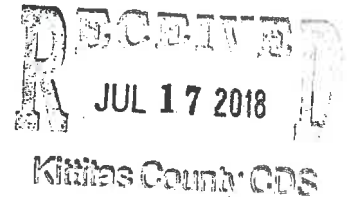


The Commons at Dry Creek

Preliminary Drainage Report

Prepared for

MDJ Contractors, LLC.
Contact: Eric Jackson
700 E Mountain View Ave #508
Ellensburg, WA 98926
(509) 925-6640



Prepared by

LDC

THE CIVIL ENGINEERING GROUP

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July 13, 2017



Job No: 16-115A

TABLE OF CONTENTS

Section	Title	
1.0	Project Overview Drainage Information Summary Form F-3042	1-1
	Appendix 1-A - Project Overview Figures	
2.0	Risk Assessment Analysis and Temporary Erosion and Sediment Control Analysis and Design	2-1
3.0	Offsite Analysis Downstream Analysis	3-1
4.0	Flow Control and Water Quality Facility Analysis and Design Existing Site Hydrology Developed Site Hydrology Flow Control System Water Quality System	4-1
	Appendix 4-A - Detention Facility Calculations and Supporting Documents	
5.0	Special Reports and Studies	5-1
	Appendix 5-A - Storm Drainage Operations and Maintenance Manual	

1.0 PROJECT OVERVIEW

The Commons at Dry Creek project is located in Kittitas County within parcel numbers 801033 and 791033. The site is located at 1910 W Dry Creek Road, Ellensburg, WA 98926. More specifically the project is located in the NW ¼ of the SW ¼ of Section 27, Township 18 N, Range 18 E, W.M., as shown in Figure 1.

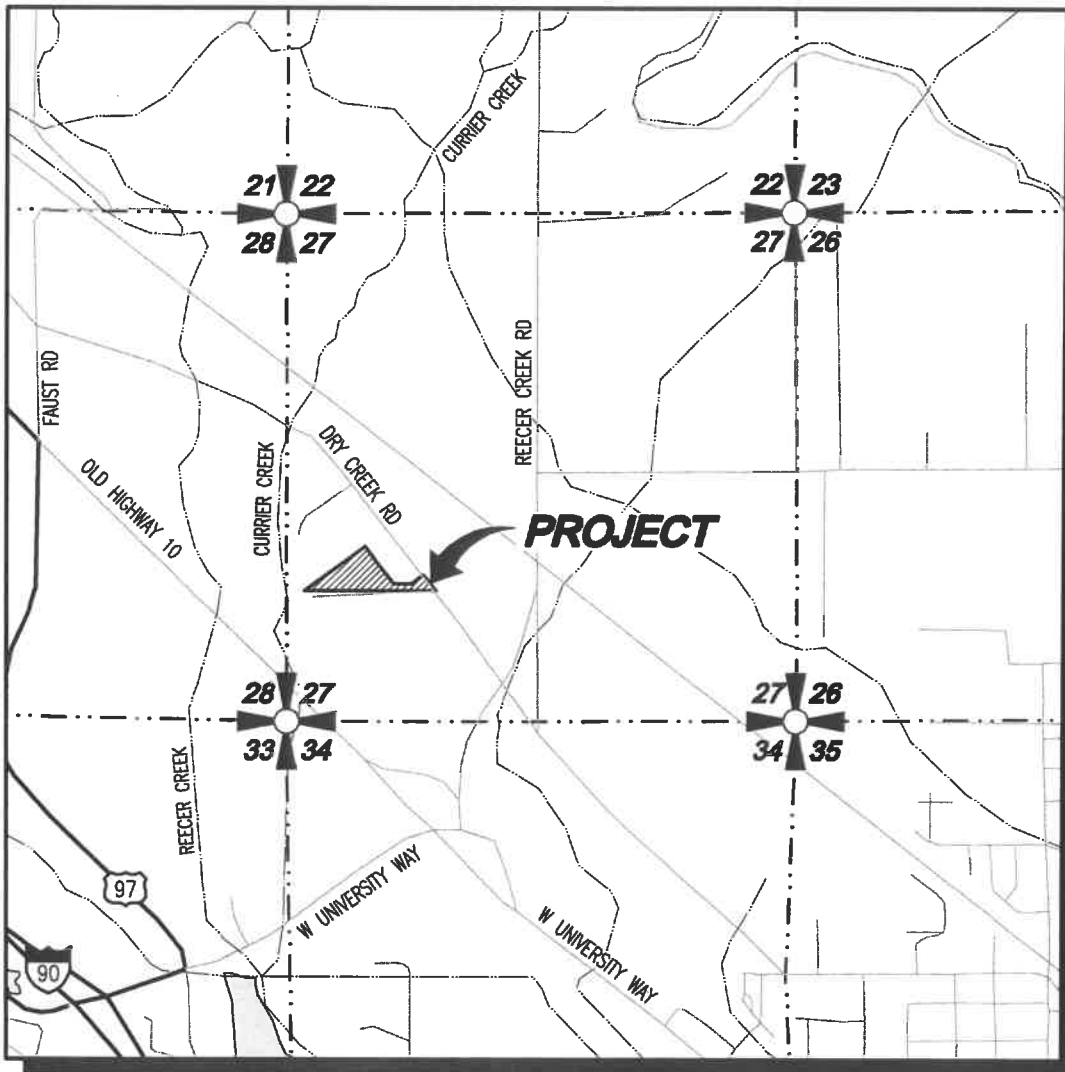
The existing site is predominately pasture. There are currently no existing single-family residences on the property. Please refer to Figure 4.0 for a depiction of the existing site conditions.

The existing site lies within the Yakima River sub-basin which is part of the Columbia River basin. The existing site runoff is best described as overland sheet flow which moves southwest across the site. It is likely that the majority of the storm water is infiltrating on site. The remainder of the storm water enters Currier Creek adjacent to the southwestern property boundary.

The proposed developed site will include approximately 5.77 acres. The developed site will include 34 new single family lots detached cottage units, and approximately 3,098 lineal feet of roadway with associated utilities. The access to the site will enter the property from Dry Creek Road, approximately 1,400' northwest of the intersection of Reecer Creek Road and Dry Creek Road. See Figure RD-01 for the proposed site layout.

According to the SCS soil survey for Kittitas County the proposed development area of the site is underlain by Mitta Ashy Silt Loam, Nack-Opnish Complex, Brickmill Gravelly Ashy Loam, and Nanum Ashy Loam, see figures in Appendix 1-A.

Flow control for the site will be obtained using perforated infiltration conveyance pipe and a sub-surface infiltration gallery. The infiltration gallery will be constructed in Tract 999 located on the southwestern project boundary.



VICINITY MAP

SCALE: 1"=2000'

Drawing: P:\2017\17-132 Cottage Grove\Exhibits\17132E-VM.dwg Plotted: Jun 19, 2017 - 2:55pm

LDC

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Planning
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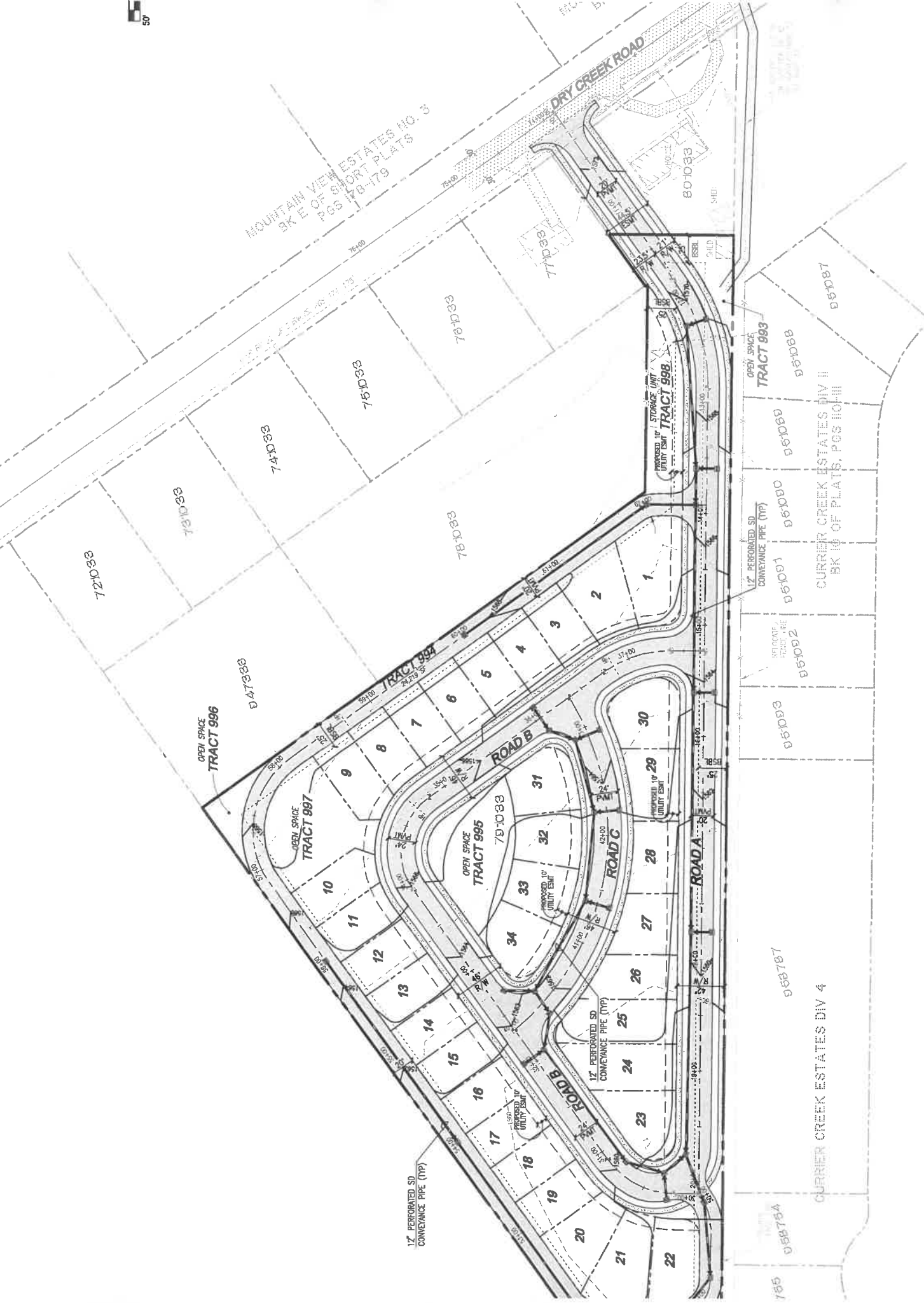
MDJ CONTRACTORS, LLC.

COTTAGE GROVE

VICINITY MAP

MOUNTAIN VIEW ESTATES NO. 3
BK E OF SHORT PLATS
PGS 170-179

DRY CREEK ROAD



TRACT 998

TRACT 997

TRACT 996

TRACT 995

TRACT 994

TRACT 993

TRACT 992

TRACT 991

TRACT 990

TRACT 989

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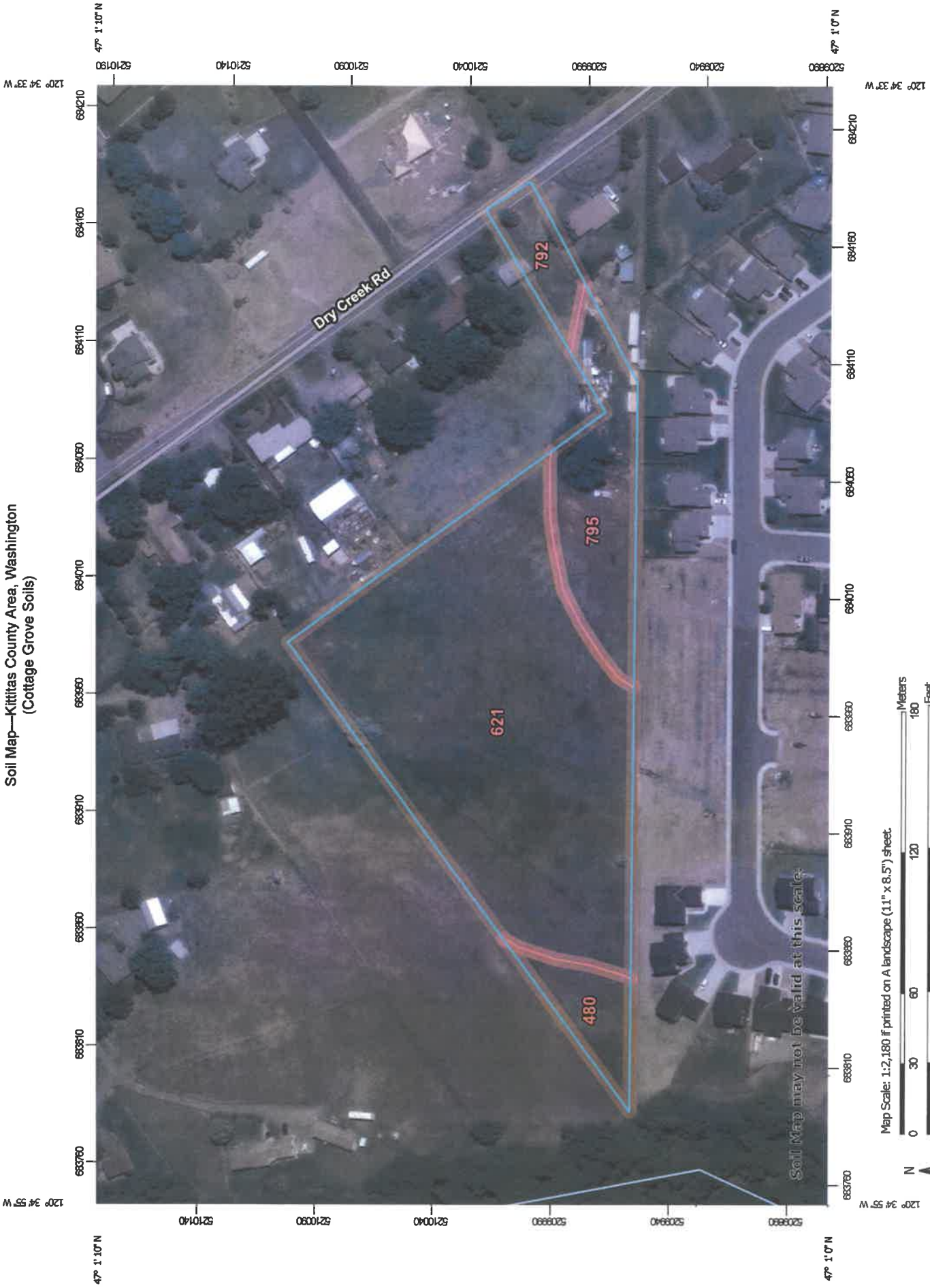
TRACT 709

TRACT 708

APPENDIX 1-A

PROJECT OVERVIEW FIGURES

Soil Map—Kittitas County Area, Washington
(Cottage Grove Soils)



Map Scale: 1:2,180 if printed on A landscape (11" x 8.5") sheet.

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

MAP LEGEND

- Area of Interest (AOI)
- Area of Interest (AOI)
- Soils
- Soil Map Unit Polygons
- Soil Map Unit Lines
- Soil Map Unit Points
- Special Point Features**
 - Blowout
 - Borrow Pit
 - Clay Spot
 - Closed Depression
 - Gravel Pit
 - Gravelly Spot
 - Landfill
 - Lava Flow
 - Marsh or swamp
 - Mine or Quarry
 - Miscellaneous Water
 - Perennial Water
 - Rock Outcrop
 - Saline Spot
 - Sandy Spot
 - Severely Eroded Spot
 - Sinkhole
 - Slide or Slip
 - Sodic Spot
- Water Features**
 - Streams and Canals
- Transportation**
 - Rails
 - Interstate Highways
 - US Routes
 - Major Roads
 - Local Roads
- Background**
 - Aerial Photography
- Spoil Area
- Stony Spot
- Very Stony Spot
- Wet Spot
- Other
- Special Line Features

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:24,000.

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

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

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

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

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

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

Soil Survey Area: Kittitas County Area, Washington
Survey Area Data: Version 10, Sep 7, 2017

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

Date(s) aerial images were photographed: Jul 3, 2014—Sep 21, 2016

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

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
480	Nanum ashy loam, 0 to 2 percent slopes	0.4	6.1%
621	Mitta ashy silt loam, flooded, 0 to 2 percent slopes	4.4	72.3%
792	Brickmill gravelly ashy loam, 0 to 5 percent slopes	0.3	5.1%
795	Nack-Opnish complex, 0 to 2 percent slopes	1.0	16.5%
Totals for Area of Interest		6.1	100.0%

Kittitas County Area, Washington

480—Nanum ashy loam, 0 to 2 percent slopes

Map Unit Setting

National map unit symbol: 2111
Elevation: 1,400 to 2,500 feet
Mean annual precipitation: 9 to 12 inches
Mean annual air temperature: 48 to 50 degrees F
Frost-free period: 130 to 150 days
Farmland classification: Prime farmland if irrigated

Map Unit Composition

Nanum and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Nanum

Setting

Landform: Alluvial fans, terraces
Down-slope shape: Linear, concave
Across-slope shape: Linear, concave
Parent material: Alluvium with an influence of volcanic ash in the upper part

Typical profile

H1 - 0 to 8 inches: ashy loam
H2 - 8 to 15 inches: ashy loam
H3 - 15 to 28 inches: ashy clay loam
H4 - 28 to 35 inches: very gravelly clay loam
H5 - 35 to 60 inches: extremely gravelly sandy clay loam

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Somewhat poorly drained
Capacity of the most limiting layer to transmit water (Ksat):
Moderately high (0.20 to 0.57 in/hr)
Depth to water table: About 21 to 28 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 5 percent
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Sodium adsorption ratio, maximum in profile: 2.0
Available water storage in profile: Moderate (about 8.1 inches)

Interpretive groups

Land capability classification (irrigated): 3w
Land capability classification (nonirrigated): 3w

Hydrologic Soil Group: C/D

Hydric soil rating: No

Minor Components

Opnish

Percent of map unit: 5 percent

Hydric soil rating: No

Nack

Percent of map unit: 5 percent

Hydric soil rating: No

Brickmill

Percent of map unit: 5 percent

Hydric soil rating: No

Data Source Information

Soil Survey Area: Kittitas County Area, Washington

Survey Area Data: Version 10, Sep 7, 2017

Kittitas County Area, Washington

621—Mitta ashy silt loam, flooded, 0 to 2 percent slopes

Map Unit Setting

National map unit symbol: 215c
Elevation: 1,500 to 2,300 feet
Mean annual precipitation: 9 to 12 inches
Mean annual air temperature: 48 to 50 degrees F
Frost-free period: 130 to 150 days
Farmland classification: Prime farmland if irrigated

Map Unit Composition

Mitta, flooded, and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Mitta, Flooded

Setting

Landform: Flood plains, fan aprons, fan skirts, inset fans
Down-slope shape: Concave, linear
Across-slope shape: Concave, linear
Parent material: Alluvium mixed with volcanic ash in the upper part

Typical profile

H1 - 0 to 6 inches: ashy silt loam
H2 - 6 to 15 inches: ashy silt loam
H3 - 15 to 34 inches: ashy silt loam
H4 - 34 to 49 inches: silty clay loam
H5 - 49 to 60 inches: silty clay loam

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Somewhat poorly drained
Capacity of the most limiting layer to transmit water (Ksat):
Moderately high (0.20 to 0.57 in/hr)
Depth to water table: About 34 to 49 inches
Frequency of flooding: Occasional
Frequency of ponding: None
Calcium carbonate, maximum in profile: 1 percent
Salinity, maximum in profile: Nonsaline to slightly saline (0.0 to 4.0 mmhos/cm)
Sodium adsorption ratio, maximum in profile: 10.0
Available water storage in profile: High (about 11.7 inches)

Interpretive groups

Land capability classification (irrigated): 3w
Land capability classification (nonirrigated): 3w
Hydrologic Soil Group: C

Hydric soil rating: No

Minor Components

Woldale

Percent of map unit: 5 percent

Hydric soil rating: No

Opnish

Percent of map unit: 5 percent

Hydric soil rating: No

Nack

Percent of map unit: 5 percent

Hydric soil rating: No

Data Source Information

Soil Survey Area: Kittitas County Area, Washington

Survey Area Data: Version 10, Sep 7, 2017

Kittitas County Area, Washington

792—Brickmill gravelly ashy loam, 0 to 5 percent slopes

Map Unit Setting

National map unit symbol: 2192
Elevation: 1,400 to 2,000 feet
Mean annual precipitation: 9 to 12 inches
Mean annual air temperature: 48 to 50 degrees F
Frost-free period: 130 to 150 days
Farmland classification: Prime farmland if irrigated

Map Unit Composition

Brickmill and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Brickmill

Setting

Landform: Alluvial fans
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Alluvium with an influence of volcanic ash in the surface

Typical profile

H1 - 0 to 12 inches: gravelly ashy loam
H2 - 12 to 28 inches: very gravelly ashy sandy loam
H3 - 28 to 38 inches: extremely gravelly sandy loam
H4 - 38 to 49 inches: extremely gravelly sandy loam
H5 - 49 to 60 inches: extremely gravelly loamy coarse sand

Properties and qualities

Slope: 0 to 5 percent
Depth to restrictive feature: 40 to 60 inches to strongly contrasting textural stratification
Natural drainage class: Somewhat poorly drained
Capacity of the most limiting layer to transmit water (Ksat):
Moderately high to high (0.57 to 1.98 in/hr)
Depth to water table: About 28 to 38 inches
Frequency of flooding: None
Frequency of ponding: None
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Sodium adsorption ratio, maximum in profile: 1.0
Available water storage in profile: Low (about 4.0 inches)

Interpretive groups

Land capability classification (irrigated): 3w
Land capability classification (nonirrigated): 3w

Hydrologic Soil Group: C
Hydric soil rating: No

Minor Components

Nanum

Percent of map unit: 10 percent
Hydric soil rating: No

Ackna

Percent of map unit: 5 percent
Hydric soil rating: No

Data Source Information

Soil Survey Area: Kittitas County Area, Washington
Survey Area Data: Version 10, Sep 7, 2017

Kittitas County Area, Washington

795—Nack-Opnish complex, 0 to 2 percent slopes

Map Unit Setting

National map unit symbol: 2195
Elevation: 1,400 to 2,400 feet
Mean annual precipitation: 9 to 12 inches
Mean annual air temperature: 48 to 50 degrees F
Frost-free period: 130 to 150 days
Farmland classification: Prime farmland if irrigated

Map Unit Composition

Nack and similar soils: 55 percent
Opnish and similar soils: 40 percent
Minor components: 5 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Nack

Setting

Landform: Alluvial fans
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Alluvium with a mantle of volcanic ash

Typical profile

H1 - 0 to 6 inches: gravelly ashy loam
H2 - 6 to 15 inches: clay loam
H3 - 15 to 60 inches: extremely gravelly sandy clay

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Somewhat poorly drained
Capacity of the most limiting layer to transmit water (Ksat):
Moderately high (0.20 to 0.57 in/hr)
Depth to water table: About 15 to 39 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 15 percent
Salinity, maximum in profile: Nonsaline to slightly saline (0.0 to 4.0 mmhos/cm)
Sodium adsorption ratio, maximum in profile: 5.0
Available water storage in profile: Low (about 4.7 inches)

Interpretive groups

Land capability classification (irrigated): 4w
Land capability classification (nonirrigated): 4w
Hydrologic Soil Group: C/D
Hydric soil rating: No

Description of Opnish

Setting

Landform: Alluvial fans

Down-slope shape: Linear

Across-slope shape: Linear

Parent material: Alluvium with an influence of volcanic ash in the upper part

Typical profile

H1 - 0 to 8 inches: ashy loam

H2 - 8 to 13 inches: ashy clay loam

H3 - 13 to 26 inches: clay loam

H4 - 26 to 60 inches: extremely gravelly clay loam

Properties and qualities

Slope: 0 to 2 percent

Depth to restrictive feature: More than 80 inches

Natural drainage class: Moderately well drained

Capacity of the most limiting layer to transmit water (Ksat):

Moderately high (0.20 to 0.57 in/hr)

Depth to water table: About 24 to 40 inches

Frequency of flooding: None

Frequency of ponding: None

Calcium carbonate, maximum in profile: 15 percent

Salinity, maximum in profile: Very slightly saline to slightly saline
(2.0 to 4.0 mmhos/cm)

Sodium adsorption ratio, maximum in profile: 13.0

Available water storage in profile: High (about 11.0 inches)

Interpretive groups

Land capability classification (irrigated): 3w

Land capability classification (nonirrigated): 3w

Hydrologic Soil Group: C

Hydric soil rating: No

Minor Components

Brickmill

Percent of map unit: 5 percent

Hydric soil rating: No

Data Source Information

Soil Survey Area: Kittitas County Area, Washington

Survey Area Data: Version 10, Sep 7, 2017

2.0 RISK ASSESSMENT ANALYSIS AND TEMPORARY EROSION AND SEDIMENT CONTROL DESIGN

Risk Assessment

The proposed site consists of 5.77 acres, all of which will be developed. According to the SCS soil survey for Kittitas County the proposed development area of the site is underlain by Mitta Ashy Silt Loam, Nack-Opnish Complex, Brickmill Gravelly Ashy Loam, and Nanum Ashy Loam. The Infiltration Testing Letter, prepared by Baer Testing Inc. on June 25th, 2018, and included with this submittal, contains a more detailed description of the onsite soils. By implementing BMP's, as described in the Stormwater Pollution Prevention Plan, the risk of erosion will be greatly reduced.

According to the survey, there appear to be no critical areas on-site, however, Currier Creek is located approximately 150' to the west of the western parcel boundary.

Temporary Erosion and Sediment Control

The Stormwater Pollution Prevention Plan for the project will be included with the construction plan submittal.

3.0 OFFSITE ANALYSIS

Downstream Analysis - Natural Drainage Course

The existing site lies within the Yakima River sub-basin which is part of the Columbia basin. The existing site runoff is best described as overland sheet flow which moves southwesterly. It appears that all storm water either infiltrates or exits the site to the southwest. Any water leaving the site as overland flow would combine with Currier Creek within approximately 150'-200' of the wester property boundary. Currier Creek continues to the south until eventually passing the quarter mile buffer. Additional verification of downstream conditions will be provided with construction documentation. Please see Figure 3.0 for a depiction of the downstream flow path.



4.0 FLOW CONTROL AND WATER QUALITY FACILITY ANALYSIS AND DESIGN

The drainage analysis was modeled using Stormshed 3G hydrology software utilizing SBUH methodology as outlined in the 2004 Stormwater Management Manual for Eastern Washington.

Precipitation depths for 24-hour storms at various recurrence intervals are derived from isopluvial mapping contained within the Stormwater Management Manual for Eastern Washington. The precipitation depths for the area in which the site is located are as follows:

2 year, 24-hour storm	0.90 in.
10 year, 24-hour storm	1.30 in.
25 year, 24-hour storm	1.60 in.
100 year, 24-hour storm	2.10 in.

Existing Site Hydrology

The existing site is predominately pasture and gently slopes from east to west. There are currently no existing single-family residences on the property. The existing site is shown in Figure 4.0.

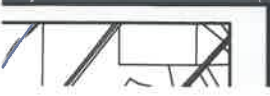


EXISTING BASIN
5.77 AC

W Dry Creek Rd

W Creeksedge Way

Currier Creek



Developed Site Hydrology

The proposed developed site will include approximately 5.77 acres. The developed site will include 34 new single family lots detached cottage units, and approximately 3,098 lineal feet of roadway with associated utilities. The access to the site will enter the property from Dry Creek Road, approximately 1,400' northwest of the intersection of Reecer Creek Road and Dry Creek Road. The developed site is shown in Figure 5.0.

TOTAL

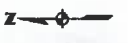


DEVELOPED BASIN
5.77 AC

W Dry Creek Rd

W Creeksedge Way

Currier Creek



Flow Control System

Detention calculations were performed using Stormshed 3G, SBUH methodology. The proposed detention and infiltration facility has been designed in conformance with the Stormwater Management Manual for Eastern Washington to infiltrate and/or retain the storm water runoff from the 2-year, 24-hour design storm event to the 25-year storm event without impairing ground water quality. The stormwater calculations and all supporting documents have been included in Appendix 4-A of this report. For this project the soil types were averaged and determined to be soil class C.

Existing Conditions:

The existing conditions were modeled using pasture. The curve numbers used with the associated land covers are from the Stormwater Management Manual for Eastern Washington. See appendix 4-A for further details of basins.

Existing Basin

CN for Till Pasture = 79

Undisturbed Forest = 5.77 Acres

Peak Flow Rates

2-year 0.025 CFS

25-year 0.112 CFS

Developed Conditions:

The proposed developed conditions include developing 5.77 acres into 34 single-family cottage lots with associated roadway and conveyance systems. The curve numbers used with the associated land covers are from the Stormwater Management Manual for Eastern Washington. Stormwater conveyance pipe will be perforated to infiltrate runoff along the path of stormwater conveyance, and an infiltration facility will be constructed in the southwest portion of the site, located within Tract 999. See appendix 4-A for further details of basins.

Developed Basin

CN for Lawn = 90

Lawn = 2.29 Acres

CN for Impervious = 98

Impervious (Roof, Sidewalks, Roadways) = 3.48 Acres

Peak Flow Rates

2-year 0.646 CFS

25-year 1.446 CFS

Water Quality System

Additional soils testing may be required to determine if the soils present have appropriate characteristics to provide water quality treatment for the site.

Conveyance System

The site drainage system will be analyzed with 25-year return period flows generated using the SBUH methodology. The analysis will be performed using StormShed computer program. The flow analysis is will be completed with the construction documents.

APPENDIX 4-A

**DETENTION FACILITY CALCULATIONS
& SUPPORTING DOCUMENTS**

Infiltration/Retention Facilities

As described previously, the entirety of stormwater runoff is intended to be infiltrated on site. The infiltration/retention facilities for the project site will be comprised of both an infiltration gallery and a perforated infiltration conveyance system. The infiltration gallery is 3' deep with dimensions of 50' wide by 70' long and filled with 40% void space rock. The conveyance system, for the entire project, will be comprised of 12" perforated conveyance pipe, which has been installed in a 3' deep by 3' wide trench and filled with 40% void space rock. Stormwater generated by individual lots will be directed to the perforated pipe conveyance system adjacent to the lots.

Infiltration/Retention Facility

The Infiltration/Retention Facility is located in the southwest corner of the site. Infiltration rates used for design are based on testing conducted by Baer Testing, Inc. A correction factor of 0.5 for long term maintenance and performance was applied for conservatism. The design infiltration rate used for this project is 4.5 inches/hour.

Required Volume 851 CF
 Design Volume* 11,706 CF

Flows, cubic feet per second

	Existing	Allowable Release	Facility Inflow	Facility Outflow
2-year/24 hour	0.025	0.013	0.646	0.000
25-year/24 hour	0.112	0.112	1.446	0.000

Retention Details

	Stage (ft)	Volume Required (cf)	Volume Designed (cf)
2-year/24 hour	0.06	231	234
25-year/24 hour	0.22	851	858

* Calculated at 3.0' Stage Storage Elevation

SBUH Analysis Basin Summary

Predeveloped Basin

Design Method	SBUH	Rainfall type	TYPE1A.RAC
Hyd Intv	10.00 min	Peaking Factor	484.00
Storm Duration	24.00 hrs	Abstraction Coeff	0.20
Pervious Area	5.77 ac	DCIA	0.00 ac
Pervious CN	79.00	DC CN	0.00
Pervious TC	52.2803 min	DC TC	0.00 min

Pervious CN Calc

Description	SubArea	Sub cn
Pasture or range (fair)	5.77 ac	79.00
Pervious Compositied CN (AMC 2)		79.00

Pervious TC Calc

Type	Description	Length	Slope	Coeff	Misc	TT
Sheet	Short prairie grass and lawns.	300.00 ft	2.0%	0.15	2.50 in	26.6955 min
Shallow	Short grass, pasture and lawns (n=0.030)	500.00 ft	1.0%	0.03		7.7879 min
Pervious TC						34.4834 min

Event Summary

BasinID	Event	Peak Q (cfs)	Peak T (hrs)	Peak Vol (ac-cf)	Area (ac)	Method/Loss	Raintype
Predeveloped Basin	2 yr 24 hr	0.0254	24.00	0.0215	5.77	SBUH	TYPE1A.RAC
Predeveloped Basin	25 year	0.112	10.17	0.1473	5.77	SBUH	TYPE1A.RAC

Developed Basin

Design Method	SBUH	Rainfall type	TYPE1A.RAC
Hyd Intv	10.00 min	Peaking Factor	484.00
Storm Duration	24.00 hrs	Abstraction Coeff	0.20
Pervious Area	2.29 ac	DCIA	3.48 ac
Pervious CN	90.00	DC CN	98.00
Pervious TC	20.9086 min	DC TC	8.7746 min

Pervious CN Calc

Description	SubArea	Sub cn
Open spaces, lawns, parks (50-75% grass)	2.29 ac	90.00
Pervious Compositd CN (AMC 2)		90.00

Pervious TC Calc

Type	Description	Length	Slope	Coeff	Misc	TT
Sheet	Short prairie grass and lawns.	100.00 ft	2.0%	0.15	0.00 in	18.4752 min
Int Channel	Concrete pipe (n=0.012)	620.00 ft	1.0%	0.012		2.4334 min
Pervious TC						20.9086 min

DCI - CN Calc

Description	SubArea	Sub cn
Impervious surfaces (pavements, roofs, etc)	3.48 ac	98.00
DC Compositd CN (AMC 2)		98.00

DCI - TC Calc

Type	Description	Length	Slope	Coeff	Misc	TT
Sheet	Smooth Surfaces.	217.00 ft	1.25%	0.011	0.00 in	5.1244 min
Int Channel	Concrete pipe (n=0.012)	930.00 ft	1.0%	0.012		3.6501 min
Pervious TC						8.7746 min

Event Summary

BasinID	Event	Peak Q (cfs)	Peak T (hrs)	Peak Vol (ac-cf)	Area (ac)	Method/Loss	Raintype
Developed Basin	2 yr 24 hr	0.6457	8.00	0.2503	5.77	SBUH	TYPE1A.RAC
Developed Basin	25 year	1.4455	8.00	0.5454	5.77	SBUH	TYPE1A.RAC

Detention Model Summary

Rainfall Intensities for Significant Storm Events:

Event	Precip (in)
2 yr 24 hr	0.90
10 year	1.30
25 year	1.60
100 year	2.10

Storage Facility Definition:

Perforated Conveyance Pipe

Record Id: Trench

Descrip:	Prototype Record	Increment	0.10 ft
Start El.	100.00 ft	Max El.	103.00 ft
Void Ratio	40.00		
Length	2085.00 ft	Width	3.00 ft
		Consider Bottom Only	
Vault Type Node			

Infiltration Gallery

Record Id: Facility

Descrip:	Prototype Record	Increment	0.10 ft
Start El.	100.00 ft	Max El.	103.00 ft
Void Ratio	40.00		
Length	70.00 ft	Width	50.00 ft
		Consider Bottom Only	
Vault Type Node			

Combo

Record Id: Combo

Descrip:	Prototype Record	Increment	0.10 ft
Start El.	100.00 ft	Max El.	103.00 ft
Void Ratio	100.00		
Combination Storage Type Node			

Control Structure Definition:

Orifices (Infiltration)

Record Id: Outlet

Infiltration			
Descrip:	Prototype Structure	Increment	0.10 ft
Start El.	100.00 ft	Max El.	103.00 ft
Infiltration rate	4.50 in/hr	WP Multiplier	1.00

Pond Outflow Summary:

HydID	Peak Q (cfs)	Peak T (hrs)	Peak Vol (ac-ft)	Cont Area (ac)
2 yr 24 hr out	0.6009	8.17	0.2503	5.77
25 year out	1.0161	8.00	0.5454	5.77

Level Pool Routing Results:

Start of live storage: 100.0000 ft

Event	Match Q (cfs)	Peak Q (cfs)	Max Depth (ft)	Vol (cf)	Vol (acft)	Time to Empty (hr)
2 yr 24 hr	0.0127	0.6009	0.0591	230.7648	0.0053	0.1667
25 year	0.112	1.0161	0.218	850.5752	0.0195	0.1667

5.0 SPECIAL REPORTS AND STUDIES

- A Stormwater Operations and Maintenance manual is located in Appendix 5-A.
- The Infiltration Testing Letter for Cottage Grove Residential Development, Kittitas, Washington, completed by Baer Testing, Inc. on June 25th, 2018, is included with this submittal.

APPENDIX 5-A

**STORM DRAINAGE
OPERATION AND MAINTENANCE MANUAL**

Operation and Maintenance

The Storm System will consist of buried pipes, catch basins, infiltration gallery facilities. These facilities will require periodic maintenance and inspection. Inspection and maintenance procedures are contained in the following pages.

NO. 1 - DETENTION PONDS

Maintenance Component	Defect	Conditions When Maintenance Is Needed	Results Expected When Maintenance Is Performed
General	Trash & Debris	Any trash and debris which exceed 1 cubic foot per 1,000 square feet (this is about equal to the amount of trash it would take to fill up one standard size office garbage can). In general, there should be no visual evidence of dumping.	Trash and debris cleared from site.
	Poisonous Vegetation	Any poisonous or nuisance vegetation which may constitute a hazard to County personnel or the public.	No danger of poisonous vegetation where County personnel or the public might normally be. (Coordination with Seattle-King County Health Department)
	Pollution	Oil, gasoline, or other contaminants of one gallon or more or any amount found that could: 1) cause damage to plant, animal, or marine life; 2) constitute a fire hazard; or 3) be flushed downstream during rain storms.	No contaminants present other than a surface film. (Coordination with Seattle/King County Health Department)
	Unmowed Grass/ Ground Cover	If facility is located in private residential area, mowing is needed when grass exceeds 18 inches in height. In other areas, the general policy is to make the pond site match adjacent ground cover and terrain as long as there is no interference with the function of the facility.	When mowing is needed, grass/ground cover should be mowed to 2 inches in height. Mowing of selected higher use areas rather than the entire slope may be acceptable for some situations.
	Rodent Holes	Any evidence of rodent holes if facility is acting as a dam or berm, or any evidence of water piping through dam or berm via rodent holes.	Rodents destroyed and dam or berm repaired. (Coordination with Seattle/King County Health Department)
	Insects	When insects such as wasps and hornets interfere with maintenance activities.	Insects destroyed or removed from site.
	Tree Growth	Tree growth does not allow maintenance access or interferes with maintenance activity (i.e., slope mowing, silt removal, vactoring, or equipment movements). If trees are not interfering with access, leave trees alone.	Trees do not hinder maintenance activities. Selectively cultivate trees such as alders for firewood.
Side Slopes of Pond	Erosion	Eroded damage over 2 inches deep where cause of damage is still present or where there is potential for continued erosion.	Slopes should be stabilized by using appropriate erosion control measure(s); e.g., rock reinforcement, planting of grass, compaction.
Storage Area	Sediment	Accumulated sediment that exceeds 10% of the designed pond depth.	Sediment cleaned out to designed pond shape and depth; pond reseeded if necessary to control erosion.
Pond Dikes	Settlements	Any part of dike which has settled 4 inches lower than the design elevation.	Dike should be built back to the design elevation.
Emergency Overflow/Spillway	Rock Missing	Only one layer of rock exists above native soil in area five square feet or larger, or any exposure of native soil at the top of out flow path of spillway. Rip-rap on inside slopes need not be replaced.	Replace rocks to design standards.

NO. 2 - INFILTRATION

Maintenance Component	Defect	Conditions When Maintenance Is Needed	Results Expected When Maintenance Is Performed
General	Trash & Debris	See "Ponds" Standard No. 1	See "Ponds" Standard No. 1
	Poisonous Vegetation	See "Ponds" Standard No. 1	See "Ponds" Standard No. 1
	Pollution	See "Ponds" Standard No. 1	See "Ponds" Standard No. 1
	Unmowed Grass/ Ground Cover	See "Ponds" Standard No. 1	See "Ponds" Standard No. 1
	Rodent Holes	See "Ponds" Standard No. 1	See "Ponds" Standard No. 1
	Insects	See "Ponds" Standard No. 1	See "Ponds" Standard No. 1
Storage Area	Sediment	A percolation test pit or test of facility indicates facility is only working at 90% of its designed capabilities. If two inches or more sediment is present, remove.	Sediment is removed and/or facility is cleaned so that infiltration system works according to design.
	Sheet Cover (If Applicable)	Sheet cover is visible and has more than three 1/4-inch holes in it.	Sheet cover repaired or replaced.
	Sump Filled with Sediment and Debris (If Applicable)	Any sediment and debris filling vault to 10% of depth from sump bottom to bottom of outlet pipe or obstructing flow into the connector pipe.	Clean out sump to design depth.
Filter Bags	Filled with Sediment and Debris	Sediment and debris fill bag more than 1/2 full.	Replace filter bag or redesign system.
Rock Filters	Sediment and Debris	By visual inspection, little or no water flows through filter during heavy rain storms.	Replace gravel in rock filter.
Side Slopes of Pond	Erosion	See "Ponds" Standard No. 1	See "Ponds" Standard No. 1
Emergency Overflow Spillway	Rock Missing	See "Ponds" Standard No. 1	
Settling Ponds and Vaults	Sediment	Remove when 6" or more.	

Note: Sediment accumulation of more than .25 inches per year may indicate excessive erosion is occurring upstream of the facility or that conveyance systems are not being properly maintained. The contributing drainage area should be checked for erosion problems or inadequate maintenance of conveyance systems if excessive sedimentation is noted in an infiltration facility.

Check twice a year during first 2 years of operation; once a year thereafter. Clean manholes/catch basins, repair damaged inlets/outlets, clean trash racks.

NO. 5 - CATCH BASINS

Maintenance Component	Defect	Conditions When Maintenance is Needed	Results Expected When Maintenance is performed	
General	Trash & Debris (Includes Sediment)	Trash or debris of more than 1/2 cubic foot which is located immediately in front of the catch basin opening or is blocking capacity of the basin by more than 10%	No Trash or debris located immediately in front of catch basin opening.	
		Trash or debris (in the basin) that exceeds 1/3 the depth from the bottom of basin to invert the lowest pipe into or out of the basin.	No trash or debris in the catch basin.	
		Trash or debris in any inlet or outlet pipe blocking more than 1/3 of its height.	Inlet and outlet pipes free of trash or debris.	
		Dead animals or vegetation that could generate odors that could cause complaints or dangerous gases (e.g., methane).	No dead animals or vegetation present within the catch basin.	
		Deposits of garbage exceeding 1 cubic foot in volume	No condition present which would attract or support the breeding of insects or rodents.	
	Structure Damage to Frame and/or Top Slab	Corner of frame extends more than 3/4 inch past curb face into the street (If applicable).	Frame is even with curb.	
		Top slab has holes larger than 2 square inches or cracks wider than 1/4 inch (intent is to make sure all material is running into basin).	Top slab is free of holes and cracks.	
		Frame not sitting flush on top slab, i.e., separation of more than 3/4 inch of the frame from the top slab.	Frame is sitting flush on top slab.	
		Cracks in Basin Walls/ Bottom	Cracks wider than 1/2 inch and longer than 3 feet, any evidence of soil particles entering catch basin through cracks, or maintenance person judges that structure is unsound.	Basin replaced or repaired to design standards.
			Cracks wider than 1/2 inch and longer than 1 foot at the joint of any inlet/ outlet pipe or any evidence of soil particles entering catch basin through cracks.	No cracks more than 1/4 inch wide at the joint of inlet/outlet pipe.
Sediment/ Misalignment	Basin has settled more than 1 inch or has rotated more than 2 inches out of alignment.	Basin replaced or repaired to design standards.		

NO. 5 - CATCH BASINS (CONTINUED)

Maintenance Component	Defect	Conditions When Maintenance is Needed	Results Expected When Maintenance is performed
	Fire Hazard	Presence of chemicals such as natural gas, oil and gasoline.	No flammable chemicals present.
	Vegetation	Vegetation growing across and blocking more than 10% of the basin opening. Vegetation growing in inlet/outlet pipe joints that is more than six inches tall and less than six inches apart.	No vegetation blocking opening to basin. No vegetation or root growth present.
	Pollution	Nonflammable chemicals of more than 1/2 cubic foot per three feet of basin length.	No pollution present other than surface film.
Catch Basin Cover	Cover Not in Place	Cover is missing or only partially in place. Any open catch basin requires maintenance.	Catch basin cover is closed
	Locking Mechanism Not Working	Mechanism cannot be opened by on maintenance person with proper tools. Bolts into frame have less than 1/2 inch of thread.	Mechanism opens with proper tools.
	Cover Difficult to Remove	One maintenance person cannot remove lid after applying 80 lbs. of lift; intent is keep cover from sealing off access to maintenance.	Cover can be removed by one maintenance person.
Ladder	Ladder Rungs Unsafe	Ladder is unsafe due to missing rungs, misalignment, rust, cracks, or sharp edges.	Ladder meets design standards and allows maintenance person safe access.
Metal Grates (If Applicable)		Grate with opening wider than 7/8 inch.	Grate opening meets design standards.
	Trash and Debris	Trash and debris that is blocking more than 20% of grate surface.	Grate free of trash and debris.
	Damaged or Missing.	Grate missing or broken member(s) of the grate.	Grate is in place and meets design standards.

NO. 6 DEBRIS BARRIERS (E.G., TRASH RACKS)

Maintenance Components	Defect	Condition When Maintenance is Needed	Results Expected When Maintenance is Performed.
General	Trash and Debris	Trash or debris that is plugging more than 20% of the openings in the barrier.	Barrier clear to receive capacity flow.
Metal	Damaged/ Missing Bars.	Bars are bent out of shape more than 3 inches.	Bars in place with no bends more than 3/4 inch.
		Bars are missing or entire barrier missing.	Bars in place according to design.
		Bars are loose and rust is causing 50% deterioration to any part of barrier.	Repair or replace barrier to design standards.

NO. 8 - FENCING

Maintenance Components	Defect	Conditions When Maintenance is Needed	Results Expected When Maintenance is Performed
General	Missing or Broken Parts	Any defect in the fence that permits easy entry to a facility.	Parts in place to provide adequate security.
	Erosion	Erosion more than 4 inches high and 12-18 inches wide permitting an opening under a fence.	No opening under the fence that exceeds 4 inches in height.
Wire Fences	Damaged Parts	Post out of plumb more than 6 inches.	Post plumb to within 1-1/2 inches.
		Top rails bent more than 6 inches.	Top rail free of bends greater than 1 inch.
		Any part of fence (including post, top rails, and fabric) more than 1 foot out of design alignment.	Fence is aligned and meets design standards.
		Missing or loose tension wire.	Tension wire in place and holding fabric.
	Missing or loose barbed wire that is sagging more than 2-1/2 inches between posts.	Barbed wire in place with less than 3/4 inch sag between post.	
Deteriorated Paint or Protective Coating	Openings in Fabric	Extension arm missing, broken, or bent out of shape more than 1 1/2 inches.	Extension arm in place with no bends larger than 3/4 inch.
		Part or parts that have a rusting or scaling condition that has affected structural adequacy.	Structurally adequate posts or parts with a uniform protective coating.
		Openings in fabric are such that an 8-inch-diameter ball could fit through.	No openings in fabric.

NO. 9 - GATES

Maintenance Component	Defect	Conditions When Maintenance is Needed	Results Expected When Maintenance is Performed
General	Damaged or Missing Members	Missing gate or locking devices.	Gates and Locking devices in place.
		Broken or missing hinges such that gate cannot be easily opened and closed by a maintenance person.	Hinges intact and lubed. Gate is working freely.
		Gate is out of plumb more than 6 inches and more than 1 foot out of design alignment.	Gate is aligned and vertical.
	Missing stretcher bar, stretcher bands, and ties.	Stretcher bar, bands and ties in place.	
	Openings in Fabric	See "Fencing" Standard No. 8	See "Fencing" Standard No. 8

NO. 10 - CONVEYANCE SYSTEMS (PIPES & DITCHES)

Maintenance Component	Defect	Conditions When Maintenance is Needed	Results Expected When Maintenance is Performed
Pipes	Sediment & Debris	Accumulated sediment that exceeds 20% of the diameter of the pipe.	Pipe cleaned of all sediment and debris.
	Vegetation	Vegetation that reduces free movement of water through pipes.	All vegetation removed so water flows freely through pipes.
	Damaged	Protective coating is damaged; rust is causing more than 50% deterioration to any part of pipe.	Pipe repaired or replaced.
		Any dent that decreases the cross section area of pipe by more than 20%.	Pipe repaired or replaced.
Open Ditches	Trash & Debris	Trash and debris exceeds 1 cubic foot per 1,000 square feet of ditch and slopes.	Trash and debris cleared from ditches.
	Sediment	Accumulated sediment that exceeds 20 % of the design depth.	Ditch cleaned/ flushed of all sediment and debris so that it matches design.
	Vegetation	Vegetation that reduces free movement of water through ditches.	Water flows freely through ditches.
	Erosion Damage to Slopes	See "Ponds" Standard No. 1	See "Ponds" Standard No. 1
	Rock Lining Out of Place or Missing (If Applicable).	Maintenance person can see native soil beneath the rock lining.	Replace rocks to design standards.
Catch Basins		See "Catch Basins" Standard No. 5	See "Catch Basins" Standard No. 5
Debris Barriers (e.g., Trash Rack)		See "Debris Barriers" Standard No.6	See "Debris Barriers" Standard No. 6

NO. 11 - GROUNDS (LANDSCAPING)

Maintenance Component	Defect	Conditions When Maintenance is Needed	Results Expected When Maintenance is Performed
General	Weeds (Nonpoisonous)	Weeds growing in more than 20% of the landscaped area (trees and shrubs only).	Weeds present in less than 5% of the landscaped area.
	Safety Hazard	Any presence of poison ivy or other poisonous vegetation.	No poisonous vegetation present in landscaped area.
	Trash or Litter	Paper, cans, bottles, totaling more than 1 cubic foot within a landscaped area (trees and shrubs only) of 1,000 square feet.	Area clear of litter.
Trees and Shrubs	Damaged	Limbs or parts of trees or shrubs that are split or broken which affect more than 25% of the total foliage of the tree or shrub.	Trees and shrubs with less than 5% of total foliage with split or broken limbs.
		Trees or shrubs that have been blown down or knocked over.	Tree or shrub in place free of injury.
		Trees or shrubs which are not adequately supported or are leaning over, causing exposure of the roots.	Tree or shrub in place and adequately supported; remove any dead or diseased trees.

NO. 12 - ACCESS ROADS/ EASEMENTS

Maintenance Component	Defect	Condition When Maintenance is Needed	Results Expected When Maintenance is Performed
General	Trash and Debris	Trash and debris exceeds 1 cubic foot per 1,000 square feet i.e., trash and debris would fill up one standards size garbage can.	Roadway free of debris which could damage tires.
	Blocked Roadway	Debris which could damage vehicle tires (glass or metal).	Roadway free of debris which could damage tires.
		Any obstruction which reduces clearance above road surface to less than 14 feet.	Roadway overhead clear to 14 feet high.
		Any obstruction restricting the access to a 10 to 12 foot width for a distance of more than 12 feet or any point restricting access to less than a 10 foot width.	Obstruction removed to allow at least a 12 foot access.
Road Surface	Settlement, Potholes, Mush Spots, Ruts	When any surface defect exceeds 6 inches in depth and 6 square feet in area. In general, any surface defect which hinders or prevents maintenance access.	Road surface uniformly smooth with no evidence of settlement, potholes, mush spots, or ruts.
	Vegetation in Road Surface	Weeds growing in the road surface that are more than 6 inches tall and less than 6 inches tall and less than 6 inches apart within a 400-square foot area.	Road surface free of weeds taller than 2 inches.
	Modular Grid Pavement	Build-up of sediment mildly contaminated with petroleum hydrocarbons.	Removal of sediment and disposal in keeping with Health Department recommendations for mildly contaminated soils or catch basin sediments.
Shoulders and Ditches	Erosion Damage	Erosion within 1 foot of the roadway more than 8 inches wide and 6 inches deep.	Shoulder free of erosion and matching the surrounding road.
	Weeds and Brush	Weeds and brush exceed 18 inches in height or hinder maintenance access.	Weeds and brush cut to 2 inches in height or cleared in such a way as to allow maintenance access.