Technical Memorandum

To: City of Eastvale

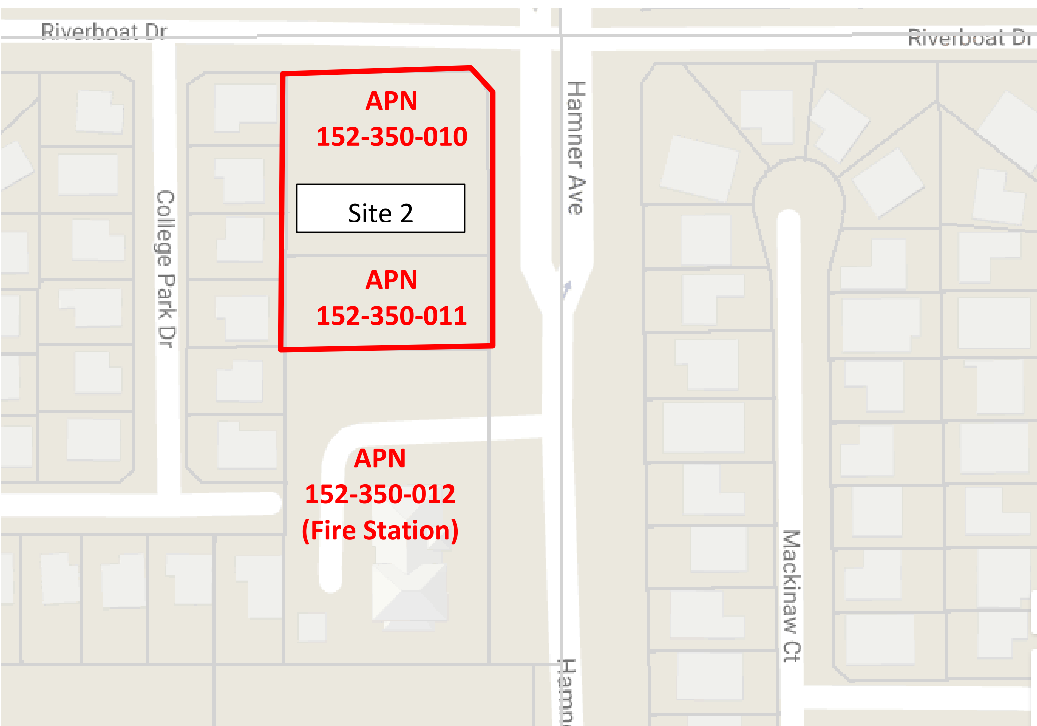
From: Teresa Gibbs, PE – Associate Engineer

Date: March 20, 2018

Re: 2017-0043 Preliminiary Hydrology & Water Quality Memorandum for APN 152-350-010/152-350-011 (**Site 2**)

Introduction

The following memorandum is prepared to preliminarily address the existing and proposed hydrologic conditions along with the water quality treatment options for the development of APNs 152-350-010 & 152-350-011 (**Site 2**). The project is proposed at the southwestern corner of Riverboat Drive and Hamner Avenue as shown below.



In the existing condition, the site is undeveloped and the surrounding parcels are fully developed. Onsite runoff travels from northwest to southeast and into Hamner Avenue through an existing under sidewalk drain. Flows traveling south along the western side of the street will be picked up in a catch basin inlet on Schleisman Road at the intersection with Hamner Avenue. The catch basin drains to the existing Line H storm drain in Hamner Avenue, which connects to existing Eastvale MDP facility Line E-3 and ultimately into the Santa Ana River.

In the proposed condition, it is assumed that the site will be developed into a commercial project and that the flow pattern will remain the same, from northwest to southeast. However, instead of runoff flowing through the street, a private onsite storm drain system will be implemented to convey runoff to Line H. Existing Line H will be extended north in order to connect to this private onsite system. The Fire Station will continue to drain into Hamner Avenue, however a catch basin inlet will be installed at the southeastern corner of the Fire Station to pick up this runoff. A proposed storm drain lateral will be required to connect the catch basin to Line H. A preliminary rational method study was prepared for the development of Site 2 and the Fire Station to determine the individual runoff from each site. For the 100 year storm event, Site 2 generated approximately 6.1 cfs, the Fire Station generates approximately 6.2 cfs, totaling approximately 11.9 cfs from the two sites. The preliminary rational method studies can be found in Attachments 2 and 3.

A separate hydrology memorandum entitled “Preliminary Offsite Hydrology and Hydraulic Study for the Polopolus Project” dated June 24, 2017 was prepared for existing Line H to show that the storm drain is capable of handling the surrounding developed condition runoff. In the memo, the 100 year rational method storm event for the development of Site 2 and the Fire Station generates approximately 10.2 cfs. This is less than the required 11.8 cfs generated from the rational method included with this memorandum. However the increase is not significant and the proposed pipe extension will be designed to ensure that this flow is able to be captured and conveyed. Due to the downstream capacity in the storm drain, no detention is proposed onsite.

A preliminary analysis was also done for the project site to determine how the site will address water quality treatment options. The water quality guidelines for the Santa Ana Watershed were used in conjunction with the City of Eastvale standards. Table 1 (taken from the Santa Ana WQMP Guidance Document) shows that the commercial site is required to treat for all the general pollutant categories.

Table 1 – Potential Pollutants Generate by Land Use Type

Priority Development Project Categories and/or Project Features	General Pollutant Categories							
	Bacterial Indicators	Metals	Nutrients	Pesticides	Toxic Organic Compounds	Sediments	Trash & Debris	Oil & Grease
Detached Residential Development	P	N	P	P	N	P	P	P
Attached Residential Development	P	N	P	P	N	P	P	P[2]
Commercial/Industrial Development	P[3]	P	P[1]	P[1]	P[5]	P[1]	P	P
Automotive Repair Shops	N	P	N	N	P[4, 5]	N	P	P
Restaurants (>5,000 ft^2)	P	N	N	N	N	N	P	P
Hillside Development (>5,000 ft^2)	P	N	P	P	N	P	P	P
Parking Lots (>5,000 ft^2)	P[6]	P	P[1]	P[1]	P[4]	P[1]	P	P
Retail Gasoline Outlets	N	P	N	N	P	N	P	P

P = Potential

N = Not Potential

[1] A potential Pollutant if non-native landscaping exists or is proposed on-site; otherwise not expected.

[2] A potential Pollutant if the project includes uncovered parking areas; otherwise not expected

[3] A potentialPpollutant is land use involves animal waste

[4] Specifically petroleum hydrocarbons

[5] Specifically solvents

[6] Bacterial indicators are routinely detected in pavement runoff

The water quality treatment hierarchy was utilized to determine the appropriate method of treating the onsite runoff:

- **Infiltration:** A preliminary geotechnical report for the Polopolus project (southeast of Site 2) determined that there was little to no infiltration in the surrounding areas. It was assumed that the Site 2 project would have similar soil infiltration restrictions, and due to this, infiltration options such as basins or trenches, were excluded from the available means of treatment.
- **Harvest and Reuse:** In previous experiences, harvest and reuse has not been feasible for this type of project site. Therefore, harvest and reuse was also excluded as a treatment option.
- **Bioretention:** Bioretention was excluded due to the required footprints for the large basin bottom areas and the small area of the project site. The site does not require detention since the existing downstream storm drain Line H facility is capable of accepting the onsite flows as explained in the memorandum entitled "Preliminary Offsite Hydrology and Hydraulic Study for the Polopolus Project" dated June 24, 2017.

Therefore, biotreatment was chosen as the most feasible treatment option for the project site layout and use. Table 2 (taken from the Riverside County WQMP for Urban Runoff Guidelines) shows the removal efficiency for the various treatment types.

Pollutant of Concern	Biofilters (2)	Detention Basins (3)	Infiltration BMPs (4)	Wet Ponds or Wetlands (5)	Filtration Systems (6)	Water Quality Inlets	Hydrodynamic Separator Systems (7)	Manufactured or Proprietary Devices (8)
Sediment/Turbidity	H/M	M	H/M	H/M	H/M	L	H/M (L for Turbidity)	U
Nutrients	L	M	H/M	H/M	L/M	L	L	U
Organic Compounds	U	U	U	U	H/M	L	L	U
Trash & Debris	L	M	U	U	H/M	M	H/M	U
Oxygen Demanding Substances	L	M	H/M	H/M	H/M	L	L	U
Bacteria & Viruses	U	U	H/M	U	H/M	L	L	U
Oil & Grease	H/M	M	U	U	H/M	M	L/M	U
Pesticides (non-soil bound)	U	U	U	U	U	L	L	U
Metals	H/M	M	H	H	H	L	L	U

Abbreviations:

L: Low removal efficiency H/M: High or medium removal efficiency U: Unknown removal efficiency

Notes:

(1) Periodic performance assessment and updating of the guidance provided by this table may be necessary.

(2) Includes grass swales, grass strips, wetland vegetation swales, and bioretention.

(3) Includes extended/dry detention basins with grass lining and extended/dry detention basins with impervious lining. Effectiveness based upon minimum 36-48-hour drawdown time.

(4) Includes infiltration basins, infiltration trenches, and porous pavements.

(5) Includes permanent pool wet ponds and constructed wetlands.

(6) Includes sand filters and media filters.

(7) Also known as hydrodynamic devices, baffle boxes, swirl concentrators, or cyclone separators.

(8) Includes proprietary stormwater treatment devices as listed in the CASQA Stormwater Best Management Practices Handbooks, other stormwater treatment BMPs not specifically listed in this WQMP, or newly developed/emerging stormwater treatment technologies.

Per the City of Eastvale standards, Modular Wetland systems are an adequate treatment device. These can be installed within the sidewalk and parkway areas and reduce the footprint required for treatment. Table 3 shows the pollutant removal efficiency for the Modular Wetland systems.

Table 3 – Modular Wetland Pollutant Removal Efficiency

TSS	Total Phosphorus	Ortho Phosphorus	Nitrogen	Dissolved Zinc	Dissolved Copper	Total Zinc	Total Copper	Motor Oil
85%	64%	67%	45%	66%	38%	69%	50%	95%

These systems can also be installed with a bypass for larger flows to drain out from the project site without any negative ponding issues at the inlets. The Modular Wetlands brochure is included in Attachment 4.

In conclusion, based on the information presented in this memorandum, the Modular Wetland system will adequately treat the site's runoff to meet the water quality treatment standards required by the Santa Ana Regional Guidelines. Appropriate sizing for the inlet will be completed and coordinated with the manufacturer.

Attachment No. 1: Rational Method Maps – Existing and Proposed Condition
Attachment No. 2: Existing Condition Hydrology – 10 Year and 100 Year
Attachment No. 3: Proposed Condition Hydrology – 10 Year and 100 Year
Attachment No. 4: Modular Wetland Brochure

SITE 2 (APN 152-350-010 & 152-350-011)
EXISTING CONDITION HYDROLOGY

LEGEND

AC / FT	-AREA (AC) -LENGTH (FT)
NODE / ELEV	-NODE NUMBER -ELEVATION (FT)
— — — —	-BOUNDARY
....	-FLOWLINE

N W E S (WEBB)

1" = 40'

20 0 40 80 120

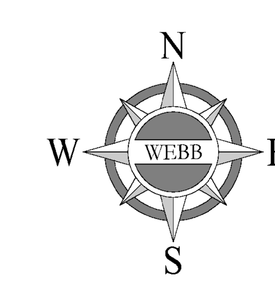
SCALE: 1" = 80' DATE: 3/20/18 DESIGNED: TMG CHECKED: JKA	ALBERT A. WEBB ASSOCIATES ENGINEERING CONSULTANTS 3788 McCRAY STREET RIVERSIDE CA. 92506 PH. (951) 686-1070 FAX (951) 788-1256	TPM 37492 EXISITING HYDROLOGY MAP	W.O. 17-0043 SHEET 1 OF 1 SHEETS
PLN CK REF: F.B.	PLOT DATE: 20-Mar-18	CITY OF EASTVALE	DWG. NO.

G:\2017\17-0043\DRAINAGE\HYD\P-HYD-EX\17-0043-P-HYD-EX SITE 2.DWG 3/20/2018 12:14:29 PM

SITE 2 (APN 152-350-010 & 152-350-011)
PROPOSED CONDITION HYDROLOGY

LEGEND

AC / FT	AREA (AC) / LENGTH (FT)
NODE / ELEV	NODE NUMBER / ELEVATION (FT)
- - - - -	BOUNDARY
———	SUBAREA
———	FLOWLINE



1" = 60'
30 0 60 120 180

SCALE: 1" = 80'	ALBERT A. WEBB ASSOCIATES	ENGINEERING CONSULTANTS 3788 McCRAY STREET RIVERSIDE CA. 92506 PH. (951) 686-1070 FAX (951) 788-1256	TPM 37492 PROPOSED HYDROLOGY MAP	W.O. 17-0043
DATE: 3/20/18				SHEET 1 OF 1 SHEETS
DESIGNED: TMG				
CHECKED: JKA				
PLN CK REF:	PLOT DATE: 20-Mar-18		CITY OF EASTVALE	DWG. NO.
F.B.				

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                    Riverside County Rational Hydrology Program

CIVILCADD/CIVILDESIGN Engineering Software,(c) 1989 - 2005 Version 7.1
        Rational Hydrology Study        Date: 03/20/18  File:100.out
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APN 152-350-011 & 152-350-010 (SITE 2)
10 YEAR RATIONAL METHOD HYDROLOGY
CITY OF EASTVALE, CA
TMG 3/20/2018
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 *********   Hydrology Study Control Information **********

 English (in-lb) Units used in input data file

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Program License Serial Number 4010

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Rational Method Hydrology Program based on
Riverside County Flood Control & Water Conservation District
1978 hydrology manual

Storm event (year) =   10.00 Antecedent Moisture Condition = 2

Standard intensity-duration curves data (Plate D-4.1)
For the [ Norco ] area used.
10 year storm 10 minute intensity =  1.960(In/Hr)
10 year storm 60 minute intensity =  0.800(In/Hr)
100 year storm 10 minute intensity =  2.940(In/Hr)
100 year storm 60 minute intensity =  1.200(In/Hr)

Storm event year =  10.0
Calculated rainfall intensity data:
1 hour intensity =  0.800(In/Hr)
Slope of intensity duration curve = 0.5000




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Process from Point/Station      100.000 to Point/Station      101.000
**** INITIAL AREA EVALUATION ****
______________________________________________________________________
Initial area flow distance =   398.000(Ft.)
Top (of initial area) elevation =   631.000(Ft.)
Bottom (of initial area) elevation =   628.000(Ft.)
Difference in elevation =     3.000(Ft.)
Slope =    0.00754  s(percent)=       0.75
TC = k(0.530)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration =   15.445 min.
Rainfall intensity =      1.577(In/Hr) for a    10.0 year storm
UNDEVELOPED (poor cover) subarea
Runoff Coefficient = 0.727
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 1.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
RI index for soil(AMC 2)  =  78.00
Pervious area fraction =  1.000; Impervious fraction =  0.000
Initial subarea runoff =      2.406(CFS)
Total initial stream area =        2.100(Ac.)
Pervious area fraction = 1.000


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Process from Point/Station      101.000 to Point/Station      102.000
**** STREET FLOW TRAVEL TIME + SUBAREA FLOW ADDITION ****
______________________________________________________________________
Top of street segment elevation =   628.000(Ft.)
End of street segment elevation =   626.000(Ft.)
Length of street segment  =   335.000(Ft.)
Height of curb above gutter flowline  =    8.0(In.)
Width of half street (curb to crown)  =  55.000(Ft.)
Distance from crown to crossfall grade break  =  18.000(Ft.)
Slope from gutter to grade break (v/hz) =   0.020
Slope from grade break to crown (v/hz)  =   0.020
Street flow is on [1] side(s) of the street
Distance from curb to property line  =  21.000(Ft.)
Slope from curb to property line (v/hz) =   0.020
Gutter width =   2.000(Ft.)
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Gutter hike from flowline =  2.000(In.)
 Manning's N in gutter =  0.0150
 Manning's N from gutter to grade break =  0.0150
 Manning's N from grade break to crown =  0.0150
Estimated mean flow rate at midpoint of street =      2.406(CFS)
Depth of flow =   0.345(Ft.), Average velocity =   1.830(Ft/s)
Streetflow hydraulics at midpoint of street travel:
Halfstreet flow width =  10.902(Ft.)
Flow velocity =   1.83(Ft/s)
Travel time =    3.05 min.     TC =   18.50  min.
 Adding area flow to street
COMMERCIAL subarea type
Runoff Coefficient = 0.862
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 1.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
RI index for soil(AMC 2)  =  56.00
Pervious area fraction =  0.100; Impervious fraction =  0.900
Rainfall intensity =      1.441(In/Hr) for a    10.0 year storm
Subarea runoff =      0.000(CFS) for      0.000(Ac.)
Total runoff =      2.406(CFS)  Total area =       2.100(Ac.)
Street flow at end of street =      2.406(CFS)
Half street flow at end of street =      2.406(CFS)
Depth of flow =   0.345(Ft.), Average velocity =   1.830(Ft/s)
Flow width (from curb towards crown)=  10.902(Ft.)


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Process from Point/Station      102.000 to Point/Station      102.000
**** CONFLUENCE OF MINOR STREAMS ****
______________________________________________________________________
Along Main Stream number: 1 in normal stream number 1
Stream flow area =      2.100(Ac.)
Runoff from this stream =      2.406(CFS)
Time of concentration =   18.50 min.
Rainfall intensity =     1.441(In/Hr)


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Process from Point/Station      103.000 to Point/Station      102.000
**** INITIAL AREA EVALUATION ****
______________________________________________________________________
Initial area flow distance =   426.000(Ft.)
Top (of initial area) elevation =   629.000(Ft.)
Bottom (of initial area) elevation =   626.000(Ft.)
Difference in elevation =     3.000(Ft.)
Slope =    0.00704  s(percent)=       0.70
TC = k(0.300)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration =    9.106 min.
Rainfall intensity =      2.053(In/Hr) for a    10.0 year storm
COMMERCIAL subarea type
Runoff Coefficient = 0.870
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 1.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
RI index for soil(AMC 2)  =  56.00
Pervious area fraction =  0.100; Impervious fraction =  0.900
Initial subarea runoff =      3.929(CFS)
Total initial stream area =       2.200(Ac.)
Pervious area fraction = 0.100


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Process from Point/Station      102.000 to Point/Station      102.000
**** CONFLUENCE OF MINOR STREAMS ****
______________________________________________________________________
Along Main Stream number: 1 in normal stream number 2
Stream flow area =      2.200(Ac.)
Runoff from this stream =      3.929(CFS)
Time of concentration =    9.11 min.
Rainfall intensity =     2.053(In/Hr)
Summary of stream data:

Stream   Flow rate      TC           Rainfall Intensity
 No.       (CFS)       (min)                (In/Hr)


1        2.406     18.50                 1.441
2        3.929      9.11                 2.053
Largest stream flow has longer or shorter time of concentration
Qp =      3.929 + sum of
          Qa          Tb/Ta
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          2.406 *    0.492 =      1.185
Qp =      5.113

Total of 2 streams to confluence:
Flow rates before confluence point:
       2.406       3.929
Area of streams before confluence:
        2.100       2.200
Results of confluence:
Total flow rate =      5.113(CFS)
Time of concentration =     9.106 min.
Effective stream area after confluence =      4.300(Ac.)
End of computations, total study area =           4.30 (Ac.)
The following figures may
be used for a unit hydrograph study of the same area.

Area averaged pervious area fraction(Ap) = 0.540
Area averaged RI index number =  66.7
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                Riverside County Rational Hydrology Program

CIVILCADD/CIVILDESIGN Engineering Software,(c) 1989 - 2005 Version 7.1
        Rational Hydrology Study        Date: 03/19/18  File:100.out
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APN 152-350-011 & 152-350-010 (SITE 2)
100 YEAR RATIONAL METHOD HYDROLOGY
CITY OF EASTVALE, CA
TMG 3/19/2018
------------------------------------------------------------------------
 *********   Hydrology Study Control Information **********

 English (in-lb) Units used in input data file

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Program License Serial Number 4010

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Rational Method Hydrology Program based on
Riverside County Flood Control & Water Conservation District
1978 hydrology manual

Storm event (year) =  100.00 Antecedent Moisture Condition = 2

Standard intensity-duration curves data (Plate D-4.1)
For the [ Norco ] area used.
10 year storm 10 minute intensity =  1.960(In/Hr)
10 year storm 60 minute intensity =  0.800(In/Hr)
100 year storm 10 minute intensity =  2.940(In/Hr)
100 year storm 60 minute intensity =  1.200(In/Hr)

Storm event year = 100.0
Calculated rainfall intensity data:
1 hour intensity =  1.200(In/Hr)
Slope of intensity duration curve = 0.5000




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Process from Point/Station      100.000 to Point/Station      101.000
**** INITIAL AREA EVALUATION ****
______________________________________________________________________
Initial area flow distance =   398.000(Ft.)
Top (of initial area) elevation =   631.000(Ft.)
Bottom (of initial area) elevation =   628.000(Ft.)
Difference in elevation =     3.000(Ft.)
Slope =    0.00754  s(percent)=       0.75
TC = k(0.530)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration =   15.445 min.
Rainfall intensity =      2.365(In/Hr) for a   100.0 year storm
UNDEVELOPED (poor cover) subarea
Runoff Coefficient = 0.777
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 1.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
RI index for soil(AMC 2)  =  78.00
Pervious area fraction =  1.000; Impervious fraction =  0.000
Initial subarea runoff =      3.857(CFS)
Total initial stream area =        2.100(Ac.)
Pervious area fraction = 1.000


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Process from Point/Station      101.000 to Point/Station      102.000
**** STREET FLOW TRAVEL TIME + SUBAREA FLOW ADDITION ****
______________________________________________________________________
Top of street segment elevation =   628.000(Ft.)
End of street segment elevation =   627.000(Ft.)
Length of street segment  =   335.000(Ft.)
Height of curb above gutter flowline  =    8.0(In.)
Width of half street (curb to crown)  =  55.000(Ft.)
Distance from crown to crossfall grade break  =  18.000(Ft.)
Slope from gutter to grade break (v/hz) =    0.020
Slope from grade break to crown (v/hz)  =    0.020
Street flow is on [1] side(s) of the street
Distance from curb to property line  =  21.000(Ft.)
Slope from curb to property line (v/hz) =    0.020
Gutter width =   2.000(Ft.)
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Gutter hike from flowline =  2.000(In.)
 Manning's N in gutter =  0.0150
 Manning's N from gutter to grade break =  0.0150
 Manning's N from grade break to crown =  0.0150
Estimated mean flow rate at midpoint of street =      3.857(CFS)
Depth of flow =   0.432(Ft.), Average velocity =   1.571(Ft/s)
Streetflow hydraulics at midpoint of street travel:
Halfstreet flow width =  15.259(Ft.)
Flow velocity =   1.57(Ft/s)
Travel time =    3.55 min.     TC =   19.00  min.
 Adding area flow to street
COMMERCIAL subarea type
Runoff Coefficient = 0.870
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 1.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
RI index for soil(AMC 2)  =  56.00
Pervious area fraction =  0.100; Impervious fraction =  0.900
Rainfall intensity =      2.133(In/Hr) for a   100.0 year storm
Subarea runoff =      0.000(CFS) for      0.000(Ac.)
Total runoff =      3.857(CFS)  Total area =       2.100(Ac.)
Street flow at end of street =      3.857(CFS)
Half street flow at end of street =      3.857(CFS)
Depth of flow =   0.432(Ft.), Average velocity =   1.571(Ft/s)
Flow width (from curb towards crown)=  15.259(Ft.)


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Process from Point/Station      102.000 to Point/Station      102.000
**** CONFLUENCE OF MINOR STREAMS ****
______________________________________________________________________
Along Main Stream number: 1 in normal stream number 1
Stream flow area =      2.100(Ac.)
Runoff from this stream =      3.857(CFS)
Time of concentration =   19.00 min.
Rainfall intensity =     2.133(In/Hr)


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Process from Point/Station      103.000 to Point/Station      102.000
**** INITIAL AREA EVALUATION ****
______________________________________________________________________
Initial area flow distance =   426.000(Ft.)
Top (of initial area) elevation =   629.000(Ft.)
Bottom (of initial area) elevation =   627.000(Ft.)
Difference in elevation =     2.000(Ft.)
Slope =    0.00469  s(percent)=       0.47
TC = k(0.300)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration =    9.876 min.
Rainfall intensity =      2.958(In/Hr) for a   100.0 year storm
COMMERCIAL subarea type
Runoff Coefficient = 0.876
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 1.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
RI index for soil(AMC 2)  =  56.00
Pervious area fraction =  0.100; Impervious fraction =  0.900
Initial subarea runoff =      5.703(CFS)
Total initial stream area =       2.200(Ac.)
Pervious area fraction = 0.100


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Process from Point/Station      102.000 to Point/Station      102.000
**** CONFLUENCE OF MINOR STREAMS ****
______________________________________________________________________
Along Main Stream number: 1 in normal stream number 2
Stream flow area =      2.200(Ac.)
Runoff from this stream =      5.703(CFS)
Time of concentration =    9.88 min.
Rainfall intensity =     2.958(In/Hr)
Summary of stream data:

Stream   Flow rate      TC           Rainfall Intensity
 No.       (CFS)       (min)                (In/Hr)


1        3.857     19.00                 2.133
2        5.703      9.88                 2.958
Largest stream flow has longer or shorter time of concentration
Qp =      5.703 + sum of
          Qa          Tb/Ta
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          3.857 *    0.520 =      2.005
Qp =      7.708

Total of 2 streams to confluence:
Flow rates before confluence point:
       3.857       5.703
Area of streams before confluence:
        2.100        2.200
Results of confluence:
Total flow rate =      7.708(CFS)
Time of concentration =     9.876 min.
Effective stream area after confluence =      4.300(Ac.)
End of computations, total study area =           4.30 (Ac.)
The following figures may
be used for a unit hydrograph study of the same area.

Area averaged pervious area fraction(Ap) = 0.540
Area averaged RI index number =  66.7
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                Riverside County Rational Hydrology Program

CIVILCADD/CIVILDESIGN Engineering Software,(c) 1989 - 2005 Version 7.1
        Rational Hydrology Study        Date: 03/20/18  File:100.out
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APN 152-350-011 & 152-350-010 (SITE 2)
10 YEAR RATIONAL METHOD HYDROLOGY
CITY OF EASTVALE, CA
TMG 3/20/2018
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 *********   Hydrology Study Control Information **********

 English (in-lb) Units used in input data file

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Program License Serial Number 4010

------------------------------------------------------------------------
Rational Method Hydrology Program based on
Riverside County Flood Control & Water Conservation District
1978 hydrology manual

Storm event (year) =   10.00 Antecedent Moisture Condition = 2

Standard intensity-duration curves data (Plate D-4.1)
For the [ Norco ] area used.
10 year storm 10 minute intensity =  1.960(In/Hr)
10 year storm 60 minute intensity =  0.800(In/Hr)
100 year storm 10 minute intensity =  2.940(In/Hr)
100 year storm 60 minute intensity =  1.200(In/Hr)

Storm event year =  10.0
Calculated rainfall intensity data:
1 hour intensity =  0.800(In/Hr)
Slope of intensity duration curve = 0.5000




++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      100.000 to Point/Station      101.000
**** INITIAL AREA EVALUATION ****
______________________________________________________________________
Initial area flow distance =   340.000(Ft.)
Top (of initial area) elevation =   631.000(Ft.)
Bottom (of initial area) elevation =   628.000(Ft.)
Difference in elevation =     3.000(Ft.)
Slope =    0.00882  s(percent)=       0.88
TC = k(0.300)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration =    7.954 min.
Rainfall intensity =      2.197(In/Hr) for a    10.0 year storm
COMMERCIAL subarea type
Runoff Coefficient = 0.871
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 1.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
RI index for soil(AMC 2)  =  56.00
Pervious area fraction =  0.100; Impervious fraction =  0.900
Initial subarea runoff =      4.019(CFS)
Total initial stream area =        2.100(Ac.)
Pervious area fraction = 0.100


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      101.000 to Point/Station      104.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****
______________________________________________________________________
Upstream point/station elevation =   622.000(Ft.)
Downstream point/station elevation =   618.500(Ft.)
Pipe length  =   355.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =     4.019(CFS)
Nearest computed pipe diameter  =     15.00(In.)
Calculated individual pipe flow  =     4.019(CFS)
Normal flow depth in pipe =    8.60(In.)
Flow top width inside pipe =   14.84(In.)
Critical Depth =    9.74(In.)
Pipe flow velocity =      5.52(Ft/s)
Travel time through pipe =    1.07 min.
Time of concentration (TC) =     9.03 min.
```

```
++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      104.000 to Point/Station      104.000
**** CONFLUENCE OF MINOR STREAMS ****
______________________________________________________________________
Along Main Stream number: 1 in normal stream number 1
Stream flow area =      2.100(Ac.)
Runoff from this stream =      4.019(CFS)
Time of concentration =    9.03 min.
Rainfall intensity =     2.063(In/Hr)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      102.000 to Point/Station      103.000
**** INITIAL AREA EVALUATION ****
______________________________________________________________________
Initial area flow distance =   364.000(Ft.)
Top (of initial area) elevation =   629.000(Ft.)
Bottom (of initial area) elevation =   626.000(Ft.)
Difference in elevation =     3.000(Ft.)
Slope =    0.00824  s(percent)=       0.82
TC = k(0.300)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration =    8.286 min.
Rainfall intensity =      2.153(In/Hr) for a    10.0 year storm
COMMERCIAL subarea type
Runoff Coefficient = 0.871
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 1.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
RI index for soil(AMC 2)  =  56.00
Pervious area fraction =  0.100; Impervious fraction =  0.900
Initial subarea runoff =      4.123(CFS)
Total initial stream area =        2.200(Ac.)
Pervious area fraction = 0.100


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      103.000 to Point/Station      104.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****
______________________________________________________________________
Upstream point/station elevation =   622.000(Ft.)
Downstream point/station elevation =   618.500(Ft.)
Pipe length  =    27.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =     4.123(CFS)
Nearest computed pipe diameter  =      9.00(In.)
Calculated individual pipe flow  =     4.123(CFS)
Normal flow depth in pipe =    5.51(In.)
Flow top width inside pipe =    8.77(In.)
Critical depth could not be calculated.
Pipe flow velocity =     14.55(Ft/s)
Travel time through pipe =    0.03 min.
Time of concentration (TC) =     8.32 min.


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      104.000 to Point/Station      104.000
**** CONFLUENCE OF MINOR STREAMS ****
______________________________________________________________________
Along Main Stream number: 1 in normal stream number 2
Stream flow area =      2.200(Ac.)
Runoff from this stream =      4.123(CFS)
Time of concentration =    8.32 min.
Rainfall intensity =     2.149(In/Hr)
Summary of stream data:

Stream   Flow rate      TC            Rainfall Intensity
 No.       (CFS)       (min)                 (In/Hr)


1        4.019      9.03                 2.063
2        4.123      8.32                 2.149
Largest stream flow has longer or shorter time of concentration
Qp =      4.123 + sum of
          Qa           Tb/Ta
           4.019 *    0.921 =      3.703
Qp =      7.826

Total of 2 streams to confluence:
Flow rates before confluence point:
       4.019       4.123
Area of streams before confluence:
        2.100        2.200
```

```
Results of confluence:
Total flow rate =      7.826(CFS)
Time of concentration =     8.317 min.
Effective stream area after confluence =      4.300(Ac.)
End of computations, total study area =           4.30 (Ac.)
The following figures may
be used for a unit hydrograph study of the same area.

Area averaged pervious area fraction(Ap) = 0.100
Area averaged RI index number =  56.0
```

```
               Riverside County Rational Hydrology Program

CIVILCADD/CIVILDESIGN Engineering Software,(c) 1989 - 2005 Version 7.1
        Rational Hydrology Study        Date: 03/20/18  File:100.out
------------------------------------------------------------------------
APN 152-350-011 & 152-350-010 (SITE 2)
100 YEAR RATIONAL METHOD HYDROLOGY
CITY OF EASTVALE, CA
TMG 3/20/2018
------------------------------------------------------------------------
 *********   Hydrology Study Control Information **********

 English (in-lb) Units used in input data file

------------------------------------------------------------------------


Program License Serial Number 4010

------------------------------------------------------------------------
Rational Method Hydrology Program based on
Riverside County Flood Control & Water Conservation District
1978 hydrology manual

Storm event (year) =  100.00 Antecedent Moisture Condition = 2

Standard intensity-duration curves data (Plate D-4.1)
For the [ Norco ] area used.
10 year storm 10 minute intensity =  1.960(In/Hr)
10 year storm 60 minute intensity =  0.800(In/Hr)
100 year storm 10 minute intensity =  2.940(In/Hr)
100 year storm 60 minute intensity =  1.200(In/Hr)

Storm event year = 100.0
Calculated rainfall intensity data:
1 hour intensity =  1.200(In/Hr)
Slope of intensity duration curve = 0.5000




++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      100.000 to Point/Station      101.000
**** INITIAL AREA EVALUATION ****
______________________________________________________________________
Initial area flow distance =   340.000(Ft.)
Top (of initial area) elevation =   631.000(Ft.)
Bottom (of initial area) elevation =   628.000(Ft.)
Difference in elevation =     3.000(Ft.)
Slope =    0.00882  s(percent)=       0.88
TC = k(0.300)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration =    7.954 min.
Rainfall intensity =      3.296(In/Hr) for a   100.0 year storm
COMMERCIAL subarea type
Runoff Coefficient = 0.878
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 1.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
RI index for soil(AMC 2)  =  56.00
Pervious area fraction =  0.100; Impervious fraction =  0.900
Initial subarea runoff =      6.079(CFS)
Total initial stream area =        2.100(Ac.)
Pervious area fraction = 0.100


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      101.000 to Point/Station      104.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****
______________________________________________________________________
Upstream point/station elevation =   622.000(Ft.)
Downstream point/station elevation =   618.500(Ft.)
Pipe length  =   355.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =      6.079(CFS)
Nearest computed pipe diameter  =     15.00(In.)
Calculated individual pipe flow  =     6.079(CFS)
Normal flow depth in pipe =   11.65(In.)
Flow top width inside pipe =   12.50(In.)
Critical Depth =   11.96(In.)
Pipe flow velocity =      5.95(Ft/s)
Travel time through pipe =    0.99 min.
Time of concentration (TC) =     8.95 min.
```

```
++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      104.000 to Point/Station      104.000
**** CONFLUENCE OF MINOR STREAMS ****
______________________________________________________________________
Along Main Stream number: 1 in normal stream number 1
Stream flow area =      2.100(Ac.)
Runoff from this stream =      6.079(CFS)
Time of concentration =    8.95 min.
Rainfall intensity =     3.107(In/Hr)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      102.000 to Point/Station      103.000
**** INITIAL AREA EVALUATION ****
______________________________________________________________________
Initial area flow distance =   364.000(Ft.)
Top (of initial area) elevation =   629.000(Ft.)
Bottom (of initial area) elevation =   626.000(Ft.)
Difference in elevation =     3.000(Ft.)
Slope =    0.00824  s(percent)=       0.82
TC = k(0.300)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration =    8.286 min.
Rainfall intensity =      3.229(In/Hr) for a   100.0 year storm
COMMERCIAL subarea type
Runoff Coefficient = 0.878
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 1.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
RI index for soil(AMC 2)  =  56.00
Pervious area fraction =  0.100; Impervious fraction =  0.900
Initial subarea runoff =      6.237(CFS)
Total initial stream area =        2.200(Ac.)
Pervious area fraction = 0.100


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      103.000 to Point/Station      104.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****
______________________________________________________________________
Upstream point/station elevation =   622.000(Ft.)
Downstream point/station elevation =   618.500(Ft.)
Pipe length  =    27.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =     6.237(CFS)
Nearest computed pipe diameter  =     12.00(In.)
Calculated individual pipe flow  =     6.237(CFS)
Normal flow depth in pipe =    5.90(In.)
Flow top width inside pipe =   12.00(In.)
Critical depth could not be calculated.
Pipe flow velocity =     16.22(Ft/s)
Travel time through pipe =    0.03 min.
Time of concentration (TC) =     8.31 min.


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      104.000 to Point/Station      104.000
**** CONFLUENCE OF MINOR STREAMS ****
______________________________________________________________________
Along Main Stream number: 1 in normal stream number 2
Stream flow area =      2.200(Ac.)
Runoff from this stream =      6.237(CFS)
Time of concentration =    8.31 min.
Rainfall intensity =     3.224(In/Hr)
Summary of stream data:

Stream   Flow rate      TC            Rainfall Intensity
 No.       (CFS)       (min)                 (In/Hr)


1        6.079      8.95                 3.107
2        6.237      8.31                 3.224
Largest stream flow has longer or shorter time of concentration
Qp =      6.237 + sum of
          Qa          Tb/Ta
           6.079 *    0.929 =      5.648
Qp =     11.885

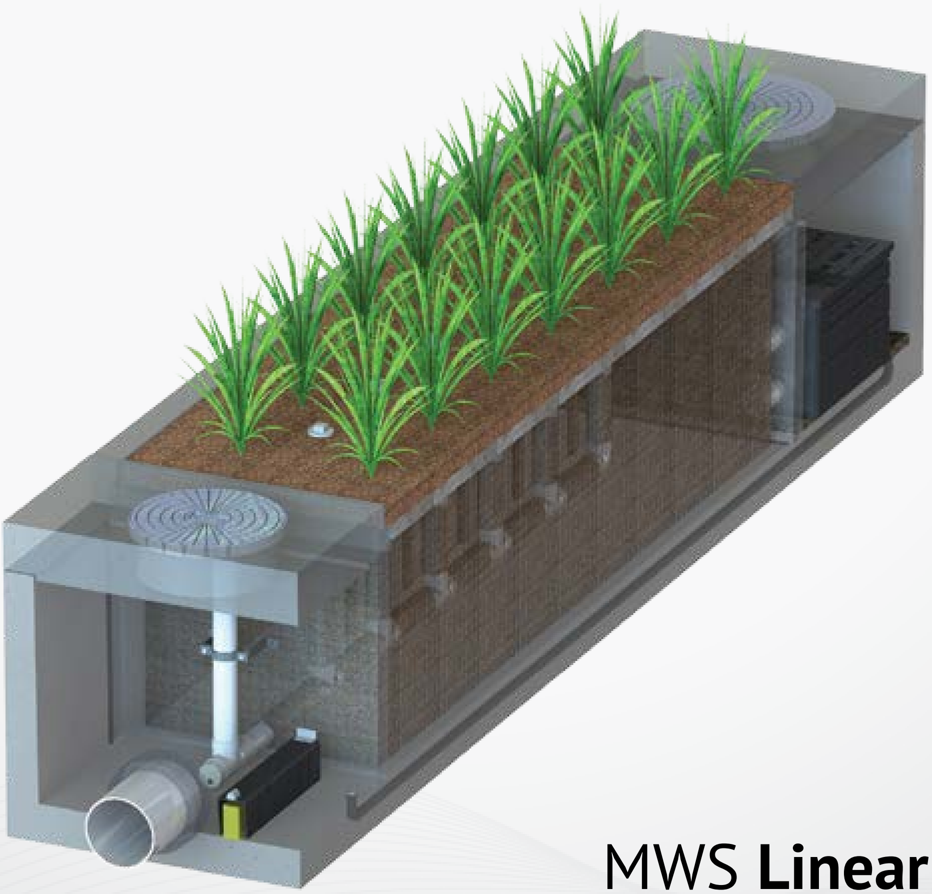
Total of 2 streams to confluence:
Flow rates before confluence point:
       6.079       6.237
Area of streams before confluence:
        2.100        2.200
```

```
Results of confluence:
Total flow rate =     11.885(CFS)
Time of concentration =     8.314 min.
Effective stream area after confluence =      4.300(Ac.)
End of computations, total study area =           4.30 (Ac.)
The following figures may
be used for a unit hydrograph study of the same area.

Area averaged pervious area fraction(Ap) = 0.100
Area averaged RI index number =  56.0
```

MODULAR WETLANDS™

*Advanced **Stormwater** Biofiltration*



MWS **Linear**

Contents

The Urban Impact

For hundreds of years natural wetlands surrounding our shores have played an integral role as nature's stormwater treatment system. But as our cities grow and develop, these natural wetlands have perished under countless roads, rooftops, and parking lots.

Plant A Wetland

Without natural wetlands our cities are deprived of water purification, flood control, and land stability. Modular Wetlands and the MWS Linear re-establish nature's presence and rejuvenate water ways in urban areas.

MWS **Linear**

The Modular Wetland System Linear represents a pioneering breakthrough in stormwater technology as the only biofiltration system to utilize patented horizontal flow, allowing for a smaller footprint and higher treatment capacity. While most biofilters use little or no pre-treatment, the MWS Linear incorporates an advanced pre-treatment chamber that includes separation and pre-filter cartridges. In this chamber sediment and hydrocarbons are removed from runoff before it enters the biofiltration chamber, in turn reducing maintenance costs and improving performance.

Applications

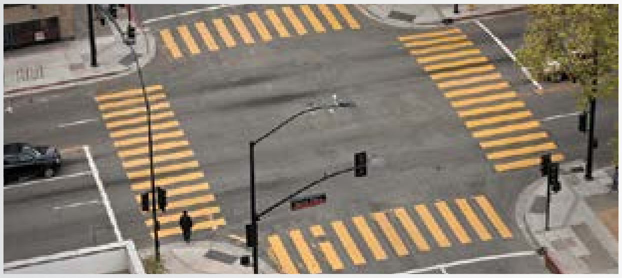
The MWS Linear has been successfully used on numerous new construction and retrofit projects. The system's superior versatility makes it beneficial for a wide range of stormwater and waste water applications - treating rooftops, streetscapes, parking lots, and industrial sites.

Industrial

Many states enforce strict regulations for discharges from industrial sites. The MWS Linear has helped various sites meet difficult EPA mandated effluent limits for dissolved metals and other pollutants.

Residential

Low to high density developments can benefit from the versatile design of the MWS Linear. The system can be used in both decentralized LID design and cost-effective end-of-the-line configurations.



Streets

Street applications can be challenging due to limited space. The MWS Linear is very adaptable, and offers the smallest footprint to work around the constraints of existing utilities on retrofit projects.

Parking Lots

Parking lots are designed to maximize space and the MWS Linear's 4 ft. standard planter width allows for easy integration into parking lot islands and other landscape medians.

Commercial

Compared to bioretention systems, the MWS Linear can treat far more area in less space - meeting treatment and volume control requirements.

Mixed Use

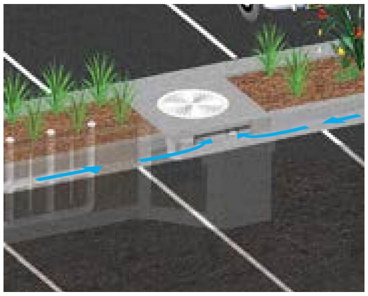
The MWS Linear can be installed as a raised planter to treat runoff from rooftops or patios, making it perfect for sustainable "live-work" spaces.

More applications are available on our website: www.ModularWetlands.com/Applications

- Agriculture
- Reuse
- Low Impact Development
- Waste Water

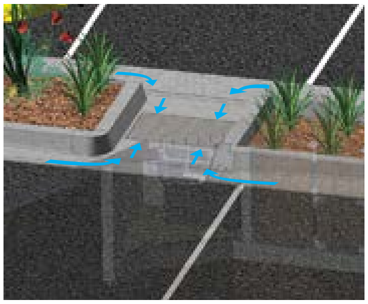
Configurations

The MWS Linear is the preferred biofiltration system of Civil Engineers across the country due to its versatile design. This highly versatile system has available "pipe-in" options on most models, along with built-in curb or grated inlets for simple integration into your stormdrain design.



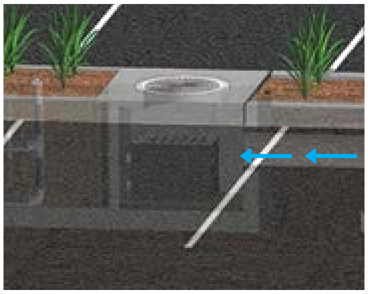
Curb Type

The *Curb Type* configuration accepts sheet flow through a curb opening and is commonly used along road ways and parking lots. It can be used in sump or flow by conditions. Length of curb opening varies based on model and size.



Grate Type

The *Grate Type* configuration offers the same features and benefits as the *Curb Type* but with a grated/drop inlet above the systems pre-treatment chamber. It has the added benefit of allowing for pedestrian access over the inlet. ADA compliant grates are available to assure easy and safe access. The *Grate Type* can also be used in scenarios where runoff needs to be intercepted on both sides of landscape islands.



Vault Type

The system's patented horizontal flow biofilter is able to accept inflow pipes directly into the pre-treatment chamber, meaning the MWS Linear can be used in end-of-the-line installations. This greatly improves feasibility over typical decentralized designs that are required with other biofiltration/bioretention systems. Another benefit of the "pipe in" design is the ability to install the system downstream of underground detention systems to meet water quality volume requirements.

Downspout Type

The *Downspout Type* is a variation of the *Vault Type* and is designed to accept a vertical downspout pipe from roof top and podium areas. Some models have the option of utilizing an internal bypass, simplifying the overall design. The system can be installed as a raised planter and the exterior can be stuccoed or covered with other finishes to match the look of adjacent buildings.

Advantages & Operation

The MWS Linear is the most efficient and versatile biofiltration system on the market, and the only system with horizontal flow which improves performance, reduces footprint, and minimizes maintenance. Figure-1 and Figure-2 illustrate the invaluable benefits of horizontal flow and the multiple treatment stages.

Featured Advantages

- Horizontal Flow Biofiltration
- Greater Filter Surface Area
- Pre-Treatment Chamber
- Patented Perimeter Void Area
- Flow Control
- No Depressed Planter Area

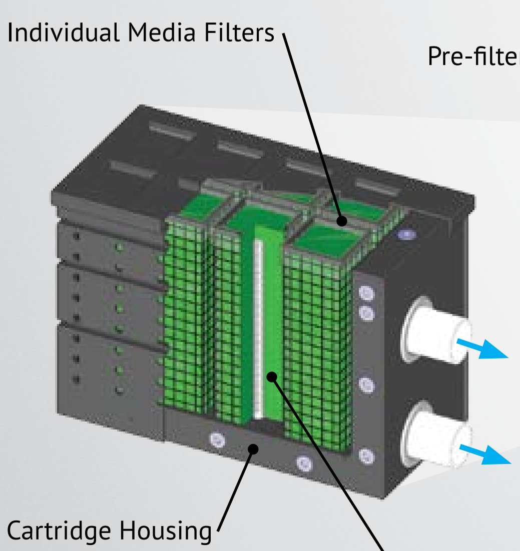
1 Pre-Treatment

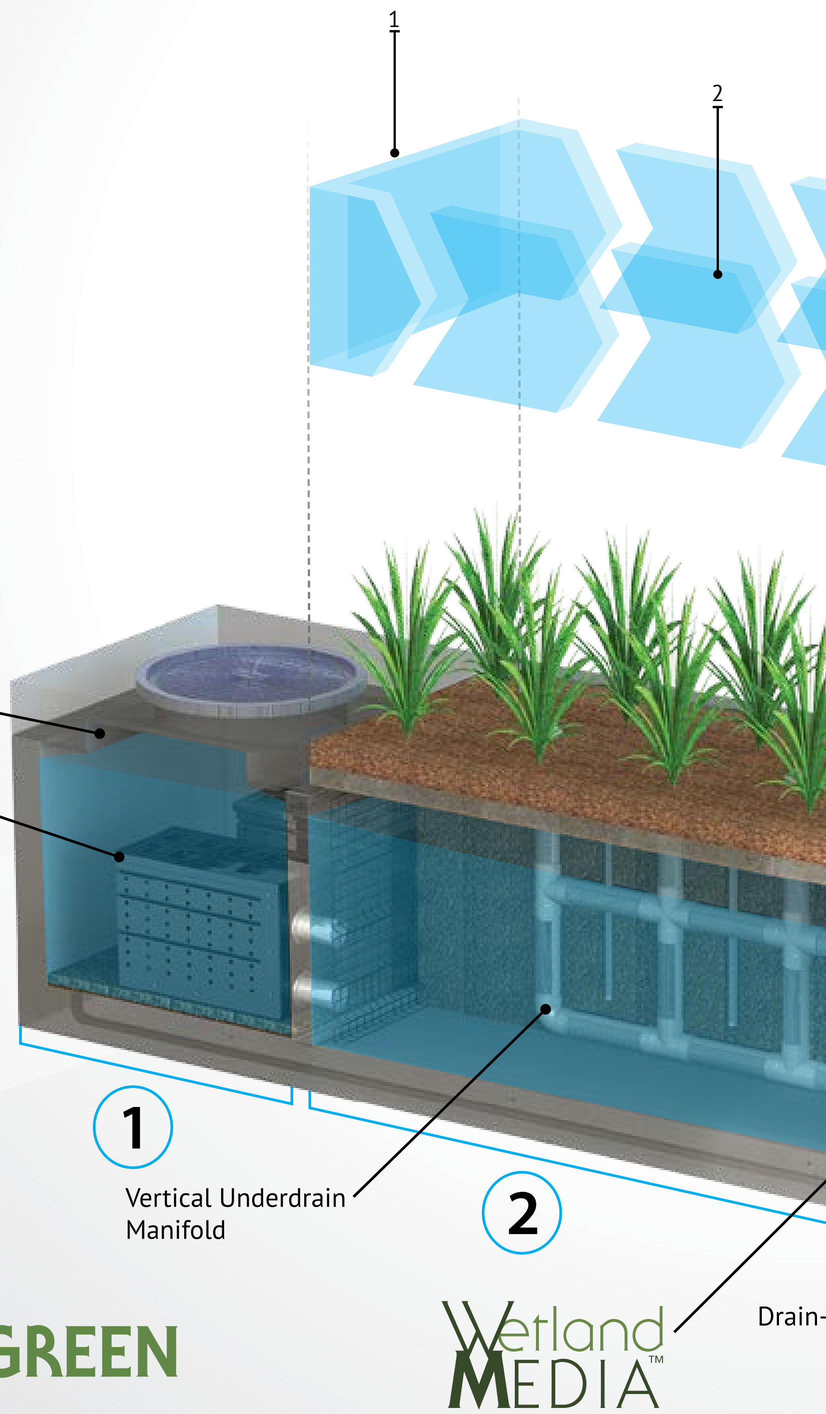
Separation

- Trash, sediment, and debris are separated before entering the pre-filter cartridges
- Designed for easy maintenance access

Pre-Filter Cartridges

- Over 25 ft^2 of surface area per cartridge
- Utilizes BioMediaGREEN filter material
- Removes over 80% of TSS & 90% of hydrocarbons
- Prevents pollutants that cause clogging from migrating to the biofiltration chamber





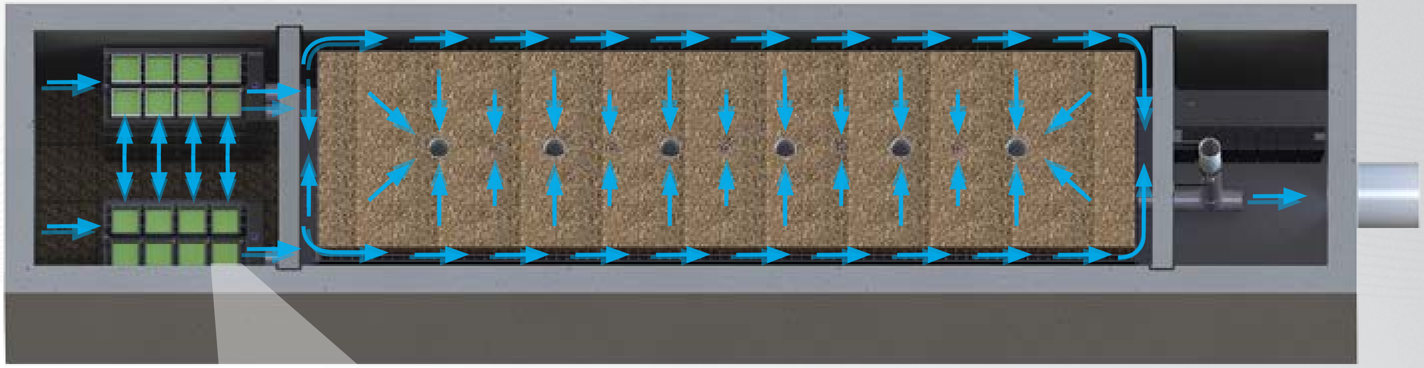
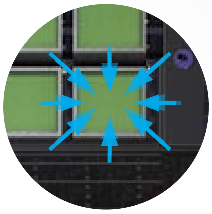


Fig. 2 - Top View

2x to 3x More Surface Area Than Traditional Downward Flow Bioretention Systems.



2 Biofiltration

Horizontal Flow

- Less clogging than downward flow biofilters
- Water flow is subsurface
- Improves biological filtration

Patented Perimeter Void Area

- Vertically extends void area between the walls and the WetlandMEDIA on all four sides.
- Maximizes surface area of the media for higher treatment capacity

WetlandMEDIA

- Contains no organics and removes phosphorus
- Greater surface area and 48% void space
- Maximum evapotranspiration
- High ion exchange capacity and light weight

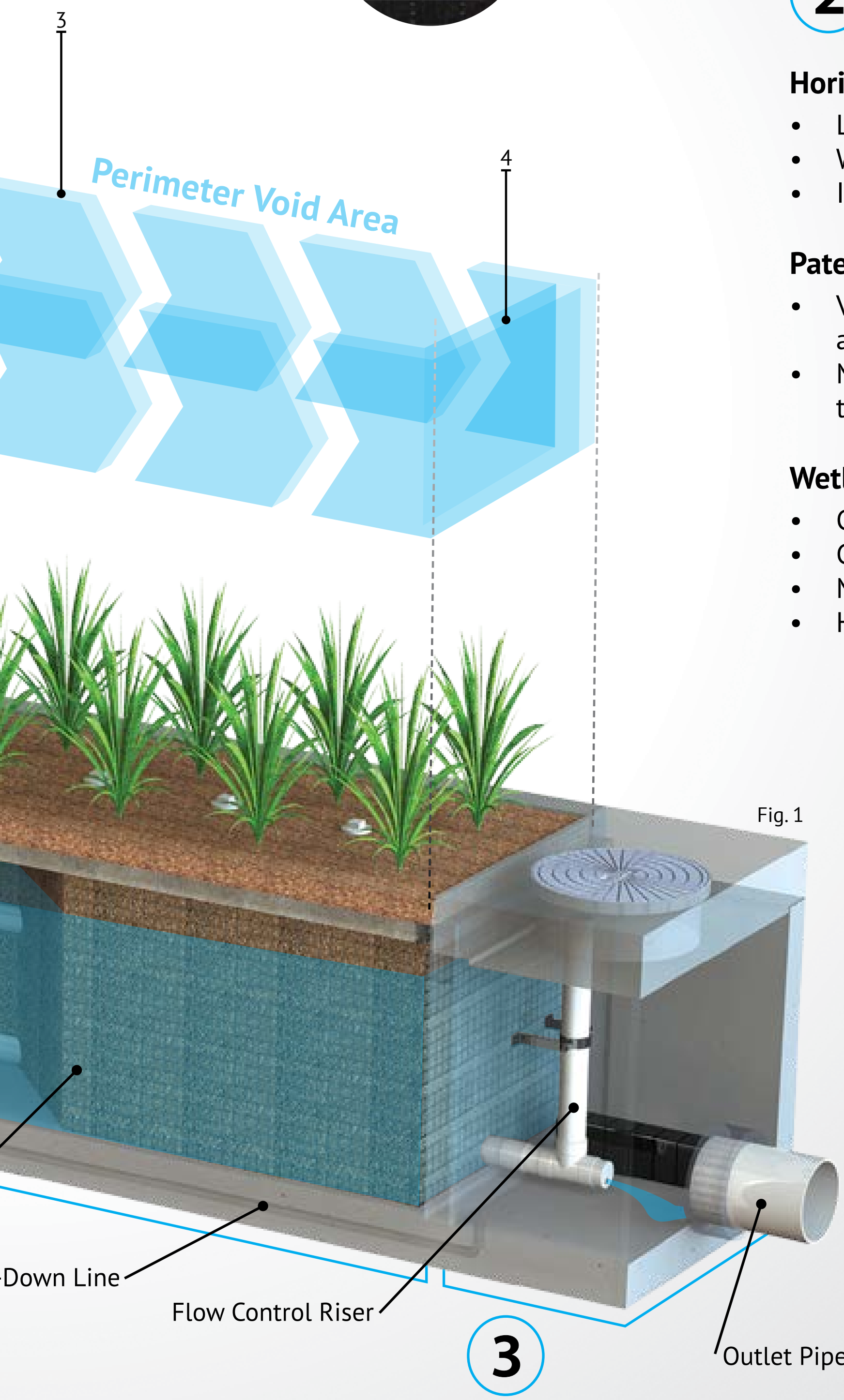


Fig. 1

3 Discharge

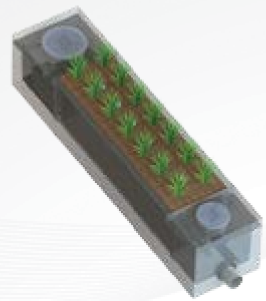
Flow Control

- Orifice plate controls flow of water through WetlandMEDIA to a level lower than the media's capacity.
- Extends the life of the media and improves performance

Drain-Down Filter

- The Drain-Down is an optional feature that completely drains the pre-treatment chamber
- Water that drains from the pre-treatment chamber between storm events will be treated

Orientations



Side-By-Side

The *Side-By-Side* orientation places the pre-treatment and discharge chamber adjacent to one another with the biofiltration chamber running parallel on either side. This minimizes the system length, providing a highly compact footprint. It has been proven useful in situations such as streets with directly adjacent sidewalks, as half of the system can be placed under that sidewalk. This orientation also offers internal bypass options as discussed below.

End-To-End

The *End-To-End* orientation places the pre-treatment and discharge chambers on opposite ends of the biofiltration chamber therefore minimizing the width of the system to 5 ft (outside dimension). This orientation is perfect for linear projects and street retrofits where existing utilities and sidewalks limit the amount of space available for installation. One limitation of this orientation is bypass must be external.

Bypass

Internal Bypass Weir (Side-by-Side Only)

The *Side-By-Side* orientation places the pre-treatment and discharge chambers adjacent to one another allowing for integration of internal bypass. The wall between these chambers can act as a bypass weir when flows exceed the system's treatment capacity, thus allowing bypass from the pre-treatment chamber directly to the discharge chamber.

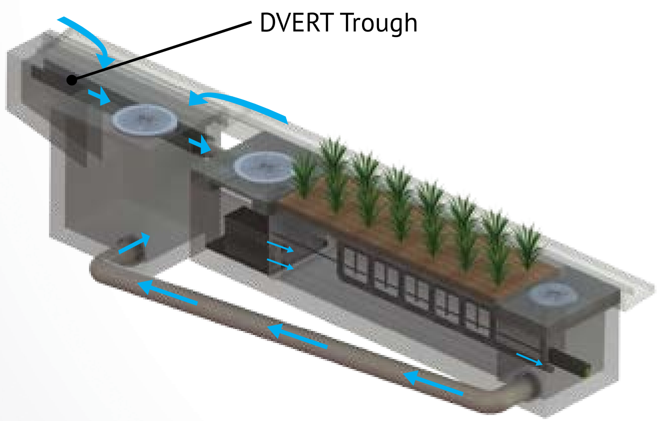
External Diversion Weir Structure

This traditional offline diversion method can be used with the MWS Linear in scenarios where runoff is being piped to the system. These simple and effective structures are generally configured with two outflow pipes. The first is a smaller pipe on the upstream side of the diversion weir - to divert low flows over to the MWS Linear for treatment. The second is the main pipe that receives water once the system has exceeded treatment capacity and water flows over the weir.

Flow By Design

This method is one in which the system is placed just upstream of a standard curb or grate inlet to intercept the first flush. Higher flows simply pass by the MWS Linear and into the standard inlet downstream.

DVERT Low Flow Diversion



This simple yet innovative diversion trough can be installed in existing or new curb and grate inlets to divert the first flush to the MWS Linear via pipe. It works similar to a rain gutter and is installed just below the opening into the inlet. It captures the low flows and channels them over to a connecting pipe exiting out the wall of the inlet and leading to the MWS Linear. The DVERT is perfect for retrofit and green street applications that allows the MWS Linear to be installed anywhere space is available.

Performance

The MWS Linear continues to outperform other treatment methods with superior pollutant removal for TSS, heavy metals, nutrients, hydrocarbons and bacteria. Since 2007 the MWS Linear has been field tested on numerous sites across the country. With it's advanced pre-treatment chamber and innovative horizontal flow biofilter, the system is able to effectively remove pollutants through a combination of physical, chemical, and biological filtration processes. With the same biological processes found in natural wetlands, the MWS Linear harnesses natures ability to process, transform, and remove even the most harmful pollutants.

Approvals

The MWS Linear has successfully met years of challenging technical reviews and testing from some of the most prestigious and demanding agencies in the nation, and perhaps the world.

State of Washington TAPE GULD Basic Enhanced/Metals Phosphorus

Washington State TAPE Approved

The MWS Linear is approved for General Use Level Designation (GULD) for Basic, Enhanced, and Phosphorus treatment at 1 gpm/ft^2 loading rate. The highest performing BMP on the market for all main pollutant categories.

TSS	Total Phosphorus	Ortho Phosphorus	Nitrogen	Dissolved Zinc	Dissolved Copper	Total Zinc	Total Copper	Motor Oil
85%	64%	67%	45%	66%	38%	69%	50%	95%

VA

DEQ Assignment

The Virginia Department of Environmental Quality assigned the MWS Linear, the highest phosphorus removal rating for manufactured treatment devices to meet the new Virginia Stormwater Management Program (VSMP) Technical Criteria.

MD

Maryland Department Of The Environment Approved

Granted ESD (Environmental Site Design) status for new construction, redevelopment and retrofitting when designed in accordance with the Design Manual.

MA

MASTEP Evaluation

The University of Massachusetts at Amherst – Water Resources Research Center, issued a technical evaluation report noting removal rates up to 84% TSS, 70% Total Phosphorus, 68.5% Total Zinc, and more.

RI

Rhode Island DEM Approved

Approved as an authorized BMP and noted to achieve the following minimum removal efficiencies: 85% TSS, 60% Pathogens, 30% Total Phosphorus, and 30% Total Nitrogen.

Flow Based Sizing

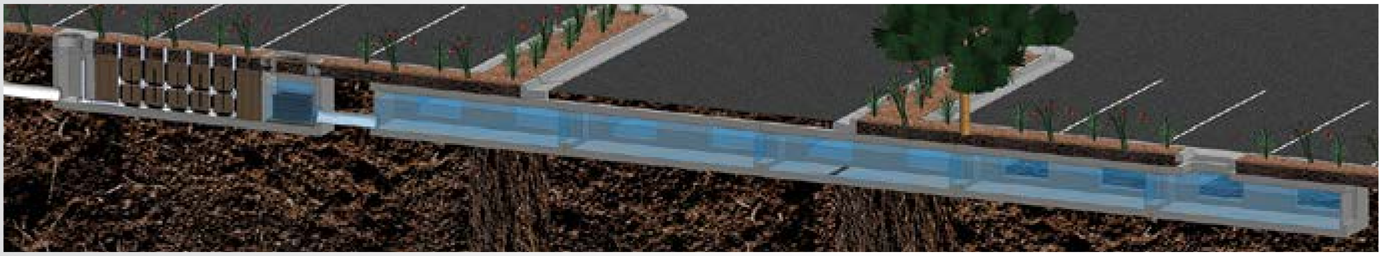
The MWS Linear can be used in stand alone applications to meet treatment flow requirements. Since the MWS Linear is the only biofiltration system that can accept inflow pipes several feet below the surface it can be used not only in decentralized design applications but also as a large central end-of-the-line application for maximum feasibility.

Treatment Flow Sizing Table

Model #	Dimensions	WetlandMedia Surface Area	Treatment Flow Rate (cfs)
MWS-L-4-4	4' x 4'	23 ft^2	0.052
MWS-L-4-6	4' x 6'	32 ft^2	0.073
MWS-L-4-8	4' x 8'	50 ft^2	0.115
MWS-L-4-13	4' x 13'	63 ft^2	0.144
MWS-L-4-15	4' x 15'	76 ft^2	0.175
MWS-L-4-17	4' x 17'	90 ft^2	0.206
MWS-L-4-19	4' x 19'	103 ft^2	0.237
MWS-L-4-21	4' x 21'	117 ft^2	0.268
MWS-L-8-8	8' x 8'	100 ft^2	0.230
MWS-L-8-12	8' x 12'	151 ft^2	0.346
MWS-L-8-16	8' x 16'	201 ft^2	0.462

Volume Based Sizing

Many states require treatment of a water quality volume and do not offer the option of flow based design. The MWS Linear and its unique horizontal flow makes it the only biofilter that can be used in volume based design installed downstream of ponds, detention basins, and underground storage systems.



Treatment Volume Sizing Table

Model #	Treatment Capacity (cu. ft.) @ 24-Hour Drain Down	Treatment Capacity (cu. ft.) @ 48-Hour Drain Down
MWS-L-4-4	1140	2280
MWS-L-4-6	1600	3200
MWS-L-4-8	2518	5036
MWS-L-4-13	3131	6261
MWS-L-4-15	3811	7623
MWS-L-4-17	4492	8984
MWS-L-4-19	5172	10345
MWS-L-4-21	5853	11706
MWS-L-8-8	5036	10072
MWS-L-8-12	7554	15109
MWS-L-8-16	10073	20145

Installation

The MWS Linear is simple, easy to install, and has a space efficient design that offers lower excavation and installation costs compared to traditional tree-box type systems. The structure of the system resembles pre-cast catch basin or utility vaults and is installed in a similar fashion.

The system is delivered fully assembled for quick installation. Generally, the structure can be unloaded and set in place in 15 minutes. Our experienced team of field technicians are available to supervise installations and provide technical support.

Maintenance

Reduce your maintenance costs, man hours, and materials with the MWS Linear. Unlike other biofiltration systems that provide no pre-treatment, the MWS Linear is a self-contained treatment train which incorporates simple and effective pre-treatment.

Maintenance requirements for the biofilter itself are almost completely eliminated, as the pre-treatment chamber removes and isolates trash, sediments, and hydrocarbons. What's left is the simple maintenance of an easily accessible pre-treatment chamber that can be cleaned by hand or with a standard vac truck. Only periodic replacement of low-cost media in the pre-filter cartridges is required for long term operation and there is absolutely no need to replace expensive biofiltration media.

Plant Selection

Abundant plants, trees, and grasses bring value and an aesthetic benefit to any urban setting, but those in the MWS Linear do even more - they increase pollutant removal. What's not seen, but very important, is that below grade the stormwater runoff/flow is being subjected to nature's secret weapon: a dynamic physical, chemical, and biological process working to break down and remove non-point source pollutants. The flow rate is controlled in the MWS Linear, giving the plants more "contact time" so that pollutants are more successfully decomposed, volatilized and incorporated into the biomass of The MWS Linear's micro/macro flora and fauna.

A wide range of plants are suitable for use in the MWS Linear, but selections vary by location and climate. View suitable plants by selecting the list relative to your project location's hardy zone.

Please visit **www.ModularWetlands.com/Plants** for more information and various plant lists.