Preliminary Drainage Report

Cove: Garden Apartments

21509220

Prepared for
Lloyd Hill Architecture
1914 Willamette Falls Drive, Suite 280
West Linn, Oregon
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August 12, 2015

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Document Information

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Document Control

Version	Date	Author	Author Initials	Reviewer	Reviewer Initials
1	8/12/2015	Atalia Raskin	ASR	Mike Towle	MDT

EXECUTIVE SUMMARY

The proposed Cove: Garden Apartment project is located southwest of Main Street in Oregon City, Oregon (See Vicinity Map). The project will redevelop a former concrete batch plant to include eleven multi-family buildings totaling 244 units. There will be 374 parking spaces and eight detached garage structures. Residential facilities include a community center, pool, and two mixed-use buildings with non-residential space.

The project includes roadway and infrastructure improvements to Main Street, the construction of a trail access parking lot, and grading within the North Park and Lot 1. These improvements are discussed in a separate report, *Drainage Report – Phase 1 Infrastructure*, by Cardno and dated August 12, 2015. This report is included within the Technical Appendix.

The design follows the City of Oregon City *Stormwater and Grading Design Standards*, issued in December 1999 and the standards within the Surface Water Management Agency of Clackamas County (SWMACC) Rules and Regulations using the *Surface Water Quality Facilities Technical Guidance Handbook dated 1991,* as well as the *Clean Water Services Low Impact Development Approaches Handbook dated July, 2009*.

Water Quality

The project discharges into the Clackamette Cove, a former gravel quarry that connects with the Clackamas River just upstream of the Willamette River. The Clackamas River is classified as water quality limited for dissolved oxygen and biological criteria. Typical pollutants from multi-family residential projects include: nutrients, pesticides, metals, oil, grease and other petroleum products, and sediment. Dissolved copper, dissolved zinc, and PAHs are generally the primary constituents of concern for stormwater runoff in Oregon streams and rivers for their impact on ESA listed species. These pollutants are specially targeted for treatment in the selected stormwater management system. The water quality storm is listed below.

- Water Quality Storm: 33% of the 2-yr, 24-hour storm event (0.83-inch precipitation depth).

The stormwater management system at the development was designed to maximize stormwater treatment through Contech StormFilters and LIDA swales.

The selected StormFilter contains cartridges filled with ZPG filter media (a mixture of zeolite, perlite, and granular activated carbon), which are designed to remove sediment, metals, and stormwater pollutants from stormwater runoff.

LIDA swales are landscaped reservoirs that collect and treat stormwater runoff through vegetation and soil media. They also provide pollutant reduction and flow attenuation to reduce hydraulic impacts from urban developments on downstream rivers. Specific elements are incorporated into the swale design to increase the effectiveness of this stormwater facility type. Design elements include trapped catch basins to remove coarse sediment, using soil media to provide stormwater filtration, and vegetation to will provide plant uptake.

The calculated peak water quality flow from the 7.18 acres of new impervious area is 1.47 cu-ft/sec with an approximate 13,619 cu-ft runoff volume.

Water Quantity

The project will connect into the proposed storm sewer within Main Street. The public storm sewer connects into an existing storm sewer before discharging into the Clackamette Cove. The Clackamette Cove exits into the Clackamas River just upstream of the Willamette River. Both the Clackamas and Willamette Rivers have drainage basins larger than 100 sq.-miles, the upper limit requiring stormwater detention. Therefore, detention is not required for this project.

Conveyance Analysis

A complete onsite conveyance analysis will be completed within the Final Drainage Report.

Preliminary Hydrology Analysis

A hydrology analysis was completed and is included within the Technical Appendix. The memorandum discusses the hydrology impacts that may occur on the receiving watershed and storm sewer as a result of the Cove development.

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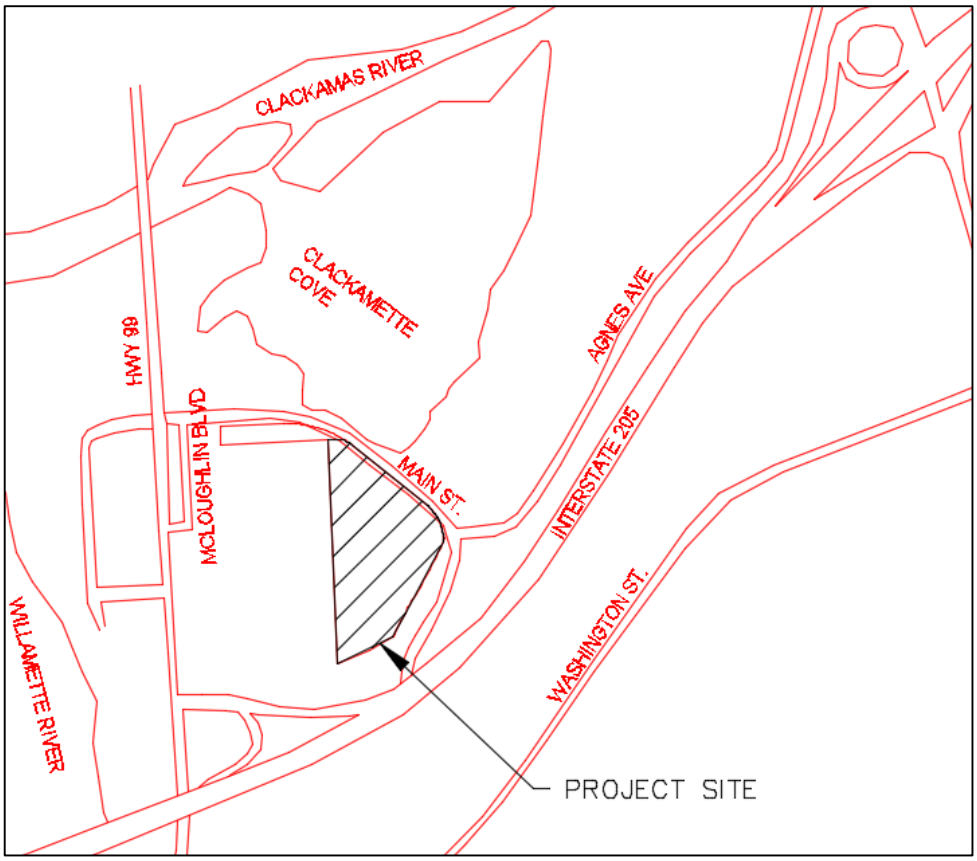
1 VICINITY MAP

Figure 1-1 Vicinity Map



2 PROJECT DESCRIPTION

2.1 Project Overview

The proposed Cove: Garden Apartment project is located southwest of Main Street in Oregon City, Oregon (See Vicinity Map). The project will redevelop a former concrete batch plant to include eleven multi-family buildings totaling 244 units. There will be 374 parking spaces and eight detached garage structures. Residential facilities include a community center, pool, and two mixed-use buildings with non-residential space.

The project includes roadway and infrastructure improvements to Main Street, the construction of a trail access parking lot, and grading within the North Park and Lot 1. These improvements are discussed in a separate report, *Drainage Report – Phase 1 Infrastructure*, by Cardno and dated August 12, 2015. This report is included within the Technical Appendix.

The design follows the City of Oregon City *Stormwater and Grading Design Standards*, issued in December 1999 and the standards within the Surface Water Management Agency of Clackamas County (SWMACC) Rules and Regulations using the *Surface Water Quality Facilities Technical Guidance Handbook dated 1991,* as well as the *Clean Water Services Low Impact Development Approaches Handbook dated July, 2009*. All elevations are NAVD 88, unless otherwise noted.

3 EXISTING CONDITIONS

3.1 Topography

The existing site slopes towards the Clackamette Cove with slopes of approximately 2-percent. Elevations at the site range from approximately 25 feet within the ditch located along the north and west side of the site up to 55 feet in the southern area of the site. A majority of the site to be developed is above the 35 feet elevation level. The ordinary high water for the Clackamette Cove is 18 feet.

3.2 Climate

The site is located in Oregon City, located approximately 90 miles inland from the Pacific Ocean. There is a gradual change in seasons with defined seasonal characteristics. Average daily temperatures range from 35°F to 82°F. Average annual rainfall recorded in this area is 47 inches.

3.3 Site Geology

There are two underlying soil types on the site as classified by the United States Department of Agriculture Soil Survey of Clackamas County, Oregon. These soil types are identified below in Table 3-1 (See Technical Appendix: Hydrologic Soils Group – Clackamas County).

Table 3-1 Soil Characteristics

Soil Type	Hydrologic Group
Urban Land	D
Newberg Fine Sandy Loam	A

Group A soils have high infiltration rates when thoroughly saturated, while group D soils have very slow infiltration rates when thoroughly saturated. Group D soils is the dominant soil type. Therefore, a soil classification of group D was conservatively assigned to the whole site.

3.4 Hydrology

Runoff from the site consists primarily of overland flow across concrete and gravel surfaces. Runoff drains into the Clackamette Cove prior to entering the Clackamas River, a tributary to the Willamette River. There is no water quality treatment for stormwater on the site. Stormwater runoff exits the area four ways: 1) through an offsite basin in the northwest, 2) through the existing 36-inch culvert outfall, 3) through the existing 15-inch culvert outfall and 4) sheet flow into the Cove.

3.5 Basin Areas

Surface areas impacted by this project are shown in Table 3-2. The existing site is approximately 59.3 percent impervious. Impervious surfaces include, concrete and compacted gravel at the site. (See Technical Appendix: Exhibit 1 – Existing Basin Delineation).

Table 3-2 Existing Basin Areas

Basin	Impervious Area (ac)	Gravel Area (ac)	Pervious Area (ac)	Total Area (ac)
Onsite	3.288	3.510	4.659	11.457

4 PROPOSED CONDITIONS

4.1 Hydrology

The proposed site will collect stormwater runoff through catch basins and roof drains and convey runoff to two StormFilter Vaults and a LIDA swale. Collected and treated runoff will discharge from the site into an existing public storm sewer in Main Street. The public storm sewer is being upsized through the Main Street improvements to accommodate future upstream development. The public storm sewer discharge into the Clackamette Cove through a 36-inch diameter pipe at an elevation of 22.24 feet. This is above the ordinary high water elevation of 18 feet. The drainage ditch located to the north and west of the site will not be impacted by this project.

4.2 Curve Number

The curve number represents runoff potential from the soil. The major factors for determining the CN values are hydrologic soil group, cover type, treatment, hydrologic condition and antecedent runoff condition. The selected pervious curve number is 90 – Open Space in good Condition (See Technical Appendix: Table 2-2 – Runoff Curve Numbers for Selected Agricultural, Suburban, and Urban Areas).

4.3 Time of Concentration

The time of concentration (T_C) as described in NEH-4 Chapter 15 is defined in two ways; the time for runoff to travel from the furthermost point of the watershed to the point in question, and the time from the end of excess rainfall to the point of inflection on the trailing limb of the unit hydrograph. Time of concentration can be estimated from several formulas.

The minimum time of concentration is 5 minutes in highly developed urban areas (i.e. parking lots) and the maximum is 100 minutes in rural areas. A condition time of concentration of 5 minutes was used for our delineated sub-basin.

4.4 Basin Areas

Impervious and pervious areas for proposed conditions are shown in Table 4-1. The proposed site will be 63.2 percent impervious (See Technical Appendix: Exhibit 2 – Proposed Basin Delineation).

Table 4-1 Proposed Basin Areas

Basin	Impervious Area (ac)	Pervious Area (ac)	Total Area (ac)
Onsite	7.179	4.278	11.457

5 HYDROLOGIC ANALYSIS DESIGN GUIDELINES

5.1 Design Guidelines

The analysis and design criteria used for stormwater management described in this section will follow the City of Oregon City *Stormwater and Grading Design Standards*, Chapter 6 Collection and Conveyance Facilities. Section 6.3 describes the allowable flow determination methods including the selected SBUH method.

5.2 Hydrograph Method

Rainstorms occur naturally over long periods of time. The most effective way of estimating storm rainfall is by using the hydrograph method. The hydrograph method generates storm runoff based on physical characteristics of the site. The Santa Barbara Urban Hydrograph (SBUH) was used for this analysis. The SBUH method is based on the curve number (CN) approach, and uses the Soil Conservation Service's (SCS) equations for computing soil absorption and precipitation excess. The SBUH method converts the incremental runoff depths into instantaneous hydrographs, which are then routed through an imaginary reservoir with a time delay equal to the basin time of concentration.

xpswmm 2013 Version 15.1 was used for our hydrology and hydraulics analysis. xpswmm is based on the public domain xpswmm program and is an approved method of analysis by Oregon City.

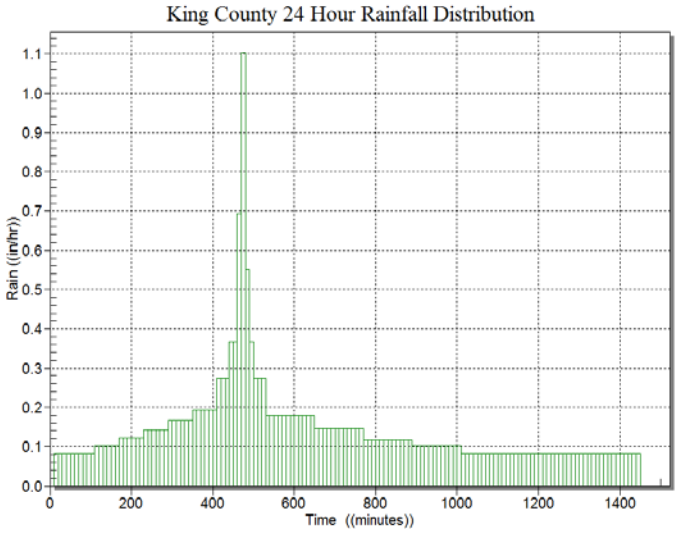
5.3 Design Storm

The rainfall distribution to be used within the Oregon City jurisdiction is the design storm of 24-hour duration based on the standard King County rainfall distribution. A typical King County 24-hour rainfall distribution for a 10-year storm event is shown in Figure 5-1. A 10-year design storm was used for all onsite conveyance design.

Table 5-1 Precipitation Depth

Recurrence interval (years)	Total Precipitation Depth (in)
WQ	0.83
10	3.40
25	4.00
50	4.40
100	4.50

Figure 5-1 10 Year King County Type 1A Rainfall Ditribution



6 HYDRAULIC ANALYSIS AND DESIGN CHARACTERISTICS

6.1 Design Guidelines

The analysis and design criteria described in this section will follow the City of Oregon City *Stormwater and Grading Design Standards*. Chapter 6 – Collection and Conveyance Facilities requires storm drainage system and facilities be designed to convey the 10-year storm event without surcharge.

6.1 Manning's 'n' Values for Pipes

A Manning's 'n' value of 0.013 was selected for all of the storm drain pipes. Additionally an exit loss coefficient between 0.02 and 0.25 was added into each catch basin and manhole. The value is dependent upon the angle of the pipe leaving each catch basin or manhole.

6.2 System Performance

A complete conveyance analysis will be completed in the final drainage analysis.

6.1 Backwater Elevation

The proposed conveyance systems will be modeled both with and without the backwater of 50.7 feet (City established design flood elevation).

7 WATER QUALITY

7.1 Water Quality Guidelines

All water quality facilities were designed per criteria set forth by the *City of Oregon City Stormwater and Grading Design Standards* to facilitate the treatment of all stormwater runoff from the proposed site. The facilities will be designed to capture and treat runoff from 1/3 of the 2-year, 24-hour storm event.

7.2 Water Quality Facility

The project discharges into the Clackamette Cove, a former gravel quarry that connects with the Clackamas River just upstream of the Willamette River. The Clackamas River is classified as water quality limited for dissolved oxygen and biological criteria. Typical pollutants from multi-family residential projects include nutrients, pesticides, metals, oil, grease and other petroleum products, and sediment. Dissolved copper, dissolved zinc, and PAHs are generally the primary constituents of concern for stormwater runoff in Oregon streams and rivers for their impact on ESA listed species. These pollutants are specially targeted for treatment in the selected stormwater management system. The water quality storm is listed below.

- Water Quality Storm: 33% of the 2-yr, 24-hour storm event (0.83-inch precipitation depth).

The stormwater management system at the development was designed to maximize stormwater treatment through Contech StormFilters and LIDA swales.

LIDA swales are landscaped reservoirs that collect and treat stormwater runoff through vegetation and soil media. They also provide pollutant reduction and flow attenuation to reduce hydraulic impacts from urban developments on downstream rivers. Specific elements are incorporated into the swale design to increase the effectiveness of this stormwater facility type. Design elements include trapped catch basins to remove coarse sediment, using soil media to provide stormwater filtration, and vegetation to will provide plant uptake.

7.2.1 Mechanical Treatment

Contech StormFilter vaults are the selected water quality facilities. These facilities were selected for their ability to integrate into the proposed site plan. Each StormFilter system will have the standard cartridge size with an 18-inch drop and have a treatment capacity of 0.033 cfs (15 gpm). The maximum bypass flow is 1.80 cfs; an internal bypass structure will be provided for stormwater vaults. The selected StormFilter contains cartridges filled with ZPG filter media (a mixture of zeolite, perlite, and granular activated carbon), which are designed to remove sediment, metals, and stormwater pollutants from stormwater runoff.

Table 7-1 lists the number of cartridges within each system. Two facilities will provide treatment to the required surface area.

Table 7-1 Mechanical Water Quality Facilities

Basin #	Impervious Area (ac)	Water Quality Flow Rate (cfs)	Quantity of Cartridges	Facility Type
North	3.122	0.535	17	8x11 Vault
South	3.230	0.589	18	8x11 Vault
Total	6.352	-	35	-

7.2.2 LIDA Facilities

The site plan includes LIDA Swales. LIDA Swales are landscaped reservoirs that collect and treat stormwater runoff through vegetation and soil media. They also provide pollutant reduction and flow attenuation to reduce hydraulic impacts from urban developments on downstream rivers.

The LIDA Swales are proposed sloped swales. Sloped swales are linear landscaped reservoirs with slopes of 0.5 to 1.0%, bottom widths of 4 feet, check dams, and 3 to 1 sloped side walls. Overflows will be provided for water depths greater than 6 inches. A perforated pipe surrounded by gravel will collect the treated stormwater and convey it to the public storm sewer. The LIDA Swales section is listed below:

- Freeboard Depth: 6 inches
- Maximum Treatment Water Depth: 6 inches
- Growing Media Depth: 18 inches
- Gravel Depth: 12 inches

Table 7-2 lists the area of the proposed LIDA Swale, and the proposed impervious draining to the facility.

Table 7-2 LIDA Swale Design

Basin	Impervious Area (ac)	Swale Surface Area (sq.-ft)	Length (ft)	Impervious Area Draining to Facility (ac)
Swale	0.723	3,298	325	0.723

8 WATER QUANTITY

8.1 Water Quantity Guidelines

The proposed stormwater management system will discharge site runoff to an existing storm sewer. As part of the conveyance analysis the public storm sewer will be evaluated for capacity. The Drain Report – Phase 1 Infrastructure includes a capacity analysis of the public storm sewer and found the sewer has capacity to convey site flows. The Clackamette Cove exits into the Clackamas River just upstream of the Willamette River. Both the Clackamas and Willamette Rivers have drainage basins larger than 100 sq.-miles, the upper limit requiring stormwater detention. Therefore detention is not required for this project.

9 SUMMARY

The proposed storm management approach follows the *City of Oregon City Stormwater and Grading Design Standards.* The Cove: Garden Apartments storm system was designed to provide water quality treatment by Contech StormFilters and a LIDA Swale.

In conclusion, the proposed stormwater management system will meet the requirements of the City of Oregon City.

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Technical Appendix

- Exhibit 1 – Existing Basin Delineation
- Exhibit 2 – Proposed Basin Delineation

- Sheet C0.0 Cover Sheet
- Sheet C1.0 Existing Conditions Plan
- C2.0-C2.1 Site Plan
- C3.0-C3.1 Grading and Erosion Control Plan
- C4.0-C4.1 Storm Plan
- C5.0-C5.1 Water Plan
- C6.0-C6.1 Sanitary Plan

- Hydrologic Soils Group – Clackamas County
- Table 2-2 – Runoff Curve Numbers for Selected Agricultural, Suburban, and Urban Areas

- xpswmm Hydrographs
  - Water Quality
  - 10-year
- Preliminary Hydrology Analysis Memorandum, Cardno, August 12, 2015
- Drainage Report – Phase 1 Infrastructure, Cardno, August 12, 2015

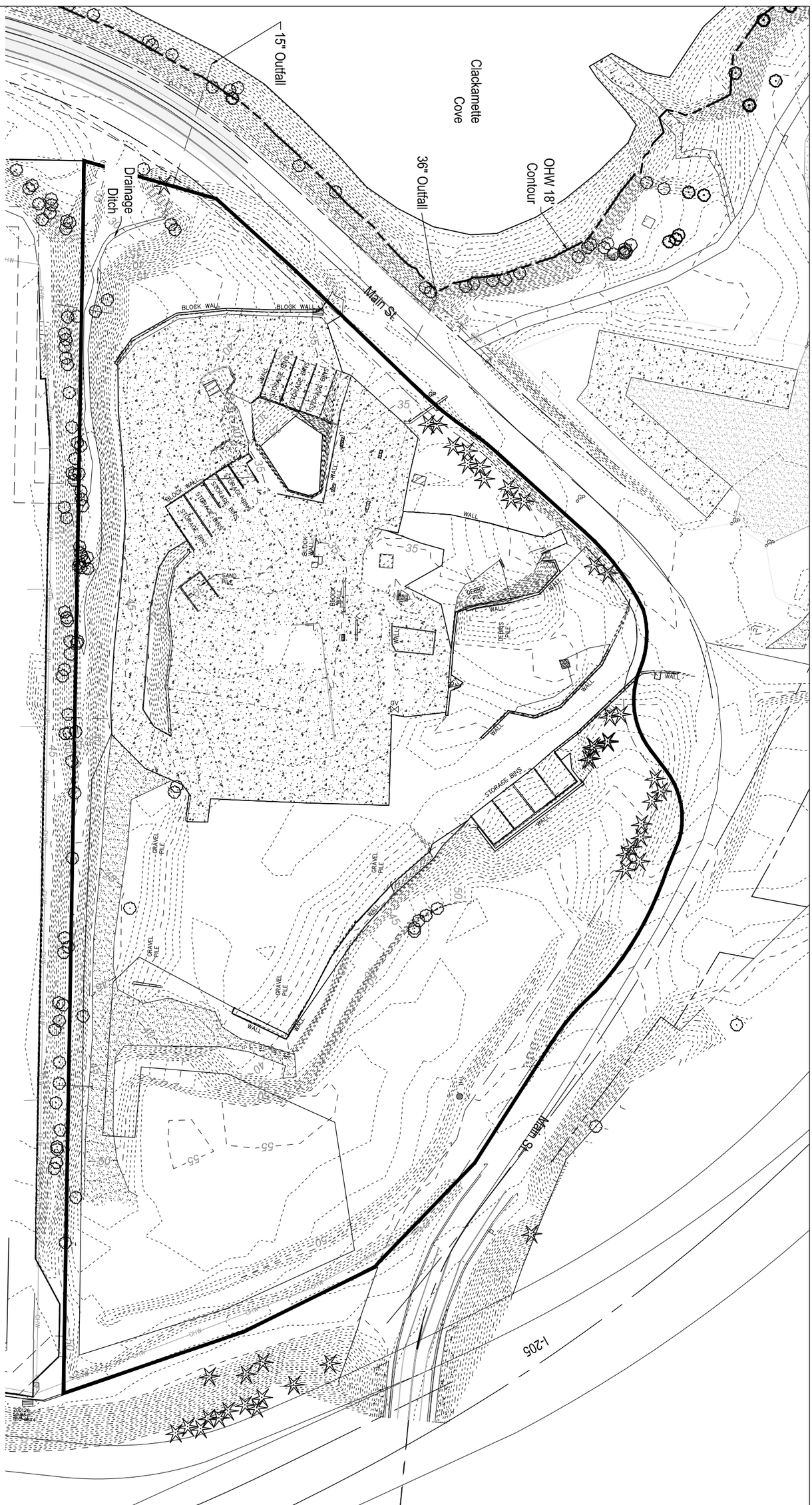
10 REFERENCES

Soil Survey of Clackamas County Area
NRCS

Technical Release 55 – Urban Hydrology of Small Watersheds
U.S. Department of Agriculture, NRCS

Surface Water Management Agency of Clackamas County, Rules and Regulations,
Issued December 2013

Surface Water Quality Facilities Technical Guidance Handbook,
Issued August 1991.



Basin	Impervious Area (ac)	Gravel Area (ac)	Pervious Area (ac)	Total Area (ac)
Existing	3.288	3.510	4.659	11.457

PROJECT NO.	211509220
DATE:	08/12/2015
BY:	ASR
EXHIBIT:	1

EXISTING BASIN DELINEATION
COVE: GARDEN APARTMENTS

GRAND COVE LLC
Oregon City, Oregon

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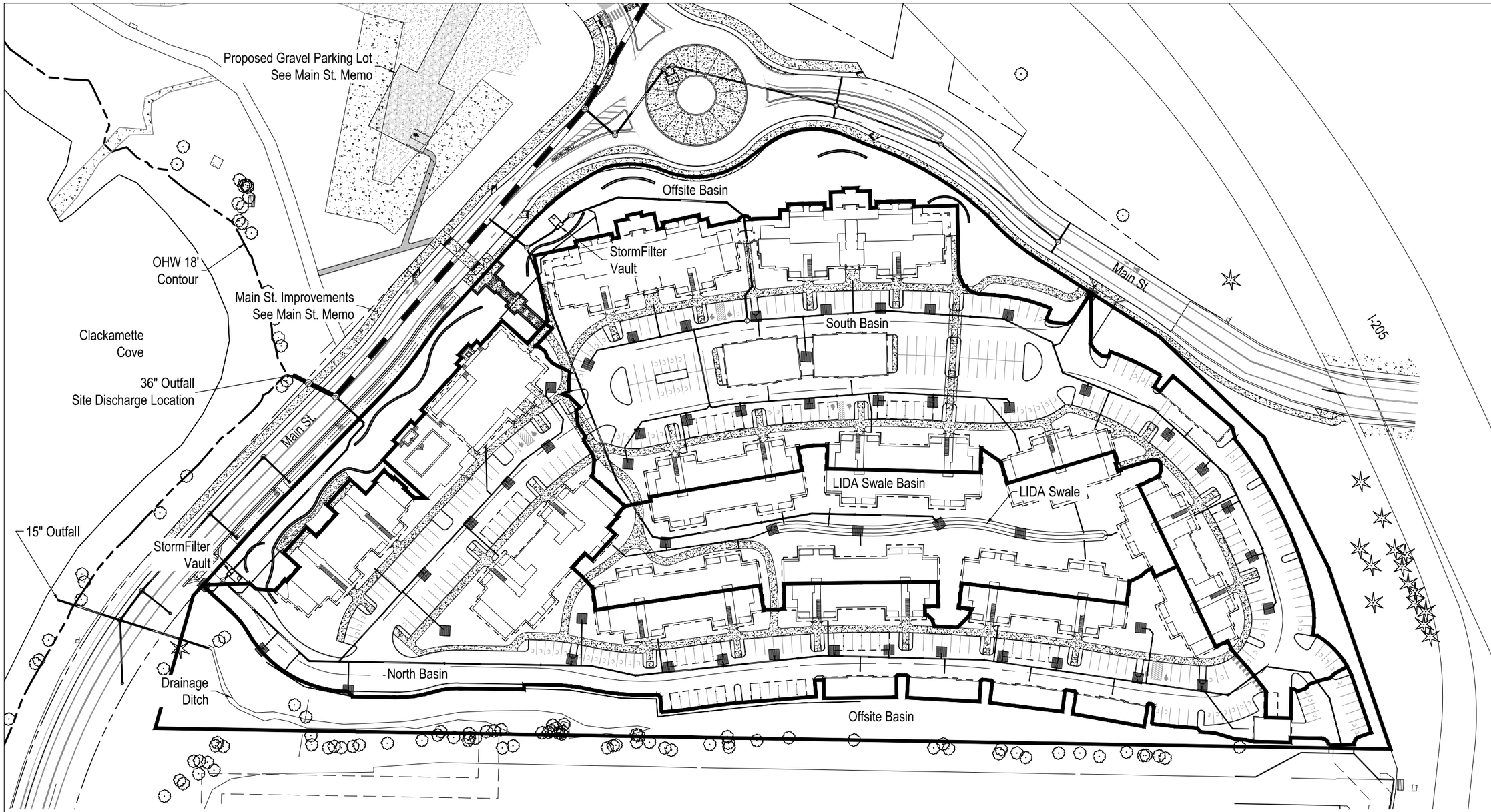

Basin	Impervious Area (ac)	Pervious Area (ac)	Total Area (ac)
North	3.122	0.586	3.708
South	3.230	0.479	3.709
LIDA Swale	0.723	0.770	1.493
Offsite	0.104	2.443	2.547
Total	7.179	4.278	11.457

SCALE: 1"=100'

100 50 0 100

PROPOSED BASIN DELINEATION
COVE: GARDEN APARTMENTS

GRAND COVE LLC
Oregon City, Oregon

PROJECT NO. 211509220
DATE: 08/12/2015
BY: ASR
EXHIBIT: 2

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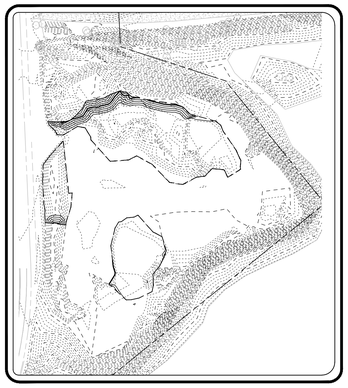
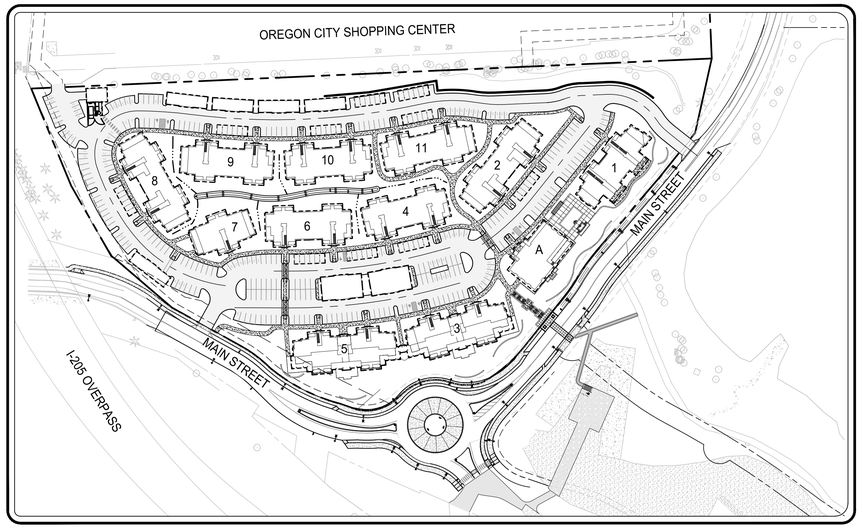
THE COVE - GARDEN APARTMENTS

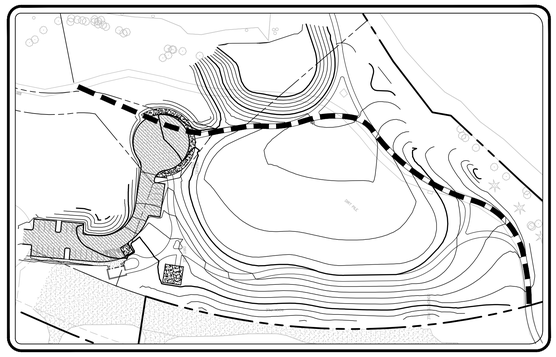
OREGON CITY, OREGON
DDP SUBMITTAL



LOT 1 SITE MAP
SCALE: NTS



GARDEN APARTMENTS SITE MAP
SCALE: NTS



NORTH PARK SITE MAP
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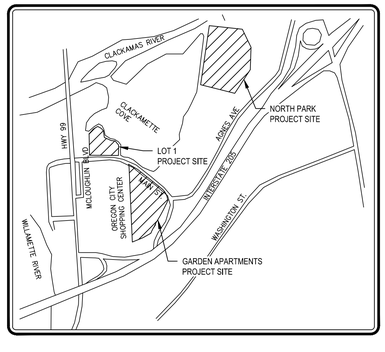

VICINITY MAP
SCALE: NTS

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INDEX OF SHEETS

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COVER SHEET
THE COVE - GARDEN APARTMENTS
GRAND COVE, LLC
OREGON CITY, OREGON

NO	DATE	DESCRIPTION	BY

REGISTERED PROFESSIONAL ENGINEER
OREGON
JANUARY 19, 1982
BENJAMIN R. WILLIAMS
PRELIMINARY NOT FOR CONSTRUCTION
EXPIRES: 06/30/16

DATE	06/26/2015
DRAWN	KRG
DESIGNED	BRS
CHECKED	MDT
PROJECT #	21509220

SHEET TITLE
COVER

SHEET NUMBER
C0.0

LAND USE # —

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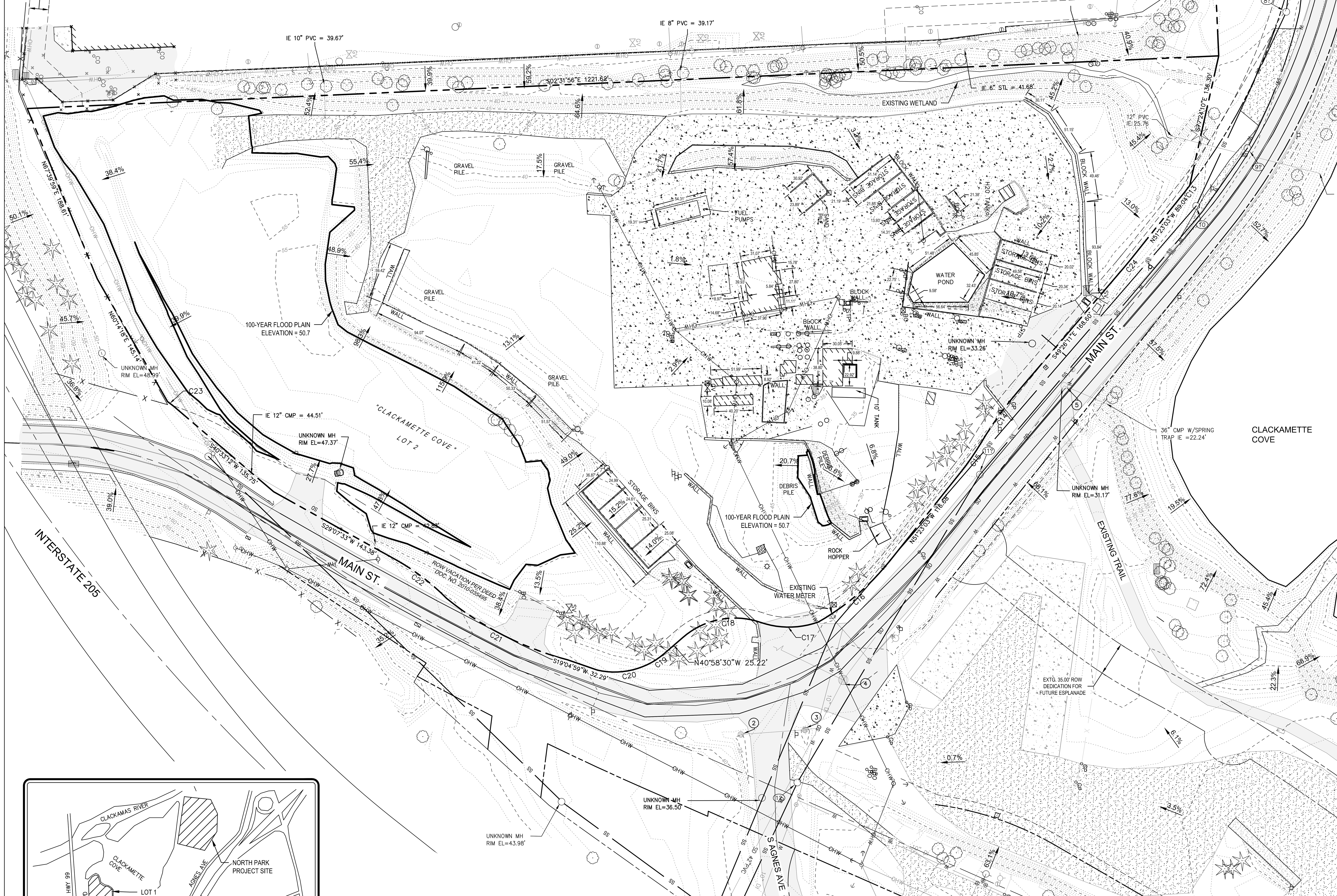
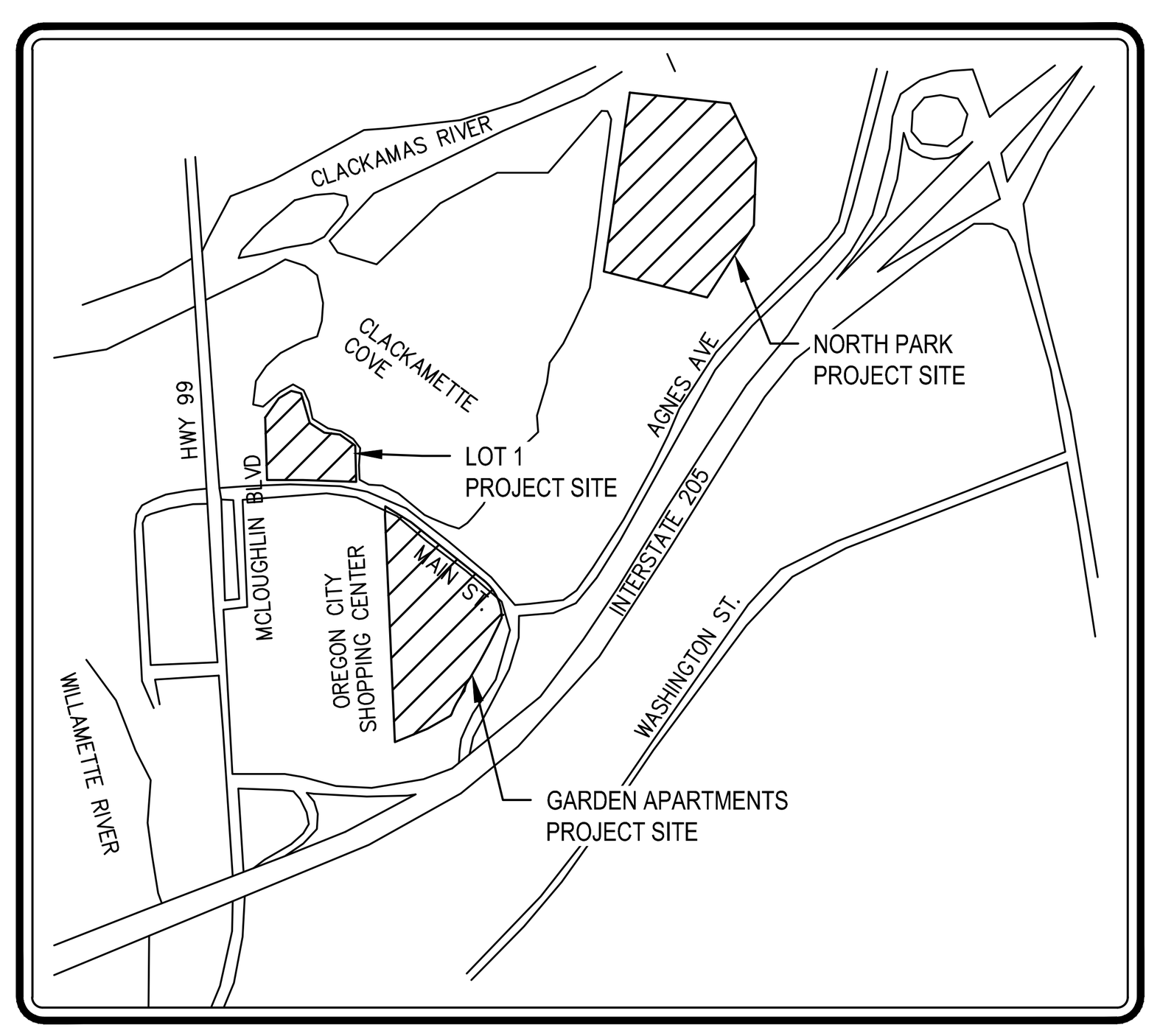


LEGEND

- EXISTING PROPERTY LINE
- EXISTING CENTERLINE
- EXISTING RIGHT-OF-WAY LINE
- EXISTING 1' CONTOUR
- EXISTING 5' CONTOUR
- BUILDING OVERHANG LINE
- WETLAND LIMITS
- X — FENCE LINE, TYPE AS NOTED
- SS — SANITARY SEWER LINE
- SD — STORM DRAINAGE LINE
- E — UNDERGROUND ELECTRICAL LINE
- OHW — OVERHEAD WIRE
- G — UNDERGROUND GAS LINE
- BUILDING FACE
- EXISTING ASPHALT SURFACE
- EXISTING CONCRETE SURFACE
- EXISTING GRAVEL SURFACE
- GV — GAS VALVE
- GAS WARNING SIGN
- SEE SANITARY SEWER TABLE
- SANITARY SEWER MANHOLE
- SEE STORM DRAINAGE TABLe
- CATCH BASIN
- AREA DRAIN
- RD — ROOF DRAIN
- FIRE HYDRANT
- FIRE DEPARTMENT CONNECTION
- WATER VALVE
- WATER METER
- WATER SPIGOT
- SPRINKLER HEAD
- SV — SPRINKLER VALVE
- STREET LIGHT (COBRA ARM)
- ELECTRICAL RISER
- TELEPHONE RISER
- T — TELEPHONE MANHOLE
- CONIFEROUS TREE
- DECIDUOUS TREE
- CO — UNKNOWN CLEANOUT
- STP — STAND PIPE
- UNKNOWN MANHOLE
- GUY WIRE
- UTILITY POLE
- U — UNKNOWN UTILITY VAULT
- BO — BOLLARD
- FP — FLAG POLE
- GP — GATE POST
- MAILBOX
- SIGN
- DOUBLE POST SIGN
- TP — TEST PIT
- MW — MONITORING WELL
- FLOW DIRECTION ARROWS



VICINITY MAP
SCALE: NTS

EXISTING CONDITIONS PLAN:
THIS PLAN IS INTENDED FOR USE AS AN EXISTING CONDITIONS PLAN SHOWING THE CONDITIONS OF THE SITE PRIOR TO CONSTRUCTION. INFORMATION SHOWN ON THIS PLAN WAS DEVELOPED FROM THE TOPOGRAPHIC SURVEY AND SITE OBSERVATIONS BY THE ENGINEER. NOT ALL SURFACE FEATURES MAY BE SHOWN. CONTRACTOR SHALL VERIFY ALL EXISTING CONDITIONS PRIOR TO CONSTRUCTION TO DETERMINE WORK SPECIFIC DETAILS. TOPOGRAPHIC INFORMATION PROVIDED BY CARDNO WRG DATED OCTOBER 4, 2006.

STORM DRAINAGE TABLE:

(2) 2' SQUARE BOX DRAIN
RIM = 34.30'
12" CONC (N) IE = 31.50'
SUMP IE = 31.50'
SUMP IE = 32.40'

(3) 2' SQUARE BOX DRAIN
RIM = 33.46'
12" CONC (S) IE = 30.16'
12" CONC (NW) IE = 29.96'
SUMP IE = 30.06'
SUMP IE = 31.06'

(4) GRATED STORM MANHOLE
RIM = 35.03'
12" CONC (SW) IE = 28.03'
42" PVC (SE) (NW)
INVERT ELEVATION = 25.88'

(5) STORM DRAIN MANHOLE
RIM=31.17'
36" CMP (N)
42" PVC (SE)
INVERT ELEVATION = 22.27'

SANITARY SEWER TABLE:

(8) SANITARY SEWER MANHOLE
RIM=30.31'
42" CONC (W)
42" CONC (E)
INVERT ELEVATION = 21.15'

(9) SANITARY SEWER MANHOLE
RIM=29.76'
84" CONC (W)
84" CONC (E)
INVERT ELEVATION = 12.60'

(10) SANITARY SEWER MANHOLE
RIM=33.06'
42" CONC (W)
42" CONC (E)
INVERT ELEVATION = 20.88'

(11) SANITARY SEWER MANHOLE
RIM=31.94'
84" CONC (E)
84" CONC (W)
INVERT ELEVATION = 12.97'

(12) SANITARY SEWER MANHOLE
RIM=36.13'
84" CONC (E)
84" CONC (W)
INVERT ELEVATION = 13.33'

(13) SANITARY SEWER MANHOLE
RIM=42.71'
72" CONC (N)
54" CONC (S)
42" CONC (W)
INVERT ELEVATION = 18.48'

(14) FLOW CONTROL STRUCTURE
RIM=42.33'
72" CONC (N)
72" CONC (S)
72" CONC (W)
INVERT ELEVATION = 13.47'

(15) SANITARY SEWER MANHOLE
RIM=42.39'
72" CONC (N)
72" CONC (S)
INVERT ELEVATION = 18.34'

(16) SANITARY SEWER MANHOLE
RIM=43.00'
72" CONC (N)
72" CONC (S)
INVERT ELEVATION = 14.30

BENCHMARK:

OREGON STATE HIGHWAY VERTICAL CONTROL RECEIVED FROM CLACKAMAS COUNTY ENGINEERING DEPARTMENT.

"A STANDARD OSHD DISK STAMPED "56 G 220 1934" LOCATED IN THE NORTHEAST CORNER OF THE JOHN MCLAOUGHLIN BRIDGE OVER THE CLACKAMAS RIVER.

PUBLISHED NGVD 29 ELEV.=56.117 FEET
CONVERTED TO NAVD 88 ELEV.=59.587 FEET

UTILITY STATEMENT:

THE UNDERGROUND UTILITIES SHOWN HAVE BEEN LOCATED FROM FIELD SURVEY INFORMATION AND EXISTING DRAWINGS. THE SURVEYOR MAKES NO GUARANTEES THAT THE UNDERGROUND UTILITIES SHOWN COMPRISE ALL SUCH UTILITIES IN THE AREA, EITHER IN SERVICE OR ABANDONED. THE SURVEYOR FURTHER DOES NOT WARRANT THAT THE UNDERGROUND UTILITIES SHOWN ARE IN THE EXACT LOCATION INDICATED ALTHOUGH HE DOES CERTIFY THAT THEY ARE LOCATED AS ACCURATELY AS POSSIBLE FROM INFORMATION AVAILABLE. THE SURVEYOR HAS NOT PHYSICALLY LOCATED THE UNDERGROUND UTILITIES.

SCALE: 1"=50'
50 25 0 50

DDP SUBMITTAL

Cardno
Shaping the Future
PORTLAND
5415 SW WESTGATE DR, STE 100, PORTLAND, OR 97221
TEL: (503) 419 - 2500 FAX: (503) 419 - 2600
www.cardno.com

EXISTING CONDITIONS PLAN - GARDEN APARTMENTS

THE COVE - GARDEN APARTMENTS

GRAND COVE, LLC
OREGON CITY, OREGON

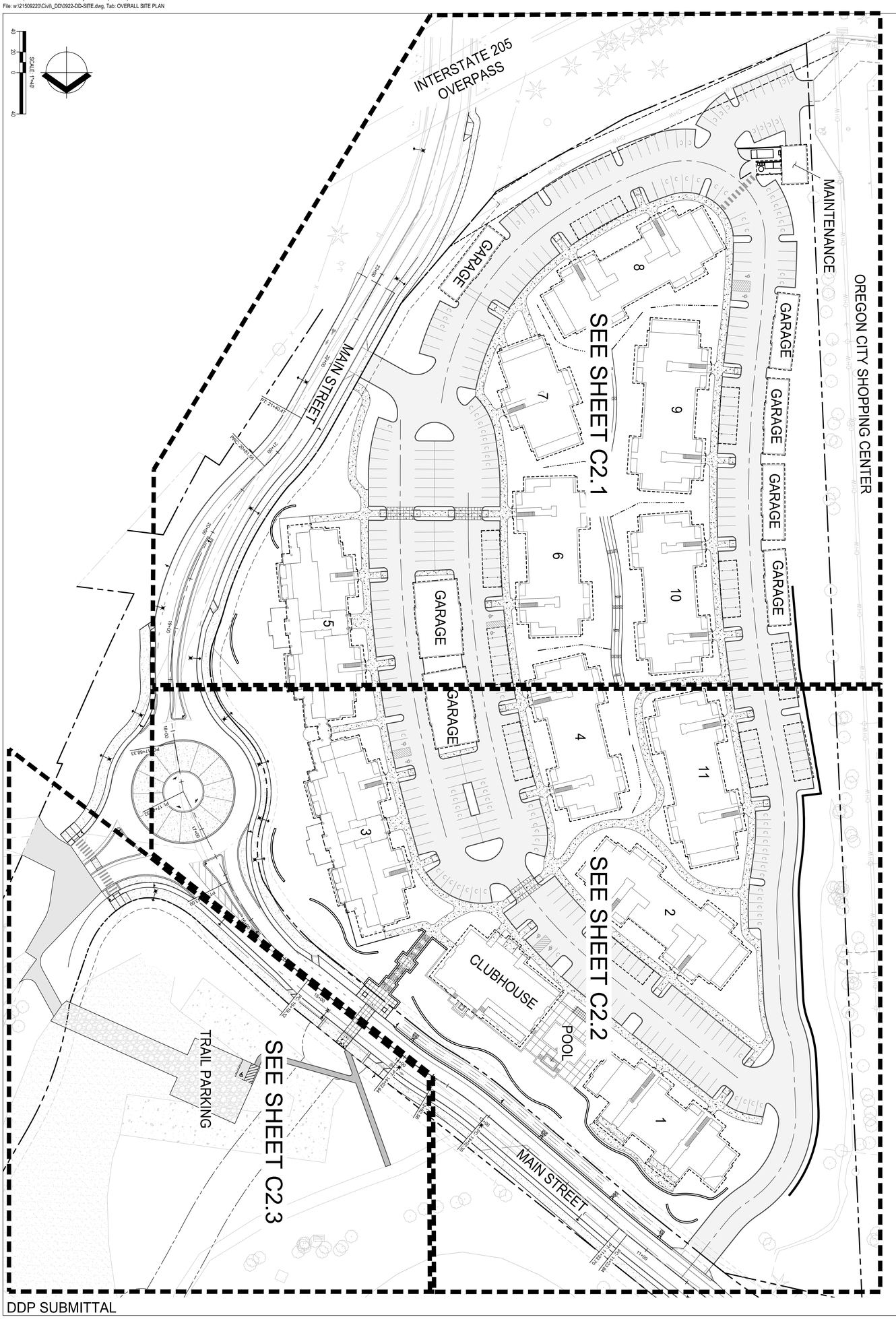
#	DATE	DESCRIPTION	BY

REGISTERED PROFESSIONAL ENGINEER
OREGON
BEN ... WILLIAMS
PRELIMINARY NOT FOR CONSTRUCTION
EXPIRES: 06/30/16

DATE	06/26/2015
DRAWN	KRG
DESIGNED	BRS
CHECKED	MDT
PROJECT #	21509220

SHEET TITLE
EXISTING
SHEET NUMBER
C1.0
LAND USE # ----

Plot Stamp: 6/26/2015 2:27:03 PM - Kyle Glidden (Portland)
File: w:\21509220\Civil_DD\0922-DD-SITE.dwg, Tab: OVERALL SITE PLAN



DDP SUBMITTAL

#	DATE	DESCRIPTION	BY

OVERALL SITE PLAN

THE COVE - GARDEN APARTMENTS

GRAND COVE, LLC

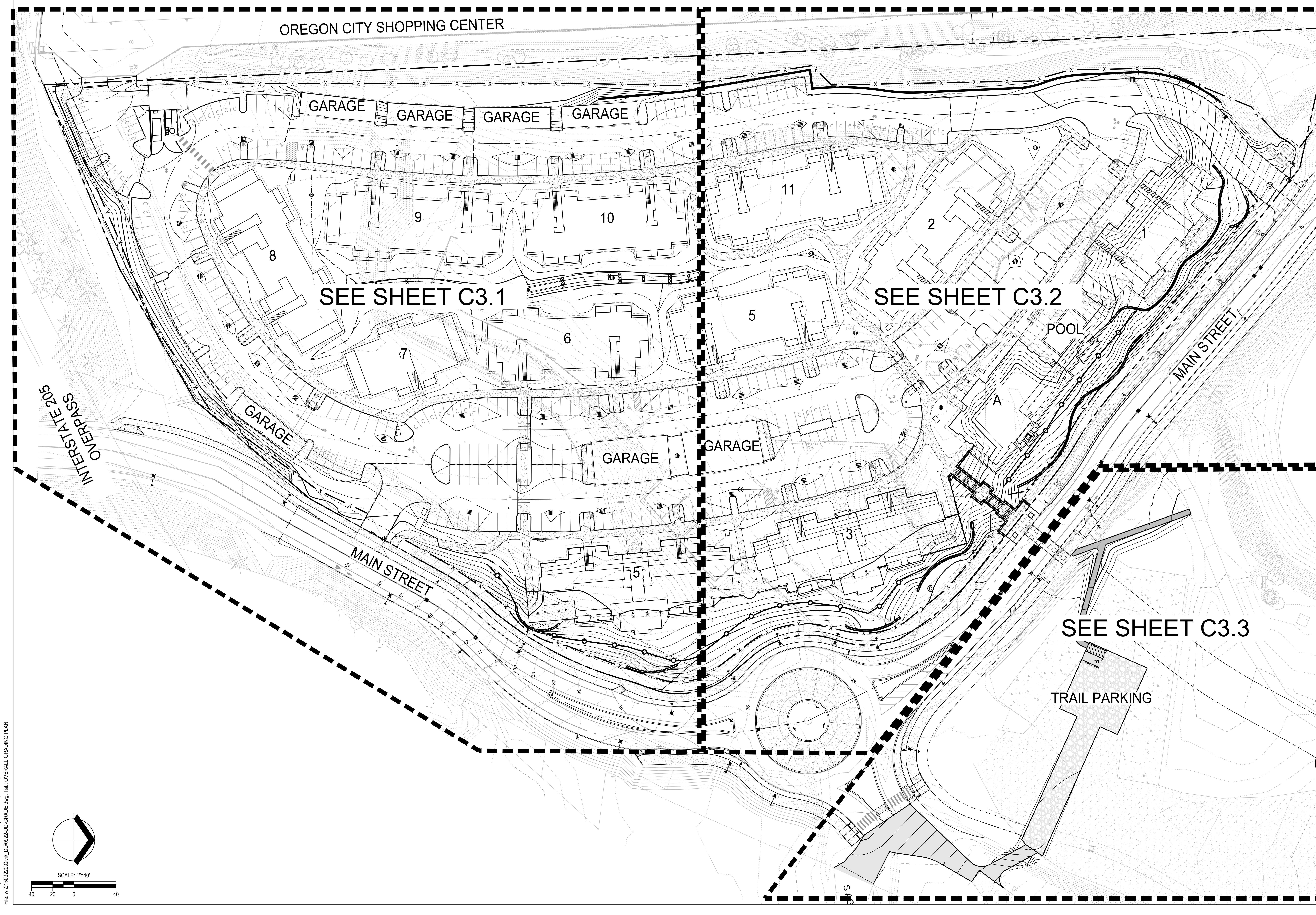
OREGON CITY, OREGON

REGISTERED PROFESSIONAL ENGINEER
OREGON
JANUARY 09, 2001
KYLE D. WILLIAMS
EXPIRES: 06/30/16

PRELIMINARY
NOT FOR CONSTRUCTION

DATE	06/26/2015
DRAWN	KRG
DESIGNED	BRS
CHECKED	MDT
PROJECT #	21509220
SHEET TITLE	OVERALL SITE
SHEET NUMBER	C2.0
LAND USE #	—

Cardno
Shaping the Future
PORTLAND
5415 SW WESTGATE DR, STE 100, PORTLAND, OR 97221
TEL: (503) 419 - 2500 FAX: (503) 419 - 2600
www.cardno.com



DDP SUBMITTAL

Plot Stamp: 6/26/2015 2:28:24 PM - Kyle Glidden (Portland)

Cardno
Shaping the Future

PORTLAND
5415 SW WESTGATE DR, STE 100, PORTLAND, OR 97221
TEL: (503) 419 - 2500 FAX: (503) 419 - 2600
www.cardno.com

OVERALL GRADING PLAN
THE COVE - GARDEN APARTMENTS
GRAND COVE, LLC
OREGON CITY, OREGON

#	DATE	DESCRIPTION	BY

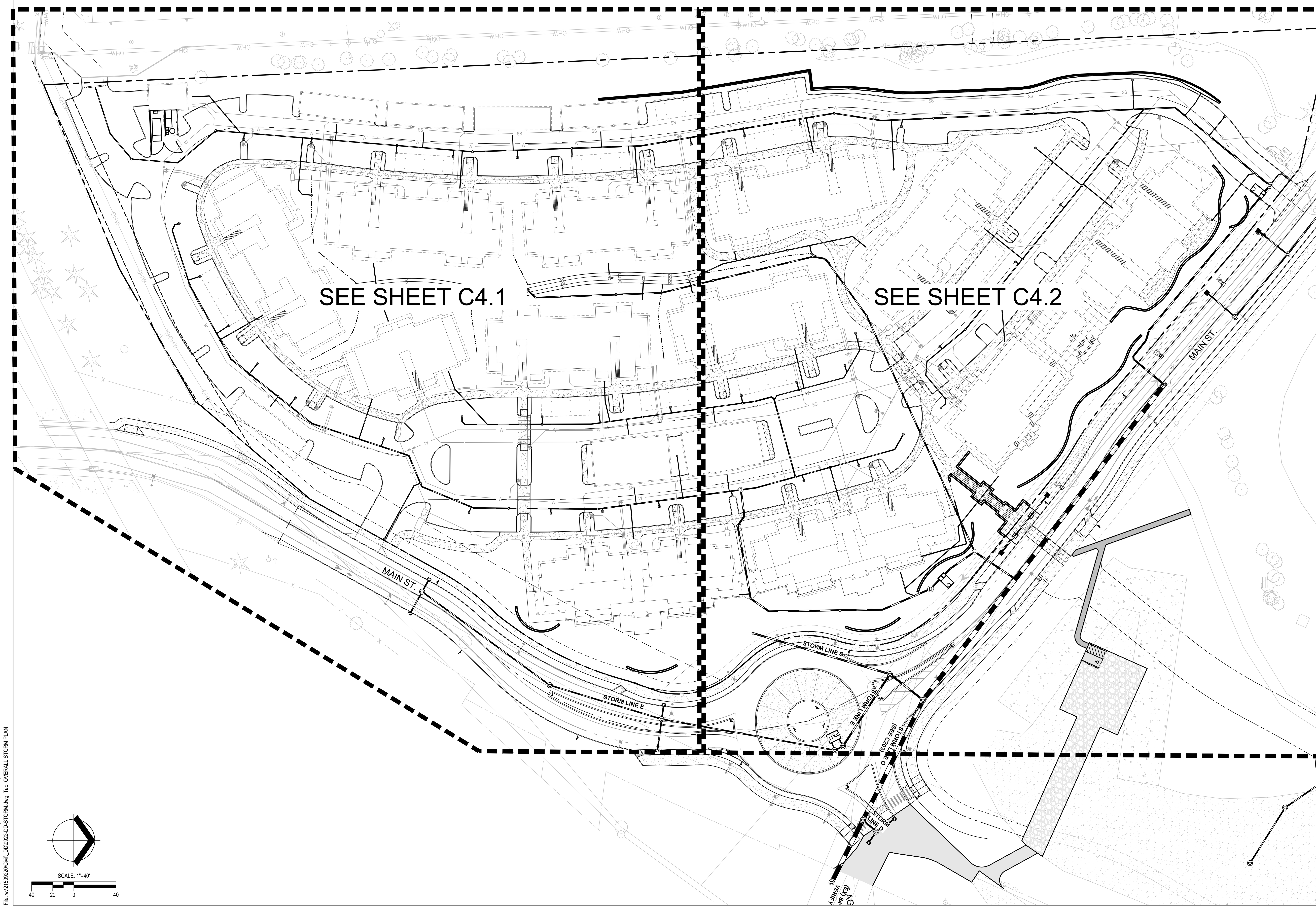
REGISTERED PROFESSIONAL ENGINEER
OREGON
BENJAMIN WILLIAMS
PRELIMINARY NOT FOR CONSTRUCTION
EXPIRES: 06/30/16

DATE	06/26/2015
DRAWN	KRG
DESIGNED	BRS
CHECKED	MDT
PROJECT #	21509220

SHEET TITLE
OVERALL GRADING

SHEET NUMBER
C3.0

LAND USE # ----



DDP SUBMITTAL

Plot Stamp: 6/26/2015 2:30:49 PM - Kyle Glidden (Portland)
File: w:\21509220\Civil_DD\0922-DD-STORM.dwg, Tab: OVERALL STORM PLAN

Cardno
Shaping the Future
PORTLAND
5415 SW WESTGATE DR, STE 100, PORTLAND, OR 97221
TEL: (503) 419 - 2500 FAX: (503) 419 - 2600
www.cardno.com

OVERALL STORM PLAN
THE COVE - GARDEN APARTMENTS

GRAND COVE, LLC
OREGON CITY, OREGON

#	DATE	DESCRIPTION	BY

REGISTERED PROFESSIONAL ENGINEER
16,109
OREGON
JULY 21, 1992
BEN ... WILLIAMS
PRELIMINARY NOT FOR CONSTRUCTION
EXPIRES: 06/30/16

DATE	06/26/2015
DRAWN	KRG
DESIGNED	BRS
CHECKED	MDT
PROJECT #	21509220

SHEET TITLE
OVERALL STORM

SHEET NUMBER
C4.0

LAND USE # ----

Plot Stamp: 6/26/2015 2:31:07 PM - Kyle Glidden (Portland)
File: w:\21509220\Civil_DD\0922-DD-STORM.dwg, Tab: C4.1

CONSTRUCTION NOTES

1. PROPOSED 4" HDPE N-12 PIPE.
2. PROPOSED 6" HDPE N-12 PIPE.
3. PROPOSED TRAPPED CATCH BASIN. SEE DATA TABLE THIS SHEET.
4. PROPOSED NYLOPLAST LANDSCAPE AREA DRAIN. SEE DATA TABLE THIS SHEET.
5. PROPOSED 48" DIA. CONCRETE OVERFLOW DRAIN 6" ABOVE SWALE BOTTOM. SEE DATA TABLE THIS SHEET.
6. PROPOSED LIDA SWALE. SECTION TO CONSIST OF JUTE MATTING, 18" OF GROWING MEDIUM, AND 12" OF DRAIN ROCK WITH A 4" PERF PIPE UNDERDRAIN. SEE GRADING PLAN FOR SECTION.
7. PROPOSED STORM CLEANOUT. SEE DATA TABLE THIS SHEET.
8. PROPOSED OUTLET STRUCTURE. SEE DATA TABLE THIS SHEET.
9. PROPOSED KLASSIKDRAIN K100 TRENCH DRAIN. SEE DATA TABLE THIS SHEET.
10. PROPOSED 4" PERFORATED PIPE FOR WALL DRAINAGE.
11. PROPOSED CONVEYANCE DITCH.
12. PROPOSED 8" HDPE N-12 PIPE.
13. PROPOSED 10" HDPE N-12 PIPE.
14. PROPOSED 12" HDPE N-12 PIPE.
15. PROPOSED RIP RAP OUTLET PAD.
16. PROPOSED ROCK CHECK DAM.

LEGEND

- EXISTING PROPERTY LINE
- PROPOSED SETBACK LINE
- EXISTING EASEMENT LINE
- PROPOSED WATER LINE
- PROPOSED STORM DRAIN PIPE
- PROPOSED SANITARY PIPE
- EXISTING CATCH BASIN
- EXISTING STORM DRAIN MANHOLE
- EXISTING FIRE HYDRANT
- EXISTING WATER VALVE
- EXISTING SANITARY MANHOLE
- PROPOSED CATCH BASIN
- PROPOSED LANDSCAPE AREA DRAIN
- PROPOSED SWALE OVERFLOW
- PROPOSED STORM CLEANOUT
- PROPOSED SANITARY CLEANOUT
- PROPOSED FIRE VAULT
- PROPOSED WATER METER
- PROPOSED DCVA
- PROPOSED FIRE DEPARTMENT CONNECTION
- PROPOSED FIRE HYDRANT
- PROPOSED WATER VALVE
- PROPOSED CONVEYANCE DITCH
- PROPOSED RIP RAP PAD
- PROPOSED ROCK CHECK DAM

CATCH BASIN DATA

SDCB-1
RIM: 50.71
IE OUT (6"S) =47.71

SDCB-2
RIM: 50.87
IE OUT (6"S) =47.87

SDCB-3
RIM: 50.82
IE OUT (6"SE) = 47.82

SDCB-4
RIM: 50.80
IE OUT (6"SE) = 47.80

SDCB-5
RIM: 50.70
IE OUT (6"SE) = 47.70

SDCB-6
RIM: 50.87
IE OUT (6"E) = 47.87

SDCB-7
RIM: 50.70
IE OUT (6"W) = 47.70

SDCB-8
RIM: 50.87
IE OUT (6"W) = 47.87

SDCB-9
RIM: 50.87
IE OUT (6"W) = 47.87

SDCB-10
RIM: 50.87
IE OUT (6"W) = 47.87

CATCH BASIN DATA

SDCB-11
RIM: 50.70
IE OUT (6"E) = 47.70

SDCB-12
RIM: 50.77
IE OUT (6"E) = 47.77

SDCB-13
RIM: 50.83
IE OUT (6"E) = 47.83

SDCB-14
RIM: 50.79
IE OUT (6"E) = 47.79

SDCB-15
RIM: 49.10
IE OUT (6"NW) = 46.10

SDCB-16
RIM: 50.87
IE OUT (6"W) = 47.87

SDCB-17
RIM: 51.20
IE OUT (6"W) = 48.20

SDCB-18
RIM: 50.87
IE OUT (6"W) = 47.87

SDCB-19
RIM: 50.87
IE OUT (6"W) = 47.87

SDCB-20
RIM: 50.70
IE OUT (6"W) = 47.70

CATCH BASIN DATA

SDCB-21
RIM: 50.87
IE OUT (6"E) = 47.87

SDCB-22
RIM: 50.87
IE OUT (6"W) = 47.87

SDCB-23
RIM: 50.87
IE OUT (6"W) = 47.87

SDCB-24
RIM: 50.70
IE OUT (6"W) = 47.70

CLEANOUT DATA

SDCO-1
RIM = 52.48'
IE (8") = 48.91'

SDCO-2
RIM = 51.43'
IE (8") = 48.00'

SDCO-3
RIM = 51.37'
IE (8") = 48.00'

SDCO-4
RIM = 51.17'
IE (8") = 44.28'

SDCO-5
RIM = 51.35'
IE (8") = 43.56'

SDCO-6
RIM = 51.28'
IE (10") = 42.82'

SDCO-7
RIM = 51.17'
IE (10") = 41.72'

SDCO-10
RIM = 51.28'
IE (12") = 44.94'

SDCO-14
RIM = 51.35'
IE (8") = 47.06'

SDCO-15
RIM = 51.47'
IE (10") = 48.47'

SDCO-16
RIM = 51.24'
IE (10") = 48.69'

SDCO-17
RIM = 51.39'
IE (10") = 44.81'

SDCO-18
RIM = 51.28'
IE (10") = 44.03'

SDCO-19
RIM = 51.33'
IE (10") = 43.13'

SDCO-20
RIM = 51.20'
IE (10") = 42.29'

SDCO-21
RIM = 51.32'
IE (10") = 41.48'

SDCO-23
RIM = 51.09'
IE (8") = 46.97'

SDCO-24
RIM = 51.01'
IE (8") = 46.01'

SDCO-32
RIM = 51.09'
IE (12") = 45.88'

CLEANOUT DATA

SDCO-16
RIM = 51.24'
IE (10") = 48.69'

SDCO-17
RIM = 51.39'
IE (10") = 44.81'

SDCO-18
RIM = 51.28'
IE (10") = 44.03'

SDCO-19
RIM = 51.33'
IE (10") = 43.13'

SDCO-20
RIM = 51.20'
IE (10") = 42.29'

SDCO-21
RIM = 51.32'
IE (10") = 41.48'

SDCO-23
RIM = 51.09'
IE (8") = 46.97'

SDCO-24
RIM = 51.01'
IE (8") = 46.01'

SDCO-32
RIM = 51.09'
IE (12") = 45.88'

OUTLET STRUCTURE DATA

SDOS-1
RIM: 49.91
IE IN (6"NW) = 47.52

TRENCH DRAIN DATA

SDTD-1
RIM: 49.93
IE OUT (6"E) = 47.70

AREA DRAIN DATA

SDAD-1
RIM: 50.00
IE OUT (6"S) = 48.00

SDAD-2
RIM: 51.62
IE OUT (4"E) = 48.62

OVERFLOW DRAIN DATA

SDOD-1
RIM: 49.64
IE OUT (12"S) = 47.14
IE IN (4"N) = 46.74
IE IN (4"S) = 46.74
IE OUT (12"NE) = 46.74

SDOD-2
RIM: 50.40
IE IN (4"N) = 46.74
IE IN (4"S) = 46.74
IE OUT (12"NE) = 46.74

SDOD-3
RIM: 49.63
IE IN (12"N) = 47.13
IE OUT (12"S) = 47.13

DDP SUBMITTAL

#	DATE	DESCRIPTION	BY

STORM PLAN

THE COVE - GARDEN APARTMENTS

GRAND COVE, LLC

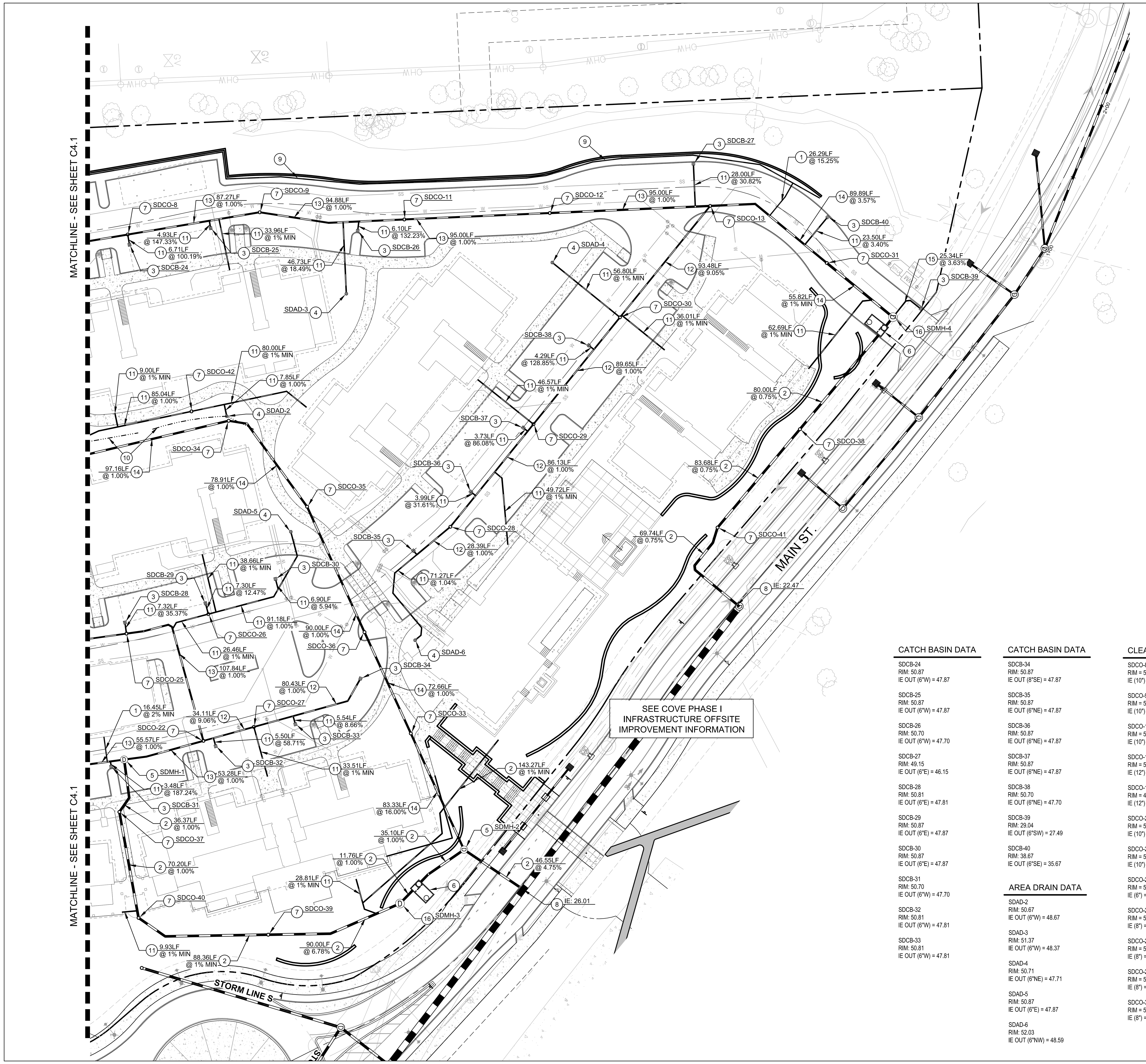
OREGON CITY, OREGON

Cardno
Shaping the Future
PORTLAND
5415 SW WESTGATE DR, STE 100, PORTLAND, OR 97221
TEL: (503) 419 - 2500 FAX: (503) 419 - 2600
www.cardno.com

REGISTERED PROFESSIONAL ENGINEER
OREGON
JULY 18, 2008
CHRISTOPHER WILLIAMS
EXPIRES: 06/30/16

PRELIMINARY NOT FOR CONSTRUCTION

DATE	06/26/2015
DRAWN	KRG
DESIGNED	BRS
CHECKED	MDT
PROJECT #	21509220
SHEET TITLE	STORM PLAN
SHEET NUMBER	C4.1
LAND USE #	–



LEGEND

- EXISTING PROPERTY LINE
- PROPOSED SETBACK LINE
- EXISTING EASEMENT LINE
- PROPOSED WATER LINE
- PROPOSED STORM DRAIN PIPE
- PROPOSED SANITARY PIPE
- EXISTING CATCH BASIN
- EXISTING STORM DRAIN MANHOLE
- EXISTING FIRE HYDRANT
- EXISTING WATER VALVE
- EXISTING SANITARY MANHOLE
- PROPOSED CATCH BASIN
- PROPOSED LANDSCAPE AREA DRAIN
- PROPOSED STORM CLEANOUT
- PROPOSED SANITARY CLEANOUT
- PROPOSED FIRE VAULT
- PROPOSED WATER METER
- PROPOSED DCVA
- PROPOSED FIRE DEPARTMENT CONNECTION
- PROPOSED FIRE HYDRANT
- PROPOSED WATER VALVE
- PROPOSED CONVEYANCE DITCH

ALL STORM & SANITARY SEWER CONNECTIONS NOT MADE AT A STRUCTURE TO BE 'WYE' CONNECTIONS

CONSTRUCTION NOTES

1. PROPOSED 4" HDPE N-12 PIPE.
2. PROPOSED 15" HDPE N-12 PIPE.
3. PROPOSED TRAPPED CATCH BASIN. SEE DATA TABLE THIS SHEET.
4. PROPOSED NYLOPLAST LANDSCAPE AREA DRAIN. SEE DATA TABLE THIS SHEET.
5. PROPOSED 48" MANHOLE. SEE DATA TABLE THIS SHEET.
6. PROPOSED 8' X 14' PEAK DIVERSION STORMFILTER TREATMENT VAULT.
7. PROPOSED STORM CLEANOUT. SEE DATA TABLE THIS SHEET.
8. CONNECT TO STORMLINE INSTALLED AS PART OF PUBLIC IMPROVEMENTS.
9. PROPOSED 4" PERFORATED PIPE FOR WALL DRAINAGE.
10. PROPOSED CONVEYANCE DITCH.
11. PROPOSED 6" HDPE N-12 PIPE.
12. PROPOSED 8" HDPE N-12 PIPE.
13. PROPOSED 10" HDPE N-12 PIPE.
14. PROPOSED 12" HDPE N-12 PIPE.
15. PROPOSED 6" HDPE C900 PIPE.
16. PROPOSED 60" SEDIMENTATION MANHOLE. SEE DATA TABLE THIS SHEET.

CATCH BASIN DATA

SDCB-24
RIM: 50.87
IE OUT (6"W) = 47.87

SDCB-25
RIM: 50.87
IE OUT (6"W) = 47.87

SDCB-26
RIM: 50.70
IE OUT (6"W) = 47.70

SDCB-27
RIM: 49.15
IE OUT (6"E) = 46.15

SDCB-28
RIM: 50.81
IE OUT (6"E) = 47.81

SDCB-29
RIM: 50.87
IE OUT (6"E) = 47.87

SDCB-30
RIM: 50.87
IE OUT (6"E) = 47.87

SDCB-31
RIM: 50.70
IE OUT (6"W) = 47.70

SDCB-32
RIM: 50.81
IE OUT (6"W) = 47.81

SDCB-33
RIM: 50.81
IE OUT (6"W) = 47.81

CATCH BASIN DATA

SDCB-34
RIM: 50.87
IE OUT (8"SE) = 47.87

SDCB-35
RIM: 50.87
IE OUT (6"NE) = 47.87

SDCB-36
RIM: 50.87
IE OUT (6"NE) = 47.87

SDCB-37
RIM: 50.87
IE OUT (6"NE) = 47.87

SDCB-38
RIM: 50.70
IE OUT (6"NE) = 47.70

SDCB-39
RIM: 29.04
IE OUT (6"SW) = 27.49

SDCB-40
RIM: 38.67
IE OUT (6"SE) = 35.67

AREA DRAIN DATA

SDAD-2
RIM: 50.67
IE OUT (6"W) = 48.67

SDAD-3
RIM: 51.37
IE OUT (6"W) = 48.37

SDAD-4
RIM: 50.71
IE OUT (6"NE) = 47.71

SDAD-5
RIM: 50.87
IE OUT (6"E) = 47.87

SDAD-6
RIM: 52.03
IE OUT (6"NW) = 48.59

CLEANOUT DATA

SDCO-8
RIM = 51.08'
IE (10") = 40.98'

SDCO-9
RIM = 51.38'
IE (10") = 40.11'

SDCO-11
RIM = 51.21'
IE (10") = 39.17'

SDCO-12
RIM = 50.26'
IE (12") = 38.22'

SDCO-13
RIM = 49.51'
IE (12") = 37.17'

SDCO-22
RIM = 51.09'
IE (10") = 43.97'

SDCO-25
RIM = 51.15'
IE (10") = 45.05'

SDCO-26
RIM = 51.06'
IE (6") = 46.96'

SDCO-27
RIM = 51.18'
IE (8") = 47.06'

SDCO-28
RIM = 51.21'
IE (8") = 47.56'

SDCO-29
RIM = 51.05'
IE (8") = 46.70'

SDCO-30
RIM = 51.06'
IE (8") = 45.80'

CLEANOUT DATA

SDCO-31
RIM = 37.97'
IE (15") = 33.96'

SDCO-33
RIM = 52.29'
IE (12") = 41.55'

SDCO-34
RIM = 50.93'
IE (12") = 43.97'

SDCO-35
RIM = 51.87'
IE (12") = 43.18'

SDCO-36
RIM = 52.08'
IE (12") = 42.28'

SDCO-37
RIM = 51.90'
IE (15") = 40.56'

SDCO-38
RIM = 33.05'
IE (15") = 23.62'

SDCO-39
RIM = 40.40'
IE (15") = 37.10'

SDCO-40
RIM = 44.98'
IE (15") = 39.86'

SDCO-41
RIM = 34.06'
IE (15") = 22.99'

SDCO-42
RIM = 51.60'
IE (6") = 48.37'

MANHOLE DATA

SDMH-1
RIM: 50.99
IE IN (10"N) = 43.43
IE IN (10"S) = 40.92
IE OUT (15"E) = 40.92

SDMH-2
RIM: 34.80
IE IN (12"SW) = 28.22
IE IN (15"SE) = 28.22
IE OUT (15"NE) = 28.22

SDMH-3
RIM: 35.16
IE IN (15"SE) = 31.00
IE OUT (15"NW) = 31.00

SDMH-4
RIM: 30.91
IE IN (6"NW) = 26.57
IE IN (15"SW) = 26.57
IE OUT (15"SE) = 26.57

SCALE: 1"=30'

30 15 0 30

DDP SUBMITTAL

Cardno
Shaping the Future
PORTLAND
5415 SW WESTGATE DR, STE 100, PORTLAND, OR 97221
TEL: (503) 419 - 2500 FAX: (503) 419 - 2600
www.cardno.com

STORM PLAN
THE COVE - GARDEN APARTMENTS

GRAND COVE, LLC
OREGON CITY, OREGON

#	DATE	DESCRIPTION	BY

REGISTERED PROFESSIONAL ENGINEER
OREGON
BEN ... WILLIAMS
PRELIMINARY NOT FOR CONSTRUCTION
EXPIRES: 06/30/16

DATE	06/26/2015
DRAWN	KRG
DESIGNED	BRS
CHECKED	MDT
PROJECT #	21509220

SHEET TITLE
STORM PLAN

SHEET NUMBER
C4.2

LAND USE # ----

Plot Stamp: 6/26/2015 2:31:26 PM - Kyle Glidden (Portland)
File: w:\21509220\Civil_DD\0922-DD-STORM.dwg, Tab: C2.1

Map Scale: 1:2,260 if printed on A portrait (8.5" x 11") sheet.

N

Meters
0 30 60 120 180

Feet
0 100 200 400 600

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 Rating Polygons
- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Soil Rating Lines
- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Soil Rating Points
- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

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: http://websoilsurvey.nrcs.usda.gov
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 9, Sep 19, 2014

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

Date(s) aerial images were photographed: Jul 26, 2014—Sep 5, 2014

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.

Hydrologic Soil Group

Hydrologic Soil Group— Summary by Map Unit — Clackamas County Area, Oregon (OR610)				
Map unit symbol	**Map unit name**	**Rating**	**Acres in AOI**	**Percent of AOI**
67	Newberg fine sandy loam	A	0.6	4.5%
82	Urban land		12.6	95.5%
Totals for Area of Interest			**13.2**	**100.0%**

Description

Hydrologic soil groups are based on estimates of runoff potential. Soils are assigned to one of four groups according to the rate of water infiltration when the soils are not protected by vegetation, are thoroughly wet, and receive precipitation from long-duration storms.

The soils in the United States are assigned to four groups (A, B, C, and D) and three dual classes (A/D, B/D, and C/D). The groups are defined as follows:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

If a soil is assigned to a dual hydrologic group (A/D, B/D, or C/D), the first letter is for drained areas and the second is for undrained areas. Only the soils that in their natural condition are in group D are assigned to dual classes.

Rating Options

Aggregation Method: Dominant Condition

Component Percent Cutoff: *None Specified*

Tie-break Rule: Higher

Table 2.2
Runoff Curve Numbers for Selected Agricultural, Suburban, and Urban Areas

(Sources: TR 55, 1986, and Stormwater Management Manual, 1992. See Section 2.1.1 for explanation)

Cover type and hydrologic condition.	CNs for hydrologic soil group A	B	C	D
Curve Numbers for Pre-Development Conditions				
Pasture, grassland, or range-continuous forage for grazing:				
Fair condition (ground cover 50% to 75% and not heavily grazed).	49	69	79	84
Good condition (ground cover >75% and lightly or only occasionally grazed)	39	61	74	80
Woods:				
Fair (Woods are grazed but not burned, and some forest litter covers the soil).	36	60	73	79
Good (Woods are protected from grazing, and litter and brush adequately cover the soil).	30	55	70	77
Curve Numbers for Post-Development Conditions				
Open space (lawns, parks, golf courses, cemeteries, landscaping, etc.)[1]				
Fair condition (grass cover on 50% - 75% of the area).	77	85	90	92
Good condition (grass cover on >75% of the area)	68	80	86	90
Impervious areas:				
Open water bodies: lakes, wetlands, ponds etc.	100	100	100	100
Paved parking lots, roofs[2], driveways, etc. (excluding right-of-way)	98	98	98	98
Permeable Pavement (See Appendix C to decide which condition below to use)				
Landscaped area	77	85	90	92
50% landscaped area/50% impervious	87	91	94	96
100% impervious area	98	98	98	98
Paved	98	98	98	98
Gravel (including right-of-way)	76	85	89	91
Dirt (including right-of-way)	72	82	87	89
Pasture, grassland, or range-continuous forage for grazing:				
Poor condition (ground cover <50% or heavily grazed with no mulch).	68	79	86	89
Fair condition (ground cover 50% to 75% and not heavily grazed).	49	69	79	84
Good condition (ground cover >75% and lightly or only occasionally grazed)	39	61	74	80
Woods:				
Poor (Forest litter, small trees, and brush are destroyed by heavy grazing or regular burning).	45	66	77	83
Fair (Woods are grazed but not burned, and some forest litter covers the soil).	36	60	73	79
Good (Woods are protected from grazing, and litter and brush adequately cover the soil).	30	55	70	77

Single family residential[3]: Dwelling Unit/Gross Acre	Should only be used for subdivisions > 50 acres	Average Percent impervious area[3,4]	
1.0 DU/GA		15	Separate curve number
1.5 DU/GA		20	shall be selected for
2.0 DU/GA		25	pervious & impervious
2.5 DU/GA		30	portions of the site or
3.0 DU/GA		34	basin
3.5 DU/GA		38	
4.0 DU/GA		42	
4.5 DU/GA		46	
5.0 DU/GA		48	
5.5 DU/GA		50	
6.0 DU/GA		52	
6.5 DU/GA		54	
7.0 DU/GA		56	
7.5 DU/GA		58	

PUD's, condos, apartments, commercial businesses, industrial areas & & subdivisions < 50 acres	%impervious must be computed	Separate curve numbers shall be selected for pervious and impervious portions of the site

For a more detailed and complete description of land use curve numbers refer to chapter two (2) of the Soil Conservation Service's Technical Release No. 55 , (210-VI-TR-55, Second Ed., June 1986).

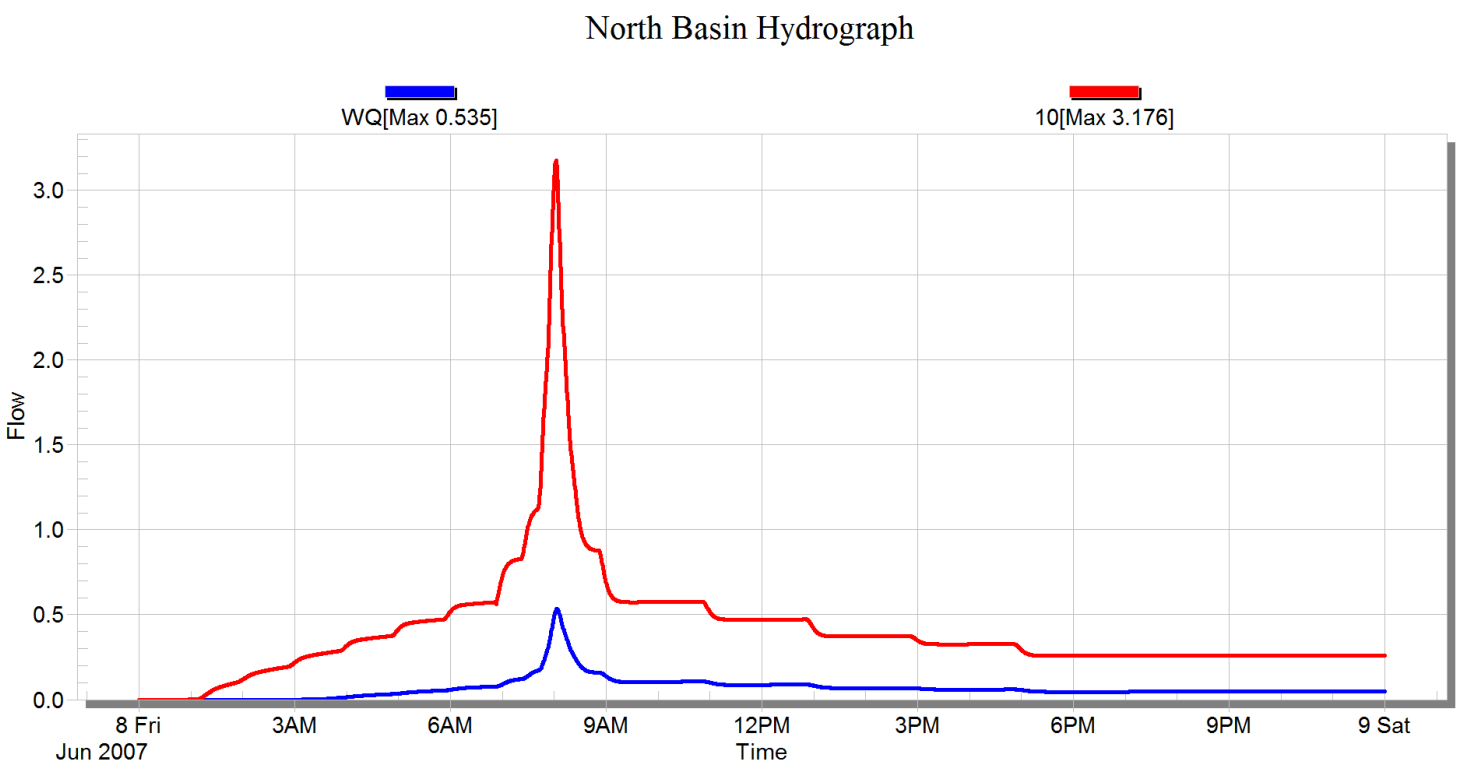
[1] Composite CN's may be computed for other combinations of open space cover type.

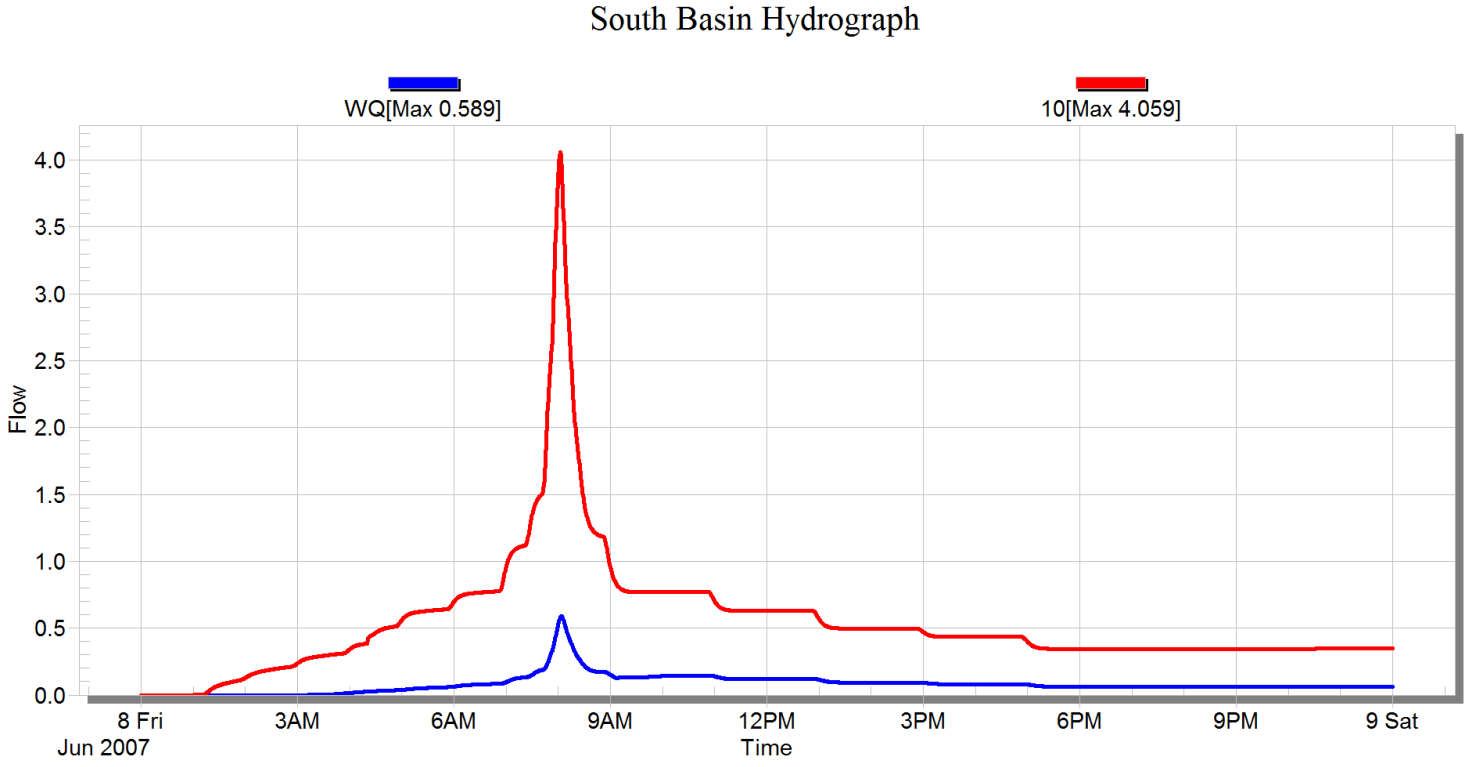
[2] Where roof runoff and driveway runoff are infiltrated or dispersed according to the requirements in Chapter 3, the average percent impervious area may be adjusted in accordance with the procedure described under "Flow Credit for Roof Downspout Infiltration" (Section 3.1.1), and "Flow Credit for Roof Downspout Dispersion" (Section 3.1.2).

[3] Assumes roof and driveway runoff is directed into street/storm system.

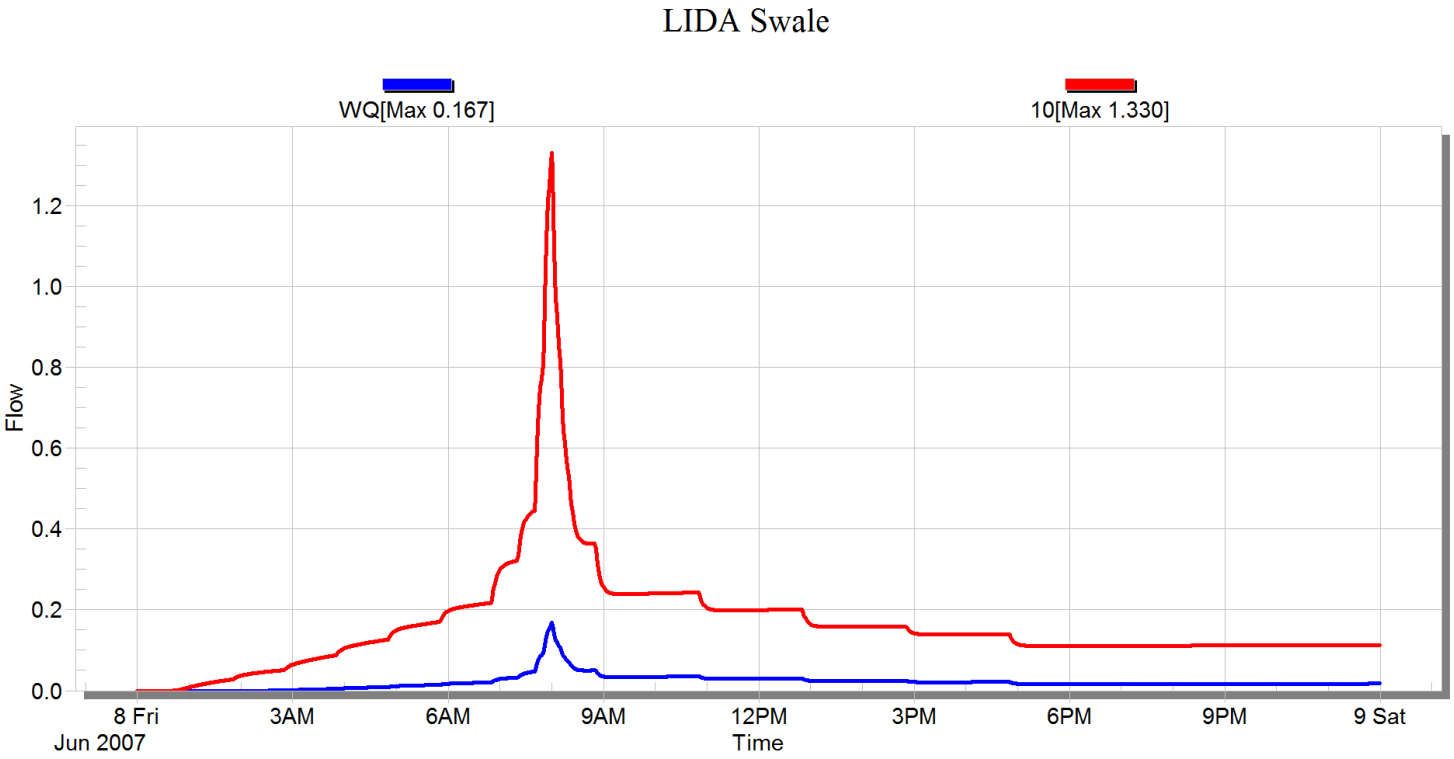
[4] All the remaining pervious area (lawn) are considered to be in good condition for these curve numbers.

Hydrographs





Hydrographs



MEMORANDUM

5415 SW Westgate Drive
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USA

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To: City of Oregon City

From: Atalia Raskin, PE
WR Senior Project Engineer

Date: August 12, 2015

Project: The Cove: Garden Apartments & Phase 1 Infrastructure
Cardno#: 21509220
Re: Preliminary Hydrology Analysis

This memorandum discusses the hydrologic impacts that may occur as a result of the Cove: Garden Apartments, Main Street Improvements, the North Park site grading, Lot 1 grading, and the trail access parking lot. The analysis reviews the proposed development impacts on the receiving storm sewer and receiving waterbodies, including the Clackamette Cove and Clackamas River and the measures being proposed to decrease these impacts.

Effects on Existing Drainage Patterns
The greater Cove development is located within the Clackamas drainage basin and flows into the Clackamette Cove either directly through sheet flow or through an existing storm sewer. The attached maps show the existing and proposed drainage patterns for the proposed development. The existing drainage patterns will be maintained as summarized below:

- North Park & Lot 1 Grading: After grading, each site will maintain the existing drainage pattern and will continue to sheet flow directly to the Cove. The sites will be replanted to maintain the infiltration capacity of these areas.
- Main Street: The roadway sheet flows either directly into the Cove or into roadside ditches before discharging into the Cove. In proposed conditions stormwater will be conveyed to a treatment facility, either a StormFilter system or LIDA swales prior to being discharged to the Cove.
- Trail Access Parking Lot: the existing gravel and concrete area sheet flows to the Cove. The proposed gravel parking lot will be built on the existing gravel and will continue to sheet flow directly to the Cove.

Effects on the Watershed
Alterations to land surface characteristics have been shown to change the runoff generating processes. This occurs as the infiltration capacity of the native soils is eliminated or greatly reduced by covering and compacting soils and removing native vegetation. Gutters and storm sewers on developed sites convey stormwater runoff more rapidly to stream channels than sheet flow and shallow groundwater flow. Additionally, the increased flow, the longer duration of higher flows, and the increased stormwater pollutant concentrations generated by urban developments can degrade stream channels and harm aquatic life.

The proposed Cove: Garden Apartment and Main Street Improvements change the land surface conditions by increasing the amount of impervious surface from the former concrete batch plant to a multi-family apartment complex. The existing site contains concrete, gravel, and pervious surfaces covered with grasses and blackberries. The proposed project will increase the amount of impervious surfaces including roof and parking lot area. The Garden Apartments project increases the amount of impervious area by 0.38 acres. The development will improve the quality of the site's pervious area with additional trees and landscaping.

The proposed Main Street project increase the impervious area by 0.27 acres. Street trees will be planted along Main Street that currently do not exist along the street. The additional tree cover over impervious area will increase evapotranspiration of rainfall thereby reducing stormwater runoff. The North Park site nor Lot 1 grading will increase the amount of impervious area. Trail access parking lot is mostly impervious in existing conditions, the project will add 0.03 acres of impervious area. The total additional impervious area for the development is 0.65 acres.

The increased amount of impervious area and the proposed onsite storm sewer will likely increase the amount of stormwater runoff generated at the site. The proposed public storm sewer in Main Street is designed to accommodate this additional runoff and runoff from future developments draining to this storm line. The public storm sewer discharges directly into the Cove, above the ordinary high water elevation of 18 (NAVD 88). A complete conveyance capacity analysis of the public storm sewer in Main Street is included in the Drainage Report – Phase 1 Infrastructure as part of the Phase 1 Infrastructure improvements.

The Clackamette Cove drains into the Clackamas River just upstream of its confluence with the Willamette River. Both the Clackamas and Willamette Rivers have drainage basins larger than 100 sq.-miles, the upper limit shown to influence channel stability. Therefore, the project will not degrade stream channels. Stormwater detention is not proposed and is not required at this project.

Therefore, the increased flow generated from the additional impervious project area will not adversely affect the watershed.

Effects on the Wetlands

A wetland is located along the west property boundary at the end of the drainage ditch. A 15-inch pipe conveys the ditch and wetlands to the Clackamette Cove. The amount of site area that drains to the wetland in existing conditions is 1.66 acres and in proposed conditions is 1.38 acres. All the proposed contributing area is pervious, maintaining existing hydrology. No other wetlands are located within the development.

Effects on the Groundwater Supply

Groundwater is located approximately 15 to 25 feet below the ground surface elevation. This is approximately equal to the ordinary high water elevation of the Clackamette Cove. Typically groundwater is supplied by surface water that is allowed to infiltrate into the ground and through interactions with adjacent waterbodies. The site's location adjacent to the Cove influences the groundwater depth at the Cove development. Stormwater infiltration is not possible for the Cove: Garden Apartments, the site is being filled to remove the proposed buildings from the floodplain elevation and the City of Oregon City jurisdictional design flood elevation (DFE). Infiltrating into fill can negatively affect the proposed retaining walls. The proposed Main Street roadside swales will treat and infiltrate runoff as soils allow, this includes 0.78 acres of impervious area. Therefore, the project will not to effect the groundwater supply. The North Park site, Lot 1 grading, and trail access parking lot will continue to infiltrate as in existing conditions and will not alter the groundwater supply.

Clackamas River Specific Considerations

The Clackamas River is required to follow OAR 340-041-0350 The Three Basin Rule: Clackamas, McKenzie & North Santiam. The Three Basin Rule states that in order to preserve or improve the existing high quality of municipal water supplies, recreation, and aquatic life new or increased waste discharges are prohibited. The Clackamette Cove joins the Clackamas River downstream of the municipal water system intake. Additionally, the Clackamas River is classified as water quality limited for TMDL's for dissolved oxygen and biological criteria. The proposed project will meet these requirements by providing water quality treatment and sending runoff to an existing outfall.

The proposed development will result in approximately 9.0 acres of pollutant generating impervious surface within the project area. New stormwater facilities are proposed for treatment of expected pollutants (i.e., PAHs, heavy metals, nutrients, oil and sediment) associated with roof runoff and vehicle use within the apartment complex and along the improved roadway. The existing site and roadway have no formal water quality treatment. Typical pollutants from multi-family residential projects include: nutrients, pesticides, metals, oil, grease and other petroleum products, and sediment. Dissolved copper, dissolved zinc, and PAHs are generally the primary constituents of concern for stormwater runoff in Oregon streams and rivers for the impact on ESA listed species. These pollutants are specially targeted for treatment in the selected stormwater management system. The water quality storm is listed below.

- Water Quality Storm: 33% of the 2-yr, 24-hour storm event (0.83-inch precipitation depth).

The stormwater management system was designed to maximize stormwater treatment through Contech StormFilters and LIDA swales. The selected StormFilter contains cartridges filled with ZPG filter media (a mixture of zeolite, perlite, and granular activated carbon), which are designed to remove sediment, metals, and stormwater pollutants from wet weather runoff.

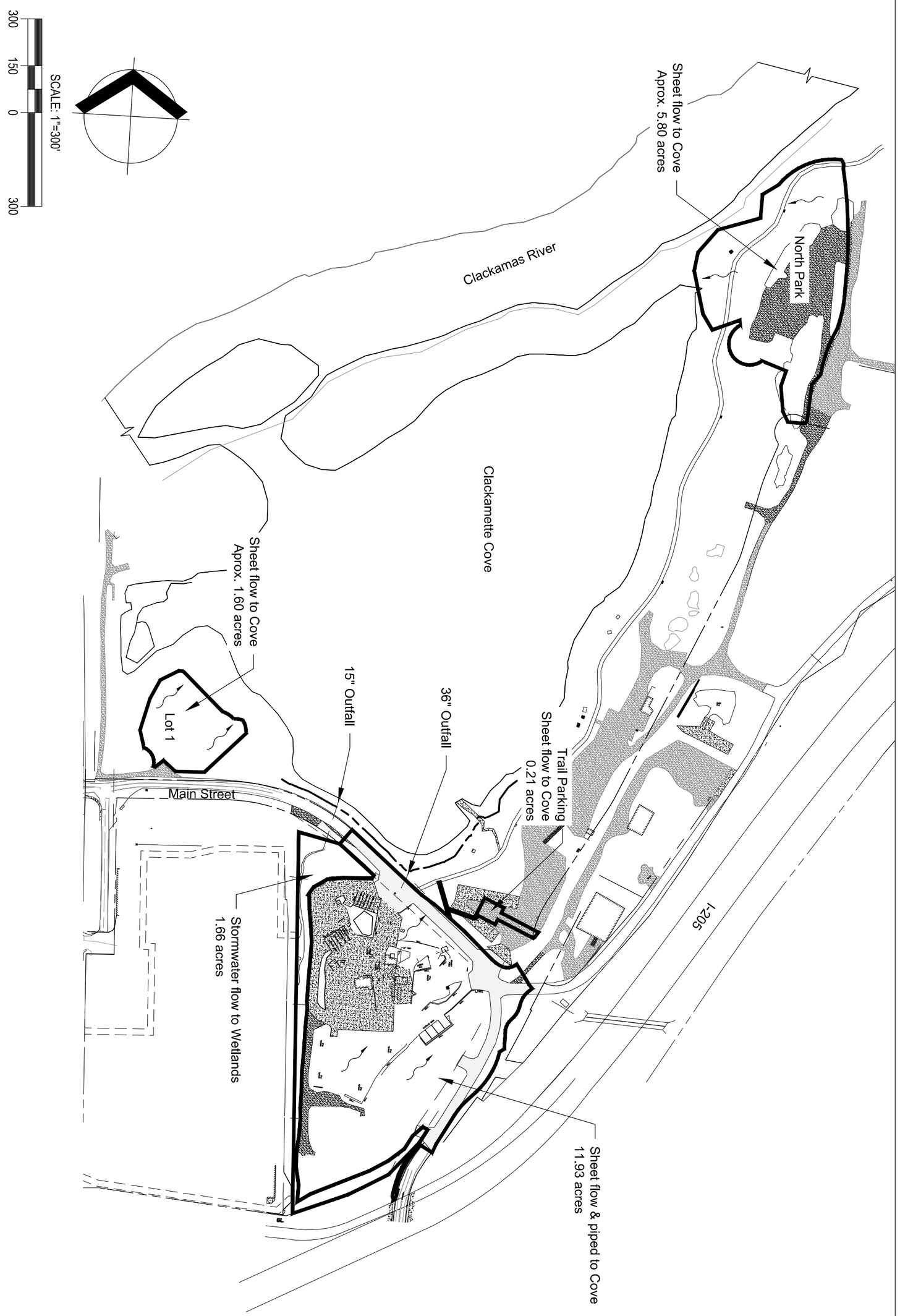
A decreased concentration of pollutants will remain within the treated stormwater runoff. These pollutants will be diluted with the Clackamette Cove water to concentrations below Oregon state water quality criteria levels.

Conclusion

The proposed project reviewed the hydrologic effects on the watershed and storm sewer. The project drains to the Clackamette Cove, followed by the Clackamas River and Willamette River. Because both of these rivers are classified as having large drainage basins, the project will not result in stream channel degradation within the watershed. Additionally, the project provides water quality treatment to target pollutants to protect water quality and aquatic life.

Attachments:

- Exhibit 1 – Existing Hydrology
- Exhibit 2 – Proposed Hydrology



PROJECT NO.	211509220
DATE:	08/12/2015
BY:	DEC
EXHIBIT:	1

EXISTING HYDROLOGY
COVE: PHASE 1 INFRASTRUCTURE

GRAND COVE LLC
Oregon City, Oregon

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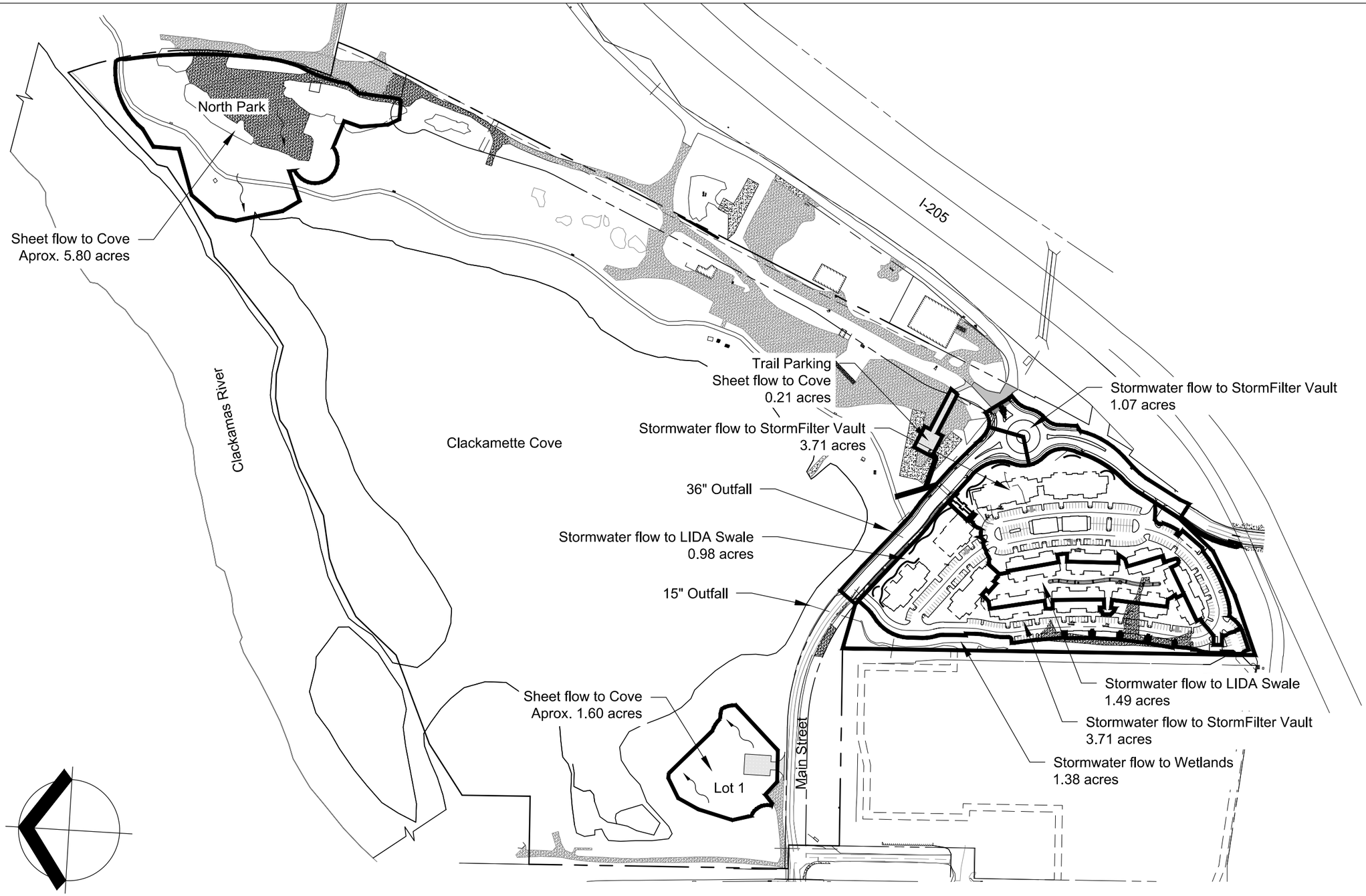

SCALE: 1"=300'

300 150 0 300

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PROPOSED HYDROLOGY
COVE: PHASE 1 INFRASTRUCTURE

GRAND COVE LLC
Oregon City, Oregon

PROJECT NO. 211509220
DATE: 08/12/2015
BY: DEC
EXHIBIT: 2

Drainage Report

Phase 1 Infrastructure

21509220

Prepared for
Grand Peaks Properties
4582 S Ulster Street, Suite 1200
Denver, Colorado
80237

August 12, 2015

Cardno
Shaping the Future

Document Information

Prepared for	Grand Peaks Properties
Project Name	Phase 1 Infrastructure
File Reference	0922-Drainage_Report.docx
Job Reference	21509220
Date	August 12, 2015

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Document Control

Version	Date	Author	Author Initials	Reviewer	Reviewer Initials
1	8/12/2015	Atalia Raskin	ASR	Mike Towle	MDT

EXECUTIVE SUMMARY

The proposed project will complete roadway and infrastructure improvements to Main Street in Oregon City, Oregon (See Vicinity Map). The Main Street improvements are a part of the larger The Cove development, and the specific development of Lot 2 (Garden Apartments) anticipated to develop concurrently with the Main Street improvements. The project will construct a roundabout at the Main Street and Agnes Street intersection. Agnes Street improvements will occur with a future development. Street construction includes grading, utility installation, landscaping, and installing public water quality facilities. Additionally a gravel parking lot will be constructed to allow trail access and grading will occur with the North Park site and Lot 1 to provide fill material for the Garden Apartment site.

Standards

The stormwater approach for the Cove follows OAR 340-041-0350 which states that new or increased waste discharges are prohibited in the Clackamas River Subbasin. By incorporating Low Impact Development methods such as LIDA swales, downstream impacts and water quality protection will be achieved.

In addition to following OAR 340-041-0350, the design follows the *Stormwater and Grading Design Standards* by the City of Oregon City, issued in December 1999 and the standards within the Surface Water Management Agency of Clackamas County (SWMACC) Rules and Regulations using the *Surface Water Quality Facilities Technical Guidance Handbook dated 1991,* as well as the *Clean Water Services Low Impact Development Approaches Handbook dated July, 2009*.

Water Quality

Stormwater treatment will be provided within the public right-of-way through the use of LIDA swales. LIDA swales are landscaped reservoirs that collect and treat stormwater runoff through vegetation and soil media. They may also provide pollutant reduction and flow attenuation to reduce hydraulic impacts from urban developments on downstream rivers. Contech StormFilters will be used in areas where it is infeasible to construct LIDA Swales.

Impervious Area Draining to LIDA Swales = 0.776 acres

Impervious Area Draining to Contech StormFilters = 0.916 acres

Conveyance Analysis

The proposed project will install and upsize the stormwater infrastructure within Main Street. Main Street will continue to discharge into two existing Cove outfalls (one 15-inch and one 36-inch). A conveyance analysis was completed to correctly size the proposed storm sewer for future build-out of the upstream basin. An upstream basin analysis was completed as part of this project.

Floodplain Analysis

The City of Oregon City regulates development within the floodplain using the jurisdictional Design Flood Elevation (DFE). The DFE is the extents of the 1996 flood event and exceeds the elevation listed on the FEMA FIRM MAP. The DFE for the site is 50.7 (NAVD88).

The proposed street improvements are located within the floodplain. Cut and fill calculations were completed to ensure the overall Cove developed is balanced. The proposed street improvements results in a net cut, increasing the provided flood storage volume.

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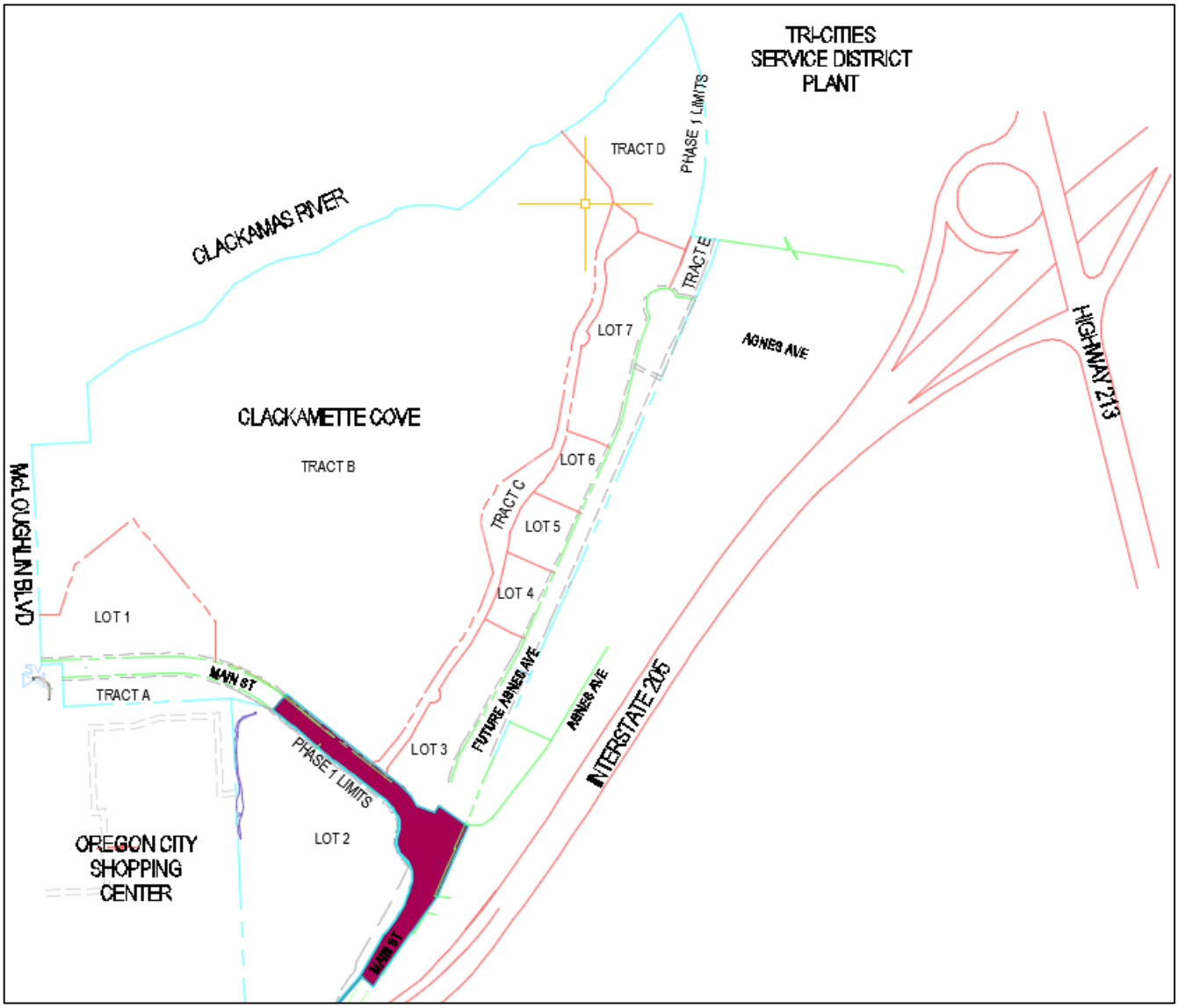
Tables

Figures

1 VICINITY MAP

Figure 1-1 Vicinity Map



2 PROJECT DESCRIPTION

2.1 Project Overview

The proposed project will complete roadway and infrastructure improvements to Main Street in Oregon City, Oregon (See Vicinity Map). The Main Street improvements are a part of the larger The Cove development, and the specific development of Lot 2 (Garden Apartments) anticipated to develop concurrently with the Main Street improvements. The project will construct a roundabout at the Main Street and Agnes Street intersection. Agnes Street improvements will occur with a future development. Street construction includes grading, utility installation, landscaping, and installing public water quality facilities. Additionally a gravel parking lot will be constructed to allow trail access, and grading will occur with the North Park site and Lot 1 to provide fill material for the Garden Apartment site.

The stormwater approach for the Cove follows OAR 340-041-0350 which states that new or increased waste discharges are prohibited in the Clackamas River Subbasin. By incorporating Low Impact Development methods such as LIDA swales, downstream impacts and water quality protection will be achieved.

In addition to following OAR 340-041-0350, the design follows the *Stormwater and Grading Design Standards* by the City of Oregon City, issued in December 1999 and the standards within the Surface Water Management Agency of Clackamas County (SWMACC) Rules and Regulations using the *Surface Water Quality Facilities Technical Guidance Handbook dated 1991,* as well as the *Clean Water Services Low Impact Development Approaches Handbook dated July, 2009*.

3 EXISTING CONDITIONS

3.1 Topography

The existing Main Street slopes away from the Clackamette Cove with slopes ranging from 1 to 4-percent. In general, street slopes range from approximately 29 feet in the west end of the street up to 50 feet in the southeast end of the street.

3.2 Climate

The site is located in Clackamas County approximately 90 miles inland from the Pacific Ocean. There is a gradual change in seasons with defined seasonal characteristics. Average daily temperatures range from 35°F to 82°F. Average annual rainfall recorded in this area is 47 inches.

3.3 Site Geology

There are two underlying soil types on the site as classified by the United States Department of Agriculture Soil Survey of Clackamas County, Oregon. These soil types are identified below in Table 1 (See Technical Appendix: Hydrologic Soils Group – Clackamas County).

Table 3-1 Soil Characteristics

Soil Type	Hydrologic Group
Urban Land	D
Newberg Fine Sandy Loam	A
Chehalis Silt Loam	B
Wapato Silty Clay Loam	C/D

Group A soils have high infiltration rates when thoroughly saturated, Group B soils have moderate infiltration rates when thoroughly saturated, while Groups D and C soils have very slow infiltration rates when thoroughly

saturated. Group D soils is the dominant soil type. Therefore, a soil classification of group D was conservatively assigned to the whole site.

3.4 Hydrology

Main Street
Runoff from the existing Main Street consists primarily of overland flow across the roadway and conveyance through road side ditches. Runoff drains into the Clackamette Cove prior to entering the Clackamas River, a tributary to the Willamette River. There is currently no water quality treatment for roadway runoff. Stormwater runoff enters the Cove either through the existing 36-inch culvert outfall, through the existing 15-inch culvert outfall, or through direct sheet flows into the Cove.

North Park, Lot 1 Grading and Trail Access Parking Lot
Runoff from the existing North Park, Lot 1, and the trail access parking lot sheet flow directly into the Clackamette Cove.

Clackamette Cove – Upstream Basin Analysis

A regional storm conveyance sewer is located within Main Street and is the receiving source of stormwater runoff from approximately 171 acres. A conveyance analysis was completed to determine the conveyance capacity of this storm line in the projected future conditions. A variety of information was reviewed to complete the regional storm conveyance analysis, including the following documents:

- Oregon City Drainage Master Plan, January 1988, Otak Incorporated.
- Clackamas County FIS, June 17, 2008, FEMA
- Field Survey – Completed in 2008 by WRG Design, Inc.
- Oregon City GIS on OCWebMaps, viewed June 2015.

The greater Cove development including The Cove: Garden Apartments and Main Street are located within the Clackamas drainage basin. The regional basin draining to the storm sewer in Main Street includes the Kelly Field Basin. The Drainage Master Plan did not complete a hydraulic analysis for these regional basins. Information on the existing storm sewer was collected from a field survey completed by WRG Design, Inc. in 2008.

The storm sewer collects runoff generated southeast of the Clackamette Cove, east of Hwy 205. The upstream basin is composed of piped storm sewers, open ditches, and culvert crossings. The storm sewer enters the Cove through an existing 36-inch diameter pipe.

3.5 Basin Areas

Main Street and Trail Access Parking Lot
Surface areas impacted by this redevelopment project are shown in Table 3-2. The existing site is approximately 51.4 percent impervious. A gravel parking lot will be constructed to allow trail access. (See Technical Appendix: Exhibit 1 – Existing Basin Delineation).

Table 3-2 Existing Basin Areas – Main Street & Trail Access

Basin	Impervious Area, ac	Pervious Area, ac	Gravel Area, ac	Total Area, ac
Main Street	1.62	0.67	0.00	2.29
Trail Parking Lot	0.02	0.03	0.16	0.21

North Park & Lot 1 Grading
Surface areas impacted by this redevelopment project grading are shown in Table 3-3. Note areas are approximate. The existing areas are zero percent impervious. (See Technical Appendix: Exhibit 1 – Existing Basin Delineation).

Table 3-3 Existing Basin Areas – North Park & Lot 1

Basin	Impervious Area, ac	Pervious Area, ac	Total Area, ac
North Park	0.00	5.80	5.80
Lot 1	0.00	1.60	1.60

4 PROPOSED CONDITIONS

4.1 Hydrology

Main Street
Stormwater treatment will be provided within the public right-of-way through the use of LIDA swales. LIDA swales are landscaped reservoirs that collect and treat stormwater runoff through vegetation and soil media. They may also provide pollutant reduction and flow attenuation to reduce hydraulic impacts from urban developments on downstream rivers. Contech StormFilters will be used in areas where it is infeasible to construct LIDA Swales.

- Impervious Area Draining to LIDA Swales = 0.776 acres
- Impervious Area Draining to Contech StormFilters = 0.916 acres

An additional area (Basin J) will flow a LIDA swale once the Main Street improvements are completed in a later phase of the project. The Garden Apartment driveway access prevents the construction of swale for this area. Basin J along with existing roadway runoff will drain to an area drain and conveyed to the Cove through the existing 15-inch storm pipe.

North Park, Lot 1 Grading and Trail Access Parking Lot
Runoff from the existing North Park, Lot 1, and the trail access parking lot will continue to sheet flow directly into the Clackamette Cove.

Clackamette Cove – Upstream Basin Analysis
The upstream basin has been modeled under future conditions with the assumed development of the former Rossman Landfill. The projected future development requires the conveyance pipe in Main Street to be upsized to accommodate this additional area. The proposed storm sewer is 48-inch. The last segment of storm pipe prior to the outfall will be upsized in the future. The hydraulic model includes the 36-inch pipe as part of the analysis.

4.2 Curve Number

The curve number represents runoff potential from the soil. The major factors for determining the CN values are hydrologic soil group, cover type, treatment, hydrologic condition and antecedent runoff condition. The selected pervious curve numbers are 90 – Open Space in good Condition and 91 – Gravel (Attached: Table 2-2 – Runoff Curve Numbers for Selected Agricultural, Suburban, and Urban Areas). Composite curve numbers were calculated for each delineated sub-basin (See Technical Appendix: Composite Curve Number Calculations).

4.3 Time of Concentration

The time of concentration (T_C) as described in NEH-4 Chapter 15 is defined in two ways; the time for runoff to travel from the furthermost point of the watershed to the point in question, and the time from the end of excess rainfall to the point of inflection on the trailing limb of the unit hydrograph. Time of concentration can be estimated from several formulas.

The minimum time of concentration is 5 minutes in highly developed urban areas (i.e. parking lots) and the maximum is 100 minutes in rural areas. A condition time of concentration was calculated for each delineated sub-basin (See Technical Appendix: Time of Concentration).

4.4 Basin Areas

Main Street and Trail Access Parking Lot
Surface areas impacted by this redevelopment project are shown in Table 4-1. The parking lot is mostly gravel, although the lot includes a concrete path and an ADA parking stall (See Technical Appendix: Exhibit 1 – Existing Basin Delineation).

Table 4-1 Proposed Basin Areas – Main Street & Trail Access

Basin	Impervious Area, ac	Pervious Area, ac	Gravel Area, ac	Total Area, ac
Main Street	1.86	0.43	0.00	2.29
Trail Parking Lot	0.05	0.00	0.16	0.21

Clackamette Cove – Upstream Basin Analysis
The contributing upstream area is composed of 10 sub-basins. The upper most basins (8, 9, and 10) are located on the former Rossman Landfill. The basins now contain a Home Depot, The End of the Oregon Trail Interpretive Center, a golf driving range, and developed and undeveloped parcels. The area will likely be redeveloped in the future as a regional mall. Stormwater runoff from these basins flow west to roadside ditches along Washington Street. A 36-inch culvert crosses Washington Street, where it outfalls to an open flat grassy area. Two basins are located between Washington Street and the rail road tracks (6 and 7). Both basin 6 and 7 are developed. Businesses in basin 7 include a landscape store, Amtrak station, and the Maverick welding supply store. Businesses in basin 6 include the Metro transfer station. The transfer station drains to a large detention pond, although the detention pond was not included within the downstream analysis.

Stormwater runoff crosses under a rail road bridge through an open channel. One basin is located between the rail road tracks and I-205 (Basin 5). Basin 5 is a vegetated basin. In 2012, the basin was graded to provide flood management and planted as a natural resource district. This basin will not be developed in the future. The restoration was completed in conjunction with the OR 213: I-205 Redland Road overcrossing project. Stormwater runoff continues under I-205 through double12-ft by 12-ft box culverts. Basin 4 is located west of I-205. The basin contains two buildings and gravel parking lots. Basin 3 is the proposed the Cove: Garden Apartments and Main Street improvements.

Basin 2 drains to an existing 15-inch culvert crossing Main Street. The culvert collects a drainage ditch located west of the Cove: Garden Apartments and Main Street northwest of the proposed roundabout. Basin 1 is the area surrounding the Clackamette Cove and includes area where stormwater runoff sheet flows into the Cove. This basin will be developed during future phases of the Cove development. Basin 1 will discharge to the Clackamette Cove through flow spreaders in future conditions. Neither Basin 1 nor 2 drains to the 36-inch culvert.

Table 3-4 lists basin areas and the projected future project impervious area. Impervious area is listed for proposed (The Cove: Garden Apartments and Main Street Improvement) and future (Basin 1, 2, 8, 9, 10). Basin delineation are shown in Exhibit 3 – Upstream Basin Delineation.

Table 4-2 Existing Upstream Basin Areas

Basin	Impervious Area, ac	Pervious Area, ac	Total Area, ac	Discharge
1	11.89	6.40	18.29	Sheetflow
2	1.63	4.42	6.05	15" Outfall
3	8.13	4.39	12.52	36" Outfall
4	2.24	19.76	22.01	36" Outfall
5	4.97	24.79	29.76	36" Outfall
6	8.50	10.11	18.61	36" Outfall
7	5.09	8.58	13.67	36" Outfall
8	26.26	6.57	32.83	36" Outfall
9	4.71	1.18	5.89	36" Outfall
10	9.12	2.28	11.40	36" Outfall
Total	82.54	88.48	171.02	-

5 HYDROLOGIC ANALYSIS DESIGN GUIDELINES

5.1 Design Guidelines

The analysis and design criteria used for stormwater management described in this section will follow the Clean Water Services *Design and Construction Standards for Sanitary Sewer and Surface Water Management* issued July 2009. Section 5.04.2 describes the allowable flow determination methods including the selected TR-55 NRCS method.

5.2 Hydrograph Method

Rainstorms occur naturally over long periods of time. The most effective way of estimating storm rainfall is by using the hydrograph method. The hydrograph method generates storm runoff based on physical characteristics of the site. The Santa Barbara Urban Hydrograph (SBUH) was used for this analysis. The SBUH method is based on the curve number (CN) approach, and uses the Soil Conservation Service's (SCS) equations for computing soil absorption and precipitation excess. The SBUH method converts the incremental runoff depths into instantaneous hydrographs, which are then routed through an imaginary reservoir with a time delay equal to the basin time of concentration.

xpswmm 2013 Version 15.1 was used for our hydrology and hydraulics analysis. xpswmm is based on the public domain xpswmm program and is an approved method of analysis by SWMACC.

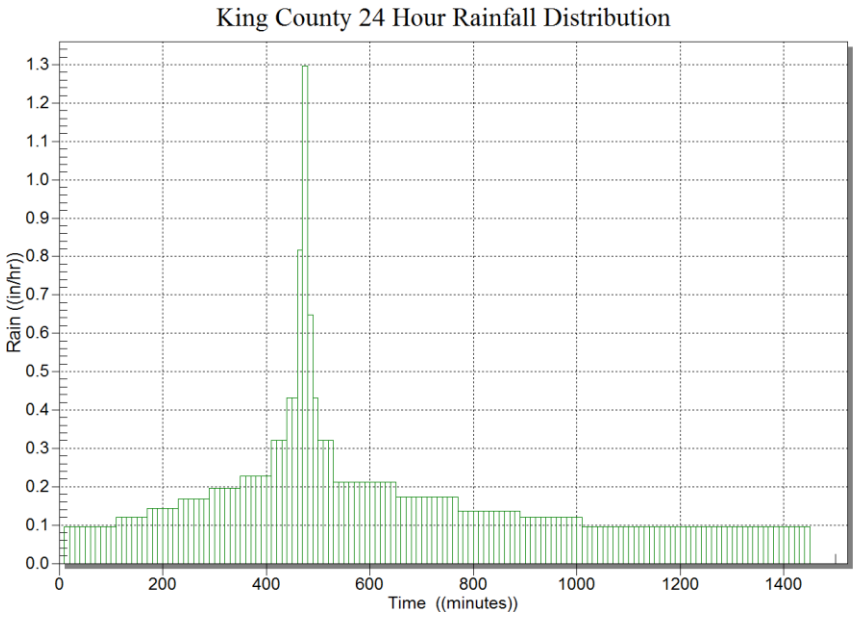
5.3 Design Storm

The rainfall distribution to be used within the City of Oregon City is the design storm of 24-hour duration based on the standard King County rainfall distribution. A typical King County 24-hour rainfall distribution for a 25-year storm event is shown in Figure 5-1. A 25-year design storm was used for all conveyance design for the regional stormwater system.

Table 5-1 Precipitation Depth

Recurrence interval (years)	Total Precipitation Depth (in)
WQ	0.87
10	3.40
25	4.00
50	4.40
100	4.50

Figure 5-1 25 Year King County Type 1A Rainfall Ditribution



6 HYDRAULIC ANALYSIS AND DESIGN CHARACTERISTICS

6.1 Design Guidelines

The analysis and design criteria described in this section will follow the City of Oregon City *Stormwater and Grading Design Standards*. Chapter 6 – Collection and Conveyance Facilities requires storm drainage system and facilities be designed to convey the 10-year storm event without surcharge.

6.1 Manning's 'n' Values for Pipes

A Manning's 'n' value of 0.013 was selected for all of the storm drain pipes. Additionally an exit loss coefficient between 0.02 and 0.25 was added into each catch basin and manhole. The value is dependent upon the angle of the pipe leaving each catch basin or manhole.

6.2 System Capacities

The proposed conveyance systems were designed to convey and contain the peak runoff from a 10-year design storm event.

6.3 System Performance

A schematic layout is included within the Technical Appendix. Note, nodes with labels starting with the letter "N" (i.e. N1) are locations where pipes/channels come together and a structure is not present.

The hydraulic model starts east of Washington Street and heads 2,575 ft (0.49 miles) west to the 36-inch outfall into the Clackamette Cove. The hydraulic model includes the existing upstream conveyance system and proposed Main Street conveyance system. The onsite Garden Apartments conveyance system is not included within the model. A complete onsite analysis will be submitted with the final Garden Apartments Drainage Report. The Garden Apartment drainage area has been added to the model within two nodes: Site N and Site S.

Maximum flow in a storm drainage pipe occurs at approximately 0.94do (Depth of flow section (do) – depth of flow normal to the direction of flow). At 0.94do the section factor of uniform flow has a maximum value which results in optimum flow for a section without surcharge conditions. During the 10-year storm event, the proposed conveyance system will operate at or below 0.94do with the exception of Links P3 and P17. These links are slightly surcharged due to backwater from the main storm sewer. A few of the upstream conveyance systems are surcharged. During the 100-year storm event, there will be no flooding with at least 0.46 foot of freeboard for the entire system (See Technical Appendix: xpswmm Schematic Layout, Runoff and Conveyance Tables).

Every effort was made to achieve flow velocities in the pipe system of at least 2.5 fps. This was met with a few exceptions.

7 WATER QUALITY

7.1 Water Quality Guidelines

All water quality facilities were designed per criteria set forth by the *City of Oregon City Stormwater and Grading Design Standards* to facilitate the treatment of all stormwater runoff from the proposed site. The facilities will be designed to capture and treat runoff from 1/3 of the 2-year, 24-hour storm event.

7.2 Water Quality Facility

Contech StormFilter catch basins and vaults are the selected water quality facilities from the east side of Main Street. These facilities were selected for their ability to integrate into site. Each StormFilter system will have the standard cartridge size with an 18-inch drop and have a treatment capacity of 0.033 cfs (15 gpm). The maximum bypass flow is 1.80 cfs. Table 7-1 lists the number of cartridges within each system. Three facilities will provide treatment to the required surface area. The selected StormFilter contains cartridges filled with ZPG filter media (a mixture of zeolite, perlite, and granular activated carbon), which are designed to remove sediment, metals, and stormwater pollutants from stormwater runoff.

Table 7-1 Mechanical Water Quality Facilities

Facility	Basin #	Impervious Area (ac)	Water Quality Flow Rate (cfs)	Quantity of Cartridges	Facility Type
SDCI D1.1	C	0.09	0.021	1	1-Cartridge CB
SDCI D1.2	D	0.11	0.025	1	1-Cartridge CB
Vault E	E, F, G & H	0.71	0.152	5	8x11 Vault
Total	-	0.91	-	7	-

7.3 LIDA Facilities

Phase 1 of the development will include LIDA swales used to treat street runoff from the west side of Main Street. LIDA swales are landscaped reservoirs that collect stormwater runoff through vegetation and soil media. They also provide pollutant reduction and flow attenuation to reduce hydraulic impacts from urban developments on downstream rivers. Overflows will be placed in the swales slightly above the water quality storm event elevation (0.5 ft) will collect rainfall from storm events greater than 1/3 of the 2 year storm event and convey it to

the proposed underground storm sewer. The runoff from the water quality event will infiltrate through 18 inches of growing medium, followed by 12 inches of drain rock. A 6 inch perforated pipe will be located at the bottom of the drain rock to convey the treated stormwater to the ditch inlet. The swales have been designed following Clean Water Services guidelines.

The Swales will be located adjacent to the south roadside and will receive sheet flow runoff from scuppers constructed through the curbs. The swales will have a sloping bottom and 3 to 1 side slopes. Each swale will have at least 0.50 feet of freeboard during the water quality storm event. Table 7.2 shows the length, water quality flow rate, depth, and freeboard for each swales (See Technical Appendix: Water Quality Hydrographs).

Table 7-2 LIDA Swales

Basin	Impervious Area Drainging to Facility (ac)	Water Quality Flow Rate (cfs)	Swale Diamentions		
			Length (ft)	Depth (ft)	10-year Freeboard Depth (ft)
A	0.15	0.03	62	0.5	1.07
B	0.63	0.13	247	0.5	0.71
Total	0.78	0.16	-	-	-

8 WATER QUANTITY

8.1 Water Quantity Guidelines

The proposed stormwater management system will discharge site runoff to an existing storm sewer. As part of the conveyance analysis the public storm sewer will be evaluated for capacity. The conveyance analysis of the public storm sewer found the sewer has capacity to convey site flows. The Clackamette Cove exits into the Clackamas River just upstream of the Willamette River. Both the Clackamas and Willamette Rivers have drainage basins larger than 100 sq.-miles, the upper limit requiring stormwater detention. Therefore detention is not required for this project.

9 FLOODPLAIN ANALYSIS

The City of Oregon City regulates development within the floodplain using the jurisdictional Design Flood Elevation (DFE). The DFE is the extents of the 1996 flood event and exceeds the elevation listed on the FEMA FIRM MAP. The DFE for the site is 50.7 (NAVD 88). The proposed street improvements will remain within the floodplain. Cut and fill calculations were completed to ensure the overall Cove developed is balanced.

10 SUMMARY

The proposed storm management approach follows the *City of Oregon City Stormwater and Grading Design Standards.* The Main Street improvements storm system was designed to provide water quality treatment by Contech StormFilters and LIDA Swales. A regional conveyance analysis was completed to design the public storm sewer in Main Street for future land-use conditions.

In conclusion, the proposed stormwater management system will meet the requirements of the City of Oregon City.

Phase 1 Infrastructure

Technical Appendix

Supporting Material

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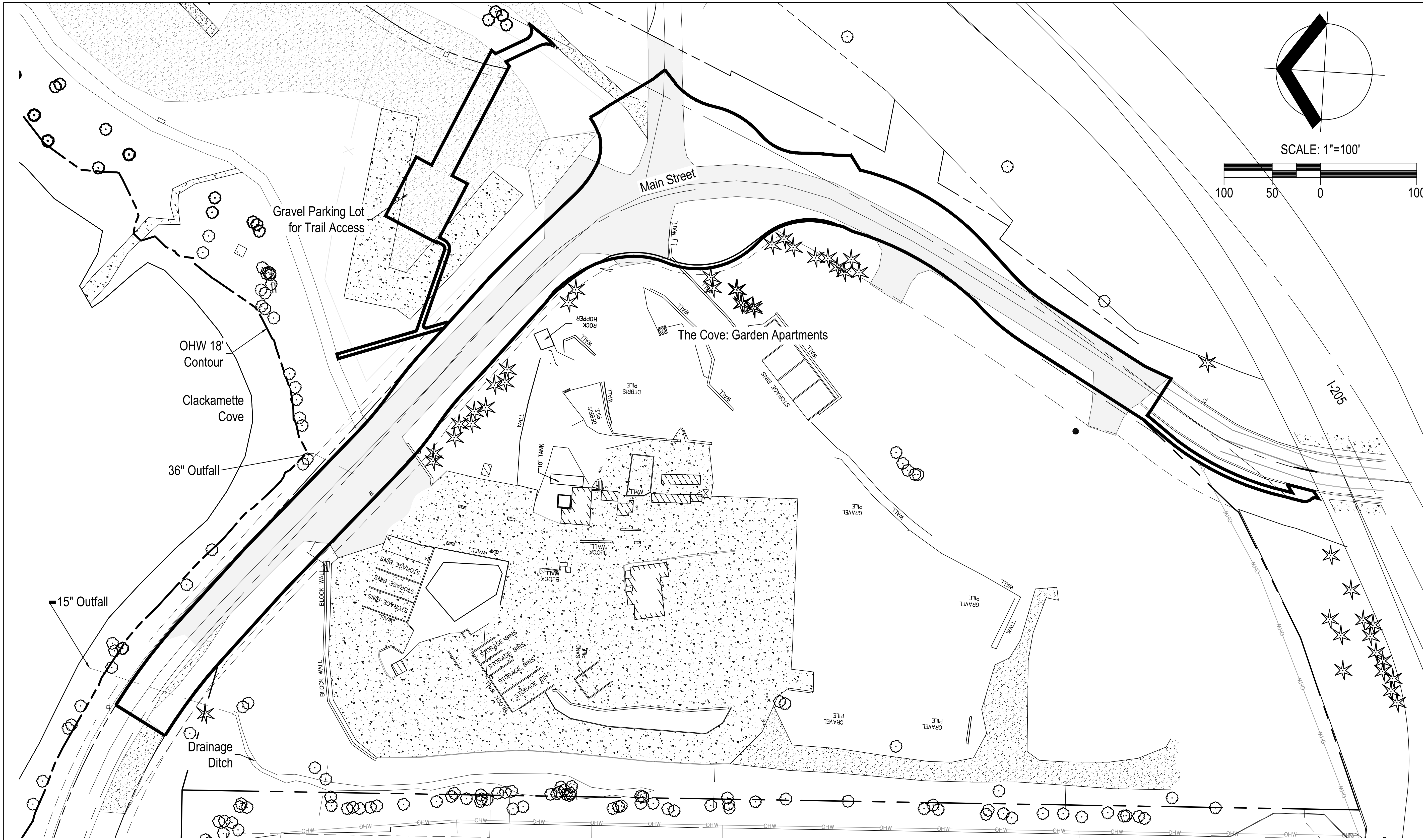
Technical Appendix

- Exhibit 1 – Existing Main Street Basin Delineation
- Exhibit 2 – Proposed Main Street Basin Delineation
- Exhibit 3 – Upstream Basin Delineation
- Exhibit 4 – North Park & Lot 1 Basin Delineation

- Hydrologic Soils Group – Clackamas County
- Table 2-2 – Runoff Curve Numbers for Selected Agricultural, Suburban, and Urban Areas
- Composite Curve Number Calculations
- Time of Concentration

- xpswmm
    - Schematic Layout
    - Runoff Tables
    - Conveyance Tables
    - Water Quality Hydrograph
    - Outfall Hydrograph
    - Proposed Main Street Profile



Basin	Impervious Area (ac)	Gravel Area (ac)	Pervious Area (ac)	Total Area (ac)
Gravel Lot	0.017	0.159	0.033	0.209
Main Street	1.621	0.000	0.669	2.290
Total	1.638	0.159	0.702	2.499

EXISTING MAIN STREET BASIN DELINEATION
COVE: PHASE 1 INFRASTRUCTURE

GRAND COVE LLC
Oregon City, Oregon

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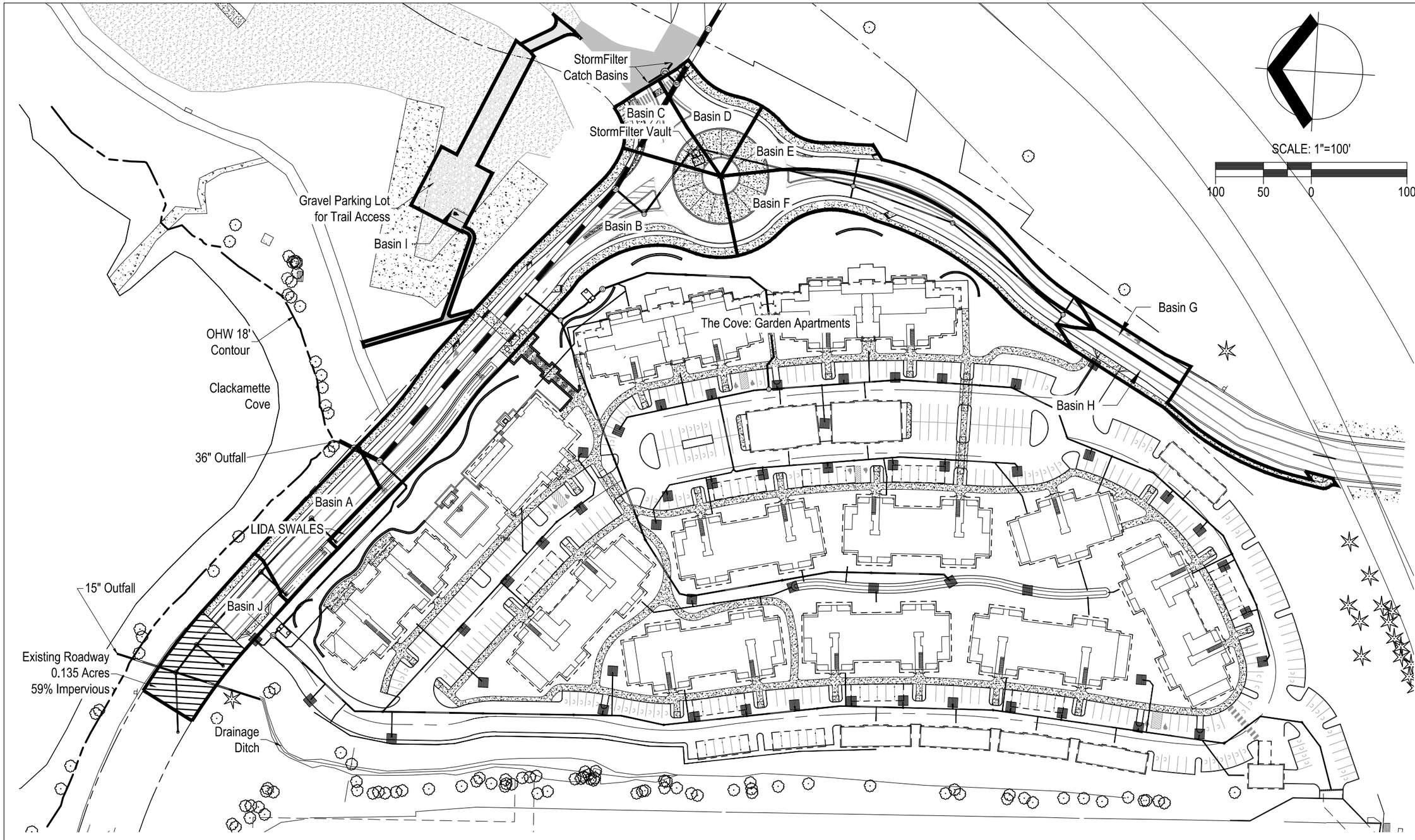
PORTLAND
5415 SW WESTGATE DR, STE 100, PORTLAND, OR 97221
TEL: (503) 419-2500 FAX: (503) 419-2600
www.cardno.com

PROJECT NO. 211509220
DATE: 08/12/2015
BY: ASR
EXHIBIT: 1



Basin	Impervious Area (ac)	Gravel Area (ac)	Pervious Area (ac)	Total Area (ac)
A	0.149	0.000	0.038	0.187
B	0.627	0.000	0.167	0.794
C	0.093	0.000	0.023	0.116
D	0.114	0.000	0.018	0.132
E	0.238	0.000	0.021	0.260
F	0.318	0.000	0.079	0.397
G	0.049	0.000	0.001	0.050
H	0.103	0.000	0.014	0.117
I	0.041	0.168	0.000	0.209
J	0.166	0.000	0.073	0.239
Total	1.899	0.168	0.432	2.499

PROPOSED MAIN STREET BASIN DELINEATION
COVE: PHASE 1 INFRASTRUCTURE

PROJECT NO. 211509220
DATE: 08/12/2015
BY: ASR
EXHIBIT: 2

GRAND COVE LLC
Oregon City, Oregon

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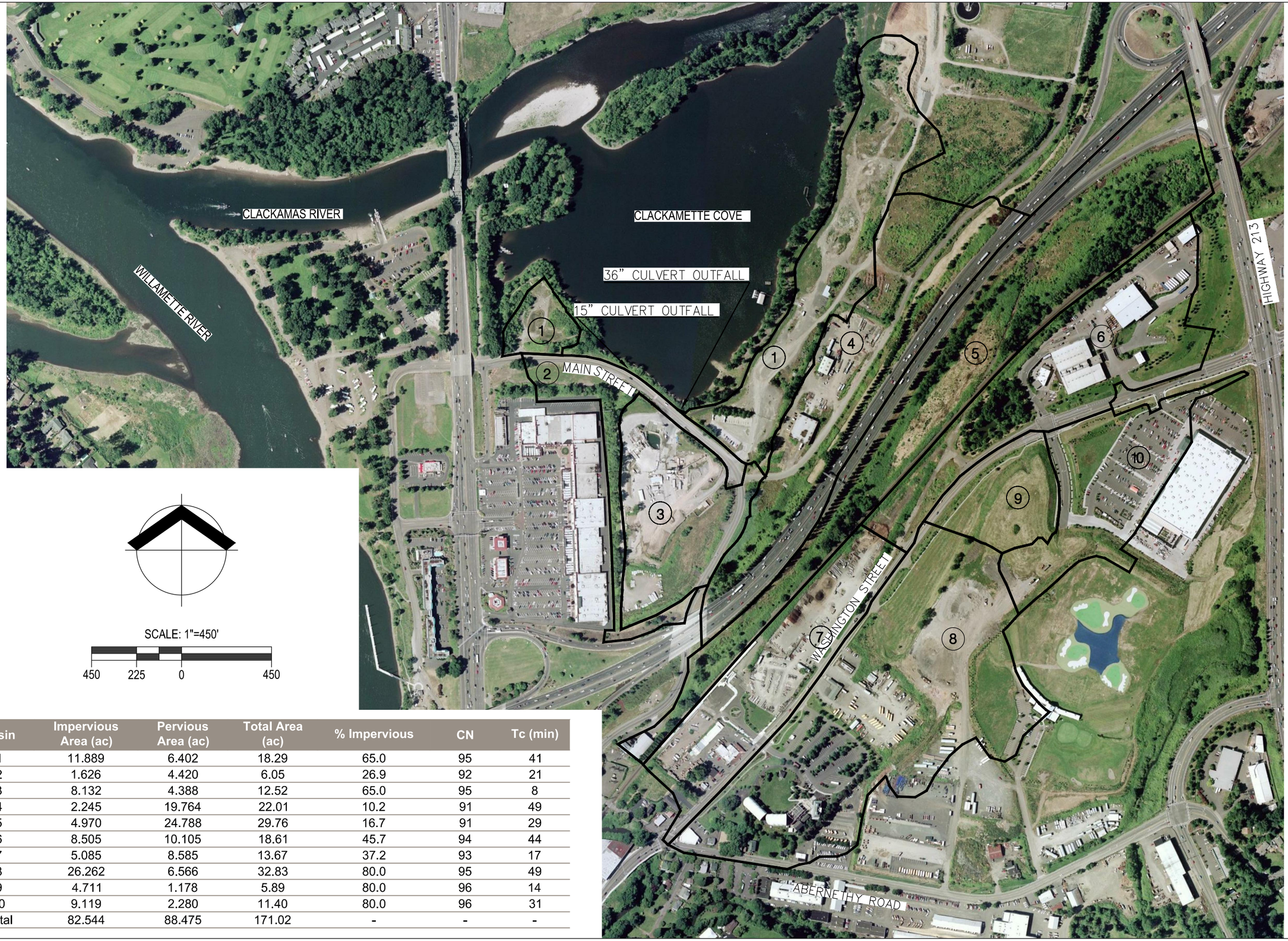

SCALE: 1"=450'

450 225 0 450

Basin	Impervious Area (ac)	Pervious Area (ac)	Total Area (ac)	% Impervious	CN	Tc (min)
1	11.889	6.402	18.29	65.0	95	41
2	1.626	4.420	6.05	26.9	92	21
3	8.132	4.388	12.52	65.0	95	8
4	2.245	19.764	22.01	10.2	91	49
5	4.970	24.788	29.76	16.7	91	29
6	8.505	10.105	18.61	45.7	94	44
7	5.085	8.585	13.67	37.2	93	17
8	26.262	6.566	32.83	80.0	95	49
9	4.711	1.178	5.89	80.0	96	14
10	9.119	2.280	11.40	80.0	96	31
Total	82.544	88.475	171.02	-	-	-

UPSTREAM BASIN DELINEATION
COVE: PHASE 1 INFRASTRUCTURE

GRAND COVE LLC
Oregon City, Oregon

PROJECT NO. 21509220
DATE: 08/12/2015
BY: ASR
EXHIBIT: 3

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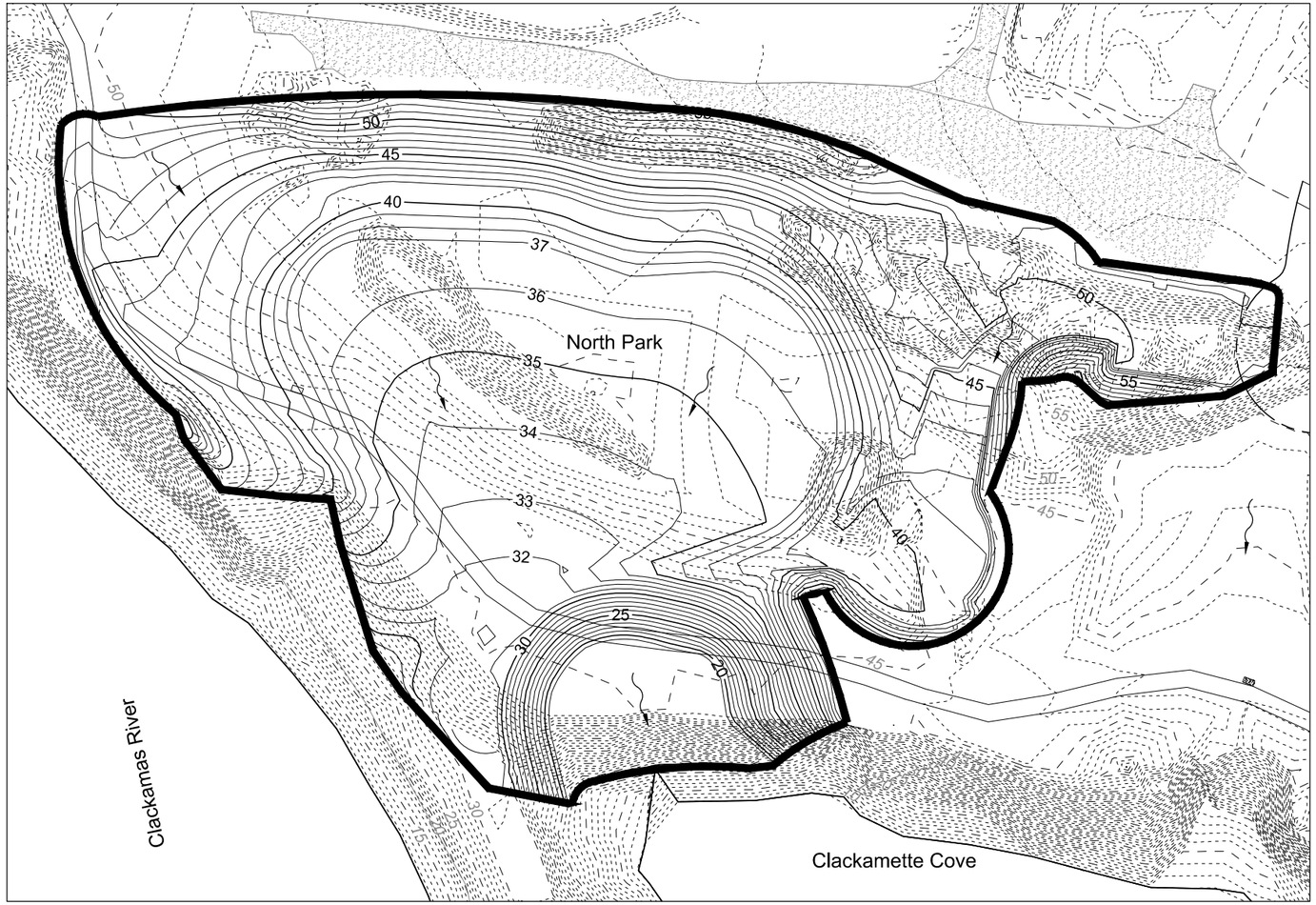
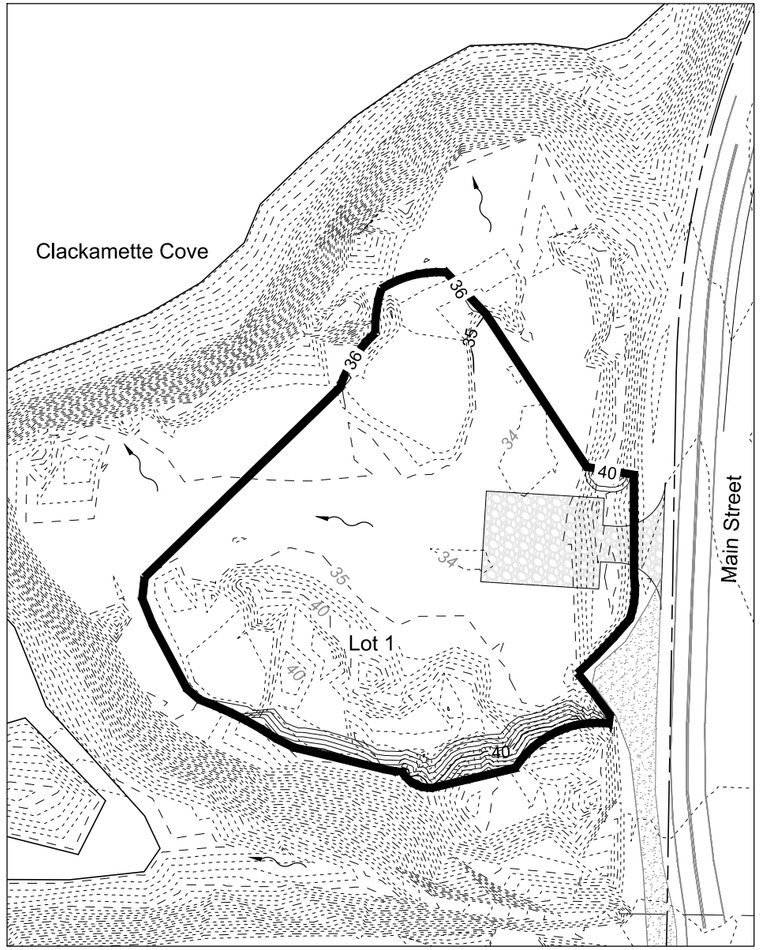


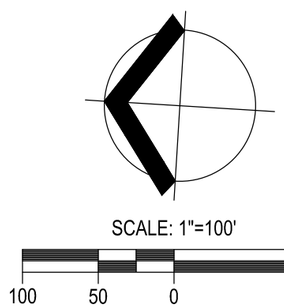
NORTH PARK

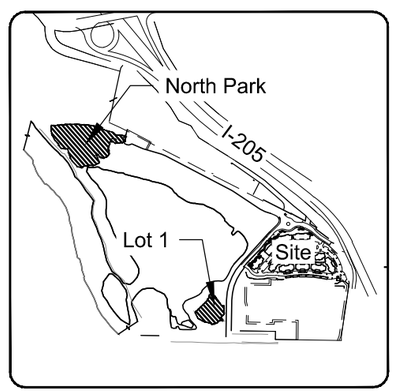
Area: Aprox. 5.80 acres



LOT 1

Area: Aprox. 1.60 acres





LOCATION MAP

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PORTLAND
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TEL: (503) 419 - 2500 FAX: (503) 419 - 2600
www.cardno.com

NORTH PARK & LOT 1 BASIN DELINEATION
COVE: PHASE 1 INFRASTRUCTURE

GRAND COVE LLC
Oregon City, Oregon

PROJECT NO. 211509220
DATE: 08/12/2015
BY: DEC
EXHIBIT: 4

Hydrologic Soil Group—Clackamas County Area, Oregon
(The Cove)

Map Scale: 1:9,030 if printed on A portrait (8.5" x 11") sheet.

N

Meters
0 100 200 400 600

Feet
0 400 800 1600 2400

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 Rating Polygons
- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Soil Rating Lines
- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Soil Rating Points
- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

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: http://websoilsurvey.nrcs.usda.gov
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 9, Sep 19, 2014

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

Date(s) aerial images were photographed: Jul 26, 2014—Sep 5, 2014

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.

Hydrologic Soil Group

Hydrologic Soil Group— Summary by Map Unit — Clackamas County Area, Oregon (OR610)				
Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
16	Chehalis silt loam	B	11.6	6.3%
67	Newberg fine sandy loam	A	28.5	15.5%
82	Urban land		126.7	68.8%
84	Wapato silty clay loam	C/D	17.2	9.4%
W	Water		0.2	0.1%
Totals for Area of Interest			**184.2**	**100.0%**

Description

Hydrologic soil groups are based on estimates of runoff potential. Soils are assigned to one of four groups according to the rate of water infiltration when the soils are not protected by vegetation, are thoroughly wet, and receive precipitation from long-duration storms.

The soils in the United States are assigned to four groups (A, B, C, and D) and three dual classes (A/D, B/D, and C/D). The groups are defined as follows:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

If a soil is assigned to a dual hydrologic group (A/D, B/D, or C/D), the first letter is for drained areas and the second is for undrained areas. Only the soils that in their natural condition are in group D are assigned to dual classes.

Rating Options

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher

Table 2.2
Runoff Curve Numbers for Selected Agricultural, Suburban, and Urban Areas

(Sources: TR 55, 1986, and Stormwater Management Manual, 1992. See Section 2.1.1 for explanation)

Cover type and hydrologic condition.	CNs for hydrologic soil group A	B	C	D
Curve Numbers for Pre-Development Conditions				
Pasture, grassland, or range-continuous forage for grazing:				
Fair condition (ground cover 50% to 75% and not heavily grazed).	49	69	79	84
Good condition (ground cover >75% and lightly or only occasionally grazed)	39	61	74	80
Woods:				
Fair (Woods are grazed but not burned, and some forest litter covers the soil).	36	60	73	79
Good (Woods are protected from grazing, and litter and brush adequately cover the soil).	30	55	70	77
Curve Numbers for Post-Development Conditions				
Open space (lawns, parks, golf courses, cemeteries, landscaping, etc.)[1]				
Fair condition (grass cover on 50% - 75% of the area).	77	85	90	92
Good condition (grass cover on >75% of the area)	68	80	86	90
Impervious areas:				
Open water bodies: lakes, wetlands, ponds etc.	100	100	100	100
Paved parking lots, roofs[2], driveways, etc. (excluding right-of-way)	98	98	98	98
Permeable Pavement (See Appendix C to decide which condition below to use)				
Landscaped area	77	85	90	92
50% landscaped area/50% impervious	87	91	94	96
100% impervious area	98	98	98	98
Paved	98	98	98	98
Gravel (including right-of-way)	76	85	89	91
Dirt (including right-of-way)	72	82	87	89
Pasture, grassland, or range-continuous forage for grazing:				
Poor condition (ground cover <50% or heavily grazed with no mulch).	68	79	86	89
Fair condition (ground cover 50% to 75% and not heavily grazed).	49	69	79	84
Good condition (ground cover >75% and lightly or only occasionally grazed)	39	61	74	80
Woods:				
Poor (Forest litter, small trees, and brush are destroyed by heavy grazing or regular burning).	45	66	77	83
Fair (Woods are grazed but not burned, and some forest litter covers the soil).	36	60	73	79
Good (Woods are protected from grazing, and litter and brush adequately cover the soil).	30	55	70	77

Single family residential[3]: Dwelling Unit/Gross Acre	Should only be used for subdivisions > 50 acres	Average Percent impervious area[3,4]	
1.0 DU/GA		15	Separate curve number
1.5 DU/GA		20	shall be selected for
2.0 DU/GA		25	pervious & impervious
2.5 DU/GA		30	portions of the site or
3.0 DU/GA		34	basin
3.5 DU/GA		38	
4.0 DU/GA		42	
4.5 DU/GA		46	
5.0 DU/GA		48	
5.5 DU/GA		50	
6.0 DU/GA		52	
6.5 DU/GA		54	
7.0 DU/GA		56	
7.5 DU/GA		58	

PUD's, condos, apartments, commercial businesses, industrial areas & & subdivisions < 50 acres	%impervious must be computed	Separate curve numbers shall be selected for pervious and impervious portions of the site

For a more detailed and complete description of land use curve numbers refer to chapter two (2) of the Soil Conservation Service's Technical Release No. 55 , (210-VI-TR-55, Second Ed., June 1986).

[1] Composite CN's may be computed for other combinations of open space cover type.

[2] Where roof runoff and driveway runoff are infiltrated or dispersed according to the requirements in Chapter 3, the average percent impervious area may be adjusted in accordance with the procedure described under "Flow Credit for Roof Downspout Infiltration" (Section 3.1.1), and "Flow Credit for Roof Downspout Dispersion" (Section 3.1.2).

[3] Assumes roof and driveway runoff is directed into street/storm system.

[4] All the remaining pervious area (lawn) are considered to be in good condition for these curve numbers.

Composite Curve Number Calculations

Subject	CN - Downstream Analysis	By	ASR	Date	8/12/2015
Project	2150922				

Runoff Curve Number - Proposed

Soil Name and Hydrologic group	Cover Description (cover type, treatment, and hydrologic condition; percent impervious; unconnected/connect impervious area ratio)	CN HSG A	CN HSG B	CN HSG C	CN HSG D	Area acres	Product of CN **X** area
$CN(Weighted) = \frac{Total\_Product}{Total\_Area}$							
Basin 1							
D	Gravel roads & parking lots				91	0.00	0
D	Open spaces-lawns, parks, golf courses, cemeteries				90	6.40	576
D	Impervious surfaces-pavement, roofs, etc.				98	11.89	1165
	Totals					18.29	1741
	Use CN					95	
Basin 2							
D	Gravel roads & parking lots				91	0	0
D	Open spaces-lawns, parks, golf courses, cemeteries				90	4.42	398
D	Impervious surfaces-pavement, roofs, etc.				98	1.63	159
	Totals					6.05	557
	Use CN					92	
Basin 3							
D	Gravel roads & parking lots				91	0.00	0
D	Open spaces-lawns, parks, golf courses, cemeteries				90	4.39	395
D	Impervious surfaces-pavement, roofs, etc.				98	8.13	797
	Totals					12.52	1192
	Use CN					95	
Basin 4							
D	Gravel roads & parking lots				91	1.44	131
D	Open spaces-lawns, parks, golf courses, cemeteries				90	18.32	1649
D	Impervious surfaces-pavement, roofs, etc.				98	2.25	220
	Totals					22.01	2000
	Use CN					91	
Basin 5							
D	Gravel roads & parking lots				91	0.00	0
D	Open spaces-lawns, parks, golf courses, cemeteries				90	24.79	2231
D	Impervious surfaces-pavement, roofs, etc.				98	4.97	487
	Totals					29.76	2718
	Use CN					91	
Basin 6							
D	Gravel roads & parking lots				91	0.00	0
D	Open spaces-lawns, parks, golf courses, cemeteries				90	10.11	909
D	Impervious surfaces-pavement, roofs, etc.				98	8.51	833
	Totals					18.61	1743
	Use CN					94	
Basin 7							
D	Gravel roads & parking lots				91	6.40	582
D	Open spaces-lawns, parks, golf courses, cemeteries				90	2.19	197
D	Impervious surfaces-pavement, roofs, etc.				98	5.09	498
	Totals					13.67	1277
	Use CN					93	

Composite Curve Number Calculations

Subject	CN - Downstream Analysis	By	ASR	Date	8/12/2015
Project	2150922				

Runoff Curve Number - Proposed

Soil Name and Hydrologic group	Cover Description (cover type, treatment, and hydrologic condition; percent impervious; unconnected/connect impervious area ratio)	CN				Area acres	Product of CN **X** area
$CN(Weighted) = \frac{Total\_Product}{Total\_Area}$		HSG A	HSG B	HSG C	HSG D		
Basin 8							
D	Gravel roads & parking lots				91	6.50	592
D	Open spaces-lawns, parks, golf courses, cemeteries				90	6.57	591
D	Impervious surfaces-pavement, roofs, etc.				98	19.76	1937
	Totals					32.83	3119
	Use CN					95	
Basin 9							
D	Gravel roads & parking lots				91	0.00	0
D	Open spaces-lawns, parks, golf courses, cemeteries				90	1.18	106
D	Impervious surfaces-pavement, roofs, etc.				98	4.71	462
	Totals					5.89	568
	Use CN					96	
Basin 10							
D	Gravel roads & parking lots				91	0.00	0
D	Open spaces-lawns, parks, golf courses, cemeteries				90	2.28	205
D	Impervious surfaces-pavement, roofs, etc.				98	9.12	894
	Totals					11.40	1099
	Use CN					96	

Time of Concentration

SUBJECT	Time of Concentration - Downstream Analysis				
PROJECT NO.	21509220	**BY**	ASR	**DATE**	8/12/2015

	Basin 1	Basin 2	Basin 3	Basin 4	Basin 5
SHEET FLOW					
INPUT	**VALUE**	**VALUE**	**VALUE**	**VALUE**	**VALUE**
Surface Description	**Type 2 Fallow (no residue)**	**Type 2 Fallow (no residue)**	**Type 1 Smooth Surface**	**Type 4 Cultivated (residue > 20%)**	**Type 3 Cultivated (residue < 20%)**
Manning's "n"	**0.05**	**0.05**	**0.011**	**0.17**	**0.06**
Flow Length, L (<300 ft)	**300** ft	**300** ft	**300** ft	**300** ft	**228** ft
2-Yr 24 Hour Rainfall, P_2	**2.6** in	**2.6** in	**2.6** in	**2.6** in	**2.6** in
Land Slope, s	**0.00077** ft/ft	**0.0132** ft/ft	**0.06** ft/ft	**0.017** ft/ft	**0.0800** ft/ft
OUTPUT					
Travel Time	0.67 hr	0.21 hr	0.03 hr	0.51 hr	0.10 hr
SHALLOW CONCENTRATED FLOW					
INPUT	**VALUE**	**VALUE**	**VALUE**	**VALUE**	**VALUE**
Surface Description	**Unpaved**	**Unpaved**	**Unpaved**	**Unpaved**	**Unpaved**
Flow Length, L	**202** ft	**900** ft	**556** ft	**1348** ft	**2500** ft
Watercourse Slope*, s	**0.119** ft/ft	**0.013** ft/ft	**0.009** ft/ft	**0.006** ft/ft	**0.012** ft/ft
OUTPUT					
Average Velocity, V	5.57 ft/s	1.84 ft/s	1.53 ft/s	1.25 ft/s	1.77 ft/s
Travel Time	0.010 hr	0.136 hr	0.101 hr	0.300 hr	0.393 hr
CHANNEL FLOW					
INPUT	**VALUE**	**VALUE**	**VALUE**	**VALUE**	**VALUE**
Cross Sectional Flow Area, a	**0** ft^2	**0** ft^2	**0** ft^2	**0** ft^2	**0** ft^2
Wetted Perimeter, P_w	**0** ft	**0** ft	**0** ft	**0** ft	**0** ft
Channel Slope, s	**0** ft/ft	**0** ft/ft	**0** ft/ft	**0** ft/ft	**0** ft/ft
Manning's "n"	**0.013**	**0.24**	**0.24**	**0.24**	**0.24**
Flow Length, L	**0** ft	**0** ft	**0** ft	**0** ft	**0** ft
OUTPUT					
Average Velocity	0.00 ft/s	0.00 ft/s	0.00 ft/s	0.00 ft/s	0.00 ft/s
Hydraulic Radius, r = a / P_w	0.00 ft	0.00 ft	0.00 ft	0.00 ft	0.00 ft
Travel Time	0.00 hr	0.00 hr	0.00 hr	0.00 hr	0.00 hr
Watershed or Subarea T_c =	**0.68 hr**	**0.35 hr**	**0.14 hr**	**0.81 hr**	**0.49 hr**
Watershed or Subarea T_c =	**41 minutes**	**21 minutes**	**8 minutes**	**49 minutes**	**29 minutes**

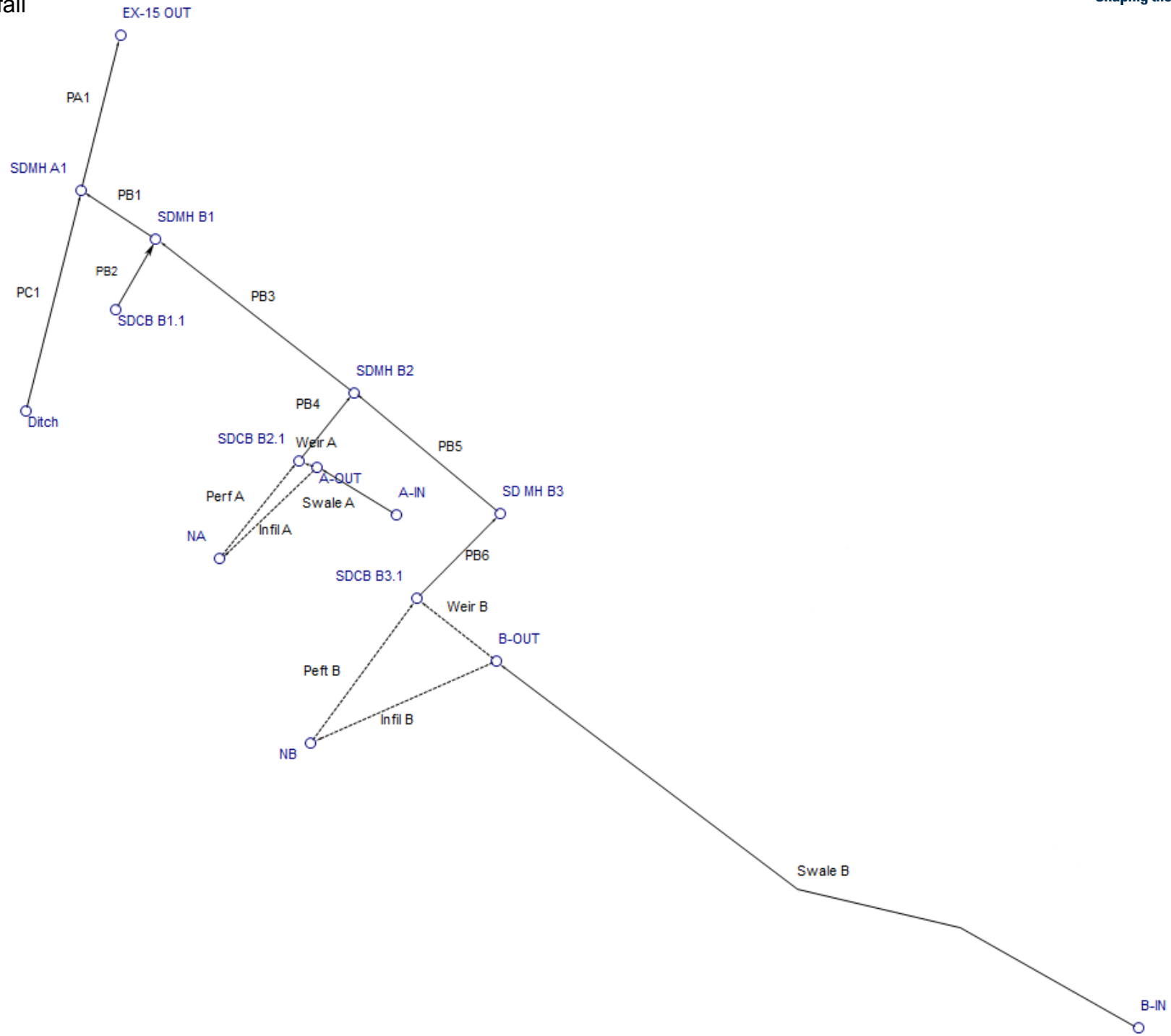
Time of Concentration

SUBJECT	Time of Concentration - Downstream Analysis				
PROJECT NO.	21509220	**BY**	ASR	**DATE**	8/12/2015

	Basin 6	Basin 7	Basin 8	Basin 9	Basin 10
SHEET FLOW					
INPUT	**VALUE**	**VALUE**	**VALUE**	**VALUE**	**VALUE**
Surface Description	**Type 4 Cultivated (residue > 20%)**	**Type 1 Smooth Surface**	**Type 4 Cultivated (residue > 20%)**	**Type 3 Cultivated (residue < 20%)**	**Type 4 Cultivated (residue > 20%)**
Manning's "n"	**0.17**	**0.011**	**0.17**	**0.06**	**0.17**
Flow Length, L (<300 ft)	**285** ft	**300** ft	**300** ft	**300** ft	**282** ft
2-Yr 24 Hour Rainfall, P_2	**2.6** in	**2.6** in	**2.6** in	**2.6** in	**2.6** in
Land Slope, s	**0.07** ft/ft	**0.016** ft/ft	**0.017** ft/ft	**0.027** ft/ft	**0.0180** ft/ft
OUTPUT					
Travel Time	0.28 hr	0.06 hr	0.51 hr	0.19 hr	0.48 hr
SHALLOW CONCENTRATED FLOW					
INPUT	**VALUE**	**VALUE**	**VALUE**	**VALUE**	**VALUE**
Surface Description	**Unpaved**	**Unpaved**	**Unpaved**	**Unpaved**	**Unpaved**
Flow Length, L	**1170** ft	**1384** ft	**1348** ft	**582** ft	**605** ft
Watercourse Slope*, s	**0.002** ft/ft	**0.011** ft/ft	**0.006** ft/ft	**0.062** ft/ft	**0.100** ft/ft
OUTPUT					
Average Velocity, V	0.72 ft/s	1.69 ft/s	1.25 ft/s	4.02 ft/s	5.10 ft/s
Travel Time	0.450 hr	0.227 hr	0.300 hr	0.040 hr	0.033 hr
CHANNEL FLOW					
INPUT	**VALUE**	**VALUE**	**VALUE**	**VALUE**	**VALUE**
Cross Sectional Flow Area, a	**0** ft^2	**0** ft^2	**0** ft^2	**0** ft^2	**0** ft^2
Wetted Perimeter, P_w	**0** ft	**0** ft	**0** ft	**0** ft	**0** ft
Channel Slope, s	**0** ft/ft	**0** ft/ft	**0** ft/ft	**0** ft/ft	**0** ft/ft
Manning's "n"	**0.013**	**0.24**	**0.24**	**0.24**	**0.24**
Flow Length, L	**0** ft	**0** ft	**0** ft	**0** ft	**0** ft
OUTPUT					
Average Velocity	0.00 ft/s	0.00 ft/s	0.00 ft/s	0.00 ft/s	0.00 ft/s
Hydraulic Radius, r = a / P_w	0.00 ft	0.00 ft	0.00 ft	0.00 ft	0.00 ft
Travel Time	0.00 hr	0.00 hr	0.00 hr	0.00 hr	0.00 hr
Watershed or Subarea T_c =	**0.73 hr**	**0.29 hr**	**0.81 hr**	**0.23 hr**	**0.51 hr**
Watershed or Subarea T_c =	**44 minutes**	**17 minutes**	**49 minutes**	**14 minutes**	**31 minutes**

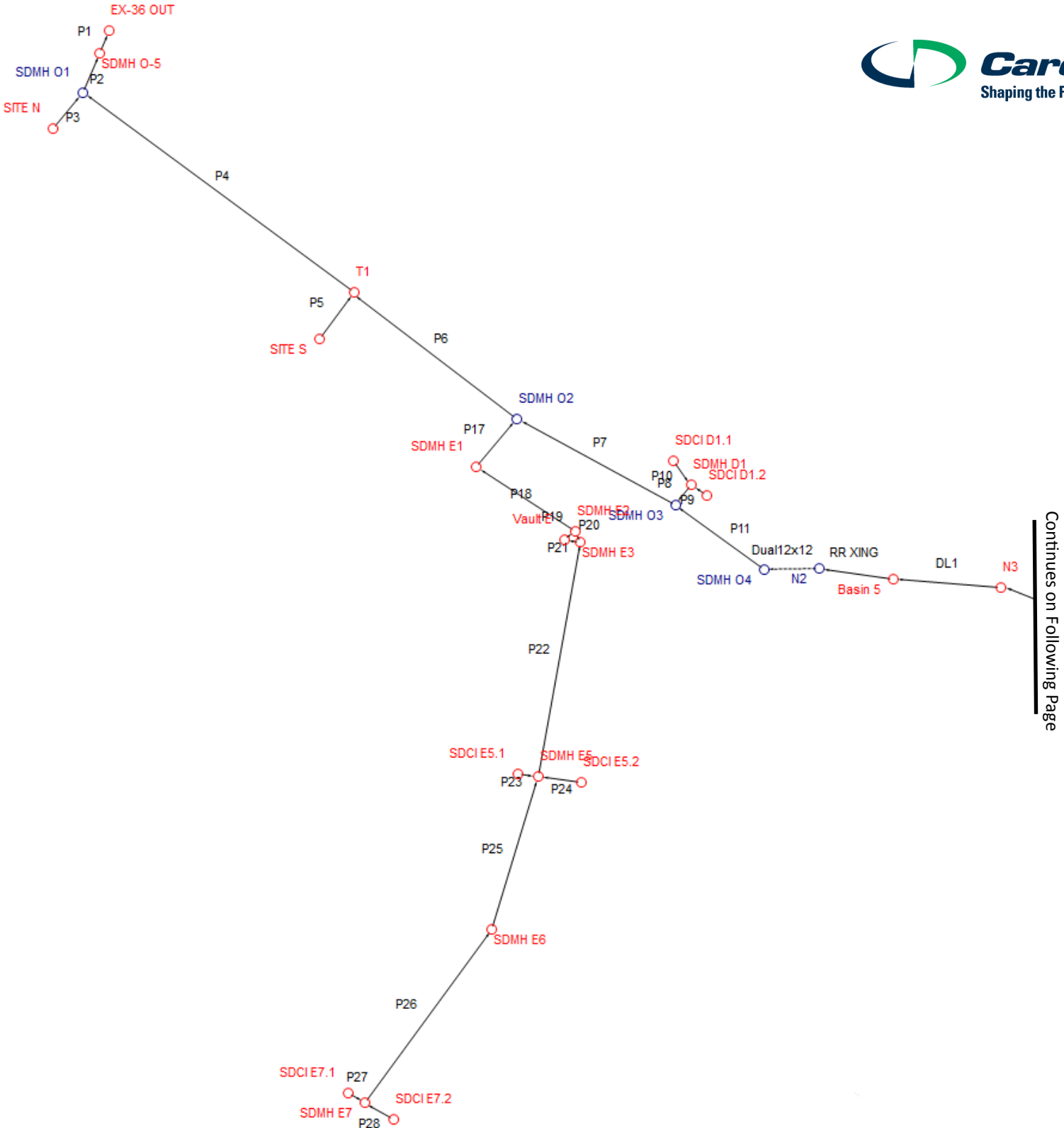
Schematic Layout

15-inch Outfall



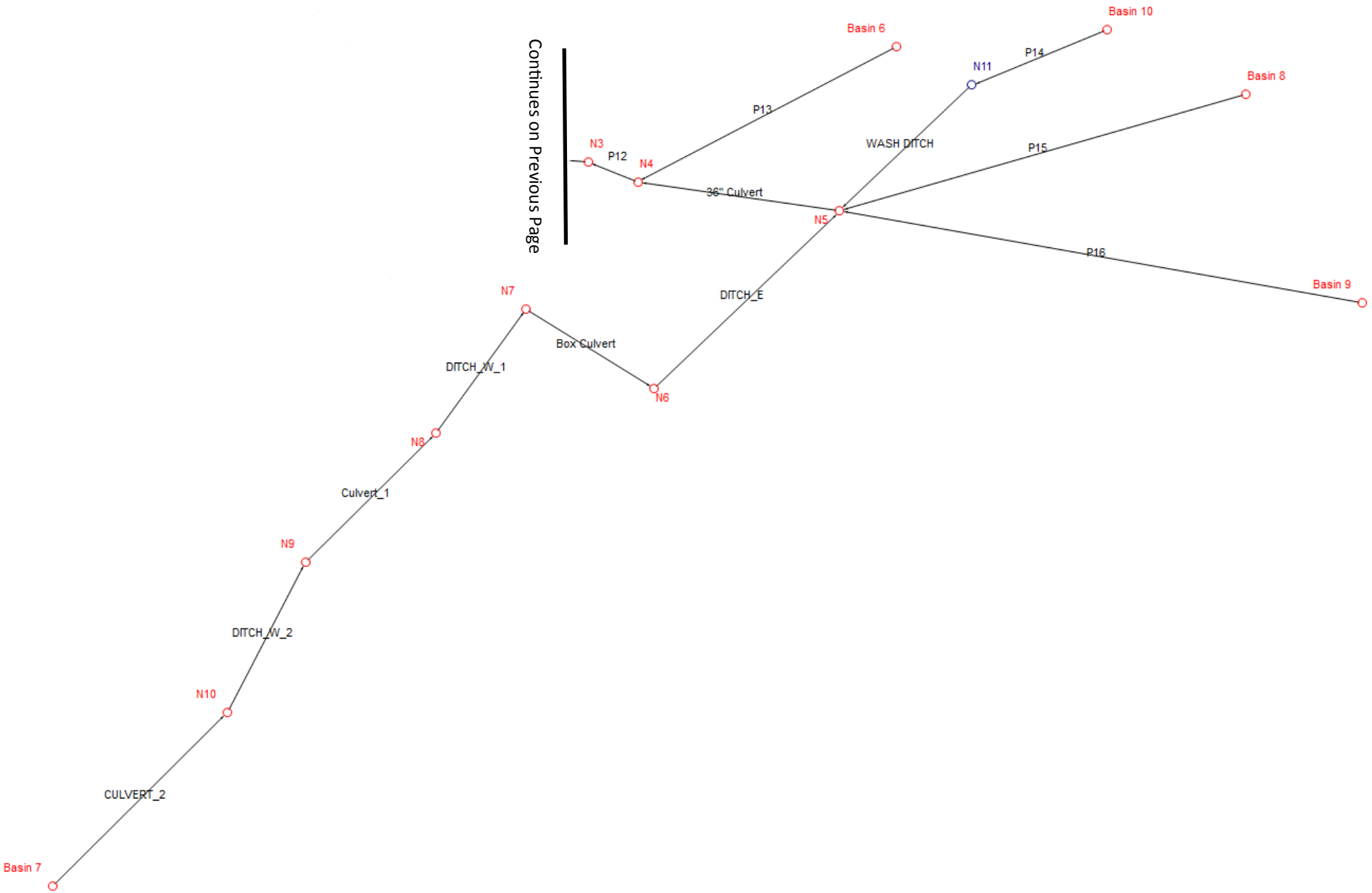
Schematic Layout

36-inch Outfall



Schematic Layout

36-inch Outfall



XPSWMM RUNOFF DATA - WQ STORM EVENT - SUB-BASINS TO 15-INCH OUTFALL								
THE COVE - OREGON CITY, OREGON								
Node Information					Runoff Information			
Node Name	Area	Impervious	Curve	Tc	Rainfall	Infiltration	Surface Runoff	
	acre	%	Number	min.	in	in	in	cfs
A-IN	0.149	100.0	0	5	0.83	0.67	0.16	0.03
A-IN	0.038	0	0	5	-	-	-	-
B-IN	0.627	100	0	5	0.83	0.67	0.16	0.13
B-IN	0.167	0	90	5	-	-	-	-
Ditch	1.38	0	0	5	0.83	0.73	0.00	0.00
SDCB B1.1	0.166	100	0	5	0.83	0.83	0.00	0.04
SDCB B1.1	0.073	0.0	0	5	-	-	-	-

XPSWMM RUNOFF DATA - 10-YR STORM EVENT - SUB-BASINS TO 15-INCH OUTFALL								
THE COVE - OREGON CITY, OREGON								
Node Information					Runoff Information			
Node Name	Area	Impervious	Curve	Tc	Rainfall	Infiltration	Surface Runoff	
	acre	%	Number	min.	in	in	in	cfs
A-IN	0.149	100	0	5	3.40	1.14	2.24	0.18
A-IN	0.038	0	0	5	-	-	-	-
B-IN	0.627	100	0	5	3.40	1.14	2.24	0.77
B-IN	0.167	0.0	90	5	-	-	-	-
Ditch	1.38	0.0	0	5	3.40	3.29	0.00	0.00
SDCB B1.1	0.166	100.0	0	5	3.40	3.39	0.00	0.18
SDCB B1.1	0.073	0.0	0	5	-	-	-	-

XPSWMM RUNOFF DATA - 25-YR STORM EVENT - SUB-BASINS TO 15-INCH OUTFALL								
THE COVE - OREGON CITY, OREGON								
Node Information					Runoff Information			
Node Name	Area	Impervious	Curve	Tc	Rainfall	Infiltration	Surface Runoff	
	acre	%	Number	min.	in	in	in	cfs
A-IN	0.149	100	0	5	4.00	1.18	2.80	0.22
A-IN	0.038	0	0	5	-	-	-	-
B-IN	0.627	100	0	5	4.00	1.18	2.80	0.92
B-IN	0.167	0.0	90	5	-	-	-	-
Ditch	1.38	0.0	0	5	4.00	3.89	0.00	0.00
SDCB B1.1	0.166	100.0	0	5	4.00	3.98	0.00	0.22
SDCB B1.1	0.073	0.0	0	5	-	-	-	-

XPSWMM RUNOFF DATA - 100-YR STORM EVENT - SUB-BASINS TO 15-INCH OUTFALL								
THE COVE - OREGON CITY, OREGON								
Node Information					Runoff Information			
Node Name	Area	Impervious	Curve	Tc	Rainfall	Infiltration	Surface Runoff	
	acre	%	Number	min.	in	in	in	cfs
A-IN	0.149	100	0	5	4.50	1.21	3.27	0.25
A-IN	0.038	0	0	5	-	-	-	-
B-IN	0.627	100	0	5	4.50	1.21	3.27	1.04
B-IN	0.167	0.0	90	5	-	-	-	-
Ditch	1.38	0.0	0	5	4.50	4.38	0.00	0.00
SDCB B1.1	0.166	100.0	0	5	4.50	4.48	0.00	0.24
SDCB B1.1	0.073	0.0	0	5	-	-	-	-

XPSWMM RUNOFF DATA - WQ STORM EVENT - SUB-BASINS TO 36-INCH OUTFALL								
THE COVE - OREGON CITY, OREGON								
Node Information					Runoff Information			
Node Name	Area	Impervious	Curve	Tc	Rainfall	Infiltration	Surface Runoff	
	acre	%	Number	min.	in	in	in	cfs
Basin 5	29.76	0.0	91	29	0.83	0.65	0.18	0.63
Basin 6	18.61	0	93	44	0.83	0.55	0.28	0.75
Basin 7	13.67	0	93	17	0.83	0.58	0.25	0.66
Basin 8*	32.83	0	98	49	0.83	0.50	0.33	1.58
Basin 9*	5.89	0	98	14	0.83	0.44	0.39	0.62
Basin 10*	11.4	0	97	31	0.83	0.44	0.38	0.85
SDCI D1.1	0.093	100	98	5	0.83	0.67	0.16	0.02
SDCI D1.1	0.023	0	90	5	-	-	-	-
SDCI D1.2	0.114	100	98	5	0.83	0.67	0.16	0.03
SDCI D1.2	0.018	0	90	5	-	-	-	-
SDCI E5.1	0.318	100	98	5	0.83	0.67	0.16	0.07
SDCI E5.1	0.079	0	90	5	-	-	-	-
SDCI E5.2	0.238	100	98	5	0.83	0.67	0.16	0.05
SDCI E5.2	0.021	0	90	5	-	-	-	-
SDCI E7.1	0.103	100	98	5	0.83	0.67	0.16	0.02
SDCI E7.1	0.014	0	90	5	-	-	-	-
SDCI E7.2	0.049	100	98	5	0.83	0.67	0.16	0.01
SDCI E7.2	0.001	0	90	5	-	-	-	-
SITE N	1.873	100	98	5	0.83	0.67	0.16	0.42
SITE N	0.591	0.0	90	5	-	-	-	-
SITE S	2.057	100.0	98	5	0.83	0.67	0.16	0.45
SITE S	0.481	0.0	90	5	-	-	-	-

XPSWMM RUNOFF DATA - 10-YR STORM EVENT - SUB-BASINS TO 36-INCH OUTFALL								
THE COVE - OREGON CITY, OREGON								
Node Information					Runoff Information			
Node Name	Area	Impervious	Curve	Tc	Rainfall	Infiltration	Surface Runoff	
	acre	%	Number	min.	in	in	in	cfs
Basin 5	29.76	0	91	29	3.40	1.08	2.30	13.70
Basin 6	18.61	0	93	44	3.40	0.81	2.57	8.27
Basin 7	13.67	0	93	17	3.40	0.88	2.51	8.62
Basin 8*	32.83	0.0	98	49	3.40	0.72	2.67	14.52
Basin 9*	5.89	0.0	98	14	3.40	0.57	2.82	4.44
Basin 10*	11.4	0.0	97	31	3.40	0.59	2.80	6.30
SDCI D1.1	0.093	100	98	5	3.40	1.14	2.24	0.12
SDCI D1.1	0.023	0	90	5	-	-	-	-
SDCI D1.2	0.114	100	98	5	3.40	1.14	2.24	0.14
SDCI D1.2	0.018	0	90	5	-	-	-	-
SDCI E5.1	0.318	100	98	5	3.40	1.14	2.24	0.41
SDCI E5.1	0.079	0	90	5	-	-	-	-
SDCI E5.2	0.238	100	98	5	3.40	1.14	2.24	0.27
SDCI E5.2	0.021	0	90	5	-	-	-	-
SDCI E7.1	0.103	100	98	5	3.40	1.14	2.24	0.12
SDCI E7.1	0.014	0	90	5	-	-	-	-
SDCI E7.2	0.049	100	98	5	3.40	1.14	2.24	0.05
SDCI E7.2	0.001	0	90	5	-	-	-	-
SITE N	1.873	100	98	5	3.40	1.14	2.24	2.51
SITE N	0.591	0.0	90	5	-	-	-	-
SITE S	2.057	100.0	98	5	3.40	1.14	2.24	2.62
SITE S	0.481	0.0	90	5	-	-	-	-

XPSWMM RUNOFF DATA - 25-YR STORM EVENT - SUB-BASINS TO 36-INCH OUTFALL								
THE COVE - OREGON CITY, OREGON								
Node Information					Runoff Information			
Node Name	Area	Impervious	Curve	Tc	Rainfall	Infiltration	Surface Runoff	
	acre	%	Number	min.	in	in	in	cfs
Basin 5	29.76	16.7	91	29	4.00	1.04	2.96	23.21
Basin 6	18.61	45.7	93	44	4.00	0.74	3.27	13.43
Basin 7	13.67	37.2	93	17	4.00	0.84	3.16	14.37
Basin 8*	32.83	80.0	98	49	4.00	0.63	3.37	23.28
Basin 9*	5.89	80.0	98	14	4.00	0.52	3.48	7.36
Basin 10*	11.4	80.0	97	31	4.00	0.52	3.48	10.28
SDCI D1.1	0.093	100	98	5	4.00	1.18	2.80	0.14
SDCI D1.1	0.023	0	90	5	-	-	-	-
SDCI D1.2	0.114	100	98	5	4.00	1.18	2.80	0.16
SDCI D1.2	0.018	0	90	5	-	-	-	-
SDCI E5.1	0.318	100	98	5	4.00	1.18	2.80	0.49
SDCI E5.1	0.079	0	90	5	-	-	-	-
SDCI E5.2	0.238	100	98	5	4.00	1.18	2.80	0.33
SDCI E5.2	0.021	0	90	5	-	-	-	-
SDCI E7.1	0.103	100	98	5	4.00	1.18	2.80	0.15
SDCI E7.1	0.014	0	90	5	-	-	-	-
SDCI E7.2	0.049	100	98	5	4.00	1.18	2.80	0.06
SDCI E7.2	0.001	0	90	5	-	-	-	-
SITE N	1.873	100	98	5	4.00	1.18	2.80	3.00
SITE N	0.591	0.0	90	5	-	-	-	-
SITE S	2.057	100.0	98	5	4.00	1.18	2.80	3.12
SITE S	0.481	0.0	90	5	-	-	-	-

XPSWMM RUNOFF DATA - 100-YR STORM EVENT - SUB-BASINS TO 36-INCH OUTFALL								
THE COVE - OREGON CITY, OREGON								
Node Information					Runoff Information			
Node Name	Area	Impervious	Curve	Tc	Rainfall	Infiltration	Surface Runoff	
	acre	%	Number	min.	in	in	in	cfs
Basin 5	29.76	16.7	91	29	4.50	1.06	3.44	27.10
Basin 6	18.61	45.7	93	44	4.50	0.75	3.76	15.46
Basin 7	13.67	37.2	93	17	4.50	0.85	3.65	16.58
Basin 8*	32.83	80.0	98	49	4.50	0.64	3.86	26.69
Basin 9*	5.89	80.0	98	14	4.50	0.53	3.98	8.37
Basin 10*	11.4	80.0	97	31	4.50	0.53	3.98	11.70
SDCI D1.1	0.093	100	98	5	4.50	1.21	3.28	0.16
SDCI D1.1	0.023	0	90	5	-	-	-	-
SDCI D1.2	0.114	100	98	5	4.50	1.21	3.28	0.19
SDCI D1.2	0.018	0	90	5	-	-	-	-
SDCI E5.1	0.318	100	98	5	4.50	1.21	3.28	0.55
SDCI E5.1	0.079	0	90	5	-	-	-	-
SDCI E5.2	0.238	100	98	5	4.50	1.21	3.28	0.37
SDCI E5.2	0.021	0	90	5	-	-	-	-
SDCI E7.1	0.103	100	98	5	4.50	1.21	3.28	0.17
SDCI E7.1	0.014	0	90	5	-	-	-	-
SDCI E7.2	0.049	100	98	5	4.50	1.21	3.28	0.07
SDCI E7.2	0.001	0	90	5	-	-	-	-
SITE N	1.873	100	98	5	4.50	1.21	3.28	3.41
SITE N	0.591	0.0	90	5	-	-	-	-
SITE S	2.057	100.0	98	5	4.50	1.21	3.28	3.54
SITE S	0.481	0.0	90	5	-	-	-	-

* Note: These basins include assumed % impervious area under future development conditions.

XPSWMM CONVEYANCE DATA (WQ STORM EVENT)

EXISTING 15-INCH CULVERT - THE COVE - OREGON CITY, OREGON

Link	Location		Conduit Properties			Conduit Results						Conduit Profile							
	Station																		
	From	To	Diameter	Length	Slope	Design Capacity	Qmax/ Qdesign	Max Flow	Max Velocity	Max Flow Depth	y/d0	US Ground Elev.	DS Ground Elev.	US IE	DS IE	US Freeboard	DS Freeboard	US HGL	DS HGL
			ft	ft	%	cfs		cfs	ft/s	ft		ft	ft	ft	ft	ft	ft	ft	ft
PA1	SDMH A1	EX-15 OUT	1.33	64.65	8.77	22.73	0.01	0.23	5.17	0.10	0.07	29.89	50.70	17.69	12.02	12.10	38.59	17.79	12.11
PB1	SDMH B1	SDMH A1	1.25	36.24	11.67	22.07	0.00	0.06	3.73	0.05	0.04	29.81	29.89	23.92	17.69	5.84	12.10	23.97	17.79
PB2	SDCB B1.1	SDMH B1	1.00	35.50	4.31	0.00	0.00	0.00	0.00	0.00	0.00	29.81	29.81	25.70	23.92	0.00	5.84	0.00	23.97
PB3	SDMH B2	SDMH B1	1.25	101.52	1.00	6.46	0.01	0.06	1.59	0.08	0.07	30.31	29.81	25.14	23.92	5.09	5.84	25.22	23.97
PB4	SDCB B2.1	SDMH B2	1.00	35.51	2.28	5.38	0.00	0.01	1.13	0.03	0.03	29.20	30.31	26.20	25.14	2.97	5.09	26.23	25.22
PB5	SD MH B3	SDMH B2	1.00	77.33	1.00	3.56	0.01	0.05	1.60	0.08	0.08	30.83	30.31	24.66	25.14	4.59	5.09	26.24	25.22
PB6	SDCB B3.1	SD MH B3	1.00	35.50	1.00	3.56	0.01	0.05	1.60	0.08	0.08	29.22	30.83	26.70	24.66	2.42	4.59	26.80	26.24
PC1	Ditch	SDMH A1	1.33	92.40	8.73	22.67	0.01	0.19	4.82	0.10	0.07	32.00	29.89	25.76	17.69	6.15	12.10	25.85	17.79
Swale A	A-IN	A-OUT	1.00	62.08	0.82	3.35	0.01	0.03	0.98	0.48	0.48	30.11	29.92	29.11	28.20	0.93	1.24	29.18	28.68
Swale B	B-IN	B-OUT	1.00	246.68	0.63	2.27	0.04	0.09	0.14	0.53	0.53	32.03	30.20	28.36	27.70	0.99	0.47	31.04	29.73

XPSWMM CONVEYANCE DATA (10-YEAR STORM EVENT)

EXISTING 15-INCH CULVERT - THE COVE - OREGON CITY, OREGON

Link	Location		Conduit Properties			Conduit Results						Conduit Profile							
	Station																		
	From	To	Diameter	Length	Slope	Design Capacity	Qmax/ Qdesign	Max Flow	Max Velocity	Max Flow Depth	y/d0	US Ground Elev.	DS Ground Elev.	US IE	DS IE	US Freeboard	DS Freeboard	US HGL	DS HGL
			ft	ft	%	cfs		cfs	ft/s	ft		ft	ft	ft	ft	ft	ft	ft	ft
PA1	SDMH A1	EX-15 OUT	1.33	64.65	8.77	22.73	0.15	3.32	11.60	0.35	0.26	29.89	50.70	17.69	12.02	11.85	38.34	18.04	12.36
PB1	SDMH B1	SDMH A1	1.25	36.24	11.67	22.07	0.04	0.80	8.46	0.16	0.13	29.81	29.89	23.92	17.69	5.73	11.85	24.08	18.04
PB2	SDCB B1.1	SDMH B1	1.00	35.50	4.31	0.00	0.00	0.00	0.00	0.00	0.00	29.81	29.81	25.70	23.92	0.00	5.73	0.00	24.08
PB3	SDMH B2	SDMH B1	1.25	101.52	1.00	6.46	0.12	0.80	3.58	0.30	0.24	30.31	29.81	25.14	23.92	4.87	5.73	25.44	24.08
PB4	SDCB B2.1	SDMH B2	1.00	35.51	2.28	5.38	0.03	0.16	3.08	0.12	0.12	29.20	30.31	26.20	25.14	2.88	4.87	26.32	25.44
PB5	SD MH B3	SDMH B2	1.00	77.33	1.00	3.56	0.18	0.64	3.43	0.29	0.29	30.83	30.31	24.66	25.14	4.38	4.87	26.45	25.44
PB6	SDCB B3.1	SD MH B3	1.00	35.50	1.00	3.56	0.18	0.64	3.43	0.29	0.29	29.22	30.83	26.70	24.66	2.21	4.38	27.01	26.45
PC1	Ditch	SDMH A1	1.33	92.40	8.73	22.67	0.12	2.62	10.62	0.35	0.26	32.00	29.89	25.76	17.69	5.93	11.85	26.07	18.04
Swale A	A-IN	A-OUT	1.00	62.08	0.82	3.35	0.05	0.17	0.98	1.07	1.00	30.11	29.92	29.11	28.20	0.73	0.65	29.38	29.27
Swale B	B-IN	B-OUT	1.00	246.68	0.63	2.27	0.29	0.65	0.26	0.69	0.69	32.03	30.20	28.36	27.70	0.64	0.31	31.39	29.89

XPSWMM CONVEYANCE DATA (25-YEAR STORM EVENT)

EXISTING 15-INCH CULVERT - THE COVE - OREGON CITY, OREGON

Link	Location		Conduit Properties			Conduit Results						Conduit Profile							
	Station																		
	From	To	Diameter	Length	Slope	Design Capacity	Qmax/ Qdesign	Max Flow	Max Velocity	Max Flow Depth	y/d0	US Ground Elev.	DS Ground Elev.	US IE	DS IE	US Freeboard	DS Freeboard	US HGL	DS HGL
			ft	ft	%	cfs		cfs	ft/s	ft		ft	ft	ft	ft	ft	ft	ft	ft
PA1	SDMH A1	EX-15 OUT	1.33	64.65	8.77	22.73	0.18	4.07	12.31	0.38	0.29	29.89	50.70	17.69	12.02	11.82	38.30	18.07	12.40
PB1	SDMH B1	SDMH A1	1.25	36.24	11.67	22.07	0.04	0.97	8.95	0.18	0.14	29.81	29.89	23.92	17.69	5.71	11.82	24.10	18.07
PB2	SDCB B1.1	SDMH B1	1.00	35.50	4.31	0.00	0.00	0.00	0.00	0.00	0.00	29.81	29.81	25.70	23.92	0.00	5.71	0.00	24.10
PB3	SDMH B2	SDMH B1	1.25	101.52	1.00	6.46	0.15	0.97	3.78	0.33	0.26	30.31	29.81	25.14	23.92	4.84	5.71	25.47	24.10
PB4	SDCB B2.1	SDMH B2	1.00	35.51	2.28	5.38	0.04	0.20	3.24	0.13	0.13	29.20	30.31	26.20	25.14	2.87	4.84	26.33	25.47
PB5	SD MH B3	SDMH B2	1.00	77.33	1.00	3.56	0.22	0.77	3.62	0.32	0.32	30.83	30.31	24.66	25.14	4.35	4.84	26.48	25.47
PB6	SDCB B3.1	SD MH B3	1.00	35.50	1.00	3.56	0.22	0.77	3.62	0.32	0.32	29.22	30.83	26.70	24.66	2.18	4.35	27.04	26.48
PC1	Ditch	SDMH A1	1.33	92.40	8.73	22.67	0.14	3.21	11.27	0.38	0.29	32.00	29.89	25.76	17.69	5.90	11.82	26.10	18.07
Swale A	A-IN	A-OUT	1.00	62.08	0.82	3.35	0.06	0.20	0.97	1.08	1.00	30.11	29.92	29.11	28.20	0.71	0.64	29.40	29.28
Swale B	B-IN	B-OUT	1.00	246.68	0.63	2.27	0.35	0.78	0.27	0.71	0.71	32.03	30.20	28.36	27.70	0.59	0.29	31.44	29.91

XPSWMM CONVEYANCE DATA (100-YEAR STORM EVENT)

EXISTING 15-INCH CULVERT - THE COVE - OREGON CITY, OREGON

Link	Location		Conduit Properties			Conduit Results						Conduit Profile							
	Station																		
	From	To	Diameter	Length	Slope	Design Capacity	Qmax/ Qdesign	Max Flow	Max Velocity	Max Flow Depth	y/d0	US Ground Elev.	DS Ground Elev.	US IE	DS IE	US Freeboard	DS Freeboard	US HGL	DS HGL
			ft	ft	%	cfs		cfs	ft/s	ft		ft	ft	ft	ft	ft	ft	ft	ft
PA1	SDMH A1	EX-15 OUT	1.33	64.65	8.77	22.73	0.21	4.70	12.81	0.41	0.31	29.89	50.70	17.69	12.02	11.79	38.27	18.10	12.43
PB1	SDMH B1	SDMH A1	1.25	36.24	11.67	22.07	0.05	1.11	9.34	0.19	0.15	29.81	29.89	23.92	17.69	5.70	11.79	24.11	18.10
PB2	SDCB B1.1	SDMH B1	1.00	35.50	4.31	0.00	0.00	0.00	0.00	0.00	0.00	29.81	29.81	25.70	23.92	0.00	5.70	0.00	24.11
PB3	SDMH B2	SDMH B1	1.25	101.52	1.00	6.46	0.17	1.11	3.93	0.35	0.28	30.31	29.81	25.14	23.92	4.82	5.70	25.49	24.11
PB4	SDCB B2.1	SDMH B2	1.00	35.51	2.28	5.38	0.04	0.23	3.37	0.14	0.14	29.20	30.31	26.20	25.14	2.86	4.82	26.34	25.49
PB5	SD MH B3	SDMH B2	1.00	77.33	1.00	3.56	0.25	0.88	3.76	0.34	0.34	30.83	30.31	24.66	25.14	4.33	4.82	26.50	25.49
PB6	SDCB B3.1	SD MH B3	1.00	35.50	1.00	3.56	0.25	0.88	3.76	0.34	0.34	29.22	30.83	26.70	24.66	2.16	4.33	27.06	26.50
PC1	Ditch	SDMH A1	1.33	92.40	8.73	22.67	0.16	3.71	11.75	0.41	0.31	32.00	29.89	25.76	17.69	5.88	11.79	26.13	18.10
Swale A	A-IN	A-OUT	1.00	62.08	0.82	3.35	0.07	0.23	1.27	1.08	1.00	30.11	29.92	29.11	28.20	0.69	0.64	29.42	29.28
Swale B	B-IN	B-OUT	1.00	246.68	0.63	2.27	0.40	0.90	0.29	0.73	0.73	32.03	30.20	28.36	27.70	0.54	0.27	31.49	29.93

XPSWMM CONVEYANCE DATA (WQ STORM EVENT) WITH POST BASINS AND UPGRADED STORM LINE IN MAIN STREET

EXISTING 36-INCH CULVERT - THE COVE - OREGON CITY, OREGON

Location			Conduit Properties			Conduit Results						Conduit Profile							
Link	Station																		
	From	To	Diameter	Length	Slope	Design Capacity	Qmax/ Qdesign	Max Flow	Max Velocity	Max Flow Depth	y/d0	US Ground Elev.	DS Ground Elev.	US IE	DS IE	US Freeboard	DS Freeboard	US HGL	DS HGL
			ft	ft	%	cfs		cfs	ft/s	ft		ft	ft	ft	ft	ft	ft	ft	ft
P1	SDMH O-5	EX-36 OUT	3.00	12.20	0.06	17.73	0.26	4.52	3.51	0.72	0.24	32.02	50.70	22.25	22.24	9.05	27.80	22.97	22.90
P2	SDMH O1	SDMH O-5	4.00	30.12	0.05	34.37	0.13	4.52	3.01	0.72	0.18	31.25	32.02	22.37	22.25	8.16	9.05	23.09	22.97
P3	SITE N	SDMH O1	1.50	32.22	0.75	8.42	0.05	0.41	1.78	0.62	0.41	30.93	31.25	22.71	22.37	7.84	8.16	23.09	23.09
P4	T1	SDMH O1	4.00	232.22	0.88	125.02	0.04	4.38	4.51	0.62	0.15	32.89	31.25	24.51	22.37	7.87	8.16	25.02	23.09
P5	SITE S	T1	1.50	36.64	4.75	21.26	0.02	0.45	4.80	0.15	0.10	32.55	32.89	27.75	24.51	4.65	7.87	27.90	25.02
P6	SDMH O2	T1	4.00	143.98	0.88	125.27	0.03	4.24	4.60	0.51	0.13	35.32	32.89	25.78	24.51	9.04	7.87	26.28	25.02
P7	SDMH O3	SDMH O2	4.00	127.13	1.00	143.62	0.03	4.18	5.05	0.47	0.12	34.83	35.32	27.25	25.78	7.11	9.04	27.72	26.28
P8	SDMH D1	SDMH O3	1.00	16.85	1.00	3.32	0.01	0.05	1.49	0.08	0.08	34.77	34.83	29.62	27.25	5.07	7.11	29.70	27.72
P9	SDCI D1.2	SDMH D1	1.00	12.88	0.85	3.06	0.01	0.03	1.15	0.06	0.06	36.29	34.77	32.03	29.62	4.20	5.07	32.09	29.70
P10	SDCI D1.1	SDMH D1	1.00	21.09	1.00	3.30	0.01	0.02	1.13	0.06	0.06	36.29	34.77	32.13	29.62	4.10	5.07	32.19	29.70
P11	SDMH O4	SDMH O3	4.00	58.56	3.71	276.51	0.02	4.17	7.94	0.34	0.09	41.65	34.83	29.62	27.25	11.69	7.11	29.96	27.72
RR XING	Basin 5	N2	4.06	50.00	0.42	309.82	0.01	4.22	1.48	0.81	0.20	50.00	50.00	29.39	29.18	19.94	20.01	30.06	29.99
DL1	N3	Basin 5	3.50	16.00	-0.12	118.95	0.03	3.59	1.21	0.69	0.20	35.00	50.00	29.37	29.39	4.92	19.94	30.08	30.06
P12	N4	N3	4.00	11.50	0.17	59.90	0.06	3.59	2.43	0.71	0.18	42.92	35.00	29.39	29.37	12.83	4.92	30.09	30.08
P13	Basin 6	N4	4.00	511.00	0.30	78.86	0.01	0.75	1.53	0.70	0.18	38.00	42.92	30.93	29.39	6.80	12.83	31.20	30.09
36" Culvert	N5	N4	3.00	343.50	0.49	46.92	0.06	2.85	3.45	0.70	0.23	36.61	42.92	31.09	29.39	5.02	12.83	31.59	30.09
WASH DITCH	N11	N5	3.21	413.00	1.18	826.77	0.00	0.85	0.89	0.50	0.16	43.00	36.61	35.95	31.09	6.93	5.02	36.07	31.59
P14	Basin 10	N11	2.00	259.00	1.37	26.49	0.03	0.85	3.31	0.29	0.14	43.00	43.00	39.50	35.95	3.22	6.93	39.79	36.07
P15	Basin 8	N5	2.50	430.00	0.85	37.84	0.04	1.58	3.56	0.50	0.20	37.50	36.61	34.75	31.09	2.40	5.02	35.10	31.59
P16	Basin 9	N5	1.50	96.00	0.85	9.71	0.06	0.62	2.76	0.50	0.33	37.50	36.61	31.91	31.09	5.33	5.02	32.17	31.59
DITCH_E	N6	N5	3.75	270.00	0.21	345.66	0.00	0.17	0.24	0.50	0.13	36.61	36.61	26.87	31.09	4.89	5.02	31.72	31.59
Box Culvert	N7	N6	4.00	120.30	1.05	257.60	0.00	0.37	0.30	4.85	1.00	35.43	36.61	28.13	26.87	3.71	4.89	31.72	31.72
DITCH_W_1	N8	N7	3.00	247.00	1.20	293.65	0.00	0.64	0.99	3.59	1.00	35.24	35.43	31.10	28.13	3.52	3.71	31.72	31.72
Culvert_1	N9	N8	3.00	59.50	0.32	37.69	0.02	0.64	2.04	0.62	0.21	35.43	35.24	31.29	31.10	3.71	3.52	31.72	31.72
DITCH_W_2	N10	N9	2.50	272.00	0.47	462.96	0.00	0.64	0.64	0.43	0.17	35.26	35.43	32.57	31.29	2.53	3.71	32.73	31.72
CULVERT_2	Basin 7	N10	2.00	60.00	0.15	8.76	0.08	0.66	2.00	0.34	0.17	35.20	35.26	32.66	32.57	2.20	2.53	33.00	32.73
P17	SDMH E1	SDMH O2	1.50	39.92	1.00	9.76	0.02	0.15	1.85	0.30	0.20	35.37	35.32	26.38	25.78	8.86	9.04	26.51	26.28
P18	SDMH E2	SDMH E1	1.50	81.72	0.50	6.91	0.02	0.15	1.53	0.16	0.11	36.75	35.37	26.99	26.38	9.60	8.86	27.15	26.51
P19	Vault E	SDMH E2	1.00	8.00	1.00	3.31	0.05	0.15	2.13	0.15	0.15	36.82	36.75	27.55	26.99	9.13	9.60	27.70	27.15
P20	SDMH E3	SDMH E2	1.00	8.50	32.47	18.85	0.00	0.00	0.00	0.00	0.00	36.82	36.75	29.93	26.99	6.73	9.60	30.10	27.15
P21	SDMH E3	Vault E	0.67	8.02	1.00	1.12	0.13	0.15	2.24	0.17	0.25	36.82	36.82	29.93	27.55	6.73	9.13	30.10	27.70
P22	SDMH E5	SDMH E3	1.00	166.67	0.50	2.33	0.06	0.15	1.61	0.18	0.18	34.77	36.82	30.96	29.93	3.63	6.73	31.14	30.10
P23	SDCI E5.1	SDMH E5	1.00	13.71	2.41	5.13	0.01	0.07	2.30	0.08	0.08	34.56	34.77	31.49	30.96	2.99	3.63	31.57	31.14
P24	SDCI E5.2	SDMH E5	1.00	30.29	1.58	4.16	0.01	0.05	1.81	0.08	0.08	34.66	34.77	31.64	30.96	2.94	3.63	31.72	31.14
P25	SDMH E6	SDMH E5	1.00	110.85	0.50	2.33	0.01	0.03	0.99	0.09	0.09	37.17	34.77	31.71	30.96	5.37	3.63	31.80	31.14
P26	SDMH E7	SDMH E6	1.00	150.00	5.56	7.80	0.00	0.03	3.75	0.05	0.05	46.25	37.17	40.25	31.71	5.95	5.37	40.30	31.80
P27	SDCI E7.1	SDMH E7	1.00	13.50	3.70	6.37	0.00	0.02	3.34	0.04	0.04	45.96	46.25	42.50	40.25	3.42	5.95	42.54	40.30
P28	SDCI E7.2	SDMH E7	1.00	23.50	2.13	4.83	0.00	0.01	1.91	0.04	0.04	45.92	46.25	42.50	40.25	3.39	5.95	42.54	40.30
Dual12x12	N2	SDMH O4	12.00	257.50	0.01	369.56	0.01	2.09	0.52	0.34	0.03	50.00	41.65	29.18	29.62	20.01	11.69	29.99	29.96
Dual12x12	N2	SDMH O4	12.00	257.50	0.01	369.56	0.01	2.09	0.52	0.34	0.03	50.00	41.65	29.18	29.62	20.01	11.69	29.99	29.96

XPSWMM CONVEYANCE DATA (10-YEAR STORM EVENT) WITH POST BASINS AND UPGRADED STORM LINE IN MAIN STREET

OFFSITE TO EXISTING 36-INCH CULVERT - THE COVE - OREGON CITY, OREGON

Location			Conduit Properties			Conduit Results						Conduit Profile							
Link	Station					Design Capacity	Qmax/ Qdesign	Max Flow	Max Velocity	Max Flow Depth	y/d0	US Ground Elev.	DS Ground Elev.	US IE	DS IE	US Freeboard	DS Freeboard	US HGL	DS HGL
	From	To	Diameter	Length	Slope														
			ft	ft	%	cfs		cfs	ft/s	ft		ft	ft	ft	ft	ft	ft	ft	ft
P1	SDMH O-5	EX-36 OUT	3.00	12.20	0.06	17.73	2.74	48.64	8.19	2.36	0.79	32.02	50.70	22.25	22.24	7.41	26.19	24.61	24.51
P2	SDMH O1	SDMH O-5	4.00	30.12	0.05	34.37	1.42	48.64	6.30	2.37	0.59	31.25	32.02	22.37	22.25	6.51	7.41	24.74	24.61
P3	SITE N	SDMH O1	1.50	32.22	0.75	8.42	0.30	2.50	1.69	2.27	1.00	30.93	31.25	22.71	22.37	6.18	6.51	24.75	24.74
P4	T1	SDMH O1	4.00	232.22	0.88	125.02	0.38	47.58	8.40	2.27	0.57	32.89	31.25	24.51	22.37	6.58	6.51	26.31	24.74
P5	SITE S	T1	1.50	36.64	4.75	21.26	0.12	2.62	8.17	0.36	0.24	32.55	32.89	27.75	24.51	4.44	6.58	28.11	26.31
P6	SDMH O2	T1	4.00	143.98	0.88	125.27	0.37	46.61	9.01	1.80	0.45	35.32	32.89	25.78	24.51	7.83	6.58	27.49	26.31
P7	SDMH O3	SDMH O2	4.00	127.13	1.00	143.62	0.32	46.29	10.18	1.56	0.39	34.83	35.32	27.25	25.78	6.02	7.83	28.81	27.49
P8	SDMH D1	SDMH O3	1.00	16.85	1.00	3.32	0.08	0.26	2.51	0.19	0.19	34.77	34.83	29.62	27.25	4.96	6.02	29.81	28.81
P9	SDCI D1.2	SDMH D1	1.00	12.88	0.85	3.06	0.05	0.14	1.96	0.14	0.14	36.29	34.77	32.03	29.62	4.12	4.96	32.17	29.81
P10	SDCI D1.1	SDMH D1	1.00	21.09	1.00	3.30	0.04	0.12	1.98	0.13	0.13	36.29	34.77	32.13	29.62	4.03	4.96	32.26	29.81
P11	SDMH O4	SDMH O3	4.00	58.56	3.71	276.51	0.17	46.20	15.62	1.36	0.34	41.65	34.83	29.62	27.25	10.91	6.02	30.74	28.81
RR XING	Basin 5	N2	4.06	50.00	0.42	309.82	0.15	46.22	4.07	1.75	0.43	50.00	50.00	29.39	29.18	18.86	19.20	31.14	30.80
DL1	N3	Basin 5	3.50	16.00	-0.12	118.95	0.29	34.02	2.85	1.79	0.51	35.00	50.00	29.37	29.39	3.82	18.86	31.18	31.14
P12	N4	N3	4.00	11.50	0.17	59.90	0.57	34.01	6.12	1.83	0.46	42.92	35.00	29.39	29.37	11.70	3.82	31.22	31.18
P13	Basin 6	N4	4.00	511.00	0.30	78.86	0.11	8.25	3.37	1.83	0.46	38.00	42.92	30.93	29.39	6.17	11.70	31.83	31.22
36" Culvert	N5	N4	3.00	343.50	0.49	46.92	0.56	26.31	4.99	2.41	0.81	36.61	42.92	31.09	29.39	3.11	11.70	33.50	31.22
WASH DITCH	N11	N5	3.21	413.00	1.18	826.77	0.01	6.25	0.98	2.41	0.75	43.00	36.61	35.95	31.09	6.69	3.11	36.31	33.50
P14	Basin 10	N11	2.00	259.00	1.37	26.49	0.24	6.30	6.13	0.76	0.38	43.00	43.00	39.50	35.95	2.74	6.69	40.26	36.31
P15	Basin 8	N5	2.50	430.00	0.85	37.84	0.38	14.50	6.29	2.41	0.97	37.50	36.61	34.75	31.09	1.64	3.11	35.86	33.50
P16	Basin 9	N5	1.50	96.00	0.85	9.71	0.45	4.41	2.87	2.41	1.00	37.50	36.61	31.91	31.09	3.94	3.11	33.56	33.50
DITCH_E	N6	N5	3.75	270.00	0.21	345.66	0.02	6.40	0.61	2.41	0.64	36.61	36.61	26.87	31.09	3.10	3.11	33.51	33.50
Box Culvert	N7	N6	4.00	120.30	1.05	257.60	0.02	6.06	0.30	6.64	1.00	35.43	36.61	28.13	26.87	1.92	3.10	33.51	33.51
DITCH_W_1	N8	N7	3.00	247.00	1.20	293.65	0.02	5.80	1.01	5.38	1.00	35.24	35.43	31.10	28.13	1.73	1.92	33.51	33.51
Culvert_1	N9	N8	3.00	59.50	0.32	37.69	0.15	5.56	2.58	2.41	0.80	35.43	35.24	31.29	31.10	1.92	1.73	33.51	33.51
DITCH_W_2	N10	N9	2.50	272.00	0.47	462.96	0.02	6.78	0.77	2.22	0.89	35.26	35.43	32.57	31.29	1.75	1.92	33.51	33.51
CULVERT_2	Basin 7	N10	2.00	60.00	0.15	8.76	0.98	8.62	5.62	1.08	0.54	35.20	35.26	32.66	32.57	1.46	1.75	33.74	33.51
P17	SDMH E1	SDMH O2	1.50	39.92	1.00	9.76	0.08	0.80	1.50	1.51	1.00	35.37	35.32	26.38	25.78	7.88	7.83	27.49	27.49
P18	SDMH E2	SDMH E1	1.50	81.72	0.50	6.91	0.12	0.84	1.98	0.91	0.61	36.75	35.37	26.99	26.38	9.25	7.88	27.50	27.49
P19	Vault E	SDMH E2	1.00	8.00	1.00	3.31	0.21	0.71	3.35	0.31	0.31	36.82	36.75	27.55	26.99	8.96	9.25	27.86	27.50
P20	SDMH E3	SDMH E2	1.00	8.50	32.47	18.85	0.01	0.15	6.91	0.06	0.06	36.82	36.75	29.93	26.99	6.51	9.25	30.31	27.50
P21	SDMH E3	Vault E	0.67	8.02	1.00	1.12	0.63	0.71	3.39	0.38	0.58	36.82	36.82	29.93	27.55	6.51	8.96	30.31	27.86
P22	SDMH E5	SDMH E3	1.00	166.67	0.50	2.33	0.37	0.85	2.68	0.43	0.43	34.77	36.82	30.96	29.93	3.38	6.51	31.39	30.31
P23	SDCI E5.1	SDMH E5	1.00	13.71	2.41	5.13	0.08	0.41	3.76	0.23	0.23	34.56	34.77	31.49	30.96	2.88	3.38	31.68	31.39
P24	SDCI E5.2	SDMH E5	1.00	30.29	1.58	4.16	0.07	0.27	2.86	0.23	0.23	34.66	34.77	31.64	30.96	2.85	3.38	31.81	31.39
P25	SDMH E6	SDMH E5	1.00	110.85	0.50	2.33	0.08	0.18	1.69	0.23	0.23	37.17	34.77	31.71	30.96	5.27	3.38	31.90	31.39
P26	SDMH E7	SDMH E6	1.00	150.00	5.56	7.80	0.02	0.18	4.02	0.10	0.10	46.25	37.17	40.25	31.71	5.90	5.27	40.35	31.90
P27	SDCI E7.1	SDMH E7	1.00	13.50	3.70	6.37	0.02	0.12	3.15	0.10	0.10	45.96	46.25	42.50	40.25	3.36	5.90	42.60	40.35
P28	SDCI E7.2	SDMH E7	1.00	23.50	2.13	4.83	0.01	0.05	2.01	0.07	0.07	45.92	46.25	42.50	40.25	3.35	5.90	42.57	40.35
Dual12x12	N2	SDMH O4	12.00	257.50	0.01	369.56	0.06	23.10	1.68	1.15	0.10	50.00	41.65	29.18	29.62	19.20	10.91	30.80	30.74
Dual12x12	N2	SDMH O4	12.00	257.50	0.01	369.56	0.06	23.10	1.68	1.15	0.10	50.00	41.65	29.18	29.62	19.20	10.91	30.80	30.74

XPSWMM CONVEYANCE DATA (25-YEAR STORM EVENT) WITH POST BASINS AND UPGRADED STORM LINE IN MAIN STREET

EXISTING 36-INCH CULVERT - THE COVE - OREGON CITY, OREGON

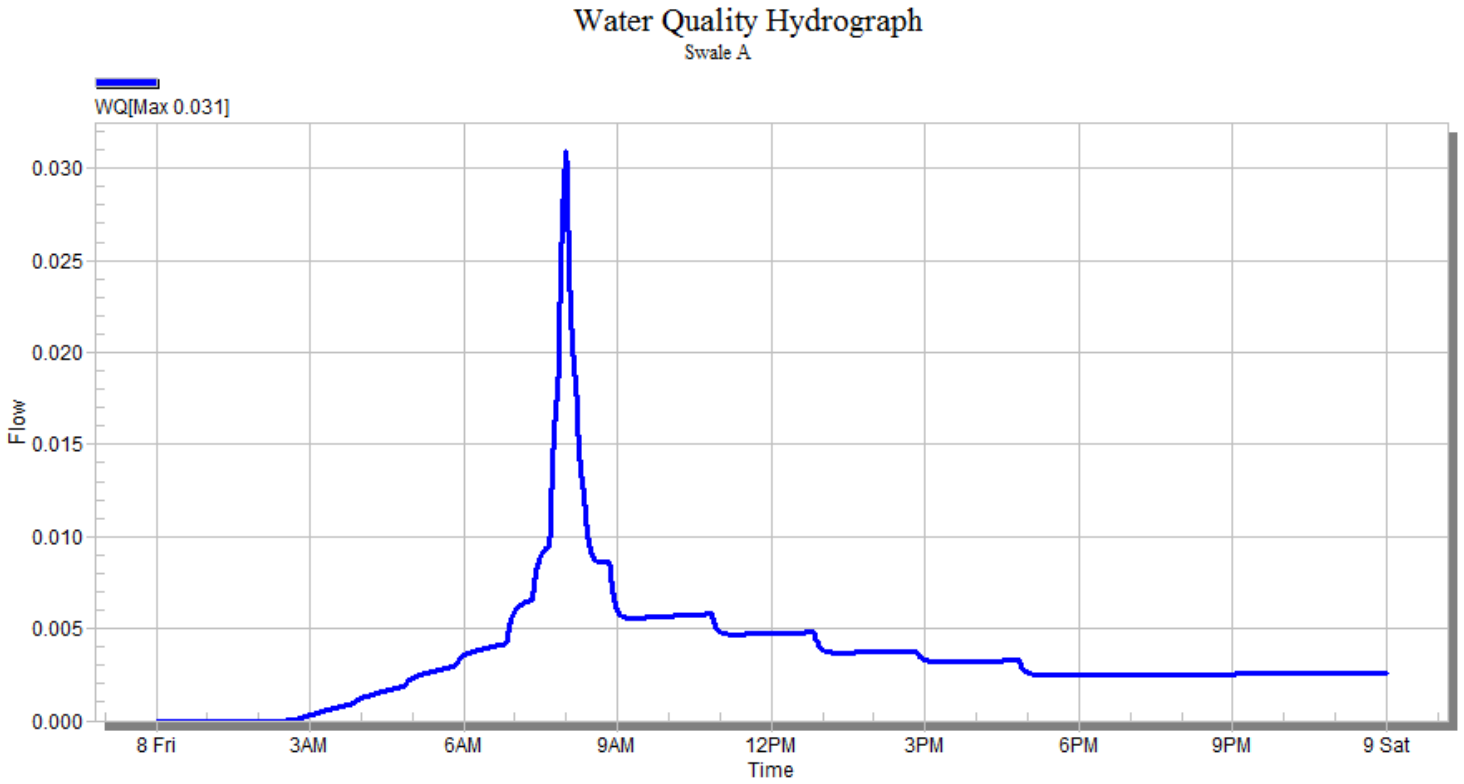
Location			Conduit Properties			Conduit Results						Conduit Profile							
Link	Station					Design Capacity	Qmax/ Qdesign	Max Flow	Max Velocity	Max Flow Depth	y/d0	US Ground Elev.	DS Ground Elev.	US IE	DS IE	US Freeboard	DS Freeboard	US HGL	DS HGL
	From	To	Diameter	Length	Slope														
			ft	ft	%	cfs		cfs	ft/s	ft		ft	ft	ft	ft	ft	ft	ft	ft
P1	SDMH O-5	EX-36 OUT	3.00	12.20	0.06	17.73	3.32	58.88	9.16	2.57	0.86	32.02	50.70	22.25	22.24	7.20	25.98	24.82	24.72
P2	SDMH O1	SDMH O-5	4.00	30.12	0.05	34.37	1.71	58.88	6.85	2.60	0.65	31.25	32.02	22.37	22.25	6.28	7.20	24.97	24.82
P3	SITE N	SDMH O1	1.50	32.22	0.75	8.42	0.36	2.99	1.77	2.50	1.00	30.93	31.25	22.71	22.37	5.95	6.28	24.98	24.97
P4	T1	SDMH O1	4.00	232.22	0.88	125.02	0.46	57.59	8.80	2.50	0.63	32.89	31.25	24.51	22.37	6.36	6.28	26.53	24.97
P5	SITE S	T1	1.50	36.64	4.75	21.26	0.15	3.12	8.59	0.52	0.35	32.55	32.89	27.75	24.51	4.41	6.36	28.14	26.53
P6	SDMH O2	T1	4.00	143.98	0.88	125.27	0.45	56.36	9.42	2.02	0.51	35.32	32.89	25.78	24.51	7.62	6.36	27.70	26.53
P7	SDMH O3	SDMH O2	4.00	127.13	1.00	143.62	0.39	55.97	10.72	1.73	0.43	34.83	35.32	27.25	25.78	5.84	7.62	28.99	27.70
P8	SDMH D1	SDMH O3	1.00	16.85	1.00	3.32	0.09	0.31	2.64	0.21	0.21	34.77	34.83	29.62	27.25	4.94	5.84	29.83	28.99
P9	SDCI D1.2	SDMH D1	1.00	12.88	0.85	3.06	0.05	0.16	2.07	0.16	0.16	36.29	34.77	32.03	29.62	4.10	4.94	32.19	29.83
P10	SDCI D1.1	SDMH D1	1.00	21.09	1.00	3.30	0.04	0.14	2.09	0.14	0.14	36.29	34.77	32.13	29.62	4.02	4.94	32.27	29.83
P11	SDMH O4	SDMH O3	4.00	58.56	3.71	276.51	0.20	55.86	16.32	1.54	0.38	41.65	34.83	29.62	27.25	10.79	5.84	30.86	28.99
RR XING	Basin 5	N2	4.06	50.00	0.42	309.82	0.18	55.88	4.30	1.89	0.47	50.00	50.00	29.39	29.18	18.72	19.08	31.28	30.92
DL1	N3	Basin 5	3.50	16.00	-0.12	118.95	0.34	40.63	3.00	1.93	0.55	35.00	50.00	29.37	29.39	3.68	18.72	31.32	31.28
P12	N4	N3	4.00	11.50	0.17	59.90	0.68	40.63	6.62	1.98	0.50	42.92	35.00	29.39	29.37	11.55	3.68	31.37	31.32
P13	Basin 6	N4	4.00	511.00	0.30	78.86	0.13	10.07	3.53	1.98	0.50	38.00	42.92	30.93	29.39	6.05	11.55	31.95	31.37
36" Culvert	N5	N4	3.00	343.50	0.49	46.92	0.67	31.30	4.95	2.72	0.91	36.61	42.92	31.09	29.39	2.80	11.55	33.81	31.37
WASH DITCH	N11	N5	3.21	413.00	1.18	826.77	0.01	7.51	0.98	2.72	0.85	43.00	36.61	35.95	31.09	6.66	2.80	36.34	33.81
P14	Basin 10	N11	2.00	259.00	1.37	26.49	0.29	7.57	6.47	0.84	0.42	43.00	43.00	39.50	35.95	2.66	6.66	40.34	36.34
P15	Basin 8	N5	2.50	430.00	0.85	37.84	0.46	17.57	6.50	2.72	1.00	37.50	36.61	34.75	31.09	1.48	2.80	36.02	33.81
P16	Basin 9	N5	1.50	96.00	0.85	9.71	0.55	5.31	2.88	2.72	1.00	37.50	36.61	31.91	31.09	3.61	2.80	33.89	33.81
DITCH_E	N6	N5	3.75	270.00	0.21	345.66	0.02	7.72	0.39	2.72	0.73	36.61	36.61	26.87	31.09	2.79	2.80	33.82	33.81
Box Culvert	N7	N6	4.00	120.30	1.05	257.60	0.04	-9.68	-0.41	6.95	1.00	35.43	36.61	28.13	26.87	1.61	2.79	33.82	33.82
DITCH_W_1	N8	N7	3.00	247.00	1.20	293.65	0.02	6.86	1.02	5.69	1.00	35.24	35.43	31.10	28.13	1.42	1.61	33.82	33.82
Culvert_1	N9	N8	3.00	59.50	0.32	37.69	0.18	6.63	2.62	2.72	0.91	35.43	35.24	31.29	31.10	1.61	1.42	33.82	33.82
DITCH_W_2	N10	N9	2.50	272.00	0.47	462.96	0.02	8.05	0.77	2.53	1.00	35.26	35.43	32.57	31.29	1.44	1.61	33.82	33.82
CULVERT_2	Basin 7	N10	2.00	60.00	0.15	8.76	1.21	10.57	5.79	1.28	0.64	35.20	35.26	32.66	32.57	1.26	1.44	33.94	33.82
P17	SDMH E1	SDMH O2	1.50	39.92	1.00	9.76	0.10	0.95	1.52	1.72	1.00	35.37	35.32	26.38	25.78	7.67	7.62	27.70	27.70
P18	SDMH E2	SDMH E1	1.50	81.72	0.50	6.91	0.14	0.99	1.80	1.12	0.74	36.75	35.37	26.99	26.38	9.05	7.67	27.70	27.70
P19	Vault E	SDMH E2	1.00	8.00	1.00	3.31	0.23	0.76	3.42	0.33	0.33	36.82	36.75	27.55	26.99	8.94	9.05	27.88	27.70
P20	SDMH E3	SDMH E2	1.00	8.50	32.47	18.85	0.01	0.26	8.42	0.21	0.21	36.82	36.75	29.93	26.99	6.49	9.05	30.33	27.70
P21	SDMH E3	Vault E	0.67	8.02	1.00	1.12	0.68	0.76	3.45	0.40	0.60	36.82	36.82	29.93	27.55	6.49	8.94	30.33	27.88
P22	SDMH E5	SDMH E3	1.00	166.67	0.50	2.33	0.44	1.02	2.81	0.47	0.47	34.77	36.82	30.96	29.93	3.34	6.49	31.43	30.33
P23	SDCI E5.1	SDMH E5	1.00	13.71	2.41	5.13	0.10	0.49	3.87	0.27	0.27	34.56	34.77	31.49	30.96	2.86	3.34	31.70	31.43
P24	SDCI E5.2	SDMH E5	1.00	30.29	1.58	4.16	0.08	0.33	2.95	0.27	0.27	34.66	34.77	31.64	30.96	2.83	3.34	31.83	31.43
P25	SDMH E6	SDMH E5	1.00	110.85	0.50	2.33	0.09	0.21	1.74	0.27	0.27	37.17	34.77	31.71	30.96	5.26	3.34	31.91	31.43
P26	SDMH E7	SDMH E6	1.00	150.00	5.56	7.80	0.03	0.21	4.85	0.11	0.11	46.25	37.17	40.25	31.71	5.89	5.26	40.36	31.91
P27	SDCI E7.1	SDMH E7	1.00	13.50	3.70	6.37	0.02	0.15	3.31	0.11	0.11	45.96	46.25	42.50	40.25	3.36	5.89	42.61	40.36
P28	SDCI E7.2	SDMH E7	1.00	23.50	2.13	4.83	0.01	0.06	2.14	0.08	0.08	45.92	46.25	42.50	40.25	3.34	5.89	42.58	40.36
Dual12x12	N2	SDMH O4	12.00	257.50	0.01	369.56	0.08	27.93	1.83	1.27	0.11	50.00	41.65	29.18	29.62	19.08	10.79	30.92	30.86
Dual12x12	N2	SDMH O4	12.00	257.50	0.01	369.56	0.08	27.93	1.83	1.27	0.11	50.00	41.65	29.18	29.62	19.08	10.79	30.92	30.86

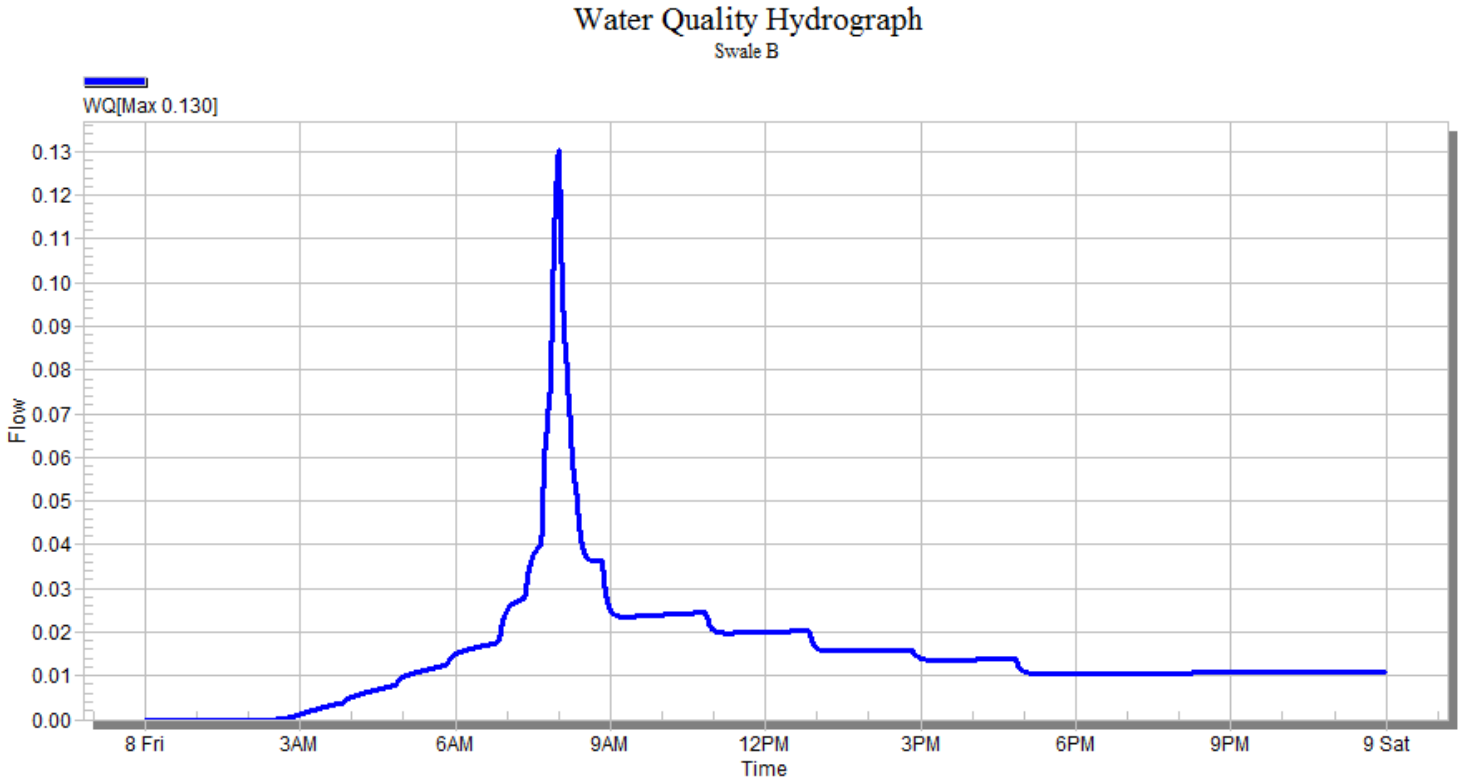
XPSWMM CONVEYANCE DATA (100-YEAR STORM EVENT) WITH POST BASINS AND UPGRADED STORM LINE IN MAIN STREET

OFFSITE TO EXISTING 36-INCH CULVERT - THE COVE - OREGON CITY, OREGON

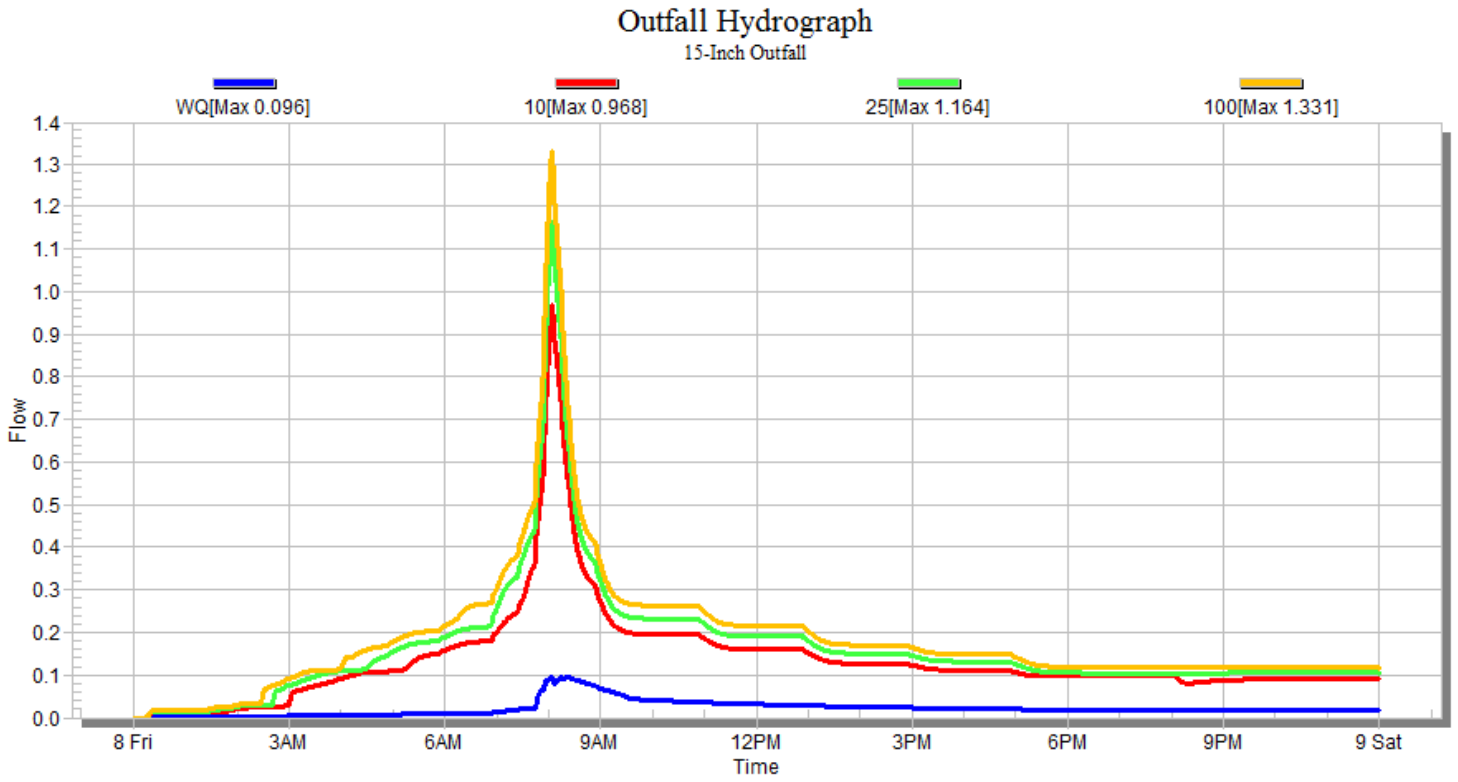
Location			Conduit Properties			Conduit Results						Conduit Profile							
Link	Station					Design Capacity	Qmax/ Qdesign	Max Flow	Max Velocity	Max Flow Depth	y/d0	US Ground Elev.	DS Ground Elev.	US IE	DS IE	US Freeboard	DS Freeboard	US HGL	DS HGL
	From	To	Diameter	Length	Slope														
			ft	ft	%	cfs		cfs	ft/s	ft		ft	ft	ft	ft	ft	ft	ft	ft
P1	SDMH O-5	EX-36 OUT	3.00	12.20	0.06	17.73	3.79	67.18	9.98	2.73	0.91	32.02	50.70	22.25	22.24	7.04	25.84	24.98	24.86
P2	SDMH O1	SDMH O-5	4.00	30.12	0.05	34.37	1.96	67.18	7.27	2.77	0.69	31.25	32.02	22.37	22.25	6.11	7.04	25.14	24.98
P3	SITE N	SDMH O1	1.50	32.22	0.75	8.42	0.40	3.40	1.92	2.67	1.00	30.93	31.25	22.71	22.37	5.78	6.11	25.15	25.14
P4	T1	SDMH O1	4.00	232.22	0.88	125.02	0.53	65.68	9.08	2.67	0.67	32.89	31.25	24.51	22.37	6.19	6.11	26.70	25.14
P5	SITE S	T1	1.50	36.64	4.75	21.26	0.17	3.54	8.77	0.69	0.46	32.55	32.89	27.75	24.51	4.39	6.19	28.16	26.70
P6	SDMH O2	T1	4.00	143.98	0.88	125.27	0.51	64.17	9.69	2.19	0.55	35.32	32.89	25.78	24.51	7.46	6.19	27.86	26.70
P7	SDMH O3	SDMH O2	4.00	127.13	1.00	143.62	0.44	63.66	11.06	1.88	0.47	34.83	35.32	27.25	25.78	5.71	7.46	29.12	27.86
P8	SDMH D1	SDMH O3	1.00	16.85	1.00	3.32	0.11	0.35	2.74	0.22	0.22	34.77	34.83	29.62	27.25	4.93	5.71	29.84	29.12
P9	SDCI D1.2	SDMH D1	1.00	12.88	0.85	3.06	0.06	0.19	2.15	0.17	0.17	36.29	34.77	32.03	29.62	4.09	4.93	32.20	29.84
P10	SDCI D1.1	SDMH D1	1.00	21.09	1.00	3.30	0.05	0.16	2.17	0.15	0.15	36.29	34.77	32.13	29.62	4.01	4.93	32.28	29.84
P11	SDMH O4	SDMH O3	4.00	58.56	3.71	276.51	0.23	63.53	16.78	1.67	0.42	41.65	34.83	29.62	27.25	10.70	5.71	30.95	29.12
RR XING	Basin 5	N2	4.06	50.00	0.42	309.82	0.21	63.54	4.46	1.99	0.49	50.00	50.00	29.39	29.18	18.62	18.98	31.38	31.02
DL1	N3	Basin 5	3.50	16.00	-0.12	118.95	0.39	45.77	3.10	2.04	0.58	35.00	50.00	29.37	29.39	3.57	18.62	31.43	31.38
P12	N4	N3	4.00	11.50	0.17	59.90	0.76	45.77	6.99	2.09	0.52	42.92	35.00	29.39	29.37	11.44	3.57	31.48	31.43
P13	Basin 6	N4	4.00	511.00	0.30	78.86	0.15	11.57	3.65	2.09	0.52	38.00	42.92	30.93	29.39	5.96	11.44	32.04	31.48
36" Culvert	N5	N4	3.00	343.50	0.49	46.92	0.75	35.16	5.13	2.96	0.99	36.61	42.92	31.09	29.39	2.56	11.44	34.05	31.48
WASH DITCH	N11	N5	3.21	413.00	1.18	826.77	0.01	8.55	1.01	2.96	0.92	43.00	36.61	35.95	31.09	6.63	2.56	36.37	34.05
P14	Basin 10	N11	2.00	259.00	1.37	26.49	0.33	8.62	6.72	0.90	0.45	43.00	43.00	39.50	35.95	2.60	6.63	40.40	36.37
P15	Basin 8	N5	2.50	430.00	0.85	37.84	0.53	20.10	6.63	2.96	1.00	37.50	36.61	34.75	31.09	1.35	2.56	36.15	34.05
P16	Basin 9	N5	1.50	96.00	0.85	9.71	0.62	6.04	3.41	2.96	1.00	37.50	36.61	31.91	31.09	3.36	2.56	34.14	34.05
DITCH_E	N6	N5	3.75	270.00	0.21	345.66	0.03	8.96	0.38	2.96	0.79	36.61	36.61	26.87	31.09	2.56	2.56	34.05	34.05
Box Culvert	N7	N6	4.00	120.30	1.05	257.60	0.05	-12.58	-0.53	7.18	1.00	35.43	36.61	28.13	26.87	1.38	2.56	34.05	34.05
DITCH_W_1	N8	N7	3.00	247.00	1.20	293.65	0.03	7.96	1.07	5.92	1.00	35.24	35.43	31.10	28.13	1.19	1.38	34.05	34.05
Culvert_1	N9	N8	3.00	59.50	0.32	37.69	0.20	7.56	2.71	2.95	0.98	35.43	35.24	31.29	31.10	1.38	1.19	34.05	34.05
DITCH_W_2	N10	N9	2.50	272.00	0.47	462.96	0.02	9.08	0.80	2.76	1.00	35.26	35.43	32.57	31.29	1.21	1.38	34.06	34.05
CULVERT_2	Basin 7	N10	2.00	60.00	0.15	8.76	1.39	12.18	5.84	1.49	0.74	35.20	35.26	32.66	32.57	1.06	1.21	34.14	34.06
P17	SDMH E1	SDMH O2	1.50	39.92	1.00	9.76	0.11	1.08	1.58	1.88	1.00	35.37	35.32	26.38	25.78	7.51	7.46	27.86	27.86
P18	SDMH E2	SDMH E1	1.50	81.72	0.50	6.91	0.16	1.12	1.67	1.28	0.85	36.75	35.37	26.99	26.38	8.89	7.51	27.86	27.86
P19	Vault E	SDMH E2	1.00	8.00	1.00	3.31	0.24	0.80	3.46	0.39	0.39	36.82	36.75	27.55	26.99	8.94	8.89	27.88	27.86
P20	SDMH E3	SDMH E2	1.00	8.50	32.47	18.85	0.02	0.36	8.42	0.37	0.37	36.82	36.75	29.93	26.99	6.48	8.89	30.35	27.86
P21	SDMH E3	Vault E	0.67	8.02	1.00	1.12	0.71	0.80	3.48	0.42	0.62	36.82	36.82	29.93	27.55	6.48	8.94	30.35	27.88
P22	SDMH E5	SDMH E3	1.00	166.67	0.50	2.33	0.49	1.15	2.90	0.51	0.51	34.77	36.82	30.96	29.93	3.30	6.48	31.47	30.35
P23	SDCI E5.1	SDMH E5	1.00	13.71	2.41	5.13	0.11	0.55	3.93	0.31	0.31	34.56	34.77	31.49	30.96	2.84	3.30	31.72	31.47
P24	SDCI E5.2	SDMH E5	1.00	30.29	1.58	4.16	0.09	0.37	3.00	0.31	0.31	34.66	34.77	31.64	30.96	2.82	3.30	31.84	31.47
P25	SDMH E6	SDMH E5	1.00	110.85	0.50	2.33	0.10	0.24	1.78	0.31	0.31	37.17	34.77	31.71	30.96	5.25	3.30	31.93	31.47
P26	SDMH E7	SDMH E6	1.00	150.00	5.56	7.80	0.03	0.24	4.75	0.12	0.12	46.25	37.17	40.25	31.71	5.88	5.25	40.37	31.93
P27	SDCI E7.1	SDMH E7	1.00	13.50	3.70	6.37	0.03	0.17	3.45	0.11	0.11	45.96	46.25	42.50	40.25	3.35	5.88	42.61	40.37
P28	SDCI E7.2	SDMH E7	1.00	23.50	2.13	4.83	0.02	0.07	2.21	0.09	0.09	45.92	46.25	42.50	40.25	3.33	5.88	42.59	40.37
Dual12x12	N2	SDMH O4	12.00	257.50	0.01	369.56	0.09	31.76	1.94	1.37	0.11	50.00	41.65	29.18	29.62	18.98	10.70	31.02	30.95
Dual12x12	N2	SDMH O4	12.00	257.50	0.01	369.56	0.09	31.76	1.94	1.37	0.11	50.00	41.65	29.18	29.62	18.98	10.70	31.02	30.95

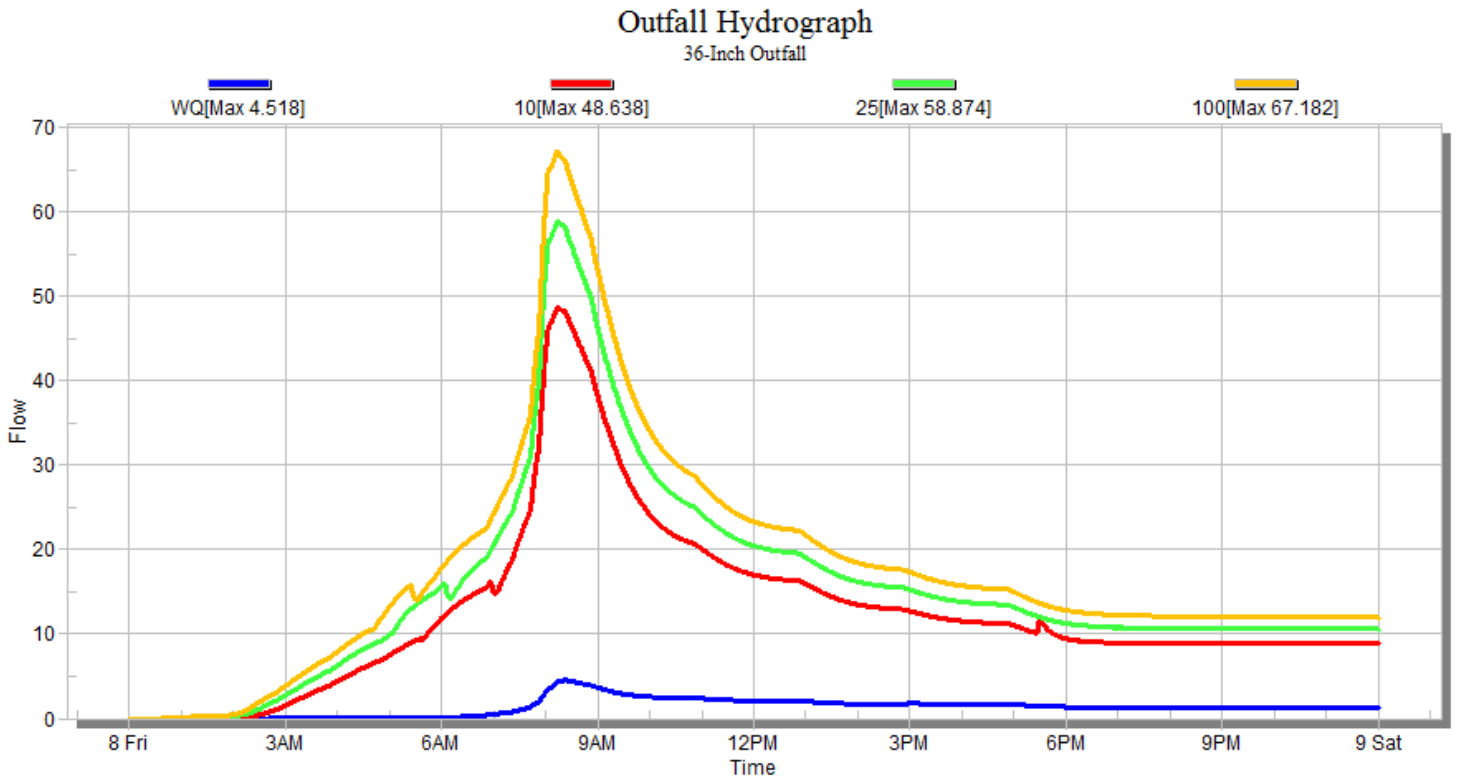
Hydrographs





Hydrographs





Downstream Profile

36-Inch Outfall—25-year Storm Event