BASELINE HYDROLOGY

FEBRUARY 22, 2019

PREPARED BY

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PREPARED FOR

ARAPAHOE COUNTY
COLORADO'S FIRST

URBAN DRAINAGE AND FLOOD CONTROL DISTRICT

Southeast Metro Stormwater Authority

AURORA

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CHERRY CREEK MINOR TRIBUTARIES

IN ARAPAHOE COUNTY

Major Drainageway Plan

BASELINE HYDROLOGY

February 22, 2019

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February 22, 2019

Ms. Shea Thomas – Manager, Watershed Services
Urban Drainage and Flood Control District
2480 West 26th Avenue, Suite 156-B
Denver, Colorado 80211

Subject: Cherry Creek Minor Tributaries
In Arapahoe County
Major Drainageway Plan Baseline Hydrology
UDFCD Agreement No. 18-08.13

Dewberry | J3 is pleased to submit this Baseline Hydrology Report for Cherry Creek Minor Tributaries in Arapahoe County to the Urban Drainage and Flood Control District, the Southeast Metro Stormwater Authority, and the City of Aurora.

This report provides new or updated hydrology for eleven (11) major basins upstream of Cherry Creek Reservoir, several of which were generally studied in a 1999 OSP by WRC. This phase provides baseline hydrology, and subsequent reports will include flood hazard area mapping, alternatives analysis, and conceptual design. These efforts will result in a Major Drainageway Plan and Flood Hazard Area Delineation. Included within the study area are more than twenty (20) miles of drainageways, which convey stormwater runoff from approximately 4,320 acres. Drivers for this project include providing additional data for unstudied areas, updating data from previously studied areas, quantifying potential impacts caused by limited regional detention, and providing guidance for development that is anticipated with the King's Point Development near 17 Mile Farm House.

The project team at Dewberry | J3 acknowledges and thanks the Urban Drainage Flood Control District, the Southeast Metro Stormwater Authority, the City of Aurora, and Arapahoe County for their assistance and cooperation in the preparation of this study. We look forward to your review, and comments to this report. Thank you for the opportunity to complete this portion of the project.

Sincerely,

Dewberry | J3

Ken S. Cecil, P.E., CFM
Client Manager

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SECTION 1. INTRODUCTION

1.1 AUTHORIZATION

The Urban Drainage and Flood Control District (UDFCD) contracted with Dewberry | J3 for engineering services to complete a Major Drainageway Plan for Cherry Creek Minor Tributaries in Arapahoe County. This report was authorized by the following project sponsors: UDFCD, the Southeast Metro Stormwater Authority (SEMSWA), and the City of Aurora (COA). Arapahoe County (AC) is also involved in this project as a stakeholder. The specific tasks completed during this project were performed in accordance with the Agreement: Contract No. 18-08.13 executed on August 30, 2018.

1.2 PURPOSE AND SCOPE

This report documents the Major Drainageway Plan (MDP) for eleven (11) major basins that are tributary to Cherry Creek. One tributary discharges directly to Cherry Creek Reservoir through Cherry Creek State Park, while another is a left bank tributary to Cottonwood Creek, with its confluence just upstream of Cherry Creek Reservoir. Seven (7) of these tributaries were previously unnamed and are subsequently named herein. The remaining three (3) named tributaries are Chenango Tributary, Joplin Tributary and Valley Club Acres Tributary. Seven (7) tributaries and four (4) DFAs were previously studied in the 1999 Cherry Creek Corridor Reservoir to County Line Outfall Systems Plan by WRC (WRC Engineering, Inc., 1999). This data is approximately twenty (20) years old at the time of this study and does not reflect all revisions to land use. Four (4) notable areas of interest are the undeveloped areas within the watershed of Kragelund Tributary; drainage across the 17 Mile Farm property; the Grove Ranch area and active erosion at the Pioneer Hills Development. Additionally, two (2) existing detention ponds, one (1) on Joplin Tributary and one (1) on North Arapahoe Tributary, are included in this analysis. This project provides new and updated hydrology, flood hazard area mapping, alternatives analysis, and conceptual design for specific improvements that correct any deficiencies that are identified.

The project is comprised of four (4) distinct phases, with each subsequent phase building upon the results of the prior phase. In order, these are Baseline Hydrology, Flood Hazard Area Delineation, Alternatives Analysis, and Conceptual Design.

Objectives for this report include the following:

1. Quantify project hydrology,
2. Quantify magnitude of runoff and associated flood risks,
3. Identify alternatives to address flood hazards and/or conveyance deficiencies, and
4. Provide conceptual design for recommended improvements.

1.3 MAJOR DRAINAGEWAY PLANNING PROCESS

The Cherry Creek Minor Tributaries in Arapahoe County MDP and FHAD was initiated by the sponsoring agencies of UDFCD, SEMSWA, and the COA, with Arapahoe County providing additional input as a project stakeholder. Each is a collaborative participant in the development of this document.

Table 1-1 summarizes the critical decisions made at project progress meetings. All meetings were organized by Dewberry | J3 and meeting invitations were provided electronically to the necessary participants. See **Appendix A** for complete meeting minutes and lists of attendees for reference.

Table 1-1. Summary of Progress Meetings

Progress Meetings	Purpose
September 10, 2018 Project Kickoff Meeting	Identified five (5) additional tributaries to be included with the project and provided the exact project limits. Several areas of interest were identified: undeveloped areas within Kragelund Tributary, drainage across the 17 Mile Farm property, the Grove Ranch area and active erosion within the Pioneer Hills Development. Additionally, existing regional detention ponds were identified at Pond RB1-4 (Joplin Tributary) and near the S. Parker/E. Arapahoe Rd. Interchange (North Arapahoe Tributary).
October 23, 2018 Progress Meeting No. 1	The project schedule was extended to account for the research and addition of five (5) tributaries to the project scope. There are no significant drainage issues that the stakeholders are aware of, other than the areas of interest introduced at the Kickoff Meeting. Future conditions hydrology is required for all basins. Because the southern two (2) basins are undeveloped, the project team will also evaluate existing conditions hydrology for these basins only (Kragelund Tributary and 17 Mile Tributary).

Portions of the project area have been studied in an Outfall Systems Plan that was completed in 1999 (WRC Engineering, Inc., 1999). However, a detailed hydraulic analysis to define the distinct floodplains has not been completed. Therefore, the project stakeholders' primary goals are to confirm the hydrology, define the floodplain and flood risks, and to evaluate alternatives to reduce or eliminate those risks, as necessary. This Major Drainageway Plan makes it possible to evaluate necessary improvements to reduce peak flows and stabilize tributary reaches by implementing detention (if possible), grade control, and water quality facilities. Any proposed improvements will be developed to minimize flooding impacts and reduce the risk to habitable structures and infrastructure.

1.4 MAPPING AND SURVEYS

One-foot contours from 2014 USGS LiDAR data were provided by UDFCD for the Project Area, as well as a structure survey for detailed information at each crossing. Other information such as jurisdictional boundaries, stormwater infrastructure, and roadways were obtained from the COA, SEMSWA, and Arapahoe County. All data is spatially referenced using the *NAD 1983 Colorado State Plane, Central Zone* projected coordinate system and vertical elevations for the contours are referenced using the *NAVD 1988* vertical datum.

1.5 DATA COLLECTION

Background research and data collection were required to conduct the analysis and to develop this Major Drainageway Plan. This included development plans, drainage reports, topographic data, land use data and miscellaneous items. Stakeholders provided much of the topographic and land use data while Dewberry | J3 located the remainder. These sources are identified in **Table 1-2**.

Table 1-2. Collected Data

Source	Date	Description
UDFCD	Sep 25, 2018	One-foot LIDAR contour shapefiles developed by the USGS in 2014.
UDFCD	Nov 5, 2018	Detailed structure surveys by Wilson & Co were provided as AutoCAD electronic files.
City of Aurora & SEMSWA	Nov 27 & Sep 27, 2018	Detailed mapping of stormwater infrastructure was downloaded from the public domain as shapefiles.
Arapahoe County	Nov 27, 2018	Partial land use data, including the 2018 Comprehensive Plan provided as shapefiles. Dewberry | J3 created shapefiles where data was incomplete.
SEMSWA	Sep 27, 2018	Impervious data for incorporated areas within the City of Centennial. Dewberry | J3 created project shape files to describe resultant Land Use.
Arapahoe County & City of Aurora	Nov 27, 2018	Zoning data for some areas. Dewberry | J3 considered these shape files when developing a Land Use layer.
National Land Cover Database	Nov 20, 2018	NLCD raster image with land use categories for entire area. Dewberry | J3 used this information to backcheck the Land Use layer.
City of Aurora	Oct 1, 2018	Digital PDF copies of development plans for the Kings Point Development.
SEMSWA & Arapahoe County	Dec 5, 2018	Development Plans for King's Point, Basin RB1-Pond 4 (RB1-4) Drainage Improvements, and Filings 7,8 & 9 of the Farm at Arapahoe County.
Arapahoe County	Nov 27, 2018	Natural water elements including streams and lakes.

1.6 ACKNOWLEDGEMENTS

Dewberry | J3 wishes to acknowledge the various individuals who assisted in the preparation of this Master Plan and who provided valuable contributions. The following individuals and the agencies they represented are:

Shea Thomas, PE	UDFCD – Watershed Services Manager
Rich Borchardt, PE, CFM	UDFCD – Cherry Creek Watershed Project Manager
Stacey Thompson, CFM	SEMSWA – Group Manager, Floodplain and Master Planning
Angela Howard, PE, CFM, LEED® AP	SEMSWA – Master Plan Coordinator
Cathleen Valencia, PE	Arapahoe County Public Works & Development – Engineer II
Roger Harvey	Arapahoe County – Open Space Planning Administrator
Craig Perl, PE, CFM	City of Aurora – Senior Engineer, Floodplain Administrator
Jonathan Villines, PE, CFM	Aurora Water – Engineer

The following project team members contributed to the preparation of this Master Plan:

Ken Cecil, PE, CFM	Dewberry | J3 – Senior Project Manager / Client Manager
Allie Beikmann, PE	Dewberry | J3 – Project Engineer
Danny Elsner, PE, CFM	Dewberry | J3 – Senior Project Manager
Haley Heinemann, EI	Dewberry | J3 – Staff Engineer
Dana McGlone	Dewberry | J3 – Staff Hydrologist

SECTION 2. STUDY AREA DESCRIPTION

2.1 PROJECT AREA

The project area consists of eleven (11) tributaries upstream of Cherry Creek Reservoir within Arapahoe County (Project Reuse Watershed No. 4600). The watersheds are within the Cities of Aurora, Centennial, and Greenwood Village, the Town of Foxfield, and unincorporated Arapahoe County. A vicinity map is shown in **Figure 2-1,** and **Figure 2-2** provides a detailed Project Area Map that shows the major basins.

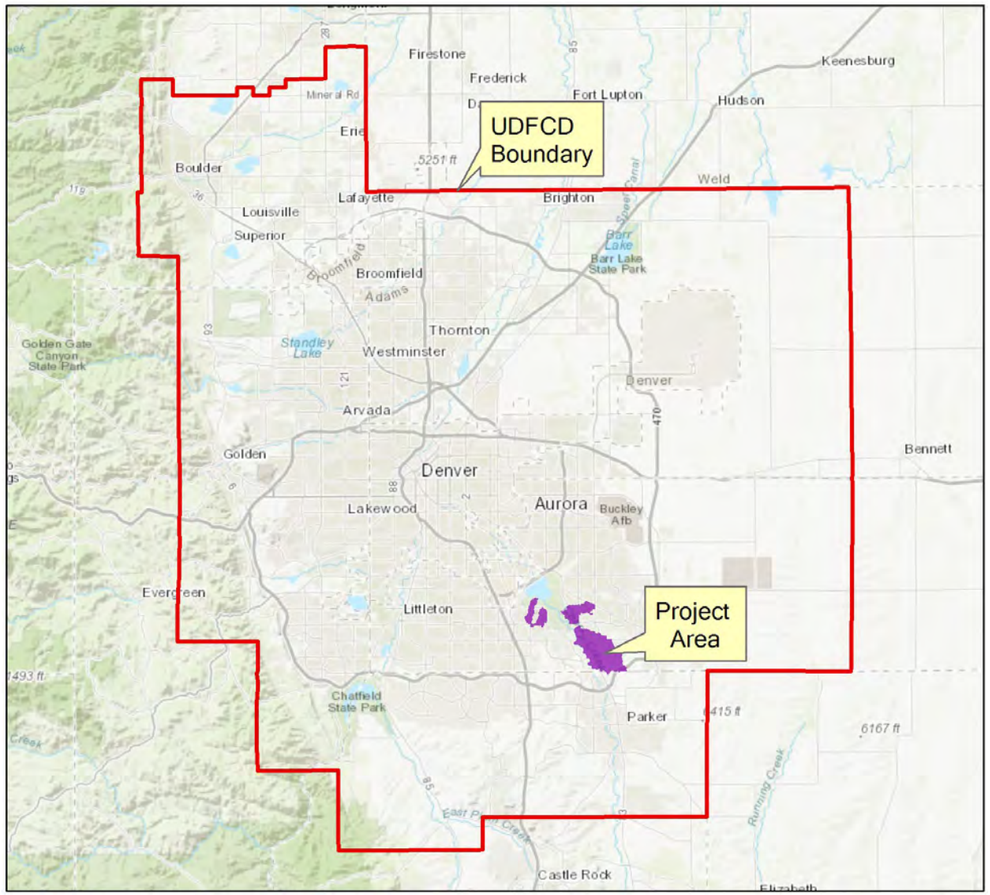


Figure 2-1. Vicinity Map for Cherry Creek Minor Tributaries in Arapahoe County

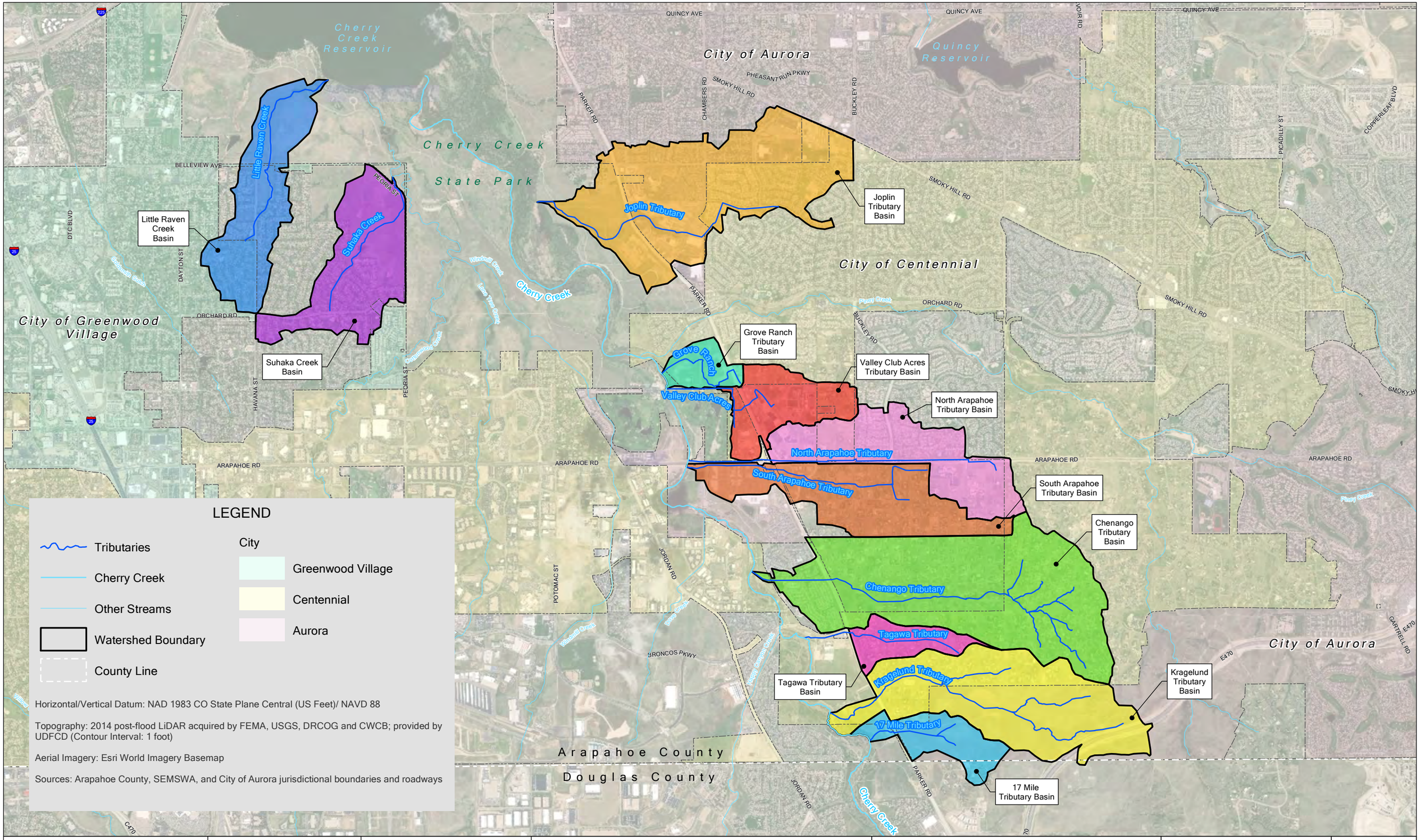
The overall project area is roughly bounded by Cherry Creek Reservoir to the north, S. Dayton St. to the west, S. Himalaya Way to the east, and the county line and E-470 to the south. Eight (8) of the tributaries are bounded by Piney Creek to the north and the county line to the south, and outfall to Cherry Creek. Joplin lies north of Piney Creek, bounded by E. Smoky Hill Rd, and outfalls to Cherry Creek. Two (2) tributaries do not outfall to Cherry Creek: Little Raven Creek and Suhaka Creek. Little Raven Creek outfalls directly to the reservoir and is bounded to the south by E. Orchard Rd. Suhaka Creek outfalls to Cottonwood Creek just upstream of the reservoir, and the basin is bounded to the west by S. Havana St. The total watershed area studied is approximately 6.75 square miles or 4,320 acres.

2.2 TRIBUTARY DESCRIPTIONS

This study analyzes eleven (11) major basins and their associated drainageway, each of which are tributary to Cherry Creek. This section summarizes important watershed characteristics and includes qualitative descriptions of the tributaries and associated basins. General tributary and watershed characteristics are described in **Table 2-1** and **Table 2-2**, and outfall and jurisdictional information is provided in **Table 2-3**.

Table 2-1. Watershed Areas and Tributary Lengths

Tributary	Tributary Length		Watershed Area	
	(ft)	(mi)	(ac)	(mi^2)
Little Raven Creek (LR)	7,700	1.5	349	0.55
Suhaka Creek (S)	6,100	1.2	360	0.56
Joplin Tributary (J)	10,420	2.0	774	1.21
Grove Ranch Tributary (GR)	4,450	0.8	81	0.13
Valley Club Acres Tributary (VCA)	5,350	1.0	207	0.32
North Arapahoe Tributary (NA)	11,220	2.1	372	0.58
South Arapahoe Tributary (SA)	9,400	1.8	396	0.62
Chenango Tributary (C)	13,900	2.6	917	1.43
Tagawa Tributary (T)	5,760	1.1	107	0.17
Kragelund Tributary (K)	12,390	2.3	611	0.95
17 Mile Tributary (17)	3,340	0.6	145	0.23
		TOTAL	**4,319**	**6.75**



LEGEND

- Tributaries
- Cherry Creek
- Other Streams
- Watershed Boundary
- County Line

City

- Greenwood Village
- Centennial
- Aurora

Horizontal/Vertical Datum: NAD 1983 CO State Plane Central (US Feet)/ NAVD 88

Topography: 2014 post-flood LiDAR acquired by FEMA, USGS, DRCOG and CWCB; provided by UDFCD (Contour Interval: 1 foot)

Aerial Imagery: Esri World Imagery Basemap

Sources: Arapahoe County, SEMSWA, and City of Aurora jurisdictional boundaries and roadways

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Designed By: AB
Drawn By: HH
Checked By: KC/DE
Date: 02/2019

N

0 1,500 3,000
Scale in Feet

1 inch = 3,000 feet

URBAN DRAINAGE AND FLOOD CONTROL DISTRICT, SOUTHEAST METRO STORMWATER AUTHORITY, CITY OF AURORA, AND ARAPAHOE COUNTY

CHERRY CREEK MINOR TRIBUTARIES IN ARAPAHOE COUNTY

PROJECT AREA MAP

FIGURE 2-2

Sheet 1 of 1

Table 2-2. Watershed Slopes and Shapes

Tributary	Highest Elevation (ft)	Lowest Elevation (ft)	Average Slope (%)	Watershed Shape	
				Length (ft)	Width (ft)
Little Raven Creek (LR)	5,757	5,552	2.4%	8,630	2,740
Suhaka Creek (S)	5,769	5,565	2.3%	7,480	2,600
Joplin Tributary (J)	5,819	5,579	2.2%	11,400	5,960
Grove Ranch Tributary (GR)	5,695	5,620	1.7%	2,880	1,700
Valley Club Acres Tributary (VCA)	5,804	5,622	2.1%	6,700	3,400
North Arapahoe Tributary (NA)	5,906	5,672	2.3%	8,400	2,000
South Arapahoe Tributary (SA)	5,912	5,633	2.4%	11,600	2,500
Chenango Tributary (C)	6,039	5,658	3.7%	13,100	4,960
Tagawa Tributary (T)	5,889	5,710	3.3%	5,300	1,950
Kragelund Tributary (K)	6,088	5,690	4.1%	9,700	3,400
17 Mile Tributary (17)	5,909	5,695	4.4%	5,530	2,000

Little Raven Creek (LR), previously referred to as North Unnamed Tributary, conveys runoff from an approximately 350-acre basin and is 7,700 feet in length. The tributary is largely controlled by Cherry Creek State Park and is the only tributary, as part of this study, with an immediate outfall into Cherry Creek Reservoir. Regional detention and water quality are not present. Upstream of the reservoir, the tributary crosses under W. Lakeview Rd., which is located within the park and utilizes a partially buried, corrugated metal pipe (CMP) to convey the tributary flow. This pipe is a 36" CMP and partially silted in. Upstream to E. Belleview Ave., the tributary is dominated by dense vegetation, several mono-culture cattail areas, and a pedestrian trail crossing named "Pope Trail". The second road crossing is E. Belleview Ave. which utilizes two (2) reinforced concrete pipes (RCPs), vertically offset by five (5) feet, to convey the tributary flow. Upstream and south of E. Belleview Ave. is a wide storage basin with no outlet controls in place. This area is adjacent to The Hills development and is owned by Cherry Creek State Park. It inadvertently provides detention, however, does not appear to be maintained and thus is not included in evaluation. The tributary continues upstream of Cherry Creek State Park through Bear Park and across S. Havana St. via an elliptical 52" x 32" RCP. Finally, the tributary continues upstream through a small concrete channel adjacent to the Hills West Swimming Pool and on to an open area that collects overland flow.

This tributary basin includes about 93 acres in the City of Greenwood Village and 256 acres in unincorporated Arapahoe County, 133 acres of which is served by SEMSWA. The area not served by SEMSWA is owned by Cherry Creek State Park. The area is fully built out and there are no vacant properties for future development within this basin. Site visits indicate that small reaches within the State Park may present the most significant challenge where active bank erosion is notable. There is at least one (1) exposed utility present, and erosion is occurring in another location along the right bank.

Table 2-3. Watershed Outfalls and Jurisdictions

Tributary	Outfall	Jurisdiction
Little Raven Creek (LR)	Cherry Creek Reservoir	SEMSWA, Unincorporated Arapahoe County, City of Greenwood Village
Suhaka Creek (S)	Cottonwood Creek	SEMSWA, Unincorporated Arapahoe County, City of Greenwood Village
Joplin Tributary (J)	Cherry Creek	SEMSWA, City of Aurora, Unincorporated Arapahoe County
Grove Ranch Tributary (GR)	Cherry Creek	SEMSWA
Valley Club Acres Tributary (VCA)	Cherry Creek	SEMSWA, City of Aurora
North Arapahoe Tributary (NA)	Cherry Creek	SEMSWA, City of Aurora, Town of Foxfield
South Arapahoe Tributary (SA)	Cherry Creek	SEMSWA, City of Aurora, Unincorporated Arapahoe County, Town of Foxfield
Chenango Tributary (C)	Cherry Creek	SEMSWA, City of Aurora, Unincorporated Arapahoe County, Town of Foxfield
Tagawa Tributary (T)	Cherry Creek	SEMSWA
Kragelund Tributary (K)	Cherry Creek	SEMSWA, City of Aurora
17 Mile Tributary (17)	Cherry Creek	SEMSWA, City of Aurora

Suhaka Creek (S) was added to the project scope of work during the Kickoff Meeting since it has not been previously studied. After the Comment Review meeting the name was changed from Tributary to Cottonwood Creek (TC) to Suhaka Creek, as described in the meeting minutes. The tributary is a left bank tributary to Cottonwood Creek, which discharges to Cherry Creek Reservoir. The drainageway conveys runoff from approximately 360 acres of single-family development with open space at the downstream reaches. The major stormwater conveyance system is comprised of open channel flow that begins upstream near E. Orchard Rd. Further downstream, it crosses Cherry Creek Dr. with two (2) 48" RCPs. After this point, the tributary flows through a stock pond that is contained on the downstream end by a berm and an elevated broad-crested weir, and is subsequently conveyed as sheet flow to S. Peoria St. Runoff ponds behind a small inlet structure with an orifice plate and overflow grate and upon entering the structure, flows under S. Peoria St. via two (2) 12" RCP pipes. Flow then continues through a natural earthen channel to Cottonwood Creek.

Most of the watershed lies in unincorporated Arapahoe County with a small 9-acre area located in Greenwood Village near Lake Ct. Approximately 193 acres of this area is served by SEMSWA and the area not served by SEMSWA is owned by Cherry Creek State Park. Challenges include erosion upstream of the stock pond, poorly defined hydraulics from the stock pond to the outfall and lack of ponds that provide water quality or extended detention.

Joplin Tributary (J) is a large tributary to Cherry Creek and is approximately 9,700 feet in length. The downstream half of the tributary runs through Cherry Creek State Park where it crosses multiple park trails, and the other half upstream of S. Parker Rd. conveys runoff from dense, mixed-use developments comprised of commercial big box stores and single- and multi-family developments in the Cities of Aurora and Centennial. The drainageway conveys runoff from 775 acres with 600 acres in the upstream portion. Runoff crosses S. Parker Rd. via two (2) 14'x4' reinforced concrete box culverts. Construction is underway at Pioneer Hills Development from the crossing at S. Parker Rd. upstream to S. Chambers Rd. This reach is dominated by wetlands and retains a cross-section showing where the floodplain connects to the overbank areas. This section has challenges including severe right bank erosion encroaching on the adjacent multi-family development, a severe channel bend, and a complex outlet structure near S. Chambers Rd. Private water quality and detention ponds are located along the banks for Pioneer Hills and adjacent shopping centers. Upstream of S. Chambers Rd., runoff is conveyed along connected property lines between S. Granby Way and Home Depot.

Upstream of this, a City of Aurora 72" and a parallel City of Centennial 36" storm sewer is aligned for approximately 550 feet at the rear lot lines of adjoining single-family residences. The storm sewers are contained within a 40' easement with 20' on the City of Aurora side and 20' on the City of Centennial side. Upstream of the piped section at S. Joplin Way, the tributary daylights at Pond RB1-4 which is owned and maintained by SEMSWA. The pond is described in the as-built drawings for The Summit at Piney Creek development and appears to be in good condition, with a boulder-lined trickle channel and other appurtenances. A pre-sedimentation forebay and micro-pool are not present. The as-built drawings indicate a maintenance path was constructed, however it was not visible during the site visit. Upstream from the pond, the tributary is contained in a 72" RCP.

The Joplin watershed combines a 360-acre area in the City of Aurora, a 218- acre area in the City of Centennial, and a 198-acre area in unincorporated Arapahoe County. SEMSWA serves the City of Centennial area and approximately 59 acres of unincorporated Arapahoe County. Subbasin J1 and parts of Subbasins J2, J3, and J4 near S. Parker Rd. are not served by SEMSWA. Challenges along Joplin Tributary include a lack of regional detention or water quality within the lower basin, some streambank erosion, stream maintenance, complex hydraulic conditions with possibly undersized elements, and potentially cumbersome easement issues should the parallel storm system need improvement.

Grove Ranch Tributary (GR) was added to the project scope of work during the Kickoff Meeting due to anticipated redevelopment and it is named in reference to the Grove Family properties within the watershed. It is the smallest watershed studied at 80 acres and less than a mile in basin length. The land use is defined by mixed-use and commercial development in the downstream basin and single-family residential development in the upstream basin. Runoff is conveyed across S. Parker Rd. by a 36" CMP and is conveyed from open channel to Cherry Creek via 36" RCP.

The Grove Ranch watershed is served entirely by SEMSWA, with 77 acres located in the City of Centennial and 4 acres within unincorporated Arapahoe County. Challenges include poorly defined open channel hydraulics in the vicinity of the Fellowship Community Church, pooling wetlands upstream of pipe conveyance to Cherry Creek, and lack of ponds that provide water quality or extended detention.

Valley Club Acres Tributary (VCA) drains a tributary area of approximately 210 acres. The tributary is predominantly contained in storm sewer, with only 600 feet of open channel at the downstream confluence with Cherry Creek. The entire open channel reach is encumbered by the regulatory floodplain of Cherry Creek, as are approximately 1,500 feet of the upstream storm sewer. System capacity will need to be evaluated with this constraint in mind. This tributary is the outfall for part of the Arapahoe Crossing Development and adjoining areas. Lower portions of the storm sewer in and around the Valley Country Club Golf Course transition from 8' x 3' RCBC to 66" RCP and then back to 8' x 3' RCBC.

The VCA area is composed of 110 acres in the City of Centennial, 91 acres in the City of Aurora, and 6 acres in unincorporated Arapahoe County. SEMSWA serves the areas in the City of Centennial and unincorporated Arapahoe County. Challenges include crowns not matching at pipe transitions mentioned in the previous paragraph and potentially undersized piping. If capacity is determined to be insufficient, alternatives will be complicated by multiple utilities including crossing and parallel sanitary lines, water lines, and golf course irrigation.

North Arapahoe Tributary (NA) was added to the project scope of work during the Kickoff Meeting to help address flows to Cherry Creek adjacent to E. Arapahoe Rd. Runoff from North Arapahoe watershed east of S. Buckley Rd. is conveyed in storm sewer and through a SEMSWA owned and maintained regional detention pond referred to herein as the North Arapahoe (NA) Pond. This pond is also referred to as Pond E by SEMSWA and is located in Tract A of Filing No. 9 for The Farm in Arapahoe County (P.R. Fletcher & Associates, Inc., 2000). Further downstream, runoff is conveyed under S. Parker Rd. in a 48" concrete pipe before discharging directly to Cherry Creek. The upper-most part of this watershed is located south of E. Arapahoe Rd. in the Town of Foxfield and drains to a downstream manhole that joins outflow from NA pond.

The North Arapahoe watershed combines a 372-acre area, 206 acres of which are served by SEMSWA, 114 acres by the Town of Foxfield, and 51 acres by the City of Aurora. Challenges include NA Pond hydraulics due to discrepancies between LiDAR contours and as-built records, complex hydraulics at the S. Parker and E. Arapahoe Rd. interchange and upstream, and potentially undersized conveyance in downstream areas.

South Arapahoe Tributary (SA) was also added to the project scope of work during the Kickoff Meeting to help address flows to Cherry Creek along E. Arapahoe Rd. Runoff is discharged by a 12' x 6' RCBC that was designed to convey 645 cfs from the previously planned Southeast Regional Detention Basin. Research indicates that the Foxfield Outfall from the E. Arapahoe/S. Parker Interchange Water Quality Pond became UDFCD maintenance eligible in January 2014. However, the downstream detention component of this pond is not publicly owned and maintained, or maintenance eligible, and so it is not included in project hydrology.

The SA watershed combines a 317-acre area in the Town of Foxfield, a 70-acre area in the City of Aurora, a 4.5-acre area in unincorporated Arapahoe County, and a 4-acre area in the City of Centennial. SEMSWA provides service to the City of Centennial area and 3 acres of unincorporated Arapahoe County. A small area near S. Parker Rd. in Subbasin SA2, an area of 1.5 acres, is not currently served by SEMSWA. Challenges include complex hydraulics at the S. Parker and E. Arapahoe interchange, WQ detention only and no regional detention, and potential bank instability in the downstream channel to the outfall.

Chenango Tributary (C) is the largest watershed and conveys runoff from 920 acres to Cherry Creek through the Cherry Creek Valley Ecological Park from the Chenango Development, which is a single-family large lot rural development that is fully built out. There are direct outfalls from the Landing at Cherry Creek development with no apparent water quality or detention. Red Hawk Ridge Elementary School provides some level of stormwater management. Regional detention and water quality do not exist along Chenango Tributary. Both developments discharge along a grouted sloping boulder drop structure and moderate infrastructure is located along portions of this tributary, predominantly in the downstream reaches. A sloped/tapered throat 10' x 5' RCBC crosses Cherokee Trail, and upstream a CDOT 3-barrel 12' x 6' RCBC with baffle chute drop structure crosses S. Parker Rd. The condition of these structures is good.

Upstream from S. Parker Rd., drainage infrastructure is more rural in design. At E. Hinsdale Way, a 54" CMP has incorporated a gated section at the outlet, presumably to function as fencing for the private property through which it passes. Seven (7) additional public road crossings and six (6) private drive crossings, some of which are bridges, are located upstream to the basin headwaters.

The Chenango watershed combines a 450-acre area in the City of Centennial, a 376-acre area in the Town of Foxfield, and a 90-acre area in unincorporated Arapahoe County. SEMSWA serves the areas in the City of Centennial and unincorporated Arapahoe County. Noted challenges that are present in this basin include no regional detention or water quality, a poorly defined or potentially undersized conveyance, a multi-split flow at the intersection of S. Richfield St. and E. Hinsdale Ave.; significant head cutting at S. Yampa St. with exposed twin 30" CMP and floating inverts due to erosion; widespread wetlands; at least one (1) manmade impoundment with rusted and partially buried CMP; bank instability in the upper reaches; and numerous roadside ditches with timber grade control. The main tributary measures more than two (2) miles in length with multiple left and right bank tributaries that measure another 1.5 miles in length.

Tagawa Tributary (T) was added to the project scope of work during the Kickoff Meeting as a direct flow area (DFA) to help address flows across S. Parker Rd. near Chenango and Kragelund Tributaries and was added as the eleventh (11^{th}) Tributary after removal of the remaining DFAs. Tagawa was named as a part of this study and has an area of approximately 107 acres. The tributary outfalls directly to Cherry Creek and is located to the south of Chenango Tributary and north of Kragelund Tributary. The crossing at S. Parker Rd. is located on the south side of E. Broncos Pkwy. The SEMSWA GIS data for stormwater mains indicates that the crossing is two (2) 42" pipes: one (1) CMP and one (1) RCP and both are noted to be in good condition. These pipes are also shown in the 1999 OSP (WRC Engineering, Inc., 1999). The area modeled is the portion east of S. Parker Rd. as this area will flow through the crossing at S. Parker Rd. and downstream 48" RCP piping to the Cherry Creek outfall.

The Tagawa watershed is entirely contained in the City of Centennial, which is served by SEMSWA. Challenges for Tagawa Tributary include poorly defined hydraulics upstream of S. Parker Rd., potentially undersized piping west of S. Parker Rd., and lack of ponds that provide water quality or extended detention.

Kragelund Tributary (K) conveys runoff from approximately 610 acres of mostly undeveloped land and provides the best opportunity for floodplain preservation. Before the Comment Review meeting Kragelund was referred to as South Unnamed Tributary, as described in the meeting minutes. Future development is anticipated from the headwaters near E-470 and King's Point, through privately owned property currently managed by the Vermillion Creek Metropolitan District, to the confluence with Cherry Creek within the PJCOS. There is currently no drainage easement across this property. Minimal infrastructure is present with the most prominent feature being a CDOT 22' x 8' RCBC crossing of S. Parker Rd. upstream of which, possibilities exist for regional detention and water quality. For approximately 2,800 feet upstream of S. Parker Rd., the floodplain is wide with no defined main channel. At this point, moderate channel definition begins, and it splits into a right stem (2,600 feet long) that drains southern portions of the existing Chenango development, and a left stem that proceeds towards the headwaters where it intersects a second right bank tributary (3,200 feet long). The majority of Kragelund Tributary is devoid of wetlands.

Kragelund watershed combines a 343-acre area in the City of Aurora, a 259 acre-area in the City of Centennial, and 7-acre area in unincorporated Arapahoe County. SEMSWA serves the areas in the City of Centennial and unincorporated Arapahoe County. Challenges for Kragelund Tributary include upstream erosion near E-470, lack of ponds that provide water quality or extended detention, and undefined conveyance to Cherry Creek.

The **17 Mile Tributary (17)** was added to the project scope of work during the Kickoff Meeting to help address flows across the 17 Mile House Farm Park. It is the most southern tributary of this study and is located just north of the Arapahoe County / Douglas County border. This poorly defined tributary drains approximately 145 acres, and is bisected by S. Parker Rd. through which, two (2) 48" RCP conveys runoff. This watershed is also largely undeveloped upstream of S. Parker Rd. but is expected to be fully built-out following development of King's Point.

17 Mile watershed combines a 97-acre area in the City of Aurora, a 17 acre-area in the City of Centennial, and 15-acre area in unincorporated Arapahoe County. SEMSWA serves the areas in the City of Centennial and unincorporated Arapahoe County. Challenges include poorly defined hydraulics from S. Parker Rd. to Cherry Creek and lack of ponds that provide water quality or extended detention.

2.3 LAND USE

Due to the built-out nature of the studied basins, future land use hydrology is considered equal to existing for all basins except two (2): 17 Mile and Kragelund Tributary, where large swaths of undeveloped area still exist. As a result, existing conditions land use and hydrology in this study were developed for 17 and K only.

Most of the existing development in the Project Area consists of residential land use. Small pockets of office, commercial, and industrial developments are also present, primarily along the major local thoroughfares such as S. Parker Rd., E. Smoky Hill Rd., and E. Arapahoe Rd. Large portions of Little Raven Creek, Suhaka Creek and Joplin Tributary basins are located within the Cherry Creek State Park. The proposed King's Point Subdivision is anticipated to build out the remaining undeveloped area within the 17 Mile and Kragelund Tributary basins east of S. Parker Rd. sometime in the near future.

Land use for existing and future conditions was evaluated based on several pieces of data, referenced in **Table 1-2**. At the start of the project, Arapahoe County and SEMSWA provided future land use GIS data for areas of unincorporated Arapahoe County from the 2018 Comprehensive Plan and PDF maps of the Centennial NEXT Plan. Other data from the County's GIS portal are used to identify land use, including zoning, parks and open space, parcels, and lakes. Additional zoning data from the City of Aurora, the City of Centennial, and Douglas County is used to categorize land use in these areas. The spatial location of the two (2) modeled regional detention pond, Pond RB1-4 in Joplin Watershed and NA Pond (Pond E) in North Arapahoe Watershed, are from SEMSWA's detention pond data. And finally, the extents for S. Parker Rd. and E. Arapahoe Rd. were digitized by hand to include street imperviousness for these major roads. **Figure B-2** depicts the sources used to develop land use by location, as well as original Arapahoe County land use designations and original City of Aurora Zoning data.

To determine appropriate percent imperviousness values, the collected land use categories were converted to UDFCD land use types and corresponding imperviousness values using *Table 6-3 Recommended Percentage Imperviousness Values* in the UDFCD Criteria Manual Volume 1, which are included in **Table 2-4** for reference (Urban Drainage and Flood Control District, 2016). Composite imperviousness values calculated for each subwatershed are listed in Table B-2 in Appendix B for the existing and future conditions hydrology and maps showing the existing and future land use are shown in Figure B-1 as the *Existing Land Use Map* and the *Future Land Use Map* layers.

Table 2-4. Land Use Categories and Imperviousness

Land Use	Imperviousness (%)
Apartments	75%
Business, Suburban	75%
Industrial, light	80%
Open Water	100%
Parks, cemeteries	10%
SF, 0.25 acres or less	45%
SF, 0.25-0.75 acres	30%
SF, 0.75-2.5 acres	20%
SF, 2.5 acres or larger	12%
Schools	55%
Streets	100%
Undeveloped Areas	2%

Imperviousness data that covers areas such as sidewalks, roofs, and roads was also made available for the City of Aurora and SEMSWA service area as a check for land use correlated imperviousness values. It was decided between stakeholders that imperviousness values from this data instead of land use data may be used during the alternatives analysis for select locations if UDFCD agrees. Also, it may be noted that land use data from the National Land Coverage Database (NLCD) was used early in the study to verify the results using UDFCD land use and values were similar.

While determining land use and corresponding imperviousness values for the studied watersheds, several specific areas were identified and discussed by stakeholders to agree on some assumptions. First, S. Parker Rd. is planned to be expanded to six (6) lanes in the future. This change is not considered as part of this study since S. Parker Rd., in addition to lakes, detention basins, and E. Arapahoe Rd., is included as a 100% imperviousness land use area and this is a conservative assumption. Land use areas are typically assumed to include adjacent roads and minor water bodies or anomalies. Second, development of the developable portion of 17 Mile Farm House is neglected since this area is only 1.8 acres in area and the parcel has a conservative existing land use of single-family 2.5 acres or larger, even though most of the area is undeveloped.

2.4 REACH DESCRIPTION – N/A

This section will be further developed with subsequent submittals of the report. At this time, existing structures are noted that impact hydraulic routing. At each roadway crossing, a detailed survey of existing conveyance structures within the Project Area was provided by UDFCD. Included with the survey were site photos, sketches of the entrance and outlet, detailed characteristics of the culvert's shape, size, length, inverts, overtopping elevations, and headwall/wingwall end treatments (if applicable). Table 2-5 summarizes the inventory of the existing infrastructure.

2.5 FLOOD HISTORY

This Master Plan lies within the FEMA Flood Insurance Rate Maps for Arapahoe County, Map Number 08005C, map panels 0476L, 0477L, 0181K, 0481L, and 0484L revised February 17, 2017, and Map Number 08005C, map panel 0483K revised December 17, 2010. Based on the FIRM panels, the floodplain is not mapped for any of the project tributaries. The project sponsors did not provide any evidence of noteworthy flooding, nor was statistical or anecdotal flood history available during the preparation of this Master Plan.

2.6 ENVIRONMENTAL ASSESSMENT – N/A

Table 2-5. Inventory of Existing Structures

Tributary	Description	Road Crossing / Type
Little Raven Creek (LR)	54" RCP and 48" x 66" Box Culvert	E. Belleview Ave.
	Wooden pedestrian bridge	Cherry Creek State Park
	Culvert Crossings	Lakeview Rd., pedestrian trails and bike paths
Suhaka Creek (S)	(2x) 60" RCP	Cherry Creek Dr.
Joplin Tributary (J)	(2x) 14'x4' Box Culverts	S. Parker Rd.
	Elevated Pipe Crossing	S. Parker Rd.
	RB1 Pond 4 / Powers Pond	S. Joplin Way and S. Chambers Rd.
	Drop Structures	S. Chambers Rd. near Bed Bath and Beyond
	Culvert Crossings	Dirt pedestrian trail
Grove Ranch Tributary (GR)	None	
Valley Club Acres (VCA) Tributary	Inlet Structure	S. Helena St.
North Arapahoe Tributary (NA)	None	
South Arapahoe Tributary (SA)	144" X 72" Box Culvert	Along E. Arapahoe Rd. from outfall to S. Parker Rd.
	WQ Pond and Outlet Structure	S. Lewiston St.
	Culvert Crossings	Across and/or along Richfield St., Pitkin St., Buckley Rd., S. Parker Rd., and private roads.
Chenango Tributary (C)	4' x 2' RC Box	Cherry Creek Trail
	Grouted boulder drop structures	Red Hawk Elementary School
	10' x 5' Box Culvert	Cherokee Trail
	(3x) 132" x 172" Box Culverts	S. Parker Rd.
	Culvert Crossings	Across and/or along Yampa St., Hinsdale Ave., Telluride Ct., Richfield St., and private drives
Kragelund Tributary (K)	22' x 8' Box Culvert	Crossing S. Parker Rd. at Kragelund Acres
17 Mile (17)	(2x) 48" RCP	S. Parker Rd.
	(2x) 48" RCP	Driveway at 17 Mile House

SECTION 3. HYDROLOGIC ANALYSIS

3.1 OVERVIEW

The hydrologic analysis presented herein was developed independent of the 1999 OSP and no existing model input files were recreated or available for use. Basins were delineated using one-foot LiDAR data described in Section 1.4 MAPPING AND SURVEYS. Shapefiles for notable infrastructure such as road networks and storm conveyance systems were also used to logically subdivide major basins at points of interest. The analysis identifies drainage patterns and runoff characteristics for the following nine (9) storm events: the 1-, 2-, 5-, 10-, 25-, 50-, 100-, 500-year and water quality (WQ) storm events. Land use was analyzed for existing and future conditions and the resultant hydrology is the foundation for the subsequent evaluation of drainage facilities and the systemwide level of service.

The Colorado Urban Hydrograph Procedure program (CUHP) 2016 version 2.0.0 was used to develop runoff hydrographs which were then routed using the EPA Storm Water Management Model (EPA SWMM) version 5.1 to account for the effects of storm sewer, stream reaches, and detention on lag and time to peak. Input data for CUHP is subwatershed specific and includes rainfall depth, watershed area, distance to centroid, length of flow path, slope, composite imperviousness, and depression storage and soil infiltration rates. This data was obtained through GIS analysis and project research to accurately model individual sub-basin conditions. Values are in accordance with recommendations provided by the UDFCD and CUHP manuals.

The baseline project hydrology for this Master Plan utilizes the future land use conditions model and the subsequent sections provide a summary of the information utilized to quantify the peak runoff values. The summary includes design rainfall, sub-watershed characteristics, hydrograph routing and the results of the analysis.

3.2 DESIGN RAINFALL

Design rainfall depths for the for the 1-, 2-, 5-, 10-, 25-, 50-, 100- and 500-year storm events were obtained from the National Oceanic and Atmospheric Administration (NOAA) Atlas 14 (Volume 8, Version 2) Point Precipitation Frequency Estimates. Specifically, the 1-hour and 6-hour recurrence interval rainfall depths were utilized as direct inputs into the CUHP rain gage data. The WQ event is pre-defined, according to the CUHP manual, to be a 0.6 in. rainfall event for the 1-hour duration recurrence interval. None of the project basins exceed ten square miles and therefore no area adjustments to rainfall were required. This study is analyzing the WQ event and the 1-year storm event as part of a UDFCD effort to assess WQ and bankfull conditions in the alternatives phase. **Table 3-1** summarizes the 1-hour and 6-hour rainfall depths, and the rainfall distributions developed by CUHP are in **Appendix B** as **Table B-1**.

Table 3-1. Point Rainfall

	Rainfall Depth (in)	
Recurrence Interval	1-Hour	6-Hour
1	0.721	1.19
2	0.868	1.39
5	1.13	1.77
10	1.37	2.13
25	1.73	2.67
50	2.03	3.13
100	2.36	3.63
500	3.21	4.96

3.3 SUBWATERSHED CHARACTERISTICS

3.3.1 SUBWATERSHED DELINEATION

The eleven (11) tributary basins are comprised of forty-four (44) subwatersheds. Each is shown on the subwatershed layer with the Baseline Hydrology Map in **Figure B-1**. The sub-basin sizes range from 21.8 to 140.0 acres, with the average value being 99.0 acres. The major basin boundary for each tributary was verified by evaluating LiDAR data, stormwater infrastructure, roadways, and field reconnaissance. Additional review of approved Drainage Reports, Construction Drawings, and As-Built Drawings within the Project Area further informed the development of the models. Where there is overlap, the basin delineation is reasonably comparable to the 1999 OSP. However, the sub-basin naming convention is fully independent and conforms to the tributary in which they are located, as follows:

Little Raven Creek: LR1 – LR3

Suhaka Creek: S1 – S3

Joplin Tributary: J1 – J8

Grove Ranch Tributary: GR1

Valley Club Acres Tributary: VCA1 – VCA2

North Arapahoe Tributary: NA1 – NA4

South Arapahoe Tributary: SA1 – SA4

Chenango Tributary: C1 – C9

Kragelund Tributary: K1 – K7

17 Mile Tributary: 17A – 17B

Reference the *Subwatershed Boundaries Map* layer of the Baseline Hydrology Map in **Figure B-1** for the locations and delineations of the CUHP sub-basins.

Numerous physical characteristics associated with each subwatershed are used to produce a storm runoff hydrograph for each subwatershed in CUHP. The hydrograph outputs from CUHP are saved in a tabular format to a text file that is then used as the Inflow file for SWMM. These hydrographs represent the overland flow for each subwatershed which are represented as nodes in SWMM. The CUHP input parameters that define the hydrograph for each subwatershed include the following and are further detailed in **Table B-2** located in **Appendix B**.

Drainage area (acres)

Length and Distance to Centroid (ft)

Watershed Slope (ft/ft)

Composite Imperviousness (%)

Horton's Soil Infiltration Rates

Depression Losses/Retention Storage Values

3.3.2 WATERSHED IMPERVIOUSNESS

Watershed imperviousness was determined using land use maps, zoning data, and aerial imagery. Most of the tributary watersheds are almost fully developed; therefore, the watershed imperviousness developed for nine (9) of the basins is considered future conditions (i.e. existing conditions = future conditions). The weighted average future percent imperviousness for all the studied basins is 33%. Existing watershed imperviousness was evaluated for the 17 Mile Tributary and the Kragelund Tributary only, since these basins are largely undeveloped at the time of this study. The weighted average existing percent imperviousness for each basin is 8% and 14%, respectively. King's Point, a planned development in the area, is anticipated to build out these basins east of S. Parker Rd. in the near future; the associated increase in imperviousness to 36% and 35% is reflected in the future conditions hydrology. For further description regarding how land use was used to determine subwatershed imperviousness, refer to Section 2.2 LAND USE.

3.3.3 NRCS SOIL INFORMATION

Soil conditions for each subwatershed were used as CUHP inputs to determine the infiltration rates based on Horton's Equation. Data for soils was collected from the National Resources Conservation Service (NRCS) Web Soil Survey (USDA, 2018) and corresponding hydrology soil groups (HSG) were determined for each soil type. The four (4) HSG types are A, B, C and D, with Type A having the highest infiltration rate and thus lowest runoff potential, and Type D have very low infiltration rates and high runoff potential. Soils in the overall Project Area are classified as: 11.8% Type A, 44.9% Type B, 20.6% Type C, and 22.7% Type D. HSG types and corresponding Horton values, including initial and final infiltration rates (in/hr) and decay coefficients (s^{-1}), were taken from *Table 6-7 Recommended Horton's equation parameters* in the UDFCD Criteria Manual Volume 1. To determine composite Horton's parameters for each subcatchment for CUHP determination of infiltration rates, an area-weighted average was used. Refer to **Table B-2** in **Appendix B** for a summary of the resultant Horton's parameters and the Soils Map layer in **Figure B-1** for a map of the hydrologic soil groups. For Baseline Hydrographs, refer to **Figure B-4** in **Appendix B.**

3.4 DETENTION

Two (2) regional detention facilities are included in the baseline hydrology EPA SWMM model: Pond RB1-4 on Joplin Tributary and North Arapahoe (NA) Pond on the North Arapahoe Tributary. North Arapahoe Pond serves the developments from Farm Filing No. 7, 8 & 9 where it is referred to as "Pond E". Both are publicly-owned and UDFCD maintenance-eligible and are herein referred to as Pond RB1-4 and NA Pond. Detention rating curves for both were sourced from engineering reports, record drawings, and survey data that are on file with the project sponsors.

Pond RB1-4, which is owned and maintained by SEMSWA, is an on-line pond located on Joplin Tributary between E. Crestline Ave. and S. Joplin Way. The detention rating curves were developed from a stage-storage-discharge table located in the as-built drawings prepared for East Cherry Creek Valley (ECCV) Water and Sanitation District on April 28, 1994 (Muller Engineering Co., Inc., 1994). The as-built data is assumed to be correct and supersedes data presented in the approved drainage report "Cherry Creek Basin RB1 Drainage Improvements" dated November 1989 (Muller Engineering Co., Inc., 1989). The as-built stage-storage curve was back-checked using 2014 LiDAR one-foot contours; the final stage-storage curve incorporates additional data points from the 2014 LiDAR and the same total storage volume as the 1994 as-builts. Refer to **Table B-3** in **Appendix B** for the Pond RB1-4 stage-storage-discharge curves.

NA Pond, also owned and maintained by SEMSWA, is not located on the main stem of the NA Tributary, however, sits on-line a tributary of North Arapahoe and serves Filings No. 7, 8 & 9 of the Farm at Arapahoe County. Detention rating curves were originally obtained from as-built drawings prepared on May 4, 2000 (Aztec Consultants & P.R. Fletcher & Associates, Inc., 2000) and the Phase III Drainage Erosion & Sedimentation Control Report dated 15, 1999 (P.R. Fletcher & Associates, Inc., 1999). However, it was noted that the 2014 LiDAR indicated that the total storage volume quoted in the as-builts was larger than physically feasible. Therefore, new stage-storage-discharge curves were calculated using survey data collected by the UDFCD in February 2019. The new storage volume was calculated from the survey using the average-end area method and totaled 4.9 acre-feet as compared to the 2000/1999 volume of 11.1 acre-feet, at an elevation of 5772 feet (approximate top of berm). The UD-Detention spreadsheet (Version 3.07, Released February 2017) was used to estimate a new stage-discharge curve according to the surveyed outlet configuration. See **Table B-3** in **Appendix B** for the NA Pond stage-storage-discharge curves and calculations.

Neither of the two (2) detention facilities was designed to detain the 500-year flow; therefore, additional points were added in the EPA SWMM model to both the stage-storage and stage-discharge curves, which minimally modifies the total storage volume but allows the 500-year maximum flows to pass without flooding model nodes.

3.5 HYDROGRAPH ROUTING

Hydrograph routing for each subwatershed through the Cherry Creek Minor Tributary basins was modeled using EPA SWMM 5.1 and the Kinematic Wave routing method. The routing scheme described in this section applies to both existing and future conditions, as no changes to hydrologic routing is anticipated. Refer to the *Baseline Hydrology SWMM Routing Map* layer in **Figure B-1** and **Figure B-3** SWMM Routing Schematic in **Appendix B** for a visual representation of the routing scheme. Summarized input and output files from EPA SWMM are included in **Table B-5** and **Table B-6**.

Each subwatershed is represented in EPA SWMM by a junction node with an invert elevation reflecting the lowest point in the subwatershed. Overland flow within each basin is routed via a conduit link labeled “SUB_OF” and contains no geometry or physical information additional to that reflected in the hydrograph output produced by CUHP. Design points are represented by junction nodes and contain the invert elevation found at that location, and these elevations dictate the slope of any attached link that represents open channel, stormwater sewer, or overflow conveyance elements. These links are labeled “SUB_OC”, “SUB_SS”, and “SUB_OVF”, respectively.

Channel characteristics and the associated SWMM routing elements were estimated using topographic contours, aerial photography, GIS and plan data, and site visits. Stormwater infrastructure shapefiles from SEMSWA and the City of Aurora were the primary source of information for conduit shape, maximum depth, length, and material. For conduit lengths that included several pipe sizes, an average size was selected for the SWMM link. Lengths were estimated using ArcGIS in the *NAD 83 Colorado State Plane, Central Zone* projected coordinate system. Most stormwater sewer conveyance elements were reinforced concrete, which corresponds to a Manning’s roughness coefficient of 0.013 and translates to a value of 0.016 for CUHP-connected models.

To obtain cross-section geometry for open channels, approximate sections were drawn using GeoHECRAS version 2.1.0.17569, which utilizes the US Army Corp HEC-RAS analysis engine version 5.0.3. Using this program and 2014 LiDAR elevation data, a total of six (6) different 4-point channel geometries were established based on open channels studied in subwatersheds LR2, J3, SA2, C4, K4, and 17A. Each open channel conduit modeled corresponds to one of these geometries depending on similar geometry. Manning’s roughness coefficients were estimated for each subwatershed using *Equation 6-8* from the UDFCD Criteria Manual Volume 1. This equation suggests that Manning’s roughness coefficient for open channels is directly proportional to the slope of the channel and inversely proportional to the hydraulic radius. FlowMaster V8i was used iteratively at various flow rates (cfs) to solve for the hydraulic radius and Manning’s roughness coefficient for five (5) slope cases: 1%, 1.5%, 2%, 2.5%, and 3%. Key tables were developed for each channel geometry and these tables were used for each conduit link to select a coefficient appropriate for the slope and channel shape. It should be noted that this determination was made using the original 8-point channel geometry determined for the six (6) shapes; however, the geometries used for the SWMM conduits were reduced to four (4) points to allow for hydrograph convergence. And finally, the open channel lengths and alignments were estimated using ArcGIS and 1-foot LiDAR-sourced contours.

To eliminate nodal flooding during the 500-year storm, nine (9) divider nodes were included at the following junctions: Lewiston_J, Laredo_J, Shalom_J, Fair_Place_VCA, Parker_T1, Waco_NA, Buckley_NA1, out_RB1-4_pond, and Parker_NA. These nodes were assigned cutoff flow values just before surcharging and direct overflow to a secondary dummy link created to convey the entire flow downstream.

Finally, detention ponds were modeled using storage unit nodes with downstream outlet links. Each storage node and outlet link used a tabular stage-storage curve and stage-discharge curve as described in Section 3.4 DETENTION.

3.6 PREVIOUS STUDIES

Two (2) sources of previous hydrologic analysis are available for the Cherry Creek Minor Tributaries to-date. The first is the 1999 Cherry Creek Corridor Reservoir to County Line Outfall Systems Plan (WRC Engineering, Inc., 1999). This is a regional study that provides a limited number of common design points for reference and comparison. The second source is individual site drainage reports. Drainage reports were referenced only where necessary for the modeling of regional detention ponds, as discussed in Section 3.4 DETENTION.

3.7 RESULTS OF ANALYSIS

Peak flow rates for the existing and future land use conditions models were established at design points after incorporating the rainfall data, hydrologic characteristics, and drainage conveyance parameters within EPA SWMM. The basin-wide peak flow rate results at each of the design points along the stream corridor for the WQ, 1-, 2-, 5-, 10-, 25-, 50-, 100-, and 500-year storm events are presented in **Appendix B** with key points shown in **Table 3-2**. As noted earlier, only Kragelund Tributary and 17 Mile Tributary have existing conditions hydrology.

A summarized input and output file from the EPA SWMM version 5.1 model are included in **Appendix B**. The summarized input and output files provide the detailed information regarding subwatershed hydrologic input and the resulting hydrograph routing and peak flows.

Table 3-2. Peak Flows at Key Design Points

Basin	Location	Existing (cfs)			Future (cfs)		
		Q_5	Q_{25}	Q_{100}	Q_5	Q_{25}	Q_{100}
Little Raven Creek (LR)	Outfall to Reservoir	-	-	-	72	253	454
	E. Belleview Ave.	-	-	-	86	242	404
Suhaka Creek (S)	Cottonwood Creek Confluence	-	-	-	65	238	423
Joplin Tributary (J)	Outfall to Cherry Creek	-	-	-	173	348	613
	S. Parker Rd.	-	-	-	182	331	535
	RB1-4 Pond Outflow	-	-	-	110	205	353
	RB1-4 Pond Inflow	-	-	-	146	345	570
Grove Ranch Tributary (GR)	Outfall to Cherry Creek	-	-	-	43	96	150
Valley Club Acres Tributary (VCA)	Outfall to Cherry Creek	-	-	-	83	211	349
North Arapahoe Tributary (NA)	Outfall to Cherry Creek	-	-	-	82	229	476
	S. Buckley Rd.	-	-	-	45	150	325
South Arapahoe Tributary (SA)	Outfall to Cherry Creek	-	-	-	66	229	426
	S. Parker Rd.	-	-	-	36	163	318
Chenango Tributary (C)	Outfall to Cherry Creek	-	-	-	112	478	942
	S. Parker Rd.	-	-	-	96	436	857
Tagawa Tributary (T)	Outfall to Cherry Creek	-	-	-	14	52	105
Kragelund Tributary (K)	Outfall to Cherry Creek	49	308	626	151	478	859
	S. Parker Rd.	50	307	615	149	472	839
	Tributary Confluence	36	181	334	121	309	505
17 Mile Tributary (17)	Outfall to Cherry Creek	8	84	169	52	155	267
	S. Parker Rd.	6	70	141	47	135	229

Table 3-4 compares the results of the 1999 OSP with the results of this Master Plan, where applicable, for future conditions hydrology. The tributaries have only a handful of comparable points and not all of the tributaries were studied in the 1999 OSP (WRC Engineering, Inc., 1999). Several variables in this Master Plan differ from the 1999 OSP. Each of these variables affected the hydrology of the tributary basins to a different degree and therefore no overall trend exists of the change in peak flows. However, a unit discharge comparison, as shown in Table 3-4, indicates that both studies resulted in similar volumes of runoff per acre.

Notable items that differ between the 1999 OSP and this Master Plan are summarized below.

- Little Raven Creek, Suhaka Creek, and Joplin Tributary were not studied in the 1999 OSP.

- Compared to the 1999 OSP, the rainfall depths used in the current MDP are lower, except for the 1-year storm event. The 100-year one-hour rainfall depth used in the 1999 OSP was 2.67 inches, as opposed to 2.36 inches used in this study.

Table 3-3. Rainfall Depths, 1999 OSP vs. MDP

Recurrence Interval	1-Hour Point Rainfall Depth (in)	
	1999 OSP	2019 MDP
1	0.4	0.721
2	0.97	0.868
5	1.38	1.13
10	1.65	1.37
50	2.32	2.03
100	2.67	2.36

- Residential land use east of S. Parker Rd. between E. Arapahoe Rd. and the southern boundary of the County was estimated as 5% and 8% vs. 20% in this Master Plan. This impacts most of the Chenango Tributary, Tagawa Tributary and South Arapahoe Tributary basins. Additionally, the 1999 OSP estimated the future King's Point development would increase existing imperviousness to 50% as opposed to the single-family land uses of 30% and 45% used in this study.

- With the benefit of a more refined data set, the variables used in this study's hydrologic analysis lead to a more detailed and comprehensive basin-wide examination. This study prepared a model with more detailed routing by identifying storm sewer drainage versus overland flow. Additionally, Manning's roughness coefficients were estimated using *Equation 6-8* from the UDFCD Criteria Manual Volume 1, which resulted in overall higher values than those used in the 1999 OSP, but values that are more appropriate for hydrologic routing. Both of these factors result in differences in the timing of the storm hydrographs and, ultimately, the calculated peak flows.

Table 3-4. 100-year Peak Flows, 1999 OSP vs. Current MDP

Basin	Design Point		Future Q_{100} (cfs)		Basin Area (acres)		Unit Discharge (cfs/acre)		Notes
	1999 OSP	2019 MDP	1999 OSP	2019 MDP	1999 OSP	2019 MDP	1999 OSP	2019 MDP	
Valley Club Acres (VCA)	164	Fair_Place_VCA	486	349	262.2	207	1.85	1.69	
North Arapahoe (NA)	n/a	Buckley_NA1	n/a	325	n/a	272	n/a	1.19	OSP combined North and South Arapahoe basins
South Arapahoe (SA)	126	Parker_SA	599	318	603.2	326	0.99	0.98	
Chenango (C)	112	Bridle_Trail_C	533	412	308.6	321	1.73	1.28	
Kragelund Tributary (K)	102	Confluence_K	453	505*	300.2	257	1.51	1.96*	*Existing is 334 cfs @ 1.30 cfs/acre
17 Mile (17)	108	Parker_17	171	229*	125.6	124	1.36	1.85*	*Existing is 141 cfs @ 1.14 cfs/acre

The following text notes the level of compatibility for comparison between design nodes found in the 1999 OSP versus design nodes used in this study. Unit discharges have been included in Table 3-4 as an alternate form of comparison given the many variables that vary between this Master Plan and the 1999 OSP.

- The stakeholder interests along Grove Ranch Tributary are to address redevelopment within the lower reaches of the basin, identify the conveyance path, and identify the outfall to Cherry Creek. Therefore, the Grove Ranch Tributary is delineated as a single sub-basin downstream of S. Parker Rd. with its outfall located at Cherry Creek. The 1999 OSP does not provide adequate delineation downstream of S. Parker Rd. Its most useful design point is upstream of S. Parker Rd. at DP109, where the 100-year future conditions flow is reported as 77 cfs. Therefore, no comparison is made.

- Valley Club Acres is compared at design point 164, which is slightly upstream from the confluence with Cherry Creek. The next downstream design point is within the main stem of Cherry Creek and therefore, includes other upstream basins. Due to basin transfers, basin 57 - that was previously modeled as part of North Arapahoe (NA) Tributary - is modeled with Valley Club Acres Tributary in this study. A comparison is made, but it is not a direct correlation.

- The Chenango Tributary and Kragelund Tributary have common design points at the respective basin outfalls to Cherry Creek, as identified in **Table 3-4**.

- The 17 Mile Tributary is modeled with the 1999 OSP. However, a review of Figure A-6.2 in that report indicates that it was not routed to a design point. OSP basin 8 is upstream of S. Parker Rd. and therefore, it is assumed to be comparable to the design point listed in **Table 3-4**.

SECTION 4. REFERENCES

Aztec Consultants & P.R. Fletcher & Associates, Inc. (2000). *The Farm at Arapahoe County Filing No. 7.* The Farm Development Company & Arapahoe 114, LLC.

Muller Engineering Co., Inc. (1989). *Cherry Creek Basin RB1 Drainage Improvements - Final Design Report.* ECCV Water and Sanitation District.

Muller Engineering Co., Inc. (1994). *Basin RB1-Pond 4 Drainage Improvements.* ECCV Water and Sanitation District.

P.R. Fletcher & Associates, Inc. (1999). *Phase III Drainage Report Erosion & Sedimentation Control Report for The Farm at Arapahoe County Filings 7 & 8.* The Farm Development Company & Arapahoe 114, LLC.

P.R. Fletcher & Associates, Inc. (2000). *The Farm at Arapahoe County Filing No. 9.*

Urban Drainage and Flood Control District. (2016). *Urban Storm Drainage Criteria Manual Volume 1.*

USDA. (2018). *Custom Soil Resource Report for Arapahoe and Douglas County Area, Colorado.* Retrieved from NRCS Web Soil Survey: https://websoilsurvey.sc.egov.usda.gov

WRC Engineering, Inc. (1999). *Cherry Creek Corridor Reservoir to County Line Outfall Systems.* Urban Drainage and Flood Control District.

APPENDIX A

PROJECT CORRESPONDENCE

ENGINEERING CONSULTANTS

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KICKOFF MEETING MINUTES

DATE/TIME: **SEPTEMBER 10, 2018 @ 10:30 A.M.**

LOCATION: **UDFCD OFFICE**

PROJECT: **CHERRY CREEK TRIBUTARIES MDP & FHAD**

ATTENDEES:

Shea Thomas - UDFCD

Richard Borchardt – UDFCD

Stacey Thompson – SEMSWA

Cathleen Valencia – Arapahoe County (Engineering)

Roger Harvey – Arapahoe County (Open Space)

Craig Perl – City of Aurora

Jonathan Villines – City of Aurora

Allie Beikmann – J3 Engineering

Ken Cecil – J3 Engineering

PURPOSE:

1. Project stakeholders and design team introductions
2. Review stakeholder known issues and project goals
3. Review project opportunities
4. Review project Scope & Schedule
5. Name the Unnamed Tributaries

DISCUSSION ITEMS:

1. Shea provided an overview of the revised Master Planning Process, which separates the project into four distinct phases beginning with Baseline Hydrology, then FHAD for the identification of flood risks, then alternatives analysis and concluding with conceptual design.
2. The three named tributaries were previously studied with the prior 1999 OSP. The unnamed tributaries have not been previously studied.

3. Additional tributaries that were not identified in the RFP were reviewed and added. These include:
    a. Tributary just west of northerly unnamed tributary
    b. Tributary just south of Arapahoe Road, with apparent Foxfield Drainage Basin.
    c. Note: Three tributaries just east of northerly tributary (Part of Cherry Creek Vistas) were noted as being part of Cottonwood Creek basin and therefore, not to be included with this study.
    d. If adding additional reaches, UDFCD may amend the contract on a dollar/foot of additional reach length.
4. SEMSWA is supportive of adding the 17-Mile House tributary, the Arapahoe/Parker interchange tributary, and would recommend including the easternmost of the northerly Unnamed Creek tributaries since it is open channel (the one that is UDFCD Maintenance Eligible).
5. UDFCD will review the DRAFT stream layer to verify the above additional tributaries, and any others that may have been missed. The following discussion includes what may result in additional tributaries to be included, or at least problem areas that require further investigation.
6. Stacey identified an area of concern for SEMSWA that is near E. Fair Place, just north of Valley Club Acres Tributary. It needs to be investigated if this area, informally referred to as the area tributary to Grove Ranch, should drain to Valley Club Acres Tributary. The land use case is called “Legends at Centennial” and is a congregate care facility. The Fellowship Community Church sold a portion of their parcel that is now in process with SEMSWA undergoing development review. The development plan is to discharge on-site detention pond flows into the Church retention pond. The viability of the Church retention pond is also in question. SEMSWA will provide additional data regarding this specific challenge.
7. Cathleen identified area south of the southerly unnamed tributary which drains to and across a portion of the 17 Mile House property and requested that it be included with this Master Plan. This area may have been studied in the 1999 OSP but may need to be added to this scope of work to address flooding problems at 17 Mile House. Roger noted that Arapahoe County Open Spaces has developed a 17-Mile House Farm Park Master Plan, but improvements have not been analyzed.
8. Shea requested local sponsor feedback whether or not resultant floodplains are to be mapped by FEMA or remain as CWCB regulated only. Jon indicated it depends on the study findings.

Stacey indicated that SEMSWA will be consistent with other regulated tributaries within their jurisdiction.

9. Cathleen asked if the study would identify funding and Shea stated that the study would only provide cost estimates broken down by jurisdiction.
10. Rich stated that he has received a call from the Townhomes (Pioneer Hills) adjacent to Joplin Tributary regarding erosion and asked that this study verify this statement. Ken confirmed that the channel is incised with sharp bends and active erosion.
11. Ken indicated that J3's cursory review during the proposal phase indicated that few detention or water quality facilities had been observed and that the Cherry Creek Basin Water Quality Authority may be interested in adding additional water quality to these tributaries. Shea will contact Cherry Creek Basin Water Quality Authority during the Alternatives Analysis phase to discuss water quality and their potential participation.
12. Jon would like to include an analysis of flow rates and velocities for roadway overtopping conditions. Shea said this would part of the Alternatives Analysis phase.
13. Shea requested local sponsor input regarding any known detention ponds. Rich mentioned the Belleview Pond, but only if the project will incorporate this tributary. Ken mentioned RB1-Pond 4 within Joplin Tributary. Rich and Shea confirmed that it is UDFCD maintained and that it should therefore be included with the baseline hydrology. The pond near the Arapahoe/Parker Roads Interchange was also identified as one that receives maintenance. Shea and Rich agreed to look for any information that UDFCD may have for this tributary or will otherwise contact CDOT for additional information.
14. A discussion regarding data collection and areas requiring further research followed and covered the following topics:
    a. Future Land Use Data – Aurora has made available all future land use data available for retrieval. J3 familiar with this data. Cathleen referenced the 2018 Comp Plan for the County and Stacey will verify what is available for the City of Centennial.
    b. Shea will provide 1-foot topography; will also initiate the structure survey once all of the additional reaches are identified that are to be included with this study.
    c. Aurora will provide site plan for Kings Point
        i. Shea indicated that Filings No. 1 and 2 show only a temporary pond – no permanent detention. This is not currently an acceptable solution.

    d. Cathleen noted a proposed detention pond near Parker Road that is planned with the King's Point Filing No. 1 Development. It outfalls under Parker Rd. and across the 17 Mile House property. (Note: location of this pond requires clarification – J3 to follow up with Cathleen). Roger noted that we would need to know where flows from the King's Point primary arterial would go.
    e. The southerly unnamed tributary does flow across Parker Road through an apparently adequately sized box culvert but is conveyed overland, and not within a defined channel. The alternatives analysis phase will need to identify a low-maintenance stream section for this reach.
    f. The Cherry Creek Basin Water Quality Authority watershed model was referenced. Rich will contact CCSP to get a better understanding of what that scope of work is so that if necessary, efforts can be coordinated.
15. Shea requested that we meet again in approximately five (5) weeks. Ken to begin scheduling.
16. Follow-up for the website is required.
17. Additional observations by J3 and/or discussion items are summarized below:

SOUTHERLY UNNAMED TRIBUTARY

- Mostly Undeveloped Land
    i. *Stacey made reference to the 17 Mile House Farm Park Master Plan and indicated that Arapahoe County Open Spaces is concerned with conveyance and increased flows from upstream King's Point development across the property. Open Spaces utilizes the property for parking during the Fall Festival.*
- Future Development
- Multiple Smaller Tributaries

CHENANGO TRIBUTARY

- Cherry Creek Valley Ecological Park;
    i. *Rich stated that we may need to consider improvements upstream of trail but in general, this reach appears in good shape.*
    ii. *Roger indicated that Arapahoe County Open Spaces would support water quality facilities on the Eco Park property.*
    iii. *Stacey indicated that there is a large, undeveloped parcel on the west side of S Parker Rd in Centennial that is expected to develop. In addition to low-maintenance stream recommendations, this plan should recommend area to reserve for floodplain.*
- Direct outfalls with no apparent water quality
- Lack of regional detention

- 1999 OSP crossings of South Parker Road – Routing impacts
- Rural drainage infrastructure upstream of Parker Road
- Multiple smaller tributaries

JOPLIN TRIBUTARY

- Densely developed basin
- Half of basin is aligned through Cherry Creek State Park;
  i. *Rich requested that we show Cherry Creek State Park Property on all affected tributaries.*
  ii. *A Cherry Creek Basin Water Quality Authority Watershed Plan is under development.*
- Active construction through Pioneer Hills Development
- Reach is dominated by wetlands
- Severe right bank erosion;
  i. *Jon indicated a narrow area between the left bank water quality ponds and the right bank Pioneer Hills Development where the drainageway necks down; the floodplain is likely not contained through this pinch point.*
- Private detention and water quality ponds
- Complex outfall structure downstream of south chambers road
- Aurora and Centennial split easement (72" and 36" RCP)
- RB1-Pond 4
- Regional detention and water quality are not present

VALLEY CLUB ACRES TRIBUTARY

- Southeast Regional Detention Basin – verify;
  i. *Stacey identified the pond at Northwest of Interchange. More research needed in this area as it is not clear which pond or outfall alternative was constructed.*
  ii. *Stacey also indicated following the meeting that there is a sub-regional extended detention basin that serves the Centennial Center commercial development (NW corner of Parker/Arapahoe) that appears to tie into the Valley Club Acres outfall system.*
- 12' x 6' RCBC – verify as it impacts basin area
- Drainageway predominantly contained in storm sewer
- Only 600 feet of open channel; all of which are within Cherry Creek Floodplain
- Challenging design will be needed if existing storm is undersized

NORTHERLY UNNAMED TRIBUTARY

- Largely within Cherry Creek State Park
- Regional detention and water quality are not present
- Active bank erosion

SCHEDULE

Kickoff Meeting	September 10, 2018
Progress Meeting (+5 Weeks)	TBD
Submit Draft Baseline Hydrology	November 16, 2018
Complete Review of Draft Baseline Hydrology	December 7, 2018
Comment Review Meeting	December 10, 2018
Complete Corrections to Draft Baseline Hydrology	December 28, 2018
Baseline Hydrology Approved	December 31, 2018

ACTION ITEMS

1. UDFCD (Shea) to review DRAFT stream layer to confirm additional tributaries for inclusion.
2. SEMSWA (Stacey) will provide additional drainage information for the area tributary to Grove Ranch Drainage.
3. UDFCD (Shea) to contact Cherry Creek Basin Water Quality Authority during the Alternatives Analysis phase to discuss water quality and potential participation.
4. UDFCD (Shea and Rich) to research additional information that may be available for the pond at the Parker/Arapahoe Road Interchange; this may require contacting CDOT.
5. J3 (Ken and Allie) will obtain as much public land use data that is currently available and request assistance from Stakeholders where necessary.
6. Arapahoe County (Cathleen) will provide J3 with additional information regarding the 2018 Comp Plan.
7. SEMSWA (Stacey) will verify availability of GIS layers for impervious land use areas what land use data from Centennial and provide what is available.
8. Aurora (J3 did not note a specific person) will provide site plan for King's Point
9. J3 (Ken and Allie) will follow up with Cathleen regarding Item 13.d
10. UDFCD (Rich) will contact Cherry Creek Basin Water Quality Authority to better identify the scope of work for their Watershed Master Plan.
11. J3 (Ken) will schedule a progress meeting
12. UDFCD (Rich) will relay website discussion to Shea for direction regarding web-based master plan.
13. J3 (Ken and Allie) will roll out project website in approximately two weeks.

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PROGRESS MEETING MINUTES

DATE/TIME: **OCTOBER 23, 2018 @ 3:00 P.M.**
LOCATION: **UDFCD OFFICE**
PROJECT: **CHERRY CREEK TRIBUTARIES MDP & FHAD**

ATTENDEES:
Shea Thomas - UDFCD
Richard Borchardt – UDFCD
Stacey Thompson – SEMSWA
Angela Howard – SEMSWA (phone)
Roger Harvey – Arapahoe County
Craig Perl – City of Aurora (phone)
Jonathan Villines – City of Aurora (phone)
Allie Beikmann – J3 Engineering
Ken Cecil – J3 Engineering

PURPOSE

1. Review Action Item status.
2. Review project progress. See Discussion Item 1.
3. Review stakeholder input for sub-basin delineation. See Discussion Item 3.
4. Review schedule – First deliverable is Draft Baseline Hydrology. See Discussion Item 4.

DISCUSSION ITEMS

1. Ken provided an update regarding the status of action items identified at the project kickoff meeting, with most being complete. Incomplete items pertain to future phases and are not critical at this time. Dewberry | J3 will continue to track and request from assigned attendees at the appropriate time. The remaining items are:

    a. UDFCD (Shea) to contact Cherry Creek Basin Water Quality Authority during the Alternatives Analysis phase to discuss water quality and potential participation.

    b. UDFCD (Shea and Rich) to research additional information that may be available for the pond at the Parker/Arapahoe Road Interchange; this may require contacting CDOT.
    c. J3 (Ken and Allie) will follow up with Cathleen regarding Item 13.d (Detention Pond @ King's Point)
    d. UDFCD (Rich) will contact Cherry Creek Basin Water Quality Authority to better identify the scope of work for their Watershed Master Plan. Rich noted that he will contact Jim Swanson and Chuck Reid to discuss funding opportunities. It was further clarified that the project scope of work will not change based on potential overlap with the Cherry Creek Water Quality Authority. However, a comparison to benefit both studies is the goal.

2. An update of project progress was provided. The project team has been working with UDFCD behind the scenes to increase the project scope of work to include four additional tributaries as requested at the kickoff meeting. This includes critically evaluating the Grove Ranch basin, the Arapahoe Road basin, Cottonwood Basin, and 17 Mile Basin. It was agreed that each of these additional basins will be included with the project.

3. A discussion of the additional basins and their resultant floodplains followed. The results of the baseline hydrology and first look at hydraulics will help inform whether to map the floodplains with CWCB, FEMA, or neither on a tributary basis. A discussion of how to address each stream will be a portion of the comment review meeting agenda.

4. Analyzing the inclusion of the additional basins effectively ended on October 11. Consequently, the design team is approximately 3 weeks behind schedule and requests that the Draft Baseline Hydrology submittal and subsequent milestones be extended to December 7. A draft revised schedule was presented, but it was requested that the schedule be further modified so that the comment review meeting occur after the first of the year. UD approved the revised schedule during the meeting.

5. Shea provided stakeholder feedback regarding additional costs that will need to be funded for the inclusion of the additional tributaries with regard to future phases. This discussion

would be ongoing, but it was requested that that the project team proceed with the study and that funding will be resolved prior to the next phase.

6. Major basin delineation is undergoing internal QA/QC. A brief review of this process was discussed:
    a. Detailed subdivision boundaries are possible by reviewing development plans. It was decided that this level of detail is not warranted and that relying on the one-foot topography is sufficient.
    b. Several areas not within the major basins require further investigation. These areas will be included with the MDP as Direct Flow Areas but will not be included with alternative analysis or concept design.
    c. The Valley Club Golf Course major basin should be validated to ensure that portions of the course are outside of the major basin as shown on the draft meeting exhibit. Rich referenced the 2D model developed by Glenn Hamilton at Muller and that we could request this to help answer the question. However, since most of the golf course is within the floodplain of Cherry Creek, the basin presented in the draft meeting exhibit is appropriate.
    d. E470 Drainage Plans need to be reviewed to clarify whether or not all road drainage is captured within the Southern Unnamed Tributary.
    e. The outfall for the Cottonwood Basin at Peoria is not observable. It may be a silted in culvert. This should be picked up via structure survey.
7. Beginning sub-basin delineation and will rely on comments received at kickoff meeting to help identify logical design points. Additional input regarding known flooding locations or trouble areas was requested but no known areas were identified.
8. Future conditions hydrology is required for all basins. Because the southern two basins are undeveloped, the project team will also evaluate existing conditions hydrology.
9. Shea referenced the Interactive Hydrology Feature and will provide documentation as an example for Dewberry | J3 to follow for the MDP.
10. Open Discussion

ACTION ITEMS

1. Doodle Poll for Comment Review Meeting (Ken).
2. Provide funding detail to stakeholders (Shea).
3. Stakeholders to resolve funding prior to next project phase (All).
4. Dewberry | J3 to continue with basin refinements (Ken, Allie & Danny).
5. Update and distribute schedule (Ken).

PROJECT SCHEDULE

Kickoff Meeting	September 10, 2018
Progress Meeting (+5 Weeks)	October 23, 2018
Submit Draft Baseline Hydrology	December 7, 2018
Complete Review of Draft Baseline Hydrology	December 28, 2018
Comment Review Meeting	December 31, 2018
Complete Corrections to Draft Baseline Hydrology	January 18, 2019
Baseline Hydrology Approved	January 21, 2019

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COMMENT REVIEW MEETING MINUTES

DATE/TIME: **JANUARY 14, 2019 @ 1:00 P.M.**
LOCATION: **UDFCD OFFICE**
PROJECT: **CHERRY CREEK TRIBUTARIES MDP & FHAD**

ATTENDEES:

Shea Thomas - UDFCD
Dana Morris – UDFCD
Stacey Thompson – SEMSWA
Cathleen Valencia – Arapahoe County
Roger Harvey – Arapahoe County
Jonathan Villines – City of Aurora
Allie Beikmann – Dewberry | J3
Ken Cecil – Dewberry | J3
Danny Elsner – Dewberry | J3

PURPOSE

1. Review select comments and present comment response action plan.
    a. Reference on screen document for discussion.
2. Discuss next steps.

DISCUSSION ITEMS

1. Personnel Updates
    a. Kurt Bauer will be the new UDFCD project manager (PM) on this project and will be joining UDFCD in approximately one month.
    b. Jon Villines will be leaving the City of Aurora and joining UDFCD. Replacement for Jon is TBD. Jon also noted that he sent comments early that morning following return to work. Dewberry | J3 reviewed them and sent response back to Jon and Shea (UDFCD) on 1/18/2019.
    c. Dana Morris (UDFCD) will be conducting the FHAD review.

2. Project Title Name
    a. Current title needs clarification “Cherry Creek Tributaries Upstream of Cherry Creek Reservoir MDP”. UDFCD indicated the title needs to start with the main tributary name “Cherry Creek”.
    b. Proposed best option is “Cherry Creek Minor Tributaries in Arapahoe County MDP”. UDFCD will review and get back with us.
3. Tributary Names
    a. UDFCD indicated that unique names are important and ideally have reference to local landmarks, such as streets.
    b. North Unnamed Tributary (NU)
        i. Suggested Lake View Tributary and attendees accepted.
        ii. 2019-1-15 Update: Lakeview is already taken in Thornton. Dewberry | J3 proposed Little Raven Creek instead.
    c. Tributary to Cottonwood Creek (TC)
        i. Suggested Suhaka Tributary due to proximity to the model airfield. Suhaka is named after an avid radio-controlled airplane flyer who built and flew his own planes out of the field at Cherry Creek State Park, also named after him.
        ii. SEMSWA verified this name was acceptable on 1/18/2019. Suhaka is currently the last name of a member on the Centennial City Council.
    d. Valley Club Acres:
        i. Agree to use Valley Club Acres (VCA) instead of Valley Club (VC) throughout.
    e. North Arapahoe and Parker, South Arapahoe and Parker:
        i. Agreed to remove “and Parker” and modify to North Arapahoe Tributary and South Arapahoe Tributary (NA, SA).
    f. South Unnamed Tributary (SU):
        i. Suggested Kragland Tributary or Dransfeldt Tributary due to historical significance.
        ii. Roger indicated he would discuss with Karen at 17-Mile Farm House to find a good, historically significant name.

4. Clarified role of Arapahoe County in this project and agreed they are a stakeholder and SEMSWA is the sponsor that operates on their behalf. Wording will be clarified in the text and Arapahoe County logos will still be reflected in documents.
5. Dewberry | J3 asked if watershed numbers could be found online and what significance they have. UDFCD indicated they are part of a filing system that is generally not used anymore. Future MDP documents don't need to include it.
6. Main Tributary Comments
    a. TC: Exhibit makes it appear tributary outfalls to Cottonwood Creek prior to crossing Peoria. Please clarify.
        i. Outfall is downstream of Peoria. Dewberry | J3 will add a street name to clarify.
    b. J: Let's discuss your travel path for subcatchment J2, since the shape factor is a bit excessive.
        i. Attendees agreed to the approach of modifying the shape of the basin by removing the narrow "tail" downstream to get a better shape factor in CUHP.
    c. NAP1: Can we discuss the catchment delineation in this area? It seems odd that NAP1 would really narrow down this much without adjacent area contributing.
        i. NAP1 (NA1) will be cut off at Parker Rd. and the area downstream of Parker Rd. will be removed from hydrology. Upstream will be routed through piping infrastructure simulated in the model.
    d. NAP3: Should this be the downstream limit for NAP3? Arapahoe Rd would then be incorporated into NAP2.
        i. The current configuration is acceptable since this area doesn't go to the pond.
7. DFA Catchments
    a. Attendees agreed to remove all DFAs with the exception of C-DFA2 which will be modeled up to Parker Rd and renamed to Tagawa Tributary. The other DFA areas do not have definitive outfall points along the tributaries and large portions are already in the floodplain.
8. Ponds
    a. RB1-4
        i. Confirmed that SEMSWA owns and maintains this pond.

        ii. Dewberry | J3 indicated that the stage-storage curve in the report needs updating to match the current curve used in the model.
    b. NAP/Pond E (North Arapahoe Pond)
        i. Confirmed that SEMSWA owns and maintains this pond.
        ii. SEMSWA indicated that they want to clarify the Filings that are served by this pond. Documents from SEMSWA indicated it serves Filings 7, 8, and 9 for the Farm at Arapahoe County.
        iii. Agreed to call the pond "North Arapahoe Pond" or NA pond for model inputs. However, a section will be included in the text noting that this is also referred to as Pond E by local agencies.
        iv. Danny discussed how Dewberry | J3 developed the stage-storage-discharge curves and the discrepancies between as-built records and current LiDAR.
        v. Attendees agreed that a survey would be beneficial and Shea estimated it would take a couple weeks to get this done.
    c. SAP Pond
        i. Confirmed this pond is not publicly owned and maintained, and not maintenance eligible.
    d. NU Detention Pond
        i. Dewberry | J3 indicated that this pond has a pseudo-outlet works at E Belleview Ave. that consists of two pipes, one five feet above the other.
        ii. The parcel appears to be owned by the United States and is part of Cherry Creek State Park. It inadvertently provides detention and thus is not included in the model. It also doesn't appear to be maintained for detention.
        iii. Ken noted that the downstream-most pipe in CC State Park appears to be very undersized for current flow conditions. This will be included in the report since it may be of interest for the Park.
        iv. Shea noted that Rich Borchardt may be a good contact for future information re: the CC Basin Water Quality Authority model, as he will be working on the project.
    e. TC Detention Pond
        i. Agreed to refer to the identified pond as a "stock pond".

9. Imperviousness and Land Use
    a. J: SEMSWA had a comment regarding the Arapahoe County 2035 Transportation Plan for future widening of Parker Rd. from 4 to 6 lanes, and if any adjustments are necessary to the future conditions impervious values.
        i. Dewberry |J3 indicated that Parker Rd. and the ROW was drawn in as a 100% impervious area and is thus a conservative land use, since typically land use areas include the adjoining streets. Attendees agreed to use the resulting comp %I for both existing and future conditions and no changes need to be reflected for future conditions.
    b. VC-DFA: SEMSWA had a comment regarding future residential development in part of Valley Club Acres Golf Course. Since this DFA subbasin is going to be removed, this issue no longer needs addressing.
    c. GR: SEMSWA indicated an area is identified as "Urban Center" on Centennial's 2040 Comprehensive Plan (Centennial NEXT).
        i. Dewberry | J3 will determine the corresponding imperviousness value for Urban Center land use. The resulting comp %I will be used as the future conditions.
    d. C1: Much of this area is identified as "Regional Commercial" on the Arapahoe County 2018 Comprehensive Plan. It is currently built-out as residential.
        i. Attendees agree this future zoning type appears odd given the built-out nature of the area. Cathleen indicated she will check with long-range planners at Arapahoe County to confirm the accuracy of this projected land use.
    e. SU1: Part of this area is identified as "Urban Center" on Centennial's 2040 Comprehensive Plan (Centennial NEXT).
        i. Dewberry | J3 Will modify and the resulting comp %I will be used as the future conditions. There will be a separate existing conditions model for this subbasin since development is proposed in a large part of the tributary basin.
            1. Note: Dewberry | J3 found following this meeting that the Urban Center area extends to a small part of Subbasin 17A. The same method of existing vs. future for SU1 will be applied to 17A.
    f. 17A: SEMSWA comments that 17-Mile House Farm park has a master plan and %I values could be adjusted to account for future development.

        i. Dewberry | J3 indicated that the current %I value is conservative since a large area is considered single-family residential for the study even though it is a large open property. Since only 1.8 acres of the land is developable and the land use is conservative, attendees agreed to use the current comp %I of 13.7% but request language added to the text.
    g. What 100-yr rainfall value was used in the previous study? How does the %I compare between that study and this one? (OSP Study).
        i. Rainfall for the current MDP is lower than the 1999 OSP. Dewberry | J3 will show the difference for the 100-year rain event and compare to Table A-5 from the 1999 OSP at possible points of comparison.
    h. Often it's better to compare unit runoff (cfs/ac) rather than just runoff. Would that be a valid comparison in this case? (pg. 3-5, UD)
        i. New comparison table shown during the meeting will be added.
    i. Arapahoe County indicated that existing and future flows from the MDP do not match the Kings Point drainage report.
        i. Dewberry | J3 found that flows for subbasin 17B are close to the drainage report but much higher for the SU tributary because the MDP included a larger area and an overall higher comp %I. CUHP/SWMM models confirmed this, although there is still a difference of 120 cfs for the 100-yr.
        ii. The MDP does not include the proposed ponds. Shea noted that she will talk to Morgan at UDFCD to see if developers will run their models without the ponds and verify similar flows (higher flows).
10. Jurisdictional questions, appendix comments and grammatical error comments were not discussed as answers and edits are readily known.
11. Additional storm events
    a. UDFCD requested modeling of two additional storm events: the 1-year and water quality (WQ) events. This would entail a short paragraph discussing the events and inclusion of a separate table in the Appendix.
12. Project Budgeting
    a. UDFCD requested that Dewberry | J3 send a comparison table of tributary length to estimate additional project cost.
    b. UDFCD and SEMSWA to discuss funding.

13. FHAD

a. The position on whether or not to conduct a FHAD for each tributary was discussed at the end of the meeting and the conclusions are below. SEMSWA noted that alternatives will be studied for tributaries even if a FHAD is not conducted for them. And UDFCD indicated that a FHAD is not required if overflow from storm infrastructure is contained in the street flow.

b. North Unnamed Tributary – limits are from Belleview Avenue to NU3 basin.

c. Tributary to Cottonwood – no FHAD.

d. Joplin Tributary – limits are from Cherry Creek floodplain to at least J6 basin, may go farther along storm sewer if concentrated sheet flow puts properties into the floodplain.

e. Grove Ranch Tributary – no FHAD.

f. Valley Club Acres Tributary – no FHAD.

g. North Arapahoe & Parker – limits could be along storm sewer if a floodplain is found in the overflow of the storm.

h. South Arapahoe & Parker – limits could be along storm sewer in SAP1 basin, but will at least be from Parker to SAP4 basin.

i. Chenango Tributary – limits are from Cherry Creek floodplain to C9 basin.

j. South Unnamed Tributary – limits are from Cherry Creek floodplain to SU7 basin.

k. 17 Mile – no FHAD.

Cherry Creek Tributaries MDP & FHAD
Comment Review Meeting Minutes

ACTION ITEMS

1. All stakeholders to confirm that “Little Raven Creek” is an acceptable name for North Unnamed Tributary.
2. Stacey (SEMSWA) to verify Suhaka is an acceptable name for Tributary to Cottonwood.
3. Roger (AC) to discuss name options for South Unnamed with Karen at 17-Mile Farm House.
4. Shea (UDFCD) to schedule a survey for North Arapahoe pond to develop accurate stage-storage-discharge curves.
5. Cathleen (AC) to check with long-range planners at Arapahoe County to confirm the accuracy of “Regional Commerical” for the area of subbasin C1 (Chenango) under future conditions.
6. Dewberry | J3 to pick up comments in final baseline hydrology report as discussed in the meeting and provided in comments by the stakeholders.
7. Dewberry | J3 to send tributary length comparison table to UDFCD for review.
8. Dewberry | J3 will review Jon Villines comments and follow-up as necessary for inclusion.

PROJECT SCHEDULE

Kickoff Meeting	September 10, 2018
Progress Meeting (+5 Weeks)	October 23, 2018
Submit Draft Baseline Hydrology	December 14, 2018
Comment Review Meeting	January 14, 2019
Complete Corrections to Draft Baseline Hydrology	February 1, 2019
Baseline Hydrology Approved	February 4, 2019

Comment	Page	Response
PROJECT NOMENCLATURE		
Would this title make more sense? "Cherry Creek Tributaries in Arapahoe County..." Let's discuss.	Cover	Modified to "Cherry Creek Minor Tributaries in Arapahoe County"
Future submittals will build on this report, so try to avoid references to just baseline hydrology. The purpose and scope should be for the entire study.	1-1	Removed references that refer to document solely as baseline hydrology.
4600	2-1	Updated text to include watershed number.
Let's name this. Let's give this a name. There are other tributaries to Cottonwood Creek so this could get confusing. Let's name this. Earlier in the report it was stated that unnamed tributaries would be named - will this be changed?	2-1 2-1 2-1 3-2	Updated text to reflect new tributary names, including Little Raven Creek (previously North Unnamed), Suhaka Creek (Trib to Cottonwood), and Kragelund (South Unnamed).
Valley Club Acres?	2-1	Revised all tributary names and references to Valley Club Acres (VCA).
Do we need to include the "and Parker" on these?	2-1	Modified tributary names to North Arapahoe (NA) and South Arapahoe (SA).
STREAM GEOMETRY		
Exhibit makes it appear tributary outfalls to Cottonwood Creek prior to crossing Peoria. Please clarify.	2-3	Added a street name to the figure to clearly identify that it crosses the road before outfalling to the creek.
Is this correct that the property is an Arapahoe County Park? I understood that it was part of State Park property.	2-3	The text was incorrect and revised to indicate the property is Cherry Creek State Park.
Are both pipes located in Centennial?	2-3	The text was incorrect and revised to indicate that the 72" pipe is in Aurora and the 36" is in Centennial.
SEMSWA's service area covers the City of Centennial and the urban areas of Unincorporated Arapahoe County.	2-5	Revised to remove Greenwood Village as part of the service area.
The Arapahoe County 2035 Transportation Plan identifies future Parker Rd improvements -- interchange at Parker/(future) Aurora Pkwy and widening between Quincy and Chambers. Are any adjustments necessary to the future conditions impervious values to account for these future roadway improvements?	2-5	No. Discussed during meeting and included in text that the land use assumption of "Streets" for the existing extent of Parker Rd. is adequate and conservative.
Where is this?	2-6	Kragland Acres is located near the now named Kragelund Tributary and the locations will be more apparent.
and Filing No. 9?	3-3	Revised to include reference to Filing No. 9 and specifically Tract A.
STAKEHOLDER INFORMATION		
Arapahoe County is a project stakeholder	1-1	Modified language to say AC is a stakeholder, not a direct sponsor.
Cherry Creek Watershed (Rich's title) Add CFM to Stacey's title and revise job title Revise Angela's job title PE	1-3 1-3 1-3 1-3	Modified personnel titles as indicated by comments.
Since there are so many municipalities involved and the boundaries are complex, maybe consider adding the names of the municipalities impacted in parentheses after each tributary name?	2-3	Included a jurisdictional table.
PONDS		
What is an undocumented pond?	2-3	Modified to "stock pond".
State who owns/maintains this pond. This facility is owned and maintained by SEMSWA. State who owns this pond.	2-3 2-3 3-3	Included text stating SEMSWA owns and maintains RB1-4.
State who owns/maintains this basin. If unknown, just state that it is privately owned.	2-3	Modified to state that it is owned by Cherry Creek State Park and does not appear to undergo maintenance.
State who owns this pond. Is this facility within The Farm at Arapahoe County Filing No. 9, Tract A? The detention basin is known as "Pond E". SEMSWA owns and maintains Pond E. State who owns this pond.	2-4 2-4 3-3	Included text stating SEMSWA owns and maintains NA Pond (Pond E).
Did you also confirm the outlet works matched the as-builts to develop the stage-discharge curve?	3-3	Included text indicating the discrepancy between LiDAR contours and as-built data and proceding steps to conduct a survey by UDFCD.
Does not match storage curve in model.	Table B-3 Detention Rating Curves	Updated storage curve in the Appendix to reflect the model.
PREVIOUS STUDIES AND FLOW COMPARISONS		
What 100-yr rainfall value was used in the previous study? How does the %I compare between that study and this one?	3-4	Included a table to compare rainfall data between the 1999 OSP and current MDP.
Often it's better to compare unit runoff (cfs/ac) rather than just runoff. Would that be a valid comparison in this case?	3-5	Updated comparison table to include cfs/ac comparison.
Why are there n/a for this study? Unit runoff instead? Also, why is a value included in the This Study column for this tributary but not the other two tributaries where no comparison is made?	3-5	Previous table was confusing. Updated and only used n/a for North Arapahoe since the OSP studied NA and SA together.
These are pretty significant decreases (23%, 42%, 44%). Include in the text the reason for the decrease - is it strictly due to different rainfall values? Is it also because of different %I used?	3-5	Updated results section with a more detailed analysis of differences between the report and influences on peak flows.
Why not include this in the table?	3-5	Included text that explains this value has no corresponding design point in our current MDP but is still valuable.
Can we just show a dash for all the streams that did not have a separate existing conditions analysis? That seems easier than having to dig for the ones that are different.	3-6	Revised table to reflect comment.
RESPEC, on behalf of the Cherry Creek Basin Water Quality Authority, is completing a Watershed Model for the CC Basin, which may be used as a point of comparison for these tributary areas.	3-4	Noted for future consideration.

Cherry Creek Tributaries MDP FHAD
Baseline Hydrology Comment Responses

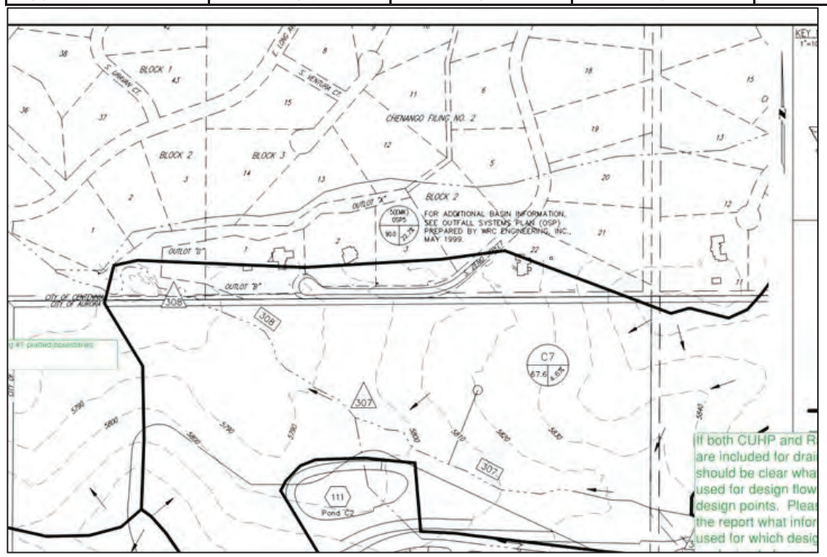
Comment	Page	Response
The existing and future flows do not match the Kings Point drainage report. Your numbers are higher and I was just wondering how you came up with them and whether you used the Kings Point report for information. Just trying to make sure I understand.	3-7	Discussed during comment review meeting. MDP will use COA zoning data and corresponding UDFCD land use and imperviousness values which are more conservative than those used in King's Point. In addition the basin areas slightly varied. A comparison was made and presented during the comment review meeting and is also included in this Appendix for reference
BASIN PARAMETERS, MODELING, AND FIGURES		
It sounds as though the zoning data was used to represent future land use, which is assumed (for most basins) to be equivalent to existing land use. COA would like for this assumption to be checked using our planimetrics (as appears to have been done for SEMSWA) for the built-out basins, since an imperviousness calculation based on actual existing conditions will be more accurate than just relying on land use data. If the NLCD was used Aurora's northern basins in lieu of zoning, as the maps in Appendix B seem to suggest, we are okay with that (but section 2.2 says that the NLCD was just used to spot-check the zoning data, although Figure B-2 doesn't show zoning data for these basins).	3-2	Dewberry evaluated the imperviousness values based on planimetrics vs land use data at the request of UDFCD and COA. Due to the scale of this study and the limited impact to flow results, it was decided to continue using land use correlated imperviousness values.
For segments where minimum slope was assumed or pipes are shown as flowing full in the 100-year (if there are any), it would be good to verify slope and invert information from as-builts.	3-4	Yes, for the short segments under Parker and a couple other road crossings, we may request as-builts to verify information for culvert analysis.
Why would we not model separate segments for each pipe size? Is selecting and average size an accurate way to model the pipe hydraulics (or will this be addressed in the hydraulics section)?	3-4	Text was included to indicate that pipes in SWMM are reflective of an average size, shape, and material for the corresponding pipe series.
More accurate roughness values (from field conditions) will be used for hydraulic modeling, correct?	3-4	Yes, used UDFCD Volume 1 Chapter 6 Section 4.2.2 procedure for Manning's n for Baseline Hydrology and will use a value corresponding to the channel/pipe roughnesses for the next phase of the MDP.
Let's discuss your travel path for subcatchment J2, since the shape factor is a bit excessive.	Figure B-1	Modified subbasin J2 geometry to remove narrow stretch of direct flow to Cherry Creek, which lowered the shape factor.
Can we discuss the catchment delineation in this area? It seems odd that NAP1 would really narrow down this much without adjacent area contributing.	Figure B-1	Modified so that NA1 basin terminates at Parker Rd. and area downstream is removed from hydrology but routed to Cherry Creek via piping.
Should this be the downstream limit for NAP3? Arapahoe Rd would then be incorporated into NAP2.	Figure B-1	Did not modify. Stakeholders agree the current configuration better reflects flow to NA Pond.
Should C-DFA1 be cut off here? Let's talk about what the goal is with some of these DFA catchments.	Figure B-1	Removed all DFAs except for C-DFA2 which was renamed to Tagawa Tributary. Other DFAs did not have definitive outfall points.
J-DFA exceeds the allowable basin shape factor in CUHP. Let's cut the portion adjacent to Cherry Creek out of this subcatchment. It appears that C-DFA 1 is shown as Regional Commercial north of Broncos Pkwy and Urban Center south of Broncos Pkwy. Should the sub-catchment boundary between C-DFA1 and C-DFA2 be Broncos Pkwy instead of Parker Rd?	Figure B-1	Removed this DFA .
This area is annexing into Aurora and is planned to be rezoned for multi-family residential. As mentioned, a portion of this area is to be rezoned and developed as multi-family residential. Property owner is annexing into Aurora. (Previously, property owner was pursuing annexation into Centennial -- proposal was approximately 15 acres/370 apartment units.)	Figure B-1 and Table B-4	Removed this DFA.
This area is identified as "Urban Center" on Centennial's 2040 Comprehensive Plan (Centennial NEXT) A portion of this sub-basin is shown as Urban Center in Centennial's Comp Plan. Should this value be increased to reflect the future land use in both the existing and future conditions models, if we are assuming full build-out at the time of study?	Figure B-1 and Table B-4	Modified land use for that area of Grove Ranch to reflect Urban Center land use for existing and future conditions.
This area is identified as "Regional Commercial" on the Arapahoe County 2018 Comprehensive Plan These areas are shown as Regional Commercial in the County's Comp Plan. Should these values be increased to reflect the future land use in both the existing and future conditions models, if we are assuming full build-out at the time of study?	Figure B-1 and Table B-4	This area will remain residential as it is built-out and Cathleen (AC) confirmed an updated COMP plan indicates it to remain residential.
This area is identified as "Urban Center" on Centennial's 2040 Comprehensive Plan (Centennial NEXT) These areas are shown as Urban Center in Centennial's Comp Plan. These values should be increased to reflect future land use.	Figure B-1 and Table B-4	Modified land use and imperviousness for subbasins K1 and 17A to reflect this.
Was the NLCD used to determine existing/future land use in this area, if no zoning data is shown?	Figure B-2	Clarified the use of NLCD data as a check in the text and removed the figure for clarity.
The 17-Mile House Farm park has a master plan. Should this value be adjusted to account for future development?	Table B-4	Did not modify since stakeholders agreed the current %I value is conservative due to it being a sparse single-family residential plot and only 1.8 acres is developable. Added text to clarify.
Please use a more detailed report. (Node Depth and Flow Summary, Outfall Loading Summary, Storage Volume Summary, etc.)	Table B-6	Modified to include additional details.
GRAMATICAL ERRORS AND WORDING ISSUES		
Grammatical, spelling, punctuation, rewording, and other revisions that address inconcequential text errors.	1-1, 1-2, 2-1, 2-2, 2-3, 2-4, 2-5, 3-2, 3-5, Interactive Figure, SWMM Routing Schematic	

KING'S POINT COMPARISON

RESPONSE TO COMMENT FROM ARAPAHOE COUNTY
REVIEWED ON JANUARY 14TH, 2019 AT THE COMMENT REVIEW MEETING

The existing and future flows do not match the Kings Point drainage report. Your numbers are higher and I was just wondering how you came up with them and whether you used the Kings Point report for information. (AC)
(future conditions)

SUBBASIN	SOUTH UNNAMED SU3 TO SU7		17B	
DESIGN POINT	KING'S POINT	BASELINE	KING'S POINT	BASELINE
	308	Bridle_Trail_SU	D1	Parker_17
Trib Area (ac)	373.9	452.9	131.4	123.7
Imperv (%)	21.09	37.6	46.1	36.2
5-YEAR	10	148	34	47
100-YEAR	282	731	194	229



Flows for Subbasin 17B are very close to the drainage report but much higher for the SU tributary, because:

- We include a much **larger area** of about 80 or so acres in Subbasin SU4, and this area is developed.
  - Foxfield has a drainage system we don't know about that diverts some water away, removing some area from this subbasin, or
  - This area's drainage is intended to be routed just downstream of their proposed pond.
- We have similar %I for existing conditions but **a higher %I** value for future conditions, because:
  - For SU7: we considered E-470 and its multi-use easements completely impervious AND assumed built out conditions for areas on either side of the toll road, and
  - OVERALL the UD values for land uses are higher than what they used for residential.

KING'S POINT COMPARISON

RESPONSE TO COMMENT FROM ARAPAHOE COUNTY
REVIEWED ON JANUARY 14TH, 2019 AT THE COMMENT REVIEW MEETING

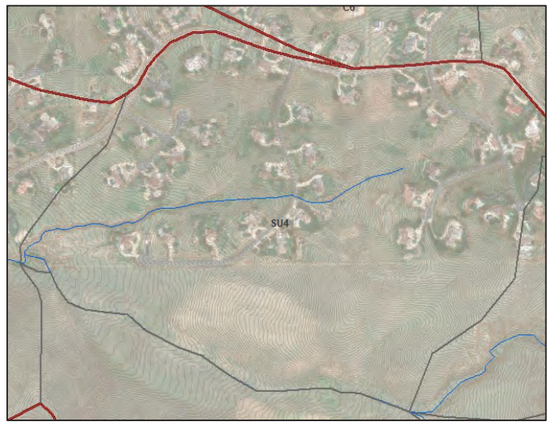
CUHP was modified to reflect lower imperviousness values and a smaller area to see if these were the only causes, and it appears to be the majority of it.

Reducing imperviousness

SUBBASIN	SOUTH UNNAMED SU3 TO SU7	
DESIGN POINT	KING'S POINT	BASELINE
	308	Bridle_Trail_SU
Trib Area (ac)	373.9	452.9
Imperv (%)	21.09	21.09
5-YEAR	10	60.92
100-YEAR	282	521.01

Reducing imperviousness and area

SUBBASIN	SOUTH UNNAMED SU3 TO SU7	
DESIGN POINT	KING'S POINT	BASELINE
	308	Bridle_Trail_SU
Trib Area (ac)	373.9	374
Imperv (%)	21.09	21.09
5-YEAR	10	47.18
100-YEAR	282	403.4



APPENDIX B

HYDROLOGIC ANALYSIS

INTERACTIVE MAP CONTROLS

Study Area Map

Soils Map

Existing Land Use Map

Future Land Use Map

Subwatershed Boundaries Map

Baseline Hydrology SWMM Routing Map

Little Raven Creek Basin

Suhaka Creek Basin

Joplin Tributary Basin

Grove Ranch Tributary Basin

Valley Club Acres Tributary Basin

North Arapahoe Tributary Basin

South Arapahoe Tributary Basin

Chenango Tributary Basin

Tagawa Tributary Basin

Kragelund Tributary Basin

17 Mile Tributary Basin

LEGEND

- Tributaries
- Cherry Creek
- Other Streams
- Watershed Boundary
- Subcatchment Boundary
- XXX Subcatchment ID
- Subcatchment ID / Subcatchment Data / Existing % Impervious / Future % Impervious / Area (acre)

SWMM Routing Elements

- Design Point
- Outfall
- Conveyance
- Detention

UDFCD Land Use (% Imperviousness)

- Undeveloped Areas (2%)
- Parks, cemeteries (10%)
- Single Family, 2.5 acres or larger (12%)
- Single Family, 0.75-2.5 acres (20%)
- Single Family, 0.25-0.75 acres (30%)
- Single Family, 0.25 acres or less (45%)
- Schools (55%)
- Business, Suburban (75%)
- Apartments (75%)
- Industrial, light (80%)
- Business, Downtown (95%)
- Open Water (100%)
- Streets, paved (100%)

Note: Existing Conditions = Future Conditions for all basins except 17 Mile and Kragelund.

Hydrologic Soil Group

- A
- B
- C
- D

Horizontal/Vertical Datum: NAD 1983 CO State Plane Central (US Feet)/ NAVD 88

Topography: 2014 post-flood LiDAR acquired by FEMA, USGS, DRCOG and CWCB; provided by UDFCD (Contour Interval: 1 foot)

Aerial Imagery: Esri World Imagery Basemap

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Designed By: AB
Drawn By: HH
Checked By: KC/DE
Date: 02/2019

N

0 1,500 3,000
Scale in Feet

1 inch = 3,000 feet

URBAN DRAINAGE AND FLOOD CONTROL DISTRICT, SOUTHEAST METRO STORMWATER AUTHORITY, CITY OF AURORA, AND ARAPAHOE COUNTY

CHERRY CREEK MINOR TRIBUTARIES IN ARAPAHOE COUNTY

BASELINE HYDROLOGY MAP

FIGURE B-1

Notes:
1) Land use information shown on this map was sourced from shapefiles provided by or downloaded from each jurisdiction in 2018. See Figure B-1 Baseline Hydrology Map in Appendix B for final imperviousness values used in the Baseline Hydrology for this study. All basins, except for Kragelund and 17 Mile, are assumed to be fully built-out; therefore only future conditions analysis were evaluated for most basins.
2) Existing land use for Kragelund and 17 Mile was, in contrast, determined by aerial imagery and Arapahoe County parcel data.

LEGEND

- Arapahoe County Land Use
- City of Aurora Zoning
- Arapahoe County Parcels
- Centennial Zoning
- Arapahoe County Zoning
- Arapahoe County Parks and Public Space
- Arapahoe County Lakes
- Centennial NEXT
- Douglas County Zoning
- SEMSWA Detention Water Quality
- Tributaries
- Subcatchment ID
- Tributary Watershed
- Subcatchments

Preliminary Sources:

Centennial. "Centennial NEXT Future Land Use Map [Draft]." 2018.

City of Aurora. Zoning.shp [Shapefile Geospatial Data]. Downloaded from https://data-auroraco.opendata.arcgis.com/, November 2018.

EMK Consultants, Inc. Final Drainage Report for Kings Point Filing 2 [2nd Review]. City of Aurora, Colorado, April 19, 2018.

–. Final Drainage Report for Kings Point Subdivision Filing No. 1 [2nd Review]. City of Aurora, Colorado, May 9, 2018.

Southeast Metro Stormwater Authority. Urban_Service_Area_LU_Complan_Unincorporated_2018.shp [Shapefile Geospatial Data]. Arapahoe County, October 2018

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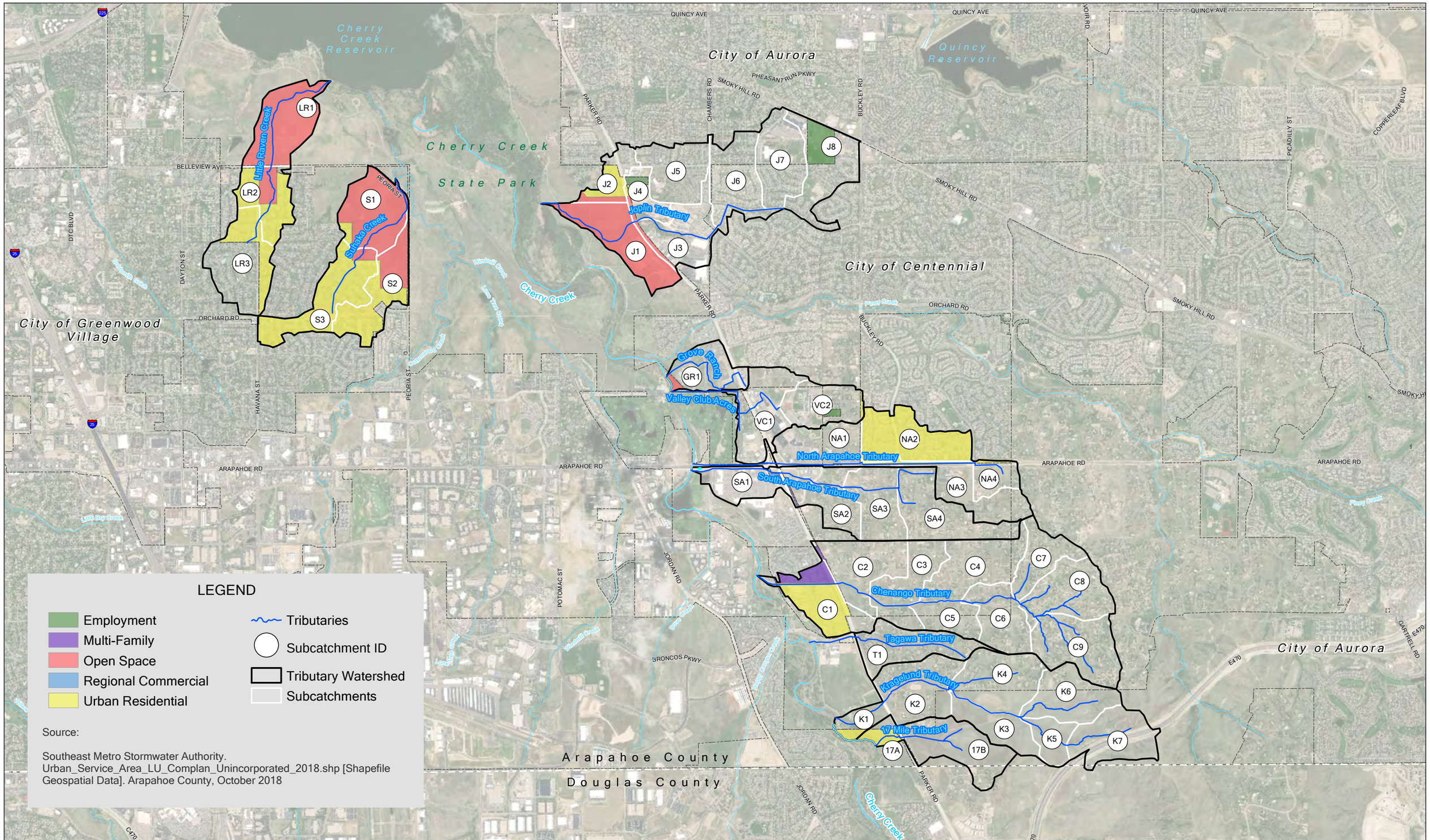
URBAN DRAINAGE AND FLOOD CONTROL DISTRICT, SOUTHEAST METRO STORMWATER AUTHORITY, CITY OF AURORA, AND ARAPAHOE COUNTY

CHERRY CREEK MINOR TRIBUTARIES IN ARAPAHOE COUNTY

FUTURE LAND USE SOURCES

FIGURE B-2



LEGEND

- Employment
- Multi-Family
- Open Space
- Regional Commercial
- Urban Residential
- Tributaries
- Subcatchment ID
- Tributary Watershed
- Subcatchments

Source:

Southeast Metro Stormwater Authority. Urban_Service_Area_LU_Complan_Unincorporated_2018.shp [Shapefile Geospatial Data]. Arapahoe County, October 2018

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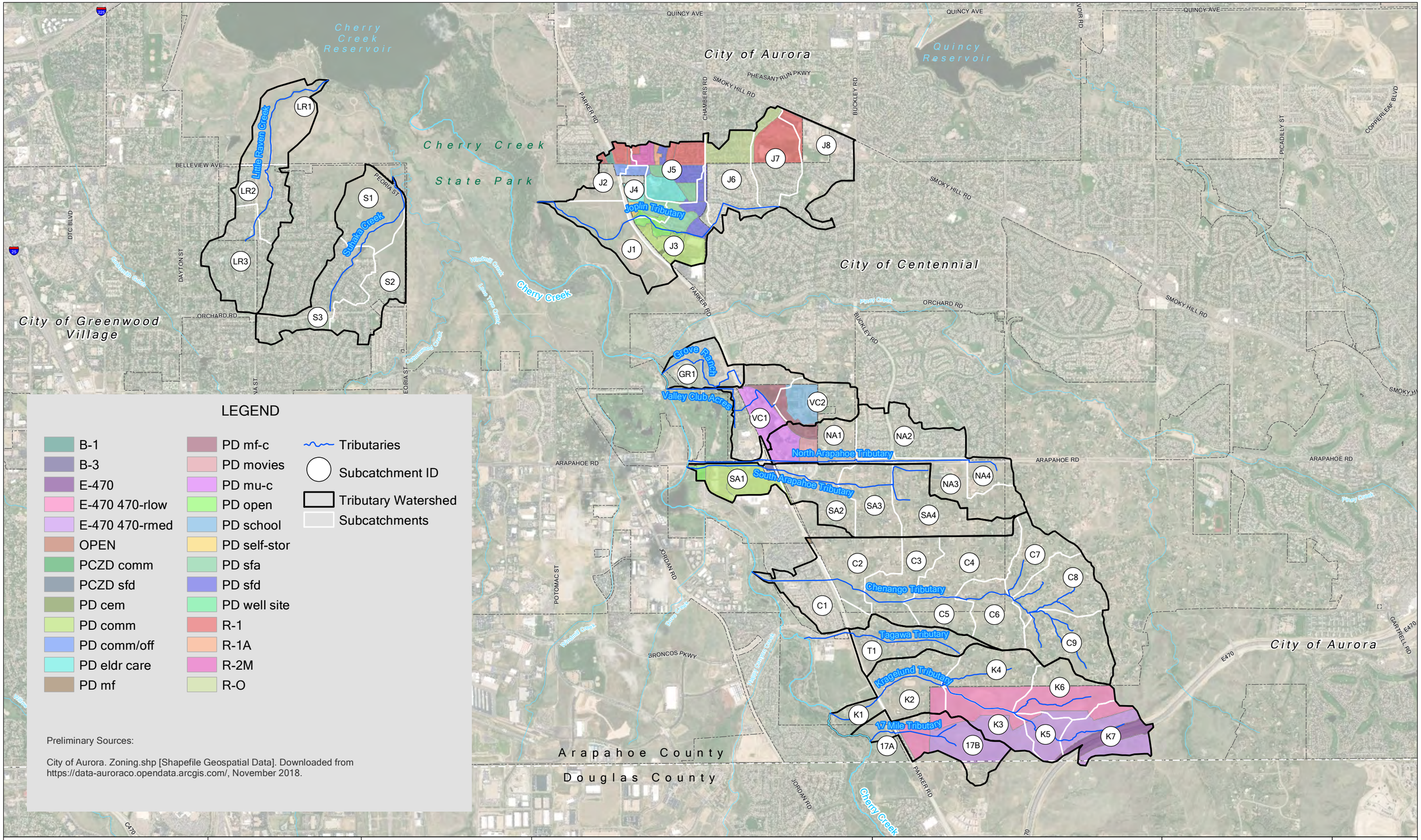
URBAN DRAINAGE AND FLOOD CONTROL DISTRICT, SOUTHEAST METRO STORMWATER AUTHORITY, CITY OF AURORA, AND ARAPAHOE COUNTY

CHERRY CREEK MINOR TRIBUTARIES IN ARAPAHOE COUNTY

ARAPAHOE COUNTY LAND USE DATA

FIGURE B-2



LEGEND

- B-1
- B-3
- E-470
- E-470 470-rlow
- E-470 470-rmed
- OPEN
- PCZD comm
- PCZD sfd
- PD cem
- PD comm
- PD comm/off
- PD eldr care
- PD mf
- PD mf-c
- PD movies
- PD mu-c
- PD open
- PD school
- PD self-stor
- PD sfa
- PD sfd
- PD well site
- R-1
- R-1A
- R-2M
- R-O

- Tributaries
- Subcatchment ID
- Tributary Watershed
- Subcatchments

Preliminary Sources:

City of Aurora. Zoning.shp [Shapefile Geospatial Data]. Downloaded from https://data-auroraco.opendata.arcgis.com/, November 2018.

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URBAN DRAINAGE AND FLOOD CONTROL DISTRICT, SOUTHEAST METRO STORMWATER AUTHORITY, CITY OF AURORA, AND ARAPAHOE COUNTY

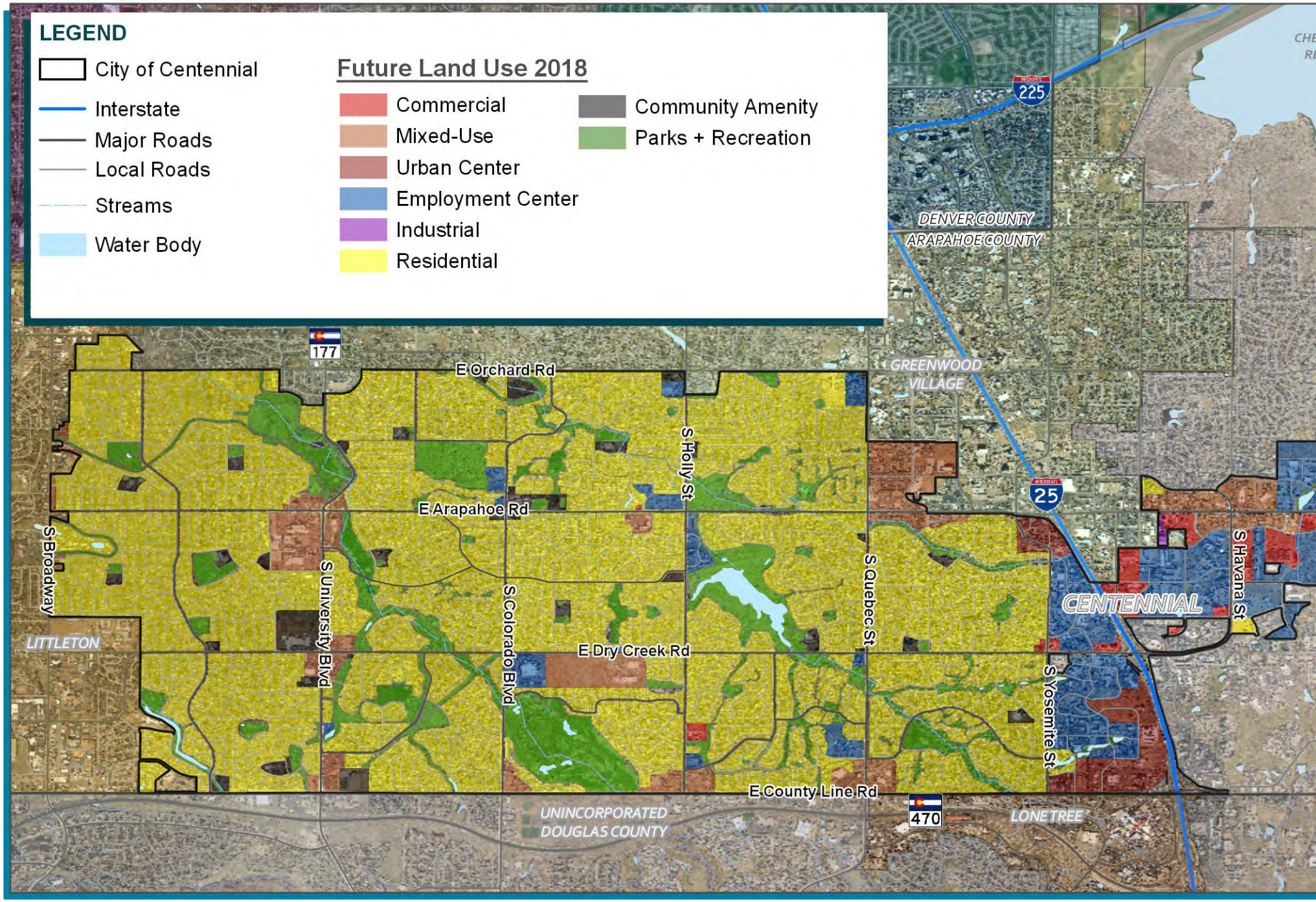
CHERRY CREEK MINOR TRIBUTARIES IN ARAPAHOE COUNTY

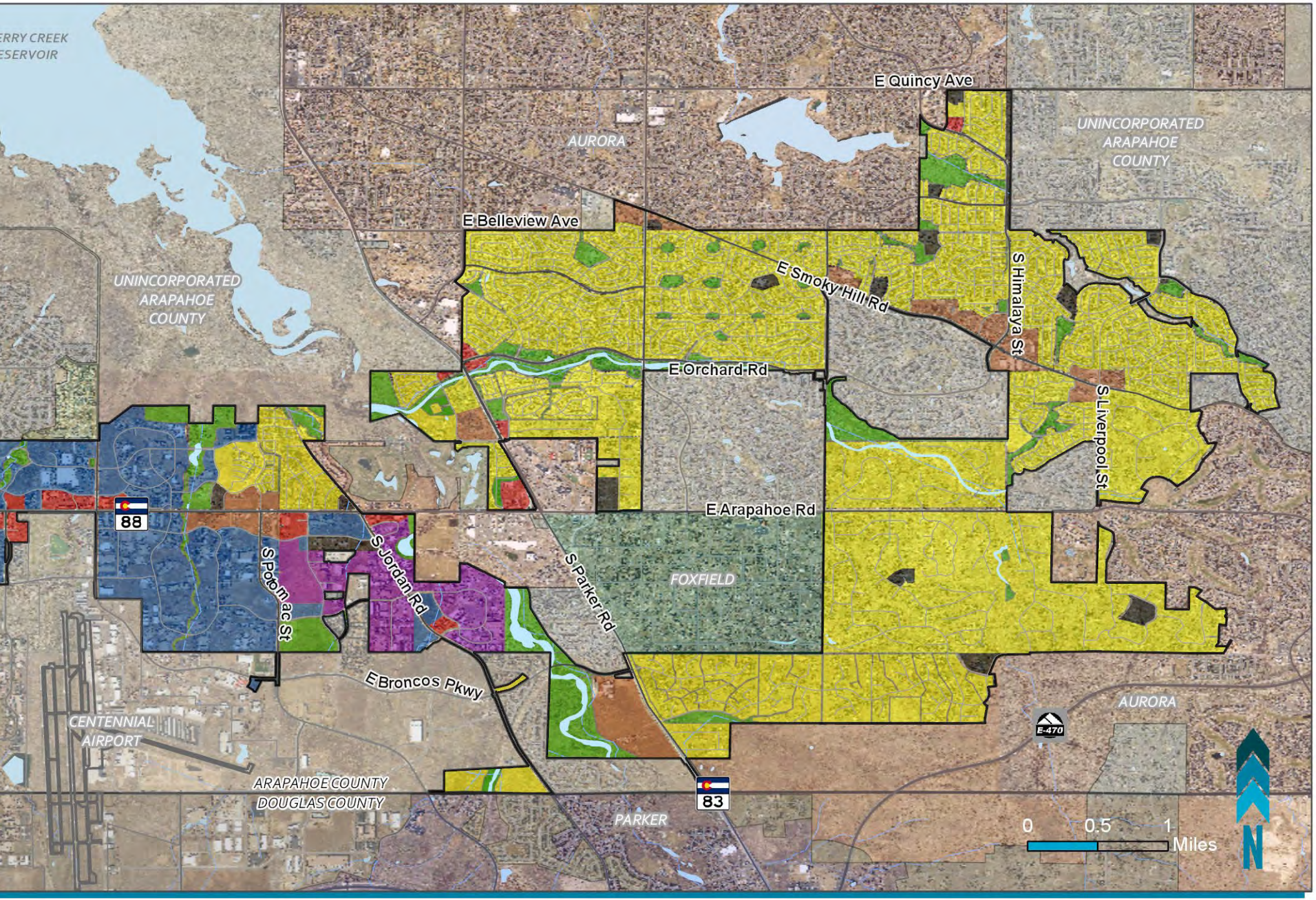
CITY OF AURORA ZONING DATA

FIGURE B-2

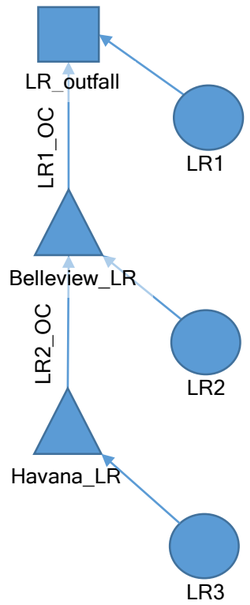
Sheet 3 of 3

FUTURE LAND USE MAP

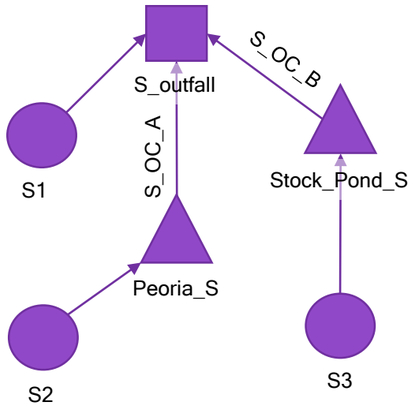



ERRY CREEK
ESERVOIR
AURORA
E Quincy Ave
UNINCORPORATED
ARAPAHOE
COUNTY
E Belleview Ave
E Smoky Hill Rd
S Himalaya St
UNINCORPORATED
ARAPAHOE
COUNTY
E Orchard Rd
S Liverpool St
88
E Arapahoe Rd
S Potomac St
S Jordan Rd
S Parker Rd
FOXFIELD
E Broncos Pkwy
AURORA
E-470
CENTENNIAL
AIRPORT
ARAPAHOE COUNTY
DOUGLAS COUNTY
83
PARKER
0
0.5
1
Miles
N

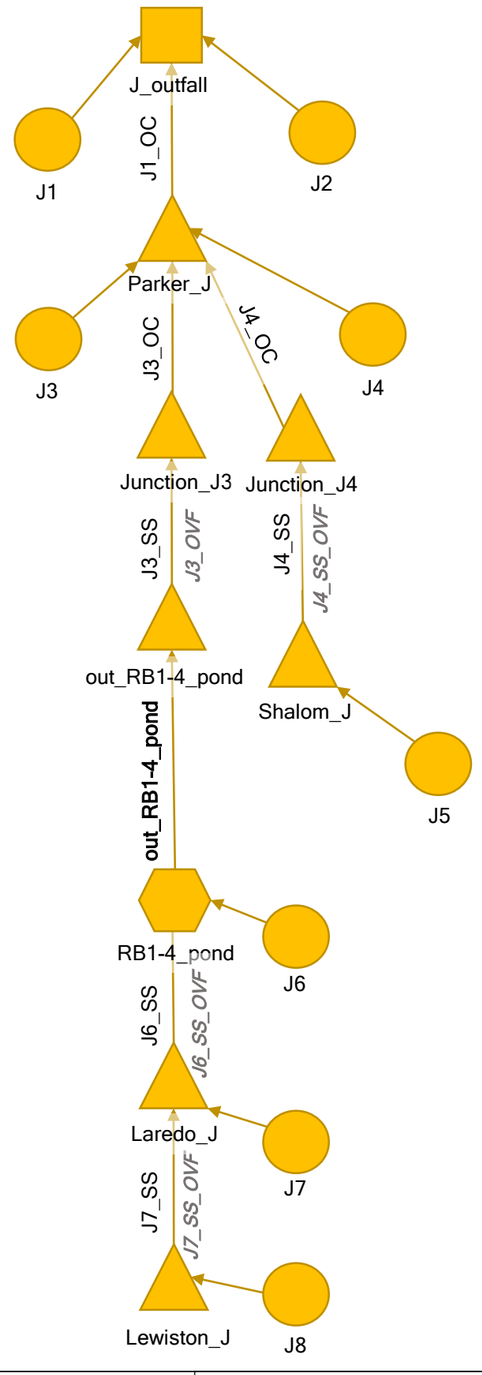
Little Raven Creek



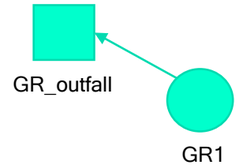
Suhaka Creek



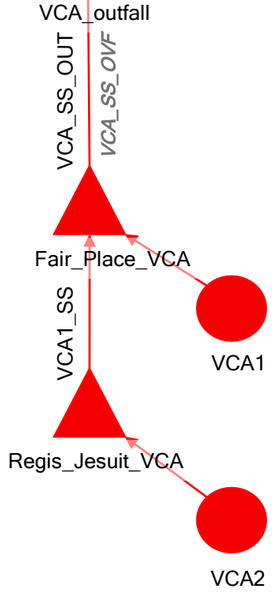
Joplin Tributary



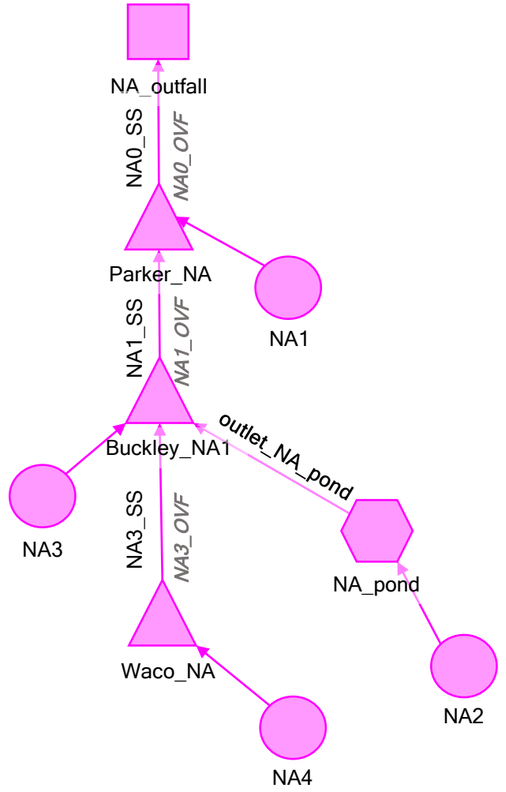
Grove Ranch Tributary



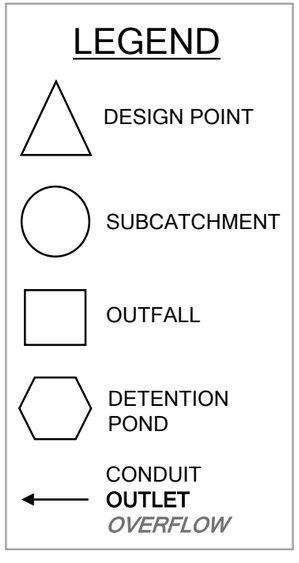
Valley Club Acres Tributary



North Arapahoe Tributary



LEGEND



Dewberry | J3
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Greenwood Village, CO 80111
O 303-368-5601
www.dewberry.com

Designed By: AB
Drawn By: HH
Checked By: KC/DE
Date: 02/2019

NOT TO SCALE

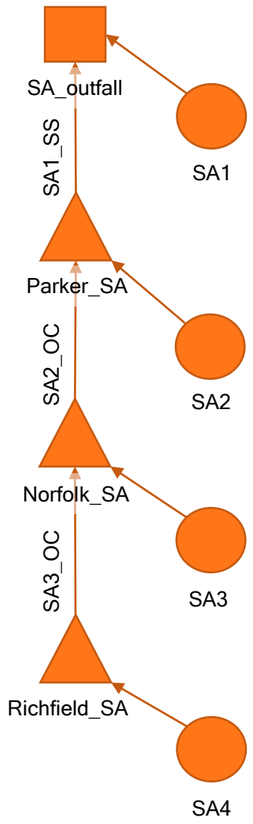
URBAN DRAINAGE AND FLOOD CONTROL DISTRICT,
SOUTHEAST METRO STORMWATER AUTHORITY,
CITY OF AURORA, AND ARAPAHOE COUNTY

CHERRY CREEK TRIBUTARIES
UPSTREAM OF CHERRY CREEK RESERVOIR
MDP & FHAD

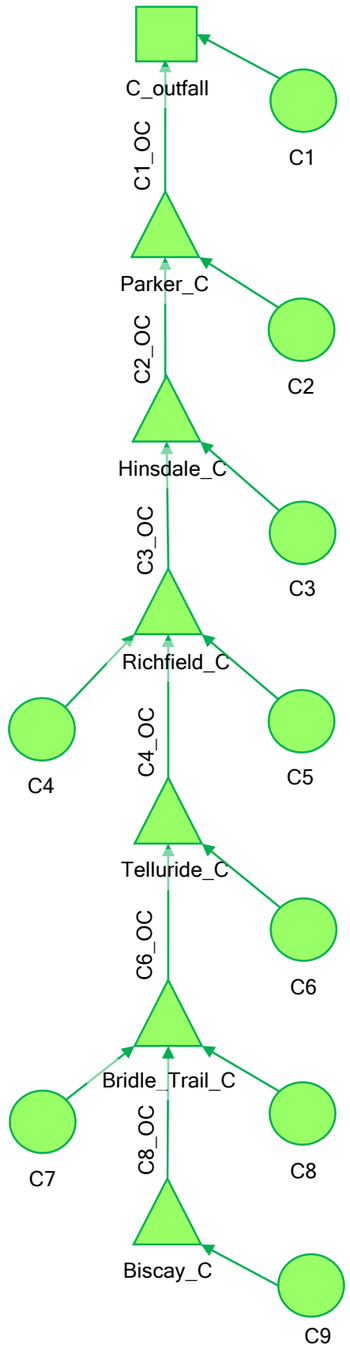
SWMM ROUTING SCHEMATIC

FIGURE B-3

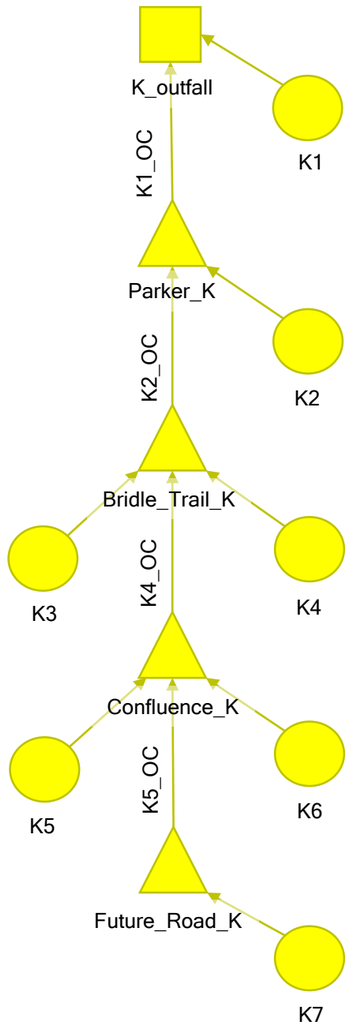
South Arapahoe Tributary



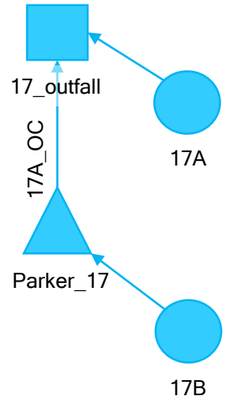
Chenango Tributary



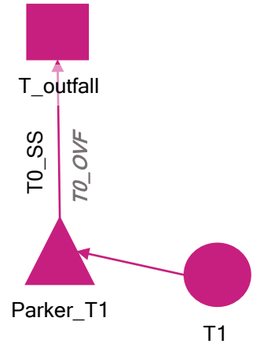
Kragelund Tributary



17 Mile Tributary



Tagawa Tributary



LEGEND

- DESIGN POINT
- SUBCATCHMENT
- OUTFALL
- DETENTION POND
- CONDUIT
- **OUTLET**
- *OVERFLOW*

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NOT TO SCALE

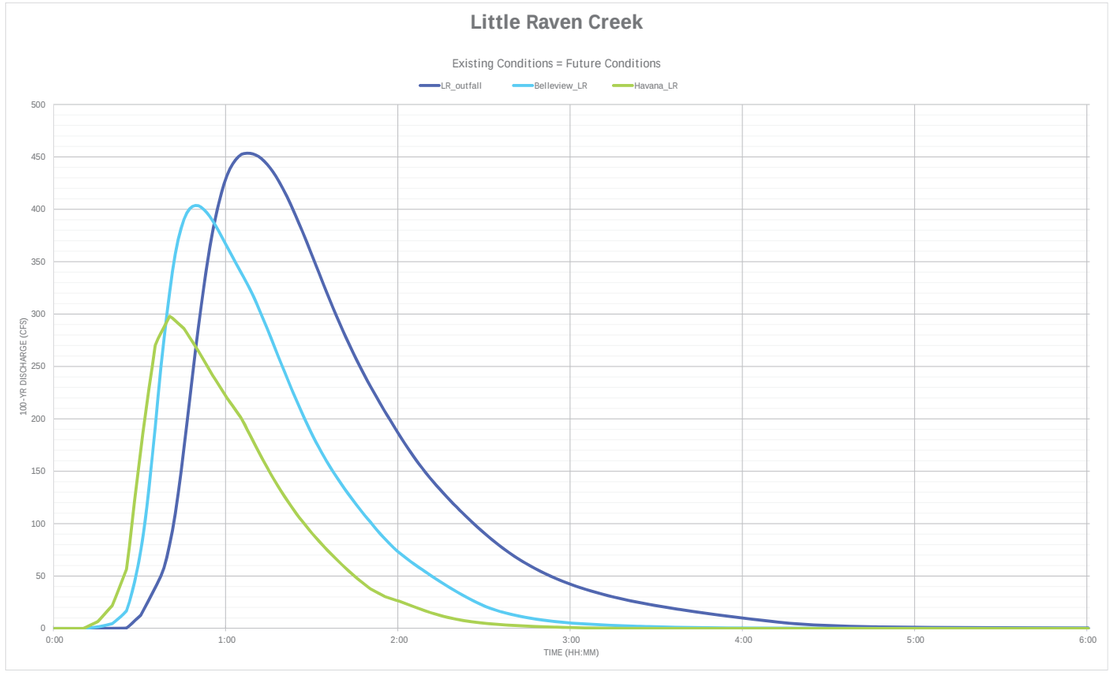
URBAN DRAINAGE AND FLOOD CONTROL DISTRICT,
SOUTHEAST METRO STORMWATER AUTHORITY,
CITY OF AURORA, AND ARAPAHOE COUNTY

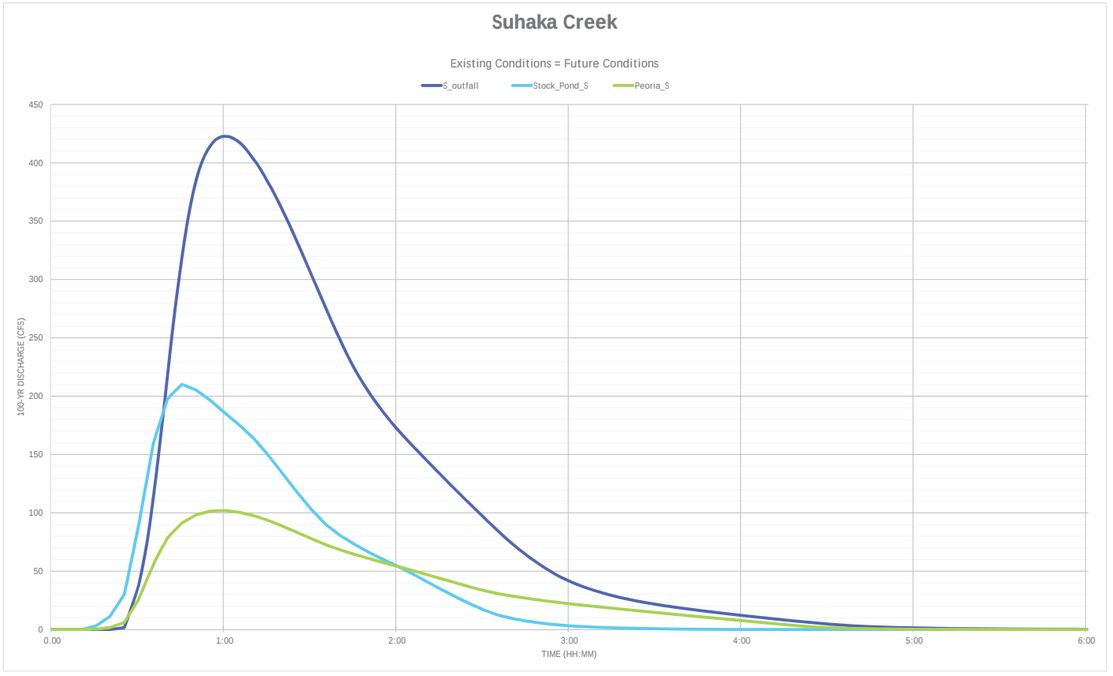
CHERRY CREEK TRIBUTARIES
UPSTREAM OF CHERRY CREEK RESERVOIR
MDP & FHAD

SWMM ROUTING SCHEMATIC

FIGURE
B-3
Sheet 2 of 2

Figure B-4. Baseline Hydrographs





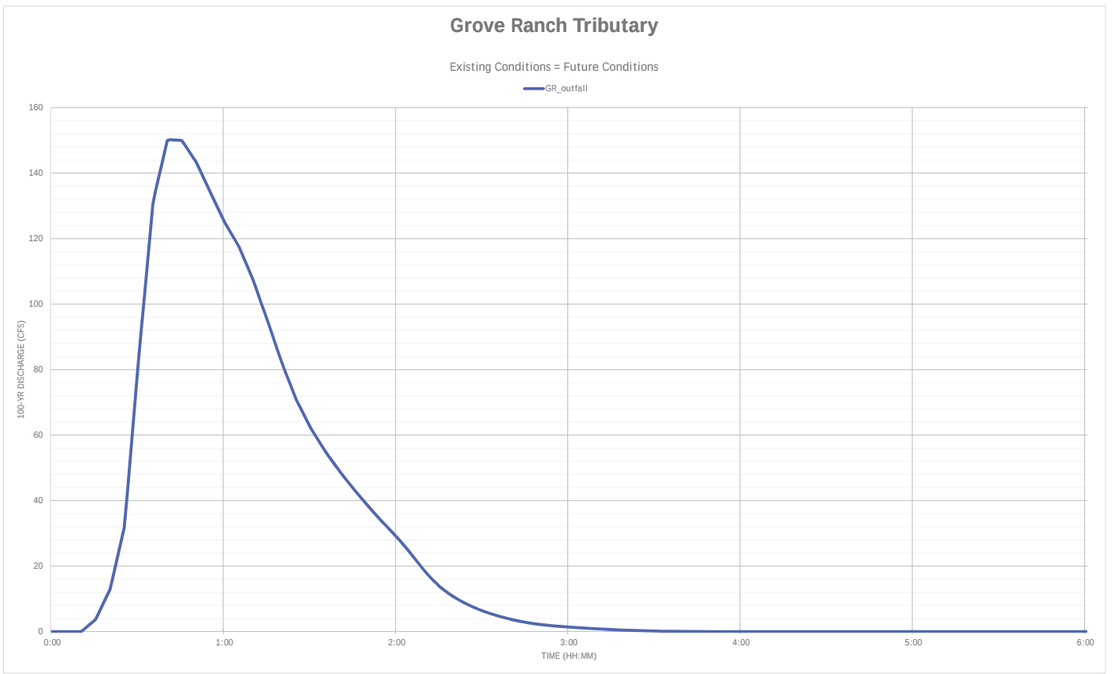
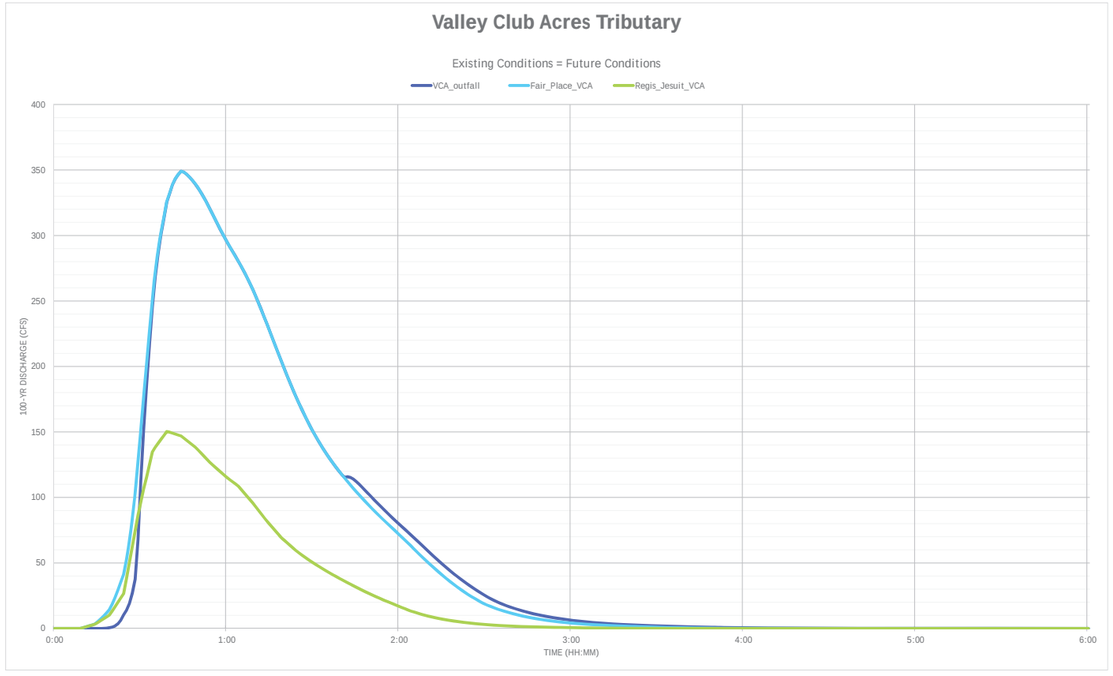
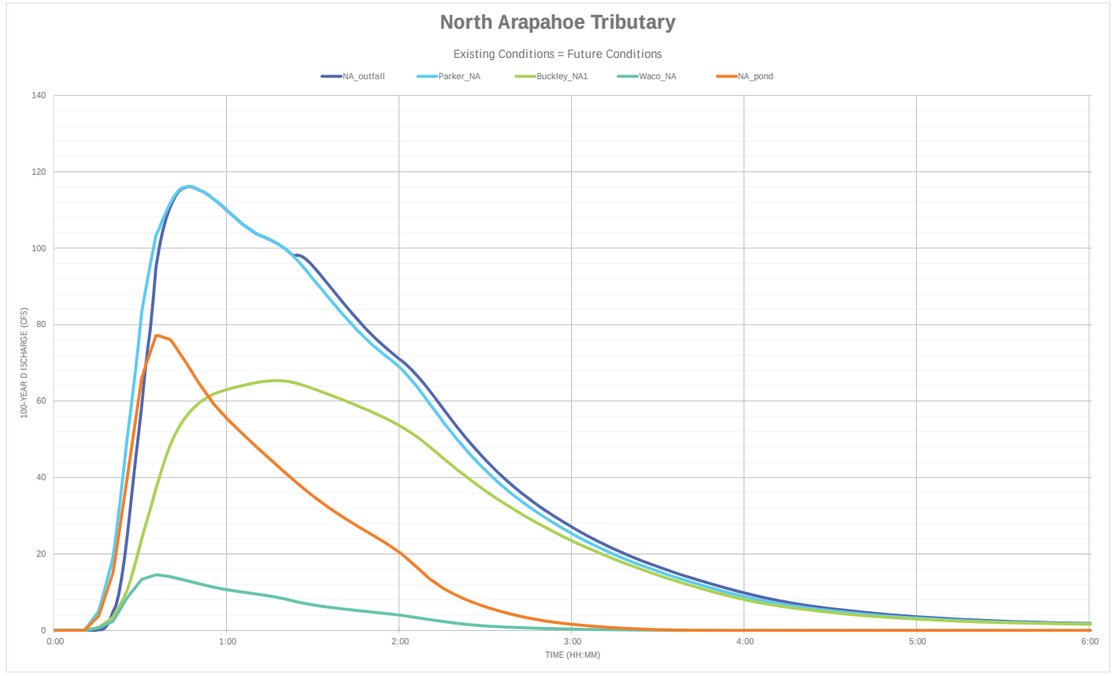
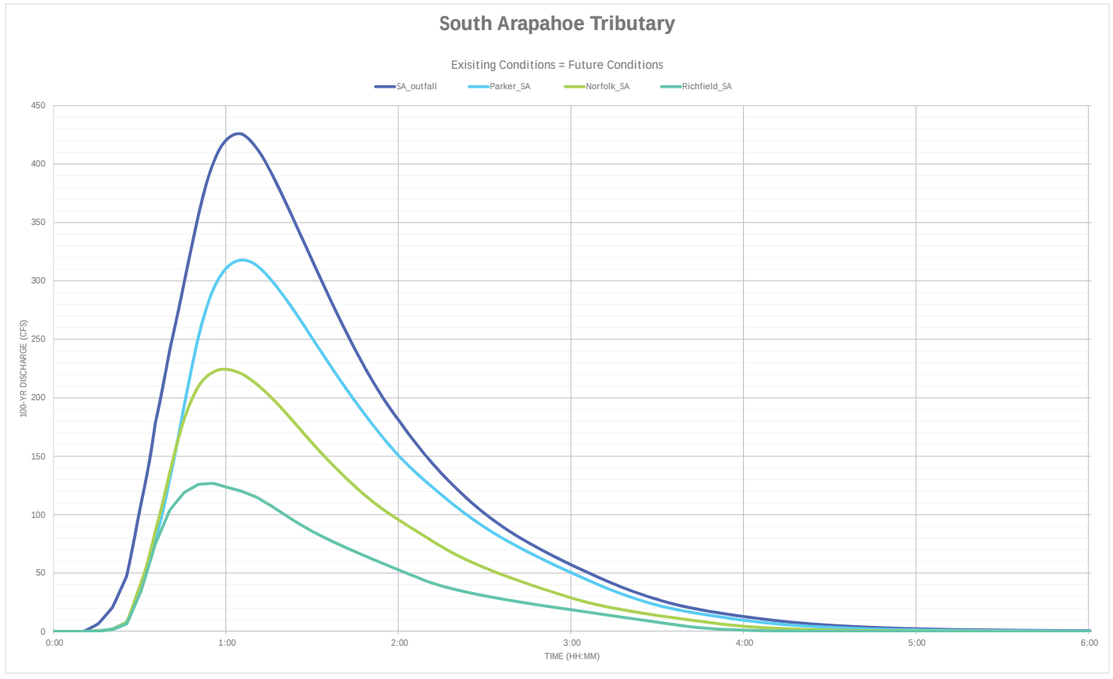


Figure B-4. Baseline Hydrographs







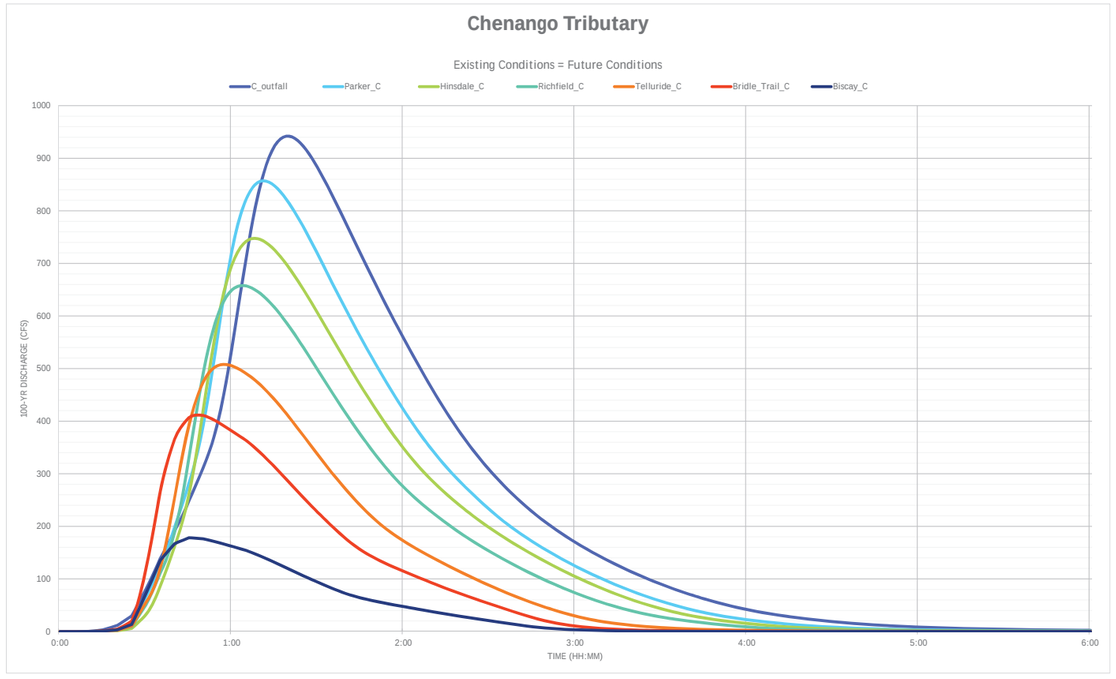
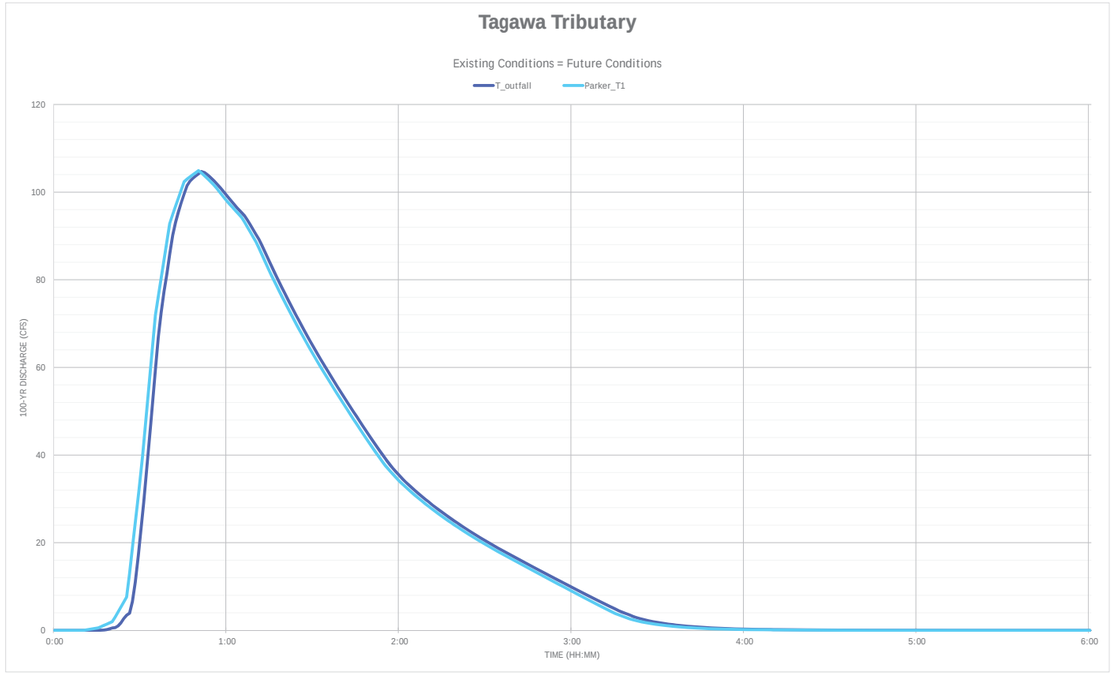
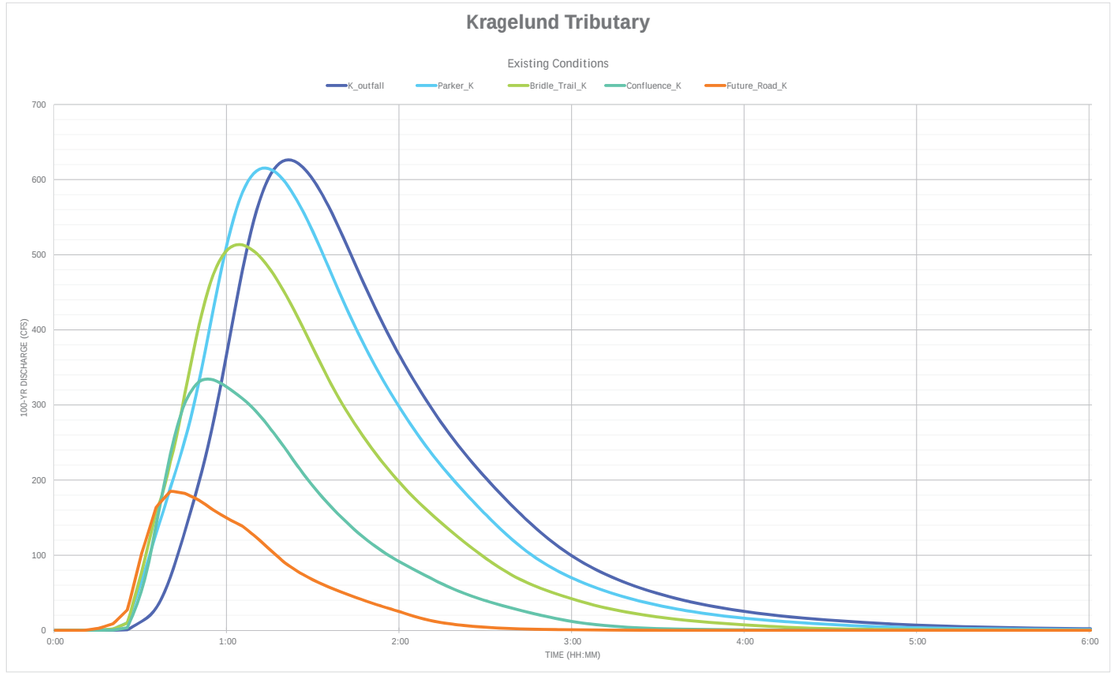
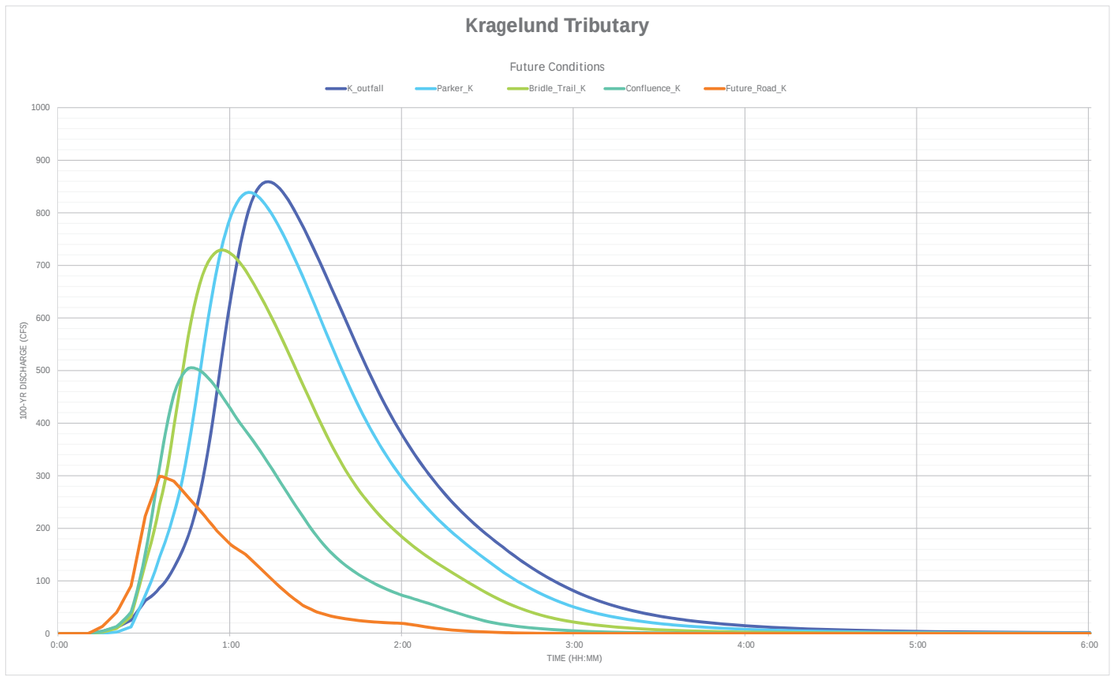


Figure B-4. Baseline Hydrographs







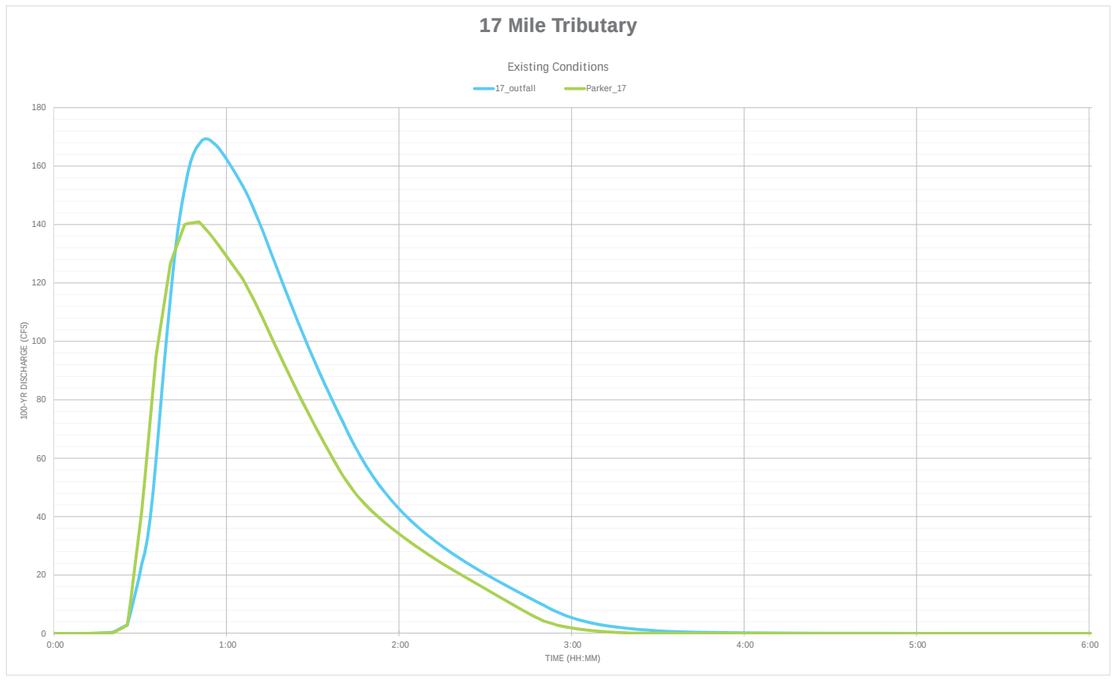


Figure B-4. Baseline Hydrographs

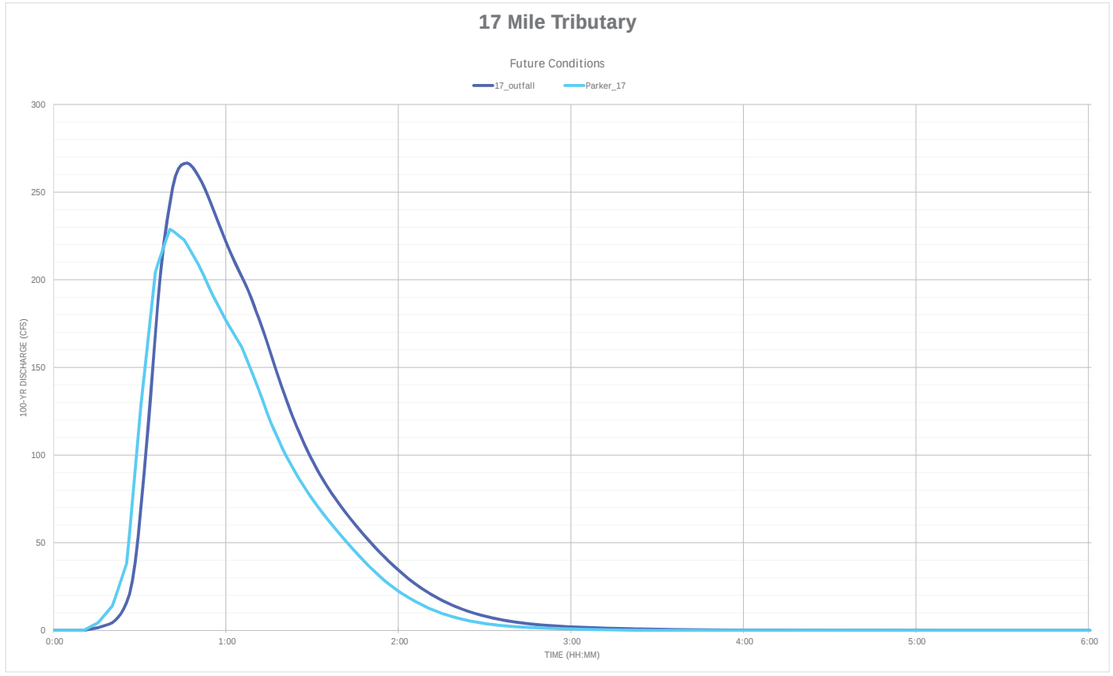
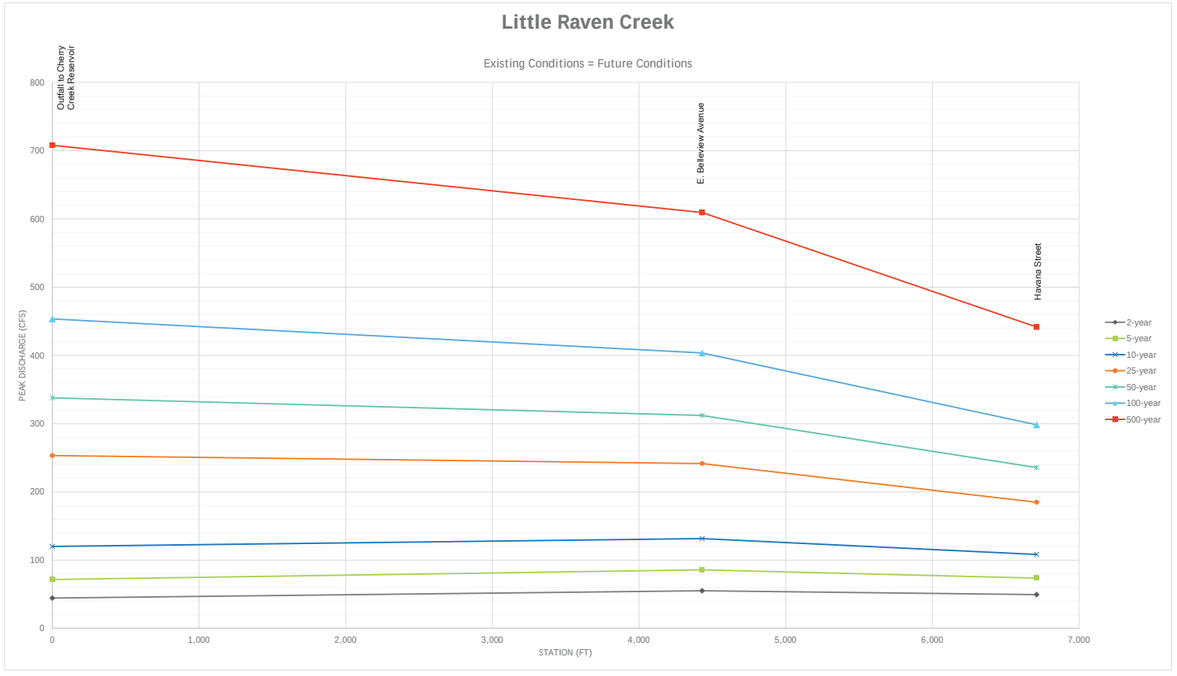
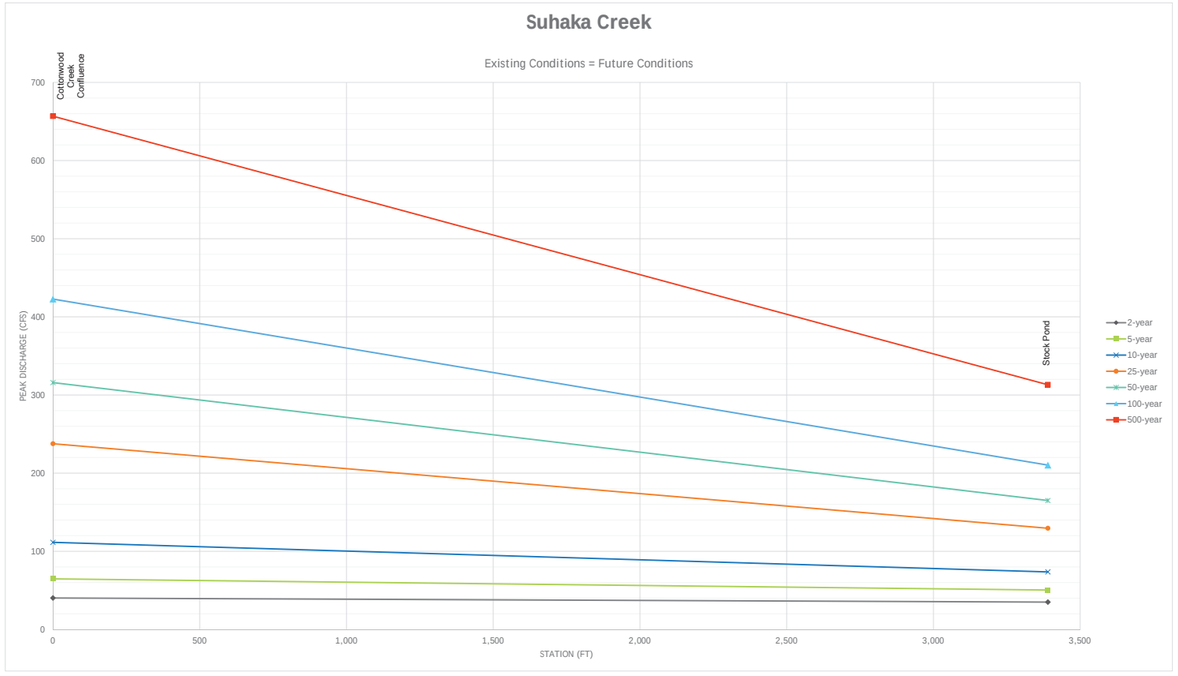
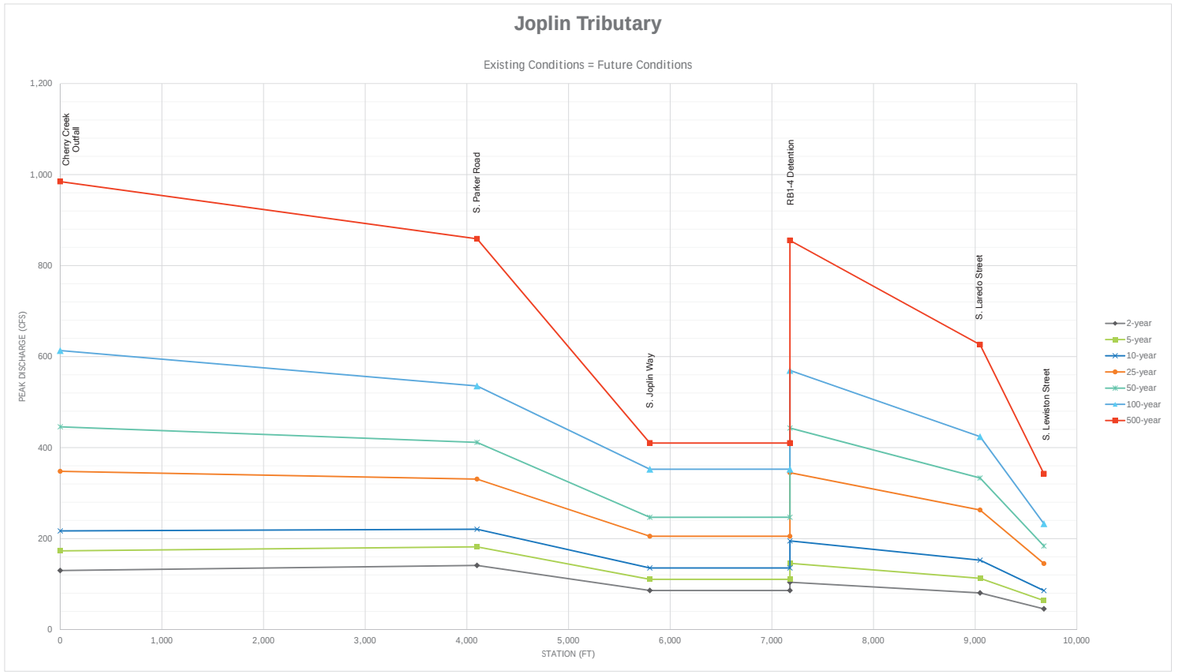


Figure B-5. Baseline Peak Flow Profiles







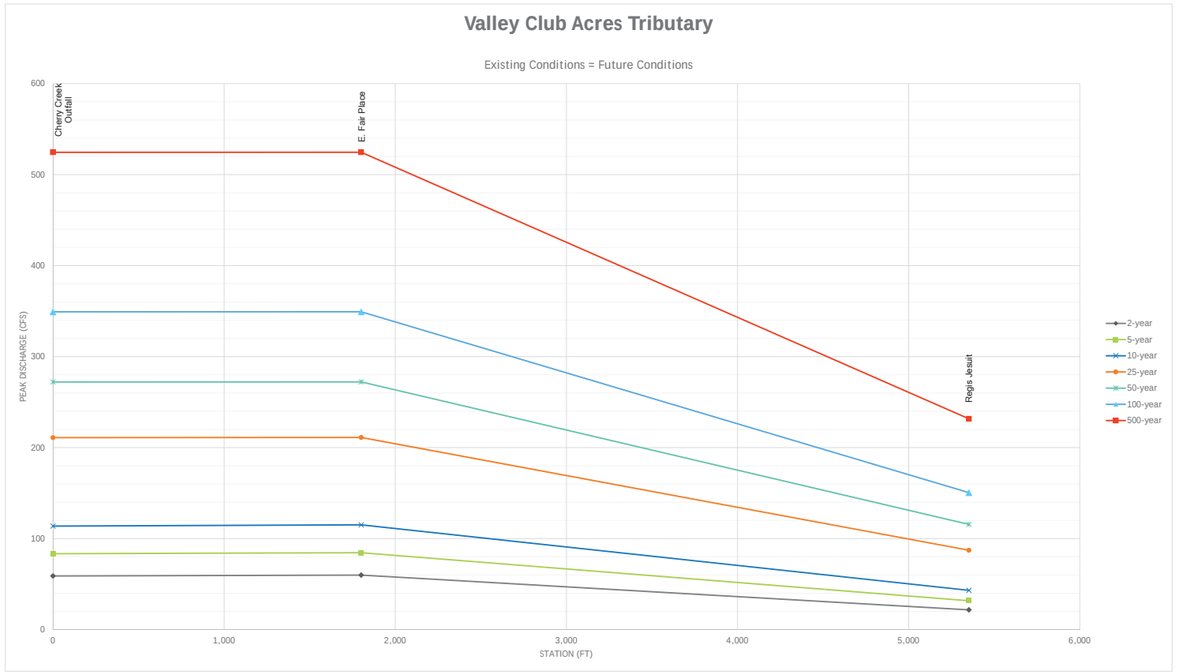
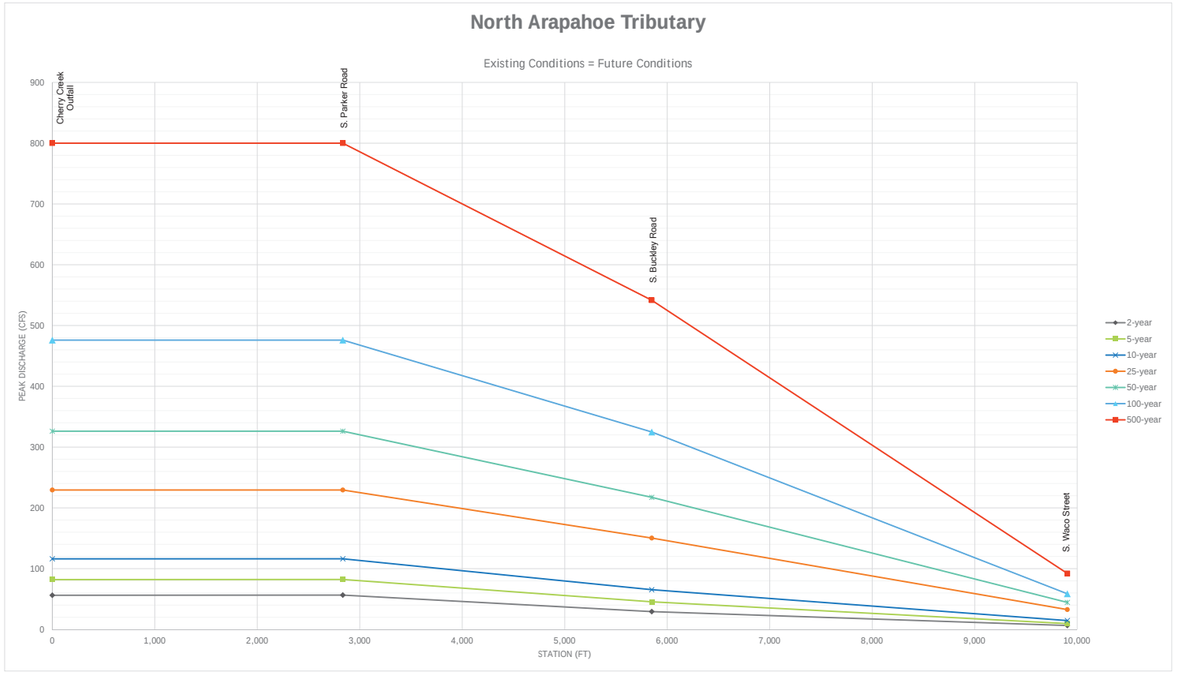
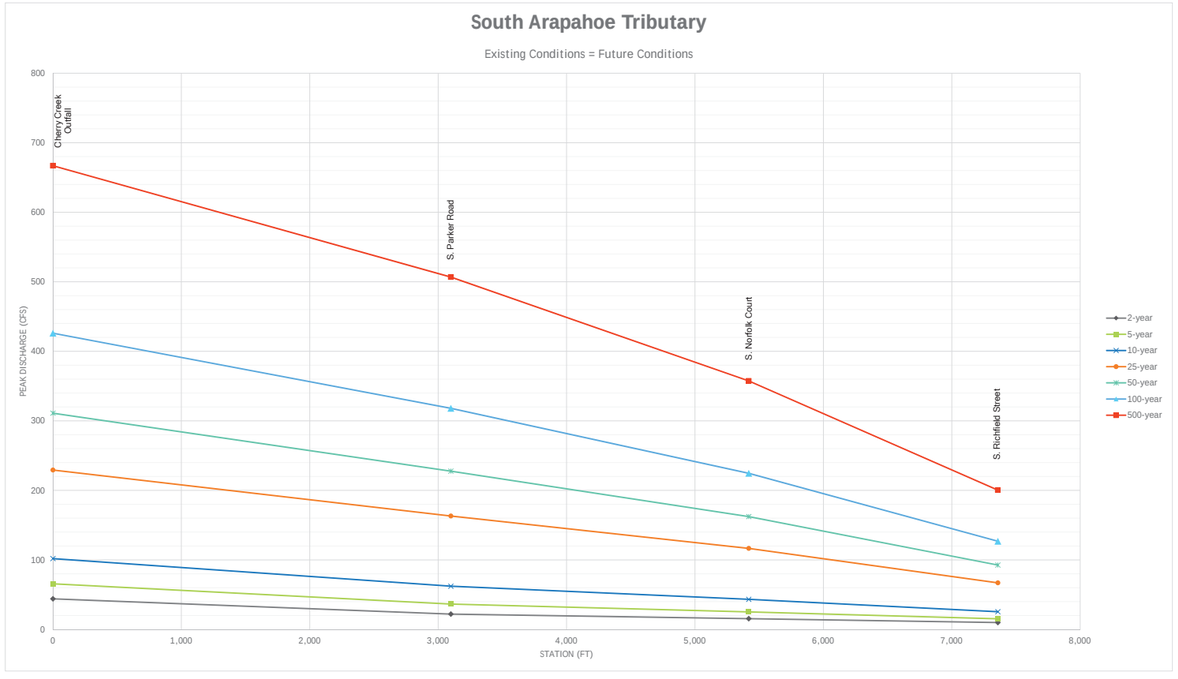
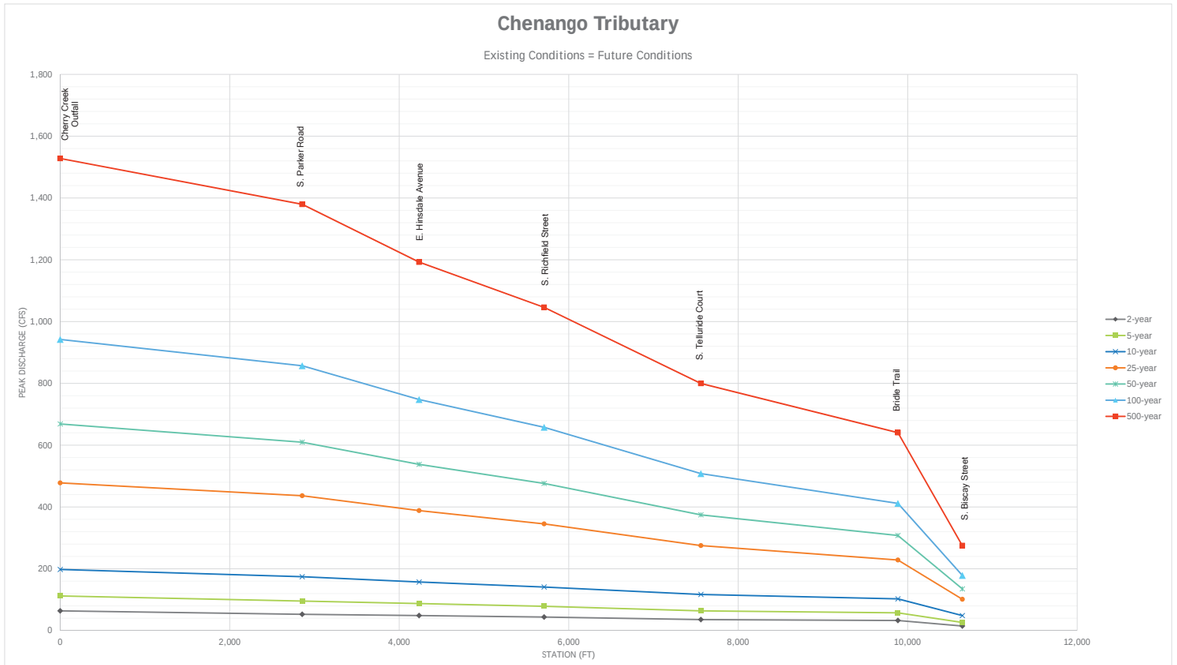


Figure B-5. Baseline Peak Flow Profiles







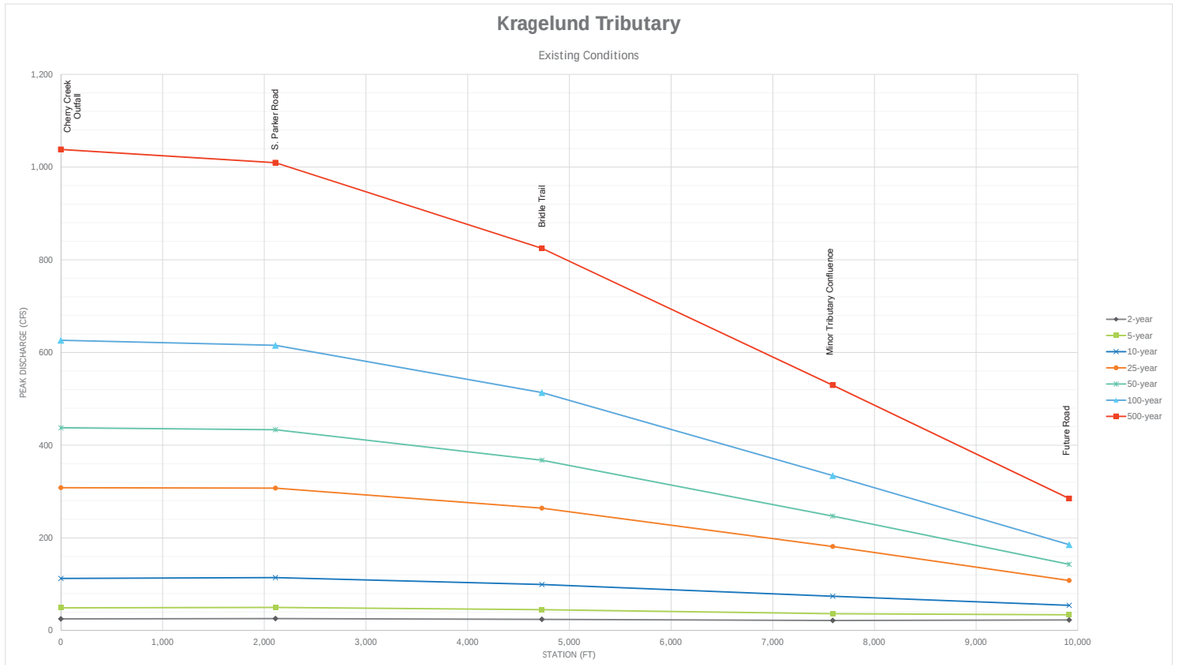


Figure B-5. Baseline Peak Flow Profiles

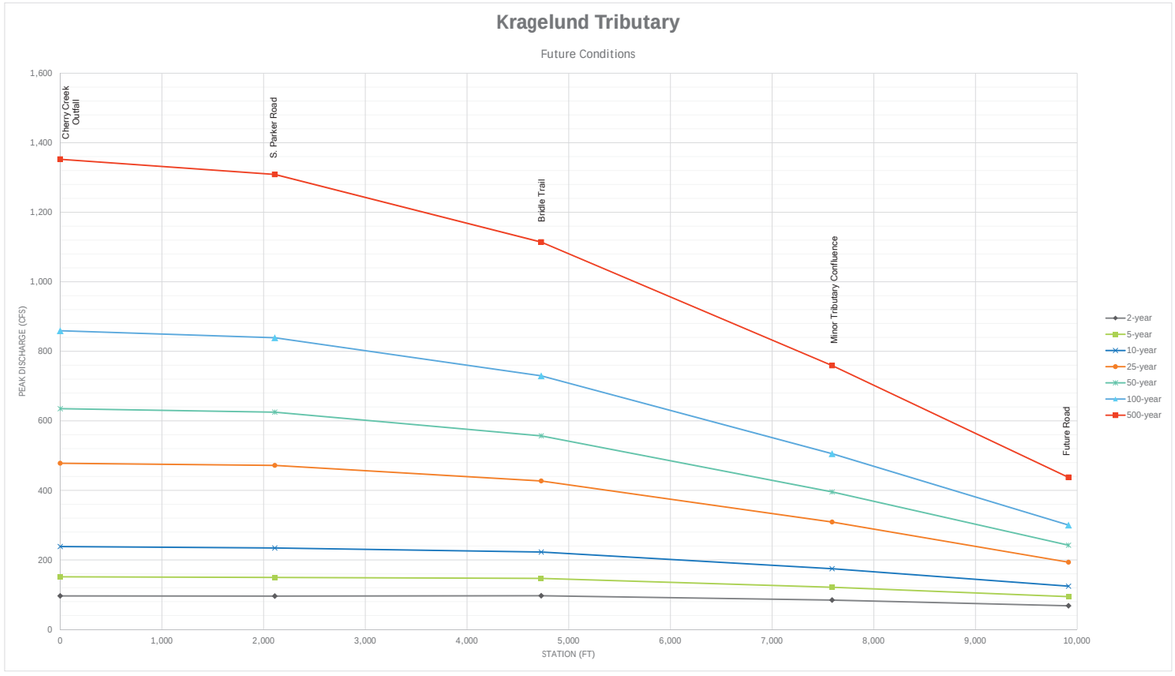


Table B-1. Rainfall Distributions

Comment	Cherry Creek Trib Water Qual	
1 Hr Depth	0.6	
Return Period	WQ	
Time	**Depth**	**CurveValue**
0:05	0.012	0.020
0:10	0.024	0.040
0:15	0.050	0.084
0:20	0.096	0.160
0:25	0.150	0.250
0:30	0.084	0.140
0:35	0.038	0.063
0:40	0.030	0.050
0:45	0.018	0.030
0:50	0.018	0.030
0:55	0.018	0.030
1:00	0.018	0.030
1:05	0.018	0.030
1:10	0.012	0.020
1:15	0.012	0.020
1:20	0.012	0.020
1:25	0.012	0.020
1:30	0.012	0.020
1:35	0.012	0.020
1:40	0.012	0.020
1:45	0.012	0.020
1:50	0.012	0.020
1:55	0.006	0.010
2:00	0.006	0.010
2:05	0.000	0.000

Comment	Cherry Creek Trib 1YR	
1 Hr Depth	0.721	
Return Period	1 Year*	
Time	**Depth**	**CurveValue**
0:05	0.014	0.020
0:10	0.029	0.040
0:15	0.061	0.084
0:20	0.115	0.160
0:25	0.180	0.250
0:30	0.101	0.140
0:35	0.045	0.063
0:40	0.036	0.050
0:45	0.022	0.030
0:50	0.022	0.030
0:55	0.022	0.030
1:00	0.022	0.030
1:05	0.022	0.030
1:10	0.014	0.020
1:15	0.014	0.020
1:20	0.014	0.020
1:25	0.014	0.020
1:30	0.014	0.020
1:35	0.014	0.020
1:40	0.014	0.020
1:45	0.014	0.020
1:50	0.014	0.020
1:55	0.007	0.010
2:00	0.007	0.010
2:05	0.000	0.000

Comment	Cherry Creek Trib 2YR	
1 Hr Depth	0.868	
Return Period	2 Years	
Time	**Depth**	**CurveValue**
0:05	0.017	0.020
0:10	0.035	0.040
0:15	0.073	0.084
0:20	0.139	0.160
0:25	0.217	0.250
0:30	0.122	0.140
0:35	0.055	0.063
0:40	0.043	0.050
0:45	0.026	0.030
0:50	0.026	0.030
0:55	0.026	0.030
1:00	0.026	0.030
1:05	0.026	0.030
1:10	0.017	0.020
1:15	0.017	0.020
1:20	0.017	0.020
1:25	0.017	0.020
1:30	0.017	0.020
1:35	0.017	0.020
1:40	0.017	0.020
1:45	0.017	0.020
1:50	0.017	0.020
1:55	0.009	0.010
2:00	0.009	0.010
2:05	0.000	0.000

Comment	Cherry Creek Trib 5YR	
1 Hr Depth	1.13	
Return Period	5 Years	
Time	**Depth**	**CurveValue**
0:05	0.023	0.020
0:10	0.042	0.037
0:15	0.098	0.087
0:20	0.173	0.153
0:25	0.283	0.250
0:30	0.147	0.130
0:35	0.066	0.058
0:40	0.050	0.044
0:45	0.041	0.036
0:50	0.041	0.036
0:55	0.034	0.030
1:00	0.034	0.030
1:05	0.034	0.030
1:10	0.034	0.030
1:15	0.028	0.025
1:20	0.025	0.022
1:25	0.025	0.022
1:30	0.025	0.022
1:35	0.025	0.022
1:40	0.017	0.015
1:45	0.017	0.015
1:50	0.017	0.015
1:55	0.017	0.015
2:00	0.015	0.013
2:05	0.000	0.000

Comment	Cherry Creek Trib 10YR	
1 Hr Depth	1.37	
Return Period	10 Years	
Time	**Depth**	**CurveValue**
0:05	0.027	0.020
0:10	0.051	0.037
0:15	0.112	0.082
0:20	0.206	0.150
0:25	0.343	0.250
0:30	0.164	0.120
0:35	0.077	0.056
0:40	0.059	0.043
0:45	0.052	0.038
0:50	0.044	0.032
0:55	0.044	0.032
1:00	0.044	0.032
1:05	0.044	0.032
1:10	0.044	0.032
1:15	0.044	0.032
1:20	0.034	0.025
1:25	0.026	0.019
1:30	0.026	0.019
1:35	0.026	0.019
1:40	0.026	0.019
1:45	0.026	0.019
1:50	0.026	0.019
1:55	0.023	0.017
2:00	0.018	0.013
2:05	0.000	0.000

*The temporal distribution for the 1-hour, 1-year design storm was assumed to be the same as that used by the 2-year design storm distribution as prepared by CUHP and defined in UDSCM Volume 1 Table 5-2.

1-Hour Depths taken from NOAA Atlas 14 Point Precipitation Frequency Estimates

Table B-1. Rainfall Distributions

Comment	Cherry Creek Trib 25YR	
1 Hr Depth	1.73	
Return Period	25 Years	
Time	**Depth**	**CurveValue**
0:05	0.022	0.013
0:10	0.061	0.035
0:15	0.087	0.050
0:20	0.138	0.080
0:25	0.260	0.150
0:30	0.433	0.250
0:35	0.208	0.120
0:40	0.138	0.080
0:45	0.087	0.050
0:50	0.087	0.050
0:55	0.055	0.032
1:00	0.055	0.032
1:05	0.055	0.032
1:10	0.042	0.024
1:15	0.042	0.024
1:20	0.031	0.018
1:25	0.031	0.018
1:30	0.024	0.014
1:35	0.024	0.014
1:40	0.024	0.014
1:45	0.024	0.014
1:50	0.024	0.014
1:55	0.024	0.014
2:00	0.024	0.014
2:05	0.000	0.000

Comment	Cherry Creek Trib 50YR	
1 Hr Depth	2.03	
Return Period	50 Years	
Time	**Depth**	**CurveValue**
0:05	0.026	0.013
0:10	0.071	0.035
0:15	0.102	0.050
0:20	0.162	0.080
0:25	0.305	0.150
0:30	0.508	0.250
0:35	0.244	0.120
0:40	0.162	0.080
0:45	0.102	0.050
0:50	0.102	0.050
0:55	0.065	0.032
1:00	0.065	0.032
1:05	0.065	0.032
1:10	0.049	0.024
1:15	0.049	0.024
1:20	0.037	0.018
1:25	0.037	0.018
1:30	0.028	0.014
1:35	0.028	0.014
1:40	0.028	0.014
1:45	0.028	0.014
1:50	0.028	0.014
1:55	0.028	0.014
2:00	0.028	0.014
2:05	0.000	0.000

Comment	Cherry Creek Trib 100YR	
1 Hr Depth	2.36	
Return Period	100 Years	
Time	**Depth**	**CurveValue**
0:05	0.024	0.010
0:10	0.071	0.030
0:15	0.109	0.046
0:20	0.189	0.080
0:25	0.330	0.140
0:30	0.590	0.250
0:35	0.330	0.140
0:40	0.189	0.080
0:45	0.146	0.062
0:50	0.118	0.050
0:55	0.094	0.040
1:00	0.094	0.040
1:05	0.094	0.040
1:10	0.047	0.020
1:15	0.047	0.020
1:20	0.028	0.012
1:25	0.028	0.012
1:30	0.028	0.012
1:35	0.028	0.012
1:40	0.028	0.012
1:45	0.028	0.012
1:50	0.028	0.012
1:55	0.028	0.012
2:00	0.028	0.012
2:05	0.000	0.000

Comment	Cherry Creek Trib 500YR	
1 Hr Depth	3.21	
Return Period	500 Years	
Time	**Depth**	**CurveValue**
0:05	0.032	0.010
0:10	0.096	0.030
0:15	0.148	0.046
0:20	0.257	0.080
0:25	0.449	0.140
0:30	0.803	0.250
0:35	0.449	0.140
0:40	0.257	0.080
0:45	0.199	0.062
0:50	0.161	0.050
0:55	0.128	0.040
1:00	0.128	0.040
1:05	0.128	0.040
1:10	0.064	0.020
1:15	0.064	0.020
1:20	0.039	0.012
1:25	0.039	0.012
1:30	0.039	0.012
1:35	0.039	0.012
1:40	0.039	0.012
1:45	0.039	0.012
1:50	0.039	0.012
1:55	0.039	0.012
2:00	0.039	0.012
2:05	0.000	0.000

CUHP SUBCATCHMENTS

									Maximum Depression Storage (Watershed inches)		Horton's Infiltration Parameters			DCIA
Subcatchment Name	EPA SWMM Target Node	Area (mi^2)	Area (acres)	Length to Centroid (mi)	Length (mi)	Slope (ft/ft)	% Imprv (Existing)	% Imprv (Future)	Pervious	Impervious	Initial Rate (in/hr)	Decay Coefficient (1/seconds)	Final Rate (in/hr)	Level 0, 1, or 2
17A	17A	0.03	21.8	0.10	0.22	0.034	13.68	36.05	0.40	0.10	3.645	0.0017	0.561	0
17B	17B	0.19	123.7	0.38	0.74	0.046	6.62	36.21	0.40	0.10	4.489	0.0018	0.599	0
NA1	NA1	0.16	99.8	0.38	0.81	0.030	--	50.61	0.40	0.10	4.385	0.0018	0.592	0
NA2	NA2	0.20	127.8	0.44	0.82	0.017	--	44.93	0.40	0.10	4.500	0.0018	0.600	0
NA3	NA3	0.16	102.9	0.86	1.39	0.021	--	40.69	0.40	0.10	4.582	0.0016	0.665	0
NA4	NA4	0.06	41.3	0.18	0.48	0.029	--	28.24	0.40	0.10	4.545	0.0017	0.636	0
SA1	SA1	0.11	70.1	0.40	0.74	0.022	--	69.54	0.40	0.10	3.344	0.0018	0.523	0
SA2	SA2	0.15	98.5	0.40	0.94	0.027	--	24.33	0.40	0.10	4.500	0.0018	0.600	0
SA3	SA3	0.15	94.8	0.33	0.73	0.024	--	20.01	0.40	0.10	4.500	0.0018	0.600	0
SA4	SA4	0.21	132.2	0.40	1.22	0.024	--	20.01	0.40	0.10	4.532	0.0017	0.625	0
C1	C1	0.17	106.2	0.55	0.97	0.021	--	49.45	0.40	0.10	3.737	0.0017	0.589	0
C2	C2	0.18	117.0	0.30	0.71	0.031	--	18.67	0.40	0.10	4.500	0.0018	0.600	0
C3	C3	0.16	101.5	0.42	0.93	0.024	--	20.00	0.40	0.10	4.209	0.0018	0.581	0
C4	C4	0.20	125.6	0.59	1.13	0.031	--	20.00	0.40	0.10	4.614	0.0015	0.700	0
C5	C5	0.09	54.7	0.36	0.64	0.036	--	20.00	0.40	0.10	3.130	0.0018	0.509	0
C6	C6	0.14	91.7	0.32	0.66	0.039	--	20.00	0.40	0.10	3.346	0.0017	0.560	0
C7	C7	0.11	72.1	0.38	0.64	0.052	--	20.00	0.40	0.10	3.780	0.0014	0.695	0
C8	C8	0.18	116.1	0.46	0.70	0.051	--	20.00	0.40	0.10	3.000	0.0018	0.500	0
C9	C9	0.21	132.2	0.42	0.83	0.048	--	20.00	0.40	0.10	3.002	0.0018	0.500	0
GR1	GR1	0.13	80.7	0.38	0.84	0.017	--	53.51	0.40	0.10	3.472	0.0018	0.544	0
J1	J1	0.19	119.8	0.64	1.13	0.015	--	2.66	0.40	0.10	3.885	0.0015	0.674	0
J2	J2	0.08	50.9	0.44	0.77	0.033	--	28.20	0.40	0.10	4.825	0.0010	0.880	0
J3	J3	0.17	106.0	0.36	0.89	0.028	--	54.12	0.40	0.10	4.804	0.0011	0.844	0
J4	J4	0.07	45.2	0.20	0.47	0.030	--	42.83	0.40	0.10	5.000	0.0007	1.000	0
J5	J5	0.16	100.6	0.37	0.81	0.028	--	40.67	0.40	0.10	4.994	0.0007	0.995	0
J6	J6	0.18	117.2	0.51	1.07	0.017	--	42.07	0.40	0.10	4.743	0.0013	0.794	0
J7	J7	0.17	108.5	0.48	0.77	0.017	--	48.05	0.40	0.10	4.503	0.0018	0.602	0
J8	J8	0.20	125.9	0.49	0.87	0.018	--	51.70	0.40	0.10	4.500	0.0018	0.600	0
LR3	LR3	0.22	140.0	0.35	0.77	0.028	--	42.47	0.40	0.10	3.000	0.0018	0.500	0
LR2	LR2	0.13	84.7	0.27	0.64	0.025	--	28.12	0.40	0.10	3.000	0.0018	0.500	0
LR1	LR1	0.19	123.9	0.50	0.99	0.019	--	2.08	0.40	0.10	3.238	0.0017	0.541	0
K1	K1	0.05	33.6	0.19	0.40	0.022	5.91	59.45	0.40	0.10	3.833	0.0013	0.707	0
K2	K2	0.19	124.3	0.27	0.75	0.027	15.79	18.49	0.40	0.10	3.659	0.0018	0.544	0
K3	K3	0.11	69.2	0.44	0.93	0.035	2.00	38.48	0.40	0.10	3.692	0.0018	0.546	0
K4	K4	0.20	126.4	0.38	0.69	0.042	14.57	22.98	0.40	0.10	3.029	0.0018	0.502	0

Table B-2. CUHP Subcatchment Input Data

									Maximum Depression Storage (Watershed inches)		Horton's Infiltration Parameters			DCIA
Subcatchment Name	EPA SWMM Target Node	Area (mi^2)	Area (acres)	Length to Centroid (mi)	Length (mi)	Slope (ft/ft)	% Imprv (Existing)	% Imprv (Future)	Pervious	Impervious	Initial Rate (in/hr)	Decay Coefficient (1/seconds)	Final Rate (in/hr)	Level 0, 1, or 2
K5	K5	0.07	45.3	0.30	0.53	0.041	4.22	44.80	0.40	0.10	3.545	0.0018	0.536	0
K6	K6	0.16	104.2	0.39	0.79	0.052	7.43	28.42	0.40	0.10	3.322	0.0018	0.521	0
K7	K7	0.17	107.9	0.36	0.72	0.052	31.70	59.55	0.40	0.10	4.005	0.0018	0.567	0
S1	S1	0.19	120.5	0.31	0.70	0.022	--	4.19	0.40	0.10	3.183	0.0018	0.512	0
S2	S2	0.17	108.6	0.63	1.11	0.021	--	26.75	0.40	0.10	3.129	0.0018	0.514	0
S3	S3	0.20	130.7	0.49	1.16	0.024	--	43.13	0.40	0.10	3.114	0.0017	0.529	0
VCA1	VCA1	0.19	120.2	0.42	1.03	0.010	--	51.33	0.40	0.10	4.275	0.0018	0.585	0
VCA2	VCA2	0.14	86.7	0.35	0.61	0.036	--	37.29	0.40	0.10	4.581	0.0016	0.665	0
T1	T1	0.17	74.2	0.38	1.02	0.033	--	21.88	0.40	0.10	4.202	0.0013	0.732	0

North Arapahoe Detention Pond [1] (i.e. Pond E)
Design Point: NA_pond

Stage-Storage			
Elevation	Depth (ft)	Area (SF)	Storage (AF)
5764.6	0.0	2,015	0.00
5765	0.4	4,029	0.03
5766	1.4	7,745	0.16
5767	2.4	13,713	0.41
5768	3.4	19,405	0.79
5769	4.4	28,097	1.33
5770	5.4	47,234	2.20
5771	6.4	60,011	3.43
5772	7.4	65,787	4.87
5773	8.4	65,787	6.38
5774	9.4	65,787	7.89

[1.] A detention rating curve was originally developed from as-built drawings prepared on May 4, 2000 by Aztec and P.R. Fletcher & Associates. However, 2014 LiDAR of the pond data varies significantly from the as-built data and new stage-storage-discharge curves were defined using survey data collected by UDFCD in February 2019. See Section 3.4 DETENTION for more detail.

[2.] Cells highlighted in red are above the surveyed pond top of berm but were included in the Baseline Hydrology SWMM model for continuity of the larger flow events.

Stage-Discharge	
Depth (ft)	Total Discharge (cfs)
0.0	0.0
0.25	0.1
0.5	0.2
0.75	0.2
1.0	0.3
1.25	0.4
1.5	0.5
1.75	0.5
2.0	0.6
2.25	0.7
2.5	0.8
2.75	0.9
3.0	0.9
3.25	1.0
3.5	1.1
3.75	1.4
4.0	2.2
4.25	3.4
4.5	5.1
4.75	7.0
5.0	9.4
5.25	12.1
5.5	15.1
5.75	18.4
6.0	22.1
6.25	26.1
6.5	30.4
6.75	34.2
7.0	36.6
7.25	45.9
7.5	61.5
7.75	81.1
8.0	100.5
8.25	122.4
8.5	173.3
8.75	239.3
9.0	317.3
9.25	405.5
9.4	464.3

RB1-4 Detention Pond [1]
Design Point: RB1-4_pond

Stage-Storage			
Elevation	Depth (ft)	Area (SF)	Storage (AF)
5687.5	0	0	0.00
5688	0.5	328	0.00
5689	1.5	2,222	0.03
5690	2.5	22,311	0.31
5691	3.5	41,170	1.04
5692	4.5	60,321	2.21
5693	5.5	75,858	3.77
5694	6.5	86,332	5.63
5695	7.5	95,521	7.72
5696	8.5	104,107	10.01
5697	9.5	112,990	12.50
5698	10.5	121,937	15.20
5699	11.5	131,448	18.11

[1.] The detention rating curve was developed from as-built drawings prepared for East Cherry Creek Valley (ECCV) Water and Sanitation District on April 28, 1994 (Muller Engineering Co.). The as-built data is assumed to be correct and supersedes data presented in the November 1989 Muller Engineering drainage report.

Stage-Discharge	
Depth (ft)	Total Discharge (cfs)
0	0
9.4	253
11.5	410
11.6	800

RB1-4 REGIONAL DETENTION

BASIN INFORMATION

AS-BUILT

~~CONTRACT~~ DRAWINGS FOR THE CONSTRUCTION OF

BASIN RB1-POND 4
DRAINAGE IMPROVEMENTS

APRIL, 1994

GENERAL NOTES:

1. THE DIRECTOR, DEPARTMENT OF HIGHWAYS/ENGINEERING (COUNTY ENGINEER) STAMP AND SIGNATURE AFFIXED TO THIS DOCUMENT INDICATES THE DEPARTMENT OF HIGHWAYS/ENGINEERING HAS REVIEWED THE DOCUMENT AND FOUND IT IN GENERAL CONFORMANCE WITH THE ARAPAHOE COUNTY SUBDIVISION REGULATIONS, OR APPROVED VARIANCES TO THOSE REGULATIONS. THE DIRECTOR, DONE THROUGH APPROVAL OF THIS DOCUMENT, ASSUMES NO RESPONSIBILITY, OTHER THAN STATED ABOVE, FOR THE COMPLETENESS AND/OR ACCURACY OF THESE DOCUMENTS. THE COUNTY DOES NOT ACCEPT THE LIABILITY FOR FACILITIES DESIGNED BY OTHERS.

2. ALL MATERIALS AND WORKMANSHIP FOR WORK INDICATED "TO BE MAINTAINED BY ARAPAHOE COUNTY" SHALL BE SUBJECT TO INSPECTION BY THE ARAPAHOE COUNTY DEPARTMENT OF HIGHWAYS/ENGINEERING. THE COUNTY RESERVES THE RIGHT TO ACCEPT OR REJECT ANY SUCH MATERIALS AND WORKMANSHIP THAT DOES NOT CONFORM TO ITS STANDARDS AND SPECIFICATIONS. CONCRETE SHALL NOT BE PLACED UNTIL A POUR SLIP HAS BEEN ISSUED. POUR SLIPS WILL NOT BE ISSUED UNLESS THE CONTRACTOR HAS, AT THE JOB SITE, A COPY OF THE APPROVED PLANS BEARING THE SIGNATURE OF THE DIRECTOR, DOHE. IF AN ARAPAHOE COUNTY ENGINEERING INSPECTOR IS NOT AVAILABLE AFTER PROPER NOTICE OF CONSTRUCTION ACTIVITY HAS BEEN PROVIDED, THE PERMITTEE MAY COMMENCE WORK WITHOUT A POUR SLIP. HOWEVER, ARAPAHOE COUNTY RESERVES THE RIGHT NOT TO ACCEPT THE STRUCTURE IF SUBSEQUENT TESTING REVEALS AN IMPROPER INSTALLATION.

3. THE CONTRACTOR SHALL NOTIFY THE ARAPAHOE COUNTY DEPARTMENT OF HIGHWAYS/ENGINEERING INSPECTION SECTION, TELEPHONE NUMBER 795-4640 A MINIMUM OF 48 HOURS AND A MAXIMUM OF 96 HOURS PRIOR TO STARTING CONSTRUCTION.

4. THE CONTRACTOR SHALL HAVE ONE (1) SIGNED COPY OF THE PLANS (APPROVED BY THE DEPARTMENT OF HIGHWAYS/ENGINEERING) AT THE JOB SITE AT ALL TIMES.

5. THE CONTRACTOR SHALL BE RESPONSIBLE FOR THE ACCEPTANCE AND CONTROL OF ALL FLOWS, IN AND ENTERING ALL DRAINAGE FACILITIES AFFECTED BY THIS PROJECT. THE CONTRACTOR SHALL BE RESPONSIBLE FOR TAKING REASONABLE STEPS THROUGH DIKING, DIVERSION PONDING, CONTROL OF EQUIPMENT OPERATIONS AND CONSTRUCTION OF SILT CAPTURING BASINS AS DETAILED ON THE PLANS TO PREVENT POLLUTION OF CHERRY CREEK.

6. LOCATIONS OF UTILITIES REPRESENT THE BEST-KNOWN LOCATIONS AT THE TIME OF PREPARATION OF DRAWINGS. THE CONTRACTOR SHALL FIELD-LOCATE ALL UTILITIES IN ADVANCE OF EXCAVATION. RELOCATION OF UTILITIES MAY OR MAY NOT BE NEEDED AFTER THEY ARE EXPOSED. ACTUAL RELOCATION OF LINES WILL NOT BE THE RESPONSIBILITY OF THE CONTRACTOR; BUT THE CONTRACTOR SHALL COOPERATE WITH UTILITY COMPANIES TO COORDINATE THE RELOCATION EFFORT. LINES NOT RELOCATED SHALL BE PROTECTED BY THE CONTRACTOR IN PLACE. NO ADDITIONAL PAYMENT WILL BE ALLOWED FOR THE MINOR ADJUSTMENT OF STRUCTURES IN ORDER TO CLEAR A CONFLICTING UTILITY. CONTACT UTILITY COMPANIES 48 HOURS IN ADVANCE WHEN WORKING ADJACENT TO THE UTILITY.

U.S. WEST (TELEPHONE)	534-6700
PUBLIC SERVICE (GAS)	534-6700
INTERMOUNTAIN REA (ELECTRIC)	688-3100
WYCO PIPELINE CO. (GAS)	690-8721
EAST CHERRY CREEK VALLEY WATER AND SANITATION DISTRICT(WATER AND SEWER)	693-3800

7. ALL EXPOSED CONCRETE SHALL HAVE A CLASS 2 OR CLASS 5 FINISH. ALL EXPOSED CONCRETE CORNERS SHALL HAVE A 3/4" X 3/4" CHAMFER. CONCRETE IN ALL STRUCTURES EXCEPT FOR THE LOW FLOW CHANNEL AND MANHOLE BASES SHALL BE CLASS D. CONCRETE IN THE LOW FLOW CHANNEL AND MANHOLE BASES MAY BE CLASS A OR B.

8. ALL REINFORCING STEEL SHALL BE GRADE 60.

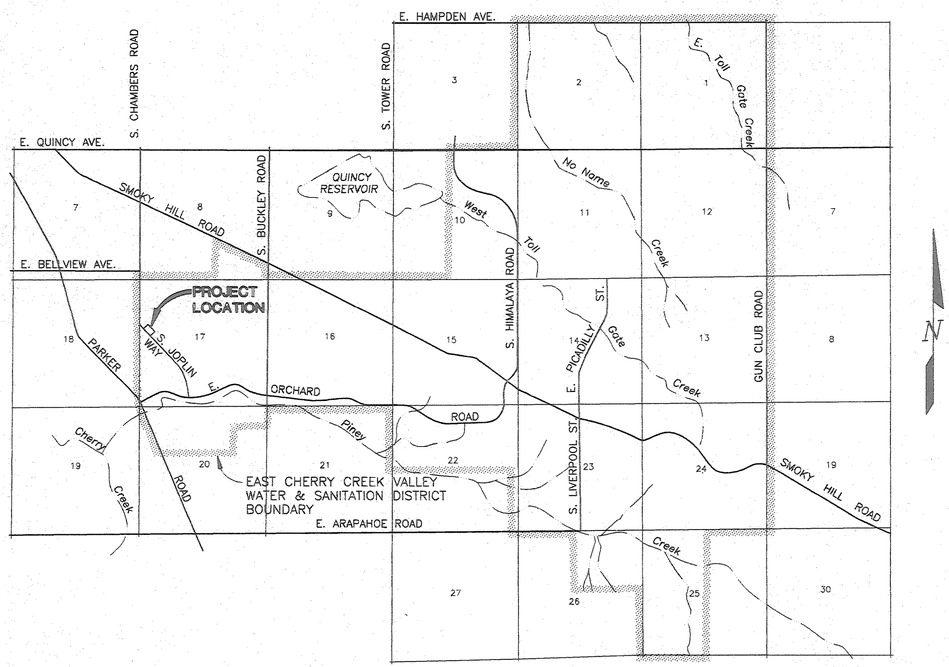
9. ALL CONCRETE PIPE SHALL BE ASTM C76, CLASS III, UNLESS OTHERWISE SHOWN. ALL JOINTS ARE SEALANT JOINTS.

10. SOIL COMPACTION REQUIREMENTS BENEATH CONCRETE STRUCTURES ARE 100% OF THE MAXIMUM DRY DENSITY MEASURED IN ACCORDANCE WITH ASTM D698. SOILS WITHIN REMAINDER OF THE PROJECT SHALL BE COMPACTED TO 95% OF THE MAXIMUM DRY DENSITY, MEASURED AS REFERENCED.

11. CONCRETE SIDEWALK AND CURB AND GUTTER SHALL BE REMOVED AT A JOINT IF THE JOINT IS LESS THAN FOUR FEET FROM A LENGTH TO BE REMOVED.

12. THE CONSTRUCTION WORK AREA IS LIMITED TO THE PUBLIC RIGHT-OF-WAY AND EASEMENTS SHOWN ON THE DRAWINGS. ALL AREAS DISTURBED SHALL BE REVEGETATED WITH NATIVE GRASSES, UNLESS OTHERWISE SHOWN ON THE DRAWINGS. SEE SPECIFICATIONS REGARDING SOIL PREPARATION AND SEEDING DETAILS.

13. CONTRACTOR TO OBTAIN APPROPRIATE COUNTY PERMITS TO ADDRESS TRAFFIC CONTROL, RIGHT OF WAY USE, ETC.



LOCATION MAP

SHEET INDEX

PREPARED BY:

MULLER ENGINEERING CO., INC.

CONSULTING ENGINEERS
IRONGATE 4, SUITE 100
777 S. WADSWORTH BLVD.
LAKEWOOD, COLORADO 80226
(303) 988-4939

"I HEARBY AFFIRM THAT THESE FINAL CONSTRUCTION PLANS FOR THE CHERRY CREEK IMPROVEMENTS AT BASIN RB1 WERE PREPARED UNDER MY DIRECT SUPERVISION IN ACCORDANCE WITH THE REQUIREMENTS OF THE ROADWAY DESIGN AND CONSTRUCTION STANDARDS AND THE STORM DRAINAGE DESIGN AND TECHNICAL CRITERIA OF ARAPAHOE COUNTY AS AMENDED AND AGREED TO BY THE INTERGOVERNMENTAL AGREEMENT BETWEEN ECCV W&S DISTRICT AND ARAPAHOE COUNTY."

Michael S. Dungan 4/28/94

MICHAEL S. DUNGAN, P.E. PROJECT MANAGER — DATE
MULLER ENGINEERING COMPANY, INC.
DISTRICT MANAGER

PREPARED FOR:

EAST CHERRY CREEK VALLEY WATER AND SANITATION DISTRICT

REVIEWED FOR EAST CHERRY CREEK VALLEY AND SANITATION DISTRICT

DATE

"To the best of my knowledge, belief, and opinion, the drainage facilities were constructed in accordance with the design intent of the approved drainage report and construction drawings."

Michael S. Dungan 2/28/95

Michael S. Dungan P.E., Project Manager — Date
Muller Engineering Company Inc.

RECORD DRAWING 1/10/95 date

This record drawing has been prepared, in part, based upon information furnished by others. While this information is believed to be reliable, Muller Engineering Company, Inc. cannot assure its accuracy, and thus is not responsible for the accuracy of this record drawing, or for any errors or omissions which may have been incorporated into it as a result. Those relying on this record drawing are advised to obtain independent verification of its accuracy before applying it for any purpose.

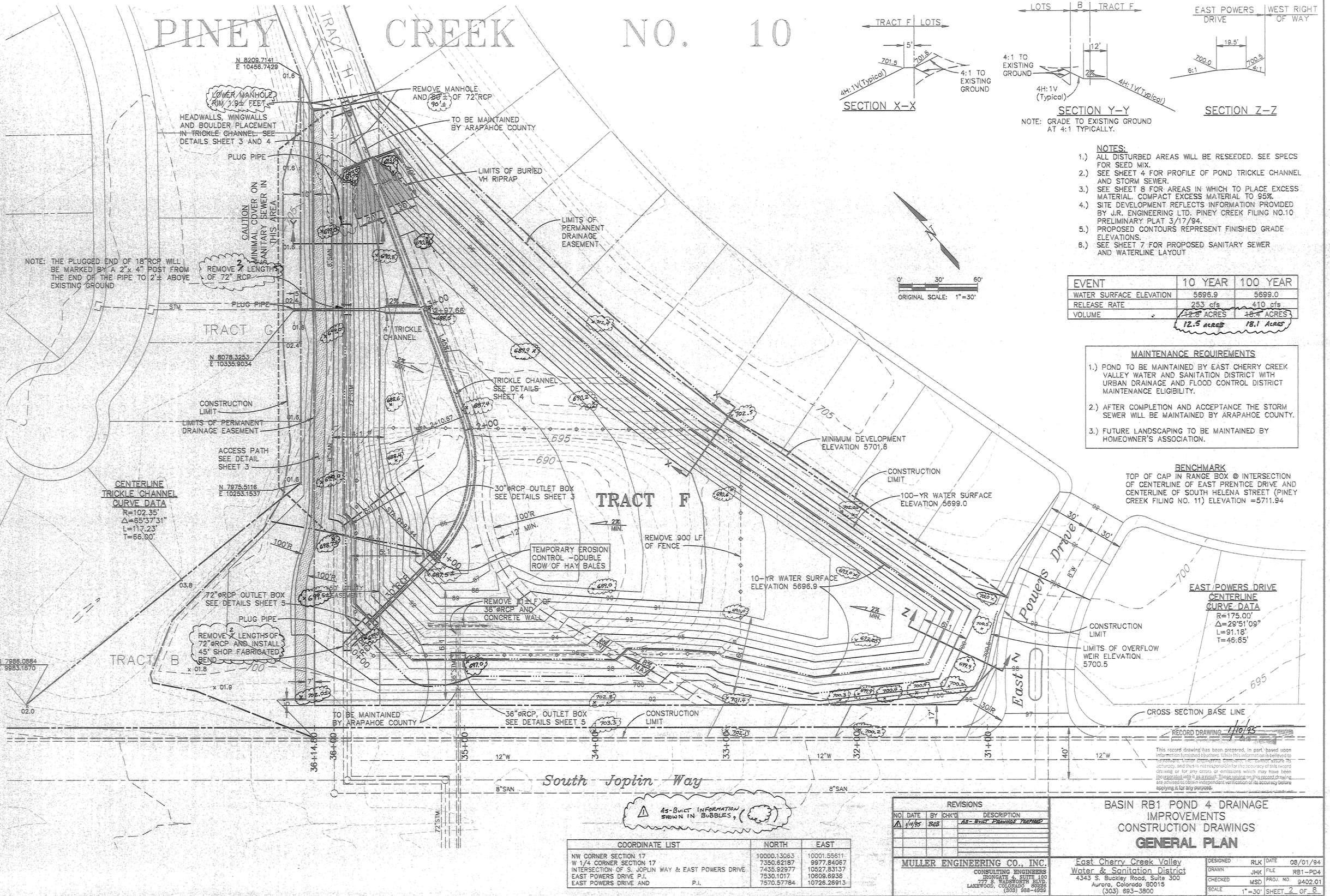
RB1-POND 4
DRAINAGE IMPROVEMENTS
MEC PROJECT NO. 9402
SHEET 1 OF 8

MULLER

DEPARTMENT OF HIGHWAY/ENGINEERING APPROVAL BLOCK

RB1-CVR 07/27/94

PINEY CREEK NO. 10



SECTION X-X

SECTION Y-Y

NOTE: GRADE TO EXISTING GROUND AT 4:1 TYPICALLY.

SECTION Z-Z

NOTES:

1.) ALL DISTURBED AREAS WILL BE RESEEDED. SEE SPECS FOR SEED MIX.
2.) SEE SHEET 4 FOR PROFILE OF POND TRICKLE CHANNEL AND STORM SEWER.
3.) SEE SHEET 8 FOR AREAS IN WHICH TO PLACE EXCESS MATERIAL. COMPACT EXCESS MATERIAL TO 95%.
4.) SITE DEVELOPMENT REFLECTS INFORMATION PROVIDED BY J.R. ENGINEERING LTD. PINEY CREEK FILING NO.10 PRELIMINARY PLAT 3/17/94.
5.) PROPOSED CONTOURS REPRESENT FINISHED GRADE ELEVATIONS.
6.) SEE SHEET 7 FOR PROPOSED SANITARY SEWER AND WATERLINE LAYOUT

N

0' 30' 60'
ORIGINAL SCALE: 1"=30'

EVENT	10 YEAR	100 YEAR
WATER SURFACE ELEVATION	5696.9	5699.0
RELEASE RATE	253 cfs	410 cfs
VOLUME	~~12.8~~ 12.5 ACRES	~~18.4~~ 18.1 ACRES

MAINTENANCE REQUIREMENTS

1.) POND TO BE MAINTAINED BY EAST CHERRY CREEK VALLEY WATER AND SANITATION DISTRICT WITH URBAN DRAINAGE AND FLOOD CONTROL DISTRICT MAINTENANCE ELIGIBILITY.

2.) AFTER COMPLETION AND ACCEPTANCE THE STORM SEWER WILL BE MAINTAINED BY ARAPAHOE COUNTY.

3.) FUTURE LANDSCAPING TO BE MAINTAINED BY HOMEOWNER'S ASSOCIATION.

BENCHMARK

TOP OF CAP IN RANGE BOX @ INTERSECTION OF CENTERLINE OF EAST PRENTICE DRIVE AND CENTERLINE OF SOUTH HELENA STREET (PINEY CREEK FILING NO. 11) ELEVATION =5711.94

RECORD DRAWING 1/10/95

This record drawing has been prepared, in part, based upon information furnished by others. While this information is believed to be authentic, Muller Engineering Company, Inc. cannot assure its accuracy, and thus is not responsible for the accuracy of this record drawing or for any errors or omissions which may have been incorporated into it as a result. Those relying on this record drawing are advised to obtain independent verification of its accuracy before applying it for any purpose.

AS-BUILT INFORMATION SHOWN IN BUBBLES.

COORDINATE LIST	NORTH	EAST
NW CORNER SECTION 17	10000.13063	10001.55611
W 1/4 CORNER SECTION 17	7350.62187	9977.84067
INTERSECTION OF S. JOPLIN WAY & EAST POWERS DRIVE	7435.92977	10527.83137
EAST POWERS DRIVE P.I.	7530.1017	10609.6938
EAST POWERS DRIVE AND P.I.	7570.57784	10726.26913

REVISIONS				
NO	DATE	BY	CHK'D	DESCRIPTION
1	1/10/95	BAB		AS-BUILT DRAWINGS PREPARED

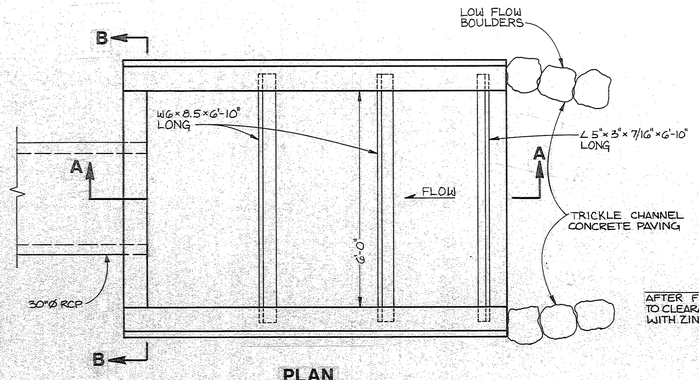
BASIN RB1 POND 4 DRAINAGE IMPROVEMENTS CONSTRUCTION DRAWINGS

GENERAL PLAN

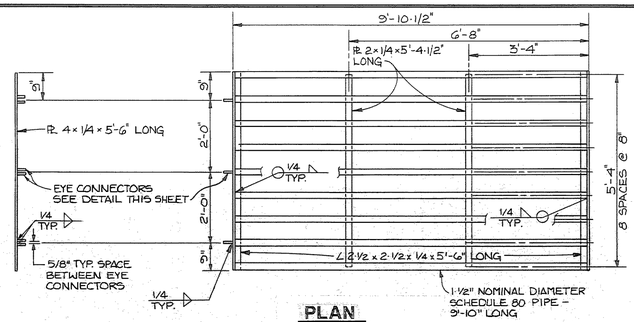
MULLER ENGINEERING CO., INC.
CONSULTING ENGINEERS
IRONGATE 4, SUITE 100
777 S. WADSWORTH BLVD.
LAKEWOOD, COLORADO 80226
(303) 988-4959

East Cherry Creek Valley Water & Sanitation District
4343 S. Buckley Road, Suite 300
Aurora, Colorado 80015
(303) 693-3800

DESIGNED	RLK	DATE	08/01/94
DRAWN	JHK	FILE	RB1-PD4
CHECKED	MSD	PROJ. NO.	9402.01
SCALE	1"=30'	SHEET	2 OF 8



PLAN
1/2"=1'-0"
TRASHRACK NOT SHOWN



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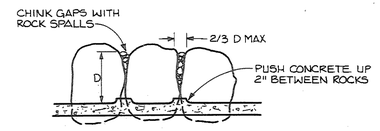
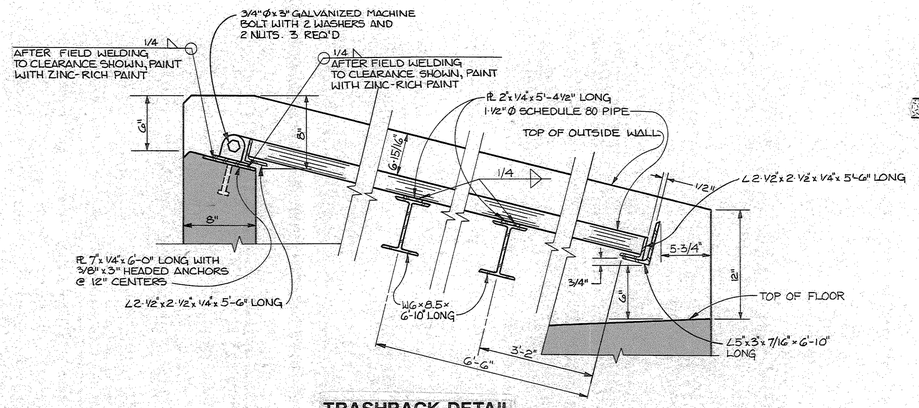
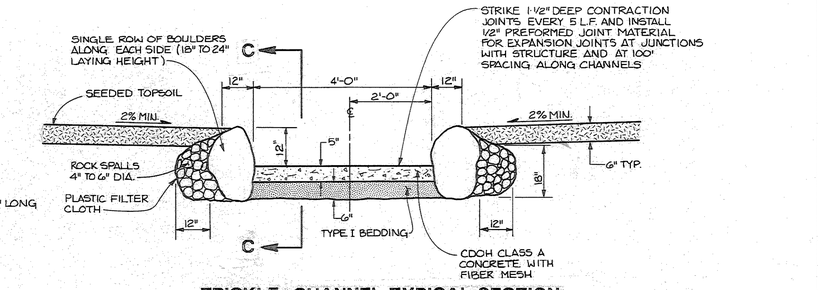


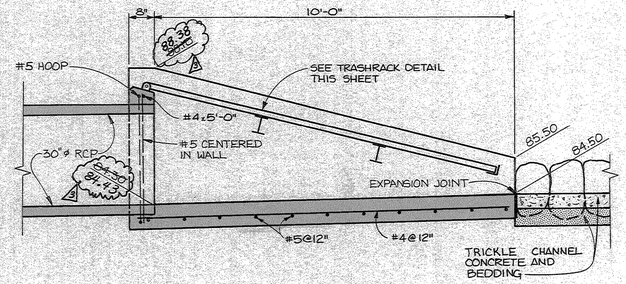
SECTION C-C
NO SCALE



TRASHRACK DETAIL
1-1/2"=1'-0"



TRICKLE CHANNEL TYPICAL SECTION
NO SCALE



SECTION A-A
1/2"=1'-0"

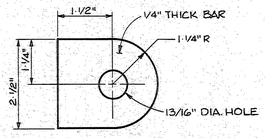
NOTES

1.) TRASHRACK AND SUPPORTS, PLATES, AND HARDWARE SHALL BE HOT-DIP GALVANIZED AFTER FABRICATION.

2.) MISCELLANEOUS STEEL SHALL MEET THE REQUIREMENTS OF ASTM A36.

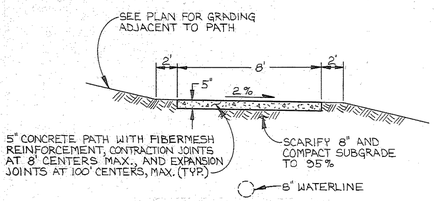
3.) HEADED ANCHORS SHALL BE NELSON WITH FLUXED ENDS OR APPROVED EQUAL.

4.) PIPE SHALL BE ASTM A501 OR A53.

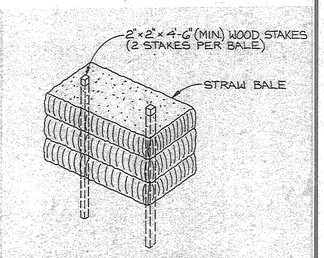


EYE CONNECTOR DETAIL
1/2"=1'-0"

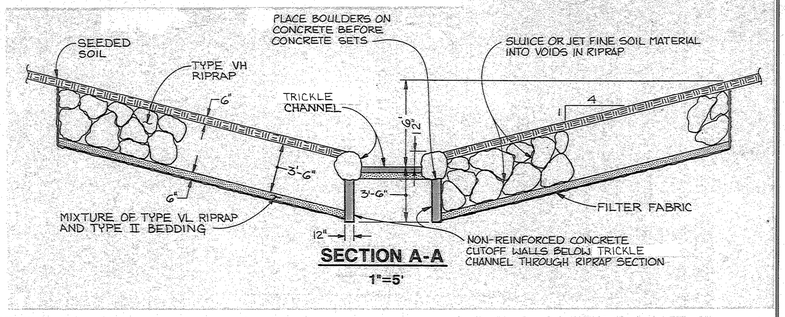
CALL UTILITY NOTIFICATION CENTER OF COLORADO
1-800-922-1987
OR **534-6700** IN METRO DENVER
CALL 2-BUSINESS DAYS IN ADVANCE BEFORE YOU DIG, GRADE, OR EXCAVATE FOR THE MARKING OF UNDERGROUND MEMBER UTILITIES.



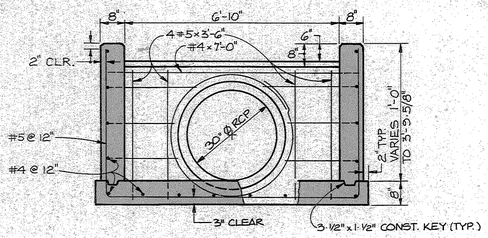
ACCESS PATH DETAIL



STRAW BALE DETAIL
N.T.S.



SECTION A-A
1"=5'



SECTION B-B
1/2"=1'-0"
TRASHRACK NOT SHOWN
SEE DETAIL FOR INSTALLATION

(2) CONSTRUCTION (AS-BUILT) WAS IN SUBSTANTIAL COMPLIANCE WITH DETAILS, LINES, AND GRADES SHOWN ON THIS SHEET

RECORD DRAWING 1/10/95
Date
This record drawing has been prepared, in part, based upon information furnished by others. While this information is believed to be reliable, Muller Engineering Company, Inc. cannot assure its accuracy and thus is not responsible for the accuracy of this record drawing or for any errors or omissions which may have been incorporated into it as a result. Those relying on this record drawing are advised to obtain independent verification of its accuracy before applying it for any purpose.

REVISIONS				
NO.	DATE	BY	CHK'D.	DESCRIPTION
1	11/01/89	CLJ	MSD	ADDED ARAPAHOE COUNTY AND UDFCD REVIEW COMMENTS
2	4/28/94	JHK	MSD	UPDATED DRAWINGS
2	1/10/95	BAB		PREPARE AS-BUILT DRAWINGS

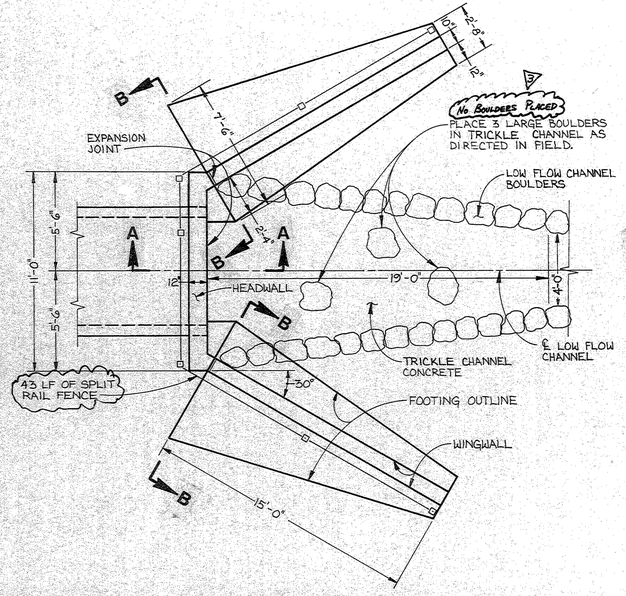
BASIN RB 1 POND 4 DRAINAGE IMPROVEMENTS CONSTRUCTION DRAWINGS

MISCELLANEOUS DETAILS

MULLER ENGINEERING COMPANY, INC.
CONSULTING ENGINEERS

EAST CHERRY CREEK VALLEY WATER AND SANITATION DISTRICT
4343 S. BUCKLEY ROAD SUITE 300
AURORA, COLORADO 80015
(303) 693-3800

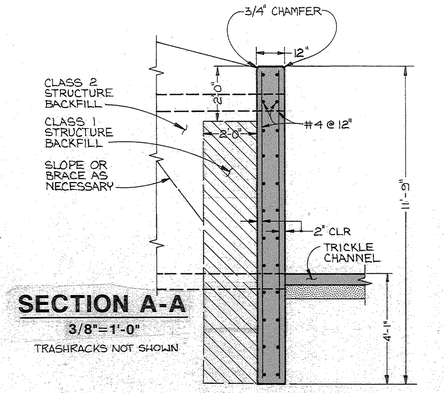
DESIGNED	MSD	DATE	JULY, 1994
DRAWN	JHK	DWG. NO.	
CHECKED	MSD	PROJ. NO.	9402.01
SCALE	AS SHOWN	SHEET	3 OF 8



STORM SEWER OUTLET PLAN

1/4"=1'-0"

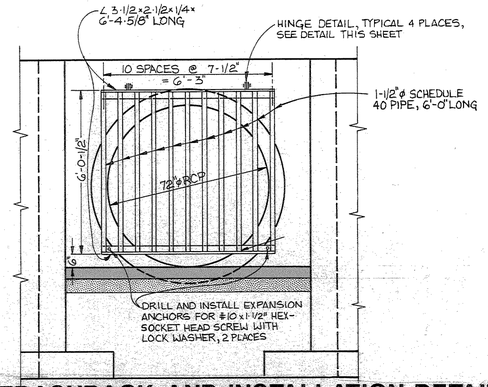
TRASHRACK NOT SHOWN - SEE INSTALLATION DETAIL THIS SHEET



SECTION A-A

3/8"=1'-0"

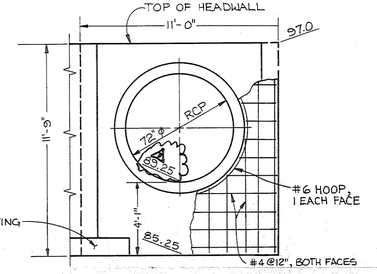
TRASHRACKS NOT SHOWN



TRASHRACK AND INSTALLATION DETAIL

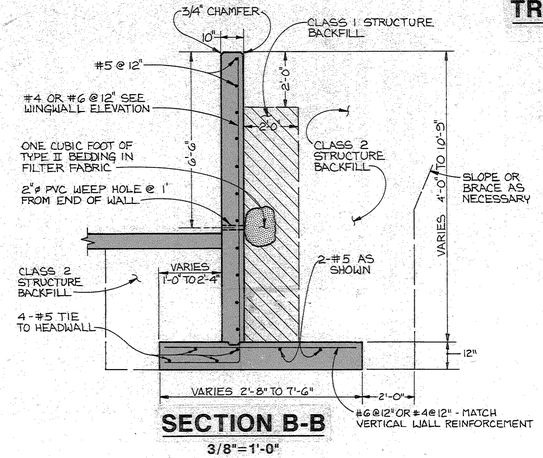
3/8"=1'-0"

SEE SHEET 5 FOR NOTES CONCERNING GRATES AND METAL WORK.



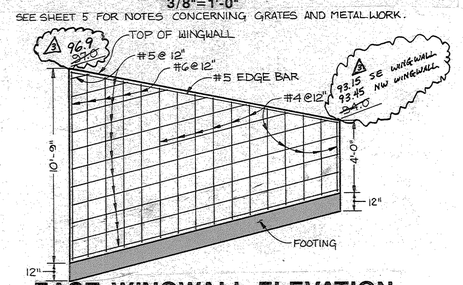
HEADWALL ELEVATION

1/4"=1'-0"



SECTION B-B

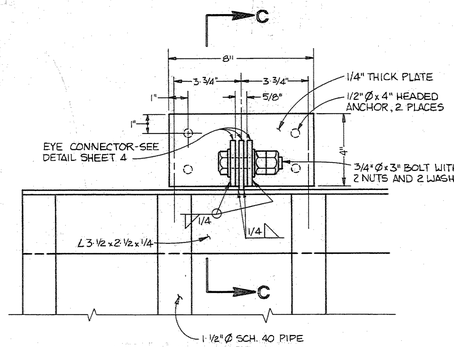
3/8"=1'-0"



EAST WINGWALL ELEVATION

1/4"=1'-0"

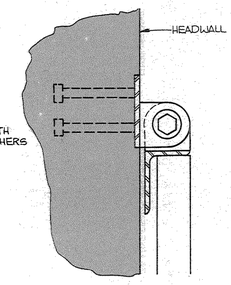
WEST WINGWALL SIMILAR



HINGE DETAIL

3"=1'-0"

2 REQUIRED

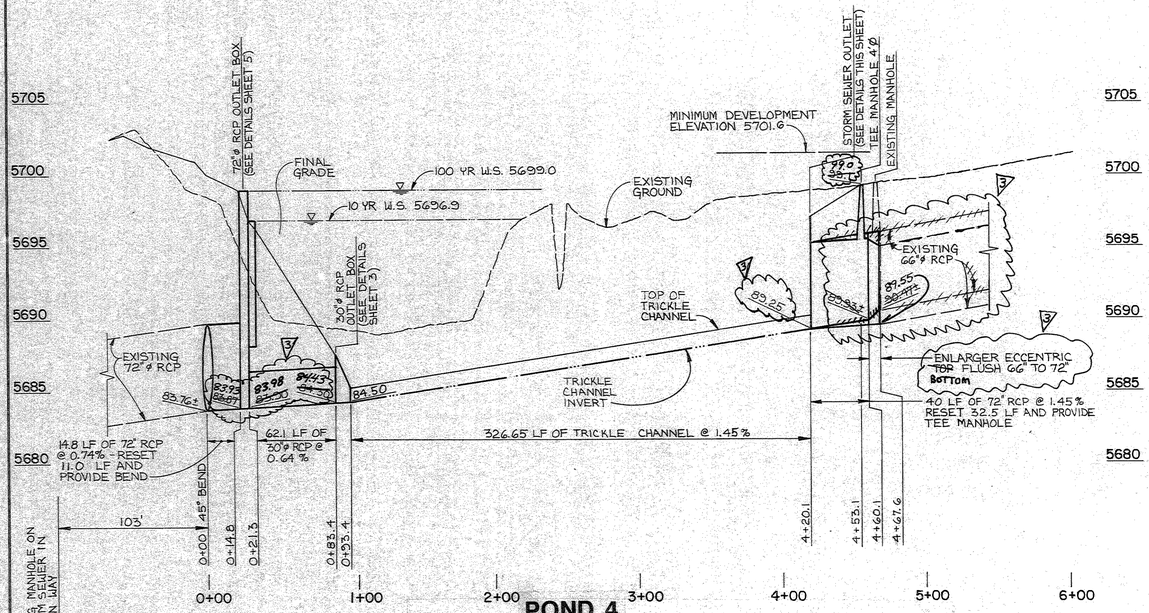


SECTION C-C

3"=1'-0"

MAINTENANCE REQUIREMENTS

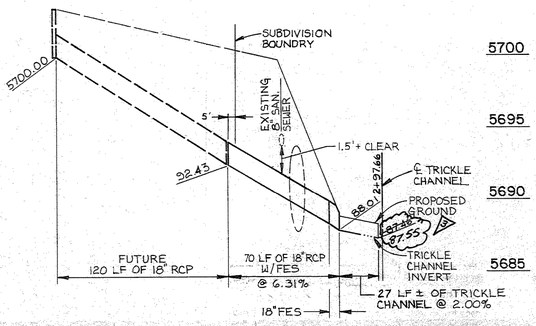
1. STORM SEWERS AND STORM SEWER OUTLETS WITH HEADWALLS AND ENTRY RACKS TO BE MAINTAINED BY ARAPAHOE COUNTY.
2. POND, LOW FLOW CHANNEL, AND POND OUTLET STRUCTURES TO BE MAINTAINED BY EAST CHERRY CREEK VALLEY WATER AND SANITATION DISTRICT WITH ELIGIBILITY FOR UDFCD MAINTENANCE ASSISTANCE.
3. FUTURE LANDSCAPING TO BE MAINTAINED BY HOMEOWNER'S ASSOCIATION.



POND 4
TRICKLE CHANNEL AND STORM SEWER PROFILE

1"=50' Hor. 1"=5' Vert.

SEE SHEET 2 FOR PLAN OF POND



STORM SEWER AND TRICKLE CHANNEL PROFILE

1"=50' Hor. 1"=5' Vert.

2 CONSTRUCTION (AS-BUILT) WAS IN SUBSTANTIAL COMPLIANCE W/ THE LINES GRADES, AND DETAILS AS SHOWN ON THIS SHEET

RECORD DRAWING 1/10/95

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REVISIONS				
NO.	DATE	BY	CHK'D	DESCRIPTION
1	11/01/94	CLJ	MSD	ADDED ARAPAHOE COUNTY AND UDFCD REVIEW COMMENTS
2	4/28/94	JHK	MSD	UPDATED DRAWINGS
3	1/10/95	BJB		PREPARE AS-BUILT DRAWINGS

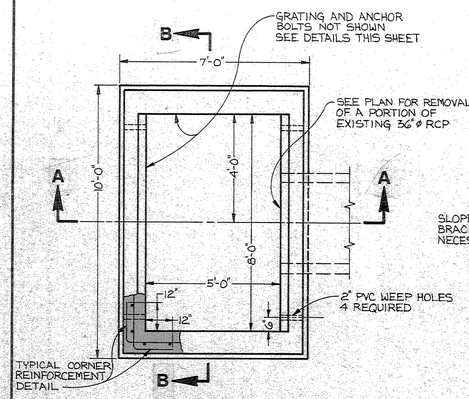
MULLER ENGINEERING COMPANY, INC.
CONSULTING ENGINEERS

EAST CHERRY CREEK VALLEY WATER AND SANITATION DISTRICT
4343 S. BUCKLEY ROAD, SUITE 300
AURORA, COLORADO 80015
(303) 693-3800

BASIN RB 1 POND 4 DRAINAGE IMPROVEMENTS
CONSTRUCTION DRAWINGS

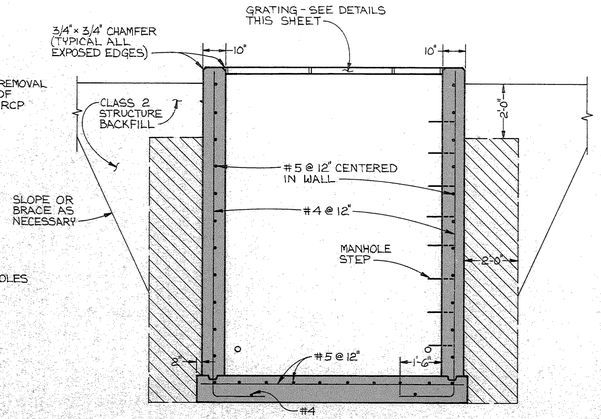
POND 4 PROFILE AND HEADWALL DETAILS

DESIGNED	MSD	DATE	APRIL, 1994
DRAWN	JHK	DWG. NO.	
CHECKED	MSD	PROJ. NO.	9402.01
SCALE	AS SHOWN	SHEET	4 OF 8



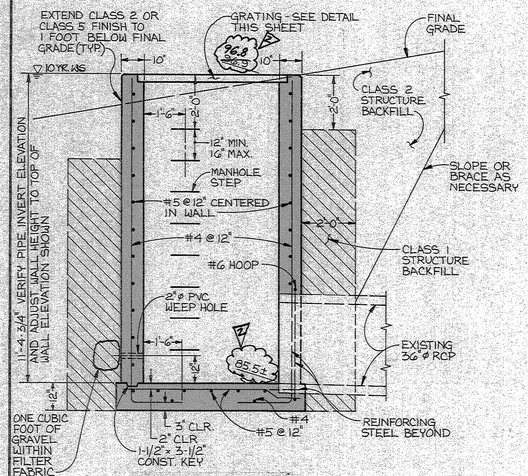
PLAN

3/8"=1'-0"



SECTON B-B

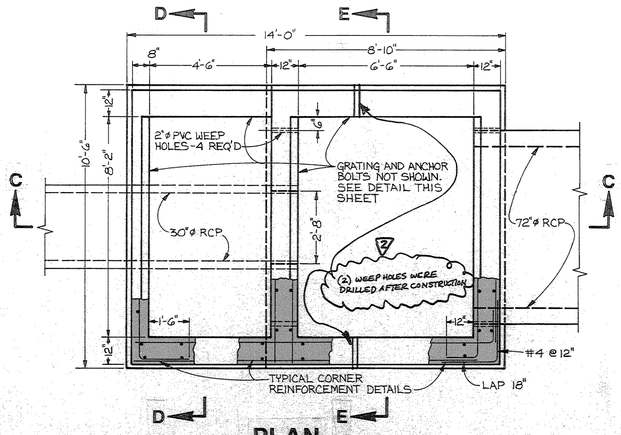
3/8"=1'-0"



SECTION A-A

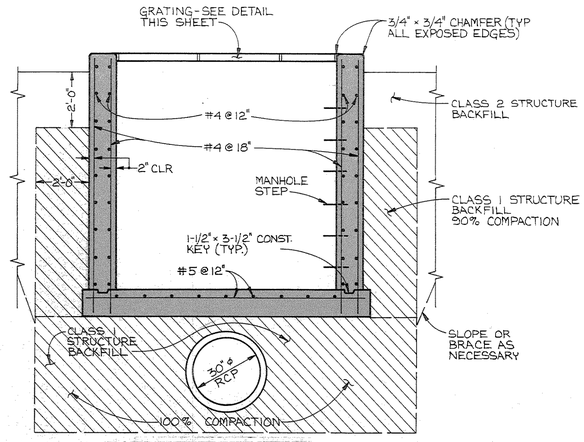
3/8"=1'-0"

36"Ø RCP OUTLET BOX



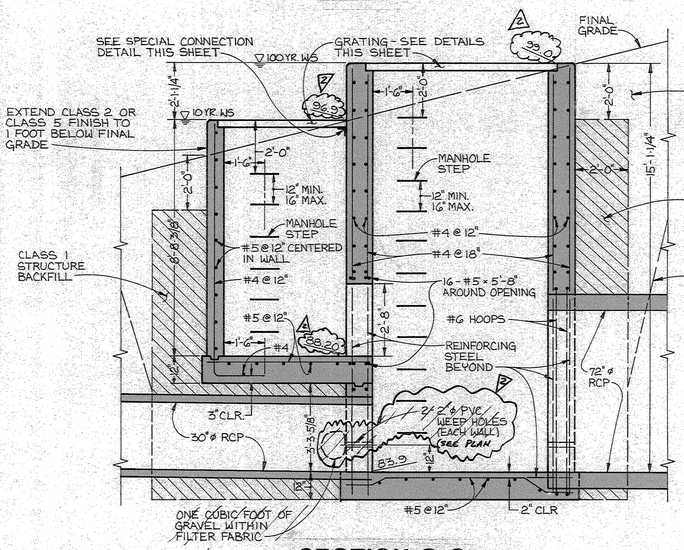
PLAN

3/8"=1'-0"



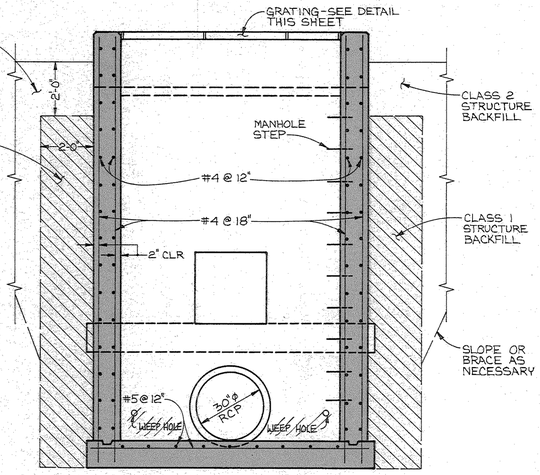
SECTION D-D

3/8"=1'-0"



SECTION C-C

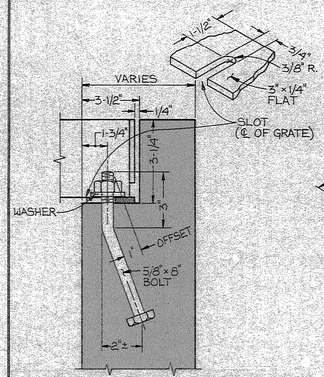
3/8"=1'-0"



SECTION E-E

3/8"=1'-0"

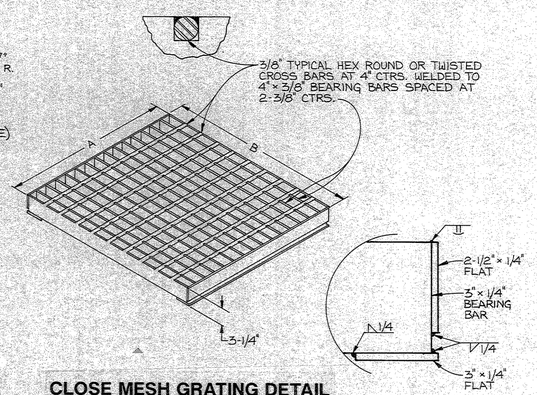
72"Ø RCP OUTLET BOX



GRATE INSTALLATION DETAIL

NO SCALE

2 BOLTS REQUIRED PER GRATE PANEL ONE BOLT AT EACH END APPROXIMATELY CENTERED. LOCATE BOLT LOCATIONS TO MATCH GRATING SLOTS.



CLOSE MESH GRATING DETAIL

NO SCALE

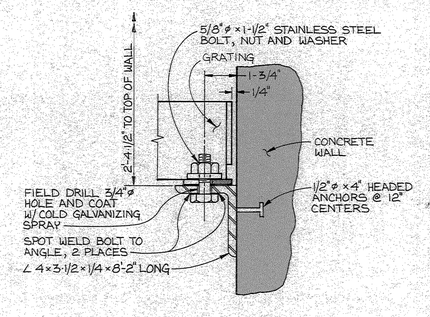
SEE TABLE FOR DIMENSIONS AND NUMBER OF GRATES REQUIRED

TABLE OF GRATE DIMENSIONS

Finished Grate Dimensions		Number of Grates Required
A	B	
2'-11 7/8"	5'-6 1/2"	2
1'-9 5/8"	5'-6 1/2"	1
2'-11 7/8"	4'-9"	2
2'-0"	4'-9"	1
2'-11 7/8"	7'-0 1/2"	2
2'-0"	7'-0 1/2"	1

NOTES:

1. FIELD VERIFY DIMENSIONS BEFORE ORDERING GRATING.
2. GRATING AND ALL SUPPORTS, PLATES AND HARDWARE SHALL BE HOT-DIP GALVANIZED AFTER FABRICATION.
3. MISCELLANEOUS STEEL SHALL MEET THE REQUIREMENTS OF ASTM A36.
4. PIPE SHALL MEET THE REQUIREMENTS OF ASTM A53, GRADE B OR A501.



SPECIAL CONNECTION DETAIL

NO SCALE

GRATING DETAILS

CONSTRUCTION (AS-BUILT) IN SUBSTANTIAL COMPLIANCE WITH THE LINES, GRADES AND DETAILS AS SHOWN ON THIS SHEET.

RECORD DRAWING 1/10/95
date

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REVISIONS				
NO.	DATE	BY	CHK'D.	DESCRIPTION
1	11/01/01	CLJ	MSD	ADDED ARAPAHOE COUNTY AND UDFCD REVIEW COMMENTS
2	1/10/95	BAB		PREPARE AS-BUILT DRAWINGS

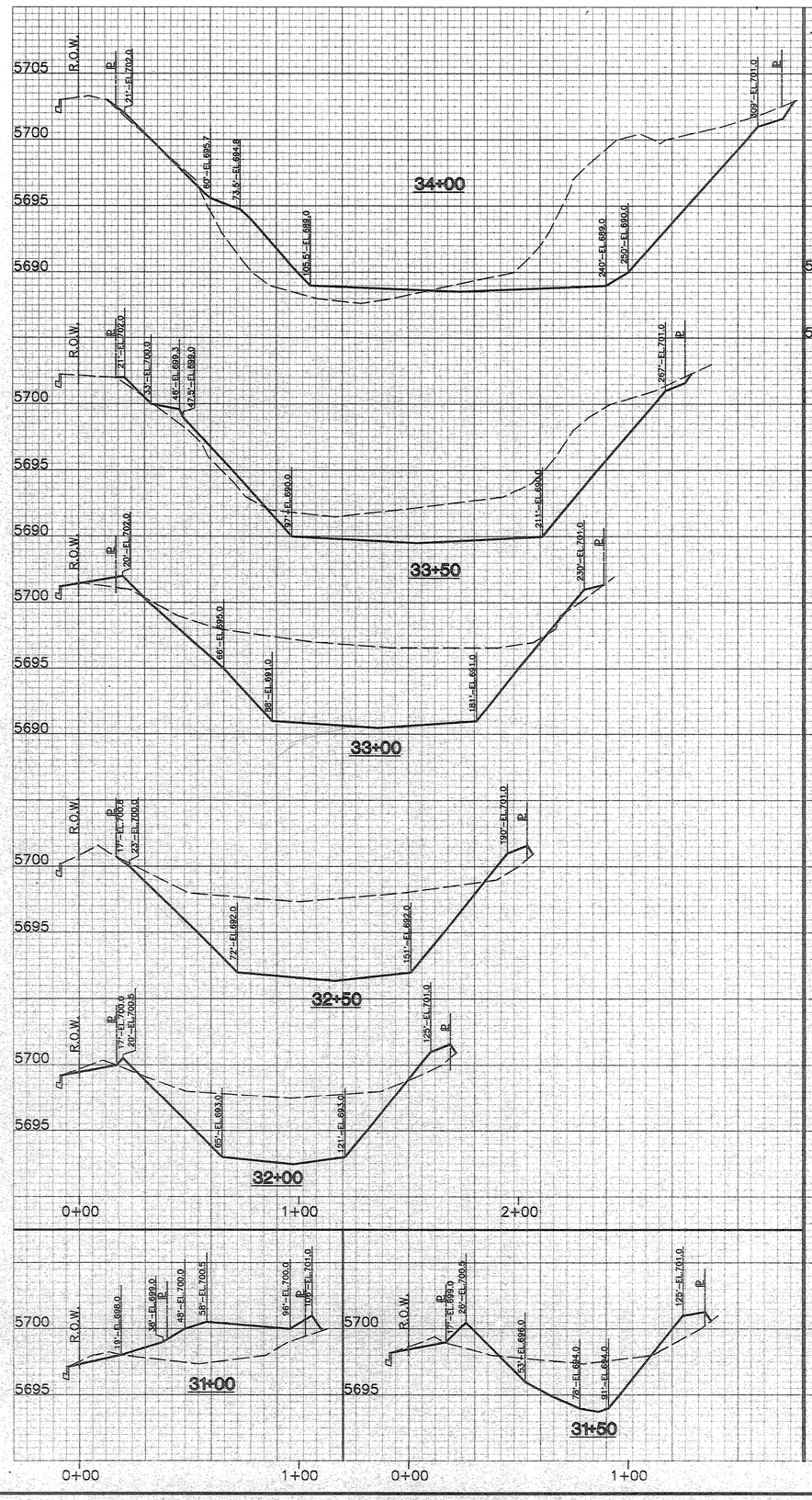
BASIN RB 1 POND 4 DRAINAGE IMPROVEMENTS CONSTRUCTION DRAWINGS

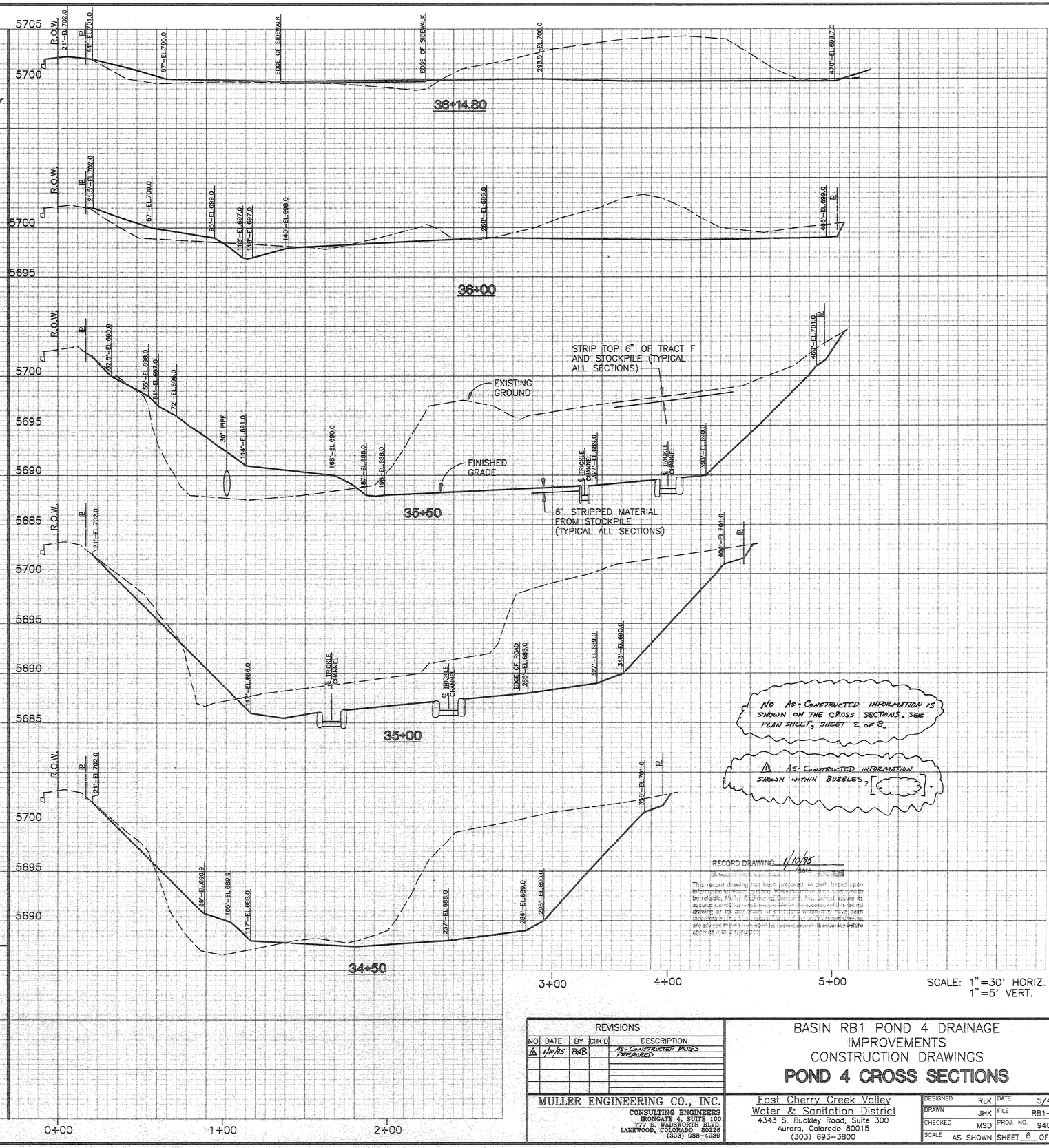
POND 4 OUTLET BOX DETAILS

MULLER ENGINEERING COMPANY, INC.
CONSULTING ENGINEERS

EAST CHERRY CREEK VALLEY WATER AND SANITATION DISTRICT
4343 S. BUCKLEY ROAD SUITE 300
AURORA, COLORADO 80015
(303) 693-3800

DESIGNED	MSD	DATE	APRIL, 1994
DRAWN	JHK	DWG. NO.	
CHECKED	MSD	PROJ. NO.	9402.01
SCALE	AS SHOWN	SHEET	5 OF 8





No As-Constructed information is shown on the cross sections, see plan sheet, sheet 2 of 8.

⚠ As-Constructed information shown within bubbles.

RECORD DRAWING 1/10/95
date

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SCALE: 1"=30' HORIZ.
1"=5' VERT.

REVISIONS				
NO.	DATE	BY	CHK'D	DESCRIPTION
⚠	1/10/95	BMB		As-Constructed Plugs Prepared

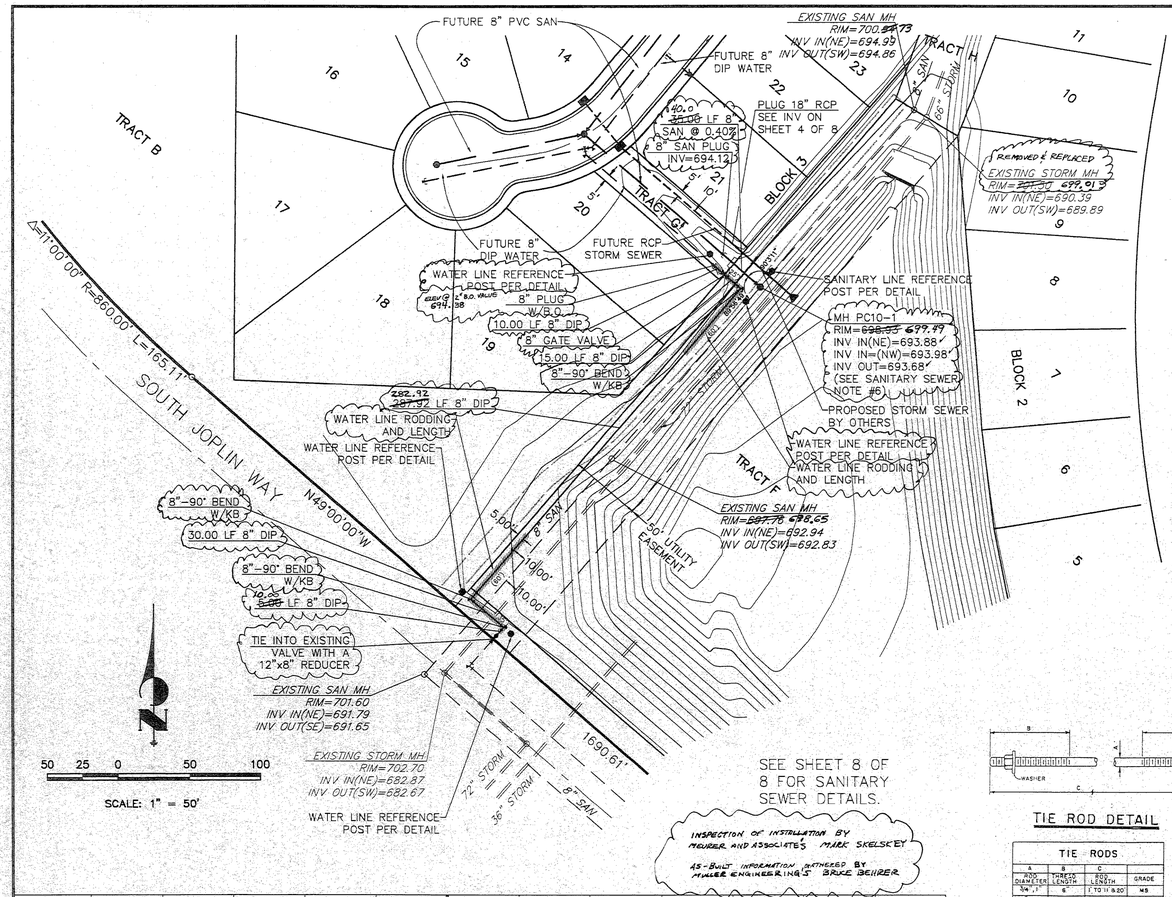
BASIN RB1 POND 4 DRAINAGE IMPROVEMENTS CONSTRUCTION DRAWINGS

POND 4 CROSS SECTIONS

MULLER ENGINEERING CO., INC.
CONSULTING ENGINEERS
IRONGATE 4, SUITE 100
777 S. WADSWORTH BLVD.
LAKEWOOD, COLORADO 80226
(303) 988-4939

East Cherry Creek Valley Water & Sanitation District
4343 S. Buckley Road, Suite 300
Aurora, Colorado 80015
(303) 693-3800

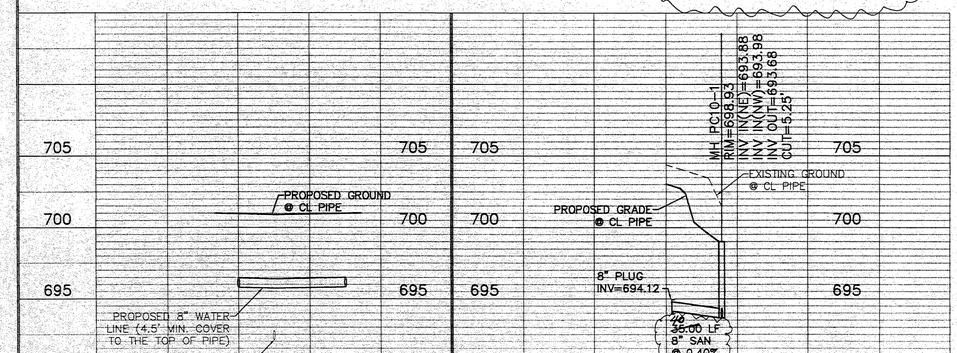
DESIGNED	RLK	DATE	5/4/94
DRAWN	JHK	FILE	RB1-SEC
CHECKED	MSD	PROJ. NO.	9402.01
SCALE	AS SHOWN	SHEET	6 OF 8



SEE SHEET 8 OF 8 FOR SANITARY SEWER DETAILS.

INSPECTION OF INSTALLATION BY MOURER AND ASSOCIATES MARK SKELSKEY

AS-BUILT INFORMATION GATHERED BY MILLER ENGINEERING'S BRUCE BEIRER



WATER LINE CROSSING PROFILE

SCALE: HORIZ:1"=20' VERT:1"=5'

PLOT SCALE: 1=50, DATE: 06/22/94, TIME: 17:56, FILE: X:\15334?\ACAD\PC10UTPF.DWG

SANITARY SEWER

1. ALL SANITARY SEWER MAINS AND SYSTEM PLANS AND CONSTRUCTION, SHALL CONFORM WITH THE EAST CHERRY CREEK VALLEY WATER AND SANITATION DISTRICT STANDARDS AND SPECIFICATIONS, AND BE SUBJECT TO CONSTRUCTION AND OBSERVATIONS BY DISTRICT PERSONNEL OR REPRESENTATIVES. COPIES OF THE DISTRICT STANDARDS AND SPECIFICATIONS MAY BE OBTAINED FROM MEURER AND ASSOCIATES, INC., OR THE DISTRICT MANAGER. THE OWNER, HIS ENGINEER OR CONTRACTOR, SHALL SCHEDULE A PRECONSTRUCTION MEETING WITH THE DISTRICT MANAGER AND DISTRICT ENGINEER AT LEAST 48 HOURS PRIOR TO THE START OF CONSTRUCTION. PLANS WITH THE DISTRICT REVIEW STAMP WILL BE DISTRIBUTED AT THE PRECONSTRUCTION MEETING. NO CONSTRUCTION WILL BE PERMITTED UNTIL FORMAL COMPLETION OF EASEMENTS AND RECORDING, AND PRIOR TO THE PRECONSTRUCTION MEETING.
2. THE PIPE USED FOR SANITARY SEWER MAINS SHALL BE IN ACCORDANCE WITH ASTM D-3034 SDR 35 PVC PIPE IN PAVED RIGHTS-OF-WAY AND EASEMENTS, AND A.W.W.A. C-900, CLASS 150 IN UNPAVED EASEMENTS.
3. PROBATIONARY ACCEPTANCE OF THE NEW SANITARY SEWER MAINS IS CONTINGENT UPON RECEIVING COPIES OF:
   A. SANITARY SEWER TRENCH COMPACTION TEST RESULTS, AND,
   B. RECORD DRAWINGS
4. THE SANITARY SEWER SYSTEM WILL BE TESTED IN ACCORDANCE WITH THE DISTRICT STANDARDS AND SPECIFICATIONS. THE DISTRICT WILL:
   A. LAMP 100% OF THE NEW SYSTEM,
   B. LOW PRESSURE AIR TEST 100% OF THE NEW SYSTEM, AND,
   C. DEFLECTION TEST, AT A MINIMUM OF 33% OF THE SYSTEM FIFTEEN (15) FEET OR LESS IN DEPTH, AND 100% OF THE SYSTEM GREATER THAN FIFTEEN (15) FEET IN DEPTH.
5. MANHOLE RIMS SHALL BE SET AT AN ELEVATION RELATIVE TO THE PAVEMENT, IN ACCORDANCE WITH CITY/COUNTY LAND USE CODES. WHETHER THE MANHOLE IS IN A PAVED OR UNPAVED GRADE, A MINIMUM OF ONE (1) AND A MAXIMUM OF FOUR (4) ROWS OF BRICK SHALL BE USED TO ADJUST RIM ELEVATIONS TO FINAL GRADE. THE MAXIMUM ACCEPTABLE VERTICAL ADJUSTMENT UTILIZING BRICK IS TWELVE (12) INCHES.
6. CONNECTIONS TO EXISTING DISTRICT LINES WILL ONLY BE PERMITTED UPON ACCEPTANCE OF THE NEW SANITARY SEWER SYSTEM. EXISTING PIPE AT THE POINT OF CONNECTION SHALL NOT BE "BROKEN OUT" UNTIL THE NEW SYSTEM IS ACCEPTED.
7. THE DISTRICT, ITS REPRESENTATIVE, AND/OR THE DISTRICT ENGINEER, IS NOT A GUARANTOR OF THE CONSTRUCTING CONTRACTORS' OBLIGATIONS AND PERFORMANCE OF CONTRACT.
8. OBSERVATIONS OF WORK IN PROGRESS AND ON-SITE VISITS ARE NOT TO BE CONSTRUED AS A GUARANTEE BY THE DISTRICT OR DISTRICT ENGINEER OF THE CONTRACTORS' CONTRACTUAL COMMITMENT.
9. THE DISTRICT AND/OR DISTRICT ENGINEER, IS NOT RESPONSIBLE FOR SAFETY IN, ON, OR ABOUT THE PROJECT SITE, NOR FOR COMPLIANCE BY THE APPROPRIATE PARTY OF ANY REGULATIONS RELATING THERETO.
10. THE DISTRICT AND/OR DISTRICT ENGINEER, EXERCISES NO CONTROL OF THE SAFETY OF ADEQUACY OF ANY EQUIPMENT, BUILDING COMPONENTS, SCAFFOLDING, FORMS, OR ANY OTHER WORK AIDS USED IN OR ABOUT THE PROJECT, OR IN THE SUPERINTENDING OF THE SAME.
11. THE CONTRACTOR SHALL VERIFY EXISTING MANHOLE INVERTS TO BE CONNECTED TO PRIOR TO CONSTRUCTION STAKING.
12. THE CONTRACTOR SHALL TAKE CARE TO PROPERLY SHAPE ALL MANHOLE INVERTS AND BENCHES IN ACCORDANCE WITH DISTRICT STANDARDS AND SPECIFICATIONS, TO PROMOTE SMOOTH FLOW THROUGH THE MANHOLE. INVERTS OF LINES INTERSECTING AT 90° AND AT HIGHLY DIVERGENT OR FLAT SLOPES ARE ESPECIALLY CRITICAL. MANHOLE INVERTS SHALL BE CONSTRUCTED WITH A SMOOTH TROWEL FINISH, AND BENCHES FINISHED WITH A LIGHT BROOM, NON-SKID FINISH.
13. THE CONTRACTOR SHALL BE RESPONSIBLE FOR THE PROTECTION OF ALL UTILITY LINES WHETHER SHOWN ON THE PLANS OR NOT.
14. MAINTAIN MINIMUM OF 10 FEET SEPARATION BETWEEN WATER AND SANITARY SEWER MAINS.
15. DISTANCES FOR SEWER ARE FROM CENTER OF MANHOLE TO CENTER OF MANHOLE.
16. THE SANITARY SEWER SERVICES SHALL BE STUBBED OUT. THE STUB SHALL EXTEND INTO THE LOT TEN (10) FEET. THE CONTRACTOR SHALL FURNISH THE DISTRICT WITH AN AS-BUILT LOCATION OF THE WYE.
17. THE CONTRACTOR SHALL BE RESPONSIBLE FOR THE PROCUREMENT OF ALL PERMITS NECESSARY FOR THE CONSTRUCTION OF THE SANITARY SEWER LINE WORK.
18. ESTIMATED COST OF SANITARY SEWER MAIN CONSTRUCTION IS $ 1,800.
19. ESTIMATED QUANTITIES (SANITARY SEWER) ARE AS FOLLOWS:
    - 35 LF – 8" PVC AWWA C900 CLASS 150
    - 1 EA – 4' DIAMETER MANHOLES

GENERAL NOTES – WATER

1. ALL WATER LINES AND SYSTEM PLANS AND CONSTRUCTION, SHALL CONFORM WITH THE EAST CHERRY CREEK VALLEY WATER AND SANITATION DISTRICT STANDARDS AND SPECIFICATIONS, AND BE SUBJECT TO CONSTRUCTION OBSERVATION BY DISTRICT PERSONNEL OR REPRESENTATIVES. COPIES OF THE DISTRICT STANDARDS AND SPECIFICATIONS MAY BE OBTAINED FROM MEURER AND ASSOCIATES, INC., OR THE DISTRICT MANAGER. THE OWNER, HIS ENGINEER OR CONTRACTOR, SHALL SCHEDULE A PRECONSTRUCTION MEETING WITH THE DISTRICT MANAGER AND DISTRICT ENGINEER AT LEAST 48 HOURS PRIOR TO THE START OF CONSTRUCTION. PLANS WITH THE DISTRICT REVIEW STAMP WILL BE DISTRIBUTED AT THE PRECONSTRUCTION MEETING. NO CONSTRUCTION WILL BE PERMITTED UNTIL FORMAL COMPLETION OF EASEMENTS AND RECORDING, AND PRIOR TO THE PRECONSTRUCTION MEETING.
2. THE PIPE SPECIFIED BY THE OWNER OR HIS ENGINEER FOR THE WATER LINES IN THE PROJECT IS CLASS 50, DUCTILE IRON PIPE. ALL WATER LINES SHALL HAVE A MINIMUM OF FOUR AND ONE-HALF (4-1/2) FEET OF COVER AND BE LOCATED A MINIMUM OF TEN (10) FEET FROM THE SANITARY SEWER, AND FIVE (5) FEET FROM THE EDGE OF CONCRETE CURB AND GUTTER PAN.
3. PROBATIONARY ACCEPTANCE OF THE NEW WATER LINES IS CONTINGENT UPON RECEIVING COPIES OF:
   A. WATER LINE TRENCH COMPACTION TEST RESULTS,
   B. RECORD DRAWINGS, AND
   C. HEALTH DEPARTMENT TESTS. (CHLORINE AND/OR CLEAR WATER AS REQUIRED.)
4. THEORETICAL STATIC WATER PRESSURES ARE ESTIMATED TO RANGE FROM 69 PSI AT USGS ELEVATION 5920 TO 56 PSI AT USGS ELEVATION 5950 BASED UPON A HYDRAULIC GRADIENT OF USGS ELEVATION OF 6079. THE DISTRICT HAS PROVIDED ONLY THE HYDRAULIC GRADIENT ELEVATION.
5. ALL WATER LINE VALVES SHALL BE SET AT THE INTERSECTION OF THE EXTENDED PROPERTY LINE AND WATER LINE EXCEPT WHERE THAT POINT FALLS IN THE FLOW LINE OF A CONCRETE CROSS PAN. IN THAT CASE, THE VALVE SHALL BE LOCATED SO THAT SURFACE DRAINAGE DOES NOT INFILTRATE THE VALVE BOX. OTHER VALVE LOCATIONS MAY BE REQUIRED AS SHOWN ON THE PLANS. VALVE BOXES SHALL BE SET AT AN ELEVATION IN ACCORDANCE WITH ARAPAHOE COUNTY PAVING REQUIREMENTS.
6. POLYETHYLENE WRAPPING SHALL BE INSTALLED AROUND ALL DUCTILE IRON PIPE, FITTINGS, VALVES, FIRE HYDRANT BARRELS, AND RODS AND CLAMPS. MINIMUM THICKNESS OF POLYETHYLENE WRAPPING SHALL BE 8 MILS.
7. ALL WATER LINES SHALL BE CHLORINATED IN ACCORDANCE WITH A.W.W.A. C-601, "DISINFECTING WATER MAINS". THE PREFERRED METHOD IS TO USE SUFFICIENT CHLORINE TABLETS TO PRODUCE A 50 MG/L SOLUTION. THE TABLETS SHALL BE ADHERED TO THE TOP OF THE PIPE WITH A FOOD GRADE ADHESIVE. THE CHLORINATION OF THE WATER LINE SHALL BE PERFORMED PRIOR TO THE HYDROSTATIC TESTING.
8. ALL WATER LINES SHALL BE HYDROSTATIC TESTED IN ACCORDANCE WITH A.W.W.A C-600 SECTION 4, "HYDROSTATIC TESTING". ALL WATER LINES SHALL BE TESTED TO A MINIMUM OF 150 PSI. THE TEST SHALL BE SCHEDULED BY THE DISTRICT AND COORDINATED WITH ANY OTHER REVIEWING OR APPROVING AGENCY. THE ALLOWABLE LEAKAGE RATES ARE AS FOLLOWS:

PIPE SIZE INSIDE DIAMETER	ALLOWABLE LEAKAGE PER 1000 FEET GALLONS PER HOUR
6"	0.55 GAL/HOUR
8"	0.74 GAL/HOUR
12"	1.10 GAL/HOUR

9. ALL BENDS, TEES, FIRE HYDRANTS, BLOW-OFFS, AND PLUGS AT DEAD END MAINS SHALL BE PROTECTED FROM THRUST BY USING CONCRETE THRUST BLOCKS PER THE DISTRICT'S STANDARD DRAWING.
10. WHEN IT IS NECESSARY TO LOWER OR RAISE WATER LINES AT STORM DRAINS AND OTHER UTILITY CROSSINGS, A MINIMUM CLEARANCE OF 1.50 FEET SHALL BE MAINTAINED BETWEEN OUTSIDE OF PIPES.
11. THE CONTRACTOR SHALL HAVE IN HIS POSSESSION AT ALL TIMES ONE (1) SIGNED COPY OF THE PLANS WHICH HAVE BEEN APPROVED BY THE DISTRICT.
12. ALL BENDS SHALL BE RODDED. ALL WORK SHALL BE INSPECTED AND APPROVED BY PERSONNEL OF THE DISTRICT AT LEAST 48 HOURS PRIOR TO THE START OF CONSTRUCTION. A SET OF AS-BUILT PLANS SHALL BE PROVIDED TO THE DISTRICT ENGINEER PRIOR TO FINAL ACCEPTANCE OF THIS PROJECT.
13. PRIOR TO INSTALLATION OF WATER MAINS, ROAD CONSTRUCTION MUST HAVE PROGRESSED TO AT LEAST THE "SUB-GRADE" STAGE. SUB-GRADE IS DEFINED AS AN ELEVATION OF NO MORE THAN SEVEN INCHES BELOW THE FINISHED STREET GRADE. ALL VALVE BOXES AND FIRE HYDRANTS WILL BE ADJUSTED TO THE FINAL FINISHED GRADE BY THE CONTRACTOR.
14. THE ESTIMATED COST OF WATER MAIN CONSTRUCTION IS $ 7,700.
15. THE ESTIMATED QUANTITIES ARE AS FOLLOWS:
    - 335 LF – 8" DIP
    - 2 EA – 45° – 8" BENDS
    - 1 EA – 90° – 6" BENDS
    - 1 EA – 8" PLUG
    - 1 EA – 12" X 8" REDUCER
    - 1 EA – TIE TO EXISTING VALVE
    - 1 EA – 8" GATE VALVE
    - 1 EA – 2" BLOW-OFF

TIE ROD DETAIL

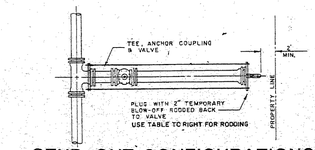
WASHER DETAIL

TIE - RODS				
A ROD DIAMETER	B THREAD LENGTH	C ROD LENGTH		GRADE
3/4"	6"	7 TO 11 @ 20		M3
3/4 - 1 1/2"	AS TH'wd	7 TO 11 @ 20		H3

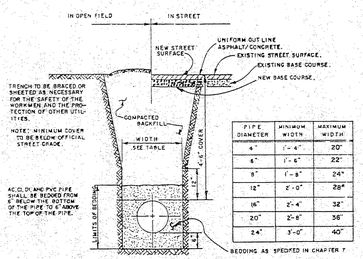
NOTE:
1. SEE TIED JOINTS ROD DIMENSIONS SHEET.
2. SEE CLAMP DETAILS AND DIMENSIONS (SHEET 21) FOR PROPER PLACEMENT OF WASHERS.
3. M3 = MILD STEEL H3 = HIGH STRENGTH

WASHERS			
D WIDTH	E HOLE DIAMETER		G THICKNESS
5"	1/8 Larger than Rod ø		1/2
6"	1/8 Larger than Rod ø		5/8

TIE ROD AND WASHER DETAILS



STUB-OUT CONFIGURATIONS FOR FUTURE EXTENSIONS



PIPE DIAMETER	MINIMUM WIDTH	MAXIMUM WIDTH
4"	1'-6"	20"
6"	1'-6"	22"
8"	1'-8"	24"
12"	2'-0"	28"
16"	2'-4"	32"
20"	2'-8"	36"
24"	3'-0"	40"

BEDDING AS SPECIFIED IN CHAPTER 7

TYPICAL TRENCH SECTION

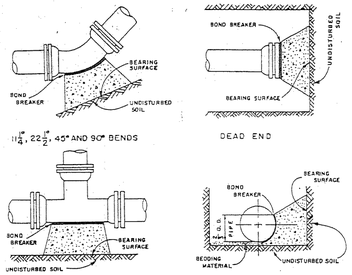
TYPICAL TRENCH SECTION PIPE PROTECTION

ROD DIAMETER, GRADE & LENGTH OF TIED PIPE

PIPE SIZE	4"			6"			8"			12"			16"			20"			24"		
FITTING	D	L	G	D	L	G	D	L	G	D	L	G	D	L	G	D	L	G	D	L	G
90° BEND, TEE, PLUG OR VALVE	3/4	30"	-	3/4	45"	M.S.	3/4	60"	M.S.	3/4	86"	M.S.	1"	108"	M.S.	1 1/4	132"	M.S.	-	150"	-
45° BEND	3/4	9"	M.S.	3/4	13"	M.S.	3/4	18"	M.S.	3/4	25"	M.S.	1"	32"	M.S.	3/4	39"	H.S.	-	45.0	-
22 1/2° BEND	3/4	1.0'	M.S.	3/4	4'	M.S.	3/4	5'	M.S.	3/4	7'	M.S.	3/4	9'	M.S.	3/4	10'	M.S.	-	12.0	-
11 1/4° BEND	—	—	—	—	—	—	3/4	1.0'	M.S.	3/4	2'	M.S.	3/4	2'	M.S.	3/4	3'	M.S.	-	3.0'	-

NOTES:
1- LENGTH OF TIED PIPE MEASURED EACH WAY FROM VALVES AND BENDS.
2- CLAMPS AND RODS NOT ALLOWED FOR 24" AND LARGER PIPES.
3- D= DIAMETER, L= LENTH, G= GRADE M.S.= MILD STEEL, H.S.= HIGH STRENGTH.
4- MINIMUM 4.5' GROUND COVER REQUIRED.
5- BASED ON 150 PSI INTERNAL PRESSURE, FOR L AND PRESSURES LISTED ON SHEET 16 OF 68 FOR D AND G.
6- M.S. MEANS MILD STEEL ROD A.S.T.M. STANDARD DESIGNATION A-36.
7- H.S. MEANS HIGH STRENGTH ROD A.S.T.M. STANDARD DESIGNATION A-193, GRADE B-7.
8- NUTS SHALL BE A.S.T.M. STANDARD DESIGNATION A-307 GRADE A OR B HEXAGON HEAVY SERIES.
9- SEE THE ROD DETAIL DRAWING. ALSO, THE ROD COUPLING DETAILS, CLAMP DETAILS AND SET CLAMP DETAILS.
10- LENGTH REFERS TO THE AMOUNT OF PIPE WHICH MUST BE TIED TOGETHER AND IS NOT NECESSARILY THE LENGTH OF THE RODS.

LENGTH OF TIED PIPE



11 1/4°, 22 1/2°, 45° AND 90° BENDS

DEAD END

TEE

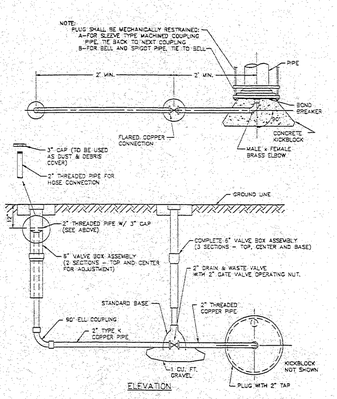
NOTES:
1 - BEARING SURFACES SHOWN IN CHART ARE MINIMUM.
2 - BASED ON 150 PSI INTERNAL PIPE PRESSURE PLUS WATER HAMMER. 4", 6", 8" AND 12" WATER HAMMER=110 PSI. 16",20" AND 24" WATER HAMMER = 70 PSI.
3- SEE SECTION 6.43 AND SECTION 8.20 OF THE ENGINEERING STANDARDS.
4- BASED ON 3,000 psf SOIL BEARING CAPACITY.
5 NA = NOT APPLICABLE.

MINIMUM BEARING SURFACE AREA (IN SQUARE FEET)

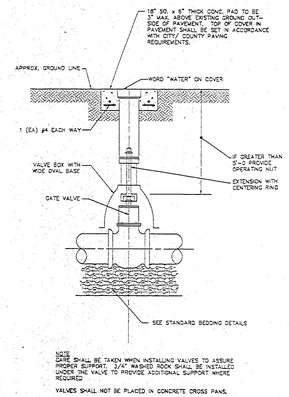
SIZE OF PIPE	B 11 1/4°	E 22 1/2°	M 45°	O 90°	TEE OR DEAD END
4"	1.00	1.00	1.00	NA	1.50
6"	1.00	1.25	2.25	NA	3.00
8"	1.00	2.00	4.00	NA	5.25
12"	2.25	4.50	8.75	NA	11.25
16"	3.75	7.50	14.50	27.00	19.00
20"	5.00	10.00	19.50	35.50	25.00
24"	7.00	14.00	27.75	51.00	36.00

TYPICAL CROSS SECTION

CONCRETE KICKBLOCKS BEARING SURFACES AND INSTALLATION

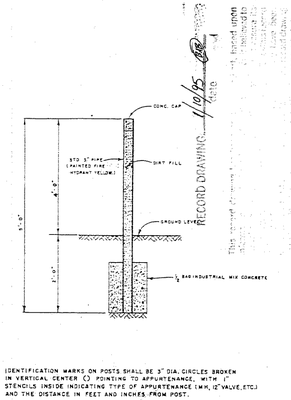


BLOW-OFF DETAIL



NOTE
CARE SHALL BE TAKEN WHEN INSTALLING VALVES TO ASSURE PROPER SUPPORT. 3/4" WASHED ROCK SHALL BE INSTALLED UNDER THE VALVE TO PROVIDE ADDITIONAL SUPPORT WHERE REQUIRED.
VALVES SHALL NOT BE PLACED IN CONCRETE CROSS PANS.

GATE VALVE DETAIL



(IDENTIFICATION MARKS ON POSTS SHALL BE 3" DIA. CIRCLES BROKEN IN VERTICAL CENTER (-) POINTING TO APPURTENANCE, WITH 1" STENCILS INSIDE INDICATING TYPE OF APPURTENANCE (W=8, 12" VALVE, ETC.) AND THE DISTANCE IN FEET AND INCHES FROM POST.

REFERENCE POST TYPICAL DETAIL

UNTIL SUCH TIME AS THESE DRAWINGS ARE APPROVED BY THE APPROPRIATE REVIEWING AGENCIES, JR ENGINEERING, LTD. APPROVES THEIR USE ONLY FOR THE PURPOSES DESIGNATED BY WRITTEN AUTHORIZATION.

CALL UTILITY NOTIFICATION CENTER OF COLORADO 1-800-922-1987 IN METRO DENVER OR 534-6700 CALL 2 BUSINESS DAYS IN ADVANCE BEFORE YOU DIG, GRADE OR EXCAVATE FOR THE MARKING OF UNDERGROUND MEMBER UTILITIES.

JR Engineering, Ltd.
6110 Greenwood Plaza Blvd.
Englewood, Colorado 80111
Tel (303) 740-9393
FAX (303) 721-9019

No.	REVISION	BY	DATE
1	PER DISTRICT COMMENTS	RFL	6/21/94
2	45° BULB INFORMATION	BAB	11/10/95

RECORD DRAWING 11/10/95

This record drawing was prepared from information furnished by others and JR Engineering, Ltd. assumes no responsibility for the accuracy of the information shown hereon.

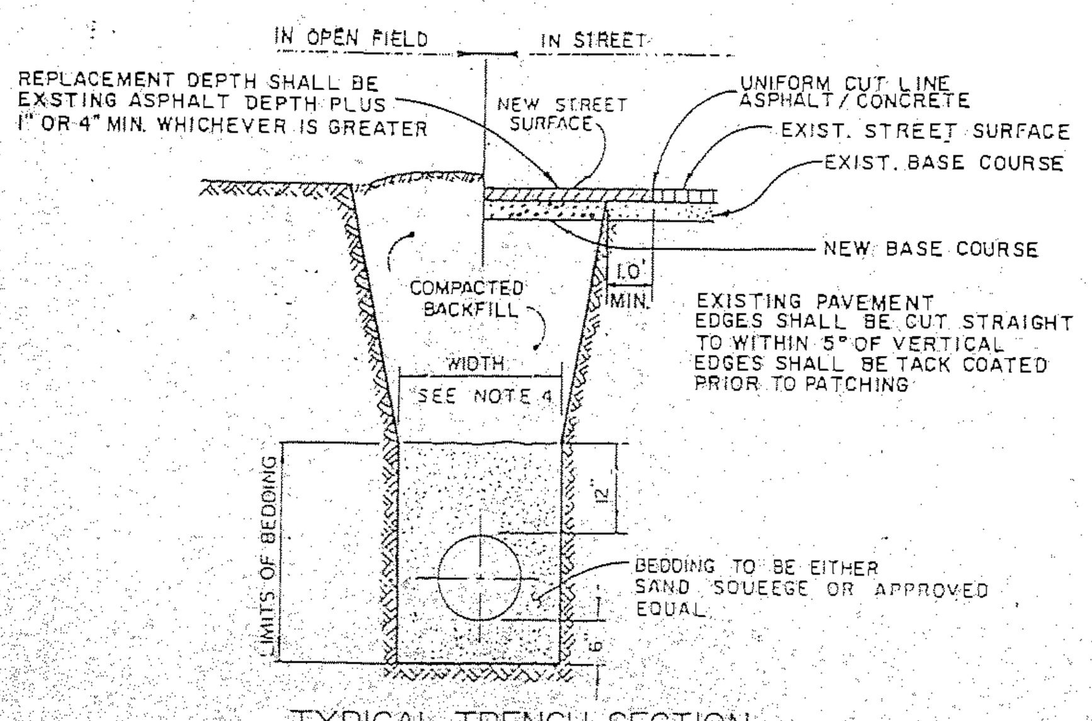
SCALE	1"=50'
DATE	05/09/94
DES. BY	RFL
CHK. BY	
DWN. BY	RFL

PINEY CREEK FILING NO. 10
WATER AND SANITARY SEWER PLAN AND PROFILE AND DETAILS
PREPARED FOR RICHMOND HOMES

SHEET 7 OF 8

JOB NO. 1533.47 | REV. 0

MEC 9402

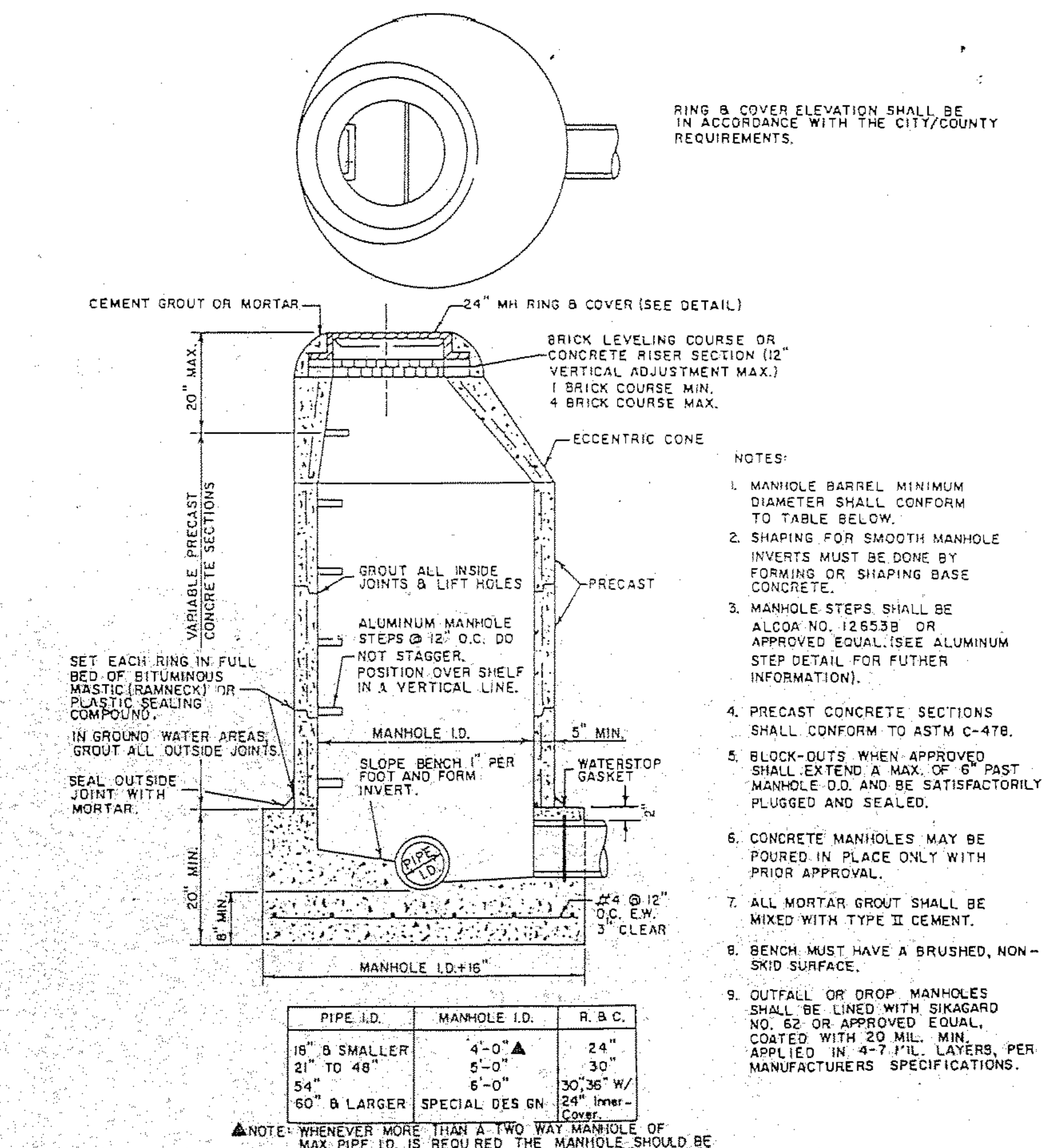


TYPICAL TRENCH SECTION

NOTES:

1. THE TRENCH SHALL BE IN ACCORDANCE WITH APPLICABLE LOCAL, STATE, AND FEDERAL SPECIFICATIONS AND SAFETY REGULATIONS.
2. A CONSTRUCTION TRAFFIC CONTROL PLAN SHALL BE SUBMITTED TO AND APPROVED BY ARAPAHOE COUNTY PRIOR TO ISSUANCE OF CONSTRUCTION PERMITS IN THE COUNTY RIGHT-OF-WAY.
3. PIPE SHALL BE BEDDED FROM 6" BELOW THE BOTTOM OF THE PIPE TO 12" ABOVE THE TOP OF PIPE.
4. TRENCH WIDTH SHALL NOT BE MORE THAN 16" NOR LESS THAN 12" WIDER THAN THE LARGEST OUTSIDE DIAMETER OF THE PIPE.
5. SHOULD THE TRENCH BE EXCAVATED WIDER THAN ALLOWED, A CONCRETE CRADLE SHALL BE PLACED WITH 2500 P.S.I. CONCRETE FROM TRENCH BOTTOM TO PIPE SPRINGLINE. (SEE SPECIAL BEDDING DETAIL.)
6. BACKFILL COMPACTION REQUIREMENTS: MINIMUM DENSITY WILL BE DETERMINED IN ACCORDANCE WITH A.A.S.H.T.O. DESIGNATION T99 OR T180 AS DEFINED BY THE STANDARD SPECIFICATION SECTION 203.11 OF THE STATE OF COLORADO STANDARD SPECIFICATION FOR ROAD AND BRIDGE CONSTRUCTION. COMPACTION SHALL BE MIN. 95% S.P.D. IN STREET R.O.W; OUTSIDE OF STREET R.O.W. SHALL BE 90% S.P.D.
7. FULL DEPTH ASPHALT CAN BE USED AS AN ALTERNATIVE TO BASE COURSE. A RATIO OF 3 INCHES BASE COUSE TO 1 INCH OF ASPHALT SHALL BE USED IN THE SUBSTITUTION. A TEMPORARY COLD-MIX ASPHALT PATCH, 4" IN DEPTH, WILL BE REQUIRED FOR ALL STREET CUTS IF A PERMANENT HOT-MIX ASPALT PATCH CANNOT BE APPLIED AFTER CONSTRUCTION IS COMPLETED.
8. THIS TRENCH PATCHING DETAILS REQUIREMENTS IN ADDITION TO THOSE SPECIFIED IN THE LATEST EDITION OF THE COLORADO DEPARTMENT OF HIGHWAY'S STANDARD SPECIFICATIONS FOR ROAD AND BRIDGE CONSTRUCTION.

STANDARD BEDDING



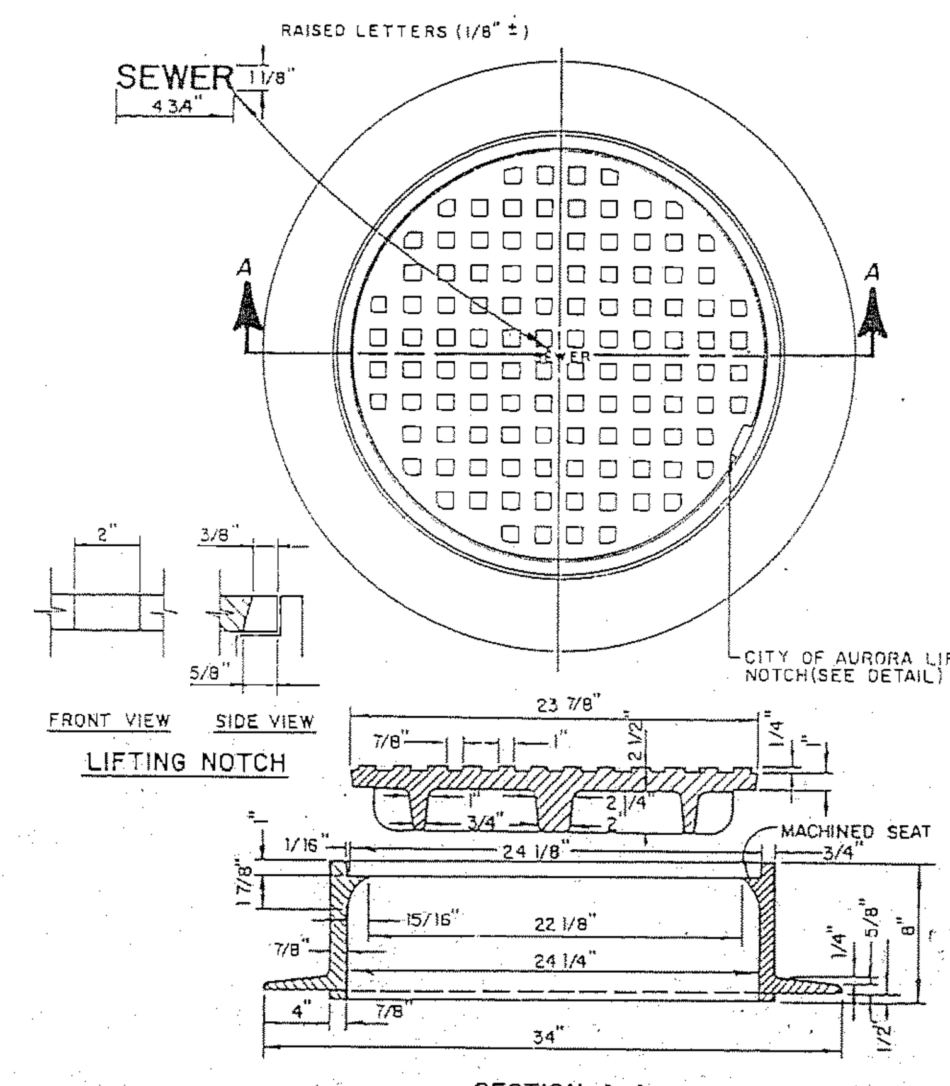
PIPE I.D.	MANHOLE I.D.	R. & C.
18" & SMALLER	4'-0"▲	24"
21" TO 48"	5'-0"	30"
54"	6'-0"	30", 36" W/
60" & LARGER	SPECIAL DES GN	24" Inner-Cover.

▲NOTE: WHENEVER MORE THAN A TWO WAY MANHOLE OF MAX. PIPE I.D. IS REQUIRED THE MANHOLE SHOULD BE INCREASED TO LARGER DIA., EG. 18"x18"x18", REQUIRES 5'-0" I.D.

NOTES:

1. MANHOLE BARREL MINIMUM DIAMETER SHALL CONFORM TO TABLE BELOW.
2. SHAPING FOR SMOOTH MANHOLE INVERTS MUST BE DONE BY FORMING OR SHAPING BASE CONCRETE.
3. MANHOLE STEPS SHALL BE ALCOA NO. 12653B OR APPROVED EQUAL. (SEE ALUMINUM STEP DETAIL FOR FUTHER INFORMATION).
4. PRECAST CONCRETE SECTIONS SHALL CONFORM TO ASTM C-478.
5. BLOCK-OUTS WHEN APPROVED SHALL EXTEND A MAX. OF 6" PAST MANHOLE O.D. AND BE SATISFACTORILY PLUGGED AND SEALED.
6. CONCRETE MANHOLES MAY BE POURED IN PLACE ONLY WITH PRIOR APPROVAL.
7. ALL MORTAR GROUT SHALL BE MIXED WITH TYPE II CEMENT.
8. BENCH MUST HAVE A BRUSHED, NON-SKID SURFACE.
9. OUTFALL OR DROP MANHOLES SHALL BE LINED WITH SIKAGARD NO. 62 OR APPROVED EQUAL, COATED WITH 20 MIL. MIN. APPLIED IN 4-7 MIL. LAYERS, PER MANUFACTURERS SPECIFICATIONS.

PRECAST MANHOLE

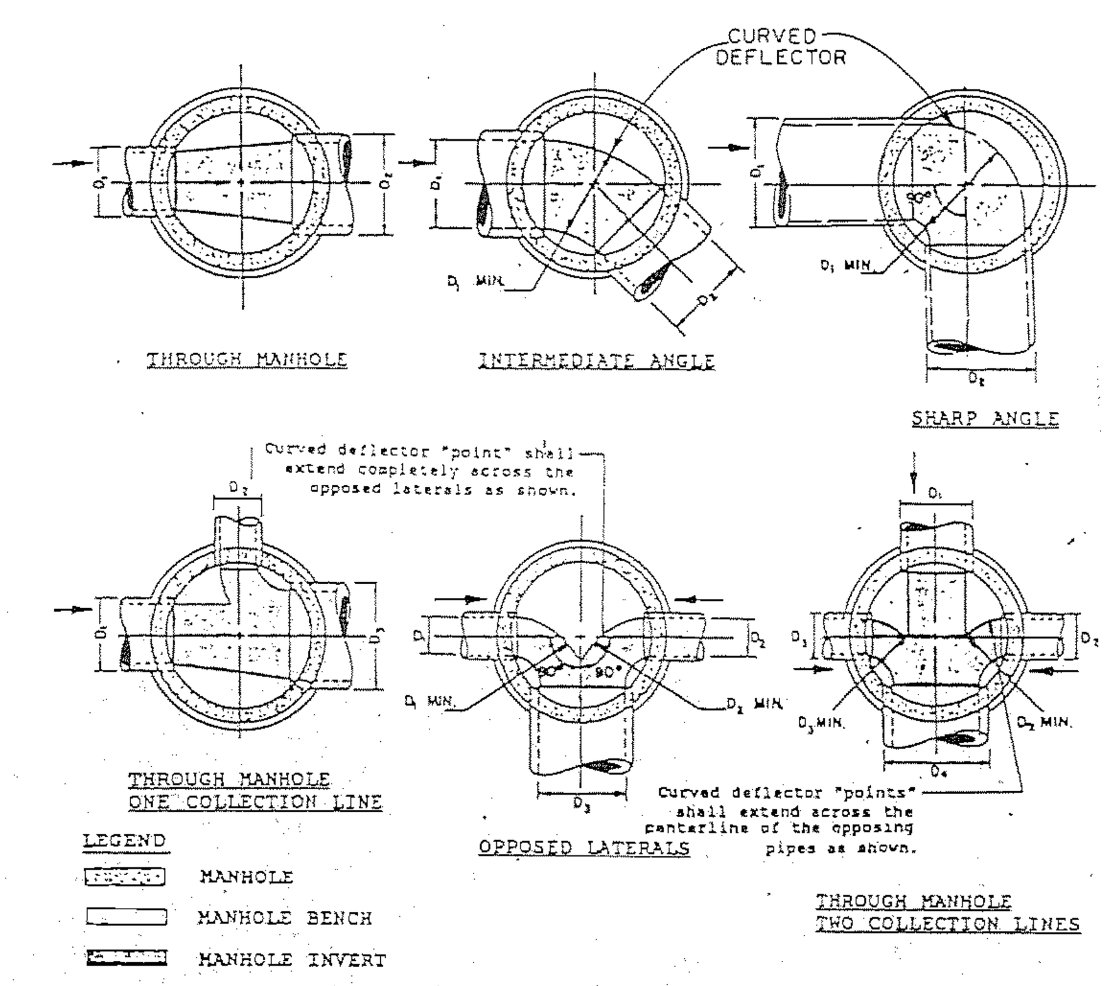


NOTE:

1. CASTING SPECIFICATIONS: ASTM A-48 WITH A MINIMUM TENSILE STRENGTH OF 25 KSI (CLASS 25)
2. ALL CASTINGS TO BE DIPPED IN ASPHALT BASE PAINT (OR APPROVED EQUAL)
3. CASTINGS SHALL BE AS SPECIFIED BELOW OR EQUAL:

MANUFACTURES	CAT. #
NEENAH CASTINGS, INC.	R-1706 MH-400-24 C.I.
HUTCHINSON FDRY. & STL. INC.	MH-400

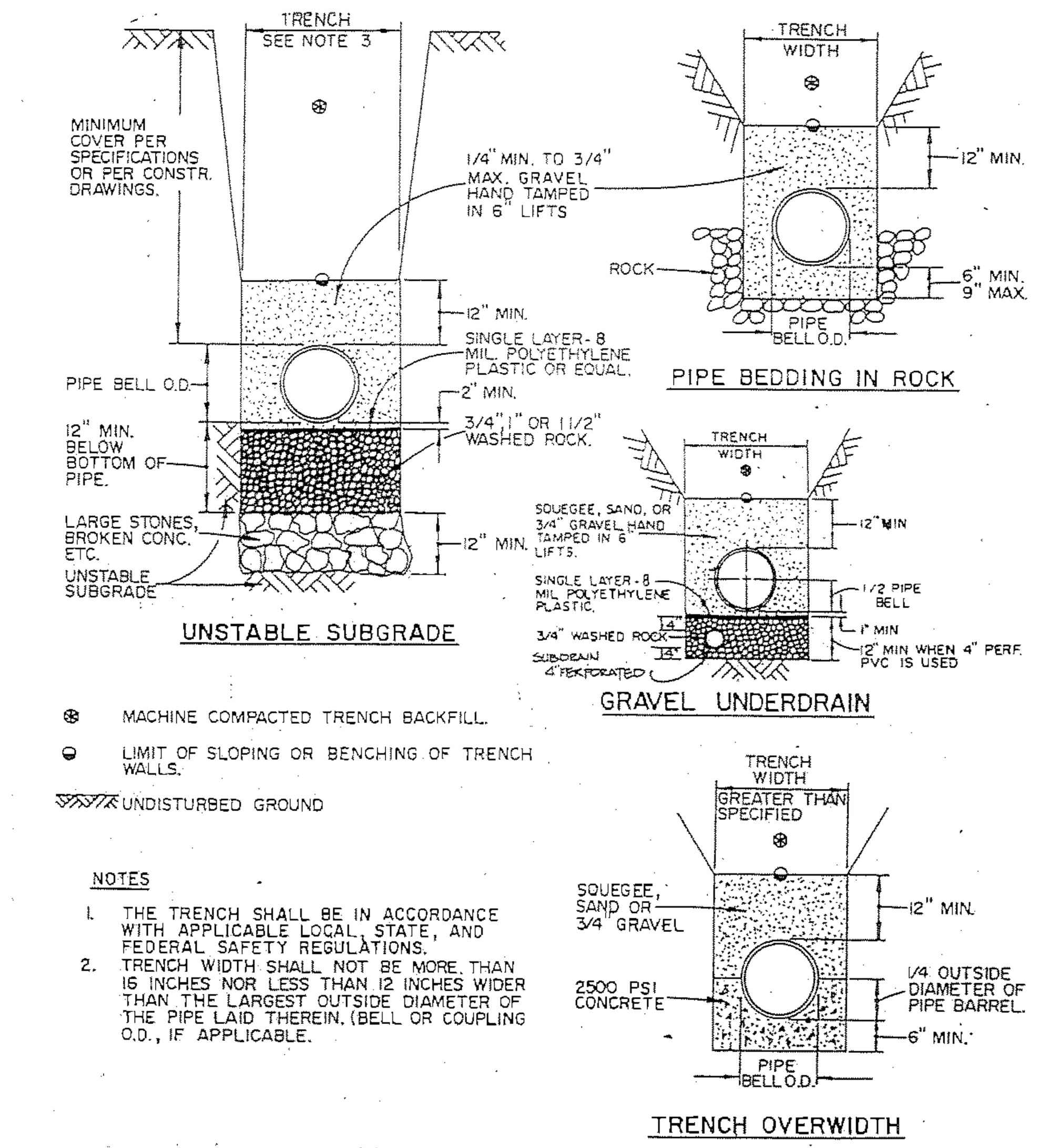
24" MANHOLE RING AND COVER



NOTES

1. Pipe invert elevations and drop through manholes shall be in conformance with the reviewed and signed Construction Plans. The intention is to promote smooth, non-turbulent flow through the manholes by keeping the larger lines lower in the manhole and bringing the smaller lines in slightly higher.
2. Maximum inside drop through any manhole shall be 12 inches.
3. Minimum drop through any manhole shall be 0.2 Ft.
4. All invert deflectors shall be curved in shape to provide smooth flow transitions as shown on this detail.
5. Minimum angle between the centerline of any incoming pipe and the centerline of the outgoing pipe shall be 90 degrees.

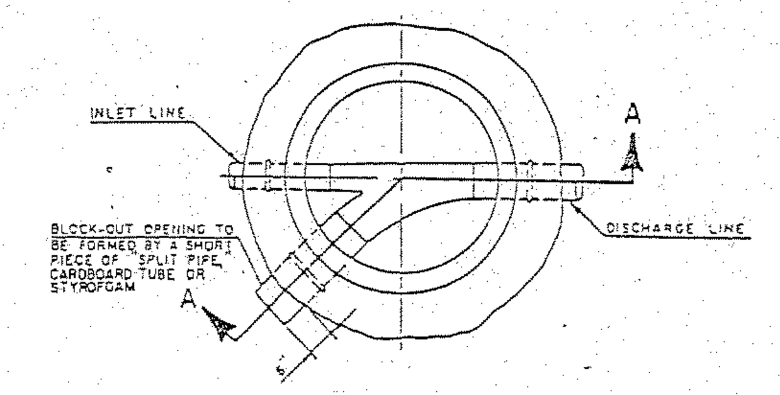
MANHOLE BASE AND DEFLECTOR



NOTES

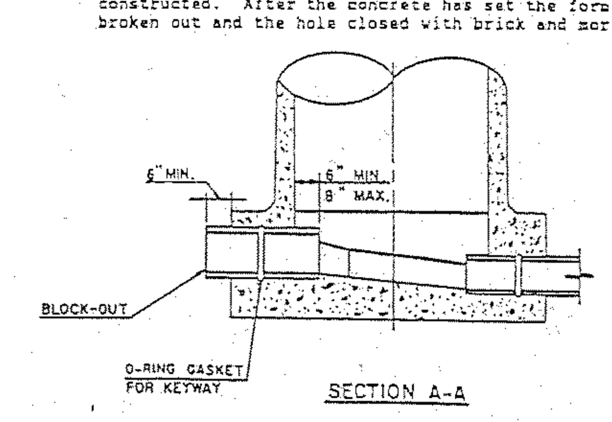
1. THE TRENCH SHALL BE IN ACCORDANCE WITH APPLICABLE LOCAL, STATE, AND FEDERAL SAFETY REGULATIONS.
2. TRENCH WIDTH SHALL NOT BE MORE THAN 16 INCHES NOR LESS THAN 12 INCHES WIDER THAN THE LARGEST OUTSIDE DIAMETER OF THE PIPE LAID THEREIN. (BELL OR COUPLING O.D., IF APPLICABLE.

SPECIAL BEDDING DETAILS

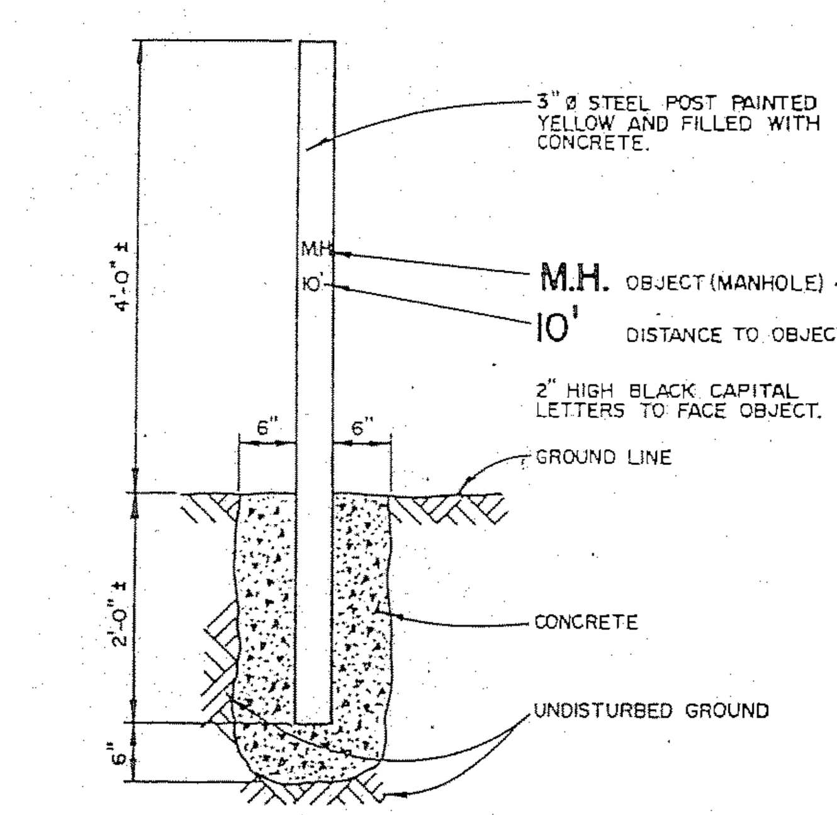


NOTE

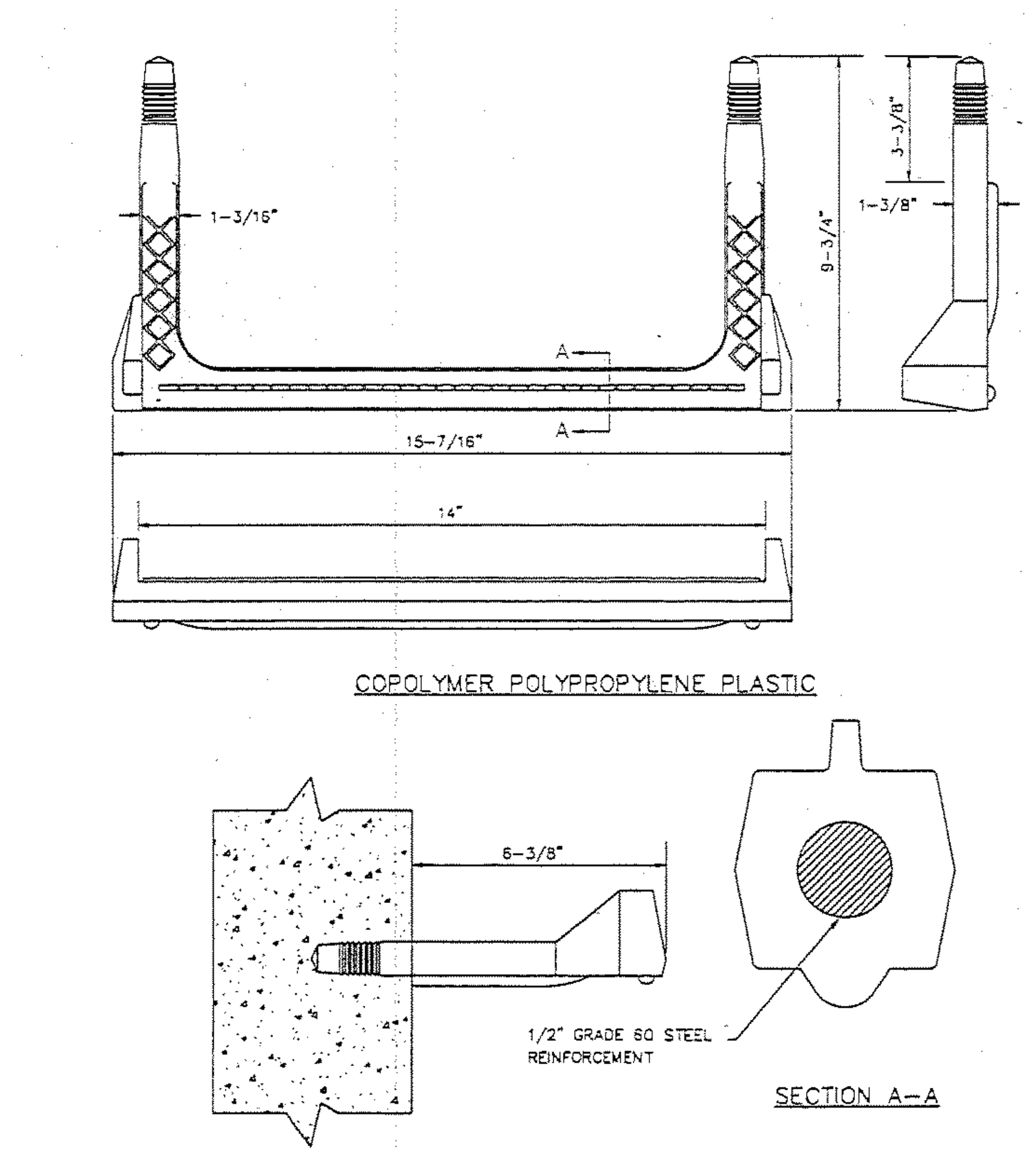
The blockout opening shall be a minimum of 12" in diameter or 3" large than the discharge line diameter. An O-Ring gasket shall be used when forming the blockout to form a "Key" for use when the future pipe is constructed. After the concrete has set the formed blockout shall be broken out and the hole closed with brick and mortar.



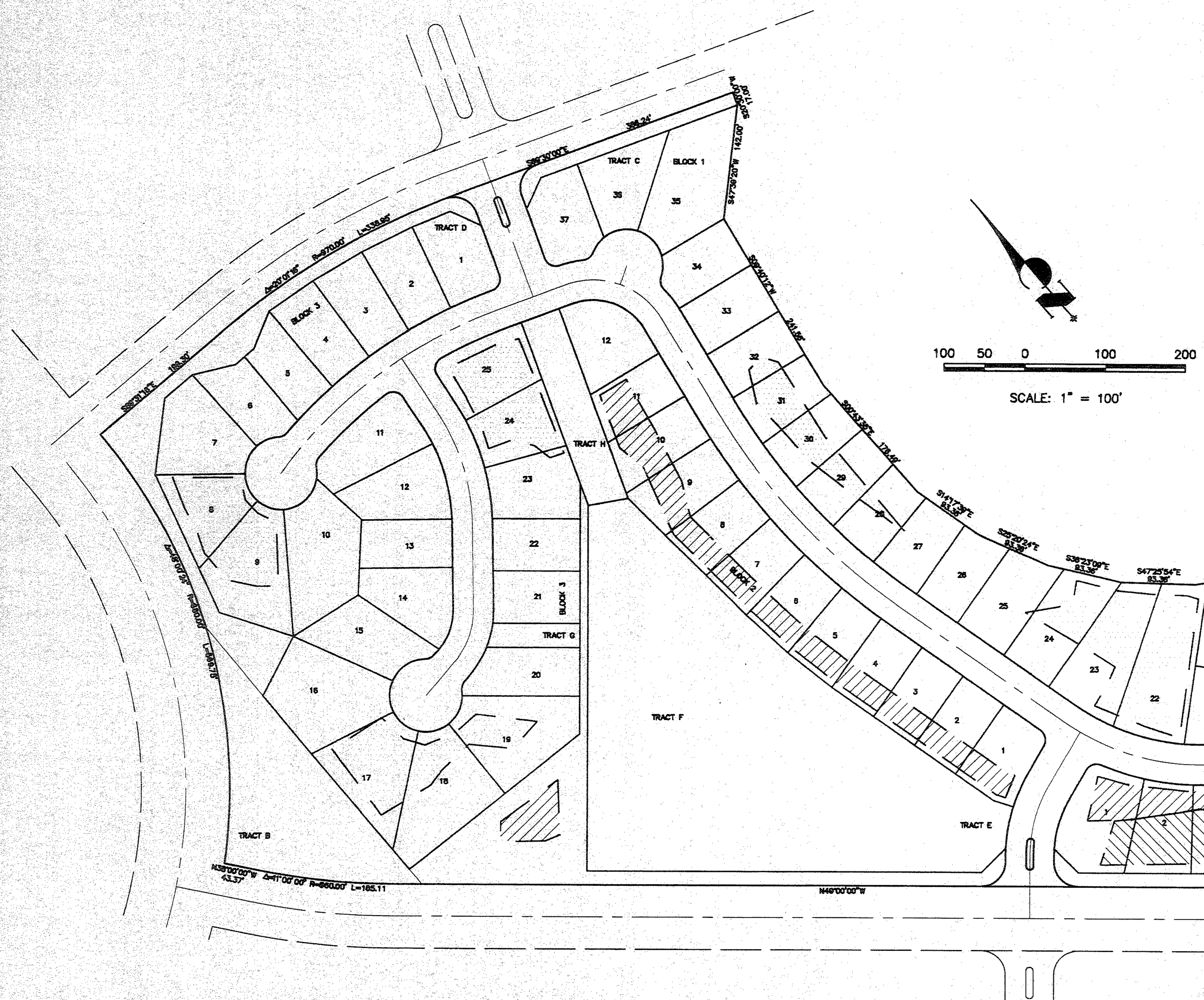
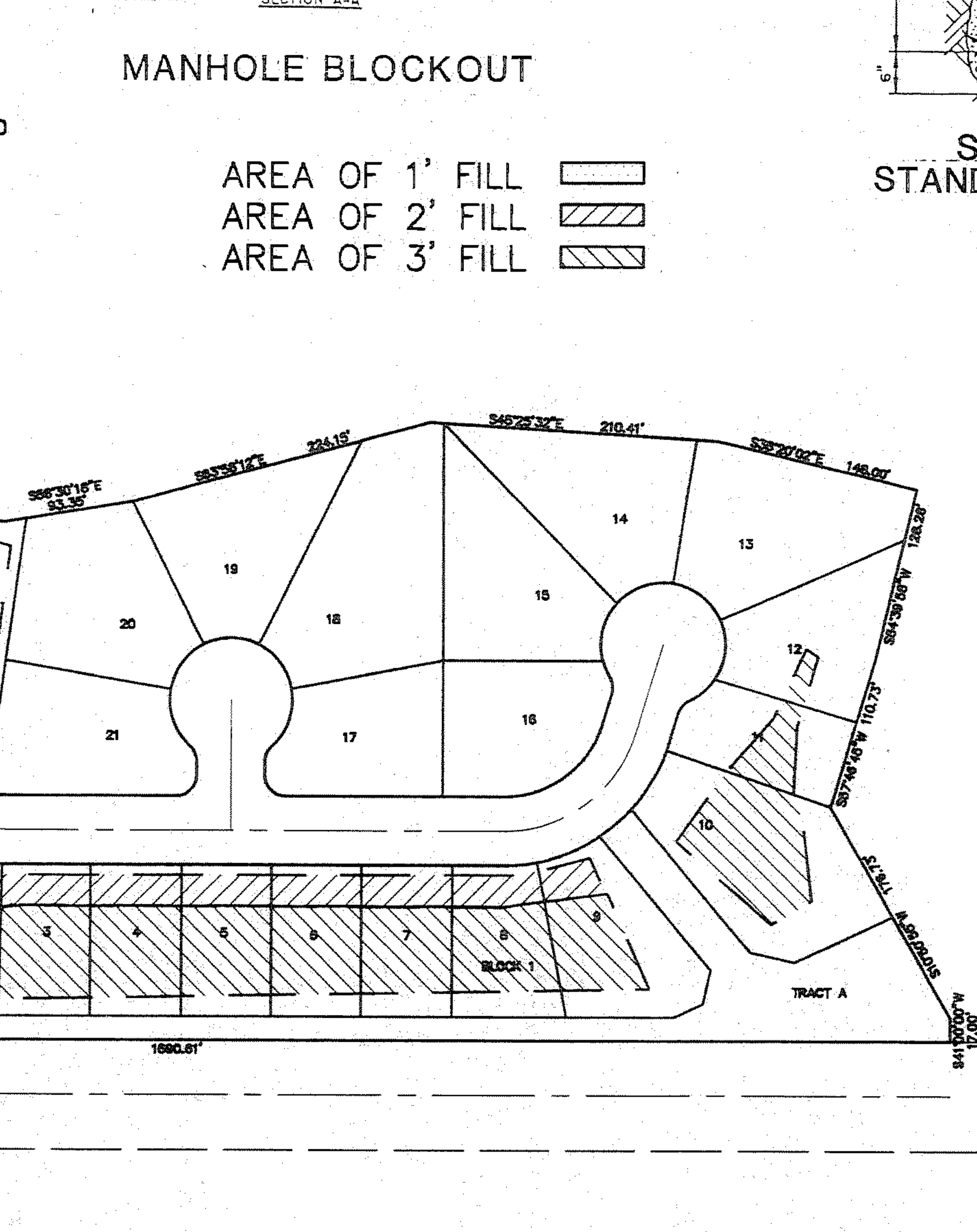
MANHOLE BLOCKOUT



SANITARY SEWER STANDARD MARKER POST



PLASTIC STEP

100 50 0 100 200

SCALE: 1" = 100'

AREA OF 1' FILL
AREA OF 2' FILL
AREA OF 3' FILL

TOTAL FILL AREA = 10,520 CY
15% = 1,580 CY
TOTAL = 12,100 CY

INSPECTION OF WATER AND SEWER CONSTRUCTION PROVIDED BY MEURER AND ASSOCIATES MARK SKELSKY

△ AS-CONSTRUCTED INFORMATION IS SHOWN WITHIN BUBBLES,

RECORD DRAWING *1/10/95* date

FOR INFORMATION ONLY

UNTIL SUCH TIME AS THESE DRAWINGS ARE APPROVED BY THE APPROPRIATE REVIEWING AGENCIES, JR ENGINEERING, LTD. APPROVES THEIR USE ONLY FOR THE PURPOSES DESIGNATED BY WRITTEN AUTHORIZATION.

CALL UTILITY NOTIFICATION CENTER OF COLORADO
1-800-922-1987
OR 534-6700 IN METRO DENVER
CALL 2-BUSINESS DAYS IN ADVANCE BEFORE YOU DIG, GRADE, OR EXCAVATE FOR THE MARKING OF UNDERGROUND MEMBER UTILITIES.

JR Engineering, Ltd.
6110 Greenwood Plaza Blvd.
Englewood, Colorado 80111
Tel. (303) 740-9393
FAX (303) 721-9019

No.	REVISION	BY	DATE
△	*PREPARE AS-BUILT DRAWINGS*	*BAB*	*1/10/95*

SCALE	1"=50'
DATE	05/09/94
DES. BY	RFL
CHK. BY	
DWN. BY	RFL

PINEY CREEK FILING NO. 10

AREA FOR PLACEMENT OF FILL MATERIALS

PREPARED FOR RICHMOND HOMES

SHEET 8 OF 8

JOB NO.	REV.
1533.47	0

MEC 9402

PLOT SCALE 1=100, DATE 05/12/94, TIME 08:05, FILE X:\153347\ACAD\PC10GR.DWG

NORTH ARAPAHOE REGIONAL

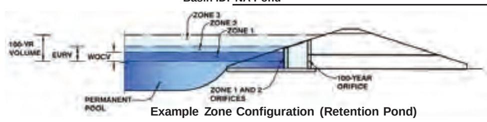
DETENTION BASIN INFORMATION

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

UD-Detention, Version 3.07 (February 2017)

Project: Cherry Creek Minor Tributaries in Arapahoe County MDP

Basin ID: NA Pond



Example Zone Configuration (Retention Pond)

Required Volume Calculation

Selected BMP Type =	EDB			
Watershed Area =	127.80	acres		
Watershed Length =	4,335	ft		
Watershed Slope =	0.017	ft/ft		
Watershed Imperviousness =	46.50%	percent		
Percentage Hydrologic Soil Group A =	0.0%	percent		
Percentage Hydrologic Soil Group B =	100.0%	percent		
Percentage Hydrologic Soil Groups C/D =	0.0%	percent		
Desired WQCV Drain Time =	40.0	hours		
Location for 1-hr Rainfall Depths =	User Input			
Water Quality Capture Volume (WQCV) =	2.097	acre-feet	Optional User Override 1-hr Precipitation	
Excess Urban Runoff Volume (EURV) =	6.316	acre-feet		
2-yr Runoff Volume (P1 = 0.87 in.) =	3.688	acre-feet	0.87	inches
5-yr Runoff Volume (P1 = 1.13 in.) =	5.233	acre-feet	1.13	inches
10-yr Runoff Volume (P1 = 1.37 in.) =	7.470	acre-feet	1.37	inches
25-yr Runoff Volume (P1 = 1.73 in.) =	11.783	acre-feet	1.73	inches
50-yr Runoff Volume (P1 = 2.03 in.) =	14.816	acre-feet	2.03	inches
100-yr Runoff Volume (P1 = 2.36 in.) =	18.817	acre-feet	2.36	inches
500-yr Runoff Volume (P1 = 3.21 in.) =	28.199	acre-feet	3.21	inches
Approximate 2-yr Detention Volume =	3.450	acre-feet		
Approximate 5-yr Detention Volume =	4.914	acre-feet		
Approximate 10-yr Detention Volume =	6.844	acre-feet		
Approximate 25-yr Detention Volume =	8.329	acre-feet		
Approximate 50-yr Detention Volume =	9.093	acre-feet		
Approximate 100-yr Detention Volume =	10.627	acre-feet		

Stage-Storage Calculation

Zone 1 Volume (WQCV) =	2.097	acre-feet
Zone 2 Volume (100-year - Zone 1) =	8.530	acre-feet
Select Zone 3 Storage Volume (Optional) =		acre-feet
Total Detention Basin Volume =	10.627	acre-feet
Initial Surcharge Volume (ISV) =	user	ft^3
Initial Surcharge Depth (ISD) =	user	ft
Total Available Detention Depth (H_{total}) =	user	ft
Depth of Trickle Channel (H_{TC}) =	user	ft
Slope of Trickle Channel (S_{TC}) =	user	ft/ft
Slopes of Main Basin Sides (S_{main}) =	user	H:V
Basin Length-to-Width Ratio ($R_{L/W}$) =	user	
Initial Surcharge Area (A_{ISV}) =	user	ft^2
Surcharge Volume Length (L_{ISV}) =	user	ft
Surcharge Volume Width (W_{ISV}) =	user	ft
Depth of Basin Floor (H_{FLOOR}) =	user	ft
Length of Basin Floor (L_{FLOOR}) =	user	ft
Width of Basin Floor (W_{FLOOR}) =	user	ft
Area of Basin Floor (A_{FLOOR}) =	user	ft^2
Volume of Basin Floor (V_{FLOOR}) =	user	ft^3
Depth of Main Basin (H_{MAIN}) =	user	ft
Length of Main Basin (L_{MAIN}) =	user	ft
Width of Main Basin (W_{MAIN}) =	user	ft
Area of Main Basin (A_{MAIN}) =	user	ft^2
Volume of Main Basin (V_{MAIN}) =	user	ft^3
Calculated Total Basin Volume (V_{total}) =	**user**	acre-feet

Depth Increment = 1 ft

Stage - Storage Description	Stage (ft)	Optional Override Stage (ft)	Length (ft)	Width (ft)	Area (ft^2)	Optional Override Area (ft^2)	Area (acre)	Volume (ft^3)	Volume (ac-ft)
Top of Micropool	--	0.00	--	--	--	2,015	0.046		
	--	0.40	--	--	--	4,029	0.092	1,169	0.027
	--	1.40	--	--	--	7,745	0.178	7,018	0.161
	--	2.40	--	--	--	13,713	0.315	17,824	0.409
	--	3.40	--	--	--	19,405	0.445	34,383	0.789
	--	4.40	--	--	--	28,097	0.645	58,135	1.335
	--	5.40	--	--	--	47,234	1.084	95,800	2.199
	--	6.40	--	--	--	60,011	1.378	149,423	3.430
	--	7.40	--	--	--	65,787	1.510	212,322	4.874
	--	8.40	--	--	--	65,787	1.510	278,109	6.385
	--	9.40	--	--	--	65,787	1.510	343,896	7.895
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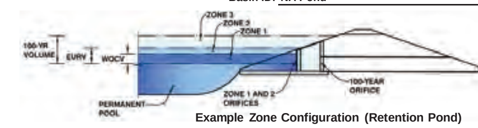
Detention Basin Outlet Structure Design

UD-Detention, Version 3.07 (February 2017)

Project: Cherry Creek Minor Tributaries in Arapahoe County MDP

Basin ID: NA Pond



Example Zone Configuration (Retention Pond)

	Stage (ft)	Zone Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	5.31	2.097	Orifice Plate
Zone 2 (100-year)		8.530	Rectangular Orifice
Zone 3			Weir&Pipe (Circular)
		10.627	Total

User Input: Orifice at Underdrain Outlet (typically used to drain WQCV in a Filtration BMP)

Underdrain Orifice Invert Depth =	N/A	ft (distance below the filtration media surface)
Underdrain Orifice Diameter =	N/A	inches

Calculated Parameters for Underdrain

Underdrain Orifice Area =	N/A	ft^2
Underdrain Orifice Centroid =	N/A	feet

User Input: Orifice Plate with one or more orifices or Elliptical Slot Weir (typically used to drain WQCV and/or EURV in a sedimentation BMP)

Invert of Lowest Orifice =	0.00	ft (relative to basin bottom at Stage = 0 ft)
Depth at top of Zone using Orifice Plate =	3.56	ft (relative to basin bottom at Stage = 0 ft)
Orifice Plate: Orifice Vertical Spacing =	N/A	inches
Orifice Plate: Orifice Area per Row =	N/A	inches

Calculated Parameters for Plate

WQ Orifice Area per Row =	N/A	ft^2
Elliptical Half-Width =	N/A	feet
Elliptical Slot Centroid =	N/A	feet
Elliptical Slot Area =	N/A	ft^2

User Input: Stage and Total Area of Each Orifice Row (numbered from lowest to highest)

	Row 1 (required)	Row 2 (optional)	Row 3 (optional)	Row 4 (optional)	Row 5 (optional)	Row 6 (optional)	Row 7 (optional)	Row 8 (optional)
Stage of Orifice Centroid (ft)	0.06	0.40	0.73	1.06	1.40	1.73	2.06	2.40
Orifice Area (sq. inches)	7.07	1.77	1.77	1.77	1.77	1.77	1.77	1.77

	Row 9 (optional)	Row 10 (optional)	Row 11 (optional)	Row 12 (optional)	Row 13 (optional)	Row 14 (optional)	Row 15 (optional)	Row 16 (optional)
Stage of Orifice Centroid (ft)	2.73	3.06	3.40					
Orifice Area (sq. inches)	1.77	1.77	1.77					

User Input: Vertical Orifice (Circular or Rectangular)

	Zone 2 Rectangular	Not Selected	
Invert of Vertical Orifice =	3.56	N/A	ft (relative to basin bottom at Stage = 0 ft)
Depth at top of Zone using Vertical Orifice =	7.01	N/A	ft (relative to basin bottom at Stage = 0 ft)
Vertical Orifice Height =	37.20	N/A	inches
Vertical Orifice Width =	20.25		inches

Calculated Parameters for Vertical Orifice

	Zone 2 Rectangular	Not Selected	
Vertical Orifice Area =	5.23	N/A	ft^2
Vertical Orifice Centroid =	1.55	N/A	feet

User Input: Overflow Weir (Dropbox) and Grate (Flat or Sloped)

	Zone 3 Weir	Not Selected	
Overflow Weir Front Edge Height, Ho =	7.01	N/A	ft (relative to basin bottom at Stage = 0 ft)
Overflow Weir Front Edge Length =	10.83	N/A	feet
Overflow Weir Slope =	0.00	N/A	H:V (enter zero for flat grate)
Horiz. Length of Weir Sides =	3.04	N/A	feet
Overflow Grate Open Area % =	70%	N/A	%, grate open area/total area
Debris Clogging % =	50%	N/A	%

Calculated Parameters for Overflow Weir

	Zone 3 Weir	Not Selected	
Height of Grate Upper Edge, H_t =	7.01	N/A	feet
Over Flow Weir Slope Length =	3.04	N/A	feet
Grate Open Area / 100-yr Orifice Area =	2.40	N/A	should be ≥ 4
Overflow Grate Open Area w/o Debris =	23.05	N/A	ft^2
Overflow Grate Open Area w/ Debris =	11.53	N/A	ft^2

User Input: Outlet Pipe w/ Flow Restriction Plate (Circular Orifice, Restrictor Plate, or Rectangular Orifice)

	Zone 3 Circular	Not Selected	
Depth to Invert of Outlet Pipe =	2.21	N/A	ft (distance below basin bottom at Stage = 0 ft)
Circular Orifice Diameter =	42.00	N/A	inches

Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate

	Zone 3 Circular	Not Selected	
Outlet Orifice Area =	9.62	N/A	ft^2
Outlet Orifice Centroid =	1.75	N/A	feet
Half-Central Angle of Restrictor Plate on Pipe =	N/A	N/A	radians

User Input: Emergency Spillway (Rectangular or Trapezoidal)

Spillway Invert Stage=	8.16	ft (relative to basin bottom at Stage = 0 ft)
Spillway Crest Length =	73.00	feet
Spillway End Slopes =	4.00	H:V
Freeboard above Max Water Surface =	2.00	feet

Calculated Parameters for Spillway

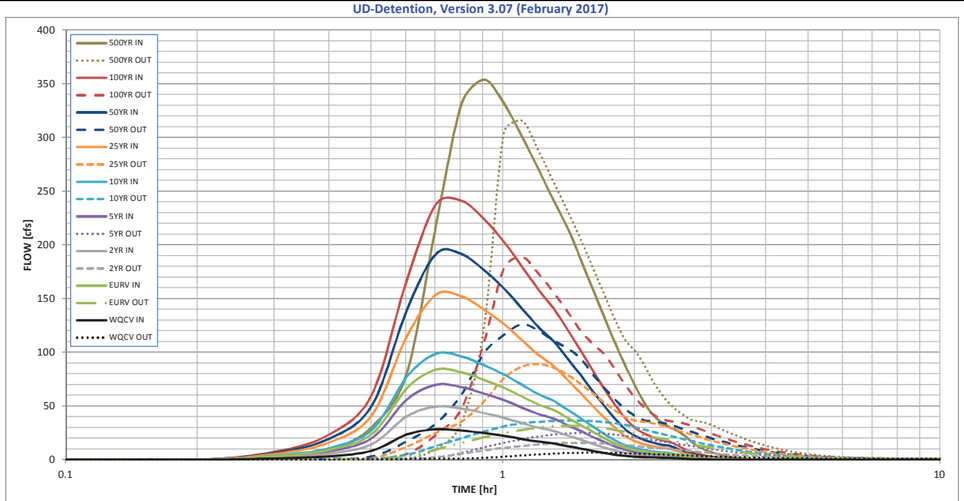
Spillway Design Flow Depth=	1.03	feet
Stage at Top of Freeboard =	11.19	feet
Basin Area at Top of Freeboard =	1.51	acres

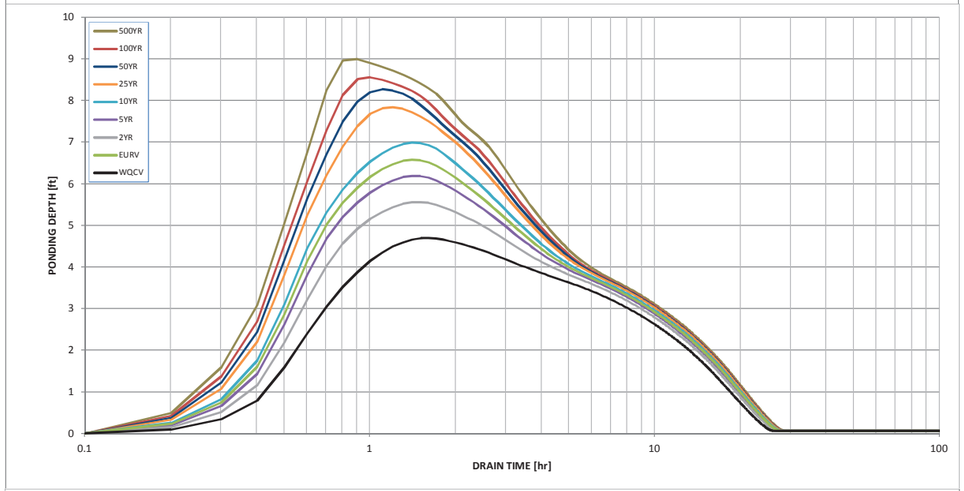
Routed Hydrograph Results

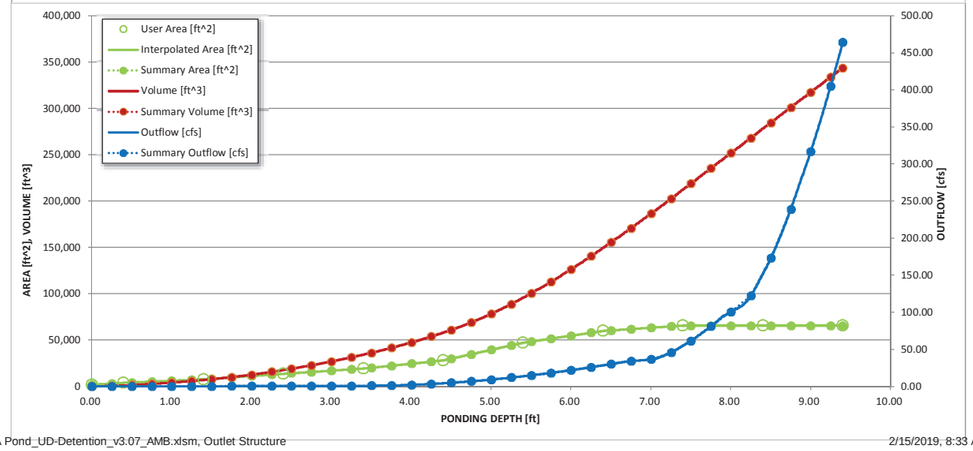
Design Storm Return Period =	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
One-Hour Rainfall Depth (in) =	0.53	1.07	0.87	1.13	1.37	1.73	2.03	2.36	3.21
Calculated Runoff Volume (acre-ft) =	2.097	6.316	3.688	5.233	7.470	11.783	14.816	18.817	28.199
OPTIONAL Override Runoff Volume (acre-ft) =									
Inflow Hydrograph Volume (acre-ft) =	2.096	6.311	3.687	5.230	7.459	11.774	14.812	18.807	28.191
Predevelopment Unit Peak Flow, q (cfs/acre) =	0.00	0.00	0.01	0.01	0.12	0.46	0.66	0.94	1.52
Predevelopment Peak Q (cfs) =	0.0	0.0	0.9	1.6	15.4	58.8	85.0	119.7	194.0
Peak Inflow Q (cfs) =	28.5	84.0	49.6	69.9	98.8	153.8	191.8	241.3	353.9
Peak Outflow Q (cfs) =	6.6	31.7	15.9	25.1	36.5	89.0	126.1	188.9	315.9
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	15.8	2.4	1.5	1.5	1.6	1.6
Structure Controlling Flow =	Vertical Orifice 1	Vertical Orifice 1	Vertical Orifice 1	Vertical Orifice 1	Vertical Orifice 1	Overflow Grate 1	Spillway	Spillway	Spillway
Max Velocity through Grate 1 (fps) =	N/A	N/A	N/A	N/A	N/A	2.0	3.1	3.6	3.9
Max Velocity through Grate 2 (fps) =	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Time to Drain 97% of Inflow Volume (hours) =	20	17	19	18	17	14	13	11	8
Time to Drain 99% of Inflow Volume (hours) =	**23**	22	23	22	21	20	19	18	16
Maximum Ponding Depth (ft) =	4.70	6.57	5.56	6.19	6.99	7.84	8.27	8.56	9.00
Area at Maximum Ponding Depth (acres) =	0.77	1.40	1.13	1.31	1.46	1.51	1.51	1.51	1.51
Maximum Volume Stored (acre-ft) =	1.540	3.666	2.377	3.134	4.266	5.539	6.188	6.626	7.276

Detention Basin Outlet Structure Design

UD-Detention, Version 3.07 (February 2017)







Detention Basin Outlet Structure Design

UD-Detention, Version 3.07 (February 2017)

Summary Stage-Area-Volume-Discharge Relationships

The user can create a summary S-A-V-D by entering the desired stage increments and the remainder of the table will populate automatically.

The user should graphically compare the summary S-A-V-D table to the full S-A-V-D table in the chart to confirm it captures all key transition points.

Stage - Storage Description	Stage [ft]	Area [ft^2]	Area [acres]	Volume [ft^3]	Volume [ac-ft]	Total Outflow [cfs]
	0.00	2,015	0.046	0	0.000	0.00
	0.25	3,223	0.074	629	0.014	0.10
	0.50	4,363	0.100	1,586	0.036	0.17
	0.75	5,292	0.121	2,793	0.064	0.24
	1.00	6,221	0.143	4,232	0.097	0.30
	1.25	7,150	0.164	5,904	0.136	0.38
	1.50	8,282	0.190	7,817	0.179	0.45
	1.75	9,774	0.224	10,074	0.231	0.52
	2.00	11,266	0.259	12,703	0.292	0.60
	2.25	12,818	0.294	15,834	0.364	0.69
	2.50	14,282	0.328	19,224	0.441	0.78
	2.75	15,705	0.361	22,972	0.527	0.86
	3.00	17,128	0.393	27,077	0.622	0.95
	3.25	18,551	0.426	31,537	0.724	1.04
	3.50	20,275	0.465	36,367	0.835	1.14
	3.75	22,448	0.515	41,708	0.957	1.43
	4.00	24,621	0.565	47,591	1.093	2.22
	4.25	26,794	0.615	54,018	1.240	3.44
	4.50	30,011	0.689	61,040	1.401	5.05
	4.75	34,795	0.799	69,141	1.587	7.04
	5.00	39,580	0.909	78,438	1.801	9.38
	5.25	44,364	1.018	88,931	2.042	12.07
	5.50	48,512	1.114	100,588	2.309	15.09
	5.75	51,706	1.187	113,115	2.597	18.44
	6.00	54,900	1.260	126,441	2.903	22.10
	6.25	58,095	1.334	140,565	3.227	26.07
	6.50	60,589	1.391	155,453	3.569	30.35
	6.75	62,033	1.424	170,781	3.921	34.17
	7.00	63,477	1.457	186,470	4.281	36.58
	7.25	64,921	1.490	202,519	4.649	45.88
	7.50	65,787	1.510	218,901	5.025	61.50
	7.75	65,787	1.510	235,348	5.403	81.09
	8.00	65,787	1.510	251,795	5.780	100.54
	8.25	65,787	1.510	268,241	6.158	122.40
	8.50	65,787	1.510	284,688	6.536	173.34
	8.75	65,787	1.510	301,135	6.913	239.31
	9.00	65,787	1.510	317,582	7.291	317.29
	9.25	65,787	1.510	334,028	7.668	405.48
	9.40	65,787	1.510	343,896	7.895	464.30

For best results, include the stages of all grade slope changes (e.g. ISV and Floor) from the S-A-V table on Sheet 'Basin'.

Also include the inverts of all outlets (e.g. vertical orifice, overflow grate, and spillway, where applicable).


1.5" HOLE
SPACED 2.5" APART
INV 1ST
HOLE FROM
TOP = 6.25"
INV
LAST HOLE
FROM TOP
=
58.25"


42
RCP
2.05
90°
90°

BASELINE PEAK FLOWS

Basin	Design Point	Drainage Area (acres)	Existing Percent Imperviousness	Future Percent Imperviousness	Existing Conditions Peak Flow (cfs)									Future Conditions Peak Flow (cfs)								
					Q_{WQ}	Q_1	Q_2	Q_5	Q_{10}	Q_{25}	Q_{50}	Q_{100}	Q_{500}	Q_{WQ}	Q_1	Q_2	Q_5	Q_{10}	Q_{25}	Q_{50}	Q_{100}	Q_{500}
Little Raven Creek	LR_outfall	349	-	25	-	-	-	-	-	-	-	-	-	23	32	45	72	120	253	338	454	708
Little Raven Creek	Belleview_LR	225	-	37	-	-	-	-	-	-	-	-	-	28	40	55	86	132	242	312	404	609
Little Raven Creek	Havana_LR	140	-	42	-	-	-	-	-	-	-	-	-	27	37	50	74	108	185	236	298	442
Little Raven Creek	LR1	124	-	2	-	-	-	-	-	-	-	-	-	0.1	0.4	1	2	15	50	72	102	166
Little Raven Creek	LR2	85	-	28	-	-	-	-	-	-	-	-	-	7	10	14	23	39	75	98	129	196
Little Raven Creek	LR3	140	-	42	-	-	-	-	-	-	-	-	-	27	37	50	74	108	185	236	298	442
Suhaka Creek	S_outfall	360	-	25	-	-	-	-	-	-	-	-	-	21	29	40	65	111	238	316	423	657
Suhaka Creek	Peoria_S	109	-	27	-	-	-	-	-	-	-	-	-	5	7	10	17	28	58	77	102	157
Suhaka Creek	Stock_Pond_S	131	-	43	-	-	-	-	-	-	-	-	-	19	26	35	50	74	129	165	210	313
Suhaka Creek	S1	121	-	4	-	-	-	-	-	-	-	-	-	0.5	1	2	7	27	74	103	142	226
Suhaka Creek	S2	109	-	27	-	-	-	-	-	-	-	-	-	5	7	10	17	28	58	77	102	157
Suhaka Creek	S3	131	-	43	-	-	-	-	-	-	-	-	-	19	26	35	50	74	129	165	210	313
Joplin Tributary	J_outfall	774	-	39	-	-	-	-	-	-	-	-	-	84	104	130	173	217	348	446	613	985
Joplin Tributary	Parker_J	603	-	47	-	-	-	-	-	-	-	-	-	96	116	141	182	221	331	411	535	859
Joplin Tributary	Junction_J3	352	-	47	-	-	-	-	-	-	-	-	-	59	70	86	110	135	205	247	352	410
Joplin Tributary	out_RB1-4_pond	352	-	47	-	-	-	-	-	-	-	-	-	59	70	86	110	135	205	247	353	410
Joplin Tributary	RB1-4_pond	352	-	47	-	-	-	-	-	-	-	-	-	63	79	104	146	195	345	443	570	855
Joplin Tributary	Laredo_J	234	-	50	-	-	-	-	-	-	-	-	-	48	60	81	113	153	263	333	424	626
Joplin Tributary	Lewiston_J	126	-	52	-	-	-	-	-	-	-	-	-	27	34	46	64	86	145	184	233	342
Joplin Tributary	Junction_J4	101	-	41	-	-	-	-	-	-	-	-	-	16	20	24	32	40	63	87	122	208
Joplin Tributary	Shalom_J	101	-	41	-	-	-	-	-	-	-	-	-	16	20	25	32	41	63	87	123	208
Joplin Tributary	J1	120	-	3	-	-	-	-	-	-	-	-	-	0.0	0.2	1	1	3	29	46	70	120
Joplin Tributary	J2	51	-	28	-	-	-	-	-	-	-	-	-	2	3	4	6	8	17	26	37	65
Joplin Tributary	J3	106	-	55	-	-	-	-	-	-	-	-	-	30	37	46	62	78	127	164	210	319
Joplin Tributary	J4	45	-	43	-	-	-	-	-	-	-	-	-	9	11	14	18	23	35	47	66	111
Joplin Tributary	J5	101	-	41	-	-	-	-	-	-	-	-	-	16	20	25	32	41	63	87	123	208
Joplin Tributary	J6	117	-	42	-	-	-	-	-	-	-	-	-	15	19	24	34	44	82	110	146	229
Joplin Tributary	J7	109	-	48	-	-	-	-	-	-	-	-	-	21	26	35	49	67	118	150	191	284
Joplin Tributary	J8	126	-	52	-	-	-	-	-	-	-	-	-	27	34	46	64	86	145	184	233	342
Grove Ranch Tributary	GR_outfall	81	-	54	-	-	-	-	-	-	-	-	-	18	23	31	43	59	96	121	150	221
Grove Ranch Tributary	GR1	81	-	54	-	-	-	-	-	-	-	-	-	18	23	31	43	59	96	121	150	221
Valley Club Acres Tributary	VCA_outfall	207	-	45	-	-	-	-	-	-	-	-	-	34	43	59	83	114	211	272	349	524
Valley Club Acres Tributary	Fair_Place_VCA	207	-	45	-	-	-	-	-	-	-	-	-	35	44	60	85	115	211	272	349	525
Valley Club Acres Tributary	Regis_Jesuit_VCA	87	-	37	-	-	-	-	-	-	-	-	-	12	15	22	32	43	87	116	151	232
Valley Club Acres Tributary	VCA1	120	-	51	-	-	-	-	-	-	-	-	-	23	29	39	54	73	126	159	201	297
Valley Club Acres Tributary	VCA2	87	-	37	-	-	-	-	-	-	-	-	-	12	15	22	32	43	87	116	151	232
North Arapahoe Tributary	NA_outfall	372	-	44	-	-	-	-	-	-	-	-	-	32	42	56	82	116	229	326	476	800
North Arapahoe Tributary	Parker_NA	372	-	44	-	-	-	-	-	-	-	-	-	33	42	57	82	116	229	326	476	800
North Arapahoe Tributary	Buckley_NA1	272	-	41	-	-	-	-	-	-	-	-	-	15	21	29	45	65	150	217	325	542
North Arapahoe Tributary	Waco_NA	41	-	28	-	-	-	-	-	-	-	-	-	3	4	6	10	15	33	44	59	92
North Arapahoe Tributary	NA_pond	128	-	46	-	-	-	-	-	-	-	-	-	23	29	39	56	77	138	176	226	336
North Arapahoe Tributary	NA1	100	-	51	-	-	-	-	-	-	-	-	-	24	30	41	56	77	131	166	209	308
North Arapahoe Tributary	NA2	128	-	46	-	-	-	-	-	-	-	-	-	23	29	39	56	77	138	176	226	336
North Arapahoe Tributary	NA3	103	-	41	-	-	-	-	-	-	-	-	-	9	12	16	23	30	60	79	103	158
North Arapahoe Tributary	NA4	41	-	28	-	-	-	-	-	-	-	-	-	3	4	6	10	15	33	44	59	92
South Arapahoe Tributary	SA_outfall	396	-	30	-	-	-	-	-	-	-	-	-	26	33	44	66	102	229	311	426	667
South Arapahoe Tributary	Parker_SA	326	-	21	-	-	-	-	-	-	-	-	-	8	14	22	36	62	163	228	318	507
South Arapahoe Tributary	Norfolk_SA	227	-	20	-	-	-	-	-	-	-	-	-	6	10	15	25	43	117	162	225	357
South Arapahoe Tributary	Richfield_SA	132	-	20	-	-	-	-	-	-	-	-	-	4	7	10	15	25	67	93	127	200
South Arapahoe Tributary	SA1	70	-	70	-	-	-	-	-	-	-	-	-	26	32	42	56	73	110	134	164	233
South Arapahoe Tributary	SA2	98	-	24	-	-	-	-	-	-	-	-	-	4	7	10	15	25	58	79	105	164
South Arapahoe Tributary	SA3	95	-	20	-	-	-	-	-	-	-	-	-	3	6	9	13	24	59	80	109	170
South Arapahoe Tributary	SA4	132	-	20	-	-	-	-	-	-	-	-	-	4	7	10	15	25	67	93	127	200
Chenango Tributary	C_outfall	917	-	23	-	-	-	-	-	-	-	-	-	26	43	64	112	198	478	669	942	1,528
Chenango Tributary	Parker_C	811	-	20	-	-	-	-	-	-	-	-	-	21	34	53	96	174	436	610	857	1,379
Chenango Tributary	Hinsdale_C	694	-	20	-	-	-	-	-	-	-	-	-	19	32	49	87	157	388	538	748	1,192
Chenango Tributary	Richfield_C	593	-	20	-	-	-	-	-	-	-	-	-	17	29	44	79	141	345	476	658	1,046
Chenango Tributary	Telluride_C	412	-	20	-	-	-	-	-	-	-	-	-	14	24	36	64	117	275	375	508	800
Chenango Tributary	Bridle_Trail_C	321	-	20	-	-	-	-	-	-	-	-	-	13	22	33	58	103	228	308	412	641
Chenango Tributary	Biscay_C	132	-	20	-	-	-	-	-	-	-	-	-	6	10	15	26	49	101	135	178	275
Chenango Tributary	C1	106	-	49	-	-	-	-	-	-	-	-	-	19	25	33	46	63	109	139	176	261
Chenango Tributary	C2	117	-	19	-	-	-	-	-	-	-	-	-	4	8	12	18	33	83	114	155	243
Chenango Tributary	C3	102	-	20	-	-	-	-	-	-	-	-	-	3	5	8	12	23	55	75	102	160
Chenango Tributary	C4	126	-	20	-	-	-	-	-	-	-	-	-	3	5	8	12	17	52	74	105	170
Chenango Tributary	C5	55	-	20	-	-	-	-	-	-	-	-	-	2	3	5	9	16	34	46	61	94

BASELINE PEAK FLOWS																				
Basin	Design Point	Drainage Area (acres)	Existing Percent Imperviousness	Future Percent Imperviousness	Existing Conditions Peak Flow (cfs)									Future Conditions Peak Flow (cfs)								
					Q_{WQ}	Q_1	Q_2	Q_5	Q_{10}	Q_{25}	Q_{50}	Q_{100}	Q_{500}	Q_{WQ}	Q_1	Q_2	Q_5	Q_{10}	Q_{25}	Q_{50}	Q_{100}	Q_{500}
Chenango Tributary	C6	92	-	20	-	-	-	-	-	-	-	-	-	4	7	10	15	29	68	91	122	191
Chenango Tributary	C7	72	-	20	-	-	-	-	-	-	-	-	-	2	4	6	10	14	40	57	79	128
Chenango Tributary	C8	116	-	20	-	-	-	-	-	-	-	-	-	6	9	13	23	43	90	120	158	243
Chenango Tributary	C9	132	-	20	-	-	-	-	-	-	-	-	-	6	10	15	26	49	101	135	178	275
Tagawa Tributary	T_outfall	107	-	22	-	-	-	-	-	-	-	-	-	3	5	9	14	18	52	74	105	180
Tagawa Tributary	Parker_T1	107	-	22	-	-	-	-	-	-	-	-	-	3	6	9	14	19	52	75	105	171
Tagawa Tributary	T1	107	-	22	-	-	-	-	-	-	-	-	-	3	6	9	14	19	52	75	105	171
Kragelund Tributary	K_outfall	611	14	42	9	16	25	49	113	308	438	626	1,038	50	69	96	151	238	478	635	859	1,352
Kragelund Tributary	Parker_K	577	14	40	9	16	26	50	114	307	433	615	1,009	50	69	96	149	234	472	625	839	1,309
Kragelund Tributary	Bridle_Trail_K	453	14	43	9	16	24	45	99	264	368	514	825	52	70	97	147	223	427	557	729	1,114
Kragelund Tributary	Confluence_K	257	17	49	9	15	22	36	74	181	247	334	529	47	62	84	121	175	309	396	505	759
Kragelund Tributary	Future_Road_K	108	32	60	10	16	23	34	54	108	143	185	285	42	53	68	94	124	193	242	300	437
Kragelund Tributary	K1	34	6	59	0.1	0.2	1	1	2	13	21	30	52	12	15	18	25	32	50	64	80	118
Kragelund Tributary	K2	124	16	18	4	7	11	17	38	91	123	166	260	5	9	13	20	41	95	128	171	266
Kragelund Tributary	K3	69	2	38	0.1	0.2	0.4	1	8	27	39	55	90	8	11	14.7	21	32	59	76	98	148
Kragelund Tributary	K4	126	15	23	4	7	10	21	43	95	129	172	267	8	13	18	30	53	108	143	188	288
Kragelund Tributary	K5	45	4	45	0.1	0.4	1	2	8	24	34	47	75	9	12	16	22	32	56	71	90	133
Kragelund Tributary	K6	104	7	28	1	2	4	8	24	64	89	121	193	8	12	17	27	46	91	120	157	241
Kragelund Tributary	K7	108	32	60	10	16	23	34	54	108	143	185	285	42	53	68	94	124	193	242	300	437
17 Mile Tributary	17_outfall	145	8	36	1	2	4	8	24	84	121	169	275	18	25	36	52	78	155	204	267	408
17 Mile Tributary	Parker_17	124	7	36	0.4	2	3	6	20	70	101	141	228	17	23	32	47	70	135	177	229	349
17 Mile Tributary	17A	22	14	36	1	1	2	3	7	19	26	35	55	4	5	7	11	16	30	39	51	77
17 Mile Tributary	17B	124	7	36	0.4	2	3	6	20	70	101	141	228	17	23	32	47	70	135	177	229	349

(-) Existing Conditions = Future Conditions

Table B-4. Baseline Peak Flows and Runoff Volumes

BASELINE RUNOFF VOLUMES																				
Basin	Design Point	Drainage Area (acres)	Existing Percent Imperviousness	Future Percent Imperviousness	Existing Conditions Runoff Volume (acre-feet)									Future Conditions Runoff Volume (acre-feet)								
					V_{WQ}	V_1	V_2	V_5	V_{10}	V_{25}	V_{50}	V_{100}	V_{500}	V_{WQ}	V_1	V_2	V_5	V_{10}	V_{25}	V_{50}	V_{100}	V_{500}
Little Raven Creek	LR_outfall	349	-	25	-	-	-	-	-	-	-	-	-	3.4	4.5	5.9	8.9	14.5	26.7	35.3	47.0	72.7
Little Raven Creek	Belleview_LR	225	-	37	-	-	-	-	-	-	-	-	-	3.1	4.1	5.3	8.2	12.0	19.7	25.3	32.5	49.4
Little Raven Creek	Havana_LR	140	-	42	-	-	-	-	-	-	-	-	-	2.3	2.9	3.8	5.7	8.2	12.9	16.5	20.9	31.3
Little Raven Creek	LR1	124	-	2	-	-	-	-	-	-	-	-	-	0.0	0.1	0.1	0.2	1.7	6.1	8.9	13.0	21.9
Little Raven Creek	LR2	85	-	28	-	-	-	-	-	-	-	-	-	0.7	1.0	1.4	2.3	3.7	6.6	8.7	11.4	17.7
Little Raven Creek	LR3	140	-	42	-	-	-	-	-	-	-	-	-	2.3	2.9	3.8	5.7	8.2	12.9	16.5	20.9	31.3
Suhaka Creek	S_outfall	360	-	25	-	-	-	-	-	-	-	-	-	3.2	4.3	5.7	8.8	14.4	26.9	35.6	47.6	74.0
Suhaka Creek	Peoria_S	109	-	27	-	-	-	-	-	-	-	-	-	0.8	1.2	1.7	2.7	4.4	8.2	10.9	14.4	22.4
Suhaka Creek	Stock_Pond_S	131	-	43	-	-	-	-	-	-	-	-	-	2.2	2.8	3.6	5.2	7.4	11.9	15.2	19.3	29.1
Suhaka Creek	S1	121	-	4	-	-	-	-	-	-	-	-	-	0.0	0.1	0.2	0.7	2.2	6.5	9.3	13.3	22.0
Suhaka Creek	S2	109	-	27	-	-	-	-	-	-	-	-	-	0.8	1.2	1.7	2.7	4.4	8.2	10.9	14.4	22.4
Suhaka Creek	S3	131	-	43	-	-	-	-	-	-	-	-	-	2.2	2.8	3.6	5.2	7.4	11.9	15.2	19.3	29.1
Joplin Tributary	J_outfall	774	-	39	-	-	-	-	-	-	-	-	-	12.5	15.3	19.2	26.5	34.7	55.9	72.7	96.7	141.5
Joplin Tributary	Parker_J	603	-	47	-	-	-	-	-	-	-	-	-	11.4	14.0	17.6	24.3	31.6	47.9	61.1	78.9	112.0
Joplin Tributary	Junction_J3	352	-	47	-	-	-	-	-	-	-	-	-	6.5	8.1	10.3	14.5	19.2	30.3	38.7	49.7	65.7
Joplin Tributary	out_RB1-4_pond	352	-	47	-	-	-	-	-	-	-	-	-	6.5	8.1	10.3	14.5	19.2	30.3	38.7	49.7	65.7
Joplin Tributary	RB1-4_pond	352	-	47	-	-	-	-	-	-	-	-	-	6.5	8.1	10.3	14.5	19.2	30.3	38.7	49.7	75.5
Joplin Tributary	Laredo_J	234	-	50	-	-	-	-	-	-	-	-	-	4.7	5.8	7.5	10.5	14.1	22.0	27.8	35.3	52.5
Joplin Tributary	Lewiston_J	126	-	52	-	-	-	-	-	-	-	-	-	2.6	3.3	4.2	5.9	7.8	12.1	15.2	19.2	28.5
Joplin Tributary	Junction_J4	101	-	41	-	-	-	-	-	-	-	-	-	1.5	1.9	2.3	3.1	4.0	5.5	7.2	9.8	16.3
Joplin Tributary	Shalom_J	101	-	41	-	-	-	-	-	-	-	-	-	1.5	1.9	2.4	3.1	4.0	5.6	7.2	9.8	16.3
Joplin Tributary	J1	120	-	3	-	-	-	-	-	-	-	-	-	0.0	0.0	0.1	0.2	0.5	4.2	6.8	10.8	18.8
Joplin Tributary	J2	51	-	28	-	-	-	-	-	-	-	-	-	0.4	0.5	0.6	0.9	1.3	2.3	3.3	4.7	8.2
Joplin Tributary	J3	106	-	55	-	-	-	-	-	-	-	-	-	2.4	3.0	3.7	5.0	6.3	9.1	11.6	14.8	22.4
Joplin Tributary	J4	45	-	43	-	-	-	-	-	-	-	-	-	0.7	0.9	1.1	1.5	1.9	2.6	3.4	4.5	7.4
Joplin Tributary	J5	101	-	41	-	-	-	-	-	-	-	-	-	1.5	1.9	2.4	3.1	4.0	5.6	7.2	9.8	16.3
Joplin Tributary	J6	117	-	42	-	-	-	-	-	-	-	-	-	1.9	2.3	2.8	4.0	5.2	8.4	11.0	14.6	22.9
Joplin Tributary	J7	109	-	48	-	-	-	-	-	-	-	-	-	2.1	2.6	3.3	4.7	6.3	9.9	12.6	16.1	24.1
Joplin Tributary	J8	126	-	52	-	-	-	-	-	-	-	-	-	2.6	3.3	4.2	5.9	7.8	12.1	15.2	19.2	28.5
Grove Ranch Tributary	GR_outfall	81	-	54	-	-	-	-	-	-	-	-	-	1.8	2.2	2.8	4.0	5.4	8.1	10.2	12.7	18.8
Grove Ranch Tributary	GR1	81	-	54	-	-	-	-	-	-	-	-	-	1.8	2.2	2.8	4.0	5.4	8.1	10.2	12.7	18.8
Valley Club Acres Tributary	VCA_outfall	207	-	45	-	-	-	-	-	-	-	-	-	3.7	4.5	5.9	8.3	11.2	18.0	23.0	29.6	44.8
Valley Club Acres Tributary	Fair_Place_VCA	207	-	45	-	-	-	-	-	-	-	-	-	3.6	4.5	5.9	8.3	11.1	18.0	23.0	29.6	44.8
Valley Club Acres Tributary	Regis_Jesuit_VCA	87	-	37	-	-	-	-	-	-	-	-	-	1.1	1.4	1.9	2.7	3.7	6.5	8.5	11.3	17.5
Valley Club Acres Tributary	VCA1	120	-	51	-	-	-	-	-	-	-	-	-	2.5	3.1	4.0	5.6	7.5	11.5	14.5	18.3	27.3
Valley Club Acres Tributary	VCA2	87	-	37	-	-	-	-	-	-	-	-	-	1.1	1.4	1.9	2.7	3.7	6.5	8.5	11.3	17.5
North Arapahoe Tributary	NA_outfall	372	-	44	-	-	-	-	-	-	-	-	-	6.2	7.7	10.0	14.2	19.3	31.6	40.8	52.5	79.5
North Arapahoe Tributary	Parker_NA	372	-	44	-	-	-	-	-	-	-	-	-	6.2	7.7	10.0	14.2	19.3	31.6	40.8	52.5	79.5
North Arapahoe Tributary	Buckley_NA1	272	-	41	-	-	-	-	-	-	-	-	-	4.1	5.2	6.8	9.7	13.2	22.2	28.8	37.4	57.1
North Arapahoe Tributary	Waco_NA	41	-	28	-	-	-	-	-	-	-	-	-	0.3	0.4	0.6	0.9	1.4	2.7	3.7	5.0	7.9
North Arapahoe Tributary	NA_pond	128	-	46	-	-	-	-	-	-	-	-	-	2.3	2.8	3.7	5.2	7.1	11.4	14.5	18.6	28.0
North Arapahoe Tributary	NA1	100	-	51	-	-	-	-	-	-	-	-	-	2.0	2.5	3.3	4.5	6.1	9.5	12.0	15.1	22.5
North Arapahoe Tributary	NA2	128	-	46	-	-	-	-	-	-	-	-	-	2.3	2.8	3.7	5.2	7.1	11.4	14.5	18.6	28.0
North Arapahoe Tributary	NA3	103	-	41	-	-	-	-	-	-	-	-	-	1.6	2.0	2.5	3.6	4.8	8.1	10.6	13.9	21.3
North Arapahoe Tributary	NA4	41	-	28	-	-	-	-	-	-	-	-	-	0.3	0.4	0.6	0.9	1.4	2.7	3.7	5.0	7.9
South Arapahoe Tributary	SA_outfall	396	-	30	-	-	-	-	-	-	-	-	-	3.7	5.1	6.8	10.2	15.1	28.4	38.1	50.6	79.2
South Arapahoe Tributary	Parker_SA	326	-	21	-	-	-	-	-	-	-	-	-	1.6	2.5	3.5	5.6	9.1	20.0	27.8	38.4	61.7
South Arapahoe Tributary	Norfolk_SA	227	-	20	-	-	-	-	-	-	-	-	-	1.0	1.5	2.2	3.6	5.9	13.5	18.9	26.3	42.4
South Arapahoe Tributary	Richfield_SA	132	-	20	-	-	-	-	-	-	-	-	-	0.5	0.9	1.2	2.0	3.3	7.7	10.8	15.1	24.4
South Arapahoe Tributary	SA1	70	-	70	-	-	-	-	-	-	-	-	-	2.1	2.6	3.3	4.6	6.0	8.3	10.1	12.3	17.6
South Arapahoe Tributary	SA2	98	-	24	-	-	-	-	-	-	-	-	-	0.6	0.9	1.2	1.9	3.1	6.4	8.8	11.9	19.0
South Arapahoe Tributary	SA3	95	-	20	-	-	-	-	-	-	-	-	-	0.4	0.6	0.9	1.5	2.5	5.7	8.0	11.0	17.8
South Arapahoe Tributary	SA4	132	-	20	-	-	-	-	-	-	-	-	-	0.5	0.9	1.2	2.0	3.3	7.7	10.8	15.1	24.4
Chenango Tributary	C_outfall	917	-	23	-	-	-	-	-	-	-	-	-	5.8	8.4	11.7	18.8	30.3	61.4	83.5	113.2	179.5
Chenango Tributary	Parker_C	811	-	20	-	-	-	-	-	-	-	-	-	3.7	5.7	8.2	13.9	23.7	51.3	70.3	97.0	155.3
Chenango Tributary	Hinsdale_C	694	-	20	-	-	-	-	-	-	-	-	-	3.2	5.0	7.2	12.2	20.7	44.2	60.8	83.5	133.2
Chenango Tributary	Richfield_C	593	-	20	-	-	-	-	-	-	-	-	-	2.8	4.2	6.1	10.5	17.8	37.7	51.9	71.2	113.9
Chenango Tributary	Telluride_C	412	-	20	-	-	-	-	-	-	-	-	-	2.0	3.1	4.4	7.6	13.3	27.4	37.4	50.9	80.7
Chenango Tributary	Bridle_Trail_C	321	-	20	-	-	-	-	-	-	-	-	-	1.5	2.3	3.3	6.0	10.3	21.1	28.9	39.3	62.6
Chenango Tributary	Biscay_C	132	-	20	-	-	-	-	-	-	-	-	-	0.7	1.0	1.4	2.6	4.7	9.3	12.5	16.8	26.5
Chenango Tributary	C1	106	-	49	-	-	-	-	-	-	-	-	-	2.1	2.6	3.4	4.7	6.4	10.0	12.6	16.0	23.8
Chenango Tributary	C2	117	-	19	-	-	-	-	-	-	-	-	-	0.4	0.7	1.0	1.7	3.0	6.9	9.7	13.5	21.8
Chenango Tributary	C3	102	-	20	-	-	-	-	-	-	-	-	-	0.4	0.7	1.0	1.6	2.9	6.3	8.7	12.0	19.3
Chenango Tributary	C4	126	-	20	-	-	-	-	-	-	-	-	-	0.5	0.7	1.1	1.8	2.5	6.4	9.2	13.3	22.0
Chenango Tributary	C5	55	-	20	-	-	-	-	-	-	-	-	-	0.3	0.4	0.6	1.0	1.9	3.8	5.1	6.9	10.9

BASELINE RUNOFF VOLUMES																				
Basin	Design Point	Drainage Area (acres)	Existing Percent Imperviousness	Future Percent Imperviousness	Existing Conditions Runoff Volume (acre-feet)									Future Conditions Runoff Volume (acre-feet)								
					V_{WQ}	V_1	V_2	V_5	V_{10}	V_{25}	V_{50}	V_{100}	V_{500}	V_{WQ}	V_1	V_2	V_5	V_{10}	V_{25}	V_{50}	V_{100}	V_{500}
Chenango Tributary	C6	92	-	20	-	-	-	-	-	-	-	-	-	0.4	0.6	0.9	1.5	2.7	5.9	8.1	11.0	17.7
Chenango Tributary	C7	72	-	20	-	-	-	-	-	-	-	-	-	0.3	0.4	0.6	1.0	1.5	3.7	5.3	7.7	12.7
Chenango Tributary	C8	116	-	20	-	-	-	-	-	-	-	-	-	0.6	0.9	1.3	2.3	4.1	8.1	11.0	14.8	23.3
Chenango Tributary	C9	132	-	20	-	-	-	-	-	-	-	-	-	0.7	1.0	1.4	2.6	4.7	9.3	12.5	16.8	26.5
Tagawa Tributary	T_outfall	107	-	22	-	-	-	-	-	-	-	-	-	0.5	0.7	1.0	1.6	2.3	5.3	7.6	11.1	18.5
Tagawa Tributary	Parker_T1	107	-	22	-	-	-	-	-	-	-	-	-	0.5	0.7	1.0	1.6	2.3	5.3	7.7	11.1	18.5
Tagawa Tributary	T1	107	-	22	-	-	-	-	-	-	-	-	-	0.5	0.7	1.0	1.6	2.3	5.3	7.7	11.1	18.5
Kragelund Tributary	K_outfall	611	14	42	2.2	3.3	4.8	8.2	16.4	38.1	52.8	73.0	117.2	8.1	10.6	13.8	20.4	30.2	51.6	66.9	86.5	132.0
Kragelund Tributary	Parker_K	577	14	40	2.1	3.3	4.7	8.0	16.1	36.5	50.6	69.7	111.7	7.2	9.5	12.4	18.5	27.8	47.9	62.3	81.0	123.7
Kragelund Tributary	Bridle_Trail_K	453	14	43	1.7	2.5	3.6	6.2	12.5	28.5	39.3	54.3	87.2	6.5	8.5	11.0	16.3	23.8	39.3	50.6	65.4	98.8
Kragelund Tributary	Confluence_K	257	17	49	1.2	1.8	2.5	4.0	7.5	16.6	22.7	31.0	49.7	4.6	5.8	7.5	10.7	15.0	23.8	30.2	38.4	57.4
Kragelund Tributary	Future_Road_K	108	32	60	1.0	1.5	2.0	2.9	4.5	8.2	10.8	14.2	22.1	2.7	3.3	4.3	5.9	7.8	11.4	14.1	17.5	25.6
Kragelund Tributary	K1	34	6	59	0.0	0.0	0.1	0.1	0.2	1.2	1.9	3.0	5.2	0.8	1.0	1.3	1.8	2.2	3.3	4.1	5.2	7.6
Kragelund Tributary	K2	124	16	18	0.4	0.6	0.9	1.6	3.3	7.7	10.6	14.6	23.6	0.5	0.8	1.2	1.9	3.7	8.0	11.0	15.0	24.0
Kragelund Tributary	K3	69	2	38	0.0	0.0	0.1	0.1	0.9	3.4	4.9	7.2	12.1	1.0	1.3	1.6	2.4	3.5	5.9	7.6	9.8	14.9
Kragelund Tributary	K4	126	15	23	0.4	0.6	0.9	1.9	3.8	8.2	11.2	15.4	24.6	0.8	1.1	1.6	2.8	4.8	9.2	12.3	16.4	25.7
Kragelund Tributary	K5	45	4	45	0.0	0.0	0.1	0.2	0.7	2.3	3.4	4.8	8.1	0.8	1.0	1.3	1.9	2.6	4.2	5.3	6.7	10.1
Kragelund Tributary	K6	104	7	28	0.1	0.2	0.3	0.8	2.1	5.8	8.3	11.7	19.2	0.9	1.2	1.7	2.7	4.3	7.9	10.5	13.9	21.5
Kragelund Tributary	K7	108	32	60	1.0	1.5	2.0	2.9	4.5	8.2	10.8	14.2	22.1	2.7	3.3	4.3	5.9	7.8	11.4	14.1	17.5	25.6
17 Mile Tributary	17_outfall	145	8	36	0.1	0.2	0.4	0.8	2.1	7.2	10.4	15.2	25.4	1.8	2.4	3.1	4.6	6.5	11.4	14.9	19.5	30.1
17 Mile Tributary	Parker_17	124	7	36	0.1	0.2	0.3	0.6	1.6	5.8	8.6	12.7	21.3	1.5	2.0	2.6	3.8	5.5	9.7	12.6	16.6	25.6
17 Mile Tributary	17A	22	14	36	0.0	0.1	0.1	0.2	0.5	1.2	1.7	2.4	4.0	0.3	0.3	0.5	0.7	1.0	1.7	2.2	2.9	4.5
17 Mile Tributary	17B	124	7	36	0.1	0.2	0.3	0.6	1.6	5.8	8.6	12.7	21.3	1.5	2.0	2.6	3.8	5.5	9.7	12.6	16.6	25.6

(-) Existing Conditions = Future Conditions

Note: Existing Conditions = Future Conditions for all basins except 17 Mile and Kragelund.

```
[Baseline Hydrology SWMM Input]
;;Cherry Creek Tribs U/S of Cherry Creek Reservoir

[OPTIONS]
;;Option            Value
FLOW_UNITS          CFS
INFILTRATION        HORTON
FLOW_ROUTING        KINWAVE
LINK_OFFSETS        DEPTH
MIN_SLOPE           0
ALLOW_PONDING       NO
SKIP_STEADY_STATE   NO

START_DATE          12/01/2018
START_TIME          00:00:00
REPORT_START_DATE   12/01/2018
REPORT_START_TIME   00:00:00
END_DATE            12/02/2018
END_TIME            00:00:00
SWEEP_START         01/01
SWEEP_END           12/31
DRY_DAYS            0
REPORT_STEP         00:01:00
WET_STEP            00:05:00
DRY_STEP            00:05:00
ROUTING_STEP        0:00:05

INERTIAL_DAMPING    PARTIAL
NORMAL_FLOW_LIMITED BOTH
FORCE_MAIN_EQUATION H-W
VARIABLE_STEP       0.75
LENGTHENING_STEP    0
MIN_SURFAREA        12.557
MAX_TRIALS          8
HEAD_TOLERANCE      0.005
SYS_FLOW_TOL        5
LAT_FLOW_TOL        5
MINIMUM_STEP        0.5
THREADS             1

[FILES]
;;Interfacing Files
USE INFLOWS "J:\506004\WR_DRN\CUHP\OUT\CC_Ex_100yr_0mi^2_BH.txt"

[EVAPORATION]
;;Data Source    Parameters
;;-------------- ----------------
CONSTANT        0.0
DRY_ONLY        NO

[JUNCTIONS]
;;Name           Elevation  MaxDepth   InitDepth  SurDepth   Aponded
;;-------------- ---------- ---------- ---------- ---------- ---------
-
Belleview_LR     5609       0          0          0          0
Havana_LR        5645       0          0          0          0
Peoria_S         5580       0          0          0          0
Stock_Pond_S     5621       0          0          0          0
Parker_J         5619       0          0          0          0
Junction_J3      5663       0          0          0          0
Junction_J4      5629.87    1.13       0          0          0
Regis_Jesuit_VCA 5689       0          0          0          0
Parker_SA        5656       0          0          0          0
Norfolk_SA       5720       0          0          0          0
Richfield_SA     5760       0          0          0          0
Parker_C         5698       0          0          0          0
Hinsdale_C       5718       0          0          0          0
Richfield_C      5745       0          0          0          0
Telluride_C      5774       0          0          0          0
Bridle_Trail_C   5814       0          0          0          0
Biscay_C         5828       0          0          0          0
Parker_K         5724       0          0          0          0
Bridle_Trail_K   5765       0          0          0          0
Confluence_K     5831       0          0          0          0
Future_Road_K    5890       0          0          0          0
Parker_17        5729       0          0          0          0
LR3              5645       0          0          0          0
LR2              5609       0          0          0          0
LR1              5552       0          0          0          0
S3               5621       0          0          0          0
S2               5580       0          0          0          0
S1               5565       0          0          0          0
J8               5738       0          0          0          0
J7               5729       0          0          0          0
J6               5688       0          0          0          0
J5               5645       0          0          0          0
J2               5579       0          0          0          0
J4               5619       0          0          0          0
J3               5619       0          0          0          0
J1               5579       0          0          0          0
VCA1             5631       0          0          0          0
VCA2             5689       0          0          0          0
NA1              5631       0          0          0          0
NA2              5765       0          0          0          0
NA4              5833       0          0          0          0
NA3              5769       0          0          0          0
SA4              5760       0          0          0          0
SA3              5720       0          0          0          0
SA2              5656       0          0          0          0
SA1              5633       0          0          0          0
C2               5698       0          0          0          0
17B              5729       0          0          0          0
17A              5695       0          0          0          0
K1               5690       0          0          0          0
```

Note: Existing Conditions = Future Conditions
for all basins except 17 Mile and Kragelund.

```
K2              5724       0          0          0          0
K3              5765       0          0          0          0
K4              5765       0          0          0          0
K6              5831       0          0          0          0
K7              5890       0          0          0          0
K5              5831       0          0          0          0
C9              5828       0          0          0          0
C8              5817       0          0          0          0
C7              5814       0          0          0          0
C4              5745       0          0          0          0
C3              5718       0          0          0          0
C6              5774       0          0          0          0
C5              5745       0          0          0          0
C1              5658       0          0          0          0
T1              5710       0          0          0          0
GR1             5620       0          0          0          0

[OUTFALLS]
;;Name           Elevation  Type       Stage Data       Gated    Route
To
;;-------------- ---------- ---------- ---------------- -------- -----
-----------
LR_outfall      5552       FREE                        NO
S_outfall       5565       FREE                        NO
J_outfall       5579       FREE                        NO
VCA_outfall     5622       FREE                        NO
NA_outfall      5631       FREE                        NO
SA_outfall      5633       FREE                        NO
T_outfall       5673       FREE                        NO
C_outfall       5658       FREE                        NO
K_outfall       5690       FREE                        NO
17_outfall      5695       FREE                        NO
GR_outfall      5620       FREE                        NO

[DIVIDERS]
;;Name           Elevation  Diverted Link    Type       Parameters
;;-------------- ---------- ---------------- ---------- ----------
Lewiston_J      5731.16    J7_SS_OVF        CUTOFF     170.5      7.7
0          0          0
Laredo_J        5717.75    J6_SS_OVF        CUTOFF     347        10
0          0          0
Shalom_J        5638.73    J4_SS_OVF        CUTOFF     122
15.27      0          0          0
Fair_Place_VCA  5626.3     VCA_SS_OVF       CUTOFF     115        4.7
0          0          0
Parker_T1       5705.6     T0_OVF           OVERFLOW   4          0
0          0
Waco_NA         5825.75    NA3_OVF          CUTOFF     43.7       6.6
0          0          0
Buckley_NA1     5756.02    NA1_OVF          CUTOFF     195.2
16.5       0          0          0
```

```
out_RB1-4_pond  5687.5     J3_OVF           CUTOFF     458.8      13
0          0          0
Parker_NA       5671.69    NA0_OVF          CUTOFF     97.9
16.5       0          0          0

[STORAGE]
;;Name           Elev.    MaxDepth   InitDepth  Shape      Curve
Name/Params           N/A      Fevap    Psi      Ksat     IMD
;;-------------- -------- ---------- ---------- ---------- ----------
----------------- -------- --------           -------- --------
RB1-4_pond      5687.5   11.5       0          TABULAR    RB1-
4_storage               0        0
NA_pond         5764.58  9.4        0          TABULAR    NA_storage
0        0

[CONDUITS]
;;Name           From Node        To Node          Length
Roughness  InOffset   OutOffset  InitFlow   MaxFlow
;;-------------- ---------------- ---------------- ---------- --------
-- ---------- ---------- ---------- ----------
LR1_OC          Belleview_LR     LR_outfall       4430       0.07
0          0          0          0
LR2_OC          Havana_LR        Belleview_LR     2280       0.076
0          0          0          0
S_OC_A          Peoria_S         S_outfall        1230       0.067
0          0          0          0
S_OC_B          Stock_Pond_S     S_outfall        3390       0.078
0          0          0          0
J1_OC           Parker_J         J_outfall        4100       0.063
0          0          0          0
J3_OC           Junction_J3      Parker_J         1700       0.097
0          0          0          0
J4_OC           Junction_J4      Parker_J         485        0.09
0          0          0          0
J3_SS           out_RB1-4_pond   Junction_J3      1378       0.016
0          0          0          0
J4_SS           Shalom_J         Junction_J4      807        0.016
0          0          0          0
J6_SS           Laredo_J         RB1-4_pond       1870       0.016
0          0          0          0
J7_SS           Lewiston_J       Laredo_J         628        0.016
0          0          0          0
VCA_SS_OUT      Fair_Place_VCA   VCA_outfall      1801       0.016
0          0          0          0
VCA1_SS         Regis_Jesuit_VCA Fair_Place_VCA   3551       0.016
0          0          0          0
NA1_SS          Buckley_NA1      Parker_NA        3014       0.016
0          0          0          0
NA3_SS          Waco_NA          Buckley_NA1      4055       0.016
0          0          0          0
SA1_SS          Parker_SA        SA_outfall       3099       0.016
0          0          0          0
```

Note: Existing Conditions = Future Conditions
for all basins except 17 Mile and Kragelund.

SA2_OC		Norfolk_SA	Parker_SA	2320	0.088	J1_OF		J1		J_outfall	400	0.01	
0	0	0	0			0	0	0	0				
SA3_OC		Richfield_SA	Norfolk_SA	1940	0.079	J2_OF		J2		J_outfall	400	0.01	
0	0	0	0			0	0	0	0				
T0_SS		Parker_T1	T_outfall	1604	0.016	VCA1_OF		VCA1		Fair_Place_VCA	400	0.01	
0	0	0	0			0	0	0	0				
C1_OC		Parker_C	C_outfall	2855	0.07	VCA2_OF		VCA2		Regis_Jesuit_VCA	400	0.01	
0	0	0	0			0	0	0	0				
C2_OC		Hinsdale_C	Parker_C	1380	0.07	NA1_OF		NA1		Parker_NA	400	0.01	
0	0	0	0			0	0	0	0				
C3_OC		Richfield_C	Hinsdale_C	1475	0.077	NA2_OF		NA2		NA_pond	400	0.01	
0	0	0	0			0	0	0	0				
C4_OC		Telluride_C	Richfield_C	1850	0.074	NA4_OF		NA4		Waco_NA	400	0.01	
0	0	0	0			0	0	0	0				
C6_OC		Bridle_Trail_C	Telluride_C	2325	0.076	NA3_OF		NA3		Buckley_NA1	400	0.01	
0	0	0	0			0	0	0	0				
C8_OC		Biscay_C	Bridle_Trail_C	760	0.077	SA4_OF		SA4		Richfield_SA	400	0.01	
0	0	0	0			0	0	0	0				
K1_OC		Parker_K	K_outfall	2110	0.077	SA3_OF		SA3		Norfolk_SA	400	0.01	
0	0	0	0			0	0	0	0				
K2_OC		Bridle_Trail_K	Parker_K	2620	0.077	SA2_OF		SA2		Parker_SA	400	0.01	
0	0	0	0			0	0	0	0				
K4_OC		Confluence_K	Bridle_Trail_K	2860	0.088	SA1_OF		SA1		SA_outfall	400	0.01	
0	0	0	0			0	0	0	0				
K5_OC		Future_Road_K	Confluence_K	2325	0.091	C2_OF		C2		Parker_C	400	0.01	
0	0	0	0			0	0	0	0				
17A_OC		Parker_17	17_outfall	1120	0.099	C3_OF		C3		Hinsdale_C	400	0.01	
0	0	0	0			0	0	0	0				
LR3_OF		LR3	Havana_LR	400	0.01	C4_OF		C4		Richfield_C	400	0.01	
0	0	0	0			0	0	0	0				
LR2_OF		LR2	Belleview_LR	400	0.01	C5_OF		C5		Richfield_C	400	0.01	
0	0	0	0			0	0	0	0				
LR1_OF		LR1	LR_outfall	400	0.01	C6_OF		C6		Telluride_C	400	0.01	
0	0	0	0			0	0	0	0				
S3_OF		S3	Stock_Pond_S	400	0.01	C7_OF		C7		Bridle_Trail_C	400	0.01	
0	0	0	0			0	0	0	0				
S2_OF		S2	Peoria_S	400	0.01	C8_OF		C8		Bridle_Trail_C	400	0.01	
0	0	0	0			0	0	0	0				
S_OF		S1	S_outfall	400	0.01	C9_OF		C9		Biscay_C	400	0.01	
0	0	0	0			0	0	0	0				
J8_OF		J8	Lewiston_J	400	0.01	C1_OF		C1		C_outfall	400	0.01	
0	0	0	0			0	0	0	0				
J7_OF		J7	Laredo_J	400	0.01	T1_OF		T1		Parker_T1	400	0.01	
0	0	0	0			0	0	0	0				
J6_OF		J6	RB1-4_pond	400	0.01	K1_OF		K1		K_outfall	400	0.01	
0	0	0	0			0	0	0	0				
J5_OF		J5	Shalom_J	400	0.01	K2_OF		K2		Parker_K	400	0.01	
0	0	0	0			0	0	0	0				
J4_OF		J4	Parker_J	400	0.01	17B_OF		17B		Parker_17	400	0.01	
0	0	0	0			0	0	0	0				
J3_OF		J3	Parker_J	400	0.01	K3_OF		K3		Bridle_Trail_K	400	0.01	
0	0	0	0			0	0	0	0				

Note: Existing Conditions = Future Conditions for all basins except 17 Mile and Kragelund.

```
K5_OF            K5               Confluence_K     400        0.01
0          0          0          0
K6_OF            K6               Confluence_K     400        0.01
0          0          0          0
K7_OF            K7               Future_Road_K    400        0.01
0          0          0          0
K4_OF            K4               Bridle_Trail_K   400        0.01
0          0          0          0
17A_OF           17A              17_outfall       400        0.01
0          0          0          0
J7_SS_OVF        Lewiston_J       Laredo_J         400        0.01
0          0          0          0
J6_SS_OVF        Laredo_J         RB1-4_pond       400        0.01
0          0          0          0
J4_SS_OVF        Shalom_J         Junction_J4      400        0.01
0          0          0          0
VCA_SS_OVF       Fair_Place_VCA   VCA_outfall      400        0.01
0          0          0          0
T0_OVF           Parker_T1        T_outfall        400        0.01
0          0          0          0
NA3_OVF          Waco_NA          Buckley_NA1      400        0.01
0          0          0          0
NA1_OVF          Buckley_NA1      Parker_NA        400        0.01
0          0          0          0
J3_OVF           out_RB1-4_pond   Junction_J3      400        0.01
0          0          0          0
GR1_OF           GR1              GR_outfall       400        0.01
0          0          0          0
NA0_SS           Parker_NA        NA_outfall       2835       0.016
0          0          0          0
NA0_OVF          Parker_NA        NA_outfall       400        0.01
0          0          0          0

[OUTLETS]
;;Name           From Node        To Node          Offset     Type
QTable/Qcoeff    Qexpon     Gated
;;-------------- ---------------- ---------------- ---------- --------
------- ---------------- ---------- --------
outlet_RB1-4_pond RB1-4_pond       out_RB1-4_pond   0
TABULAR/DEPTH   RB1-4_rating                NO
outlet_NA_pond   NA_pond          Buckley_NA1      0
TABULAR/DEPTH   NA_rating                   NO

[XSECTIONS]
;;Link           Shape        Geom1            Geom2      Geom3
Geom4      Barrels    Culvert
;;-------------- ------------ ---------------- ---------- ---------- -
--------- ---------- ----------
LR1_OC           IRREGULAR    LR2_OC           0          0          0
1
LR2_OC           IRREGULAR    LR2_OC           0          0          0
1
S_OC_A           IRREGULAR    LR2_OC           0          0          0
1
S_OC_B           IRREGULAR    LR2_OC           0          0          0
1
J1_OC            IRREGULAR    J3_OC            0          0          0
1
J3_OC            IRREGULAR    J3_OC            0          0          0
1
J4_OC            IRREGULAR    J3_OC            0          0          0
1
J3_SS            CIRCULAR     6                0          0          0
1
J4_SS            CIRCULAR     4                0          0          0
1
J6_SS            CIRCULAR     5.5              0          0          0
1
J7_SS            CIRCULAR     4                0          0          0
1
VCA_SS_OUT       RECT_CLOSED  3                8          0          0
1
VCA1_SS          CIRCULAR     5.5              0          0          0
1
NA1_SS           CIRCULAR     4                0          0          0
1
NA3_SS           CIRCULAR     2.5              0          0          0
1
SA1_SS           RECT_OPEN    6                12         0          0
1
SA2_OC           IRREGULAR    SA2_OC           0          0          0
1
SA3_OC           IRREGULAR    SA2_OC           0          0          0
1
T0_SS            CIRCULAR     4                0          0          0
1
C1_OC            IRREGULAR    C4_OC            0          0          0
1
C2_OC            IRREGULAR    C4_OC            0          0          0
1
C3_OC            IRREGULAR    C4_OC            0          0          0
1
C4_OC            IRREGULAR    C4_OC            0          0          0
1
C6_OC            IRREGULAR    C4_OC            0          0          0
1
C8_OC            IRREGULAR    C4_OC            0          0          0
1
K1_OC            IRREGULAR    K4_OC            0          0          0
1
K2_OC            IRREGULAR    K4_OC            0          0          0
1
K4_OC            IRREGULAR    K4_OC            0          0          0
1
```

Note: Existing Conditions = Future Conditions for all basins except 17 Mile and Kragelund.

K5_OC	IRREGULAR	K4_OC	0	0	0	C2_OF	DUMMY	0	0	0	0
1						1					
17A_OC	IRREGULAR	17A	0	0	0	C3_OF	DUMMY	0	0	0	0
1						1					
LR3_OF	DUMMY	0	0	0	0	C4_OF	DUMMY	0	0	0	0
1						1					
LR2_OF	DUMMY	0	0	0	0	C5_OF	DUMMY	0	0	0	0
1						1					
LR1_OF	DUMMY	0	0	0	0	C6_OF	DUMMY	0	0	0	0
1						1					
S3_OF	DUMMY	0	0	0	0	C7_OF	DUMMY	0	0	0	0
1						1					
S2_OF	DUMMY	0	0	0	0	C8_OF	DUMMY	0	0	0	0
1						1					
S_OF	DUMMY	0	0	0	0	C9_OF	DUMMY	0	0	0	0
1						1					
J8_OF	DUMMY	0	0	0	0	C1_OF	DUMMY	0	0	0	0
1						1					
J7_OF	DUMMY	0	0	0	0	T1_OF	DUMMY	0	0	0	0
1						1					
J6_OF	DUMMY	0	0	0	0	K1_OF	DUMMY	0	0	0	0
1						1					
J5_OF	DUMMY	0	0	0	0	K2_OF	DUMMY	0	0	0	0
1						1					
J4_OF	DUMMY	0	0	0	0	17B_OF	DUMMY	0	0	0	0
1						1					
J3_OF	DUMMY	0	0	0	0	K3_OF	DUMMY	0	0	0	0
1						1					
J1_OF	DUMMY	0	0	0	0	K5_OF	DUMMY	0	0	0	0
1						1					
J2_OF	DUMMY	0	0	0	0	K6_OF	DUMMY	0	0	0	0
1						1					
VCA1_OF	DUMMY	0	0	0	0	K7_OF	DUMMY	0	0	0	0
1						1					
VCA2_OF	DUMMY	0	0	0	0	K4_OF	DUMMY	0	0	0	0
1						1					
NA1_OF	DUMMY	0	0	0	0	17A_OF	DUMMY	0	0	0	0
1						1					
NA2_OF	DUMMY	0	0	0	0	J7_SS_OVF	DUMMY	0	0	0	0
1						1					
NA4_OF	DUMMY	0	0	0	0	J6_SS_OVF	DUMMY	0	0	0	0
1						1					
NA3_OF	DUMMY	0	0	0	0	J4_SS_OVF	DUMMY	0	0	0	0
1						1					
SA4_OF	DUMMY	0	0	0	0	VCA_SS_OVF	DUMMY	0	0	0	0
1						1					
SA3_OF	DUMMY	0	0	0	0	T0_OVF	DUMMY	0	0	0	0
1						1					
SA2_OF	DUMMY	0	0	0	0	NA3_OVF	DUMMY	0	0	0	0
1						1					
SA1_OF	DUMMY	0	0	0	0	NA1_OVF	DUMMY	0	0	0	0
1						1					

Note: Existing Conditions = Future Conditions for all basins except 17 Mile and Kragelund.

```
J3_OVF           DUMMY        0               0          0          0
1
GR1_OF           DUMMY        0               0          0          0
1
NA0_SS           CIRCULAR     3.5             0          0          0
1
NA0_OVF          DUMMY        0               0          0          0
1

[TRANSECTS]
;;Transect Data in HEC-2 format
;
NC 0.073    0.073    0.073
X1 LR2_OC            4        20       65       0.0      0.0      0.0
0.0      0.0
GR 5615     0        5609     37.5     5609     47.5     5615     85
;
NC 0.083    0.083    0.083
X1 J3_OC             4        20       100      0.0      0.0      0.0
0.0      0.0
GR 5614     0        5609     50       5609     70       5614     120
;
NC 0.084    0.084    0.084
X1 SA2_OC            4        28       52       0.0      0.0      0.0
0.0      0.0
GR 5711     0        5705.5   35       5705.5   45       5711     80
;
NC 0.074    0.074    0.074
X1 C4_OC             4        50       90       0.0      0.0      0.0
0.0      0.0
GR 5761     0        5755.5   65       5755.5   75       5761     140
;
NC 0.083    0.083    0.083
X1 K4_OC             4        25       101      0.0      0.0      0.0
0.0      0.0
GR 5780     0        5776     53       5776     73       5779     126
;
NC 0.099    0.099    0.099
X1 17A               4        22       60       0.0      0.0      0.0
0.0      0.0
GR 5712.5   0        5709.5   33       5709.5   49       5712.5   82

[CURVES]
;;Name           Type       X-Value    Y-Value
;;-------------- ---------- ---------- ----------
RB1-4_rating     Rating     0          0
RB1-4_rating                9.4        253
RB1-4_rating                11.5       410
RB1-4_rating                11.6       800
;
NA_rating        Rating     0          0
NA_rating                   0.25       0.099577919
NA_rating                   0.5        0.172682303
NA_rating                   0.75       0.235463946
NA_rating                   1          0.303475519
NA_rating                   1.25       0.378053554
NA_rating                   1.5        0.452743879
NA_rating                   1.75       0.523860156
NA_rating                   2          0.602156867
NA_rating                   2.25       0.690636693
NA_rating                   2.5        0.776927912
NA_rating                   2.75       0.860797569
NA_rating                   3          0.947930776
NA_rating                   3.25       1.044520098
NA_rating                   3.5        1.141315466
NA_rating                   3.75       1.427128841
NA_rating                   4          2.217337784
NA_rating                   4.25       3.437682479
NA_rating                   4.5        5.05247785
NA_rating                   4.75       7.039439785
NA_rating                   5          9.382521139
NA_rating                   5.25       12.06927874
NA_rating                   5.5        15.08960806
NA_rating                   5.75       18.43503888
NA_rating                   6          22.09830396
NA_rating                   6.25       26.07305627
NA_rating                   6.5        30.35367403
NA_rating                   6.75       34.16548676
NA_rating                   7          36.58187651
NA_rating                   7.25       45.87887399
NA_rating                   7.5        61.50071109
NA_rating                   7.75       81.09168456
NA_rating                   8          100.5413678
NA_rating                   8.25       122.3952724
NA_rating                   8.5        173.3363635
NA_rating                   8.75       239.3125024
NA_rating                   9          317.2942551
NA_rating                   9.25       405.4828343
NA_rating                   9.4        464.2985611
;
RB1-4_storage    Storage    0.0        0
RB1-4_storage               0.5        328
RB1-4_storage               1.5        2222
RB1-4_storage               2.5        22311
RB1-4_storage               3.5        41170
RB1-4_storage               4.5        60321
RB1-4_storage               5.5        75858
RB1-4_storage               6.5        86332
RB1-4_storage               7.5        95521
RB1-4_storage               8.5        104107
RB1-4_storage               9.5        112990
RB1-4_storage               10.5       121937
RB1-4_storage               11.5       131448
;
```

Note: Existing Conditions = Future Conditions for all basins except 17 Mile and Kragelund.

```
NA_storage       Storage    0          2015
NA_storage                  0.4        4028.5
NA_storage                  1.4        7744.803
NA_storage                  2.4        13712.894
NA_storage                  3.4        19405.348
NA_storage                  4.4        28097.354
NA_storage                  5.4        47234.436
NA_storage                  6.4        60011.204
NA_storage                  7.4        65786.986
NA_storage                  8.4        65786.986
NA_storage                  9.4        65786.986

[REPORT]
;;Reporting Options
INPUT      NO
CONTROLS   NO
SUBCATCHMENTS ALL
NODES ALL
LINKS ALL

[TAGS]

[MAP]
DIMENSIONS -2727.273 0.000 12727.273 10000.000
Units      None

[COORDINATES]
;;Node           X-Coord            Y-Coord
;;-------------- ------------------ ------------------
Belleview_LR     -123.123           8276.677
Havana_LR        -252.770           7640.991
Peoria_S         1527.855           7754.128
Stock_Pond_S     1010.237           7302.238
Parker_J         4212.105           7615.032
Junction_J3      4882.479           7462.368
Junction_J4      4371.553           7768.648
Regis_Jesuit_VCA 5966.849           5401.173
Parker_SA        5972.160           4615.175
Norfolk_SA       6718.568           4442.553
Richfield_SA     7370.156           4437.690
Parker_C         6631.041           3292.549
Hinsdale_C       7034.637           3151.534
Richfield_C      7501.446           3029.969
Telluride_C      8114.133           3085.889
Bridle_Trail_C   8790.034           3090.751
Biscay_C         9016.145           2898.679
Parker_K         7199.965           1862.945
Bridle_Trail_K   7968.256           2028.274
Confluence_K     8814.347           1702.480
Future_Road_K    9385.702           1366.961
Parker_17        7423.645           1459.350
LR3              -491.676           7030.960
LR2              39.980             7737.180
LR1              90.166             8615.430
S3               624.102            6776.536
S2               1313.661           6895.122
S1               838.769            7732.998
J8               6593.833           8275.416
J7               5980.369           8205.306
J6               5406.342           8262.270
J5               4661.421           8336.762
J2               4034.812           8319.235
J4               4337.162           8060.703
J3               4931.228           7223.949
J1               4424.799           7188.708
VCA1             5848.912           5554.265
VCA2             6650.797           5506.064
NA1              6855.406           5031.735
NA2              8013.564           5032.820
NA4              8740.957           4603.396
NA3              8459.378           4196.992
SA4              8109.965           3968.022
SA3              7325.608           4024.987
SA2              6799.782           4125.770
SA1              5752.511           4480.703
C2               7268.643           3573.653
17B              8233.267           1213.789
17A              7202.397           1595.503
K1               7022.480           1675.735
K2               7664.343           1794.869
K3               8692.782           1437.468
K4               8644.156           2322.461
K6               9283.588           2008.823
K7               10335.963          1338.891
K5               9222.805           1247.827
C9               9796.991           2473.799
C8               9735.645           3152.991
C7               9152.854           3753.310
C4               8561.300           3674.436
C3               7728.741           3547.361
C6               8736.575           2627.165
C5               8061.765           2898.842
C1               6791.018           2885.696
T1               7991.654           2578.964
GR1              5274.885           5913.579
LR_outfall       600.387            9309.666
S_outfall        1366.321           8133.280
J_outfall        3129.927           7841.141
VCA_outfall      4662.222           5584.703
NA_outfall       4920.786           4725.636
SA_outfall       4899.957           4644.351
T_outfall        6384.231           2499.017
C_outfall        5685.266           3389.801
K_outfall        6623.748           1685.461
```

Note: Existing Conditions = Future Conditions for all basins except 17 Mile and Kragelund.

```
17_outfall       7097.851           1366.961
GR_outfall       4636.318           5812.849
Lewiston_J       6015.436           7829.562
Laredo_J         5773.126           7792.686
Shalom_J         4467.849           7866.084
Fair_Place_VCA   5272.176           5592.329
Parker_T1        6901.788           2534.646
Waco_NA          8270.083           4743.724
Buckley_NA1      6942.831           4717.330
out_RB1-4_pond   5207.572           7550.921
Parker_NA        6049.035           4729.177
RB1-4_pond       5244.212           7583.078
NA_pond          7032.246           4835.941

[VERTICES]
;;Link           X-Coord            Y-Coord
;;-------------- ------------------ ------------------
LR1_OC           -39.481            9016.916
LR2_OC           -89.666            7891.920
S_OC_B           1181.705           7507.163
S_OC_B           1478.637           7703.723
J3_SS            5076.347           7414.844
J6_SS            5319.937           7778.454
C1_OC            5857.889           3290.118
K1_OC            6808.526           1619.816
LR1_OF           198.901            9004.369
J8_OF            6300.610           7900.577
J2_OF            3785.394           7860.260
NA1_OF           6340.787           4761.594
NA3_OF           8082.527           4313.694
NA3_OF           7861.278           4717.290
C3_OF            7445.526           3270.667
C4_OF            7754.301           3081.026
C6_OF            8345.107           3068.869
C8_OF            9042.889           3005.656
C1_OF            5957.572           3273.098
C1_OF            5809.263           3309.568
K3_OF            8118.996           1824.045
K5_OF            8999.126           1607.659
J7_SS_OVF        5902.881           7873.780
J6_SS_OVF        5309.509           7786.517
J4_SS_OVF        4380.048           7844.493
VCA_SS_OVF       5048.151           5604.438
T0_OVF           6637.415           2457.233
NA3_OVF          7598.916           4792.742
NA1_OVF          6568.539           4761.101
J3_OVF           5069.958           7505.387
NA0_OVF          5517.588           4782.996


  EPA STORM WATER MANAGEMENT MODEL - VERSION 5.1 (Build 5.1.012)
  ---------------------------------------------------------------

WARNING 04: minimum elevation drop used for Conduit LR3_OF
WARNING 04: minimum elevation drop used for Conduit LR2_OF
WARNING 04: minimum elevation drop used for Conduit LR1_OF
WARNING 04: minimum elevation drop used for Conduit S3_OF
WARNING 04: minimum elevation drop used for Conduit S2_OF
WARNING 04: minimum elevation drop used for Conduit S_OF
WARNING 04: minimum elevation drop used for Conduit J4_OF
WARNING 04: minimum elevation drop used for Conduit J3_OF
WARNING 04: minimum elevation drop used for Conduit J1_OF
WARNING 04: minimum elevation drop used for Conduit J2_OF
WARNING 04: minimum elevation drop used for Conduit VCA2_OF
WARNING 04: minimum elevation drop used for Conduit SA4_OF
WARNING 04: minimum elevation drop used for Conduit SA3_OF
WARNING 04: minimum elevation drop used for Conduit SA2_OF
WARNING 04: minimum elevation drop used for Conduit SA1_OF
WARNING 04: minimum elevation drop used for Conduit C2_OF
WARNING 04: minimum elevation drop used for Conduit C3_OF
WARNING 04: minimum elevation drop used for Conduit C4_OF
WARNING 04: minimum elevation drop used for Conduit C5_OF
WARNING 04: minimum elevation drop used for Conduit C6_OF
WARNING 04: minimum elevation drop used for Conduit C7_OF
WARNING 04: minimum elevation drop used for Conduit C9_OF
WARNING 04: minimum elevation drop used for Conduit C1_OF
WARNING 04: minimum elevation drop used for Conduit K1_OF
WARNING 04: minimum elevation drop used for Conduit K2_OF
WARNING 04: minimum elevation drop used for Conduit 17B_OF
WARNING 04: minimum elevation drop used for Conduit K3_OF
WARNING 04: minimum elevation drop used for Conduit K5_OF
WARNING 04: minimum elevation drop used for Conduit K6_OF
WARNING 04: minimum elevation drop used for Conduit K7_OF
WARNING 04: minimum elevation drop used for Conduit K4_OF
WARNING 04: minimum elevation drop used for Conduit 17A_OF
WARNING 04: minimum elevation drop used for Conduit GR1_OF
WARNING 02: maximum depth increased for Node Junction_J4
WARNING 02: maximum depth increased for Node Fair_Place_VCA

***********************************************************
NOTE: The summary statistics displayed in this report are
based on results found at every computational time step,
not just on results from each reporting time step.
***********************************************************

****************
Analysis Options
****************
Flow Units ..............  CFS
Process Models:
  Rainfall/Runoff ........ NO
  RDII ................... NO
  Snowmelt ............... NO
```

Note: Existing Conditions = Future Conditions for all basins except 17 Mile and Kragelund.

```
  Groundwater ............ NO
  Flow Routing ........... YES
  Ponding Allowed ........ NO
  Water Quality .......... NO
Flow Routing Method ...... KINWAVE
Starting Date ............ 12/01/2018 00:00:00
Ending Date .............. 12/02/2018 00:00:00
Antecedent Dry Days ...... 0.0
Report Time Step ......... 00:01:00
Routing Time Step ........ 5.00 sec


*************************        Volume        Volume
Flow Routing Continuity       acre-feet      10^6 gal
*************************     ---------     ---------
Dry Weather Inflow .......         0.000         0.000
Wet Weather Inflow .......         0.000         0.000
Groundwater Inflow .......         0.000         0.000
RDII Inflow ..............         0.000         0.000
External Inflow ..........       541.315       176.396
External Outflow .........       549.077       178.925
Flooding Loss ............         0.000         0.000
Evaporation Loss .........         0.000         0.000
Exfiltration Loss ........         0.000         0.000
Initial Stored Volume ....         0.000         0.000
Final Stored Volume ......         0.076         0.025
Continuity Error (%) .....        -1.448


*******************************
Highest Flow Instability Indexes
*******************************
Link J3_SS (5)
Link J3_OC (5)
Link outlet_RB1-4_pond (4)
Link J1_OC (3)


************************
Routing Time Step Summary
************************
Minimum Time Step           :     5.00 sec
Average Time Step           :     5.00 sec
Maximum Time Step           :     5.00 sec
Percent in Steady State     :     0.00
Average Iterations per Step :     1.00
Percent Not Converging      :     0.00


******************
Node Depth Summary
******************
```

Node	Type	Average Depth Feet	Maximum Depth Feet	Maximum HGL Feet	Time of Max Occurrence days hr:min	Reported Max Depth Feet
Belleview_LR	JUNCTION	0.22	3.46	5612.46	0 00:49	3.46
Havana_LR	JUNCTION	0.16	2.89	5647.89	0 00:40	2.88
Peoria_S	JUNCTION	0.19	1.86	5581.86	0 01:00	1.86
Stock_Pond_S	JUNCTION	0.17	2.43	5623.43	0 00:45	2.43
Parker_J	JUNCTION	0.34	3.42	5622.42	0 01:11	3.42
Junction_J3	JUNCTION	0.35	3.94	5666.94	0 01:20	3.94
Junction_J4	JUNCTION	0.18	3.27	5633.14	0 00:42	3.27
Regis_Jesuit_VCA	JUNCTION	0.14	2.47	5691.47	0 00:40	2.47
Parker_SA	JUNCTION	0.23	2.35	5658.35	0 01:07	2.35
Norfolk_SA	JUNCTION	0.22	2.37	5722.37	0 00:58	2.37
Richfield_SA	JUNCTION	0.17	1.94	5761.94	0 00:55	1.94
Parker_C	JUNCTION	0.40	3.90	5701.90	0 01:11	3.90
Hinsdale_C	JUNCTION	0.36	3.66	5721.66	0 01:07	3.66
Richfield_C	JUNCTION	0.31	3.30	5748.30	0 01:03	3.30
Telluride_C	JUNCTION	0.25	3.06	5777.06	0 00:57	3.06
Bridle_Trail_C	JUNCTION	0.20	2.75	5816.75	0 00:48	2.75
Biscay_C	JUNCTION	0.13	1.89	5829.89	0 00:45	1.89
Parker_K	JUNCTION	0.28	2.91	5726.91	0 01:12	2.91
Bridle_Trail_K	JUNCTION	0.24	2.71	5767.71	0 01:03	2.71
Confluence_K	JUNCTION	0.15	2.04	5833.04	0 00:52	2.04

Note: Existing Conditions = Future Conditions for all basins except 17 Mile and Kragelund.

Future_Road_K		JUNCTION	0.09	1.52	5891.52	0
00:40	1.52					
Parker_17		JUNCTION	0.10	1.58	5730.58	0
00:50	1.58					
LR3		JUNCTION	0.00	0.00	5645.00	0
00:00	0.00					
LR2		JUNCTION	0.00	0.00	5609.00	0
00:00	0.00					
LR1		JUNCTION	0.00	0.00	5552.00	0
00:00	0.00					
S3		JUNCTION	0.00	0.00	5621.00	0
00:00	0.00					
S2		JUNCTION	0.00	0.00	5580.00	0
00:00	0.00					
S1		JUNCTION	0.00	0.00	5565.00	0
00:00	0.00					
J8		JUNCTION	0.00	0.00	5738.00	0
00:00	0.00					
J7		JUNCTION	0.00	0.00	5729.00	0
00:00	0.00					
J6		JUNCTION	0.00	0.00	5688.00	0
00:00	0.00					
J5		JUNCTION	0.00	0.00	5645.00	0
00:00	0.00					
J2		JUNCTION	0.00	0.00	5579.00	0
00:00	0.00					
J4		JUNCTION	0.00	0.00	5619.00	0
00:00	0.00					
J3		JUNCTION	0.00	0.00	5619.00	0
00:00	0.00					
J1		JUNCTION	0.00	0.00	5579.00	0
00:00	0.00					
VCA1		JUNCTION	0.00	0.00	5631.00	0
00:00	0.00					
VCA2		JUNCTION	0.00	0.00	5689.00	0
00:00	0.00					
NA1		JUNCTION	0.00	0.00	5631.00	0
00:00	0.00					
NA2		JUNCTION	0.00	0.00	5765.00	0
00:00	0.00					
NA4		JUNCTION	0.00	0.00	5833.00	0
00:00	0.00					
NA3		JUNCTION	0.00	0.00	5769.00	0
00:00	0.00					
SA4		JUNCTION	0.00	0.00	5760.00	0
00:00	0.00					
SA3		JUNCTION	0.00	0.00	5720.00	0
00:00	0.00					
SA2		JUNCTION	0.00	0.00	5656.00	0
00:00	0.00					
SA1		JUNCTION	0.00	0.00	5633.00	0
00:00	0.00					
C2		JUNCTION	0.00	0.00	5698.00	0
00:00	0.00					
17B		JUNCTION	0.00	0.00	5729.00	0
00:00	0.00					
17A		JUNCTION	0.00	0.00	5695.00	0
00:00	0.00					
K1		JUNCTION	0.00	0.00	5690.00	0
00:00	0.00					
K2		JUNCTION	0.00	0.00	5724.00	0
00:00	0.00					
K3		JUNCTION	0.00	0.00	5765.00	0
00:00	0.00					
K4		JUNCTION	0.00	0.00	5765.00	0
00:00	0.00					
K6		JUNCTION	0.00	0.00	5831.00	0
00:00	0.00					
K7		JUNCTION	0.00	0.00	5890.00	0
00:00	0.00					
K5		JUNCTION	0.00	0.00	5831.00	0
00:00	0.00					
C9		JUNCTION	0.00	0.00	5828.00	0
00:00	0.00					
C8		JUNCTION	0.00	0.00	5817.00	0
00:00	0.00					
C7		JUNCTION	0.00	0.00	5814.00	0
00:00	0.00					
C4		JUNCTION	0.00	0.00	5745.00	0
00:00	0.00					
C3		JUNCTION	0.00	0.00	5718.00	0
00:00	0.00					
C6		JUNCTION	0.00	0.00	5774.00	0
00:00	0.00					
C5		JUNCTION	0.00	0.00	5745.00	0
00:00	0.00					
C1		JUNCTION	0.00	0.00	5658.00	0
00:00	0.00					
T1		JUNCTION	0.00	0.00	5710.00	0
00:00	0.00					
GR1		JUNCTION	0.00	0.00	5620.00	0
00:00	0.00					
LR_outfall		OUTFALL	0.26	3.27	5555.27	0
01:08	3.27					
S_outfall		OUTFALL	0.22	2.33	5567.33	0
01:01	2.33					
J_outfall		OUTFALL	0.39	3.40	5582.40	0
01:27	3.40					
VCA_outfall		OUTFALL	0.20	2.43	5624.43	0
01:43	2.43					
NA_outfall		OUTFALL	0.55	2.90	5633.90	0
02:20	2.89					
SA_outfall		OUTFALL	0.19	2.34	5635.34	0
01:08	2.34					

Note: Existing Conditions = Future Conditions
for all basins except 17 Mile and Kragelund.

```
  T_outfall           OUTFALL      0.17     2.30  5675.30     0
00:51        2.30
  C_outfall           OUTFALL      0.41     3.85  5661.85     0
01:21        3.85
  K_outfall           OUTFALL      0.29     2.89  5692.89     0
01:21        2.89
  17_outfall          OUTFALL      0.11     1.57  5696.57     0
00:53        1.57
  GR_outfall          OUTFALL      0.00     0.00  5620.00     0
00:00        0.00
  Lewiston_J          DIVIDER      0.21     3.28  5734.44     0
00:33        3.28
  Laredo_J            DIVIDER      0.28     4.51  5722.26     0
00:34        4.51
  Shalom_J            DIVIDER      0.18     3.27  5642.00     0
00:39        3.27
  Fair_Place_VCA      DIVIDER      0.20     2.45  5628.75     0
00:45        2.45
  Parker_T1           DIVIDER      0.17     2.31  5707.91     0
00:50        2.31
  Waco_NA             DIVIDER      0.13     2.05  5827.80     0
00:32        2.05
  Buckley_NA1         DIVIDER      0.47     3.28  5759.30     0
00:45        3.28
  out_RB1-4_pond      DIVIDER      0.35     3.94  5691.44     0
01:19        3.94
  Parker_NA           DIVIDER      0.56     3.29  5674.98     0
01:37        3.29
  RB1-4_pond          STORAGE      0.88    10.73  5698.23     0
01:19       10.73
  NA_pond             STORAGE      2.95     8.51  5773.09     0
01:04        8.51


  ********************
  Node Inflow Summary
  ********************

  -------------------------------------------------------------------------
-----------------------------
                                  Maximum  Maximum
Lateral       Total        Flow
                                  Lateral    Total  Time of Max
Inflow      Inflow     Balance
                                   Inflow   Inflow   Occurrence
Volume      Volume       Error
  Node                Type           CFS      CFS  days hr:min
10^6 gal    10^6 gal     Percent
  -------------------------------------------------------------------------
-----------------------------
  Belleview_LR        JUNCTION      0.00   403.67     0  00:49
0        10.6       0.000
  Havana_LR           JUNCTION      0.00   298.37     0  00:40
0        6.82       0.000
  Peoria_S            JUNCTION      0.00   101.97     0  01:00
0        4.69       0.000
  Stock_Pond_S        JUNCTION      0.00   210.26     0  00:45
0        6.29       0.000
  Parker_J            JUNCTION      0.00   535.49     0  01:11
0        25.7       0.000
  Junction_J3         JUNCTION      0.00   352.47     0  01:20
0        16.2       0.000
  Junction_J4         JUNCTION      0.00   121.87     0  00:42
0        3.18       0.000
  Regis_Jesuit_VCA    JUNCTION      0.00   150.53     0  00:40
0        3.68       0.000
  Parker_SA           JUNCTION      0.00   317.99     0  01:05
0        12.5       0.000
  Norfolk_SA          JUNCTION      0.00   224.51     0  00:58
0        8.56       0.000
  Richfield_SA        JUNCTION      0.00   126.80     0  00:55
0        4.91       0.000
  Parker_C            JUNCTION      0.00   857.09     0  01:11
0        31.6       0.000
  Hinsdale_C          JUNCTION      0.00   747.71     0  01:07
0        27.2       0.000
  Richfield_C         JUNCTION      0.00   657.82     0  01:03
0        23.2       0.000
  Telluride_C         JUNCTION      0.00   507.99     0  00:57
0        16.6       0.000
  Bridle_Trail_C      JUNCTION      0.00   411.64     0  00:48
0        12.8       0.000
  Biscay_C            JUNCTION      0.00   178.39     0  00:45
0        5.49       0.000
  Parker_K            JUNCTION      0.00   615.45     0  01:12
0        22.7       0.000
  Bridle_Trail_K      JUNCTION      0.00   513.51     0  01:03
0        17.7       0.000
  Confluence_K        JUNCTION      0.00   334.43     0  00:52
0        10.1       0.000
  Future_Road_K       JUNCTION      0.00   185.44     0  00:40
0        4.63       0.000
  Parker_17           JUNCTION      0.00   140.87     0  00:50
0        4.13       0.000
  LR3                 JUNCTION    298.37   298.37     0  00:40
6.82        6.82       0.000
  LR2                 JUNCTION    129.14   129.14     0  00:45
3.73        3.73       0.000
  LR1                 JUNCTION    101.66   101.66     0  01:00
4.23        4.23       0.000
  S3                  JUNCTION    210.26   210.26     0  00:45
6.29        6.29       0.000
  S2                  JUNCTION    101.97   101.97     0  01:00
4.69        4.69       0.000
```

Note: Existing Conditions = Future Conditions for all basins except 17 Mile and Kragelund.

S1		JUNCTION	141.81	141.81	0	00:50
4.34	4.34	0.000				
J8		JUNCTION	232.67	232.67	0	00:45
6.25	6.25	0.000				
J7		JUNCTION	191.47	191.47	0	00:45
5.23	5.23	0.000				
J6		JUNCTION	146.38	146.38	0	00:50
4.77	4.77	0.000				
J5		JUNCTION	122.80	122.80	0	00:40
3.18	3.18	0.000				
J2		JUNCTION	37.41	37.41	0	00:50
1.53	1.53	0.000				
J4		JUNCTION	66.39	66.39	0	00:40
1.47	1.47	0.000				
J3		JUNCTION	209.86	209.86	0	00:40
4.82	4.82	0.000				
J1		JUNCTION	70.04	70.04	0	01:05
3.51	3.51	0.000				
VCA1		JUNCTION	201.48	201.48	0	00:45
5.97	5.97	0.000				
VCA2		JUNCTION	150.53	150.53	0	00:40
3.68	3.68	0.000				
NA1		JUNCTION	208.71	208.71	0	00:40
4.92	4.92	0.000				
NA2		JUNCTION	225.69	225.69	0	00:45
6.06	6.06	0.000				
NA4		JUNCTION	58.66	58.66	0	00:40
1.64	1.64	0.000				
NA3		JUNCTION	103.46	103.46	0	00:55
4.52	4.52	0.000				
SA4		JUNCTION	126.80	126.80	0	00:55
4.91	4.91	0.000				
SA3		JUNCTION	108.73	108.73	0	00:50
3.6	3.6	0.000				
SA2		JUNCTION	105.35	105.35	0	00:50
3.89	3.89	0.000				
SA1		JUNCTION	163.67	163.67	0	00:40
4.01	4.01	0.000				
C2		JUNCTION	154.81	154.81	0	00:45
4.39	4.39	0.000				
17B		JUNCTION	140.87	140.87	0	00:50
4.13	4.13	0.000				
17A		JUNCTION	34.55	34.55	0	00:40
0.798	0.798	0.000				
K1		JUNCTION	30.48	30.48	0	00:45
0.973	0.973	0.000				
K2		JUNCTION	165.59	165.59	0	00:45
4.77	4.77	0.000				
K3		JUNCTION	55.17	55.17	0	01:00
2.35	2.35	0.000				
K4		JUNCTION	172.15	172.15	0	00:45
5.01	5.01	0.000				
K6		JUNCTION	121.37	121.37	0	00:50
3.81	3.81	0.000				
K7		JUNCTION	185.44	185.44	0	00:40
4.63	4.63	0.000				
K5		JUNCTION	46.64	46.64	0	00:50
1.58	1.58	0.000				
C9		JUNCTION	178.39	178.39	0	00:45
5.49	5.49	0.000				
C8		JUNCTION	158.13	158.13	0	00:45
4.82	4.82	0.000				
C7		JUNCTION	79.31	79.31	0	00:45
2.5	2.5	0.000				
C4		JUNCTION	104.80	104.80	0	00:55
4.33	4.33	0.000				
C3		JUNCTION	101.60	101.60	0	00:50
3.92	3.92	0.000				
C6		JUNCTION	122.15	122.15	0	00:45
3.6	3.6	0.000				
C5		JUNCTION	60.80	60.80	0	00:50
2.25	2.25	0.000				
C1		JUNCTION	176.28	176.28	0	00:45
5.2	5.2	0.000				
T1		JUNCTION	104.95	104.95	0	00:50
3.62	3.62	0.000				
GR1		JUNCTION	150.25	150.25	0	00:40
4.14	4.14	0.000				
LR_outfall		OUTFALL	0.00	453.53	0	01:07
0	15.3	0.000				
S_outfall		OUTFALL	0.00	422.74	0	01:00
0	15.5	0.000				
J_outfall		OUTFALL	0.00	613.26	0	01:24
0	31.5	0.000				
VCA_outfall		OUTFALL	0.00	349.18	0	00:45
0	9.65	0.000				
NA_outfall		OUTFALL	0.00	476.03	0	00:59
0	17.1	0.000				
SA_outfall		OUTFALL	0.00	426.06	0	01:04
0	16.5	0.000				
T_outfall		OUTFALL	0.00	104.71	0	00:51
0	3.61	0.000				
C_outfall		OUTFALL	0.00	942.12	0	01:19
0	36.9	0.000				
K_outfall		OUTFALL	0.00	626.36	0	01:21
0	23.8	0.000				
17_outfall		OUTFALL	0.00	169.37	0	00:52
0	4.96	0.000				
GR_outfall		OUTFALL	0.00	150.25	0	00:40
0	4.14	0.000				
Lewiston_J		DIVIDER	0.00	232.67	0	00:45
0	6.25	0.000				
Laredo_J		DIVIDER	0.00	424.14	0	00:45
0	11.5	0.000				

Note: Existing Conditions = Future Conditions for all basins except 17 Mile and Kragelund.

```
  Shalom_J              DIVIDER       0.00   122.80     0  00:40
0        3.18       0.000
  Fair_Place_VCA        DIVIDER       0.00   349.24     0  00:45
0        9.64       0.000
  Parker_T1             DIVIDER       0.00   104.95     0  00:50
0        3.62       0.000
  Waco_NA               DIVIDER       0.00    58.66     0  00:40
0        1.64       0.000
  Buckley_NA1           DIVIDER       0.00   324.75     0  01:03
0        12.2       0.000
  out_RB1-4_pond        DIVIDER       0.00   352.51     0  01:19
0        16.2       0.000
  Parker_NA             DIVIDER       0.00   476.03     0  00:59
0        17.1       0.000
  RB1-4_pond            STORAGE       0.00   569.69     0  00:45
0        16.2       0.011
  NA_pond               STORAGE       0.00   225.69     0  00:45
0        6.06       0.028


  ********************
  Node Flooding Summary
  ********************

  No nodes were flooded.


  ********************
  Storage Volume Summary
  ********************

  ------------------------------------------------------------------------
------------------------------
                          Average     Avg  Evap Exfil       Maximum
Max    Time of Max    Maximum
                           Volume    Pcnt  Pcnt  Pcnt        Volume
Pcnt     Occurrence    Outflow
  Storage Unit           1000 ft3    Full  Loss  Loss      1000 ft3
Full    days hr:min        CFS
  ------------------------------------------------------------------------
------------------------------
  RB1-4_pond               43.139       5     0     0       690.474
88       0  01:18     352.51
  NA_pond                  43.569      13     0     0       285.349
83       0  01:04     175.99


  ***********************
  Outfall Loading Summary
  ***********************

  ---------------------------------------------------------
```

```
                          Flow       Avg       Max       Total
                          Freq      Flow      Flow      Volume
Outfall Node              Pcnt       CFS       CFS    10^6 gal
---------------------------------------------------------------
LR_outfall               99.13     23.83    453.53      15.265
S_outfall                79.69     30.02    422.74      15.460
J_outfall                99.30     49.02    613.26      31.456
VCA_outfall              44.97     33.19    349.18       9.646
NA_outfall               99.08     26.74    476.03      17.120
SA_outfall               99.30     25.75    426.06      16.526
T_outfall                22.65     24.69    104.71       3.615
C_outfall                99.30     57.56    942.12      36.938
K_outfall                99.28     37.07    626.36      23.785
17_outfall               44.81     17.12    169.37       4.958
GR_outfall               14.91     43.00    150.25       4.143
---------------------------------------------------------------
System                   72.95    367.98   4310.13     178.912


  ********************
  Link Flow Summary
  ********************

  ------------------------------------------------------------------------
---------
                                          Maximum  Time of Max   Maximum
Max/    Max/
                                          |Flow|   Occurrence   |Veloc|
Full    Full
  Link                 Type                CFS  days hr:min    ft/sec
Flow   Depth
  ------------------------------------------------------------------------
---------
  LR1_OC               CHANNEL          355.23     0  01:08      3.92
0.24    0.54
  LR2_OC               CHANNEL          278.12     0  00:50      3.75
0.17    0.46
  S_OC_A               CHANNEL          101.42     0  01:05      2.55
0.07    0.31
  S_OC_B               CHANNEL          191.94     0  01:01      3.51
0.12    0.39
  J1_OC                CHANNEL          526.08     0  01:27      3.35
0.42    0.68
  J3_OC                CHANNEL          351.13     0  01:25      4.41
0.17    0.45
  J4_OC                CHANNEL          121.27     0  00:44      2.64
0.06    0.27
  J3_SS                CONDUIT          352.47     0  01:20     17.90
0.77    0.66
  J4_SS                CONDUIT          121.87     0  00:42     11.16
1.00    0.82
```

Note: Existing Conditions = Future Conditions for all basins except 17 Mile and Kragelund.

```
  J6_SS              CONDUIT    347.74     0  01:01     16.83
1.00    0.82
  J7_SS              CONDUIT    170.68     0  01:08     15.55
1.00    0.82
  VCA_SS_OUT         CONDUIT    115.86     0  01:43      6.08
1.00    0.80
  VCA1_SS            CONDUIT    147.93     0  00:45     14.61
0.41    0.44
  NA1_SS             CONDUIT    196.00     0  01:37     18.03
1.00    0.82
  NA3_SS             CONDUIT     44.22     0  01:10     10.70
1.01    0.82
  SA1_SS             CONDUIT    317.45     0  01:08     11.36
0.26    0.39
  SA2_OC             CHANNEL    221.56     0  01:07      3.84
0.14    0.43
  SA3_OC             CHANNEL    123.79     0  01:02      2.96
0.09    0.35
  T0_SS              CONDUIT    104.71     0  00:51     14.02
0.63    0.58
  C1_OC              CHANNEL    834.46     0  01:21      4.01
0.42    0.70
  C2_OC              CHANNEL    743.91     0  01:12      3.87
0.36    0.66
  C3_OC              CHANNEL    654.25     0  01:08      4.09
0.29    0.60
  C4_OC              CHANNEL    500.33     0  01:04      3.63
0.24    0.55
  C6_OC              CHANNEL    397.45     0  00:58      3.56
0.18    0.49
  C8_OC              CHANNEL    177.03     0  00:50      2.93
0.08    0.34
  K1_OC              CHANNEL    606.59     0  01:21      3.32
0.45    0.72
  K2_OC              CHANNEL    498.06     0  01:16      3.17
0.38    0.66
  K4_OC              CHANNEL    315.77     0  01:08      3.28
0.20    0.50
  K5_OC              CHANNEL    170.71     0  00:55      2.87
0.10    0.36
  17A_OC             CHANNEL    139.29     0  00:53      2.69
0.25    0.52
  LR3_OF             DUMMY      298.37     0  00:40
  LR2_OF             DUMMY      129.14     0  00:45
  LR1_OF             DUMMY      101.66     0  01:00
  S3_OF              DUMMY      210.26     0  00:45
  S2_OF              DUMMY      101.97     0  01:00
  S_OF               DUMMY      141.81     0  00:50
  J8_OF              DUMMY      232.67     0  00:45
  J7_OF              DUMMY      191.47     0  00:45
  J6_OF              DUMMY      146.38     0  00:50
  J5_OF              DUMMY      122.80     0  00:40
  J4_OF              DUMMY       66.39     0  00:40
  J3_OF              DUMMY      209.86     0  00:40
  J1_OF              DUMMY       70.04     0  01:05
  J2_OF              DUMMY       37.41     0  00:50
  VCA1_OF            DUMMY      201.48     0  00:45
  VCA2_OF            DUMMY      150.53     0  00:40
  NA1_OF             DUMMY      208.71     0  00:40
  NA2_OF             DUMMY      225.69     0  00:45
  NA4_OF             DUMMY       58.66     0  00:40
  NA3_OF             DUMMY      103.46     0  00:55
  SA4_OF             DUMMY      126.80     0  00:55
  SA3_OF             DUMMY      108.73     0  00:50
  SA2_OF             DUMMY      105.35     0  00:50
  SA1_OF             DUMMY      163.67     0  00:40
  C2_OF              DUMMY      154.81     0  00:45
  C3_OF              DUMMY      101.60     0  00:50
  C4_OF              DUMMY      104.80     0  00:55
  C5_OF              DUMMY       60.80     0  00:50
  C6_OF              DUMMY      122.15     0  00:45
  C7_OF              DUMMY       79.31     0  00:45
  C8_OF              DUMMY      158.13     0  00:45
  C9_OF              DUMMY      178.39     0  00:45
  C1_OF              DUMMY      176.28     0  00:45
  T1_OF              DUMMY      104.95     0  00:50
  K1_OF              DUMMY       30.48     0  00:45
  K2_OF              DUMMY      165.59     0  00:45
  17B_OF             DUMMY      140.87     0  00:50
  K3_OF              DUMMY       55.17     0  01:00
  K5_OF              DUMMY       46.64     0  00:50
  K6_OF              DUMMY      121.37     0  00:50
  K7_OF              DUMMY      185.44     0  00:40
  K4_OF              DUMMY      172.15     0  00:45
  17A_OF             DUMMY       34.55     0  00:40
  J7_SS_OVF          DUMMY       62.17     0  00:45
  J6_SS_OVF          DUMMY       77.14     0  00:45
  J4_SS_OVF          DUMMY        0.80     0  00:40
  VCA_SS_OVF         DUMMY      234.24     0  00:45
  T0_OVF             DUMMY        0.00     0  00:00
  NA3_OVF            DUMMY       14.96     0  00:40
  NA1_OVF            DUMMY      129.55     0  01:03
  J3_OVF             DUMMY        0.00     0  00:00
  GR1_OF             DUMMY      150.25     0  00:40
  NA0_SS             CONDUIT     98.74     0  02:20     12.02
1.01    0.82
  NA0_OVF            DUMMY      378.13     0  00:59
  outlet_RB1-4_pond  DUMMY      352.51     0  01:19
  outlet_NA_pond     DUMMY      175.99     0  01:04


  *************************
  Conduit Surcharge Summary
  *************************
```

Note: Existing Conditions = Future Conditions for all basins except 17 Mile and Kragelund.

```
  ---------------------------------------------------------------------
--------
                                                          Hours
Hours
                        --------- Hours Full --------   Above Full
Capacity
  Conduit               Both Ends  Upstream  Dnstream   Normal Flow
Limited
  ---------------------------------------------------------------------
--------
  J6_SS                      0.01      0.01      0.01      0.02
0.01
  J7_SS                      0.01      0.01      0.01      0.01
0.01
  VCA_SS_OUT                 0.01      0.01      0.01      0.03
0.01
  NA1_SS                     0.01      0.01      0.01      0.03
0.01
  NA3_SS                     0.01      0.01      0.01      0.07
0.01
  NA0_SS                     0.01      0.01      0.01      0.04
0.01


  Analysis begun on:  Mon Feb 11 11:07:13 2019
  Analysis ended on:  Mon Feb 11 11:07:14 2019
  Total elapsed time: 00:00:01
```

```
[Baseline Hydrology SWMM Input]
;;Cherry Creek Tribs U/S of Cherry Creek Reservoir

[OPTIONS]
;;Option             Value
FLOW_UNITS           CFS
INFILTRATION         HORTON
FLOW_ROUTING         KINWAVE
LINK_OFFSETS         DEPTH
MIN_SLOPE            0
ALLOW_PONDING        NO
SKIP_STEADY_STATE    NO

START_DATE           12/01/2018
START_TIME           00:00:00
REPORT_START_DATE    12/01/2018
REPORT_START_TIME    00:00:00
END_DATE             12/02/2018
END_TIME             00:00:00
SWEEP_START          01/01
SWEEP_END            12/31
DRY_DAYS             0
REPORT_STEP          00:01:00
WET_STEP             00:05:00
DRY_STEP             00:05:00
ROUTING_STEP         0:00:05

INERTIAL_DAMPING     PARTIAL
NORMAL_FLOW_LIMITED  BOTH
FORCE_MAIN_EQUATION  H-W
VARIABLE_STEP        0.75
LENGTHENING_STEP     0
MIN_SURFAREA         12.557
MAX_TRIALS           8
HEAD_TOLERANCE       0.005
SYS_FLOW_TOL         5
LAT_FLOW_TOL         5
MINIMUM_STEP         0.5
THREADS              1

[FILES]
;;Interfacing Files
USE INFLOWS "J:\506004\WR_DRN\CUHP\OUT\CC_Fut_100yr_0mi^2_BH.txt"

[EVAPORATION]
;;Data Source    Parameters
;;-------------- ----------------
CONSTANT         0.0
DRY_ONLY         NO

[JUNCTIONS]
;;Name           Elevation  MaxDepth   InitDepth  SurDepth   Aponded
;;-------------- ---------- ---------- ---------- ---------- ---------
-
Belleview_LR     5609       0          0          0          0
Havana_LR        5645       0          0          0          0
Peoria_S         5580       0          0          0          0
Stock_Pond_S     5621       0          0          0          0
Parker_J         5619       0          0          0          0
Junction_J3      5663       0          0          0          0
Junction_J4      5629.87    1.13       0          0          0
Regis_Jesuit_VCA 5689       0          0          0          0
Parker_SA        5656       0          0          0          0
Norfolk_SA       5720       0          0          0          0
Richfield_SA     5760       0          0          0          0
Parker_C         5698       0          0          0          0
Hinsdale_C       5718       0          0          0          0
Richfield_C      5745       0          0          0          0
Telluride_C      5774       0          0          0          0
Bridle_Trail_C   5814       0          0          0          0
Biscay_C         5828       0          0          0          0
Parker_K         5724       0          0          0          0
Bridle_Trail_K   5765       0          0          0          0
Confluence_K     5831       0          0          0          0
Future_Road_K    5890       0          0          0          0
Parker_17        5729       0          0          0          0
LR3              5645       0          0          0          0
LR2              5609       0          0          0          0
LR1              5552       0          0          0          0
S3               5621       0          0          0          0
S2               5580       0          0          0          0
S1               5565       0          0          0          0
J8               5738       0          0          0          0
J7               5729       0          0          0          0
J6               5688       0          0          0          0
J5               5645       0          0          0          0
J2               5579       0          0          0          0
J4               5619       0          0          0          0
J3               5619       0          0          0          0
J1               5579       0          0          0          0
VCA1             5631       0          0          0          0
VCA2             5689       0          0          0          0
NA1              5631       0          0          0          0
NA2              5765       0          0          0          0
NA4              5833       0          0          0          0
NA3              5769       0          0          0          0
SA4              5760       0          0          0          0
SA3              5720       0          0          0          0
SA2              5656       0          0          0          0
SA1              5633       0          0          0          0
C2               5698       0          0          0          0
17B              5729       0          0          0          0
17A              5695       0          0          0          0
K1               5690       0          0          0          0
```

```
K2              5724       0          0          0          0
K3              5765       0          0          0          0
K4              5765       0          0          0          0
K6              5831       0          0          0          0
K7              5890       0          0          0          0
K5              5831       0          0          0          0
C9              5828       0          0          0          0
C8              5817       0          0          0          0
C7              5814       0          0          0          0
C4              5745       0          0          0          0
C3              5718       0          0          0          0
C6              5774       0          0          0          0
C5              5745       0          0          0          0
C1              5658       0          0          0          0
T1              5710       0          0          0          0
GR1             5620       0          0          0          0

[OUTFALLS]
;;Name           Elevation  Type       Stage Data       Gated    Route
To
;;-------------- ---------- ---------- ---------------- -------- -----
-----------
LR_outfall      5552       FREE                        NO
S_outfall       5565       FREE                        NO
J_outfall       5579       FREE                        NO
VCA_outfall     5622       FREE                        NO
NA_outfall      5631       FREE                        NO
SA_outfall      5633       FREE                        NO
T_outfall       5673       FREE                        NO
C_outfall       5658       FREE                        NO
K_outfall       5690       FREE                        NO
17_outfall      5695       FREE                        NO
GR_outfall      5620       FREE                        NO

[DIVIDERS]
;;Name           Elevation  Diverted Link    Type       Parameters
;;-------------- ---------- ---------------- ---------- ----------
Lewiston_J      5731.16    J7_SS_OVF        CUTOFF     170.5      7.7
0          0          0
Laredo_J        5717.75    J6_SS_OVF        CUTOFF     347        10
0          0          0
Shalom_J        5638.73    J4_SS_OVF        CUTOFF     122
15.27      0          0          0
Fair_Place_VCA  5626.3     VCA_SS_OVF       CUTOFF     115        4.7
0          0          0
Parker_T1       5705.6     T0_OVF           OVERFLOW   4          0
0          0
Waco_NA         5825.75    NA3_OVF          CUTOFF     43.7       6.6
0          0          0
Buckley_NA1     5756.02    NA1_OVF          CUTOFF     195.2
16.5       0          0          0
```

```
out_RB1-4_pond  5687.5     J3_OVF           CUTOFF     458.8      13
0          0          0
Parker_NA       5671.69    NA0_OVF          CUTOFF     97.9
16.5       0          0          0

[STORAGE]
;;Name           Elev.    MaxDepth   InitDepth  Shape      Curve
Name/Params           N/A      Fevap    Psi      Ksat     IMD
;;-------------- -------- ---------- ---------- ---------- ----------
------------------ -------- --------           -------- --------
RB1-4_pond      5687.5   11.5       0          TABULAR    RB1-
4_storage               0        0
NA_pond         5764.58  9.4        0          TABULAR    NA_storage
0        0

[CONDUITS]
;;Name           From Node        To Node          Length
Roughness  InOffset   OutOffset  InitFlow   MaxFlow
;;-------------- ---------------- ---------------- ---------- --------
-- ---------- ---------- ---------- ----------
LR1_OC          Belleview_LR     LR_outfall       4430       0.07
0          0          0          0
LR2_OC          Havana_LR        Belleview_LR     2280       0.076
0          0          0          0
S_OC_A          Peoria_S         S_outfall        1230       0.067
0          0          0          0
S_OC_B          Stock_Pond_S     S_outfall        3390       0.078
0          0          0          0
J1_OC           Parker_J         J_outfall        4100       0.063
0          0          0          0
J3_OC           Junction_J3      Parker_J         1700       0.097
0          0          0          0
J4_OC           Junction_J4      Parker_J         485        0.09
0          0          0          0
J3_SS           out_RB1-4_pond   Junction_J3      1378       0.016
0          0          0          0
J4_SS           Shalom_J         Junction_J4      807        0.016
0          0          0          0
J6_SS           Laredo_J         RB1-4_pond       1870       0.016
0          0          0          0
J7_SS           Lewiston_J       Laredo_J         628        0.016
0          0          0          0
VCA_SS_OUT      Fair_Place_VCA   VCA_outfall      1801       0.016
0          0          0          0
VCA1_SS         Regis_Jesuit_VCA Fair_Place_VCA   3551       0.016
0          0          0          0
NA1_SS          Buckley_NA1      Parker_NA        3014       0.016
0          0          0          0
NA3_SS          Waco_NA          Buckley_NA1      4055       0.016
0          0          0          0
SA1_SS          Parker_SA        SA_outfall       3099       0.016
0          0          0          0
```

SA2_OC		Norfolk_SA	Parker_SA	2320	0.088	J1_OF		J1		J_outfall	400	0.01	
0	0	0	0			0	0	0	0				
SA3_OC		Richfield_SA	Norfolk_SA	1940	0.079	J2_OF		J2		J_outfall	400	0.01	
0	0	0	0			0	0	0	0				
T0_SS		Parker_T1	T_outfall	1604	0.016	VCA1_OF		VCA1		Fair_Place_VCA	400	0.01	
0	0	0	0			0	0	0	0				
C1_OC		Parker_C	C_outfall	2855	0.07	VCA2_OF		VCA2		Regis_Jesuit_VCA	400	0.01	
0	0	0	0			0	0	0	0				
C2_OC		Hinsdale_C	Parker_C	1380	0.07	NA1_OF		NA1		Parker_NA	400	0.01	
0	0	0	0			0	0	0	0				
C3_OC		Richfield_C	Hinsdale_C	1475	0.077	NA2_OF		NA2		NA_pond	400	0.01	
0	0	0	0			0	0	0	0				
C4_OC		Telluride_C	Richfield_C	1850	0.074	NA4_OF		NA4		Waco_NA	400	0.01	
0	0	0	0			0	0	0	0				
C6_OC		Bridle_Trail_C	Telluride_C	2325	0.076	NA3_OF		NA3		Buckley_NA1	400	0.01	
0	0	0	0			0	0	0	0				
C8_OC		Biscay_C	Bridle_Trail_C	760	0.077	SA4_OF		SA4		Richfield_SA	400	0.01	
0	0	0	0			0	0	0	0				
K1_OC		Parker_K	K_outfall	2110	0.077	SA3_OF		SA3		Norfolk_SA	400	0.01	
0	0	0	0			0	0	0	0				
K2_OC		Bridle_Trail_K	Parker_K	2620	0.077	SA2_OF		SA2		Parker_SA	400	0.01	
0	0	0	0			0	0	0	0				
K4_OC		Confluence_K	Bridle_Trail_K	2860	0.088	SA1_OF		SA1		SA_outfall	400	0.01	
0	0	0	0			0	0	0	0				
K5_OC		Future_Road_K	Confluence_K	2325	0.091	C2_OF		C2		Parker_C	400	0.01	
0	0	0	0			0	0	0	0				
17A_OC		Parker_17	17_outfall	1120	0.099	C3_OF		C3		Hinsdale_C	400	0.01	
0	0	0	0			0	0	0	0				
LR3_OF		LR3	Havana_LR	400	0.01	C4_OF		C4		Richfield_C	400	0.01	
0	0	0	0			0	0	0	0				
LR2_OF		LR2	Belleview_LR	400	0.01	C5_OF		C5		Richfield_C	400	0.01	
0	0	0	0			0	0	0	0				
LR1_OF		LR1	LR_outfall	400	0.01	C6_OF		C6		Telluride_C	400	0.01	
0	0	0	0			0	0	0	0				
S3_OF		S3	Stock_Pond_S	400	0.01	C7_OF		C7		Bridle_Trail_C	400	0.01	
0	0	0	0			0	0	0	0				
S2_OF		S2	Peoria_S	400	0.01	C8_OF		C8		Bridle_Trail_C	400	0.01	
0	0	0	0			0	0	0	0				
S_OF		S1	S_outfall	400	0.01	C9_OF		C9		Biscay_C	400	0.01	
0	0	0	0			0	0	0	0				
J8_OF		J8	Lewiston_J	400	0.01	C1_OF		C1		C_outfall	400	0.01	
0	0	0	0			0	0	0	0				
J7_OF		J7	Laredo_J	400	0.01	T1_OF		T1		Parker_T1	400	0.01	
0	0	0	0			0	0	0	0				
J6_OF		J6	RB1-4_pond	400	0.01	K1_OF		K1		K_outfall	400	0.01	
0	0	0	0			0	0	0	0				
J5_OF		J5	Shalom_J	400	0.01	K2_OF		K2		Parker_K	400	0.01	
0	0	0	0			0	0	0	0				
J4_OF		J4	Parker_J	400	0.01	17B_OF		17B		Parker_17	400	0.01	
0	0	0	0			0	0	0	0				
J3_OF		J3	Parker_J	400	0.01	K3_OF		K3		Bridle_Trail_K	400	0.01	
0	0	0	0			0	0	0	0				

```
K5_OF            K5               Confluence_K     400        0.01
0          0          0          0
K6_OF            K6               Confluence_K     400        0.01
0          0          0          0
K7_OF            K7               Future_Road_K    400        0.01
0          0          0          0
K4_OF            K4               Bridle_Trail_K   400        0.01
0          0          0          0
17A_OF           17A              17_outfall       400        0.01
0          0          0          0
J7_SS_OVF        Lewiston_J       Laredo_J         400        0.01
0          0          0          0
J6_SS_OVF        Laredo_J         RB1-4_pond       400        0.01
0          0          0          0
J4_SS_OVF        Shalom_J         Junction_J4      400        0.01
0          0          0          0
VCA_SS_OVF       Fair_Place_VCA   VCA_outfall      400        0.01
0          0          0          0
T0_OVF           Parker_T1        T_outfall        400        0.01
0          0          0          0
NA3_OVF          Waco_NA          Buckley_NA1      400        0.01
0          0          0          0
NA1_OVF          Buckley_NA1      Parker_NA        400        0.01
0          0          0          0
J3_OVF           out_RB1-4_pond   Junction_J3      400        0.01
0          0          0          0
GR1_OF           GR1              GR_outfall       400        0.01
0          0          0          0
NA0_SS           Parker_NA        NA_outfall       2835       0.016
0          0          0          0
NA0_OVF          Parker_NA        NA_outfall       400        0.01
0          0          0          0

[OUTLETS]
;;Name           From Node        To Node          Offset     Type
QTable/Qcoeff    Qexpon     Gated
;;-------------- ---------------- ---------------- ---------- --------
------- ---------------- ---------- --------
outlet_RB1-4_pond RB1-4_pond       out_RB1-4_pond   0
TABULAR/DEPTH   RB1-4_rating                NO
outlet_NA_pond   NA_pond          Buckley_NA1      0
TABULAR/DEPTH   NA_rating                   NO

[XSECTIONS]
;;Link           Shape        Geom1            Geom2      Geom3
Geom4      Barrels    Culvert
;;-------------- ------------ ---------------- ---------- ---------- -
--------- ---------- ----------
LR1_OC           IRREGULAR    LR2_OC           0          0          0
1
LR2_OC           IRREGULAR    LR2_OC           0          0          0
1
S_OC_A           IRREGULAR    LR2_OC           0          0          0
1
S_OC_B           IRREGULAR    LR2_OC           0          0          0
1
J1_OC            IRREGULAR    J3_OC            0          0          0
1
J3_OC            IRREGULAR    J3_OC            0          0          0
1
J4_OC            IRREGULAR    J3_OC            0          0          0
1
J3_SS            CIRCULAR     6                0          0          0
1
J4_SS            CIRCULAR     4                0          0          0
1
J6_SS            CIRCULAR     5.5              0          0          0
1
J7_SS            CIRCULAR     4                0          0          0
1
VCA_SS_OUT       RECT_CLOSED  3                8          0          0
1
VCA1_SS          CIRCULAR     5.5              0          0          0
1
NA1_SS           CIRCULAR     4                0          0          0
1
NA3_SS           CIRCULAR     2.5              0          0          0
1
SA1_SS           RECT_OPEN    6                12         0          0
1
SA2_OC           IRREGULAR    SA2_OC           0          0          0
1
SA3_OC           IRREGULAR    SA2_OC           0          0          0
1
T0_SS            CIRCULAR     4                0          0          0
1
C1_OC            IRREGULAR    C4_OC            0          0          0
1
C2_OC            IRREGULAR    C4_OC            0          0          0
1
C3_OC            IRREGULAR    C4_OC            0          0          0
1
C4_OC            IRREGULAR    C4_OC            0          0          0
1
C6_OC            IRREGULAR    C4_OC            0          0          0
1
C8_OC            IRREGULAR    C4_OC            0          0          0
1
K1_OC            IRREGULAR    K4_OC            0          0          0
1
K2_OC            IRREGULAR    K4_OC            0          0          0
1
K4_OC            IRREGULAR    K4_OC            0          0          0
1
```

K5_OC	IRREGULAR	K4_OC	0	0	0	C2_OF	DUMMY	0	0	0	0
1						1					
17A_OC	IRREGULAR	17A	0	0	0	C3_OF	DUMMY	0	0	0	0
1						1					
LR3_OF	DUMMY	0	0	0	0	C4_OF	DUMMY	0	0	0	0
1						1					
LR2_OF	DUMMY	0	0	0	0	C5_OF	DUMMY	0	0	0	0
1						1					
LR1_OF	DUMMY	0	0	0	0	C6_OF	DUMMY	0	0	0	0
1						1					
S3_OF	DUMMY	0	0	0	0	C7_OF	DUMMY	0	0	0	0
1						1					
S2_OF	DUMMY	0	0	0	0	C8_OF	DUMMY	0	0	0	0
1						1					
S_OF	DUMMY	0	0	0	0	C9_OF	DUMMY	0	0	0	0
1						1					
J8_OF	DUMMY	0	0	0	0	C1_OF	DUMMY	0	0	0	0
1						1					
J7_OF	DUMMY	0	0	0	0	T1_OF	DUMMY	0	0	0	0
1						1					
J6_OF	DUMMY	0	0	0	0	K1_OF	DUMMY	0	0	0	0
1						1					
J5_OF	DUMMY	0	0	0	0	K2_OF	DUMMY	0	0	0	0
1						1					
J4_OF	DUMMY	0	0	0	0	17B_OF	DUMMY	0	0	0	0
1						1					
J3_OF	DUMMY	0	0	0	0	K3_OF	DUMMY	0	0	0	0
1						1					
J1_OF	DUMMY	0	0	0	0	K5_OF	DUMMY	0	0	0	0
1						1					
J2_OF	DUMMY	0	0	0	0	K6_OF	DUMMY	0	0	0	0
1						1					
VCA1_OF	DUMMY	0	0	0	0	K7_OF	DUMMY	0	0	0	0
1						1					
VCA2_OF	DUMMY	0	0	0	0	K4_OF	DUMMY	0	0	0	0
1						1					
NA1_OF	DUMMY	0	0	0	0	17A_OF	DUMMY	0	0	0	0
1						1					
NA2_OF	DUMMY	0	0	0	0	J7_SS_OVF	DUMMY	0	0	0	0
1						1					
NA4_OF	DUMMY	0	0	0	0	J6_SS_OVF	DUMMY	0	0	0	0
1						1					
NA3_OF	DUMMY	0	0	0	0	J4_SS_OVF	DUMMY	0	0	0	0
1						1					
SA4_OF	DUMMY	0	0	0	0	VCA_SS_OVF	DUMMY	0	0	0	0
1						1					
SA3_OF	DUMMY	0	0	0	0	T0_OVF	DUMMY	0	0	0	0
1						1					
SA2_OF	DUMMY	0	0	0	0	NA3_OVF	DUMMY	0	0	0	0
1						1					
SA1_OF	DUMMY	0	0	0	0	NA1_OVF	DUMMY	0	0	0	0
1						1					

```
J3_OVF           DUMMY        0               0          0          0
1
GR1_OF           DUMMY        0               0          0          0
1
NA0_SS           CIRCULAR     3.5             0          0          0
1
NA0_OVF          DUMMY        0               0          0          0
1

[TRANSECTS]
;;Transect Data in HEC-2 format
;
NC 0.073    0.073    0.073
X1 LR2_OC            4        20       65       0.0      0.0      0.0
0.0      0.0
GR 5615     0        5609     37.5     5609     47.5     5615     85
;
NC 0.083    0.083    0.083
X1 J3_OC             4        20       100      0.0      0.0      0.0
0.0      0.0
GR 5614     0        5609     50       5609     70       5614     120
;
NC 0.084    0.084    0.084
X1 SA2_OC            4        28       52       0.0      0.0      0.0
0.0      0.0
GR 5711     0        5705.5   35       5705.5   45       5711     80
;
NC 0.074    0.074    0.074
X1 C4_OC             4        50       90       0.0      0.0      0.0
0.0      0.0
GR 5761     0        5755.5   65       5755.5   75       5761     140
;
NC 0.083    0.083    0.083
X1 K4_OC             4        25       101      0.0      0.0      0.0
0.0      0.0
GR 5780     0        5776     53       5776     73       5779     126
;
NC 0.099    0.099    0.099
X1 17A               4        22       60       0.0      0.0      0.0
0.0      0.0
GR 5712.5   0        5709.5   33       5709.5   49       5712.5   82

[CURVES]
;;Name           Type       X-Value    Y-Value
;;-------------- ---------- ---------- ----------
RB1-4_rating     Rating     0          0
RB1-4_rating                9.4        253
RB1-4_rating                11.5       410
RB1-4_rating                11.6       800
;
NA_rating        Rating     0          0
NA_rating                   0.25       0.099577919
NA_rating                   0.5        0.172682303
NA_rating                   0.75       0.235463946
NA_rating                   1          0.303475519
NA_rating                   1.25       0.378053554
NA_rating                   1.5        0.452743879
NA_rating                   1.75       0.523860156
NA_rating                   2          0.602156867
NA_rating                   2.25       0.690636693
NA_rating                   2.5        0.776927912
NA_rating                   2.75       0.860797569
NA_rating                   3          0.947930776
NA_rating                   3.25       1.044520098
NA_rating                   3.5        1.141315466
NA_rating                   3.75       1.427128841
NA_rating                   4          2.217337784
NA_rating                   4.25       3.437682479
NA_rating                   4.5        5.05247785
NA_rating                   4.75       7.039439785
NA_rating                   5          9.382521139
NA_rating                   5.25       12.06927874
NA_rating                   5.5        15.08960806
NA_rating                   5.75       18.43503888
NA_rating                   6          22.09830396
NA_rating                   6.25       26.07305627
NA_rating                   6.5        30.35367403
NA_rating                   6.75       34.16548676
NA_rating                   7          36.58187651
NA_rating                   7.25       45.87887399
NA_rating                   7.5        61.50071109
NA_rating                   7.75       81.09168456
NA_rating                   8          100.5413678
NA_rating                   8.25       122.3952724
NA_rating                   8.5        173.3363635
NA_rating                   8.75       239.3125024
NA_rating                   9          317.2942551
NA_rating                   9.25       405.4828343
NA_rating                   9.4        464.2985611
;
RB1-4_storage    Storage    0.0        0
RB1-4_storage               0.5        328
RB1-4_storage               1.5        2222
RB1-4_storage               2.5        22311
RB1-4_storage               3.5        41170
RB1-4_storage               4.5        60321
RB1-4_storage               5.5        75858
RB1-4_storage               6.5        86332
RB1-4_storage               7.5        95521
RB1-4_storage               8.5        104107
RB1-4_storage               9.5        112990
RB1-4_storage               10.5       121937
RB1-4_storage               11.5       131448
;
```

```
NA_storage       Storage    0          2015
NA_storage                  0.4        4028.5
NA_storage                  1.4        7744.803
NA_storage                  2.4        13712.894
NA_storage                  3.4        19405.348
NA_storage                  4.4        28097.354
NA_storage                  5.4        47234.436
NA_storage                  6.4        60011.204
NA_storage                  7.4        65786.986
NA_storage                  8.4        65786.986
NA_storage                  9.4        65786.986

[REPORT]
;;Reporting Options
INPUT      NO
CONTROLS   NO
SUBCATCHMENTS ALL
NODES ALL
LINKS ALL

[TAGS]

[MAP]
DIMENSIONS -2727.273 0.000 12727.273 10000.000
Units      None

[COORDINATES]
;;Node           X-Coord            Y-Coord
;;-------------- ------------------ ------------------
Belleview_LR     -123.123           8276.677
Havana_LR        -252.770           7640.991
Peoria_S         1527.855           7754.128
Stock_Pond_S     1010.237           7302.238
Parker_J         4212.105           7615.032
Junction_J3      4882.479           7462.368
Junction_J4      4371.553           7768.648
Regis_Jesuit_VCA 5966.849           5401.173
Parker_SA        5972.160           4615.175
Norfolk_SA       6718.568           4442.553
Richfield_SA     7370.156           4437.690
Parker_C         6631.041           3292.549
Hinsdale_C       7034.637           3151.534
Richfield_C      7501.446           3029.969
Telluride_C      8114.133           3085.889
Bridle_Trail_C   8790.034           3090.751
Biscay_C         9016.145           2898.679
Parker_K         7199.965           1862.945
Bridle_Trail_K   7968.256           2028.274
Confluence_K     8814.347           1702.480
Future_Road_K    9385.702           1366.961
Parker_17        7423.645           1459.350
LR3              -491.676           7030.960
LR2              39.980             7737.180
LR1              90.166             8615.430
S3               624.102            6776.536
S2               1313.661           6895.122
S1               838.769            7732.998
J8               6593.833           8275.416
J7               5980.369           8205.306
J6               5406.342           8262.270
J5               4661.421           8336.762
J2               4034.812           8319.235
J4               4337.162           8060.703
J3               4931.228           7223.949
J1               4424.799           7188.708
VCA1             5848.912           5554.265
VCA2             6650.797           5506.064
NA1              6855.406           5031.735
NA2              8013.564           5032.820
NA4              8740.957           4603.396
NA3              8459.378           4196.992
SA4              8109.965           3968.022
SA3              7325.608           4024.987
SA2              6799.782           4125.770
SA1              5752.511           4480.703
C2               7268.643           3573.653
17B              8233.267           1213.789
17A              7202.397           1595.503
K1               7022.480           1675.735
K2               7664.343           1794.869
K3               8692.782           1437.468
K4               8644.156           2322.461
K6               9283.588           2008.823
K7               10335.963          1338.891
K5               9222.805           1247.827
C9               9796.991           2473.799
C8               9735.645           3152.991
C7               9152.854           3753.310
C4               8561.300           3674.436
C3               7728.741           3547.361
C6               8736.575           2627.165
C5               8061.765           2898.842
C1               6791.018           2885.696
T1               7991.654           2578.964
GR1              5274.885           5913.579
LR_outfall       600.387            9309.666
S_outfall        1366.321           8133.280
J_outfall        3129.927           7841.141
VCA_outfall      4662.222           5584.703
NA_outfall       4920.786           4725.636
SA_outfall       4899.957           4644.351
T_outfall        6384.231           2499.017
C_outfall        5685.266           3389.801
K_outfall        6623.748           1685.461
```

```
17_outfall       7097.851           1366.961
GR_outfall       4636.318           5812.849
Lewiston_J       6015.436           7829.562
Laredo_J         5773.126           7792.686
Shalom_J         4467.849           7866.084
Fair_Place_VCA   5272.176           5592.329
Parker_T1        6901.788           2534.646
Waco_NA          8270.083           4743.724
Buckley_NA1      6942.831           4717.330
out_RB1-4_pond   5207.572           7550.921
Parker_NA        6049.035           4729.177
RB1-4_pond       5244.212           7583.078
NA_pond          7032.246           4835.941

[VERTICES]
;;Link           X-Coord            Y-Coord
;;-------------- ------------------ ------------------
LR1_OC           -39.481            9016.916
LR2_OC           -89.666            7891.920
S_OC_B           1181.705           7507.163
S_OC_B           1478.637           7703.723
J3_SS            5076.347           7414.844
J6_SS            5319.937           7778.454
C1_OC            5857.889           3290.118
K1_OC            6808.526           1619.816
LR1_OF           198.901            9004.369
J8_OF            6300.610           7900.577
J2_OF            3785.394           7860.260
NA1_OF           6340.787           4761.594
NA3_OF           8082.527           4313.694
NA3_OF           7861.278           4717.290
C3_OF            7445.526           3270.667
C4_OF            7754.301           3081.026
C6_OF            8345.107           3068.869
C8_OF            9042.889           3005.656
C1_OF            5957.572           3273.098
C1_OF            5809.263           3309.568
K3_OF            8118.996           1824.045
K5_OF            8999.126           1607.659
J7_SS_OVF        5902.881           7873.780
J6_SS_OVF        5309.509           7786.517
J4_SS_OVF        4380.048           7844.493
VCA_SS_OVF       5048.151           5604.438
T0_OVF           6637.415           2457.233
NA3_OVF          7598.916           4792.742
NA1_OVF          6568.539           4761.101
J3_OVF           5069.958           7505.387
NA0_OVF          5517.588           4782.996


  EPA STORM WATER MANAGEMENT MODEL - VERSION 5.1 (Build 5.1.012)
```

```
------------------------------------------------------------

WARNING 04: minimum elevation drop used for Conduit LR3_OF
WARNING 04: minimum elevation drop used for Conduit LR2_OF
WARNING 04: minimum elevation drop used for Conduit LR1_OF
WARNING 04: minimum elevation drop used for Conduit S3_OF
WARNING 04: minimum elevation drop used for Conduit S2_OF
WARNING 04: minimum elevation drop used for Conduit S_OF
WARNING 04: minimum elevation drop used for Conduit J4_OF
WARNING 04: minimum elevation drop used for Conduit J3_OF
WARNING 04: minimum elevation drop used for Conduit J1_OF
WARNING 04: minimum elevation drop used for Conduit J2_OF
WARNING 04: minimum elevation drop used for Conduit VCA2_OF
WARNING 04: minimum elevation drop used for Conduit SA4_OF
WARNING 04: minimum elevation drop used for Conduit SA3_OF
WARNING 04: minimum elevation drop used for Conduit SA2_OF
WARNING 04: minimum elevation drop used for Conduit SA1_OF
WARNING 04: minimum elevation drop used for Conduit C2_OF
WARNING 04: minimum elevation drop used for Conduit C3_OF
WARNING 04: minimum elevation drop used for Conduit C4_OF
WARNING 04: minimum elevation drop used for Conduit C5_OF
WARNING 04: minimum elevation drop used for Conduit C6_OF
WARNING 04: minimum elevation drop used for Conduit C7_OF
WARNING 04: minimum elevation drop used for Conduit C9_OF
WARNING 04: minimum elevation drop used for Conduit C1_OF
WARNING 04: minimum elevation drop used for Conduit K1_OF
WARNING 04: minimum elevation drop used for Conduit K2_OF
WARNING 04: minimum elevation drop used for Conduit 17B_OF
WARNING 04: minimum elevation drop used for Conduit K3_OF
WARNING 04: minimum elevation drop used for Conduit K5_OF
WARNING 04: minimum elevation drop used for Conduit K6_OF
WARNING 04: minimum elevation drop used for Conduit K7_OF
WARNING 04: minimum elevation drop used for Conduit K4_OF
WARNING 04: minimum elevation drop used for Conduit 17A_OF
WARNING 04: minimum elevation drop used for Conduit GR1_OF
WARNING 02: maximum depth increased for Node Junction_J4
WARNING 02: maximum depth increased for Node Fair_Place_VCA

**********************************************************
NOTE: The summary statistics displayed in this report are
based on results found at every computational time step,
not just on results from each reporting time step.
**********************************************************

****************
Analysis Options
****************
Flow Units ............... CFS
Process Models:
  Rainfall/Runoff ........ NO
  RDII ................... NO
  Snowmelt ............... NO
```

```
  Groundwater ............ NO
  Flow Routing ........... YES
  Ponding Allowed ........ NO
  Water Quality .......... NO
Flow Routing Method ...... KINWAVE
Starting Date ............ 12/01/2018 00:00:00
Ending Date .............. 12/02/2018 00:00:00
Antecedent Dry Days ...... 0.0
Report Time Step ......... 00:01:00
Routing Time Step ........ 5.00 sec


*************************       Volume       Volume
Flow Routing Continuity       acre-feet     10^6 gal
*************************     ---------    ---------
Dry Weather Inflow .......        0.000        0.000
Wet Weather Inflow .......        0.000        0.000
Groundwater Inflow .......        0.000        0.000
RDII Inflow ..............        0.000        0.000
External Inflow ..........      559.246      182.239
External Outflow .........      566.949      184.749
Flooding Loss ............        0.000        0.000
Evaporation Loss .........        0.000        0.000
Exfiltration Loss ........        0.000        0.000
Initial Stored Volume ....        0.000        0.000
Final Stored Volume ......        0.076        0.025
Continuity Error (%) .....       -1.391


*******************************
Highest Flow Instability Indexes
*******************************
Link J3_SS (5)
Link J3_OC (5)
Link outlet_RB1-4_pond (4)
Link J1_OC (3)


************************
Routing Time Step Summary
************************
Minimum Time Step           :     5.00 sec
Average Time Step           :     5.00 sec
Maximum Time Step           :     5.00 sec
Percent in Steady State     :     0.00
Average Iterations per Step :     1.00
Percent Not Converging      :     0.00


******************
Node Depth Summary
******************
```

Node	Type	Average Depth Feet	Maximum Depth Feet	Maximum HGL Feet	Time of Max Occurrence days hr:min	Reported Max Depth Feet
Belleview_LR	JUNCTION	0.22	3.46	5612.46	0 00:49	3.46
Havana_LR	JUNCTION	0.16	2.89	5647.89	0 00:40	2.88
Peoria_S	JUNCTION	0.19	1.86	5581.86	0 01:00	1.86
Stock_Pond_S	JUNCTION	0.17	2.43	5623.43	0 00:45	2.43
Parker_J	JUNCTION	0.34	3.42	5622.42	0 01:11	3.42
Junction_J3	JUNCTION	0.35	3.94	5666.94	0 01:20	3.94
Junction_J4	JUNCTION	0.18	3.27	5633.14	0 00:42	3.27
Regis_Jesuit_VCA	JUNCTION	0.14	2.47	5691.47	0 00:40	2.47
Parker_SA	JUNCTION	0.23	2.35	5658.35	0 01:07	2.35
Norfolk_SA	JUNCTION	0.22	2.37	5722.37	0 00:58	2.37
Richfield_SA	JUNCTION	0.17	1.94	5761.94	0 00:55	1.94
Parker_C	JUNCTION	0.40	3.90	5701.90	0 01:11	3.90
Hinsdale_C	JUNCTION	0.36	3.66	5721.66	0 01:07	3.66
Richfield_C	JUNCTION	0.31	3.30	5748.30	0 01:03	3.30
Telluride_C	JUNCTION	0.25	3.06	5777.06	0 00:57	3.06
Bridle_Trail_C	JUNCTION	0.20	2.75	5816.75	0 00:48	2.75
Biscay_C	JUNCTION	0.13	1.89	5829.89	0 00:45	1.89
Parker_K	JUNCTION	0.28	3.30	5727.30	0 01:06	3.30
Bridle_Trail_K	JUNCTION	0.24	3.14	5768.14	0 00:56	3.14
Confluence_K	JUNCTION	0.15	2.46	5833.46	0 00:46	2.46

Future_Road_K		JUNCTION	0.09	1.90	5891.90	0	C2		JUNCTION	0.00	0.00	5698.00	0
00:35	1.90						00:00	0.00					
Parker_17		JUNCTION	0.11	1.99	5730.99	0	17B		JUNCTION	0.00	0.00	5729.00	0
00:40	1.99						00:00	0.00					
LR3		JUNCTION	0.00	0.00	5645.00	0	17A		JUNCTION	0.00	0.00	5695.00	0
00:00	0.00						00:00	0.00					
LR2		JUNCTION	0.00	0.00	5609.00	0	K1		JUNCTION	0.00	0.00	5690.00	0
00:00	0.00						00:00	0.00					
LR1		JUNCTION	0.00	0.00	5552.00	0	K2		JUNCTION	0.00	0.00	5724.00	0
00:00	0.00						00:00	0.00					
S3		JUNCTION	0.00	0.00	5621.00	0	K3		JUNCTION	0.00	0.00	5765.00	0
00:00	0.00						00:00	0.00					
S2		JUNCTION	0.00	0.00	5580.00	0	K4		JUNCTION	0.00	0.00	5765.00	0
00:00	0.00						00:00	0.00					
S1		JUNCTION	0.00	0.00	5565.00	0	K6		JUNCTION	0.00	0.00	5831.00	0
00:00	0.00						00:00	0.00					
J8		JUNCTION	0.00	0.00	5738.00	0	K7		JUNCTION	0.00	0.00	5890.00	0
00:00	0.00						00:00	0.00					
J7		JUNCTION	0.00	0.00	5729.00	0	K5		JUNCTION	0.00	0.00	5831.00	0
00:00	0.00						00:00	0.00					
J6		JUNCTION	0.00	0.00	5688.00	0	C9		JUNCTION	0.00	0.00	5828.00	0
00:00	0.00						00:00	0.00					
J5		JUNCTION	0.00	0.00	5645.00	0	C8		JUNCTION	0.00	0.00	5817.00	0
00:00	0.00						00:00	0.00					
J2		JUNCTION	0.00	0.00	5579.00	0	C7		JUNCTION	0.00	0.00	5814.00	0
00:00	0.00						00:00	0.00					
J4		JUNCTION	0.00	0.00	5619.00	0	C4		JUNCTION	0.00	0.00	5745.00	0
00:00	0.00						00:00	0.00					
J3		JUNCTION	0.00	0.00	5619.00	0	C3		JUNCTION	0.00	0.00	5718.00	0
00:00	0.00						00:00	0.00					
J1		JUNCTION	0.00	0.00	5579.00	0	C6		JUNCTION	0.00	0.00	5774.00	0
00:00	0.00						00:00	0.00					
VCA1		JUNCTION	0.00	0.00	5631.00	0	C5		JUNCTION	0.00	0.00	5745.00	0
00:00	0.00						00:00	0.00					
VCA2		JUNCTION	0.00	0.00	5689.00	0	C1		JUNCTION	0.00	0.00	5658.00	0
00:00	0.00						00:00	0.00					
NA1		JUNCTION	0.00	0.00	5631.00	0	T1		JUNCTION	0.00	0.00	5710.00	0
00:00	0.00						00:00	0.00					
NA2		JUNCTION	0.00	0.00	5765.00	0	GR1		JUNCTION	0.00	0.00	5620.00	0
00:00	0.00						00:00	0.00					
NA4		JUNCTION	0.00	0.00	5833.00	0	LR_outfall		OUTFALL	0.26	3.27	5555.27	0
00:00	0.00						01:08	3.27					
NA3		JUNCTION	0.00	0.00	5769.00	0	S_outfall		OUTFALL	0.22	2.33	5567.33	0
00:00	0.00						01:01	2.33					
SA4		JUNCTION	0.00	0.00	5760.00	0	J_outfall		OUTFALL	0.39	3.40	5582.40	0
00:00	0.00						01:27	3.40					
SA3		JUNCTION	0.00	0.00	5720.00	0	VCA_outfall		OUTFALL	0.20	2.43	5624.43	0
00:00	0.00						01:43	2.43					
SA2		JUNCTION	0.00	0.00	5656.00	0	NA_outfall		OUTFALL	0.55	2.90	5633.90	0
00:00	0.00						02:20	2.89					
SA1		JUNCTION	0.00	0.00	5633.00	0	SA_outfall		OUTFALL	0.19	2.34	5635.34	0
00:00	0.00						01:08	2.34					

```
  T_outfall           OUTFALL      0.17     2.30  5675.30     0
00:51        2.30
  C_outfall           OUTFALL      0.41     3.85  5661.85     0
01:21        3.85
  K_outfall           OUTFALL      0.29     3.28  5693.28     0
01:13        3.28
  17_outfall          OUTFALL      0.11     1.97  5696.97     0
00:46        1.97
  GR_outfall          OUTFALL      0.00     0.00  5620.00     0
00:00        0.00
  Lewiston_J          DIVIDER      0.21     3.28  5734.44     0
00:33        3.28
  Laredo_J            DIVIDER      0.28     4.51  5722.26     0
00:34        4.51
  Shalom_J            DIVIDER      0.18     3.27  5642.00     0
00:39        3.27
  Fair_Place_VCA      DIVIDER      0.20     2.45  5628.75     0
00:45        2.45
  Parker_T1           DIVIDER      0.17     2.31  5707.91     0
00:50        2.31
  Waco_NA             DIVIDER      0.13     2.05  5827.80     0
00:32        2.05
  Buckley_NA1         DIVIDER      0.47     3.28  5759.30     0
00:45        3.28
  out_RB1-4_pond      DIVIDER      0.35     3.94  5691.44     0
01:19        3.94
  Parker_NA           DIVIDER      0.56     3.29  5674.98     0
01:37        3.29
  RB1-4_pond          STORAGE      0.88    10.73  5698.23     0
01:19       10.73
  NA_pond             STORAGE      2.95     8.51  5773.09     0
01:04        8.51


  ********************
  Node Inflow Summary
  ********************

  -------------------------------------------------------------------------
-----------------------------
                                  Maximum  Maximum
Lateral       Total        Flow
                                  Lateral    Total  Time of Max
Inflow      Inflow     Balance
                                   Inflow   Inflow   Occurrence
Volume      Volume       Error
  Node                Type           CFS      CFS  days hr:min
10^6 gal    10^6 gal     Percent
  -------------------------------------------------------------------------
-----------------------------
  Belleview_LR        JUNCTION      0.00   403.67     0  00:49
0        10.6       0.000
  Havana_LR           JUNCTION      0.00   298.37     0  00:40
0        6.82       0.000
  Peoria_S            JUNCTION      0.00   101.97     0  01:00
0        4.69       0.000
  Stock_Pond_S        JUNCTION      0.00   210.26     0  00:45
0        6.29       0.000
  Parker_J            JUNCTION      0.00   535.49     0  01:11
0        25.7       0.000
  Junction_J3         JUNCTION      0.00   352.47     0  01:20
0        16.2       0.000
  Junction_J4         JUNCTION      0.00   121.87     0  00:42
0        3.18       0.000
  Regis_Jesuit_VCA    JUNCTION      0.00   150.53     0  00:40
0        3.68       0.000
  Parker_SA           JUNCTION      0.00   317.99     0  01:05
0        12.5       0.000
  Norfolk_SA          JUNCTION      0.00   224.51     0  00:58
0        8.56       0.000
  Richfield_SA        JUNCTION      0.00   126.80     0  00:55
0        4.91       0.000
  Parker_C            JUNCTION      0.00   857.09     0  01:11
0        31.6       0.000
  Hinsdale_C          JUNCTION      0.00   747.71     0  01:07
0        27.2       0.000
  Richfield_C         JUNCTION      0.00   657.82     0  01:03
0        23.2       0.000
  Telluride_C         JUNCTION      0.00   507.99     0  00:57
0        16.6       0.000
  Bridle_Trail_C      JUNCTION      0.00   411.64     0  00:48
0        12.8       0.000
  Biscay_C            JUNCTION      0.00   178.39     0  00:45
0        5.49       0.000
  Parker_K            JUNCTION      0.00   838.96     0  01:06
0        26.4       0.000
  Bridle_Trail_K      JUNCTION      0.00   729.46     0  00:56
0        21.3       0.000
  Confluence_K        JUNCTION      0.00   505.48     0  00:46
0        12.5       0.000
  Future_Road_K       JUNCTION      0.00   300.21     0  00:35
0        5.71       0.000
  Parker_17           JUNCTION      0.00   229.15     0  00:40
0        5.41       0.000
  LR3                 JUNCTION    298.37   298.37     0  00:40
6.82        6.82       0.000
  LR2                 JUNCTION    129.14   129.14     0  00:45
3.73        3.73       0.000
  LR1                 JUNCTION    101.66   101.66     0  01:00
4.23        4.23       0.000
  S3                  JUNCTION    210.26   210.26     0  00:45
6.29        6.29       0.000
  S2                  JUNCTION    101.97   101.97     0  01:00
4.69        4.69       0.000
```

S1		JUNCTION	141.81	141.81	0	00:50
4.34	4.34	0.000				
J8		JUNCTION	232.67	232.67	0	00:45
6.25	6.25	0.000				
J7		JUNCTION	191.47	191.47	0	00:45
5.23	5.23	0.000				
J6		JUNCTION	146.38	146.38	0	00:50
4.77	4.77	0.000				
J5		JUNCTION	122.80	122.80	0	00:40
3.18	3.18	0.000				
J2		JUNCTION	37.41	37.41	0	00:50
1.53	1.53	0.000				
J4		JUNCTION	66.39	66.39	0	00:40
1.47	1.47	0.000				
J3		JUNCTION	209.86	209.86	0	00:40
4.82	4.82	0.000				
J1		JUNCTION	70.04	70.04	0	01:05
3.51	3.51	0.000				
VCA1		JUNCTION	201.48	201.48	0	00:45
5.97	5.97	0.000				
VCA2		JUNCTION	150.53	150.53	0	00:40
3.68	3.68	0.000				
NA1		JUNCTION	208.71	208.71	0	00:40
4.92	4.92	0.000				
NA2		JUNCTION	225.69	225.69	0	00:45
6.06	6.06	0.000				
NA4		JUNCTION	58.66	58.66	0	00:40
1.64	1.64	0.000				
NA3		JUNCTION	103.46	103.46	0	00:55
4.52	4.52	0.000				
SA4		JUNCTION	126.80	126.80	0	00:55
4.91	4.91	0.000				
SA3		JUNCTION	108.73	108.73	0	00:50
3.6	3.6	0.000				
SA2		JUNCTION	105.35	105.35	0	00:50
3.89	3.89	0.000				
SA1		JUNCTION	163.67	163.67	0	00:40
4.01	4.01	0.000				
C2		JUNCTION	154.81	154.81	0	00:45
4.39	4.39	0.000				
17B		JUNCTION	229.15	229.15	0	00:40
5.41	5.41	0.000				
17A		JUNCTION	50.58	50.58	0	00:35
0.95	0.95	0.000				
K1		JUNCTION	79.95	79.95	0	00:35
1.69	1.69	0.000				
K2		JUNCTION	170.56	170.56	0	00:45
4.88	4.88	0.000				
K3		JUNCTION	98.30	98.30	0	00:45
3.19	3.19	0.000				
K4		JUNCTION	188.35	188.35	0	00:45
5.36	5.36	0.000				
K6		JUNCTION	157.48	157.48	0	00:45
4.52	4.52	0.000				
K7		JUNCTION	300.21	300.21	0	00:35
5.71	5.71	0.000				
K5		JUNCTION	89.58	89.58	0	00:40
2.19	2.19	0.000				
C9		JUNCTION	178.39	178.39	0	00:45
5.49	5.49	0.000				
C8		JUNCTION	158.13	158.13	0	00:45
4.82	4.82	0.000				
C7		JUNCTION	79.31	79.31	0	00:45
2.5	2.5	0.000				
C4		JUNCTION	104.80	104.80	0	00:55
4.33	4.33	0.000				
C3		JUNCTION	101.60	101.60	0	00:50
3.92	3.92	0.000				
C6		JUNCTION	122.15	122.15	0	00:45
3.6	3.6	0.000				
C5		JUNCTION	60.80	60.80	0	00:50
2.25	2.25	0.000				
C1		JUNCTION	176.28	176.28	0	00:45
5.2	5.2	0.000				
T1		JUNCTION	104.95	104.95	0	00:50
3.62	3.62	0.000				
GR1		JUNCTION	150.25	150.25	0	00:40
4.14	4.14	0.000				
LR_outfall		OUTFALL	0.00	453.53	0	01:07
0	15.3	0.000				
S_outfall		OUTFALL	0.00	422.74	0	01:00
0	15.5	0.000				
J_outfall		OUTFALL	0.00	613.26	0	01:24
0	31.5	0.000				
VCA_outfall		OUTFALL	0.00	349.18	0	00:45
0	9.65	0.000				
NA_outfall		OUTFALL	0.00	476.03	0	00:59
0	17.1	0.000				
SA_outfall		OUTFALL	0.00	426.06	0	01:04
0	16.5	0.000				
T_outfall		OUTFALL	0.00	104.71	0	00:51
0	3.61	0.000				
C_outfall		OUTFALL	0.00	942.12	0	01:19
0	36.9	0.000				
K_outfall		OUTFALL	0.00	859.16	0	01:12
0	28.2	0.000				
17_outfall		OUTFALL	0.00	266.65	0	00:45
0	6.37	0.000				
GR_outfall		OUTFALL	0.00	150.25	0	00:40
0	4.14	0.000				
Lewiston_J		DIVIDER	0.00	232.67	0	00:45
0	6.25	0.000				
Laredo_J		DIVIDER	0.00	424.14	0	00:45
0	11.5	0.000				

```
  Shalom_J             DIVIDER      0.00   122.80     0  00:40
0        3.18       0.000
  Fair_Place_VCA       DIVIDER      0.00   349.24     0  00:45
0        9.64       0.000
  Parker_T1            DIVIDER      0.00   104.95     0  00:50
0        3.62       0.000
  Waco_NA              DIVIDER      0.00    58.66     0  00:40
0        1.64       0.000
  Buckley_NA1          DIVIDER      0.00   324.75     0  01:03
0        12.2       0.000
  out_RB1-4_pond       DIVIDER      0.00   352.51     0  01:19
0        16.2       0.000
  Parker_NA            DIVIDER      0.00   476.03     0  00:59
0        17.1       0.000
  RB1-4_pond           STORAGE      0.00   569.69     0  00:45
0        16.2       0.011
  NA_pond              STORAGE      0.00   225.69     0  00:45
0        6.06       0.028


  *********************
  Node Flooding Summary
  *********************

  No nodes were flooded.


  **********************
  Storage Volume Summary
  **********************

  ------------------------------------------------------------------------
-----------------------------
                          Average     Avg  Evap Exfil       Maximum
Max    Time of Max    Maximum
                           Volume    Pcnt  Pcnt  Pcnt        Volume
Pcnt     Occurrence    Outflow
  Storage Unit           1000 ft3    Full  Loss  Loss      1000 ft3
Full    days hr:min        CFS
  ------------------------------------------------------------------------
-----------------------------
  RB1-4_pond               43.139       5     0     0       690.474
88       0  01:18     352.51
  NA_pond                  43.569      13     0     0       285.349
83       0  01:04     175.99


  ************************
  Outfall Loading Summary
  ************************

  ------------------------------------------------------------
```

```
                                Flow       Avg       Max       Total
                                Freq      Flow      Flow      Volume
Outfall Node                    Pcnt       CFS       CFS   10^6 gal
-----------------------------------------------------------------
LR_outfall                     99.13     23.83    453.53      15.265
S_outfall                      79.69     30.02    422.74      15.460
J_outfall                      99.30     49.02    613.26      31.456
VCA_outfall                    44.97     33.19    349.18       9.646
NA_outfall                     99.08     26.74    476.03      17.120
SA_outfall                     99.30     25.75    426.06      16.526
T_outfall                      22.65     24.69    104.71       3.615
C_outfall                      99.30     57.56    942.12      36.938
K_outfall                      99.30     43.94    859.16      28.195
17_outfall                     43.70     22.56    266.65       6.371
GR_outfall                     14.91     43.00    150.25       4.143
-----------------------------------------------------------------
System                         72.85    380.29   4627.49     184.735


  *********************
  Link Flow Summary
  *********************

  ------------------------------------------------------------------------
---------
                                                  Maximum  Time of Max   Maximum
Max/    Max/
                                                    |Flow|   Occurrence   |Veloc|
Full    Full
  Link                  Type                          CFS  days hr:min    ft/sec
Flow   Depth
  ------------------------------------------------------------------------
---------
  LR1_OC                CHANNEL     355.23     0  01:08      3.92
0.24    0.54
  LR2_OC                CHANNEL     278.12     0  00:50      3.75
0.17    0.46
  S_OC_A                CHANNEL     101.42     0  01:05      2.55
0.07    0.31
  S_OC_B                CHANNEL     191.94     0  01:01      3.51
0.12    0.39
  J1_OC                 CHANNEL     526.08     0  01:27      3.35
0.42    0.68
  J3_OC                 CHANNEL     351.13     0  01:25      4.41
0.17    0.45
  J4_OC                 CHANNEL     121.27     0  00:44      2.64
0.06    0.27
  J3_SS                 CONDUIT     352.47     0  01:20     17.90
0.77    0.66
  J4_SS                 CONDUIT     121.87     0  00:42     11.16
1.00    0.82
```

```
  J6_SS              CONDUIT    347.74     0  01:01     16.83
1.00    0.82
  J7_SS              CONDUIT    170.68     0  01:08     15.55
1.00    0.82
  VCA_SS_OUT         CONDUIT    115.86     0  01:43      6.08
1.00    0.80
  VCA1_SS            CONDUIT    147.93     0  00:45     14.61
0.41    0.44
  NA1_SS             CONDUIT    196.00     0  01:37     18.03
1.00    0.82
  NA3_SS             CONDUIT     44.22     0  01:10     10.70
1.01    0.82
  SA1_SS             CONDUIT    317.45     0  01:08     11.36
0.26    0.39
  SA2_OC             CHANNEL    221.56     0  01:07      3.84
0.14    0.43
  SA3_OC             CHANNEL    123.79     0  01:02      2.96
0.09    0.35
  T0_SS              CONDUIT    104.71     0  00:51     14.02
0.63    0.58
  C1_OC              CHANNEL    834.46     0  01:21      4.01
0.42    0.70
  C2_OC              CHANNEL    743.91     0  01:12      3.87
0.36    0.66
  C3_OC              CHANNEL    654.25     0  01:08      4.09
0.29    0.60
  C4_OC              CHANNEL    500.33     0  01:04      3.63
0.24    0.55
  C6_OC              CHANNEL    397.45     0  00:58      3.56
0.18    0.49
  C8_OC              CHANNEL    177.03     0  00:50      2.93
0.08    0.34
  K1_OC              CHANNEL    824.85     0  01:13      3.63
0.62    0.82
  K2_OC              CHANNEL    701.19     0  01:07      3.45
0.53    0.77
  K4_OC              CHANNEL    469.75     0  00:58      3.63
0.29    0.59
  K5_OC              CHANNEL    265.26     0  00:47      3.30
0.16    0.45
  17A_OC             CHANNEL    223.42     0  00:46      3.06
0.40    0.65
  LR3_OF             DUMMY      298.37     0  00:40
  LR2_OF             DUMMY      129.14     0  00:45
  LR1_OF             DUMMY      101.66     0  01:00
  S3_OF              DUMMY      210.26     0  00:45
  S2_OF              DUMMY      101.97     0  01:00
  S_OF               DUMMY      141.81     0  00:50
  J8_OF              DUMMY      232.67     0  00:45
  J7_OF              DUMMY      191.47     0  00:45
  J6_OF              DUMMY      146.38     0  00:50
  J5_OF              DUMMY      122.80     0  00:40
  J4_OF              DUMMY       66.39     0  00:40
  J3_OF              DUMMY      209.86     0  00:40
  J1_OF              DUMMY       70.04     0  01:05
  J2_OF              DUMMY       37.41     0  00:50
  VCA1_OF            DUMMY      201.48     0  00:45
  VCA2_OF            DUMMY      150.53     0  00:40
  NA1_OF             DUMMY      208.71     0  00:40
  NA2_OF             DUMMY      225.69     0  00:45
  NA4_OF             DUMMY       58.66     0  00:40
  NA3_OF             DUMMY      103.46     0  00:55
  SA4_OF             DUMMY      126.80     0  00:55
  SA3_OF             DUMMY      108.73     0  00:50
  SA2_OF             DUMMY      105.35     0  00:50
  SA1_OF             DUMMY      163.67     0  00:40
  C2_OF              DUMMY      154.81     0  00:45
  C3_OF              DUMMY      101.60     0  00:50
  C4_OF              DUMMY      104.80     0  00:55
  C5_OF              DUMMY       60.80     0  00:50
  C6_OF              DUMMY      122.15     0  00:45
  C7_OF              DUMMY       79.31     0  00:45
  C8_OF              DUMMY      158.13     0  00:45
  C9_OF              DUMMY      178.39     0  00:45
  C1_OF              DUMMY      176.28     0  00:45
  T1_OF              DUMMY      104.95     0  00:50
  K1_OF              DUMMY       79.95     0  00:35
  K2_OF              DUMMY      170.56     0  00:45
  17B_OF             DUMMY      229.15     0  00:40
  K3_OF              DUMMY       98.30     0  00:45
  K5_OF              DUMMY       89.58     0  00:40
  K6_OF              DUMMY      157.48     0  00:45
  K7_OF              DUMMY      300.21     0  00:35
  K4_OF              DUMMY      188.35     0  00:45
  17A_OF             DUMMY       50.58     0  00:35
  J7_SS_OVF          DUMMY       62.17     0  00:45
  J6_SS_OVF          DUMMY       77.14     0  00:45
  J4_SS_OVF          DUMMY        0.80     0  00:40
  VCA_SS_OVF         DUMMY      234.24     0  00:45
  T0_OVF             DUMMY        0.00     0  00:00
  NA3_OVF            DUMMY       14.96     0  00:40
  NA1_OVF            DUMMY      129.55     0  01:03
  J3_OVF             DUMMY        0.00     0  00:00
  GR1_OF             DUMMY      150.25     0  00:40
  NA0_SS             CONDUIT     98.74     0  02:20     12.02
1.01    0.82
  NA0_OVF            DUMMY      378.13     0  00:59
  outlet_RB1-4_pond  DUMMY      352.51     0  01:19
  outlet_NA_pond     DUMMY      175.99     0  01:04


  *************************
  Conduit Surcharge Summary
  *************************
```

```
  ---------------------------------------------------------------------
--------
                                                          Hours
Hours
                        --------- Hours Full --------   Above Full
Capacity
  Conduit               Both Ends  Upstream  Dnstream   Normal Flow
Limited
  ---------------------------------------------------------------------
--------
  J6_SS                     0.01      0.01      0.01      0.02
0.01
  J7_SS                     0.01      0.01      0.01      0.01
0.01
  VCA_SS_OUT                0.01      0.01      0.01      0.03
0.01
  NA1_SS                    0.01      0.01      0.01      0.03
0.01
  NA3_SS                    0.01      0.01      0.01      0.07
0.01
  NA0_SS                    0.01      0.01      0.01      0.04
0.01


  Analysis begun on:  Mon Feb 11 10:59:27 2019
  Analysis ended on:  Mon Feb 11 10:59:28 2019
  Total elapsed time: 00:00:01
```