NEW MODULE IN PONDS 3.2 APPLICATION SUITE:
SWALES AND OVERLAND FLOW
WITH OR WITHOUT INFILTRATION COMPONENT

presented at:

ASCE STORMWATER LUNCHEON
Thursday JAN 17th 2002 at Noon
Lee's Lakeside Inn, Orlando, Florida

presented by:

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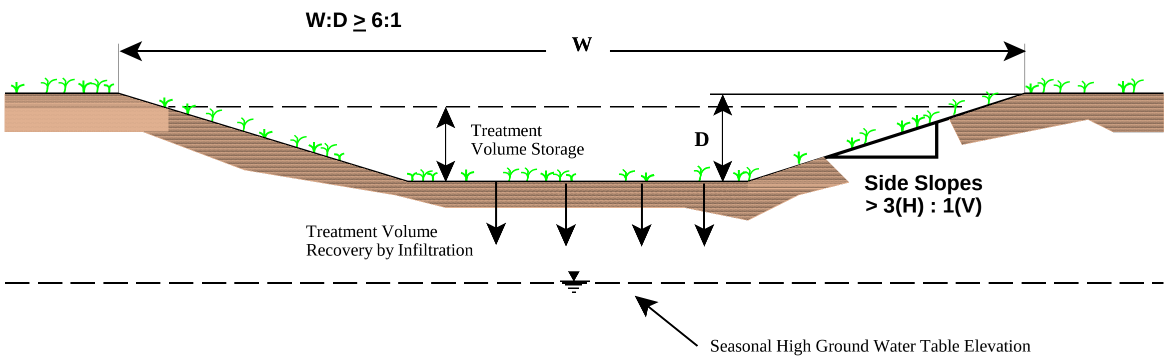
Conceptual Model for Swales



Notes:

① **Unlike a pond, there is open channel flow while the water is infiltrating**

② **Recommend that this be applied only for unsaturated infiltration. Suitable for sites with HSG "A" soils with sand and deep water table.**

③ **Most engineers do not analyze this properly**

④ **3yr/1 hr storm; analyze to see is 80% of volume can be percolated.**

SWALE/OVERLAND FLOW MODULE IN PONDS 3.2

SOME KNOWN APPLICATIONS - LIST 1 OF 2

- Demonstrate/Compute Water Quality Treatment Efficiency for Unlined Swales With Infiltration. In other words, all or a portion of the water quality treatment is achieved in the unlined conveyance system before the point of discharge.

- Demonstrate/Compute Water Quality Treatment Efficiency for Overland Flow Systems With Infiltration. Appropriate for analyses of vegetative natural buffers and wide strips of land such as airport infields, ballfields, etc.

- Computation of channel flow velocities and factor of safety against erosion for the specified channel lining.

SWALE/OVERLAND FLOW MODULE IN PONDS 3.2

SOME KNOWN APPLICATIONS - LIST 2 OF 2

- Compute Width of Spread in Lined Channels such as pavement gutters.
- Compute interception efficiency of inlets within unlined gutters.
- Compute normal depth of flow in an open channel for a given flow rate (wetted perimeter, mean veolicty, etc.)

SWALE/OVERLAND FLOW MODULE IN PONDS 3.2

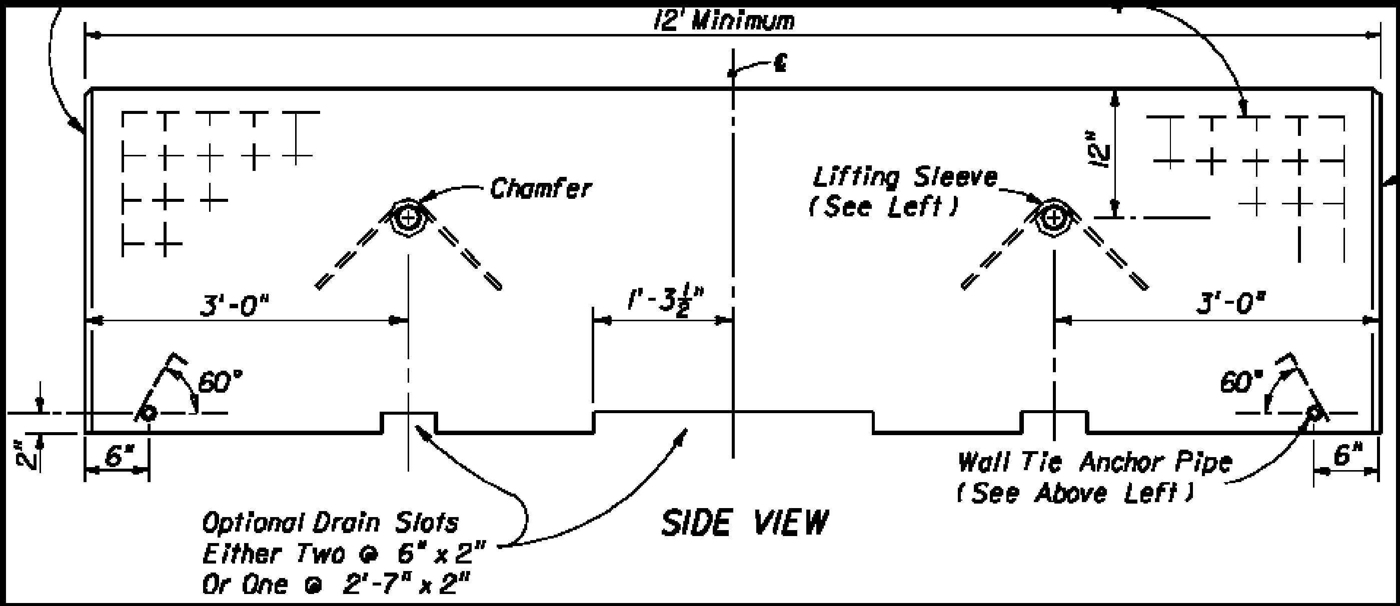
REAL-WORLD APPLICATION #1, ORLANDO EXECUTIVE AIRPORT
OVERLAND FLOW WITH INFILTRATION FOR WATER QUALITY TREATMENT

Shows how the module was used to demonstrate water quality treatment by overland flow in the infield areas with major saving in pond construction and satisfaction of FAA criteria.

SWALE/OVERLAND FLOW MODULE IN PONDS 3.2

REAL-WORLD APPLICATION #2, I-4 GUTTER SPREAD

COMPUTE WIDTH OF SPREAD & INTERCEPTION EFFICIENCY ADJACENT TO INDEX 415 BARRIERS



SWALE/OVERLAND FLOW MODULE IN PONDS 3.2

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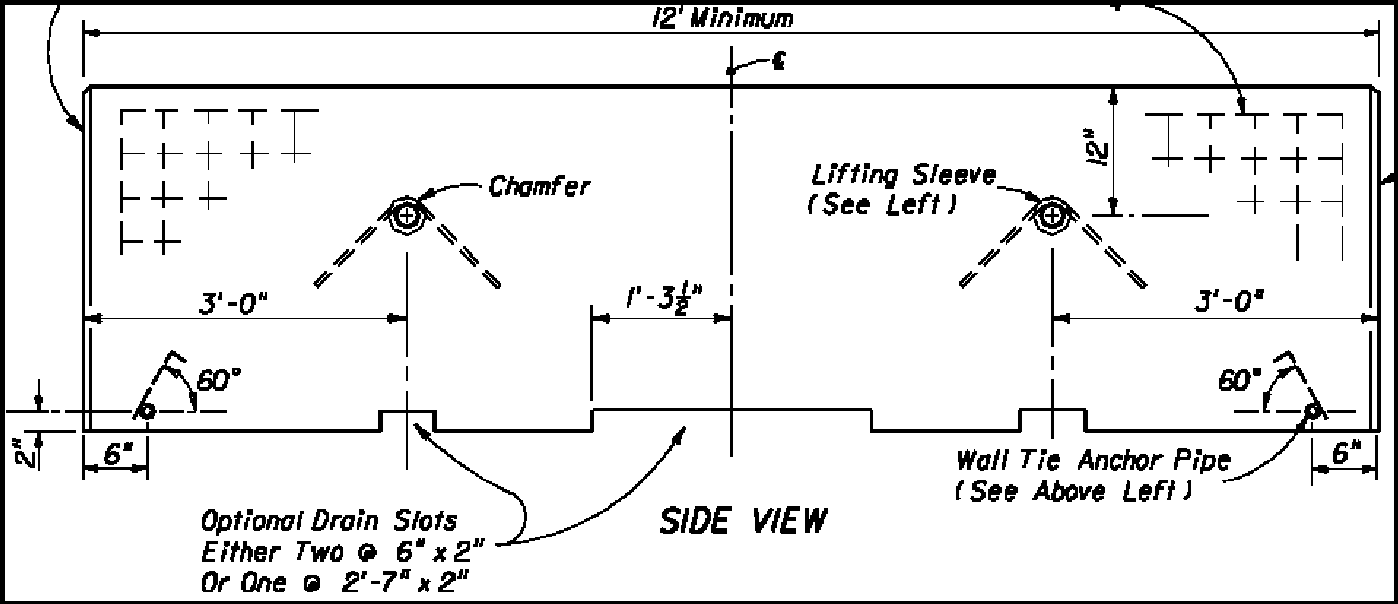

SWALE/OVERLAND FLOW MODULE IN PONDS 3.2

THREE (3) BASIC COMPUTATIONAL STEPS

1. Generate the hydrograph which in this case is computation of the peak flow rate for the design storm event given the basin parameters.

2. Perform the open channel flow hydraulic calculations to determine the flow velocity and normal depth for the swale cross-section. This is an iterative procedure within the computer code to calculate the normal depth of flow.

3. Perform the infiltration rate and soil-storage volume calculations to extract the ground water component from the surface water flow.

SWALE/OVERLAND FLOW MODULE

CALCULATION STEP #1 - RUNOFF HYDROGRAPH

NOTE: HIGHLIGHTED NUMBERS ARE COMPUTED; OTHERS ARE INPUT

	A	B	C	D
3	Project Name: Orlando Executive Airport - Holding Bays, Blast Pads, & Stubouts			
4	Swale Location: Holding Bay 31			
5				
6	**Step #1: Runoff Hydrograph Calculations**			
7	PARAMETER	SYMBOL	UNIT	MAGNITUDE
8	Drainage Area to swale	A	ac	0.94
9	Runoff Coefficient	C	-	0.98
10	Rainfall Intensity	ID	in/hr	2.60
11	Peak Runoff Rate	Qp	cfs	2.40
12				
13	Storm duration	D	min	60
14	Time of concentration	Tc	min	6
15				
16	Volume of runoff (treatment volume)	Vr	ft^3	8,622
17	Runoff depth		in	2.55
18				
19	Length of swale	L	ft	670
20				

SWALE/OVERLAND FLOW MODULE

CALCULATION STEP #2 - OPEN CHANNEL HYDRAULICS

NOTE: HIGHLIGHTED NUMBERS ARE COMPUTED; OTHERS ARE INPUT

	A	B	C	D
23	Step #2: Open Channel Flow Calculations			
24	PARAMETER	SYMBOL	UNIT	MAGNITUDE
25				
26	Input Parameters			
27	Normal Depth of flow	d	ft	0.4449
28	Bottom Width of Channel	B	ft	0.0
29	Left Side Slope of Channel	Z1	?H:1V	15.0
30	Right Side Slope of Channel	Z2	?H:1V	20.0
31	Top Width of Water Surface	Wt	ft	15.6
32	Average bed or energy slope	S2	ft/ft	0.0031
33	Lining Type	-	-	Bahia
34	Manning's Roughness Coefficient	N	-	0.044
35	Permissible velocity	Vp	fps	5
36	Unit weight of water	Y	pcf	62.4
37				
38	Calculated Parameters			
39	Cross-sectional flow area	A	sq. ft	3.5
40	Wetted perimeter on left slope	Pl	ft	6.7
41	Wetted perimeter on right slope	Pr	ft	8.9
42	Total wetted perimeter	P	ft	15.6
43	Hydraulic radius	Rh	ft	0.22
44	Discharge Rate	Q	cfs	2.40
45	Mean veolcity	V	fps	0.7
46	Factor of safety against erosion	FS1	-	7.23

SWALE/OVERLAND FLOW MODULE

CALCULATION STEP #3 - INFILTRATION/TREATMENT CALCS

NOTE: HIGHLIGHTED NUMBERS ARE COMPUTED; OTHERS ARE INPUT

49	Step #3: Infiltration/Treatment Calculations			
50	PARAMETER	SYMBOL	UNIT	MAGNITUDE
51				
52	Unsaturated vertical infiltration rate	Kvu	ft/day	30
53	Factor of Safety (for soil infiltration)	FS2	-	2.00
54	Design infiltration rate	Id	ft/day	15.00
55	Effective swale bottom area	Ab	ft^2	10,450
56	Infiltration rate at normal depth	Qip	cfs	1.81
57	Computed max infiltration volume	V1	ft^3	6,690
58				
59	Soil Porosity	f	%	30%
60	Depth to water table from bottom of swale	hb	ft	5.3
61	Available soil storage volume below swale		ft^3	16,432
62				
63	Treatment Efficiency			
64	Actual Infiltration Volume/Runoff Volume		%	**78%**

DESIGN CRITERIA AT OEA

SJRWMD	FAA	ORLANDO
Water Quality For overland flow with infiltration and swales, infiltrate 80% of the volume. Water quality volume is the runoff volume for the 3 yr/1 hr storm (2.6 inches) Water Quantity The system is considered by SJRWMD to be a landlocked stormwater management system. Therefore, the postdevelopment runoff volume for the 25 yr/96 hr storm (11.6 inches) shall not exceed the corresponding predevelopment runoff volume.	Water Quantity The runoff volume for the 5 yr/1 hr storm (2.9 inches) shall be recovered within 24 hours of the storm event.	Water Quality Water quality volume is equal to the first ½ inch of runoff or runoff from 1 inch of rainfall. Water Quantity The 25 yr/24 hr storm is the design standard for the primary system.