# SIDM User's Guide and Reference Manual

**GUIDE TO USING THE SIMPLE INFILL DETENTION METHOD FOR STORMWATER DETENTION ON NON-BONDED SINGLE-FAMILY DETACHED RESIDENTIAL INFILL LOTS**

FAIRFAX COUNTY LAND DEVELOPMENT SERVICES

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# SIDM USER'S GUIDE AND REFERENCE

## THE SIDM METHODOLOGY

### *Purpose*

SIDM, the acronym for **S**imple **I**nfill **D**etention **M**ethod, is a Fairfax County, Virginia (County) detention facility design methodology specifically developed for (and only for) non-bonded residential infill lot development projects.

The application of SIDM to such projects will result in detention facility designs that sufficiently mitigate the stormwater impacts related to increases in impervious areas. Compliance with SIDM for these projects satisfies the detention and outfall channel/flood protection requirements of the Stormwater Management Ordinance (SWMO – Fairfax County, Virginia - Code of Ordinances, Chapter 124), the Public Facilities Manual (PFM), and the Virginia Erosion and Sediment Control Regulations Minimum Standard 19 (MS 19). The application of SIDM is strictly subject to the specified design and use limitations of the methodology.

The County has developed design tools and standard details for four acceptable detention practices that may be used with this method: urban bioretention planter box (UPB1 and UPB2), bioretention-detention rain garden (RG), and underground pipe detention (UPD). The proper use of, and strict adherence to these tools and details will result in the streamlined design and review (and, in time, construction) of detention facilities that can reliably be expected to be acceptable to the County with the first plan submittal.

This User's Guide and Reference document is intended to assist the designer with gaining abetter understanding of SIDM, as well as gaining a good understanding of the appropriate application of the associated design tools and details to a project. This document is available online here: https://www.fairfaxcounty.gov/landdevelopment/stormwater-management-design-residential-infill-lot-grading-plans

### *SIDM General Detention Facility Design Requirements*

The County's "*Localized Flooding Mitigation Policy for Residential Infill Development-Detention Requirements*" (Land Development Services Technical Bulletin 22-06), established SIDM as a simple means to comply with stormwater quantity regulations by providing onsite detention storage capacity for a stormwater volume equal to 2.56 inches of rainfall assumed to be direct runoff from the proposed net increase in total impervious area. In addition to this detention volume requirement, a SIDM facility is also designed to discharge its allowed outflow, which equals the predevelopment flow from the facility's contributing drainage area, at full storage capacity. Both of these facility-sizing requirements are integrated into the SIDM design tools, as are the other applicable County and Virginia Department of Environmental Quality (DEQ) facility-specific design requirements.

**NOTE**: SIDM is applicable to any non-bonded residential infill lot development project that can comply with the design and use limitations of the methodology, regardless of whether the stormwater discharged from the disturbed area will be concentrated flow or sheetflow. When SIDM is appropriately applied to the project the design professional need not conduct a channel protection and flood protection outfall analysis, nor the routing analyses for the proposed detention facilities, nor provide a water quantity narrative.

## *SIDM Design Tools*

SIDM only allows the use of four standard detention facilities listed below. Each of the four standard detention facilities has a facility-specific Standard Design Calculations Spreadsheet (Calculations Spreadsheet or Spreadsheet) and Standard Design [Plan] Sheet (Design Sheet) with which the facility must be designed. The Standard Pretreatment/Outlet Protection Details [Plan] Sheet, and Standard General Site SWM/BMP Data [Plan] Sheet must also be integrated into the design.

The file names and links for downloading the files for the facility-specific design tools are listed below:

- UPB1, Urban Planter Box 1:
    - Calculations Spreadsheet – Ffx Co_Urban Bioretention Planter Box-UPB1-Design for Infill Lots.xlsm
    - Design Sheet – Ffx Co_UPB1 Standard Design Plan Sheet for Infill Lots.dwg
- UPB2, Urban Planter Box 2:
    - Calculations Spreadsheet – Ffx Co_Urban Bioretention Planter Box-UPB2-Design for Infill Lots.xlsm
    - Design Sheet – Ffx Co_UPB2 Standard Design Plan Sheet for Infill Lots.dwg
- RG, Rain Garden:
    - Calculations Spreadsheet – Ffx Co_Bio-Detention Rain Garden-RG-Design for Infill Lots.xlsm
    - Design Sheet – Ffx Co_RG Standard Design Plan Sheet for Infill Lots.dwg
- UPD, Underground Pipe Detention:
    - Calculations Spreadsheet – Ffx Co_Underground Pipe Detention-UPD-Design for Infill Lots.xlsm
    - Design Sheet – Ffx Co_UPD Standard Design Plan Sheet for Infill Lots.dwg

## *SIDM Submission Requirements*

A complete submission using the SIDM will include the following:

1. **Standard Design [Plan] Sheet** for each facility type proposed. Specific tables generated in the corresponding **Standard Design Calculations Spreadsheet** must also be incorporated into the Standard Design [Plan] Sheet for each facility type proposed.
2. **Standard Pretreatment/Outlet Protection Details [Plan] Sheet**.
3. **Standard General Site SWM/BMP Data [Plan] Sheet**, consisting of sheets 1 and 2. Additional (sheet 2 of 2) plan sheets may be used if needed.

## *SIDM Standard Design Calculations Spreadsheets*

Each facility-specific Spreadsheet is an Excel workbook composed of three common sheets or tabs, with the bioretention facility (UPB1, UPB2, and RG) Spreadsheets each having a fourth tab containing a list of plants recommended for the specific facility type.

The three common Spreadsheet tabs (See Figure 1 below) are titled: DesignCalcs, DesignData, and DesignData-2. The fourth tab, for the bioretention facilities only, is RG Plant List or UPB1 / UPB2 Plant List.

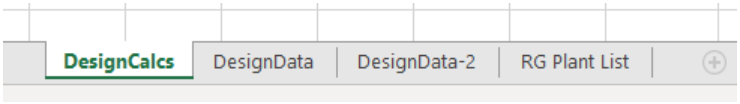



*Figure 1: Spreadsheet Tabs in Excel Workbook*

*Table 1: Purpose of Each Spreadsheet Tab*

| Spreadsheet Tab | Use of Tab |
|---|---|
| DesignCalcs tab | Used to develop the Design Quantities Tables (DQ Tables*) |
| DesignData tab | Used to develop the Design Data and Pretreatment Practices/Outlet Protection Tables (DD and POP Tables*) |
| DesignData-2 tab | Used to develop the Hydraulic Structure Location Table (HSL Table)* |
| UPB1, UPB2 or RG Plant List tab | Used in selecting plants for bioretention facilities from among the county-recommended species. |

*These respective tables must ultimately be inserted into the Standard Design [Plan] Sheets for each corresponding facility type.

**NOTE: One or more of a particular facility type can be sized using one facility-specific Spreadsheet and more than one facility type may be proposed to satisfy the lot's total detention requirements. A separate, stand-alone Spreadsheet is required for each different facility type proposed for an individual lot.**

The designer must enter limited data in the Spreadsheet, with all data entry cells highlighted in yellow. (Note that only these highlighted cells are active, and no other cells can be accessed on the tabs – other than the CLEAR ALL button. Left-clicking this button will do exactly as described on and below the button for all of the data tables on all three of the Spreadsheet tabs for the facility type.) When beginning a new design, the CLEAR ALL button should be used to clear out any remaining data in the Spreadsheet tabs. As the designer enters the required data, proceeding in order from the DesignCalcs tab to the DesignData-2 tab, the Spreadsheet populates the various tables with computed facility sizing dimensions and elevations, as well as other information pertaining to the facility details and specifications.

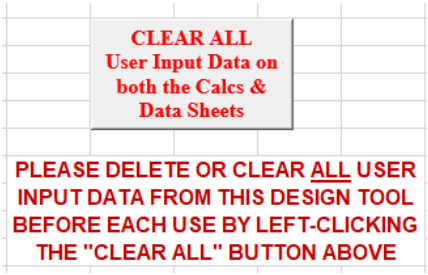



*Figure 2: "Clear All" Button Common to All Spreadsheets*

The data the designer must enter to size facilities are facility-type specific (i.e., each Spreadsheet is unique for the facility type). NOTE: Each Spreadsheet tab includes detailed instructions on how to enter the required data, and lists design limitations. The following sections discuss the required input for each facility type, along with some additional design limitations associated with each facility type.

## UPB1 AND UPB2 FACILITY DESIGN

The UPB1 and UPB2 are standardized planter boxes that can receive stormwater flow from downspout discharges, or in the case of the UPB2, also from impervious surface drainage within a localized drainage area. The UPB1 can only receive drainage via a downspout and is placed next to the residential structure. The UPB2 requires a minimum 10-foot separation from the structure. See Table 2 below for the differences between UPB1 and UPB2.

*Table 2: General Design Parameters for UPB1 and UPB2*

| ***Facility Type*** | ***Facility Location*** | ***Contributing Drainage Area*** | ***BMP Credit*** | ***Minimum Box Length and Width*** |
|---|---|---|---|---|
| UPB1 | Locate adjacent to residential structure | Roof only up to a maximum 2,500 SF | Level 1 | 2 ft. x 2 ft. |
| UPB2 | Locate a minimum 10 feet from residential structure | Onsite impervious area only, up to maximum 5,500 SF (and no pervious area) | Level 1 | 2 ft. x 2 ft. |

### *Standard Design Calculations Spreadsheet*

Directions for completing the UPB1 and UPB2 Spreadsheet tabs are discussed in the following subsections.

#### DesignCalcs Tab

The DesignCalcs tab is used for entering basic facility sizing design data based on actual project site conditions. Under this tab the calculation sheet is comprised of the Design Quantities Table, which is further subdivided into a "General Facility-Type Data" block and the "Individual Facility Data" block that is composed of tables for each individual facility. Up to five (UPB1) or three (UPB2) individual facilities can be designed for a single lot with one facility-type Spreadsheet.

##### *General Facility-Type Data Block*

Figure 3 and Figure 4 below illustrate the General Facility-Type Data portions of the DQ Tables for the respective UPB1 (to row 18) and UPB2 (to row 16).

- The first data to be entered in cell H8 (typical for all facility types) is the proposed total net additional impervious surface created by a project's total proposed land disturbance. This value must match the Stormwater Requirement Determination information block on the standard INF cover sheet, line #7.

- In cell H11, (typical for all facility types) enter the portion of this onsite total net additional impervious surface that the designer wishes to allocate to the particular facility type. This

allocation is typically based on the designer's proposed locations for individual facilities, and the drainage area that is or can be directed to those locations.

- The designer must also choose whether water quality credit is to be claimed for the facilities (cell H17 for UPB1, cell H16 for UPB2) by clicking within the highlighted cell to activate the cell then using the down-arrow to select "Yes" or "No" from the drop-down menu.

| | A | B | C | D | E | F | G | H | I | J |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | **URBAN BIORETENTION FOR INFILL LOTS: PLANTER BOX (UPB1)** | | | | | | | | | |
| 2 | **DESIGN QUANTITIES TABLE** | | | | | | | | | |
| 3 | (A UPB1 may be located within 10' of a residential structure and MUST drain only roof area) | | | | | | | | | |
| 4 | | | | | | | | | | |
| 5 | **A separate stand-alone design & Design Quantities Table is required for each lot** | | | | | | | | | |
| 6 | | | | | | | | | | |
| 7 | *Enter the requested design data in the* | | | | *yellow* | *cells below.* | | | | |
| 8 | Net additional impervious area created by proposed project: | | | | | | | | sq. ft. | |
| 9 | ***MUST** match net additional impervious area value identified on Cover Sheet* | | | | | | | | | |
| 10 | *For UPB1(s) proposed on this sheet:* | | | | | | | | | |
| 11 | Total impervious **roof** area to be drained to UPB1(s): | | | | | | | | sq. ft. | |
| 12 | *only **roof** area **MUST** drain into UPB1(s)* | | | | | | | | | |
| 13 | % of equivalent net impervious area to be drained to UPB1(s): | | | | | | | 0 | % | |
| 14 | Total required stormwater volume to be detained by UPB1(s): | | | | | | | 0 | cu. ft. | |
| 15 | Total required surface area of UPB1(s): | | | | | | | 0 | sq. ft. | |
| 16 | Number of individual UPB1(s) proposed: | | | | | | | 0 | | |
| 17 | Is Water Quality credit to be claimed for proposed UPB1(s)? | | | | | | | | | |
| 18 | Approx. total TP removed by proposed UPB1(s) - Level 1 Design: | | | | | | | 0.00 | lb./yr. | |

*Figure 3: General Facility-Type Data block of the UPB1 Design Quantities Table*

| | A | B | C | D | E | F | G | H | I | J |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | **URBAN BIORETENTION FOR INFILL LOTS: PLANTER BOX (UPB2)** | | | | | | | | | |
| 2 | **DESIGN QUANTITIES TABLE** | | | | | | | | | |
| 3 | (A UPB2 MUST be located at least 10' from a residential structure and drain only impervious area) | | | | | | | | | |
| 4 | | | | | | | | | | |
| 5 | **A separate stand-alone design & Design Quantities Table is required for each lot** | | | | | | | | | |
| 6 | | | | | | | | | | |
| 7 | *Enter the requested design data in the* | | | | *yellow* | *cells below.* | | | | |
| 8 | Net additional impervious area created by proposed project: | | | | | | | | sq. ft. | |
| 9 | ***MUST** match net additional impervious area value identified on Cover Sheet* | | | | | | | | | |
| 10 | *For UPB2(s) proposed on this sheet:* | | | | | | | | | |
| 11 | Total **onsite** impervious area drained to UPB2(s): | | | | | | | | sq. ft. | |
| 12 | *onsite pervious area and all offsite area **MUST NOT** drain into UPB2(s)* | | | | | | | | | |
| 13 | % of equivalent net impervious area to be drained to UPB2(s): | | | | | | | 0 | % | |
| 14 | Total required stormwater volume to be detained by UPB2(s): | | | | | | | 0 | cu. ft. | |
| 15 | Number of individual UPB2(s) proposed: | | | | | | | 0 | | |
| 16 | Is Level 1 Water Quality credit to be claimed for proposed UPB2(s)? | | | | | | | | | |

*Figure 4: General Facility-Type Data block of the UPB2 Design Quantities Table*

A few additional quantities are automatically calculated in the General Facility-Type Data blocks, based on the data entered by the designer.

- In cells H13 & H14, for both facility types, the % of the project's total net impervious area to be drained to the individual facilities of the facility type, and the total required detention volume to be provided by the individual facilities of that facility type, are, respectively, displayed. If the value in cell H13 is less than 100%, then another facility type (or types) must be proposed to capture the stormwater runoff from the remaining impervious area of the project's (cell H8) requirement.

- The number of proposed individual facilities for the facility type is displayed (and continually updated) in cell H16 for UPB1, and cell H15 for UPB2, as the designer sequentially (always starting with individual facility #1) enters data in the Individual Facility Data block.

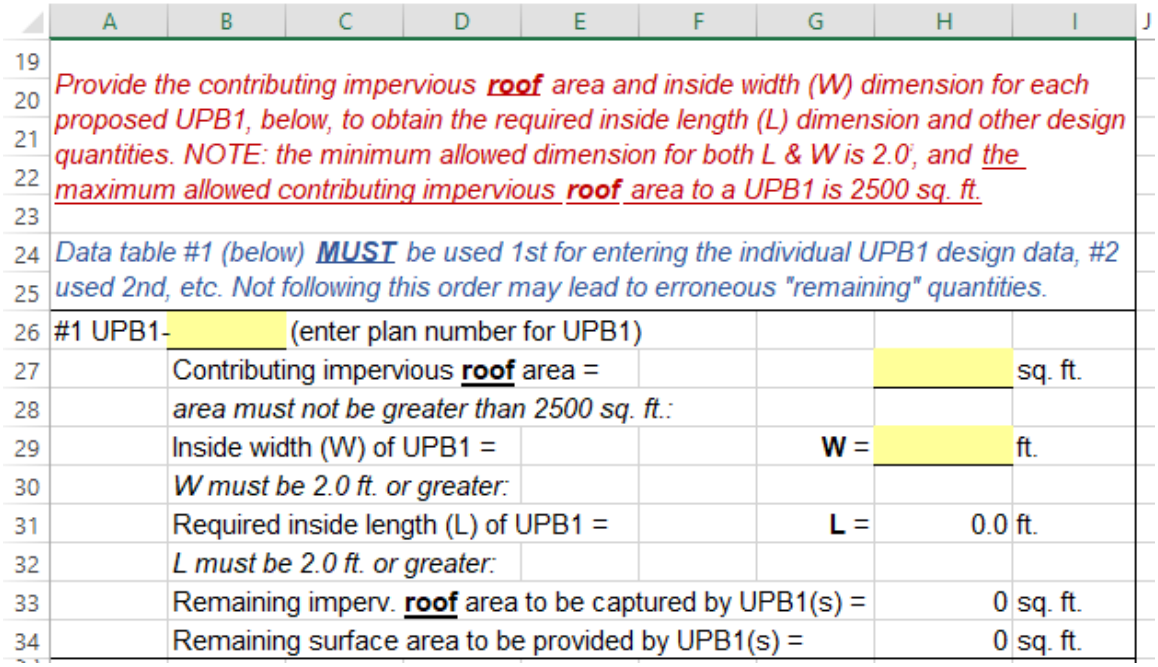
- For UPB1 only, the total required surface area to be provided by the individual facilities, and the approximate TP removal to be achieved by the individual facilities, are displayed in cells H15 & H18, respectively. The UPB1 surface area is based on the required detention volume for the UPB1 facility type divided by the effective depth of the standard UPB1 design profile (consisting of a 12" surface storage depth, 18" soil media depth, and 12" gravel depth (3" pea gravel plus 9" VDOT #57 stone). The TP removal estimate is per the VRRM equations, given only impervious roof area is allowed to drain to a UPB1 facility.

***Individual Facility Data Block***

See Figure 5 and Figure 6 below for an illustration of the Individual Facility Data blocks of the respective UPB1 (starting at row 19) and UPB2 (starting at row 17) DQ Tables. The initial

portions of these blocks include some instructions (blue font) for entering the individual facility data, as well as the identification of a few design limitations (red font).

Only roof area (UPB1) or onsite impervious area (UPB2) is permitted to drain to these respective facility types, with no more than 2,500 sq. ft. (UPB1) or 5,500 sq. ft. (UPB2) allowed to drain to an individual facility. Also, all offsite flows must bypass a UPB2, and no pervious area is allowed to drain to these facilities. Up to five (UPB1) or three (UPB2) individual facilities can be designed for a single lot with one facility-type Spreadsheet.



| | A | B | C | D | E | F | G | H | I | J |
|---|---|---|---|---|---|---|---|---|---|---|
| 19 | | | | | | | | | | |
| 20 | *Provide the contributing impervious **roof** area and inside width (W) dimension for each proposed UPB1, below, to obtain the required inside length (L) dimension and other design quantities. NOTE: the minimum allowed dimension for both L & W is 2.0', and the maximum allowed contributing impervious **roof** area to a UPB1 is 2500 sq. ft.* | | | | | | | | | |
| 21 | | | | | | | | | | |
| 22 | | | | | | | | | | |
| 23 | | | | | | | | | | |
| 24 | *Data table #1 (below) **MUST** be used 1st for entering the individual UPB1 design data, #2* | | | | | | | | | |
| 25 | *used 2nd, etc. Not following this order may lead to erroneous "remaining" quantities.* | | | | | | | | | |
| 26 | #1 UPB1- | | (enter plan number for UPB1) | | | | | | | |
| 27 | | Contributing impervious **roof** area = | | | | | | | sq. ft. | |
| 28 | | *area must not be greater than 2500 sq. ft.:* | | | | | | | | |
| 29 | | Inside width (W) of UPB1 = | | | | | **W** = | | ft. | |
| 30 | | *W must be 2.0 ft. or greater:* | | | | | | | | |
| 31 | | Required inside length (L) of UPB1 = | | | | | **L** = | 0.0 | ft. | |
| 32 | | *L must be 2.0 ft. or greater:* | | | | | | | | |
| 33 | | Remaining imperv. **roof** area to be captured by UPB1(s) = | | | | | | 0 | sq. ft. | |
| 34 | | Remaining surface area to be provided by UPB1(s) = | | | | | | 0 | sq. ft. | |

*Figure 5: Individual Facility #1 of the Individual Facility Data Block of the UPB1 Design Quantities Table*

The first data to be entered in the Individual Facility Data blocks are the designer's unique ID numbers and/or letters for the #1 facility, in cell B26 for UPB1 and cell B24 for UPB2. The remaining data entries for the #1 facility design tables are:

- The impervious area to be drained to the facility (cell H27 for UPB1 and cell H25 for UPB2).
- The proposed facility width, must be 2 feet or wider (cell H29 for both facility types), determined by the designer based on site conditions.
- The proposed soil media depth (cell H33 for UPB2). The minimum soil media depth for a UPB2 facility must be 24" when the contributing drainage area is at least 1500 sq. ft. A minimum depth of 18" is applicable to a UPB2 facility when the contributing drainage area is less than 1500 sq. ft. and 18" is the default value for a UPB1 facility.

| | A | B | C | D | E | F | G | H | I | J |
|---|---|---|---|---|---|---|---|---|---|---|
| 17 | *Provide the total contributing **onsite** impervious area, inside width (W) dimension, and* | | | | | | | | | |
| 18 | *soil media depth for each proposed UPB2, below, to obtain the required inside length (L)* | | | | | | | | | |
| 19 | *dimension, soil media surface area, and other design quantities. NOTE: the min. dim. for* | | | | | | | | | |
| 20 | *both W & L is 2.0 ft., and the max. allowed contributing **onsite** (only) impervious area to* | | | | | | | | | |
| 21 | *a UPB2 is 5500 sq. ft., with no pervious area allowed* - ***offsite flows must be bypassed.*** | | | | | | | | | |
| 22 | *Data table #1 (below) **MUST** be used 1st for entering individual UPB2 design data, #2* | | | | | | | | | |
| 23 | *used 2nd, etc. Not following this order may lead to erroneous "remaining" quantities.* | | | | | | | | | |
| 24 | #1 UPB2- | | (enter plan number for UPB2) | | | | | | | |
| 25 | | Contributing **onsite** impervious area = | | | | | | | sq. ft. | |
| 26 | | *area must not be greater than 5500 sq. ft.:* | | | | | | | | |
| 27 | | ***pervious and offsite area prohibited*** | | | | | | | | |
| 28 | | Stormwater volume required to be detained = | | | | | | 0 | cu. ft. | |
| 29 | | Inside width (W) of UPB2 = | | | | | **W** = | | ft. | |
| 30 | | *W must be 2.0 ft. or greater:* | | | | | | | | |
| 31 | | Required inside length (L) of UPB2 = | | | | | **L** = | 0.0 | ft. | |
| 32 | | *L must be 2.0 ft. or greater:* | | | | | | | | |
| 33 | | Proposed Soil Media Depth (18" or 24" min.) = | | | | | | | in. | |
| 34 | | ***18" minimum if DA < 1500 sq. ft., otherwise 24" minimum*** | | | | | | | | |
| 35 | | Remaining **onsite** imperv. area to be captured by UPB2(s) | | | | | | 0 | sq. ft. | |

*Figure 6: Individual Facility #1 of the Individual Facility Data Block of the UPB2 Design Quantities Table*

A few additional quantities are automatically calculated in the #1 facility design tables, based on the data entered by the designer.

- In cell H28, Figure 6 (UPB2) the required detention volume to be provided by the facility is displayed.
- In cell H31 (for both facility types) the required individual planter box design length (**L**) is displayed. This required length is based on dividing the required facility surface area (internally computed and equal to the required detention storage for the provided facility drainage area divided by the effective depth of the applicable standard UPB1 or UPB2 design profile) by the provided planter box design width (**W**).
- The remaining drainage area allocated to the facility type, and for which additional individual facilities are still needed, is displayed in cell H33 (UPB1) and H35 (UPB2).
- The remainder of the required, cumulative individual facility surface area is also displayed in cell H34 for only UPB1 (Figure 5).
- These “remainders” discussed in the two bullets above are displayed to remind the designer, and alert the reviewer, that additional individual facilities must be proposed for the facility type in order to fulfill the total detention requirement for the impervious drainage area allocated to the facility type by the designer. The remainder values are reduced by the design quantities of each added individual planter box.

- **NOTE: Each of the remainder values must display 0 sq. ft., before the allocated detention requirement will be satisfied for the facility type**.

Figure 5 and Figure 6 show only one individual facility (#1) design table for the UPB1 and UPB2 facility types, respectively. As identified previously, five (5) individual UPB1 facilities, and three (3) individual UPB2 facilities can be designed using only one corresponding facility-type spreadsheet. The designer will find four (4) more individual facility design tables identical to the #1 design table (Figure 5) in the actual UPB1 DQ Table, and two (2) more design tables identical to the #1 design table (Figure 6) in the actual UPB2 DQ Table. The data entries for these additional individual facility design tables will be the same as has been described above for the #1 design table of the facility type.

See Figure 7 and Figure 8 for an example of a completed Design Quantities Table populated with example data entries for UPB1 and UPB2, respectively.

A DQ Table (completed only for the actual number of proposed individual facilities for a facility type) must ultimately be placed on the corresponding Standard Design (CAD) Sheet for that facility type. See the related discussion under the "Standard Design Sheet" heading below.

## URBAN BIORETENTION FOR INFILL LOTS: PLANTER BOX (UPB1)
## DESIGN QUANTITIES TABLE

(A UPB1 may be located within 10' of a residential structure and MUST drain only roof area)

**A separate stand-alone design & Design Quantities Table is required for each lot**

*Enter the requested design data in the yellow cells below.*

| | | |
|---|---|---|
| Net additional impervious area created by proposed project: | 4000 | sq. ft. |
| ***MUST** match net additional impervious area value identified on Cover Sheet* | | |
| *For UPB1(s) proposed on this sheet:* | | |
| Total impervious **roof** area to be drained to UPB1(s): | 3000 | sq. ft. |
| *only **roof** area **MUST** drain into UPB1(s)* | | |
| % of equivalent net impervious area to be drained to UPB1(s): | 75 | % |
| Total required stormwater volume to be detained by UPB1(s): | 640 | cu. ft. |
| Total required surface area of UPB1(s): | 361 | sq. ft. |
| Number of individual UPB1(s) proposed: | 5 | |
| Is Water Quality credit to be claimed for proposed UPB1(s)? | NO | |
| Approx. total TP removed by proposed UPB1(s) - Level 1 Design: | 0.00 | lb./yr. |

*Provide the contributing impervious **roof** area and inside width (W) dimension for each proposed UPB1, below, to obtain the required inside length (L) dimension and other design quantities. NOTE: the minimum allowed dimension for both L & W is 2.0', and the maximum allowed contributing impervious **roof** area to a UPB1 is 2500 sq. ft.*

*Data table #1 (below) **MUST** be used 1st for entering the individual UPB1 design data, #2 used 2nd, etc. Not following this order may lead to erroneous "remaining" quantities.*

| | | | |
|---|---|---|---|
| #1 UPB1- 100 (enter plan number for UPB1) | | | |
| Contributing impervious **roof** area = | | 1000 | sq. ft. |
| *area must not be greater than 2500 sq. ft.:* | | ok | |
| Inside width (W) of UPB1 = | **W** = | 6.0 | ft. |
| *W must be 2.0 ft. or greater:* | | ok | |
| Required inside length (L) of UPB1 = | **L** = | 20.0 | ft. |
| *L must be 2.0 ft. or greater:* | | ok | |
| Remaining imperv. **roof** area to be captured by UPB1(s) = | | 2000 | sq. ft. |
| Remaining surface area to be provided by UPB1(s) = | | 240 | sq. ft. |
| | | | |
| #2 UPB1- 200 (enter plan number for UPB1) | | | |
| Contributing impervious **roof** area = | | 500 | sq. ft. |
| *area must not be greater than 2500 sq. ft.:* | | ok | |
| Inside width (W) of UPB1 = | **W** = | 5.0 | ft. |
| *W must be 2.0 ft. or greater:* | | ok | |
| Required inside length (L) of UPB1 = | **L** = | 12.0 | ft. |
| *L must be 2.0 ft. or greater:* | | ok | |
| Remaining imperv. **roof** area to be captured by UPB1(s) = | | 1500 | sq. ft. |
| Remaining surface area to be provided by UPB1(s) = | | 180 | sq. ft. |

| | | | | |
|---|---|---|---|---|
| #3 UPB1- 300 (enter plan number for UPB1) | | | | |
| | Contributing impervious **roof** area = | | 500 | sq. ft. |
| | *area must not be greater than 2500 sq. ft.:* | | ok | |
| | Inside width (W) of UPB1 = | **W** = | 4.5 | ft. |
| | *W must be 2.0 ft. or greater:* | | ok | |
| | Required inside length (L) of UPB1 = | **L** = | 13.4 | ft. |
| | *L must be 2.0 ft. or greater:* | | ok | |
| | Remaining imperv. **roof** area to be captured by UPB1(s) = | | 1000 | sq. ft. |
| | Remaining surface area to be provided by UPB1(s) = | | 120 | sq. ft. |
| | | | | |
| #4 UPB1- 400 (enter plan number for UPB1) | | | | |
| | Contributing impervious **roof** area = | | 500 | sq. ft. |
| | *area must not be greater than 2500 sq. ft.:* | | ok | |
| | Inside width (W) of UPB1 = | **W** = | 4.0 | ft. |
| | *W must be 2.0 ft. or greater:* | | ok | |
| | Required inside length (L) of UPB1 = | **L** = | 15.0 | ft. |
| | *L must be 2.0 ft. or greater:* | | ok | |
| | Remaining imperv. **roof** area to be captured by UPB1(s) = | | 500 | sq. ft. |
| | Remaining surface area to be provided by UPB1(s) = | | 60 | sq. ft. |
| | | | | |
| #5 UPB1- 500 (enter plan number for UPB1) | | | | |
| | Contributing impervious **roof** area = | | 500 | sq. ft. |
| | *area must not be greater than 2500 sq. ft.:* | | ok | |
| | Inside width (W) of UPB1 = | **W** = | 3.0 | ft. |
| | *W must be 2.0 ft. or greater:* | | ok | |
| | Required inside length (L) of UPB1 = | **L** = | 20.0 | ft. |
| | *L must be 2.0 ft. or greater:* | | ok | |
| | Remaining imperv. **roof** area to be captured by UPB1(s) = | | 0 | sq. ft. |
| | Remaining surface area to be provided by UPB1(s) = | | 0 | sq. ft. |

*Figure 7: UPB1 Design Quantities Table With Example Data Entries*

## URBAN BIORETENTION FOR INFILL LOTS: PLANTER BOX (UPB2)
## DESIGN QUANTITIES TABLE

(A UPB2 MUST be located at least 10' from a residential structure and drain only impervious area)

**A separate stand-alone design & Design Quantities Table is required for each lot**

*Enter the requested design data in the* yellow *cells below.*

| | | |
|---|---|---|
| Net additional impervious area created by proposed project: | 9000 | sq. ft. |
| ***MUST*** *match net additional impervious area value identified on Cover Sheet* | | |
| *For UPB2(s) proposed on this sheet:* | | |
| Total **onsite** impervious area drained to UPB2(s): | 7000 | sq. ft. |
| *onsite pervious area and all offsite area* ***MUST NOT*** *drain into UPB2(s)* | | |
| % of equivalent net impervious area to be drained to UPB2(s): | 78 | % |
| Total required stormwater volume to be detained by UPB2(s): | 1493 | cu. ft. |
| Number of individual UPB2(s) proposed: | 3 | |
| Is Level 1 Water Quality credit to be claimed for proposed UPB2(s)? | YES | |

*Provide the total contributing* ***onsite*** *impervious area, inside width (W) dimension, and soil media depth for each proposed UPB2, below, to obtain the required inside length (L) dimension, soil media surface area, and other design quantities. NOTE: the min. dim. for both W & L is 2.0 ft., and the max. allowed contributing* ***onsite*** *(only) impervious area to a UPB2 is 5500 sq. ft., with no pervious area allowed -* ***offsite flows must be bypassed.***

*Data table #1 (below)* ***MUST*** *be used 1st for entering individual UPB2 design data, #2 used 2nd, etc. Not following this order may lead to erroneous "remaining" quantities.*

| | | | | |
|---|---|---|---|---|
| #1 UPB2- | 100 | (enter plan number for UPB2) | | |
| | Contributing **onsite** impervious area = | | 2500 | sq. ft. |
| | *area must not be greater than 5500 sq. ft.:* | | ok | |
| | ***pervious and offsite area prohibited*** | | | |
| | Stormwater volume required to be detained = | | 533 | cu. ft. |
| | Inside width (W) of UPB2 = | **W** = | 10.0 | ft. |
| | *W must be 2.0 ft. or greater:* | | ok | |
| | Required inside length (L) of UPB2 = | **L** = | 28.1 | ft. |
| | *L must be 2.0 ft. or greater:* | | ok | |
| | Proposed Soil Media Depth (18" or 24" min.) = | | 48 | in. |
| | ***18" minimum if DA < 1500 sq. ft., otherwise 24" minimum*** | | | |
| | Remaining **onsite** imperv. area to be captured by UPB2(s) = | | 4500 | sq. ft. |

| | | | | |
|---|---|---|---|---|
| #2 UPB2- | 200 | (enter plan number for UPB2) | | |
| | Contributing **onsite** impervious area = | | 2500 | sq. ft. |
| | *area must not be greater than 5500 sq. ft.:* | | ok | |
| | ***pervious and offsite area prohibited*** | | | |
| | Stormwater volume required to be detained = | | 533 | cu. ft. |
| | Inside width (W) of UPB2 = | **W** = | 15.0 | ft. |
| | *W must be 2.0 ft. or greater:* | | ok | |
| | Required inside length (L) of UPB2 = | **L** = | 18.7 | ft. |
| | *L must be 2.0 ft. or greater:* | | ok | |
| | Proposed Soil Media Depth (18" or 24" min.) = | | 42 | in. |
| | ***18" minimum if DA < 1500 sq. ft., otherwise 24" minimum*** | | | |
| | Remaining **onsite** imperv. area to be captured by UPB2(s) = | | 2000 | sq. ft. |

| | | | |
|---|---|---|---|
| #3 UPB2- 300 (enter plan number for UPB2) | | | |
| Contributing **onsite** impervious area = | | 2000 | sq. ft. |
| *area must not be greater than 5500 sq. ft.:* | | ok | |
| ***pervious and offsite area prohibited*** | | | |
| Stormwater volume required to be detained = | | 427 | cu. ft. |
| Inside width (W) of UPB2 = | **W** = | 8.0 | ft. |
| *W must be 2.0 ft. or greater:* | | ok | |
| Required inside length (L) of UPB2 = | **L** = | 28.1 | ft. |
| *L must be 2.0 ft. or greater:* | | ok | |
| Proposed Soil Media Depth (18" or 24" min.) = | | 36 | in. |
| ***18" minimum if DA < 1500 sq. ft., otherwise 24" minimum*** | | | |
| Remaining **onsite** imperv. area to be captured by UPB2(s) = | | 0 | sq. ft. |

*Figure 8: UPB2 Design Quantities Table With Example Data Entries*

## DesignData Tab

Once the designer has completed the DesignCalcs tab the designer should move to the DesignData tab of the Spreadsheet. The DesignData tab is used for entering specific design elevation data, as well as selecting the pretreatment and outlet protection practices for each of the individual facilities proposed in the DQ Table located on the DesignCalcs tab. (Note that it is good practice to complete the DQ Table before advancing to the DesignData tab.) Under this tab, then, the Design Data and the Pretreatment Practices/Outlet Protection Tables (DD and POP Tables) are developed from the required designer input and through self-population, considering the respective UPB1 and UPB2 standard design backfill profiles and other standard design requirements. (The POP Design [Plan] Sheet must be consulted for information pertinent to the selection of the allowable pretreatment and outlet protection practices.)

Data entry into the highlighted cells is explained at the tops of the spreadsheet tabs (see Figure 9 and Figure 10). Use, as applicable, the Typical UPB1 Generalized Section A-A or Typical UPB2 Generalized Section A-A depicted on the respective facility-type Standard Design [Plan] Sheet to clarify the elevations that need to be input by the designer. Then, also using the site grading plan, the designer must enter the following:

1. The finished grade elevation at each proposed UPB1 or UPB2 (DD Table: Column D).

2. The inside bottom elevation for each proposed UPB1 or UPB2 (DD Table: Column E).

3. The finished flow-control grade elevation at each facility outlet (DD Table: Column F). The finished flow-control grade elevation should be the ground elevation (normally) that first allows the discharge to freely flow away from the outlet pipe and facility. For example, this would be the lowest ground elevation (not within a sump) in the vicinity of the top of a drywell's pop-up sprinkler cover, or the lowest ground elevation (not within a sump) in the vicinity of the erosion protection location, which could be the outlet pipe's invert elevation for this latter case if the erosion protection or surrounding ground does not create a sump condition at the invert.

4. For the UPB1 the designer must identify whether a downspout for a particular individual facility will be connected to a pipe (or otherwise need a longer extension for the

downspout outlet) and if so, choose the "In-line leaf strainer/separator" pre-treatment practice in the "for Downspout" column of the POP Table.

5. The designer must also choose the type of outlet protection for each individual facility, in the corresponding column of the POP Table, by clicking within the highlighted cell to activate the cell then using the down-arrow to select from the drop-down menu. The chosen outlet protection practice must be determined from the value of the contributing drainage area to the outlet, in accordance with the corresponding design tables included on the POP Standard Design [Plan] Sheet (See Figure 33).

6. For the UPB2 the designer must choose the drainage area source (e.g., roof only, roof + other impervious area, other impervious area only) for each individual UPB2 facility, in the corresponding column of the POP Table. The designer must also choose the type of outlet protection for each individual facility, in the corresponding column of the Table, by clicking within the highlighted cell to activate the cell then using the down-arrow to select from the drop-down menu. The chosen outlet protection practice must be determined from the size of the contributing drainage area to the outlet, in accordance with the corresponding design tables included on the POP Standard Design [Plan] Sheet (See Figure 33).

See Figure 9 and Figure 10 below for an example of completed Design Data and Pretreatment Practices/Outlet Protection Tables populated with example data entries for UPB1 and UPB2, respectively. The DD and POP Table combination (completed only for the actual number of proposed individual facilities identified in the DQ Table for a facility type) must ultimately be placed on the corresponding Standard Design (CAD) Sheet for that facility type. See the related discussion under the "Standard Design Sheet" heading below.

## URBAN BIORETENTION FOR INFILL LOTS: PLANTER BOX (UPB1)
## DESIGN DATA & NOTES

1. In Column E, below, **enter** the inside bottom elevation for each proposed UPB1.
2. In Column D, below, **enter** the finished grade elevation at each proposed UPB1.
3. In Column F, below, **enter** the finished flow-control grade elevation at each proposed Drywell Outlet, or the finished flow-control grade elevation at each proposed grass, turf/sod, or small rock riprap outlet, or the outlet invert elevation at each existing impervious surface or point of connection to an existing adequate conveyance system.
4. Gutter Leaf Screening and Inflow Rock erosion protection are required - and those cells will self-populate.
5. **Choose**, for each UPB1, and from the drop-down list for each cell, the proposed type of outlet erosion protection, as well as if an In-line Leaf Strainer is required (i.e., downspout connected to pipe).

*Enter the requested design data in the yellow cells below.*

**URBAN BIORETENTION - PLANTER BOX (UPB1) - FOR INFILL LOTS: DESIGN DATA**

| Planter Box ID | Elevations (ft) | | | | | | | | Weir Len. (ft) | Overflow Pipes | Chimney Pipes |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | A | B | C | D | E | F | G | H | | | |
| UPB1- 100 | 254.00 | 253.75 | 252.50 | 252.00 | 250.00 | 249.00 | 253.67 | 253.83 | 3.3 | 1 | 1 |
| UPB1- 200 | 254.00 | 253.75 | 252.50 | 252.00 | 250.00 | 249.00 | 253.67 | 253.83 | 2.0 | 1 | 1 |
| UPB1- 300 | 254.00 | 253.75 | 252.50 | 252.00 | 250.00 | 249.00 | 253.67 | 253.83 | 2.0 | 1 | 1 |
| UPB1- 400 | 254.00 | 253.75 | 252.50 | 252.00 | 250.00 | 249.00 | 253.67 | 253.83 | 2.0 | 1 | 1 |
| UPB1- 500 | 254.00 | 253.75 | 252.50 | 252.00 | 250.00 | 249.00 | 253.67 | 253.83 | 2.0 | 1 | 1 |

| Planter Box ID | PRETREATMENT PRACTICES | | | OUTLET PROTECTION |
|---|---|---|---|---|
| | for Roof Gutter | for Inflow | for Downspout | |
| UPB1- 100 | Gutter Screen | Inflow Rock | In-line leaf strainer/separator | Drywell |
| UPB1- 200 | Gutter Screen | Inflow Rock | | Exist. Imperv. Surface |
| UPB1- 300 | Gutter Screen | Inflow Rock | In-line leaf strainer/separator | Grass |
| UPB1- 400 | Gutter Screen | Inflow Rock | | Small Rock Riprap |
| UPB1- 500 | Gutter Screen | Inflow Rock | In-line leaf strainer/separator | Exist. Adequate Conveyance |

↑— cut here —↑

*Figure 9: Example of UPB1 DesignData Tab*

**URBAN BIORETENTION FOR INFILL LOTS: PLANTER BOX (UPB2)**
**DESIGN DATA & NOTES**

1. In Column E, below, **enter** the inside bottom elevation for each proposed UPB2.
2. In Column D, below, **enter** the finished grade elevation at each proposed UPB2.
3. In Column F, below, **enter** the finished flow-control grade elevation at each proposed Drywell Outlet, or the finished flow-control grade elevation at each proposed grass, turf/sod, or small rock riprap outlet, or the outlet invert elevation at each existing impervious surface or point of connection to an existing adequate conveyance system.
4. **Choose**, for each UPB2 facility, and from the drop-down list, the Drainage Area Source, or surface cover of the contributing drainage area: roof only, or roof + other impervious area, or other impervious area only.
5. Gutter Leaf Screening is required along all contributing roof perimeter, an In-line Leaf Strainer/Separator is required on each contributing downspout, a Debris Trap is required on each inflow pipeline that conveys stormwater from any non-roof impervious area [or "other (IA)"], and Inflow Rock is required at the outlet of each inflow pipe - and those cells will self-populate.
6. **Choose**, for each UPB2, and from the drop-down list, the proposed type of outlet erosion protection.

*Enter the requested design data in the yellow cells below.*

**URBAN BIORETENTION - PLANTER BOX (UPB2) - FOR INFILL LOTS: DESIGN DATA**

| Planter Box ID | Elevations (ft) | | | | | | | | Weir Len. (ft) | Overflow Pipes | Chimney Pipes |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | A | B | C | D | E | F | G | H | | | |
| UPB2- 100 | 256.50 | 256.25 | 255.00 | 252.00 | 250.00 | 249.00 | 256.17 | 256.33 | 8.4 | 2 | 2 |
| UPB2- 200 | 256.00 | 255.75 | 254.50 | 252.00 | 250.00 | 249.00 | 255.67 | 255.83 | 8.4 | 2 | 2 |
| UPB2- 300 | 255.50 | 255.25 | 254.00 | 252.00 | 250.00 | 249.00 | 255.17 | 255.33 | 6.7 | 1 | 1 |

| Planter Box ID | Drainage Area Source | PRETREATMENT PRACTICES | | | OUTLET PROTECTION |
|---|---|---|---|---|---|
| | | for Roof Gutter | for Downspout | for Inflow Pipeline | |
| UPB2- 100 | Roof Only | Gutter Screen | In-line Leaf Strainer/Separator | Inflow Rock | Small Rock Riprap |
| UPB2- 200 | Other IA Only | | | Debris Trap + Inflow Rock | Turf/Sod |
| UPB2- 300 | Roof + Other IA | Gutter Screen | In-line Leaf Strainer/Separator | Debris Trap + Inflow Rock | Exist. Imperv. Surface |

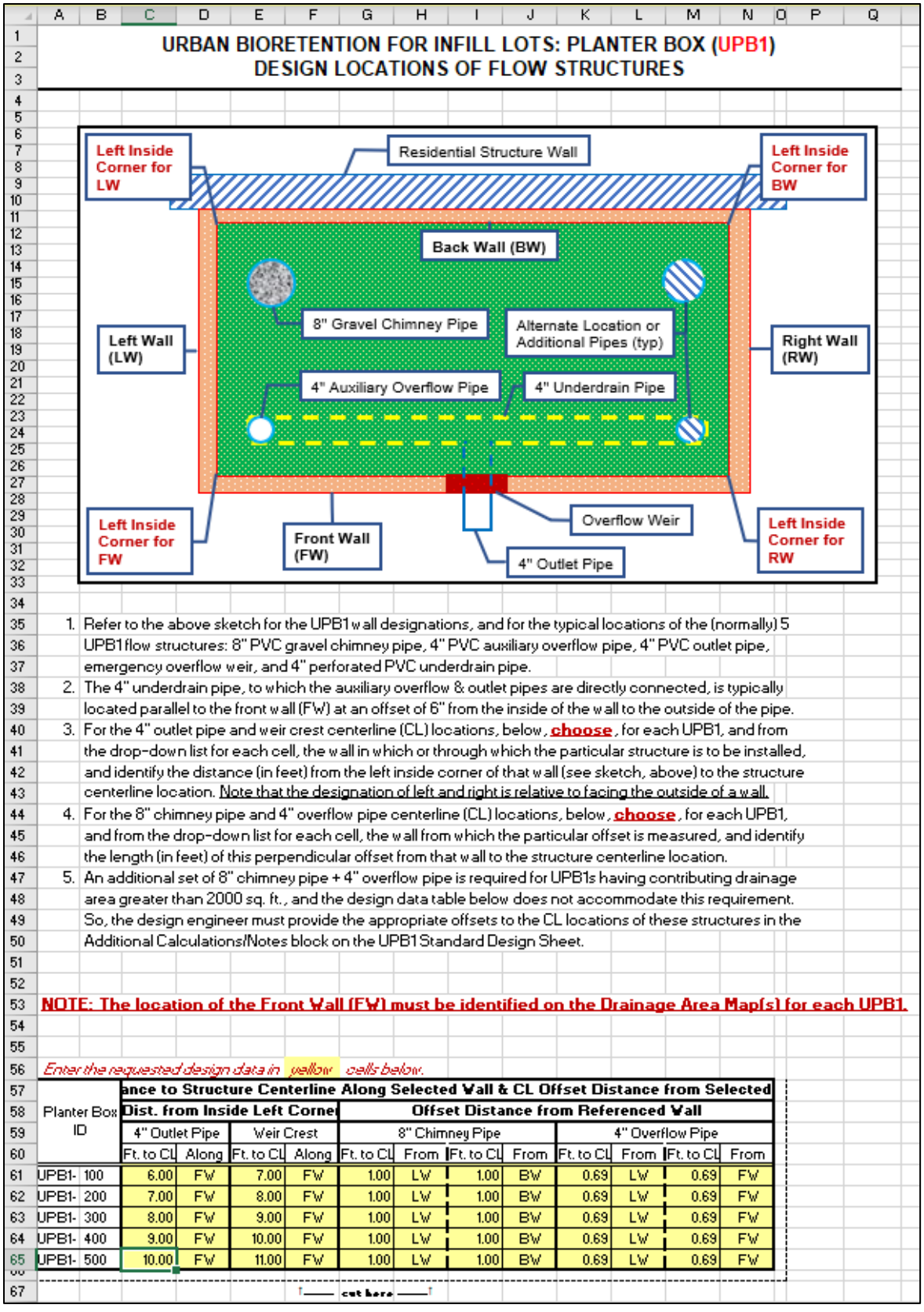
*Figure 10: Example of UPB2 DesignData tab*

## DesignData-2 Tab

Once the designer has completed the DesignData tab the designer should move to the DesignData-2 tab of the Spreadsheet. The DesignData-2 tab is used to generate a table of design locations for the various hydraulic structures that are required to be installed on and within each of the individual planter box facilities proposed in the DQ Table located on the DesignCalcs tab. (Note that it is good practice to complete the DQ Table, as well as the DD and POP Tables [on the DesignData tab], before advancing to the DesignData-2 tab.) Under this tab, then, the Hydraulic Structure Location (HSL) Tables are developed solely from designer input. (The typical detail sketches and other notes shown on the respective UPB1 and UPB2 Standard Design [Plan] Sheet must also be consulted for information pertinent to minimum required offsets and other limitations).

The tops of the respective spreadsheet tabs (see Figure 11 & Figure 13 for UPB1, and Figure 12 & Figure 14 for UPB2) include a general layout sketch and specific instructions for how to determine the offset distances from the facility walls to the outlet pipe, weir crest, 8" chimney pipe, and 4" overflow pipe for each facility.

The designer then populates the highlighted cells in the table at the bottom of the tab with the intended measurements and corresponding wall references for each individual facility. Dimensions are in feet from the inside face of the wall. References to the wall from which the dimension is taken are front wall (FW), right wall (RW), left wall (LW), and back wall (BW). The wall orientation is shown in the sketch at the top of the DesignData-2 tab. The BW is considered the wall adjacent to the residential structure foundation for UPB1. The front wall (FW) must be identified on the drainage area maps for each UPB1 and UPB2.




1. Refer to the above sketch for the UPB1 wall designations, and for the typical locations of the (normally) 5 UPB1 flow structures: 8" PVC gravel chimney pipe, 4" PVC auxiliary overflow pipe, 4" PVC outlet pipe, emergency overflow weir, and 4" perforated PVC underdrain pipe.
2. The 4" underdrain pipe, to which the auxiliary overflow & outlet pipes are directly connected, is typically located parallel to the front wall (FW) at an offset of 6" from the inside of the wall to the outside of the pipe.
3. For the 4" outlet pipe and weir crest centerline (CL) locations, below, **choose**, for each UPB1, and from the drop-down list for each cell, the wall in which or through which the particular structure is to be installed, and identify the distance (in feet) from the left inside corner of that wall (see sketch, above) to the structure centerline location. Note that the designation of left and right is relative to facing the outside of a wall.
4. For the 8" chimney pipe and 4" overflow pipe centerline (CL) locations, below, **choose**, for each UPB1, and from the drop-down list for each cell, the wall from which the particular offset is measured, and identify the length (in feet) of this perpendicular offset from that wall to the structure centerline location.
5. An additional set of 8" chimney pipe + 4" overflow pipe is required for UPB1s having contributing drainage area greater than 2000 sq. ft., and the design data table below does not accommodate this requirement. So, the design engineer must provide the appropriate offsets to the CL locations of these structures in the Additional Calculations/Notes block on the UPB1 Standard Design Sheet.

**NOTE: The location of the Front Wall (FW) must be identified on the Drainage Area Map(s) for each UPB1.**

*Enter the requested design data in yellow cells below.*

| Planter Box ID | Distance to Structure Centerline Along Selected Wall & CL Offset Distance from Selected | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Dist. from Inside Left Corner | | | | Offset Distance from Referenced Wall | | | | | | | |
| | 4" Outlet Pipe | | Weir Crest | | 8" Chimney Pipe | | | | 4" Overflow Pipe | | | |
| | Ft. to CL | Along | Ft. to CL | Along | Ft. to CL | From | Ft. to CL | From | Ft. to CL | From | Ft. to CL | From |
| UPB1- 100 | 6.00 | FW | 7.00 | FW | 1.00 | LW | 1.00 | BW | 0.69 | LW | 0.69 | FW |
| UPB1- 200 | 7.00 | FW | 8.00 | FW | 1.00 | LW | 1.00 | BW | 0.69 | LW | 0.69 | FW |
| UPB1- 300 | 8.00 | FW | 9.00 | FW | 1.00 | LW | 1.00 | BW | 0.69 | LW | 0.69 | FW |
| UPB1- 400 | 9.00 | FW | 10.00 | FW | 1.00 | LW | 1.00 | BW | 0.69 | LW | 0.69 | FW |
| UPB1- 500 | 10.00 | FW | 11.00 | FW | 1.00 | LW | 1.00 | BW | 0.69 | LW | 0.69 | FW |

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*Figure 11: DesignData-2 Tab for UPB1*

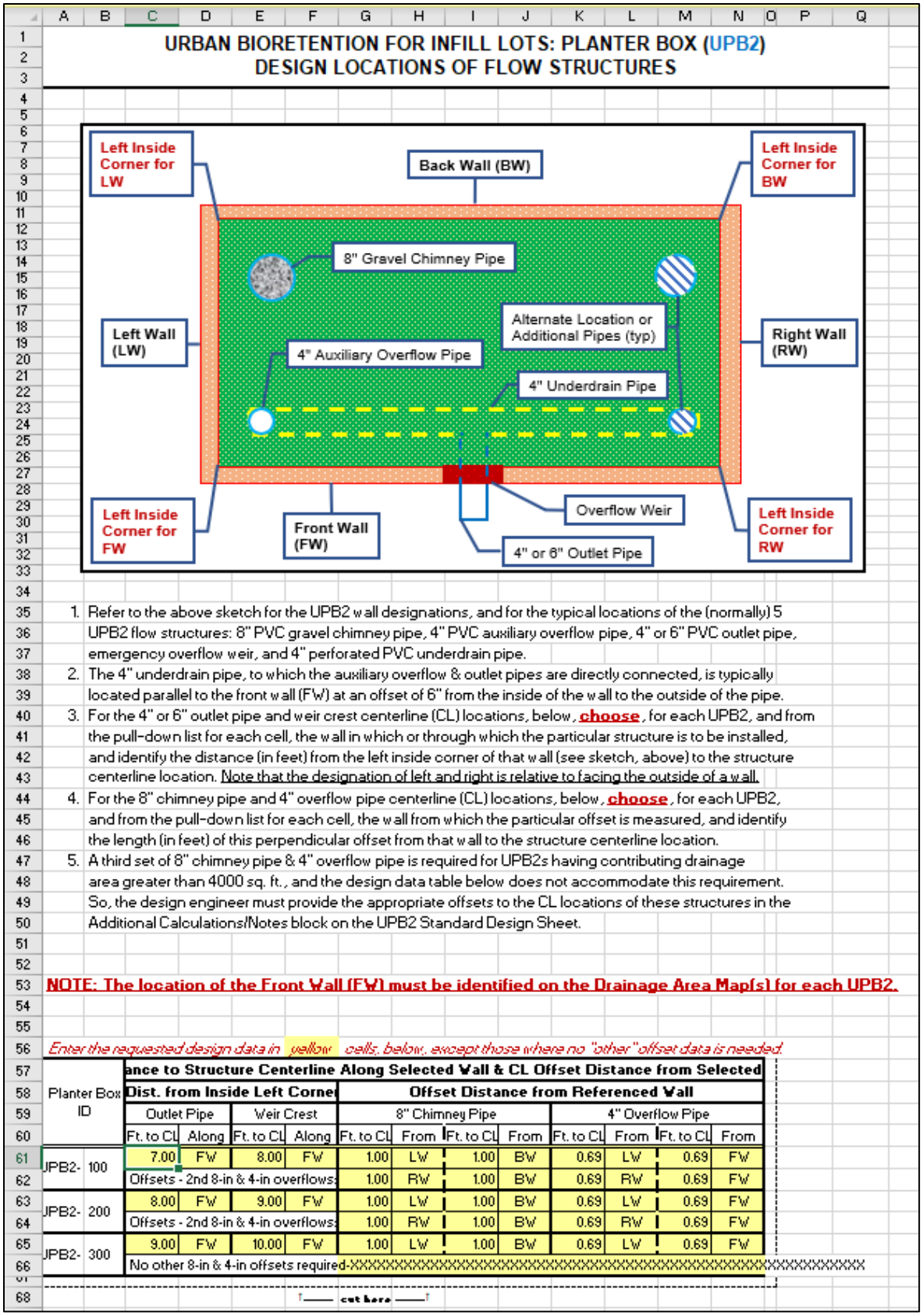
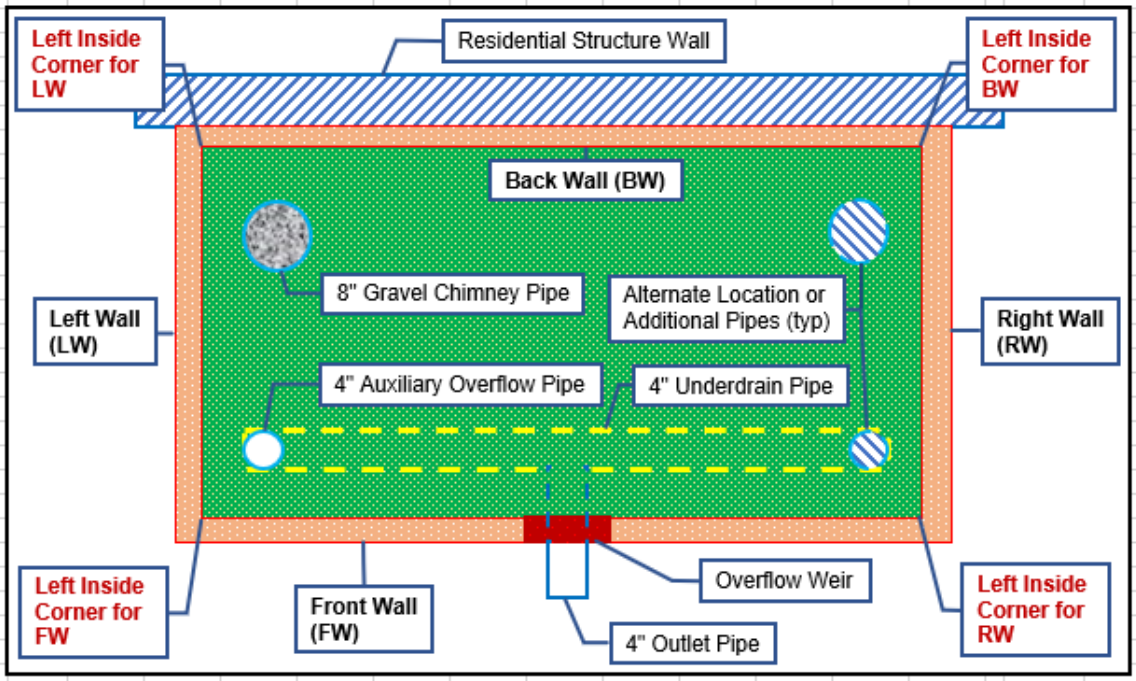



*Figure 12: DesignData-2 Tab for UPB2*

**URBAN BIORETENTION FOR INFILL LOTS: PLANTER BOX (UPB1)** **DESIGN**
**LOCATIONS OF FLOW STRUCTURES**




1. Refer to the above sketch for the UPB1 wall designations, and for the typical locations of the (normally) 5 UPB1 flow structures: 8" PVC gravel chimney pipe, 4" PVC auxiliary overflow pipe, 4" PVC outlet pipe, emergency overflow weir, and 4" perforated PVC underdrain pipe.
2. The 4" underdrain pipe, to which the auxiliary overflow & outlet pipes are directly connected, is typically located parallel to the front wall (FW) at an offset of 6" from the inside of the wall to the outside of the pipe.
3. For the 4" outlet pipe and weir crest centerline (CL) locations, below, choose, for each UPB1, and from the drop-down list for each cell, the wall in which or through which the particular structure is to be installed, and identify the distance (in feet) from the left inside corner of that wall (see sketch, above) to the structure centerline location. Note that the designation of left and right is relative to facing the outside of a wall.
4. For the 8" chimney pipe and 4" overflow pipe centerline (CL) locations, below, choose, for each UPB1, and from the drop-down list for each cell, the wall from which the particular offset is measured, and identify the length (in feet) of this perpendicular offset from that wall to the structure centerline location.
5. An additional set of 8" chimney pipe + 4" overflow pipe is required for UPB1s having contributing drainage area greater than 2000 sq. ft., and the design data table below does not accommodate this requirement. So, the design engineer must provide the appropriate offsets to the CL locations of these structures in the Additional Calculations/Notes block on the UPB1 Standard Design Sheet.

**NOTE: The location of the Front Wall (FW) must be identified on the Drainage Area Map(s) for each UPB1.**

*Figure 13: Top portion of DesignData-2 Tab, UPB1*

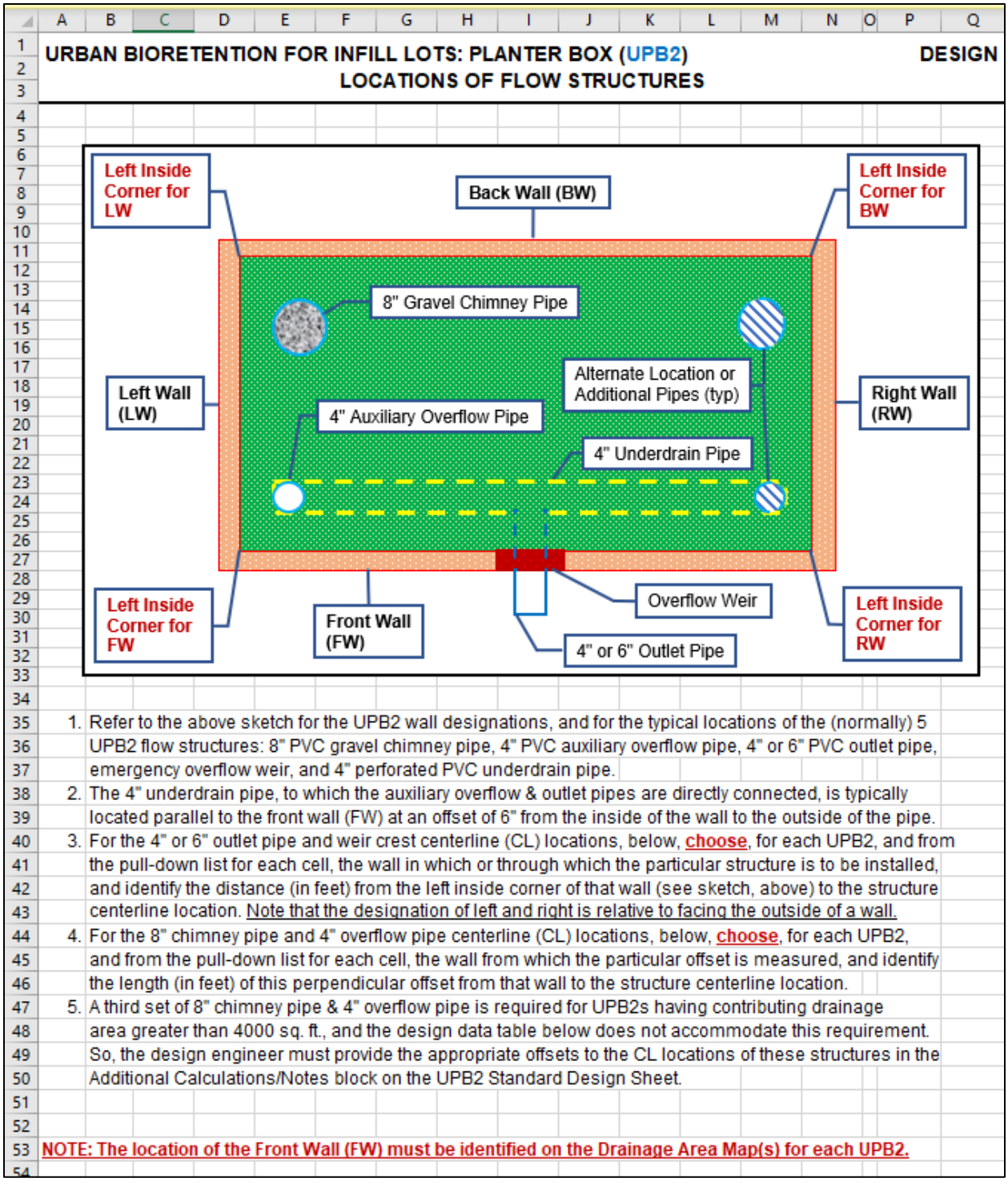



*Figure 14: Top portion of DesignData-2 Tab, UPB2*

See Figure 15 and Figure 16 below for an example of completed Hydraulic Structure Location (HSL) Tables populated with example data entries for UPB1 and UPB2, respectively. The HSL Table (completed only for the actual number of proposed individual facilities identified in the DQ Table for a facility type) must ultimately be placed on the corresponding Standard Design

(CAD) Sheet for that facility type. See the related discussion under the "Standard Design Sheet" heading below.

Enter the requested design data in yellow cells below.

| Planter Box ID | Distance to Structure Centerline Along Selected Wall & CL Offset Distance from Selected Wall | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Dist. from Inside Left Corner | | | | Offset Distance from Referenced Wall | | | | | | | |
| | 4" Outlet Pipe | | Weir Crest | | 8" Chimney Pipe | | | | 4" Overflow Pipe | | | |
| | Ft. to CL | Along | Ft. to CL | Along | Ft. to CL | From | Ft. to CL | From | Ft. to CL | From | Ft. to CL | From |
| UPB1- 100 | 6.00 | FW | 7.00 | FW | 1.00 | LW | 1.00 | BW | 0.69 | LW | 0.69 | FW |
| UPB1- 200 | 7.00 | FW | 8.00 | FW | 1.00 | LW | 1.00 | BW | 0.69 | LW | 0.69 | FW |
| UPB1- 300 | 8.00 | FW | 9.00 | FW | 1.00 | LW | 1.00 | BW | 0.69 | LW | 0.69 | FW |
| UPB1- 400 | 9.00 | FW | 10.00 | FW | 1.00 | LW | 1.00 | BW | 0.69 | LW | 0.69 | FW |
| UPB1- 500 | 10.00 | FW | 11.00 | FW | 1.00 | LW | 1.00 | BW | 0.69 | LW | 0.69 | FW |

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*Figure 15: Example of UPB1 Hydraulic Structure Location Table*

Enter the requested design data in yellow cells, below, except those where no "other" offset data is needed.

| Planter Box ID | Distance to Structure Centerline Along Selected Wall & CL Offset Distance from Selected Wall | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Dist. from Inside Left Corner | | | | Offset Distance from Referenced Wall | | | | | | | |
| | Outlet Pipe | | Weir Crest | | 8" Chimney Pipe | | | | 4" Overflow Pipe | | | |
| | Ft. to CL | Along | Ft. to CL | Along | Ft. to CL | From | Ft. to CL | From | Ft. to CL | From | Ft. to CL | From |
| UPB2- 100 | 7.00 | FW | 8.00 | FW | 1.00 | LW | 1.00 | BW | 0.69 | LW | 0.69 | FW |
| | Offsets - 2nd 8-in & 4-in overflows: | | | | 1.00 | RW | 1.00 | BW | 0.69 | RW | 0.69 | FW |
| UPB2- 200 | 8.00 | FW | 9.00 | FW | 1.00 | LW | 1.00 | BW | 0.69 | LW | 0.69 | FW |
| | Offsets - 2nd 8-in & 4-in overflows: | | | | 1.00 | RW | 1.00 | BW | 0.69 | RW | 0.69 | FW |
| UPB2- 300 | 9.00 | FW | 10.00 | FW | 1.00 | LW | 1.00 | BW | 0.69 | LW | 0.69 | FW |
| | No other 8-in & 4-in offsets required-XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX | | | | | | | | | | | |

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*Figure 16: Example of UPB2 Hydraulic Structure Location Table*

### UPB1 or UPB2 Plant List Tab

This tab provides a Fairfax County recommended plant list for planter box bioretention facilities that the designer should use for selecting appropriate plant species.

## *Standard Design Sheet*

The Standard Design Sheet for each facility type contains facility-specific notes and instructions, materials specifications, pretreatment notes, maintenance notes, and construction notes. A standard plan view of a typical generalized facility is provided, along with a typical cross-section of the facility. **The standard notes and facility details must not be modified by the designer**, and the "Certification of No Change" statement that can be found on each of the Design Sheets must be appropriately dated and signed by the same professional who signs and seals the particular Design Sheet**.** For this discussion the UPB1 and UPB2 Standard Design Sheets are

similar enough, although not interchangeable, so only the UPB1 Design Sheet is illustrated below in Figure 17.

The blank areas on the Design Sheet are for the designer to insert site-specific design information from the Spreadsheet, as well as other designer-created information.

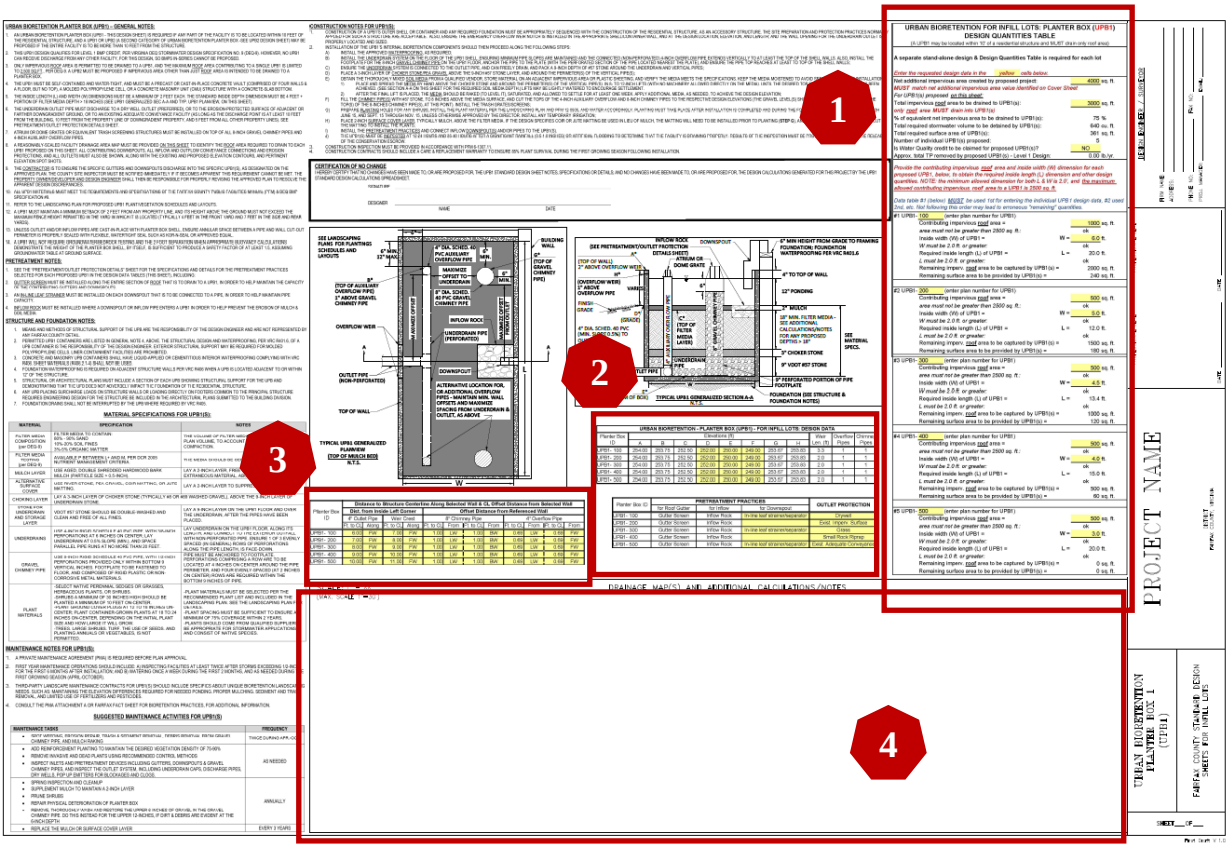



*Figure 17: Example of Completed UPB1 Standard Design Sheet*

The design professional's responsibilities for completing this Design Sheet are as follows:

1. Insert the completed Design Quantities Table, extracted from the corresponding Spreadsheet's DesignCalcs Tab (see example tables in Figure 7 and Figure 8 for UPB1 and UPB2, respectively), in the blank space to the left of the title block (see block 1, Figure 17 above).

   Note: the AutoCAD versions of the Design Sheets include instructions pertaining to extracting the appropriate tables from the Spreadsheets and inserting these tables at the appropriate locations on the Design Sheets. Insertion points will vary from sheet to sheet, so follow the specific instructions contained on a particular Design Sheet. The printing properties for each of the Spreadsheet tabs have been preset to extract only the appropriate table extents from a particular tab.

2. Insert the completed Design Data Table and Pretreatment Practices/Outlet Protection Table, extracted from the DesignData Tab of the corresponding Spreadsheet (see example

tables in Figure 9 and Figure 10 for UPB1 and UPB2, respectively), in the blank space below the typical facility cross-section sketch (see block 2, Figure 17).

3. Insert the completed Hydraulic Structure Locations Table, extracted from the DesignData-2 Tab of the corresponding Spreadsheet (see example tables in Figure 15 and Figure 16 for UPB1 and UPB2, respectively), below the generalized facility plan view sketch (see block 3, Figure 17).

4. The remaining blank space (see block 4, Figure 17) is for the designer to provide one or more scaled drainage area maps detailing the drainage area to each individual facility of the specific facility type for the Design Sheet, and any additional calculations or notes deemed necessary by the designer. The design professional should review all of the standard notes and details contained on the Design Sheet prior to signing and sealing the sheet and add supplemental information to this space as a particular site/project may require.

5. Complete the Design Sheet title block.

# RG FACILITY DESIGN

The RG facility is a bioretention-detention rain garden that can receive stormwater flow from both impervious and pervious onsite surface drainage within a localized drainage area. The RG must be placed at least 10 feet from a structure. The maximum allowed contributing onsite impervious area to an RG is 5500 sq. ft. with no more pervious area allowed than double the actual impervious area drained to the RG. No offsite area may drain to an RG.

## *Standard Design Calculations Spreadsheet*

Each SIDM facility type has its own Standard Design Calculations Spreadsheet. Each facility-specific Spreadsheet is an Excel workbook composed of three common sheets or tabs, with the bioretention facility (UPB1, UPB2, and RG) Spreadsheets each having a fourth tab containing a list of plants recommended for the specific facility type. Directions for completing the RG Spreadsheet tabs are discussed in the following sections.

### DesignCalcs Tab

The DesignCalcs tab is used for entering basic facility sizing design data based on actual project site conditions. Under this tab the calculation sheet is comprised of the Design Quantities Table, which is further subdivided into a ”General Facility-Type Data” block and the “Individual Facility Data” block that is composed of tables for each individual facility. Up to three (3) individual RG facilities can be designed for a single lot with one design calculations Spreadsheet.

#### *General Facility-Type Data Block*

See Figure 18 below for the General Facility-Type Data block of the RG DQ Table (to row 19). The impervious and pervious area data are entered by the designer in the highlighted cells in this block, which also includes a few design notes.

- The first data to be entered in cell H8 (typical for all facility types) is the proposed total net additional impervious surface created by a project’s total proposed land disturbance.

This value must match the Stormwater Requirement Determination information block on the standard INF cover sheet, line #7.

- In cell H11, (typical for all facility types) enter the portion of this onsite total net additional impervious surface that the designer wishes to allocate to the particular facility type. This allocation is typically based on the designer's proposed locations for individual facilities, and the drainage area that is or can be directed to those locations.

- In cell H13 the designer enters the total onsite area, including the allowed (but limited) onsite pervious area, that is to be drained to the individual facilities of this facility type.

- For the final general data entry for this facility type, the designer must choose whether water quality credit is to be claimed for the facilities (cell H19) by clicking within the highlighted cell to activate the cell then using the down-arrow to select "Yes" or "No" from the drop-down menu.

A few additional quantities are automatically calculated in the General Facility-Type Data block, based on the data entered by the designer.

- In cells H16 and H17, the % of the project's total net impervious area to be drained to the individual facilities of the facility type, and the total required detention volume to be provided by the individual facilities of the facility type, are, respectively, displayed. If the value in cell H16 is less than 100%, then another facility type (or types) must be proposed to capture the remaining impervious area.

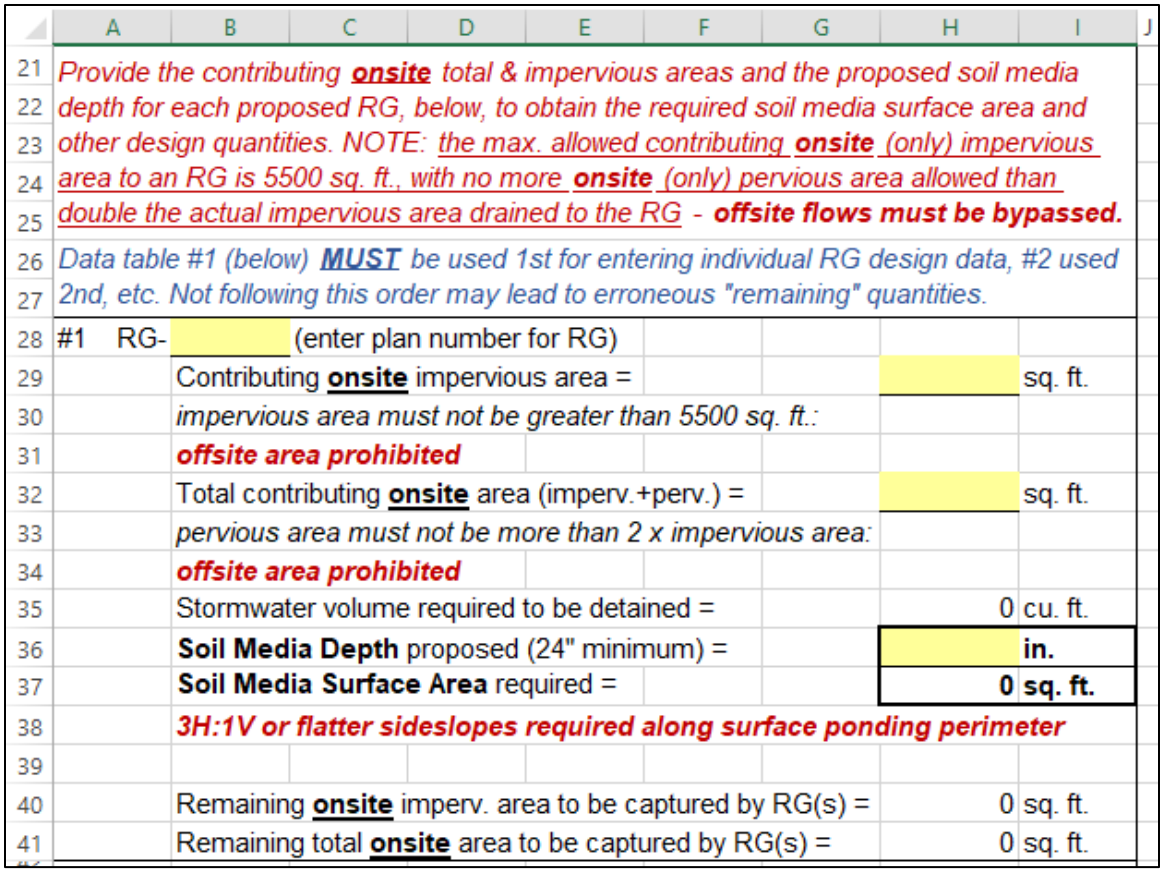
- The number of proposed individual facilities for the facility type is displayed (and continually updated) in cell H18, as the designer sequentially (always starting with individual facility #1) enters data in the Individual Facility Data block.

| | A | B | C | D | E | F | G | H | I |
|---|---|---|---|---|---|---|---|---|---|
| 4 | | | | | | | | | |
| 5 | **A separate stand-alone design & Design Quantities Table is required for each lot** | | | | | | | | |
| 6 | | | | | | | | | |
| 7 | *Enter the requested design data in the* | | | | *yellow* | *cells below.* | | | |
| 8 | Net additional impervious area created by proposed project: | | | | | | | 9000 | sq. ft. |
| 9 | ***MUST*** *match net additional impervious area value identified on Cover Sheet* | | | | | | | | |
| 10 | *For RG(s) proposed* ***on this sheet:*** | | | | | | | | |
| 11 | Total **onsite** impervious area drained to RG(s): | | | | | | | 8000 | sq. ft. |
| 12 | *offsite area* ***MUST NOT*** *drain into RG(s)* | | | | | | | | |
| 13 | Total **onsite** area (impervious+pervious) drained to RG(s): | | | | | | | 24000 | sq. ft. |
| 14 | *pervious area must be no more than 2 x impervious area:* | | | | | | | ok | |
| 15 | *offsite area* ***MUST NOT*** *drain into RG(s)* | | | | | | | | |
| 16 | % of equivalent net impervious area to be drained to RG(s): | | | | | | | 89 | % |
| 17 | Total required stormwater volume to be detained by RG(s): | | | | | | | 1707 | cu. ft. |
| 18 | Number of individual RG(s) proposed: | | | | | | | 3 | |
| 19 | Is Water Quality credit to be claimed for proposed RG(s)? | | | | | | | YES | |
| 20 | | | | | | | | Choose YES or NO | |

*Figure 18: General Data Block of the RG Design Quantities Table*

***Individual Facility Data Block***

See Figure 19 below for an example of the Individual Facility Data block of the RG (starting at row 20) DQ Table. The initial portion of this block includes some instructions for entering the individual facility data (blue font), as well as the identification of a few design limitations (red font). Only onsite area is permitted to drain to this facility type, with no more than 5,500 sq. ft. of impervious area allowed to drain to an individual facility, and individual facility pervious area allowed at no more than twice the actual impervious area draining to the facility. All offsite flows must bypass an RG.



| | A | B | C | D | E | F | G | H | I | J |
|---|---|---|---|---|---|---|---|---|---|---|
| 21 | *Provide the contributing **onsite** total & impervious areas and the proposed soil media* | | | | | | | | | |
| 22 | *depth for each proposed RG, below, to obtain the required soil media surface area and* | | | | | | | | | |
| 23 | *other design quantities. NOTE: the max. allowed contributing **onsite** (only) impervious* | | | | | | | | | |
| 24 | *area to an RG is 5500 sq. ft., with no more **onsite** (only) pervious area allowed than* | | | | | | | | | |
| 25 | *double the actual impervious area drained to the RG - **offsite flows must be bypassed.*** | | | | | | | | | |
| 26 | *Data table #1 (below) **MUST** be used 1st for entering individual RG design data, #2 used* | | | | | | | | | |
| 27 | *2nd, etc. Not following this order may lead to erroneous "remaining" quantities.* | | | | | | | | | |
| 28 | #1 RG- | | (enter plan number for RG) | | | | | | | |
| 29 | | Contributing **onsite** impervious area = | | | | | | | sq. ft. | |
| 30 | | *impervious area must not be greater than 5500 sq. ft.:* | | | | | | | | |
| 31 | | ***offsite area prohibited*** | | | | | | | | |
| 32 | | Total contributing **onsite** area (imperv.+perv.) = | | | | | | | sq. ft. | |
| 33 | | *pervious area must not be more than 2 x impervious area:* | | | | | | | | |
| 34 | | ***offsite area prohibited*** | | | | | | | | |
| 35 | | Stormwater volume required to be detained = | | | | | | 0 | cu. ft. | |
| 36 | | **Soil Media Depth** proposed (24" minimum) = | | | | | | | **in.** | |
| 37 | | **Soil Media Surface Area** required = | | | | | | **0** | **sq. ft.** | |
| 38 | | ***3H:1V or flatter sideslopes required along surface ponding perimeter*** | | | | | | | | |
| 39 | | | | | | | | | | |
| 40 | | Remaining **onsite** imperv. area to be captured by RG(s) = | | | | | | 0 | sq. ft. | |
| 41 | | Remaining total **onsite** area to be captured by RG(s) = | | | | | | 0 | sq. ft. | |

*Figure 19: Example of Individual Facility #1 of the Individual Facility Data Block of the RG Design Quantities Table*

Up to three individual RG facilities can be designed for a single lot with one spreadsheet. The first data to be entered in the Individual Facility Data block (shown above) is the unique ID numbers and/or letters for the #1 facility, in cell B28. The remaining data entries for the #1 facility design table are: the onsite impervious area (cell H29) and total (impervious + pervious) area (cell H32) to be drained to the facility, and the proposed soil media depth for the facility (cell H36). The minimum soil media depth for an RG facility is 24”, and this minimum value is used as the default soil media design depth for this facility type.

A few additional quantities are automatically calculated in the #1 facility design table, based on the data entered by the designer.

- In cell H35 the required detention volume to be provided by the facility is displayed. Then, in cell H37 the required facility surface area is displayed. This required surface area is based on the facility’s required detention storage, represented by the contributing impervious area, and an equivalent depth relationship that accounts for the additional surface storage created by the required 3H:1V facility side slopes.

- The remaining impervious area allocated to the facility type, and for which additional individual facilities are still needed, is displayed in cell H40. Also, the remainder of the total allocated drainage area (impervious + pervious) is displayed in cell H41. These “remainders” are displayed to remind the designer, and alert the reviewer, that additional

individual facilities must be proposed for the facility type in order to fulfill the total detention requirement for the impervious drainage area allocated to the facility type by the designer. The remainder values are reduced by the design quantities of each added individual RG facility. **Each of the remainder values must display 0 sq. ft., before the allocated detention requirement will be satisfied for the facility type**.

Figure 19 above shows only one individual facility (#1) design table for the RG facility type. As identified previously, three (3) RG facilities can be designed using only one (1) spreadsheet. So, the designer will find two (2) more design tables identical to #1 design table (Figure 19) in the actual RG DQ Table. The data entries for these additional individual facility design tables will be the same as has been described above for the #1 design table.

See Figure 20 below for an example of a completed RG Design Calculations Table populated with example data entries.

A DQ Table completed only for the actual number of proposed individual facilities for a facility type must ultimately be inserted on the corresponding Standard Design (CAD) Sheet for that facility type. See the related discussion under the "Standard Design Sheet" heading below.

## BIORETENTION DETENTION FOR INFILL LOTS: RAIN GARDEN (RG) - DESIGN QUANTITIES TABLE

(An RG MUST be located at least 10' from a residential structure)

**A separate stand-alone design & Design Quantities Table is required for each lot**

*Enter the requested design data in the yellow cells below.*

| | | |
|---|---|---|
| Net additional impervious area created by proposed project: | 9000 | sq. ft. |
| ***MUST** match net additional impervious area value identified on Cover Sheet* | | |
| *For RG(s) proposed on this sheet:* | | |
| Total **onsite** impervious area drained to RG(s): | 8000 | sq. ft. |
| *offsite area **MUST NOT** drain into RG(s)* | | |
| Total **onsite** area (impervious+pervious) drained to RG(s): | 24000 | sq. ft. |
| *pervious area must be no more than 2 x impervious area:* | ok | |
| *offsite area **MUST NOT** drain into RG(s)* | | |
| % of equivalent net impervious area to be drained to RG(s): | 89 | % |
| Total required stormwater volume to be detained by RG(s): | 1707 | cu. ft. |
| Number of individual RG(s) proposed: | 3 | |

**Water Quality credit is not available for these proposed Rain Gardens.**

*Provide the contributing **onsite** total & impervious areas and the proposed soil media depth for each proposed RG, below, to obtain the required soil media surface area and other design quantities. NOTE: the max. allowed contributing **onsite** (only) impervious area to an RG is 5500 sq. ft., with no more **onsite** (only) pervious area allowed than double the actual impervious area drained to the RG - **offsite flows must be bypassed.***

*Data table #1 (below) **MUST** be used 1st for entering individual RG design data, #2 used 2nd, etc. Not following this order may lead to erroneous "remaining" quantities.*

| | | | |
|---|---|---|---|
| #1 RG- 100 (enter plan number for RG) | | | |
| Contributing **onsite** impervious area = | 4000 | sq. ft. | |
| *impervious area must not be greater than 5500 sq. ft.:* | ok | | |
| ***offsite area prohibited*** | | | |
| Total contributing **onsite** area (imperv.+perv.) = | 12000 | sq. ft. | |
| *pervious area must not be more than 2 x impervious area:* | ok | | |
| ***offsite area prohibited*** | | | |
| Stormwater volume required to be detained = | 853 | cu. ft. | |
| **Soil Media Depth** proposed (24" minimum) = | **48** | **in.** | |
| **Soil Media Surface Area** required = | **375** | **sq. ft.** | |
| ***3H:1V or flatter sideslopes required along surface ponding perimeter*** | | | |
| Remaining **onsite** imperv. area to be captured by RG(s) = | 4000 | sq. ft. | |
| Remaining total **onsite** area to be captured by RG(s) = | 12000 | sq. ft. | |

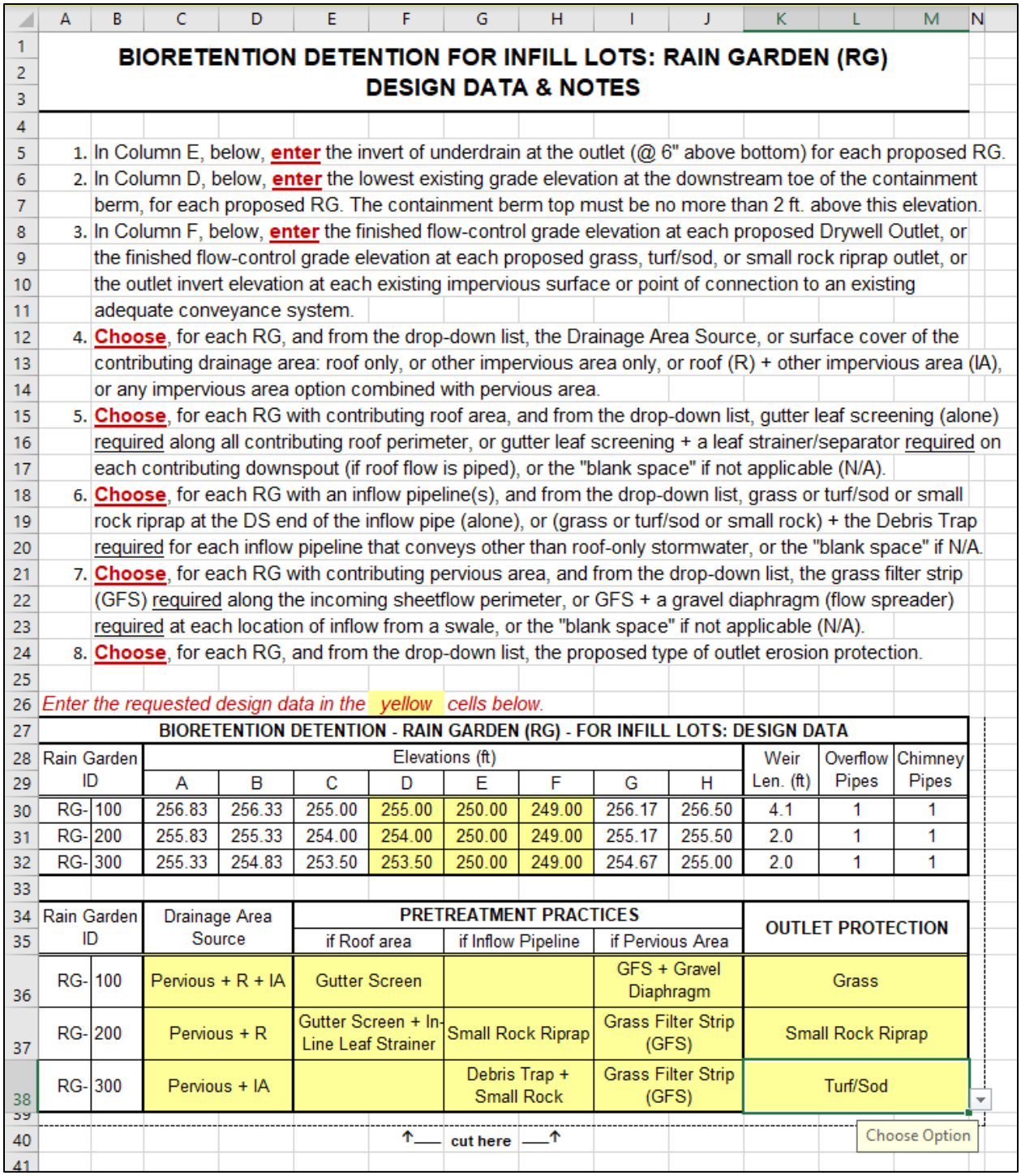
*Figure 20: RG Design Quantities Table with Example Data Entries (continued below)*

| | | | |
|---|---|---|---|
| #2 | RG- 200 (enter plan number for RG) | | |
| | Contributing **onsite** impervious area = | 2000 | sq. ft. |
| | *impervious area must not be more than 5500 sq. ft.:* | | |
| | ***offsite area prohibited*** | | |
| | Total contributing **onsite** area (imperv.+perv.) = | 6000 | sq. ft. |
| | *pervious area must not be more than 2 x impervious area:* | ok | |
| | ***offsite area prohibited*** | | |
| | Stormwater volume required to be detained = | 427 | cu. ft. |
| | **Soil Media Depth** proposed (24" minimum) = | **36** | **in.** |
| | **Soil Media Surface Area** required = | **174** | **sq. ft.** |
| | ***3H:1V or flatter sideslopes required along surface ponding perimeter*** | | |
| | Remaining **onsite** imperv. area to be captured by RG(s) = | 2000 | sq. ft. |
| | Remaining total **onsite** area to be captured by RG(s) = | 6000 | sq. ft. |
| #3 | RG- 300 (enter plan number for RG) | | |
| | Contributing **onsite** impervious area = | 2000 | sq. ft. |
| | *impervious area must not be more than 5500 sq. ft.:* | | |
| | ***offsite area prohibited*** | | |
| | Total contributing **onsite** area (imperv.+perv.) = | 6000 | sq. ft. |
| | *pervious area must not be more than 2 x impervious area:* | ok | |
| | ***offsite area prohibited*** | | |
| | Stormwater volume required to be detained = | 427 | cu. ft. |
| | **Soil Media Depth** proposed (24" minimum) = | **30** | **in.** |
| | **Soil Media Surface Area** required = | **174** | **sq. ft.** |
| | ***3H:1V or flatter sideslopes required along surface ponding perimeter*** | | |
| | Remaining **onsite** imperv. area to be captured by RG(s) = | 0 | sq. ft. |
| | Remaining total **onsite** area to be captured by RG(s) = | 0 | sq. ft. |

## DesignData Tab

The DesignData tab is used for entering specific design elevation data, as well as selecting the drainage area source, and the pretreatment and outlet protection practices, for each of the individual facilities proposed in the DQ Table located on the DesignCalcs tab. (Note that it is good practice to complete the DQ Table before advancing to the DesignData tab.) Under this tab, then, the Design Data and the Pretreatment Practices/Outlet Protection Tables (DD and POP Tables) are developed from the required designer input and through self-population, considering the RG standard design backfill profile and other standard design requirements. (The POP Design [Plan] Sheet must be consulted for information pertinent to the selection of the allowable pretreatment and outlet protection practices.)

Refer to Figure 21 below for an example of the DesignData tab.



**BIORETENTION DETENTION FOR INFILL LOTS: RAIN GARDEN (RG)**
**DESIGN DATA & NOTES**

1. In Column E, below, **enter** the invert of underdrain at the outlet (@ 6" above bottom) for each proposed RG.
2. In Column D, below, **enter** the lowest existing grade elevation at the downstream toe of the containment berm, for each proposed RG. The containment berm top must be no more than 2 ft. above this elevation.
3. In Column F, below, **enter** the finished flow-control grade elevation at each proposed Drywell Outlet, or the finished flow-control grade elevation at each proposed grass, turf/sod, or small rock riprap outlet, or the outlet invert elevation at each existing impervious surface or point of connection to an existing adequate conveyance system.
4. **Choose**, for each RG, and from the drop-down list, the Drainage Area Source, or surface cover of the contributing drainage area: roof only, or other impervious area only, or roof (R) + other impervious area (IA), or any impervious area option combined with pervious area.
5. **Choose**, for each RG with contributing roof area, and from the drop-down list, gutter leaf screening (alone) required along all contributing roof perimeter, or gutter leaf screening + a leaf strainer/separator required on each contributing downspout (if roof flow is piped), or the "blank space" if not applicable (N/A).
6. **Choose**, for each RG with an inflow pipeline(s), and from the drop-down list, grass or turf/sod or small rock riprap at the DS end of the inflow pipe (alone), or (grass or turf/sod or small rock) + the Debris Trap required for each inflow pipeline that conveys other than roof-only stormwater, or the "blank space" if N/A.
7. **Choose**, for each RG with contributing pervious area, and from the drop-down list, the grass filter strip (GFS) required along the incoming sheetflow perimeter, or GFS + a gravel diaphragm (flow spreader) required at each location of inflow from a swale, or the "blank space" if not applicable (N/A).
8. **Choose**, for each RG, and from the drop-down list, the proposed type of outlet erosion protection.

*Enter the requested design data in the yellow cells below.*

**BIORETENTION DETENTION - RAIN GARDEN (RG) - FOR INFILL LOTS: DESIGN DATA**

| Rain Garden ID | Elevations (ft) A | B | C | D | E | F | G | H | Weir Len. (ft) | Overflow Pipes | Chimney Pipes |
|---|---|---|---|---|---|---|---|---|---|---|---|
| RG-100 | 256.83 | 256.33 | 255.00 | 255.00 | 250.00 | 249.00 | 256.17 | 256.50 | 4.1 | 1 | 1 |
| RG-200 | 255.83 | 255.33 | 254.00 | 254.00 | 250.00 | 249.00 | 255.17 | 255.50 | 2.0 | 1 | 1 |
| RG-300 | 255.33 | 254.83 | 253.50 | 253.50 | 250.00 | 249.00 | 254.67 | 255.00 | 2.0 | 1 | 1 |

| Rain Garden ID | Drainage Area Source | PRETREATMENT PRACTICES if Roof area | if Inflow Pipeline | if Pervious Area | OUTLET PROTECTION |
|---|---|---|---|---|---|
| RG-100 | Pervious + R + IA | Gutter Screen | | GFS + Gravel Diaphragm | Grass |
| RG-200 | Pervious + R | Gutter Screen + In-Line Leaf Strainer | Small Rock Riprap | Grass Filter Strip (GFS) | Small Rock Riprap |
| RG-300 | Pervious + IA | | Debris Trap + Small Rock | Grass Filter Strip (GFS) | Turf/Sod |

cut here

Choose Option

*Figure 21: DesignData Tab for RG*

Data entry into the highlighted cells is explained at the top of the spreadsheet tab (see Figure 21 above, which is also an example of completed RG Design Data and Pretreatment Practices/Outlet Protection Tables populated with example data entries). Refer to the Typical RG Generalized Section A-A depicted on the RG Standard Design [Plan] Sheet to clarify the elevations that need to be input by the designer (See Figure 23). Then, also using the site grading plan, the designer must enter the following:

1. The lowest existing grade at the downstream toe of the containment berm (DD Table: Column D).

2. The invert of the underdrain at the outlet (DD Table: Column E)

3. The finished flow-control grade at the outlet (DD Table: Column F). The finished flow-control grade elevation should be the ground elevation (normally) that first allows the discharge to freely flow away from the outlet pipe and facility. For example, this would be the lowest ground elevation (not within a sump) in the vicinity of the top of a drywell's pop-up sprinkler cover, or the lowest ground elevation (not within a sump) in the vicinity of the erosion protection location, which could be the outlet pipe's invert elevation for this latter case if the erosion protection or surrounding ground does not create a sump condition at the invert.
4. The designer must choose the drainage area source or surface cover for the contributing drainage area using the drop-down menu. Left click inside the cell for the appropriate individual facility in the Drainage Area Source column of the POP Table to activate the cell. Then click the down-arrow on the right side to see the menu and choose the appropriate source description (i.e., roof only, other impervious area only, R + other IA, pervious area + R, pervious + IA, pervious + R + IA).

5. Select the proposed pretreatment practices in the POP Table for each category of roof, inflow pipeline, and pervious area that applies to the specific individual facility, by again left clicking within the appropriate cells to activate the cells, clicking the down-arrows to the right of the cells and using the menus to select the appropriate practices. Refer to the POP Standard Design [Plan] Sheet for descriptions, notes, and details for all allowable pretreatment and outlet practices. Note: some allowable pretreatment practices and all allowable outlet protection practices must be determined from the size of the contributing drainage area to the inlet or the outlet, as is appropriate, and in accordance with the corresponding design tables included on the POP Design [Plan] Sheet.

6. The designer must also choose the type of outlet protection for each individual facility, in the POP Table, by right clicking within the highlighted cell to activate the cell then use the down-arrow to select from the drop-down menu. Refer to the POP Standard Design [Plan] Sheet (see Figure 33) for descriptions, notes, and details for all allowable pretreatment and outlet practices, and see the Note in item 5 above.

A few additional quantities are automatically calculated in the Design Data table for each individual facility, based on the data entered by the designer, and are as follows:

- Column A displays the computed lowest elevation of the top of the containment berm for each individual RG facility

- Column B displays the computed elevation of the top of auxiliary (4") overflow pipe

- Column C displays the computed elevation of the top of soil media layer

- Column G displays the computed elevation of the top of the primary overflow pipe (8" gravel chimney pipe)

- Column H displays the computed elevation of the crest of the emergency overflow weir

- In addition, the table displays the required weir length (ft.), required number of overflow pipes and required number of chimney pipes.

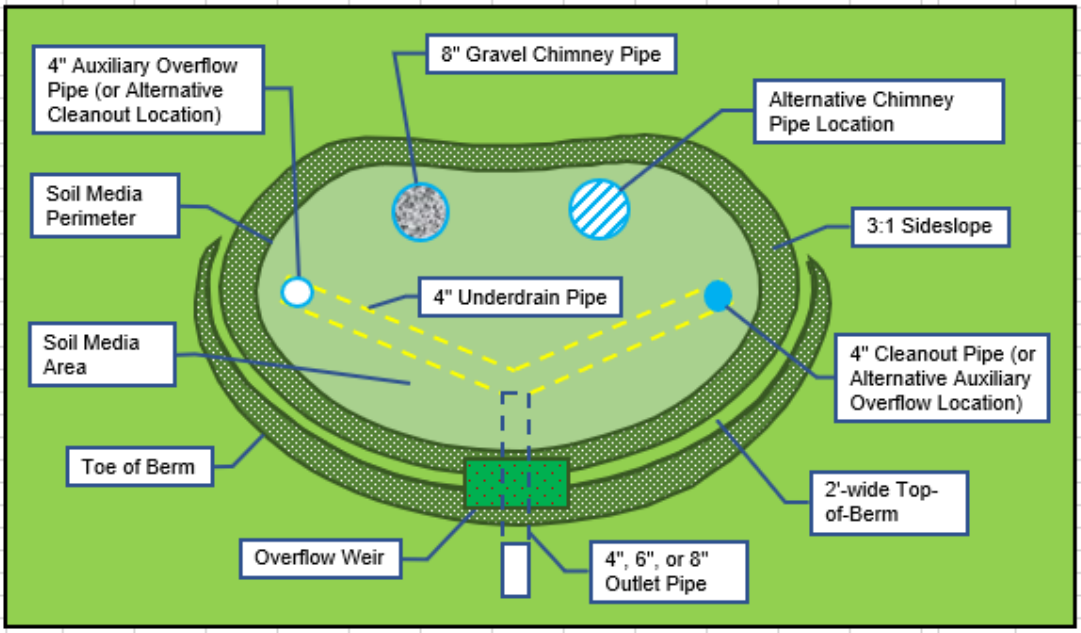
The DD and POP Table combination (completed only for the actual number of proposed individual facilities identified in the DQ Table for a facility type) must ultimately be placed on the corresponding Standard Design (CAD) Sheet for that facility type. See the related discussion under the "Standard Design Sheet" heading below.

### DesignData-2 Tab

The DesignData-2 tab is used to generate a table of design locations for the various hydraulic structures that are required to be installed within each of the individual RG facilities proposed in the DQ Table located on the DesignCalcs tab. (Note that it is good practice to complete the DQ Table, as well as the DD and POP Tables [on the DesignData tab], before advancing to the DesignData-2 tab.) Under this tab, then, the Hydraulic Structure Location Table is developed solely from designer input. (The typical detail sketches and other notes shown on the RG Standard Design [Plan] Sheet must also be consulted for information pertinent to minimum required offsets and other limitations).

The top of the DesignData-2 spreadsheet tab (see **Error! Reference source not found.** below) includes a general layout sketch and specific instructions for how to determine the distances from property line to weir crest, outlet pipe centerlines and vertical pipe centerlines (8" chimney, 4" overflow pipe, 4" cleanout) for each individual facility. The designer then populates the highlighted cells with the intended measurements and corresponding property line references. In cases where irregular lot line configurations or large separation distances from property lines make offsets unwieldy, the designer can establish a construction baseline as long as it is clearly shown and located on the SIDM drawings.

## BIORETENTION DETENTION FOR INFILL LOTS: RAIN GARDEN (RG)
## DESIGN LOCATIONS OF FLOW STRUCTURES




1. Refer to the above sketch for the typical locations of the 5 RG flow structures: 8" PVC gravel chimney pipe, 4" PVC auxiliary overflow pipe, 4", 6", or 8" PVC outlet pipe, emergency overflow weir, and 4" perforated PVC underdrain pipe. An additional 4" PVC cleanout pipe is also required for the underdrain.
2. The 4" underdrain pipe, to which the auxiliary overflow, outlet & cleanout pipes are directly connected, is to be generally aligned with the soil media perimeter along the extent of the longest facility dimension or axis, and is located within 6" to 1' of the soil media perimeter wall at each of the auxiliary overflow, outlet & cleanout pipe locations.
3. The emergency overflow weir is located at an appropriate location along the RG berm or containment perimeter, the 4", 6", or 8" outlet pipe extends from its connection with the 4" underdrain (UD) pipe to the outlet protection (OP) location, the 8" chimney pipe is located within 6" to 1' of the soil media perimeter wall and as far away from the underdrain & outlet as possible, the 4" auxilliary overflow pipe is located at the end of the underdrain pipe that is farthest away from the outlet, and the 4" cleanout pipe is located at the other end of the underdrain pipe.
4. For the structures identified in the table below, and for each RG, provide the perpendicular property line (PL) offset coordinate values (in feet) for each specified centerline (CL) location. (PL ID = N, NE, E, SE, S, etc.)

*Enter the requested design data in yellow cells below.*

| Rain Garden ID | erpendicular Property Line Offset Coordinates for Structure Centerline (CL) Locatio | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Weir & Outlet Pipe CL's | | | | | | Vertical Pipe CL's | | | | | |
| | Weir Crest | | Out. Pipe @ UD | | Out. Pipe @ OP | | 8" Chimney | | 4" Overflow | | 4" Cleanout | |
| | Dist. | PL ID | Dist. | PL ID | Dist. | PL ID | Dist. | PL ID | Dist. | PL ID | Dist. | PL ID |
| RG- 100 | 30.00 | W | 30.00 | W | 30.00 | W | 25.00 | W | 20.00 | W | 40.00 | W |
| | 10.00 | S | 15.00 | S | 5.00 | S | 25.00 | S | 20.00 | S | 20.00 | S |
| RG- 200 | 30.00 | W | 30.00 | W | 30.00 | W | 25.00 | W | 20.00 | W | 40.00 | W |
| | 10.00 | S | 15.00 | S | 5.00 | S | 25.00 | S | 20.00 | S | 20.00 | S |
| RG- 300 | 30.00 | W | 30.00 | W | 30.00 | W | 25.00 | W | 20.00 | W | 40.00 | W |
| | 10.00 | S | 15.00 | S | 5.00 | S | 25.00 | S | 20.00 | S | 20.00 | S |

cut here

*Figure 22: DesignData-2 Tab for RG*

See the bottom of Figure 22 above for an example of a completed RG Hydraulic Structure Location (HSL) Table populated with example data entries. The HSL Table (completed only for the actual number of proposed individual facilities identified in the DQ Table for a facility type) must ultimately be placed on the corresponding Standard Design (CAD) Sheet for that facility type. See the related discussion under the "Standard Design Sheet" heading below.

### RG Plant List Tab

This tab provides a Fairfax County recommended plant list for in-ground bioretention facilities that the designer should use for selecting appropriate plant species.

## *Standard Design Sheet*

The Standard Design Sheet for each facility type contains facility-specific notes and instructions, materials specifications, pretreatment notes, maintenance notes, and construction notes. A standard plan view of a typical generalized facility is provided, along with a typical cross-section of the facility. **The standard notes and facility details must not be modified by the designer**, and the "Certification of No Change" statement that can be found on each of the Design Sheets must be appropriately dated and signed by the same professional who signs and seals the particular Design Sheet**.**

The blank areas on the Design Sheet are for the designer to insert site-specific design information from the Spreadsheet tabs, as well as designer-created information. See Figure 23 for an example of the Standard Design Sheet for RG.

The design professional's responsibilities for completing this Design Sheet are as follows:

1. Insert the completed Design Quantities Table, extracted from the Spreadsheet's DesignCalcs Tab (see example in Figure 20), in the blank space to the left of the title block (see block 1, Figure 23 below).

   Note: the AutoCAD versions of the Design Sheets include instructions pertaining to extracting the appropriate tables from the Spreadsheets and inserting these tables at the appropriate locations on the Design Sheets. Insertion points will vary from sheet to sheet, so follow the specific instructions contained on a particular Design Sheet. The printing properties for each of the Spreadsheet tabs have been preset to extract only the appropriate table extents from a particular tab.

2. Insert the completed Design Data Table and Pretreatment Practices/Outlet Protection Table, extracted from the DesignData Tab of the corresponding Spreadsheet (see example tables in Figure 21), in the blank space below the typical facility cross-section sketch (see block 2, Figure 23).

3. Insert the completed Hydraulic Structure Location Table, extracted from the DesignData-2 Tab of the corresponding Spreadsheet (see an example table in Figure 22), below the generalized facility plan view sketch (see block 3, Figure 23).

4. The remaining blank space (see block 4, Figure 23) is for the designer to provide one or more scaled drainage area maps detailing the drainage area to each individual facility of the facility type for the Design Sheet, and any additional calculations or notes deemed

necessary by the designer. The design professional should review all of the standard notes and details contained on the Design Sheet prior to signing and sealing the sheet, and add supplemental information to this space as a particular site/project may require.

5. Complete the Design Sheet title block.

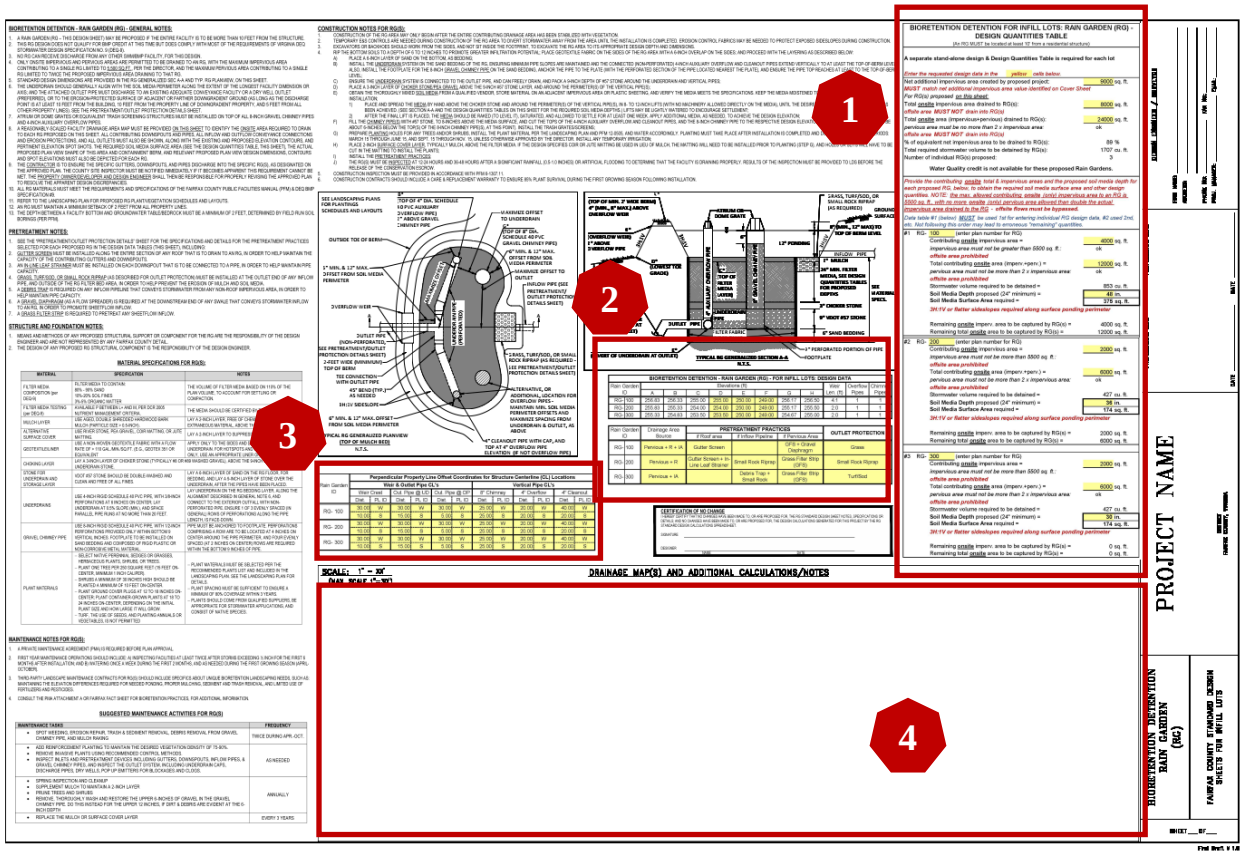



*Figure 23: Example of Completed RG Standard Design Sheet*

# UPD FACILITY DESIGN

The UPD is an underground pipe detention system. A UPD facility must be located a minimum of 10 feet from a structure and can only drain onsite impervious area (with minimum and maximum allowed areas of 600 sq. ft. and 25,000 sq. ft., respectively, and no pervious area allowed). The standard design includes a choice of any one of three pipe diameters, 24-inch, 30-inch, or 36-inch, for an individual facility. The DesignData-2 tab of the Calculations Spreadsheet, as well as the corresponding Design Sheet, include illustrations of the standard system configurations: a double manifold system for multiple rows of pipe, or a single pipeline in a straight, L-shaped, C/U-shaped or Z-shaped configuration. No offsite area may drain to a UPD facility.

## *Standard Design Calculations Spreadsheet*

Each SIDM facility type has its own Standard Design Calculations Spreadsheet. Each facility-specific Spreadsheet is an Excel workbook composed of three common sheets or tabs. Directions for completing the UPD Spreadsheet tabs are discussed in the following sections.

### DesignCalcs Tab

The DesignCalcs tab is used for entering basic facility sizing design data based on actual project site conditions. Under this tab the calculation sheet is comprised of the Design Quantities Table, which is further subdivided into a "General Facility-Type Data" block and the "Individual Facility Data" block that is composed of tables for each individual facility. Up to two (2) individual UPD facilities can be designed for a single lot with one design calculations Spreadsheet.

#### *General Facility-Type Data Block*

See Figure 24 below for the General Facility-Type Data block of the UPD DQ Table (to row 15). The impervious area data are entered by the designer in the highlighted cells in this block.

- The first data to be entered in cell H8 (typical for all facility types) is the proposed total net additional impervious surface created by a project's total proposed land disturbance. This value must match the Stormwater Requirement Determination information block on the standard INF cover sheet, line #7.

- In cell H11, (typical for all facility types) enter the portion of this onsite total net additional impervious surface that the designer wishes to allocate to the particular facility type. This allocation is typically based on the designer's proposed locations for individual facilities, and the drainage area that is or can be directed to those locations.

This block also includes a few design notes such as: a UPD facility must be located at least 10 feet from a residential structure. There is no other general data entry for this facility type. Once the two general area data have been entered, proceed to the Individual Facility Data block (Figure 25) of the DQ Table (starting at row 16).

A few additional quantities are automatically calculated in the General Facility-Type Data block, based on the data entered by the designer.

- In cells H13 and H14, the % of the project's total net impervious area to be drained to the individual facilities of the facility type, and the total required detention volume to be provided by the individual facilities of the facility type, are, respectively, displayed. If the value in cell H13 is less than 100%, then another facility type (or types) must be proposed to capture the remaining impervious area.

- Then, the number of proposed individual facilities for the facility type is displayed (and continually updated) in cell H15, as the designer sequentially (always starting with individual facility #1) enters data in the Individual Facility Data block.

| | A | B | C | D | E | F | G | H | I |
|---|---|---|---|---|---|---|---|---|---|
| 1 | **UNDERGROUND PIPE DETENTION (UPD) FOR INFILL LOTS:** | | | | | | | | |
| 2 | **DESIGN QUANTITIES TABLE** | | | | | | | | |
| 3 | (A UPD facility MUST be located at least 10' from a residential structure and drain only impervious area) | | | | | | | | |
| 4 | | | | | | | | | |
| 5 | **A separate stand-alone design & Design Quantities Table is required for each lot** | | | | | | | | |
| 6 | | | | | | | | | |
| 7 | *Enter the requested design data in the* | | | | *yellow* | *cells below.* | | | |
| 8 | Net additional impervious area created by proposed project: | | | | | | | 6000 | sq. ft. |
| 9 | ***MUST*** *match net additional impervious area value identified on Cover Sheet* | | | | | | | | |
| 10 | *For UPD(s) proposed on this sheet:* | | | | | | | | |
| 11 | Total **onsite** impervious area drained to UPD(s) (not < 600 sq. ft.): | | | | | | | 4000 | sq. ft. |
| 12 | *onsite pervious area and all offsite area* ***MUST NOT*** *drain into UPD facilities* | | | | | | | | |
| 13 | % of equivalent net impervious area to be drained to UPD(s): | | | | | | | 67 | % |
| 14 | Total required stormwater volume to be detained by UPD(s): | | | | | | | 853 | cu. ft. |
| 15 | Number of individual UPD(s) proposed: | | | | | | | 2 | |

*Figure 24: General Data Block of the UPD Design Quantities Table*

***Individual Facility Data Block***

See Figure 25 below for an example of the Individual Facility Data block of the UPD DQ Table (starting at row 16). The initial portion of this block includes some instructions for entering the individual facility data (blue font), as well as the identification of a few design limitations (red font). Only onsite impervious area is permitted to drain to this facility type, with no less than 600 sq. ft., nor more than 25,000 sq. ft., of impervious area allowed to drain to an individual facility. Also, all offsite flows must bypass a UPD, and no pervious area is allowed to drain to these facilities.

Up to two individual UPD facilities can be designed for a single lot with one spreadsheet. The first data to be entered in the Individual Facility Data block is the unique ID numbers and/or letters for the #1 facility, in cell B23. The remaining data entries for the #1 facility design table are:

- The onsite impervious area to be drained to the facility (cell H24), and the proposed diameter (cell H27), material (cell H28), and row length or **RL** (cell H34) for the facility.

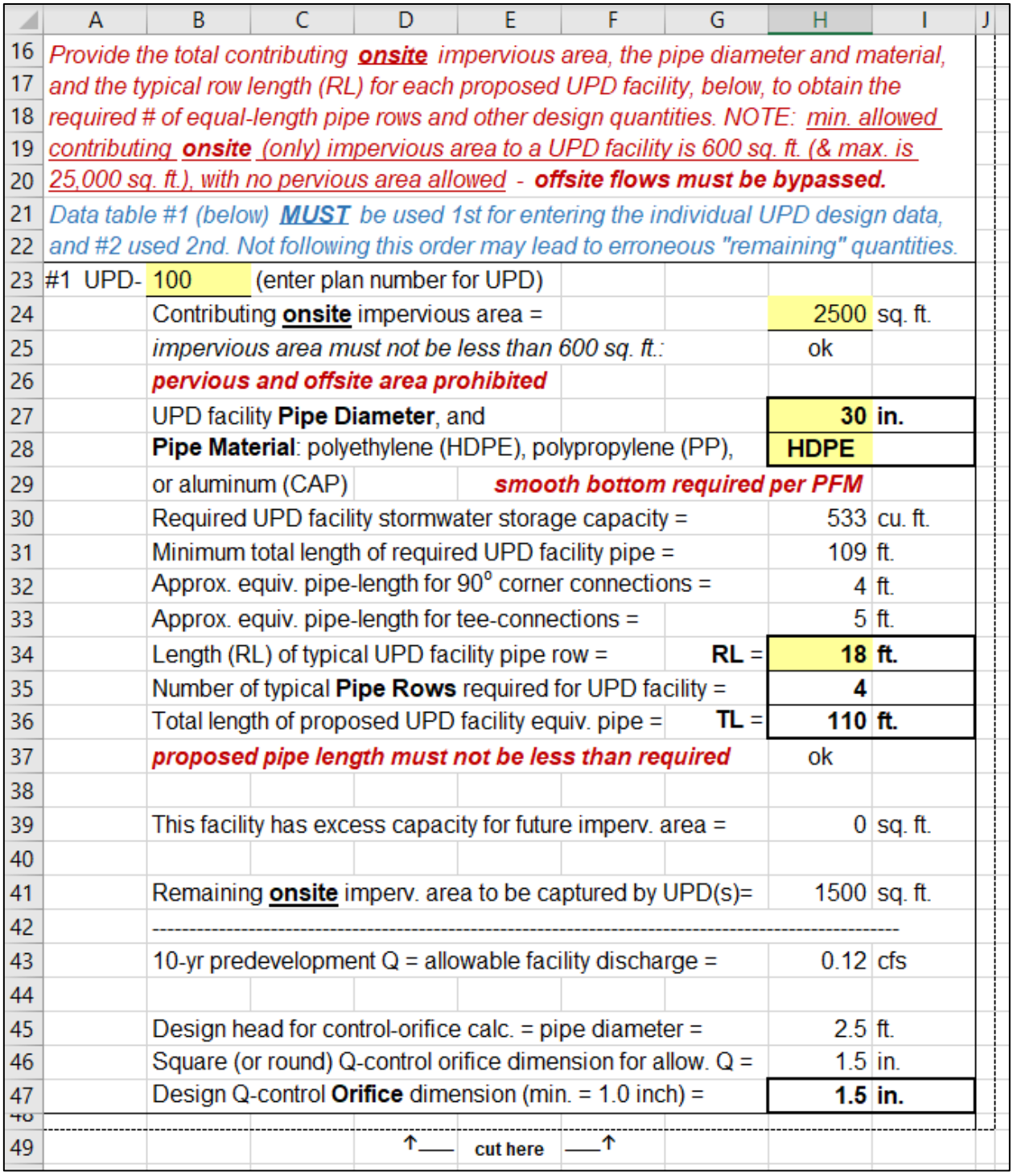
The **RL** value is based on the designer's assessment of the site's physical constraints on where the UPD can be located.

- The allowed pipe diameters are limited to 24", 30" and 36". The desired diameter for the facility can be selected by left-clicking cell H27 to activate the selection table, then left-click the down-arrow to the right of the cell to drop-down the selection menu. Left-click the appropriate diameter value from the menu.

- The allowed materials are also limited to HDPE (high-density polyethylene pipe), PP (polypropylene pipe) and CAP (corrugated aluminum pipe) with smooth pipe bottoms required. The desired material for the facility can be similarly selected by left-clicking cell H28 to activate the selection table, then left-click the down-arrow to the right of the cell to drop-down the selection menu. Left click the appropriate material type from the menu.

**NOTE**: The facility **RL** can be optimized by iterating (via trial-and-error) the entered cell-H34 value until the computed **TL** value (cell H36 Total Length of proposed UPD-facility equivalent pipe) most closely converges with the "minimum total length of required UPD facility pipe" displayed in cell H31.

Also note that if only a single-row or single pipeline UPD facility is desired, enter in cell H34 an **RL** value = the cell-H31 value; otherwise, multiple rows of the same length (= entered cell-H34 value) will be assumed in the calculation of the cell-H36 **TL** value.



| | A | B | C | D | E | F | G | H | I | J |
|---|---|---|---|---|---|---|---|---|---|---|
| 16 | *Provide the total contributing **onsite** impervious area, the pipe diameter and material,* | | | | | | | | | |
| 17 | *and the typical row length (RL) for each proposed UPD facility, below, to obtain the* | | | | | | | | | |
| 18 | *required # of equal-length pipe rows and other design quantities. NOTE: min. allowed* | | | | | | | | | |
| 19 | *contributing **onsite** (only) impervious area to a UPD facility is 600 sq. ft. (& max. is* | | | | | | | | | |
| 20 | *25,000 sq. ft.), with no pervious area allowed - **offsite flows must be bypassed.*** | | | | | | | | | |
| 21 | *Data table #1 (below) **MUST** be used 1st for entering the individual UPD design data,* | | | | | | | | | |
| 22 | *and #2 used 2nd. Not following this order may lead to erroneous "remaining" quantities.* | | | | | | | | | |
| 23 | #1 UPD- | 100 | (enter plan number for UPD) | | | | | | | |
| 24 | | Contributing **onsite** impervious area = | | | | | | 2500 | sq. ft. | |
| 25 | | *impervious area must not be less than 600 sq. ft.:* | | | | | | ok | | |
| 26 | | ***pervious and offsite area prohibited*** | | | | | | | | |
| 27 | | UPD facility **Pipe Diameter**, and | | | | | | **30** | **in.** | |
| 28 | | **Pipe Material**: polyethylene (HDPE), polypropylene (PP), | | | | | | **HDPE** | | |
| 29 | | or aluminum (CAP) | | | ***smooth bottom required per PFM*** | | | | | |
| 30 | | Required UPD facility stormwater storage capacity = | | | | | | 533 | cu. ft. | |
| 31 | | Minimum total length of required UPD facility pipe = | | | | | | 109 | ft. | |
| 32 | | Approx. equiv. pipe-length for 90° corner connections = | | | | | | 4 | ft. | |
| 33 | | Approx. equiv. pipe-length for tee-connections = | | | | | | 5 | ft. | |
| 34 | | Length (RL) of typical UPD facility pipe row = | | | | | **RL =** | **18** | **ft.** | |
| 35 | | Number of typical **Pipe Rows** required for UPD facility = | | | | | | **4** | | |
| 36 | | Total length of proposed UPD facility equiv. pipe = | | | | | **TL =** | **110** | **ft.** | |
| 37 | | ***proposed pipe length must not be less than required*** | | | | | | ok | | |
| 38 | | | | | | | | | | |
| 39 | | This facility has excess capacity for future imperv. area = | | | | | | 0 | sq. ft. | |
| 40 | | | | | | | | | | |
| 41 | | Remaining **onsite** imperv. area to be captured by UPD(s)= | | | | | | 1500 | sq. ft. | |
| 42 | | --- | | | | | | | | |
| 43 | | 10-yr predevelopment Q = allowable facility discharge = | | | | | | 0.12 | cfs | |
| 44 | | | | | | | | | | |
| 45 | | Design head for control-orifice calc. = pipe diameter = | | | | | | 2.5 | ft. | |
| 46 | | Square (or round) Q-control orifice dimension for allow. Q = | | | | | | 1.5 | in. | |
| 47 | | Design Q-control **Orifice** dimension (min. = 1.0 inch) = | | | | | | **1.5** | **in.** | |
| 49 | | | | ↑— | **cut here** | —↑ | | | | |

*Figure 25: Example of Individual Facility #1 of the Individual Facility Data Block of the UPD Design Quantities Table*

A few additional quantities are automatically calculated in the #1 facility design table, based on the data entered by the designer.

- In cell H30 the required detention volume to be provided by the facility is displayed.

- In cell H31 the minimum total length of straight pipe required to store the facility's required detention volume is displayed. This pipe length is based on the entered cell-H27 pipe diameter.

- Cells H32 & H33 display, for the diameter chosen in cell H27, the straight lengths of pipe that will provide storage volumes approximately equivalent to the storage volumes provided by the respective standard "elbow (@ 90-degree)" and "tee" connections included in the double manifold configuration (which is the automatic default configuration when more than one row of pipe is proposed). The elbows are used to connect outer rows to the manifold pipes, while the tees are used to connect interior rows to the manifold pipes. Tees are also used for connecting inflow and outflow pipes to the system. Based on the **RL** input by the designer triggering the multiple pipe row design, the computed total length of equivalent pipe (cell H36) accounts for the system's elbows and tees.

- Cell H35 displays the number of equal-length (= **RL**) rows that are included in the proposed double manifold system configuration, if value > 1. A value = 1 displayed in this cell indicates a single pipeline (i.e., no rows) system is proposed.

- Cell H36 displays the proposed equivalent pipe length that is computed on the basis of the pipe diameter and **RL** values entered by the designer, as well as the standard double manifold configuration. If a single pipeline is desired the values displayed in cells H31, H34 & H36 must be the same, and will be the same if the value displayed in cell H31 is also entered in cell H34 by the designer.

- Any excess storage capacity provided by the proposed UPD facility design is displayed in cell H39. Excess capacity is reported in terms of impervious area, and will be identified if a greater amount of impervious area than required for the entire project is included in the current UPD facility designs.

- The remainder of the total allocated impervious area for the facility type is displayed in cell H41. This "remainder" is displayed to remind the designer, and alert the reviewer, that an additional individual facility must be proposed for the facility type in order to fulfill the total detention requirement for the impervious drainage area allocated to the facility type by the designer. The remainder value is reduced by the design quantity of each added individual facility. **This remainder value must display 0 sq. ft., before the allocated detention requirement will be satisfied for the facility type**.

- Cells H43, H45, H46 & H47 are all related to the determination of the UPD facility's required discharge control orifice dimension/diameter, and respectively display: the allowed facility discharge (= 10-yr predevelopment flow [Rational Method C = 0.3] for the cell H24 drainage area), the design headwater depth at the orifice (= the maximum storage depth = the cell 27 pipe diameter), the dimension of a square orifice determined by the orifice equation (for the cell H43 & H45 values and an orifice discharge coefficient, C = 0.6), and the design dimension of the square (or round, conservatively) orifice for the facility = cell H46 or 1.0", if cell H46 < 1.0".

Figure 25 shows only one individual facility (#1) design table for the UPD facility type. As identified previously, two (2) UPD facilities can be designed using only one (1) spreadsheet. So, the designer will find one (1) more design table identical to #1 design table in the actual UPD DQ Table (See Figure 26). The data entries for this additional individual facility design table will be the same as has been described above for the #1 design table.

A DQ Table (completed only for the actual number of proposed individual facilities for a facility type) must ultimately be inserted on the corresponding Standard Design (CAD) Sheet for that facility type. See the related discussion under the "Standard Design Sheet" heading below.

| | A | B | C | D | E | F | G | H | I | J |
|---|---|---|---|---|---|---|---|---|---|---|
| 53 | #2 UPD- | 200 | (enter plan number for UPD) | | | | | | | |
| 54 | | Contributing **onsite** impervious area = | | | | | | 1500 | sq. ft. | |
| 55 | | *impervious area must not be less than 600 sq. ft.:* | | | | | | ok | | |
| 56 | | ***pervious and offsite area prohibited*** | | | | | | | | |
| 57 | | UPD facility **Pipe Diameter**, and | | | | | | **24** | **in.** | |
| 58 | | **Pipe Material**: polyethylene (HDPE), polypropylene (PP), | | | | | | **PP** | | |
| 59 | | or aluminum (CAP) | | | ***smooth bottom required per PFM*** | | | | | |
| 60 | | Required UPD facility stormwater storage capacity = | | | | | | 320 | cu. ft. | |
| 61 | | Minimum total length of required UPD facility pipe = | | | | | | 102 | ft. | |
| 62 | | Approx. equiv. pipe-length for 90° corner connections = | | | | | | 3 | ft. | |
| 63 | | Approx. equiv. pipe-length for tee-connections = | | | | | | 4 | ft. | |
| 64 | | Length (RL) of typical UPD facility pipe row = | | | | | **RL** = | **18** | **ft.** | |
| 65 | | Number of typical **Pipe Rows** required for UPD facility = | | | | | | **4** | | |
| 66 | | Total length of proposed UPD facility equiv. pipe = | | | | | **TL** = | **102** | **ft.** | |
| 67 | | ***proposed pipe length must not be less than required*** | | | | | | ok | | |
| 68 | | | | | | | | | | |
| 69 | | The facilities have excess capacity for future imperv. area= | | | | | | 0 | sq. ft. | |
| 70 | | | | | | | | | | |
| 71 | | Remaining **onsite** imperv. area to be captured by UPD(s)= | | | | | | 0 | sq. ft. | |
| 72 | | ---------- | | | | | | | | |
| 73 | | 10-yr predevelopment Q = allowable facility discharge = | | | | | | 0.07 | cfs | |
| 74 | | | | | | | | | | |
| 75 | | Design head for control-orifice calc. = pipe diameter = | | | | | | 2.0 | ft. | |
| 76 | | Square (or round) Q-control orifice dimension for allow. Q = | | | | | | 1.2 | in. | |
| 77 | | Design Q-control **Orifice** dimension (min. = 1.0 inch) = | | | | | | **1.2** | **in.** | |
| 79 | | | | ↑— | **cut here** | —↑ | | | | |

*Figure 26: Continuation of the Individual Facility Block, UPD*

## DesignData Tab

The DesignData tab is used for entering specific design elevation data, as well as selecting the drainage area source, facility configuration, and outlet protection practice, for each of the individual facilities proposed in the DQ Table located on the DesignCalcs tab. (Note that it is good practice to complete the DQ Table before advancing to the DesignData tab.) Under this tab, then, the Design Data and the Pretreatment Practices/Outlet Protection Tables (DD and POP

Tables) are developed from the required designer input and through self-population, considering the UPD generalized design sketches and other standard design requirements. (The POP Design [Plan] Sheet must be consulted for information pertinent to the selection of the allowable outlet protection practices.) Refer to Figure 27 below, which includes example data entries.

Data entry into the highlighted cells is explained at the top of the spreadsheet tab (below). The elevation input for values for columns A and B are clarified by referring to the UPD Generalized Section A-A depicted on the UPD Standard Design [Plan] Sheet. Column C (discharge control elevation) is shown in the UPD Generalized Section B-B depicted on that same sheet (See Figure 30). Then, also using the site grading plan the designer must enter the following:

1. Elevation of the lowest finished grade above the UPD facility (DD Table: Column A).

2. Elevation of the inside invert or bottom of the UPD facility (DD Table: Column B).

3. Elevation of the finished flow-control grade at the outlet (DD Table: Column C). The finished flow-control grade elevation should be the ground elevation (normally) that first allows the discharge to freely flow away from the outlet pipe and facility. For example, this would be the lowest ground elevation (not within a sump) in the vicinity of the top of a drywell's pop-up sprinkler cover, or the lowest ground elevation (not within a sump) in the vicinity of the erosion protection location, which could be the outlet pipe's invert elevation for this latter case if the erosion protection or surrounding ground does not create a sump condition at the invert.

4. The designer must choose the drainage area source or surface cover for the contributing drainage area using the drop-down menu. Left click inside the cell for the appropriate individual facility in the Drainage Area Source column of the DD Table to activate the cell. Then click the down-arrow on the right side to see the menu and choose the appropriate source description (i.e., roof [R] only, other impervious area [IA] only, R + other IA).

5. Also, in the DD Table, select the individual facility configuration or shape to be installed by applying the above-described cell activation process to the Facility Configuration column, and choosing the proposed shape from that menu (i.e., straight row, L-shaped row, C- or Z-shaped row, double manifold). Sketch plans under the DesignData-2 tab, as well as on the UPD Design Sheet, show the potential configurations, and the only configurations permitted. Note that the C-shaped row can be U-shaped or the reverse of either, depending on the designer's point of view for that particular "single pipeline" configuration.

6. Select the proposed outlet protection practice for each individual facility, in the POP Table, by again left clicking within the appropriate cell to activate the cell, clicking the down-arrow to the right of the cell and using the menu to select the appropriate practice. Refer to the POP Standard Design [Plan] Sheet for descriptions, notes, and details for all allowable pretreatment and outlet practices. Note: some allowable pretreatment practices and all allowable outlet protection practices must be determined from the size of the contributing drainage area to the inlet or the outlet, as is appropriate, and in accordance with the corresponding design tables included on the POP Design Sheet.

1. Enter the depth (in feet) of ground cover to be provided above the top of the storage pipes at the lowest finished grade elevation, in the appropriate cell under the Minimum UPD Ground Cover column in the POP Table. This value should be no less than 2 feet.

A few additional quantities are automatically calculated in the Design Data table for each individual facility, based on the data entered by the designer, as follows:

1. The user designated UPD Facility ID is extracted from the Design Calcs Tab and displayed in the Design Data Table.

2. The user-selected pipe diameter extracted from the DesignCalcs tab (cells H27 and H57) is displayed.

3. The user-selected pipe material extracted from the DesignCalcs tab (cells H28 and H58) is displayed.

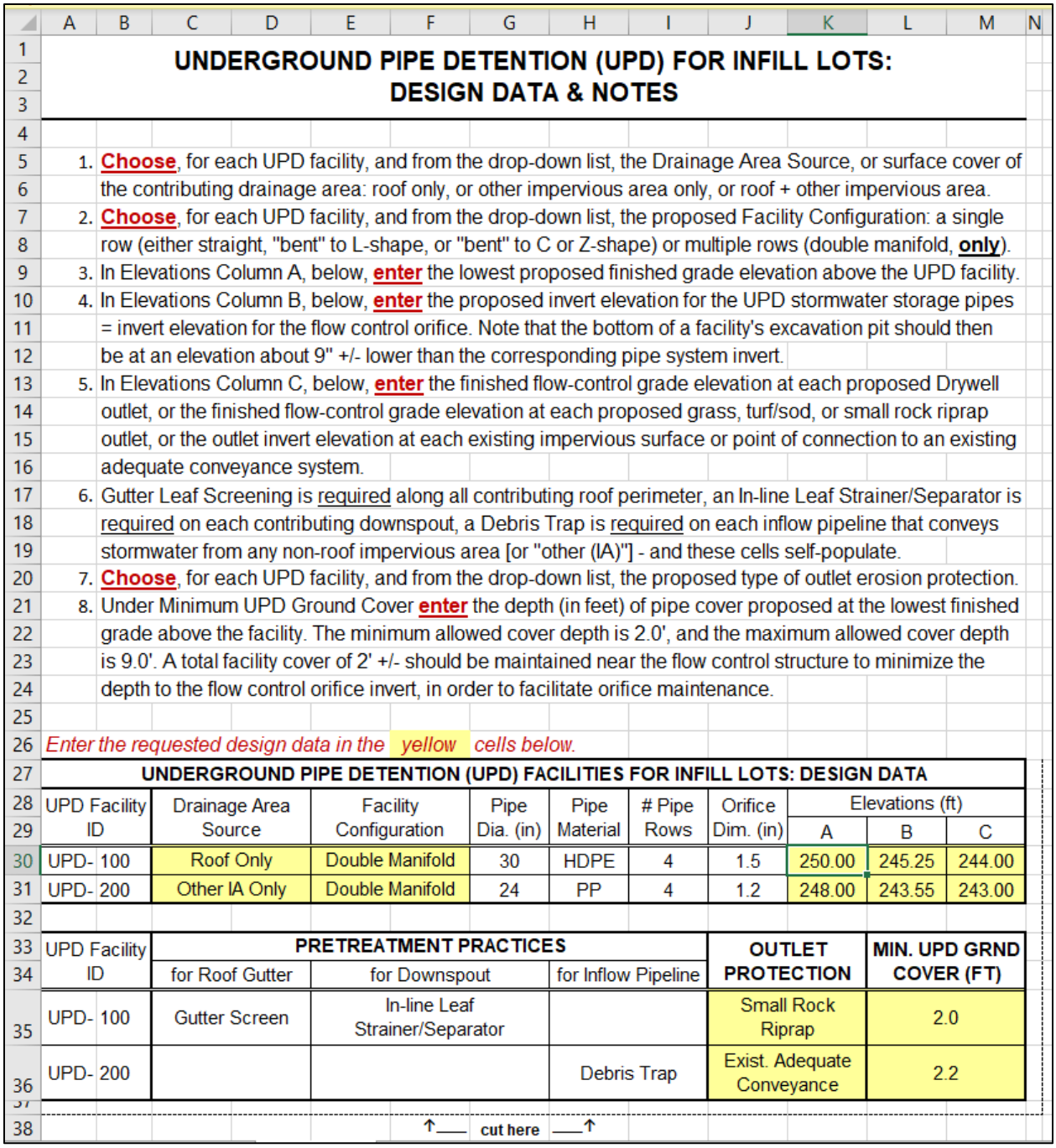
4. The number of pipe rows extracted from the DesignCalcs tab (cells H35 and H65) is displayed.

5. The required orifice size is extracted from the DesignCalcs tab (cells H47 and H77).

6. The Pretreatment Practices/Outlet Protection Table is populated depending upon the designer's input for the drainage area source.

See Figure 27 below for an example of completed UPD Design Data and Pretreatment Practices/Outlet Protection Tables populated with example data entries.

The DD and POP Table combination (completed only for the actual number of proposed individual facilities identified in the DQ Table for a facility type) must ultimately be placed on the corresponding Standard Design (CAD) Sheet for that facility type. See the related discussion under the "Standard Design Sheet" heading below.



**UNDERGROUND PIPE DETENTION (UPD) FOR INFILL LOTS: DESIGN DATA & NOTES**

1. **Choose**, for each UPD facility, and from the drop-down list, the Drainage Area Source, or surface cover of the contributing drainage area: roof only, or other impervious area only, or roof + other impervious area.
2. **Choose**, for each UPD facility, and from the drop-down list, the proposed Facility Configuration: a single row (either straight, "bent" to L-shape, or "bent" to C or Z-shape) or multiple rows (double manifold, **only**).
3. In Elevations Column A, below, **enter** the lowest proposed finished grade elevation above the UPD facility.
4. In Elevations Column B, below, **enter** the proposed invert elevation for the UPD stormwater storage pipes = invert elevation for the flow control orifice. Note that the bottom of a facility's excavation pit should then be at an elevation about 9" +/- lower than the corresponding pipe system invert.
5. In Elevations Column C, below, **enter** the finished flow-control grade elevation at each proposed Drywell outlet, or the finished flow-control grade elevation at each proposed grass, turf/sod, or small rock riprap outlet, or the outlet invert elevation at each existing impervious surface or point of connection to an existing adequate conveyance system.
6. Gutter Leaf Screening is required along all contributing roof perimeter, an In-line Leaf Strainer/Separator is required on each contributing downspout, a Debris Trap is required on each inflow pipeline that conveys stormwater from any non-roof impervious area [or "other (IA)"] - and these cells self-populate.
7. **Choose**, for each UPD facility, and from the drop-down list, the proposed type of outlet erosion protection.
8. Under Minimum UPD Ground Cover **enter** the depth (in feet) of pipe cover proposed at the lowest finished grade above the facility. The minimum allowed cover depth is 2.0', and the maximum allowed cover depth is 9.0'. A total facility cover of 2' +/- should be maintained near the flow control structure to minimize the depth to the flow control orifice invert, in order to facilitate orifice maintenance.

*Enter the requested design data in the yellow cells below.*

**UNDERGROUND PIPE DETENTION (UPD) FACILITIES FOR INFILL LOTS: DESIGN DATA**

| UPD Facility ID | Drainage Area Source | Facility Configuration | Pipe Dia. (in) | Pipe Material | # Pipe Rows | Orifice Dim. (in) | Elevations (ft) A | B | C |
|---|---|---|---|---|---|---|---|---|---|
| UPD-100 | Roof Only | Double Manifold | 30 | HDPE | 4 | 1.5 | 250.00 | 245.25 | 244.00 |
| UPD-200 | Other IA Only | Double Manifold | 24 | PP | 4 | 1.2 | 248.00 | 243.55 | 243.00 |

| UPD Facility ID | PRETREATMENT PRACTICES for Roof Gutter | for Downspout | for Inflow Pipeline | OUTLET PROTECTION | MIN. UPD GRND COVER (FT) |
|---|---|---|---|---|---|
| UPD-100 | Gutter Screen | In-line Leaf Strainer/Separator | | Small Rock Riprap | 2.0 |
| UPD-200 | | | Debris Trap | Exist. Adequate Conveyance | 2.2 |

cut here

*Figure 27: DesignData Tab for UPD*

## DesignData-2 Tab

The DesignData-2 tab is used to generate a table of facility excavation location points and the design locations for the hydraulic structures that are required to be installed for each of the individual UPD facilities proposed in the DQ Table located on the DesignCalcs tab. (Note that it is good practice to complete the DQ Table, as well as the DD and POP Tables [on the DesignData tab], before advancing to the DesignData-2 tab.) Under this tab, then, the Hydraulic Structure Location (HSL) Table is developed solely from designer input. (The typical detail

sketches and other notes shown on the UPD Standard Design [Plan] Sheet must also be consulted for information pertinent to minimum required offsets and other limitations).

The top of the spreadsheet tab (see Figure 28 below) includes general layout sketches, and the bottom of the spreadsheet tab (see Figure 29 below) includes specific instructions for how to determine the distances from property line to four corners of the excavation pit or to four points along the excavation trench alignment (for a single pipeline), the control structure centerline, and the discharge location for each facility. The designer then populates the highlighted cells with the intended measurements and corresponding property line references. In cases where irregular lot line configurations or large separation distances from property lines make offsets unwieldy, the designer can establish a construction baseline as long as it is clearly shown and located on the SIDM drawings.

See Figure 29 below, the lower portion of the DesignData-2 Tab, for an example of a completed UPD Hydraulic Structure Location (HSL) Table populated with example data entries.

The HSL Table (completed only for the actual number of proposed individual facilities identified in the DQ Table for a facility type) must ultimately be placed on the corresponding Standard Design (CAD) Sheet for that facility type. See the related discussion under the "Standard Design Sheet" heading below.

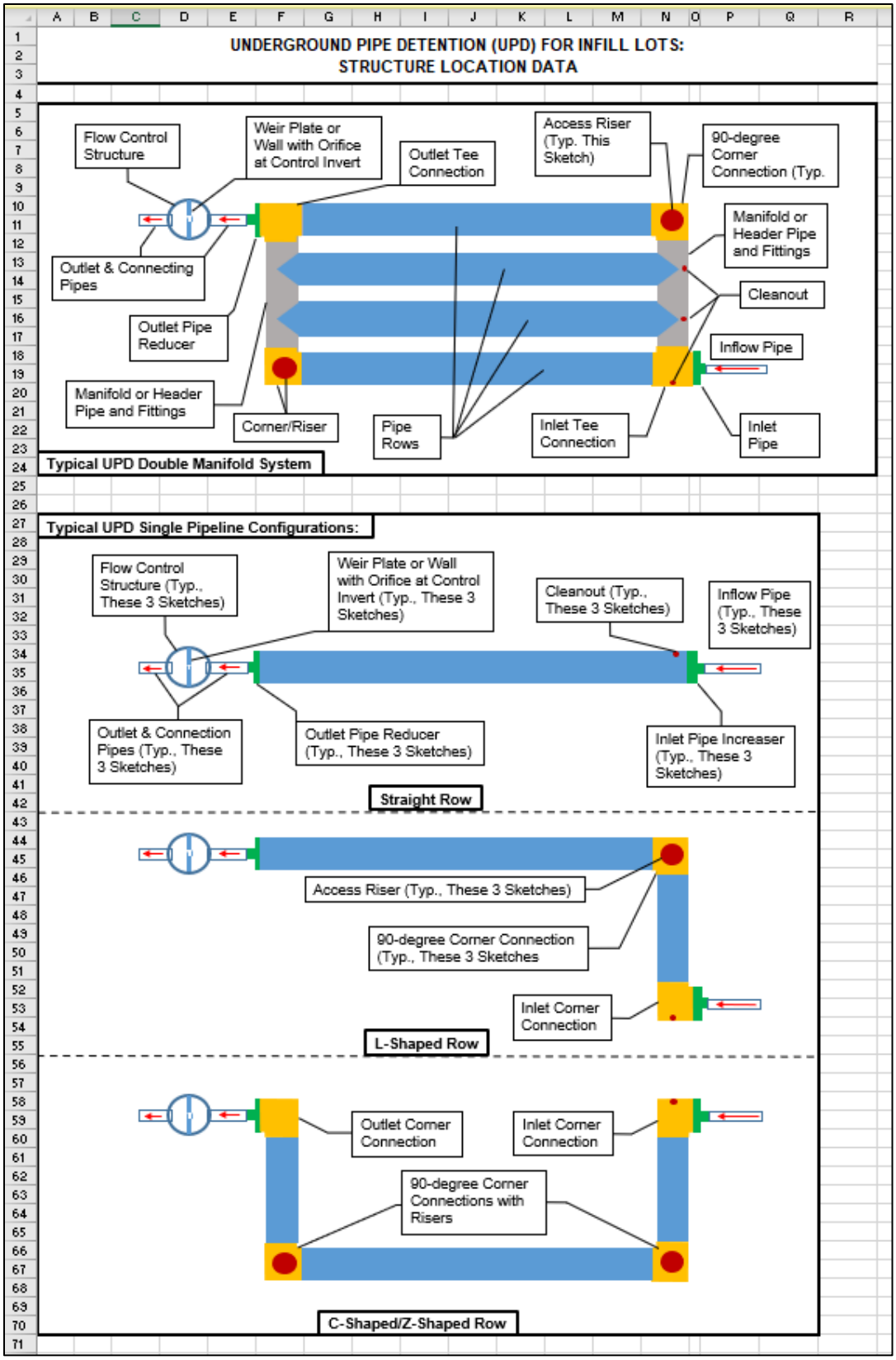
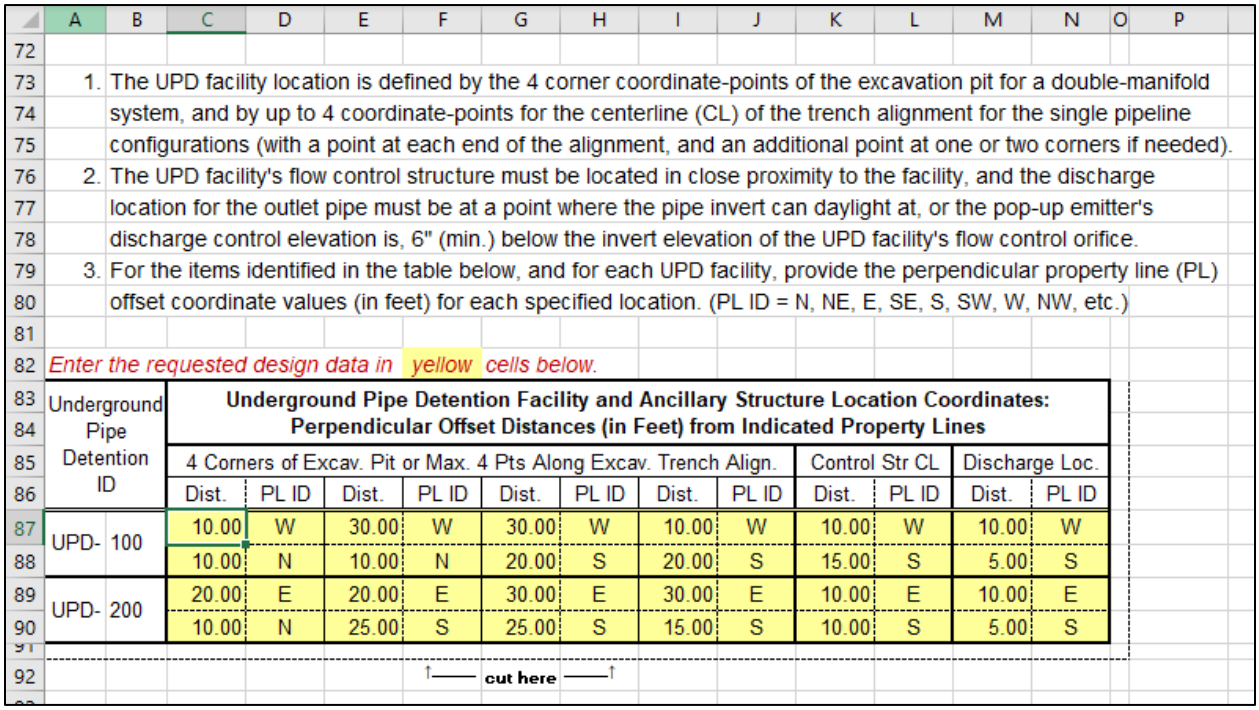



*Figure 28: Top portion DesignData-2 Tab for UPD*



1. The UPD facility location is defined by the 4 corner coordinate-points of the excavation pit for a double-manifold system, and by up to 4 coordinate-points for the centerline (CL) of the trench alignment for the single pipeline configurations (with a point at each end of the alignment, and an additional point at one or two corners if needed).
2. The UPD facility's flow control structure must be located in close proximity to the facility, and the discharge location for the outlet pipe must be at a point where the pipe invert can daylight at, or the pop-up emitter's discharge control elevation is, 6" (min.) below the invert elevation of the UPD facility's flow control orifice.
3. For the items identified in the table below, and for each UPD facility, provide the perpendicular property line (PL) offset coordinate values (in feet) for each specified location. (PL ID = N, NE, E, SE, S, SW, W, NW, etc.)

*Enter the requested design data in yellow cells below.*

| Underground Pipe Detention ID | Underground Pipe Detention Facility and Ancillary Structure Location Coordinates: Perpendicular Offset Distances (in Feet) from Indicated Property Lines | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 4 Corners of Excav. Pit or Max. 4 Pts Along Excav. Trench Align. | | | | | | | | Control Str CL | | Discharge Loc. | |
| | Dist. | PL ID | Dist. | PL ID | Dist. | PL ID | Dist. | PL ID | Dist. | PL ID | Dist. | PL ID |
| UPD- 100 | 10.00 | W | 30.00 | W | 30.00 | W | 10.00 | W | 10.00 | W | 10.00 | W |
| | 10.00 | N | 10.00 | N | 20.00 | S | 20.00 | S | 15.00 | S | 5.00 | S |
| UPD- 200 | 20.00 | E | 20.00 | E | 30.00 | E | 30.00 | E | 10.00 | E | 10.00 | E |
| | 10.00 | N | 25.00 | S | 25.00 | S | 15.00 | S | 10.00 | S | 5.00 | S |

cut here

*Figure 29: Bottom portion of DesignData-2 Tab for UPD*

## *Standard Design Sheet*

The Standard Design Sheet for each facility type contains facility-specific notes and instructions, materials specifications, pretreatment notes, maintenance notes, and construction notes. Standard plan views of typical generalized facilities are provided, along with typical cross-sections for the facilities. **The standard notes and facility details must not be modified by the designer**, and the "Certification of No Change" statement that can be found on each of the Design Sheets must be appropriately dated and signed by the same professional who signs and seals the particular Design Sheet.

The blank areas on the Design Sheet are for the designer to insert site-specific design information from the Spreadsheet, as well as designer-created information. See Figure 30 for an example of the Standard Design Sheet for UPD.

The design professional's responsibilities for completing this Design Sheet are as follows:

1. Insert the completed Design Quantities Table, extracted from the Spreadsheet's DesignCalcs Tab (see example in Figure 24 and Figure 25), in the blank space to the left of the title block (see block 1, Figure 30 below).

   Note: the AutoCAD versions of the Design Sheets include instructions pertaining to extracting the appropriate tables from the Spreadsheets and inserting these tables at the appropriate locations on the Design Sheets. Insertion points will vary from sheet to sheet, so follow the specific instructions contained on a particular Design Sheet. The printing

properties for each of the Spreadsheet tabs have been preset to extract only the appropriate table extents from a particular tab.

2. Insert the completed Design Data Table and Pretreatment Practices/Outlet Protection Tables, extracted from the DesignData Tab of the corresponding Spreadsheet (see example tables in Figure 23), in the blank space below the "Facility Inflow and Discharge Assembly Descriptions" notes (see block 3, Figure 30).

3. Insert the completed Hydraulic Structure Location Table, extracted from the DesignData-2 Tab of the corresponding Spreadsheet (see an example table in Figure 28), below the generalized "Section A-A" sketch (see block 2, Figure 30).

4. The remaining blank space (see block 4, Figure 30) is for the designer to provide one or more scaled drainage area maps detailing the drainage area to each individual facility of the facility type for the Design Sheet, and any additional calculations or notes deemed necessary by the designer. The design professional should review all of the standard notes and details contained on the Design Sheet prior to signing and sealing the sheet and add supplemental information to this space as a particular site/project may require.

5. Complete the Design Sheet title block.

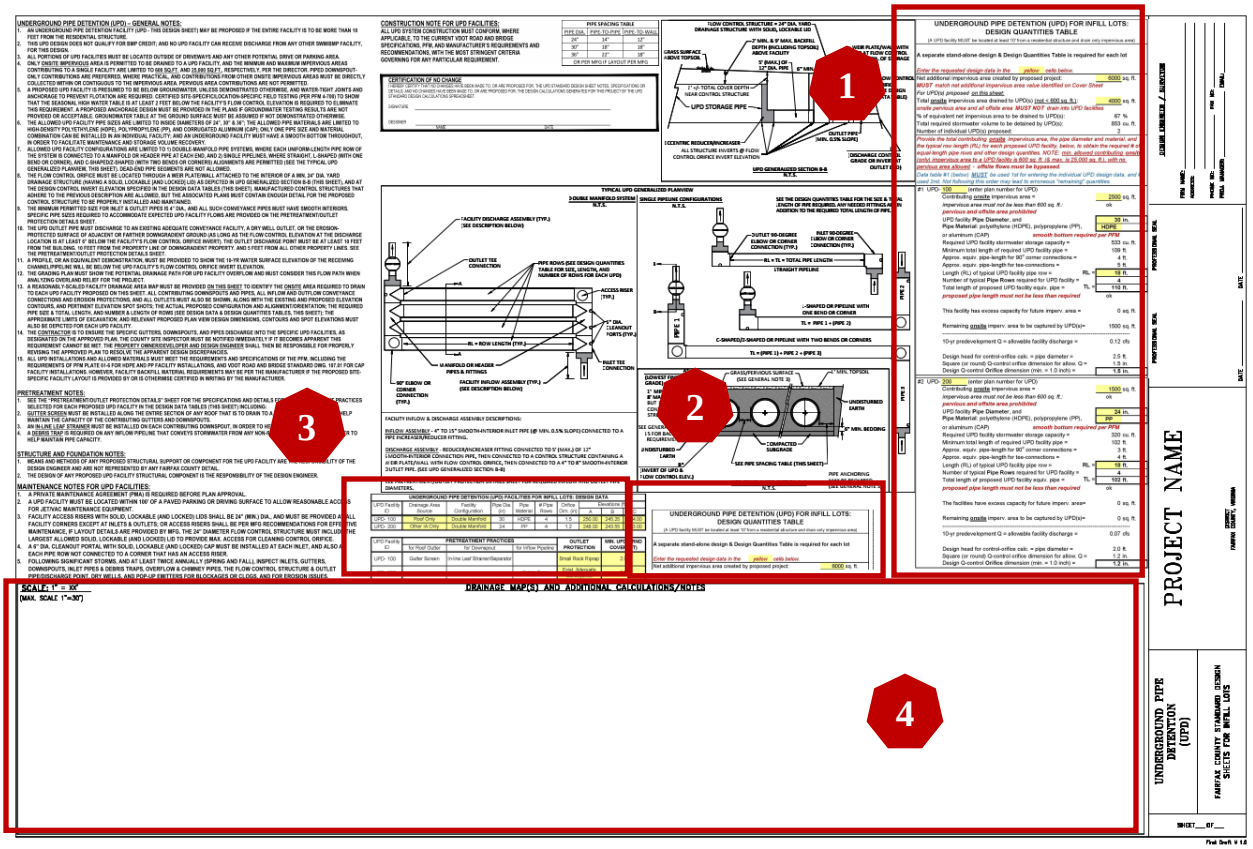



*Figure 30: Example of Completed UPD Standard Design Sheet*

## GENERAL DESIGN PLAN SHEETS

The designer applying SIDM to a project design must use the SIDM standard plan sheets for presenting all of the project's stormwater management design information. In addition to the appropriate standard facility design plan sheets discussed in the previous sections of this manual, the SIDM standard plan sheets include the plan sheets discussed below. These plan sheets must also be included in every SIDM project submittal.

### *General Site SWM/BMP Data (GSD Sheet 1 of 2)*

The GSD Design [Plan] Sheet, sheet 1 of 2, (See Figure 31 below) contains a detailed description of SIDM and general project and plan sheet notes, as well as blank spaces for the VRRM Analysis results, the Water Quality Narrative, and the Offsite Nutrient Credit Availability letter (if needed). **The notes, descriptions, and details of this design plan sheet must not be modified by the designer**, and the "Certification of No Change" statement that can be found on each of the Design Sheets must be appropriately dated and signed by the same professional who signs and seals the particular Design Sheet.

It is highly recommended that the design professional review, in detail, the SIDM description prior to applying this design methodology to a project, especially the "Terms of Use" section. Note that there will be no exceptions to, or exemptions from, the SIDM Terms of Use, since this design methodology is not required to be used for any project. Only use SIDM when **all** of the methodology's design requirements and limitations can be met.

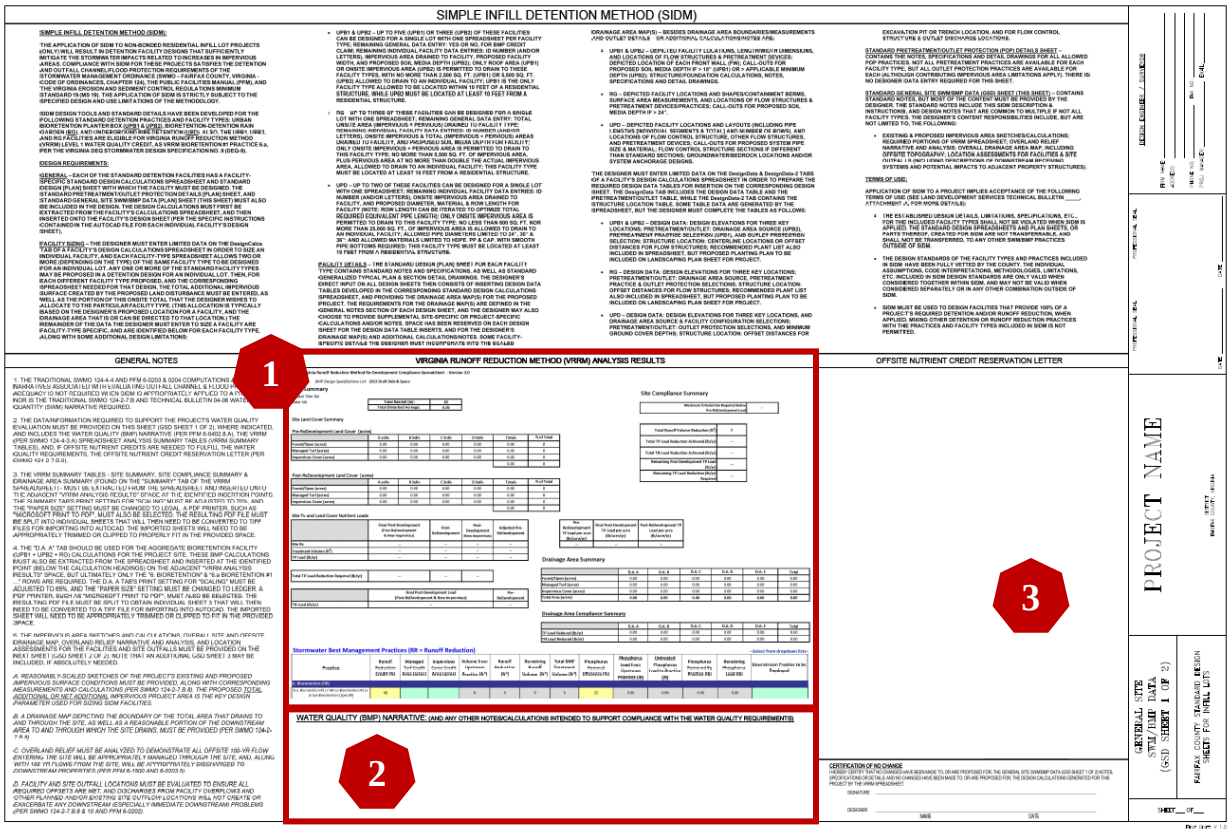



*Figure 31: General Site SWM / BMP Data Sheet 1 of 2*

The blank areas on the Design Sheet are for the designer to insert site-specific design information. See Figure 31 (above) for an example of the partially completed Standard Design Sheet for GSD sheet 1 of 2.

The design professional's responsibilites for completing this Design Sheet are as follows:

1. Insert the required portions of the project's Virginia Runoff Reduction Method (VRRM) spreadsheet, as described in the General Notes, in the blank space below the "Virginia Runoff Reduction Method (VRRM) Analysis Results" heading (see block 1, Figure 31).

   Note: the AutoCAD version of this Design Sheet includes instructions pertaining to inserting the required tables at the appropriate locations on the Design Sheet.

2. Insert or create the Water Quality Narrative, and any other notes or calculations intended to support compliance with the water quality requirements, in the blank space below the "Water Quality (BMP) Narrative" heading (see block 2, Figure 31).

3. If purchasing offsite nutrient credits to satisfy all, or part of the water quality requirements, insert the Offsite Nutrient Credit Availability Letter in the blank space below the heading with the same name (see block 3, Figure 31).

4. Complete the Design Sheet title block.

## *General Site SWM/BMP Data (GSD Sheet 2 of 2)*

This sheet is entirely blank (See Figure 32 below) and may be used by the designer to present information such as impervious area sketches, calculations, overall or offsite drainage area maps, overland relief narrative and analysis, and location assessments for facilities or site outfalls.

See General Note #5 on the GSD (sheet 1 of 2) Design Sheet for a list and descriptions of the minimum required information to be placed on this sheet for a SIDM project. Note that an additional GSD Design Sheet (2 of 2) may be developed if absolutely necessary, and would be distinguished from the original "2 of 2" sheet by adding the letter "B" to the end of the sheet title, as follows: (GSD Sheet 2 of 2)-B.


*Figure 32: GSD Design Sheet. Sheet 2 of 2*

## *Pretreatment / Outlet Protection Details Sheet*

The POP Design [Plan] Sheet (See Figure 33 below) includes the details and specifications for all of the pretreatment and outlet protection practices allowed under SIDM and must be included in a SIDM submittal plan set. Allowed pretreatment practices include Gutter Screen, Grass Filter Strip, In-Line Leaf Strainer/Separator, Debris Trap, Scour / Erosion Protection and Gravel Diaphragm. Outlet protection practices include Drywell, Scour / Erosion Protection, and Riprap Outlet Protection (modified VDOT EC-1). Refer to the design tables included on this Design Sheet to determine which of the specific practices are permitted for a particular facility type.

The design tables for identifying the permitted inflow and outlet pipe diameters and erosion protection practices for a particular contributing impervious area (and pipe slope for diameter determinations) are also located on this Design Sheet.

The designer must become familiar with the design criteria, limitations, and appropriate use of each pretreatment and outlet protection practice. No substitutions will be accepted for the practices and design tables as they are described and detailed on this Design Sheet.

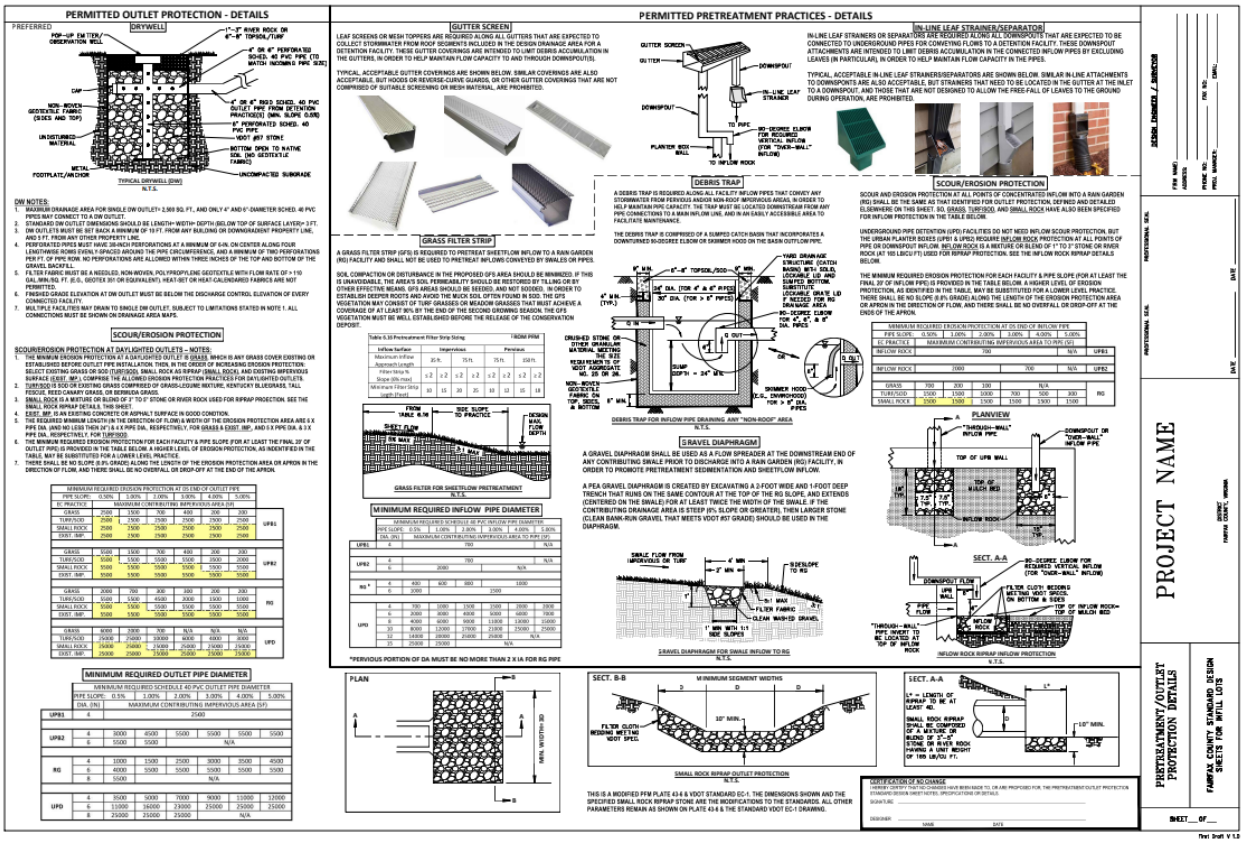



*Figure 33: Pretreatment / Outlet Protection Details Sheet*