

**EXECUTIVE SUMMARY**

**ES.1 PURPOSE AND SCOPE**

The Mile High Flood District (MHFD), in partnership with the City of Aurora (hereafter referred to as Aurora) and City and County of Denver (hereafter referred to as Denver), contracted Bohannon Huston, Inc. (BHI) to develop an Outfall Systems Plan (OSP) for Westerly Creek downstream of the Westerly Creek Dam. The purpose of this study was to determine potential flooding, drainage, and water quality deficiencies in the Westerly Creek watershed. Per the direction of MHFD, additional outfalls within the Easterly Creek catchment were also included in this OSP due to recurring flooding issues near the Easterly Creek outfall to Westerly Creek. This OSP aimed to mitigate potential flood damages in the study area by recommending upgrades to the existing stormwater infrastructure, including new or improved conveyances and detention facilities. Additionally, this OSP aimed to determine the feasibility of increasing the conveyance of Westerly Creek via the replacement of below-ground conveyances with open channels, where possible.

**ES.2 PLANNING PROCESS**

The recommendations made as part of this study impact both Denver and Aurora, as well as MHFD. Therefore, it was important that stakeholders from both municipalities and MHFD be involved in the planning process. The project sponsors provided valuable feedback throughout this study. Multiple progress meetings were held between BHI and the project sponsors to ensure that goals and expectations of all project sponsors were being met. The specific goals of this OSP included:

- Evaluating existing studies and being mindful of their original intent;
- Identifying drainage system deficiencies, specifically where flooding is in excess of one foot;
- Identifying and planning upgrades to the existing stormwater system facilities and proposing new improvements that meet the drainage/flooding criteria, including new conveyances and the daylighting of storm drains where possible;
- Preserving or enhancing existing or new open space, if open space is evaluated for stormwater management;
- Prioritizing stormwater projects;
- Improving water quality in dense, urbanized areas; and
- Developing a conceptual design for the Selected Plan.

A project kickoff meeting as well as progress meetings during both the alternatives analysis and conceptual design phases were held. During the alternatives analysis phase progress meeting, the project stakeholders collaborated to prioritize at-risk flood areas and select alternatives for further

analysis. A progress meeting was held during the conceptual design phase where project sponsors weighed in on the development of a recommended plan for future drainage improvements.

Due to the occurrence of the COVID-19 pandemic, in-person engagements with project stakeholders were not possible throughout this study. Therefore, all interactions were held in a virtual setting. BHI also maintained a website, which included details about the project status, meeting minutes and stakeholder contact information, to allow for further engagement with stakeholders and members of the public.

Meeting minutes from all phases of this study are provided in Appendix A. Project participants are listed in Table ES-1.

**Table ES-1 – Project Participants**

Name	Organization	Project Role
Mark Schutte	MHFD	Project Manager
Morgan Lynch	MHFD	Watershed Manager
Craig Hoover	BHI	Principal-in-Charge
Rifka Wine	BHI	Project Manager
Casey Bangs	BHI	Project Engineer
Madeline Olivas	BHI	Project Engineer
Elizabeth Lefebvre	Aurora	Senior PIO, Aurora Water
Sam Miller	Aurora	Local Sponsor, Aurora Water
Vern Adam	Aurora	Local Sponsor, Aurora Water
Craig Perl	Aurora	Floodplain Administrator
Tony Tran	Aurora	Stormwater Engineer, Aurora Water
Gary Burke	Aurora	Stormwater Superintendent
Tracy Young	Aurora	Parks, Recreation, and Open Space
Curtis Bish	Aurora	Parks, Recreation, and Open Space
Chris Best	Denver	Senior Engineer – IPM Wastewater
David Morrisey	Denver	Senior Engineer - Floodplain Administration
Kevin Lewis	Denver	Local Sponsor
Cincere Eades	Denver	Senior Planner

### ES.3 PROJECT AREA DESCRIPTION

This OSP study area covers approximately seven square miles, including both the western portion of Aurora and the eastern portion of Denver downstream of the Westerly Creek Dam. The Westerly Creek watershed is highly urbanized and is comprised of a mix of industrial and residential areas. Several storm drain systems have been previously constructed in the Westerly Creek watershed. However, many of the storm drain systems do not have capacity to convey the 100-year flood and are therefore considered undersized for the purposes of this study. The upstream limits of this study begin at Westerly Creek Dam at an approximate elevation of 5,380 feet. Runoff flows south to north to the outfall to Sand Creek in the Central Park area at an elevation of 5,255 feet.

The Easterly Creek outfall with Westerly Creek is located at 19<sup>th</sup> Avenue, within the study area of this OSP. There has historically been significant overland flooding in this area due to the undersized pipe network that currently conveys Easterly Creek. Given the significant flooding in this area and the proximity to Westerly Creek, select outfalls within the Easterly Creek catchment were also analyzed, including the 19<sup>th</sup> Avenue, 22<sup>nd</sup> Avenue, and 23<sup>rd</sup> Avenue outfalls.

The study area of this OSP was divided into nine subbasins. The subbasin boundaries and naming conventions are based on the *Original Aurora Stormwater Master Plan* and *Denver SDMP*. Basins 1-7 are based on the *Original Aurora Stormwater Master Plan*. Basins 4401-01, 4401-02, and 4401-03 are based on the *Denver SDMP* subbasins. Basin boundaries from both studies were adjusted as needed to meet the analysis needs of this study. See Figure ES-1 for the Study Area of the Westerly Creek watershed downstream of the Westerly Creek Dam.

### ES.4 ALTERNATIVES ANALYSIS

The goal of the alternatives analysis was to identify flooding areas that do not meet Denver and Aurora criteria to determine which improvements best mitigate flooding depths. The primary alternatives assessed as part of this OSP are as follows:

- Replacement of existing storm drains;
- Construction of new storm drains;
- Construction of open-channel conveyances; and
- Construction of detention facilities.

One of the goals of this OSP was to be mindful of the several prior master planning studies that have been completed for the project area. Previously recommended improvements were therefore assessed and revised as part of this OSP. Prior to analysis of any alternatives, a pre-screening matrix was used to determine which types of alternatives were feasible to implement in drainage basins with identified flooding problem areas. Due to the highly urbanized nature of the Westerly Creek watershed,

there are few opportunities to implement open channel conveyances or new detention facilities in most basins.

High peak runoff rates generated by the Easterly Creek and Westerly Creek watersheds required a combination of several alternatives to be implemented to sufficiently reduce street flooding depths. Several alternatives were determined to be critical to mitigating flooding issues. These alternatives were selected as Base Alternatives. Six Alternative Plans were developed to include all Base Alternatives and additional alternatives that were not eliminated during the pre-screening matrix or initial modeling phases.

The project sponsors were involved throughout the alternatives assessment process to ensure that all the alternatives being assessed were appropriate with regard to planning, construction and jurisdictional criteria. A Recommended Plan was provided by BHI and was approved by all project sponsors.

### ES.5 MASTER PLAN SUMMARY

The Selected Plan essentially follows the Recommended Plan as outlined in Chapter 6 of this report. Minor modifications were made to the Recommended Plan based on additional analysis completed during the Conceptual Design phase. The primary goal of the conceptual design is to reduce street 100-year street flooding depth to within jurisdictional criteria. This was accomplished through a combination of storm drain improvements and improved detention facilities. The recommended improvements are summarized by drainage basin in Sections ES.5.1 to ES.5.4 and are shown schematically in Figure ES.1.

#### ES.5.1 BASIN 3

Stormwater originating in the Easterly Creek watershed is conveyed into Basin 3 by Del Mar Parkway. New storm drains along E 22<sup>nd</sup> Avenue and E 23<sup>rd</sup> Avenue are recommended to alleviate street flooding in this area. Both storm drains would collect street flows and convey them to Westerly Creek at new outfalls. Both the E 22<sup>nd</sup> Avenue and E 23<sup>rd</sup> Avenue storm drains are currently planned by Aurora through partnership with private development and were incorporated into this OSP.

#### ES.5.2 BASIN 5

The Easterly Creek watershed contributes to significant street flooding in the vicinity of E 22<sup>nd</sup> Avenue, E 23<sup>rd</sup> Avenue and along Del Mar Parkway. Aurora currently has plans for improvements to the Havana Park Pond as well as minor storm drain improvements along Del Mar Parkway. These planned improvements were incorporated into this OSP. The pond should be improved to increase storage volume to reduce peak flows throughout the Easterly Creek watershed.

The Chesapeake Townhomes Pond is an existing privately-owned detention facility. Overflows from the pond flow into the High Line Canal (HLC). However, these overflows are currently assumed to overtop the canal and flow through the Westerly Creek watershed. It is recommended that stormwater overflow into the HLC be formalized, allowing for overflows to be conveyed out of the watershed.

A relief storm drain is also recommended along E 17<sup>th</sup> Avenue. The storm drain would divert flows out of the existing storm drain that runs along Del Mar Parkway, allowing for greater interception of stormwater downstream of E 17<sup>th</sup> Avenue.

**ES.5.3 BASIN 7**

Overland flows originating from the Easterly Creek watershed, Basin 6, and Basin 4401-03 are conveyed to E 11<sup>th</sup> Avenue, causing street flooding issues in the vicinity of Alton Street and Beeler Street. A new storm drain is recommended to capture street beginning at the intersection of Beeler Street and E 11<sup>th</sup> Avenue to a new outfall to Westerly Creek at Colfax Avenue. The recommended improvement will reduce 100-year street flooding depths to criteria in this area.

**ES.5.4 BASIN 4401-02**

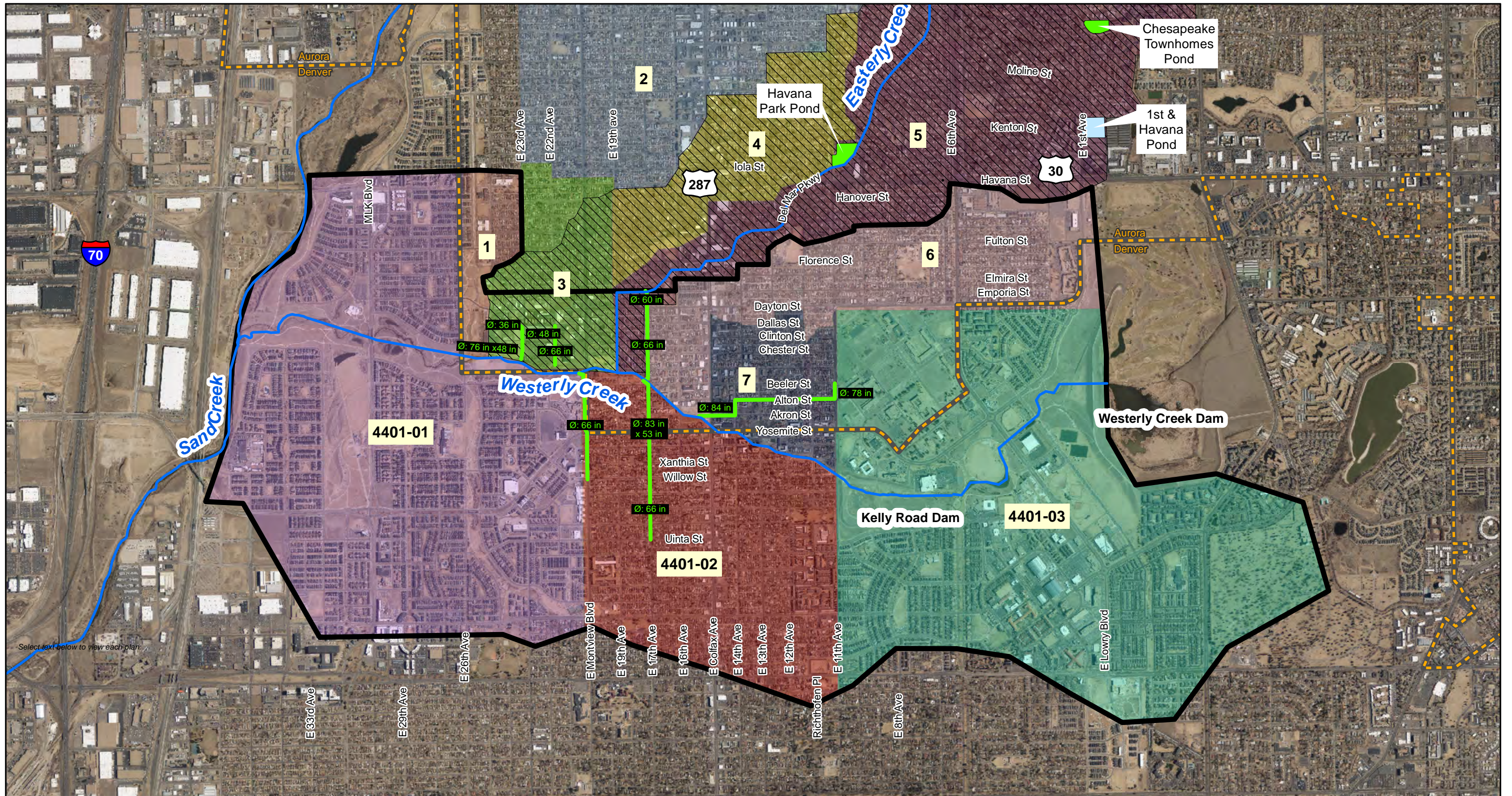
A large portion of Basin4401-02 drains to Montview Boulevard, which does not have sufficient capacity to convey 100-year flows. A relief storm drain along E 17<sup>th</sup> Avenue is recommended to divert flows out of the existing storm drain system that conveys flows to Montview Boulevard. Replacement of a portion of the existing Montview Boulevard storm drain is also recommended. These improvements will collectively reduce 100-year street flooding depths to criteria within Basin 4401-02.

**ES.6 MASTER PLAN COST ESTIMATE**

Improvement costs, including capital, operation and maintenance, right-of-way acquisition, and contingencies costs for each alternative component were estimated using the MHFD Cost Estimator for Master Planning (UD-MP Cost Version 2.2). A summary of the final costs by drainage basin is provided in Table ES-2.

**Table ES-2 – Summary of Master Plan Costs**

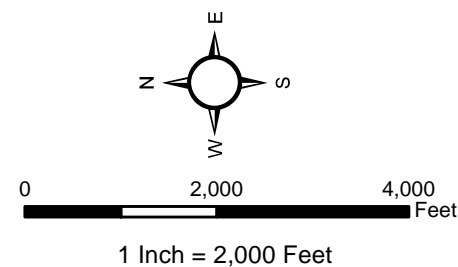
Basin ID	Jurisdiction	Item	Total Capital Improvement Cost	Annual O&M
Basin 3	Aurora	E 22 <sup>nd</sup> Avenue Storm Drain	\$1,375,272	\$1,152
	Aurora	E 23 <sup>rd</sup> Avenue Storm Drain	\$1,857,314	\$2,016
Basin 5	Aurora	Chesapeake Townhomes Detention Pond	\$2,245,115	\$6,726
	Aurora	Havana Park Pond & Del Mar Parkway Improvements	\$2,650,000	\$17,936
	Aurora	Alternative Component 5.4: E 17 <sup>th</sup> Avenue Relief Storm Drain (Aurora)	\$3,567,932	\$7,776
Basin 7	Aurora	Alternative Component 7.3: Alton Street Storm Drain	\$6,971,591	\$16,560
Basin 4401-02	Denver	Alternative Component 4401-02.1: E 17 <sup>th</sup> Avenue Relief Storm Drain (Denver) & Montview Boulevard Storm Drain	\$8,683,215	\$8,220
<b>Aurora Subtotal</b>			<b>\$18,667,224</b>	<b>\$52,166</b>
<b>Denver Subtotal</b>			<b>\$8,683,215</b>	<b>\$8,220</b>
<b>Total</b>			<b>\$27,350,439</b>	<b>\$60,386</b>



Select text below to view each plan.

**Legend**

- Proposed Storm Drains
- Streams
- Study Area Boundary
- Jurisdictions
- Easterly Creek Catchment
- Proposed Detention Facility
- Basin ID
- Existing Detention Facility



**Westerly Creek OSP**  
**Figure ES.1 - Study Area**  
**&**  
**Recommended Improvements**