

APPENDIX III-2A-4

Hydraulic Design Toolbox Input and Output



GOLDER ASSOCIATES INC.
Professional Engineering Firm
Registration Number F-2578

INTENDED FOR PERMITTING
PURPOSES ONLY

For Part III, Attachment 2, Appendix III-2A-4:
Hydraulic Toolbox modeling inputs and
outputs dated November 10, 2020

HYDRAULIC TOOLBOX

RIPRAP ANALYSIS

HAWTHORN PARK RDF

North (-0+88.45 to -73.5)

Structure type: ▾

Geotextile/Granular Filter Design...

Parameter	Value	Units
Channel Parameters		
Select Channel	▾	
	Channel Calculator...	
Input Parameters		
	Transfer Values From Channel Calculator	
Channel Type	trapezoidal channel ▾	
Local Depth of Flow	3.370	ft
Riprap Shape	angular rock ▾	
Stability Coefficient	0.300	
Blanket Thickness Coefficient	1.000	
Channel Cross-sectional Average Velocity	2.200	ft/s
Centerline Radius of Curvature of Channel Bend	999999999	ft
Width of Water Surface at Upstream End of Channel Bend	45.200	ft
Bank Angle	3.000	H:V (:1)
Bank Angle	18.435	degrees
Protection Location	straight channel ▾	
Specific Gravity of Riprap	2.500	
Safety Factor	1.100	
Results		
Side Slope Correction Factor	0.977	
Velocity Distribution Coefficient	1.000	
Design Velocity	2.200	ft/s
D30	0.170	in
D30	0.014	ft
D50	0.204	in
D50	0.017	ft
Riprap Class		
Riprap Class Name	CLASS I	
Riprap Class Order	1	
D15	4.50	in
D50	6.50	in
D85	9.00	in
D100	12.00	in
Layout		
Minimum Riprap Thickness	12.000	in

North (0+8.36 to 0+ 18.36)

Structure type:

Geotextile/Granular Filter Design

Parameter	Value	Units
Channel Parameters		
Select Channel	<input type="text" value="Channel Calculator..."/>	
Input Parameters		
	Transfer Values From Channel Calculator	
Channel Type	trapezoidal channel	
Local Depth of Flow	3.220	ft
Riprap Shape	angular rock	
Stability Coefficient	0.300	
Blanket Thickness Coefficient	1.000	
Channel Cross-sectional Average Velocity	4.370	ft/s
Centerline Radius of Curvature of Channel Bend	999999999	ft
Width of Water Surface at Upstream End of Channel Bend	24.900	ft
Bank Angle	2.500	H:V (:1)
Bank Angle	21.801	degrees
Protection Location	downstream from concrete channel	
Specific Gravity of Riprap	2.500	
Safety Factor	1.100	
Results		
Side Slope Correction Factor	0.942	
Velocity Distribution Coefficient	1.250	
Design Velocity	4.370	ft/s
D30	1.250	in
D30	0.104	ft
D50	1.500	in
D50	0.125	ft
Riprap Class		
Riprap Class Name	CLASS I	
Riprap Class Order	1	
D15	4.50	in
D50	6.50	in
D85	9.00	in
D100	12.00	in
Layout		
Minimum Riprap Thickness	12.000	in

Structure type: Revetment (chan

Geotextile/Granular Filter Design...

Parameter	Value	Units
Channel Parameters		
Select Channel	▼	
	Channel Calculator...	
Input Parameters		
	Transfer Values From Channel Calculator	
Channel Type	trapezoidal channel ▼	
Local Depth of Flow	1.770	ft
Riprap Shape	angular rock ▼	
Stability Coefficient	0.300	
Blanket Thickness Coefficient	1.000	
Channel Cross-sectional Average Velocity	6.200	ft/s
Centerline Radius of Curvature of Channel Bend	999999999	ft
Width of Water Surface at Upstream End of Channel Bend	16.940	ft
Bank Angle	3.000	H:V (: 1)
Bank Angle	18.435	degrees
Protection Location	straight channel ▼	
Specific Gravity of Riprap	2.500	
Safety Factor	1.100	
Results		
Side Slope Correction Factor	0.977	
Velocity Distribution Coefficient	1.000	
Design Velocity	6.200	ft/s
D30	2.660	in
D30	0.222	ft
D50	3.193	in
D50	0.266	ft
Riprap Class		
Riprap Class Name	CLASS I	
Riprap Class Order	1	
D15	4.50	in
D50	6.50	in
D85	9.00	in
D100	12.00	in
Layout		
Minimum Riprap Thickness	12.000	in

East (-0+72.3 to 0+00)

Structure type: Revetment (channe

Geotextile/Granular Filter Design...

Parameter	Value	Units
Channel Parameters		
Select Channel	▼	
	Channel Calculator...	
Input Parameters		
	Transfer Values From Channel Calculator	
Channel Type	trapezoidal channel	▼
Local Depth of Flow	1.980	ft
Riprap Shape	angular rock	▼
Stability Coefficient	0.300	
Blanket Thickness Coefficient	1.000	
Channel Cross-sectional Average Velocity	5.410	ft/s
Centerline Radius of Curvature of Channel Bend	999999999	ft
Width of Water Surface at Upstream End of Channel Bend	17.780	ft
Bank Angle	3.000	H:V (:1)
Bank Angle	18.435	degrees
Protection Location	straight channel	▼
Specific Gravity of Riprap	2.500	
Safety Factor	1.100	
Results		
Side Slope Correction Factor	0.977	
Velocity Distribution Coefficient	1.000	
Design Velocity	5.410	ft/s
D30	1.840	in
D30	0.153	ft
D50	2.208	in
D50	0.184	ft
Riprap Class		
Riprap Class Name	CLASS I	
Riprap Class Order	1	
D15	4.50	in
D50	6.50	in
D85	9.00	in
D100	12.00	in
Layout		
Minimum Riprap Thickness	12.000	in

East (0+00 to 0+ 1.5)

Structure type: ▾

Geotextile/Granular Filter Design...

Parameter	Value	Units
Channel Parameters		
Select Channel	<input type="text" value="Channel Calculator..."/> ▾	
Input Parameters		
	Transfer Values From Channel Calculator	
Channel Type	trapezoidal channel ▾	
Local Depth of Flow	2.030	ft
Riprap Shape	angular rock ▾	
Stability Coefficient	0.300	
Blanket Thickness Coefficient	1.000	
Channel Cross-sectional Average Velocity	4.690	ft/s
Centerline Radius of Curvature of Channel Bend	999999999	ft
Width of Water Surface at Upstream End of Channel Bend	20.510	ft
Bank Angle	3.000	H:V (.:1)
Bank Angle	18.435	degrees
Protection Location	straight channel ▾	
Specific Gravity of Riprap	2.500	
Safety Factor	1.100	
Results		
Side Slope Correction Factor	0.977	
Velocity Distribution Coefficient	1.000	
Design Velocity	4.690	ft/s
D30	1.279	in
D30	0.107	ft
D50	1.535	in
D50	0.128	ft
Riprap Class		
Riprap Class Name	CLASS I	
Riprap Class Order	1	
D15	4.50	in
D50	6.50	in
D85	9.00	in
D100	12.00	in
Layout		
Minimum Riprap Thickness	12.000	in

Structure type:

Geotextile/Granular Filter Design...

Parameter	Value	Units
Channel Parameters		
Select Channel	<input type="text" value="Channel Calculator..."/>	
Input Parameters		
	Transfer Values From Channel Calculator	
Channel Type	trapezoidal channel	
Local Depth of Flow	2.030	ft
Riprap Shape	angular rock	
Stability Coefficient	0.300	
Blanket Thickness Coefficient	1.000	
Channel Cross-sectional Average Velocity	4.690	ft/s
Centerline Radius of Curvature of Channel Bend	13	ft
Width of Water Surface at Upstream End of Channel Bend	20.500	ft
Bank Angle	3.000	H:V (.:1)
Bank Angle	18.435	degrees
Protection Location	outside of bend	
Specific Gravity of Riprap	2.500	
Safety Factor	1.100	
Results		
Side Slope Correction Factor	0.977	
Velocity Distribution Coefficient	1.323	
Design Velocity	8.744	ft/s
D30	8.030	in
D30	0.669	ft
D50	9.636	in
D50	0.803	ft
Riprap Class		
Riprap Class Name	CLASS III	
Riprap Class Order	3	
D15	9.00	in
D50	12.50	in
D85	17.00	in
D100	24.00	in
Layout		
Minimum Riprap Thickness	24.000	in

Structure type:

Geotextile/Granular Filter Design...

Parameter	Value	Units
Channel Parameters		
Select Channel	<input type="text" value="Channel Calculator..."/>	
Input Parameters		
	Transfer Values From Channel Calculator	
Channel Type	trapezoidal channel	
Local Depth of Flow	1.960	ft
Riprap Shape	angular rock	
Stability Coefficient	0.300	
Blanket Thickness Coefficient	1.000	
Channel Cross-sectional Average Velocity	2.100	ft/s
Centerline Radius of Curvature of Channel Bend	13	ft
Width of Water Surface at Upstream End of Channel Bend	16.920	ft
Bank Angle	3.000	H:V (:1)
Bank Angle	18.435	degrees
Protection Location	outside of bend	
Specific Gravity of Riprap	2.500	
Safety Factor	1.100	
Results		
Side Slope Correction Factor	0.977	
Velocity Distribution Coefficient	1.306	
Design Velocity	3.778	ft/s
D30	0.982	in
D30	0.082	ft
D50	1.178	in
D50	0.098	ft
Riprap Class		
Riprap Class Name	CLASS I	
Riprap Class Order	1	
D15	4.50	in
D50	6.50	in
D85	9.00	in
D100	12.00	in
Layout		
Minimum Riprap Thickness	12.000	in

Structure type: Revetment (channel ▾)

Geotextile/Granular Filter Design...

Parameter	Value	Units
Channel Parameters		
Select Channel	▾	
	Channel Calculator...	
Input Parameters		
	Transfer Values From Channel Calculator	
Channel Type	trapezoidal channel	▾
Local Depth of Flow	2.380	ft
Riprap Shape	angular rock	▾
Stability Coefficient	0.300	
Blanket Thickness Coefficient	1.000	
Channel Cross-sectional Average Velocity	1.760	ft/s
Centerline Radius of Curvature of Channel Bend	999999999	ft
Width of Water Surface at Upstream End of Channel Bend	19.350	ft
Bank Angle	3.000	H:V (:1)
Bank Angle	18.435	degrees
Protection Location	downstream from concrete channel	▾
Specific Gravity of Riprap	2.500	
Safety Factor	1.100	
Results		
Side Slope Correction Factor	0.977	
Velocity Distribution Coefficient	1.250	
Design Velocity	1.760	ft/s
D30	0.133	in
D30	0.011	ft
D50	0.159	in
D50	0.013	ft
Riprap Class		
Riprap Class Name	CLASS I	
Riprap Class Order	1	
D15	4.50	in
D50	6.50	in
D85	9.00	in
D100	12.00	in
Layout		
Minimum Riprap Thickness	12.000	in

East-S (1+25 to 1+30)

Structure type: Revetment (channel slopes 2% or les ▼

Geotextile/Granular Filter Design...

Parameter	Value	Units
Channel Parameters		
Select Channel	▼	
	Channel Calculator...	
Input Parameters		
	Transfer Values From Channel Calculator	
Channel Type	trapezoidal channel ▼	
Local Depth of Flow	2.310	ft
Riprap Shape	angular rock ▼	
Stability Coefficient	0.300	
Blanket Thickness Coefficient	1.000	
Channel Cross-sectional Average Velocity	1.270	ft/s
Centerline Radius of Curvature of Channel Bend	999999999	ft
Width of Water Surface at Upstream End of Channel Bend	20.370	ft
Bank Angle	3.000	H:V (_:1)
Bank Angle	18.435	degrees
Protection Location	straight channel ▼	
Specific Gravity of Riprap	2.500	
Safety Factor	1.100	
Results		
Side Slope Correction Factor	0.977	
Velocity Distribution Coefficient	1.000	
Design Velocity	1.270	ft/s
D30	0.047	in
D30	0.004	ft
D50	0.057	in
D50	0.005	ft
Riprap Class		
Riprap Class Name	CLASS I	
Riprap Class Order	1	
D15	4.50	in
D50	6.50	in
D85	9.00	in
D100	12.00	in
Layout		
Minimum Riprap Thickness	12.000	in

East-N (0+1.5 to 0+11.1)

Structure type:

Geotextile/Granular Filter Design...

Parameter	Value	Units
Channel Parameters		
Select Channel	<input type="text" value="Channel Calculator..."/>	
Input Parameters		
	Transfer Values From Channel Calculator	
Channel Type	trapezoidal channel	
Local Depth of Flow	2.030	ft
Riprap Shape	angular rock	
Stability Coefficient	0.300	
Blanket Thickness Coefficient	1.000	
Channel Cross-sectional Average Velocity	4.690	ft/s
Centerline Radius of Curvature of Channel Bend	13	ft
Width of Water Surface at Upstream End of Channel Bend	20.500	ft
Bank Angle	3.000	H:V (_:1)
Bank Angle	18.435	degrees
Protection Location	outside of bend	
Specific Gravity of Riprap	2.500	
Safety Factor	1.100	
Results		
Side Slope Correction Factor	0.977	
Velocity Distribution Coefficient	1.323	
Design Velocity	8.744	ft/s
D30	8.030	in
D30	0.669	ft
D50	9.636	in
D50	0.803	ft
Riprap Class		
Riprap Class Name	CLASS III	
Riprap Class Order	3	
D15	9.00	in
D50	12.50	in
D85	17.00	in
D100	24.00	in
Layout		
Minimum Riprap Thickness	24.000	in

East-N (0+11.1 to 0+20.6)

Structure type:

Geotextile/Granular Filter Design

Parameter	Value	Units
Channel Parameters		
Select Channel	<input type="text" value="Channel Calculator..."/>	
Input Parameters		
	Transfer Values From Channel Calculator	
Channel Type	trapezoidal channel	
Local Depth of Flow	1.480	ft
Riprap Shape	angular rock	
Stability Coefficient	0.300	
Blanket Thickness Coefficient	1.000	
Channel Cross-sectional Average Velocity	5.670	ft/s
Centerline Radius of Curvature of Channel Bend	13	ft
Width of Water Surface at Upstream End of Channel Bend	14.640	ft
Bank Angle	3.000	H:V (.:1)
Bank Angle	18.435	degrees
Protection Location	outside of bend	
Specific Gravity of Riprap	2.500	
Safety Factor	1.100	
Results		
Side Slope Correction Factor	0.977	
Velocity Distribution Coefficient	1.293	
Design Velocity	9.924	ft/s
D30	11.663	in
D30	0.972	ft
D50	13.996	in
D50	1.166	ft
Riprap Class		
Riprap Class Name	CLASS IV	
Riprap Class Order	4	
D15	10.50	in
D50	15.50	in
D85	21.00	in
D100	30.00	in
Layout		
Minimum Riprap Thickness	30.000	in

Structure type: Revetment (chan ▾)

Geotextile/Granular Filter Design...

Parameter	Value	Units
Channel Parameters		
Select Channel	▾	
	Channel Calculator...	
Input Parameters		
	Transfer Values From Channel Calculator	
Channel Type	trapezoidal channel ▾	
Local Depth of Flow	2.960	ft
Riprap Shape	angular rock ▾	
Stability Coefficient	0.300	
Blanket Thickness Coefficient	1.000	
Channel Cross-sectional Average Velocity	3.020	ft/s
Centerline Radius of Curvature of Channel Bend	999999999	ft
Width of Water Surface at Upstream End of Channel Bend	47.110	ft
Bank Angle	3.000	H:V (: 1)
Bank Angle	18.435	degrees
Protection Location	straight channel ▾	
Specific Gravity of Riprap	2.500	
Safety Factor	1.100	
Results		
Side Slope Correction Factor	0.977	
Velocity Distribution Coefficient	1.000	
Design Velocity	3.020	ft/s
D30	0.387	in
D30	0.032	ft
D50	0.465	in
D50	0.039	ft
Riprap Class		
Riprap Class Name	CLASS I	
Riprap Class Order	1	
D15	4.50	in
D50	6.50	in
D85	9.00	in
D100	12.00	in
Layout		
Minimum Riprap Thickness	12.000	in

South (-1+07.8 to -0+86)

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Structure type: Revetment (chann ▾)

Geotextile/Granular Filter Design...

Parameter	Value	Units
Channel Parameters		
Select Channel	▾	
	Channel Calculator...	
Input Parameters		
	Transfer Values From Channel Calculator	
Channel Type	trapezoidal channel	▾
Local Depth of Flow	2.970	ft
Riprap Shape	angular rock	▾
Stability Coefficient	0.300	
Blanket Thickness Coefficient	1.000	
Channel Cross-sectional Average Velocity	3.140	ft/s
Centerline Radius of Curvature of Channel Bend	999999999	ft
Width of Water Surface at Upstream End of Channel Bend	45.380	ft
Bank Angle	3.000	H:V (:1)
Bank Angle	18.435	degrees
Protection Location	downstream from concrete channel	▾
Specific Gravity of Riprap	2.500	
Safety Factor	1.100	
Results		
Side Slope Correction Factor	0.977	
Velocity Distribution Coefficient	1.250	
Design Velocity	3.140	ft/s
D30	0.533	in
D30	0.044	ft
D50	0.640	in
D50	0.053	ft
Riprap Class		
Riprap Class Name	CLASS I	
Riprap Class Order	1	
D15	4.50	in
D50	6.50	in
D85	9.00	in
D100	12.00	in
Layout		
Minimum Riprap Thickness	12.000	in

Structure type: Revetment (chai ▾)

Geotextile/Granular Filter Design...

Parameter	Value	Units
Channel Parameters		
Select Channel	▾	
	Channel Calculator...	
Input Parameters		
	Transfer Values From Channel Calculator	
Channel Type	trapezoidal channel ▾	
Local Depth of Flow	3.330	ft
Riprap Shape	angular rock ▾	
Stability Coefficient	0.300	
Blanket Thickness Coefficient	1.000	
Channel Cross-sectional Average Velocity	3.390	ft/s
Centerline Radius of Curvature of Channel Bend	999999999	ft
Width of Water Surface at Upstream End of Channel Bend	34.960	ft
Bank Angle	3.000	H:V (.:1)
Bank Angle	18.435	degrees
Protection Location	downstream from concrete channel ▾	
Specific Gravity of Riprap	2.500	
Safety Factor	1.100	
Results		
Side Slope Correction Factor	0.977	
Velocity Distribution Coefficient	1.250	
Design Velocity	3.390	ft/s
D30	0.628	in
D30	0.052	ft
D50	0.753	in
D50	0.063	ft
Riprap Class		
Riprap Class Name	CLASS I	
Riprap Class Order	1	
D15	4.50	in
D50	6.50	in
D85	9.00	in
D100	12.00	in
Layout		
Minimum Riprap Thickness	12.000	in

Structure type: Revetment (chanr ▾)

Geotextile/Granular Filter Design...

Parameter	Value	Units
Channel Parameters		
Select Channel	▾	
	Channel Calculator...	
Input Parameters		
	Transfer Values From Channel Calculator	
Channel Type	trapezoidal channel	▾
Local Depth of Flow	2.840	ft
Riprap Shape	angular rock	▾
Stability Coefficient	0.300	
Blanket Thickness Coefficient	1.000	
Channel Cross-sectional Average Velocity	0.680	ft/s
Centerline Radius of Curvature of Channel Bend	999999999	ft
Width of Water Surface at Upstream End of Channel Bend	32.700	ft
Bank Angle	3.000	H:V (_:1)
Bank Angle	18.435	degrees
Protection Location	downstream from concrete channel	▾
Specific Gravity of Riprap	2.500	
Safety Factor	1.100	
Results		
Side Slope Correction Factor	0.977	
Velocity Distribution Coefficient	1.250	
Design Velocity	0.680	ft/s
D30	0.012	in
D30	0.001	ft
D50	0.014	in
D50	0.001	ft
Riprap Class		
Riprap Class Name	CLASS I	
Riprap Class Order	1	
D15	4.50	in
D50	6.50	in
D85	9.00	in
D100	12.00	in
Layout		
Minimum Riprap Thickness	12.000	in

South (71+20 - 71+25.5)

Structure type: ▾

Geotextile/Granular Filter Design...

Parameter	Value	Units
Channel Parameters		
Select Channel	<input type="text" value="Channel Calculator..."/> ▾	
Input Parameters		
	Transfer Values From Channel Calculator	
Channel Type	trapezoidal channel ▾	
Local Depth of Flow	2.920	ft
Riprap Shape	angular rock ▾	
Stability Coefficient	0.300	
Blanket Thickness Coefficient	1.000	
Channel Cross-sectional Average Velocity	0.710	ft/s
Centerline Radius of Curvature of Channel Bend	999999999	ft
Width of Water Surface at Upstream End of Channel Bend	31.910	ft
Bank Angle	3.000	H:V (: 1)
Bank Angle	18.435	degrees
Protection Location	straight channel ▾	
Specific Gravity of Riprap	2.500	
Safety Factor	1.100	
Results		
Side Slope Correction Factor	0.977	
Velocity Distribution Coefficient	1.000	
Design Velocity	0.710	ft/s
D30	0.010	in
D30	0.001	ft
D50	0.013	in
D50	0.001	ft
Riprap Class		
Riprap Class Name	CLASS I	
Riprap Class Order	1	
D15	4.50	in
D50	6.50	in
D85	9.00	in
D100	12.00	in
Layout		
Minimum Riprap Thickness	12.000	in

HYDRAULIC TOOLBOX

RIPRAP CLASSES

HAWTHORN PARK RDF

Riprap Classes

Riprap Class Name: CLASS I

Riprap Class Order: 1

The following values are an 'average' of the size fraction range for the selected riprap class.

d100: 12 in

d85: 9 in

d50: 6.5 in

d15: 4.5 in

Riprap Class Name: CLASS II

Riprap Class Order: 2

The following values are an 'average' of the size fraction range for the selected riprap class.

d100: 18 in

d85: 13 in

d50: 9.5 in

d15: 7 in

Riprap Class Name: CLASS III

Riprap Class Order: 3

The following values are an 'average' of the size fraction range for the selected riprap class.

d100: 24 in

d85: 17 in

d50: 12.5 in

d15: 9 in

Riprap Class Name: CLASS IV

Riprap Class Order: 4

The following values are an 'average' of the size fraction range for the selected riprap class.

d100: 30 in

d85: 21 in

d50: 15.5 in

d15: 10.5 in

Riprap Class Name: CLASS V

Riprap Class Order: 5

The following values are an 'average' of the size fraction range for the selected riprap class.

d100: 36 in

d85: 25.5 in

d50: 18.5 in

d15: 13 in