

SYSTEM HYDRAULICS

MWS – Linear

Hybrid Stormwater Filtration System



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HYDRAULIC OPERATION

Curb, Grate, and Vault Type – Flow based design.

Flows -

- Primary Treatment Peak Flow Rate (all types) = 120 gpm or .27 cfs
- GRATE TYPE Internal Bypass Peak Flow Rate = 1926 gpm or 4.28 cfs
- CURB TYPE Internal Bypass Peak Flow Rate = 904.5 gpm or 2.01 cfs
- VAULT TYPE “please consult manufacturer; varies with available head”

Dimensions -

- I.D Dimensions = 21' x 4' x 4'
- O.D Dimensions = 22' x 5' x 4.8'

Hydraulic Fall Required –

- Curb Type Minimum Fall Required = 3.57' (bottom of curb to invert out)
- Grate Type Minimum Fall Required = 4.13' (top of grate to invert out)
- Vault Type Minimum Fall Required = “varies, please consult manufacturer”

Capacity –

- Storage Capacity = 1000 Lbs (settling chamber storage)

Vault Type – Volume based design

Volume -

- Primary Treatment Volume = 4000 Cubic Feet
 - 10 gpm discharge rate & 48-hour drain down time.
 - Pre – Storage Required

Dimensions -

- I.D Dimensions = 21' x 4' x 4'
- O.D Dimensions = 22' x 5' x 5.6'

Hydraulic Fall Required –

- Vault Type Minimum Fall Required = 4.13" (finish grade to invert out)

Capacity –

- Storage Capacity = 1000 Lbs (settling chamber storage)

Modular Wetlands Hydraulics Calculator

Page One: Basic Parameters

Enter and/or Verify Parameters in Units as Specified:

Sedimentation and Media Filter Chamber

Interior Dimensions of Chamber	Length:	48	Inches
	Width:	48	Inches
	Height:	41	Inches
Approximate Maximum Chamber Volume in Cubic Feet:		55	CuFt
Approximate Maximum Chamber Volume in Gallons:		409	Gallons

Wetlands Chamber

Interior Dimensions of Wetlands Chamber	Length:	166	Inches
	Width:	48	Inches
	Height:	48	Inches
Approximate Maximum Chamber Volume in Cubic Feet:		221	CuFt
Approximate Maximum Chamber Volume in Gallons:		1656	Gallons

Discharge Chamber

Interior Dimensions of Discharge Chamber	Length:	30	Inches
	Width:	48	Inches
	Height:	48	Inches
Approximate Maximum Chamber Volume in Cubic Feet:		40	CuFt
Approximate Maximum Chamber Volume in Gallons:		299	Gallons

Media Filter

Width of Transverse Media Panels:	30	Inches
Number of Transverse Media Panels (1 or 2):	2	quantity
Width of Longitudinal Media Panels	30	Inches
Number of Longitudinal Media Panels (2):	2	quantity
Height of Media Filter Panels:	24	Inches
Calculated Surface Area of Media Filter:	20.0	Sq Ft
Test Sample Width:	24.00	Inches
Test Sample Height:	6.00	Inches
Test Sample Flow Rate at Utilized Thickness in gpm:	5.0	gpm
Calculated Flow Rate for Media Filter at Utilized Thickness:	20	gpm/SqFt/Ft
Dynamic Viscosity of Water:	2.0E-05	lb-s/SqFt
Grain Diameter Equivalent or d30 of Media Material:	20	microns
Reynolds Number for Specified Flow Rate (Darcian if less than one.):	3.E-01	none

Wetlands Filter

Void Volume Percentage of Wetlands Media	30%	Percent
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Interconnection Pipes

Height of Invert of Inlet Pipe to Wetlands Chamber:	6.00	Inches
Height of Invert of Lower Outlet Pipe from Wetlands Chamber:	6.00	Inches
Height of Invert of Upper Outlet Pipe from Wetlands Chamber:	21.00	Inches
Diameter of Above Inlet and Outlet Pipes:	4.00	Inches

Bypass Pipes

Invert Height of Inlet to Bypass Pipe:	28.50	Inches
Invert Height of Outlet to Bypass Pipe:	25.90	Inches
Length of Bypass Pipe:	174	Inches
Diameter of Bypass Pipe:	8.00	Inches
Number of Bypass Pipes:	2	quantity
Manning's loss coefficient for Bypass Pipe:	0.0090	(metric)
Calculated Slope of Bypass Pipe	0.0149	Ft/Ft

Drain-Down Pipe

Diameter of Drain-Down Pipe	0.50	Inches
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Modular Wetlands Hydraulics Calculator

Page Two: Basic Calculations

Depths Used in the Following Calculations

Minimum Wetlands Depth:	6.00	Inches
Media Filter Overflow Depth:	24.00	Inches
Minimum Bypass Depth:	28.50	Inches
Hydraulic Depth (Depth to Top of Inlet Grate or Bottom of Curb):	48.00	Inches

Sedimentation Chamber

Sedimentation Chamber Footprint Area:	6.3	SqFt
Sedimentation Chamber Volume	at Minimum Wetlands Depth:	3 CuFt
	at Media Filter Overflow Depth:	13 CuFt
	at Minimum Bypass Depth:	15 CuFt
Enter Test Flow Rate in gpm for Resident Time Calculation:	90	gpm
Resident Time Calculations	at Minimum Wetlands Depth:	16 seconds
	at Media Filter Overflow Depth:	63 seconds
	at Minimum Bypass Depth:	74 seconds

Wetlands Chamber

Wetlands Chamber Footprint Area:	55	SqFt
Void Volume Percentage of Wetlands Media (from page 1):	30%	Percent
Wetlands Chamber Volume	at Minimum Wetlands Depth:	8 CuFt
	at Media Filter Overflow Depth:	33 CuFt
	at Minimum Bypass Depth:	39 CuFt
Enter Test Flow Rate in gpm for Resident Time Calculation:	90	gpm
Resident Time Calculations	at Minimum Wetlands Depth:	42 seconds
	at Media Filter Overflow Depth:	166 seconds
	at Minimum Bypass Depth:	197 seconds

Flow Rate Calculations for Drain-Down Pipe

Pipe Diameter (from page 1):	0.50	Inches
Pipe Cross-Sectional Area in Square Inches:	0.196	SqIn
Contraction Loss Coefficient:	0.50	none
Pipe Entrance Velocities	at Minimum Wetlands Depth:	4.6 fps
	at Media Filter Overflow Depth:	9.3 fps
	at Minimum Bypass Depth:	10.1 fps
	at Depth Equal to Top of Grate:	13.1 fps
Pipe Flow rates	at Minimum Wetlands Depth:	2.84 gpm
	at Media Filter Overflow Depth:	5.68 gpm
	at Minimum Bypass Depth:	6.19 gpm
	at Depth Equal to Top of Grate:	8.04 gpm
Drain-Down Time from Minimum Wetlands Depth:	42.2	minutes

Modular Wetlands Hydraulics Calculator

Page Three: Maximum Flow Rate Calculations

Maximum Bypass Flow Rate Calculations

Invert Height of Inlet to Bypass Pipe:	28.50	Inches
Invert Height of Outlet to Bypass Pipe:	25.90	Inches
Length of Bypass Pipe:	174	Inches
Diameter of Bypass Pipe:	8.00	Inches
Number of Bypass Pipes:	2	quantity
Manning's coefficient for Bypass Pipe:	0.0090	(metric)
Calculated Slope of Bypass Pipe	0.0149	Ft/Ft
Maximum Bypass Head (Pipe Crown to Top of Grate Inlet):	11.50	Inches
Enter Entrance Contraction Loss Coefficient:	0.50	none
If Required, Enter Error Correction from Below for Insufficient Pipe Slope:	0.200	none
Bypass Flow Rate for Above Head in cfs:	4.44	cfs
Bypass Flow Rate for Above Head in gpm:	1997	gpm
Slope Required by Manning's Equation:	0.0161	Ft/Ft
Error Correction for Insufficient Pipe Slope (Re-enter above until equal.):	0.20	Inches
Is Above Error Correction Correctly Entered:	Yes	

Maximum Flow Rate through Upper Wetlands Outlet

Height of Invert of Upper Outlet Pipe from Wetlands Chamber:	21.00	Inches
Invert Height of Inlet to Bypass Pipe:	28.50	Inches
Diameter of Outlet Pipe:	4.00	Inches
Differential Head Driving Flow through Upper Outlet Pipe:	3.50	Inches
Enter Estimated Loss Coefficient:	2.00	none
Flow Rate for Head Equal to Minimum Bypass Depth in cfs:	0.22	cfs
Flow Rate for Head Equal to Minimum Bypass Depth in gpm:	98	gpm

Maximum Flow Rate through Lower Wetlands Outlet

Height of Invert of Lower Outlet Pipe from Wetlands Chamber:	6.00	Inches
Invert Height of Inlet to Bypass Pipe:	28.50	Inches
Diameter of Outlet Pipe:	4.00	Inches
Differential Head Driving Flow through Lower Outlet Pipe:	18.50	Inches
Enter Estimated Loss Coefficient:	2.00	none
Flow Rate for Head Equal to Minimum Bypass Depth in cfs:	0.50	cfs
Flow Rate for Head Equal to Minimum Bypass Depth in gpm:	226	gpm

Maximum Flow Rates through Filter Media

Calculated Surface Area of Media Filter:	20.0	Sq Ft
Calculated Flow Rate for Media Filter from Test Sample:	20.0	gpm/SqFt/Ft
Dynamic Viscosity of Water:	2.0E-05	lb-s/SqFt
Grain Diameter Equivalent or d30 of Media Material:	20	microns
Reynolds Number for Specified Flow Rate (Darcian if less than one.):	3.E-01	none
Media Filter Overflow Depth:	24.00	Inches

Maximum Flow Rates for Depth Just Below Media Filter Overflow Depth:

Wetlands Depth in Inches:	6.00	375.00	gpm
Wetlands Depth in Inches:	9.00	343.75	gpm
Wetlands Depth in Inches:	12.00	300.00	gpm
Wetlands Depth in Inches:	15.00	243.75	gpm
Wetlands Depth in Inches:	18.00	175.00	gpm
Wetlands Depth in Inches:	21.00	93.75	gpm
Wetlands Depth in Inches:	24.00	0.00	gpm
Wetlands Depth in Inches:	27.00	NA	gpm
Wetlands Depth in Inches:	30.00	NA	gpm

Modular Wetlands Hydraulics Calculator

Page One: Basic Parameters

Enter and/or Verify Parameters in Units as Specified:

Sedimentation and Media Filter Chamber

Interior Dimensions of Chamber	Length:	48	Inches
	Width:	48	Inches
	Height:	41	Inches
Approximate Maximum Chamber Volume in Cubic Feet:		55	CuFt
Approximate Maximum Chamber Volume in Gallons:		409	Gallons

Wetlands Chamber

Interior Dimensions of Wetlands Chamber	Length:	166	Inches
	Width:	48	Inches
	Height:	48	Inches
Approximate Maximum Chamber Volume in Cubic Feet:		221	CuFt
Approximate Maximum Chamber Volume in Gallons:		1656	Gallons

Discharge Chamber

Interior Dimensions of Discharge Chamber	Length:	30	Inches
	Width:	48	Inches
	Height:	48	Inches
Approximate Maximum Chamber Volume in Cubic Feet:		40	CuFt
Approximate Maximum Chamber Volume in Gallons:		299	Gallons

Media Filter

Width of Transverse Media Panels:	30	Inches
Number of Transverse Media Panels (1 or 2):	2	quantity
Width of Longitudinal Media Panels	30	Inches
Number of Longitudinal Media Panels (2):	2	quantity
Height of Media Filter Panels:	24	Inches
Calculated Surface Area of Media Filter:	20.0	Sq Ft
Test Sample Width:	24.00	Inches
Test Sample Height:	6.00	Inches
Test Sample Flow Rate at Utilized Thickness in gpm:	5.0	gpm
Calculated Flow Rate for Media Filter at Utilized Thickness:	20	gpm/SqFt/Ft
Dynamic Viscosity of Water:	2.0E-05	lb-s/SqFt
Grain Diameter Equivalent or d30 of Media Material:	20	microns
Reynolds Number for Specified Flow Rate (Darcian if less than one.):	3.E-01	none

Wetlands Filter

Void Volume Percentage of Wetlands Media	30%	Percent
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Interconnection Pipes

Height of Invert of Inlet Pipe to Wetlands Chamber:	6.00	Inches
Height of Invert of Lower Outlet Pipe from Wetlands Chamber:	6.00	Inches
Height of Invert of Upper Outlet Pipe from Wetlands Chamber:	21.00	Inches
Diameter of Above Inlet and Outlet Pipes:	4.00	Inches

Bypass Pipes

Invert Height of Inlet to Bypass Pipe:	28.50	Inches
Invert Height of Outlet to Bypass Pipe:	25.90	Inches
Length of Bypass Pipe:	174	Inches
Diameter of Bypass Pipe:	8.00	Inches
Number of Bypass Pipes:	2	quantity
Manning's loss coefficient for Bypass Pipe:	0.0090	(metric)
Calculated Slope of Bypass Pipe	0.0149	Ft/Ft

Drain-Down Pipe

Diameter of Drain-Down Pipe	0.50	Inches
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Modular Wetlands Hydraulics Calculator

Page Two: Basic Calculations

Depths Used in the Following Calculations

Minimum Wetlands Depth:	6.00	Inches
Media Filter Overflow Depth:	24.00	Inches
Minimum Bypass Depth:	28.50	Inches
Hydraulic Depth (Depth to Top of Inlet Grate or Bottom of Curb):	40.00	Inches

Sedimentation Chamber

Sedimentation Chamber Footprint Area:	6.3	SqFt
Sedimentation Chamber Volume	at Minimum Wetlands Depth:	3 CuFt
	at Media Filter Overflow Depth:	13 CuFt
	at Minimum Bypass Depth:	15 CuFt
Enter Test Flow Rate in gpm for Resident Time Calculation:	90	gpm
Resident Time Calculations	at Minimum Wetlands Depth:	16 seconds
	at Media Filter Overflow Depth:	63 seconds
	at Minimum Bypass Depth:	74 seconds

Wetlands Chamber

Wetlands Chamber Footprint Area:	55	SqFt
Void Volume Percentage of Wetlands Media (from page 1):	30%	Percent
Wetlands Chamber Volume	at Minimum Wetlands Depth:	8 CuFt
	at Media Filter Overflow Depth:	33 CuFt
	at Minimum Bypass Depth:	39 CuFt
Enter Test Flow Rate in gpm for Resident Time Calculation:	90	gpm
Resident Time Calculations	at Minimum Wetlands Depth:	42 seconds
	at Media Filter Overflow Depth:	166 seconds
	at Minimum Bypass Depth:	197 seconds

Flow Rate Calculations for Drain-Down Pipe

Pipe Diameter (from page 1):	0.50	Inches
Pipe Cross-Sectional Area in Square Inches:	0.196	SqIn
Contraction Loss Coefficient:	0.50	none
Pipe Entrance Velocities	at Minimum Wetlands Depth:	4.6 fps
	at Media Filter Overflow Depth:	9.3 fps
	at Minimum Bypass Depth:	10.1 fps
	at Depth Equal to Top of Grate:	12.0 fps
Pipe Flow rates	at Minimum Wetlands Depth:	2.84 gpm
	at Media Filter Overflow Depth:	5.68 gpm
	at Minimum Bypass Depth:	6.19 gpm
	at Depth Equal to Top of Grate:	7.34 gpm
Drain-Down Time from Minimum Wetlands Depth:	42.2	minutes

Modular Wetlands Hydraulics Calculator

Page Three: Maximum Flow Rate Calculations

Maximum Bypass Flow Rate Calculations

Invert Height of Inlet to Bypass Pipe:	28.50	Inches
Invert Height of Outlet to Bypass Pipe:	25.90	Inches
Length of Bypass Pipe:	174	Inches
Diameter of Bypass Pipe:	8.00	Inches
Number of Bypass Pipes:	2	quantity
Manning's coefficient for Bypass Pipe:	0.0090	(metric)
Calculated Slope of Bypass Pipe	0.0149	Ft/Ft
Maximum Bypass Head (Pipe Crown to Top of Grate Inlet):	3.50	Inches
Enter Entrance Contraction Loss Coefficient:	0.50	none
If Required, Enter Error Correction from Below for Insufficient Pipe Slope:	0.000	none
Bypass Flow Rate for Above Head in cfs:	2.47	cfs
Bypass Flow Rate for Above Head in gpm:	1111	gpm
Slope Required by Manning's Equation:	0.0050	Ft/Ft
Error Correction for Insufficient Pipe Slope (Re-enter above until equal.):	0.00	Inches
Is Above Error Correction Correctly Entered:	Yes	

Maximum Flow Rate through Upper Wetlands Outlet

Height of Invert of Upper Outlet Pipe from Wetlands Chamber:	21.00	Inches
Invert Height of Inlet to Bypass Pipe:	28.50	Inches
Diameter of Outlet Pipe:	4.00	Inches
Differential Head Driving Flow through Upper Outlet Pipe:	3.50	Inches
Enter Estimated Loss Coefficient:	2.00	none
Flow Rate for Head Equal to Minimum Bypass Depth in cfs:	0.22	cfs
Flow Rate for Head Equal to Minimum Bypass Depth in gpm:	98	gpm

Maximum Flow Rate through Lower Wetlands Outlet

Height of Invert of Lower Outlet Pipe from Wetlands Chamber:	6.00	Inches
Invert Height of Inlet to Bypass Pipe:	28.50	Inches
Diameter of Outlet Pipe:	4.00	Inches
Differential Head Driving Flow through Lower Outlet Pipe:	18.50	Inches
Enter Estimated Loss Coefficient:	2.00	none
Flow Rate for Head Equal to Minimum Bypass Depth in cfs:	0.50	cfs
Flow Rate for Head Equal to Minimum Bypass Depth in gpm:	226	gpm

Maximum Flow Rates through Filter Media

Calculated Surface Area of Media Filter:	20.0	Sq Ft
Calculated Flow Rate for Media Filter from Test Sample:	20.0	gpm/SqFt/Ft
Dynamic Viscosity of Water:	2.0E-05	lb-s/SqFt
Grain Diameter Equivalent or d30 of Media Material:	20	microns
Reynolds Number for Specified Flow Rate (Darcian if less than one.):	3.E-01	none
Media Filter Overflow Depth:	24.00	Inches

Maximum Flow Rates for Depth Just Below Media Filter Overflow Depth:

Wetlands Depth in Inches:	6.00	375.00	gpm
Wetlands Depth in Inches:	9.00	343.75	gpm
Wetlands Depth in Inches:	12.00	300.00	gpm
Wetlands Depth in Inches:	15.00	243.75	gpm
Wetlands Depth in Inches:	18.00	175.00	gpm
Wetlands Depth in Inches:	21.00	93.75	gpm
Wetlands Depth in Inches:	24.00	0.00	gpm
Wetlands Depth in Inches:	27.00	NA	gpm
Wetlands Depth in Inches:	30.00	NA	gpm