

CEEn-2016CPST-002

Team Members: Cameron Lusvardi, Jacob Wadman, William Shelton

Soil Data Percolation App Development

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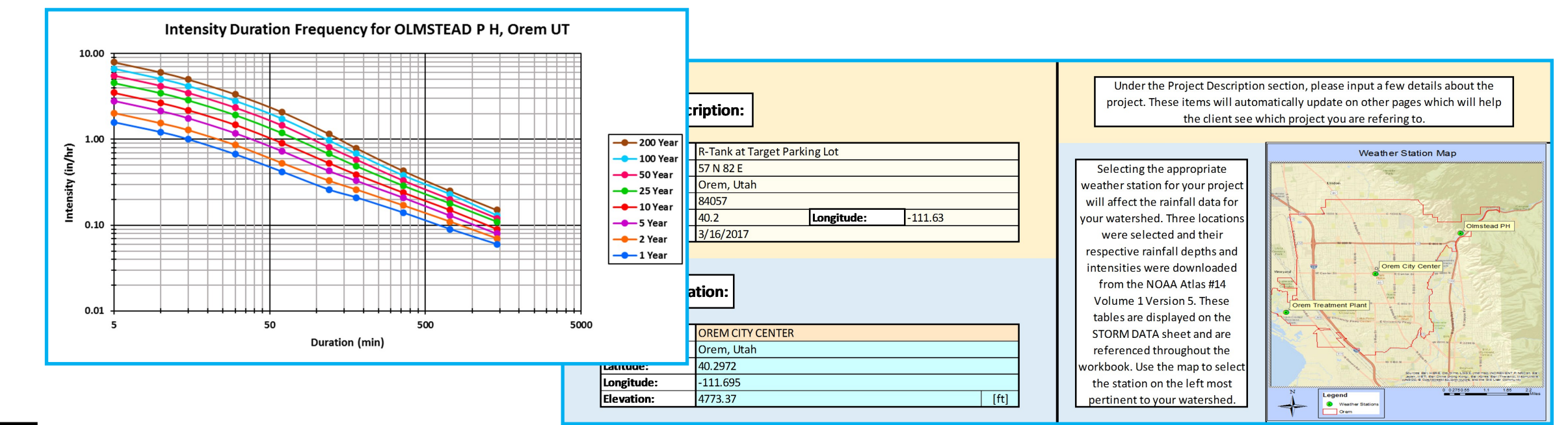
Objective

The Project that the SWL Engineers completed for the City of Orem was the development of an application capable of comparing and designing storm water management systems considering percolation. The systems of interest were R-Tanks, Storm Chambers, Sumps, Swales and Detention Ponds.



Storm Demands

The precipitation data was downloaded from NOAA which provided the application with rainfall depths and intensities for various return periods and durations. This data is the most basic unit of the model from which watershed flows can be determined. Knowing how much water falls on the watershed over time is a vital piece of the watershed flow equations. The data is gathered and used in calculations based of the observation station selected. Three stations were tabulated for the Orem Area.



Percolation

Based on the percolation surface area of the system, soil description, and hydraulic head, a percolation rate is automatically calculated and input to the Water Balance Table. The user also has the option to input a known percolation rate for the site location or use the GIS map created to apply a generic rate for the soil layer that the site falls within. Using percolation in design adjusts the required storage volume which can decrease the system's volume and save money. Most new systems for Orem City use percolation for groundwater recharge instead of piping the storm water off site.

Storm Demands

Water Balance

Water Balance

The user defines the watershed parameters on the first sheet of the application. This sheet can be seen to the left. Three options are provided being a simplified and complex rational method along with the NRCS method for determining composite coefficients and runoff flows. Depending on the method used, a time of concentration can be calculated or input by the user. These inflows occur at the storm drain and are shown in the table below under the Rainfall and Surface Tab.

Percolation

Design Process

Storage Required

System Design

The application contains multiple design sheets for the various specified systems. Each sheet uses a collection of unique system dependent parameters. Descriptions are given for each input for a user friendly interaction. A plethora of dimensions are automatically calculated for the user. The percolation is determined using the design layout and input instantaneously into the water balance page. These percolation values adjust the storage demands. This demand can then be compared with the storage capacity of the system. Iterations can then be made to specify an efficient design. Example design sheet shown to left.

System of Interest: Sump

Calculated Percolation: 0.52725215 [cfs]

Allowable Release Rate: 0 [cfs]

Storm of Interest: 999 Hours

Input Value: Time of Concentration: 20 (min)

Water Balance Table for Given Storm

Duration (days)	Rainfall			Surface			Percolation			Outflow (Release)			Storage
	Depth (in)	Intensity (in/hr)	Volume (ft ³)	Runoff (cfs)	Q Peak (cfs)	Q Volume (ft ³)	Q (cfs)	Q Volume (ft ³)	Q (cfs)	Q Volume (ft ³)	Volume (ft ³)		
0.003	5	0.22	2.64	7986	15.58	4673	15.58	0.53	158.18	0	0	4515	
0.007	10	0.34	2.01	12342	11.86	7115	11.86	0.53	316.35	0	0	6799	
0.010	15	0.41	1.66	14883	9.79	8815	9.79	0.53	474.53	0	0	8540	
0.021	30	0.56	1.12	20328	6.61	11894	6.61	0.53	949.05	0	0	10945	
0.042	60	0.69	0.69	25047	4.07	14656	4.07	0.53	1388.11	0	0	12757	
0.083	120	0.80	0.40	29040	2.36	16992	2.36	0.53	3796.22	0	0	13196	
0.125	180	0.90	0.30	32670	1.77	19116	1.77	0.53	5694.32	0	0	13422	
0.250	360	1.11	0.19	40293	1.12	24214	1.12	0.53	11388.05	0	0	12825	
0.500	720	1.41	0.12	51183	0.71	30586	0.71	0.53	22777.29	0	0	7808	
1.000	1440	1.67	0.07	60621	0.41	35883	0.41	0.53	45545.59	0	0	0	
2.000	2880	1.96	0.04	71348	0.24	40781	0.24	0.53	91191.17	0	0	0	
3.000	4320	2.18	0.03	79134	0.18	45478	0.18	0.53	136663.76	0	0	0	
4.000	5760	2.40	0.03	87120	0.18	61771	0.18	0.53	182218.34	0	0	0	
7.000	10080	2.79	0.02	101277	0.12	71366	0.12	0.53	318882.10	0	0	0	
10.000	14400	3.14	0.01	113982	0.06	50976	0.06	0.53	455545.86	0	0	0	

Storage Required: 13422 [ft³]

Storage Required

The Table above is system dependent for percolation and outflow and determines the maximum storage required which is reported below the table. Percolation and outflow will change based on the design. This is why the design process is a cycle. Changes to the parameters on the various design sheets will change the storage demands.