SDHM 3.0
User Workshop
Afternoon Session

Instructor: Doug Beyerlein, P.E., P.H., D.WRE
Clear Creek Solutions, Inc.
www.clearcreeksolutions.com

CLEAR CREEK SOLUTIONS

SDHM 3.0 User Workshop
Afternoon Session

In this afternoon session we will cover the more advanced features in SDHM 3.0.

CLEAR CREEK SOLUTIONS

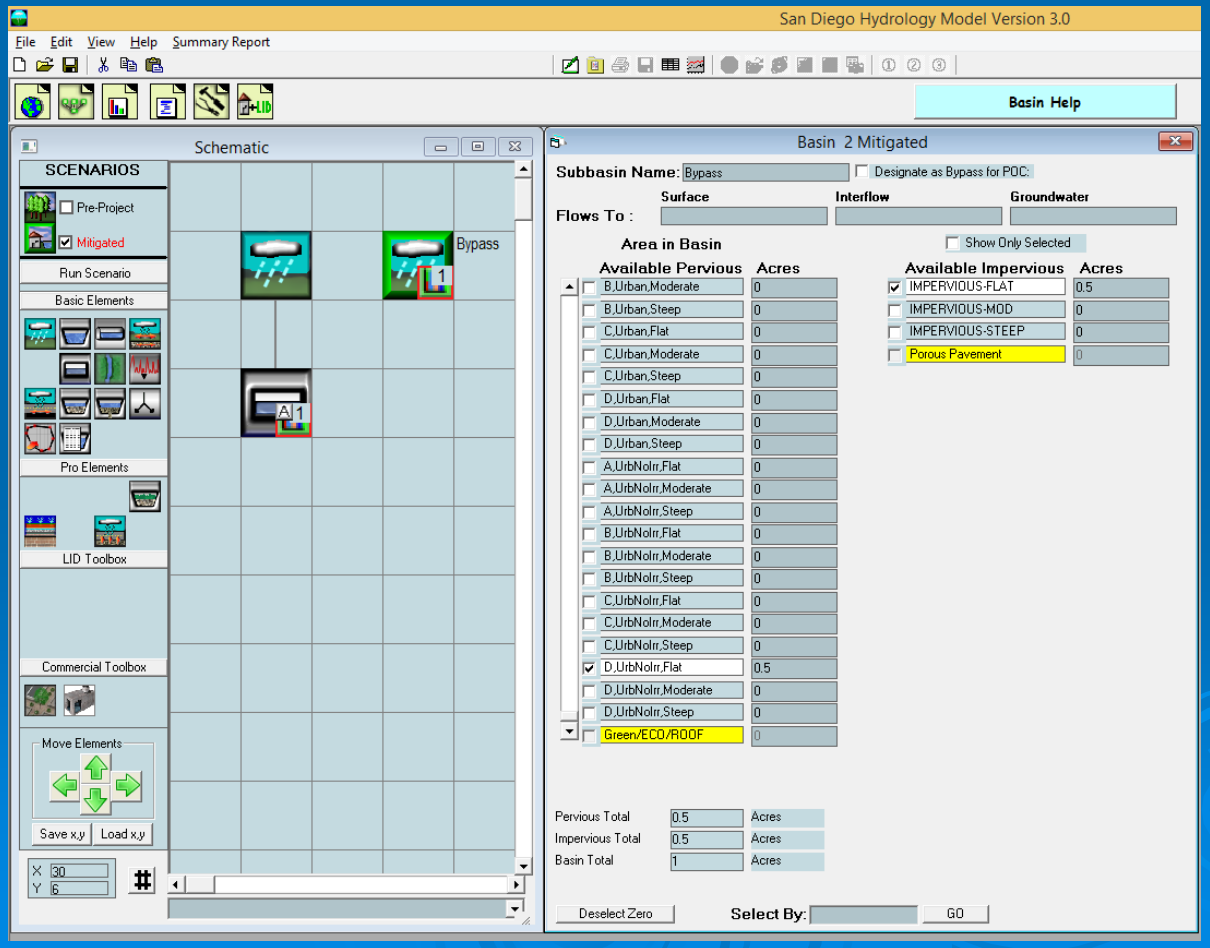
SDHM Advanced Topics

1. bypass basin
2. infiltration
3. flow splitter
4. gravel trench/infiltration trench
5. lateral flow basins
6. permeable pavement
7. bioretention/planter boxes
8. Your topics of interest?

CLEAR CREEK SOLUTIONS

Bypass Basin

A bypass basin is a basin that is in the project site, but does not drain to the project mitigation facility.



CLEAR CREEK SOLUTIONS

Bypass Basin Example

Pre-Project land use:

- Project: 10 ac D, Dirt, Flat

Developed mitigated land use:

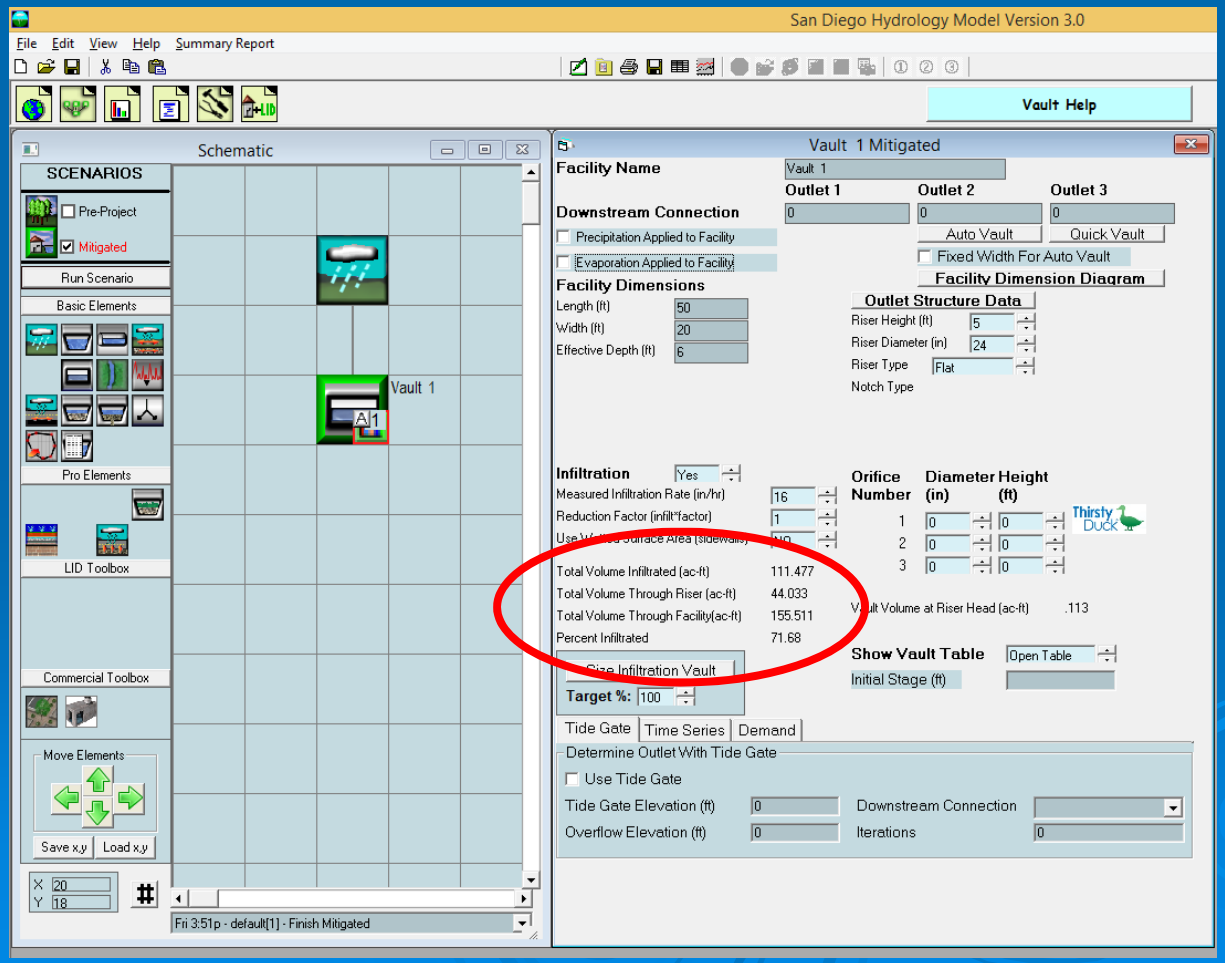
- Project: 2.5 ac D, UrbNoIrr, Flat
  6.5 ac Imp, Flat

- Bypass: 0.5 ac D, UrbNoIrr, Flat
  0.5 ac Imp, Flat

CLEAR CREEK SOLUTIONS

Infiltration

Runoff is infiltrated to groundwater through the bottom of the project mitigation facility.



CLEAR CREEK SOLUTIONS

Infiltration Facility Example

Predevelopment land use:

- Project: 10 ac B, NatVeg, Flat

Developed mitigated land use:

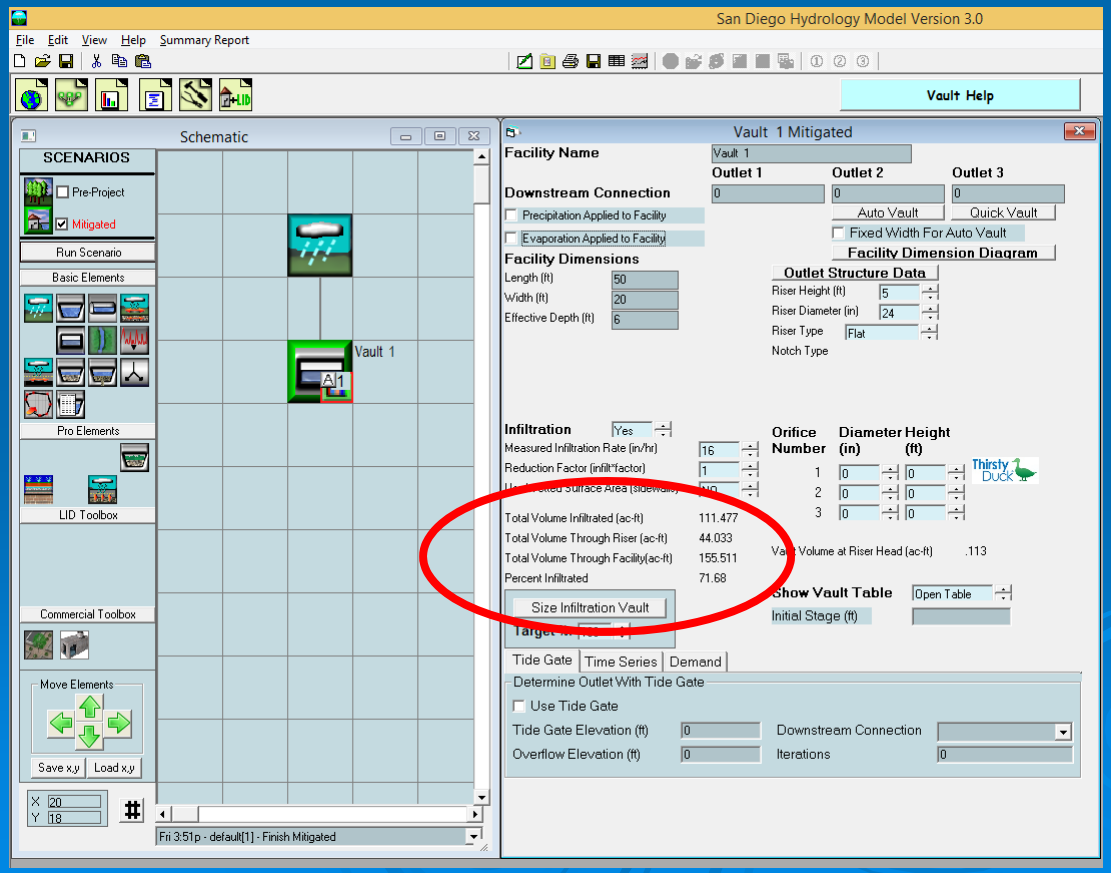
- Project: 3 ac B, UrbNoIrr, Flat

  7 ac Imp, Flat

CLEAR CREEK SOLUTIONS

Partial Infiltration

Less than 100% of the runoff is infiltrated to groundwater through the bottom of the project mitigation facility. The remaining surface discharge must meet the flow duration standard.



CLEAR CREEK SOLUTIONS

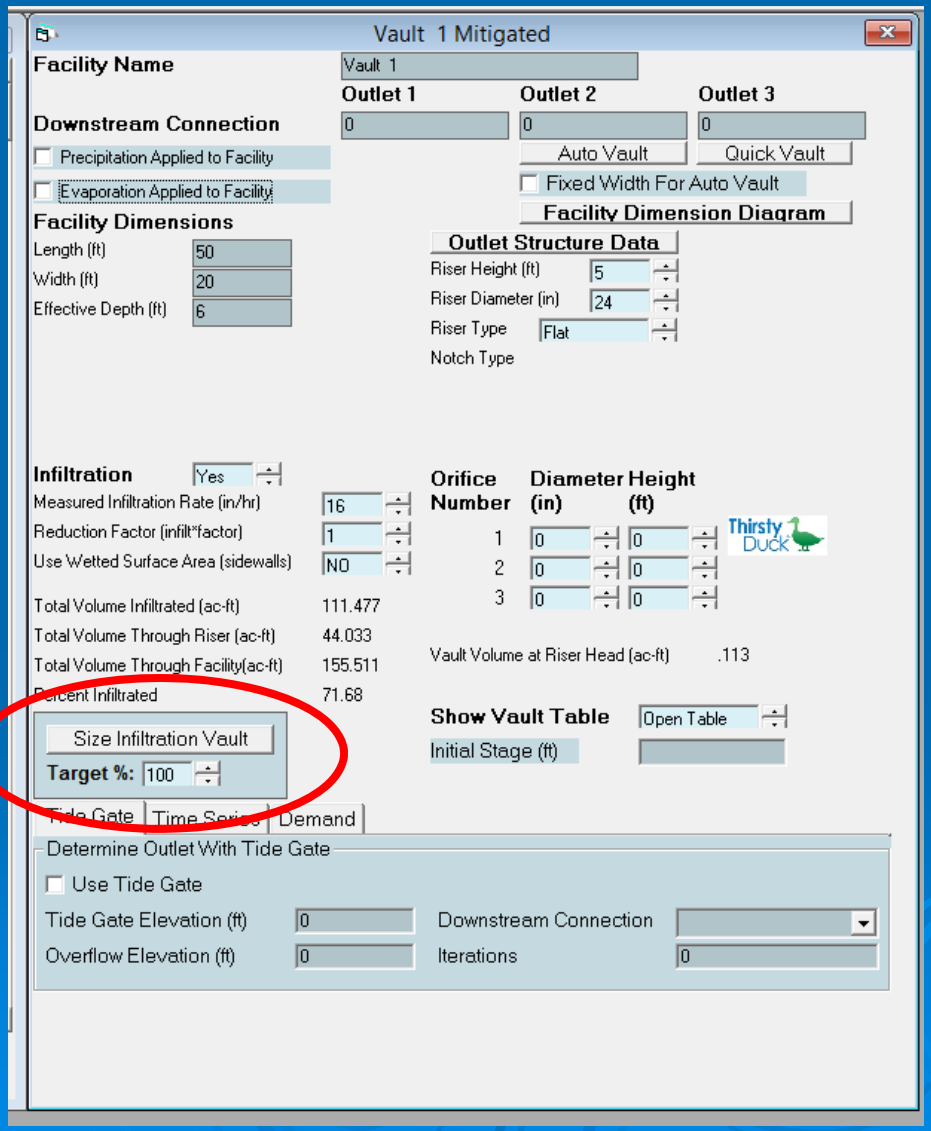
SDHM 3.0 Infiltration Facilities

These elements include the option to infiltrate:

1. Trapezoidal pond
2. Irregular-shaped pond
3. Vault
4. Tank
5. Open channel
6. Gravel trench bed
7. SSD Table
8. Bioretention/Rain Garden
9. Permeable/Porous pavement
10. In-ground planter
11. Infiltration basin
12. Infiltration trench
13. Dry well

CLEAR CREEK SOLUTIONS

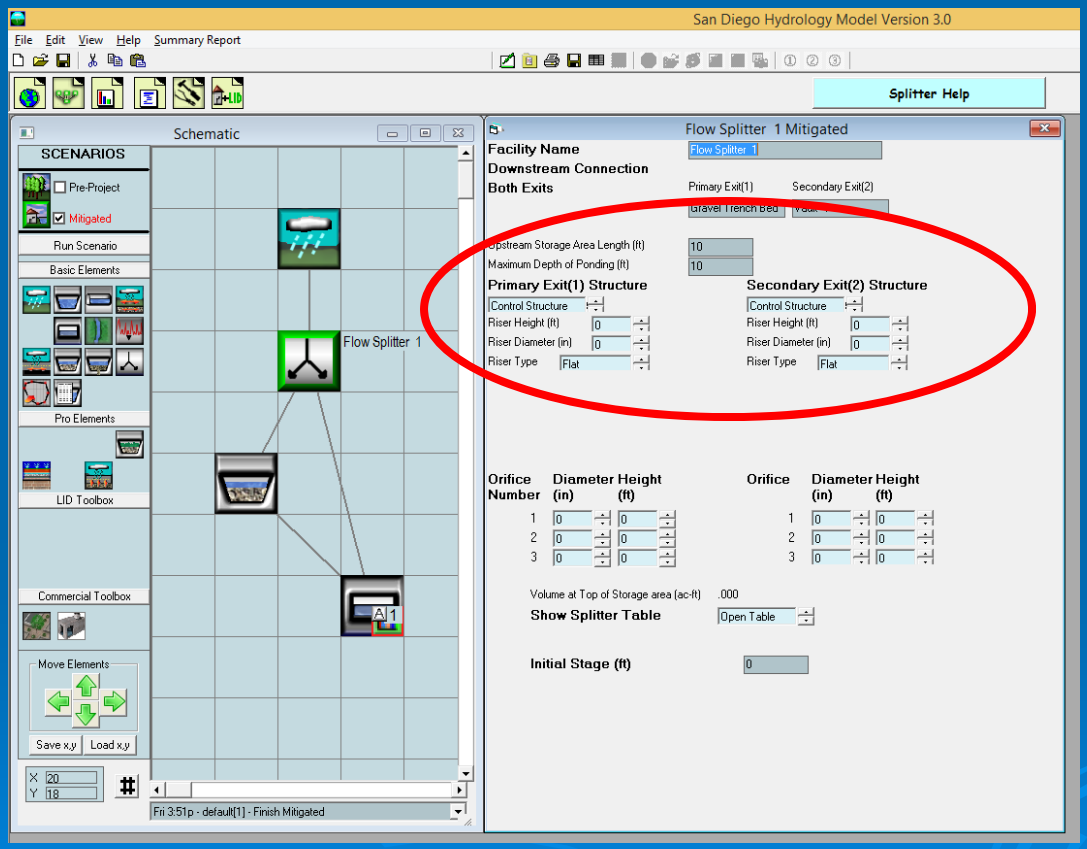
Automated Infiltration Facility Sizing



CLEAR CREEK SOLUTIONS

Flow Splitter

A flow splitter sends water in two different directions.

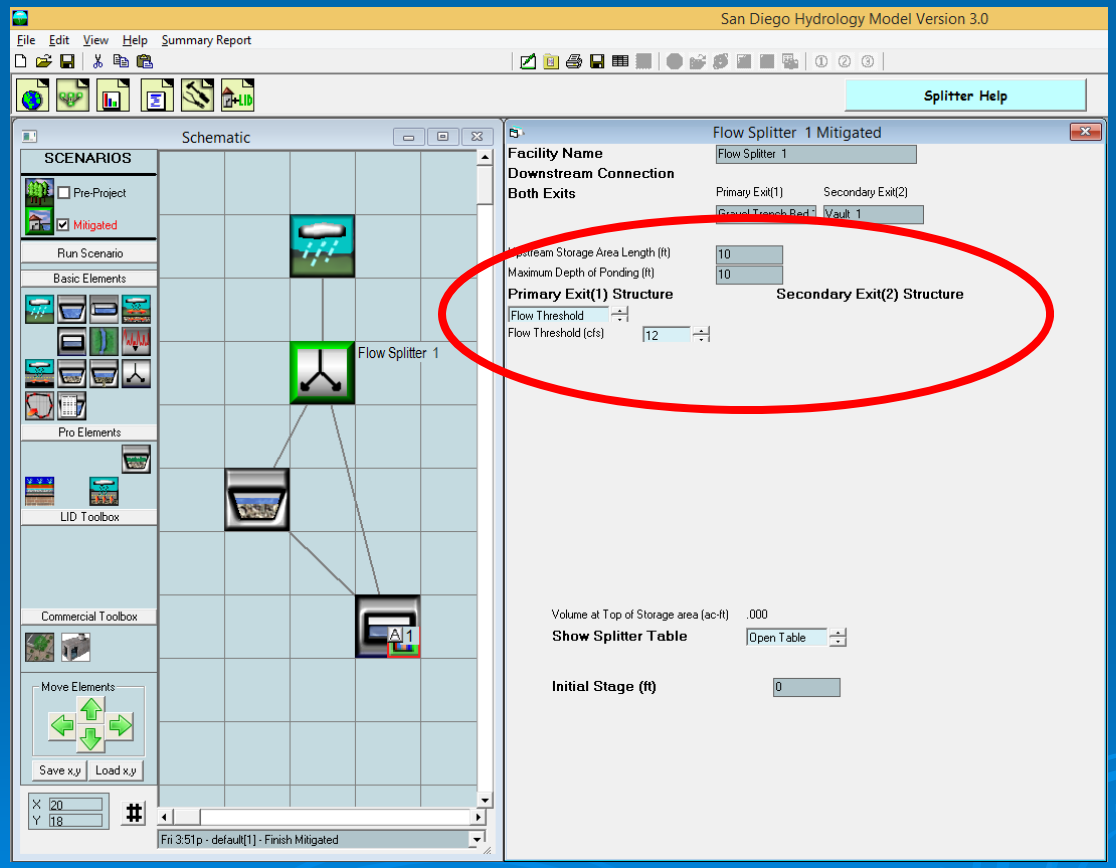


Split can be based on control structure dimensions

CLEAR CREEK SOLUTIONS

Flow Splitter

A flow splitter sends water in two different directions.

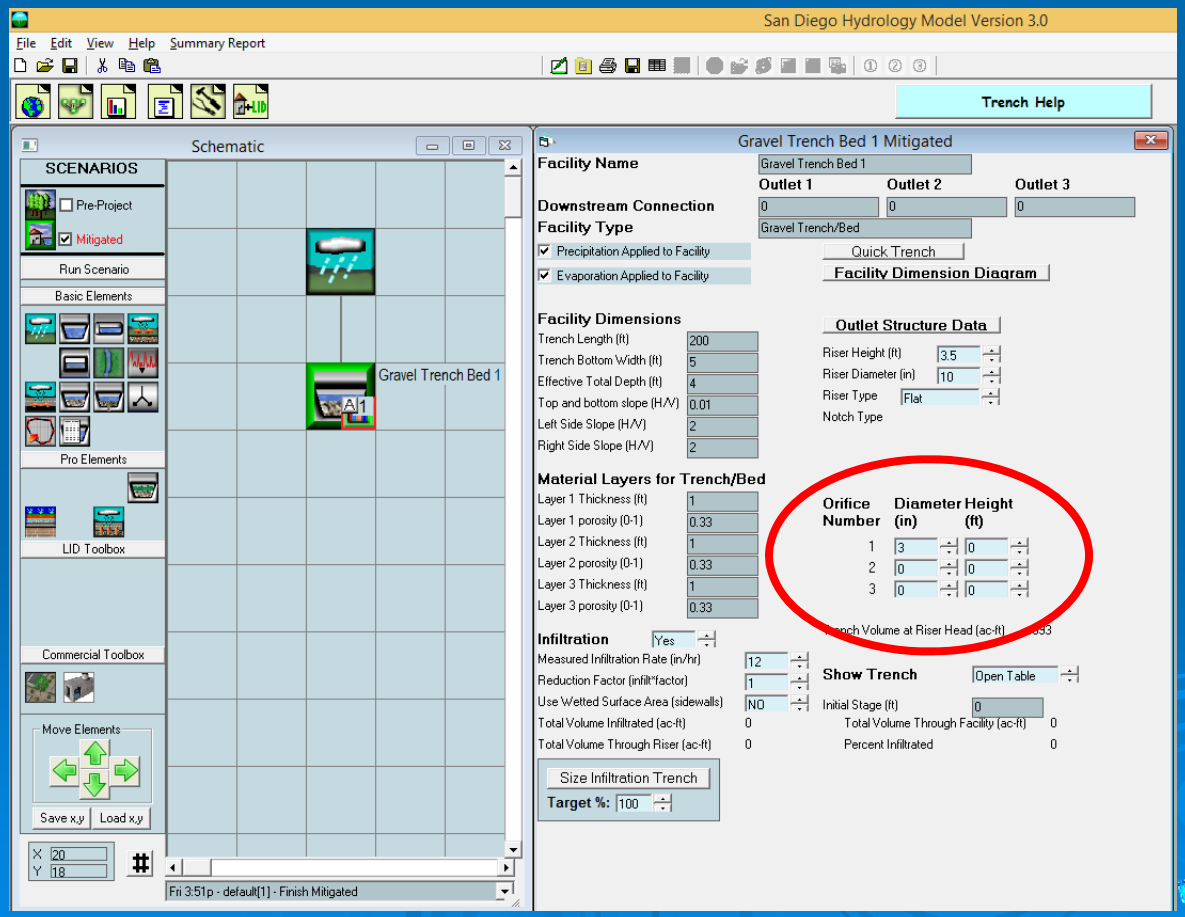


Split can be based on flow threshold.

CLEAR CREEK SOLUTIONS

Gravel Trench/Infiltration Trench

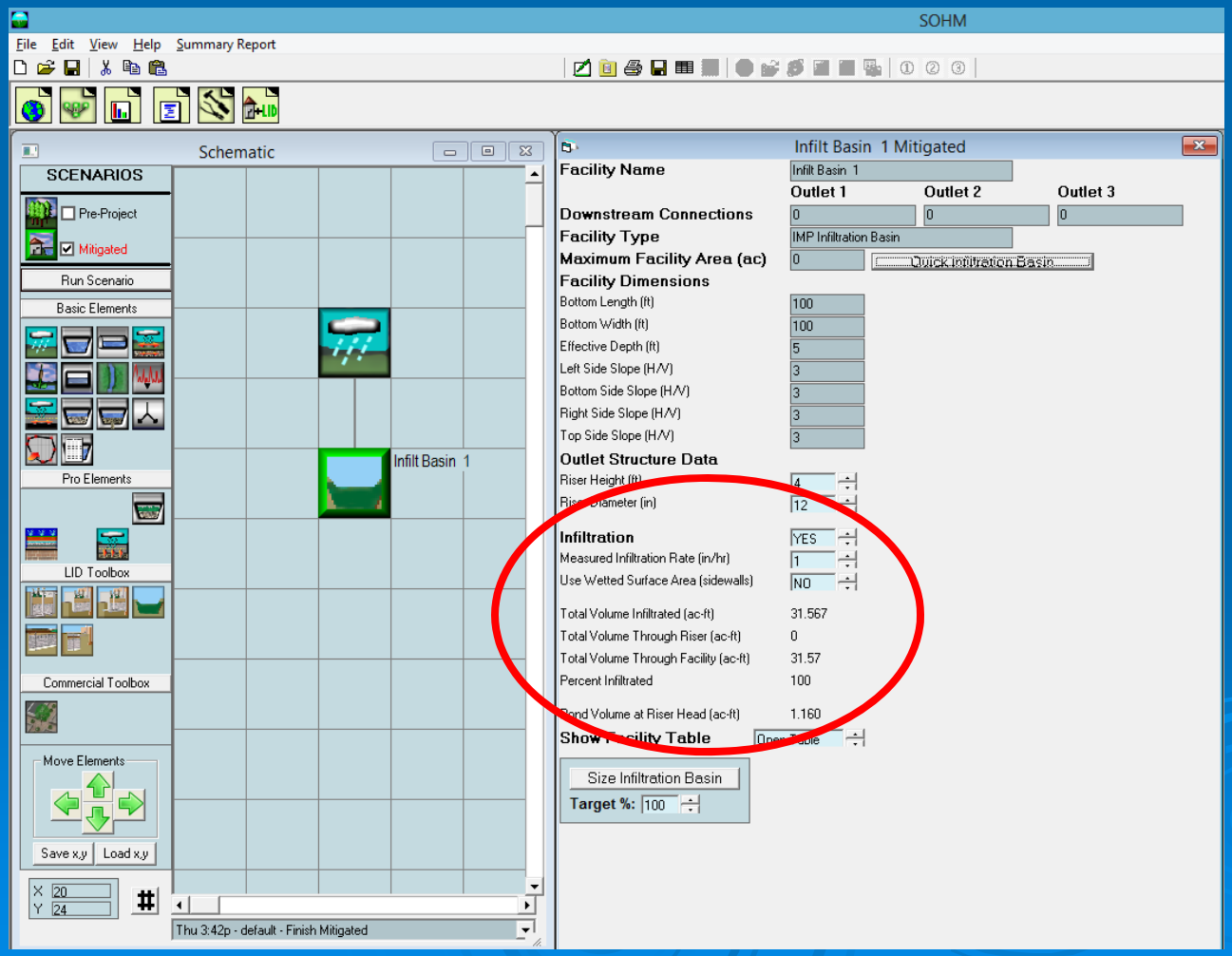
A gravel trench can infiltrate and include an underdrain (using the orifice diameter and height input).



CLEAR CREEK SOLUTIONS

Gravel Trench/Infiltration Trench

An infiltration trench can only infiltrate (no underdrain).



CLEAR CREEK SOLUTIONS

SDHM 3.0 LID Modeling

- Lateral flow basins/impervious runoff dispersion.
- Permeable pavement.
- Green roof.
- Bioretention/planter boxes.

CLEAR CREEK SOLUTIONS

How LID Works

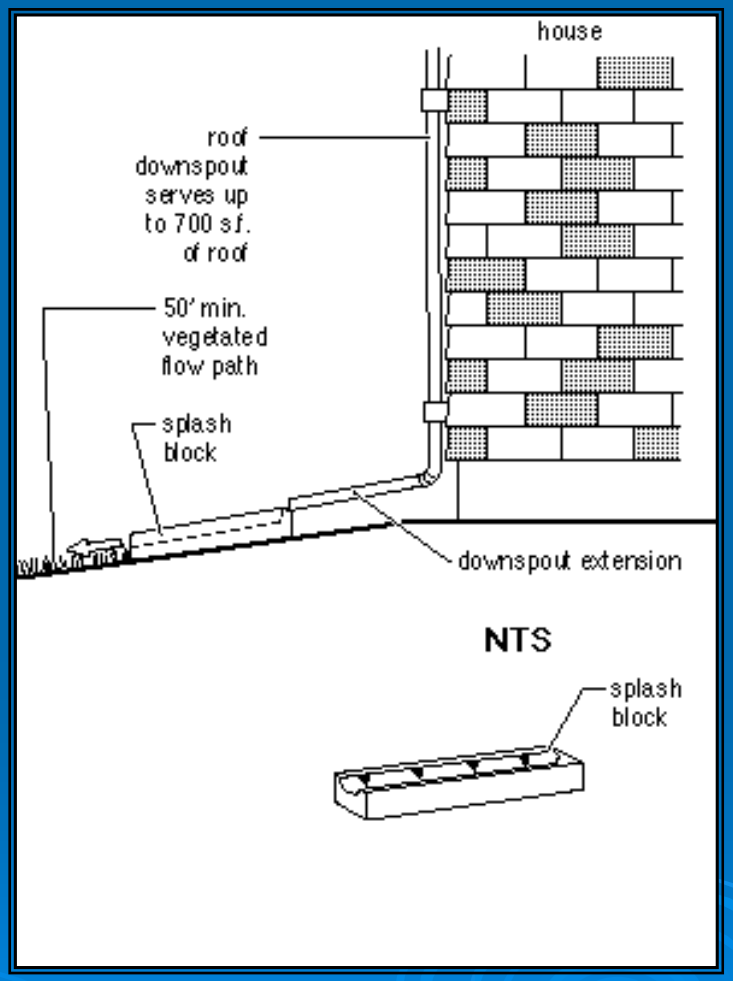
- Uses long-term on-site infiltration and evapotranspiration to reduce stormwater runoff.

- What happens between storm events is more important than what happens during storm events.

CLEAR CREEK SOLUTIONS

Impervious Runoff Dispersion

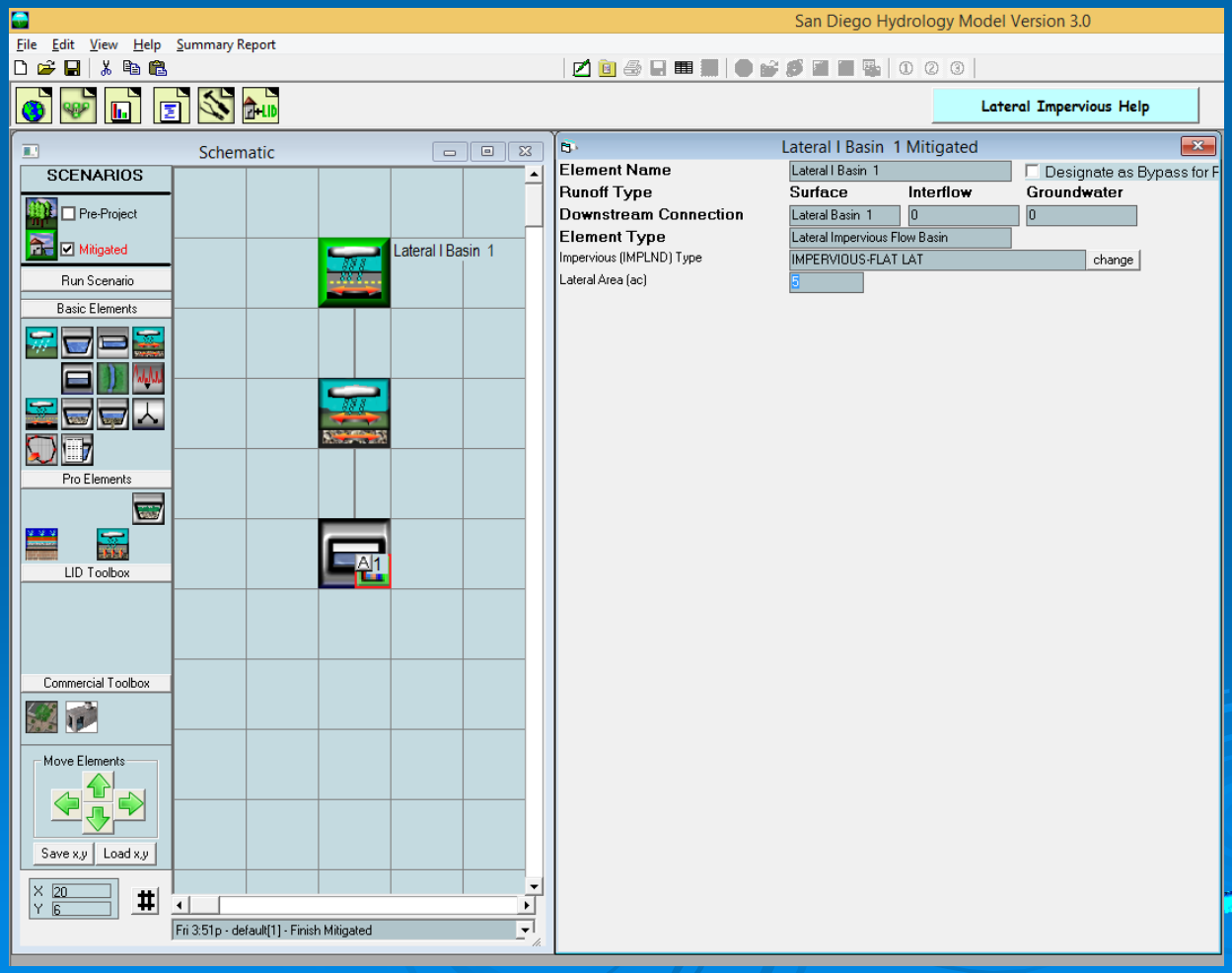
Dispersion of impervious roof runoff on adjacent pervious lawn allowing some water to infiltrate before becoming stormwater runoff. Use lateral flow basins.



CLEAR CREEK SOLUTIONS

Lateral Flow Basins

Lateral flow basins allow the flow from an impervious basin to flow across a pervious basin. Total runoff is reduced.



CLEAR CREEK SOLUTIONS

Lateral Flow Basin Example

Predevelopment land use:

- Project: 10 ac C, Dirt, Flat

Developed mitigated land use:

- Project: 5 ac C, UrbNoIrr, Flat (Lateral Flow Soil Basin)

  5 ac Imp, Flat (Lateral Flow Impervious Area)

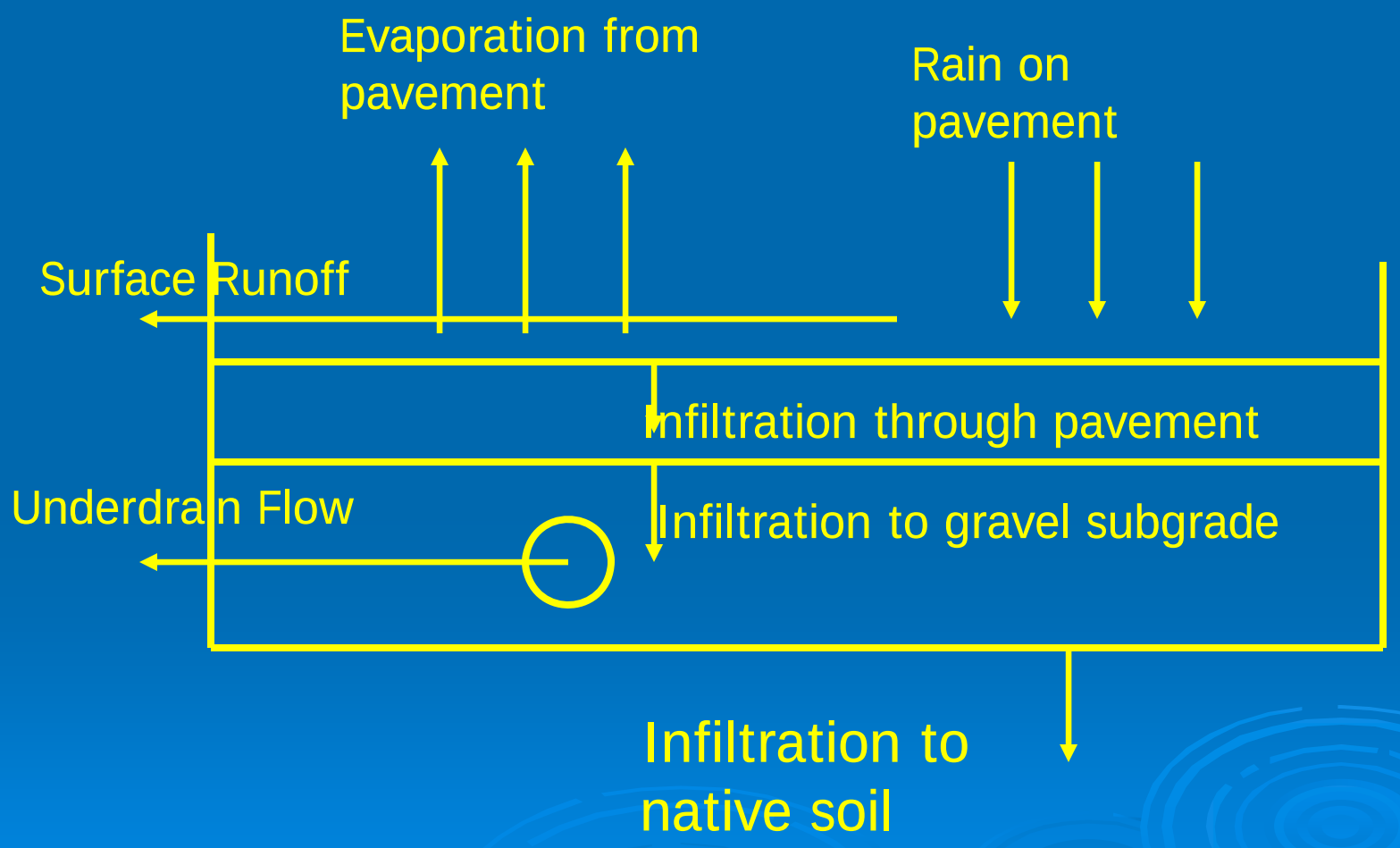
Parking lot runoff sheet flows onto the adjacent lawn area.

CLEAR CREEK SOLUTIONS

Permeable/Porous Pavement Element

CLEAR CREEK SOLUTIONS

Permeable/Porous Pavement Element

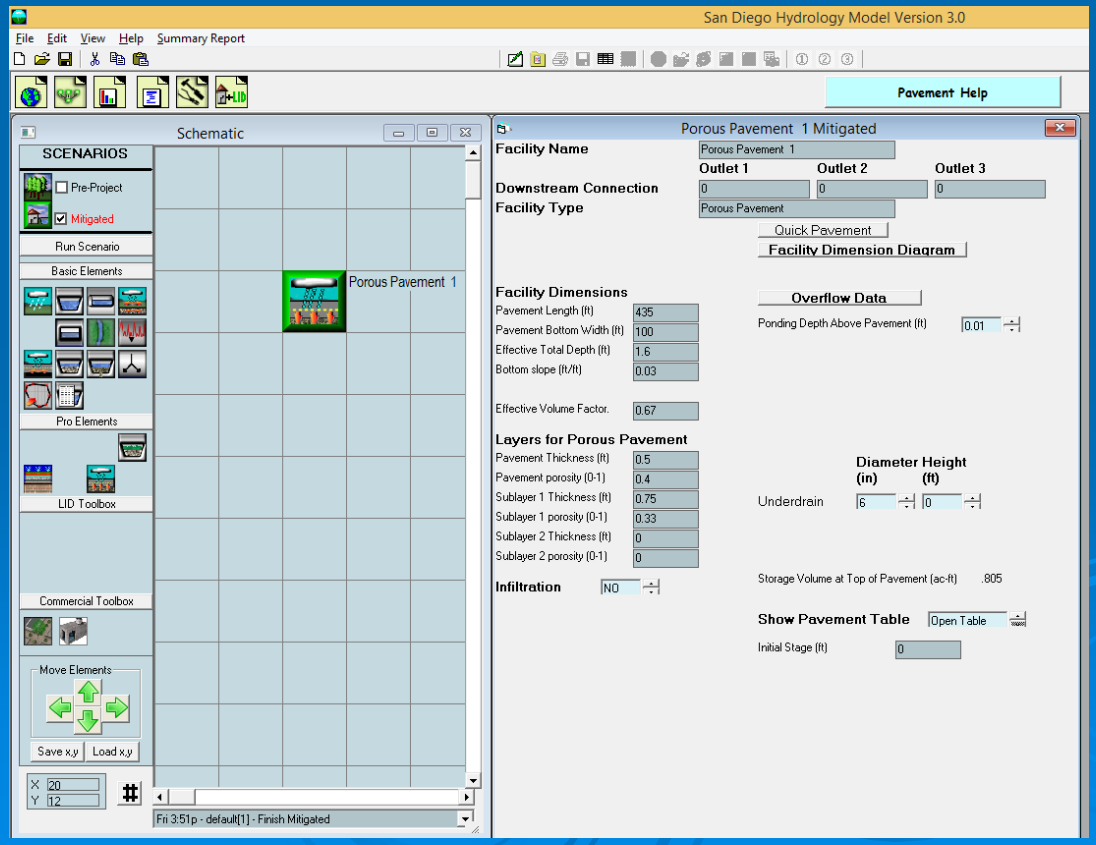


CLEAR CREEK SOLUTIONS

Permeable/Porous Pavement Element

Includes the effect of slope on storage:

Effective Volume Factor for >2%: 0 to 1 (fraction ratio of the average max water height behind a check dam compared to the max gravel layer depth; for 6" average max water height and 9" gravel depth Effective Volume Factor = 0.67)



CLEAR CREEK SOLUTIONS

Permeable/Porous Pavement Element

Major issues:

• Pavements with bottom slopes greater than 2% should include Effective Volume Factor (average useable gravel depth/maximum gravel depth).

• Permeable pavement must include infiltration into native soil and/or an underdrain to remove water from gravel subgrade.

CLEAR CREEK SOLUTIONS

Porous Pavement Example

Pre-Project land use:

- Project: 1 ac C, Dirt, Flat

Developed mitigated land use:

- Project: 1 ac Parking (included in Permeable Pavement element dimensions 435’ x 100’)

  3% slope

  Pavement depth 6 inches

  Gravel depth 9 inches

  Average max water depth in gravel layer 6 inches

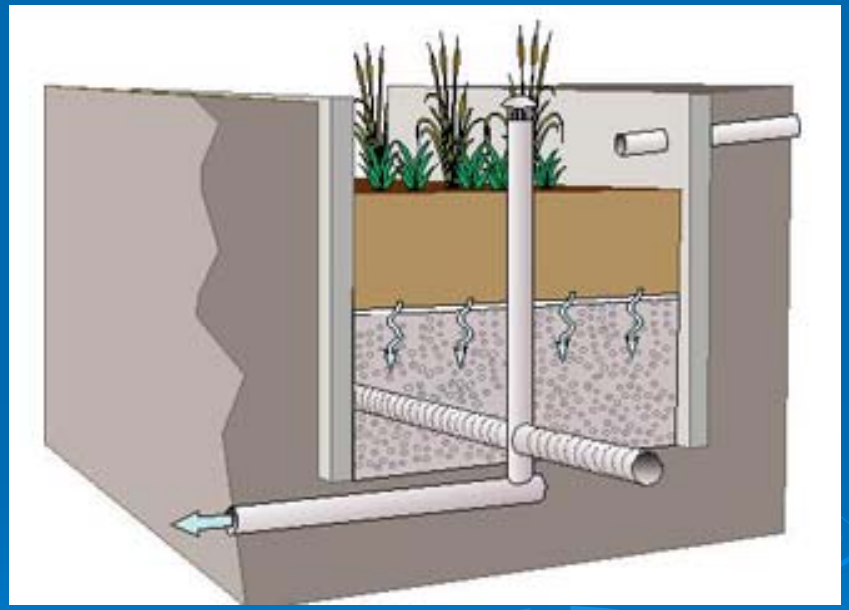
  EVF = 6/9 = 0.67

  Underdrain dia = 6 inches

CLEAR CREEK SOLUTIONS

Bioretention (Bio-Swale) Element

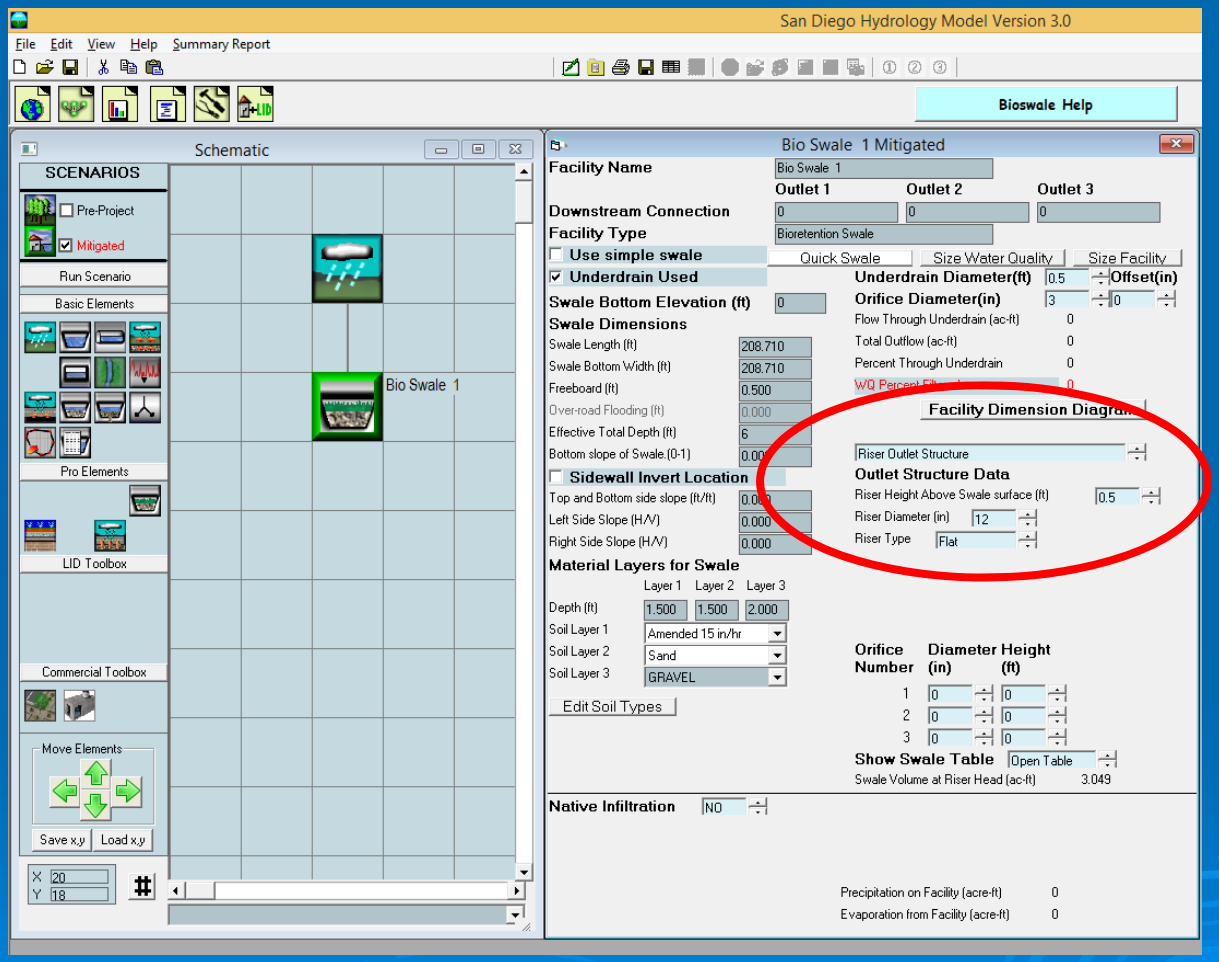
Bioretention/rain garden/planter boxes



Water infiltrates into the soil before runoff.

CLEAR CREEK SOLUTIONS

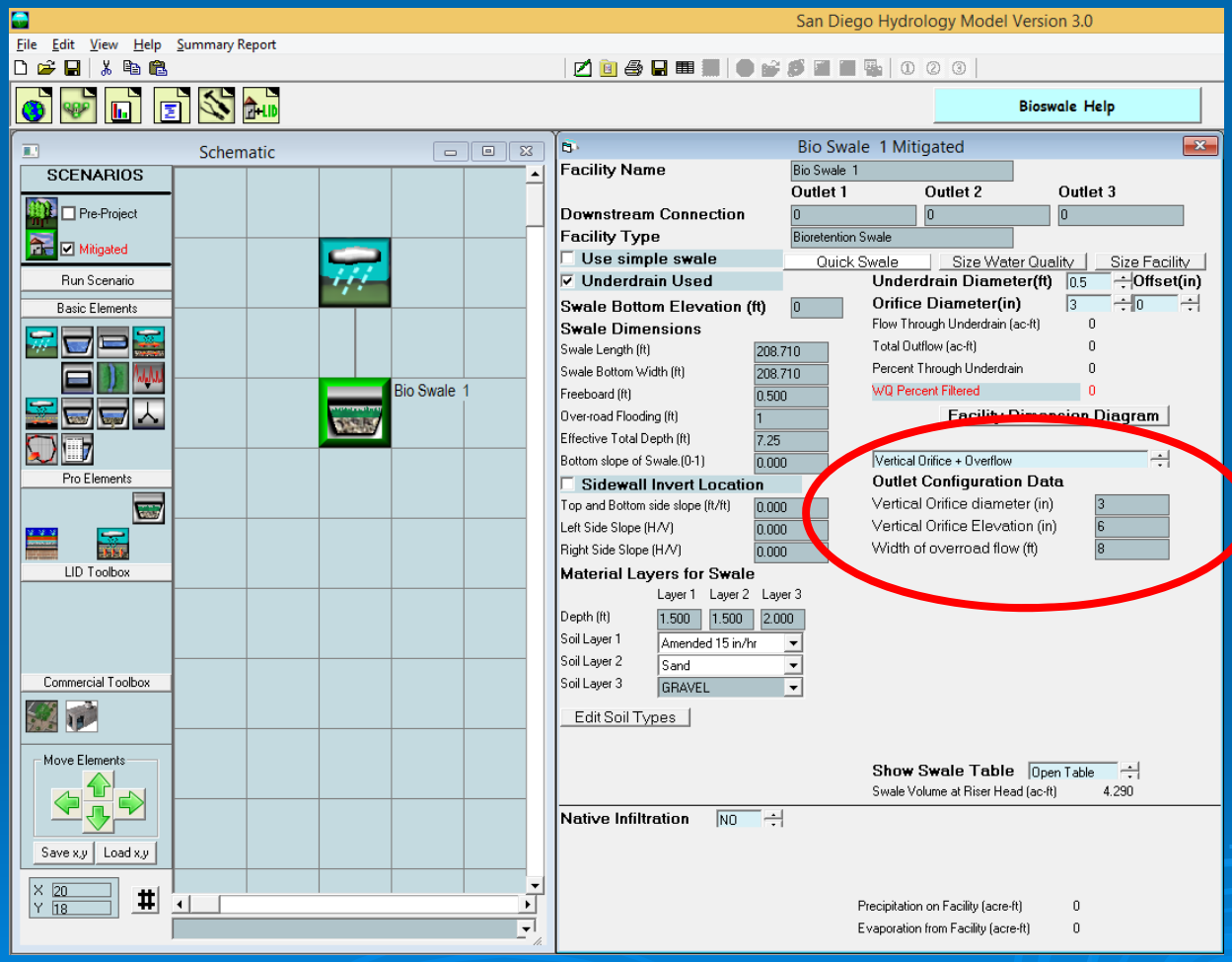
Bioretention (Bio-Swale) Element



Riser outlet option

CLEAR CREEK SOLUTIONS

Bioretention (Bio-Swale) Element

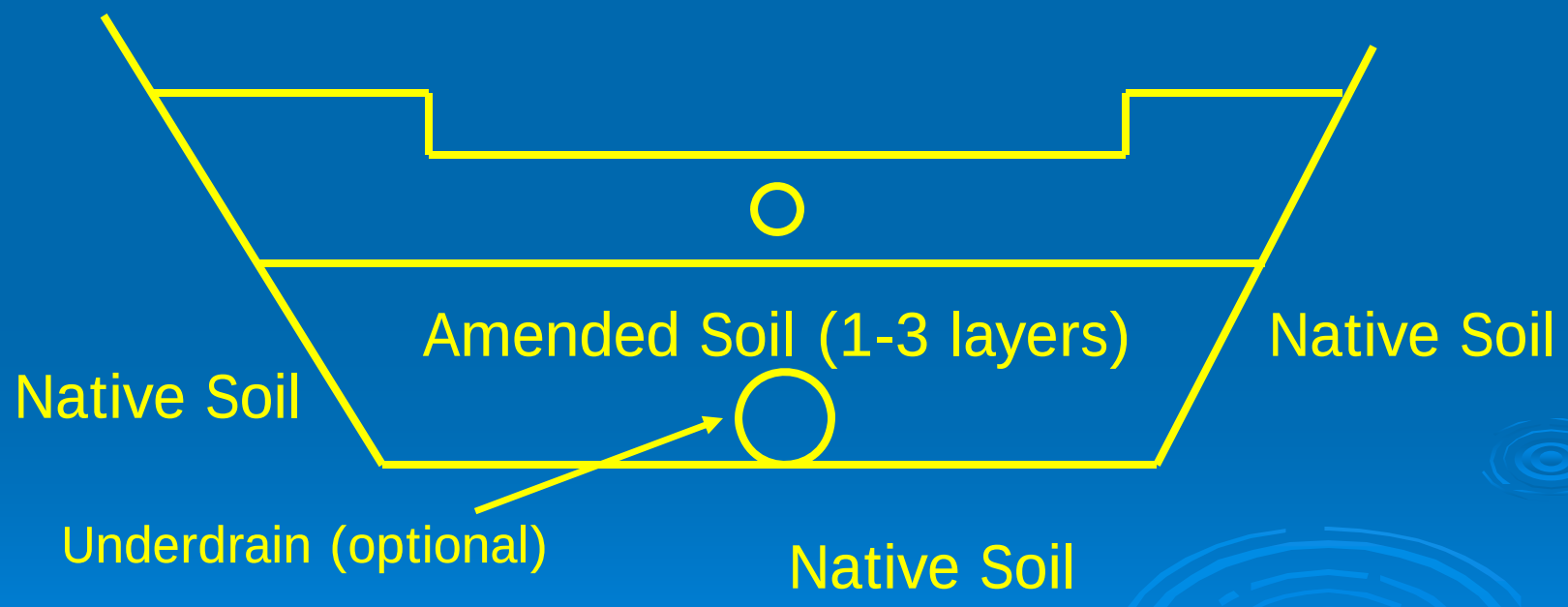


Vertical orifice and overflow outlet option

CLEAR CREEK SOLUTIONS

Bioretention (Bio-Swale) Element

Vertical orifice and overflow outlet option



CLEAR CREEK SOLUTIONS

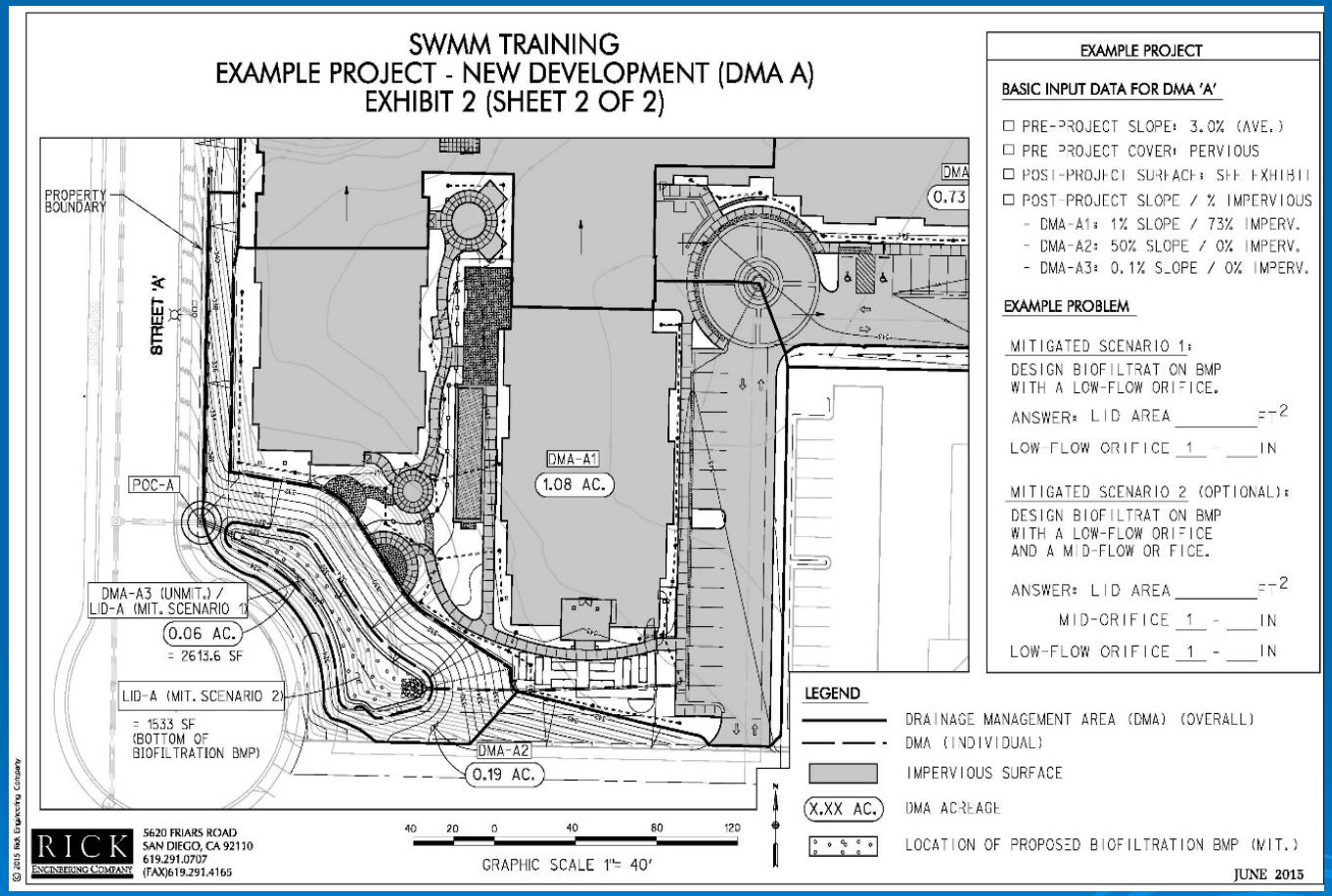
Bioretention (Bio-Swale) Element

Major issues:

- The top engineered soil layer must meet permit requirements.
- Infiltration to the native soil is encouraged even if there is an underdrain.

CLEAR CREEK SOLUTIONS

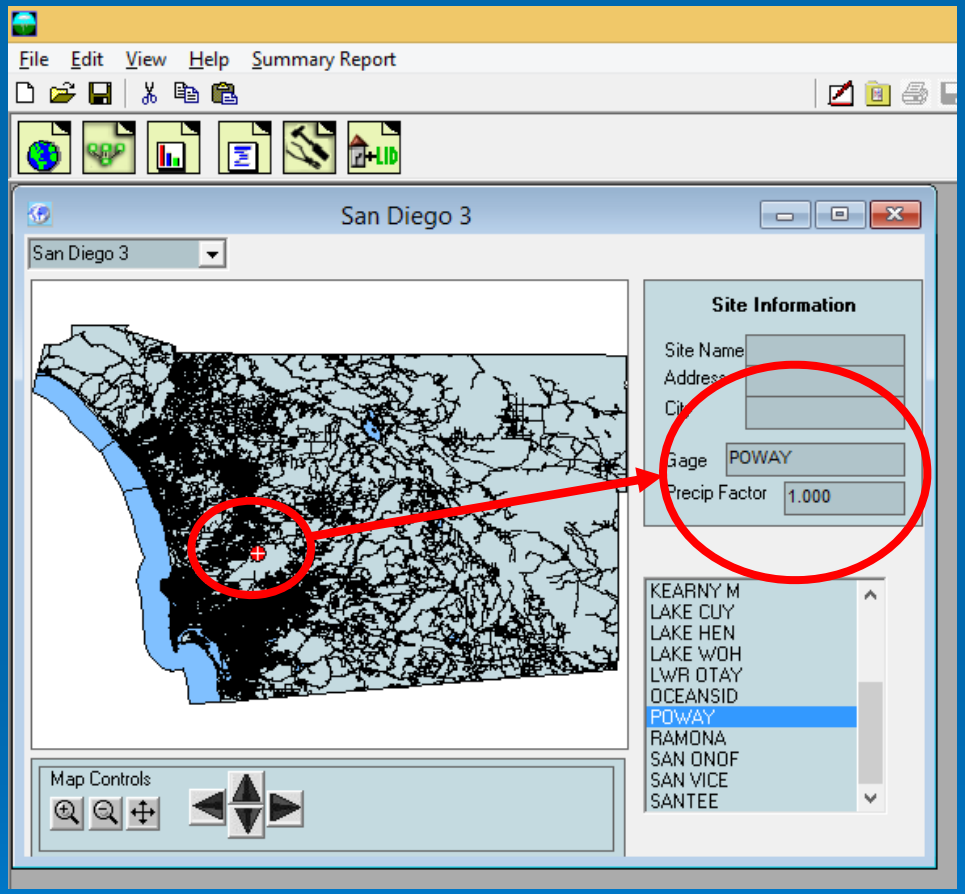
Bioretention Example



Hydromod low threshold is 0.1Q2 (10% of the 2-year peak flow), as calculated by SDHM 3.0

CLEAR CREEK SOLUTIONS

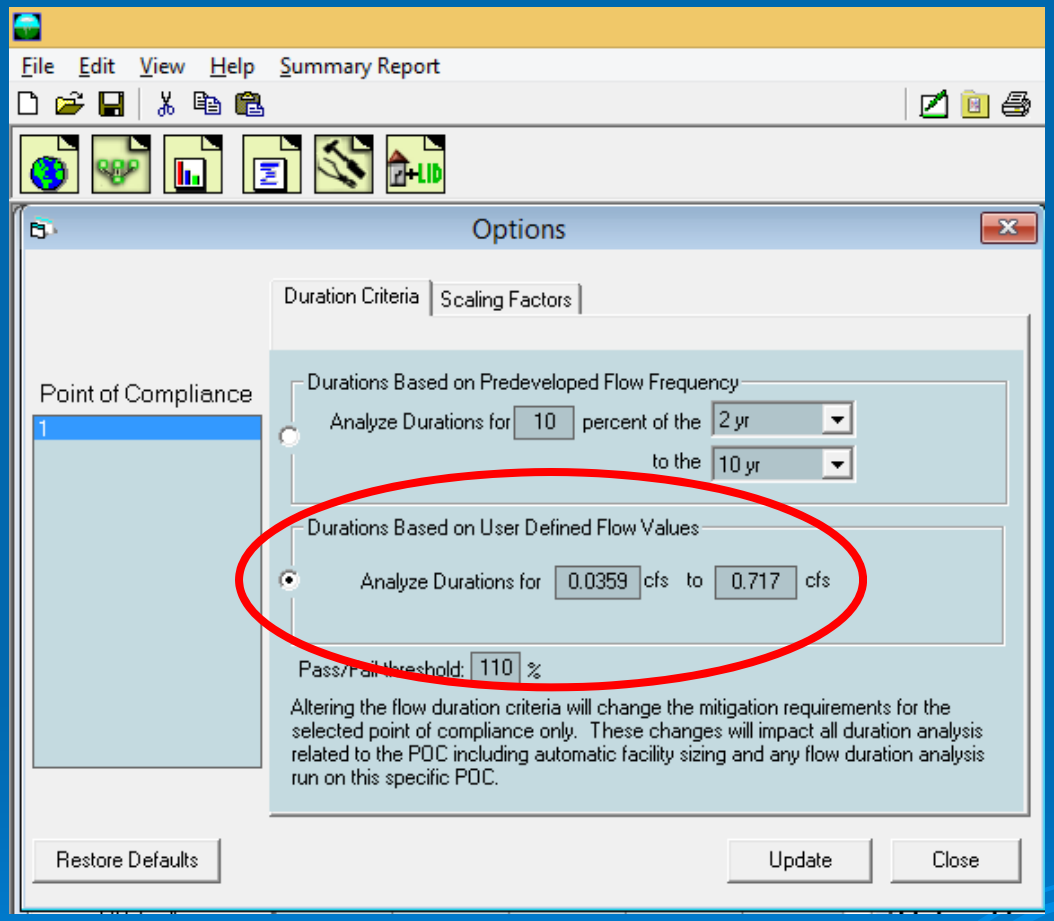
Bioretention Example



Rainfall: Poway

CLEAR CREEK SOLUTIONS

Bioretention Example



USGS Q2 = 0.359 cfs

USGS Q10 = 0.717 cfs

CLEAR CREEK SOLUTIONS

Bioretention Example

Predevelopment land use:

- Project: 1.33 ac D, Dirt, Flat

Developed mitigated land use:

- Project:

DMA	Description	Total (ac)	% Impervious	Imp (ac)	Perv (ac)
1a	building, courtyard, parking	1.08	73%	0.79	0.29
1b	graded slope (steep)	0.19	0%	0.00	0.19
1c	biofiltration basin	0.06	0%	0.00	0.06
Total		1.33		0.79	0.54

- Bioretention area: do not include in Basin element area draining to bioretention

CLEAR CREEK SOLUTIONS

Bioretention Example

Developed mitigated land use:

- Project:

DMA	Description	Total (ac)	% Impervious	Imp (ac)	Perv (ac)
1a	building, courtyard, parking	1.08	73%	0.79	0.29
1b*	graded slope (steep)	0.05	0%	0.00	0.05
1c	biofiltration basin bottom	0.06	0%	0.00	0.06
1c**	biofiltration basin sides	0.14	0%	0.00	0.14
Total		1.33		0.79	0.54

* Slopes not draining directly to biofiltration basin.
** Slopes draining directly to biofiltration basin.

- Bioretention area: do not include in Basin element area draining to bioretention

CLEAR CREEK SOLUTIONS

Bioretention Example

Developed mitigated land use:

- Project:

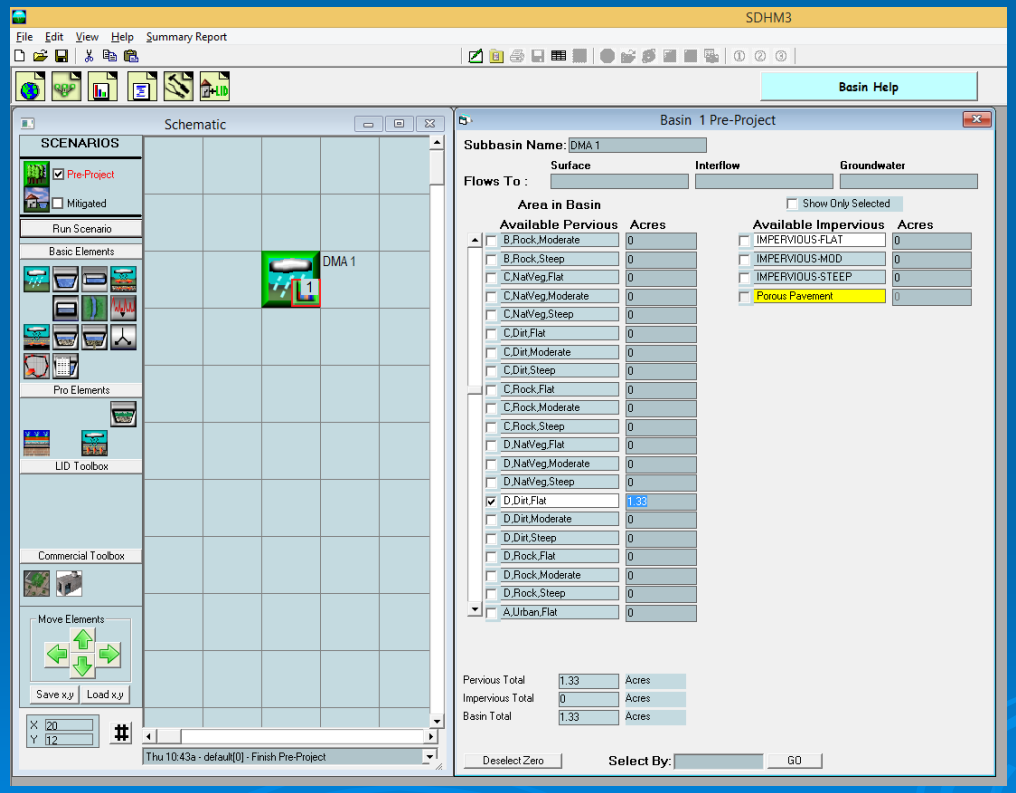
Description	Area (ac)
D, UrbNoIrr, Flat	0.29
D, UrbNoIrr, Steep	0.05
Bioretention Total Area	0.20
Impervous, Flat	0.79
Total	1.33

- Bioretention area: do not include in Basin element area draining to bioretention

CLEAR CREEK SOLUTIONS

Bioretention Example

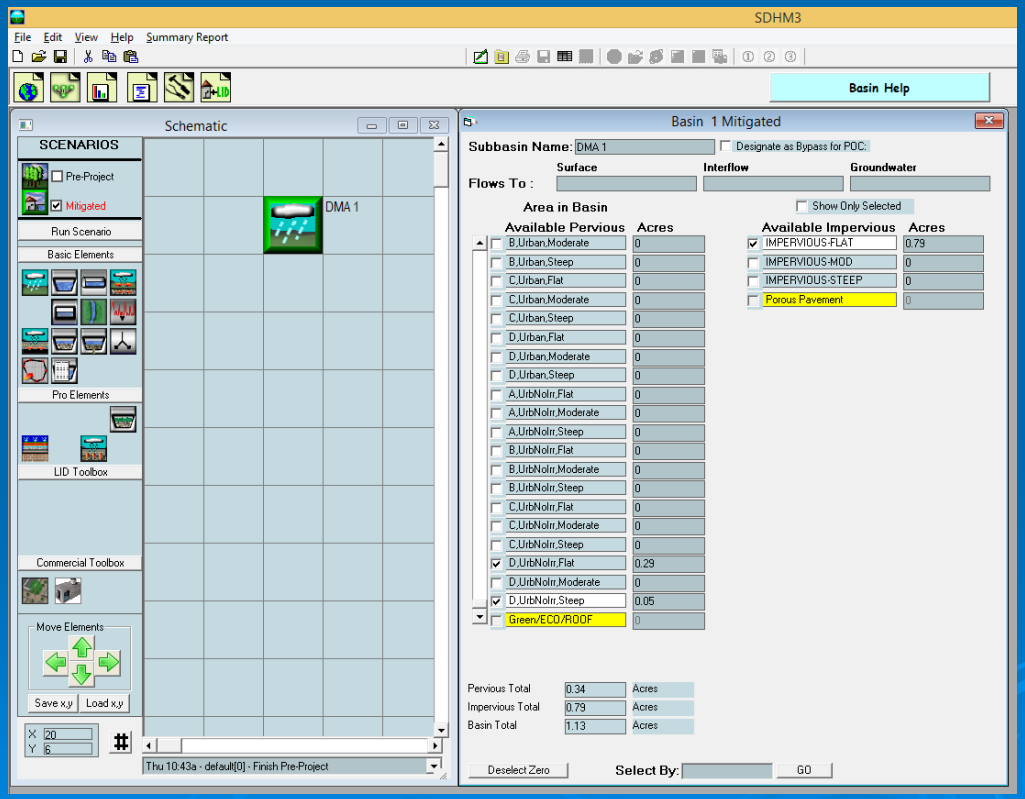
Pre-Project scenario land use (DMA 1):



CLEAR CREEK SOLUTIONS

Bioretention Example

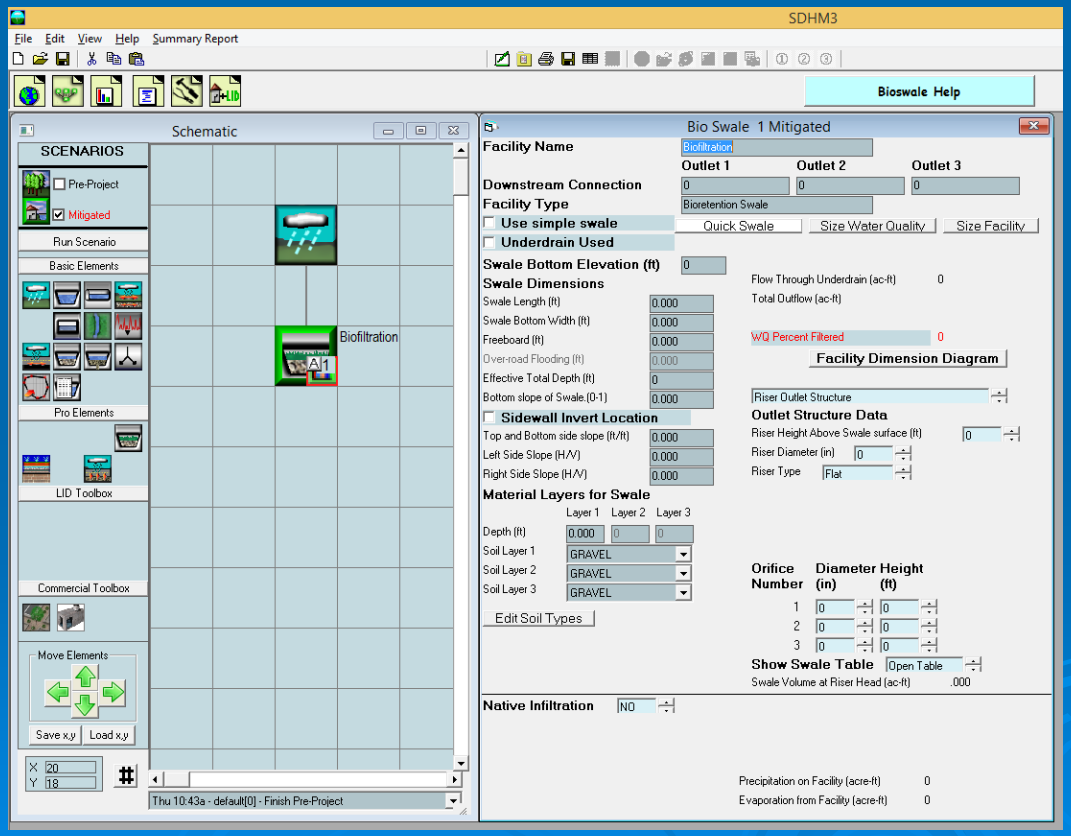
Mitigated scenario land use (DMA 1):



CLEAR CREEK SOLUTIONS

Bioretention Example

Mitigated scenario biofiltration basin:



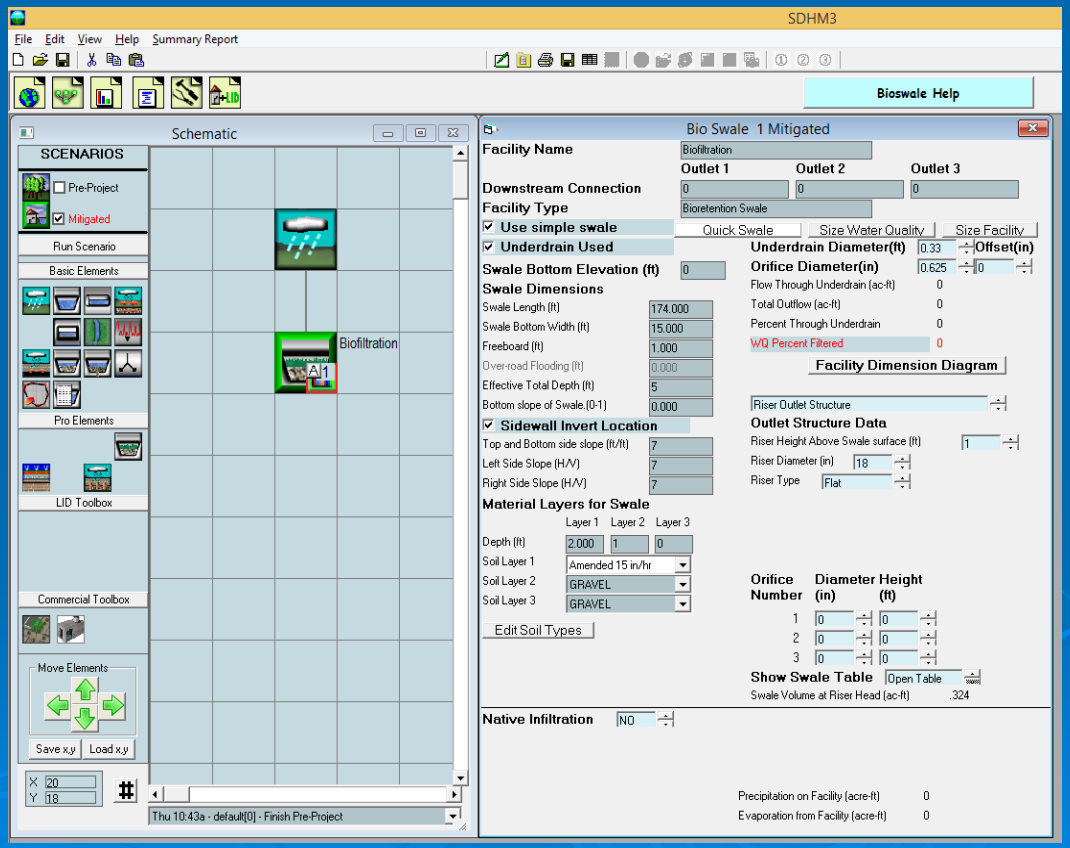
CLEAR CREEK SOLUTIONS

Bioretention Example

Mitigated scenario biofiltration basin:

- bottom length 174 ft
- bottom width 15 ft
- freeboard 1 ft
- bottom slope 0.000 ft/ft
- above ground side slopes 7H:1V
- below ground side slopes: vertical
- soil layer 1: 2 ft, amended 15 in/hr
- soil layer 2: 1 ft, gravel
- underdrain dia 0.33 ft
- underdrain orifice dia 0.625 in
- underdrain offset 0 in
- riser height 1 ft
- riser dia 10 in

- bottom surface area 0.06 ac
- top surface area 0.20 ac

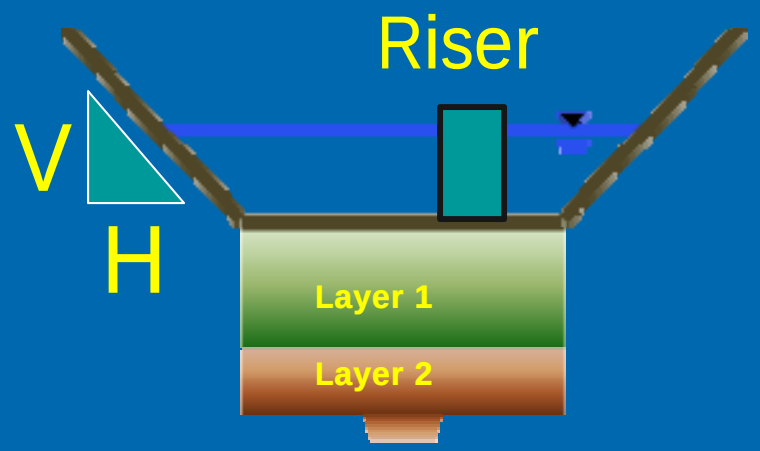


CLEAR CREEK SOLUTIONS

Bioretention Example

Mitigated scenario biofiltration basin:

- above ground side slopes 7H:1V
- below ground side slopes vertical
- soil layer 1: 2 ft, amended 15 in/hr
- soil layer 2: 1 ft, gravel
- riser height 1 ft
- riser dia 10 in
- freeboard 1 ft



CLEAR CREEK SOLUTIONS

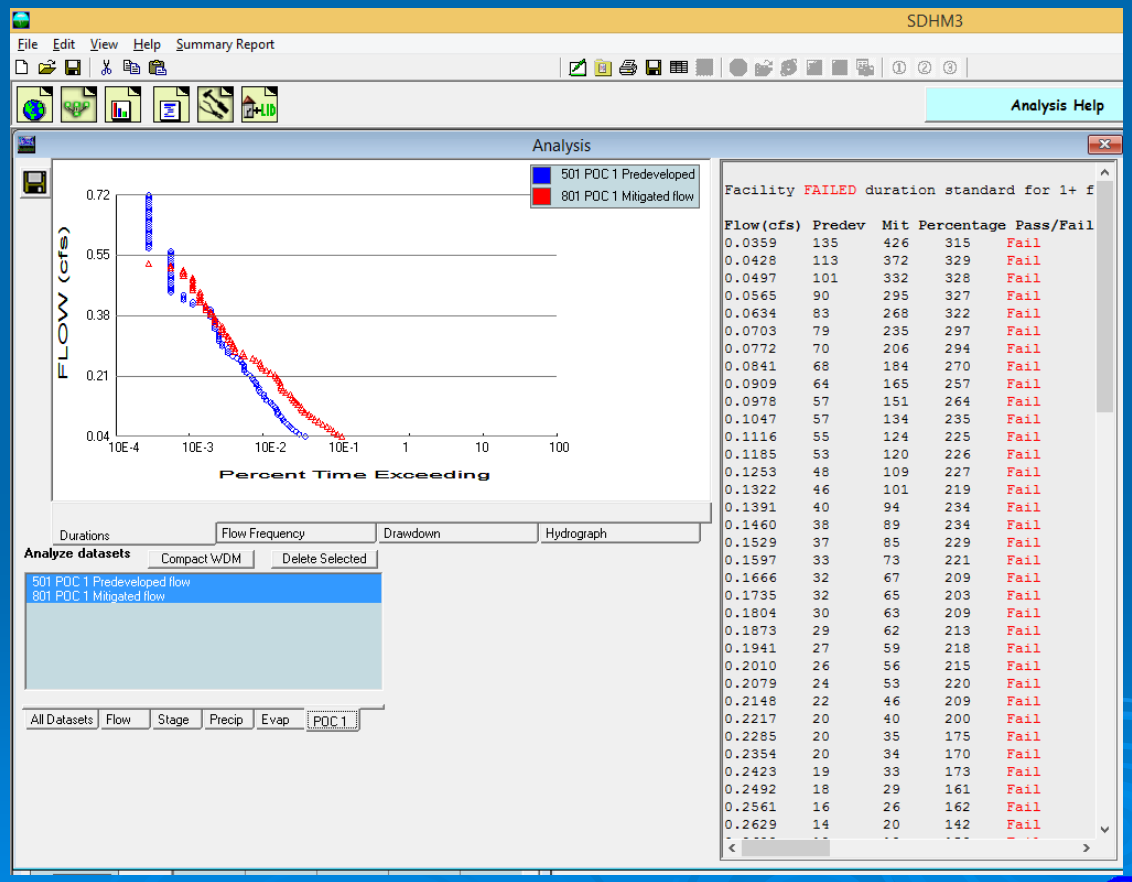
Bioretention Example

Mitigated scenario biofiltration basin (1st iteration):

1. Analysis

2. Durations

3. POC 1



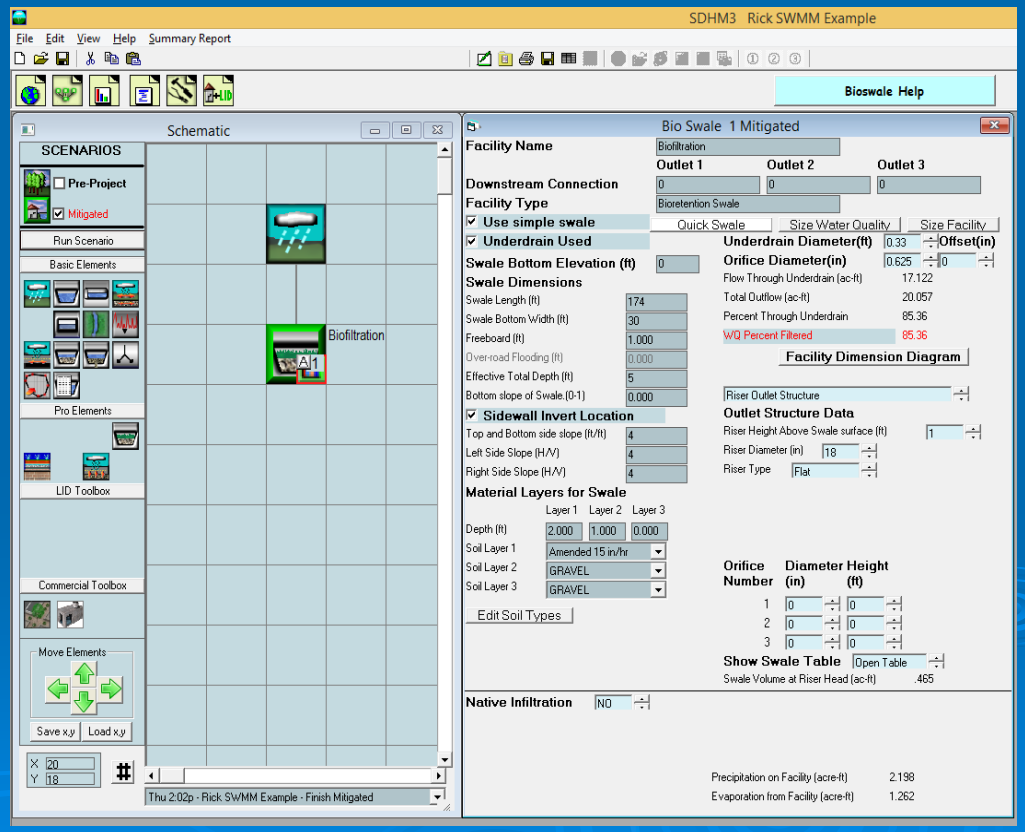
Hydromod duration criteria: <u>Failed</u>

CLEAR CREEK SOLUTIONS

Bioretention Example

Mitigated scenario biofiltration basin:

1. Increase bottom area
2. Adjust side slopes
3. Rerun scenario



CLEAR CREEK SOLUTIONS

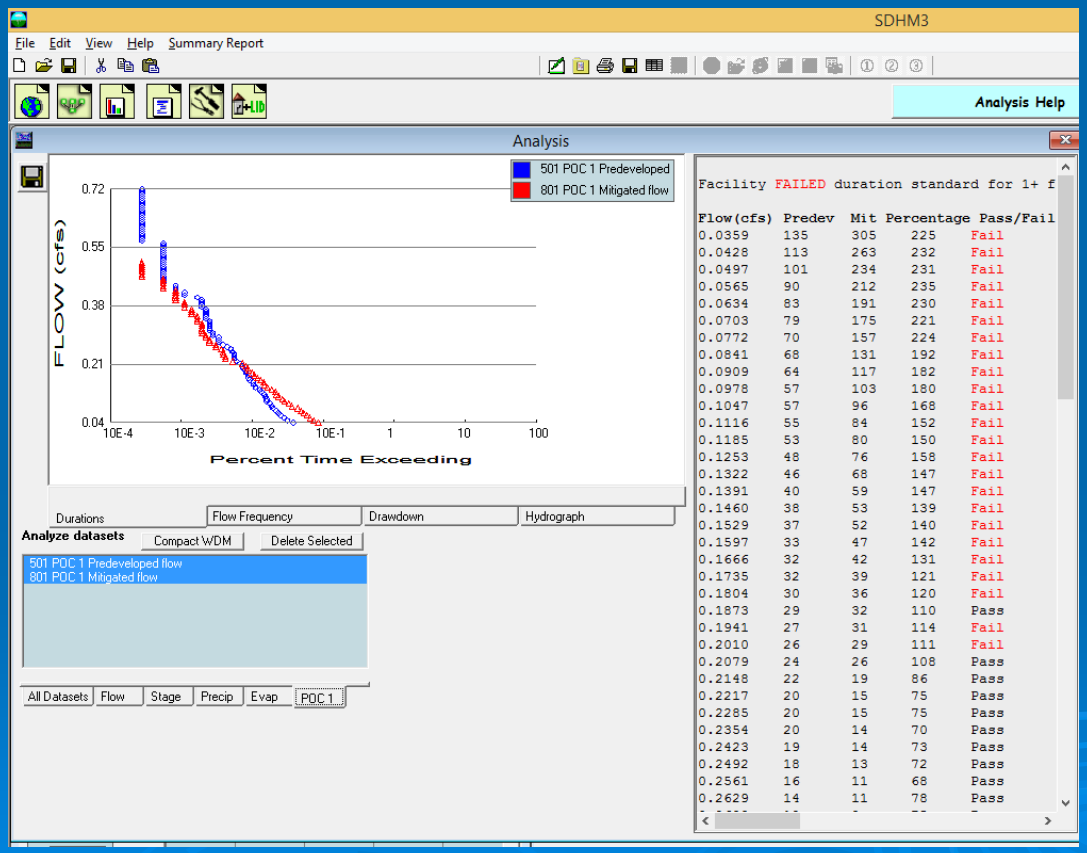
Bioretention Example

Mitigated scenario biofiltration basin (2nd iteration):

1. Analysis

2. Durations

3. POC 1



Flow(cfs)	Predev	Mit	Percentage	Pass/Fail
0.0359	135	305	225	Fail
0.0428	113	263	232	Fail
0.0497	101	234	231	Fail
0.0565	90	212	235	Fail
0.0634	83	191	230	Fail
0.0703	79	175	221	Fail
0.0772	70	157	224	Fail
0.0841	68	131	192	Fail
0.0909	64	117	182	Fail
0.0978	57	103	180	Fail
0.1047	57	96	168	Fail
0.1116	55	84	152	Fail
0.1185	53	80	150	Fail
0.1253	48	76	158	Fail
0.1322	46	68	147	Fail
0.1391	40	59	147	Fail
0.1460	38	53	139	Fail
0.1529	37	52	140	Fail
0.1597	33	47	142	Fail
0.1666	32	42	131	Fail
0.1735	32	39	121	Fail
0.1804	30	36	120	Fail
0.1873	29	32	110	Pass
0.1941	27	31	114	Fail
0.2010	26	29	111	Fail
0.2079	24	26	108	Pass
0.2148	22	19	86	Pass
0.2217	20	15	75	Pass
0.2285	20	15	75	Pass
0.2354	20	14	70	Pass
0.2423	19	14	73	Pass
0.2492	18	13	72	Pass
0.2561	16	11	68	Pass
0.2629	14	11	78	Pass

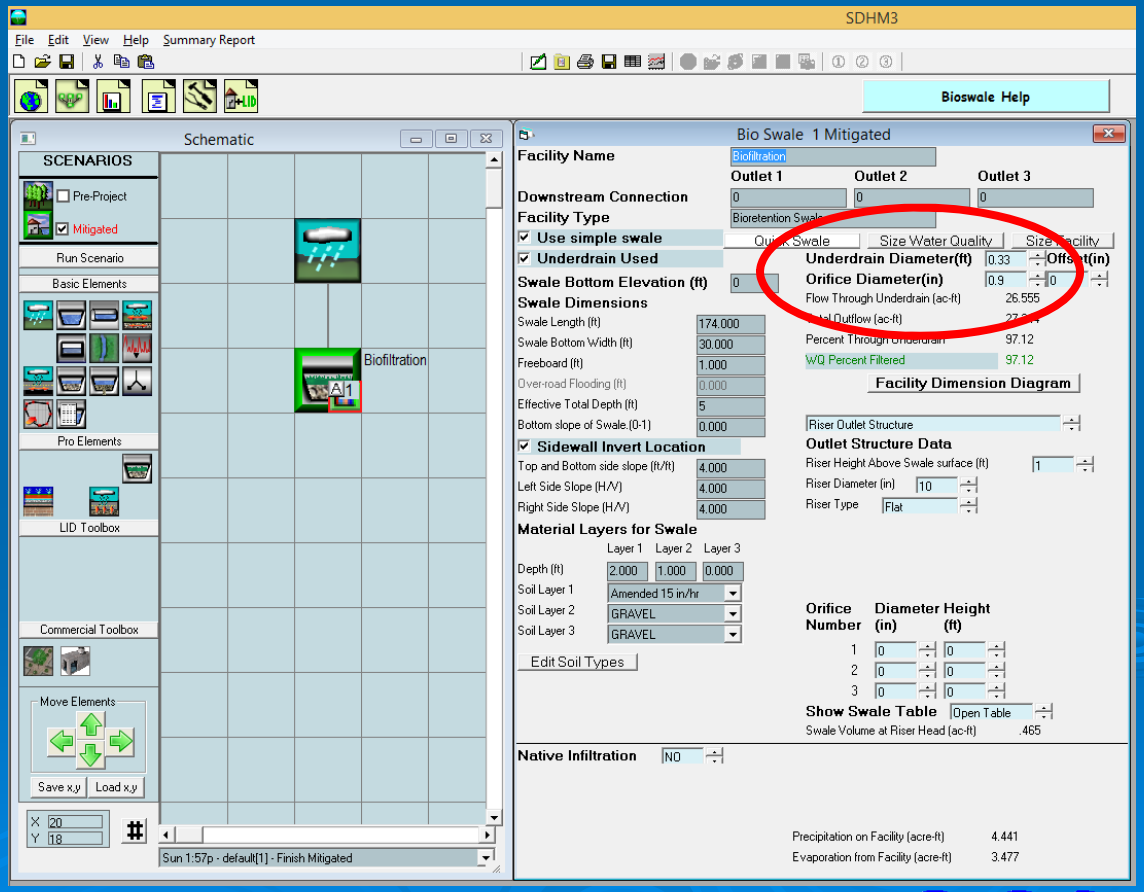
Hydromod duration criteria: <u>Failed</u>

CLEAR CREEK SOLUTIONS

Bioretention Example

Mitigated scenario biofiltration basin:

Increase underdrain orifice diameter from 0.625 in to 0.90 in



CLEAR CREEK SOLUTIONS

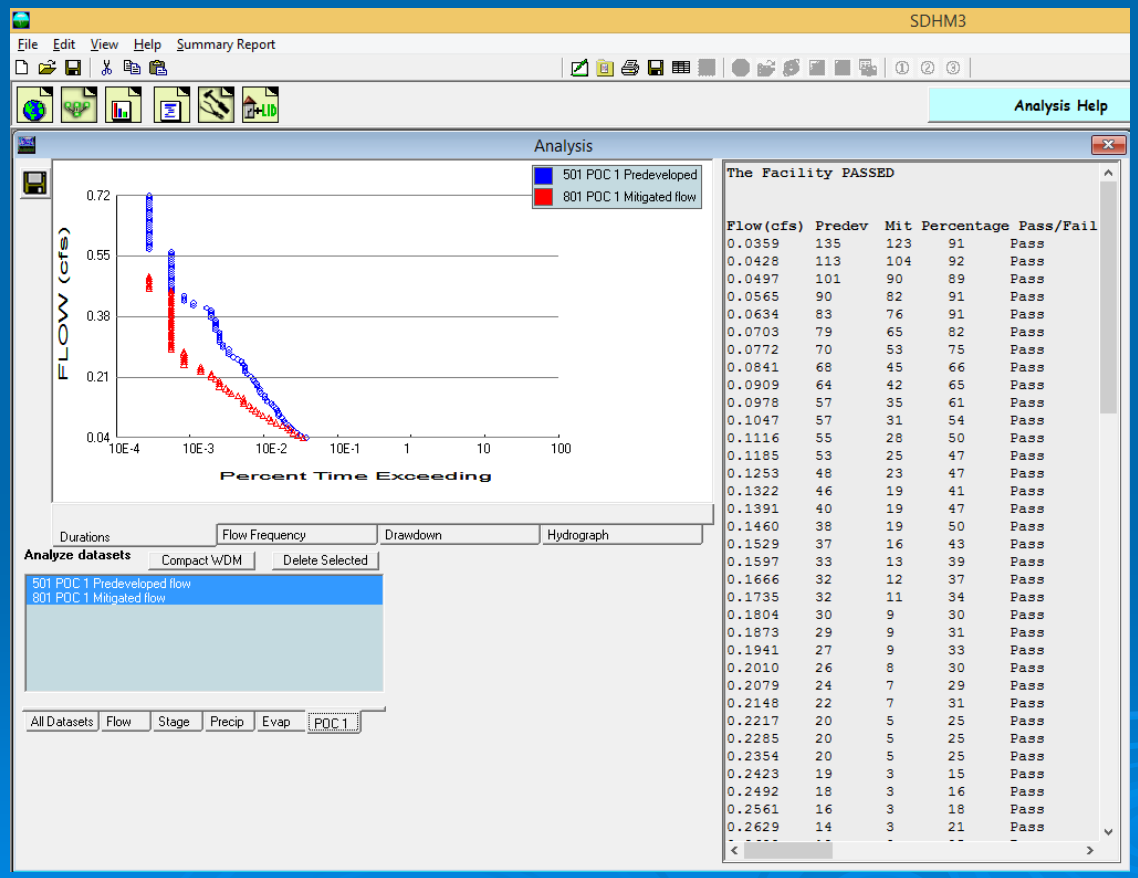
Bioretention Example

Mitigated scenario biofiltration basin (3rd iteration):

1. Analysis

2. Durations

3. POC 1



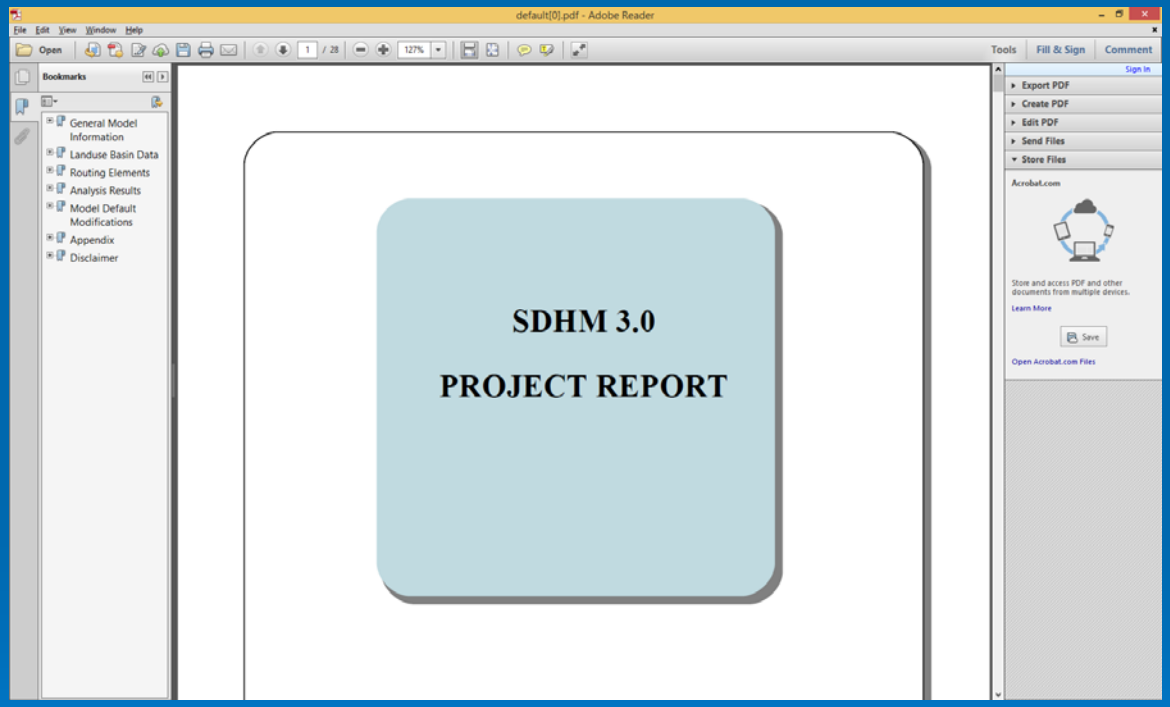
Flow(cfs)	Predev	Mit	Percentage	Pass/Fail
0.0359	135	123	91	Pass
0.0428	113	104	92	Pass
0.0497	101	90	89	Pass
0.0565	90	82	91	Pass
0.0634	83	76	91	Pass
0.0703	79	65	82	Pass
0.0772	70	53	75	Pass
0.0841	68	45	66	Pass
0.0909	64	42	65	Pass
0.0978	57	35	61	Pass
0.1047	57	31	54	Pass
0.1116	55	28	50	Pass
0.1185	53	25	47	Pass
0.1253	48	23	47	Pass
0.1322	46	19	41	Pass
0.1391	40	19	47	Pass
0.1460	38	19	50	Pass
0.1529	37	16	43	Pass
0.1597	33	13	39	Pass
0.1666	32	12	37	Pass
0.1735	32	11	34	Pass
0.1804	30	9	30	Pass
0.1873	29	9	31	Pass
0.1941	27	9	33	Pass
0.2010	26	8	30	Pass
0.2079	24	7	29	Pass
0.2148	22	7	31	Pass
0.2217	20	5	25	Pass
0.2285	20	5	25	Pass
0.2354	20	5	25	Pass
0.2423	19	3	15	Pass
0.2492	18	3	16	Pass
0.2561	16	3	18	Pass
0.2629	14	3	21	Pass

Hydromod duration criteria: PASSED

CLEAR CREEK SOLUTIONS

Bioretention Example

Create Project Report:



FINISHED!

CLEAR CREEK SOLUTIONS

Questions?

Doug Beyerlein 425.225.5997
beyerlein@clearcreeksolutions.com

Joe Brascher 360.943.0304
brascher@clearcreeksolutions.com

CLEAR CREEK SOLUTIONS