X. Storm Drainage Report

Tievoli Commons

J.O. SGL 22-036

PRELIMINARY STORM DRAINAGE REPORT

October 23, 2023

EXPIRES: 6/30/2024

DATED: 10/23/2023

SISUL ENGINEERING

A Division of Sisul Enterprises, Inc.

375 PORTLAND AVE.

Gladstone, OR 97027

phone: (503) 657-0188

Tievoli Commons:

Site Description:

The Tievoli Commons development will be located at 486 S Knott Street and 360 SE Township Road, in northeast Canby. It is adjacent t0 the north side of Township Road between S. Locust and S. Knott Streets. The site also has frontage on S Knott Street. It is an irregular shaped parcel that is tucked inside the block formed by Township Road, S Knott St., S Locust St., and SE 2nd Avenue. The Tievoli Commons development is proposed to develop the site with 30 townhouse-style multi-family units.

The property is between elevations 153 and 158 MSL. The site slopes from the south to the north at roughly 1 percent. There is little grade difference east to west across the site. The nearest river is the Molalla River, located approximately 5,400 feet southeast of the site at an approximately elevation of 116 feet. The nearest surface water is Burden's pond between SE 1st Avenue and Highway 99E, which is 5,250 feet northeast of the site at an elevation of 110 feet. Public street grades around the site are generally less than 2.5 percent.

The neighborhood consists of mostly older residential structures, although there are redevelopment sites in the vicinity. Residential properties are a mix of single family and multi-family. South of the site, across Township Rd., is the Canby Evangelical Church. One tree is on the site near S Knott St. Other site vegetation is primarily grasses and gardens.

Drainage Pattern and Description of Storm Drainage System:

This area of Canby is not served by a conveyance pipe storm drain system to carry runoff to a stream or river. Canby has very few storm drainage pipe networks and has typically relied on drywell infiltration as the preferred method of stormwater disposal. Surrounding streets are served by drywells for stormwater disposal and they function well in this part of Canby. Onsite runoff is also through infiltration. There are 4 existing homes onsite and the roof drains drain to the surface of the yard. Disposal is accomplished by stormwater ponding at low points in the yard, and then either infiltrating or evaporating.

The proposed storm drain system for Tievoli Commons is proposed to collect the storm water runoff from the roofs and private driveways in inlets and downspouts and convey the runoff to water quality treatment manholes and then drywells. Some LID elements will also be used to infiltrate stormwater at the surface, prior to it running into catch basin inlets. The water quality treatment manholes will have a "snout" outlet that will provide an oil/grease trap to remove those floating contaminants from the stormwater and a sump for collection of sediments. After the runoff water goes through the water quality treatment manholes, it will go into drywells for underground injection.

The private storm system will not be designed to collect or treat public stormwater runoff. Public street drainage systems in Township Road and Knott Street already exist and will remain in place. Public stormwater runoff will continue to be directed to existing public drywells in Township Road and S Knott St. Analysis of the public drainage system is not included in this report. The development will not modify the drainage paths of either public street. The existing public drywells are registered, and rule authorized with Oregon DEQ and included in the City of Canby's drywell inventory.

Design Storm:

The table in Section 4.301.a of the City of Canby Public Works Design Standards (December 2019) identifies the minimum design storm recurrence interval for a variety of storm drainage facilities. The table identifies that the following facilities shall be designed using a design storm with the noted recurrence intervals below:

Infiltration Facilities: UIC, LID elements	10 years
Minor: Streets, curbs, gutters, inlets, catch basin & connector drains	10 years
Major: Laterals (collectors) <250 tributary acres	10 years

1973 NOAA Atlas 2, Volume X and U.S. Department of Agriculture Isolpluvials for 24-hour storms in Oregon identify the 10-year, 24-hour storm event for Canby as having less than 3.5 inches of precipitation. The Oregon Department of Transportation TranGIS website identifies the 24-Hour Precipitation for this area of Canby as being 3.03 inches. A 24-hour storm having total rainfall of 3.5 inches therefore meets the meets or exceeds these two sources.

Soils:

Per the Soil Survey of Clackamas County Area, Oregon, prepared by the USDA, the soils underlying the surrounding area are 53A Latourell loam, hydrologic group "B".

Drywell Capacity and Infiltration Testing:

The City of Canby Public Works Design Standards, December 2019, Section 4.312 Infiltration Facilities, subsection c.3 states, "Drywells (UIC's) shall be located to collect up to a maximum of one half of an acre-foot of runoff. Gutter flow shall be limited to 400-500 lineal feet, provided the flow does not exceed 3" in height against the curb line. Any variation from this guideline shall be based on field infiltration tests."

Nearby Testing:

Dinsmore Estates: On October 21, 2013, GeoPacific Engineering, Inc. conducted performance testing of drywells located on SE 16th Avenue in the Dinsmore Estates subdivision east of Hope Village for the purpose of establishing a maximum rate of flow for a 26-foot-deep drywell in this part of Canby. Using three fire hoses connected to three separate fire hydrants, none of the drywells tested could be filled to its maximum capacity. A November 5, 2013, Infiltration Report from GeoPacific Engineering states that "Drywells one through four may be assumed to infiltrate at a maximum estimated rate of 2,500 gpm."[1] The Dinsmore Estates drywells are located approximately 4,000 feet south of Tievoli Commons in the same Latourell loam soils as the proposed development.

Faist Addition: On February 8th, 2017, GeoPacific Engineering, Inc. conducted a performance test of a drywell at Faist Addition No. 7 subdivision, located approximately 4,500 feet southeast of Tievoli Commons. A report prepared by GeoPacific Engineering, Inc. dated on February 14th, 2017, states that "Water sources for the test included a fire hydrant (metered to discharge 1,475 gpm), irrigation well (225 gpm), and a water truck (500 gpm). The water sources added until a static head level stabilized. 4 feet of static head was

[1] GeoPacific Engineering, Inc., James D. Imbrie PE, CEG, Infiltration Testing of As-Built Drywells, Dinsmore Estates, Canby, Oregon, November 5, 2013. See Appendix A.

achieved with the simultaneous addition of all three water sources, which total approximately 2,200 gpm."[2] The soils at Faist Addition No. 7 are the same Latourell loam soils as the Tievoli Commons site.

Canby High School: On June 11, 2018, Geotech Solutions, Inc. observed performance testing of a drywell near the Construction Building at Canby High School for the purpose of establishing a maximum rate of flow for a 26-foot-deep drywell in this part of Canby. The drywell had approximately 1.5 feet of sediment in the bottom at the time of the test. A six-inch fire hose was used to provide water for testing. The water level stabilized 10-feet below grade at a rate of 300 gallons per minute. The drywell flow rate is likely somewhat higher, with higher head, and even higher with the sediment removed from the bottom of the drywell. The Canby High School drywell is located approximately 3,800 feet west of the site. "[3] The soils in the location of the drywell at Canby High School is Canderly sandy loam, a different soil than at Tievoli Commons.

The Canby High School drywell is the most conservative test of the three drywells tested. The drywell was more than 20 years old at the time of the test and it had significant sediment loading in the base of the drywell. Because it was an older drywell, it was not protected on the upstream end with a water quality treatment manhole as is typical with new storm drainage system approvals. Having upstream water quality manholes reduces the sediment loading to the drywells and helps preserve their infiltration rate.

The high school drywell is located in Canderly sandy loam soil, whereas the other two drywells tested, and the Tievoli Commons site, are in the Latourell loam soil areas of Canby.

Although it may be overconservative to use the tested rate for the Canby High School drywell, we will use that drywell test for design purposes. A factor of safety is typically applied to the tested rate of a drywell in order to allow for slowing of the infiltration rate over time. However, because the High School drywell is already more than 20 years old, having a significant sediment load of 1.5 feet in the bottom of it, and because the test did not fill the drywell to its maximum elevation and its potential peak flow capacity, the tested rate is already conservative. An additional Factor of Safety will not be applied.

Conversion from GPM to CFS is made by the equation 448.8 GPM = 1 CFS.

Using the 300 GPM rate tested, 300 GPM * (1 CFS / 448.8 GPM) = 0.67 CFS

0.67 cfs is the assumed infiltration rate for one drywell. 1.34 cfs will be used for two drywells.

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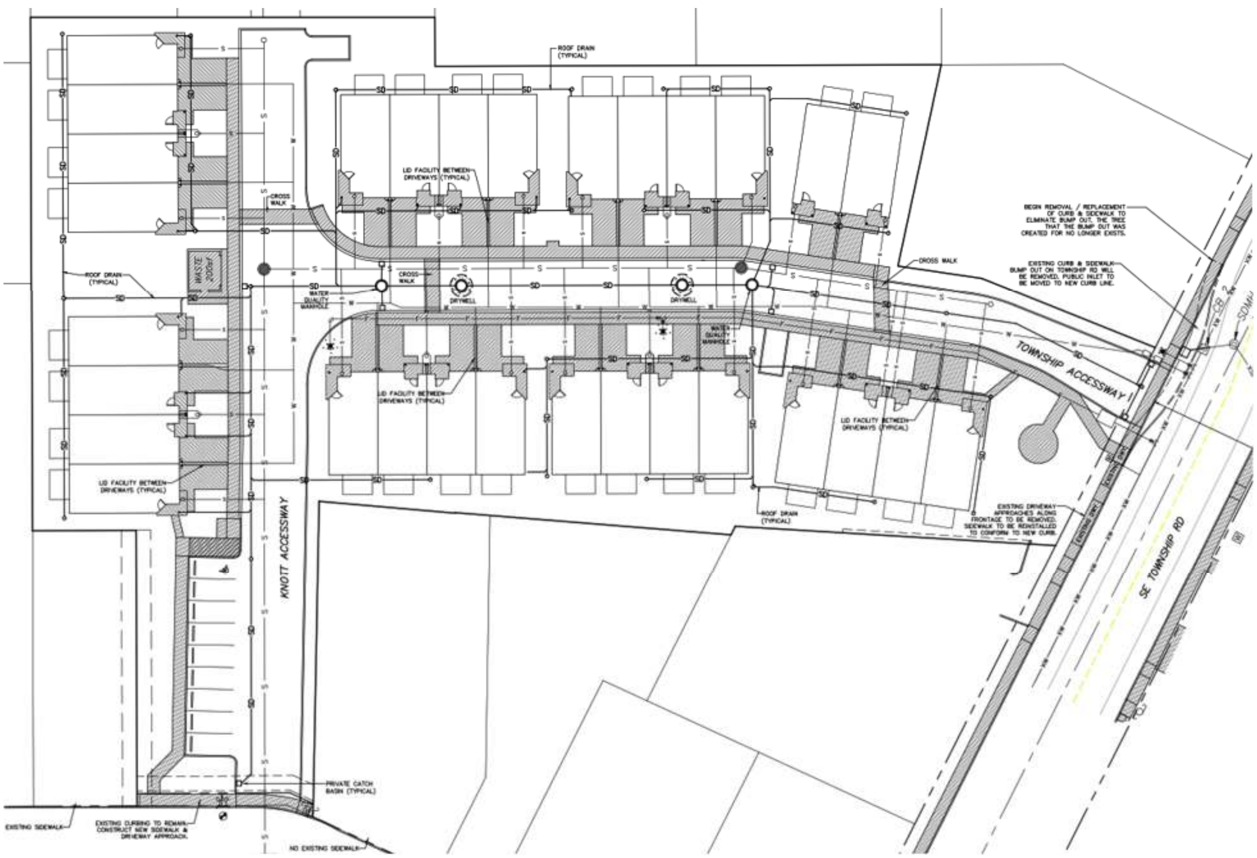
[2] GeoPacific Engineering, Inc., James D. Imbrie PE, CEG, Drywell Performance Test, Timber Park, Canby, Oregon, February 14, 2017.

[3] Geotech Solutions, Inc., Don Rondema PE, Geotechnical Engineering Services, Drywell Infiltration Testing Observation, Canby High School, Canby, Oregon, June 11, 2018. See Appendix A.

Contributing Basin Area:

CALCULATING STORMWATER FLOWS: Stormwater flows will be calculated using the Santa Barbara Urban Hydrograph (SBUH) method using a Type 1A SCS storm.

Site improvements will consist of eight new multifamily buildings with private accessways, sidewalks, and parking. Much of the site will be landscaped and will remain pervious. The drywells will be sized for the entire parcel.



<u>Contributing Areas:</u>

Roof, sidewalk, driveway	59,964 sf = 1.38 Ac
Landscaped areas	26,793 sf = 0.62 Ac.

Calculation Methodology:

Stormwater flow from the developed site will be calculated using the Santa Barbara Urban Hydrograph (SBUH) method using a Type 1A SCS storm.

Runoff Curve Numbers:

Per the Web Soil Survey, the site has Latourell loam soil, 53A. This soil is hydrologic soil group B. CN numbers for the site are identified below per Appendix D: Table 28 Runoff Curve Numbers, Clackamas County Water Environment Services Stormwater Standards, April 2023:

Paved streets, Sidewalks, Driveways,	CN = 98
Landscaping areas (poor condition, little grass)	CN = 79

Time of Concentration:

Time of concentration will be a combination of sheet flow, shallow concentrated flow and pipe flow. The time of concentration is from the hydraulically most distance point in the drainage basin. Following development, sheet flow distances will be minimal. For the purposes of this study, the time of concentration will be assumed to be the minimum time of concentration, 5 minutes.

King County SBUH Computations for 10-Year, 24-Hour Storm Event & Drywell Analysis:

KING COUNTY SBUH COMPUTATIONS FOR 10 YEAR, 24-HOUR STORM:

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                   KING COUNTY DEPARTMENT OF PUBLIC WORKS
                     Surface Water Management Division

                            HYDROGRAPH PROGRAMS
                                Version 4.20

                         1 - INFO ON THIS PROGRAM
                         2 - SBUHYD
                         3 - ROUTE
                         4 - ROUTE2
                         5 - ADDHYD
                         6 - BASEFLOW
                         7 - PLOTHYD
                         8 - DATA
                         9 - RDFAC
                        10 - RETURN TO DOS

ENTER OPTION: 2

SBUH/SCS METHOD FOR COMPUTING RUNOFF HYDROGRAPH

STORM OPTIONS:

1 - S.C.S. TYPE-1A
2 - 7-DAY DESIGN STORM
3 - STORM DATA FILE

SPECIFY STORM OPTION: 1

S.C.S. TYPE-1A RAINFALL DISTRIBUTION
ENTER: FREQ(YEAR), DURATION(HOUR), PRECIP(INCHES)
10,24,3.5
----------------------------------------------------------------------
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******************* S.C.S. TYPE-1A DISTRIBUTION *******************
*********  10-YEAR  24-HOUR STORM  ****  3.50" TOTAL PRECIP. *********
---------------------------------------------------------------------
ENTER: A(PERV), CN(PERV), A(IMPERV), CN(IMPERV), TC FOR BASIN NO.  1
.62,79,1.38,98,5

DATA PRINT-OUT:

  AREA(ACRES)     PERVIOUS     IMPERVIOUS   TC(MINUTES)
                  A      CN      A      CN
       2.0         .6  79.0    1.4    98.0         5.0

  PEAK-Q(CFS)   T-PEAK(HRS)    VOL(CU-FT)
     1.49          7.67          19887
```

←10 YEAR PEAK FLOW

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ENTER [d:][path]filename[.ext] FOR STORAGE OF COMPUTED HYDROGRAPH:
TComm10.dev

SPECIFY: C - CONTINUE, N - NEWSTORM, P - PRINT, S - STOP
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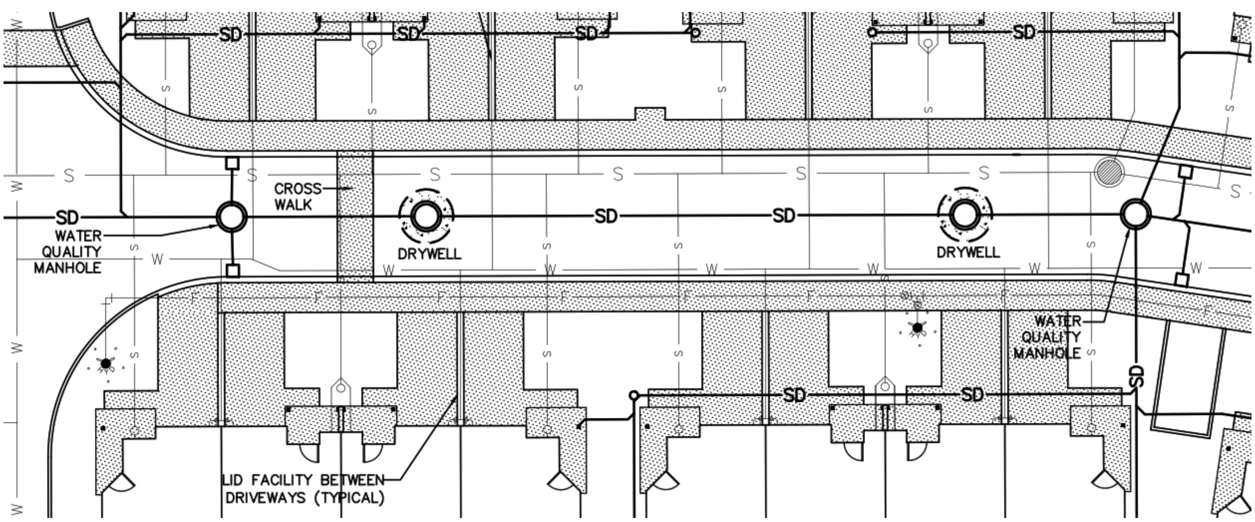
Comparison of Peak Flow to Drywell Capacity & Design Storm Routing:

The peak flow for the basin is calculated as 1.49 cfs for the 10-year storm event. This is higher than the 1.34 cfs peak flow rate of two drywells. Therefore, we shall route the storm through the drywell system to determine whether two drywells can accommodate the peak flow from a 10-year, 24-hour storm event.

Two drywells will be assumed to be adequate for initial calculation purposes, each one 26-feet deep, having a 4-foot interior diameter, 5-foot exterior diameter, and an annulus rock zone around the exterior measuring 9 feet diameter. The inflow rate into each of the two drywells will be approximately 60-40, near enough to 50-50 that the distribution will be modeled as even (see diagram on the following sheet). A pipe will connect the drywells at 12 feet below grade to evenly distribute the flow. There will be no piped overflow. A diagram of the system is below:



The bottom ten feet of the drywells will be perforated and that will be assumed to be the only portion of the system infiltrating into surrounding soils. The perimeter gravel layer will extend upwards to the ground surface, so infiltration will be able to occur along the entire water level, however, the highest infiltration rates are only anticipated to occur in the deeper soils. Neglecting the infiltration into the shallower soils will add additional conservatism into the design.

A spreadsheet of the stage-storage-discharge relationship is below.

Drywell Calculations
SGL 22-036
Tievoli Commons

Manhole Inside Diameter (ft) =	4.0		Infiltration rate per 1' section =	0.06676	(cfs)
Manhole Outside Diameter (ft) =	5.0				
Rock Thickness (ft) =	2.0				
Infiltration Rate (cubic in/sq. in/hr) =	102.0000				
Infiltration Rate (ft/sec) =	0.00236				
Factor of Safety =	1				
Wetted Area for 1' tall section (sf)	28.3				
Porosity of Rock =	40%				

Depth Below Grade (ft)	Water Depth (ft)	One Drywell: Drywell Storage Volume (cu. ft.)	One Drywell: Rock Layer Storage Volume (cu. ft.)	One Drywell: Total Storage Volume (cu. ft.)	One Drywell: Qout (cfs)	Two Drywells: Total Storage Volume (cu. ft.)	Two Drywells: Qout (cfs)
26	0	0.00	0.00	0.00	0.00	0.0	0.00
25	1	12.56	13.19	25.75	0.07	51.5	0.13
24	2	25.12	26.38	51.50	0.13	103.0	0.27
23	3	37.68	39.56	77.24	0.20	154.5	0.40
22	4	50.24	52.75	102.99	0.27	206.0	0.53
21	5	62.80	65.94	128.74	0.33	257.5	0.67
20	6	75.36	79.13	154.49	0.40	309.0	0.80
19	7	87.92	92.32	180.24	0.47	360.5	0.93
18	8	100.48	105.50	205.98	0.53	412.0	1.07
17	9	113.04	118.69	231.73	0.60	463.5	1.20
16	10	125.60	131.88	257.48	0.67	515.0	1.34
15	11	138.16	145.07	283.23	0.67	566.5	1.34
14	12	150.72	158.26	308.98	0.67	618.0	1.34
13	13	163.28	171.44	334.72	0.67	669.4	1.34
12	14	175.84	184.63	360.47	0.67	720.9	1.34
11	15	188.40	197.82	386.22	0.67	772.4	1.34
10	16	200.96	211.01	411.97	0.67	823.9	1.34
9	17	213.52	224.20	437.72	0.67	875.4	1.34
8	18	226.08	237.38	463.46	0.67	926.9	1.34
7	19	238.64	250.57	489.21	0.67	978.4	1.34
6	20	251.20	263.76	514.96	0.67	1029.9	1.34
5	21	263.76	276.95	540.71	0.67	1081.4	1.34
4	22	276.32	290.14	566.46	0.67	1132.9	1.34
3	23	288.88	303.32	592.20	0.67	1184.4	1.34
2	24	301.44	316.51	617.95	0.67	1235.9	1.34
1	25	314.00	329.70	643.70	0.67	1287.4	1.34
0	26	326.56	342.89	669.45	0.67	1338.9	1.34

Routing the design storm through the system is modeled using SBUH, KING COUNTY DEPARTMENT OF PUBLIC WORKS Surface Water Management Division, HYDROGRAPH PROGRAMS Version 4.20.

RESERVOIR ROUTING INFLOW/OUTFLOW ROUTINE

SPECIFY [d:][path]filename[.ext] OF ROUTING DATA Tievoli.*dat*
DISPLAY ROUTING DATA (Y or N)? *y*

ROUTING DATA:

STAGE(FT)	DISCHARGE(CFS)	STORAGE(CU-FT)	PERM-AREA(SQ-FT)
.00	.00	.0	.0
1.00	.13	51.5	.0
2.00	.27	103.0	.0
3.00	.40	154.5	.0
4.00	.53	206.0	.0
5.00	.67	257.5	.0
6.00	.80	309.0	.0
7.00	.93	360.5	.0
8.00	1.07	412.0	.0
9.00	1.20	463.5	.0
10.00	1.34	515.0	.0
11.00	1.34	566.5	.0
12.00	1.34	618.0	.0
13.00	1.34	669.4	.0
14.00	1.34	720.9	.0
15.00	1.34	772.4	.0
16.00	1.34	823.9	.0
17.00	1.34	875.4	.0
18.00	1.34	926.9	.0
19.00	1.34	978.4	.0
20.00	1.34	1029.9	.0
21.00	1.34	1081.4	.0
22.00	1.34	1132.9	.0
23.00	1.34	1184.4	.0
24.00	1.34	1235.9	.0
25.00	1.34	1287.4	.0
26.00	1.34	1338.9	.0

AVERAGE PERM-RATE: .0 MINUTES/INCH

ENTER [d:][path]filename[.ext] OF COMPUTED HYDROGRAPH:
TComm10.dev

INFLOW/OUTFLOW ANALYSIS:

PEAK-INFLOW(CFS)	PEAK-OUTFLOW(CFS)	OUTFLOW-VOL(CU-FT)
1.49	1.34	19995

INITIAL-STAGE(FT)	TIME-OF-PEAK(HRS)	PEAK-STAGE-ELEV(FT)
130.00	7.83	**140.88**

PEAK STORAGE: 560 CU-FT

ENTER [d:][path]filename[.ext] FOR STORAGE OF COMPUTED HYDROGRAPH:
TComm10.rte

The water level in the drywells is modeled to reach a depth of feet (elevation 140.9 feet) in the 10-year, 24-hour storm event. This would be approximately 15 feet below the drywell rim elevation and approximately 13.5 feet lower than the lowest catch basin grate elevation where runoff could back out of the system.

Two drywells are adequate to infiltrate a 10-year, 24-hour storm over the contributary area. ✓

Water Quality Treatment:

Water Quality treatment will be provided through the City of Canby's preferred method of catch basins with sumps and water quality treatment manholes. Because the City of Canby does not have a Water Quality Manhole detail, sump requirements will be sized based on Clean Water Services standards. Per CWS Drawing No. 250, 20 cu. ft. of sump volume is required per 1.0 cfs inflow. The entire basin has a peak flow of about 1.5 cfs. With the flow split more or less evenly between two water quality manholes, each water quality manhole will receive about 0.75 cfs, requiring a sump volume of 15 cu. ft.

Minimum sump depths are 3 feet. A 60-inch diameter manhole having a sump depth of 3 feet would provide a sump volume of 58.9 cu. ft.

3-foot sump depths are adequate. ✓

Water Quality is also being provided through the installation of pervious LID facilities including pervious surfacing in the area by the picnic tables and landscaped & graveled LID planters between the driveways. The purpose of these facilities is to provide water quality treatment through surface infiltration and uptake of pollutants in near surface soils and the plant community.

Conveyance Piping Calculations:

Conveyance piping shall be able to carry the 10-year storm event without surcharge. Per Section 4.206 of the City of Canby Public Works Design Standards, the Santa Barbara Urban Hydrograph (SBUH) method will be acceptable for estimating the peak runoff rates to be used in sizing storm drainage conveyance improvements. As determined earlier, using the SBUH method, the peak 10-year flow for the site is 1.5 cfs.

According to Section 4.301(b) of the City of Canby Public Works Design Standards: all storm drains shall be on a grade which produces a mean velocity, when flowing full, of at least three (3') feet per second. The minimum pipe grade used in this project is 0.5%.

```
                 Haestad Methods FlowMaster I version 3.13

       Circular Channel: Manning's Equation - Township Partition

 Comment:  8" Pipe capacity

  Solve For......Full Flow Capacity

  Diameter.......     0.66 ft          Velocity......      3.44 fps
  Slope..........     0.0100 ft/ft     Flow Area.....      0.34 sf
  Manning's n....     0.013            Critical Slope      0.0110 ft/ft
  Discharge......     1.18 cfs         Critical Depth      0.52 ft
  Depth..........     0.66 ft          Percent Full..    100.00 %
                                       Froude Number.    FULL
                                       Full Capacity.      1.18 cfs
                                       QMAX @.94D....      1.27 cfs
```

An 8" pipe laid at 1.0 percent would produce a velocity of 3.44 fps when flowing full or ½ full. Because the site flow will be divided and some flow will enter the southern drywell from the south while other flow will enter the northern drywell from the north, thereby dividing the 1.49 cfs peak flow more or less in half, an 8-inch pipe at a minimum 1% slope is anticipated to be adequate to carry the maximum anticipated pipe flow for the site. This can be confirmed at final design when the final piping scheme has been determined.

Summary:

The preceding calculations have shown that the planned storm drainage system will be adequate to convey the anticipated runoff from a 10-year, 24-hour storm event, to treat it to required water quality standards, and to dispose of the runoff into two 26-foot deep drywells. The calculations also demonstrate that an 8-inch diameter pipe at a 1% slope will produce a velocity of more than 3 feet per second.

Appendices:

Appendix A: Dinsmore Estates Drywell Testing:

November 5, 2013
Project No. 07-1252

Scott Investments
130 SW 2nd Avenue
Canby, Oregon 97013
Email: Tomscott @scott-investments.com

Copy: Email PatSisul@Sisulengineering.com

SUBJECT: INFILTRATION TESTING OF AS-BUILT DRYWELLS
DINSMORE ESTATES
CANBY, OREGON

This report presents the results of recent and higher capacity infiltration testing conducted by GeoPacific Engineering, Inc. (GeoPacific) for the above referenced project. Six years ago some dry well testing was performed, but the maximum flow rate achieved was only 300 to 400 gpm and no appreciable level of water was observed in the well. The purpose of our recent testing was to determine a constant head infiltration rate of the as-built drywells with a larger flow rate. Drywells were designed by Sisul Engineering Inc. for subsurface disposal of storm water. A total of four drywells were constructed within SE 16th Avenue. We measured the depth of the dry wells **one** (westernmost) and **four** (easternmost) at 27.5 and 26.5 feet deep feet, respectively. The contractor previously indicated that clean gravels were encountered during the construction of all of the drywells at a depth of 5 to 6 feet and gravel extended to the bottom of the drywell.

INFILTRATION TESTING

On October 31, 2013, GeoPacific observed infiltration tests in Drywell one and Drywell four. Tests were performed by using three 2½ inch fire hoses drained into the drywell from the only three fire hydrants in the area. Water meter readings, the volume of water in the water truck and the start and end time of each test was recorded. The rate of infiltration did not allow a significant depth of water to accumulate in the drywells, and falling head tests were not feasible since they drained in less than 30 seconds. An observed constant head infiltration rate was obtained by calculating the total volume of water introduced into the drywell divided by the time required for the dry well to empty.

The observed, constant head infiltration test rates of Drywell one and four was 633 gpm with 2.5 feet of head pressure. Tests were performed from about one to three hours long. No change was noted after the 3 hour test. We understand there is approximately 16 vertical feet from the bottom of the drywells to the inverts of the incoming pipes. It is our opinion that the tested drywells are capable of infiltrating stormwater at a rate of at least 4 times what was delivered into the wells. Infiltration testing was limited by the ability to pump water into the drywell. For planning purposes, Drywells one through four may be assumed to infiltrate at a maximum estimated rate of 2,500 gpm.

14835 SW 72nd Avenue
Portland, Oregon 97224

Tel (503) 598-8445
Fax (503) 941-9281

Project No. 07-1252
Dinsmore Estates

ENVIRONMENTAL CONSIDERATIONS AND LIMITATIONS

Subsurface stormwater disposal systems have the potential to affect groundwater quality, since they provide a more direct pathway for infiltrating surface water to reach groundwater aquifers. Consequently, disposal systems should be constructed and maintained in accordance with Oregon Department of Environmental Quality requirements for groundwater protection. Systems receiving runoff from pavement areas, typically include water quality elements such as oil traps, filters or similar measures.

Infiltration test methods and procedures attempt to simulate the as-built conditions of the planned subsurface disposal system or systems. However, due to natural variations in soil properties, actual infiltration rates may vary from the measured and/or recommended design rates. Storm events in excess of the design event are inevitable. All systems should be constructed such that potential overflow is discharged in a controlled manner away from structures.

We appreciate this opportunity to be of service. Please call if you have any questions.

Sincerely,

GEOPACIFIC ENGINEERING, INC.

REGISTERED PROFESSIONAL ENGINEER
14743PE
OREGON
JAN. 23, 1990
JAMES D. IMBRIE

EXPIRES: 06/30/2015

James D. Imbrie, P.E., C.E.G.
Geotechnical Engineer

Appendix B: Faist Addition Drywell Testing:

Real-World Geotechnical Solutions
Investigation • Design • Construction Support

February 14, 2017
GeoPacific Project No. 16-4426

Joe Schiewe
Timber Park LLC.
PO Box 61426
Vancouver, WA 98666
Via email: joe@holthomes.com

CC: Pat Sisul, Sisul Engineering via email: patsisul@sisulengineering.com

Subject: DRYWELL PERFORMANCE TEST
SE 11TH AVENUE & SE VINE STREET
CANBY, OREGON

Reference: *Geotechnical Engineering Report, Timber Park, 2134, 2192, & 2220 SE 13th Avenue, Canby, Clackamas County, Oregon*; GeoPacific Engineering, Inc. report dated December 29, 2016.

On February 8, 2017, GeoPacific Engineering, Inc. (GeoPacific) conducted a performance test of an existing drywell at the subdivision adjacent to the proposed Timber Park Subdivision. The drywell is 4 feet in diameter, 26.3 feet deep, and located near the intersection of SE 11th Avenue and SE Vine Street. Soils in the bottom of the drywell were observed to consist of subrounded gravel and boulders. Water sources for the test included a fire hydrant (metered to discharge 1,475 gallons per minute), irrigation well (225 gallons per minute), and a water truck (500 gallons per minute). The water sources were added until a static head level stabilized. 4 feet of static head was achieved with the simultaneous addition of all three water sources, which total approximately 2,200 gallons per minute. The 4 feet of head sustained for the duration of the test, which continued until the water truck was empty.

We appreciate this opportunity to be of service.

Sincerely,

GEOPACIFIC ENGINEERING, INC.

REGISTERED PROFESSIONAL ENGINEER
14743PE
OREGON
JAN. 23, 1990
JAMES D. IMBRIE

James D. Imbrie, P.E.
Principal Geotechnical Engineer EXPIRES: 06/30/2017

Appendix C: Canby High School Drywell Testing:

Geotech Solutions Inc.

June 11, 2018 *sisul-18-4-gi*

Sisul Engineering
pat@sisulengineering.com

GEOTECHNICAL ENGINEERING SERVICES
DRY WELL INFILTRATION TESTING OBSERVATION
Canby High School, Canby, Oregon

As authorized, on June 11, 2018 we observed testing of the dry well located at Canby High School south of the shop buildings in a gravel area adjacent to the greenhouses. NTA was conducting the testing, and our measurements and theirs indicated a 26 foot deep dry well from grade, with roughly 1.5 feet of sediment in the base. The lower 10 feet of the dry well consisted of 10 feet of 5 foot diameter perforated rings, with solid risers above that to the surface manhole. NTA stated they built this dry well, and recalled a one foot annuls of gravel around the rings as was typical.

For testing a hydrant and 6-inch line were used along with a flow meter and testing trailer. A rate of 300 gallons per minute was used for dry well filling. With the water level 10 feet below grade, the water level in the well stabilized. This was sustained for several minutes, with no change in rate or water level, and a total volume of 5,000 gallons used in the test. Falling head readings were taken for several minutes after flow shut off, and confirmed these rates.

Based on this testing the dry well at present has a flow rate of 300 gpm with water levels 10 feet below present grade. The dry well flow rate is likely somewhat higher with a higher head, and likely could be increased by removing sediment.

We appreciate the opportunity to work with you on this project. Please contact us if you have any questions.

Sincerely,

Don Rondema, MS, PE, GE
Principal

REGISTERED PROFESSIONAL ENGINEER 16,073
OREGON
JULY 21, 1992
DON RONDEMA
Expires 12/31/18

1112 7th Street, Oregon City, OR 97045 *p 503.657.3487 f 503.722.9946*

Appendix D: Soil Data

Soil Map—Clackamas County Area, Oregon
(Tievoli Commons)

Map Scale: 1:970 if printed on A portrait (8.5" x 11") sheet.

Meters: 0, 10, 20, 40, 60

Feet: 0, 45, 90, 180, 270

N

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 10N WGS84

MAP LEGEND

Area of Interest (AOI)
- Area of Interest (AOI)

Soils
- Soil Map Unit Polygons
- Soil Map Unit Lines
- Soil Map Unit Points

Special Point Features
- Blowout
- Borrow Pit
- Clay Spot
- Closed Depression
- Gravel Pit
- Gravelly Spot
- Landfill
- Lava Flow
- Marsh or swamp
- Mine or Quarry
- Miscellaneous Water
- Perennial Water
- Rock Outcrop
- Saline Spot
- Sandy Spot
- Severely Eroded Spot
- Sinkhole
- Slide or Slip
- Sodic Spot
- Spoil Area
- Stony Spot
- Very Stony Spot
- Wet Spot
- Other
- Special Line Features

Water Features
- Streams and Canals

Transportation
- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background
- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:20,000.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Clackamas County Area, Oregon
Survey Area Data: Version 20, Sep 7, 2023

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Sep 26, 2022—Oct 11, 2022

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
53A	Latourell loam, 0 to 3 percent slopes	1.9	100.0%
Totals for Area of Interest		**1.9**	**100.0%**

Appendix E: Curve numbers:

Table 28. Runoff Curve Numbers[2]

	Curve Numbers for Hydrological Soil Groups			
Description	**A**	**B**	**C**	**D**
Open space (lawns, parks, golf courses, cemeteries)				
Poor condition (< 50% grass coverage)	68	79	86	89
Fair condition (50 to 75% grass coverage)	49	69	79	84
Good condition (>75% grass coverage)	39	61	74	80
Impervious Areas				
Paved areas (parking lots, roofs, driveways)	98	98	98	98
Streets and roads				
Paved with curbs	98	98	98	98
Paved with open ditches	83	89	92	93
Gravel	76	85	89	91
Dirt	72	82	87	89
Urban Districts				
Commercial and business (85% impervious)	89	92	94	95
Industrial (72% impervious)	81	88	91	93
Residential districts by average lot size				
1/8 acre or less (65% impervious)	77	85	90	92
1/4 acre (38% impervious)	61	75	83	87
1/3 acre (30% impervious)	57	72	81	86
1/2 acre (25% impervious)	54	70	80	85
Woods (Good Hydrologic Condition)	70*			

** CN for Predeveloped Forest Condition is assumed to be equivalent to Woods condition with Hydrologic Soil Group C.*

[2] Urban Hydrology for Small Watersheds (TR-55), USDA Soil Conservation Service Engineering Division (1986).