

City of Madison Terrace Rain Gardens



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City of Madison-Engineering

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What is a Terrace Rain Garden?

- For the City of Madison it is a small bioretention system installed by the city as part of a street reconstruct in the area between the sidewalk and the back of curb.
- This garden will treat public water including street water and will be **PRIVATELY MAINTAINED** by the property owner.



Adams Street Pilot Rain Garden Project - HOW/WHY

- Friends of Lake Wingra request City Engineering include rain gardens as part of a 2004 street reconstruction project in the Wingra watershed.
- Request made in the Fall of 2002 / RECON scheduled for Summer 2003
- City decision made to try a pilot project during Spring of 2003
- Site selection (Summer 2003)
 - Requested site did not work (topographic problems) & short time frame
 - Expanded search to all streets scheduled for reconstruction in the next 5 years within the Wingra watershed
 - Adams Street identified, in the late Summer of 2003, as a good candidate. Adams Street scheduled for reconstruction during the Summer of 2005

Adams Street Pilot Rain Garden Project

- + PROJECT IDENTIFIED IN SUMMER 2003
- + CONSTRUCTED SUMMER 2005

WHAT DID WE DO FOR TWO YEARS???

- **Sell** the project to **neighbors** (raingardens were not household terms in 2003)
- **Sell** project to & design it in accord with requirements from multiple **City Agencies**



Selling rain gardens to neighbors

VOLUNTEER LOCATION OF THE GARDENS. THIS DECISION HAD REAL DESIGN CONSEQUENCES FOR THE PROJECT.

- First residents were educated on rain gardens (several meetings) then they were asked who might be interested.
- Then we met on site with each resident to review each site specifically.
- Gardens are located where residents wanted them, where there was room (utilities/trees) and where storm could be routed to them.
- **NOT** where the site geometrics make the most sense to place them.



Selling rain gardens to City Agencies

- Internal requirements:

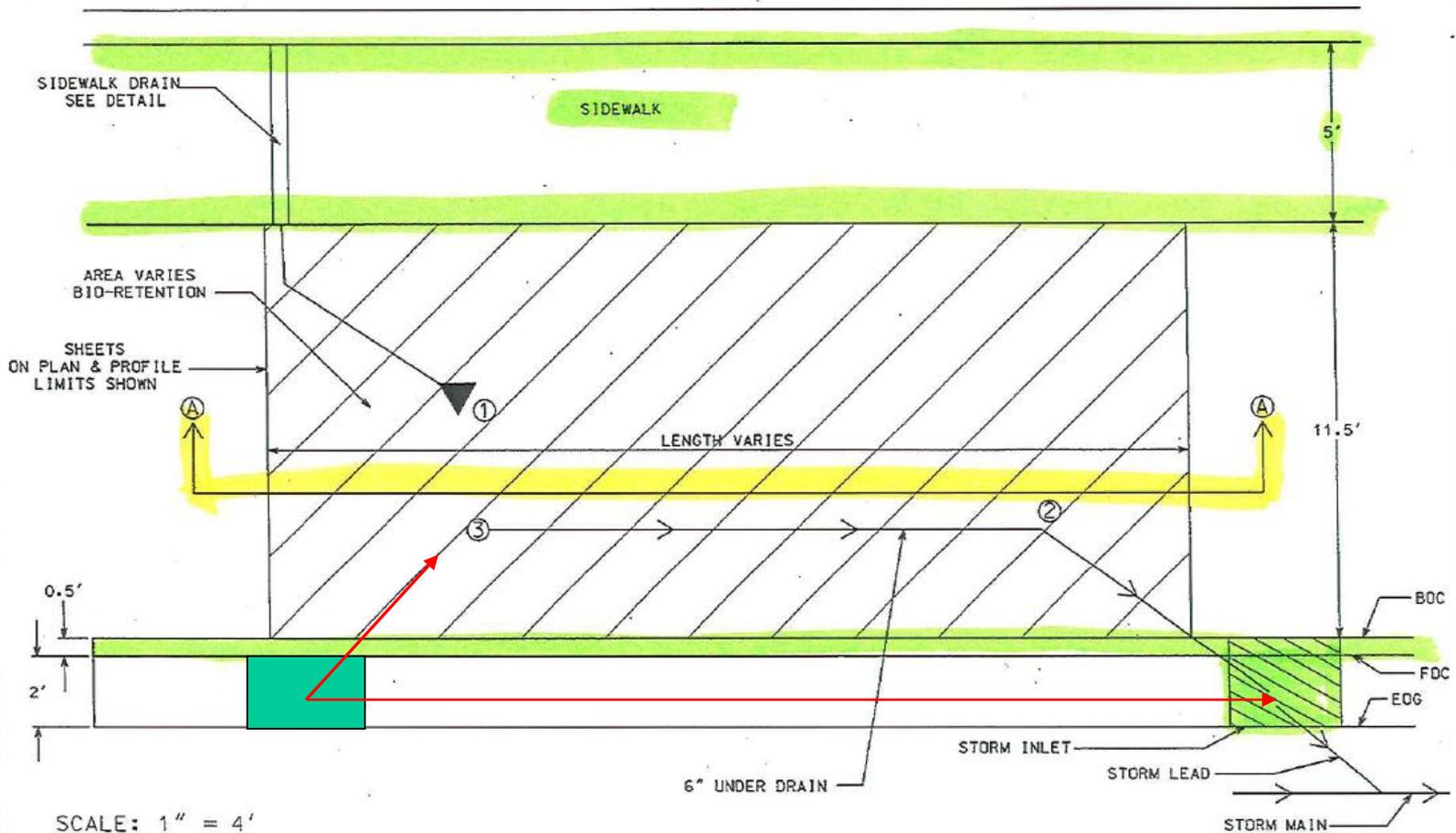
- **Curb and gutter** - (re: maintenance issues) – Streets and Engineering operations use the curb as a guide during snow and leaf removal
- **Pretreatment** – sumps (re: longevity of gardens) – Madison uses sand for winter icing operations
- **Site distances** – only allow 50% visual occlusion at 24” above adjacent walk – played into plant selection
- **NO MOW LAWNS** – max of 50% grasses to be a garden
- **Tree compatible** - (only diseased trees were removed) several residents requested their tree be removed to allow a rain garden
- **PARKING** - no loss of parking (neighborhood requirement)
- **ADA compliance** - recovery zone off sidewalk and parking access from street



Adams Street Pilot - DESIGN

- Rain Garden design:
 - **Runoff** - to garden from street inlet via a pipe out the back of a standard H/TYPE 3/WDOT inlet
 - **Pipe design** vs. a flume - requires a deep garden 2' minimum below adjacent top of curb
 - **Pre-treatment** - provided via a two-foot sump in the inlet feeding the garden
 - **Engineered fill** - required (2-3 feet below planting surface)
 - Equal parts topsoil, compost, sand (washed)
 - **Underdrains** – 4" perforated pipe in (1) foot of clear stone
 - **Overflow pipes** – inside the garden (many adjacent homes were lower than
 - **Filter fabric** – provided at native layer & between clear stone and engineered fill (simplified materials needed)
 - **Off-line** – rain garden must be able to be removed at homeowner's option (**without any work in the street**)





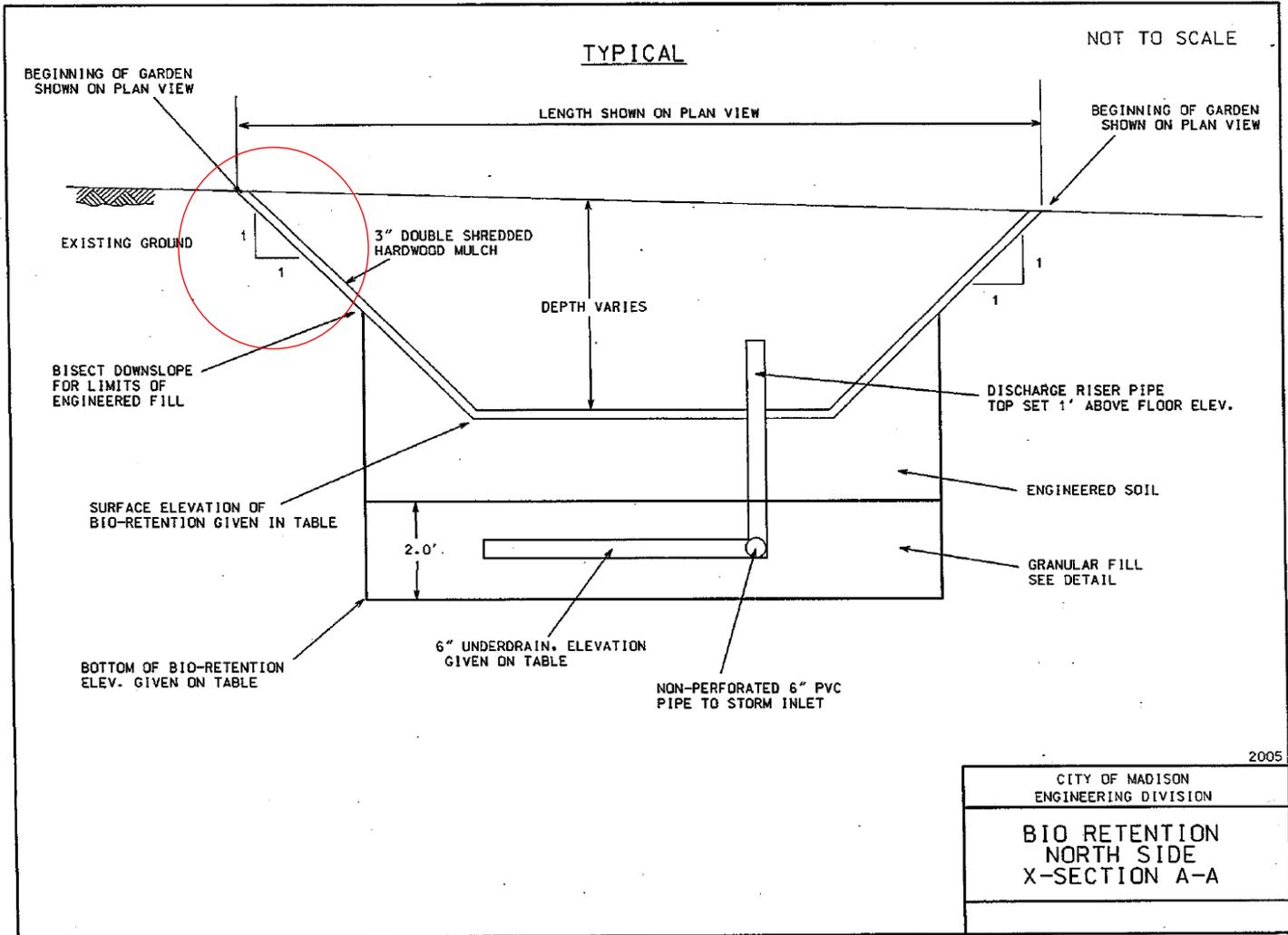
SCALE: 1" = 4'

- ① 6" PVC MITRED @ 45 DEGREE ANGLE
STANDPIPE OUTLET STRUCTURE
- ② 6" PVC SET 90 DEGREES TO HORIZONTAL
TIES TO UNDER DRAIN AND TO STORM SYSTEM
- ③ UNDER DRAIN CONNECTED TO STORM SYSTEM

2005

CITY OF MADISON ENGINEERING DIVISION
NORTH SIDE BIO-RETENTION TYPICAL PLAN VIEW



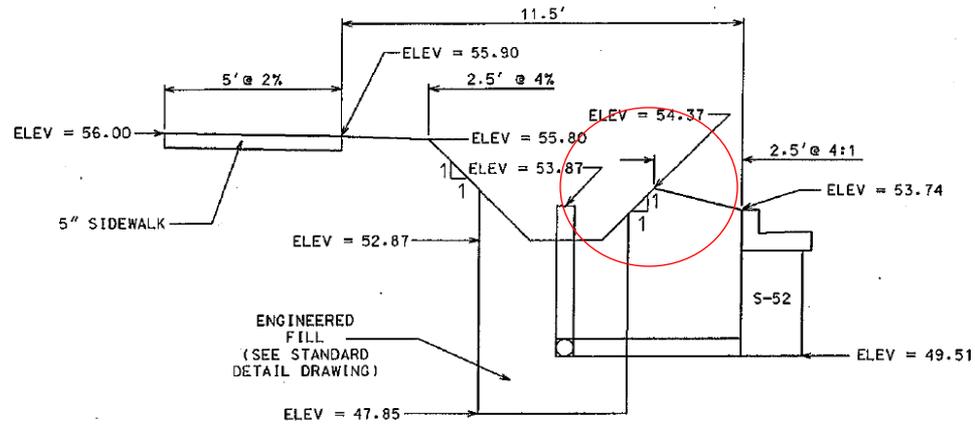


Longitudinal X-Section

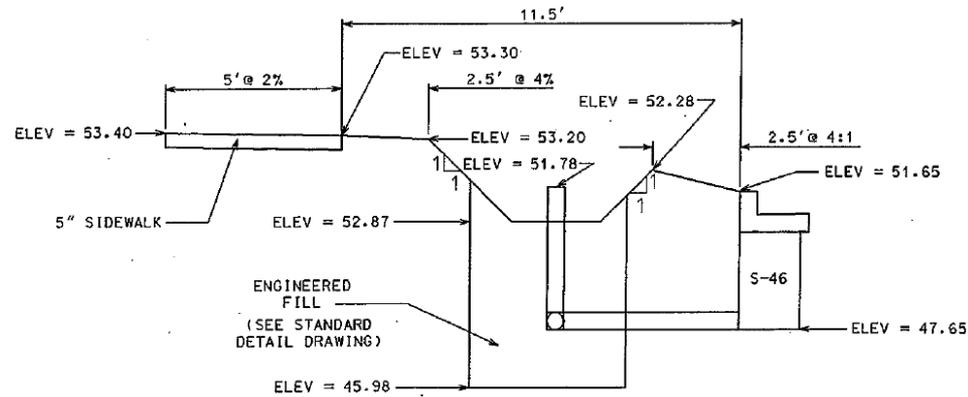


SCALE: 1" = 4'

RAINGARDEN: R-6



RAINGARDEN: R-4



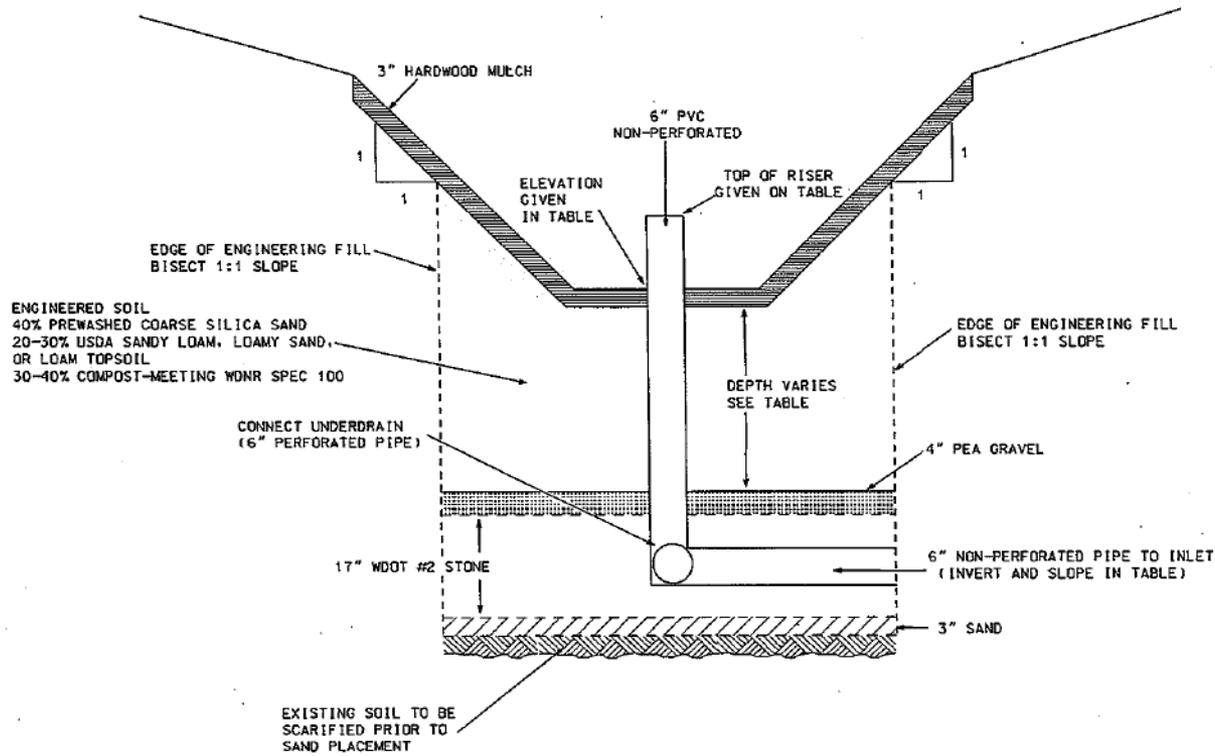
2005

CITY OF MADISON
ENGINEERING DIVISION

RAINGARDENS
R6 & R4



BIO-RETENTION OUTLET STRUCTURE/RISER/UNDERDRAIN



2004

CITY OF MADISON
ENGINEERING DIVISION

BIO-RETENTION
OUTLET STRUCTURE/RISER/UNDERDRAIN

STANDARD DETAIL DRAWING 1.01



Adams Street Pilot Participation

- 9 homeowners participated (out of a possible 20 and with a total of 33 homes on the project)
 - 7 rain gardens total (2 were shared)
- Constructed in fall 2005
- Covered with mulch over winter
 - Mulch had to be removed in spring (now we polymer the garden and mulch after/during planting)
- Planted in June 2006





Rain Garden Site Before





During Street Construction





During Construction





This shared garden had to be designed so either ½ could be removed by either property owner – see twin riser pipes





Water from curb inlet & sidewalk drains



Planting day (June 1-3, 2006): consultants, homeowners, city staff, volunteers



6/14/2006



7/17/2006

Planting density about 1 per SF





2007



9/22/08 – Note the two inlets – one is inlet one provides input the second allows for the underdrain (deep) to be discharged to storm sewer.



9/22/08 – note sidewalk drains, many gardens were on the high side of the street and could only be “fed” with sidewalk drains.



Adams Street: Lessons Learned

- Locate possible sites BEFORE any meetings
- Consider the following:
 - Size (set a minimum – ours is 15' long, 10' terrace width)
 - Trees (discuss with forestry)
 - Topography
 - Street (max longitudinal slope 5%)
 - Terrace (max of 1' sidewalk elevation above adjacent top curb)
 - Relative to house (house needs to be above adjacent walk)
- Cost \approx \$20,000/garden
 - To cut costs **DRAMATICALLY**, eliminate underdrains/ overflow pipes, feed with curb inlets (no flumes)



Rain Garden Program VERSION 2.2

- Streets on our coming year reconstruct or resurfacing list are reviewed by staff for the possibility of rain gardens. This includes looking at:
 - Terrace width
 - Longitudinal slope
 - Size of trees
 - Slope of terrace
 - Field visit



Rain garden 2.2

- **Design** – City Engineering wanted a “sustainable/affordable” rain garden design and put together a new design
- **Construction** - City Engineering now asks the property owner to pay a fixed price \$400.00 for a planted garden and \$350.00 for a garden they need to plat.
- **Removal of garden** - with no street damage required
- **Eliminate** – street inlet, sump, under-drain, and overflow pipe



Rain Garden Program VERSION 2.2

If the street has the possibility for a rain garden in general terms then a letter is sent out to all residents on the street with guidance documentation telling them about the costs of the program and asking them to self select for rain garden.

Self selection includes:

- Do I want a garden?
- Yes – can I have one?
- Look at the physical constraints of your particular lot to determine the possibilities.



Rain Garden Program VERSION 2.2

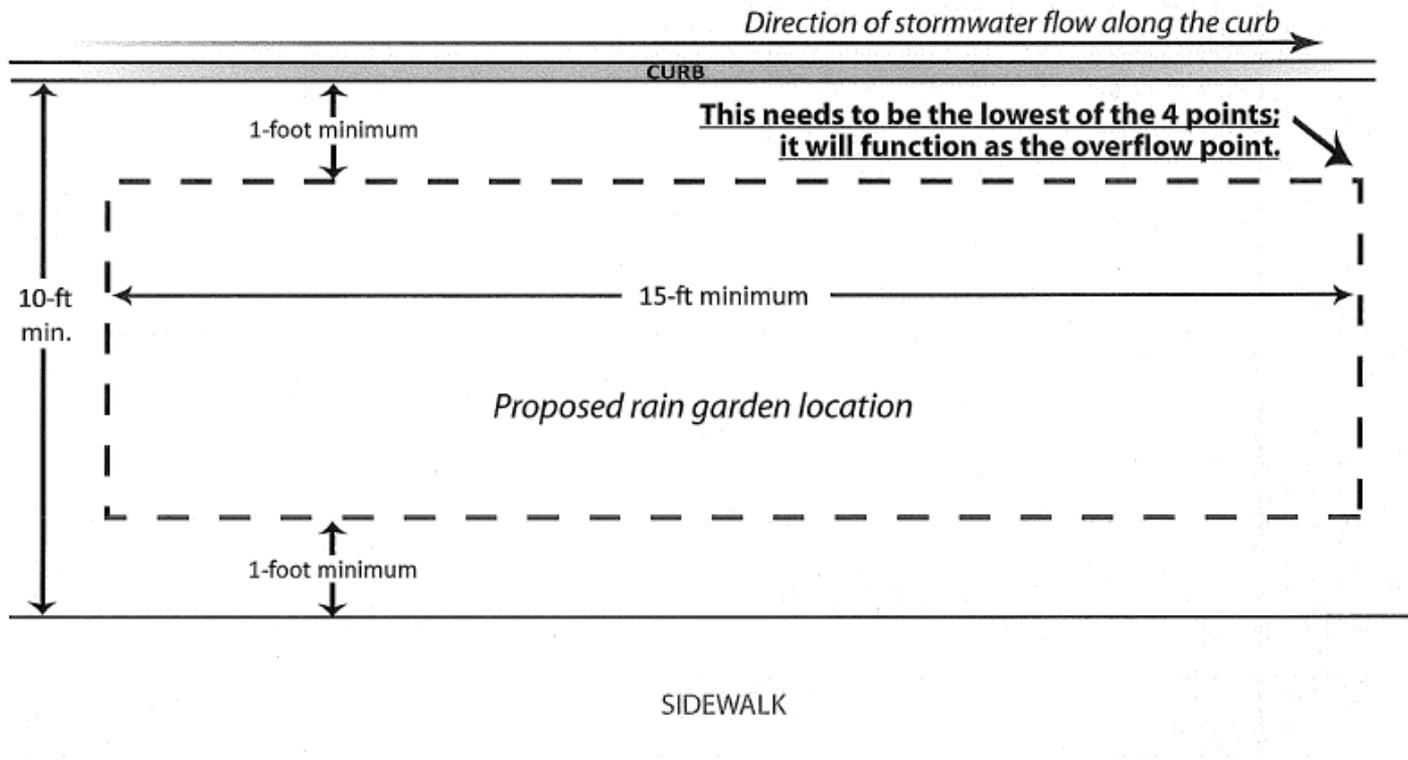
- Once the resident decides to proceed with a garden. City Engineering does the following:
 - Includes the costs in the assessments for the project (we do allow late decisions with waivers of special assessments).
 - Design and include the rain garden in the bid documents
 - Begin working with the resident on the planting plan.



Rain Gardens in the Street Terrace

Determining site suitability:

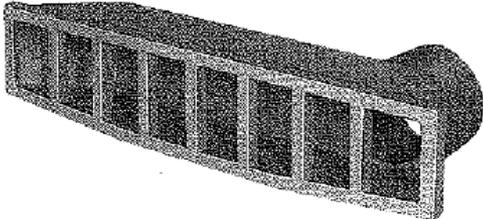
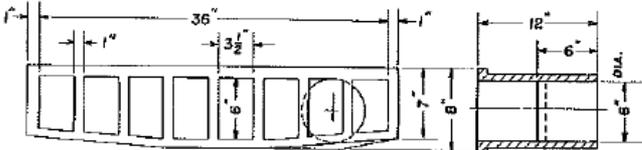
1. Terrace must be at least 10 feet wide from back of curb to edge of sidewalk
2. Rain garden will be a minimum of 15 feet long
3. Trees need to be at least 10 feet from edge of rain garden
4. Driveways and sidewalk ramps need to be at least 3 feet from edge of rain garden
5. The rain garden would need to overflow back into the curb, away from the sidewalk/house
6. The terrace cannot be too steep in either direction (lengthwise or crosswise).
7. If you are unclear as to a site's suitability, City Engineering staff will do a site visit and make a determination based on the above criteria.



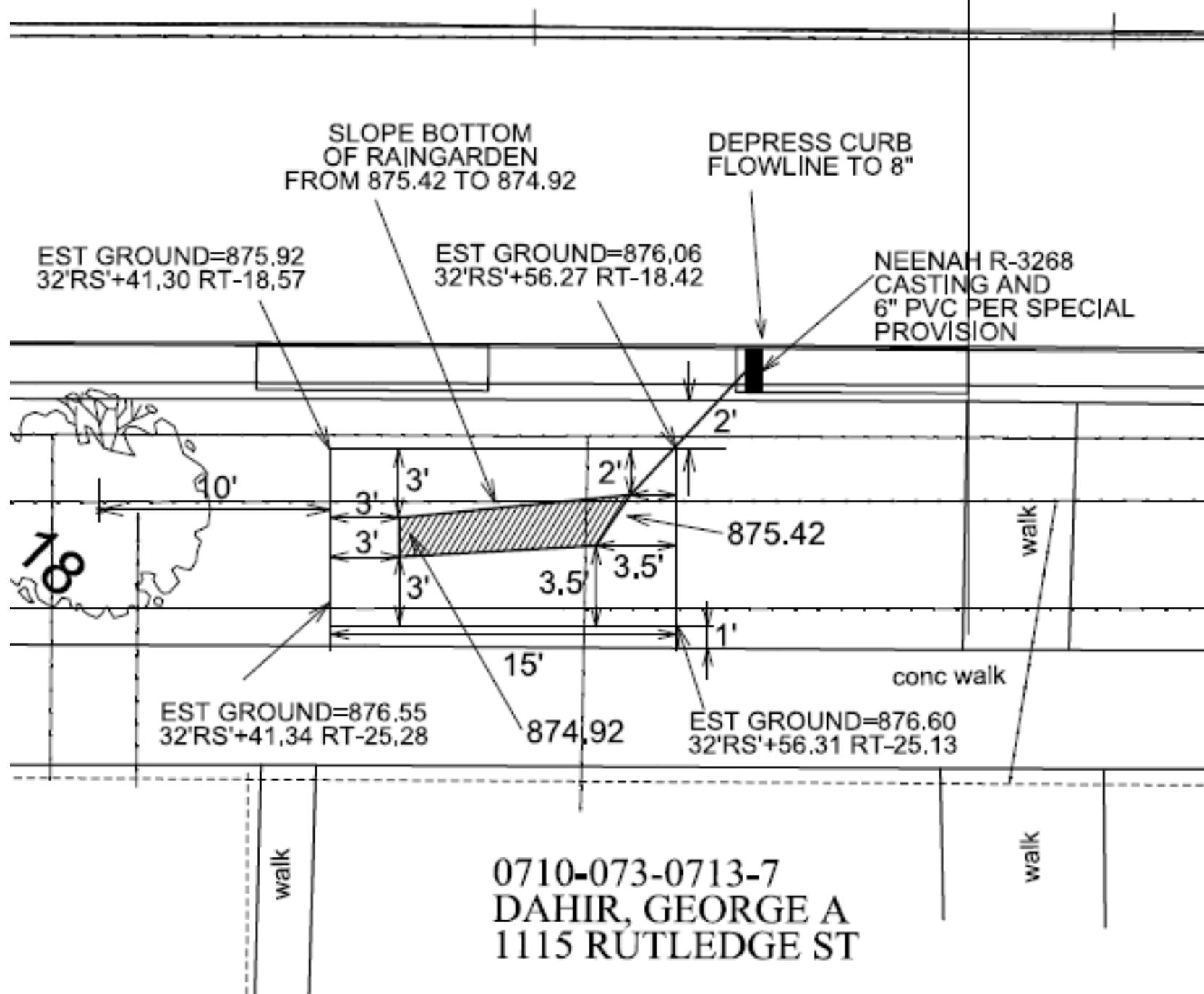
Garden now feed from street with 6" PVC from a small curb inlet

R-3268 Storm Water Curb Opening

Heavy Duty



Hubless Connector



0710-073-0713-7
 DAHIR, GEORGE A
 1115 RUTLEDGE ST

butterfly garden - full sun

RAIN GARDEN PLANTS FULL SUN 6+ Hours

butterfly garden

dry



LITTLE BLUE STEM
Scirpochyrium scoparium



COLUMBINE (Apr-Jun)
Apulginia canadensis



LANCELEAF COREOPSIS (May-Aug)
Coenopsis lanceolata



BUTTERFLY WEED (Jan-Aug)
Asclepias tuberosa

medium



BLACK-EYED SUSAN (Jan-Oct)
Rudbeckia hirta



PRAIRIE DROPSEED
Sporobolus heterolepis



MARSH PHLOX (Jan-Sep)
Phlox glaberrima var. *minor*



NODDING ONION (Jan-Aug)
Allium cernuum



RAIN GARDEN LAYOUT

wet



RIDGELL'S GOLDENROD (Aug-Oct)
Solidago rigida



VIRGINIA MOUNTAIN MINT (Jan-Sep)
Pycnanthemum virginianum



BROWN FOX SEDGE
Carex vulpocarpa



SPIDERWORT (May-Jul)
Tradescantia virginiana

Notes:
Plants are 3' tall or less
Follow spacing guidelines for each plant species or assume 12-18" spacing
Gardens may require watering during the first year
Bloom times may vary

www.cityofmadison.com/engineering/stormwater/raingardens



cool colors - full sun

RAIN GARDEN PLANTS FULL SUN 6+ Hours

cool colors

dry



HAREBELL (Jan-Sep)
Campanula rotundifolia



SIDE OATS GRAMA GRASS
Stipa capensis



HEATH ASTER (Aug-Oct)
Aster heptaneurus

medium



SKY BLUE ASTER (Aug-Oct)
Aster carolinensis



PRAIRIE DROPSEED
Sporobolus heterolepis



WETLAND SHOOTING STAR (Jan-Jul)
Lobelia spicata



CANADA ANEMONE
Anemone canadensis



RAIN GARDEN LAYOUT

wet



WILD GERANIUM (Apr-Jul)
Geranium maculatum



BLUE LOBELIA (Jul-Oct)
Lobelia spicata



VIRGINIA MOUNTAIN MINT (Jan-Sep)
Pycnanthemum virginianum



NORTHERN BLUE FLAG IRIS (May-Jul)
Iris versicolor



BROWN FOX SEDGE
Carex vulpocarpa

Notes:
Plants are 3' tall or less
Follow spacing guidelines for each plant species or assume 12-18" spacing
Gardens may require watering during the first year
Bloom times may vary

www.cityofmadison.com/engineering/stormwater/raingardens



something sweet - partial shade

serenity now - partial shade

RAIN GARDEN PLANTS
PARTIAL SHADE 3-6 Hours

dry

medium

wet

RAIN GARDEN LAYOUT

Notes:
 Plants are 3' tall or less.
 Follow spacing guidelines for each plant species or assume 12-18" spacing.
 Gardens may require watering during the first year.
 Bloom times may vary.

Side-Oats Grama Grass *Bouteloua curtipendula*

Common Oak Sedge *Carex pennsylvanica*

Jacob's Ladder (May-Jun) *Polemonium reptans*

Canada Anemone *Anemone canadensis*

Nodding Onion (Jul-Aug) *Allium cernuum*

Cream Wild Indigo* *Baptisia auripetala*

Bottle Gentian (Aug-Sept) *Gentiana canadensis*

Harebell (Jun-Sep) *Campanula rotundifolia*

Virginia Mountain Mint (Jul-Sep) *Pycnanthemum virginianum*

Blue Lobelia (Jul-Oct) *Lobelia siphilitica*

Sweet Grass *Theropachne odorata*

Virginia Bluebells (Apr-May) *Mertensia virginica*

*For Cream Palace Indigo (*Baptisia bracteata*)

www.cityofmadison.com/engineering/sustainable/raingardens

RAIN GARDEN PLANTS
PARTIAL SHADE 3-6 Hours

dry

medium

wet

RAIN GARDEN LAYOUT

Notes:
 Plants are 3' tall or less.
 Follow spacing guidelines for each plant species or assume 12-18" spacing.
 Gardens may require watering during the first year.
 Bloom times may vary.

Wild Geranium (Apr-Jun) *Geranium macranthum*

Silky Aster (Aug-Oct) *Aster verticillatus*

Anise Hyssop (Jul-Sept) *Agastache hermoniacum*

Mistflower (Jul-Oct) *F. purpureum confertiflorum*

Side-Oats Grama Grass *Bouteloua curtipendula*

Common Oak Sedge *Carex pennsylvanica*

Marsh Phlox (Jun-Sep) *Phlox glaberrima incolor*

Midland Shooting Star (Apr-Jun) *Dodecatheon meadia*

Virginia Mountain Mint (Jul-Sep) *Pycnanthemum virginianum*

Prairie Phlox (May-Jun) *Phlox pilosa*

Sweet Grass *Theropachne odorata*

Monkey Flower (Jun-Sep) *Mimulus ringens*

www.cityofmadison.com/engineering/sustainable/raingardens







2 HOUR
PARKING
8 AM - 6 PM
CITY OF BOSTON

STOP

LAKELAND

A 655852







9/28/08 – less than one year of planting



*CURB IS
DEPRESSED 3"
TO FORCE CURB
WATER TO THE
GARDEN*

SLAMM MODELING

When Adams Street was conceived SLAMM did not have the ability to distribute these systems throughout a watershed.

It now does so SLAMM was run for the Eton Ridge project, with some interesting results.



WinSLAMM Model Output

File View

Runoff Volume Particulate Solids Pollutants **Output Summary**

File Name: C:\Program Files\WinSLAMM\WDNRFILES\slu_files_curent\ETON_RUGBY_POST3.dat

Drainage System and Outfall Output Summary

	Runoff Volume (cu. ft.)	Percent Runoff Reduction	Runoff Coefficient (Rv)	Particulate Solids Conc. (mg/L)	Particulate Solids Yield (lbs)	Percent Particulate Solids Reduction
Source Area Total without Controls	3.597E+06	<== Percent Reduction Basis Value	0.37	385.7		
Outfall Total without Controls					86545	<== Basis Value
<hr/>						
Current File Output: Total Before Drainage System	3.017E+06	16.12 %	0.31	376.4	70842	
Current File Output: Total After Drainage System	3.017E+06	16.12 %	0.31	311.9	58712	
Current File Output: Total After Outfall Controls	3.017E+06	16.12 %	0.31	311.9	58712	32.16 %
Current File Output: Annualized Total After Outfall Controls	603494				11742	
Total Area Modeled (ac)	16.49	Years in Model Run:	5.00			

Print Output Summary to Text File

Total Control Practice Costs

Capital Cost	N/A
Land Cost	N/A
Annual Maintenance Cost	N/A
Present Value of All Costs	N/A
Annualized Value of All Costs	N/A

Receiving Water Impacts Due To Stormwater Runoff

Perform Flow Duration Curve Calculations	Calculated Rv	Approx. Biological Condition of Receiving Water
Without Controls	0.37	Poor
With Controls	0.31	Poor

32% removal with 12 rain gardens and 3 catch basins



WinSLAMM Model Output

File View

Runoff Volume Particulate Solids Pollutants **Output Summary**

File Name: C:\Program Files\WinSLAMM\WDNRFILES\slu_files_curent\ETON_RUGBY_POST3A.dat

Drainage System and Outfall Output Summary

	Runoff Volume (cu. ft.)	Percent Runoff Reduction	Runoff Coefficient (Rv)	Particulate Solids Conc. (mg/L)	Particulate Solids Yield (lbs)	Percent Particulate Solids Reduction
Source Area Total without Controls	3.597E+06	<== Percent Reduction Basis Value	0.37	385.7		
Outfall Total without Controls					86545	<== Basis Value
<hr/>						
Current File Output: Total Before Drainage System	3.597E+06	0.00 %	0.37	385.7	86545	
Current File Output: Total After Drainage System	3.597E+06	0.00 %	0.37	318.2	71381	
Current File Output: Total After Outfall Controls	3.597E+06	0.00 %	0.37	318.2	71381	17.52 %
Current File Output: Annualized Total After Outfall Controls	719338				14276	
Total Area Modeled (ac)	16.49	Years in Model Run:	5.00			

Print Output Summary to Text File

Total Control Practice Costs

Capital Cost	N/A
Land Cost	N/A
Annual Maintenance Cost	N/A
Present Value of All Costs	N/A
Annualized Value of All Costs	N/A

Receiving Water Impacts Due To Stormwater Runoff

Perform Flow Duration Curve Calculations	Calculated Rv	Approx. Biological Condition of Receiving Water
	Without Controls	Poor
	With Controls	Poor

Just catch basins modeled – gives us a 17.5% removal



WinSLAMM Model Output

File View

Runoff Volume Particulate Solids Pollutants **Output Summary**

File Name: C:\Program Files\WinSLAMM\WDNRFILES\slu_files_curent\ETON_RUGBY_POST3.dat

Drainage System and Outfall Output Summary

	Runoff Volume (cu. ft.)	Percent Runoff Reduction	Runoff Coefficient (Rv)	Particulate Solids Conc. (mg/L)	Particulate Solids Yield (lbs)	Percent Particulate Solids Reduction
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Current File Output: Total After Outfall Controls	3.017E+06	16.12 %	0.31	376.4	70842	18.14 %
Current File Output: Annualized Total After Outfall Controls	603494				14168	
Total Area Modeled (ac)	16.49	Years in Model Run:	5.00			

Print Output Summary to Text File

Total Control Practice Costs

Capital Cost	N/A
Land Cost	N/A
Annual Maintenance Cost	N/A
Present Value of All Costs	N/A
Annualized Value of All Costs	N/A

Receiving Water Impacts Due To Stormwater Runoff

Perform Flow Duration Curve Calculations	Without Controls	0.37	Poor
	With Controls	0.31	Poor

Calculated Rv Approx. Biological Condition of Receiving Water

Just rain gardens modeled gives us 18% removal



QUESTIONS???

Contact info:

Greg Fries

608-267-1199

gfries@cityofmadison.com





Department of Public Works
City Engineering Division

Robert F. Phillips, P.E.
City Engineer

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210 Martin Luther King, Jr. Boulevard
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FAX 608 264 9275
www.cityofmadison.com

608 266 4751

Assistant City Engineer
Michael R. Dailey, P.E.

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Christina M. Bachmann, P.E.
John S. Fahrney, P.E.
Gregory T. Fries, P.E.
Christopher J. Petykowski, P.E.

Facilities & Sustainability
Jeanne E. Hoffman, Manager
James C. Whitney, A.I.A.

Operations Manager
Kathleen M. Cryan

GIS Manager
David A. Davis, R.L.S.

Financial Officer
Steven B. Danner-Rivers

Hydrogeologist
Brynn Bemis

December 28, 2011

To: Property owners adjacent to 2012 City street construction
From: Rob Phillips, P.E., City Engineer

Re: Eligibility for Terrace Rain Garden Cost Share Program

Please accept this letter as an opportunity to participate in the City of Madison's Terrace Rain Garden Cost-Share Program. Each year, City Engineering compiles a list of streets to be reconstructed or resurfaced the following year. You are receiving this letter because your property is adjacent to a street that falls within the limits of one of these projects (you will be receiving more information on your individual project in the near future) and provides the opportunity to install terrace rain gardens.

What is a "terrace rain garden"?

Terrace rain gardens are small-scale stormwater management **devices?** between the curb and gutter and sidewalk designed to take untreated street runoff and slow it down and remove some of the pollutants before allowing it to soak into the ground. The gardens are constructed in conjunction with the street and utility work and planted at the very end of construction or the following spring, depending on the time of year.

Terrace Rain Garden History

City Engineering has been installing rain gardens in terraces since 2005, when we installed 7 as part of a pilot project along Adams Street on the near west side. The interest in these gardens has increased each year, and we now have a total of 79 terrace rain gardens installed all around the City.

Site Feasibility

There is a specific site criterion that needs to be met in order to be considered for the program. Terraces (the area between the curb and sidewalk) need to be at least 10 feet wide, trees cannot be too close, and the ground has to be fairly level. More details on our site criteria are included on the back of this letter.

Cost-Share Program

The City of Madison and the property owners share the cost of rain garden installation. The City is responsible for installation and planting of the rain gardens, and all maintenance is the responsibility of the homeowner. Homeowners are responsible for 25% of the total cost of installation of the garden, not to exceed \$400. Please remember, participation is 100% voluntary and property owners who chose to install these gardens help all of us keep our lakes clean.

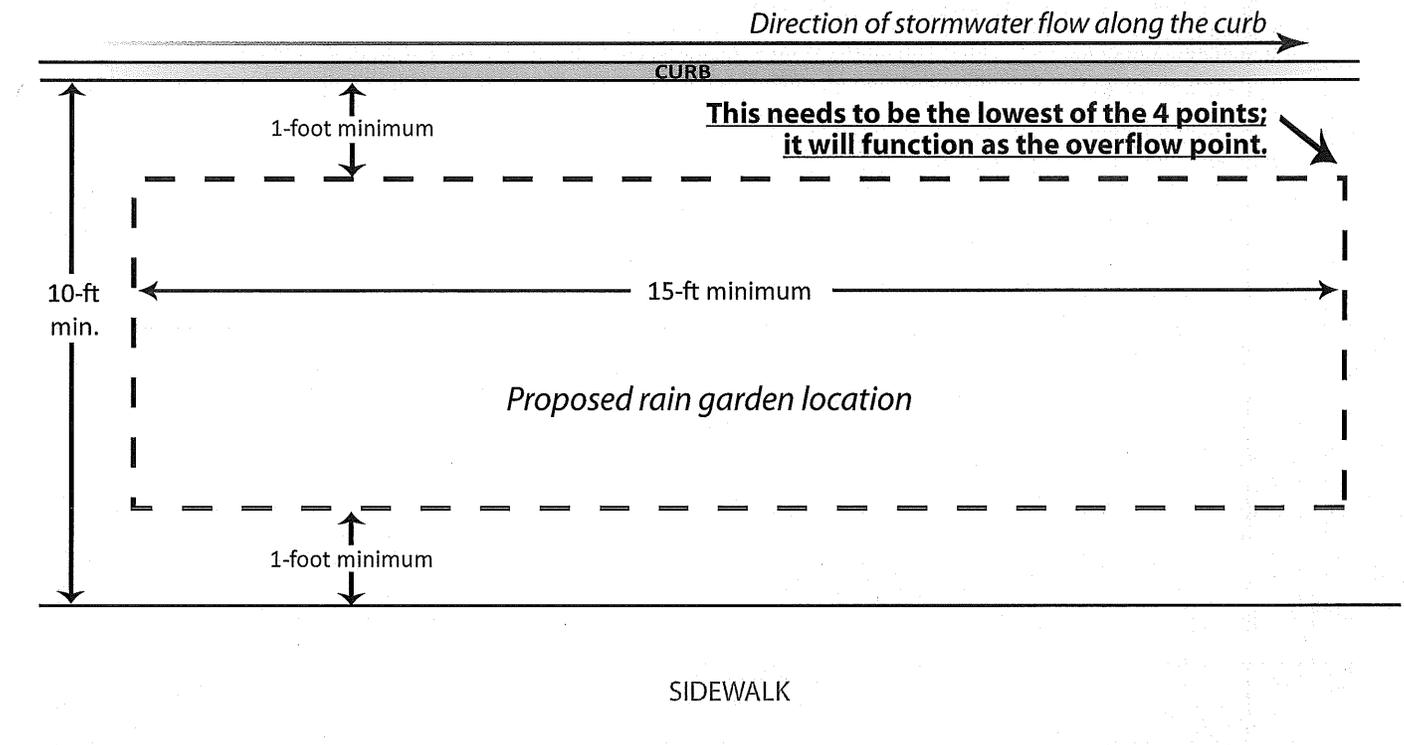
To register your interest in participating or if you have questions please contact Genesis Steinhorst, of my staff, at 608-266-4059 or gsteinhorst@cityofmadison.com.

More information about rain gardens and the program can be found online here:
<http://www.cityofmadison.com/engineering/stormwater/raingardens>.

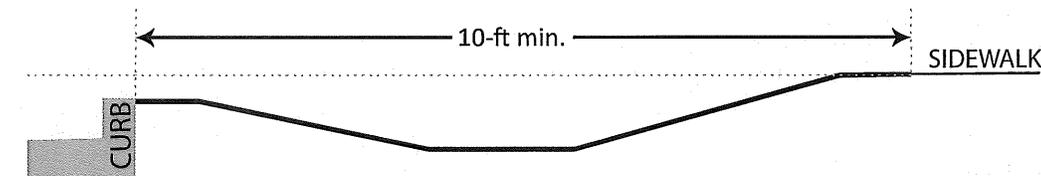
Rain Gardens in the Street Terrace

Determining site suitability:

1. Terrace must be at least 10 feet wide from back of curb to edge of sidewalk
2. Rain garden will be a minimum of 15 feet long
3. Trees need to be at least 10 feet from edge of rain garden
4. Driveways and sidewalk ramps need to be at least 3 feet from edge of rain garden
5. The rain garden would need to overflow back into the curb, away from the sidewalk/house
6. The terrace cannot be too steep in either direction (lengthwise or crosswise).
7. If you are unclear as to a site's suitability, City Engineering staff will do a site visit and make a determination based on the above criteria.



Not to scale



Not to scale

Note that the sidewalk needs to be higher than the curb so that the water overflows back into the street, away from the house.



More information about rain gardens can be found here:
www.cityofmadison.com/engineering/stormwater/raingardens

Questions may be directed to either
Genesis Steinhorst (266-4059) · gsteinhorst@cityofmadison.com
or Greg Fries (267-1199) · gfries@cityofmadison.com

BID ITEM 90040 – TERRACE RAIN GARDEN

DESCRIPTION

Work under this item shall include all work (including but not limited to excavation, removal and disposal of existing material, provision and placement of engineered material), all materials (including but not limited to castings, pipes, engineered fill and mulch), labor, and incidentals required to construct the rain garden system meeting the sizes, locations, specifications, and detail drawings contained in this document and in the plan set.

The Contractor shall review the detail drawings for each system in detail. The size of each garden is specific as is the means of providing stormwater to the system. This item does not include planting of the rain garden system. Planting will be completed by others.

The City reserves the right to add or remove rain gardens from the contract. The Contractor shall not be compensated in any matter for the removal or addition of rain gardens from the contract. The addition of rain gardens shall be consistent with the already designed gardens as indicated in the plan set.

Specifically included are the following:

- 1) Excavation, removal and disposal offsite, at a location provided by the Contractor, of existing material to the bottom of rain garden system grade shown on the detail drawings.
- 2) Standard excavation shall begin at the outer polygon shown on the detail drawings and shall be on a continuous slope from the existing elevation to the finish horizontal location and elevation as depicted by the inner polygon. This inner polygon represents the bottom of the rain garden. Excavation below finish grade and replacement of existing material with engineered fill is required only below the inner polygon. Excavation below finish grade inside the inner polygon shall consist of two (2) feet of excavation below the finish grade shown on the detail drawings. This volume shall then be filled with engineered fill (meeting the specifications below) to the finish grade noted on the detail.
- 3) All ULO's needed to construct each rain garden; there are utilities (gas, sanitary & water) near or in all of these features. All work necessary to locate and work around these utilities is included in the price for these items. If any utility is located within the excavation depths of engineered fill, the contractor shall excavate with caution and use proper construction methods. The contractor shall install Rock Shield around the existing utility to provide protection and shall be included in this item.
- 4) Construction of a curb inlet casting to the rain garden system. Inlet to the rain garden shall be a Neenah casting R-3268 poured into the curb with a 6" PVC pipe draining from the casting into the rain garden system. The piping and all couplings and fittings required for the 6-inch PVC pipe shall be included.
- 5) This casting system requires the curb flow-line at the casting be depressed 3" to force water from the curb to enter the casting and move toward the rain garden system. The curb flow-line depression shall be completed over three (3) feet on either side of the casting and the additional handwork associated with the curb pour is included in with this bid item. Upon placement of the PVC pipe into the bioretention system the pipe shall be capped (temporarily – no glue) such that water does not enter the system.

- 6) Provision of all required engineered fill as called out on the typical section including, compost, topsoil, sand, and shredded mulch to be placed upon complete construction of the garden. Each of these materials shall meet the specifications below.
- 7) All finishing work required to provide a finished engineered soil layer prior to placement of mulch.
- 8) Mulch – The work shall consist of furnishing and installing three (3) inches of double shredded hardwood mulch. The mulch shall be free of foreign material, including other plant material. Mulch shall only be installed once the garden has been brought to finish grade. The 3” of mulch is to be added on top of engineered fill and above the finish grade noted in the plan set.
- 9) If a water valve is located within the limits of the rain garden, this item shall include all materials, labor, and incidentals required to lower the top of the valve such that it is flush with the new finished grades of the rain garden.

ENGINEERED SOIL SHALL MEET THE FOLLOWING:

- 1) The planting mixture shall consist of a mixture of sand, compost and topsoil. The mix shall be designed to approximate the following percentages, by volume.

Engineered Soil Component	% Composition by volume
Sand	45-55%
Topsoil	10-15%
Compost	30%-50%

- 2) The sand component shall at a minimum meet the following criteria:
 - a) Crushed & screened sandstone
 - b) 100% passing a #4 sieve
 - c) Maximum of 5% passing a #200 sieve
- 3) **The topsoil component shall be a USDA classified sandy loam, loamy sand or loam texture. The topsoil component textural class shall be verified by a laboratory analysis or a professional acceptable to the jurisdiction having authority. The topsoil shall be pulverized prior to mixing with the other materials. No soil particle size over 1” diameter shall be accepted and will require removal of all material from the site and a new mix being provided.**
- 4) The compost component shall meet the requirements listed below:
 - a. Particle Size – 98% of the compost shall pass through a 0.75-inch screen.
 - b. Physical Contaminants – Less than 1% combined glass, metal and plastic.

- c. Organic Matter/Ash Content – At least 40% organic matter; less than 60% ash content.
 - d. Carbon to Nitrogen Ratio – 10-20:1 C:N ratio.
 - e. pH – Between 6 and 8.
 - f. Soluble Salts – Electrical conductivity below 10 dS m⁻¹ (mmhos cm⁻¹)
 - g. Moisture Content – Between 35% and 50% by weight.
 - h. Maturity – The compost shall be resistant to further decomposition and free of compounds, such as ammonia and organic acids, in concentrations toxic to plant growth.
 - i. Residual Seeds & Pathogens – Pathogens and noxious seeds shall be minimized.
 - j. Pathogens – The compost shall meet the Class A requirements for pathogens as specified in s. NR 204.07(6)(a), Wis. Adm. Code.
 - k. Other Chemical Contaminants – The compost shall meet the high quality pollutant concentrations as specified in s. NR 204.07(5)(c), Wis. Adm. Code.
- 5) The engineered soil mix shall be free of rocks, stumps, roots, brush or **other material over 1 inch in diameter**. No other materials shall be mixed with the planting soil that may be harmful to plant growth or prove a hindrance to planting or maintenance.

METHOD OF MEASUREMENT

Terrace Rain Garden shall be measured as each system is completed in the field.

BASIS OF PAYMENT

Terrace Rain Garden shall be measured as described above which shall be full compensation for all work, materials and incidentals to complete the work as described above.