SP18-04/6

STORMWATER MANAGEMENT, GRADING and EROSION CONTROL PLAN for WILSON TRUST PROPOSED STORAGE FACILITY 477995 HIGHWAY 95 NORTH PONDERAY, IDAHO

Project:	The applicant is requesting special use permit approval within the Rural District authorizing rental warehouses, boat and/or recreational vehicle storage or ministorage to be developed in four phases.
Landowner:	Wilson Trust
Prepared by:	James A. Sewell & Associates, LLC 1319 North Division Avenue Sandpoint, Idaho 83864
Date:	July 23, 2018

PROFESSIONAL ENGINEER REGISTERED 9992 7-24-18 STATE OF IDAHO TIM C. BLANKENSHIP

INTRODUCTION

The purpose of this report is to assess the capability of the proposed site to manage stormwater runoff and control erosion from impervious surfaces attributed to the construction of an approximately 6.5 acre storage facility.

The scope of this report is based on and limited to the known general and specific topography of the site, soil types as identified by site inspection, information obtained from the "Soil Survey of Bonner County", and observed surface site features.

EXISTING SITE CONDITIONS

The lot being developed is 17.8 acres and is located on US Highway 95. The lot currently contains a single family residence, a garage and a gravel driveway. The lot was previously the site of a drive-in-theater and there is a large gravel road remaining from the theater. The lot is mostly covered in grasses, and matures trees. The site is generally flat.

SOILS

The Bonner County Soil Survey indicates that the site is located in an area that contains Mission silt loam. Properties of the soil are found below:

Mission Silt Loam, 0 to 2 percent slopes

Setting:

Position on landscape:	terraces
Elevation:	2,000 – 2,800 feet
Mean annual precipitation:	25 to 38 inches
Mean annual temperature:	43° to 45° F
Frost free season:	90 to 120 days

Typical Profile:

0-1 inches:	slightly decomposed plant material
1-21 inches:	silt loam
21-33 inches:	silt
33-48 inches:	silt loam
48-67 inches:	fine sand

Soil Properties:

Slope:	0 to 2 percent
Depth to restrictive feature:	10 to 20 inches to fragipan
Drainage:	somewhat poorly drained
Permeability:	very low to moderately low
Available water storage:	very low (about 2.7 inches)
Depth to water table:	about 6 to 18 inches

From the Soil Survey of Bonner County Area, Idaho, 1982 published by the USDA Soil Conservation Service.

PROPOSED SITE CONDITIONS

The western 7.8 acres will remain as it is, aside from the addition of a business sign, and will not be considered in the stormwater management plan. The existing drainage patterns will remain unchanged. The eastern 10 acres is the site proposed for the storage facility. The storage facility will contain about 6.25 acres of impervious surface, with sixteen (16) 30'x100' buildings, eight (8) 100'x100' buildings, travel aisles, stormwater ditches, and a 37,000 sf swale with two v-notched weir outlets. The site is proposed to be constructed in four (4) phases as shown on the stormwater plan.

EXISTING IMPERVIOUS SURFACES

As noted above, only the eastern 10 acres will be considered in the stormwater management plan. There is currently part of a gravel road on the site.

Existing Gravel Road	6,034 sf

The total existing impervious area on the site is 6,034 sf. This gravel road will remain

TOTAL CREATED IMPERVIOUS SURFACES

A storage facility is proposed for the site.

Existing Gravel Road	6,034 sf
Proposed Buildings	128,000 sf
Proposed Hard Surfaced Area	144,414 sf
Total	278,448 sf

The total proposed increase in impervious surface is:
278,448 sf – 6,034 sf = 272,414 sf.

STORM WATER MANAGEMENT DESIGN PARAMETERS

Stormwater collection facilities in this report are designed to intercept and treat runoff from created impervious surfaces attributed to new building and hard surfaced travel aisle construction. Stormwater facilities described are designed to capture the first half inch of runoff from the created impervious surface areas and ensure that there will be no measurable increase in the peak rate of runoff from the site after development when compared with the runoff rate from the undeveloped state, for a 25-year storm, as required by the City of Ponderay city code. The following calculations demonstrate these requirements for both storage and treatment structures.

The site is effectively split into two watersheds. The western approximately 44% of the property will not be altered and the water from it will not drain into proposed GIAs. The proposed GIAs are designed to detain the increase in runoff due to the addition of the impervious surfaces attributed to construction of the storage building and hard surfaced travel aisles. According to the soil survey, the permeability of the existing soil is between 0.00 in/hr and 0.06 in/hr. Because of the low permeability of the native soils, it is assumed that no water will be infiltrated through the swale area. Therefore, a controlled method of releasing the water off-site has been designed to drain the swales at a rate at or below the pre-development rate.

The outflow rate from the proposed GIAs will be regulated by two 120-degree v-notched weirs. Flow balance tables have been calculated for each 25-year storm in order to determine the height in the swale and the corresponding outflow rate at each minute of each storm event. A swale area was sized that satisfied all of the following conditions:

- The outflow rate at the weir staying at or below the pre-development rate.
- The height in the GIA not exceeding the design depth of 8 inches.
- The swale can detain the volume of first half inch of runoff from additional impervious surfaces.

Created Impervious Surfaces

Proposed Buildings	128,000 sf
Proposed Paved Roads (Aisles)	143,134 sf
First ½" of Runoff	11,297 cf (271,134 sf x ½" of runoff)

Existing Conditions:
Time of Concentration – The time of concentration has been calculated using the Kerby equation. The Kerby equation was developed from data in watersheds having watercourses less than 1200ft., slopes less than 0.01ft/ft, and areas 10 acres or less.

$t_c = G\ (L*r / S^{0.5})^{0.467}$
where:
G = 0.8268 (constant)
L = 660' (longest watershed length)
r = 0.30 (poor grass)
S = 0.004 ft/ft (slope)

gives:
t_c = 35.5 min. (use 35 min. for design)

Rational Method

C = 0.70, Forest, Poor Cover, Soil Type D	Area = 3.33 acres
C = 0.84, Pasture, Poor Condition, Soil Type D	Area = 6.53 acres
C = 0.84, Gravel Surface, Soil Type D	Area = 0.14 acres

Total Composite C = 0.793

I = 1.1 inches per hour for the 25-year, 35-minute storm event
A = 10 acres
Q = 8.72 cfs

8.72 cfs is the maximum peak flow rate of discharge from the pre-developed site in the east watershed. 8.72 cfs is also the maximum discharge rate allowed from the post development east watershed. Actual post development outflow is 2.83 cfs through the proposed weir system. See Appendix B.

Proposed Construction:

Time of Concentration

$t_c = G\ (L^{*}r / S^{0.5})^{0.467}$

where:
G = 0.8268 (constant)
L = 810' (longest watershed length)

r = 0.02 (smooth pavement)	(length 150 ft)
r= 0.80 (dense grass)	(length 660 ft)

Total composite r = 0.66
S = 0.005 ft/ft (slope)

gives:
t_c = 53.5 min. (use 50 min. for design)

Rational Method:

C = 0.70, Forest, Poor Cover, Soil Type D	Area = 1.32 acres
C = 0.84, Pasture, Poor Condition, Soil Type D	Area = 1.12 acres
C = 0.65, Grass, Swale, Soil Type D	Area = 1.17 acres
C = 0.84, Gravel Surface, Soil Type D	Area = 0.14 acres
C = 0.99, Buildings	Area = 2.94 acres
C = 0.99, Asphalt Roads (Aisles)	Area = 3.32 acres

Total Composite C = 0.893
I = 0.87 inches per hour for the 25-year, 50-minute storm event
A = 10 acres
Q = 7.77 cfs

Lengthening the flow path through the watershed, as well as increasing the surface friction of the flow surface causes the proposed total outflow to be less than the pre-development rate. The proposed weir structures will limit the depth of water in the swale to 8 inches, per city requirements.

Storage Volume Required

As required by City of Ponderay code, the stormwater facilities shown have been designed to detain a volume equal to the first one-half inch (1/2") of runoff over the tributary created impervious area. The storm water facilities have also been designed to accommodate the 25-year storm event and not discharge water at a rate greater than the pre-development peak runoff rate. The Bowstring Method has been implemented to ensure that the peak discharge rate of the post-developed site not exceed that of the pre-development site. A summary can be found in Appendix B.

First ½" of runoff from impervious additional surface areas:	11,297 cf

Storage Volume Provided

Storage volume provided:	24,679 cf

The total storage volume shown on the plans is 24,679 cf utilizing a 8" depth. The GIA will be constructed 25 feet in from the south property line. Two v-notched weirs will control flow out of the GIA and into existing ditches to the south of the property.

Calculations Summary

The volume of the proposed GIA exceeds the requirements set forth by the City of Ponderay Code. The volume of the proposed GIA is greater than the volume of the first ½ inch of runoff from created impervious surfaces and there will be no increase in stormwater runoff rate from the site when compared to the pre-development conditions because the increase in runoff volume will be stored on site.

TEMPORARY EROSION CONTROL PLAN

Erosion control shall be maintained through the use of existing vegetation, silt fencing, reseeding of areas denuded of vegetation, and straw mulching. Only the phase currently under construction shall be cleared and grubbed .Native vegetation shall be maintained in all other areas to reduce erosion potential. Silt fencing shall be placed downslope of construction areas as shown in the stormwater management plan. Areas where construction activities temporarily cease for more than 21 days shall be stabilized with seeding or straw mulching. All erosion control measures shall be maintained in good working order. The contractor shall be responsible for maintenance of erosion control measures until such time that final stabilization of the site is complete. Once final stabilization is complete, the owner shall be responsible for maintenance of permanent erosion control measures.

Site Re-Vegetation

Existing grass and meadow areas disturbed during construction shall be reseeded as soon as possible after finish grading. Seed mixture recommendations may be obtained from the U.S.D.A. Natural Resource Conservation Service, landscape architect or a commercially marketed grass mixture may be applied according to the attached instructions.

Fertilization

It is recommended that a soil analysis be performed prior to fertilization and seeding. The fertilization guidelines should be determined by the soils analysis. The fertilizer type and rate of application should follow the recommendation of the U.S.D.A. Natural Resource Conservation Service or landscape architect.

MAINTENANCE AND CONSTRUCTION

During Construction

During construction the contractor shall walk the site and inspect storm water and erosion control measures at least once every 7 days and following any storm event of 0.5 inches or greater. Items the contractor shall inspect are:

- Silt Fence
    - Depth of sediment (sediment shall be removed from silt fence when it has reached 1/3 the height of the silt fence)
    - Tears in fabric
    - Fabric secured to fence posts, fence posts firmly in ground

- Reseeding / Straw Mulching
    - Bare spots, washouts, and healthy growth

If maintenance is found to be necessary, the contractor shall begin repairs within 24 hours.

After Final Stabilization

Upon completion of construction and final stabilization, the owners shall take responsibility for operation and maintenance of the storm water management and erosion control system as well as the funding for the continued maintenance of this system. After final stabilization, the storm water management and erosion control system shall be inspected at least every six months. The items that shall be inspected are:

- Grassy Infiltration Areas (GIA)
  - Check for sediment build up. If sediment depth exceeds 10% of GIA depth (0.8"), excavate sediment and re-seed GIA bottom.
- Reseeded Areas
  - Bare spots, washouts, and healthy vegetation growth
- V-Notched Weir
  - Clogs, sediment buildup, signs of erosion

IMPLEMENTATION SCHEDULE

The proposed construction schedule is as follows:

Summer 2018
- Install temporary erosion control prior to site disturbance
- Clear & grub building sites

Fall/Winter 2018
- Construct buildings and GIA
- Finish Grade
- Hydroseed or broadcast seed and mulch disturbed areas
- Check re-vegetated areas for bare spots, washouts, etc.
- Repair and reseed as necessary
- Remove temporary erosion control
- Final stabilization complete

Spring 2019
- Start additional phases of project and repeat implementation schedule

SUMMARY

With the proper implementation of the best management practices listed above and the recommendations listed in this report, the subject property is capable of supporting the proposed construction without substantial risk of soil erosion or sedimentation of surface waters. The site is capable of retaining and treating stormwater runoff in accordance with the City of Ponderay City Code.

APPENDIX A

Area Classification Map, Rainfall Intensity Diagram, Runoff Coefficients

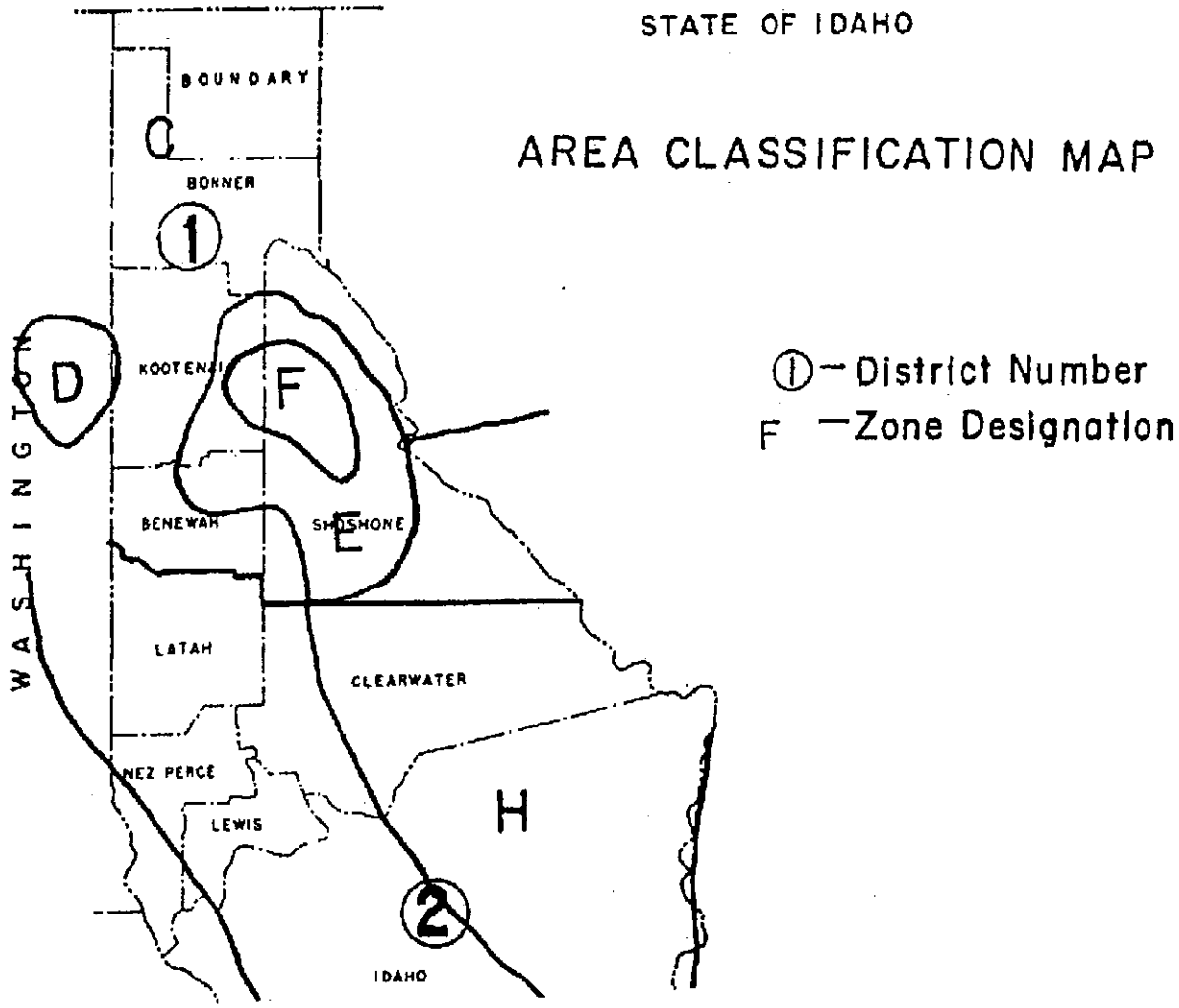


FIGURE 6-3 AREA CLASSIFICATION MAP FOR IDF CURVES - IDAHO
(IDAHO TRANSPORTATION DEPARTMENT)

FIGURE 6-4 ZONE C, INTENSITY-DURATION-FREQUENCY CURVE
(IDAHO TRANSPORTATION DEPARTMENT)

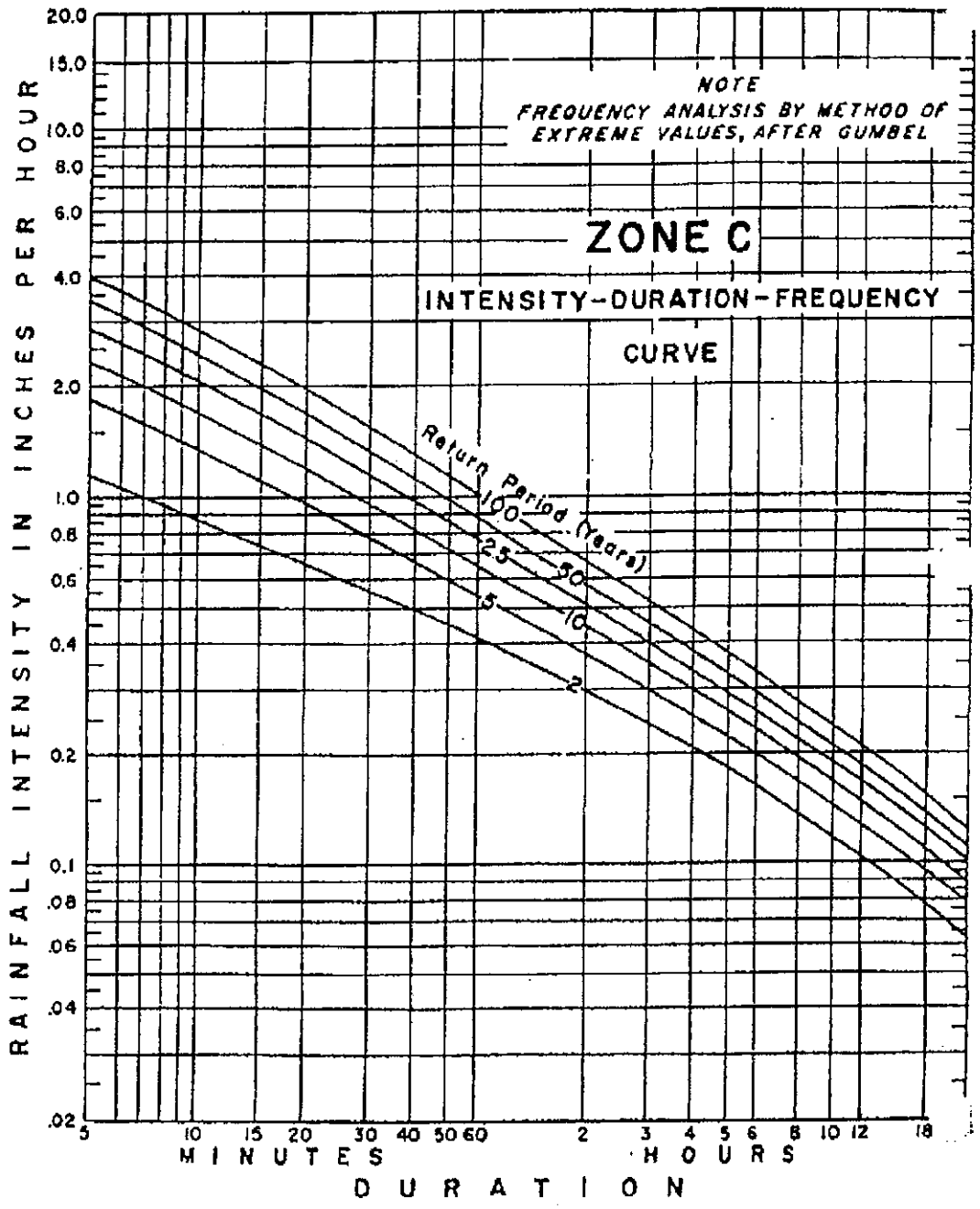


Table 1A.2. Values of Runoff Coefficient (C) for Rational Formula

Land Use	Description	Hydrologic Soils Group			
		A	B	C	D
Cultivated Land	Without conservation treatment	0.49	0.67	0.81	0.88
	With conservation treatment	0.27	0.43	0.67	0.67
Pasture or Range Land	Poor condition	0.38	0.63	0.78	0.84
	Good condition	---	0.25	0.51	0.65
Meadow	Good condition	---	---	0.41	0.61
Wood or Forest Land	Thin stand, poor cover, no mulch	---	0.34	0.59	0.70
	Good cover	---	---	0.45	0.59
Open Space, Lawn, Park, Golf Course, or Cemetery	Good condition (grass cover on 75% or more)	---	0.25	0.51	0.65
	Fair condition (grass cover on 50% to 75%)	---	0.45	0.63	0.74
Commercial and Business Area	85% impervious	0.84	0.90	0.93	0.96
Industrial District	72% impervious	0.67	0.81	0.88	0.92
Residential Lot Average lot size (acres): 1/8 1/4 1/3 1/2 1.0	Average % of lot impervious: 65 38 30 25 20	 0.59 0.29 --- --- ---	 0.76 0.55 0.49 0.45 0.41	 0.86 0.70 0.67 0.65 0.63	 0.90 0.80 0.78 0.76 0.74
Paved Area	Parking lots, roofs, driveways, etc.	0.99	0.99	0.99	0.99
Street or Road	Paved with curbs and storm sewers	0.99	0.99	0.99	0.99
	Gravel	0.57 0.49	0.76 0.69	0.84 0.80	0.88 0.84

Note: The designer must use judgment to select the appropriate C value within the range. Generally, larger areas with permeable soils, flat slopes, and dense vegetation should have the lowest C values. Smaller areas with dense soils, moderate to steep slopes, and sparse vegetation should assigned the highest C values.

APPENDIX B

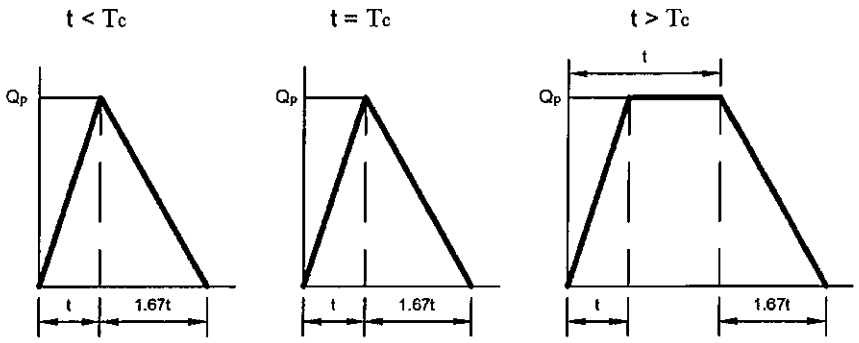
Stormwater Calculations and BMP Sizing

Bowstring Method (Modified Rational Method)

The bowstring method is used to estimate storage requirements for a given design storm using a series of hydrographs for different storm durations (t). This method computes the inflow volume and the outflow volume at intervals for a total of 24 hours. The required storage is taken as the maximum difference between the inflow and the outflow volumes during the duration of the design storm.

The time of concentration (T_c) is the time for stormwater runoff to travel from the hydraulically most distant point to the point of discharge. T_c is calculated with the Manning-Kinematic Equation.

Depending on the relative magnitude of the time of concentration (T_c) and the storm duration, the shape of the hydrograph generated with this method varies from triangular to trapezoidal



The total volume under the hydrograph at a given time (t) is given by the equation:

$V_{IN}(t) = 1.34 \times Q_p \times t$ for $t \leq Tc$

$V_{IN}(t) = (Q_p \times t) + (0.34 \times Q_p \times Tc)$ for $t > Tc$

The total volume leaving the hydrograph at a given time (t) is given by the equation:

$V_{OUT}(t) = Q_{OUT} \times t$

Note: The release of runoff off the site is limited to the peak pre-development rate at the time of concentration (T_c).

The storage required using the bowstring method is the maximum storage volume calculated for different storm durations (t).

$V_{STORAGE}(t) = V_{IN}(t) - V_{OUT}(t)$

Project: Wilson Trust Storage Facility
Date: 7/23/2018
By: JFQ

Time of Concentration (Tc)

Kerby Eqn: $T_c = G\left(\frac{Lr}{S^{0.5}}\right)^{0.467}$

Pre Development			*Post Development*		
G =	0.8268	constant	G =	0.8268	constant
L =	660	longest watershed length	L =	810	longest watershed length
r =	0.30	composite	r =	0.66	composite
S =	0.004	ft/ft (slope)	S =	0.005	ft/ft (slope)
Tc =	**35.5**	**min**	**Tc =**	**53.5**	**min**
use:	**35.0**	**min storm**	**use:**	**50.0**	**min storm**

Bowstring Method

	post		pre	
Composite C =	0.893		0.793	
Area (ac) =	10.00		10	
Tc=	50.0		35.0	
Max GIA Outflow Rate =	**7.77**	cfs	**8.72**	cfs

Number of Weir Outlets	2	
V-Notch Weir Angle	120	degrees
GIA area	37,000	sf
GIA perimeter	1,230	ft
GIA Design Depth	0.67	ft
Max Depth	0.63	ft
Max GIA Outflow:	2.83	(cfs)

OK

Time (min)	Elapsed Time (sec)	Intensity (in/hr)	Qin (cfs)	Vol in (cf)	Max GIA Depth (ft)	Max Qout (cfs)	Storage Req. (cf)
0	0	2.8	25.00				
5	300	2.8	25.00	10,052	0.27	0.32	9,921
7	420	2.5	22.33	12,565	0.33	0.55	12,275
10	600	2.1	18.75	15,077	0.39	0.83	14,499
15	900	1.7	15.18	18,308	0.43	1.25	17,056
20	1,200	1.5	13.40	21,539	0.49	1.71	19,297
25	1,500	1.35	12.06	24,232	0.47	2.08	20,845
30	1,800	1.2	10.72	25,847	0.46	2.24	21,474
35	2,100	1.1	9.82	27,642	0.48	2.42	22,136
40	2,400	0.97	8.66	27,857	0.44	2.33	21,799
45	2,700	0.92	8.22	29,724	0.46	2.49	22,410
50	3,000	0.87	7.77	31,232	0.46	2.59	22,766
55	3,300	0.81	7.23	31,248	0.47	2.55	22,617
60	3,600	0.75	6.70	30,942	0.50	2.47	18,350
75	4,500	0.7	6.25	34,506	0.57	2.83	23,585
120	7,200	0.51	4.55	37,436	0.63	2.82	23,145
180	10,800	0.4	3.57	42,221	0.63	2.82	23,145
240	14,400	0.34	3.04	46,818	0.63	2.70	23,150
300	18,000	0.29	2.59	49,256	0.60	2.43	22,190
360	21,600	0.28	2.50	56,559	0.60	2.44	22,205
420	25,200	0.26	2.32	60,878	0.59	2.29	21,673
480	28,800	0.25	2.23	66,573	0.58	2.22	21,397
540	32,400	0.23	2.05	68,641	0.56	2.05	20,718
600	36,000	0.22	1.96	72,729	0.55	1.96	20,368
660	39,600	0.2	1.79	72,547	0.53	1.78	19,613
720	43,200	0.19	1.70	75,028	0.52	1.70	19,220
780	46,800	0.185	1.65	79,001	0.51	1.65	19,020
840	50,400	0.18	1.61	82,653	0.51	1.61	18,815
900	54,000	0.17	1.52	83,526	0.50	1.52	18,391
960	57,600	0.165	1.47	86,374	0.49	1.47	18,174
1020	61,200	0.16	1.43	88,900	0.49	1.43	17,953
1080	64,800	0.15	1.34	88,166	0.47	1.34	17,497
1140	68,400	0.145	1.29	89,888	0.47	1.29	17,262
1200	72,000	0.14	1.25	91,290	0.46	1.25	17,023
1260	75,600	0.13	1.16	88,948	0.45	1.16	16,527
1320	79,200	0.125	1.12	89,546	0.44	1.12	16,271
1380	82,800	0.12	1.07	89,822	0.02	1.07	16,008
1440	86,400	0.11	0.98	85,873	0.42	0.98	15,462

Design Values

C Pre-development (Forest, Poor Cover, Soil Type D)	0.70
C Pre-development (Pasture, Poor Condition, Soil Type D)	0.84
C Grass (Swale Area, Soil Type D)	0.65
C Impervious surface:	0.99
C Gravel Surface , Soil Type D	0.84

Existing Conditions

	Acres	Sq. Ft
Total Contributing Area	10.00	435,600
Existing Forest	3.33	145,000
Existing Pasture Area	6.53	284,566
Existing Gravel Area	0.14	6,034

Composite C 0.793

Proposed Conditions

		Acres	Sq. Ft
Wood/Forest Area		1.32	57,486
Existing Pasture		1.14	49,875
Grassy Swale (Including Sides)		1.17	51072
Existing Gravel Area		0.14	6,034
Proposed Building		2.94	128,000
Paved Aisles & Parking		3.29	143,133
	Total	10.0	435,600

Composite C 0.893