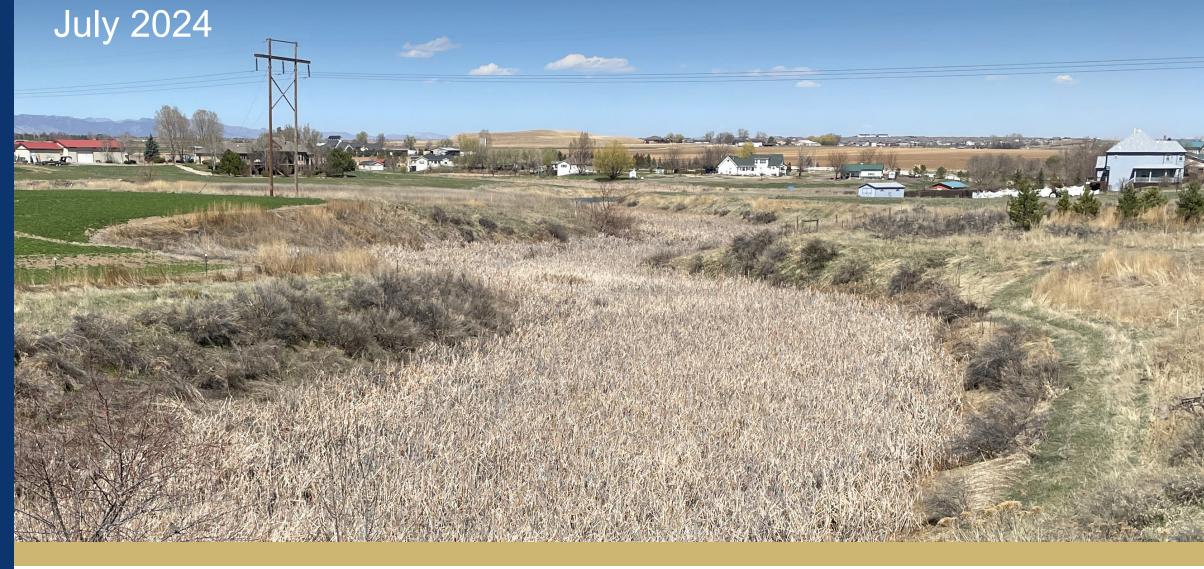






Comprehensive Drainage Plan Oklahoma Basins 700 & 800 Concept Design Report









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7/31/2024

Mr. Ryan Davis, PE, PTOE Senior Transportation Project Manager Bolton & Menk, Inc. 430 E Grand Ave, Ste 101 Des Moines, IA 50309

RE: Comprehensive Drainage Plan Oklahoma Basins 700 & 800 PO – 20231851 – Bolton & Menk – US 34 & WCR 17 Concept Design Report Final

Dear Mr. Davis:

Matrix Design Group, Inc. is pleased to submit the enclosed *Concept Design Report* for the Oklahoma Basins 700 & 800. The analysis in this report follows the previously submitted *Alternatives Analysis Report* and *Baseline Hydrology Report*. We have addressed the City of Greeley comments on the *Concept Design Report Draft*, received July 29, 2024, and incorporated revisions into the attached document. Responses to comments for each project phase are included in Appendix A of the report.

The report format and submittal are intended to follow the requirements of the *City of Greeley Master Plan Procedures / Preparation Guide* (2001), but there have also been efforts to include similar information to what would normally comprise a Mile High Flood District Major Drainageway Planning study. The City of Greeley Master Plan Template Checklist for this report is attached.

The Concept Design Report provides a description of the watershed, updated hydrologic and hydraulic modeling, updated flows and velocities and detailed recommendations revolving around Low Impact Development (LID) practices. With historical rain events and flood occurring more frequently, the importance of stabilizing drainageways to reduce flood hazards, improving water quality, and reduce aggradation and degradation from channel instability becomes more important with the increase of urban development.

We appreciate the opportunity to provide an evaluation of the proposed improvements and recommendations for management of these drainageways. Reducing the city's risk of long-term urbanized flooding is essential in protecting the health and safety of the public and in providing a higher quality of life for its residents.

Sincerely,

Matrix Design Group, Inc.

Drew Beck, PE Officer In Charge Benjamin Liu, PE Project Manager

CC: Mr. Aaron Stines, PE, City of Greeley



EXECUTIVE SUMMARY

This study creates a master plan framework for two drainage basins: the Oklahoma Basins 700 and 800. Recommendations are provided on how the City of Greeley and the Town of Windsor can protect their water quality and preserve floodplains and natural channels to reduce future flood risks. Conceptual drainage improvements, LID practices, and expected costs are included to help guide capital planning. No public meetings were held during the study.

Updated hydrologic information on both existing and future conditions in the Oklahoma Basins was collected and synthesized. Three hydrologic models were developed:

- 1. Baseline Hydrology for existing conditions;
- 2. Baseline Hydrology for future full-developed conditions;
- 3. Master Plan Hydrology with future runoff reduction (to match undeveloped release rates).

Due to the vast size of the Oklahoma Basin, it was divided into 12 main contributing major drainageways. Major drainageways have been defined as natural runoff collection reaches that include more than 130 acres of contributing area. This study comprises major drainageways 700 and 800. Each major drainageway was further divided into smaller subbasins for hydrologic calculations.

Using the Colorado Urban Hydrograph Procedure (CUHP), runoff was calculated for the 2-year, 5-year, 10-year, 25-year, 50-year, and 100-year storm events in both existing conditions and future conditions. Results from this study were compared to peak flows documented in the *Town of Windsor Master Drainage Plan (2003)*: some 100-year results were higher and some lower, reflecting different land use assumptions.

The Environmental Protection Agency Storm Water Management Model (EPA SWMM) was used to combine and route hydrographs created from CUHP. Runoff peak flows and volumes for existing and future conditions were calculated. Routed results showed that future conditions peak flows will be significantly higher than existing conditions peak flows, which has the potential to cause hazardous flooding and major damage to structures. Field observations and survey indicated that existing culverts and channels along these drainageways are not capable of dealing with future conditions floods.

An alternative analysis with four broad alternatives was created by the Matrix team to provide recommendations that the City of Greeley could use in preparation for future development. The four alternatives are:

- 1. No Action: Showing what structures and reaches are likely to fail and which are likely to be stable without any capital improvements.
- 2. Detention: Showing the results of proposed regional detention basins to reduce runoff.
- 3. Channel improvements: Showing the results of proposed channel improvements to improve the stability of the reaches.
- 4. Low Impact Development: Showing the results of Low Impact Development (LID) to reduce runoff.

Various combinations of these broad alternatives were developed and tested for each major drainageway's unique needs. The options were scored in eight criteria: constructability, maintenance, meeting multiple

objectives, water quality, public safety, habitat and environment, aesthetics, and criteria compliance. In general, the alternatives that featured runoff reduction such as detention and LID scored higher than other alternatives in aggregate.

After evaluating the various alternatives, the City of Greeley selected Option 4: LID for all major drainageways within the Oklahoma Basin. Note that Option 4 focuses on green infrastructure but also includes detention and channel improvements to meet the study goals. This alternative was developed into the Conceptual Design/Master Plan improvements. Three main Goals were identified during the creation of the Master Plan:

Goal #1 – Implement LID effectively;

Goal #2 – Implement stormwater detention effectively;

Goal #3 – Implement channel improvements effectively.

For Goal #1, all new developments within the study area should implement LID practices that intercept and treat runoff from new impervious surfaces. Depending on the desired function, use, and aesthetics, multiple types of LID could be used. LID elements that are regionally accepted and recommended for use within the Oklahoma Basins are shown in the table below:

Lid Types					
Vegetated buffer	Green roof				
Vegetated swale	Green alley				
Curb cut / No-Curb	Permeable pavement				
Trench drain	Greenway corridor				
Bioretention - rain garden	Sand filter				
Bioretention - porous landscape design	n Tree filter				
Rain barrel	Retention ponds/constructed wetland ponds				

LIDs have minor impacts on peak flows during large storm events. For Goal #2, both regional flood detention facilities and sub-regional Excess Urban Runoff Volume (EURV) basins are proposed to reduce the peak flows and volumes for future land use conditions. Tables summarizing the required volume and surface areas of these ponds are shown below:

Flood Control Pond No.	Volume (ac-ft)	Area (ac)
D_FC_711	6.5	1.3
D_FC_823	20	5
D_FC_838	17.3	3.3
D_FC_842	2.4	0.6

EURV Basin No.	Volume (ac-ft)	Area (ac)
D_EURV_711	2.4	0.6
D_EURV_820	5.5	1.3
D_EURV_830	5.6	1.5
D_EURV_840	5.4	3.1
D_EURV_842	14.3	9.5
D_EURV_844	9.4	2.3



These detention facilities, together with distributed LID, reduce future peak flows and volumes across the watersheds to similar levels as pre-development conditions. A comparison of the 100-year peak flows at each major drainageway outfall is provided below:

Major Drainageway	Drainage Area (ac)	Nothing		Future Conditions Concept Design Q ₁₀₀	
700	90 160		172	110	
800	696	1,039	2,072	306	

For Goal #3, it is important to remember that channel improvements can range from small to large scale designs. Instead of focusing solely on the conveyance channel, proposed stream corridors must be designed to promote and incorporate natural system processes. The future major drainageways should feature multiple stages to serve multiple storm events, similar to existing natural channels. Major drainageway 800 was split up into three reaches. These reaches were 800, 829, and 843. Major drainageway 700 has a singular reach. Only two areas, one being the 700 outfall and the other being the channel upstream of the existing Southgate detention basin, require further channel improvements to become stable in the future.

Existing drainageway crossings occur at roadways and railroads. Each crossing location was examined, and culvert calculations performed to determine the existing performance. The concept culverts in the table below were sized to safely convey 100-year flows, but note that final designs should follow geomorphic practices where multiple barrels include floodplain relief culverts that are higher than the primary low-flow culvert:

Structure Number	Concept Design Q100 (cfs)	Structure Size/Type		
702	111	1-48" RCP		
704	170	2-48" RCP		
801	535	2-9'x4' CBC		
804	283	1-6'x5' CBC		
805	283	2-8'x3' CBC		
807	311	1-12'x4' CBC		
808	292	1-12'x4' CBC		
809	528	2-10'x4' CBC		

Estimated Master Plan costs were calculated using the MHFD UD-MP worksheets. These calculations reflect the expected costs for the City of Greeley, additional distributed costs such as LID are expected to be borne by developers or metro districts. Summaries of each major drainageway are provided below.

Major Drainageway 700 within the Oklahoma Basin only comprises one reach. While hydraulic analysis shows that the existing channel conditions are stable, channel improvements will be necessary with new development. There are two culverts that need improvements. The capital cost for the Master Plan improvements is estimated to be \$1,043,298 while the cost of maintenance and operation for 50 years is estimated to be \$198,750.

Major Drainageway 800 within the Oklahoma Basin comprises of three reaches. While hydraulic analysis shows that the existing channel conditions are mostly stable, channel improvements will be necessary with new development. There are six culverts that need improvements. The capital cost for the Master Plan improvements is estimated to be \$11,561,232 while the cost of maintenance and operation for 50 years is estimated to be \$1,454,950.

Total costs for the Oklahoma Basin are estimated to be \$14,876,170. Continuous maintenance of the proposed drainage infrastructure is required to protect the city and will ultimately result in reduced costs compared to major reconstruction efforts. Maintenance should be done regularly and on an as-needed basis, especially after significant flood events or growth of invasive species. See the summary table below for a breakdown of expected costs along each major drainageway:

Major Drainageway	Acquisition Capital Cost	Crossing Improvement Capital Cost	Channel Improvement Capital Cost	Regional Detention Capital Cost	Total Capital Cost ^a	50 Year O & M Cost	Total Cost ^b
700	\$14,596	\$66,000	\$34,047	\$494,988	\$1,043,298	\$198,750	\$1,242,048
800	\$119,017	\$1,762,349	\$4,759,500	\$4,759,500	\$11,561,232	\$1,454,950	\$13,016,182
Study Totals	\$133,613	\$1,828,349	\$4,793,547	\$5,254,488	\$12,604,530	\$1,653,700	\$14,258,230

a. Total capital cost also includes mobilization, stormwater management/erosion control, engineering, legal/administration, construction management, and contingency estimates.

To conclude, Matrix recommends the following general actions for the City of Greeley:

- 1. Prioritize Detention and LID (runoff reduction) improvements, as both will have significant impacts on downstream channel stability and flood risk, reducing the scope of required channel improvements. LID BMPs can serve double duty to reduce runoff and capture pollutants.
- 2. Widespread implementation of EURV basins will result in a system that mimics the flow duration and frequencies of an undeveloped natural system.
- 3. Design and construct geomorphically stable channels within the proposed stream management corridors. This can be achieved through multistage cross sections and appropriate channel profiles.

b.Total cost includes capital cost plus operations and maintenance cost over 50 years.



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Greeley

July 2024

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CHAPTER 1 - PRELIMINARIES

1.1 Authorization

Matrix Design Group, Inc. (Matrix) contracted with the City of Greeley (Greeley) to complete the Comprehensive Drainage Plan (CDP) for Oklahoma Basins 700 & 800. This project is solely sponsored by Greeley, but Matrix is a sub-consultant to Bolton & Menk. The Agreement for this CDP Oklahoma Basins 700 & 800 is Change Order #1 for the US 34 & WCR 17 Design (project 12658), executed on April 16, 2024.

1.2 Purpose and Scope

This study provides the framework for the Oklahoma Basins to:

- Protect water quality from degradation due to urbanization,
- Define and preserve floodplains from encroachment prior to development,
- Preserve natural channel function, character and habitat,
- Master plan and budget drainageway improvements, and
- Program regional detention facilities, with a preference for full-spectrum detention where possible.

This study applies updated mapping and land use projections, conducts field stream assessments, develops alternative drainageway planning concepts, and prepares a concept design of facilities for implementation.

The Oklahoma watershed is largely undeveloped at this time. The impact of future development on the watersheds without mitigation is expected to significantly increase the frequency and severity of stormwater runoff over existing levels. This increase in runoff will not only provide an increased threat of flooding and structural damages in the future, but also have significant negative impacts on water quality and stream stability. Alternatives have been developed to offset the impacts of future development by focusing on reducing flood magnitudes, increasing conveyance capacities, removing pollutants from the runoff, and stabilizing the stream against erosion.

This report is provided to update hydrologic information for existing and future conditions in the Oklahoma Basins 700 and 800 (hereinafter called the Study Area). The hydrologic information documented in this study can be used by Greeley as a guideline for future developments within the watersheds and provide the basis for agreements of controlled hydrology at jurisdictional boundaries.

Tasks to define existing and future drainage conditions hydrology, and evaluate proposed drainage improvement concepts include:

- 1. Meet regularly with the sponsors to obtain background information, present preliminary study findings, and discuss results of the planning tasks.
- 2. Contact agencies and/or individuals that have knowledge or specific interest in the study area.

- 3. Collect existing information, including previous Master Drainage Plans (MDPs) or site-specific drainage studies for proposed development.
- 4. Obtain GIS information from project sponsors, such as future land use mapping.
- 5. Inventory and compile information on the existing drainage system, including high-level geomorphic stream assessments.
- 6. Prepare hydrologic analyses for existing and future development watershed conditions. Determine subbasin boundaries and parameters in accordance with Greeley and Mile High Flood District (MHFD) criteria. Develop existing and future (fully developed) conditions hydrologic models using CUHP 2005, version 2.0.1 and EPA SWMM 5.2, version 5.2.4. Compile this information in an interim Baseline Hydrology Report for review by project sponsors.
- Conduct hydraulic analyses along the major drainageway to ascertain capacities of existing structures, determine location of flood hazards, and analyze hydraulic impacts of future peak discharges.
- 8. Develop drainageway improvement alternatives that address future drainage impacts.
- 9. Evaluate alternatives based on criteria, estimated construction costs, potential flood risk reduction, and planning constraints, and recommend alternatives for each reach of the drainageways. Compile this information in an interim Alternatives Analysis Report for review by project sponsors.
- 10. Sponsor acceptance of the selected alternative via a Selected Plan.
- 11. Prepare a Concept Design Report which further evaluates the feasibility of the selected improvements. Include detailed cost estimates of concept design improvements.

There is no existing regulatory floodplain within the Study Area. The major problems identified in the Oklahoma Basin are due to the expected significant increase in flows under future conditions without mitigation. Alternatives to protect the community include reducing the future flood hazard areas with a policy of floodplain protection and maintenance, flood insurance, structural drainage improvements or Low Impact Development practices to reduce flood magnitudes, and local protection measures.

1.3 Planning Process

A kickoff meeting with Greeley was held on January 31, 2024. Progress meetings were held once or twice per month (as needed) to update sponsors on the project status. Public workshops were not included for this study. Meeting minutes are included in Appendix A.

Updated hydrology documented in this report represents an updated analysis of the study area using the most current version of CUHP, and version 5.2 of EPA SWMM since the CUHP multiple runs functionality does not always work with the latest version of SWMM (5.2.4). The analysis examined existing, proposed, and planned developments in the study area.

The basin delineations were based upon 1-foot contour mapping. Subbasins were further subdivided to calculate peak flows at critical locations or if basins were larger than 130 acres which is the threshold for major drainage systems that has been established by MHFD through regional experience. Basins were modeled using a 2-hour rainfall storm, with no area corrections, per criteria.

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Two hydrologic models were produced for this study:

- 1. Baseline hydrology for existing conditions,
- 2. Baseline hydrology for future fully-developed conditions.

1.4 Mapping and Surveys

Mapping information for this project was provided by several agencies. Where multiple data sources existed, attempts were made to use the best available data. The following describes the various mapping components and their sources.

Topographic Contours

One-foot, LiDAR-derived topographic contour data collected, in the fall of 2018, was used to delineate drainage basin boundaries. The Colorado Water Conservation Board (CWCB), the Federal Emergency Management Agency (FEMA), and the United States Geological Survey (USGS) partnered to provide this data as part of the Colorado Hazard Mapping (CHAMP) program.

Aerial Photography

Color aerial ortho-photography from 2018 was available for the study area through Nearmap. The majority of the watershed was captured in half-foot pixel resolution.

Hydrologic Soil Groups

Soils information was obtained from the Natural Resources Conservation Service (NRCS) for the study area with an access date in February 2024.

Base Mapping

Base mapping information including street centerlines, storm drainage infrastructure, parcels, existing land use, zoning, and jurisdictional boundaries were provided by Greeley. Future land use was digitized from figures published in the *City of Greeley 2060 Comprehensive Plan* and *2016 Windsor Comprehensive Plan*. Section 2.3.3 of this report provides a more detailed discussion of existing land use data sources. Linear water features were obtained from the National Hydrography Dataset.

Coordinate System and Datum

All GIS mapping and data for this study were developed using the Colorado State Plane, North Zone coordinate system in U.S. feet. The horizontal datum is NAD83 HARN and the vertical datum is NAVD88.

Survey information

A detailed survey was not performed for this project. Measurements of existing roadway crossings were completed by Matrix in April 2024.

1.5 Acknowledgements

A Technical Advisory Committee (TAC) made up of the project sponsors provided guidance during the study process. The TAC met regularly during the course of the project study. Representatives who were directly involved with this study are listed below:

Table 1-1 Project Participants and Affiliations

Name	Representing	Role
Aaron Stines	City of Greeley	Project Manager
Karen Reynolds	City of Greeley	Stormwater Manager
Brian Hathaway	City of Greeley	Water Quality and Regulations Manager
Brian Fischer	City of Greeley	Oklahoma & South Basins PM
Drew Beck	Matrix Design Group	Officer in Charge
Ben Liu	Matrix Design Group	Project Manager
Andrew Greer	Matrix Design Group	Project Engineer
Sabastian Ortega	Matrix Design Group	Project Engineer
Ellie Garza	Matrix Design Group	Project Landscape Architect
Nastaran Khodaei	Matrix Design Group	GIS Analyst
Sarah Beckingham	Matrix Design Group	GIS Analyst
Chris Martin	Matrix Design Group	GIS Manager

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Comprehensive Drainage Plan Oklahoma Basins 700 & 800 Concept Design Report





CHAPTER 2 - THE WHY

2.1 Overview

2.1.1 Project Area

The total project area is 1.32 square miles and Figure 2-1 shows the project area, jurisdictional limits, and a vicinity map.

General topography of the watershed slopes from high ground in the south towards the Oklahoma mainstem drainageway in the north. The average slope is approximately 2 percent. The highest elevation of the Study Area is 5060 feet above sea level; and the lowest point is the Oklahoma Drainageway immediately upstream of the WCR 17 bridge at an elevation of 4816 feet above sea level.

Major drainageways have been defined as reaches that include more than 130 acres of contributing area. Figure 2-2 shows the study reaches of this study. Note that this study does not include analysis of the main Oklahoma Drainageway but does include two tributaries, identified as Major Drainageways 700 and 800.

2.1.2 History

The study area is partially undeveloped. The flatter upstream areas have historically been used for agriculture. North of US-34 there are a limited number of homesteads, one residential neighborhood, and immediately adjacent to US-34 are multiple large business/industrial parks. Drainageways have remained natural adjacent to undeveloped areas, with riparian wetlands forming large extents. We have not discovered a past history of channel instability or severe flooding.

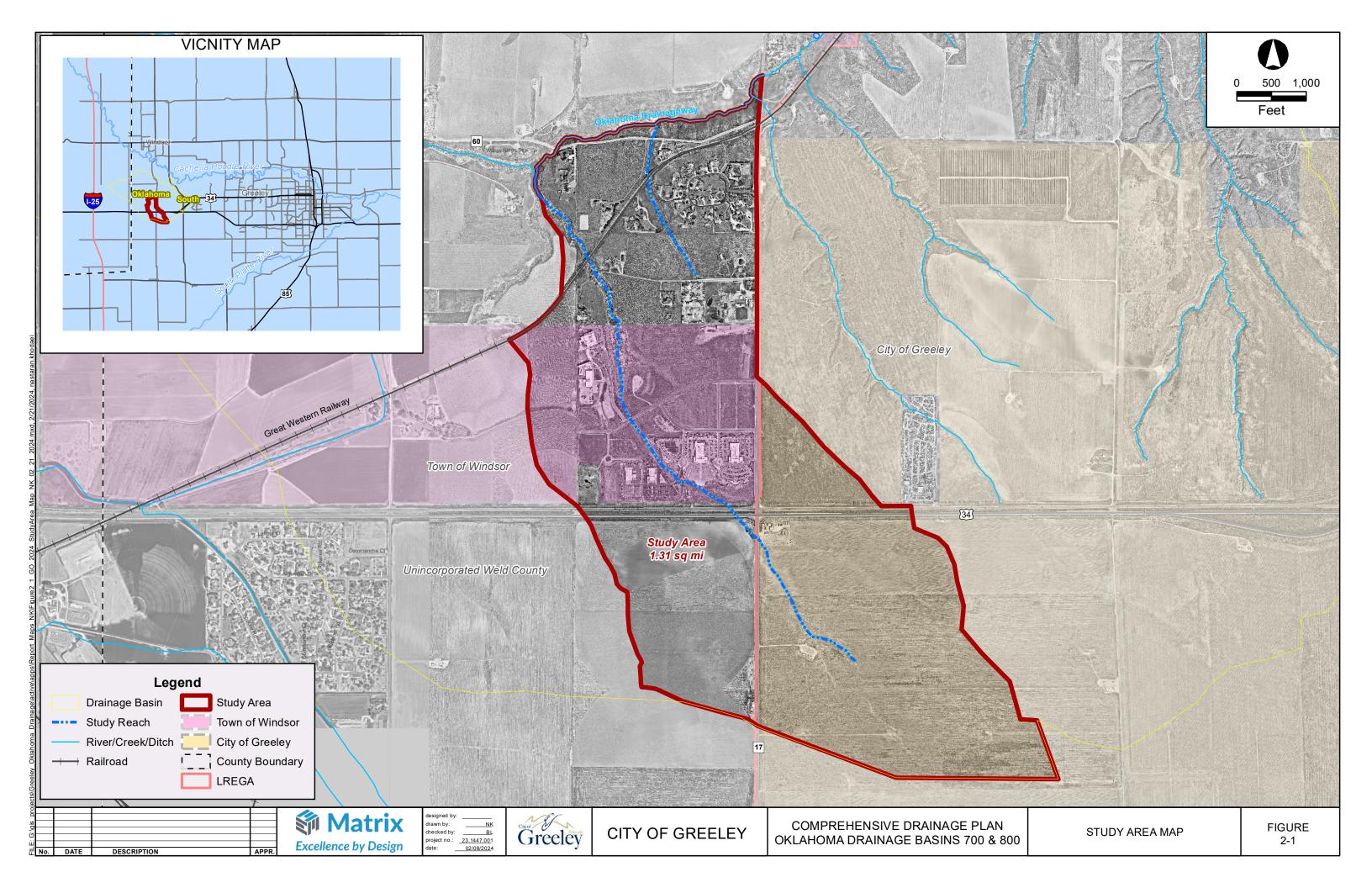
2.1.3 Relevant Information from Past Plans

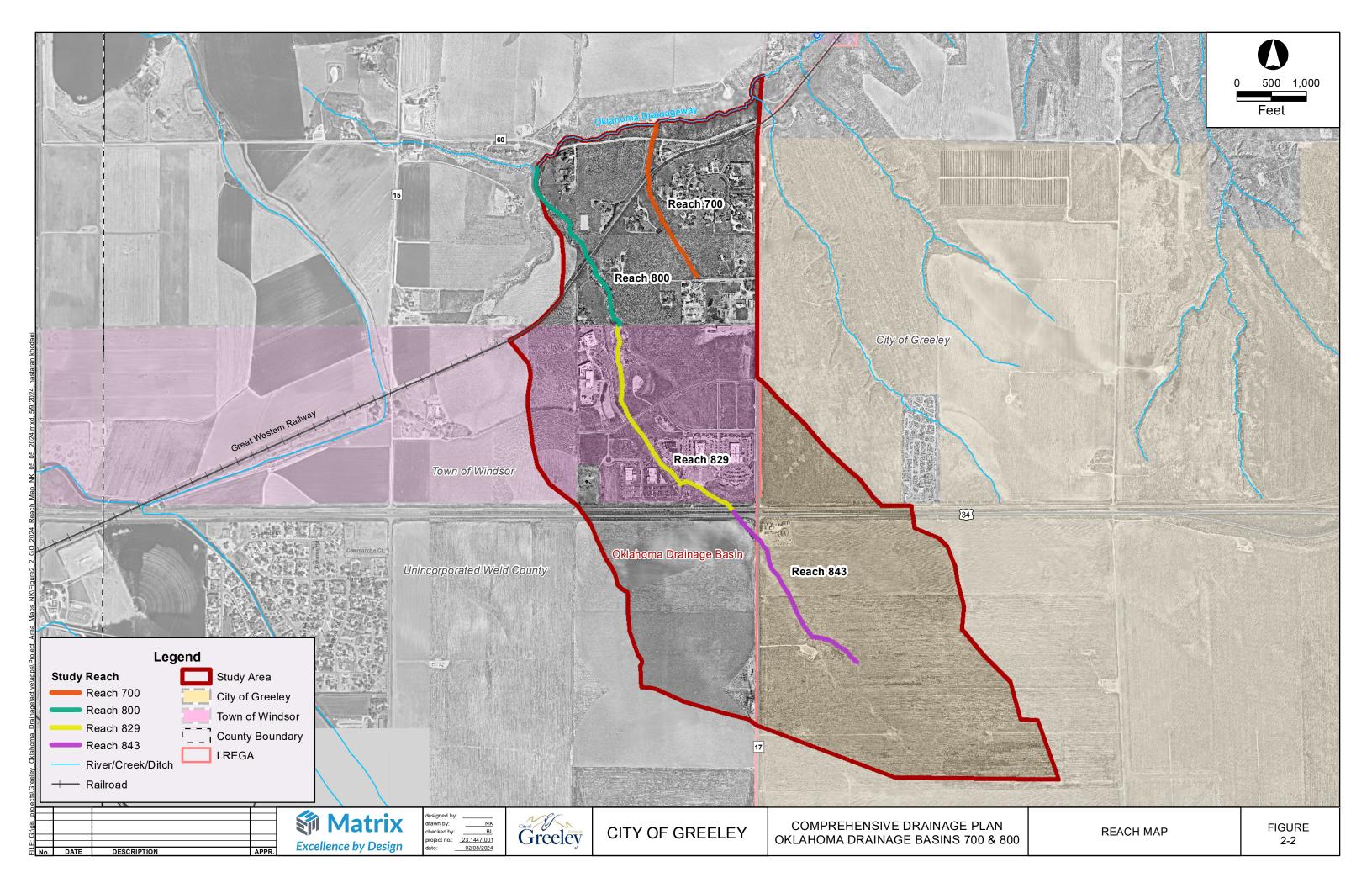
Both watersheds were previously included in the Town of Windsor's growth management boundary, and the *Town of Windsor Master Drainage Plan* was completed in 2003. That previous study was performed at a much larger scale than this current study, with subbasin areas exceeding 1000 acres in the hydrologic models. The recommended master plan improvements focused on improvements to crossing structures along the Oklahoma Drainageway at SH-257, the Great Western Railroad (GWR), and WCR-17. They also recommended formalizing a regional detention pond immediately west of WCR-17 along the main Oklahoma Drainageway.

2.2 Plan Horizon

This report follows the master plan developed and refined with the *Imagine Greeley process*. Future conditions for the hydrologic models reflect the anticipated land use shown in the *City of Greeley 2060 Comprehensive Plan*, which was adopted in 2018, and the *2016 Windsor Comprehensive Plan*, which represented a 20-year development road map.

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2.3 Existing Conditions

2.3.1 Reach Description

The study area includes two significant drainageways (700 and 800) that have been subdivided into four study reaches. Figure 2-2 shows these reaches and current jurisdictional limits. All study reaches except for 843 are outside the existing city limits and the Long Range Expected Growth Area (LREGA) of Greeley. All study reaches are in either a natural state or constructed open channel, and ephemeral with no base flows. Figure D-1 in Appendix D shows the potential wetlands and riparian zones within the study area. The following narrative provides a description of each drainageway.

Reach 700: Oklahoma Basin Primary Tributary

Reach 700 is the only defined reach for Major Drainageway 700, which is the first tributary west of WCR-17. It covers approximately 2,400 feet (Sta. 0+00 – 24+00), extending from the Oklahoma Drainageway south to Gratitude Lane. This drainageway is generally poorly defined, although the short section between WCR-60 and the Great Western Railway appears to feature a constructed ditch and small storage area as seen in Figure 2-3 and Figure 2-4. Immediately upstream of the Great Western Railway there is a small constructed embankment across the drainageway (Figure 2-4), and farther upstream a fenced off area covered in bushes and trees, seen in Figure 2-5.



Figure 2-3 Reach 700



Figure 2-4 Reach 700



Figure 2-5 Reach 700

Reach 800: Oklahoma Basin Primary Tributary

Major Drainageway 800, which is the second tributary west of WCR-17, contains three reaches. Reach 800 is the downstream-most reach, extending approximately 2,800 feet (Sta. 0+00 – 28+00) from the Oklahoma Drainageway south to the existing Town of Windsor boundary. The confluence of Reach 800 and the Oklahoma Drainageway is a constructed wet pond as seen in Figure 2-6. This pond also collects runoff from another tributary to the west. Large portions of Reach 800 are covered with wetland vegetation, seen in Figure 2-7. There is an existing stagnant pond/wetland



area immediately upstream of Gratitude Lane, shown in Figure 2-8. Nearby property owners mentioned that this used to be a more significant wet pond with clean (flowing) water.



Figure 2-6 Reach 800



Figure 2-7 Reach 800



Figure 2-8 Reach 800

Reach 829: Oklahoma Basin Primary Tributary

Reach 829 is the middle reach of Major Drainageway 800, comprising the portion within the existing Town of Windsor limits. Reach 829 extends approximately 3,500 feet (Sta. 28+00 – 63+00) from the Windsor boundary southeast to US-34. The downstream portion of Reach 829 is a large constructed detention basin for the Southgate development. As shown in Figure 2-9, this detention basin appears to have received a fair amount of sedimentation since construction and is currently full of reedy vegetation. Between the constructed detention basin and Southgate Drive, the existing drainageway does not appear to be stable, the channel profile and alignment appear to be changing due to erosive water forces as shown in Figure 2-10.

The section between Southgate Drive and the Kia access road features a small rectangular concrete low-flow channel and three drop structures that extend across the floodplain (Figure 2-11). This existing low-flow channel is overgrown and damaged. Upstream of the Kia access road, an existing 48-in RCP storm drain conveys smaller flows, with overflows traveling over the grassed surface. This 48-in RCP connects to another rectangular concrete low-flow channel, seen in Figure 2-12, that extends to US-34. Portions of this concrete are failing due to channel bed movement.





Figure 2-9 Reach 829



Figure 2-10 Reach 829



Figure 2-11 Reach 829



Figure 2-12 Reach 829

Reach 843: Oklahoma Basin Primary Tributary

Reach 843 is the upstream-most reach of Major Drainageway 800, extending approximately 2,900 feet (Sta. 63+00-92+00) from US-34 southeast to existing farming fields. Between the US-34 and WCR-17 culverts, the drainageway has a poorly defined earthen low-flow channel with large portions covered in vegetation, seen in Figure 2-13. Upstream of WCR-17, there is very little channel definition through the actively farmed fields.





Figure 2-13 Reach 843

2.3.2 Existing Crossings

Table 2-1 provides an inventory of the existing crossing structures, and Figure 2-14 shows the locations of the existing crossing structures.

2.3.3 Land Use

Existing vegetation within the study area is primarily grasses. The area north of US-34 contains both native grasses in undeveloped portions and lawn or landscaped grasses in the developed portions. The area south of US-34 contains agricultural crops. Existing land use within the study area is varied with rural, commercial, industrial, and residential uses throughout the study area, with the more intensive uses such as car dealerships, business parks, and college complexes located within the Town of Windsor portion. The paved thoroughfares of US-34 and WCR-17 pass through the study area. Existing land use was compiled in ArcGIS by combining parcel, roadway, and land use data obtained from Greeley with aerial imagery. Publicly owned land is shown in Figure 2-15.

2.3.4 Flood History

No stream gage information was found for the study area. Many portions of the Oklahoma Basin are undeveloped or historical farm uses, where infiltration is rapid, therefore past heavy rainfall has not caused major flood damages in recent history. As the watersheds develop further, future runoff will be significantly increased above past flood events if mitigation measures such as runoff reducing practices or regional detention are not implemented.

2.3.5 Environmental Assessment

The 2060 Comprehensive Plan included an environmental investigation to determine areas of ecological significance. No reach was identified as ecologically significant.

.4 Public Engagement

The technical team will reach out to stakeholders such as the Town of Windsor to obtain the best available data. Workshops with the general public are not included in this study, but multiple public engagement meetings and a public-facing website were created for the previously broader Oklahoma and South Basins study.

2.5 Future Trends

This study does not intend to update or change the general future trends documented in the *2060 Comprehensive Plan* and *2016 Windsor Comprehensive Plan*. Rather, the future trends identified in City of Greeley, Town of Windsor, and Weld County planning documents were used to inform the long-range storm drainage recommendations that are the focus of this study. Although the study watersheds are located approximately 10 miles west of the downtown core of Greeley, population growth has resulted in this area already facing development pressures. The US-34 corridor in particular is likely to be developed in the near to medium future.

Metropolitan districts are increasingly being established to finance and develop site infrastructure for large master-planned mixed-use communities in Colorado. These districts result in large scale changes to the watershed. The Town of Windsor has seen extensive development through metropolitan districts in recent years. Two existing metropolitan districts near the study area that were recently built or under construction are the Tri-Pointe/Promontory community immediately southeast of the study area (between US-34 Business and US-34) and the Water Valley community north of the study area (Town of Windsor). The Poudre Heights metropolitan district, located east of the study area, north of US-34 Business, is in the planning phases and was approved for rezone and preliminary planned unit development in April 2022.

2.5.1 Near-Term Developments

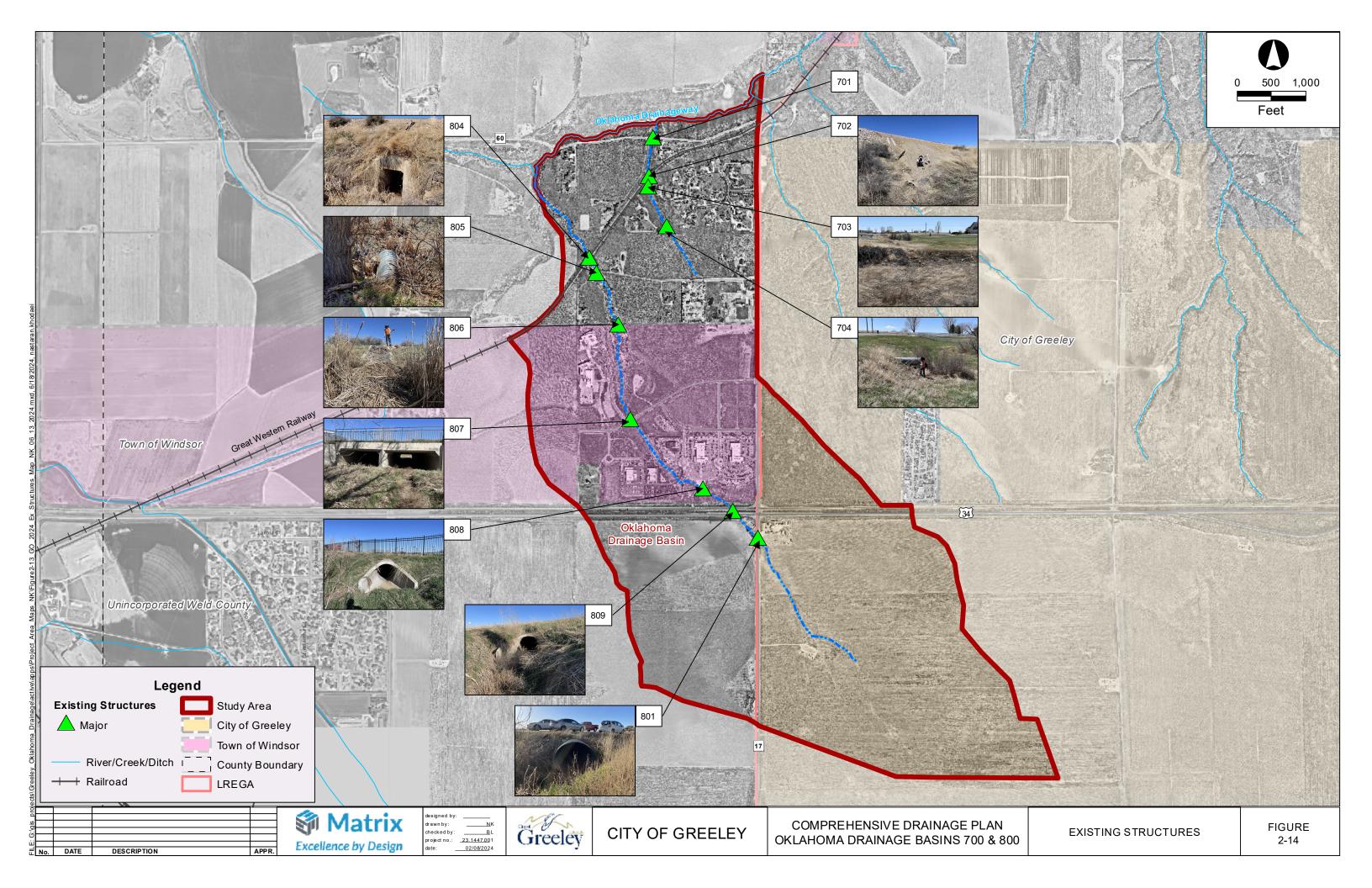
The Delantero project is an 822-acre proposed metropolitan district that is partially within the study area. Delantero is located south of US-34 between WCR-17 and SH-257 and includes 274 acres within the broader Oklahoma Basin. The other Delantero areas drain to the Sheep Draw and Big Thompson Basins. The *Conceptual Drainage Report for Delantero* (CWC Consulting Group, 2022) indicates that Delantero will be split into at least seven Planning Areas, with each Planning Area potentially constructed at a different time. It is expected to add thousands of housing units to the area along with more limited commercial and industrial developments.

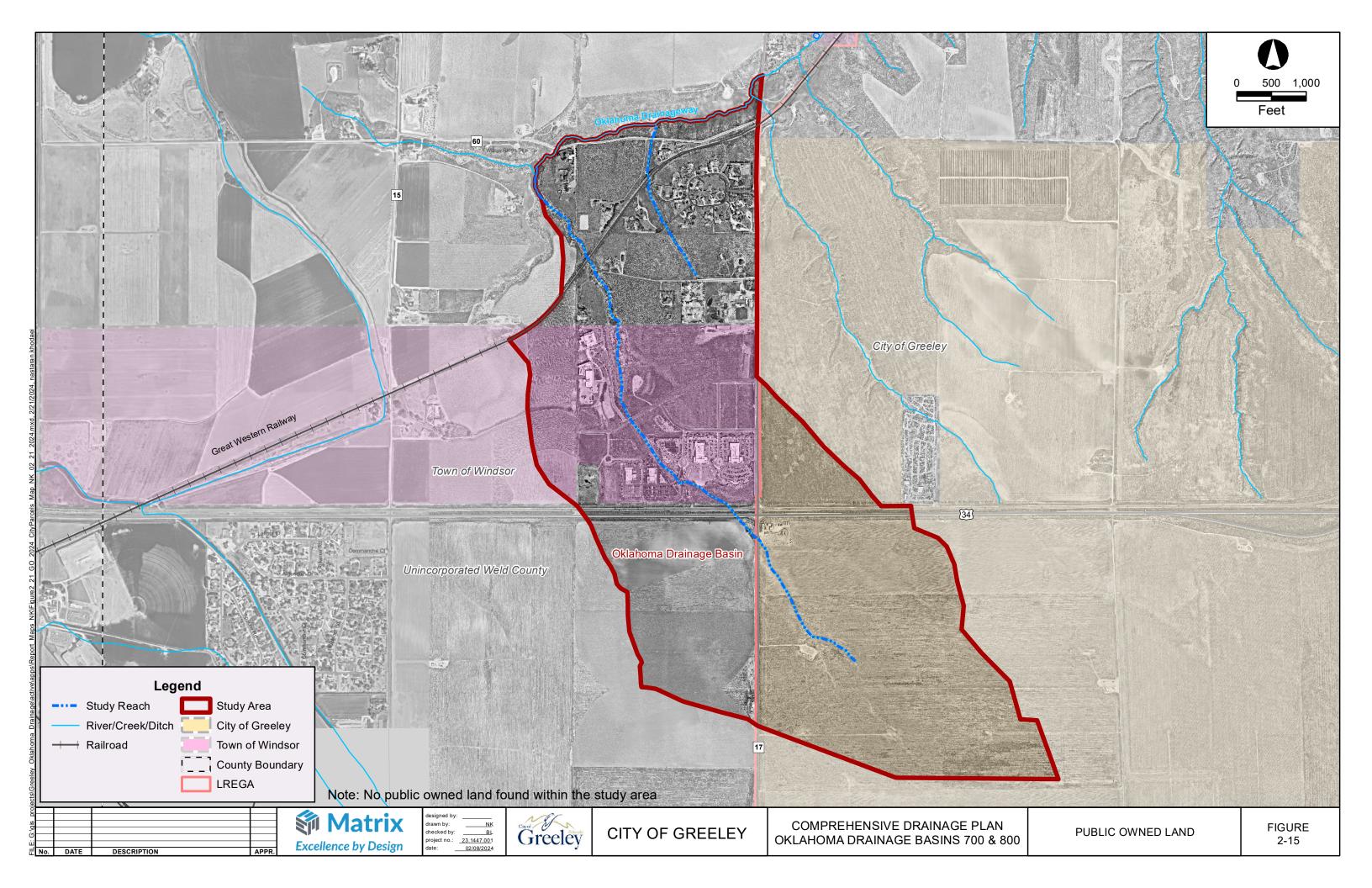
There is also an Uptown development project located immediately southeast of WCR-17 and US-34 (adjacent to Delantero). We do not have much information on this development yet.

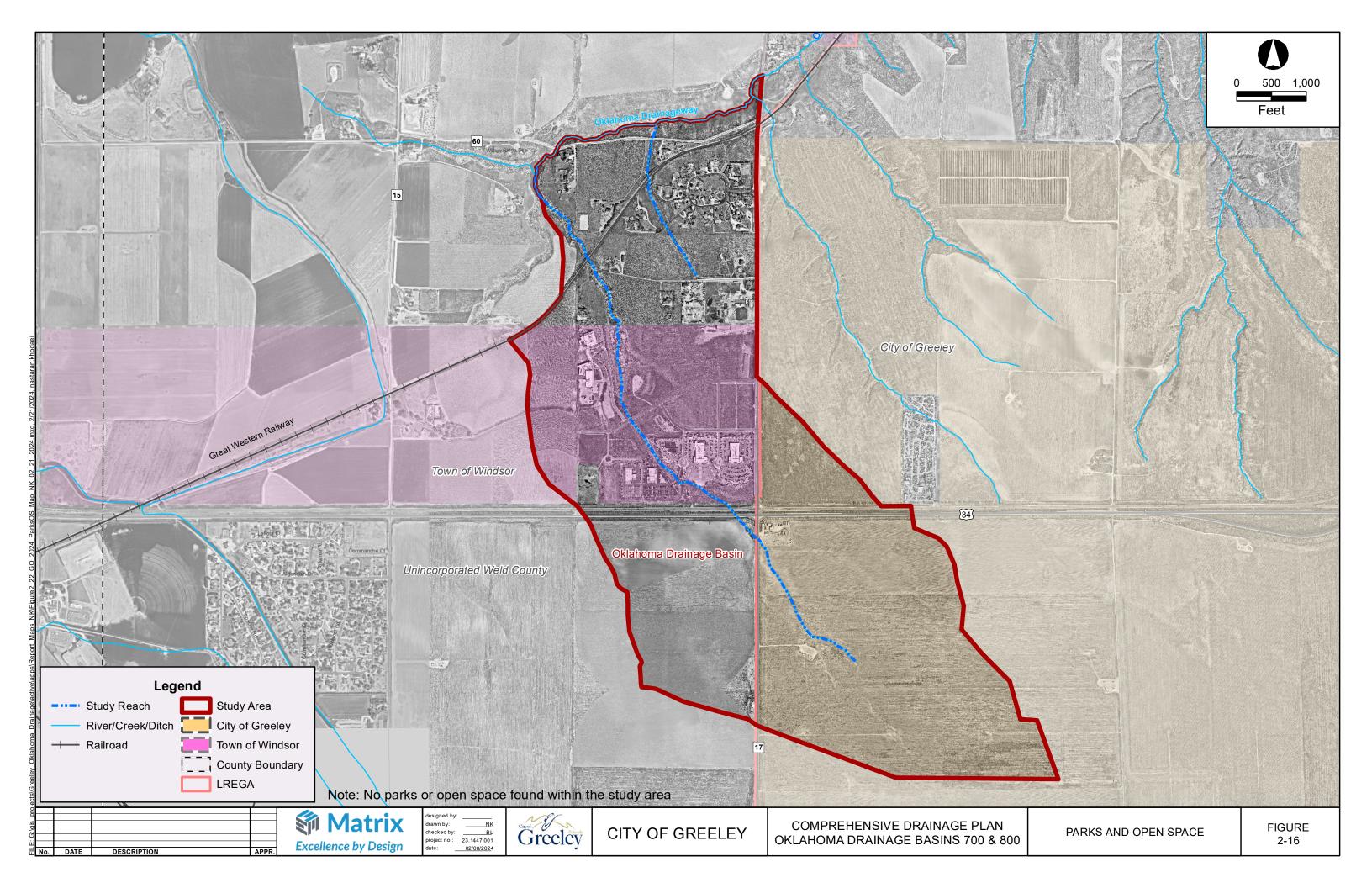


Table 2-1 Major Crossing Structure Inventory

Structure Number	Reach Number	Location	Crossing Type	Structure Description	Structure Station	Existing Structure Size/Type	Approximate Culvert Length (LF)	Future Storm Event Capacity	Existing Capacity (CFS)
702	700	Great Western Railway	Railroad	Culvert	8+00	1-24" CMP	97	10-Year	47
704	700	Windsong Rd	Roadway	Culvert	16+00	1-30" CMP	89	5-Year	37
801	843	CR-17	Roadway	Culvert	69+00	1-48" CMP	74	< 2-Year	138
804	800	Great Western Railway	Railroad	Culvert	17+00	1-5'x6.3' CBC	90	< 2-Year	98
805	800	Private Land	Dirt Road	Culvert	19+00	1 -24" CMP	62	< 2-Year	25
807	829	Southgate Dr	Roadway	Culvert	42+00	2- 12'x5' CBC	80	50-Year	1247
808	829	Private Land	Fencing	Culvert	58+00	1-48" RCP	527	< 2-Year	150
809	843	US-34	Roadway	Culvert	63+00	1-48" RCP	304	< 2-Year	176









CHAPTER 3 - THE WHAT

3.1 Hydrologic Analysis

3.1.1 Overview

The purpose of this study is to prepare a storm drainage master plan to identify major flood and drainage hazards and advise future development. The study area contains reaches of varying stability and existing culverts at roadways and railways.

3.1.2 Design Rainfall

The rainfall duration used with CUHP varies with the size of the watershed being analyzed. For watersheds 2 square miles or greater, there is an adjustment made to the incremental precipitation depths to consider the averaging effects of greater watershed size (area correction). For this study, the correction factors were not used. From the *USDCM*, Table 5-1: Storm Duration and Area Adjustment for CUHP modeling in the *USDCM* (reproduced below in Table 3-1) recommends a 2-hour storm duration for watershed area less than 15 square miles.

Table 3-1 Storm Duration and Area Adjustment for CUHP Modeling

Design Storm	Watershed Area (square miles)	Recommended Storm Duration	Apply DRF?
2-, 5-, and 10-	A ≤ 2.0	2 hours	No
2-, 3-, and 10- Year	2.0 < A < 15.0	2 hours	Yes – Use Table 5-3
i ear	A ≥ 15.0	6 hours	Yes – Use Table 5-3
25-, 50-, 100-,	A < 15.0	2 hours	No
and 500-Year	A ≥ 15.0	6 hours	Yes – Use Table 5-4

The Oklahoma Basins 700 and 800 are less than 15 square miles, so the recommended 2-hour duration design storm was used. To develop a 2-hour duration design storm, the first step is to determine the 1-hour and 6-hour point rainfall depths. The one-hour and six-hour rainfall depths (Table 3-2) were read from the *NOAA Atlas 14, Volume 8, Version 2* for the project location at Latitude 40.4181° and Longitude -104.889°.

Table 3-2 Point Rainfall Depths (inch)

	2-Year	5-Year	10-Year	25-Year	50-Year	100- Year	500- Year
1-Hour Point Rainfall	0.84	1.12	1.40	1.87	2.31	2.80	4.18
6-Hour Point Rainfall	1.28	1.67	2.08	2.78	3.41	4.13	6.19

Note the exact precipitation values used for the *Town of Windsor Master Drainage Plan* were not specified for comparison, but that report stated that NOAA Atlas Volume III (1973) values were used. Inspection of the Rainfall Intensity-Duration Curves presented in the *Town of Windsor Storm Drainage Design Criteria* (2020) suggests that the NOAA Atlas Volume III 100-Year, 1-Hour Rainfall was 2.58-inches.

To create a design hyetograph, the 1-hour rainfall depths were converted into 2-hour design storms by multiplying the 1-hour precipitation depths by the temporal distribution shown in the *USDCM*, Table 5-2 (reproduced below as Table 3-3). These recommended storm distributions take into account the "leading intensity" nature of storms in the Front Range and are intended for use with CUHP. The rainfall distributions used for each storm event are included as Table B-1 in Appendix B.

Table 3-3 Design Storm Distributions of 1-hour Rainfall

	l able 3-3	Design Otom	Distribution	is of 1-flour Kaiffi	an
Time		Percent of	f 1-hour precip	itation depth (%)	
Minutes	2-Year	5-Year	10-Year	25- and 50-Year	100- and 500-Year
5	2.0	2.0	2.0	1.3	1.0
10	4.0	3.7	3.7	3.5	3.0
15	8.4	8.7	8.2	5.0	4.6
20	16.0	15.3	15.0	8.0	8.0
25	25.0	25.0	25.0	15.0	14.0
30	14.0	13.0	12.0	25.0	25.0
35	6.3	5.8	5.6	12.0	14.0
40	5.0	4.4	4.3	8.0	8.0
45	3.0	3.6	3.8	5.0	6.2
50	3.0	3.6	3.2	5.0	5.0
55	3.0	3.0	3.2	3.2	4.0
60	3.0	3.0	3.2	3.2	4.0
65	3.0	3.0	3.2	3.2	4.0
70	2.0	3.0	3.2	2.4	2.0
75	2.0	2.5	3.2	2.4	2.0
80	2.0	2.2	2.5	1.8	1.2
85	2.0	2.2	1.9	1.8	1.2
90	2.0	2.2	1.9	1.4	1.2
95	2.0	2.2	1.9	1.4	1.2
100	2.0	1.5	1.9	1.4	1.2
105	2.0	1.5	1.9	1.4	1.2
110	2.0	1.5	1.9	1.4	1.2
115	1.0	1.5	1.7	1.4	1.2
120	1.0	1.3	1.3	1.4	1.2
Totals	115.7%	115.7%	115.7%	115.6%	115.6%

3.1.3 Basin Delineations

Subbasins were defined using the digital one-foot contour mapping provided for the project. Major basin and subbasin boundaries were established based on topographic and physical drainage boundaries, such as major roadways (e.g., US-34) and railroad. The main Oklahoma Drainageway serves as the downstream boundary for subbasins within the Oklahoma Basin. Watershed boundaries will be verified with upcoming fieldwork.

Major basins were generally divided into subbasins with a target area of approximately 100 acres. Larger subbasins were kept in some cases, particularly in undeveloped areas, but subbasin sizes were not allowed to exceed 130 acres. Smaller subbasins were often necessary to evaluate more complicated drainage conditions where existing embankments or tributary confluences were located. Figure B-1 in Appendix B shows the subbasin delineations for the study area, and Table 3-4 presents a summary of the subbasin characteristics.



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Table 3-4	Subbasin	Gilarac	LELISLICS

	Total	Sub	Number of		
Watershed	Area (mi²)	Average	Minimum	Maximum	Subbasins
Oklahoma	1.32	70	22	127	12

A summary of the CUHP 2005 model input parameters can be found in Appendix B, existing conditions in Table B-2 and future conditions in Table B-4. One-foot contour mapping was used to determine the existing conditions flow path lengths and distance to centroid values.

3.1.4 Basin Imperviousness

A GIS-based approach was used to calculate the composite percent imperviousness within the watershed based on existing and future land use information. The land use data described in the previous sections was used in conjunction with Table 6-3 in the USDCM, to create percent impervious values for each land use type. Table 3-5 lists each land use type and the associated percent impervious values used in the analysis, and Figure 3-1 shows the limited existing impervious surfaces within the study area. GIS data representing existing and future land use was intersected with subbasin polygons to calculate area-weighted, or composite, percent impervious values for each subbasin. Percent impervious values for existing and future conditions are shown in Figure B-1 of Appendix B.

Table 3-5 Future Land Use Impervious Summary

Table 3-3	i didie Land Ose imperi	1000 00	Timilar y	
Land Use Description	MHFD Land Use	% Imp*	Percent of Existing Area (%)	Percent of Future Area (%)
Employment Uses, Business Parks	Business: Suburban Areas	75	10.5	62.2
Land Suitable for Future Development, Residential Low Density	Residential Lot, Single- family: 2.5 acres or larger	12	4.5	9.1
Land Suitable for Future Development, Residential Medium Density	Residential Lot, Single- family: 0.75 - 2.5 acres	20	6.3	6.3
Land Suitable for Future Development, Residential High Density	Residential Lot, Single-family: 0.25 acres or less	45	ı	8.8
Industrial Uses, Light Industrial Parks	Industrial: Light Areas	80	2.7	2.7
Open Space, Moderately Sensitive Ecologically Significant Land	Undeveloped Areas	2	72.0	6.9
Pavement	Paved Streets	100	3.3	3.3
Gravel Road or Lot	Gravel (Packed) Streets	40	0.7	0.7

*Percent imperviousness were determined from MHFD USDCM Table 6-

Depression losses/retention storage were determined using Table 6-6 in the *USDCM* (reproduced below as Table 3-6). An impervious depression loss of 0.1-inches was used for all subbasin in both the existing and future conditions. The pervious depression loss of 0.35-inches was used for future subbasins that are shown as developed in future land use, and a pervious depression loss of 0.4-inches was used for future subbasins that are planned to be kept as open space and existing undeveloped areas.

Table 3-6 Typical Depression Losses for Various Land Covers (All values in inches for use with the CUHP.)

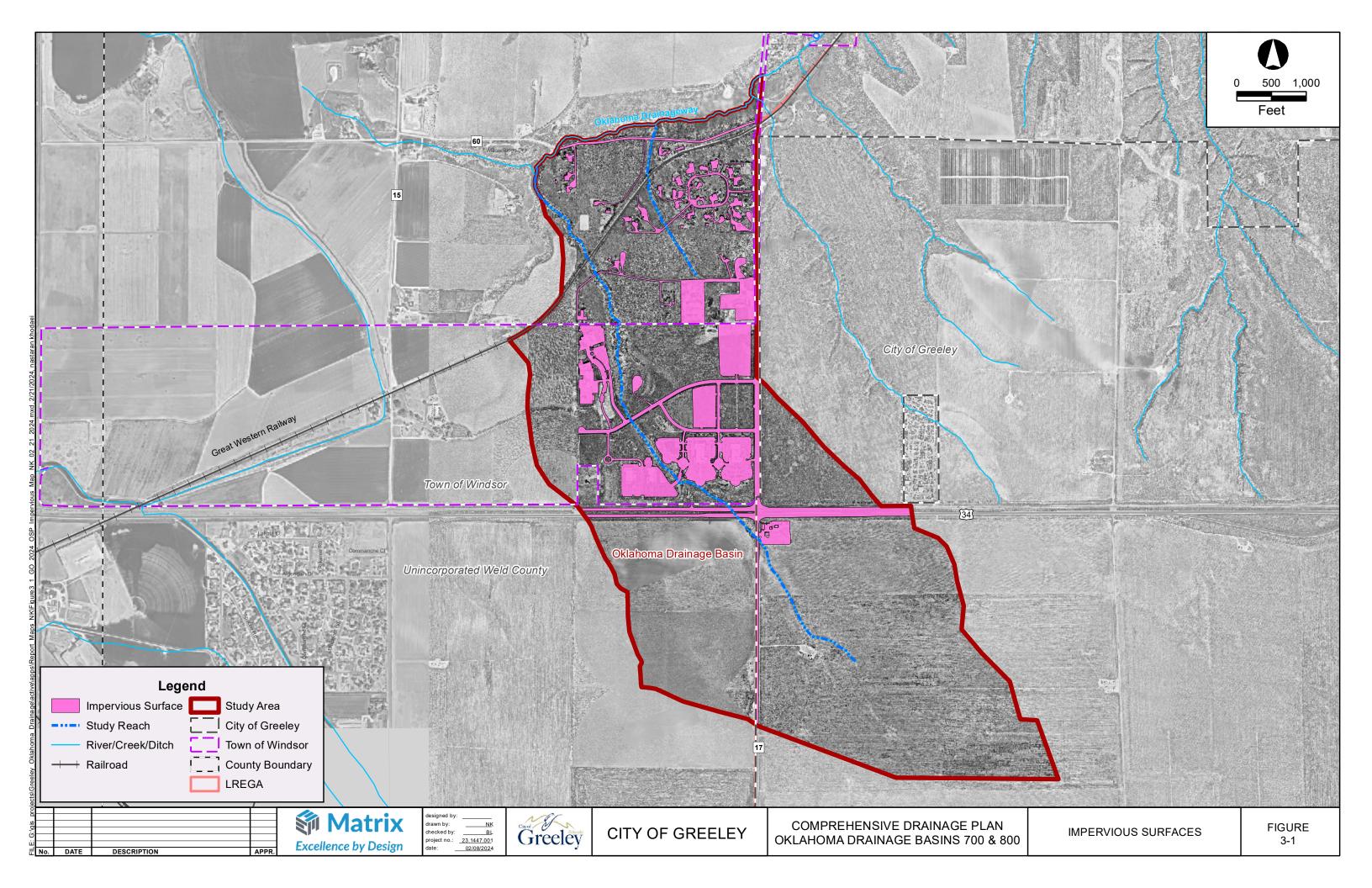
Land Cover	Range in Depression (Retention) Losses	Recommended
Impervious:		
Large paved areas	0.05 - 0.15	0.1
Roofs-flat	0.1 - 0.3	0.1
Roofs-sloped	0.05 - 0.1	0.05
Pervious:		
Lawn grass	0.2 - 0.5	0.35
Wooded areas and open fields	0.2 - 0.6	0.4

The soils in the watershed consist primarily of all four hydrologic soils group (HSG) classifications, with HSG C comprising the largest area, as defined by the NRCS. Figure B-1 in Appendix B shows the HSG distribution. HSG-A soils are generally characterized by the highest infiltration rates and HSG-D soils characterized by the lowest infiltration rates. Table 3-7 shows the HSG distribution by area within the study area.

Table 3-7 Hydrologic Soil Group Distribution

Study Area Basins Only											
HSG A B C D											
Infiltration Rate	High	Moderate	Low	Very Low	Total						
Area (acre)	223	272	335	12	842						
% Area	27	32	40	1	100						

Initial and final infiltration rates and Horton's decay rate were determined using Table 6-7 in the *USDCM*. For HSG-A soils, the initial infiltration rate was 5.0 inches per hour, the final infiltration rate was 1.0 inches per hour, and the decay coefficient was 0.0007. For HSG-B soils, the initial infiltration rate was 4.5 inches per hour, the final infiltration rate was 0.6 inches per hour, and the decay coefficient was 0.0018. For HSG-C and HSG-D soils, the initial infiltration rate was 3.0 inches per hour, the final infiltration rate was 0.5 inches per hour, and the decay coefficient was 0.0018. The most conservative (slowest to infiltrate) HSG classification within each subbasin was used to determine the infiltration and decay rates used in the CUHP models.





3.1.5 Detention

No detention areas were modeled for the Baseline Hydrology, following a policy to recognize only regional, publicly-owned facilities that have assurances that they will be maintained as designed. No such facilities exist within the existing watersheds, although the Southgate detention basin in Reach 829 may have been intended to provide regional detention. Inadvertent detention behind roadway embankments and in low depression areas occurs at several locations within the study area, but future development may eliminate these by adding culverts and increasing capacity under the highways or railways; therefore, this detention caused by undersized culverts was not included in the models.

3.1.6 Hydrograph Routing

The Manning's roughness values were determined based on the 2018 aerial imagery and supplemented by field observation. Table 3-8 shows the general rule-of-thumb for Manning's n values used for hydrograph routing (different from roughness values used for hydraulic analyses).

Table 3-8 Manning's Roughness Coefficients for SWMM

Routing Element Description	Original 'n'	Increase 'n' by 25%*
Reinforced Concrete Pipe	0.013	0.016
Asphalt Pavement	0.016	0.020
Engineered Channel, Ditch	0.035	0.044
Natural Drainageway with No Brush	0.035	0.044
Natural Drainageway with Brush	0.044 - 0.052	0.055 - 0.065
Natural Drainageway with Trees	0.060	0.075

^{*} As recommended in USDCM Chapter 6 Section 4.2

Hydrographs from individual subbasins were routed through the drainageway system using the EPA SWMM 5.2 computer model. The drainage system was modeled using a system of channels, junction points, and direct flow elements. The conveyance element input parameters include length, slope, roughness coefficient, and cross-section geometry. The EPA SWMM input parameters are included as Table B-8 of Appendix B. A schematic of the EPA SWMM model elements, including subbasins, design points and conveyance elements is shown in Figure B-1 of Appendix B.

Existing channel elements were determined from the digital project mapping. Length, change in elevation, and cross-section shape were estimated from the one-foot interval topographic mapping and aerial imagery for each routing reach. The study area reaches were generally modeled as trapezoidal or triangular open channels. Future channel geometries are not yet known, so the existing reach geometry was also used for the future conditions routing model.

3.1.7 Previous Studies

A direct comparison of the runoff calculated from this CDP with the runoff from the *Town of Windsor Master Drainage Plan* was performed at several key points within the same tributary areas, and the results are summarized in Table 3-9. As seen from the table, the 100-year flow rates predicted by the current model are lower than the flow rates documented in the *Town of Windsor Master Drainage Plan* (2003) for existing conditions and higher for future conditions. This is because of differences in the land uses for the existing and future conditions models, subbasin delineations, and detention routing. Some more detailed observations of the comparison are listed below.

- This study used the Greeley 2060 Comprehensive Plan and 2016 Windsor Comprehensive Plan for future land uses and impervious areas.
- The major basins in this study do not exactly match the major basin delineations in the *Town*of Windsor Master Drainage Plan. The 2003 Windsor MDP was focused on the developing
 peak flows only for the mainline tributaries, so their SWMM model does not include routing
 elements within our study area.
- This study divides the major basins into many more, much smaller subbasins than the *Town* of *Windsor Master Drainage Plan*. As noted in Chapter 6 Section 4.2 of the *USDSM*, discretization of large catchments into smaller ones often results in increased unit discharges.
- The decreases in peak flows are most likely due to the 2003 Windsor MDP accounting for both inadvertent and proposed detention in their hydrologic models. As explained in Section 3.1.5, this study does not include detention.

3.1.8 Results of Analysis

The CUHP and SWMM models were run for the 2-, 5-, 10-, 25-, 50-, and 100-year storm events under existing conditions and future conditions, resulting in 12 hydrology scenarios. The computed baseline peak discharges and volumes for all of the EPA SWMM design points can be found in Tables B-6 and B-7 of Appendix B. Summaries of peak flow rates and runoff volumes at key design points are provided below in Table 3-10 and Table 3-11. Figure B-2 in Appendix B shows hydrographs generated by EPA SWMM 5.2 for the 10-year and 100-year storms for existing and future conditions at the outfall of each study reach. A sample SWMM output report (from the 100-year future conditions storm event) is included in Appendix B as Table B-9.



Table 3-9 Previous Studies Hydrology Comparison

		2003 Wi	ndsor	This S	tudy	Existi	ng Conditi	ons Q ₁₀₀	Proposed Conditions Q ₁₀₀			
Basin	Location	SWMM Element	Area (ac)	SWMM Element	Area (ac)	2003 Windsor (cfs)	This Study (cfs)	Increase / (Decrease) (%)	2003 Windsor (cfs)	This Study (cfs)	Increase / (Decrease) (%)	
Oklahoma	Study Outfalls into Mainstem Drainageway	0808	1,402	O_620, O_712, O_714, O_803	842	1,695	1,362	(20)	1,692	2,445	44	

Note Windsor future peak flows represent a detained release

Table 3-10 Peak Flows at Key Locations

Locations ¹	Design Points /	Total Drainage Area		Station ²	ion ² Existing Conditions Peak Flows (cfs)						Future Conditions Peak Flow (cfs)						
	Conveyance Elements	(acres)	(mi²)	(ft)	\mathbf{Q}_2	\mathbf{Q}_5	Q ₁₀	Q ₂₅	Q 50	Q ₁₀₀	Q_2	Q ₅	Q ₁₀	Q ₂₅	\mathbf{Q}_{50}	Q ₁₀₀	
Reach 700 Outfall at Oklahoma Mainstem	O_708	90	0.14	0+00	13	24	42	85	118	160	15	28	47	93	128	172	
Reach 800 Outfall at Oklahoma Mainstem	O_803	696	1.09	0+00	63	108	192	494	722	1,039	348	515	709	1,203	1,591	2,072	
Reach 800 Culvert at US-34	809	401	0.63	63+00	7	34	96	275	407	578	252	362	485	782	1,018	1,300	

¹ Direct flow areas 620 and 714 not included in reach summaries

 Table 3-11
 Runoff Volume at Key Locations

Locations ¹	Design Points /	Total Drainage Area		Station ²	Station ² Existing Conditions Runoff Volume (ac-ft)						Future Conditions Runoff Volume (ac-ft)					
Locations-	Conveyance Elements	(acres)	(mi²)	(ft)	V ₂	V ₅	V ₁₀	V ₂₅	V ₅₀	V ₁₀₀	V ₂	V ₅	V ₁₀	V ₂₅	V ₅₀	V ₁₀₀
Reach 700 Outfall at Oklahoma Mainstem	O_708	90	0.14	0+00	1.4	2.6	4.4	8.3	11.6	15.8	1.6	2.8	4.6	8.5	11.9	16.1
Reach 800 Outfall at Oklahoma Mainstem	O_803	696	1.09	0+00	6.7	13.1	25.1	54.6	79.5	111.7	30.7	43.9	59.2	88.1	114.5	145.8
Reach 800 Culvert at US-34	809	401	0.63	63+00	0.8	3.4	9.9	27.3	41.4	60.5	18.7	26.6	35.9	52.8	68.4	86.5

¹ Direct flow areas 620 and 714 not included in reach summaries



3.2 Hydraulic Analysis

3.2.1 Evaluation of Existing Facilities

There are 9 existing culvert crossings located within the study area. Refer to Figure 2-14 for the locations of existing crossing structures. Culvert sizes and material were observed during the Matrix field visit on March 12, 2024. One goal of the hydraulic analysis was to determine the capacity of these structures and identify structures that are undersized and will need to be replaced to safely convey the 100-year future flows. For this analysis it was assumed that any overtopping was unacceptable and proposed crossing sizes pass future flows without overtopping the embankment. None of the existing crossings has a 100-year capacity. Table 2-1 summarizes the existing capacities, and Table 3-19 shows the proposed culvert improvements for the study area.

HY-8 version 7.80.2 software was used to evaluate the hydraulic capacity of crossings within the study reach. Survey data was collected for each crossing and used for the elevation inputs and crossing length inputs. LiDAR data was used to approximate the channel cross section geometry and embankment profiles. Proposed culvert improvements were assumed to have the same invert elevations and length as existing structures for the purposes of this capacity analysis. Table 3-12 shows a summary of Manning's n used in the model based on the culvert material. It should be noted that the manning's n values used in the HY-8 models are different compared to the SWMM models as the HY-8 models are being used for a culvert analysis while the SWMM models are being used for a runoff analysis. Detailed HY-8 inputs and outputs for existing crossing structures can be found in Appendix C.

Table 3-12 Manning's n-Values

Culvert Material	Manning's n
Reinforced Concrete Pipe (RCP)	0.011-0.012
Corrugated Steel (CMP)	0.024
Concrete Box Culvert	0.013
Polyvinyl Chloride (PVC)	0.013

Crossing 804 is a unique structure as its inlet is a concrete box culvert with its outlet becoming a wooden box culvert. There are also two restrictor plates inside of the structure shortening the opening. To simulate this, an embankment depth of 60 inches was placed into the crossing model. Crossing 701 while noted, was excluded from the study due to its inlet possibly being located inside of a pond. This could not be confirmed due to the pond being located inside private property.

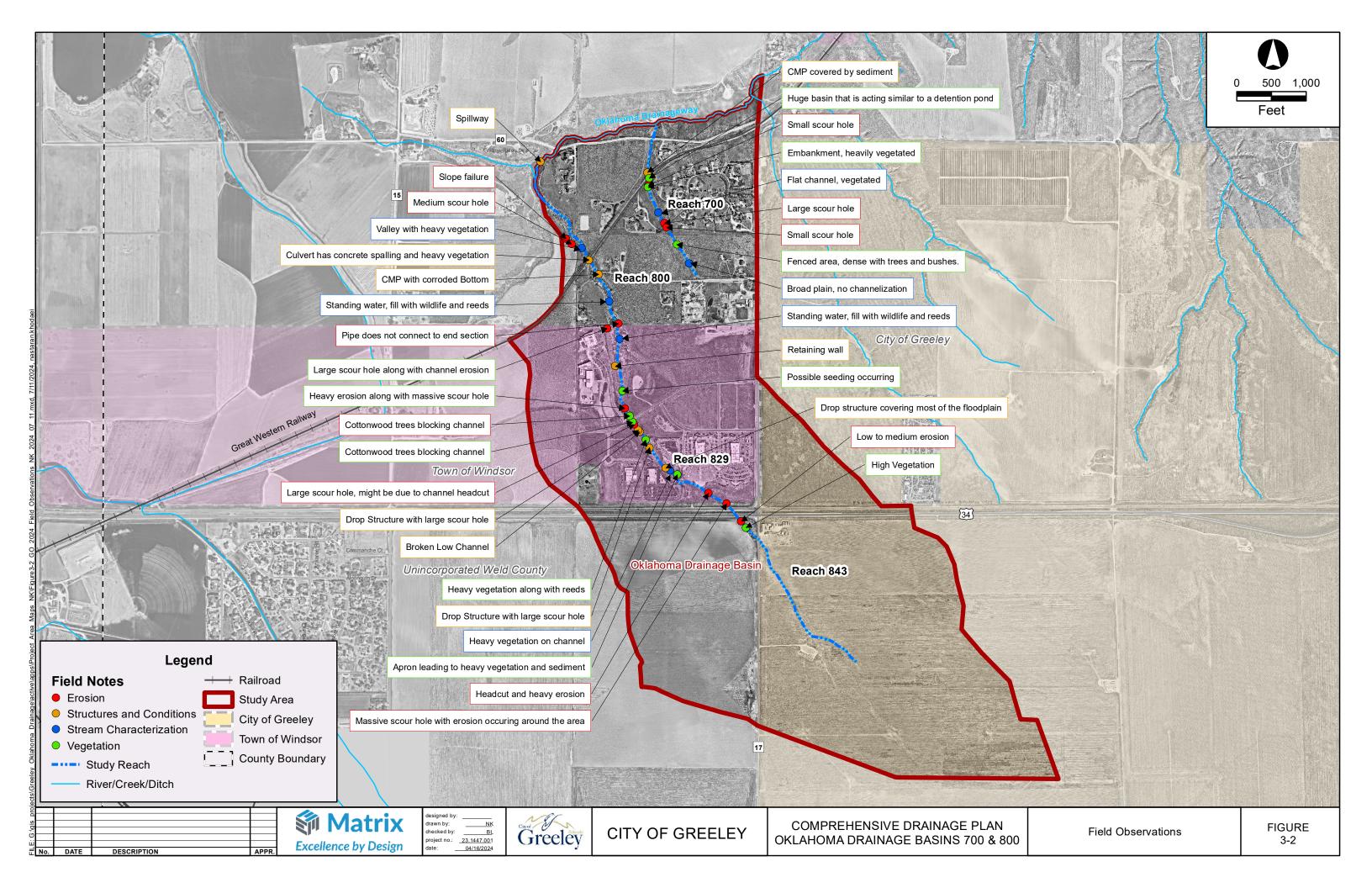
Structure 806 and 703 were not included in the report. Structure 806 was deemed an outlet structure for the existing Southgate detention basin and Structure 703 was located at the end of a small embankment. Due to these situations, it was decided to not design 100-year pipe conveyance for either pipe.

3.2.2 Flood Hazards

There are no existing mapped floodplain hazards within the study area. This study did not include detailed river hydraulics or flood mapping. Figure 3-2 presents the observations made during field assessments. Observations were grouped into four categories: erosion, structures and conditions, stream characterization and vegetation. Detailed geomorphic analyses were not performed as part of this study, but the general health and shape of existing flood valleys were noted.

3.2.3 Previous Analyses

No previous hydraulic analyses of the study reaches were identified.





3.3 Alternatives Analysis

3.3.1 Action Plan

Alternative Development Process

Alternative options were selected based on applicability, effectiveness, and ease of implementation. Matrix evaluated four broad classes of alternatives for every reach in the study area.

The first alternative considered was a 'no action' option. This alternative is useful for identifying existing reaches that may be stable under future flows and provides a baseline to compare other alternatives against.

The second alternative considered was detention because it can be scaled up or down based on watershed needs. Detention basins are effective at reducing the peak flows on receiving channels and can reduce or eliminate the need for channel improvements and stabilization in receiving channels. Detention basins can also provide water quality treatment to reduce pollutants that reach the Cache la Poudre River. Potential drawbacks of detention basins are the large footprint and maintenance requirements, but advanced planning and budget prioritization can minimize these concerns.

The third option considered was channel improvements. Channel improvements were defined as establishing channel geometry that can convey the 100-year event in a non-erosive manner. Channel improvements are useful for addressing reach instability at either a reach or watershed level. Channel improvements also provide the opportunity to make stream corridors into a community asset by building trail networks, parks, and open spaces.

The fourth alternative considered was implementing low impact development (LID) practices within the study area. LID, also known as green infrastructure, encompasses a wide suite of practices including bioretention/rain gardens, vegetated/green rooftops, rain barrels, permeable pavement, grass swales, and vegetated buffers. This planning study focused on vegetated buffers, which are gently sloping, grass or other dense vegetation strategically placed to break up impervious areas. Disconnecting paved areas slows runoff and increases infiltration, filters out sediment and pollutants, and reduces peak flows. Incorporating LIDs on developed land can reduce the need for structural improvements such as detention and large flood channels.

Various combinations of the alternatives presented above were evaluated in this analysis. The methods and results are discussed below.

3.3.2 Policy Recommendations

Implementing a comprehensive drainage plan along each major drainageway is necessary to achieve the sponsor goals. Isolated proposed improvements described in this study should not be constructed without considering the performance of the entire drainageway. For example, if a particular channel improvement is located downstream of a reach with recommended regional detention, the upstream detention must be in operation, or the downstream channel will be undersized.

Multiple alternatives are presented in this report, and an alternatives evaluation matrix was used to compare the benefits and drawbacks of each alternative for each reach. The highest scoring alternatives become the recommended alternatives for long-range implementation.

3.3.3 Alternatives Criteria

Major drainageways 700 and 800 were evaluated comprehensively so that the effects of upstream alternatives on downstream reaches could be determined. Combinations of the alternatives were formed into four Options. Option 1 considered only the do nothing alternative for each reach within a drainageway. Option 2 included detention and if necessary, channel improvements. Option 3 considered only using channel improvements to address reach stability. Lastly, Option 4 assumed watershed-wide LID implementation, then included detention and channel improvements as necessary. The assumptions and criteria used for each alternative category are discussed below.

Do Nothing

This alternative evaluated channel stability with future hydrology if no action is taken.

Detention

Regional in-line, full spectrum extended detention basins were assumed for this analysis. Full spectrum detention (FSD) refers to a design process that seeks to control both the 100-year flood and smaller, more frequent storm events. FSD basins typically feature multistage outlet works to achieve multiple goals. Proposed detention basins were designed to reduce the future peak flow to match the existing peak flow.

Channel Improvements

Proposed channel improvements assumed a trapezoid cross section with 5H:1V side slopes. The bottom width of the channel was widened until the average 100-year velocity was below 5 ft/s. 1' of freeboard was assumed and included in corridor width recommendations.

Low Impact Development (LID)

Low impact development was defined as grass buffers between paved areas to slow runoff velocities and increase infiltration. LID practices were assumed to be applied to all new development areas.

3.3.4 Alternatives Modeling

Different combinations of the four alternatives presented above were evaluated for each major drainageway using the Environmental Protection Agency Stormwater Management Model (SWMM). The kinematic wave flow routing method was used in SWMM to perform hydraulic calculations. A summary of the alternative options and where each option was considered is provided in Table 3-13.



Table 3-13 Alternative Options Descriptions

Option	Option Description	Major Drainageway			
No.	Option Description	700	800		
1	Do Nothing except crossing structure upgrades	х	Х		
2	Detention in all major tributaries	х	Х		
3	Channel only improvements	х	х		
4	LID, detention, and channel improvements	х	х		

All of the options except 1 (Do Nothing) include some form of channel improvements. This improvement would be at L_829 which is located right after culvert 807 and L_708 which is located by reach 700 outfall. Both locations experience heavy erosion and steep channels. The specific methods used for modeling each alternative are discussed below.

Option 1 – Do Nothing

Future 100-year flows were used for the SWMM input hydrology. Hydraulic inputs for the nodes and links matched the existing and future conditions SWMM models. A channel threshold 100-year velocity criteria was set at 5 ft/s for the boundary between erosive and non-erosive flows. This threshold is typically appropriate for vegetated channels without hardened erosion protection. If 5 ft/s was exceeded the channel was deemed to be inadequate to convey future flows and no action was not considered a viable option.

Option 2 - Detention

The Mile High Flood District Detention workbook version 4.06 was used to design the detention basins. With the exception of (pre-existing) Detention Basin 823, conceptual detention basins assumed the minimum rectangular footprint with 4:1 side slopes that would result in the required volume. The workbook has an integrated CUHP model that runs and determines the necessary volume to detain. For consistency, the same CUHP inputs used to develop the hydrology were used in the detention basin worksheets. When this was not possible the inputs were kept as close as possible.

The basins were designed for full spectrum detention and had three zones: water quality capture volume (WQCV), excess urban runoff volume (EURV), and the 100-year event. The design 100-year depth for the detention basins was six feet to avoid additional requirements associated with jurisdictional dams. Note depth-area rating tables were provided up to ten feet to provide calculation robustness in larger storms. Also the (pre-existing) Detention Basin 823 utilizes a 10-foot max design depth to match the existing design.

The WQCV, EURV, and 100-year outlet structures were assumed to be an orifice plate, vertical orifice, and weir and pipe with a restrictor plate respectively. The target release time for the 100-year event was 72 hours. Once the basin and outlet structures had been

properly sized, the storage curve and rating curve were imported into the SWMM model. Table 3-14 summarizes the proposed detention basin alternatives. Detailed outputs from the MHFD Detention worksheets are in Appendix E.

Table 3-14 Option 2 Detention Basin Summary

Detention	Reach	Contributing	Storage	Drainage	-	sed Detenti 100 Future	-
Facility No.	Location	Subbasins	Volume (acre-feet)	Area (acre)	Size (acre)	Peak Inflow (cfs)	Peak Outflow (cfs)
D711	700	712	6.5	90.0	1.6	176	127
D823	829	820/830/824/844	43	327.0	6.3	793	356
D841	843	842/850	25	210.6	12.2	647	41
D844	844	844	17	126.7	4.4	523	204

Where possible detention facilities were placed to take advantage of existing topographic features such as roadway embankments or partially enclosed areas. Typically, these features were undersized but could be expanded to meet detention needs.

Option 3 – Channel Improvements

Channel improvements were modeled in SWMM. A trapezoid with 5H:1V side slopes and a varying bottom width was proposed for channel geometry. Other link inputs were not changed. Channel size was based on meeting the threshold velocity criteria of 5 ft/s. The reported channel top widths for each alternative include 1 feet of freeboard. The peak discharge in each reach is dependent on upstream conditions.

For this alternatives analysis, simple trapezoidal cross sections and existing longitudinal slopes were assumed. Multistage channels and grade control structures should be considered during subsequent design. A multistage section generally results in greater stream stability and is more aesthetically pleasing. However, going from a simple trapezoid to a multistage section does not drastically reduce the required corridor width since the 100-year storm event still needs to be spread out over a similar area to the simple trapezoid. Figure 3-3 depicts the modeled trapezoid channel configuration (solid lines) and also the potential bankfull and flood terrace stages (dashed lines). Future grade control could reduce longitudinal slopes and increase proposed flood depths if desired. Table 3-18 summarizes the required channel top width for each option and depth of flow during the 100-year event.



Option 4 – LID

LIDs were assumed to be grass buffers that would be implemented in parcels zoned with a developed land use. The impact of LIDs on watershed hydrology was evaluated by changing the directly connected impervious area (DCIA) input option in CUHP from 0 to 1. The DCIA input accepts 0, 1, and 2 indicating different levels of disconnecting the runoff generated from impervious surfaces. 0 indicates no LIDs are used, 1 indicated grass buffers or similar are used, and 2 reflects conveyance-based LIDs such as grass swales are used. To be conservative and not overestimate implementation of LIDs a DCIA values of 1 was entered for all subbasins. These LID-modified CUHP inputs and outputs are included in Appendix E.

LID practices alone did not reduce peak flows of larger storm events very much, so EURV and flood control (100-year event) detention ponds were sized in conjunction with the LID-modified CUHP results. EURV and flood control were placed upstream of any channels that had a velocity greater than 5 ft/s. These detention ponds were generally smaller than the regional detention ponds described in Option 2. A subsequent SWMM model was created using the revised CUHP outputs and detention rating curves developed in the MHFD detention workbooks (see Appendix E for detention workbook results) for each study reach to evaluate channel velocities and determine if further action was needed.

Table 3-15 Option 4 LID Detention Basin Summary

			Drainage	EURV Ponds					Flood Control Ponds			
Detention Facility No.	Reach Location	Contributing Subbasins	Area (acre)	Future Imperv.	Storage Volume (acre- feet)	Size (acre)	Peak Inflow (cfs)	Peak Outflow (cfs)	Storage Volume (acre- feet)	Size (acre)	Peak Inflow (cfs)	Peak Outflow (cfs)
D_EURV_711	700	712	90.0	30.2%	2.40	0.60	170	155	6.5	1.3	155.2	110.8
D_EURV_820	829	820	81.0	69.80%	5.50	1.30	332	240	-	-	-	-
D_EURV_830	829	830	829.0	67.80%	5.60	1.50	293	193	-	-	-	-
D_EURV_840	843	840	63.0	76.5%	5.40	3.10	200	165	-	-	-	-
D_EURV_842	843	842/850	210.5	68.6%	14.30	9.50	646	328	2.4	0.6	328.3	284.0
D_EURV_844	N/A (Upstream of 843)	844	126.5	76.2%	9.40	2.30	523	382	-	-	1	-
D_FC_823	829	820/830/844/842/840	327.0	73.0%	-	-	-	-	43.1	6.3	474.7	282.7
D_FC_838	829	844	126.5	76.2%	-	-	-	-	17.3	3.3	524.4	292.0

The hydraulic results and required channels parameters for each option are shown in Table 3-16, Table 3-17, and Table 3-18. Results discussions for each major drainageway follows.



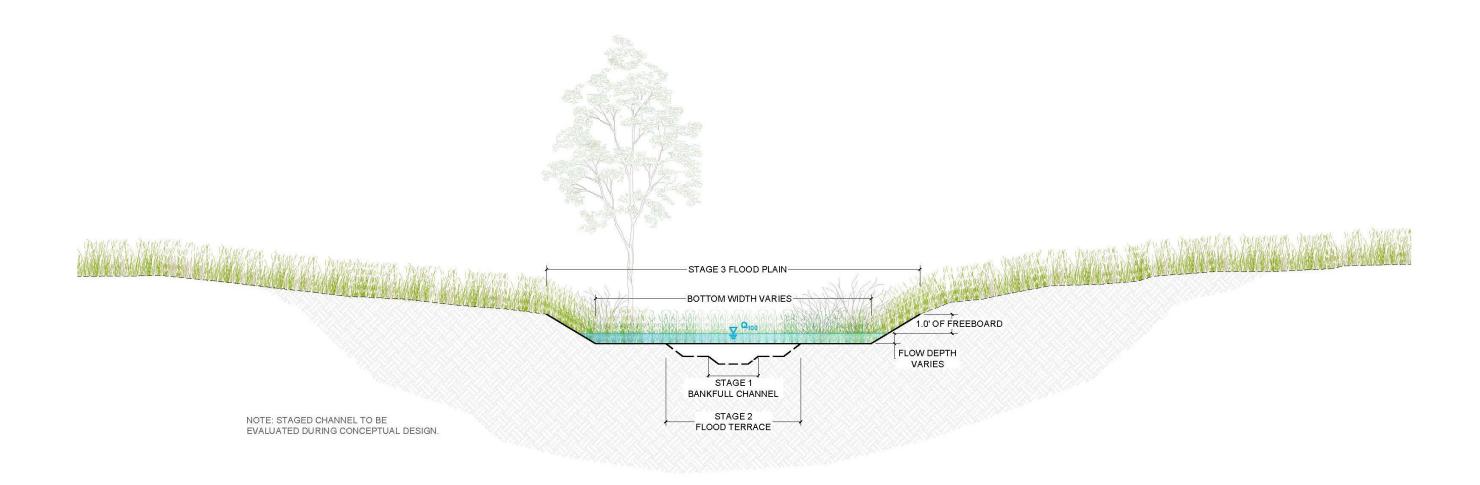


Figure 3-3 Typical Channel Cross Section



Table 3-16 100-Year Channel Velocities

100-Yr Velocity (ft/s) **Option 3 Channel** Reach **SWMM Link** Existing **Option 1 Do Nothing Option 2 Detention Option 4 LID** Improvements L_708 700 10.4 10.7 9.6 5.0 9.1 700 5.4 5.6 5.0 4.8 4.7 L_709 4.3 4.4 3.9 4.4 3.7 700 L_710 4.2 700 L_711 4.1 4.1 4.2 3.4 L_712 3.7 3.7 3.7 3.7 3.7 700 700 L_713 2.9 3.0 3.0 3.0 3.0 4.9 6.3 3.6 3.2 L_808 5.0 800 5.3 6.8 3.7 4.9 3.4 800 L_811 3.5 4.6 2.4 2.2 800 L_819 4.6 4.1 829 L_823 3.1 2.6 4.1 1.7 829 L_829 8.0 10.6 6.4 4.9 5.9 3.3 4.3 2.8 4.3 829 L_834 2.6 8.6 OV_836 829 6.2 4.4 5.0 3.4 4.4 5.5 L_838 3.8 5.0 2.6 829 3.0 4.0 2.5 843 L_839 4.0 3.4 4.5 843 L_841 4.7 6.3 5.0 4.6 4.9 6.0 4.8 843 L_850 5.0 4.9

Note: red values exceed 5 ft/s



 Table 3-17
 100-Year Channel Discharges

	1able 3-17 100-Year Channel Discharges 100-Yr Peak Flows (cfs)								
Reach	SWMM Link	Existing	Option 1 Do Nothing	Option 2 Detention	Option 3 Channel Improvements	Option 4 LID			
700	L_708	160	172	128	172	111			
700	L_709	160	172	128	172	111			
700	L_710	160	172	129	172	111			
700	L_711	160	172	172	172	170			
700	L_712	160	173	173	173	170			
700	L_713	160	173	173	173	170			
800	L_808	1023	2049	412	2032	298			
800	L_811	928	1882	355	1871	283			
800	L_819	928	1882	355	1872	283			
829	L_823	709	1504	434	1498	311			
829	L_829	711	1511	434	1506	311			
829	L_834	576	1290	340	1289	292			
829	OV_836	331	1053	95	806	46			
829	L_838	577	1300	341	1300	524			
843	L_839	372	844	203	844	528			
843	L_841	290	306	305	306	304			
843	L_850	139	649	41	649	284			



Table 3-18 Proposed Channel Geometry

		December 1		Option 1- Do Nothing Option 2 Detention		etention	Option 3 Cl Improvem		Option	4 LID
Reach	SWMM Link	Reach Length (LF)	Top Width (ft)	Depth (ft)	Top Width (ft)	Depth (ft)	Top Width (ft)	Depth (ft)	Top Width (ft)	Depth (ft)
700	L_708	202	40	0.7	39	0.6	187	0.2	39	0.5
700	L_709	560	70	0.6	69	0.5	94	0.5	69	0.5
700	L_710	154	87	0.5	87	0.5	87	0.5	87	0.4
700	L_711	615	92	0.5	93	0.6	92	0.5	94	0.7
700	L_712	485	133	0.4	133	0.4	133	0.4	133	0.4
700	L_713	338	88	0.9	88	0.9	88	0.9	88	0.9
800	L_808	1197	105	4.2	90	1.7	179	2.8	88	1.3
800	L_811	183	150	2.3	133	0.9	176	2.6	130	0.7
800	L_819	761	150	3.3	137	1.2	150	3.3	136	1.0
829	L_823	943	265	1.5	257	0.7	265	1.5	258	0.8
829	L_829	290	102	1.7	96	0.9	127	3.2	95	0.7
829	L_834	1040	107	2.3	92	1.1	107	2.3	91	1.0
829	OV_363	442	91	1.2	64	0.3	141	0.9	61	0.2
829	L_838	314	105	2.2	75	1.2	133	1.7	99	2.0
843	L_839	541	137	1.1	125	0.5	137	1.1	131	0.8
843	L_841	190	200	3.6	200	1.3	200	3.6	200	2.6
843	L_850	1740	76	1.7	78	1.8	76	1.7	76	1.7



Table 3-19 Proposed Crossing Structures

Structure	Reach	Structure Size and Type			Design Q100 Capacity (CFS)a				
Number	Number	Option 1	Option 2	Option 3	Option 4	Option 1	Option 2	Option 3	Option 4
702	700	2-42" RCP	2-36" RCP	2-42" RCP	1-48" RCP	172	128	172	111
704	700	2-48" RCP	2-48" RCP	2-48" RCP	2-48" RCP	172	172	172	170
801	843	2-9'x5' CBC	1 - 6'x4' CBC	2-9'x5' CBC	2-9'x4' CBC	846	203	846	535
804	800	2-10'x8' CBC	1-6'x7' CBC	2-10'x8' CBC	1-6'x5' CBC	2057	413	2045	283
805	800	10-10'x3' CBC	3-8'x3' CBC	10-10'x3' CBC	2-8'x3' CBC	1882	355	1872	283
807	829	3-12'x5' CBC	1-12'x4' CBC	3-12'x5' CBC	1-12'x4' CBC	1511	435	1507	311
808	829	3-12'x5' CBC	1-12'x4' CBC	3-12'x5' CBC	1-12'x4' CBC	1300	341	1300	292
809	843	2-12'x7' CBC	1-10'x4' CBC	2-12'x7' CBC	2-10'x4' CBC	1300	341	1300	528

a. Crossing structures designed to convey expected future conditions flows (Q100).



Major Drainageway 700

Option 1 was considered infeasible due to velocities significantly exceeding 5 ft/s near the outfall of the reach. Thus, improvements are needed to ensure the reach is stable under future conditions.

Option 2 considered placing a detention basin immediately upstream of the railroad embankment. This was able to reduce the basin peak flows to pre-development levels. However, existing flows exiting the reach were still above 5 ft/s, so channel improvements were proposed for lowest part of Reach 700 (between the Oklahoma Drainageway and the Great Western Railway).

Option 3 has the largest required channel corridors due to the existing channel having the largest velocity between all reaches.

Option 4 incorporates LIDs in future developed areas of the watershed to provide water quality and minor flow reduction. Option 4 also incorporates a singular EURV basin in the same location as the Option 2 detention basin. A regional flood control basin was placed behind the EURV to help with additional peak flow reduction. Existing flows exiting the reach were still above 5 ft/s so channel improvements were proposed for the lowest part of Reach 700.

Major Drainageway 800

Option 1 was considered infeasible due to all of the reaches having velocities significantly exceeding 5 ft/s in both existing and future conditions. Thus, improvements are needed to ensure the reach is stable under future conditions.

Option 2 considered placing a detention basin upstream of WCR-17 in Reach 843 along with restoring full function of the existing Southgate detention basin that is located in Reach 829. This was able to reduce large portions of the basin peak flows to pre-development levels. However, channel protection was still proposed for the short, relatively steep section between Southgate Drive and the Southgate detention basin since expected 100-year velocities were above 5 ft/s.

Option 3 requires a channel corridor width approximately double of other options to convey the 100-year event.

Option 4 incorporates LIDs in developed areas of the watershed to provide water quality and minor flow reduction. Option 4 also incorporates a regional flood control basin at the same location as Option 2 upper detention basin, along with a regional flood control basin as a replacement for the detention basin located in the middle of major drainageway 800. Throughout the drainageway, six smaller EURV basins were placed which helped reduce peak runoff. However, channel protection was still proposed for the short, relatively steep section between Southgate Drive and the Southgate detention basin since expected 100-year velocities were above 5 ft/s.

3.3.5 Alternative Costs

Costs associated with each option were estimated using the MHFD Master Plan Cost version 2.2 workbook. The sections in the cost estimate used in this analysis include:

- Concrete box culverts
- Channel improvements
- Detention/water quality facilities
- Removals
- Landscaping and maintenance improvements
- Special items
- Land acquisition
- Operation and maintenance

The special items category was used for LID options. A user entered unit cost was used for land acquisition and LID items, see Table 3-20 below. All other items used the default unit cost. The construction cost index (CCI) data for the second quarter of 2022 was used to adjust for inflation. The published CDOT CCI for 2022 Q2 was 1.67.

Table 3-20 Special Unit Costs

Item	Unit Cost	Units
Land Acquisition	\$11,228	Acre

The cost estimate inputs were based on the proposed geometries calculated in the alternatives analysis. Detention costs were estimated based on the basin volume using the 'complete-in-place' option in the workbook. Earthwork volume was used to estimate channel improvements. The area of the detention basin and/or channel corridor was used to estimate the revegetation area. Culvert removal was assumed to be equal to the length of culvert being installed. Culvert improvements were based on the proposed culvert sizes from the HY-8 model. Land acquisition was based on the detention basin and/or channel corridor area required. LID costs were estimated based on acres of developed land use. For detailed cost estimate inputs see the MHFD MP Cost worksheets in the Appendix E.

Cost estimates associated with land acquisition were based on recent (previous 10 years) sales data for Weld County, see Table 3-21. The listed parcels were within and/or adjacent to the project area, and these parcel sales were used to generate an average cost per acre for acquisition cost estimates.



Table 3-21 Weld County Land Sales Data for Project Area

Parcel No.	Land Type	Area (acre)	Date of Sale	Sale Price	Cost/Acre
95702000004	Agricultural	890	3/29/2022	\$8,500,000	\$9,551
95704100010	Agricultural	63	5/25/2021	\$515,000	\$8,175
95704100011	Agricultural	45	7/22/2020	\$375,000	\$8,333
95709000009	Commercial	18	9/29/2020	\$1,000,000	\$55,556
95709101001	State Assessed	70	10/8/2015	\$750,000	\$10,714
95709401002	State Assessed	237	6/29/2016	\$2,490,400	\$10,508
95711002010	Agricultural	21	7/21/2021	\$900,000	\$42,857
95711100001	Commercial	21	8/8/2017	\$475,000	\$22,619
95711102001	Exempt	15	9/17/2014	\$490,100	\$ 32,673

Table 3-22 summarizes the cost of the alternative options for each major drainageway. The expected capital costs to improve each drainageway for future 100-year flood protection are discussed below.

Major Drainageway 700

Option 3 is the most expensive due to high capital costs involved with improving the entire length of drainageway, and only addresses channel stability. Option 1 has the lowest costs but does not achieve the goals of this study – taking the Do Nothing approach would result in increased risk of future flood damages to people or property within this watershed. Option 4 has slightly lower costs than Option 2 because distributed LID and EURV costs (both construction and maintenance) are expected to be borne by developers.

Major Drainageway 800

Option 1 has the lowest cost but does not achieve the goals of this study – taking the Do Nothing approach would result in increased risk of future flood damages to people or property within this watershed. Options 2 and 3 are the most expensive due to high capital and maintenance costs. Option 2 represents significant investment in multiple regional detention basins, and Option 3 represents significant investment to improve the entire length of drainageway. Option 4 has the lowest expected costs because distributed LID and EURV costs (both construction and maintenance) are expected to be borne by developers. Option 4 does include regional detention costs, but these detention costs will be significantly less than Options 2 since the upstream distributed facilities decrease the required sizes of regional detention facilities.



Table 3-22 Alternative Plans Cost Estimate Summary

Major Drainageway	Alternative	Acquisition Capital Cost	Crossing Improvement Capital Cost	Channel Improvement Capital Cost	Regional Detention Capital Cost	Total Capital Cost ^a	50 Year O & M Cost	Total Cost ^b
	Option 1: Do Nothing	-	\$89,598	-	-	\$152,766	\$37,200	\$189,966
700	Option 2: Detention	\$17,965	\$83,778	\$34,515	\$497,660	\$1,068,165	\$237,600	\$1,305,765
700	Option 3: Channel Improvement	\$65,684	\$89,598	\$504,879	-	\$1,079,268	\$397,200	\$1,476,468
	Option 4: LID	\$14,596	\$72,138	\$34,047	\$497,159	\$1,043,298	\$198,750	\$1,242,048
	Option 1: Do Nothing	-	\$5,855,486	-	-	\$9,983,604	\$337,700	\$10,321,304
900	Option 2: Detention	\$257,121	\$1,830,956	\$65,637	\$6,511,163	\$14,592,347	\$2,994,350	\$17,586,697
800	Option 3: Channel Improvement	\$274,637	\$5,858,648	\$3,462,346	-	\$16,166,933	\$1,484,000	\$17,650,933
	Option 4: LID	\$114,526	\$1,868,805	\$65,637	\$4,935,532	\$8,578,110	\$1,404,850	\$9,982,960

a. Total cost also includes mobilization, stormwater management/erosion control, engineering, legal/administration, construction management, and contingency estimates.

b.Total cost includes capital cost plus operations and maintenance cost over 50 years.



3.3.6 Alternative Plans

In addition to the quantitative results presented in previous sections, qualitative aspects of the local area should also be considered when selecting the most appropriate alternatives. Refer to Figure 3-2 for potential drainage issues noted during the field assessment. These potential issues can sometimes also be opportunities, especially since specific locations that have notable existing hazards should be prioritized when planning capital projects. See Table 3-23 for a summary of qualitative drainage issues and opportunities in each reach.



 Table 3-23
 Potential Drainage Issues and Opportunities

Major Drainageway	Reach Number	Problems	Opportunities				
700	Reach 700	(2) Undersized minor roadway crossing structures (1) Undersized railroad crossing structure Informal embankment blocks drainageway	Improve crossing capacity at GWR, WCR-60, and Windsong Rd Formalize detention upstream of GWR and/or Windsong Rd embankment				
	Reach 800	Heavy vegetation impeding flows (1) Undersized/corroded minor roadway crossing structure (1) Undersized railroad crossing structure Flared section not connected to pipe outlet	Improve crossing capacity at GWR and Gratitude Ln Formalize detention upstream of Gratitude Ln embankment Repair existing detention basin outlet				
800	Reach 829	Localized bank erosion Existing detention basin contains sediment and reeds (2) Undersized minor roadway crossing structures Trees in channel impeding flows Headcuts and entrenchment in low-flow channel (5) Scour holes at culvert outlets and drop structures	Stabilize banks through erosion-resistant materials or flatten bank slopes Update Southgate detention basin with maintenance plan and additional forebay Improve crossing capacity at Southgate Dr and Kia Access Rd Stabilize channel profile through bed protection and low-flow channel definition Replace trees with more desirable vegetation Stabilize outlets with erosion-resistant materials and/or formalize scour holes				
	Reach 843	(2) Undersized major roadway crossing structures (1) Minor channel and bank erosion upstream of culvert	Improve crossing capacity at US-34 and WCR-17 Stabilize banks through erosion-resistant materials or flatten bank slopes Stabilize channel profile through bed protection and low-flow channel definition				



3.3.7 Results of Analysis

Benefit Cost Analysis

There are no regulatory floodplains within the study area, and subsequently no habitable structures within a Special Flood Hazard Area. A benefit cost analysis was not completed with this study.

Evaluation of Alternatives

The alternative options were evaluated based on the cost of improvements, hydraulic calculations and future operations and maintenance of the future stream corridors. They were also evaluated on qualitative aspects, including public safety, water quality enhancement, land use context, surrounding land redevelopment potential, and anticipated general acceptance by the community. The feasibility of each alternative with respect to qualitative aspects was evaluated based upon the hydraulic analysis of the 100-year flood. The recommended alternative provides the highest benefit when considering both quantitative and qualitative aspects of the project.

The following eight qualitative aspects were considered in the alternatives analysis:

Constructability	Public Safety				
Maintenance	Habitat and Environment				
Meets Multiple Objectives	Aesthetics				
Water Quality	Criteria Compliance				

The listed categories above were used to evaluate each alternative option on a scoring of: 0-no opportunity, 1-minimal opportunity, 2-average opportunity, and 3-high opportunity. Note that "Meets Multiple Objectives" refers to the estimated ability to serve desirable functions other than flood control, such as trails, parks, or other community amenities. A summary of the alternatives screening scores is presented in Table 3-24.

Recommended Plan

The restoration objective for these major drainageways is to promote low maintenance stream geomorphology, which is based on improving the function of reach-scale hydrology, hydraulics, and geomorphology. All of the recommended alternatives include some channel improvements – successful restoration influences many of the other qualitative aspects by reducing maintenance, improving safety, promoting multi-use facilities, indirectly improving water quality, and protecting habitat and the environment. The goal of the proposed alternatives is to improve the function of the riverine system in future conditions, which is expected to undergo significant urbanization and flow alterations. The following discusses the recommended improvements for each major drainageway to best achieve this goal, and a summary of the recommended plan cost estimates is provided in Table 3-25.

Major Drainageway 700

Option 4 (LID, detention and channel improvements) is the recommended alternative. Option 2 (detention and channel improvements) scored almost as highly, and since Basin 700 is relatively small Option 2 and Option 4 would likely look similar if implemented. Option 4 gains a slight edge because implementing watershed-wide practices to increase infiltration, evapotranspiration, and reuse of stormwater allows the greatest amount of flexibility and ability to integrate smoothly with the surrounding developments.

Major Drainageway 800

Option 4 (LID, detention and channel improvements) is the recommended alternative. Both Option 2 (detention and channel improvements) and Option 4 scored highly, but Option 4 is expected to have a lower cost, improved constructability, better coverage of water quality, improved public safety, and better aesthetics than Option 2. This is mostly due to the distributed nature of Option 4, implementing watershed-wide practices to increase infiltration, evapotranspiration, and reuse of stormwater allows the greatest amount of flexibility and ability to integrate smoothly with the surrounding developments.



 Table 3-24
 Alternatives Evaluation Matrix

		Constructability	Maintenance	Meets Multiple Objectives	Water Quality	Public Safety	Habitat and Environment	Aesthetics	Criteria Compliance	TOTAL WEIGHTED AVERAGE	
Major Drainageway	Alternative	Weighting									
Dramageway		20%	15%	15%	10%	20%	5%	5%	10%	100%	
	Option 1:Do Nothing except crossing structure upgrades	3	0	1	1	0	2	1	0	1.00	
700	Option 2: Detention and channel improvements	2	2	3	3	2	2	2	3	2.35	
700	Option 3: Channel only improvements	2	3	2	0	2	2	2	2	1.95	
	Option 4: LID, detention and channel improvements	2	2	3	3	3	3	2	2	2.50	
	Option 1:Do Nothing except crossing structure upgrades	3	1	1	1	0	2	1	0	1.15	
000	Option 2: Detention and channel improvements	2	2	3	3	2	2	2	3	2.35	
800	Option 3: Channel only improvements	2	2	2	0	2	2	2	2	1.80	
	Option 4: LID, detention and channel improvements	2	2	3	3	3	3	2	2	2.50	

Scoring: 0 - No Opportu Opportunity

0 - No Opportunity 1 - Minimal Opportunity

2 - Average Opportunity

3 - High



Table 3-25 Recommended Plan Cost Estimate

Major Drainageway	Acquisition Capital Cost	Crossing Improvement Capital Cost	Channel Improvement Capital Cost	Regional Detention Capital Cost	Total Capital Cost ^a	50 Year O & M Cost	Total Cost ^b
700	\$14,596	\$66,000	\$34,047	\$494,988	\$1,043,298	\$198,750	\$1,242,048
800	\$119,017	\$1,762,349	\$4,759,500	\$4,759,500	\$11,561,232	\$1,454,950	\$13,016,182
Study Totals	\$133,613	\$1,828,349	\$4,793,547	\$5,254,488	\$12,604,530	\$1,653,700	\$14,258,230

a.Total capital cost also includes mobilization, stormwater management/erosion control, engineering, legal/administration, construction management, and contingency estimates.

b.Total cost includes capital cost plus operations and maintenance cost over 50 years.



3.4 Community Indicators

3.4.1 Funding

This is a long-range drainage planning document, and funding for the recommended alternatives has not been determined to our knowledge. Potential funding sources could include City of Greeley capital improvement budgets, stormwater utility fees, and private developer-paid improvements. Federal grants, such as the Building Resilient Infrastructure and Communities (BRIC) program, are also a potential funding source, but historically it has been challenging to demonstrate a sufficient benefit cost analysis for federal grants in undeveloped areas.

Regarding private development cost sharing, there are multiple ways to include developers to protect and enhance these natural drainageways in the future. Distributed options, such as LID, will likely be directly constructed and maintained by the private developments. For regional improvements such as detention basins and channel improvements the costs should be shared by everyone within the watershed instead of just the property where the facility is located. Major drainageways are vital links for the whole community. Greeley could pursue a development fee-in-lieu program for this purpose to allow specialized designers and builders to facilitate and streamline the process.



CHAPTER 4 - THE HOW

4.1 Plan Development Overview

The City of Greeley reviewed the Alternatives Analysis and Recommended Plan presented in Chapter 3, and decided to proceed with Conceptual Design featuring Option 4: LID, detention, and channel improvements for all study reaches. Refer to Appendix A for the Selected Plan letter. The Conceptual Design, also known as the Master Plan, is based on the following principal elements, goals, and objectives.

4.1.1 Mitigation of Flood Hazards

The major problems identified in the Oklahoma Basin are due to the expected significant increase in flows under future conditions without mitigation. The Master Plan aims to minimize future increases in flood hazard risk with a policy of targeted major drainageway protection and maintenance, together with the adoption of distributed best practices such as Low Impact Development (LID) and Excess Urban Runoff Volume (EURV) management as properties within the watershed are developed. The proposed stream management corridors and detention basins keep the highest flood risks within the limits of these drainage features.

The Master Plan also proposes increases in the capacity of road and railroad crossings. All of the existing major crossings in this watershed are undersized for the 100-year storm event. Undersized culverts may become silted and unable to convey more than the low flow condition, potentially endangering properties located immediately upstream of the crossing embankments. The proposed culverts in the Master Plan are sized to safely convey the 100-year future conditions event.

4.1.2 General Recommendations

This report generally recommends the following:

- 1. Low Maintenance Stream Design: Preserve a stream management corridor and establish a high functioning and low maintenance stream. The low maintenance stream cross-section and stream management corridor shall be designed by a professional trained in fluvial geomorphology.
- 2. Crossing Improvements: Increase capacity of all major roadway and railroad crossing structures to convey the Master Plan 100-year flow using culvert structures or bridges. Distributed crossing layouts, where low-flows are conveyed separately from overbank flows, should be implemented in downstream reaches. Our analysis assumed that existing embankment and channel thalweg profiles would be preserved, but future projects could examine grade changes at crossings on an individual basis.
- 3. New land development and publicly funded projects provide to the maximum extent practicable runoff volume control practices. This includes minimizing directly connected impervious areas, employing infiltrating Best Management Practices (BMPs), and constructing EURV basins.
- 4. All BMPs for all new development, redevelopment, and publicly funded projects provide to the maximum extent practicable a Water Quality Capture Volume (WQCV).
- 5. The overall layout of a development that incorporates LID, detention facilities, and channel improvements should promote the contiguous overland connection between the various elements and areas to maximize benefits of these spaces and mitigate wildlife/human conflicts.

- Development should promote the design of communities that incorporate existing topography and topographic features and minimize oversimplified overlot grading to promote and augment existing stormwater conveyance features and areas.
- 7. Development to promote stormwater conveyance should incorporate separated "undeveloped spaces" to promote the development and/or preservation of environmentally sensitive areas.
- 8. Natural or architectural forms and native and natural building materials should be utilized to the maximum extent possible to enhance community cohesivity and cultural character. Natural forms should be promoted over maximizing usable space within a parcel which tends to promote an unnatural square or rectangle shape.
- 9. Consider sun and aspect and the potential impact these may have on design elements. Incorporate and promote the inclusion and incorporation of shade trees to offer further water quality benefits.
- 10. Designs should consider in situ soils and incorporate considerations for amendments to increase permeability and vegetation establishment success.
- 11. Native vegetation should be utilized to the maximum extent possible. Successful designs will include the provision of supplemental watering to support efficient native vegetation establishment.
- 12. Groundwater explorations should further inform design opportunities.

4.2 Master Plan Description

The recommended plan was chosen based on a combination of quantitative and qualitative measurements. The Master Plan will minimize stormwater and flood-related damages to streams, public infrastructure, and private property. In addition, we recommend approaches to protect and enhance water quality, promote opportunities to allow runoff infiltration, and preserve the natural character of the drainageways and their terrestrial and aquatic habitat resources.

The proposed conceptual plan elements are presented in Figures G-1 of Appendix G. The conceptual design was based on the Selected Plan, and the Master Plan improvements are intended to provide flood hazard protection to the community while adhering to the City of Greeley drainage criteria. The total estimated cost of proposed capital improvements within the Oklahoma Basin is \$14,876,170.

The Master Plan analysis generally include the following assumptions:

- CUHP version 2.0.1 with DCIA = 1 option was used to calculate the runoff reduction impact of LID practices on future peak flows. Master Plan CUHP inputs and results are provided in Appendix-F.
- MHFD-Detention worksheet version 4.06 was used to size detention basins that reduce 100-year peak flows within each major drainageway. To provide greater flexibility for land and phasing requirements, the required EURV and 100-year flood control basins were modeled separately instead of assuming a single full spectrum detention basin. Output from the detention worksheets is provided in Appendix F-2.
- EPA SWMM version 5.2.4 was used to analyze future channel stability and size recommended floodplain sections. Master Plan SWMM inputs are included in Appendix F-3, and Master Plan SWMM results are provided in Appendix F-4.



- HY-8 version 7.80.02 was used to determine the number and size of culverts required to convey the Master Plan (future conditions) 100-year peak flows. All crossings were sized to provide at least 1-ft of freeboard. Master Plan HY-8 inputs and results are included in Appendix F-6.
- The cost summaries for each major drainageway are provided below in Table 4-1. Detailed cost estimates are provided in Appendix F-7.
 - Estimated earthwork quantities for channel improvements did not assume a balanced earthwork system (where soils removed from one location can be used for fill at another location). Balanced earthwork might not be feasible due to project phasing and multiple landowners within most reaches.
 - Estimated quantities to re-vegetate the channel corridor and embankments were based on the square footage of the minimum stream management corridor.
 - Additional capital improvement costs, including engineering (15% of capital improvement cost subtotal), mobilization (5%), stormwater management and erosion control (5%), legal/administrative (5%), contract administration and construction management (10%) were included in the cost estimates. A substantial contingency cost (25% of capital improvement cost subtotal) was also included, but noted that site-specific costs such as dewatering and traffic control were not explicitly defined for this study.
 - Annual maintenance of culverts, channel, regional detention and hydraulic structures was included in the total costs. Distributed LID and EURV basins are not included in the costs.

Table 4-1 Master Plan Cost Estimate Summary

Major Drainageway	Acquisition Capital Cost	Crossing Improvement Capital Cost	Channel Improvement Capital Cost	Regional Detention Capital Cost	Total Capital Cost ^a	50 Year O & M Cost	Total Cost ^b
700	\$14,596	\$66,000	\$34,047	\$494,988	\$1,043,298	\$198,750	\$1,242,048
800	\$119,017	\$1,762,349	\$4,759,500	\$4,759,500	\$11,561,232	\$1,454,950	\$13,016,182
Study Totals	\$133,613	\$1,828,349	\$4,793,547	\$5,254,488	\$12,604,530	\$1,653,700	\$14,258,230

a. Total capital cost also includes mobilization, stormwater management/erosion control, engineering, legal/administration, construction management, and contingency estimates.

4.2.1 Vision Statement, Goals, and Objectives

Vision Statement

The vision for the successful implementation of the Oklahoma concept design is of a stormwater conveyance system that utilizes LID, detention, and channel improvements to promote stormwater volume

reduction and water quality enhancement while achieving flood protection for the 100-year future conditions storm event.

Goals & Objectives

To achieve the vision for the Oklahoma concept design, the following goals and corresponding objectives have been identified:

Goal #1 - Implement LID effectively

Objective #1 – Promote development that weaves in LID to uplift stormwater conveyance improvements as a community amenity.

Objective #2 – Provide guidance on LID design criteria that promotes the effective use of regional materials and supports local cultural practices but allows for creative solutions.

Objective #3 – Support long-term maintenance of LID by determining achievable performance criteria and effective planning and budgeting by LID owners.

Goal #2 – Implement stormwater detention effectively

Objective #1 – Reduce future conditions 100-year peak flows and volumes to existing conditions levels.

Objective #2 - Promote development that provides detention facilities that allow for multiple uses of the facility such as a community use area or as preserved wildlife habitat in combination with the stormwater conveyance to uplift stormwater conveyance improvements as a community amenity.

Objective #3 – Support long-term maintenance of detention facilities by determining achievable performance criteria and effective planning and budgeting by detention facility owners.

Goal #3 – Implement channel improvements effectively

Objective #1 – Safely convey future conditions 100-year flows.

Objective #2 - Promote development that uplifts stormwater conveyance improvements into community amenities by realizing the direct and indirect benefits provided by the healthy ecosystems of natural channel systems.

Objective #3 – Support long-term maintenance of channel improvements by determining achievable performance criteria and effective planning and budgeting by channel landowners.

4.2.2 Concept Design Description

This Master Plan envisions the use of a combination of LID, detention facilities, and channel improvements to achieve long-term success in conveying stormwater safely and efficiently. The proposed LID and detention elements work together to reduce future conditions runoff within the major drainageways to levels similar to existing conditions. A comparison of peak flows at major drainageway outfalls is provided below in Table 4-2, and peak flows and volumes at all design points are included in Appendix F-5.

b. Total cost includes capital cost plus operations and maintenance cost over 50 years.



The following sections describe overall guidelines, current elements and practices to employ, definitions of elements, as well as individual guidelines for elements to achieve the concept design.

Table 4-2 Master Plan Peak Flows Summary

Design Point		Drainage Area	Existing Conditions (cfs)	Future Conditions Do Nothing (cfs)	Future Conditions Concept Design (cfs)		
Number	Туре	(acres)	Q ₁₀₀	Q ₁₀₀	Q ₁₀₀		
0_708	Outfall	90	160	172	111		
0_803	Outfall	696	1,039	2,072	306		

¹ Direct flow areas 620 and 714 not included in reach summaries

<u>LID</u>

LID refers to systems and practices that use or mimic natural processes that result in the infiltration, evapotranspiration, or use of stormwater in order to protect water quality and associated aquatic habitat. This often includes the management of wet weather flows that use these processes, and to refer to the patchwork of natural areas that provide habitat, flood protection, cleaner air, and cleaner water (*Compendium of MS4 Permitting Approaches*, EPA, 2022). LID is the smallest, finest scale of design elements usually implemented successfully at a site-scale. See Figure 4-1 and Figure 4-2 for example sketches from the *Low Impact Design Implementation Manual* (City of Fort Collins, 2017). Maintenance requirements tend to be higher for these elements and are typically owned by an individual owner, Homeowner's Association (HOA), Metropolitan District or similar development group/entity. Operation and maintenance of LID can be split across several beneficiaries which can make for complexity in long-term planning. LID components generally focus on water quality improvements over volume reduction capabilities.



Figure 4-1 LID Single Family Residential Example



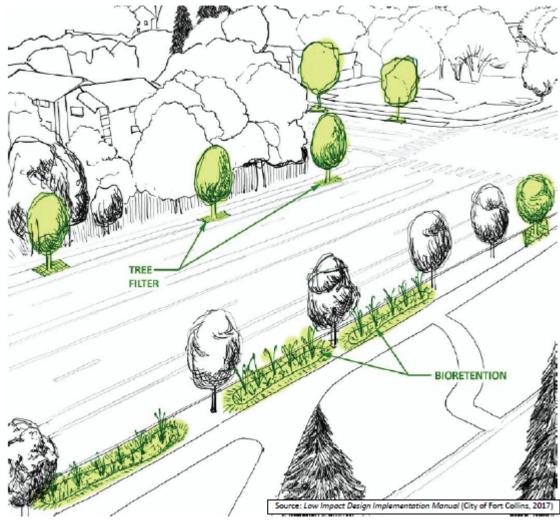


Figure 4-2 LID Street Right of Way Example

The following LID elements are regionally accepted and recommended for use within the Oklahoma Basin:

- **Vegetated buffer:** Areas of natural or established vegetation used to improve stormwater runoff quality by slowing down runoff velocity, promoting infiltration, and catching sediment.
- **Vegetated swale:** Ditches or channels that are densely planted with trees, shrubs, or grasses. It's designed to gather any runoff from impervious surfaces, slowing the velocity of the flow as well as filtering sediment that passes through.
- **Curb cut / no-curb:** Openings in a curb that allows stormwater runoff from impervious surfaces, like roads, to enter areas with infiltration.
- **Trench drain:** A gutter like drainage system that is placed into the ground and covered with a grate. They are used to control any excess surface water and direct it to a more desirable location.
- **Bioretention:** A treatment method, which also goes by the name rain garden or porous landscape design, that uses soil and vegetation to remove sedimentation and contaminants and reduce the volume of stormwater runoff.

- **Rain barrel:** Involves storing rain that lands on a roof in a barrel, decreasing runoff and conserving water to later be used for lawns, gardens, or indoor plants.
- **Green roof:** Involves partially or completely covering a roof with vegetation. This can decrease imperviousness and storm runoff.
- **Green alley:** Alleys that use sustainable materials, such as permeable pavement. This allows stormwater filtering to reduce runoff and improve water quality.
- **Permeable pavement:** Porous, or open space material used in the pavement mix that allows stormwater to flow through, decreasing runoff and improving water quality.
- **Greenway corridor:** Corridor of undeveloped land, used for recreational use as well as environmental protection. Helps protect important habitants as well as improving water quality.
- Sand filter: A type of filtration basin featuring a clean sand bed, used to treat stormwater.
- **Tree filter:** A concrete box that is placed around a tree root, allowing the soil and roots to filter stormwater and reduce runoff.
- Retention ponds/ constructed wetland ponds: A permanent pond that is designed for additional storage capacity for storm events. It helps treat stormwater through sedimentation and biological processes.

LID Guidelines

- 1. Each development should employ several and varying LID elements to increase water quality improvement potential and community appeal.
- 2. Operations and maintenance should be an essential element of the planning and design phase.
- 3. Performance and maintenance criteria should allow for some LID elements to look less "manicured", such as by allowing areas to remain unmowed or allowing standing dead vegetation material to remain overwinter, to allow for important ecosystem processes to take place and to support the cultural acceptance of this landscape appeal.
- 4. Point sources of stormwater found within a development, such as at rain gutter outlets or storm drain inlets, should be focused on to capitalize on this water source.
- 5. Utilize a mix of Colorado and North American native plant species that will tolerate both periodic flooding and drought. Nonnative plants generally will not survive without irrigation. See Figure 4-3 for an example.
- 6. Establish minimal distance from adjacent structures, provide a barrier, or amend in situ soils where soils with moderate to high swelling potential are present.



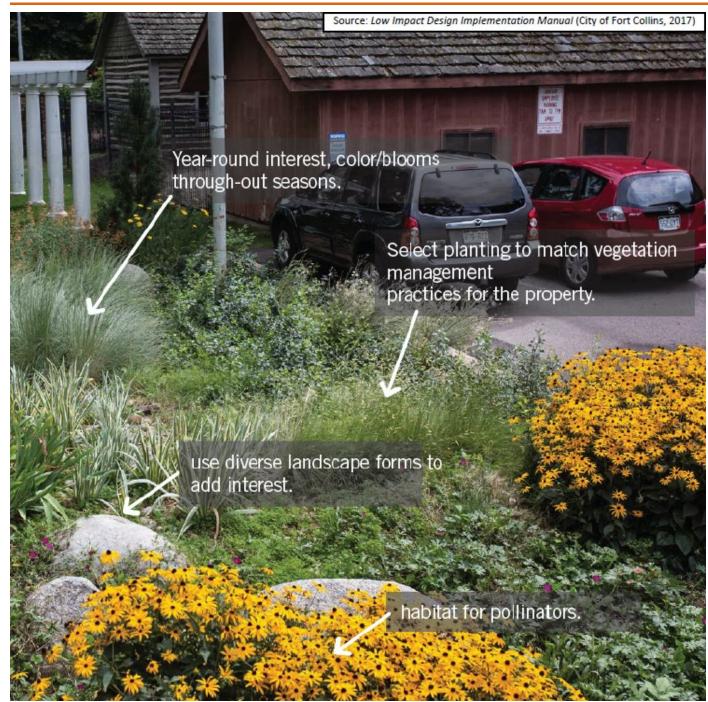


Figure 4-3 LID Vegetation Example

With so many types of available LID elements, implementers can choose the ones that are most suitable for the character of each development. However, not all types of LID are suitable for every application. A general guide to the applicability of each LID for various proposed land uses is provided below in Table 4-3.

Table 4-3 LID Suitability by Land Use

		Residential								Duringer		
	9	ingle Family			М	ulti-Family		Multi-	Civia	Business	Cammanaial	la du atai al
	Single	Agriculture	Metro /	Multi	Dow	Anartmant	Motro	Use	CIVIC	Improvement District	Commerciai	Industrial
LID Type	Lot	Holding	HOA	Unit	KOW	Apartment	Apartment Metro			District		
Vegetated buffer	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Vegetated swale	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Curb cut / No-Curb			YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Trench drain	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Bioretention - rain garden	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Bioretention -												
porous landscape design			YES				YES	YES	YES	YES	YES	YES
Rain barrel	YES	YES	YES		YES		YES					
Green roof	YES	YES	YES	YES	YES	YES	YES	YES			YES	YES
Green alley			YES				YES	YES	YES	YES	YES	YES
Permeable pavement	YES	YES	YES	YES	YES	YES	YES					
Greenway corridor			YES				YES		YES	YES		
Sand filter								YES			YES	YES
Tree filter			YES	YES	YES	YES	YES	YES	YES	YES	YES	
Retention ponds/								-				
constructed wetland ponds			YES				YES		YES	YES		

LID Resources

For more detailed discussions of LID design in this region, please refer to the *Urban Storm Drainage Criteria Manual, Volume 3: Stormwater Quality* (MHFD, 2021), *Ultra-Urban Green Infrastructure Guidelines* (City and County of Denver, 2019), and the *Low Impact Design Implementation Manual* (City of Fort Collins, 2017) for guidelines and performance criteria for LID. For additional guidance on LID practices, the Environmental Protection Agency has developed the following recommended documents:

- Green Infrastructure in Parks: A Guide to Collaboration, Funding, and Community Engagement, June 2017;
- Compendium of MS4 Permitting Approaches, June 2022;
- Green Streets Handbook, March 2021;
- Saving the Rain Green Stormwater Solutions for Congregations, May 2020.

Stormwater Detention Facilities

Stormwater detention facilities manage stormwater quantity by attenuating peak flows during flood events. Depending on the design, they can also enhance stormwater quality by incorporating design components to promote sedimentation, infiltration, and biological uptake (MHFD, 2017). For the purposes of this study, EURV and 100-year detention facilities should focus on volume reduction capabilities over water quality improvements. A summary of the Master Plan detention sizes and results is provided in Table 4-4.



Table 4-4 Master Plan Dete	ention Summary	
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Detention		Contributing	Drainage % Area Future (acre) Imperv.		EURV Ponds				Flood Control Ponds			
Facility No.	Reach Location	Subbasins		Storage Volume (acre- feet)	Size (acre)	Peak Inflow (cfs)	Peak Outflow (cfs)	Storage Volume (acre- feet)	Size (acre)	Peak Inflow (cfs)	Peak Outflow (cfs)	
D_EURV_711	700	712	90.0	30.2%	2.4	0.6	170	155	6.5	1.3	155	111
D_EURV_820	829	820	81.0	69.80%	5.5	1.3	332	240	-	-	-	-
D_EURV_830	829	830	829.0	67.80%	5.6	1.5	293	193	-	-	-	-
D_EURV_840	843	840	63.0	76.5%	5.4	3.1	200	165	-	-	-	-
D_EURV_842	843	842/850	210.5	68.6%	14.3	9.5	646	328	2.4	0.6	328	284
D_EURV_844	N/A (Upstream of 843)	844	126.5	76.2%	9.4	2.3	523	383	-	-	-	-
D_FC_823	829	820/830/844/842/840	327.0	73.0%	-	-	-	-	43.3	6.3	475	283
D_FC_838	829	844	126.5	76.2%	-	-	-	-	17.3	3.3	524	292

Greeley and Windsor has a semi-arid environment with rain events tending to be high intensity and infrequent resulting in runoff events that are heavy with sediments and other accumulated pollutants that flush out. Therefore, pretreatment is essential to the long-term functionality of detention basins. The various forms of recommended pretreatment are listed below:

- **Forebays:** Natural or artificial reservoirs used to settle out coarse sediment by dissipating the energy and flow from incoming runoff.
- **Presedimentation/Sedimentation basins:** Preliminary treatment process that is used to remove sediment from the source water though settling.
- **Micropools**: Smaller permanent pools that are built in front of the outflow structure, designed to reduce potential clogging of outlets and minimize resuspension of sediment.
- **Infiltration**: The process of water from the surface flowing into the subsurface. Areas with high amount of infiltration reduce stormwater runoff which helps reduce erosion and maintenance costs.
- Biological uptake: Removing organic and inorganic constituents by using plants and microbes.
- **Maintenance path access**: Planned pathway for maintenance vehicles and maintenance personnel to be able to easily access structures to routinely clean them out.

On-Site and Sub-Regional Detention

On-site and sub-regional stormwater detention facilities are a small or medium scale design element typically implemented on the neighborhood or singular development (Commercial and Industrial) and are typically owned by an individual owner, Homeowner's Association (HOA), Metropolitan District or similar development group/entity. Operation and maintenance of these can be split across several beneficiaries which can make for complexity in long-term planning. Figure 4-4 shows some natural elements that can be incorporated into offline (located outside of the primary flow channel) detention basins to achieve multiple purposes. The following on-site and sub-regional detention facilities are regionally accepted and recommended for use within the Oklahoma Basin.

- Extended Detention Basin;
- Underground Infiltration.

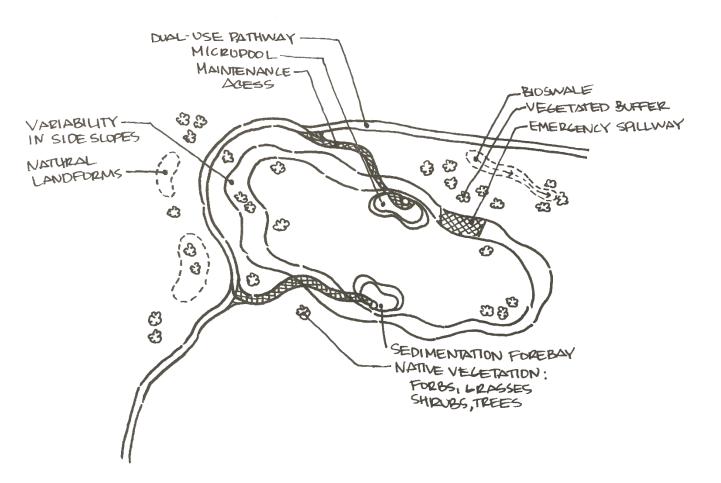


Figure 4-4 Offline basin elements



Regional

Regional stormwater detention facilities are the largest scale design element implemented on a regional level and are typically owned by a municipality. Operation and maintenance of these are typically assumed by the municipality and funded by taxpayer initiatives. Figure 4-5 shows natural elements that can be incorporated into online detention basins (situated within the primary flow channel) to fulfill multiple purposes. The following regional detention facilities are regionally accepted and recommended for use within the Oklahoma Basin:

- Standard (100-year flood control only);
- Full-spectrum.

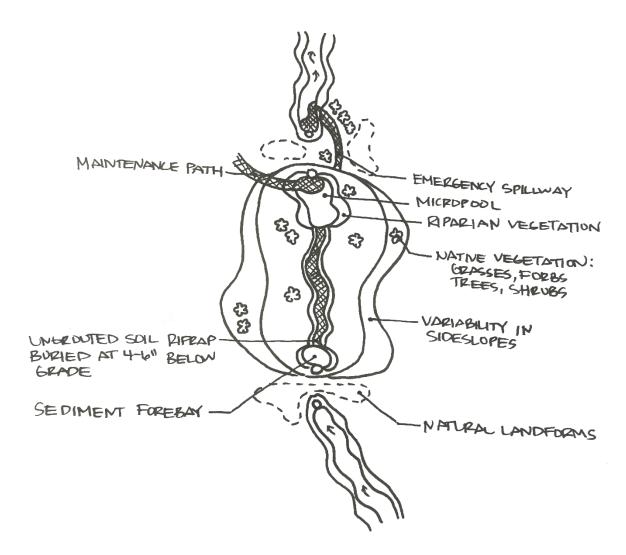


Figure 4-5 Online basin elements

Stormwater Detention Facility Guidelines

Refer to the *Design Criteria and Construction Specifications: Storm Drainage Volume II* (City of Greeley, 2024) and the *Urban Storm Drainage Criteria Manual, Volume 3: Stormwater Quality* (MHFD, 2021) for detailed guidelines and performance criteria of detention facilities. Some additional non-engineering considerations that lead to more pleasing detention spaces are listed below:

- 1. Stormwater detention facilities should allow for multiple uses of the facility such as a community use area or as preserved wildlife habitat in combination with the stormwater conveyance to uplift stormwater conveyance improvements as a community amenity.
- 2. Consider the sun and aspect and impacts on detention facility slopes. Consider incorporating elements such as a northern-facing sledding hill as an intentional design feature.
- 3. Incorporate a natural or architectural form in the forebay, sedimentation bay, and micropool elements.
- 4. Consideration should be given to water depth and length of time detained. Maximizing water detention depth and length of time thresholds can limit the plant palette opportunities that can survive during periods of extended detention.

Channel Improvements

At the outfall of Reach 700, channel improvements are recommended due to severe erosion observed in this area, which is likely caused by the steep gradient of the channel. This will require further investigation as the inlet side of the outlet is on private property. Channel improvements are also recommended downstream of the culvert at Southgate Dr. Severe erosion was observed in this area, which is likely caused by the steep gradient of the channel going into an existing detention pond.

Channel improvements can be a small to large scale design element implemented on a site to a regional scale, however the major drainageways discussed in this document are regional by nature. Ownership, operation and maintenance of these are typically assumed by the municipality and funded by taxpayer initiatives. In order of decreasing importance, channel improvements can provide flood conveyance, water quality improvements, and volume reduction capabilities. The following channel improvements are regionally accepted and promoted:

- **Constructed wetland channel:** Channel that uses dense vegetation to slow down runoff allowing for biological uptake and sedimentation to occur.
- Rosgen stream classification: A system that categorizes streams based on channel morphology.
- **Channel morphology:** Also known as river morphology, is the complete study of the channel from geography to channel fluid dynamics.
- **Multistage Design:** Channels that have multiple stages, with lower stages designed to minimize sediment deposition and provide ecological benefit during frequent storms, while higher stages improve bank stability and provide capacity for larger storms.



- **Grade control structures:** An earthen, wooden, concrete, or other material structure used to prevent gully development and bed erosion. It works by reducing the stream slope and flow velocity which leads to less erosion. Some forms of grade control structures are:
 - Soil lifts: Compacted course soil, wrapped with biodegradable fabric, used for erosion control. Usually lined around the stream banks, with the hope that vegetation growth occurs, creating a more stable bank.
 - **Riprap:** A permanent layer of large boulders or stones typically used to stabilize and protect the soil surface against erosion and scour in areas of concentrated flow or wave energy.
 - Log / rock drop: Layers of rock or logs placed into a section of a fast-flowing, highly eroded, and largely impermeable streambed to slow down water, recharge water tables, and create healthy riparian habitats. It also has the potential to weaken floods, filter water, sequester carbon, reestablish wetland ecosystems, and regulate microclimates.
 - Log / rock vane: Rocks or logs placed in a way that cuts into the stream channel in an upstream direction. These features can slow the rate of water flow significantly, reducing the risk of erosion.
 - Log / rock toe: A row of stone or logs are placed at the toe of an eroding bank, parallel to the stream. The toe is considered the bottom of the slope and supports the weight of the bank. This improvement helps with erosion control, preservation of much of the existing vegetation on the bank slope and encourages the growth of additional vegetation as the bank slope stabilizes.

Channel Guidelines

Refer to the *Design Criteria and Construction Specifications: Storm Drainage Volume II* (City of Greeley, 2024) and the *Urban Storm Drainage Criteria Manual, Volume 3: Stormwater Quality* (MHFD, 2021) for detailed guidelines and performance criteria of channels. For major drainageways, natural multistage channels are strongly preferred, see Figure 4-6 for an example typical section. Additional guidance on these types of channels can be found in *Natural Channel Design: Fundamental Concepts, Assumptions, and Methods* (Rosgen, 2011). Some additional non-engineering considerations that lead to more pleasing stream corridors are listed below:

- 1. Channel improvements should focus on promoting and incorporating natural system processes to support ecosystem services, the many and varied benefits to humans provided by the natural environment and healthy ecosystems.
- 2. Improvements to the extent possible should focus on preservation of areas within the natural channels that are in good condition to support efficient establishment of adjacent channel modifications.
- 3. Channel improvements should focus water quality improvements at point sources such as stormwater outfalls to capitalize on this water source.
- 4. While improvements should focus on enhancing and preserving natural resources, select areas of community use for nature exploration and nature play should be incorporated at key locations to promote community appeal and education while minimizing wildlife/human conflicts.

5. Culverts and outfalls should be sized and designed in a way to promote safe wildlife (terrestrial or aquatic) passage.

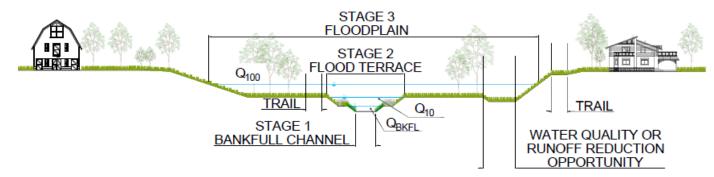


Figure 4-6 Master Plan Channel Typical

Crossing Improvements

Improved major drainageway crossing structures are proposed at all roadway and railroad crossing locations. The Master Plan culverts listed below in Table 4-5 are sized to safely convey the 100-year future conditions event. The concept design calculations assumed simple culverts with existing embankment and channel thalweg profiles to facilitate planning. When more detailed survey information is available during future design, it is recommended that grade changes and distributed layouts (where low-flows are conveyed separately from overbank flows) are explored to implement crossings that minimize maintenance requirements and ecological disruptions.

Table 4-5 Master Plan Crossing Improvements Summary

Structure Number	Reach Number	SWMM Node	Design Q100 (cfs)	Structure Size/Type	Outlet Velocity (ft/s)
702	700	710	111	1-48" RCP	20
704	700	711	170	2-48" RCP	14.4
801	843	839	535	2-9'x4' CBC	9.9
804	800	809	283	1-6'x5' CBC	25.6
805	800	811	283	2-8'x3' CBC	14.7
807	829	829	311	1-12'x4' CBC	13.3
808	829	836	292	1-12'x4' CBC	17.9
809	843	843	528	1-10'x4' CBC	21

4.2.3 Metrics

The three metrics proposed below are intended to achieve the goals of this study.

<u>Low Impact Development</u>: At least 80% of new impervious surface areas shall drain through pervious LID elements before connecting to rapid conveyance elements (gutters, pipes, concrete channels).



<u>Stormwater Detention Facilities:</u> Proposed 100-year peak flows shall be equal to or less than the existing conditions 100-year peaks flows at the outfall.

<u>Channel Improvements</u>: Proposed major drainageways shall be stable during storm events ranging from the low-flow to the future conditions 100-year storm event. Shear stresses in the floodplain fringe should be less than 1 pound/square foot, and the channel section should be designed for the appropriate hydrologic and geomorphic regime.



4.2.4 Major Drainageway 700

Major Drainageway 700 is within the Oklahoma Basin and only comprises one reach. The hydraulic analysis showed that existing channel conditions are fairly stable, but channel improvements may be necessary if peak flows increase with development. There are two existing crossings, one next to the Great Western Railway, and one at Windsong Rd

LID and EURV basins are recommended for all new developments. See Table 4-4 for the Master Plan detention sizes.

Riprap is recommended near the outfall of 700 due to significant erosion and steep slopes that result in high water velocities. For the cost estimate, the riprap has been categorized as Type M soil riprap.

Crossing improvements include the removal and replacement of two existing culverts. See Table 4-5 for Master Plan crossing improvements. When these culverts are replaced, the appropriate headwalls, wingwalls, aprons, and energy dissipation features should be designed in detail. Note, existing structure 701 (while not included) should be investigated in the future as it could have a direct impact on outfall 708.

The capital cost of these Master Plan improvements is estimated to be \$1,043,298 The cost of maintenance and operation for 50 years is estimated to be \$198,750 A detailed cost analysis is provided in Table 4-6.

Т	Table 4-6 Major Drainageway 700 Cost Estimate					
	·	_	_	_	_	TOTAL
DESCRIPTION			QUANTITY	UNIT	UNIT COST	COST
Pipe Culverts and Storm Drains	5					
Circular Pipes						
Diameter (in)	Length (ft)	No. of Barrels				
48-inch	97	1	97	L.F.	\$240.00	\$23,280.00
48-inch	89	2	178	L.F.	\$240.00	\$42,720.00
Channel Improvements						
Soil Riprap, Type M			291	C.Y.	\$117.00	\$34,047.00
Detention/Water Quality Facilit	ies					
Detention (Complete-in-Place)						
Detention Facility 1 (Complete-in-Place)			6.5	AC-FT	\$76,152.00	\$494,988.00
Removals						
Removal of culvert pipe (D<48")			186	L.F.	\$33.00	\$6,138.00
Landscaping and Maintenance	Improvements					
Reclamation & seeding (native grasses)]		1.3	ACRE	\$1,670.00	\$2,171.00
Land Acquisition						
Easement/ROW Acquisition	1		1.30	ACRE	\$11,228.00	\$14,596,00

Master Plan	Capital Improvement Cost Sur	mmary		
Capital Improvement Costs				
Pipe Culverts and Storm Drains			\$66,000.00	
Concrete Box Culverts			\$0.00	
Hydraulic Structures			\$0.00	
Channel Improvements			\$34,047.00	
Detention/Water Quality Facilities			\$494,988.00	
Removals			\$6,138.00	
Landscaping and Maintenance Improvements			\$2,171.00	
Special Items (User Defined)			\$0.00	
Subtotal Capital Improvement Costs			\$603,344.00	
Additional Capital Improvement Costs				
Dewatering		L.S.	\$0.00	
Mobilization	5%		\$30,167.00	
Traffic Control		L.S.	\$0.00	
Utility Coordination/Relocation		L.S.	\$0.00	
Stormwater Management/Erosion Control	5%		\$30,167.00	
Subtotal Additional Capital Improvement Costs			\$60,334.00	
Land Acquisition Costs				
ROW/Easements			\$14,596.00	
Subtotal Land Acquisition Costs			\$14,596.00	
Other Costs (percentage of Capital Improvement Costs)				
Engineering	15%		\$99,552.00	
Legal/Administrative	5%		\$33,184.00	
Contract Admin/Construction Management	10%		\$66,368.00	
Contingency	25%		\$165,920.00	
Subtotal Other Costs				
Total Capital Improvement Costs			\$1,043,298.00	

Master Plan Operation and Maintenance Cost Summary						
Description	Quantity	Unit	Unit Cost	Total Annual Cost		
Culvert Maintenance (e.g. sediment & debris removal, erosion at entrance/exit, structural repairs, e	359	L.F.	\$2.00	\$718.00		
Detention/WQ Maintenance (e.g. sediment & debris removal, mucking out, tree & weed removal, s	1.3	ACRE	\$2,505.00	\$3,257.00		
Total Annual Operation and Maintenance Cost						
Effective Interest Rate						
Total Operation and Maintenance Costs Over 50 Years						



4.2.5 Major Drainageway 800

Major Drainageway 800 is within the Oklahoma Basin and comprises three reaches. The hydraulic analysis showed that existing channel conditions are fairly stable, but channel improvements may be necessary if peak flows increase with development. There are 6 existing crossings across three reaches.

LID and EURV basins are recommended for all new developments. See Table 4-4 for the Master Plan detention sizes. Note that the largest single improvement cost involves the restoration of function and improvement for the existing Southgate detention basin in Windsor. This study has provided a conservative cost estimate for planning purposes, but there may be opportunities to identify and execute targeted, less costly improvements at this critical stormwater facility during design phases.

Riprap is recommended near the entrance of the existing detention pond, due to significant erosion and steep slopes that result in high water velocities. For the cost estimate, the riprap has been categorized as Type M soil riprap.

Crossing improvements include the removal and replacement of six existing culverts. See Table 4-5 for Master Plan crossing improvements. When these culverts are replaced, the appropriate headwalls, wingwalls, aprons, and energy dissipation features should be designed in detail. Note that we have treated Culvert 805 the same as the other crossings (provide future 100-year conveyance under the roadway), but since this appears to be more of a driveway than a public roadway, we recommend considering smaller solutions that allow overtopping during design phases.

The capital cost of these Master Plan improvements is estimated to be \$11,561,232. The cost of maintenance and operation for 50 years is estimated to be \$1,454,950. A detailed cost analysis is provided in Table 4-7.

Table 4-7 Major Drainageway 800 Cost Estimate						
▼	~	· ·	_	*	~	TOTAL I
DESCRIPTION	1		QUANTITY	UNIT	UNIT COST	COST
Concrete Box Culverts						
Box Culvert Pipe						
Individual Box Span (ft)	Box Height (ft)	No. of Barrels	Length (ft)			
6	5	1	90	L.F.	\$1,095.56	\$98,601.00
8	3	2	62	L.F.	\$2,191.13	\$135,850.00
12	4	1	80	L.F.	\$1,529.18	\$122,335.00
12	4	1	527	L.F.	\$1,529.18	\$805,879.00
9	4	2	74	L.F.	\$2,537.62	\$187,784.00
10	4	1	304	L.F.	\$1,354.93	\$411,900.00
Channel Improvements						
Soil Riprap, Type M			561	C.Y.	\$117.00	\$65,637.00
Detention/Water Quality Faciliti	es					
Detention (Complete-in-Place)						
Detention Facility 1 (Complete-in-Place)			43	AC-FT	\$76,152.00	\$3,282,151.00
Detention Facility 2 (Complete-in-Place)			17	AC-FT	\$76,152.00	\$1,294,584.00
Detention Facility 3 (Complete-in-Place)			2	AC-FT	\$76,152.00	\$182,765.00
Removals						
Removal of culvert pipe (D<48")			62	L.F.	\$33.00	\$2,046.00
Removal of culvert pipe (48" <d<84")< td=""><td></td><td></td><td>905</td><td>L.F.</td><td>\$84.00</td><td>\$76,020.00</td></d<84")<>			905	L.F.	\$84.00	\$76,020.00
Concrete Box Culvert			170	L.F./CELL	\$167.00	\$28,390.00
Landscaping and Maintenance	Improvements					
Reclamation & seeding (native grasses)	-		10	ACRE	\$1,670.00	\$17,034.00
Land Acquisition						
Easement/ROW Acquisition			10.60	ACRE	\$11,228.00	\$119,017.00

Master Plan Capital Improvement Cost Summary					
Capital Improvement Costs					
Pipe Culverts and Storm Drains			\$0.00		
Concrete Box Culverts			\$1,762,349.00		
Hydraulic Structures			\$0.00		
Channel Improvements			\$65,637.00		
Detention/Water Quality Facilities			\$4,759,500.00		
Removals			\$106,456.00		
Landscaping and Maintenance Improvements			\$17,034.00		
Special Items (User Defined)			\$0.00		
Subtotal Capital Improvement Costs			\$6,710,976.00		
Additional Capital Improvement Costs					
Dewatering		L.S.	\$0.00		
Mobilization	5%		\$335,549.00		
Traffic Control		L.S.	\$0.00		
Utility Coordination/Relocation		L.S.	\$0.00		
Stormwater Management/Erosion Control	5%		\$335,549.00		
Subtotal Additional Capital Improvement Costs			\$671,098.00		
Land Acquisition Costs					
ROW/Easements			\$119,017.00		
Subtotal Land Acquisition Costs			\$119,017.00		
Other Costs (percentage of Capital Improvement Costs)					
Engineering	15%		\$1,107,311.00		
Legal/Administrative	5%		\$369,104.00		
Contract Admin/Construction Management	10%	·	\$738,207.00		
Contingency	25%		\$1,845,519.00		
Subtotal Other Costs			\$4,060,141.00		
Total Capital Improvement Costs	_		\$11,561,232.00		

Master Plan Operation and Maintenance Cost Summary						
Description	Quantity	Unit	Unit Cost	Total Annual Cost		
Culvert Maintenance (e.g. sediment & debris removal, erosion at entrance/exit, structural repairs, e	1273	L.F.	\$2.00	\$2,546.00		
Detention/WQ Maintenance (e.g. sediment & debris removal, mucking out, tree & weed removal, s	10.6	ACRE	\$2,505.00	\$26,553.00		
Total Annual Operation and Maintenance Cost		\$29,099.00				
Effective Interest Rate						
Total Operation and Maintenance Costs Over 50 Years						



4.3 Prioritizing and Phasing

Any downstream flood controls and EURVs in the developed portions of the basin should be prioritized before the upstream undeveloped regions. For undeveloped regions, improvements will generally be constructed commensurate with development. There is not currently a visible stream (or obvious low flow channel) in some upstream portions of the study area. Any upstream improvements, particularly along the Highway 34 corridor, will need to take this into account.

Detention and LID (runoff reduction) improvements should be prioritized due to the impact of these structural and non-structural measures on downstream channel stability and flood risk. If detention elements are not implemented, wider stream management corridors than those presented in this document may be required to protect properties from larger peak flows.

4.4 Water Quality Impacts

As the majority of the Oklahoma upper region is historically agricultural or natural land uses, it will be important to protect the major drainageways from urban pollutants as development occurs. This comprehensive drainage plan addresses these water quality concerns through multiple methods. Foremost is the recommendation that LID practices be implemented throughout the watersheds. LID BMPs both reduce runoff and capture pollutants by intercepting, slowing down, and infiltrating surface flows that come from impervious sources such as roadways, buildings, and parking lots.

The Master Plan also recommends the widespread implementation of EURV basins and 100-year detention ponds. These larger scale options are primarily targeted at runoff reduction – not just peak flow reductions but also volume reductions. These controls result in a proposed system that more closely mimics the flow durations and frequencies of a natural system.

4.5 Operations and Maintenance

Regular stream management is recommended to:

- 1. Maintain channel/culvert/hydraulic structure conveyance by removing sediment, trash and debris, which could restrict flow;
- 2. Manage noxious weeds and invasive plant species.

Ongoing maintenance of low maintenance streams, detention ponds, and floodplain culverts is required to protect infrastructure and people. Maintenance is recommended at regular intervals and on an as-needed basis (after significant flood events or growth of invasive species). Critical crossings structures and detention basins may need to be cleaned out on a more frequent basis to maintenance system functionality.

Regarding detention, the regional 100-year detention basins maintained by the City of Greeley and the Town of Windsor will require much less maintenance if the upstream distributed LID and EURV basins are functioning properly. While the maintenance burden of these smaller drainage features will be held by the private owners, it is recommended that Greeley and Windsor implement a regular inspection program to ensure that all components of the Master Plan drainage system are kept in satisfactory condition. Overall, implementation of the improvements to provide 100-year capacity should result in reduced maintenance costs after major flood events.

4.6 Environmental and Safety Assessment

The holistic approach described in this Master Plan will result in improved environmental outcomes compared to a standard piecemeal development process. Each major drainageway should be considered as a connected system. The widespread adoption of LID practices should create a proposed system that more closely matches the natural ecosystem. Incorporating natural system processes into detention basins and stream corridors where possible will also support a healthy ecosystem, which in turn provides many health benefits to humans.

The flood control improvements described in this Master Plan will result in improved safety within the Oklahoma Basins 700 and 800. The LID practices, EURV basins, 100-year detention ponds work together to reduce runoff, which can lessen the impacts of flood hazards to property and humans during large storm events. The stream management corridors improvements will also improve safety by stabilizing channels and more clearly defining the conveyance areas that should be avoided during floods. Lastly, the proposed crossing improvements will explicitly improve safety by conveying storm flows up to the 100-year event through culverts instead of allowing the roadway and railroad embankments to overtop.



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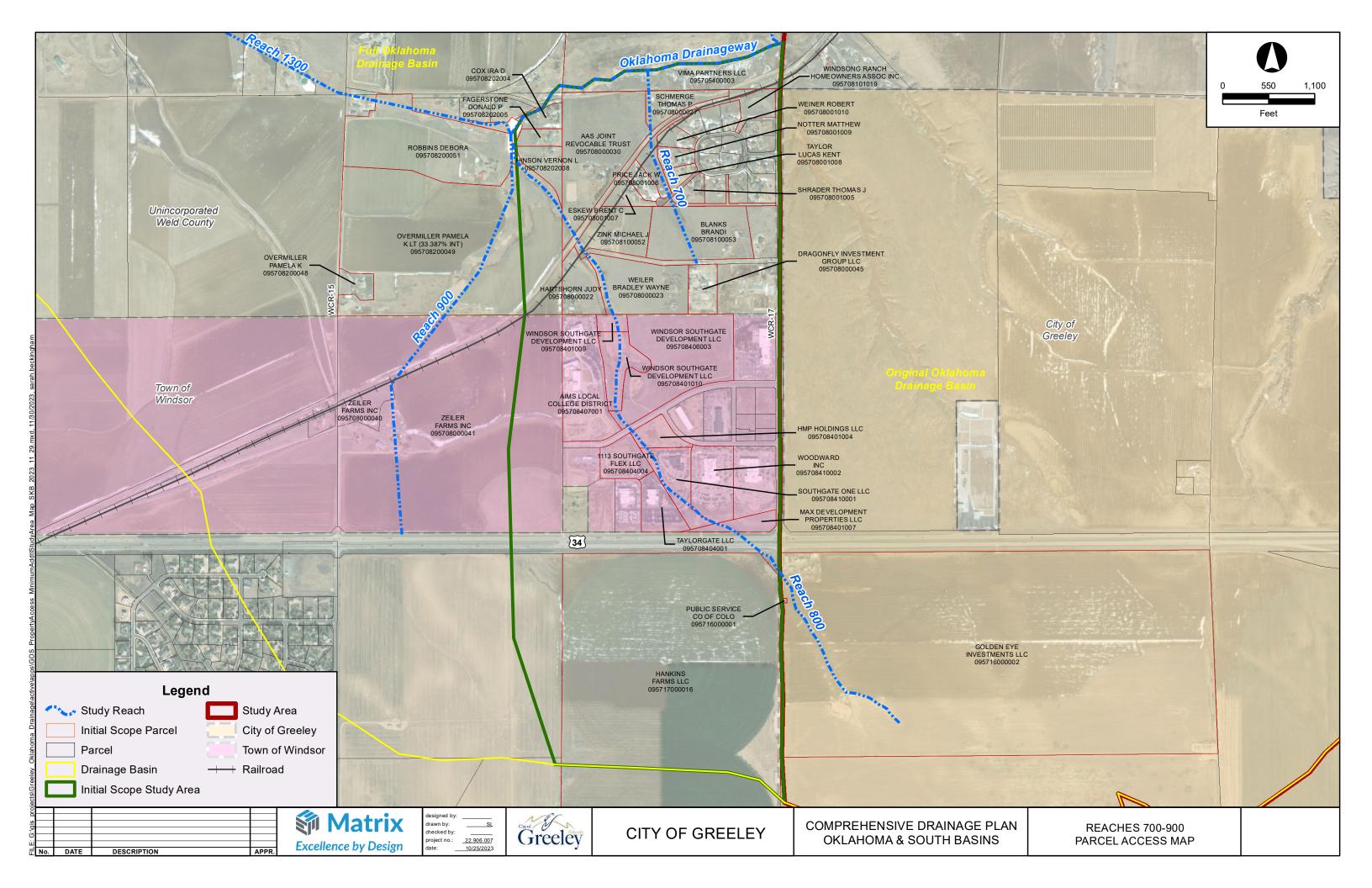
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Appendix A – Project Correspondence





Matrix Design Group, Inc. 707 17th Street, Suite 3150 Denver, CO 80202 O 303.572.0200 F 303.572.0202 matrixdesigngroup.com

KICK-OFF MEETING NOTES Greeley Comprehensive Drainage Plan Oklahoma Basins 700-800 January 31, 2024 at 8am

Teams Meeting

Attendees:

Bhooshan Karnik	City of Greeley	970-573-0331	bhooshan.karnik@greeleygov.com
Aaron Stines	City of Greeley	970-302-0461	aaron.stines@greeleygov.com
Ryan Davis	Bolton & Menk	515-988-8013	ryan.davis@bolton-menk.com
Ben Liu	Matrix Design Group	303-572-0200	ben.liu@matrixdesigngroup.com
Drew Beck	Matrix Design Group	303-572-0200	drew.beck@matrixdesigngroup.com

Key: blue text indicates meeting notes, <u>red italic underlined text indicates action items</u>

1. Introductions

- a. Roles
 - i. Bhooshan = Greeley Deputy Director/Chief Engineer, PM of interchange project
 - ii. Aaron = Greeley PM for this study
 - iii. Ryan = Bolton Menk PM for interchange project
 - 1. ICON is BM stormwater consultant (Craig Jacobsen)
 - 2. Don Sterna is design manager for BM project
 - iv. Ben = Matrix PM for this study
 - v. Drew = Matrix Director of Water Resources
- b. Contact Information (see above)

2. Contract Status

- a. Matrix will be subconsultant to Bolton & Menk
 - i. Ryan will send sub-agreement to Greeley today (under Task 8)
 - ii. Ryan to send Matrix terms and conditions of sub agreement
 - 1. Greeley terms will also apply
 - iii. Probably will be another week before contract is signed
 - iv. Matrix will send invoices directly to Ryan Davis
- b. Initial proposal submitted to Greeley November 2, 2023
- c. Notice to Proceed received December 19, 2023
- d. Revised proposal submitted to Bolton & Menk January 9, 2024

3. Project Purpose

- a. Sponsor goals and objectives
 - i. Greeley wants to see accurate crossing sizings based on future developments
 - ii. Greeley wants to see regional storm approach instead of driven by individual developers, piecemeal approach in other areas has resulted in more flow/sediment than expected at downstream components
- b. How this ties into other projects
 - i. US34/CR17 intersection project going on now, may turn into interchange in ~20 yrs

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- ii. Already in discussions with Delantero/Roache developments, they seem open to regional drainage approach. Delantero would like their plans approved this summer with construction in late 2024, Roache would like to start in 2025
- c. Include Town of Windsor and/or Weld County?
 - i. Windsor is trying to do drainage study (Wilson & Company, Dan Evans) of WCR-17 crossing *Ben to reach out, Aaron to send contacts*
 - ii. Windsor and Weld County are not sponsors/formal stakeholders
 - iii. Greeley long-range area extends to WCR-17

4. Project Schedule

Dr	Drainageways 700/800 Schedule			2024											
TΑ	ASK	Jan		Feb		Mar		Apr		May		Jun		Jul	
1	PROJECT MANAGEMENT & COORDINATION														
2	PROGRESS MEETINGS														
5	DATA COLLECTION														
6	BASELINE HYDROLOGY AND HYDRAULICS														
Ľ	Greeley Review														
7	ALTERNATIVES ANALYSIS: DWYS 700/800														
Ĺ	Greeley Review														
Г	CONCEPTUAL DESIGN REPORT: DWYS 700/800														
8	Greeley Review														
L	Final Deliverable														

- a. Who will review and can they be done in 2 weeks?
 - i. Aaron will review and can complete reviews in less than 2 weeks
 - ii. Submittals should go through Bolton Menk
 - iii. Suggest scheduling meeting with Delantero/Roache after Alternatives Analysis
- b. Aaron will get back to us on parcel access timeline
- c. Group accepted above schedule as appropriate
 - i. Ben noted that we are currently one week behind due to lengthy contracting process, Matrix cannot submit deliverable until contract is enacted

5. Project Deliverables

- a. Parcel access maps submitted to Greeley November 30, 2023
- b. Draft land use maps submitted to Greeley January 25, 2024
 - i. Aaron says they look reasonable, and also conform to Windsor plans
- c. Project Status
 - i. Ben provided update on hydrology progress
 - ii. Initial modeling expected to be complete this week
- d. Future deliverables:
 - i. Baseline Hydrology Report
 - ii. Alternatives Analysis Report
 - iii. Conceptual Design Report
- e. Each deliverable report will build on the last

Page 2



6. Data Gathering

- a. Site survey access
 - i. We already have access to any property that touches US-34, ¼ mi south and 1/2 mi north that touch WCR-17 (*Ryan will send their access map*)
- b. Are utility locates desired? Not needed for this study
- c. Known existing studies:
 - i. Imagine Greeley Comprehensive Plan (2018)
 - ii. Windsor Master Drainage Plan (2003)
 - iii. Windsor Comprehensive Plan (2016)
 - 1. Windsor is in middle of updating, draft expected in a week
 - 2. Our study area is unlikely to change
 - iv. Windsor Open Space and Trails Strategic Plan (2022)
 - v. Weld County Property Portal (online)
 - vi. Delantero preliminary drainage report
- d. Other sources?

7. Additional Topics

a. Copy Ryan on all emails, can also copy Bhooshan

Page 3



Matrix Design Group, Inc. 707 17th Street, Suite 3150 Denver, CO 80202 O 303.572.0200 F 303.572.0202 matrixdesigngroup.com

WINDSOR/GREELEY COORDINATION MEETING NOTES Greeley Comprehensive Drainage Plan Oklahoma Basins 700-800 February 12, 2024 at 10am

Teams Meeting

Attendees:

Dan Evans	Wilson & Company	Daniel.Evans@wilsonco.com
Aaron Stines	City of Greeley	aaron.stines@greeleygov.com
Ryan Davis	Bolton & Menk	ryan.davis@bolton-menk.com
· ·		ben.liu@matrixdesigngroup.com
Doug Roth	Town of Windsor	droth@windsorgov.com

- Anderson did an analysis/report on this area last July (focus was on WCR-17 crossing)
- During reviews, Doug identified different routing from 2003 Windsor MDP
 - Potential overtopping at WCR-17
 - This triggered Dan's involvement to update Master Plan model
- Windsor needs WCR-17 concept crossing cost estimates by June/July
 - Wilson will have updated models in Mar/Apr
 - o They are primarily interested in the upstream part of watershed
- New Windsor comprehensive plan coming out, Doug posted draft link: https://plan.konveio.com/draft-town-windsor-comprehensive-plan
- Aaron confirmed that Greeley is looking to update hydrology for the full Oklahoma Basin
 - o CDOT should be involved in SH-257 discussion
- Which detention ponds should be modeled in hydrology/master plan?
 - Ben said their conservative practice was to only count regional or publicmaintained facilities
 - Dan says Ft Collins followed FEMA requirements (ponds modeled as full)
 - Doug says maintenance agreements for developer ponds are required, should result in better conditions
- Matrix will send Oklahoma Basins 700 & 800 hydrology to Wilson

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GO_BaselineHydrology_Report_Draft-Compiled Comments.pdf Markup Summary

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Subject: Re: Engineer Revised Page Label: 18 Author: ben liu Date: 6/14/2024 9:32:37 AM Status: Color: Layer: Space: Subject: Engineer Report starts with stating that the area is 1.32 sq. Page Label: 18 miles. This portion can be confusing and seems to Author: stinesa suggest a correction factor is used. Recommend Date: 4/19/2024 8:13:26 AM rewording this section to make what was done Status: more clear. Color: Layer: Space: Subject: Re: Engineer Added additional sentence about not using Page Label: 18 correction factors. Author: ben liu **Date:** 6/14/2024 9:33:17 AM Status: Color: Laver: Space: Subject: Engineer This is confusing. Statement says the study Page Label: 21 used...,which were not available. consider Author: stinesa rewording. Date: 4/19/2024 8:14:22 AM Status: Color: Laver: Space: Subject: Re: Engineer Revised Page Label: 21 Author: ben_liu **Date:** 6/14/2024 9:33:47 AM Status: Color: Layer: Space: Subject: Engineer Legend for Interactive figures Page Label: 31 Author: stinesa Date: 4/22/2024 11:30:54 AM Status: Color: Layer: Space:

Subject: Re: Engineer We believe this is already implied Page Label: 31 Author: ben liu Date: 6/14/2024 9:34:37 AM Status: Color: Layer: Space: Subject: Engineer "interactive" Page Label: 31 Author: stinesa Figu Date: 4/22/2024 11:30:33 AM Hydrolog Status: rainage Basins 700 Color: Layer: Space: Subject: Re: Engineer Revised Page Label: 31 Author: ben liu **Date:** 6/14/2024 9:36:33 AM Status: Color: Laver: Space: Subject: Engineer Are either of these on the map? Also Freshwater Page Label: 62 Pond and Forested/Shrub... are very similar in Author: stinesa color. Consider removing if not on the map and Date: 4/19/2024 8:16:14 AM considering altering color to be distinct. Status: Color: Laver: Space: Subject: Re: Engineer Revised symbology Page Label: 62 Author: ben_liu **Date:** 6/14/2024 9:39:42 AM Status: Color: Layer: Space: Subject: Engineer Shut in well is not indicated in legend. Page Label: 63 Author: stinesa Date: 4/19/2024 8:16:47 AM

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ubject: Re: Engineer age Label: 63 uthor: ben_liu ate: 6/14/2024 9:40:20 AM tatus: olor:		
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July 8, 2024

VIA ELECTRONIC MAIL

Matrix Design Group Ben Liu 707 17th Street, Suite 3150 Denver, Colorado 80202

RE: Alternative Selection – Oklahoma Master Plan Basins 700 & 800

Dear Mr. Ben Liu,

The City of Greeley Stormwater Division has concluded its review of the Alternatives Analysis Report for the Oklahoma Master Plan Basins 700 & 800. The City elects to adopt the recommended plan and selects Option 4: LID, Detention and Channel Improvements for each basin.

Sincerely,

Aaron Stines

Stormwater Engineer

Public Works Department, Stormwater Division

2835 W. 10th Street, Greeley, CO 80631

Aaron.Stines@Greeleygov.com

2024_06_18_GO_Alternatives Analysis_Report-ALS COMMENTS.pdf Markup Summary

Engineer (17)		
26 F F F F	Subject: Engineer Page Label: 5 Author: stinesa Date: 7/2/2024 10:12:18 AM Status: Color: Layer: Space:	
_	Subject: Sticky Note Page Label: 5 Author: sabastian.ortega Date: 7/9/2024 1:46:49 PM Status: Color: Layer: Space:	Revised
15 Figure 2-2	Subject: Engineer Page Label: 5 Author: stinesa Date: 7/2/2024 10:12:29 AM Status: Color: Layer: Space:	
	Subject: Sticky Note Page Label: 5 Author: sabastian.ortega Date: 7/9/2024 1:46:45 PM Status: Color: Layer: Space:	Revised
All the margin and dark for the sury ware deadler for the sury	Subject: Engineer Page Label: 8 Author: stinesa Date: 7/2/2024 10:19:03 AM Status: Color: Layer: Space:	
_	Subject: Sticky Note Page Label: 8 Author: sabastian.ortega Date: 7/9/2024 1:47:38 PM Status: Color: Layer:	Changed to "Measurements of existing roadway crossings were completed by Matrix in March 2024."

Subject: Engineer "3-2" Page Label: 20 Author: stinesa Date: 7/2/2024 2:27:43 PM 1-Hour Point Status: Color: Layer: Space: Subject: Sticky Note Revised Page Label: 20 Author: sabastian.ortega Date: 7/9/2024 1:48:03 PM Status: Color: Layer: Space: Subject: Engineer itation depths Page Label: 20 3 Tabe Thes Author: stinesa Date: 7/2/2024 2:30:21 PM storms in the Status: Color: Layer: Space: Subject: Sticky Note Revised Page Label: 20 Author: sabastian.ortega Date: 7/9/2024 1:47:51 PM Status: Color: Layer: Space: Subject: Engineer both ina Page Label: 23 Othis st Author: stinesa Date: 7/2/2024 3:28:37 PM 3.1.8 Results Status: Color: Layer: Space: Subject: Sticky Note Fixed Page Label: 23 Author: sabastian.ortega Date: 7/8/2024 9:56:00 AM Status: Color: Layer: Space:



Subject: Engineer Page Label: 26 Author: stinesa

Date: 7/3/2024 7:46:23 AM

Status: Color: Layer: Space:

Subject: Sticky Note Page Label: 26

Author: sabastian.ortega Date: 7/9/2024 1:48:50 PM

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Subject: Engineer

Page Label: 26 Author: stinesa

Date: 7/3/2024 7:47:47 AM

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Page Label: 26

Author: sabastian.ortega Date: 7/9/2024 1:48:54 PM

Status: Color: Layer: Space:

Subject: Engineer

Page Label: 26 Author: stinesa

Date: 7/3/2024 7:49:43 AM

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Subject: Sticky Note Page Label: 26

Author: sabastian.ortega Date: 7/9/2024 1:48:57 PM

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Subject: Engineer Page Label: 26 Author: stinesa

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Subject: Sticky Note

Page Label: 26

Author: sabastian.ortega Date: 7/9/2024 1:49:01 PM

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Revised

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Revised

consider rewording

Subject: Engineer Page Label: 25 Author: stinesa

Date: 7/3/2024 7:51:33 AM

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Subject: Sticky Note Page Label: 25 Author: sabastian.ortega

Date: 7/9/2024 1:48:26 PM Status: Color:

Layer: Space:

Subject: Engineer Page Label: 27

Author: stinesa Date: 7/3/2024 8:06:35 AM

Status: Color: Layer: Space:

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Subject: Sticky Note Page Label: 27

Author: sabastian.ortega Date: 7/9/2024 1:49:39 PM

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e recommended alternatives for long-range emplementations. 20 and 500 were evaluated comprehensively, so that rain maches could by pleasurement. Combinations of 21 included designed and of recessary, cleared larger channel impregements to address reach stability. Late commend the production and commend of the country o	Subject: Engineer Page Label: 27 Author: stinesa Date: 7/3/2024 8:11:06 AM Status: Color: Layer: Space:	","
\	Subject: Sticky Note Page Label: 27 Author: sabastian.ortega Date: 7/9/2024 1:49:31 PM Status: Color: Layer: Space:	Revised
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_•	Subject: Sticky Note Page Label: 28 Author: sabastian.ortega Date: 7/9/2024 1:49:50 PM Status: Color: Layer: Space:	Revised

Subject: Engineer 1' per report Page Label: 30 Author: stinesa Date: 7/3/2024 10:21:35 AM Status: Color: Layer: Space: Subject: Sticky Note Changed to 1' Page Label: 30 Author: sabastian.ortega Date: 7/9/2024 1:50:01 PM Status: Color: Layer: Space: Subject: Engineer Provide title for each option selected Page Label: 96 Author: stinesa Date: 7/5/2024 11:45:39 AM Status: Color: Layer: Space: Subject: Sticky Note Revised Page Label: 96 Author: sabastian.ortega Date: 7/9/2024 1:50:15 PM

Status: Color: Layer: Space:

Comments from Mary Mateo

Alts Analysis, July 12, 2024 Greeley Comments: Black text Matrix Responses: Blue text

Referencing Tables 3-14 and 3-15 below, MHFD Detention Workbooks are not included in Appendix E-2 for: D841 EURV 840 EURV 842. Also, there is a workbook for EURV 823, but this is not shown in the tables below.

Table 3-14 Option 2 Detention Basin Summary

Detention Facility No.	Reach Location	Contributing Subbasins	Storage Volume (acre-feet)	Drainage	Proposed Detention Facility (Q100 Future Sizing)			
				Area (acre)	Size (acre)	Peak Inflow (cfs)	Peak Outflow (cfs)	
D711	700	712 6.5		90.0	1.6	172	129	
D823	829	820/830/824/844	43	327.0	6.3	793	356	
D841	843	842/850	25	210.6	12.2	647	41	
D844	844	844	17	126.7	4.4	523	204	

Table 3-15 Option 4 LID Detention Basin Summary

	Reach Location	Contributing Subbasins	Drainage Area (acre)		EURV Ponds				Flood Control Ponds			
Detention Facility No.					Storage Volume (acre- feet)	Size (acre)	Peak Inflow (cfs)	Peak Outflow (cfs)	Storage Volume (acre- feet)	Size (acre)	Peak Inflow (cfs)	Peak Outflow (cfs)
D_EURV_711	700	712	90.0	30.2%	2.40	0.60	170	155	6.5	1.3	155.2	110.8
D_EURV_820	829	820	81.0	69.80%	5.50	1.30	332	240		-		
D_EURV_830	829	830	829.0	67.80%	5.60	1.50	293	193				
D_EURV_840	843	840	63.0	76.5%	5.40	3.10	200	165		-		
D_EURV_842	843	842/850	210.5	68.6%	14.30	9.50	646	328	2.4	0.6	328.3	284.0
D_EURV_844	N/A (Upstream of 843)	844	126.5	76.2%	9.40	2.30	523.28	382.80	-	-	-	-
D_FC_823	829	820/830/844/842/840	327.0	73.0%	-	-	-	-	20.0	5.0	474.7	261.0
D_FC_838	829	844	126.5	76.2%	-	-	-		17.3	3.3	524.4	292.0

Response:

EURV 823 was removed, and D841, EURV 840, and EURV 842 are now added to the Appendix.

How were the stage storage tables created for the proposed detention basins?

MHFD detention workbooks created stage storage tables by incorporating a sub-basin characteristic along with variables determined by Matrix. These variables were the same across every workbook, with the sub-basin characteristic being the only difference between them. With the exception of (Pre-existing) Detention Basin 823, conceptual detention basins assumed the minimum rectangular footprint with 4:1 Side slopes that would results in the required volume. This can be found in section 3.3.4 Alternatives Modeling, under option 2.

Discuss the placement of EURV Ponds with Flood Control Ponds and LID for Option 4?

EURV and flood control were placed upstream of any channels that had a velocity greater than 5 ft/s. This can be found in section 3.3.4 Alternatives Modeling, under option 4.

Why is the watershed length for Detention 711 different than that for EURV/Flood Control 711.

Thank you for catching this. This was fixed and replaced back into the report. This can be seen in Appendix E-2.

Per Section 3.3.4 Option 2 – Detention, "The design 100-year depth for the detention basins was six feet to avoid additional requirements associated with jurisdictional dams." However, the MHFD Detention Workbooks for Option 2, Detention 823 and Option 4, Flood Control 823 show the 100-year volume at 10' of depth. The areas indicated at stages 8.49', 9.00' and 10.00' of the workbook for Option 2, Detention 823 are all identical, as are the areas indicated at stages 4.00' through 10.00' of the workbook for Option 4, Flood Control 823.

823 is an existing detention basin with a previously designed depth of 10 ft. We attempted to keep the concept geometry similar to the original design when possible. This has been written in the report, In section 3.3.4 Alternatives Modeling Option 2.

These measurements were taken from an older report of the area, with the measurements of the existing detention pond. In section 3.3.4 Alternatives Modeling Option 2.

Thank you for noticing Option 4 Flood Control 823 error. We have corrected the rating table to now match the other 823 geometries.

Tables 3-8 and 3-12 use different Manning's n values for Reinforced Concrete Pipe. Should this be consistent in all applications?

It will be noted in the sections that the Mannings between the HY and SWMM are different. This can be found in section 3.2.1 Evaluation of Existing Facilities.

Section 3.1.7 Last bullet point references Section "0"

Done

Section 3.2.1

Last paragraph references culvert 807 then culvert 803. One of these appears to be a typo.

Next to last paragraph – typo – "possibility" should be possibly.

Done

Section 3.2.2 First paragraph – typo – "steam" characterization should be streaming characterization.

Done

Section 3.3.2 First paragraph – "the performance entire drainageway" should read "the performance of the entire drainageway."

Done

Section 3.3.4

Option 2 – second paragraph – text missing from next to last sentence.

Option 3 – second paragraph – text missing from last sentence.

Done

On Page 38 of 188 – Heading is 3.3.1 Alternative Plans – should be 3.3.6? Also, reference to Figure 3-3 in this section appears to be incorrect.

Done

Figure 3-3 indicates 1.5' of freeboard – report indicates 1' (Sections 3.3.3 and 3.3.4 regarding Channel Improvements).

Done

Comments from BF

Concept Design Draft, July 29, 2024 Greeley Comments: Black text Matrix Responses: Blue text

Figure 2-14 is missing an image for design point 701

The inclusion of Structure 701 in the imagery was not possible for several reasons. Firstly, the property owner did not permit the use of images of their land for Matrix. Second, the pipe is submerged in a private pond- although no size could be verified, we believe it is a small diameter pipe.

Figure 2-15 and 2-16 seem unnecessary

The Greeley Project, comprising three main reports, includes a comprehensive analysis of land use. The first report does have areas with public lands along with parks and open spaces. Although the second report covers an area lacking public lands and parks, it still includes maps depicting these features to offer a comprehensive overview of Greeley's land allocation. This approach ensures a complete picture of the city's landscape, highlighting both the presence and absence of public recreational spaces across different sectors

• Pg 18 (25/254) Table 3-10 and 3-11: Are there only 2 key locations (at the outfall)? Would any other points within the model be helpful to have in a table?

To maintain consistency across drainageways, we initially designated a single key point for both Drainageway 700 and Drainageway 800, with the latter's key point being its outfall. However, upon further consideration, we have decided to add a second key location for Drainageway 800 at structure 809, us-34 upstream of the highway.

• Pg 19 (26/254) I am unclear why culvert 703 is not in the report. Sentence states it is at the end of a small embankment, but why is that reason to remove it from the report? Also what is meant by these two culverts are not in the report? Does that mean they were not modeled? Not accounted for?

We will change confusing terminology -- 806 is a detention pond outlet pipe and should not be calculated as a culvert. 703 is a small-diameter pipe through a small, informal embankment. Based on our field observations, we believe 703 is intended to provide some positive drainage but it not a major crossing structure. It is possible that this embankment could be removed in the future if the drainageway is improved so we do not wish to include in the major crossing analysis.

• Table 3-13 seems unnecessary

While Table 3-13 seem unnecessary since both drainageways covers all alternative options, we chose to keep it in the report to facilitate merging this 700 & 800 study into the larger Oklahoma report (that includes more variety).

• Pg 44 (51/254) Stormwater Detention Facility Guidelines references the old City criteria. All references within the master plan should be updated to reference the new criteria. Beyond the references the document should align with the latest criteria.

Thank you for catching that, the wrong date was written, and all data in the report should be referencing the March 2024 updated report.

Comments from MM

Concept Design Draft, July 29, 2024 Greeley Comments: Black text Matrix Responses: Blue text

Section 4.2 – 2nd paragraph – City "of" Greeley

This will be fixed in the final concept design.

End of page 39 and beginning of page 40 – text doesn't flow.

This will be changed to "The following sections describe overall guidelines, current elements and practices to employ, definitions of elements, as well as individual guidelines for elements to achieve the concept design."

Page 41 – Permeable pavement – typo "though" should be "through"

Retention ponds/constructed wetland ponds - typo "though" should be "through"

Thank you for catching those spelling mistakes, that will be fixed in the final version.

End of page 43 and beginning of page 44 – text doesn't flow.

This was rewritten as "Figure 4.5 shows natural elements that can be incorporated into online detention basins (situated within the primary flow channel) to fulfill multiple purposes." Can be found on page 43-44.

Page 44 – Stormwater Detention Facility Guidelines – 1st paragraph – reference current (2024) City of Greeley stormwater criteria.

we will get that fixed.

Page 45 – Channel Guidelines – 1st paragraph - reference current (2024) City of Greeley stormwater criteria. we will get that fixed.

Page 46 – add period at end of sentence.

Thank you for catching that, we will get that fixed.

Section 4.2.4 3rd paragraph needs reworded.

This was reworded to "Riprap is recommended near the outfall of 700 due to significant erosion and steep slopes that result in high water velocities. For the cost estimate, the riprap has been categorized as Type M soil riprap." And can be found in Section 4.2.4 3rd paragraph

Section 4.2.5 3rd paragraph needs reworded.

This was reworded to "Riprap is recommended near the entrance of the existing detention pond, due to significant erosion and steep slopes that result in high water velocities. For the cost estimate, the riprap has been categorized as Type M soil riprap.." And can be found in Section 4.2.5 3rd paragraph

Tables 4-6 and 4-7 Descriptions under Master Plan O&M Cost Summary are cut off.

The full description can be seen in Appendix F-7. The summaries on Section 4 had to be truncated to fit on a single page with the description.

2024-07-15 GO_Concept Design_Report_Draft-ALS Comments.pdf Markup Summary

Engineer (17) Subject: Engineer "improve on" or "improving"? Page Label: 2 Author: stinesa Date: 7/19/2024 2:38:01 PM Status: Completed set by sabastian.ortega on 7/29/2024 at 8:23:24 AM Color: Laver: Space: Subject: Sticky Note Will remove "Improve of" and replace with Page Label: 2 Author: sabastian.ortega Date: 7/30/2024 3:28:59 PM Status: Color: Layer: Space: Subject: Engineer "Basin.' Page Label: 3 Author: stinesa Date: 7/19/2024 2:38:25 PM Status: Completed set by sabastian.ortega on 7/29/2024 at 8:25:13 AM Color: Layer: Space: Subject: Sticky Note Change to Basin Page Label: 3 Author: sabastian.ortega Date: 7/30/2024 3:29:28 PM Status: Color: Layer: Space: Subject: Engineer Should this be "surface area of these ponds?" or Page Label: 3 "water surface area of these facilities?" Just trying Author: stinesa to eliminate any confusion. Date: 7/19/2024 2:38:36 PM Status: Completed set by sabastian.ortega on 7/29/2024 at 8:26:27 AM Color: Layer: Space:

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                Author: stinesa
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Subject: Sticky Note

Subject: Sticky Note Fixed Page Label: 29 Author: sabastian.ortega Date: 7/30/2024 3:32:42 PM Status: Color: Layer: Space: Subject: Engineer Page Label: 45 n Figures G 1 of Appendix G. The Plan improvements are intended City Greeley drainage criteria. Author: stinesa Date: 7/22/2024 10:26:46 AM Status: Completed set by sabastian.ortega on 7/29/2024 at 8:45:40 AM Color: Layer: Space: Subject: Sticky Note Fixed Page Label: 45 Author: sabastian.ortega Date: 7/30/2024 3:33:08 PM Status: Color: Laver: Space: Subject: Engineer "Basin is" Page Label: 45 Author: stinesa Date: 7/22/2024 10:32:48 AM Status: Completed set by sabastian.ortega on 7/29/2024 at 8:45:45 AM Color: Layer: Space: Subject: Sticky Note Fixed Page Label: 45 Author: sabastian.ortega Date: 7/30/2024 3:33:05 PM Status: Color: Layer: Space: Subject: Engineer "were' Page Label: 46 Author: stinesa Date: 7/22/2024 10:37:12 AM Status: Completed set by sabastian.ortega on 7/29/2024 at 8:48:04 AM Color: Layer: Space:

Subject: Sticky Note Fix Page Label: 46 Author: sabastian.ortega Date: 7/30/2024 3:33:24 PM Status: Color: Layer: Space: Subject: Engineer Consider revising this sentence Page Label: 46 Author: stinesa Date: 7/22/2024 10:48:12 AM Status: Completed set by sabastian.ortega on 7/29/2024 at 8:53:37 AM Color: Layer: Space: Subject: Sticky Note fix Page Label: 46 Author: sabastian.ortega Date: 7/30/2024 3:33:27 PM Status: Color: Laver: Space: Subject: Engineer "Basin" Page Label: 51 Author: stinesa Date: 7/22/2024 11:09:33 AM Status: Completed set by sabastian.ortega on 7/29/2024 at 8:54:04 AM Color: Layer: Space: Subject: Sticky Note fixed Page Label: 51 Author: sabastian.ortega Date: 7/30/2024 3:33:49 PM Status: Color: Layer: Space: Subject: Engineer "was observed" Page Label: 51 Author: stinesa Date: 7/22/2024 11:13:00 AM Status: Completed set by sabastian.ortega on 7/29/2024 at 8:54:33 AM Color: Layer:

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Subject: Sticky Note fixed Page Label: 51 Author: sabastian.ortega Date: 7/30/2024 3:33:47 PM Status: Color: Layer: Space: Subject: Engineer "to" be equal or less than the exi Page Label: 52 Author: stinesa Date: 7/23/2024 7:58:42 AM Status: Completed set by sabastian.ortega on 7/29/2024 at 8:55:57 AM Color: Layer: Space: Subject: Sticky Note added Page Label: 52 Author: sabastian.ortega Date: 7/30/2024 3:33:59 PM Status: Color: Laver: Space: Subject: Engineer "summarized"? Page Label: 54 Author: stinesa Date: 7/29/2024 9:00:22 AM Status: Completed set by sabastian.ortega on 7/29/2024 at 9:00:20 AM Color: Layer: Space: Subject: Sticky Note Fixed Page Label: 54 Author: sabastian.ortega Date: 7/30/2024 3:34:05 PM Status: Color: Layer: Space: opportunities to identify Subject: Engineer luring design phases. Page Label: 55 vere summaries as sc Author: stinesa Date: 7/23/2024 8:14:45 AM cement of six existing of Status: Completed set by sabastian.ortega on 7/29/2024 at 9:00:28 AM Color: Layer: Space:

Subject: Sticky Note Fixed Page Label: 55 Author: sabastian.ortega Date: 7/30/2024 3:34:17 PM Status: Color: Layer: Space: -----environmental c Subject: Engineer inageway should Page Label: 56 create in a prop Author: stinesa n which in turn r Status: Completed set by sabastian.ortega on 7/29/2024 at 8:59:38 AM Color: Layer: Space: Subject: Engineer Repeat of previous page Page Label: 62 Author: stinesa Date: 7/23/2024 9:16:22 AM Status: Completed set by sabastian.ortega on 7/29/2024 at 8:56:21 AM Color: Layer: Space: Subject: Sticky Note Removed Page Label: 62 Author: sabastian.ortega Date: 7/30/2024 3:34:35 PM

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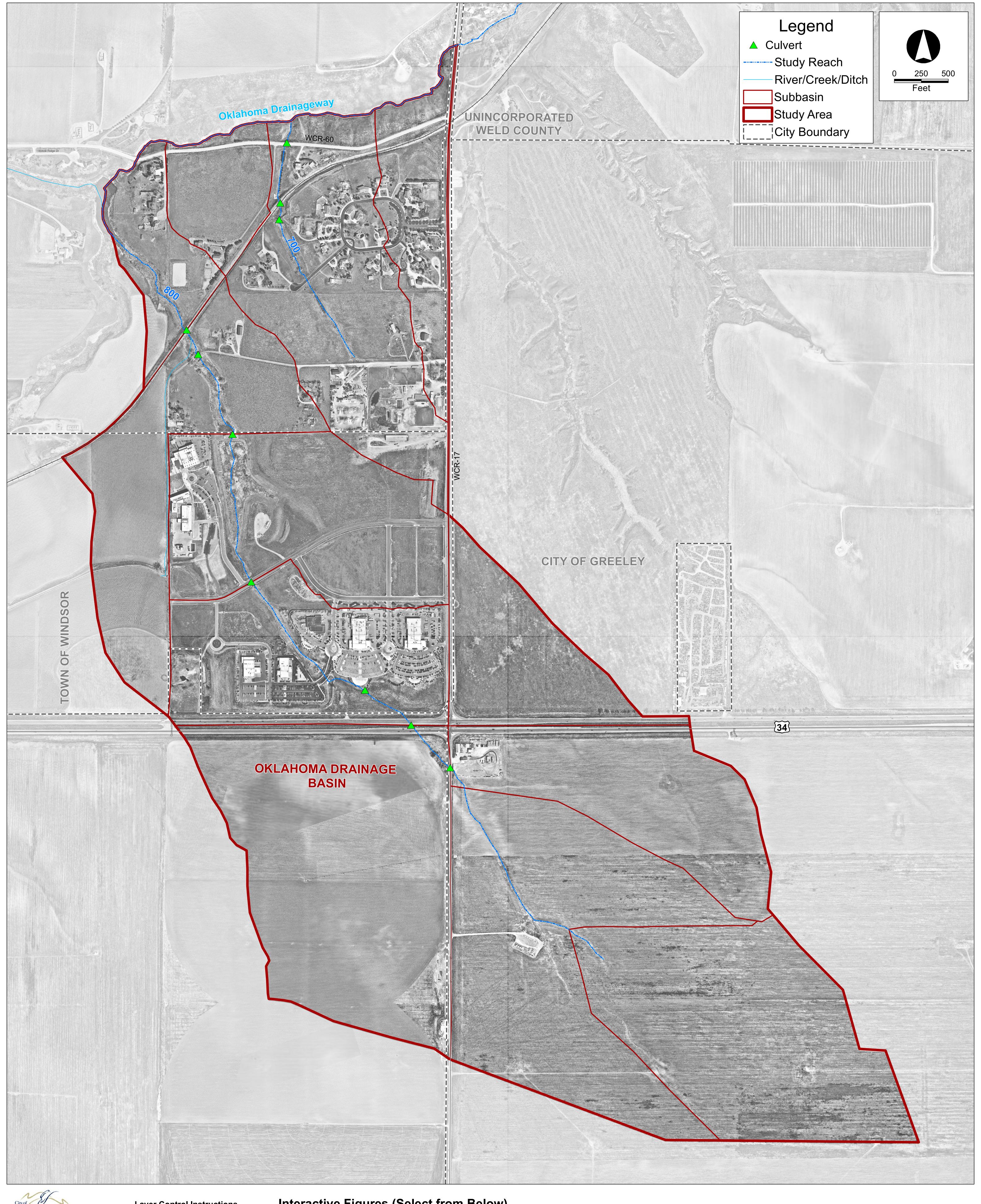
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Appendix B – Hydrologic Analysis





Layer Control Instructions

The Map Controls to the right set the visibility of the layers automatically for the selected map. Additional layer control is available through the "Layers" Navigational Panel which can be accessed from the View Menu under Navigational Panels. In the Panel, the visibility of layers and layer groups can be changed by clicking the square left of the layer/group. An eye in the square indicates that the layer is on. An empty square indicates that the layer is off. Layer groups can be expanded and reduced by clicking the +/-symbol left of the layer/group

Interactive Figures (Select from Below)

Study Area Map

Existing Land Use Map

Future Land Use Map

Hydrologic Soils Groups

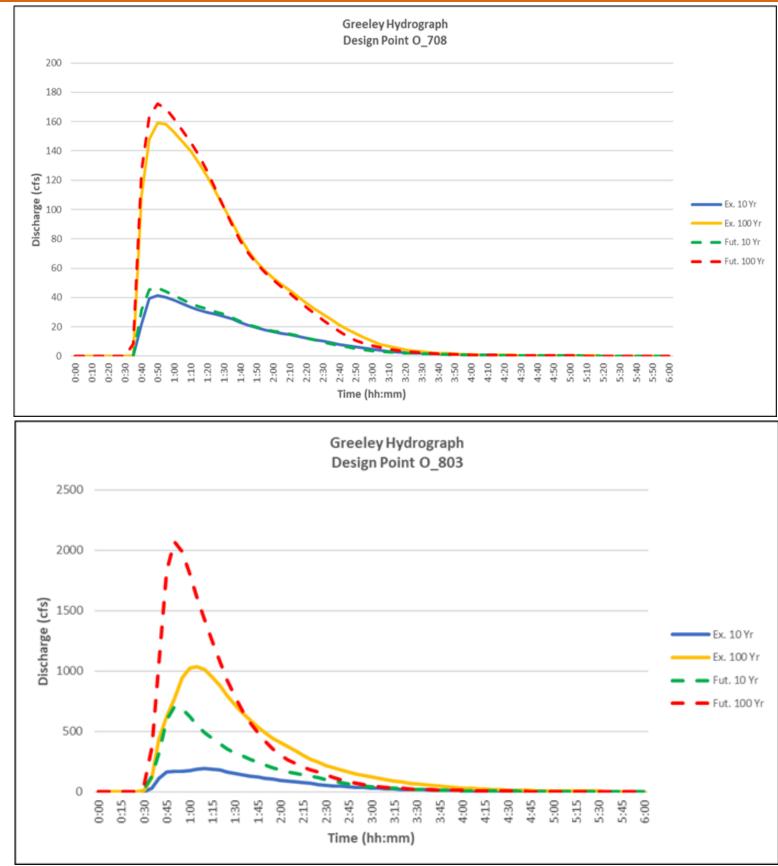
Existing Imperviousness Map

Future Imperviousness Map

Baseline Hydrology SWMM Routing Map

Figure B-1
Interactive Hydrology Map
Oklahoma Drainage Basins 700 & 800





Appendix B - Hydrologic Analysis



Return Period	2-Year		Return Period	5-Year		Return Period	10-Year		Return Period	25-Year	Return Period	50-Year	Return Period	100- Year
1Hr Depth	0.84		1Hr Depth	1.12		1Hr Depth	1.40	-	1Hr Depth	1.87	1Hr Depth	2.31	1Hr Depth	2.8
6Hr Depth	1.28		6Hr Depth	1.67		6Hr Depth	2.08	<u> </u>	6Hr Depth	2.78	6Hr Depth	3.41	6Hr Depth	4.11
Area Adjust	0 Sq. Mi.		Area Adjust	0 Sq. Mi.		Area Adjust	0 Sq. Mi.		Area Adjust	0 Sq. Mi.	Area Adjust	0 Sq. Mi.	Area Adjust	0 Sq. Mi.
Time	Depth		Time	Depth		Time	Depth		Time	Depth	Time	Depth	Time	Depth
0:05	0.02	-	0:05	0.02		0:05	0.03		0:05	0.02	0:05	0.03	0:05	0.03
0:10	0.02	_	0:10	0.02		0:10	0.05		0:10	0.02	0:10	0.08	0:10	0.03
0:15	0.03	-	0:15	0.10		0:15	0.03		0:15	0.09	0:15	0.12	0:15	0.13
0:13	0.13	_	0:13	0.17		0:13	0.11		0:20	0.05	0:13	0.12	0:13	0.13
0:25	0.21	-	0:25	0.28		0:25	0.35		0:25	0.28	0:25	0.35	0:25	0.39
0:30	0.11	<u> </u>	0:25	0.15		0:30	0.17	•	0:30	0.47	0:30	0.58	0:30	0.70
0:35	0.05	-	0:35	0.06		0:35	0.08		0:35	0.22	0:35	0.28	0:35	0.39
0:40	0.04	-	0:40	0.05		0:40	0.06	-	0:40	0.15	0:40	0.18	0:40	0.22
0:45	0.03		0:45	0.04		0:45	0.05		0:45	0.09	0:45	0.12	0:45	0.17
0:50	0.03		0:50	0.04	•	0:50	0.04	İ	0:50	0.09	0:50	0.12	0:50	0.14
0:55	0.03		0:55	0.03		0:55	0.04	İ	0:55	0.06	0:55	0.07	0:55	0.11
1:00	0.03		1:00	0.03		1:00	0.04	Ī	1:00	0.06	1:00	0.07	1:00	0.11
1:05	0.03		1:05	0.03		1:05	0.04	Ī	1:05	0.06	1:05	0.07	1:05	0.11
1:10	0.03		1:10	0.03		1:10	0.04	Ī	1:10	0.04	1:10	0.06	1:10	0.06
1:15	0.02		1:15	0.03		1:15	0.04		1:15	0.04	1:15	0.06	1:15	0.06
1:20	0.02		1:20	0.02		1:20	0.03		1:20	0.03	1:20	0.04	1:20	0.03
1:25	0.02		1:25	0.02		1:25	0.03		1:25	0.03	1:25	0.04	1:25	0.03
1:30	0.02		1:30	0.02		1:30	0.03		1:30	0.03	1:30	0.03	1:30	0.03
1:35	0.02		1:35	0.02		1:35	0.03		1:35	0.03	1:35	0.03	1:35	0.03
1:40	0.01	_	1:40	0.02		1:40	0.03		1:40	0.03	1:40	0.03	1:40	0.03
1:45	0.01		1:45	0.02		1:45	0.03		1:45	0.03	1:45	0.03	1:45	0.03
1:50	0.01		1:50	0.02		1:50	0.03		1:50	0.03	1:50	0.03	1:50	0.03
1:55	0.01		1:55	0.02		1:55	0.02		1:55	0.03	1:55	0.03	1:55	0.03
2:00	0.01		2:00	0.01		2:00	0.02		2:00	0.03	2:00	0.03	2:00	0.03
2:05	0.00		2:05	0.00		2:05	0.00		2:05	0.00	2:05	0.00	2:05	0.00
Total Depth (in) 0.97		Total Depth (in)	1.30		Total Depth (in	1.62		Total Depth (in) 2.16	Total Depth (in	n) 2.67	Total Depth (in	3.23

"R:\23.1447.001 Greeley - Oklahoma Drainage MP\200 Design\220 Drainage-WR\222 Reports\2 Alternatives Analysis\Tables\GO_Alternatives_Tables.xlsx"



									Hort	on's Infiltra	ation					
								Depressio	n Storage		Parameters		DCIA L	evel and Fr	actions	
Catchment Name/ID	SWMM Node/ID	Raingage Name/ID	Area (sq.mi.)	Dist. to Centroid (miles)	Length (miles)	Slope (ft./ft.)	Percent Imperv.	Pervious (inches)	Imperv. (inches)	Initial Rate (in./hr.)	Final Rate (in.hr.)	Decay Coeff. (1/sec.)	DCIA Level	Dir. Con'ct Imperv. Fraction	Receiv. Perv. Fraction	Percent Eff. Imperv.
620	620	GREELEY	0.053	0.272	0.598	0.008	23.4	0.35	0.10	3.00	0.50	0.0018	0.00	0.47	0.14	22.29
712	712	GREELEY	0.140	0.346	0.764	0.033	27.3	0.35	0.10	3.00	0.50	0.0018	0.00	0.55	0.16	26.15
714	714	GREELEY	0.035	0.091	0.212	0.030	5.0	0.35	0.10	3.00	0.50	0.0018	0.00	0.10	0.05	4.57
804	804	GREELEY	0.040	0.085	0.381	0.018	10.0	0.35	0.10	5.00	1.00	0.0007	0.00	0.20	0.10	8.06
810	810	GREELEY	0.115	0.242	0.599	0.011	4.7	0.35	0.10	3.00	0.50	0.0018	0.00	0.09	0.05	4.26
820	820	GREELEY	0.127	0.170	0.537	0.021	52.0	0.35	0.10	3.00	0.50	0.0018	0.00	0.86	0.24	51.19
824	824	GREELEY	0.068	0.192	0.421	0.017	13.6	0.35	0.10	3.00	0.50	0.0018	0.00	0.27	0.11	12.63
830	830	GREELEY	0.111	0.121	0.541	0.019	50.6	0.35	0.10	3.00	0.50	0.0018	0.00	0.85	0.23	49.78
840	840	GREELEY	0.100	0.339	0.674	0.023	8.0	0.35	0.10	3.00	0.50	0.0018	0.00	0.16	0.08	7.34
842	842	GREELEY	0.173	0.312	0.834	0.016	2.6	0.35	0.10	3.00	0.50	0.0018	0.00	0.05	0.03	2.37
844	844	GREELEY	0.198	0.278	0.542	0.016	6.7	0.35	0.10	3.00	0.50	0.0018	0.00	0.13	0.07	6.11
850	850	GREELEY	0.156	0.361	0.569	0.023	2.0	0.35	0.10	4.50	0.60	0.0018	0.00	0.04	0.02	1.76



				Uni	t Hydrogra _l	ph Paramet	ers and Res	ults			Excess	Precip.		Storm H	lydrograph	
Catchment Name/ID	User Comment for Catchment	ст	Ср	W50 (min.)	W50 Before Peak	W75 (min.)	W75 Before Peak	Time to Peak (min.)	Peak (cfs)	Volume (c.f)	Excess (inches)	Excess (c.f.)	Time to Peak (min.)	Peak Flow (cfs)	Total Volume (c.f.)	Runoff per Unit Area (cfs/acre)
620		0.108	0.097	70.0	6.69	36.4	4.73	11.2	23	122,352	2.06	252,584	60.0	37	252,646	1.10
712		0.103	0.155	37.4	5.95	19.5	4.20	9.9	112	325,181	2.11	686,125	45.0	161	685,320	1.79
714		0.146	0.098	24.4	3.33	12.7	2.35	5.6	44	82,342	1.85	152,497	40.0	50	151,408	2.19
804		0.133	0.095	33.1	3.92	17.2	2.77	6.5	36	92,961	0.87	80,657	40.0	25	80,377	0.99
810		0.147	0.167	48.6	7.74	25.3	5.47	12.9	71	267,236	1.85	493,919	50.0	101	493,780	1.37
820		0.088	0.218	15.1	4.02	7.8	2.84	6.7	253	295,500	2.40	710,118	35.0	292	707,269	3.59
824		0.121	0.113	39.9	4.95	20.7	3.50	8.3	51	157,588	1.95	307,167	45.0	70	306,460	1.62
830		0.088	0.202	14.4	3.73	7.5	2.63	6.2	231	256,828	2.39	612,914	35.0	259	607,571	3.66
840		0.136	0.146	53.1	7.44	27.6	5.26	12.4	56	231,423	1.89	436,328	50.0	82	436,099	1.29
842		0.154	0.210	48.6	9.34	25.3	6.60	15.6	107	402,357	1.83	734,488	50.0	152	733,957	1.37
844		0.140	0.201	35.7	7.00	18.6	4.94	11.7	167	460,600	1.87	861,565	45.0	221	860,656	1.74
850		0.156	0.203	41.6	7.99	21.6	5.64	13.3	113	362,833	1.65	597,107	50.0	142	596,571	1.42



								Depressio	n Storage	Horton's I	nfiltration P	arameters	DCIA	Level and Fra	actions	
Catchment Name/ID	SWMM Node/ID	Raingage Name/ID	Area (sq.mi.)	Dist. to Centroid (miles)	Length (miles)	Slope (ft./ft.)	Percent Imperv.	Pervious (inches)	Imperv. (inches)	Initial Rate (in./hr.)	Final Rate (in.hr.)	Decay Coeff. (1/sec.)	DCIA Level	Dir. Con'ct Imperv. Fraction	Receiv. Perv. Fraction	Percent Eff. Imperv.
620	620	GREELEY	0.053	0.272	0.598	0.008	23.5	0.35	0.10	3.00	0.50	0.0018	0.00	0.47	0.14	22.34
712	712	GREELEY	0.140	0.346	0.764	0.033	30.2	0.35	0.10	3.00	0.50	0.0018	0.00	0.60	0.17	29.00
714	714	GREELEY	0.035	0.091	0.212	0.030	12.5	0.35	0.10	3.00	0.50	0.0018	0.00	0.25	0.11	11.63
804	804	GREELEY	0.040	0.085	0.381	0.018	10.0	0.35	0.10	5.00	1.00	0.0007	0.00	0.20	0.10	8.08
810	810	GREELEY	0.115	0.242	0.599	0.011	48.1	0.35	0.10	3.00	0.50	0.0018	0.00	0.84	0.22	47.23
820	820	GREELEY	0.127	0.170	0.537	0.021	69.8	0.35	0.10	3.00	0.50	0.0018	0.00	0.92	0.30	69.13
824	824	GREELEY	0.068	0.192	0.421	0.017	78.0	0.35	0.10	3.00	0.50	0.0018	0.00	0.94	0.32	77.40
830	830	GREELEY	0.111	0.121	0.541	0.019	67.8	0.35	0.10	3.00	0.50	0.0018	0.00	0.92	0.29	67.16
840	840	GREELEY	0.100	0.339	0.674	0.023	76.5	0.35	0.10	3.00	0.50	0.0018	0.00	0.93	0.32	75.96
842	842	GREELEY	0.173	0.312	0.834	0.016	68.6	0.35	0.10	3.00	0.50	0.0018	0.00	0.92	0.30	67.93
844	844	GREELEY	0.198	0.278	0.542	0.016	76.2	0.35	0.10	3.00	0.50	0.0018	0.00	0.93	0.32	75.62
850	850	GREELEY	0.156	0.361	0.569	0.023	60.1	0.35	0.10	4.50	0.60	0.0018	0.00	0.90	0.27	59.16



				Ur	nit Hydrogra	ph Paramete	ers and Resu	lts			Exces	s Precip.		Storm H	lydrograph	
Catchment Name/ID	User Comment for Catchment	ст	Ср	W50 (min.)	W50 Before Peak	W75 (min.)	W75 Before Peak	Time to Peak (min.)	Peak (cfs)	Volume (c.f)	Excess (inches)	Excess (c.f.)	Time to Peak (min.)	Peak Flow (cfs)	Total Volume (c.f.)	Runoff per Unit Area (cfs/acre)
620		0.107	0.097	70.0	6.69	36.4	4.73	11.1	23	122,352	2.07	252,663	60.0	37	252,726	1.10
712		0.100	0.165	34.2	5.83	17.8	4.12	9.7	123	325,181	2.14	696,996	45.0	173	696,646	1.93
714		0.123	0.085	23.7	3.04	12.3	2.15	5.1	45	82,342	1.94	159,503	40.0	51	157,367	2.27
804		0.133	0.095	33.1	3.92	17.2	2.77	6.5	36	92,961	0.87	80,701	40.0	25	80,421	0.99
810		0.090	0.200	24.7	5.29	12.8	3.74	8.8	140	267,236	2.36	629,730	40.0	190	628,295	2.58
820		0.080	0.244	12.3	3.81	6.4	2.69	6.4	310	295,500	2.62	772,751	35.0	331	753,342	4.07
824		0.078	0.190	15.2	3.71	7.9	2.62	6.2	134	157,588	2.71	427,581	35.0	165	425,111	3.80
830		0.081	0.227	11.7	3.54	6.1	2.50	5.9	283	256,828	2.59	665,619	35.0	294	649,995	4.15
840		0.078	0.224	19.9	4.92	10.3	3.48	8.2	150	231,423	2.70	623,972	40.0	200	618,994	3.13
842		0.081	0.279	19.2	5.61	10.0	3.96	9.3	271	402,357	2.60	1,046,455	40.0	353	1,041,854	3.19
844		0.078	0.299	13.3	4.57	6.9	3.23	7.6	446	460,600	2.69	1,240,016	35.0	523	1,235,897	4.13
850		0.084	0.254	17.9	4.99	9.3	3.53	8.3	262	362,833	2.42	878,086	35.0	316	873,638	3.16



Desig	n Point	Drainage Area			Existing Cond	ditions Peak F	lows (cfs)				Future Co	onditions Peak F	low (cfs)	
Number	Туре	(acres)	Q ₂	Q 5	Q ₁₀	Q ₂₅	Q 50	Q ₁₀₀	Q ₂	Q ₅	Q ₁₀	Q ₂₅	Q 50	Q ₁₀₀
620	Basin	34	3	5	9	19	27	37	3	5	9	19	27	37
712	Basin	90	13	25	42	86	119	161	16	29	47	93	129	173
714	Basin	23	1	4	10	25	36	50	2	6	12	27	38	52
803	Junction	670	63	108	192	494	722	1,039	348	515	709	1,203	1,591	2,072
804	Basin	26	0	1	2	5	14	25	0	1	2	5	14	25
809	Junction	596	66	112	192	491	716	1,024	353	520	714	1,206	1,586	2,058
810	Basin	74	1	8	19	50	72	101	28	43	63	110	146	190
819	Junction	515	67	108	178	448	651	929	337	490	669	1,113	1,460	1,887
820	Basin	81	47	72	103	170	226	292	70	100	133	201	259	331
824	Basin	43	3	8	16	36	51	70	38	53	69	102	130	165
829	Junction	444	40	63	130	345	500	711	284	407	550	900	1,176	1,511
830	Basin	71	40	63	91	150	199	259	61	87	117	177	228	294
839	Junction	253	3	18	59	176	262	372	158	228	309	506	661	846
840	Basin	64	2	7	17	41	59	82	44	63	82	124	160	200
841	Junction	142	1	11	43	136	203	290	117	169	232	385	505	649
842	Basin	111	1	10	28	74	108	152	71	102	137	215	277	353
843	Junction	317	7	34	96	275	407	578	252	362	485	782	1,018	1,300
844	Basin	127	5	19	45	111	160	221	118	166	218	325	415	523
850	Basin	100	1	2	18	65	99	142	56	80	112	186	247	316
O_620	Outfall	34	3	5	9	19	27	37	3	5	9	19	27	37
0_712	Outfall	90	13	24	42	85	118	160	15	28	47	93	128	172
0_714	Outfall	23	1	4	10	25	36	50	2	6	12	27	38	52
O_803	Outfall	696	63	108	192	494	722	1,039	348	515	709	1,203	1,591	2,072



Desig	n Point	Drainage Area			Existing Condi	tions Peak Volu	ume (ac-ft)			ļ.	uture Condition	ons Peak Volur	me (ac-ft)	
Number	Туре	(acres)	V ₂	V ₅	V ₁₀	V ₂₅	V ₅₀	V ₁₀₀	V ₂	V ₅	V ₁₀	V ₂₅	V ₅₀	V ₁₀₀
620	Basin	34	0	0	0	1	1	2	0	0	0	1	1	2
712	Basin	90	0	1	1	3	4	5	1	1	1	3	4	5
714	Basin	23	0	0	0	1	1	1	0	0	0	1	1	1
803	Junction	670	2	4	8	18	26	36	10	14	19	29	37	48
804	Basin	26	0	0	0	0	0	1	0	0	0	0	0	1
809	Junction	596	2	4	8	18	26	36	10	14	19	29	37	47
810	Basin	74	0	0	1	2	3	4	1	1	2	3	4	5
819	Junction	515	2	4	7	16	23	32	9	13	18	26	33	42
820	Basin	81	1	1	2	3	4	5	1	2	2	3	4	6
824	Basin	43	0	0	0	1	2	2	1	1	1	2	3	3
829	Junction	444	1	2	5	12	17	24	7	10	14	20	26	33
830	Basin	71	1	1	2	3	3	5	1	1	2	3	4	5
839	Junction	253	0	1	2	6	9	13	4	6	8	12	15	19
840	Basin	64	0	0	1	2	2	3	1	2	2	3	4	5
841	Junction	142	0	0	1	4	7	10	3	4	6	9	11	14
842	Basin	111	0	0	1	2	4	5	2	2	3	5	6	8
843	Junction	317	0	1	3	9	14	20	6	9	12	17	22	28
844	Basin	127	0	0	1	3	4	6	2	3	4	6	7	9
850	Basin	100	0	0	0	2	3	4	1	2	2	4	5	7
0_620	Outfall	34	0	0	0	1	1	2	0	0	0	1	1	2
0_712	Outfall	90	0	1	1	3	4	5	1	1	2	3	4	5
0_714	Outfall	23	0	0	0	1	1	1	0	0	0	1	1	1
0_803	Outfall	696	2	4	8	18	26	36	10	14	19	29	37	48



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[TITLE]
;;Project Title/Notes
City of Greeley
Storm Drainage Master Plan
Oklahoma Baseline Alternatives
Additional Basins 700-800
Matrix Design Group, Inc. 2024
Scenario ID = Fut_100yr_GO_Do_Nothing
[OPTIONS]
          Value
;;Option
FLOW UNITS CFS
INFILTRATION HORTON
FLOW ROUTING KINWAVE
LINK OFFSETS DEPTH
MIN_SLOPE 0
ALLOW_PONDING NO
SKIP_STEADY_STATE NO
START DATE
              01/01/2005
START TIME
              00:00:00
REPORT_START_DATE 01/01/2005
REPORT START TIME 00:00:00
END DATE
             01/01/2005
END TIME
             12:00:00
SWEEP START 01/01
SWEEP END
              12/31
DRY_DAYS
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REPORT_STEP 00:05:00
WET_STEP
              00:05:00
DRY_STEP
             01:00:00
ROUTING_STEP 0:00:20
RULE_STEP
              00:00:00
INERTIAL DAMPING PARTIAL
NORMAL_FLOW_LIMITED BOTH
FORCE MAIN EQUATION H-W
VARIABLE STEP 0.75
LENGTHENING STEP 0
MIN SURFAREA 12.566
MAX_TRIALS 8
HEAD_TOLERANCE 0.005
SYS_FLOW_TOL 5
LAT_FLOW_TOL 5
MINIMUM_STEP 0.5
THREADS
[FILES]
;;Interfacing Files
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Models\CUHP_SWMM\CUHP\7_Ex_100yr_0mi^2_Greeley_7.8.txt"
[EVAPORATION]
;;Data Source Parameters
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CONSTANT 0.0 DRY_ONLY NO

JUNCTION	JS1											
;;Name	-	ion Ma	xDepth	InitDe	pth S	SurDept	h Apo	nded				
;; 620	4920	 10	0	0	 0							
712	4915	10	0	0	0							
714	4864	10	0	0	0							
803	4866	10	0	0	0							
804	4882	10	0	0	0							
809	4890	25	0	0	0							
810	4925	10	0	0	0							
819	4901	10	0	0	0							
820	4945	10	0	0	0							
824	4961	10	0	0	0							
829	4918	15	0	0	0							
830	4972	10	0	0	0							
839	4965	15	0	0	0							
840	4990	10	0	0	0							
841	4967	10	0	0	0							
842	5000	10	0	0	0							
843	4959	15	0	0	0							
844	4995	10	0	0	0							
850	4990	10	0	0	0							
711	4889	10	0	0	0							
710	4871	10	0	0	0							
709	4866	10	0	0	0							
708	4851	10	0	0	0							
713	4898	10	0	0	0							
811	4893	10	0	0	0							
822	4932	10	0	0	0							
823	4908	10	0	0	0							
834	4932	15	0	0	0							
838	4949	15	0	0	0							
831	4928.5	15	0	0	0							
808	4885	0	0	0	0							
[OUTFALLS	S]											
;;Name	_	ion Typ	e S	tage Da	ata	Gated	l Rou	te To				
;;	4005											
O_803	4865	FRE			NO							
O_708	4828	FRE			NO							
O_620	4817	FRE			NO							
O_714	4838	FRE	E		NO)						
[DIVIDERS]											
;;Name	Elevat	ion Div	erted Li	nk Ty	/pe	Paran	neters					
836	4945	OV_8	 36	OVE	RFLO	- W 15	0	0	0			
[CONDUITS	3]											
;;Name		Node	To No	ode	Le	ngth	Roughr	ness In	Offset	OutOffset	InitFlow	MaxFlow
;; DL 620	620		 D_620	 1	 -00	0.01	0	0	0	0		
DL_020 DL_714	714		D_020 D_714		00	0.01		0	0	0		
DL_803	803		D_803		00	0.01	0	0	0	0		
DL_804	804		303	40		0.01	0	0	0	0		
DL_004	040		200	40		0.01	0	0	0	0		

400 0.01 0 0 0 0

DL_810

810



DL_820	820	819	400	0.01	0	0	0	0
DL_830	830	829	400	0.01	0	0	0	0
DL_840	840	839	400	0.01	0	0	0	0
DL_842	842	841	400	0.01	0	0	0	0
DL_844	844	843	400	0.01	0	0	0	0
L_808	808	803	1197	0.07	0	0	0	0
L_823	823	819	943	0.04	0	0	0	0
L_839	839	843	541	0.048	0	0	0	0
L_841	841	839	190	.044	0	0	0	0
L_850	850	841	1740	0.044	0	0	0	0
L_708	708	O_708	202	0.035	0	0	0	0
L_709	709	708	560.2	0.03	0	0	0	0
L_710	710	709	154.3	0.04	0	0	0	0
L_711	711	710	615.3	0.04	0	0	0	0
L_713	713	711	338.1	0.07	0	0	0	0
L_712	712	713	485.4	.04	0	0	0	0
L_838	838	836	314.88	0.048	0	0	0	0
L_811	811	809	183	0.045	0	0	0	0
L_843	843	838	304	0.035	0	0	0	0
L_819	819	811	761	0.07	0	0	0	0
L_824	824	822	1270	0.035	0	0	0	0
L_822	822	819	671	0.04	0	0	0	0
L_829	829	823	290	0.035	0	0	0	0
L 836	836	834	442	0.013	0	0	0	0
OV_836	836	834	442	.035	0	0	0	0
L 831	831	829	105	0.04	0	0	0	0
_ L_834	834	831	1040	0.04	0	0	0	0
L_809	809	808	90	0.013	0	0	0	0
_								

[XSECTIONS]

;;Link	Shape	Geom1	Geo	om2	Geo	om3	G	Geom4	Barrels	Culvert
,, DL_620	DUMM	Y 0	0	0		0		 1		
DL_714	DUMM'	Y 0	0	0		0		1		
DL_803	DUMM'	Y 0	0	0		0		1		
DL_804	DUMM'	Y 0	0	0		0		1		
DL_810	DUMM'	Y 0	0	0		0		1		
DL_820	DUMM'	Y 0	0	0		0		1		
DL_830	DUMM'	Y 0	0	0		0		1		
DL_840	DUMM'	Y 0	0	0		0		1		
DL_842	DUMM'	Y 0	0	0		0		1		
DL_844	DUMM'	Y 0	0	0		0		1		
L_808	TRAPEZ	ZOIDAL 10		65	3		3	1		
L_823	TRAPEZ	ZOIDAL 10		235	5		5	1		
L_839	TRAPEZ	ZOIDAL 15		100	27	•	10	1		
L_841	TRIANG	SULAR 10		200	0		0	1		
L_850	TRAPEZ	ZOIDAL 10		20	12		12	1		
L_708	TRAPEZ	ZOIDAL 10		22	2		2	1		
L_709	TRAPEZ	ZOIDAL 10		50	4		4	1		
L_710	TRAPEZ	ZOIDAL 10		70	2		2	1		
L_711	TRAPEZ	ZOIDAL 10		73	4		4	1		
L_713	TRAPEZ	ZOIDAL 10		55	10		10	1		
L_712	TRAPEZ	ZOIDAL 10		106	15	,	15	1		
L_838	TRAPEZ	ZOIDAL 15		24	15		15	1		
L_811	TRAPEZ	ZOIDAL 10		107	6		6	1		
L_843	CIRCUL	.AR 15	0	()	0		1		
L_819	TRAPEZ	ZOIDAL 10		115	3		3	1		

TRAPEZOIDAL 10	657	30	30	1
TRAPEZOIDAL 10	235	5	5	1
TRAPEZOIDAL 10	75	3.5	6.5	1
CIRCULAR 4	0 0	0	1	
TRAPEZOIDAL 15	40	15	15	1
TRAPEZOIDAL 15	65	6	6	1
TRAPEZOIDAL 15	64	6	6	1
RECT_CLOSED 15	5	0	0	1
	TRAPEZOIDAL 10 TRAPEZOIDAL 10 CIRCULAR 4 TRAPEZOIDAL 15 TRAPEZOIDAL 15 TRAPEZOIDAL 15	TRAPEZOIDAL 10 235 TRAPEZOIDAL 10 75 CIRCULAR 4 0 0 TRAPEZOIDAL 15 40 TRAPEZOIDAL 15 65 TRAPEZOIDAL 15 64	TRAPEZOIDAL 10 235 5 TRAPEZOIDAL 10 75 3.5 CIRCULAR 4 0 0 0 TRAPEZOIDAL 15 40 15 TRAPEZOIDAL 15 65 6 TRAPEZOIDAL 15 64 6	TRAPEZOIDAL 10 235 5 5 TRAPEZOIDAL 10 75 3.5 6.5 CIRCULAR 4 0 0 0 1 TRAPEZOIDAL 15 40 15 15 TRAPEZOIDAL 15 65 6 6 TRAPEZOIDAL 15 64 6 6

[REPORT]
;;Reporting Options
INPUT YES
CONTROLS YES
SUBCATCHMENTS ALL NODES ALL LINKS ALL

[TAGS]

[MAP] DIMENSIONS 0.000 0.000 8882.267 8132.154

Y-Coord

Units None

[COORDINATES] ;;Node X-Coord

,,1 1 00e	X-00014	1-00014
;; 620	3176.446	5603.079
712	2895.562	4845.602
714	2396.597	5524.935
803	2046.787	5306.170
804	2224.496	5288.834
809	2304.222	4931.686
810	2221.307	4534.501
819	2458.581	4607.362
820	2858.872	4455.858
824	3212.781	4053.026
829	2531.995	4090.155
830	2310.615	3639.827
839	3222.537	3474.569
840	4296.625	2946.685
841	3225.328	3393.633
842	4116.415	2195.542
843	3098.576	3589.753
844	3175.492	2589.454
850	3628.528	2902.994
711	2728.325	5128.419
710	2635.627	5340.281
709	2645.107	5386.630
708	2650.374	5598.361
713	2796.803	5016.287
811	2326.424	4882.578
822	2779.481	4253.460
823	2482.561	4170.492
834	2793.200	3771.985
838	3041.708	3648.672
831	2539.570	4080.449
808	2290.503	4963.697



2037.522	5457.441
2644.492	5672.936
3155.399	5761.408
2402.976	5620.622
2952.697	3687.647
	2644.492 3155.399 2402.976

[VERTICE	:S]	
;;Link	X-Coord	Y-Coord
;; DL 803	2026.861	5357.978
DL_803	2038.817	5412.975
DL 810	2232.974	4619.614
DL 810	2245.732	4810.989
DL 830	2525.911	4040.117
DL 840	4169.043	3071.079
DL 840	4092.493	3157.197
DL 840	3953.747	3410.768
DL 840	3583.757	3433.095
DL 840	3315.833	3429.905
DL_842	3580.567	2554.368
DL_842	3454.075	2733.989
DL_842	3356.793	2914.200
DL_842	3278.649	3199.666
DL_844	3186.655	2742.553
DL_844	3202.603	2914.790
DL_844	3193.034	3211.420
DL_844	3164.328	3249.694
DL_844	3183.466	3396.415
L_808	2265.576	5028.444
L_808	2246.438	5036.418
L_808	2206.569	5066.719
L_808	2203.379	5100.210
L_808	2190.621	5159.217
L_808	2137.993	5194.302
L_808	2080.325	5208.102
L_808	2060.399	5283.821
L_823	2485.244	4167.900
L_823	2482.053	4247.674
L_823	2482.053	4378.503
L_850	3608.479	2914.796
L_850	3593.723	2919.982
L_850	3576.180	2921.577
L_850	3539.500	2931.146
L_850	3506.010	2942.309
L_850	3486.872	2971.016
L_850	3467.735	2998.127
L_850	3439.029	3045.970
L_850	3419.891	3090.624
L_850	3389.590	3162.390
L_850	3365.669	3202.259
L_850	3341.747	3250.103
L_850	3308.256	3289.973
L_850	3271.576	3334.626
OV_836	2870.006	3747.691

[Polygons]

FILE "R:\23.1447.001 Greeley - Oklahoma Drainage MP\200 Design\220 Drainage-WR\221 Models\CUHP_SWMM\SWMM\Backgrounds\Final

DIMENSIONS 735.737 1837.108 8882.267 8132.154

"R:\23.1447.001 Greeley - Oklahoma Drainage MP\200 Design\220 Drainage-WR\221 Models\CUHP_SWMM\SWMM\Alternatives\Fut_100yr_GO_Do_Nothing.inp"



City of Greeley

Storm Drainage Master Plan Oklahoma Baseline Alternatives

Element Count

Number of rain gages 0 Number of subcatchments ... 0 Number of nodes 36 Number of links 33 Number of pollutants 0

Number of land uses 0

Node Summary ******

	Invert	Max. I	Ponded	External	
Name	Type	Elev. De	epth A	rea Inflov	٧
620	JUNCTION	4920.00	10.00	0.0	
712	JUNCTION	4915.00	10.00	0.0	
714	JUNCTION	4864.00	10.00	0.0	
803	JUNCTION	4866.00	10.00	0.0	
804	JUNCTION	4882.00	10.00	0.0	
809	JUNCTION	4890.00	25.00	0.0	
810	JUNCTION	4925.00	10.00	0.0	
819	JUNCTION	4901.00	10.00	0.0	
820	JUNCTION	4945.00	10.00	0.0	
824	JUNCTION	4961.00	10.00	0.0	
829	JUNCTION	4918.00	15.00	0.0	
830	JUNCTION	4972.00	10.00	0.0	
839	JUNCTION	4965.00	15.00	0.0	
840	JUNCTION	4990.00	10.00	0.0	
841	JUNCTION	4967.00	10.00	0.0	
842	JUNCTION	5000.00	10.00	0.0	
843	JUNCTION	4959.00	15.00	0.0	
844	JUNCTION	4995.00	10.00	0.0	
850	JUNCTION	4990.00	10.00	0.0	
711	JUNCTION	4889.00	10.00	0.0	
710	JUNCTION	4871.00	10.00	0.0	
709	JUNCTION	4866.00	10.00	0.0	
708	JUNCTION	4851.00	10.00	0.0	
713	JUNCTION	4898.00	10.00	0.0	
811	JUNCTION	4893.00	10.00	0.0	
822	JUNCTION	4932.00	10.00	0.0	
823	JUNCTION	4908.00	10.00	0.0	
834	JUNCTION	4932.00	15.00	0.0	
838	JUNCTION	4949.00	15.00	0.0	
831	JUNCTION	4928.50	15.00	0.0	
808	JUNCTION	4885.00	15.00	0.0	
O_803	OUTFALL	4865.00	0.00	0.0	
O_708	OUTFALL	4828.00	10.00	0.0	
O_620	OUTFALL	4817.00	0.00	0.0	
O_714	OUTFALL	4838.00	0.00	0.0	
836	DIVIDER	4945.00	15.00	0.0	

Link Summary ******

*********** Name	From Node	To Nod	e Type	Length %Slope Roughness
DL_620	620	O_620	CONDUIT	400.0 26.6486 0.0100
DL_714	714	O_714	CONDUIT	400.0 6.5138 0.0100
DL_803	803	O_803	CONDUIT	400.0 0.2500 0.0100
DL_804	804	803	CONDUIT	400.0 4.0032 0.0100
DL_810	810	809	CONDUIT	400.0 8.7837 0.0100
DL_820	820	819	CONDUIT	400.0 11.0672 0.0100
DL_830	830	829	CONDUIT	400.0 13.6247 0.0100
DL_840	840	839	CONDUIT	400.0 6.2622 0.0100
DL_842	842	841	CONDUIT	400.0 8.2782 0.0100
DL_844	844	843	CONDUIT	400.0 9.0367 0.0100
L_808	808	803	CONDUIT	1197.0 1.5875 0.0700
L_823	823	819	CONDUIT	943.0 0.7423 0.0400
L_839	839	843	CONDUIT	541.0 1.1091 0.0480
L_841	841	839	CONDUIT	190.0 1.0527 0.0440
L_850	850	841	CONDUIT	1740.0 1.3220 0.0440
L_708	708	O_708	CONDUIT	202.0 11.4607 0.0350
L_709	709	708	CONDUIT	560.2 2.6786 0.0300
L_710	710	709	CONDUIT	154.3 3.2421 0.0400
L_711	711	710	CONDUIT	615.3 2.9267 0.0400
L_713	713	711	CONDUIT	338.1 2.6629 0.0700
L_712	712	713	CONDUIT	485.4 3.5044 0.0400
L_838	838	836	CONDUIT	314.9 1.2704 0.0480
L_811	811	809	CONDUIT	183.0 1.6396 0.0450
L_843	843	838	CONDUIT	304.0 3.2913 0.0350
L_819	819	811	CONDUIT	761.0 1.0513 0.0700
L_824	824	822	CONDUIT	1270.0 2.2841 0.0350
L_822	822	819	CONDUIT	671.0 4.6249 0.0400
L_829	829	823	CONDUIT	290.0 3.4503 0.0350
L_836	836	834	CONDUIT	442.0 2.9424 0.0130
OV_836	836	834	CONDUIT	442.0 2.9424 0.0350
L_831	831	829	CONDUIT	105.0 10.0504 0.0400
L_834	834	831	CONDUIT	1040.0 0.3365 0.0400
L_809	809	808	CONDUIT	90.0 5.5641 0.0130

****** Cross Section Summary

Conduit	Full Shape	Full H Depth	yd. N Area	Max. N Rad.		Full Barrels	Flow
DL_620	DUMMY	0.00	0.00	0.00	0.00	1	0.00
DL_714	DUMMY	0.00	0.00	0.00	0.00	1	0.00
DL_803	DUMMY	0.00	0.00	0.00	0.00	1	0.00
DL_804	DUMMY	0.00	0.00	0.00	0.00	1	0.00
DL_810	DUMMY	0.00	0.00	0.00	0.00	1	0.00
DL_820	DUMMY	0.00	0.00	0.00	0.00	1	0.00
DL_830	DUMMY	0.00	0.00	0.00	0.00	1	0.00
DL_840	DUMMY	0.00	0.00	0.00	0.00	1	0.00
DL_842	DUMMY	0.00	0.00	0.00	0.00	1	0.00



DL 844	DUMMY	0.00 0.00 0.00 0.00 1 0.00
L_808	TRAPEZOIDAL	10.00 950.00 7.41 125.00 1 9655.82
L_823	TRAPEZOIDAL	10.00 2850.00 8.46 335.00 1 37867.18
L_839	TRAPEZOIDAL	15.00 5662.50 8.63 655.00 1 77684.49
L_841	TRIANGULAR	10.00 1000.00 4.98 200.00 1 10098.48
L_850	TRAPEZOIDAL	10.00 1400.00 5.37 260.00 1 16665.33
L_708	TRAPEZOIDAL	10.00 420.00 6.29 62.00 1 20580.76
L_709	TRAPEZOIDAL	10.00 900.00 6.79 130.00 1 26173.35
L_710	TRAPEZOIDAL	10.00 900.00 7.85 110.00 1 23769.29
L_711	TRAPEZOIDAL	10.00 1130.00 7.27 153.00 1 26947.94
L_713	TRAPEZOIDAL	10.00 1550.00 6.05 255.00 1 17837.15
L_712	TRAPEZOIDAL	10.00 2560.00 6.30 406.00 1 60698.05
L_838	TRAPEZOIDAL	15.00 3735.00 7.86 474.00 1 51535.74
L_811	TRAPEZOIDAL	10.00 1670.00 7.30 227.00 1 26581.36
L_843	CIRCULAR	15.00 176.71 3.75 15.00 1 3285.42
L_819	TRAPEZOIDAL	10.00 1450.00 8.13 175.00 1 12765.94
L_824	TRAPEZOIDAL	10.00 9570.00 7.61 1257.00 1 237606.05
L_822	TRAPEZOIDAL	10.00 2850.00 8.46 335.00 1 94518.19
L_829	TRAPEZOIDAL	10.00 1250.00 7.06 175.00 1 36264.24
L_836	CIRCULAR	4.00 12.57 1.00 4.00 1 246.40
OV_836	TRAPEZOIDAL	15.00 3975.00 8.10 490.00 1 116720.41
L_831	TRAPEZOIDAL	15.00 2325.00 9.39 245.00 1 121915.29
L_834	TRAPEZOIDAL	15.00 2310.00 9.37 244.00 1 22129.56
L_809	RECT_CLOSED	15.00 75.00 1.88 5.00 1 3074.94

Analysis Options

Analysis Option

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 01/01/2005 00:00:00

Ending Date 01/01/2005 12:00:00

Antecedent Dry Days 0.0

Report Time Step 00:05:00

Routing Time Step 20.00 sec

Flow Routing Continuity	Volume acre-feet	Volume 10^6 ga
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	135.719	44.226
External Outflow	136.848	44.594
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	0.021	0.007
Continuity Error (%)	-0.847	

Highest Flow Instability Indexes

Link L_829 (1) Link L_831 (1)

Link L_819 (1) Link L_823 (1)

Link L_834 (1)

Routing Time Step Summary

Minimum Time Step : 20.00 sec
Average Time Step : 20.00 sec
Maximum Time Step : 20.00 sec
% of Time in Steady State : 0.00
Average Iterations per Step : 1.00
% of Steps Not Converging : 0.00

Analysis begun on: Thu Jun 13 09:57:02 2024 Analysis ended on: Thu Jun 13 09:57:02 2024

Total elapsed time: < 1 sec

"R:\23.1447.001 Greeley - Oklahoma Drainage MP\200 Design\220 Drainage-WR\221 Models\CUHP_SWMM\SWMM\Alternatives\Fut_100yr_GO_Do_Nothing.inp"



```
[TITLE]
;;Project Title/Notes
City of Greeley
Storm Drainage Master Plan
Oklahoma Baseline Alternatives
Additional Basins 700-800
Matrix Design Group, Inc. 2024
Scenario ID = Fut_100yr_GO_Do_Nothing
[OPTIONS]
          Value
;;Option
FLOW UNITS CFS
INFILTRATION HORTON
FLOW ROUTING KINWAVE
LINK OFFSETS DEPTH
MIN_SLOPE 0
ALLOW_PONDING NO
SKIP_STEADY_STATE NO
START DATE
              01/01/2005
START TIME
              00:00:00
REPORT_START_DATE 01/01/2005
REPORT START TIME 00:00:00
END DATE
             01/01/2005
END TIME
             12:00:00
SWEEP START 01/01
SWEEP END
              12/31
DRY_DAYS
             0
REPORT_STEP 00:05:00
WET_STEP
              00:05:00
DRY_STEP
             01:00:00
ROUTING_STEP 0:00:20
RULE_STEP
              00:00:00
INERTIAL DAMPING PARTIAL
NORMAL_FLOW_LIMITED BOTH
FORCE MAIN EQUATION H-W
VARIABLE STEP 0.75
LENGTHENING STEP 0
MIN_SURFAREA 12.566
MAX_TRIALS 8
HEAD TOLERANCE 0.005
SYS_FLOW_TOL 5
LAT_FLOW_TOL 5
MINIMUM_STEP 0.5
THREADS
[FILES]
;;Interfacing Files
USE INFLOWS "R:\23.1447.001 Greeley - Oklahoma Drainage MP\200 Design\220 Drainage-WR\221
Models\CUHP SWMM\CUHP\15 Fut 100yr 0mi^2 Greeley 7.8.txt"
[EVAPORATION]
;;Data Source Parameters
```

CONSTANT 0.0 DRY_ONLY NO

[JUNCTION ;;Name	_	ion Ma	xDepth	InitD	epth S	SurDept	h Apo	nded				
;; 620	4920	 10	0	0	0							
712	4915	10	0	0	0							
714	4864	10	0	0	0							
803	4866	10	0	0	0							
804	4882	10	0	0	0							
809	4890	25	0	0	0							
810	4925	10	0	0	0							
819	4901	10	0	0	0							
820	4945	10	0	0	0							
824	4961	10	0	0	0							
829	4918	15	0	0	0							
830	4972	10	0	0	0							
839	4965	15	0	0	0							
840	4990	10	0	0	0							
841	4967	10	0	0	0							
842	5000	10	0	0	0							
843	4959	15	0	0	0							
844	4995	10	0	0	0							
850	4990	10	0	0	0							
711	4889	10	0	0	0							
710	4871	10	0	0	0							
709	4866	10	0	0	0							
708	4851	10	0	0	0							
713	4898	10	0	0	0							
811	4893	10	0	0	0							
822	4932	10	0	0	0							
823	4908	10	0	0	0							
834	4932	15	0	0	0							
838	4949	15	0	0	0							
831	4928.5	15	0	0	0							
808	4885	0	0	0	0							
[OUTFALL												
;;Name ;;	Elevat	ion Typ	oe S	Stage C)ata 	Gated	d Rou	te To				
" O_803	4865	FRE	Ε		NC)						
O 708	4828	FRE			NO							
O_620	4817	FRE			NC							
O_714	4838				NC							
[DIVIDERS	S1											
;;Name		ion Div	erted L	ink T	уре	Parar	neters					
836	4945	OV_8	36	OVE	RFLO	- W 15	0	0	0			
[CONDUIT	S]											
;;Name ;;	From I	Node	To N	ode	Le	ngth	Rough	ness In	Offset	OutOffset	InitFlow	MaxFlow
,, DL_620	620	(D_620		400	0.01	0	0	0	0		
DL_714	714		0_714		400	0.01		0	0	0		
DL_803	803		_ D_803		400	0.01	0	0	0	0		
DL_804	804		303	40	00	0.01	0	0	0	0		

400 0.01 0 0 0 0

DL_810



DL_820	820	819	400	0.01	0	0	0	0
DL_830	830	829	400	0.01	0	0	0	0
DL_840	840	839	400	0.01	0	0	0	0
DL_842	842	841	400	0.01	0	0	0	0
DL_844	844	843	400	0.01	0	0	0	0
L_808	808	803	1197	0.07	0	0	0	0
L_823	823	819	943	0.04	0	0	0	0
L_839	839	843	541	0.048	0	0	0	0
L_841	841	839	190	.044	0	0	0	0
L_850	850	841	1740	0.044	0	0	0	0
L_708	708	O_708	202	0.035	0	0	0	0
L_709	709	708	560.2	0.03	0	0	0	0
L_710	710	709	154.3	0.04	0	0	0	0
L_711	711	710	615.3	0.04	0	0	0	0
L_713	713	711	338.1	0.07	0	0	0	0
L_712	712	713	485.4	.04	0	0	0	0
L_838	838	836	314.88	0.048	0	0	0	0
L_811	811	809	183	0.045	0	0	0	0
L_843	843	838	304	0.035	0	0	0	0
L_819	819	811	761	0.07	0	0	0	0
L_824	824	822	1270	0.035	0	0	0	0
L_822	822	819	671	0.04	0	0	0	0
L_829	829	823	290	0.035	0	0	0	0
L 836	836	834	442	0.013	0	0	0	0
OV_836	836	834	442	.035	0	0	0	0
L 831	831	829	105	0.04	0	0	0	0
_ L_834	834	831	1040	0.04	0	0	0	0
L_809	809	808	90	0.013	0	0	0	0
_								

[XSECTIONS]

;;Link	Shape	Geom1	Geom		Geo	m3	G	Geom4	Barrels	Culvert
,, DL_620	 'DUMM		0	0		0		 1		
DL_714	DUMM	Y 0	0	0		0		1		
DL_803	DUMM	Y 0	0	0		0		1		
DL_804	DUMM	Y 0	0	0		0		1		
DL_810	DUMM	Y 0	0	0		0		1		
DL_820	DUMM'	Y 0	0	0		0		1		
DL_830	DUMM	Y 0	0	0		0		1		
DL_840	DUMM	Y 0	0	0		0		1		
DL_842	DUMM	Y 0	0	0		0		1		
DL_844	DUMM	Y 0	0	0		0		1		
L_808	TRAPEZ	OIDAL 10	6	5	3		3	1		
L_823	TRAPEZ	OIDAL 10	23	35	5		5	1		
L_839	TRAPEZ	OIDAL 15	10	00	27		10	1		
L_841	TRIANG	ULAR 10	20	00	0		0	1		
L_850	TRAPEZ	OIDAL 10	20	0	12		12	1		
L_708	TRAPEZ	OIDAL 10	2:	2	2		2	1		
L_709	TRAPEZ	OIDAL 10	50	0	4		4	1		
L_710	TRAPEZ	OIDAL 10	70	0	2		2	1		
L_711	TRAPEZ	OIDAL 10	7:	3	4		4	1		
L_713	TRAPEZ	OIDAL 10	5	5	10		10	1		
L_712	TRAPEZ	OIDAL 10	10	06	15		15	1		
L_838	TRAPEZ	OIDAL 15	24	4	15		15	1		
L_811	TRAPEZ	OIDAL 10	10	07	6		6	1		
L_843	CIRCUL	AR 15	0	0		0		1		
L_819	TRAPEZ	OIDAL 10	1	15	3		3	1		

TRAPEZOIDAL 10	657	30	30	1
TRAPEZOIDAL 10	235	5	5	1
TRAPEZOIDAL 10	75	3.5	6.5	1
CIRCULAR 4	0 0	0	1	
TRAPEZOIDAL 15	40	15	15	1
TRAPEZOIDAL 15	65	6	6	1
TRAPEZOIDAL 15	64	6	6	1
RECT_CLOSED 15	5	0	0	1
	TRAPEZOIDAL 10 TRAPEZOIDAL 10 CIRCULAR 4 TRAPEZOIDAL 15 TRAPEZOIDAL 15 TRAPEZOIDAL 15	TRAPEZOIDAL 10 235 TRAPEZOIDAL 10 75 CIRCULAR 4 0 0 TRAPEZOIDAL 15 40 TRAPEZOIDAL 15 65 TRAPEZOIDAL 15 64	TRAPEZOIDAL 10 235 5 TRAPEZOIDAL 10 75 3.5 CIRCULAR 4 0 0 0 TRAPEZOIDAL 15 40 15 TRAPEZOIDAL 15 65 6 TRAPEZOIDAL 15 64 6	TRAPEZOIDAL 10 235 5 5 TRAPEZOIDAL 10 75 3.5 6.5 CIRCULAR 4 0 0 0 1 TRAPEZOIDAL 15 40 15 15 TRAPEZOIDAL 15 65 6 6 TRAPEZOIDAL 15 64 6 6

[REPORT]
;;Reporting Options
INPUT YES
CONTROLS YES
SUBCATCHMENTS ALL NODES ALL LINKS ALL

[TAGS]

[MAP] DIMENSIONS 0.000 0.000 8882.267 8132.154

Y-Coord

Units None

[COORDINATES] ;;Node X-Coord

,,1 1 00e	X-00014	1-00014
;; 620	3176.446	5603.079
712	2895.562	4845.602
714	2396.597	5524.935
803	2046.787	5306.170
804	2224.496	5288.834
809	2304.222	4931.686
810	2221.307	4534.501
819	2458.581	4607.362
820	2858.872	4455.858
824	3212.781	4053.026
829	2531.995	4090.155
830	2310.615	3639.827
839	3222.537	3474.569
840	4296.625	2946.685
841	3225.328	3393.633
842	4116.415	2195.542
843	3098.576	3589.753
844	3175.492	2589.454
850	3628.528	2902.994
711	2728.325	5128.419
710	2635.627	5340.281
709	2645.107	5386.630
708	2650.374	5598.361
713	2796.803	5016.287
811	2326.424	4882.578
822	2779.481	4253.460
823	2482.561	4170.492
834	2793.200	3771.985
838	3041.708	3648.672
831	2539.570	4080.449
808	2290.503	4963.697



2037.522	5457.441
2644.492	5672.936
3155.399	5761.408
2402.976	5620.622
2952.697	3687.647
	2644.492 3155.399 2402.976

[VERTICES]				
;;Link 	X-Coord	Y-Coord		
;; DL 803	2026.861	5357.978		
DL 803	2038.817	5412.975		
DL 810	2232.974	4619.614		
DL 810	2245.732	4810.989		
DL_830	2525.911	4040.117		
DL 840	4169.043	3071.079		
DL 840	4092.493	3157.197		
DL 840	3953.747	3410.768		
DL 840	3583.757	3433.095		
DL 840	3315.833	3429.905		
DL 842	3580.567	2554.368		
DL 842	3454.075	2733.989		
DL 842	3356.793	2914.200		
_ DL_842	3278.649	3199.666		
DL 844	3186.655	2742.553		
DL_844	3202.603	2914.790		
DL 844	3193.034	3211.420		
_ DL_844	3164.328	3249.694		
DL 844	3183.466	3396.415		
L 808	2265.576	5028.444		
L 808	2246.438	5036.418		
L 808	2206.569	5066.719		
L 808	2203.379	5100.210		
L 808	2190.621	5159.217		
L 808	2137.993	5194.302		
L 808	2080.325	5208.102		
L 808	2060.399	5283.821		
L 823	2485.244	4167.900		
L 823	2482.053	4247.674		
L_823	2482.053	4378.503		
L_850	3608.479	2914.796		
L_850	3593.723	2919.982		
L_850	3576.180	2921.577		
L_850	3539.500	2931.146		
L_850	3506.010	2942.309		
L_850	3486.872	2971.016		
L_850	3467.735	2998.127		
L_850	3439.029	3045.970		
L_850	3419.891	3090.624		
L_850	3389.590	3162.390		
L_850	3365.669	3202.259		
_ L_850	3341.747	3250.103		
_ L_850	3308.256	3289.973		
L_850	3271.576	3334.626		
OV_836	2870.006	3747.691		

[Polygons]

FILE "R:\23.1447.001 Greeley - Oklahoma Drainage MP\200 Design\220 Drainage-WR\221 Models\CUHP_SWMM\SWMM\Backgrounds\Final

DIMENSIONS 735.737 1837.108 8882.267 8132.154

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City of Greeley

Storm Drainage Master Plan Oklahoma Baseline Alternatives

Element Count

Number of rain gages 0
Number of subcatchments ... 0
Number of nodes 36
Number of links 33
Number of pollutants 0
Number of land uses 0

Node Summary

	Inver	t Max. F	onded	External
Name	Туре	Elev. De	pth A	rea Inflow
620	JUNCTION	4920.00	10.00	0.0
712	JUNCTION	4915.00	10.00	0.0
714	JUNCTION	4864.00	10.00	0.0
803	JUNCTION	4866.00	10.00	0.0
804	JUNCTION	4882.00	10.00	0.0
809	JUNCTION	4890.00	25.00	0.0
810	JUNCTION	4925.00	10.00	0.0
819	JUNCTION	4901.00	10.00	0.0
820	JUNCTION	4945.00	10.00	0.0
824	JUNCTION	4961.00	10.00	0.0
829	JUNCTION	4918.00	15.00	0.0
830	JUNCTION	4972.00	10.00	0.0
839	JUNCTION	4965.00	15.00	0.0
840	JUNCTION	4990.00	10.00	0.0
841	JUNCTION	4967.00	10.00	0.0
842	JUNCTION	5000.00	10.00	0.0
843	JUNCTION	4959.00	15.00	0.0
844	JUNCTION	4995.00	10.00	0.0
850	JUNCTION	4990.00	10.00	0.0
711	JUNCTION	4889.00	10.00	0.0
710	JUNCTION	4871.00	10.00	0.0
709	JUNCTION	4866.00	10.00	0.0
708	JUNCTION	4851.00	10.00	0.0
713	JUNCTION	4898.00	10.00	0.0
811	JUNCTION	4893.00	10.00	0.0
822	JUNCTION	4932.00	10.00	0.0
823	JUNCTION	4908.00	10.00	0.0
834	JUNCTION	4932.00	15.00	0.0
838	JUNCTION	4949.00	15.00	0.0
831	JUNCTION	4928.50	15.00	0.0
808	JUNCTION	4885.00	15.00	0.0
O_803	OUTFALL	4865.00	0.00	0.0
O_708	OUTFALL	4828.00	10.00	0.0
O_620	OUTFALL	4817.00	0.00	0.0
O_714	OUTFALL	4838.00	0.00	0.0
836	DIVIDER	4945.00	15.00	0.0

Link Summary

Name	From Node	To Nod	е Туре	Length %Slope Roughnes
DL_620	620	O_620	CONDUIT	400.0 26.6486 0.0100
DL_714	714	O_714	CONDUIT	400.0 6.5138 0.0100
DL_803	803	O_803	CONDUIT	400.0 0.2500 0.0100
DL_804	804	803	CONDUIT	400.0 4.0032 0.0100
DL_810	810	809	CONDUIT	400.0 8.7837 0.0100
DL_820	820	819	CONDUIT	400.0 11.0672 0.0100
DL_830	830	829	CONDUIT	400.0 13.6247 0.0100
DL_840	840	839	CONDUIT	400.0 6.2622 0.0100
DL_842	842	841	CONDUIT	400.0 8.2782 0.0100
DL_844	844	843	CONDUIT	400.0 9.0367 0.0100
L_808	808	803	CONDUIT	1197.0 1.5875 0.0700
L_823	823	819	CONDUIT	943.0 0.7423 0.0400
L_839	839	843	CONDUIT	541.0 1.1091 0.0480
L_841	841	839	CONDUIT	190.0 1.0527 0.0440
L_850	850	841	CONDUIT	1740.0 1.3220 0.0440
L_708	708	O_708	CONDUIT	202.0 11.4607 0.0350
L_709	709	708	CONDUIT	
L_710	710	709	CONDUIT	154.3 3.2421 0.0400
L_711	711	710	CONDUIT	615.3 2.9267 0.0400
L_713	713	711	CONDUIT	338.1 2.6629 0.0700
L_712	712	713	CONDUIT	485.4 3.5044 0.0400
L_838	838	836	CONDUIT	314.9 1.2704 0.0480
L_811	811	809	CONDUIT	183.0 1.6396 0.0450
L_843	843	838	CONDUIT	304.0 3.2913 0.0350
L_819	819	811	CONDUIT	761.0 1.0513 0.0700
L_824	824	822	CONDUIT	1270.0 2.2841 0.0350
L_822	822	819	CONDUIT	671.0 4.6249 0.0400
L_829	829	823	CONDUIT	290.0 3.4503 0.0350
L_836	836	834	CONDUIT	442.0 2.9424 0.0130
OV_836	836	834	CONDUIT	442.0 2.9424 0.0350
L_831	831	829	CONDUIT	105.0 10.0504 0.0400
L_834	834	831	CONDUIT	1040.0 0.3365 0.0400
L_809	809	808	CONDUIT	90.0 5.5641 0.0130

Cross Section Summary

Full Full Hyd. Max. No. of Full Shape Conduit Depth Area Rad. Width Barrels Flow DL 620 DUMMY 0.00 0.00 0.00 0.00 1 0.00 DL_714 DUMMY 0.00 0.00 0.00 0.00 1 0.00 DL_803 DUMMY 0.00 0.00 0.00 0.00 1 0.00 DL_804 DUMMY 0.00 0.00 0.00 0.00 1 0.00 DL 810 DUMMY 0.00 0.00 0.00 0.00 1 0.00 DL_820 DUMMY 0.00 0.00 0.00 0.00 1 0.00 DL_830 DUMMY 0.00 0.00 0.00 0.00 1 0.00 DL_840 DUMMY 0.00 0.00 0.00 0.00 1 0.00 DL_842 DUMMY 0.00 0.00 0.00 0.00 1 0.00



DL_844	DUMMY	0.00 0.00 0.00 0.00 1 0.00
L_808	TRAPEZOIDAL	10.00 950.00 7.41 125.00 1 9655.82
L_823	TRAPEZOIDAL	10.00 2850.00 8.46 335.00 1 37867.18
L_839	TRAPEZOIDAL	15.00 5662.50 8.63 655.00 1 77684.49
L_841	TRIANGULAR	10.00 1000.00 4.98 200.00 1 10098.48
L_850	TRAPEZOIDAL	10.00 1400.00 5.37 260.00 1 16665.33
L_708	TRAPEZOIDAL	10.00 420.00 6.29 62.00 1 20580.76
L_709	TRAPEZOIDAL	10.00 900.00 6.79 130.00 1 26173.35
L_710	TRAPEZOIDAL	10.00 900.00 7.85 110.00 1 23769.29
L_711	TRAPEZOIDAL	10.00 1130.00 7.27 153.00 1 26947.94
L_713	TRAPEZOIDAL	10.00 1550.00 6.05 255.00 1 17837.15
L_712	TRAPEZOIDAL	10.00 2560.00 6.30 406.00 1 60698.05
L_838	TRAPEZOIDAL	15.00 3735.00 7.86 474.00 1 51535.74
L_811	TRAPEZOIDAL	10.00 1670.00 7.30 227.00 1 26581.36
L_843	CIRCULAR	15.00 176.71 3.75 15.00 1 3285.42
L_819	TRAPEZOIDAL	10.00 1450.00 8.13 175.00 1 12765.94
L_824	TRAPEZOIDAL	10.00 9570.00 7.61 1257.00 1 237606.05
L_822	TRAPEZOIDAL	10.00 2850.00 8.46 335.00 1 94518.19
L_829	TRAPEZOIDAL	10.00 1250.00 7.06 175.00 1 36264.24
L_836	CIRCULAR	4.00 12.57 1.00 4.00 1 246.40
OV_836	TRAPEZOIDAL	15.00 3975.00 8.10 490.00 1 116720.41
L_831	TRAPEZOIDAL	15.00 2325.00 9.39 245.00 1 121915.29
L_834	TRAPEZOIDAL	15.00 2310.00 9.37 244.00 1 22129.56
L_809	RECT_CLOSED	15.00 75.00 1.88 5.00 1 3074.94

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 01/01/2005 00:00:00

Ending Date 01/01/2005 12:00:00 Antecedent Dry Days 0.0

Report Time Step 00:05:00

Routing Time Step 20.00 sec

****** Control Actions Taken

Flow Routing Continuity	Volume acre-feet	Volume 10^6 ga
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	170.202	55.463
External Outflow	171.109	55.758
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	0.012	0.004
Continuity Error (%)	-0.540	

Highest Flow Instability Indexes ********

Link L_831 (1) Link L_834 (1) Link L_829 (1)

Routing Time Step Summary

Minimum Time Step : 20.00 sec Average Time Step : 20.00 sec

Maximum Time Step : 20.00 sec % of Time in Steady State : 0.00 Average Iterations per Step: 1.01 % of Steps Not Converging : 0.00

Analysis begun on: Thu Jun 13 10:02:06 2024 Analysis ended on: Thu Jun 13 10:02:06 2024

Total elapsed time: < 1 sec

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CUHP Results for Multiple Scenarios

SWMM Run Wait Time (sec)

(Optional) SWMM Time Series Inflow "Modification Type" (LU, RP, or LU&RP)

(Optional) SWMM Time Series Inflow Table "NAME"

60

Subcatchment Name	Existing Landuse % Imperviousness	Future Landuse % Imperviousness
620	23.42	23.48
712	27.31	30.15
714	5.01	12.53
804	9.96	9.98
810	4.67	48.10
820	52.02	69.77
824	13.57	77.95
830	50.62	67.82
840	8.02	76.53
842	2.61	68.58
844	6.68	76.19

2.00

60.07

850

Raingage	Return Period (Years)	1 Hr Depths (in)	6 Hr Depths (in)
	WQ	0.600	N/A
Oraclay	2	0.844	1.280
	5	1.120	1.670
	10	1.400	2.080
Greeley	25	1.870	2.780
	50	2.310	3.410
	100	2.800	4.130
	500	4.180	6.190

Enter "X" to Run Scenario	Scenario ID	Land Use (E or F)	Return Period (yr)	Correction Area (Sq.Mi.
X	1	Е	WQ	0
X	2	E	2	0
X	3	Е	5	0
X	4	Е	10	0
X	5	Е	25	0
X	6	Е	50	0
X	7	Ε	100	0
X	8	Е	500	0
X	9	F	WQ	0
X	10	F	2	0
X	11	F	5	0
X	12	F	10	0
X	13	F	25	0
X	14	F	50	0
X	15	F	100	0
Χ	16	F	500	0

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Appendix C – Hydraulic Analysis



Site Data - Structure#702

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 ft Inlet Elevation: 4867.00 ft Outlet Station: 97.00 ft Outlet Elevation: 4862.00 ft

Number of Barrels: 1

Culvert Data Summary - Structure#702

Barrel Shape: Circular Barrel Diameter: 2.00 ft

Barrel Material: Corrugated Steel

Embedment: 0.00 in Barrel Manning's n: 0.0240 Culvert Type: Straight

Inlet Configuration: Mitered to Conform to Slope (Ke=0.7)

Inlet Depression: None

Table 1- Culvert Summary Table: Structure#702

Discharge Names	Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth (ft)	Outlet Control Depth (ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)
5 Year	24.91 cfs	24.91 cfs	4871.48	4.48	2.530	5-S2n	1.47	1.76	1.47	0.23	10.03	2.12
100 Year	170.02 cfs	46.38 cfs	4883.59	12.46	16.591	6-FFc	2.00	2.00	2.00	0.72	14.76	4.44

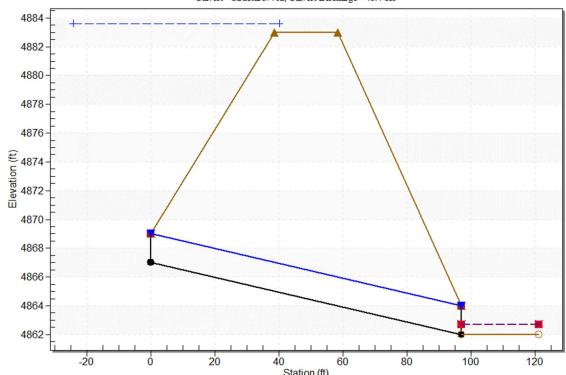
Culvert Barrel Data

Culvert Barrel Type Straight Culvert Inlet Elevation (invert): 4867.00 ft, Outlet Elevation (invert): 4862.00 ft

Culvert Length: 97.13 ft, Culvert Slope: 0.0515

Water Surface Profile Plot for Culvert: Structure#702

Crossing - Structure#702, Reach 700, Great Western Railway, Design Discharge - 170.0 cfs
Culvert - Structure#702, Culvert Discharge - 46.4 cfs



Tailwater Data for Crossing: Structure#702, Reach 700

Table 2 - Downstream Channel Rating Curve (Crossing: Structure#702, Reach 700)

Flow (cfs)	Water Surface Elev (ft)	Velocity (ft/s)	Depth (ft)	Shear (psf)	Froude Number	
24.91	4862.23	0.23	2.12	0.43	0.79	
172	4862.72	0.72	4.44	1.35	0.94	

Tailwater Channel Data - Structure#702, Reach 700

Tailwater Channel Option: Trapezoidal Channel

Bottom Width: 50.00 ft Side Slope (H:V): 4.00 (_:1) Channel Slope: 0.0300 Channel Manning's n: 0.0450 Channel Invert Elevation: 4862.00 ft

Roadway Data for Crossing: Structure#702, Reach 700

Roadway Profile Shape: Constant Roadway Elevation

Crest Length: 100.00 ft Crest Elevation: 4883.00 ft Roadway Surface: Gravel Roadway Top Width: 20.00 ft



Site Data - Structure#703,

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 ft Inlet Elevation: 4872.00 ft Outlet Station: 42.00 ft Outlet Elevation: 4871.00 ft

Number of Barrels: 1

Culvert Data Summary - Structure#703,

Barrel Shape: Circular Barrel Diameter: 0.83 ft Barrel Material: PVC Embedment: 0.00 in Barrel Manning's n: 0.0130 Culvert Type: Straight

Inlet Configuration: Mitered to Conform to Slope (Ke=0.7)

Inlet Depression: None

Table 3 - Culvert Summary Table: Structure#703

Discharge Names	Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth (ft)	Outlet Control Depth (ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)
5 Year	24.91 cfs	6.21 cfs	4879.17	7.17	6.613	6-FFc	0.83	0.83	0.83	0.16	11.39	2.18
100 Year	172.00 cfs	6.45 cfs	4879.71	7.71	7.155	6-FFc	0.83	0.83	0.83	0.52	11.83	4.68

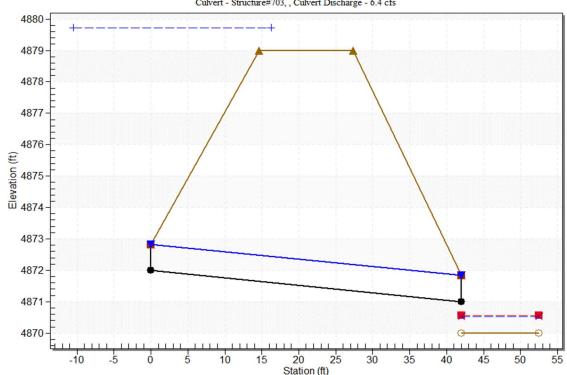
Culvert Barrel Data

Culvert Barrel Type Straight Culvert Inlet Elevation (invert): 4872.00 ft, Outlet Elevation (invert): 4871.00 ft

Culvert Length: 42.01 ft, Culvert Slope: 0.0238

Water Surface Profile Plot for Culvert: Structure#703

Crossing - Structure#703, Reach 700, Design Discharge - 172.0 cfs Culvert - Structure#703, , Culvert Discharge - 6.4 cfs



Tailwater Data for Crossing: Structure#703, Reach 700

Table 4 - Downstream Channel Rating Curve (Crossing: Structure#703, Reach 700)

Flow (cfs)	Water Surface Elev (ft)	Velocity (ft/s)	Depth (ft)	Shear (psf)	Froude Number	ĺ
24.91	4870.16	0.16	2.18	0.22	0.95	
172	4870.52	0.52	4.68	0.71	1.15	

Tailwater Channel Data - Structure#703, Reach 700

Tailwater Channel Option: Trapezoidal Channel

Bottom Width: 70.00 ft Side Slope (H:V): 2.00 (_:1) Channel Slope: 0.0220 Channel Manning's n: 0.0300 Channel Invert Elevation: 4870.00 ft

Roadway Data for Crossing: Structure#703, Reach 700

Roadway Profile Shape: Constant Roadway Elevation

Crest Length: 100.00 ft Crest Elevation: 4879.00 ft Roadway Surface: Gravel Roadway Top Width: 12.76 ft



Site Data - Structure#704

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 ft
Inlet Elevation: 4891.00 ft
Outlet Station: 89.00 ft
Outlet Elevation: 4888.00 ft
Number of Barrels: 1

Culvert Data Summary - Structure#704

Barrel Shape: Circular Barrel Diameter: 2.50 ft

Barrel Material: Corrugated Steel

Embedment: 0.00 in Barrel Manning's n: 0.0240 Culvert Type: Straight

Inlet Configuration: Thin Edge Projecting (Ke=0.9)

Inlet Depression: None

Table 5 - Culvert Summary Table: Structure#704

Discharge Names	Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth (ft)	Outlet Control Depth (ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)
5 Year	24.91 cfs	24.91 cfs	4893.98	2.98	0.573	5-S2n	1.41	1.70	1.41	0.16	8.73	2.09
100 Year	172.00 cfs	36.92 cfs	4895.58	4.58	3.393	5-S2n	1.86	2.06	1.86	0.51	9.43	4.47

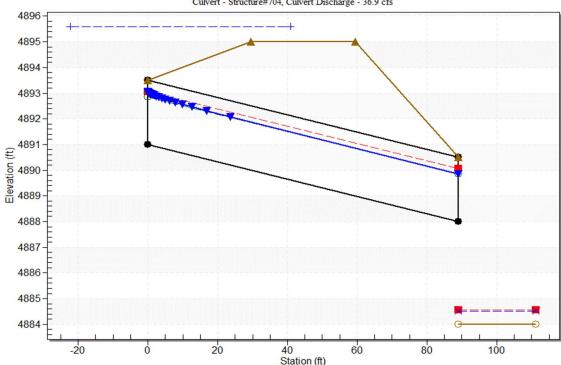
Culvert Barrel Data

Culvert Barrel Type Straight Culvert Inlet Elevation (invert): 4891.00 ft, Outlet Elevation (invert): 4888.00 ft

Culvert Length: 89.05 ft, Culvert Slope: 0.0337

Water Surface Profile Plot for Culvert: Structure#704

Crossing - Structure#704, Reach 700, 7700 Windsong Rd, Design Discharge - 172.0 cfs
Culvert - Structure#704, Culvert Discharge - 36.9 cfs



Tailwater Data for Crossing: Structure#704, Reach 700

Table 6 - Downstream Channel Rating Curve (Crossing: Structure#704, Reach 700)

Flow (cfs)	Water Surface Elev (ft)	Velocity (ft/s)	Depth (ft)	Shear (psf)	Froude Number
24.91	4884.16	0.16	2.09	0.28	0.92
172.00	4884.51	0.51	4.47	0.90	1.11

Tailwater Channel Data - Structure#704, Reach 700

Tailwater Channel Option: Trapezoidal Channel

Bottom Width: 73.00 ft Side Slope (H:V): 4.00 (_:1) Channel Slope: 0.0280 Channel Manning's n: 0.0350 Channel Invert Elevation: 4884.00 ft

Roadway Data for Crossing: Structure#704, Reach 700

Roadway Profile Shape: Constant Roadway Elevation

Crest Length: 100.00 ft Crest Elevation: 4895.00 ft Roadway Surface: Paved Roadway Top Width: 30.00 ft



Site Data - Structure#801

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 ft Inlet Elevation: 4960.15 ft Outlet Station: 74.00 ft Outlet Elevation: 4960.01 ft

Culvert Data Summary - Structure#801

Barrel Shape: Circular Barrel Diameter: 4.00 ft

Number of Barrels: 1

Barrel Material: Corrugated Steel

Embedment: 0.00 in Barrel Manning's n: 0.0240 Culvert Type: Straight

Inlet Configuration: Thin Edge Projecting (Ke=0.9)

Inlet Depression: None

Table 7 - Culvert Summary Table: Structure#801

Discharge Names	Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth (ft)	Outlet Control Depth (ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)
5 Year	18.94 cfs	18.94 cfs	4962.29	1.90	2.145	2-M2c	2.16	1.28	1.28	0.15	5.47	1.25
100 Year	846.00 cfs	137.19 cfs	4969.60	8.94	9.458	7-M2c	4.00	3.48	3.48	1.42	11.81	5.23

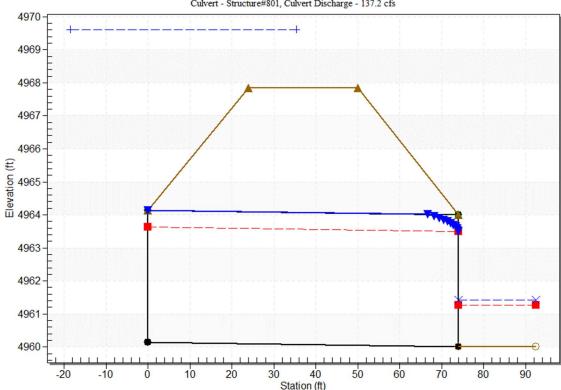
Culvert Barrel Data

Culvert Barrel Type Straight Culvert Inlet Elevation (invert): 4960.15 ft, Outlet Elevation (invert): 4960.01 ft

Culvert Length: 74.00 ft, Culvert Slope: 0.0018

Water Surface Profile Plot for Culvert: Structure#801

Crossing - Structure#801, Reach 800, CR-17, Design Discharge - 846.0 cfs
Culvert - Structure#801, Culvert Discharge - 137.2 cfs



Tailwater Data for Crossing: Structure#802, Reach 800

Table 8 - Downstream Channel Rating Curve (Crossing: Structure#802, Reach 800)

Flow (cfs)	Water Surface Elev (ft)	Velocity (ft/s)	Depth (ft)	Shear (psf)	Froude Number	
18.94	4960.16	0.15	1.25	0.17	0.58	
846.00	4961.43	1.42	5.23	1.63	0.82	

Tailwater Channel Data - Structure#801, Reach 800

Tailwater Channel Option: Trapezoidal Channel

Bottom Width: 100.00 ft Side Slope (H:V): 10.00 (_:1) Channel Slope: 0.0185 Channel Manning's n: 0.0450 Channel Invert Elevation: 4960.01 ft

Roadway Data for Crossing: Structure#801, Reach 800

Roadway Profile Shape: Constant Roadway Elevation

Crest Length: 100.00 ft Crest Elevation: 4967.84 ft Roadway Surface: Paved Roadway Top Width: 26.00 ft



Site Data - Structure#804

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 ft
Inlet Elevation: 4889.00 ft
Outlet Station: 90.00 ft
Outlet Elevation: 4881.00 ft

Number of Barrels: 1Culvert Data Summary - Structure#804

Barrel Shape: Concrete Box

Barrel Span: 5.00 ft Barrel Rise: 6.33 ft Barrel Material: Concrete Embedment: 60.00 in

Barrel Manning's n: 0.0130 (top and sides)

Manning's n: 0.0130 (bottom) Culvert Type: Straight

Inlet Configuration: Square Edge (30-75° flare) Wingwall (Ke=0.4)

Inlet Depression: None

Table 9 - Culvert Summary Table: Structure#804

Discharge Names	Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth (ft)	Outlet Control Depth (ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)
5 Year	126.99 cfs	85.50 cfs	4901.29	7.29	0.0*	5-S2n	0.73	1.33	0.81	0.92	21.16	2.04
100 Year	2058.00 cfs	103.95 cfs	4904.46	10.46	2.606	5-S2n	0.83	1.33	0.92	4.70	22.52	5.54

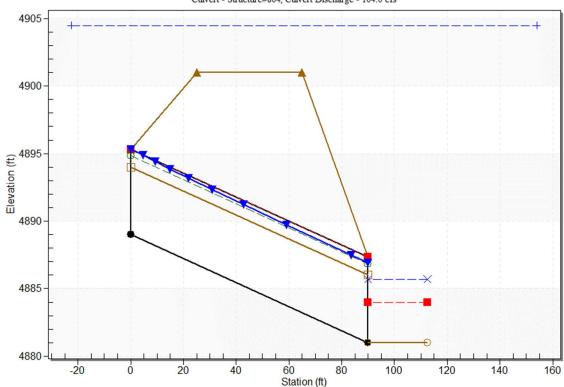
Culvert Barrel Data

Culvert Barrel Type Straight Culvert Inlet Elevation (invert): 4894.00 ft, Outlet Elevation (invert): 4886.00 ft

Culvert Length: 90.35 ft, Culvert Slope: 0.0889

Water Surface Profile Plot for Culvert: Structure#804

Crossing - Structure#804, Reach 800, Great Western Railway, Design Discharge - 2058.0 cfs
Culvert - Structure#804, Culvert Discharge - 104.0 cfs



Tailwater Data for Crossing: Structure#804, Reach 800

Table 10 - Downstream Channel Rating Curve (Crossing: Structure#804, Reach 800)

Flow (cfs)	Water Surface Elev (ft)	Velocity (ft/s)	Depth (ft)	Shear (psf)	Froude Number	
126.99	4881.92	0.92	2.04	0.63	0.38	
2058.00	4885.70	4.70	5.54	3.22	0.49	

Tailwater Channel Data - Structure#804, Reach 800

Tailwater Channel Option: Trapezoidal Channel

Bottom Width: 65.00 ft Side Slope (H:V): 3.00 (_:1) Channel Slope: 0.0110 Channel Manning's n: 0.0700 Channel Invert Elevation: 4881.00 ft

Roadway Data for Crossing: Structure#804, Reach 800

Roadway Profile Shape: Constant Roadway Elevation

Crest Length: 100.00 ft Crest Elevation: 4901.00 ft Roadway Surface: Gravel Roadway Top Width: 40.00 ft



Site Data - Structure#805

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 ft Inlet Elevation: 4893.00 ft Outlet Station: 62.00 ft Outlet Elevation: 4892.00 ft Number of Barrels: 1

Culvert Data Summary - Structure#805

Barrel Shape: Circular Barrel Diameter: 2.00 ft

Barrel Material: Corrugated Steel

Embedment: 0.00 in Barrel Manning's n: 0.0240 Culvert Type: Straight

Inlet Configuration: Thin Edge Projecting (Ke=0.9)

Inlet Depression: None

Table 11 - Culvert Summary Table: Structure#805

			,			_						
Discharge Names	Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth (ft)	Outlet Control Depth (ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)
5 Year	126.99 cfs	19.78 cfs	4896.54	3.39	3.538	7-M2c	2.00	1.60	1.60	0.40	7.35	2.93
100 Year	1882.00	27.78 cfs	4899.41	5.49	6.405	7-M2c	2.00	1.82	1.82	1.96	9.24	8.10

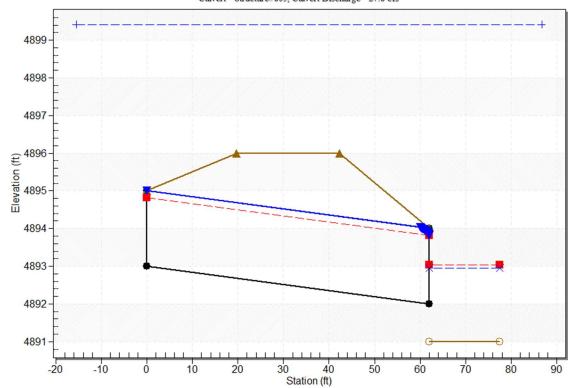
Culvert Barrel Data

Culvert Barrel Type Straight Culvert Inlet Elevation (invert): 4893.00 ft, Outlet Elevation (invert): 4892.00 ft

Culvert Length: 62.01 ft, Culvert Slope: 0.0161

Water Surface Profile Plot for Culvert: Structure#805

Crossing - Structure#805, Reach 800, Design Discharge - 1882.0 cfs
Culvert - Structure#805, Culvert Discharge - 27.8 cfs



Tailwater Data for Crossing: Structure#805, Reach 800

Table 12 - Downstream Channel Rating Curve (Crossing: Structure#805, Reach 800)

Flow (cfs)	Water Surface Elev (ft)	Velocity (ft/s)	Depth (ft)	Shear (psf)	Froude Number
126.99	4891.40	0.40	2.93	0.69	0.83
1882.00	4892.96	1.96	8.10	3.42	1.07

Tailwater Channel Data - Structure#805, Reach 800

Tailwater Channel Option: Trapezoidal Channel

Bottom Width: 107.00 ft Side Slope (H:V): 6.00 (_:1) Channel Slope: 0.0280 Channel Manning's n: 0.0450 Channel Invert Elevation: 4891.00 ft

Roadway Data for Crossing: Structure#805, Reach 800

Roadway Profile Shape: Constant Roadway Elevation

Crest Length: 100.00 ft Crest Elevation: 4896.00 ft Roadway Surface: Gravel Roadway Top Width: 22.60 ft



Site Data - Structure#806

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 ft Inlet Elevation: 4900.00 ft Outlet Station: 50.00 ft Outlet Elevation: 4899.00 ft

Number of Barrels: 1

Culvert Data Summary - Structure#806

Barrel Shape: Circular Barrel Diameter: 2.00 ft Barrel Material: Concrete Embedment: 0.00 in Barrel Manning's n: 0.0130 Culvert Type: Straight

Inlet Configuration: Square Edge with Headwall (Ke=0.5)

Inlet Depression: None

Table 13 - Culvert Summary Table: Structure#806

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Discharge Names	Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth (ft)	Outlet Control Depth (ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)
5 Year	124.66 cfs	35.58 cfs	4906.44	6.44	5.217	7-M2c	2.00	1.82	1.82	0.57	11.85	1.88
100 Year	1887.00	44.00 cfs	4909.33	9.33	8.320	4-FFf	2.00	2.00	2.00	2.87	14.01	5.32

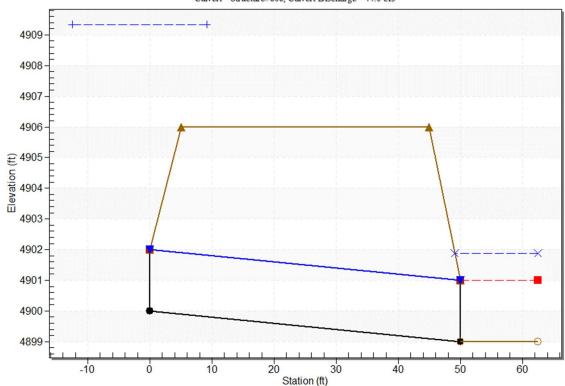
Culvert Barrel Data

Culvert Barrel Type Straight Culvert Inlet Elevation (invert): 4900.00 ft, Outlet Elevation (invert): 4899.00 ft

Culvert Length: 50.01 ft, Culvert Slope: 0.0200

Water Surface Profile Plot for Culvert: Structure#806

Crossing - Structure#806, Reach 800, Design Discharge - 1887.0 cfs
Culvert - Structure#806, Culvert Discharge - 44.0 cfs



Tailwater Data for Crossing: Structure#806, Reach 800

Table 14 - Downstream Channel Rating Curve (Crossing: Structure#806, Reach 800)

Flow (cfs)	Water Surface Elev (ft)	Velocity (ft/s)	Depth (ft)	Shear (psf)	Froude Number	
124.66	4899.57	0.57	1.88	0.60	0.44	
1887.00	4901.87	2.87	5.32	3.04	0.57	

Tailwater Channel Data - Structure#806, Reach 800

Tailwater Channel Option: Trapezoidal Channel

Bottom Width: 115.00 ft Side Slope (H:V): 3.00 (_:1) Channel Slope: 0.0170 Channel Manning's n: 0.0700 Channel Invert Elevation: 4899.00 ft

Roadway Data for Crossing: Structure#806, Reach 800

Roadway Profile Shape: Constant Roadway Elevation

Crest Length: 100.00 ft Crest Elevation: 4906.00 ft Roadway Surface: Paved Roadway Top Width: 40.00 ft



Site Data - Structure#807

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 ft Inlet Elevation: 4917.00 ft Outlet Station: 80.00 ft Outlet Elevation: 4916.00 ft Number of Barrels: 2

Culvert Data Summary - Structure#807

Barrel Shape: Concrete Box Barrel Span: 12.00 ft Barrel Rise: 5.00 ft Barrel Material: Concrete

Embedment: 0.00 in Barrel Manning's n: 0.0120 Culvert Type: Straight

Inlet Configuration: Square Edge (30-75° flare) Wingwall (Ke=0.4)

Inlet Depression: None

Table 15 - Culvert Summary Table: Structure#807

Discharge Names	Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth (ft)	Outlet Control Depth (ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)
5 Year	63.00 cfs	63.00 cfs	4917.91	0.91	0.0*	1-S2n	0.38	0.60	0.38	0.27	6.97	0.98
100 Year	1511.00 cfs	1294.26 cfs	4924.80	7.80	6.555	5-S2n	2.61	4.49	3.37	1.82	16.00	3.40

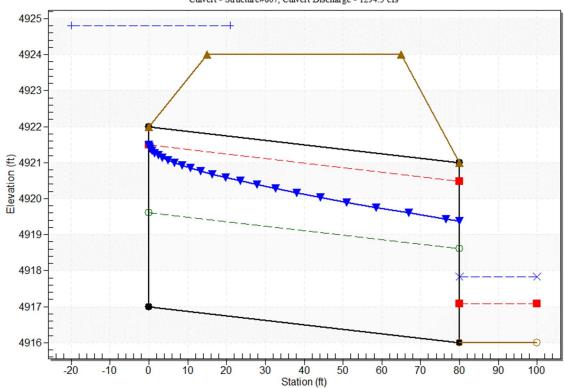
Culvert Barrel Data

Culvert Barrel Type Straight Culvert Inlet Elevation (invert): 4917.00 ft, Outlet Elevation (invert): 4916.00 ft

Culvert Length: 80.01 ft, Culvert Slope: 0.0125

Water Surface Profile Plot for Culvert: Structure#807

Crossing - Structure#807, Reach 829, 1120 Southgate Dr, Design Discharge - 1511.0 cfs
Culvert - Structure#807, Culvert Discharge - 1294.3 cfs



Tailwater Data for Crossing: Structure#807, Reach 829

Table 16 - Downstream Channel Rating Curve (Crossing: Structure#807, Reach 829)

Flow (cfs)	Water Surface Elev (ft)	Velocity (ft/s)	Depth (ft)	Shear (psf)	Froude Number
63.00	4916.27	0.27	0.98	0.09	0.33
1511.00	4917.82	1.82	3.40	0.57	0.45

Tailwater Channel Data - Structure#807, Reach 829

Tailwater Channel Option: Trapezoidal Channel

Bottom Width: 235.00 ft Side Slope (H:V): 5.00 (_:1) Channel Slope: 0.0050 Channel Manning's n: 0.0450 Channel Invert Elevation: 4916.00 ft

Roadway Data for Crossing: Structure#807, Reach 829

Roadway Profile Shape: Constant Roadway Elevation

Crest Length: 100.00 ft Crest Elevation: 4924.00 ft Roadway Surface: Paved Roadway Top Width: 50.00 ft



Site Data - Structure#808

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 ft Inlet Elevation: 4942.00 ft Outlet Station: 527.00 ft Outlet Elevation: 4932.00 ft

Number of Barrels: 1

Culvert Data Summary - Structure#808

Barrel Shape: Circular Barrel Diameter: 4.00 ft Barrel Material: Concrete Embedment: 0.00 in Barrel Manning's n: 0.0130 Culvert Type: Straight

Inlet Configuration: Square Edge with Headwall (Ke=0.5)

Inlet Depression: None

Table 17 - Culvert Summary Table: Structure#808

			<u> </u>									
Discharge Names	Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth (ft)	Outlet Control Depth (ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)
5 Year	36.03 cfs	36.03 cfs	4944.55	2.55	0.0*	1-S2n	1.15	1.79	1.16	0.33	11.92	1.64
100 Year	1300.00	152.07 cfs	4950.43	8.43	3.091	5-S2n	2.63	3.61	2.65	2.74	17.18	6.02

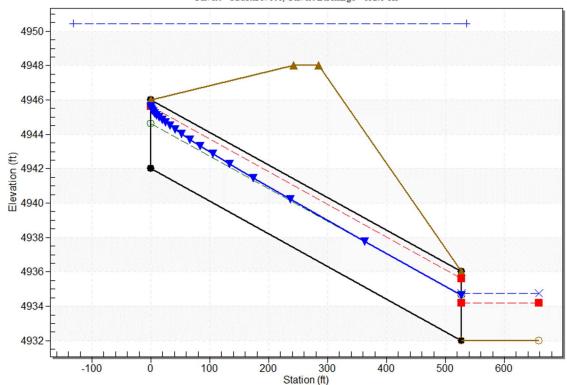
Culvert Barrel Data

Culvert Barrel Type Straight Culvert Inlet Elevation (invert): 4942.00 ft, Outlet Elevation (invert): 4932.00 ft

Culvert Length: 527.09 ft, Culvert Slope: 0.0190

Water Surface Profile Plot for Culvert: Structure#808

Crossing - Structure#808, Reach 829, Design Discharge - 1300.0 cfs
Culvert - Structure#808, Culvert Discharge - 152.1 cfs



Tailwater Data for Crossing: Structure#808, Reach 829

Table 18 - Downstream Channel Rating Curve (Crossing: Structure#808, Reach 829)

Flow (cfs)	Water Surface Elev (ft)	Velocity (ft/s)	Depth (ft)	Shear (psf)	Froude Number	
36.03	4932.33	0.33	1.64	0.23	0.51	
1300.00	4934.74	2.74	6.02	1.88	0.70	

Tailwater Channel Data - Structure#808, Reach 829

Tailwater Channel Option: Trapezoidal Channel

Bottom Width: 64.00 ft Side Slope (H:V): 5.40 (_:1) Channel Slope: 0.0110 Channel Manning's n: 0.0450 Channel Invert Elevation: 4932.00 ft

Roadway Data for Crossing: Structure#808, Reach 829

Roadway Profile Shape: Constant Roadway Elevation

Crest Length: 100.00 ft Crest Elevation: 4948.00 ft Roadway Surface: Paved Roadway Top Width: 43.00 ft



Site Data - Structure#809

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 ft Inlet Elevation: 4958.00 ft Outlet Station: 304.00 ft Outlet Elevation: 4948.00 ft

Number of Barrels: 1

Culvert Data Summary - Structure#809

Barrel Shape: Circular Barrel Diameter: 4.00 ft Barrel Material: Concrete Embedment: 0.00 in Barrel Manning's n: 0.0110 Culvert Type: Straight

Inlet Configuration: Square Edge with Headwall (Ke=0.5)

Inlet Depression: None

Table 19 - Culvert Summary Table: Structure#809

			<u> </u>									
Discharge Names	Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth (ft)	Outlet Control Depth (ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)
5 Year	36.03 cfs	36.03 cfs	4960.52	2.52	0.0*	1-S2n	0.92	1.79	0.92	0.11	16.43	21.45
100 Year	1300.00	175.97 cfs	4968.39	10.39	1.695	5-S2n	2.16	3.76	2.31	0.98	23.45	86.35

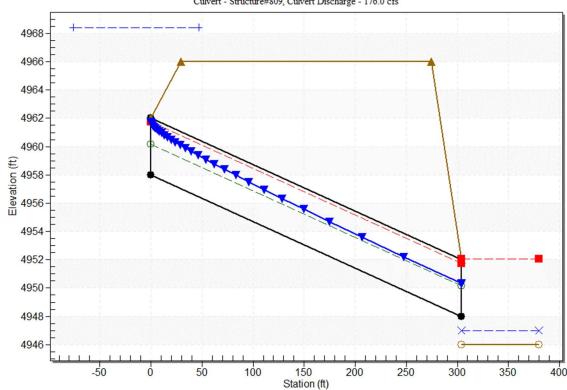
Culvert Barrel Data

Culvert Barrel Type Straight Culvert Inlet Elevation (invert): 4958.00 ft, Outlet Elevation (invert): 4948.00 ft

Culvert Length: 304.16 ft, Culvert Slope: 0.0329

Water Surface Profile Plot for Culvert: Structure#809

Crossing - Structure#809, Reach 843, US-34, Design Discharge - 1300.0 cfs
Culvert - Structure#809, Culvert Discharge - 176.0 cfs



Tailwater Data for Crossing: Structure#809, Reach 843

Table 20 - Downstream Channel Rating Curve (Crossing: Structure#809, Reach 843)

Flow (cfs)	Water Surface Elev (ft)	Velocity (ft/s)	Depth (ft)	Shear (psf)	Froude Number
36.03	4946.11	0.11	21.45	34.03	11.45
1300.00	4946.98	0.98	86.35	305.00	15.39

Tailwater Channel Data - Structure#809, Reach 843

Tailwater Channel Option: Rectangular Channel

Bottom Width: 15.40 ft Channel Slope: 5.0000 Channel Manning's n: 0.0350 Channel Invert Elevation: 4946.00 ft

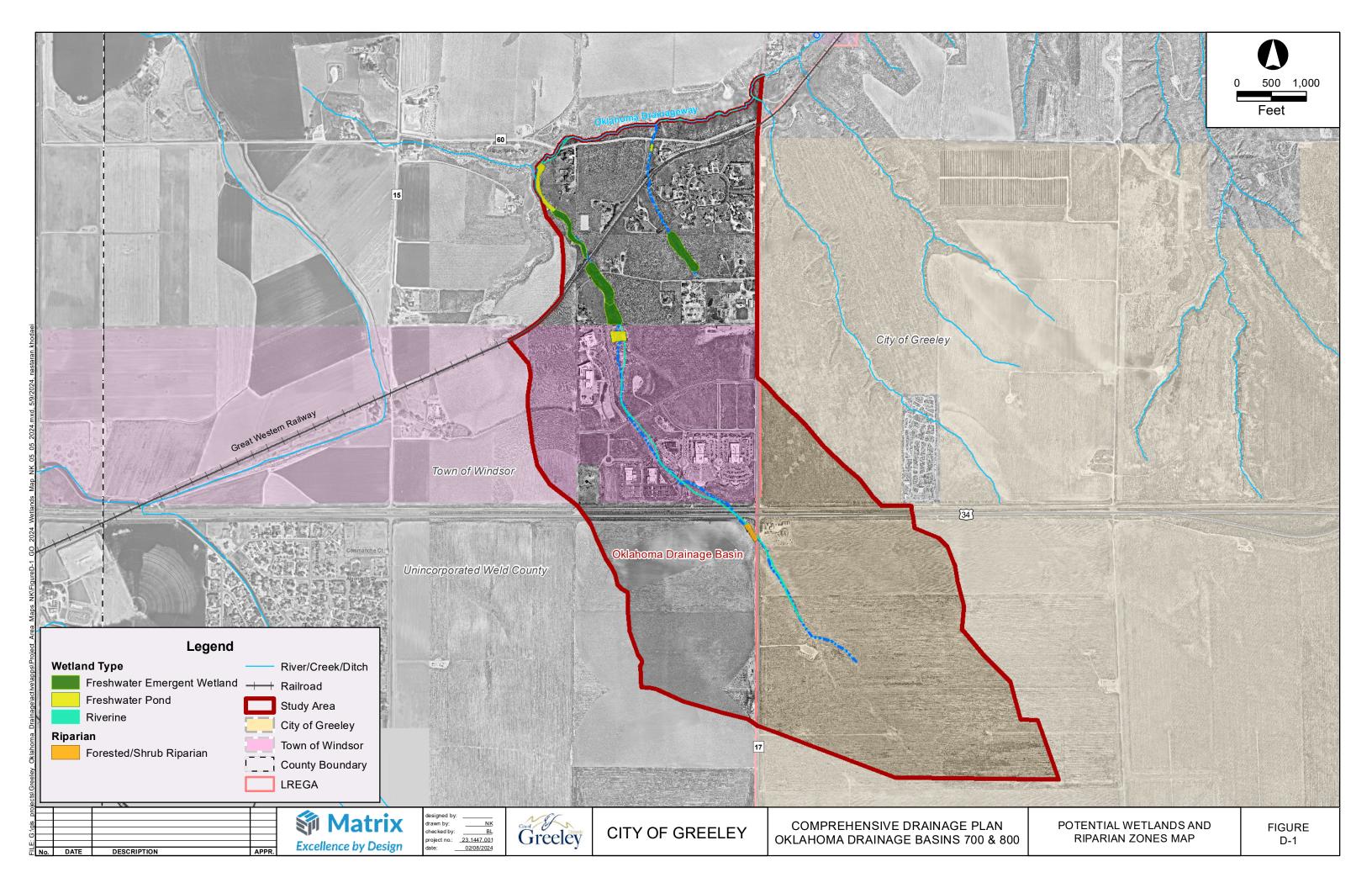
Roadway Data for Crossing: Structure#809, Reach 843

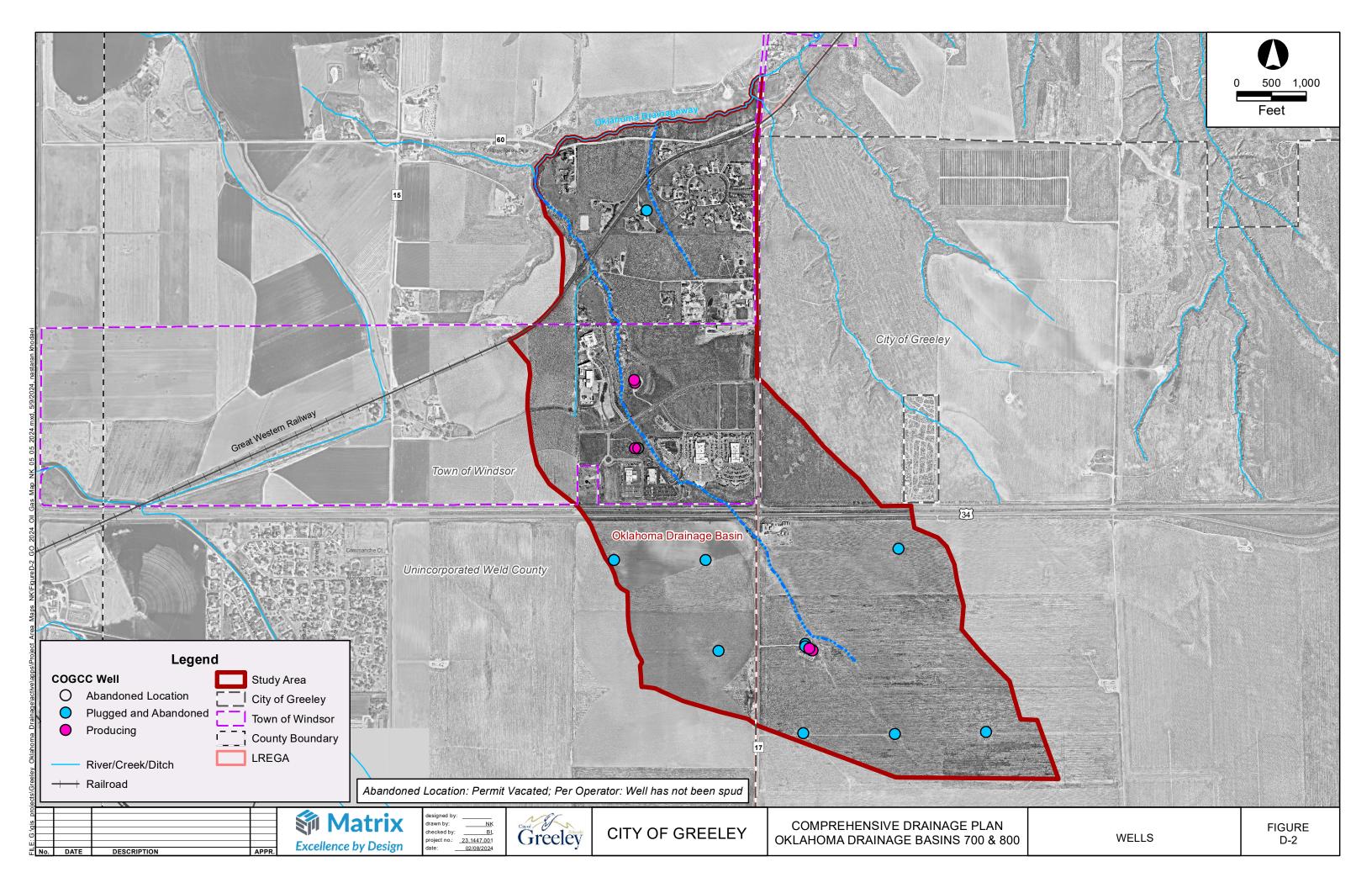
Roadway Profile Shape: Constant Roadway Elevation

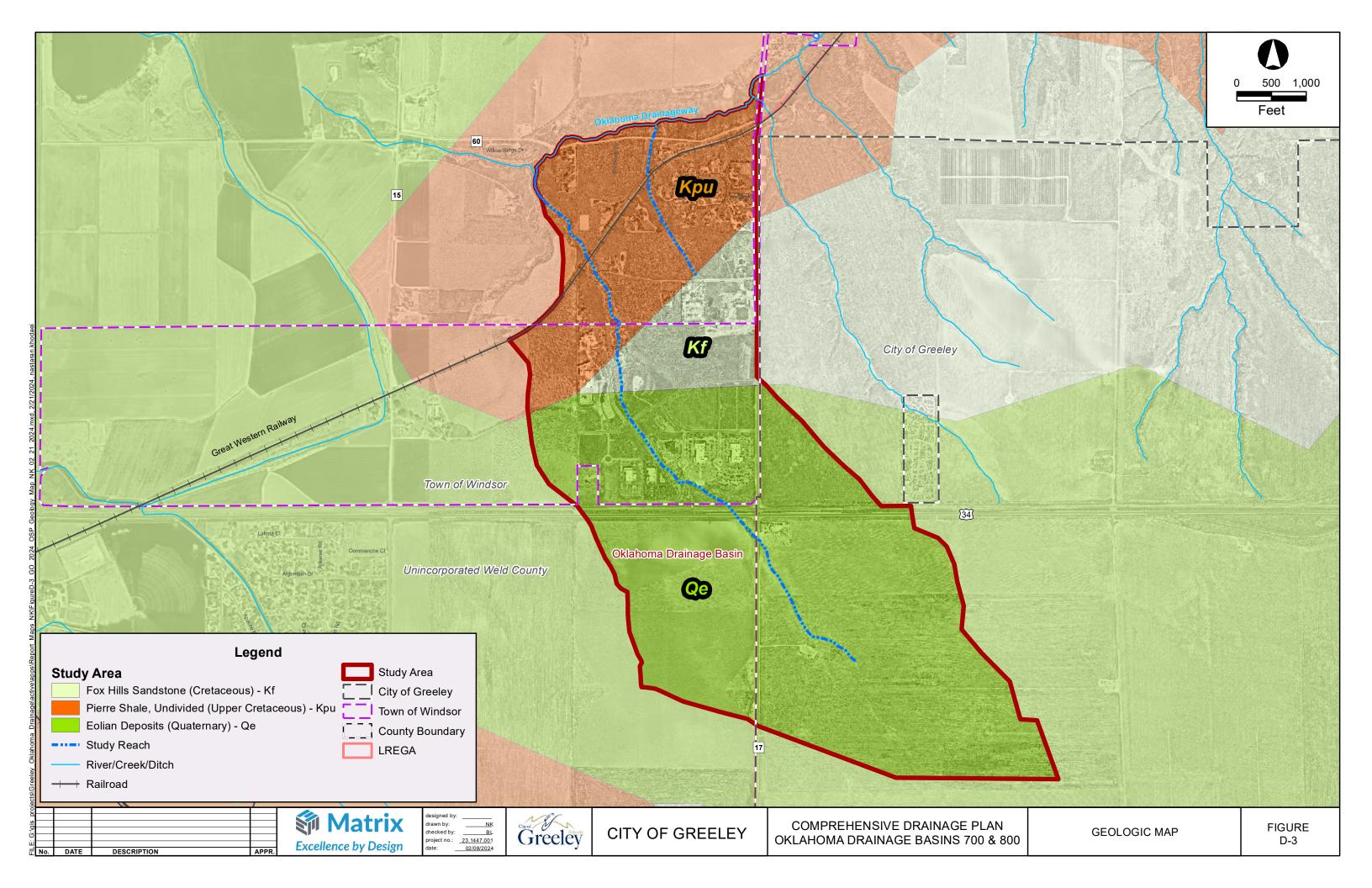
Crest Length: 100.00 ft Crest Elevation: 4966.00 ft Roadway Surface: Paved Roadway Top Width: 245.00 ft



Appendix D – Wetland and Riparian Inventory

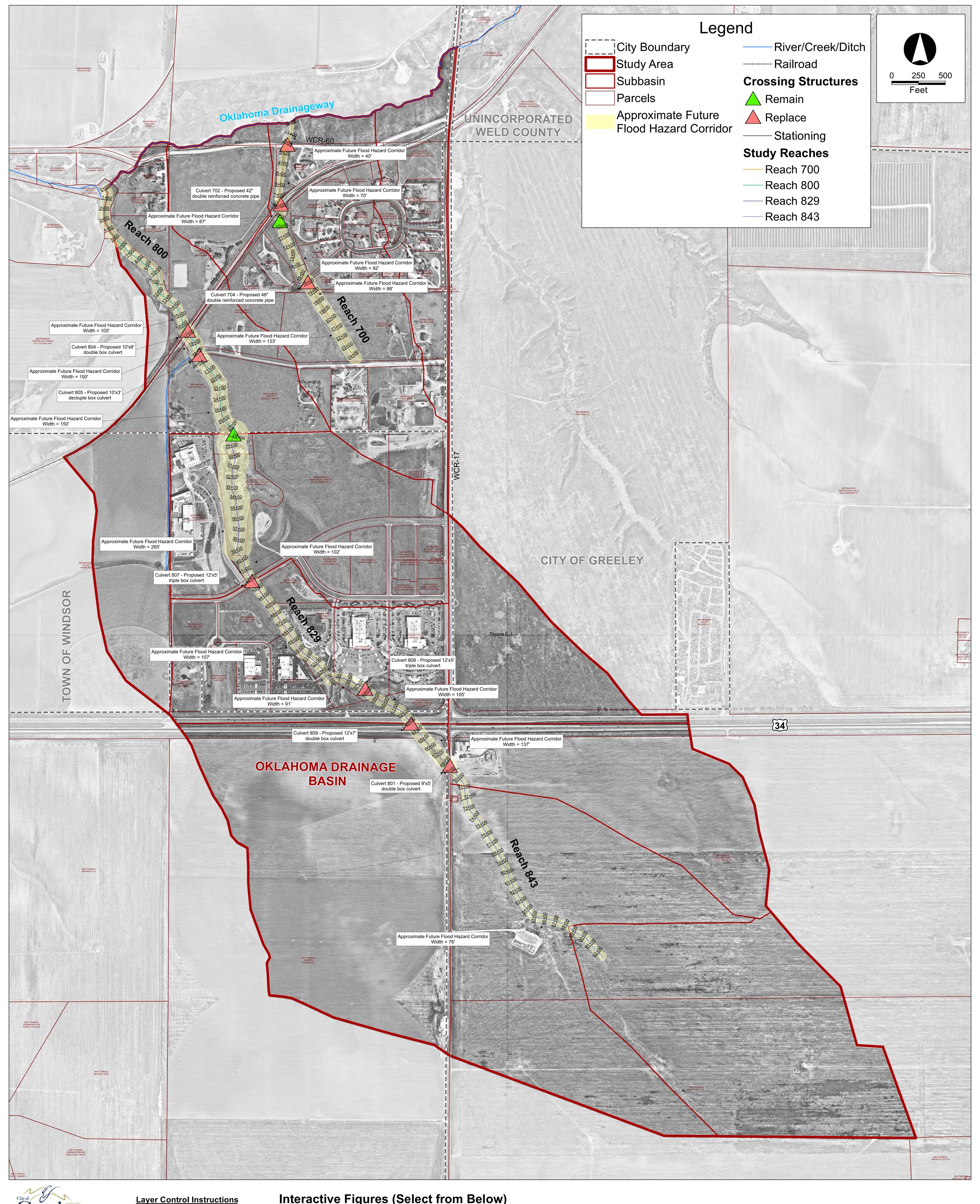


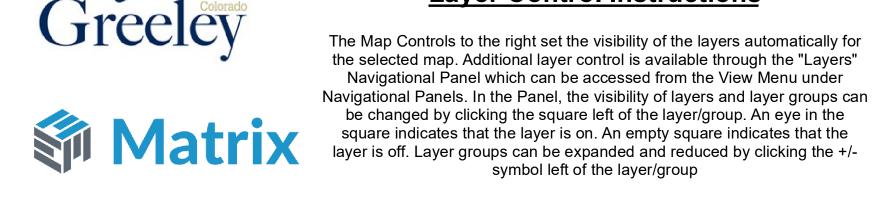






Appendix E – Alternatives Analysis







Appendix E-2 MHFD Detention Workbooks



		DET	FΝΤΙΩΙ	N BAS	IN STAGE-S	TORA	GE TAI	BI F BI	III DEF	2				
		DLI	LIVITO		D-Detention, Version			DLL D(JILDLI	\			Clear Work	book
Project:	24.1447.001	1 Greeley- (Oklahoma Dra	inage MP										
Basin ID:	Option 2 De	tenetion 71	1											
	2 DNE 1													
OLUME EURY WQCV		1												
,		100-YE ORIFIC	AR e		Depth Increment =	0.50	l _{ft}							
PERMANENT ORIFIC							Optional	l	VA /: Jul.	Area	Optional Override	A	Volume	Valores
Example Zone	Configura	ition (Rete	ntion Pona)		Stage - Storage Description	Stage (ft)	Override Stage (ft)	Length (ft)	Width (ft)	(ft ²)	Area (ft ²)	Area (acre)	(ft ³)	Volume (ac-ft)
atershed Information					Top of Micropool	0.00		41.9	41.9	1,752		0.040		
xtended Detention Basin (EDB)	EDB				ISV	0.33		41.9	41.9	1,752		0.040	578	0.013
Watershed Area =	90.00	acres				0.50		41.9	41.9	1,752		0.040	876	0.020
Watershed Length = Watershed Length to Centroid =	3,900 1,738	ft ft				1.00		99.2 267.9	70.2 153.5	6,962 41,122		0.160	2,148 12,998	0.049
Watershed Length to Centroid = Watershed Slope =	0.031	ft/ft			Hoor	1.61		305.0	171.9	52,410		1.203	18,130	0.416
Watershed Imperviousness =	30.20%	percent			11001	2.00		308.1	175.0	53,907		1.238	38,861	0.892
Percentage Hydrologic Soil Group A =	0.0%	percent			Zone 1 (WQCV)	2.20		309.7	176.6	54,683		1.255	49,720	1.141
Percentage Hydrologic Soil Group B =	0.0%	percent				2.50		312.1	179.0	55,855		1.282	66,300	1.522
Percentage Hydrologic Soil Groups C/D =	100.0%	percent				3.00		316.1	183.0	57,836		1.328	94,722	2.175
Target WQCV Drain Time =	40.0	hours			Zone 2 (EURV)	3.23		317.9	184.8	58,757		1.349	108,130	2.482
Location for 1-hr Rainfall Depths =	Denver - Capito	ol Building		▼		3.50		320.1	187.0	59,848		1.374	124,141	2.850
After providing required inputs above inc depths, click 'Run CUHP' to generate rund			Run CUHI	-		4.00		324.1 328.1	191.0 195.0	61,892 63,968		1.421	154,575	3.549 4.271
the embedded Colorado Urban Hydro			Optional Use	r Overrides		5.00		332.1	195.0	66,077		1.517	186,038 218,548	5.017
Water Quality Capture Volume (WQCV) =	1.141	acre-feet	ppuoliui Ose	acre-feet		5.50		336.1	203.0	68,217		1.566	252,120	5.788
Excess Urban Runoff Volume (EURV) =	2.470	acre-feet	,	acre-feet	Zone 3 (100-year)	5.97		339.9	206.7	70,258		1.613	284,661	6.535
2-yr Runoff Volume (P1 = 0.85 in.) =	1.598	acre-feet	0.85	inches		6.00		340.1	207.0	70,389		1.616	286,770	6.583
5-yr Runoff Volume (P1 = 1.12 in.) =	2.810	acre-feet	1.12	inches		6.50		344.1	211.0	72,593		1.667	322,515	7.404
10-yr Runoff Volume (P1 = 1.4 in.) =	4.602	acre-feet	1.40	inches		7.00		348.1	215.0	74,830		1.718	359,369	8.250
25-yr Runoff Volume (P1 = 1.87 in.) =	8.506	acre-feet	1.87	inches		7.50		352.1	219.0	77,098		1.770	397,350	9.122
50-yr Runoff Volume (P1 = 2.3 in.) =	11.792	acre-feet	2.30	inches		8.00		356.1	223.0	79,398		1.823	436,472	10.020
100-yr Runoff Volume (P1 = 2.79 in.) = 500-yr Runoff Volume (P1 = 4.16 in.) =	15.995 27.074	acre-feet acre-feet	2.79 4.16	inches		9.00		360.1 364.1	227.0 231.0	81,730 84,095		1.876	476,753 518,208	10.945 11.896
Approximate 2-yr Detention Volume =	1.515	acre-feet	4.10	inches		9.50		368.1	235.0	86,491		1.931	560,853	12.875
Approximate 5-yr Detention Volume =	2.643	acre-feet				10.00		372.1	239.0	88,919		2.041	604,704	13.882
Approximate 10-yr Detention Volume =	3.285	acre-feet				10.50		376.1	243.0	91,379		2.098	649,777	14.917
Approximate 25-yr Detention Volume =	4.314	acre-feet				11.00		380.1	247.0	93,872		2.155	696,089	15.980
Approximate 50-yr Detention Volume =	4.931	acre-feet				11.50		384.1	251.0	96,396		2.213	743,654	17.072
Approximate 100-yr Detention Volume =	6.534	acre-feet				12.00		388.1	255.0	98,952		2.272	792,490	18.193
						12.50		392.1	259.0	101,540		2.331	842,611	19.344
fine Zones and Basin Geometry one 1 Volume (WQCV)	1.141	acre-feet				13.00		396.1 400.1	263.0 267.0	104,161		2.391	894,035 946,777	20.524
one 2 Volume (EURV - Zone 1)	1.329	acre-feet				14.00		404.1	271.0	106,813		2.514	1,000,853	22.976
Cone 3 Volume (100-year - Zones 1 & 2)	4.064	acre-feet				14.50		408.1	275.0	112,213		2.576	1,056,280	24.249
Total Detention Basin Volume =	6.534	acre-feet				15.00		412.1	279.0	114,962		2.639	1,113,072	25.553
Initial Surcharge Volume (ISV) =	578	ft ³				15.50		416.1	283.0	117,742		2.703	1,171,246	26.888
Initial Surcharge Depth (ISD) =	0.33	ft				16.00		420.1	287.0	120,554		2.768	1,230,819	28.256
Total Available Detention Depth (H _{total}) =	6.00	ft				16.50		424.1	291.0	123,398		2.833	1,291,806	29.656
Depth of Trickle Channel (H _{TC}) =	0.50	ft				17.00		428.1	295.0	126,275		2.899	1,354,223	31.089
Slope of Trickle Channel (S _{TC}) =	0.003	ft/ft				17.50		432.1	299.0	129,183		2.966	1,418,086	32.555
Slopes of Main Basin Sides (S_{main}) = Basin Length-to-Width Ratio ($R_{L/W}$) =	2	H:V				18.00		436.1 440.1	303.0 307.0	132,123 135,095		3.033	1,483,411	34.054 35.588
Sasin Lengur-to-Widdi Rado (RL/W) =						19.00		444.1	311.0	138,100		3.170	1,618,511	37.156
Initial Surcharge Area (A _{ISV}) =	1,752	ft ²				19.50		448.1	315.0	141,136		3.240	1,688,319	38.758
Surcharge Volume Length $(L_{ISV}) =$	41.9	ft				20.00		452.1	319.0	144,204		3.310	1,759,652	40.396
Surcharge Volume Width (W _{ISV}) =	41.9	ft				20.50		456.1	323.0	147,304		3.382	1,832,528	42.069
Depth of Basin Floor (H_{FLOOR}) =	0.78	ft				21.00		460.1	327.0	150,436		3.454	1,906,962	43.778
Length of Basin Floor $(L_{FLOOR}) =$	305.0	ft				21.50		464.1	331.0	153,601		3.526	1,982,970	45.523
Width of Basin Floor (W _{FLOOR}) =	171.9	ft a 2				22.00		468.1	335.0	156,797		3.600	2,060,568	47.304
Area of Basin Floor (A _{FLOOR}) =	52,410	ft ²				22.50		472.1	339.0	160,025		3.674	2,139,772	49.122
Volume of Basin Floor (V _{FLOOR}) =	16,573 4.39	ft ³				23.00		476.1 480.1	343.0 347.0	163,285 166,578		3.749	2,220,599	50.978 52.871
Depth of Main Basin (H_{MAIN}) = Length of Main Basin (L_{MAIN}) =	340.1	ft			1	24.00		484.1	351.0	169,902		3.900	2,303,063	54.802
Width of Main Basin (W _{MAIN}) =	207.0	ft				24.50		488.1	355.0	173,258		3.977	2,472,970	56.772
Area of Main Basin (A _{MAIN}) =	70,389	ft ²				25.00		492.1	359.0	176,646		4.055	2,560,445	58.780
Volume of Main Basin (V _{MAIN}) =	268,575	ft ³				25.50		496.1	363.0	180,067		4.134	2,649,622	60.827
Calculated Total Basin Volume (V _{total}) =	6.579	acre-feet				26.00		500.1	367.0	183,519		4.213	2,740,517	62.914

			BASIN OUT HFD-Detention, V			_52511			
		ley- Oklahoma Dra		(- 4/)	,				
Basin ID:	Option 2 Deteneti	ion 711		F-M	F-Wtd				1
ZONE 2 ZONE 1				Estimated Stage (ft)	Estimated	Outlet Type		nput Parameters uding Tables)	
OO-YR EURY WOCV			Zene 1 (WOCIA	Stage (ft)	Volume (ac-ft)	Outlet Type Orifice Plate			
+ com + wacy			Zone 1 (WQCV)	2.20	1.141		Orifice Plate	- 20.2	
ZONE 1 AND 2	100-YEAR ORIFICE		Zone 2 (EURV)		1.329	Rectangular Orifice	Vertical Orifice (Recta		
PERMANENT—ORIFICES POOL Example Zone	Configuration (I		Zone 3 (100-year)		4.064	Weir&Pipe (Rect.)	Weir and Pipe (w/ Re	ctangular Orifice Plate)	\blacksquare
			n DMD)	Total (all zones)	6.534	1	Calculated Davam	ators for Underdra	nin.
<u>ser Input: Orifice at Underdrain Outlet (typic</u> 	N/A		। । । । the filtration medi	a surface)	Underd	Irain Orifice Area =	N/A	eters for Underdra Tft ²	1111
Underdrain Orifice Diameter =	N/A	inches	the filtration medi	a surface)		Orifice Centroid =	N/A	feet	
Oracididii Office Barretti –	14/74	inches .	•		Officeration	Office certable =	14/74	licer	
lser Input: Orifice Plate with one or more ori	fices or Elliptical Slo	t Weir (typically us	ed to drain WQCV	and/or EURV in a	sedimentation BM	P)	Calculated Parame	eters for Plate	
Centroid of Lowest Orifice =	0.00		in bottom at Stage			ce Area per Row =	2.861E-02	ft ²	
Depth at top of Zone using Orifice Plate =	2.20	ft (relative to bas	in bottom at Stage	e = 0 ft	Eli	iptical Half-Width =	N/A	feet	
Orifice Plate: Orifice Vertical Spacing =	8.80	inches			Ellipt	ical Slot Centroid =	N/A	feet	
Orifice Plate: Orifice Area per Row =	4.12	sq. inches (use re	ectangular opening	s)	E	Elliptical Slot Area =	N/A	ft²	
					. 1				
	_				to match rain Time				
ser Input: Stage and Total Area of Each Or		- NO. 100 NO. 100 NO.				1 2 27 22 22		T = 27 = ==	7
	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)		0.73	1.47						•
Orifice Area (sq. inches)	4.12	4.12	4.12						
	Row 9 (optional)	Row 10 (optional)	Row 11 (optional)	Row 12 (optional)	Row 13 (optional)	Row 14 (optional)	Row 15 (optional)	Row 16 (optional)	1
Stage of Orifice Centroid (ft)	Row 9 (optional)	ROW 10 (Optional)	Row 11 (optional)	Row 12 (opuonai)	ROW 13 (Optional)	ROW 14 (Optional)	Row 15 (opuonal)	Row 16 (opublial)	•
Orifice Area (sq. inches)						,			•
ormeernaa (aqrimanas)									_
ser Input: Vertical Orifice (Circular or Rectar	gular)						Calculated Parame	eters for Vertical C)rifice
	Zone 2 Rectangula	Not Selected					Zone 2 Rectangula	Not Selected	
Invert of Vertical Orifice =	2.20	N/A		in bottom at Stage		tical Orifice Area =	0.26	N/A	ft ²
Depth at top of Zone using Vertical Orifice =	3.23	N/A		in bottom at Stage	e = 0 ft) Vertical	Orifice Centroid =	0.08	N/A	feet
Vertical Orifice Height =	2.00	N/A	inches						Ĭ
Vertical Orifice Width =	18.79		inches			Size Vertic	cal Orifice to drain (EU	JRV - WQCV) Only	
I To to O of the Wait (Donate and Elet	Clared Carte		D /T		- O. H-t B:)		Calandata d Damana	-t f O f	14/
lser Input: Overflow Weir (Dropbox with Flat	Zone 3 Weir	Not Selected	Rectangular/Trape	ezoidal Weir and N	o Outlet Pipe)			eters for Overflow	weir
Overflow Weir Front Edge Height, Ho =	3.23	N/A	ft (relative to basin	hottom at Stage = 0	ft) Hoight of Crato	Upper Edge, H₁ =	Zone 3 Weir 6.56	Not Selected N/A	feet
Overflow Weir Front Edge Length =	62.00	N/A	feet	bottom at Stage = 0		eir Slope Length =	10.54	N/A	feet
Overflow Weir Front Edge Length =	3.00	N/A	H:V	Gra	e Open Area / 10		35.44	N/A	leet
Horiz. Length of Weir Sides =	10.00	N/A	feet		erflow Grate Open	The second secon	454.86	N/A	ft ²
Overflow Grate Type =		N/A ▼				Area w/ Debris =	227.43	N/A	ft ²
Debris Clogging % =	50%	N/A	%					,	1
				1	•				
Iser Input: Outlet Pipe w/ Flow Restriction Pla	te (Circular Orifice,	Restrictor Plate, o	r Rectangular Orifi	ce)	Cal	culated Parameters	for Outlet Pipe w	/ Flow Restriction I	Plate
	Zone 3 Rectangula	Not Selected					Zone 3 Rectangula	Not Selected	
Depth to Invert of Outlet Pipe =	0.33	N/A		asin bottom at Stage		utlet Orifice Area =	12.83	N/A	ft ²
Rectangular Orifice Width =	43.90	N/A	inches			: Orifice Centroid =	1.75	N/A	feet
Rectangular Orifice Height =	42.10		inches	Half-Cent	al Angle of Restrict	tor Plate on Pipe =	N/A	N/A	radians
			t Plate to match 90%						
Iser Input: Emergency Spillway (Rectangular			nt 100-year Peak Runo		C-1 D	- i Fl. DH	Calculated Parame		
Spillway Invert Stage=	5.70	the Salar to the Control of the Cont	in bottom at Stage	e = 0 ft		esign Flow Depth=	0.96	feet	
Spillway Crest Length =	59.00	feet Size Em	ergency Spillway to pa	iss		op of Freeboard =	7.66	feet	
Spillway End Slopes = Freeboard above Max Water Surface =	4.00 1.00	Develope	d 100-yr Peak Runoff F	Rate		op of Freeboard = op of Freeboard =	1.79	acres	
Freeboard above Max Water Surface =	1.00	feet ———			basin volume at 1	op or Freeboard =	9.41	acre-ft	
outed Hydrograph Results	The user can ove	erride the default C	CUHP hydrographs	and runoff volume	es by entering new	values in the Inflo	w Hydrographs tal	ble (Columns W th	hrough A
Design Storm Return Period =	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 \
One-Hour Rainfall Depth (in) =	N/A	N/A	0.85	1.12	1.40	1.87	2.30	2.79	4.:
CUHP Runoff Volume (acre-ft) = Inflow Hydrograph Volume (acre-ft) =	1.141 N/A	2.470 N/A	1.598 1.598	2.810 2.810	4.602 4.602	8.506 8.506	11.792 11.792	15.995 15.995	27.0
CUHP Predevelopment Peak Q (cfs) =	N/A N/A	N/A	0.8	8.6	24.1	64.2	93.3	131.2	225
PPTIONAL Override Predevelopment Peak Q (cfs) =	N/A	N/A							
Predevelopment Unit Peak Flow, q (cfs/acre) =	N/A	N/A	0.01	0.10	0.27	0.71	1.04	1.46	2
Peak Inflow Q (cfs) =	N/A	N/A	16.2	29.4	48.3	95.8	131.0	176.7	29:
Peak Outflow Q (cfs) = Ratio Peak Outflow to Predevelopment Q =	0.5 N/A	1.9 N/A	1.0 N/A	0.2	15.3 0.6	51.6 0.8	82.4 0.9	126.6 1.0	253
Structure Controlling Flow =	Vertical Orifice 1				Overflow Weir 1	Overflow Weir 1	Overflow Weir 1	Outlet Plate 1	Spill
Max Velocity through Grate 1 (fps) =	N/A	N/A	N/A	0.0	0.0	0.1	0.2	0.3	0.
Max Velocity through Grate 2 (fps) =	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/
Time to Drain 97% of Inflow Volume (hours) =	37	49	45	52	50	45	42	37	2
	40	52	48	55	55	53	52	50	4.
Time to Drain 99% of Inflow Volume (hours) =		3 23	2 44	3 75	3 70	1 456	5 05	5 5 5 2	1 6 /
Time to Drain 99% of Inflow Volume (hours) = Maximum Ponding Depth (ft) = Area at Maximum Ponding Depth (acres) =	2.20 1.26	3.23 1.35	2.44 1.28	3.25 1.35	3.79 1.40	4.56 1.47	5.05 1.52	5.63 1.58	6.4 1.6



<u> </u>		ULI	LIVITON DASI	IN STAGE-S	TUKA	GE I A	DLE DU	ITLDER					
				D-Detention, Version	on 4.06 (Ju	ıly 2022)						Clear Work	book
			Oklahoma Drainage MP										
Basin ID:	Option 2, De	tention 82	3										
ZONE	2 ONE 1		_										
100-YR VOLUME EURV WOCV		\vdash											
'		100-YE		Depth Increment =	1.00	l _{ft}							
PERMANENT—ORIFIC						Optional		um let	A	Optional Override		Volume	A SECTION SECT
POOL Example Zone	Configurat	don (Rete	ntion Pona)	Stage - Storage Description	Stage (ft)	Override Stage (ft)	Length (ft)	Width (ft)	Area (ft ²)	Area (ft 2)	Area (acre)	(ft 3)	Volume (ac-ft)
Watershed Information				Top of Micropool		0.00				37,664	0.865		
Extended Detention Basin (EDB)	EDB				-	1.00				77,436	1.778	57,550	1.321
Watershed Area =	327.00	acres				2.00				133,078	3.055	162,807	3.738
Watershed Length =	4,753	ft				3.00				163,864	3.762	311,278	7.146
Watershed Length to Centroid = Watershed Slope =	2,751 0.012	ft ft/ft				4.00 5.00				190,605 204,897	4.376 4.704	488,512 686,263	11.215 15.754
Watershed Imperviousness =	72.98%	percent				6.00				215,528	4.948	896,476	20.580
Percentage Hydrologic Soil Group A =	0.0%	percent				7.00				226,286	5.195	1,117,383	25.652
Percentage Hydrologic Soil Group B =	0.0%	percent				8.00		1.00		237,198	5.445	1,349,125	30.972
Percentage Hydrologic Soil Groups C/D =	100.0%	percent				8.49				273,603	6.281	1,474,271	33.845
Target WQCV Drain Time =	40.0	hours				9.00		1000		273,603	6.281	1,613,808	37.048
Location for 1-hr Rainfall Depths =						10.00				273,603	6.281	1,887,411	43.329
After providing required inputs above inc depths, click 'Run CUHP' to generate rund			Run CUHP										
the embedded Colorado Urban Hydro			Optional User Overrides										
Water Quality Capture Volume (WQCV) =	7.879	acre-feet	acre-feet					11					
Excess Urban Runoff Volume (EURV) =	23.271	acre-feet	acre-feet		-		-	250	.55				
2-yr Runoff Volume (P1 = 0.85 in.) =	16.082	acre-feet	0.85 inches		-			()					
5-yr Runoff Volume (P1 = 1.12 in.) =	22.795	acre-feet	1.12 inches										
10-yr Runoff Volume (P1 = 1.4 in.) = 25-yr Runoff Volume (P1 = 1.87 in.) =	30.462 44.522	acre-feet acre-feet	1.40 inches										
50-yr Runoff Volume (P1 = 2.3 in.) =	57.083	acre-feet	2.30 inches										
100-yr Runoff Volume (P1 = 2.79 in.) =	71.969	acre-feet	2.79 inches										
500-yr Runoff Volume (P1 = 4.16 in.) =	112.726	acre-feet	4.16 inches		=								
Approximate 2-yr Detention Volume =	14.974	acre-feet						1					
Approximate 5-yr Detention Volume =	21.673	acre-feet											
Approximate 10-yr Detention Volume = Approximate 25-yr Detention Volume =	26.650 33.089	acre-feet acre-feet											
Approximate 50-yr Detention Volume =	37.124	acre-feet											
Approximate 100-yr Detention Volume =	43.128	acre-feet									1		
Define Zones and Basin Geometry					-								
Zone 1 Volume (WQCV) ▼	7.879	acre-feet						120					
Zone 2 Volume (EURV - Zone 1)	15.391	acre-feet						100					
Zone 3 Volume (100-year - Zones 1 & 2) Total Detention Basin Volume =	19.857 43.128	acre-feet acre-feet											-
Initial Surcharge Volume (ISV) =	43.126 user	ft ³											<u> </u>
Initial Surcharge Depth (ISD) =	user	ft			-		-						
Total Available Detention Depth (H _{total}) =	user	ft			-		-	7					
Depth of Trickle Channel (H_{TC}) =	user	ft					1						
Slope of Trickle Channel (S_{TC}) =		ft/ft											
Slopes of Main Basin Sides (S _{main}) =	user	H:V						(***)					
Basin Length-to-Width Ratio $(R_{L/W})$ =	user	I											
Initial Surcharge Area (A _{ISV}) =	user	ft ²											
Surcharge Volume Length (L _{ISV}) =	user	ft					1						
Surcharge Volume Width (W_{ISV}) =	user	ft						1.55					
Depth of Basin Floor (H_{FLOOR}) =	user	ft											
Length of Basin Floor (L _{FLOOR}) =	user	ft									1		
Width of Basin Floor (W _{FLOOR}) =	user	ft ft²											
Area of Basin Floor (A_{FLOOR}) = 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						11					
Area of Main Basin (A _{MAIN}) =	user	ft²											
Volume of Main Basin (V_{MAIN}) =	user	ft ³											
Calculated Total Basin Volume (Vtotal) =	user	acre-feet											

	DET		BASIN OUT		JCTURE DI	ESIGN			
		ley - Oklahoma Dra		croion 1.00 (sur)	2022)				
ZONE 3	Option 2, Detention	on 823		Estimated	Estimated				1
ZONE 2 ZONE 1				Stage (ft)	Volume (ac-ft)	Outlet Type	Clear I (Incl	nput Parameters uding Tables)	
VOLUME EURY WOCV			Zone 1 (WQCV)	3.20	7.879	Orifice Plate	Orifice Plate		_
ZONE LAND 2	100-YEAR ORIFICE		Zone 2 (EURV)	6.54	15.391	Rectangular Orifice	Vertical Orifice (Recta	ngular)	•
PERMANENT ZONE 1 AND 2 ORIFICES POOL Fyample 7 one	Configuration (I		Zone 3 (100-year)	9.97	19.857	Weir&Pipe (Restrict)	Weir and Pipe (w/ Re	strictor Plate)	~
User Input: Orifice at Underdrain Outlet (typic			a RMP)	Total (all zones	43.128	J	Cabulated Parame	eters for Underdra	in
Underdrain Orifice Invert Depth =	N/A	The Company of the Co	the filtration medi	a surface)	Underd	rain Orfice Area =	N/A	ft ²	<u></u>
Underdrain Orifice Diameter =	N/A	inches			Underdrain	Orifice Centroid =	N/A	feet	
User Input: Orifice Plate with one or more orif	ices or Elliptical Slo	t Weir (typically us	ed to drain WOCV	and/or EURV in a	sedimentation BM	P)	Calculated Parame	eters for Plate	
Centroid of Lowest Orifice =	0.00	ft (relative to basi	in bottom at Stage	= 0 ft)	WQ Orific	e Area per Row =	2.387E-01	ft²	
Depth at top of Zone using Orifice Plate =	2.23 8.90	• No. 18	in bottom at Stage	= 0 ft		ptical Half-Width =		feet	
Orifice Plate: Orifice Vertical Spacing = Orifice Plate: Orifice Area per Row =	34.37	inches sq. inches (use re	ectangular openings	5)		ical Slot Centroid = :lliptical Slot Area =	N/A N/A	feet ft ²	
		,							
Heav Innuts, Stage and Total Avec of Each Or	fice Day (number	ad from louiset to	hinhoot\		e to match Drain Time				
User Input: Stage and Total Area of Each Or	Row 1 (required)	Row 2 (optional)	Row 3 (optional)	Row 4 (optional)	Row 5 (optional)	Row 6 (optional)	Row 7 (optional)	Row 8 (optional)	1
Stage of Orifice Centroid (ft)	0.00	0.74	1.49	,,,,,,	· · · · · · · ·				
Orifice Area (sq. inches)	34.37	34.37	34.37]
	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)				``	` ' '			7	
Orifice Area (sq. inches)]
User Input: Vertical Orifice (Circular or Rectan	gular)						Calculated Parame	eters for Vertical C	rifice
	Zone 2 Rectangula		0 (10) 1 1 1		0.63		Zone 2 Rectangula		6.7
Invert of Vertical Orifice = Depth at top of Zone using Vertical Orifice =	3.20 6.54	N/A N/A	ft (relative to basi ft (relative to basi		The second secon	tical Orifice Area = Orifice Centroid =	0.92	N/A N/A	ft ² feet
Vertical Orifice Height =	2.00	N/A	inches		,		-		1
Vertical Orifice Width =	66.37		inches			Size Verti	cal Orifice to drain (E	URV - WQCV) Only	
User Input: Overflow Weir (Dropbox with Flat	or Sloped Grate a	nd Outlet Pipe OR	Rectangular/Trape	ezoidal Weir and N	lo Outlet Pipe)		Calculated Parame	eters for Overflow	Weir
	Zone 3 Weir	Not Selected					Zone 3 Weir	Not Selected	
Overflow Weir Front Edge Height, Ho = Overflow Weir Front Edge Length =	6.54 106.00	N/A N/A	ft (relative to basin feet	bottom at Stage = ((t) Height of Grate Overflow W	Upper Edge, $H_t =$ eir Slope Length =	9.87 10.54	N/A N/A	feet feet
Overflow Weir Grate Slope =	3.00	N/A	H:V	Gra	te Open Area / 10	CACHERON CONTRACTOR CONTRACTOR		N/A	licet
Horiz. Length of Weir Sides =	10.00	N/A	feet		erflow Grate Open			N/A	ft ²
Overflow Grate Type = Debris Clogging % =	Type C Grate	N/A ▼	%	0	verflow Grate Oper	Area W/ Debris =	388.83	N/A	ft²
		,			•				
User Input: Outlet Pipe w/ Flow Restriction Plan	te (Circular Orifice, Zone 3 Restrictor		r Rectangular Orfi	ce)	Cal	culated Parameter			<u>Plate</u>
Depth to Invert of Outlet Pipe =	0.33	Not Selected N/A	ft (distance below b	asin bottom at Stag	e = 0 ft) Ou	ıtlet Orifice Area =	Zone 3 Restrictor 31.46	Not Selected N/A	ft ²
Outlet Pipe Diameter =	84.00	N/A	inches		Outlet	Orifice Centroid =	2.94	N/A	feet
Restrictor Plate Height Above Pipe Invert =	64.00]	inches	AUGUSTA LOUGHA	ral Angle of Restrict	tor Plate on Pipe =	2.12	N/A	radians
User Input: Emergency Spilway (Rectangular	or Trapezoidal)		t Plate to match 90% nt 100-vear Peak Run				Calculated Parame	eters for Spillway	
Spilway Invert Stage=	10.00	THE RESERVE TO BE AND ADDRESS OF THE PARTY O	in bottom at Stage	= 0 ft		esign Flow Depth=		feet	
Spilway Crest Length = Spilway End Slopes =	367.00 4.00		ergency Spillway to p			op of Freeboard = op of Freeboard =	11.99 6.28	feet acres	
Freeboard above Max Water Surface =	1.00	feet Develope	d 100-yr Peak Runoff	Rate	Basin Volume at T			acre-ft	
Routed Hydrograph Results	The user can ove	erride the default C	CUHP hydrographs	and runoff volum	es by entering new	values in the Inflo	w Hydrographs ta	ble (Columns W th	
Design Storm Return Period = One-Hour Rainfall Depth (in) =	WQCV N/A	EURV N/A	2 Year 0.85	5 Year 1.12	10 Year 1.40	25 Year 1.87	50 Year 2.30	100 Year 2.79	500 Year 4.16
CUHP Runoff Volume (acre-ft) =	7.879	23.271	16.082	22.795	30.462	44.522	57.083	71.969	112.726
Inflow Hydrograph Volume (acre-ft) = CUHP Predevelopment Peak Q (cfs) =	N/A N/A	N/A N/A	16.082 2.8	22.795 28.0	30.462 80.3	44.522 215.9	57.083 314.9	71.969 444.4	112.726 766.4
OPTIONAL Override Predevelopment Peak Q (cfs) =	N/A	N/A							
Predevelopment Unit Peak Flow, q (cfs/acre) = Peak Inflow Q (cfs) =	N/A N/A	N/A N/A	0.01 237.7	0.09 333.0	0.25 440.1	0.66 680.2	0.96 868.8	1.36 1099.7	2.34 1700.2
Peak Outflow Q (cfs) =	5.3	16.3	12.1	15.2	43.9	153.2	259.8	380.1	380.1
Ratio Peak Outflow to Predevelopment Q = Structure Controlling Flow =	N/A Vertical Orifice 1	N/A Overflow Weir 1	N/A Vertical Orifice 1	0.5 Vertical Orifice 1	0.5 Overflow Weir 1	0.7 Overflow Weir 1	0.8 Overflow Weir 1	0.9 N/A	0.5 N/A
Max Velocity through Grate 1 (fps) =	N/A	N/A	N/A	N/A	0.0	0.2	0.3	0.5	0.5
Max Velocity through Grate 2 (fps) = Time to Drain 97% of Inflow Volume (hours) =	N/A 36	N/A 44	N/A 43	N/A 45	N/A 46	N/A 43	N/A 41	N/A 38	N/A 34
Time to Drain 99% of Inflow Volume (hours) =	40	52 6 54	49	53	55 7.17	53	51 9.21	49 10.00	46
Maximum Ponding Depth (ft) = Area at Maximum Ponding Depth (acres) =	3.20 3.88	6.54 5.08	4.71 4.61	6.00 4.95	5.24	8.37 6.08	6.28	6.28	10.00 6.28
Maximum Volume Stored (acre-ft) =	7.911	23.288	14.358	20.531	26.538	33.103	38.304	43.329	43.329



	DET		BASIN OUT			ESIGN			
Droingt	22 1447 001 Orac		HFD-Detention, Ve	ersion 4.06 (July	2022)				
	23.1447.001 Gree Option 2, Detention		ападе мР						
ZONE 3				Estimated	Estimated		Clear I	nput Parameters	1
20NE 1				Stage (ft)	Volume (ac-ft)	Outlet Type	(Incl	uding Tables)	
VOLUME EURY WOCV			Zone 1 (WQCV)	2.63	3.229	Orifice Plate	Orifice Plate		•
7	100-YEAR ORIFICE		Zone 2 (EURV)	4.18	6.211	Rectangular Orifice	Vertical Orifice (Recta	ngular)	▼
PERMANENT ORIFICES POOL Towns 1- 7			Zone 3 (100-year)	6.00	7.827	Weir&Pipe (Restrict)	Weir and Pipe (w/ Re	strictor Plate)	•
Example Zone	e Configuration (I			Total (all zones)	17.267				
User Input: Orifice at Underdrain Outlet (typic					11.1.1			eters for Underdra	in
Underdrain Orifice Invert Depth = Underdrain Orifice Diameter =	N/A N/A	inches	the filtration media	surrace)		Irain Orifice Area = Orifice Centroid =	N/A N/A	ft ² feet	
oracidian office burneter =	TV/A	inches ,	•		Onderdian	Office Centron =	NA	Jicci	
User Input: Orifice Plate with one or more ori	ices or E l iptical Slo	t Weir (typically us	sed to drain WQCV	and/or EURV in a			Calculated Parame	eters for Plate	
Centroid of Lowest Orifice =			in bottom at Stage			ce Area per Row =	8.528E-02	ft ²	
Depth at top of Zone using Orifice Plate = Orifice Plate: Orifice Vertical Spacing =	3.55	ft (relative to bas inches	in bottom at Stage	= 0 ft)		iptical Half-Width = ical Slot Centroid =	N/A N/A	feet feet	
Orifice Plate: Orifice Area per Row =	12.28	10 /0 10	ectangular openings	1		Elliptical Slot Area =	N/A N/A	ft ²	
office face. Office face per form	12.20	Joq. menes (use)	ceangaar openings	,		inputed Size 7 ii ed	14/7	Jic.	
					to match				
User Input: Stage and Total Area of Each Or		T			rain Time				T
	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) Orifice Area (sq. inches)		1.18	2.37 12.28			•			
Office Area (sq. fildres)	12.20	12.20	14.20						1
	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)									
Orifice Area (sq. inches)]
User Input: Vertical Orifice (Circular or Rectar	ngular)						Calculated Parame	eters for Vertical O	rifice
	Zone 2 Rectangula	Not Selected]				Zone 2 Rectangula	Not Selected	
Invert of Vertical Orifice =	2.63	N/A	ft (relative to basi			tical Orifice Area =	1.39	N/A	ft ²
Depth at top of Zone using Vertical Orifice =	4.18 2.00	N/A N/A	ft (relative to basi inches	n bottom at Stage	e = 0 ft) Vertica	Orifice Centroid =	0.08	N/A	feet
Vertical Orifice Height = Vertical Orifice Width =	99.87	IN/A	inches			Size Verti	cal Orifice to drain (El	JRV - WQCV) Only	
refeed of the Wall	33.07	1	a let res						
User Input: Overflow Weir (Dropbox with Flat			Rectangular/Trape	zoidal Weir and N	o Outlet Pipe)		Calculated Parame	eters for Overflow	Weir
	Zone 3 Weir	Not Selected					Zone 3 Weir	Not Selected	
Overflow Weir Front Edge Height, Ho = Overflow Weir Front Edge Length =	4.83	N/A N/A	ft (relative to basin I feet	oottom at Stage = 0		Upper Edge, H _t = eir Slope Length =	8.16 10.54	N/A N/A	feet feet
Overflow Weir Front Edge Length =		N/A	H:V	Grat		0-yr Orifice Area =	94.15	N/A	ieet
Horiz. Length of Weir Sides =		N/A	feet			Area w/o Debris =	1929.50	N/A	ft ²
Overflow Grate Type =		N/A 🔻		Ov	erflow Grate Oper	Area w/ Debris =	964.75	N/A	ft ²
Debris Clogging % =	50%	N/A] %						
User Input: Outlet Pipe w/ Flow Restriction Pla	te (Circular Orifice	Pestrictor Plate	or Pactangular Orific	(م	Cal	culated Parameters	for Outlet Pine w	/ Flow Pestriction [Plate
Oser Impac. Outlet i pe w/ 1 bw Nestreton i a	Zone 3 Restrictor		TRECtangual Offic	<u>e,</u>	Car	cuated i alameters	Zone 3 Restrictor		l
Depth to Invert of Outlet Pipe =		N/A	ft (distance below b	asin bottom at Stage	e = 0 ft)	utlet Orifice Area =	20.49	N/A	ft ²
Outlet Pipe Diameter =	72.00	N/A	inches			Orifice Centroid =	2.29	N/A	feet
Restrictor Plate Height Above Pipe Invert =	49.00	1	inches		al Angle of Restric	tor Plate on Pipe =	1.94	N/A	radians
User Input: Emergency Spillway (Rectangular	or Trapezoidal)		et Plate to match 90% nt 100-year Peak Runc				Calculated Parame	eters for Spillway	
Spillway Invert Stage=			in bottom at Stage		Spilway D	esign Flow Depth=	0.98	feet	
Spillway Crest Length =	174.00	feet Sino Fee	organou Ca'll			op of Freeboard =	8.08	feet	
Spillway End Slopes =	4.00	Develope	nergency Spillway to pa ed 100-yr Peak Runoff I	Rate		op of Freeboard =	4.80	acres	
Freeboard above Max Water Surface =	1.00	feet			Basin Volume at T	op of Freeboard =	26.87	acre-ft	
				1 (1)	o by antaring nou	values in the Inflo			
Routed Hydrograph Results			CUHP hydrographs						500 Year 4.16
Design Storm Return Period =	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year 2 30	100 Year 2 79	
	WQCV N/A						50 Year 2.30 22.433	2.79 28.164	43.897
Design Storm Return Period = One-Hour Rainfall Depth (in) = CUHP Runoff Volume (acre-ft) = Inflow Hydrograph Volume (acre-ft) =	WQCV N/A 3.229 N/A	N/A 9.439 N/A	2 Year 0.85 6.502 6.502	5 Year 1.12 9.158 9.158	10 Year 1.40 12.151 12.151	25 Year 1.87 17.573 17.573	2.30 22.433 22.433	2.79 28.164 28.164	43.897 43.897
Design Storm Return Period = One-Hour Rainfall Depth (n) = CUHP Runoff Volume (acre-ft) = Inflow Hydrograph Volume (acre-ft) = CUHP Predevelopment Peak Q (cfs) =	WQCV N/A 3.229 N/A N/A	N/A 9.439 N/A N/A	2 Year 0.85 6.502	5 Year 1.12 9.158	10 Year 1.40 12.151	25 Year 1.87 17.573	2.30 22.433	2.79 28.164	43.897
Design Storm Return Period = One-Hour Rainfall Depth (n) = CUHP Runoff Volume (acre-ft) = Inflow Hydrograph Volume (acre-ft) = CUHP Predevelopment Peak (Q (cfs) = OPTIONAL Override Predevelopment Peak Q (xfs) = Predevelopment think Peak Flow, q (cfs/acre) =	WQCV N/A 3.229 N/A N/A N/A N/A	N/A 9.439 N/A N/A N/A N/A	2 Year 0.85 6.502 6.502 1.4	5 Year 1.12 9.158 9.158 14.7	10 Year 1.40 12.151 12.151 41.1 0.32	25 Year 1.87 17.573 17.573 106.6	2.30 22.433 22.433 155.2	2.79 28.164 28.164 216.5	43.897 43.897 372.0 2.94
Design Storm Return Period at One-Hour Rainfall Depth (in) = CHPR Return Period at CHPR Returned You've (are-ft) = Inflow Hydrograph Volume (acre-ft) = CUHP Predevelopment Peak Q (cfs) = OPTIONAL Override Predevelopment Peak Q (cfs) = Predevelopment thint Peak Flow, q (cfs) acre Predevelopment Teak Q (cfs) = Predevelopment thint Peak Flow, q (cfs) = Predevelopment Teak Thorw Q (cfs) =	WQCV N/A 3.229 N/A N/A N/A N/A N/A	EURV N/A 9.439 N/A N/A N/A N/A	2 Year 0.85 6.502 6.502 1.4 0.01 119.6	5 Year 1.12 9.158 9.158 14.7 0.12 166.5	10 Year 1.40 12.151 12.151 41.1 0.32 218.6	25 Year 1.87 17.573 17.573 106.6	2.30 22.433 22.433 155.2 1.23 413.4	2.79 28.164 28.164 216.5 1.71 522.6	43.897 43.897 372.0 2.94 803.0
Design Storm Return Period = One-Hour Rainfall Depth (n) = CUHP Rundf Volume (acre-ft) = Inflow Hydrograph Volume (acre-ft) = CUHP Predevelopment Peak Q (cfs) = OPTIONAL Override Predevelopment Peak Q (cfs) = Predevelopment Unit Peak Flow, q (cfs/acre) = Peak Outflow Q (cfs) = Peak Outflow Q (cfs) =	WQCV N/A 3.229 N/A N/A N/A N/A N/A 1.4	EURV N/A 9.439 N/A N/A N/A N/A N/A 10.1	2 Year 0.85 6.502 6.502 1.4 0.01 119.6 6.7	5 Year 1.12 9.158 9.158 14.7 0.12 166.5 9.0	10 Year 1.40 12.151 12.151 41.1 0.32 218.6 11.1	25 Year 1.87 17.573 17.573 106.6 0.84 325.1 46.8	2.30 22.433 22.433 155.2 1.23 413.4 107.7	2.79 28.164 28.164 216.5 1.71 522.6 198.6	43.897 43.897 372.0 2.94 803.0 478.5
Design Storm Return Period a One-Hour Rainfall Depth (in) = CUHP Runoff Volume (acre-ft) = Infilow Hydrograph Volume (acre-ft) = CUHP Predevelopment Peak Q (cfs) = OPTIONAL Override Predevelopment Peak Q (cfs) = Predevelopment Unit Peak Filow, Q (cfs) acre Peak Inflow Q (cfs) = Peak Outflow Q (cfs) = Ratio Peak Outflow to Predevelopment Q = Structure Controlling Flow = Structure Controlling Flow	WQCV N/A 3.229 N/A N/A N/A N/A N/A 1.4 N/A Vertical Orifice 1	EURV N/A 9.439 N/A N/A N/A N/A N/A N/A N/A N/A Vertical Orifice 1	2 Year 0.85 6.502 6.502 1.4 0.01 119.6 6.7 N/A Vertical Orifice 1	5 Year 1.12 9.158 9.158 14.7 0.12 166.5 9.0 0.6 Vertical Orifice 1	10 Year 1.40 12.151 12.151 41.1 0.32 218.6 11.1 0.3 Vertical Orifice 1	25 Year 1.87 17.573 17.573 106.6 0.84 325.1 46.8 0.4 Overflow Weir 1	2.30 22.433 22.433 155.2 1.23 413.4 107.7 0.7 Overflow Weir 1	2.79 28.164 28.164 216.5 1.71 522.6 198.6 0.9 Outlet Plate 1	43.897 43.897 372.0 2.94 803.0 478.5 1.3 Spillway
Design Storm Return Period = One-Hour Rainfail Depth (n) = CUHP Rundf Volume (acre-ft) = Inflow Hydrograph Volume (acre-ft) = CUHP Predevelopment Peak Q (cfs) = OPTIONAL Override Predevelopment Peak Q (cfs) = Predevelopment Unit Peak Flow, q (cfs/acre) = Peak Outflow Q (cfs) = Ratio Peak Outflow to Predevelopment Q = Max Velocity through Grabe 1 (fps) = Max Velocity through Grabe 1 (fps) =	WQCV N/A 3.229 N/A N/A N/A N/A N/A N/A 1.4 N/A Vertical Orifice 1 N/A EURV N/A 9.439 N/A N/A N/A N/A N/A N/A N/A V/A Vertical Orfice 1	2 Year 0.85 6.502 6.502 1.4 0.01 119.6 6.7 N/A Vertical Orifice 1	5 Year 1.12 9.158 9.158 14.7 0.12 166.5 9.0 0.6 Vertical Orifice 1 N/A	10 Year 1.40 12.151 12.151 41.1 0.32 218.6 11.1 0.3 Vertical Orfice 1	25 Year 1.87 17.573 17.573 106.6 0.84 325.1 46.8 0.4 Overflow Weir 1 0.0	2.30 22.433 22.433 155.2 1.23 413.4 107.7 0.7 Overfbw Weir 1	2.79 28.164 28.164 216.5 1.71 522.6 198.6 0.9 Outlet Plate 1 0.1	43.897 43.897 372.0 2.94 803.0 478.5 1.3 Spillway 0.1	
Design Storm Return Period a One-Hour Rainfall Depth (in) = CUHP Runoff Volume (acre-ft) = Infilow Hydrograph Volume (acre-ft) = CUHP Predevelopment Peak Q (cfs) = OPTIONAL Override Predevelopment Peak Q (cfs) = Predevelopment Unit Peak Filow, Q (cfs) acre Peak Inflow Q (cfs) = Peak Outflow Q (cfs) = Ratio Peak Outflow to Predevelopment Q = Structure Controlling Flow = Structure Controlling Flow	WQCV N/A	EURV N/A 9.439 N/A N/A N/A N/A N/A N/A N/A N/A Vertical Orifice 1	2 Year 0.85 6.502 6.502 1.4 0.01 119.6 6.7 N/A Vertical Orifice 1	5 Year 1.12 9.158 9.158 14.7 0.12 166.5 9.0 0.6 Vertical Orifice 1	10 Year 1.40 12.151 12.151 41.1 0.32 218.6 11.1 0.3 Vertical Orifice 1	25 Year 1.87 17.573 17.573 106.6 0.84 325.1 46.8 0.4 Overflow Weir 1	2.30 22.433 22.433 155.2 1.23 413.4 107.7 0.7 Overflow Weir 1	2.79 28.164 28.164 216.5 1.71 522.6 198.6 0.9 Outlet Plate 1	43.897 43.897 372.0 2.94 803.0 478.5 1.3 Spillway
Design Storm Return Period = One-Hour Rainfall Depth (n) = CUHP Rundf Volume (acre-ft) = Inflow Hydrograph Volume (acre-ft) = CUHP Predevelopment Peak Q (cfs) = OPTIONAL Override Predevelopment Peak Q (cfs) = Predevelopment Unit Peak Flow, q (cfs/acre) = Peak Noutflow Q (cfs) = Ratio Peak Outflow to Predevelopment Q = Structure Controlling Flow = Max Velocity through Grate 1 (fps) = Max Velocity through Grate 1 (fps) = Max Peak Outflow Volume (hours) = Time to Drain 97% of Inflow Volume (hours) = Time to Drain 97% of Inflow Volume (hours) =	WQCV N/A 3,229 N/A 38 40 N/A EURV N/A 9.439 N/A N/A N/A N/A 10.1 N/A Vertical Orifice 1 N/A N/A 8 N/A 48 52	2 Year 0.85 6.502 6.502 1.4 0.01 0.01 19.6 6.7 N/A Vertical Orifice 1 N/A N/A 47 50	5 Year 1.12 9.158 9.158 9.158 14.7 0.12 166.5 9.0 0.6 Vertical Orifice 1 N/A N/A 49 53	10 Year 1.40 12.151 12.151 41.1 0.32 218.6 11.1 0.3 Vertical Orifice 1 N/A N/A 51 55	25 Year 1.87 17.573 17.573 106.6 0.84 325.1 46.8 0.4 Overflow Weir 1 0.0 N/A 51 56	2.30 22.433 22.433 155.2 1.23 413.4 107.7 0.7 Overflow Weir 1 0.0 N/A 49	2.79 28.164 28.164 216.5 1.71 522.6 198.6 0.9 Outlet Plate 1 0.1 N/A 46 55	43.897 43.897 372.0 2.94 803.0 478.5 1.3 Spillway 0.1 N/A 41 52	
Design Storm Return Period a One-Hour Rainfall Depth (in) = CUHP Runoff Volume (acre-ft) = Infilow Hydrograph Volume (acre-ft) = Infilow Hydrograph Volume (acre-ft) = OPTIONAL Override Predevelopment Peak Q (cfs) = Predevelopment Unit Peak Flow, q (cfs) acre Peak Infilow Q (cfs) = Peak Infolw Q (cfs) = Ratio Peak Outflow to Predevelopment Q = Structure Controlling Flow = Max Velocity through Grate 1 (fps) = Max Velocity through Grate 2 (fps) = Time to Drain 97% of finflow Volume (hours) =	WQCV N/A 3.229 N/A Vertical Orifice 1 N/A N/A 38 40 2.63	EURV N/A 9.439 N/A N/A N/A N/A N/A N/A N/A N/A 10.1 N/A Vertical Orifice 1 N/A N/A N/A N/A N/A N/A N/A N/A N/A N/A	2 Year 0.85 6.502 6.502 1.4 0.01 119.6 6.7 N/A Vertical Orifice 1 N/A N/A 147	5 Year 1.12 9.158 9.158 9.158 14.7 0.12 166.5 9.0 0.6 Vertical Orifice 1 N/A N/A 49	10 Year 1.40 12.151 12.151 41.1 0.32 218.6 11.1 0.3 Vertical Orifice 1 N/A N/A N/A 51	25 Year 1.87 17.573 17.573 106.6 0.84 325.1 46.8 0.4 Overflow Weir 1 0.0 N/A 51	2.30 22.433 22.433 155.2 1.23 413.4 107.7 0.7 Overflow Weir 1 0.0 N/A 49	2.79 28.164 28.164 216.5 1.71 522.6 198.6 0.9 Outlet Plate 1 0.1 N/A 46	43.897 43.897 372.0 2.94 803.0 478.5 1.3 Spillway 0.1 N/A 41

	DEI	ENTION BAS	D-Detention, Version			DEE DU	JIGULI	·			01	hard.
Project: 23.1447.	001 Greeley -	Oklahoma Drainage MP)-Detention, Versio	טע) סט. וי חי	uly 2022)						Clear Work	book
Basin ID: Option 2												
ZONE 3												
100-YR												
VOLUME EURY WOCY			1		1							
ZONE 1 AND 2 ORIFICES	ORIFIC	EAR CE	Depth Increment =	0.50	ft Optional			1	Optional		1	
POOL Example Zone Config	uration (Rete	ention Pond)	Stage - Storage	Stage	Override	Length	Width	Area	Override	Area	Volume	Volume
atershed Information			Description Top of Micropool	(ft) 0.00	Stage (ft)	(ft) 41.9	(ft) 41.9	(ft ²) 1,752	Area (ft ²)	(acre) 0.040	(ft ³)	(ac-ft)
Extended Detention Basin (EDB)			ISV	0.33		41.9	41.9	1,752		0.040	578	0.013
Watershed Area = 126.6	-			0.50		41.9	41.9	1,752		0.040	876	0.020
Watershed Length = 3,111	ft			1.00		99.2	70.2	6,962		0.160	2,148	0.049
Watershed Length to Centroid = 1,437	_			1.50		267.9	153.5	41,122		0.944	12,998	0.298
Watershed Slope = 0.019 Watershed Imperviousness = 76.209	-		Hoor	2.00		436.5 561.3	236.9 298.5	103,393 167,571		2.374 3.847	47,956 97,609	1.101 2.241
Percentage Hydrologic Soil Group A = 0.0%			HOOI	2.50		562.4	299.6	168,467		3.867	119,452	2.742
Percentage Hydrologic Soil Group B = 0.0%	percent		Zone 1 (WQCV)	2.63		563.4	300.6	169,364		3.888	141,411	3.246
Percentage Hydrologic Soil Groups C/D = 100.09	6 percent			3.00		566.4	303.6	171,930		3.947	204,550	4.696
Target WQCV Drain Time = 40.0	hours			3.50		570.4	307.6	175,426		4.027	291,387	6.689
Location for 1-hr Rainfall Depths = Denver - C	apitol Building	▼	7 2 (FURNO)	4.00		574.4	311.6	178,954		4.108	379,981	8.723 9.465
After providing required inputs above including 1-h depths, click 'Run CUHP' to generate runoff hydrog	our rainfall aphs using	Run CUHP	Zone 2 (EURV)	4.18		575.8 578.4	313.0 315.6	180,232 182,514		4.138	412,308	10.798
the embedded Colorado Urban Hydrograph Pro		Optional User Overrides		5.00		582.4	319.6	186,105		4.272	562,500	12.913
Water Quality Capture Volume (WQCV) = 3.229	acre-feet	acre-feet		5.50		586.4	323.6	189,729		4.356	656,457	15.070
Excess Urban Runoff Volume (EURV) = 9.439	acre-feet	acre-feet	Zone 3 (100-year)	6.00		590.4	327.6	193,385		4.440	752,235	17.269
2-yr Runoff Volume (P1 = 0.85 in.) = 6.502 5-yr Runoff Volume (P1 = 1.12 in.) = 9.158	acre-feet acre-feet	0.85 inches		6.50 7.00		594.4 598.4	331.6 335.6	197,073 200,793		4.524	849,848 949,313	19.510 21.793
5-yr Runoff Volume (P1 = 1.12 in.) = 9.158 10-yr Runoff Volume (P1 = 1.4 in.) = 12.151	acre-feet	1.40 inches		7.50		602.4	339.6	200,793		4.696	1,050,646	24.120
25-yr Runoff Volume (P1 = 1.87 in.) = 17.573		1.87 inches		8.00		606.4	343.6	208,328		4.783	1,153,862	26.489
50-yr Runoff Volume (P1 = 2.3 in.) = 22.433	acre-feet	2.30 inches		8.50		610.4	347.6	212,144		4.870	1,258,979	28.902
100-yr Runoff Volume (P1 = 2.79 in.) = 28.164	_	2.79 inches		9.00		614.4	351.6	215,992		4.958	1,366,012	31.359
500-yr Runoff Volume (P1 = 4.16 in.) = 43.897	acre-feet	4.16 inches		9.50		618.4	355.6	219,871		5.048	1,474,976	33.861
Approximate 2-yr Detention Volume = 6.088 Approximate 5-yr Detention Volume = 8.743	acre-feet acre-feet			10.00		622.4 626.4	359.6 363.6	223,783		5.137 5.228	1,585,888	36.407 38.998
Approximate 10-yr Detention Volume = 10.768	-			11.00		630.4	367.6	231,703		5.319	1,813,621	41.635
Approximate 25-yr Detention Volume = 13.353	acre-feet			11.50		634.4	371.6	235,710		5.411	1,930,473	44.318
Approximate 50-yr Detention Volume = 14.966	-			12.00		638.4	375.6	239,750		5.504	2,049,336	47.046
Approximate 100-yr Detention Volume = 17.267	acre-feet			12.50		642.4	379.6	243,822		5.597	2,170,228	49.822
Define Zones and Basin Geometry				13.00		646.4 650.4	383.6 387.6	247,926 252,062		5.692 5.787	2,293,164	52.644 55.513
Zone 1 Volume (WQCV) ▼ 3.229	acre-feet			14.00		654.4	391.6	256,229		5.882	2,545,231	58.430
Zone 2 Volume (EURV - Zone 1) ▼ 6.211	acre-feet			14.50		658.4	395.6	260,429		5.979	2,674,394	61.396
Zone 3 Volume (100-year - Zones 1 & 2) ▼ 7.827	acre-feet			15.00		662.4	399.6	264,661		6.076	2,805,665	64.409
Total Detention Basin Volume = 17.26	acre-feet		1	15.50		666.4 670.4	403.6 407.6	268,925		6.174	2,939,060	67.472 70.583
Initial Surcharge Volume (ISV) = 578 Initial Surcharge Depth (ISD) = 0.33	ft			16.00 16.50		674.4	411.6	273,220 277,548		6.272	3,074,595	73.744
Total Available Detention Depth (H _{total}) = 6.00	ft			17.00		678.4	415.6	281,908		6.472	3,352,149	76.955
Depth of Trickle Channel (H_{TC}) = 0.50	ft			17.50		682.4	419.6	286,300		6.573	3,494,199	80.216
Slope of Trickle Channel (S _{TC}) = 0.003	ft/ft			18.00		686.4	423.6	290,723		6.674	3,638,454	83.527
Slopes of Main Basin Sides (S _{main}) = 4 Basin Length-to-Width Ratio (R _{LOW}) = 2	H:V			18.50 19.00		690.4 694.4	427.6 431.6	295,179 299,667		6.776	3,784,928	86.890 90.304
Basin Length-to-Width Ratio (R _{L/W}) = 2				19.50		698.4	431.6	304,187		6.983	4,084,600	93.770
Initial Surcharge Area (A _{ISV}) = 1,752	ft ²			20.00		702.4	439.6	308,739		7.088	4,237,830	97.287
Surcharge Volume Length $(L_{ISV}) = 41.9$	ft			20.50		706.4	443.6	313,322		7.193	4,393,344	100.857
Surcharge Volume Width (W _{ISV}) = 41.9	ft			21.00		710.4	447.6	317,938		7.299	4,551,158	104.480
Depth of Basin Floor (H _{FLOOR}) = 1.54	ft			21.50		714.4	451.6	322,586		7.406	4,711,288	108.156
Length of Basin Floor (L_{FLOOR}) = 561.3 Width of Basin Floor (W_{FLOOR}) = 298.5	ft ft			22.00 22.50		718.4 722.4	455.6 459.6	327,266 331,977		7.513 7.621	4,873,749 5,038,558	111.886
Area of Basin Floor (A _{FLOOR}) = 167,57				23.00		726.4	463.6	336,721		7.730	5,205,732	119.507
Volume of Basin Floor (V _{FLOOR}) = 95,713	ft ³			23.50		730.4	467.6	341,497		7.840	5,375,285	123.400
Depth of Main Basin (H _{MAIN}) = 3.63	ft			24.00		734.4	471.6	346,305		7.950	5,547,234	127.347
Length of Main Basin (L _{MAIN}) = 590.4	ft			24.50		738.4	475.6	351,144		8.061	5,721,595 5,898,384	131.350
Width of Main Basin (W_{MAIN}) = 327.6 Area of Main Basin (A_{MAIN}) = 193,38	ft ft ²			25.00 25.50		742.4 746.4	479.6 483.6	356,016 360,920		8.173 8.286	5,898,384 6,077,617	135.408 139.523
Volume of Main Basin (V _{MAIN}) = 654,57				26.00		750.4	487.6	365,856		8.399	6,259,309	143.694
Calculated Total Basin Volume (V _{total}) = 17.25				26.50		754.4	491.6	370,824		8.513	6,443,478	147.922
	_			27.00		758.4 762.4	495.6 499.6	375,823 380,855		8.628 8.743	6,630,138 6,819,306	152.207 156.550
				27.50		766.4	503.6	385,919		8.859	7,010,998	160.950



		DET	TENTION BAS	IN STAGE-ST	ORAGI	E TABL	E BUII	_DER					
			MHF	D-Detention, Version 4	1.06 (July .	2022)						Clear Workb	ook
	Greely - Okl		in										
Basin ID:	Detention_	841											
	2 ONE 1		_										
VOLUME EURY WOCY		1											
,		100-YE	AR	Depth Increment =	0.50	ft							
PERMANENT ORIFIC		ORIFIC			0.00	Optional				Optio	12		
POOL Example Zone	e Configura	tion (Rete	ntion Pond)	Stage - Storage Description	Stage (ft)	Override Stage (ft)	Length (ft)	Width (ft)	Area (ft ²)	nal Overr	Area (acre)	Volume (ft ³)	Volume (ac-ft)
Watershed Information				Top of Micropool	0.00		41.9	41.9	1,753		0.040		
Extended Detention Basin (EDB)	EDB			ISV	0.33		41.9	41.9	1,753		0.040	578	0.013
Watershed Area =	210.60	acres			0.50		41.9	41.9	1,753		0.040	876	0.020
Watershed Length =	4,665	ft			1.00		76.5	58.9	4,506		0.103	1,970	0.045
Watershed Length to Centroid = Watershed Slope =	2,450 0.019	ft/ft			1.50 2.00		178.5 280.5	108.9 158.9	19,438 44,570		0.446 1.023	7,531 23,108	0.173 0.530
Watershed Imperviousness =	64.50%	percent			2.50		382.5	208.9	79,901		1.834	53,801	1.235
Percentage Hydrologic Soil Group A =	0.0%	percent			3.00		484.5	258.9	125,433		2.880	104,710	2.404
Percentage Hydrologic Soil Group B =	0.0%	percent			3.50		586.5	308.9	181,165		4.159	180,934	4.154
Percentage Hydrologic Soil Groups C/D =	100.0%	percent		Zone 1 (WQCV)	3.57		600.8	315.9	189,781		4.357	193,916	4.452
Target WQCV Drain Time =	40.0	hours			4.00		688.5	358.9	247,097		5.673	287,575	6.602
Location for 1-hr Rainfall Depths =	Denver - Capit	ol Building	▼	7 7 / 7	4.50		790.5	408.9	323,229		7.420	429,731	9.865
After providing required inputs above inc depths, click 'Run CUHP' to generate rund			Run CUHP	Zone 2 (EURV)	4.90 5.00		872.1 892.5	448.9 458.9	391,478 409,560		9.402	572,455 612,503	13.142 14.061
the embedded Colorado Urban Hydro			Optional User Overrides		5.50		994.5	508.9	506,092		11.618	840,991	19.307
Water Quality Capture Volume (WQCV) =	4.426	acre-feet	acre-feet	Hoor	5.61		1,017.0	519.9	528,698		12.137	897,900	20.613
Excess Urban Runoff Volume (EURV) =	13.115	acre-feet	acre-feet	Zone 3 (100-year)	6.00		1,020.1	523.0	533,503		12.248	1,105,029	25.368
2-yr Runoff Volume (P1 = 0.85 in.) =	8.993	acre-feet	0.85 inches		6.50		1,024.1	527.0	539,691		12.390	1,373,326	31.527
5-yr Runoff Volume (P1 = 1.12 in.) =	13.071	acre-feet	1.12 inches		7.00		1,028.1	531.0	545,912		12.532	1,644,725	37.758
10-yr Runoff Volume (P1 = 1.4 in.) =	17.845	acre-feet	1.40 inches		7.50		1,032.1	535.0	552,164		12.676	1,919,243	44.060
25-yr Runoff Volume (P1 = 1.87 in.) =	26.911	acre-feet	1.87 inches		8.00		1,036.1	539.0	558,448		12.820	2,196,895	50.434
50-yr Runoff Volume (P1 = 2.3 in.) = 100-yr Runoff Volume (P1 = 2.79 in.) =	34.919 44.551	acre-feet acre-feet	2.30 inches		9.00		1,040.1	543.0 547.0	564,765 571,113		12.965	2,477,697 2,761,665	56.880 63.399
500-yr Runoff Volume (P1 = 4.16 in.) =	70.739	acre-feet	4.16 inches		9.50		1,048.1	551.0	577,493		13.257	3,048,815	69.991
Approximate 2-yr Detention Volume =	8.334	acre-feet			10.00		1,052.1	555.0	583,906		13.405	3,339,164	76.657
Approximate 5-yr Detention Volume =	12.417	acre-feet			10.50		1,056.1	559.0	590,350		13.553	3,632,726	83.396
Approximate 10-yr Detention Volume =	15.210	acre-feet			11.00		1,060.1	563.0	596,827		13.701	3,929,519	90.209
Approximate 25-yr Detention Volume =	18.972	acre-feet			11.50		1,064.1	567.0	603,335		13.851	4,229,558	97.097
Approximate 50-yr Detention Volume =	21.353	acre-feet			12.00		1,068.1	571.0	609,875		14.001	4,532,859	104.060
Approximate 100-yr Detention Volume =	25.297	acre-feet			12.50		1,072.1	575.0	616,448		14.152	4,839,439	111.098
Define Zones and Basin Geometry					13.00 13.50		1,076.1	579.0 583.0	623,052 629,688		14.303 14.456	5,149,312 5,462,496	118.212 125.402
Zone 1 Volume (WQCV)	4.426	acre-feet			14.00		1,084.1	587.0	636,357		14.609	5,779,006	132.668
Zone 2 Volume (EURV - Zone 1)	8.689	acre-feet			14.50		1,088.1	591.0	643,057		14.763	6,098,858	140.011
Zone 3 Volume (100-year - Zones 1 & 2)	12.181	acre-feet			15.00		1,092.1	595.0	649,790		14.917	6,422,069	147.430
Total Detention Basin Volume =	25.297	acre-feet			15.50		1,096.1	599.0	656,554		15.072	6,748,653	154.928
Initial Surcharge Volume (ISV) =	578	ft ³			16.00		1,100.1	603.0	663,350		15.228	7,078,628	162.503
Initial Surcharge Depth (ISD) =	0.33	ft			16.50		1,104.1	607.0	670,179		15.385	7,412,009	170.156
Total Available Detention Depth $(H_{total}) =$ Depth of Trickle Channel $(H_{TC}) =$	0.50	ft			17.00 17.50		1,108.1	611.0 615.0	677,039 683,931		15.543	7,748,812 8,089,053	177.888 185.699
Slope of Trickle Channel (S _{TC}) =	0.005	ft/ft			18.00		1,116.1	619.0	690,856		15.860	8,432,749	193.589
Slopes of Main Basin Sides (S _{main}) =	4	H:V			18.50		1,120.1	623.0	697,812		16.020	8,779,915	201.559
Basin Length-to-Width Ratio ($R_{L/W}$) =	2				19.00		1,124.1	627.0	704,801		16.180	9,130,566	209.609
					19.50		1,128.1	631.0	711,821		16.341	9,484,720	217.739
Initial Surcharge Area (A _{ISV}) =	1,753	ft ²			20.00		1,132.1	635.0	718,873		16.503	9,842,393	225.950
Surcharge Volume Length (L _{ISV}) =	41.9	ft			20.50		1,136.1	639.0	725,958		16.666	10,203,599	234.242
Surcharge Volume Width $(W_{ISV}) =$ Depth of Basin Floor $(H_{FLOOR}) =$	41.9	ft			21.00		1,140.1	643.0 647.0	733,074 740,222		16.829 16.993	10,568,356	242.616 251.072
Length of Basin Floor (H_{FLOOR}) =	1,017.0	ft			22.00		1,144.1	651.0	747,403		17.158	11,308,584	259.609
Width of Basin Floor $(W_{FLOOR}) =$	519.9	ft			22.50		1,152.1	655.0	754,615		17.324	11,684,087	268.230
Area of Basin Floor (A_{FLOOR}) =	528,698	ft ²			23.00		1,156.1	659.0	761,860		17.490	12,063,204	276.933
Volume of Basin Floor (V_{FLOOR}) =	893,690	ft ³			23.50		1,160.1	663.0	769,136		17.657	12,445,952	285.720
Depth of Main Basin (H _{MAIN}) =	0.39	ft			24.00		1,164.1	667.0	776,444		17.825	12,832,346	294.590
Length of Main Basin (L _{MAIN}) =	1,020.1	ft			24.50		1,168.1	671.0	783,785		17.993	13,222,401	303.545
Width of Main Basin (W _{MAIN}) =	523.0	ft a 2			25.00		1,172.1	675.0	791,157		18.162 18.332	13,616,136	312.583
Area of Main Basin $(A_{MAIN}) = Volume of Main Basin (V_{MAIN}) = V_{MAIN}$	533,503 207,128	ft ²			25.50 26.00		1,176.1 1,180.1	679.0 683.0	798,561 805,998		18.503	14,013,564 14,414,702	321.707 330.916
Calculated Total Basin Volume (V _{total}) =	25.305	acre-feet			26.50		1,184.1	687.0	813,466		18.675	14,819,567	340.210
(total)									0.000 FT \$100 TS				

	5.5		NA GENT OLUM		ICTURE R	FOLON			
	DET	MH	BASIN OUT AFD-Detention, V			ESIGN			
	Greely - Oklahoma	Basin							
Basin ID:	Detention_841			Falling at a d	Fakir aka d				1
ZONE 2 ZONE 1		_		Estimated Stage (ft)	Estimated Volume (ac-ft)	Outlet Type	Clear I (Incl	nput Parameters uding Tables)	
100-YR VOLUME EURV WQCV			Zone 1 (WQCV)	3.57	4.426	Orifice Plate	Orifice Plate		—
T	100-YEAR		Zone 2 (EURV)	4.90	8.689	Rectangular Orifice	Vertical Orifice (Recta	ngular)	-
ZONE 1 AND 2 PERMANENT ORIFICES	ORIFICE		Zone 3 (100-year)	6.00	12.181	Weir&Pipe (Restrict)			ij
	Configuration (I		Lone 3 (100 year)	Total (all zones)		Well at the (Resulte)	well allu ripe (w/ Ke	crictor Flate)	
User Input: Orifice at Underdrain Outlet (typic	ally used to drain V	VQCV in a Filtration	n BMP)		23,237	_	Calculated Param	eters for Underdra	ain
Underdrain Orifice Invert Depth =		ft (distance below		a surface)	Underd	drain Orifice Area =	N/A	ft ²	
Underdrain Orifice Diameter =	N/A	inches			Underdrain	Orifice Centroid =	N/A	feet	
Hear Innut. Outline Diete with one or more exi	ions or Elimbiaal Cla	t Mair (tunionly un	ad to drain MOO/	and/or FUDY in a	sadimentation DM	ID)	0 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1		
User Input: Orifice Plate with one or more ori Centroid of Lowest Orifice =	0.00	ft (relative to basi				ce Area per Row =	Calculated Parame 8.458E-02	ft ²	
Depth at top of Zone using Orifice Plate =	3.57	ft (relative to basi	_	,		liptical Half-Width =	N/A	feet	
Orifice Plate: Orifice Vertical Spacing =	14.30	inches	3	,		ical Slot Centroid =	N/A	feet	
Orifice Plate: Orifice Area per Row =	12.18	sq. inches (use re	ctangular openings	5)	I	Elliptical Slot Area =	N/A	ft ²	
		•		Cin o Diote	e to match				
Heav Junety Chara and Tatal Aven of Facts On	Fine David (mumban	ad 6 laak ka l	ninhaat)		rain Time				
User Input: Stage and Total Area of Each Or	Row 1 (required)	Row 2 (optional)	Row 3 (optional)	Row 4 (optional)	Row 5 (optional)	Row 6 (optional)	Row 7 (optional)	Row 8 (optional)	1
Stage of Orifice Centroid (ft)		1.19	2.38	non i (opacital)	TOTAL S (OPERATOR)	non o (opconia)	non / (opacital)	non o (opacinal)	
Orifice Area (sq. inches)	12.18	12.18	12.18	,					
									_
	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)									•
Orifice Area (sq. inches)									
User Input: Vertical Orifice (Circular or Rectar	gular)		5				Calculated Parame	eters for Vertical C	<u>Orifice</u>
	Zone 2 Rectangula						Zone 2 Rectangula		
Invert of Vertical Orifice =	3.57	N/A	ft (relative to basi			tical Orifice Area =	0.30	N/A	ft ²
Depth at top of Zone using Vertical Orifice = Vertical Orifice Height =	4.90 2.00		ft (relative to basi inches	n bottom at Stage	e = 0 ft) Vertica	Orifice Centroid =	0.08	N/A	feet
Vertical Orifice Width =	21.39		inches			Size Vertic	al Orifice to drain (El	JRV - WQCV) Only	
refeed office main	21.05	1	a reries						
User Input: Overflow Weir (Dropbox with Flat	or Sloped Grate a	nd Outlet Pipe OR	Rectangular/Trape	zoidal Weir and N	o Outlet Pipe)		Calculated Param	eters for Overflow	Weir
	Zone 3 Weir	Not Selected					Zone 3 Weir	Not Selected	
Overflow Weir Front Edge Height, Ho =	7.00			bottom at Stage = 0		Upper Edge, H _t =	10.33	N/A	feet
Overflow Weir Front Edge Length = Overflow Weir Grate Slope =	425.00 3.00	N/A N/A	feet H:V	Graf		/eir Slope Length = 0-yr Orifice Area =	10.54 103.59	N/A N/A	feet
Horiz. Length of Weir Sides =	10.00	N/A	feet		and the second second second second	Area w/o Debris =	3118.01	N/A	ft ²
Overflow Grate Type =		N/A 🔻			the second second	n Area w/ Debris =	1559.00	N/A	ft ²
Debris Clogging % =	50%	N/A	%						
	(6 6 %		D 0.7				f 0 11 1 B	/ El . B	DI 1
User Input: Outlet Pipe w/ Flow Restriction Plan	Zone 3 Restrictor		<u>r Rectangular Onfik</u> 	<u>ce)</u>	<u>Ca</u>	<u>kulated Parameters</u>	Zone 3 Restrictor		<u>Plate</u>
Depth to Invert of Outlet Pipe =	0.33	N/A	ft (distance below b	asin bottom at Stage	= = 0 ft) O	utlet Orifice Area =	30.10	N/A	ft ²
Outlet Pipe Diameter =	90.00	N/A	inches		15	t Orifice Centroid =	2.73	N/A	feet
Restrictor Plate Height Above Pipe Invert =	58.00		inches	Half-Centr	al Angle of Restric	tor Plate on Pipe =	1.86	N/A	radians
			t Plate to match 90%						
User Input: Emergency Spilway (Rectangular			nt 100-year Peak Run		Cultura D		Calculated Parame		
Spillway Invert Stage= Spillway Crest Length =	9.00	feet	n bottom at Stage	= 010		esign Flow Depth= op of Freeboard =	2.45 12.45	feet feet	
Spillway End Slopes =	4.00	H-V Size Em	ergency Spillway to p			op of Freeboard =	14.14	acres	
Freeboard above Max Water Surface =	1.00	feet Develope	d 100-yr Peak Runoff	Rate		op of Freeboard =	110.39	acre-ft	
Routed Hydrograph Results	The user can over	erride the default (TIHP hydrographs	and runoff volume	es hy entering neu	v values in the Inflo	w Hydrographs ta	hle (Columns W H	brough 4F)
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) =	N/A	N/A	0.85	1.12	1.40	1.87	2.30	2.79	4.16
CUHP Runoff Volume (acre-ft) = Inflow Hydrograph Volume (acre-ft) =	4.426 N/A	13.115 N/A	8.993 8.993	13.071 13.071	17.845 17.845	26.911 26.911	34.919 34.919	44.551 44.551	70.739 70.739
CUHP Predevelopment Peak Q (cfs) =	N/A	N/A	1.8	18.6	53.2	142.5	207.1	292.7	502.7
OPTIONAL Override Predevelopment Peak Q (cfs) =	N/A	N/A	0.04	0.00	0.05	0.50		4.00	2.20
Predevelopment Unit Peak Flow, q (cfs/acre) = Peak Inflow Q (cfs) =	N/A N/A	N/A N/A	0.01 128.0	0.09 185.8	0.25 251.8	0.68 403.9	0.98 521.3	1.39 666.8	2.39 1040.9
Peak Outflow Q (cfs) =	1.8	3.9	3.3	3.8	4.3	4.9	5.4	40.8	282.2
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	0.2	0.1	0.0	0.0	0.1	0.6
Structure Controlling Flow = Max Velocity through Grate 1 (fps) =	Vertical Orifice 1 N/A	Vertical Orifice 1 N/A	Vertical Orifice 1 N/A	Vertical Orifice 1 N/A	Vertical Orifice 1 N/A	Vertical Orifice 1 N/A	Vertical Orifice 1 N/A	Overflow Weir 1 0.0	0.1
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) =	38	68	57	69	81	101	117	>120	119
Time to Drain 99% of Inflow Volume (hours) =	40 3.57	72 4.90	60 4.30	73 4.82	86 5.30	108 6.05	>120 6.70	>120 7.31	>120 8.20
Maximum Ponding Depth (ft) =									



					N STAGE-S D-Detention, Version					•			24	
Project:	23.1447.00	1 Greelev -	Oklahoma Dr)-Deterition, versio	111 4 .00 (30	ily 2022)					_	Clear Work	book
	Option4, El													
ZONE 3	2 ONE 1													
O-YR EURV WQCV				_										
		100-YE	EAR	\rightarrow	5 11 7	0.50	1.							
PERMANENT ORIFIC	1 AND 2	ORIFIC	CE		Depth Increment =	0.50	Optional				Optional			
POOL Example Zone	Configura	tion (Rete	ntion Pond)		Stage - Storage Description	Stage (ft)	Override Stage (ft)	Length (ft)	Width (ft)	Area (ft 2)	Override Area (ft ²)	Area (acre)	Volume (ft ³)	Volun (ac-f
atershed Information					Top of Micropool	0.00		41.9	41.9	1,752	,,,,,	0.040		1
tended Detention Basin (EDB)	EDB				ISV	0.33		41.9	41.9	1,752		0.040	578	0.01
Watershed Area =	90.00	acres				0.50		41.9	41.9	1,752		0.040	876	0.02
Watershed Length =	3,900	ft			П	1.00		99.2	70.2	6,962		0.160	2,148	0.04
Watershed Length to Centroid = Watershed Slope =	1,738 0.031	ft/ft			Floor	1.18		159.9 162.5	100.2 102.7	16,021 16,694		0.368	4,162 9,396	0.09
Watershed Imperviousness =	30.20%	percent				2.00		166.5	106.7	17,771		0.408	18,011	0.41
Percentage Hydrologic Soil Group A =	0.0%	percent				2.50		170.5	110.7	18,879		0.433	27,172	0.62
Percentage Hydrologic Soil Group B =	0.0%	percent				3.00		174.5	114.7	20,020		0.460	36,896	0.84
Percentage Hydrologic Soil Groups C/D = Target WQCV Drain Time =	100.0% 40.0	percent			Zone 1 (WQCV)	3.50		178.5 179.4	118.7 119.7	21,193		0.487	47,198 49,758	1.08
Location for 1-hr Rainfall Depths =	10.0000			~	TOUR I (MACEA)	4.00		182.5	122.7	22,398		0.493	58,094	1.14
After providing required inputs above inc						4.50		186.5	126.7	23,635		0.543	69,601	1.59
depths, dick 'Run CUHP' to generate rund	off hydrograph	hs using	Run CUH	Р		5.00		190.5	130.7	24,904		0.572	81,735	1.87
the embedded Colorado Urban Hydro		7	Optional Use	T		5.50		194.5	134.7	26,205		0.602	94,511	2.17
Water Quality Capture Volume (WQCV) = Excess Urban Runoff Volume (EURV) =	1.141 2.470	acre-feet		acre-feet	Zone 2 (EURV)	5.99		198.4 198.5	138.7 138.7	27,511		0.632	107,670 107,945	2.47
2-yr Runoff Volume (P1 = 0.85 in.) =	1.598	acre-feet acre-feet	0.85	acre-feet inches		6.00		202.5	138.7	27,538 28,903		0.632	107,945	2.47
5-yr Runoff Volume (P1 = 1.12 in.) =	2.810	acre-feet	1.12	inches		7.00		206.5	146.7	30,299		0.696	136,853	3.14
10-yr Runoff Volume (P1 = 1.4 in.) =	4.602	acre-feet	1.40	inches		7.50		210.5	150.7	31,728		0.728	152,358	3.49
25-yr Runoff Volume (P1 = 1.87 in.) =	8.506	acre-feet	1.87	inches		8.00		214.5	154.7	33,189		0.762	168,586	3.87
50-yr Runoff Volume (P1 = 2.3 in.) =	11.792 15.995	acre-feet	2.30	inches		8.50		218.5	158.7	34,682		0.796	185,553	4.26
100-yr Runoff Volume (P1 = 2.79 in.) = 500-yr Runoff Volume (P1 = 4.16 in.) =	27.074	acre-feet acre-feet	2.79 4.16	inches		9.00		226.5	162.7 166.7	36,207 37,764		0.831	203,274	4.66 5.09
Approximate 2-yr Detention Volume =	1.515	acre-feet	1.10	Inches		10.00		230.5	170.7	39,353		0.903	241,043	5.53
Approximate 5-yr Detention Volume =	2.643	acre-feet				10.50		234.5	174.7	40,974		0.941	261,123	5.99
Approximate 10-yr Detention Volume =	3.285	acre-feet				11.00		238.5	178.7	42,627		0.979	282,022	6.47
Approximate 25-yr Detention Volume =	4.314	acre-feet				11.50		242.5	182.7	44,311		1.017	303,755	6.97
Approximate 50-yr Detention Volume = Approximate 100-yr Detention Volume =	4.931 6.534	acre-feet acre-feet				12.00 12.50		246.5 250.5	186.7 190.7	46,028 47,777		1.057	326,339 349,789	7.49 8.03
Approximate 100-yr beterition volume =	0.554	acre-leet				13.00		254.5	194.7	49,558		1.138	374,122	8.58
efine Zones and Basin Geometry						13.50		258.5	198.7	51,371		1.179	399,353	9.16
Zone 1 Volume (WQCV)	1.141	acre-feet				14.00		262.5	202.7	53,216		1.222	425,498	9.76
Zone 2 Volume (EURV - Zone 1)	1.329	acre-feet		ntion volume		14.50		266.5	206.7	55,093		1.265	452,574	10.39
Select Zone 3 Storage Volume (Optional) Total Detention Basin Volume =	2.470	acre-feet acre-feet	is less than volume.	1 100-year		15.00 15.50		270.5 274.5	210.7 214.7	57,002 58,943		1.309	480,596 509,581	11.03
Initial Surcharge Volume (ISV) =	578	ft ³				16.00		278.5	218.7	60,915		1.398	539,544	12.38
Initial Surcharge Depth (ISD) =	0.33	ft				16.50		282.5	222.7	62,920		1.444	570,502	13.09
Total Available Detention Depth (H _{total}) =	6.00	ft				17.00		286.5	226.7	64,957		1.491	602,470	13.83
Depth of Trickle Channel (H _{TC}) =	0.50	ft 0/0				17.50		290.5	230.7	67,026		1.539	635,464	14.58
Slope of Trickle Channel (S _{TC}) = Slopes of Main Basin Sides (S _{TC}) =	0.003	ft/ft H:V				18.00 18.50		294.5 298.5	234.7	69,127 71,260		1.587	669,501 704,597	15.3
Slopes of Main Basin Sides (S_{main}) = Basin Length-to-Width Ratio ($R_{L/W}$) =	2	1				19.00		302.5	242.7	73,425		1.686	740,766	17.00
		_				19.50		306.5	246.7	75,622		1.736	778,027	17.86
Initial Surcharge Area (A _{ISV}) =	1,752	ft ²				20.00		310.5	250.7	77,851		1.787	816,393	18.7
Surcharge Volume Length (L _{ISV}) =	41.9	ft				20.50		314.5	254.7	80,111		1.839	855,883	19.6
Surcharge Volume Width (W_{ISV}) = Depth of Basin Floor (H_{FLOOR}) =	41.9 0.35	ft ft				21.00		318.5 322.5	258.7 262.7	82,404 84,729		1.892	896,510 938,292	20.5
Length of Basin Floor (H _{FLOOR}) =	159.9	ft				22.00		326.5	266.7	87,086		1.999	981,245	22.5
Width of Basin Floor (W _{FLOOR}) =	100.2	ft				22.50		330.5	270.7	89,475		2.054	1,025,384	23.5
Area of Basin Floor (A _{FLOOR}) =	16,021	ft ²				23.00		334.5	274.7	91,896		2.110	1,070,725	24.58
Volume of Basin Floor (V _{FLOOR}) =	2,692	ft ³				23.50		338.5	278.7	94,349		2.166	1,117,285	25.64
Depth of Main Basin (H_{MAIN}) = Length of Main Basin (L_{MAIN}) =	4.82 198.5	ft				24.00 24.50		342.5 346.5	282.7 286.7	96,834 99,351		2.223	1,165,079 1,214,124	26.7
Width of Main Basin $(L_{MAIN}) = Width of Main Basin (W_{MAIN}) = $	138.7	ft				25.00		350.5	290.7	101,899		2.339	1,214,124	29.0
Area of Main Basin (A _{MAIN}) =	27,538	ft ²				25.50		354.5	294.7	104,480		2.399	1,316,029	30.2
Volume of Main Basin (V _{MAIN}) =	103,732	ft ³				26.00		358.5	298.7	107,093		2.459	1,368,921	31.4
Calculated Total Basin Volume (V_{total}) =	2.477	acre-feet				26.50		362.5	302.7	109,738		2.519	1,423,127	32.6
						27.00 27.50		366.5 370.5	306.7 310.7	112,415 115,124		2.581	1,478,664 1,535,548	33.9 ⁴ 35.25
						28.00 28.50		374.5 378.5	314.7 318.7	117,865 120,638		2.706 2.769	1,593,794 1,653,418	36.58 37.9
						29.00		382.5	322.7	123,443		2.834	1,714,437	39.3
						29.50 30.00		386.5 390.5	326.7 330.7	126,279 129,148		2.899	1,776,866	40.7

	DET	ENITION F		LET CTDL	ICTUDE D	ECTON			
	DET		BASIN OUT HFD-Detention, V			ESIGN			
Project:	23.1447.001 Gree			ersion 4.00 (July	2022)				
Basin ID:	Option4 , EURV 71	1							1
ZONE 2 ZONE 2 ZONE 1				Estimated Stage (ft)	Estimated Volume (ac-ft)	Outlet Type		Input Parameters Iuding Tables)	
100-YR VOLUME EURV WOCV			Zone 1 (WQCV)	Stage (ft) 3.62	1.141	Orifice Plate	Orifice Plate		▼
± ±	100-YEAR	$\overline{}$	Zone 2 (EURV)	5.99	1.329	Weir&Pipe (Restrict		estrictor Plate)	<u></u>
ZONE 1 AND 2 PERMANENT ORIFICES	ORIFICE		Zone 3	3.33	1.525	Not Utilized	Zone 3 Not Utilized	- Timetor Flate)	<u> </u>
	e Configuration (F	Retention Pond)		Total (all zones)	2.470				
User Input: Orifice at Underdrain Outlet (typic	ally used to drain V					_	Calculated Param	eters for Underdr	ain
Underdrain Orifice Invert Depth =		. 8	the filtration medi	a surface)		drain Orifice Area =	N/A	ft ²	
Underdrain Orifice Diameter =	N/A	inches	•		Underdrair	Orifice Centroid =	N/A	feet	
User Input: Orifice Plate with one or more or	fices or Elliptical Slo	t Weir (typically us	ed to drain WQCV	and/or EURV in a	sedimentation BM	<u>1P)</u>	Calculated Param	eters for Plate	
Centroid of Lowest Orifice =	0.00	,	in bottom at Stage	,	_	ce Area per Row =		ft²	
Depth at top of Zone using Orifice Plate = Orifice Plate: Orifice Vertical Spacing =	3.62 14.50	ft (relative to bas inches	in bottom at Stage	= 0 ft)		liptical Half-Width =		feet feet	
Orifice Plate: Orifice Area per Row =	4.41		ectangular openings	;)		tical Slot Centroid = Elliptical Slot Area =	N/A	ft ²	
			3 , 3				,	1	
	000 000 00 00	22 22 222	200		to match rain Time				
User Input: Stage and Total Area of Each Or	fice Row (numbers Row 1 (required)	Row 2 (optional)	The state of the s	Row 4 (optional)		Da 6 (anti-nal)	Row 7 (optional)	D 0 (
Stage of Orifice Centroid (ft)		1.21	Row 3 (optional) 2.41	Row 4 (optional)	Row 5 (optional)	Row 6 (optional)	Kow / (opublial)	Row 8 (optional)	•
Orifice Area (sq. inches)		4.41	4.41						
			1						_
Street of Oviding Control of the	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) Orifice Area (sq. inches)									
									_
User Input: Vertical Orifice (Circular or Rectar		Not Colombod	1					Not Selected	Orifice
Invert of Vertical Orifice =	Not Selected N/A	Not Selected N/A	ft (relative to basi	n bottom at Stage	= 0 ft) Ver	rtical Orifice Area =	Not Selected N/A	Not Selected N/A	ft ²
Depth at top of Zone using Vertical Orifice =		N/A	ft (relative to basi			I Orifice Centroid =		N/A	feet
Vertical Orifice Diameter =	N/A	N/A	inches				•		
User Input: Overflow Weir (Dropbox with Flat	or Sloped Grate a	nd Outlet Pipe OR	Poctangular/Trans						
			Nectaliqual/ Hapt	ezoldal Weir and N	o Outlet Pipe)		Calculated Param	eters for Overflow	v Weir
	Zone 2 Weir	Not Selected	Rectangular/ Frape	ezoidal Weir and N	o Outlet Pipe)		Zone 2 Weir	Not Selected	w Weir
Overflow Weir Front Edge Height, Ho =	4.00	N/A	ft (relative to basin		ft) Height of Grate	e Upper Edge, H _t =	Zone 2 Weir 7.33	Not Selected N/A	feet
Overflow Weir Front Edge Length =	4.00 800.00	N/A N/A	ft (relative to basin feet	bottom at Stage = 0	ft) Height of Grate Overflow W	/eir Slope Length =	Zone 2 Weir 7.33 10.54	Not Selected N/A N/A	
	4.00 800.00 3.00	N/A	ft (relative to basin	bottom at Stage = 0 Grati	ft) Height of Grate Overflow W e Open Area / 10		Zone 2 Weir 7.33 10.54 11382.38	Not Selected N/A	feet
Overflow Weir Front Edge Length = Overflow Weir Grate Slope = Horiz. Length of Weir Sides = Overflow Grate Type =	4.00 800.00 3.00 10.00 Type C Grate ▼	N/A N/A N/A N/A	ft (relative to basin feet H:V feet	bottom at Stage = 0 Grat Ove	ft) Height of Grate Overflow W e Open Area / 10 rflow Grate Open	/eir Slope Length = 10-yr Orifice Area =	Zone 2 Weir 7.33 10.54 11382.38 5869.19	Not Selected N/A N/A N/A	feet feet
Overflow Weir Front Edge Length = Overflow Weir Grate Slope = Horiz. Length of Weir Sides =	4.00 800.00 3.00 10.00	N/A N/A N/A N/A	ft (relative to basin feet H:V	bottom at Stage = 0 Grat Ove	ft) Height of Grate Overflow W e Open Area / 10 rflow Grate Open	/eir Slope Length = 10-yr Orifice Area = Area w/o Debris =	Zone 2 Weir 7.33 10.54 11382.38 5869.19	Not Selected N/A N/A N/A N/A	feet feet ft²
Overflow Weir Front Edge Length = Overflow Weir Grate Slope = Horiz. Length of Weir Sides = Overflow Grate Type = Debris Clogging % =	4.00 800.00 3.00 10.00 Type C Grate \$\times\$	N/A N/A N/A N/A N/A N/A	ft (relative to basin feet H:V feet %	bottom at Stage = 0 Grat Ove Ov	ft) Height of Grate Overflow W e Open Area / 10 rflow Grate Open erflow Grate Open	/eir Slope Length = 10-yr Orifice Area = Area w/o Debris = n Area w/ Debris =	Zone 2 Weir 7.33 10.54 11382.38 5869.19 2934.59	Not Selected N/A N/A N/A N/A N/A N/A N/A	feet feet ft ² ft ²
Overflow Weir Front Edge Length = Overflow Weir Grate Slope = Horiz. Length of Weir Sides = Overflow Grate Type =	4.00 800.00 3.00 10.00 Type C Grate \$\times\$	N/A N/A N/A N/A N/A N/A	ft (relative to basin feet H:V feet %	bottom at Stage = 0 Grat Ove Ov	ft) Height of Grate Overflow W e Open Area / 10 rflow Grate Open erflow Grate Open	/eir Slope Length = 10-yr Orifice Area = Area w/o Debris =	Zone 2 Weir 7.33 10.54 11382.38 5869.19 2934.59	Not Selected N/A N/A N/A N/A N/A N/A N/A N/A N/A	feet feet ft ² ft ²
Overflow Weir Front Edge Length = Overflow Weir Grate Slope = Horiz. Length of Weir Sides = Overflow Grate Type = Debris Clogging % = User Input: Outlet Pipe w/ Flow Restriction Pla Depth to Invert of Outlet Pipe =	4.00 800.00 3.00 10.00 Type C Grate ▼ 50% te (Circular Orifice, Zone 2 Restrictor 2.50	N/A N/A N/A N/A N/A N/A N/A N/A N/A N/A	fft (relative to basin feet H:V feet % r Rectangular Orific ft (distance below b	bottom at Stage = 0 Grat Ove Ov	ft) Height of Grate Overflow W e Open Area / 10 rflow Grate Open erflow Grate Open Ca e = 0 ft) O	/eir Slope Length = 10-yr Orifice Area = Area w/o Debris = n Area w/ Debris = kulated Parameter utlet Orifice Area =	Zone 2 Weir 7.33 10.54 11382.38 5869.19 2934.59 s for Outlet Pipe w Zone 2 Restrictor 0.52	Not Selected N/A N/A N/A N/A N/A N/A N/A N/A N/A N/A	feet feet ft² ft²
Overflow Weir Front Edge Length = Overflow Weir Grate Slope = Horiz. Length of Weir Sides = Overflow Grate Type = Debris Clogging % = User Input: Outlet Pipe w/ Flow Restriction Pla Depth to Invert of Outlet Pipe = Outlet Pipe Diameter =	4.00 800.00 3.00 10.00 Type C Grate 50% te (Circular Orifice, Zone 2 Restrictor 2.50 18.00	N/A N/A N/A N/A N/A N/A N/A N/A N/A N/A	ft (relative to basin feet H:V feet % or Rectangular Orific ft (distance below b inches	bottom at Stage = 0 Grat Ove Ov	ft) Height of Grate Overflow W e Open Area / 10 rfflow Grate Open erflow Grate Open Ca = 0 ft) Outlee	/eir Slope Length = 10-yr Orffice Area = Area w/o Debris = n Area w/ Debris = kulated Parameter utlet Orifice Area = t Orifice Centroid =	Zone 2 Weir 7.33 10.54 11382.38 5869.19 2934.59 s for Outlet Pipe w Zone 2 Restrictor 0.52 0.29	Not Selected N/A N/A N/A N/A N/A N/A N/A N/A N/A N/A	feet feet ft² ft² Plate ft² feet
Overflow Weir Front Edge Length = Overflow Weir Grate Slope = Horiz. Length of Weir Sides = Overflow Grate Type = Debris Clogging % = User Input: Outlet Pipe w/ Flow Restriction Pla Depth to Invert of Outlet Pipe =	4.00 800.00 3.00 10.00 Type C Grate 50% te (Circular Orifice, Zone 2 Restrictor 2.50 18.00	N/A N/A N/A N/A N/A N/A N/A N/A N/A N/A	fft (relative to basin feet H:V feet % r Rectangular Orific ft (distance below b	bottom at Stage = 0 Grat Ove Ov	ft) Height of Grate Overflow W e Open Area / 10 rfflow Grate Open erflow Grate Open Ca = 0 ft) Outlee	/eir Slope Length = 10-yr Orifice Area = Area w/o Debris = n Area w/ Debris = kulated Parameter utlet Orifice Area =	Zone 2 Weir 7.33 10.54 11382.38 5869.19 2934.59 s for Outlet Pipe w Zone 2 Restrictor 0.52 0.29	Not Selected N/A N/A N/A N/A N/A N/A N/A N/A N/A N/A	feet feet ft² ft²
Overflow Weir Front Edge Length = Overflow Weir Grate Slope = Horiz. Length of Weir Sides = Overflow Grate Type = Debris Clogging % = User Input: Outlet Pipe w/ Flow Restriction Pla Depth to Invert of Outlet Pipe = Outlet Pipe Diameter =	4.00 800.00 3.00 10.00 1ype € Grate 50% te (Circular Orifice, Zone 2 Restrictor 2.50 18.00 6.00	N/A N/A N/A N/A N/A N/A N/A N/A N/A N/A	ft (relative to basin feet H:V feet % or Rectangular Orific ft (distance below b inches	bottom at Stage = 0 Grat Ove Ov	ft) Height of Grate Overflow W e Open Area / 10 rfflow Grate Open erflow Grate Open Ca = 0 ft) Outlee	/eir Slope Length = 10-yr Orffice Area = Area w/o Debris = n Area w/ Debris = kulated Parameter utlet Orifice Area = t Orifice Centroid =	Zone 2 Weir 7.33 10.54 11382.38 5869.19 2934.59 s for Outlet Pipe w Zone 2 Restrictor 0.52 0.29	Not Selected N/A N/A N/A N/A N/A N/A N/A N/A N/A N/A	feet feet ft² ft² Plate ft² feet
Overflow Weir Front Edge Length = Overflow Weir Grate Slope = Horiz. Length of Weir Sides = Overflow Grate Type = Debris Clogging % = User Input: Outlet Pipe w/ Flow Restriction Pla Depth to Invert of Outlet Pipe = Outlet Pipe Diameter = Restrictor Plate Height Above Pipe Invert = User Input: Emergency Spilway (Rectangular Spilway Invert Stage=	4.00 800.00 3.00 10.00 Type C Grate 50% te (Circular Orifice, Zone 2 Restrictor 2.50 18.00 6.00 or Trapezoidal) 9.00	N/A N/A N/A N/A N/A N/A N/A N/A N/A Restrictor Plate, o Not Selected N/A N/A N/A ft (relative to bas	ft (relative to basin feet H:V feet % or Rectangular Orific ft (distance below b inches	bottom at Stage = 0 Grat Ove Ov ee) asin bottom at Stage Half-Centr	ft) Height of Grate Overflow W e Open Area / 10 rfflow Grate Open erflow Grate Open Ca = 0 ft) Outle al Angle of Restrict Spillway D	Veir Slope Length = 10-yr Orfice Area = Area w/o Debris = n Area w/ Debris = kulated Parameter: utlet Orfice Area = t Orfice Centroid = tor Plate on Pipe = Design Flow Depth=	Zone 2 Weir 7.33 10.54 11382.38 5869.19 2934.59 S for Outlet Pipe w Zone 2 Restrictor 0.52 0.29 1.23 Calculated Param 0.96	Not Selected N/A N/A N/A N/A N/A N/A N/A N/A N/A N/A	feet feet ft² ft² Plate ft² feet
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Overflow Weir Front Edge Length = Overflow Weir Grate Slope = Horiz. Length of Weir Sides = Overflow Grate Type = Debris Clogging % = Debris Clogging % = User Input: Outlet Pipe w/ Flow Restriction Pla Depth to Invert of Outlet Pipe = Outlet Pipe Diameter = Restrictor Plate Height Above Pipe Invert = User Input: Emergency Spillway (Rectangular Spillway Invert Stage = Spillway Crest Length = Spillway End Slopes = Freeboard above Max Water Surface = Routed Hydrograph Results Design Storm Return Period = One-Hour Rainfall Depth (in) = CUHP Runoff Volume (acre-ft) = Inflow Hydrograph Volume (acre-ft) = CUHP Predevelopment Peak Q (cfs) = Predevelopment Unit Peak Flow, q (cfs) acre Predevelopment Unit Peak Flow, q (cfs) acre Peak Inflow Q (cfs) = Ratio Peak Outflow to Predevelopment Q = Structure Controlling Flow = Max Velocity through Grate 1 (fps) =	4.00 800.00 3.00 3.00 10.00 Type C Grate 50% te (Circular Orifice, Zone 2 Restrictor 2.50 18.00 6.00 or Trapezoidal) 9.00 4.00 1.00 The user can ove WQCV N/A 1.141 N/A N/A N/A N/A N/A N/A N/A N/A N/A N/A	N/A N/A N/A N/A N/A N/A N/A N/A N/A N/A	ft (relative to basin feet H:V feet H:V feet H:V feet feet H:V feet feet ft ft distance below be inches finches ce) asin bottom at Stage = 0 Grat Ove Ov Ov asin bottom at Stage Half-Centr = 0 ft) ass Rate 5 Year 1.12 2.810 2.810 2.810 6.7 0.8 Outlet Plate 1 0.0	ft) Height of Grate Overflow W e Open Area / 10 rflow Grate Open erflow Grate Open Outte al Angle of Restric Spillway D Stage at T Basin Area at T Basin Volume at T 1.40 4.602 4.602 24.1 0.27 48.3 7.7 0.3 Outtet Plate 1 0.0	Veir Slope Length = 10-yr Orfice Area = Area w/o Debris = n Area w	Zone 2 Weir 7.33 10.54 11382.38 5869.19 2934.59 Zone 2 Restrictor 0.52 0.29 1.23 Calculated Param 0.96 10.96 0.98 6.44 So Year 2.30 11.792 11.792 11.792 11.792 1.04 131.0 98.6 1.1 Spillway 0.0	Not Selected N/A N/A N/A N/A N/A N/A N/A N/A N/A N/A	feet feet feet feet feet feet feet feet	
Overflow Weir Front Edge Length = Overflow Weir Grate Slope = Horiz. Length of Weir Sides = Overflow Grate Type = Debris Clogging % = Debris Clogging % = User Input: Outlet Pipe w/ Flow Restriction Plat Depth to Invert of Outlet Pipe = Outlet Pipe Diameter = Restrictor Plate Height Above Pipe Invert = User Input: Emergency Spillway (Rectangular Spillway Invert Stage= Spillway Crest Length = Spillway End Slopes = Freeboard above Max Water Surface = Routled Hydrograph Results Design Storm Return Period one-Hour Rainfall Depth (in) = CUHP Runoff Volume (acre-ft) = Inflow Hydrograph Volume (acre-ft) = CUHP Predevelopment Peak Q (cfs) = Predevelopment Unit Peak Flow, q (crfs/care) = Peak Inflow Q (cfs) = Peak Outflow Q (cfs) = Ratio Peak Outflow to Predevelopment Q = Structure Controlling Flow =	4.00 800.00 3.00 10.00 Type C Grate 50% te (Circular Orfice, Zone 2 Restrictor 2.50 18.00 6.00 or Trapezoidal) 9.00 59.00 1.00 The user can ove WQCV N/A 1.141 N/A N/A N/A N/A N/A N/A N/A N/A N/A N/A	N/A N/A N/A N/A N/A N/A N/A N/A N/A N/A	ft (relative to basin feet H:V feet H:V feet h:V feet feet feet feet feet feet feet fee	ce) asin bottom at Stage = 0 Grat Ove Ov Ov asin bottom at Stage Half-Centre = 0 ft) ass Rate 1.12 2.810 2.810 2.810 2.810 2.810 2.810 3.6 0.10 29.4 6.7 0.8 Outlet Plate 1	ft) Height of Grate Overflow W e Open Area / 10 rflow Grate Open erflow Grate Open erflow Grate Open erflow Grate Open erflow Grate Open Sale = 0 ft) Outle al Angle of Restrict Spillway E Stage at T Basin Area at T Basin Volume at T 1.40 4.602 4.602 24.1	Veir Slope Length = 10-yr Orfice Area = Area w/o Debris = n Area w	Zone 2 Weir 7.33 10.54 11382.38 5869.19 2934.59 S for Outlet Pipe w Zone 2 Restrictor 0.52 0.29 1.23 Cakulated Param 0.96 10.96 0.98 6.44 SO Year 2.30 11.792 93.3 1.04 131.0 98.6 1.1 Spillway	Not Selected N/A N/A N/A N/A N/A N/A N/A N/A N/A N/A	feet feet feet feet feet feet feet feet
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Overflow Weir Front Edge Length = Overflow Weir Grate Slope = Horiz. Length of Weir Sides = Overflow Grate Type = Debris Clogging % = Debris Clogging % = User Input: Outlet Pipe w/ Flow Restriction Plate Depth to Invert of Outlet Pipe = Outlet Pipe Diameter = Restrictor Plate Height Above Pipe Invert = User Input: Emergency Spillway (Rectangular Spillway Invert Stage= Spillway Crest Length = Spillway End Slopes = Freeboard above Max Water Surface = Routled Hydrograph Results Design Storm Return Period = One-Hour Rainfall Depth (in) = CUHP Runoff Volume (acre-ft) = Inflow Hydrograph Volume (acre-ft) = Inflow Hydrograph Volume (acre-ft) = CUHP Predevelopment Peak Q (cfs) = Peak Inflow Q (cfs) = Peak Inflow Q (cfs) = Peak Outflow to Predevelopment Q = Structure Controlling Flow = Max Velocity through Grate 1 (fps) = Max Velocity through Grate 2 (fps) = Time to Drain 97% of Inflow Volume (nours) =	4.00 800.00 3.00 10.00 Type C Grate 50% te (Circular Orfice, Zone 2 Restrictor 2.50 18.00 6.00 or Trapezoidal) 9.00 59.00 1.00 The user can ove WQCV N/A 1.141 N/A N/A N/A N/A N/A N/A N/A N/A N/A N/A	N/A N/A N/A N/A N/A N/A N/A N/A N/A N/A	ft (relative to basin feet H:V feet H:V feet h:V feet feet feet feet feet feet feet fee	ce) asin bottom at Stage = 0 Grat Ove Ov Ov asin bottom at Stage Half-Centr = 0 ft) ass Rate 1.12 2.810 2.810 2.810 2.810 2.810 0.10 2.94 6.7 0.8 Outlet Plate 1 0.0 N/A 41	ft) Height of Grate Overflow W e Open Area / 10 rflow Grate Open rflow Grate Open erflow Grate Open erflow Grate Open Ca Se = 0 ft) Outle al Angle of Restric Spillway E Stage at T Basin Area at T Basin Volume at T 1.40 4.602 24.1	Veir Slope Length = 10-yr Orfice Area = Area w/o Debris = n Area w	Zone 2 Weir 7.33 10.54 11382.38 5869.19 2934.59 Zone 2 Restrictor 0.52 0.29 1.23 Calculated Param 0.96 10.96 0.98 6.44 So Year 2.30 11.792 11.792 11.792 93.3 1.04 131.0 98.6 1.1 Spillway 0.0 N/A 32	Not Selected N/A N/A N/A N/A N/A N/A N/A N/A N/A N/A	feet feet feet feet feet feet feet feet



				мыст	D-Detention, Versio		The same of the sa		JILDEF	`			21	
Project:	23.1447.00	1 Greelev -	Oklahoma Dr		o-Detention, versio	111 4 .00 (30	IIY 2022)						Clear Work	book
	Option 4, El													
ZONE 3	2 ONE 1	_												
O-YR EURV WQCV				_										
T		100-YE	AR	\rightarrow	[1.							
PERMANENT ORIFIC	1 AND 2	ORIFIC	E		Depth Increment =	0.50	Optional				Optional			
POOL Example Zone	Configura	tion (Rete	ntion Pond)		Stage - Storage Description	Stage (ft)	Override Stage (ft)	Length (ft)	Width (ft)	Area (ft ²)	Override Area (ft ²)	Area (acre)	Volume (ft ³)	Volur (ac-f
atershed Information					Top of Micropool	0.00	Stage (II)	41.9	41.9	1,752	Area (IL.)	0.040	(10)	(ac-i
xtended Detention Basin (EDB)	EDB	1			ISV	0.33		41.9	41.9	1,752		0.040	578	0.01
Watershed Area =	81.00	acres				0.50		41.9	41.9	1,752		0.040	876	0.02
Watershed Length =	2,600	ft				1.00		99.2	70.2	6,962		0.160	2,148	0.04
Watershed Length to Centroid =	720	ft				1.50		267.9	153.5	41,122		0.944	12,998	0.29
Watershed Slope =	0.022	ft/ft			Floor	1.51		271.2	155.2	42,092		0.966	13,414	0.30
Watershed Imperviousness = Percentage Hydrologic Soil Group A =	69.80%	percent				2.00		275.2 279.2	159.1 163.1	43,779 45,532		1.005	34,451 56,778	0.79
Percentage Hydrologic Soil Group B =	0.0%	percent				3.00		283.2	167.1	47,317		1.086	79,988	1.83
Percentage Hydrologic Soil Groups C/D =	100.0%	percent			Zone 1 (WQCV)	3.02		283.3	167.3	47,389		1.088	80,935	1.85
Target WQCV Drain Time =	40.0	hours				3.50		287.2	171.1	49,134		1.128	104,100	2.39
Location for 1-hr Rainfall Depths =	Denver - Capit	ol Building		~		4.00		291.2	175.1	50,983		1.170	129,128	2.96
After providing required inputs above inc			Run CUH	P		4.50		295.2	179.1	52,864		1.214	155,088	3.56
depths, dick 'Run CUHP' to generate rund the embedded Colorado Urban Hydro	off hydrograph	ns using		24 0 4		5.00		299.2	183.1	54,777		1.258	181,997	4.17
	1.850	acre-feet	Optional Use	acre-feet		5.50 6.00		303.2 307.2	187.1 191.1	56,722 58,699		1.302	209,871	4.81 5.48
Water Quality Capture Volume (WQCV) = Excess Urban Runoff Volume (EURV) =	1.850 5.493	acre-feet		acre-feet	Zone 2 (EURV)	6.00		307.2	191.1	58,699		1.348	238,/25	5.48
2-yr Runoff Volume (P1 = 0.85 in.) =	3.732	acre-feet	0.85	inches		6.50		311.2	195.1	60,708		1.394	268,575	6.16
5-yr Runoff Volume (P1 = 1.12 in.) =	5.323	acre-feet	1.12	inches		7.00		315.2	199.1	62,749		1.441	299,438	6.87
10-yr Runoff Volume (P1 = 1.4 in.) =	7.165	acre-feet	1.40	inches		7.50		319.2	203.1	64,822		1.488	331,330	7.60
25-yr Runoff Volume (P1 = 1.87 in.) =	10.587	acre-feet	1.87	inches		8.00		323.2	207.1	66,927		1.536	364,266	8.36
50-yr Runoff Volume (P1 = 2.3 in.) =	13.634	acre-feet	2.30	inches		8.50		327.2	211.1	69,064		1.586	398,263	9.14
100-yr Runoff Volume (P1 = 2.79 in.) =	17.263	acre-feet	2.79	inches		9.00		331.2	215.1	71,234		1.635	433,336	9.94
500-yr Runoff Volume (P1 = 4.16 in.) = Approximate 2-yr Detention Volume =	27.180 3.526	acre-feet acre-feet	4.16	inches		9.50		335.2 339.2	219.1	73,435 75,668		1.686	469,501 506,776	10.7
Approximate 2-yr Detention Volume =	5.146	acre-feet				10.50		343.2	227.1	77,933		1.789	545,174	12.5
Approximate 10-yr Detention Volume =	6.318	acre-feet				11.00		347.2	231.1	80,230		1.842	584,714	13.42
Approximate 25-yr Detention Volume =	7.856	acre-feet				11.50		351.2	235.1	82,559		1.895	625,409	14.3
Approximate 50-yr Detention Volume =	8.825	acre-feet				12.00		355.2	239.1	84,920		1.949	667,278	15.31
Approximate 100-yr Detention Volume =	10.325	acre-feet				12.50		359.2	243.1	87,313		2.004	710,335	16.30
						13.00		363.2	247.1	89,738		2.060	754,596	17.32
efine Zones and Basin Geometry	1.850	Jama faat				13.50		367.2 371.2	251.1 255.1	92,195		2.117	800,078	18.36
Zone 1 Volume (WQCV) Zone 2 Volume (EURV - Zone 1)	3.643	acre-feet acre-feet				14.00 14.50		375.2	259.1	94,684 97,205		2.232	846,796 894,767	20.54
Select Zone 3 Storage Volume (Optional)	5.015	acre-feet	Total deter is less than	ntion volume 100-vear		15.00		379.2	263.1	99,758		2.290	944,007	21.67
Total Detention Basin Volume =	5.493	acre-feet	volume.			15.50		383.2	267.1	102,343		2.349	994,530	22.83
Initial Surcharge Volume (ISV) =	578	ft ³				16.00		387.2	271.1	104,960		2.410	1,046,355	24.02
Initial Surcharge Depth (ISD) =	0.33	ft				16.50		391.2	275.1	107,609		2.470	1,099,496	25.24
Total Available Detention Depth (H _{total}) =	6.00	ft				17.00		395.2	279.1	110,290		2.532	1,153,970	26.49
Depth of Trickle Channel (H _{TC}) =	0.50	ft A/A				17.50		399.2	283.1	113,003		2.594	1,209,792	27.7
Slope of Trickle Channel (S _{TC}) =	0.003	ft/ft H:V				18.00 18.50		403.2 407.2	287.1 291.1	115,748		2.657	1,266,978 1,325,545	29.08
Slopes of Main Basin Sides (S_{main}) = Basin Length-to-Width Ratio ($R_{L/W}$) =	2	1				19.00		411.2	291.1	118,525 121,334		2.721	1,325,545	31.80
= (NL/W)	_	1				19.50		415.2	299.1	124,176		2.851	1,446,885	33.2
Initial Surcharge Area (A _{ISV}) =	1,752	ft ²				20.00		419.2	303.1	127,049		2.917	1,509,690	34.6
Surcharge Volume Length $(L_{ISV}) =$	41.9	ft				20.50		423.2	307.1	129,954		2.983	1,573,939	36.1
Surcharge Volume Width $(W_{ISV}) =$	41.9	ft				21.00		427.2	311.1	132,891		3.051	1,639,649	37.6
Depth of Basin Floor (H _{FLOOR}) =	0.68	ft				21.50		431.2	315.1	135,860		3.119	1,706,835	39.1
Length of Basin Floor (L _{FLOOR}) =	271.2	ft				22.00		435.2	319.1	138,861		3.188	1,775,514	40.7
Width of Basin Floor (W_{FLOOR}) = Area of Basin Floor (A_{FLOOR}) =	155.2 42,092	ft ft ²				22.50		439.2 443.2	323.1 327.1	141,894 144,959		3.257	1,845,701 1,917,413	42.3 44.0
Area of Basin Floor (A_{FLOOR}) = Volume of Basin Floor (V_{FLOOR}) =	11,884	ft 3				23.50		447.2	331.1	148,056		3.328	1,917,413	45.6
Depth of Main Basin (H _{MAIN}) =	4.49	ft				24.00		451.2	335.1	151,185		3.471	2,065,474	47.4
Length of Main Basin (L _{MAIN}) =	307.2	ft				24.50		455.2	339.1	154,346		3.543	2,141,856	49.1
Width of Main Basin (W _{MAIN}) =	191.1	ft				25.00		459.2	343.1	157,539		3.617	2,219,826	50.9
Area of Main Basin (A _{MAIN}) =	58,699	ft²				25.50		463.2	347.1	160,764		3.691	2,299,400	52.7
Volume of Main Basin $(V_{MAIN}) =$	225,245	ft ³				26.00		467.2	351.1	164,021		3.765	2,380,595	54.6
Calculated Total Basin Volume $(V_{total}) =$	5.477	acre-feet				26.50		471.2	355.1	167,310		3.841	2,463,427	56.5
						27.00 27.50		475.2 479.2	359.1 363.1	170,631 173,984		3.917 3.994	2,547,911 2,634,063	58.4 60.4
						28.00		483.2	367.1	177,369		4.072	2,721,900	62.4
						28.50 29.00		487.2 491.2	371.1 375.1	180,786 184,235		4.150	2,811,438	66.6
					1							4.229	2,902,692	

	DET	ENTION F	BASIN OUT	I FT STRI	ICTURE D	FSIGN			
Project:	23.1447.001 Gree	MF	HFD-Detention, Ve			LOIGIV			
	Option 4, EURV 82		•						
ZONE 3				Estimated	Estimated			nput Parameters	
100-YR ZONE 1				Stage (ft)	Volume (ac-ft)	Outlet Type	(Incl	uding Tables)	
VOLUME EURY WOCV			Zone 1 (WQCV)	3.02	1.850	Orifice Plate	Orifice Plate		•
	100-YEAR		Zone 2 (EURV)	6.01	3.643	Weir&Pipe (Restrict)	Weir and Pipe (w/ Re	strictor Plate)	▼
PERMANENT ZONE 1 AND 2 ORIFICES	Onnioe		Zone 3			Not Utilized	Zone 3 Not Utilized		-
POOL Example Zone	e Configuration (I	Retention Pond)		Total (all zones)	5.493				
User Input: Orifice at Underdrain Outlet (typic	ally used to drain V	NQCV in a Filtration	n BMP)				Calculated Parame	eters for Underdra	<u>ain</u>
Underdrain Orifice Invert Depth =	N/A	ft (distance below	the filtration media	surface)	Underd	rain Orifice Area =	N/A	ft ²	
Underdrain Orifice Diameter =	N/A	inches			Underdrain	Orifice Centroid =	N/A	feet	
	C			1/ FUD:/:	P. 11: DM	D)			
User Input: Orifice Plate with one or more ori Centroid of Lowest Orifice =	0.00		ied to drain WQCV in bottom at Stage			e Area per Row =	5.097E-02	eters for Plate ft ²	
Depth at top of Zone using Orifice Plate =	3.60	,	in bottom at Stage in bottom at Stage	•		ptical Half-Width =	N/A	feet	
Orifice Plate: Orifice Vertical Spacing =	14.40	inches	in bottom at stage	- 010)		ical Slot Centroid =	N/A	feet	
Orifice Plate: Orifice Area per Row =	7.34		ectangular openings)		Elliptical Slot Area =	N/A	ft ²	
onios rater onios reta per ten	7.00	1941 11101100 (000 11	occurigation openings	,		impacar oloci i aca	.,,,,	li c	
					to match				
User Input: Stage and Total Area of Each Or	ifice Row (number	ed from lowest to	highest)	WQCV D	rain Time				_
7.0	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)	0.00	1.20	2.40	101	100]
Orifice Area (sq. inches)	7.34	7.34	7.34						
									7
	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)									•
Orifice Area (sq. inches)									
User Input: Vertical Orifice (Circular or Rectar	igular)						Calculated Parame	eters for Vertical C	Orifice
	Not Selected	Not Selected	1				Not Selected	Not Selected	1
Invert of Vertical Orifice =	N/A	N/A	ft (relative to basi	n bottom at Stage	= 0 ft) Ver	tical Orifice Area =	N/A	N/A	ft ²
Depth at top of Zone using Vertical Orifice =	N/A	N/A	ft (relative to basi	bottom at Stage	= 0 ft) Vertical	Orifice Centroid =	N/A	N/A	feet
Vertical Orifice Diameter =	N/A	N/A	inches				F1		-
						•			
User Input: Overflow Weir (Dropbox with Flat			Rectangular/Trape	zoidal Weir and N	o Outlet Pipe)		Calculated Param		Weir
	Zone 2 Weir	Not Selected					Zone 2 Weir	Not Selected	
Overflow Weir Front Edge Height, Ho =	3.02	N/A	ft (relative to basin l	oottom at Stage = 0	-		6.35	N/A	feet
Overflow Weir Front Edge Length =	800.00 3.00	N/A	feet H:V	Crat		eir Slope Length =	10.54 11382.38	N/A	feet
Overflow Weir Grate Slope = Horiz, Length of Weir Sides =	10.00	N/A N/A	feet		to the same of the	0-yr Orifice Area = Area w/o Debris =	5869.19	N/A N/A	ft ²
Overflow Grate Type =		N/A 🔻	l			Area w/ Debris =	2934.59	N/A	ft ²
Debris Clogging % =	50%	N/A	%	01	cirow diate oper	TAICU W DEBIB -	233 1.33	N/A	lic
Besit clegging //	3070	1,477	1 10		t .				
User Input: Outlet Pipe w/ Flow Restriction Pla	te (Circular Orifice,	Restrictor Plate, o	r Rectangular Orific	e)	Cal	culated Parameters	for Outlet Pipe w	/ Flow Restriction	Plate
, , , , , , , , , , , , , , , , , , , ,	Zone 2 Restrictor	Not Selected]	*			Zone 2 Restrictor		
Depth to Invert of Outlet Pipe =	3.00	N/A	ft (distance below b	asin bottom at Stage	e = 0 ft) Ot	utlet Orifice Area =	0.52	N/A	ft ²
Outlet Pipe Diameter =	18.00	N/A	inches		Outlet	Orifice Centroid =	0.29	N/A	feet
Restrictor Plate Height Above Pipe Invert =	6.00		inches	Half-Centr	al Angle of Restrict	tor Plate on Pipe =	1.23	N/A	radians
User Input: Emergency Spillway (Rectangular		A (nahari -	in haller/ C'	- 0.41	C-# =	anima Flatto	Calculated Parame	The second secon	
Spillway Invert Stage=	6.00		in bottom at Stage	= υπ)		esign Flow Depth=	0.97	feet	
Spillway Crest Length =	72.00	feet	c ''' .		stage at 1	op of Freeboard =	7.97	feet acres	
	4.00	LL-V Size Em	ergency Spillway to pa	ISS		on of Freeheard -			
Spillway End Slopes = Freeboard above Max Water Surface =	4.00	Develope	d 100-yr Peak Runoff I	Rate	Basin Area at T	op of Freeboard =	1.53 8.32	4	
Spillway End Slopes = Freeboard above Max Water Surface =				Rate	Basin Area at T	op of Freeboard = op of Freeboard =	1.53 8.32	acre-ft	
Freeboard above Max Water Surface =	1.00	feet Develope	d 100-yr Peak Runoff I	Rate	Basin Area at T Basin Volume at T	op of Freeboard =	8.32	acre-ft	
Freeboard above Max Water Surface = Routed Hydrograph Results	1.00 The user can over	feet Develope	d 100-yr Peak Runoff I	Rate E	Basin Area at To Basin Volume at To as by entering new	op of Freeboard =	8.32 w Hydrographs tal	acre-ft ble (Columns W ti	
Freeboard above Max Water Surface = Routed Hydrograph Results Design Storm Return Period =	1.00 The user can over water	feet Develope	d 100-yr Peak Runoff I	Rate I and runoff volume 5 Year	Basin Area at To Basin Volume at To Basin Volume at To Basin Volume at To Basin Volume at To Basin Area at To Basin Area at To Basin Area at To Basin Area at To Basin Volume at To Basi	op of Freeboard = values in the Inflo 25 Year	8.32 w Hydrographs tal	acre-ft ble (Columns W th 100 Year	500 Year
Freeboard above Max Water Surface = Routed Hydrograph Results Design Storm Return Period = One-Hour Rainfall Depth (in) =	1.00 The user can over work N/A	feet Develope feet EURV N/A	d 100-yr Peak Runoff I OHP hydrographs 3 2 Year 0.85	and runoff volume 5 Year 1.12	Basin Area at To Basin Volume at To Basin Volume at To Basin Volume at To Basin Volume 10 Year 1.40	op of Freeboard = values in the Inflo 25 Year 1.87	8.32 w Hydrographs tal 50 Year 2.30	ble (Columns W th	500 Year 4.16
Freeboard above Max Water Surface = Routed Hydrograph Results Design Storm Return Period =	The user can ove WQCV N/A 1.850	feet Develope	d 100-yr Peak Runoff I	Rate I and runoff volume 5 Year	Basin Area at To Basin Volume at To Basin Volume at To Basin Volume at To Basin Volume at To Basin Area at To Basin Area at To Basin Area at To Basin Area at To Basin Volume at To Basi	op of Freeboard = values in the Inflo 25 Year	8.32 w Hydrographs tal	acre-ft ble (Columns W th 100 Year	500 Year
Freeboard above Max Water Surface = Routed Hydrograph Results Design Storm Return Period = One-Hour Rainfall Depth (in) = CUHP Runoff Volume (acre-ft) = Inflow Hydrograph Volume (acre-ft) = CUHP Predevelopment Peak Q (cfs) =	The user can ove WQCV N/A 1.850 N/A N/A	feet Develope Perride the default C EURV N/A 5.493 N/A N/A	d 100-yr Peak Runoff I	and runoff volume 5 Year 1.12 5.323	Basin Area at To Basin Volume at To Basin Volume at To Basin Volume at To Basin Volume at To 10 Year 1.40 7.165	op of Freeboard = values in the Inflo 25 Year 1.87 10.587	8.32 w Hydrographs ta. 50 Year 2.30 13.634	ble (Columns W th 100 Year 2.79 17.263	500 Year 4.16 27.180
Routed Hydrograph Results Design Storm Return Period = One-Hour Rainfall Depth (in) = CUHP Runoff Volume (acre-ft) = Inflow Hydrograph Volume (acre-ft) = CUHP Predevelopment Peak Q (cfs) = OPTIONAL Override Predevelopment Peak Q (cfs) =	1.00 The user can ove WQCV N/A 1.850 N/A N/A N/A	feet Develope erride the default C EURV N/A 5.493 N/A N/A N/A	CUHP hydrographs - 2 Year 0.85 3.732 3.732 1.1	and runoff volume 5 Year 1.12 5.323 5.323 11.7	Basin Area at T Basin Volume at T S by entering new 10 Year 1.40 7.165 7.165 32.5	values in the Inflo 25 Year 1.87 10.587 10.587 82.7	8.32 w Hydrographs ta 50 Year 2.30 13.634 13.634 120.4	acre-ft ble (Columns W ti 100 Year 2.79 17.263 17.263 166.0	500 Year 4.16 27.180 27.180 285.0
Routed Hydrograph Results Design Storm Return Period = One-Hour Rainfall Depth (in) = CUHP Runoff Volume (acre-ft) = Inflow Hydrograph Volume (acre-ft) = CUHP Predevelopment Peak Q (cfs) = Predevelopment Unit Peak Flow, q (cfs/acre) = Predevelopment Unit Peak Flow, q (cfs/acre) =	The user can ove WQCV N/A 1.850 N/A N/A N/A	feet Develope erricle the default C EURV N/A 5.493 N/A N/A N/A N/A	UHP hydrographs 2 Year 0.85 3.732 3.732 1.1 0.01	### Steam File	Basin Area at To Basin Volume at To Basin Volume at To Basin Volume at To 10 Year 1.40 7.165 7.165 32.5	values in the Inflo 25 Year 1.87 10.587 10.587 82.7	8.32 w Hydrographs ta. 50 Year 2.30 13.634 13.634 120.4	acre-ft ble (Columns W ti 100 Year 2.79 17.263 17.263 166.0	500 Year 4.16 27.180 27.180 285.0
Routed Hydrograph Results Design Storm Return Period = One-Hour Rainfall Depth (in) = CUHP Runoff Volume (acre-ft) = Inflow Hydrograph Volume (acre-ft) = CUHP Predevelopment Peak Q (cfs) = OPTIONAL Override Predevelopment Peak Q (cfs) =	1.00 The user can ove WQCV N/A 1.850 N/A N/A N/A N/A N/A	feet Develope erride the default C EURV N/A 5.493 N/A N/A N/A	CUHP hydrographs - 2 Year 0.85 3.732 3.732 1.1	and runoff volume 5 Year 1.12 5.323 5.323 11.7	Basin Area at T Basin Volume at T S by entering new 10 Year 1.40 7.165 7.165 32.5	values in the Inflo 25 Year 1.87 10.587 10.587 82.7	8.32 w Hydrographs ta 50 Year 2.30 13.634 13.634 120.4	acre-ft ble (Columns W th 100 Year 2.79 17.263 166.0 2.05 355.1	500 Year 4.16 27.180 27.180 285.0
Routed Hydrograph Results Design Storm Return Period — One-Hour Rainfall Depth (in) — CUHP Runoff Volume (acre-ft) = Inflow Hydrograph Volume (acre-ft) = CUHP Predevelopment Peak Q (cfs) = Predevelopment Peak Q (cfs) = Predevelopment Unit Peak Flow, q (cfs/acre) = Peak Inflow Q (cfs) = Peak Outflow Q (cfs) = Ratio Peak Outflow to Predevelopment Q =	1.00 The user can ove WQCV N/A 1.850 N/A N/A N/A N/A N/A N/A N/A N/A N/A N/A	feet Develope erride the default C EURV N/A 5.493 N/A N/A N/A N/A N/A N/A N/A N/A N/A	0 d 100-yr Peak Runoff I 2 Year 0.85 3.732 1.1 0.01 76.5	### State Family Family Family	Basin Area at To Basin Volume at To Basin Volume at To Basin Volume at To 10 Year 1.40 7.165 7.165 32.5 0.40 143.4	values in the Inflo 25 Year 1.87 10.587 10.587 82.7	8.32 w Hydrographs tal 50 Year 2.30 13.634 120.4 1.49 277.2	acre-ft ble (Columns W ti 100 Year 2.79 17.263 17.263 166.0	500 Year 4.16 27.180 27.180 285.0 3.52 547.6
Routed Hydrograph Results Design Storm Return Period = One-Hour Rainfall Depth (in) = CUHP Runoff Volume (acre-ft) = Inflow Hydrograph Volume (acre-ft) = CUHP Predevelopment Peak Q (cfs) = Predevelopment Peak P (cfs) = Predevelopment Unit Peak Flow, q (cfs) = Peak Inflow Q (cfs) = Peak Outflow Q (cfs) = Ratio Peak Outflow to Predevelopment Q = Structure Controlling Flow =	1.00 The user can ove WQCV N/A 1.850 N/A N/A N/A N/A N/A N/A N/A O.9 N/A Overflow Weir 1	feet Develope Feet Develope Feet Develope Feet Develope Function the default of the default	CUHP hydrographs 2 2 Year 0.85 3.732 1.1 0.01 76.5 6.4 N/A Outlet Plate 1	sand runoff volume 5 Year 1.12 5.323 5.323 11.7 0.14 108.0 7.0 0.6 Outlet Plate 1	Basin Area at To Basin Volume at To Basin Volume at To Basin Volume at To 10 Year 1.40 7.165 7.165 32.5 0.40 143.4 17.3 0.5 Spilway	values in the Inflo 25 Year 1.87 10.587 10.587 82.7 1.02 215.3 102.6 1.2 \$p\$mway	8.32 W Hydrographs ta. 50 Year 2.30 13.634 13.634 120.4 1.49 277.2 169.8 1.4 Spilway	acre-ft ble (Columns W ti 100 Year 2.79 17.263 17.263 166.0 2.05 355.1 269.5 1.6 Spilvay	500 Year 4.16 27.180 27.180 285.0 3.52 547.6 507.4 1.8 Spilway
Routed Hydrograph Results Design Storm Return Period = One-Hour Rainfall Depth (in) = CUHP Runoff Volume (acre-ft) = Inflow Hydrograph Volume (acre-ft) = CUHP Predevelopment Peak Q (cfs) = OPTIONAL Override Predevelopment Peak Q (cfs) = Predevelopment Unit Peak Flow, q (cfs/acre) = Peak Inflow Q (cfs) = Peak Outflow Q (cfs) = Structure Controlling Flow = Max Velocity through Grate 1 (fps) =	1.00 The user can ove WQCV N/A 1.850 N/A N/A N/A N/A N/A O.9 N/A Overflow Weir 1 N/A	rive periode the default C EURV N/A 5.493 N/A N/A N/A N/A N/A N/A N/A N/A N/A Spillway 0.00	CUHP hydrographs 2 Year 0.85 3.732 3.732 1.1 0.01 76.5 6.4 N/A Outlet Plate 1 0.00	Aste 1 Sand runoff volume 5 Year 1.12 5.323 5.323 11.7 0.14 108.0 7.0 0.6 Outlet Plate 1 0.0	Basin Area at Ti Basin Volume at Ti Basin Volume at Ti 10 Year 1.40 7.165 7.165 32.5 0.40 143.4 17.3 0.5 Spilway 0.0	values in the Inflo 25 Year 1.87 10.587 10.587 82.7 1.02 215.3 102.6 1.2 Spilway	8.32 w Hydrographs ta. 50 Year 2.30 13.634 13.634 120.4 1.49 277.2 169.8 1.4 Spilway 0.0	acre-ft ble (Columns W th 100 Year 2.79 17.263 17.263 166.0 2.05 355.1 269.5 1.6 Spilway 0.0	500 Year 4.16 27.180 27.180 285.0 3.52 547.6 507.4 1.8 Spilway 0.0
Routed Hydrograph Results Design Storm Return Period = One-Hour Rainfall Depth (in) = CUIPP Runoff Volume (acre-ft) = Inflow Hydrograph Volume (acre-ft) = CUIPP Predevelopment Peak Q (cfs) = Predevelopment Unit Peak Flow, q (cfs/acre) = Peak Inflow Q (cfs) = Peak Unflow Q (cfs) = Ratio Peak Outflow Q (cfs) = Ratio Peak Outflow G (cfs) = Ratio Peak Outflow Terdevelopment Q = Structure Controlling Flow = Max Velocity through Grate 1 (fps) = Max Velocity through Grate 1 (fps) =	1.00 The user can ove WQCV N/A 1.850 N/A N/A N/A N/A N/A N/A N/A N/A O.9 N/A Overflow Weir 1 N/A N/A N/A	feet Develope feet Develope feet Develope First Develope Fir	UHP hydrographs 2 Year 0.85 3.732 3.732 1.1 0.01 76.5 6.4 N/A Outlet Plate 1 0.00 N/A	sand runoff volume 5 Year 1.12 5.323 5.323 11.7 0.14 108.0 7.0 0.6 Outlet Plate 1 0.0 N/A	Basin Area at Ti Basin Volume at Ti Basin Volume at Ti 10 Year 1.40 7.165 7.165 32.5 0.40 143.4 17.3 0.5 Spilway 0.0	values in the Inflo 25 Year 1.87 10.587 10.587 82.7 1.02 215.3 102.6 1.2 Spilway 0.0 N/A	8.32 W Hydrographs ta. 50 Year 2.30 13.634 13.634 120.4 1.49 277.2 169.8 1.4 Spillway 0.0 N/A	acre-ft ble (Columns W th 100 Year 2.79 17.263 17.263 166.0 2.05 355.1 269.5 1.6 Spillway N/A	500 Year 4.16 27.180 27.180 285.0 3.52 547.6 507.4 1.8 Spilway 0.0 N/A
Routed Hydrograph Results Design Storm Return Period = One-Hour Rainfall Depth (in) = CUHP Runoff Volume (acre-ft) = Inflow Hydrograph Volume (acre-ft) = CUHP Predevelopment Peak Q (cfs) = OPTIONAL Override Predevelopment Peak Q (cfs) = Predevelopment Unit Peak Flow, q (cfs/acre) = Peak Inflow Q (cfs) = Peak Outflow Q (cfs) = Structure Controlling Flow = Max Velocity through Grate 1 (fps) =	1.00 The user can ove WQCV N/A 1.850 N/A N/A N/A N/A N/A N/A N/A N/A N/A N/A	rive periode the default C EURV N/A 5.493 N/A N/A N/A N/A N/A N/A N/A N/A N/A Spillway 0.00	CUHP hydrographs 2 Year 0.85 3.732 3.732 1.1 0.01 76.5 6.4 N/A Outlet Plate 1 0.00	Aste 1 Sand runoff volume 5 Year 1.12 5.323 5.323 11.7 0.14 108.0 7.0 0.6 Outlet Plate 1 0.0	Basin Area at Ti Basin Volume at Ti Basin Volume at Ti 10 Year 1.40 7.165 7.165 32.5 0.40 143.4 17.3 0.5 Spilway 0.0	values in the Inflo 25 Year 1.87 10.587 10.587 82.7 1.02 215.3 102.6 1.2 Spilway	8.32 w Hydrographs ta. 50 Year 2.30 13.634 13.634 120.4 1.49 277.2 169.8 1.4 Spilway 0.0	acre-ft ble (Columns W th 100 Year 2.79 17.263 17.263 166.0 2.05 355.1 269.5 1.6 Spilway 0.0	500 Year 4.16 27.180 27.180 285.0 3.52 547.6 507.4 1.8 Spilway 0.0
Routed Hydrograph Results Design Storm Return Period = One-Hour Rainfall Depth (in) = CUHP Runoff Volume (acre-ft) = Inflow Hydrograph Volume (acre-ft) = OPTIONAL Override Predevelopment Peak Q (cfs) = Predevelopment Unit Peak Flow, q (cfs/acre) = Peak Inflow Q (cfs) = Peak Outflow Q (cfs) = Ratio Peak Outflow to Predevelopment Q = Structure Controlling Flow = Max Velocity through Grate 1 (fps) = Max Velocity through Grate 1 (fps) = Time to Drain 97% of Inflow Volume (hours) = Time to Drain 99% of Inflow Volume (hours) = Maximum Ponding Depth (ft) =	1.00 The user can ove WQCV N/A 1.850 N/A N/A N/A N/A N/A N/A N/A N/A N/A N/A	Five default C EURV N/A S,493 N/A N/A N/A N/A N/A Spillway 0.00 N/A 45 6.01	UHP hydrographs 2 Year 0.85 3.732 3.732 1.1 0.01 76.5 6.4 N/A Outlet Plate 1 0.00 N/A 40 43 3.98	Section Sect	Basin Area at T Basin Volume at T Basin Volume at T 10 Year 1.40 7.165 7.165 32.5 0.40 143.4 17.3 0.5 Spilway 0.0 N/A 41 46 6.13	values in the Inflo 25 Year 1.87 10.587 10.587 82.7 1.02 215.3 102.6 1.2 Spilway 0.0 N/A 38 45 6.57	8.32 W Hy drographs ta. 50 Year 2.30 13.634 13.634 120.4 1.49 277.2 169.8 1.4 Spillway 0.0 N/A 36 44 6.81	acre-ft ble (Columns W th 100 Year 2.79 17.263 166.0 2.05 355.1 269.5 1.6 Spilway 0.0 N/A 33 43 7.10	500 Year 4.16 27.180 27.180 285.0 3.52 547.6 507.4 1.8 Spilway 0.0 N/A 27 40 7.67
Routed Hydrograph Results Design Storm Return Period = One-Hour Rainfall Depth (in) = CUHP Runoff Volume (acre-ft) = Inflow Hydrograph Volume (acre-ft) = CUHP Predevelopment Peak Q (cfs) = OPTIONAL Override Predevelopment Peak Q (cfs) = Predevelopment Unit Peak Flow, q (cfs) = Peak Inflow Q (cfs) = Peak Outflow Q (cfs) = Ratio Peak Outflow to Predevelopment Q = Structure Controlling Flow = Max Velocity through Grate 1 (fps) = Max Velocity through Grate 2 (fps) = Time to Drain 97% of Inflow Volume (hours) = Time to Drain 99% of Inflow Volume (hours) =	1.00 The user can ove WQCV N/A 1.850 N/A N/A N/A N/A N/A N/A 0.9 N/A Overflow Weir 1 N/A N/A 38 40 3.02	Fix Develope feet Develope feet Develope feet Develope feet Develope feet Develope feet feet feet feet feet feet feet fe	CUHP hydrographs 2 Year 0.85 3.732 1.1 0.01 76.5 6.4 N/A Outlet Plate 1 0.00 N/A 40 43	and runoff volume 5 Year 1.12 5.323 5.323 11.7 0.14 108.0 7.0 0.6 Outlet Plate 1 0.0 N/A 41 45	Basin Area at Ti Basin Volume at Ti Basin Volume at Ti 10 Year 1.40 7.165 7.165 32.5 0.40 143.4 17.3 0.5 Spillway 0.0 N/A	values in the Inflo 25 Year 1.87 10.587 10.587 82.7 1.02 215.3 102.6 1.2 Spilway 0.0 N/A 38	8.32 w Hydrographs ta. 50 Year 2.30 13.634 13.634 120.4 1.49 277.2 169.8 1.4 Spillway 0.0 N/A 36 44	acre-ft ble (Columns W th 100 Year 2.79 17.263 166.0 2.05 355.1 269.5 1.6 Spilway 0.0 N/A 33 43	500 Year 4.16 27.180 27.180 285.0 3.52 547.6 507.4 1.8 Spilway 0.0 N/A 27



		DFT	ENTION	V BASI	N STAGE-S	TORA	GF TAI	BI F BI	JTI DEF	2				
				a veneze v	D-Detention, Versio	at anyone to be a				•			Clear Work	book
Project:	Greeley Okla	ahoma Sout	th											
Basin ID:	DP 842, EUR	RV												
ZONE 3 ZONE 2	2 ONE 1													
100-YR VOLUME EURV WQCV		$oldsymbol{1}$												
		100-YE	AR	\rightarrow	Depth Increment =	0.25	ft							
PERMANENT ORIFIC	1 AND 2	ORIFIC	E		Deput Increment =	0.25	Optional				Optional		Î	
POOL Example Zone	Configura	tion (Rete	ntion Pond)		Stage - Storage Description	Stage (ft)	Override Stage (ft)	Length (ft)	Width (ft)	Area (ft ²)	Override Area (ft ²)	Area (acre)	Volume (ft ³)	Volume (ac-ft)
Watershed Information					Top of Micropool	0.00		26.3	26.3	694	,,,,,	0.016		(22.7)
Extended Detention Basin (EDB)	EDB				ISV	0.50		26.3	26.3	694		0.016	347	0.008
Watershed Area =	210.53	acres				0.75		26.3	26.3	694		0.016	521	0.012
Watershed Length =	4,665	ft				1.00		26.3	26.3	694		0.016	694	0.016
Watershed Length to Centroid =	2,450	ft a/a				1.25		77.3	51.3	3,972		0.091	1,224	0.028
Watershed Slope = Watershed Imperviousness =	0.019 64.54%	ft/ft percent				1.50		128.3 179.3	76.3 101.3	9,799 18,176		0.225	2,892 6,336	0.066
Percentage Hydrologic Soil Group A =	8.7%	percent				2.00		230.3	126.3	29,104		0.668	12,193	0.280
Percentage Hydrologic Soil Group B =	45.0%	percent				2.25		281.3	151.3	42,581		0.978	21,101	0.484
Percentage Hydrologic Soil Groups C/D =	46.3%	percent				2.50		332.3	176.3	58,608		1.345	33,696	0.774
Target WQCV Drain Time =	40.0	hours				2.75		383.3	201.3	77,186		1.772	50,617	1.162
Location for 1-hr Rainfall Depths =				▼		3.00		434.3	226.3	98,313		2.257	72,502	1.664
After providing required inputs above includents, click 'Run CUHP' to generate rund			Run CUHF	-	Zone 1 (WQCV)	3.25		485.3 511.9	251.3 264.3	121,991 135,311		2.801 3.106	99,986 116,704	2.295
the embedded Colorado Urban Hydro			Optional User	r Overrides	(iiqei)	3.50		536.3	276.3	148,218		3.403	133,709	3.070
Water Quality Capture Volume (WQCV) =	2.656	acre-feet	2.656	acre-feet		3.75		587.3	301.3	176,995		4.063	174,308	4.002
Excess Urban Runoff Volume (EURV) =	14.210	acre-feet		acre-feet		4.00		638.3	326.3	208,323		4.782	222,420	5.106
2-yr Runoff Volume (P1 = 0.85 in.) =	8.937	acre-feet	0.85	inches		4.25		689.3	351.3	242,200		5.560	278,682	6.398
5-yr Runoff Volume (P1 = 1.12 in.) =	12.514	acre-feet	1.12	inches		4.50		740.3	376.3	278,628		6.396	343,732	7.891
10-yr Runoff Volume (P1 = 1.4 in.) =	17.051	acre-feet	1.40	inches		4.75		791.3 842.3	401.3	317,605		7.291	418,208	9.601
25-yr Runoff Volume (P1 = 1.87 in.) = 50-yr Runoff Volume (P1 = 2.3 in.) =	26.080 33.878	acre-feet acre-feet	2.30	inches inches		5.00		893.3	426.3 451.3	359,132 403,210		8.245 9.256	502,747 597,987	11.541
100-yr Runoff Volume (P1 = 2.79 in.) =	43.453	acre-feet	2.79	inches	Zone 2 (EURV)	5.31		905.6	457.3	414,168		9.508	622,507	14.291
500-yr Runoff Volume (P1 = 4.16 in.) =	69.294	acre-feet	4.16	inches	Hoor	5.37		917.8	463.3	425,273		9.763	647,690	14.869
Approximate 2-yr Detention Volume =	8.255	acre-feet				5.50		918.9	464.4	426,710		9.796	703,069	16.140
Approximate 5-yr Detention Volume =	11.858	acre-feet				5.75		920.9	466.4	429,481		9.860	810,092	18.597
Approximate 10-yr Detention Volume =	15.324	acre-feet				6.00		922.9	468.4	432,259		9.923	917,810	21.070
Approximate 25-yr Detention Volume = Approximate 50-yr Detention Volume =	19.392 22.076	acre-feet acre-feet			Zone 3 (100-year)	6.25		924.9 926.9	470.4 472.4	435,046 437,840		9.987	1,026,223	23.559
Approximate 100-yr Detention Volume =	26.029	acre-feet			2011e 3 (100-year)	6.75		928.9	474.4	440,643		10.116	1,245,143	28.585
, , , , , , , , , , , , , , , , , , , ,]				7.00		930.9	476.4	443,453		10.180	1,355,655	31.122
Define Zones and Basin Geometry		_				7.25		932.9	478.4	446,272		10.245	1,466,871	33.675
Zone 1 Volume (WQCV)	2.656	acre-feet				7.50		934.9	480.4	449,098		10.310	1,578,792	36.244
Zone 2 Volume (EURV - Zone 1)	11.554	acre-feet				7.75		936.9	482.4	451,933		10.375	1,691,420	38.830
Zone 3 Volume (100-year - Zones 1 & 2)	11.819 26.029	acre-feet acre-feet				8.00 8.25		938.9 940.9	484.4 486.4	454,775		10.440	1,804,759	41.432 44.050
Total Detention Basin Volume = Initial Surcharge Volume (ISV) =	347	ft 3				8.50		940.9	488.4	457,626 460,484		10.571	2,033,572	46.684
Initial Surcharge Depth (ISD) =	0.50	ft				8.75		944.9	490.4	463,351		10.637	2,149,051	49.335
Total Available Detention Depth (H _{total}) =	6.50	ft				9.00		946.9	492.4	466,225		10.703	2,265,248	52.003
Depth of Trickle Channel (H_{TC}) =	0.50	ft				9.25		948.9	494.4	469,108		10.769	2,382,165	54.687
Slope of Trickle Channel (S _{TC}) =	0.005	ft/ft				9.50		950.9	496.4	471,998		10.836	2,499,803	57.388
Slopes of Main Basin Sides (S _{main}) =	4	H:V				9.75		952.9	498.4	474,897		10.902	2,618,164	60.105
Basin Length-to-Width Ratio $(R_{L/W}) = $	2					10.00		954.9 956.9	500.4 502.4	477,803 480,718		10.969	2,737,252 2,857,067	62.839 65.589
Initial Surcharge Area (A _{ISV}) =	694	ft ²				10.50		958.9	504.4	483,640		11.103	2,977,611	68.357
Surcharge Volume Length (L_{ISV}) =	26.3	ft				10.75		960.9	506.4	486,571		11.170	3,098,887	71.141
Surcharge Volume Width (W _{ISV}) =	26.3	ft				11.00		962.9	508.4	489,509		11.238	3,220,897	73.942
Depth of Basin Floor $(H_{FLOOR}) =$	4.37	ft				11.25		964.9	510.4	492,456		11.305	3,343,643	76.759
Length of Basin Floor (L _{FLOOR}) =	917.8	ft				11.50		966.9	512.4	495,410		11.373	3,467,126	79.594
Width of Basin Floor (W _{FLOOR}) =	463.3 425,273	ft ft²				11.75		968.9 970.9	514.4 516.4	498,373 501,343		11.441	3,591,349 3,716,313	82.446 85.315
Area of Basin Floor $(A_{FLOOR}) = Volume of Basin Floor (V_{FLOOR}) = Volume (V_{FLOOR})$	645,520	ft ³				12.00		970.9	518.4	501,343		11.578	3,716,313	88.201
Depth of Main Basin (H _{MAIN}) =	1.13	ft				12.50		974.9	520.4	507,308		11.646	3,968,474	91.104
Length of Main Basin (L _{MAIN}) =	926.9	ft				12.75		976.9	522.4	510,303		11.715	4,095,676	94.024
Width of Main Basin (W _{MAIN}) =	472.4	ft				13.00		978.9	524.4	513,305		11.784	4,223,627	96.961
Area of Main Basin (A _{MAIN}) =	437,840	ft ²				13.25		980.9	526.4	516,316		11.853	4,352,329	99.916
Volume of Main Basin (V _{MAIN}) =	487,641	ft ³				13.50		982.9	528.4	519,334		11.922	4,481,785	102.888
Calculated Total Basin Volume $(V_{total}) = [$	26.030	acre-feet				13.75		984.9	530.4	522,361		11.992	4,611,997	105.877

Company Comp		DET	ENTION F	RASIN OUT	LET STRE	ICTURE D	SIGN			
Separation Description D			MH				_310IV			
Ethnicide Ethn			South							
See Top 2. See Top 3. See	ZONE 3				Estimated	Estimated		Clear I	nput Parameters	1
Section Comparison Configuration (Reterrisin Pend) Section 1.15 Section	100 VP				Stage (ft)	Volume (ac-ft)	Outlet Type	(Incl	uding Tables)	<u> </u>
Section Part	VOLUME EURY WOCV									
Description Description	ZONE 1 AND 2	100-YEAR ORIFICE							strictor Plate)	
Calculated Parameters for Underdain Underdain Office Area Underdain Office	PERMANENT ORIFICES	e Configuration (Zone 3 (100-year)	1 11 11 11 11 11 11		Not Utilized	Zone 3 Not Utilized		▼
Unicidated notifies Invest Depths N/A				n RMP)	i otal (all zones)	26.029		Calculated Parame	eters for Underdra	in
					a surface)	Underd	rain Orifice Area =			
Depth at top of Zone using Ortice Pate 3.38 The relative to base hottom at Stage = 0 ft) Section 14 movement of the Pate 3.38 The relative to base hottom at Stage = 0 ft) Section 14 movement 14 mo	Underdrain Orifice Diameter =	N/A	inches		,	Underdrain	Orifice Centroid =	N/A	feet	
Depth at top of Zone using Orlice Falls 3.38	Icer Input: Orifice Plate with one or more ori	fices or Ellintical Sh	t Weir (typically us	ed to drain WOOV	and/or FLIDV in a	cadimentation RM	D)	Calculated Davam	atom for Diato	
Depth at top of Zone uang Orline Rate 3.38 (reletate to basin bottom at Stage = 0.11) Epipical 164 / Width = N/A Feet							-			
Orifice Pates of Each Office Centrol (1) Stage and Total Area of Each Office Row (numbered from breat to highest) Stage of Orifice Centrol (1) Orifice Area (is, include) Stage of Orifice Centrol (1) Orifice Area (is, include) Stage of Orifice Centrol (1) Orifice Area (is, include) Stage of Orifice Centrol (1) Orifice Area (is, include) Stage of Orifice Centrol (1) Orifice Area (is, include) Row 1 (control) Row 2 (control) Row 3 (control) Row 1 (c			,	_	,	Elli	otical Half-Width =		+	
Stage and Total Area of Each Office Row (numbered from lowest to highest)									1	
Separation Sep	Orifice Plate: Orifice Area per Row =	7.09	sq. inches (use re	ectangular openings	5)	Е	lliptical Slot Area =	N/A]ft²	
Sage of Orifice Cerebroid (Pt) Control Peace (In International Control Peace (In Internati					Size Plate	to match				
Stage of Orline Ceres of Rp 2.00	ser Input: Stage and Total Area of Each Or	ifice Row (number	ed from lowest to	highest)	WQCV DI	rain Time				
Stage of Orline Cereboid (R)	110 77				Row 4 (optional)	Row 5 (optional)	Row 6 (optional)	Row 7 (optional)	Row 8 (optional)	
Stage of Orfice Centroid (Rev 9 (optional) Rev 11 (optional) Rev 12 (optional) Rev 13 (optional) Rev 14 (optional) Rev 15 (optional) Rev 15 (optional) Rev 15 (optional) Rev 16 (optional)										
See Input: Vertical Office (Cruiter or Rectangular)	Orifice Area (sq. inches)	7.09	7.09	7.09						J
See Input: Vertical Orfice Area (sc. inches) See Input: Vertical Orfice Area (sc. inches)		Row 9 (optional)	Row 10 (optional)	Row 11 (optional)	Row 12 (optional)	Row 13 (optional)	Row 14 (optional)	Row 15 (optional)	Row 16 (optional)	
Calculated Parameters for Vertical Orfice Not Selected Not S	Stage of Orifice Centroid (ft)									
Not Selected Not	Orifice Area (sq. inches)			1]
Invert of Vertical Orfice N/A	ser Input: Vertical Orifice (Circular or Rectan	igular)						Calculated Parame	eters for Vertical C	rifice
Depth at top of Zone using vertical Orfice N/A N/A N/A nches	\		Not Selected]						
Vertical Orifice Diameter			1000	The second secon	The state of the s				-	+
Ser Input: Overflow Weir (Dropbox with Fist or Sloped Grate and Outlet Pipe OR Rectangular/Trapezoidal Weir and No Outlet Pipe). Calculated Parameters for Overflow Weir Zone 2 Weir Not Selected				1. 6	n bottom at Stage	= 0 ft) Vertical	Orifice Centroid =	N/A	N/A	feet
Overflow Weir Front Edge Height, Ho	Vertical Office Diameter =	N/A	14/75	il Cics				0		
Overflow Weir Front Edge Height, Ho										
Overflow Weir Front Edge Length 10 3.38 N/A feet 4.00 feet 4.0	ser Input: Overflow Weir (Dropbox with Flat			Rectangular/Trape	ezoidal Weir and No	o Outlet Pipe)				Weir
Overflow Weir Front Edge Length	Overflow Web Front Eden Height He	the state of the s		G. ()						e
Overflow Wier Grate Stope = Horiz. Length of Wier Sides = Horiz. L					bottom at Stage = 0					
Horiz, Lergth of Wer Sides		-			Grat		- 1 Total 1			Teet
Debris Clogging % = 50% N/A %	Horiz. Length of Weir Sides =	4.00	N/A	feet	Ove	rflow Grate Open	Area w/o Debris =	11.14	N/A	ft ²
Seer Input: Outlet Pipe w/ Flow Restriction Plate Circular Orfice, Restrictor Plate, or Rectangular Orfice		_		·	Ov	erflow Grate Open	Area w/ Debris =	5.57	N/A	ft ²
Depth to Invert of Outlet Pipe Depth to Invert of Outlet Pipe Depth to Invert of Outlet Pipe Depth to Invert of Outlet Pipe Depth to Invert of Outlet Pipe Depth to Invert of Outlet Pipe Depth to Invert Sex	Debris Clogging % =	50%	N/A] %						
Depth to Invert of Outlet Pipe Depth to Invert of Outlet Pipe Depth to Invert of Outlet Pipe Depth to Invert of Outlet Pipe Depth to Invert of Outlet Pipe Depth to Invert of Outlet Pipe Depth to Invert Sex	ser Input: Outlet Pipe w/ Flow Restriction Plat	te (Circular Orifice.	Restrictor Plate, c	or Rectangular Orific	ce)	Cak	culated Parameters	s for Outlet Pipe w	/ Flow Restriction F	Plate
Outlet Pipe Diameter = Restrictor Plate Height Above Pipe Invert = 18.00 N/A inches inches Half-Central Angle of Restrictor Plate Height Above Pipe Invert = 6.50 N/A inches inches Half-Central Angle of Restrictor Plate on Pipe = 1.29 N/A radia radia radia radia feet Feet Feet Feet Feet Feet Feet Feet	, , , , , , , , , , , , , , , , , , , ,									
Restrictor Plate Height Above Pipe Invert 6.50 Inches Half-Central Angle of Restrictor Plate on Pipe 1.29 N/A radia ser Input: Emergency Spillway (Rectangular or Trapezoidal) Spillway (Invert Stage= 6.51 ft (relative to basin bottom at Stage = 0 ft) Spillway Design Flow Depth= Stage at Top of Freeboard = 7.87 feet Spillway End Slopes 4.00 H.V. Spillway to pass Developed 100-yr Peak Runoff Rate Basin Volume at Top of Freeboard = 10.01 acres 10.00 acre-ft 10.00				• A 2	asin bottom at Stage	15.0				
Spillway Invert Stage	the same and the s		N/A							+
Spillway Invert Stage	Restrictor Plate Height Above Pipe Invert =	6.50	1	inches	Half-Centra	al Angle of Restrict	or Plate on Pipe =	1.29	N/A	radians
Spillway Crest Length	and the control of th			•				Calculated Parame	eters for Spillway	
Spillway End Slopes		or Trapezoidal)							1	
Developed 100-yr Peak Runoff Rate Basin Avea at 1 op of Freeboard 10.41 acres	ser Input: Emergency Spilway (Rectangular		ft (relative to basi	in bottom at Stage	= 0 ft)	Spillway De	esign Flow Depth=	0.36	ICCL	
Design Storm Return Period One-Hour Rainfall Depth (in) = CHP Number 10 Ventre CHP Number 10 Ventre CHP Number 10 Ventre CHP Runoff Volume (acre-ft)	ser Input; Emergency Spilway (Rectangular o Spilway Invert Stage=	6.51 1000.00	feet	-		(6)			The same	
Design Storm Return Period One- Hour Rainfall Depth (in) = N/A N/A N/A 0.85 1.12 1.40 1.87 2.30 2.79 4	ser Input: Emergency Spilway (Rectangular i Spilway Invert Stage= Spilway Crest Length = Spilway End Slopes =	6.51 1000.00 4.00	feet H:V Size Em Develope	ergency Spillway to p	ass Rate	Stage at To Basin Area at To	op of Freeboard = op of Freeboard =	7.87 10.41	feet acres	
Design Storm Return Period One- Hour Rainfall Depth (in) = N/A N/A N/A 0.85 1.12 1.40 1.87 2.30 2.79 4	ser Input: Emergency Spilway (Rectangular i Spilway Invert Stage= Spilway Crest Length = Spilway End Slopes =	6.51 1000.00 4.00	feet H:V Size Em Develope	ergency Spillway to p	ass Rate	Stage at To Basin Area at To	op of Freeboard = op of Freeboard =	7.87 10.41	feet acres	
One-Hour Rainfall Depth (in) = CHP Runoff Volume (acre-ft) = CHP Predevelopment Peak Q (cfs) = N/A N/A N/A N/A N/A N/A N/A N/A N/A N/A	ser Input: Emergency Spilway (Rectangular Spilway Invert Stage= Spilway Crest Length = Spilway End Slopes =	6.51 1000.00 4.00	feet H:V Size Em Develope	ergency Spillway to p	ass Rate	Stage at To Basin Area at To	op of Freeboard = op of Freeboard =	7.87 10.41	feet acres	
CUHP Runoff Volume (acre-ft) =	ser Input: Emergency Spilway (Rectangular Spilway Invert Stage= Spilway Crest Length = Spilway End Slopes = Freeboard above Max Water Surface = outed Hydrograph Results	6.51 1000.00 4.00 1.00	feet H:V Size Em Develope feet	ergency Spillway to p ed 100-yr Peak Runoff CUHP hydrographs	ass Rate E and runoff volume	Stage at To Basin Area at To Basin Volume at To as by entering new	op of Freeboard = op of Freeboard = op of Freeboard = op of Freeboard = values in the Inflo	7.87 10.41 40.08	feet acres acre-ft ble (Columns W th	
Inflow Hydrograph Volume (acre-ft) = N/A N/A 8.937 12.514 17.051 26.080 33.878 43.453 65 CUHP Predevelopment Peak Q (cfs) = N/A N/A N/A 1.6 5.5 35.7 125.8 188.7 272.4 4	ser Input: Emergency Spilway (Rectangular of Spilway Invert Stage	6.51 1000.00 4.00 1.00 The user can ove	feet H:V feet Develope erride the default C EURV	nergency Spillway to p rd 100-yr Peak Runoff CUHP hydrographs 2 Year	ass Rate E	Stage at To Basin Area at To Basin Volume at To as by entering new 10 Year	op of Freeboard = op of Freeboard = op of Freeboard = op of Freeboard = values in the Inflo 25 Year	7.87 10.41 40.08 w Hydrographs tau	feet acres acre-ft ble (Columns W th	500 Y
PTIONAL Override Predevelopment Peak Q (cfs) = Predevelopment Peak Plow, q (cfs) = N/A N/A N/A N/A N/A 1.26.1 1.74.4 239.1 392.2 509.2 653.8 11 N/A N/A 1.26.1 1.74.4 239.1 392.2 509.2 653.8 11 N/A N/A 1.26.1 1.74.4 239.1 392.2 509.2 653.8 11 N/A N/A N/A N/A N/A N/A N/A N/A N/A N/A	ser Input: Emergency Spillway (Rectangular - Spillway Invert Stage= Spillway Crest Length = Spillway End Slopes = Freeboard above Max Water Surface = Outed Hydrograph Results Design Storm Return Period = One-Hour Rainfail Depth (in) =	6.51 1000.00 4.00 1.00 The user can ove WQCV N/A 2.656	feet H:V feet Great Size Em Develope Euride the default C EURV N/A 14.210	cult Phydrographs 2 Year 0.85 8.937	and runoff volume 5 Year 1.12 12.514	Stage at To Basin Area at To Basin Volume at To ses by entering new 10 Year 1.40 17.051	op of Freeboard = op of Freeboard = op of Freeboard = op of Freeboard = values in the Inflo 25 Year 1.87 26.080	7.87 10.41 40.08 w Hydrographs tat 50 Year 2.30 33.878	feet acres acre-ft ble (Columns W th 100 Year 2.79 43.453	500 Y 4.1 69.2
Predevelopment Unit Peak Flow, q (cfs/acre) = N/A N/A N/A 0.01 0.03 0.17 0.60 0.90 1.29 7.20 1.20 1.20 1.20 1.20 1.20 1.20 1.20 1	ser Input: Emergency Spillway (Rectangular of Spillway Invert Stage = Spillway Crest Length = Spillway End Slopes = Freeboard above Max Water Surface = Spillway End Slopes = Freeboard above Max Water Surface = Spillway End Slopes = Spillway End Slopes = Freeboard above Max Water Surface = Spillway End S	6.51 1000.00 4.00 1.00 The user can ove WQCV N/A 2.656 N/A	feet H:V feet Develope Feet Size Em Develope Feet Size Em Develope Feet N/A 14.210 N/A	ergency Spillway to p d 100-yr Peak Runoff CUHP hydrographs 2 Year 0.85 8.937 8.937	ass Rate E and runoff volume 5 Year 1.12 12.514 12.514	Stage at To Basin Area at To Basin Volume at To Basin Volume at To In Year 1.40 17.051 17.051	op of Freeboard = op of Freeboard = op of Freeboard = op of Freeboard = op of Freeboard = values in the Inflormation 1.87 26.080 26.080	7.87 10.41 40.08 w Hydrographs tat 50 Year 2.30 33.878 33.878	feet acres acre-ft ble (Columns W th 100 Year 2.79 43.453 43.453	500 Y 4.1 69.2 69.2
Peak Outflow Q (cfs) = 1.0 7.6 7.2 7.4 7.7 8.1 132.1 342.0 8	ser Input: Emergency Spillway (Rectangular of Spillway Invert Stage	6.51 1000.00 4.00 1.00 The user can ove WQCV N/A 2.656 N/A N/A	feet H:V feet Develope Feet Size Em Develope Feet Size Em Develope Feet N/A 14.210 N/A N/A	ergency Spillway to p d 100-yr Peak Runoff CUHP hydrographs 2 Year 0.85 8.937 8.937	ass Rate E and runoff volume 5 Year 1.12 12.514 12.514	Stage at To Basin Area at To Basin Volume at To Basin Volume at To In Year 1.40 17.051 17.051	op of Freeboard = op of Freeboard = op of Freeboard = op of Freeboard = op of Freeboard = values in the Inflormation 1.87 26.080 26.080	7.87 10.41 40.08 w Hydrographs tat 50 Year 2.30 33.878 33.878	feet acres acre-ft ble (Columns W th 100 Year 2.79 43.453 43.453	500 Y 4.1 69.2 69.2
Ratio Peak Outflow to Predevelopment Q = Structure Controlling Flow = Max Velocity through Grate 1 (fips) = MAX Velocity through Grate 1 (fips) = MAX Velocity through Grate 2 (fips) = N/A N/A N/A N/A N/A N/A N/A N/A N/A N/A	ser Input: Emergency Spilway (Rectangular - Spilway Invert Stage - Spilway Crest Length = Spilway End Slopes = Freeboard above Max Water Surface = Outed Hydrograph Results Design Storm Return Period - One-Hour Rainfail Depth (in) = CUHP Runoff Volume (acre-ft) = Inflow Hydrograph Volume (acre-ft) = CUHP Predevelopment Peak Q (cfs) = PTIONAL Override Predevelopment Peak Q (cfs) = Predevelopment Unit Peak Flow, q (cfs/acre) = Predevelopment Peak Q (cfs) = Predevelopment Unit Peak Flow, q (cfs/acre) = Predevelopment Peak Q (cfs) = Pre	6.51 1000.00 4.00 1.00 The user can ove WQCV N/A 2.656 N/A N/A N/A N/A	feet H:V feet Size Em Develope Feet Size Em Develope Feet Size Em Develope Feet Size Em Develope Feet Size Em Develope Feet Size Em Develope Feet Size Em Develope Feet Size Em Develope Feet Size Em Develope Feet Size Em Develope Feet Size Em Develope Feet Size Em Develope Feet Size Em Develope Feet Size Em Develope Feet Size Em Develope Feet Size Em Size	culture from the first series of the first ser	and runoff volume 5 Year 1.12 12.514 12.514 5.5 0.03	Stage at To Basin Area at To Basin Volume at To Is by entering new 10 Year 1.40 17.051 17.051 35.7	op of Freeboard = op of Freeboard = op of Freeboard = op of Freeboard = values in the Infloating 1.87 26.080 26.080 125.8	7.87 10.41 40.08 w Hydrographs tal 50 Year 2.30 33.878 33.878 188.7	feet acres acre-ft ble (Columns W th 100 Year 2.79 43.453 43.453 272.4	500 Y 4.1 69.2 69.2 482
Structure Controlling Flow = Overflow Weir 1 Outlet Plate 1 Outlet	ser Input: Emergency Spilway (Rectangular Spilway Invert Stage Spilway Crest Length Spilway End Slopes Spilway End Slopes Freeboard above Max Water Surface Duted Hydrograph Results Design Storm Return Period One-Hour Rainfall Depth (in) Ul-Predevelopment Peak Q (cfs) Inflow Hydrograph Volume (acre-ft) CUHP Predevelopment Peak Q (cfs) Predevelopment Peak Q (cfs) Predevelopment Unit Peak Flow, q (cfs) Cfs) Predevelopment Unit Peak Flow, q (cfs) Peak Inflow Q (cfs)	6.51 1000.00 4.00 1.00 The user can ove WQCV N/A 2.656 N/A N/A N/A N/A N/A	feet H:V Size Em Develope Ferride the default C EURV N/A 14.210 N/A N/A N/A N/A N/A N/A N/A N/A N/A N/A	CUHP hydrographs 2 Year 0.85 8.937 1.6 0.01 126.1	and runoff volume 5 Year 1.12 12.514 12.514 5.5 0.03 174.4	Stage at To Basin Area at To Basin Volume at To Is by entering new 10 Year 1.40 17.051 17.051 35.7	op of Freeboard = op of Freeboard = op of Freeboard = op of Freeboard = values in the Inflo 25 Year 1.87 26.080 26.080 125.8 0.60 392.2	7.87 10.41 40.08 w Hydrographs tail 50 Year 2.30 33.878 33.878 188.7	feet acres acre-ft ble (Columns W th 100 Year 2.79 43.453 272.4 1.29 653.8	500 Y 4.1 69.2 69.2 482 2.2 1027
Max Velocity through Grate 2 (fps) = N/A N/A <td>ser Input: Emergency Spilway (Rectangular Spilway Invert Stage Spilway Invert Stage Spilway Crest Length Spilway Crest Length Spilway End Slopes Freeboard above Max Water Surface Douted Hydrograph Results Design Storm Return Period One-Hour Rainfall Depth (in) CUHP Runoff Volume (acre-ft) CUHP Runoff Volume (acre-ft) CUHP Predevelopment Peak Q (cfs) Prional Override Predevelopment Peak Q (cfs) Predevelopment Unit Peak Inflow Q (cfs) Peak Outflow Q (cfs) Peak Outflow Q (cfs) Peak Outflow Q (cfs)</td> <td>6.51 1000.00 4.00 1.00 The user can ove WQCV N/A 2.656 N/A N/A N/A N/A N/A N/A 1.0</td> <td>feet H:V feet Size Em Develope EURV N/A 14.210 N/A N/A N/A N/A N/A N/A N/A 7.6</td> <td>CUHP hydrographs 2 Year 0.85 8.937 8.937 1.6 0.01 126.1 7.2</td> <td>and runoff volume 5 Year 1.12 12.514 12.514 5.5 0.03 174.4 7.4</td> <td>Stage at To Basin Area at To Basin Volume at To Is by entering new 10 Year 1.40 17.051 17.051 17.051 235.7</td> <td>op of Freeboard = op of Freebo</td> <td>7.87 10.41 40.08 w Hydrographs tai 50 Year 2.30 33.878 33.878 188.7 0.90 509.2 132.1</td> <td>feet acres acre-ft ble (Columns W th 100 Year 2.79 43.453 43.453 272.4 1.29 653.8 342.0</td> <td>500 Y 4.10 69.29 69.29 482. 2.29 1027 805.</td>	ser Input: Emergency Spilway (Rectangular Spilway Invert Stage Spilway Invert Stage Spilway Crest Length Spilway Crest Length Spilway End Slopes Freeboard above Max Water Surface Douted Hydrograph Results Design Storm Return Period One-Hour Rainfall Depth (in) CUHP Runoff Volume (acre-ft) CUHP Runoff Volume (acre-ft) CUHP Predevelopment Peak Q (cfs) Prional Override Predevelopment Peak Q (cfs) Predevelopment Unit Peak Inflow Q (cfs) Peak Outflow Q (cfs) Peak Outflow Q (cfs) Peak Outflow Q (cfs)	6.51 1000.00 4.00 1.00 The user can ove WQCV N/A 2.656 N/A N/A N/A N/A N/A N/A 1.0	feet H:V feet Size Em Develope EURV N/A 14.210 N/A N/A N/A N/A N/A N/A N/A 7.6	CUHP hydrographs 2 Year 0.85 8.937 8.937 1.6 0.01 126.1 7.2	and runoff volume 5 Year 1.12 12.514 12.514 5.5 0.03 174.4 7.4	Stage at To Basin Area at To Basin Volume at To Is by entering new 10 Year 1.40 17.051 17.051 17.051 235.7	op of Freeboard = op of Freebo	7.87 10.41 40.08 w Hydrographs tai 50 Year 2.30 33.878 33.878 188.7 0.90 509.2 132.1	feet acres acre-ft ble (Columns W th 100 Year 2.79 43.453 43.453 272.4 1.29 653.8 342.0	500 Y 4.10 69.29 69.29 482. 2.29 1027 805.
Time to Drain 97% of Inflow Volume (hours) = 38 54 50 53 58 67 66 62 Time to Drain 99% of Inflow Volume (hours) = 40 60 54 59 65 77 77 75 Maximum Ponding Depth (ft) = 3.38 5.31 4.49 4.97 5.45 6.36 6.63 6.74 (6)	ser Input: Emergency Spilway (Rectangular Spilway Invert Stage = Spilway Crest Length = Spilway End Slopes = Freeboard above Max Water Surface = Outed Hydrograph Results Design Storm Return Period = One-Hour Rainfall Depth (in) = CUHP Runoff Volume (acre-tt) = Inflow Hydrograph Volume (acre-tt) = CUHP Predevelopment Peak Q (cfs) = Predevelopment Unit Peak Flow, q (cfs/acre) = Peak Inflow Q (cfs) = Peak Outflow Q (cfs) = Ratio Peak Outflow to Predevelopment Q = Ratio Peak Outflow to Predevelopment Q = Structure Controlling Flow = Structure Controlling Flow	6.51 1000.00 4.00 1.00 The user can ove WQCV N/A 2.656 N/A N/A N/A N/A N/A N/A N/A N/A	feet H:V Develope Ferride the default C EURV N/A 14.210 N/A N/A N/A N/A N/A N/A N/A N/A N/A N/A	CUHP hydrographs 2 Year 0.85 8.937 1.6 0.01 126.1 7.2 N/A Outlet Plate 1	and runoff volume 5 Year 1.12 12.514 12.514 5.5 0.03 174.4 7.4 1.3 Outlet Plate 1	Stage at To Basin Area at To Basin Volume at To Is by entering new 10 Year 1.40 17.051 17.051 35.7 0.17 239.1 7.7 0.2 Outlet Plate 1	op of Freeboard = op of Freeboard = op of Freeboard = op of Freeboard = values in the Inflo 25 Year 1.87 26.080 26.080 125.8 0.60 392.2 8.1 0.1 Outlet Plate 1	7.87 10.41 40.08 w Hydrographs tail 50 Year 2.30 33.878 188.7 0.90 509.2 132.1 0.7 Spilway	feet acres acre-ft ble (Columns W th 100 Year 2.79 43.453 272.4 1.29 653.8 342.0 1.3 Spilway	4.10 69.20 69.20 482. 2.20 1027 805. 5pilw
Time to Drain 99% of Inflow Volume (hours) = 40 60 54 59 65 77 77 75 Maximum Ponding Depth (ft) = 3.38 5.31 4.49 4.97 5.45 6.36 6.63 6.74 (6)	ser Input: Emergency Spilway (Rectangular Spilway Invert Stage Spilway Invert Stage Spilway Crest Length Spilway End Slopes Freeboard above Max Water Surface Outed Hydrograph Results Design Storm Return Period One-Hour Rainfall Depth (in) CUHP Runoff Volume (acre-ft) CUHP Predevelopment Peak Q (cfs) Prional Cuthon (acre-ft) Predevelopment Peak Q (cfs) Predevelopment Peak Q (cfs) Predevelopment Unit Peak Inflow Q (cfs) Ratio Peak Outflow to Predevelopment Q (cfs) Ratio Peak Outflow to Predevelopment Q (cfs) Ratio Peak Outflow to Predevelopment Q Structure Controlling Flow Max Velocity through Grate 1 (fps)	6.51 1000.00 4.00 1.00 The user can ove WQCV N/A 2.656 N/A N/A N/A N/A N/A N/A 1.0 N/A Overflow Weir 1 N/A	feet H:V feet Size Em Develope EURV N/A 14.210 N/A N/A N/A N/A N/A N/A N/A Outlet Plate 1 0.55	CUHP hydrographs 2 Year 0.85 8.937 1.6 0.01 126.1 7.2 N/A Outlet Plate 1 0.53	and runoff volume 5 Year 1.12 12.514 12.514 5.5 0.03 174.4 7.4 1.3 Outlet Plate 1 0.5	Stage at To Basin Area at To Basin Volume at To Is by entering new 10 Year 1.40 17.051 17.051 17.051 239.1 7.7 0.2 Outlet Plate 1	op of Freeboard = op of Freebo	7.87 10.41 40.08 w Hydrographs tall 50 Year 2.30 33.878 33.878 188.7 0.90 509.2 132.1 0.7 Spilway 0.6	feet acres acre-ft ble (Columns W th. 100 Year 2.79 43.453 43.453 272.4 1.29 653.8 342.0 1.3 Spillway 0.6	500 Y 6 4.16 69.29 69.29 482. 2.29 1027 805. 1.7 Spillwa 0.6
	ser Input: Emergency Spilway (Rectangular in Spilway). Spilway Invert Stage = Spilway Crest Length = Spilway Experience Spilway Experience Spilway Experience = Spilway Experienc	6.51 1000.00 4.00 1.00 1.00 The user can ove WQCV N/A 2.656 N/A N/A N/A N/A N/A 1.0 N/A Overflow Weir 1 N/A N/A	feet H:V feet Size Em Develope Fericle the default C EURV N/A 14.210 N/A N/A N/A N/A N/A N/A N/A N/A Outlet Plate 1 0.55 N/A	EUHP hydrographs 2 Year 0.85 8.937 8.937 1.6 0.01 126.1 7.2 N/A Outlet Plate 1 0.53 N/A	and runoff volume 5 Year 1.12 12.514 12.514 5.5 0.03 174.4 7.4 1.3 Outlet Plate 1 0.5 N/A	Stage at To Basin Area at To Basin Volume at To 10 Year 1.40 17.051 17.051 35.7 0.17 239.1 7.7 0.2 Outlet Plate 1 0.6 N/A	pp of Freeboard = pp of Freeboard = pp of Freeboard = pp of Freeboard = pp of Freeboard = 25 Year 1.87 26.080 26.080 125.8 0.60 392.2 8.1 0.1 Outlet Plate 1 0.6 N/A	7.87 10.41 40.08 w Hydrographs tai 50 Year 2.30 33.878 33.878 188.7 0.90 509.2 132.1 0.7 Spilway 0.6 N/A	feet acres acre-ft ble (Columns W th: 100 Year 2.79 43.453 43.453 272.4 1.29 653.8 342.0 1.3 Spillway 0.6 N/A	4.10 69.29 69.29 482. 2.29 1027 805. 1.7
Area at Maximum Ponding Depth (acres) = 3.11 9.51 6.33 8.09 9.78 10.01 10.08 10.11 1	ser Input: Emergency Spilway (Rectangular Spilway Invert Stage Spilway Invert Stage Spilway Protest Length Spilway Protest Length Spilway Forest Length Spilway End Slopes Freeboard above Max Water Surface Souted Hydrograph Results Design Storm Return Period One-Hour Rainfall Depth (in) CUHP Runoff Volume (acre-ft) CUHP Runoff Volume (acre-ft) CUHP Predevelopment Peak Q (cfs) Predevelopment Peak Q (cfs) Predevelopment Peak Production Q (cfs) Peak Inflow Q (cfs) Peak Unflow Q (cfs) Ratio Peak Outflow to Predevelopment Q Structure Controlling Flore Structure Controlling Flore Max Velocity through Grate 2 (fps) Max Velocity through Grate 2 (fps) Time to Drain 97% of Inflow Volume (hours) Time to Drain 97% of Inflow Volume (hours)	6.51 1000.00 4.00 1.00 1.00 The user can ove WQCV N/A 2.656 N/A N/A N/A N/A N/A N/A N/A N/A	feet H:V feet Size Em Develope EURV N/A 14.210 N/A N/A N/A N/A N/A N/A N/A N/A 0uttet Plate 1 0.55 N/A 54 60	CUHP hydrographs 2 Year 0.85 8.937 1.6 0.01 126.1 7.2 N/A Outlet Plate 1 0.53 N/A 50 54	and runoff volume 5 Year 1.12 12.514 12.514 5.5 0.03 174.4 7.4 1.3 Outlet Plate 1 0.5 N/A 53 59	Stage at To Basin Area at To Basin Volume at To Is by entering new 10 Year 1.40 17.051 17.051 35.7 0.17 239.1 7.7 0.2 Outlet Plate 1 0.6 N/A 58	pp of Freeboard = pp of Freeboard = pp of Freeboard = pp of Freeboard = pp of Freeboard = values in the Inflo 25 Year 1.87 26.080 26.080 26.080 125.8 0.60 392.2 8.1 0.1 Outlet Plate 1 0.6 N/A 67 77	7.87 10.41 40.08 w Hydrographs tau 50 Year 2.30 33.878 33.878 188.7 0.90 509.2 132.1 0.7 Spilway 0.6 N/A 66	feet acres acre-ft ble (Columns W th. 100 Year 2.79 43.453 43.453 272.4 1.29 653.8 342.0 1.3 Spillway 0.6 N/A 62 75	500 Y 4.1(69.29 69.29 482. 2.29 1027 805. 1.7 Spilwe 0.6



		DET	ENTION	N BASI	N STAGE-S	TORA	GE TAI	BLE BL	JILDEF	}				
					D-Detention, Version					_			Clear Work	book
Project:	Greeley Okla	ahoma Sout	th											
Basin ID:	DP 840, EUR	RV .												
ZONE 3	2 DNE 1		_											
100-YR VOLUME EURV WQCV														
± ±		100-YE	AR	\rightarrow	D	0.25								
ZONE : PERMANENT ORIFIC	1 AND 2	ORIFIC	E		Depth Increment =	0.25	ft Optional				Optional			
POOL Example Zone	Configura	tion (Rete	ntion Pond)		Stage - Storage Description	Stage (ft)	Override Stage (ft)	Length (ft)	Width (ft)	Area (ft ²)	Override Area (ft ²)	Area (acre)	Volume (ft ³)	Volume (ac-ft)
Watershed Information					Top of Micropool	0.00	Stage (It)	16.1	16.1	258	Alea (It)	0.006	(10)	(ac-rt)
Extended Detention Basin (EDB)	EDB				ISV	0.50		16.1	16.1	258		0.006	129	0.003
Watershed Area =	63.86	acres				0.75		16.1	16.1	258		0.006	193	0.004
Watershed Length =	3,575	ft				1.00		16.1	16.1	258		0.006	258	0.006
Watershed Length to Centroid =	1,789	ft				1.25		48.3	31.7	1,530		0.035	460	0.011
Watershed Slope =	0.023	ft/ft				1.50		80.6	47.3	3,810		0.087	1,107	0.025
Watershed Imperviousness =	76.73%	percent				1.75		112.8	62.9	7,098		0.163	2,449	0.056
Percentage Hydrologic Soil Group A = Percentage Hydrologic Soil Group B =	5.8% 76.8%	percent				2.00		145.1 177.3	78.6 94.2	11,394 16,698		0.262	4,740 8,231	0.109
Percentage Hydrologic Soil Groups C/D =	17.4%	percent				2.25		209.6	109.8	23,010		0.528	13,173	0.189
Target WQCV Drain Time =	40.0	hours				2.75		241.8	125.4	30,329		0.696	19,819	0.455
Location for 1-hr Rainfall Depths =				•		3.00		274.1	141.1	38,656		0.887	28,421	0.652
After providing required inputs above incl	luding 1-hour	rainfall	D. 01111			3.25		306.3	156.7	47,991		1.102	39,231	0.901
depths, click 'Run CUHP' to generate runo	off hydrograph	ns using	Run CUHF		Zone 1 (WQCV)	3.33		316.6	161.7	51,191		1.175	43,198	0.992
the embedded Colorado Urban Hydro			Optional User			3.50		338.6	172.3	58,334		1.339	52,501	1.205
Water Quality Capture Volume (WQCV) =	0.986	acre-feet	0.986	acre-feet		3.75		370.8	187.9	69,684		1.600	68,482	1.572
Excess Urban Runoff Volume (EURV) = 2-yr Runoff Volume (P1 = 0.85 in.) =	5.367 3.261	acre-feet acre-feet	0.85	acre-feet inches		4.00		403.1 435.3	203.6	82,043 95,409		1.883 2.190	87,427 109,587	2.007 2.516
5-yr Runoff Volume (P1 = 0.03 iii.) =	4.496	acre-feet	1.12	inches		4.50		467.6	234.8	109,783		2.520	135,215	3.104
10-yr Runoff Volume (P1 = 1.4 in.) =	5.952	acre-feet	1.40	inches		4.75		499.8	250.4	125,165		2.873	164,563	3.778
25-yr Runoff Volume (P1 = 1.87 in.) =	8.664	acre-feet	1.87	inches	Hoor	4.83		510.1	255.4	130,300		2.991	174,781	4.012
50-yr Runoff Volume (P1 = 2.3 in.) =	11.063	acre-feet	2.30	inches		5.00		511.5	256.8	131,343		3.015	197,020	4.523
100-yr Runoff Volume (P1 = 2.79 in.) =	13.930	acre-feet	2.79	inches		5.25		513.5	258.8	132,883		3.051	230,048	5.281
500-yr Runoff Volume (P1 = 4.16 in.) =	21.754	acre-feet	4.16	inches	Zone 2 (EURV)	5.28		513.7	259.0	133,069		3.055	234,038	5.373
Approximate 2-yr Detention Volume =	3.057	acre-feet				5.50		515.5	260.8	134,432		3.086	263,463	6.048
Approximate 5-yr Detention Volume =	4.250 5.588	acre-feet acre-feet				5.75 6.00		517.5 519.5	262.8 264.8	135,988 137,553		3.122	297,265 331,458	7.609
Approximate 10-yr Detention Volume = Approximate 25-yr Detention Volume =	7.033	acre-feet				6.25		521.5	266.8	139,125		3.194	366,042	8.403
Approximate 50-yr Detention Volume =	7.997	acre-feet			Zone 3 (100-year)	6.50		523.5	268.8	140,706		3.230	401,021	9.206
Approximate 100-yr Detention Volume =	9.192	acre-feet				6.75		525.5	270.8	142,295		3.267	436,396	10.018
L		,				7.00		527.5	272.8	143,891		3.303	472,169	10.840
Define Zones and Basin Geometry		_				7.25		529.5	274.8	145,496		3.340	508,342	11.670
Zone 1 Volume (WQCV) ▼	0.986	acre-feet				7.50		531.5	276.8	147,108		3.377	544,917	12.510
Zone 2 Volume (EURV - Zone 1)	4.381	acre-feet				7.75		533.5	278.8	148,729		3.414	581,897	13.359
Zone 3 Volume (100-year - Zones 1 & 2) Total Detention Basin Volume =	3.825 9.192	acre-feet acre-feet				8.00 8.25		535.5 537.5	280.8 282.8	150,357 151,994		3.452 3.489	619,282 657,076	14.217 15.084
Initial Surcharge Volume (ISV) =	129	ft 3				8.50		539.5	284.8	153,638		3.527	695,280	15.961
Initial Surcharge Depth (ISD) =	0.50	ft				8.75		541.5	286.8	155,291		3.565	733,896	16.848
Total Available Detention Depth (H _{total}) =	6.50	ft				9.00		543.5	288.8	156,951		3.603	772,926	17.744
Depth of Trickle Channel (H_{TC}) =	0.50	ft				9.25		545.5	290.8	158,620		3.641	812,372	18.650
Slope of Trickle Channel (S_{TC}) =	0.008	ft/ft				9.50		547.5	292.8	160,297		3.680	852,237	19.565
Slopes of Main Basin Sides (S _{main}) =	4	H:V				9.75		549.5	294.8	161,981		3.719	892,521	20.489
Basin Length-to-Width Ratio $(R_{L/W}) =$	2					10.00		551.5	296.8	163,674		3.757	933,228	21.424
	250	10.2				10.25		553.5	298.8	165,374		3.796	974,359	22.368
Initial Surcharge Area $(A_{ISV}) =$ Surcharge Volume Length $(L_{ISV}) =$	258 16.1	ft ²				10.50		555.5 557.5	300.8 302.8	167,083 168,799		3.836 3.875	1,015,916	23.322 24.286
Surcharge Volume Length (L _{ISV}) = Surcharge Volume Width (W _{ISV}) =	16.1	ft				11.00		559.5	304.8	170,524		3.915	1,100,316	25.260
Depth of Basin Floor (H _{FLOOR}) =	3.83	ft				11.25		561.5	306.8	172,256		3.954	1,143,163	26.243
Length of Basin Floor (L _{FLOOR}) =	510.1	ft				11.50		563.5	308.8	173,997		3.994	1,186,445	27.237
Width of Basin Floor (W _{FLOOR}) =	255.4	ft				11.75		565.5	310.8	175,745		4.035	1,230,162	28.241
Area of Basin Floor (A _{FLOOR}) =	130,300	ft ²				12.00		567.5	312.8	177,502		4.075	1,274,318	29.254
Volume of Basin Floor $(V_{FLOOR}) =$	174,076	ft ³				12.25		569.5	314.8	179,266		4.115	1,318,914	30.278
Depth of Main Basin (H _{MAIN}) =	1.67	ft				12.50		571.5	316.8	181,039		4.156	1,363,952	31.312
Length of Main Basin (L _{MAIN}) =	523.5	ft				12.75		573.5	318.8	182,820		4.197	1,409,434	32.356
Width of Main Basin (W _{MAIN}) =	268.8 140,706	ft ft ²				13.00		575.5 577.5	320.8 322.8	184,608 186,405		4.238 4.279	1,455,362 1,501,739	33.411 34.475
Area of Main Basin $(A_{MAIN}) = Volume of Main Basin (V_{MAIN}) = Volume of Main Basin (V_{MAIN})$	226,234	ft ³				13.25		579.5	324.8	188,209		4.279	1,548,565	35.550
Calculated Total Basin Volume (V _{total}) =	9.196	acre-feet				13.75		581.5	326.8	190,022		4.362	1,595,844	36.636
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	DET	ENTION E	BASIN OUT	LET STRE	ICTLIRE D	ESIGN			
		MH	HFD-Detention, V			LOIU			
	Greeley Oklahoma DP 840, EURV	South							
ZONE 3	J. 510/ 2011			Estimated	Estimated		Clear I	nput Parameters	
ZONE 1				Stage (ft)	Volume (ac-ft)	Outlet Type		uding Tables)	
VOLUME EURY WOCY			Zone 1 (WQCV)	3.33	0.986	Orifice Plate	Orifice Plate		_
ZONE 1 AND 2	100-YEAR ORIFICE		Zone 2 (EURV)		4.381	Weir&Pipe (Restrict)	Weir and Pipe (w/ Re	strictor Plate)	_
PERMANENT ORIFICES	Configuration (F		Zone 3 (100-year)		3.825	Not Utilized	Zone 3 Not Utilized		•
130		3)	a PMD)	Total (all zones)	9.192	l,	Calculated Parame	atom for Undorder	ain
<u>Jser Input: Orifice at Underdrain Outlet (typica</u> Underdrain Orifice Invert Depth =		_	। छा <u>न्।</u> । the filtration medi	a surface)	Underd	rain Orifice Area =	N/A	ft ²	dill
Underdrain Orifice Diameter =		inches				Orifice Centroid =	N/A	feet	
ser Input: Orifice Plate with one or more orifice			<u>ied to drain WQCV</u> in bottom at Stage			<u>P)</u> ce Area per Row =	1.840E-02	eters for Plate ft ²	
Depth at top of Zone using Orifice Plate =		,	in bottom at Stage in bottom at Stage			ptical Half-Width =	N/A	feet	
Orifice Plate: Orifice Vertical Spacing =		inches				ical Slot Centroid =	N/A	feet	
Orifice Plate: Orifice Area per Row =	2.65	sq. inches (diame	ter = 1-13/16 inch	es)	E	Elliptical Slot Area =	N/A	ft²	
	•			Siza Plata	to match				
ser Input: Stage and Total Area of Each Orif	ice Row (number	ed from lowest to l	highest)		rain Time				
Sample Stage and Total Area of Lacif Offi	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)	0.00	1.11	2.22						
Orifice Area (sq. inches)	2.65	2.65	2.65						
Г	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)	Row 9 (optional)	Row 10 (optional)	Row II (optional)	Row 12 (optional)	Row 13 (optional)	Row 14 (optional)	Row 15 (optional)	Row 16 (optional)	
Orifice Area (sq. inches)					2				
									- 151
ser Input: Vertical Orifice (Circular or Rectang	Not Selected	Not Selected	1				Not Selected	Not Selected	Onrice
Invert of Vertical Orifice =	N/A	N/A	ft (relative to basi	n bottom at Stage	= 0 ft) Ver	tical Orifice Area =	N/A	N/A	ft ²
Depth at top of Zone using Vertical Orifice =	N/A		ft (relative to basi			Orifice Centroid =	N/A	N/A	feet
Vertical Orifice Diameter =	N/A	N/A	inches						
ser Input: Overflow Weir (Dropbox with Flat	or Shood Grate a	nd Outlot Dina OP	Poetangular/Trans	azoidal Woir and N	Outlot Pipo)		Calculated Parame	otors for Overflow	, Moir
ser Input. Overnow Well (Diopbox With Hat V	Zone 2 Weir	Not Selected	Rectangular/ Frape	szoldai vveii ailu ivi	o Outlet Fipe)				V VVCII
Overflow Weir Front Edge Height, Ho =	3.33						/one / Weir	Not Selected	
	5.55	N/A	ft (relative to basin	bottom at Stage = 0	ft) Height of Grate	Upper Edge, H _t =	Zone 2 Weir 3.33	Not Selected N/A	feet
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		DET	ENTIO	n basi	N STAGE-S	STORA	GE TAI	BLE Bl	JILDEF	₹				
					D-Detention, Version	n 4.06 (Ju	uly 2022)						Clear Work	book
			Oklahoma Dr	ainage MP										
ZONE 3	Option 4, EU	RV 830												
ZONE	ONE 1													
VOLUME EURY WOCV														
ZONE	AND 2	100-YEA	AR E		Depth Increment =	0.50	ft							
PERMANENT ORIFIC	ES	tion (Reter	ntion Pond)		Stage - Storage	Stage	Optional Override	Length	Width	Area	Optional Override	Area	Volume	Volume
		,	,		Description	(ft)	Stage (ft)	(ft)	(ft)	(ft²)	Area (ft 2)	(acre)	(ft ³)	(ac-ft)
Watershed Information	EDB	•			Top of Micropool ISV	0.00		41.9 41.9	41.9	1,752		0.040	578	0.013
Extended Detention Basin (EDB) Watershed Area =	90.00	acres			154	0.50		41.9	41.9	1,752		0.040	876	0.020
Watershed Length =	2,406	ft				1.00		99.2	70.2	6,962		0.160	2,148	0.049
Watershed Length to Centroid =	1,738	ft				1.50		267.9	153.5	41,122		0.944	12,998	0.298
Watershed Slope =	0.031	ft/ft			Floor	1.55		284.7	161.9	46,084		1.058	15,177	0.348
Watershed Imperviousness = Percentage Hydrologic Soil Group A =	67.80%	percent				2.00		288.3	165.5 169.5	47,705 49,536		1.095	36,279 60,587	0.833
Percentage Hydrologic Soil Group B =	0.0%	percent				3.00		292.3	173.5	51,399		1.137	85,820	1.970
Percentage Hydrologic Soil Groups C/D =	100.0%	percent			Zone 1 (WQCV)	3.02		296.5	173.6	51,474		1.182	86,848	1.994
Target WQCV Drain Time =	40.0	hours				3.50		300.3	177.5	53,294		1.223	111,992	2.571
Location for 1-hr Rainfall Depths =	Denver - Capit	ol Building		~		4.00		304.3	181.5	55,221		1.268	139,119	3.194
After providing required inputs above inc depths, click 'Run CUHP' to generate rund			Run CUH	P		4.50 5.00		308.3 312.3	185.5 189.5	57,180 59,171		1.313	167,218 196,305	3.839 4.507
the embedded Colorado Urban Hydro			Optional Use	er Overrides		5.50		316.3	193.5	61,195		1.405	226,395	5.197
Water Quality Capture Volume (WQCV) =	1.991	acre-feet		acre-feet		6.00		320.3	197.5	63,250		1.452	257,505	5.911
Excess Urban Runoff Volume (EURV) =	5.915	acre-feet		acre-feet	Zone 2 (EURV)	6.01		320.4	197.5	63,291		1.453	258,137	5.926
2-yr Runoff Volume (P1 = 0.85 in.) =	4.073	acre-feet	0.85	inches		6.50		324.3	201.5	65,337		1.500	289,650	6.649
5-yr Runoff Volume (P1 = 1.12 in.) = 10-yr Runoff Volume (P1 = 1.4 in.) =	5.835 7.895	acre-feet acre-feet	1.12	inches		7.00		328.3 332.3	205.5	67,456 69,607		1.549	322,847 357,111	7.412 8.198
25-yr Runoff Volume (P1 = 1.87 in.) =	11.755	acre-feet	1.87	inches		8.00		336.3	213.5	71,790		1.648	392,459	9.010
50-yr Runoff Volume (P1 = 2.3 in.) =	15.181	acre-feet	2.30	inches		8.50		340.3	217.5	74,005		1.699	428,907	9.846
100-yr Runoff Volume (P1 = 2.79 in.) =	19.277	acre-feet	2.79	inches		9.00		344.3	221.5	76,253		1.751	466,470	10.709
500-yr Runoff Volume (P1 = 4.16 in.) = Approximate 2-yr Detention Volume =	30.442	acre-feet acre-feet	4.16	inches		9.50		348.3 352.3	225.5	78,532 80,843		1.803 1.856	505,165 545,007	11.597 12.512
Approximate 5-yr Detention Volume =	5.563	acre-feet				10.50		356.3	233.5	83,186		1.910	586,013	13.453
Approximate 10-yr Detention Volume =	6.823	acre-feet				11.00		360.3	237.5	85,561		1.964	628,198	14.421
Approximate 25-yr Detention Volume =	8.494	acre-feet				11.50		364.3	241.5	87,968		2.019	671,579	15.417
Approximate 50-yr Detention Volume =	9.547	acre-feet				12.00		368.3	245.5	90,407		2.075	716,172	16.441
Approximate 100-yr Detention Volume =	11.222	acre-feet				12.50 13.00		372.3 376.3	249.5 253.5	92,878 95,382		2.132	761,992 809,056	17.493 18.573
Define Zones and Basin Geometry						13.50		380.3	257.5	97,917		2.248	857,379	19.683
Zone 1 Volume (WQCV)	1.991	acre-feet				14.00		384.3	261.5	100,484		2.307	906,978	20.821
Zone 2 Volume (EURV - Zone 1)	3.924	acre-feet		ntion volume		14.50		388.3	265.5	103,083		2.366	957,868	21.990
Select Zone 3 Storage Volume (Optional) Total Detention Basin Volume =	5.915	acre-feet acre-feet	is less than volume.	100-year		15.00 15.50		392.3 396.3	269.5 273.5	105,714		2.427	1,010,066	23.188
Initial Surcharge Volume (ISV) =	578	ft ³				16.00		400.3	277.5	111,072		2.550	1,118,448	25.676
Initial Surcharge Depth (ISD) =	0.33	ft				16.50		404.3	281.5	113,799		2.612	1,174,665	26.967
Total Available Detention Depth (H_{total}) =	6.00	ft				17.00		408.3	285.5	116,559		2.676	1,232,253	28.289
Depth of Trickle Channel (H _{TC}) =	0.50	ft				17.50		412.3	289.5	119,350		2.740	1,291,229	29.643
Slope of Trickle Channel (S_{TC}) = Slopes of Main Basin Sides (S_{main}) =	0.003	ft/ft H:V				18.00 18.50		416.3 420.3	293.5 297.5	122,173 125,028		2.805	1,351,608	31.029 32.447
Basin Length-to-Width Ratio $(R_{L/W})$ =	2					19.00		424.3	301.5	127,915		2.937	1,476,641	33.899
						19.50		428.3	305.5	130,834		3.004	1,541,327	35.384
Initial Surcharge Area (A_{ISV}) =	1,752	ft²				20.00		432.3	309.5	133,785		3.071	1,607,481	36.903
Surcharge Volume Length (L _{ISV}) =	41.9	ft				20.50		436.3	313.5	136,768		3.140	1,675,118	38.455
Surcharge Volume Width (W_{ISV}) = Depth of Basin Floor (H_{FLOOR}) =	41.9 0.72	ft				21.00		440.3 444.3	317.5 321.5	139,784 142,831		3.209 3.279	1,744,255	40.043 41.665
Length of Basin Floor $(L_{FLOOR}) =$	284.7	ft				22.00		448.3	325.5	145,910		3.350	1,887,091	43.322
Width of Basin Floor (W_{FLOOR}) =	161.9	ft				22.50		452.3	329.5	149,021		3.421	1,960,822	45.014
Area of Basin Floor (A_{FLOOR}) =	46,084	ft²				23.00		456.3	333.5	152,164		3.493	2,036,117	46.743
Volume of Basin Floor (V _{FLOOR}) =	13,637 4.45	ft ³ ft				23.50 24.00		460.3 464.3	337.5 341.5	155,339 158,546		3.566 3.640	2,112,992	48.508 50.309
Depth of Main Basin (H_{MAIN}) = Length of Main Basin (L_{MAIN}) =	320.3	ft				24.00		468.3	341.5	161,785		3.714	2,191,462	52.147
Width of Main Basin (W _{MAIN}) =	197.5	ft				25.00		472.3	349.5	165,057		3.789	2,353,253	54.023
Area of Main Basin $(A_{MAIN}) =$	63,250	ft²				25.50		476.3	353.5	168,360		3.865	2,436,605	55.937
Volume of Main Basin (V _{MAIN}) =	242,262	ft ³				26.00		480.3	357.5	171,695		3.942	2,521,618	57.888
Calculated Total Basin Volume (V _{total}) =	5.908	acre-feet				26.50 27.00		484.3 488.3	361.5 365.5	175,062 178,461		4.019 4.097	2,608,305 2,696,685	59.878 61.907
						27.50		492.3	369.5	181,892		4.176	2,786,772	63.975
						28.00 28.50		496.3 500.3	373.5 377.5	185,355 188,851		4.255 4.335	2,878,583	66.083 68.231
						29.00 29.50		504.3 508.3	381.5 385.5	192,378 195,937		4.416 4.498	3,067,438 3,164,516	70.419 72.647
						30.00		512.3	389.5	199,528		4.581	3,263,381	74.917

	DET		BASIN OUT			ESIGN			
Project:	23.1447.001 Gree		HFD-Detention, Veninage MP	ersion 4.06 (July	2022)				
	Option 4, EURV 83								
ZONE 3 ZONE 2 ZONE 1				Estimated	Estimated			Input Parameters	
100.VB T				Stage (ft)	Volume (ac-ft)	Outlet Type	(Inci	luding Tables)	
VOLUME EURY WOCV			Zone 1 (WQCV)	3.02	1.991	Orifice Plate	Orifice Plate		
ZONE 1 AND 2	100-YEAR ORIFICE		Zone 2 (EURV)	6.01	3.924	Weir&Pipe (Restrict)	Weir and Pipe (w/ Re	strictor Plate)	▼
PERMANENT ORIFICES	a Configuration (Potention Bond)	Zone 3			Not Utilized	Zone 3 Not Utilized		▼
1001	e Configuration (I			Total (all zones)	5.915				
<u> ser Input: Orifice at Underdrain Outlet (typic</u> 			<u>n BMP)</u> the filtration media	a surface)	Undors	drain Orifice Area =		eters for Underdra Tft ²	<u>iin</u>
Underdrain Orlice Diameter =		inches	rthe mitration medic	a surrace)		n Orifice Centroid =	N/A N/A	feet	
oracidium office burneter =	Type	Inches			Oliceratur	TOTILCE CENTROL =	1971	Jicco	
lser Input: Orifice Plate with one or more ori	fices or Elliptical Slo	t Weir (typically us	ed to drain WQCV	and/or EURV in a	sedimentation BM	1P)	Calculated Param	eters for Plate	
Centroid of Lowest Orifice =		,	in bottom at Stage	•		ce Area per Row =	4.840E-02	ft ²	
Depth at top of Zone using Orifice Plate =		,	in bottom at Stage	= 0 ft		liptical Half-Width =	N/A	feet	
Orifice Plate: Orifice Vertical Spacing =		inches	octangular oponing	.)		tical Slot Centroid =	N/A	feet ft ²	
Orifice Plate: Orifice Area per Row =	6.97	sq. inches (use re	ectangular openings	5)		Elliptical Slot Area =	N/A	JIT.	
				Size Plate	to match				
ser Input: Stage and Total Area of Each Or	fice Row (number	ed from lowest to	highest)	WQCV D	rain Time				_
77	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)		1.01	2.01						
Orifice Area (sq. inches)	6.97	6.97	6.97						
	Pour O (outilized)	Row 10 (optional)	Pow 11 /out	Row 12 (optional)	Row 13 (optional)	Pow 14 (er#"	Dow 15 /art N	Pow 15 /ortion 15	1
Stage of Orifice Centroid (ft)	Row 9 (optional)	Kow 10 (optional)	Row 11 (optional)	Kow 12 (optional)	ROW 13 (optional)	Row 14 (optional)	Row 15 (optional)	Row 16 (optional)	1
Orifice Area (sq. inches)	,								1
		•							
ser Input: Vertical Orifice (Circular or Rectar			1					eters for Vertical C	<u>Orifice</u>
T	Not Selected	Not Selected	A full time to be at		0.60	+i1 O *i A	Not Selected	Not Selected	6.2
Invert of Vertical Orifice =		N/A	ft (relative to basi			rtical Orifice Area =	N/A	N/A	ft ²
Depth at top of Zone using Vertical Orifice = Vertical Orifice Diameter =		N/A N/A	ft (relative to basi inches	n bottom at Stage	e = 0 ft) Vertica	Il Orifice Centroid =	N/A	N/A	feet
Vertical Office Diameter =	IN/A	IN/A	linches						
ser Input: Overflow Weir (Dropbox with Flat	or Sloped Grate a	nd Outlet Pipe OR	Rectangular/Trape	zoidal Weir and N	o Outlet Pipe)		Calculated Param	eters for Overflow	Weir
	Zone 2 Weir	Not Selected					Zone 2 Weir	Not Selected	
Overflow Weir Front Edge Height, Ho =		N/A	ft (relative to basin	bottom at Stage = 0	ft) Height of Grate	Upper Edge, H _t =	6.35	N/A	feet
Overflow Weir Front Edge Length =		N/A	feet	7990		/eir Slope Length =	10.54	N/A	feet
Overflow Weir Grate Slope =		N/A	H:V		trans and the second se	0-yr Orifice Area =	12272.31	N/A	6.2
Horiz. Length of Weir Sides = Overflow Grate Type =		N/A ▼	feet		and the same of th	Area w/o Debris = n Area w/ Debris =	5869.19 2934.59	N/A N/A	ft ² ft ²
Debris Clogging % =		N/A	%	Ov	errow drate Oper	IT ATEA WY DEDIS -	2934.39	IN/A	JIC.
bebib ebgging 70 =	3070	19/7	/*	,	•				
ser Input: Outlet Pipe w/ Flow Restriction Pla	te (Circular Orifice,	Restrictor Plate, o	r Rectangular Orific	ce)	Ca	kulated Parameters	for Outlet Pipe w	/ Flow Restriction F	Plate
	Zone 2 Restrictor	Not Selected					Zone 2 Restrictor	Not Selected	
Depth to Invert of Outlet Pipe =		N/A	ft (distance below b	asin bottom at Stage	if a mar	utlet Orifice Area =	0.48	N/A	ft ²
Outlet Pipe Diameter =		N/A	inches			t Orifice Centroid =	0.29	N/A	feet
Restrictor Plate Height Above Pipe Invert =	6.00		inches	Half-Centr	al Angle of Restric	tor Plate on Pipe =	1.32	N/A	radians
ser Input: Emergency Spillway (Rectangular	or Transzoidal)	15					Calculated Param	eters for Spillupy	
Spillway Invert Stage=		ft (relative to bas	in bottom at Stage	= 0 ft	Spillway D	esign Flow Depth=	0.98	feet	
Spillway Crest Length =	the state of the s	feet	in bottom at stage	- 010	and the same	op of Freeboard =	8.08	feet	
Spillway End Slopes =		LI-V Size Em	ergency Spillway to pa		and the second of the second of	op of Freeboard =	1.66	acres	
Freeboard above Max Water Surface =		feet Develope	d 100-yr Peak Runoff	Rate		op of Freeboard =	9.14	acre-ft	
								•	
outed Hydrograph Docults	The user can su	arride the defear	TIHD bydragrant	and runoff waker	e hu entarina n	v values in the Inflo	w Hydrographa +	the (Calimna III 4	arough A
outed Hydrograph Results Design Storm Return Period =		EURV	2 Year	5 Year	10 Year	25 Year	<i>W Hydrographs ta</i> 50 Year	100 Year	500 Y
One-Hour Rainfall Depth (in) =	N/A	N/A	0.85	1.12	1.40	1.87	2.30	2.79	4.1
CUHP Runoff Volume (acre-ft) =	1.991	5.915	4.073	5.835	7.895	11.755	15.181	19.277	30.4
Inflow Hydrograph Volume (acre-ft) =		N/A	4.073	5.835	7.895	11.755	15.181	19.277	30.4
CUHP Predevelopment Peak Q (cfs) = PTIONAL Override Predevelopment Peak Q (cfs) =		N/A N/A	1.0	10.6	29.5	76.5	111.1	155.2	266
Predevelopment Unit Peak Flow, q (cfs/acre) =	N/A	N/A	0.01	0.12	0.33	0.85	1.23	1.72	2.9
Peak Inflow Q (cfs) =	N/A	N/A	72.5	103.5	139.7	214.5	275.9	352.0	546
Peak Outflow Q (cfs) = Ratio Peak Outflow to Predevelopment Q =		6.6 N/A	5.8 N/A	6.3 0.6	21.4 0.7	114.7	194.4 1.7	298.5 1.9	552 2.1
	Overflow Weir 1	Outlet Plate 1	Outlet Plate 1	Outlet Plate 1	Spillway	Spillway	Spillway	Spillway	Spilly
Sylicture Controlling Flow =		0.00	0.00	0.0	0.0	0.0	0.0	0.0	0.0
Max Velocity through Grate 1 (fps) =		1 41/4	NI/A	N/A	N/A	N/A	N/A	N/A	N/A
Max Velocity through Grate 1 (fps) = $Max Velocity through Grate 2 (fps) = $		N/A	N/A						
Max Velocity through Grate 1 (fps) = Max Velocity through Grate 2 (fps) = Time to Drain 97% of Inflow Volume (hours) =	38	42	41	43	43	40	37	34	
Max Velocity through Grate 1 (fps) = Max Velocity through Grate 2 (fps) = Time to Drain 97% of Inflow Volume (hours) = Time to Drain 99% of Inflow Volume (hours) =	38	42 46	41 44	43 47	43 48	40 47	37 46	34 44	41
Max Velocity through Grate 1 (fps) = Max Velocity through Grate 2 (fps) = Time to Drain 97% of Inflow Volume (hours) =	38 40 3.02	42	41	43	43	40	37	34	27 41 7.4 1.5



				MUET	D-Detention, Versio		The same of the sa		JILDEF	•			01	
Project:	23.1447.00	1 Greelev -	Oklahoma Dr		o-Detention, versio	111 4 .00 (30	IIY 2022)					_	Clear Work	book
	Option 4, El													
ZONE 3	2 ONE 1													
O-YR EURY WQCV				_										
		100-YE	AR	\rightarrow	[1.							
ZONE ORIFIC	1 AND 2	ORIFIC	Œ		Depth Increment =	0.50	ft Optional				Optional			
POOL Example Zone	Configura	ition (Rete	ntion Pond)		Stage - Storage Description	Stage (ft)	Override Stage (ft)	Length (ft)	Width (ft)	Area (ft 2)	Override Area (ft ²)	Area (acre)	Volume (ft ³)	Volur (ac-
atershed Information					Top of Micropool	0.00	Stage (II)	41.9	41.9	1,752	Area (It.)	0.040	(10)	(ac-
xtended Detention Basin (EDB)	EDB	1			ISV	0.33		41.9	41.9	1,752		0.040	578	0.01
Watershed Area =	126.50	acres				0.50		41.9	41.9	1,752		0.040	876	0.02
Watershed Length =	2,939	ft				1.00		99.2	70.2	6,962		0.160	2,148	0.04
Watershed Length to Centroid =	1,428	ft				1.50		267.9	153.5	41,122		0.944	12,998	0.29
Watershed Slope =	0.031	ft/ft			Floor	1.84		382.6	210.2	80,408		1.846	33,290	0.76
Watershed Imperviousness =	76.20%	percent				2.00		383.8 387.8	211.5	81,168 83,565		1.863	46,216 87,398	2.00
Percentage Hydrologic Soil Group A = Percentage Hydrologic Soil Group B =	0.0%	percent				3.00		391.8	219.5	85,994		1.974	129,786	2.97
Percentage Hydrologic Soil Groups C/D =	100.0%	percent			Zone 1 (WQCV)	3.13		392.9	220.5	86,631		1.989	141,007	3.23
Target WQCV Drain Time =	40.0	hours			,	3.50		395.8	223.5	88,456		2.031	173,398	3.98
Location for 1-hr Rainfall Depths =	Denver - Capit	ol Building		~		4.00		399.8	227.5	90,949		2.088	218,247	5.01
After providing required inputs above inc			Run CUH	p		4.50		403.8	231.5	93,474		2.146	264,352	6.06
depths, dick 'Run CUHP' to generate rund the embedded Colorado Urban Hydro	off hydrograph	ns using		30 000		5.00		407.8	235.5	96,031		2.205	311,727	7.15
		-	Optional Use	■		5.50		411.8	239.5	98,621		2.264	360,388	8.27
Water Quality Capture Volume (WQCV) = Excess Urban Runoff Volume (EURV) =	3.226 9.432	acre-feet acre-feet		acre-feet acre-feet	Zone 2 (EURV)	6.00		415.8 415.9	243.5 243.5	101,242 101,294		2.324	410,353 411,365	9.42
2-yr Runoff Volume (P1 = 0.85 in.) =	6.396	acre-feet	0.85	inches	ZORE Z (LURV)	6.50		419.8	247.5	101,294		2.325	461,636	10.59
5-yr Runoff Volume (P1 = 1.12 in.) =	9.013	acre-feet	1.12	inches		7.00		423.8	251.5	106,580		2.447	514,253	11.80
10-yr Runoff Volume (P1 = 1.4 in.) =	11.961	acre-feet	1.40	inches		7.50		427.8	255.5	109,297		2.509	568,221	13.0
25-yr Runoff Volume (P1 = 1.87 in.) =	17.299	acre-feet	1.87	inches		8.00		431.8	259.5	112,047		2.572	623,556	14.3
50-yr Runoff Volume (P1 = 2.3 in.) =	22.084	acre-feet	2.30	inches		8.50		435.8	263.5	114,828		2.636	680,273	15.6
100-yr Runoff Volume (P1 = 2.79 in.) =	27.727	acre-feet	2.79	inches		9.00		439.8	267.5	117,641		2.701	738,389	16.9
500-yr Runoff Volume (P1 = 4.16 in.) =	43.218	acre-feet	4.16	inches		9.50		443.8	271.5	120,486		2.766	797,919	18.3
Approximate 2-yr Detention Volume =	6.083	acre-feet				10.00		447.8	275.5	123,363		2.832	858,880	19.7
Approximate 5-yr Detention Volume =	8.736	acre-feet				10.50		451.8	279.5	126,273		2.899	921,288	21.1
Approximate 10-yr Detention Volume = Approximate 25-yr Detention Volume =	10.760	acre-feet acre-feet				11.00		455.8 459.8	283.5 287.5	129,214 132,187		2.966 3.035	985,158 1,050,507	22.6
Approximate 50-yr Detention Volume =	14.954	acre-feet				12.00		463.8	291.5	135,192		3.104	1,117,350	25.6
Approximate 100-yr Detention Volume =	17.253	acre-feet				12.50		467.8	295.5	138,229		3.173	1,117,330	27.2
Approximate 200 yr Determine Volume	271200	_ aaro noot				13.00		471.8	299.5	141,299		3.244	1,255,585	28.8
efine Zones and Basin Geometry						13.50		475.8	303.5	144,400		3.315	1,327,009	30.4
Zone 1 Volume (WQCV)	3.226	acre-feet				14.00		479.8	307.5	147,533		3.387	1,399,990	32.13
Zone 2 Volume (EURV - Zone 1)	6.206	acre-feet	Total deter	ntion volume		14.50		483.8	311.5	150,698		3.460	1,474,547	33.85
Select Zone 3 Storage Volume (Optional)		acre-feet	is less than	100-year		15.00		487.8	315.5	153,895		3.533	1,550,694	35.59
Total Detention Basin Volume =	9.432	acre-feet	volume.			15.50		491.8	319.5	157,125		3.607	1,628,448	37.38
Initial Surcharge Volume (ISV) =	578	ft ³				16.00		495.8	323.5	160,386		3.682	1,707,824	39.2
Initial Surcharge Depth (ISD) =	0.33 6.00	ft ft				16.50 17.00		499.8 503.8	327.5 331.5	163,679 167,004		3.758 3.834	1,788,839 1,871,508	41.0
Total Available Detention Depth $(H_{total}) =$ Depth of Trickle Channel $(H_{TC}) =$	0.50	ft.				17.50		503.8	331.5	170,362		3.834	1,955,849	44.9
Slope of Trickle Channel (S_{TC}) =	0.003	ft/ft				18.00		511.8	339.5	173,751		3.989	2,041,875	46.8
Slopes of Main Basin Sides (S _{main}) =	4	H:V				18.50		515.8	343.5	177,172		4.067	2,129,605	48.88
Basin Length-to-Width Ratio (R _{L/W}) =	2					19.00		519.8	347.5	180,625		4.147	2,219,053	50.9
		_				19.50		523.8	351.5	184,110		4.227	2,310,235	53.0
Initial Surcharge Area (A_{ISV}) =	1,752	ft ²				20.00		527.8	355.5	187,628		4.307	2,403,168	55.1
Surcharge Volume Length $(L_{ISV}) =$	41.9	ft				20.50		531.8	359.5	191,177		4.389	2,497,868	57.3
Surcharge Volume Width (W _{ISV}) =	41.9	ft				21.00		535.8	363.5	194,758		4.471	2,594,350	59.5
Depth of Basin Floor (H _{FLOOR}) =	1.01	ft				21.50		539.8	367.5	198,371		4.554	2,692,631	61.8
Length of Basin Floor (L _{FLOOR}) =	382.6	ft				22.00		543.8	371.5	202,016		4.638	2,792,727	64.1
Width of Basin Floor (W_{FLOOR}) = Area of Basin Floor (A_{FLOOR}) =	210.2 80,408	ft 2				22.50		547.8 551.8	375.5 379.5	205,694		4.722 4.807	2,894,653 2,998,426	66.4
Volume of Basin Floor (V _{FLOOR}) =	31,656	ft ³				23.50		555.8	383.5	213,144		4.893	3,104,061	71.2
Depth of Main Basin (H _{MAIN}) =	4.16	ft				24.00		559.8	387.5	216,917		4.980	3,211,575	73.7
Length of Main Basin (L _{MAIN}) =	415.8	ft				24.50		563.8	391.5	220,722		5.067	3,320,984	76.2
Width of Main Basin (W _{MAIN}) =	243.5	ft				25.00		567.8	395.5	224,560		5.155	3,432,303	78.7
Area of Main Basin $(A_{MAIN}) =$	101,242	ft²				25.50		571.8	399.5	228,429		5.244	3,545,549	81.3
Volume of Main Basin $(V_{MAIN}) =$	377,000	ft ³				26.00		575.8	403.5	232,330		5.334	3,660,737	84.0
Calculated Total Basin Volume $(V_{total}) =$	9.415	acre-feet				26.50		579.8	407.5	236,263		5.424	3,777,884	86.7
						27.00 27.50		583.8 587.8	411.5 415.5	240,228 244,226		5.515 5.607	3,897,006 4,018,118	89.4 92.2
						28.00		591.8	419.5	248,255		5.699	4,141,237	95.0
						28.50		595.8	423.5	252,316		5.792	4,266,378 4,393,558	97.9
						29.00		599.8	427.5	256,409		5.886		

	DET	ENTION E	BASIN OUT	I FT STRI	ICTURE D	FSIGN			
Project:	23.1447.001 Gree		HFD-Detention, Ve			LJION			
	Option 4, EURV 84	4							-1
ZONE 3				Estimated	Estimated			Input Parameters	
100-YR				Stage (ft)	Volume (ac-ft)	Outlet Type		luding Tables)	
VOLUME EURY WOCV			Zone 1 (WQCV)	3.13	3.226	Orifice Plate	Orifice Plate		
ZONE 1 AND 2	100-YEAR ORIFICE		Zone 2 (EURV)	6.01	6.206	Weir&Pipe (Restrict)	Weir and Pipe (w/ Re	estrictor Plate)	~
PERMANENT—ORIFICES	C C		Zone 3			Not Utilized	Zone 3 Not Utilized		•
Example Zone	Configuration (Retention Pond)		Total (all zones)	9.432				
Jser Input: Orifice at Underdrain Outlet (typic								eters for Underdra	<u>in</u>
Underdrain Orifice Invert Depth =	N/A	,	the filtration media	a surface)		drain Orifice Area =	N/A	ft ²	
Underdrain Orifice Diameter =	N/A	inches			Underdrair	n Orifice Centroid =	N/A	feet	
Jser Input: Orifice Plate with one or more ori	ices or Elliptical Slo	t Weir (typically us	ed to drain WOCV	and/or EURV in a	sedimentation BM	1P)	Calculated Param	eters for Plate	
Centroid of Lowest Orifice =	0.00	ft (relative to bas	in bottom at Stage	= 0 ft)	WQ Orifi	ice Area per Row =	8.056E-02	ft ²	
Depth at top of Zone using Orifice Plate =	3.63	ft (relative to bas	in bottom at Stage	= 0 ft)	E	lliptical Half-Width =	N/A	feet	
Orifice Plate: Orifice Vertical Spacing =	14.50	inches			Ellipt	tical Slot Centroid =	N/A	feet	
Orifice Plate: Orifice Area per Row =	11.60	sq. inches (use re	ectangular openings	5)		Elliptical Slot Area =	N/A	_ft²	
				Cin o Diote	to match				
lear Inputs Chago and Tatal Assa of Facts Of	Fice Day (ad from keeps to	highost)		rain Time				
lser Input: Stage and Total Area of Each Or	Row 1 (required)	Row 2 (optional)	Row 3 (optional)	Row 4 (optional)	Row 5 (optional)	Row 6 (optional)	Row 7 (optional)	Row 8 (optional)	1
Stage of Orifice Centroid (ft)	0.00	1.21	2.42	NOW T (Optional)	NOW 5 (optional)	Now o (opuonal)	NOW / (Opublial)	NOW 0 (Optional)	1
Orifice Area (sq. inches)	11.60	11.60	11.60			•			1
55 , 1.51 (54, 116165)									-
	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)]
Orifice Area (sq. inches)									
ser Input: Vertical Orifice (Circular or Rectan	aubr)						Calculated Param	eters for Vertical C	rifico
sei Iriput. Vertical Office (Circular di Rectali	Not Selected	Not Selected	1				Not Selected	Not Selected	7
Invert of Vertical Orifice =	N/A	N/A	ft (relative to basi	n bottom at Stage	e = 0 ft) Ve	rtical Orifice Area =	N/A	N/A	ft ²
Depth at top of Zone using Vertical Orifice =	N/A	N/A	ft (relative to basi	THE RESERVE TO SECURE A SECURE ASSESSMENT AS		al Orifice Centroid =	N/A	N/A	feet
Vertical Orifice Diameter =	N/A	N/A	inches	3				,	
			(•			
lser Input: Overflow Weir (Dropbox with Flat			Rectangular/Trape	zoidal Weir and N	o Outlet Pipe)		Calculated Param	eters for Overflow	Weir
	Zone 2 Weir	Not Selected					Zone 2 Weir	Not Selected	
Overflow Weir Front Edge Height, Ho =	3.13	N/A		bottom at Stage = 0	-	e Upper Edge, H _t =	6.46	N/A	feet
Overflow Weir Front Edge Length = Overflow Weir Grate Slope =	800.00 3.00	N/A N/A	feet H:V	Grat		Veir Slope Length = 00-yr Orifice Area =	10.54 11382.38	N/A N/A	reet
Horiz. Length of Weir Sides =	10.00	N/A	feet		the state of the s	Area w/o Debris =	5869.19	N/A	ft ²
Overflow Grate Type =		N/A 🔻			and the same of th	n Area w/ Debris =	2934.59	N/A	ft ²
Debris Clogging % =	50%	N/A	%						
					•				
ser Input: Outlet Pipe w/ Flow Restriction Pla			r Rectangular Orific	ce)	Ca	kulated Parameters		T	Plate
	Zone 2 Restrictor	Not Selected		8			Zone 2 Restrictor		1
Depth to Invert of Outlet Pipe =	3.00	N/A	ft (distance below b	asin bottom at Stage		utlet Orifice Area =	0.52	N/A	ft ²
Outlet Pipe Diameter =	18.00 6.00	N/A	inches inches	Half Cambr		t Orifice Centroid =	0.29 1.23	N/A	feet
Restrictor Plate Height Above Pipe Invert =	6.00	I	inches	naii-centr	al Angle of Result	ctor Plate on Pipe =	1.23	N/A	radians
ser Input: Emergency Spilway (Rectangular	or Trapezoidal)		•				Calculated Param	eters for Spillway	
Spillway Invert Stage=	6.10	ft (relative to bas	in bottom at Stage	= 0 ft	Spillwav D	Design Flow Depth=	0.98	feet	
Spillway Crest Length =	183.00	feet				op of Freeboard =	8.08	feet	
Spillway End Slopes =	4.00	H-V/ Size Em	ergency Spillway to pa d 100-yr Peak Runoff I		AND THE PARTY OF T	op of Freeboard =	2.58	acres	
Freeboard above Max Water Surface =	1.00	feet Develope	a 100-yi reak Kunoff I	IBIC	Basin Volume at T	op of Freeboard =	14.52	acre-ft	
outed Hydrograph Results	The user can our	erride the default (TIHP hydrographs	and runoff volume	es hy entering nov	w values in the Inflo	w Hydrographe to	the (Columns III) H	rough AF
Design Storm Return Period =	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Ye
One-Hour Rainfall Depth (in) =		N/A	0.85	1.12	1.40	1.87	2.30	2.79	4.16
		0.400	6.396	9.013	11.961	17.299	22.084	27.727	43.21
CUHP Runoff Volume (acre-ft) =	3.226	9.432				17.299	22.084	27.727	43.21
CUHP Runoff Volume (acre-ft) = Inflow Hydrograph Volume (acre-ft) =	3.226 N/A	N/A	6.396	9.013	11.961			241 0	412.1
CUHP Runoff Volume (acre-ft) = Inflow Hydrograph Volume (acre-ft) = CUHP Predevelopment Peak Q (cfs) =	3.226 N/A N/A	N/A N/A		9.013	11.961 46.2	119.1	172.4	241.0	
CUHP Runoff Volume (acre-ft) = Inflow Hydrograph Volume (acre-ft) = CUHP Predevelopment Peak Q (cfs) =	3.226 N/A N/A N/A	N/A	6.396					241.0 1.90	3.26
CUHP Runoff Volume (acre-ft) = Inflow Hydrograph Volume (acre-ft) = CUHP Predevelopment Peak Q (cfs) = PTIONAL Override Predevelopment Peak Q (cfs) = Predevelopment Unit Peak Flow, q (cfs/acre) = Peak Inflow Q (cfs) =	3.226 N/A N/A N/A N/A N/A	N/A N/A N/A N/A N/A	6.396 1.6 0.01 126.7	0.13 175.8	0.36 229.8	0.94 339.1	172.4 1.36 430.4	1.90 547.8	840.3
CUHP Runoff Volume (acre-ft) Inflow Hydrograph Volume (acre-ft) CUHP Predevelopment Peak Q (cfs) = PTIONAL Override Predevelopment Peak Q (cfs) = Predevelopment Unit Peak Flow, q (cfs/acre) = Peak Inflow Q (cfs) = Peak Outflow Q (cfs) =	3.226 N/A N/A N/A N/A N/A 1.5	N/A N/A N/A N/A N/A 7.3	6.396 1.6 0.01 126.7 6.5	0.13 175.8 7.1	0.36 229.8 28.9	0.94 339.1 156.4	1.36 430.4 272.4	1.90 547.8 435.5	840.3 823.8
CUHP Runoff Volume (acre-ft) = Inflow Hydrograph Volume (acre-ft) = CUHP Predevelopment Peak Q (cfs) = OPTIONAL Override Predevelopment Peak Q (cfs) = Predevelopment Unit Peak Flow, q (cfs/acre) = Peak Inflow Q (cfs) = Peak Outflow Q (cfs) = Ratio Peak Outflow to Predevelopment Q =	3.226 N/A N/A N/A N/A N/A N/A 1.5	N/A N/A N/A N/A N/A 7.3	6.396 1.6 0.01 126.7 6.5 N/A	0.13 175.8 7.1 0.4	0.36 229.8 28.9 0.6	0.94 339.1 156.4 1.3	172.4 1.36 430.4 272.4 1.6	1.90 547.8 435.5 1.8	840.3 823.8 2.0
CUHP Runoff Volume (acre-ft) = Inflow Hydrograph Volume (acre-ft) = CUHP Predevelopment Peak Q (cfs) = Predevelopment Peak Q (cfs) = Predevelopment Unit Peak Flow, q (cfs/acre) = Peak Inflow Q (cfs) = Peak Outflow Q (cfs) =	3.226 N/A N/A N/A N/A N/A N/A 1.5	N/A N/A N/A N/A N/A 7.3	6.396 1.6 0.01 126.7 6.5	0.13 175.8 7.1	0.36 229.8 28.9	0.94 339.1 156.4	1.36 430.4 272.4	1.90 547.8 435.5	840.3 823.8 2.0
CUHP Runoff Volume (acre-ft) Inflow Hydrograph Volume (acre-ft) CUHP Predevelopment Peak Q (cfs) = OPTIONAL Override Predevelopment Peak Q (cfs) = Predevelopment Unit Peak Flow, q (cfs/acre) = Peak Inflow Q (cfs) = Peak Outflow Q (cfs) = Ratio Peak Outflow to Predevelopment Q = Structure Controlling Flow = Max Velocity through Graet 1 (fps) = Max Velocity through Graet 2 (fps) =	3.226 N/A N/A N/A N/A N/A 1.5 N/A Overflow Weir 1 N/A N/A	N/A N/A N/A N/A N/A 7.3 N/A Outlet Plate 1 0.00 N/A	6.396 1.6 0.01 126.7 6.5 N/A Outlet Plate 1 0.00 N/A	16.9 0.13 175.8 7.1 0.4 Outlet Plate 1 0.0 N/A	46.2 0.36 229.8 28.9 0.6 Spillway 0.0 N/A	0.94 339.1 156.4 1.3 Spillway 0.0 N/A	172.4 1.36 430.4 272.4 1.6 Spilway 0.0 N/A	1.90 547.8 435.5 1.8 Spillway 0.0 N/A	840.3 823.8 2.0 Spilwar 0.0 N/A
CUHP Runoff Volume (acre-ft) Inflow hydrograph Volume (acre-ft) CUHP Predevelopment Peak Q (cfs) CUHP Predevelopment Peak Q (cfs) Predevelopment Peak Q (cfs) Predevelopment Unit Peak Flow, q (cfs/acre) Peak Inflow Q (cfs) Peak Outflow Q (cfs) Ratio Peak Outflow to Predevelopment Q Structure Controlling Flow Max Velocity through Grate 1 (fps) Max Velocity through Grate 2 (fps) Time to Drain 97% of Inflow Volume (hours)	3.226 N/A N/A N/A N/A N/A 1.5 N/A Overflow Weir 1 N/A N/A 38	N/A N/A N/A N/A N/A 7.3 N/A Outlet Plate 1 0.00 N/A 46	6.396 1.6 0.01 126.7 6.5 N/A Outlet Plate 1 0.00 N/A 43	16.9 0.13 175.8 7.1 0.4 Outlet Plate 1 0.0 N/A 46	46.2 0.36 229.8 28.9 0.6 Spillway 0.0 N/A 47	119.1 0.94 339.1 156.4 1.3 Spillway 0.0 N/A 45	172.4 1.36 430.4 272.4 1.6 Spilway 0.0 N/A 42	1.90 547.8 435.5 1.8 Spillway 0.0 N/A 40	840.3 823.8 2.0 Spillway 0.0 N/A 34
CUHP Runoff Volume (acre-ft) = Inflow Hydrograph Volume (acre-ft) = CUHP Predevelopment Peak Q (cfs) = CUHP Predevelopment Peak Q (cfs) = Predevelopment Unit Peak Flow, q (cfs/acre) = Peak Inflow Q (cfs) = Peak Outflow Q (cfs) = Ratio Peak Outflow to Predevelopment Q = Structure Controlling Flow = Max Velocity through Grate 1 (fps) = Max Velocity through Grate 2 (fps) = Time to Drain 99% of Inflow Volume (hours) = Time to Drain 99% of Inflow Volume (hours) =	3.226 N/A N/A N/A N/A 1.5 N/A Overflow Weir 1 N/A N/A 38 40	N/A N/A N/A N/A N/A 7.3 N/A Outlet Plate 1 0.00 N/A 46	6.396 1.6 0.01 126.7 6.5 N/A Outlet Plate 1 0.00 N/A 43	16.9 0.13 175.8 7.1 0.4 Outlet Plate 1 0.0 N/A 46 50	46.2 0.36 229.8 28.9 0.6 Spillway 0.0 N/A 47 52	119.1 0.94 339.1 156.4 1.3 Spilway 0.0 N/A 45 51	172.4 1.36 430.4 272.4 1.6 Spillway 0.0 N/A 42 50	1.90 547.8 435.5 1.8 Spillway 0.0 N/A 40	840.3 823.8 2.0 Spilway 0.0 N/A 34 46
CUHP Runoff Volume (acre-ft) Inflow hydrograph Volume (acre-ft) CUHP Predevelopment Peak Q (cfs) CUHP Predevelopment Peak Q (cfs) Predevelopment Peak Q (cfs) Predevelopment Unit Peak Flow, q (cfs/acre) Peak Inflow Q (cfs) Peak Outflow Q (cfs) Ratio Peak Outflow to Predevelopment Q Structure Controlling Flow Max Velocity through Grate 1 (fps) Max Velocity through Grate 2 (fps) Time to Drain 97% of Inflow Volume (hours)	3.226 N/A N/A N/A N/A N/A N/A 1.5 N/A Overflow Weir 1 N/A N/A 38 40 3.13	N/A N/A N/A N/A N/A 7.3 N/A Outlet Plate 1 0.00 N/A 46	6.396 1.6 0.01 126.7 6.5 N/A Outlet Plate 1 0.00 N/A 43	16.9 0.13 175.8 7.1 0.4 Outlet Plate 1 0.0 N/A 46	46.2 0.36 229.8 28.9 0.6 Spillway 0.0 N/A 47	119.1 0.94 339.1 156.4 1.3 Spillway 0.0 N/A 45	172.4 1.36 430.4 272.4 1.6 Spilway 0.0 N/A 42	1.90 547.8 435.5 1.8 Spillway 0.0 N/A 40	840.3 823.8 2.0 Spillway 0.0 N/A 34



		DET	ENTIO	N BAS	IN STAGE-S	TORA	GE I A	RLF R	JILDE	(
					D-Detention, Version	on 4.06 (Ju	ıly 2022)						Clear Work	book
	23.1447.001			rainage MP										
ZONE 3	Option 4, Flo	od Control	/11											
·mve T	ONE 1	1												
VOLUME EURY WQCV					,		-							
ZONE	1 AND 2	100-YEA	AR E		Depth Increment =	0.50	ft							
PERMANENT ORIFI		tion (Rete	ntion Pond)		Stage - Storage	Stage	Optional Override	Length	Width	Area	Optional Override	Area	Volume	Volum
			man mone		Description	(ft)	Stage (ft)	(ft)	(ft)	(ft ²)	Area (ft 2)	(acre)	(ft 3)	(ac-fi
/atershed Information	No BMP	troi Only			Media Surface	0.00		271.7 275.7	135.9 139.9	36,922 38,568		0.848	18,871	0.433
Flood Control Only Watershed Area =	90.00	acres				1.00		279.7	143.9	40,247		0.924	38,574	0.433
Watershed Length =	3,900	ft				1.50		283.7	147.9	41,957		0.963	59,123	1.357
Watershed Length to Centroid =	1,738	ft				2.00		287.7	151.9	43,700		1.003	80,536	1.84
Watershed Slope =	0.031	ft/ft				2.50		291.7	155.9	45,474		1.044	102,828	2.36
Watershed Imperviousness =	30.20%	percent				3.00		295.7	159.9	47,280		1.085	126,015	2.893
Percentage Hydrologic Soil Group A = Percentage Hydrologic Soil Group B =	0.0%	percent				3.50 4.00		299.7 303.7	163.9 167.9	49,119 50,989		1.128	150,114 175,139	3.446 4.021
Percentage Hydrologic Soil Groups C/D =	100.0%	percent				4.50		307.7	171.9	52,892		1.214	201,108	4.617
Target WQCV Drain Time =	N/A	hours				5.00		311.7	175.9	54,826		1.259	228,036	5.235
Location for 1-hr Rainfall Depths =	Denver - Capit	ol Building		\blacksquare		5.50		315.7	179.9	56,793		1.304	255,940	5.876
After providing required inputs above inc			Run CUH	IP	Zone 1 (100-year)	6.00		319.7	183.9	58,791		1.350	284,834	6.539
depths, click 'Run CUHP' to generate run the embedded Colorado Urban Hydro			Optional Use			6.50 7.00		323.7 327.7	187.9 191.9	60,822 62,884		1.396	314,736 345,661	7.225
Water Quality Capture Volume (WQCV) =	1.141	acre-feet	Spacial Ost	acre-feet		7.50		331.7	195.9	64,978		1.492	377,626	8.669
Excess Urban Runoff Volume (EURV) =	2.470	acre-feet		acre-feet		8.00		335.7	199.9	67,105		1.541	410,645	9.427
2-yr Runoff Volume (P1 = 0.85 in.) =	1.598	acre-feet	0.85	inches		8.50		339.7	203.9	69,263		1.590	444,736	10.21
5-yr Runoff Volume (P1 = 1.12 in.) =	2.810	acre-feet	1.12	inches		9.00		343.7	207.9	71,454		1.640	479,914	11.01
10-yr Runoff Volume (P1 = 1.4 in.) = 25-yr Runoff Volume (P1 = 1.87 in.) =	4.602	acre-feet	1.40	inches		9.50		347.7	211.9	73,676		1.691	516,195	11.85
25-yr Runoff Volume (P1 = 1.87 in.) = 50-yr Runoff Volume (P1 = 2.3 in.) =	8.506 11.792	acre-feet	1.87 2.30	inches		10.00		351.7 355.7	215.9	75,931 78,217		1.743	553,595 592,131	12.70
100-yr Runoff Volume (P1 = 2.79 in.) =	15.995	acre-feet	2.79	inches		11.00		359.7	223.9	80,536		1.849	631,818	14.50
500-yr Runoff Volume (P1 = 4.16 in.) =	27.074	acre-feet	4.16	inches		11.50		363.7	227.9	82,886		1.903	672,672	15.44
Approximate 2-yr Detention Volume =	1.515	acre-feet		_		12.00		367.7	231.9	85,268		1.957	714,709	16.40
Approximate 5-yr Detention Volume =	2.643	acre-feet				12.50		371.7	235.9	87,683		2.013	757,946	17.40
Approximate 10-yr Detention Volume =	3.285 4.314	acre-feet acre-feet				13.00 13.50		375.7 379.7	239.9	90,129		2.069	802,398 848,081	18.42
Approximate 25-yr Detention Volume = Approximate 50-yr Detention Volume =	4.931	acre-feet				14.00		383.7	247.9	95,118		2.126	895,011	20.54
Approximate 100-yr Detention Volume =	6.534	acre-feet				14.50		387.7	251.9	97,661		2.242	943,204	21.65
		1				15.00		391.7	255.9	100,235		2.301	992,677	22.78
Define Zones and Basin Geometry						15.50		395.7	259.9	102,842		2.361	1,043,445	23.95
Zone 1 Volume (100-year)	6.534	acre-feet				16.00		399.7	263.9	105,480		2.421	1,095,524	25.150
Select Zone 2 Storage Volume (Optional) Select Zone 3 Storage Volume (Optional)		acre-feet acre-feet				16.50 17.00		403.7 407.7	267.9 271.9	108,151		2.483	1,148,930	26.376
Total Detention Basin Volume =	6.534	acre-feet				17.50		411.7	275.9	113,587		2.608	1,259,788	28.921
Initial Surcharge Volume (ISV) =	N/A	ft ³				18.00		415.7	279.9	116,354		2.671	1,317,272	30.240
Initial Surcharge Depth (ISD) =	N/A	ft				18.50		419.7	283.9	119,152		2.735	1,376,148	31.592
Total Available Detention Depth (H _{total}) =	6.00	ft				19.00		423.7	287.9	121,983		2.800	1,436,430	32.976
Depth of Trickle Channel (H _{TC}) =		ft a/a				19.50		427.7	291.9	124,845		2.866	1,498,136	34.39
Slope of Trickle Channel (S_{TC}) = Slopes of Main Basin Sides (S_{main}) =	0.003	ft/ft H:V				20.00		431.7 435.7	295.9 299.9	127,740 130,666		3.000	1,561,281	35.84
Basin Length-to-Width Ratio $(R_{L/W}) =$	2	1				21.00		439.7	303.9	133,625		3.068	1,691,952	38.842
2VL/W/		_				21.50		443.7	307.9	136,615		3.136	1,759,511	40.39
Initial Surcharge Area (A_{ISV}) =	0	ft ²				22.00		447.7	311.9	139,637		3.206	1,828,573	41.97
Surcharge Volume Length (L _{ISV}) =	0.0	ft				22.50		451.7	315.9	142,692		3.276	1,899,154	43.59
Surcharge Volume Width (W _{ISV}) =	0.0	ft				23.00		455.7 459.7	319.9 323.9	145,778 148,897		3.347	1,971,270 2,044,937	45.25 46.94
Depth of Basin Floor (H_{FLOOR}) = Length of Basin Floor (L_{FLOOR}) =	271.7	ft.				24.00		463.7	323.9	152,047		3.491	2,044,937	48.67
Width of Basin Floor $(W_{FLOOR}) =$	135.9	ft				24.50		467.7	331.9	155,230		3.564	2,196,990	50.43
Area of Basin Floor (A _{FLOOR}) =	36,922	ft ²				25.00		471.7	335.9	158,444		3.637	2,275,407	52.23
Volume of Basin Floor (V_{FLOOR}) =	0	ft ³				25.50		475.7	339.9	161,691		3.712	2,355,439	54.07
Depth of Main Basin (H _{MAIN}) =	6.00	ft				26.00		479.7	343.9	164,969		3.787	2,437,103	55.94
Length of Main Basin (L _{MAIN}) =	319.7	ft A				26.50		483.7	347.9	168,280		3.863	2,520,414	57.86
Width of Main Basin (W _{MAIN}) = Area of Main Basin (A _{MAIN}) =	183.9 58,791	ft ft²				27.00 27.50		487.7 491.7	351.9 355.9	171,622 174,996		3.940 4.017	2,605,388	59.81 61.80
Volume of Main Basin (V _{MAIN}) =	284,607	ft ³				28.00		495.7	359.9	178,403		4.096	2,780,390	63.82
Calculated Total Basin Volume (V _{total}) =	6.534	acre-feet				28.50		499.7	363.9	181,841		4.175	2,870,449	65.89
						29.00 29.50		503.7	367.9	185,312		4.254	2,962,236	68.00
						30.00		507.7 511.7	371.9 375.9	188,814 192,349		4.335 4.416	3,055,766 3,151,056	70.15 72.33

	DET	ENTION F	RASIN OUT	LET STRU	ICTURE DI	ESIGN			
Project:	23.1447.001 Gree		IFD-Detention, Ve	ersion 4.06 (July		_51011			
	Option 4, Flood Co								
ZONE 3 ZONE 2				Estimated	Estimated		Clear In	nput Parameters	
ZONE 1				Stage (ft)	Volume (ac-ft)	Outlet Type	(Incl	uding Tables)	
VOLUME EURY WOCV			Zone 1 (100-year)	6.00	6.534	Rectangular Orifice	Vertical Orifice (Recta	ngular)	-
1	100-YEAR		Zone 2				Select Zone 2 Outlet 1	Гуре	—
PERMANENT ORIFICES	ORIFICE		Zone 3				Select Zone 3 Outlet 1	Гуре	▼
POOL Example Zone	Configuration (Retention Pond)		Total (all zones)	6.534				
User Input: Orifice at Underdrain Outlet (typic	ally used to drain V	VQCV in a Filtration	BMP)			Į.	Calculated Parame	eters for Underdra	in
Underdrain Orifice Invert Depth =		ft (distance below		a surface)	Underd	rain Orifice Area =	N/A	ft ²	
Underdrain Orifice Diameter =	N/A	inches			Underdrain	Orifice Centroid =	N/A	feet	
User Input: Orifice Plate with one or more orifi				•			Calculated Parame		
Centroid of Lowest Orifice =	N/A	ft (relative to basi	_	,		e Area per Row =		ft²	
Depth at top of Zone using Orifice Plate =	N/A	ft (relative to basi	n bottom at Stage	= 0 ft		otical Half-Width =	N/A	feet	
Orifice Plate: Orifice Vertical Spacing =	N/A	inches				cal Slot Centroid =		feet	
Orifice Plate: Orifice Area per Row =	N/A	sq. inches			E	lliptical Slot Area =	N/A	ft²	
User Input: Stage and Total Area of Each On	fice Row (number	ed from lowest to l	nighest)						
A THE STATE OF LEGIT OF LEGIT OF	Row 1 (optional)	Row 2 (optional)	Row 3 (optional)	Row 4 (optional)	Row 5 (optional)	Row 6 (optional)	Row 7 (optional)	Row 8 (optional)	1
Stage of Orifice Centroid (ft)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	•
Orifice Area (sq. inches)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1
		* ***							-
	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)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A]
Orifice Area (sq. inches)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A]
User Input: Vertical Orifice (Circular or Rectan		Not Colored					Calculated Parame		<u>Onfice</u>
	Zone 1 Rectangula 0.00		Gr (malastica sa basai	- battan at Chan	0.61) \/		Zone 1 Rectangula	Not Selected	612
Invert of Vertical Orifice =	6.00			n bottom at Stage		tical Orifice Area =	30.00 2.50		ft ²
Depth at top of Zone using Vertical Orifice = Vertical Orifice Height =	60.00		inches	n bottom at Stage	- UTL) Vertical	Orifice Centroid =	2.30		feet
Vertical Orifice Width =	72.00		inches						
verdedi Office vvidi –	72.00	l .	il ici ics						
User Input: Overflow Weir (Dropbox with Flat	or Sloped Grate a	nd Outlet Pipe OR	Rectangular/Trape	ezoidal Weir and No	Outlet Pipe)		Calculated Parame	eters for Overflow	Weir
User Input: Overflow Weir (Dropbox with Flat	or Sloped Grate a	nd Outlet Pipe OR Not Selected	Rectangular/Trape	ezoidal Weir and No	Outlet Pipe)	į.	Calculated Parame	eters for Overflow Not Selected	Weir
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		DET	ENTIO	N BASI	IN STAGE-S	TORA	GE TA	BLE BL	JILDE <u>R</u>	₹				
				MHFL	D-Detention, Version	N. INDEXES TON							Clear Work	book
	23.1447.00 Option 4, Fe	0 0	Oklahoma Dra	ainage MP										
ZONE 3		oou contro	1 623											
	ZÔNE 1													
VOLUME EURY WOCV			ran.	\geq			1							
ZONI PERMANENT ORIF	E 1 AND 2	ORIFI	CE		Depth Increment =	0.50	ft Optional			Ī	Optional			
POOL Example Zon	e Configura	ation (Rete	ntion Pond)		Stage - Storage Description	Stage (ft)	Override Stage (ft)	Length (ft)	Width (ft)	Area (ft²)	Override Area (ft ²)	Area (acre)	Volume (ft ³)	Volume (ac-ft)
Watershed Information	Flood Con	trol Only			Media Surface		0.00				37,664	0.865		(1111)
Flood Control Only	No BMP						1.00				77,436	1.778	57,550	1.321
Watershed Area = Watershed Length =	327.00 4,753	acres					2.00 3.00				133,078 163,864	3.055	162,807 311,278	3.738 7.146
Watershed Length to Centroid =	2,751	ft					4.00				190,605	4.376	488,512	11.215
Watershed Slope =	0.012	ft/ft					5.00	1000			204,897	4.704	686,263	15.754
Watershed Imperviousness =	72.98%	percent					6.00				215,528	4.948	896,476	20.580
Percentage Hydrologic Soil Group A = Percentage Hydrologic Soil Group B =	0.0%	percent					7.00 8.00				226,286 237,198	5.195 5.445	1,117,383	25.652 30.972
Percentage Hydrologic Soil Groups C/D =	100.0%	percent					8.49				273,603	6.281	1,474,271	33.845
Target WQCV Drain Time =	N/A	hours					9.00				273,603	6.281	1,613,808	37.048
Location for 1-hr Rainfall Depths =				▼			10.00	122			273,603	6.281	1,887,411	43.329
After providing required inputs above in depths, click 'Run CUHP' to generate run			Run CUHI	P										
the embedded Colorado Urban Hydro			Optional Use	r Overrides						(55)				
Water Quality Capture Volume (WQCV) =	7.879	acre-feet		acre-feet										
Excess Urban Runoff Volume (EURV) = 2-yr Runoff Volume (P1 = 0.85 in.) =	23.271	acre-feet	0.85	acre-feet inches										
5-yr Runoff Volume (P1 = 1.12 in.) =	22.795	acre-feet	1.12	inches										
10-yr Runoff Volume (P1 = 1.4 in.) =	30.462	acre-feet	1.40	inches				1.00						
25-yr Runoff Volume (P1 = 1.87 in.) =	44.522	acre-feet	1.87	inches				1						
50-yr Runoff Volume (P1 = 2.3 in.) = 100-yr Runoff Volume (P1 = 2.79 in.) =	57.083 71.969	acre-feet acre-feet	2.30	inches										
500-yr Runoff Volume (P1 = 4.16 in.) =	112.726	acre-feet	4.16	inches										
Approximate 2-yr Detention Volume =	14.974	acre-feet						255						
Approximate 5-yr Detention Volume =	21.673	acre-feet												
Approximate 10-yr Detention Volume = Approximate 25-yr Detention Volume =	26.650	acre-feet												-
Approximate 50-yr Detention Volume =	37.124	acre-feet												
Approximate 100-yr Detention Volume =	43.128	acre-feet						155		(55)				
Dofine Zones and Pasin Coometry														
Define Zones and Basin Geometry Zone 1 Volume (100-year) ▼	43.128	acre-feet												
Select Zone 2 Storage Volume (Optional)		acre-feet												
Select Zone 3 Storage Volume (Optional) ▼		acre-feet						1,555		(55)				
Total Detention Basin Volume = Initial Surcharge Volume (ISV) =	43.128 N/A	acre-feet												
Initial Surcharge Volume (ISV) = Initial Surcharge Depth (ISD) =	N/A	ft.												
Total Available Detention Depth (H _{total}) =	user	ft							-					
Depth of Trickle Channel (H _{TC}) =	user	ft												
Slope of Trickle Channel (S_{TC}) = Slopes of Main Basin Sides (S_{main}) =	user	ft/ft H:V												-
Basin Length-to-Width Ratio ($R_{L/W}$) =		1												
		•				#			3					
Initial Surcharge Area (A _{ISV}) =	user	ft ²											-	
Surcharge Volume Length (L_{ISV}) = Surcharge Volume Width (W_{ISV}) =	user	ft.												
Depth of Basin Floor (H_{FLOOR}) =	user	ft												
Length of Basin Floor (L _{FLOOR}) =	user	ft								.551				
Width of Basin Floor (W_{FLOOR}) = Area of Basin Floor (A_{FLOOR}) =	user	ft ft²											-	-
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}) = Area of Main Basin (A_{MAIN}) =	user	ft ft²												
Volume of Main Basin (V_{MAIN}) =	user	ft ³												
Calculated Total Basin Volume (V _{total}) =	user	acre-feet												

	DET	ENTION	RASTNLOLI	LI ET STDI	JCTURE D	ESIGN _			
	DEI	MH	HFD-Detention, V	ersion 4.06 (July		ESIGN			
	23.1447.001 Gree Option 4, Hood Co		inage MP						
ZONE 3	Option 4, Hood Co	iitioi 823		Estimated	Estimated		Class h	nput Parameters	
ZONE 2 ZONE 1		_		Stage (ft)	Volume (ac-ft)	Outlet Type		uding Tables)	
100-YR VOLUME EURV WQCV			Zone 1 (100-year)		43.128	Rectangular Orifice	Vertical Orifice (Recta	ngular)	~
	100-YEAR		Zone 2				Select Zone 2 Outlet 1	íype	<u>_</u>
PERMANENT ORIFICES	ORIFICE		Zone 3				Select Zone 3 Outlet 1	Type	—
POOL Example Zone	Configuration (F	Retention Pond)		Total (all zones)	43.128				
User Input: Orifice at Underdrain Outlet (typic					2001			eters for Underdrai	ב
Underdrain Orifice Invert Depth =		ft (distance below	the filtration medi	a surface)		rain Orifice Area =		ft ²	
Underdrain Orifice Diameter =	N/A	inches	6		Underdrain	Orifice Centroid =	N/A	feet	
User Input: Orifice Plate with one or more ori	ices or Elliptical Slo	t Weir (typically us	ed to drain WQCV	and/or EURV in a	sedimentation BM	P)	Calculated Parame	eters for Plate	
Centroid of Lowest Orifice =		ft (relative to basi	_	•		ce Area per Row =		ft ²	
Depth at top of Zone using Orifice Plate =		ft (relative to basi	n bottom at Stage	e = 0 ft)		ptical Half-Width =		feet	
Orifice Plate: Orifice Vertical Spacing =		inches				ical Slot Centroid =		feet	
Orifice Plate: Orifice Area per Row =	N/A	sq. inches				Elliptical Slot Area =	N/A	ft ²	
				,	•				
User Input: Stage and Total Area of Each Or	fice Row (number	ed from lowest to I	nighest)	1			ı		
	Row 1 (optional)	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)		N/A	N/A	N/A	N/A	N/A	N/A	N/A	
Orifice Area (sq. inches)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	
	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)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	
Orifice Area (sq. inches)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	
User Input: Vertical Orifice (Circular or Rectar	ngular)						Calculated Parame	eters for Vertical O	ifice
· · · · · · · · · · · · · · · · · · ·	Zone 1 Rectangula	Not Selected					Zone 1 Rectangula		
Invert of Vertical Orifice =	0.00		ft (relative to basi	in bottom at Stage	e = 0 ft) Ver	tical Orifice Area =	29.17		ft ²
Depth at top of Zone using Vertical Orifice =	9.97			in bottom at Stage	e = 0 ft) Vertical	Orifice Centroid =	2.50		feet
Vertical Orifice Height = Vertical Orifice Width =	70.00		inches inches			1			
vertical office width =	70.00	l.	licies						
User Input: Overflow Weir (Dropbox with Flat	or Sloped Grate a	nd Outlet Pipe OR	Rectangular/Trape	ezoidal Weir and N	o Outlet Pipe)		Calculated Parame	eters for Overflow	Weir
	Not Selected	Not Selected					Not Selected	Not Selected	
Overflow Weir Front Edge Height, Ho =		•		bottom at Stage = 0	ft) Height of Grate				feet
Overflow Weir Front Edge Length = Overflow Weir Grate Slope =	,		feet H:V	Grai	te Open Area / 10	eir Slope Length =			feet
Horiz. Length of Weir Sides =			feet		erflow Grate Open				ft ²
Overflow Grate Type =	Select Grate Type	Select Grate Type						t i	TU
Debris Clogging % =				0,	erflow Grate Oper	Area w/ Debris =			ft ²
			%		verflow Grate Oper	Area w/ Debris =			
User Input: Outlet Dine w/ Flow Postriction Dia	o (Circular Orifica	Postrictor Data o			•		for Outlot Pipo w		ft²
User Input: Outlet Pipe w/ Flow Restriction Pla					•			/ Flow Restriction P	ft²
User Input: Outlet Pipe w/ Flow Restriction Pla Depth to Invert of Outlet Pipe =	te (Circular Orifice, Not Selected	Not Selected	r Rectangular Orific		<u>Cal</u>		s for Outlet Pipe w. Not Selected	/ Flow Restriction P	ft²
		Not Selected	r Rectangular Orific	<u>ce)</u>	<u>Cal</u>	culated Parameters		/ Flow Restriction P	ft ² late
Depth to Invert of Outlet Pipe =		Not Selected	<u>r Rectangular Orific</u> ft (distance below b	ce) pasin bottom at Stage	<u>Cal</u>	culated Parameters utlet Orifice Area = Orifice Centroid =		/ Flow Restriction P Not Selected	ft² <u>late</u> ft²
Depth to Invert of Outlet Pipe = Circular Orifice Diameter =	Not Selected	Not Selected	<u>r Rectangular Orific</u> ft (distance below b	ce) pasin bottom at Stage	Cal e = 0 ft) Outlet	culated Parameters utlet Orifice Area = Orifice Centroid =	Not Selected N/A	/ Flow Restriction PI Not Selected N/A	ft² <u>ate</u> ft² feet
Depth to Invert of Outlet Pipe = Circular Orifice Diameter = User Input: Emergency Spilway (Rectangular	Not Selected	Not Selected	r Rectangular Orifix ft (distance below b inches	ce) pasin bottom at Stage Half-Centr	<u>Cal</u> e = 0 ft) Ou Outlet ral Angle of Restrict	culated Parameters utlet Orifice Area = Orifice Centroid = Cor Plate on Pipe =	Not Selected N/A Calculated Parame	/ Flow Restriction PI Not Selected N/A	ft² <u>ate</u> ft² feet
Depth to Invert of Outlet Pipe = Circular Orifice Diameter =	Not Selected	Not Selected ft (relative to basifeet	r Rectangular Orific ft (distance below b inches n bottom at Stage	oasin bottom at Stage Half-Centr	Cal e = 0 ft) Outlet ral Angle of Restrict Spilway D	culated Parameters utlet Orifice Area = Orifice Centroid =	Not Selected N/A Calculated Parame	/ Flow Restriction Pl Not Selected N/A N/A	ft² <u>ate</u> ft² feet
Depth to Invert of Outlet Pipe = Circular Orifice Diameter = User Input: Emergency Spillway (Rectangular Spillway Invert Stage= Spillway Crest Length = Spillway End Slopes =	Not Selected or Trapezoidal)	Not Selected ft (relative to basifeet H:V Size Em Develope:	r Rectangular Orifix ft (distance below b inches	pasin bottom at Stage Half-Centr e = 0 ft) asss Rate	Cal e = 0 ft) Ou Outlet ral Angle of Restrict Spilway D Stage at T Basin Area at T	culated Parameters utlet Orfice Area = Orfice Centroid = tor Plate on Pipe = esign Flow Depth= op of Freeboard = op of Freeboard =	Not Selected N/A Calculated Parame	/ Flow Restriction P Not Selected N/A Peters for Spillway feet feet acres	ft² <u>ate</u> ft² feet
Depth to Invert of Outlet Pipe = Circular Orifice Diameter = <u>User Input: Emergency Spilway (Rectangular</u> Spilway Invert Stage= Spilway Crest Length =	Not Selected or Trapezoidal)	Not Selected ft (relative to basifeet	r Rectangular Orific ft (distance below b inches n bottom at Stage	pasin bottom at Stage Half-Centr e = 0 ft) asss Rate	Cal e = 0 ft) Ou Outlet ral Angle of Restrict Spillway D Stage at T	culated Parameters utlet Orfice Area = Orfice Centroid = tor Plate on Pipe = esign Flow Depth= op of Freeboard = op of Freeboard =	Not Selected N/A Calculated Parame	Not Selected N/A N/A eters for Spillway feet feet	ft² <u>ate</u> ft² feet
Depth to Invert of Outlet Pipe = Circular Orifice Diameter = User Input: Emergency Spillway (Rectangular Spillway Invert Stage= Spillway Crest Length = Spillway End Slopes =	Not Selected or Trapezoidal)	Not Selected ft (relative to basifeet H:V Size Em Develope:	r Rectangular Orific ft (distance below b inches n bottom at Stage	pasin bottom at Stage Half-Centr e = 0 ft) asss Rate	Cal e = 0 ft) Ou Outlet ral Angle of Restrict Spilway D Stage at T Basin Area at T	culated Parameters utlet Orfice Area = Orfice Centroid = tor Plate on Pipe = esign Flow Depth= op of Freeboard = op of Freeboard =	Not Selected N/A Calculated Parame	/ Flow Restriction P Not Selected N/A Peters for Spillway feet feet acres	ft² <u>ate</u> ft² feet
Depth to Invert of Outlet Pipe = Circular Orifice Diameter = User Input: Emergency Spilway (Rectangular Spilway Invert Stage= Spilway Crest Length = Spilway End Slopes = Freeboard above Max Water Surface = Routed Hydrograph Results	Not Selected or Trapezoidal) The user can over	ft (relative to basifeet H:V feet erricle the default C	r Rectangular Orific ft (distance below b inches n bottom at Stage ergency Spillway to p d 100-yr Peak Runoff	pasin bottom at Stage Half-Centr e = 0 ft) hass Rate	Cal e = 0 ft) Ou Outlet ral Angle of Restrict Spilway D Stage at T Basin Area at T Basin Volume at T	culated Parameters utlet Orifice Area = Orifice Centroid = tor Plate on Pipe = esign Flow Depth= op of Freeboard = op of Freeboard = op of Freeboard =	Not Selected N/A Calculated Parame w Hydrographs tal	/ Flow Restriction P Not Selected N/A ters for Spillway feet feet acres acre-ft ble (Columns W thi	ft ² late ft ² feet radians
Depth to Invert of Outlet Pipe = Circular Orifice Diameter = User Input: Emergency Spilway (Rectangular Spilway Invert Stage= Spilway Crest Length = Spilway End Slopes = Freeboard above Max Water Surface = Routed Hydrograph Results Design Storm Return Period =	Not Selected or Trapezoidal) The user can ove	ft (relative to basifeet H:V feet Develope:	r Rectangular Orfik ft (distance below b inches n bottom at Stage ergency Spillway to p d 100-yr Peak Runoff UHP hydrographs 2 Year	pasin bottom at Stage Half-Centr e = 0 ft) ass Rate and runoff volume 5 Year	Cal c = 0 ft) Ou Outlet ral Angle of Restrict Spilway D Stage at T: Basin Area at T: Basin Volume at T: 25 by entering new 10 Year	culated Parameters thet Orifice Area = Orifice Centroid = tor Plate on Pipe = esign Flow Depth= pop of Freeboard = pop of Freeboard = pop of Freeboard = pop of Freeboard =	Not Selected N/A Calculated Parame w Hydrographs tall 50 Year	Not Selected N/A Not Selected N/A eters for Spilway feet feet acres acres acre-ft ble (Columns W thr 100 Year	ft ² ate ft ² feet radians ough AF). 500 Year
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					D-Detention, Version								Clear Work	book
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ZONE 3	Option4, Flo	od Control	838											
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100-YR VOLUME EURV WQCV				\rightarrow	1		7							
	1 AND 2	ORIFIC	AR E		Depth Increment =	0.50	ft Optional			1	Optional		1	Т
PERMANENT ORIFI POOL Example Zone		tion (Rete	ntion Pond)		Stage - Storage	Stage	Override	Length	Width	Area	Override	Area	Volume	Volume
Watershed Information	Flood Cont	trol Only			Description Media Surface	(ft) 0.00	Stage (ft)	(ft) 464.4	(ft) 232.2	(ft ²) 107,813	Area (ft 2)	(acre) 2.475	(ft ³)	(ac-ft)
Flood Control Only	No BMP	1				0.50		468.4	236.2	110,615		2.539	54,606	1.254
Watershed Area =	126.50	acres				1.00		472.4	240.2	113,449		2.604	110,621	2.539
Watershed Length =	2,939	ft				1.50		476.4	244.2	116,315		2.670	168,060	3.858
Watershed Length to Centroid = Watershed Slope =	1,428 0.031	ft ft/ft				2.00		480.4 484.4	248.2 252.2	119,214		2.737	226,941 287,279	5.210 6.595
Watershed Imperviousness =	76.20%	percent				3.00		488.4	256.2	125,106		2.872	349,090	8.014
Percentage Hydrologic Soil Group A =	0.0%	percent				3.50		492.4	260.2	128,100		2.941	412,391	9.467
Percentage Hydrologic Soil Group B =	0.0%	percent				4.00		496.4	264.2	131,126		3.010	477,196	10.955
Percentage Hydrologic Soil Groups C/D = Target WQCV Drain Time =	100.0% N/A	percent				4.50 5.00		500.4 504.4	268.2 272.2	134,184		3.080	543,522 611,385	12.478
Location for 1-hr Rainfall Depths =	_			•		5.50		508.4	276.2	140,397		3.223	680,802	15.629
After providing required inputs above inc	luding 1-hour	rainfall	Run CUH		Zone 1 (100-year)	6.00		512.4	280.2	143,551		3.295	751,787	17.259
depths, click 'Run CUHP' to generate run the embedded Colorado Urban Hydro	off hydrograph	ns using				6.50		516.4	284.2	146,737		3.369	824,358	18.925
Water Quality Capture Volume (WQCV) =		acre-feet	Optional Use	acre-feet		7.00		520.4 524.4	288.2	149,955 153,205		3.442	898,529 974,318	20.627
Excess Urban Runoff Volume (EURV) =	9.432	acre-feet		acre-feet		8.00		528.4	296.2	156,487		3.592	1,051,740	24.145
2-yr Runoff Volume (P1 = 0.85 in.) =	6.396	acre-feet	0.85	inches		8.50		532.4	300.2	159,801		3.669	1,130,811	25.960
5-yr Runoff Volume (P1 = 1.12 in.) =	9.013	acre-feet	1.12	inches		9.00		536.4	304.2	163,147		3.745	1,211,546	27.813
10-yr Runoff Volume (P1 = 1.4 in.) = 25-yr Runoff Volume (P1 = 1.87 in.) =	11.961 17.299	acre-feet acre-feet	1.40	inches		9.50		540.4 544.4	308.2 312.2	166,526 169,936		3.823 3.901	1,293,963	29.705 31.636
50-yr Runoff Volume (P1 = 2.3 in.) =	22.084	acre-feet	2.30	inches		10.50		548.4	316.2	173,378		3.980	1,463,904	33.607
100-yr Runoff Volume (P1 = 2.79 in.) =	27.727	acre-feet	2.79	inches		11.00		552.4	320.2	176,852		4.060	1,551,461	35.617
500-yr Runoff Volume (P1 = 4.16 in.) =	43.218	acre-feet	4.16	inches		11.50		556.4	324.2	180,358		4.140	1,640,762	37.667
Approximate 2-yr Detention Volume = Approximate 5-yr Detention Volume =	6.083 8.736	acre-feet acre-feet				12.00 12.50		560.4 564.4	328.2 332.2	183,896 187,466		4.222	1,731,824	39.757 41.889
Approximate 10-yr Detention Volume =	10.760	acre-feet				13.00		568.4	336.2	191,069		4.386	1,919,296	44.061
Approximate 25-yr Detention Volume =	13.343	acre-feet				13.50		572.4	340.2	194,703		4.470	2,015,737	46.275
Approximate 50-yr Detention Volume =	14.954	acre-feet				14.00		576.4	344.2	198,369		4.554	2,114,004	48.531
Approximate 100-yr Detention Volume =	17.253	acre-feet				14.50 15.00		580.4 584.4	348.2 352.2	202,067		4.639 4.724	2,214,111	50.829 53.170
Define Zones and Basin Geometry						15.50		588.4	356.2	209,559		4.811	2,419,914	55.554
Zone 1 Volume (100-year) ▼	17.253	acre-feet				16.00		592.4	360.2	213,353		4.898	2,525,641	57.981
Select Zone 2 Storage Volume (Optional) ▼		acre-feet				16.50		596.4	364.2	217,179		4.986	2,633,272	60.452
Select Zone 3 Storage Volume (Optional)	47.252	acre-feet				17.00		600.4	368.2	221,038		5.074	2,742,825	62.967
Total Detention Basin Volume = Initial Surcharge Volume (ISV) =	17.253 N/A	acre-feet ft 3				17.50 18.00		604.4	372.2 376.2	224,928		5.164 5.254	2,854,315 2,967,758	65.526 68.130
Initial Surcharge Depth (ISD) =	N/A	ft				18.50		612.4	380.2	232,804		5.344	3,083,171	70.780
Total Available Detention Depth (H _{total}) =	6.00	ft				19.00		616.4	384.2	236,790		5.436	3,200,568	73.475
Depth of Trickle Channel (H _{TC}) =	0.50	ft A/A				19.50		620.4	388.2	240,808		5.528	3,319,966	76.216
Slope of Trickle Channel (S_{TC}) = Slopes of Main Basin Sides (S_{main}) =	0.003	ft/ft H:V				20.00		624.4 628.4	392.2 396.2	244,858 248,941		5.621 5.715	3,441,381 3,564,830	79.003 81.837
Basin Length-to-Width Ratio $(R_{L/W})$ =	2	1				21.00		632.4	400.2	253,055		5.809	3,690,327	84.718
, JW		•				21.50		636.4	404.2	257,201		5.905	3,817,890	87.647
Initial Surcharge Area (A _{ISV}) =	0	ft²				22.00		640.4	408.2	261,379		6.000	3,947,533	90.623
Surcharge Volume Length (L_{ISV}) = Surcharge Volume Width (W_{ISV}) =	0.0	ft ft				22.50		644.4	412.2 416.2	265,589 269,831		6.097	4,079,274	93.647 96.720
Depth of Basin Floor $(H_{FLOOR}) =$	0.00	ft				23.50		652.4	420.2	274,105		6.293	4,349,111	99.842
Length of Basin Floor (L _{FLOOR}) =	464.4	ft				24.00		656.4	424.2	278,411		6.391	4,487,238	103.013
Width of Basin Floor (W _{FLOOR}) =	232.2	ft				24.50		660.4	428.2	282,750		6.491	4,627,527	106.233
Area of Basin Floor (A_{FLOOR}) = Volume of Basin Floor (V_{FLOOR}) =	107,813	ft ² ft ³				25.00 25.50		664.4 668.4	432.2 436.2	287,120 291,522		6.591 6.692	4,769,993 4,914,652	109.504 112.825
Volume of Basin Floor (V_{FLOOR}) = Depth of Main Basin (H_{MAIN}) =	6.00	ft.				26.00		672.4	440.2	291,522		6.794	5,061,521	116.197
Length of Main Basin (L _{MAIN}) =	512.4	ft				26.50		676.4	444.2	300,422		6.897	5,210,614	119.619
Width of Main Basin (W_{MAIN}) =	280.2	ft				27.00		680.4	448.2	304,920		7.000	5,361,948	123.093
Area of Main Basin (A _{MAIN}) =	143,551	ft ²				27.50		684.4	452.2	309,450		7.104	5,515,539	126.619
Volume of Main Basin (V_{MAIN}) = Calculated Total Basin Volume (V_{total}) =	751,538 17.253	ft ³ acre-feet				28.00		688.4 692.4	456.2 460.2	314,013 318,607		7.209 7.314	5,671,404 5,829,557	130.198
carculated Total basin volume (v _{total}) =	27.233	Tad 6-166r				29.00		696.4	464.2	323,233		7.420	5,990,016	137.512
						29.50 30.00		700.4 704.4	468.2 472.2	327,891 332,581		7.527 7.635	6,152,795 6,317,912	141.249 145.039
													-,,	

·	DET		BASIN OUT			ESIGN			
	23.1447.001 Gree	ley - Oldahoma Dra	HFD-Detention, Ve ainage MP	ersion 4.06 (July	2022)				
ZONE 3	Option4, Flood Cor	itrol 838		Estimated	Estimated		a		1
ZONE 2 ZONE 1		_		Stage (ft)	Volume (ac-ft)	Outlet Type	Clear I	nput Parameters uding Tables)	
OO-YR EURY WOCY			Zone 1 (100-year)		17.253	Rectangular Orifice	Vertical Orifice (Recta	ngulari	▼
± + T	100-YEAR		Zone 2		17.255	,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,	Select Zone 2 Outlet		-
ZONE 1 AND 2 PERMANENT ORIFICES	ORIFICE		Zone 3				Select Zone 3 Outlet		
	e Configuration (I	Retention Pond)	20110 0	Total (all zones)	17.253		34444	.,,,,	
ser Input: Orifice at Underdrain Outlet (typic	ally used to drain \	NQCV in a Filtration	n BMP)	CONTROL VIEW PROPERTY		J	Calculated Parame	eters for Underdra	<u>in</u>
Underdrain Orifice Invert Depth =	N/A	ft (distance below	the filtration media	a surface)		rain Orifice Area =	N/A	ft²	
Underdrain Orifice Diameter =	N/A	inches	•		Underdrain	Orifice Centroid =	N/A	feet	
ser Input; Orifice Plate with one or more ori	fices or Elliptical Sh	t Weir (typically us	ed to drain WOCV	and/or FLID\/ in a	sedimentation RM	D)	Calculated Parame	ators for Diato	
Centroid of Lowest Orifice =	N/A		in bottom at Stage			e Area per Row =	N/A	ft ²	
Depth at top of Zone using Orifice Plate =		,	in bottom at Stage	•		ptical Half-Width =	N/A	feet	
Orifice Plate: Orifice Vertical Spacing =	N/A	inches				ical Slot Centroid =	N/A	feet	
Orifice Plate: Orifice Area per Row =	N/A	sq. inches			E	lliptical Slot Area =	N/A	ft ²	
ser Input: Stage and Total Area of Each Or	ifice Row (number	ed from lowest to	highest)						
,	Row 1 (optional)	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)		N/A	N/A	N/A	N/A	N/A	N/A	N/A	
Orifice Area (sq. inches)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A]
	Day O (:	Row 10 (optional)	Day 11 /	Row 12 (optional)	Day 12 ("	Row 14 (optional)	Day 15 / "	Day 15 / " "	7
Stage of Orifice Centroid (ft)	Row 9 (optional) N/A	N/A	Row 11 (optional) N/A	N/A	Row 13 (optional) N/A	N/A	Row 15 (optional) N/A	Row 16 (optional) N/A	•
Orifice Area (sq. inches)	-	N/A	N/A	N/A	N/A	N/A	N/A	N/A	•
er Input: Vertical Orifice (Circular or Rectar		Not Colored	1				Calculated Parame		<u>Orifice</u>
Invert of Vertical Orifice =	Zone 1 Rectangula 0.00	Not Selected	ft (relative to baci	in bottom at Stage	- 0 ft) Ver	tical Orifice Area =	Zone 1 Rectangula 29.17	Not Selected	ft ²
Depth at top of Zone using Vertical Orifice =	2000000			in bottom at Stage		Orifice Centroid =	2.50	7	feet
Vertical Orifice Height =			inches		,				1
Vertical Orifice Width =	70.00		inches						
ser Input: Overflow Weir (Dropbox with Flat	Not Selected	Not Selected	Rectangular/Trape	ezoidal Weir and N	o Outlet Pipe)		Calculated Parame		Weir
Overflow Weir Front Edge Height, Ho =	100000000000000000000000000000000000000	Not selected	ft (relative to basin	bottom at Stage = 0	ft) Height of Grate	Unner Edge H -	Not Selected	Not Selected	feet
Overflow Weir Front Edge Length =			feet	Double of the second	-	eir Slope Length =			feet
Overflow Weir Grate Slope =			H:V	Grat	e Open Area / 100				
Horiz. Length of Weir Sides =			feet		erflow Grate Open				ft ²
Overflow Grate Type =	Select Grate Type	Select Grate Type	l _a ,	Ov	erflow Grate Open	Area w/ Debris =			ft ²
Debris Clogging % =		<u> </u>]%						
	te (Circular Orifice.	Restrictor Plate o	D - 1 - 0 'C		•				
ser Input: Outlet Pipe w/ Flow Restriction Pla			ir Rectangular Orlik	ce)	Cak	culated Parameters	for Outlet Pipe w	/ Flow Restriction F	Plate
ser Input: Outlet Pipe w/ Flow Restriction Pla	Not Selected	Not Selected	<u>r Rectangular Orlik</u>	<u>ce)</u>	<u>Cak</u>	<u>culated Parameters</u>	for Outlet Pipe w. Not Selected	/ Flow Restriction I	<u>Plate</u>
Depth to Invert of Outlet Pipe =	Not Selected		ft (distance below b	<u>ce)</u> pasin bottom at Stage	e = 0 ft) Ou	ıtlet Orifice Area =			ft ²
1	Not Selected			pasin bottom at Stage	e = 0 ft) Outlet	itlet Orifice Area = Orifice Centroid =	Not Selected	Not Selected	ft² feet
Depth to Invert of Outlet Pipe =	Not Selected		ft (distance below b	pasin bottom at Stage	e = 0 ft) Ou	itlet Orifice Area = Orifice Centroid =			ft² feet
Depth to Invert of Outlet Pipe = Circular Orifice Diameter =	Not Selected		ft (distance below b	pasin bottom at Stage	e = 0 ft) Outlet	itlet Orifice Area = Orifice Centroid =	Not Selected N/A	Not Selected N/A	ft² feet
Depth to Invert of Outlet Pipe = Circular Orfice Diameter =	Not Selected or Trapezoidal)	Not Selected	ft (distance below b	oasin bottom at Stage Half-Centr	e = 0 ft) Outlet Outlet al Angle of Restrict	itlet Orifice Area = Orifice Centroid =	Not Selected	Not Selected N/A	ft² feet
Depth to Invert of Outlet Pipe = Circular Orifice Diameter = ser Input: Emergency Spilway (Rectangular	Not Selected or Trapezoidal)	Not Selected ft (relative to basifeet	ft (distance below b inches in bottom at Stage	pasin bottom at Stage Half-Centr	e = 0 ft) Outlet Outlet al Angle of Restrict Spillway De	utlet Orifice Area = Orifice Centroid = or Plate on Pipe =	Not Selected N/A	Not Selected N/A eters for Spillway	ft²
Depth to Invert of Outlet Pipe = Circular Orifice Diameter = ser Input: Emergency Spillway (Rectangular Spillway Invert Stage= Spillway Crest Length = Spillway End Slopes =	Not Selected or Trapezoidal)	ft (relative to basi feet H:V Size Em Develope	ft (distance below b inches in bottom at Stage	Half-Centron = 0 ft) ass Rate	e = 0 ft) Ou Outlet al Angle of Restrict Spillway De Stage at To Basin Area at To	orfice Area = Orfice Centroid = cor Plate on Pipe = esign Flow Depth= op of Freeboard = op of Freeboard =	Not Selected N/A	Not Selected N/A N/A eters for Spillway feet feet acres	ft² feet
Depth to Invert of Outlet Pipe = Circular Orifice Diameter = ser Input: Emergency Spilway (Rectangular Spilway Invert Stage= Spilway Crest Length =	Not Selected or Trapezoidal)	Not Selected ft (relative to basifeet	ft (distance below b inches in bottom at Stage	Half-Centron = 0 ft) ass Rate	e = 0 ft) Outlet al Angle of Restrict Spillway De Stage at To	orfice Area = Orfice Centroid = cor Plate on Pipe = esign Flow Depth= op of Freeboard = op of Freeboard =	Not Selected N/A	Not Selected N/A eters for Spillway feet feet	ft² feet
Depth to Invert of Outlet Pipe = Circular Orifice Diameter = ser Input: Emergency Spillway (Rectangular Spillway Invert Stage= Spillway Crest Length = Spillway End Slopes =	Not Selected or Trapezoidal)	ft (relative to basi feet H:V Size Em Develope	ft (distance below b inches in bottom at Stage	Half-Centron = 0 ft) ass Rate	e = 0 ft) Ou Outlet al Angle of Restrict Spillway De Stage at To Basin Area at To	orfice Area = Orfice Centroid = cor Plate on Pipe = esign Flow Depth= op of Freeboard = op of Freeboard =	Not Selected N/A	Not Selected N/A N/A eters for Spillway feet feet acres	ft² feet
Depth to Invert of Outlet Pipe = Circular Orifice Diameter = ser Input: Emergency Spillway (Rectangular Spillway Invert Stage= Spillway Crest Length = Spillway End Slopes = Freeboard above Max Water Surface = outled Hydrograph Results	or Trapezoidal) The user can ove	ft (relative to basifeet H:V feet periode the default C	ft (distance below b inches in bottom at Stage lergency Spillway to p. ed 100-yr Peak Runoff I	Half-Centre e = 0 ft) ass Rate	e = 0 ft) Ou Outlet al Angle of Restrict Spillway De Stage at To Basin Area at To Basin Volume at To	orfice Area = Orifice Centroid = Orifice Centroid = Orifice Centroid = Orifice Centroid = Orifice Centroid = Orifice Area Orifice Centroid = Orifice Area Orifice	Not Selected N/A Cakulated Parame	Not Selected N/A eters for Spillway feet feet acres acre-ft ble (Columns W th.	ft ² feet radians
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Appendix E-3 HY8 Culvert Sizing



Site Data - Structure#702

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 ft
Inlet Elevation: 4867.00 ft
Outlet Station: 97.00 ft
Outlet Elevation: 4862.00 ft
Number of Barrels: 2

Culvert Data Summary - Structure#702

Barrel Shape: Circular Barrel Diameter: 3.50 ft Barrel Material: Concrete Embedment: 0.00 in Barrel Manning's n: 0.0120 Culvert Type: Straight

Inlet Configuration: Square Edge with Headwall

Inlet Depression: None

Table 1 - Culvert Summary Table: Structure#702

Discharge Names	Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth (ft)	Outlet Control Depth (ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)
5 Year	24.91 cfs	24.91 cfs	4868.42	1.42	0.0*	1-S2n	0.53	1.07	0.56	0.23	12.54	2.12
100 Year	172.00 cfs	172.00 cfs	4872.41	5.41	0.655	5-S2n	1.42	2.89	1.64	0.73	19.36	4.46

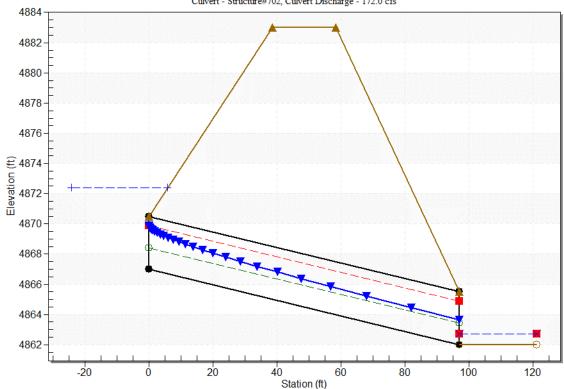
Culvert Barrel Data

Culvert Barrel Type Straight Culvert Inlet Elevation (invert): 4867.00 ft, Outlet Elevation (invert): 4862.00 ft

Culvert Length: 97.13 ft, Culvert Slope: 0.0515

Water Surface Profile Plot for Culvert: Structure#702

Crossing - Structure#702, Reach 700, Great Western Railway, Design Discharge - 172.0 cfs
Culvert - Structure#702, Culvert Discharge - 172.0 cfs



Tailwater Data for Crossing: Structure#702, Reach 700

Table 2 - Downstream Channel Rating Curve (Crossing: Structure#702, Reach 700)

Flow (cfs)	Water Surface Elev (ft)	Velocity (ft/s)	Depth (ft)	Shear (psf)	Froude Number	
24.91	4862.23	0.23	2.12	0.43	0.79	
172.00	4862.73	0.73	4.46	1.36	0.95	

Tailwater Channel Data - Structure#702, Reach 700

Tailwater Channel Option: Trapezoidal Channel

Bottom Width: 50.00 ft Side Slope (H:V): 4.00 (_:1) Channel Slope: 0.0300 Channel Manning's n: 0.0450

Roadway Data for Crossing: Structure#702, Reach 700

Roadway Profile Shape: Constant Roadway Elevation

Crest Length: 100.00 ft Crest Elevation: 4883.00 ft Roadway Surface: Gravel Roadway Top Width: 20.00 ft



Site Data - Structure#703,

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 ft
Inlet Elevation: 4872.00 ft
Outlet Station: 42.00 ft
Outlet Elevation: 4871.00 ft
Number of Barrels: 2

Culvert Data Summary - Structure#703,

Barrel Shape: Circular Barrel Diameter: 3.50 ft Barrel Material: Concrete Embedment: 0.00 in Barrel Manning's n: 0.0120 Culvert Type: Straight

Inlet Configuration: Square Edge with Headwall

Inlet Depression: None

Table 3 - Culvert Summary Table: Structure#703

Discharge Names	Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth (ft)	Outlet Control Depth (ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)
5 Year	24.91 cfs	24.91 cfs	4873.45	1.45	0.116	1-S2n	0.64	1.07	0.70	0.16	9.01	2.18
100 Year	172.00 cfs	172.00 cfs	4877.46	5.46	4.314	5-S2n	1.77	2.89	2.18	0.52	13.62	4.68

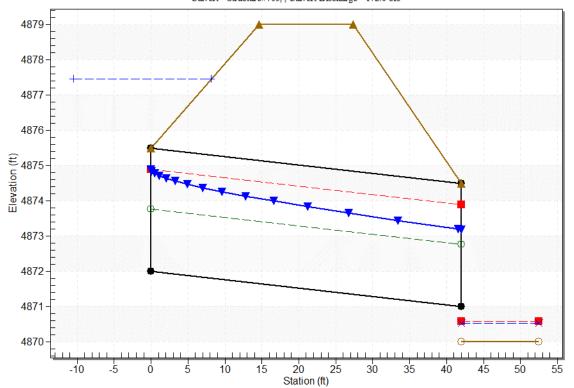
Culvert Barrel Data

Culvert Barrel Type Straight Culvert Inlet Elevation (invert): 4872.00 ft, Outlet Elevation (invert): 4871.00 ft

Culvert Length: 42.01 ft, Culvert Slope: 0.0238

Water Surface Profile Plot for Culvert: Structure#703

Crossing - Structure#703, Reach 700, Design Discharge - 172.0 cfs



Tailwater Data for Crossing: Structure#703, Reach 700

Table 4 - Downstream Channel Rating Curve (Crossing: Structure#703, Reach 700)

Flow (cfs)	Water Surface Elev (ft)	Velocity (ft/s)	Depth (ft)	Shear (psf)	Froude Number	
24.91	4870.16	0.16	2.18	0.22	0.95	
172.00	4870.52	0.52	4.68	0.71	1.15	

Tailwater Channel Data - Structure#703, Reach 700

Tailwater Channel Option: Trapezoidal Channel

Bottom Width: 70.00 ft Side Slope (H:V): 2.00 (_:1) Channel Slope: 0.0220 Channel Manning's n: 0.0300 Channel Invert Elevation: 4870.00 ft

Roadway Data for Crossing: Structure#703, Reach 700

Roadway Profile Shape: Constant Roadway Elevation

Crest Length: 100.00 ft Crest Elevation: 4879.00 ft Roadway Surface: Gravel Roadway Top Width: 12.76 ft



Site Data - Structure#704

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 ft Inlet Elevation: 4890.00 ft Outlet Station: 89.00 ft Outlet Elevation: 4888.00 ft Number of Barrels: 2

Culvert Data Summary - Structure#704

Barrel Shape: Circular Barrel Diameter: 4.00 ft Barrel Material: Concrete Embedment: 0.00 in Barrel Manning's n: 0.0120 Culvert Type: Straight

Inlet Configuration: Square Edge with Headwall

Inlet Depression: None

Table 5 - Culvert Summary Table: Structure#704

Discharge Names	Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth (ft)	Outlet Control Depth (ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)
5 Year	24.91 cfs	24.91 cfs	4891.39	1.39	0.0*	1-S2n	0.63	1.03	0.64	0.16	9.50	2.09
100 Year	172.00 cfs	172.00 cfs	4894.52	4.52	2.172	5-S2n	1.68	2.81	1.91	0.51	14.47	4.47

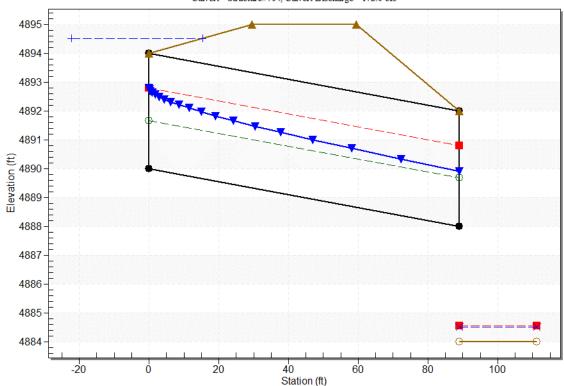
Culvert Barrel Data

Culvert Barrel Type Straight Culvert Inlet Elevation (invert): 4890.00 ft, Outlet Elevation (invert): 4888.00 ft

Culvert Length: 89.02 ft, Culvert Slope: 0.0225

Water Surface Profile Plot for Culvert: Structure#704

Crossing - Structure#704, Reach 700, 7700 Windsong Rd, Design Discharge - 172.0 cfs
Culvert - Structure#704, Culvert Discharge - 172.0 cfs



Tailwater Data for Crossing: Structure#704, Reach 700

Table 6 - Downstream Channel Rating Curve (Crossing: Structure#704, Reach 700)

Flow (cfs)	Water Surface Elev (ft)	Velocity (ft/s)	Depth (ft)	Shear (psf)	Froude Number
24.91	4884.16	0.16	2.09	0.28	0.92
172.00	4884.51	0.51	4.47	0.90	1.11

Tailwater Channel Data - Structure#704, Reach 700

Tailwater Channel Option: Trapezoidal Channel

Bottom Width: 73.00 ft Side Slope (H:V): 4.00 (_:1) Channel Slope: 0.0280 Channel Manning's n: 0.0350 Channel Invert Elevation: 4884.00 ft

Roadway Data for Crossing: Structure#704, Reach 700

Roadway Profile Shape: Constant Roadway Elevation

Crest Length: 100.00 ft Crest Elevation: 4895.00 ft Roadway Surface: Paved Roadway Top Width: 30.00 ft



Site Data - Structure#801

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 ft Inlet Elevation: 4960.15 ft Outlet Station: 74.00 ft Outlet Elevation: 4960.01 ft Number of Barrels: 2

Culvert Data Summary - Structure#801

Barrel Shape: Concrete Box

Barrel Span: 9.00 ft
Barrel Rise: 5.00 ft
Barrel Material: Concrete
Embedment: 0.00 in
Barrel Manning's n: 0.0120
Culvert Type: Straight

Inlet Configuration: Square Edge (90°) Headwall

Inlet Depression: None

Table 7 - Culvert Summary Table: Structure#801

Discharge Names	Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth (ft)	Outlet Control Depth (ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)
5 Year	18.94 cfs	18.94 cfs	4960.71	0.56	0.560	2-M2c	0.39	0.33	0.33	0.15	3.24	1.25
100 Year	845.00 cfs	845.00 cfs	4967.59	7.44	7.036	7-M2c	5.00	4.09	4.09	1.41	11.48	5.23

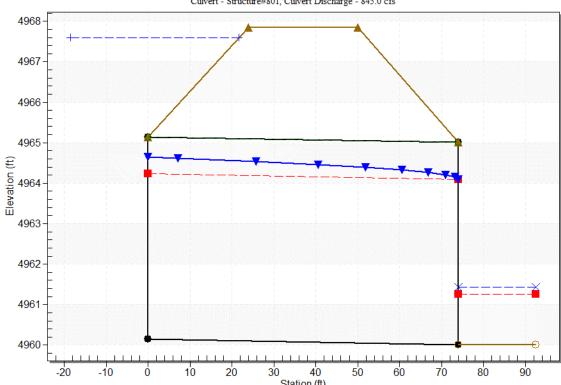
Culvert Barrel Data

Culvert Barrel Type Straight Culvert Inlet Elevation (invert): 4960.15 ft, Outlet Elevation (invert): 4960.01 ft

Culvert Length: 74.00 ft, Culvert Slope: 0.0018

Water Surface Profile Plot for Culvert: Structure#801

Crossing - Structure#801, Reach 800, CR-17, Design Discharge - 845.0 cfs
Culvert - Structure#801, Culvert Discharge - 845.0 cfs



Tailwater Data for Crossing: Structure#802, Reach 800

Table 8 - Downstream Channel Rating Curve (Crossing: Structure#802, Reach 800)

Flow (cfs)	Water Surface Elev (ft)	Velocity (ft/s)	Depth (ft)	Shear (psf)	Froude Number	
18.94	4960.16	0.15	1.25	0.17	0.58	
845.00	4961.42	1.41	5.23	1.63	0.82	

Tailwater Channel Data - Structure#801, Reach 800

Tailwater Channel Option: Trapezoidal Channel

Bottom Width: 100.00 ft Side Slope (H:V): 10.00 (_:1) Channel Slope: 0.0185 Channel Manning's n: 0.0450 Channel Invert Elevation: 4960.01 ft

Roadway Data for Crossing: Structure#801, Reach 800

Roadway Profile Shape: Constant Roadway Elevation

Crest Length: 100.00 ft Crest Elevation: 4967.84 ft Roadway Surface: Paved Roadway Top Width: 26.00 ft



Site Data - Structure#804

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 ft Inlet Elevation: 4889.00 ft Outlet Station: 90.00 ft Outlet Elevation: 4881.00 ft Number of Barrels: 2

Culvert Data Summary - Structure#804

Barrel Shape: Concrete Box

Barrel Span: 10.00 ft
Barrel Rise: 8.00 ft
Barrel Material: Concrete
Embedment: 0.00 in
Barrel Manning's n: 0.0130

Culvert Type: Straight

Inlet Configuration: Square Edge (30-75° flare) Wingwall

Inlet Depression: None

Table 9 - Culvert Summary Table: Structure#804

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Discharge Names	Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth (ft)	Outlet Control Depth (ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)
5 Year	126.99 cfs	126.99 cfs	4890.53	1.53	0.0*	1-S2n	0.37	1.08	0.38	0.92	16.52	2.04
100 Year	2045.00 cfs	2045.00 cfs	4900.34	11.34	3.375	5-S2n	2.24	6.87	3.48	4.68	29.35	5.53

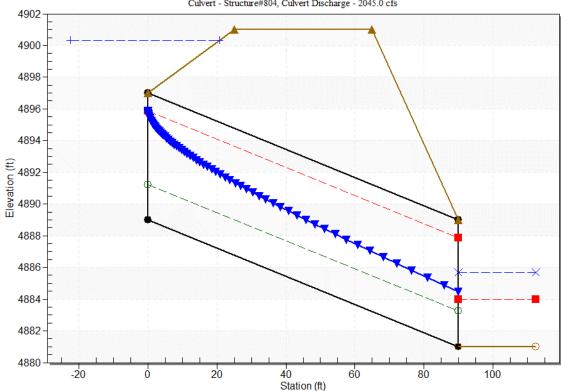
Culvert Barrel Data

Culvert Barrel Type Straight Culvert Inlet Elevation (invert): 4889.00 ft, Outlet Elevation (invert): 4881.00 ft

Culvert Length: 90.35 ft, Culvert Slope: 0.0889

Water Surface Profile Plot for Culvert: Structure#804

Crossing - Structure#804, Reach 800, Great Western Railway, Design Discharge - 2045.0 cfs
Culvert - Structure#804, Culvert Discharge - 2045.0 cfs



Tailwater Data for Crossing: Structure#804, Reach 800

Table 10 - Downstream Channel Rating Curve (Crossing: Structure#804, Reach 800)

Flow (cfs)	Water Surface Elev (ft)	Velocity (ft/s)	Depth (ft)	Shear (psf)	Froude Number
126.99	4881.92	0.92	2.04	0.63	0.38
2045.00	4885.68	4.68	5.53	3.21	0.49

Tailwater Channel Data - Structure#804, Reach 800

Tailwater Channel Option: Trapezoidal Channel

Bottom Width: 65.00 ft Side Slope (H:V): 3.00 (_:1) Channel Slope: 0.0110 Channel Manning's n: 0.0700 Channel Invert Elevation: 4881.00 ft

Roadway Data for Crossing: Structure#804, Reach 800

Roadway Profile Shape: Constant Roadway Elevation

Crest Length: 100.00 ft Crest Elevation: 4901.00 ft Roadway Surface: Gravel Roadway Top Width: 40.00 ft



Site Data - Structure#805

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 ft Inlet Elevation: 4892.00 ft Outlet Station: 62.00 ft Outlet Elevation: 4890.00 ft Number of Barrels: 6

Culvert Data Summary - Structure#805

Barrel Shape: Concrete Box

Barrel Span: 16.00 ft Barrel Rise: 3.50 ft Barrel Material: Concrete Embedment: 0.00 in Barrel Manning's n: 0.0120 Culvert Type: Straight

Inlet Configuration: Square Edge (90°) Headwall

Inlet Depression: None

Table 11 - Culvert Summary Table: Structure#805

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Discharge Names	Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth (ft)	Outlet Control Depth (ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)
5 Year	126.99 cfs	126.99 cfs	4892.63	0.63	0.0*	1-S2n	0.18	0.38	0.18	0.40	7.16	2.93
100 Year	1872.00	1872.00	4895.84	3.84	1.077	5-S2n	0.97	2.28	1.28	1.95	15.23	8.09

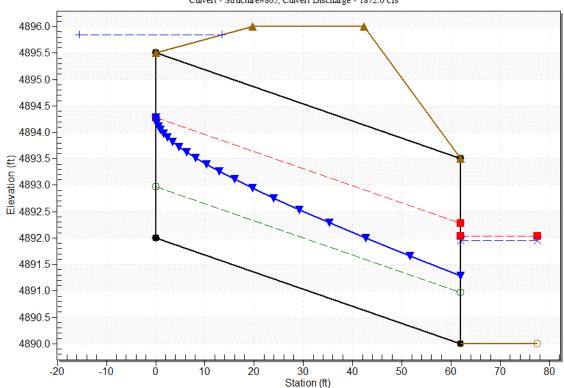
Culvert Barrel Data

Culvert Barrel Type Straight Culvert Inlet Elevation (invert): 4892.00 ft, Outlet Elevation (invert): 4890.00 ft

Culvert Length: 62.03 ft, Culvert Slope: 0.0323

Water Surface Profile Plot for Culvert: Structure#805

Crossing - Structure#805, Reach 800, Design Discharge - 1872.0 cfs



Tailwater Data for Crossing: Structure#805, Reach 800

Table 12 - Downstream Channel Rating Curve (Crossing: Structure#805, Reach 800)

Flow (cfs)	Water Surface Elev (ft)	Velocity (ft/s)	Depth (ft)	Shear (psf)	Froude Number	
126.99	4890.40	0.40	2.93	0.69	0.83	
1872.00	4891.95	1.95	8.09	3.41	1.07	

Tailwater Channel Data - Structure#805, Reach 800

Tailwater Channel Option: Trapezoidal Channel

Bottom Width: 107.00 ft Side Slope (H:V): 6.00 (_:1) Channel Slope: 0.0280 Channel Manning's n: 0.0450 Channel Invert Elevation: 4890.00 ft

Roadway Data for Crossing: Structure#805, Reach 800

Roadway Profile Shape: Constant Roadway Elevation

Crest Length: 100.00 ft Crest Elevation: 4896.00 ft Roadway Surface: Gravel Roadway Top Width: 22.60 ft



Site Data - Structure#806

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 ft Inlet Elevation: 4900.00 ft Outlet Station: 50.00 ft Outlet Elevation: 4899.00 ft Number of Barrels: 5

Culvert Data Summary - Structure#806

Barrel Shape: Concrete Box

Barrel Span: 12.00 ft
Barrel Rise: 4.00 ft
Barrel Material: Concrete
Embedment: 0.00 in
Barrel Manning's n: 0.0120
Culvert Type: Straight

Inlet Configuration: Square Edge (90°) Headwall

Inlet Depression: None

Table 13 - Culvert Summary Table: Structure#806

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Discharge Names	Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth (ft)	Outlet Control Depth (ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)
5 Year	124.66 cfs	124.66 cfs	4900.86	0.86	0.0*	1-S2n	0.28	0.51	0.29	0.57	7.11	1.88
100 Year	1877.00	1877.00	4905.53	5.53	4.101	5-S2n	1.55	3.12	2.17	2.86	14.45	5.31

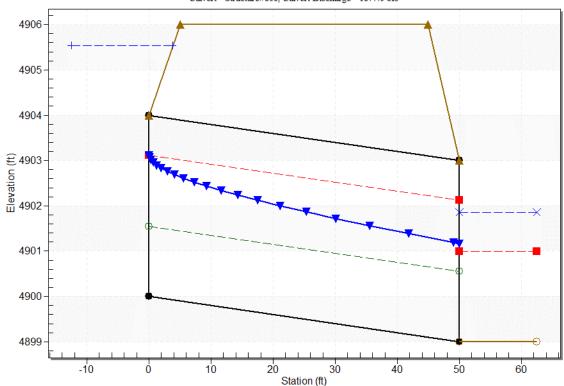
Culvert Barrel Data

Culvert Barrel Type Straight Culvert Inlet Elevation (invert): 4900.00 ft, Outlet Elevation (invert): 4899.00 ft

Culvert Length: 50.01 ft, Culvert Slope: 0.0200

Water Surface Profile Plot for Culvert: Structure#806

Crossing - Structure#806, Reach 800, Design Discharge - 1877.0 cfs



Tailwater Data for Crossing: Structure#806, Reach 800
Table 14 - Downstream Channel Rating Curve (Crossing: Structure#806, Reach 800)

Flow (cfs)	Water Surface Elev (ft)	Velocity (ft/s)	Depth (ft)	Shear (psf)	Froude Number	
124.66	4899.57	0.57	1.88	0.60	0.44	
1877.00	4901.86	2.86	5.31	3.03	0.57	

Tailwater Channel Data - Structure#806, Reach 800

Tailwater Channel Option: Trapezoidal Channel

Bottom Width: 115.00 ft Side Slope (H:V): 3.00 (_:1) Channel Slope: 0.0170 Channel Manning's n: 0.0700 Channel Invert Elevation: 4899.00 ft

Roadway Data for Crossing: Structure#806, Reach 800

Roadway Profile Shape: Constant Roadway Elevation

Crest Length: 100.00 ft Crest Elevation: 4906.00 ft Roadway Surface: Paved Roadway Top Width: 40.00 ft



Site Data - Structure#807

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 ft Inlet Elevation: 4917.00 ft Outlet Station: 80.00 ft Outlet Elevation: 4916.00 ft Number of Barrels: 3

Culvert Data Summary - Structure#807

Barrel Shape: Concrete Box

Barrel Span: 12.00 ft Barrel Rise: 5.00 ft Barrel Material: Concrete Embedment: 0.00 in Barrel Manning's n: 0.0120 Culvert Type: Straight

Inlet Configuration: Square Edge (30-75° flare) Wingwall

Inlet Depression: None

Table 15 - Culvert Summary Table: Structure#807

Tubic 10	- Ouivei	t Guillilla	ily labic.	Othuct	ui ciroo							
Discharge Names	Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth (ft)	Outlet Control Depth (ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)
5 Year	63.00 cfs	63.00 cfs	4917.69	0.69	0.0*	1-S2n	0.29	0.46	0.29	0.27	6.01	0.98
100 Year	1507.00	1507.00	4923.08	6.08	5.089	5-S2n	2.20	3.79	2.79	1.82	15.02	3.39

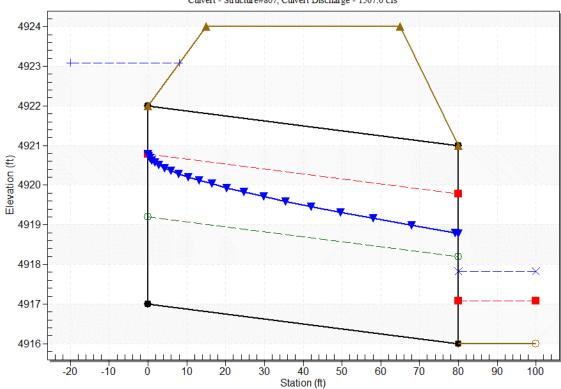
Culvert Barrel Data

Culvert Barrel Type Straight Culvert Inlet Elevation (invert): 4917.00 ft, Outlet Elevation (invert): 4916.00 ft

Culvert Length: 80.01 ft, Culvert Slope: 0.0125

Water Surface Profile Plot for Culvert: Structure#807

Crossing - Structure#807, Reach 829, 1120 Southgate Dr, Design Discharge - 1507.0 cfs
Culvert - Structure#807, Culvert Discharge - 1507.0 cfs



Tailwater Data for Crossing: Structure#807, Reach 829

Table 16 - Downstream Channel Rating Curve (Crossing: Structure#807, Reach 829)

Flow (cfs	Water Surface Elev (ft)	Velocity (ft/s)	Depth (ft)	Shear (psf)	Froude Number	
63.00	4916.27	0.27	0.98	0.09	0.33	
1507.00	4917.82	1.82	3.39	0.57	0.45	

Tailwater Channel Data - Structure#807, Reach 829

Tailwater Channel Option: Trapezoidal Channel

Bottom Width: 235.00 ft Side Slope (H:V): 5.00 (_:1) Channel Slope: 0.0050 Channel Manning's n: 0.0450 Channel Invert Elevation: 4916.00 ft

Roadway Data for Crossing: Structure#807, Reach 829

Roadway Profile Shape: Constant Roadway Elevation

Crest Length: 100.00 ft Crest Elevation: 4924.00 ft Roadway Surface: Paved Roadway Top Width: 50.00 ft



Site Data - Structure#808

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 ft Inlet Elevation: 4942.00 ft Outlet Station: 527.00 ft Outlet Elevation: 4932.00 ft Number of Barrels: 3

Culvert Data Summary - Structure#808

Barrel Shape: Concrete Box

Barrel Span: 12.00 ft Barrel Rise: 5.00 ft Barrel Material: Concrete Embedment: 0.00 in Barrel Manning's n: 0.0120 Culvert Type: Straight

Inlet Configuration: Square Edge (90°) Headwall

Inlet Depression: None

Table 17 - Culvert Summary Table: Structure#808

I UDIC 17	- Ouivei	Countin	ily labic.	Othuct	ui ciroo	0						
Discharge Names	Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth (ft)	Outlet Control Depth (ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)
5 Year	36.03 cfs	36.03 cfs	4942.53	0.53	0.0*	1-S2n	0.18	0.31	0.18	0.33	5.63	1.64
100 Year	1300.00	1300.00	4947.88	5.88	0.0*	5-S2n	1.73	3.43	1.78	2.74	20.29	6.02

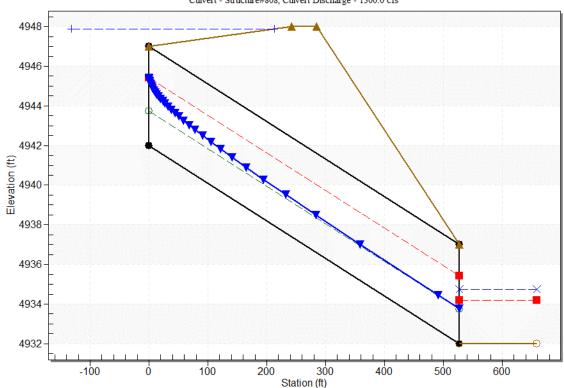
Culvert Barrel Data

Culvert Barrel Type Straight Culvert Inlet Elevation (invert): 4942.00 ft, Outlet Elevation (invert): 4932.00 ft

Culvert Length: 527.09 ft, Culvert Slope: 0.0190

Water Surface Profile Plot for Culvert: Structure#808

Crossing - Structure#808, Reach 829, Design Discharge - 1300.0 cfs
Culvert - Structure#808, Culvert Discharge - 1300.0 cfs



Tailwater Data for Crossing: Structure#808, Reach 829
Table 18 - Downstream Channel Rating Curve (Crossing: Structure#808, Reach 829)

Flow (cfs)	Water Surface Elev (ft)	Velocity (ft/s)	Depth (ft)	Shear (psf)	Froude Number	
36.03	4932.33	0.33	1.64	0.23	0.51	
1300.00	4934.74	2.74	6.02	1.88	0.70	

Tailwater Channel Data - Structure#808, Reach 829

Tailwater Channel Option: Trapezoidal Channel

Bottom Width: 64.00 ft Side Slope (H:V): 5.40 (_:1) Channel Slope: 0.0110 Channel Manning's n: 0.0450 Channel Invert Elevation: 4932.00 ft

Roadway Data for Crossing: Structure#808, Reach 829

Roadway Profile Shape: Constant Roadway Elevation

Crest Length: 100.00 ft Crest Elevation: 4948.00 ft Roadway Surface: Paved Roadway Top Width: 43.00 ft



Site Data - Structure#809

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 ft Inlet Elevation: 4958.00 ft Outlet Station: 304.00 ft Outlet Elevation: 4948.00 ft Number of Barrels: 2

Culvert Data Summary - Structure#809

Barrel Shape: Concrete Box

Barrel Span: 12.00 ft
Barrel Rise: 7.00 ft
Barrel Material: Concrete
Embedment: 0.00 in
Barrel Manning's n: 0.0120
Culvert Type: Straight

Inlet Configuration: Square Edge (90°) Headwall

Inlet Depression: None

Table 19 - Culvert Summary Table: Structure#809

I GDIO 10	Guitoi	Counning	ily rabio.	Otiaot	ai on oo	•						
Discharge Names	Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth (ft)	Outlet Control Depth (ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)
5 Year	36.03 cfs	36.03 cfs	4958.68	0.68	0.0*	1-S2n	0.20	0.41	0.20	0.11	7.67	21.45
100 Year	1300.00	1300.00	4965.58	7.58	0.0*	5-S2n	1.89	4.50	2.13	0.98	25.43	86.35

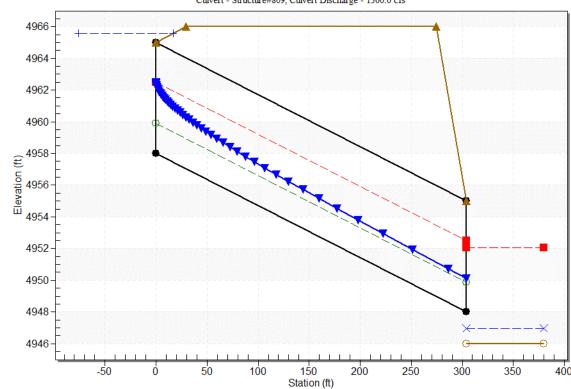
Culvert Barrel Data

Culvert Barrel Type Straight Culvert Inlet Elevation (invert): 4958.00 ft, Outlet Elevation (invert): 4948.00 ft

Culvert Length: 304.16 ft, Culvert Slope: 0.0329

Water Surface Profile Plot for Culvert: Structure#809

Crossing - Structure#809, Reach 843, US-34, Design Discharge - 1300.0 cfs
Culvert - Structure#809, Culvert Discharge - 1300.0 cfs



Tailwater Data for Crossing: Structure#809, Reach 843
Table 20 - Downstream Channel Rating Curve (Crossing: Structure#809, Reach 843)

Flow (cfs)	Water Surface Elev (ft)	Velocity (ft/s)	Depth (ft)	Shear (psf)	Froude Number	
36.03	4946.11	0.11	21.45	34.03	11.45	
1300.00	4946.98	0.98	86.35	305.00	15.39	

Tailwater Channel Data - Structure#809, Reach 843

Tailwater Channel Option: Rectangular Channel

Bottom Width: 15.40 ft Channel Slope: 5.0000 Channel Manning's n: 0.0350 Channel Invert Elevation: 4946.00 ft

Roadway Data for Crossing: Structure#809, Reach 843

Roadway Profile Shape: Constant Roadway Elevation

Crest Length: 100.00 ft Crest Elevation: 4966.00 ft Roadway Surface: Paved Roadway Top Width: 245.00 ft



Site Data - Structure#702

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 ft
Inlet Elevation: 4867.00 ft
Outlet Station: 97.00 ft
Outlet Elevation: 4862.00 ft
Number of Barrels: 2

Culvert Data Summary - Structure#702

Barrel Shape: Circular Barrel Diameter: 3.00 ft Barrel Material: Concrete Embedment: 0.00 in Barrel Manning's n: 0.0120 Culvert Type: Straight

Inlet Configuration: Square Edge with Headwall

Inlet Depression: None

Table 1 - Culvert Summary Table: Structure#702

Discharge Names	Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth (ft)	Outlet Control Depth (ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)
5 Year	24.91 cfs	24.91 cfs	4868.49	1.49	0.0*	1-S2n	0.56	1.12	0.56	0.23	13.73	2.12
100 Year	128.47 cfs	128.47 cfs	4872.19	5.19	0.473	5-S2n	1.30	2.57	1.47	0.61	18.64	4.00

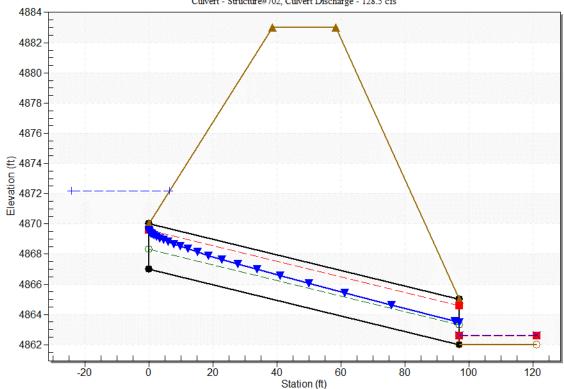
Culvert Barrel Data

Culvert Barrel Type Straight Culvert Inlet Elevation (invert): 4867.00 ft, Outlet Elevation (invert): 4862.00 ft

Culvert Length: 97.13 ft, Culvert Slope: 0.0515

Water Surface Profile Plot for Culvert: Structure#702

Crossing - Structure#702, Reach 700, Great Western Railway, Design Discharge - 128.5 cfs



Tailwater Data for Crossing: Structure#702, Reach 700

Table 2 - Downstream Channel Rating Curve (Crossing: Structure#702, Reach 700)

Flow (cfs)	Water Surface Elev (ft)	Velocity (ft/s)	Depth (ft)	Shear (psf)	Froude Number
24.91	4862.23	0.23	2.12	0.43	0.79
128.47	4862.61	0.61	4.00	1.15	0.92

Tailwater Channel Data - Structure#702, Reach 700

Tailwater Channel Option: Trapezoidal Channel

Bottom Width: 50.00 ft Side Slope (H:V): 4.00 (_:1) Channel Slope: 0.0300 Channel Manning's n: 0.0450 Channel Invert Elevation: 4862.00 ft

Roadway Data for Crossing: Structure#702, Reach 700

Roadway Profile Shape: Constant Roadway Elevation

Crest Length: 100.00 ft Crest Elevation: 4883.00 ft Roadway Surface: Gravel Roadway Top Width: 20.00 ft



Site Data - Structure#703,

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 ft Inlet Elevation: 4872.00 ft Outlet Station: 42.00 ft Outlet Elevation: 4871.00 ft Number of Barrels: 2

Culvert Data Summary - Structure#703,

Barrel Shape: Circular Barrel Diameter: 3.00 ft Barrel Material: Concrete Embedment: 0.00 in Barrel Manning's n: 0.0120 Culvert Type: Straight

Inlet Configuration: Square Edge with Headwall

Inlet Depression: None

Table 3 - Culvert Summary Table: Structure#703

Discharge Names	Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth (ft)	Outlet Control Depth (ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)
5 Year	24.91 cfs	24.91 cfs	4873.53	1.53	0.206	1-S2n	0.68	1.12	0.74	0.16	9.15	2.18
100 Year	128.00 cfs	128.00 cfs	4877.21	5.21	4.022	5-S2n	1.63	2.57	1.95	0.43	13.12	4.17

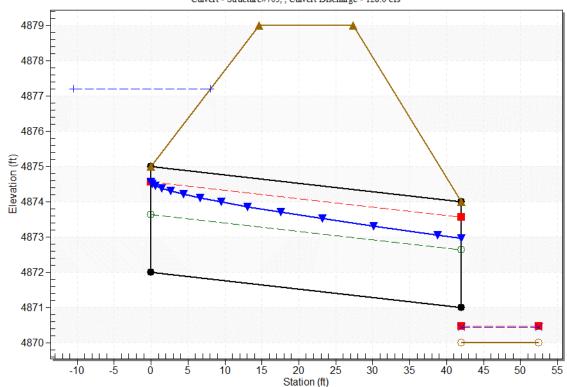
Culvert Barrel Data

Culvert Barrel Type Straight Culvert Inlet Elevation (invert): 4872.00 ft, Outlet Elevation (invert): 4871.00 ft

Culvert Length: 42.01 ft, Culvert Slope: 0.0238

Water Surface Profile Plot for Culvert: Structure#703

Crossing - Structure#703, Reach 700, Design Discharge - 128.0 cfs



Tailwater Data for Crossing: Structure#703, Reach 700

Table 4 - Downstream Channel Rating Curve (Crossing: Structure#703, Reach 700)

Flow (cfs)	Water Surface Elev (ft)	Velocity (ft/s)	Depth (ft)	Shear (psf)	Froude Number	
24.91	4870.16	0.16	2.18	0.22	0.95	
128.00	4870.43	0.43	4.17	0.60	1.12	

Tailwater Channel Data - Structure#703, Reach 700

Tailwater Channel Option: Trapezoidal Channel

Bottom Width: 70.00 ft Side Slope (H:V): 2.00 (_:1) Channel Slope: 0.0220 Channel Manning's n: 0.0300 Channel Invert Elevation: 4870.00 ft

Roadway Data for Crossing: Structure#703, Reach 700

Roadway Profile Shape: Constant Roadway Elevation

Crest Length: 100.00 ft Crest Elevation: 4879.00 ft Roadway Surface: Gravel Roadway Top Width: 12.76 ft



Site Data - Structure#704

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 ft
Inlet Elevation: 4890.00 ft
Outlet Station: 89.00 ft
Outlet Elevation: 4888.00 ft
Number of Barrels: 2

Culvert Data Summary - Structure#704

Barrel Shape: Circular Barrel Diameter: 4.00 ft Barrel Material: Concrete Embedment: 0.00 in Barrel Manning's n: 0.0120 Culvert Type: Straight

Inlet Configuration: Square Edge with Headwall

Inlet Depression: None

Table 5 - Culvert Summary Table: Structure#704

Discharge Names	Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth (ft)	Outlet Control Depth (ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)
5 Year	24.91 cfs	24.91 cfs	4891.39	1.39	0.0*	1-S2n	0.63	1.03	0.64	0.16	9.50	2.09
100 Year	172.00 cfs	172.00 cfs	4894.52	4.52	2.172	5-S2n	1.68	2.81	1.91	0.51	14.47	4.47

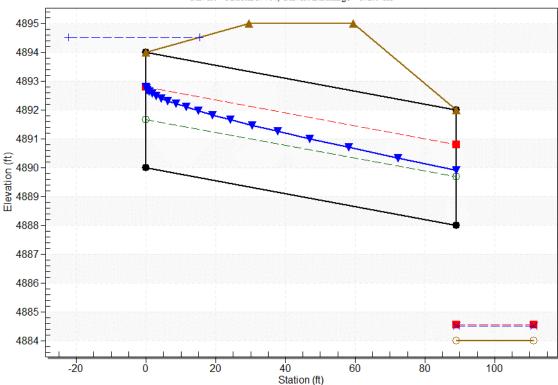
Culvert Barrel Data

Culvert Barrel Type Straight Culvert Inlet Elevation (invert): 4890.00 ft, Outlet Elevation (invert): 4888.00 ft

Culvert Length: 89.02 ft, Culvert Slope: 0.0225

Water Surface Profile Plot for Culvert: Structure#704

Crossing - Structure#704, Reach 700, 7700 Windsong Rd, Design Discharge - 172.0 cfs
Culvert - Structure#704, Culvert Discharge - 172.0 cfs



Tailwater Data for Crossing: Structure#704, Reach 700

Table 6 - Downstream Channel Rating Curve (Crossing: Structure#704, Reach 700)

Flow (cfs)	Water Surface Elev (ft)	Velocity (ft/s)	Depth (ft)	Shear (psf)	Froude Number
24.91	4884.16	0.16	2.09	0.28	0.92
172.00	4884.51	0.51	4.47	0.90	1.11

Tailwater Channel Data - Structure#704, Reach 700

Tailwater Channel Option: Trapezoidal Channel

Bottom Width: 73.00 ft Side Slope (H:V): 4.00 (_:1) Channel Slope: 0.0280 Channel Manning's n: 0.0350 Channel Invert Elevation: 4884.00 ft

Roadway Data for Crossing: Structure#704, Reach 700

Roadway Profile Shape: Constant Roadway Elevation

Crest Length: 100.00 ft Crest Elevation: 4895.00 ft Roadway Surface: Paved Roadway Top Width: 30.00 ft



Site Data - Structure#801

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 ft Inlet Elevation: 4960.15 ft Outlet Station: 74.00 ft Outlet Elevation: 4960.01 ft

Number of Barrels: 1

Culvert Data Summary - Structure#801

Barrel Shape: Concrete Box

Barrel Span: 6.00 ft
Barrel Rise: 4.00 ft
Barrel Material: Concrete
Embedment: 0.00 in
Barrel Manning's n: 0.0120
Culvert Type: Straight

Inlet Configuration: Square Edge (90°) Headwall

Inlet Depression: None

Table 7 - Culvert Summary Table: Structure#801

Discharge Names	Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth (ft)	Outlet Control Depth (ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)
5 Year	18.94 cfs	18.94 cfs	4961.31	1.16	1.162	2-M2c	0.80	0.68	0.68	0.15	4.67	1.25
100 Year	203.00 cfs	203.00 cfs	4966.14	5.99	5.647	7-M2c	4.00	3.29	3.29	0.61	10.29	3.12

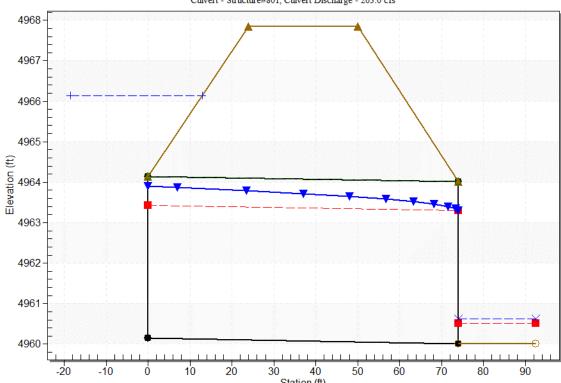
Culvert Barrel Data

Culvert Barrel Type Straight Culvert Inlet Elevation (invert): 4960.15 ft, Outlet Elevation (invert): 4960.01 ft

Culvert Length: 74.00 ft, Culvert Slope: 0.0018

Water Surface Profile Plot for Culvert: Structure#801

Crossing - Structure#801, Reach 800, CR-17, Design Discharge - 203.0 cfs
Culvert - Structure#801, Culvert Discharge - 203.0 cfs



Tailwater Data for Crossing: Structure#802, Reach 800

Table 8 - Downstream Channel Rating Curve (Crossing: Structure#802, Reach 800)

Flow (cfs)	Water Surface Elev (ft)	Velocity (ft/s)	Depth (ft)	Shear (psf)	Froude Number	
18.94	4960.16	0.15	1.25	0.17	0.58	
203.00	4960.62	0.61	3.12	0.71	0.72	

Tailwater Channel Data - Structure#801, Reach 800

Tailwater Channel Option: Trapezoidal Channel

Bottom Width: 100.00 ft Side Slope (H:V): 10.00 (_:1) Channel Slope: 0.0185 Channel Manning's n: 0.0450 Channel Invert Elevation: 4960.01 ft

Roadway Data for Crossing: Structure#801, Reach 800

Roadway Profile Shape: Constant Roadway Elevation

Crest Length: 100.00 ft Crest Elevation: 4967.84 ft Roadway Surface: Paved Roadway Top Width: 26.00 ft



Site Data - Structure#804

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 ft Inlet Elevation: 4889.00 ft Outlet Station: 90.00 ft Outlet Elevation: 4881.00 ft

Number of Barrels: 1

Culvert Data Summary - Structure#804

Barrel Shape: Concrete Box

Barrel Span: 6.00 ft
Barrel Rise: 7.00 ft
Barrel Material: Concrete
Embedment: 0.00 in
Barrel Manning's n: 0.0130
Culvert Type: Straight

Inlet Configuration: Square Edge (30-75° flare) Wingwall

Inlet Depression: None

Table 9 - Culvert Summary Table: Structure#804

1 4510	o ourrore	Gaiiiiiai	y i abioi	<u> </u>	1011001							
Dischard Names	ge Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth (ft)	Outlet Control Depth (ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)
5 Year	126.99 cfs	126.99 cfs	4892.40	3.40	0.0*	1-S2n	0.83	2.41	0.96	0.92	22.06	2.04
100 Year	413.00 cfs	413.00 cfs	4897.20	8.20	0.593	5-S2n	1.84	5.28	2.55	1.85	26.95	3.17

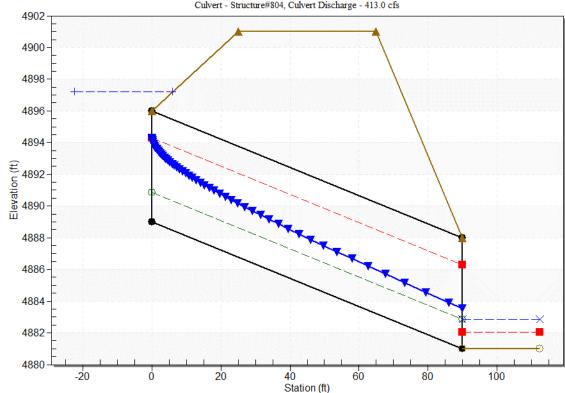
Culvert Barrel Data

Culvert Barrel Type Straight Culvert Inlet Elevation (invert): 4889.00 ft, Outlet Elevation (invert): 4881.00 ft

Culvert Length: 90.35 ft, Culvert Slope: 0.0889

Water Surface Profile Plot for Culvert: Structure#804

Crossing - Structure#804, Reach 800, Great Western Railway, Design Discharge - 413.0 cfs
Culvert - Structure#804, Culvert Discharge - 413.0 cfs



Tailwater Data for Crossing: Structure#804, Reach 800

Table 10 - Downstream Channel Rating Curve (Crossing: Structure#804, Reach 800)

Flow (cfs)	Water Surface Elev (ft)	Velocity (ft/s)	Depth (ft)	Shear (psf)	Froude Number	
126.99	4881.92	0.92	2.04	0.63	0.38	
413.00	4882.85	1.85	3.17	1.27	0.43	

Tailwater Channel Data - Structure#804, Reach 800

Tailwater Channel Option: Trapezoidal Channel

Bottom Width: 65.00 ft Side Slope (H:V): 3.00 (_:1) Channel Slope: 0.0110 Channel Manning's n: 0.0700 Channel Invert Elevation: 4881.00 ft

Roadway Data for Crossing: Structure#804, Reach 800

Roadway Profile Shape: Constant Roadway Elevation

Crest Length: 100.00 ft Crest Elevation: 4901.00 ft Roadway Surface: Gravel Roadway Top Width: 40.00 ft



Site Data - Structure#805

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 ft Inlet Elevation: 4892.00 ft Outlet Station: 62.00 ft Outlet Elevation: 4890.00 ft

Number of Barrels: 3

Culvert Data Summary - Structure#805

Barrel Shape: Concrete Box

Barrel Span: 8.00 ft
Barrel Rise: 3.00 ft
Barrel Material: Concrete
Embedment: 0.00 in
Barrel Manning's n: 0.0120
Culvert Type: Straight

Inlet Configuration: Square Edge (90°) Headwall

Inlet Depression: None

Table 11 - Culvert Summary Table: Structure#805

Discharge Names	Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth (ft)	Outlet Control Depth (ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)
5 Year	126.99 cfs	126.99 cfs	4893.59	1.59	0.0*	1-S2n	0.44	0.95	0.48	0.40	10.94	2.93
100 Year	355.00 cfs	355.00 cfs	4895.18	3.18	0.547	5-S2n	0.84	1.89	1.05	0.73	14.15	4.36

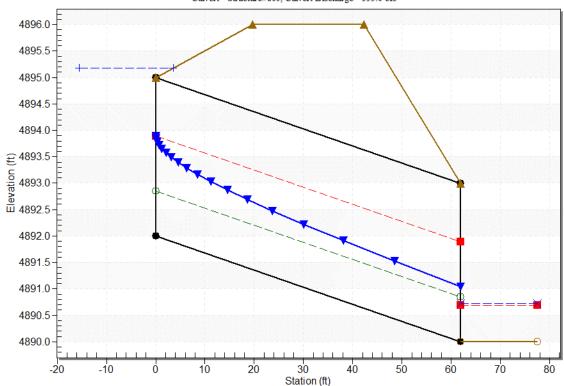
Culvert Barrel Data

Culvert Barrel Type Straight Culvert Inlet Elevation (invert): 4892.00 ft, Outlet Elevation (invert): 4890.00 ft

Culvert Length: 62.03 ft, Culvert Slope: 0.0323

Water Surface Profile Plot for Culvert: Structure#805

Crossing - Structure#805, Reach 800, Design Discharge - 355.0 cfs
Culvert - Structure#805, Culvert Discharge - 355.0 cfs



Tailwater Data for Crossing: Structure#805, Reach 800

Table 12 - Downstream Channel Rating Curve (Crossing: Structure#805, Reach 800)

Flow (cfs)	Water Surface Elev (ft)	Velocity (ft/s)	Depth (ft)	Shear (psf)	Froude Number
126.99	4890.40	0.40	2.93	0.69	0.83
355.00	4890.73	0.73	4.36	1.28	0.92

Tailwater Channel Data - Structure#805, Reach 800

Tailwater Channel Option: Trapezoidal Channel

Bottom Width: 107.00 ft Side Slope (H:V): 6.00 (_:1) Channel Slope: 0.0280 Channel Manning's n: 0.0450 Channel Invert Elevation: 4890.00 ft

Roadway Data for Crossing: Structure#805, Reach 800

Roadway Profile Shape: Constant Roadway Elevation

Crest Length: 100.00 ft Crest Elevation: 4896.00 ft Roadway Surface: Gravel Roadway Top Width: 22.60 ft



Site Data - Structure#806

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 ft Inlet Elevation: 4900.00 ft Outlet Station: 50.00 ft Outlet Elevation: 4899.00 ft

Number of Barrels: 1

Culvert Data Summary - Structure#806

Barrel Shape: Concrete Box

Barrel Span: 12.00 ft
Barrel Rise: 4.00 ft
Barrel Material: Concrete
Embedment: 0.00 in
Barrel Manning's n: 0.0120
Culvert Type: Straight

Inlet Configuration: Square Edge (90°) Headwall

Inlet Depression: None

Table 13 - Culvert Summary Table: Structure#806

Discharge Names	Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth (ft)	Outlet Control Depth (ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)
5 Year	124.66 cfs	124.66 cfs	4902.51	2.51	0.666	1-S2n	0.77	1.50	0.93	0.57	11.14	1.88
100 Year	355.00 cfs	355.00 cfs	4905.26	5.26	3.881	5-S2n	1.49	3.01	2.07	1.06	14.26	2.83

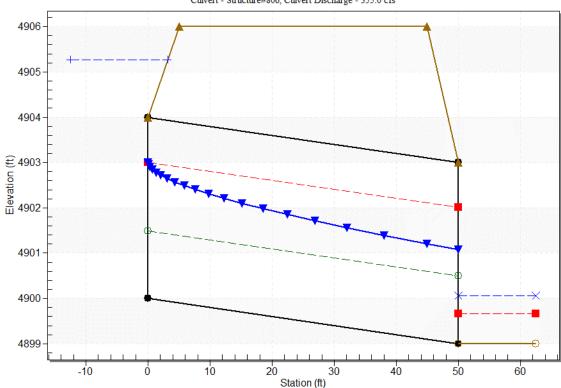
Culvert Barrel Data

Culvert Barrel Type Straight Culvert Inlet Elevation (invert): 4900.00 ft, Outlet Elevation (invert): 4899.00 ft

Culvert Length: 50.01 ft, Culvert Slope: 0.0200

Water Surface Profile Plot for Culvert: Structure#806

Crossing - Structure#806, Reach 800, Design Discharge - 355.0 cfs
Culvert - Structure#806, Culvert Discharge - 355.0 cfs



Tailwater Data for Crossing: Structure#806, Reach 800

Table 14 - Downstream Channel Rating Curve (Crossing: Structure#806, Reach 800)

Flow (cfs)	Water Surface Elev (ft)	Velocity (ft/s)	Depth (ft)	Shear (psf)	Froude Number	
124.66	4899.57	0.57	1.88	0.60	0.44	
355.00	4900.06	1.06	2.83	1.13	0.49	

Tailwater Channel Data - Structure#806, Reach 800

Tailwater Channel Option: Trapezoidal Channel

Bottom Width: 115.00 ft Side Slope (H:V): 3.00 (_:1) Channel Slope: 0.0170 Channel Manning's n: 0.0700 Channel Invert Elevation: 4899.00 ft

Roadway Data for Crossing: Structure#806, Reach 800

Roadway Profile Shape: Constant Roadway Elevation

Crest Length: 100.00 ft Crest Elevation: 4906.00 ft Roadway Surface: Paved Roadway Top Width: 40.00 ft



Site Data - Structure#807

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 ft Inlet Elevation: 4917.00 ft Outlet Station: 80.00 ft Outlet Elevation: 4916.00 ft

Number of Barrels: 1

Culvert Data Summary - Structure#807

Barrel Shape: Concrete Box

Barrel Span: 12.00 ft
Barrel Rise: 4.00 ft
Barrel Material: Concrete
Embedment: 0.00 in
Barrel Manning's n: 0.0120
Culvert Type: Straight

Inlet Configuration: Square Edge (30-75° flare) Wingwall

Inlet Depression: None

Table 15 - Culvert Summary Table: Structure#807

Discharge Names	Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth (ft)	Outlet Control Depth (ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)
5 Year	63.00 cfs	63.00 cfs	4918.44	1.44	0.0*	1-S2n	0.58	0.95	0.61	0.27	8.64	0.98
100 Year	435.00 cfs	435.00 cfs	4922.84	5.84	4.755	5-S2n	2.00	3.44	2.50	0.87	14.49	2.10

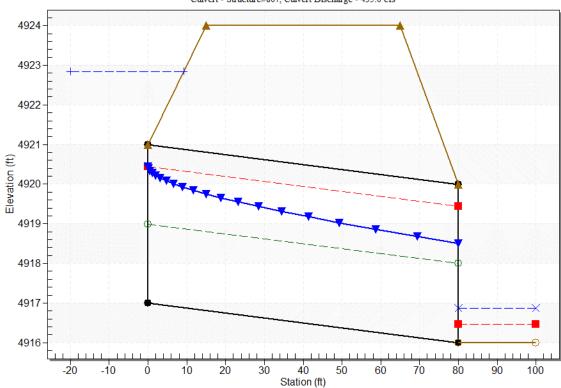
Culvert Barrel Data

Culvert Barrel Type Straight Culvert Inlet Elevation (invert): 4917.00 ft, Outlet Elevation (invert): 4916.00 ft

Culvert Length: 80.01 ft, Culvert Slope: 0.0125

Water Surface Profile Plot for Culvert: Structure#807

Crossing - Structure#807, Reach 829, 1120 Southgate Dr, Design Discharge - 435.0 cfs
Culvert - Structure#807, Culvert Discharge - 435.0 cfs



Tailwater Data for Crossing: Structure#807, Reach 829

Table 16 - Downstream Channel Rating Curve (Crossing: Structure#807, Reach 829)

Flow (cfs)	Water Surface Elev (ft)	Velocity (ft/s)	Depth (ft)	Shear (psf)	Froude Number	
63.00	4916.27	0.27	0.98	0.09	0.33	
435.00	4916.87	0.87	2.10	0.27	0.40	

Tailwater Channel Data - Structure#807, Reach 829

Tailwater Channel Option: Trapezoidal Channel

Bottom Width: 235.00 ft Side Slope (H:V): 5.00 (_:1) Channel Slope: 0.0050 Channel Manning's n: 0.0450 Channel Invert Elevation: 4916.00 ft

Roadway Data for Crossing: Structure#807, Reach 829

Roadway Profile Shape: Constant Roadway Elevation

Crest Length: 100.00 ft Crest Elevation: 4924.00 ft Roadway Surface: Paved Roadway Top Width: 50.00 ft



Site Data - Structure#808

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 ft Inlet Elevation: 4942.00 ft Outlet Station: 527.00 ft Outlet Elevation: 4932.00 ft

Number of Barrels: 1

Culvert Data Summary - Structure#808

Barrel Shape: Concrete Box

Barrel Span: 12.00 ft
Barrel Rise: 4.00 ft
Barrel Material: Concrete
Embedment: 0.00 in
Barrel Manning's n: 0.0120
Culvert Type: Straight

Inlet Configuration: Square Edge (90°) Headwall

Inlet Depression: None

Table 17 - Culvert Summary Table: Structure#808

Discharge Names	Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth (ft)	Outlet Control Depth (ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)
5 Year	36.03 cfs	36.03 cfs	4943.10	1.10	0.0*	1-S2n	0.36	0.65	0.36	0.33	8.38	1.64
100 Year	341.00 cfs	341.00 cfs	4947.09	5.09	0.0*	5-S2n	1.48	2.93	1.51	1.27	18.77	3.80

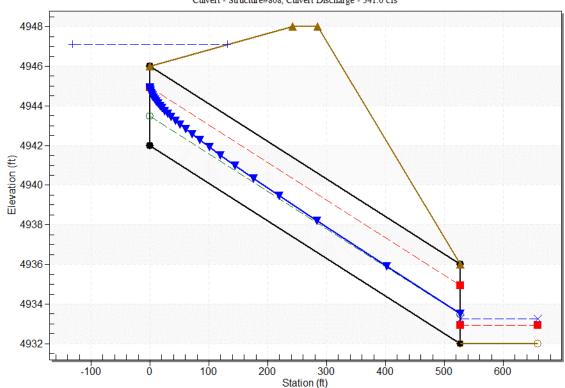
Culvert Barrel Data

Culvert Barrel Type Straight Culvert Inlet Elevation (invert): 4942.00 ft, Outlet Elevation (invert): 4932.00 ft

Culvert Length: 527.09 ft, Culvert Slope: 0.0190

Water Surface Profile Plot for Culvert: Structure#808

Crossing - Structure#808, Reach 829, Design Discharge - 341.0 cfs
Culvert - Structure#808, Culvert Discharge - 341.0 cfs



Tailwater Data for Crossing: Structure#808, Reach 829
Table 18 - Downstream Channel Rating Curve (Crossing: Structure#808, Reach 829)

Flow (cfs)	Water Surface Elev (ft)	Velocity (ft/s)	Depth (ft)	Shear (psf)	Froude Number	
36.03	4932.33	0.33	1.64	0.23	0.51	
341.00	4933.27	1.27	3.80	0.87	0.62	

Tailwater Channel Data - Structure#808, Reach 829

Tailwater Channel Option: Trapezoidal Channel

Bottom Width: 64.00 ft Side Slope (H:V): 5.40 (_:1) Channel Slope: 0.0110 Channel Manning's n: 0.0450 Channel Invert Elevation: 4932.00 ft

Roadway Data for Crossing: Structure#808, Reach 829

Roadway Profile Shape: Constant Roadway Elevation

Crest Length: 100.00 ft Crest Elevation: 4948.00 ft Roadway Surface: Paved Roadway Top Width: 43.00 ft



Site Data - Structure#809

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 ft Inlet Elevation: 4958.00 ft Outlet Station: 304.00 ft Outlet Elevation: 4948.00 ft

Number of Barrels: 1

Culvert Data Summary - Structure#809

Barrel Shape: Concrete Box

Barrel Span: 10.00 ft
Barrel Rise: 4.00 ft
Barrel Material: Concrete
Embedment: 0.00 in
Barrel Manning's n: 0.0120
Culvert Type: Straight

Inlet Configuration: Square Edge (90°) Headwall

Inlet Depression: None

Table 19 - Culvert Summary Table: Structure#809

Discharge Names	Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth (ft)	Outlet Control Depth (ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)
5 Year	36.03 cfs	36.03 cfs	4959.23	1.23	0.0*	1-S2n	0.34	0.74	0.34	0.11	10.59	21.45
100 Year	341.00 cfs	341.00 cfs	4963.98	5.98	0.0*	5-S2n	1.42	3.31	1.51	0.43	22.53	51.90

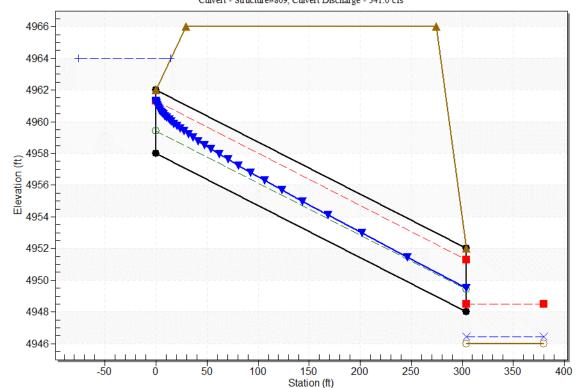
Culvert Barrel Data

Culvert Barrel Type Straight Culvert Inlet Elevation (invert): 4958.00 ft, Outlet Elevation (invert): 4948.00 ft

Culvert Length: 304.16 ft, Culvert Slope: 0.0329

Water Surface Profile Plot for Culvert: Structure#809

Crossing - Structure#809, Reach 843, US-34, Design Discharge - 341.0 cfs
Culvert - Structure#809, Culvert Discharge - 341.0 cfs



Tailwater Data for Crossing: Structure#809, Reach 843
Table 20 - Downstream Channel Rating Curve (Crossing: Structure#809, Reach 843)

Flow (cfs)	Water Surface Elev (ft)	Velocity (ft/s)	Depth (ft)	Shear (psf)	Froude Number	
36.03	4946.11	0.11	21.45	34.03	11.45	
341.00	4946.43	0.43	51.90	133.12	14.00	

Tailwater Channel Data - Structure#809, Reach 843

Tailwater Channel Option: Rectangular Channel

Bottom Width: 15.40 ft Channel Slope: 5.0000 Channel Manning's n: 0.0350 Channel Invert Elevation: 4946.00 ft

Roadway Data for Crossing: Structure#809, Reach 843

Roadway Profile Shape: Constant Roadway Elevation

Crest Length: 100.00 ft Crest Elevation: 4966.00 ft Roadway Surface: Paved Roadway Top Width: 245.00 ft



Culvert Data: Structure#702 Site Data - Structure#702

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 ft Inlet Elevation: 4867.00 ft Outlet Station: 97.00 ft Outlet Elevation: 4862.00 ft Number of Barrels: 1

Culvert Data Summary - Structure#702

Barrel Shape: Circular Barrel Diameter: 4.00 ft Barrel Material: Concrete Embedment: 0.00 in Barrel Manning's n: 0.0120 Culvert Type: Straight

Inlet Configuration: Square Edge with Headwall

Inlet Depression: None

Table 1 - Culvert Summary Table: Structure#702

1 0.10 1			,									
Discharge Names	Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth (ft)	Outlet Control Depth (ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)
5 Year	24.91 cfs	24.91 cfs	4868.96	1.96	0.0*	1-S2n	0.72	1.47	0.76	0.23	14.91	2.12
100 Year	111.00 cfs	111.00 cfs	4872.67	5.67	0.901	5-S2n	1.54	3.18	1.82	0.56	19.98	3.78

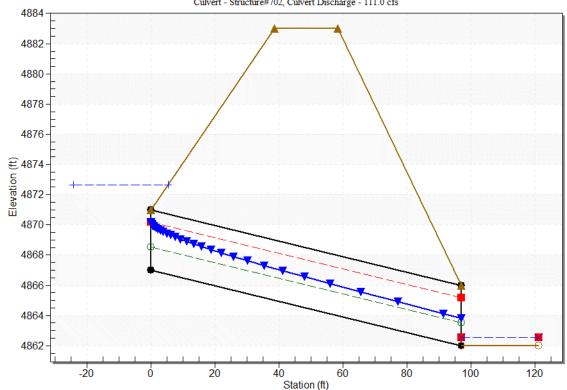
Culvert Barrel Data

Culvert Barrel Type Straight Culvert Inlet Elevation (invert): 4867.00 ft, Outlet Elevation (invert): 4862.00 ft

Culvert Length: 97.13 ft, Culvert Slope: 0.0515

Water Surface Profile Plot for Culvert: Structure#702

Crossing - Structure#702, Reach 700, Great Western Railway, Design Discharge - 111.0 cfs
Culvert - Structure#702, Culvert Discharge - 111.0 cfs



Tailwater Data for Crossing: Structure#702, Reach 700

Table 2 - Downstream Channel Rating Curve (Crossing: Structure#702, Reach 700)

Flow (cfs)	Water Surface Elev (ft)	Velocity (ft/s)	Depth (ft)	Shear (psf)	Froude Number	
24.91	4862.23	0.23	2.12	0.43	0.79	
111.00	4862.56	0.56	3.78	1.05	0.91	

Tailwater Channel Data - Structure#702, Reach 700

Tailwater Channel Option: Trapezoidal Channel

Bottom Width: 50.00 ft Side Slope (H:V): 4.00 (_:1) Channel Slope: 0.0300 Channel Manning's n: 0.0450 Channel Invert Elevation: 4862.00 ft

Roadway Data for Crossing: Structure#702, Reach 700

Roadway Profile Shape: Constant Roadway Elevation

Crest Length: 100.00 ft Crest Elevation: 4883.00 ft Roadway Surface: Gravel Roadway Top Width: 20.00 ft



Site Data - Structure#703,

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 ft Inlet Elevation: 4872.00 ft Outlet Station: 42.00 ft Outlet Elevation: 4871.00 ft Number of Barrels: 2

Culvert Data Summary - Structure#703,

Barrel Shape: Circular Barrel Diameter: 3.00 ft Barrel Material: Concrete Embedment: 0.00 in Barrel Manning's n: 0.0120 Culvert Type: Straight

Inlet Configuration: Square Edge with Headwall

Inlet Depression: None

Table 3 - Culvert Summary Table: Structure#703

Discharge Names	Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth (ft)	Outlet Control Depth (ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)
5 Year	24.91 cfs	24.91 cfs	4873.53	1.53	0.206	1-S2n	0.68	1.12	0.74	0.16	9.15	2.18
100 Year	111.00 cfs	111.00 cfs	4876.41	4.41	3.391	5-S2n	1.49	2.42	1.79	0.40	12.59	3.94

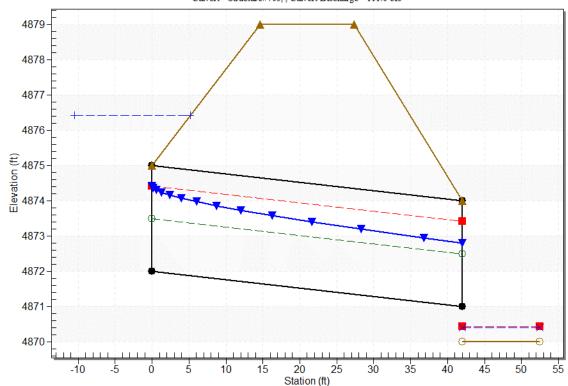
Culvert Barrel Data

Culvert Barrel Type Straight Culvert Inlet Elevation (invert): 4872.00 ft, Outlet Elevation (invert): 4871.00 ft

Culvert Length: 42.01 ft, Culvert Slope: 0.0238

Water Surface Profile Plot for Culvert: Structure#703

Crossing - Structure#703, Reach 700, Design Discharge - 111.0 cfs



Tailwater Data for Crossing: Structure#703, Reach 700

Table 4 - Downstream Channel Rating Curve (Crossing: Structure#703, Reach 700)

Flow (cfs)	Water Surface Elev (ft)	Velocity (ft/s)	Depth (ft)	Shear (psf)	Froude Number	
24.91	4870.16	0.16	2.18	0.22	0.95	
111.00	4870.40	0.40	3.94	0.55	1.11	

Tailwater Channel Data - Structure#703, Reach 700

Tailwater Channel Option: Trapezoidal Channel

Bottom Width: 70.00 ft Side Slope (H:V): 2.00 (_:1) Channel Slope: 0.0220 Channel Manning's n: 0.0300 Channel Invert Elevation: 4870.00 ft

Roadway Data for Crossing: Structure#703, Reach 700

Roadway Profile Shape: Constant Roadway Elevation

Crest Length: 100.00 ft Crest Elevation: 4879.00 ft Roadway Surface: Gravel Roadway Top Width: 12.76 ft



Site Data - Structure#704

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 ft Inlet Elevation: 4890.00 ft Outlet Station: 89.00 ft Outlet Elevation: 4888.00 ft Number of Barrels: 2

Culvert Data Summary - Structure#704

Barrel Shape: Circular Barrel Diameter: 4.00 ft Barrel Material: Concrete Embedment: 0.00 in Barrel Manning's n: 0.0120 Culvert Type: Straight

Inlet Configuration: Square Edge with Headwall

Inlet Depression: None

Table 5 - Culvert Summary Table: Structure#704

Discharge Names	Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth (ft)	Outlet Control Depth (ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)
5 Year	24.91 cfs	24.91 cfs	4891.39	1.39	0.0*	1-S2n	0.63	1.03	0.64	0.16	9.50	2.09
100 Year	170.00 cfs	170.00 cfs	4894.48	4.48	2.124	5-S2n	1.67	2.79	1.90	0.51	14.43	4.45

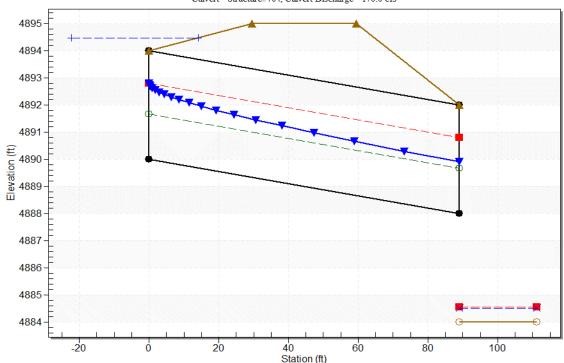
Culvert Barrel Data

Culvert Barrel Type Straight Culvert Inlet Elevation (invert): 4890.00 ft, Outlet Elevation (invert): 4888.00 ft

Culvert Length: 89.02 ft, Culvert Slope: 0.0225

Water Surface Profile Plot for Culvert: Structure#704

Crossing - Structure#704, Reach 700, 7700 Windsong Rd, Design Discharge - 170.0 cfs
Culvert - Structure#704, Culvert Discharge - 170.0 cfs



Tailwater Data for Crossing: Structure#704, Reach 700

Table 6 - Downstream Channel Rating Curve (Crossing: Structure#704, Reach 700)

Flow (cfs)	Water Surface Elev (ft)	Velocity (ft/s)	Depth (ft)	Shear (psf)	Froude Number
24.91	4884.16	0.16	2.09	0.28	0.92
170.00	4884.51	0.51	4.45	0.89	1.11

Tailwater Channel Data - Structure#704, Reach 700

Tailwater Channel Option: Trapezoidal Channel

Bottom Width: 73.00 ft Side Slope (H:V): 4.00 (_:1) Channel Slope: 0.0280 Channel Manning's n: 0.0350 Channel Invert Elevation: 4884.00 ft

Roadway Data for Crossing: Structure#704, Reach 700

Roadway Profile Shape: Constant Roadway Elevation

Crest Length: 100.00 ft Crest Elevation: 4897.00 ft Roadway Surface: Paved Roadway Top Width: 25.30 ft



Site Data - Structure#801

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 ft Inlet Elevation: 4960.15 ft Outlet Station: 74.00 ft Outlet Elevation: 4960.01 ft Number of Barrels: 2

Culvert Data Summary - Structure#801

Barrel Shape: Concrete Box

Barrel Span: 9.00 ft
Barrel Rise: 4.00 ft
Barrel Material: Concrete
Embedment: 0.00 in
Barrel Manning's n: 0.0120
Culvert Type: Straight

Inlet Configuration: Square Edge (90°) Headwall

Inlet Depression: None

Table 7 - Culvert Summary Table: Structure#801

Discharge Names	Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth (ft)	Outlet Control Depth (ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)
5 Year	18.94 cfs	18.94 cfs	4960.71	0.56	0.560	2-M2c	0.39	0.33	0.33	0.15	3.24	1.25
100 Year	535.00 cfs	535.00 cfs	4965.47	5.32	5.188	7-M2c	3.54	3.02	3.02	1.08	9.85	4.45

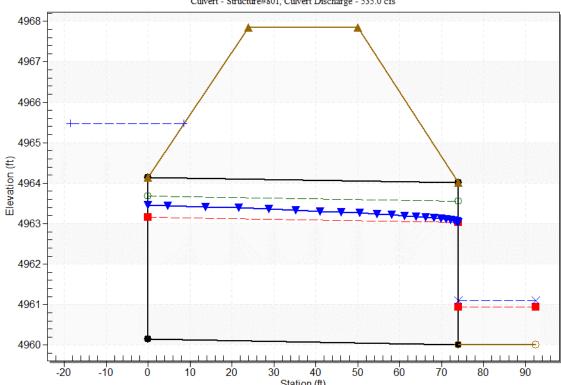
Culvert Barrel Data

Culvert Barrel Type Straight Culvert Inlet Elevation (invert): 4960.15 ft, Outlet Elevation (invert): 4960.01 ft

Culvert Length: 74.00 ft, Culvert Slope: 0.0018

Water Surface Profile Plot for Culvert: Structure#801

Crossing - Structure#801, Reach 800, CR-17, Design Discharge - 535.0 cfs
Culvert - Structure#801, Culvert Discharge - 535.0 cfs



Tailwater Data for Crossing: Structure#802, Reach 800

Table 8 - Downstream Channel Rating Curve (Crossing: Structure#802, Reach 800)

Flow (cfs)	Water Surface Elev (ft)	Velocity (ft/s)	Depth (ft)	Shear (psf)	Froude Number	
18.94	4960.16	0.15	1.25	0.17	0.58	
535.00	4961.09	1.08	4.45	1.25	0.79	

Tailwater Channel Data - Structure#801, Reach 800

Tailwater Channel Option: Trapezoidal Channel

Bottom Width: 100.00 ft Side Slope (H:V): 10.00 (_:1) Channel Slope: 0.0185 Channel Manning's n: 0.0450 Channel Invert Elevation: 4960.01 ft

Roadway Data for Crossing: Structure#801, Reach 800

Roadway Profile Shape: Constant Roadway Elevation

Crest Length: 100.00 ft Crest Elevation: 4967.84 ft Roadway Surface: Paved Roadway Top Width: 26.00 ft



Site Data - Structure#804

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 ft Inlet Elevation: 4889.00 ft Outlet Station: 90.00 ft Outlet Elevation: 4881.00 ft

Number of Barrels: 1

Culvert Data Summary - Structure#804

Barrel Shape: Concrete Box

Barrel Span: 6.00 ft
Barrel Rise: 5.00 ft
Barrel Material: Concrete
Embedment: 0.00 in
Barrel Manning's n: 0.0130
Culvert Type: Straight

Inlet Configuration: Square Edge (30-75° flare) Wingwall

Inlet Depression: None

Table 9 - Culvert Summary Table: Structure#804

10000			,									
Discharge Names	Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth (ft)	Outlet Control Depth (ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)
5 Year	126.99 cfs	126.99 cfs	4892.50	3.50	0.0*	1-S2n	0.83	2.41	0.96	0.92	22.06	2.04
100 Year	261.00 cfs	261.00 cfs	4895.10	6.10	0.0*	5-S2n	1.34	3.89	1.74	1.41	25.06	2.68

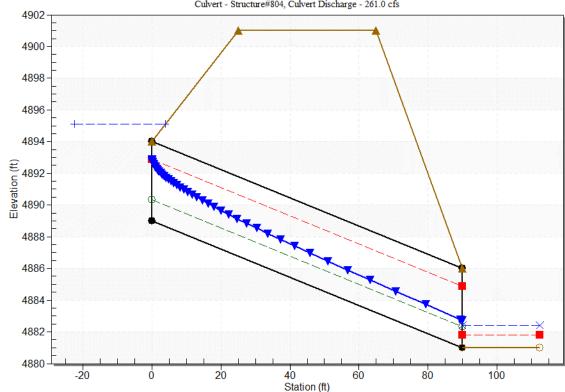
Culvert Barrel Data

Culvert Barrel Type Straight Culvert Inlet Elevation (invert): 4889.00 ft, Outlet Elevation (invert): 4881.00 ft

Culvert Length: 90.35 ft, Culvert Slope: 0.0889

Water Surface Profile Plot for Culvert: Structure#804

Crossing - Structure#804, Reach 800, Great Western Railway, Design Discharge - 261.0 cfs
Culvert - Structure#804, Culvert Discharge - 261.0 cfs



Tailwater Data for Crossing: Structure#804, Reach 800

Table 10 - Downstream Channel Rating Curve (Crossing: Structure#804, Reach 800)

Flow (cfs)	Water Surface Elev (ft)	Velocity (ft/s)	Depth (ft)	Shear (psf)	Froude Number
126.99	4881.92	0.92	2.04	0.63	0.38
261.00	4882.41	1.41	2.68	0.97	0.41

Tailwater Channel Data - Structure#804, Reach 800

Tailwater Channel Option: Trapezoidal Channel

Bottom Width: 65.00 ft Side Slope (H:V): 3.00 (_:1) Channel Slope: 0.0110 Channel Manning's n: 0.0700 Channel Invert Elevation: 4881.00 ft

Roadway Data for Crossing: Structure#804, Reach 800

Roadway Profile Shape: Constant Roadway Elevation

Crest Length: 100.00 ft Crest Elevation: 4901.00 ft Roadway Surface: Gravel Roadway Top Width: 40.00 ft



Site Data - Structure#805

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 ft Inlet Elevation: 4892.00 ft Outlet Station: 62.00 ft Outlet Elevation: 4890.00 ft Number of Barrels: 2

Culvert Data Summary - Structure#805

Barrel Shape: Concrete Box

Barrel Span: 8.00 ft
Barrel Rise: 3.00 ft
Barrel Material: Concrete
Embedment: 0.00 in
Barrel Manning's n: 0.0120
Culvert Type: Straight

Inlet Configuration: Square Edge (90°) Headwall

Inlet Depression: None

Table 11 - Culvert Summary Table: Structure#805

Discharge Names	Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth (ft)	Outlet Control Depth (ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)
5 Year	126.99 cfs	126.99 cfs	4894.07	2.07	0.0*	1-S2n	0.57	1.25	0.65	0.40	12.28	2.93
100 Year	261.00 cfs	261.00 cfs	4895.43	3.43	0.816	5-S2n	0.90	2.02	1.13	0.61	14.44	3.88

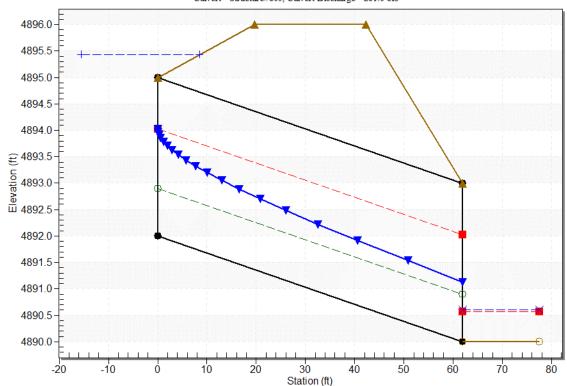
Culvert Barrel Data

Culvert Barrel Type Straight Culvert Inlet Elevation (invert): 4892.00 ft, Outlet Elevation (invert): 4890.00 ft

Culvert Length: 62.03 ft, Culvert Slope: 0.0323

Water Surface Profile Plot for Culvert: Structure#805

Crossing - Structure#805, Reach 800, Design Discharge - 261.0 cfs
Culvert - Structure#805, Culvert Discharge - 261.0 cfs



Tailwater Data for Crossing: Structure#805, Reach 800

Table 12 - Downstream Channel Rating Curve (Crossing: Structure#805, Reach 800)

Flow (cfs)	Water Surface Elev (ft)	Velocity (ft/s)	Depth (ft)	Shear (psf)	Froude Number
126.99	4890.40	0.40	2.93	0.69	0.83
261.00	4890.61	0.61	3.88	1.06	0.89

Tailwater Channel Data - Structure#805, Reach 800

Tailwater Channel Option: Trapezoidal Channel

Bottom Width: 107.00 ft Side Slope (H:V): 6.00 (_:1) Channel Slope: 0.0280 Channel Manning's n: 0.0450 Channel Invert Elevation: 4890.00 ft

Roadway Data for Crossing: Structure#805, Reach 800

Roadway Profile Shape: Constant Roadway Elevation

Crest Length: 100.00 ft Crest Elevation: 4896.00 ft Roadway Surface: Gravel Roadway Top Width: 22.60 ft



Site Data - Structure#806

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 ft Inlet Elevation: 4900.00 ft Outlet Station: 50.00 ft Outlet Elevation: 4899.00 ft

Number of Barrels: 1

Culvert Data Summary - Structure#806

Barrel Shape: Concrete Box

Barrel Span: 12.00 ft
Barrel Rise: 4.00 ft
Barrel Material: Concrete
Embedment: 0.00 in
Barrel Manning's n: 0.0120
Culvert Type: Straight

Inlet Configuration: Square Edge (90°) Headwall

Inlet Depression: None

Table 13 - Culvert Summary Table: Structure#806

Discharge Names	Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth (ft)	Outlet Control Depth (ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)
5 Year	124.66 cfs	124.66 cfs	4902.51	2.51	0.666	1-S2n	0.77	1.50	0.93	0.57	11.14	1.88
100 Year	261.00 cfs	261.00 cfs	4904.13	4.13	2.194	5-S2n	1.23	2.45	1.64	0.88	13.27	2.51

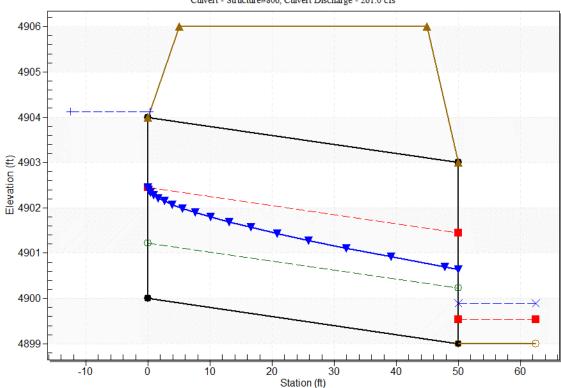
Culvert Barrel Data

Culvert Barrel Type Straight Culvert Inlet Elevation (invert): 4900.00 ft, Outlet Elevation (invert): 4899.00 ft

Culvert Length: 50.01 ft, Culvert Slope: 0.0200

Water Surface Profile Plot for Culvert: Structure#806

Crossing - Structure#806, Reach 800, Design Discharge - 261.0 cfs
Culvert - Structure#806, Culvert Discharge - 261.0 cfs



Tailwater Data for Crossing: Structure#806, Reach 800

Table 14 - Downstream Channel Rating Curve (Crossing: Structure#806, Reach 800)

Flow (cfs)	Water Surface Elev (ft)	Velocity (ft/s)	Depth (ft)	Shear (psf)	Froude Number	
124.66	4899.57	0.57	1.88	0.60	0.44	
261.00	4899.88	0.88	2.51	0.94	0.48	

Tailwater Channel Data - Structure#806, Reach 800

Tailwater Channel Option: Trapezoidal Channel

Bottom Width: 115.00 ft Side Slope (H:V): 3.00 (_:1) Channel Slope: 0.0170 Channel Manning's n: 0.0700 Channel Invert Elevation: 4899.00 ft

Roadway Data for Crossing: Structure#806, Reach 800

Roadway Profile Shape: Constant Roadway Elevation

Crest Length: 100.00 ft Crest Elevation: 4906.00 ft Roadway Surface: Paved Roadway Top Width: 40.00 ft



Site Data - Structure#807

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 ft Inlet Elevation: 4917.00 ft Outlet Station: 80.00 ft Outlet Elevation: 4916.00 ft

Number of Barrels: 1

Culvert Data Summary - Structure#807

Barrel Shape: Concrete Box

Barrel Span: 12.00 ft
Barrel Rise: 4.00 ft
Barrel Material: Concrete
Embedment: 0.00 in
Barrel Manning's n: 0.0120
Culvert Type: Straight

Inlet Configuration: Square Edge (30-75° flare) Wingwall

Inlet Depression: None

Table 15 - Culvert Summary Table: Structure#807

I able 10	- Ouivei	t Guillilla	ily labic.	Ottact	ui cmoo	1						
Discharge Names	Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth (ft)	Outlet Control Depth (ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)
5 Year	63.00 cfs	63.00 cfs	4918.44	1.44	0.0*	1-S2n	0.58	0.95	0.61	0.27	8.64	0.98
100 Year	311.00 cfs	311.00 cfs	4921.32	4.32	2.792	5-S2n	1.60	2.75	1.94	0.71	13.33	1.84

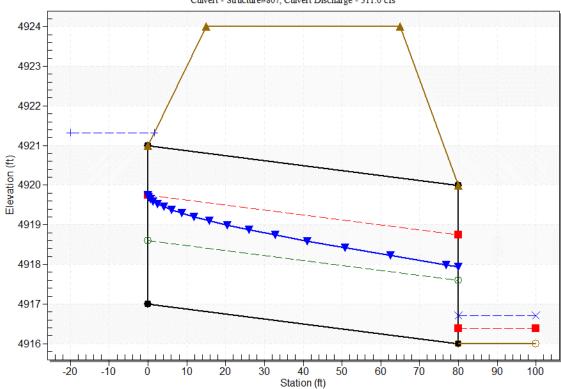
Culvert Barrel Data

Culvert Barrel Type Straight Culvert Inlet Elevation (invert): 4917.00 ft, Outlet Elevation (invert): 4916.00 ft

Culvert Length: 80.01 ft, Culvert Slope: 0.0125

Water Surface Profile Plot for Culvert: Structure#807

Crossing - Structure#807, Reach 829, 1120 Southgate Dr, Design Discharge - 311.0 cfs
Culvert - Structure#807, Culvert Discharge - 311.0 cfs



Tailwater Data for Crossing: Structure#807, Reach 829

Table 16 - Downstream Channel Rating Curve (Crossing: Structure#807, Reach 829)

Flow (cfs)	Water Surface Elev (ft)	Velocity (ft/s)	Depth (ft)	Shear (psf)	Froude Number	
63.00	4916.27	0.27	0.98	0.09	0.33	
311.00	4916.71	0.71	1.84	0.22	0.39	

Tailwater Channel Data - Structure#807, Reach 829

Tailwater Channel Option: Trapezoidal Channel

Bottom Width: 235.00 ft Side Slope (H:V): 5.00 (_:1) Channel Slope: 0.0050 Channel Manning's n: 0.0450 Channel Invert Elevation: 4916.00 ft

Roadway Data for Crossing: Structure#807, Reach 829

Roadway Profile Shape: Constant Roadway Elevation

Crest Length: 100.00 ft Crest Elevation: 4924.00 ft Roadway Surface: Paved Roadway Top Width: 50.00 ft



Site Data - Structure#808

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 ft Inlet Elevation: 4942.00 ft Outlet Station: 527.00 ft Outlet Elevation: 4932.00 ft

Number of Barrels: 1

Culvert Data Summary - Structure#808

Barrel Shape: Concrete Box

Barrel Span: 12.00 ft
Barrel Rise: 4.00 ft
Barrel Material: Concrete
Embedment: 0.00 in
Barrel Manning's n: 0.0120
Culvert Type: Straight

Inlet Configuration: Square Edge (90°) Headwall

Inlet Depression: None

Table 17 - Culvert Summary Table: Structure#808

Discharge Names	Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth (ft)	Outlet Control Depth (ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)
5 Year	36.03 cfs	36.03 cfs	4943.10	1.10	0.0*	1-S2n	0.36	0.65	0.36	0.33	8.38	1.64
100 Year	292.00 cfs	292.00 cfs	4946.49	4.49	0.0*	5-S2n	1.34	2.64	1.36	1.16	17.89	3.60

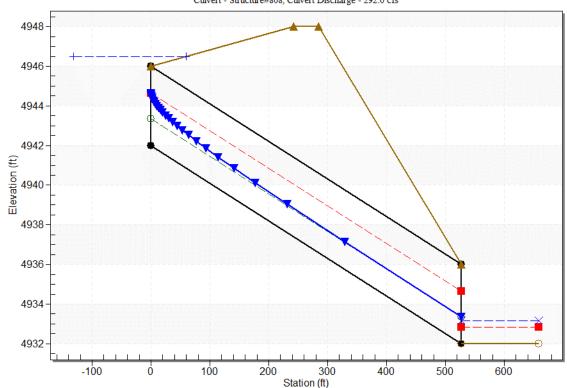
Culvert Barrel Data

Culvert Barrel Type Straight Culvert Inlet Elevation (invert): 4942.00 ft, Outlet Elevation (invert): 4932.00 ft

Culvert Length: 527.09 ft, Culvert Slope: 0.0190

Water Surface Profile Plot for Culvert: Structure#808

Crossing - Structure#808, Reach 829, Design Discharge - 292.0 cfs
Culvert - Structure#808, Culvert Discharge - 292.0 cfs



Tailwater Data for Crossing: Structure#808, Reach 829

Table 18 - Downstream Channel Rating Curve (Crossing: Structure#808, Reach 829)

Flow (cfs)	Water Surface Elev (ft)	Velocity (ft/s)	Depth (ft)	Shear (psf)	Froude Number	
36.03	4932.33	0.33	1.64	0.23	0.51	
292.00	4933.16	1.16	3.60	0.79	0.62	

Tailwater Channel Data - Structure#808, Reach 829

Tailwater Channel Option: Trapezoidal Channel

Bottom Width: 64.00 ft Side Slope (H:V): 5.40 (_:1) Channel Slope: 0.0110 Channel Manning's n: 0.0450 Channel Invert Elevation: 4932.00 ft

Roadway Data for Crossing: Structure#808, Reach 829

Roadway Profile Shape: Constant Roadway Elevation

Crest Length: 100.00 ft Crest Elevation: 4948.00 ft Roadway Surface: Paved Roadway Top Width: 43.00 ft



Site Data - Structure#809

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 ft Inlet Elevation: 4958.00 ft Outlet Station: 304.00 ft Outlet Elevation: 4948.00 ft Number of Barrels: 2

Culvert Data Summary - Structure#809

Barrel Shape: Concrete Box

Barrel Span: 10.00 ft
Barrel Rise: 4.00 ft
Barrel Material: Concrete
Embedment: 0.00 in
Barrel Manning's n: 0.0120
Culvert Type: Straight

Inlet Configuration: Square Edge (90°) Headwall

Inlet Depression: None

Table 19 - Culvert Summary Table: Structure#809

Discharge Names	Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth (ft)	Outlet Control Depth (ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)
5 Year	36.03 cfs	36.03 cfs	4958.77	0.77	0.0*	1-S2n	0.22	0.47	0.22	0.11	8.12	21.45
100 Year	528.00 cfs	528.00 cfs	4962.76	4.76	0.0*	5-S2n	1.20	2.79	1.26	0.56	21.01	61.42

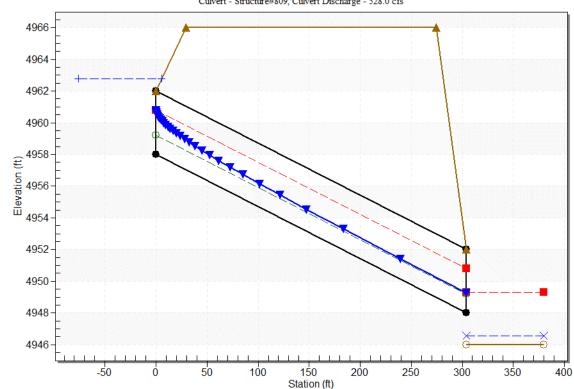
Culvert Barrel Data

Culvert Barrel Type Straight Culvert Inlet Elevation (invert): 4958.00 ft, Outlet Elevation (invert): 4948.00 ft

Culvert Length: 304.16 ft, Culvert Slope: 0.0329

Water Surface Profile Plot for Culvert: Structure#809

Crossing - Structure#809, Reach 843, US-34, Design Discharge - 528.0 cfs
Culvert - Structure#809, Culvert Discharge - 528.0 cfs



Tailwater Data for Crossing: Structure#809, Reach 843
Table 20 - Downstream Channel Rating Curve (Crossing: Structure#809, Reach 843)

Flow (cfs)	Water Surface Elev (ft)	Velocity (ft/s)	Depth (ft)	Shear (psf)	Froude Number	
36.03	4946.11	0.11	21.45	34.03	11.45	
528.00	4946.56	0.56	61.42	174.16	14.49	

Tailwater Channel Data - Structure#809, Reach 843

Tailwater Channel Option: Rectangular Channel

Bottom Width: 15.40 ft Channel Slope: 5.0000 Channel Manning's n: 0.0350 Channel Invert Elevation: 4946.00 ft

Roadway Data for Crossing: Structure#809, Reach 843

Roadway Profile Shape: Constant Roadway Elevation

Crest Length: 100.00 ft Crest Elevation: 4966.00 ft Roadway Surface: Paved Roadway Top Width: 245.00 ft



Appendix E-4
SWMM Inputs/Outputs
Option 1: Do Nothing



```
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Storm Drainage Master Plan
Oklahoma Baseline Alternatives
Additional Basins 700-800
Matrix Design Group, Inc. 2024
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INFILTRATION
                HORTON
FLOW ROUTING
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LINK_OFFSETS
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SKIP_STEADY_STATE NO
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START_TIME
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REPORT START DATE 01/01/2005
REPORT_START_TIME 00:00:00
END_DATE
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END_TIME
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SWEEP_END
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WET_STEP
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DRY STEP
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RULE_STEP
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HEAD TOLERANCE 0.005
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LAT FLOW TOL
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MINIMUM STEP
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[EVAPORATION]
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CONSTAN DRY_ONLY							
[JUNCTION ;;Name		ion Ma	axDepth	InitD	epth S	urDepth	Aponded
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712	4915	10	0	0	0		
714	4864	10	0	0	0		
803	4866	10	0	0	0		
804	4882	10	0	0	0		
809	4890	25	0	0	0		
810	4925	10	0	0	0		
819	4901	10	0	0	0		
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840	4990	10	0	0	0		
841	4967	10	0	0	0		
842	5000	10	0	0	0		
843	4959	15	0	0	0		
844	4995	10	Ō	Ö	Ō		
850	4990	10	0	0	0		
711	4889	10	0	0	0		
710	4871	10	0	0	0		
709	4866	10	0	0	0		
708	4851	10	0	0	0		
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834	4932	15	0	0	0		
838	4949	15	0	0	0		
831	4928.5	15	0	0	0		
808	4885	0	0	0	0		
OUTFALLS	31						
;;Name		ion Tv	pe S	tage D)ata	Gated	Route To
;;							
Ö 803		FRI	ΞE		NO		
O_708					NO		
O_620					NO		
	4838				NO		
[DIVIDERS			,			5	
;;Name ::	Elevat	ıon Div 	verted Li	nk T 	ype 	Parame -	eters
836	4945	OV_8	336	OVE	RFLO	N 15	0 0

0



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;;										max. 10 m
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DL_714	714	0_714	400	0.01	0	0	0	0		
DL_803	803	O_803	400	0.01	0	0	0	0		
DL_804	804	803	400	0.01	0	0	0	0		
DL_810	810	809	400	0.01	0	0	0	0		
DL_820	820	819	400	0.01	0	0	0	0		
DL_830	830	829	400	0.01	0	0	0	0		
DL_840	840	839	400	0.01	0	0	0	0		
DL_842	842	841	400	0.01	0	0	0	0		
DL_844	844	843	400	0.01	0	0	0	0		
L_808	808	803	1197	0.07	0	0	0	0		
L_823	823	819	943	0.04	0	0	0	0		
L_839	839	843	541	0.048	0	0	0	0		
L_841	841	839	190	.044	0	0	0	0		
L_850	850	841	1740	0.044	0	0	0	0		
L_708	708	O_708	202	0.035		0	0	0		
L_709	709	708	560.2	0.03	0	0	0	0		
L_710	710	709	154.3	0.04	0	0	0	0		
L_711	711	710	615.3	0.04	0	0	0	0		
L_713	713	711	338.1	0.07	0	0	0	0		
L_712	712	713	485.4	.04	0	0	0	0		
L_838	838	836	314.88	0.048	0	0	0	0		
L_811	811	809	183	0.045	0	0	0	0		
L_843	843	838	304	0.035	0	0	0	0		
L_819	819	811	761	0.07	0	0	0	0		
L_824	824	822	1270	0.035	0	0	0	0		
L_822	822	819	671	0.04	0	0	0	0		
L_829	829	823	290	0.035	0	0	0	0		
L_836	836	834	442	0.013	0	0	0	0		
OV_836	836	834	442	.035	0	0	0	0		
L_831	831	829	105	0.04	0	0	0	0		
L_834	834	831	1040	0.04	0	0	0	0		
L_809	809	808	90	0.013	0	0	0	0		
IVOE OTION	VIO1									
[XSECTION	-	1	C	0	-2	C = = = 1	Daw	ala Culua	.4	
;;Link 	Shape G	eom1	Geom2	Geor	113	Geom4	Barr	els Culver	T.	
;;					 ^	 1				
DL_620	DUMMY	0	0		0	1				
DL_714	DUMMY	0	0		0	1				
DL_803	DUMMY	0	0		0	1				
DL_804	DUMMY	0	0		0	1				
DL_810	DUMMY	0	0		0	1				
DL_820	DUMMY	0	0		0	1				
DL_830	DUMMY	0	0		0	1				
DL_840	DUMMY	0	0		0	1				

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NODES ALL
LINKS ALL

[TAGS]

[MAP]

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Units None

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304	2224.496	5288.834
309	2304.222	4931.686
310	2221.307	4534.501
319	2458.581	4607.362
320	2858.872	4455.858
324	3212.781	4053.026
329	2531.995	4090.155
330	2310.615	3639.827
339	3222.537	3474.569
340	4296.625	2946.685
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0 0

0 1

5 1

65 3 3 1

100 27 10

235 5

DL_842

DL_844

L_808

L⁸²³

L_839

DUMMY 0

DUMMY 0

TRAPEZOIDAL 10

TRAPEZOIDAL 10

TRAPEZOIDAL 15



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710	2635.627	5340.281
709	2645.107	5386.630
822	2779.481	4253.460
823	2482.561	4170.492
834	2793.200	3771.985
838	3041.708	3648.672
831	2539.570	4080.449
808	2290.503	4963.697
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O_714	2402.976	5620.622
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DL_810	2245.732	4810.989
DL_830	2525.911	4040.117
DL_840	4169.043	3071.079
DL_840	4092.493	3157.197
DL_840	3953.747	3410.768
DL_840	3583.757	3433.095
DL_840	3315.833	3429.905
DL_842	3580.567	2554.368
DL_842	3454.075	2733.989
DL_842	3356.793	2914.200
DL_842	3278.649	3199.666

DL 844	3186.655	2742.553
DL ⁻ 844	3202.603	2914.790
DL_844	3193.034	3211.420
DL_844	3164.328	3249.694
DL_844	3183.466	3396.415
L_808	2265.576	5028.444
L_808	2246.438	5036.418
L_808	2206.569	5066.719
L_808	2203.379	5100.210
L_808	2190.621	5159.217
L_808	2137.993	5194.302
L_808	2080.325	5208.102
L_808	2060.399	5283.821
L_823	2485.244	4167.900
L_823	2482.053	4247.674
L_823	2482.053	4378.503
L_850	3608.479	2914.796
L_850	3593.723	2919.982
L_850	3576.180	2921.577
L_850	3539.500	2931.146
L_850	3506.010	2942.309
L_850	3486.872	2971.016
L_850	3467.735	2998.127
L_850	3439.029	3045.970
L_850	3419.891	3090.624
L_850	3389.590	3162.390
L_850	3365.669	3202.259
L_850	3341.747	3250.103
L_850	3308.256	3289.973
L_850	3271.576	3334.626
OV_836	2870.006	3747.691

[Polygons]

[BACKDROP]

FILE "R:\23.1447.001 Greeley - Oklahoma Drainage MP\200 Design\220 Drainage-WR\221 Models\CUHP_SWMM\SWMM\Backgrounds\Final Map.jpg" DIMENSIONS 735.737 1837.108 8882.267 8132.154"



City of Greeley Storm Drainage Master Plan Oklahoma Baseline Alternatives

Element Count

Number of rain gages 0
Number of subcatchments ... 0
Number of nodes 36
Number of links 33
Number of pollutants 0
Number of land uses 0

	Inve	rt Max. F	Ponded	External
Name	Туре	Elev. De	pth A	rea Inflo
620	JUNCTION	4920.00	10.00	0.0
712	JUNCTION	4915.00	10.00	0.0
714	JUNCTION	4864.00	10.00	0.0
803	JUNCTION	4866.00	10.00	0.0
804	JUNCTION	4882.00	10.00	0.0
809	JUNCTION	4890.00	25.00	0.0
810	JUNCTION	4925.00	10.00	0.0
819	JUNCTION	4901.00	10.00	0.0
820	JUNCTION	4945.00	10.00	0.0
824	JUNCTION	4961.00	10.00	0.0
829	JUNCTION	4918.00	15.00	0.0
830	JUNCTION	4972.00	10.00	0.0
839	JUNCTION	4965.00	15.00	0.0
840	JUNCTION	4990.00	10.00	0.0
841	JUNCTION	4967.00	10.00	0.0
842	JUNCTION	5000.00	10.00	0.0
843	JUNCTION	4959.00	15.00	0.0
844	JUNCTION	4995.00	10.00	0.0
850	JUNCTION	4990.00	10.00	0.0
711	JUNCTION	4889.00	10.00	0.0
710	JUNCTION	4871.00	10.00	0.0
709	JUNCTION	4866.00	10.00	0.0
708	JUNCTION	4851.00	10.00	0.0
713	JUNCTION	4898.00	10.00	0.0
811	JUNCTION	4893.00	10.00	0.0
822	JUNCTION	4932.00	10.00	0.0
823	JUNCTION	4908.00	10.00	0.0
834	JUNCTION	4932.00	15.00	0.0

838	JUNCTION	4949.00	15.00	0.0
831	JUNCTION	4928.50	15.00	0.0
808	JUNCTION	4885.00	15.00	0.0
O_803	OUTFALL	4865.00	0.00	0.0
O_708	OUTFALL	4828.00	10.00	0.0
O_620	OUTFALL	4817.00	0.00	0.0
O 714	OUTFALL	4838.00	0.00	0.0
836	DIVIDER	4945.00	15.00	0.0

Link Summary

Name	From Node	To Nod	е Туре	Length %Slope Roughness
DL_620	620	O_620	CONDUIT	400.0 26.6486 0.0100
DL_714	714	O_714	CONDUIT	400.0 6.5138 0.0100
DL_803	803	O_803	CONDUIT	400.0 0.2500 0.0100
DL_804	804	803	CONDUIT	400.0 4.0032 0.0100
DL_810	810	809	CONDUIT	400.0 8.7837 0.0100
DL_820	820	819	CONDUIT	400.0 11.0672 0.0100
DL_830	830	829	CONDUIT	400.0 13.6247 0.0100
DL_840	840	839	CONDUIT	400.0 6.2622 0.0100
DL_842	842	841	CONDUIT	400.0 8.2782 0.0100
DL_844	844	843	CONDUIT	400.0 9.0367 0.0100
L_808	808	803	CONDUIT	1197.0 1.5875 0.0700
L_823	823	819	CONDUIT	943.0 0.7423 0.0400
L_839	839	843	CONDUIT	541.0 1.1091 0.0480
L_841	841	839	CONDUIT	190.0 1.0527 0.0440
L_850	850	841	CONDUIT	1740.0 1.3220 0.0440
L_708	708	O_708	CONDUIT	202.0 11.4607 0.0350
L_709	709	708	CONDUIT	560.2 2.6786 0.0300
L_710	710	709	CONDUIT	154.3 3.2421 0.0400
L_711	711	710	CONDUIT	615.3 2.9267 0.0400
L_713	713	711	CONDUIT	338.1 2.6629 0.0700
L_712	712	713	CONDUIT	485.4 3.5044 0.0400
L_838	838	836	CONDUIT	314.9 1.2704 0.0480
L_811	811	809	CONDUIT	183.0 1.6396 0.0450
L_843	843	838	CONDUIT	304.0 3.2913 0.0350
L_819	819	811	CONDUIT	761.0 1.0513 0.0700
L_824	824	822	CONDUIT	1270.0 2.2841 0.0350
L_822	822	819	CONDUIT	671.0 4.6249 0.0400
L_829	829	823	CONDUIT	290.0 3.4503 0.0350
L_836	836	834	CONDUIT	442.0 2.9424 0.0130
OV_836	836	834	CONDUIT	442.0 2.9424 0.0350
L_831	831	829	CONDUIT	105.0 10.0504 0.0400
L_834	834	831	CONDUIT	1040.0 0.3365 0.0400
L_809	809	808	CONDUIT	90.0 5.5641 0.0130

Cross Section Summary



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 01/01/2005 00:00:00 Ending Date 01/01/2005 12:00:00

Antecedent Dry Days	0.0
Report Time Step	00:05:00
Routing Time Step	20.00 sec

****** **Control Actions Taken** ******

Flow Routing Continuity	Volume acre-fee	Volume et 10^6 gal
Dry Weather Inflow Wet Weather Inflow Groundwater Inflow RDII Inflow External Inflow External Outflow Flooding Loss Evaporation Loss Exfiltration Loss Initial Stored Volume Final Stored Volume Continuity Error (%)	0.000 0.000 0.000 170.202 171.109 0.000 0.000 0.000 0.000 0.012 -0.540	0.000 0.000 0.000 0.000 55.463 55.758 0.000 0.000 0.000 0.000

Highest Flow Instability Indexes **********

Link L 831 (1)

Link L_834 (1) Link L_829 (1)

Routing Time Step Summary *******

Minimum Time Step : 20.00 sec Average Time Step : 20.00 sec Maximum Time Step : 20.00 sec % of Time in Steady State : 0.00 Average Iterations per Step: 1.01 % of Steps Not Converging : 0.00

Analysis begun on: Wed Jun 12 15:04:07 2024 Analysis ended on: Wed Jun 12 15:04:07 2024

Total elapsed time: < 1 sec



Appendix E-5 Alternatives Results Summary



	Channel Results Reach 700						
Options	Link	W _{bot}	Side S	Q ₁₀₀	V ₁₀₀	Depth	W_{top}
	L_708	22	2	172.3	10.7	0.7	39.8
	L_709	50	4	172.3	5.55	0.6	69.8
Ontion 1 Do Nothing	L_710	70	2	172.4	4.42	0.5	87
Option 1 Do Nothing	L_711	73	4	172.4	4.18	0.5	92
	L_712	106	15	172.8	3.73	0.4	133
	L_713	55	10	172.6	2.97	0.9	88
	L_708	22	2	128.5	9.59	0.6	39.4
	L_709	50	4	128.5	4.96	0.5	69.0
D. L. Miller	L_710	70	2	128.5	3.94	0.5	87
Detention	L_711	73	4	172.4	4.11	0.6	92.8
	L_712	106	15	172.8	3.73	0.4	133
	L_713	55	10	172.6	2.97	0.9	88
	L_708	170	5	172.2	4.95	0.2	187
	L_709	75	4	172.2	4.8	0.5	94
Character and the same to	L_710	70	2	172.4	4.42	0.5	87
Channel Improvements	L_711	73	4	172.4	4.18	0.5	92
	L_712	106	15	172.8	3.73	0.4	133
	L_713	55	10	172.6	2.97	0.9	88
	L_708	22	2	110.8	9.07	0.5	39
	L_709	50	4	110.8	4.69	0.5	69
	L_710	70	2	110.8	3.72	0.4	86.6
LID	L_711	73	4	169.7	3.36	0.7	93.6
	L_712	106	15	170.3	3.71	0.4	133
	L_713	55	10	170.1	2.96	0.9	88

Vol Volume, acre-ft H:V	Side S - Channel side slopes,
Q _{in} - Inflow, cfs velocity, ft/sec	V_{100} - Average channel
Q _{out} - Outflow, cfs channel, ft/sec	Q_{100} - Maximum flow in
W _{bot} - Bottom width, ft	Depth - 100-yr flow depth, ft
W _{top} - Top width, Area - acres	



Channel Results Reach 800							
Options	Link	W _{bot}	Side S	Q ₁₀₀	V ₁₀₀	Depth	W_{top}
	L_808	65	3	2049.2	6.29	4.2	105.2
Do Nothing	L_811	107	6	1882.0	6.82	2.3	149.6
	L_819	115	3	1882.2	4.58	3.3	149.8
	L_808	65	3	412.2	3.57	1.7	90.2
Detention	L_811	107	6	355.3	3.7	0.9	132.8
	L_819	115	3	355.3	2.44	1.2	137.2
	L_808	130	6	2031.6	4.97	2.8	178.6
Channel Improvements	L_811	130	6	1871.3	4.85	2.6	176.2
	L_819	115	3	1871.6	4.57	3.3	149.8
	L_808	65	3	277.6	3.08	1.3	87.8
LID	L_811	107	6	260.9	3.29	0.7	130.4
	L_819	115	3	260.9	2.17	1	136

Vol Volume, acre-ft H:V	Side S - Channel side slopes,
Q _{in} - Inflow, cfs velocity, ft/sec	V_{100} - Average channel
Q _{out} - Outflow, cfs channel, ft/sec	Q_{100} - Maximum flow in
W _{bot} - Bottom width, ft	Depth - 100-yr flow depth, ft
W _{top} - Top width, Area - acres	



Channel Results Reach 829							
Options	Link	W _{bot}	Side S	Q ₁₀₀	V ₁₀₀	Depth	W _{top}
	L_823	235	5	1503.6	4.14	1.5	265
	L_829	75	3.5	1511.3	10.56	1.7	101.9
Do Nothing	L_834	64	6	1290.1	4.33	2.3	106.6
	OV_836	40	15	1052.9	8.64	1.2	91
	L_838	24	15	1299.7	5.46	2.2	105
	L_823	235	5	433.6	2.55	0.7	257
	L_829	75	3.5	434.4	6.43	0.9	96.3
Detention	L_834	64	6	339.7	2.8	1.1	92.2
	OV_836	40	15	94.6	4.43	0.3	64
	L_838	24	15	341.1	3.84	1.2	75
	L_823	235	5	1498.3	4.13	1.5	265
	L_825	75	7	1506.3	8.8	1.3	108.2
Channal Improvements	L_829	80	5	1506.3	4.94	3.2	127
Channel Improvements	L_834	64	6	1289.5	4.33	2.3	106.6
	OV_836	90	20	805.8	5	0.9	141
	L_838	50	20	1299.7	4.99	1.7	133
	L_823	235	5	310.9	1.73	0.8	258
	L_829	75	3.5	311.3	5.89	0.7	94.9
LID	L_834	64	6	291.5	2.63	1	91
	OV_836	40	15	45.5	3.35	0.2	61
	L_838	24	15	524.4	2.6	2	99

Vol Volume, acre-ft H:V	Side S - Channel side slopes,
Q _{in} - Inflow, cfs velocity, ft/sec	V_{100} - Average channel
Q _{out} - Outflow, cfs channel, ft/sec	Q_{100} - Maximum flow in
W _{bot} - Bottom width, ft	Depth - 100-yr flow depth, ft
W _{top} - Top width, Area - acres	



	Chan	nel Resu	ılts Reach 8	843			
Options	Link	W _{bot}	Side S	Q ₁₀₀	V ₁₀₀	Depth	W _{top}
De Madhin -	L_839	100	10	843.9	3.95	1.1	137
Do Nothing	L_850	20	12	306.1	4.37	1.7	75.8
Datastias	L_839	100	10	202.8	2.46	0.5	125
Detention	L_850	20	12	304.9	4.15	1.8	78.2
	L_839	100	10	843.9	3.95	1.1	137
Channel Improvements	L_850	20	12	306.1	4.37	1.7	75.8
1:4	L_839	100	10	528.3	3.42	0.8	131
Lid	L_850	20	12	303.9	4.36	1.7	75.8

Vol Volume, acre-ft H:V	Side S - Channel side slopes,
Q _{in} - Inflow, cfs velocity, ft/sec	${ m V}_{ m 100}$ - Average channel
Q _{out} - Outflow, cfs channel, ft/sec	Q_{100} - Maximum flow in
\boldsymbol{W}_{bot} - Bottom width, ft	Depth - 100-yr flow depth, f
W _{top} - Top width, Area -	acres



		Detention Results				
Options	Reach	ID	Vol.	Area	\mathbf{Q}_{in}	Q _{out}
Do Nothing	-	-	-	-	-	-
	700	D_711	6.5	1.6	172.39	128.51
Detention	829	D_823	43	6.3	793.39	355.81
Detention	843	D_841	25	12.2	646.8	41.02
	043	D_844	17	4.4	523.46	205.44
Channel Improvement	-	-	-	-	-	-
	700	D_EURV_711	2.4	0.6	169.72	155.18
	829	D_EURV_820	5.5	1.3	331.54	239.67
	843	D_EURV_830	5.6	1.5	293.46	192.74
	843	D_EURV_840	5.4	3.1	199.75	164.78
LID	843	D_EURV_842	14.3	9.5	646.49	328.28
LID	829	D_EURV_844	9.4	2.3	523.28	382.8
	700	D_FC_711	6.5	1.3	155.18	110.83
	829	D_FC_823	20	5	474.73	260.99
	829	D_FC_838	17.3	3.3	524.38	291.98
	843	D_FC842	2.4	0.6	328.28	283.97

Vol Volume, acre-ft H:V	Side S - Channel side slopes,
Q _{in} - Inflow, cfs velocity, ft/sec	V_{100} - Average channel
Q _{out} - Outflow, cfs channel, ft/sec	Q_{100} - Maximum flow in
W _{bot} - Bottom width, ft	Depth - 100-yr flow depth, ft
W _{top} - Top width, Area - acres	



Appendix E-6 MHFD Cost Estimate Workbooks



PROJECT: 23.1447.001 Greeley - Comprehensive Drainage Plan Oklahoma Alteratives Analysis

DRAINAGEWAY: Reach 700

REACH: 700

JURISDICTION : Greeley

REACH ID: Option 1 -Reach700 Sabastian Ortega DATE: 6/11/2024

DESCRIPTION Pipe Culverts and Storm Drains			QUANTITY	UNIT	UNIT COST	TOTAL
Circular Pipes Diameter (in)	Length (ft)	No. of Barrels				
42-inch	97	2	194	L.F.	\$210.00	\$40,740.00
48-inch	89	2	178	L.F.	\$240.00	\$42,720.00
Removals						
Removal of culvert pipe (D<48")			186	L.F.	\$33.00	\$6,138.00

Master Plan Capital Im	provement Cost Sumr	mary	-
Capital Improvement Costs			
Pipe Culverts and Storm Drains			\$83,460.00
Concrete Box Culverts			\$0.00
Hydraulic Structures			\$0.00
Channel Improvements			\$0.00
Detention/Water Quality Facilities			\$0.00
Removals			\$6,138.00
Landscaping and Maintenance Improvements			\$0.00
Special Items (User Defined)			\$0.00
Subtotal Capital Improvement Costs			\$89,598.00
Additional Capital Improvement Costs			
Dewatering	L	.S.	\$0.00
Mobilization	5%		\$4,480.00
Traffic Control	L	.S.	\$0.00
Utility Coordination/Relocation	L	.S.	\$0.00
Stormwater Management/Erosion Control	5%		\$4,480.00
Subtotal Additional Capital Improvement Costs			\$8,960.00



Land Acquisition Costs		
ROW/Easements		\$0.00
Subtotal Land Acquisition Costs		\$0.00
Other Costs (percentage of Capital Improvement Costs)		
Engineering	15%	\$14,784.00
Legal/Administrative	5%	\$4,928.00
Contract Admin/Construction Management	10%	\$9,856.00
Contingency	25%	\$24,640.00
Subtotal Other Costs		\$54,208.00
Total Capital Improvement Costs		\$152,766.00

Master Plan Operation and Maintenance Cost Summary						
Description	Quantity	Unit	Unit Cost	Total Annual Cost		
Culvert Maintenance (e.g. sediment & debris removal, erosion at entrance/exit, structural repairs, etc.)		372	L.F.	\$2.00	\$744.00	
Total Annual Operation and Maintenance Cost		-		\$744.00		
Effective Interest Rate			-	0.00%]	
Total Operation and Maintenance Costs Over 50 Years				\$37,200.00		

Summary for Tabulation (Does Not Print) Capital Improvement Costs \$98,558.00 ROW/Easements \$0.00 Engineering \$14,784.00 Legal/Administrative \$4,928.00 Contract Admin/Construction Management \$9,856.00 Contingency \$24,640.00 Total Capital Improvement Costs \$152,766.00 Total Annual Operation and Maintenance Cost \$744.00 Total Operation and Maintenance Costs Over 50 Years \$37,200.00



PROJECT: 23.1447.001 Greeley - Comprehensive Drainage Plan Oklahoma Alteratives Analysis

DRAINAGEWAY: Reach 700

REACH: 700

JURISDICTION: Greeley

REACH ID: Option 2-Reach700 Sabastian Ortega DATE: 6/11/2024

		-	-			
DESCRIPTION			QUANTITY	UNIT	UNIT COST	TOTAL COST
Pipe Culverts and Storm Drains						
Circular Pipes						
Diameter (in)	Length (ft)	No. of Barrels				
36-inch	97	2	194	L.F.	\$180.00	\$34,920.00
48-inch	89	2	178	L.F.	\$240.00	\$42,720.00
Channel Improvements						
Soil Riprap, Type M			295	C.Y.	\$117.00	\$34,515.00
Detention/Water Quality Facilities						
Detention (Complete-in-Place)						
Detention Facility 1 (Complete-in-Place)			7	AC-FT	\$76,152.00	\$494,988.00
Removals						
Removal of culvert pipe (D<48")			186	L.F.	\$33.00	\$6,138.00
Landscaping and Maintenance						
Improvements						
Reclamation & seeding (native grasses)			2	ACRE	\$1,670.00	\$2,672.00
Land Acquisition						
Easement/ROW Acquisition			1.60	ACRE	\$11,228.00	\$17,965.00

Master Plan Capital Improver	nent Cost Summary
Capital Improvement Costs	
Pipe Culverts and Storm Drains	\$77,640.00
Concrete Box Culverts	\$0.00
Hydraulic Structures	\$0.00
Channel Improvements	\$34,515.00
Detention/Water Quality Facilities	\$494,988.00
Removals	\$6,138.00
Landscaping and Maintenance Improvements	\$2,672.00
Special Items (User Defined)	\$0.00



Subtotal Capital Improvement Costs			\$615,953.00
Additional Capital Improvement Costs			
Dewatering		L.S.	\$0.00
Mobilization	5%		\$30,798.00
Traffic Control		L.S.	\$0.00
Utility Coordination/Relocation		L.S.	\$0.00
Stormwater Management/Erosion Control	5%		\$30,798.00
Subtotal Additional Capital Improvement Costs		-	\$61,596.00
Land Acquisition Costs			
ROW/Easements			\$17,965.00
Subtotal Land Acquisition Costs			\$17,965.00
Other Costs (percentage of Capital Improvement Costs)			
Engineering	15%		\$101,632.00
Legal/Administrative	5%		\$33,877.00
Contract Admin/Construction Management	10%		\$67,755.00
Contingency	25%		\$169,387.00
Subtotal Other Costs			\$372,651.00
Total Capital Improvement Costs			\$1,068,165.00

Master Plan Operation and Ma	intenance Cos	t Summary	- - -		-
Description	Quantity	Unit	Unit Cost	Total Annual Cost	
Culvert Maintenance (e.g. sediment & debris removal, erosion at entrance/exit, structural repairs, etc.)		372	L.F.	\$2.00	\$744.00
Detention/WQ Maintenance (e.g. sediment & debris removal, mucking out, tree & weed removal, structural repairs	, etc.)	1.6	ACRE	\$2,505.00	\$4,008.00
Total Annual Operation and Maintenance Cost				\$4,752.00	
Effective Interest Rate		-		0.00%	
Total Operation and Maintenance Costs Over 50 Years				\$237,600.00	

Summary for Tabulation (Does Not Print)			
Capital Improvement Costs	\$677,549.00		
ROW/Easements	\$17,965.00		
Engineering	\$101,632.00		
Legal/Administrative	\$33,877.00		
Contract Admin/Construction Management	\$67,755.00		
Contingency	\$169,387.00		
Total Capital Improvement Costs	\$1,068,165.00		
Total Annual Operation and Maintenance Cost	\$4,752.00		
Total Operation and Maintenance Costs Over 50 Years	\$237,600.00		



PROJECT: 23.1447.001 Greeley - Comprehensive Drainage Plan Oklahoma Alteratives Analysis

DRAINAGEWAY: Reach 700 REACH: 700

Greeley JURISDICTION:

6/11/2024 Option 3-Reach700 Sabastian Ortega DATE: REACH ID:

						TOTAL
DESCRIPTION			QUANTITY	UNIT	UNIT COST	COST
Pipe Culverts and Storm Drains						
Circular Pipes						
Diameter (in)	Length (ft)	No. of Barrels				
42-inch	97	2	194	L.F.	\$210.00	\$40,740.00
48-inch	89	2	178	L.F.	\$240.00	\$42,720.00
Channel Improvements						
Excavation, Mid Range			12378	C.Y.	\$40.00	\$495,109.00
Removals						
Removal of culvert pipe (D<48")			186	L.F.	\$33.00	\$6,138.00
Landscaping and Maintenance						
Improvements						
Reclamation & seeding (native grasses)			6	ACRE	\$1,670.00	\$9,770.00
Land Acquisition						
Easement/ROW Acquisition			5.85	ACRE	\$11,228.00	\$65,684.00

Master Plan Capital Improvement Cos	st Summary	
Capital Improvement Costs		
Pipe Culverts and Storm Drains		\$83,460.00
Concrete Box Culverts		\$0.00
Hydraulic Structures		\$0.00
Channel Improvements		\$495,109.00
Detention/Water Quality Facilities		\$0.00
Removals		\$6,138.00
Landscaping and Maintenance Improvements		\$9,770.00
Special Items (User Defined)		\$0.00
Subtotal Capital Improvement Costs		\$594,477.00
Additional Capital Improvement Costs		
Dewatering	L.S.	\$0.00



Mobilization	5%		\$29,724.00
Traffic Control		L.S.	\$0.00
Utility Coordination/Relocation		L.S.	\$0.00
Stormwater Management/Erosion Control	5%		\$29,724.00
Subtotal Additional Capital Improvement Costs			\$59,448.00
Land Acquisition Costs			
ROW/Easements			\$65,684.00
Subtotal Land Acquisition Costs			\$65,684.00
Other Costs (percentage of Capital Improvement Costs)			
Engineering	15%		\$98,089.00
Legal/Administrative	5%		\$32,696.00
Contract Admin/Construction Management	10%		\$65,393.00
Contingency	25%		\$163,481.00
Subtotal Other Costs			\$359,659.00
Total Capital Improvement Costs			\$1,079,268.00

Master Plan Operation and M	aintenance Cost	Summary			
Description	Quantity	Unit	Unit Cost	Total Annual Cost	
Culvert Maintenance (e.g. sediment & debris removal, erosion at entrance/exit, structural repairs, etc.)		372	L.F.	\$2.00	\$744.00
Channel Maintenance (e.g. sediment & debris removal, erosion, tree & weed removal, etc.)	2400	L.F.	\$3.00	\$7,200.00	
Total Annual Operation and Maintenance Cost				\$7,944.00	
Effective Interest Rate				0.00%	
Total Operation and Maintenance Costs Over 50 Years	-			\$397,200.00	

Summary for Tabulation (Does Not Print)				
Capital Improvement Costs	\$653,925.00			
ROW/Easements	\$65,684.00			
Engineering	\$98,089.00			
Legal/Administrative	\$32,696.00			
Contract Admin/Construction Management	\$65,393.00			
Contingency	\$163,481.00			
Total Capital Improvement Costs	\$1,079,268.00			
Total Annual Operation and Maintenance Cost	\$7,944.00			
Total Operation and Maintenance Costs Over 50 Years	\$397,200.00			



PROJECT: 23.1447.001 Greeley - Comprehensive Drainage Plan Oklahoma Alteratives Analysis

DRAINAGEWAY: Reach 700

REACH: 700

JURISDICTION: Greeley

REACH ID: Option 4-Reach700 Sabastian Ortega DATE: 6/11/2024

						TOTAL
DESCRIPTION			QUANTITY	UNIT	UNIT COST	COST
Pipe Culverts and Storm Drains						
Circular Pipes						
Diameter (in)	Length (ft)	No. of Barrels				
48-inch	97	1	97	L.F.	\$240.00	\$23,280.00
48-inch	89	2	178	L.F.	\$240.00	\$42,720.00
Channel Improvements						
Soil Riprap, Type M			291	C.Y.	\$117.00	\$34,047.00
Detention/Water Quality Facilities						
Detention (Complete-in-Place)						
Detention Facility 1 (Complete-in-Place)			6.5	AC-FT	\$76,152.00	\$494,988.00
Removals						
Removal of culvert pipe (D<48")			186	L.F.	\$33.00	\$6,138.00
Landscaping and Maintenance						
Improvements						
Reclamation & seeding (native grasses)			1.3	ACRE	\$1,670.00	\$2,171.00
Land Acquisition						
Easement/ROW Acquisition			1.30	ACRE	\$11,228.00	\$14,596.00

Master Plan Capital Impro	vement Cost Summary
Capital Improvement Costs	
Pipe Culverts and Storm Drains	\$66,000.00
Concrete Box Culverts	\$0.00
Hydraulic Structures	\$0.00
Channel Improvements	\$34,047.00
Detention/Water Quality Facilities	\$494,988.00
Removals	\$6,138.00
Landscaping and Maintenance Improvements	\$2,171.00
Special Items (User Defined)	\$0.00
Subtotal Capital Improvement Costs	\$603,344.00



Additional Capital Improvement Costs			
Dewatering		L.S.	\$0.00
Mobilization	5%		\$30,167.00
Traffic Control		L.S.	\$0.00
Utility Coordination/Relocation		L.S.	\$0.00
Stormwater Management/Erosion Control	5%		\$30,167.00
Subtotal Additional Capital Improvement Costs			\$60,334.00
Land Acquisition Costs			
ROW/Easements			\$14,596.00
Subtotal Land Acquisition Costs			\$14,596.00
Other Costs (percentage of Capital Improvement Costs)			
Engineering	15%		\$99,552.00
Legal/Administrative	5%		\$33,184.00
Contract Admin/Construction Management	10%		\$66,368.00
Contingency	25%		\$165,920.00
Subtotal Other Costs			\$365,024.00
Total Capital Improvement Costs			\$1,043,298.00

Master Plan Operation and Ma	intenance Co	st Summary	-		<u> </u>
Description	Quantity	Unit	Unit Cost	Total Annual Cost	
Culvert Maintenance (e.g. sediment & debris removal, erosion at entrance/exit, structural repairs, etc.)		359	L.F.	\$2.00	\$718.00
Detention/WQ Maintenance (e.g. sediment & debris removal, mucking out, tree & weed removal, structural repa	irs, etc.)	1.3	ACRE	\$2,505.00	\$3,257.00
Total Annual Operation and Maintenance Cost	-			\$3,975.00	
Effective Interest Rate				0.00%	
Total Operation and Maintenance Costs Over 50 Years	_			\$198,750.00	

Summary for Tabulation	(Does Not Print)
Capital Improvement Costs	\$663,678.00
ROW/Easements	\$14,596.00
Engineering	\$99,552.00
Legal/Administrative	\$33,184.00
Contract Admin/Construction Management	\$66,368.00
Contingency	\$165,920.00
Total Capital Improvement Costs	\$1,043,298.00
Total Annual Operation and Maintenance Cost	\$3,975.00
Total Operation and Maintenance Costs Over 50 Years	\$198,750.00



PROJECT: 23.1447.001 Greeley - Comprehensive Drainage Plan Oklahoma Alteratives Analysis

DRAINAGEWAY: Rea

Reach 800

REACH:

800 Greeley

JURISDICTION: REACH ID:

· _

Option 1 -Reach800 Sabastian Ortega

DATE:

6/11/2024

DESCRIPTION Concrete Box Culverts Box Culvert Pipe			QUANTITY	UNIT	UNIT COST	TOTAL COST
Individual Box Span (ft)	Box Height (ft)	No. of Barrels	Length (ft)			
10	8	2	90	L.F.	\$3,677.22	\$330,949.00
10	3	10	62	L.F.	\$12,688.10	\$786,662.00
Removals						
Removal of culvert pipe (D<48")			62	L.F.	\$33.00	\$2,046.00
Concrete Box Culvert			90	L.F./CELL	\$167.00	\$15,030.00

Master Plan Capital Im	provement Co	st Summary			
Capital Improvement Costs					
Pipe Culverts and Storm Drains			\$0.00		
Concrete Box Culverts			\$1,117,611.00		
Hydraulic Structures			\$0.00		
Channel Improvements			\$0.00		
Detention/Water Quality Facilities			\$0.00		
Removals			\$17,076.00		
Landscaping and Maintenance Improvements					
Special Items (User Defined)	-		\$0.00		
Subtotal Capital Improvement Costs	-	·	\$1,134,687.00		
Additional Capital Improvement Costs					
Dewatering		L.S.	\$0.00		
Mobilization	5%		\$56,734.00		
Traffic Control		L.S.	\$0.00		
Utility Coordination/Relocation		L.S.	\$0.00		
Stormwater Management/Erosion Control	5%		\$56,734.00		



Subtotal Additional Capital Improvement Costs		\$113,468.00
Land Acquisition Costs		
ROW/Easements		\$0.00
Subtotal Land Acquisition Costs		\$0.00
Other Costs (percentage of Capital Improvement Costs)		
Engineering	15%	\$187,223.00
Legal/Administrative	5%	\$62,408.00
Contract Admin/Construction Management	10%	\$124,816.00
Contingency	25%	\$312,039.00
Subtotal Other Costs		\$686,486.00
Total Capital Improvement Costs		\$1,934,641.00

Master Plan Operation and Maintenance Cost Summary					
Description	Quantity	Unit	Unit Cost	Total Annual Cost	
Culvert Maintenance (e.g. sediment & debris removal, erosion at entrance/exit, structural repairs, etc.)		800	L.F.	\$2.00	\$1,600.00
Total Annual Operation and Maintenance Cost				\$1,600.00	
Effective Interest Rate			-	0.00%	
Total Operation and Maintenance Costs Over 50 Years			-	\$80,000.00	

Summary for Tabulation (Does Not Print)				
Capital Improvement Costs	\$1,248,155.00			
ROW/Easements	\$0.00			
Engineering	\$187,223.00			
Legal/Administrative	\$62,408.00			
Contract Admin/Construction Management	\$124,816.00			
Contingency	\$312,039.00			
Total Capital Improvement Costs	\$1,934,641.00			
Total Annual Operation and Maintenance Cost	\$1,600.00			
Total Operation and Maintenance Costs Over 50 Years	\$80,000.00			



PROJECT: 23.1447.001 Greeley - Comprehensive Drainage Plan Oklahoma Alteratives Analysis

DRAINAGEWAY: Reach 800

REACH: 800

JURISDICTION: Greeley

REACH ID: Option 2-Reach800 Sabastian Ortega DATE: 6/11/2024

DESCRIPTION			QUANTITY	UNIT	UNIT COST	TOTAL COST
Concrete Box Culverts						
Box Culvert Pipe						
Individual Box Span (ft)	Box Height (ft)	No. of Barrels	Length (ft)			
6	7	1	90	L.F.	\$1,141.67	\$102,750.00
8	3	3	62	L.F.	\$3,286.69	\$203,775.00
				L.F.	\$0.00	\$0.00
Removals						
Removal of culvert pipe (48" <d<84")< td=""><td></td><td></td><td>62</td><td>L.F.</td><td>\$84.00</td><td>\$5,208.00</td></d<84")<>			62	L.F.	\$84.00	\$5,208.00
Concrete Box Culvert			90	L.F./CELL	\$167.00	\$15,030.00

Master Plan Capital Improvement Cost Summary				
Capital Improvement Costs				
Pipe Culverts and Storm Drains			\$0.00	
Concrete Box Culverts			\$306,525.00	
Hydraulic Structures			\$0.00	
Channel Improvements			\$0.00	
Detention/Water Quality Facilities			\$0.00	
Removals			\$20,238.00	
Landscaping and Maintenance Improvements			\$0.00	
Special Items (User Defined)			\$0.00	
Subtotal Capital Improvement Costs			\$326,763.00	
Additional Capital Improvement Costs				
Dewatering		L.S.	\$0.00	
Mobilization	5%		\$16,338.00	
Traffic Control		L.S.	\$0.00	



Utility Coordination/Relocation	L.S.	\$0.00
Stormwater Management/Erosion Control	5%	\$16,338.00
Subtotal Additional Capital Improvement Costs	- -	\$32,676.00
Land Acquisition Costs		
ROW/Easements		\$0.00
Subtotal Land Acquisition Costs		\$0.00
Other Costs (percentage of Capital Improvement Costs)		
Engineering	15%	\$53,916.00
Legal/Administrative	5%	\$17,972.00
Contract Admin/Construction Management	10%	\$35,944.00
Contingency	25%	\$89,860.00
Subtotal Other Costs		\$197,692.00
Total Capital Improvement Costs		\$557,131.00

Master Plan Operation and Maintenance Cost Summary					
Description	Quantity	Unit	Unit Cost	Total Annual Cost	
Culvert Maintenance (e.g. sediment & debris removal, erosion at entrance/exit, structural repairs, etc.)		276	L.F.	\$2.00	\$552.00
Total Annual Operation and Maintenance Cost				\$552.00	
Effective Interest Rate				0.00%	
Total Operation and Maintenance Costs Over 50 Years				\$27,600.00	

Summary for Tabulation (Does Not Print)				
Capital Improvement Costs	\$359,439.00			
ROW/Easements	\$0.00			
Engineering	\$53,916.00			
Legal/Administrative	\$17,972.00			
Contract Admin/Construction Management	\$35,944.00			
Contingency	\$89,860.00			
Total Capital Improvement Costs	\$557,131.00			
Total Annual Operation and Maintenance Cost	\$552.00			
Total Operation and Maintenance Costs Over 50 Years	\$27,600.00			



PROJECT: 23.1447.001 Greeley - Comprehensive Drainage Plan Oklahoma Alteratives Analysis

DRAINAGEWAY: Reach 800

REACH: 800

JURISDICTION: Greeley

REACH ID: Option 3-Reach800 Sabastian Ortega DATE: 6/11/2024

					LINIT	TOTAL
DESCRIPTION			QUANTITY	UNIT	UNIT COST	COST
Concrete Box Culverts						
Box Culvert Pipe						
Individual Box Span (ft)	Box Height (ft)	No. of Barrels	Length (ft)			
10	8	2	90	L.F.	\$3,677.22	\$330,949.00
10	3	10	62	L.F.	\$12,688.10	\$786,662.00
Channel Improvements						
Excavation, Mid Range			36879	C.Y.	\$40.00	\$1,475,141.00
Removals						
Removal of culvert pipe (48" <d<84")< td=""><td></td><td></td><td>62</td><td>L.F.</td><td>\$84.00</td><td>\$5,208.00</td></d<84")<>			62	L.F.	\$84.00	\$5,208.00
Concrete Box Culvert			90	L.F./CELL	\$167.00	\$15,030.00
Landscaping and Maintenance						
Improvements						
Reclamation & seeding (native grasses)			8	ACRE	\$1,670.00	\$13,811.00
Land Acquisition						
Easement/ROW Acquisition			8.27	ACRE	\$11,228.00	\$92,856.00

Master Plan Capital Improven	ment Cost Summary
Capital Improvement Costs	
Pipe Culverts and Storm Drains	\$0.00
Concrete Box Culverts	\$1,117,611.00
Hydraulic Structures	\$0.00
Channel Improvements	\$1,475,141.00
Detention/Water Quality Facilities	\$0.00
Removals	\$20,238.00
Landscaping and Maintenance Improvements	\$13,811.00
Special Items (User Defined)	\$0.00



Subtotal Capital Improvement Costs			\$2,626,801.00
Additional Capital Improvement Costs			
Dewatering		L.S.	\$0.00
Mobilization	5%		\$131,340.00
Traffic Control		L.S.	\$0.00
Utility Coordination/Relocation		L.S.	\$0.00
Stormwater Management/Erosion Control	5%		\$131,340.00
Subtotal Additional Capital Improvement Costs	-		\$262,680.00
Land Acquisition Costs			
ROW/Easements			\$92,856.00
Subtotal Land Acquisition Costs			\$92,856.00
Other Costs (percentage of Capital Improvement Costs)			
Engineering	15%		\$433,422.00
Legal/Administrative	5%		\$144,474.00
Contract Admin/Construction Management	10%		\$288,948.00
Contingency	25%		\$722,370.00
Subtotal Other Costs			\$1,589,214.00
Total Capital Improvement Costs			\$4,571,551.00

Master Plan Operation and Maintenance Cost Summary						
Description	Quantity	Unit	Unit Cost	Total Annual Cost		
Culvert Maintenance (e.g. sediment & debris removal, erosion at entrance/exit, structural repairs, etc.)		800	L.F.	\$2.00	\$1,600.00	
Channel Maintenance (e.g. sediment & debris removal, erosion, tree & weed removal, etc.) 2141 L.F. \$3.00			\$6,423.00			
Total Annual Operation and Maintenance Cost						
Effective Interest Rate				0.00%		
Total Operation and Maintenance Costs Over 50 Years				\$401,150.00		

Summary for Tabulation (Does Not Print)			
Capital Improvement Costs	\$2,889,481.00		
ROW/Easements	\$92,856.00		
Engineering	\$433,422.00		
Legal/Administrative	\$144,474.00		
Contract Admin/Construction Management	\$288,948.00		
Contingency	\$722,370.00		
Total Capital Improvement Costs	\$4,571,551.00		
Total Annual Operation and Maintenance Cost	\$8,023.00		
Total Operation and Maintenance Costs Over 50 Years	\$401,150.00		



PROJECT: 23.1447.001 Greeley - Comprehensive Drainage Plan Oklahoma Alteratives Analysis

DRAINAGEWAY: Reach 800

REACH: 800 JURISDICTION:

Greeley

Option 4-Reach800 Sabastian Ortega DATE: 6/11/2024 REACH ID:

DESCRIPTION			QUANTITY	UNIT	UNIT COST	TOTAL COST
Concrete Box Culverts						
Box Culvert Pipe						
Individual Box Span (ft)	Box Height (ft)	No. of Barrels	Length (ft)			
6	5	1	90	L.F.	\$1,095.56	\$98,601.00
8	3	2	62	L.F.	\$2,191.13	\$135,850.00
				L.F.	\$0.00	\$0.00
Removals						
Removal of culvert pipe (D<48")			62	L.F.	\$33.00	\$2,046.00
Concrete Box Culvert			90	L.F./CELL	\$167.00	\$15,030.00

Master Plan Capital Improvement Cost Summary					
Capital Improvement Costs					
Pipe Culverts and Storm Drains			\$0.00		
Concrete Box Culverts			\$234,451.00		
Hydraulic Structures			\$0.00		
Channel Improvements					
Detention/Water Quality Facilities					
Removals					
Landscaping and Maintenance Improvements					
Special Items (User Defined)			\$0.00		
Subtotal Capital Improvement Costs		-	\$251,527.00		
Additional Capital Improvement Costs					
Dewatering		L.S.	\$0.00		
Mobilization	5%		\$12,576.00		
Traffic Control		L.S.	\$0.00		
Utility Coordination/Relocation		L.S.	\$0.00		



Stormwater Management/Erosion Control	5%	\$12,576.00
Subtotal Additional Capital Improvement Costs	-	\$25,152.00
Land Acquisition Costs		
ROW/Easements		\$0.00
Subtotal Land Acquisition Costs		\$0.00
Other Costs (percentage of Capital Improvement Costs)		
Engineering	15%	\$41,502.00
Legal/Administrative	5%	\$13,834.00
Contract Admin/Construction Management	10%	\$27,668.00
Contingency	25%	\$69,170.00
Subtotal Other Costs		\$152,174.00
Total Capital Improvement Costs		\$428,853.00

Master Plan Operation and Maintenance Cost Summary						
Description	Quantity	Unit	Unit Cost	Total Annual Cost	<u> </u>	
Culvert Maintenance (e.g. sediment & debris removal, erosion at entrance/exit, structural repairs, etc.)		214	L.F.	\$2.00	\$428.00	
Total Annual Operation and Maintenance Cost				\$428.00		
Effective Interest Rate				0.00%		
Total Operation and Maintenance Costs Over 50 Years		<u> </u>	a	\$21,400.00		

Summary for Tabulation (Does Not Print)				
Capital Improvement Costs	\$276,679.00			
ROW/Easements	\$0.00			
Engineering	\$41,502.00			
Legal/Administrative	\$13,834.00			
Contract Admin/Construction Management	\$27,668.00			
Contingency	\$69,170.00			
Total Capital Improvement Costs	\$428,853.00			
Total Annual Operation and Maintenance Cost	\$428.00			
Total Operation and Maintenance Costs Over 50 Years	\$21,400.00			



PROJECT: 23.1447.001 Greeley - Comprehensive Drainage Plan Oklahoma Alteratives Analysis

DRAINAGEWAY: Reach 829
REACH: 829

JURISDICTION: Greeley

REACH ID: Option 1 -Reach829 Sabastian Ortega DATE: 6/11/2024

DESCRIPTION Concrete Box Culverts			QUANTITY	UNIT	UNIT COST	TOTAL COST
Box Culvert Pipe						
Individual Box Span (ft)	Box Height (ft)	No. of Barrels	Length (ft)			
12	5	3	80	L.F.	\$5,227.30	\$418,184.00
12	5	3	527	L.F.	\$5,227.30	\$2,754,785.00
Removals						
Removal of culvert pipe (48" <d<84")< td=""><td></td><td></td><td>527</td><td>L.F.</td><td>\$84.00</td><td>\$44,268.00</td></d<84")<>			527	L.F.	\$84.00	\$44,268.00
Concrete Box Culvert			80	L.F./CELL	\$167.00	\$13,360.00

Mas	ter Plan Capital Improvement Co	st Summary	
Capital Improvement Costs		•	
Pipe Culverts and Storm Drains			\$0.00
Concrete Box Culverts			\$3,172,969.00
Hydraulic Structures			\$0.00
Channel Improvements			\$0.00
Detention/Water Quality Facilities			\$0.00
Removals			\$57,628.00
Landscaping and Maintenance Improvements			\$0.00
Special Items (User Defined)			\$0.00
Subtotal Capital Improvement Costs		-	\$3,230,597.00
Additional Capital Improvement Costs			
Dewatering		L.S.	\$0.00
Mobilization	5%		\$161,530.00
Traffic Control		L.S.	\$0.00
Utility Coordination/Relocation		L.S.	\$0.00
Stormwater Management/Erosion Control	5%		\$161,530.00
Subtotal Additional Capital Improvement Costs			\$323,060.00



Land Acquisition Costs		
ROW/Easements		\$0.00
Subtotal Land Acquisition Costs		\$0.00
Other Costs (percentage of Capital Improvement Costs)		
Engineering	15%	\$533,049.00
Legal/Administrative	5%	\$177,683.00
Contract Admin/Construction Management	10%	\$355,366.00
Contingency	25%	\$888,414.00
Subtotal Other Costs		\$1,954,512.00
Total Capital Improvement Costs		 \$5,508,169.00

Master Plan Operation and Maintenance Cost Summary						
Description	Quantity	Unit	Unit Cost	Total Annual Cost		
Culvert Maintenance (e.g. sediment & debris removal, erosion at entrance/exit, structural repairs, etc.)		1821	L.F.	\$2.00	\$3,642.00	
Total Annual Operation and Maintenance Cost				\$3,642.00		
Effective Interest Rate				0.00%		
Total Operation and Maintenance Costs Over 50 Years		-		\$182,100.00		

Summary for Tabulation (Does Not Print)				
Capital Improvement Costs	\$3,553,657.00			
ROW/Easements	\$0.00			
Engineering	\$533,049.00			
Legal/Administrative	\$177,683.00			
Contract Admin/Construction Management	\$355,366.00			
Contingency	\$888,414.00			
Total Capital Improvement Costs	\$5,508,169.00			
Total Annual Operation and Maintenance Cost	\$3,642.00			
Total Operation and Maintenance Costs Over 50 Years	\$182,100.00			



PROJECT: 23.1447.001 Greeley - Comprehensive Drainage Plan Oklahoma Alteratives Analysis

DRAINAGEWAY: Reach 829

REACH: 829

JURISDICTION: Greeley

REACH ID: Option 2-Reach829 Sabastian Ortega DATE: 6/11/2024

						TOTAL
DESCRIPTION			QUANTITY	UNIT	UNIT COST	COST
			QUANTITI	Oldii	ONIT COST	0001
Concrete Box Culverts						
Box Culvert Pipe						
Individual Box Span (ft)	Box Height (ft)	No. of Barrels	Length (ft)			
12	4	1	80	L.F.	\$1,529.18	\$122,335.00
12	4	1	527	L.F.	\$1,529.18	\$805,879.00
Channel Improvements						
Soil Riprap, Type M			561	C.Y.	\$117.00	\$65,637.00
Detention/Water Quality Facilities						
Detention (Complete-in-Place)						
Detention Facility 1 (Complete-in-Place)			43	AC-FT	\$76,152.00	\$3,274,536.00
Removals						
Removal of culvert pipe (48" <d<84")< td=""><td></td><td></td><td>527</td><td>L.F.</td><td>\$84.00</td><td>\$44,268.00</td></d<84")<>			527	L.F.	\$84.00	\$44,268.00
Concrete Box Culvert			80	L.F./CELL	\$167.00	\$13,360.00
Landscaping and Maintenance						
Improvements						
Reclamation & seeding (native grasses)			6	ACRE	\$1,670.00	\$10,521.00
Land Acquisition						
Easement/ROW Acquisition			6.30	ACRE	\$11,228.00	\$70,736.00

Master Plan Capital Improvement Cos	st Summary
Capital Improvement Costs	
Pipe Culverts and Storm Drains	\$0.00
Concrete Box Culverts	\$928,214.00
Hydraulic Structures	\$0.00
Channel Improvements	\$65,637.00
Detention/Water Quality Facilities	\$3,274,536.00
Removals	\$57,628.00
Landscaping and Maintenance Improvements	\$10,521.00
Special Items (User Defined)	\$0.00



Subtotal Capital Improvement Costs					
Additional Capital Improvement Costs					
Dewatering		L.S.	\$0.00		
Mobilization	5%		\$216,827.00		
Traffic Control		L.S.	\$0.00		
Utility Coordination/Relocation		L.S.	\$0.00		
Stormwater Management/Erosion Control	5%		\$216,827.00		
Subtotal Additional Capital Improvement Costs	-	<u> </u>	\$433,654.00		
Land Acquisition Costs					
ROW/Easements			\$70,736.00		
Subtotal Land Acquisition Costs					
Other Costs (percentage of Capital Improvement Costs)					
Engineering	15%		\$715,529.00		
Legal/Administrative	5%		\$238,510.00		
Contract Admin/Construction Management	10%		\$477,019.00		
Contingency	25%		\$1,192,548.00		
Subtotal Other Costs			\$2,623,606.00		
Total Capital Improvement Costs			\$7,464,532.00		

Master Plan Operation and Maintenance Cost Summary							
Description	Quantity	Unit	Unit Cost	Total Annual Cost			
Culvert Maintenance (e.g. sediment & debris removal, erosion at entrance/exit, structural repairs, etc.)		607	L.F.	\$2.00	\$1,214.00		
Detention/WQ Maintenance (e.g. sediment & debris removal, mucking out, tree & weed removal, structural repairs, etc.)			ACRE	\$2,505.00	\$15,782.00		
Total Annual Operation and Maintenance Cost			\$16,996.00				
Effective Interest Rate				0.00%			
Total Operation and Maintenance Costs Over 50 Years				\$849,800.00			

Summary for Tabulation (Does Not Print)				
Capital Improvement Costs	\$4,770,190.00			
ROW/Easements	\$70,736.00			
Engineering	\$715,529.00			
Legal/Administrative	\$238,510.00			
Contract Admin/Construction Management	\$477,019.00			
Contingency	\$1,192,548.00			
Total Capital Improvement Costs	\$7,464,532.00			
Total Annual Operation and Maintenance Cost	\$16,996.00			
Total Operation and Maintenance Costs Over 50 Years	\$849,800.00			



PROJECT: 23.1447.001 Greeley - Comprehensive Drainage Plan Oklahoma Alteratives Analysis

DRAINAGEWAY: Reach 829

REACH: 829

JURISDICTION: Greeley

REACH ID: Option 3-Reach829 Sabastian Ortega DATE: 6/11/2024

DESCRIPTION		-	QUANTITY	UNIT	UNIT COST	TOTAL COST
Concrete Box Culverts			QUARTITI	Oldii	ONIT COOT	0001
Box Culvert Pipe						
Individual Box Span (ft)	Box Height (ft)	No. of Barrels	Length (ft)			
12	5	3	80	L.F.	\$5,227.30	\$418,184.00
12	5	3	527	L.F.	\$5,227.30	\$2,754,785.00
Channel Improvements						
Soil Riprap, Type M			561	C.Y.	\$117.00	\$65,637.00
Excavation, Mid Range			38190	C.Y.	\$40.00	\$1,527,600.00
Removals						
Removal of culvert pipe (48" <d<84")< td=""><td></td><td></td><td>527</td><td>L.F.</td><td>\$84.00</td><td>\$44,268.00</td></d<84")<>			527	L.F.	\$84.00	\$44,268.00
Concrete Box Culvert			80	L.F./CELL	\$167.00	\$13,360.00
Landscaping and Maintenance						
Improvements						
Reclamation & seeding (native grasses)			11	ACRE	\$1,670.00	\$19,138.00
Land Acquisition						
Easement/ROW Acquisition			11.46	ACRE	\$11,228.00	\$128,673.00

Master Plan Capital Impro	vement Cost Summary
Capital Improvement Costs	
Pipe Culverts and Storm Drains	\$0.00
Concrete Box Culverts	\$3,172,969.00
Hydraulic Structures	\$0.00
Channel Improvements	\$1,593,237.00
Detention/Water Quality Facilities	\$0.00
Removals	\$57,628.00
Landscaping and Maintenance Improvements	\$19,138.00
Special Items (User Defined)	\$0.00
Subtotal Capital Improvement Costs	\$4,842,972.00
Additional Capital Improvement Costs	



Dewatering		L.S.	\$0.00			
Mobilization	5%		\$242,149.00			
Traffic Control		L.S.	\$0.00			
Utility Coordination/Relocation		L.S.	\$0.00			
Stormwater Management/Erosion Control	5%		\$242,149.00			
Subtotal Additional Capital Improvement Costs						
Land Acquisition Costs						
ROW/Easements						
Subtotal Land Acquisition Costs						
Other Costs (percentage of Capital Improvement Costs)						
Engineering	15%		\$799,091.00			
Legal/Administrative	5%		\$266,364.00			
Contract Admin/Construction Management	10%		\$532,727.00			
Contingency	25%		\$1,331,818.00			
Subtotal Other Costs						
Total Capital Improvement Costs						

Master Plan Operation and Maintenance Cost Summary						
Description	Quantity	Unit	Unit Cost	Total Annual Cost		
Culvert Maintenance (e.g. sediment & debris removal, erosion at entrance/exit, structural repairs, etc.)		1821	L.F.	\$2.00	\$3,642.00	
Channel Maintenance (e.g. sediment & debris removal, erosion, tree & weed removal, etc.)	3030	L.F.	\$3.00	\$9,090.00		
Total Annual Operation and Maintenance Cost						
Effective Interest Rate						
Total Operation and Maintenance Costs Over 50 Years				\$636,600.00		

Summary for Tabulation (Does Not Print)				
Capital Improvement Costs	\$5,327,270.00			
ROW/Easements	\$128,673.00			
Engineering	\$799,091.00			
Legal/Administrative	\$266,364.00			
Contract Admin/Construction Management	\$532,727.00			
Contingency	\$1,331,818.00			
Total Capital Improvement Costs	\$8,385,943.00			
Total Annual Operation and Maintenance Cost	\$12,732.00			
Total Operation and Maintenance Costs Over 50 Years	\$636,600.00			



PROJECT: 23.1447.001 Greeley - Comprehensive Drainage Plan Oklahoma Alteratives Analysis
DRAINAGEWAY: Reach 829

REACH: 829

JURISDICTION: Greeley

REACH ID: Option 4-Reach829 Sabastian Ortega DATE: 6/11/2024

		:	-			TOTAL
DESCRIPTION			QUANTITY	UNIT	UNIT COST	COST
			QUANTITI	Oldii	OIIII OOOI	0001
Concrete Box Culverts						
Box Culvert Pipe						
Individual Box Span (ft)	Box Height (ft)	No. of Barrels	Length (ft)			
12	4	1	80	L.F.	\$1,529.18	\$122,335.00
12	4	1	527	L.F.	\$1,529.18	\$805,879.00
Channel Improvements						
Soil Riprap, Type M			561	C.Y.	\$117.00	\$65,637.00
Detention/Water Quality Facilities						
Detention (Complete-in-Place)						
Detention Facility 1 (Complete-in-Place)			20	AC-FT	\$76,152.00	\$1,523,040.00
Detention Facility 2 (Complete-in-Place)			17	AC-FT	\$76,152.00	\$1,317,430.00
Removals			_			
Removal of culvert pipe (48" <d<84")< td=""><td></td><td></td><td>527</td><td>L.F.</td><td>\$84.00</td><td>\$44,268.00</td></d<84")<>			527	L.F.	\$84.00	\$44,268.00
Concrete Box Culvert			80	L.F./CELL	\$167.00	\$13,360.00
Landscaping and Maintenance						
Improvements						
Reclamation & seeding (native grasses)			8	ACRE	\$1,670.00	\$13,861.00
Land Acquisition						
Easement/ROW Acquisition			8.30	ACRE	\$11,228.00	\$93,192.00

Master Plan Capital Imp	rovement Cost Summary
Capital Improvement Costs	
Pipe Culverts and Storm Drains	\$0.00
Concrete Box Culverts	\$928,214.00
Hydraulic Structures	\$0.00
Channel Improvements	\$65,637.00
Detention/Water Quality Facilities	\$2,840,470.00
Removals	\$57,628.00



Landscaping and Maintenance Improvements			\$13,861.00	
Special Items (User Defined)	_		\$0.00	
Subtotal Capital Improvement Costs			\$3,905,810.00	
Additional Capital Improvement Costs				
Dewatering		L.S.	\$0.00	
Mobilization	5%		\$195,291.00	
Traffic Control		L.S.	\$0.00	
Utility Coordination/Relocation		L.S.	\$0.00	
Stormwater Management/Erosion Control	5%		\$195,291.00	
Subtotal Additional Capital Improvement Costs				
Land Acquisition Costs				
ROW/Easements			\$93,192.00	
Subtotal Land Acquisition Costs			\$93,192.00	
Other Costs (percentage of Capital Improvement Costs)				
Engineering	15%		\$644,459.00	
Legal/Administrative	5%		\$214,820.00	
Contract Admin/Construction Management	10%		\$429,639.00	
Contingency	25%		\$1,074,098.00	
Subtotal Other Costs			\$2,363,016.00	
Total Capital Improvement Costs			\$6,752,600.00	

Master Plan Operation and Maintenance Cost Summary							
Description Quantity Unit Unit Cost Total Annual Cost							
Culvert Maintenance (e.g. sediment & debris removal, erosion at entrance/exit, structural repairs, etc.)			L.F.	\$2.00	\$1,214.00		
Detention/WQ Maintenance (e.g. sediment & debris removal, mucking out, tree & weed removal, structural repairs, etc.)		8.3	ACRE	\$2,505.00	\$20,792.00		
Total Annual Operation and Maintenance Cost				\$22,006.00			
Effective Interest Rate			-	0.00%			
Total Operation and Maintenance Costs Over 50 Years				\$1,100,300.00			

Summary for Tabulation (Does Not Print)				
Capital Improvement Costs	\$4,296,392.00			
ROW/Easements	\$93,192.00			
Engineering	\$644,459.00			
Legal/Administrative	\$214,820.00			
Contract Admin/Construction Management	\$429,639.00			
Contingency	\$1,074,098.00			
Total Capital Improvement Costs	\$6,752,600.00			
Total Annual Operation and Maintenance Cost	\$22,006.00			
Total Operation and Maintenance Costs Over 50 Years	\$1,100,300.00			



PROJECT: 23.1447.001 Greeley - Comprehensive Drainage Plan Oklahoma Alteratives Analysis

DRAINAGEWAY: Reach 843

REACH: 843
RISDICTION: Greeley

JURISDICTION:
REACH ID:

Option 1 -Reach843 Sabastian Ortega

DATE:

6/11/2024

DESCRIPTION			QUANTITY	UNIT	UNIT COST	TOTAL COST
Concrete Box Culverts						
Box Culvert Pipe						
Individual Box Span (ft)	Box Height (ft)	No. of Barrels	Length (ft)			
9	5	2	74	L.F.	\$2,764.44	\$204,569.00
12	7	2	304	L.F.	\$4,124.61	\$1,253,881.00
Removals						
Removal of culvert pipe (48" <d<84")< td=""><td></td><td></td><td>378</td><td>L.F.</td><td>\$84.00</td><td>\$31,752.00</td></d<84")<>			378	L.F.	\$84.00	\$31,752.00

Master Plan Capital Improvement Cost Summary					
Capital Improvement Costs					
Pipe Culverts and Storm Drains			\$0.00		
Concrete Box Culverts			\$1,458,450.00		
Hydraulic Structures			\$0.00		
Channel Improvements			\$0.00		
Detention/Water Quality Facilities			\$0.00		
Removals			\$31,752.00		
Landscaping and Maintenance Improvements			\$0.00		
Special Items (User Defined)			\$0.00		
Subtotal Capital Improvement Costs					
Additional Capital Improvement Costs					
Dewatering		L.S.	\$0.00		
Mobilization	5%		\$74,510.00		
Traffic Control		L.S.	\$0.00		
Utility Coordination/Relocation		L.S.	\$0.00		
Stormwater Management/Erosion Control	5%		\$74,510.00		
Subtotal Additional Capital Improvement Costs		<u> </u>	\$149,020.00		



Land Acquisition Costs		
ROW/Easements		\$0.00
Subtotal Land Acquisition Costs		\$0.00
Other Costs (percentage of Capital Improvement Costs)		
Engineering	15%	\$245,883.00
Legal/Administrative	5%	\$81,961.00
Contract Admin/Construction Management	10%	\$163,922.00
Contingency	25%	\$409,806.00
Subtotal Other Costs		\$901,572.00
Total Capital Improvement Costs		 \$2,540,794.00

Master Plan Operation and Maintenance Cost Summary					
Description	Quantity	Unit	Unit Cost	Total Annual Cost	
Culvert Maintenance (e.g. sediment & debris removal, erosion at entrance/exit, structural repairs, etc.)		756	L.F.	\$2.00	\$1,512.00
Total Annual Operation and Maintenance Cost				\$1,512.00	
Effective Interest Rate				0.00%	
Total Operation and Maintenance Costs Over 50 Years			<u>-</u>	\$75,600.00	

Summary for Tabulation (Does Not Print)				
Capital Improvement Costs	\$1,639,222.00			
ROW/Easements	\$0.00			
Engineering	\$245,883.00			
Legal/Administrative	\$81,961.00			
Contract Admin/Construction Management	\$163,922.00			
Contingency	\$409,806.00			
Total Capital Improvement Costs	\$2,540,794.00			
Total Annual Operation and Maintenance Cost	\$1,512.00			
Total Operation and Maintenance Costs Over 50				
Years	\$75,600.00			



PROJECT: 23.1447.001 Greeley - Comprehensive Drainage Plan Oklahoma Alteratives Analysis

REACH: 843

JURISDICTION: Greeley

REACH ID: Option 2-Reach843 Sabastian Ortega DATE: 6/11/2024

DESCRIPTION			QUANTITY	UNIT	UNIT COST	TOTAL COST
Concrete Box Culverts						
Box Culvert Pipe						
Individual Box Span (ft)	Box Height (ft)	No. of Barrels	Length (ft)			
6	4	1	74	L.F.	\$1,009.44	\$74,699.00
10	4	1	304	L.F.	\$1,354.93	\$411,900.00
Detention/Water Quality Facilities						
Detention (Complete-in-Place)						
Detention Facility 1 (Complete-in-Place)			25	AC-FT	\$76,152.00	\$1,903,800.00
Detention Facility 2 (Complete-in-Place)			17	AC-FT	\$76,152.00	\$1,294,584.00
Removals						
Removal of culvert pipe (48" <d<84")< td=""><td></td><td></td><td>378</td><td>L.F.</td><td>\$84.00</td><td>\$31,752.00</td></d<84")<>			378	L.F.	\$84.00	\$31,752.00
Landscaping and Maintenance	_					
Improvements						
Reclamation & seeding (native grasses)			16.60	ACRE	\$1,670.00	\$27,722.00
Land Acquisition						
Easement/ROW Acquisition			16.60	ACRE	\$11,228.00	\$186,385.00

Master Plan Capital Improve	ement Cost Summary
Capital Improvement Costs	
Pipe Culverts and Storm Drains	\$0.00
Concrete Box Culverts	\$486,599.00
Hydraulic Structures	\$0.00
Channel Improvements	\$0.00
Detention/Water Quality Facilities	\$3,198,384.00
Removals	\$31,752.00
Landscaping and Maintenance Improvements	\$27,722.00
Special Items (User Defined)	\$0.00
Subtotal Capital Improvement Costs	\$3,744,457.00
Additional Capital Improvement Costs	



Dewatering		L.S.	\$0.00		
Mobilization	5%		\$187,223.00		
Traffic Control		L.S.	\$0.00		
Utility Coordination/Relocation		L.S.	\$0.00		
Stormwater Management/Erosion Control	5%		\$187,223.00		
Subtotal Additional Capital Improvement Costs			\$374,446.00		
Land Acquisition Costs					
ROW/Easements					
Subtotal Land Acquisition Costs					
Other Costs (percentage of Capital Improvement Costs)					
Engineering	15%		\$617,835.00		
Legal/Administrative	5%		\$205,945.00		
Contract Admin/Construction Management	10%		\$411,890.00		
Contingency	25%		\$1,029,726.00		
Subtotal Other Costs					
Total Capital Improvement Costs					

Master Plan Operation and Mair	ntenance Co	ost Summary			-
Description	Quantity	Unit	Unit Cost	Total Annual Cost	
Culvert Maintenance (e.g. sediment & debris removal, erosion at entrance/exit, structural repairs, etc.)		378	L.F.	\$2.00	\$756.00
Detention/WQ Maintenance (e.g. sediment & debris removal, mucking out, tree & weed removal, structural repairs, etc.)		16.6	ACRE	\$2,505.00	\$41,583.00
Total Annual Operation and Maintenance Cost				\$42,339.00	
Effective Interest Rate			-	0.00%	
Total Operation and Maintenance Costs Over 50 Years				\$2,116,950.00	

Summary for Tabulation (Does Not Print)				
Capital Improvement Costs	\$4,118,903.00			
ROW/Easements	\$186,385.00			
Engineering	\$617,835.00			
Legal/Administrative	\$205,945.00			
Contract Admin/Construction Management	\$411,890.00			
Contingency	\$1,029,726.00			
Total Capital Improvement Costs	\$6,570,684.00			
Total Annual Operation and Maintenance Cost	\$42,339.00			
Total Operation and Maintenance Costs Over 50 Years	\$2,116,950.00			



PROJECT: 23.1447.001 Greeley - Comprehensive Drainage Plan Oklahoma Alteratives Analysis

REACH: 843

JURISDICTION: Greeley

REACH ID: Option 3-Reach843 Sabastian Ortega DATE: 6/11/2024

						TOTAL
DESCRIPTION			QUANTITY	UNIT	UNIT COST	COST
Concrete Box Culverts						
Box Culvert Pipe						
Individual Box Span (ft)	Box Height (ft)	No. of Barrels	Length (ft)			
9	5	2	74	L.F.	\$2,764.44	\$204,569.00
12	7	2	304	L.F.	\$4,124.61	\$1,253,881.00
Channel Improvements						
Excavation, Mid Range			8828	C.Y.	\$40.00	\$353,120.00
Removals						
Removal of culvert pipe (48" <d<84")< td=""><td></td><td></td><td>378</td><td>L.F.</td><td>\$84.00</td><td>\$31,752.00</td></d<84")<>			378	L.F.	\$84.00	\$31,752.00
Landscaping and Maintenance						
Improvements						
Reclamation & seeding (native grasses)			5	ACRE	\$1,670.00	\$7,899.00
Land Acquisition						
Easement/ROW Acquisition			4.73	ACRE	\$11,228.00	\$53,108.00

Master Plan Capital Improve	ment Cost Summary
Capital Improvement Costs	
Pipe Culverts and Storm Drains	\$0.00
Concrete Box Culverts	\$1,458,450.00
Hydraulic Structures	\$0.00
Channel Improvements	\$353,120.00
Detention/Water Quality Facilities	\$0.00
Removals	\$31,752.00
Landscaping and Maintenance Improvements	\$7,899.00
Special Items (User Defined)	\$0.00
Subtotal Capital Improvement Costs	\$1,851,221.00
Additional Capital Improvement Costs	



Dewatering		L.S.	\$0.00
Mobilization	5%		\$92,561.00
Traffic Control		L.S.	\$0.00
Utility Coordination/Relocation		L.S.	\$0.00
Stormwater Management/Erosion Control	5%		\$92,561.00
Subtotal Additional Capital Improvement Costs			\$185,122.00
Land Acquisition Costs			
ROW/Easements			\$53,108.00
Subtotal Land Acquisition Costs			\$53,108.00
Other Costs (percentage of Capital Improvement Costs)			
Engineering	15%		\$305,451.00
Legal/Administrative	5%		\$101,817.00
Contract Admin/Construction Management	10%		\$203,634.00
Contingency	25%		\$509,086.00
Subtotal Other Costs			\$1,119,988.00
Total Capital Improvement Costs			\$3,209,439.00

Master Plan Operation and Ma	aintenance Co	ost Summary			-
Description	Quantity	Unit	Unit Cost	Total Annual Cost	
Culvert Maintenance (e.g. sediment & debris removal, erosion at entrance/exit, structural repairs, etc.)		756	L.F.	\$2.00	\$1,512.00
Channel Maintenance (e.g. sediment & debris removal, erosion, tree & weed removal, etc.)	2471	L.F.	\$3.00	\$7,413.00	
Total Annual Operation and Maintenance Cost				\$8,925.00	
Effective Interest Rate				0.00%]
Total Operation and Maintenance Costs Over 50 Years				\$446,250.00	

Summary for Tabulation (Does Not Print)				
Capital Improvement Costs	\$2,036,343.00			
ROW/Easements	\$53,108.00			
Engineering	\$305,451.00			
Legal/Administrative	\$101,817.00			
Contract Admin/Construction Management	\$203,634.00			
Contingency	\$509,086.00			
Total Capital Improvement Costs	\$3,209,439.00			
Total Annual Operation and Maintenance Cost	\$8,925.00			
Total Operation and Maintenance Costs Over 50 Years	\$446,250.00			



PROJECT: 23.1447.001 Greeley - Comprehensive Drainage Plan Oklahoma Alteratives Analysis

DRAINAGEWAY: Reach 843

REACH: 843

JURISDICTION: Greeley

REACH ID: Option 4-Reach843 Sabastian Ortega DATE: 6/11/2024

						TOTAL
DESCRIPTION			QUANTITY	UNIT	UNIT COST	COST
Concrete Box Culverts						
Box Culvert Pipe						
Individual Box Span (ft)	Box Height (ft)	No. of Barrels	Length (ft)			
9	4	2	74	L.F.	\$2,537.62	\$187,784.00
10	4	1	304	L.F.	\$1,354.93	\$411,900.00
Detention/Water Quality Facilities						
Detention (Complete-in-Place)						
Detention Facility 1 (Complete-in-Place)			2	AC-FT	\$76,152.00	\$182,765.00
Removals						
Removal of culvert pipe (48" <d<84")< td=""><td></td><td></td><td>378</td><td>L.F.</td><td>\$84.00</td><td>\$31,752.00</td></d<84")<>			378	L.F.	\$84.00	\$31,752.00
Landscaping and Maintenance						
Improvements						
Reclamation & seeding (native grasses)			1	ACRE	\$1,670.00	\$1,002.00
Land Acquisition						
Easement/ROW Acquisition			0.60	ACRE	\$11,228.00	\$6,737.00

Master Plan Capital Improvement Cost Summary	
Capital Improvement Costs	
Pipe Culverts and Storm Drains	\$0.00
Concrete Box Culverts	\$599,684.00
Hydraulic Structures	\$0.00
Channel Improvements	\$0.00
Detention/Water Quality Facilities	\$182,765.00
Removals	\$31,752.00
Landscaping and Maintenance Improvements	\$1,002.00
Special Items (User Defined)	\$0.00
Subtotal Capital Improvement Costs	\$815,203.00
Additional Capital Improvement Costs	



Dewatering		L.S.	\$0.00
Mobilization	5%		\$40,760.00
Traffic Control		L.S.	\$0.00
Utility Coordination/Relocation		L.S.	\$0.00
Stormwater Management/Erosion Control	5%		\$40,760.00
Subtotal Additional Capital Improvement Costs			\$81,520.00
Land Acquisition Costs			
ROW/Easements			\$6,737.00
Subtotal Land Acquisition Costs			\$6,737.00
Other Costs (percentage of Capital Improvement Costs)			
Engineering	15%		\$134,508.00
Legal/Administrative	5%		\$44,836.00
Contract Admin/Construction Management	10%		\$89,672.00
Contingency	25%		\$224,181.00
Subtotal Other Costs			\$493,197.00
Total Capital Improvement Costs			\$1,396,657.00

Master Plan Operation and Ma	aintenance Co	st Summary	*		
Description	Quantity	Unit	Unit Cost	Total Annual Cost	
Culvert Maintenance (e.g. sediment & debris removal, erosion at entrance/exit, structural repairs, etc.)		452	L.F.	\$2.00	\$904.00
Detention/WQ Maintenance (e.g. sediment & debris removal, mucking out, tree & weed removal, structural	l repairs, etc.)	0.6	ACRE	\$2,505.00	\$1,503.00
Total Annual Operation and Maintenance Cost				\$2,407.00	
Effective Interest Rate				0.00%	
Total Operation and Maintenance Costs Over 50 Years	_			\$120,350.00	

Summary for Tabulation (Does Not Print)			
Capital Improvement Costs	\$896,723.00		
ROW/Easements	\$6,737.00		
Engineering	\$134,508.00		
Legal/Administrative	\$44,836.00		
Contract Admin/Construction Management	\$89,672.00		
Contingency	\$224,181.00		
Total Capital Improvement Costs	\$1,396,657.00		
Total Annual Operation and Maintenance Cost	\$2,407.00		
Total Operation and Maintenance Costs Over 50 Years	\$120,350.00		



Appendix F – Conceptual Design Information



Appendix F-1
Master Plan CUHP



CUHP SUBCATCHMENTS

Columns with this color heading are for required user-input
Columns with this color heading are for optional override values
Columns with this color heading are for program-calculated values

								Maximum Depro (Watershe	_	Но	rton's Infiltrat Parameters	ion	DCIA
Subcatchment Name	EPA SWMM Target Node	Raingage	Area (mi²)	Length to Centroid (mi)	Length (mi)	Slope (ft/ft)	Percent Imperviousness	Pervious	Impervious	Initial Rate (in/hr)	Decay Coefficient (1/seconds)	Final Rate (in/hr)	Level 0, 1, or 2
620	620	Greeley	0.0526652	0.271836742	0.5979167	0.007773202	23.47804331	0.35	0.1	3	0.0018	0.5	1
712	712	Greeley	0.1399709	0.346194886	0.7643939	0.032943508	30.15040126	0.35	0.1	3	0.0018	0.5	1
714	714	Greeley	0.0354436	0.090906439	0.2119318	0.03002681	12.53367488	0.35	0.1	3	0.0018	0.5	1
804	804	Greeley	0.0400141	0.084873939	0.38125	0.018132141	9.980909512	0.35	0.1	5	0.0007	1	1
810	810	Greeley	0.1150293	0.241703788	0.5992424	0.01062579	48.09703793	0.35	0.1	3	0.0018	0.5	1
820	820	Greeley	0.1271955	0.170171383	0.5369318	0.021358025	69.77	0.35	0.1	3	0.0018	0.5	1
824	824	Greeley	0.0678322	0.192091856	0.4208333	0.017484248	77.95	0.35	0.1	3	0.0018	0.5	1
830	830	Greeley	0.1105492	0.120804545	0.5405303	0.018826209	67.82	0.35	0.1	3	0.0018	0.5	1
840	840	Greeley	0.099614	0.338775	0.6744318	0.023139568	76.53	0.35	0.1	3	0.0018	0.5	1
842	842	Greeley	0.1731909	0.312127273	0.8337121	0.016110859	68.58	0.35	0.1	3	0.0018	0.5	1
844	844	Greeley	0.1982611	0.278277273	0.5422348	0.016028641	76.19	0.35	0.1	3	0.0018	0.5	1
850	850	Greeley	0.156178	0.361078598	0.5691288	0.02344426	60.07	0.35	0.1	4.5	0.0018	0.6	1



RUN MULTIPLE CUHP AND SWMM SCENARIOS

Columns with this color heading are for required user-input
Columns with this color heading are for program-calculated values

SWMM Run Wait Time (sec) 60 (Optional) SWMM Time Series Inflow "Modification Type" (LU, RP, or LU&RP)

Subcatchment Name	Existing Landuse % Imperviousness	Future Landuse % Imperviousness
620	23.42	23.48
712	27.31	30.15
714	5.01	12.53
804	9.96	9.98
810	4.67	48.10
820	52.02	69.77
824	13.57	77.95
830	50.62	67.82
840	8.02	76.53
842	2.61	68.58
844	6.68	76.19
850	2.00	60.07

Raingage	Return Period (Years)	1 Hr Depths (in)	6 Hr Depths (in)
	WQ	0.600	N/A
	2	0.844	1.280
	5	1.120	1.670
Greeley	10	1.400	2.080
Oreciey	25	1.870	2.780
	50	2.310	3.410
	100	2.800	4.130
	500	4.180	6.190

Enter "X"			Return	Correction
to Run	Sconario	Land Use	Period	Area
Scenario	ID	(E or F)	(yr)	(Sq.Mi.)
X	1	E	WQ	0
X	2	E	2	0
X	3	E	5	0
X	4	E	10	0
X	5	E	25	0
X	6	E	50	0
X	7	E	100	0
X	8	E	500	0
X	9	F	WQ	0
X	10	F	2	0
X	11	F	5	0
X	12	F	10	0
X	13	F	25	0
X	14	F	50	0
X	15	F	100	0
X	16	F	500	0



Summary of Unit Hydrograph Parameters Used By Program and Calculated Results (Version 2.0.1)

				Unit	Hydrograp	h Paramet	ers and Re	sults			Exces	s Precip.		Storm	Hydrograph	
Catchment Name/ID	User Comment for Catchment	СТ	Ср	W50 (min.)	W50 Before Peak	W75 (min.)	W75 Before Peak	Time to Peak (min.)	Peak (cfs)	Volume (c.f)	Excess (inches)	Excess (c.f.)	Time to Peak (min.)	Peak Flow (cfs)	Total Volume (c.f.)	Runoff per Unit Area (cfs/acre)
620		0.108	0.097	70.4	6.72	36.6	4.75	11.2	22	122,352	2.06	251,828	60.0	37	251,875	1.10
712		0.101	0.162	35.0	5.86	18.2	4.14	9.8	120	325,181	2.14	694,753	45.0	171	694,138	1.91
714		0.124	0.085	23.8	3.05	12.4	2.16	5.1	45	82,342	1.93	158,953	40.0	52	156,881	2.27
804		0.135	0.096	33.2	3.95	17.2	2.79	6.6	36	92,961	0.86	79,978	40.0	25	79,718	0.99
810		0.090	0.198	25.1	5.32	13.0	3.76	8.9	138	267,236	2.35	627,887	40.0	188	626,375	2.55
820		0.081	0.243	12.4	3.82	6.5	2.70	6.4	307	295,500	2.61	771,295	35.0	332	753,111	4.07
824		0.078	0.189	15.2	3.72	7.9	2.63	6.2	133	157,588	2.71	426,988	35.0	165	424,631	3.80
830		0.081	0.226	11.8	3.55	6.1	2.51	5.9	281	256,828	2.59	664,304	35.0	293	647,959	4.15
840		0.078	0.224	20.0	4.93	10.4	3.48	8.2	150	231,423	2.69	623,051	40.0	200	618,472	3.13
842		0.081	0.278	19.3	5.62	10.0	3.97	9.4	269	402,357	2.60	1,044,424	40.0	353	1,040,010	3.18
844		0.079	0.299	13.4	4.57	7.0	3.23	7.6	444	460,600	2.69	1,238,160	35.0	523	1,234,651	4.12
850		0.085	0.252	18.2	5.01	9.4	3.54	8.4	258	362,833	2.41	874,190	35.0	313	869,553	3.13



Summary of CUHP Input Parameters (Version 2.0.1)

								Depression	on Storage	Horton's	Infiltration Pa	rameters	DCIA I	evel and Fra	ctions	İ
Catchment Name/ID	SWMM Node/ID	Raingage Name/ID	Area (sq.mi.)	Dist. to Centroid (miles)	Length (miles)	Slope (ft./ft.)	Percent Imperv.	Pervious (inches)	Imperv. (inches)	Initial Rate (in./hr.)	Final Rate (in.hr.)	Decay Coeff. (1/sec.)	DCIA Level	Dir. Con'ct Imperv. Fraction	Receiv. Perv. Fraction	Percent Eff. Imperv.
620	620	GREELEY	0.053	0.272	0.598	0.008	23.5	0.35	0.10	3.00	0.50	0.0018	1.00	0.28	0.26	21.74
712	712	GREELEY	0.140	0.346	0.764	0.033	30.2	0.35	0.10	3.00	0.50	0.0018	1.00	0.37	0.29	28.27
714	714	GREELEY	0.035	0.091	0.212	0.030	12.5	0.35	0.10	3.00	0.50	0.0018	1.00	0.14	0.21	11.27
804	804	GREELEY	0.040	0.085	0.381	0.018	10.0	0.35	0.10	5.00	1.00	0.0007	1.00	0.11	0.20	7.52
810	810	GREELEY	0.115	0.242	0.599	0.011	48.1	0.35	0.10	3.00	0.50	0.0018	1.00	0.59	0.37	46.22
820	820	GREELEY	0.127	0.170	0.537	0.021	69.8	0.35	0.10	3.00	0.50	0.0018	1.00	0.77	0.47	68.30
824	824	GREELEY	0.068	0.192	0.421	0.017	78.0	0.35	0.10	3.00	0.50	0.0018	1.00	0.83	0.50	76.78
830	830	GREELEY	0.111	0.121	0.541	0.019	67.8	0.35	0.10	3.00	0.50	0.0018	1.00	0.75	0.46	66.30
840	840	GREELEY	0.100	0.339	0.674	0.023	76.5	0.35	0.10	3.00	0.50	0.0018	1.00	0.82	0.50	75.31
842	842	GREELEY	0.173	0.312	0.834	0.016	68.6	0.35	0.10	3.00	0.50	0.0018	1.00	0.76	0.46	67.08
844	844	GREELEY	0.198	0.278	0.542	0.016	76.2	0.35	0.10	3.00	0.50	0.0018	1.00	0.82	0.49	74.96
850	850	GREELEY	0.156	0.361	0.569	0.023	60.1	0.35	0.10	4.50	0.60	0.0018	1.00	0.70	0.42	57.88



Appendix F-2 Master Plan Detention



		<u>UL I</u>	CIVITO	<u> </u>	N STAGE-S	<u> TUKA</u>	GE TAI	RE RE	<u>JILDEF</u>	<u> </u>				
				MHFD	D-Detention, Version	on 4.06 (Ju	ıly 2022)						Clear Work	book
Project:	23.1447.00	1 Greeley -	Oklahoma Dr	ainage MP									Oldai Trolla	DOOK
Basin ID:	Option4, EU	JRV 711												
ZONE 3	2													
OLUME EURY WOCV	ONE 1	1												
OLUME EURV WOCV				\rightarrow			Т							
ZONE	1 AND 2	ORIFIC			Depth Increment =	0.50	ft Optional		1		Optional			_
POOL Example Zone		tion (Rete	ntion Pond)		Stage - Storage	Stage	Override	Length	Width	Area	Override	Area	Volume	Volum
atarahad Information					Description Top of Missensel	(ft)	Stage (ft)	(ft)	(ft) 41.9	(ft²)	Area (ft 2)	(acre) 0.040	(ft ³)	(ac-fi
atershed Information xtended Detention Basin (EDB)	EDB	•			Top of Micropool ISV	0.00		41.9 41.9	41.9	1,752 1,752		0.040	578	0.013
tended Detention Basin (EDB) Watershed Area =	90.00	acres			LSV .	0.50		41.9	41.9	1,752		0.040	876	0.013
Watershed Length =	3,900	ft				1.00		99.2	70.2	6,962		0.160	2,148	0.049
Watershed Length to Centroid =	1,738	ft			Hoor	1.18		159.9	100.2	16,021		0.368	4,162	0.096
Watershed Slope =	0.031	ft/ft				1.50		162.5	102.7	16,694		0.383	9,396	0.216
Watershed Imperviousness =	30.20%	percent				2.00		166.5	106.7	17,771		0.408	18,011	0.413
Percentage Hydrologic Soil Group A =	0.0%	percent				2.50		170.5	110.7	18,879		0.433	27,172	0.624
Percentage Hydrologic Soil Group B =	0.0%	percent				3.00		174.5	114.7	20,020		0.460	36,896	0.847
Percentage Hydrologic Soil Groups C/D =	100.0%	percent			Zene 1 (WOC)	3.50		178.5	118.7	21,193		0.487	47,198	1.084
Target WQCV Drain Time = Location for 1-hr Rainfall Depths =	40.0	hours of Building		▼	Zone 1 (WQCV)	3.62 4.00		179.4 182.5	119.7 122.7	21,479 22,398		0.493	49,758 58,094	1.142
					<u> </u>	4.50		186.5	126.7	23,635		0.514	69,601	1.59
After providing required inputs above inc depths, click 'Run CUHP' to generate rund			Run CUH	P		5.00		190.5	130.7	24,904		0.572	81,735	1.87
the embedded Colorado Urban Hydro			Optional Use	r Overrides		5.50		194.5	134.7	26,205		0.602	94,511	2.17
Water Quality Capture Volume (WQCV) =	1.141	acre-feet		acre-feet	Zone 2 (EURV)	5.99		198.4	138.7	27,511		0.632	107,670	2.47
Excess Urban Runoff Volume (EURV) =	2.470	acre-feet		acre-feet		6.00		198.5	138.7	27,538		0.632	107,945	2.47
2-yr Runoff Volume (P1 = 0.85 in.) =	1.598	acre-feet	0.85	inches	<u> </u>	6.50		202.5	142.7	28,903		0.664	122,054	2.80
5-yr Runoff Volume (P1 = 1.12 in.) =	2.810	acre-feet	1.12	inches		7.00		206.5	146.7	30,299		0.696	136,853	3.14
10-yr Runoff Volume (P1 = 1.4 in.) =	4.602	acre-feet	1.40	inches		7.50		210.5	150.7	31,728		0.728	152,358	3.49
25-yr Runoff Volume (P1 = 1.87 in.) = 50-yr Runoff Volume (P1 = 2.3 in.) =	8.506 11.792	acre-feet acre-feet	2.30	inches		8.00 8.50		214.5 218.5	154.7 158.7	33,189 34,682		0.762	168,586 185,553	3.87 4.26
100-yr Runoff Volume (P1 = 2.79 in.) =	15.995	acre-feet	2.79	inches		9.00		222.5	162.7	36,207		0.790	203,274	4.66
500-yr Runoff Volume (P1 = 4.16 in.) =	27.074	acre-feet	4.16	inches		9.50		226.5	166.7	37,764		0.867	221,765	5.09
Approximate 2-yr Detention Volume =	1.515	acre-feet		4		10.00		230.5	170.7	39,353		0.903	241,043	5.53
Approximate 5-yr Detention Volume =	2.643	acre-feet				10.50		234.5	174.7	40,974		0.941	261,123	5.99
Approximate 10-yr Detention Volume =	3.285	acre-feet				11.00		238.5	178.7	42,627		0.979	282,022	6.47
Approximate 25-yr Detention Volume =	4.314	acre-feet				11.50		242.5	182.7	44,311		1.017	303,755	6.97
Approximate 50-yr Detention Volume =	4.931	acre-feet				12.00		246.5	186.7	46,028		1.057	326,339	7.49
Approximate 100-yr Detention Volume =	6.534	acre-feet				12.50		250.5	190.7	47,777		1.097	349,789	8.03
fine Zones and Basin Coomsta						13.00 13.50		254.5 258.5	194.7 198.7	49,558 51,371		1.138	374,122 399,353	9.16
efine Zones and Basin Geometry Zone 1 Volume (WQCV)	1.141	acre-feet				14.00		262.5	202.7	53,216		1.222	425,498	9.76
Zone 2 Volume (EURV - Zone 1)	1.329	acre-feet				14.50		266.5	206.7	55,093		1.265	452,574	10.39
Select Zone 3 Storage Volume (Optional)		acre-feet	Total deter is less than			15.00		270.5	210.7	57,002		1.309	480,596	11.03
Total Detention Basin Volume =	2.470	acre-feet	volume.			15.50		274.5	214.7	58,943		1.353	509,581	11.69
Initial Surcharge Volume (ISV) =	578	ft ³				16.00		278.5	218.7	60,915		1.398	539,544	12.38
Initial Surcharge Depth (ISD) =	0.33	ft				16.50		282.5	222.7	62,920		1.444	570,502	13.09
Total Available Detention Depth $(H_{total}) =$	6.00	ft				17.00		286.5	226.7	64,957		1.491	602,470	13.83
Depth of Trickle Channel $(H_{TC}) =$	0.50	ft			<u> </u>	17.50		290.5	230.7	67,026		1.539	635,464	14.58
Slope of Trickle Channel (S _{TC}) =	0.003	ft/ft			<u> </u>	18.00		294.5	234.7	69,127		1.587	669,501	15.37
Slopes of Main Basin Sides (S _{main}) =	4	H:V			<u> </u>	18.50		298.5	238.7	71,260		1.636	704,597	16.17
Basin Length-to-Width Ratio $(R_{L/W}) =$	2	1			<u> </u>	19.00 19.50		302.5 306.5	242.7 246.7	73,425 75,622		1.686	740,766 778,027	17.00
Initial Surcharge Area (A _{ISV}) =	1,752	ft ²				20.00		310.5	250.7	77,851		1.787	816,393	18.74
Surcharge Volume Length (L _{ISV}) =	41.9	ft				20.50		314.5	254.7	80,111		1.839	855,883	19.64
Surcharge Volume Width (W _{ISV}) =	41.9	ft				21.00		318.5	258.7	82,404		1.892	896,510	20.58
Depth of Basin Floor (H _{FLOOR}) =	0.35	ft				21.50		322.5	262.7	84,729		1.945	938,292	21.54
Length of Basin Floor (L_{FLOOR}) =	159.9	ft				22.00		326.5	266.7	87,086		1.999	981,245	22.52
Width of Basin Floor (W_{FLOOR}) =	100.2	ft				22.50		330.5	270.7	89,475		2.054	1,025,384	23.54
Area of Basin Floor (A _{FLOOR}) =	16,021	ft ²			<u> </u>	23.00		334.5	274.7	91,896		2.110	1,070,725	24.58
Volume of Basin Floor (V _{FLOOR}) =	2,692	ft ³			<u> </u>	23.50		338.5	278.7	94,349		2.166	1,117,285	25.64
Depth of Main Basin (H _{MAIN}) =	4.82 198.5	ft			<u> </u>	24.00		342.5	282.7	96,834		2.223	1,165,079	26.74
Length of Main Basin (L_{MAIN}) = Width of Main Basin (W_{MAIN}) =	198.5	ft ft			<u> </u>	24.50 25.00		346.5 350.5	286.7 290.7	99,351 101,899		2.281	1,214,124 1,264,435	27.87
Area of Main Basin (W _{MAIN}) =	27,538	ft ²				25.50		350.5	290.7	101,899		2.339	1,316,029	30.21
Volume of Main Basin (V _{MAIN}) =	103,732	π ft ³			<u> </u>	26.00		358.5	294.7	107,093		2.459	1,368,921	31.42
Calculated Total Basin Volume (V _{total}) =	2.477	acre-feet				26.50		362.5	302.7	109,738		2.519	1,423,127	32.67
- · · · · · · · · · · · · · · · · · · ·		-				27.00		366.5	306.7	112,415		2.581	1,478,664	33.94
						27.50 28.00		370.5 374.5	310.7 314.7	115,124 117,865		2.643	1,535,548 1,593,794	35.25 36.58
						28.50		378.5	318.7	120,638		2.769	1,653,418	37.95
					<u> </u>	29.00 29.50		382.5 386.5	322.7 326.7	123,443 126,279		2.834 2.899	1,714,437 1,776,866	39.35 40.79
						30.00		390.5	330.7	129,148		2.965	1,840,721	42.25

	DET	ENTION E				ESIGN			
	23.1447.001 Gree	ley - Oklahoma Dra	HFD-Detention, Volinage MP	ersion 4.06 (July	2022)				
Basin ID: /ZONE 3	Option4 , EURV 71	1							1
ZONE 2				Estimated	Estimated	Outlet Torre			
100-YR VOLUME SURV			7 4 (140,000)	Stage (ft)	Volume (ac-ft)	Outlet Type			
VOLUME EURY WOCV			Zone 1 (WQCV)	3.62	1.141	Orifice Plate	Orifice Plate		_
ZONE 1 AND 2	100-YEAR ORIFICE		Zone 2 (EURV)	5.99	1.329	Weir&Pipe (Restrict)		strictor Plate)	
PERMANENT ORIFICES POOL			Zone 3		2 472	Not Utilized	Zone 3 Not Utilized		▼
Jser Input: Orifice at Underdrain Outlet (typic	ally used to drain V	VOCV in a Eiltration	PMD)	Total (all zones)	2.470	1	Calculated Daram	eters for Underdra	in
Underdrain Orifice Invert Depth =	N/A		the filtration media	a surface)	Underd	rain Orifice Area =	N/A	ft ²	<u></u>
Underdrain Orifice Diameter =		inches		,		Orifice Centroid =	N/A	feet	
		•	·					-	
Jser Input: Orifice Plate with one or more or			-			-	Calculated Parame		
Centroid of Lowest Orifice =	0.00	-	in bottom at Stage		-	ce Area per Row =	3.063E-02	ft²	
Depth at top of Zone using Orifice Plate =	3.62 14.50	-	in bottom at Stage	= 0π)		ptical Half-Width =	N/A	feet	
Orifice Plate: Orifice Vertical Spacing = Orifice Plate: Orifice Area per Row =		inches sq. inches (use re	ectangular onening	:)		ical Slot Centroid = Elliptical Slot Area =	N/A N/A	feet ft ²	
Office Face. Office Area per Now =	7.71	sq. Inches (use re	ctarigular operiirigs	?)		implical Sot Area –	IV/A	Tire.	
					to match				
Iser Input: Stage and Total Area of Each Or					rain Time		ı	_	T
	Row 1 (required)	Row 2 (optional)	Row 3 (optional)	Row 4 (optional)	Row 5 (optional)	Row 6 (optional)	Row 7 (optional)	Row 8 (optional)	ļ
Stage of Orifice Centroid (ft)		1.21	2.41						ł
Orifice Area (sq. inches)	4.41	4.41	4.41						1
	Row 9 (optional)	Row 10 (optional)	Row 11 (optional)	Row 12 (optional)	Row 13 (optional)	Row 14 (optional)	Row 15 (optional)	Row 16 (optional)	Ī
Stage of Orifice Centroid (ft)		(1)	(1).11.2.2.7	(3),333	(1)	(1) 11	,	(1) 11 29	
Orifice Area (sq. inches)	,								
to Table Walled O'Co (C' a la la Parte	1: .						Cala lata I Barra		· •
lser Input: Vertical Orifice (Circular or Rectar	Not Selected	Not Selected	1				Not Selected	eters for Vertical O Not Selected	i <u>ririce</u> T
Invert of Vertical Orifice =	N/A		ft (relative to basi	n hottom at Stage	= 0 ft) Ver	tical Orifice Area =	N/A	N/A	ft²
Depth at top of Zone using Vertical Orifice =			ft (relative to basi	-	,	Orifice Centroid =	N/A	N/A	feet
Vertical Orifice Diameter =	N/A	N/A	inches				.,,	.,,	1
Jser Input: Overflow Weir (Dropbox with Flat	Zone 2 Weir		Rectangular/Trape	ezoidal Weir and N	n Outlet Pine)		Calculated Parame	eters for Overflow	Weir
Overflow Weir Front Edge Height Ho =		Not Selected	ft (relative to basin			Unner Edge H -	Zone 2 Weir	Not Selected	
Overflow Weir Front Edge Height, Ho =	4.00	N/A			ft) Height of Grate	Upper Edge, H _t =	Zone 2 Weir 7.33	Not Selected N/A	feet
Overflow Weir Front Edge Height, Ho = Overflow Weir Front Edge Length = Overflow Weir Grate Slope =	4.00	N/A N/A	ft (relative to basin feet H:V	bottom at Stage = 0	ft) Height of Grate Overflow W	Upper Edge, H _t = eir Slope Length = 0-yr Orifice Area =	Zone 2 Weir	Not Selected	
Overflow Weir Front Edge Length =	4.00 800.00	N/A N/A	feet	bottom at Stage = 0 Grat	ft) Height of Grate Overflow W	eir Slope Length = 0-yr Orifice Area =	Zone 2 Weir 7.33 10.54	Not Selected N/A N/A	feet
Overflow Weir Front Edge Length = Overflow Weir Grate Slope = Horiz. Length of Weir Sides = Overflow Grate Type =	4.00 800.00 3.00 10.00 Type C Grate	N/A N/A N/A N/A	feet H:V feet J	bottom at Stage = 0 Grat Ove	ft) Height of Grate Overflow W e Open Area / 10	eir Slope Length = 0-yr Orifice Area = Area w/o Debris =	Zone 2 Weir 7.33 10.54 11382.38	Not Selected N/A N/A N/A	feet feet
Overflow Weir Front Edge Length = Overflow Weir Grate Slope = Horiz. Length of Weir Sides =	4.00 800.00 3.00 10.00	N/A N/A N/A N/A	feet H:V	bottom at Stage = 0 Grat Ove	ft) Height of Grate Overflow W e Open Area / 10 rflow Grate Open	eir Slope Length = 0-yr Orifice Area = Area w/o Debris =	Zone 2 Weir 7.33 10.54 11382.38 5869.19	Not Selected N/A N/A N/A N/A	feet feet ft²
Overflow Weir Front Edge Length = Overflow Weir Grate Slope = Horiz. Length of Weir Sides = Overflow Grate Type = Debris Clogging % =	4.00 800.00 3.00 10.00 Type C Grate ▼	N/A N/A N/A N/A N/A N/A	feet H:V feet %	bottom at Stage = 0 Grat Ove Ov	ft) Height of Grate Overflow W e Open Area / 10 rflow Grate Open erflow Grate Oper	eir Slope Length = 0-yr Orifice Area = Area w/o Debris = n Area w/ Debris =	Zone 2 Weir 7.33 10.54 11382.38 5869.19 2934.59	Not Selected N/A N/A N/A N/A N/A N/A N/A	feet feet ft ² ft ²
Overflow Weir Front Edge Length = Overflow Weir Grate Slope = Horiz. Length of Weir Sides = Overflow Grate Type = Debris Clogging % =	4.00 800.00 3.00 10.00 Type C Grate ▼ 50%	N/A N/A N/A N/A N/A N/A N/A Restrictor Plate, o	feet H:V feet %	bottom at Stage = 0 Grat Ove Ov	ft) Height of Grate Overflow W e Open Area / 10 rflow Grate Open erflow Grate Oper	eir Slope Length = 0-yr Orifice Area = Area w/o Debris =	Zone 2 Weir 7.33 10.54 11382.38 5869.19 2934.59	Not Selected N/A N/A N/A N/A N/A N/A N/A N/A N/A N/A	feet feet ft ² ft ²
Overflow Weir Front Edge Length = Overflow Weir Grate Slope = Horiz. Length of Weir Sides = Overflow Grate Type = Debris Clogging % =	4.00 800.00 3.00 10.00 Type C Grate ▼	N/A N/A N/A N/A N/A N/A N/A N/A Restrictor Plate, o	feet H:V feet %	bottom at Stage = 0 Grat Ove Ov	ft) Height of Grate Overflow W e Open Area / 10 rflow Grate Open erflow Grate Open Cal	eir Slope Length = 0-yr Orifice Area = Area w/o Debris = n Area w/ Debris =	Zone 2 Weir 7.33 10.54 11382.38 5869.19 2934.59	Not Selected N/A N/A N/A N/A N/A N/A N/A N/A N/A N/A	feet feet ft ² ft ²
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Overflow Weir Front Edge Length = Overflow Weir Grate Slope = Horiz. Length of Weir Sides = Overflow Grate Type = Overflow Grate Type = Debris Clogging % = User Input: Outlet Pipe w/ Flow Restriction Plat Depth to Invert of Outlet Pipe = Outlet Pipe Diameter = Restrictor Plate Height Above Pipe Invert = User Input: Emergency Spillway (Rectangular Spillway Invert Stage = Spillway Invert Stage = Spillway Crest Length = Spillway End Slopes = Freeboard above Max Water Surface = Routed Hydrograph Results Design Storm Return Period = One-Hour Rainfall Depth (in) = CUHP Runoff Volume (acre-ft) = Inflow Hydrograph Volume (acre-ft) = CUHP Predevelopment Peak Q (cfs) = Peak Inflow (Q (cfs) = Peak Inflow Q (cfs) = Ratio Peak Outflow to Predevelopment Q = Structure Controlling Flow = Max Velocity through Grate 1 (fps) = Max Velocity through Grate 2 (fps) = Time to Drain 97% of Inflow Volume (hours) = Time to Drain 99% of Inflow Volume (hours) =	4.00 800.00 3.00 3.00 10.00 Type C Grate 50% te (Circular Orfice, Zone 2 Restrictor 2.50 18.00 6.00 or Trapezoidal) 9.00 4.00 1.00 The user can ove WQCV N/A 1.141 N/A N/A N/A N/A N/A N/A N/A N/A N/A N/A	N/A N/A N/A N/A N/A N/A N/A N/A N/A N/A	feet H:V feet H:V feet H:V feet fee	Grat Over Over Over Over Over Over Over Over	ft) Height of Grate Overflow W e Open Area / 10 rflow Grate Open erflow Grate Open erflow Grate Open erflow Grate Open Cal = 0 ft) Ou Outlet al Angle of Restrict Spillway D Stage at T Basin Area at T Basin Area at T Basin Volume at T 1.40 4.602 4.602 24.1 0.27 48.3 7.7 0.3 Outlet Plate 1 0.0 N/A 40 46	leir Slope Length = D-yr Orfice Area = D-yr Orfice Area = Area w/o Debris = h Area w/ Deb	Zone 2 Weir 7.33 10.54 11382.38 5869.19 2934.59 Sone 2 Restrictor 0.52 0.29 1.23 Calculated Parame 0.96 0.98 6.44 So Year 2.30 11.792 11.792 11.792 93.3 1.04 131.0 98.6 1.1 Spillway 0.0 N/A 32 43	Not Selected N/A N/A N/A N/A N/A N/A N/A N/A N/A N/A	feet feet feet feet feet feet ft² ft² ft² ft² ft² ft² ft² feet radians feet feet radians feet feet feet feet feet feet feet fee



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Sept Secretary Secretary Secr	Project:	23.1447.00	1 Greeley -	Oklahoma Dr			•							OICEI WORK	DOOK
Section Part	Basin ID:	Option 4, EU	JRV 820												
Comparison Com	ZONE 3	2													
Company Comp	DO-YR	ONE	1												
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Sign: Strongs Sign: Strong	ZONE	1 AND 2				Depth Increment =	0.50	ft				Ontional			т —
The following in the control of th			tion (Rete	ntion Pond)				Override				Override			Volum
March and Estate Association 1968 1969	aterched Information							Stage (ft)				Area (ft ²)		(ft ³)	(ac-fi
Witercland Longin Common		EDB	1											578	0.013
Waterback large for Common 5 728 1915 1920 1915 1915 1920			acres												0.020
Westerded Spore Duild Processor P	Watershed Length =	2,600	ft				1.00		99.2	70.2	6,962		0.160	2,148	0.049
Waterbed Improvenances 68,00% Processes February (2016)	Watershed Length to Centroid =	720	ft				1.50		267.9	153.5	41,122		0.944	12,998	0.298
Precentage Hydrology 601 Group A Precentage Hydrology 601 Group A	·		• 1			Floor					· ·				0.308
Precreate Hadroigs Col Group D			₹											· ·	0.791
Target W/O Char Time			₹'												1.836
Secretary 1.50 1.			₹			Zone 1 (WOCV)					_				1.858
## Professional Systems (1997) 1-100			₹'			,								· ·	2.390
Secretary Secr	Location for 1-hr Rainfall Depths =	Denver - Capit	ol Building		▼		4.00		291.2	175.1	50,983		1.170	129,128	2.964
Some controlled Control Units 1,500 1,50				Run CI III											3.560
Water Quality Capture Volume (NVCV) = 1.500 3.000 1.000				14011 0011											4.178
Excess than Rusort Volume (RNF) = .5.693 c.er feet 2.yr Rusort Volume (P = .4.5 In .) = .3.272 c.er feet 5.yr Rusort Volume (P = .4.5 In .) = .3.272 c.er feet 1.120 c.er feet 1.400 c.e. feet 1.400			7	Optional Use	7	<u> </u>									4.818 5.48
2-y Fund'f Volume (P1 = 1.2 hz s) = 5.521 cere feet 3-y Fund'f Volume (P1 = 1.2 hz s) = 5.522 cere feet 3-y Fund'f Volume (P1 = 1.8 hz s) = 5.522 cere feet 3-y Fund'f Volume (P1 = 1.8 hz s) = 5.523 cere feet 3-y Fund'f Volume (P1 = 2.8 hz s) = 5.523 cere feet 3-y Fund'f Volume (P1 = 2.8 hz s) = 5.523 cere feet 3-y Fund'f Volume (P1 = 2.8 hz s) = 5.524 cere feet 3-y Fund'f Volume (P1 = 2.8 hz s) = 5.525 cere			+		•	Zone 2 (FLIRV)									5.494
5-yr Runff Volume (P) = 1,4 (n) 7,2 (n) 5.323 30 or Feet 1,40 Inches 7.00 315.2 190.1 62,799 1,141 299,88 8.6 1,000 1,0			+	0.85	-										6.166
25 yr Ruoff Volume (Pt = 2.79 in)	5-yr Runoff Volume (P1 = 1.12 in.) =	5.323	acre-feet	1.12	inches		7.00		315.2	199.1	62,749		1.441	+	6.874
50 yr Runoff Volume (P1 = 2.9 in.) = 1.56 yr Accepted 2.20 in ordes 8.50 332.2 211.1 10,0064 1.506 382.23 9.1	10-yr Runoff Volume (P1 = 1.4 in.) =	7.165	acre-feet	1.40	inches		7.50		319.2	203.1	64,822		1.488	331,330	7.606
100-yr Ruroff Volume (P1 = 4.16 in) 1.263 2.29 notes	, , ,		+		₹									_	8.36
Solvy Ruroff Volume (P1 = A16 in.) Z710 Acce-feet			+		•										9.143
Approximate 2-yn Detention Volume 3.325 sere-feet 10.00 339.2 221.1 73,668 1.777 556,776 11.6 1.777 1.773 1.775 1.7			+		•									_	9.948
Approximate 10-yr Deterition Volume - Approximate 10-yr Deterition Volume - Approximate 59-yr Deterition Volume - Sabati 11.50			•	4.10	Inches										11.63
Approximate 10-yr Chetridin Volume Approximate 25-yr Chetridin Volume Approximate 25-yr Chetridin Volume Approximate 25-yr Chetridin Volume Approximate 10-yr Chetridin Volume 10.325 xcre-feet			•											_	12.51
Approximate 10-yr Detention Volume 8.825 acre-feet 12.00 355.2 239.1 84,920 1.949 667,276 15.3 15.2		6.318	acre-feet				11.00		347.2	231.1	80,230		1.842	584,714	13.42
Approximate 100-yr Detention Volume = 10.325 sore-feet	Approximate 25-yr Detention Volume =	7.856	acre-feet				11.50		351.2	235.1	82,559		1.895	625,409	14.35
13.00 363.2 247.1 89,738 2.060 754,596 17.3			•												15.31
13.50 367.2 251.1 92.195 2.117 800.078 18.3	Approximate 100-yr Detention Volume =	10.325	acre-feet								· ·			<u> </u>	_
Start Volume (WQCV) V 1.850 acre-feet 3.463 acre-fee	efine Zones and Rasin Geometry														18.36
Total detention polymen Same Pol		1.850	acre-feet								· ·			<u> </u>	19.44
Select Zone 3 Storage Volume (Optional) Value of Basin Floor (H _{LOOR}) Select Total Detention Basin (Volume of Basin Floor (H _{LOOR}) Select Total Available Detention Depth (H _{Gool}) Game of Select Total Available Depth of Select Total Depth of Select Total Depth of Select Total Available Depth of Main Basin (H _{Gool}) Game of Select Total Available Depth of Main Basin (H _{Gool}) Game of Select Total Depth of Main Basin (H _{Gool}) Game of Select Total Depth of Main Basin (H _{Gool}) Game of Select Total Depth of Main Basin (H _{Gool}) Game of M _{Gool} Total Depth of Main Basin (H _{Gool}) Game of M _{Gool} Total Depth of Main Basin (H _{Gool}) Game of M _{Gool} Total Depth of M _{Gool} Total Depth of M _{Gool} Total Depth of M _{Gool} Total Depth of M _{Gool} Total Depth of M _{Gool} Total Depth of M _{Gool} Total Depth of M _{Gool} Total Depth of M _{Gool} Total Depth of M _{Gool} Total Depth of M _{Gool} Total Depth of M _G	Zone 2 Volume (EURV - Zone 1)	3.643	acre-feet	Total deter	ntion volume		14.50		375.2	259.1	97,205		2.232	894,767	20.54
Initial Surcharge Volume (Sr)	Select Zone 3 Storage Volume (Optional)		acre-feet	is less than			15.00		379.2	263.1	99,758		2.290	944,007	21.67
Initial Surcharge Depth (ISD) = 0.33 ft 16.50 391.2 275.1 107,609 2.470 1,099,496 25.2 Except 17.00 395.2 279.1 110,290 2.532 1,153,370 26.6 Except 17.00 395.2 279.1 110,290 2.532 1,153,370 26.6 Except 17.00 395.2 279.1 110,290 2.532 1,153,370 26.6 Except 17.00 395.2 279.1 110,290 2.532 1,153,370 26.6 Except 17.00 395.2 279.1 110,290 2.532 1,153,370 26.6 Except 17.00 395.2 279.1 110,290 2.532 1,153,370 26.6 Except 17.00 395.2 279.1 110,290 2.532 1,153,370 26.6 Except 17.00 395.2 279.1 113,003 2.594 1,209,702 27.7 Except 17.00 395.2 279.1 115,003 2.57 1,209,702 27.7 Except 17.00 395.2 279.1 115,009 2.57 1,209,702 27.7 Except 17.00 395.2 279.1 115,009 2.57 1,209,702 27.7 Except 17.00 395.2 279.1 115,009 2.57 1,209,702 27.7 Except 17.00 395.2 279.1 115,009 2.57 1,209,702 27.7 Except 17.00 395.2 279.1 115,009 2.57 1,209,702 27.7 Except 17.00 395.2 27	Total Detention Basin Volume =		1	volume.							· '			<u> </u>	22.83
Total Available Detention Depth (H _{obal}) = Depth of Trickle Channel (H _{TC}) = 0.50			-												24.02
Depth of Trickle Channel (Hr.) = 0.50 ft			₹			<u> </u>					· ·			<u> </u>	25.24 26.49
Slope of Trickle Channel (Str.) = 0.003 ft/ft 18.00 403.2 287.1 115,748 2.657 1,266,978 29.00	1 (1043)		.												26.49
Slopes of Main Basin Sides (S _{main}) = 4 H:V 18.50 407.2 291.1 118,525 2.721 1,325,545 30.4			J												29.08
Basin Length-to-Width Ratio (R _{L/W}) = 2			1				40.50		407.2	204.4	440 505		2 724	4 225 545	30.43
Initial Surcharge Area (A _{ISV}) = 1,752 ft ² 20.00 419.2 303.1 127,049 2.917 1,509,690 34.6 Surcharge Volume Length (L _{ISV}) = 41.9 ft 20.50 423.2 307.1 129,954 2.983 1,573,939 36.1 Surcharge Volume Width (W _{ISV}) = 41.9 ft 21.00 427.2 311.1 132,891 3.051 1,639,649 37.6 Length of Basin Floor (H _{ELOOR}) = 0.68 ft 21.50 431.2 315.1 135,860 3.119 1,706,835 39.1 Length of Basin Floor (M _{ELOOR}) = 42.71.2 ft 22.00 435.2 319.1 138,861 3.188 1,775,514 40.7 Width of Basin Floor (M _{ELOOR}) = 42.092 ft ² 23.00 443.2 327.1 144,959 3.328 1,917,413 44.6 Length of Main Basin (H _{MAIN}) = 4.49 ft 24.00 451.2 335.1 151,185 3.471 2,065,474 47.4 Length of Main Basin (H _{MAIN}) = 4.49 ft 24.00 451.2 335.1 151,185 3.471 2,065,474 47.4 Width of Main Basin (M _{MAIN}) = 58,699 ft ² 25.50 463.2 347.1 160,764 3.691 2,299,400 52.7 Calculated Total Basin Volume (V _{Iotal}) = 5.477 acre-feet 26.50 471.2 355.1 160,710 3.841 2,463,427 56.5 Calculated Total Basin Volume (V _{Iotal}) = 5.477 acre-feet 26.50 483.2 367.1 177,369 4.072 2,721,900 62.4 Ength of Main Basin (M _{MAIN}) = 5.477 acre-feet 26.50 483.2 367.1 177,369 4.072 2,721,900 62.4 Ength of Main Basin (M _{MAIN}) = 5.477 acre-feet 26.50 483.2 367.1 177,369 4.072 2,721,900 62.4 Ength of Main Basin (M _{MAIN}) = 5.477 acre-feet 26.50 483.2 367.1 177,369 4.072 2,721,900 62.4 Ength of Main Basin (M _{MAIN}) = 5.477 acre-feet 26.50 483.2 367.1 177,369 4.072 2,721,900 62.4 Ength of Main Basin (M _{MAIN}) = 5.477 acre-feet 26.50 483.2 367.1 177,369 4.072 2,721,900 62.4 Ength of Main Basin (M _{MAIN}) = 5.477 acre-feet 26.50 483.2 367.1 177,369 4.072 2,721,900 62.4 Ength of Main Basin (M _{MAIN}) = 5.477 acre-feet 26.50 483.2 367.1 177,369 4.072 2,721,900 62.4 Ength of Main Ba	Basin Length-to-Width Ratio $(R_{L/W}) =$	2					19.00		411.2	295.1	121,334		2.785	1,385,509	31.80
Surcharge Volume Length (Lisv) = 41.9 ft 20.50 423.2 307.1 129,954 2.983 1,573,939 36.1 Surcharge Volume Width (Wisv) = 41.9 ft 21.00 427.2 311.1 132,891 3.051 1,639,649 37.6 21.00 427.2 311.1 132,891 3.051 1,639,649 37.6 21.00 427.2 311.1 132,891 3.051 1,639,649 37.6 21.00 427.2 311.1 132,891 3.051 1,639,649 37.6 21.00 427.2 311.1 132,891 3.051 1,639,649 37.6 21.00 427.2 311.1 132,891 3.051 1,639,649 37.6 21.00 427.2 311.1 132,891 3.051 1,639,649 37.6 21.00 427.2 311.1 132,891 3.051 1,639,649 37.6 21.00 427.2 311.1 132,891 3.051 1,639,649 37.6 21.00 427.2 311.1 132,891 3.051 1,639,649 37.6 21.00 427.2 31.1 132,891 3.051 1,639,649 37.6 21.00 427.2 31.1 132,891 3.051 1,639,649 37.6 27.1 2.00 43.2 327.1 148,940 3.257 1,845,701 42.3 27.1 148,949 3.257 1,845,701 42.3 27.1 148,959 3.328 1,917,413 44.0 47.4 47.4 47.4 47.4 47.4 47.4 47.4		,	.												33.21
Surcharge Volume Width (W _{ISV}) = Depth of Basin Floor (H _{FLOOR}) = Depth of Basin Floor (H _{FLOOR}) = Uength of Basin Floor (H _{FLOOR}) = Uength of Basin Floor (H _{FLOOR}) = Uidth of Basin Floor (H _{FLOOR}) = Vidth of Basin Vidth of Basin Vidth of Main Basin (H _{MAIN}) = Vidth of Basin Vidth of			┪												34.65
Depth of Basin Floor (H _{ELOOR}) = Length of Basin Floor (H _{ELOOR}) = Width of Basin Floor (H _{ELOOR}) = Width of Basin Floor (H _{ELOOR}) = Width of Basin Floor (H _{ELOOR}) = Volume of Basin Floor (H _{ELOOR}) = 42,792		-	┥												_
Length of Basin Floor (LFLOOR) = 271.2			┪												39.18
Width of Basin Floor (WFLOOR) 155.2 ft 22.50 439.2 323.1 141,894 3.257 1,845,701 42.3 Volume of Basin Floor (VFLOOR) 42,092 ft 23.00 443.2 327.1 144,959 3.328 1,917,413 44.0 Depth of Main Basin (MFLORIN) 11,884 ft 23.50 447.2 331.1 148,056 3.399 1,990,665 45.6 Length of Main Basin (MALIN) 4.49 ft 24.00 451.2 335.1 151,185 3.471 2,056,747 47.4 Width of Main Basin (MALIN) 307.2 ft 25.00 459.2 333.1 154,346 3.543 2,141,856 49.1 Area of Main Basin (MALIN) 58,699 ft 25.50 465.2 347.1 160,764 3.691 2,299,400 52.7 Volume of Main Basin (VMLIN) 58,699 ft 25.50 467.2 351.1 164,021 3.765 2,380,595 54.6 Calculated Total Basin Volume (Violai) 54.77 acre-feet 26.50 471.2 355.1 167,310 3.841 2,463,427 5		,	┥												40.76
Area of Basin Floor (A _{FLOOR}) = 42,092			┪												42.37
Depth of Main Basin (H _{MAIN}) = Length of Main Basin (L _{MAIN}) = Length of Main Basin (L _{MAIN}) = 307.2 ft 24.50 455.2 339.1 151,185 3.471 2,065,474 47.	Area of Basin Floor (A_{FLOOR}) =	42,092					23.00			327.1	144,959		3.328	1,917,413	44.01
Length of Main Basin (L _{MAIN}) = 307.2 ft 24.50 455.2 339.1 154,346 3.543 2,141,856 49.1		-	₹								<u> </u>			+	45.69
Width of Main Basin (W _{MAIN}) 191.1 ft 25.00 459.2 343.1 157,539 3.617 2,219,826 50.9 Volume of Main Basin (A _{MAIN}) 58,699 ft 2 25.50 463.2 347.1 160,764 3.691 2,299,400 52.7 Volume of Main Basin (V _{MAIN}) 225,245 ft 3 26.00 467.2 351.1 164,021 3.765 2,380,595 54.6 Calculated Total Basin Volume (V _{total}) 5.477 27.00 475.2 355.1 167,310 3.841 2,634,633 60.4 27.00 475.2 363.1 173,984 3.994 2,634,063 60.4 28.00 483.2 367.1 177,369 4.072 2,721,900 62.4 28.50 487.2 371.1 180,786 4.150 2,811,438 64.5 29.00 491.2 375.1 184,235 4.229 2,902,692 66.6			┪												47.41
Area of Main Basin (A _{MAIN}) = Volume of Main Basin (V _{MAIN}) = Vo		,	┪												_
Volume of Main Basin (V _{MAIN}) = C25,245 tr ³ 26.00 467.2 351.1 164,021 3.765 2,380,595 54.6 2.		,	→											+	50.96
Calculated Total Basin Volume (V _{total}) = 5.477 acre-feet 26.50 471.2 355.1 167.310 3.841 2,463,427 56.5 27.00 475.2 359.1 170,631 3.917 2,547,911 58.4 27.50 479.2 363.1 173,984 3.994 2,634,063 6.6 28.00 483.2 367.1 177,369 4.072 2,721,900 62.4 28.50 487.2 371.1 180,786 4.150 2,811,438 64.5 29.00 491.2 375.1 184,235 4.229 2,902,692 64.5 29.00 491.2 375.1 184,235 4.229 2,902,692 64.5 2.6 2.6 2.6 2.6 2.6 2.6 2.6 2.6 2.6 2.6			→								-				54.65
27.00 475.2 359.1 170,631 3,917 2,547,911 58.4 27.50 479.2 363.1 173,984 3,994 2,634,063 60.4 28.00 483.2 367.1 177,369 4,072 2,721,900 62.4 28.50 487.2 371.1 180,786 4,150 2,811,438 64.5 29.00 491.2 375.1 184,235 4,229 2,902,692 64.5			┪												56.55
28.00 483.2 367.1 177,369 4.072 2,721,900 62.4 28.50 487.2 371.1 180,786 4.150 2,811,438 64.5 29.00 491.2 375.1 184,235 4.229 2,902,692 66.6		,	•												58.49
28.50 487.2 371.1 180,786 4.150 2,811,438 64.5 29.00 491.2 375.1 184,235 4.229 2,902,692 66.6															62.48
									487.2		180,786				64.54
							29.50		495.2	379.1	187,717		4.309	2,995,679	68.77

	DET		Basin out			ESIGN													
	22447224		HFD-Detention, Vo	ersion 4.06 (July	2022)														
	23.1447.001 Gree Option 4, EURV 82		inage MP																
ZONE 3	Option 4, Loca 02	<u> </u>		Estimated	Estimated														
ZONE 2 ZONE 1				Stage (ft)	Volume (ac-ft)	Outlet Type													
00-YR COLUME EURY WQCV			Zone 1 (WQCV)	3.02	1.850	Orifice Plate	Orifice Plate												
+ - + -	1	$\overline{}$							_										
ZONE 1 AND 2	100-YEAR ORIFICE		Zone 2 (EURV)	6.01	3.643	Weir&Pipe (Restrict)		strictor Plate)	▼										
PERMANENT ORIFICES POOL			Zone 3			Not Utilized	Zone 3 Not Utilized		▼										
				Total (all zones)	5.493	1													
er Input: Orifice at Underdrain Outlet (typic								eters for Underdra	<u>iin</u>										
Underdrain Orifice Invert Depth =		ft (distance below	the filtration media	a surface)		drain Orifice Area =	N/A	ft²											
Underdrain Orifice Diameter =	N/A	inches	ı		Underdrain	n Orifice Centroid =	N/A	feet											
er Input: Orifice Plate with one or more ori	fices or Elliptical Cla	t Woir (typically us	od to drain WOCV	and/or ELIDV in a	codimentation RM	ID)	Calarilated Danas	ataua fau Diata											
Centroid of Lowest Orifice =	0.00	ft (relative to basi	-			ce Area per Row =	5.097E-02	ft ²											
Depth at top of Zone using Orifice Plate =	3.60	ft (relative to basi	_		-	liptical Half-Width =	N/A	feet											
Orifice Plate: Orifice Vertical Spacing =	14.40	inches	ii bottoiii at Stage	- 010)		tical Slot Centroid =	N/A	feet											
Orifice Plate: Orifice Area per Row =		sq. inches (use re	ctangular openings	5)	-	Elliptical Slot Area =	N/A	ft²											
Office Face. Office Area per Now =	7.51	sq. menes (use re	etarigatar operiirige	• /	•	Liipticai Siot Ai ca —	14/74	J.c											
					to match														
er Input: Stage and Total Area of Each Or	ifice Row (number	ed from lowest to	nighest)	WQCV D	rain Time														
	Row 1 (required)	Row 2 (optional)	Row 3 (optional)	Row 4 (optional)	Row 5 (optional)	Row 6 (optional)	Row 7 (optional)	Row 8 (optional)	1										
Stage of Orifice Centroid (ft)	` ' '	1.20	2.40			,,,,,,,		1											
Orifice Area (sq. inches)		7.34	7.34																
									_										
	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)																			
Orifice Area (sq. inches)							· ·	,											
er Input: Vertical Orifice (Circular or Rectar								eters for Vertical C	<u>Orifice</u>										
	Not Selected	Not Selected					Not Selected	Not Selected	1,										
Invert of Vertical Orifice =	N/A	N/A		n bottom at Stage		rtical Orifice Area =	N/A	N/A	ft ²										
Depth at top of Zone using Vertical Orifice =	N/A	N/A	· -	n bottom at Stage	= 0 ft) Vertica	Il Orifice Centroid =	N/A	N/A	feet										
Vertical Orifice Diameter =	N/A	N/A	inches																
ser Input: Overflow Weir (Dropbox with Flat	or Sloped Grate a	nd Outlet Pine OR	Rectangular/Trans	zoidal Weir and N	o Outlet Pine)		Calculated Parame	eters for Overflow	Weir										
	Zone 2 Weir	Not Selected					Zone 2 Weir	Not Selected											
Overflow Weir Front Edge Height, Ho =	3.02	N/A	ft (relative to basin	bottom at Stage = 0	ft) Height of Grate	Upper Edge, H _t =	6.35	N/A	feet										
Overflow Weir Front Edge Length =	800.00	N/A	feet		Overflow W	eir Slope Length =	10.54	N/A	feet										
Overflow Weir Grate Slope =	3.00	N/A	H:V	Grat	e Open Area / 10	0-yr Orifice Area =													
Horiz. Length of Weir Sides =	10.00	N/A	feet	Ove			11382.38	N/A	1										
Overflow Grate Type =	Type C Grate ▼	N/A ▼		OVC		Area w/o Debris =	11382.38 5869.19	N/A	ft²										
		1411	ļ		rflow Grate Open				ft² ft²										
Debris Clogging % =	50%	N/A	 %		rflow Grate Open	Area w/o Debris =	5869.19	N/A											
Debris Clogging % =		N/A		Ov	rflow Grate Open erflow Grate Oper	Area w/o Debris = n Area w/ Debris =	5869.19 2934.59	N/A N/A]ft²										
Debris Clogging % =	te (Circular Orifice,	N/A Restrictor Plate, or		Ov	rflow Grate Open erflow Grate Oper	Area w/o Debris =	5869.19 2934.59 s for Outlet Pipe w	N/A N/A]ft²										
Debris Clogging % = ser Input: Outlet Pipe w/ Flow Restriction Pla	te (Circular Orifice, Zone 2 Restrictor	N/A Restrictor Plate, o Not Selected	r Rectangular Orific	Ov <u>·</u> <u>··e)</u>	rflow Grate Open erflow Grate Oper Cal	Area w/o Debris = n Area w/ Debris = kulated Parameter	5869.19 2934.59 s for Outlet Pipe w Zone 2 Restrictor	N/A N/A // Flow Restriction I Not Selected]ft² <u>Plate</u>										
Debris Clogging % = ser Input: Outlet Pipe w/ Flow Restriction Pla Depth to Invert of Outlet Pipe =	te (Circular Orifice, Zone 2 Restrictor 3.00	N/A Restrictor Plate, o Not Selected N/A	r Rectangular Orific ft (distance below b	Ov	rflow Grate Open erflow Grate Open Cal	Area w/o Debris = n Area w/ Debris = lculated Parameter: utlet Orifice Area =	5869.19 2934.59 s for Outlet Pipe w Zone 2 Restrictor 0.52	N/A N/A / Flow Restriction I Not Selected N/A	ft² Plate ft²										
Debris Clogging % = ser Input: Outlet Pipe w/ Flow Restriction Pla Depth to Invert of Outlet Pipe = Outlet Pipe Diameter =	te (Circular Orifice, Zone 2 Restrictor 3.00 18.00	N/A Restrictor Plate, o Not Selected	r Rectangular Orific ft (distance below b inches	Ov ce) asin bottom at Stage	rflow Grate Open erflow Grate Open <u>Cal</u> = 0 ft) Or Outlet	Area w/o Debris = n Area w/ Debris = lculated Parameter utlet Orifice Area = t Orifice Centroid =	5869.19 2934.59 s for Outlet Pipe w Zone 2 Restrictor 0.52 0.29	N/A N/A // Flow Restriction I Not Selected N/A N/A	ft² Plate ft² fteet										
Debris Clogging % = ser Input: Outlet Pipe w/ Flow Restriction Pla Depth to Invert of Outlet Pipe =	te (Circular Orifice, Zone 2 Restrictor 3.00 18.00	N/A Restrictor Plate, o Not Selected N/A	r Rectangular Orific ft (distance below b	Ov ce) asin bottom at Stage	rflow Grate Open erflow Grate Open <u>Cal</u> = 0 ft) Or Outlet	Area w/o Debris = n Area w/ Debris = lculated Parameter: utlet Orifice Area =	5869.19 2934.59 s for Outlet Pipe w Zone 2 Restrictor 0.52	N/A N/A / Flow Restriction I Not Selected N/A	ft² Plate ft² fteet										
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Debris Clogging % = ser Input: Outlet Pipe w/ Flow Restriction Pla Depth to Invert of Outlet Pipe = Outlet Pipe Diameter = Restrictor Plate Height Above Pipe Invert = ser Input: Emergency Spilway (Rectangular Spilway Invert Stage= Spilway Crest Length = Spilway End Slopes =	te (Circular Orifice, Zone 2 Restrictor 3.00 18.00 6.00 or Trapezoidal) 72.00 4.00	N/A Restrictor Plate, o Not Selected N/A N/A N/A ft (relative to basi feet H:V Restrictor Plate, o Restri	r Rectangular Orific ft (distance below b inches inches	Over the state of	rflow Grate Open erflow Grate Open Cai = 0 ft) Outlet al Angle of Restric Spillway D Stage at T Basin Area at T	Area w/o Debris = n Area w/ Debris = n Area w/ Debris =	5869.19 2934.59 s for Outlet Pipe w Zone 2 Restrictor 0.52 0.29 1.23 Calculated Param 0.97 7.97	N/A N/A / Flow Restriction I Not Selected N/A N/A N/A N/A feet feet acres	ft² Plate ft² fteet										
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Debris Clogging % = ser Input: Outlet Pipe w/ Flow Restriction Pla Depth to Invert of Outlet Pipe = Outlet Pipe Diameter = Restrictor Plate Height Above Pipe Invert = ser Input: Emergency Spilway (Rectangular Spilway Invert Stage= Spilway Invert Stage= Spilway Invert Stage= Spilway Invert Stage= Spilway Find Slopes = Freeboard above Max Water Surface = Outled Hydrograph Results Design Storm Return Period = One-Hour Rainfall Depth (in) = CUHP Runoff Volume (acre-ft) = CUHP Predevelopment Peak Q (cfs) = Perional Override Predevelopment Peak Q (cfs) = Peak Inflow Q (cfs) = Peak Outflow Q (cfs) = Peak Outflow Q (cfs) = Ratio Peak Outflow to Predevelopment Q = Structure Controlling Flow = Max Velocity through Grate 1 (fps) = Max Velocity through Grate 1 (fps) = Time to Drain 99% of Inflow Volume (hours) = Time to Drain 99% of Inflow Volume (hours) = Time to Drain 99% of Inflow Volume (hours) = Maximum Ponding Depth (ft) =	te (Circular Orfice, Zone 2 Restrictor 3.00 18.00 6.00 or Trapezoidal) 6.00 72.00 4.00 1.00 The user can ove WQCV N/A 1.850 N/A N/A N/A N/A N/A N/A N/A N/A N/A N/A	Restrictor Plate, o Not Selected N/A N/A N/A Ift (relative to basi feet H:V feet Size Em Developer EURV N/A 5.493 N/A N/A N/A N/A N/A N/A N/A N/A N/A N/A	r Rectangular Orfice ft (distance below b inches in	asin bottom at Stage Half-Centr = 0 ft) ass Rate 1 2 3 3 3 4 1 5 1 6 0 1 7 0 7 0 8 0 9 0 10 10 10 10 10 10	rflow Grate Open erflow Grate Open erflow Grate Open Cal = 0 ft) Or Outlet al Angle of Restric Spilway D Stage at T Basin Area at T Basin Volume at T 8 by entering new 1.40 7.165 7.165 32.5 0.40 143.4 17.3 0.5 Spilway 0.0 N/A 41 46 6.13	Area w/o Debris = n Area w/o Debris = n Area w/ Debris = n Area w/ Debris = n Area w/ Debris = n Area w/ Debris = utlet Orifice Area = t Orifice Centroid = tor Plate on Pipe = n Area w/o Plate on Pipe = n Area	5869.19 2934.59 Zone 2 Restrictor 0.52 0.29 1.23 Calculated Param 0.97 1.53 8.32 Whydrographs ta 50 Year 2.30 13.634 120.4 1.49 277.2 169.8 1.4 Spilway 0.0 N/A 36 44 6.81	N/A N/A N/A N/A N/A N/A Not Selected N/A N/A N/A N/A N/A N/A N/A eters for Spilway feet feet acres acre-ft Die (Columns W th 100 Year 2.79 17.263 17.263 166.0 2.05 355.1 269.5 1.6 Spillway 0.0 N/A 33 43 7.10	## R ² Plate ## R ²	Debris Clogging % = Seer Input: Outlet Pipe w/ Flow Restriction Pla Depth to Invert of Outlet Pipe = Outlet Pipe Diameter = Restrictor Plate Height Above Pipe Invert = Seer Input: Emergency Spilway (Rectangular Spilway Invert Stage = Spilway Invert Stage = Spilway Crest Length = Spilway End Slopes = Freeboard above Max Water Surface = Spilway End Slopes = Freeboard above Max Water Surface = Coutled Hydrograph Results Design Storm Return Period = One-Hour Rainfall Depth (in) = CUHP Runoff Volume (acre-ft) = Inflow Hydrograph Volume (acre-ft) = Inflow Hydrograph Volume (acre-ft) = Inflow Hydrograph Volume (acre-ft) = Predevelopment Peak Q (cfs) = Peak Inflow Q (cfs) = Peak Outflow Q (cfs) = Ratio Peak Outflow to Predevelopment Q = Structure Controlling Flow = Max Velocity through Grate 2 (fps) = Max Velocity through Grate 2 (fps) = Max Velocity through Grate 2 (fps) = Time to Drain 99% of Inflow Volume (hours) = Time to Drain 99% of Inflow Volume (hours) = Time to Drain 99% of Inflow Volume (hours) =	te (Circular Orifice,	Restrictor Plate, o Not Selected N/A N/A N/A ft (relative to basi feet H:V feet Size Em Develope EURV N/A 5.493 N/A N/A N/A N/A N/A N/A N/A N/A N/A N/A	r Rectangular Orfice ft (distance below b inches in	asin bottom at Stage Half-Centr = 0 ft) ass Rate 5 Year 1.12 5.323 5.323 11.7 0.14 108.0 7.0 0.6 Outlet Plate 1 0.0 N/A 41 45	rflow Grate Open erflow Grate Open erflow Grate Open carbon Grate Open Call and Call	Area w/o Debris = n Area w/o Debris = n Area w/ Deb	5869.19 2934.59 s for Outlet Pipe w Zone 2 Restrictor 0.52 0.29 1.23 Calculated Param 0.97 7.97 1.53 8.32 w Hydrographs ta 50 Year 2.30 13.634 13.634 120.4 1.49 277.2 169.8 1.4 Spilway 0.0 N/A 36 44	N/A N/A N/A N/A N/A N/A Not Selected N/A N/A N/A N/A N/A N/A N/A N/A N/A N/A	Rt2 Rt2



		DET	ENTIO	NI BVC.	IN STAGE-S	TODA	CE TAI	DI E DI	III DED)				
		DLI	LIVITO		D-Detention, Version			DLL DU	JILDER	\			Class Made	ha a la
Project:	Greeley Okla	ahoma Sout	th	,,,,,	becertain, versie	1.00 (St	., 2022)					_	Clear Work	DOOK
Basin ID:	DP 842, EUR	v												
ZONE 3	2 ONE 1													
100-YR VOLUME EURV WQCV														
TODO WACY		100-YE	AD	\rightarrow			ī							
ZONE PERMANENT ORIFIC	1 AND 2	ORIFIC	E		Depth Increment =	0.25	ft Optional				Optional			
POOL Example Zone	Configura	tion (Rete	ntion Pond)		Stage - Storage Description	Stage (ft)	Override Stage (ft)	Length (ft)	Width (ft)	Area (ft 2)	Override Area (ft ²)	Area (acre)	Volume (ft 3)	Volume (ac-ft)
Watershed Information					Top of Micropool	0.00	Stage (It)	26.3	26.3	694	Alea (It)	0.016	(11)	(ac-it)
Extended Detention Basin (EDB)	EDB				ISV	0.50		26.3	26.3	694		0.016	347	0.008
Watershed Area =	210.53	acres				0.75		26.3	26.3	694		0.016	521	0.012
Watershed Length =	4,665	ft				1.00		26.3	26.3	694		0.016	694	0.016
Watershed Length to Centroid = Watershed Slope =	2,450 0.019	ft ft/ft				1.25		77.3 128.3	51.3 76.3	3,972 9,799		0.091	1,224 2,892	0.028
Watershed Imperviousness =	64.54%	percent				1.75		179.3	101.3	18,176		0.223	6,336	0.145
Percentage Hydrologic Soil Group A =	8.7%	percent				2.00		230.3	126.3	29,104		0.668	12,193	0.280
Percentage Hydrologic Soil Group B =	45.0%	percent				2.25		281.3	151.3	42,581		0.978	21,101	0.484
Percentage Hydrologic Soil Groups C/D =	46.3%	percent				2.50		332.3	176.3	58,608		1.345	33,696	0.774
Target WQCV Drain Time =	40.0	hours				2.75		383.3	201.3	77,186		1.772	50,617	1.162
Location for 1-hr Rainfall Depths =						3.00		434.3 485.3	226.3 251.3	98,313 121,991		2.257	72,502 99,986	1.664 2.295
After providing required inputs above inc depths, click 'Run CUHP' to generate rund			Run CUH	Р	Zone 1 (WQCV)	3.25		511.9	264.3	135,311		3.106	116,704	2.679
the embedded Colorado Urban Hydro			Optional Use	er Overrides		3.50		536.3	276.3	148,218		3.403	133,709	3.070
Water Quality Capture Volume (WQCV) =	2.656	acre-feet	2.656	acre-feet		3.75		587.3	301.3	176,995		4.063	174,308	4.002
Excess Urban Runoff Volume (EURV) =	14.210	acre-feet		acre-feet		4.00		638.3	326.3	208,323		4.782	222,420	5.106
2-yr Runoff Volume (P1 = 0.85 in.) =	8.937	acre-feet	0.85	inches		4.25		689.3	351.3	242,200		5.560	278,682	6.398
5-yr Runoff Volume (P1 = 1.12 in.) = 10-yr Runoff Volume (P1 = 1.4 in.) =	12.514	acre-feet	1.12	inches		4.50		740.3 791.3	376.3	278,628		6.396 7.291	343,732	7.891
25-yr Runoff Volume (P1 = 1.4 in.) =	17.051 26.080	acre-feet acre-feet	1.40	inches		4.75 5.00		791.3 842.3	401.3 426.3	317,605 359,132		7.291 8.245	418,208 502,747	9.601 11.541
50-yr Runoff Volume (P1 = 2.3 in.) =	33.878	acre-feet	2.30	inches		5.25		893.3	451.3	403,210		9.256	597,987	13.728
100-yr Runoff Volume (P1 = 2.79 in.) =	43.453	acre-feet	2.79	inches	Zone 2 (EURV)	5.31		905.6	457.3	414,168		9.508	622,507	14.291
500-yr Runoff Volume (P1 = 4.16 in.) =	69.294	acre-feet	4.16	inches	Floor	5.37		917.8	463.3	425,273		9.763	647,690	14.869
Approximate 2-yr Detention Volume =	8.255	acre-feet				5.50		918.9	464.4	426,710		9.796	703,069	16.140
Approximate 5-yr Detention Volume =	11.858	acre-feet				5.75		920.9	466.4	429,481		9.860	810,092	18.597
Approximate 10-yr Detention Volume = Approximate 25-yr Detention Volume =	15.324 19.392	acre-feet acre-feet				6.00		922.9 924.9	468.4 470.4	432,259 435,046		9.923	917,810 1,026,223	21.070
Approximate 50-yr Detention Volume =	22.076	acre-feet			Zone 3 (100-year)	6.50		926.9	472.4	437,840		10.051	1,135,333	26.064
Approximate 100-yr Detention Volume =	26.029	acre-feet			, , , ,	6.75		928.9	474.4	440,643		10.116	1,245,143	28.585
		_				7.00		930.9	476.4	443,453		10.180	1,355,655	31.122
Define Zones and Basin Geometry		•				7.25		932.9	478.4	446,272		10.245	1,466,871	33.675
Zone 1 Volume (WQCV)	2.656	acre-feet				7.50		934.9	480.4	449,098		10.310	1,578,792	36.244
Zone 2 Volume (EURV - Zone 1) Zone 3 Volume (100-year - Zones 1 & 2) ▼	11.554 11.819	acre-feet acre-feet				7.75 8.00		936.9 938.9	482.4 484.4	451,933 454,775		10.375	1,691,420 1,804,759	38.830 41.432
Total Detention Basin Volume =	26.029	acre-feet				8.25		940.9	486.4	457,626		10.506	1,918,809	44.050
Initial Surcharge Volume (ISV) =	347	ft ³				8.50		942.9	488.4	460,484		10.571	2,033,572	46.684
Initial Surcharge Depth (ISD) =	0.50	ft				8.75		944.9	490.4	463,351		10.637	2,149,051	49.335
Total Available Detention Depth (H _{total}) =	6.50	ft				9.00		946.9	492.4	466,225		10.703	2,265,248	52.003
Depth of Trickle Channel (H _{TC}) =	0.50	ft e/e				9.25		948.9	494.4	469,108		10.769	2,382,165	54.687
Slope of Trickle Channel (S_{TC}) = Slopes of Main Basin Sides (S_{main}) =	0.005	ft/ft H:V				9.50 9.75		950.9 952.9	496.4 498.4	471,998 474,897		10.836	2,499,803	57.388 60.105
Basin Length-to-Width Ratio $(R_{L/W})$ =	2	1				10.00		954.9	500.4	477,803		10.969	2,737,252	62.839
		_				10.25		956.9	502.4	480,718		11.036	2,857,067	65.589
Initial Surcharge Area $(A_{ISV}) =$	694	ft²				10.50		958.9	504.4	483,640		11.103	2,977,611	68.357
Surcharge Volume Length (L _{ISV}) =	26.3	ft				10.75		960.9	506.4	486,571		11.170	3,098,887	71.141
Surcharge Volume Width (W _{ISV}) =	26.3 4.37	ft ft				11.00 11.25		962.9 964.9	508.4 510.4	489,509		11.238	3,220,897	73.942 76.759
Depth of Basin Floor (H_{FLOOR}) = Length of Basin Floor (L_{FLOOR}) =	917.8	π ft				11.25		964.9	510.4	492,456 495,410		11.305 11.373	3,343,643 3,467,126	76.759
Width of Basin Floor $(W_{FLOOR}) =$	463.3	ft				11.75		968.9	514.4	498,373		11.441	3,591,349	82.446
Area of Basin Floor (A _{FLOOR}) =	425,273	ft ²				12.00		970.9	516.4	501,343		11.509	3,716,313	85.315
Volume of Basin Floor (V_{FLOOR}) =	645,520	ft ³				12.25		972.9	518.4	504,322		11.578	3,842,021	88.201
Depth of Main Basin (H _{MAIN}) =	1.13	ft				12.50		974.9	520.4	507,308		11.646	3,968,474	91.104
Length of Main Basin (L _{MAIN}) =	926.9	ft				12.75		976.9 978.9	522.4	510,303		11.715	4,095,676	94.024
Width of Main Basin (W_{MAIN}) = Area of Main Basin (A_{MAIN}) =	472.4 437,840	ft ft²				13.00 13.25		980.9	524.4 526.4	513,305 516,316		11.784	4,223,627 4,352,329	96.961 99.916
Volume of Main Basin (V _{MAIN}) =	487,641	ft ³				13.50		982.9	528.4	519,334		11.922	4,481,785	102.888
Calculated Total Basin Volume (V _{total}) =	26.030	acre-feet				13.75		984.9	530.4	522,361		11.992	4,611,997	105.877
, was		-			1									-

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Project	Greeley Oklahoma		rv-vetention, ve	ersion 4.06 (July	2022)				
	DP 842, EURV								1
ZONE 2 ZONE 2 ZONE 1				Estimated Stage (ft)	Estimated Volume (ac-ft)	Outlet Type			
100-YR VOLUME EURV WOCV			Zone 1 (WQCV)	3.38	2.656	Orifice Plate	Orifice Plate		<u> </u>
	100-YEAR		Zone 2 (EURV)	5.31	11.554	Weir&Pipe (Restrict	Weir and Pipe (w/ Re	estrictor Plate)	▼
PERMANENT ORIFICES POOL	ONIFICE		Zone 3 (100-year)	6.50	11.819	Not Utilized	Zone 3 Not Utilized		▼
				Total (all zones)	26.029				
<u>User Input: Orifice at Underdrain Outlet (typic</u> <u>Underdrain Orifice Invert Depth =</u>			i BMP) the filtration media	a surface)	Under	drain Orifice Area =		eters for Underdra	<u>ain</u>
Underdrain Orifice Diameter =	N/A	inches		,	Underdrair	n Orifice Centroid =		feet	
User Input: Orifice Plate with one or more or	fices or Ellintical Cle	t Mair (tunically us	ad to drain WOCV	and/or FUDV in a	sadimentation PM	AD)	Colo late d December	. L C. Dist.	
Centroid of Lowest Orifice =	0.00		n bottom at Stage			ice Area per Row =	Calculated Parameter 4.924E-02	ft ²	
Depth at top of Zone using Orifice Plate =	3.38		n bottom at Stage	= 0 ft)	El	liptical Half-Width =		feet	
Orifice Plate: Orifice Vertical Spacing =	21.20 7.09	inches	stangular ananings		-	tical Slot Centroid =		feet ft ²	
Orifice Plate: Orifice Area per Row =	7.09	sq. Inches (use re	ctangular openings	·)	· · · · · · · · · · · · · · · · · · ·	Elliptical Slot Area =	IN/A	Ίπ	
					to match				
User Input: Stage and Total Area of Each O	Row 1 (required)	ed from lowest to I Row 2 (optional)	nighest) Row 3 (optional)	Row 4 (optional)	Row 5 (optional)	Row 6 (optional)	Row 7 (optional)	Row 8 (optional)	٦
Stage of Orifice Centroid (ft)	1	1.13	2.25	now + (upuonai)	ком э (прионат)	ком о (орионаі)	NOW / (OPBORAL)	now o (uptional)	
Orifice Area (sq. inches		7.09	7.09						
	Row 9 (optional)	Row 10 (optional)	Row 11 (optional)	Row 12 (optional)	Row 13 (optional)	Row 14 (optional)	Row 15 (optional)	Row 16 (optional)	7
Stage of Orifice Centroid (ft)		KOW 10 (Optional)	ROW 11 (Optional)	ROW 12 (Optional)	KOW 13 (Optional)	Row 14 (optional)	Row 15 (optional)	Row 16 (optional)	
Orifice Area (sq. inches									
User Input: Vertical Orifice (Circular or Rectar	ngular)						Calculated Parami	eters for Vertical (Orifice
SOUTH THE TENED OF THE CONTROL OF THE CONTROL	Not Selected	Not Selected					Not Selected	Not Selected	
Invert of Vertical Orifice =	N/A	N/A	ft (relative to basi	_	•	rtical Orifice Area =	N/A	N/A	ft ²
Depth at top of Zone using Vertical Orifice = Vertical Orifice Diameter =	N/A N/A	N/A N/A	ft (relative to basi inches	n bottom at Stage	e = U rt) Vertica	al Orifice Centroid =	N/A	N/A	feet
verteel office bullicter =	NA	14/7	il ici ici			,	•		
Hear Toronto Occarda co Maio (Donada co co table File	han Claused Coats a	and Outliet Diago OD	Dt /T	: \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \	- O. Hat Dina)		Calardata d Davasa	-t f 0fl	. 14/
User Input: Overflow Weir (Dropbox with Fla	Zone 2 Weir	Not Selected	Rectangular/ i rape	ezoldai weir and in	o Outlet Pipe)		Zone 2 Weir	Not Selected	<u>v weir</u>
Overflow Weir Front Edge Height, Ho =	3.38	N/A	ft (relative to basin	bottom at Stage = 0	ft) Height of Grate	Upper Edge, H _t =		N/A	feet
Overflow Weir Front Edge Length =	4.00	N/A	feet	Cont		/eir Slope Length =		N/A	feet
Overflow Weir Grate Slope = Horiz. Length of Weir Sides =	0.00 4.00	N/A N/A	H:V feet		e Open Area / 10	10-yr Orifice Area =			
Overflow Grate Type =		N/A ▼			rflow Grate Open	Area w/o Debris =		N/A N/A	ft ²
Debris Clogging % =	50%	N/A	,	Ov	-	Area w/o Debris = n Area w/ Debris =	11.14	· · · · · · · · · · · · · · · · · · ·	ft² ft²
		1973	%	Ov	-		11.14	N/A	_
User Input: Outlet Pipe w/ Flow Restriction Pla	te (Circular Orifice,			•	erflow Grate Ope		11.14 5.57	N/A N/A	ft²
	Zone 2 Restrictor	Restrictor Plate, o	r Rectangular Orific	<u>ce)</u>	erflow Grate Öper	n Area w/ Debris =	11.14 5.57 s for Outlet Pipe w Zone 2 Restrictor	N/A N/A N/A N/A N/A N/ Flow Restriction Not Selected	ft²
Depth to Invert of Outlet Pipe =	Zone 2 Restrictor 2.50	Restrictor Plate, o Not Selected N/A	r Rectangular Orific	•	erflow Grate Oper Ca e = 0 ft) O	n Area w/ Debris = <u>kulated Parameter</u> utlet Orifice Area =	11.14 5.57 s for Outlet Pipe w Zone 2 Restrictor 0.58	N/A N/A N/A // Flow Restriction Not Selected N/A	ft ² Plate ft ²
	Zone 2 Restrictor	Restrictor Plate, o	r Rectangular Orific	<u>ce)</u> asin bottom at Stage	cerflow Grate Oper Ca := 0 ft) O Outle	n Area w/ Debris =	11.14 5.57 s for Outlet Pipe w Zone 2 Restrictor 0.58 0.32	N/A N/A N/A N/A N/A N/ Flow Restriction Not Selected	ft²
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Depth to Invert of Outlet Pipe = Outlet Pipe Diameter = Restrictor Plate Height Above Pipe Invert = Restrictor Plate Height Above Pipe Invert = Spillway Invert Stage= Spillway Invert Stage= Spillway End Slopes = Spillway End Slopes = Freeboard above Max Water Surface = Routed Hydrograph Results Design Storm Return Period = One-Hour Rainfall Depth (in) = CUHP Runoff Volume (acre-ft) = Inflow Hydrograph Volume (acre-ft) = Inflow Hydrograph Volume (acre-ft) = CUHP Predevelopment Peak Q (cfs) = Predevelopment Unit Peak Flow, q (cfs) are Peak Inflow Q (cfs) = Ratio Peak Outflow to Predevelopment Q (cfs) = Ratio Peak Outflow to Predevelopment Q (cfs) = Max Velocity through Grate 1 (fps) = Time to Drain 99% of Inflow Volume (hours) = Time to Drain 99% of Inflow Volume (hours) =	Zone 2 Restrictor 2.50 18.00 6.50 or Trapezoidal) 6.51 1000.00 4.00 1.00 The user can ove WQCV N/A 2.656 N/A N/A N/A N/A N/A 1.0 N/A 0verflow Weir 1 N/A N/A 38 40	Restrictor Plate, o Not Selected N/A N/A N/A Ift (relative to basi feet H:V feet Size Em Develope EURV N/A 14.210 N/A N/A N/A N/A N/A N/A N/A N/A N/A N/A	r Rectangular Orifice ft (distance below be inches) in bottom at Stage inches in bottom at Stage inches in bottom at Stage inches in bottom at Stage inches in bottom at Stage in bottom	### Half-Central H	erflow Grate Operation of the control of the contro	n Area w/ Debris =	11.14 5.57 s for Outlet Pipe w Zone 2 Restrictor 0.58 0.32 1.29 Calculated Param 0.36 7.87 10.41 40.08 w Hydrographs tal 50 Year 2.30 33.878 33.878 33.878 188.7 0.90 509.2 132.1 0.7 Spillway 0.6 N/A 66 77	N/A N/A N/A N/A N/A N/A N/A N/A N/A N/A	ft² ft² ft² feet radians hrough AF). 500 Year 4.16 69.294 69.294 482.2 2.29 1027.4 805.4 1.7 Spilway 0.6 N/A 52 71
Depth to Invert of Outlet Pipe = Outlet Pipe Dameter = Restrictor Plate Height Above Pipe Invert = Spillway Invert Stage= Spillway Crest Length = Spillway Crest Length = Spillway Crest Length = Spillway End Slopes = Freeboard above Max Water Surface = Routed Hydrograph Results Design Storm Return Period = One-Hour Rainfall Depth (in) = CUHP Runoff Volume (acre-ft) = Inflow Hydrograph Volume (acre-ft) = CUHP Predevelopment Peak Q (cfs) = Predevelopment Unit Peak Flow, q (cfs) = Predevelopment Unit Peak Flow, q (cfs) = Peak Outflow to Predevelopment Q (cfs) = Ratio Peak Outflow to Predevelopment Q = Structure Controlling Flow = Max Velocity through Grate 1 (fps) = Max Velocity through Grate 1 (fps) = Max Velocity through Grate 2 (fps) = Max Velocity through Grate 1 (fps) =	Zone 2 Restrictor 2.50 18.00 6.50 or Trapezoidal) 6.51 1000.00 4.00 1.00 The user can ove WQCV N/A 2.656 N/A N/A N/A N/A N/A N/A N/A N/A N/A N/A	Restrictor Plate, o Not Selected N/A N/A N/A N/A N/A ft (relative to basi feet H:V feet Size Em Develope Funde the default C EURV N/A 14.210 N/A N/A N/A N/A N/A N/A N/A N/A N/A N/A	r Rectangular Orific ft (distance below b inches inches in bottom at Stage ergency Spillway to px d 100-yr Peak Runoff UHP hydrographs 2 Year 0.85 8.937 1.6 0.01 126.1 7.2 N/A Outlet Plate 1 0.53 N/A 50	Half-Centre = 0 ft) ass Rate	erflow Grate Open Ca E = 0 ft) O Outle al Angle of Restrict Spillway E Stage at T Basin Area at T Basin Volume at T 1.40 17.051 17.051 35.7 0.17 239.1 7.7 0.2 Outlet Plate 1 0.6 N/A 58	n Area w/ Debris = liculated Parameter utlet Orifice Area = t Orifice Centroid = tor Plate on Pipe = Design Flow Depth= Op of Freeboard = Op of Freeboard = Op of Freeboard = Op of Freeboard = 1.87 26.080 26.080 125.8 0.60 392.2 8.1 0.1 Outlet Plate 1 0.6 N/A 67	11.14 5.57 s for Outlet Pipe w Zone 2 Restrictor 0.58 0.32 1.29 Calculated Parame 0.36 7.87 10.41 40.08 sw Hydrographs ta 50 Year 2.30 33.878 33.878 33.878 188.7 0.90 509.2 132.1 0.7 Spillway 0.6 66	N/A N/A N/A N/A N/A N/A N/A N/A N/A N/A	ft² Plate ft² feet ft² feet radians 500 Year 4.16 69.294 482.2 1.29 1027.4 805.4 1.7 Spillway 0.6 N/A 52



		DET	ENTION BAS	IN STAGE-9	STORA	GF TA	BI F BI	JII DEF	2				
		DLI		D-Detention, Version			DEE DO		`			Clear Work	book
	Greeley Okla		th										
ZONE 3	DP 840, EUR	RV											
100 100	2 ONE 1												
100-YR VOLUME EURV WOCV						-							
	1 AND 2	100-YE ORIFIC	EAR CE	Depth Increment =	0.25	ft				Optional			
PERMANENT ORIFI POOL Example Zone	ces e Configura	tion (Rete	ntion Pond)	Stage - Storage	Stage	Optional Override	Length	Width	Area	Override	Area	Volume	Volume
Watershed Information				Description Top of Micropool	(ft) 0.00	Stage (ft)	(ft) 16.1	(ft) 16.1	(ft ²) 258	Area (ft 2)	(acre) 0.006	(ft 3)	(ac-ft)
Extended Detention Basin (EDB)	EDB	1		ISV	0.50		16.1	16.1	258		0.006	129	0.003
Watershed Area =	63.86	acres			0.75		16.1	16.1	258		0.006	193	0.004
Watershed Length =	3,575	ft			1.00		16.1	16.1	258		0.006	258	0.006
Watershed Length to Centroid = Watershed Slope =	1,789 0.023	ft ft/ft			1.25 1.50		48.3 80.6	31.7 47.3	1,530 3,810		0.035	460 1,107	0.011
Watershed Imperviousness =	76.73%	percent			1.75		112.8	62.9	7,098		0.163	2,449	0.056
Percentage Hydrologic Soil Group A =	5.8%	percent			2.00		145.1	78.6	11,394		0.262	4,740	0.109
Percentage Hydrologic Soil Group B =	76.8%	percent			2.25		177.3	94.2	16,698		0.383	8,231	0.189
Percentage Hydrologic Soil Groups C/D = Target WQCV Drain Time =	17.4% 40.0	percent			2.50		209.6 241.8	109.8 125.4	23,010 30,329		0.528	13,173 19,819	0.302 0.455
Location for 1-hr Rainfall Depths =		1.1001.3	▼		3.00		274.1	141.1	38,656		0.887	28,421	0.652
After providing required inputs above inc		rainfall			3.25		306.3	156.7	47,991		1.102	39,231	0.901
depths, click 'Run CUHP' to generate run the embedded Colorado Urban Hydro	off hydrograph	ns using	Run CUHP	Zone 1 (WQCV)	3.33		316.6	161.7	51,191		1.175	43,198	0.992
Water Quality Capture Volume (WQCV) =	0.986	acre-feet	Optional User Overrides 0.986 acre-feet		3.50 3.75		338.6 370.8	172.3 187.9	58,334 69,684		1.339	52,501 68,482	1.205 1.572
Excess Urban Runoff Volume (EURV) =	5.367	acre-feet	acre-feet		4.00		403.1	203.6	82,043		1.883	87,427	2.007
2-yr Runoff Volume (P1 = 0.85 in.) =	3.261	acre-feet	0.85 inches		4.25		435.3	219.2	95,409		2.190	109,587	2.516
5-yr Runoff Volume (P1 = 1.12 in.) =	4.496	acre-feet	1.12 inches		4.50		467.6	234.8	109,783		2.520	135,215	3.104
10-yr Runoff Volume (P1 = 1.4 in.) =	5.952	acre-feet	1.40 inches		4.75		499.8	250.4	125,165		2.873	164,563	3.778
25-yr Runoff Volume (P1 = 1.87 in.) = 50-yr Runoff Volume (P1 = 2.3 in.) =	8.664 11.063	acre-feet acre-feet	1.87 inches	Floor	4.83 5.00		510.1 511.5	255.4 256.8	130,300 131,343		2.991 3.015	174,781 197,020	4.012 4.523
100-yr Runoff Volume (P1 = 2.79 in.) =	13.930	acre-feet	2.79 inches		5.25		513.5	258.8	132,883		3.051	230,048	5.281
500-yr Runoff Volume (P1 = 4.16 in.) =	21.754	acre-feet	4.16 inches	Zone 2 (EURV)	5.28		513.7	259.0	133,069		3.055	234,038	5.373
Approximate 2-yr Detention Volume =	3.057	acre-feet			5.50		515.5	260.8	134,432		3.086	263,463	6.048
Approximate 5-yr Detention Volume = Approximate 10-yr Detention Volume =	4.250 5.588	acre-feet acre-feet			5.75 6.00		517.5 519.5	262.8 264.8	135,988 137,553		3.122 3.158	297,265 331,458	6.824 7.609
Approximate 15-yr Detention Volume =	7.033	acre-feet			6.25		521.5	266.8	139,125		3.194	366,042	8.403
Approximate 50-yr Detention Volume =	7.997	acre-feet		Zone 3 (100-year)	6.50		523.5	268.8	140,706		3.230	401,021	9.206
Approximate 100-yr Detention Volume =	9.192	acre-feet			6.75		525.5	270.8	142,295		3.267	436,396	10.018
Define Zance and Basin Counsely.					7.00		527.5	272.8	143,891		3.303	472,169	10.840
Define Zones and Basin Geometry Zone 1 Volume (WQCV) ▼	0.986	acre-feet			7.25 7.50		529.5 531.5	274.8 276.8	145,496 147,108		3.340 3.377	508,342 544,917	11.670 12.510
Zone 2 Volume (EURV - Zone 1) ▼	4.381	acre-feet			7.75		533.5	278.8	148,729		3.414	581,897	13.359
Zone 3 Volume (100-year - Zones 1 & 2)	3.825	acre-feet			8.00		535.5	280.8	150,357		3.452	619,282	14.217
Total Detention Basin Volume =	9.192	acre-feet			8.25		537.5	282.8	151,994		3.489	657,076	15.084
Initial Surcharge Volume (ISV) = Initial Surcharge Depth (ISD) =	0.50	ft ³			8.50 8.75		539.5 541.5	284.8 286.8	153,638 155,291		3.527 3.565	695,280 733,896	15.961 16.848
Total Available Detention Depth (H _{total}) =	6.50	ft			9.00		543.5	288.8	156,951		3.603	772,926	17.744
Depth of Trickle Channel (H_{TC}) =	0.50	ft			9.25		545.5	290.8	158,620		3.641	812,372	18.650
Slope of Trickle Channel (S _{TC}) =	0.008	ft/ft			9.50		547.5	292.8	160,297		3.680	852,237	19.565
Slopes of Main Basin Sides $(S_{main}) =$ Basin Length-to-Width Ratio $(R_{L/W}) =$	2	H:V			9.75 10.00		549.5 551.5	294.8 296.8	161,981 163,674		3.719 3.757	892,521 933,228	20.489
busin tengan to-widan nado (nt/w) =		_			10.25		553.5	298.8	165,374		3.796	974,359	22.368
Initial Surcharge Area $(A_{ISV}) =$	258	ft²			10.50		555.5	300.8	167,083		3.836	1,015,916	23.322
Surcharge Volume Length (L _{ISV}) =	16.1	ft			10.75		557.5	302.8	168,799		3.875	1,057,901	24.286
Surcharge Volume Width $(W_{ISV}) =$ Depth of Basin Floor $(H_{FLOOR}) =$	3.83	ft ft			11.00 11.25		559.5 561.5	304.8 306.8	170,524 172,256		3.915 3.954	1,100,316 1,143,163	25.260 26.243
Length of Basin Floor (I_{FLOOR}) =	510.1	ft			11.50		563.5	308.8	172,230		3.994	1,145,165	27.237
Width of Basin Floor (W _{FLOOR}) =	255.4	ft			11.75		565.5	310.8	175,745		4.035	1,230,162	28.241
Area of Basin Floor (A _{FLOOR}) =	130,300	ft²			12.00		567.5	312.8	177,502		4.075	1,274,318	29.254
Volume of Basin Floor (V _{FLOOR}) =	174,076	ft ³			12.25		569.5	314.8	179,266		4.115	1,318,914	30.278
Depth of Main Basin $(H_{MAIN}) =$ Length of Main Basin $(L_{MAIN}) =$	1.67 523.5	ft ft			12.50 12.75		571.5 573.5	316.8 318.8	181,039 182,820		4.156 4.197	1,363,952 1,409,434	31.312 32.356
Width of Main Basin (W _{MAIN}) =	268.8	ft			13.00		575.5	320.8	184,608		4.238	1,455,362	33.411
Area of Main Basin (A _{MAIN}) =	140,706	ft²			13.25		577.5	322.8	186,405		4.279	1,501,739	34.475
Volume of Main Basin (V _{MAIN}) =	226,234	ft ³		<u> </u>	13.50		579.5	324.8	188,209		4.321	1,548,565	35.550
Calculated Total Basin Volume (V _{total}) =	9.196	acre-feet			13.75		581.5	326.8	190,022		4.362	1,595,844	36.636

	DET		BASIN OUT			ESIGN			
	Greeley Oklahoma		HFD-Detention, Ve	ersion 4.06 (July	2022)				
Basin ID:	DP 840, EURV			Estimated	Estimated				1
ZONE 1				Stage (ft)	Volume (ac-ft)	Outlet Type			
VOLUME EURY WOCV	1		Zone 1 (WQCV)	3.33	0.986	Orifice Plate	Orifice Plate		▼
ZONE 1 AND 2	100-YEAR ORIFICE		Zone 2 (EURV)		4.381	Weir&Pipe (Restrict)	Weir and Pipe (w/ Re	estrictor Plate)	▼
PERMANENT ORIFICES POOL			Zone 3 (100-year)	6.50	3.825	Not Utilized	Zone 3 Not Utilized		▼
User Input: Orifice at Underdrain Outlet (typic	ally used to drain \	MOCV in a Eiltration	PMD)	Total (all zones)	9.192	1	Cakubtod Param	eters for Underdra	in
Underdrain Orifice Invert Depth =	N/A		the filtration medi	a surface)	Under	drain Orifice Area =	N/A	Tft ²	<u>II 1</u>
Underdrain Orifice Diameter =	N/A	inches			Underdrai	n Orifice Centroid =	N/A	feet	
User Input: Orifice Plate with one or more ori	ficac or Ellintical Cla	t Woir (typically us	od to drain WOCV	and/or ELIDV/ in a	codimontation PA	AD)	Calculated Param	atawa faw Dhita	
Centroid of Lowest Orifice =	0.00		n bottom at Stage			ice Area per Row =	1.840E-02	ft ²	
Depth at top of Zone using Orifice Plate =	3.33	ft (relative to basi	n bottom at Stage	e = 0 ft)	E	liptical Half-Width =	N/A	feet	
Orifice Plate: Orifice Vertical Spacing =	13.30	inches				tical Slot Centroid =	N/A	feet	
Orifice Plate: Orifice Area per Row =	2.65	sq. inches (diame	ter = 1-13/16 inch	ies)		Elliptical Slot Area =	N/A	ft²	
					to match				
User Input: Stage and Total Area of Each Or				_	rain Time	Ţ			1
Charles Carlotte	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) Orifice Area (sq. inches)	0.00 2.65	1.11 2.65	2.22 2.65						
5c. /									
	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) Orifice Area (sq. inches)	,								
Office Area (sq. inches)									J
User Input: Vertical Orifice (Circular or Rectar	F		1					eters for Vertical O	rifice
Invert of Vertical Orifice =	Not Selected N/A	Not Selected N/A	ft (robtivo to baci	in bottom at Stage	- 0 ft) Vo	rtical Orifice Area =	Not Selected N/A	Not Selected N/A	ft²
Depth at top of Zone using Vertical Orifice =	N/A		ft (relative to basi	-	•	al Orifice Centroid =	N/A	N/A	feet
Vertical Orifice Diameter =	N/A	N/A	inches		,		•	,	
User Input: Overflow Weir (Dropbox with Flat	or Sloped Grate a	nd Outlet Pine OR	Rectangular/Trans	ezoidal Weir and N	n Outlet Pine)		Calculated Param	eters for Overflow	Weir
SSE TIPUL STEINST WEE (STOPSON WILL)	Zone 2 Weir	Not Selected	, recearing a contract of the	ozoladi. Wez dila il	<u> </u>		Zone 2 Weir	Not Selected]
Overflow Weir Front Edge Height, Ho =	3.33	N/A		bottom at Stage = 0	-	e Upper Edge, H_t =	3.33	N/A	feet
Overflow Weir Front Edge Length =	4.00	N/A	feet	C		Veir Slope Length =	4.00	N/A	feet
Overflow Weir Grate Slope = Horiz. Length of Weir Sides =	0.00 4.00	N/A N/A	H:V feet			00-yr Orifice Area = Area w/o Debris =	54.86 11.14	N/A N/A	ft²
Overflow Grate Type =		N/A 🔻			•	n Area w/ Debris =	5.57	N/A	ft ²
Debris Clogging % =	50%	N/A	%					•	•
User Input: Outlet Pipe w/ Flow Restriction Pla	te (Circular Orifice	Restrictor Plate o	r Rectangular Orific	re)	Ca	Iculated Parameters	for Outlet Pine w	// Flow Restriction F	Plate
SSC TIPUL CULLET PE TY TISTITICS CLEET LA	Zone 2 Restrictor		- recearing day or an	997	<u>55</u>	incanacea i araimetere	Zone 2 Restrictor	_	
Depth to Invert of Outlet Pipe =	2.50	N/A	ft (distance below b	oasin bottom at Stage		utlet Orifice Area =	0.20	N/A	ft ²
Outlet Pipe Diameter =	18.00	N/A	inches	Half Contr		t Orifice Centroid =	0.15	N/A	feet
Restrictor Plate Height Above Pipe Invert =	3.10	ļ	inches	naii-Centi	ai Ailyte Ui KeS(f)(ctor Plate on Pipe =	0.86	N/A	radians
User Input: Emergency Spillway (Rectangular	or Trapezoidal)						Calculated Param	eters for Spillway	
Spillway Invert Stage=	5.29		n bottom at Stage	e = 0 ft		Design Flow Depth=	0.16	feet	
Spilway Crest Length = Spilway End Slopes =	1000.00 4.00		ergency Spillway to p		-	op of Freeboard =	6.45 3.22	feet acres	
Freeboard above Max Water Surface =	1.00	feet Develope	d 100-yr Peak Runoff	Rate		op of Freeboard =	9.04	acre-ft	
		•						-	
Routed Hydrograph Results	The user can ove	erride the default C	UHP hydrographs	and runoff volume	es by entering nev	v values in the Inflo	w Hydrographs ta	ble (Columns W th	rough AF).
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) = CUHP Runoff Volume (acre-ft) =	N/A 0.986	N/A 5.367	0.85 3.261	1.12 4.496	1.40 5.952	1.87 8.664	2.30 11.063	2.79 13.930	4.16 21.754
Inflow Hydrograph Volume (acre-ft) =	N/A	N/A	3.261	4.496	5.952	8.664	11.063	13.930	21.754
CUHP Predevelopment Peak Q (cfs) = OPTIONAL Override Predevelopment Peak Q (cfs) =	N/A N/A	N/A N/A	0.4	0.7	8.8	33.2	50.3	73.2	130.4
Predevelopment Unit Peak Flow, q (cfs/acre) =	N/A N/A	N/A N/A	0.01	0.01	0.14	0.52	0.79	1.15	2.04
Peak Inflow Q (cfs) =	N/A	N/A	44.2	60.6	79.8	122.0	156.4	196.7	305.2
Peak Outflow Q (cfs) = Ratio Peak Outflow to Predevelopment Q =	0.4 N/A	2.7 N/A	2.5 N/A	2.6 3.5	5.3 0.6	67.6 2.0	115.5 2.3	162.2 2.2	357.6 2.7
Structure Controlling Flow =	Overflow Weir 1	Outlet Plate 1	Outlet Plate 1	Outlet Plate 1	Spillway	Spillway	Spillway	Spillway	Spillway
Max Velocity through Grate 1 (fps) = Max Velocity through Grate 2 (fps) =	N/A N/A	0.19 N/A	0.19 N/A	0.2 N/A	0.2 N/A	0.2 N/A	0.2 N/A	0.2 N/A	0.2 N/A
Time to Drain 97% of Inflow Volume (hours) =	38	53	48	51	55	51	49	45	37
Time to Drain 99% of Inflow Volume (hours) =	40	60	52	57	62	60	59	57	54
Maximum Ponding Depth (ft) = Area at Maximum Ponding Depth (acres) =	3.33 1.18	5.28 3.05	4.40 2.37	4.84 2.99	5.30 3.06	5.37 3.07	5.40 3.07	5.43 3.08	5.53 3.09
	0.002	E 272	2.025	4.042	E 402	F.C10	F 740	E 022	C 141



			LIVITOIV	נכחם	<u>IN STAGE-S</u>	TUKA	IUL IA	DLL D	JILDL	`				
				MHFL	D-Detention, Version	on 4.06 (Ju	uly 2022)						Clear Work	:book
•			Oklahoma Drain	age MP										
ZONE 3	Option 4, EU	JRV 830												
ZONE	ONE 1													
100-YR VOLUME EURV WQCV							_							
ZONE	1 AND 2	100-YE ORIFIC	AR CE		Depth Increment =	0.50	ft							
PERMANENT ORIFIC	ES	tion (Rete	ntion Pond)		Stage - Storage	Stage	Optional Override	Length	Width	Area	Optional Override	Area	Volume	Volum
•	- coga.a		o		Description	(ft)	Stage (ft)	(ft)	(ft)	(ft²)	Area (ft 2)	(acre)	(ft 3)	(ac-fi
Watershed Information	FDD	•			Top of Micropool	0.00		41.9	41.9	1,752		0.040	570	
Extended Detention Basin (EDB) Watershed Area =	EDB 90.00	acres			ISV	0.33		41.9 41.9	41.9 41.9	1,752 1,752		0.040	578 876	0.013
Watershed Length =	2,406	ft				1.00		99.2	70.2	6,962		0.160	2,148	0.049
Watershed Length to Centroid =	1,738	ft				1.50		267.9	153.5	41,122		0.944	12,998	0.298
Watershed Slope =	0.031	ft/ft			Floor	1.55		284.7	161.9	46,084		1.058	15,177	0.348
Watershed Imperviousness = Percentage Hydrologic Soil Group A =	67.80%	percent				2.00		288.3 292.3	165.5 169.5	47,705 49,536		1.095	36,279 60,587	1.391
Percentage Hydrologic Soil Group B =	0.0%	percent				3.00		296.3	173.5	51,399		1.137	85,820	1.970
Percentage Hydrologic Soil Groups C/D =	100.0%	percent			Zone 1 (WQCV)	3.02		296.5	173.6	51,474		1.182	86,848	1.994
Target WQCV Drain Time =	40.0	hours		_		3.50		300.3	177.5	53,294		1.223	111,992	2.571
Location for 1-hr Rainfall Depths =				▼		4.00		304.3	181.5	55,221		1.268	139,119	3.194
After providing required inputs above inc depths, click 'Run CUHP' to generate rund			Run CUHP			4.50 5.00		308.3 312.3	185.5 189.5	57,180 59,171		1.313	167,218 196,305	3.839 4.507
the embedded Colorado Urban Hydro			Optional User O	verrides		5.50		316.3	193.5	61,195		1.405	226,395	5.197
Water Quality Capture Volume (WQCV) =	1.991	acre-feet		re-feet		6.00		320.3	197.5	63,250		1.452	257,505	5.911
Excess Urban Runoff Volume (EURV) =	5.915 4.073	acre-feet acre-feet	-	re-feet ches	Zone 2 (EURV)	6.01 6.50		320.4 324.3	197.5 201.5	63,291 65,337		1.453 1.500	258,137 289,650	5.926
2-yr Runoff Volume (P1 = 0.85 in.) = 5-yr Runoff Volume (P1 = 1.12 in.) =	5.835	acre-feet acre-feet	-	ches ches		7.00		324.3	201.5	65,337		1.500	322,847	7.412
10-yr Runoff Volume (P1 = 1.4 in.) =	7.895	acre-feet	-	ches		7.50		332.3	209.5	69,607		1.598	357,111	8.198
25-yr Runoff Volume (P1 = 1.87 in.) =	11.755	acre-feet	_	ches		8.00		336.3	213.5	71,790		1.648	392,459	9.010
50-yr Runoff Volume (P1 = 2.3 in.) =	15.181	acre-feet		ches		8.50		340.3	217.5	74,005		1.699	428,907	9.846
100-yr Runoff Volume (P1 = 2.79 in.) = 500-yr Runoff Volume (P1 = 4.16 in.) =	19.277 30.442	acre-feet acre-feet		ches ches		9.00 9.50		344.3 348.3	221.5 225.5	76,253 78,532		1.751	466,470 505,165	10.70
Approximate 2-yr Detention Volume =	3.791	acre-feet	1.10	LIKES		10.00		352.3	229.5	80,843		1.856	545,007	12.51
Approximate 5-yr Detention Volume =	5.563	acre-feet				10.50		356.3	233.5	83,186		1.910	586,013	13.45
Approximate 10-yr Detention Volume =	6.823	acre-feet				11.00		360.3	237.5	85,561		1.964	628,198	14.42
Approximate 25-yr Detention Volume = Approximate 50-yr Detention Volume =	8.494 9.547	acre-feet acre-feet				11.50 12.00		364.3 368.3	241.5 245.5	87,968 90,407		2.019	671,579 716,172	15.41
Approximate 100-yr Detention Volume =	11.222	acre-feet				12.50		372.3	249.5	92,878		2.132	761,992	17.49
		_				13.00		376.3	253.5	95,382		2.190	809,056	18.57
Define Zones and Basin Geometry		•				13.50		380.3	257.5	97,917		2.248	857,379	19.683
Zone 1 Volume (WQCV)	1.991 3.924	acre-feet				14.00 14.50		384.3 388.3	261.5 265.5	100,484		2.307 2.366	906,978	20.82
Zone 2 Volume (EURV - Zone 1) Select Zone 3 Storage Volume (Optional)	3.924	acre-feet acre-feet	Total detention is less than 10			15.00		392.3	269.5	105,063		2.427	957,868 1,010,066	23.188
Total Detention Basin Volume =	5.915	acre-feet	volume.			15.50		396.3	273.5	108,377		2.488	1,063,587	24.417
Initial Surcharge Volume (ISV) =	578	ft ³				16.00		400.3	277.5	111,072		2.550	1,118,448	25.676
Initial Surcharge Depth (ISD) =	6.00	ft ft				16.50 17.00		404.3 408.3	281.5 285.5	113,799		2.612	1,174,665	26.96
Total Available Detention Depth $(H_{total}) =$ Depth of Trickle Channel $(H_{TC}) =$	0.50	ft				17.50		412.3	289.5	116,559 119,350		2.740	1,232,253	29.64
Slope of Trickle Channel (S _{TC}) =	0.003	ft/ft				18.00		416.3	293.5	122,173		2.805	1,351,608	31.02
Slopes of Main Basin Sides (S _{main}) =	4	H:V				18.50		420.3	297.5	125,028		2.870	1,413,407	32.44
Basin Length-to-Width Ratio ($R_{L/W}$) =	2]				19.00		424.3	301.5	127,915		2.937	1,476,641	33.899
Initial Surcharge Area (A _{ISV}) =	1,752	ft ²				19.50 20.00		428.3 432.3	305.5 309.5	130,834 133,785		3.004	1,541,327	35.38
Surcharge Volume Length (L _{ISV}) =	41.9	ft				20.50		436.3	313.5	136,768		3.140	1,675,118	38.45
Surcharge Volume Width (W _{ISV}) =	41.9	ft				21.00		440.3	317.5	139,784		3.209	1,744,255	40.04
Depth of Basin Floor $(H_{FLOOR}) =$	0.72	ft				21.50		444.3	321.5	142,831		3.279	1,814,907	41.66
Length of Basin Floor (L _{FLOOR}) =	284.7 161.9	ft ft				22.00 22.50		448.3 452.3	325.5 329.5	145,910 149,021		3.350 3.421	1,887,091 1,960,822	43.32 45.01
Width of Basin Floor (W_{FLOOR}) = Area of Basin Floor (A_{FLOOR}) =	46,084	ft ²				23.00		456.3	333.5	152,164		3.493	2,036,117	46.74
Volume of Basin Floor (V _{FLOOR}) =	13,637	ft ³				23.50		460.3	337.5	155,339		3.566	2,112,992	48.50
Depth of Main Basin (H_{MAIN}) =	4.45	ft				24.00		464.3	341.5	158,546		3.640	2,191,462	50.30
Length of Main Basin (L _{MAIN}) =	320.3	ft			<u> </u>	24.50		468.3	345.5	161,785		3.714	2,271,543	52.14
Width of Main Basin (W_{MAIN}) = Area of Main Basin (A_{MAIN}) =	197.5 63,250	ft ft²				25.00 25.50		472.3 476.3	349.5 353.5	165,057 168,360		3.789 3.865	2,353,253 2,436,605	54.02 55.93
Volume of Main Basin (V _{MAIN}) =	242,262	ft ³				26.00		480.3	357.5	171,695		3.942	2,521,618	57.88
Calculated Total Basin Volume (V _{total}) =	5.908	acre-feet				26.50		484.3	361.5	175,062		4.019	2,608,305	59.87
•						27.00 27.50		488.3 492.3	365.5 369.5	178,461 181,892		4.097 4.176	2,696,685 2,786,772	61.90
						28.00 28.50		496.3 500.3	373.5 377.5	185,355 188,851		4.255 4.335	2,878,583	66.08
						29.00		504.3	381.5	192,378		4.416	3,067,438	70.41
						29.50 30.00		508.3 512.3	385.5 389.5	195,937 199,528		4.498	3,164,516	72.64

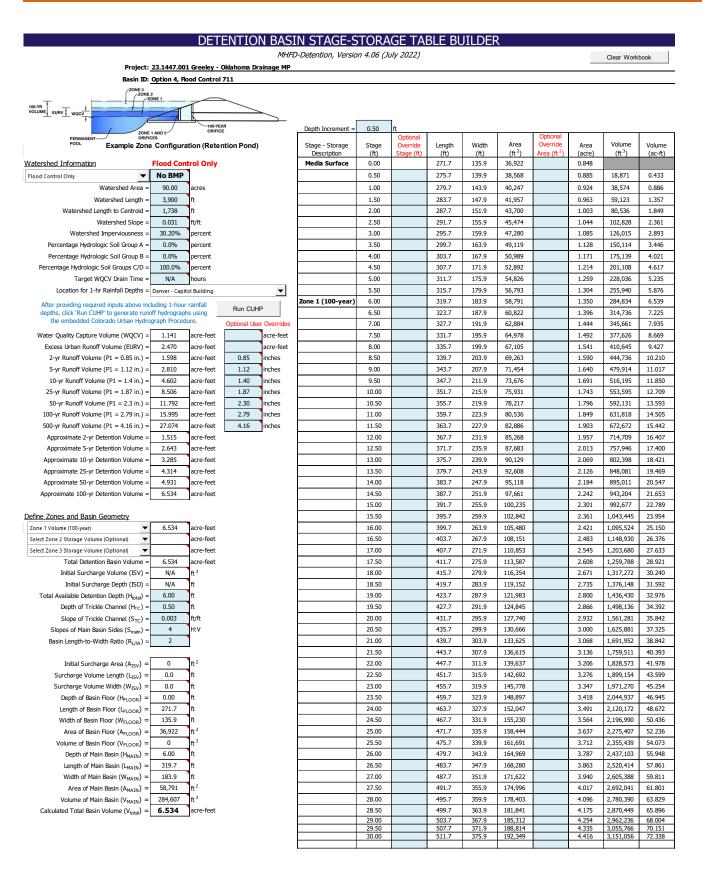
	DET		Basin out			ESIGN			
			HFD-Detention, Ve	ersion 4.06 (July	2022)				
	23.1447.001 Gree Option 4, EURV 83		inage MP						
ZONE 3	Option 4, Loca 65			Fatinatad	Cation at a d				1
ZONE 2 ZONE 1				Estimated Stage (ft)	Estimated Volume (ac-ft)	Outlot Type			
OO-YR EURY WOCV			7 1 (1400)	Stage (ft)	Volume (ac-ft)	Outlet Type	0.7. 0.1		
1 2011 J WOCY	1		Zone 1 (WQCV)	3.02	1.991	Orifice Plate	Orifice Plate		
ZONE 1 AND 2	100-YEAR ORIFICE		Zone 2 (EURV)	6.01	3.924	Weir&Pipe (Restrict)		strictor Plate)	▼
PERMANENT—ORIFICES POOL			Zone 3			Not Utilized	Zone 3 Not Utilized		
				Total (all zones)	5.915	1			
ser Input: Orifice at Underdrain Outlet (typic			•		l la da u	O.::Einn A		eters for Underdra Top	ain_
Underdrain Orifice Invert Depth = Underdrain Orifice Diameter =	N/A N/A	inches	the filtration media	а ѕипасе)		Irain Orifice Area = n Orifice Centroid =	N/A N/A	ft ² feet	
Office diameter =	N/A	liicies			Officerurali	i Office Certifold =	IN/A	lieer	
er Input: Orifice Plate with one or more ori	ices or Elliptical Slo	t Weir (typically us	ed to drain WOCV	and/or EURV in a	sedimentation BM	IP)	Calculated Parame	eters for Plate	
Centroid of Lowest Orifice =			n bottom at Stage			ce Area per Row =	4.840E-02	ft ²	
Depth at top of Zone using Orifice Plate =	3.02	ft (relative to basi	n bottom at Stage	e = 0 ft)	El	iptical Half-Width =	N/A	feet	
Orifice Plate: Orifice Vertical Spacing =	12.10	inches			Ellipt	ical Slot Centroid =	N/A	feet	
Orifice Plate: Orifice Area per Row =	6.97	sq. inches (use re	ctangular openings	s)		Elliptical Slot Area =	N/A	ft²	
					. 1				
					to match rain Time				
er Input: Stage and Total Area of Each Or						D. 21	I 5	I 5	7
60	Row 1 (required)	Row 2 (optional)	Row 3 (optional)	Row 4 (optional)	Row 5 (optional)	Row 6 (optional)	Row 7 (optional)	Row 8 (optional)	1
Stage of Orifice Centroid (ft)		1.01	2.01						•
Orifice Area (sq. inches)	6.97	6.97	6.97						_
	Row 9 (optional)	Row 10 (optional)	Row 11 (optional)	Row 12 (optional)	Row 13 (optional)	Row 14 (optional)	Row 15 (optional)	Row 16 (optional)	1
Stage of Orifice Centroid (ft)	5 (optional)	10 (optional)		12 (optional)	15 (opdorial)	11 (optional)	15 (optional)	10 (optional)	1
Orifice Area (sq. inches)		`		`			`		1
									-
er Input: Vertical Orifice (Circular or Rectar			•					eters for Vertical C	<u>Drifice</u>
	Not Selected	Not Selected					Not Selected	Not Selected	1.
Invert of Vertical Orifice =	N/A	N/A		in bottom at Stage		tical Orifice Area =	N/A	N/A	ft ²
Depth at top of Zone using Vertical Orifice =	N/A	N/A	· -	in bottom at Stage	= 0 ft) Vertica	Orifice Centroid =	N/A	N/A	feet
Vertical Orifice Diameter =	N/A	N/A	inches			•			
ser Input: Overflow Weir (Dropbox with Flat	or Shood Crata a	nd Outlot Pino OP	Poetangular/Trans	azoidal Woir and N	Outlot Pino		Calculated Param	eters for Overflow	/ Moir
ici input. Overnow well (Dropbox with Fish	Zone 2 Weir	Not Selected	 	szoldál vveli álla ív	o oddet ripe)		Zone 2 Weir	Not Selected	T
Overflow Weir Front Edge Height, Ho =	3.02	N/A	ft (relative to basin	bottom at Stage = 0	ft) Height of Grate	Upper Edge, H _t =	6.35	N/A	feet
Overflow Weir Front Edge Length =	800.00	N/A	feet		-	eir Slope Length =	10.54	N/A	→
Overflow Weir Grate Slope =	3.00	N/A	H:V		Overnow w				feet
Horiz. Length of Weir Sides =	10.00			Grat		0-yr Orifice Area =	12272.31	N/A	feet
		N/A	feet		e Open Area / 10	0-yr Orifice Area = Area w/o Debris =	12272.31 5869.19	· · · · · · · · · · · · · · · · · · ·	feet ft ²
Overflow Grate Type =		N/A ▼		Ove	e Open Area / 10 rflow Grate Open			N/A	1
Overflow Grate Type = Debris Clogging % =				Ove	e Open Area / 10 rflow Grate Open	Area w/o Debris =	5869.19	N/A N/A	ft²
Debris Clogging % =	Type C Grate 50%	N/A N/A	feet %	Ove Ov	e Open Area / 10 rflow Grate Open erflow Grate Open	Area w/o Debris = n Area w/ Debris =	5869.19 2934.59	N/A N/A N/A	ft²
Debris Clogging % =	Type C Grate 50%	N/A N/A Restrictor Plate, o	feet %	Ove Ov	e Open Area / 10 rflow Grate Open erflow Grate Open	Area w/o Debris =	5869.19 2934.59 s for Outlet Pipe w	N/A N/A N/A	ft²
Debris Clogging % = ser Input: Outlet Pipe w/ Flow Restriction Pla	Type C Grate 50% te (Circular Orifice, Zone 2 Restrictor	N/A N/A Restrictor Plate, o Not Selected	feet % <u>r Rectangular Orific</u>	Ove Ov <u>v</u>	e Open Area / 10 rflow Grate Open erflow Grate Open erflow Grate Open <u>Ca</u>	Area w/o Debris = n Area w/ Debris = kulated Parameter	5869.19 2934.59 s for Outlet Pipe w Zone 2 Restrictor	N/A N/A N/A N/A / Flow Restriction Not Selected	ft² ft²
Debris Clogging % = ser Input: Outlet Pipe w/ Flow Restriction Pla Depth to Invert of Outlet Pipe =	Type C Grate 50% te (Circular Orifice, Zone 2 Restrictor 2.50	N/A N/A Restrictor Plate, o Not Selected N/A	feet % <u>r Rectangular Orific</u> ft (distance below b	Ove Ov	e Open Area / 10 rflow Grate Open erflow Grate Open erflow Grate Open Ca = 0 ft) O	Area w/o Debris = n Area w/ Debris = ncluded Parameter utlet Orifice Area =	5869.19 2934.59 s for Outlet Pipe w Zone 2 Restrictor 0.48	N/A N/A N/A N/A / Flow Restriction Not Selected N/A	ft² ft²
Debris Clogging % = ser Input: Outlet Pipe w/ Flow Restriction Pla Depth to Invert of Outlet Pipe = Outlet Pipe Diameter =	Type C Grate 50% te (Circular Orifice, Zone 2 Restrictor 2.50 16.00	N/A N/A Restrictor Plate, o Not Selected	feet % *Rectangular Orific ft (distance below b inches	Ove Ov <u>ce)</u> asin bottom at Stage	e Open Area / 10 rflow Grate Open erflow Grate Open erflow Grate Open <u>Ca</u> = 0 ft) Outle	Area w/o Debris = n Area w/ Debris = culated Parameter utlet Orifice Area = t Orifice Centroid =	5869.19 2934.59 s for Outlet Pipe w Zone 2 Restrictor 0.48 0.29	N/A N/A N/A N/A / Flow Restriction Not Selected N/A N/A	ft² ft² Plate ft² ft²
Debris Clogging % = ser Input: Outlet Pipe w/ Flow Restriction Pla Depth to Invert of Outlet Pipe =	Type C Grate 50% te (Circular Orifice, Zone 2 Restrictor 2.50	N/A N/A Restrictor Plate, o Not Selected N/A	feet % <u>r Rectangular Orific</u> ft (distance below b	Ove Ov <u>ce)</u> asin bottom at Stage	e Open Area / 10 rflow Grate Open erflow Grate Open erflow Grate Open <u>Ca</u> = 0 ft) Outle	Area w/o Debris = n Area w/ Debris = ncluded Parameter utlet Orifice Area =	5869.19 2934.59 s for Outlet Pipe w Zone 2 Restrictor 0.48	N/A N/A N/A N/A / Flow Restriction Not Selected N/A	ft² ft²
Debris Clogging % = <u>ser Input: Outlet Pipe w/ Flow Restriction Pla</u> Depth to Invert of Outlet Pipe = Outlet Pipe Diameter = Restrictor Plate Height Above Pipe Invert =	Type C Grate 50% te (Circular Orifice, Zone 2 Restrictor 2.50 16.00 6.00	N/A N/A Restrictor Plate, o Not Selected N/A	feet % *Rectangular Orific ft (distance below b inches	Ove Ov <u>ce)</u> asin bottom at Stage	e Open Area / 10 rflow Grate Open erflow Grate Open erflow Grate Open <u>Ca</u> = 0 ft) Outle	Area w/o Debris = n Area w/ Debris = culated Parameter utlet Orifice Area = t Orifice Centroid =	5869.19 2934.59 s for Outlet Pipe w Zone 2 Restrictor 0.48 0.29 1.32	N/A N/A N/A N/A N/A Not Selected N/A N/A N/A N/A	ft² ft² Plate ft² ft²
Debris Clogging % = ser Input: Outlet Pipe w/ Flow Restriction Pla Depth to Invert of Outlet Pipe = Outlet Pipe Diameter = Restrictor Plate Height Above Pipe Invert = ser Input: Emergency Spilway (Rectangular	Type C Grate 50% te (Circular Orifice, Zone 2 Restrictor 2.50 16.00 6.00 or Trapezoidal)	N/A N/A Restrictor Plate, o Not Selected N/A N/A	feet % r Rectangular Orific ft (distance below b inches inches	Ove Ov ce) easin bottom at Stage Half-Centr	e Open Area / 10 rflow Grate Open erflow Grate Open Ca = 0 ft) Oute al Angle of Restrict	Area w/o Debris = n Area w/ Debris = culated Parameter: utlet Orifice Area = t Orifice Centroid = tor Plate on Pipe =	5869.19 2934.59 s for Outlet Pipe w Zone 2 Restrictor 0.48 0.29 1.32 Calculated Param	N/A N/A N/A N/A / Flow Restriction Not Selected N/A N/A N/A N/A eters for Spilway	ft² ft² Plate ft² ft²
Debris Clogging % = ser Input: Outlet Pipe w/ Flow Restriction Pla Depth to Invert of Outlet Pipe = Outlet Pipe Diameter = Restrictor Plate Height Above Pipe Invert = ser Input: Emergency Spilway (Rectangular Spilway Invert Stage=	Type C Grate 50% te (Circular Orifice, 2.50 16.00 6.00 or Trapezoidal) 6.10	N/A N/A Restrictor Plate, o Not Selected N/A N/A N/A	feet % *Rectangular Orific ft (distance below b inches	Ove Ov ce) easin bottom at Stage Half-Centr	e Open Area / 10 rflow Grate Open erflow Grate Open Ca = 0 ft) O Outle Spillway D	Area w/o Debris = n Area w/ Debris = lculated Parameter utlet Orifice Area = t Orifice Centroid = tor Plate on Pipe = lesign Flow Depth=	5869.19 2934.59 s for Outlet Pipe w Zone 2 Restrictor 0.48 0.29 1.32 Calculated Param 0.98	N/A N/A N/A N/A N/A NOTE Selected N/A N/A N/A N/A N/A N/A N/A N/A N/A N/A	ft² ft² Plate ft² ft²
Debris Clogging % = ser Input: Outlet Pipe w/ Flow Restriction Pla Depth to Invert of Outlet Pipe = Outlet Pipe Diameter = Restrictor Plate Height Above Pipe Invert = ser Input: Emergency Spilway (Rectangular	Type C Grate 50% te (Circular Orifice, Zone 2 Restrictor 2.50 16.00 6.00 or Trapezoidal) 6.10	N/A N/A Restrictor Plate, o Not Selected N/A N/A N/A ft (relative to basifeet H-V Size Em	feet // // // // // // // // // // // // /	Ove Ov Deasin bottom at Stage Half-Centr	e Open Area / 10 rflow Grate Open erflow Grate Open erflow Grate Open Ca = 0 ft) O Outle al Angle of Restric Spillway D Stage at T	Area w/o Debris = n Area w/ Debris = culated Parameter: utlet Orifice Area = t Orifice Centroid = tor Plate on Pipe =	5869.19 2934.59 s for Outlet Pipe w Zone 2 Restrictor 0.48 0.29 1.32 Calculated Param	N/A N/A N/A N/A / Flow Restriction Not Selected N/A N/A N/A N/A eters for Spilway	ft² ft² Plate ft² ft²
Debris Clogging % = ser Input: Outlet Pipe w/ Flow Restriction Pla Depth to Invert of Outlet Pipe = Outlet Pipe Diameter = Restrictor Plate Height Above Pipe Invert = ser Input: Emergency Spilway (Rectangular Spilway Invert Stage= Spilway Crest Length =	Type C Grate 50% te (Circular Orifice, 2.50 16.00 6.00 or Trapezoidal) 6.10 117.00	N/A N/A Restrictor Plate, o Not Selected N/A N/A N/A ft (relative to basifeet H-V Size Em	feet // // // // // // // // // // // // /	Ove Ov Deasin bottom at Stage Half-Centr	e Open Area / 10 rflow Grate Open erflow Grate Open crown of the Carlo Carlo Outle al Angle of Restric Spillway D Stage at T Basin Area at T	Area w/o Debris = n Area w/ Debris = n Area w/ Debris =	5869.19 2934.59 s for Outlet Pipe w Zone 2 Restrictor 0.48 0.29 1.32 Calculated Param 0.98 8.08	N/A N/A N/A N/A N/A Not Selected N/A N/A N/A N/A Feters for Spilway feet feet	ft² ft² Plate ft² ft²
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Debris Clogging % = Ser Input: Outlet Pipe w/ Flow Restriction Pla Depth to Invert of Outlet Pipe = Outlet Pipe Diameter = Restrictor Plate Height Above Pipe Invert = Ser Input: Emergency Spilway (Rectangular Spilway Invert Stage = Spilway Invert Stage = Spilway Invert Stage = Spilway Find Slopes = Freeboard above Max Water Surface = One-Hour Rainfall Depth (in) = CUHP Runoff Volume (acre-tt) = CUHP Predevelopment Peak Q (cfs) = Predevelopment University Predevelopment Peak Q (cfs) = Peak Inflow Q (cfs) = Peak Inflow Q (cfs) = Peak Outflow Q (cfs) = Ratio Peak Outflow to Predevelopment Q = Storuture Controlling Flow = Max Velocity through Grate 2 (fps) = Max Velocity through Grate 2 (fps) =	Type C Grate 50% te (Circular Orifice, Zone 2 Restrictor 2.50 16.00 6.00 or Trapezoidal) 6.10 117.00 1.00 The user can ove WQCV N/A 1.991 N/A N/A N/A N/A N/A N/A N/A N/A N/A N/A	N/A Restrictor Plate, o Not Selected N/A N/A Rt (relative to basifeet H:V feet Size Em Develope Feet N/A N/A N/A N/A N/A N/A N/A N/A N/A N/	feet /// // // // // // // // // // // //	Over Over Over Over Over Over Over Over	e Open Area / 10 rflow Grate Open erflow Grate Open erflow Grate Open erflow Grate Open erflow Grate Open Ca = 0 ft) O Outle al Angle of Restric Spilway D Stage at T Basin Area at T Basin Volume at T 10 Year 1.40 7.895 7.895 29.5 0.33 139.7 21.4 0.7 Spilway 0.0 N/A	Area w/o Debris = n Area w/o Debris = n Area w/ Debris = n Area w/ Debris = n Area w/ Debris = n Area w/ Debris = n Area w/ Debris = utlet Orifice Area = t Orifice Centroid = tor Plate on Pipe = op of Freeboard = op of Freeboard = op of Freeboard = op of Freeboard = n.87	5869.19 2934.59 Zone 2 Restrictor 0.48 0.29 1.32 Calculated Param 0.98 8.08 1.66 9.14 So Year 2.30 15.181 111.1 1.23 275.9 194.4 1.7 Spilway 0.0 N/A	N/A N/A N/A N/A N/A N/A N/A N/A N/A N/Selected N/A N/A N/A N/A N/A N/A N/A N/A 100 Year 2.79 19.277 19.277 155.2 1.72 352.0 298.5 1.9 Spillway 0.0 N/A	ft ² ft ²
Debris Clogging % = ser Input: Outlet Pipe w/ Flow Restriction Pla Depth to Invert of Outlet Pipe = Outlet Pipe Diameter = Restrictor Plate Height Above Pipe Invert = ser Input: Emergency Spilway (Rectangular Spilway Invert Stage= Spilway Invert Stage= Spilway Invert Stage= Spilway Invert Stage= Spilway Find Slopes = Freeboard above Max Water Surface = Outled Hydrograph Results Design Storm Return Period = One-Hour Rainfall Depth (in) = CUHP Runoff Volume (acre-ft) = CUHP Predevelopment Peak Q (cfs) = Predevelopment Peak Q (cfs) = Peak Inflow Q (cfs) = Peak Inflow Q (cfs) = Peak Outflow Q (cfs) = Ratio Peak Outflow to Predevelopment Q = Structure Controlling Flow = Max Velocity through Grate 1 (fps) = Max Velocity through Grate 1 (fps) = Time to Drain 99% of Inflow Volume (hours) = Time to Drain 99% of Inflow Volume (hours) = Time to Drain 99% of Inflow Volume (hours) = Time to Drain 99% of Inflow Volume (hours) = Maximum Ponding Depth (ft) =	Type C Grate 50% te (Circular Orifice, Zone 2 Restrictor 2.50 16.00 6.00 or Trapezoidal) 6.10 117.00 1.00 The user can over WQCV N/A 1.991 N/A N/A N/A N/A N/A N/A N/A N/A N/A N/A	N/A N/A Restrictor Plate, o Not Selected N/A N/A N/A It (relative to basifeet H:V feet Size Em Develope Feet N/A N/A N/A N/A N/A N/A N/A N/	feet // r Rectangular Orific ft (distance below b inches	Over Over Over Over Over Over Over Over	e Open Area / 10 rflow Grate Open erflow Grate Open erflow Grate Open erflow Grate Open erflow Grate Open Ca = 0 ft) O Outle al Angle of Restric Spillway D Stage at T Basin Area at T Basin Volume at T 10 Year 1.40 7.895 7.895 29.5 0.33 139.7 21.4 0.7 Spillway D N/A 43 48 6.22	Area w/o Debris = n Area w/o Debris = n Area w/ Debris = n Area w/ Debris = n Area w/ Debris = n Area w/ Debris = n Area w/ Debris = utlet Orifice Area = t Orifice Centroid = tor Plate on Pipe = op of Freeboard = op of Freeboard = op of Freeboard = op of Freeboard = n.87	5869.19 2934.59 Zone 2 Restrictor 0.48 0.29 1.32 Calculated Param 0.98 8.08 1.66 9.14 50 Year 2.30 15.181 111.1 1.23 275.9 194.4 1.7 Spilway 0.0 N/A 37 46 6.75	N/A N/A N/A N/A N/A N/A N/A N/A N/A N/A	ft² ft² ft² ft² ft² ft² ft² ft² ft² ft²
Debris Clogging % = Jeser Input: Outlet Pipe w/ Flow Restriction Pla Depth to Invert of Outlet Pipe = Outlet Pipe Diameter = Restrictor Plate Height Above Pipe Invert = Jeser Input: Emergency Spilway (Rectangular Spilway Invert Stage = Spilway Invert Stage = Spilway Crest Length = Spilway End Slopes = Freeboard above Max Water Surface = Routed Hydrograph Results Design Storm Return Period = One-Hour Rainfall Depth (in) = CUHP Runoff Volume (acre-ft) = Inflow Hydrograph Volume (acre-ft) = OPTIONAL Override Predevelopment Peak Q (cfs) = Peak Inflow Q (cfs) = Peak Outflow Q (cfs) = Ratio Peak Outflow to Predevelopment Q = Max Velocity through Grate 2 (fps) = Max Velocity through Grate 1 (fps) = Max Velocity through Grate 2 (fps) = Time to Drain 97% of Inflow Volume (hours) = Time to Drain 99% of Inflow Volume (hours) =	Type C Grate 50% te (Circular Orifice, Zone 2 Restrictor 2.50 16.00 6.00 or Trapezoidal) 6.10 117.00 4.00 1.00 The user can ove WQCV N/A 1.991 N/A N/A N/A N/A 1.0 N/A 1.0 N/A 1.0 N/A 1.0 N/A N/A 1.0 Overflow Weir 1 N/A N/A N/A 38 40	N/A N/A Restrictor Plate, o Not Selected N/A N/A N/A N/A If (relative to basifeet H:V feet Size Em Develope Feet N/A N/A N/A N/A N/A N/A N/A N/	feet // // // // // // // // // // // // /	And runoff volume Second Paris Paris	e Open Area / 10 rflow Grate Open erflow Grate Open erflow Grate Open erflow Grate Open erflow Grate Open Ca = 0 ft) O Outbe al Angle of Restrict Spillway D Stage at T Basin Area at T Basin Volume at T 1.40 7.895 7.895 7.895 29.5 0.33 139.7 21.4 0.7 Spillway 0.7 Spillway 0.7 Spillway 0.0 N/A 43 48	Area w/o Debris = n Area w/o Debris = n Area w/ Debris = n Area w/ Debris = n Area w/ Debris = n Area w/ Debris = n Area w/ Debris = n Area w/ Debris = t Orifice Area = t Orifice Centroid = tor Plate on Pipe = op of Freeboard = op of Freeboard = op of Freeboard = op of Freeboard = n Area	5869.19 2934.59 S for Outlet Pipe w Zone 2 Restrictor 0.48 0.29 1.32 Calculated Param 0.98 8.08 1.66 9.14 SO Year 2.30 15.181 15.181 111.1 1.23 275.9 194.4 1.7 Spillway 0.0 N/A 37 46	N/A N/A N/A N/A N/A N/A N/A N/A N/A N/A	Pate ft ² fteet radians feet radians foot 4.1. 30.4 30.4 2.99 2.99 2.00 500 500 500 500 500 500 500 500 500



	DETENTIO	N BASI	IN STAGE-S	TORA	GE TAI	BLE BL	JILDEF	₹				
		MHFL	D-Detention, Versio	n 4.06 (Ju	ıly 2022)						Clear Worki	oook
	Greeley - Oklahoma D	rainage MP										
Basin ID: Option 4, EU	RV 844											
ZONE 2 ZONE 1												
O-YR EURY WQCV	\vdash											
	100-YEAR ORIFICE		Depth Increment =	0.50	Ī _{ft}							
PERMANENT ZONE 1 AND 2 ORIFICES POOL Example Zone Configuration					Optional			Aron	Optional		Valuma	
POOL Example Zone Configurat	ion (Retention Pond))	Stage - Storage Description	Stage (ft)	Override Stage (ft)	Length (ft)	Width (ft)	Area (ft²)	Override Area (ft ²)	Area (acre)	Volume (ft ³)	Volum (ac-ft)
atershed Information			Top of Micropool	0.00		41.9	41.9	1,752		0.040		
tended Detention Basin (EDB) EDB			ISV	0.33		41.9	41.9	1,752		0.040	578	0.013
Watershed Area = 126.50	acres			0.50		41.9	41.9	1,752		0.040	876	0.020
Watershed Length = 2,939 Watershed Length to Centroid = 1,428	ft			1.00		99.2 267.9	70.2 153.5	6,962 41,122		0.160	2,148 12,998	0.049
Watershed Eligin to Certable = 1,428 Watershed Slope = 0.031	ft/ft		Floor	1.84		382.6	210.2	80,408		1.846	33,290	0.764
Watershed Imperviousness = 76.20%	percent			2.00		383.8	211.5	81,168		1.863	46,216	1.061
Percentage Hydrologic Soil Group A = 0.0%	percent			2.50		387.8	215.5	83,565		1.918	87,398	2.006
Percentage Hydrologic Soil Group B = 0.0%	percent			3.00		391.8	219.5	85,994		1.974	129,786	2.979
Percentage Hydrologic Soil Groups C/D = 100.0%	percent		Zone 1 (WQCV)	3.13		392.9	220.5	86,631		1.989	141,007	3.237
Target WQCV Drain Time = 40.0	hours	1		3.50 4.00		395.8 399.8	223.5	88,456 90,949		2.031	173,398 218,247	3.981 5.010
Location for 1-hr Rainfall Depths = Denver - Capito				4.00		403.8	227.5	90,949		2.088	264,352	6.069
After providing required inputs above including 1-hour idepths, click 'Run CUHP' to generate runoff hydrograph:	s using Run CUF	IP		5.00		407.8	235.5	96,031		2.205	311,727	7.156
the embedded Colorado Urban Hydrograph Procedu	**	er Overrides		5.50		411.8	239.5	98,621		2.264	360,388	8.273
Water Quality Capture Volume (WQCV) = 3.226	acre-feet	acre-feet		6.00		415.8	243.5	101,242		2.324	410,353	9.420
Excess Urban Runoff Volume (EURV) = 9.432	acre-feet	acre-feet	Zone 2 (EURV)	6.01		415.9	243.5	101,294		2.325	411,365	9.444
2-yr Runoff Volume (P1 = 0.85 in.) = 6.396 5-yr Runoff Volume (P1 = 1.12 in.) = 9.013	acre-feet 0.85 acre-feet 1.12	inches		6.50 7.00		419.8 423.8	247.5 251.5	103,895 106,580		2.385	461,636 514,253	10.598
10-yr Runoff Volume (P1 = 1.12 iii.) = 9.013	acre-feet 1.40	inches		7.50		423.8	255.5	109,297		2.509	568,221	13.045
25-yr Runoff Volume (P1 = 1.87 in.) = 17.299	acre-feet 1.87	inches		8.00		431.8	259.5	112,047		2.572	623,556	14.315
50-yr Runoff Volume (P1 = 2.3 in.) = 22.084	acre-feet 2.30	inches		8.50		435.8	263.5	114,828		2.636	680,273	15.617
100-yr Runoff Volume (P1 = 2.79 in.) = 27.727	acre-feet 2.79	inches		9.00		439.8	267.5	117,641		2.701	738,389	16.951
500-yr Runoff Volume (P1 = 4.16 in.) = 43.218	acre-feet 4.16	inches		9.50		443.8	271.5	120,486		2.766	797,919	18.318
Approximate 2-yr Detention Volume = 6.083	acre-feet			10.00		447.8	275.5	123,363		2.832	858,880	19.717
Approximate 5-yr Detention Volume = 8.736 Approximate 10-yr Detention Volume = 10.760	acre-feet acre-feet			10.50 11.00		451.8 455.8	279.5 283.5	126,273 129,214		2.899	921,288 985,158	21.150
Approximate 25-yr Detention Volume = 13.343	acre-feet			11.50		459.8	287.5	132,187		3.035	1,050,507	24.116
Approximate 50-yr Detention Volume = 14.954	acre-feet			12.00		463.8	291.5	135,192		3.104	1,117,350	25.651
Approximate 100-yr Detention Volume = 17.253	acre-feet			12.50		467.8	295.5	138,229		3.173	1,185,705	27.220
				13.00		471.8	299.5	141,299		3.244	1,255,585	28.824
efine Zones and Basin Geometry				13.50		475.8	303.5	144,400		3.315	1,327,009	30.464
Zone 1 Volume (WQCV) ▼ 3.226 Zone 2 Volume (EURV - Zone 1) ▼ 6.206	acre-feet			14.00 14.50		479.8 483.8	307.5 311.5	147,533 150,698		3.387 3.460	1,399,990	32.139 33.851
Select Zone 3 Storage Volume (Optional)	lotal dete	ntion volume n 100-year		15.00		487.8	315.5	153,895		3.533	1,550,694	35.599
Total Detention Basin Volume = 9.432	acre-feet volume.			15.50		491.8	319.5	157,125		3.607	1,628,448	37.384
Initial Surcharge Volume (ISV) = 578	ft ³			16.00		495.8	323.5	160,386		3.682	1,707,824	39.206
Initial Surcharge Depth (ISD) = 0.33	ft			16.50		499.8	327.5	163,679		3.758	1,788,839	41.066
Total Available Detention Depth (H _{total}) = 6.00	ft			17.00		503.8	331.5	167,004		3.834	1,871,508	42.964
Depth of Trickle Channel (H_{TC}) = 0.50 Slope of Trickle Channel (S_{TC}) = 0.003	ft/ft			17.50 18.00		507.8 511.8	335.5 339.5	170,362 173,751		3.911	1,955,849 2,041,875	44.900
Slope of Trickle Channel (S_{TC}) = 0.003 Slopes of Main Basin Sides (S_{main}) = 4	π/π H:V			18.00		511.8	343.5	173,751		4.067	2,041,875	48.889
Basin Length-to-Width Ratio $(R_{L/W}) = 2$				19.00		519.8	347.5	180,625		4.147	2,219,053	50.942
- ' ' ' ' ' ' ' ' ' ' ' ' ' ' ' ' ' ' '				19.50		523.8	351.5	184,110		4.227	2,310,235	53.036
	ft²			20.00		527.8	355.5	187,628		4.307	2,403,168	55.169
Surcharge Volume Length (L _{ISV}) = 41.9	ft			20.50		531.8	359.5	191,177		4.389	2,497,868	57.343
Surcharge Volume Width (W _{ISV}) = 41.9 Depth of Basin Floor (H _{ELOOP}) = 1.01	ft			21.00 21.50		535.8 539.8	363.5 367.5	194,758 198,371		4.471 4.554	2,594,350 2,692,631	59.558 61.814
Depth of Basin Floor $(H_{FLOOR}) = 1.01$ Length of Basin Floor $(L_{FLOOR}) = 382.6$	ft.			22.00		543.8	367.5	202,016		4.638	2,792,727	64.112
Width of Basin Floor (W_{FLOOR}) = 210.2	ft			22.50		547.8	375.5	205,694		4.722	2,894,653	66.452
Area of Basin Floor (A _{FLOOR}) = 80,408	ft²			23.00		551.8	379.5	209,403		4.807	2,998,426	68.834
Volume of Basin Floor (V _{FLOOR}) = 31,656	ft ³			23.50		555.8	383.5	213,144		4.893	3,104,061	71.259
Depth of Main Basin (H _{MAIN}) = 4.16	ft			24.00		559.8	387.5	216,917		4.980	3,211,575	73.728
Length of Main Basin (L_{MAIN}) = 415.8 Width of Main Basin (W_{MAIN}) = 243.5	ft			24.50 25.00		563.8 567.8	391.5 395.5	220,722 224,560		5.067 5.155	3,320,984 3,432,303	76.239 78.795
Width of Main Basin (W_{MAIN}) = 243.5 Area of Main Basin (A_{MAIN}) = 101,242	ft ²			25.00		567.8	395.5	228,429		5.155	3,432,303	81.395
Volume of Main Basin (V _{MAIN}) = 377,000	ft ³			26.00		575.8	403.5	232,330		5.334	3,660,737	84.039
	acre-feet			26.50		579.8	407.5	236,263		5.424	3,777,884	86.728
				27.00 27.50		583.8 587.8	411.5 415.5	240,228 244,226		5.515 5.607	3,897,006 4,018,118	89.463 92.243
				28.00		591.8	419.5	248,255		5.699	4,141,237	95.070
				28.50 29.00		595.8 599.8	423.5 427.5	252,316 256,409		5.792 5.886	4,266,378 4,393,558	97.943 100.86
				29.50		603.8	431.5	260,535		5.981	4,522,793	103.82

	DET	CNITION D	ACINI OLIT	LET CTDL	ICTUDE D	ECICN			
	DET		BASIN OUT			ESIGN			
Project:	23.1447.001 Gree	<i>Mi-</i> ley - Oklahoma Dra	<i>IFD-Detention, Ve</i>	ersion 4.06 (July	2022)				
_	Option 4, EURV 84								
ZONE 3				Estimated	Estimated				
ZONE 1				Stage (ft)	Volume (ac-ft)	Outlet Type			
VOLUME EURY WOCV	1 —		Zone 1 (WQCV)	3.13	3.226	Orifice Plate	Orifice Plate		▼
1	100-YEAR		Zone 2 (EURV)	6.01	6.206	Weir&Pipe (Restrict)	Weir and Pipe (w/ Re	strictor Plate)	▼
PERMANENT ORIFICES	ORIFICE		Zone 3			Not Utilized	Zone 3 Not Utilized		▼
POOL				Total (all zones)	9.432				
User Input: Orifice at Underdrain Outlet (typical	ally used to drain V	VQCV in a Filtration	BMP)			-	Calculated Parame	eters for Underdra	<u>in</u>
Underdrain Orifice Invert Depth =	N/A		the filtration media	surface)		drain Orifice Area =	N/A	ft ²	
Underdrain Orifice Diameter =	N/A	inches			Underdrair	n Orifice Centroid =	N/A	feet	
User Input: Orifice Plate with one or more orif	icoc or Ellintical Clo	t Wair (typically us	od to drain WOCV	and/or ELID\/ in a	codimentation RM	ID)	Calardata d Danasa	store for Dista	
Centroid of Lowest Orifice =	0.00		n bottom at Stage			ce Area per Row =	Calculated Parame 8.056E-02	ft ²	
Depth at top of Zone using Orifice Plate =	3.63	-	n bottom at Stage	•	-	liptical Half-Width =	N/A	feet	
Orifice Plate: Orifice Vertical Spacing =	14.50	inches	_	-	Ellipt	tical Slot Centroid =	N/A	feet	
Orifice Plate: Orifice Area per Row =	11.60	sq. inches (use re	ctangular openings	s)	1	Elliptical Slot Area =	N/A	ft²	
					1				
Size Plate to match WQCV Drain Time									
User Input: Stage and Total Area of Each Or						Dow 6 (tin	Daw 7 (+	Bow 9 (#: 1)	7
Stage of Orifice Centroid (ft)	Row 1 (required) 0.00	Row 2 (optional) 1.21	Row 3 (optional) 2.42	Row 4 (optional)	Row 5 (optional)	Row 6 (optional)	Row 7 (optional)	Row 8 (optional)	1
Orifice Area (sq. inches)	11.60	11.60	11.60				•		†
Since Area (sq. iliclies)			11.00						_
	Row 9 (optional)	Row 10 (optional)	Row 11 (optional)	Row 12 (optional)	Row 13 (optional)	Row 14 (optional)	Row 15 (optional)	Row 16 (optional)	I
Stage of Orifice Centroid (ft)]
Orifice Area (sq. inches)]
User Input: Vertical Orifice (Circular or Rectan	audor)						Calculated Davame	eters for Vertical C) rifico
oser input. Vertical Office (Circular of Rectan	Not Selected	Not Selected	Ī				Not Selected	Not Selected	T
Invert of Vertical Orifice =	N/A	N/A	ft (relative to basi	n bottom at Stage	= 0 ft) Ver	rtical Orifice Area =	N/A	N/A	ft ²
Depth at top of Zone using Vertical Orifice =	N/A	N/A	ft (relative to basi			I Orifice Centroid =	N/A	N/A	feet
Vertical Orifice Diameter =	N/A	N/A	inches				,	•	•
							•		
User Input: Overflow Weir (Dropbox with Flat			Rectangular/Trape	ezoidal Weir and No	Outlet Pipe)			eters for Overflow	<u>Weir</u> T
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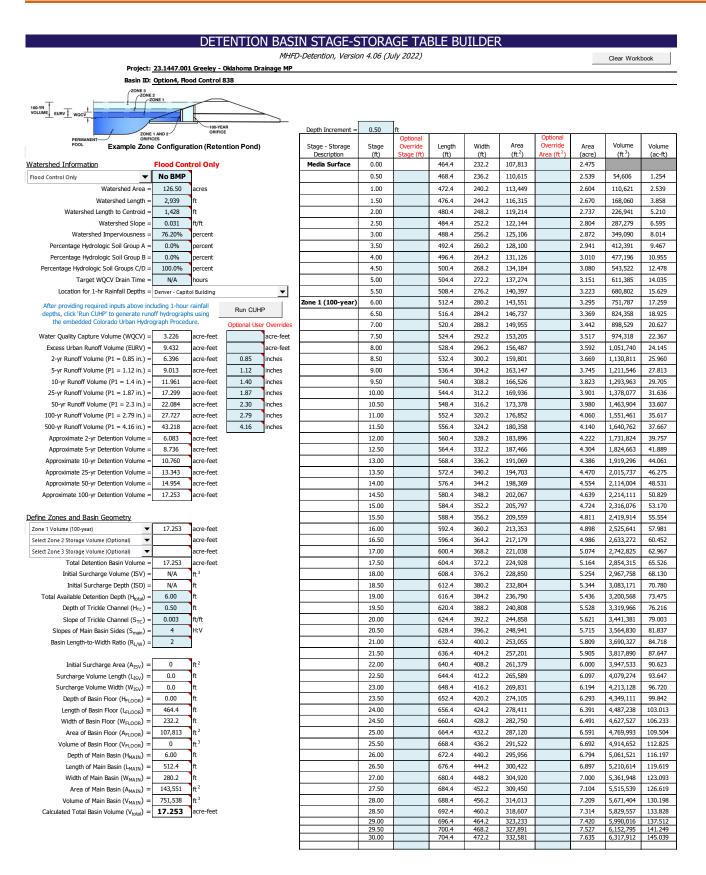
	DET		BASIN OUT HFD-Detention, V			ESIGN			
-		ley - Oklahoma Dra							
ZONE 3	Option 4, Flood Co	ntroi /11		Fating at a d	Fatire at a d				1
ZONE 2 ZONE 1		_		Estimated Stage (ft)	Estimated Volume (ac-ft)	Outlet Type			
100-YR VOLUME EURY WOCV			Zone 1 (100-year)	6.00	6.534	Rectangular Orifice	Vertical Orifice (Recta	angular)	<u> </u>
T	100-YEAR		Zone 2	0.00	0.551	recearigatar or mee	Select Zone 2 Outlet 1		₩
ZONE 1 AND 2 PERMANENT ORIFICES	ORIFICE		Zone 3				Select Zone 3 Outlet 1		▼
POOL			20110 3	Total (all zones)	6.534		Select Zone 5 outlet	1,500	
User Input: Orifice at Underdrain Outlet (typic	ally used to drain \	VQCV in a Filtration	n BMP)	1 0001 (011 201105)	0.55 1	1	Calculated Parame	eters for Underdra	ain_
Underdrain Orifice Invert Depth =	N/A	ft (distance below	the filtration media	a surface)		Irain Orifice Area =		ft²	
Underdrain Orifice Diameter =	N/A	inches			Underdrain	Orifice Centroid =	N/A	feet	
User Input: Orifice Plate with one or more ori	ficac or Ellintical Cla	t Wair (typically us	od to drain WOCV	and/or ELIDV in a	codimontation RM	ID)	Calculated Parame	atawa faw Diata	
Centroid of Lowest Orifice =	N/A		in bottom at Stage			ce Area per Row =	N/A	ft ²	
Depth at top of Zone using Orifice Plate =	N/A		in bottom at Stage	•		iptical Half-Width =	N/A	feet	
Orifice Plate: Orifice Vertical Spacing =	N/A	inches			Ellipti	ical Slot Centroid =	N/A	feet	
Orifice Plate: Orifice Area per Row =	N/A	sq. inches			E	Elliptical Slot Area =	N/A	ft²	
		•		•					
User Input: Stage and Total Area of Each Orifice Row (numbered from lowest to highest)									
SSS. 111pac. Stage and 1 ottal rated of LaCH Of	Row 1 (optional)	Row 2 (optional)	Row 3 (optional)	Row 4 (optional)	Row 5 (optional)	Row 6 (optional)	Row 7 (optional)	Row 8 (optional)	1
Stage of Orifice Centroid (ft)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A]
Orifice Area (sq. inches)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A]
	D. 0/ ". "	I n	I n	D. 437	D 427 :: ::	D. 444	D. 457	l n	7
Stage of Orifice Centroid (ft)	Row 9 (optional) N/A	Row 10 (optional) N/A	Row 11 (optional) N/A	Row 12 (optional) N/A	Row 13 (optional) N/A	Row 14 (optional) N/A	Row 15 (optional) N/A	Row 16 (optional) N/A	•
Orifice Area (sq. inches)	N/A	N/A	N/A N/A	N/A	N/A	N/A N/A	N/A	N/A	1
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User Input: Vertical Orifice (Circular or Rectar		1	1				Calculated Parame		<u>Orifice</u>
	Zone 1 Rectangula	Not Selected	6. (laki ka baai		0.60		Zone 1 Rectangula	Not Selected	ft²
Invert of Vertical Orifice = Depth at top of Zone using Vertical Orifice =	0.00 6.00		ft (relative to basi ft (relative to basi		,	tical Orifice Area = Orifice Centroid =	30.00 2.50		feet
Vertical Orifice Height =	60.00		inches	bottom at badyt	. o rej rereieu	. OTHER CONTINUE	2.50		1.000
Vertical Orifice Width =	72.00	`	inches			•	ı		
	•								
User Input: Overflow Weir (Dropbox with Flat			Rectangular/Trape	ezoidal Weir and N	o Outlet Pipe)		Calculated Parame		<u>Weir</u>
Overflow Weir Front Edge Height, Ho =	Not Selected	Not Selected	ft (rolative to bacin	hottom at Stage = 0	ft) Hoight of Crato	Upper Edge, H _t =	Not Selected	Not Selected	feet
Overflow Weir Front Edge Length =			feet	bottom at Stage = 0	_				→
Overflow Weir Grate Slope =	•	•				eir Siode Lenath =			feet
			H:V	Grat	e Open Area / 100	'eir Slope Length = 0-yr Orifice Area =			feet
Horiz. Length of Weir Sides =	`		feet	Ove	e Open Area / 100 erflow Grate Open	0-yr Orifice Area = Area w/o Debris =			ft²
Overflow Grate Type	Select Grate Type ▼	Select Grate Type ▼	feet	Ove	e Open Area / 100 erflow Grate Open	0-yr Orifice Area =			
	Select Grate Type	Select Grate Type ▼	•	Ove	e Open Area / 100 erflow Grate Open	0-yr Orifice Area = Area w/o Debris =			ft²
Overflow Grate Type = Debris Clogging % =			feet %	Ove Ov	e Open Area / 100 erflow Grate Open erflow Grate Oper	0-yr Orifice Area = Area w/o Debris = n Area w/ Debris =	s for Outlet Pipe w	/ Flow Restriction	ft² ft²
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Overflow Grate Type = Debris Clogging % = Debris Clogging % = User Input: Outlet Pipe w/ Flow Restriction Pla Depth to Invert of Outlet Pipe = Circular Orfice Diameter = User Input: Emergency Spilway (Rectangular Spilway Invert Stage = Spilway Invert Stage = Spilway Invert Stage = Spilway Crest Length = Spilway End Slopes = Freeboard above Max Water Surface = Routed Hydrograph Results Design Storm Return Period = One-Hour Rainfall Depth (in) = CUHP Predevelopment Peak Q (cfs) = OPTIONAL Override Predevelopment Peak Q (cfs) = Predevelopment Unit Peak Flow, q (cfs/acre) = Peak Inflow Q (cfs) = Peak Outflow Q (cfs) = Ratio Peak Outflow to Predevelopment Q = Structure Controlling Flow Max Velocity through Grate 1 (fps) = Max Velocity through Grate 1 (fps) = Max Velocity through Grate 1 (fps) = Time to Drain 99% of Inflow Volume (hours) = Time to Drain 99% of Inflow Volume (hours) =	The user can over N/A N/A N/A N/A N/A N/A N/A N/A N/A N/A	Restrictor Plate, o Not Selected ft (relative to basifeet H:V feet Size Em Develope EURV N/A 2.470 N/A N/A N/A N/A N/A N/A N/A N/A N/A N/A	feet 9% If Rectangular Orifix If (distance below b inches In bottom at Stage ergency Spillway to p od 100-yr Peak Runoff 2 Year 0.85 1.598 1.598 0.8 0.01 16.2 8.1 N/A N/A N/A 12 27	Overlical Orifice 1 N/A ee Open Area / 100 erflow Grate Open erflow Grate Open erflow Grate Open erflow Grate Open erflow Grate Open erflow Grate Open Cal e = 0 ft) Ou Outlet al Angle of Restrict Spillway D Stage at Tr Basin Area at Tr Basin Area at Tr Basin Volume at Tr 1.40 4.602 4.602 24.1 0.27 48.3 30.7 1.3 Vertical Orifice 1 N/A N/A 6 6 13	0-yr Orifice Area = Area w/o Debris = n Area w/o Debris = n Area w/ Debris = n Area w/ Debris = culated Parameters utlet Orifice Area = c Orifice Centroid = tor Plate on Pipe = esign Flow Depth= op of Freeboard = op of Freeboard = op of Freeboard = op of Freeboard = values in the Inflo 25 Year 1.87 8.506 8.506 64.2 0.71 95.8 69.9 1.1 Vertical Orifice 1 N/A N/A S 9	Not Selected N/A Calculated Parame W Hydrographs tat 50 Year 2.30 11.792 11.792 93.3 1.04 131.0 100.5 1.1 Vertical Orifice 1 N/A N/A 4 7	Not Selected	ft² ft² ft² ft² ft² ft² feet radians srough AF). 500 Year 4.16 27.074 27.074 27.074 225.3 2.50 291.6 241.4 1.1 ertical Orifice N/A N/A N/A 3 5	



		DFI	ΈΝΤΙΩ	N BAS	IN STAGE-S	STORA	GF TAI	BI F. BL	ITI DEF	2				
					D-Detention, Version				-1-2-1	•			Clear Work	book
Project:	23.1447.00	1 Greeley -	Oklahoma Dr		. ,	- (. ,						JIGGI VYOIK	JOON
	Option 4, Flo	ood Control	1 823											
ZONE 3	2 20NE 1		_											
100-YR VOLUME EURV WQCV		\bot												
		100-YE	EAR		Depth Increment =	0.50	ft							
PERMANENT—ORIFI		ORIFIC	CE				Optional			_	Optional			
POOL Example Zone	e Configura	ation (Rete	ntion Pond)		Stage - Storage Description	Stage (ft)	Override Stage (ft)	Length (ft)	Width (ft)	Area (ft ²)	Override Area (ft ²)	Area (acre)	Volume (ft ³)	Volume (ac-ft)
Watershed Information	Flood Con	trol Only			Media Surface		0.00		-		37,664	0.865		
Flood Control Only	No BMP						1.00		-		77,436	1.778	57,550	1.321
Watershed Area =	327.00	acres					2.00				133,078	3.055	162,807	3.738
Watershed Length =	4,753 2,751	ft ft					3.00 4.00				163,864 190,605	3.762 4.376	311,278 488,512	7.146 11.215
Watershed Length to Centroid = Watershed Slope =	0.012	ft/ft					5.00				204,897	4.704	686,263	15.754
Watershed Imperviousness =	72.98%	percent					6.00				215,528	4.948	896,476	20.580
Percentage Hydrologic Soil Group A =	0.0%	percent					7.00				226,286	5.195	1,117,383	25.652
Percentage Hydrologic Soil Group B =	0.0%	percent					8.00				237,198	5.445	1,349,125	30.972
Percentage Hydrologic Soil Groups C/D =	100.0%	percent					9.00				273,603	6.281	1,474,271	33.845 37.048
Target WQCV Drain Time = Location for 1-hr Rainfall Depths =	N/A Denver - Canit	hours of Building		-			9.00				273,603 273,603	6.281	1,613,808 1,887,411	43.329
After providing required inputs above inc							10.00		-		2,3,003	0.201	1,007,111	.5.525
depths, click 'Run CUHP' to generate run	off hydrograpl	hs using _	Run CUH	IP					-					
the embedded Colorado Urban Hydro	ograph Proced	lure.	Optional Use	er Overrides					-					
Water Quality Capture Volume (WQCV) =	7.879	acre-feet		acre-feet										
Excess Urban Runoff Volume (EURV) = 2-yr Runoff Volume (P1 = 0.85 in.) =	23.271 16.082	acre-feet acre-feet	0.85	acre-feet inches					-					
5-yr Runoff Volume (P1 = 0.05 iii.) =	22.795	acre-feet	1.12	inches										
10-yr Runoff Volume (P1 = 1.4 in.) =	30.462	acre-feet	1.40	inches										
25-yr Runoff Volume (P1 = 1.87 in.) =	44.522	acre-feet	1.87	inches										
50-yr Runoff Volume (P1 = 2.3 in.) =	57.083	acre-feet	2.30	inches										
100-yr Runoff Volume (P1 = 2.79 in.) = 500-yr Runoff Volume (P1 = 4.16 in.) =	71.969	acre-feet	2.79 4.16	inches										
Approximate 2-yr Detention Volume =	112.726 14.974	acre-feet acre-feet	4.10	inches										
Approximate 5-yr Detention Volume =	21.673	acre-feet												
Approximate 10-yr Detention Volume =	26.650	acre-feet							-					
Approximate 25-yr Detention Volume =	33.089	acre-feet												
Approximate 50-yr Detention Volume =	37.124	acre-feet												
Approximate 100-yr Detention Volume =	43.128	acre-feet												
Define Zones and Basin Geometry														
Zone 1 Volume (100-year) ▼	43.128	acre-feet												
Select Zone 2 Storage Volume (Optional) ▼		acre-feet												
Select Zone 3 Storage Volume (Optional)	42 :	acre-feet												1
Total Detention Basin Volume = Initial Surcharge Volume (ISV) =	43.128 N/A	acre-feet ft 3												
Initial Surcharge Volume (ISV) = Initial Surcharge Depth (ISD) =	N/A	ft 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							-					<u> </u>
Slopes of Main Basin Sides (S _{main}) =	user	H:V												1
Basin Length-to-Width Ratio $(R_{L/W})$ =	user	1							-					
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												1
Length of Basin Floor (L_{FLOOR}) = Width of Basin Floor (W_{FLOOR}) =	user	ft ft											-	-
width of Basin Floor (W_{FLOOR}) = 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 $(A_{MAIN}) =$ Volume of Main Basin $(V_{MAIN}) =$	user	ft ²							-				-	
Calculated Total Basin Volume (V_{MAIN}) =	user	acre-feet												
		1								<u> </u>				1

	DET	ENTION E	BASIN OUT	LET STRU	ICTURE DE	ESIGN			
Duniostu	22 1447 001 Cross	<i>MF</i> ley - Oklahoma Dra	FD-Detention, Ve	ersion 4.06 (July	2022)				
-	Option 4, Flood Co	•	паде мР						
ZONE 3 ZONE 2 ZONE 1				Estimated	Estimated				
100-YR VOLUME EURV WQCV			7 1 (100 ···)	Stage (ft)	Volume (ac-ft)	Outlet Type			
Tan Twee	100-YEAR		Zone 1 (100-year) Zone 2	9.97	43.128	Rectangular Orifice	Vertical Orifice (Recta Select Zone 2 Outlet		▼
ZONE 1 AND 2 PERMANENT ORIFICES	ORIFICE		Zone 3				Select Zone 3 Outlet		-
POOL				Total (all zones)	43.128				
<u>User Input: Orifice at Underdrain Outlet (typica</u> <u>Underdrain Orifice Invert Depth =</u>	ally used to drain V N/A		<u>n BMP)</u> the filtration media	a curfaco)	Undord	rain Orifice Area =	Calculated Parame	eters for Underdra ft ²	<u>in</u>
Underdrain Orifice Diameter =	N/A	inches	the hid adon medic	a surface)		Orifice Centroid =	N/A	feet	
User Input: Orifice Plate with one or more orifi	ices or Elliptical Slo		-		sedimentation BM	<u>P)</u>	Calculated Parame		
Centroid of Lowest Orifice = Depth at top of Zone using Orifice Plate =	N/A N/A		n bottom at Stage n bottom at Stage		-	e Area per Row = ptical Half-Width =	N/A N/A	ft ² feet	
Orifice Plate: Orifice Vertical Spacing =	N/A	inches	ii bottoiii at stage	= 0 It)		cal Slot Centroid =	N/A	feet	
Orifice Plate: Orifice Area per Row =	N/A	sq. inches			-	lliptical Slot Area =	N/A	ft ²	
User Input: Stage and Total Area of Each Or	Row 1 (optional)	Row 2 (optional)	nighest) Row 3 (optional)	Row 4 (optional)	Row 5 (optional)	Row 6 (optional)	Row 7 (optional)	Row 8 (optional)	1
Stage of Orifice Centroid (ft)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	
Orifice Area (sq. inches)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	
	Row 9 (optional)	Row 10 (optional)	Row 11 (optional)	Row 12 (optional)	Row 13 (optional)	Row 14 (optional)	Row 15 (optional)	Row 16 (optional)	1
Stage of Orifice Centroid (ft)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	
Orifice Area (sq. inches)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	
User Input: Vertical Orifice (Circular or Rectan	nular)						Calculated Parame	eters for Vertical O	rifice
	Zone 1 Rectangula	Not Selected					Zone 1 Rectangula	1	T T
Invert of Vertical Orifice =	0.00		ft (relative to basi		,	tical Orifice Area =	29.17		ft²
Depth at top of Zone using Vertical Orifice =	9.97		ft (relative to basi	n bottom at Stage	= 0 ft) Vertical	Orifice Centroid =	2.50		feet
Vertical Orifice Height = Vertical Orifice Width =	60.00 70.00	_	inches inches			•	ı		
	70.00	Vertical Orifice Width = 70.00 inches							
User Input: Overflow Weir (Dropbox with Flat			Rectangular/Trape	ezoidal Weir and N	Outlet Pipe)			eters for Overflow	<u>Weir</u>
	or Sloped Grate a Not Selected	Not Selected				Upper Edge H. =	Calculated Parame	Not Selected	
User Input: Overflow Weir (Dropbox with Flat Overflow Weir Front Edge Height, Ho = Overflow Weir Front Edge Length =		Not Selected	Rectangular/Trape ft (relative to basin feet		ft) Height of Grate	Upper Edge, H _t = eir Slope Length =			Weir feet feet
Overflow Weir Front Edge Height, Ho = Overflow Weir Front Edge Length = Overflow Weir Grate Slope =		Not Selected	ft (relative to basin feet H:V	bottom at Stage = 0 Grat	ft) Height of Grate Overflow W e Open Area / 100	eir Slope Length = 0-yr Orifice Area =			feet feet
Overflow Weir Front Edge Height, Ho = Overflow Weir Front Edge Length = Overflow Weir Grate Slope = Horiz. Length of Weir Sides =	Not Selected	Not Selected	ft (relative to basin feet	bottom at Stage = 0 Grat Ove	ft) Height of Grate Overflow W e Open Area / 100 rflow Grate Open A	eir Slope Length = 0-yr Orifice Area = Area w/o Debris =			feet feet ft²
Overflow Weir Front Edge Height, Ho = Overflow Weir Front Edge Length = Overflow Weir Grate Slope = Horiz. Length of Weir Sides = Overflow Grate Type =	Not Selected	Not Selected	ft (relative to basin l feet H:V feet	bottom at Stage = 0 Grat Ove	ft) Height of Grate Overflow W e Open Area / 100	eir Slope Length = 0-yr Orifice Area = Area w/o Debris =			feet feet
Overflow Weir Front Edge Height, Ho = Overflow Weir Front Edge Length = Overflow Weir Grate Slope = Horiz. Length of Weir Sides =	Not Selected	Not Selected	ft (relative to basin feet H:V	bottom at Stage = 0 Grat Ove	ft) Height of Grate Overflow W e Open Area / 100 rflow Grate Open A	eir Slope Length = 0-yr Orifice Area = Area w/o Debris =			feet feet ft²
Overflow Weir Front Edge Height, Ho = Overflow Weir Front Edge Length = Overflow Weir Grate Slope = Horiz. Length of Weir Sides = Overflow Grate Type =	Not Selected Select Grate Type te (Circular Orfice,	Not Selected Select Grate Type Restrictor Plate, o	ft (relative to basin feet H:V feet 	bottom at Stage = 0 Grat Ove Ov	ft) Height of Grate Overflow W e Open Area / 100 rflow Grate Open erflow Grate Open	eir Slope Length = 0-yr Orifice Area = Area w/o Debris =	Not Selected Not Selected	Not Selected Not Restriction F	feet feet ft² ft²
Overflow Weir Front Edge Height, Ho = Overflow Weir Front Edge Length = Overflow Weir Grate Slope = Horiz. Length of Weir Sides = Overflow Grate Type = Debris Clogging % = User Input: Outlet Pipe w/ Flow Restriction Plan	Not Selected Select Grate Type ▼	Not Selected Select Grate Type Restrictor Plate, o Not Selected	ft (relative to basin feet H:V feet % %	bottom at Stage = 0 Grat Ove Ov	ft) Height of Grate Overflow W. e Open Area / 100 rflow Grate Open erflow Grate Open <u>Cak</u>	eir Slope Length = 0-yr Orifice Area = Area w/o Debris = Area w/ Debris = culated Parameters	Not Selected	Not Selected	feet feet ft ² ft ²
Overflow Weir Front Edge Height, Ho = Overflow Weir Front Edge Length = Overflow Weir Grate Slope = Horiz. Length of Weir Sides = Overflow Grate Type = Debris Clogging % =	Not Selected Select Grate Type te (Circular Orfice,	Not Selected Select Grate Type Restrictor Plate, o Not Selected	ft (relative to basin I feet H:V feet] % r Rectangular Orific ft (distance below b	bottom at Stage = 0 Grat Ove Ov	ft) Height of Grate Overflow W e Open Area / 100 rfflow Grate Open erflow Grate Open <u>Cak</u> = 0 ft) Ou	eir Slope Length = D-yr Orifice Area = Area w/o Debris = Area w/ Debris = Lulated Parameters Litlet Orifice Area =	Not Selected Not Selected	Not Selected Not Restriction F	feet feet ft² ft² <u>late</u>
Overflow Weir Front Edge Height, Ho = Overflow Weir Front Edge Length = Overflow Weir Grate Slope = Horiz. Length of Weir Sides = Overflow Grate Type = Debris Clogging % = User Input: Outlet Pipe w/ Flow Restriction Plat	Not Selected Select Grate Type te (Circular Orfice,	Not Selected Select Grate Type Restrictor Plate, o Not Selected	ft (relative to basin feet H:V feet % %	bottom at Stage = 0 Grat Ove Ov Ce) asin bottom at Stage	ft) Height of Grate Overflow W e Open Area / 100 rfflow Grate Open erflow Grate Open <u>Cak</u> = 0 ft) Ou	eir Slope Length = D-yr Orifice Area = Area w/o Debris = Area w/ Debris = Lulated Parameters Utlet Orifice Area = Orifice Centroid =	Not Selected Not Selected	Not Selected Not Restriction F	feet feet ft² ft²
Overflow Weir Front Edge Height, Ho = Overflow Weir Front Edge Length = Overflow Weir Grate Slope = Horiz. Length of Weir Sides = Overflow Grate Type = Debris Clogging % = User Input: Outlet Pipe w/ Flow Restriction Plai Depth to Invert of Outlet Pipe = Circular Onfice Diameter =	Not Selected Select Grate Type The Circular Orifice, Not Selected	Not Selected Select Grate Type Restrictor Plate, o Not Selected	ft (relative to basin I feet H:V feet] % r Rectangular Orific ft (distance below b	bottom at Stage = 0 Grat Ove Ov Ce) asin bottom at Stage	ft) Height of Grate Overflow W. e Open Area / 100 rflow Grate Open erflow Grate Open Cak = 0 ft) Ou Outlet	eir Slope Length = D-yr Orifice Area = Area w/o Debris = Area w/ Debris = Lulated Parameters Utlet Orifice Area = Orifice Centroid =	Not Selected Selected For Outlet Pipe w. Not Selected N/A	Not Selected / Flow Restriction F Not Selected N/A	feet feet ft² ft² ft² ft² fteet
Overflow Weir Front Edge Height, Ho = Overflow Weir Front Edge Length = Overflow Weir Grate Slope = Horiz. Length of Weir Sides = Overflow Grate Type = Debris Clogging % = User Input: Outlet Pipe w/ Flow Restriction Plat Depth to Invert of Outlet Pipe = Circular Orifice Diameter = User Input: Emergency Spillway (Rectangular	Select Grate Type te (Circular Orifice, Not Selected or Trapezoidal)	Select Grate Type Restrictor Plate, o Not Selected	ft (relative to basin in feet H:V feet , % r Rectangular Orific ft (distance below book inches	bottom at Stage = 0 Grat Ove Ov ee) asin bottom at Stage Half-Centr	ft) Height of Grate Overflow W. e Open Area / 100 rflow Grate Open erflow Grate Open Cak = 0 ft) Outlet al Angle of Restrict	eir Slope Length = D-yr Orifice Area = Area w/o Debris = Area w/ Debris = Area w/ Debris = Culated Parameters Area = Orifice Area = Orifice Centroid = Or Plate on Pipe =	Not Selected S for Outlet Pipe w Not Selected N/A Calculated Parameter	/ Flow Restriction F Not Selected N/A eters for Spillway	feet feet ft² ft² ft² ft² fteet
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	— DLI		HFD-Detention, V			LOIGIN			
-	23.1447.001 Gree	ey - Oklahoma Dra							
ZONE 3	Option4, Flood Cor	itrol 838		F.C I. I	Fallendad				1
ZONE 2 ZONE 1				Estimated Stage (ft)	Estimated Volume (ac-ft)	Outlet Type			
DLUME EURY WOCV			Zone 1 (100-year)	6.00	17.253	Rectangular Orifice	Vertical Orifice (Recta	angular)	
	100-YEAR		Zone 2	0.00	17.255	rectangular office	Select Zone 2 Outlet		-
ZONE 1 AND 2 PERMANENT ORIFICES	ORIFICE		Zone 3				Select Zone 3 Outlet		▼
POOL			20110 3	Total (all zones)	17.253		Scient Zone 3 Odner	Type	
er Input: Orifice at Underdrain Outlet (typic	ally used to drain V	VQCV in a Filtration	n BMP)			1	Calculated Parame	eters for Underdra	<u>in</u>
Underdrain Orifice Invert Depth =		ft (distance below	the filtration media	a surface)	Underd	Irain Orifice Area =	N/A	ft²	
Underdrain Orifice Diameter =	N/A	inches			Underdrain	Orifice Centroid =	N/A	feet	
er Input: Orifice Plate with one or more ori	ficac or Ellintical Cla	Woir (typically us	ad to drain WOCV	and/or ELIDV in a	codimontation RM	ID)	Calculated Param	stans for Dista	
Centroid of Lowest Orifice =	N/A		in bottom at Stage	•		ce Area per Row =	N/A	ft ²	
Depth at top of Zone using Orifice Plate =		-	in bottom at Stage	•	-	iptical Half-Width =	N/A	feet	
Orifice Plate: Orifice Vertical Spacing =		inches			Ellipt	ical Slot Centroid =	N/A	feet	
Orifice Plate: Orifice Area per Row =	N/A	sq. inches			E	Elliptical Slot Area =	N/A	ft²	
				•	ı.				
er Input: Stage and Total Area of Each O	ifice Row (number	ed from lowest to	highest)						
	Row 1 (optional)	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)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	
Orifice Area (sq. inches)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A]
	Row 9 (optional)	Dow 10 (onti1)	Row 11 (optional)	Row 12 (optional)	Row 13 (optional)	Row 14 (optional)	Dow 15 /or5"	Dow 16 (action 1)	1
Stage of Orifice Centroid (ft)	` ` `	Row 10 (optional) N/A	N/A	N/A	N/A	N/A	Row 15 (optional) N/A	Row 16 (optional) N/A	1
Orifice Area (sq. inches)	,	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1
				-					
er Input: Vertical Orifice (Circular or Rectar		Nat Calastad	I				Calculated Parame Zone 1 Rectangula	eters for Vertical C	<u>Orifice</u> T
Invert of Vertical Orifice =	Zone 1 Rectangula 0.00	Not Selected	ft (relative to basi	in bottom at Stage	= 0 ft) Ver	tical Orifice Area =	29.17	Not Selected	ft ²
Pepth at top of Zone using Vertical Orifice =	6.00	•		in bottom at Stage		Orifice Centroid =	2.50		feet
Vertical Orifice Height =	60.00		inches	_	-				-
Vertical Orifice Width =	70.00		inches						
I	an Claused Costs a	ad Outlet Diag OD	Danta and Jaw (Tonas	id- \\/-id \\	O that Disa		Calardata d Danas	-t f Ofl	14/
er Input: Overflow Weir (Dropbox with Flat	Not Selected	Not Selected	Rectangular/ i rape	ezoldai Welrand IV	Outlet Pipe)		Not Selected	Not Selected	weir T
Overflow Weir Front Edge Height, Ho =	0.00	Not Selected	ft (relative to basin	bottom at Stage = 0	ft) Height of Grate	Upper Edge, H _t =	Not Selected	Not Selected	feet
Overflow Weir Front Edge Length =			feet	-	-	eir Slope Length =			feet
Overflow Weir Grate Slope =			H:V			0-yr Orifice Area =			1
Horiz. Length of Weir Sides =			feet		-	Area w/o Debris =			ft²
Overflow Grate Type = Debris Clogging % =	Select Grate Type	Select Grate Type] %	Ov	erflow Grate Oper	n Area W/ Debris =			ft ²
Debits clogging 70 =			170	•	i.				
er Input: Outlet Pipe w/ Flow Restriction Pla	te (Circular Orifice,	Restrictor Plate, o	r Rectangular Orific	<u>ce)</u>	Cal	culated Parameters	for Outlet Pipe w	/ Flow Restriction	<u>Plate</u>
	Not Selected	Not Selected					Not Selected	Not Selected] .
Depth to Invert of Outlet Pipe =				asin bottom at Stage	,	utlet Orifice Area = : Orifice Centroid =			ft ²
Circular Orifice Diameter =			inches		Ouner				
				Half-Centr			N/A	N/A	feet
				Half-Centr		tor Plate on Pipe =	N/A	N/A	radians
er Input: Emergency Spilway (Rectangular	or Trapezoidal)			Half-Centr			N/A <u>Calculated Parame</u>		-
Spillway Invert Stage=	or Trapezoidal)		ı in bottom at Stage	0.5)	al Angle of Restrict Spillway D	tor Plate on Pipe = esign Flow Depth=	· · · · · · · · · · · · · · · · · · ·	eters for Spillway feet	-
Spillway Invert Stage= Spillway Crest Length =	or Trapezoidal)	feet		e = 0 ft)	al Angle of Restrict Spillway D Stage at T	tor Plate on Pipe = esign Flow Depth= op of Freeboard =	· · · · · · · · · · · · · · · · · · ·	eters for Spillway feet feet	-
Spillway Invert Stage= Spillway Crest Length = Spillway End Slopes =	or Trapezoidal)	feet H:V Size Em	in bottom at Stage ergency Spillway to p d 100-yr Peak Runoff	e = 0 ft)	al Angle of Restric Spillway D Stage at T Basin Area at T	tor Plate on Pipe = esign Flow Depth= op of Freeboard = op of Freeboard =	· · · · · · · · · · · · · · · · · · ·	eters for Spilway feet feet acres	-
Spillway Invert Stage= Spillway Crest Length =	or Trapezoidal)	feet Size Em	ergency Spillway to p	e = 0 ft)	al Angle of Restric Spillway D Stage at T Basin Area at T	tor Plate on Pipe = esign Flow Depth= op of Freeboard =	· · · · · · · · · · · · · · · · · · ·	eters for Spillway feet feet	→
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Spilway Invert Stage= Spilway Crest Length = Spilway End Slopes = Freeboard above Max Water Surface = Duted Hydrograph Results Design Storm Return Period = One-Hour Rainfall Depth (in) = CUHP Runoff Volume (acre-ft) = CUHP Predevelopment Peak Q (cfs) = Predevelopment Peak Q (cfs) = Predevelopment Peak Q (cfs) = Predevelopment Peak Q (cfs) =	The user can ove WQCV N/A 3.226 N/A N/A N/A N/A N/A N/A N/A N/A	feet H:V feet Size Em Develope Finde the default C EURV N/A 9,432 N/A N/A N/A N/A N/A N/A N/A N/A N/A N/A	ergency Spillway to p d 100-yr Peak Runoff TUHP hydrographs 2 Year 0.85 6.396 6.396 1.6 0.01 126.7 25.5 N/A	and runoff volume 5 Year 1.12 9.013 9.013 16.9 0.13 175.8 41.5 2.5	Spilway D Stage at T Basin Area at T Basin Volume at T 10 Year 1.40 11.961 46.2 0.36 229.8 260.6 1.3	tor Plate on Pipe = esign Flow Depth= op of Freeboard = op of Freeboard = op of Freeboard = / values in the Inflo 25 Year 1.87 17.299 17.299 119.1 0.94 339.1 116.5 1.0	w Hydrographs ta 50 Year 2.30 22.084 22.084 172.4 1.36 430.4 161.5 0.9	teters for Spilway feet feet feet acres acre-ft 100 Year 2.79 27.727 49.811 241.0 1.90 511.0 293.9 1.2	radians arough AF 500 Ye 4.16 43.21 412. 3.26 840. 308. 0.7
Spilway Invert Stage= Spilway Crest Length = Spilway Crest Length = Spilway End Slopes = Freeboard above Max Water Surface = Duted Hydrograph Results Design Storm Return Period = One-Hour Rainfall Depth (in) = CUHP Runoff Volume (acre-ft) = er Override Inflow Hydrograph Volume (acre-ft) = OUHIP Predevelopment Peak Q (cfs) = Predevelopment Peak Q (cfs) = Predevelopment Unit Peak Flow, q (cfs)- Peak Inflow Q (cfs) = Ratio Peak Outflow to Predevelopment Q = Structure Controlling Flow =	The user can ove WOCV N/A 3.226 N/A N/A N/A N/A N/A N/A N/A Vertical Orifice 1	feet H:V feet Size Em Develope FURV N/A 9.432 N/A N/A N/A N/A N/A N/A N/A N/A N/A N/A	ergency Spillway to p d 100-yr Peak Runoff UHP hydrographs 2 Year 0.85 6.396 6.396 1.6 0.01 126.7 25.5 N/A Vertical Orifice 1	and runoff volume 5 Year 1.12 9.013 9.013 16.9 0.13 175.8 41.5 Vertical Orifice 1	Spilway D Stage at T: Basin Area at T: Sasin Volume at T: s by entering new 10 Year 1.40 11.961 46.2 0.36 229.8 60.6 1.3 Vertical Orfice 1	tor Plate on Pipe = esign Flow Depth= op of Freeboard = op of Freeboard = op of Freeboard = op of Freeboard = values in the Inflo 25 Year 1.87 17.299 119.1 0.94 339.1 116.5 1.0 Vertical Orifice 1	w Hydrographs ta 50 Year 2.30 22.084 172.4 1.36 430.4 161.5 0.9 Vertical Orifice 1	teters for Spilway feet feet feet acres acre-ft 100 Year 2.79 27.727 49.811 241.0 1.90 511.0 293.9 1.2 Vertical Orifice 1	radians arough AFF 500 Yr 4.16 43.22 43.22 412. 3.26 840. 3.08. 0.7 ertical O
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Spilway Crest Length = Spilway End Slopes = Freeboard above Max Water Surface = Outed Hydrograph Results Design Storm Return Period = One-Hour Rainfall Depth (in) = CUHP Runoff Volume (acre-ft) = Ser Override Inflow Hydrograph Volume (acre-ft) = Ser Override Inflow Hydrograph Volume (acre-ft) = Ser Override Inflow Hydrograph Volume (acre-ft) = Ser Override Inflow Hydrograph Volume (acre-ft) = Ser Override Predevelopment Peak Q (cfs) = Predevelopment Unit Peak Flow, q (cfs) = Peak Inflow Q (cfs) = Peak Outflow Q (cfs) = Structure Controlling Flow = Max Velocity through Grate 1 (fps) = Max Velocity through Grate 2 (fps) = Time to Drain 97% of Inflow Volume (hours) =	The user can ove WQCV N/A 3.226 N/A N/A N/A N/A N/A Vertical Orifice 1 N/A N/A 41	feet H:V feet Size Em Develope EURV N/A 9.432 N/A N/A N/A N/A N/A N/A N/A N/A N/A N/A	ergency Spillway to p d 100-yr Peak Runoff UHP hydrographs 2 Year 0.85 6.396 6.396 1.6 0.01 126.7 25.5 N/A Vertical Orifice 1 N/A N/A 24	and runoff volume 5 Year 1.12 9.013 9.013 16.9 0.13 175.8 41.5 2.5 Vertical Orifice 1 N/A N/A 19	Spilway D Stage at T: Basin Area at T: Basin Volume at T: Sis by entering new 10 Year 1.40 11.961 46.2 0.36 229.8 60.6 1.3 Vertical Orifice 1 N/A N/A 15	tor Plate on Pipe = esign Flow Depth= op of Freeboard = op of Freeboard = op of Freeboard = op of Freeboard = values in the Inflo 25 Year 1.87 17.299 17.299 119.1 0.94 339.1 116.5 1.0 Vertical Orifice 1 N/A N/A 12	Calculated Parame w Hydrographs ta 50 Year 2.30 22.084 172.4 1.36 430.4 161.5 0.9 Vertical Orifice 1 N/A N/A 10	ble (Columns W th 100 Year 2.79 27.727 49.811 241.0 1.90 511.0 293.9 1.2 Vertical Orifice 1 N/A N/A 8	7 arough AF 300 Y 41.16 43.21 43.21 41.2. 840. 308.3 0.7 ertical 01 N/A 7



Appendix F-3 Master Plan SWMM Input



[EVAPORATION]

```
[TITLE]
;;Project Title/Notes
City of Greeley
Storm Drainage Master Plan
Master Plan Öklahoma Concept Design
Oklahoma Basins 700-800
Matrix Design Group, Inc. 2024
Scenario ID = Fut_100yr_GO_Option_4_LID
[OPTIONS]
            Value
;;Option
FLOW UNITS
                CFS
INFILTRATION
                HORTON
FLOW ROUTING
                 KINWAVE
LINK_OFFSETS
                DEPTH
MIN SLOPE
               0
ALLOW_PONDING NO
SKIP_STEADY_STATE NO
START DATE
                01/01/2005
START_TIME
                00:00:00
REPORT START DATE 01/01/2005
REPORT_START_TIME 00:00:00
END DATE
               01/01/2005
END TIME
               12:00:00
SWEEP_START
                 01/01
SWEEP END
                12/31
DRY DAYS
               0
REPORT_STEP
                 00:05:00
WET_STEP
               00:05:00
DRY STEP
               01:00:00
ROUTING STEP
                 0:00:20
RULE_STEP
               00:00:00
INERTIAL_DAMPING PARTIAL
NORMAL FLOW LIMITED BOTH
FORCE MAIN EQUATION H-W
VARIABLE_STEP 0.75
LENGTHENING STEP 0
MIN_SURFAREA 12.566
MAX_TRIALS
              8
HEAD TOLERANCE 0.005
SYS FLOW TOL
                5
LAT FLOW TOL
                 5
MINĪMUM STEP
                 0.5
THREADS
[FILES]
;;Interfacing Files
USE INFLOWS "R:\23.1447.001 Greeley - Oklahoma Drainage MP\200 Design\220 Drainage-WR\221
Models\CUHP_SWMM\CUHP\Alternative Option
4\15 Fut 100yr 0mi^2 12 Fut 10yr 0mi^2 Greeley 7.8 DCIA1 Output.txt"
```

;;Data Sour	ce Para	ameter	s					
CONSTAN DRY_ONLY								
[JUNCTION ;;Name		ion Ma	axDepth	InitDe	epth S	urDepth	Aponde	d
620 712 714 803 804 809 810 819 820 824 829 830 839 840 841 842 843 844 850 711 710 709 708 713 811 822 823 834 838 831 808	4920 4915 4864 4866 4882 4890 4925 4901 4945 4961 4918 4972 4965 4990 4967 5000 4959 4995 4990 4889 4871 4866 4851 4898 4893 4932 4949 4928.5 4885	10 10 10 10 10 10 10 10 10 10 10 10 10 1	000000000000000000000000000000000000000					
[OUTFALLS ;;Name ;;		ion Ty	pe S	tage D)ata 	Gated	Route T	0
O_803 O_708 O_620	4865 4828 4817 4838	FRI FRI	EE EE		NO NO NO NO			
[DIVIDERS ;;Name] Elevat	ion Di	verted Li	nk T	ype	Parame	eters	
;; 836	4945	OV_8	336	OVE	RFLOV	V 15	0	0

0



[STORAGE] ;;Name E IMD	Elev. Max	:Depth InitD	epth Shape	e Curv	/e Type/Pa	rams	SurD	epth Feva	ap Psi	Ksat
D_EURV_842 D_FC842 D_EURV_840 D_EURV_711 D_EURV_830 D_EURV_844 D_EURV_820 D_FC_711 D_FC_823 D_FC_838	4965 4880 4935 4977 4931 4875 1 4905 1	10 0 10 0 10 0 10 0 10 0 10 0 10 0 0 0 0	TABULA TABULA TABULA TABULA TABULA TABULAF TABULAF TABULAF	R D_F(AR D_I AR D_I AR D_I AR D_I AR D_I AR D_F(AR	EURV_840 EURV_711 EURV_830 EURV_844 EURV_820 C_711 C_811	C	0 0 0 0 0 0	0 0 0 0 0		
[CONDUITS] ;;Name F	rom Node	To Nod	e Leng	th Ro	ughness In	Offset C	OutOffse	t InitFlow	MaxFlow	
DL_714 DL_803 DL_804 DL_810 DL_820 DL_830 DL_840 DL_842 DL_844 L_808 L_823 L_839 L_841 L_850 L_708 L_709 T_710 T_711 T_712 T_713 T_712 T_838 T_811 T_843 T_844 T_8	620 714 803 804 810 820 830 840 842 844 808 823 839 841 850 708 709 710 711 712 838 811 843 819 824 822 836 836 837 838 831 838 839 840 841 843 844 844 850 861 870 870 870 870 870 870 870 870	O_620 O_714 O_803 803 809 D_EURV_6 D_EURV_6 D_EURV_8 0_EURV_8 0_FC_823 843 839 D_EURV_8 0_708 709 D_EURV_7 711 713 D_FC_838 809 838 811 822 D_FC_823 823 834 834 829 831 808	400 400 400 0 400 0 820 400 840 840 400 842 400 844 400 1197 0.0 943 541 0.0 190 0.0 42 1740 202 0.154.3 0.1 11 615.3 338.1 0.485.4 0.338.1 0.485.4 0.6761 0.0671 290 0.0642 0.0671 290 0.0642 0.0671	0.04 0.035 03 0 04 0 03 0.04 07 0 4 0 0.048 045 0 035 0 0.04 035 0 013 0 035 0 04 0))))		

[OUTLETS] ;;Name	From Node	To Node	Offset	Тур	oe .	QTab	ole/Qcoe	ff Qexpon	Gated	
O_FC_842	42 D_EURV_ D_FC_842 40 D_EURV_ 11 D_EURV_ 44 D_EURV_ 30 D_EURV_ 20 D_EURV_ D_FC_711 D_FC_823 D_FC_838	841	0	TAE	BULAR/I TABULA TABULA TABULA TAE ULAR/I ULAR/I	DEPTH AR/DEF BULAR/ AR/DEF AR/DEF BULAR/ DEPTH DEPTH	I O_FC PTH O_ DEPTH PTH O_ PTH O_ DEPTH O_FC_ O FC	_842 EURV_840 O_EURV_ EURV_844 EURV_830 O_EURV_ 711	NO 711	NO NO NO NO NO
[XSECTION ;;Link	Shape Geor	m1 Geo	m2 G	eom3	Geo		Barrels	Culvert		
DL_620 DL_714 DL_803 DL_804 DL_810 DL_820 DL_830 DL_840 DL_842 DL_842 L_823 L_823 L_823 L_829 L_710 L_711 L_713 L_712 L_838 L_811 L_843 L_819 L_824 L_829 L_829 L_826 CV_836 L_831 L_834 L_809	TRAPEZOIDAL TRAPEZOIDAL TRIANGULAR TRAPEZOIDAL TRAPEZOIDAL TRAPEZOIDAL TRAPEZOIDAL TRAPEZOIDAL TRAPEZOIDAL TRAPEZOIDAL TRAPEZOIDAL TRAPEZOIDAL TRAPEZOIDAL	0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	1 1 1 1 1 1 1 1 3 5 10 0 12 2 4 15 16 1 3 3 5 6 6 6 6 0	1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1				
[CURVES] ;;Name	Type X-Va	lue Y-Value								



;;		
;60% WQCV, 100	0% EURV	
O_EURV_842	Rating 0	0.00
O_EURV_842	0.5	0.17
O_EURV_842	0.75	0.21
O EURV 842	1	0.24
O_EURV_842	1.25	0.35
O_EURV_842 O_EURV_842	1.5	0.43
O_EURV_842	1.75	0.50
O_EURV_842	2	0.56
O_EURV_842	2.25	0.61
O_EURV_842	2.5	0.77
O_EURV_842	2.75	0.86
O_EURV_842	3	0.94
O_EURV_842	3.25	1.01
O_EURV_842	3.38	1.04
O_EURV_842	3.5 3.75	2.14 6.75
O_EURV_842	3.75 4	6.89
O_EURV_842 O_EURV_842	4.25	7.02
O_EURV_842	4.23	7.02 7.16
O_EURV_842	4.75	7.10
O_EURV_842	5	7.42
O_EURV_842	5.25	7.55
O_EURV_842	5.31	7.58
O_EURV_842	5.37	7.61
O_EURV_842	5.5	7.68
O_EURV_842	5.75	7.80
O_EURV_842	6	7.92
O EURV 842	6.25	8.04
O EURV 842	6.5	8.16
O_EURV_842	6.75	361.27
O_EURV_842	7	1039.01
O_EURV_842	7.25	1922.74
O_EURV_842	7.5	2973.09
O_EURV_842	7.75	4167.58
O_EURV_842	8	5491.18
O_EURV_842	8.25	6932.94
O_EURV_842	8.5	8484.40
O_EURV_842	8.75	10138.82
O_EURV_842	9	11890.64
O_EURV_842	9.25	13735.19
O_EURV_842	9.5	15668.45
O_EURV_842	9.75	17686.96
O_EURV_842	10	19787.68
;	laad Cantral C) m.l
;72"x60" 100-yr F O FC 842		•
O_FC_842 O_FC_842	Rating 0 0.25	0.00 1.01
O_FC_842 O_FC_842	0.25	3.54
O_FC_842	0.75	7.37
O_FC_842		7.37 12.40
O_FC_842	1.25	18.58
	20	

O_FC_842 O_FC_842 O_FC_842 O_FC_842 O_FC_842 O_FC_842 O_FC_842 O_FC_842 O_FC_842 O_FC_842 O_FC_842 O_FC_842 O_FC_842 O_FC_842 O_FC_842 O_FC_842 O_FC_842 O_FC_842	1.5 1.75 2 2.25 2.5 2.75 3 3.25 3.5 3.75 4 4.25 4.5	25.84 34.15 43.49 53.83 65.14 77.40 90.60 104.73 119.76 135.69 152.50 170.19 188.74
O_FC_842 O_FC_842 O_FC_842 O_FC_842 O_FC_842 O_FC_842 O_FC_842 O_FC_842 O_FC_842 O_FC_842 O_FC_842 O_FC_842 O_FC_842	4.75 5 5.25 5.5 5.75 6 6.25 6.5 6.75	208.14 228.39 239.54 250.19 260.41 270.24 279.72 288.90 297.79 306.42
O_FC_842 O_FC_842 O_FC_842 O_FC_842 O_FC_842 O_FC_842 O_FC_842 O_FC_842 O_FC_842 O_FC_842 O_FC_842 O_FC_842 O_FC_842	7.25 7.5 7.75 8 8.25 8.5 8.75 9 9.25 9.5 9.75	314.82 323.00 330.97 338.76 346.38 353.83 361.12 368.27 375.29 382.18 388.94
O_FC_842 ;;60% WQCV, 100 O_EURV_840	10	0.00 0.06 0.08 0.09 0.13 0.16 0.19 0.21 0.24 0.29 0.32 0.35 0.38 0.39 2.21 2.41



O_EURV_840 O_EURV_840	4 4.25 4.5 4.75 4.83 5 5.25 5.28 5.5 5.75 6 6.25 6.5 6.75 7 7.25 7.5 7.75 8 8.25 8.75 9 9.25 9.5 9.75 10	2.46 2.51 2.56 2.60 2.62 2.65 2.69 2.70 291.63 940.12 1801.67 2833.35 4011.37 5320.05 6748.04 8286.66 9928.97 11669.30 13502.88 15425.62 17434.01 19524.95 21695.70 23943.81 26267.08 28663.52 31131.31
; O_EURV_711	Rating 0.00 0.50 1.00 1.50 2.00 2.50 3.00 3.50 3.57 4.00 4.50 4.90 5.00 5.50 5.61 6.00 6.50 7.00 7.50 8.00 8.50 9.00 9.50 10.00	0.00 0.10 0.15 0.26 0.34 0.44 0.57 0.65 0.73 6.43 6.67 6.89 7.11 7.33 7.53 7.74 7.93 8.12 8.31 72.77 195.27 368.27 382.18 395.59

O_EURV_823 O_EURV_823	Rating 0.00 0.50 1.00 1.50 2.00 2.50 3.00 3.57 4.00 4.50 4.90 5.00 5.50 5.61 6.00 6.50 7.00 7.50 8.00 8.50 9.00 9.50 10.00	0.00 3.44 12.06 25.12 42.28 63.33 88.09 116.43 120.68 148.27 183.50 214.08 222.05 243.24 247.66 262.73 280.87 297.91 314.03 329.35 344.00 358.05 371.56 384.60
O_EURV_844 O_EURV_844	Rating 0.00 0.50 1.00 1.50 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 6.00 6.50 7.00 7.50 8.00 8.50 9.00 9.50 10.00	0.0 0.3 0.4 0.7 0.9 1.2 1.5 6.2 6.4 6.7 6.9 7.1 7.3 147.4 483.9 939.6 1493.7 2135.2 2857.2 3655.1 4525.5
; O_EURV_830 O_EURV_830 O_EURV_830 O_EURV_830 O_EURV_830	Rating 0.00 0.50 1.00 1.50 2.00 2.50	0.0 0.2 0.2 0.4 0.6 0.8



O_EURV_830 O_EURV_830 O_EURV_830 O_EURV_830 O_EURV_830 O_EURV_830 O_EURV_830 O_EURV_830 O_EURV_830 O_EURV_830 O_EURV_830 O_EURV_830 O_EURV_830 O_EURV_830 O_EURV_830 O_EURV_830 O_EURV_830 O_EURV_830 O_EURV_830	3.00 3.50 4.00 4.50 5.00 5.50 6.00 6.50 7.00 7.50 8.00 8.50 9.00 9.50	1.0 5.5 5.7 6.0 6.2 6.4 6.6 96.6 314.1 610.9 974.4 1398.2 1878.6 2413.0 2999.8
O_EURV_810 O_EURV_810	Rating 0.00 0.50 1.00 1.50 2.00 2.50 3.00 3.50 4.00 4.50 5.00 6.50 7.00 7.50 8.00 8.50 9.00 9.50 10.00	0.0 0.1 0.2 0.3 0.4 0.5 0.6 6.2 6.4 6.7 6.9 7.1 7.3 77.1 209.3 387.1 605.5 862.1 1155.8 1485.9 1852.1
O_EURV_820 O_EURV_820	Rating 0.00 0.50 1.00 1.50 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 6.00 6.50 7.00	0.0 0.2 0.2 0.4 0.6 0.7 0.9 6.2 6.4 6.7 6.9 7.1 7.3 85.6 233.3

O_EURV_820 O_EURV_820 O_EURV_820 O_EURV_820 O_EURV_820 O_EURV_820 ;		7.50 8.00 8.50 9.00 9.50 10.00	431.2 673.4 957.0 1280.5 1643.0 2044.
O_FC_711 O_FC_711	1. 2. 2. 3. 3. 4. 4. 5. 5. 5. 6. 6. 7. 8. 8. 9.	0.00 .50 .00 .50 .00 .50 .50 .50 .50 .50	0.00 3.54 12.40 25.84 43.49 65.14 90.60 119.76 124.13 152.50 188.74 220.19 228.39 250.19 254.74 270.24 288.90 306.42 323.00 338.76 353.83 368.27 382.18 395.59
O_FC_823 O_FC_823	1. 2. 2. 3. 3. 3. 4. 4. 5. 5. 6. 7. 7. 8.	0.00 .50 .00 .50 .00 .50 .50 .50 .50 .90 .00 .50 .50 .50 .50 .50 .50 .50	0.00 3.44 12.06 25.12 42.28 63.33 88.09 116.43 120.68 148.27 183.50 214.08 222.05 243.24 247.66 262.73 280.87 297.91 314.03 329.35 344.00



O_FC_823 O_FC_823 O_FC_823	9.00 9.50 10.00	358.05 371.56 384.60
; O_FC_844	Rating 0.00 0.50 1.00 1.50 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 6.00 6.50 7.00 7.50 8.00 8.50 9.00 9.50 10.00	0.00 3.44 12.06 25.12 42.28 63.33 88.09 116.43 148.27 183.50 222.05 243.24 262.73 280.87 297.91 314.03 329.35 344.00 358.05 371.56 384.60
O_FC_838 O_FC_838	Rating 0.00 0.50 1.00 1.50 2.00 2.50 3.00 3.50 3.57 4.00 4.50 4.90 5.00 5.50 5.61 6.00 6.50 7.00 7.50 8.00 8.50 9.00 9.50 10.00	0.00 3.44 12.06 25.12 42.28 63.33 88.09 116.43 120.68 148.27 183.50 214.08 222.05 243.24 247.66 262.73 280.87 297.91 314.03 329.35 344.00 358.05 371.56 384.60
, 60% WQCV, 10 D_EURV_842	00% EURV Storage 0	694

D	EURV	842		0.5	6	94
D		842		0.7		694
D	EURV	842		1		94
D	EURV	842		1.2	5 3	3972
D	EURV	842		1.5	g	799
D_{-}	EURV	_842		1.7	5	18176
D_{-}^{-}	EURV	842		2	2	9104
D_{-}	EURV	842		2.2	5 4	42581
$D_{_}$	EURV	842		2.5	5	8098
$D_{}$	EURV	_842		2.7	5 .	77186
$D_{_}$	EURV	842		3		8313
D_{-}	_EURV_	_842		3.2	5	121991
D_{-}	_EURV_	_842		3.38		135311
D_{-}	_EURV_	_842		3.5	1	48218
D_{-}	_EURV_	_842		3.7	5	176995
D_{-}	_EURV_	_842		4		08323
D_{-}	_EURV_	_842		4.2		242200
D_{-}	_EURV_	_842		4.5	2	78628
D_{-}	_EURV_	_842		4.7		317605
D_{-}	_EURV_	_842		5	_	59132
D_{-}	_EURV_	_842		5.2		403210
D_{-}	_EURV_	_842		5.3		414168
D_{-}	_EURV_	_842		5.3		425273
$D_{_}$	_EURV_	_842		5.5		26710
D_	_EURV_	_842		5.7		429481
D_	_EURV_	_842		6		32259
D_	_EURV_	_842		6.2		435046
D_	_EURV_	_842		6.5		37840
D_	_EURV_	_842		6.7		440643
D_	_EURV_	_842		7		43453
D_	EURV	_842		7.2		446272
D_	EURV	_842		7.5		49098
D_	_EURV_	_842		7.7		451933
D_	_EURV_	_842		8		54775
D_	EURV	_842		8.2		457626
D_	EURV	_842		8.5		60484 463351
D_	_EURV_ EURV	_842 842		8.75 9		463331 66225
	EURV EURV			9.2		469108
_	_EURV	_		9.5		71998
_	_EURV	_		9.7		474897
_	EURV	_		10		77803
	LOIV	_042		10	7	11005
·10	00-yr Fl	ood C	ontrol			
	FC_81		Storag	ae 0		10528
D	FC_81	4	- 10.0.5	0.25		967
D	FC 81			0.5		415
	FC_81			0.75		870
D	FC_81			1	123	
D^{-}	FC_81			1.25		805
	FC_81			1.5		284
_	FC_81			1.75		771
_	FC_81			2	142	
_	_					



D_FC_814 D_FC_814	2.25 2.5 2.75 3 3.25 3.5 3.75 4 4.25 4.5 4.75 5 5.25 5.75 6 6.25 6.5 6.75 7 7.25 7.75 8 8.25 8.5 8.75 9 9.25 9.5 9.75 10	14770 15281 15801 16328 16863 17407 17958 18517 19085 19660 20243 20835 21434 22041 22657 23280 23911 24551 25198 25853 26517 27188 27867 28554 29250 29953 30664 31384 32111 32846 33590 34341
;255'x510' D_EURV_840	Storage 0 0.5 0.75 1 1.25 1.5 1.75 2 2.25 2.75 3 3.25 3.33 3.5 3.75 4 4.25 4.5	258 258 258 1530 3810

D_EURV_840 D_EURV_840	4.75 4.83 5 5.25 5.28 5.5 5.75 6 6.25 6.5 6.75 7 7.25 7.5 7.75 8 8.25 8.75 9 9.25 9.5 9.75	125165 130300 131343 132883 133069 134432 135988 137553 139125 140706 142295 143891 145496 147108 148729 150357 151994 153638 155291 156951 158620 160297 161981 163674
D_EURV_711 D_EURV_711	Storage 0.0 0.33 0.50 1.00 1.18 1.50 2.00 2.50 3.00 3.50 3.62 4.00 4.50 5.00 5.50 5.99 6.00 6.50 7.00 7.50 8.00 8.50 9.00 9.50 10.00	0 1752 1752 1752 6962 16021 16694 17771 18879 20020 21193 21479 22398 23635 24904 26205 27511 27538 28903 30299 31728 33189 34682 36207 37764 39353
D_EURV_823 D_EURV_823	Storage 0.0 0.33	0 1752 1752



D_EURV_823 D_EURV_823	0.50 1.00 1.50 2.00 2.50 2.73 3.00 3.43 3.50 4.00 4.50 5.00 5.50 5.99 6.00 6.50 7.00 7.50 8.00 8.50 9.00 9.50 10.00	1752 6962 41122 103393 193775 244790 247044 250653 251243 255473 259736 264030 268357 272628 272715 277106 281528 285983 290469 294988 299538 304121 308735
; D_EURV_844	Storage 0.00 0.33 0.50 1.00 1.30 1.50 2.00 2.50 3.00 3.50 3.63 4.00 4.50 5.00 5.50 6.00 6.03 6.50 7.00 7.50 8.00 8.50 9.00 9.50 10.00	1752 1752 6962 41122 80408 81168 83565 85994 86631 88456 90949 93474 96031 98621 101242 101294 103895 106580 109297 112047 114828 117641 120486 123363
D_EURV_830 D_EURV_830 D_EURV_830	Storage 0.00 0.33 0.50	1752 1752 1752

D_EURV_830 D_EURV_830	1.00 1.18 1.50 2.00 2.50 3.00 3.50 3.62 4.00 4.50 5.00 5.50 5.99 6.00 6.50 7.00 7.50 8.00 8.50 9.00 9.50 10.00	6962 41122 46084 47705 49536 51399 51474 53294 55221 57180 59171 61195 63250 63291 65337 67456 69607 71790 74005 76253 78532 80843
D_EURV_810 D_EURV_810	Storage 0.00 0.33 0.50 1.00 1.50 2.00 2.06 2.50 2.63 3.00 3.50 4.00 4.50 5.00 5.50 6.00 6.50 7.00 7.50 8.00 8.50 9.00 9.50 10.00	1752 1752 1752 1752 6962 23884 25175 25333 26499 26848 27855 29242 30662 32113 33597 35113 36660 38240 39852 41495 43171 44878 46618 48390 50193
; D_EURV_820 D_EURV_820 D_EURV_820 D_EURV_820 D_EURV_820	Storage 0.00 0.33 0.50 1.00 1.15	1752 1752 1752 1752 6962 41122



D_EURV_820 D_EURV_820	1.50 2.00 2.50 3.00 3.50 3.60 4.00 4.50 5.00 5.50 5.94 6.00 6.50 7.00 7.50 8.00 8.50 9.00 9.50 10.00	42092 43779 45532 47317 47389 49134 50983 52864 54777 56722 58699 58739 60708 62749 64822 66927 69064 71234 73435 75668
; D_FC_823	Storage 1	1
D_FC_83 D_FC_83 D_FC_83 D_FC_83 D_FC_83 D_FC_83 D_FC_83 D_FC_83 D_FC_83 D_FC_83	2.00 3.00 4.00 5.00 6.00 7.00 8.00	37664 77436 133078 163864 190605 204897 215528 226286 237198 273603
; D_FC_711 D_FC_711 D_FC_711 D_FC_711 D_FC_711 D_FC_711 D_FC_711 D_FC_711 D_FC_711 D_FC_711 D_FC_711 D_FC_711 D_FC_711 D_FC_711 D_FC_711 D_FC_711 D_FC_711 D_FC_711 D_FC_711	Storage 0.00 0.50 1.00 1.50 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 6.00 6.50 7.00 7.50 8.00 8.50 9.00	36922 38568 40247 41957 43700 45474 47280 49119 50989 52892 54826 56793 58791 60822 62884 64978 67105 69263 71454

D_FC_711 D_FC_711	9.50 10.00	73676 75931
; D_FC_811 D_FC_811 D_FC_811 D_FC_811 D_FC_811 D_FC_811 D_FC_811 D_FC_811 D_FC_811 D_FC_811	Storage 0.00 1.00 2.00 3.00 4.00 5.00 6.00 7.00 8.00 8.49 9.00 10.00	37664 77436 133078 163864 190605 204897 215528 226286 237198 273603 273603
D_FC_844 D_FC_844	Storage 0.00 0.50 1.00 1.50 2.00 2.50 3.00 3.50 4.00 4.50 5.00 6.50 7.00 7.50 8.00 8.50 9.00 9.50 10.00	107813 110615 113449 116315 119214 122144 125106 128100 131126 134184 137274 140397 143551 146737 149955 153205 156487 159801 163147 166526 169936
D_FC_838 D_FC_838 D_FC_838 D_FC_838 D_FC_838 D_FC_838 D_FC_838 D_FC_838 D_FC_838 D_FC_838 D_FC_838 D_FC_838 D_FC_838 D_FC_838	Storage 0.00 0.50 1.00 1.50 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 6.00 6.50 7.00	107813 110615 113449 116315 119214 122144 125106 128100 131126 134184 137274 140397 143551 146737 149955



D_FC_838	7.50	153205
D_FC_838	8.00	156487
D_FC_838	8.50	159801
D_FC_838	9.00	163147
D_FC_838	9.50	166526
D_FC_838	10.00	169936

[REPORT] ;;Reporting Options INPUT YES CONTROLS YES SUBCATCHMENTS ALL NODES ALL LINKS ALL

[TAGS]

[MAP] DIMENSIONS 0.000 0.000 8882.267 8132.154

Units None

[COORDINATES] ;;Node X-Coord

**	X-Coord	Y-Coord
;; 620	3176.446	5603.079
712	2895.562	4845.602
714	2396.597	5524.935
803	2046.787	5306.170
804	2224.496	5288.834
809	2304.222	4931.686
810	2221.307	4534.501
819	2458.581	4607.362
820	2858.872	4455.858
824	3212.781	4053.026
829	2531.995	4090.155
830	2310.615	3639.827
839	3222.537	3474.569
840	4296.625	2946.685
841	3232.367	3448.535
842	4116.415	2195.542
843	3098.576	3589.753
844	3175.492	2589.454
850	3628.528	2902.994
711	2728.325	5128.419
710	2635.627	5340.281
709	2645.107	5386.630
708	2650.374	5598.361
713	2796.803	5016.287
811	2326.424	4882.578
822	2779.481	4253.460
823	2482.561	4170.492
834	2793.200	3771.985
838	3041.708	3648.672

831 25	39.570	4080.449
808 22	290.503	4963.697
O_803	2037.522	5457.441
O_708	2644.492	5672.936
O_620	3155.399	5761.408
O_714	2402.976	5620.622
836 29	952.697	3687.647
D_EURV_842	3387.469	3130.936
D_FC842	3310.327	3270.126
D_EURV_840	3399.324	3473.799
D_EURV_711	2689.247	5218.198
D_EURV_830	2509.561	4014.873
D_EURV_844	3104.348	3288.010
D_EURV_820	2613.011	4521.636
D_FC_711	2670.611	5308.833
D_FC_823	2475.252	4529.969
D_FC_838	3027.364	3680.041

[VERTICES]

;;Link	X-Coord	Y-Coord
;; DL 803	2026.861	5357.978
DL_803	2038.817	5412.975
DL_810	2232.974	4619.614
DL_810	2237.218	4666.792
DL_830	2423.812	3865.099
DL_840	4169.043	3071.079
DL_840	4092.493	3157.197
DL_840	3953.747	3410.768
DL_840	3583.757	3433.095
DL_840	3441.035	3473.264
DL_842	3580.567	2554.368
DL_842	3454.075	2733.989
DL_842	3356.793	2914.200
DL_842	3340.070	3019.591
DL_844	3186.655	2742.553
DL_844	3202.603	2914.790
DL_844	3193.034	3211.420
DL_844	3182.258	3223.040
DL_844	3175.394	3235.624
L_808	2265.576	5028.444
L_808	2246.438	5036.418
L_808	2206.569	5066.719
L_808	2203.379	5100.210
L_808	2190.621	5159.217
L_808	2137.993	5194.302
L_808	2080.325	5208.102
L_808	2060.399	5283.821
L_823	2485.244	4167.900
L_823	2482.053	4247.674
L_823	2482.053	4378.503
L_850	3608.479	2914.796
L_850	3593.723	2919.982



L_850	3576.180	2921.577
L_850	3539.500	2931.146
L_850	3506.010	2942.309
L_850	3486.872	2971.016
L_850	3467.735	2998.127
L_850	3448.750	3035.607
L_850	3451.038	3018.447
L_850	3437.310	3036.751
L_850	3429.302	3047.047
L_850	3420.150	3066.495
L_850	3414.430	3080.223
L_850	3405.278	3098.526
OV_836	2870.006	3747.691

[Polygons]

;;Storage Node	X-Coord	Y-Coord
;; D_EURV_842	3382.130	3133.605
D EURV 842	3391.282	3125.597
D EURV 842	3388.994	3133.605
D_FC842	3306.134	3266.314
D_FC842	3311.851	3269.744
D_FC842	3307.849	3269.172
D_FC842	3307.849	3265.742
D_EURV_840	3401.419	3474.656
D_EURV_840	3398.277	3474.370
D_EURV_840	3398.277	3472.371
D_EURV_711	2686.959	5219.914
D_EURV_711	2691.535	5216.482
D_EURV_830	2512.421	4009.725
D_EURV_830	2506.701	4020.021
D_EURV_844	3106.064	3284.006
D_EURV_844	3102.632	3292.014
D_EURV_820	2617.587	4525.640
D_EURV_820	2608.435	4517.632
D_FC_711	2680.526	5305.401
D_FC_711	2665.654	5305.401
D_FC_711	2665.654	5315.697
D_FC_823	2477.541	4517.378
D_FC_823	2472.963	4542.561
D_FC_838	3029.651	3677.468
D_FC_838	3025.078	3682.613

[BACKDROP]
FILE "R:\23.1447.001 Greeley - Oklahoma Drainage MP\200 Design\220 Drainage-WR\221 Models\CUHP_SWMM\SWMM\Backgrounds\Final Map.jpg"
DIMENSIONS 735.737 1837.108 8882.267 8132.154



Appendix F-4 Master Plan SWMM Output



EPA STORM WATER MANAGEMENT MODEL - VERSION 5.2 (Build 5.2.4)

City of Greeley Storm Drainage Master Plan Master Plan Oklahoma Concept Design

Element Count

Number of rain gages 0 Number of subcatchments ... 0 Number of nodes 46 Number of links 43 Number of pollutants 0 Number of land uses 0

Node Summary

Invert Max. Ponded External Elev. Depth Area Inflow Name Type 0.0 620 JUNCTION 4920.00 10.00 712 JUNCTION 4915.00 10.00 0.0 714 JUNCTION 4864.00 10.00 0.0 803 JUNCTION 4866.00 10.00 0.0 804 JUNCTION 4882.00 10.00 0.0 809 JUNCTION 4890.00 25.00 0.0 810 4925.00 10.00 0.0 JUNCTION 819 JUNCTION 4901.00 10.00 0.0 JUNCTION 10.00 0.0 820 4945.00 JUNCTION 4961.00 10.00 0.0 824 829 JUNCTION 4918.00 15.00 0.0 10.00 830 JUNCTION 4972.00 0.0 839 JUNCTION 4965.00 15.00 0.0 840 JUNCTION 4990.00 10.00 0.0 841 JUNCTION 4967.00 10.00 0.0 842 JUNCTION 5000.00 10.00 0.0 843 JUNCTION 4959.00 15.00 0.0 844 JUNCTION 4995.00 10.00 0.0 850 JUNCTION 4990.00 10.00 0.0 711 JUNCTION 4889.00 10.00 0.0 710 JUNCTION 4871.00 10.00 0.0 709 JUNCTION 4866.00 10.00 0.0 708 10.00 JUNCTION 4851.00 0.0 4898.00 10.00 0.0 713 JUNCTION JUNCTION 10.00 811 4893.00 0.0 822 JUNCTION 4932.00 10.00 0.0 823 10.00 0.0 JUNCTION 4908.00 834 JUNCTION 4932.00 15.00 0.0 838 JUNCTION 4949.00 15.00 0.0

831	JUNCTION	4928.50	15.00	0.0	
808	JUNCTION	4885.00	15.00	0.0	
O_803	OUTFALL	4865.00	0.00	0.0	
O_708	OUTFALL	4828.00	10.00	0.0	
O_620	OUTFALL	4817.00	0.00	0.0	
O_714	OUTFALL	4838.00	0.00	0.0	
836	DIVIDER 4	4945.00 <i>1</i>	15.00	0.0	
D_EURV_842	STORAGE	496	7.00 1	0.00	0.0
D_FC842	STORAGE	4967.	00 10	.00	0.0
D_EURV_840	STORAGE	496	5.00 1	0.00	0.0
D_EURV_711	STORAGE	488	0.00 1	0.00	0.0
D_EURV_830	STORAGE	493	5.00 1	0.00	0.0
D_EURV_844	STORAGE	497	7.00 1	0.00	0.0
D_EURV_820	STORAGE	493	1.00 1	0.00	0.0
D_FC_711	STORAGE	4875.0	00 10.	00	0.0
D_FC_823	STORAGE	4905.0	00 10.	00	0.0
D FC 838	STORAGE	4948.0	00 10.	00 (0.0

Link Summary

Name	From Node	To Nod	е Туре	Length	%Slope Roughness
DL_620	620	O_620	CONDUIT	400.0 2	26.6486 0.0100
DL_714	714	O_714	CONDUIT	400.0	6.5138 0.0100
DL_803	803	O_803	CONDUIT	400.0	0.2500 0.0100
DL_804	804	803	CONDUIT	400.0 4.	0032 0.0100
DL_810	810	809	CONDUIT	400.0 8.	7837 0.0100
DL_820	820	D_EURV_	820 CONDU	IT 400	.0 3.5021 0.0100
DL_830	830	D_EURV_	830 CONDU	IT 400	.0 9.2898 0.0100
DL_840	840	D_EURV_	840 CONDU	IT 400	.0 6.2622 0.0100
DL_842	842	D_EURV_	840 CONDU 842 CONDU	IT 400	.0 8.2782 0.0100
DL_844	844	D_EURV_	844 CONDU	IT 400	.0 4.5046 0.0100
L_808	808	803		1197.0 1.	5875 0.0700
L_823	823	D_FC_823			0.3181 0.0400
L_839	839		CONDUIT	541.0 1.1	091 0.0480
L_841	841	839	CONDUIT	190.0 1.0	
L_850	850	D_EURV_8			
L_708	708		CONDUIT		
L_709	709	708			786 0.0300
L_710	710	709	CONDUIT		
L_711	711	D_EURV_7			3 1.4629 0.0400
L_713	713	711	CONDUIT		
L_712	712	713	CONDUIT		
L_838	838	D_FC_838			
L_811	811	809	CONDUIT		
L_843	843	838			913 0.0350
L_819	819	811			
L_824	824	822	CONDUIT	1270.0 2.3	
	822	D_FC_823			4.0271 0.0400
_	829	823	CONDUIT		
L_836	836	834	CONDUIT	442.0 2.9	0.0130



OV 836	836 834	CONE	OUIT 4	442.0 2.9424	0.0350
L_831 8	31 829	CONDU	JIT 10	05.0 10.0504	0.0400
L_834 8	34 831	COND	JIT 10	40.0 0.3365	0.0400
L_809 8	09 808	COND	JIT 9	0.0 5.5641	0.0130
O_EURV_842	D_EURV_84	2 D_FC8	342 OL	JTLET	
O_FC_842	D_FC842		OUTLET		
O_EURV_840	D_EURV_84	0 839	OUTLE	T	
O_EURV_711	D_EURV_71	1 D_FC_7	11 OU	TLET	
	D_EURV_84		OUTLE	T	
	D_EURV_83	0 831	OUTLE	T	
O_EURV_820	D_EURV_82	0 D_FC_82	23 OU	TLET	
	D_FC_711		OUTLET		
O_FC_823	D_FC_823	819	OUTLET		
O_FC_838	D_FC_838	836	OUTLET		

Cross Section Summary

Conduit	Full Shape 	Full Hyd. Max. No. of Full Depth Area Rad. Width Barrels Flow
DL_620	DUMMY	0.00 0.00 0.00 0.00 1 0.00
DL_714	DUMMY	0.00 0.00 0.00 0.00 1 0.00
DL_803	DUMMY	0.00 0.00 0.00 0.00 1 0.00
DL_804	DUMMY	0.00 0.00 0.00 0.00 1 0.00
DL_810	DUMMY	0.00 0.00 0.00 0.00 1 0.00
DL_820	DUMMY	0.00 0.00 0.00 0.00 1 0.00
DL_830	DUMMY	0.00 0.00 0.00 0.00 1 0.00
DL_840	DUMMY	0.00 0.00 0.00 0.00 1 0.00
DL_842	DUMMY	0.00 0.00 0.00 0.00 1 0.00
DL_844		0.00 0.00 0.00 0.00 1 0.00
L_808	TRAPEZOIDAL	
L_823	TRAPEZOIDAL	
L_839	TRAPEZOIDAL	
L_841	TRIANGULAR	
L_850	TRAPEZOIDAL	
L_708	TRAPEZOIDAL	
L_709	TRAPEZOIDAL	
L_710	TRAPEZOIDAL	
L_711	TRAPEZOIDAL	
L_713	TRAPEZOIDAL	
L_712	TRAPEZOIDAL	
L_838	TRAPEZOIDAL	
L_811	TRAPEZOIDAL	
L_843	CIRCULAR	15.00 176.71 3.75 15.00 1 3285.42
L_819	TRAPEZOIDAL	
L_824	TRAPEZOIDAL	
L_822	TRAPEZOIDAL	
L_829	TRAPEZOIDAL	
L_836	CIRCULAR	4.00 12.57 1.00 4.00 1 246.40
OV_836	TRAPEZOIDA	
L_831	TRAPEZOIDAL	15.00 2325.00 9.39 245.00 1 121915.29

```
L_834 TRAPEZOIDAL 15.00 2310.00 9.37 244.00 1 22129.56
L_809 RECT_CLOSED 15.00 75.00 1.88 5.00 1 3074.94
```

*******	Volume	Volume
Flow Routing Continuity	acre-fee	t 10^6 ga

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	169.814	55.336
External Outflow	130.054	42.380
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	40.905	13.330
Continuity Error (%)	-0.674	

Highest Flow Instability Indexes

Link L_829 (1)



Routing Time Step Summary

: 20.00 sec Minimum Time Step : 20.00 sec Average Time Step Maximum Time Step : 20.00 sec
% of Time in Steady State : 0.00 Average Iterations per Step: 1.00 % of Steps Not Converging : 0.00

Analysis begun on: Fri Jul 12 14:18:31 2024 Analysis ended on: Fri Jul 12 14:18:31 2024 Total elapsed time: < 1 sec



Appendix F-5 Master Plan Hydrology Summary



Design Point Dr		Design Point Drainage Area Existing Co		Future Conditions Do Nothing (cfs)	Future Conditions Concept Design (cfs)
Number Type (Acres)		Q ₁₀₀	Q ₁₀₀	Q ₁₀₀	
620	Basin	34	37	37	37
712	Basin	90	161	173	171
714	Basin	23	50	52	52
803	Junction	670	1,039	2,072	306
804	Basin	26	25	25	25
809	Junction	596	1,024	2,058	299
810	Basin	74	101	190	188
819	Junction	515	929	1,887	283
820	Basin	81	292	331	332
824	Basin	43	70	165	165
829	Junction	444	711	1,511	311
830	Basin	71	259	294	293
839	Junction	253	372	846	535
840	Basin	64	82	200	200
841	Junction	142	290	649	284
842	Basin	111	152	353	353
843	Junction	317	578	1,300	528
844	Basin	127	221	523	523
850	Basin	100	142	316	313
O_620	Outfall	34	37	37	37
0_708	Outfall	90	160	172	111
0_714	Outfall	23	50	52	52
0_803	Outfall	696	1,039	2,072	306



Desig	n Point	Drainage Area		Future Conditions Concept Desig			esign Peak Flo	ws (cfs)	
Number	Туре	(Acres)	Q ₂	Q ₅	Q ₁₀	Q ₂₅	Q 50	Q ₁₀₀	Q ₅₀₀
620	Basin	34	2	5	9	19	27	37	62
712	Basin	90	14	28	46	91	127	171	284
714	Basin	23	2	6	12	27	38	52	87
803	Junction	670	23	38	57	111	191	306	534
804	Basin	26	0	0	1	5	14	25	56
809	Junction	596	26	43	62	110	190	299	497
810	Basin	74	26	43	62	108	145	188	303
819	Junction	515	15	24	32	92	184	283	385
820	Basin	81	70	102	134	202	259	332	513
824	Basin	43	37	53	69	102	130	165	254
829	Junction	444	15	18	23	77	179	311	479
830	Basin	71	60	88	117	177	228	293	456
839	Junction	253	16	17	46	201	347	535	1,065
840	Basin	64	44	63	82	124	159	200	309
841	Junction	142	7	7	8	8	128	284	396
842	Basin	111	70	103	136	215	277	353	549
843	Junction	317	16	17	45	198	341	528	1,064
844	Basin	127	117	168	219	325	415	523	806
850	Basin	100	53	79	111	184	245	313	500
O_620	Outfall	34	2	5	9	19	27	37	62
0_708	Outfall	90	1	6	8	37	68	111	215
0_714	Outfall	23	2	6	12	27	38	52	87
0_803	Outfall	696	23	38	57	111	191	306	534



Design	n Point	Drainage Area			Future (Conditions Conce	pt Peak Volume (Arce-ft)	
Number	Туре	(Acres)	V ₂	V ₅	V ₁₀	V ₂₅	V ₅₀	V ₁₀₀	V ₅₀₀
620	Basin	34	0	0	0	1	1	2	3
712	Basin	90	0	1	1	3	4	5	9
714	Basin	23	0	0	0	1	1	1	2
803	Junction	670	5	7	9	16	24	35	55
804	Basin	26	0	0	0	0	0	1	1
809	Junction	596	5	7	10	16	24	34	54
810	Basin	74	1	1	2	3	4	5	8
819	Junction	515	4	6	8	14	21	30	46
820	Basin	81	1	2	2	3	4	6	9
824	Basin	43	1	1	1	2	3	3	5
829	Junction	444	3	5	6	9	15	22	35
830	Basin	71	1	1	2	3	4	5	8
839	Junction	253	4	5	6	8	13	19	33
840	Basin	64	1	1	2	3	4	5	7
841	Junction	142	2	2	2	2	5	8	14
842	Basin	111	2	2	3	5	6	8	12
843	Junction	317	3	5	6	8	13	19	33
844	Basin	127	2	3	4	6	7	9	14
850	Basin	100	1	2	2	4	5	7	11
O_620	Outfall	34	0	0	0	1	1	2	3
0_708	Outfall	90	0	1	1	2	4	5	8
O_714	Outfall	23	0	0	0	1	1	1	2
0_803	Outfall	696	5	7	9	16	24	35	55



Appendix F-6 Master Plan HY-8 Culverts



Site Data - Structure#702

Site Data Option: Culvert Invert Data Inlet Station: 0.00 ft

Inlet Elevation: 4867.00 ft
Outlet Station: 97.00 ft
Outlet Elevation: 4862.00 ft
Number of Barrels: 1

Culvert Data Summary - Structure#702

Barrel Shape: Circular Barrel Diameter: 4.00 ft Barrel Material: Concrete Embedment: 0.00 in Barrel Manning's n: 0.0120 Culvert Type: Straight

Inlet Configuration: Square Edge with Headwall

Inlet Depression: None

Table 1 - Culvert Summary Table: Structure#702

Discharge Names	Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth (ft)	Outlet Control Depth (ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)
5 Year	24.91 cfs	24.91 cfs	4868.96	1.96	0.0*	1-S2n	0.72	1.47	0.76	0.23	14.91	2.12
100 Year	111.00 cfs	111.00 cfs	4872.67	5.67	0.901	5-S2n	1.54	3.18	1.82	0.56	19.98	3.78

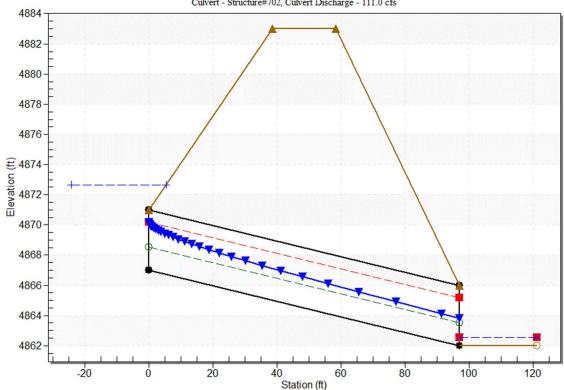
Culvert Barrel Data

Culvert Barrel Type Straight Culvert Inlet Elevation (invert): 4867.00 ft, Outlet Elevation (invert): 4862.00 ft

Culvert Length: 97.13 ft, Culvert Slope: 0.0515

Water Surface Profile Plot for Culvert: Structure#702

Crossing - Structure#702, Reach 700, Great Western Railway, Design Discharge - 111.0 cfs



Tailwater Data for Crossing: Structure#702, Reach 700

Table 2 - Downstream Channel Rating Curve (Crossing: Structure#702, Reach 700)

Flow (cfs)	Water Surface Elev (ft)	Velocity (ft/s)	Depth (ft)	Shear (psf)	Froude Number	
24.91	4862.23	0.23	2.12	0.43	0.79	
111.00	4862.56	0.56	3.78	1.05	0.91	

Tailwater Channel Data - Structure#702, Reach 700

Tailwater Channel Option: Trapezoidal Channel

Bottom Width: 50.00 ft Side Slope (H:V): 4.00 (_:1) Channel Slope: 0.0300 Channel Manning's n: 0.0450 Channel Invert Elevation: 4862.00 ft

Roadway Data for Crossing: Structure#702, Reach 700

Roadway Profile Shape: Constant Roadway Elevation

Crest Length: 100.00 ft Crest Elevation: 4883.00 ft Roadway Surface: Gravel Roadway Top Width: 20.00 ft



Site Data - Structure#704

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 ft Inlet Elevation: 4890.00 ft Outlet Station: 89.00 ft Outlet Elevation: 4888.00 ft Number of Barrels: 2

Culvert Data Summary - Structure#704

Barrel Shape: Circular Barrel Diameter: 4.00 ft Barrel Material: Concrete Embedment: 0.00 in Barrel Manning's n: 0.0120 Culvert Type: Straight

Inlet Configuration: Square Edge with Headwall

Inlet Depression: None

Table 3 - Culvert Summary Table: Structure#704

Discharge Names	Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth (ft)	Outlet Control Depth (ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)
5 Year	24.91 cfs	24.91 cfs	4891.39	1.39	0.0*	1-S2n	0.63	1.03	0.64	0.16	9.50	2.09
100 Year	170.00 cfs	170.00 cfs	4894.48	4.48	2.124	5-S2n	1.67	2.79	1.90	0.51	14.43	4.45

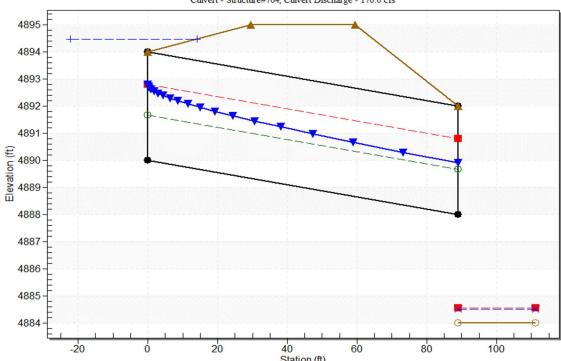
Culvert Barrel Data

Culvert Barrel Type Straight Culvert Inlet Elevation (invert): 4890.00 ft, Outlet Elevation (invert): 4888.00 ft

Culvert Length: 89.02 ft, Culvert Slope: 0.0225

Water Surface Profile Plot for Culvert: Structure#704

Crossing - Structure#704, Reach 700, 7700 Windsong Rd, Design Discharge - 170.0 cfs
Culvert - Structure#704, Culvert Discharge - 170.0 cfs



Tailwater Data for Crossing: Structure#704, Reach 700

 Table 4 - Downstream Channel Rating Curve (Crossing: Structure#704, Reach 700)

Flow (cfs)	Water Surface Elev (ft)	Velocity (ft/s)	Depth (ft)	Shear (psf)	Froude Number
24.91	4884.16	0.16	2.09	0.28	0.92
170.00	4884.51	0.51	4.45	0.89	1.11

Tailwater Channel Data - Structure#704, Reach 700

Tailwater Channel Option: Trapezoidal Channel

Bottom Width: 73.00 ft Side Slope (H:V): 4.00 (_:1) Channel Slope: 0.0280 Channel Manning's n: 0.0350 Channel Invert Elevation: 4884.00 ft

Roadway Data for Crossing: Structure#704, Reach 700

Roadway Profile Shape: Constant Roadway Elevation

Crest Length: 100.00 ft Crest Elevation: 4897.00 ft Roadway Surface: Paved Roadway Top Width: 25.30 ft



Site Data - Structure#801

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 ft Inlet Elevation: 4960.15 ft Outlet Station: 74.00 ft Outlet Elevation: 4960.01 ft Number of Barrels: 2

Culvert Data Summary - Structure#801

Barrel Shape: Concrete Box

Barrel Span: 9.00 ft
Barrel Rise: 4.00 ft
Barrel Material: Concrete
Embedment: 0.00 in
Barrel Manning's n: 0.0120
Culvert Type: Straight

Inlet Configuration: Square Edge (90°) Headwall

Inlet Depression: None

Table 5 - Culvert Summary Table: Structure#801

Discharge Names	Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth (ft)	Outlet Control Depth (ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)
5 Year	18.94 cfs	18.94 cfs	4960.71	0.56	0.560	2-M2c	0.39	0.33	0.33	0.15	3.24	1.25
100 Year	535.00 cfs	535.00 cfs	4965.47	5.32	5.188	7-M2c	3.54	3.02	3.02	1.08	9.85	4.45

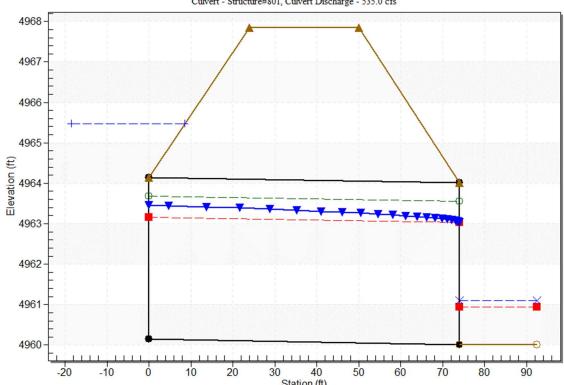
Culvert Barrel Data

Culvert Barrel Type Straight Culvert Inlet Elevation (invert): 4960.15 ft, Outlet Elevation (invert): 4960.01 ft

Culvert Length: 74.00 ft, Culvert Slope: 0.0018

Water Surface Profile Plot for Culvert: Structure#801

Crossing - Structure#801, Reach 800, CR-17, Design Discharge - 535.0 cfs
Culvert - Structure#801, Culvert Discharge - 535.0 cfs



Tailwater Data for Crossing: Structure#802, Reach 800

Table 6 - Downstream Channel Rating Curve (Crossing: Structure#802, Reach 800)

Flow (cfs)	Water Surface Elev (ft)	Velocity (ft/s)	Depth (ft)	Shear (psf)	Froude Number	
18.94	4960.16	0.15	1.25	0.17	0.58	
535.00	4961.09	1.08	4.45	1.25	0.79	

Tailwater Channel Data - Structure#801, Reach 800

Tailwater Channel Option: Trapezoidal Channel

Bottom Width: 100.00 ft Side Slope (H:V): 10.00 (_:1) Channel Slope: 0.0185 Channel Manning's n: 0.0450 Channel Invert Elevation: 4960.01 ft

Roadway Data for Crossing: Structure#801, Reach 800

Roadway Profile Shape: Constant Roadway Elevation

Crest Length: 100.00 ft Crest Elevation: 4967.84 ft Roadway Surface: Paved Roadway Top Width: 26.00 ft



Site Data - Structure#804

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 ft Inlet Elevation: 4889.00 ft Outlet Station: 90.00 ft Outlet Elevation: 4881.00 ft

Number of Barrels: 1

Culvert Data Summary - Structure#804

Barrel Shape: Concrete Box

Barrel Span: 6.00 ft
Barrel Rise: 5.00 ft
Barrel Material: Concrete
Embedment: 0.00 in
Barrel Manning's n: 0.0130
Culvert Type: Straight

Inlet Configuration: Square Edge (30-75° flare) Wingwall

Inlet Depression: None

Table 7 - Culvert Summary Table: Structure#804

1 0.1010			<i>y</i>									
Dischar Names	ge Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth (ft)	Outlet Control Depth (ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)
5-Yr	126.99 cfs	126.99 cfs	4892.50	3.50	0.0*	1-S2n	0.83	2.41	0.96	0.92	22.06	2.04
100-Yr	298.54 cfs	298.54 cfs	4895.97	6.97	0.0*	5-S2n	1.47	4.25	1.94	1.52	25.61	2.81

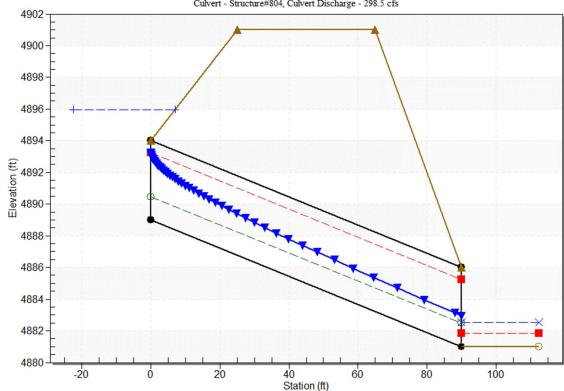
Culvert Barrel Data

Culvert Barrel Type Straight Culvert Inlet Elevation (invert): 4889.00 ft, Outlet Elevation (invert): 4881.00 ft

Culvert Length: 90.35 ft, Culvert Slope: 0.0889

Water Surface Profile Plot for Culvert: Structure#804

Crossing - Structure#804, Reach 800, Great Western Railway, Design Discharge - 298.5 cfs
Culvert - Structure#804, Culvert Discharge - 298.5 cfs



Tailwater Data for Crossing: Structure#804, Reach 800

 Table 8 - Downstream Channel Rating Curve (Crossing: Structure#804, Reach 800)

Flow (cfs)	Water Surface Elev (ft)	Velocity (ft/s)	Depth (ft)	Shear (psf)	Froude Number	
126.99	4881.92	0.92	2.04	0.63	0.38	
298.54	4882.52	1.52	2.81	1.05	0.41	

Tailwater Channel Data - Structure#804, Reach 800

Tailwater Channel Option: Trapezoidal Channel

Bottom Width: 65.00 ft Side Slope (H:V): 3.00 (_:1) Channel Slope: 0.0110 Channel Manning's n: 0.0700 Channel Invert Elevation: 4881.00 ft

Roadway Data for Crossing: Structure#804, Reach 800

Roadway Profile Shape: Constant Roadway Elevation

Crest Length: 100.00 ft Crest Elevation: 4901.00 ft Roadway Surface: Gravel Roadway Top Width: 40.00 ft



Site Data - Structure#805

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 ft Inlet Elevation: 4892.00 ft Outlet Station: 62.00 ft Outlet Elevation: 4890.00 ft

Number of Barrels: 2

Culvert Data Summary - Structure#805

Barrel Shape: Concrete Box

Barrel Span: 8.00 ft
Barrel Rise: 3.00 ft
Barrel Material: Concrete
Embedment: 0.00 in
Barrel Manning's n: 0.0120
Culvert Type: Straight

Inlet Configuration: Square Edge (90°) Headwall

Inlet Depression: None

Table 9 - Culvert Summary Table: Structure#805

Discharge Names	Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth (ft)	Outlet Control Depth (ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)
5-Yr	126.99 cfs	126.99 cfs	4894.07	2.07	0.0*	1-S2n	0.57	1.25	0.65	0.40	12.28	2.93
100-Yr	282.68 cfs	282.68 cfs	4895.66	3.66	1.064	5-S2n	0.95	2.13	1.20	0.64	14.67	4.00

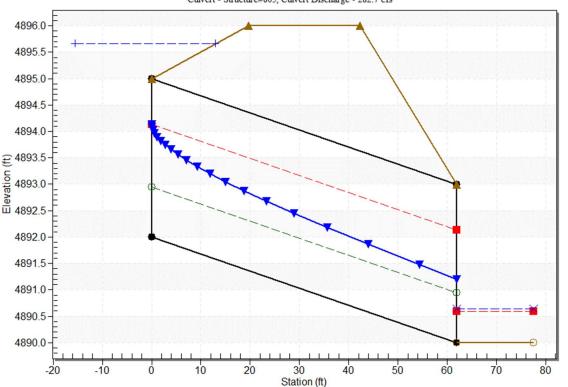
Culvert Barrel Data

Culvert Barrel Type Straight Culvert Inlet Elevation (invert): 4892.00 ft, Outlet Elevation (invert): 4890.00 ft

Culvert Length: 62.03 ft, Culvert Slope: 0.0323

Water Surface Profile Plot for Culvert: Structure#805

Crossing - Structure#805, Reach 800, Design Discharge - 282.7 cfs
Culvert - Structure#805, Culvert Discharge - 282.7 cfs



Tailwater Data for Crossing: Structure#805, Reach 800

Table 10 - Downstream Channel Rating Curve (Crossing: Structure#805, Reach 800)

Flow (cfs)	Water Surface Elev (ft)	Velocity (ft/s)	Depth (ft)	Shear (psf)	Froude Number	
126.99	4890.40	0.40	2.93	0.69	0.83	
282.68	4890.64	0.64	4.00	1.11	0.90	

Tailwater Channel Data - Structure#805, Reach 800

Tailwater Channel Option: Trapezoidal Channel

Bottom Width: 107.00 ft Side Slope (H:V): 6.00 (_:1) Channel Slope: 0.0280 Channel Manning's n: 0.0450 Channel Invert Elevation: 4890.00 ft

Roadway Data for Crossing: Structure#805, Reach 800

Roadway Profile Shape: Constant Roadway Elevation

Crest Length: 100.00 ft Crest Elevation: 4896.00 ft Roadway Surface: Gravel Roadway Top Width: 22.60 ft



Site Data - Structure#807

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 ft Inlet Elevation: 4917.00 ft Outlet Station: 80.00 ft Outlet Elevation: 4916.00 ft

Number of Barrels: 1

Culvert Data Summary - Structure#807

Barrel Shape: Concrete Box

Barrel Span: 12.00 ft
Barrel Rise: 4.00 ft
Barrel Material: Concrete
Embedment: 0.00 in
Barrel Manning's n: 0.0120
Culvert Type: Straight

Inlet Configuration: Square Edge (30-75° flare) Wingwall

Inlet Depression: None

Table 11 - Culvert Summary Table: Structure#807

Discharge Names	Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth (ft)	Outlet Control Depth (ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)
5 Year	63.00 cfs	63.00 cfs	4918.44	1.44	0.0*	1-S2n	0.58	0.95	0.61	0.27	8.64	0.98
100 Year	311.00 cfs	311.00 cfs	4921.32	4.32	2.792	5-S2n	1.60	2.75	1.94	0.71	13.33	1.84

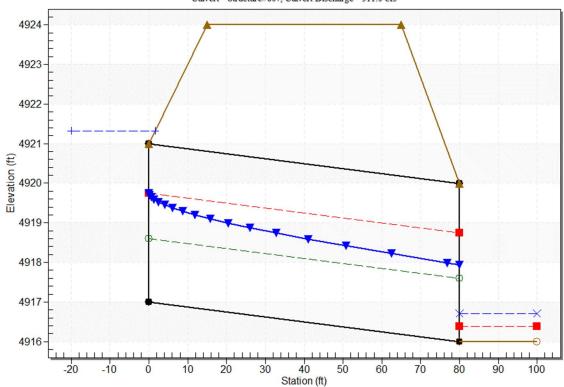
Culvert Barrel Data

Culvert Barrel Type Straight Culvert Inlet Elevation (invert): 4917.00 ft, Outlet Elevation (invert): 4916.00 ft

Culvert Length: 80.01 ft, Culvert Slope: 0.0125

Water Surface Profile Plot for Culvert: Structure#807

Crossing - Structure#807, Reach 829, 1120 Southgate Dr, Design Discharge - 311.0 cfs
Culvert - Structure#807, Culvert Discharge - 311.0 cfs



Tailwater Data for Crossing: Structure#807, Reach 829

Table 12 - Downstream Channel Rating Curve (Crossing: Structure#807, Reach 829)

Flow (cfs)	Water Surface Elev (ft)	Velocity (ft/s)	Depth (ft)	Shear (psf)	Froude Number
63.00	4916.27	0.27	0.98	0.09	0.33
311.00	4916.71	0.71	1.84	0.22	0.39

Tailwater Channel Data - Structure#807, Reach 829

Tailwater Channel Option: Trapezoidal Channel

Bottom Width: 235.00 ft Side Slope (H:V): 5.00 (_:1) Channel Slope: 0.0050 Channel Manning's n: 0.0450 Channel Invert Elevation: 4916.00 ft

Roadway Data for Crossing: Structure#807, Reach 829

Roadway Profile Shape: Constant Roadway Elevation

Crest Length: 100.00 ft Crest Elevation: 4924.00 ft Roadway Surface: Paved Roadway Top Width: 50.00 ft



Site Data - Structure#808

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 ft Inlet Elevation: 4942.00 ft Outlet Station: 527.00 ft Outlet Elevation: 4932.00 ft

Number of Barrels: 1

Culvert Data Summary - Structure#808

Barrel Shape: Concrete Box

Barrel Span: 12.00 ft
Barrel Rise: 4.00 ft
Barrel Material: Concrete
Embedment: 0.00 in
Barrel Manning's n: 0.0120
Culvert Type: Straight

Inlet Configuration: Square Edge (90°) Headwall

Inlet Depression: None

Table 13 - Culvert Summary Table: Structure#808

Table 13	- Guivei	Coullillia	ily Table.	Juli	ui choo	U						
Discharge Names	Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth (ft)	Outlet Control Depth (ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)
5 Year	36.03 cfs	36.03 cfs	4943.10	1.10	0.0*	1-S2n	0.36	0.65	0.36	0.33	8.38	1.64
100 Year	292.00 cfs	292.00 cfs	4946.49	4.49	0.0*	5-S2n	1.34	2.64	1.36	1.16	17.89	3.60

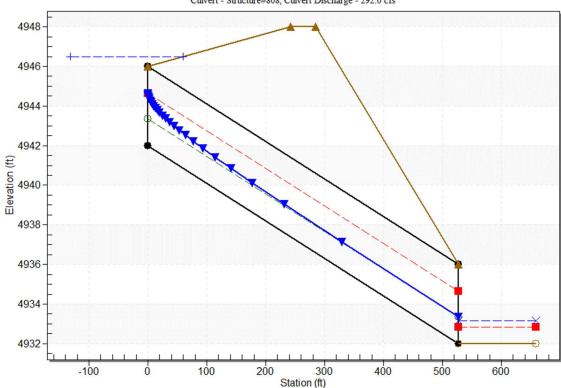
Culvert Barrel Data

Culvert Barrel Type Straight Culvert Inlet Elevation (invert): 4942.00 ft, Outlet Elevation (invert): 4932.00 ft

Culvert Length: 527.09 ft, Culvert Slope: 0.0190

Water Surface Profile Plot for Culvert: Structure#808

Crossing - Structure#808, Reach 829, Design Discharge - 292.0 cfs
Culvert - Structure#808, Culvert Discharge - 292.0 cfs



Tailwater Data for Crossing: Structure#808, Reach 829

Table 14 - Downstream Channel Rating Curve (Crossing: Structure#808, Reach 829)

Flow (cfs)	Water Surface Elev (ft)	Velocity (ft/s)	Depth (ft)	Shear (psf)	Froude Number	
36.03	4932.33	0.33	1.64	0.23	0.51	
292.00	4933.16	1.16	3.60	0.79	0.62	

Tailwater Channel Data - Structure#808, Reach 829

Tailwater Channel Option: Trapezoidal Channel

Bottom Width: 64.00 ft Side Slope (H:V): 5.40 (_:1) Channel Slope: 0.0110 Channel Manning's n: 0.0450 Channel Invert Elevation: 4932.00 ft

Roadway Data for Crossing: Structure#808, Reach 829

Roadway Profile Shape: Constant Roadway Elevation

Crest Length: 100.00 ft Crest Elevation: 4948.00 ft Roadway Surface: Paved Roadway Top Width: 43.00 ft



Site Data - Structure#809

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 ft Inlet Elevation: 4958.00 ft Outlet Station: 304.00 ft Outlet Elevation: 4948.00 ft Number of Barrels: 2

Culvert Data Summary - Structure#809

Barrel Shape: Concrete Box

Barrel Span: 10.00 ft
Barrel Rise: 4.00 ft
Barrel Material: Concrete
Embedment: 0.00 in
Barrel Manning's n: 0.0120
Culvert Type: Straight

Inlet Configuration: Square Edge (90°) Headwall

Inlet Depression: None

Table 15 - Culvert Summary Table: Structure#809

Discharge Names	Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth (ft)	Outlet Control Depth (ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)
5 Year	36.03 cfs	36.03 cfs	4958.77	0.77	0.0*	1-S2n	0.22	0.47	0.22	0.11	8.12	21.45
100 Year	528.00 cfs	528.00 cfs	4962.76	4.76	0.0*	5-S2n	1.20	2.79	1.26	0.56	21.01	61.42

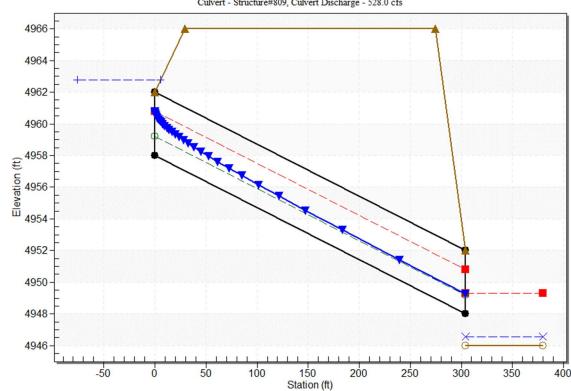
Culvert Barrel Data

Culvert Barrel Type Straight Culvert Inlet Elevation (invert): 4958.00 ft, Outlet Elevation (invert): 4948.00 ft

Culvert Length: 304.16 ft, Culvert Slope: 0.0329

Water Surface Profile Plot for Culvert: Structure#809

Crossing - Structure#809, Reach 843, US-34, Design Discharge - 528.0 cfs
Culvert - Structure#809, Culvert Discharge - 528.0 cfs



Tailwater Data for Crossing: Structure#809, Reach 843

Table 16 - Downstream Channel Rating Curve (Crossing: Structure#809, Reach 843)

Flow (cfs)	Water Surface Elev (ft)	Velocity (ft/s)	Depth (ft)	Shear (psf)	Froude Number
36.03	4946.11	0.11	21.45	34.03	11.45
528.00	4946.56	0.56	61.42	174.16	14.49

Tailwater Channel Data - Structure#809, Reach 843

Tailwater Channel Option: Rectangular Channel

Bottom Width: 15.40 ft Channel Slope: 5.0000 Channel Manning's n: 0.0350 Channel Invert Elevation: 4946.00 ft

Roadway Data for Crossing: Structure#809, Reach 843

Roadway Profile Shape: Constant Roadway Elevation

Crest Length: 100.00 ft Crest Elevation: 4966.00 ft Roadway Surface: Paved Roadway Top Width: 245.00 ft



Appendix F-7 Master Plan Cost Estimate



MASTER PLAN COST ESTIMATE FOR INDIVIDUAL REACH

PROJECT:

23.1447.001 Greeley - Comprehensive Drainage Plan Oklahoma Concept Design

DRAINAGEWAY:

Drainageway 700

REACH:

700

JURISDICTION:

Greeley LID_700-Reach700

REACH ID:

Sabastian Ortega

DATE:

7/12/2024

DESCRIPTION			QUANTITY	UNIT	UNIT COST	TOTAL COST
Pipe Culverts and Storm Drains						
Circular Pipes						
Diameter (in)	Length (ft)	No. of Barrels				
48-inch	97	1	97	L.F.	\$240.00	\$23,280.00
48-inch	89	2	178	L.F.	\$240.00	\$42,720.00
Channel Improvements						
Soil Riprap, Type M			291	C.Y.	\$117.00	\$34,047.00
Detention/Water Quality Facilities						
Detention (Complete-in-Place)						
Detention Facility 1 (Complete-in-Place)			6.5	AC-FT	\$76,152.00	\$494,988.00
Removals						
Removal of culvert pipe (D<48")			186	L.F.	\$33.00	\$6,138.00
Landscaping and Maintenance						
Improvements						
Reclamation & seeding (native grasses)			1.3	ACRE	\$1,670.00	\$2,171.00
Land Acquisition						
Easement/ROW Acquisition			1.30	ACRE	\$11,228.00	\$14,596.00

Master Plan Capital	Improvement Cost Summary	
Capital Improvement Costs		
Pipe Culverts and Storm Drains		\$66,000.00
Concrete Box Culverts		\$0.00
Hydraulic Structures		\$0.00
Channel Improvements		\$34,047.00
Detention/Water Quality Facilities		\$494,988.00
Removals		\$6,138.00



Landscaping and Maintenance Improvements			\$2,171.00
Special Items (User Defined)			\$0.00
Subtotal Capital Improvement Costs		•	\$603,344.00
Additional Capital Improvement Costs			
Dewatering		L.S.	\$0.00
Mobilization	5%		\$30,167.00
Traffic Control		L.S.	\$0.00
Utility Coordination/Relocation		L.S.	\$0.00
Stormwater Management/Erosion Control	5%		\$30,167.00
Subtotal Additional Capital Improvement Costs		•	\$60,334.00
Land Acquisition Costs			
ROW/Easements			\$14,596.00
Subtotal Land Acquisition Costs			\$14,596.00
Other Costs (percentage of Capital Improvement Costs)			
Engineering	15%		\$99,552.00
Legal/Administrative	5%		\$33,184.00
Contract Admin/Construction Management	10%		\$66,368.00
Contingency	25%		\$165,920.00
Subtotal Other Costs			\$365,024.00
Total Capital Improvement Costs			\$1,043,298.00

Master Plan Operation and Ma	intenance Cos	t Summary			
Description	Quantity	Unit	Unit Cost	Total Annual Cost	
Culvert Maintenance (e.g. sediment & debris removal, erosion at entrance/exit, structural repairs, etc.)			L.F.	\$2.00	\$718.00
Detention/WQ Maintenance (e.g. sediment & debris removal, mucking out, tree & weed removal, structural repairs, etc.)		1.3	ACRE	\$2,505.00	\$3,257.00
Total Annual Operation and Maintenance Cost	\$3,975.00				
Effective Interest Rate			-	0.00%	
Total Operation and Maintenance Costs Over 50 Years		-		\$198,750.00	



MASTER PLAN COST ESTIMATE FOR INDIVIDUAL REACH

PROJECT: 23.1447.001 Greeley - Comprehensive Drainage Plan Oklahoma Concept Design

DRAINAGEWAY: Drainageway 800

REACH: Drainageway 800

JURISDICTION: Greeley

REACH ID: LID_800. Sabastian Ortega DATE: 7/12/2024

DESCRIPTION			QUANTITY	UNIT	UNIT COST	TOTAL COST
Concrete Box Culverts						
Box Culvert Pipe						
Individual Box Span (ft)	Box Height (ft)	No. of Barrels	Length (ft)			
6	5	1	90	L.F.	\$1,095.56	\$98,601.00
8	3	2	62	L.F.	\$2,191.13	\$135,850.00
12	4	1	80	L.F.	\$1,529.18	\$122,335.00
12	4	1	527	L.F.	\$1,529.18	\$805,879.00
9	4	2	74	L.F.	\$2,537.62	\$187,784.00
10	4	1	304	L.F.	\$1,354.93	\$411,900.00
Channel Improvements						
Soil Riprap, Type M			561	C.Y.	\$117.00	\$65,637.00
Detention/Water Quality Facilities						
Detention (Complete-in-Place)						
Detention Facility 1 (Complete-in-Place)			43	AC-FT	\$76,152.00	\$3,282,151.00
Detention Facility 2 (Complete-in-Place)			17	AC-FT	\$76,152.00	\$1,294,584.00
Detention Facility 3 (Complete-in-Place)			2	AC-FT	\$76,152.00	\$182,765.00
Removals						
Removal of culvert pipe (D<48")			62	L.F.	\$33.00	\$2,046.00
Removal of culvert pipe (48" <d<84")< td=""><td></td><td></td><td>905</td><td>L.F.</td><td>\$84.00</td><td>\$76,020.00</td></d<84")<>			905	L.F.	\$84.00	\$76,020.00
Concrete Box Culvert			170	L.F./CELL	\$167.00	\$28,390.00
Landscaping and Maintenance						
Improvements						
Reclamation & seeding (native grasses)			10	ACRE	\$1,670.00	\$17,034.00
Land Acquisition						
Easement/ROW Acquisition			10.60	ACRE	\$11,228.00	\$119,017.00

Master Plan Capital Improvement Cost Summary



Capital Improvement Costs			
Pipe Culverts and Storm Drains			\$0.00
Concrete Box Culverts			\$1,762,349.00
Hydraulic Structures			\$0.00
Channel Improvements			\$65,637.00
Detention/Water Quality Facilities			\$4,759,500.00
Removals			\$106,456.00
Landscaping and Maintenance Improvements			\$17,034.00
Special Items (User Defined)			\$0.00
Subtotal Capital Improvement Costs			\$6,710,976.00
Additional Capital Improvement Costs			
Dewatering		L.S.	\$0.00
Mobilization	5%		\$335,549.00
Traffic Control		L.S.	\$0.00
Utility Coordination/Relocation		L.S.	\$0.00
Stormwater Management/Erosion Control	5%		\$335,549.00
Subtotal Additional Capital Improvement Costs			\$671,098.00
Land Acquisition Costs			
ROW/Easements			\$119,017.00
Subtotal Land Acquisition Costs			\$119,017.00
Other Costs (percentage of Capital Improvement Costs)			
Engineering	15%		\$1,107,311.00
Legal/Administrative	5%		\$369,104.00
Contract Admin/Construction Management	10%		\$738,207.00
Contingency	25%		\$1,845,519.00
Subtotal Other Costs			\$4,060,141.00
Total Capital Improvement Costs			\$11,561,232.00

Master Plan Operation and Ma	aintenance Co	st Summary			
Description	Quantity	Unit	Unit Cost	Total Annual Cost	
Culvert Maintenance (e.g. sediment & debris removal, erosion at entrance/exit, structural repairs, etc.)		1273	L.F.	\$2.00	\$2,546.00
Detention/WQ Maintenance (e.g. sediment & debris removal, mucking out, tree & weed removal, structural repairs, etc.)		10.6	ACRE	\$2,505.00	\$26,553.00
Total Annual Operation and Maintenance Cost	-			\$29,099.00	
Effective Interest Rate				0.00%]
Total Operation and Maintenance Costs Over 50 Years	-			\$1,454,950.00	



Appendix G – Master Plan Maps

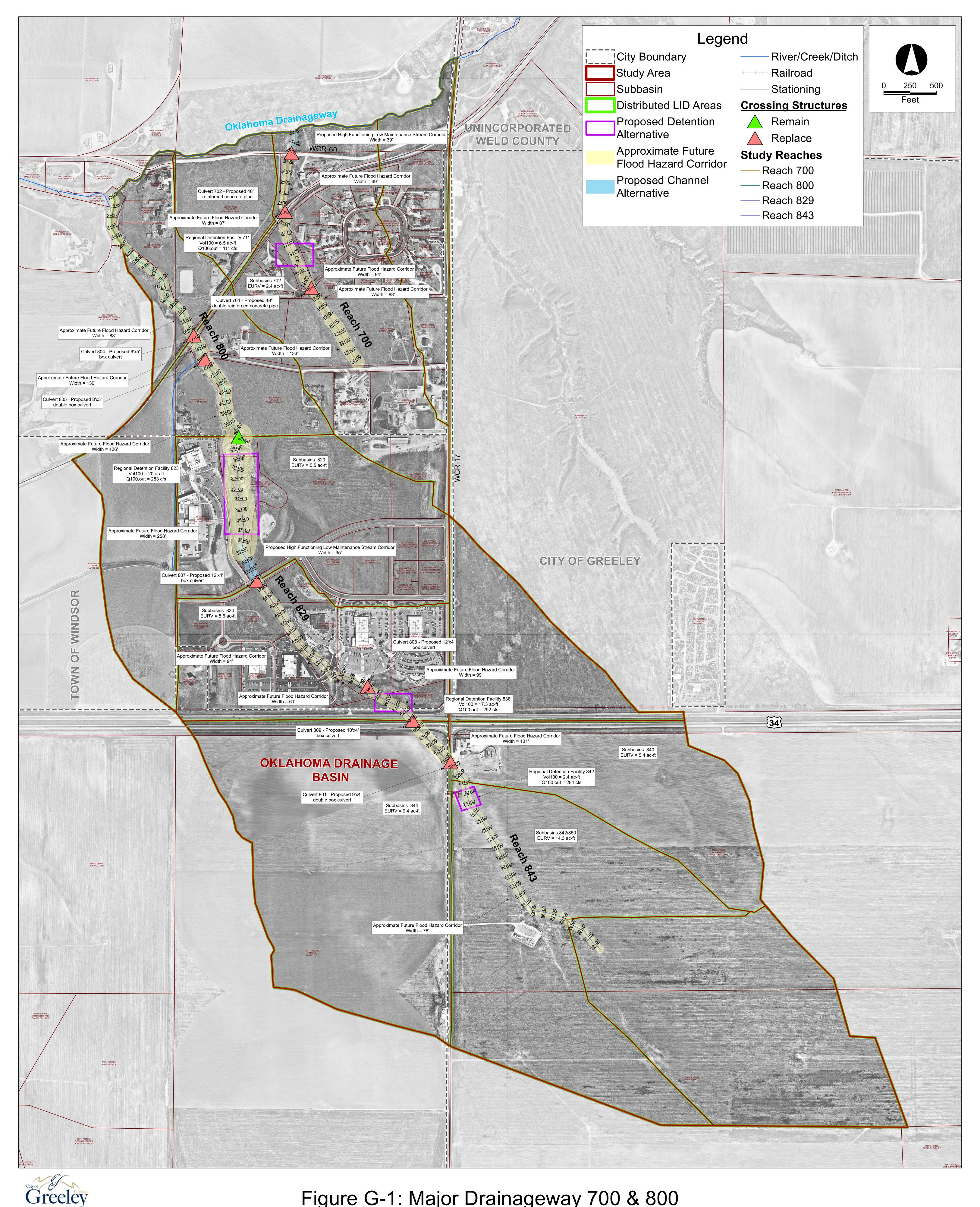




Figure G-1: Major Drainageway 700 & 800 Comprehensive Drainage Plan Oklahoma Basin Concept Design Map (July 2024)



Appendix H – Funding Sources

(funding sources were not included with this study)









