WDY Structural • Civil Engineers

PRELIMINARY STORM DRAINAGE REPORT

FOR

Altabird Corneluis

N 4th Ave & N Holladay St
Cornelius, OR 97113

August 5, 2022

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WDY Structural • Civil Engineers

Mildren Design Group, P.C.
4875 SW Griffith Dr. Ste 300
Beaverton, OR 97005

August 5, 2022

RE: Altabird Cornelius "Storm Drainage Narrative"
N 4th Ave & N Holladay St
Cornelius, OR 97113

Dear Mr. Tuan,

At your request, WDY, Inc. has completed the following preliminary storm drainage calculations for a new site in Cornelius, OR. The purpose of this report is to analyze the proposed improvements to meet the requirements of the 2019 Clean Water Services (CWS).

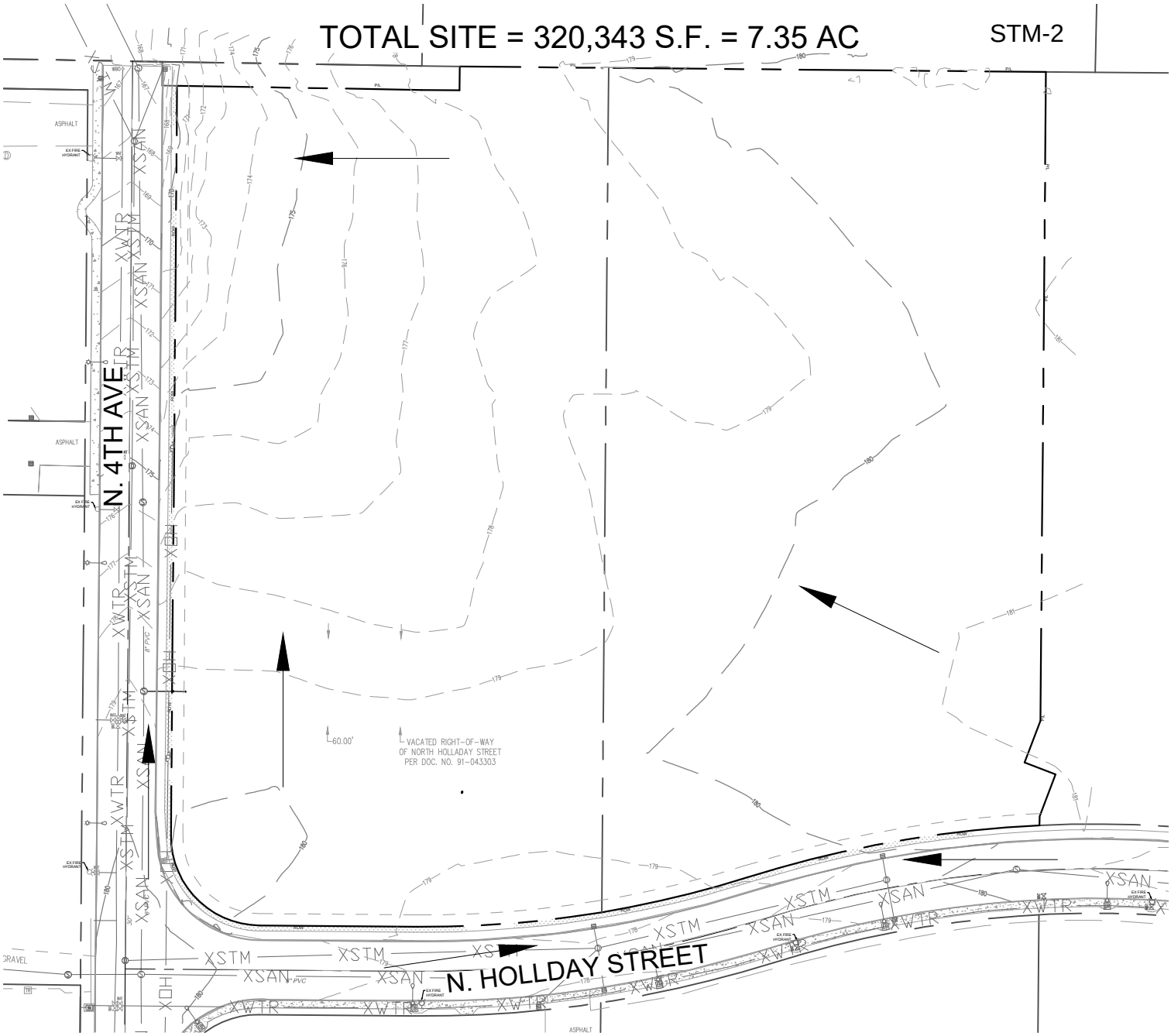
Site Existing Conditions:
The site is on four vacant lots totaling 7.35 acres consisting of a grassy field. The site generally slopes from the southeast corner of the site to the northwest corner with two wetland areas on the western half of the lot. There is an existing 24 inch diameter storm pipe in N Holladay that heads west. There is also a 30 inch diameter storm pipe in N 4th Ave that heads north to Council Creek. There is an existing curb along N 4th Ave and N Holladay St frontage, but no existing sidewalk. See STM-2 for an existing conditions map.

Proposed New Site Development:
The proposed site improvements will install a new 156,000 SF building, 122,000 SF of onsite asphalt parking and 8,500 SF of onsite concrete sidewalk. Offsite improvements includes new 6' wide sidewalk behind the existing curb and (3) driveway entrances. See STM-3 and for proposed improvements map.

The City of Cornelius mostly follows CWS' requirements for stormwater mitigation. CWS requirements have been used to size the water quality and quantity facilities. The site falls into CWS's Category 2 (Risk-Lot; Developed Area; Large Project) for determining detention and hydromodification requirements. Using table 4-7, the 2-year post-developed release rate will need to be discharged at 50% of the pre-developed release rate. The 5- and 10-year post-developed release rates are required to be less than or equal to their pre-developed release rates. The stormwater runoff from the new impervious area will be collected and routed to new Contech Storm Filter units or vegetated LIDA facility which convey to an underground detention system beneath the asphalt areas.

The site has been divided into 2 separate basins for calculations – North and South. The site will have loading docks located in the North drainage basin that will be 4 feet lower than the finish floor. The north and south drainage basin is separated by the midline of the new building.

Both basins will be collected via catch basins and routed to a filtered vault for water quality treatment sized for each basin's tributary areas. After treatment, the runoff will be routed to 48" diameter underground storm detention pipes, with overflow to the existing storm main within 4th Avenue. Due to the layout of the site, vegetative systems were maximized when available. Each drainage basin has an unlined vegetated stormwater facility to provide treatment and some detention prior to overflow to the underground detention pipes. See the following for project areas, storm mitigation and pipe conveyance for the proposed project site improvements.



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EXISTING AREA MAP

STORMWATER EXISTING TRIBUTARY AREA MAP		**SCALE:**	1"=100'-0"
Job Name:	ALTABIRD CORNELIUS	**Date:**	2022-05-12
Job No.:	22120.80	**Drawn:**	JR
Client:	MDG	**Sheet:**	STM-2 OF 02

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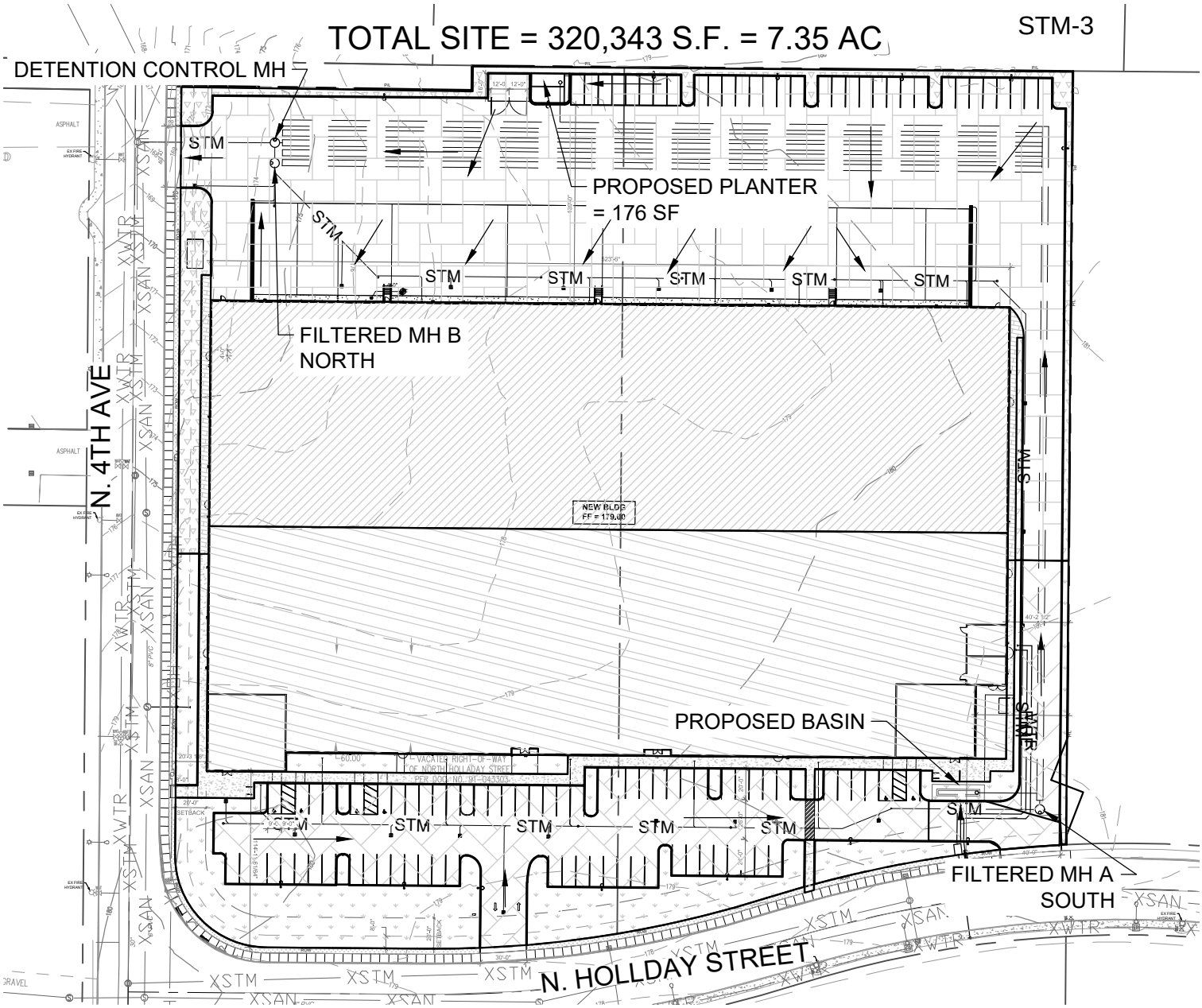
FILE: 22120_DRAINAGE MAPS.DWG EXISTING 8/9/2022 10:56:37 AM – KUBOYAMA



PROPOSED IMPERVIOUS N. ROOF: 77,478 SF CN=98	PROPOSED IMPERVIOUS N. AC: 85,810 SF CN=98	PROPOSED PERVIOUS N. LANDSCAPE: 9,142 SF CN=86	PROPOSED IMPERVIOUS N. SIDEWALK: 1,884 SF CN=98
PROPOSED IMPERVIOUS S. ROOF: 78,124 SF CN=98	PROPOSED IMPERVIOUS S. AC: 36,806 SF CN=98	PROPOSED PERVIOUS S. LANDSCAPE: 24,499 SF CN=86	PROPOSED IMPERVIOUS S. SIDEWALK: 6,600 SF CN=98

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PROPOSED AREA MAP

STORMWATER PROPOSED TRIBUTARY AREA MAP

		SCALE:	1"=100'-0"
Job Name:	ALTABIRD CORNELIUS	**Date:**	2022-05-12
Job No.:	22120.80	**Drawn:**	JR
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FILE: 22120_DRAINAGE MAPS.DWG PROPOSED 8/9/2022 10:56:51 AM – KUBOYAMA

Project Storm Drainage Design Criteria

Rainfall Depths per CWS Standard Drawing No. 1280:

Storm Event	Rainfall Depth
2 yr	2.5 in
5 yr	3.10 in
10 yr	3.45 in
25 yr	3.90 in
100 yr	4.50 in

Table 1: 24 Hour Rainfall Depths

Stormwater Quality Management Design Criteria:

- CWS: Stormwater quality approaches shall be designed for a dry weather storm event totaling 0.36 inches of precipitation falling in 4 hours with an average storm return period of 96 hour

Stormwater Quantity Management Design Criteria:

- CWS: CWS requires hydromodification for this site as it falls in Category 2, (Risk-Low; Developed Area, Large Project).
  - Peak Runoff per CWS Table 4-7:

Post-Development Peak Runoff Rate	Pre-Development Peak Runoff Rate Target
2 yr, 24-hour	50% of 2-year, 24-hour
5 yr, 24-hour	5 yr, 24-hour
10 yr, 24-hour	10 yr, 24-hour

  - Target Rates for CWS criteria (CN=79):

Pre-Development Peak Runoff Rate	Peak Runoff Rate Target
2 yr, 24-hour	0.72 cfs x 0.5 = .36 cfs
5 yr, 24-hour	1.26 cfs
10 yr, 24-hour	1.55 cfs

Project Areas

Pre-Developed Area **On**site (Entire Site) = 320,343 SF = 7.35 AC

Landscape (CN=79) =	320,343 SF

Post-Developed Area **On**site (North Site) = 174,314 SF

Building (CN=98) =	77,478 SF
Parking Lot (CN=98) =	85,810 SF
Sidewalk (CN=98) =	1,884 SF
Landscape (CN=86) =	9,142 SF

Post-Developed Area **On**site (South Site) = 146,029 SF

Building (CN=98) =	78,124 SF
Parking Lot (CN=98) =	36,806 SF
Sidewalk (CN=98) =	6,600 SF
Landscape (CN=86) =	24,499 SF

Post-Developed Area **On**site Total= 320,343 SF

Building (CN=98) =	155,602 SF
Parking Lot (CN=98) =	122,616 SF
Sidewalk (CN=98) =	8,484 SF
Landscape (CN=86) =	33,641 SF

Time of Concentration

Typical Time of Concentration Equations

- Sheet Flow: $Tc = \frac{0.42\,(n * L)^{0.8}}{(I)^{0.5}\,(S)^{0.4}}$;
  - Where n = Manning's Roughness Coefficient; L = Length; I = Intensity; S = Slope
- Shallow Flow: $Tc = \frac{L}{(V)\,(60\text{ sec/min})}$;
  - Where V = Velocity = $k\,(S)^{0.5}$; k = time of concentration velocity factor

Pre-Developed Time of Concentration (CWS)

- Sheet Flow:
  - L = 150 ft; S = 0.7%; n = 0.15; I = 2.5"/hr
  - Tc_1 = 23.3 min
- Shallow Flow
  - L = 544 ft; k = 7; S = 2.0%
  - Tc_2 = 9.1 min
- $T_{Pre\text{-}Dev}$ = 32.4 min; **Use 33 min for design**

Time of Concentration T_c FOR PROPOSED CONDITIONS = 5 min

Water Quality Treatment Calculations

Planter N = 176 SF (Max 6% treatment Area = 2,933)

- N Area Asphalt = 1,438 SF

Basin S = 160 SF (Max 6% treatment Area = 2,666)

- S Area Asphalt = 2,095 SF

South Contech MH

- Asphalt = 33,016 SF
- Sidewalk = 6,226 SF
- S. Roof = 78,124 SF
- **Total Impervious = 117,366 SF**
- **Total Pervious = 24,499 SF**

North Contech MH

- Asphalt = 82,483 SF
- Sidewalk = 2,258 SF
- N. Roof = 77,478 SF
- **Total Impervious = 162,219 SF**
- **Total Pervious = 9,142 SF**

Sizing the Onsite (South) Treatment Cartridges (CWS): Total Impervious Area

$$\text{Water Quality Flow (WQF)} = \frac{(0.36\text{ in}) \times (117{,}366\text{ sf})}{(12\text{ in/ft})\,(4\text{ hr})\,(60\text{ min/hr})\,(60\text{ sec/min})} = 0.24\text{ cfs}$$

$$\#\text{ of Cartridges} = \frac{(\text{WQF}) \times (60\text{ sec/min}) \times 7.48\text{ gal/ft}^3}{22.5\text{ GPM/cartridge}} = 4.8\text{ Cartridges (min)}$$

Sizing the Onsite (North) Treatment Cartridges(CWS): Total Impervious Area

$$\text{Water Quality Flow (WQF)} = \frac{(0.36\text{ in}) \times (162{,}219\text{ sf})}{(12\text{ in/ft})\,(4\text{ hr})\,(60\text{ min/hr})\,(60\text{ sec/min})} = 0.34\text{ cfs}$$

$$\#\text{ of Cartridges} = \frac{(\text{WQF}) \times (60\text{ sec/min}) \times 7.48\text{ gal/ft}^3}{22.5\text{ GPM/cartridge}} = 6.8\text{ Cartridges (min)}$$

Summary for Storm Water Quantity

The site is managed by a single storm detention manhole. The site will require 3,000 LF of 48 inch diameter pipe. See STM-14 to STM-16 for print outs.

Storm Event	Target Rate	Post-Dev (No Detention)	Post-Dev Onsite w/ Detention
2-yr	0.36 cfs	4.01 cfs	0.36 cfs
5 yr	1.26 cfs	5.08 cfs	0.75 cfs
10 yr	1.55 cfs	5.61 cfs	0.97 cfs

22120_Storm *Type IA 24-hr 2 yr Rainfall=2.50"*
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Summary for Subcatchment 10S: Pre-Dev CWS

Runoff = 0.72 cfs @ 8.19 hrs, Volume= 0.513 af, Depth> 0.84"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-26.00 hrs, dt= 0.01 hrs
Type IA 24-hr 2 yr Rainfall=2.50"

	Area (sf)	CN	Description
*	320,343	79	PERV
	320,343	79	100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
33.0					**Direct Entry,**

22120_Storm *Type IA 24-hr 5 yr Rainfall=3.10"*
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Summary for Subcatchment 10S: Pre-Dev CWS

Runoff = 1.26 cfs @ 8.12 hrs, Volume= 0.773 af, Depth> 1.26"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-26.00 hrs, dt= 0.01 hrs
Type IA 24-hr 5 yr Rainfall=3.10"

	Area (sf)	CN	Description
*	320,343	79	PERV
	320,343	79	100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
33.0					**Direct Entry,**

22120_Storm *Type IA 24-hr 10 yr Rainfall=3.40"*
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Summary for Subcatchment 10S: Pre-Dev CWS

Runoff = 1.55 cfs @ 8.10 hrs, Volume= 0.912 af, Depth> 1.49"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-26.00 hrs, dt= 0.01 hrs
Type IA 24-hr 10 yr Rainfall=3.40"

	Area (sf)	CN	Description
*	320,343	79	PERV
	320,343	79	100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
33.0					**Direct Entry,**

22120_Storm *Type IA 24-hr 2 yr Rainfall=2.50"*
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Summary for Subcatchment 2S: Post Dev Site

Runoff = 4.01 cfs @ 7.89 hrs, Volume= 1.326 af, Depth= 2.16"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-26.00 hrs, dt= 0.01 hrs
Type IA 24-hr 2 yr Rainfall=2.50"

	Area (sf)	CN	Description
*	154,956	98	Bldg
*	123,629	98	Parking
*	8,342	98	Sidewalk
*	33,416	86	Landscape
	320,343	97	Weighted Average
	33,416	86	10.43% Pervious Area
	286,927	98	89.57% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Summary for Subcatchment 2S: Post Dev Site

Runoff = 5.08 cfs @ 7.88 hrs, Volume= 1.686 af, Depth= 2.75"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-26.00 hrs, dt= 0.01 hrs
Type IA 24-hr 5 yr Rainfall=3.10"

	Area (sf)	CN	Description
*	154,956	98	Bldg
*	123,629	98	Parking
*	8,342	98	Sidewalk
*	33,416	86	Landscape
	320,343	97	Weighted Average
	33,416	86	10.43% Pervious Area
	286,927	98	89.57% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Summary for Subcatchment 2S: Post Dev Site

Runoff = 5.61 cfs @ 7.88 hrs, Volume= 1.867 af, Depth= 3.05"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-26.00 hrs, dt= 0.01 hrs
Type IA 24-hr 10 yr Rainfall=3.40"

	Area (sf)	CN	Description
*	154,956	98	Bldg
*	123,629	98	Parking
*	8,342	98	Sidewalk
*	33,416	86	Landscape
	320,343	97	Weighted Average
	33,416	86	10.43% Pervious Area
	286,927	98	89.57% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

22120_Storm *Type IA 24-hr 2 yr Rainfall=2.50"*
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Summary for Pond 20P: 48" Detention CWS (MA EDIT)

Inflow Area = 7.354 ac, 89.50% Impervious, Inflow Depth = 2.16" for 2 yr event
Inflow = 4.01 cfs @ 7.89 hrs, Volume= 1.325 af
Outflow = 0.36 cfs @ 23.26 hrs, Volume= 0.601 af, Atten= 91%, Lag= 922.4 min
Primary = 0.36 cfs @ 23.26 hrs, Volume= 0.601 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-26.00 hrs, dt= 0.01 hrs / 9
Peak Elev= 167.14' @ 23.26 hrs Surf.Area= 8,646 sf Storage= 34,040 cf
Flood Elev= 172.00' Surf.Area= 0 sf Storage= 37,699 cf

Plug-Flow detention time= 526.5 min calculated for 0.601 af (45% of inflow)
Center-of-Mass det. time= 245.6 min (925.9 - 680.4)

Volume	Invert	Avail.Storage	Storage Description
#1	163.75'	37,699 cf	**48.0" D x 3,000.0'L Pipe Storage**

Device	Routing	Invert	Outlet Devices
#1	Primary	163.55'	**12.0" Round Culvert** L= 85.0' CMP, end-section conforming to fill, Ke= 0.500 Inlet / Outlet Invert= 163.55' / 162.70' S= 0.0100 '/' Cc= 0.900 n= 0.013, Flow Area= 0.79 sf
#2	Device 1	163.55'	**2.7" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#3	Device 1	167.14'	**6.1" Vert. Orifice/Grate** C= 0.600
#4	Device 1	167.74'	**12.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=0.36 cfs @ 23.26 hrs HW=167.14' (Free Discharge)
└─**1=Culvert** (Passes 0.36 cfs of 5.72 cfs potential flow)
  ├─**2=Orifice/Grate** (Orifice Controls 0.36 cfs @ 9.12 fps)
  ├─**3=Orifice/Grate** (Controls 0.00 cfs)
  └─**4=Orifice/Grate** (Controls 0.00 cfs)

22120_Storm *Type IA 24-hr 5 yr Rainfall=3.10"*
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Summary for Pond 20P: 48" Detention CWS (MA EDIT)

Inflow Area = 7.354 ac, 89.50% Impervious, Inflow Depth = 2.75" for 5 yr event
Inflow = 5.08 cfs @ 7.88 hrs, Volume= 1.685 af
Outflow = 0.75 cfs @ 14.29 hrs, Volume= 0.928 af, Atten= 85%, Lag= 384.1 min
Primary = 0.75 cfs @ 14.29 hrs, Volume= 0.928 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-26.00 hrs, dt= 0.01 hrs / 9
Peak Elev= 167.54' @ 14.29 hrs Surf.Area= 5,338 sf Storage= 36,948 cf
Flood Elev= 172.00' Surf.Area= 0 sf Storage= 37,699 cf

Plug-Flow detention time= 519.9 min calculated for 0.928 af (55% of inflow)
Center-of-Mass det. time= 270.3 min (944.0 - 673.8)

Volume	Invert	Avail.Storage	Storage Description
#1	163.75'	37,699 cf	**48.0" D x 3,000.0'L Pipe Storage**

Device	Routing	Invert	Outlet Devices
#1	Primary	163.55'	**12.0" Round Culvert** L= 85.0' CMP, end-section conforming to fill, Ke= 0.500 Inlet / Outlet Invert= 163.55' / 162.70' S= 0.0100 '/' Cc= 0.900 n= 0.013, Flow Area= 0.79 sf
#2	Device 1	163.55'	**2.7" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#3	Device 1	167.14'	**6.1" Vert. Orifice/Grate** C= 0.600
#4	Device 1	167.74'	**12.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=0.75 cfs @ 14.29 hrs HW=167.54' (Free Discharge)
└─**1=Culvert** (Passes 0.75 cfs of 6.05 cfs potential flow)
  ├─**2=Orifice/Grate** (Orifice Controls 0.38 cfs @ 9.62 fps)
  ├─**3=Orifice/Grate** (Orifice Controls 0.37 cfs @ 2.16 fps)
  └─**4=Orifice/Grate** (Controls 0.00 cfs)

22120_Storm *Type IA 24-hr 10 yr Rainfall=3.40"*
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Summary for Pond 20P: 48" Detention CWS (MA EDIT)

Inflow Area = 7.354 ac, 89.50% Impervious, Inflow Depth = 3.05" for 10 yr event
Inflow = 5.61 cfs @ 7.88 hrs, Volume= 1.866 af
Outflow = 0.97 cfs @ 11.57 hrs, Volume= 1.105 af, Atten= 83%, Lag= 221.1 min
Primary = 0.97 cfs @ 11.57 hrs, Volume= 1.105 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-26.00 hrs, dt= 0.01 hrs / 9
Peak Elev= 167.74' @ 11.57 hrs Surf.Area= 871 sf Storage= 37,696 cf
Flood Elev= 172.00' Surf.Area= 0 sf Storage= 37,699 cf

Plug-Flow detention time= 486.2 min calculated for 1.105 af (59% of inflow)
Center-of-Mass det. time= 251.9 min (923.0 - 671.2)

Volume	Invert	Avail.Storage	Storage Description
#1	163.75'	37,699 cf	**48.0" D x 3,000.0'L Pipe Storage**

Device	Routing	Invert	Outlet Devices
#1	Primary	163.55'	**12.0" Round Culvert** L= 85.0' CMP, end-section conforming to fill, Ke= 0.500 Inlet / Outlet Invert= 163.55' / 162.70' S= 0.0100 '/' Cc= 0.900 n= 0.013, Flow Area= 0.79 sf
#2	Device 1	163.55'	**2.7" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#3	Device 1	167.14'	**6.1" Vert. Orifice/Grate** C= 0.600
#4	Device 1	167.74'	**12.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=0.97 cfs @ 11.57 hrs HW=167.74' (Free Discharge)
└─**1=Culvert** (Passes 0.97 cfs of 6.21 cfs potential flow)
  ├─**2=Orifice/Grate** (Orifice Controls 0.39 cfs @ 9.86 fps)
  ├─**3=Orifice/Grate** (Orifice Controls 0.58 cfs @ 2.85 fps)
  └─**4=Orifice/Grate** (Weir Controls 0.00 cfs @ 0.22 fps)