Table of Contents

User Guide for the ACHD Stormwater Calculation Spreadsheet

General Description

This spreadsheet assists the plan designer and ACHD staff with stormwater design calculations. The spreadsheet format standardizes how calculations are submitted for review to establish consistency and streamline the review process. This saves Engineers and ACHD time in developing and reviewing stormwater calculations.

The designer can still use their traditional methods for stormwater calculations and enter their results into the spreadsheet for ACHD review.

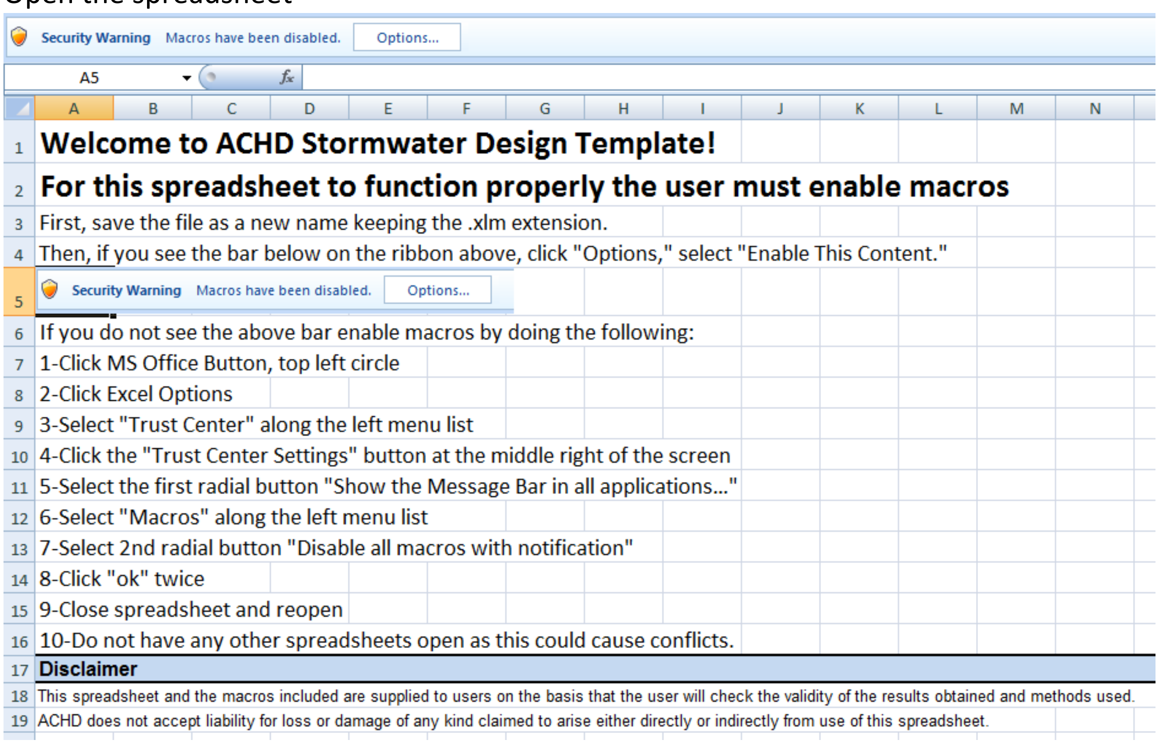
Methodology

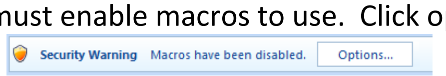
The spreadsheet uses ACHD Stormwater Policy Section 8000 & 8200 and FHWA Hydraulic Engineering Circular #22 (HEC-22) methodologies. The spreadsheet uses the Rational Method in accordance with ACHD policy section 8012 for watersheds up to 100-acres. A TR-55 module is also included for larger watersheds greater than 100-acres.

Download & Open

Check to be sure you are using the most current spreadsheet by checking the ACHD website at http://www.achdidaho.org/AboutACHD/PolicyManual.aspx, look under Section 8200 and click the link for 8000 Policy Stormwater Design Spreadsheet

Open the spreadsheet



The user must enable macros to use. Click options on the security bar and select "Enable This Content." 

a. Note current spreadsheet version is displayed on the welcome popup window.

Version 8.7

The current version of the spreadsheet is **Version 8.4 dated April, 2016**.

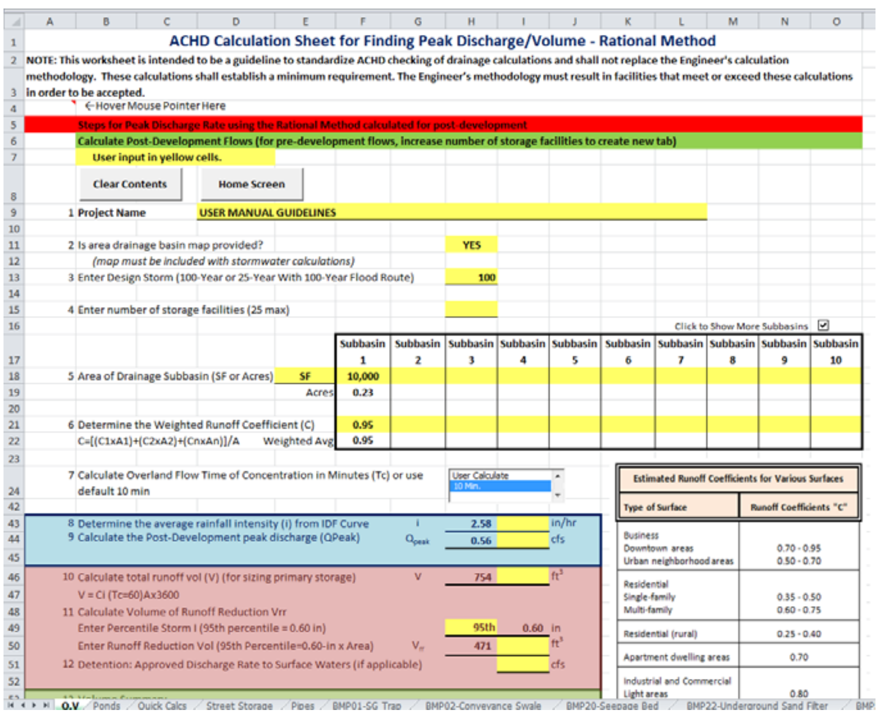
Navigating Around the ACHD Stormwater Spreadsheet

There are worksheet tabs for calculating storage volumes, peak flows, street and pipe capacity as well as sizing various approved BMPs.

Most tabs have line item numbers for reference. Throughout this guide, references are made to line item number and, when needed, by cell column and row number.

The user enters data into the yellow cells. The calculation portions of the spreadsheet are immediately left of a yellow cell. The user can override this calculated this value by entering a value into the yellow cell. Leaving a yellow cell blank results in the spreadsheet using the calculated default value unless user input is required.

The "Clear Contents" button included on every tab will clear the user entered values to start a new project. You should do a File/Save or click the floppy disk icon to save any data you want to keep prior to clicking the clear button.



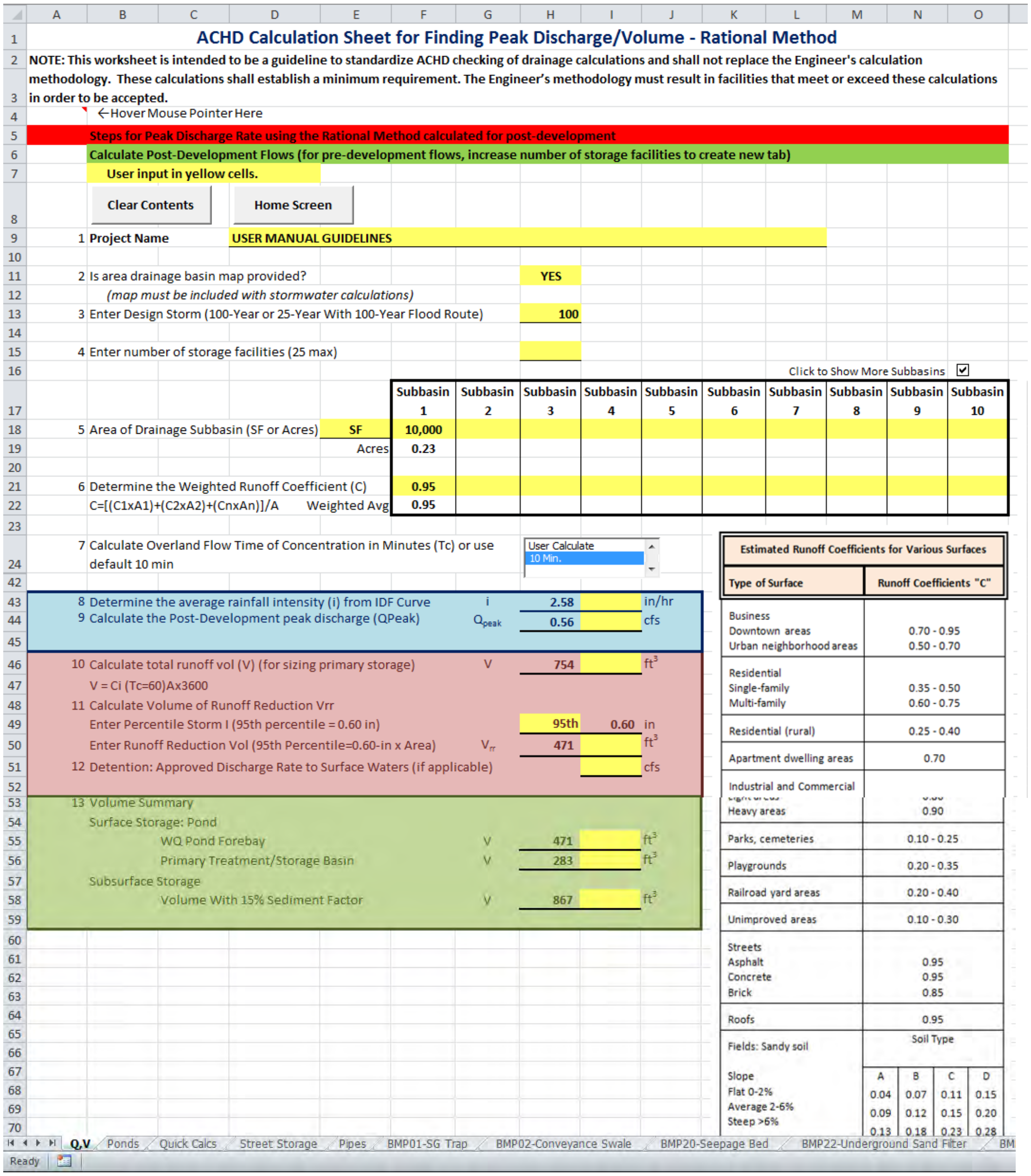
Printing

The tabs should be set up to print in a readable format. If you have problems printing, verify your general print settings are correct by printing a test page from another application.

If you still have problems, highlight the area to print with the mouse and/or keyboard arrows. Click Page Layout, select Print Area, Set Print Area, and click OK. Next select Page Setup, on the Page Tab under Scaling select "Print to" 1 page wide by 1 or 2 pages tall. Try printing again.

TAB 1: Q,V Tab

The first tab in the workbook is the “Q,V” tab. This tab is used to calculate peak flows and storage volume. Always start with this tab for sizing of storage facilities. The Q,V tab screen looks like this.



User data is entered to the yellow cells as described in the “Navigating Around the ACHD Stormwater Spreadsheet” section.

Line Item Description

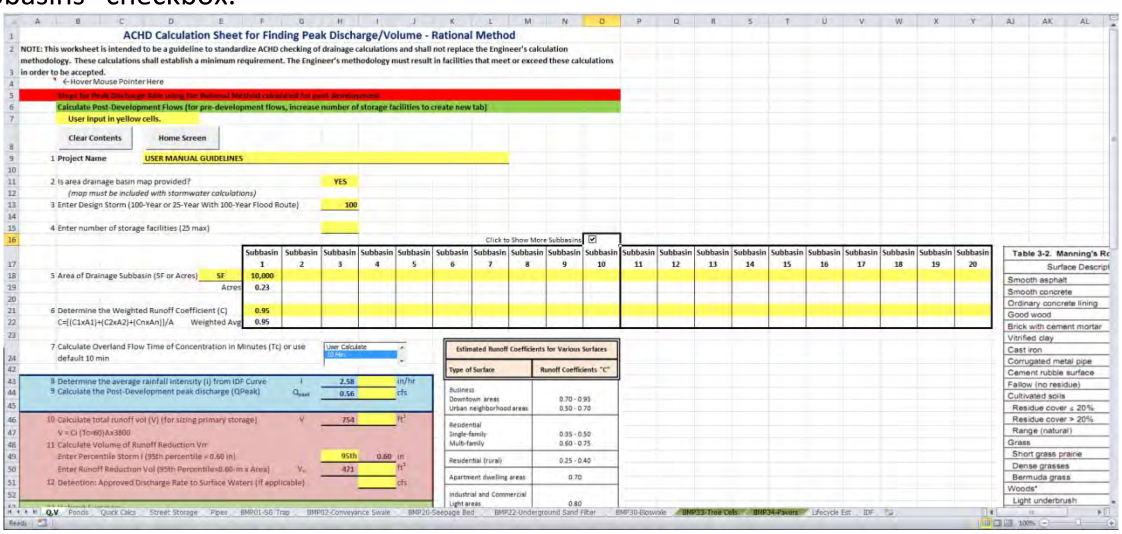
1. Start by entering the project name on line 1. The project name will carry through to all other tabs in the workbook.

2. On line 2, select “Yes” for drainage basin map. Default is Yes.
   If No is selected the remainder of the spreadsheet is hatched out as a reminder that the basin map is required. It is important to create and submit a color drainage area basin map with stormwater calculations as required by Policy Section 8013.6.

3. On line 3, select “100” Year design storm for sizing ACHD facilities.
   The 50, 25, 10, 5, 2 year storms may be used for other jurisdictional requirements or for calculating predevelopment flows as required by a ditch owner/operator.

4. Enter the number of storage facilities to design, up to 25 max on line 4. The spreadsheet will copy the Peak Q,V Tab creating tabs for the number of facilities entered up to 25 facilities.
   Note the “Clear” Button and line item #4 are removed on the copied tabs.
   To revise the number of storage facilities go to the original Peak Q,V Tab and either enter a different number of storage facilities or click “Clear” and reenter the new number of facilities. Entering a number less than was there previously will not delete tabs just in case you have entered something you do not want to lose.
   On the Project Name line #1, the spreadsheet will add Facility ## after the project name. Modify the default descriptors as needed to distinguish between each facility.

5. Enter basin areas in Acres or SF on line 5. Select the units from the yellow dropdown menu. Enter as many as 10 basins for sizing the primary storage facilities.
   Ten additional basins (20 total) can quickly be added by clicking the “Click to Show More Subbasins” checkbox.

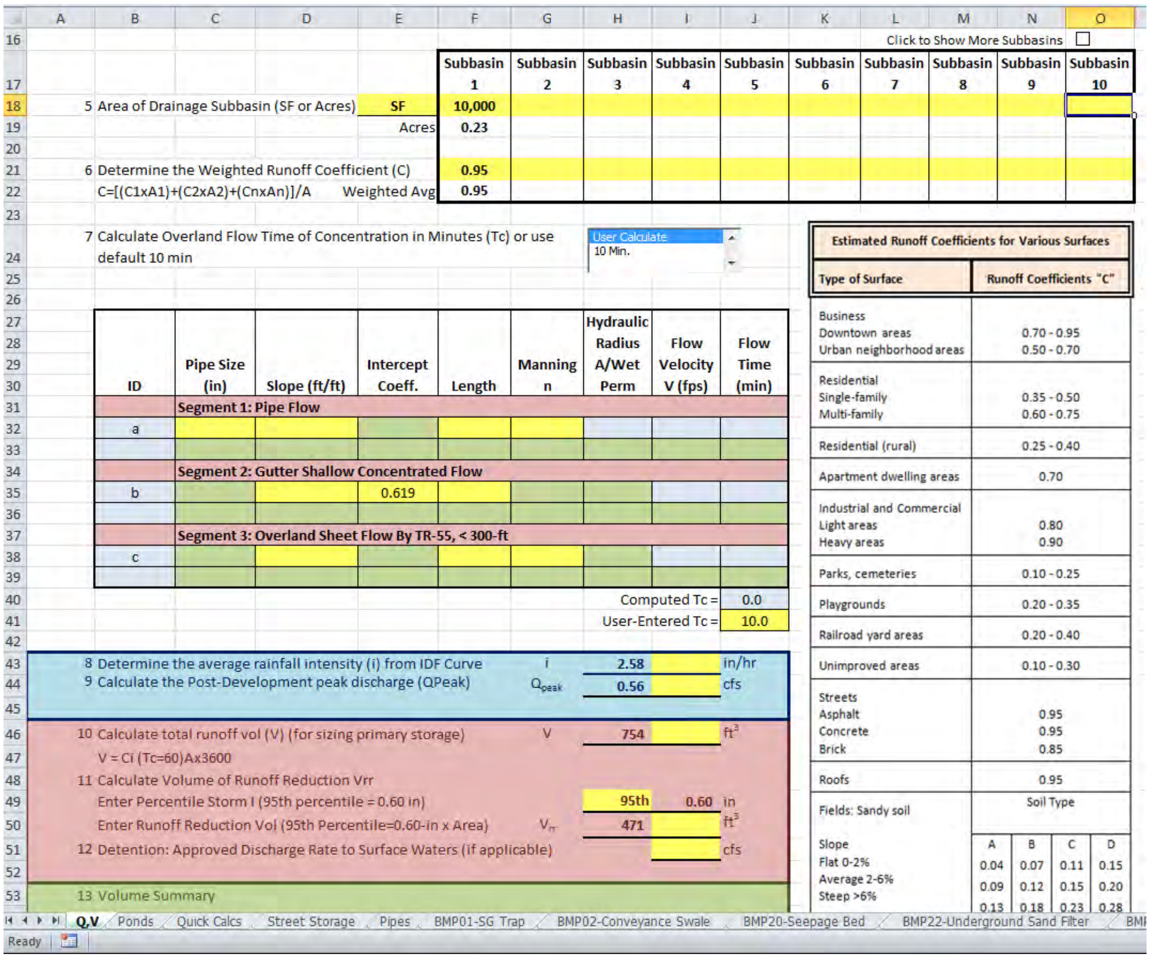


   The calculations are already set up to use these additional 10 basins if they are needed.
   To hide the additional 10 subbasins, click the “Click to Show More Subbasins” checkbox again.

6. Enter the Coefficient of Runoff factor for each basin on line 6. The spreadsheet calculates a weighted average C-Factor.

Note there is a table of C Factors right of the data area starting at Column AA. The other tables right of column AA are for Manning's n factors and Intercept Coefficients and will be described in the next section for Time of Concentration calculations.

7. The user can use the default Time of Concentration, Tc, of 10 minutes or calculate Tc for sheet and concentrated flow. If "User Calculate" is selected a data entry table will open up.



To Calculate Tc, work backwards starting at the outlet (end of the pipes), back to gutter flow, then back to sheet flow off the lots.

Enter the pipe size in Column C.

Enter the % slope in Column D (slope as a percent is 2 decimal places right).

Enter the length of pipe run into Column F.

Manning's n, enter into Column G. You can get Manning's Roughness Coefficients from the tables to the right of Column R. Note the first table is C-Factors (see #6). The fourth table is Manning's Coefficients (3-4).

Tc for Segment 1 should calculate once the row data is entered.

Segment 2 Tc is for gutter flow time in the street.

Go to Column D to enter the % slope. Calculate the gutter flow time on each side of the inlets and use the greater of the two.

The next column on the Tc calcs is the Intercept Coefficient (IC). This is a velocity and slope relationship used in FHWA HEC-22. The third table (3-3) to the right of Column R has the IC for various surfaces. Paved Areas is 0.619.

Enter the length of gutter flow in Column F.

Tc for Segment 2 should calculate once the row data is entered.

Finally calculate Segment 3, Overland Sheet Flow.

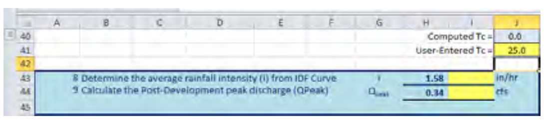
Enter the % slope into Column D.

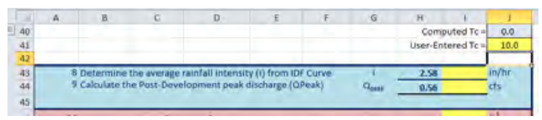
Enter the length into Column F.

Look at Table 3-2 to the right of Column R and find the Manning's n factor for Dense Grasses, n=0.24 or the applicable overland flow surface. Enter the n factor into Column G.

Tc for Segment 3 should calculate once the row data is entered. The spreadsheet gives a total Tc based on the greater values in Segments 1 through 3. Enter the Tc into Column J.

8. The rainfall intensity i changes with the values entered in the yellow User Entered Tc Cell J77. Shorter Tc = higher intensity i = greater peak flow.





9. The spreadsheet calculates the peak discharge on line 9 based on the C-Factor, rainfall intensity, and area.

10. The total runoff volume is calculated on line 10.

11. The Runoff Reduction storage volume is calculated on line 11. This is used for sizing of Runoff Reduction treatment BMPs. The current design standard for the percentile storm is the 95th percentile which is 0.60-inches.

12. Line 12 is where you enter any approved discharge rate to discharge to existing waterways. For on-site retention leave the yellow cell blank or enter 0.

13. Volume Summary online 13.

Volume for Surface Storage, Ponds is calculated. Ponds need to have a forebay and a primary storage basin.

Volume for Subsurface Storage, Seepage Beds, require a 15% sedimentation factor.

TAB for Q,V TR55 (Hidden Unless Selected from Menu)

The second tab in the workbook is the "Q,V TR55" tab. This tab is used to calculate peak flows and storage volume using HEC TR-55 methodology for large watersheds. An example using TR-55 methodology is included in this guide in the Examples section.

TAB 2: Ponds

The Ponds tab is used to size a pond forebay and primary basin. The Ponds tab is not listed as a specific BMP because there are multiple types of ponds: retention, detention, wet, extended detention, etc. An example for sizing a pond is included in this guide.

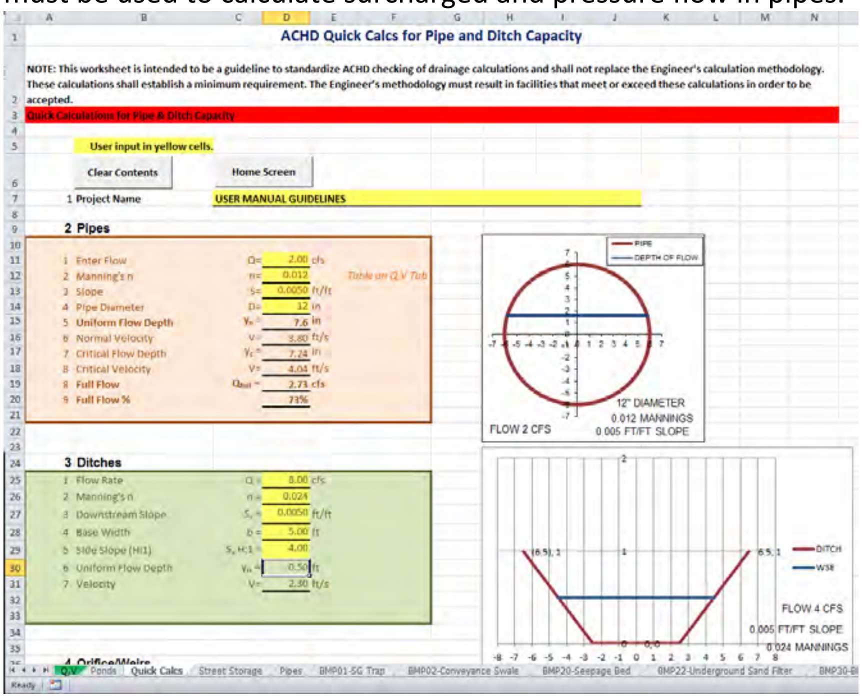
TAB 3: Quick Calcs

The Quick Calcs tab is a handy tool to quickly check the capacity of pipes, ditches and orifices/weirs.

Section 2-Pipes is the most popular and uses the following inputs to determine the maximum pipe capacity for gravity flow:

Flow, Q
Manning's n Roughness Coefficient
Slope
Pipe Diameter

Once these factors are entered, a graph of the pipe cross section and flow depth is displayed. The normal flow velocity, critical flow depth, and other factors are calculated. TAB 5, Pipes, must be used to calculate surcharged and pressure flow in pipes.



TAB 4: Street Storage

The Street Storage tab can be used to calculate inlet capacity, evaluate flow spread and estimate storage volume on the street surface.

TAB 5: Pipes

The Pipes tab can be used to plot a profile for a storm drain trunk line and check the Hydraulic Grade Line (HGL) to verify the system has capacity. The calculations are based on Hydraulic

Engineering Circular HEC-22 methodology. Tailwater and the effects of system surcharge are factored into the calculations. A conveyance system check example is included in this guide.

Example #1 for Peak Q,V Tab

Use Englefield Green 3 plans as an example to calculate storage volume to size a seepage bed. Plans are included in Appendix A of this guide.

Line Item Description

1. Enter Project Name: “Englefield Greens Example”

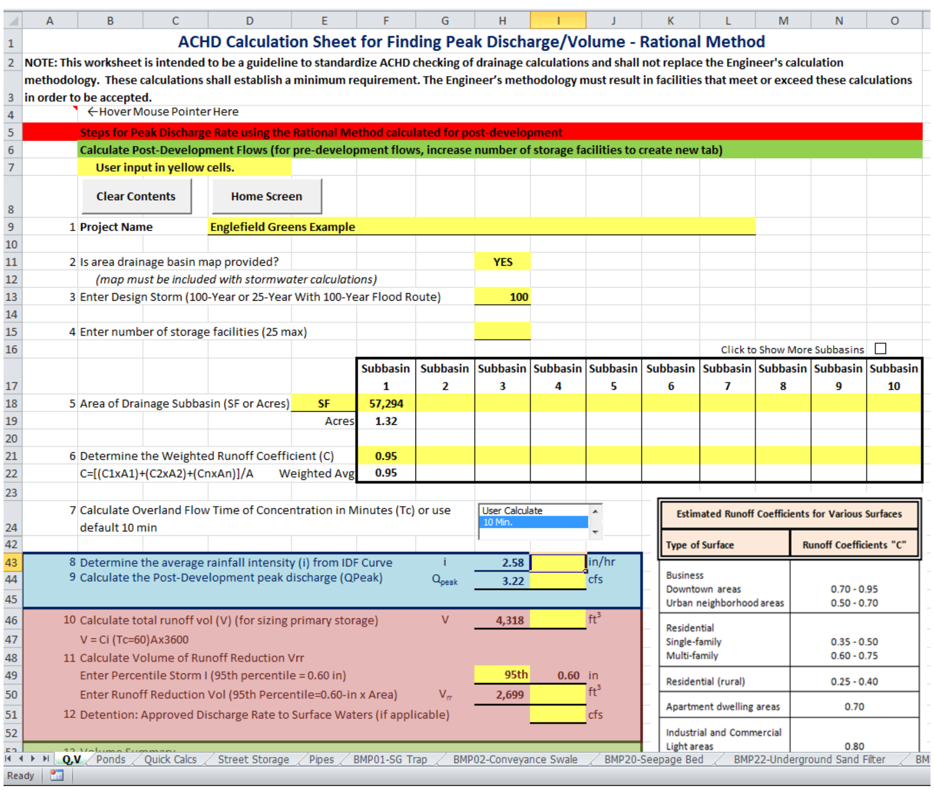
2. Select “Yes” for drainage basin map. Default is Yes.

3. Select “100” Year for design storm.

4. For Number of Storage Facilities enter 1.

5. Enter 57,294 SF area for drainage basin.

6. Enter C Factor of 0.95.



7. Use default Time of Concentration, Tc, of 10 min or calculate Tc. For this example we will calculate the Tc. Click “User Calculate” on the two item list for line #7.

Enter the pipe run between the inlets on the street for Segment 1.
Enter 12 for 12-inch pipe in Cell C32.
The plans show it is 0.5% slope so enter 0.005 in Cell D32 (slope percent is 2 decimal places right).
Length is 47-ft, enter in Cell F32.
Manning's n, Cell G41. You can get Manning's Roughness Coeff. from the tables to the right of Column R. Note the first table is C-Factors (see #5). The fourth table is Manning's Coefficients (3-4). Look for Plastic Pipe, Smooth. It has a range from .009 to .015. HDPE Smooth Wall is normally n=0.012 so use that.
Tc should calculate to 0.2 min for pipe flow segment 1.

For Segment 2 we are going to calculate the gutter flow time in the street.

Go to Cell D35 to enter the % slope. Looking at the plan profile you will see the inlets are in a sag. We want to calculate the gutter flow time on each side of the inlets and use the greater of the two. Start with the profile left of the DIs and enter 0.006 into Cell D35 for the slope.
The next column on our Tc calcs says Intercept Coefficient. This is a velocity and slope relationship used in HEC-22 created by FHWA. The third table (3-3) has the IC for Paved Areas is 0.619. The program defaults to 0.619 in Cell E35.
Enter 402 for length in Cell F35.
The spreadsheet calculates 4.3 min for Tc for gutter flow segment 2.

Finally calculate Segment 3, Overland Sheet Flow. Assume there are grass yards adjacent to this section of Allumbaugh.

Assume 1% slope, enter 0.01 into Cell D38.
Assume 50-ft length, enter 50 into Cell F38.
Look at Table 3-2 to the right and find Dense Grasses n=0.24. Enter 0.24 into Cell G65. The spreadsheet calculates Tc=17.7 min for overland flow segment 3.
The spreadsheet gets a total Tc of 22.1, so use 22.1 in Cell J41.

Click to Show More Subbasins ☐

		Subbasin 1	Subbasin 2	Subbasin 3	Subbasin 4	Subbasin 5	Subbasin 6	Subbasin 7	Subbasin 8	Subbasin 9	Subbasin 10
5 Area of Drainage Subbasin (SF or Acres)	SF	57,294									
	Acres	1.32									
6 Determine the Weighted Runoff Coefficient (C)		0.95									
C=[(C1xA1)+(C2xA2)+(CnxAn)]/A	Weighted Avg	0.95									

7 Calculate Overland Flow Time of Concentration in Minutes (Tc) or use default 10 min — User Calculate / 10 Min.

ID	Pipe Size (in)	Slope (ft/ft)	Intercept Coeff.	Length	Manning n	Hydraulic Radius A/Wet Perm	Flow Velocity V (fps)	Flow Time (min)
	Segment 1: Pipe Flow							
a	12	0.005		47	0.012	0.25	3.5	0.2
	Segment 2: Gutter Shallow Concentrated Flow							
b		0.006	0.619	402			1.6	4.3
	Segment 3: Overland Sheet Flow By TR-55, < 300-ft							
c		0.010		50	0.240		2.8	17.7
							Computed Tc =	22.1
							User-Entered Tc =	22.1

8 Determine the average rainfall intensity (i) from IDF Curve	i	1.81		in/hr
9 Calculate the Post-Development peak discharge (QPeak)	Q_{peak}	2.26		cfs
10 Calculate total runoff vol (V) (for sizing primary storage)	V	4,318		ft^3
V = Ci (Tc=60)Ax3600				
11 Calculate Volume of Runoff Reduction Vrr				
Enter Percentile Storm I (95th percentile = 0.60 in)		95th	0.60	in
Enter Runoff Reduction Vol (95th Percentile=0.60-in x Area)	V_{rr}	2,699		ft^3
12 Detention: Approved Discharge Rate to Surface Waters (if applicable)				cfs
13 Volume Summary				

Q,V | Ponds | Quick Calcs | Street Storage | Pipes | BMP01-SG Trap | BMP02-Conveyance Swale | BMP20-Seepage Bed | BMP22-Underground Sand Filter | BMP3
Ready

Estimated Runoff Coefficients for Various Surfaces

Type of Surface	Runoff Coefficients "C"			
Business Downtown areas Urban neighborhood areas	0.70 - 0.95 0.50 - 0.70			
Residential Single-family Multi-family	0.35 - 0.50 0.60 - 0.75			
Residential (rural)	0.25 - 0.40			
Apartment dwelling areas	0.70			
Industrial and Commercial Light areas Heavy areas	0.80 0.90			
Parks, cemeteries	0.10 - 0.25			
Playgrounds	0.20 - 0.35			
Railroad yard areas	0.20 - 0.40			
Unimproved areas	0.10 - 0.30			
Streets Asphalt Concrete Brick	0.95 0.95 0.85			
Roofs	0.95			
Fields: Sandy soil	Soil Type			
Slope	A	B	C	D
Flat 0-2%	0.04	0.07	0.11	0.15
Average 2-6%	0.09	0.12	0.15	0.20
Steep >6%	0.13	0.18	0.23	0.28

8. Rainfall intensity calculates to 1.81 in/hr.

9. Post Development Qpeak calculates to 2.26 cfs.

10. Runoff Volume calculates to 4,318 ft^3.

11. Runoff Reduction Volume calculates to 2,699 ft3 using a 95^{th} percentile 0.60 in.

12. Detention: Discharge rate leave blank.

13. Summary

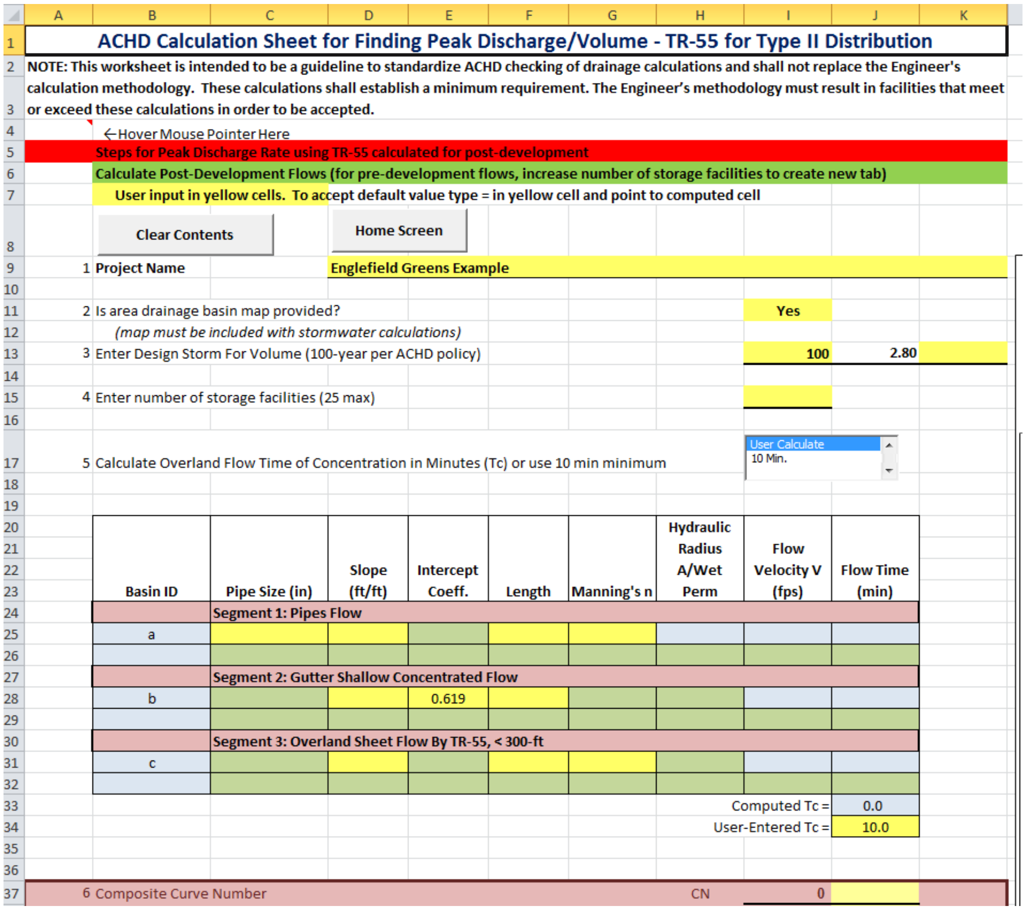
    Ignore Surface Storage, Pond since we are sizing a seepage bed.

    For Subsurface Storage – Seepage Bed Volume calculates to 4,966 cf volume with 15% sediment factor.

Go to the tab "BMP20-Seepage Bed." Follow Example #7 for Sizing a Seepage Bed.

TR-55 Tab

TR-55 can be used for watersheds greater than 100-acres. Peak flows and volume sizing are greater than the values calculated using the Rational Method. The Peak Q,V tab screen looks like this.



ACHD Calculation Sheet for Finding Peak Discharge/Volume - TR-55 for Type II Distribution

NOTE: This worksheet is intended to be a guideline to standardize ACHD checking of drainage calculations and shall not replace the Engineer's calculation methodology. These calculations shall establish a minimum requirement. The Engineer's methodology must result in facilities that meet or exceed these calculations in order to be accepted.

←Hover Mouse Pointer Here

Steps for Peak Discharge Rate using TR-55 calculated for post-development

Calculate Post-Development Flows (for pre-development flows, increase number of storage facilities to create new tab)

User input in yellow cells. To accept default value type = in yellow cell and point to computed cell

Clear Contents | Home Screen

1 Project Name: Englefield Greens Example

2 Is area drainage basin map provided? Yes

(map must be included with stormwater calculations)

3 Enter Design Storm For Volume (100-year per ACHD policy): 100 | 2.80

4 Enter number of storage facilities (25 max)

5 Calculate Overland Flow Time of Concentration in Minutes (Tc) or use 10 min minimum: User Calculate / 10 Min.

Basin ID	Pipe Size (in)	Slope (ft/ft)	Intercept Coeff.	Length	Manning's n	Hydraulic Radius A/Wet Perm	Flow Velocity V (fps)	Flow Time (min)
	Segment 1: Pipes Flow							
a								
	Segment 2: Gutter Shallow Concentrated Flow							
b			0.619					
	Segment 3: Overland Sheet Flow By TR-55, < 300-ft							
c								

Computed Tc = 0.0

User-Entered Tc = 10.0

6 Composite Curve Number | CN | 0

7	Ia=(200/CN)-2	Ia	0.00
8	Ia/P	Ia/P	0.00

Watershed Table

9 Cover Type		Soil Type	Acres	Miles^2	CN (from TR-55)	S	Q Runoff (in)	Runoff Volume (ft^3)
Open Space (lawns,parks,golf courses, cemeteries, etc)								
Poor condition (grass cover <50%)				0.00	89	1.2	1.72	0
Fair condition (grass cover 50% to 7				0.00	84	1.9	1.35	0
Good condition (grass cover >75%)				0.00	80	2.5	1.10	0
Urban Districts								
Commercial and business				0.00	95	0.5	2.25	0
Industrial				0.00	93	0.8	2.06	0
Residential Districts by Average Lot Size								
1/8 acre or less (town houses)				0.00	92	0.9	1.97	0
1/4 acre				0.00	87	1.5	1.57	0
1/3 acre				0.00	86	1.6	1.49	0
1/2 acre				0.00	85	1.8	1.42	0
1 acre				0.00	84	1.9	1.35	0
2 acres				0.00	82	2.2	1.22	0
Impervious Areas								
				0.00	98	0.2	2.57	0
Other:				0.00		0.0	2.80	0
10 **TOTAL:**			**0.00**	**0.00**				**0**

Q Runoff (in) = P-0.2 x ((1000/CN)-10)]^2/[P+0.8x(1000/CN)-10)]
24_Hr_Storm= 100-Year, 24-Hour Rainfall (in)
S = 1000/ CN - 10
CN = Curve Number
Q = Runoff (cfs)

Area = Area of land cover (ft^2)
P= 24 Hour Storm
Runoff Volume (ft^3) = Q x 1/12 x Area

11	Runoff Volume Watershed Inches	Qa	0.000		Wtrshd In
12	Calculate total runoff vol (V) (for sizing primary storage)	V	0		ft^3
13	Enter Percentile Storm i (80th percentile = 1.20 in for 24 hr)	P_{80th}	80th	1.20	in
14	Enter WQ Volume +15% (V_{WQ} = P80th-0.2x(1000/CN-10)^2/(P80th+0.8xA (in sf)) x 1.15	V_{WQ}	0		ft^3
15	Enter approved discharge rate for the given storm (if applicable)				cfs
16	Area Miles^2	A_Mi^2	0.00		Area Mi^2
17	Unit Peak Discharge from TR-55 Exhibit 4-11	Qu	800		cfs/mi^2/in
18	Calculate the Post-Development peak discharge Q_{peak}=Qu x A_Mi^2 x Qa	Q_{peak}	0.00		cfs
19	Calculate peak Q_{WQ} (uses 2-yr storm)	Q_{WQ}	0.00		cfs
	(used for S/G Trap throat velocity, WQ storm conveyance system sizing)				
	Unit Peak Discharge from TR-55 Exhibit 4-11	Qu_{WQ}	0	cfs/mi^2/in	
	Runoff Volume Watershed Inches	Qa_{WQ}	0.00	Wtrshd In	
	Ia=(200/CN)-2	Ia_{WQ}	0.00		
	Ia/P	Ia/P_{WQ}	0.00		

20	Summary				
	Surface Storage: Pond				
	WQ Pond Forebay + 15% sediment	V	0		ft^3
	Primary Treatment/Storage Basin	V	0		ft^3
	Subsurface Storage: Seepage Bed				
	Volume Without Sediment Factor	V	0		ft^3
	See BMP04 Seepage Bed for Design Volume With Sediment				

Q,V TR55

Ready

User data is entered to the yellow cells as described in the "Navigating Around the ACHD Stormwater Spreadsheet" section.

Line Item Description

1. Start by entering the project name on the Peak Q,V Tab. The project name entered on the Peak Q,V Tab will carry through to all other tabs in the workbook.

2. Select "Yes" for drainage basin map. Default is Yes.
   If No is selected the remainder of the spreadsheet is hatched out as a reminder that the basin map is required. It is important to create and submit the drainage area basin map with stormwater calculations.

3. Select "100" Year for design storm for sizing ACHD facilities.
   The 50, 25, 10, 5, 2 year storms may be used for other jurisdictional requirements or for calculating predevelopment flows as required by a ditch owner/operator.

4. Enter the number of storage facilities to design, up to 25 max. The spreadsheet will copy the Peak Q,V TR55 Tab creating tabs for the number of facilities entered up to 25 facilities.

   Note the "Clear" Button and line item #4 are removed on the copied tabs.

   To revise the number of storage facilities go to the original Peak Q,V TR55 Tab and either enter a different number of storage facilities or click "Clear" and reenter the new number of facilities. Entering a number less than was there previously will not delete tabs just in case you have entered something you do not want to lose.

   On the Project Name line #1, the spreadsheet will add Facility ## after the project name. Modify the default descriptors as needed to distinguish between each facility.

5. The user can use the default Time of Concentration, Tc, of 10 min or calculate Tc. If User Calculate is selected a data entry table will open up. See Line Item Description on Peak Q,V Tab for details on how to complete the Tc calculations.

6. Select Composite Curve Number CN.
   This is computed using a weighted average from the CNs entered in the table 9 below.

7. Ia=(200/CN)-2. Calculated or override in yellow cell.

8. Ia/P. Calculated or override in yellow cell.

9. Watershed Table.
   Several ground conditions and soil types are pre-entered into the table.
   The user first selects the units to enter subbasin areas: Acres or Square Miles in cell F41.
   Select the Soil Type in Column E, enter the area in Acres or Miles^2 into Column F. The appropriate Curve Number CN in Column H is determined by the program.

10. Total. The spreadsheet totals the area and volume.

11. Runoff Volume in Watershed Inches.

12. Total Runoff Volume for Primary Storage Facilities in cubic feet is calculated.

13. Enter the Percentile Runoff Reduction Storm i.

14. Enter the Runoff Reduction Volume.

15. Enter the approved discharge rate (if applicable).

16. Area in Square Miles is calculated from the Watershed Table, line item 9 data.

17. The Unit Peak Discharge Qu changes with the values entered in the yellow User Entered Tc Cell J34. Shorter Tc = higher intensity Qu = greater peak flow.
    The spreadsheet calculates the unit peak discharge based on the Tc and a lookup table for TR-55 for Ia/P.
    See TR-55 methodology for more information at NRCS TR-55: http://www.nrcs.usda.gov/

18. The peak discharge Qpeak is calculated.

19. The peak Runoff Reduction discharge Qrr is calculated.
    A preliminary Runoff Reduction Curve Number is selected given the 80^{th} percentile storm of 1.2-inches or 95^{th} percentile storm of 1.6-inches.
    Unit Peak Discharge Qu_{WQ} in $cfs/mi^2/in$.
    Runoff Volume in Watershed Inches Qa_{WQ}
    $Ia_{WQ} = 200/CN - 2$
    $Ia/P = Ia_{WQ}/P80th$

20. Summary
    Volume for Surface Storage, Ponds is calculated.

    Volume for Subsurface Storage, Seepage Beds which includes a 15% sedimentation factor.

Example #2 for TR-55 Tab

Use the TR-55 Example to calculate storage volume to size a pond.
Plans are included in Appendix A of this guide.

Line Item Description

1. Enter Project Name: “TR-55 Example”

2. Select “Yes” for drainage basin map. Default is Yes.

3. Select “50” Year for design storm.
   For this example override the P=2.60 in/24-hrs for the Boise area to 6.5 in/24-hrs for Franklin County, Missouri.

4. For Number of Storage Facilities enter 1.

5. Select User Calculate.
   Enter “=.195*60” or 11.7 into Cell J34 for Tc.

   Skip to line 9, select Acres.
   Go to Other at bottom of table. Enter 12.5 acres, 78 CN.

6. The Composite CN shows 78.
   Note if additional watershed areas were entered into the table the spreadsheet would calculate a weighted CN.

7. Ia calculates to 0.56.

8. Ia/P calculates to 0.09.

9. Entered prior.

10. Total shows the 12.5 acres and total volume of 182,584 cf.
    Note this matches the on A-11 of the Win TR-55 software example.

11. Qa calculates to 4.024 watershed inches.
    This converts to 4.024 watershed inches x 1-in/12-ft x 12.5 acres x 43560 ft^2 / acre = 182,584 ft^3.

12. Total Runoff Volume calculates to 182,584 ft^3.

13. The default for the 95^{th} Percentile Storm for Runoff Reduction is 1.6-in/24-hrs.

14. The Runoff Reduction volume calculates to 14,520 cf.

15. Approved Discharge Rate. This project retains on-site so enter 0.

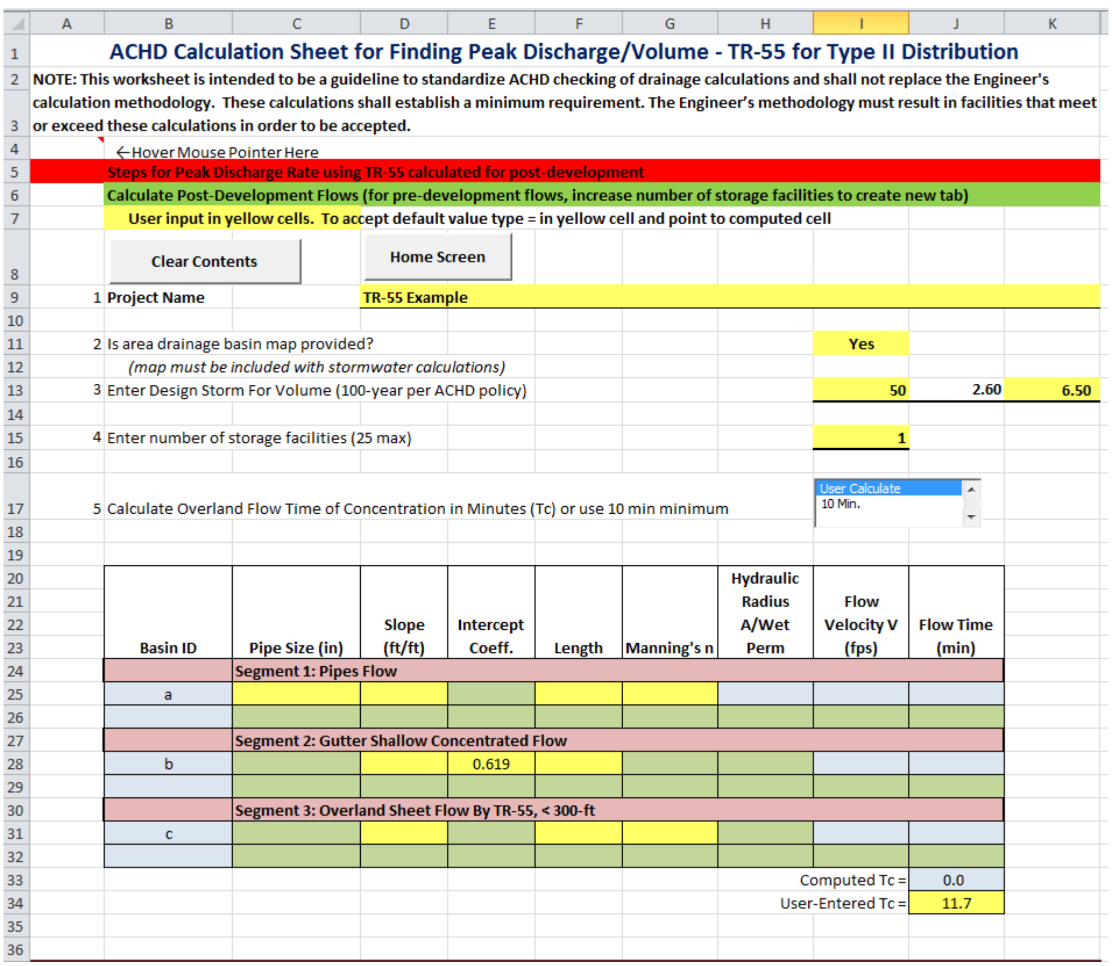
16. The spreadsheet converts 12.5 acres to miles^2 = 0.02.

17. The Unit Peak Discharge Qu calculates to 800 cfs/mi^2/in.

18. Qpeak calculates to 62.87 cfs.
    Note this is close to the value of 66.81 cfs calculated on pages A-9 and A-11 of the example using Win TR-55 software.

19. Qrr calculates to 3.53 cfs.
    Note this value is low because the 95th percentile WQ storm for Boise is 1.6-in/24 hrs. The storm used for this Franklin County, Missouri example is 6.5-in/24-hrs.

20. Summary
    Surface Storage: Pond calculates to:
    Runoff Reduction Volume=14,520 cf
    Primary Storage =168,064 cf



6 Composite Curve Number	CN	78
7 Ia=(200/CN)-2	Ia	0.56
8 Ia/P	Ia/P	0.09

Watershed Table

9 Cover Type		Soil Type	Acres	Miles^2	CN (from TR-55)	S	Q Runoff (in)	Runoff Volume (ft^3)
Open Space (lawns,parks,golf courses, cemeteries, etc)								
Poor condition (grass cover <50%)				0.00	89	1.2	5.22	0
Fair condition (grass cover 50% to 7				0.00	84	1.9	4.67	0
Good condition (grass cover >75%)				0.00	80	2.5	4.24	0
Urban Districts								
Commercial and business				0.00	95	0.5	5.91	0
Industrial				0.00	93	0.8	5.68	0
Residential Districts by Average Lot Size								
1/8 acre or less (town houses)				0.00	92	0.9	5.56	0
1/4 acre				0.00	87	1.5	5.00	0
1/3 acre				0.00	86	1.6	4.89	0
1/2 acre				0.00	85	1.8	4.78	0
1 acre				0.00	84	1.9	4.67	0
2 acres				0.00	82	2.2	4.45	0
Impervious Areas								
				0.00	98	0.2	6.26	0
Other:			**12.50**	0.02	**78**	2.8	4.02	182,584
10 **TOTAL:**			**12.50**	**0.02**				**182,584**

Q Runoff (in) = P-0.2 x ((1000/CN)-10)]^2/[P+0.8x(1000/CN)-10)]

24_Hr_Storm= 100-Year, 24-Hour Rainfall (in)

S = 1000/ CN - 10

CN = Curve Number

Q = Runoff (cfs)

Area = Area of land cover (ft^2)

Row	No.	Description	Symbol	Value	Input	Units
68		P= 24 Hour Storm				
69		Runoff Volume (ft^3) = Q x 1/12 x Area				
70						
71	11	Runoff Volume Watershed Inches	Qa	4.024		Wtrshd In
72	12	Calculate total runoff vol (V) (for sizing primary storage)	V	182,584		ft^3
73						
74	13	Enter Percentile Storm i (95th percentile = 1.60 in for 24 hr)	P_{95th}	95th	1.60	in
75	14	Enter Runoff Reduction Volume +15% (Vrr = P95th-0.2x(1000/CN-10)^2/(P95th+0.8xA (ir	Vrr	14,520		ft^3
76	15	Enter approved discharge rate for the given storm (if applicable)			0.00	cfs
77						
78	16	Area Miles^2	A_Mi^2	0.02		Area Mi^2
79	17	Unit Peak Discharge from TR-55 Exhibit 4-11	Qu	800		cfs/mi^2/in
80	18	Calculate the Post-Development peak discharge Q_{peak}=Qu x A_Mi^2 x Qa	Q_{peak}	62.87		cfs
81	19	Calculate peak Qrr (uses 2-yr storm)	Qrr	3.53		cfs
82		(used for S/G Trap throat velocity, rr storm conveyance system sizing)				
83		Unit Peak Discharge from TR-55 Exhibit 4-11	Qu rr	650	cfs/mi^2/in	
84		Runoff Volume Watershed Inches	Qa rr	0.28	Wtrshd In	
85		Ia=(200/CN)-2	Iarr	0.56		
86		Ia/P	Ia/Prr	0.35		
87						
88	20	Summary				
89		Surface Storage: Pond				
90		Runoff Reduction Pond Forebay	V	14,520		ft^3
91		Primary Treatment/Storage Basin	V	168,064		ft^3
92		Subsurface Storage: Seepage Bed				
93		Volume With 15% Sediment Factor	V	209,972		ft^3

Q,V TR55

Ready

Street Storage

This tab is set up as a quick check to look at flow spread on the pavement of an urban street section. Once the data for item #8 is entered, a cross section of the street is plotted at the lower right of the screen. The water spread on the pavement is shown with a blue line. The face of curb is the vertical line.

Line Item Description

1. Project Name. The last project name used on the Peak Q,V Tab is used.

2. Functional Street Classification. Select Local, Collector, or Arterial.

3. Curb Type. The two curb options available are the only two ISPWC approved curbs:
   1-6” Standard Vertical Curb
   2-3” Rolled Curb

4. Height of Curb at Gutter Flowline. This is automatically entered as 5.75-in for 6” Standard Curb and 3.25-in for 3” Rolled Curb.

5. Gutter Depression a. This is automatically entered as 1.25-in for both 6” and 3” curb.

6. Gutter Width w. Automatically entered as 1.5-ft for 6” Curb and 1.17-ft for 3” Curb.

7. Gutter Cross Slope Sw. Per HEC-22 this is a/w + Sw. For 6” Curb it is automatically entered as .069 and for 3” Rolled Curb is entered as 0.089.

8. Distance From TBC to Street Crown. The half street section from Top Back Curb to crown.

9. Pavement Cross Slope.

10. Planter Width.

11. Planter Cross Slope.

12. Sidewalk Width.

13. Longitudinal Slope.

14. Manning’s Roughness Coefficient for Street Section. Manning’s Roughness Coefficients for various street sections is included in table 4.3 to the right.

15. Maximum Allowable Spread. The value the user must meet or exceed the minimum requirements for dry pavement.

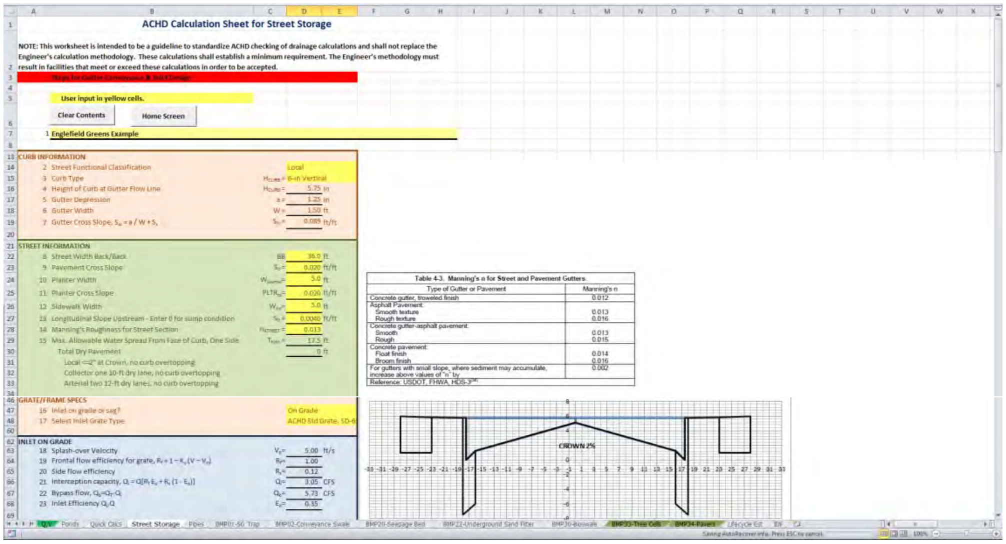
    Requirements for dry pavement:

Total Dry Pavement

Local <=2" at Crown, no curb overtopping

Collector one 10-ft dry lane, no curb overtopping

Arterial two 12-ft dry lanes, no curb overtopping



16. Inlet on Grade or Sag? This dropdown affects the inlet capacity calculations. If on grade there may be bypass flow but if in a sag there is assumed no bypass flow.

17. Select Inlet Grate Type. There are two options available for ISPWC Standard grates
    1-SD-610A with vertical bars
    2- SD-610A with 45° Bars

18. Splash Over Velocity. Calculated

19. Frontal Flow Efficiency. Calculated.

20. Side Flow Efficiency. Calculated.

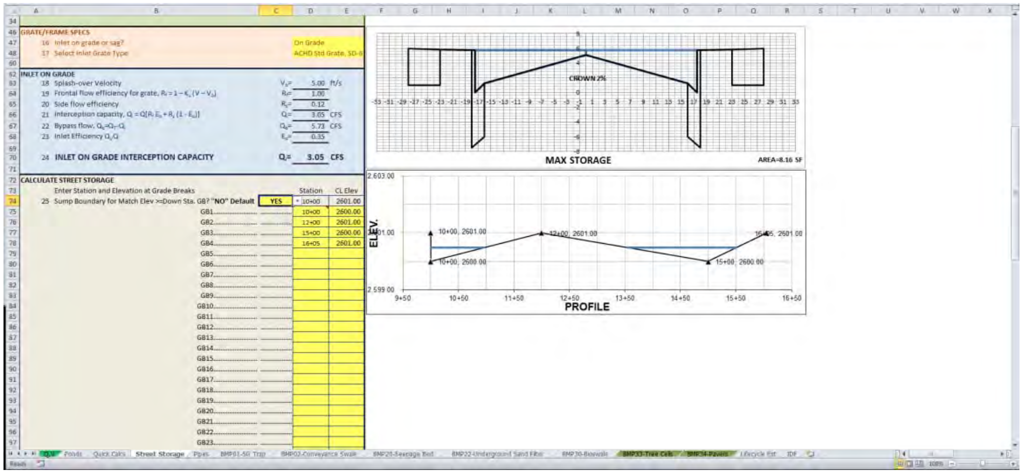
21. Interception Capacity. Calculated.

22. Bypass Flow. Calculated.

23. Inlet Efficiency. Calculated.

24. Inlet on Grade Interception Capacity. Calculated.

25. Enter profile grade breaks.


GRATE/FRAME SPECS
16 Inlet on grade or sag?
On Grade
17 Select Inlet Grate Type
ACHD Std Grate, SD-6
INLET ON GRADE
18 Splash-over Velocity
5.00 ft/s
19 Frontal flow efficiency for grate
1.00
20 Side flow efficiency
0.12
21 Interception capacity
3.05 CFS
22 Bypass flow
5.73 CFS
23 Inlet Efficiency
0.35
24 INLET ON GRADE INTERCEPTION CAPACITY
3.05 CFS
CALCULATE STREET STORAGE
Enter Station and Elevation at Grade Breaks
Station
CL Elev
25 Sump Boundary for Match Elev >=Down Sta. GB? "NO" Default
YES
10+00
2601.00
GB1
10+00
2600.00
GB2
12+00
2601.00
GB3
15+00
2600.00
GB4
16+05
2601.00
CROWN 2%
MAX STORAGE
AREA=8.16 SF
ELEV.
PROFILE
10+00, 2601.00
10+00, 2600.00
12+00, 2601.00
15+00, 2600.00
16+05, 2601.00
Street Storage

Pipes Tab

This tab combines all the conveyance factors together onto one summary. The worksheet starts by entering information regarding the pavement width, Street Classification, Manning's n Friction Factors, high water elevation, Curb Type, Allowable Spread. The user then enters information about each manhole including pipe lengths, pipe sizes, pipe direction from manhole and invert elevations. Next data for the inlets, drainage basin size and C Factor, Gutter Slope are entered.

The spreadsheet plots manholes, pipes and a finish grade profile along with the calculated Hydraulic Grade Line (HGL) in red. If the HGL plots above a manhole the manhole there is risk water will surcharge and come out of the inlets or manhole. The design must be checked and modified when this is the case.

Manholes & Inlets

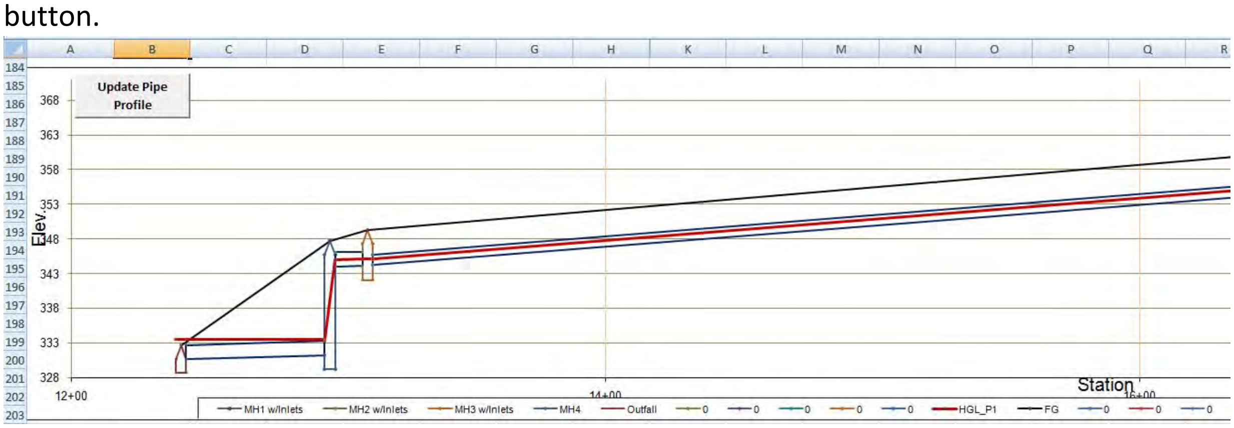
Inlets join the drainage system at manhole locations. The dropdown menu for manholes includes MH#x and MH#x w/Inlets. When MH#x w/Inlets is selected, cells are colored yellow in Columns R & S for DI Rt. and DI Lt. where invert elevations for the inlet pipe at the MH are entered. Plunging flow from the inlets has minor impact the HGL calculations but should not be overlooked.

Outfall

Once all the pipes and manholes are entered a dummy manhole must be placed at the end of the pipe run called "Outfall." "Outfall" is an option from the dropdown menu for every manhole. The main purpose of the "Outfall" is to tell the spreadsheet where the end of the system to analyze is. The calculations start at the "Outfall" and work back through the system to be beginning.

Use Update Pipe Profile Button

A plot of the profile is included at the bottom of the worksheet. If the profile plot does not update once data is entered for a manhole and pipe section, click the "Update Pipe Profile" Button at the top left of the graph. Sometimes the manholes and finish grade line will plot without the Hydraulic Grade Line. When that happens, simply hit the "Update Pipe Profile" button.

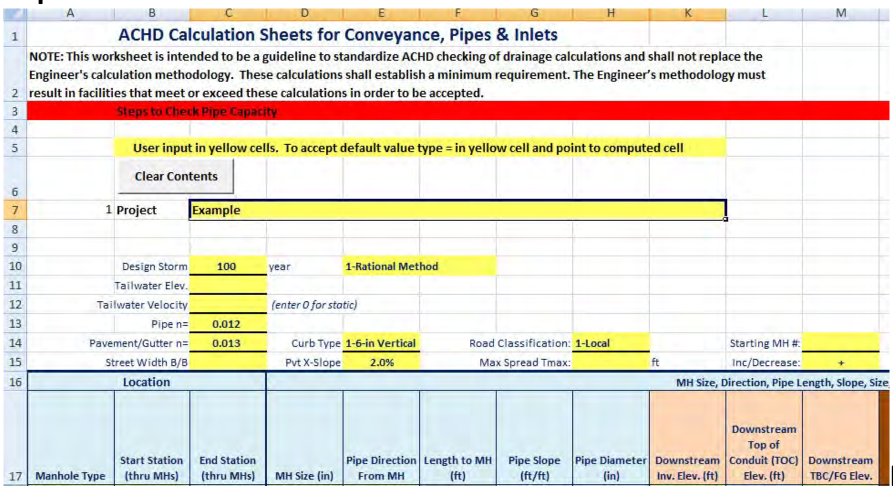


Data Entry

This worksheet does not have line item numbers for each yellow data entry point so the worksheet will be described in groups.

Line Item Description

Top Part


ACHD Calculation Sheets for Conveyance, Pipes & Inlets
NOTE: This worksheet is intended to be a guideline to standardize ACHD checking of drainage calculations and shall not replace the Engineer's calculation methodology. These calculations shall establish a minimum requirement. The Engineer's methodology must result in facilities that meet or exceed these calculations in order to be accepted.
Steps to Check Pipe Capacity
User input in yellow cells. To accept default value type = in yellow cell and point to computed cell
Clear Contents
1 Project: Example
Design Storm: 100 year; 1-Rational Method
Tailwater Elev.
Tailwater Velocity (enter 0 for static)
Pipe n= 0.012
Pavement/Gutter n= 0.013; Curb Type: 1-6-in Vertical; Road Classification: 1-Local; Starting MH #:
Street Width B/B; Pvt X-Slope: 2.0%; Max Spread Tmax: ft; Inc/Decrease: +
Location; MH Size, Direction, Pipe Length, Slope, Size
Manhole Type | Start Station (thru MHs) | End Station (thru MHs) | MH Size (in) | Pipe Direction From MH | Length to MH (ft) | Pipe Slope (ft/ft) | Pipe Diameter (in) | Downstream Inv. Elev. (ft) | Downstream Top of Conduit (TOC) Elev. (ft) | Downstream TBC/FG Elev.

Project Name. Enter in Line

1. Item #1 or the name pulls from the Peak Q,V Tab.
   Design Storm. Data pulls from the Peak Q,V Tab.

   Rational Method or TR-55. Use the dropdown menu to select between either of the two options.

   Tailwater Elev. This is the 100-year high water elevation in a pond, seepage bed or other storage facility.

   Tailwater Velocity. If the pipe outfalls to a stream enter the velocity of the waterway.

   Pipe n. This is Manning's n coefficient for the pipe. Table 3-4 to the right of the worksheet has typical Manning's n coefficients for pipes starting at Column ER.

   Pavement/Gutter n. This is Manning's n coefficient for the pavement and gutter section. Table 4-3 to the right of Table 3-4 has typical Manning's n coefficients for pavement and gutter sections.

   Street Width B/B. Enter the Back of Curb to Back of Curb width of the street. This width is used to calculate the amount of dry pavement remaining once the water spread is calculated.

   Curb Type. The two curb options available are the only two ISPWC approved curbs:
   1-6" Standard Vertical Curb
   2-3" Rolled Curb

Pavement X-Slope.

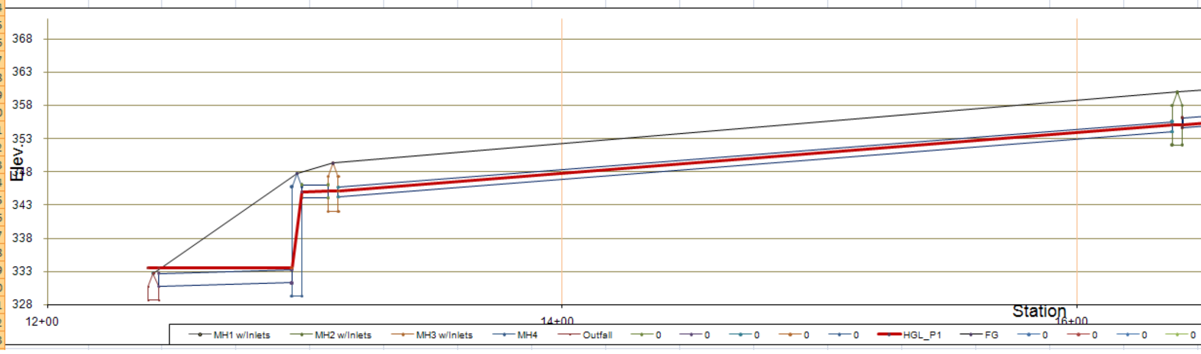
Road Classification. Select between three classifications of roadway from the dropdown menu.

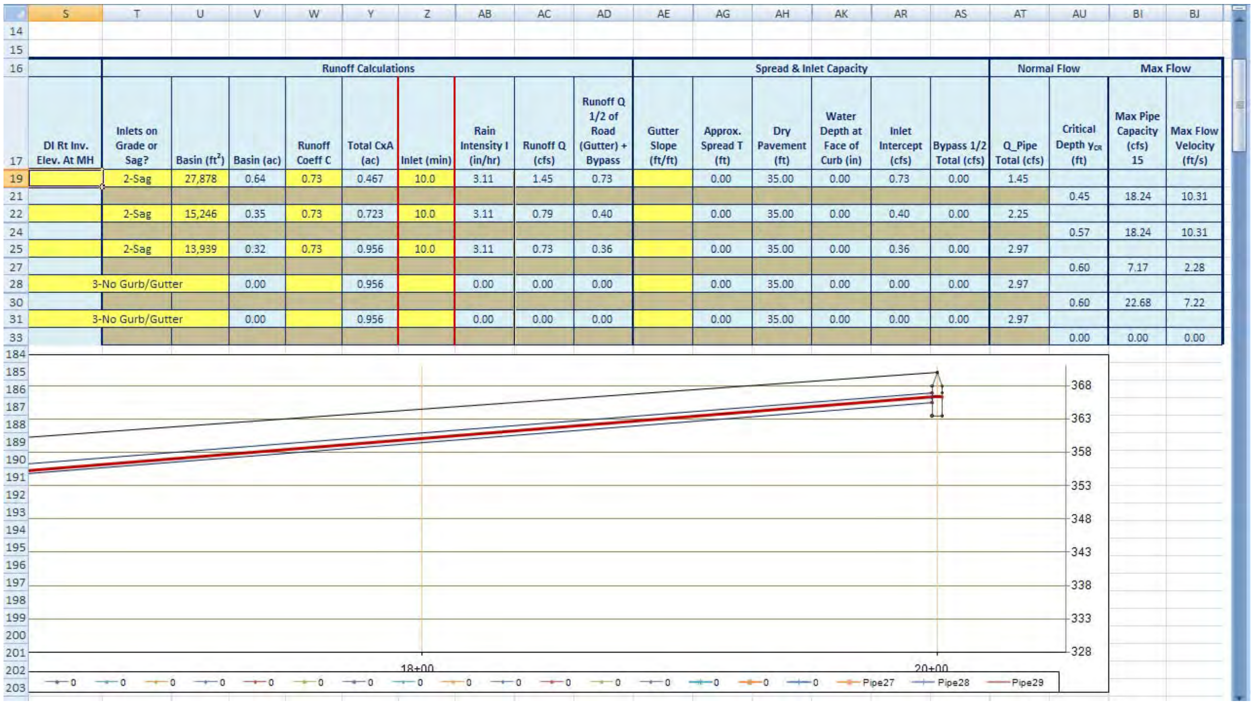
- 1-Local
- 2-Collector
- 3-Arterial

Max Spread Tmax. Enter the amount of allowable flow spread on the pavement.

Pavement/Gutter n=	0.013	Curb Type	1-6-in Vertical	Road Classification:	1-Local
Street Width B/B	36.00	Pvt X-Slope	2.0%	Max Spread Tmax:	10.00

Location			MH Size, Direction, Pipe Length, Slope, Size, Inverts											
Manhole Type	Start Station (thru MHs)	End Station (thru MHs)	MH Size (in)	Pipe Direction From MH	Length to MH (ft)	Pipe Slope (ft/ft)	Pipe Diameter (in)	Downstream Inv. Elev. (ft)	Downstream Top of Conduit (TOC) Elev. (ft)	Downstream TBC/FG Elev.	MH	Upstream Inv. Elev. (ft)	Upstream Top of Conduit (TOC) Elev. (ft)	Upstream TBC/FG Elev.	DI Lt Inv. Elev. At MH
MH1 w/Inlets	20+00	20+00	48	Manhole 180°				365.50	367.00	370.00					370.00
Pipe1	20+00	16+39			361.00	0.0300	18	354.67	356.17	360.00		365.50	367.00	370.00	
MH2 w/Inlets	16+39	16+39	48	Manhole 180°				354.07	355.57	360.00		354.67	356.17	360.00	360.00
Pipe2	16+39	13+11			328.00	0.0300	18	344.23	345.73	349.31		354.07	355.57	360.00	
MH3 w/Inlets	13+11	13+11	48	Manhole 90°				344.07	345.57	349.31		344.23	345.73	360.00	349.31
Pipe3	13+11	12+97			14.10	0.0010	24	344.06	346.06	347.76		344.07	346.07	349.31	
MH4	12+97	12+97	48	Manhole 180°				331.27	333.27	347.76		344.06	346.06	349.31	
Pipe4	12+97	12+41			55.80	0.0100	24	330.71	332.71	332.71		331.27	333.27	347.76	
Outfall	12+41	12+41	48	Manhole 180°				330.71	332.71	332.71		330.71	332.71	347.76	
Pipe5	12+41							330.71	330.71	0.00		330.71	330.71	332.71	

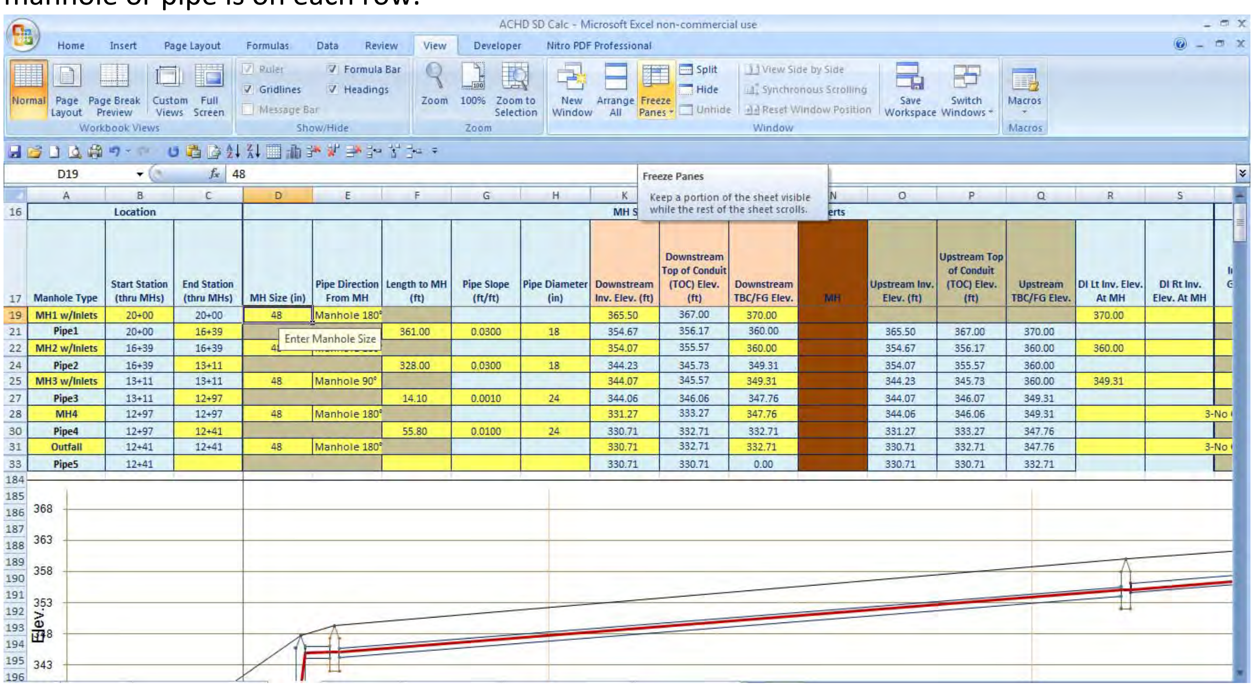




	DI Rt Inv. Elev. At MH	Inlets on Grade or Sag?	Basin (ft²)	Basin (ac)	Runoff Coeff C	Total CxA (ac)	Inlet (min)	Rain Intensity I (in/hr)	Runoff Q (cfs)	Runoff Q 1/2 of Road (Gutter) + Bypass	Gutter Slope (ft/ft)	Approx. Spread T (ft)	Dry Pavement (ft)	Water Depth at Face of Curb (in)	Inlet Intercept (cfs)	Bypass 1/2 Total (cfs)	Q_Pipe Total (cfs)	Critical Depth Y_{CR} (ft)	Max Pipe Capacity (cfs) 15	Max Flow Velocity (ft/s)
16		Runoff Calculations									Spread & Inlet Capacity						Normal Flow		Max Flow	
19		2-Sag	27,878	0.64	0.73	0.467	10.0	3.11	1.45	0.73		0.00	35.00	0.00	0.73	0.00	1.45			
21																		0.45	18.24	10.31
22		2-Sag	15,246	0.35	0.73	0.723	10.0	3.11	0.79	0.40		0.00	35.00	0.00	0.40	0.00	2.25			
24																		0.57	18.24	10.31
25		2-Sag	13,939	0.32	0.73	0.956	10.0	3.11	0.73	0.36		0.00	35.00	0.00	0.36	0.00	2.97			
27																		0.60	7.17	2.28
28	3-No Gurb/Gutter			0.00		0.956		0.00	0.00	0.00		0.00	35.00	0.00	0.00	0.00	2.97			
30																		0.60	22.68	7.22
31	3-No Gurb/Gutter			0.00		0.956		0.00	0.00	0.00		0.00	35.00	0.00	0.00	0.00	2.97			
33																		0.00	0.00	0.00

Use Freeze Panes

Navigating around the Pipes Tab is made easier by using Excel's ability to Freeze Panes. After entering data on the top section point to a cell with the mouse pointer in Row 19 (Row 18 if existing pipe row is unhidden) like Column B or D, then go to the View Tab, select "Freeze Panes." This will allow the worksheet to scroll right on the long rows and still see what manhole or pipe is on each row.



	Manhole Type	Start Station (thru MHs)	End Station (thru MHs)	MH Size (in)	Pipe Direction From MH	Length to MH (ft)	Pipe Slope (ft/ft)	Pipe Diameter (in)	Downstream Inv. Elev. (ft)	Downstream Top of Conduit (TOC) Elev. (ft)	Downstream TBC/FG Elev.	MH	Upstream Inv. Elev. (ft)	Upstream Top of Conduit (TOC) Elev. (ft)	Upstream TBC/FG Elev.	DI Lt Inv. Elev. At MH	DI Rt Inv. Elev. At MH
16	Location																
19	MH1 w/Inlets	20+00	20+00	48	Manhole 180°				365.50	367.00	370.00					370.00	
21	Pipe1	20+00	16+39			361.00	0.0300	18	354.67	356.17	360.00		365.50	367.00	370.00		
22	MH2 w/Inlets	16+39	16+39	4					354.07	355.57	360.00		354.67	356.17	360.00	360.00	
24	Pipe2	16+39	13+11			328.00	0.0300	18	344.23	345.73	349.31		354.07	355.57	360.00		
25	MH3 w/Inlets	13+11	13+11	48	Manhole 90°				344.07	345.57	349.31		344.23	345.73	360.00	349.31	
27	Pipe3	13+11	12+97			14.10	0.0010	24	344.06	346.06	347.76		344.07	346.07	349.31		
28	MH4	12+97	12+97	48	Manhole 180°				331.27	333.27	347.76		344.06	346.06	349.31		3-No
30	Pipe4	12+97	12+41			55.80	0.0100	24	330.71	332.71	332.71		331.27	333.27	347.76		
31	Outfall	12+41	12+41	48	Manhole 180°				330.71	332.71	332.71		330.71	332.71	347.76		3-No
33	Pipe5	12+41							330.71	330.71	0.00		330.71	330.71	332.71		

Bottom Part

MHx. The first Column A of the main table has dropdown menus for MHx, MHx w/Inlets, Outfall. The spreadsheet accepts up to 30 manholes and pipes.

If there is an existing pipe with flow entering the system do the following:

- Click Row 17 & 19
- Right click, select Unhide
- A hidden row is revealed with an option to select "Pipe0 Existing Entering."
- Enter Start Station and End Station
- The estimated pipe length is calculated in Column F
- In Column AC "Runoff Q (cfs)" enter the flow that will enter the system from existing pipes.

16	Location			MH Size, Direction, Pipe Length, Slope, Size, Inverts													
17	Manhole Type	Start Station (thru MHs)	End Station (thru MHs)	MH Size (in)	Pipe Direction From MH	Length to MH (ft)	Pipe Slope (ft/ft)	Pipe Diameter (in)	Downstream Inv. Elev. (ft)	Downstream Top of Conduit (TOC) Elev. (ft)	Downstream TBC/FG Elev.	MH	Upstream Inv. Elev. (ft)	Upstream Top of Conduit (TOC) Elev. (ft)	Upstream TBC/FG Elev.	DI Lt Inv. Elev. At MH	DI Rt Inv. Elev. At MH
19	MH1 w/Inlets	20+00	20+00	48	Manhole 180°				365.50	367.00	370.00					370.00	
21	Pipe1	20+00	16+39			361.00	0.0300	18	354.67	356.17	360.00		365.50	367.00	370.00		
22	MH2 w/Inlets	16+39	16+39	48	Manhole 180°				354.07	355.57	360.00		354.67	356.17	360.00	360.00	
24	Pipe2	16+39	13+11			328.00	0.0300	18	344.23	345.73	349.31		354.07	355.57	360.00		
25	MH3 w/Inlets	13+11	13+11	48	Manhole 90°				344.07	345.57	349.31		344.23	345.73	360.00	349.31	
27	Pipe3	13+11	12+97			14.10	0.0010	24	344.06	346.06	347.76		344.07	346.07	349.31		
28	MH4	12+97	12+97	48	Manhole 180°				331.27	333.27	347.76		344.06	346.06	349.31		3-
30	Pipe4	12+97	12+41			55.80	0.0100	24	330.71	332.71	332.71		331.27	333.27	347.76		
31	Outfall	12+41	12+41	48	Manhole 180°				330.71	332.71	332.71		330.71	332.71	347.76		3-
33	Pipe5	12+41							330.71	330.71	0.00		330.71	330.71	332.71		
34		+	+							0.00			330.71	330.71	332.71		

16	Location			MH Size, Direction, Pipe Length, Slope, Size, Inverts													
17	Manhole Type	Start Station (thru MHs)	End Station (thru MHs)	MH Size (in)	Pipe Direction From MH	Length to MH (ft)	Pipe Slope (ft/ft)	Pipe Diameter (in)	Downstream Inv. Elev. (ft)	Downstream Top of Conduit (TOC) Elev. (ft)	Downstream TBC/FG Elev.	MH	Upstream Inv. Elev. (ft)	Upstream Top of Conduit (TOC) Elev. (ft)	Upstream TBC/FG Elev.	DI Lt Inv. Elev. At MH	DI Rt Inv. Elev. At MH
18	e0-Existing Enter																
19	Pipe0-Existing Entering	20+00	20+00	48	Manhole 180°				365.50	367.00	370.00					370.00	
21	None Pipe1	20+00	16+39			361.00	0.0300	18	354.67	356.17	360.00		365.50	367.00	370.00		
22	MH2 w/Inlets	16+39	16+39	48	Manhole 180°				354.07	355.57	360.00		354.67	356.17	360.00	360.00	
24	Pipe2	16+39	13+11			328.00	0.0300	18	344.23	345.73	349.31		354.07	355.57	360.00		
25	MH3 w/Inlets	13+11	13+11	48	Manhole 90°				344.07	345.57	349.31		344.23	345.73	360.00	349.31	
27	Pipe3	13+11	12+97			14.10	0.0010	24	344.06	346.06	347.76		344.07	346.07	349.31		
28	MH4	12+97	12+97	48	Manhole 180°				331.27	333.27	347.76		344.06	346.06	349.31		3-
30	Pipe4	12+97	12+41			55.80	0.0100	24	330.71	332.71	332.71		331.27	333.27	347.76		
31	Outfall	12+41	12+41	48	Manhole 180°				330.71	332.71	332.71		330.71	332.71	347.76		3-
33	Pipe5	12+41							330.71	330.71	0.00		330.71	330.71	332.71		

MHx Row (continued).

Start Station (Thru MHs). Enter the station of the center of the Manhole x in Column B.

End Station (Thru MHs). This is the same station as the Start Station for manholes. For pipes enter the end station in the yellow cell.

Manhole Diameter. Enter the diameter of the manhole (in) in Column D.

Manhole Angle. Select the angle change of direction at the Manhole. For a straight pipe run select the last option in the dropdown menu for "Manhole 180°."

Length to MH (Column F). The spreadsheet calculates the difference between stations entered and enters the value in the "Length to MH" column. Note this is a yellow cell so the user can override the default value by typing in the cell without damaging any equations. It is important that the actual length of pipe be as accurate as possible because the spreadsheet will calculate the downstream invert elevation using the length and slope that is entered later. Errors in the pipe length can cause irregularities in the hydraulic calculations later.

Some Civil Plans have the pipe lengths shown in the plan profile. The pipe lengths used may be measured from center of manhole to center of manhole or may be measured from outside of manhole to outside of manhole. For whichever method of measurement is used it is important to be consistent.

Pipe Slope. Enter the pipe slope in Column G.

Pipe Diameter. Enter the pipe diameter in Column H.

Enter Manhole Invert Elevations

k. to q. Columns K through Q are where manhole pipe invert elevations are entered.

	A	K	L	M	N	O	P	Q
16		MH Size, Direction, Pipe Length, Slope, Size, Inverts						
17	Manhole Type	Downstream Inv. Elev. (ft)	Downstream Top of Conduit (TOC) Elev. (ft)	Downstream TBC/FG Elev.	MH	Upstream Inv. Elev. (ft)	Upstream Top of Conduit (TOC) Elev. (ft)	Upstream TBC/FG Elev.
19	MH1 w/Inlets	365.50	367.00	370.00				
21	Pipe1	354.67	356.17	360.00		365.50	367.00	370.00
22	MH2 w/Inlets	354.07	355.57	360.00		354.67	356.17	360.00
24	Pipe2	344.23	345.73	349.31		354.07	355.57	360.00
25	MH3 w/Inlets	344.07	345.57	349.31		344.23	345.73	360.00
27	Pipe3	344.06	346.06	347.76		344.07	346.07	349.31
28	MH4	331.27	333.27	347.76		344.06	346.06	349.31
30	Pipe4	330.71	332.71	332.71		331.27	333.27	347.76
31	Outfall	330.71	332.71	332.71		330.71	332.71	347.76

This table is arranged assuming the pipe flows right to left (ie. the right side of the brown column is the pipes entering the manhole and the left side is the pipes leaving the manhole).

Enter the downstream invert elevations for the pipes.

Enter the finish grade elev. for the downstream pipes at the manholes. Note, this is the same as the Rim Elevation of the manhole that is usually called out on the plan profile.

The upstream pipe invert, top of pipe, finish grade elevations are calculated from the pipe slopes entered before.

r. to s. Enter the invert elevations at the MH for the drop inlet pipe runs.

Inlets on Grade or Sag? Select from either option on the dropdown menu. Inlets on grade may have gutter flow bypass, inlets in sag will not have bypass flow.

Basin Area (sf). Enter the size of the drainage basin contributing to the inlet in sf.

Basin Area (acres). The spreadsheet converts the sf to acres.

Runoff Coefficient. Enter the C Factor for the basin.

Hidden

Total CxA. This is the C Factor multiplied by Area in acres.

Inlet Time (min). Enter the Tc in minutes (10 min. minimum) for the basin.

Hidden

ab. Rainfall Intensity i. The spreadsheet pulls the appropriate rainfall intensity based on the Tc entered in Column Z.

ac. Runoff Q (cfs). This is calculated from the inputs of the prior cells.

ad. Runoff Q ½ of Road (Gutter) + Bypass. This is ½ of the total Q for the flow in each gutter.

ae. Gutter Slope. Enter the longitudinal slope of the gutter.

af. Hidden

ag. Approximate Spread T (ft).

ah. Dry Pavement (ft).

ai. to aj. Hidden

ak. Water Depth at Face of Curb (in).
al. to aq. Hidden
ar. Total Intercept (cfs).
as. Bypass ½ Total (cfs).
at. A_Pipe Total.
au. Critical Depth ycr.
av. to bh. Hidden
bi. Max Pipe Capacity (cfs). Calculated based on pipe size, slope, Manning's n
bj. to er. Hidden

Example #4 Conveyance, Pipes and Inlets

Use plans in Appendix B from HEC-22 as the example for Hydraulic Grade Line (HGL) calculations.

1. Enter Project Name "Example."

ACHD Calculation Sheets for Conveyance, Pipes & Inlets

NOTE: This worksheet is intended to be a guideline to standardize ACHD checking of drainage calculations and s replace the Engineer's calculation methodology. These calculations shall establish a minimum requirement. Th methodology must result in facilities that meet or exceed these calculations in order to be accepted.

Steps to Check Pipe Capacity

User input in yellow cells. To accept default value type = in yellow cell and point to compute

Clear Contents

1 Project: Example

Design Storm	100	year			
Tailwater Elev.	333.50				
Tailwater Velocity	0.00	*(enter 0 for static)*			
Pipe n=	0.013				
Pavement/Gutter n=	0.013	Curb Type	1-6-in Vertical	Road Classification:	1-Local
Street Width B/B	36.00	Pvt X-Slope	2.0%	Max Spread Tmax:	10.00

Manhole Type	Location: Start Station (thru MHs)	End Station (thru MHs)	MH Size (in)	Pipe Direction From MH	Length to MH (ft)	Pipe Slope (ft/ft)	Pipe Diameter (in)
MH1 w/Inlets	20+00	20+00	48	Manhole 180°			
Pipe1	20+00	16+39			361.00	0.0300	18
MH2 w/Inlets	16+39	16+39	48	Manhole 180°			
Pipe2	16+39	13+11			328.00	0.0300	18
MH3 w/Inlets	13+11	13+11	48	Manhole 90°			
Pipe3	13+11	12+97			14.10	0.0010	24
MH4	12+97	12+97	48	Manhole 180°			
Pipe4	12+97	12+41			55.80	0.0100	24
Outfall	12+41	12+41	48	Manhole 180°			
Pipe5	12+41						

2. Enter Project Name "Example."
   Design Storm. 100-year Design Storm pulls from the Peak Q,V Tab.
   Tailwater Elev. Enter 333.5
   Tailwater Velocity. Enter 0
   Pipe n. Enter 0.013
   Pavement/Gutter n. Enter 0.013
   Street Width B/B. Enter 36
   Curb Type. Select 1-6" Standard Vertical Curb
   Pavement X-Slope. Enter 0.02
   Road Classification. Select 1-Local
   Max Spread Tmax. Enter 10

Enter Remaining Data

Row 19, MHx, select MH1-w/Inlets

Start Station (Thru MHs). Enter 2000

End Station (Thru MHs). Shows 20+00

Manhole Diameter. Enter 48

MH Angle. Select "Manhole 180°"

Length to MH (Column F). The spreadsheet calculates 361

Pipe Slope. Enter 0.03

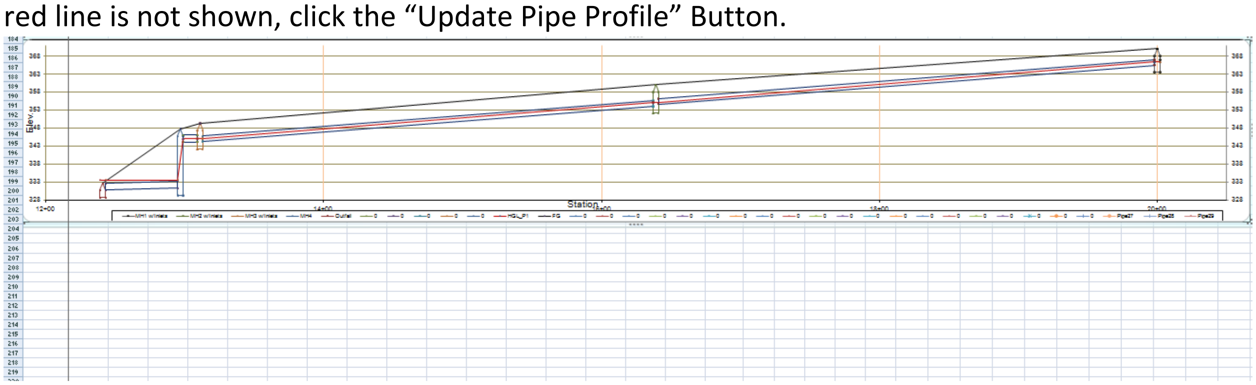
Pipe Diameter. Enter 18

Enter the elevations and remaining data as shown below:

	A	B	C	D	E	F	G	H	K	L	M	N	O	P	Q	R	S
16		Location		MH Size, Direction, Pipe Length, Slope, Size, Inverts													
17	Manhole Type	Start Station (thru MHs)	End Station (thru MHs)	MH Size (in)	Pipe Direction From MH	Length to MH (ft)	Pipe Slope (ft/ft)	Pipe Diameter (in)	Downstream Inv. Elev. (ft)	Downstream Top of Conduit (TOC) Elev. (ft)	Downstream TBC/FG Elev.	MH	Upstream Inv. Elev. (ft)	Upstream Top of Conduit (TOC) Elev. (ft)	Upstream TBC/FG Elev.	DI Lt Inv. Elev. At MH	DI Rt Inv. Elev. At MH
19	MH1 w/Inlets	20+00	20+00	48	Manhole 180°				365.50	367.00	370.00					370.00	
21	Pipe1	20+00	16+39			361.00	0.0300	18	354.67	356.17	360.00		365.50	367.00	370.00		
22	MH2 w/Inlets	16+39	16+39	48	Manhole 180°				354.07	355.57	360.00		354.67	356.17	360.00	360.00	
24	Pipe2	16+39	13+11			328.00	0.0300	18	344.23	345.73	349.31		354.07	355.57	360.00		
25	MH3 w/Inlets	13+11	13+11	48	Manhole 90°				344.07	345.57	349.31		344.23	345.73	360.00	349.31	
27	Pipe3	13+11	12+97			14.10	0.0010	24	344.06	346.06	347.76		344.07	346.07	349.31		
28	MH4	12+97	12+97	48	Manhole 180°				331.27	333.27	347.76		344.06	346.06	349.31		3-
30	Pipe4	12+97	12+41			55.80	0.0100	24	330.71	332.71	332.71		331.27	333.27	347.76		
31	Outfall	12+41	12+41	48	Manhole 180°				330.71	332.71	332.71		330.71	332.71	347.76		3-
33	Pipe5	12+41							330.71	330.71	0.00		330.71	330.71	332.71		

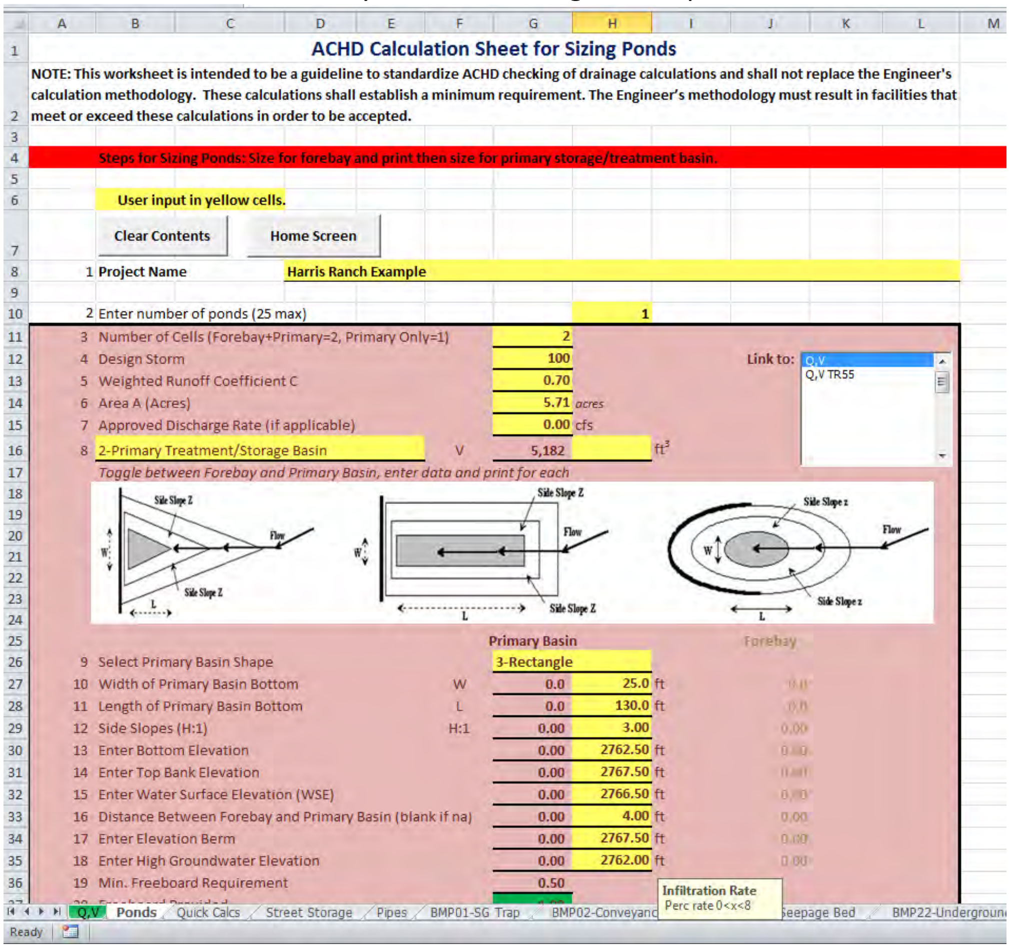
	A	T	U	V	W	Y	Z	AB	AC	AD	AE	AG	AH	AK	AR	AS	AT	AU	BI
16		Runoff Calculations									Spread & Inlet Capacity						Normal Flow		Max Flow
17	Manhole Type	Inlets on Grade or Sag?	Basin Area (ft^2)	Basin (ac)	Runoff Coeff C	Total CxA (ac)	Inlet (min)	Rain Intensity I (in/hr)	Runoff Q (cfs)	Runoff Q 1/2 of Road (Gutter) + Bypass	Gutter Slope (ft/ft)	Approx. Spread T (ft)	Dry Pavement (ft)	Water Depth at Face of Curb (in)	Inlet Intercept (cfs)	Bypass 1/2 Total (cfs)	Q_Pipe Total (cfs)	Critical Depth y_{CR} (ft)	Max Pipe Capacity (cfs) 15
19	MH1 w/Inlets	2-Sag	27,878	0.64	0.73	0.467	10.0	3.11	1.45	0.73	0.0040	5.80	23.40	2.64	0.73	0.00	1.45		
21	Pipe1																	0.45	18.24
22	MH2 w/Inlets	2-Sag	15,246	0.35	0.73	0.723	10.0	3.11	0.79	0.40	0.0040	4.60	25.80	2.35	0.40	0.00	2.25		
24	Pipe2																	0.57	18.24
25	MH3 w/Inlets	2-Sag	13,939	0.32	0.73	0.956	10.0	3.11	0.73	0.36	0.0040	4.50	26.00	2.33	0.36	0.00	2.97		
27	Pipe3																	0.60	7.17
28	MH4	-No Gurb/Gutter		0.00		0.956		0.00	0.00	0.00	0.0040	0.00	35.00	0.00	0.00	0.00	2.97		
30	Pipe4																	0.60	22.68
31	Outfall	-No Gurb/Gutter		0.00		0.956		0.00	0.00	0.00	0.0040	0.00	35.00	0.00	0.00	0.00	2.97		
33	Pipe5																	0.00	0.00

Once the data is entered the spreadsheet will produce a graph that should look like this. If the red line is not shown, click the "Update Pipe Profile" Button.



Pond Sizing Tab

The pond sizing tab is used to check the sizing of retention and detention ponds. Per 8000 & 8200 Stormwater Policy, ponds shall be designed with a Forebay and Primary Basin. Small ponds less than 1500 sf can be designed without a forebay. The Pond Sizing worksheet can be used with two basins or only one basin using the dropdown menu on Line Item #3.



Number of Cells

If the incorrect number of cells is selected the calculations will be misleading because the total volume is not divided between the forebay and the primary cell.

Line Item Description

1. Enter Project Name.

2. Enter the number of ponds to design, up to 25 max. The spreadsheet creates new tabs for the number of ponds entered. The spreadsheet will copy the Pond Sizing tab for the number of ponds entered.

   Note the “Clear” Button is removed on the copied tabs as well as line item #2 that changes the number of storage facilities.

To revise the number of storage facilities go to the original Ponds Sizing tab and either enter a different number of storage facilities or click “Clear” and re-enter the new number of facilities.

On the Project Name line #1, the spreadsheet will add Pond ## after the project name. Modify the default descriptors as needed to distinguish between each facility.

3. Enter number of pond cells. ACHD policy requires 2 ea for new ponds, a forebay and primary storage. For small ponds, if the total footprint of the pond is <1500 sf one chamber can be used.

4. The design storm pulls from the Peak Q,V tab. The volume can be overridden.

5. Weighted runoff C coefficient pulls from the Peak Q,V Tab or the user can modify as needed.

6. Area A in acres pulls from the Peak Q,V Tab or the user can modify as needed.

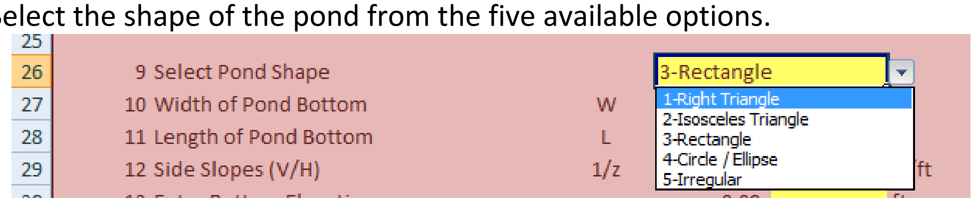
7. Approved discharge rate for the given storm (if applicable) pulls from the Peak Q,V Tab or the user can modify as needed.

8. Select between 1-Pond Forebay, or 2-Primary Basin.

   Note this dropdown menu is the major toggle switch for the entire spreadsheet. Instead of repeating data entry for the same items for the forebay and primary basin you enter the data for the forebay, switch this toggle to the primary and enter that data.

   The design volume pulls from the Peak Q,V Tab or the user can enter an override value in the yellow cell.

9. Select the shape of the pond from the five available options.



10. Width of Pond Bottom. Enter the bottom dimension for the pond width of the Forebay or Primary Basin, whichever toggle #8 is set at.

11. Length of Pond Bottom. Enter the bottom dimension for the pond width of the Forebay or Primary Basin, whichever toggle #8 is set at.

12. Side Slopes. Enter the side slope as H:1.

13. Enter Bottom Elevation. Enter the bottom design elevation from the plans.

14. Enter Top Bank Elevation. Enter the top elevation.

15. Enter Water Surface Elevation (WSE). Enter the 100-year storm operating level elevation for the design.

16. Distance Between Forebay and Primary Storage Basin. This is for plotting the cross section of the Forebay and Primary Basin and does not affect the storage calculations.

17. Enter Berm Elevation. This is the top elevation of the dike between the Forebay and Primary Basin.

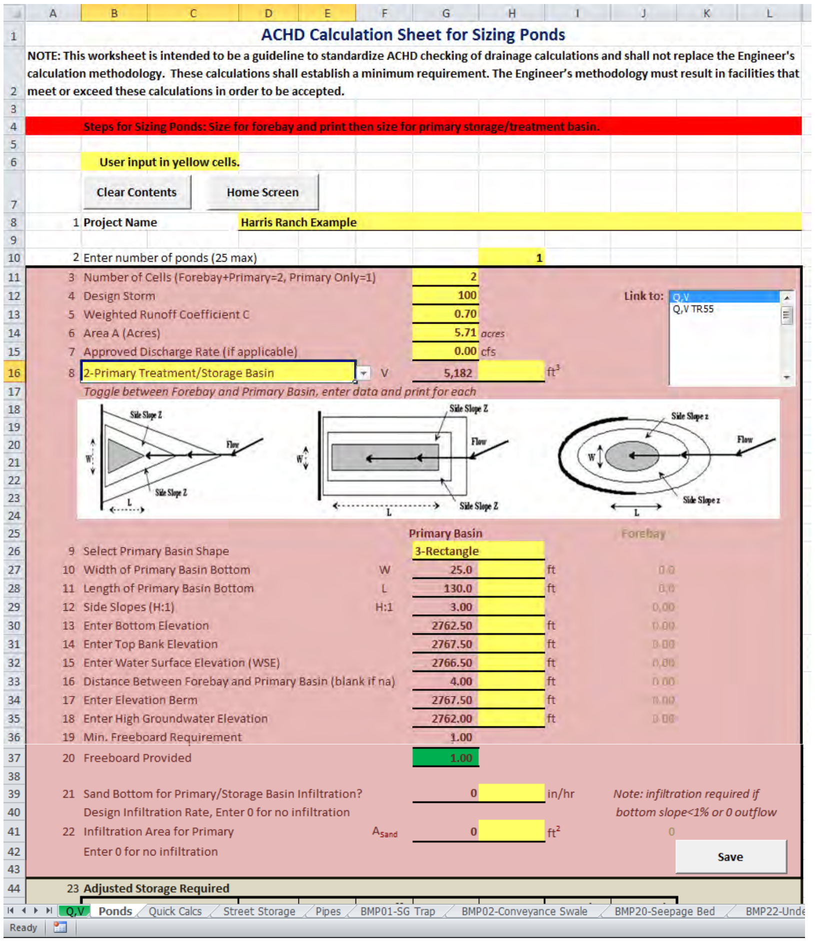
18. Enter High Groundwater Elevation. This is to plot the high GW on the pond cross section. It is used as a reminder that high GW elevation must be established for the design.

19. Minimum Freeboard Requirement. Per ACHD 8000 Policy, 0.5-ft of freeboard is required for ponds up to 3-ft in depth, 1-ft freeboard is required for ponds >3-ft deep.

20. Freeboard Provided. Spreadsheet subtracts the 100-year WSE from the top bank to see if freeboard requirement is met. If the requirement is met the cell will be **green**, if not met the cell will be **red**.

21. Sand Bottom for Infiltration? Enter the infiltration rate not to exceed 8 in/hr or 0 if not applicable.

22. Infiltration Window Area. Enter SF of sand bottom or 0 if not applicable.
    VERY IMPORTANT, CLICK SAVE! This sends the inputs to the holding table.



Example #5a Peak Q,V and Pond Sizing Tab, Forebay

Line Item Description

1. Start with the Peak Q,V Tab. Enter project name “Harris Ranch 11 Example.”

2. For Is Drainage Basin Map Provided select “Yes.”

3. For Design Storm select “100-Year.”

4. On Number of Storage Facilities enter 1.

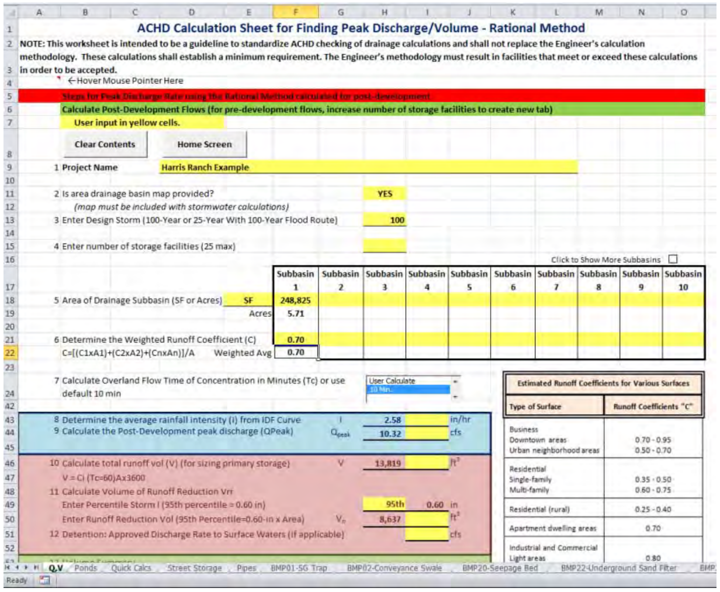
5. For Drainage Basin Area enter 248,825. This converts to 5.71 acres.

6. For C Factor enter 0.70.

7. For Time of Concentration select the 10 minute default.

   The rest calculates automatically, leaving a Pond Forebay volume of 8,637 CF and Primary Basin volume of 5,182 cf.

Click the Pond Sizing tab.

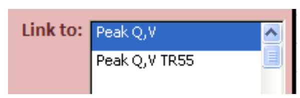


1. On the Pond Sizing Tab, notice the Project Name is inserted.

2. For number of ponds enter 1.

3. Item #3, select 2 from the dropdown. This pond has a Forebay and Primary Basin.

4. The design storm pulls from the Peak Q,V Tab.



5. Weighted runoff C coefficient pulls from the Peak Q,V Tab and is 0.70.

6. Area A in acres pulls from the Peak Q,V Tab and is 5.71 acres.

7. Approved discharge rate for the given storm (if applicable) pulls from the Peak Q,V Tab and is 0 cfs.

8. Calculated volume for Forebay is 8,637 cf from the Peak Q,V Tab.

9. Select Pond Shape. We are going to use "#3-Rectangle"

10. Pond bottom width, take the average from the plans "=(22.4+12)/2"

11. Enter length of 30

12. Enter side slopes of 3

13. Bottom elevation is 2762.5

14. Top elevation is 2767.5

15. WSE is 2766.5

16. Distance between forebay and primary is 4

17. Elevation of berm is 2767.5

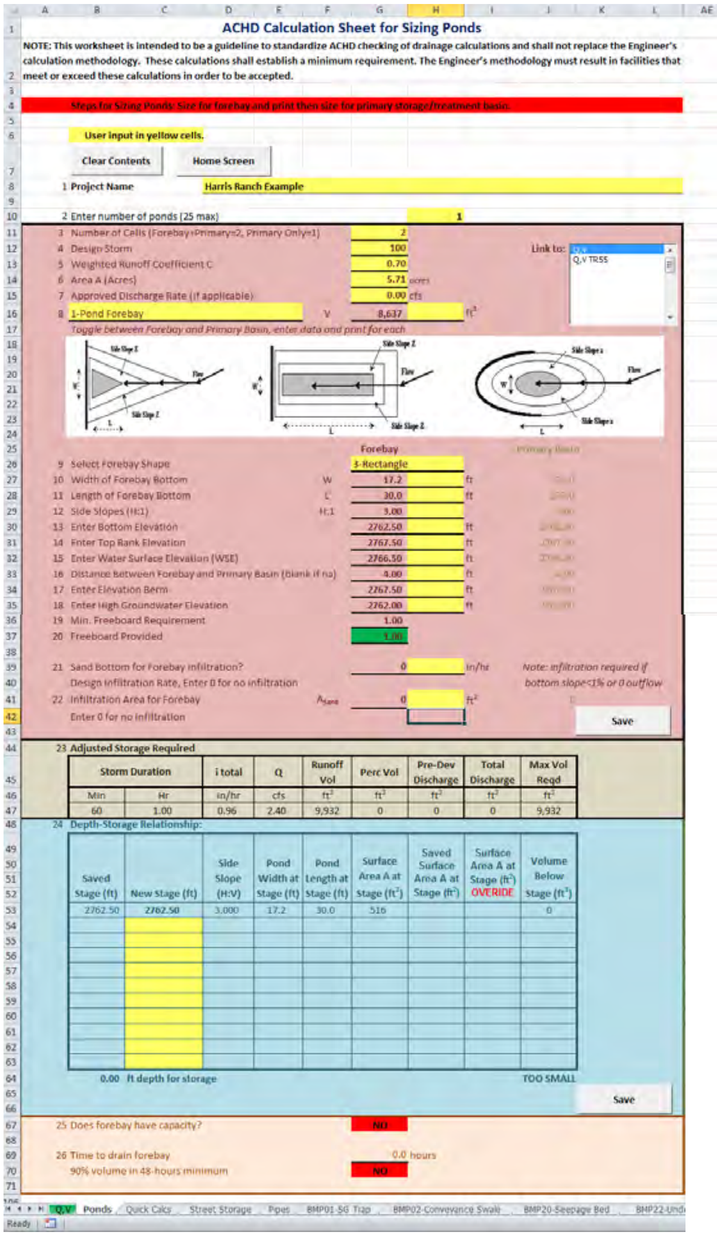
18. High GW is 2762. Note there is not 3-ft separation to bottom of forebay. The drainage calcs show the forebay is lined.

19. (auto calculates), freeboard requirement is 1-ft

20. (auto calculates), freeboard provided is 1-ft (green)

21. Sand perc rate is 0 since pond is lined.

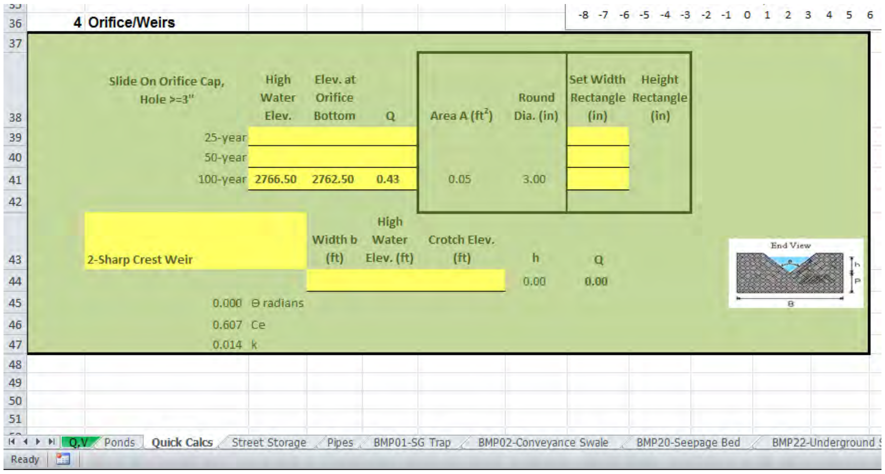
22. Infiltration window area is 0.
    VERY IMPORTANT, CLICK SAVE! This sends the inputs to the holding table.



23. Line 23 is the Adjusted Storage Required. It calculates the required given the infiltration or discharge rate.

24. Depth Storage Relationship Table. Note that since the pond is lined there is no perc. however; there is an orifice outlet. We need to find the discharge rate in #24.

- Go to row 41 of the Quick Calcs Tab and enter the high water elev. of 2766.50 and water elev. at orifice bottom of 2762.50 in the 100 Year. Try various Qpre rates until the Round Dia. calculation is 3.00 inches. This will come out to be about 0.43 cfs. This is the rate flow will exit the forebay to the primary basin.



a. Go back to line item #7 on the Pond Sizing Tab and enter 0.43 cfs and also line item #12 on the Peak Q,V Tab and enter 0.43 cfs. This will reduce the storage requirements in the Forebay from 9,932 cf to 8,384 cf.

23 Adjusted Storage Required

Storm Duration		i total	Q	Runoff Vol	Perc Vol	Pre-Dev Discharge	Total Discharge	Max Vol Reqd
Min	Hr	in/hr	cfs	ft^3	ft^3	ft^3	ft^3	ft^3
60	1.00	0.96	2.40	9,932	0	1,548	1,548	8,384

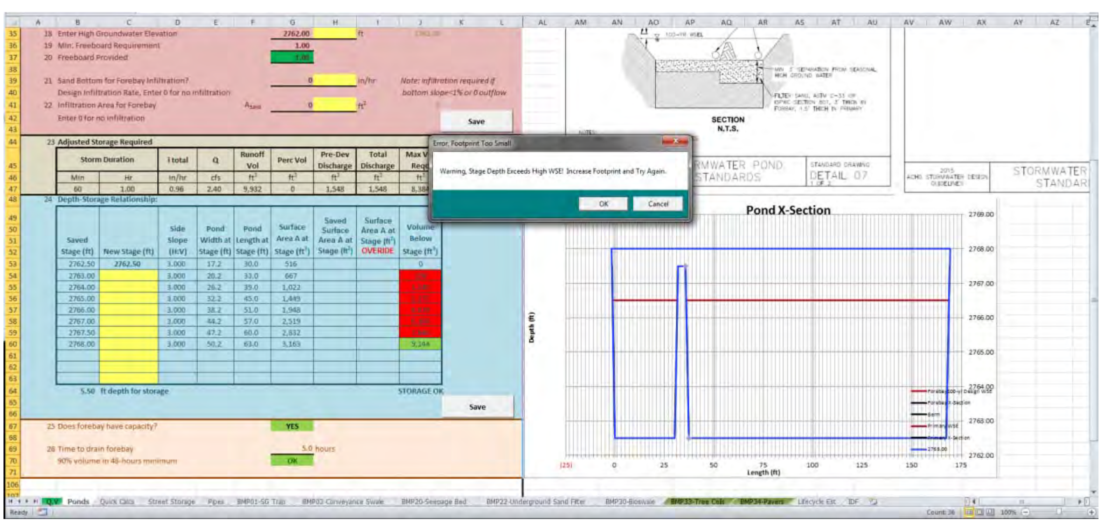
b. Go back to the Pond Sizing Tab

Enter increasing elevations for staging depth.

Note the storage requirement is met at elev. 2768, which is above top of bank elevation of 2767.50. This pond was designed under a different criteria resulting in less volume than the current policy.

Click Save

Notice a warning window pops up saying "Warning, Water Depth Exceeds WSE! Increase Footprint and Try Again."



Repeat data entry for the Primary Basin.

Example #5b Pond Sizing Tab, Primary Basin

Line Item Description

1. On the Pond Sizing Tab, item #3, 2 basins should still be selected on the dropdown.

2. 100 year storm is still selected

3. The weighted C of 0.70 pulls from the Peak Q,V Tab.

4. The area 5.71 acres pulls from the Peak Q,V Tab.

5. The 0.43 cfs predevelopment discharge pulls from Peak Q,V. This is for the orifice from the Forebay to the Primary Basin. Change line #7 to 4.22 cfs which is found on the plans at the 12" outlet pipe to update the primary outfall pipe.

6. Select "2-Primary Treatment/Storage Basin." Volume is 3,634 cf
   The 12"pipe out of the Primary Basin discharges at 4.22 cfs when the pond is full.
   If we enter 0 on line item #12 of the Peak Q,V Tab and 4.22 cfs into line item #7 of the Pond Sizing Tab the storage volume shows 5,182 cf.

   Select "3-Rectangle." The primary basin is an odd shape but is close to a rectangle if you imagine pushing the center in and straightening it out. We will approximate the dimensions to check the capacity.

   We will use a conservative 25-ft width

   Try a conservative 130-ft width

   Enter side slopes of 3

   Bottom elevation is 2762.5

   Top elevation is 2767.5

   WSE is 2766.5

   Distance between forebay and primary is 4

   Elevation of berm is 2767.5

   High GW is 2762. Note: We do not have to meet separation because the forebay is lined and treats the WQ flows.

   (auto calculates), freeboard requirement is 1-ft (auto calculates), freeboard provided is 1-ft (green).

Sand perc rate is 8 in/hr.

Infiltration window area is "=25x130" (entire bottom).
CLICK SAVE! This sends the inputs to the holding table.

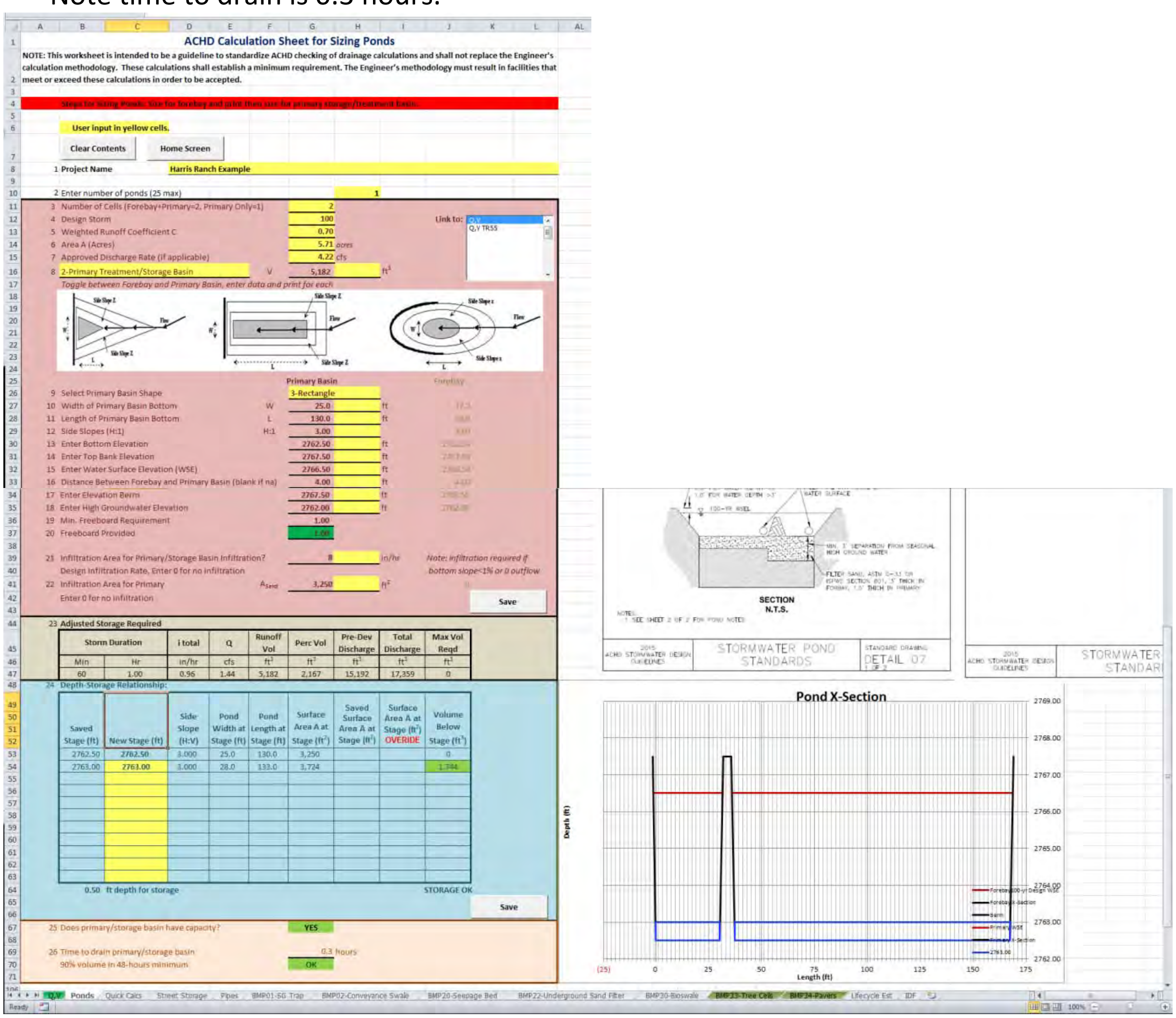
Note we have a sand bottom and outfall pipe. A conservative assumption is that the pond outlet discharge is the same as the forebay discharge of 0.43 cfs. The plans actually show Q100=4.9 cfs through the 12" pipe.

Enter increasing elevations for staging depth.

Adjusted storage required is calculated.

Note Primary Basin has capacity at 0.50-ft depth.

Note time to drain is 0.3 hours.

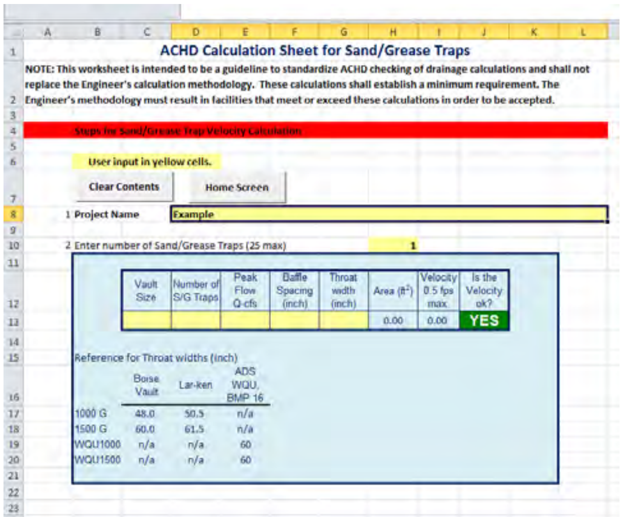


BMP01-SG Trap

This tab is used to help ensure proper sizing of Sand & Grease Traps. To help prevent resuspension of sediment, the Sand/Grease Trap shall be designed such that the throat velocity does not exceed 0.5 fps. Sand/Grease Traps shall be designed to be an offline system so the entire system design flow does not pass through the tank.

Line Item Description

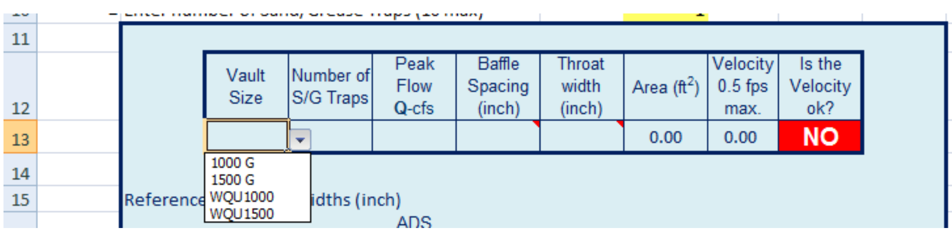
On the BMP01-SG Trap Tab, notice the Project Name from prior projects is inserted.



Enter Number of Sand/Grease Traps (25 max). This allows the user to size multiple tanks.

Vault Size. Select the vault size from the dropdown menu. Options include:

- 1000 Gallon
- 1500 Gallon
- 1000 Gallon Water Quality Unit
- 1500 Gallon Water Quality Unit



Enter Number S/G Traps

Enter Peak Flow Q in cfs

Enter Baffle Spacing, normally 20-inches

Enter Throat Width of Tank. Typical dimensions are shown below.

2 Enter number of Sand/Grease Traps (10 max) **1**

Vault Size	Number of S/G Traps	Peak Flow Q-cfs	Baffle Spacing (inch)	Throat width (inch)	Area (ft^2)	Velocity 0.5 fps max.	Is the Velocity ok?
1000 G	1	2	20	48	6.67	0.30	YES

Reference for Throat widths (inch)

	Boise Vault	Lar-ken	ADS WQU, BMP 16
1000 G	48.0	50.5	n/a
1500 G	60.0	61.5	n/a
WQU1000	n/a	n/a	60
WQU1500	n/a	n/a	60

Example #6 BMP01-SG Trap Tab

Line Item Description

1. Call the project name "Example."

2. Enter Number of Sand/Grease Traps (25 max). Enter 1.
    a. Vault Size. Select 1000 G.
    b. Enter Number S/G Traps. Enter 1.
    c. Enter Peak Flow Q in cfs. Enter 2 cfs.
    d. Enter Baffle Spacing. Enter 20-inches.
    e. Enter Throat Width of Tank. Enter 48 for a Boise Vault Tank.
    f. Notice Velocity is 0.30 fps. The velocity is <0.50 fps so the velocity check is **Yes.**

ACHD Calculation Sheet for Sand/Grease Traps

NOTE: This worksheet is intended to be a guideline to standardize ACHD checking of drainage calculations and shall not replace the Engineer's calculation methodology. These calculations shall establish a minimum requirement. The Engineer's methodology must result in facilities that meet or exceed these calculations in order to be accepted.

Steps for Sand/Grease Trap Velocity Calculation

User input in yellow cells.

Clear Contents | Home Screen

1 **Project Name** **Example**

2 Enter number of Sand/Grease Traps (25 max) **1**

Vault Size	Number of S/G Traps	Peak Flow Q-cfs	Baffle Spacing (inch)	Throat width (inch)	Area (ft^2)	Velocity 0.5 fps max.	Is the Velocity ok?
1000 G	1	2	20	48	6.67	0.30	YES

Reference for Throat widths (inch)

	Boise Vault	Lar-ken	ADS WQU, BMP 16
1000 G	48.0	50.5	n/a
1500 G	60.0	61.5	n/a
WQU1000	n/a	n/a	60
WQU1500	n/a	n/a	60

BMP02-Conveyance Swale

BMP02-Conveyance Swale is used to size a swale for pretreatment.

1. Project Name.

2. Design Inflow Qin in cfs.

3. Design Outflow Q out in cfs.

4. Storage Volume Vstore in cf

5. Swale Bottom Width.

6. Swale Depth.

7. Swale Side Slopes.

8. Swale Cross Sectional Area calculates automatically.

9. Find Length for Capacity calculates automatically.

10. Time to Drain. Must drain at least 90% volume in 48-hours.

11. Enter Longitudinal Slope.

12. Manning's n. Note Manning's n coefficients are located in the table to the right of Column L.

13. Solve for Depth of Flow. Uses Manning's Equation and an iterative process to solve for flow depth.

14. Solve for Area of Flow. Spreadsheet derives after depth of flow is calculated.

15. Find Wetted Perimeter. Spreadsheet calculates based on the flow perimeter touching the sides of the swale.

16. Find Hydraulic Radius. Calculates from Flow Area/Wetted Perimeter.

17. Find Velocity. Calculated based on the Q and slope of the swale.
    Is Velocity <0.9 ft/s

18. Calculate Length.
    Note treatment swales are very long and may not be practical for all situations.

Row					
1	**ACHD Calculation Sheet for Sizing Conveyance Swale**				
2–3	**NOTE: This worksheet is intended to be a guideline to standardize ACHD checking of drainage calculations and shall not replace the Engineer's calculation methodology. These calculations shall establish a minimum requirement. The Engineer's methodology must result in facilities that meet or exceed these calculations in order to be accepted.**				
4	**Note this spreadsheet pulls information from the "Peak Q,V" tab**				
5	**Steps for Sizing Conveyance Swale**				
6					
7	**User input in yellow cells.**				
8	**Clear Contents**	**Home Screen**			
9	1	**Project Name**		**Example**	
10					
11	2	Enter Design Inflow	Q_{in}		cfs
12	3	Enter Design Outflow	Q_{out}		cfs
13					
14	4	Storage Volume	V_{store}	0	ft^3
15		VStore=(Qin-Qout)x3600			
16					
17	5	Set Swale Bottom Width	b		ft
18	6	Set Swale Depth	y		ft
19	7	Swale Side Slopes H:1	H:1		
20	8	Calculate cross-sectional area	A_{XS}	0.00	ft^2
21					
22	9	Find length for capacity	L		ft
23	10	Time to Drain		0.0	hours
24		90% volume in 48-hours minimum		OK	
25					
26	**For Conveyance Swales Only**				
27	11	Enter longitudinal slope	S_L		ft/ft
28	12	Enter Manning's n for swale	n		
29					
30	13	Solve for depth of flow	y_{Flow}		ft
31	14	Solve for area flow	A_{flow}		ft^2
32	15	Find Wetted Perimeter	P		ft
33		P = b + 2y(1 + z2)1/2			
34	16	Find Hydraulic Radius	R_H	0.00	ft
35		RH = (by + zy2)/[b + 2y(1 + z2)1/2]			
36	17	Find Velocity	V	0.00	ft/s
37		V=Q/A			
38		Is V<0.9 fps?		YES	
39	18	Calculate Length		0	ft
40		L=Vx540s (9 minx60 s/min)			
41		Residence time 9 min minimum			
42					

Example #7 for BMP02-Conveyance Swale

Use Englefield Green 3 plans as an example to size a Bio Swale.

Line Item Description

1. Project Name. Call the project name "Example."
2. Enter a design inflow of 1.51 cfs (Line Item #10 from Example #6 & #7).
3. Enter a design outflow of 0.5 cfs. Note, this would assume there was another storage facility.
4. Storage Volume calculates to 3,636 cf
5. Swale Bottom Width. Enter 0.
6. Swale Depth. Enter 2.
7. Swale Side Slopes. Enter 3.
8. Cross Sectional Area calculates to 6 sf.
9. Find Length for Capacity calculates to 606 ft.
10. Time to Drain calculates to 5.4 hours.

	Item	Description	Symbol	Value	Unit
1	ACHD Calculation Sheet for Sizing Conveyance Swale				
2–3	NOTE: This worksheet is intended to be a guideline to standardize ACHD checking of drainage calculations and shall not replace the Engineer's calculation methodology. These calculations shall establish a minimum requirement. The Engineer's methodology must result in facilities that meet or exceed these calculations in order to be accepted.				
4	Note this spreadsheet pulls information from the "Peak Q,V" tab				
5	Steps for Sizing Conveyance Swale				
6					
7		User input in yellow cells.			
8		Clear Contents	Home Screen		
9	1	Project Name		Example	
10					
11	2	Enter Design Inflow	Q_{in}	1.51	cfs
12	3	Enter Design Outflow	Q_{out}	0.50	cfs
13					
14	4	Storage Volume	V_{store}	3,636	ft^3
15		VStore=(Qin-Qout)x3600			
16					
17	5	Set Swale Bottom Width	b	0.00	ft
18	6	Set Swale Depth	y	2.00	ft
19	7	Swale Side Slopes H:1	H:1	3.00	
20	8	Calculate cross-sectional area	A_{XS}	6.00	ft^2
21					
22	9	Find length for capacity	L	606	ft
23	10	Time to Drain		5.4	hours
24		90% volume in 48-hours minimum		OK	
25					

11. Enter Longitudinal Slope. Enter 0.01

12. Manning's n. Enter 0.020 for vegetated channel. Note Manning's n coefficients are located to the right of Column L.

13. Solve for Depth of Flow. Calculates to 0.29 ft

14. Solve for Area of Flow. Calculates to 0.25 sf

15. Find Wetted Perimeter. Calculates to 0.61

16. Find Hydraulic Radius. Calculates to 0.41

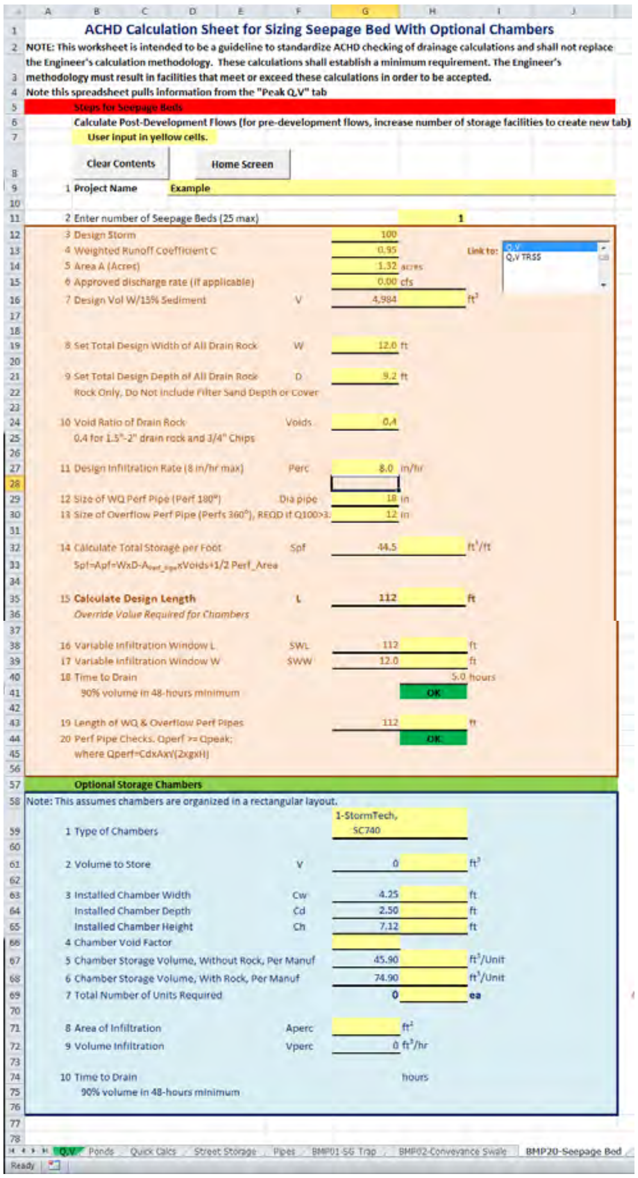
17. Find Velocity. Calculates to 1.98 ft/s
Is Velocity <0.9 ft/s, **NO**

18. Calculate Length. Calculates to 1,069 ft.
Note this is a very long swale and may not be practical.

	A–E	F	G	H
13				
14	4 Storage Volume	V_{store}	3,636	ft^3
15	VStore=(Qin-Qout)x3600			
16				
17	5 Set Swale Bottom Width	b	0.00	ft
18	6 Set Swale Depth	y	2.00	ft
19	7 Swale Side Slopes H:1	H:1	3.00	
20	8 Calculate cross-sectional area	A_{XS}	6.00	ft^2
21				
22	9 Find length for capacity	L	606	ft
23	10 Time to Drain		5.4	hours
24	90% volume in 48-hours minimum		OK	
25				
26	**For Conveyance Swales Only**			
27	11 Enter longitudinal slope	S_L	0.010	ft/ft
28	12 Enter Manning's n for swale	n	0.020	
29				
30	13 Solve for depth of flow	y_{Flow}	0.29	ft
31	14 Solve for area flow	A_{flow}	0.25	ft^2
32	15 Find Wetted Perimeter	P	0.61	ft
33	P = b + 2y(1 + z2)1/2			
34	16 Find Hydraulic Radius	R_H	0.41	ft
35	RH = (by + zy2)/[b + 2y(1 + z2)1/2]			
36	17 Find Velocity	V	1.98	ft/s
37	V=Q/A			
38	Is V<0.9 fps?		NO	
39	18 Calculate Length		1,069	ft
40	L=Vx540s (9 minx60 s/min)			
41	Residence time 9 min minimum			

BMP20-Seepage Bed Tab

The BMP20-Seepage Bed Tab is used to size seepage beds. Per ACHD Stormwater Policy Section 8000 & 8200, seepage beds shall be sized to store the entire 100-year design storm assuming no infiltration. Facilities must infiltrate 90% of the design storm in 48-hours through the area of the sand filter. The storage volume shall be increased by 15% to account for sediment if the infiltration rate is less than 8 in/hr.



Line Item Description

1. Enter Project Name Example.

2. Enter the number of seepage beds that will be designed. For this example, enter 1.

3. Design storm of 100-year is carried over from the Peak Q,V Tab.

4. Weighted runoff C Coefficient is carried over from the Peak Q,V Tab. User can override this default by typing a different value in the yellow cell.

5. Area A in acres is carried over from the Peak Q,V Tab. User can override this default by typing a different value in the yellow cell.

6. Predevelopment discharge is carried over from the Peak Q,V Tab. User can override this default by typing a different value in the yellow cell.

7. Design Volume. This is linked to the Peak Q,V tab.

8. Set Design Width.

9. Set Design Depth.

10. Void Ratio for Drain Rock. Typically 0.4 for drain rock.

11. Design Infiltration Rate. Max rate of 8 in/hr.

12. Size of WQ Perf Pipe. Normally 18 per BMP20. Note the area of pipe used in the spreadsheet for storage is ½ of the diameter of the pipe because the bottom half is non-perforated sediment storage.

13. Size of Overflow Perf Pipe. Normally 12 per BMP20. Note the area of pipe used in the spreadsheet for storage is the entire diameter of the pipe because the entire pipe is perforated.

14. Storage/ft. Calculated by (Width x Depth – Perf Pipe Area) x Void Ratio + Perf Pipe Area)

15. Design Length. This calculates once all the required inputs are entered.

    Note the Maximum Vol Required is calculated based on various Peak Design storms to ensure the bed design can store the peak storms within a 24-hour period. In some cases the Max Vol Required may be greater than initial volume if there is a low infiltration rate or the infiltration area is small.
    If the user enters a length of bed less than the calculated length the spreadsheet assumes

the additional volume will go to optional storage chambers. This will be explained shortly.

16. Variable infiltration window length. User can override if needed.

17. Variable infiltration window length. User can override if needed.

18. Time to Drain. Must drain at least 90% volume in 48-hours.

19. Total Length of Perf Pipe. Calculates automatically, assumed same as seepage bed length.

20. Perf Pipe Check. Displays a green "OK" cell if there are enough perforations to accommodate the peak flow.

Example #8 for BMP20-Seepage Bed

Use Englefield Green 3 plans as an example to calculate storage volume to size a seepage bed.
Plans are included in Appendix A of this guide.
Sheet C302 has areas for the drainage basin and trench size.
If you have not completed Example #1 for Peak Q,V tab do that now before starting this example.

Line Item Description

1. Project Name: "Englefield Greens Example"

2. Number of Seepage Beds. Enter 1

3. Design Storm. Pulls 100-year from Peak Q,V Tab.

4. Weighted Runoff Coefficient C of 0.95 pulls form the Peak Q,V Tab.

5. Area 1.32 Acres pulls from the Peak Q,V Tab.

6. Approved Discharge Rate is 0

7. Design Volume with 15% Sediment is 4,984 cf.

8. Set Design Width. Enter 12

9. Set Design Depth. Enter 9.2

10. Void Ratio of Drain Rock. Enter 0.4

11. Design Infiltration Rate. Enter 8

12. Size of WQ Perf Pipe. Enter 18

13. Size of Overflow Perf Pipe. Enter 12

14. Total Storage per Foot. Calculates to 44.5 cf

15. Calculate Design Length. Calculates to 112 ft. Enter an override value of 75 to store some volume in chambers.

16. Leave blank.

17. Leave blank.

18. Time to Drain. Calculates to 5.0 hours

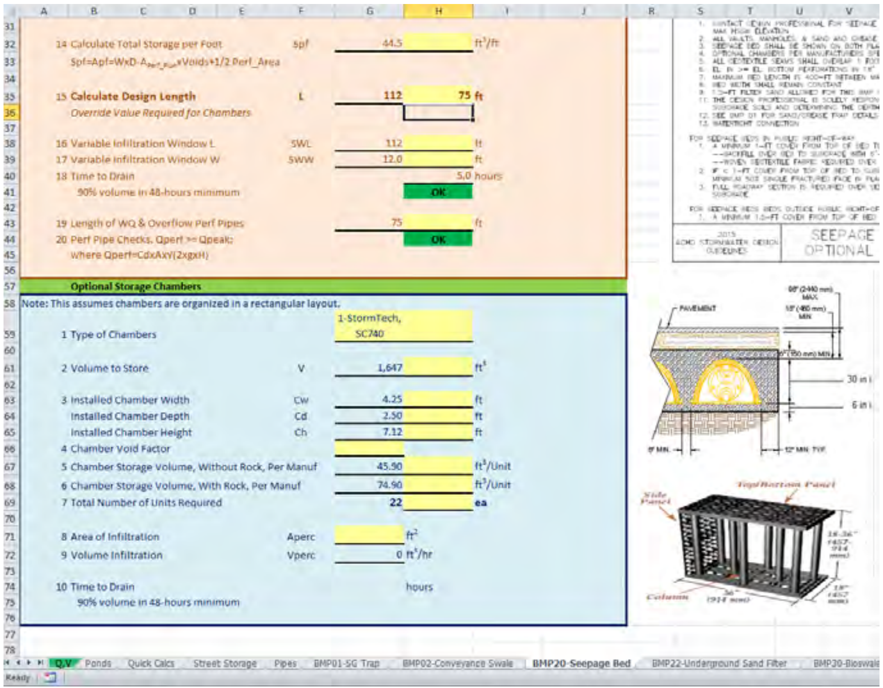
19. Total length of perf pipe. Same as seepage bed length

20. Perf Pipe Check. Displays green OK

Example #8a for BMP20-Seepage Bed, Storage Chambers

Use Englefield Green 3 plans as an example for calculating storage volume and sizing a seepage bed.
Plans are included in Appendix A of this guide.
Sh C302 has areas for the drainage basin and trench size.
If you have not completed Example #1 & #7 do that now before starting this example.

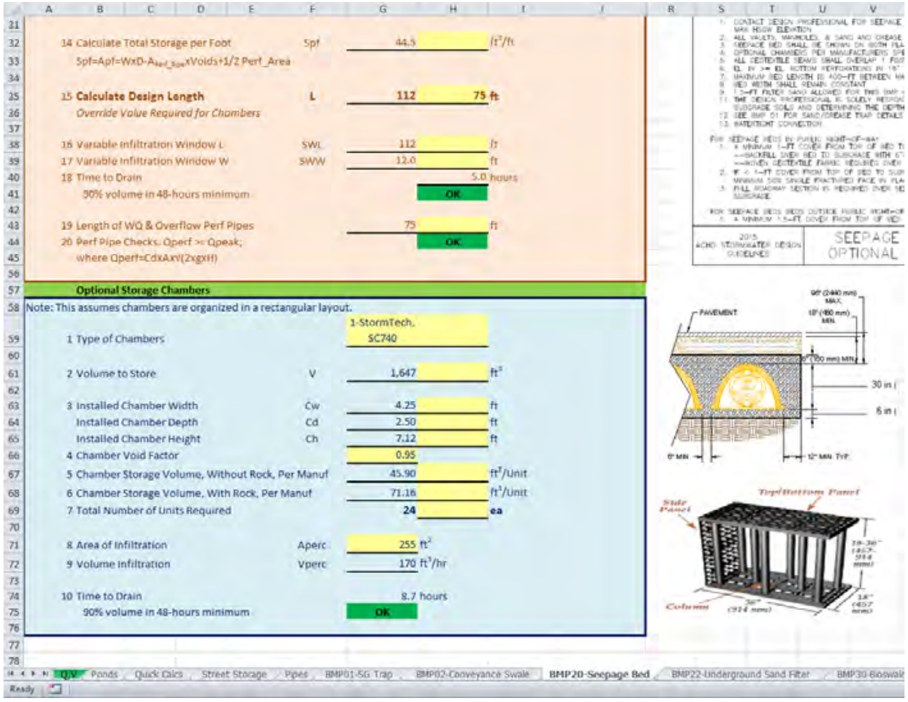
Line Item Description
The override length of 75-ft entered on line 15 above instead of using the calculated 112-ft added volume to be stored in chambers.



Go to the Optional Storage Chambers section

Line Item Description

1. Select option 1-StormTech, SC740 from the dropdown list.
2. Accept the default 1,647 CF or enter an alternate value into the yellow cell.
3. The spreadsheet shows the installed dimensions for this chamber.
4. Enter void factor of 0.95
5. Accept default value of 45.90 ft^3/unit.
6. Accept default value of 71.16 ft^3/unit.
7. Total number of units required calculates to 24 ea.
8. Area of infiltration, enter “=G69*G63*G64”
9. Volume infiltration is 170 ft^3/hr
10. Time to drain is 8.7 hours.



Row	Item	Symbol	Value	Override	Units
32	14 Calculate Total Storage per Foot	Spf	44.5		ft²/ft
33	Spf=Apf=WxD-A$_{Bed_Size}$xVoids+1/2 Perf_Area				
35	**15 Calculate Design Length**	**L**	**112**	**75**	**ft**
36	*Override Value Required for Chambers*				
38	16 Variable Infiltration Window L	SWL	112		ft
39	17 Variable Infiltration Window W	SWW	12.0		ft
40	18 Time to Drain			5.0	hours
41	90% volume in 48-hours minimum			OK	
43	19 Length of WQ & Overflow Perf Pipes		75		ft
44	20 Perf Pipe Checks. Qperf >= Qpeak;			OK	
45	where Qperf=CdxAx√(2xgxH)				
57	**Optional Storage Chambers**				
58	Note: This assumes chambers are organized in a rectangular layout.				
59	1 Type of Chambers		1-StormTech, SC740		
61	2 Volume to Store	V	1,647		ft³
63	3 Installed Chamber Width	Cw	4.25		ft
64	Installed Chamber Depth	Cd	2.50		ft
65	Installed Chamber Height	Ch	7.12		ft
66	4 Chamber Void Factor		0.95		
67	5 Chamber Storage Volume, Without Rock, Per Manuf		45.90		ft³/Unit
68	6 Chamber Storage Volume, With Rock, Per Manuf		71.16		ft³/Unit
69	7 Total Number of Units Required		**24**		**ea**
71	8 Area of Infiltration	Aperc	255		ft²
72	9 Volume Infiltration	Vperc	170		ft³/hr
74	10 Time to Drain		8.7		hours
75	90% volume in 48-hours minimum		OK		

BMP22-Underground Sand Filter

BMP22-Underground Sand Filter is used to size a sand vault with filter sand for pretreatment.

Line Item Description

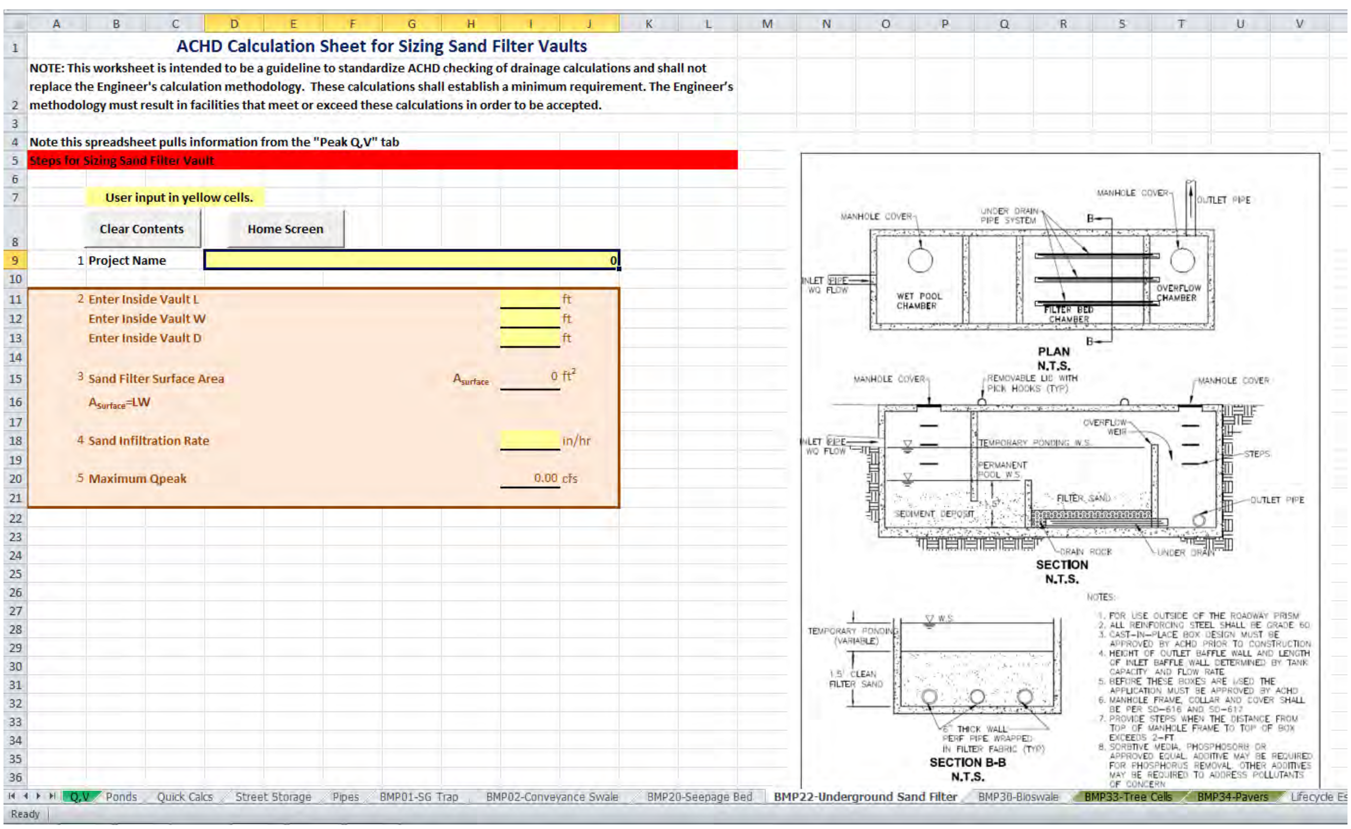
1. Project Name.

2. Enter Inside Vault L. This is the inside length of the vault.
   Enter Inside Vault W. This is the inside width of the vault.
   Enter Inside Vault D. This is the inside depth of the vault.

3. Enter Sand Filter Surface Area. This is the area of the sand in sf.

4. Enter Sand Infiltration Rate. ACHD Policy is 8 in/hr maximum.

5. Maximum Peak. The spreadsheet calculates the maximum Peak Q in cfs that can be treated.



Example #9 for BMP22-Underground Sand Filter

Use Englefield Green 3 plans as an example to size a sand vault.

Line Item Description

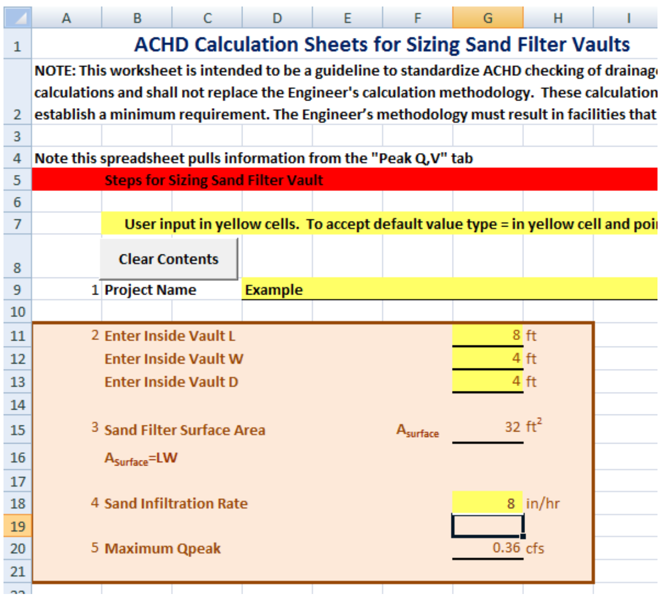
1. Project Name. Call the project name "Example."

2. Try a Length of 8
   Try a Width of 4
   Try a Depth of 4

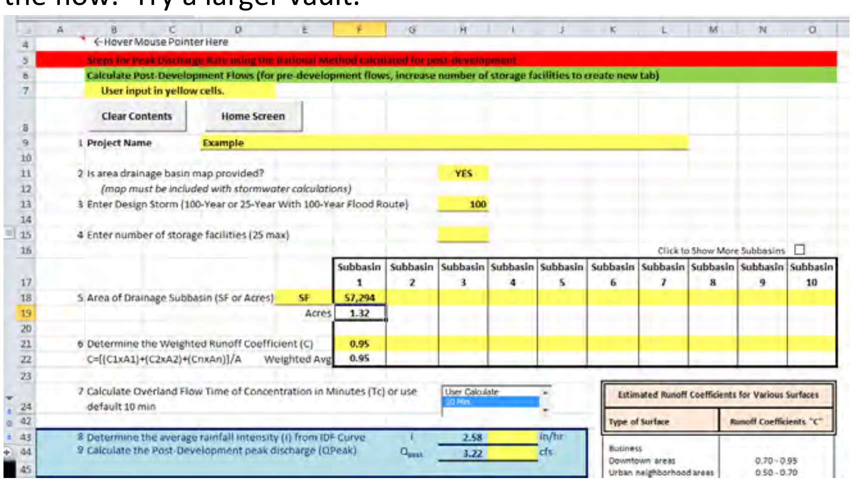
3. Sand filter surface area calculates to 32 ft^2.

4. Enter Sand infiltration rate of 8 in/hr.

5. Maximum Q calculates to 0.36 cfs.



For Englefield Greens, the Peak Flow is 3.22 cfs. Thus a larger sand vault is needed to treat the flow. Try a larger vault.



Try a Length of 30

Try a Width of 10
Try a Depth of 5

Maximum Q calculates to 3.33 cfs. This exceeds the Q=3.22 cfs.

ACHD Calculation Sheet for Sizing Sand Filter Vaults

NOTE: This worksheet is intended to be a guideline to standardize ACHD checking of drainage calculations and shall not replace the Engineer's calculation methodology. These calculations shall establish a minimum requirement. The Engineer's methodology must result in facilities that meet or exceed these calculations in order to be accepted.

Note this spreadsheet pulls information from the "Peak Q,V" tab

Steps for Sizing Sand Filter Vault

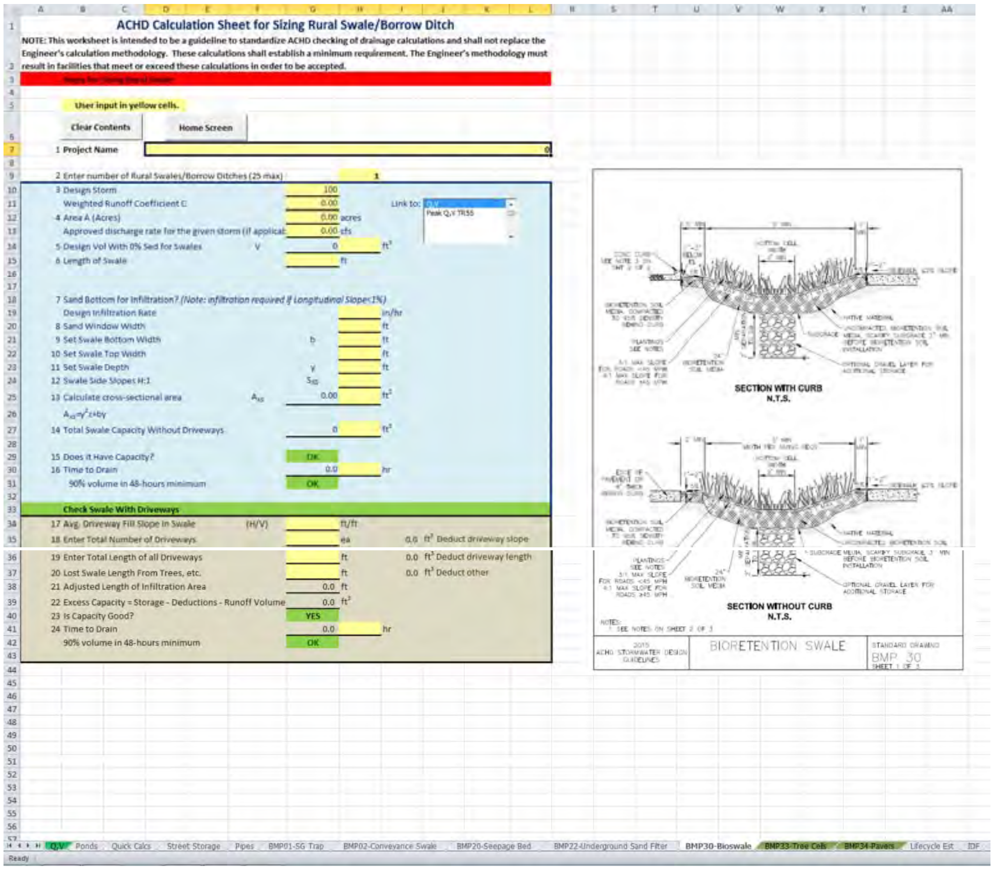
User input in yellow cells.

Clear Contents | Home Screen

1	Project Name	Example		
2	Enter Inside Vault L		30	ft
	Enter Inside Vault W		10	ft
	Enter Inside Vault D		5	ft
3	Sand Filter Surface Area	$A_{surface}$	300	ft^2
	$A_{surface}$=LW			
4	Sand Infiltration Rate		8	in/hr
5	Maximum Qpeak		3.33	cfs

BMP30-Bioswale

BMP30-Bioswale is used for pretreatment and final treatment. Note Rural swales are only allowed on one-acre and larger rural lots.



Line Item Description

1. Average Driveway Fill Slope in Swale

2. Enter Total Number of Driveways.

3. Enter Total Length of All Driveways.

4. Enter Lost Swale Length From Trees, Etc.

5. Adjusted Length of Infiltration Area.

6. Excess Capacity = Storage-Deductions-Runoff Volume.

7. Is Capacity Good?

8. Time to Drain. Must drain at least 90% volume in 48-hours.

Check Borrow Ditch Infiltration Windows
This section allows the user to check a borrow ditch infiltration window sizing

9. Enter Infiltration Window Length

10. Enter Infiltration Window Width

11. Time to Drain
    Must drain 95% in 24 hours.

12. Project Name.

13. Enter 1

14. Design storm.

15. Enter area in acres.

16. Enter design volume.

17. Enter length of swale.

18. Infiltration Window.
    Enter infiltration rate if applicable.

19. Infiltration Window Width.

Enter infiltration window width if applicable.

20. Set Swale Bottom Width.

21. Set Swale Top Width.

22. Set Swale Depth.

23. Swale Side Slopes H:1

24. Calculate Cross-Sectional Area
    Calculated from width, depth, slope

25. Total Swale Capacity Without Driveways
    Calculated from user inputs.

26. Does it Have Capacity?
    Calculated from user inputs.

27. Time to Drain
    Calculated from user inputs.

Check Swale Run with Driveways

This section allows the user to check a swale run deducting for loss of swale storage from driveways, trees, etc.

28. Average Driveway Fill Slope in Swale

29. Enter Total Number of Driveways.

30. Enter Total Length of All Driveways.

31. Enter Lost Swale Length From Trees, Etc.

32. Adjusted Length of Infiltration Area.

33. Excess Capacity = Storage-Deductions-Runoff Volume.

34. Is Capacity Good?

35. Time to Drain. Must drain at least 90% volume in 48-hours.

Check Borrow Ditch Infiltration Windows

This section allows the user to check a borrow ditch infiltration window sizing

36. Enter Infiltration Window Length

37. Enter Infiltration Window Width

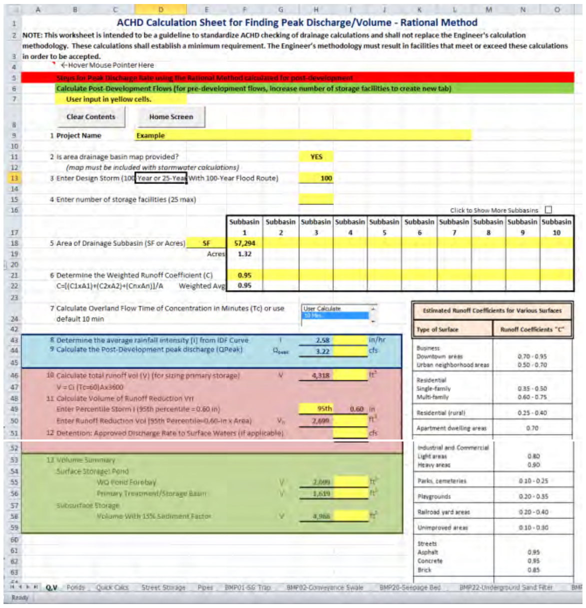
38. Time to Drain

    Must drain 95% in 24 hours.

Example #10 for BMP30-Bioswale

An example to size a bioswale.

Enter data on the Q,V Tab as follows.



Line Item Description

1. Project Name. Call the project name ”Example.”

2. Enter 1.

3. 100 is pulled from the Q,V Tab.

4. Program pulls 1.32 acres from Q,V Tab.

5. 0 from Q,V Tab.

6. Enter length of swale = 250.

7. Infiltration Window. Enter 8.

8. Infiltration Window Width. Enter 2.

9. Set Swale Bottom Width.
   a. Enter 0.

10. Set Swale Top Width.
    a. Enter 8.

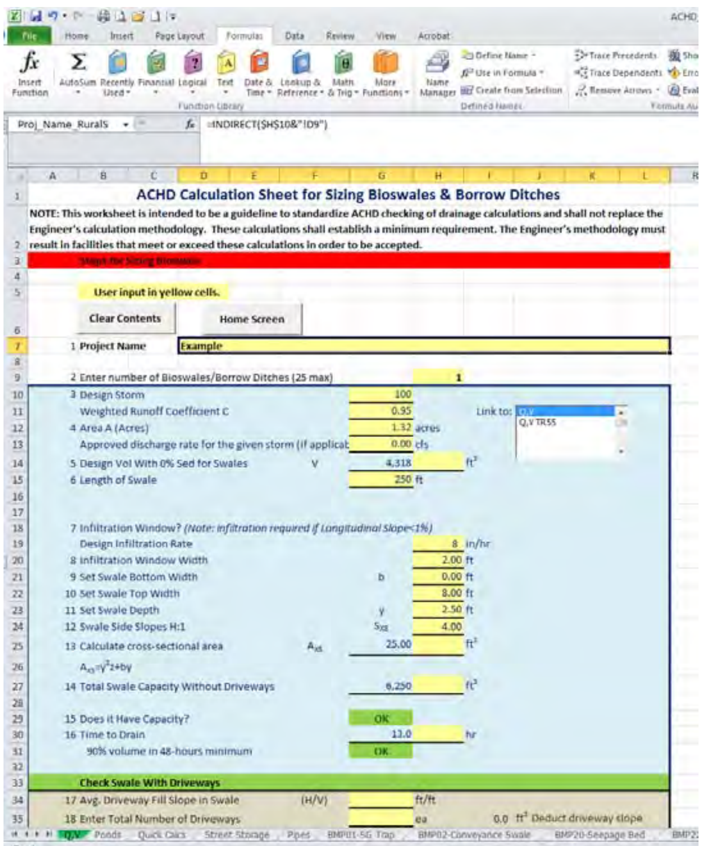
11. Set Swale Depth.
    a. Enter 1.

12. Swale Side Slopes H:1
    a. Enter 4.

13. Calculate Cross-Sectional Area. Program calculates 4 ft^2.

14. Total Swale Capacity Without Driveways. Program calculates 1000 ft^3.

15. Does it Have Capacity? Program displays NO. The design volume is 4,318 ft^3 and available capacity is only 1,000 ft^3. A longer and or wider swale would be needed. Changing the swale depth to 2.5-ft would provide adequate capacity.



16. Time to Drain. Program calculates 13 hours.

17. Enter =1/4

18. Enter 5

19. Enter 100

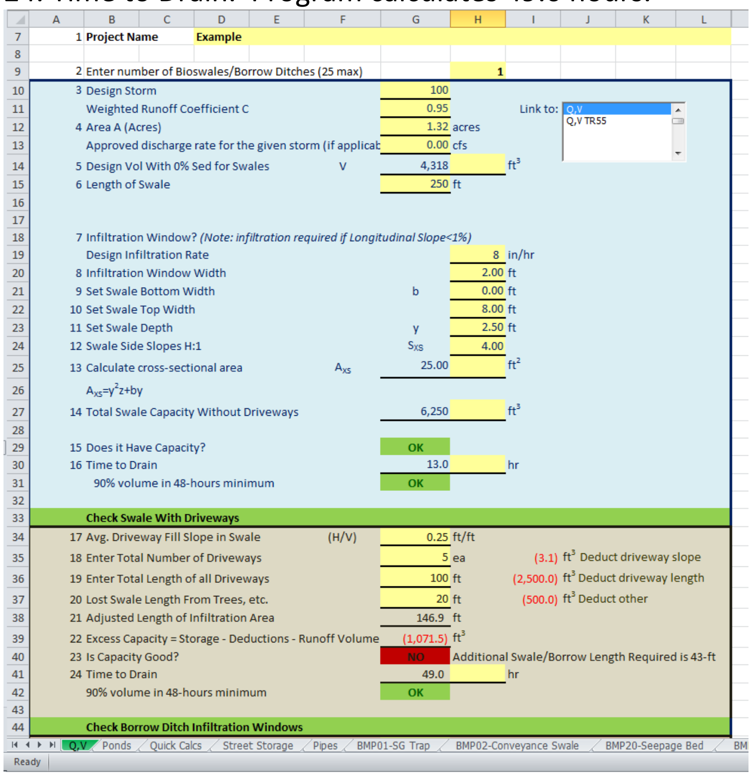
20. Enter 20

21. Adjusted Length of Infiltration Area.

22. Excess Capacity calculates to (1,071.5 ft^3)

23. Is Capacity Good? Program displays NO.

24. Time to Drain. Program calculates 49.0 hours.



Row	#	Item	Symbol	G	H	Units / Notes
7	1	**Project Name**		**Example**		
8						
9	2	Enter number of Bioswales/Borrow Ditches (25 max)			**1**	
10	3	Design Storm		100		
11		Weighted Runoff Coefficient C		0.95		Link to: Q,V / Q,V TR55
12	4	Area A (Acres)		1.32	acres	
13		Approved discharge rate for the given storm (if applicab		0.00	cfs	
14	5	Design Vol With 0% Sed for Swales	V	4,318		ft^3
15	6	Length of Swale		250	ft	
16						
17						
18	7	Infiltration Window? *(Note: infiltration required if Longitudinal Slope<1%)*				
19		Design Infiltration Rate			8	in/hr
20	8	Infiltration Window Width			2.00	ft
21	9	Set Swale Bottom Width	b		0.00	ft
22	10	Set Swale Top Width			8.00	ft
23	11	Set Swale Depth	y		2.50	ft
24	12	Swale Side Slopes H:1	S_{XS}		4.00	
25	13	Calculate cross-sectional area	A_{XS}	25.00		ft^2
26		$A_{XS}=y^2z+by$				
27	14	Total Swale Capacity Without Driveways		6,250		ft^3
28						
29	15	Does it Have Capacity?		OK		
30	16	Time to Drain		13.0		hr
31		90% volume in 48-hours minimum		OK		
32						
33		**Check Swale With Driveways**				
34	17	Avg. Driveway Fill Slope in Swale	(H/V)	0.25	ft/ft	
35	18	Enter Total Number of Driveways		5	ea	(3.1) ft^3 Deduct driveway slope
36	19	Enter Total Length of all Driveways		100	ft	(2,500.0) ft^3 Deduct driveway length
37	20	Lost Swale Length From Trees, etc.		20	ft	(500.0) ft^3 Deduct other
38	21	Adjusted Length of Infiltration Area		146.9	ft	
39	22	Excess Capacity = Storage - Deductions - Runoff Volume		(1,071.5)	ft^3	
40	23	Is Capacity Good?		NO	Additional Swale/Borrow Length Required is 43-ft	
41	24	Time to Drain		49.0		hr
42		90% volume in 48-hours minimum		OK		
43						
44		**Check Borrow Ditch Infiltration Windows**				

Check Borrow Ditch Infiltration Windows

This section allows the user to check a borrow ditch infiltration window sizing

25. Enter 50.

26. Enter 2.

27. Time to Drain. Program calculates 72.0 hours. Calculations use the design volume of 4,318 ft^3 over the 50'x2' infiltration window.

    Program displays NO for 90% volume in 48 hours.

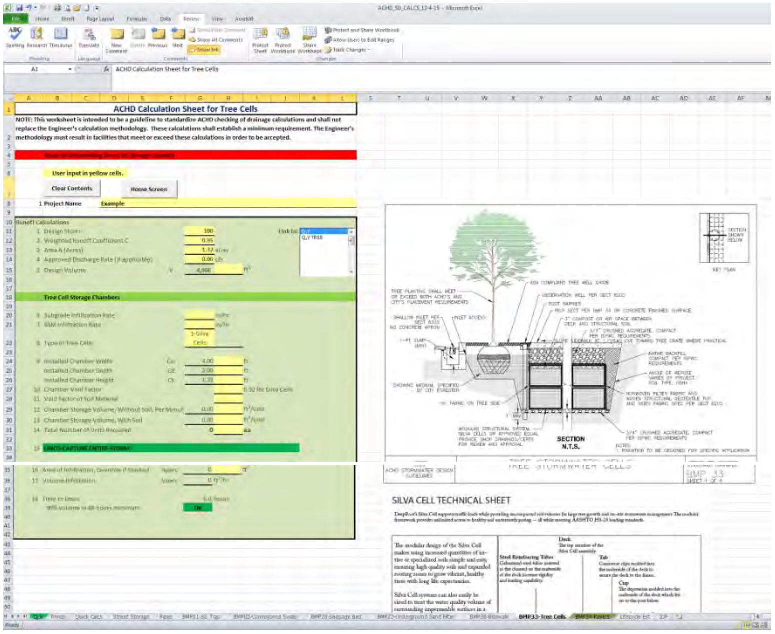
Row	Description	Symbol	G	H	Unit / Notes
19	Design Infiltration Rate			8	in/hr
20	8 Infiltration Window Width			2.00	ft
21	9 Set Swale Bottom Width		b	0.00	ft
22	10 Set Swale Top Width			8.00	ft
23	11 Set Swale Depth		y	2.50	ft
24	12 Swale Side Slopes H:1		S_{xS}	4.00	
25	13 Calculate cross-sectional area	A_{xS}	25.00		ft^2
26	$A_{xS}=y^2z+by$				
27	14 Total Swale Capacity Without Driveways		6,250		ft^3
28					
29	15 Does it Have Capacity?		OK		
30	16 Time to Drain		13.0		hr
31	90% volume in 48-hours minimum		OK		
32					
33	**Check Swale With Driveways**				
34	17 Avg. Driveway Fill Slope in Swale	(H/V)	0.25		ft/ft
35	18 Enter Total Number of Driveways		5		ea (3.1) ft^3 Deduct driveway slope
36	19 Enter Total Length of all Driveways		100		ft (2,500.0) ft^3 Deduct driveway length
37	20 Lost Swale Length From Trees, etc.		20		ft (500.0) ft^3 Deduct other
38	21 Adjusted Length of Infiltration Area		146.9		ft
39	22 Excess Capacity = Storage - Deductions - Runoff Volume		(1,071.5)		ft^3
40	23 Is Capacity Good?		NO		Additional Swale/Borrow Length Required is 43-ft
41	24 Time to Drain		49.0		hr
42	90% volume in 48-hours minimum		OK		
43					
44	**Check Borrow Ditch Infiltration Windows**				
45	25 Enter Infiltration Window Length		50.00		ft
46	26 Enter Infiltration Window Width		2		lf
47	27 Time to Drain		72.0		hr
48	90% volume in 48-hours minimum		NO		

Q,V | Ponds | Quick Calcs | Street Storage | Pipes | BMP01-SG Trap | BMP02-Conveyance Swale | BMP20-Seepage Bed | BMP22

Ready

BMP33-Tree Cells

BMP33-Tree Cells is used for pretreatment and final treatment. Note Tree Cells will normally have an overflow to an existing storm drain system.



Line Item Description

1. Project Name.

2. Runoff Coefficient.

3. Total Drainage Area in acres.

4. Approved Discharge Rate. For overflow to existing storm drain if applicable.

5. Design Volume.

6. Enter Subgrade Infiltration Rate.

7. Enter BSM Infiltration Rate.

8. Enter Type of Tree Cells.
   Currently only Silva Cells 4’x2’x1.33’. Will add other proprietary products as needed.

9. Program displays Width, Depth, Height. User can override values if needed.

10. Enter Chamber Void Factor.
    For Silva Cells uses 0.92. Other products may vary.

11. Enter Void Factor of Soil Material.

12. Enter Chamber Storage Volume (without soil).
    This comes from the manufacturer and discounts volume lost due to the support piers.

13. Enter Chamber Storage Volume (with soil).
    This comes from the manufacturer and also depends on the soils void factor.

14. Total Number of Units Required. Calculated by spreadsheet and takes the Design Volume / Storage Per Unit With Soil.
    User can override the calculated number of units if there is an overflow to existing storm drain.

15. Information field, tells if entire volume is retained in the units or if there is an overflow.

16. Area of Infiltration. Calculated assuming layers are 1 deep, user can override area if units are stacked.

17. Calculates volume of infiltration per hour given area of infiltration.

18. Time to Drain. Requires 90% volume in 48-hours.

Example #11 for BMP33-Tree Cells

An example to size a Tree Cells swale.

Line Item Description

1. Go to Peak Q,V Tab. Enter Project Name. Call the project name ”Example.”

2. Is Drainage Basin Area Map Included. Verify “Yes” is selected to continue.

3. Enter Design Storm (100-Year or 25-Year With 100-Year Flood Route)

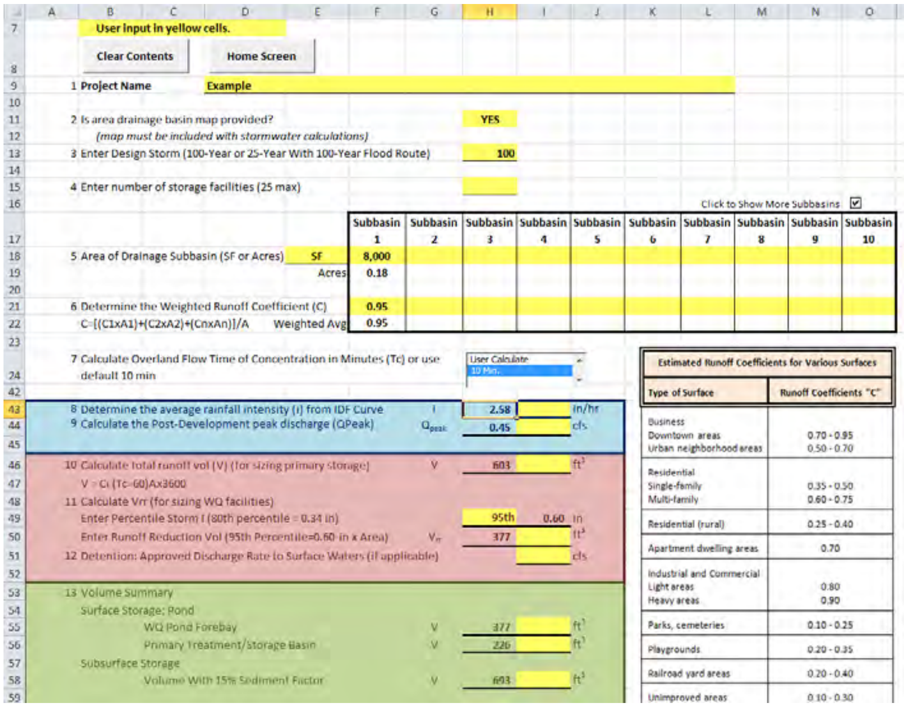
4. Enter number of storage facilities (25 max).
   Enter 1.

5. Area of Drainage Subbasin (SF or Acres)
   Enter 8000 SF, program converts to 0.18 acres

6. Determine the Weighted Runoff Coefficient (C)
   Enter 0.95

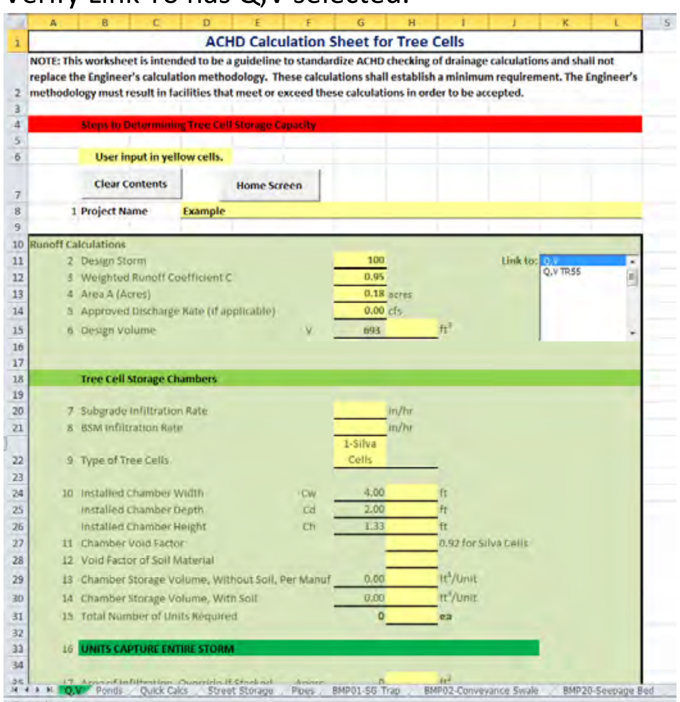
7. Calculate Overland Flow Time of Concentration in Minutes (Tc)
   Choose default 10 min

8. The design volume is 693 cf for subsurface storage.



Go to BMP33-Tree Cells Tab.

Verify Link To has Q,V selected.



6. Verify the 693 cf design volume transferred to the BMP 33 Tree Cells tab.

Numbering revised to match BMP 33 Tree Cells Line Items:
UPDATED: 12/15/15

7. Enter Subgrade Infiltration Rate
   Assume 8 in/hr

8. BSM Infiltration Rate
   a. Assume 5 in/hr

9. Type of Tree Cells
   Select 1-Silva Cells. This proprietary produce is the only option in the spreadsheet.

10. Installed chamber dimensions from manufacturer's specifications. Accept default values.
    Chamber Width: 4
    Chamber Depth: 2
    Chamber Height: 1.33

11. Chamber void factor.
    Enter 0.92 per manufacturer's specifications.

12. Void Factor of Soil Material
    Enter 0.20

13. Chamber Storage Volume, Without Soil
    a. Calculates to 9.81 ft^3/unit.

14. Chamber Storage Volume, With Soil
    Calculates to 2.45 ft^3/unit.

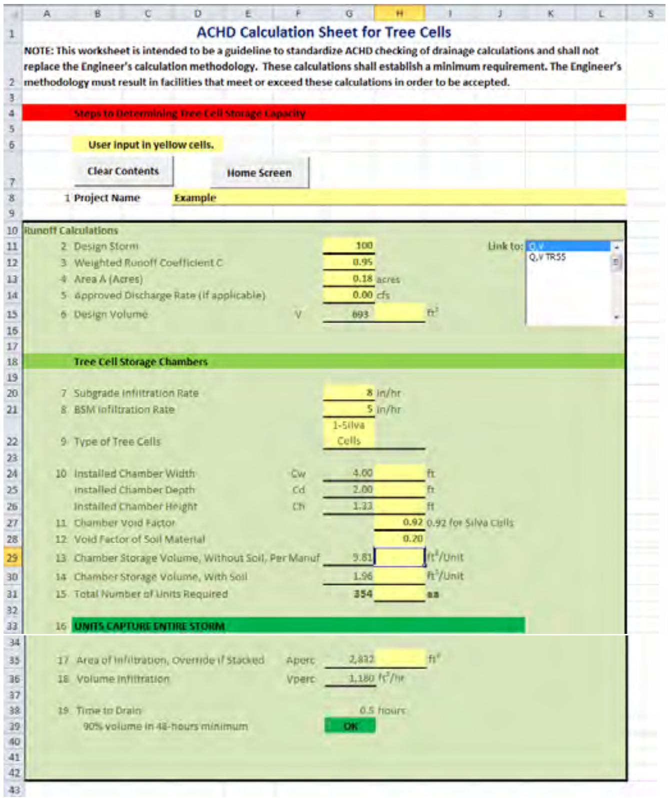
15. Total Number of Units Required
    Calculates to 354 Units. Notes units can be arranged in any configuration including stacked.

16. Note from program if units capture entire storm or overflow to a storm drain.

17. Area of Infiltration
    Calculates to 2,832 ft^3 (assumes units are not stacked). Override infiltration area if stacked.

18. Volume of Infiltration per hour
    Calculates to 1,180 ft^3.

19. Time to Drain
    Calculates to 0.5 hours.



ACHD Calculation Sheet for Tree Cells

NOTE: This worksheet is intended to be a guideline to standardize ACHD checking of drainage calculations and shall not replace the Engineer's calculation methodology. These calculations shall establish a minimum requirement. The Engineer's methodology must result in facilities that meet or exceed these calculations in order to be accepted.

Steps to Determining Tree Cell Storage Capacity

User input in yellow cells.

Clear Contents | Home Screen

1	**Project Name**		**Example**	

Runoff Calculations

Link to: Q,V / Q,V TR55

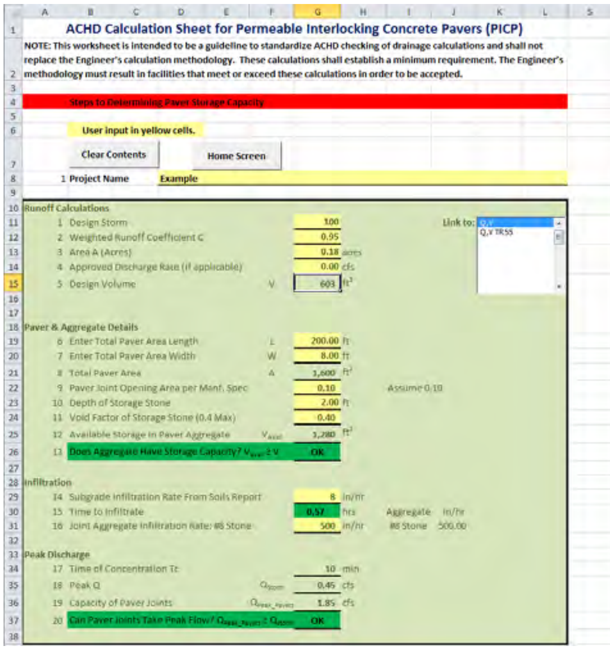
2	Design Storm		100	
3	Weighted Runoff Coefficient C		0.95	
4	Area A (Acres)		0.18	acres
5	Approved Discharge Rate (if applicable)		0.00	cfs
6	Design Volume	V	893	ft^3

Tree Cell Storage Chambers

7	Subgrade Infiltration Rate		8	in/hr
8	BSM Infiltration Rate		5	in/hr
9	Type of Tree Cells		1-Silva Cells	
10	Installed Chamber Width	Cw	4.00	ft
	Installed Chamber Depth	Cd	2.00	ft
	Installed Chamber Height	Ch	1.33	ft
11	Chamber Void Factor		0.92	0.92 for Silva Cells
12	Void Factor of Soil Material		0.20	
13	Chamber Storage Volume, Without Soil, Per Manuf		9.81	ft^3/Unit
14	Chamber Storage Volume, With Soil		1.96	ft^3/Unit
15	Total Number of Units Required		**354**	**ea**
16	**UNITS CAPTURE ENTIRE STORM**			
17	Area of Infiltration, Override if Stacked	Aperc	2,832	ft^2
18	Volume Infiltration	Vperc	1,180	ft^3/hr
19	Time to Drain		0.5	hours
	90% volume in 48-hours minimum		**OK**	

BMP34-Permeable Pavers

BMP34-Permeable Pavers are used for pretreatment and final treatment.



Example #12 for BMP34-Permeable Pavers

An example to size Permeable Pavers.

Go to Q,V Tab and enter same project information as included in the example for BMP33-Tree Cells.

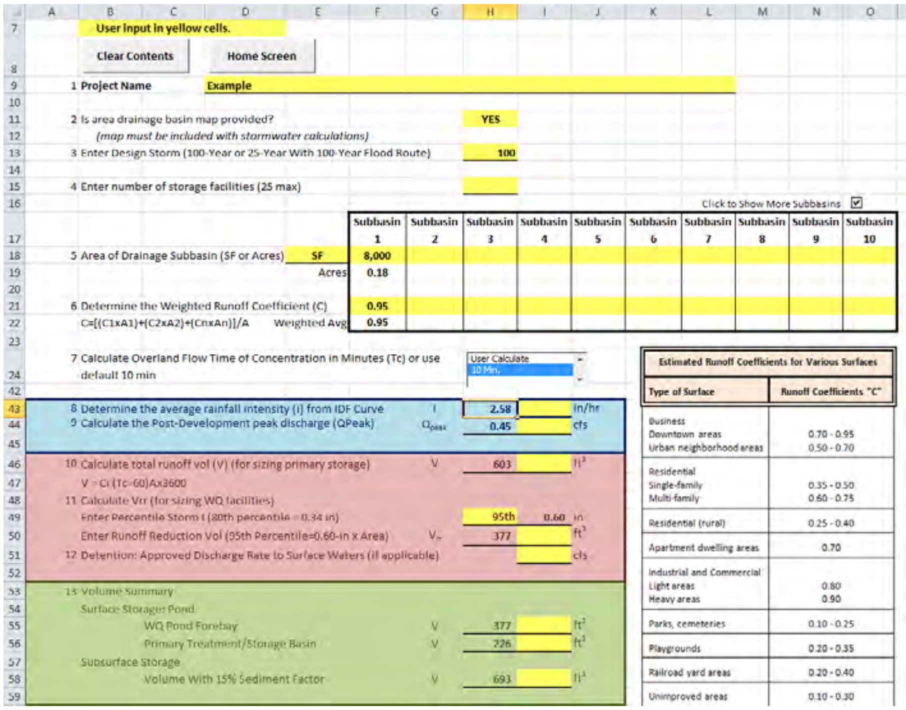
Line Item Description

1. Project Name.
   Verify name is Example

2. Verify Runoff Coefficient C is 0.95.

3. Verify area is 0.18 acres.

4. Verify discharge rate is 0.



Go to BMP34-Pavers Tab

5. Verify design volume is 603 ft^3

6. Enter paver area length of 200.

7. Enter 8 ft for pavers in parking area.

8. Total Paver Area calculates to 1,600 ft^2.

9. Enter 0.10, standard 10% of total area is open joint area.

10. Enter 2 ft.

11. Enter 0.40

12. Program calculates 1,280 ft^3

13. Program calculates OK (1280 ft^3 > 603 ft^3)

14. Enter 8 in/hr.

15. Program calculates 0.65 hours

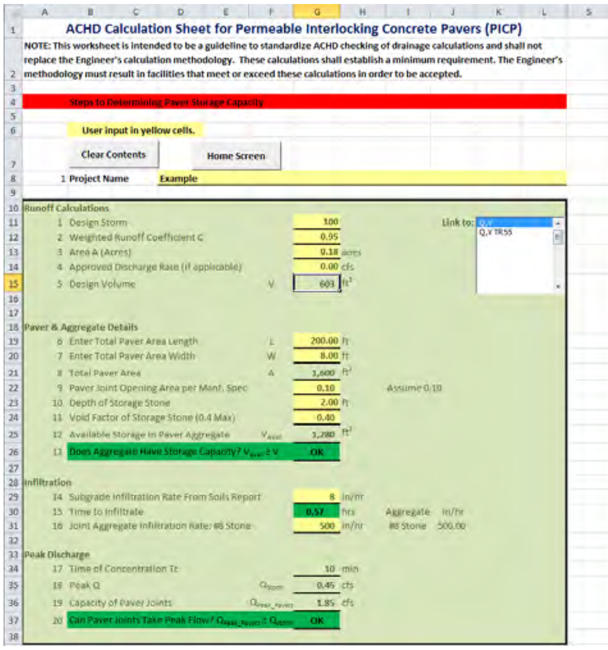
16. Enter 500 in/hr

17. Time of concentration. Program pulls 10 min from Q,V Tab.

18. Program pulls 0.45 cfs from Q,V Tab

19. Program calculates 1.85 cfs

20. Program calculates “OK”.


ACHD Calculation Sheet for Permeable Interlocking Concrete Pavers (PICP)

NOTE: This worksheet is intended to be a guideline to standardize ACHD checking of drainage calculations and shall not replace the Engineer's calculation methodology. These calculations shall establish a minimum requirement. The Engineer's methodology must result in facilities that meet or exceed these calculations in order to be accepted.

Steps to Determining Paver Storage Capacity

User input in yellow cells.

Clear Contents | Home Screen

1 Project Name: Example

Runoff Calculations				
1 Design Storm		100		Link to: Q,V / Q,V TR55
2 Weighted Runoff Coefficient C		0.95		
3 Area A (Acres)		0.18	acres	
4 Approved Discharge Rate (if applicable)		0.00	cfs	
5 Design Volume	V	603	ft^3	
Paver & Aggregate Details				
6 Enter Total Paver Area Length	L	200.00	ft	
7 Enter Total Paver Area Width	W	8.00	ft	
8 Total Paver Area	A	1,600	ft^2	
9 Paver Joint Opening Area per Manf. Spec		0.10		Assume 0.10
10 Depth of Storage Stone		2.00	ft	
11 Void Factor of Storage Stone (0.4 Max)		0.40		
12 Available Storage in Paver Aggregate	V_{avail}	1,280	ft^3	
13 Does Aggregate Have Storage Capacity? $V_{avail} \geq V$		OK		
Infiltration				
14 Subgrade Infiltration Rate From Soils Report		8	in/hr	
15 Time to Infiltrate		0.57	hrs	Aggregate: in/hr
16 Joint Aggregate Infiltration Rate: #8 Stone		500	in/hr	#8 Stone: 500.00
Peak Discharge				
17 Time of Concentration Tc		10	min	
18 Peak Q	Q_{Storm}	0.45	cfs	
19 Capacity of Paver Joints	Q_{Peak_Pavers}	1.85	cfs	
20 Can Paver Joints Take Peak Flow? $Q_{Peak\_Pavers} \geq Q_{Storm}$		OK		

Lifecycle Cost Estimate

This tab is used for selection of BMPs on ACHD Capital Roadway Projects. The user enters estimated costs in today's dollars for installation of a particular BMP and estimated future maintenance costs out to a 50-year design life.

ACHD Calculation Sheets for Lifecycle Cost

Steps for Calculating Lifecycle Cost

User input in yellow cells. To accept default value type = in yellow cell and point to computed cell

Clear Contents

1 **Project Name** Example

Stormwater Capital & Rehabilitation/Replacement Costs in Today's Dollar

BMP: Pond With Forebay

Year	Const Cost ($)	Contingency Eng/Admin Costs per BMP ($)	Land Cost ($)	Total Capital Cost ($)	Maintenance Cost ($)	Total Maintenance Cost ($)	Desc
0	$50,000	$5,000	$75,000	$130,000			
5					$2,200	$2,200	Remove sediment and top
10					$2,200	$4,400	Remove sediment and top
15					$2,200	$6,600	Remove and replace sand f
20					$2,200	$8,800	Remove sediment and top
25					$10,300	$19,100	Remove/replace sand in fc
30					$2,200	$21,300	Remove sediment and top
35					$2,200	$23,500	Remove sediment and top
40					$2,200	$25,700	Remove and replace sand f
45					$2,200	$27,900	Remove sediment and top
50					$10,300	$38,200	Remove/replace sand in fc
						$168,200	**TOTAL COST OF BMP**

Maintenance Crew Costs

1	HR	Crew Chief	$60.00
1	HR	Operator	$50.00
1	HR	Laborer	$40.00

Equipment Costs

1	HR	Hydrovac Truck	$100.00
1	HR	Front End Load	$80.00
1	HR	Track Excavator	$80.00
1	HR	Dump Truck	$70.00
1	HR	Grader	$70.00

Materials

1	CY	Filter Sand	$50.00
1	CY	Pitrun	$15.00
1	CY	2" Drainrock	$35.00

Example #13 for Lifecycle Cost Estimate

This example will estimate the cost for a pond with forebay.

Year

0 Enter construction cost of $50,000.
Contingency cost of $5,000
Land cost of $75,000
Total Capital Cost = $130,000

5 Minor Rehab
Enter maintenance cost of
Laborer: 10 hrs x $40/hr=$400 x 2 ea = $800
Operator: 10 hrs x $50/hr=$500
Crew Chief: 10 hrs x $60/hr = $600
Front End Loader: 2 hrs x $80/hr = $160
Dump Truck: 2 hrs x $70/hr = $140
Total = $2,200

10 Same $2,200

15 Same $2,200

20 Same $2,200

25 Major Rehab
Enter maintenance cost of
Laborer: 20 hrs x $40/hr=$800 x 2 ea = $1,600
Operator: 20 hrs x $50/hr=$1,000
Crew Chief: 20 hrs x $60/hr = $1,200
Front End Loader: 10 hrs x $80/hr = $800
Dump Truck: 10 hrs x $70/hr = $700
Filter Sand: 100 CY x $50/CY = $5,000
Total = $10,300

30 Minor Rehab
Enter maintenance cost of
Laborer: 10 hrs x $40/hr=$400 x 2 ea = $800
Operator: 10 hrs x $50/hr=$500
Crew Chief: 10 hrs x $60/hr = $600
Front End Loader: 2 hrs x $80/hr = $160
Dump Truck: 2 hrs x $70/hr = $140
Total = $2,200

35 Same $2,200

40 Same $2,200

45 Same $2,200

50 Major Rehab
Enter maintenance cost of
Laborer: 20 hrs x $40/hr=$800 x 2 ea = $1,600

Operator: 20 hrs x $50/hr=$1,000
Crew Chief: 20 hrs x $60/hr = $1,200
Front End Loader: 10 hrs x $80/hr = $800
Dump Truck: 10 hrs x $70/hr = $700
Filter Sand: 100 CY x $50/CY = $5,000
Total = $10,300

Appendix A – Example Plans
Englefield 3
Harris Ranch 11

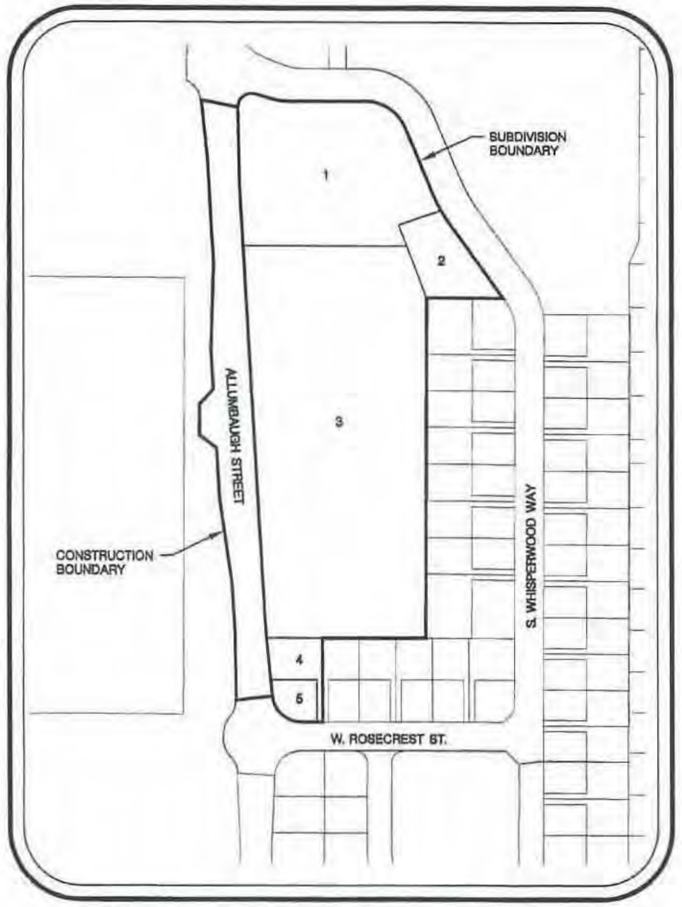
Englefield 3 Plans

REVISED 11/10/08

CONSTRUCTION PLANS FOR

ENGLEFIELD GREEN SUBDIVISION NO. 3

5-LOT RESIDENTIAL SUBDIVISION



SITE MAP

SCALE: 1"= 150'

PROJECT TEAM

DEVELOPER

VISION FIRST, LLC.
ATTN: KEN ELLIOT
881 S. RIVERSHORE LANE, SUITE 120
EAGLE, ID 83616
(208) 938-4665 (PHONE)
(208) 938-4765 (FAX)

CIVIL ENGINEER

WRG DESIGN, INC.
ATTN: BRIAN DEHAAS, PE
1173 E. WINDING CREEK DR.
EAGLE, ID 83616
(208) 246-8300 (PHONE)
(208) 246-8320 (FAX)

SURVEYOR

WRG DESIGN, INC.
1173 E. WINDING CREEK DR.
EAGLE, ID 83616
(208) 246-8300 (PHONE)
(208) 246-8320 (FAX)

LANDSCAPE ARCHITECT

WRG DESIGN, INC.
ATTN: DAVE PHILLIPS
1173 E. WINDING CREEK DR.
EAGLE, ID 83616
(208) 246-8300 (PHONE)
(208) 246-8320 (FAX)

GEOTECHNICAL ENGINEER

STRATA, INC.
8653 W. HACKAMORE DRIVE
BOISE, ID 83709
(208) 376-8200 (PHONE)
(208) 376-8201 (FAX)

UTILITY CONTACTS

POWER

IDAHO POWER
1221 W. IDAHO STREET
BOISE, ID 83702
(208) 388-2200 (PHONE)

WATER

UNITED WATER
8248 W. VICTORY RD.
BOISE, ID 83709
(208) 362-7304

TELEPHONE

QWEST
999 MAIN STREET
FLOOR 8
BOISE, ID 83702
(208) 364-3980 (PHONE)

CABLE

CABLE ONE
8400 WESTPARK STREET
BOISE, ID 83704
(208) 375-8288 (PHONE)
(208) 472-6330 (FAX)

GAS

INTERMOUNTAIN GAS COMPANY
555 SOUTH COLE RD.
BOISE, ID 83709
(208) 377-6840 (PHONE)

SANITARY SEWER

WEST BOISE SEWER DISTRICT
ATTN: PAUL KUNZ, P.E.
7608 W. USTICK ROAD
BOISE, ID 83704-5843
(208) 375-8521 (PHONE)
(208) 327-0894 (FAX)

VICINITY MAP

SCALE: 1" = 800'

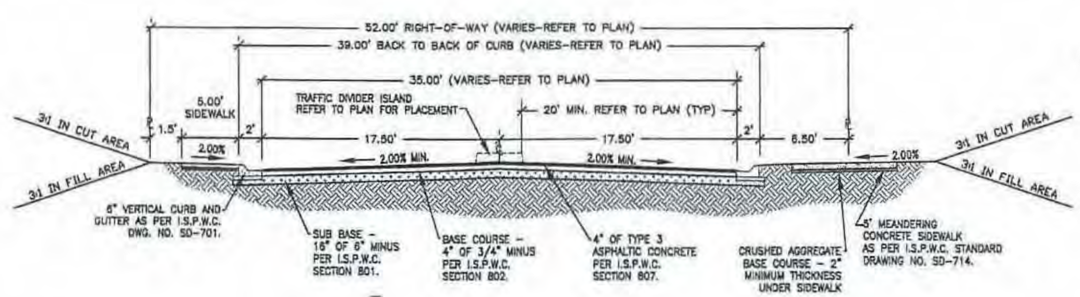
A PARCEL OF LAND SITUATE IN THE NORTH HALF OF SECTION 18, TOWNSHIP 3 NORTH, RANGE 2 EAST, BOISE MERIDIAN, BOISE CITY, ADA COUNTY, IDAHO.

LEGEND

——— - - - ———	PROJECT / PROPERTY BOUNDARY
————————	LOT LINE
— · · — · · —	PROPOSED SEWER MAIN LINE
——W——	PROPOSED WATER MAIN LINE
	FUTURE SITE IMPROVEMENTS (SHOWN FOR REFERENCE)
TC2700.00	FINISH GRADE @ TOP BACK OF VERTICAL CURB
FG2700.00	FINISH GRADE @ TOP OF PAVEMENT SURFACE
2.00%——	GRADE DIRECTION
	1000 GALLON SEDIMENT TANK
	TYPE 1 INLET CATCH BASIN
(S)	PROPOSED SANITARY SEWER MANHOLE
	BLOW-OFF ASSEMBLY
	PROPOSED WATER METER
3	LOT NUMBER
(3)	BLOCK NUMBER
[1]	STREET KEYNOTE REFERENCE
(6)	STORM WATER SYSTEM KEYNOTE REFERENCE
(12)	SANITARY SYSTEM KEYNOTE REFERENCE
◇13	WATER SYSTEM KEYNOTE REFERENCE

ABBREVIATIONS

R/W - RIGHT-OF-WAY
ISPWC - IDAHO STANDARDS FOR PUBLIC WORK CONSTRUCTION
TBC - TOP BACK OF CURB
SD - STORM DRAIN
CB - CATCH BASIN
S&G - SAND AND GREASE
MH - MANHOLE
Q100 - 100 YEAR PEAK FLOW
SS - SANITARY SEWER
IE - INVERT ELEVATION
FL - FLOW LINE
LF - LINEAL FEET
STA - STATION
GB - GRADE BREAK
PC - POINT OF CURVATURE
PT - POINT OF TANGENCY
PRC - POINT OF REVERSE CURVATURE
PCC - POINT OF COMPOUND CURVATURE
LT - LEFT OFFSET
RT - RIGHT OFFSET
CL - CENTERLINE
HP - HIGH POINT
LP - LOW POINT
R - RADIUS
L - LENGTH
PVC - POLYVINYL CHLORIDE PIPE
PIRR - PRESSURE IRRIGATION
IRR - IRRIGATION
GIRR - GRAVITY IRRIGATION
W - WATER
MJ - MECHANICAL JOINT
FL - FLANGE
GV - GATE VALVE



(1) ALLUMBAUGH STREET & CASSIA STREET - LOOKING NORTH

Not To Scale

BENCH MARK

SOUTHEAST CORNER OF ABUTMENT WALL LOCATED 25-FEET NORTH OF FRANKLIN ROAD.
ELEVATION: 2706.07 (NAVD88)

ADD 2.68' TO ALL ELEVATIONS SHOWN HERIN TO GAIN NAVD 88 ELEVATIONS.
EXAMPLE: PLAN ELEV. = 2700.00, NAVD 88 ELEV. = 2702.68

INDEX OF SHEETS

Approved Construction Set

W R G DESIGN INC.
1173 E. Winding Creek Dr. Eagle, ID 83616
Tel. 208.246.8300 Fax. 208.246.8320
PLANNERS • ENGINEERS • LANDSCAPE ARCHITECTS • SURVEYORS

RECEIVED NOV 12 2008 ACHD PLANS REVIEW SVCS

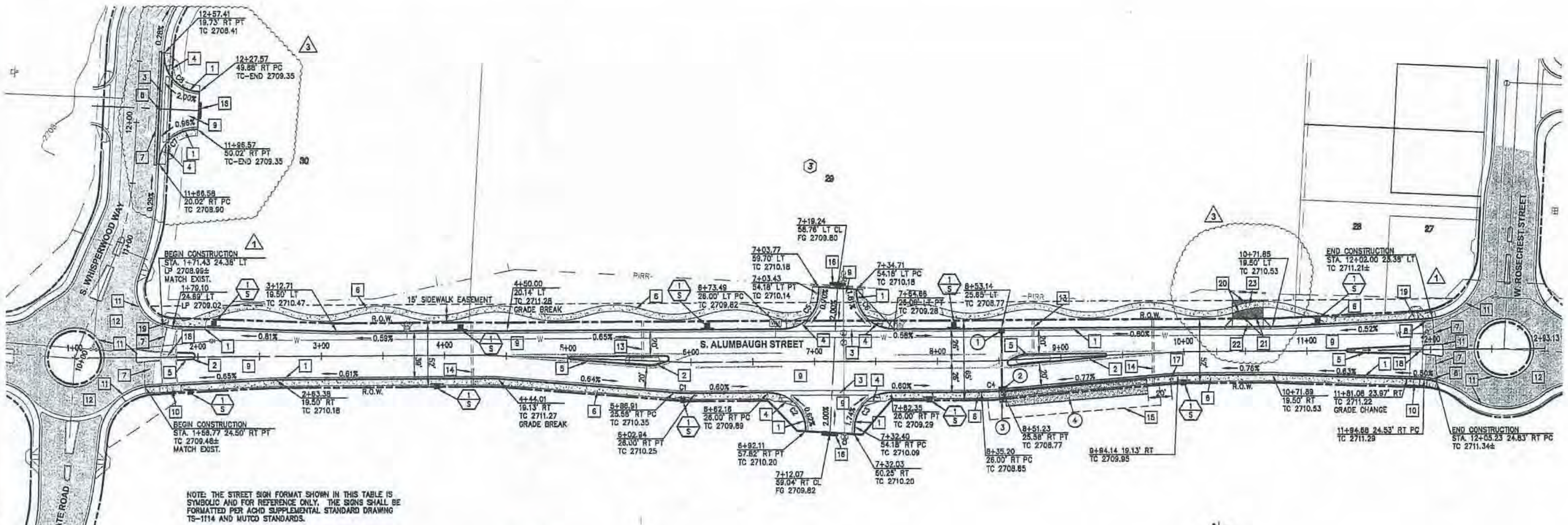
GENERAL COVER
Englefield Green Subdivision No.3
Vision First, LLC.
Boise, Idaho

#	DATE	DESCRIPTION	BY
1	07/02/07	ACHD Review Comments dated 05/23/07	CIJ
2	07/02/07	ACHD Review Comments dated 07/25/07	
	11-10-08	ACHD Re Accept (4' s/w)	

PROFESSIONAL ENGINEER REGISTERED 11800 7/26/07 STATE OF IDAHO BRIAN C. DEHAAS

DATE	07/26/07
DRAWN	CIJ
DESIGNED	CIJ
CHECKED	
PROJECT #	6066630.00

SHEET TITLE
GENERAL COVER
SHEET NUMBER
C000
OF # SHEETS



NOTE: THE STREET SIGN FORMAT SHOWN IN THIS TABLE IS SYMBOLIC AND FOR REFERENCE ONLY. THE SIGNS SHALL BE FORMATTED PER ACHD SUPPLEMENTAL STANDARD DRAWING TS-1114 AND MUTCD STANDARDS.

REFER TO ACHD APPROVED SIGNAGE AND STRIPING PLAN PREPARED BY EARTHTECH, DATED 12-21-05 FOR STRIPING AND ADDITIONAL SIGNAGE REQUIREMENTS.

NO PARKING ANY TIME

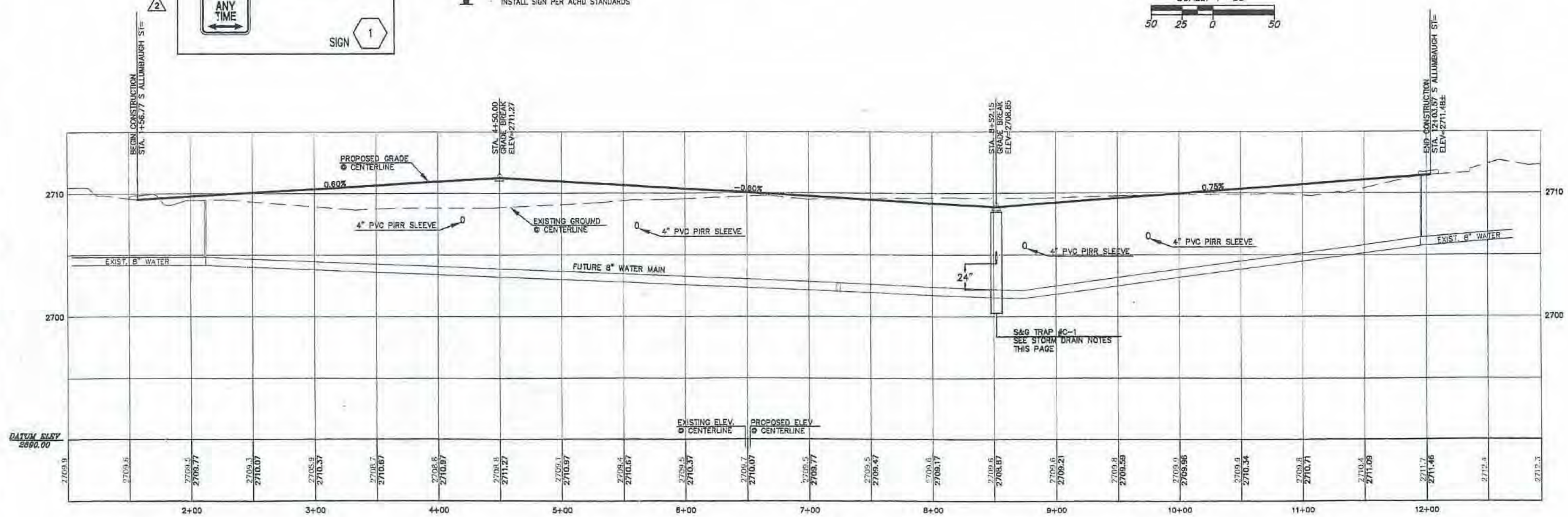
CODE: R7-1
SIZE: 12"x18"
QUANTITY: 10

SIGN 1

LEGEND

- SIGN #
- STEEL "TELESPAR"
- INSTALL SIGN PER ACHD STANDARDS

SCALE: 1"=50'



N. ALLUMBAUGH STREET

SCALE: 1" = 50' HORIZ
1" = 5' VERT

SITE CONSTRUCTION NOTES

1. CONSTRUCT 6" VERTICAL CURB AND GUTTER IN ACCORDANCE WITH THE 2005 IDAHO STANDARDS FOR PUBLIC WORKS CONSTRUCTION (ISPWC) STANDARD DETAIL SD-701.
2. CONSTRUCT 8" VERTICAL CURB W/O GUTTER IN ACCORDANCE WITH THE 2005 IDAHO STANDARDS FOR PUBLIC WORKS CONSTRUCTION (ISPWC) STANDARD DETAIL SD-701A.
3. CONSTRUCT 4' VALLEY GUTTER IN ACCORDANCE WITH THE 2005 IDAHO STANDARDS FOR PUBLIC WORKS CONSTRUCTION (ISPWC) STANDARD DETAIL SD-708.
4. CONSTRUCT TYPE "C3" PEDESTRIAN RAMP WITH YELLOW TRUNCATED DOMES IN ACCORDANCE WITH THE ~~2005~~ CURRENT IDAHO STANDARDS FOR PUBLIC WORKS CONSTRUCTION (ISPWC) STANDARD DETAIL SD-712 AND SD-712C.
5. CONSTRUCT TRAFFIC DIVIDER ISLAND. REFER TO SHEET C303 FOR SPECIFIC ISLAND DIMENSIONS AND RIGHT-OF -WAY PLACEMENT.
6. CONSTRUCT 5-FOOT WIDE CONCRETE SIDEWALK IN ACCORDANCE WITH THE 2005 IDAHO STANDARDS FOR PUBLIC WORKS CONSTRUCTION (ISPWC) STANDARD DETAIL SD-709.
7. SAW-CUT AND REMOVE EXISTING ASPHALTIC PAVEMENT. ALL PAVEMENT REPAIRS TO BE PER ISPWC STANDARD DRAWING SD-303 & SD-806.
8. SAW-CUT AND REMOVE EXISTING CURB, GUTTER AND SIDEWALK.
9. CONSTRUCT ASPHALTIC PAVEMENT. PAVEMENT SHALL BE 4" OVER 4" OF 3/4" MINUS CRUSHED AGGREGATE OVER 16" OF 6" MINUS PIT-RUN COMPACTED TO 95% STANDARD PROCTOR.
10. CONSTRUCT PEDESTRIAN ACCESS RAMP IN ACCORDANCE WITH ISPWC STANDARD DETAILS ACHD-712 AND SD-712.
11. EXISTING CURB, GUTTER AND SIDEWALK TO REMAIN PROTECTED IN PLACE.
12. EXISTING ASPHALTIC PAVEMENT TO REMAIN PROTECTED IN PLACE.
13. INSTALL 30 LF 4" PVC IRRIGATION SLEEVE. SEE SHEET C200.
14. INSTALL 64 LF 4" PVC IRRIGATION SLEEVE. SEE SHEET C200.
15. ACHD DRAINAGE EASEMENT. REFER TO ENGLEFIELD GREEN NO.3 FINAL PLAT FOR SPECIFIC DRAINAGE EASEMENT LOCATION.
16. INSTALL TYPE III TERMINUS BARRICADE STATING "ROADWAY WILL BE EXTENDED IN THE FUTURE".
17. (Rev. 1) CONSTRUCT DRAINAGE FACILITY MONITORING WELL IN ACCORDANCE WITH ISPWC SD-827.
18. CONSTRUCT TRUNCATED DOMES IN ACCORDANCE WITH ISPWC SD-712.
19. CONSTRUCT PEDESTRIAN ACCESS RAMP IN ACCORDANCE WITH ISPWC STANDARD DETAILS SD-712E (TYPE G1) AND SD-712.
20. (Rev. 3) CONSTRUCT GRASS-PAVE ACCESS DRIVE AT EMERGENCY ENTRANCE PER MANUFACTURERS SPECIFICATIONS.
21. (Rev. 3) INSTALL REMOVABLE BOLLARD AT EMERGENCY ENTRANCE COORDINATE WITH EMERGENCY SERVICES ON BOLLARD TYPE AND LOCATION.
22. (Rev. 3) CONSTRUCT 25' WIDE DRIVEWAY APPROACH PER ISPWC SD-710 CENTERLINE OF APPROACH AT STA: 10+52.00.
23. (Rev. 3) DETACHED SIDEWALK LOCATED BEHIND APPROACH THROAT TO BE THICKENED SECTION AS REQUIRED BY ISPWC SD-710 (NOTE D)

STORM DRAIN CONSTRUCTION NOTES

(1) (Rev. 1) SD CB #C-1 TYPE I PER ISPWC SD-601
STA. 8+53.14, 23.65' LT S. ALLUMBAUGH ST.
TC: 2708.77
IE OUT (12" E)= 2704.40
SUMP= 2703.40
INSTALL 47 LF 12" SDR 35 ASTM D3034 PVC @ S= 0.50%
Q = 0.655 cfs

(2) (Rev. 1) SD CB #C-2 TYPE I PER ISPWC SD-601
STA. 8+51.23, 23.58' RT S. ALLUMBAUGH ST.
TC: 2708.77
IE IN (12" W)= 2704.16
IE OUT (12" E)= 2704.16
SUMP= 2703.16
INSTALL 1 LF 12" SDR 35 ASTM D3034 PVC @ S= 0.50%
Q = 0.655 cfs

(3) (Rev. 1) S&G TRAP #C-1
1000 GALLON SAND & GREASE TANK PER ISPWC SD-624
STA. 8+53.14, 28.00' RT S. ALLUMBAUGH ST.
(CENTER OF EAST RIM)
RIM: 2708.81
IE IN (12" E)= 2704.16
IE OUT (12" S)= 2702.83 (114 LF OF 12" PERFORATED PVC PIPE)
TOP OF BAFFLE= 2704.08
MIN. BAFFLE WIDTH= 12"
Q = 1.31 cfs
THROAT VELOCITY= 0.33 FT/SEC

(4) INFILTRATION/PERCOLATION FACILITY "C"

LENGTH:	115'
WIDTH:	12'
DEPTH (BTM ROCK):	9.2'
VOLUME:	11,316 CF
NET VOLUME:	4,526 CF
REQUIRED VOLUME:	4,482 CF
TOP EL. (TOP ROCK):	2704.83
BTM EL. (BTM ROCK):	2695.63

** SEASONAL HIGH GROUNDWATER = ±2690.00 ACCORDING TO THE GEOTECHNICAL INVESTIGATION PERFORMED BY STRATA INC. DATED 9/25/02. **

PAVEMENT REPAIR NOTE

ACTUAL FIELD CONDITIONS DURING TRENCHING MAY REQUIRE ADDITIONAL PAVEMENT REPAIR BEYOND THE LIMITS SHOWN ON THE PLANS. THE FOLLOWING CONDITIONS ARE LISTED IN SECTION 6008.13.11 OF ACHD POLICY MANUAL.

1. ALL ASPHALT MATCH LINES FOR PAVEMENT REPAIR SHALL BE PARALLEL TO CENTERLINE OF THE STREET AND INCLUDE ANY AREA DAMAGED BY EQUIPMENT DURING TRENCHING OPERATIONS.
2. IF THE CUMALATIVE DAMAGED PAVEMENT AREA EXCEEDS 50% OF THE TOTAL ROAD SURFACE, CONTRACTOR SHALL REPLACE THE ENTIRE ROADWAY SURFACE.
3. CONTRACTOR SHALL REPLACE THE PAVEMENT SURFACE TO ENSURE MATCH LINE DOES NOT FALL WITHIN THE WHEEL PATH OF A LANE. MATCH LINE SHALL ONLY FALL IN THE CENTER OR EDGE OF THE TRAVEL LANE.
4. FLOWABLE FILL OR IMPORTED MATERIAL MAY BE REQUIRED IF THE NATIVE TRENCH MATERIAL IS DEEMED UNSUITABLE BY ACHD INSPECTOR, DOES NOT MEET COMPACTION STANDARDS OR TIME IS A CRITICAL FACTOR.
5. ANY EXCEPTIONS TO THESES RULES SHALL BE PRE-APPROVED IN WRITING BY DISTRICT STAFF BEFORE CONSTRUCTION BEGINS.

CURVE TABLE

CURVE	LENGTH	RADIUS	DELTA ANGLE
C1	17.18	200.00	4°55'14"
C2	48.95	30.00	93°28'55"
C3	45.30	30.00	86°31'05"
C4	17.18	200.00	4°55'14"
C5	45.30	30.00	86°31'05"
C6	48.95	30.00	93°28'55"
C7	47.11	30.00	89°58'45"
C8	47.11	30.00	89°58'45"

NOTE: CURVE DATA IS GIVEN AT BACK OF CURB

Approved Construction Set

#	DATE	DESCRIPTION	BY
1	07/02/07	ACHD Review Comments dated 05/23/07	CIJ
2	07/02/07	ACHD Review Comments dated 07/25/07	
3	11/14/07	Site Entrance/Utility Modification dated 10/10/07	

STREET/STORM PLAN & PROFILES
Englefield Green Subdivision No.3

Vision First, LLC.
Boise, Idaho

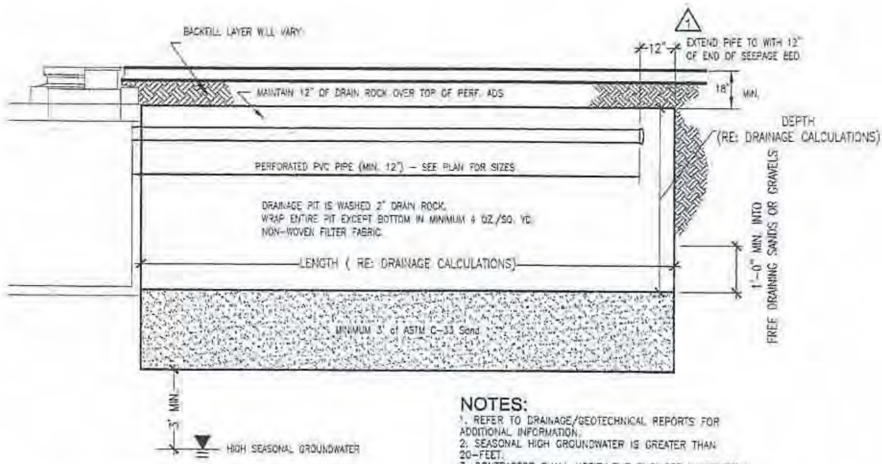
W R G DESIGN INC
1173 E. Winding Creek Dr. Eagle, ID 83616
Tel. 208.246.8300 Fax. 208.246.8320
PLANNERS • ENGINEERS • LANDSCAPE ARCHITECTS • SURVEYORS

PROFESSIONAL ENGINEER REGISTERED 11800 12/4/07 STATE OF IDAHO BRIAN C. DEHAAS

DATE	07/26/07
DRAWN	CIJ
DESIGNED	CIJ
CHECKED	
PROJECT #	6066630.00

SHEET TITLE
STREET/STORM

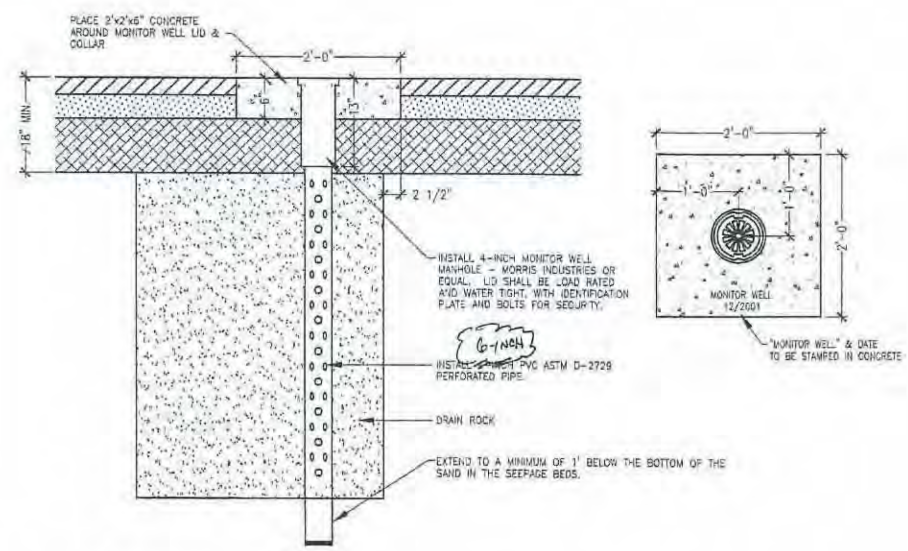
SHEET NUMBER
C100



NOTES:
1. REFER TO DRAINAGE/GEOTECHNICAL REPORTS FOR ADDITIONAL INFORMATION.
2. SEASONAL HIGH GROUNDWATER IS GREATER THAN 20-FEET.
3. CONTRACTOR SHALL NOTIFY THE ENGINEER IMMEDIATELY IF GROUNDWATER IS ENCOUNTERED WITHIN 3-FEET OF THE BOTTOM DESIGN ELEVATION FOR ANY INFILTRATION FACILITY.

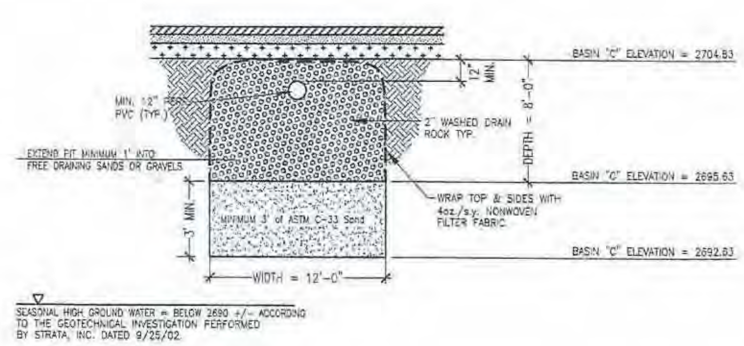
(1) TYPICAL SEEPAGE PIT - SECTION

Scale: N.T.S.



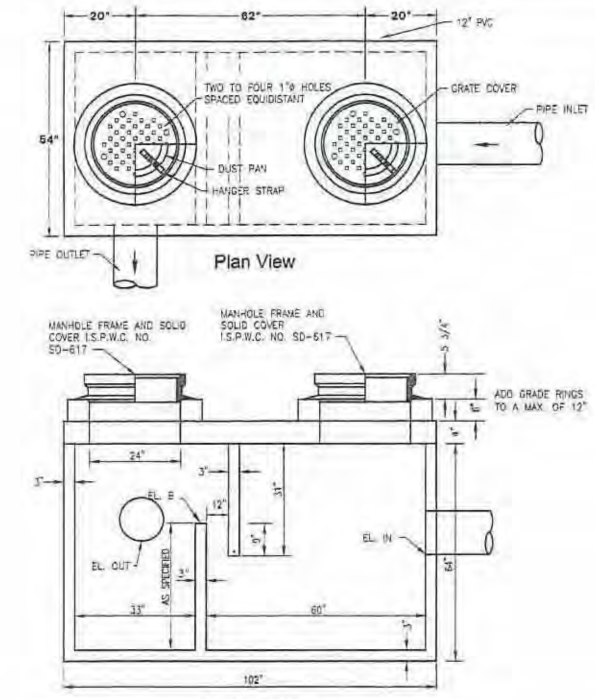
(2) MONITOR WELL DETAIL

Scale: N.T.S.



(3) TYPICAL SEEPAGE PIT CROSS-SECTION

Scale: N.T.S.



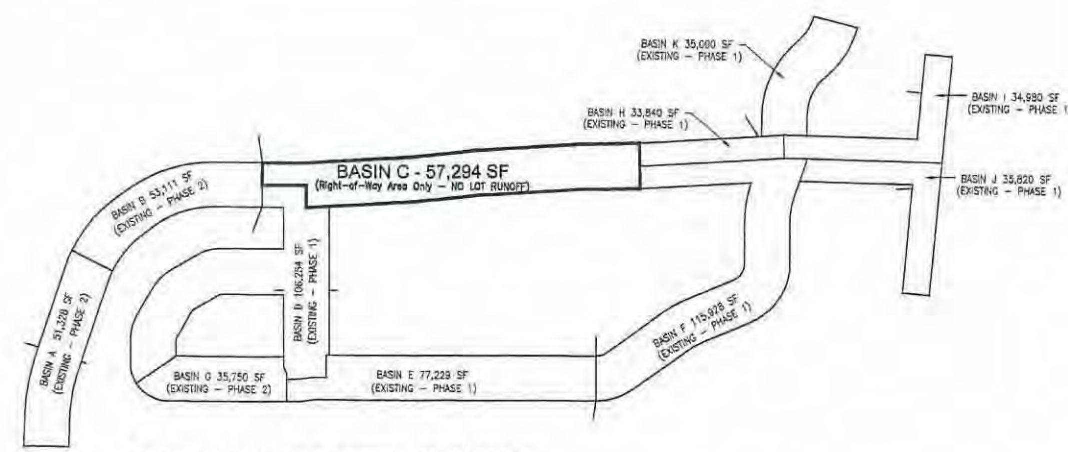
SEDIMENT TANK NOTES:
1. REFER TO DRAINAGE REPORT FOR ADDITIONAL INFORMATION.
2. SEASONAL HIGH GROUNDWATER IS GREATER THAN 20-FEET.
3. CONTRACTOR SHALL NOTIFY THE ENGINEER IMMEDIATELY IF GROUNDWATER IS ENCOUNTERED WITHIN 3-FEET OF THE BOTTOM DESIGN ELEVATION FOR ANY INFILTRATION FACILITY.

NOTES:
1. REFER TO DRAINAGE REPORT FOR ADDITIONAL INFORMATION.
2. SEASONAL HIGH GROUNDWATER IS GREATER THAN 20-FEET.
3. CONTRACTOR SHALL NOTIFY THE ENGINEER IMMEDIATELY IF GROUNDWATER IS ENCOUNTERED WITHIN 3-FEET OF THE BOTTOM DESIGN ELEVATION FOR ANY INFILTRATION FACILITY.

NOTES
1. SEE PLAN SHEETS FOR PIPE SIZES, ELEVATIONS, AND LOCATIONS.
2. 1000 GALLON SAND AND GREASE TRAP SHALL BE DESIGNED TO SUPPORT AN HS-25 TRAFFIC LOAD.
3. SAND & GREASE TRAP SHALL BE LAR-KEN 1000 GAL OR EQUAL.
4. ALL DIMENSIONS SHOWN ARE FOR REFERENCE PURPOSES. TANK SHALL BE CONSTRUCTED TO MANUFACTURERS SPECIFICATIONS.
5. EL. IN > EL. B BY 1" MIN. EL. OUT < EL. B BY 3" MIN. UNLESS OTHERWISE APPROVED BY THE ENGINEER.
6. REFER TO PLAN VIEW FOR SPECIFIC ELEVATIONS.

(4) TYPICAL SEDIMENT TANK DETAIL

Scale: N.T.S.



△1 (5) DRAINAGE BASIN - KEY MAP

Scale: N.T.S.

BASIN "C"

△1

	SEEPAGE BED	
A = 57,294 SF	Length = 115 ft	Bottom infilt. Area = 1,380 SF
C = 0.95	Width = 12 ft	2/3 sides Infilt. Area = 1,395 SF
A = 1.32 Acre	Depth = 9.2 ft	Pit Retention Volume = 4,526 CF
Infiltration Area = 1,395 SF	Freeboard = 1 ft	Maximum Req. Vol. = 4,482 CF
Infiltration Rate = 8 in/hr	Pit Vol. - Freeboard = 11,316 CF	Q @ Tc = 1.31 CFS
Outflow = 0		

(6) DRAINAGE BASIN CALCULATIONS

Approved Construction Set

W R I G H T
D E S I G N

1173 E. Winding Creek Dr. Eagle, ID 83616
Tel. 208.246.8300 Fax. 208.246.8320
PLANNERS • ENGINEERS • LANDSCAPE ARCHITECTS • SURVEYORS

CONSTRUCTION DETAILS
Englefield Green Subdivision No.3
Vision First, LLC.
Boise, Idaho

#	DATE	DESCRIPTION	BY
1	07/02/07	ACHD Review Comments dated 05/23/07	CIJ
2	07/02/07	ACHD Review Comments dated 07/25/07	

PROFESSIONAL ENGINEER REGISTERED 11800 7/26/07 STATE OF IDAHO BRIAN C. DEHAAS

DATE	07/26/07
DRAWN	CIJ
DESIGNED	CIJ
CHECKED	
PROJECT #	606663000

SHEET TITLE
CONST. DETAILS
SHEET NUMBER
C302
OF # SHEETS

Harris Ranch 11 Plans

Engineering NorthWest, LLC

HARRIS RANCH SUBDIVISION NO. 11
DETENTION POND
BOISE, ADA COUNTY, IDAHO

PROFESSIONAL ENGINEER
REGISTERED
7529
STATE OF IDAHO
EUGENE P. SMITH

HARRIS RANCH SUBDIVISION NO. 11 DETENTION POND

GENERAL

1. ALL WORK SHALL BE DONE IN ACCORDANCE WITH THE SPECIFICATIONS AND/OR REQUIREMENTS OF BOISE CITY AND/OR THE ADA COUNTY HIGHWAY DISTRICT AND I.S.P.W.C.
2. A PRE CONSTRUCTION CONFERENCE WILL BE HELD A MINIMUM OF 48 HOURS PRIOR TO START OF WORK. ALL CONTRACTORS, SUBCONTRACTORS AND/OR UTILITY CONTRACTORS SHOULD BE PRESENT.
3. SHOULD ENGINEERING NORTHWEST, LLC PROVIDE CONSTRUCTION STAKES FOR THE PROJECT: STAKING MUST BE REQUESTED A MINIMUM OF 48 HOURS PRIOR TO PLANNED USE.
4. THE CONTRACTOR(S) SHALL REMOVE ALL OBSTRUCTIONS, BOTH ABOVE AND BELOW GROUND, AS REQUIRED FOR THE CONSTRUCTION OF THE PROPOSED IMPROVEMENTS. THIS SHALL INCLUDE CLEARING AND GRUBBING WHICH CONSISTS OF CLEARING THE GROUND SURFACE OF ALL TREES, STUMPS, BRUSH, UNDERGROWTH, HEDGES, HEAVY GROWTH OF GRASS OR WEEDS, FENCES, STRUCTURES, DEBRIS, RUBBISH, AND SUCH MATERIAL WHICH, IN THE OPINION OF THE ENGINEER, IS UNSUITABLE FOR THE FOUNDATION OF PAVEMENTS. ALL MATERIAL NOT SUITABLE FOR FUTURE USE ON SITE SHALL BE DISPOSED OF OFF SITE.
5. CERTAIN CONTROL POINTS WILL BE SET BY THE ENGINEER, OR ITS REPRESENTATIVE, WHICH ARE CRITICAL TO THE CONSTRUCTION STAKING OF THE PROJECT. THESE POINTS WILL BE DESIGNATED AT THE TIME THEY ARE SET AND THE CONTRACTOR SO NOTIFIED. DESTRUCTION OF THESE POINTS BY THE CONTRACTOR OR HIS SUBCONTRACTORS SHALL BE GROUNDS FOR CHARGING THE CONTRACTOR FOR REESTABLISHING SAID POINTS.
6. THE CONTRACTOR SHALL MAINTAIN ALL EXISTING DRAINAGE FACILITIES WITHIN THE CONSTRUCTION AREA UNTIL THE DRAINAGE IMPROVEMENTS ARE IN PLACE AND FUNCTIONING.
7. ALL CONTRACTORS WORKING WITHIN THE PROJECT BOUNDARIES ARE RESPONSIBLE FOR COMPLIANCE WITH ALL APPLICABLE SAFETY LAWS OF ANY JURISDICTIONAL BODY. THE CONTRACTOR SHALL BE RESPONSIBLE FOR ALL BARRICADES, SAFETY DEVICES AND CONTROL OF TRAFFIC WITHIN AND AROUND THE CONSTRUCTION AREA.
8. EXISTING A.C. PAVEMENT SHALL BE CUT TO A NEAT STRAIGHT LINE PARALLEL OR PERPENDICULAR TO THE STREET CENTERLINE AND THE EXPOSED EDGE SHALL BE TACKED WITH EMULSION PRIOR TO PAVING.
9. ALL MATERIALS FURNISHED ON OR FOR THE PROJECT MUST MEET THE MINIMUM REQUIREMENTS OF THE APPROVING AGENCIES OR AS SET FORTH HEREIN, WHICHEVER IS MORE RESTRICTIVE. CONTRACTORS MUST FURNISH PROOF THAT ALL MATERIALS INSTALLED ON THIS PROJECT MEET THESE REQUIREMENTS AT THE REQUEST OF THE AGENCY AND/OR THE ENGINEER.
10. THE LOCATIONS OF EXISTING UNDERGROUND UTILITIES ARE SHOWN IN APPROXIMATE LOCATIONS. THE CONTRACTOR SHALL DETERMINE THE EXACT LOCATION OF ALL EXISTING UTILITIES BEFORE COMMENCING WORK. THE CONTRACTOR AGREES TO BE FULLY RESPONSIBLE FOR ANY AND ALL DAMAGES WHICH MIGHT OCCUR BY HIS FAILURE TO EXACTLY LOCATE AND PRESERVE ANY AND ALL UNDERGROUND UTILITIES. CALL "DIG LINE INC." @ 1-800-342-1585.
11. ALL CONTRACTORS WORKING WITHIN THE PUBLIC ROAD RIGHT-OF-WAY ARE REQUIRED TO SECURE A RIGHT-OF-WAY PERMIT FROM A.C.H.D. AT LEAST 24 HOURS PRIOR TO ANY CONSTRUCTION.
12. ALL COSTS OF RETESTING FOR PREVIOUSLY FAILED TESTS SHALL BE BACKCHARGED TO THE CONTRACTOR BY THE OWNER.
13. ALL COSTS TO THE CONTRACTOR INCURRED IN CORRECTING DEFICIENT WORK SHALL BE TO THE CONTRACTORS ACCOUNT. FAILURE TO CORRECT SUCH WORK WILL BE CAUSE FOR A STOP WORK ORDER AND POSSIBLE TERMINATION.
14. THE CONTRACTOR IS TO FIELD VERIFY ALL EXISTING CURB & GUTTER, STORM DRAIN, CHANNEL CROSSINGS AND SEWER ELEVATIONS OR INVERTS PRIOR TO CONSTRUCTION AND NOTIFY THE ENGINEER WHEN ELEVATIONS OR INVERTS DO NOT MATCH PLANS.
15. THE CONTRACTOR SHALL FILE AND SUBMIT A NOTICE OF INTENT (NOI) ALONG WITH A STORM WATER POLLUTION PREVENTION PLAN TO MEET THE REQUIREMENTS OF THE ENVIRONMENTAL PROTECTION AGENCY (EPA) FOR CONSTRUCTION ACTIVITIES FOR THIS PROJECT.
16. ALL DITCHES ON SITE SHALL BE BACK FILLED AND COMPACTED PER THE ONSITE GEOTECHNICAL RECOMMENDATIONS. COORDINATE WITH THE DEVELOPER PRIOR TO COMPACTION.

ROADWAY

1. ALL CONSTRUCTION IN THE PUBLIC RIGHT-OF-WAY SHALL CONFORM TO THE 2005 EDITION OF THE I.S.P.W.C. AND THE ACHD SUPPLEMENTAL SPECIFICATIONS. NO EXCEPTIONS TO DISTRICT POLICY, STANDARDS, AND THE I.S.P.W.C. WILL BE ALLOWED UNLESS SPECIFICALLY AND PREVIOUSLY APPROVED IN WRITING BY THE DISTRICT.
2. ADA COUNTY HIGHWAY DISTRICT WILL INSPECT AND APPROVE ALL STORM DRAINAGE IMPROVEMENTS. BOISE CITY PUBLIC WORKS WILL INSPECT STORM DRAINAGE IMPROVEMENTS SERVING PRIVATE ROADS, PARKING LOTS AND OTHER PAVING IMPROVEMENTS OUTSIDE THE PUBLIC RIGHT-OF-WAY.
3. PLACE ALL WATER VALVES, BLOW-OFFS AND MANHOLES SO THAT THEY DO NOT CONFLICT WITH ANY CONCRETE CURB AND GUTTER, VALLEY GUTTER OR SIDEWALK IMPROVEMENTS.
4. WHEN DISCREPANCIES OCCUR BETWEEN PLANS AND SPECIFICATIONS, THE CONTRACTOR SHALL IMMEDIATELY NOTIFY THE ENGINEER. UNTIMELY NOTIFICATION SHALL NEGATE ANY CONTRACTORS CLAIM FOR ADDITIONAL COMPENSATION.
5. ALL TOPS OF VALVE BOXES AND SEWER MANHOLES SHALL BE SET FLUSH WITH THE SLOPE OF THE FINISHED STREET GRADES. THE ROADWAY CONTRACTOR SHALL INSTALL AND ADJUST ALL SPACERS, GRADE RINGS, MANHOLE RINGS AND LIDS.
6. ALL COSTS OF RETESTING FOR PREVIOUSLY FAILED TESTS SHALL BE BACKCHARGED TO THE CONTRACTOR BY THE OWNER.
7. ALL COSTS TO THE CONTRACTOR INCURRED IN CORRECTING DEFICIENT WORK SHALL BE TO THE CONTRACTORS ACCOUNT. FAILURE TO CORRECT SUCH WORK WILL BE CAUSE FOR A STOP WORK ORDER AND POSSIBLE TERMINATION.
8. ALL STORM DRAINAGE APPURTENANCES SHALL BE INSPECTED AND CERTIFIED BY ADA COUNTY HIGHWAY DISTRICT.
9. ALL WATER METERS AND FIRE HYDRANTS ARE TO BE LOCATED OUT OF THE ROAD RIGHT-OF-WAY. THERE MUST BE AT LEAST A ONE (1) FOOT SEPARATION BETWEEN ANY BACK OF SIDEWALK (OR CURB IF NO SIDEWALK OR DETACHED SIDEWALK) AND THE LEADING EDGE OF ANY FIRE HYDRANT.
10. OVER EXCAVATION AND ADDITIONAL GRANULAR BACKFILL MAY BE REQUIRED IN HIGH GROUNDWATER AREAS WHICH ARE TO BE DETERMINED BY THE FIELD INSPECTOR.
11. ALL WORK SHALL BE INSPECTED BY THE ADA COUNTY HIGHWAY DISTRICT IN ACCORDANCE WITH THE LATEST EDITION OF THE "CONSTRUCTION QUALITY ASSURANCE MANUAL."
12. ROADWAY CONSTRUCTION WILL MEET SPECIFIC DETAILS AND REQUIREMENTS OF THE IDAHO STANDARDS FOR PUBLIC WORKS CONSTRUCTION STANDARD DRAWINGS. (2005 EDITION) INCLUDING:
    1. RESIDENTIAL STREET SECTION, DRAWING NO. SD-801, AND SECTIONS AS SHOWN ON ROADWAY DETAIL SHEET.
    2. STANDARD 6" VERTICAL CURB & GUTTER, DRAWING NO. SD-701.
    3. ROLLED CURB AND GUTTER, DRAWING NO. SD-702.
    4. PEDESTRIAN RAMP FOR HANDICAPPED, DRAWING NO. SD-712B AND SD-712C.
    5. SIDEWALKS, DRAWING NO. SD-709.
    6. STANDARD DROP INLET TYPE IV, WITH 12" SUMP, DRAWING NO. SD-604A, UNLESS OTHERWISE NOTED.
    7. VALLEY GUTTER (4') DRAWING NO. SD-708.
13. EXISTING A.C. PAVEMENT SHALL BE CUT TO A NEAT STRAIGHT LINE PARALLEL OR PERPENDICULAR TO THE STREET CENTERLINE AND THE EXPOSED EDGE SHALL BE TACKED WITH EMULSION PRIOR TO PAVING. CONTRACTOR SHALL MATCH EXISTING ROAD SECTION PER ACHD REQUIREMENTS.

VICINITY MAP
-NTS-

-INDEX OF PLAN SHEETS-

NOTES TO CONTRACTOR:

1) CONTRACTOR TO FIELD VERIFY ALL EXISTING CURB & GUTTER, STORM DRAIN, CHANNEL CROSSINGS, & SEWER ELEVATIONS OR INVERTS PRIOR TO CONSTRUCTION AND NOTIFY ENGINEER WHEN ELEVATIONS OR INVERTS DO NOT MATCH PLANS.
2) THE LOCATIONS OF EXISTING UNDERGROUND UTILITIES ARE SHOWN IN APPROXIMATE LOCATIONS. THE CONTRACTOR SHALL DETERMINE THE EXACT LOCATION OF ALL EXISTING UTILITIES BEFORE COMMENCING WORK. HE AGREES TO BE FULLY RESPONSIBLE FOR ANY AND ALL DAMAGES WHICH MIGHT OCCUR BY HIS FAILURE TO EXACTLY LOCATE AND PRESERVE ANY AND ALL UNDERGROUND UTILITIES.

Harris Ranch

DEVELOPER:
HARRIS/BRIGHTON, LLC
BOISE, IDAHO

NO.	REVISIONS	BY	DATE		
5				DESIGNED BY:	DATE:
4				DRAWN BY:	DATE:
3				CHECKED BY:	DATE:
2				APPROVED:	DATE:
1	ADDED FORBAY INTO POND & DETAIL	BDG	3/23/10		

Engineering NorthWest, LLC
423 N. ANCESTOR PL.
SUITE 180
BOISE, IDAHO 83704
(208)376-5000

HARRIS RANCH SUBDIVISION NO. 11
DETENTION POND

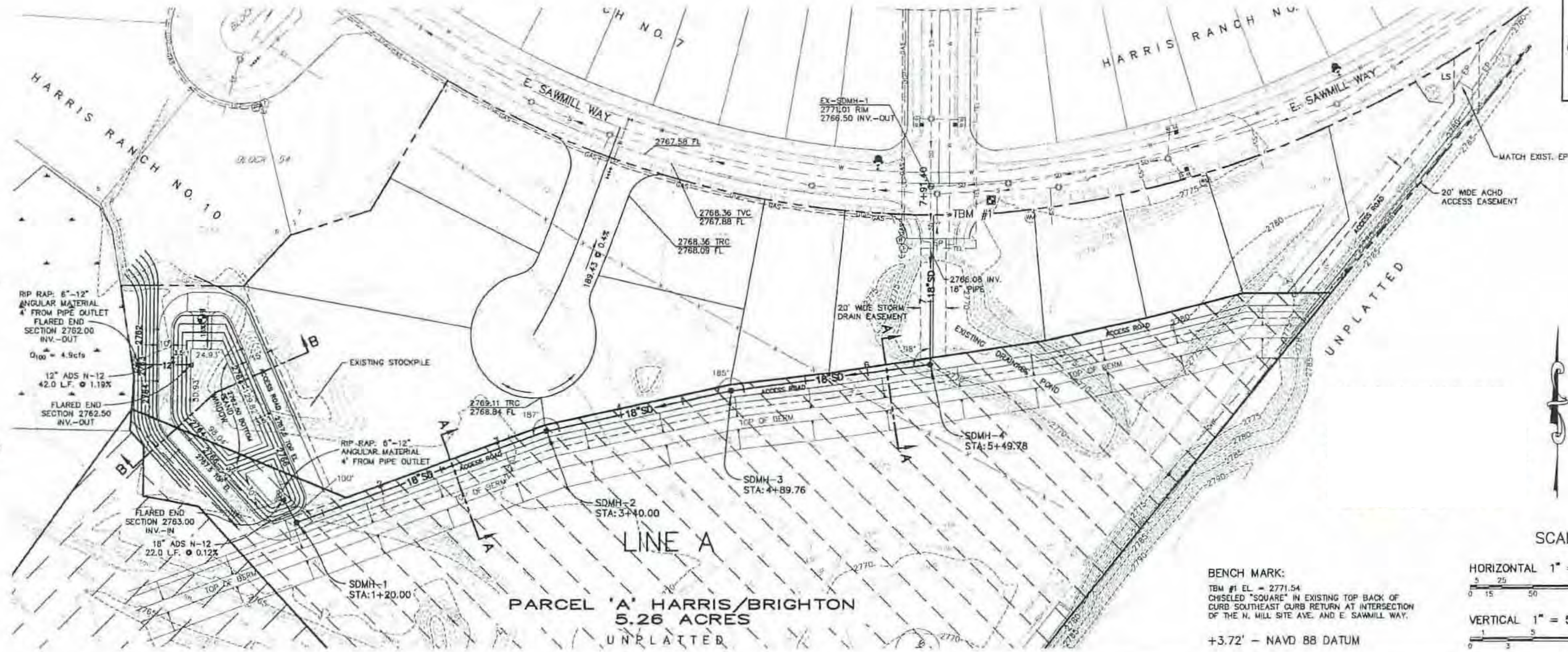
COVER SHEET & NOTES

JOB NO. 08-017-01

SHEET NO. 1

LEGEND

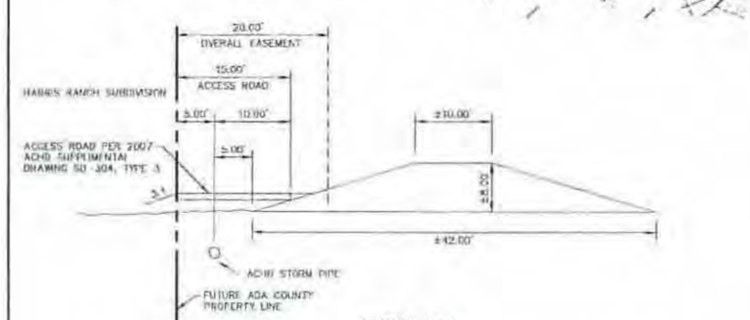
- PARCEL BOUNDARY LINE
- RIGHT-OF-WAY LINE
- LOT LINE
- CENTERLINE
- EXISTING LOT LINE
- EXISTING LOT NUMBER
- EXISTING BLOCK NUMBER
- STORM DRAIN WITH MANHOLE (48"⌀ MANHOLE PER ISPWC SD-501)
- EXISTING EDGE OF PAVEMENT
- EXISTING VERTICAL CURB
- EXISTING CURB, GUTTER & SIDEWALK
- EXISTING STORM DRAIN DROP INLET
- EXISTING SEWER LINE WITH MANHOLE
- EXISTING STORM DRAIN WITH MANHOLE
- EXISTING WATER LINE WITH VALVE
- EXISTING WATER METER
- EXISTING FIRE HYDRANT WITH VALVE
- EXISTING BLOW-OFF VALVE
- EXISTING POWER POLE
- EXISTING OVERHEAD POWER LINE
- EXISTING UNDERGROUND POWER
- EXISTING POWER JUNCTION BOX (RISER)
- EXISTING TELEPHONE JUNCTION BOX RISER
- TELEPHONE UNDERGROUND LINE
- EXISTING NATURAL GAS LINE
- EDGE OF DIRT ROAD
- LANDSCAPE AREA
- EXISTING FENCE LINE
- TREE
- TEST PIT LOCATION



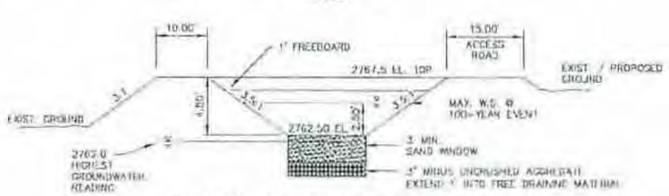
BENCH MARK:
TBM #1 EL. = 2771.54
CHISELED "SQUARE" IN EXISTING TOP BACK OF CURB SOUTHEAST CURB RETURN AT INTERSECTION OF THE N. MILL SITE AVE. AND E. SAWMILL WAY.

+3.72' – NAVD 88 DATUM

SCALE:
HORIZONTAL 1" = 50'
VERTICAL 1" = 5'

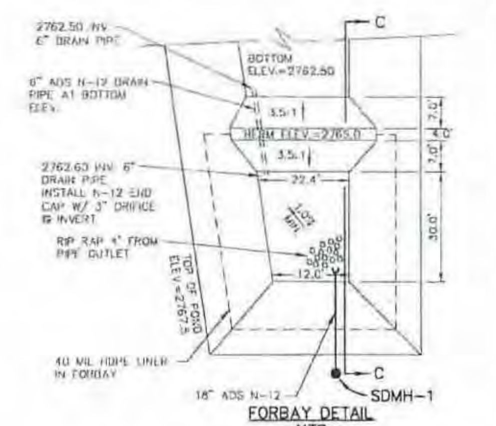


SECTION A-A
-NTS-



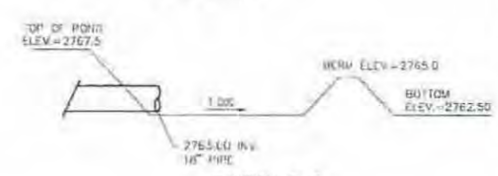
POND AREA: BASE 3,990 SQ.FT. / TOP 10,437

SECTION B-B
POND CROSS SECTION PER ACHD STD. DWG. 641
-NTS-

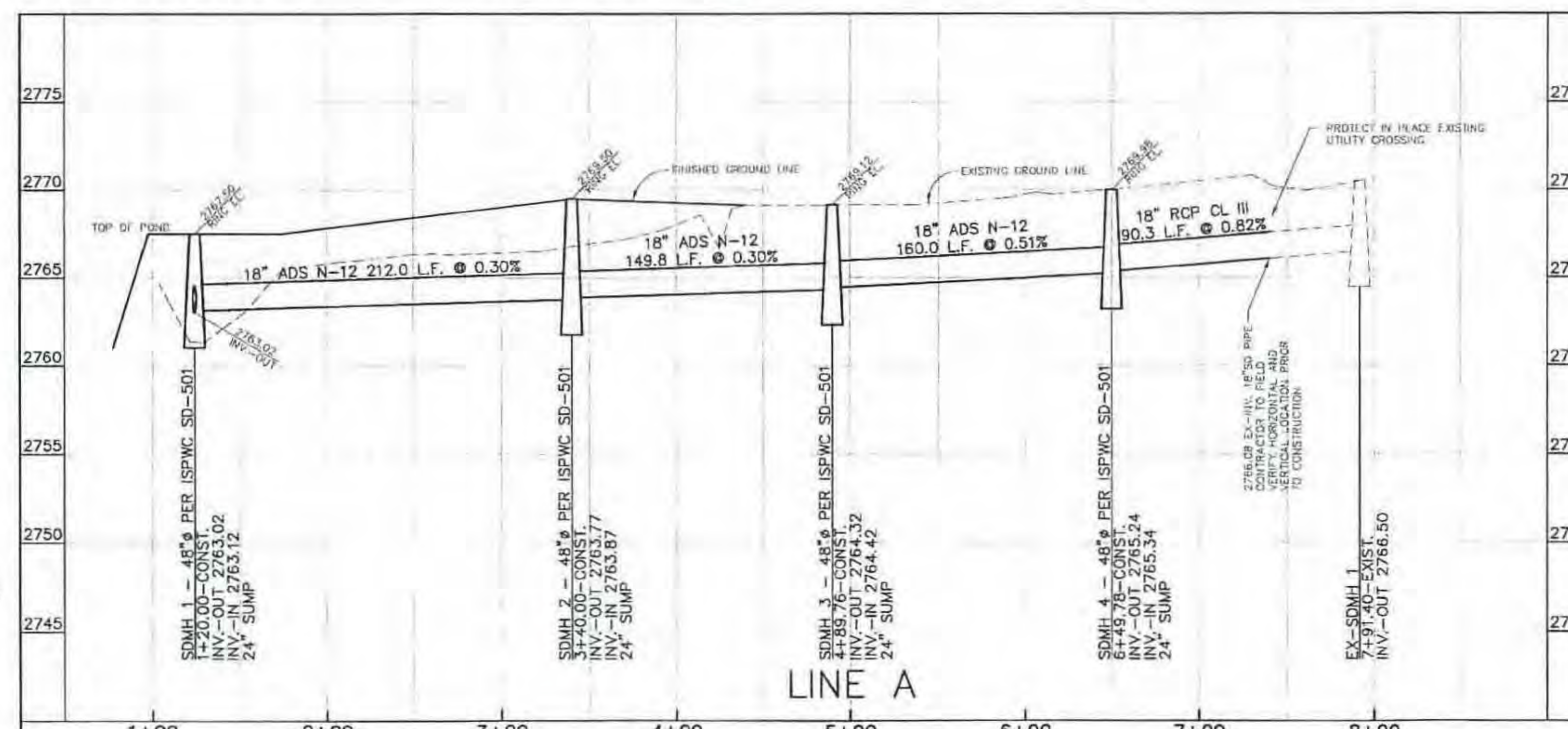


FORBAY DETAIL
-NTS-

18" INLET: Q_{100} = 8.53cfs
V = 4.8fps



SECTION C-C
-NTS-



NOTES TO CONTRACTOR:
1) CONTRACTOR TO FIELD VERIFY ALL EXISTING CURB & GUTTER, STORM DRAIN, CHANNEL CROSSINGS, & SEWER ELEVATIONS OR INVERTS PRIOR TO CONSTRUCTION AND NOTIFY ENGINEER WHEN ELEVATIONS OR INVERTS DO NOT MATCH PLANS.
2) THE LOCATIONS OF EXISTING UNDERGROUND UTILITIES ARE SHOWN IN APPROXIMATE LOCATIONS. THE CONTRACTOR SHALL DETERMINE THE EXACT LOCATION OF ALL EXISTING UTILITIES BEFORE COMMENCING WORK. HE AGREES TO BE FULLY RESPONSIBLE FOR ANY AND ALL DAMAGES WHICH MIGHT OCCUR BY HIS FAILURE TO EXACTLY LOCATE AND PRESERVE ANY AND ALL UNDERGROUND UTILITIES.

NO.	REVISIONS	BY	DATE		
	ADDED FORBAY INTO POND & DETAIL	BDG	3/23/10	AS-BUILTS BY:	DATE:
				DESIGNED BY:	DATE:
				DRAWN BY:	DATE:
				CHECKED BY:	DATE:
				APPROVED:	DATE:

Engineering NorthWest, LLC
423 N. ANCESTOR PL. SUITE 180
BOISE, IDAHO 83704
(208)376-5000

HARRIS RANCH SUBDIVISION NO. 11
DETENTION POND

LINE A
STORM DRAIN PLAN & PROFILE

JOB NO. 08-017-01
SHEET NO. 2

REGISTERED PROFESSIONAL ENGINEER 7529 3/31/2010 STATE OF IDAHO EUGENE P. SMITH

HEC-22 HGL Example

Example 7-3 Preliminary Storm Drain Design - English Units

Given: *The roadway plan and section illustrated in Figure 7-12, duration intensity information in Table 7-9, and inlet drainage area information in Table 7-8. All grates are type P 50 x 100, all piping is reinforced concrete pipe (RCP) with a Manning's n value of 0.013, and the minimum design pipe diameter = 18 in for maintenance purposes.*

Find:

(1) Using the procedures outlined in Section 7.4 determine appropriate pipe sizes and inverts for the system illustrated in Figure 7-12.

(2) Evaluate the HGL for the system configuration determined in part (1) using the procedure outlined in Section 7-5.

Solution:

(1) Preliminary Storm Drain Design (English Units)

Step 1. Figure 7-12 illustrates the proposed system layout including location of storm drains, access holes, and other structures. All structures have been numbered for reference. Figure 7-13 (a) and (b) illustrate the corresponding storm drain profiles.

Step 2. Drainage areas, runoff coefficients, and times of concentration are tabulated in Table 7-9. Example problems documenting the computation of these values are included in Chapter 4.

Starting at the upstream end of a conduit run, Steps 3 and 4 from Section 7.4 are completed for each storm drain pipe. A summary tabulation of the computational process is provided in Figure 7-14. The column by column computations for each section of conduit follow:

Table 7-8. Drainage Area Information for Design Example 7-3 (English units).

Inlet No.	Drainage Area (ac)	"C"	Time of Concentration (min)
40	0.64	0.73	3
41	0.35	0.73	2
42	0.32	0.73	2
43	--	--	--
44			

Table 7-9. Intensity/Duration Data for Example 7-3 (English Units).

Time (min)	5	10	15	20	30	40	50	60	120
Intensity (in/hr)	7.1	5.9	5.1	4.5	3.5	3.0	2.6	2.4	1.4

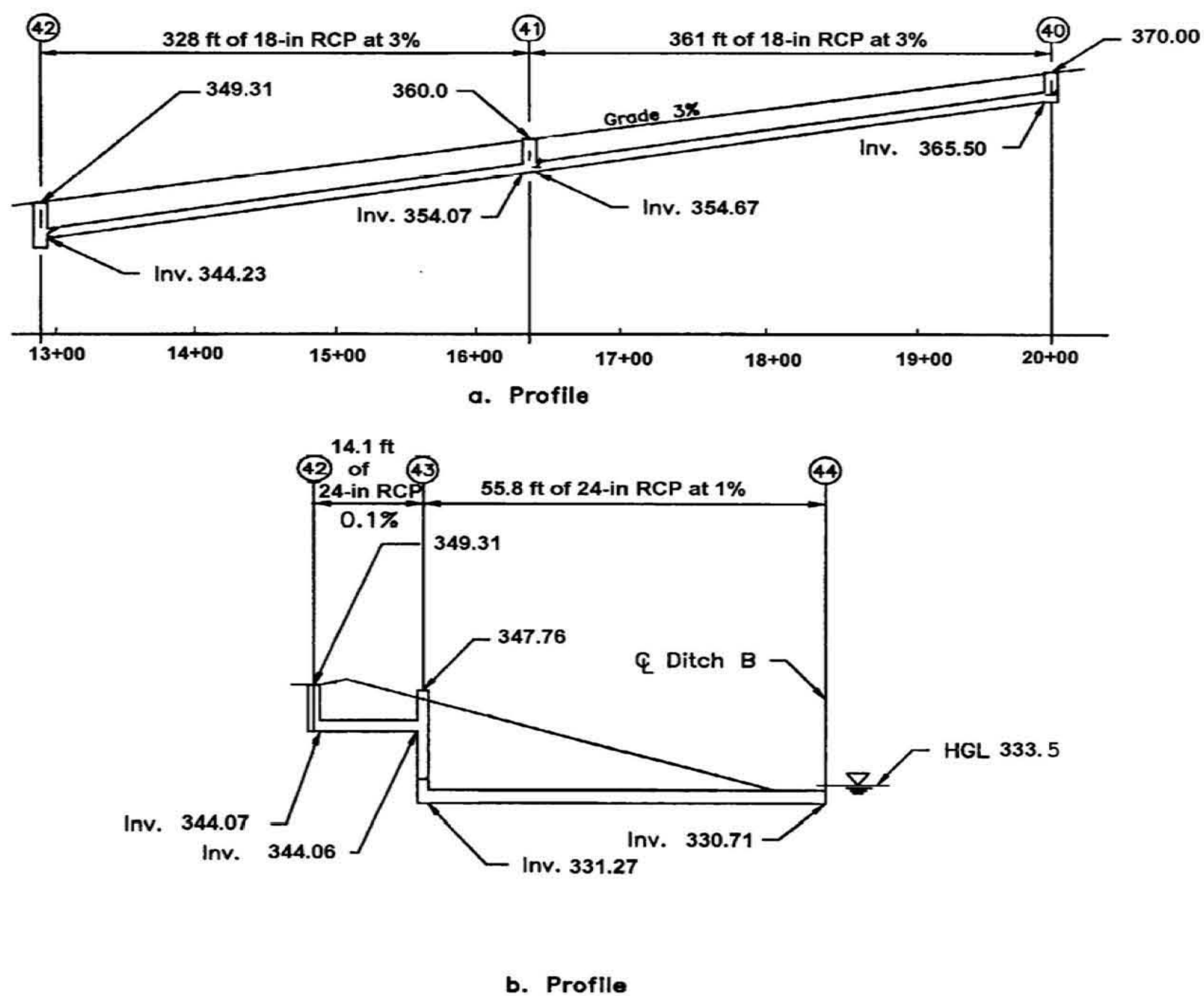
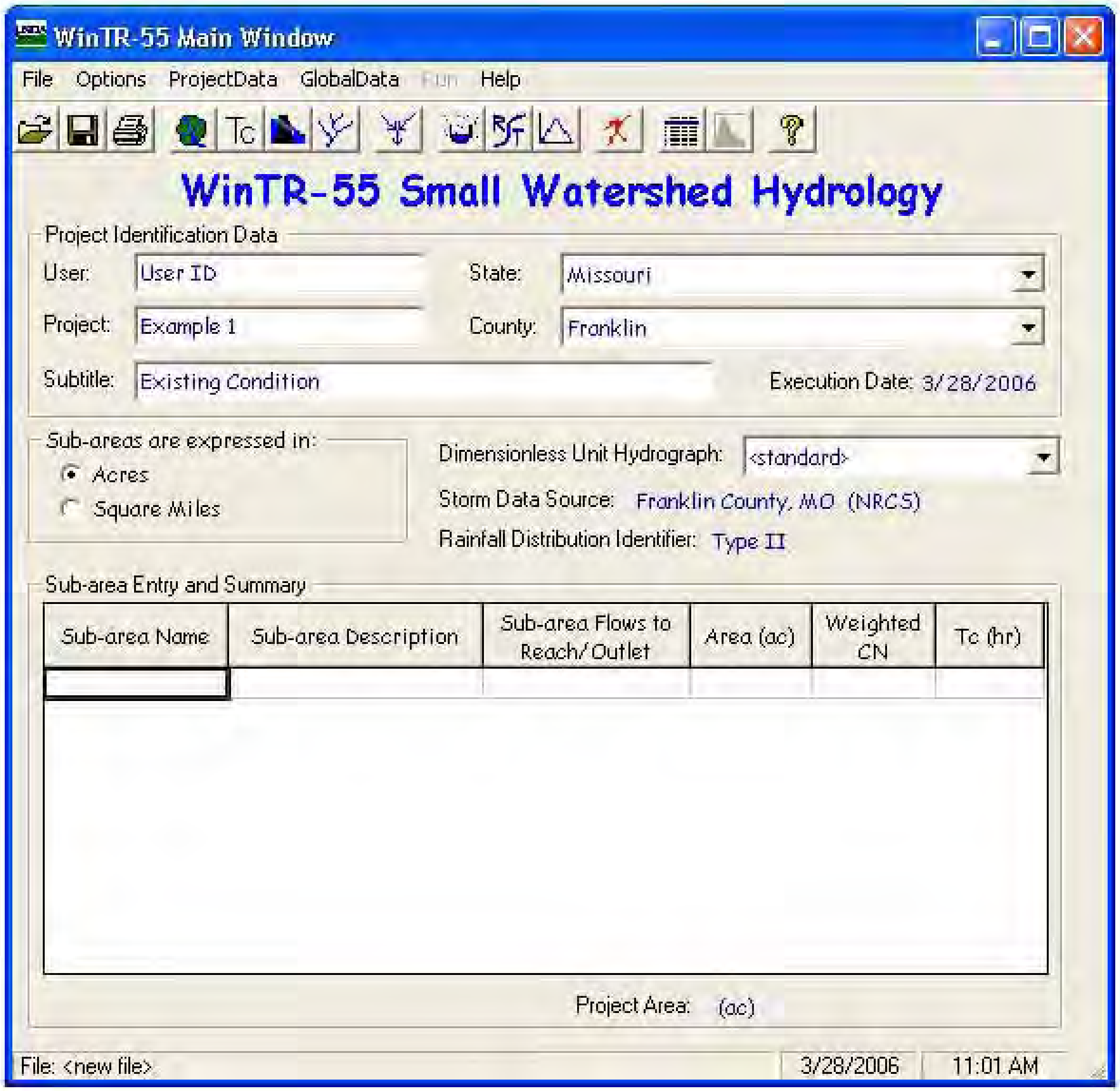


Figure 7-13 English. Storm drain profiles for Example 7-3 English.

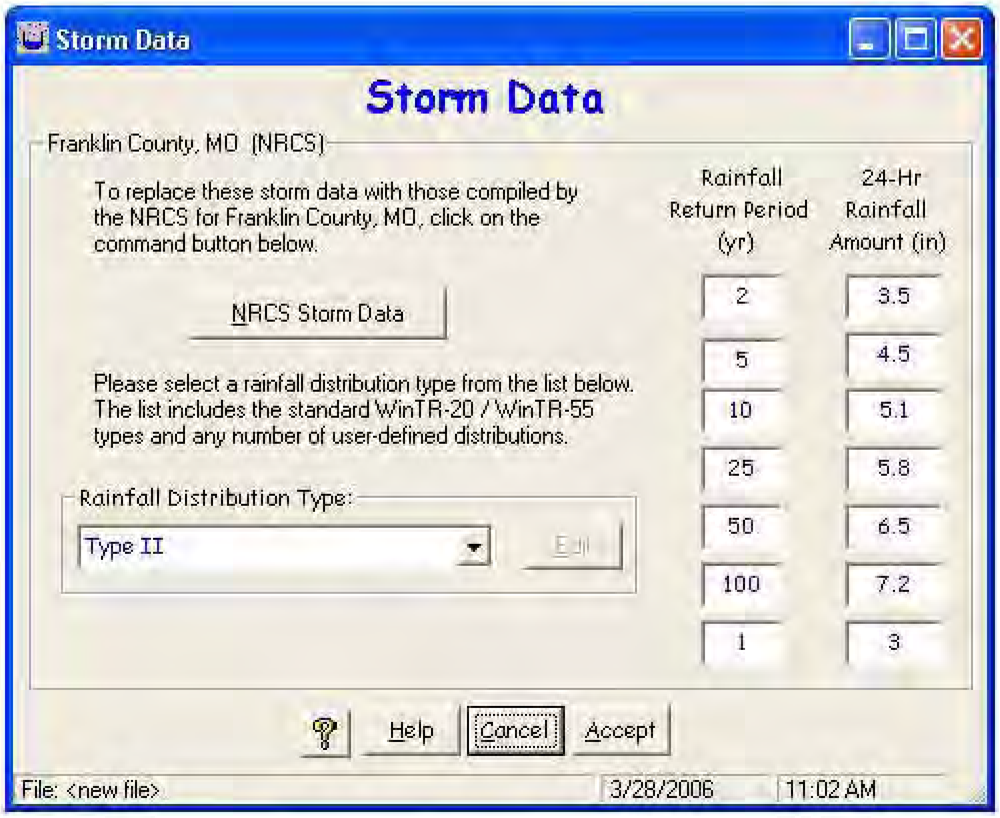
TR-55 Example

Part A Determine existing condition peak discharge and runoff volume

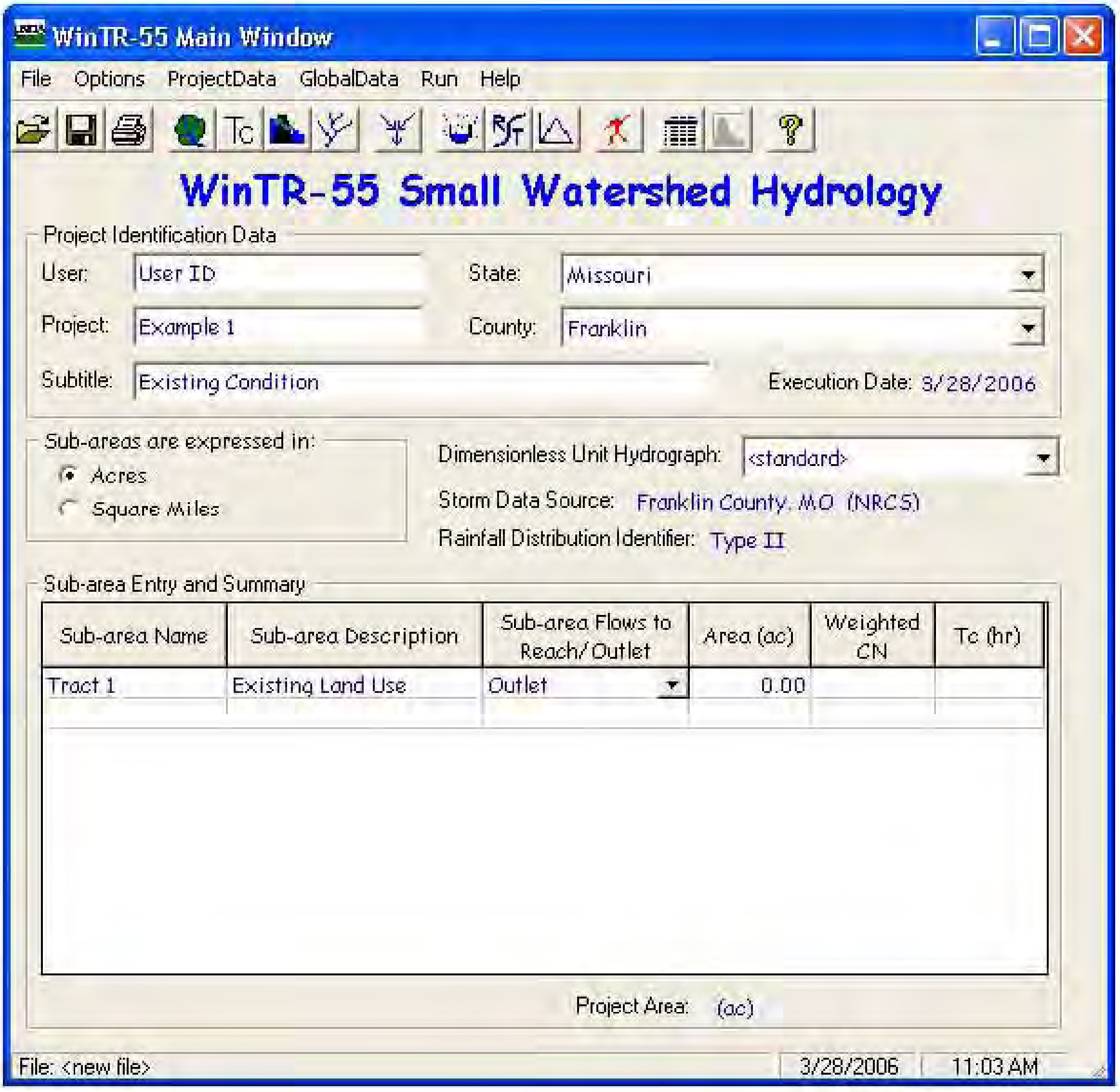
Step 1: Start the WinTR–55 program and enter User ID, Project name, Subtitle, State, and County. Specify Sub-area units (default is acres). Use the Storm Data Source default values based on the state and county specified. To make certain the correct Storm Data Source and Rainfall Distribution Identifier are selected, the user MUST complete step 2.



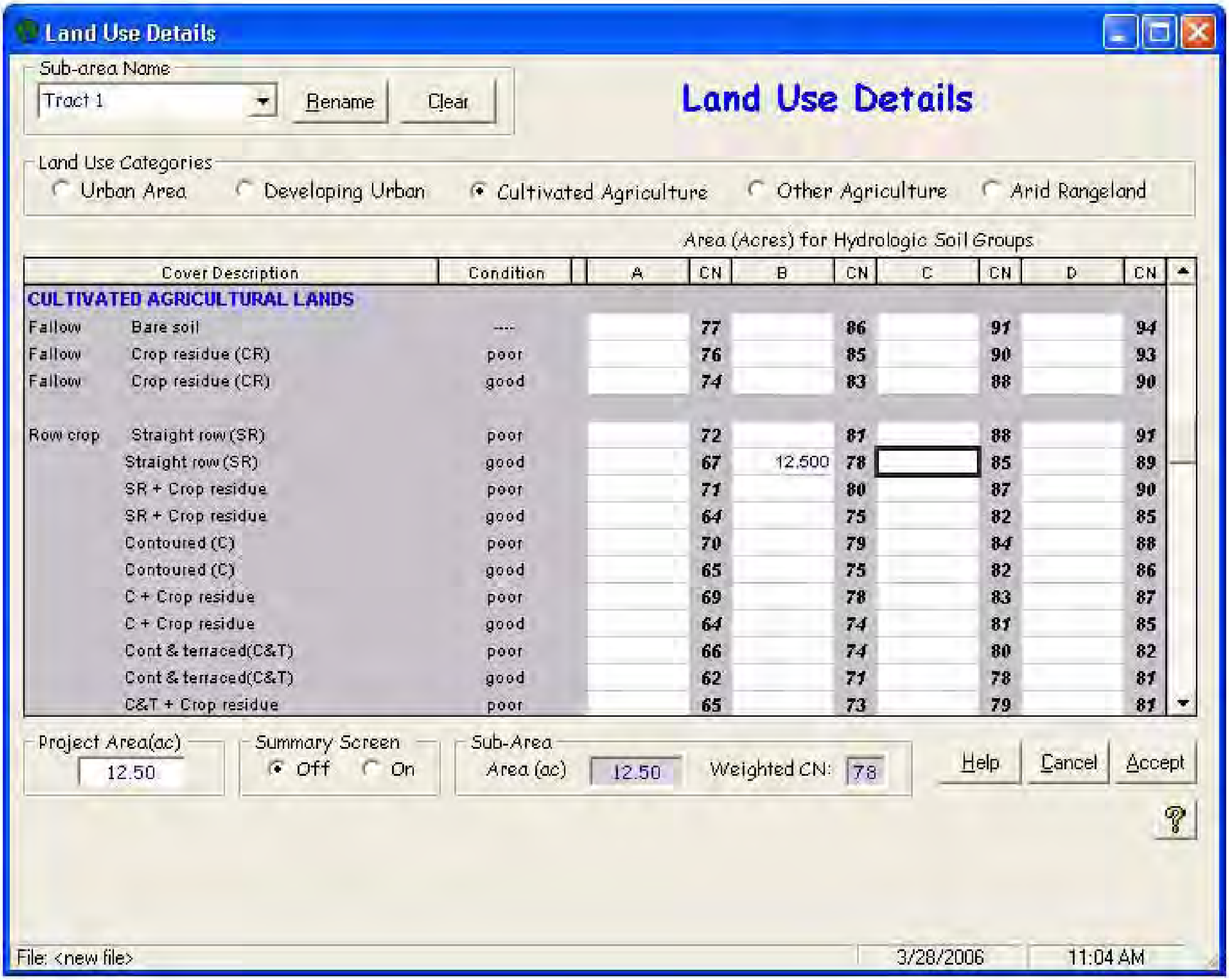
Step 2: From the **WinTR–55 Main Window** menu, select **GlobalData**. From that drop-down menu, select **Storm Data**. On the **Storm Data** window, click the **NRCS Storm Data** button if the user decides to use the default database values for the county-state combination being modeled. Clicking the **Accept** button accepts the data and returns the user to the **WinTR–55 Main Window**.



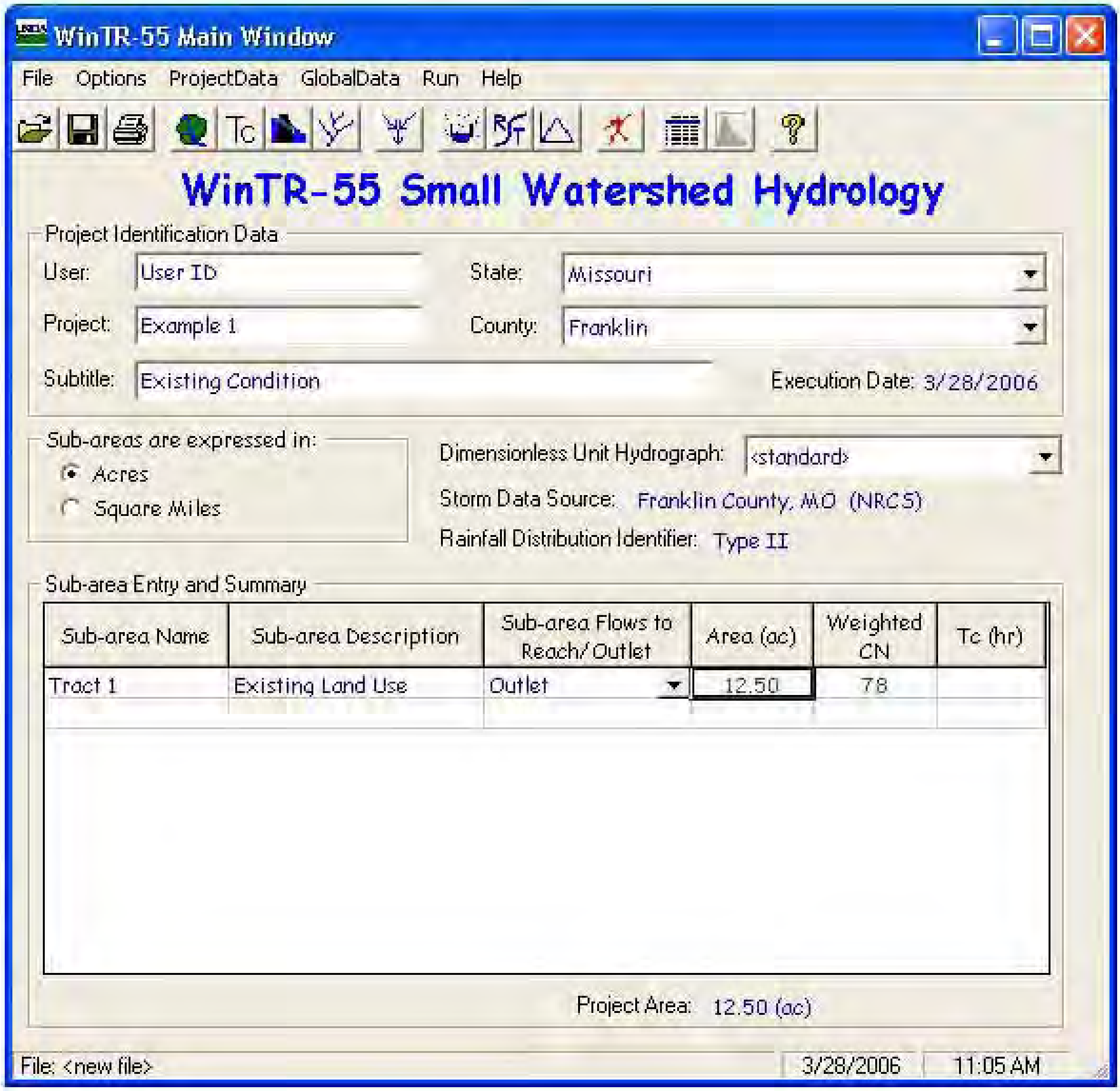
Step 3: Enter Sub-area Name, Sub-area Description, and where the water leaving this sub-area flows in the Sub-area Flows to Reach/Outlet box.



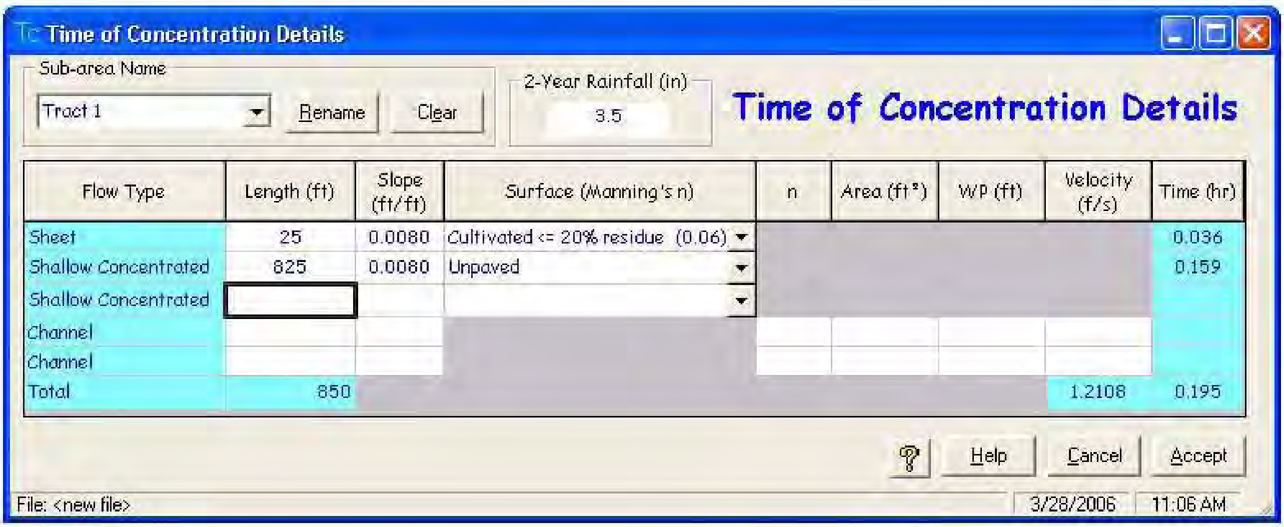
Step 4: Click **Land Use Details** button to open the **Land Use Details** window. In this window, enter the area of the sub-area in the appropriate location. Click the **Accept** button to accept the data and return to the **WinTR–55 Main Window**.



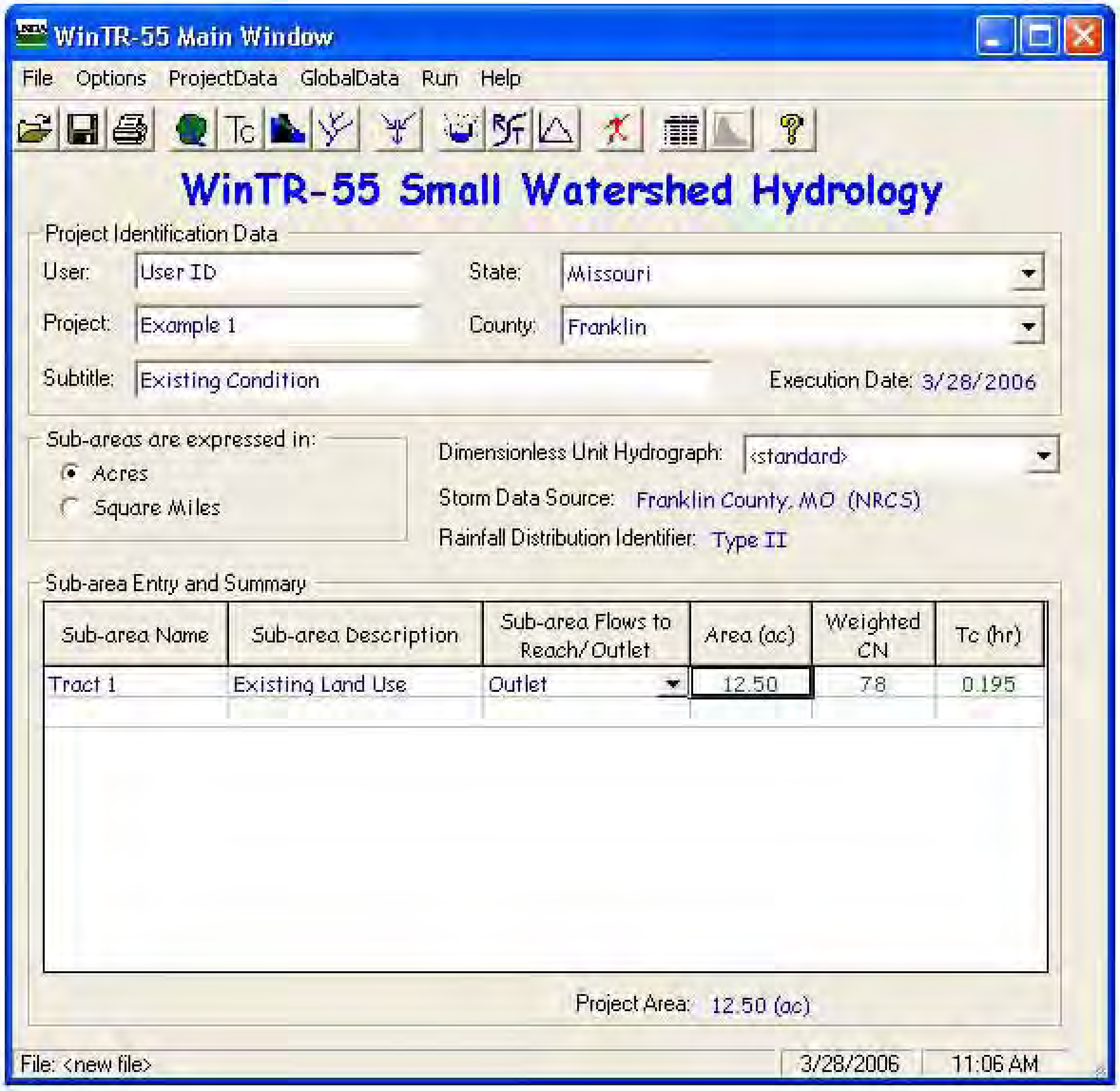
The sub-area area and runoff curve number now appear in the Sub-area Entry and Summary portion of the **WinTR–55 Main Window**.



Step 5: Click **Time of Concentration Details** button to open the **Time of Concentration Details** window. In this window, enter the appropriate information to compute the sub-area time of concentration. Click the **Accept** button to accept the data and return to the **WinTR–55 Main Window**.

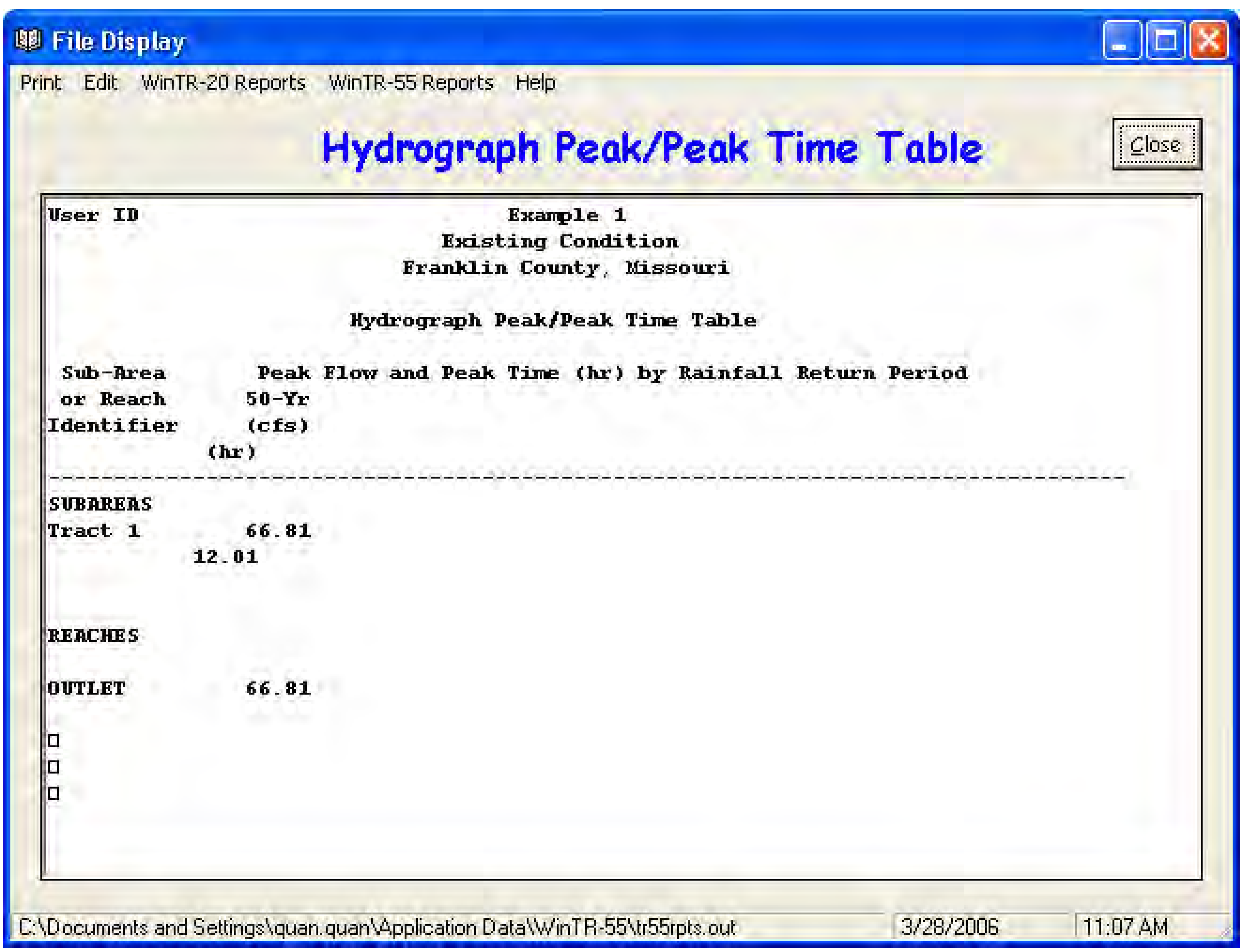


The sub-area time of concentration now appears in the Sub-area Entry and Summary portion of the **WinTR–55 Main Window**.



Step 6: Click the **Run** button to open the **Run WinTR–55** window. Select the 50–year storm event for this example. Once the storm events have been selected, click the **Run** button to execute the run.

Step 7: When the run is complete, the **File Display** window opens showing the **Hydrograph Peak/Peak Time Table**. To review other output, click **Win TR–20 Reports** or **WinTR–55 Reports**, and select the reports to view. When complete, click the **Close** button to close the **File Display** window and return to the **WinTR–55 Main Window**.



Step 8: To save the data, click **File** and **SaveAs**. In the **Save a WinTR–55 data file as ...** popup window, specify a location and file name, and click Save. The data are now saved, the popup window closes, and **WinTR–55 Main Window** is redisplayed.

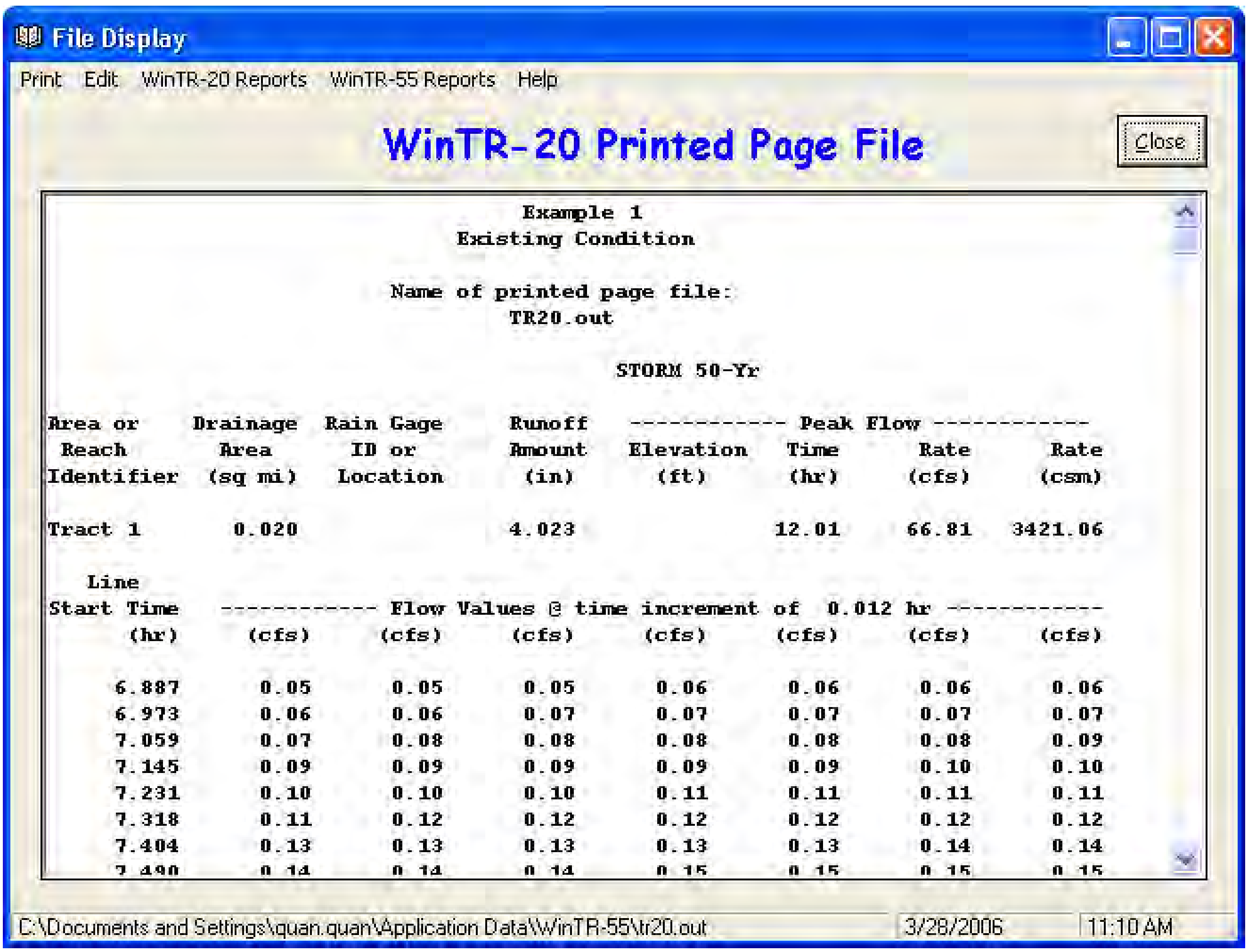
Part A Results

50-year Pre-Development Discharge = 66.8 ft^3/s

50-year Pre-Development Runoff Volume = 4.023 in (watershed-inches) = 4.19 acre-ft

$$\left(\frac{4.023}{12}\text{ ft}\right)\left(12.50\text{ ac}\right) = 4.19\text{ ac-ft}$$

The runoff volume can be accessed on the **File Display** window by selecting the **WinTR–20 Printed Page File**.



Example 1
Existing Condition

Name of printed page file:
TR20.out

STORM 50-Yr

Area or Reach Identifier	Drainage Area (sq mi)	Rain Gage ID or Location	Runoff Amount (in)	Peak Flow Elevation (ft)	Peak Flow Time (hr)	Peak Flow Rate (cfs)	Peak Flow Rate (csm)
Tract 1	0.020		4.023		12.01	66.81	3421.06

Line Start Time (hr)	Flow Values @ time increment of 0.012 hr (cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)
6.887	0.05	0.05	0.05	0.06	0.06	0.06	0.06
6.973	0.06	0.06	0.07	0.07	0.07	0.07	0.07
7.059	0.07	0.08	0.08	0.08	0.08	0.08	0.09
7.145	0.09	0.09	0.09	0.09	0.09	0.10	0.10
7.231	0.10	0.10	0.10	0.11	0.11	0.11	0.11
7.318	0.11	0.12	0.12	0.12	0.12	0.12	0.12
7.404	0.13	0.13	0.13	0.13	0.13	0.14	0.14
7.490	0.14	0.14	0.14	0.15	0.15	0.15	0.15