GI Implementation Forms
Continued Tutorial: Redevelopment Site

This Continued Tutorial guides the user through a redevelopment site using the Oregon State University Extension Service's **Green Infrastructure** (**GI**) Implementation Forms.

This guide assumes you have first read through the Introductory Tutorial. This Continued Tutorial demonstrates an example redevelopment of an office site in eastern Oregon using the Type II GI Implementation Forms. This site contains examples of retrofit and pavement removal BMPs.

Table of Contents:

The additional tutorials found below contain further information:

Introductory Tutorial

Contains more detailed background information on how to use GI Implementation Forms.

- Catchment 1: (Porous Pavement & Rain Garden)

Continued Tutorial: New Development Site

Manages Catchments #2-5 from the introductory tutorial new development site. Contains examples of additional BMP worksheets and ways to overcome challenging soil conditions.

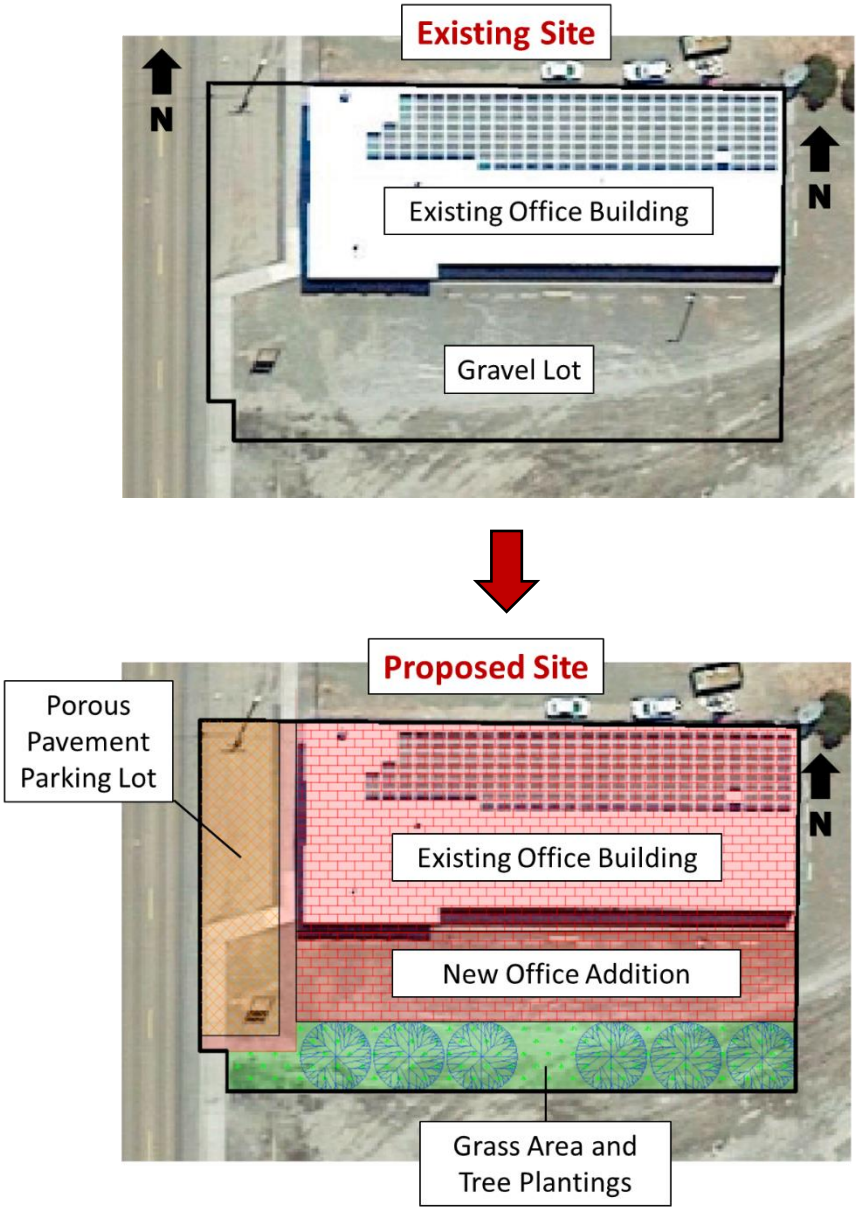
- Catchment 2: (Stormwater Planter)
- Catchment 3: (Vegetated Roofs, Downspout Disconnection)
- Catchment 4: (Lined Stormwater Planter, slow-draining soils)
- Catchment 5: (Vegetated Filter Strip, expansive clay soils)

Redevelopment Site

Click to return to Table of Contents

In this second example project, we have a mock redevelopment design for an OSU Extension office building in Wallowa County, Oregon.

The designer wishes to construct an addition to the office building as well as provide stormwater treatment on-site to display in an educational exhibit for the community. Some of the surrounding gravel areas will be converted into a porous paving parking lot and some into a grassed area with tree plantings. This grassed area will serve as a picnic spot for employees during lunchtime and the tree plantings on the south side of the building will provide shading to save on summer cooling costs.



Before Starting the GI Implementation Forms

(see Introductory Tutorial for more information)

Click to return to Table of Contents

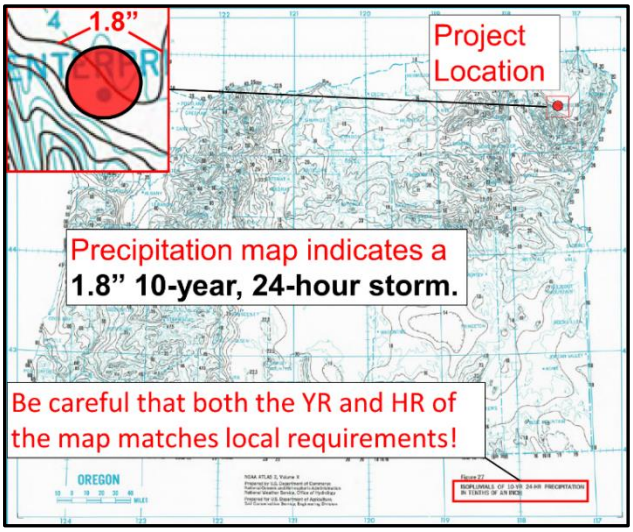
Prior to filling out the GI Implementation Forms, you will need the following information.

1. Check Rainfall Depth Requirements

(OSU Extension link) (NOAA Link)

Jurisdictions generally require stormwater designs to manage rainfall depth of a given **design storm**.

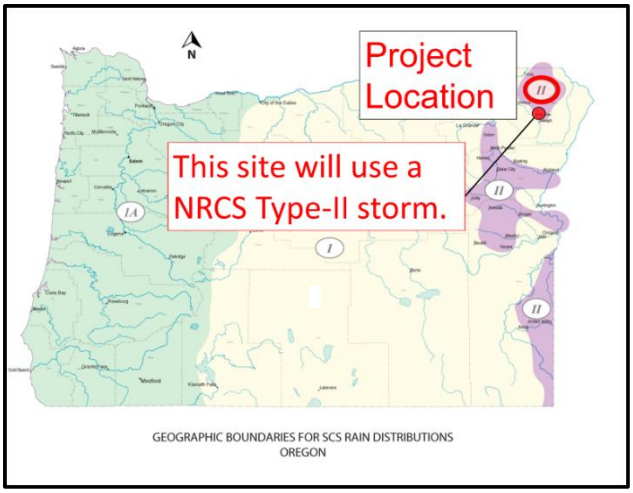
In this example project, the builders choose to manage the 10-year, 24-hour design storm. A rainfall depth of **1.8"** for this design storm in the site location is found from the NOAA map listed above.



2. Check NRCS/SCS Storm Type (link)

The NRCS/SCS **Storm Type** determines the design storm precipitation timing and intensity. There is a separate GI Implementation Form spreadsheet package for each storm type.

This site falls in the NRCS **Type II** storm region, so we will need to use the Type II GI Implementation package.



3. Perform Soil Infiltration Testing (link)

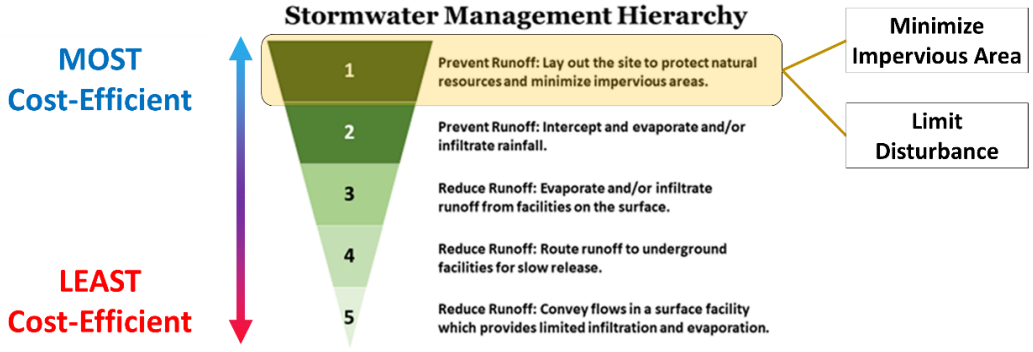
The types of BMPs available and the sizes required depend on the **infiltration rate** of local soils. Local soils infiltration tests yielded **0.6 inches/hour** consistent throughout the site. This is very slow! While it is a common perception that you cannot install infiltration facilities in slow-draining soils, this tutorial will show how Green Infrastructure BMPs can still be used even in areas with poor soils.

Site Layout

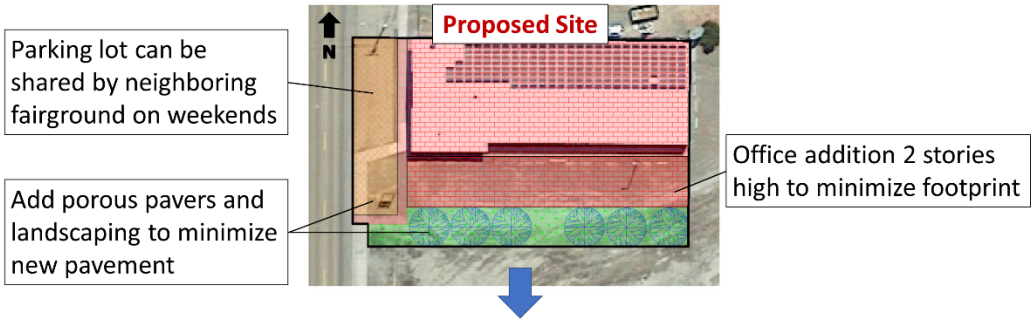
(see Introductory Tutorial for more information)

Click to return to Table of Contents

We will now open up the **Type II GI Implementation Form** (link) and begin filling it out.



First, fill out the **Site Layout** form to see what practices can be implemented to minimize impervious area and limit disturbance. In this example, we are limiting our disturbance to include only gravel areas that have been previously developed. We are also converting some of the gravel to porous pavement or vegetation to minimize impervious area. These practices are among the most cost-efficient methods to manage stormwater (see the **Stormwater Management Hierarchy**).



In the **Site Layout** form, we enter our practices to minimize impervious area and limit disturbance.

Site Form: Steps to an LID Site & Sizing Facilities

Complete Sections A-B in tabs, "Instructions & Site Layout", "Site Landscape Areas", and "Site Hardscape Areas" once for ENTIRE SITE

A. CREATE SITE LAYOUT & LID STRATEGY (ENTIRE SITE)

Minimize Impervious Area

These practices reduce the drainage area to be managed by Runoff BMPs and reduce stormwater management costs (and some of them also reduce overall project costs). If not incorporated, provide justification.

	Incorporated	Not Feasible	Not Applicable	Justification if not incorporated
1. Shared parking spaces BMP	X			
2. Minimize Pavement Widths BMP	X			
3. Minimize Front Setbacks BMP	X			
4. Share a Driveway BMP			X	No driveways
5. Minimize Building Footprint(s) BMP	X			
6. Minimize Roadway Cross Section(s) BMP			X	No roads in site
7. Minimize New Pavement BMP	X			
Limit Disturbance				
8. Construction Sequencing BMP	X			
9. Conserve Fast(er) Draining Soils BMP	X			

Site Landscape Areas

(see Introductory Tutorial for more information)

Click to return to Table of Contents

In the **Site Landscape Areas** form, we will manage the runoff from the site's landscape areas (lawn, meadow, forest, grasses, shrubs, etc.).

Landscape Area: Consists of newly planted grass area.

In the **Site Landscape Areas** form, we enter BMPs until all landscape areas are managed and Step 16 becomes True.

B. PR… FROM LANDSCAPE AREAS (ENTIRE SITE)

10. Enter Landscape Drainage Area. Enter total drainage area of landscape surfaces for the entire site. **2,770** square feet

Limit Disturbance of Protected Landscape Areas

Apply these BMPs to landscape areas that will be protected in their natural current or restored state in the proposed development. These reduce the amount of impervious area to be managed in Runoff BMPs below and reduce stormwater management costs (and some of them also reduce overall project costs).

			Area Managed Equation			Area Managed	
11. **Cluster Development BMP.** Enter natural landscape areas protected from all development impacts in first box and multiply by value shown to calculate area managed	=	1.00	x	square feet of BMP	=	0	sf
12. **Tree Protection BMP.** Enter area of tree canopy farther than 10 feet from an impervious area and properly protected from all development impacts, in first box and multiply by value shown to calculate area managed.	=	1.5	x	square feet of BMP	=	0	sf

To add Tree Plantings, open Worksheet B1. Areas managed in B1 will automatically show up here.

Prevent Runoff from Developed Landscape Areas

Apply these BMPs to any proposed landscape areas where disturbance has taken place. These reduce the amount of runoff to be managed in Runoff BMPs below.

13. **Tree Planting BMP (Landscape).** Enter the landscape area managed with trees.	=	*Area set automatically to D41 in WS B1 Tree Planting (LS)*			=	2,770	sf
14. **Restored Soils BMP.** Enter area of newly disturbed or existing landscape to be restored and planted with perennial flowers, shrubs, grasses, and grass-likes in first box and multiply by value shown to calculate area managed.	=	1.00	x	square feet of BMP	=	0	sf
15. **SECTION B AREA MANAGED SUBTOTAL: Calculate landscape areas managed with runoff prevention BMPs = Step 11 + Step 12 + Step 13 + Step 14 + Step 15**					=	2,770	sf
16. Is Step 15 equal to or greater than Step 10? If TRUE, then yes. If FALSE, then manage landscape areas until TRUE.					=	TRUE	

Click to open Worksheet B1 to find landscape area managed by Tree Plantings

Step 16 is **True**. Success!

The only landscape area for this site will the proposed grassed area picnic area to the south. Enter the total landscape area on the **Site Landscape Areas** form. To manage this area, we enter our tree plantings of 6 small evergreens as **Tree Planting (Landscape BMP)**. To enter area here, we will need to input our tree plantings into **Worksheet B1** (*note: only count new trees planted further than 10 ft. from impervious areas).*

Existing vegetation would be entered in the Site Landscape Areas form as Cluster Development BMP or Tree Protection BMP. However, there is none present for this site.

In **Worksheet B1**, we enter our Tree Plantings to count towards the **Site Landscape Areas** managed.

WORKSHEET B1. TREE PLANTING (LANDSCAPE AREA) BMP WORKSHEET

Use this form to determine:
1. The maximum landscape area that may be managed with newly planted/proposed trees.
2. The landscape area managed by trees that may be entered in Site Landscape Areas for both deciduous and evergreen trees.

a. Specify if the Tree Plantings will take place on the **Entire Site** or within specific **Catchment #'s**: Entire Site

b. Did you put the right tree in the right place? In other words, are all conditions met (especially soil volume) to plant tree(s) in a location where the tree(s) can grow to full maturity? If Yes, continue to Step c.. If No, then this location is unsuitable for newly planted trees, so enter 0 in Step 13 of the Site Landscape Areas Form. Yes — Enter Yes or No

Determine available proposed canopy of evergreen trees to manage landscape areas:

Entering our **6 small Evergreen** Tree Plantings.

Evergreen (Landscape). Calculate the total mature canopy for multiple evergreen trees to manage landscape area runoff. (If desired, trees within 10 feet of hardscape areas may be used E1 instead.)

c.	Small Canopy (for trees with small mature canopy area spreads, which include small trees and many trees with upright canopies, tree canopy diameter is about 20 feet). Enter number of trees in first box and multiply by assumed canopy area.	=	315 square feet	x	6	# of small proposed trees	=	1890 sf
d.	Medium Canopy (for trees with medium mature canopy area spreads, tree canopy diameter is about 25 feet). Enter number of trees in first box and multiply by assumed canopy area.	=	490 square feet	x		# of med proposed trees	=	0 sf
e.	Large Canopy (for trees with large mature canopy area spreads, tree canopy diameter is about 30 feet). Enter number of trees in first box and multiply by assumed canopy area.	=	700 square feet	x		# of large proposed trees	=	0 sf
f.	Calculate available proposed evergreen canopy = Step c. + Step d. + Step e.							1890 sf
g.	Calculate landscape area that could be managed by proposed evergreen trees = Step f. x value shown.	=	1.50	x	1890	square feet	=	**2835 sf**

Determine available proposed canopy of deciduous trees to manage landscape areas:

Deciduous (Landscape). Calculate the total mature canopy for multiple trees. Enter only decidous trees to manage landscape area runoff. (Trees within 10 feet of hardscape areas may be used to prevent runoff from hardscape, if desired. Use Worksheet E1 instead.)

h.	Small Canopy (for trees with small mature canopy area spreads, which include small trees and many trees with upright canopies, tree canopy diameter is about 20 feet). Enter number of trees in first box and multiply by assumed canopy area.	=	315 square feet	x		# of small proposed trees	=	0 sf
i.	Medium Canopy (for trees with medium mature canopy area spreads, tree canopy diameter is about 25 feet). Enter number of trees in first box and multiply by assumed canopy area.	=	490 square feet	x		# of med proposed trees	=	0 sf
j.	Large Canopy (for trees with large mature canopy area spreads, tree canopy diameter is about 30 feet). Enter number of trees in first box and multiply by assumed canopy area.	=	700 square feet	x		# of large proposed trees	=	0 sf
k.	Calculate available proposed deciduous canopy = Step h. + Step i. + Step j.							0 sf
l.	Calculate landscape area that could be managed by proposed deciduous trees = Step k. x value shown.	=	1.00	x	0	square feet	=	**0** sf
m.	Calculate the total landscape area managed by proposed evergreen and deciduous trees = Step g. + Step l.						=	**2835** sf

Determine area managed to enter on LID Implementation Form:

n. Enter the actual

o. The smaller of t

Area Managed from **Worksheet B1** here will be automatically added to the **Site Landscape Areas** form.

= 2770 square feet

2770 **square feet**

Used to determine "Area Managed" on Site Landscape Areas form

Site Hardscape Areas

(see Introductory Tutorial for more information)
Click to return to Table of Contents

In the **Site Hardscape Areas** form, we will take an inventory of the new and existing hardscape areas.

Since this is a redevelopment project, the existing hardscape area in this form. Given that the whole site is currently either rooftop, gravel, or pavement, we will enter the entire site area (17,450 ft^2) as existing hardscape.

In the **Site Hardscape Areas** form, we enter the total # of catchments and the hardscape areas for each catchment.

INVENTORY OF SITE HARDSCAPE AREAS

Enter # of Catchments (drainage areas) in site | 1

1. Enter total # of catchments here to get the rows below to appear.

Enter total hardscape area for each catchment
(rows appear when # of Catchments is entered above)
• Hardscape areas include any pavement (including porous pavements) or roof.

	Existing Hardscape		New Hardscape		Total Hardscape	
Catchment 1	17,450	square feet	0	square feet	17,450	square feet

For each catchment, click to open a new Catchment Form

2. Enter in our hardscape areas.

In the next step, we will click here to open up a **Catchment Form** for Catchment #1.

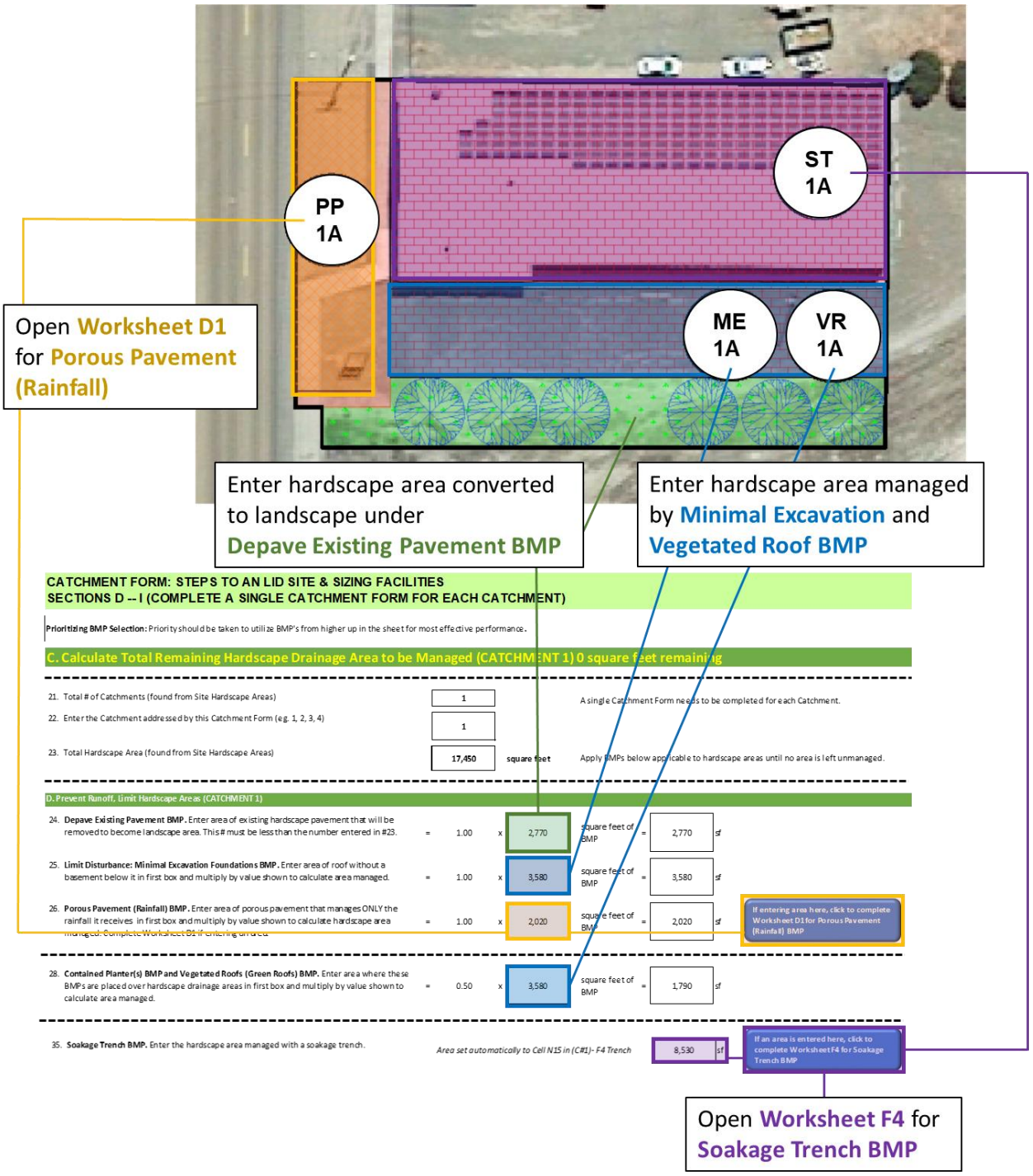
There is only one catchment for this site, so next click on the blue button manage Catchment #1.

Catchment Form

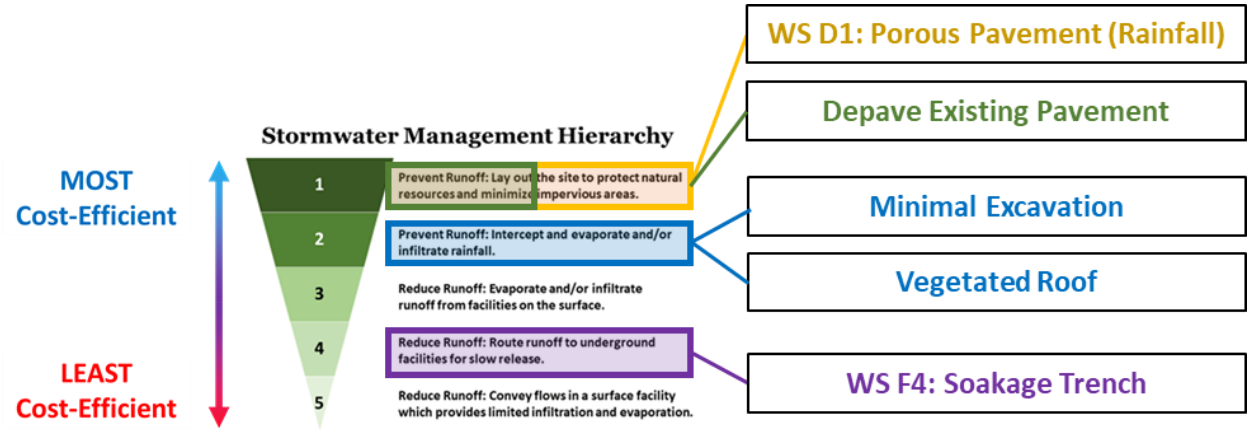
(see Introductory Tutorial for more information)

Click to return to Table of Contents

To manage the hardscape areas using the **Catchment Form**, we will implementing a wide variety of BMPs that the designer wishes to display for educational outreach.



The designer has done a good job selecting BMPs at the top of the **Stormwater Management Hierarchy**. These BMPs should have strong drainage performance at relatively low cost compared to other BMPs.



The office addition will be constructed with a **Vegetated Roof BMP** (also known as green roof) to infiltrate rainfall from above and **Minimal Excavation BMP** (meaning no basement) to allow runoff to infiltrate underneath. The **Depave Existing Pavement BMP** removes portions of the gravel lot to allow water to infiltrate in our new grass picnic area. Enter the Areas Managed by each of these BMPs directly into the Catchment Form.

An old portion of the parking lot will also be converted to **Porous Pavement (Rainfall) BMP**, so we will need to complete **Worksheet D1**.

Using **Worksheet D1** to enter **Porous Pavement (Rainfall)**

WORKSHEET D1. POROUS PAVEMENT (RAINFALL) BMP WORKSHEET [View BMP Factsheet] [View BMP Suitability Matrix]

Porous Pavement (Rainfall) is designed to treat runoff only from the porous pavement area itself (to treat runoff from outside areas, see Worksheet F1).
For multiple porous pavement (rainfall) BMPs, complete this worksheet for each different base rock depth recommended for structural stability in Step h.

Use this form to:
1. Confirm site suitability for infiltration of rainfall using porous pavement.
2. Determine the minimum depth of base rock needed to store the design storm and provide structural stability

a.	Enter a unique identifier for the BMP. (PP-1A, etc.)	**Porous Pavement Designation:**	PP-1A
b.		**In Catchment #:**	1

Confirm suitability for infiltration of rainfall with porous pavement:

c.	Under 'Physical Setting' in the Rain Gardens fact sheet, are all conditions met to safely infiltrate the rainfall it receives? If Yes, continue to Step d. If No, then site is unsuitable for porous pavement to manage rainfall, so enter a 0 on Step 19 of LID Form-1.	Yes	Enter Yes or No
d.	See the BMP Suitability Matrix. Do any site conditions exist in the footprint of the porous pavement that are grayed out (i.e. not applicable)? If Yes, then site is unsuitable for porous pavement to manage rainfall, so enter a 0 for Area Managed by Porous Pavement (Rainfall) on Step 26 of the Catchment Form. If No, continue to Step e..	No	Enter Yes or No
e.	Enter tested design infiltration rate, performed within the footprint of the porous pavement. If the infiltration rate is less than 0.3 inch/hour , a qualified licensed engineer should perform hydrologic modeling and provide specifications for construction.	0.6	inches/hour

Enter tested local soil infiltration rate

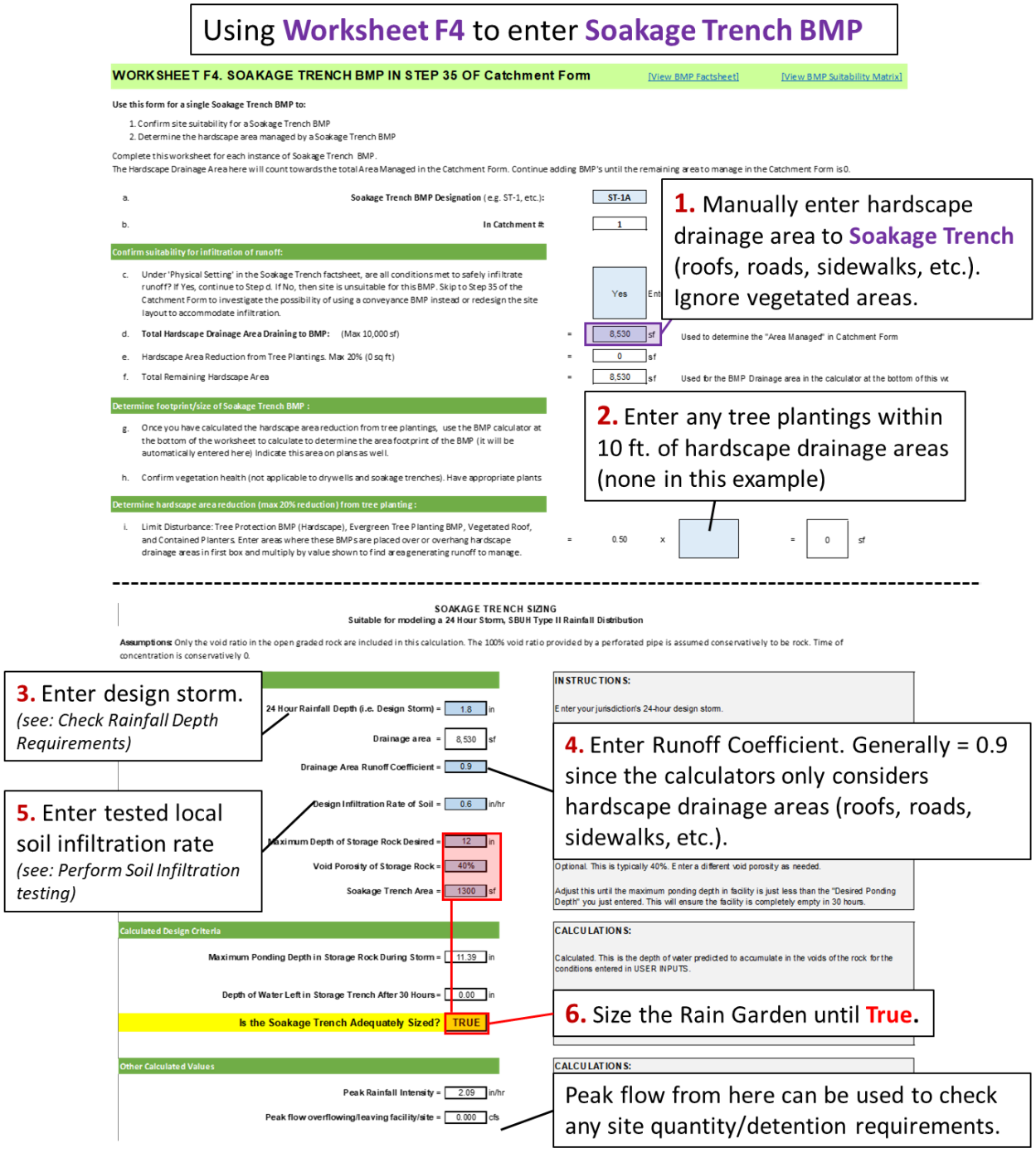
Determine minimum base rock depth:

f.	Enter design storm event to manage. See precipitation maps.	1.8	inches of r
g.	Enter base rock depth required for structural stability (from pavement section developed by a qualified licensed professional who has investigated the site soils).	24	inches
h.	Calculate base rock depth required to manage design storm = 0.7 x design storm [inches].	= 0.7 x 1.8 inch(es) = 1.26	inches
i.	Determine minimum base rock depth. Enter the larger of steps g. and h. and indicate this minimum base rock depth on construction plans and/or details.	24	inches

Enter design storm.
(see: Check Rainfall Depth Requirements)

The base rock depth in Step i. will usually be equal to the structural requirement in Step g.

Finally, we will install a **Soakage Trench BMP** to wrap around the old office building and collect any runoff coming off the roof. We will need to complete **Worksheet F4** for the Soakage Trench.



After entering all these BMPs, the Catchment Form displays 0 square feet remaining of hardscape area to manage. This means the stormwater design is complete, great work!