STORM WATER RUNOFF
Detention Volume Calculations

for

WOLF MOUNTAIN SKI RESORT
Patron Parking & Building Area
Including Proposed Building
Site Plan
Rev. 05/01/13
Liberty, UT

Criteria & Conclusions

Return Period: 100 year
Duration: 24 hour
Allowable Runoff 0.37 cfs
Max Storage Volume @ 12 hours

Upper Pond
Orifice Diameter 3.5"
Total Required Storage 1050 cu. ft.

Lower Pond
Orifice Diameter 3.0"
Total Required Storage 17,745 cu. ft.

Report Date: 05/20/13

PRICE ENGINEERING Inc.
STRUCTURAL • CIVIL

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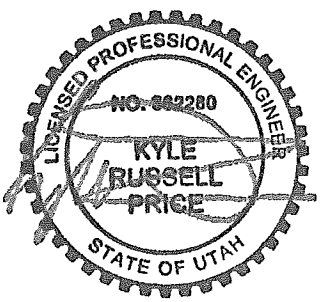

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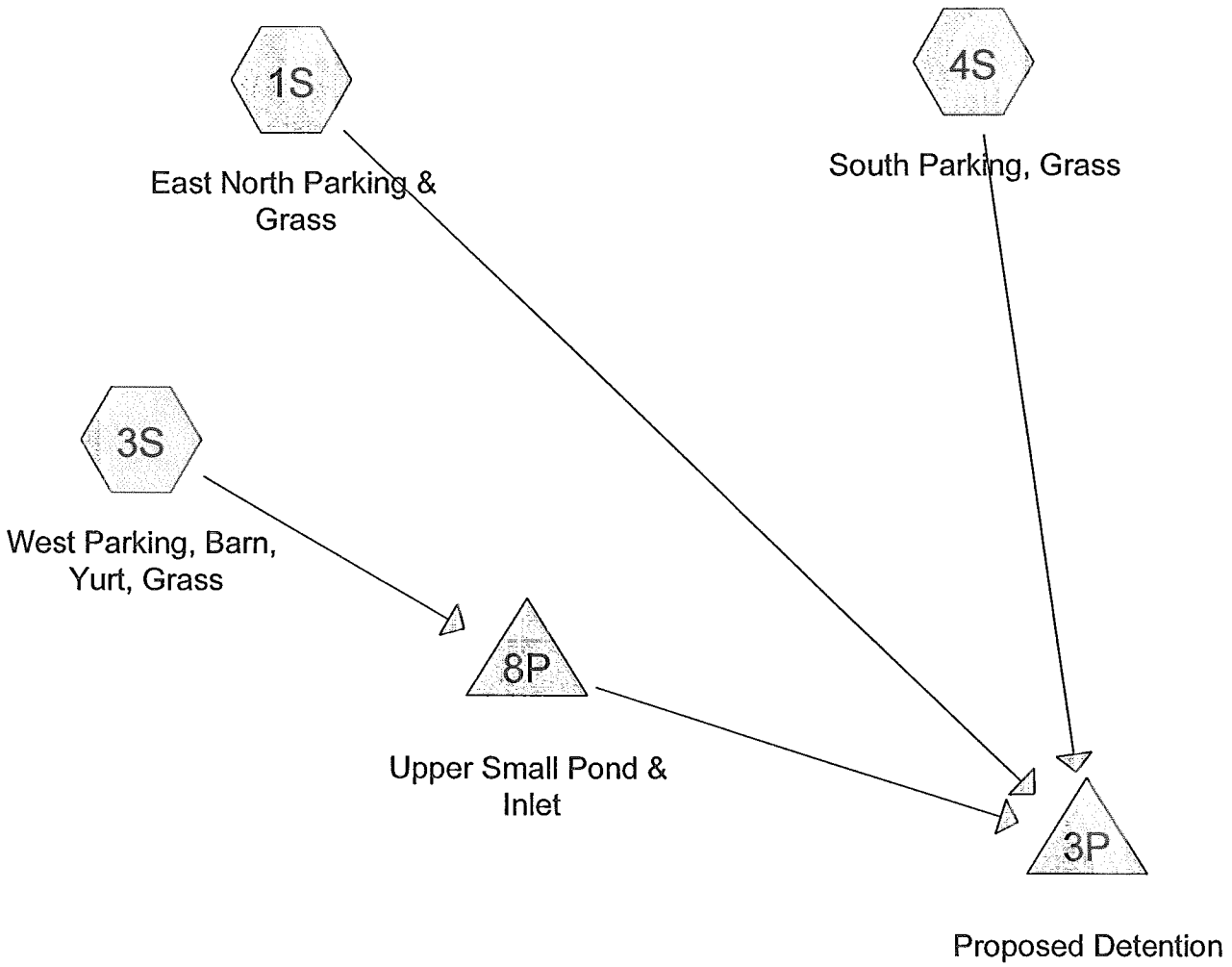


Subcat Reach Pond Link

Drainage Diagram for Wolf Mountian
Prepared by Price Engineering, Inc. 801-771-0542 5/20/2013

Wolf Mountain Patron Parking & Ski Building Area
Revision 05/20/13

Site Area Calculations

	Building	Parking Paved	Parking Gravel	Landscape
	4,376	44,388	64,309	46,665
Total	4,376	44,388	64,309	46,665
Acres	0.10	1.02	1.48	1.07

	(Sq. Ft.)	(Acres)
Total Hard Surface	48,764	1.12
Total Hard + Gravel	113,073	2.60
Total All	159,738	3.67
Grass Percentage	*29.2%*	

Storm Runoff Totals (See attached Calculations)

Return Interval	100	(Years)
Allowable Runoff	0.1	(cfs / Acre)
Allowable Runoff Total	0.37	cfs
Calculated Runoff Total	0.38	cfs
Outlet Diameter	3	(in)

Duration (min)	15	30	60	120	180	360
Storage Required (cu. ft.)	8783	12082	14878	16921	16680	16970

Duration (min)	720	1440
Storage Required (cu. ft.)	17745	14855

Area Listing (all nodes)

Area (acres)	C	Description (subcats)
0.279	0.30	Grass Natural Terrain (4S)
0.793	0.30	North East Grass Area (1S)
1.476	0.60	Gravel Parking (1S,4S)
0.100	0.75	Proposed Building+ Grass (1S)
1.019	0.90	Parking Hard Surface (3S)
3.667		

Time span=0.00-30.00 hrs, dt=0.01 hrs, 3001 points
Runoff by Rational method, Rise/Fall=1.0/1.0 xTc
Reach routing by Stor-Ind method - Pond routing by Stor-Ind method

Subcatchment 1S: East North Parking & Grass Runoff Area=93,359 sf Runoff Depth=1.89"
Flow Length=200' Slope=0.0500 '/' Tc=8.3 min C=0.50 Runoff=0.34 cfs 0.338 af

Subcatchment 3S: West Parking, Barn, Yurt, Grass Runoff Area=44,386 sf Runoff Depth=3.40"
Flow Length=300' Slope=0.0500 '/' Tc=11.4 min C=0.90 Runoff=0.29 cfs 0.289 af

Subcatchment 4S: South Parking, Grass Runoff Area=21,991 sf Runoff Depth=1.63"
Flow Length=300' Slope=0.0500 '/' Tc=11.4 min C=0.43 Runoff=0.07 cfs 0.068 af

Pond 3P: Proposed Detention Peak Elev=5,002.67' Storage=17,745 cf Inflow=0.70 cfs 0.695 af
Outflow=0.38 cfs 0.648 af

Pond 8P: Upper Small Pond & Inlet Peak Elev=5,010.96' Storage=0.024 af Inflow=0.29 cfs 0.289 af
Outflow=0.29 cfs 0.289 af

Total Runoff Area = 3.667 ac Runoff Volume = 0.695 af Average Runoff Depth = 2.27"
100.00% Pervious Area = 3.667 ac 0.00% Impervious Area = 0.000 ac

Subcatchment 1S: East North Parking & Grass

Runoff = 0.34 cfs @ 0.14 hrs, Volume= 0.338 af, Depth= 1.89"

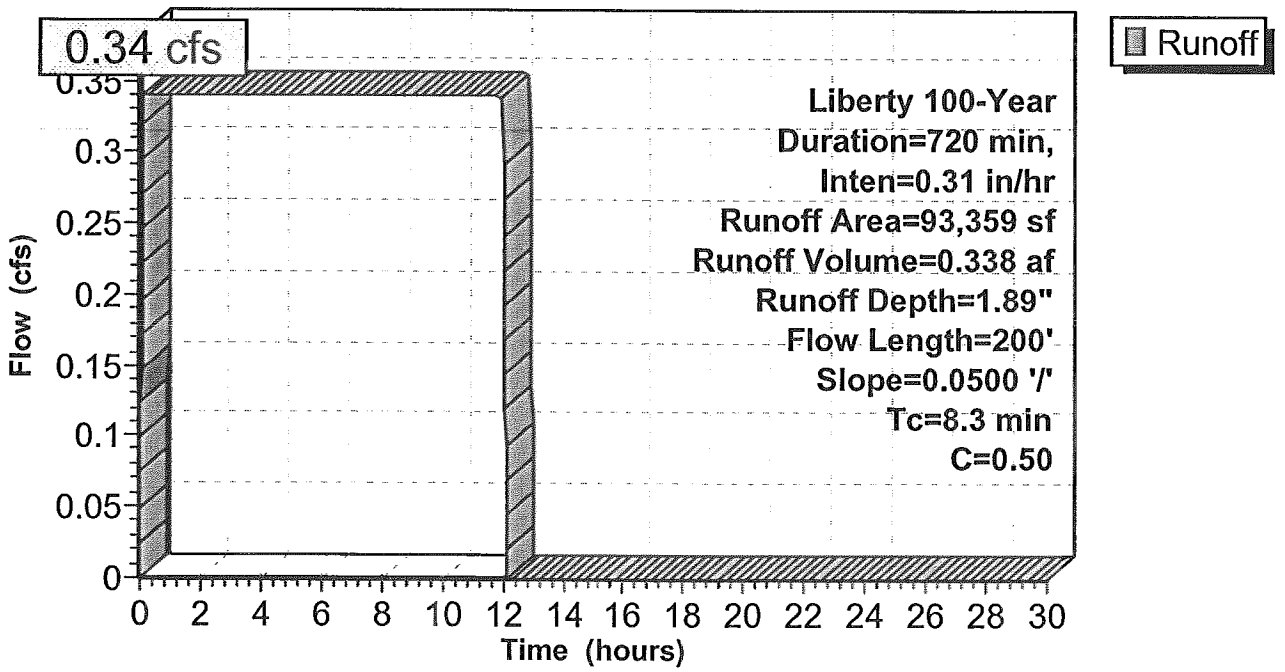
Runoff by Rational method, Rise/Fall=1.0/1.0 xTc, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Liberty 100-Year Duration=720 min, Inten=0.31 in/hr

Area (sf)	C	Description
54,450	0.60	Gravel Parking
4,376	0.75	Proposed Building+ Grass
34,533	0.30	North East Grass Area
93,359	0.50	Weighted Average
93,359	0.50	Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.3	200	0.0500	0.40		**Sheet Flow, Sheet** Smooth surfaces n= 0.011 P2= 0.10"

Subcatchment 1S: East North Parking & Grass

Hydrograph



Subcatchment 3S: West Parking, Barn, Yurt, Grass

Runoff = 0.29 cfs @ 0.19 hrs, Volume= 0.289 af, Depth= 3.40"

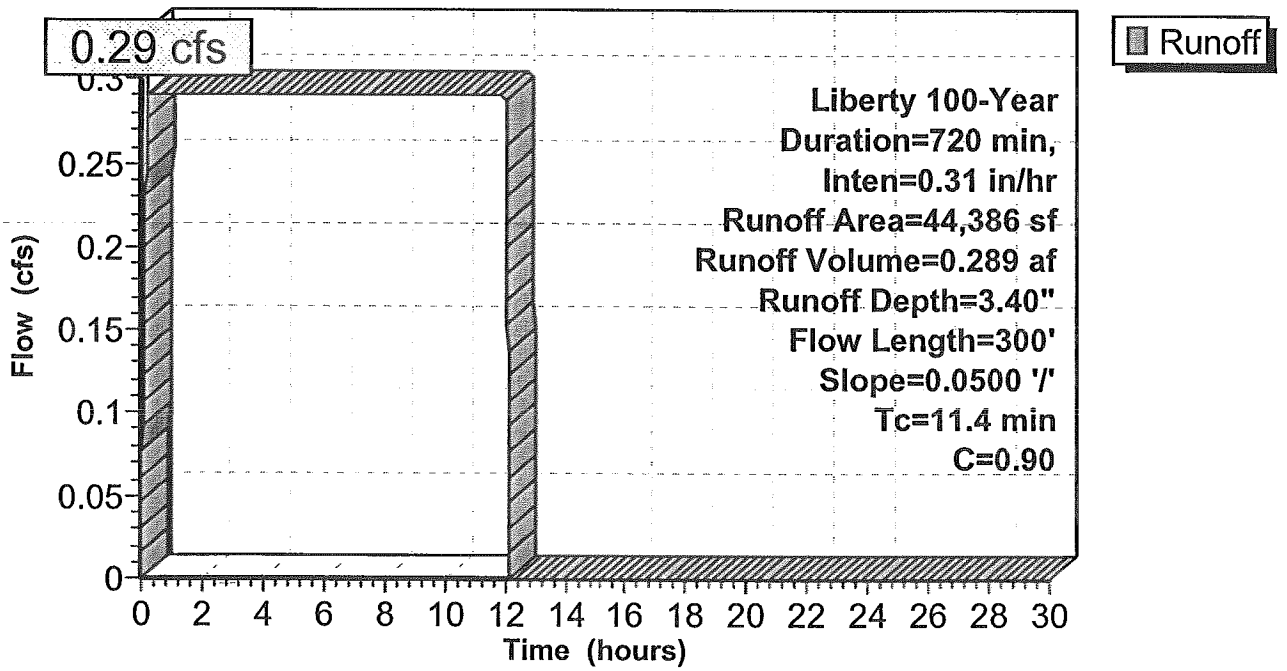
Runoff by Rational method, Rise/Fall=1.0/1.0 xTc, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Liberty 100-Year Duration=720 min, Inten=0.31 in/hr

Area (sf)	C	Description
44,386	0.90	Parking Hard Surface
44,386	0.90	Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
11.4	300	0.0500	0.44		**Sheet Flow, Sheet** Smooth surfaces n= 0.011 P2= 0.10"

Subcatchment 3S: West Parking, Barn, Yurt, Grass

Hydrograph



Subcatchment 4S: South Parking, Grass

Runoff = 0.07 cfs @ 0.19 hrs, Volume= 0.068 af, Depth= 1.63"

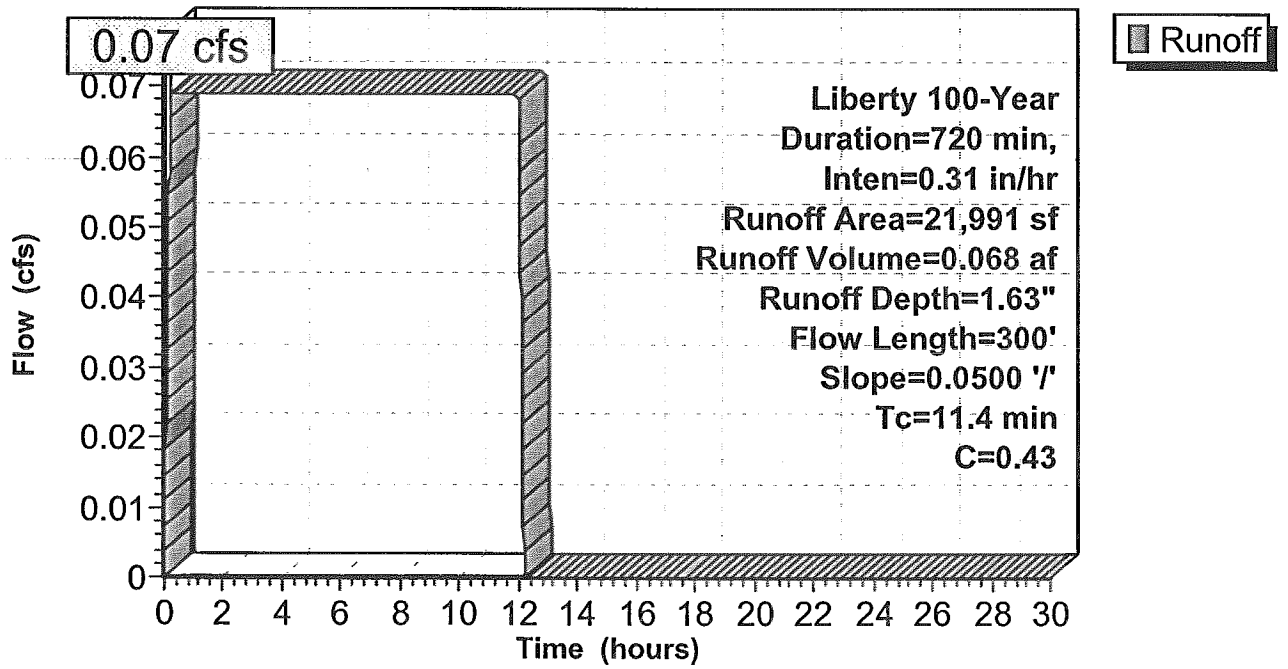
Runoff by Rational method, Rise/Fall=1.0/1.0 xTc, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Liberty 100-Year Duration=720 min, Inten=0.31 in/hr

Area (sf)	C	Description
9,859	0.60	Gravel Parking
12,132	0.30	Grass Natural Terrain
21,991	0.43	Weighted Average
21,991	0.43	Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
11.4	300	0.0500	0.44		**Sheet Flow, Sheet** Smooth surfaces n= 0.011 P2= 0.10"

Subcatchment 4S: South Parking, Grass

Hydrograph



Pond 3P: Proposed Detention

Inflow Area = 3.667 ac, Inflow Depth > 2.27" for 100-Year event
Inflow = 0.70 cfs @ 12.00 hrs, Volume= 0.695 af
Outflow = 0.38 cfs @ 12.11 hrs, Volume= 0.648 af, Atten= 46%, Lag= 6.8 min
Primary = 0.38 cfs @ 12.11 hrs, Volume= 0.648 af

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Peak Elev= 5,002.67' @ 12.11 hrs Surf.Area= 8,108 sf Storage= 17,745 cf

Plug-Flow detention time= 509.1 min calculated for 0.647 af (93% of inflow)
Center-of-Mass det. time= 483.2 min (872.3 - 389.1)

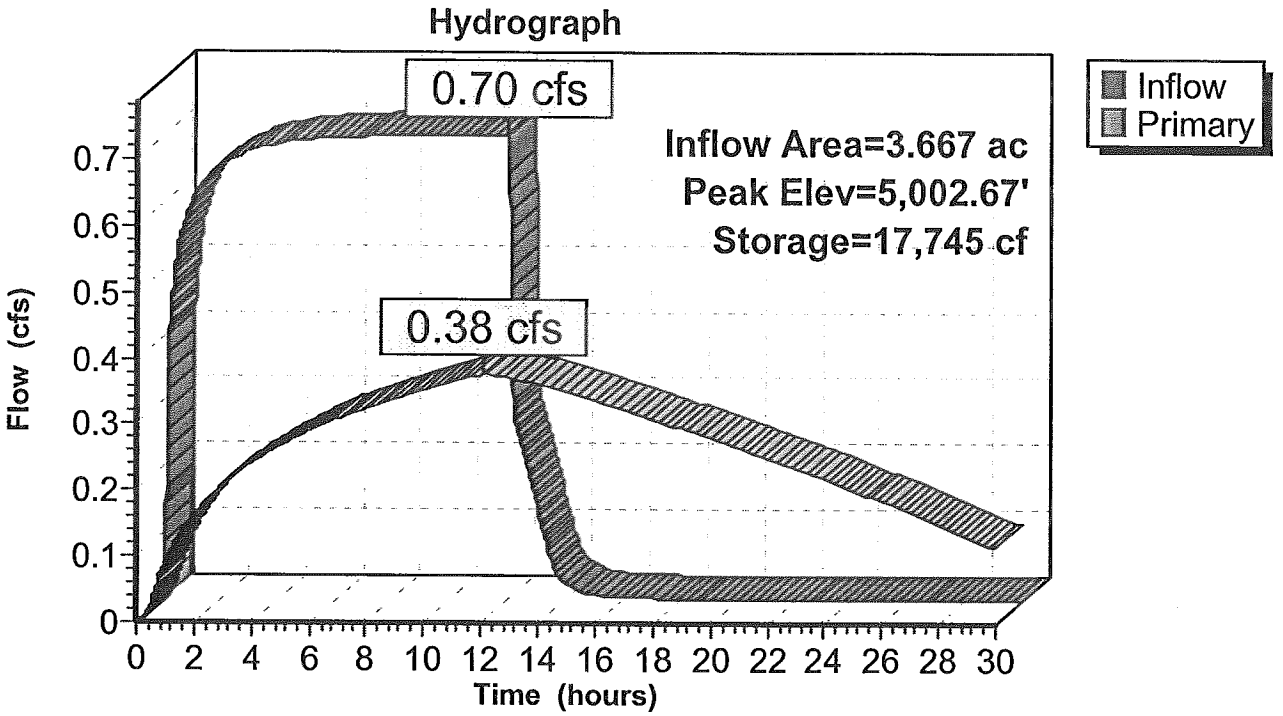
Volume	Invert	Avail.Storage	Storage Description
#1	5,000.00'	39,816 cf	**Custom Stage Data (Prismatic)** Listed below

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
5,000.00	5,150	0	0
5,001.00	6,200	5,675	5,675
5,002.00	7,317	6,759	12,434
5,003.00	8,494	7,906	20,339
5,004.00	9,714	9,104	29,443
5,005.00	11,031	10,373	39,816

Device	Routing	Invert	Outlet Devices
#1	Primary	5,000.00'	**3.0" Vert. Orifice/Grate** C= 0.600

Primary OutFlow Max=0.38 cfs @ 12.11 hrs HW=5,002.67' (Free Discharge)
↑—**1=Orifice/Grate** (Orifice Controls 0.38 cfs @ 7.68 fps)

Pond 3P: Proposed Detention



Pond 8P: Upper Small Pond & Inlet

Inflow Area = 1.019 ac, Inflow Depth = 3.40" for 100-Year event
Inflow = 0.29 cfs @ 0.19 hrs, Volume= 0.289 af
Outflow = 0.29 cfs @ 12.00 hrs, Volume= 0.289 af, Atten= 0%, Lag= 708.6 min
Primary = 0.29 cfs @ 12.00 hrs, Volume= 0.289 af

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Peak Elev= 5,010.96' @ 12.00 hrs Surf.Area= 0.028 ac Storage= 0.024 af

Plug-Flow detention time= 58.3 min calculated for 0.289 af (100% of inflow)
Center-of-Mass det. time= 58.1 min (423.8 - 365.7)

Volume	Invert	Avail.Storage	Storage Description
#1	5,010.00'	0.025 af	**5.00'W x 200.00'L x 1.00'H Prismatoid Z=0.5**

Device	Routing	Invert	Outlet Devices
#1	Primary	5,010.00'	**3.5" Vert. Orifice/Grate** C= 0.600

Primary OutFlow Max=0.29 cfs @ 12.00 hrs HW=5,010.96' (Free Discharge)
↑—**1=Orifice/Grate** (Orifice Controls 0.29 cfs @ 4.36 fps)

Pond 8P: Upper Small Pond & Inlet