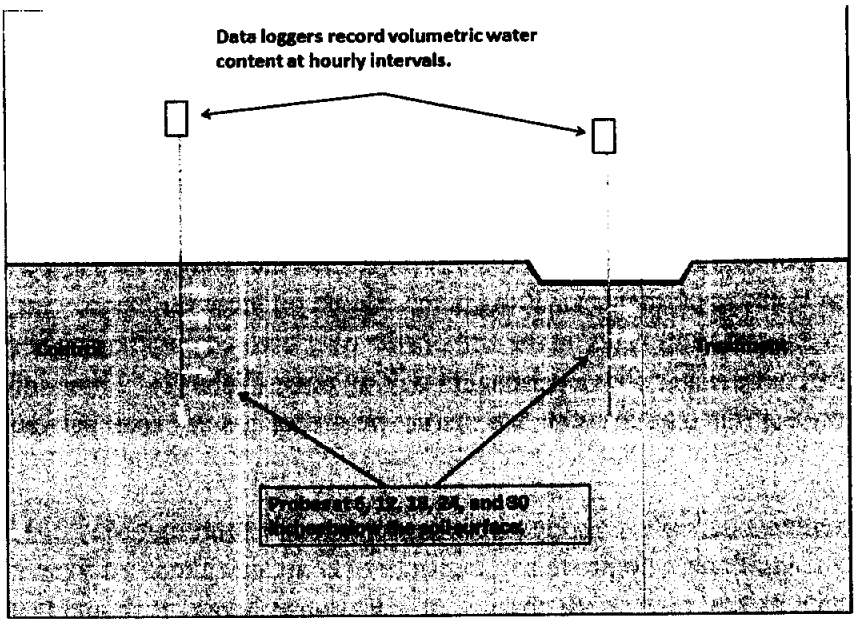


Figure 1. Diagram of field methods used to assess volumetric water content by treatment and soil profile depth.

Figure 2. Decagon 5TM soil moisture probes inserted into an Alire Loam soil profile at 6 inch intervals below the soil surface.

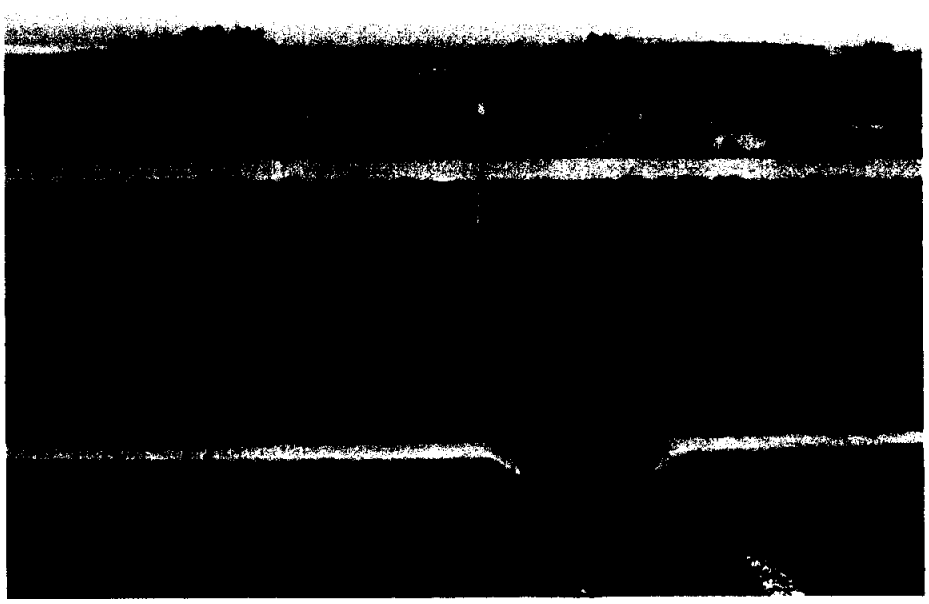


Figure 3. Curb cut without a rain garden (i.e. Control).

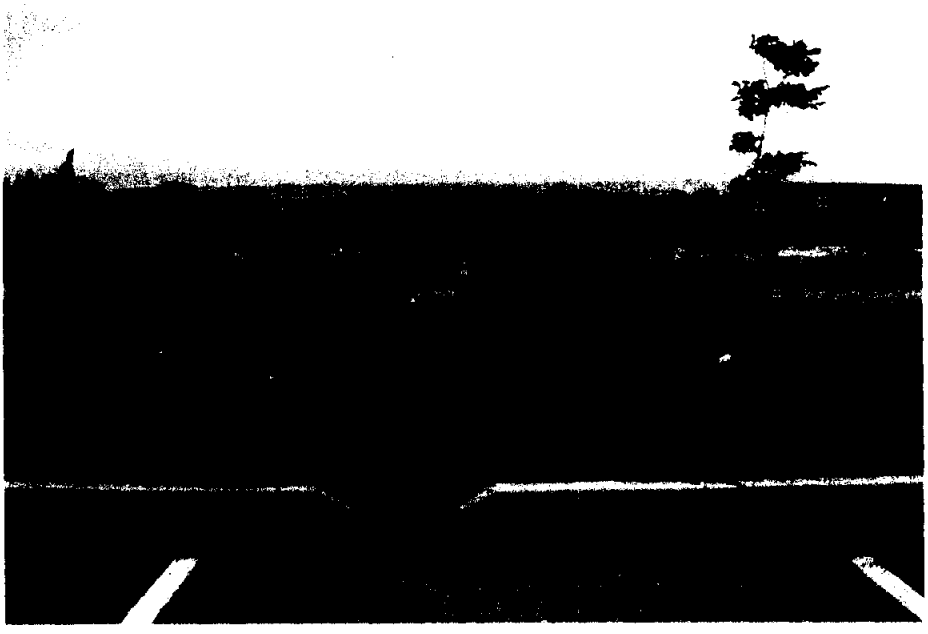


Figure 4. Curb cut with a rain garden (i.e. Treatment).

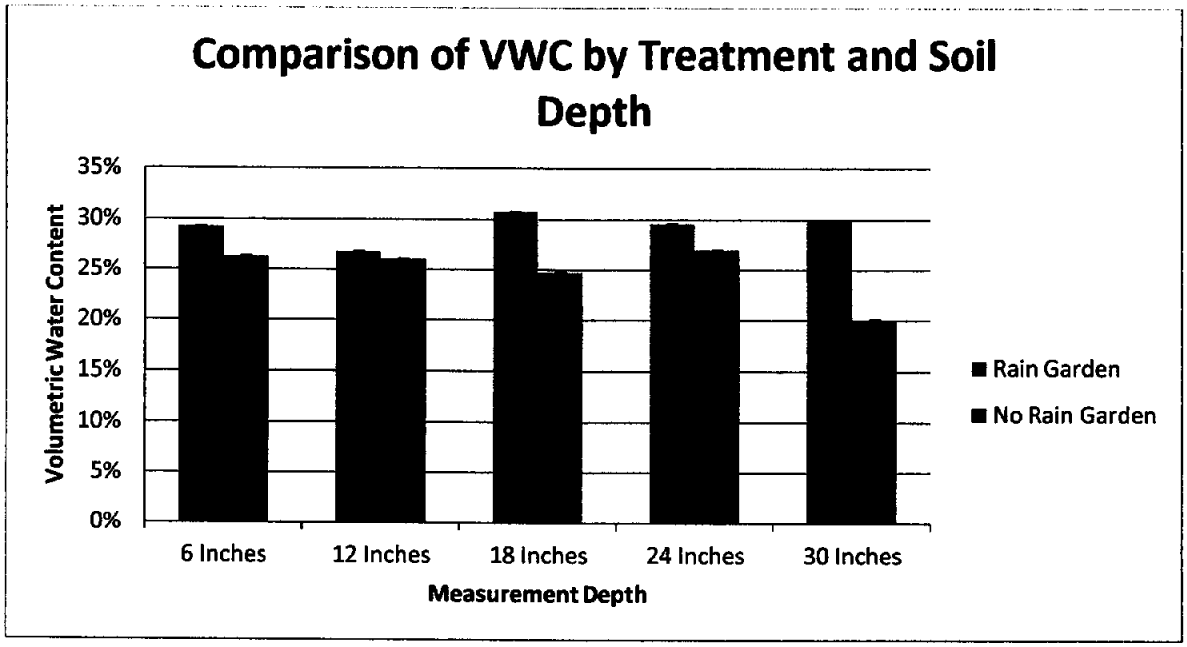


Figure 5. Mean Volumetric Water Content (90% Confidence Intervals) by depth and treatment for a 9-month period (September 1, 2014-May 30, 2015).

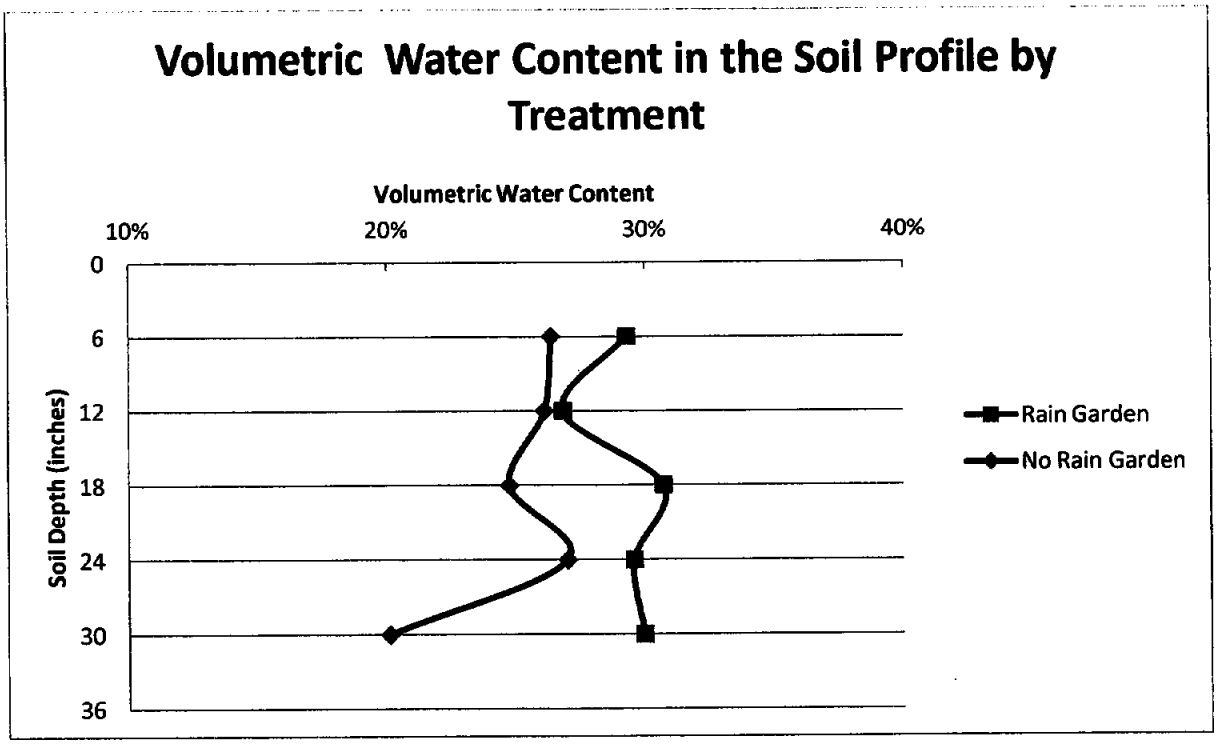


Figure 6. Average volumetric water content in the soil profile measured over 9-months at the Santa Fe Community College.

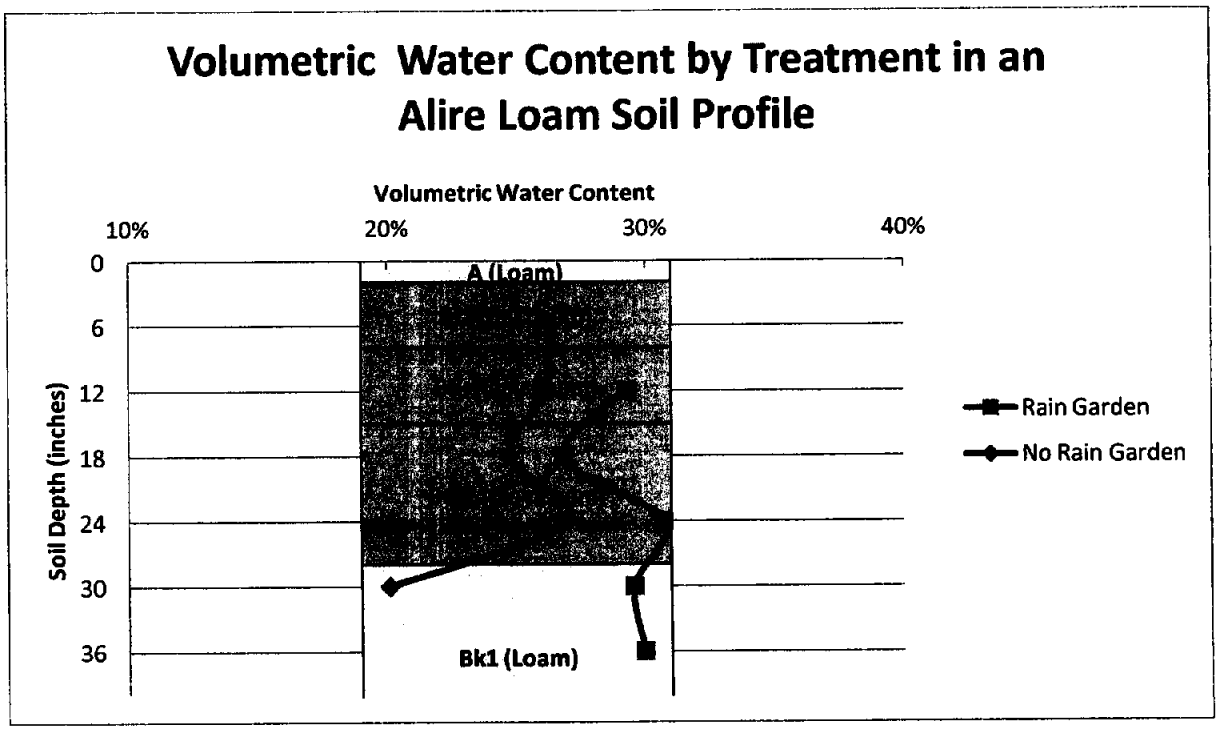


Figure 7. Average volumetric water content in an Alire Loam soil profile measured over 9-months at the Santa Fe Community College. Average measurements are offset according to where soil moisture probes would have been placed in the soil profile after rain garden excavation.

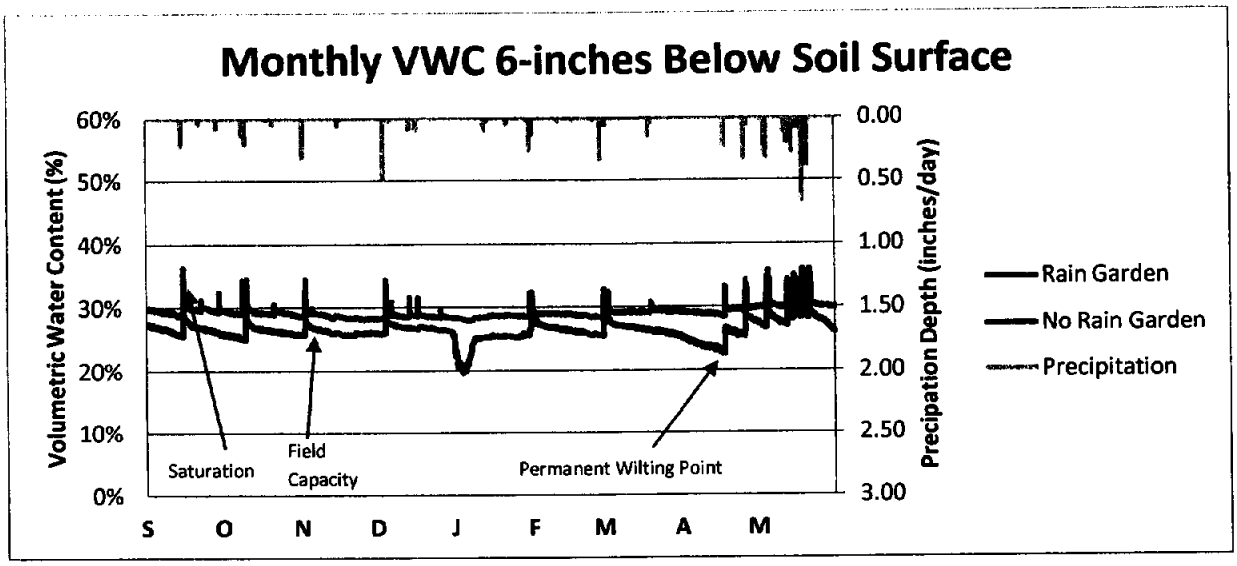


Figure 8. Monthly volumetric water content measurements compared by treatments. The dip in VWC in early January for the control data should be disregarded (probably a consequence of several days of below freezing temperatures).

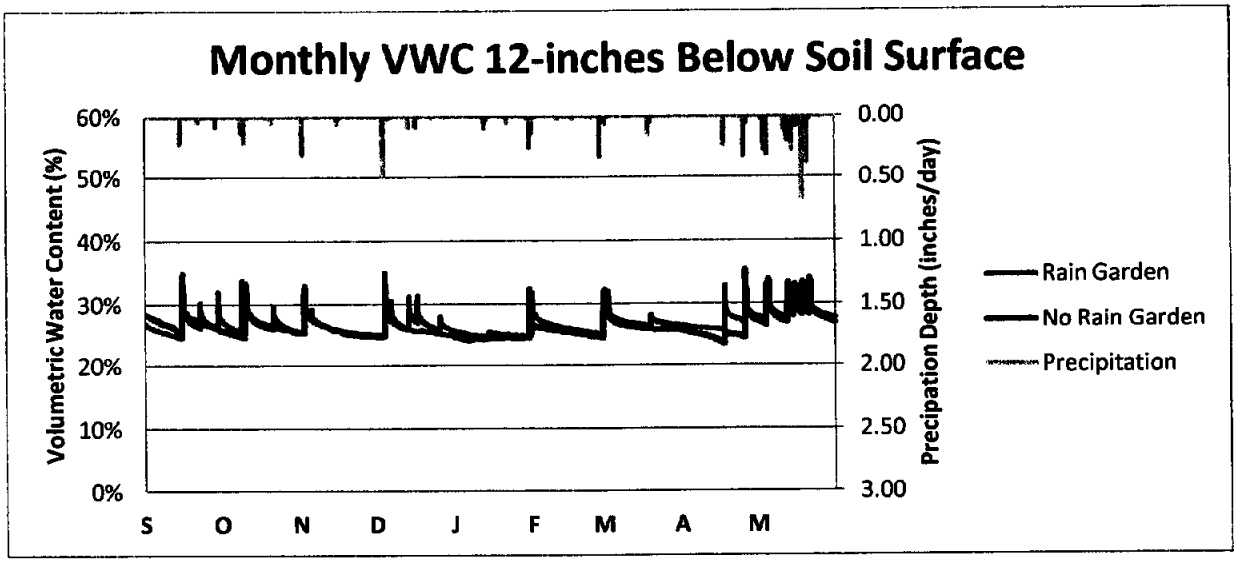


Figure 9. Monthly volumetric water content measurements compared by treatments.

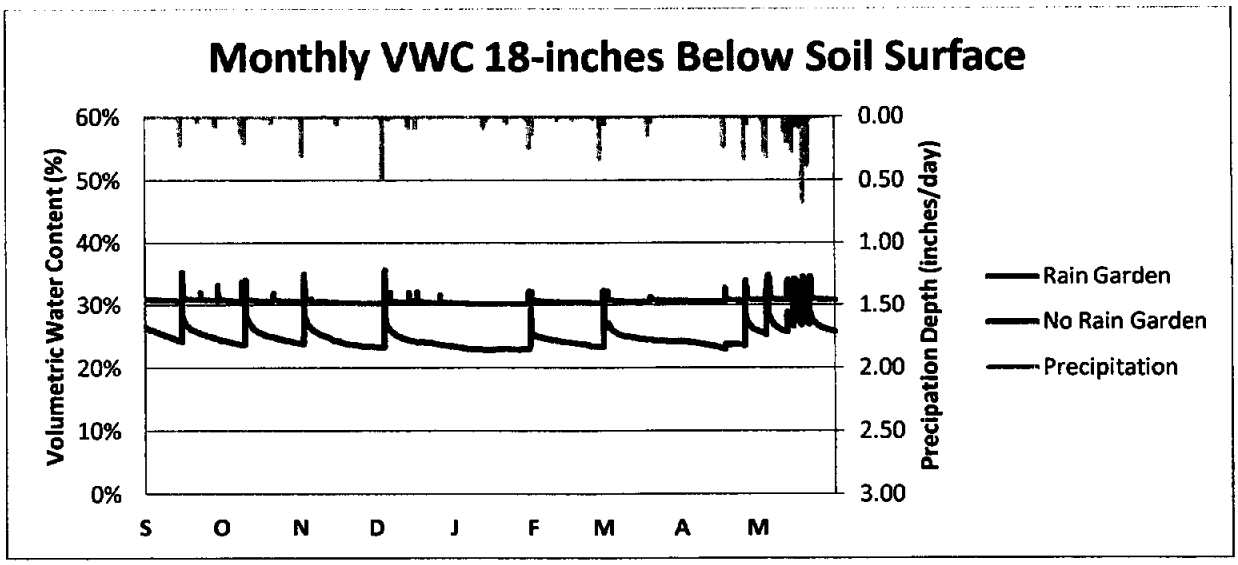


Figure 10. Monthly volumetric water content measurements compared by treatments.

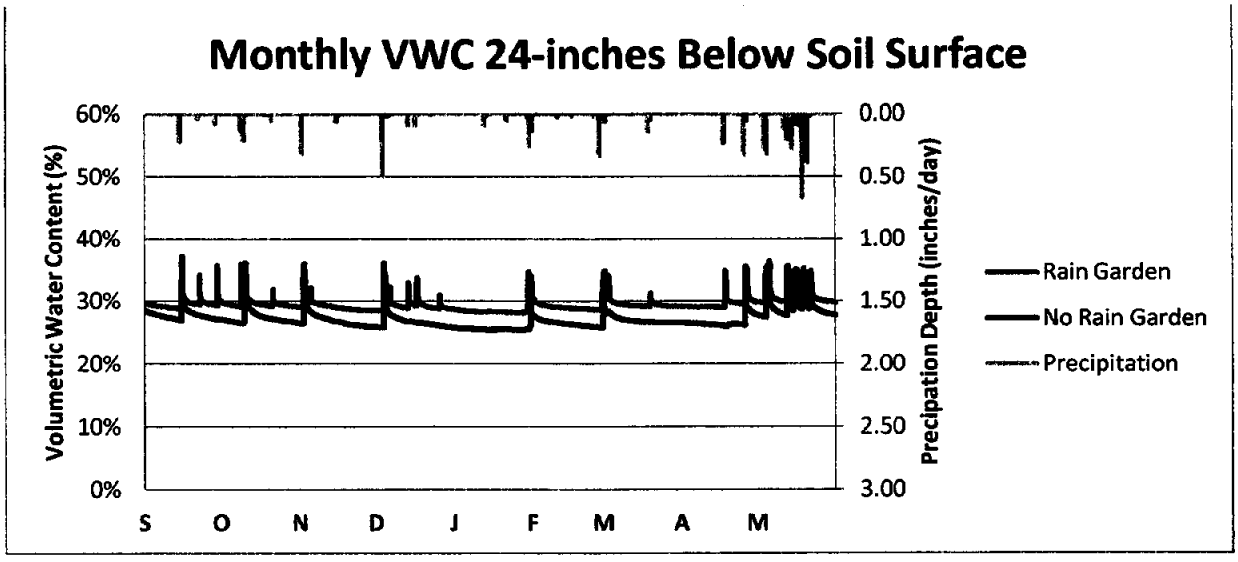


Figure 11. Monthly volumetric water content measurements compared by treatments.

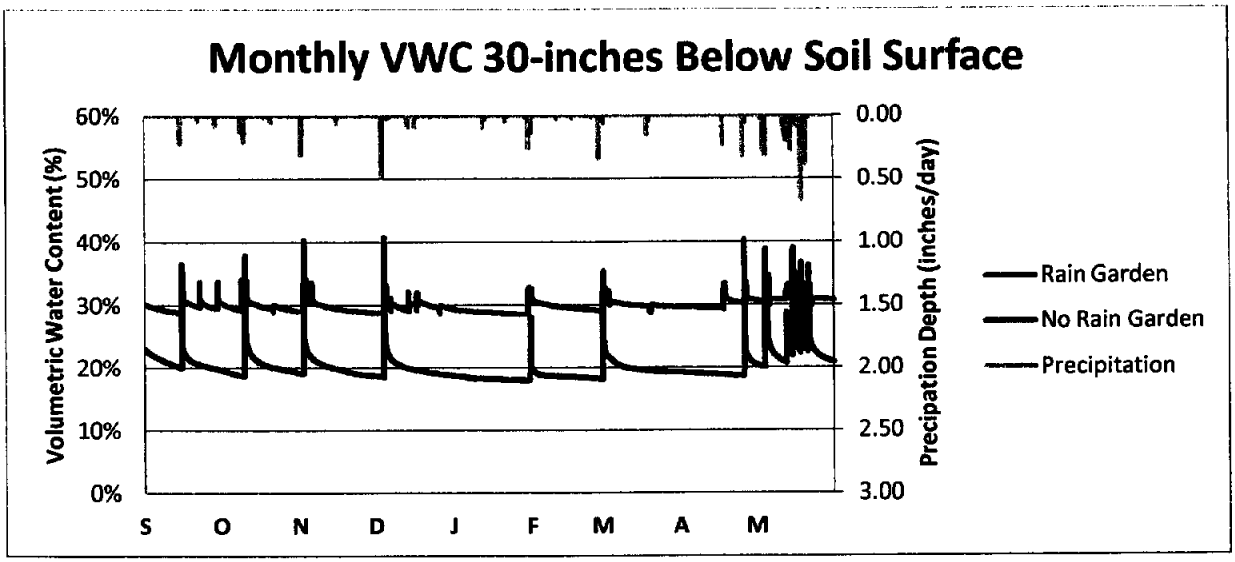


Figure 12. Monthly volumetric water content measurements compared by treatments.

Table 1. Average volumetric water content by treatment and expected soil textures at respective soil profile depths.

Soil Depth	Rain Garden Soil Texture	Rain Garden Average VWC	No Rain Garden Soil Texture	No Rain Garden Average VWC
6	Clay Loam	29%	Clay Loam	26%
12	Clay Loam	27%	Clay Loam	26%
18	Clay Loam	31%	Clay Loam	25%
24	Loam	30%	Clay Loam	27%
30	Loam	30%	Loam	20%

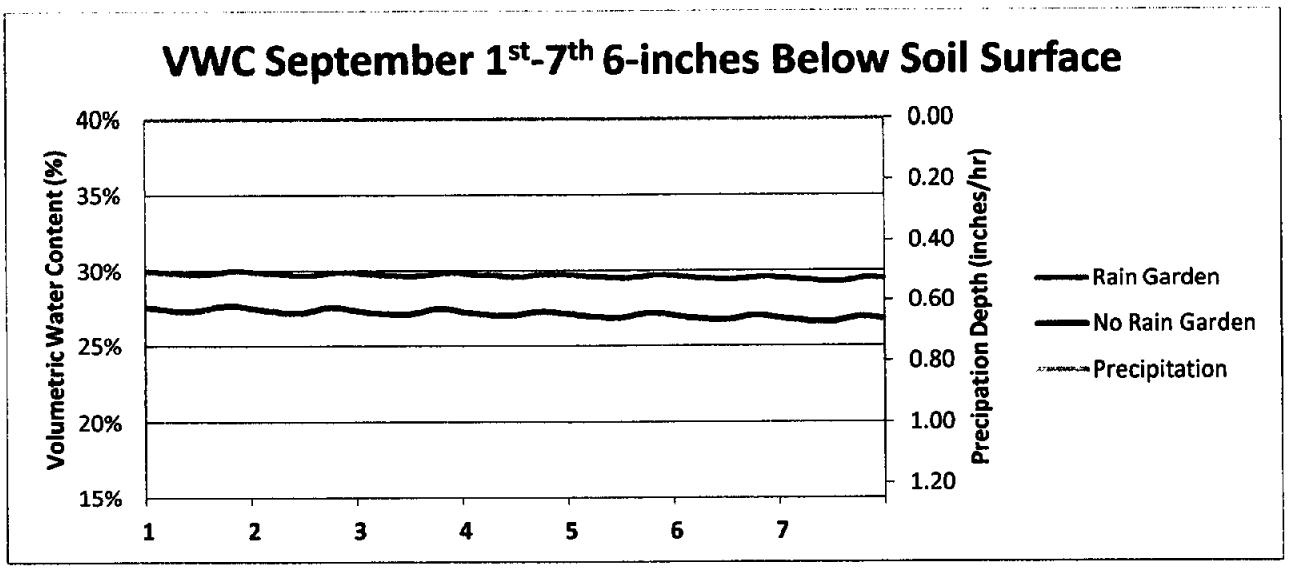


Figure 13. Diurnal fluctuations in volumetric water content by treatment.

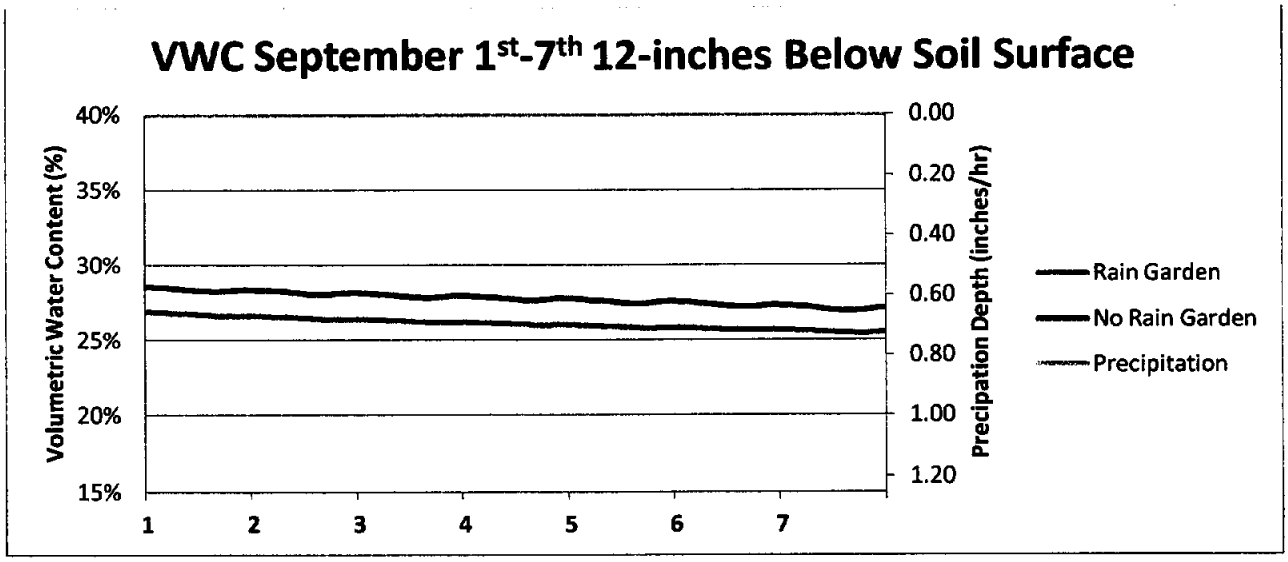


Figure 14. Diurnal fluctuations in volumetric water content by treatment.

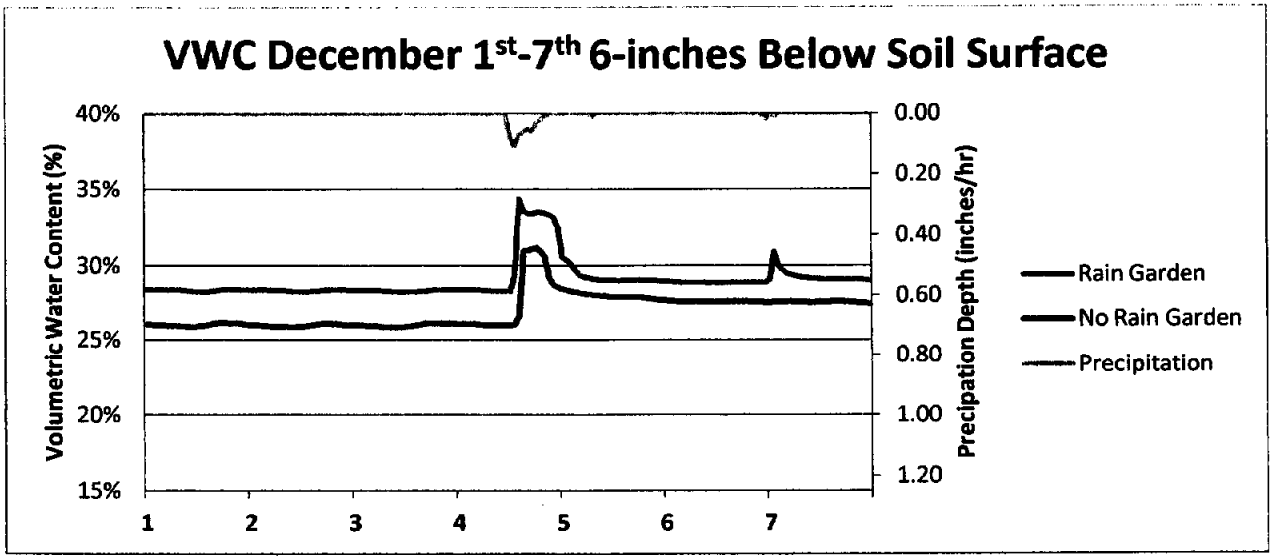


Figure 15. Diurnal fluctuations in volumetric water content by treatment.

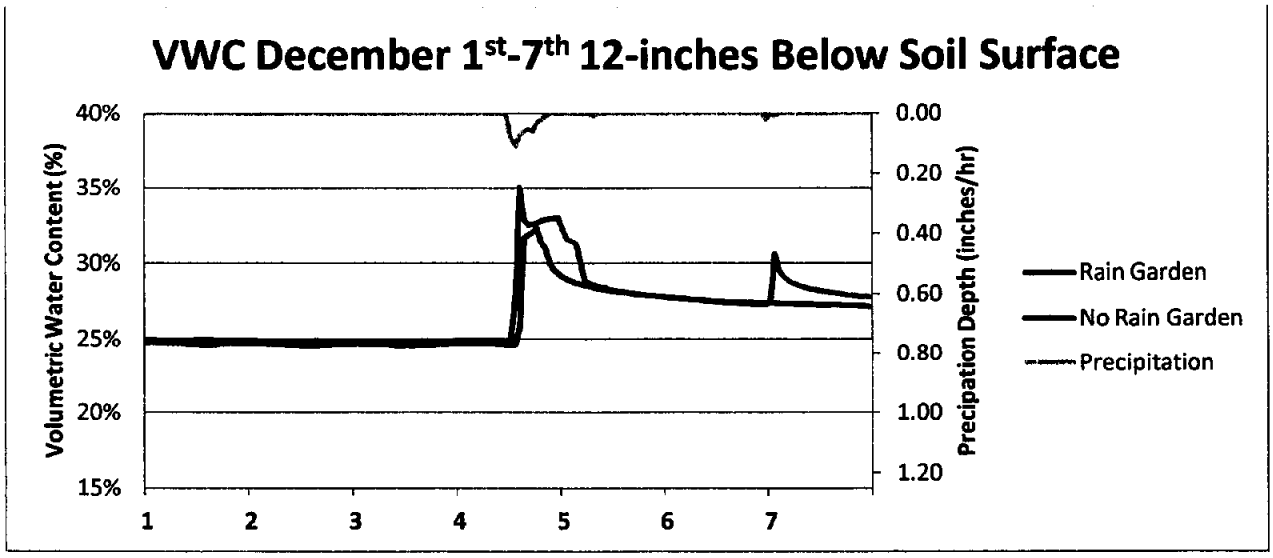


Figure 16. Diurnal fluctuations in volumetric water content by treatment.

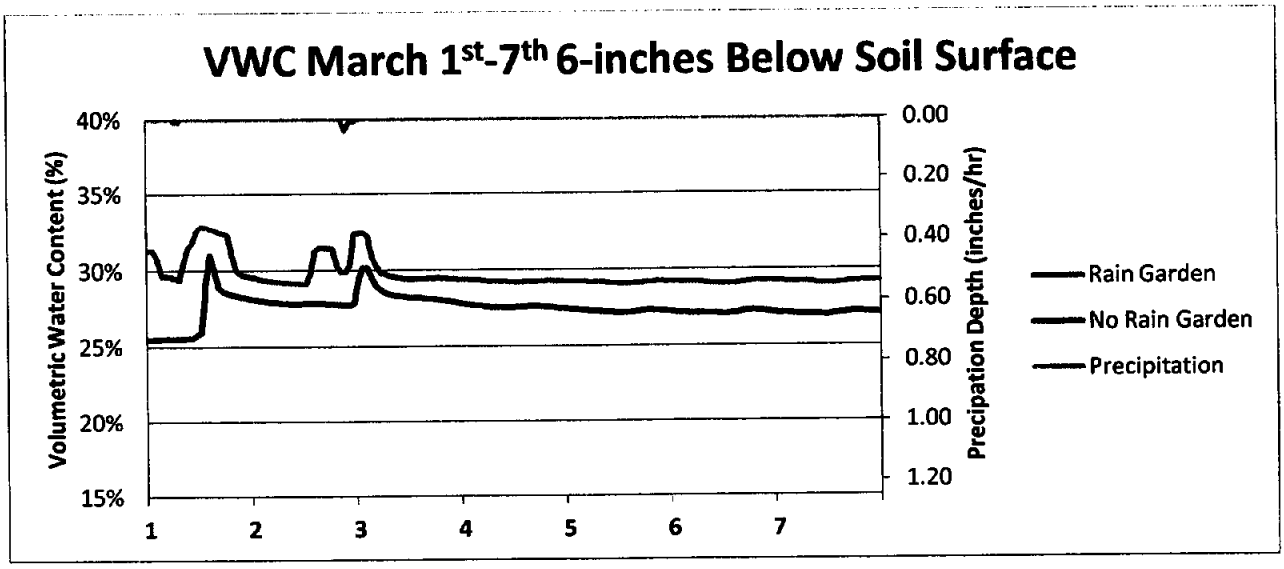


Figure 17. Diurnal fluctuations in volumetric water content by treatment.

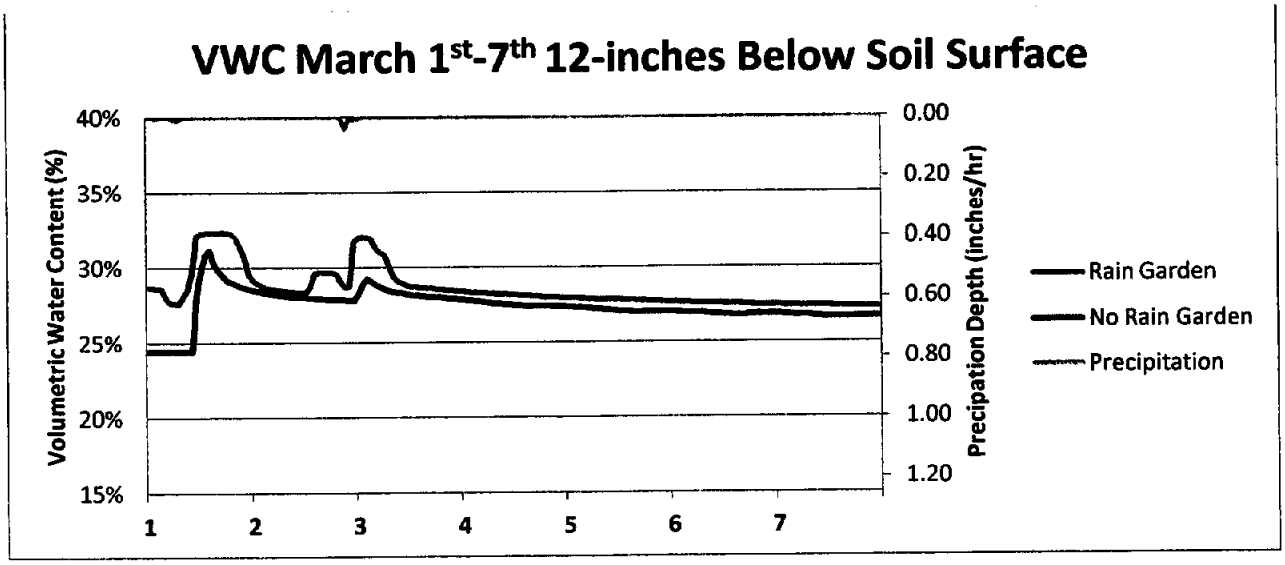


Figure 18. Diurnal fluctuations in volumetric water content by treatment.

Table 2. Estimated water consumption by a mature tree (100 sqft canopy) during a warm (0.25 inches ET) Spring/Fall day. Note that the first two columns are cited in the reference column, while columns three and four are extrapolations based on data from the Santa Fe Community College.

Tree Type	Gallons/Day	Extra Days of Water above Control Sites	Extra Days of Water above PWP	Reference (Gallons/Day)
Not Indicated	7.8	15.9	37.7	University of California Center for Landscape and Urban Horticulture
Fruit Tree	12.5	9.9	23.5	Vossen (2000)
Broadleaf Shade Tree	14.6	8.5	20.2	Utah State University Forestry Extension
Average	11.6	10.7	25.3	

Table 3. Estimated available water content (gallons) by depth, treatment, and anticipated permanent wilting point.

Probe depth	RG Gallons of water in Soil Profile	No RG Gallons of water in Soil Profile (PWP Values)	Difference in Gallons for RG and Control (RG:PWP)
6	164.4	148.1 (123.0)	16.3 (41.4)
12	150.3	146.4 (123.0)	3.9 (27.3)
18	172.2	138.6 (123.0)	33.7 (49.2)
24	166.1	151.5 (79.0)	14.6 (87.1)
30	168.3	112.8 (79.0)	55.5 (89.3)
Total	821.3	697.3 (527.0)	124.0 (294.3)

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United States Department of Agriculture, Natural Resources Conservation Service, Web Soil Survey http://websoilsurvey.sc.egov.usda.gov/App/HomePage.htm

University of California Center for Landscape and Urban Horticulture http://ucanr.edu/sites/UrbanHort/Water_Use_of_Turfgrass_and_Landscape_Plant_Materials/Easy_Calculators_for_Estimating_Landscape_Water_Needs/

Utah State University Forestry Extension http://forestry.usu.edu/htm/city-and-town/tree-care/drip-irrigation/

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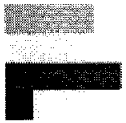
Drought, Monsoon/El Nino, and ESA Update

As the Committee/Board is aware, our region is has suffered through a prolonged drought, lasting over four consecutive years of record drought, heat, and wildfires – albeit drought conditions have eased lately due to the reappearance of a strong El Nino. Recent model runs indicate a wetter and cooler than normal remaining summer, fall, and into early winter. However, the models also indicate the return of drought conditions by late spring in 2016, which could present significant challenges to all water purveyors, water utilities, and irrigators going forward. Regional reservoir levels on the Rio Grande and Chama Rivers are still low but rising. Deliveries from the SJCP Project have been recently upgraded. The City has received about 85% of normal firm yield through July 1st of this year. If the active monsoonal precipitation continues it is possible that the City could receive 100% of normal firm yield. There are no Endangered Species Act (ESA) updates, except that an environmental group has resurrected its previous threat to file a Notice of Intent to file suit over the protected status of the Rio Grande Cutthroat Trout. Updates on this, and other endangered species issues, will be made as needed. A draft "Biological Assessment" (BA) has very recently been issued by the BoR (addressing broad ESA coverage for significant listed species such as the SW willow flycatcher and the silvery minnow). However, it is still too soon for City staff, other water management agencies, and related regulatory agencies, to have completed a review of the documents. Updates on this issue will be made as appropriate.



Southwest
Hydrology

Stormwater Irrigation

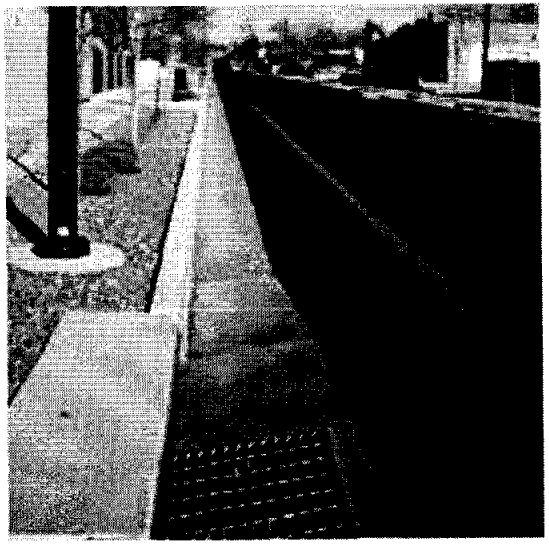
Can rain gardens significantly improve soil moisture?

Prepared for: Soil and Water Conservation Commission

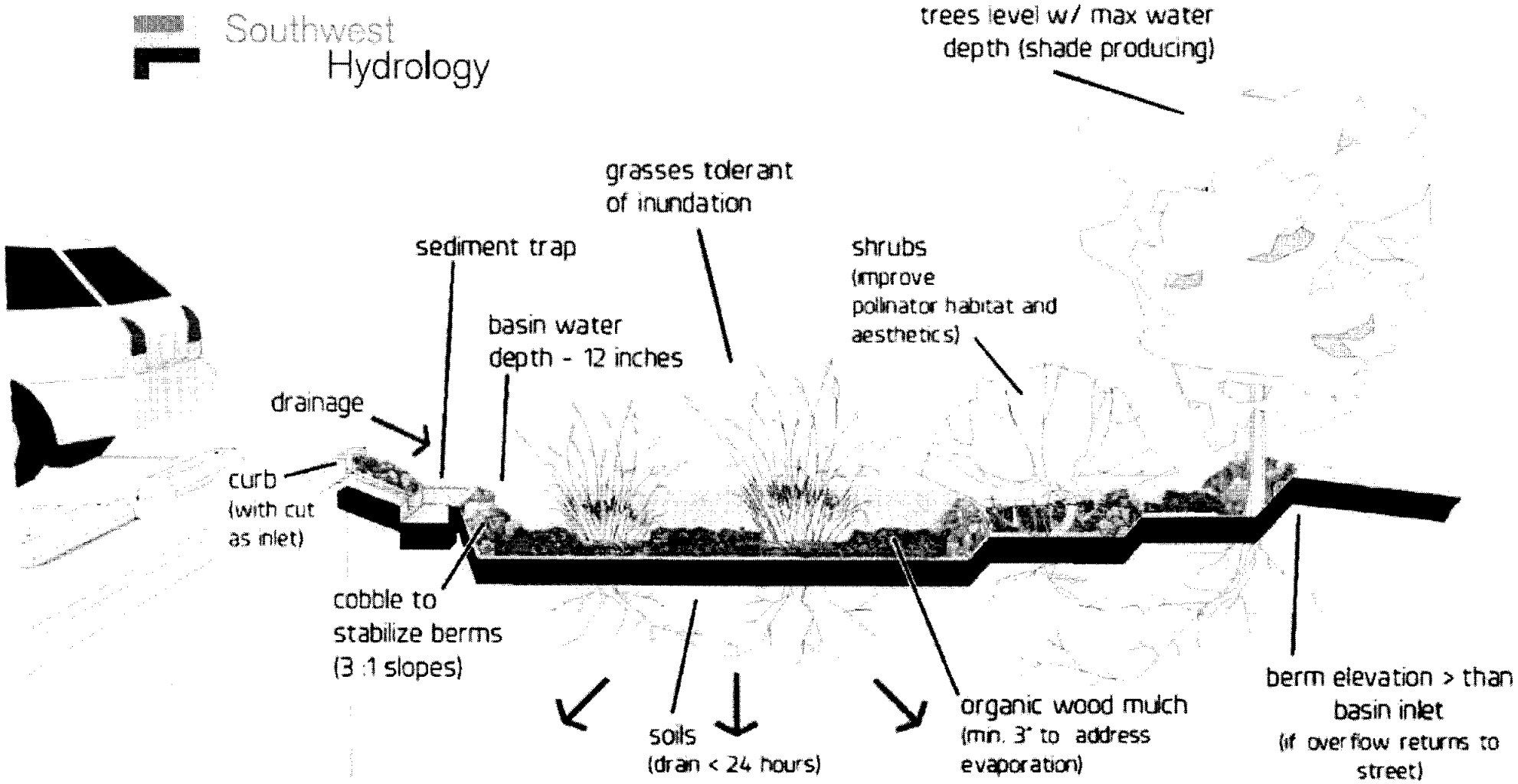
Contact: Aaron Kauffman | aaron@southwesturbanhydrology.com | www.southwesturbanhydrology.com

Urban Forestry

Water Resources Burden?



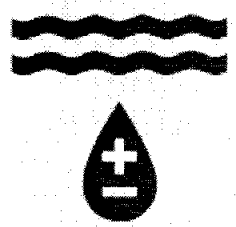
Southwest Hydrology



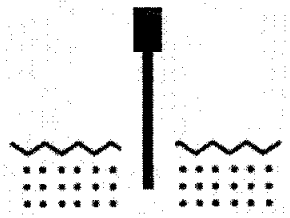
Basic Basin Design Considerations

diagram by
Paul Navrot
for SUH

Study Objective

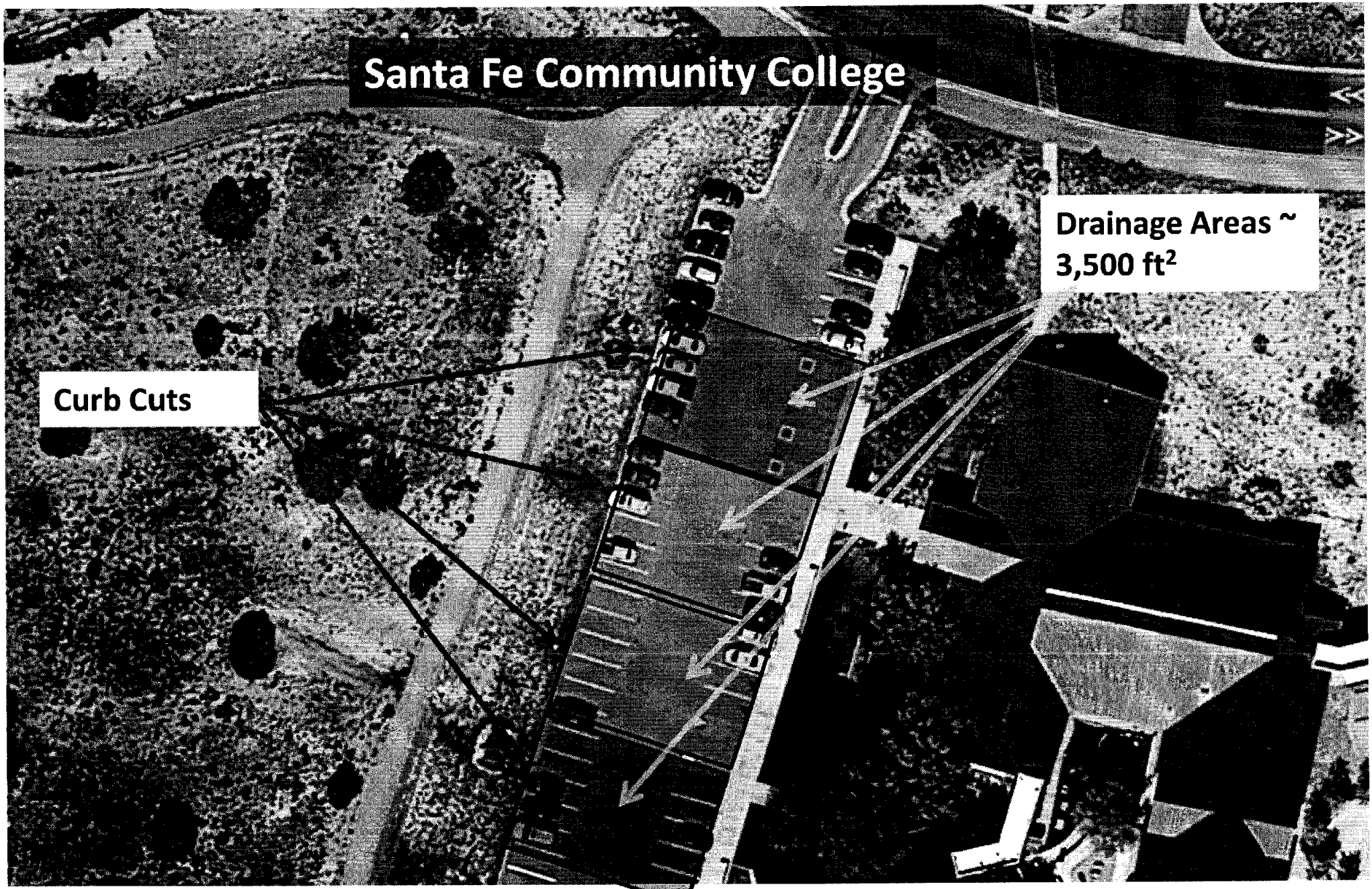


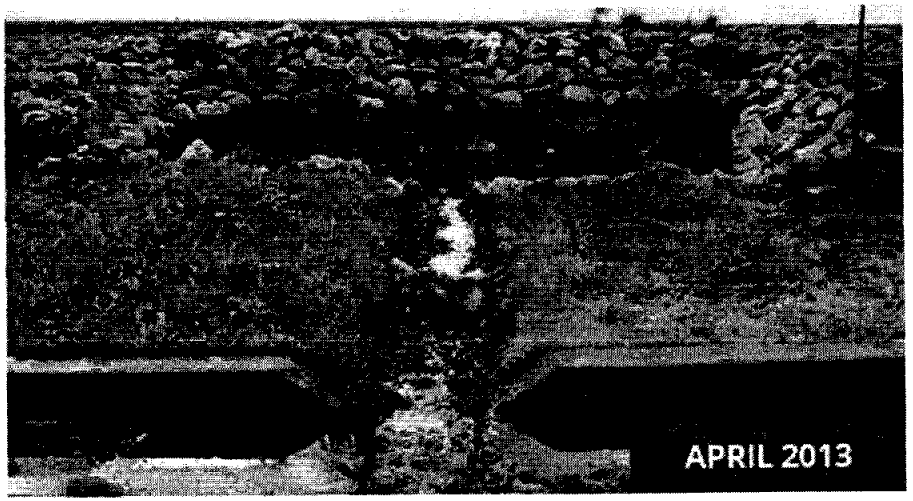
Measure soil moisture at curb cuts with and without rain gardens



Determine whether soil moisture varies with depth

Monitor how precipitation influences soil moisture at varying depths and treatments


Santa Fe Community College
Drainage Areas ~ 3,500 ft²
Curb Cuts



- Basin Dimension

  15 x 10 x 1 (ft)

- Approximate Drainage Area

  3,500 (sq ft)

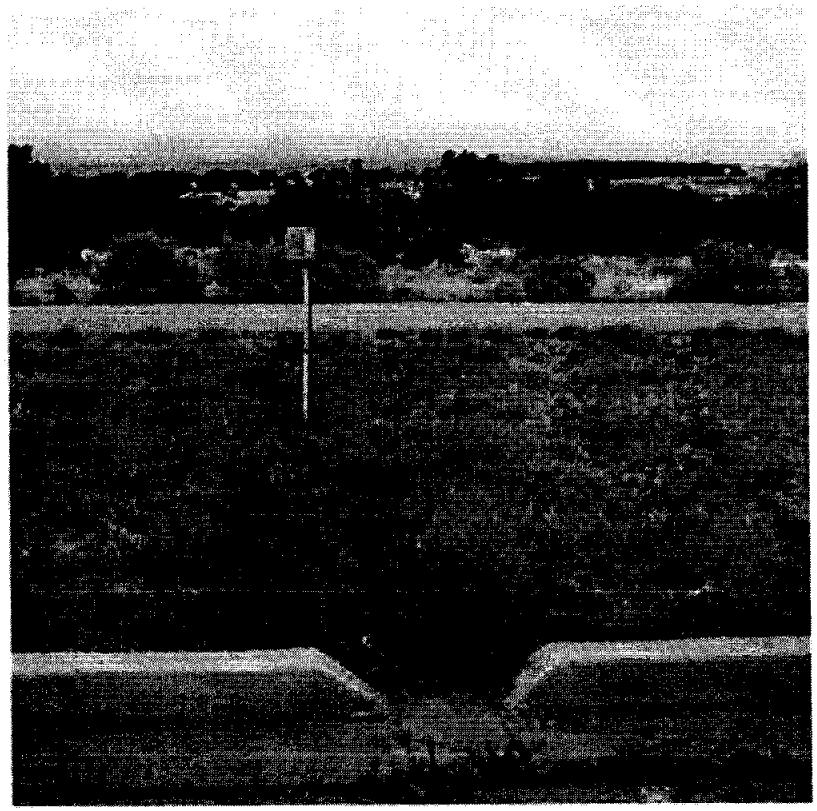
- Basin Volume Capacity

  1,122 (gal.)

- Annual Catchment*

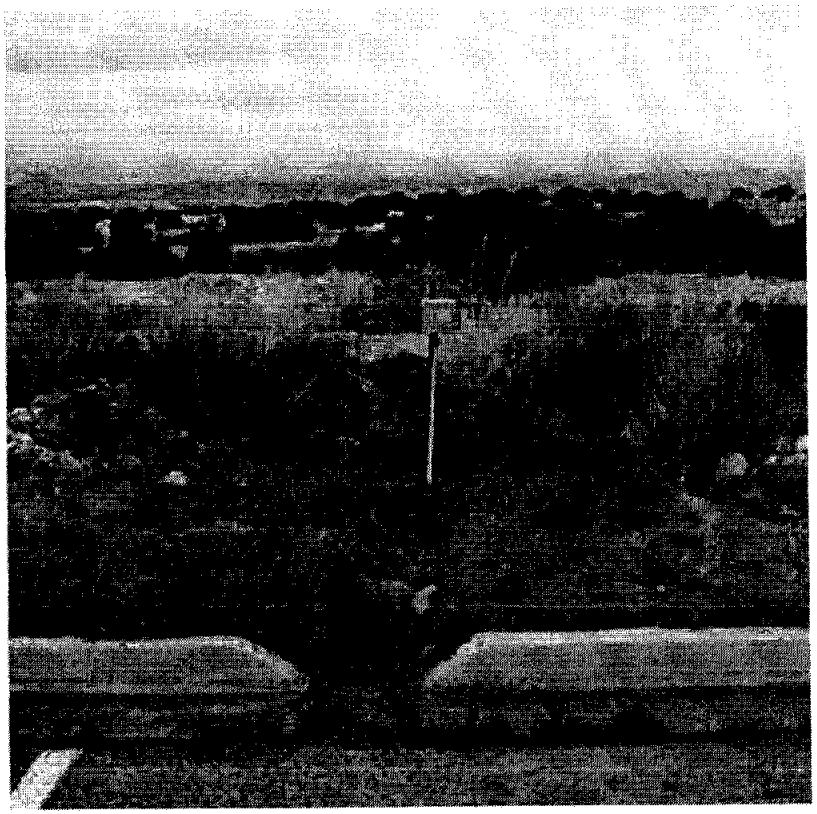
  13,464 (gal.) *Assuming 12" of Precipitation

CONTROL

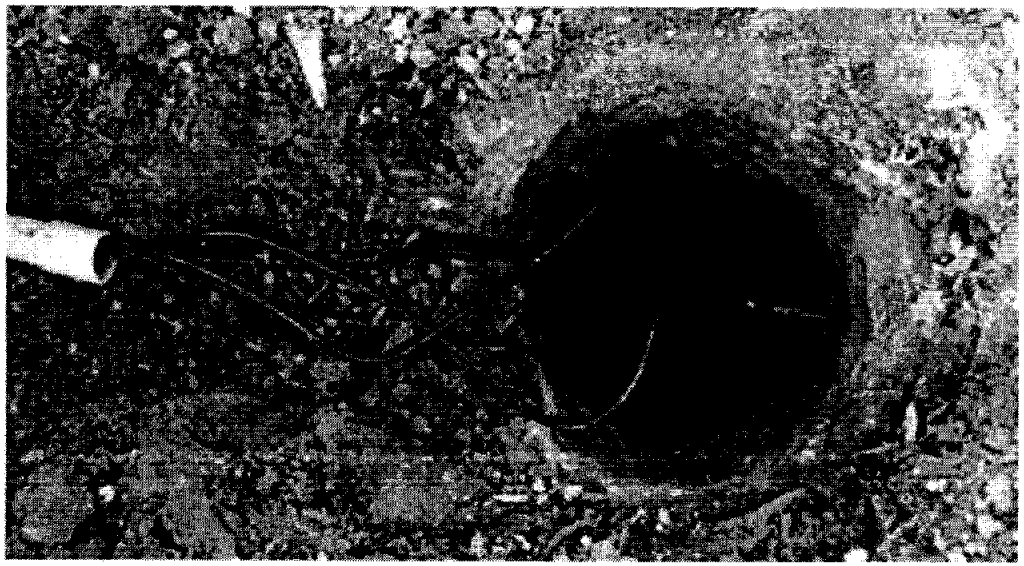


Curb cut **without** rain garden

TREATMENT

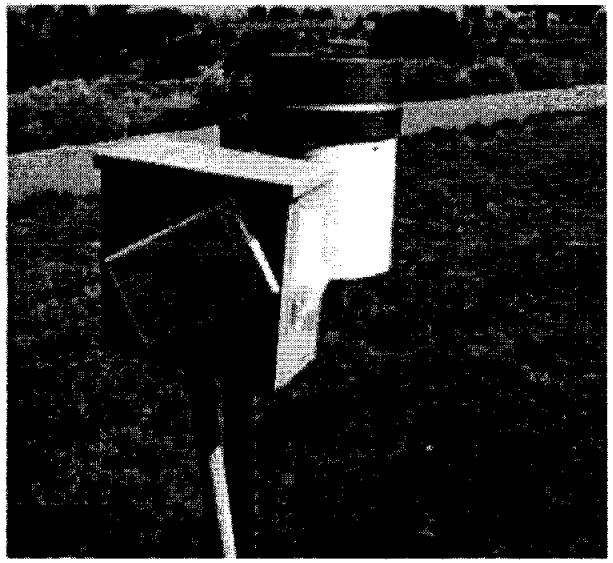


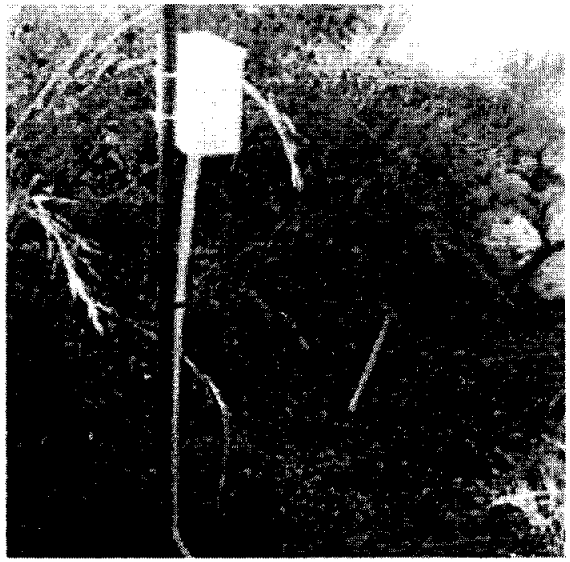
Curb cut **with** rain garden

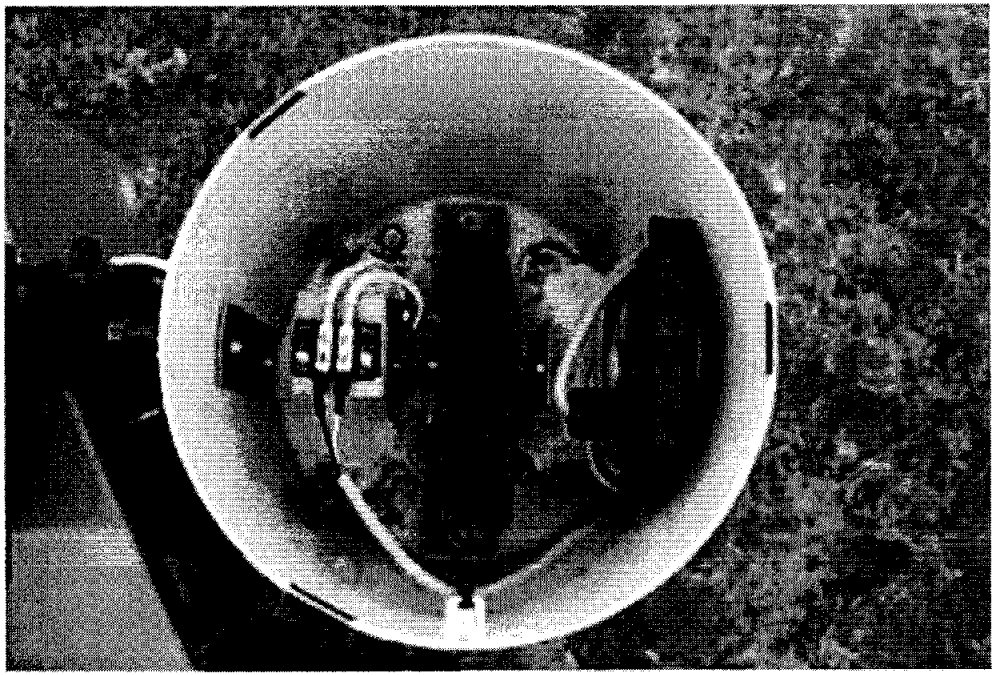


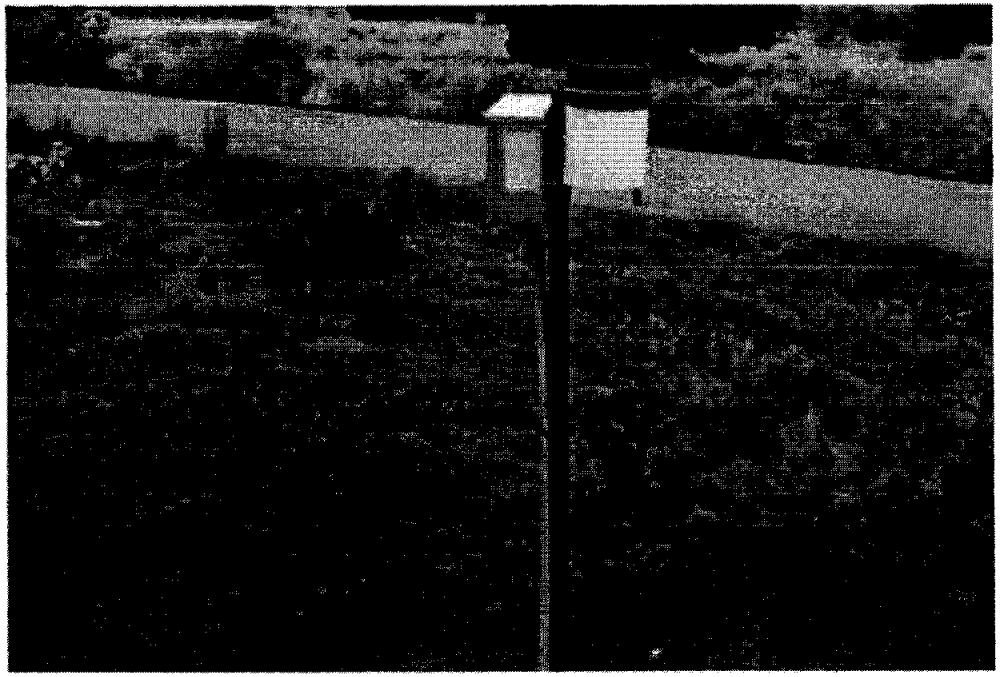
Probes installed at 6, 12, 18, 24, and 30 inches below the soil surface to measure Volumetric Water Content (VWC).

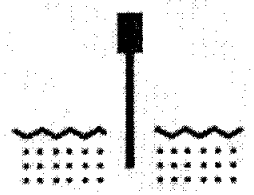
Volumetric water content measured hourly by Decagon EM50 data loggers



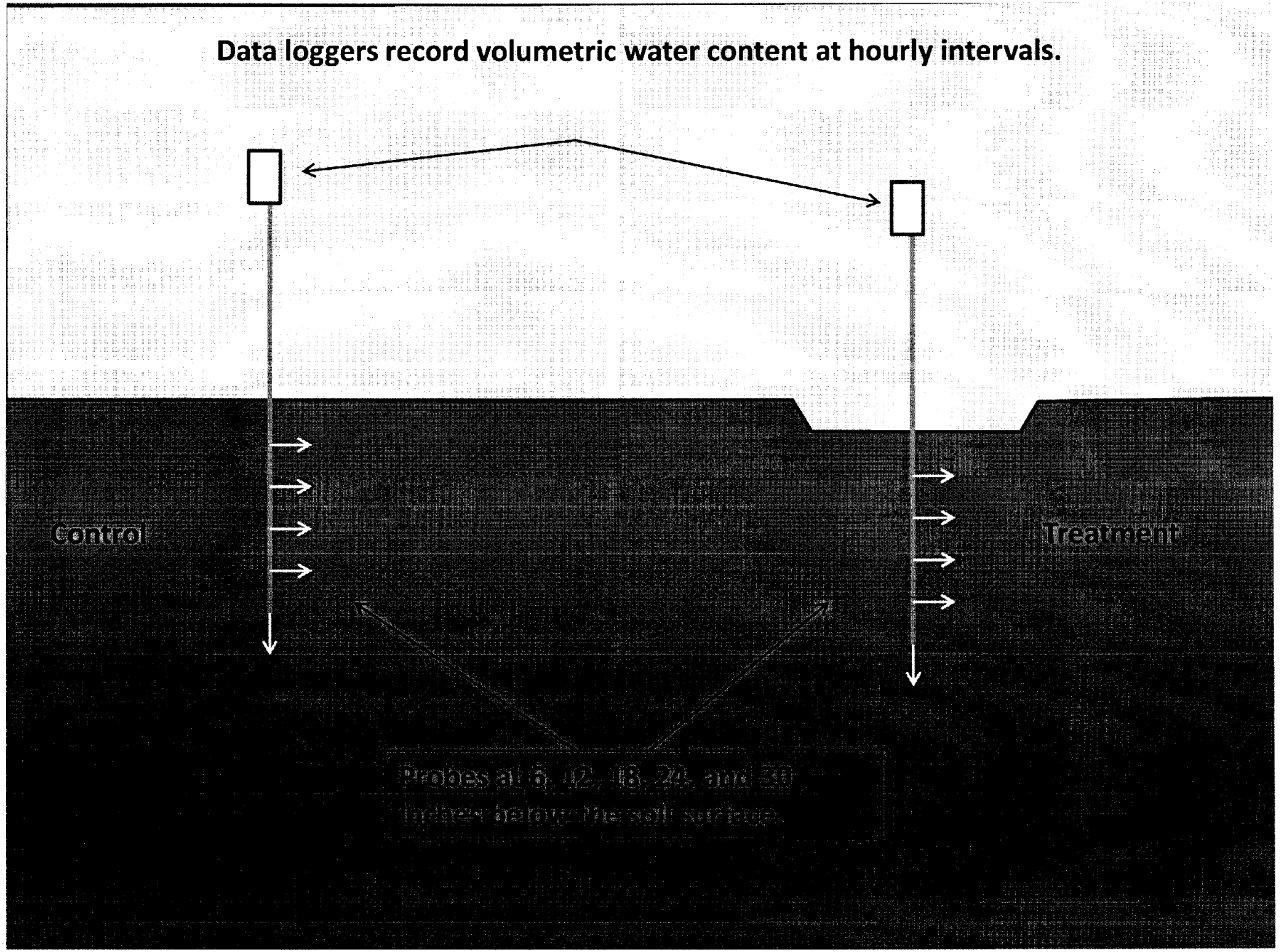


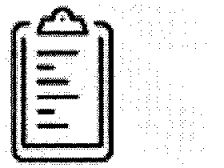






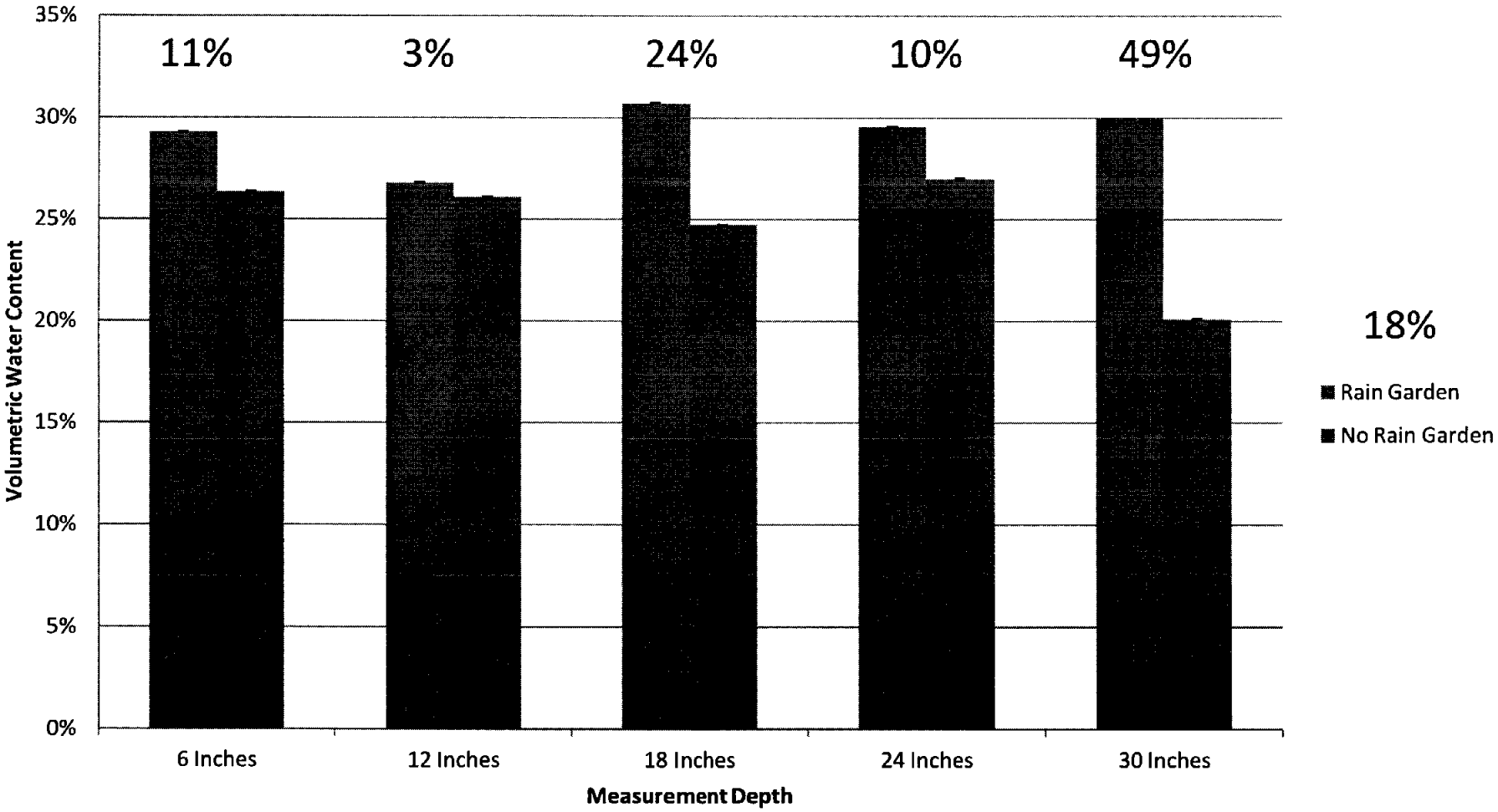
Onset tipping bucket precipitation gauge meaured depth to the nearest 1/100 inch


Data loggers record volumetric water content at hourly intervals.
Control
Treatment
Probes at 6, 12, 18, 24, and 30
inches below the soil surface

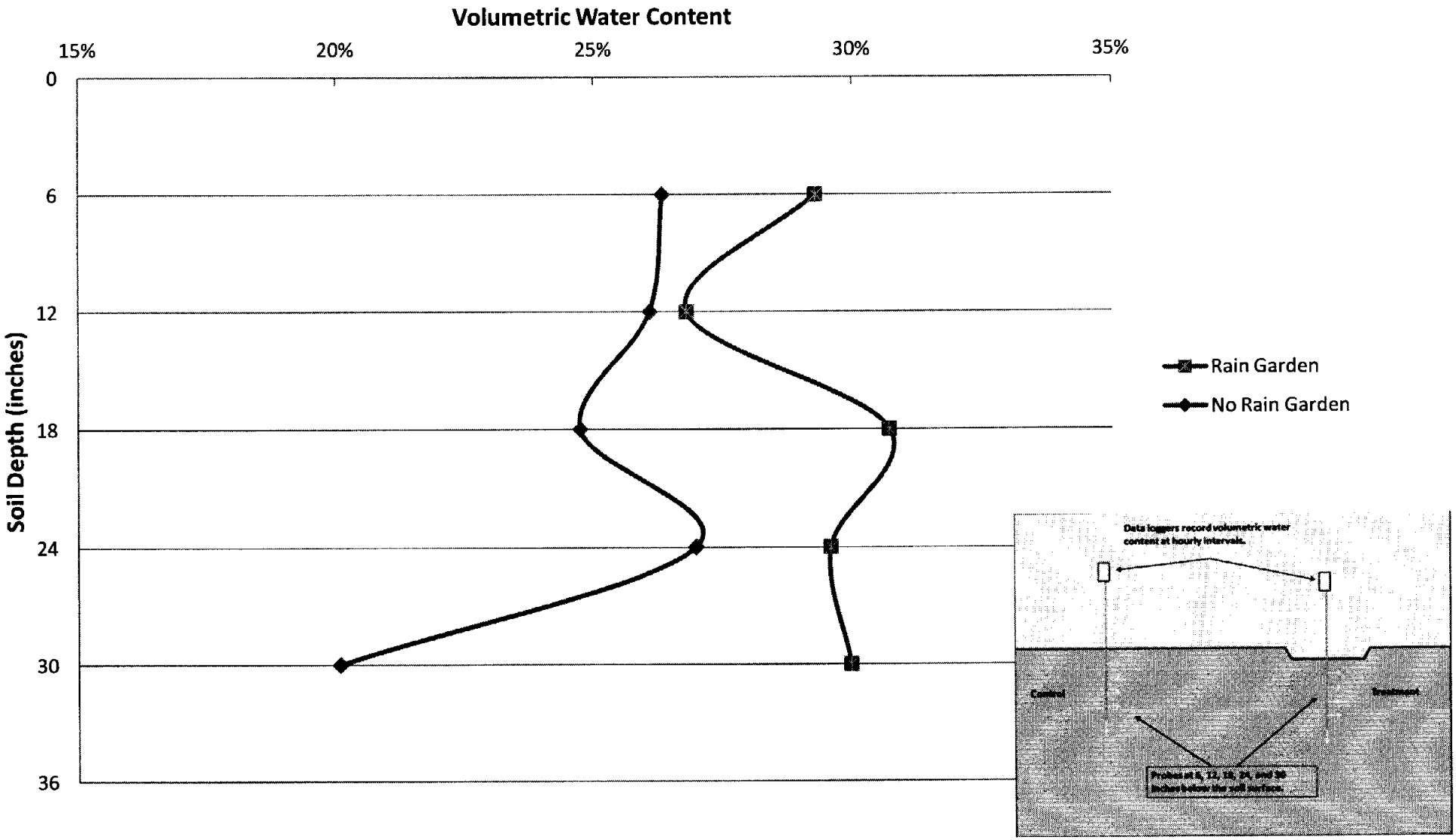


Results

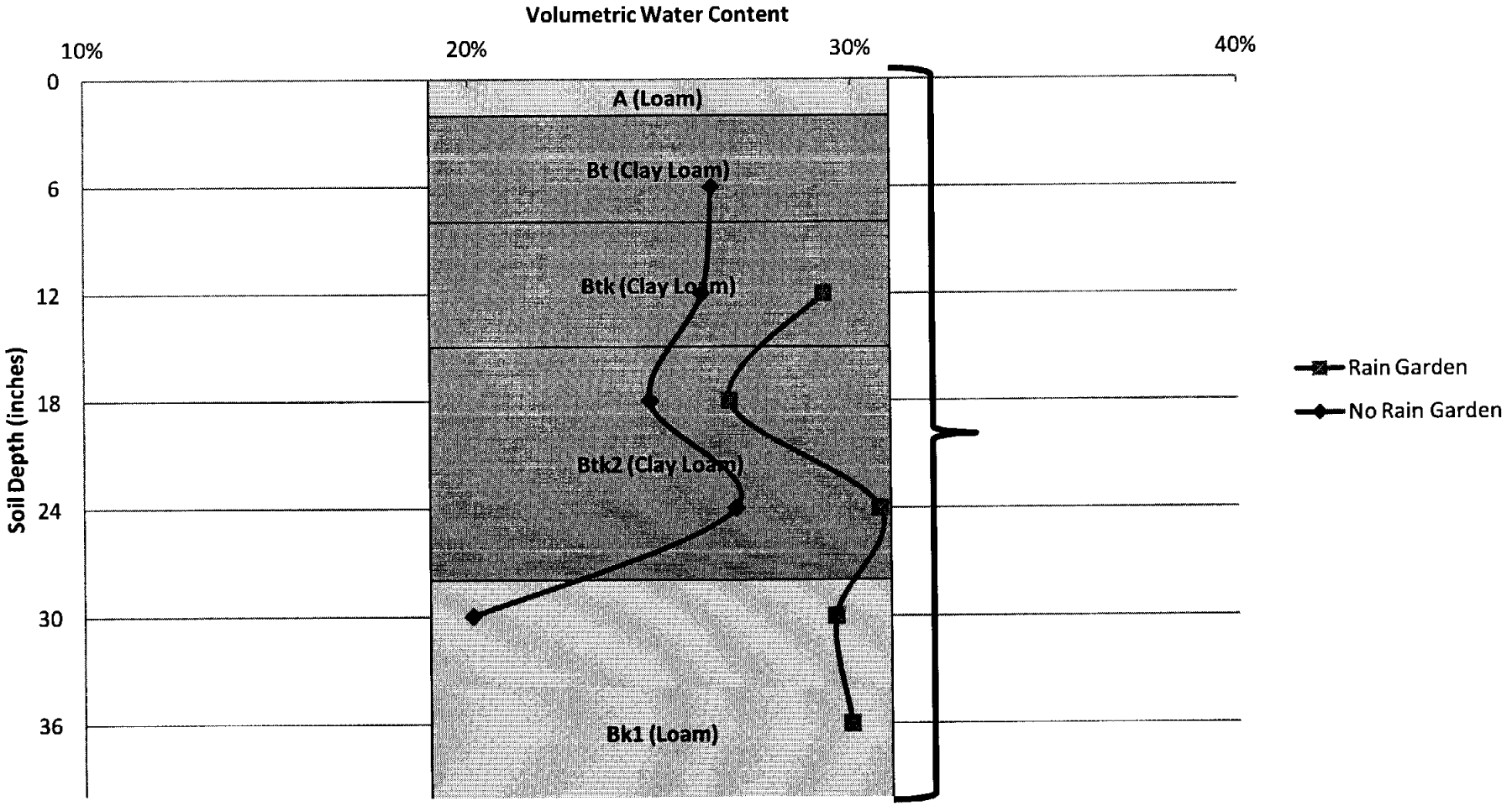
Comparison of VWC by Treatment and Soil Depth



Volumetric Water Content in the Soil Profile by Treatment

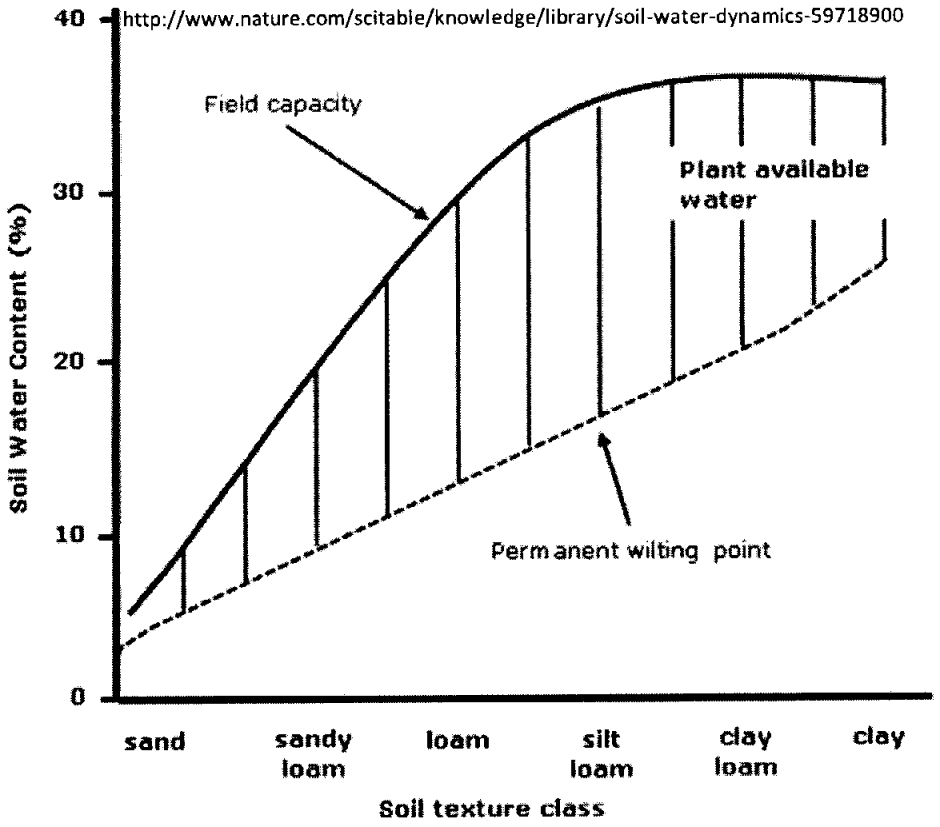


Volumetric Water Content by Treatment in an Alire Loam Soil Profile



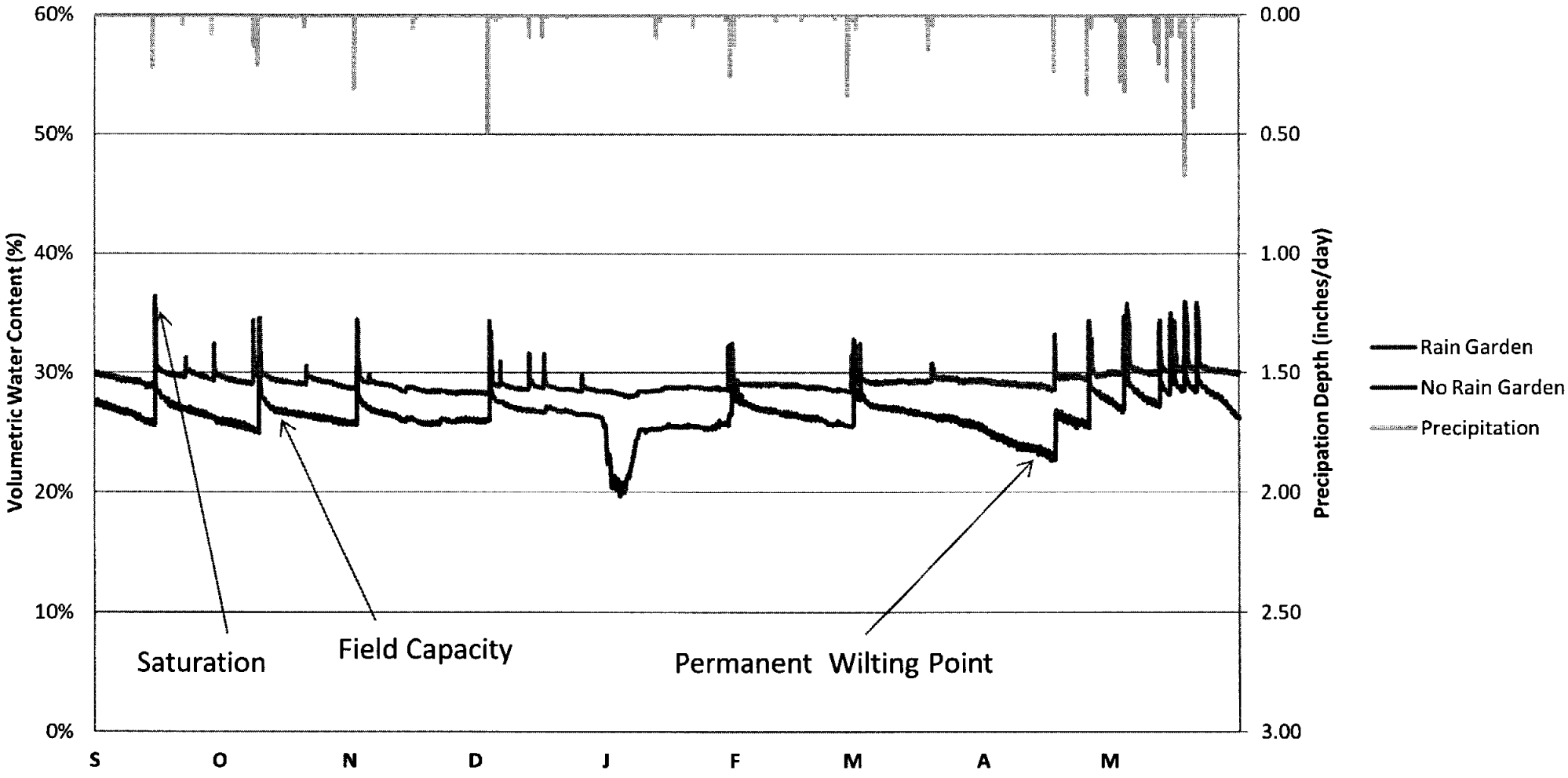
Soil Texture	Field Capacity	Permanent Wilting Point
Clay Loam	36%	22%
Loam	28%	14%

*Saxton and Rawls 2006

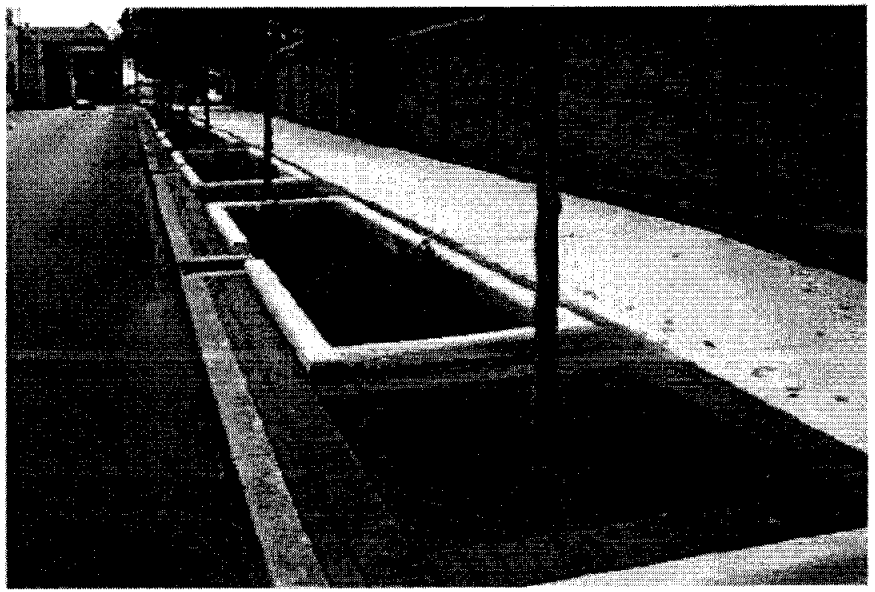


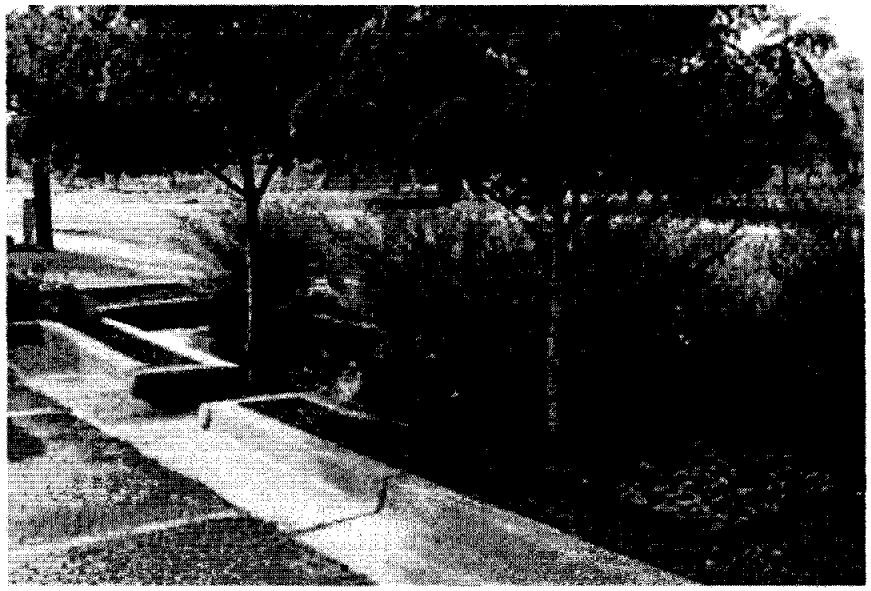
Soil Depth	Rain Garden Soil Texture	Rain Garden Average VWC	No Rain Garden Soil Texture	No Rain Garden Average VWC
6	Clay Loam	29%	Clay Loam	26%
12	Clay Loam	27%	Clay Loam	26%
18	Clay Loam	31%	Clay Loam	25%
24	Loam	30%	Clay Loam	27%
30	Loam	30%	Loam	20%

Monthly VWC 6-inches Below Soil Surface



Implications and Opportunities





Passive Irrigation Improvements

Probe depth	RG Gallons of water in Soil Profile	No RG Gallons of water in Soil Profile (PWP Values)	Difference in Gallons for RG and Control (RG:PWP)
6	164.4	148.1 (123.0)	16.3 (41.4)
12	150.3	146.4 (123.0)	3.9 (27.3)
18	172.2	138.6 (123.0)	33.7 (49.2)
24	166.1	151.5 (79.0)	14.6 (87.1)
30	168.3	112.8 (79.0)	55.5 (89.3)
Total	821.3	697.3 (527.0)	124.0 (294.3)

How Much Water Does a Tree Need?

Tree Type	Water Use by a Mature Tree (Gallons/ Day)*	Extra Days of Water above Control Sites	Extra Days of Water above PWP	Reference (Gallons/Day)
Not Indicated	7.8	15.9	37.7	University of California Center for Landscape and Urban Horticulture
Fruit Tree	12.5	9.9	23.5	Vossen (2000)
Broadleaf Shade Tree	14.6	8.5	20.2	Utah State University Forestry Extension
Average	11.6	10.7	25.3	

*Mature Tree (~100sqft Canopy)
Warm Spring/Fall Day (~0.25 inches of ET)

Questions

Special thanks to:
•Santa Fe-Pojoaque SWCD
•SWCC (Water Quality Conservation Grant Program)
•Santa Fe Community College
•Studio DC Design
•Clara Dubois
•Paige Grant
•Joseph Marcoline
•Melissa McDonald
•Shawn Miller
•Alex Mundt
•Lynn Mundt
•Mike Mundt
•Cody Stropki
•Joe Vinson
•Neil Williams
•Xubi Wilson

2015 Meeting Schedule

Santa Fe Water Conservation Committee

Location: City Councilors' Conference Room, 200 Lincoln Avenue

Time: 4-6 PM

Day: Second Tuesday of the month (except as noted)

Meeting Date	Caption Deadline, 3 PM	Packet Material Deadline, 3 PM
January 13, 2015	Tuesday, December 23, 2014	Monday, December 29, 2014
February 10, 2015	Monday, January 26, 2015	Wednesday, January 28, 2015
March 10, 2015	Monday, February 23, 2015	Wednesday, February 25, 2015
April 14, 2015	Monday, March 30, 2015	Wednesday, April 1, 2015
May 12, 2015	Monday, April 27, 2015	Wednesday, April 29, 2015
June 9, 2015	Friday, May 22, 2015	Wednesday, May 27, 2015
July 14, 2015	Friday, June 26, 2015	Monday, June 29, 2015
August 11, 2015	Monday, July 27, 2015	Wednesday, July 29, 2015
September 10, 2015 (Thursday)	Monday, August 24, 2015	Wednesday, August 26, 2015
October 15, 2015 (Thursday)	Monday, September 28, 2015	Wednesday, September 30, 2015
November 10, 2015	Monday, October 26, 2015	Wednesday, October 28, 2015
December 8, 2015	Friday, November 20, 2015	Monday, November 23, 2015