

Utility Master Plan

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The City of Thornton

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Utility Master Plan

Attachments (Provided Separately)

Volume II. Raw Water Supply Master Plan

Volume III. Water Treatment Facilities Master Plan

Volume IV. Water and Wastewater Infrastructure Master Plan

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List of Acronyms

%	Percent
AACE	Association for the Advancement of Cost Engineering
ADD	Average Daily Demand
CapEx	Capital Expenditure
CBA	Cost-Benefit Analysis
CIP	Capital Improvement Program
EGL4	East Gravel Lake #4
ft	Feet
gpm	Gallons per Minute
IMP	Integrated Master Plan
in	Inch
KPI	Key Performance Index
LF	Linear Feet
M	Million
MDD	Maximum Daily Demand
MG	Million Gallons
mgd	Million Gallons per Day
MIB	2-methylisoborneol
N/A	Not Applicable
NTU	Nephelometric Turbidity Unit
NWTP	Northern Water Treatment Plant
O&M	Operation and Maintenance
PDWQ	Peak Dry Weather Flow
PS	Pump Station
SLR	Sludge Loading Rate
TM	Technical Memorandum
TWP	Thornton Water Project
TWTP	Thornton Water Treatment Plant
UMP	Utility Master Plan
WBWTP	Wes Brown Water Treatment Plant
WTP	Water Treatment Plant
WGL2	West Gravel Lake #2
YR	Year

Chapter 1 Utility Master Plan

Section 1-1 Introduction and Purpose

The city of Thornton (Thornton) Utility Master Plan (UMP) includes Thornton's raw water supply, water treatment facilities, water distribution, and wastewater collection systems. The planning basis was carefully developed with Thornton for the Water and Wastewater Infrastructure Master Plan to identify future system requirements for raw water supply, water treatment facilities, water distribution and wastewater collection.

Requirements for each of the systems were identified in the individual master plans through an integrated planning process. This included an update to the 2009 Water and Wastewater Infrastructure Master Plan (presented in Volume IV) and concurrent completion of the Raw Water Supply Master Plan (presented in Volume II) and the Water Treatment Facilities Master Plan (presented in Volume III). The completed master plans were coordinated into a single Integrated Master Plan (IMP) (presented here in Volume I) that supports the 2019 Comprehensive Plan to meet future growth requirements. The IMP presents development of a Capital Improvement Program (CIP), which included a comprehensive evaluation of identified alternatives from each of the individual master plans, and selection of a preferred alternative to meet future system needs.



Figure 1.1: Integrated Plan Components

Thornton currently provides service to a population of over 166,000 habitants within the city as well as outside its limits. At build-out, anticipated to occur by 2065, the systems are expected to serve a population of 268,843 within the existing Thornton water and wastewater service areas.

To serve the anticipated future growth, the water treatment facilities will require an overall increase in production capacity of an additional 21.5 million gallons per day (mgd). Three future alternatives were developed and evaluated to meet the expected future need considering impacts across the raw water, water treatment, and water distribution systems. These alternatives involved either the construction of a new Northern Water Treatment Plant (NWTP), or the expansion of the Thornton Water Treatment Plant (TWTP), or the expansion of Wes Brown Water Treatment Plant (WBWTP).

The alternatives development and evaluation process was structured to encourage consideration of a full range of improvement strategies. Alternative improvements were developed to meet performance criteria for each system based on technical analyses outlined in the individual master plans and to meet future system demands.

The performance criteria for each system were divided into three tiers to establish a hierarchical structure for the levels of service associated with the various system improvements. This structure can provide Thornton guidance and flexibility in implementation of improvement projects based on balancing desired level of service and budgetary goals. The three tiers are summarized as follows:

- Tier 1: Criteria that must be met by the system.

- Tier 2: Criteria that represent best practice and should be met by the system, but may not be required.
- Tier 3: Criteria that are desired and should be met if practicable, but are not required.

Construction of a new NWTP located in the northern portion of the service area was selected as the preferred alternative to best meet future system requirements based on a cost-benefit analysis (CBA) of the integrated alternatives described in Chapter 3 of this Volume I report.

The CIP for the preferred alternative was developed for each system to provide a plan that phases and prioritizes the improvement projects and associated costs. This IMP finalized the CIP phasing and costs based on detailed analysis with Thornton on information provided in the individual master plans. CIP projects associated with the Thornton Water Project (TWP) are limited to those located within Thornton's city limits. Costs of improvements north of the city limits are not included in the CIP. This program is described in Chapter 2 of this Volume I report.

Section 1-2 Utility Master Plan Framework

This UMP is comprised of 4 parts:

Volume I: Utility Master Plan Integrated Master Plan

The purpose of the UMP Technical Report is to document the CIP. The report is structured to present the development of the CIP in Chapter 2. The cost-benefit evaluation of the integrated alternatives and selection of a preferred alternative to meet future requirements are presented subsequently in Chapter 3.

Volume II: Raw Water Supply Master Plan

The Raw Water Supply Master Plan includes the definition of performance criteria and the analysis of the alternatives related to the raw water supply system to meet current and future demands. This included evaluation of the current Gravel Lakes operations and water quality and preliminary evaluation of pipeline alignments within city limits for the Thornton Water Project (TWP). A water balance model of the Gravel Lakes system was developed to evaluate the Gravel Lakes' hydraulics. Additionally, an Operational Plan and Water Quality Monitoring Plan were developed to improve the water quality at the Gravel Lakes.

Volume III: Water Treatment Facilities Master Plan

The Water Treatment Facilities Master Plan includes the definition of performance criteria and the analysis of the alternatives related to the water treatment facilities to meet current and future demands. A water treatment performance and regulatory evaluation was also completed for WBWTP and identified recommend improvements to the existing facility. Additionally, an assessment of the sustainable production capacity of the membranes expected to result following completion of recommended WBWTP improvements was completed.

Volume IV: Water and Wastewater Infrastructure Master Plan

The Water and Wastewater Infrastructure Master Plan includes the development of the UMP planning basis utilized in each of the individual master plans, definition of distribution and collection system performance criteria, the analysis of the alternatives related to the water distribution and wastewater collection systems to meet future demands, and the development of improvements to accommodate buildout flows. Thornton's hydraulic models of the distribution and collection systems were updated and utilized to complete the alternatives analysis. Additionally, Thornton's Rehabilitation and Replacement program was evaluated to determine if current funding is adequate to maintain the respective systems. A pipeline risk assessment tool was developed to evaluate and prioritize the recommended rehabilitation and replacement improvements.

Revisions to Utility Master Plan

At the time of completion of the UMP, an alternative centered around an increased treatment capacity of 36.5 mgd at the NWTP and decreased capacity of 40 mgd at WBWTP was in development. This

alternative resulted in revisions to the CIP plan presented in Volume I. An independent document, titled “Thornton Plan Utility Master Plan”, was created to document the revisions necessary to accommodate the alternative WTP capacities in the CIP plan.

Chapter 2 Capital Improvement Program

Section 2-1 Introduction and Purpose

Following the Integrated Alternatives Evaluation presented in Chapter 3 of this Utility Master Plan Thornton selected Alternative 1 – Construction of a new Northern Water Treatment Plant (NWTP) to meet future water demands. Chapter 2 presents the Capital Improvement Program (CIP) for Alternative 1. This CIP provides a plan that phases and prioritizes improvement projects and associated costs across the raw water supply system, water treatment facilities, and the water distribution and wastewater collection systems. The methodology used to prepare the CIP Plan is summarized in this Chapter. Documentation of the CIP Plan includes:

1. An index of all CIP projects organized by system type, phase and priority;
2. Informational cutsheets for each CIP project;
3. CIP Location Map and
4. Annual estimated expenditures to provide guidance of future planning and budgeting efforts.

The following sections summarize key aspects of the CIP necessary to achieve improvement goals in each of the systems (raw water supply, water treatment facilities, water distribution, and wastewater collection).

Section 2-2 Raw Water Supply CIP Plan Summary

A variety of raw water supply CIP projects were identified to supply current and future demands with improved raw water quality. Recommended improvements to meet existing deficiencies include a raw water pipeline interconnect (McKay Interconnect) between the existing 36-inch McKay pipeline and the EGL4 PS. This improvement will allow for McKay Pump Station (PS) to deliver directly to WBWTP, TWTP and East Gravel Lake #4 (EGL4). The interconnect will consist of a valve vault, a moderate length of pipe and flow control valves and meters. Additionally a raw water pipeline from West Gravel Lake #2 (WGL2) to EGL4 (including a new pump station) is recommended to meet Tier 1 performance criteria. These pipelines will allow the Gravel Lakes to be operated in series, which is expected to improve water quality. This new operational plan for the Gravel Lake system is recommended to be followed year-round.

Two studies are recommended to improve the understanding of the raw water quality characteristics under existing conditions and identify new methods for improving the raw water quality as follows:

1. Pilot study on the effectiveness and operational cost of precipitant addition to the Burlington Canal diversions for total suspended solids removal and phosphorus sequestration at Gravel Lakes and resulting reduction of phosphorus in supply to water treatment facilities.
2. Feasibility analysis of floating solar panel installation in the Gravel Lakes. In addition to generating electricity, these solar panels would provide shade and lower the water temperature, thereby reducing algae production.

The following new water quality profiling and monitoring systems are also recommended under the existing improvements for the Gravel Lakes:

- A sonde (water quality sampler) to collect water quality data placed at the deepest location or center of each lake, with samples collected at different strata. It is possible for the individual lakes to have varying water quality between the different bodies of water and therefore it is recommended that a sonde be placed at each lake to identify the unique water quality profiles.
- Nutrient monitoring should continue near the Gravel Lake shorelines. It is possible for the individual lakes to have varying water quality between the different bodies of water and therefore

it is recommended that nutrient monitoring continue at each lake to identify the unique water quality profiles.

- New temperature data monitor and new profiling system at EGL4, WGL2, and South Cell – Cooley West Lake.
- Collection of a monthly integrated water column sample at EGL4 to gain better insight into phytoplankton species, which influence taste and odor events.
- Collection of geosmin, 2-methylisoborneol (MIB), and microcystin-LR samples at EGL4, WGL2, and South Cell – Cooley West Lake, and collection of geosmin and MIB samples at the Burlington Canal Gravel Lake inflows to help document the onset and duration of taste, odor, and toxin events.

The Tier 1 CIP projects that were identified to provide additional raw water supply capacity to meet future demands include the Phase I Thornton Water Project (TWP) pipeline, a bypass pipeline from the TWP pipeline to the Gravel Lakes in the vicinity of McKay PS, a new pipeline from the TWP pipeline on Quebec Street to the NWTP, a new pipeline and pump station from Hammer Reservoir to the TWP pipeline on Quebec Street at the intersection with E-470, a feasibility study to evaluate options to add 10 mgd of capacity to McKay PS, and two pre-treatment chemical feed facilities. One of the chemical feed facilities will be located north of 140th Avenue on the TWP pipeline on Quebec Street, the other will be located at McKay PS.

The Tier 1 CIP projects also include an interconnect between the new Phase I of the TWP 42-inch pipeline and the existing 36-inch pipeline in Thornton Parkway that extends to the TWTP (TWP Interconnect). The interconnect will allow for TWP water to be delivered to TWTP and WBWTP. The interconnect will consist of a valve vault, a moderate length of pipe and flow control valves and meters.

The Tier 2 projects for raw water supply consist of the Phase II TWP pipeline, an increase in the booster pump capacity at the McKay PS, and a new pipeline and pump station from Rogers Reservoir to the TWP pipeline on Quebec Street at the intersection with 168th Avenue.

Tier 3 projects consist primarily of redundant raw water pipelines.

Raw Water CIP Phasing

Prioritization of raw water CIP projects was developed based on phasing considerations to meet population and demand growth, project timing and sequencing with related or dependent projects, performance criteria tier rating, and other considerations and comments from Thornton. The projects were also sequenced to maintain the system's total average annual expenditure as consistently as possible.

Projects were organized into three construction phases, based on required completion date; Phase I: 2020 - 2025 (5-year), Phase II: 2025 - 2035 (15-year), and Phase III: 2035 -2065 (service area buildout). All the raw water Tier 1 and 2 CIP projects are listed by phase in Table 2.1. In order to balance available CIP project budgets, the improvements to the existing raw water system recommended in the Raw Water Supply Master Plan to address Gravel Lakes water quality have been deferred until Phase II.

Table 2.1. Raw Water CIP Project Phasing

CIP ID	RAW WATER CIP PROJECT
	PHASE I (2020-2025)
RAW-E03	Study: Precipitant Addition to Burlington Canal
RAW-E04	Study: Feasibility of Floating Solar Panel Installation on Gravel Lakes
RAW-E05	Mobile Pump Stations Back-up Power
RAW-E06	New water quality profiling system and temperature data monitoring system on EGL4
RAW-F01	Thornton Water Project Phase I - 42-in raw water pipeline from 168th Ave to WBWTP
RAW-F03	TWP Interconnect
RAW-F08	TWP Bypass pipeline
RAW-F09	North Chemical Feed Facility
	PHASE II (2025-2035)
RAW-E01	McKay Interconnect
RAW-E02	Raw water pipeline from WGL2 to EGL4 with pump station
RAW-F04	36-in raw water pipeline from Quebec St & 140th to NWTP
RAW-F05	Hammer Reservoir Raw water pipeline and PS
RAW-F06	Feasibility study to add 10 MG capacity to McKay Pump Station.
RAW-F10	McKay PS Expansion
RAW-F11	McKay Chemical Feed Facility
	PHASE III (2035-2065)
RAW-F02	Thornton Water Project Phase II - 42-in raw water pipeline from WBWTP to TWTP
RAW-F07	Rogers Reservoir Raw water pipeline and Pump Station

Supply Operations

The Raw Water Master Plan developed performance criteria that were used to define the operating requirements of the raw water infrastructure. This section describes the proposed implementation of new raw water supply improvements to satisfy the Tier 1 performance criteria for the raw water infrastructure.

Table 2.2 and Figure 2.1 presents timing of future capacity requirements for the raw water supply system and water treatment facilities. Note that the maximum raw water supply capacities include deliveries from only the WGL2 PS, EGL4 PS, and Standley Lake through 2024. From 2025 onward, it includes delivery from the McKay PS and an additional 40 mgd from the completion of the TWP.

Table 2.2. Future Capacity Requirements for Raw and Water Treatment Systems

Raw Water CIP Phase	WTP Supply Requirement (mgd)			WTP Production Requirement (mgd)		
	WBWTP	TWTP	NWTP	WBWTP	TWTP	NWTP
Phase I: 2020 - 2025	60.3	21.2	0	54.8	20	0
Phase II: 2025 - 2035	60.3	21.2	11.4	54.8	20	10.8
Phase III: 2035 - 2065	60.3	21.2	22.8	54.8	20	21.5

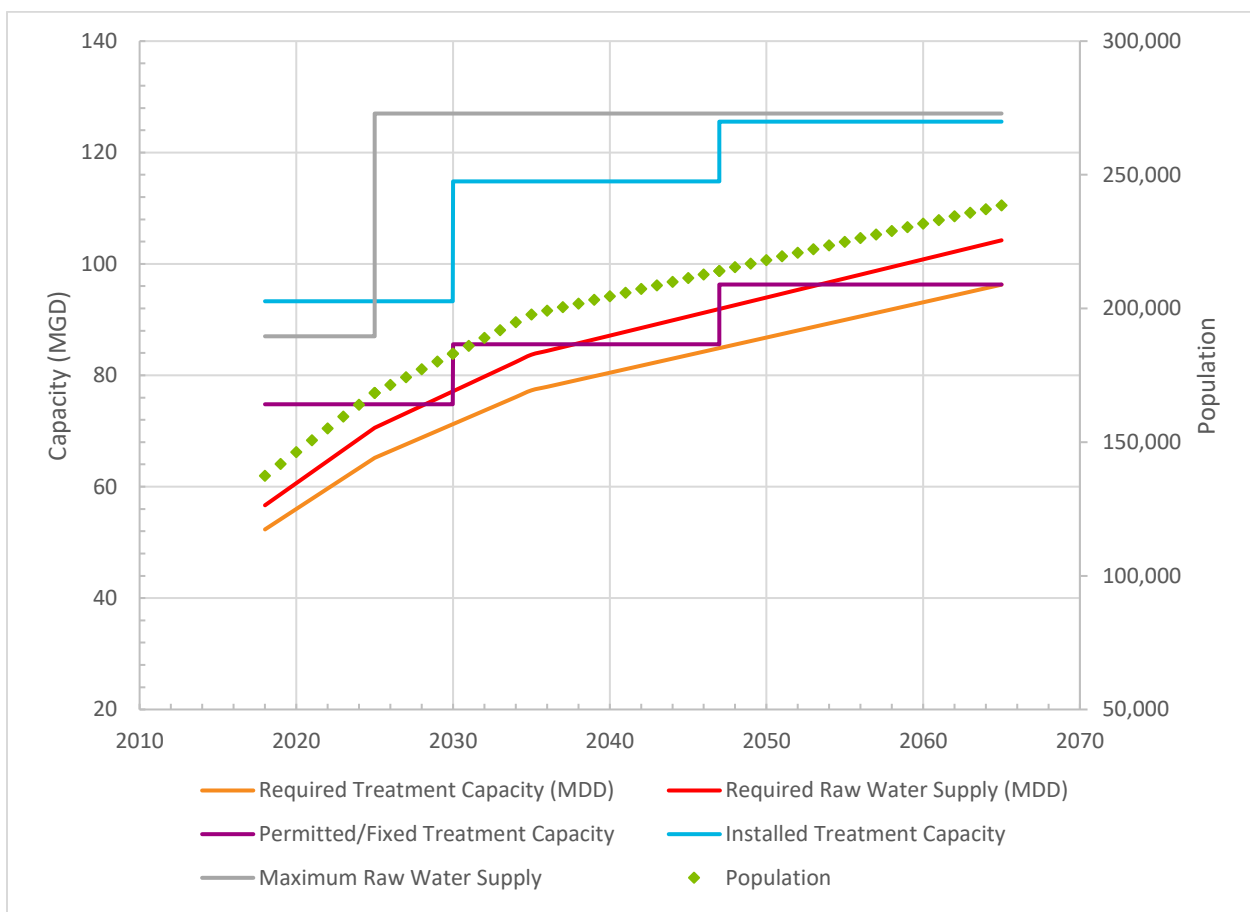


Figure 2.1. Future Capacity Requirements for Raw and Water Treatment Systems

Annual Supply Summary

Figure 2.2 presents one possible combination of how Thornton's different water supplies can be delivered to meet annual demands. Each unit block of available water rights in the figure could be reallocated to a different time of the year within Thornton's water rights operations to generate other combinations of possible delivery of water supplies. This estimated water supply availability provides a basic framework that could be used to deliver water supplies to each of the water treatment facilities under buildout conditions.

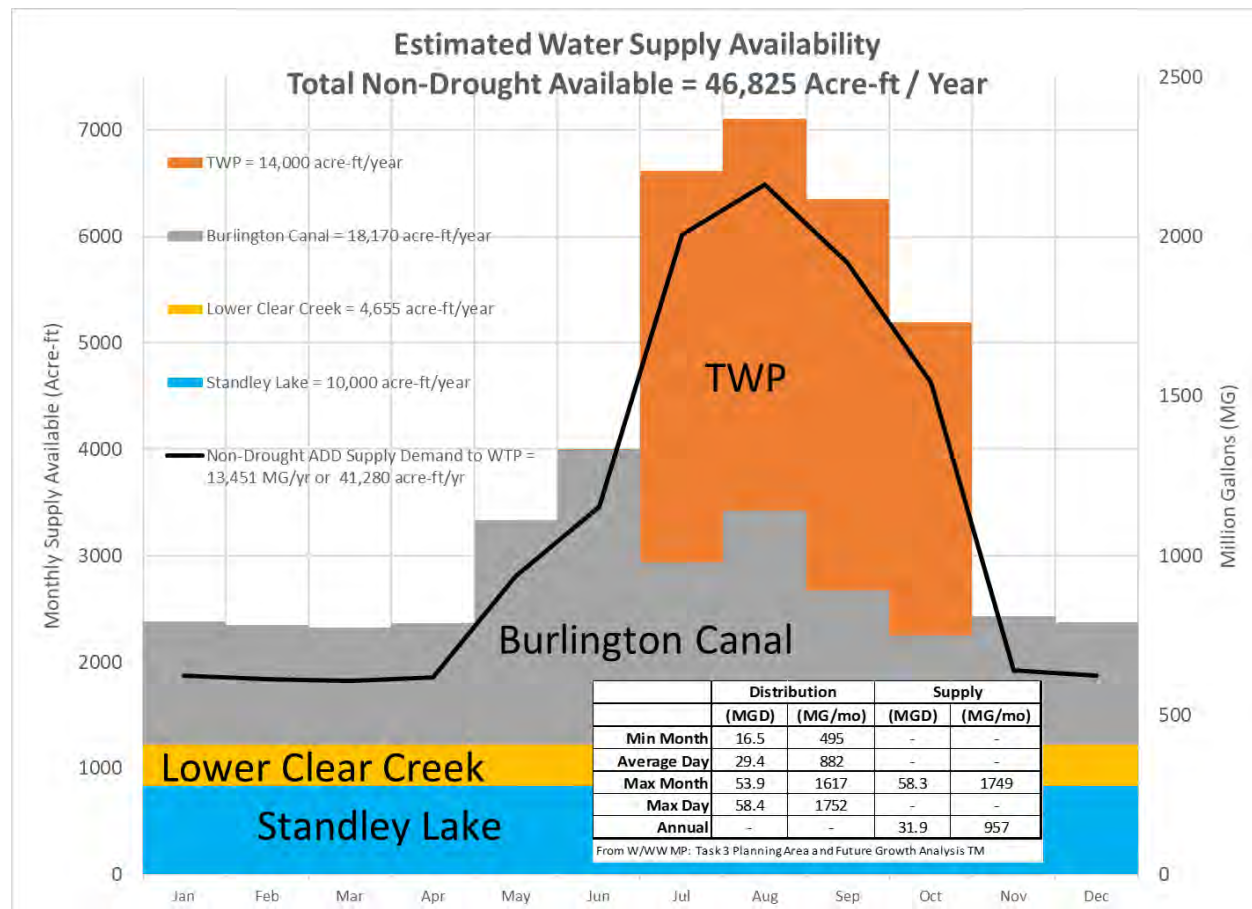


Figure 2.2. Estimated Water Supply Availability

Raw Water Supply Requirements at Buildout

This Utility Master Plan was developed on the basis of the forecasted buildout pumping capacities required for flow deliveries to each WTP presented in Table 2.3.

Table 2.3. Raw Water Delivery Capacity to Each Water Treatment Facility

Water Treatment Facility	Standley Lake Delivery Capacity (mgd)	Gravel Lakes Delivery Capacity (mgd)	TWP Delivery Capacity (mgd)
NWTP	0	10	22.8
TWTP	21.2	21.2	21.2
WBWTP	22	60.3	40.0

Table 2.3 Assumptions

- Annual Standley Lake supply is limited to 6,000 acre-feet under most stringent conditions.
- If not all the available water from Standley Lake is used by TWTP, the remaining raw water will be sent to WBWTP in order to use all volume of available supply from Standley Lake.
- Annual Lower Clear Creek flows are limited to existing use (4,800 acre-feet under most stringent conditions).
- Annual Thornton Water Project flows are limited to 14,000 acre-feet and maximum daily flow is limited to 40 mgd.
- Additional water supplies from Burlington Canal are assumed to be available as needed.

The capacities of existing and future raw water infrastructure facilities are described below for all of the CIP phases. Two possible operation scenarios for each CIP phase are presented as well. Both operation scenarios are for maximum day demand. The objective of Scenario 1 is to maximize the use of Standley Lake supply and minimize raw water pumping costs. The objective of Scenario 2 is to maximize raw water quality and maximize the use of TWP and Standley Lake supply. Operating constraints are provided for each phase. Objectives applied to both scenarios are listed below:

- Allocate Gravel Lakes to TWTP over WBWTP
- Prioritize McKay PS before EGL4 PS and WGL2 PS for series operation of Gravel Lakes (not possible during peak demands)
- TWP allocation first to NWTP, second to WBWTP

Operation Scenario: Current Conditions

Maximum and firm operating capacities for Current Conditions are summarized in Table 2.4. Firm capacity is operational capacity of the pump station with the largest pump out of service.

Table 2.4. Current Raw Water Supply Capacity Summary

Raw Water PS / Source	Firm Capacity ¹ (mgd)			Max Capacity ¹ (mgd)		
	Water Treatment Plant			Water Treatment Plant		
	WBWTP	TWTP	NWTP	WBWTP	TWTP	NWTP
Standley Lake (typ/drought)	-	10.7 / 5.4 ³	-	-	20 ⁴	-
EGL 4 (Gravel Lakes)	22	7.5 ²	-	22	15 ²	-
WGL2 (Gravel Lakes)	22	-	-	22	-	-

1. Capacities are limited by pipe size unless noted. Pipe capacity determined by pipe velocity guideline of 5 ft/s.

2. Capacity limited by pump size

3. Capacity limited by water rights

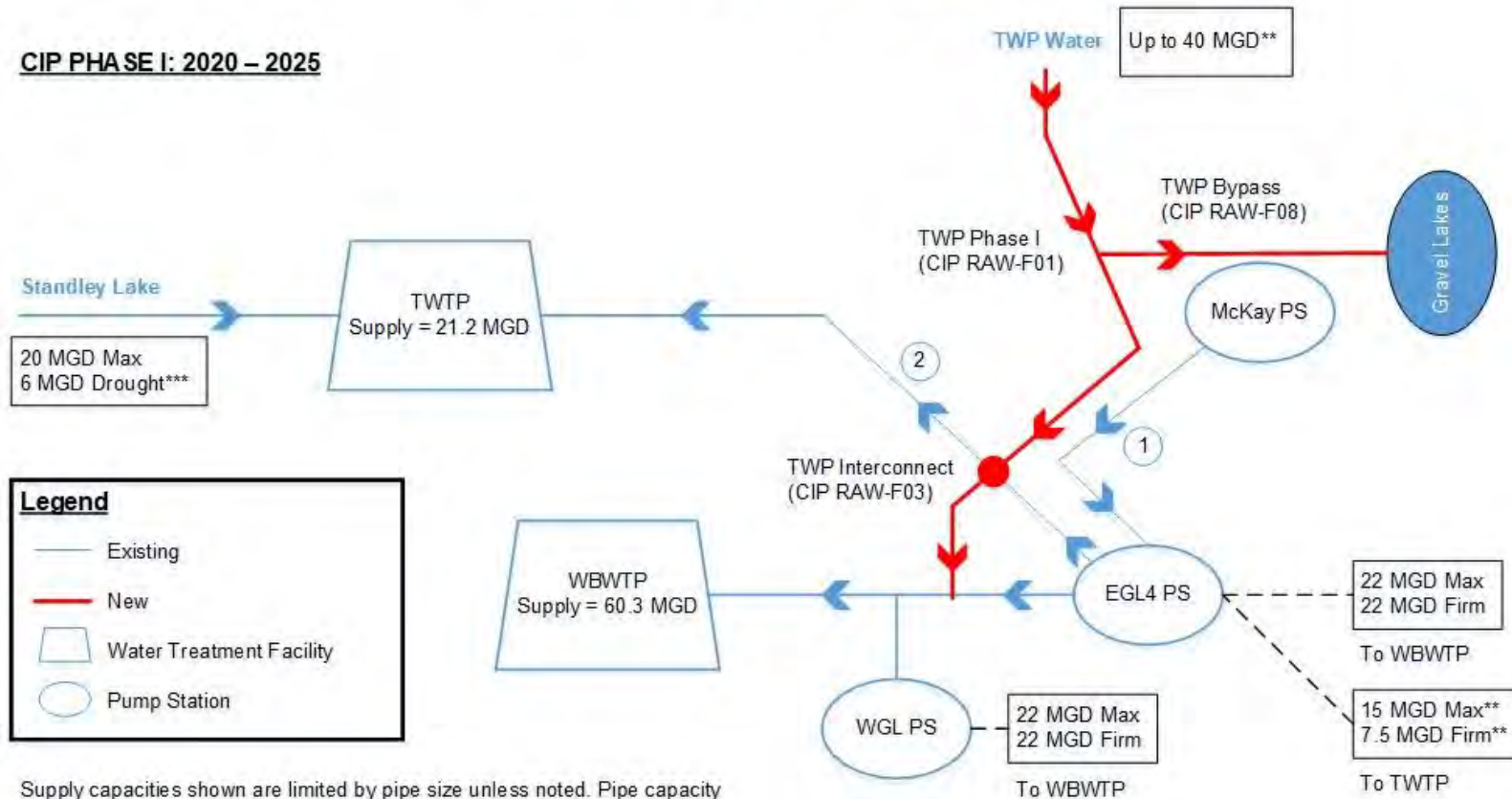
4. Maximum peak capacity over a short time frame

Operation Scenario: CIP Phase I (2020-2025) - TWP Pipeline extension to the WBWTP

Connection of the TWP Pipeline to the existing piping infrastructure via the TWP Interconnect will allow for raw water deliveries to TWTP and WBWTP. The flow capacity of the new TWP Pipeline will be driven by the pumping capabilities of the TWP pumps. The ability to deliver TWP raw water to WBWTP and TWTP will provide increased flexibility in raw water operations to address poor water quality events. Blending of raw water supplies to the water treatment plants will be possible but will increase the complexity of operations.

In addition to delivering all water supply sources to all WTPs, Phase I allows for the delivery of the full 40 mgd from the TWP to WBWTP. This provides operational flexibility in managing current water quality issues in the Gravel Lakes. During poor water quality periods TWP water may be delivered to WBWTP and Gravel Lakes water may be sent to TWTP where the conventional filtration process is better suited for treating poor raw water quality.

Figure 2.3 presents a schematic representation of the raw water infrastructure for Phase I.

Raw Water Supply CIP Phasing**CIP PHASE I: 2020 – 2025**

Supply capacities shown are limited by pipe size unless noted. Pipe capacity determined by 5 f/s velocity guideline.

* CIP RAW-F07, New Pump Station and Pipeline from Rogers Reservoir not shown

** Capacity limited by pump size

*** Capacity limited by water rights

1. Existing 36" diameter pipeline. McKay PS to EGL4 capacity = 22 MGD

2. Existing 36" diameter Thornton Parkway pipeline. EGL4 PS to TWTP capacity = 22 MGD

TWTP treatment process loss = 6%

WBWTP treatment process loss = 10%

Figure 2.3. Raw Water Supply CIP Phasing – Phase I: 2020 - 2025

Maximum and firm operating capacities for Phase I are summarized in Table 2.5

Table 2.5. Phase I Raw Water Supply Capacity Summary

Raw Water PS / Source	Firm Capacity ¹ (mgd)			Max Capacity ¹ (mgd)		
	Water Treatment Plant			Water Treatment Plant		
	WBWTP	TWTP	NWTP	WBWTP	TWTP	NWTP
Standley Lake (typ/drought)	-	10.7 / 5.4 ³	-	-	20 ⁴	-
EGL 4 (Gravel Lakes)	22	7.5 ²	-	22	15 ²	-
WGL2 (Gravel Lakes)	22	-	-	22	-	-
TWP	30	22	-	30	22	-

1. Capacities are limited by pipe size unless noted. Pipe capacity determined by pipe velocity guideline of 5 ft/s.

2. Capacity limited by pump size

3. Capacity limited by water rights

4. Maximum peak capacity over a short time frame

Maximum demand day operating scenarios for Phase I are presented in Table 2.6.

Table 2.6. Phase I Raw Water Operation Scenarios

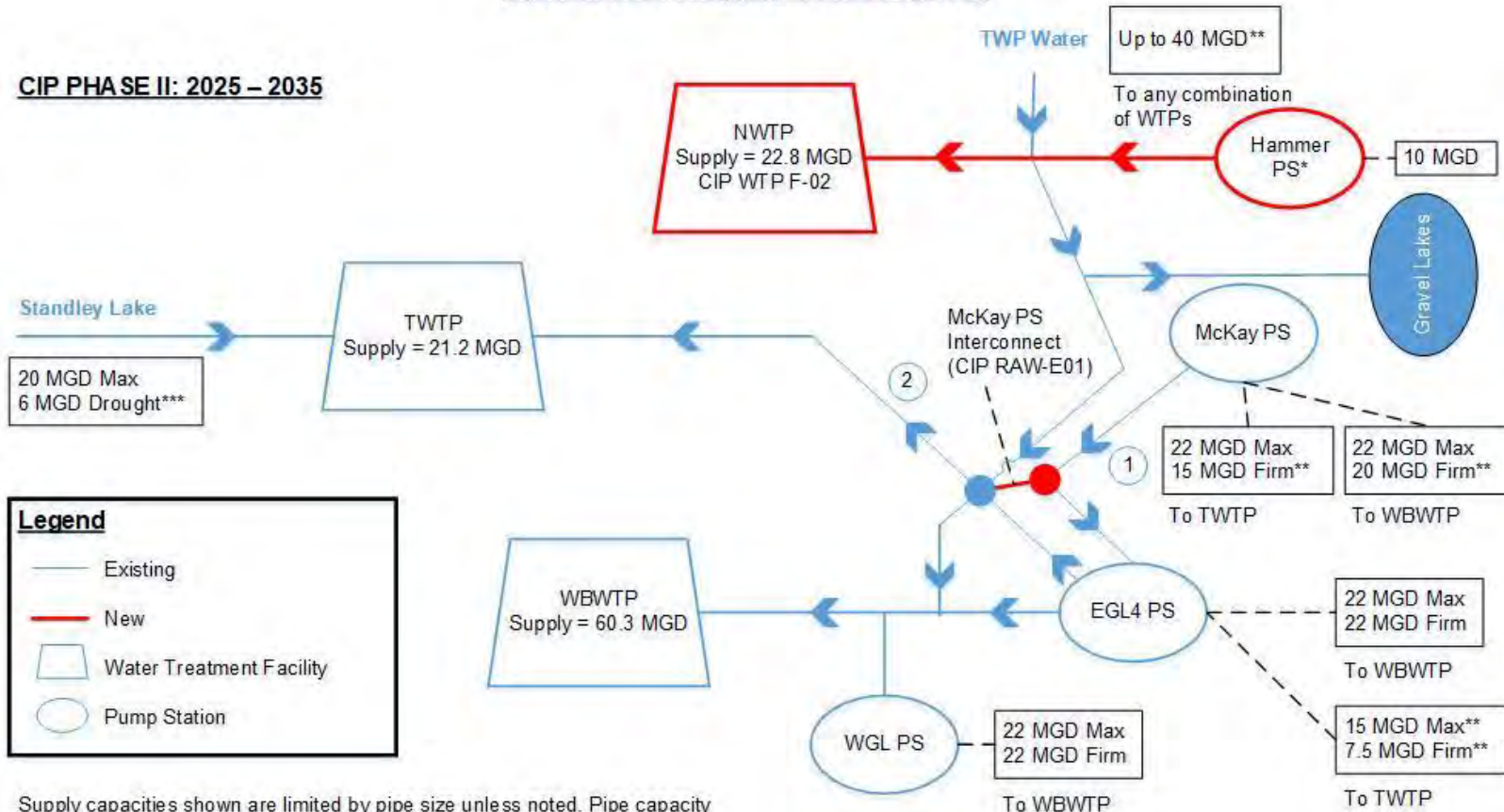
Raw Water Supply / Source	Scenario 1: Maximum Day Demand / Minimize Pumping Costs			Scenario 2: Maximum Day Demand / Maximize Water Quality (TWP and Standley Lake)		
	WTP Supply Requirement (mgd)			WTP Supply Requirement (mgd)		
	WBWTP	TWTP	NWTP	WBWTP	TWTP	NWTP
	60.3	21.2	0	60.3	21.2	0
Standley Lake		20.0			20.0	
EGL 4 (Gravel Lakes)	22.0				1.2	
WGL2 (Gravel Lakes)	22.0			20.3		
TWP	16.3	1.2		40.0		
Total	60.3	21.2	0.0	60.3	21.2	0.0

Operating constraints in Phase I include:

- TWP or Gravel Lakes water deliveries to TWTP utilize a 2-way pipeline that can only deliver these supplies to TWTP when the pipeline is not delivering Standley Lake supplies to the Gravel Lakes.
- The maximum rate at which TWP or Gravel Lakes water supplies can be delivered to TWTP is 22 mgd. This constraint is due to the pipeline capacity limits of the Thornton Parkway pipeline.
- The Gravel Lakes cannot operate in series when EGL4 PS or WGL2 PS is used to deliver water supplies to treatment facilities. The current raw water supply system allows for McKay to deliver to EGL4 PS, however the full benefits of operating the Gravel Lakes in series will not be realized. Short circuiting may occur and some water will have a shorter detention time, however water quality will improve upon existing conditions.

Operation Scenario: Phase II (2025-2035) - Gravel Lakes in Series and NWTP Online

Phase II includes the construction of the NWTP, the supply pipeline from the TWP to NWTP, and the new Hammer Reservoir supply pump stations and pipeline to the NWTP. Additionally the McKay Interconnect will be constructed, allowing for the Gravel Lakes to be operated in series. Figure 2.4 presents a schematic representation of the raw water infrastructure for Phase II.

Raw Water Supply CIP Phasing**CIP PHASE II: 2025 – 2035****Figure 2.4. Raw Water Supply CIP Phasing – Phase II: 2025 - 2035**

Maximum and firm operating capacities for Phase II are summarized in Table 2.7

Table 2.7. Phase II Raw Water Supply Capacity Summary

Raw Water PS / Source	Firm Capacity ¹ (mgd)			Max Capacity ¹ (mgd)		
	Water Treatment Plant			Water Treatment Plant		
	WBWTP	TWTP	NWTP	WBWTP	TWTP	NWTP
Standley Lake (typ/drought)	-	10.7 / 5.4 ³	-	-	20 ⁴	-
EGL 4 (Gravel Lakes)	22	7.5 ²	-	22	15 ²	-
WGL2 (Gravel Lakes)	22	-	-	22	-	-
TWP	30	22	30	30	22	30
McKay (Gravel Lakes)	20 ²	15 ²	-	22	22	-

1. Capacities are limited by pipe size unless noted. Pipe capacity determined by pipe velocity guideline of 5 ft/s.

2. Capacity limited by pump size

3. Capacity limited by water rights

4. Maximum peak capacity over a short time frame

Maximum demand day operating scenarios for Phase II are presented in Table 2.8.

Table 2.8. Phase II Raw Water Operation Scenarios

Raw Water Supply / Source	Scenario 1: Maximum Day Demand / Minimize Pumping Costs			Scenario 2: Maximum Day Demand / Maximize Water Quality (TWP and Standley Lake)		
	WTP Supply Requirement (mgd)			WTP Supply Requirement (mgd)		
	WBWTP	TWTP	NWTP	WBWTP	TWTP	NWTP
	60.3	21.2	11.4	60.3	21.2	11.4
Standley Lake		20.0			20.0	
EGL 4 (Gravel Lakes)	22.0			9.7		
WGL2 (Gravel Lakes)	17.5					
TWP			11.4	28.6		11.4
McKay (Gravel Lakes)	20.8	1.2		22.0	1.2	
Total	60.3	21.2	11.4	60.3	21.2	11.4

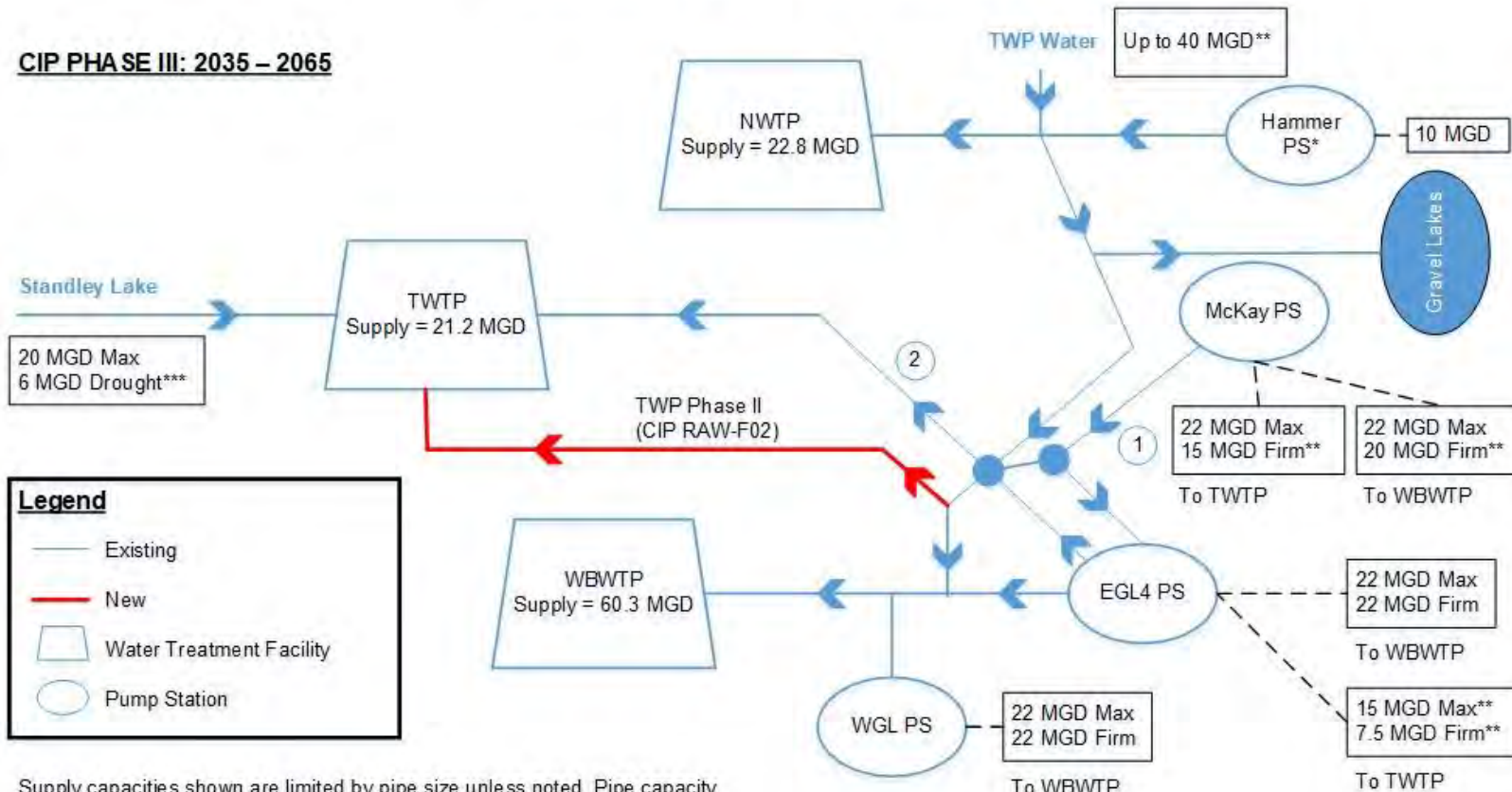
The same operating constraints from Phase II apply to Phase II with the following exceptions:

- TWP water can be delivered to TWTP and/or WBWTP concurrent with the Gravel Lakes operating in series, or when the McKay PS pumps Gravel Lakes water to TWTP.
- The Gravel Lakes cannot operate in series when EGL 4 PS or WGL2 PS is used to deliver water to WBWTP.

Operation Scenario - Phase III (2035-2065): TWP Pipeline Extension to the TWTP

The new TWP pipeline extension to TWTP will allow water from TWP to be delivered to all three WTPs concurrently, and to allow the Gravel Lakes to be operated in series at the same time. Phase III provides for added operational flexibility. The Thornton Parkway pipeline will no longer be required to deliver TWP water to TWTP. The Phase III improvements will remove all operating constraints from Phase I and II and will allow a full range of options for blending raw water from all raw water supplies at all the WTPs.

Figure 2.5 presents a schematic representation of the raw water infrastructure for Phase III.

Raw Water Supply CIP Phasing**CIP PHASE III: 2035 – 2065**

Supply capacities shown are limited by pipe size unless noted. Pipe capacity determined by 5 f/s velocity guideline.

* CIP RAW-F07, New Pump Station and Pipeline from Rogers Reservoir not shown

** Capacity limited by pump size

*** Capacity limited by water rights

1. Existing 36" diameter pipeline. McKay PS to EGL4 capacity = 22 MGD

2. Existing 36" diameter Thornton Parkway pipeline. EGL4 PS to TWTP capacity = 22 MGD

TWTP treatment process loss = 6%

WBWTP treatment process loss = 10%

Figure 2.5. Raw Water Supply CIP Phasing – Phase III: 2035 - 2065

Maximum and firm operating capacities for Phase III are summarized in Table 2.9

Table 2.9. Phase III Raw Water Supply Capacity Summary

Raw Water PS / Source	Firm Capacity ¹ (mgd)			Max Capacity ¹ (mgd)		
	Water Treatment Plant			Water Treatment Plant		
	WBWTP	TWTP	NWTP	WBWTP	TWTP	NWTP
Standley Lake (typ/drought)	-	10.7 / 5.4 ³	-	-	20 ⁴	-
EGL 4 (Gravel Lakes)	22	7.5 ²	-	22	15 ²	-
WGL2 (Gravel Lakes)	22	-	-	22	-	-
TWP	30	30	30	30	30	30
McKay (Gravel Lakes)	20 ²	15 ²	-	22	22	-

1. Capacities are limited by pipe size unless noted. Pipe capacity determined by pipe velocity guideline of 5 ft/s.

2. Capacity limited by pump size

3. Capacity limited by water rights

4. Maximum peak capacity over a short time frame

Maximum demand day operating scenarios for Phase III are presented in Table 2.10.

Table 2.10. Phase III Raw Water Operation Scenarios

Raw Water Supply / Source	Scenario 1: Maximum Day Demand / Minimize Pumping Costs			Scenario 2: Maximum Day Demand / Maximize Water Quality (TWP and Standley Lake)		
	WTP Supply Requirement (mgd)			WTP Supply Requirement (mgd)		
	WBWTP	TWTP	NWTP	WBWTP	TWTP	NWTP
	60.3	21.2	22.8	60.3	21.2	22.8
Standley Lake		20.0			20.0	
EGL 4 (Gravel Lakes)	22.0			21.1		
WGL2 (Gravel Lakes)	17.5					
TWP			22.8	17.2		22.8
McKay (Gravel Lakes)	20.8	1.2		22.0	1.2	
Total	60.3	21.2	22.8	60.3	21.2	22.8

The Raw Water Supply CIP Plan is summarized in Table 2.13. Associated capital expenditures are summarized in Table 2.19. Associated CIP project cutsheets are included in Appendix A.

The Raw Water Supply Master Plan located in Volume II of the Utility Master Plan.

Section 2-3 Water Treatment Facilities CIP Plan Summary

The Water Treatment Facilities CIP Plan consists of improvement projects at the two existing and one new water treatment facilities. Improvements at the existing WBWTP include projects intended to address limitations in the treatment processes with regards to criteria for water quality and production capacity as well as improved redundancy and reduced maintenance activities. The projects include studies to investigate options to eliminate the recycling of the clean-in-place wastes and decant water from treatment residuals to the Gravel Lakes system.

The elimination of the recycling will improve raw water quality delivered to WBWTP. Other WBWTP improvements, some already in-progress, include:

- converting to aluminum-based coagulants
- increasing membrane surface area
- completing an evaluation to improve solids handling
- executing maintenance projects for clarifier rehabilitation and coagulant storage tank repairs

CIP projects intended to address future demands are focused on providing an additional 21.5 mgd of treatment capacity by constructing a new NWTP. The projects include the acquisition of 15 acres of land for the new treatment facility site, construction of the new NWTP, including a mechanical dewatering facility, and developing the necessary power supply and standby power supply. Construction of the NWTP will be divided between two phases. Each phase is identified as a separate CIP project and each phase will provide an additional treatment capacity of 10.75 mgd.

A conceptual site plan for the NWTP at 21.5 mgd buildout capacity has been developed in the CIP as follows that reflects comments from Thornton on the original plan presented in the Water Treatment Facilities Master Plan:

- A new water storage tank associated with the Water Distribution CIP was relocated from 1,000 feet east of the NWTP to a high point on the facility site so the tank will be mostly buried while able to float on the Zone 1 hydraulic grade.
- The NWTP building location was revised to accommodate the new storage tank location and the addition of a mechanical dewatering building.
- The facility site was limited to 15 acres.
- The NWTP finished water clearwell will not be at the same elevation as the TWTP finished water clearwell, which feeds by gravity to Zone 1. Based on site elevations, pumping from the NWTP to new Zone 1 storage tank will be required.

Site plan, site sections, and an isometric rendering of the site are included in Appendix B of this Volume I report with the project cutsheets. Key elevation points for the new Zone 1 storage tank and the NWTP clearwell are summarized below in Table 2.11.

Table 2.11. Key Water Treatment Elevation Points for NWTP

Key Elevation Points	Elevation (feet)
New Storage Tank – High Water Level	5,375
New Storage Tank – Low Water Level	5,344
Estimated NWTP Clearwell Water Level	5,330

The Water Treatment Facilities CIP Plan is summarized in Table 2.14. Associated capital expenditures are summarized in Table 2.20. Associated CIP project cutsheets are included in Appendix B.

The Water Treatment Facilities Master Plan located in Volume III of the Utility Master Plan.

Section 2-4 Water Distribution CIP Plan Summary

Distribution, transmission, storage, and pumping projects were evaluated for the Water Distribution System CIP Plan in order to meet future water demands. Distribution system improvements resulting from future growth in new developed areas are expected to be funded by developers; thus, those projects are not included in the CIP Plan. The proposed CIP projects are summarized as follows:

- Approximately 33,000 linear feet (LF) of distribution improvements are proposed to meet Tier 1 and Tier 2 criteria in the system.
- Approximately 79,000 LF will be improvements to the transmission system with diameters larger or equal to 36 inches.
- Three storage tanks are included, two in Zone 1 near Sintra Lewis Pointe Park and adjacent to TWTP Clearwell 1, and one in Zone 3 near the existing Cherokee Tank. The total storage volume of the three tanks is 14.5 million gallons (MG). These improvements will require additional 12,200 LF of piping.
- Pumping improvements include an upgrade in capacity to Zone 5, Zone 3A, and WBWTP High Service Pump Stations, and a new pump station at the NWTP clearwell to connect the new NWTP to Zone 1.

The Water Distribution System CIP Plan is summarized in Table 2.15. Associated capital expenditures are summarized in Table 2.21. Associated CIP project cutsheets are included in Appendix C.

The Water and Wastewater Infrastructure Master Plan located in Volume IV of the Utility Master Plan.

Section 2-5 Wastewater Collection CIP Plan Summary

A total of seven Tier 1 CIP projects for the existing wastewater collection system were identified to meet the buildout peak dry weather flows. The projects will primarily occur in the northern portion of the collection system, where most of the growth is planned. The largest projects required to meet Tier 1 criteria include completion of a parallel to the Big Dry Creek Interceptor, which is necessary as growth occurs in the northwest portion of the collection system, and a main parallel to the Heritage Todd Creek Interceptor to accommodate planned growth in the northeast portion of the collection system. The remaining CIP projects for the existing system represent smaller but necessary improvement projects along the Big Dry Creek Interceptor and Heritage Todd Creek Interceptor.

As development occurs, portions of the collection system will need to be extended to serve new developments. A total of eight future CIP projects were identified to meet future peak dry weather flows in those areas. The future infrastructure is primarily located in the northern portion of the service area where the majority of future growth is planned, except for construction of an 88th Avenue Interceptor that is necessary for planned infill development.

Three CIP projects were also identified to meet peak wet weather requirements (Tier 2). All three projects are capacity improvement projects along the Big Dry Creek Interceptor upstream of the Big Dry Creek lift station.

CIP projects that are the responsibility of the developer are not included in the CIP Plan.

The Wastewater Collection System CIP Plan is summarized in Table 2.16. Associated capital expenditures are summarized in Table 2.22. Associated CIP project cutsheets are included in Appendix D.

The Water and Wastewater Infrastructure Master Plan is located in Volume IV of the Utility Master Plan.

Section 2-6 Water/Wastewater Rehabilitation and Replacement Program

The current water distribution and wastewater collection system pipeline Rehabilitation and Replacement Program was evaluated to determine if current funding is adequate to maintain the respective systems. The evaluation involved assessing the risk exposure associated with pipeline assets within each system, estimating rehabilitation and replacements schedules for pipeline assets, development of associated long-term funding, and prioritization of pipeline improvements.

The key findings of the risk exposure evaluation and prioritization analysis, are as follows after applying a unit pipe cost of \$19 per foot length, per inch pipe diameter to develop annual projected expenditures:

- The majority of the water system (86%), and the majority of the wastewater system (97%) fall within the Monitor and Forecast category; this action level implies that the assets are at a relatively low risk and monitoring can be completed on a more opportunistic basis.
- Three pipes in the water system and none of those in the wastewater system fall in the Urgent Rehab/Replace category; this action level implies immediate attention to avoid catastrophic system failures and potentially expensive emergency repairs.
- The current annual funding level for water main replacement of \$1 million (M) is significantly below the estimated recommended funding level of approximately \$7M/year.
- The estimated annual level of funding for water main replacement will address approximately 1% of the system in a 100-year average, while addressing approximately 2% of the system in the short-term.
- The current annual funding level for wastewater main replacement of \$1M is significantly below the estimated recommended funding level of approximately \$4.7M/year.
- The estimated annual level of funding for wastewater main replacement will address approximately 1.1% of the system in a 100-year average, while addressing approximately 2.2% of the system in the short-term.

Annual and longer-term expenditures of the Rehabilitation and Replacement Program are presented in Section 2-8.

More information on this evaluation of the Rehabilitation and Replacement Program can be found in the Water and Wastewater Infrastructure Master Plan located in Volume IV of the Utility Master Plan.

Section 2-7 CIP Plan Development

To develop the CIP Plan, the CIP projects summarized in Sections 2-2 through 2-5 were catalogued by system and listed in order by phase and priority. Each CIP project is identified with a CIP ID. A legend of the CIP ID nomenclature is presented in Table 2.12. CIP ID's for Water Distribution and Wastewater Collection are organized without suffix in the Water and Wastewater Infrastructure Master Plan and on CIP project cutsheets.

Table 2.12. CIP ID Legend

*CIP ID LEGEND
PREFIX DEFINITION
RAW = Raw Water Supply System Project
WTP = Water Treatment Facilities Project
DD = Water Distribution System Project / Distribution Pipeline
TT= Water Distribution System Project / Transmission Pipeline
P = Water Distribution System Project / Pump
SS = Water Distribution System Project / Storage
WW = Wastewater Collection System Project
SUFFIX DEFINITION
E = Existing System Deficiency
F = Future System Improvement

*CIP ID's for Water Distribution and Wastewater Collection are organized without suffix in the Water and Wastewater Infrastructure Master Plan and on CIP project cutsheets

Project priority was developed with phasing consideration to meet population and demand growth, project timing and sequencing with related or dependent projects, performance criteria tier rating, and other considerations and comments from Thornton. The projects were also sequenced to maintain the system's total average annual expenditure as close as possible. Projects were organized into three construction phases, based on required completion date; Phase I: 2020 - 2025 (5-year), Phase II: 2025 - 2035 (15-year), and Phase III: 2035 -2065 (service area buildout).

Section 2-8 CIP Plan

Documentation of the CIP Plan consists of four parts:

1. An index of all CIP projects organized by system type, phase and priority;
2. Informational cutsheets for each CIP project;
3. CIP Location Maps
4. Annual estimated expenditures to provide guidance of future planning and budgeting efforts.

Tier 3 level projects were not included in the cutsheets, the CIP location map, nor the annual expenditures. An index of CIP projects and CIP project cutsheets were not developed for the Rehabilitation and Replacement improvements since they are annual recurring expenditures.

A CIP Location Map, in reference to Tables 2.13 through 2.16, is provided in Figure E.1 in Appendix E. This map locates all the CIP projects on one map for planning reference. CIP projects associated with improvements to WBTWP (CIP ID: WTP-E01 through E12) and construction of the NWTP (CIP ID: WTP-F01 through F07) are not included on the map. Additionally CIP projects associated with feasibility studies and other improvements that do not have a specific location (CIP ID: RAW-E03 through E05, and RAW-F06), such as mobile back-up power to be used at multiple pump stations, are not included on the map.

A CIP Location Map of Improvements by Funding Source, in reference to Table E.1 and E.2, is provided in Figure E.2 in Appendix E. This map is limited to major developer funded improvements to the water transmission and wastewater collection systems. Additional developer funded improvements to the water distribution system and wastewater collection system within developments are not shown. Project cutsheets were not developed for developer funded projects. The length and size of the water transmission and wastewater collection projects are provided in Table E.1 and E.2 in Appendix E of Volume I. Some projects listed Tables E.1 and E.2 were eliminated as noted in the Figure E.2 legend. These projects were incorporated into other adjacent CIP projects after the completion of the Water and Wastewater Infrastructure Master Plan. Projects south of 88th Ave are not included in the figure for clarity as there are no improvements by developer.

Index tables for the Raw Water Supply, Water Treatment Facilities, Water Distribution and Wastewater Collection CIP Plans are presented in Tables 2.13 through 2.16, respectively.

Table 2.13. Raw Water Master CIP Table

CIP ID**	Phase (Project Completion Date)	Purpose	Project Type	Project Description	TWP Prj	Cost	Trigger	Project Timeline (Start / Completion)	
RAW-E03	2020-2025	Tier 1 - Raw Water Quality	Raw Water Quality	Study: Precipitant Addition to Burlington Canal		\$ 70,000	Existing Improvement	2020	2021
RAW-E04	2020-2025	Tier 1 - Raw Water Quality	Raw Water Quality	Study: Feasibility of Floating Solar Panel Installation on Gravel Lakes		\$ 70,000	Existing Improvement	2020	2021
RAW-E05	2020-2025	Tier 1 - Redundancy	Raw Water Quality	Mobile Pump Stations Back-up Power		\$ 11,940,000	Existing Improvement	2021	2022
RAW-E06	2020-2025	Tier 1 - Raw Water Quality	Raw Water Quality	New water quality profiling system and temperature data monitoring system on EGL4		\$ 480,000	Existing Improvement	2020	2021
RAW-F01	2020-2025	Tier 1 - Capacity	Raw Water Supply	Thornton Water Project Phase I - 42-in raw water pipeline from 168th Ave to WBWTP (shown on 2 figures)	x	\$ 56,355,000	Growth - MDD = 74.8 MGD	2022	2025
RAW-F03	2020-2025	Tier 1 - Capacity	Raw Water Supply	Interconnect to deliver TWP water to TWTP & WBWTP, includes the pipe, valves, meters, vaults and connection to SCADA, connect new 42-in TWP pipeline to 36-in Thornton Pkwy pipeline	x	\$ 8,600,000	Growth - MDD = 74.8 MGD	2023	2026
RAW-F08	2020-2025	Tier 1 - Capacity	Raw Water Supply	TWP Bypass pipeline to Gravel Lakes, located near McKay PS, includes tee and approx 20 LF pipe	x	\$ 1,500,000	Growth - MDD = 74.8 MGD	2023	2026
RAW-F09	2020-2025	Tier 1 - Capacity	Raw Water Supply	Chemical Feed Facility located north of 140th Avenue on the TWP pipeline on Quebec Street, sized for buildout capacity	x	\$ 595,000	Growth - MDD = 74.8 MGD	2024	2025
RAW-E01	2025-2035	Tier 1 - Raw Water Quality	Raw Water Quality	Interconnect to allow Gravel Lakes operation in series and for McKay PS deliver directly to WBWTP & TWTP, includes moderate length of pipe and valving to connect 36-inch McKay pipeline to 54-inch WBWTP supply and 36-inch Thornton Pkwy pipeline		\$ 3,530,000	Existing Improvement	2026	2027
RAW-E02	2025-2035	Tier 1 - Raw Water Quality	Raw Water Quality	Raw water pipeline from WGL2 to EGL4 with pump station		\$ 6,840,000	Existing Improvement	2026	2027
RAW-F04	2025-2035	Tier 1 - Capacity	Raw Water Supply	36-in raw water pipeline from Quebec St & 140th to NWTP		\$ 10,160,000	Growth - MDD = 74.8 MGD	2026	2027
RAW-F05	2025-2035	Tier 1 - Capacity	Raw Water Supply	24-in Raw water pipeline from Hammer Reservoir to Quebec St & E-470 Ave and New Pump Station		\$ 11,530,000	Growth - MDD = 74.8 MGD	2025	2026
RAW-F06	2025-2035	Tier 2 - Water Quality	Raw Water Supply	Feasibility study to add 10 MG capacity to McKay Pump Station.		\$ 210,000	Growth - MDD = 74.8 MGD	2026	2027
RAW-F10	2025-2035	Tier 2 - Water Quality	Raw Water Supply	Addition of 10 MGD capacity at McKay PS, includes new pump with VFD, electrical upgrade, bldg expansion and chemical feed equipment increase feed capacity		\$ 10,000,000	Growth - MDD = 74.8 MGD	2028	2029
RAW-F11	2025-2035	Tier 1 - Water Quality	Raw Water Supply	Chemical Feed Facility located at McKay PS, building sized for 20 mgd, equipment sized for 10 mgd		\$ 595,000	Growth - MDD = 74.8 MGD	2026	2027
RAW-F02	2035-2065	Tier 2 - Capacity	Raw Water Supply	Thornton Water Project Phase II - 42-in raw water pipeline from WBWTP to TWTP along Hoffman Way	x	\$ 8,645,000	Tier 2 Improvement	2035	2036
RAW-F07	2035-2065	Tier 2 - Redundancy	Raw Water Supply	24-in Raw water pipeline from Rogers Reservoir to Quebec St & 168 th Ave and New Pump Station		\$ 17,660,000	Tier 2 Improvement	2040	2041
RAW-F12	2035-2065	Tier 3 - Redundancy	Raw Water Supply	Redundant Thornton Water Project Phase I - raw water pipeline 168th Ave to WBWTP		\$ 56,355,000	Tier 3 Improvement	N/A	N/A
RAW-F13	2035-2065	Tier 3 - Redundancy	Raw Water Supply	Redundant Thornton Water Project Phase II - WBWTP to TWTP		\$ 8,645,000	Tier 3 Improvement	N/A	N/A
RAW-F14	2035-2065	Tier 3 - Redundancy	Raw Water Supply	Redundant raw water pipeline from Quebec Blvd & 140th to NWTP		\$ 10,160,000	Tier 3 Improvement	N/A	N/A
RAW-F15	2035-2065	Tier 3 - Redundancy	Raw Water Supply	Redundant raw water pipeline from Standley Lake to TWTP - 48 inch portion		\$ 43,830,000	Tier 3 Improvement	N/A	N/A
RAW-F16	2035-2065	Tier 3 - Redundancy	Raw Water Supply	Redundant raw water pipeline from Standley Lake to TWTP - 36 inch portion		\$ 19,580,000	Tier 3 Improvement	N/A	N/A
RAW-F17	2035-2065	Tier 3 - Redundancy	Raw Water Supply	Redundant raw water pipeline from EGL4 to TWTP (include river crossing)		\$ 21,600,000	Tier 3 Improvement	N/A	N/A
RAW-F18	2035-2065	Tier 3 - Redundancy	Raw Water Supply	Redundant raw water pipeline from EGL4 to WBWTP (include river crossing)		\$ 8,000,000	Tier 3 Improvement	N/A	N/A
RAW-F19	2035-2065	Tier 3 - Redundancy	Raw Water Supply	Redundant raw water pipeline from McKay to WBWTP (parallel existing 36 inch to EGL#4, no river crossing)		\$ 15,160,000	Tier 3 Improvement	N/A	N/A
RAW-F20	2035-2065	Tier 3 - Energy Cost Savings	Sustainability	Study: Micro-Hydro Power on Standley Lake Supply Pipeline		\$ 40,000	Tier 3 Improvement	N/A	N/A
RAW-F21	2035-2065	Tier 3 - Reduce Raw Water Losses	Sustainability	Study: Water Evaporation Reduction Technologies on RWGLS		\$ 70,000	Tier 3 Improvement	N/A	N/A

**Project Cutsheets not provided for Tier 3 improvements

*CIP ID LEGEND:

PREFIX DEFINITION

RAW = Raw Water Supply System Project

WTP = Water Treatment Facilities Project

DD = Water Distribution System Project / Distribution Pipeline

TT= Water Distribution System Project / Transmission Pipeline

P = Water Distribution System Project / Pump

SS = Water Distribution System Project / Storage

WW = Wastewater Collection System Project

SUFFIX DEFINITION

E = Existing System Deficiency

F = Future System Improvement

*CIP ID's for Water Distribution and Wastewater Collection are organized without suffix in the Water and Wastewater Infrastructure Master Plan and on CIP project cutsheets

Table 2.14. Water Treatment Master CIP Table

CIP ID**	Phase (Project Completion Date)	Purpose	Project Type	Project Description	Cost	Dependant CIP	Trigger	Project Timeline (Start / Completion)	
WTP-E01	2020-2025	Tier 1 - Water Quality	Water Treatment	Existing WBWTP Improvement: Convert to alumimun-based coagulants from iron-based coagulants	\$ -		Existing Improvement	2020	2021
WTP-E02	2020-2025	Tier 1 - Water Quality	Water Treatment	Existing WBWTP Improvement: Improvements for PAC dry storage and installation of PAC wetting system	\$ 710,000	WTP-E01	Existing Improvement	2020	2021
WTP-E03	2020-2025	Tier 1 - Capacity	Water Treatment	Existing WBWTP Improvement: Increase membrane surface area by using older membranes to equip unused cassettes	\$ -		Existing Improvement	2020	2021
WTP-E04	2020-2025	Tier 1 - Operations	Water Treatment	Existing WBWTP Improvement: Residuals management improvement, addition of 70,000 sq ft of lagoons	\$ 1,100,000		Existing Improvement	2020	2021
WTP-E05	2020-2025	Tier 1 - Operations	Water Treatment	Existing WBWTP Improvement: Study to evaluate clarifier flow distribution	\$ 30,000		Existing Improvement	2020	2021
WTP-E06	2020-2025	Tier 1 - Water Quality	Water Treatment	Existing WBWTP Improvement: Study to Eliminate Recycling for Clean-in-Place Wastes	\$ 30,000		Existing Improvement	2020	2021
WTP-E07	2020-2025	Tier 1 - Water Quality	Water Treatment	Existing WBWTP Improvement: Study to determine best practices for lagoon discharge water management	\$ 50,000	WTP-E06,E08	Existing Improvement	2020	2021
WTP-E08	2020-2025	Tier 1 - Water Quality	Water Treatment	Existing WBWTP Improvement: Study to determine best practices to manage water treatment residuals	\$ 110,000		Existing Improvement	2020	2021
WTP-E09	2020-2025	Tier 1 - Maintenance	Water Treatment	Existing WBWTP Improvement: Clarifier Coating Rehabilitation	\$ 500,000		Existing Improvement	2020	2021
WTP-E10	2020-2025	Tier 1 - Redundancy	Water Treatment	Existing WBWTP Improvement: Additional air compressor and reject pump for membrane system	\$ 500,000		Existing Improvement	2020	2021
WTP-E11	2020-2025	Tier 1 - Capacity	Water Treatment	Existing WBWTP Improvement: Expansion of Membrane Train 8	\$ 1,840,000		Existing Improvement	2020	2021
WTP-E12	2020-2025	Tier 1 - Maintenance	Water Treatment	Existing WBWTP Improvement: Coagulant Tank Repairs	\$ 30,000		Existing Improvement	2020	2021
WTP-F01	2020-2025	Tier 1 - Capacity	Water Treatment	Land Acquisition for NWTP	\$ 3,000,000		Growth - MDD = 74.8 MGD	2025	2026
WTP-F02	2025-2035	Tier 1 - Capacity	Water Treatment	New NWTP Phase I - 10.75 MGD capacity, treatment plant only, does not include dewatering, finished water storage tank, off site power supply to transformer	\$ 43,842,000		Growth - MDD = 74.8 MGD	2027	2030
WTP-F03	2025-2035	Tier 1 - Capacity	Water Treatment	Mechanical Dewatering Infrastructure	\$ 15,620,000		Growth - MDD = 74.8 MGD	2029	2030
WTP-F04	2025-2035	Tier 1 - Capacity	Water Treatment	Power Supply to NWTP, baseline power supply cost, including offsite infrastructure and power supply to transformer	\$ 1,990,000		Growth - MDD = 74.8 MGD	2028	2029
WTP-F05	2025-2035	Tier 1 - Redundancy	Water Treatment	Standby Power (Tier 1 – Provide Standby Generator for Full Production)	\$ 2,210,000		Growth - MDD = 74.8 MGD	2028	2029
WTP-F06	2025-2035	Tier 2 - Redundancy	Water Treatment	Standby Power (Tier 2 – Upgrade to Second Utility feed)	\$ 1,330,000		Growth - MDD = 74.8 MGD	2028	2029
WTP-F07	2035-2065	Tier 1 - Capacity	Water Treatment	NWTP Phase II - additional 10.75 MGD capacity	\$ 43,842,000		Growth - MDD = 85.6 MGD	2046	2047
WTP-F08	2035-2065	Tier 3	Water Treatment	Standby Power (Tier 3 – Upgrade to Emergency Generator meeting NEC)	\$ 220,000		Growth - MDD = 74.8 MGD	N/A	N/A

**Project Cutsheets not provided for Tier 3 improvements

*CIP ID LEGEND:

PREFIX DEFINITION

RAW = Raw Water Supply System Project

WTP = Water Treatment Facilities Project

DD = Water Distribution System Project / Distribution Pipeline

TT= Water Distribution System Project / Transmission Pipeline

P = Water Distribution System Project / Pump

SS = Water Distribution System Project / Storage

WW = Wastewater Collection System Project

SUFFIX DEFINITION

E = Existing System Deficiency

F = Future System Improvement

*CIP ID's for Water Distribution and Wastewater Collection are organized without suffix in the Water and Wastewater Infrastructure Master Plan and on CIP project cutsheets

Table 2.15. Water Distribution Master CIP Table (page 1 of 2)

CIP ID	Phase (Project Completion Date)	Purpose	Project Type	Project Description	Cost	Dependant CIP	Zone	Trigger	Project Timeline (Start / Completion)	
P-01(E)	2020-2025	Tier 1 - Pumping	Pump unit replacement	Replacement of 2 units in Zone 5 Pump Station, each with a capacity of 1,500gpm.	\$ 146,900		Zone 5	Existing improvement	2020	2021
SS-01(F)	2020-2025	Tier 1 - Storage	New ground storage	New 5MG Tank west of Sintra Lewis Pointe Park, north of 140th Ave.	\$ 13,214,900		Zone 1	Zone 1 Storage Upgrade	2021	2022
SS-02(F)	2020-2025	Tier 1 - Storage	New ground storage	New 3.5 MG tank near existing Cherokee Tank.	\$ 9,522,500		Zone 3	Zone 3 Storage Upgrade	2022	2023
TT13(F)	2020-2025	Tier 1 - Supply	New transmission pipe	New pipe from Hilltop Tank to the new 5MG Tank. The new line is a 48-in with an approximate length of 1,900 ft.	\$ 2,209,600		Zone 1	Zone 1 Storage Upgrade	2022	2023
DD31(E)	2020-2025	Tier 1 - Capacity	New pipe or pipe replacement	Installation of a parallel pipe along Eppinger Boulevard, between Hoffman Way and Ellen Court. The new line is a 12-in with an approximate length of 300 ft.	\$ 118,470		Zone 2	Existing improvement	2025	2026
DD32(E)	2020-2025	Tier 1 - Capacity	New pipe or pipe replacement	Installation of a parallel pipe on the west side of TWTP. The new line is a 16-in with an approximate length of 700 ft.	\$ 358,050		Zone 2	Existing improvement	2023	2024
DD34(E)	2020-2025	Tier 1 - Capacity	New pipe or pipe replacement	New pipe on property west of the TWTP. The new line is a 16-in with an approximate length of 700ft. This project will improve service pressure.	\$ 358,050	DD35	Zone 2	Existing improvement	2023	2024
DD35(E)	2020-2025	Tier 1 - Capacity	New pipe or pipe replacement	New pipe on property west of the TWTP. The new line is a 16-in with an approximate length of 100ft. This project will improve service pressure.	\$ 51,150		Zone 1	Existing improvement	2023	2024
DD25(E)	2025-2035	Tier 1 - Capacity, Fire flow	New pipe or pipe replacement	New pipe along Katherine Way between W 84th Ave and N Pecos St, and along N Pecos St between Katherine Way and W 82nd Pl. The new line is a 12-in with an approximate length of 1,700ft.	\$ 671,320		Zone 3	Existing improvement	2026	2027
DD27(E)	2025-2035	Tier 1 - Capacity, Fire flow	New pipe or pipe replacement	Installation of a parallel pipe along W 82nd Pl, between Nela Dr and Pecos Way. The new line is a 12-in with an approximate length of 400ft.	\$ 157,960		Zone 3	Existing improvement	2026	2027
DD28(E)	2025-2035	Tier 1 - Capacity, Fire flow	New pipe or pipe replacement	New pipe along Douglas Dr between Greenwood Blvd and N Pecos St, and along 82nd St between N Pecos St and Nola Dr. The new line is a 8-in with an approximate length of 3,300ft.	\$ 1,015,840		Zone 3	Existing improvement	2025	2026
DD30(F)	2025-2035	Tier 1 - Capacity	New pipe or pipe replacement	New pipe along Thornton Pkwy, just west of I-25. The line is a 12-in with an approximate length of 800 ft.	\$ 315,920		Zone 3	Growth - Average System Demand = 37mgd	2034	2035
P-03(F)	2025-2035	Tier 1 - Pumping	Pump unit replacement	Replacement of two units in Zone 1 - Wes Brown High Service Pump Station, each with a capacity of 10,000gpm.	\$ 4,614,000		Zone 1	Growth - Average System Demand = 37mgd	2029	2030
P-04(F)	2025-2035	Tier 1 - Pumping	New pump station	New pump station, pumping from NWTP to Zone 1, with four units, each with a capacity of 5,000gpm.	\$ 566,300		Zone 1	NWTP Construction	2033	2034
SS-03(F)	2025-2035	Tier 1 - Storage	New ground storage	New 6 MG tank adjacent to TWTP Clearwell 2.	\$ 15,857,900		Zone 1	Zone 1 Storage Upgrade	2034	2035
TT07(F)	2025-2035	Tier 1 - Facilitate Growth	New Pipe	New pipe parallel to and north of E-470 between Holly St and Quebec St, and along Holly St from E-470 to E 152th Ave. The new line is a 42-in with an approximate length of 5,200ft.	\$ 5,198,300		Zone 1	Growth North of Highway I470	2028	2029
TT10(F)	2025-2035	Tier 1 - Facilitate Growth	New Pipe	New pipe crossing E-470, then parallel to and south of E-470 between Holly St and Quebec St, and along Quebec St from E-470 to E 138th Ave. The new line is a 24-in with an approximate length of 7,400ft.	\$ 4,809,000		Zone 1	Growth North of Highway I470	2027	2028
TT14(F)	2025-2035	Tier 1 - Supply	New transmission pipe	New pipe from Clearwell 2 at TWTP along Thornton Pkwy and E 96th Ave to just west of the South Platte River . The new line is a 48-in and 16-in with an approximate length of 14,300 ft.	\$ 16,629,700	TT26	Zone 1	WBWTP Upgrade	2032	2033
TT16(F)	2025-2035	Tier 1 - Supply	Connection to existing pipe	New pipe just south of TWTP. The new line is a 24-in with an approximate length of 200 ft.	\$ 130,000	TT33	Zone 1	Zone 1 Storage Upgrade	2034	2035
TT17(F)	2025-2035	Tier 1 - Storage	New transmission pipe	New pipe from Cherokee Tank to I-25, along I-25 to E 105th Ave, along E 105th Ave to Grant Dr, along Grant Dr to E104th Ave, along E 104th Ave to to Washington St, and along Washington St to Old E 100th Ave. The new line is a 36-in with an approximate length of 12,200 ft.	\$ 10,507,900	TT25, TT18, TT19, or TT20	Zone 1	Zone 3 Storage Upgrade	2030	2031
TT18(F)	2025-2035	Tier 1 - Storage	Connection to existing pipe	New pipe along 102nd Ave crossing Washington St. The new line is a 24-in with an approximate length of 200 ft.	\$ 130,000	TT17	Zone 3	Zone 3 Storage Upgrade	2034	2035

Table 2.15. Water Distribution Master CIP Table (page 2 of 2)

	Phase (Project Completion Date)	Purpose	Project Type	Project Description	Cost	Dependant CIP	Zone	Trigger	Project Timeline (Start / Completion)	
TT19(F)	2025-2035	Tier 1 - Storage	Connection to existing pipe	New pipe crossing Washington St at Old E 100th Ave. The new line is a 24-in with an approximate length of 200 ft.	\$ 130,000	TT17	Zone 1	Zone 1 Storage Upgrade	2034	2035
TT20(F)	2025-2035	Tier 1 - Storage	New transmission pipe	New pipe from TWTP, running along Dorothy Blvd, Hoffman Way, and 95th Ave to Washington St, then running parallel to Washington St until Old E 100th Ave. The new line is a 36-in with an approximate length of 5,100 ft.	\$ 4,392,700	TT17	Zone 3	Zone 1 Storage Upgrade	2031	2032
DD29(F)	2035-2065	Tier 2 - Capacity	New pipe or pipe replacement	Installation of a parallel pipe along Thornton Pkwy, crossing I-25. The line is a 16-in with an approximate length of 700 ft.	\$ 358,050		Zone 3	Growth - Average System Demand = 37mgd	N/A	N/A
DD37(F)	2035-2065	Tier 2 - Capacity	New pipe or pipe replacement	New pipe along 104th Ave between Washington St and Irma Dr. The new line is a 16-in with an approximate length of 4,300 ft.	\$ 2,199,430		Zone 1	Growth - Average System Demand = 37mgd	N/A	N/A
DD41(F)	2035-2065	Tier 2 - Capacity	New pipe or pipe replacement	Installation of a parallel pipe along York St east of Lake Avery. The new line is a 16-in with an approximate length of 2,200 ft.	\$ 1,125,290		Zone 1	Growth - Average System Demand = 44mgd	N/A	N/A
DD42(F)	2035-2065	Tier 2 - Capacity	New pipe or pipe replacement	Installation of a parallel pipe along 136th Ave just east of York St. The new line is a 16-in with an approximate length of 600 ft.	\$ 306,900		Zone 1	Growth - Average System Demand = 37mgd	N/A	N/A
DD49(F)	2035-2065	Tier 1 - Facilitate Growth	New Pipe	New pipe east of Colorado Blvd, running south from south of E 160th Ave to intersect with bend in Colorado Blvd. The new line is a 36-in with an approximate length of 2,600 ft.	\$ 2,239,400	TT04	Zone 1	Developments north of E 156th Avenue	N/A	N/A
P-02(F)	2035-2065	Tier 1 - Pumping	Additional pump unit	Replacement of one unit in Zone 3A Pump Station, with a capacity of 8,000gpm.	\$ 1,153,500		Zone 3A	Growth - Average System Demand = 44mgd	N/A	N/A
TT02(F)	2035-2065	Tier 1 - Facilitate Growth	New Pipe	New pipe along Colorado Blvd at E 160th Ave. The new line is a 20-in with an approximate length of 200 ft.	\$ 111,700	TT04	Zone 1	Growth North of E 156th Avenue	N/A	N/A
TT04(F)	2035-2065	Tier 1 - Facilitate Growth	New Pipe	New pipe along E 160th Ave, from neighborhood east of York St, across Colorado Blvd to east of Holly St. The new line is a 24-in with an approximate length of 4,600 ft.	\$ 2,989,400		Zone 1	Growth North of E 156th Avenue	N/A	N/A
TT05(F)	2035-2065	Tier 1 - Facilitate Growth	New Pipe	New pipe along Colorado Blvd from just north of E-470 to the bend in the road. The new line is a 36-in with an approximate length of 1,500 ft.	\$ 1,292,000	TT06	Zone 1	Growth North of E 156th Avenue	N/A	N/A
TT06(F)	2035-2065	Tier 2 - Capacity	New pipe or pipe replacement	New pipe along Colorado Blvd, with the north end crossing E-470. The new line is a 24-in with an approximate length of 3,800 ft.	\$ 2,469,480	TT14	Zone 1	Growth North of Highway E470	N/A	N/A
TT08(F)	2035-2065	Tier 1 - Facilitate Growth	New Pipe	New pipe from E-470 west of Quebec St, along Ehler Pkwy, bending south near Unita St, crossing E-470 and bending east south of 144th Ave, then south along Yosemite St to 136th Ave. The new pipe is 36-in and 42-in with an approximate length of 15,400 ft.	\$ 15,394,900	TT07	Zone 1	Growth North of Highway I470	N/A	N/A
TT09(F)	2035-2065	Tier 1 - Facilitate Growth	New Pipe	New pipe along Quebec St from E 152nd Ave to Ehler Pkwy. The new line is a 20-in with an approximate length of 2,700 ft.	\$ 1,507,000		Zone 3H	Growth North of Highway I470	N/A	N/A
TT11(F)	2035-2065	Tier 1 - Supply	New transmission pipe	New pipe from WBWTP along Riverdale Rd and Yosemite St to E 136th Ave, along Holly St from E 136th Ave to 140th Ave, and along E 140th Ave to a NWTP tie-in. The new line is 36-in and 48-in with an approximate length of 57,400 ft.	\$ 66,751,100		Zone 1	WBWTP Upgrade	N/A	N/A
TT21(F)	2035-2065	Tier 2 - Capacity	New pipe or pipe replacement	New pipe along 120th Ave from Grant St to Washington St, and along Washington St from 120th Ave to 128th Ave. The new line is a 24-in with an approximate length of 7,700 ft.	\$ 5,003,940		Zone 3A	Growth - Average System Demand = 44mgd	N/A	N/A
TT22(F)	2035-2065	Tier 2 - Capacity	New pipe or pipe replacement	New pipe along 136th Ave from 136th Ave from Clayton St to connection north of 136th Ave Tank. The new line is a 24-in with an approximate length of 2,700 ft.	\$ 1,754,630		Zone 1	Growth - Average System Demand = 44mgd	N/A	N/A
TT26(F)	2035-2065	Tier 1 - Supply	Configuration change	New pipe bypassing the new 6MG tank (CIP SS-03), adjacent to TWTP Clearwell 2. The new line is a 48-in with an approximate length of 300 ft.	\$ 348,900	TT14	Zone 1	Growth - Average System Demand = 44mgd	N/A	N/A

CIPID#'s revised from Water and Wastewater Infrastructure Master Plan: CIPID DD46 was removed from the CIP Plan because the project was incorporated into an adjacent CIP project.

*CIP ID LEGEND:

PREFIX DEFINITION

RAW = Raw Water Supply System Project

WTP = Water Treatment Facilities Project

DD = Water Distribution System Project / Distribution Pipeline

TT= Water Distribution System Project / Transmission Pipeline

P = Water Distribution System Project / Pump

SS = Water Distribution System Project / Storage

WW = Wastewater Collection System Project

SUFFIX DEFINITION

E = Existing System Deficiency

F = Future System Improvement

*CIP ID's for Water Distribution and Wastewater Collection are organized without suffix in the Water and Wastewater Infrastructure Master Plan and on CIP project cutsheets

Table 2.16. Wastewater Collection Master CIP Table

CIP ID	Phase (Project Completion Date)	Purpose	Project Type	Project Description	Cost	***Trigger Flow (gpm)	Project Timeline (Start / Completion)	
WW4 (F)	2020-2025	Tier 1 - Buildout PDWQ d/D	Gravity Main Replacement	Todd Creek Collector Improvements. Gravity flow pipe is 12 to 15-in with a length of 3,068 ft.	\$ 624,000	900	2020	2021
WW6 (F)	2020-2025	Tier 1 - Buildout PDWQ d/D	Parallel Gravity Main	Heritage Todd Creek Interceptor Parallel. Gravity flow pipe is 18 to 21-in with a length of 5,708 ft.	\$ 3,022,000	2,300	2021	2022
WW1B (F)	2020-2025	Tier 1 - Buildout PDWQ d/D	Lift Station Expansion	Big Dry Creek Lift Station Expansion. Lift station has a flow of 8,043 gpm.	\$ 5,404,000	3,100	2024	2025
WW1A (F)	2025-2035	Tier 1 - Buildout PDWQ d/D	Parallel Gravity Main	Big Dry Creek Interceptor Parallel. Gravity flow pipe is 15 to 24-in with a length of 8,197 ft.	\$ 2,819,000	6,100	2027	2028
WW2 (F)	2025-2035	Tier 1 - Buildout PDWQ d/D	Gravity Main Replacement	Upstream Big Dry Creek Interceptor Improvement. Gravity flow pipe is 24-in with a length of 188 ft.	\$ 57,000	2,600	2030	2031
WW3 (F)	2025-2035	Tier 1 - Buildout PDWQ d/D	Gravity Main Replacement	Big Dry Creek Lateral Improvement. Gravity flow pipe is 12-in with a length of 1,600 ft.	\$ 225,000	900	2030	2031
WW5 (F)	2025-2035	Tier 1 - Buildout PDWQ d/D	Gravity Main Replacement	Upstream Heritage Todd Creek Interceptor Improvement. Gravity flow pipe is 15-in with a length of 1,269 ft.	\$ 578,000	900	2030	2031
WW17 (F)	2025-2035	Tier 2 - Buildout PDWQ d/D	Gravity Main Replacement	Big Dry Creek Lift Station Inlet. Gravity flow pipe is 27-in with a length of 141 ft.	\$ 53,000	4,600	2031	2032
WW18 (F)	2025-2035	Tier 2 - Buildout PDWQ d/D	Gravity Main Replacement	Upstream Big Dry Creek Interceptor Improvement. Gravity flow pipe is 24-in with a length of 498 ft.	\$ 141,000	2,600	2031	2032
WW19 (F)	2025-2035	Tier 2 - Buildout PDWQ d/D	Gravity Main Replacement	Upstream Big Dry Creek Interceptor Parallel Improvement. Gravity flow pipe is 24-in with a length of 417 ft.	\$ 163,000	2,300	2031	2032

*** Trigger = 70% Measure Flow

CIPID#'s revised from Water and Wastewater Infrastructure Master Plan:

CIPID WW17 is listed as CIP #15 in Table 13 of the Wastewater Collection System Evaluation (Chapter 6) of the Water and Wastewater Infrastructure Master Plan

CIPID WW18 is listed as CIP #16 in Table 13 of the Wastewater Collection System Evaluation (Chapter 6) of the Water and Wastewater Infrastructure Master Plan

CIPID WW19 is listed as CIP #17 in Table 13 of the Wastewater Collection System Evaluation (Chapter 6) of the Water and Wastewater Infrastructure Master Plan

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WW = Wastewater Collection System Project

SUFFIX DEFINITION

E = Existing System Deficiency

F = Future System Improvement

*CIP ID's for Water Distribution and Wastewater Collection are organized without suffix in the Water and Wastewater Infrastructure Master Plan and on CIP project cutsheets

Individual CIP project cutsheets are provided in Appendix A through D of the Utility Master Plan. The cutsheets are organized by CIP identification (ID) number order and grouped by system. Triggers for each project were used as a basis for the required construction schedules; these triggers are included on the cutsheets. Table 2.17 provides a summary of the trigger descriptions.

Table 2.17. CIP Project Trigger Descriptions

Trigger	Description
Existing Improvement	Improvement is required to address an existing deficiency
Growth - Average System Demand = 37mgd	Improvement will be required in the future, pending on expected growth
Growth - Average System Demand = 44mgd	Improvement will be required in the future, pending on expected growth
Developments north of E 156th Avenue	Improvement will serve future developments, pending on localized growth
WBWTP Upgrade	Improvement will support increase in supply capacity at WBWTP
Growth North of E-470	Improvement will serve future developments, pending on localized growth
Zone 1 Storage Upgrade	Improvement will support increase in storage capacity
Zone 3 Storage Upgrade	Improvement will support increase in storage capacity
NWTP Construction	Improvement will support supply improvements at NWTP
70% Measured Sewer Flow =	Improvement is required to meet future flows
Growth - Max Day Demand = 74.8 mgd	Improvement will be required in the future, pending on expected growth
Growth - Max Day Demand = 85.6 mgd	Improvement will be required in the future, pending on expected growth
Tier 2	Improvement identified as Tier 2
Tier 3	Improvement identified as Tier 3

The total CIP project costs and average annual CIP project costs for each of the planning periods are summarized in Table 2.18.

Table 2.18. Total and Average Annual CIP Costs by Phase

Phase	Total CIP Cost	Average Annual CIP Cost
2020-2025	\$122,554,012	\$20,425,669
2025-2035	\$178,734,448	\$17,873,445
2035-2065	\$357,083,620	\$17,854,181

Annual Expenditures for 2020 to 2035 for Raw Water, Water Treatment, Water Distribution, and Wastewater Collection are presented in Tables 2.19 through 2.22 and on Figures 2.6 through 2.9, respectively.

The total average annual expenditure for each system was calculated by using the project timeline from the master CIP tables. The CIP project costs were distributed over the timeline by assuming 20% of the cost in the first year of the project timeline, and the remaining cost split evenly over the remaining project years. Annual expenditures were calculated through 2035 to assist in annual budgeting. Annual expenditures were not calculated beyond the 15-year projection period because the information for longer projection periods would not be used for planning purposes without refinement.

The annual expenditure schedule was developed by scheduling the construction of each CIP project within the system's project timeline with the intent to meet phasing requirements. It was assumed that

each CIP project has a construction period of two years, design and construction, with the exception of the projects below:

1. The NWTP will be constructed over 4 years
2. Phase I of the TWP will be constructed over 3 years.

Table 2.19. Raw Water Annual Expenditures

*Annual Expenditures	
From	To
2020	2035
Total Cost	\$124,204,000
# of Years	15
Total Average	\$8,280,267
Year	Annual Spending
2020	\$124,000
2021	\$2,884,000
2022	\$20,823,000
2023	\$24,562,000
2024	\$30,741,000
2025	\$2,782,000
2026	\$13,491,000
2027	\$17,068,000
2028	\$2,000,000
2029	\$8,000,000
2030	\$0
2031	\$0
2032	\$0
2033	\$0
2034	\$0
2035	\$1,729,000

*Annual Expenditures do not include Tier 3 CIPs

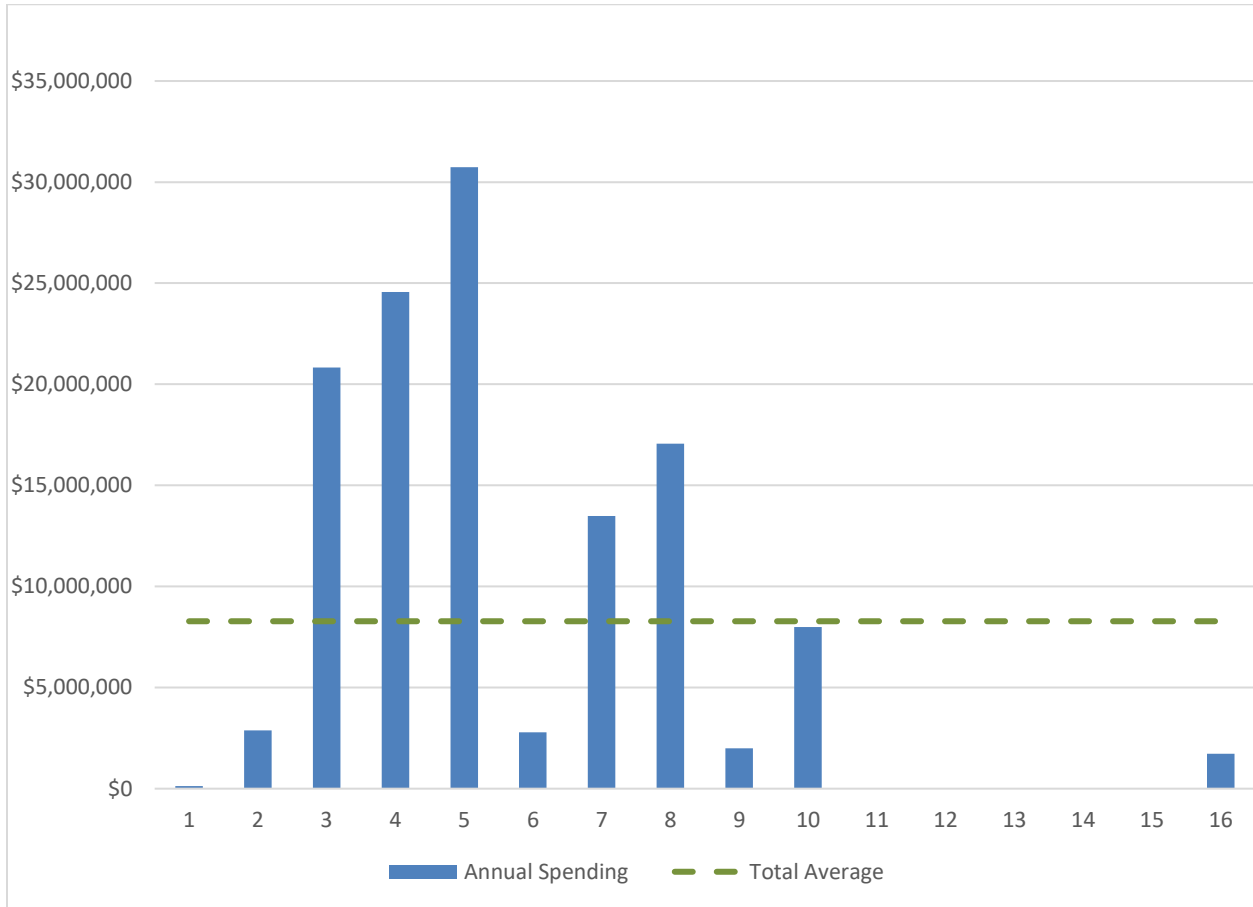


Figure 2.6. Raw Water Annual Expenditures (2020-2035)

Table 2.20. Water Treatment Annual Expenditures

*Annual Expenditures	
From	To
2020	2035
Total Cost	\$72,892,000
# of Years	15
Total Average	\$4,859,467
Year	Annual Spending
2020	\$980,000
2021	\$3,920,000
2022	\$0
2023	\$0
2024	\$0
2025	\$600,000
2026	\$2,400,000
2027	\$8,768,400
2028	\$12,797,200
2029	\$19,239,200
2030	\$24,187,200
2031	\$0
2032	\$0
2033	\$0
2034	\$0
2035	\$0

*Annual Expenditures do not include Tier 3 CIPs

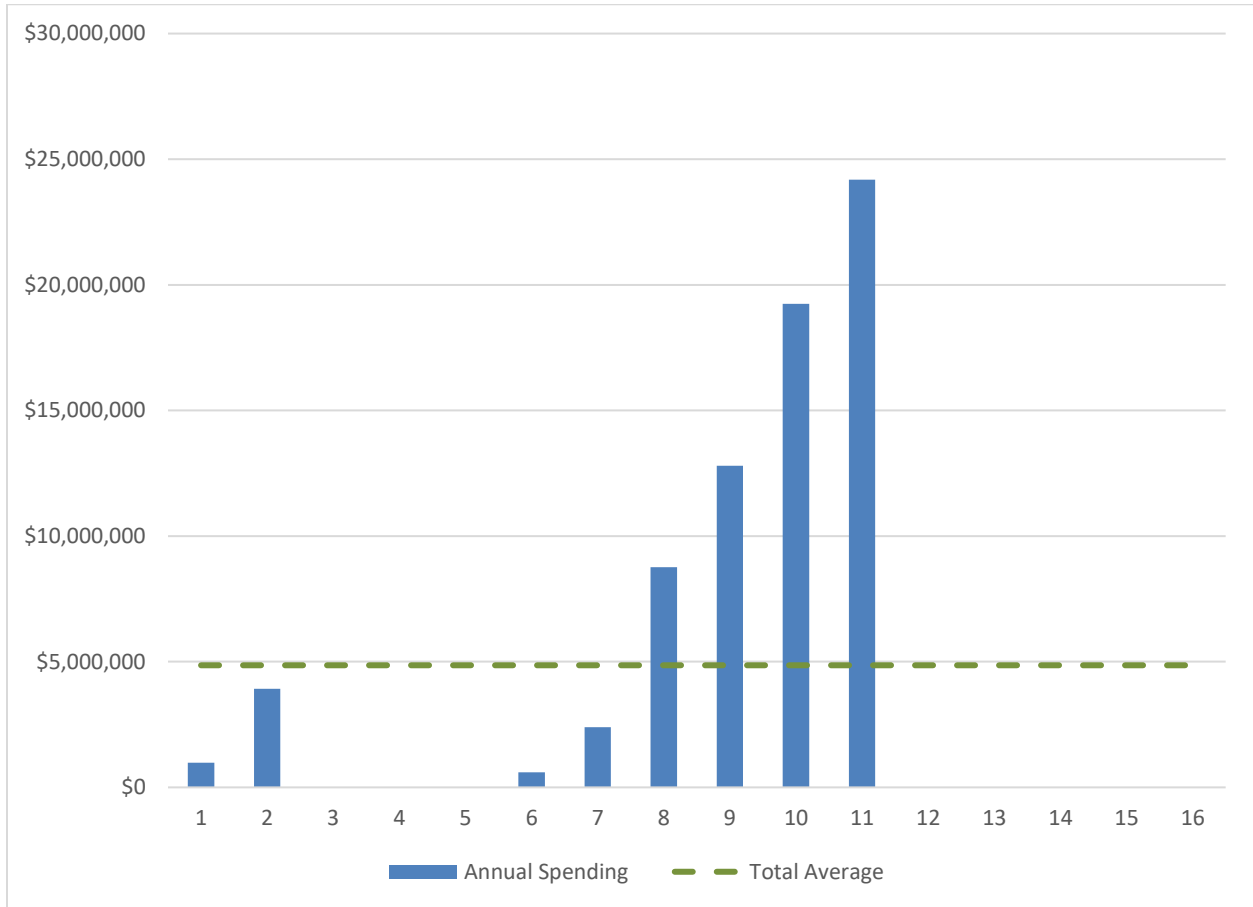


Figure 2.7. Water Treatment Annual Expenditures (2020-2035)

Table 2.21. Water Distribution Annual Expenditures

Annual Expenditures	
From	To
2020	2035
Total Cost	\$91,106,460
# of Years	15
Total Average	\$6,073,764
Year	Annual Spending
2020	\$29,380
2021	\$2,760,500
2022	\$12,918,340
2023	\$9,539,130
2024	\$613,800
2025	\$226,862
2026	\$1,073,304
2027	\$1,625,224
2028	\$4,886,860
2029	\$5,081,440
2030	\$5,792,780
2031	\$9,284,860
2032	\$6,840,100
2033	\$13,417,020
2034	\$3,765,804
2035	\$13,251,056

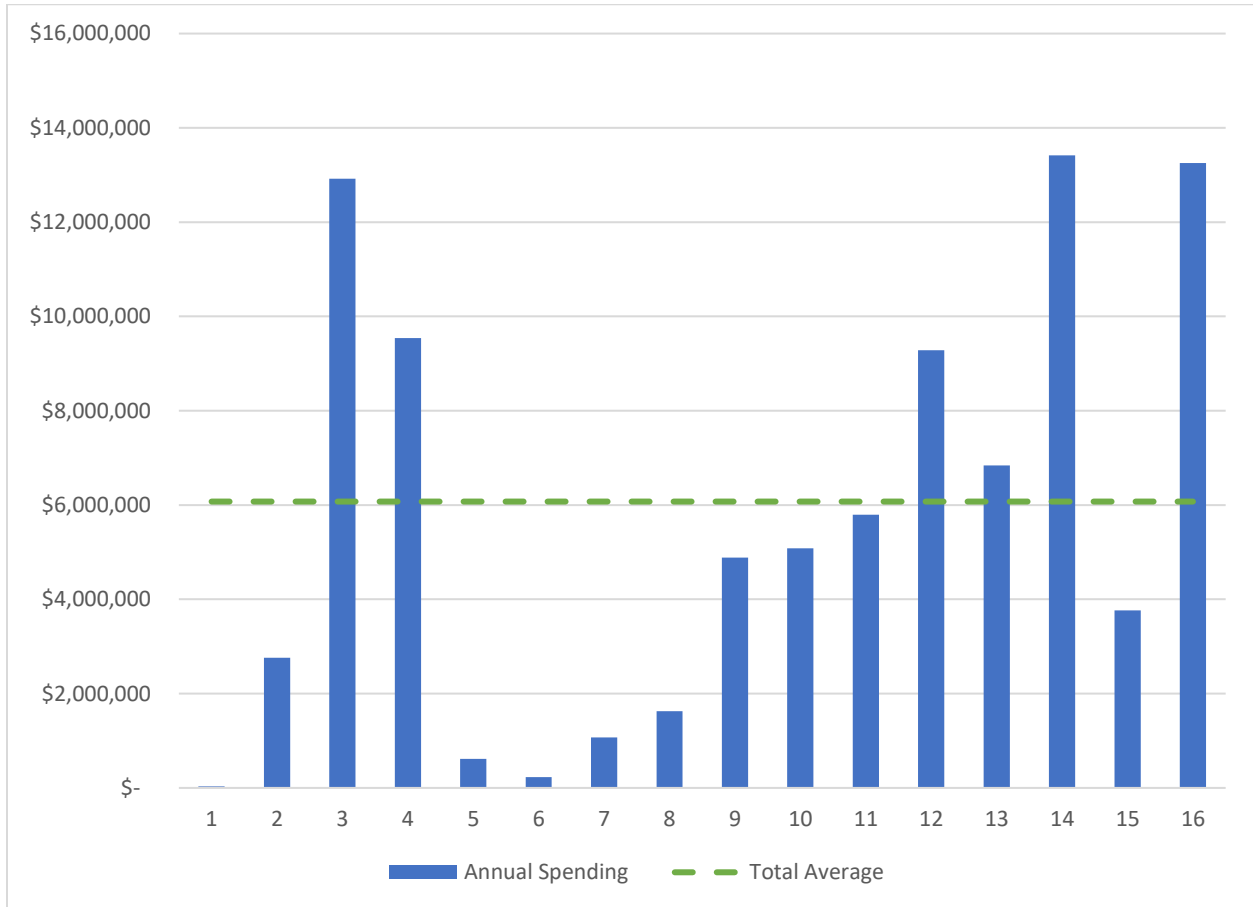


Figure 2.8. Water Distribution Annual Expenditures (2020-2035)

Table 2.22. Wastewater Collection Annual Expenditures

Annual Expenditures	
From	To
2020	2035
Total Cost	\$13,086,000
# of Years	15
Total Average	\$872,400
Year	Annual Spending
2020	\$124,800
2021	\$1,103,600
2022	\$2,417,600
2023	\$0
2024	\$1,080,800
2025	\$4,323,200
2026	\$0
2027	\$563,800
2028	\$2,255,200
2029	\$0
2030	\$172,000
2031	\$759,400
2032	\$285,600
2033	\$0
2034	\$0
2035	\$0

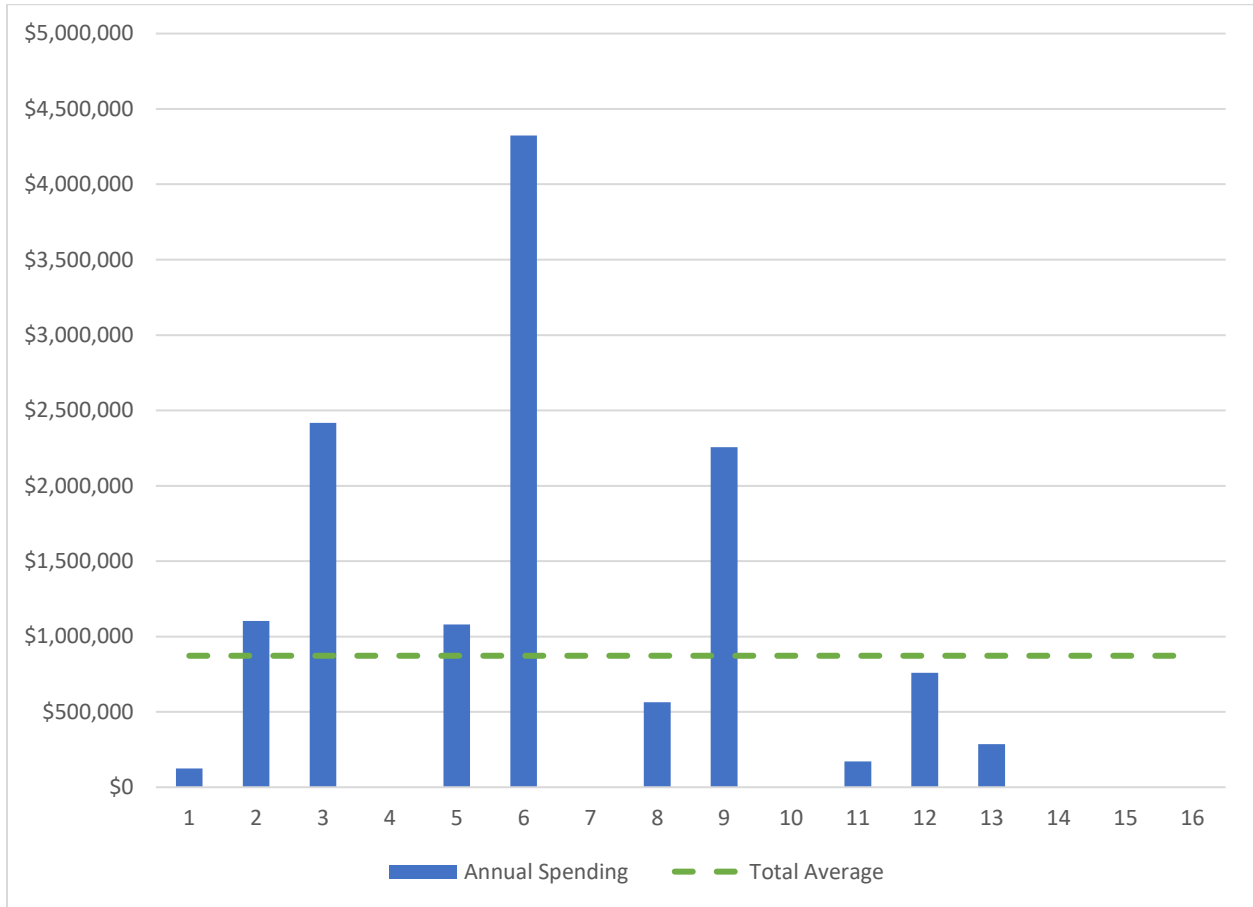


Figure 2.9. Wastewater Collection Annual Expenditures (2020-2035)

Total annual expenditures are presented in Table 2.23 and on Figure 2.10.

Table 2.23. Total Annual Expenditures

*Annual Expenditures	
From	To
2020	2035
Total Cost	\$301,288,460
# of Years	15
Total Average	\$20,085,897
Year	Annual Spending
2020	\$1,258,180
2021	\$10,668,100
2022	\$36,158,940
2023	\$34,101,130
2024	\$32,435,600
2025	\$7,932,062
2026	\$16,964,304
2027	\$28,025,424
2028	\$21,939,260
2029	\$32,320,640
2030	\$30,151,980
2031	\$10,044,260
2032	\$7,125,700
2033	\$13,417,020
2034	\$3,765,804
2035	\$14,980,056

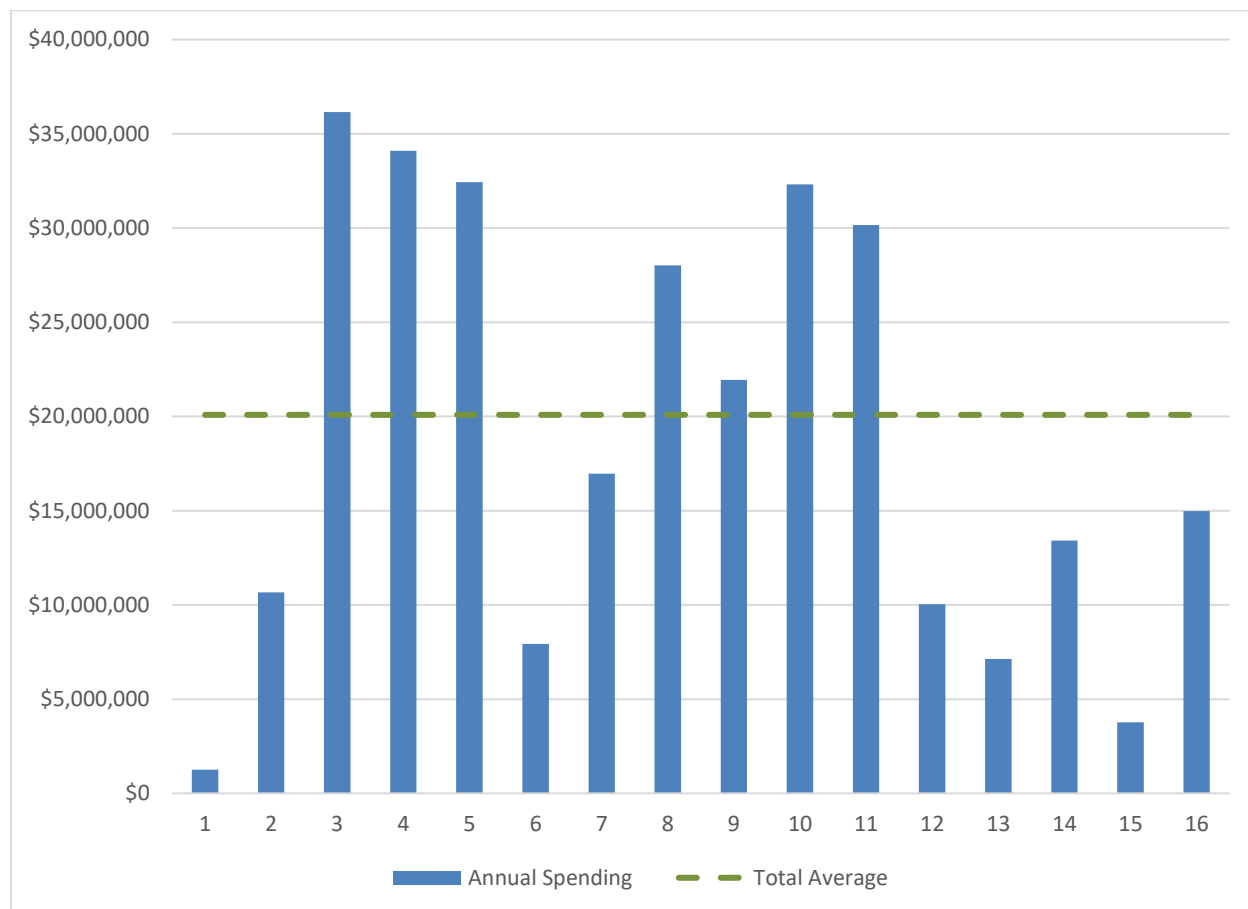


Figure 2.10. Total Annual Expenditures (2020-2035)

A summary of the Rehabilitation and Replacement Program for the water distribution and transmission system is presented in Table 2.24.

Table 2.24. Rehabilitation and Replacement Program Summary – Water Distribution and Transmission System

Timeframe	Average Cost (\$/year)	Average Length (ft)	Average Percent of the System (%)
100 years	7,004,300	33,000	1.0
5 years	9,751,600	67,000	2.1
10 years	9,665,400	66,000	2.0
20 years	6,294,800	40,000	1.2

A summary of the Rehabilitation and Replacement Program for the wastewater collection system is presented in Table 2.25.

Table 2.25. Rehabilitation and Replacement Program Summary – Wastewater Collection System

Timeframe	Average Cost (\$/year)	Average Length (ft)	Average Percent of the System (%)
100 years	4,710,800	26,600	1.1
5 years	10,043,700	53,200	2.1
10 years	9,869,600	53,000	2.1
20 years	5,372,600	33,000	1.3

Annual expenditures for the water pipeline Rehabilitation and Replacement program over 10-year, 25-year, and 100-year planning periods are presented below on Figures 2.11 through 2.13, respectively. Annual expenditures for the wastewater pipeline Rehabilitation and Replacement program over 10-year, 25-year, and 100-year planning periods are presented below on Figures 2.14 through 2.16, respectively. The annual costs are the raw results from the risk assessment, the 10-year average expenditure is the goal of the Rehabilitation and Replacement program, and the long term 100-year average is the minimum required if some of these costs were elected to be deferred by Thornton.

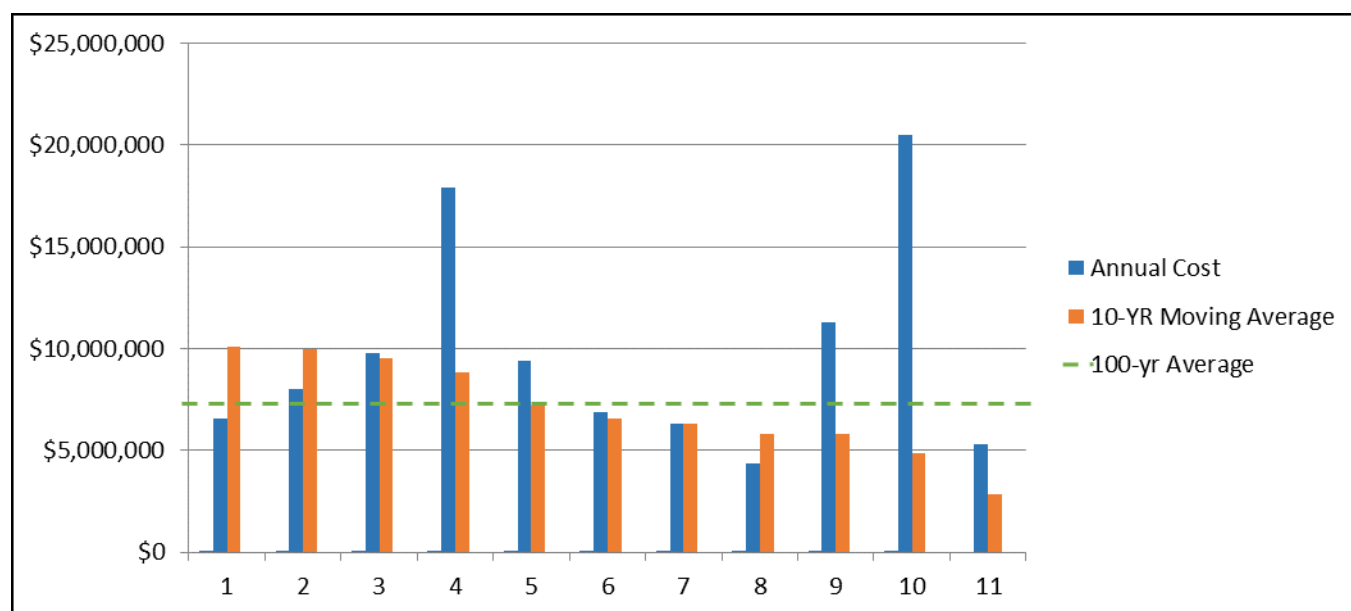


Figure 2.11. 10-year Expenditures for Water Pipeline Rehabilitation and Replacement Program

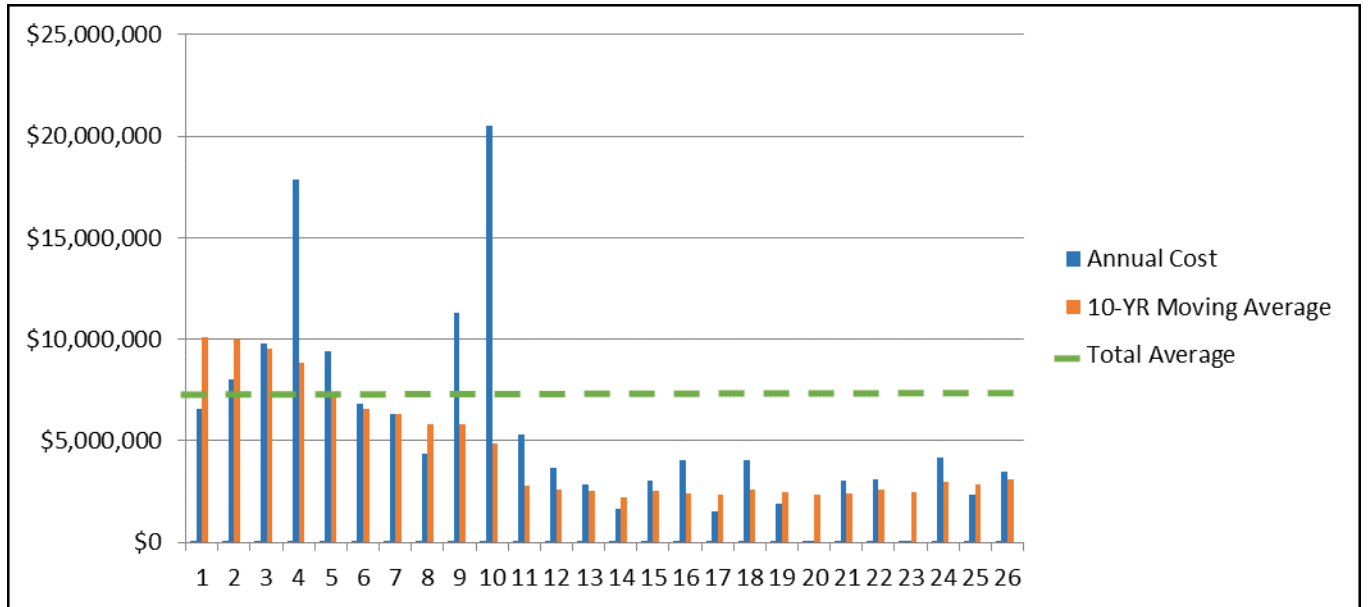


Figure 2.12. 25-year Expenditures for Water Pipeline Rehabilitation and Replacement Program

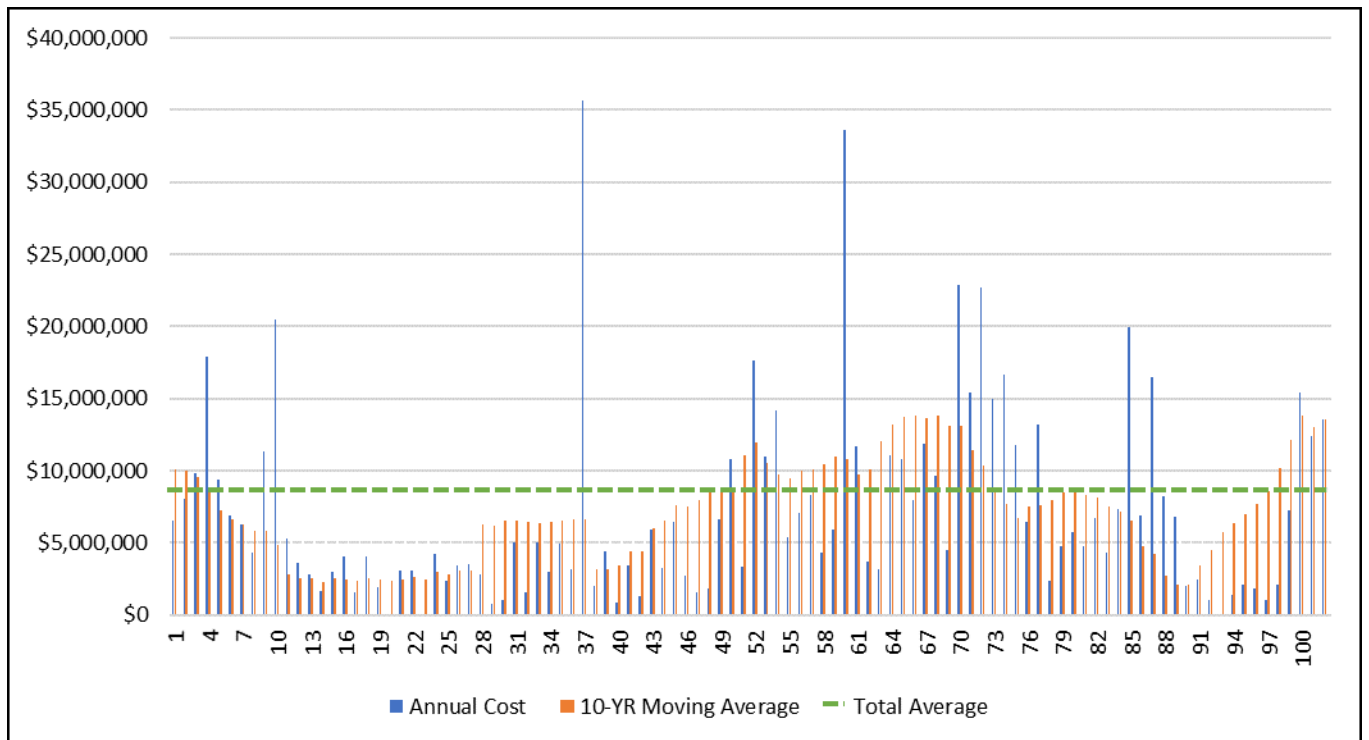


Figure 2.13. 100-year Expenditures for Water Pipeline Rehabilitation and Replacement Program

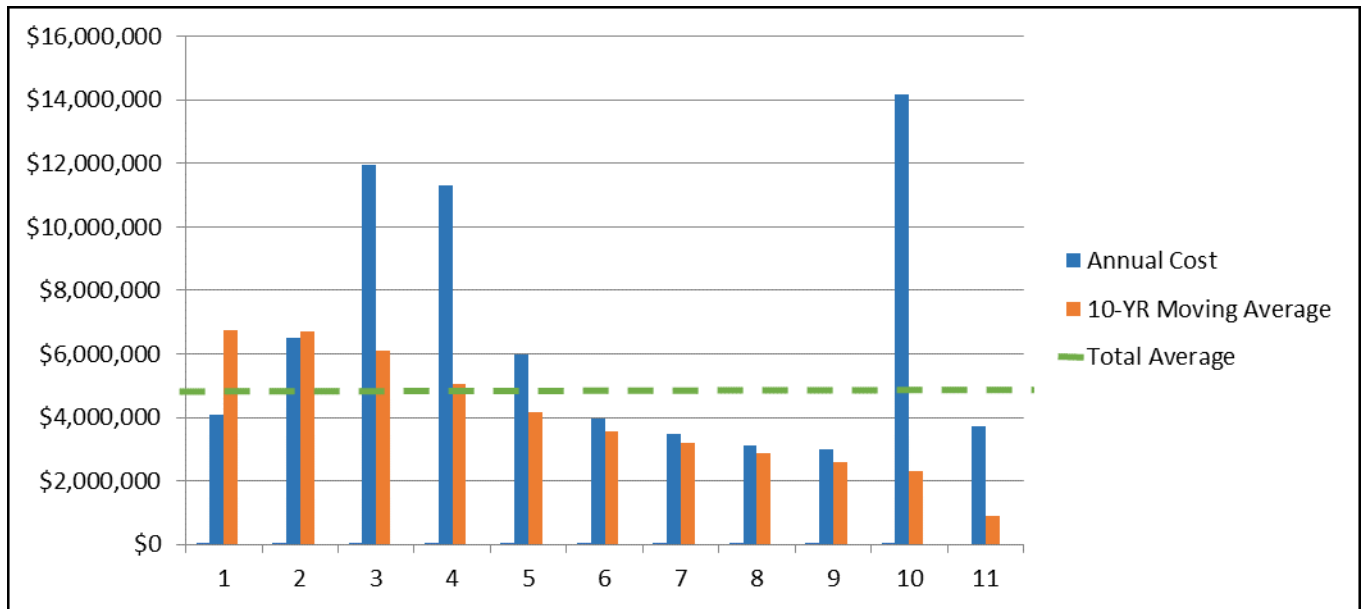


Figure 2.14. 10-year Expenditures for Wastewater Pipeline Rehabilitation and Replacement Program

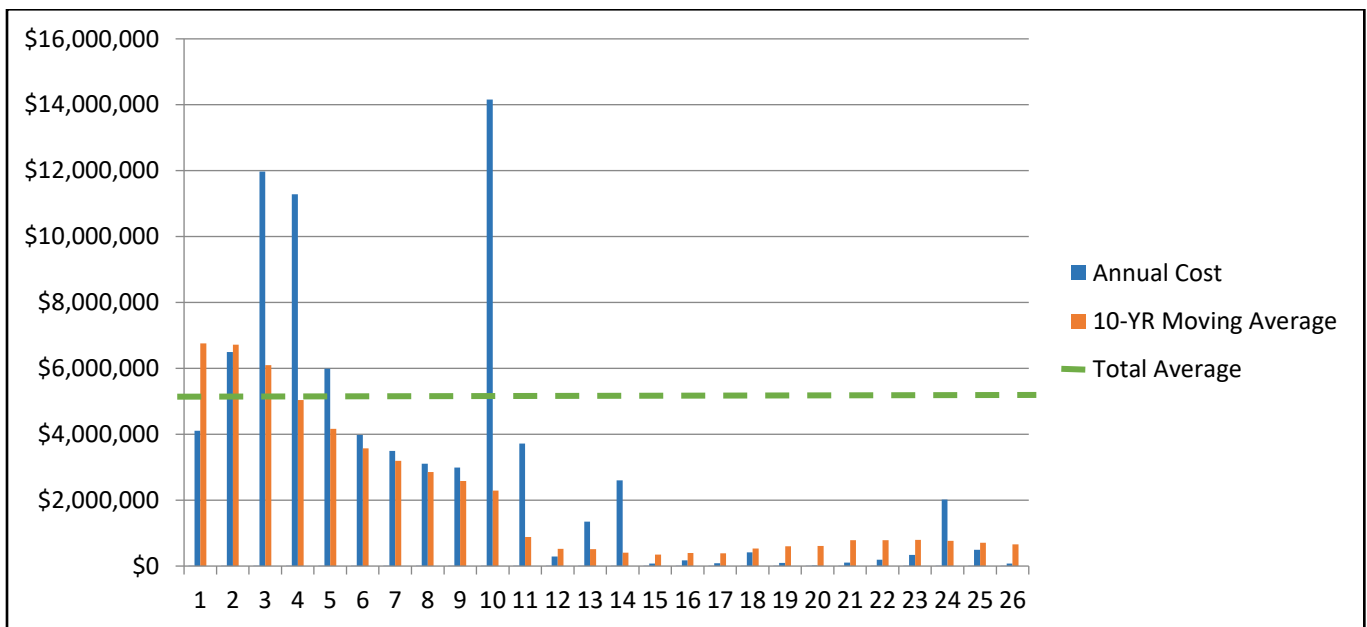


Figure 2.15. 25-year Expenditures for Wastewater Pipeline Rehabilitation and Replacement Program

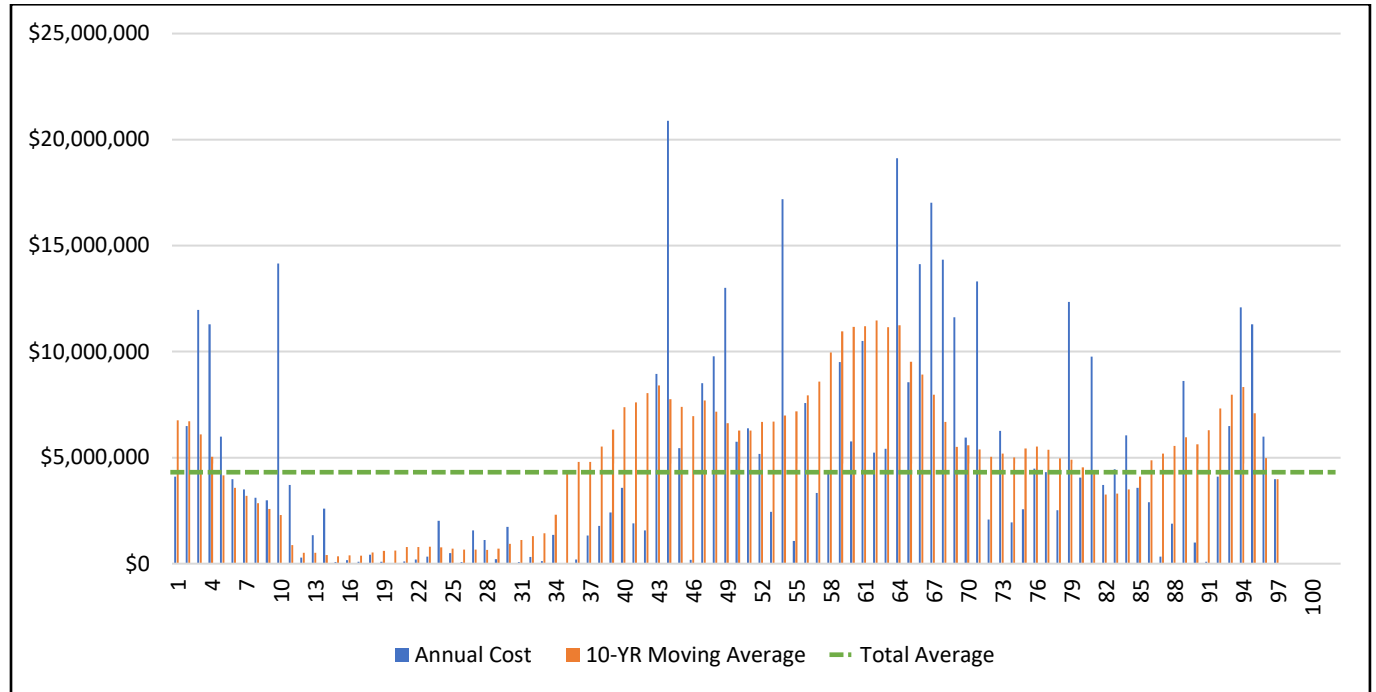


Figure 2.16. 100-year Expenditures for Wastewater Pipeline Rehabilitation and Replacement Program

Chapter 3 Integrated Alternatives Evaluation

Section 3-1 Introduction and Purpose

Thornton has complex raw water, water treatment, water distribution, and wastewater collection systems that provide service to over 166,000 customers within the city as well as outside its limits, including service to Western Hills, Welby, Unincorporated Adams County, and Federal Heights (wastewater service only) communities. Thornton must serve its customer base and plan for future growth in a cost-effective manner, while simultaneously meeting high standards of service. At buildout (anticipated to occur by 2065), the systems are expected to serve a population of 268,843.

To serve the anticipated future population, the water treatment system will need to increase in capacity by 21.5 million gallons per day (mgd). Three future alternatives were developed and evaluated to meet the future need in consideration of impacts across the raw water, water treatment, and water distribution systems as summarized below:

- **Alternative 1:** Construct a new Northern Water Treatment Plant (NWTP) located in the northern portion of the service area with 21.5 mgd capacity. The future capacity of the Thornton Water Treatment Plant (TWTP) would be 20 mgd, and the future capacity of the Wes Brown Water Treatment Plant (WBWTP) would be 54.8 mgd.
- **Alternative 2:** Expand the new TWTP by 21.5 mgd to a permitted production capacity of 41.5 mgd. The future capacity of the WBWTP would be 54.8 mgd.
- **Alternative 3:** Expand the WBWTP by 21.5 mgd to a permitted production capacity of 76.3 mgd. The future capacity of the TWTP would be 20 mgd.

An individual Master Plan was developed for each water system (raw water supply, water treatment facilities, and water and wastewater infrastructure) to identify a capital improvement program (CIP) for each alternative. Identified CIP projects for each system under each alternative were developed based on a combination of data review, hydraulic analyses, technical evaluations related to system performance criteria to meet Thornton's goals and objectives, and through close coordination and input from Thornton staff. The individual Master Plans provide analyses, results, recommendations, and cost estimates for the proposed CIP projects for each of the three alternatives. This Utility Master Plan (UMP), assembles the CIP projects developed for each system into three integrated alternatives across the systems; and establishes a basis and selection of a single preferred alternative utilizing a cost-benefit analysis (CBA) decisions making process. The selection of a single preferred alternative allows for development, phasing, and prioritization of an integrated CIP that provides Thornton with a road map to most effectively serve the future system needs.

The wastewater collection system CIP projects are not impacted based on the three alternatives; therefore, a single set of improvements was identified to meet the performance criteria and accommodate projected buildout conditions.

Chapter 3 describes the development and evaluation of the three integrated alternatives, including review of improvements required to meet service goals in the raw water, water treatment, water distribution, and wastewater collection systems. This IMP also describes the cost-benefit analysis decision making process and identification of the preferred alternative.

Section 3-2 Performance Criteria

The alternatives development and evaluation process was structured to encourage consideration of a full range of improvement strategies. Alternative improvements were developed to meet the performance criteria for each system based on technical analysis as specified in the individual Master Plans, while meeting future system demands.

The performance criteria for each system were divided into three tiers to establish different levels of performance and provide Thornton flexibility in selecting improvements based on these levels of service. The three tiers can be summarized as follows:

- **Tier 1:** Criteria that MUST be met by the system;
- **Tier 2:** Criteria that represent best practice and should be met by the system, but may not be required; and
- **Tier 3:** Criteria that are desired and should be met if practicable but are not required.

These criteria include considerations necessary to provide reasonable reliability and redundancy of the water supply, treatment, and distribution systems.

Section 3-3 Raw Water Supply Evaluation Conclusions

The Raw Water Supply CIP projects for each alternative were developed to meet all supply requirements, separated by each of the three performance criteria tiers. Each alternative is faced with unique challenges and, therefore, differentiators. For Alternative 1, a second raw water supply pipeline will be required from Hammer Reservoir to the NWTP to meet Tier 1 criteria. A third raw water supply pipeline will be required from Rodgers Reservoir to the NWTP to meet Tier 2 criteria. For Alternative 2, negative water quality impacts may be experienced due to the larger proportion of Gravel Lakes water being delivered to the WBWTP. Alternative 3 will require the largest raw water supply due to the higher loss rates at WBWTP.

Section 3-4 Water Treatment Facilities Evaluation Conclusions

The Water Treatment Facilities CIP projects for each alternative were developed to meet production requirements, separated by each of the three performance criteria tiers. During alternatives development, it was assumed the NWTP would follow a similar treatment process to that used for the new TWTP; therefore, Alternative 1 and Alternative 2 are equivalent with regard to the Tier 1 performance criteria. As currently configured, there are no significant performance differentiators between any of the alternatives for Tier 1 criteria. All of the alternatives provide the required water treatment capacity; however, Alternative 1 provides the largest total treatment redundancy. Alternatives 1 and 2 include mechanical dewatering due to land availability, and Alternative 3 includes solids handling lagoons.

Thornton is also continuing to evaluate options to defer the timing associated with construction of additional treatment capacity. These options include operating the TWTP and/or WBWTP at a higher capacity, revising population growth rates to less aggressive assumptions for planning purposes, and implementing a management plan to restrict water use during dry periods.

Section 3-5 Water Distribution and Wastewater Collection Evaluation Conclusions

Water Distribution and Wastewater Collection CIP projects for each alternative were developed to meet all Tier 1 and Tier 2 performance criteria; no Tier 3 improvements were identified. The Water Distribution

evaluation included the assessment of capacity of distribution improvements to serve future developments, storage, pumping, and transmission and distribution pipelines. In general, the distribution system analysis results indicate that the existing system has storage and transmission deficiencies, and infrastructure improvements are needed to meet buildout requirements.

After analyzing the existing infrastructure under buildout conditions for the three future alternatives, the following main conclusions were identified:

- The alternatives do not affect the size and location of distribution improvements except for pumping and transmission improvements described further below.
- Pumping improvements are common for all alternatives, with exception to improvements required for the WBWTP High Service PS in Alternative 3 and the NWTP Finished Water PS in Alternative 1.
- The water distribution system evaluation showed a deficiency in existing transmission capacity from the WBWTP and the TWTP to the northern portion of the buildout service area for all alternatives, where most of the population growth is expected to occur.
- CIP projects that are specific to each alternative include transmission lines that connect treatment plants to existing and proposed treated water storage facilities (tanks). The diameter of these pipeline improvements varies for each alternative, but the alignment is relatively consistent.
- The wastewater collection system improvements are not impacted based on the three alternatives; therefore, a single set of improvements was developed to meet the design criteria and accommodate projected buildout conditions.

Section 3-6 Integrated CIP Alternatives

Figures 3.1 through 3.3 present summaries of each integrated alternative's key components. Full inventory of the alternatives are documented in the Raw Water Future Alternatives Evaluation Technical Memorandum (TM), the Water Treatment Future Alternatives Evaluation TM, and the Water Distribution System Analysis TM.

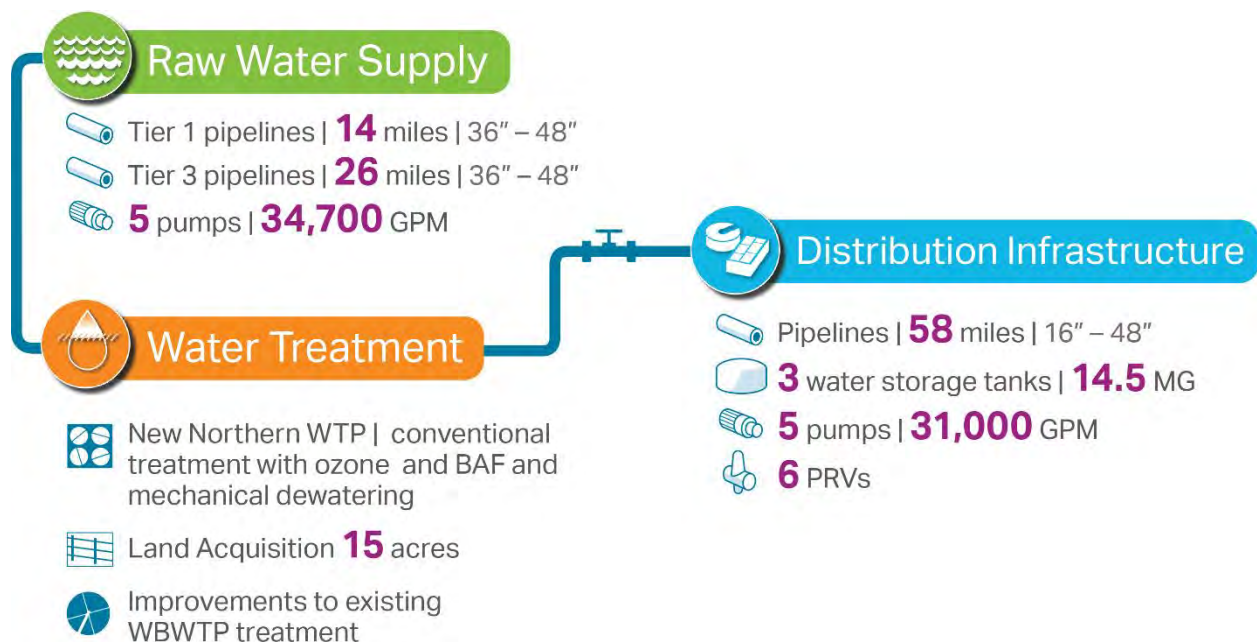


Figure 3.1. Alternative 1 New NWTP

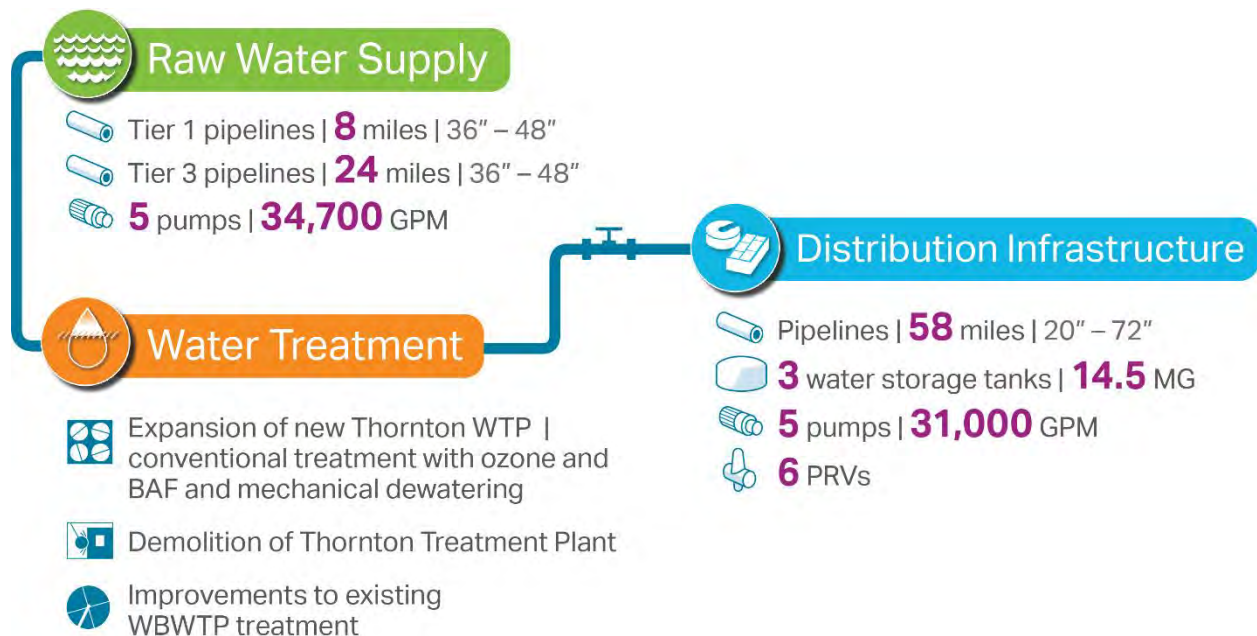


Figure 3.2. Alternative 2 Expanded TWTP

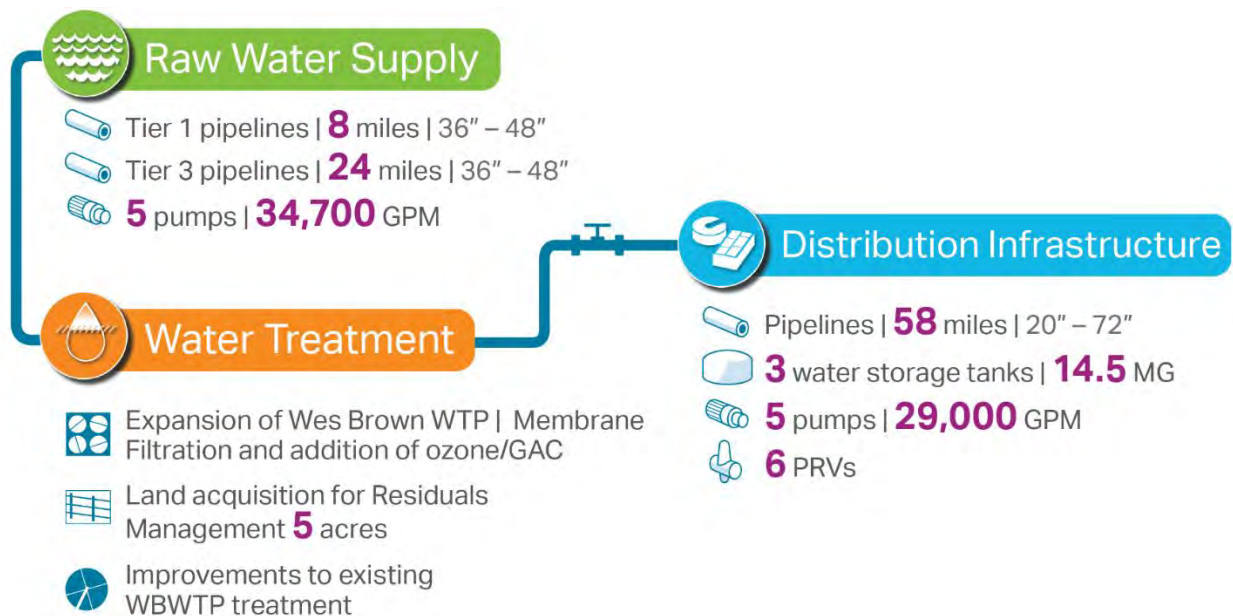


Figure 3.3. Alternative 3 Expanded WBWTP

Section 3-7 Alternative Costs

Estimated project costs were developed for each CIP project to meet buildout demands. The costs are consistent with Association for the Advancement of Cost Engineering (AACE) Class V estimating guidance. This opinion of probable costs is based on conceptual design and the basis of estimate summarized in this report, representing planning-level accuracy and opinions of costs (+50%, -30%). The

estimated costs include the sum of materials, labor, and equipment for key features of a project. The estimated total project costs include the sum of construction costs with additional allowances for direct and indirect costs. Across systems, the CIP costs include \$73M in existing improvements for the raw water, water treatment, water distribution, and wastewater collection systems to meet Tier 1 criteria. The existing improvements will be constructed in accordance with the phasing and prioritization presented in the CIP in Chapter 2. The proposed existing improvements are common to all the alternatives and assumed to be in place prior to proposed future improvements.

Twenty-year net operation and maintenance (O&M) costs that vary significantly between the three future alternatives were developed. Total O&M costs were not developed. O&M pumping costs for the raw water supply and water distribution systems were developed, assuming an energy cost of \$0.10/kilowatt (kW). Water treatment O&M costs include labor, energy, chemicals, membranes, filter media, and equipment replacement.

Raw Water Supply Costs

Capital expenditure (CapEx) and O&M costs for raw water supply are presented in Table 3.1 for each alternative. Raw Water Supply CIP costs do not include:

- Transmission pipeline costs for the Thornton Water Project (TWP) north of McKay PS
- Capital costs for pumps associated with the TWP
- Cost for a second electric utility feed to the EGL4 and TWP pump stations, a Tier 3 improvement
- Costs of additional water rights
- Costs of additional raw water storage volume needed for all alternatives

The resulting costs of additional water rights and storage are significant and, therefore, not a viable option. It was assumed Thornton will meet the criteria of securing additional raw water supply by utilizing existing storage and water rights. The cost for the supplementary water supply needed for WBWTP due to the greater losses through the membrane treatment process in Alternative 3 was included in the capital costs.

Table 3.1. Raw Water Supply CapEx and O&M Alternative CIP Costs

Raw Water	Alternative 1	Alternative 2	Alternative 3
Tier 1 - CapEx	\$108,000,000	\$81,000,000	\$81,000,000
Tier 2- CapEx	\$12,000,000	\$12,000,000	\$34,000,000
Tier 3- CapEx	\$147,000,000	\$138,000,000	\$138,000,000
Total	\$267,000,000	\$231,000,000	\$253,000,000
20-yr Net O&M	\$0	\$200,000	\$210,000

Water Treatment Facilities Costs

Capital and O&M costs for water treatment facilities are presented in Table 3.2 for each alternative. The capital costs have been updated to include mechanical dewatering in Alternative 1 and 2. A raw water turbidity of 50 Nephelometric Turbidity Units (NTU) and a sludge loading rate (SLR) of 25 lb/day/sf were assumed for conceptual sizing of the dewatering system.

Table 3.2. Water Treatment Facilities CapEx and O&M Alternative CIP Costs

Water Treatment	Alternative 1	Alternative 2	Alternative 3
Tier 1 - CapEx	\$100,790,000	\$102,640,000	\$100,660,000
Tier 2- CapEx	\$1,330,000	\$1,330,000	\$1,330,000
Tier 3- CapEx	\$220,000	\$220,000	\$220,000
Total	\$102,000,000	\$104,000,000	\$102,000,000
20 yr Net O&M	\$10,000,000	\$0	\$30,000,000

Water Distribution System Costs

Capital and O&M costs for water distribution are presented in Table 3.3 for each alternative.

Table 3.3. Water Distribution CapEx and O&M Alternative CIP Costs

Water Distribution	Alternative 1	Alternative 2	Alternative 3
Tier 1 - CapEx	\$172,000,000	\$241,000,000	\$241,000,000
Tier 2- CapEx	\$25,000,000	\$25,000,000	\$25,000,000
Tier 3- CapEx	\$0	\$0	\$0
Total	\$197,000,000	\$266,000,000	\$266,000,000
20 yr Net O&M	\$12,200,000	\$6,500,000	\$19,100,000

Wastewater Collection System Costs

Capital and O&M costs for wastewater collection are presented in Table 3.4 for each alternative.

Table 3.4. Wastewater Collection CapEx and O&M Alternative CIP Costs

Collection System	Alternative 1	Alternative 2	Alternative 3
Tier 1 - CapEx	\$14,400,000	\$14,400,000	\$14,400,000
Tier 2- CapEx	\$357,000	\$357,000	\$357,000
Tier 3- CapEx	\$0	\$0	\$0
Total	\$15,000,000	\$15,000,000	\$15,000,000
20 yr Net O&M	\$0	\$0	\$0

Total Capital Costs

Total capital costs are summarized by system in Table 3.5 for each alternative.

Table 3.5. Total CapEx Alternative CIP Costs by System

Total Utility System Capital Cost	Alternative 1	Alternative 2	Alternative 3
Raw Water	\$267,000,000	\$231,000,000	\$253,000,000
Water Treatment	\$102,000,000	\$104,000,000	\$102,000,000
Distribution	\$197,000,000	\$266,000,000	\$266,000,000
Wastewater Collection System	\$15,000,000	\$15,000,000	\$15,000,000
Total Capital Cost	\$581,000,000	\$616,000,000	\$636,000,000

Total capital costs are summarized by performance criteria tiers in Table 3.6 for each alternative.

Table 3.6. Total CapEx Alternative CIP Costs by Performance Criteria Tiers

Total Performance Criteria Capital Cost	Alternative 1	Alternative 2	Alternative 3
Tier 1	\$395,000,000	\$439,000,000	\$437,000,000
Tier 2	\$39,000,000	\$39,000,000	\$61,000,000
Tier 3	\$147,000,000	\$138,000,000	\$138,000,000
Total Capital Cost	\$581,000,000	\$616,000,000	\$636,000,000

Total 20-Year Net O&M Costs

Total 20-year Net O&M costs are summarized in Table 3.7 for each alternative.

Table 3.7. Total 20-year Net O&M Alternative Costs

20-yr Net O&M	Alternative 1	Alternative 2	Alternative 3
Total	\$22,200,000	\$6,700,000	\$49,310,000

Observations from Alternative Cost Evaluation

Alternative 1 has the lowest total capital cost with a savings of \$35M compared to Alternative 2, while Alternative 3 has the highest capital costs. When compared to Tier 1 costs, Alternative 1 offers a cost savings of \$44M compared to Alternative 2, and \$42M compared to Alternative 3, respectively.

Alternative 2 has the lowest net O&M costs, largely due to a reduction in additional personnel being required for the expansion of the conventional treatment system at the TWTP. The higher O&M costs for Alternative 1 are primarily attributed to the additional labor necessary to operate a third water treatment facility. The O&M costs for Alternative 3 are the highest, with costs of the membrane filters and increased pumping being the largest contributors.

A summary of the total capital and O&M costs for each alternative are presented on Figure 3.4 by system and by performance criteria tiers.

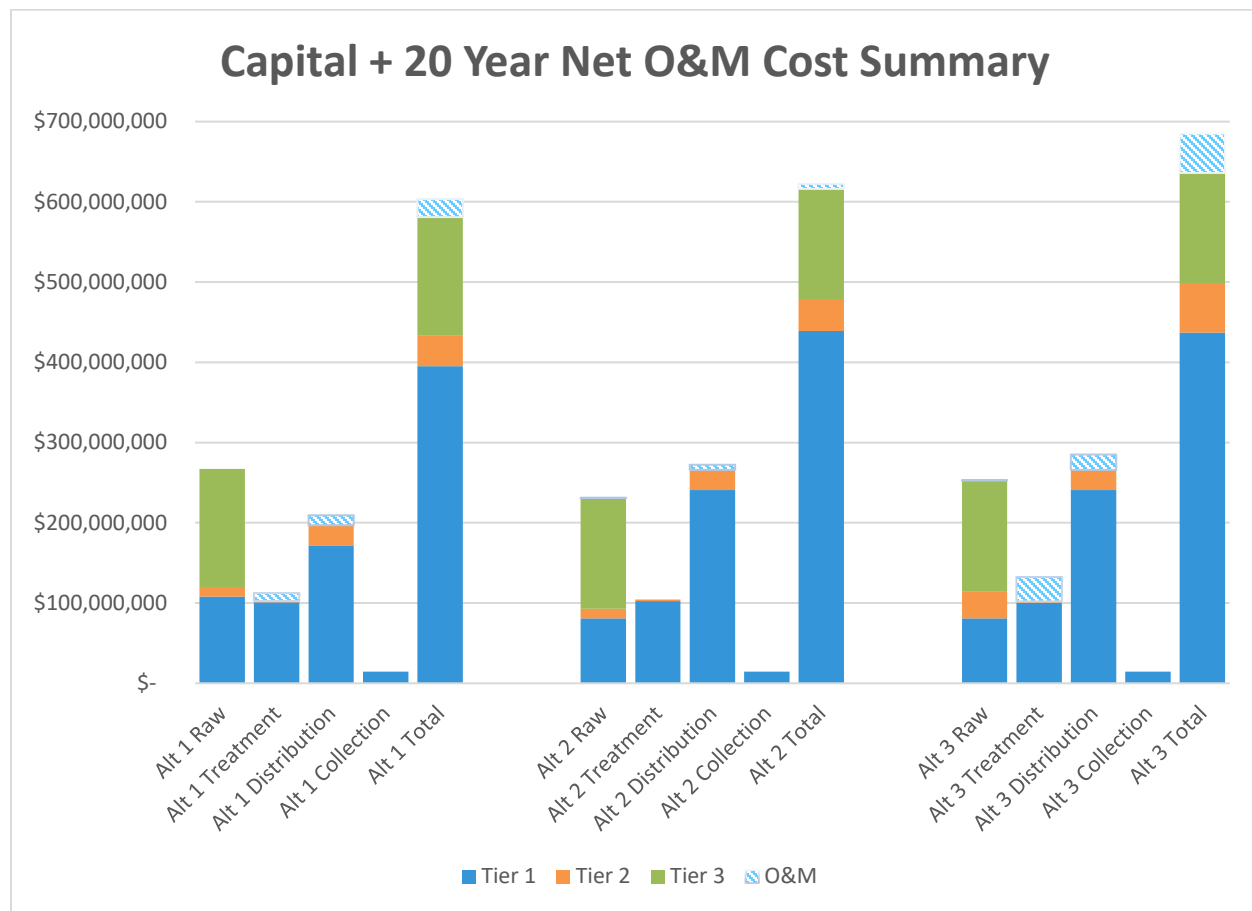


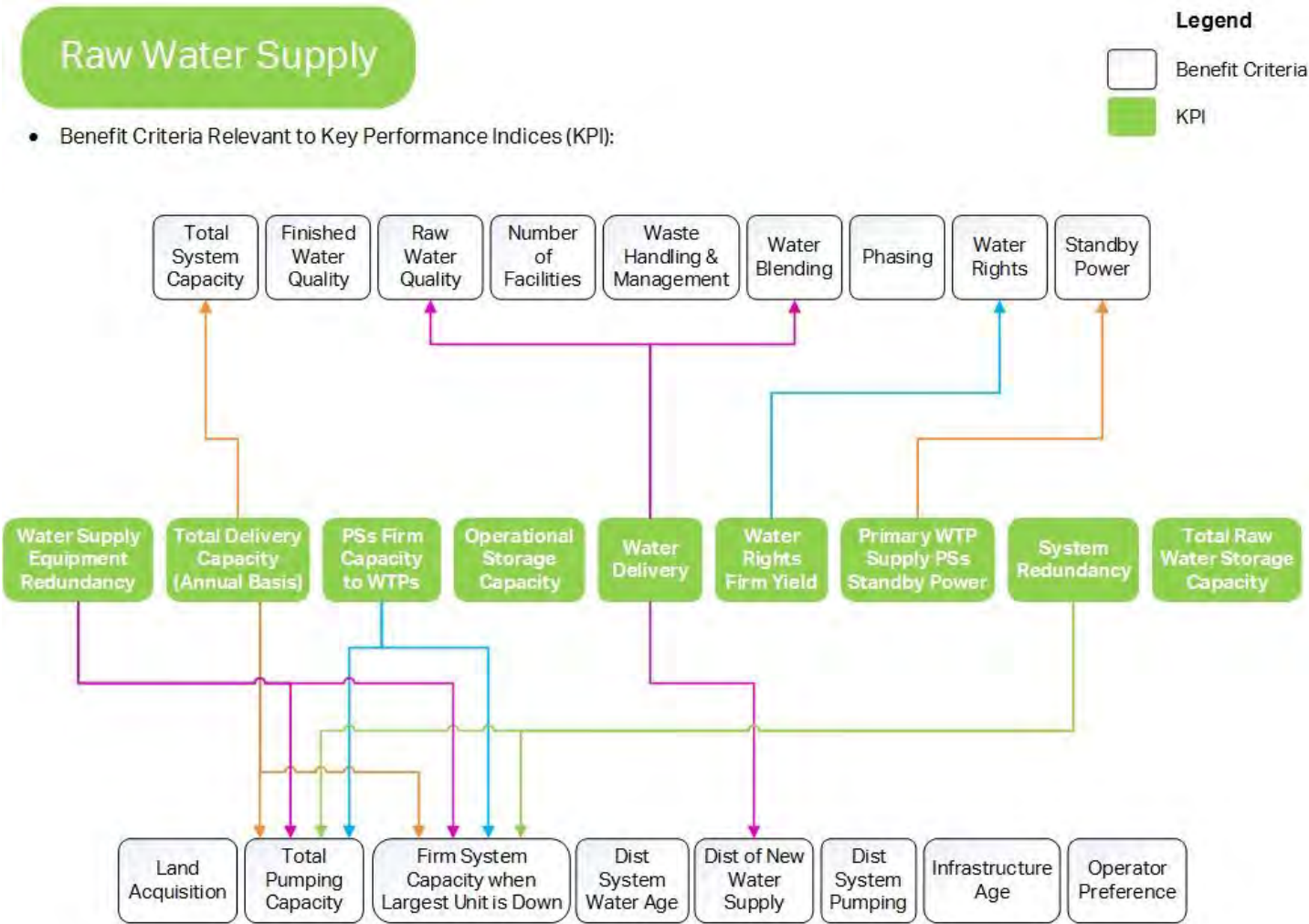
Figure 3.4. Capital and O&M Alternative Cost Summary

Section 3-8 Alternatives Evaluation Framework

This section provides a performance overview of each alternative related to key goals and objectives, including water quality, supply blending, and redundancy by establishing benefit categories and criteria for each alternative that will be used in the CBA.

Alternatives Evaluation Criteria

The integrated alternatives summarized above were evaluated based on benefit categories and criteria developed from the key performance indices (KPIs) identified in the individual Master Plans. Figures 3.5 through 3.7 illustrate the relationship between the benefit criteria and the KPIs for each of the systems. As previously discussed, the wastewater collection system was not impacted by the various supply alternatives; therefore, an alternatives evaluation was not performed.



Note: Benefit Category 'Meets COT Needs' applies to all KPI performance criteria.

Figure 3.5. Raw Water Supply Benefit Criteria from Individual Master Plan KPIs

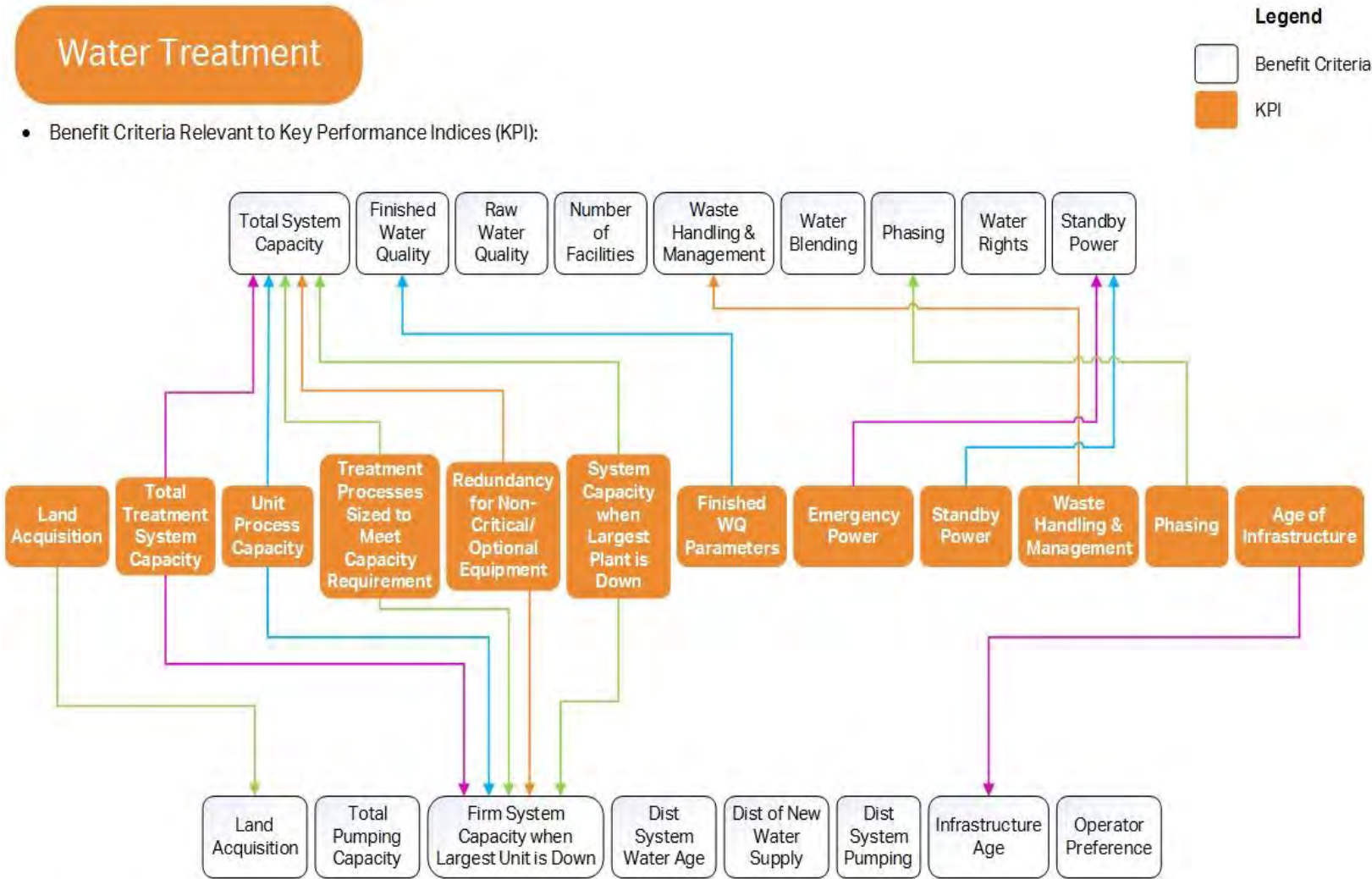
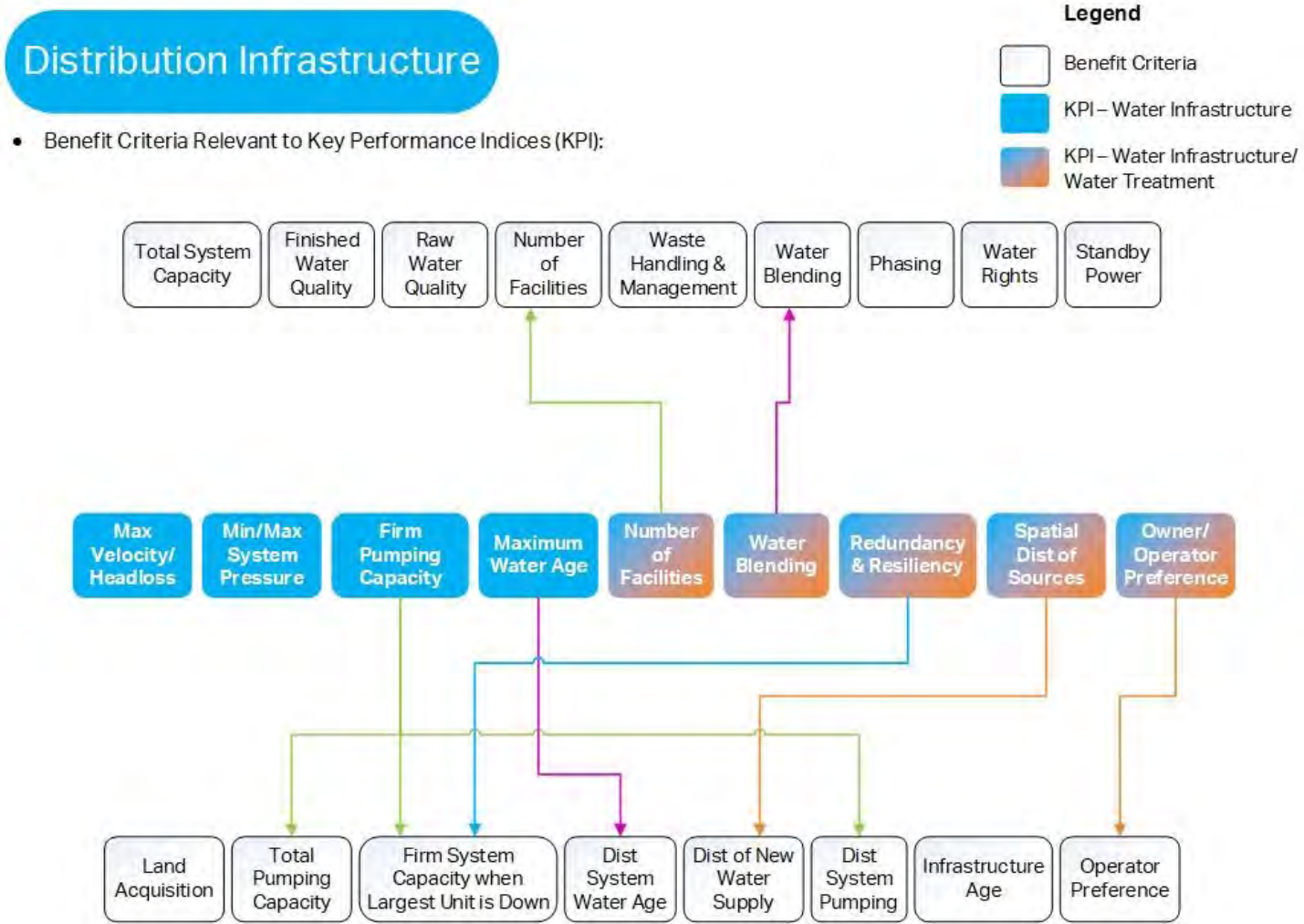


Figure 3.6. Water Treatment Benefit Criteria from Individual Master Plan KPIs



Note: Benefit Category 'Meets COT Needs' applies to all KPI performance criteria.

Figure 3.7. Water Distribution Benefit Criteria from Individual Master Plan KPIs

Alternative Benefit Evaluation

Each of the systems were assigned a score for each of the applicable benefit criteria for each of the alternatives. Scores ranged from 1 to 5, with 1 providing the least benefit and 5 providing the greatest benefit. The scores were assigned based on relative performance related to each alternative. Generally, low scores were not assigned because the alternatives were developed to meet the performance criteria and Thornton's goals' and objectives. Table 3.8 presents the resulting alternative benefit evaluation.

Table 3.8. Alternative Benefit Evaluation Results

Category	Engineering										O&M					Social & Economic		Redundancy & Reliability		Total Benefit Score
Category Weighting	40%										30%					15%		15%		
Criteria	Meets COT Needs	Total System Capacity	Finished Water Quality	Raw Water Quality	Increased No. of Facilities	Waste Handling & Mgmt	Water Blending	Phasing	Water Rights	Standby Power	Operator Preference	Infrastructure Age	Total Pumping Capacity	Dist System Water Age	Distribution of New Water Supply	Land Acquisition	System Capacity when Largest WTP is Down			
Criteria Weighting	20%	10%	10%	10%	10%	10%	10%	10%	10%	18%	23%	13%	23%	23%	50%	50%	100%			
Alternative #1 - Construction of New Water Treatment Plant																				
Raw Water	5	5	5	5	3	-	3	0	5	5	-	-	5	-	3	-	5			
Water Treatment	5	5	5	-	3	5	3	4	-	4	5	5	-	-	5	3	5			
Distribution System	5	5	-	-	3	-	3	0	-	-	5	-	5	5	5	-	5			
Collection System	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-			
Average	5.0	5.0	5.0	5.0	3.0	5.0	3.0	4.0	5.0	4.5	5.0	5.0	5.0	5.0	4.3	3.0	5.0		4.6	
Alternative #2 - Expansion of Thornton Water Treatment Plant																				
Raw Water	5	5	5	4	5	-	5	0	5	5	-	-	5	-	4	-	5			
Water Treatment	5	4	5	-	5	4	5	5	-	5	5	5	-	-	4	5	5			
Distribution System	5	5	-	-	5	-	4	0	-	-	4	-	5	5	5	-	4			
Collection System	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-			
Average	5.0	4.7	5.0	4.0	5.0	4.0	4.7	5.0	5.0	5.0	4.5	5.0	5.0	5.0	4.3	5.0	4.7		4.8	
Alternative #3 - Expansion of Wes Brown Water Treatment Plant																				
Raw Water	5	5	5	3	5	-	4	0	3	5	-	-	5	-	5	-	5			
Water Treatment	5	4	5	-	5	2	3	5	-	4	3	3	-	-	2	4	1			
Distribution System	5	5	-	-	5	-	5	0	-	-	3	-	3	3	2	-	3			
Collection System	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-			
Average	5.0	4.7	5.0	3.0	5.0	2.0	4.0	5.0	3.0	4.5	3.0	3.0	4.0	3.0	3.0	4.0	3.0		3.7	

Sensitivity Analysis

A sensitivity analysis was conducted on the alternative benefit evaluation results. The goal of the sensitivity analysis was to evaluate the impact of each benefit category, benefit criteria, weighting and benefit scores. The sensitivity analysis did not include costs. The sensitivity analysis involved 42 different scenarios that adjusted the benefit weights and scores within a reasonable range. The ranking of the alternatives did not change due to the sensitivity analysis. It was necessary to adjust 40% of the lowest scores to improve the ranking of Alternative 3. This is well beyond a reasonable margin of error; it was then concluded that the alternative benefit evaluation and results were reasonable.

Alternative Cost Benefit Analysis

A summary of the Alternative Benefit Evaluation Results is presented in Table 3.9.

Table 3.9. Summary of Alternative Benefit Evaluation Results

Alternative	Engineering Impacts	O&M Impacts	Social & Economic Impacts	Redundancy & Reliability	Total Benefit Score
Alternative 1	1.8	1.5	0.6	0.8	4.6
Alternative 2	1.9	1.5	0.7	0.7	4.8
Alternative 3	1.7	1.1	0.5	0.5	3.7

A summary of the Alternative Benefit Evaluation Results is presented in Table 3.10.

Table 3.10. Summary of Alternative Costs

Alternative	Capital Cost \$ M	Net O&M Cost \$M	Total Cost \$M
Alternative 1	\$581	\$22	\$603
Alternative 2	\$616	\$7	\$623
Alternative 3	\$636	\$49	\$685

CBA scores for each alternative were calculated by dividing the total benefit score from Table 3.8 by the capital cost and the capital plus (+) O&M costs. The CBA scores are summarized in Table 3.11.

Table 3.11. Cost Benefit Analysis Results

Alternative	CBA Score Capital Only	CBA Score Cap+O&M
Alternative 1	7.9	7.6
Alternative 2	7.7	7.6
Alternative 3	5.8	5.4

Section 3-9 Alternative Cost Benefit Analysis Results

The CBA scores for Alternative 1 and Alternative 2 in Table 3.11 are similar and could be considered roughly comparable, given a reasonable margin of error of the CBA. Alternative 3 has a significantly lower CBA score, roughly 30% less than Alternative 1 and 2. Alternative 3 was removed from further consideration in the alternatives evaluation.

An Alternatives Evaluation Workshop was held to review the advantages and disadvantages associated with Alternatives 1 and 2 to identify the key performance and benefit differentiators between them,

recognizing that the sensitivity of the CBA scores and conclusions is dependent upon Thornton's priorities based on the comparable results for Alternatives 1 and 2 from the CBA.

The top priorities identified by Thornton as the basis to differentiate the performance and benefits associated with Alternatives 1 and 2 are as follows:

Equity of New Water Supply – Based on the New Treatment Plant Supply Trace analysis and discussion in the Water Distribution System Analysis TM, water from the TWP is expected to be distributed to practically all customers within the distribution system for Alternative 1. Depending on the TWP supply delivery throughout the year to the separate WTPs, as much as 98% or greater of all customers will receive TWP water. Alternatives 2 and 3 have similar expectations for water distribution performance.

Smart Planning – The location of the NTWP in Alternative 1 provides the most efficient raw water supply and water distribution. The new treatment facility location best matches the geographic location of future growth. This alternative also utilizes water supplies from the Roger and Hammer reservoirs.

Redundancy and Flexibility – The addition of a third treatment facility in Alternative 1 will provide more redundancy and flexibility. A water treatment system with three independent treatment facilities will allow for one treatment plant to be taken offline for maintenance or expansion while the other two facilities remain in operation.

Limited Public Disruption – Construction in the southern portion of Thornton is difficult because several current roadways and pipeline corridors are located above existing underground utilities. Construction of the NWTP and related capital improvements for supply and distribution will cause less disruption to the public.

Costs – Alternative 1 provides a savings of \$44M in Tier 1 CIP projects compared to Alternative 2. It is difficult to justify the selection of Alternative 2 with this potential savings. The additional staffing of the NWTP does pose a disadvantage in higher O&M costs for Alternative 1; however, these costs do not necessarily outweigh the other advantages of this alternative.

Alternative Selection

Based on the top priorities presented above in parallel with the CBA, Alternative 1 was identified as the preferred alternative for the Utility Master Plan and allows Thornton to best meet future water demands.

Section 3-10 Conclusion

The CIP projects of the three future alternatives developed in the individual Master Plans were combined into three integrated alternatives. Improvements required to meet service goals for the three integrated alternatives in the raw water, water treatment, water distribution and wastewater collection systems were reviewed. A cost comparison was then completed with a review of CBA scores to identify the preferred future treatment supply alternative.

Differentiators between the alternatives were discussed at the Integrated Alternatives Evaluation Workshop. Thornton's top priorities, in parallel with the CBA scores, identified Alternative 1 (construction of a new NWTP) as the preferred alternative for the Utility Master Plan and allows Thornton to best meet future water demands.



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Utility Master Plan

Project No. 17-467

Raw Water Supply Capital Improvement Program
Project Cutsheets Master Plan

The City of Thornton

Project number: 60560104

March 2020

Table 2.13. Raw Water Master CIP Table

CIP ID**	Phase (Project Completion Date)	Purpose	Project Type	Project Description	TWP Prj	Cost	Trigger	Project Timeline (Start / Completion)	
RAW-E03	2020-2025	Tier 1 - Raw Water Quality	Raw Water Quality	Study: Precipitant Addition to Burlington Canal		\$ 70,000	Existing Improvement	2020	2021
RAW-E04	2020-2025	Tier 1 - Raw Water Quality	Raw Water Quality	Study: Feasibility of Floating Solar Panel Installation on Gravel Lakes		\$ 70,000	Existing Improvement	2020	2021
RAW-E05	2020-2025	Tier 1 - Redundancy	Raw Water Quality	Mobile Pump Stations Back-up Power		\$ 11,940,000	Existing Improvement	2021	2022
RAW-E06	2020-2025	Tier 1 - Raw Water Quality	Raw Water Quality	New water quality profiling system and temperature data monitoring system on EGL4		\$ 480,000	Existing Improvement	2020	2021
RAW-F01	2020-2025	Tier 1 - Capacity	Raw Water Supply	Thornton Water Project Phase I - 42-in raw water pipeline from 168th Ave to WBWTP (shown on 2 figures)	x	\$ 56,355,000	Growth - MDD = 74.8 MGD	2022	2025
RAW-F03	2020-2025	Tier 1 - Capacity	Raw Water Supply	Interconnect to deliver TWP water to TWTP & WBWTP, includes the pipe, valves, meters, vaults and connection to SCADA, connect new 42-in TWP pipeline to 36-in Thornton Pkwy pipeline	x	\$ 8,600,000	Growth - MDD = 74.8 MGD	2023	2026
RAW-F08	2020-2025	Tier 1 - Capacity	Raw Water Supply	TWP Bypass pipeline to Gravel Lakes, located near McKay PS, includes tee and approx 20 LF pipe	x	\$ 1,500,000	Growth - MDD = 74.8 MGD	2023	2026
RAW-F09	2020-2025	Tier 1 - Capacity	Raw Water Supply	Chemical Feed Facility located north of 140th Avenue on the TWP pipeline on Quebec Street, sized for buildout capacity	x	\$ 595,000	Growth - MDD = 74.8 MGD	2024	2025
RAW-E01	2025-2035	Tier 1 - Raw Water Quality	Raw Water Quality	Interconnect to allow Gravel Lakes operation in series and for McKay PS deliver directly to WBWTP & TWTP, includes moderate length of pipe and valving to connect 36-inch McKay pipeline to 54-inch WBWTP supply and 36-inch Thornton Pkwy pipeline		\$ 3,530,000	Existing Improvement	2026	2027
RAW-E02	2025-2035	Tier 1 - Raw Water Quality	Raw Water Quality	Raw water pipeline from WGL2 to EGL4 with pump station		\$ 6,840,000	Existing Improvement	2026	2027
RAW-F04	2025-2035	Tier 1 - Capacity	Raw Water Supply	36-in raw water pipeline from Quebec St & 140th to NWTP		\$ 10,160,000	Growth - MDD = 74.8 MGD	2026	2027
RAW-F05	2025-2035	Tier 1 - Capacity	Raw Water Supply	24-in Raw water pipeline from Hammer Reservoir to Quebec St & E-470 Ave and New Pump Station		\$ 11,530,000	Growth - MDD = 74.8 MGD	2025	2026
RAW-F06	2025-2035	Tier 2 - Water Quality	Raw Water Supply	Feasibility study to add 10 MG capacity to McKay Pump Station.		\$ 210,000	Growth - MDD = 74.8 MGD	2026	2027
RAW-F10	2025-2035	Tier 2 - Water Quality	Raw Water Supply	Addition of 10 MGD capacity at McKay PS, includes new pump with VFD, electrical upgrade, bldg expansion and chemical feed equipment increase feed capacity		\$ 10,000,000	Growth - MDD = 74.8 MGD	2028	2029
RAW-F11	2025-2035	Tier 1 - Water Quality	Raw Water Supply	Chemical Feed Facility located at McKay PS, building sized for 20 mgd, equipment sized for 10 mgd		\$ 595,000	Growth - MDD = 74.8 MGD	2026	2027
RAW-F02	2035-2065	Tier 2 - Capacity	Raw Water Supply	Thornton Water Project Phase II - 42-in raw water pipeline from WBWTP to TWTP along Hoffman Way	x	\$ 8,645,000	Tier 2 Improvement	2035	2036
RAW-F07	2035-2065	Tier 2 - Redundancy	Raw Water Supply	24-in Raw water pipeline from Rogers Reservoir to Quebec St & 168 th Ave and New Pump Station		\$ 17,660,000	Tier 2 Improvement	2040	2041
RAW-F12	2035-2065	Tier 3 - Redundancy	Raw Water Supply	Redundant Thornton Water Project Phase I - raw water pipeline 168th Ave to WBWTP		\$ 56,355,000	Tier 3 Improvement	N/A	N/A
RAW-F13	2035-2065	Tier 3 - Redundancy	Raw Water Supply	Redundant Thornton Water Project Phase II - WBWTP to TWTP		\$ 8,645,000	Tier 3 Improvement	N/A	N/A
RAW-F14	2035-2065	Tier 3 - Redundancy	Raw Water Supply	Redundant raw water pipeline from Quebec Blvd & 140th to NWTP		\$ 10,160,000	Tier 3 Improvement	N/A	N/A
RAW-F15	2035-2065	Tier 3 - Redundancy	Raw Water Supply	Redundant raw water pipeline from Standley Lake to TWTP - 48 inch portion		\$ 43,830,000	Tier 3 Improvement	N/A	N/A
RAW-F16	2035-2065	Tier 3 - Redundancy	Raw Water Supply	Redundant raw water pipeline from Standley Lake to TWTP - 36 inch portion		\$ 19,580,000	Tier 3 Improvement	N/A	N/A
RAW-F17	2035-2065	Tier 3 - Redundancy	Raw Water Supply	Redundant raw water pipeline from EGL4 to TWTP (include river crossing)		\$ 21,600,000	Tier 3 Improvement	N/A	N/A
RAW-F18	2035-2065	Tier 3 - Redundancy	Raw Water Supply	Redundant raw water pipeline from EGL4 to WBWTP (include river crossing)		\$ 8,000,000	Tier 3 Improvement	N/A	N/A
RAW-F19	2035-2065	Tier 3 - Redundancy	Raw Water Supply	Redundant raw water pipeline from McKay to WBWTP (parallel existing 36 inch to EGL#4, no river crossing)		\$ 15,160,000	Tier 3 Improvement	N/A	N/A
RAW-F20	2035-2065	Tier 3 - Energy Cost Savings	Sustainability	Study: Micro-Hydro Power on Standley Lake Supply Pipeline		\$ 40,000	Tier 3 Improvement	N/A	N/A
RAW-F21	2035-2065	Tier 3 - Reduce Raw Water Losses	Sustainability	Study: Water Evaporation Reduction Technologies on RWGLS		\$ 70,000	Tier 3 Improvement	N/A	N/A

**Project Cutsheets not provided for Tier 3 improvements

*CIP ID LEGEND:

PREFIX DEFINITION

RAW = Raw Water Supply System Project

WTP = Water Treatment Facilities Project

DD = Water Distribution System Project / Distribution Pipeline

TT= Water Distribution System Project / Transmission Pipeline

P = Water Distribution System Project / Pump

SS = Water Distribution System Project / Storage

WW = Wastewater Collection System Project

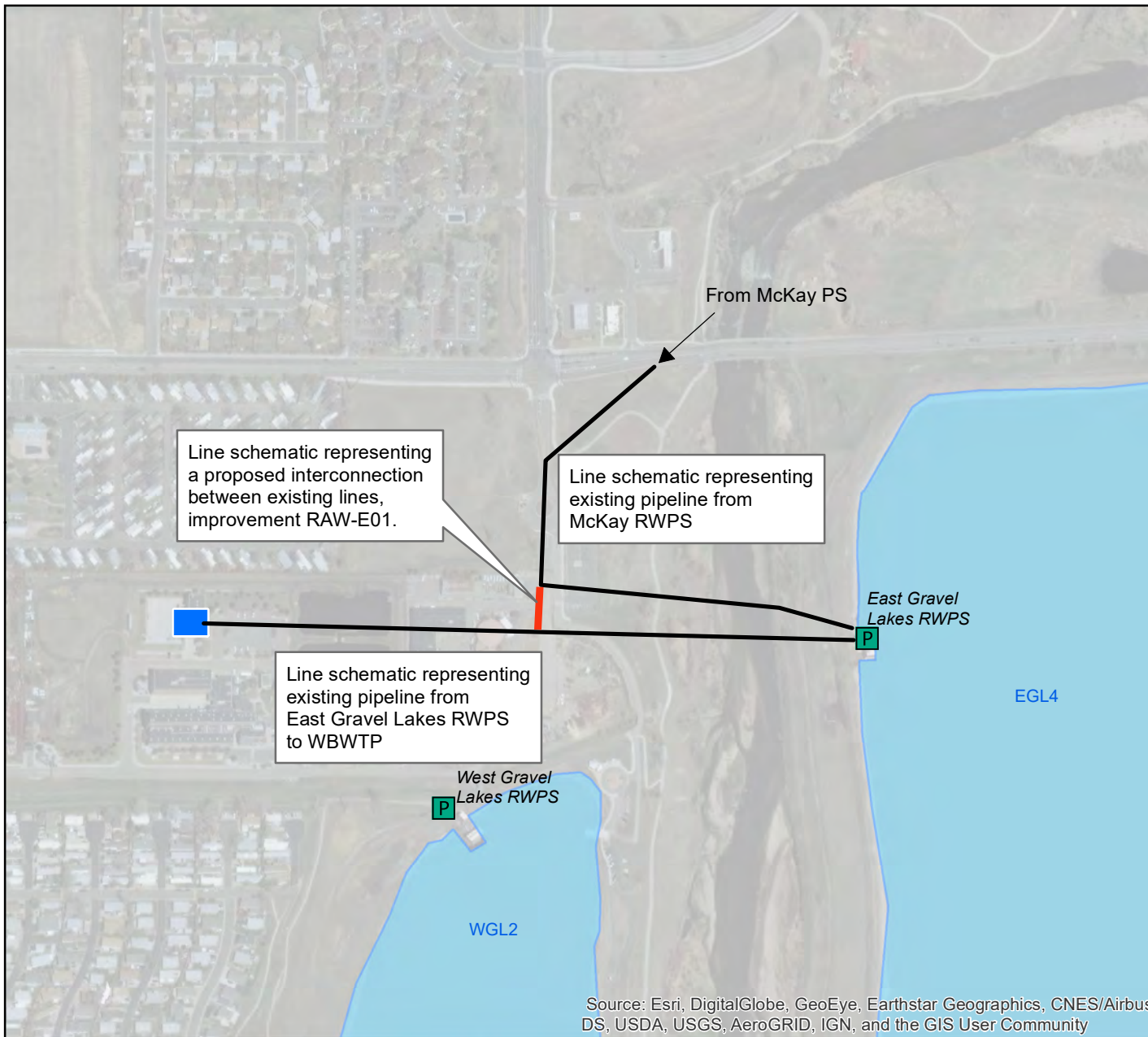
SUFFIX DEFINITION

E = Existing System Deficiency

F = Future System Improvement

*CIP ID's for Water Distribution and Wastewater Collection are organized without suffix in the Water and Wastewater Infrastructure Master Plan and on CIP project cutsheets

Trigger	Description
Existing Improvement	Improvement is required to address an existing deficiency
Growth - Average System Demand = 37mgd	Improvement will be required in the future, pending on expected growth
Growth - Average System Demand = 44mgd	Improvement will be required in the future, pending on expected growth
Developments north of E 156th Avenue	Improvement will serve future developments, pending on localized growth
WBWTP Upgrade	Improvement will support increase in supply capacity at WBWTP
Growth North of E-470	Improvement will serve future developments, pending on localized growth
Zone 1 Storage Upgrade	Improvement will support increase in storage capacity
Zone 3 Storage Upgrade	Improvement will support increase in storage capacity
NWTP Construction	Improvement will support supply improvements at NWTP
70% Measured Sewer Flow =	Improvement is required to meet future flows
Growth - Max Day Demand = 74.8 mgd	Improvement will be required in the future, pending on expected growth
Growth - Max Day Demand = 85.6 mgd	Improvement will be required in the future, pending on expected growth
Tier 2	Improvement identified as Tier 2
Tier 3	Improvement identified as Tier 3



Legend

- Raw Water Supply Pump Station
- WTP
- CIP Project
- Gravel Lakes

Project Information

Raw water pipeline interconnect to allow for McKay PS to deliver directly to WBWTP and TWTP, and for the Gravel Lakes to operate in series. The interconnect will connect the existing 36-in McKay pipeline to the 54-in WBWTP feed and the 36-in Thornton Pkwy pipeline. The interconnect consists of a valve vault, moderate length of pipe and flow control valves, meters for each WTP and connection to SCADA.

Cost

\$3,530,000

Phase

2025-2035

Purpose

Tier 1 - Raw Water Quality

Trigger

Existing

WTP

Wes Brown/Thornton

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9500 Civic Center Drive
Thornton, Colorado 80229
(303) 538-7295

AECOM
6200 South Quebec Street
Greenwood Village, Colorado 80111

Raw Water Improvements






CIP RAW-E01



1 inch = 500 feet



Legend

-  Raw Water Supply Pump Station
-  Raw Water Pumping Improvement
-  WTP
-  CIP Project
-  Gravel Lakes

Project Information

Raw water pipeline from WGL2 to EGL4 with pump station. Includes river crossing. Improvement allows for Gravel Lakes to be operated in series.

Cost

\$6,840,000

Phase

2025-2035

Purpose


Tier 1 - Raw Water Quality

Trigger

Existing

WTP

Wes Brown/Thornton

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9500 Civic Center Drive
Thornton, Colorado 80229
(303) 538-7295

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6200 South Quebec Street
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Raw Water Improvements

CIP RAW-E02



1 inch = 800 feet

Raw Water Improvements

CIP ID: RAW-E03

Project Information: Pilot study on effectiveness and operational cost of precipitant addition on the Burlington Canal water for phosphorus reduction

Potential Resulting CIP: Addition of new coagulant feed equipment on the Burling Canal Diversion.

Cost: \$70,000

Phase: 2020 - 2025

Purpose: Tier 1 – Raw Water Quality

Trigger: Existing Improvement

WTP: Wes Brown



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Raw Water Improvements

CIP ID: RAW-E04

Project Information: Evaluation of feasibility of installing floating solar panels on Gravel Lakes. Benefits of the solar panels are renewable power generation for operation of adjacent pump stations, reduction of water temperature, algae production and taste and odor events, and reduction of water evaporation. Goals of the study include identification of equipment capital cost and equipment sizing for maximized rate of return.

Potential Resulting CIP: Addition of solar energy generation equipment on Gravel Lakes.

Cost: \$70,000

Phase: 2020 - 2025

Purpose: Tier 1 – Raw Water Quality

Trigger: Existing Improvement

WTP: Wes Brown



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Raw Water Improvements

CIP ID:	RAW-E05
Project Information:	New Mobile Generator Sets sized to provide backup power for EGL Pump Station, WGL Pump Station or McKay Pump Station. Includes modifications to pump stations to accommodate generators, installation of transfer switches and conduit/conductors.
Cost:	\$11,940,000
Phase:	2020-2025
Purpose:	Tier 1 – Redundancy
Trigger:	Existing Improvement
WTP:	Wes Brown






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Legend

-  Raw Water Supply Pump Station
-  Project Location
-  Gravel Lakes

Project Information

New water quality profiling system and temperature data monitoring system on EGL4. Buoy mounted.

Cost

\$480,000

Phase

2020-2025

Purpose

Tier 1 - Raw Water Quality

Trigger

Existing

WTP

Wes Brown/Thornton

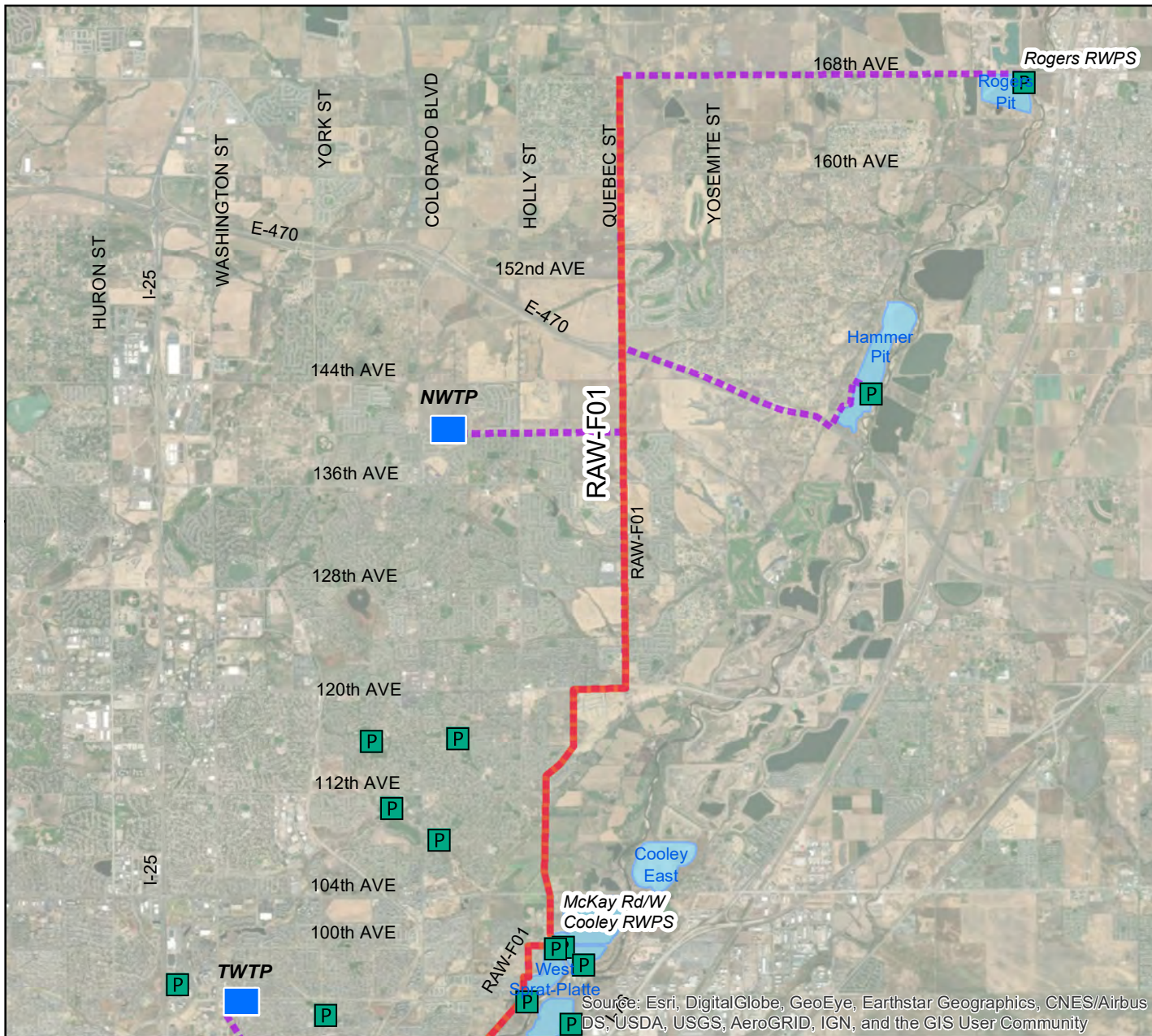
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6200 South Quebec Street
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Raw Water Improvements

CIP RAW-E06





Legend

- WTP
- P Raw Water Supply Pump Station
- CIP Project
- Other Improvements
- Gravel Lakes

Project Information

Phase I of New Thornton Water Project (TWP) 42-in, approximately 13 miles raw water pipeline from 168th Ave to WBWTP.

Cost

\$56,355,000

Phase

2020-2025

Purpose

Tier 1 - Capacity

Trigger

Growth - Max Day Demand = 74.8 MGD

WTP

Wes Brown / Thornton / Northern

City of Thornton
9500 Civic Center Drive
Thornton, Colorado 80229
(303) 538-7295

AECOM
6200 South Quebec Street
Greenwood Village, Colorado 80111

Raw Water Improvements

CIP RAW-F01 Figure 1 of 2



1 inch = 8,000 feet



Legend

- WTP
- P Raw Water Supply Pump Station
- CIP Project
- Other Improvements
- Gravel Lakes

Project Information

Phase I of New Thornton Water Project (TWP) 42-in, approximately 13 miles raw water pipeline from 168th Ave to WBWTP.

Cost

\$56,355,000

Phase

2020-2025

Purpose

Tier 1 - Capacity

Trigger

Growth - Max Day Demand = 74.8 MGD

WTP

Wes Brown / Thornton

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9500 Civic Center Drive
Thornton, Colorado 80229
(303) 538-7295

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6200 South Quebec Street
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Raw Water Improvements

CIP RAW-F01 Figure 2 of 2



1 inch = 2,500 feet



Legend

- WTP
- P Raw Water Supply Pump Station
- CIP Project
- - - Other Improvements
- Gravel Lakes

Project Information

Phase II of New Thornton Water Project (TWP) 42-in, approximately 2 miles raw water pipeline from WBWTP to TWTP.

Cost

\$8,645,000

Phase

2035-2065

Purpose

Tier 2 - Capacity

Trigger

Tier 2 Improvement

WTP

Thornton

City of Thornton
9500 Civic Center Drive
Thornton, Colorado 80229
(303) 538-7295

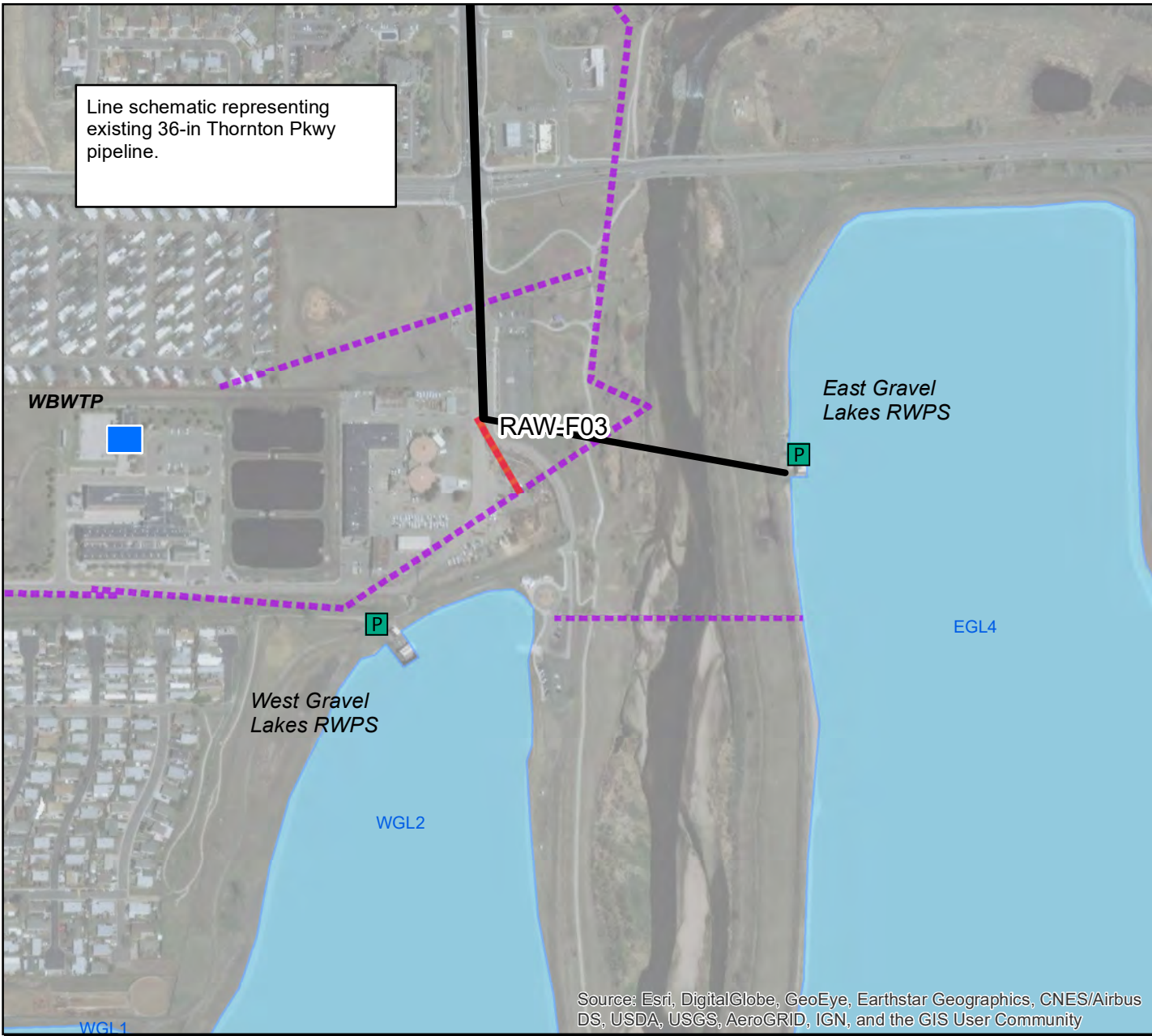
AECOM
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Greenwood Village, Colorado 80111

Raw Water Improvements

CIP RAW-F02



1 inch = 2,000 feet



Legend

- WTP
- P Raw Water Supply Pump Station
- CIP Project
- Other Improvements
- Gravel Lakes

Project Information

Raw water pipeline interconnect to allow TWP water to be delivered to TWTP & WBWTP. The interconnect will connect the new TWP 42-in pipeline to the existing 36-in Thornton Pkwy pipeline (RAW-F01). The interconnect consists of a valve vault, moderate length of pipe, valves, meters and connection to SCADA.

Cost

\$8,600,00

Phase

2020-2025

Purpose

Tier 1 - Capacity

Trigger

Growth - Max Day Demand = 74.8 MGD

WTP

Wes Brown / Thornton

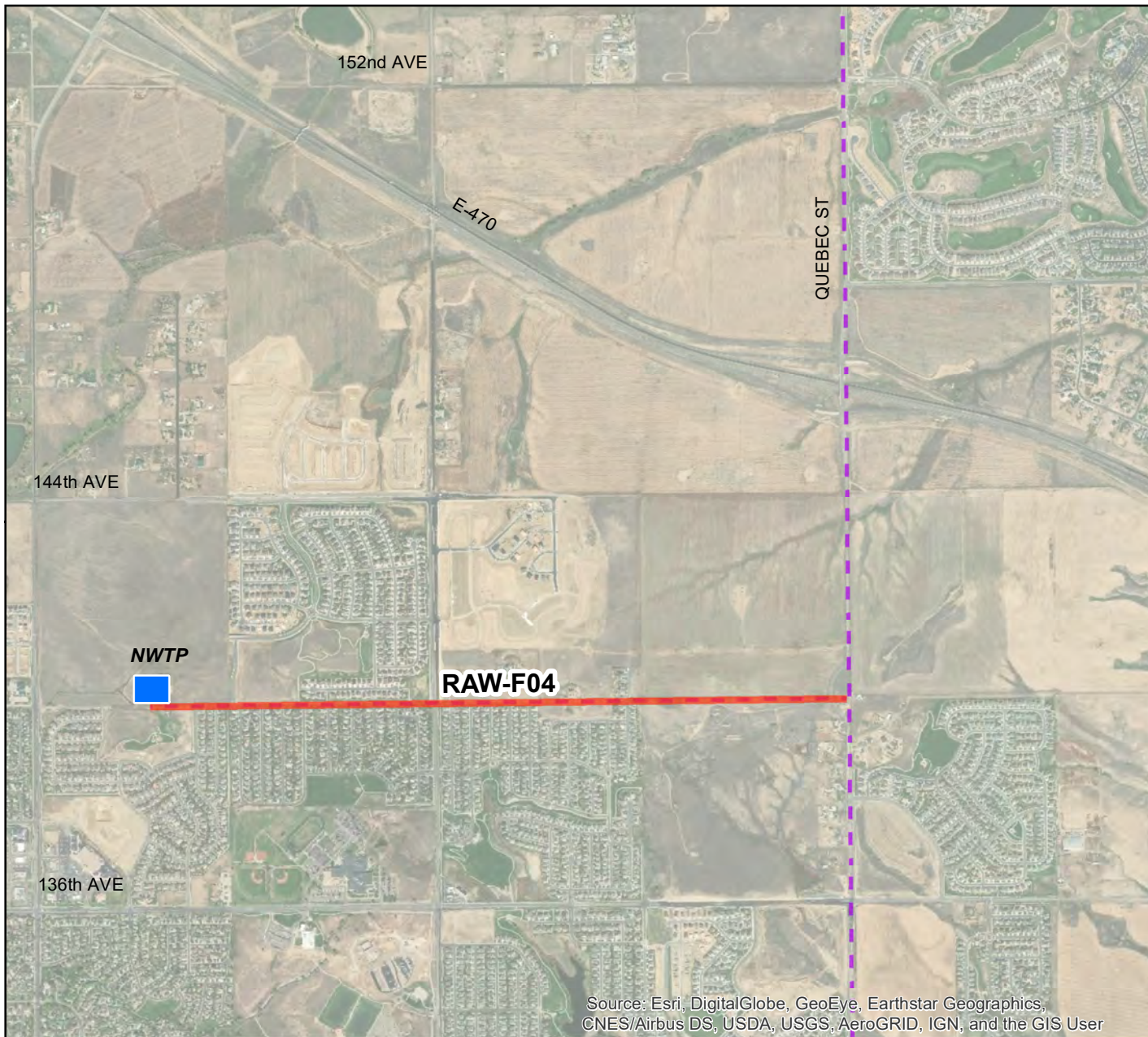
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Raw Water Improvements CIP RAW-F03



1 inch = 500 feet



Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User

Legend

- WTP
- P Gravel Lakes Pump Station
- CIP Project
- - - Other Improvements
- Gravel Lakes

Project Information

New 36-in, approximately 10,600 ft raw water pipeline from intersection of Quebec St and 140th Ave to NWTP.

Cost

\$10,160,000

Phase

2025-2035

Purpose

Tier 1 - Capacity

Trigger

Growth - Max Day Demand = 74.8 MGD

WTP

Northern

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9500 Civic Center Drive
Thornton, Colorado 80229
(303) 538-7295

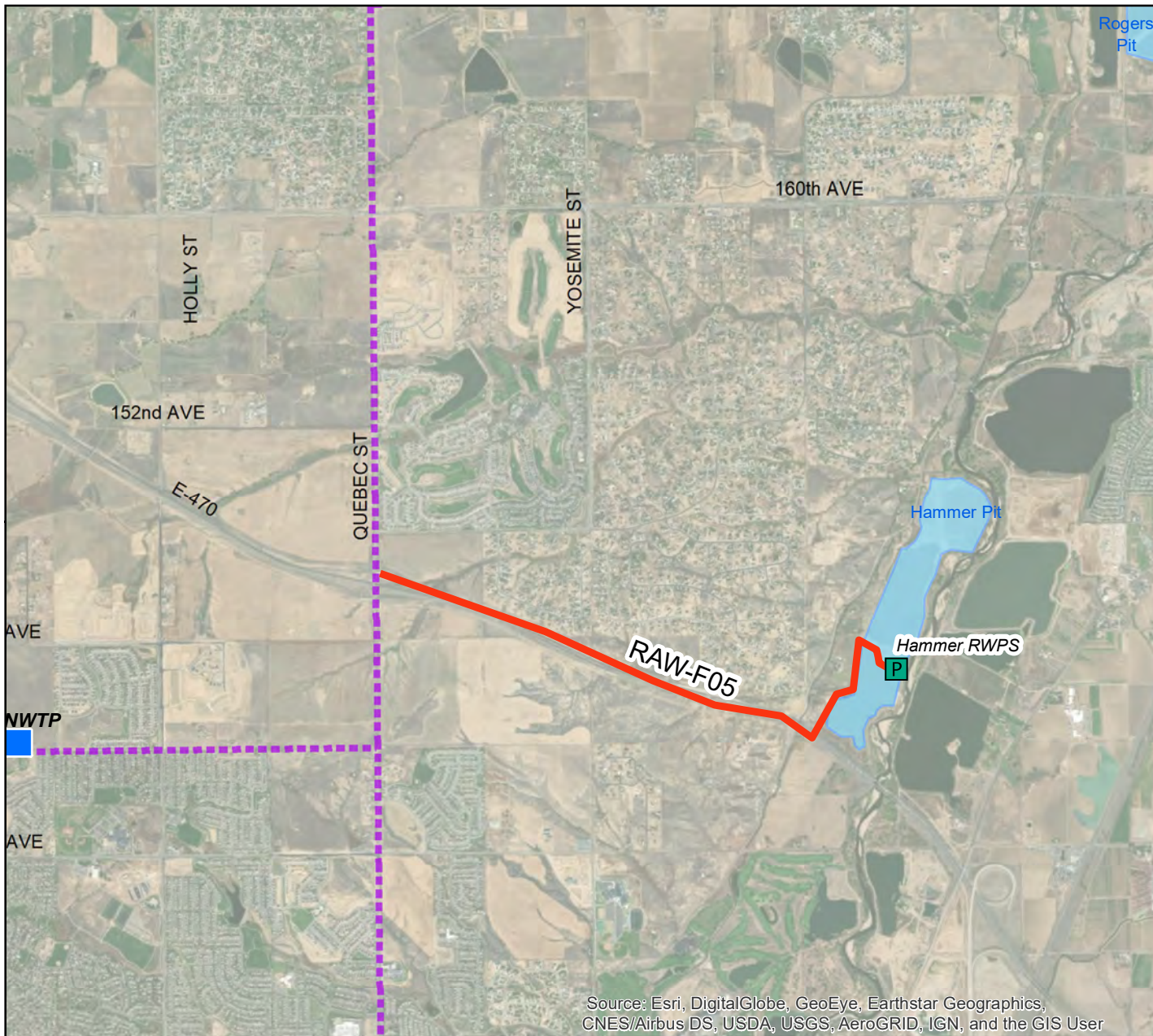
AECOM
6200 South Quebec Street
Greenwood Village, Colorado 80111

Raw Water Improvements

CIP RAW-F04



1 inch = 2,000 feet



Legend

- WTP
- P Raw Water Supply Pump Station
- CIP Project
- Other Improvements
- Gravel Lakes

Project Information

New 24-in, 2.7 mile raw water pipeline from Hammer Reservoir to intersection of Quebec St and E-470. Improvements include new pump station.

Cost

\$11,530,000

Phase

2025-2035

Purpose

Tier 1 - Capacity

Trigger

Growth - Max Day Demand = 74.8 MGD

WTP

Northern

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6200 South Quebec Street
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Raw Water Improvements

CIP RAW-F05






1 inch = 3,835 feet



Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

Legend

-  Raw Water Supply Pump Station
-  Project Location
-  Gravel Lakes

Project Information

Study to evaluate options to add 10 MGD of capacity to McKay PS. Existing system curves will be evaluated. Possible outcomes are addition of VFD's to existing pumps, piping improvements to take advantage of available head, or addition of new pumps.

Cost

\$210,000

Phase

2025-2035

Purpose


Tier 2 - Water Quality

Trigger

Growth - Max Day Demand = 74.8 MGD

WTP

Wes Brown/Thornton

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Raw Water Improvements

CIP RAW-F06



1 inch = 400 feet



Legend

- WTP
- Raw Water Supply Pump Station
- CIP Project
- TWP Alignment
- Gravel Lakes

Project Information

New 24-in, 21,600 ft raw water pipeline from Rogers Reservoir to intersection of Quebec St and 168th Ave. Improvements include new pump station.

Cost

\$17,660,000

Phase

2035-2065

Purpose

Tier 2 - Redundancy

Trigger

Tier 2 Improvement

WTP

Northern

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9500 Civic Center Drive
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Greenwood Village, Colorado 80111

Raw Water Improvements

CIP RAW-F07



1 inch = 3,500 feet



Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User

Legend

- WTP
- P Raw Water Supply Pump Station
- CIP Project
- Other Improvements
- Gravel Lakes

Project Information

TWP bypass pipeline to Gravel Lakes. Improvement includes tee and approximately 20 ft of pipe.

Cost

\$1,500,000

Phase

2020-2025

Purpose

Tier 1 - Capacity

Trigger

Growth - Max Day Demand = 74.8 MGD

WTP

Wes Brown / Thornton

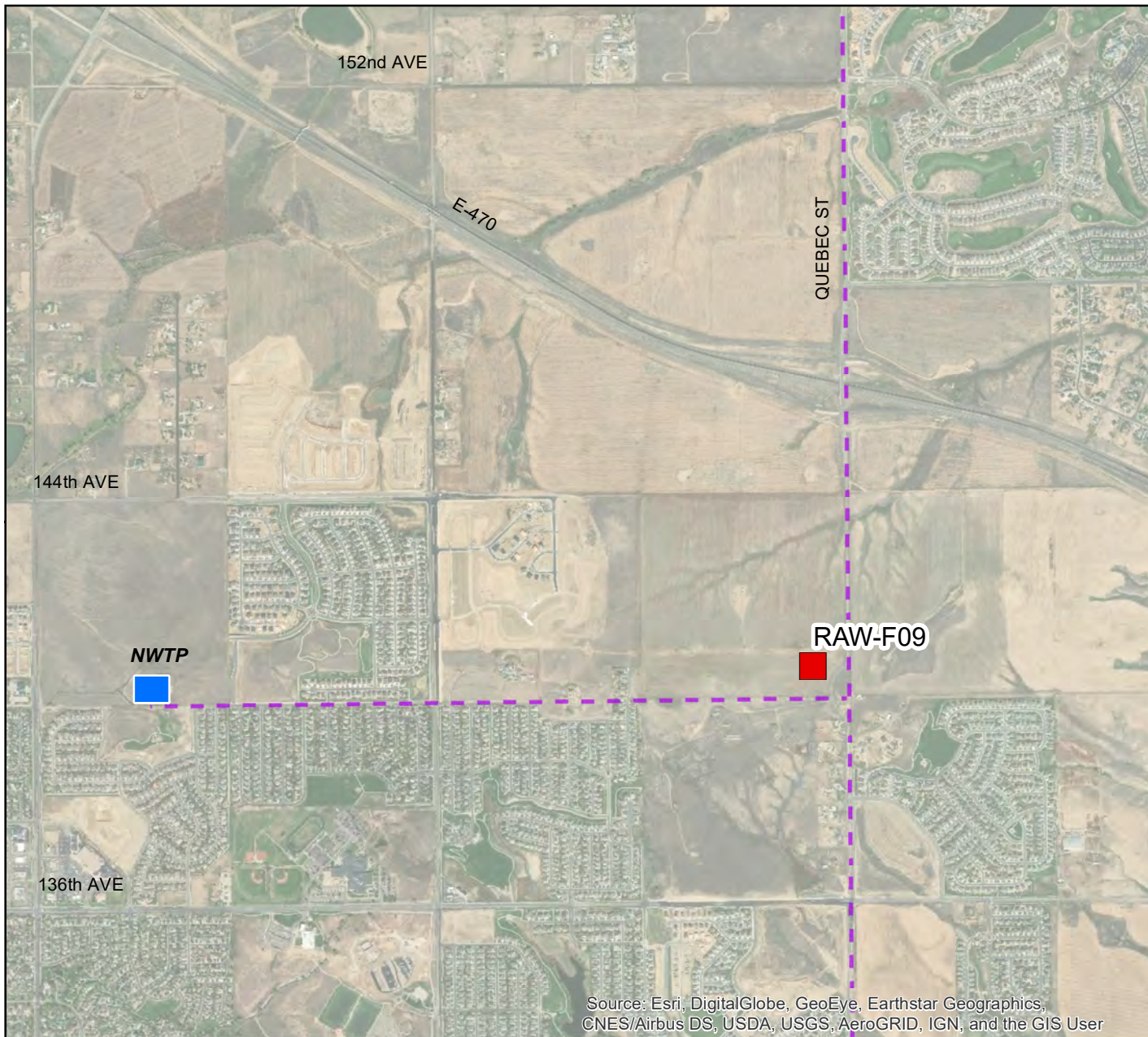
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Raw Water Improvements CIP RAW-F08



1 inch = 500 feet



Legend

- CIP Project
- WTP
- P Raw Water Supply Pump Station
- Other Improvements
- Gravel Lakes

Project Information

Construction of new chemical feed facility on new 42-in TWP raw water pipeline (RAW-F01), upstream of tee with new 36-in raw water pipeline to NWTP (RAW-F04).

Cost

\$595,000

Phase

2020-2025

Purpose

Tier 1 - Capacity

Trigger

Growth - Max Day Demand = 74.8 MGD

WTP

Northern

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Thornton, Colorado 80229
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Raw Water Improvements

CIP RAW-F09






1 inch = 2,000 feet



Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

Legend

-  Raw Water Supply Pump Station
-  Project Location
-  Gravel Lakes

Project Information

Addition of 10 MGD capacity to McKay PS, includes new pump with VFD, electrical upgrade, and building expansion.

Cost

\$10,000,000

Phase

2025-2035

Purpose

Tier 2 - Water Quality

Trigger

Growth - Max Day Demand = 74.8 MGD

WTP

Wes Brown/Thornton

 City of Thornton
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Raw Water Improvements

CIP RAW-F10






1 inch = 400 feet



Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

Legend

-  Raw Water Supply Pump Station
-  Project Location
-  Gravel Lakes

Project Information

Construction of new chemical feed facility located at McKay PS

Cost

\$595,000

Phase

2025-2035

Purpose

Tier 1 - Water Quality

Trigger

Growth - Max Day Demand = 74.8 MGD

WTP

Wes Brown/Thornton

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Raw Water Improvements

CIP RAW-F11



1 inch = 400 feet



Imagine it.
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Utility Master Plan

Project No. 17-467

Water Treatment Facilities Capital Improvement
Program Project Cutsheets

The City of Thornton

Project number: 60560104

March 2020

Table 2.14. Water Treatment Master CIP Table

CIP ID**	Phase (Project Completion Date)	Purpose	Project Type	Project Description	Cost	Dependant CIP	Trigger	Project Timeline (Start / Completion)	
WTP-E01	2020-2025	Tier 1 - Water Quality	Water Treatment	Existing WBWTP Improvement: Convert to alumimun-based coagulants from iron-based coagulants	\$ -		Existing Improvement	2020	2021
WTP-E02	2020-2025	Tier 1 - Water Quality	Water Treatment	Existing WBWTP Improvement: Improvements for PAC dry storage and installation of PAC wetting system	\$ 710,000	WTP-E01	Existing Improvement	2020	2021
WTP-E03	2020-2025	Tier 1 - Capacity	Water Treatment	Existing WBWTP Improvement: Increase membrane surface area by using older membranes to equip unused cassettes	\$ -		Existing Improvement	2020	2021
WTP-E04	2020-2025	Tier 1 - Operations	Water Treatment	Existing WBWTP Improvement: Residuals management improvement, addition of 70,000 sq ft of lagoons	\$ 1,100,000		Existing Improvement	2020	2021
WTP-E05	2020-2025	Tier 1 - Operations	Water Treatment	Existing WBWTP Improvement: Study to evaluate clarifier flow distribution	\$ 30,000		Existing Improvement	2020	2021
WTP-E06	2020-2025	Tier 1 - Water Quality	Water Treatment	Existing WBWTP Improvement: Study to Eliminate Recycling for Clean-in-Place Wastes	\$ 30,000		Existing Improvement	2020	2021
WTP-E07	2020-2025	Tier 1 - Water Quality	Water Treatment	Existing WBWTP Improvement: Study to determine best practices for lagoon discharge water management	\$ 50,000	WTP-E06,E08	Existing Improvement	2020	2021
WTP-E08	2020-2025	Tier 1 - Water Quality	Water Treatment	Existing WBWTP Improvement: Study to determine best practices to manage water treatment residuals	\$ 110,000		Existing Improvement	2020	2021
WTP-E09	2020-2025	Tier 1 - Maintenance	Water Treatment	Existing WBWTP Improvement: Clarifier Coating Rehabilitation	\$ 500,000		Existing Improvement	2020	2021
WTP-E10	2020-2025	Tier 1 - Redundancy	Water Treatment	Existing WBWTP Improvement: Additional air compressor and reject pump for membrane system	\$ 500,000		Existing Improvement	2020	2021
WTP-E11	2020-2025	Tier 1 - Capacity	Water Treatment	Existing WBWTP Improvement: Expansion of Membrane Train 8	\$ 1,840,000		Existing Improvement	2020	2021
WTP-E12	2020-2025	Tier 1 - Maintenance	Water Treatment	Existing WBWTP Improvement: Coagulant Tank Repairs	\$ 30,000		Existing Improvement	2020	2021
WTP-F01	2020-2025	Tier 1 - Capacity	Water Treatment	Land Acquisition for NWTP	\$ 3,000,000		Growth - MDD = 74.8 MGD	2025	2026
WTP-F02	2025-2035	Tier 1 - Capacity	Water Treatment	New NWTP Phase I - 10.75 MGD capacity, treatment plant only, does not include dewatering, finished water storage tank, off site power supply to transformer	\$ 43,842,000		Growth - MDD = 74.8 MGD	2027	2030
WTP-F03	2025-2035	Tier 1 - Capacity	Water Treatment	Mechanical Dewatering Infrastructure	\$ 15,620,000		Growth - MDD = 74.8 MGD	2029	2030
WTP-F04	2025-2035	Tier 1 - Capacity	Water Treatment	Power Supply to NWTP, baseline power supply cost, including offsite infrastructure and power supply to transformer	\$ 1,990,000		Growth - MDD = 74.8 MGD	2028	2029
WTP-F05	2025-2035	Tier 1 - Redundancy	Water Treatment	Standby Power (Tier 1 – Provide Standby Generator for Full Production)	\$ 2,210,000		Growth - MDD = 74.8 MGD	2028	2029
WTP-F06	2025-2035	Tier 2 - Redundancy	Water Treatment	Standby Power (Tier 2 – Upgrade to Second Utility feed)	\$ 1,330,000		Growth - MDD = 74.8 MGD	2028	2029
WTP-F07	2035-2065	Tier 1 - Capacity	Water Treatment	NWTP Phase II - additional 10.75 MGD capacity	\$ 43,842,000		Growth - MDD = 85.6 MGD	2046	2047
WTP-F08	2035-2065	Tier 3	Water Treatment	Standby Power (Tier 3 – Upgrade to Emergency Generator meeting NEC)	\$ 220,000		Growth - MDD = 74.8 MGD	N/A	N/A

**Project Cutsheets not provided for Tier 3 improvements

*CIP ID LEGEND:

PREFIX DEFINITION

RAW = Raw Water Supply System Project

WTP = Water Treatment Facilities Project

DD = Water Distribution System Project / Distribution Pipeline

TT= Water Distribution System Project / Transmission Pipeline

P = Water Distribution System Project / Pump

SS = Water Distribution System Project / Storage

WW = Wastewater Collection System Project

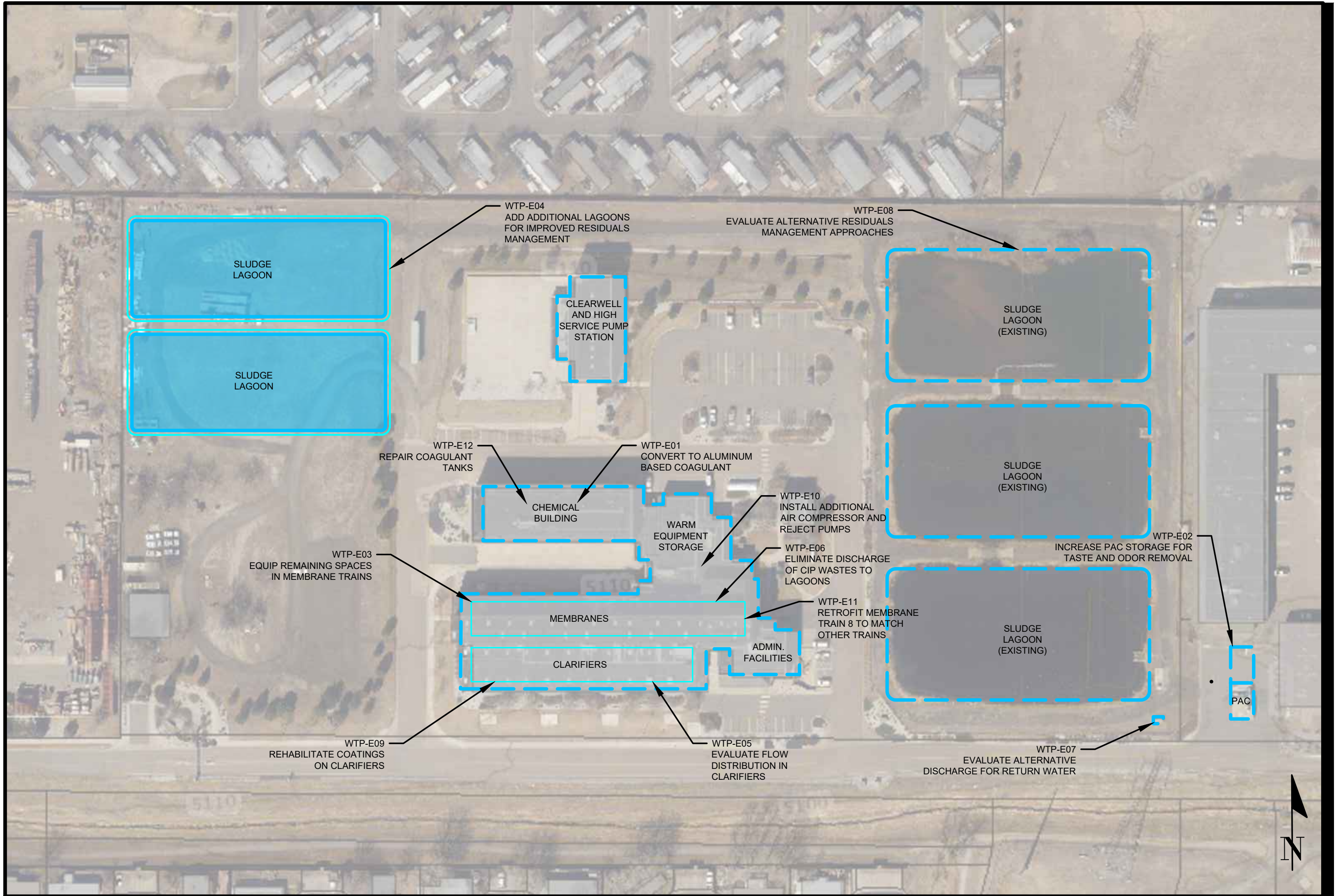
SUFFIX DEFINITION

E = Existing System Deficiency

F = Future System Improvement

*CIP ID's for Water Distribution and Wastewater Collection are organized without suffix in the Water and Wastewater Infrastructure Master Plan and on CIP project cutsheets

Trigger	Description
Existing Improvement	Improvement is required to address an existing deficiency
Growth - Average System Demand = 37mgd	Improvement will be required in the future, pending on expected growth
Growth - Average System Demand = 44mgd	Improvement will be required in the future, pending on expected growth
Developments north of E 156th Avenue	Improvement will serve future developments, pending on localized growth
WBWTP Upgrade	Improvement will support increase in supply capacity at WBWTP
Growth North of E-470	Improvement will serve future developments, pending on localized growth
Zone 1 Storage Upgrade	Improvement will support increase in storage capacity
Zone 3 Storage Upgrade	Improvement will support increase in storage capacity
NWTP Construction	Improvement will support supply improvements at NWTP
70% Measured Sewer Flow =	Improvement is required to meet future flows
Growth - Max Day Demand = 74.8 mgd	Improvement will be required in the future, pending on expected growth
Growth - Max Day Demand = 85.6 mgd	Improvement will be required in the future, pending on expected growth
Tier 2	Improvement identified as Tier 2
Tier 3	Improvement identified as Tier 3



Water Treatment Improvements

CIP ID:	WTP-E01
Project Information:	Convert to aluminum-based coagulants from iron-based coagulants at WBWTP.
Cost:	\$0
Phase:	2020 - 2025
Purpose:	Tier 1 – Water Quality
Trigger:	Existing Improvement
WTP:	Wes Brown



9500 Civic Center Drive
Thornton, Colorado 80229
(303) 538-7295



6200 South Quebec Street
Greenwood Village, Colorado 80111

Water Treatment Improvements

CIP ID: WTP-E02

Project Information: Improvements at WBWTP for PAC dry storage and installation of PAC wetting system. Improve piping configuration, ensure long radius elbows, additional hose connection points for regular flushing, additional dismantling points. This improvement aids in taste & odor removal.

Cost: \$710,000

Phase: 2020 - 2025 / Delay until results known of WTP-E01

Purpose: Tier 1 – Water Quality

Trigger: Existing Improvement

WTP: Wes Brown



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(303) 538-7295



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Water Treatment Improvements

CIP ID: WTP-E03

Project Information: Increase membrane surface area at WBWTP by using older membranes to equip unused cassettes to increase treatment capacity.

Cost: \$0

Phase: 2020 - 2025

Purpose: Tier 1 – Capacity

Trigger: Existing Improvement

WTP: Wes Brown



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6200 South Quebec Street
Greenwood Village, Colorado 80111

Water Treatment Improvements

CIP ID: WTP-E04

Project Information: Residuals Management Improvements at WBTWP,
70,000 square feet of additional lagoons, 3 ft deep.

Cost: \$1,100,000

Phase: 2020 - 2025

Purpose: Tier 1 – Operations

Trigger: Existing Improvement

WTP: Wes Brown



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(303) 538-7295



6200 South Quebec Street
Greenwood Village, Colorado 80111

Water Treatment Improvements

CIP ID: WTP-E05

Project Information: Study to evaluate clarifier flow distribution system at WBWTP. Goals include determining differences in hydraulic grade line at each unit and potential to improve tuning of control valves to allow for use of flow balancing control. End goal is to provide recommendation for improvements; expectation is that physical changes would be minor, if any.

Potential Resulting CIP: \$100K CIP to add additional instrumentation to reduce noise in system; similar cost could be applied to physically modifying the influent channel to adjust HGL.

Cost: \$30,000

Phase: 2020 - 2025

Purpose: Tier 1 – Operations

Trigger: Existing Improvement

WTP: Wes Brown



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Water Treatment Improvements

CIP ID: WTP-E06

Project Information: Study to Eliminate Recycling for Clean-in-Place Wastes at WBWTP. Evaluate water quality data from CIP and assemble application for SIC discharges to sewer. Limited analytical work to characterize CIP waste.

Potential Resulting CIP: Up to \$50k CIP; based on the assumption that the existing sewer line from WBWTP could be used to discharge CIP wastes to MWRD. Alternative approach could be creating an unloading station for hauling off wastes by truck. Changes are anticipated to be minor.

Cost: \$30,000

Phase: 2020 - 2025

Purpose: Tier 1 – Water Quality

Trigger: Existing Improvement

WTP: Wes Brown



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Water Treatment Improvements

CIP ID: WTP-E07

Project Information: Evaluate the potential to return lagoon discharge from WBWTP downstream of Gravel Lakes to eliminate potential for foulants accumulation in Gravel Lakes.

Potential Resulting CIP: Up to \$14M CIP; including new 7 MGD return water discharge pump station and 24-inch pipeline extending approximately 4.2 miles to a location downstream of the Gravel Lakes.

Cost: \$50,000

Phase: 2020 - 2025 / Delay until results known of WTP-E06 and WTP-E08

Purpose: Tier 1 – Water Quality

Trigger: Existing Improvement

WTP: Wes Brown



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Water Treatment Improvements

CIP ID: WTP-E08

Project Information: Evaluate means to best manage water treatment residuals. Study would include evaluation of existing lagoon operations at WBWTP as well as potential enhancement, such as addition of residuals management at TWTP or inclusion of mechanical dewatering at WBWT and/or TWTP.

Potential Resulting CIP: Up to \$3M CIP depending on redundancy, and inclusion of a Belt Filter Press.

Cost: \$110,000

Phase: 2020 - 2025

Purpose: Tier 1 – Water Quality

Trigger: Existing Improvement

WTP: Wes Brown



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Water Treatment Improvements

CIP ID: WTP-E09

Project Information: Clarifier Coating Rehabilitation a WBWTP. Existing Maintenance project identified in order to maintain the service life of clarification equipment.

Cost: \$500,000

Phase: 2020 - 2025

Purpose: Tier 1 – Maintenance

Trigger: Existing Improvement

WTP: Wes Brown



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Water Treatment Improvements

CIP ID:	WTP-E10
Project Information:	Addition of a redundant air compressor and reject pump to the membrane filtration system at WBTWP to improve redundancy.
Cost:	\$500,000
Phase:	2020 - 2025
Purpose:	Tier 1 – Redundancy
Trigger:	Existing Improvement
WTP:	Wes Brown



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Water Treatment Improvements

CIP ID: WTP-E11

Project Information: Increase capacity of Membrane Train No. 8 at WBWTP by 5 cassettes along with addition of vacuum pumps and blowers.

Cost: \$1,840,000

Phase: 2020 - 2025

Purpose: Tier 1 – Capacity

Trigger: Existing Improvement

WTP: Wes Brown



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Water Treatment Improvements

CIP ID: WTP-E12

Project Information: Coagulant Tank Repairs at WBWTP. Maintenance project to address risk of cracking when the tank is filled to capacity.

Cost: \$30,000

Phase: 2020

Purpose: Tier 1 – Maintenance

Trigger: Existing Improvement

WTP: Wes Brown



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Water Treatment Improvements

CIP ID:	WTP-F01
Project Information:	Purchase of 15 acres in unincorporated Adams County. Northwest of East 140th Ave and Dahlia Way as future site of NWTP.
Cost:	\$3,000,000
Phase:	2020 - 2025
Purpose:	Tier 1 – Capacity
Trigger:	Growth - Max Day Demand = 74.8 MGD
WTP:	Northern



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Water Treatment Improvements

CIP ID: WTP-F02 (page 1 of 2)

Project Information: Construction of Phase I of Northern Water Treatment Plant, does not include land acquisition and mechanical dewatering. Phase I capacity = 10.75 MGD, Phase II/Ultimate capacity = 21.5 MGD.

Cost: \$43,842,000

Phase: 2025 - 2035

Purpose: Tier 1 – Capacity

Trigger: Growth - Max Day Demand = 74.8 MGD

WTP: Northern

NWTP Process Summary:

Conventional Treatment Process

- Pretreatment: Flash mixing, in-line with raw water
- Flocculation: 2 out of 3 trains, each rated at 10.75 MGD. Each train will include 3 stages of flocculation.
- Sedimentation: 2 out of 3 trains constructed, each rated at 10.75 MGD. Each train will include 1 zone of sedimentation.
- Ozone: 2 ozone generators, sized for ultimate plant rated capacity, with companion feed and destruct systems, oxygen storage and feed equipment, 2 parallel contact basins sized for the target contact time at the ultimate plant rated capacity.
- Biological Filtration: 4 filters loaded granular activated carbon (GAC). Each filter will be sized for 20% of the ultimate plant rated capacity
- Clearwell: 0.7 Baffle Factor, 1.5 Safety Factor, designed to work with hypochlorite to achieve the additional 0.5 Log Giardia and 2.0 Log Virus disinfection contact time
- Filter Backwash: supply tank, pumps (1 operational, 1 standby), backwash waste equalization tank



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Water Treatment Improvements

CIP ID: WTP-F02 (page 2 of 2)

NWTP Process Summary (continued):

Solids Handling

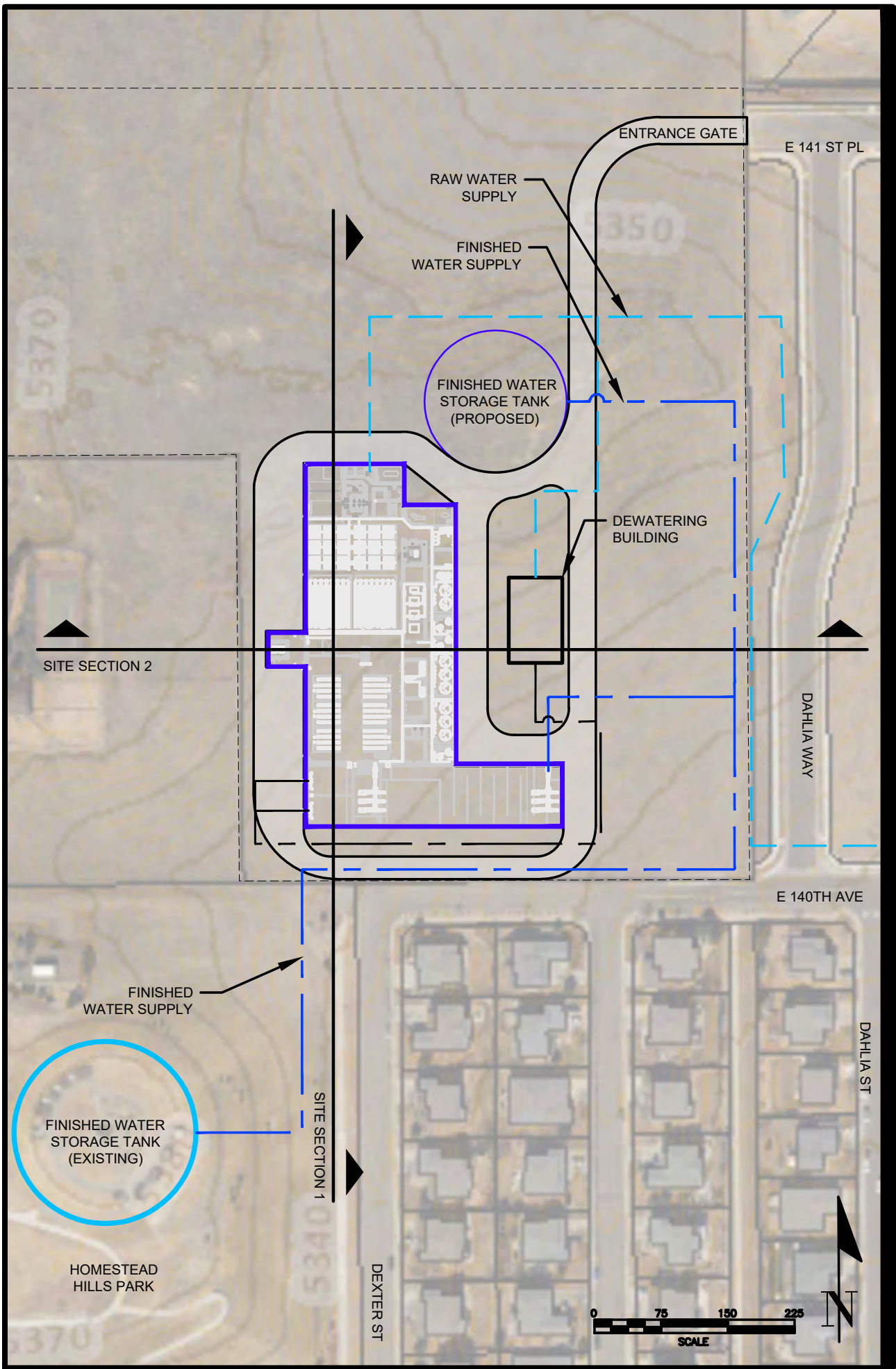
- Gravity Thickener: 2 basins, 1 equipped with mechanical equipment
- Return Water storage tank
- Return Water pumps: 2 operational (duty/standby)
- Belt Filter Press: 1 operational
- Sludge Conditioning Tank
- Polymer Feed System
- Screw Conveyors

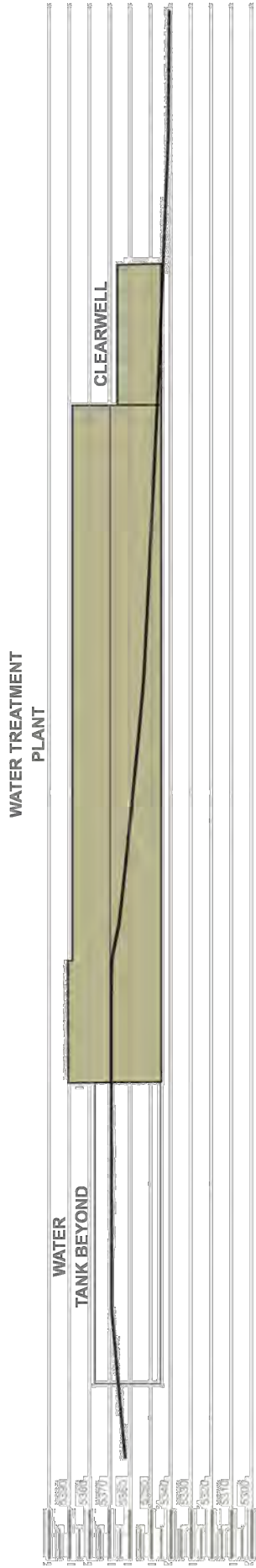


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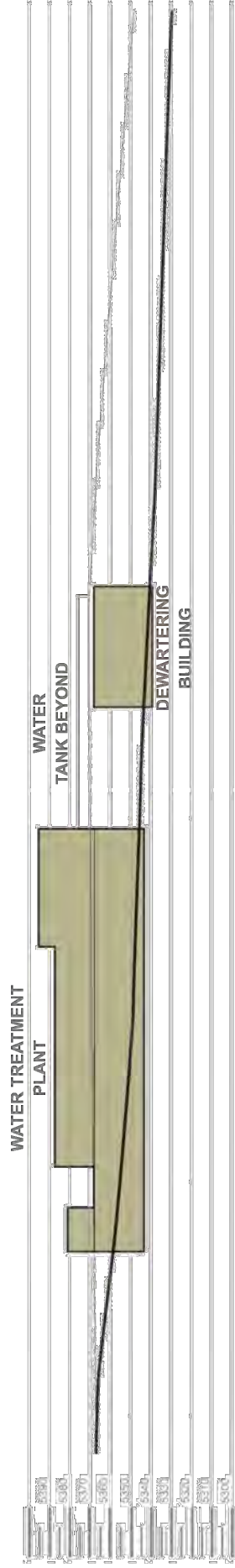


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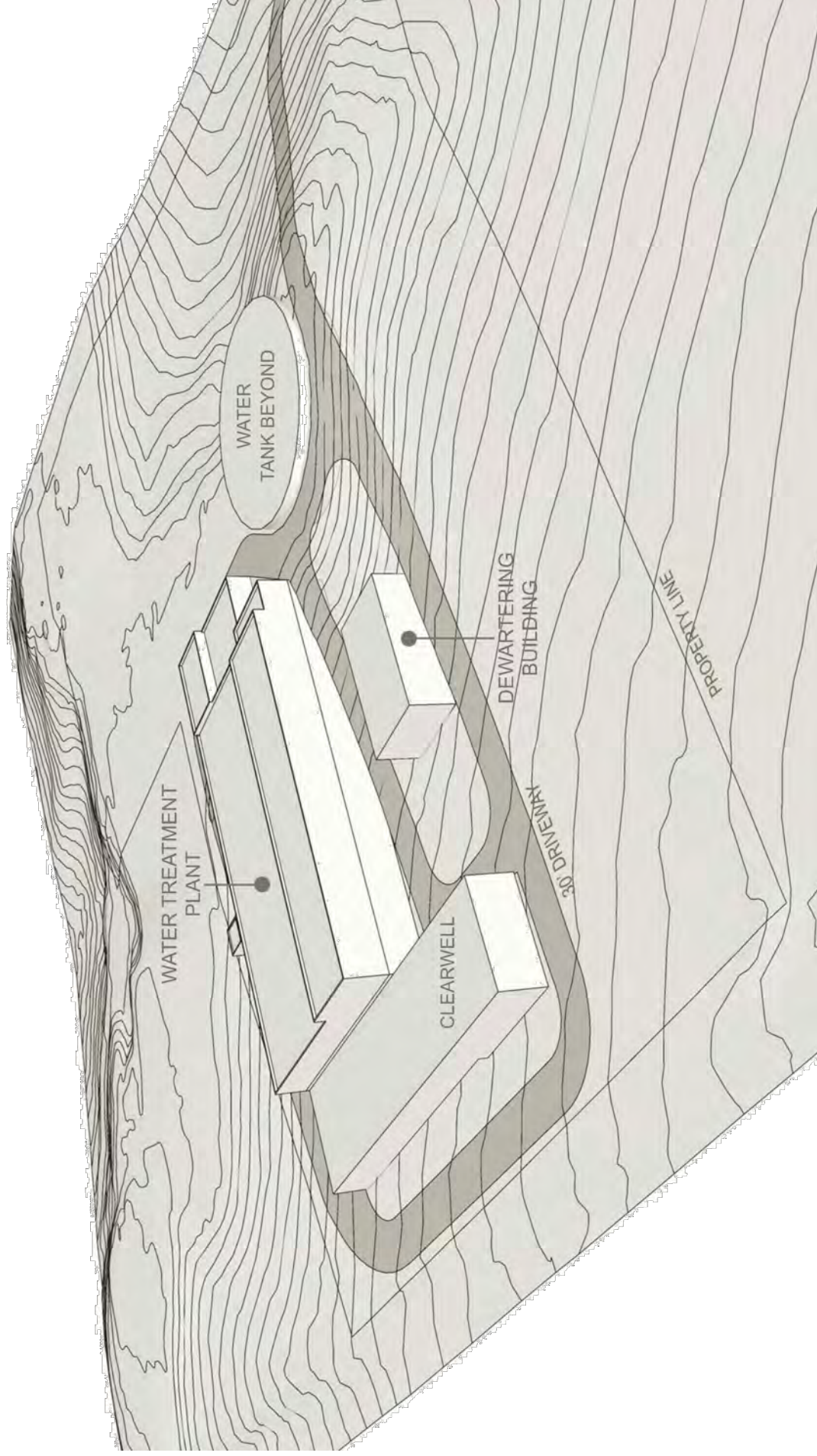




ENLARGED SITE SECTION 1



ENLARGED SITE SECTION 2



Water Treatment Improvements

CIP ID:	WTP-F03
Project Information:	Construction of mechanical dewatering system at NWTP, in concurrence of NWTP construction. Conceptual design assumptions: Turbidity = 50 NTU. SLR = 25 lbs/day/sf
Cost:	\$15,620,000
Phase:	2025 - 2035
Purpose:	Tier 1 – Capacity
Trigger:	Growth - Max Day Demand = 74.8 MGD
WTP:	Northern



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Water Treatment Improvements

CIP ID:	WTP-F04
Project Information:	Baseline Power Supply to NWTP, including offsite infrastructure and power supply to transformer on NWTP site.
Cost:	\$1,990,000
Phase:	2025 - 2035
Purpose:	Tier 1 – Capacity
Trigger:	Growth - Max Day Demand = 74.8 MGD
WTP:	Northern



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Water Treatment Improvements

CIP ID: WTP-F05

Project Information: Standby generator sized for full production

Cost: \$2,210,000

Phase: 2025 - 2035

Purpose: Tier 1 - Redundancy

Trigger: Growth - Max Day Demand = 74.8 MGD

WTP: Northern



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Water Treatment Improvements

CIP ID: WTP-F06

Project Information: Second utility feed to NWTP from different substation

Cost: \$1,330,000

Phase: 2025 - 2035

Purpose: Tier 2 - Redundancy

Trigger: Growth - Max Day Demand = 74.8 MGD

WTP: Northern



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Water Treatment Improvements

CIP ID: WTP-F07

Project Information: Construction of Phase II of Northern Water Treatment Plant, does not include land acquisition and mechanical dewatering. Phase II/Ultimate capacity = 21.5 MGD.

Cost: \$43,842,000

Phase: 2035 - 2065

Purpose: Tier 1 – Capacity

Trigger: Growth - Max Day Demand = 85.6 MGD

WTP: Northern

NWTP Process Summary:

Conventional Treatment Process

- Flocculation: 1 train, rated at 10.75 MGD. Each train will include 3 stages of flocculation.
- Sedimentation: 1 train, rated at 10.75 MGD. Each train will include 1 zone of sedimentation.
- Biological Filtration: 2 filters loaded granular activated carbon (GAC). Each filter will be sized for 20% of the ultimate plant rated capacity

Solids Handling

- Gravity Thickener: equipment for 2nd unit
- Return Water pumps: 3rd pump (reconfigure for lead/lag/standby)
- Belt Filter Press: 2nd operational unit (parallel operation)



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Utility Master Plan

Project No. 17-467

Water Distribution Capital Improvement
Program Project Cutsheets

The City of Thornton

Project number: 60560104

March 2020

Table 2.15. Water Distribution Master CIP Table (page 1 of 2)

CIP ID	Phase (Project Completion Date)	Purpose	Project Type	Project Description	Cost	Dependant CIP	Zone	Trigger	Project Timeline (Start / Completion)	
P-01(E)	2020-2025	Tier 1 - Pumping	Pump unit replacement	Replacement of 2 units in Zone 5 Pump Station, each with a capacity of 1,500gpm.	\$ 146,900		Zone 5	Existing improvement	2020	2021
SS-01(F)	2020-2025	Tier 1 - Storage	New ground storage	New 5MG Tank west of Sintra Lewis Pointe Park, north of 140th Ave.	\$ 13,214,900		Zone 1	Zone 1 Storage Upgrade	2021	2022
SS-02(F)	2020-2025	Tier 1 - Storage	New ground storage	New 3.5 MG tank near existing Cherokee Tank.	\$ 9,522,500		Zone 3	Zone 3 Storage Upgrade	2022	2023
TT13(F)	2020-2025	Tier 1 - Supply	New transmission pipe	New pipe from Hilltop Tank to the new 5MG Tank. The new line is a 48-in with an approximate length of 1,900 ft.	\$ 2,209,600		Zone 1	Zone 1 Storage Upgrade	2022	2023
DD31(E)	2020-2025	Tier 1 - Capacity	New pipe or pipe replacement	Installation of a parallel pipe along Eppinger Boulevard, between Hoffman Way and Ellen Court. The new line is a 12-in with an approximate length of 300 ft.	\$ 118,470		Zone 2	Existing improvement	2025	2026
DD32(E)	2020-2025	Tier 1 - Capacity	New pipe or pipe replacement	Installation of a parallel pipe on the west side of TWTP. The new line is a 16-in with an approximate length of 700 ft.	\$ 358,050		Zone 2	Existing improvement	2023	2024
DD34(E)	2020-2025	Tier 1 - Capacity	New pipe or pipe replacement	New pipe on property west of the TWTP. The new line is a 16-in with an approximate length of 700ft. This project will improve service pressure.	\$ 358,050	DD35	Zone 2	Existing improvement	2023	2024
DD35(E)	2020-2025	Tier 1 - Capacity	New pipe or pipe replacement	New pipe on property west of the TWTP. The new line is a 16-in with an approximate length of 100ft. This project will improve service pressure.	\$ 51,150		Zone 1	Existing improvement	2023	2024
DD25(E)	2025-2035	Tier 1 - Capacity, Fire flow	New pipe or pipe replacement	New pipe along Katherine Way between W 84th Ave and N Pecos St, and along N Pecos St between Katherine Way and W 82nd Pl. The new line is a 12-in with an approximate length of 1,700ft.	\$ 671,320		Zone 3	Existing improvement	2026	2027
DD27(E)	2025-2035	Tier 1 - Capacity, Fire flow	New pipe or pipe replacement	Installation of a parallel pipe along W 82nd Pl, between Nela Dr and Pecos Way. The new line is a 12-in with an approximate length of 400ft.	\$ 157,960		Zone 3	Existing improvement	2026	2027
DD28(E)	2025-2035	Tier 1 - Capacity, Fire flow	New pipe or pipe replacement	New pipe along Douglas Dr between Greenwood Blvd and N Pecos St, and along 82nd St between N Pecos St and Nola Dr. The new line is a 8-in with an approximate length of 3,300ft.	\$ 1,015,840		Zone 3	Existing improvement	2025	2026
DD30(F)	2025-2035	Tier 1 - Capacity	New pipe or pipe replacement	New pipe along Thornton Pkwy, just west of I-25. The line is a 12-in with an approximate length of 800 ft.	\$ 315,920		Zone 3	Growth - Average System Demand = 37mgd	2034	2035
P-03(F)	2025-2035	Tier 1 - Pumping	Pump unit replacement	Replacement of two units in Zone 1 - Wes Brown High Service Pump Station, each with a capacity of 10,000gpm.	\$ 4,614,000		Zone 1	Growth - Average System Demand = 37mgd	2029	2030
P-04(F)	2025-2035	Tier 1 - Pumping	New pump station	New pump station, pumping from NWTP to Zone 1, with four units, each with a capacity of 5,000gpm.	\$ 566,300		Zone 1	NWTP Construction	2033	2034
SS-03(F)	2025-2035	Tier 1 - Storage	New ground storage	New 6 MG tank adjacent to TWTP Clearwell 2.	\$ 15,857,900		Zone 1	Zone 1 Storage Upgrade	2034	2035
TT07(F)	2025-2035	Tier 1 - Facilitate Growth	New Pipe	New pipe parallel to and north of E-470 between Holly St and Quebec St, and along Holly St from E-470 to E 152th Ave. The new line is a 42-in with an approximate length of 5,200ft.	\$ 5,198,300		Zone 1	Growth North of Highway I470	2028	2029
TT10(F)	2025-2035	Tier 1 - Facilitate Growth	New Pipe	New pipe crossing E-470, then parallel to and south of E-470 between Holly St and Quebec St, and along Quebec St from E-470 to E 138th Ave. The new line is a 24-in with an approximate length of 7,400ft.	\$ 4,809,000		Zone 1	Growth North of Highway I470	2027	2028
TT14(F)	2025-2035	Tier 1 - Supply	New transmission pipe	New pipe from Clearwell 2 at TWTP along Thornton Pkwy and E 96th Ave to just west of the South Platte River . The new line is a 48-in and 16-in with an approximate length of 14,300 ft.	\$ 16,629,700	TT26	Zone 1	WBWTP Upgrade	2032	2033
TT16(F)	2025-2035	Tier 1 - Supply	Connection to existing pipe	New pipe just south of TWTP. The new line is a 24-in with an approximate length of 200 ft.	\$ 130,000	TT33	Zone 1	Zone 1 Storage Upgrade	2034	2035
TT17(F)	2025-2035	Tier 1 - Storage	New transmission pipe	New pipe from Cherokee Tank to I-25, along I-25 to E 105th Ave, along E 105th Ave to Grant Dr, along Grant Dr to E104th Ave, along E 104th Ave to to Washington St, and along Washington St to Old E 100th Ave. The new line is a 36-in with an approximate length of 12,200 ft.	\$ 10,507,900	TT25, TT18, TT19, or TT20	Zone 1	Zone 3 Storage Upgrade	2030	2031
TT18(F)	2025-2035	Tier 1 - Storage	Connection to existing pipe	New pipe along 102nd Ave crossing Washington St. The new line is a 24-in with an approximate length of 200 ft.	\$ 130,000	TT17	Zone 3	Zone 3 Storage Upgrade	2034	2035

Table 2.15. Water Distribution Master CIP Table (page 2 of 2)

	Phase (Project Completion Date)	Purpose	Project Type	Project Description	Cost	Dependant CIP	Zone	Trigger	Project Timeline (Start / Completion)	
TT19(F)	2025-2035	Tier 1 - Storage	Connection to existing pipe	New pipe crossing Washington St at Old E 100th Ave. The new line is a 24-in with an approximate length of 200 ft.	\$ 130,000	TT17	Zone 1	Zone 1 Storage Upgrade	2034	2035
TT20(F)	2025-2035	Tier 1 - Storage	New transmission pipe	New pipe from TWTP, running along Dorothy Blvd, Hoffman Way, and 95th Ave to Washington St, then running parallel to Washington St until Old E 100th Ave. The new line is a 36-in with an approximate length of 5,100 ft.	\$ 4,392,700	TT17	Zone 3	Zone 1 Storage Upgrade	2031	2032
DD29(F)	2035-2065	Tier 2 - Capacity	New pipe or pipe replacement	Installation of a parallel pipe along Thornton Pkwy, crossing I-25. The line is a 16-in with an approximate length of 700 ft.	\$ 358,050		Zone 3	Growth - Average System Demand = 37mgd	N/A	N/A
DD37(F)	2035-2065	Tier 2 - Capacity	New pipe or pipe replacement	New pipe along 104th Ave between Washington St and Irma Dr. The new line is a 16-in with an approximate length of 4,300 ft.	\$ 2,199,430		Zone 1	Growth - Average System Demand = 37mgd	N/A	N/A
DD41(F)	2035-2065	Tier 2 - Capacity	New pipe or pipe replacement	Installation of a parallel pipe along York St east of Lake Avery. The new line is a 16-in with an approximate length of 2,200 ft.	\$ 1,125,290		Zone 1	Growth - Average System Demand = 44mgd	N/A	N/A
DD42(F)	2035-2065	Tier 2 - Capacity	New pipe or pipe replacement	Installation of a parallel pipe along 136th Ave just east of York St. The new line is a 16-in with an approximate length of 600 ft.	\$ 306,900		Zone 1	Growth - Average System Demand = 37mgd	N/A	N/A
DD49(F)	2035-2065	Tier 1 - Facilitate Growth	New Pipe	New pipe east of Colorado Blvd, running south from south of E 160th Ave to intersect with bend in Colorado Blvd. The new line is a 36-in with an approximate length of 2,600 ft.	\$ 2,239,400	TT04	Zone 1	Developments north of E 156th Avenue	N/A	N/A
P-02(F)	2035-2065	Tier 1 - Pumping	Additional pump unit	Replacement of one unit in Zone 3A Pump Station, with a capacity of 8,000gpm.	\$ 1,153,500		Zone 3A	Growth - Average System Demand = 44mgd	N/A	N/A
TT02(F)	2035-2065	Tier 1 - Facilitate Growth	New Pipe	New pipe along Colorado Blvd at E 160th Ave. The new line is a 20-in with an approximate length of 200 ft.	\$ 111,700	TT04	Zone 1	Growth North of E 156th Avenue	N/A	N/A
TT04(F)	2035-2065	Tier 1 - Facilitate Growth	New Pipe	New pipe along E 160th Ave, from neighborhood east of York St, across Colorado Blvd to east of Holly St. The new line is a 24-in with an approximate length of 4,600 ft.	\$ 2,989,400		Zone 1	Growth North of E 156th Avenue	N/A	N/A
TT05(F)	2035-2065	Tier 1 - Facilitate Growth	New Pipe	New pipe along Colorado Blvd from just north of E-470 to the bend in the road. The new line is a 36-in with an approximate length of 1,500 ft.	\$ 1,292,000	TT06	Zone 1	Growth North of E 156th Avenue	N/A	N/A
TT06(F)	2035-2065	Tier 2 - Capacity	New pipe or pipe replacement	New pipe along Colorado Blvd, with the north end crossing E-470. The new line is a 24-in with an approximate length of 3,800 ft.	\$ 2,469,480	TT14	Zone 1	Growth North of Highway E470	N/A	N/A
TT08(F)	2035-2065	Tier 1 - Facilitate Growth	New Pipe	New pipe from E-470 west of Quebec St, along Ehler Pkwy, bending south near Unita St, crossing E-470 and bending east south of 144th Ave, then south along Yosemite St to 136th Ave. The new pipe is 36-in and 42-in with an approximate length of 15,400 ft.	\$ 15,394,900	TT07	Zone 1	Growth North of Highway I470	N/A	N/A
TT09(F)	2035-2065	Tier 1 - Facilitate Growth	New Pipe	New pipe along Quebec St from E 152nd Ave to Ehler Pkwy. The new line is a 20-in with an approximate length of 2,700 ft.	\$ 1,507,000		Zone 3H	Growth North of Highway I470	N/A	N/A
TT11(F)	2035-2065	Tier 1 - Supply	New transmission pipe	New pipe from WBWTP along Riverdale Rd and Yosemite St to E 136th Ave, along Holly St from E 136th Ave to 140th Ave, and along E 140th Ave to a NWTP tie-in. The new line is 36-in and 48-in with an approximate length of 57,400 ft.	\$ 66,751,100		Zone 1	WBWTP Upgrade	N/A	N/A
TT21(F)	2035-2065	Tier 2 - Capacity	New pipe or pipe replacement	New pipe along 120th Ave from Grant St to Washington St, and along Washington St from 120th Ave to 128th Ave. The new line is a 24-in with an approximate length of 7,700 ft.	\$ 5,003,940		Zone 3A	Growth - Average System Demand = 44mgd	N/A	N/A
TT22(F)	2035-2065	Tier 2 - Capacity	New pipe or pipe replacement	New pipe along 136th Ave from 136th Ave from Clayton St to connection north of 136th Ave Tank. The new line is a 24-in with an approximate length of 2,700 ft.	\$ 1,754,630		Zone 1	Growth - Average System Demand = 44mgd	N/A	N/A
TT26(F)	2035-2065	Tier 1 - Supply	Configuration change	New pipe bypassing the new 6MG tank (CIP SS-03), adjacent to TWTP Clearwell 2. The new line is a 48-in with an approximate length of 300 ft.	\$ 348,900	TT14	Zone 1	Growth - Average System Demand = 44mgd	N/A	N/A

CIPID#'s revised from Water and Wastewater Infrastructure Master Plan: CIPID DD46 was removed from the CIP Plan because the project was incorporated into an adjacent CIP project.

*CIP ID LEGEND:

PREFIX DEFINITION

RAW = Raw Water Supply System Project

WTP = Water Treatment Facilities Project

DD = Water Distribution System Project / Distribution Pipeline

TT= Water Distribution System Project / Transmission Pipeline

P = Water Distribution System Project / Pump

SS = Water Distribution System Project / Storage

WW = Wastewater Collection System Project

SUFFIX DEFINITION

E = Existing System Deficiency

F = Future System Improvement

*CIP ID's for Water Distribution and Wastewater Collection are organized without suffix in the Water and Wastewater Infrastructure Master Plan and on CIP project cutsheets

Trigger	Description
Existing Improvement	Improvement is required to address an existing deficiency
Growth - Average System Demand = 37mgd	Improvement will be required in the future, pending on expected growth
Growth - Average System Demand = 44mgd	Improvement will be required in the future, pending on expected growth
Developments north of E 156th Avenue	Improvement will serve future developments, pending on localized growth
WBWTP Upgrade	Improvement will support increase in supply capacity at WBWTP
Growth North of E-470	Improvement will serve future developments, pending on localized growth
Zone 1 Storage Upgrade	Improvement will support increase in storage capacity
Zone 3 Storage Upgrade	Improvement will support increase in storage capacity
NWTP Construction	Improvement will support supply improvements at NWTP
70% Measured Sewer Flow =	Improvement is required to meet future flows
Growth - Max Day Demand = 74.8 mgd	Improvement will be required in the future, pending on expected growth
Growth - Max Day Demand = 85.6 mgd	Improvement will be required in the future, pending on expected growth
Tier 2	Improvement identified as Tier 2
Tier 3	Improvement identified as Tier 3



Legend

- New PRVs
- Storage
- Pump
- Existing Pipelines
- NWTP
- Pumping CIP
- Storage CIP
- CIP Improvements
- Other Improvements
- Developer
- COT

Project Information

New pipe from Hilltop Tank to the new 5MG Tank. The new line is a 48-in with an approximate length of 1,900 ft.

Cost

\$2,209,600

Phase

2025

Purpose

Supply

Trigger

Zone 1 Storage Upgrade

Zone

Zone 1

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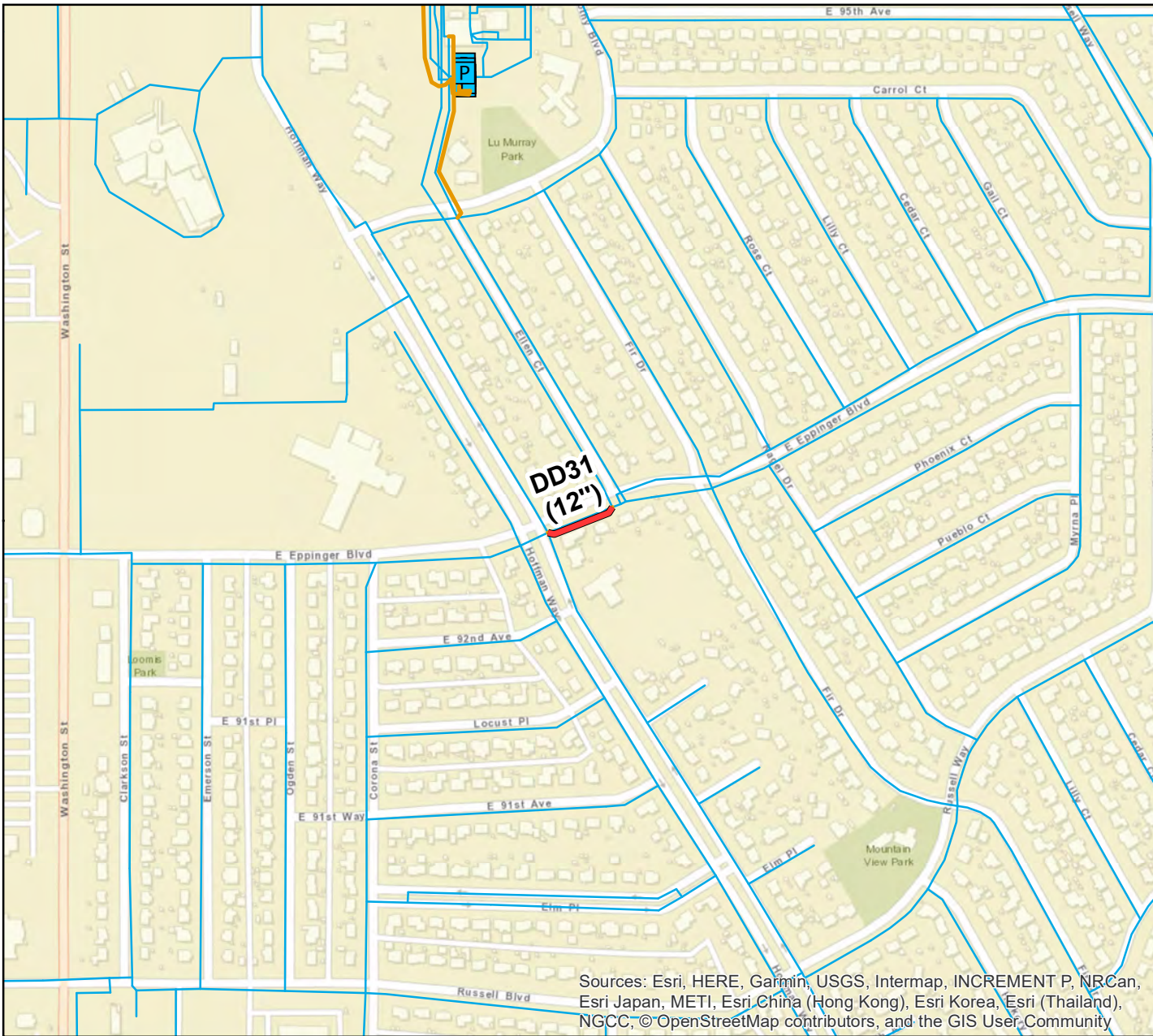
Water Distribution and Transmission Improvements

AECOM
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CIP TT13



1 inch = 500 feet



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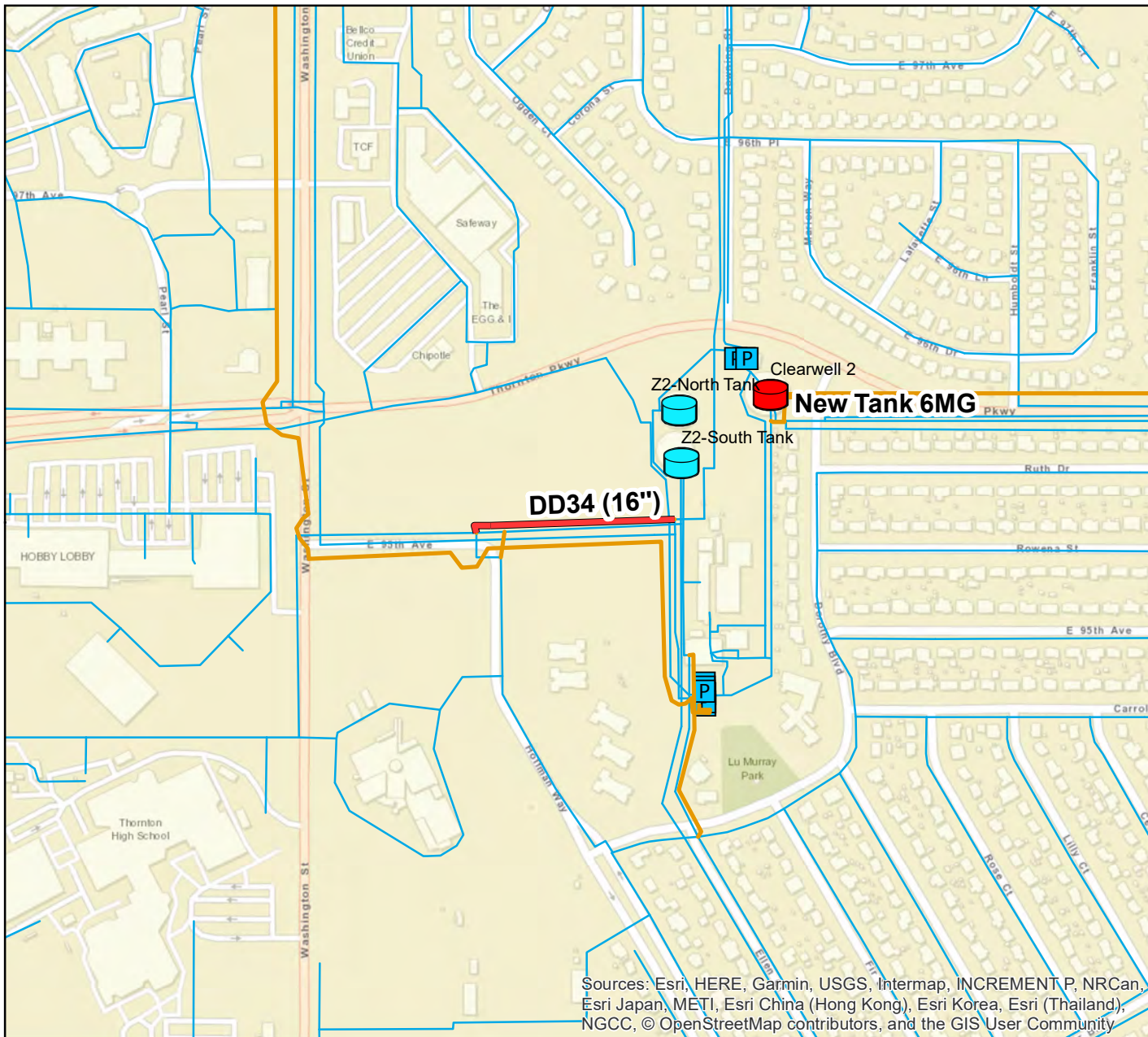
AECOM
6200 South Quebec Street
Greenwood Village, Colorado 80111

Water Distribution and Transmission Improvements

CIP DD31



1 inch = 500 feet



Legend

- New PRVs
- Storage
- P Pump
- Existing Pipelines
- WTP NWTP
- P Pumping CIP
- Storage CIP
- CIP Improvements
- Other Improvements
- Developer
- COT

Project Information

New pipe on property west of the TWTP. The new line is a 16-in with an approximate length of 700ft. This project will improve service pressure.

Cost

\$358,050

Phase

2025

Purpose

Tier 1 - Capacity

Trigger

Existing improvement

Zone

Zone 2

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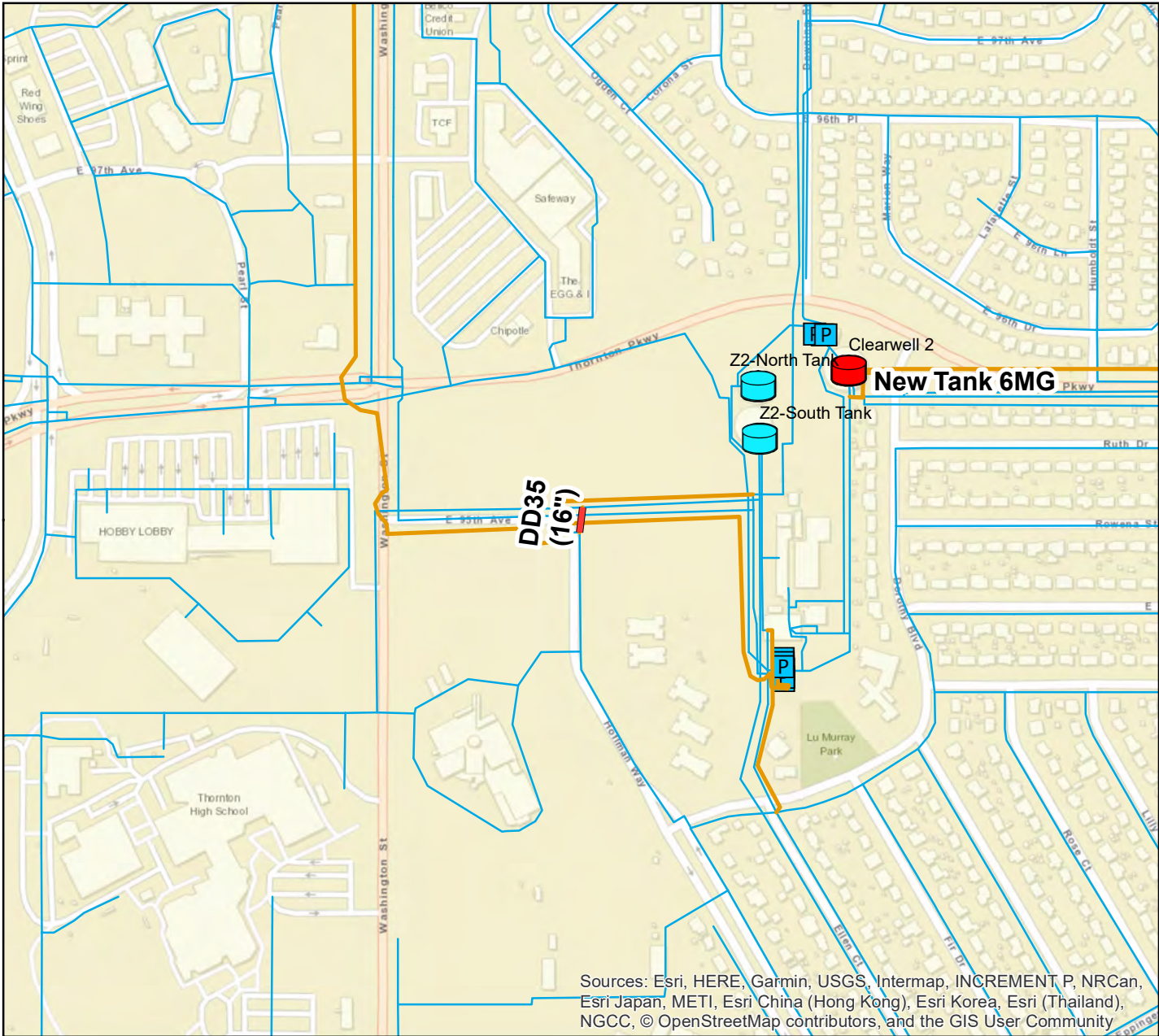
Water Distribution and Transmission Improvements

AECOM
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Greenwood Village, Colorado 80111

CIP DD34



1 inch = 500 feet



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Legend

- New PRVs
- Storage
- Pump
- Existing Pipelines
- NWTP
- Pumping CIP
- Storage CIP
- CIP Improvements
- Other Improvements
- Developer
- COT

Project Information

New pipe on property west of the TWTP. The new line is a 16-in with an approximate length of 100ft. This project will improve service pressure.

Cost

\$51,150

Phase

2025

Purpose

Tier 1 - Capacity

Trigger

Existing improvement

Zone

Zone 1

City of Thornton
9500 Civic Center Drive
Thornton, Colorado 80229
(303) 538-7295

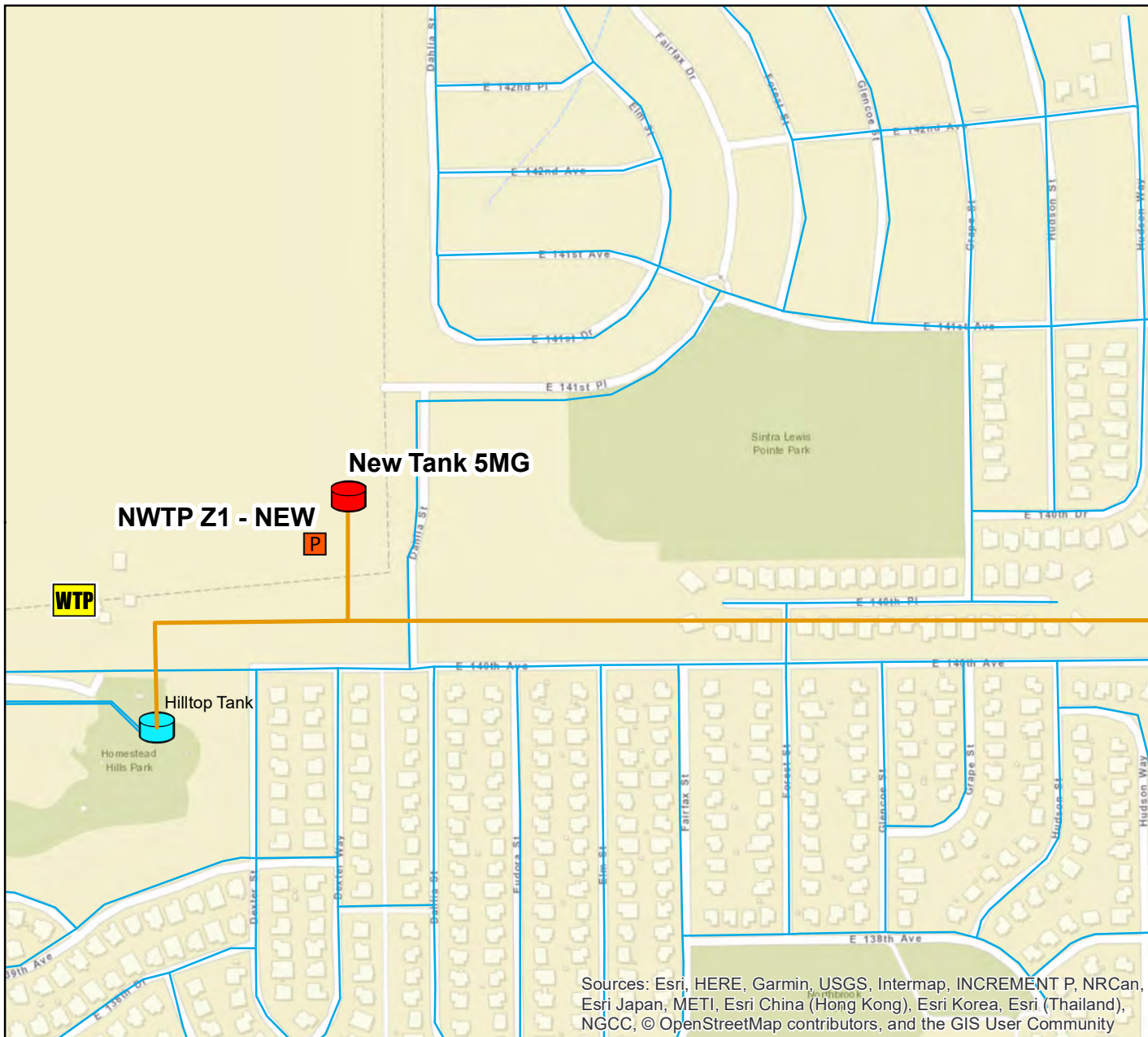
AECOM
6200 South Quebec Street
Greenwood Village, Colorado 80111

**Water Distribution and Transmission
Improvements**












CIP DD35



1 inch = 500 feet



Legend

-  New PRVs
-  Storage
-  Pump
-  Existing Pipelines
-  NWTP
-  Pumping CIP
-  Storage CIP
-  CIP Improvements
-  Other Improvements
-  Developer
-  COT

Project Information

New 5MG Tank west of Sintra Lewis Pointe Park, north of 140th Ave.

Cost

\$13,214,900

Phase

2025

Purpose

Tier 1 - Storage

Trigger

Zone 1 Storage Upgrade

Zone

Zone 1

City of Thornton
9500 Civic Center Drive
Thornton, Colorado 80229
(303) 538-7295

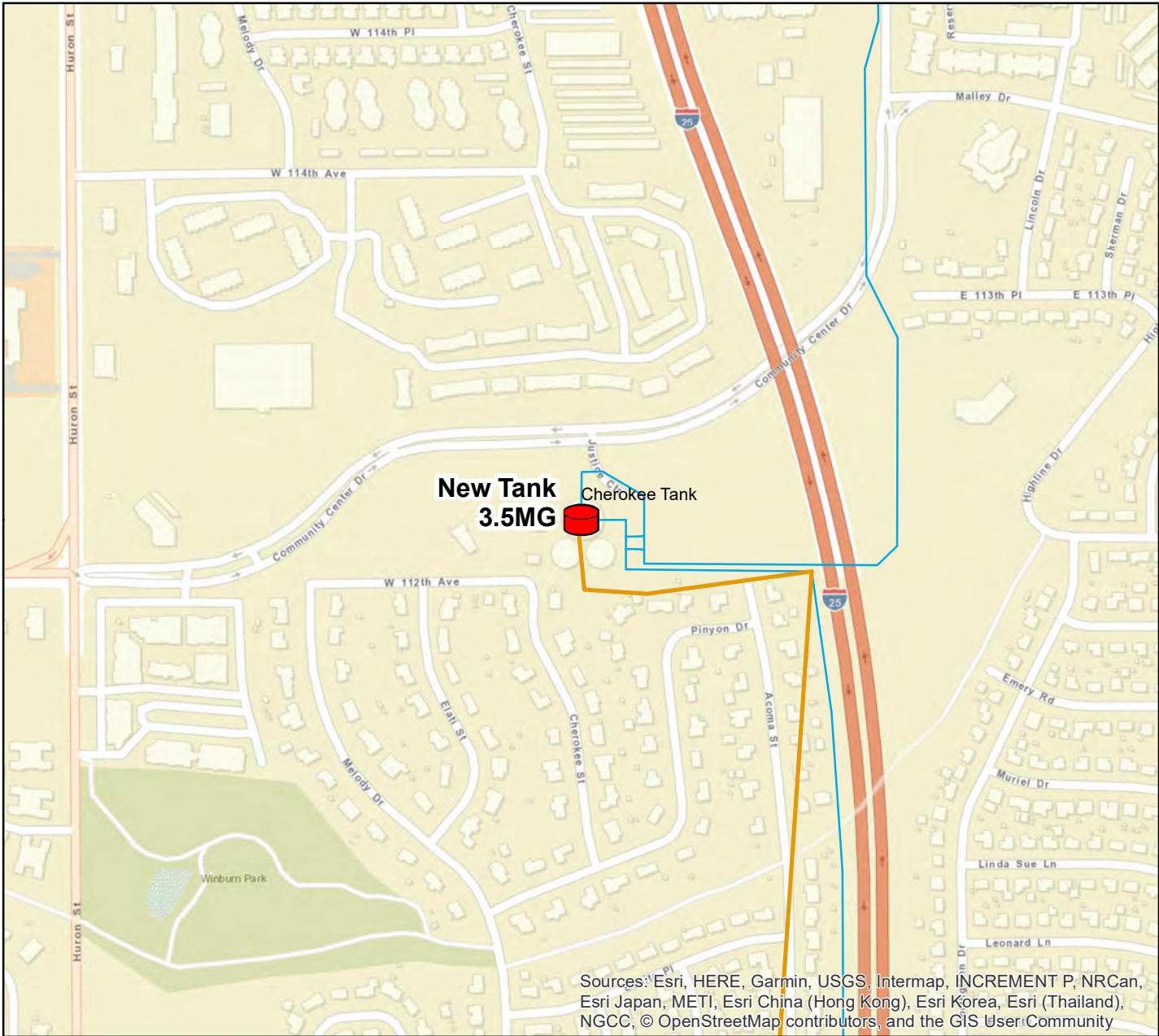
Water Distribution and Transmission Improvements

CIP SS-01

AECOM
6200 South Quebec Street
Greenwood Village, Colorado 80111



1 inch = 500 feet



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Legend

- | | |
|--------------------|--------------------|
| New PRVs | Pumping CIP |
| Storage | Storage CIP |
| Pump | CIP Improvements |
| Existing Pipelines | Other Improvements |
| NWTP | Developer |
| | COT |

Project Information

New 3.5 MG tank near existing Cherokee Tank.

Cost

\$9,522,500

Phase

2025

Purpose

Tier 1 - Storage

Trigger

Zone 3 Storage Upgrade

Zone

Zone 3

City of Thornton
9500 Civic Center Drive
Thornton, Colorado 80229
(303) 538-7295

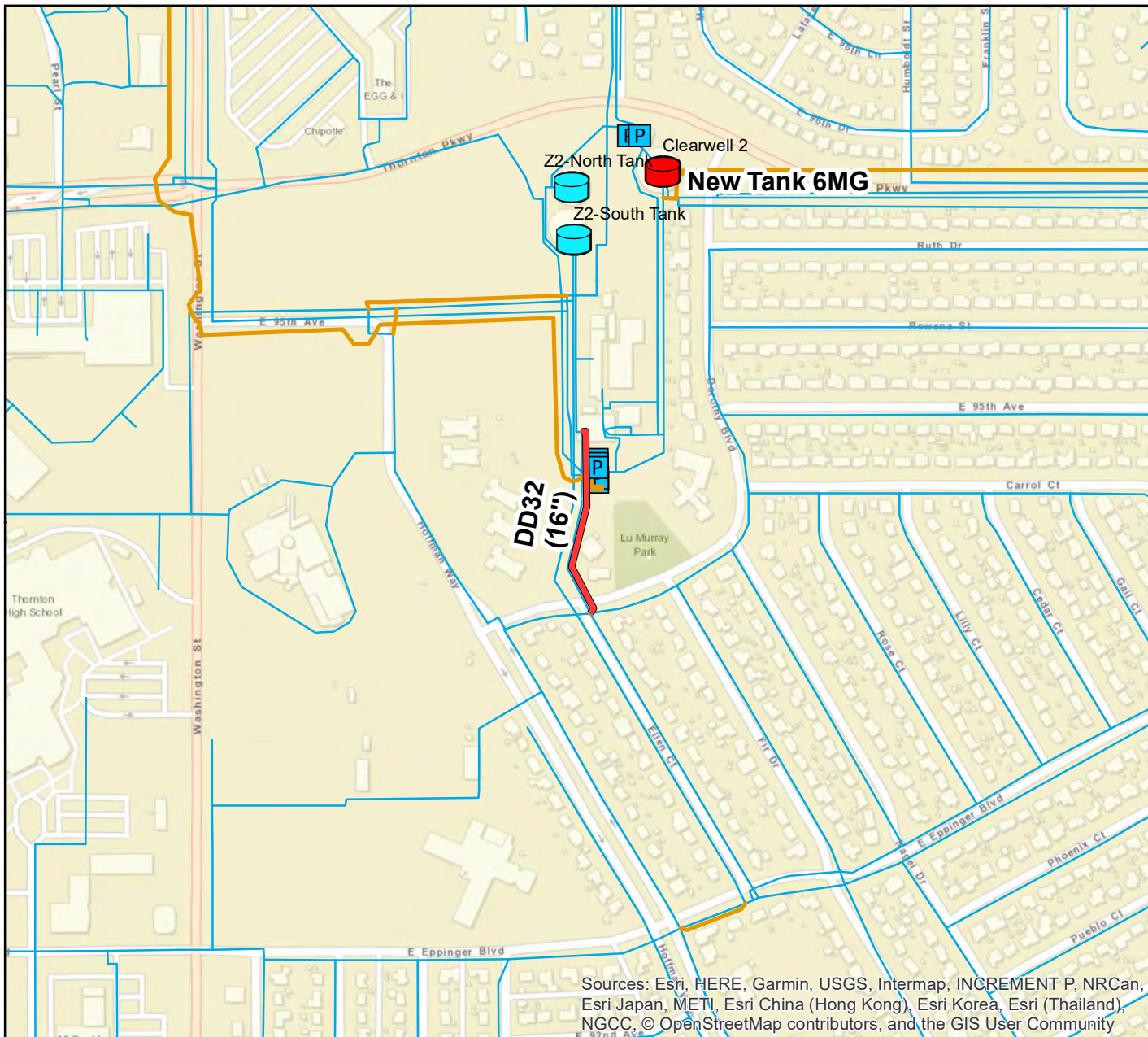
Water Distribution and Transmission Improvements

CIP SS-02



1 inch = 500 feet

AECOM
6200 South Quebec Street
Greenwood Village, Colorado 80111



Legend

- ✕ New PRVs
- Storage
- P Pump
- WTP NWTP
- P Pumping CIP
- Storage CIP
- CIP Improvements
- Other Improvements
- Developer
- COT

Project Information

Installation of a parallel pipe on the west side of TWTP. The new line is a 16-in with an approximate length of 700 ft.

Cost

\$358,050

Phase

2025

Purpose

Tier 1 - Capacity

Trigger

Existing improvement

Zone

Zone 2

City of Thornton
9500 Civic Center Drive
Thornton, Colorado 80229
(303) 538-7295

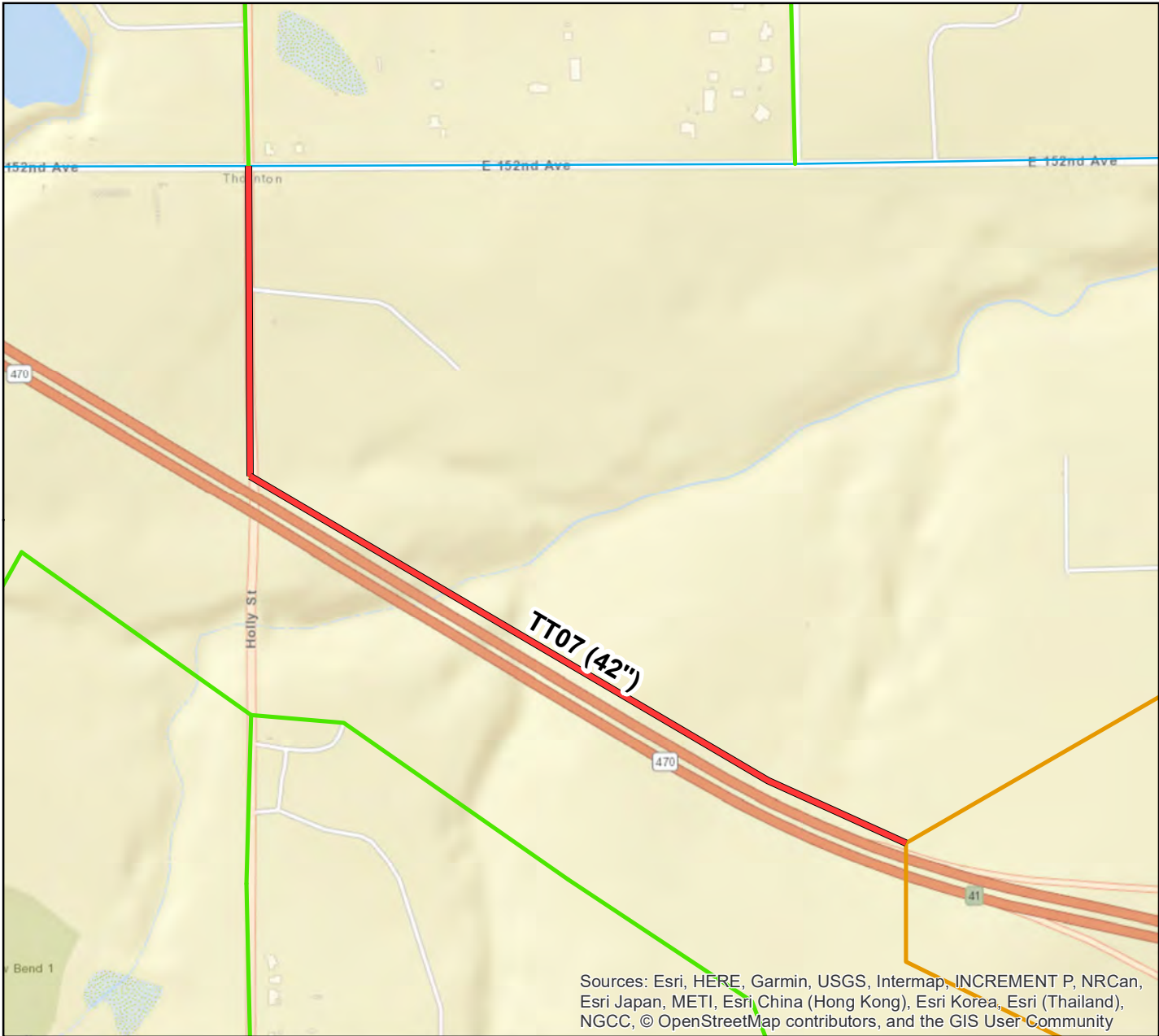
Water Distribution and Transmission Improvements

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CIP DD32



1 inch = 500 feet



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Legend

- New PRVs
- Storage
- Pump
- Existing Pipelines
- NWTP
- Pumping CIP
- Storage CIP
- CIP Improvements
- Other Improvements
- Developer
- COT

Project Information

New pipe parallel to and north of E-470 between Holly St and Quebec St, and along Holly St from E-470 to E 152th Ave. The new line is a 42-in with an approximate length of 5,200ft.

Cost

\$5,198,300

Phase

2025-2035

Purpose

Facilitate Growth

Trigger

Growth North of Highway I470

Zone

Zone 1

City of Thornton
9500 Civic Center Drive
Thornton, Colorado 80229
(303) 538-7295

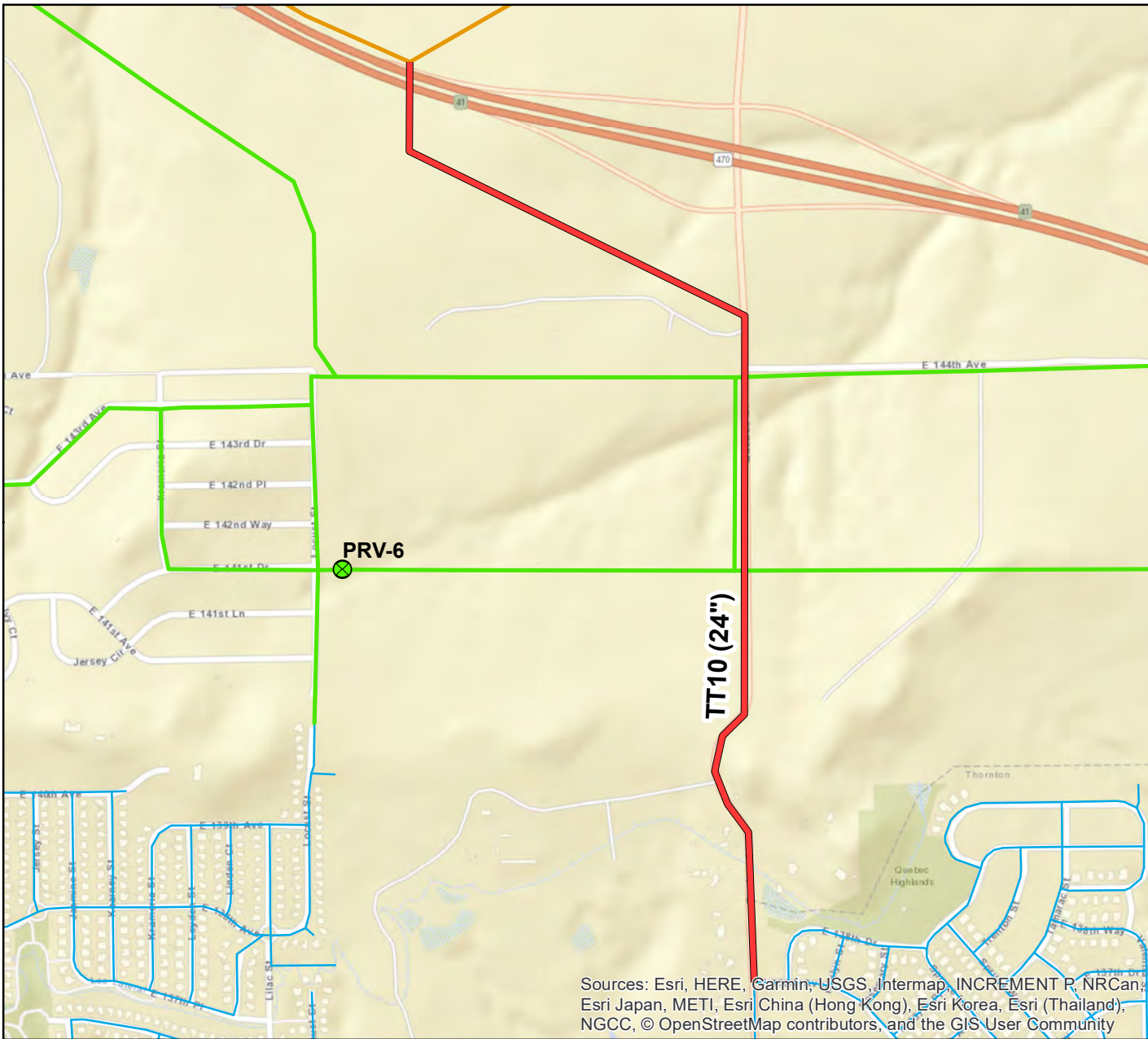
AECOM
6200 South Quebec Street
Greenwood Village, Colorado 80111

Water Distribution and Transmission Improvements

CIP TT07



1 inch = 750 feet



Legend

- | | |
|--------------------|--------------------|
| New PRVs | Pumping CIP |
| Storage | Storage CIP |
| Pump | CIP Improvements |
| Existing Pipelines | Other Improvements |
| NWTP | Developer |
| | COT |

Project Information

New pipe crossing E-470, then parallel to and south of E-470 between Holly St and Quebec St, and along Quebec St from E-470 to E 138th Ave. The new line is a 24-in with an approximate length of 7,400ft.

Cost

\$4,809,000

Phase

2025-2035

Purpose

Facilitate Growth

Trigger

Growth North of Highway I470

Zone

Zone 1

City of Thornton
9500 Civic Center Drive
Thornton, Colorado 80229
(303) 538-7295

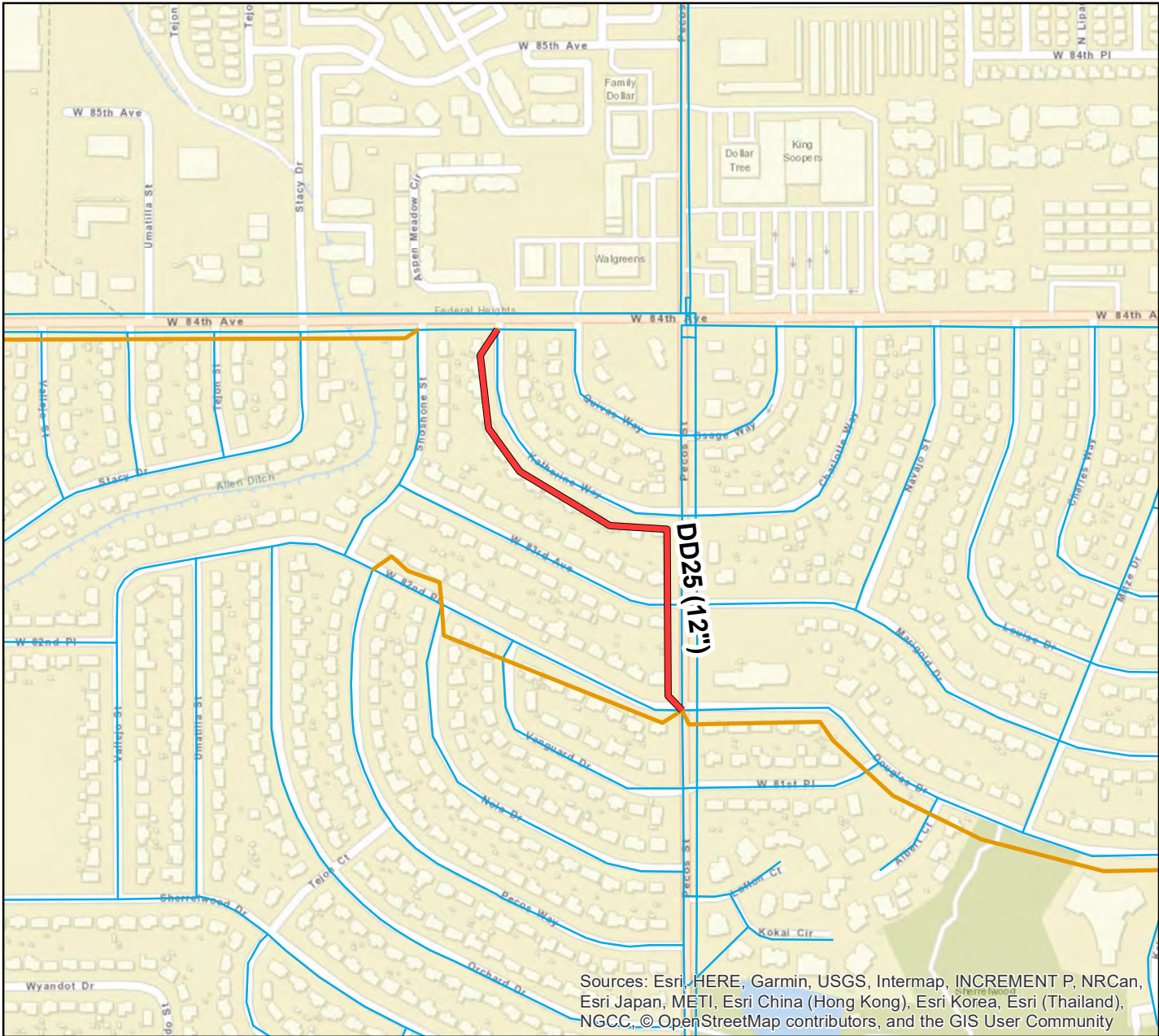
Water Distribution and Transmission Improvements

AECOM
6200 South Quebec Street
Greenwood Village, Colorado 80111

CIP TT10



1 inch = 1,000 feet



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Legend

- New PRVs
- Storage
- Pump
- Existing Pipelines
- NWTP
- Pumping CIP
- Storage CIP
- CIP Improvements
- Other Improvements
- Developer
- COT

Project Information

New pipe along Katherine Way between W 84th Ave and N Pecos St, and along N Pecos St between Katherine Way and W 82nd PI. The new line is a 12-in with an approximate length of 1,700ft.

Cost

\$671,320

Phase

2025-2035

Purpose

Tier 1 - Capacity, Fire flow

Trigger

Existing improvement

Zone

Zone 3

City of Thornton
9500 Civic Center Drive
Thornton, Colorado 80229
(303) 538-7295

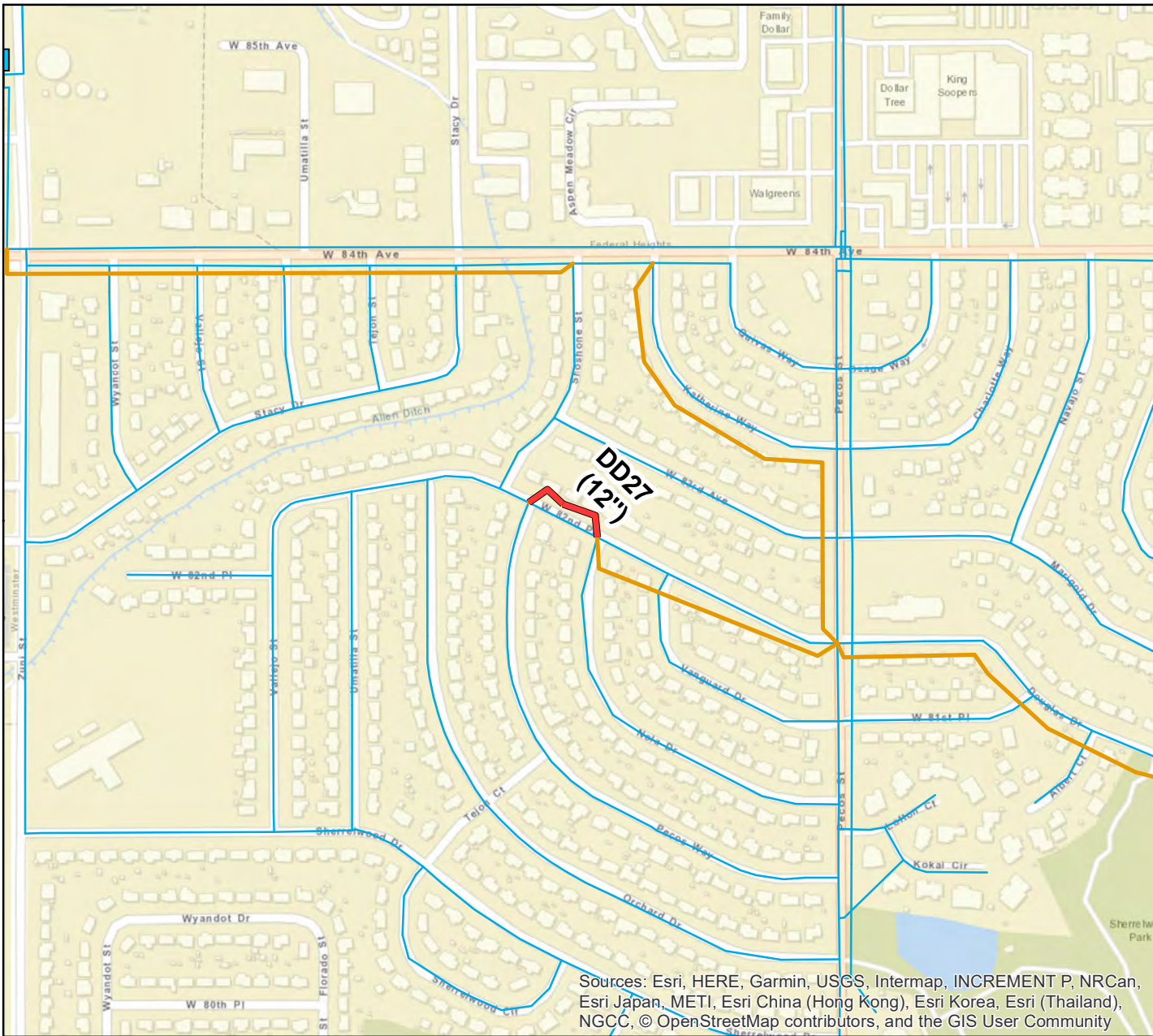
Water Distribution and Transmission Improvements

CIP DD25



1 inch = 500 feet

AECOM
6200 South Quebec Street
Greenwood Village, Colorado 80111



Legend

- New PRVs
- Storage
- Pump
- Existing Pipelines
- NWTP
- Pumping CIP
- Storage CIP
- CIP Improvements
- Other Improvements
- Developer
- COT

Project Information

Installation of a parallel pipe along W 82nd Pl, between Nela Dr and Pecos Way. The new line is a 12-in with an approximate length of 400ft.

Cost

\$157,960

Phase

2025-2035

Purpose

Tier 1 - Capacity, Fire flow

Trigger

Existing improvement

Zone

Zone 3

City of Thornton
9500 Civic Center Drive
Thornton, Colorado 80229
(303) 538-7295

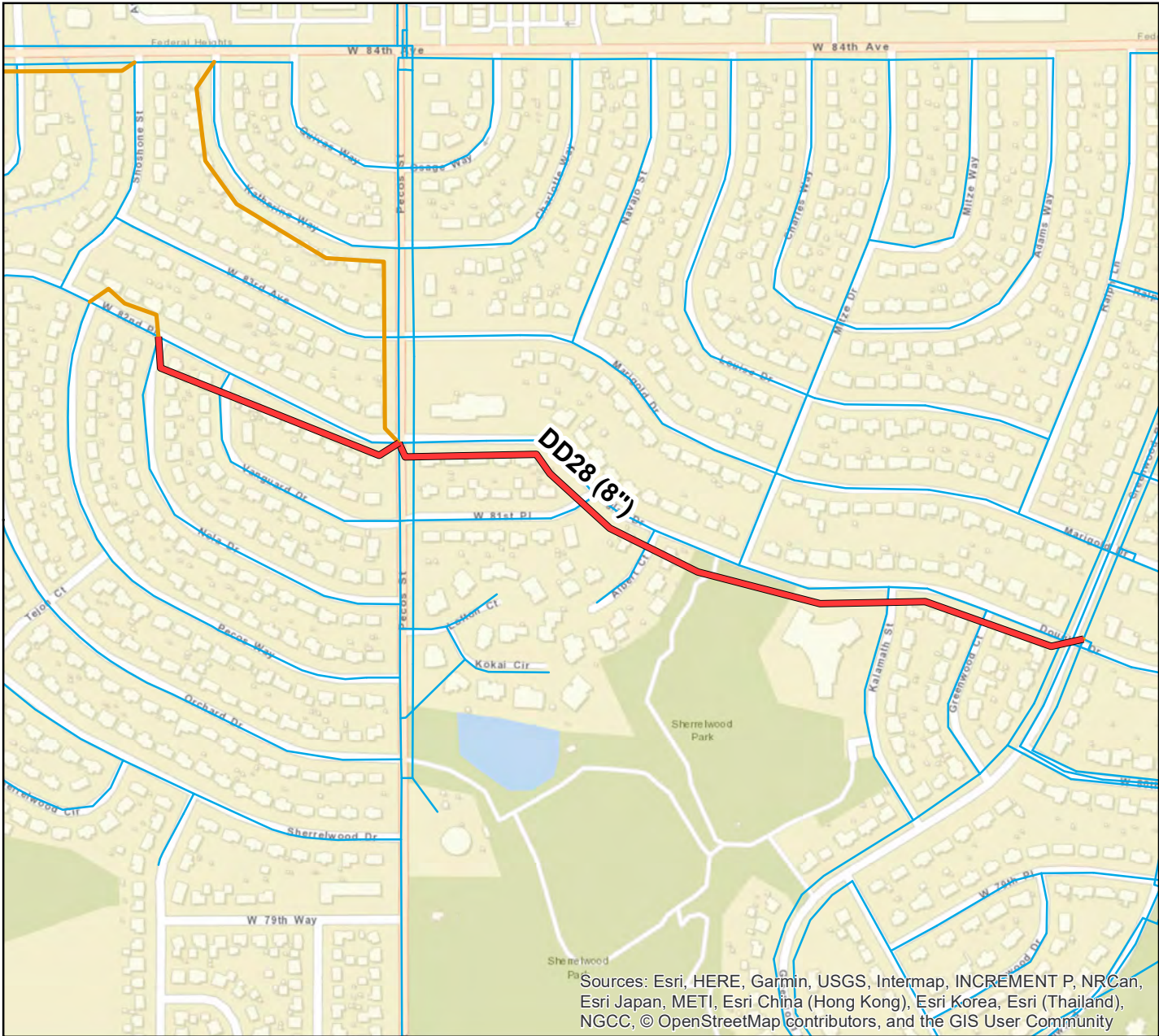
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6200 South Quebec Street
Greenwood Village, Colorado 80111

Water Distribution and Transmission Improvements

CIP DD27



1 inch = 500 feet



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Legend

- New PRVs
- Storage
- Pump
- Existing Pipelines
- NWTP
- Pumping CIP
- Storage CIP
- CIP Improvements
- Other Improvements
- Developer
- COT

Project Information

New pipe along Douglas Dr between Greenwood Blvd and N Pecos St, and along 82nd St between N Pecos St and Nola Dr. The new line is a 8-in with an approximate length of 3,300ft.

Cost

\$1,015,840

Phase

2025-2035

Purpose

Tier 1 - Capacity, Fire flow

Trigger

Existing improvement

Zone

Zone 3

City of Thornton
9500 Civic Center Drive
Thornton, Colorado 80229
(303) 538-7295

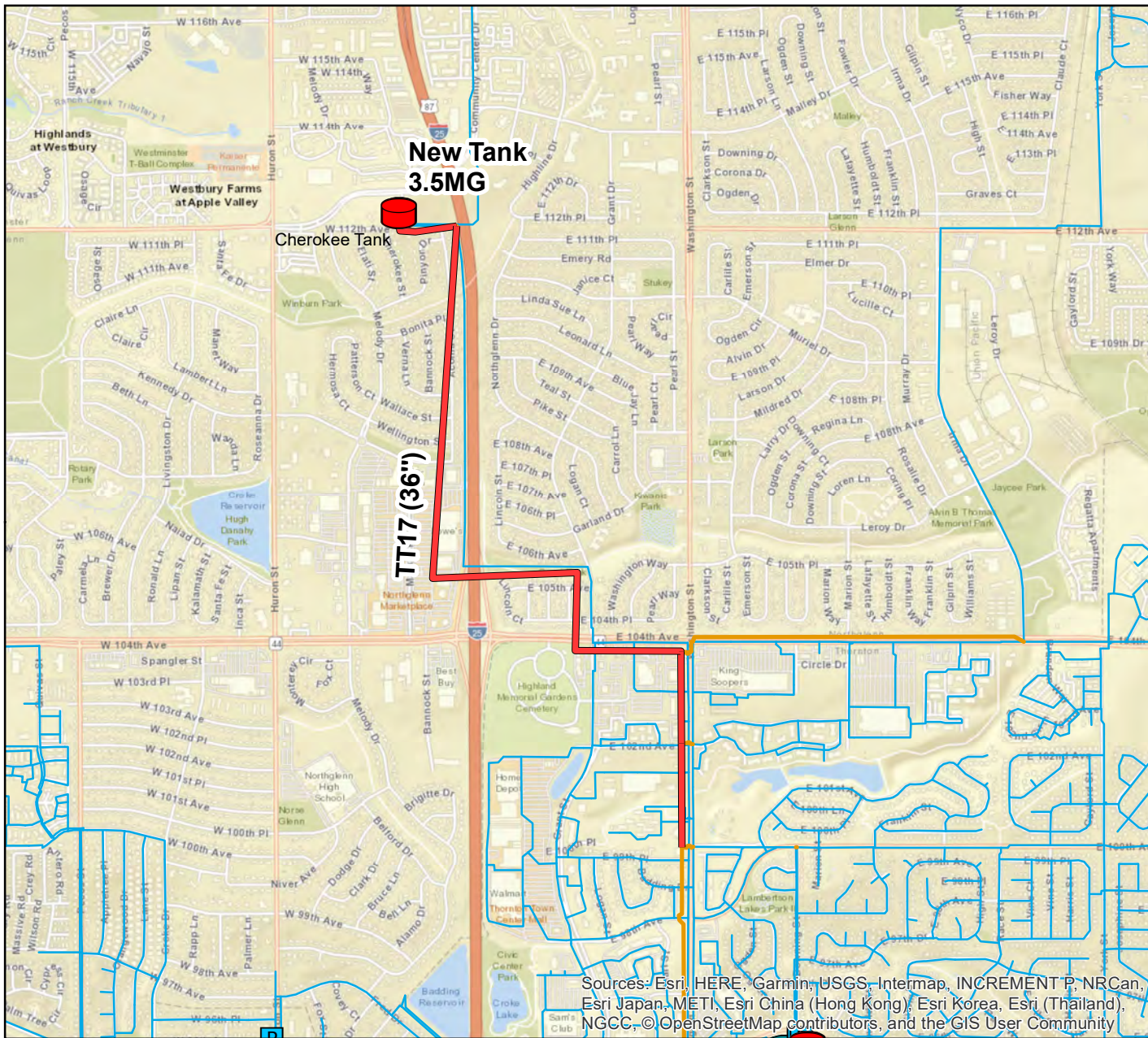
Water Distribution and Transmission Improvements

CIP DD28

AECOM
6200 South Quebec Street
Greenwood Village, Colorado 80111



1 inch = 500 feet



Project Information

New pipe from Cherokee Tank to I-25, along I-25 to E 105th Ave, along E 105th Ave to Grant Dr, along Grant Dr to E104th Ave, along E 104th Ave to to Washington St, and along Washington St to Old E 100th Ave. The new line is a 36-in with an approximate I

Cost

\$10,507,900

Phase

2035

Purpose

Storage

Trigger

Zone 3 Storage Upgrade

Zone

Zone 1

City of Thornton
9500 Civic Center Drive
Thornton, Colorado 80229
(303) 538-7295

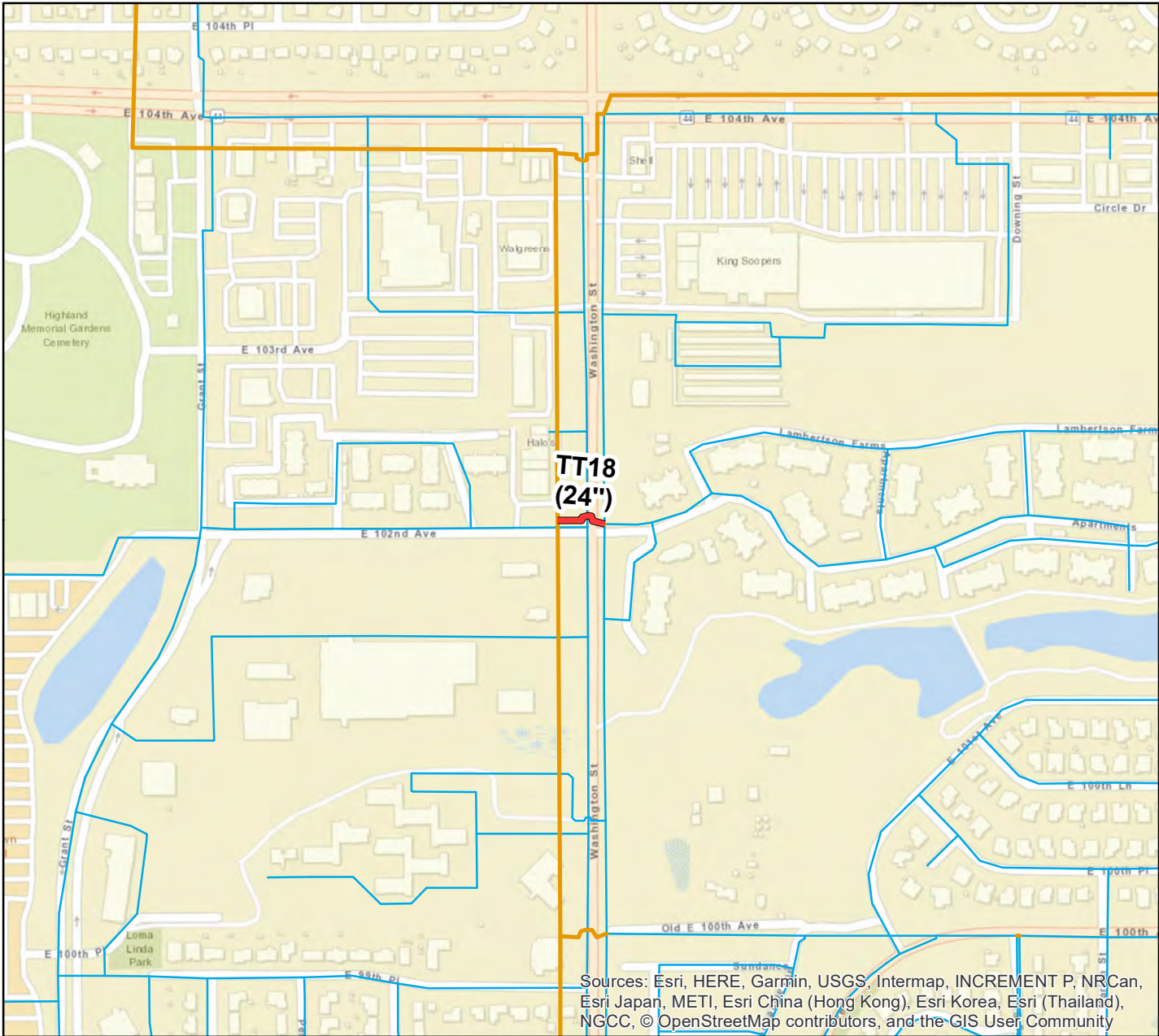
Water Distribution and Transmission Improvements

CIP TT17

AECOM
6200 South Quebec Street
Greenwood Village, Colorado 80111



1 inch = 2,000 feet



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Legend

- New PRVs
- Storage
- Pump
- Existing Pipelines
- NWTP
- Pumping CIP
- Storage CIP
- CIP Improvements
- Other Improvements
- Developer
- COT

Project Information

New pipe along 102nd Ave crossing Washington St. The new line is a 24-in with an approximate length of 200 ft.

Cost

\$130,000

Phase

2035

Purpose

Storage

Trigger

Zone 3 Storage Upgrade

Zone

Zone 3

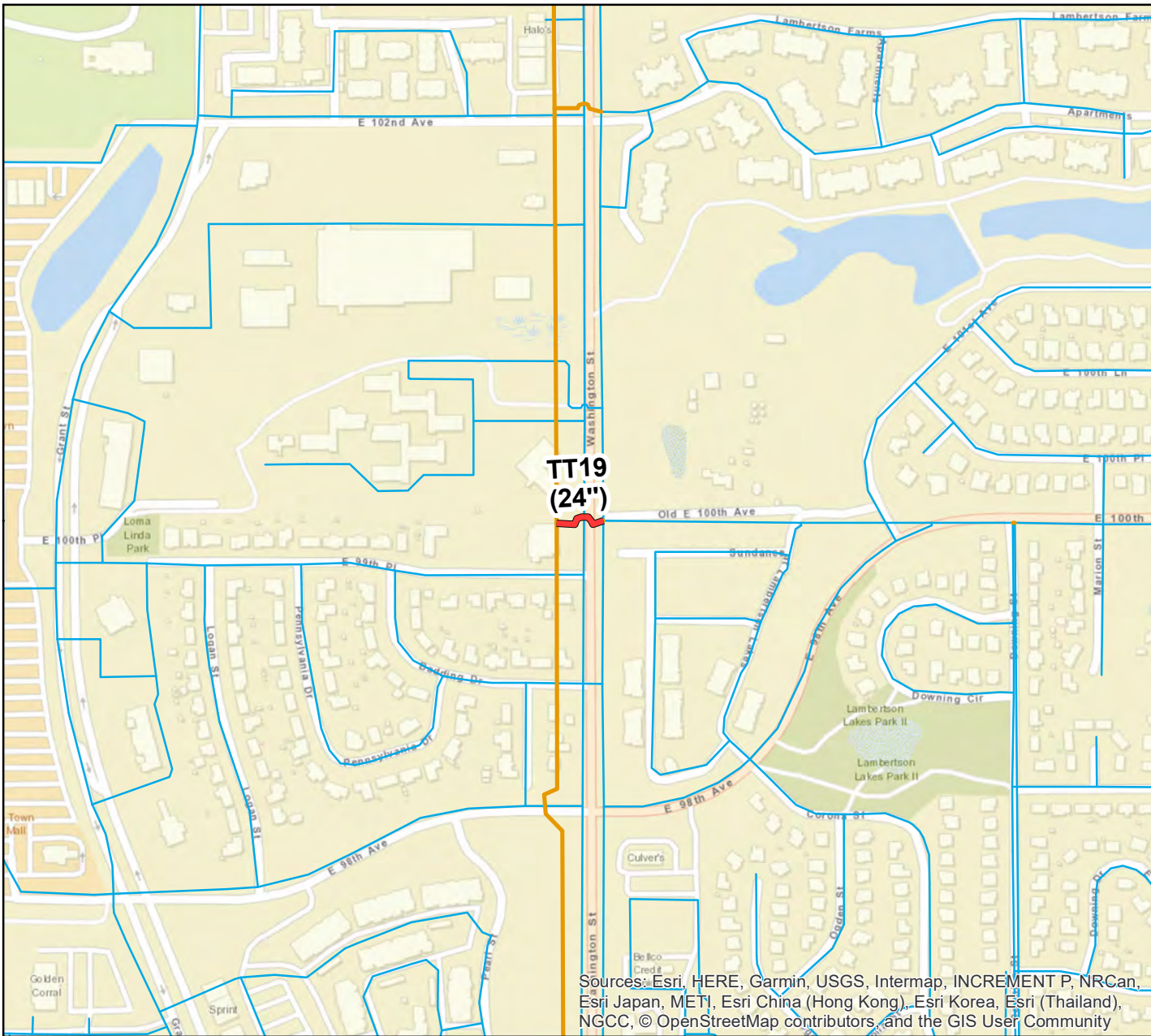
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Thornton, Colorado 80229
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Water Distribution and Transmission Improvements

AECOM
6200 South Quebec Street
Greenwood Village, Colorado 80111

CIP TT18





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Legend

- New PRVs
- Storage
- Pump
- Existing Pipelines
- NWTP
- Pumping CIP
- Storage CIP
- CIP Improvements
- Other Improvements
- Developer
- COT

Project Information

New pipe crossing Washington St at Old E 100th Ave. The new line is a 24-in with an approximate length of 200 ft.

Cost

\$130,000

Phase

2035

Purpose

Storage

Trigger

Zone 1 Storage Upgrade

Zone

Zone 1

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Thornton, Colorado 80229
(303) 538-7295

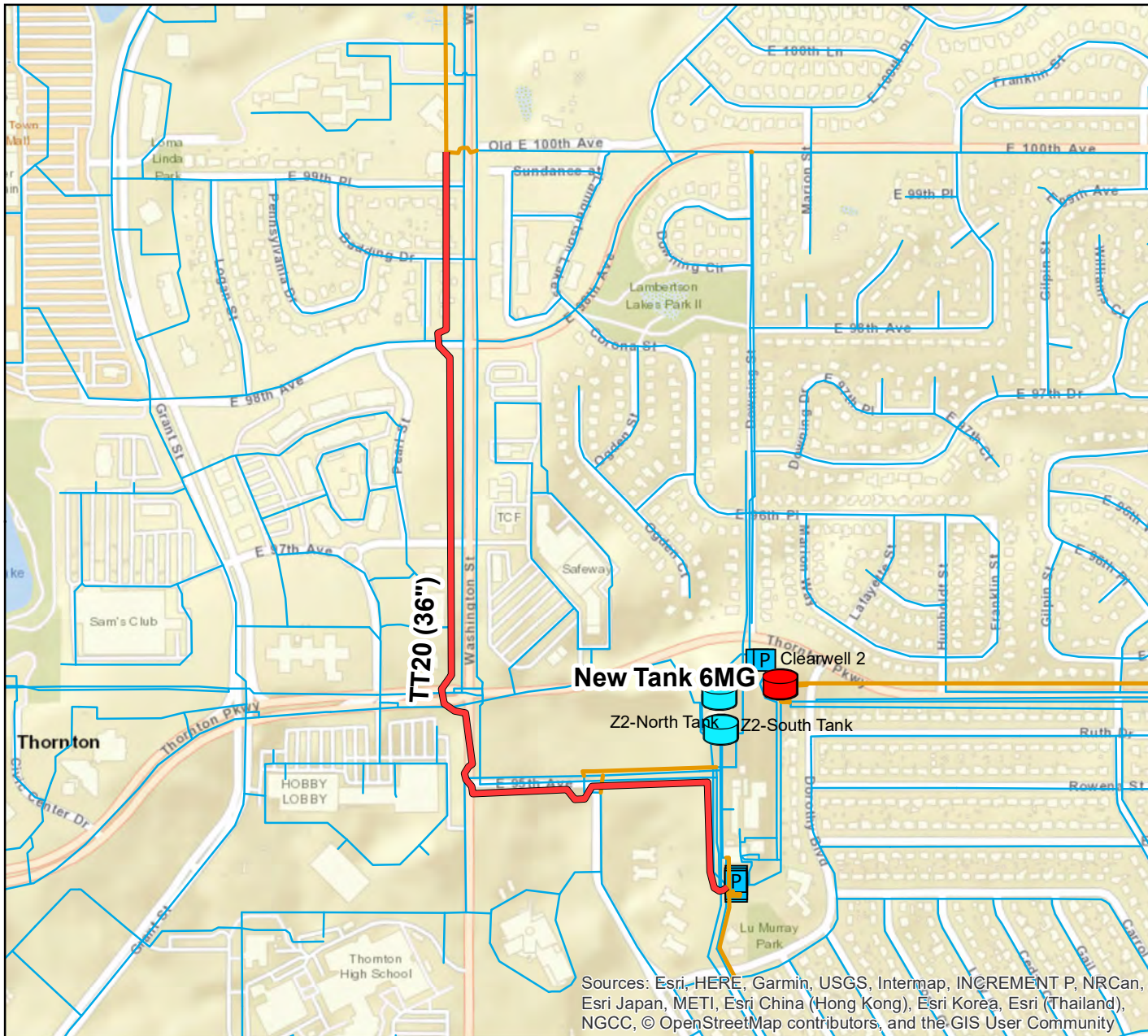
Water Distribution and Transmission Improvements

CIP TT19

AECOM
6200 South Quebec Street
Greenwood Village, Colorado 80111



1 inch = 500 feet



Legend

- New PRVs
- Storage
- Pump
- Existing Pipelines
- NWTP
- Pumping CIP
- Storage CIP
- CIP Improvements
- Other Improvements
- Developer
- COT

Project Information

New pipe from TWTP, running along Dorothy Blvd, Hoffman Way, and 95th Ave to Washington St, then running parallel to Washington St until Old E 100th Ave. The new line is a 36-in with an approximate length of 5,100 ft.

Cost

\$4,392,700

Phase

2035

Purpose

Storage

Trigger

Zone 1 Storage Upgrade

Zone

Zone 3

City of Thornton
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Thornton, Colorado 80229
(303) 538-7295

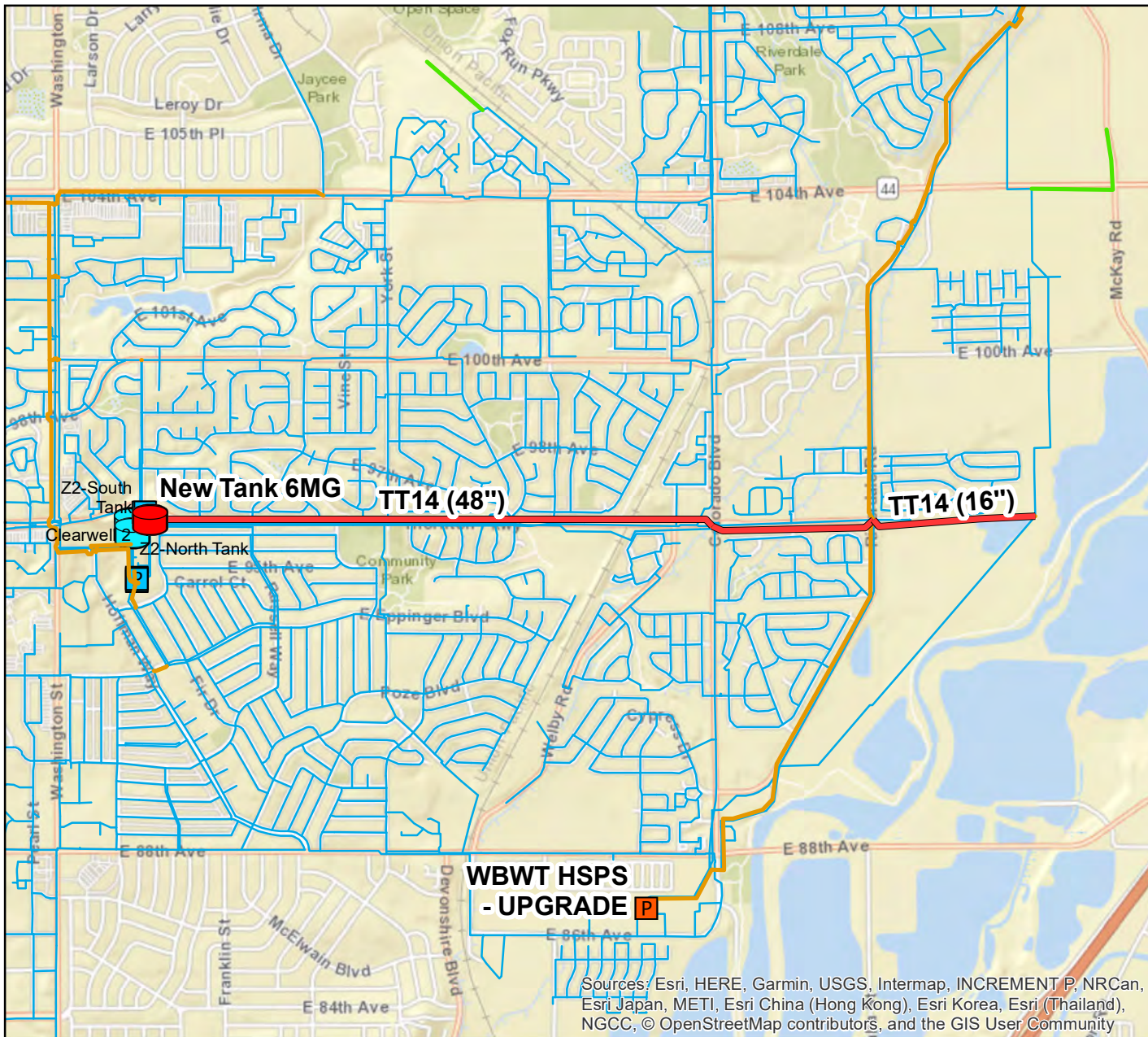
Water Distribution and Transmission Improvements

AECOM
6200 South Quebec Street
Greenwood Village, Colorado 80111

CIP TT20



1 inch = 750 feet



Legend

- ⊗ New PRVs
- ⬮ Storage
- P Pump
- Existing Pipelines
- WTP NWTP
- P Pumping CIP
- ⬮ Storage CIP
- CIP Improvements
- Other Improvements
- Developer
- COT

Project Information

New pipe from Clearwell 2 at TWTP along Thornton Pkwy and E 96th Ave to just west of the South Platte River . The new line is a 48-in and 16-in with an approximate length of 14,300 ft.

Cost

\$16,629,700

Phase

2035

Purpose

Supply

Trigger

WBWTP Upgrade

Zone

Zone 1

City of Thornton
9500 Civic Center Drive
Thornton, Colorado 80229
(303) 538-7295

Water Distribution and Transmission Improvements

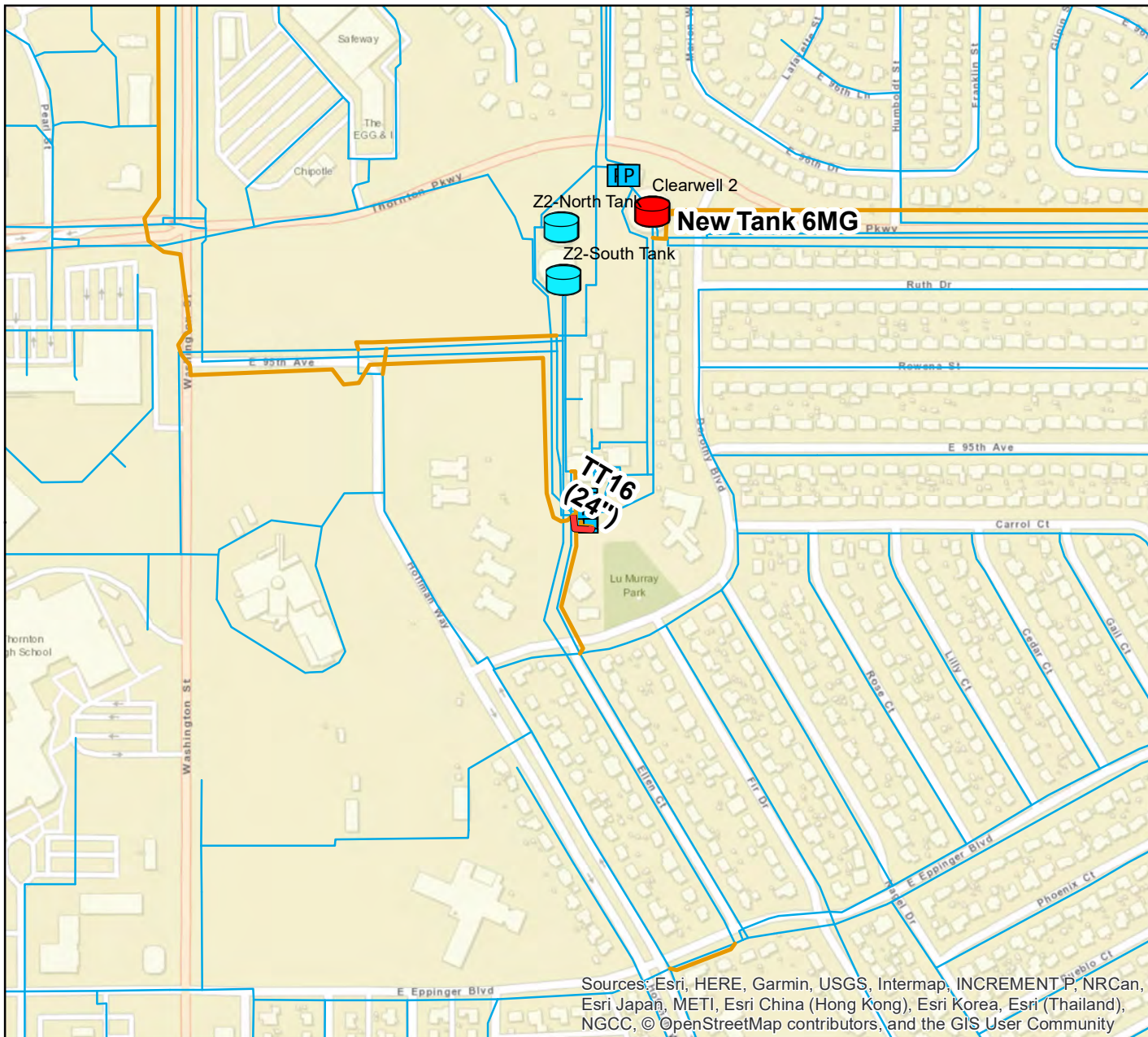
AECOM
6200 South Quebec Street
Greenwood Village, Colorado 80111

CIP TT14













1 inch = 2,500 feet

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Legend

-  New PRVs
-  Storage
-  Pump
-  NWTP
-  Pumping CIP
-  Storage CIP
-  CIP Improvements
-  Other Improvements
-  Developer
-  COT

Project Information

New pipe just south of TWTP. The new line is a 24-in with an approximate length of 200 ft.

Cost

\$130,000

Phase

2035

Purpose

Supply

Trigger

Zone 1 Storage Upgrade

Zone

Zone 1

City of Thornton
9500 Civic Center Drive
Thornton, Colorado 80229
(303) 538-7295

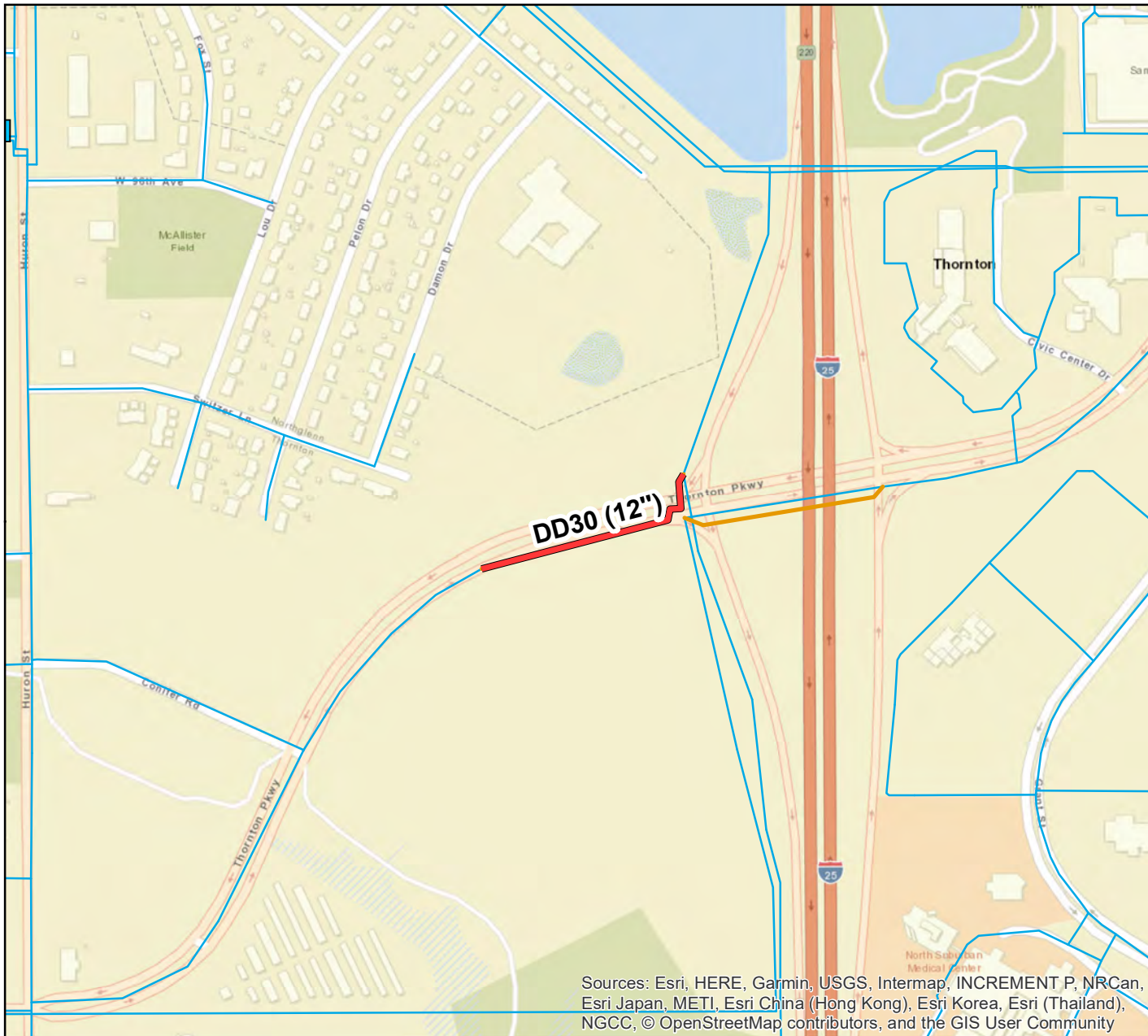
Water Distribution and Transmission Improvements

AECOM
6200 South Quebec Street
Greenwood Village, Colorado 80111

CIP TT16



1 inch = 500 feet



Legend

- ⊗ New PRVs
- ⬮ Storage
- P Pump
- WTP NWTP
- P Pumping CIP
- ⬮ Storage CIP
- CIP Improvements
- Existing Pipelines
- Other Improvements
- Developer
- COT

Project Information

New pipe along Thornton Pkwy, just west of I-25. The line is a 12-in with an approximate length of 800 ft.

Cost

\$315,920

Phase

2035

Purpose

Tier 1 - Capacity

Trigger

Growth - Average System Demand = 37mgd

Zone

Zone 3

City of Thornton
9500 Civic Center Drive
Thornton, Colorado 80229
(303) 538-7295

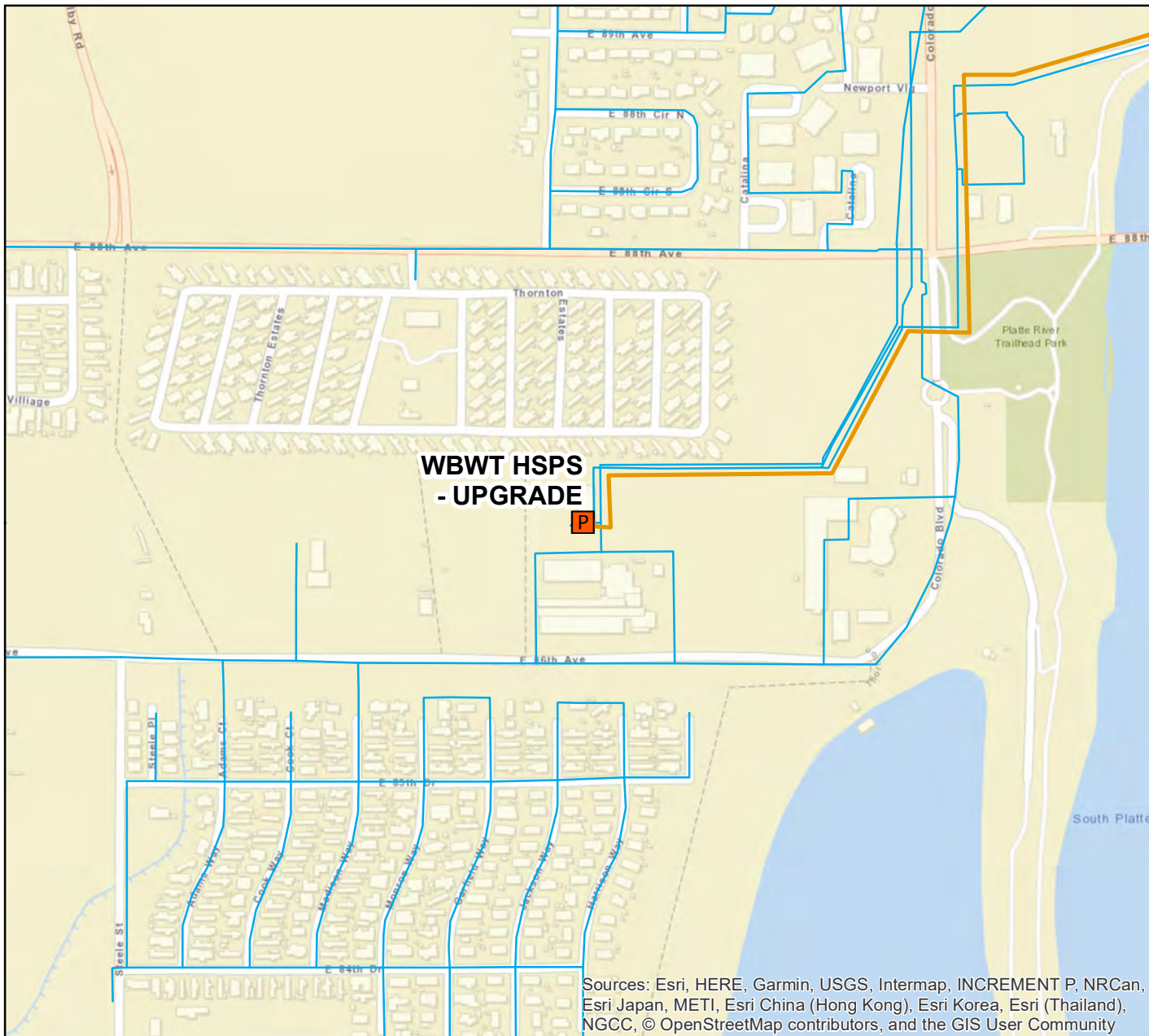
Water Distribution and Transmission Improvements

AECOM
6200 South Quebec Street
Greenwood Village, Colorado 80111

CIP DD30













1 inch = 500 feet



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Legend

-  New PRVs
-  Storage
-  Pump
-  NWTP
-  Pumping CIP
-  Storage CIP
-  CIP Improvements
-  Other Improvements
-  Developer
-  COT

Project Information

Replacement of two units in Zone 1 - Wes Brown High Service Pump Station, each with a capacity of 10,000gpm.

Cost

\$4,614,000

Phase

2035

Purpose

Tier 1 - Pumping

Trigger

Growth - Average System Demand = 37mgd

Zone

Zone 1

City of Thornton
9500 Civic Center Drive
Thornton, Colorado 80229
(303) 538-7295

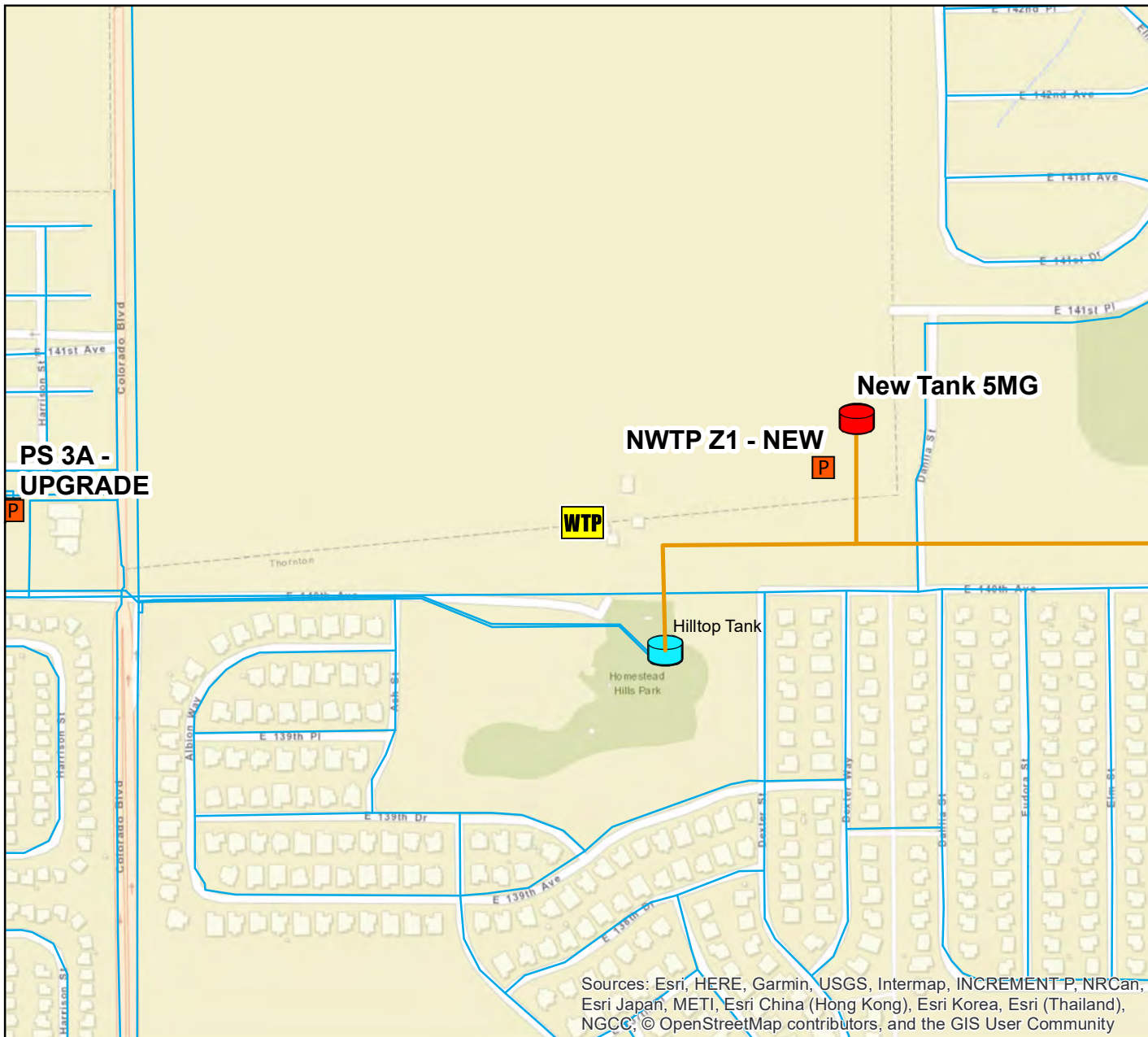
Water Distribution and Transmission Improvements

AECOM
6200 South Quebec Street
Greenwood Village, Colorado 80111












CIP P-03



1 inch = 500 feet



Legend

- | | |
|--|--|
|  New PRVs |  Pumping CIP |
|  Storage |  Storage CIP |
|  Pump |  CIP Improvements |
|  Existing Pipelines |  Other Improvements |
|  NWTP |  Developer |
| |  COT |

Project Information

New pump station, pumping from NWTP to Zone 1, with four units, each with a capacity of 5,000gpm.

Cost

\$566,300

Phase

2035

Purpose

Tier 1 - Pumping

Trigger

NWTP Construction

Zone

Zone 1

City of Thornton
9500 Civic Center Drive
Thornton, Colorado 80229
(303) 538-7295

AECOM
6200 South Quebec Street
Greenwood Village, Colorado 80111

Water Distribution and Transmission Improvements

CIP P-04



1 inch = 500 feet



Legend

- New PRVs
- Storage
- Pump
- Existing Pipelines
- NWTP
- Pumping CIP
- Storage CIP
- CIP Improvements
- Other Improvements
- Developer
- COT

Project Information

New 6 MG tank adjacent to TWTP Clearwell 2.

Cost

\$15,857,900

Phase

2035

Purpose

Tier 1 - Storage

Trigger

Zone 1 Storage Upgrade

Zone

Zone 1

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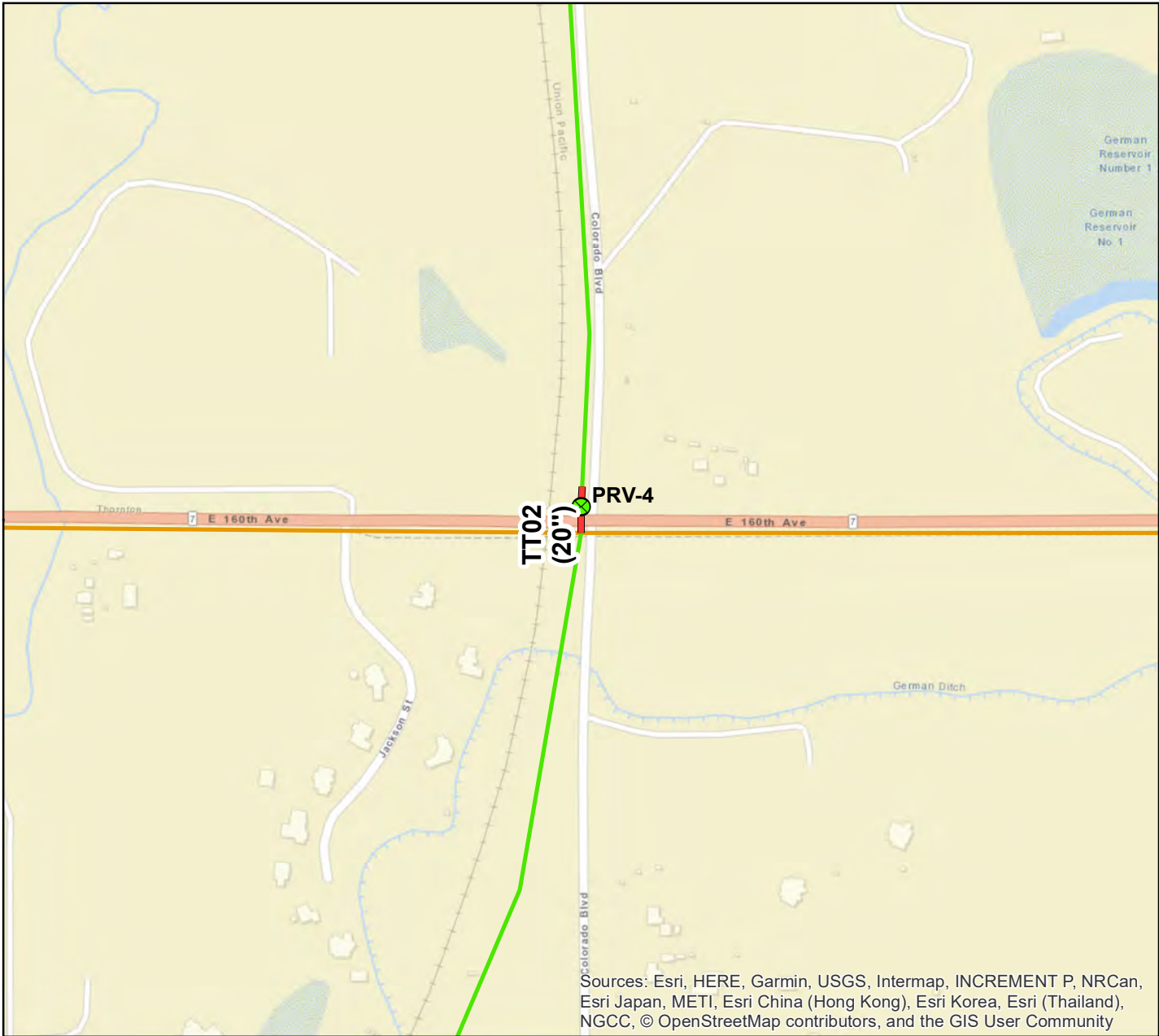
AECOM
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Greenwood Village, Colorado 80111

**Water Distribution and Transmission
Improvements**

CIP SS-03



1 inch = 500 feet



Legend

- New PRVs
- Storage
- Pump
- NWTP
- Pumping CIP
- Storage CIP
- CIP Improvements
- Existing Pipelines
- Other Improvements
- Developer
- COT

Project Information

New pipe along Colorado Blvd at E 160th Ave. The new line is a 20-in with an approximate length of 200 ft.

Cost

\$111,700

Phase

2035-2065

Purpose

Facilitate Growth

Trigger

Growth North of E 156th Avenue

Zone

Zone 1

City of Thornton
 9500 Civic Center Drive
 Thornton, Colorado 80229
 (303) 538-7295

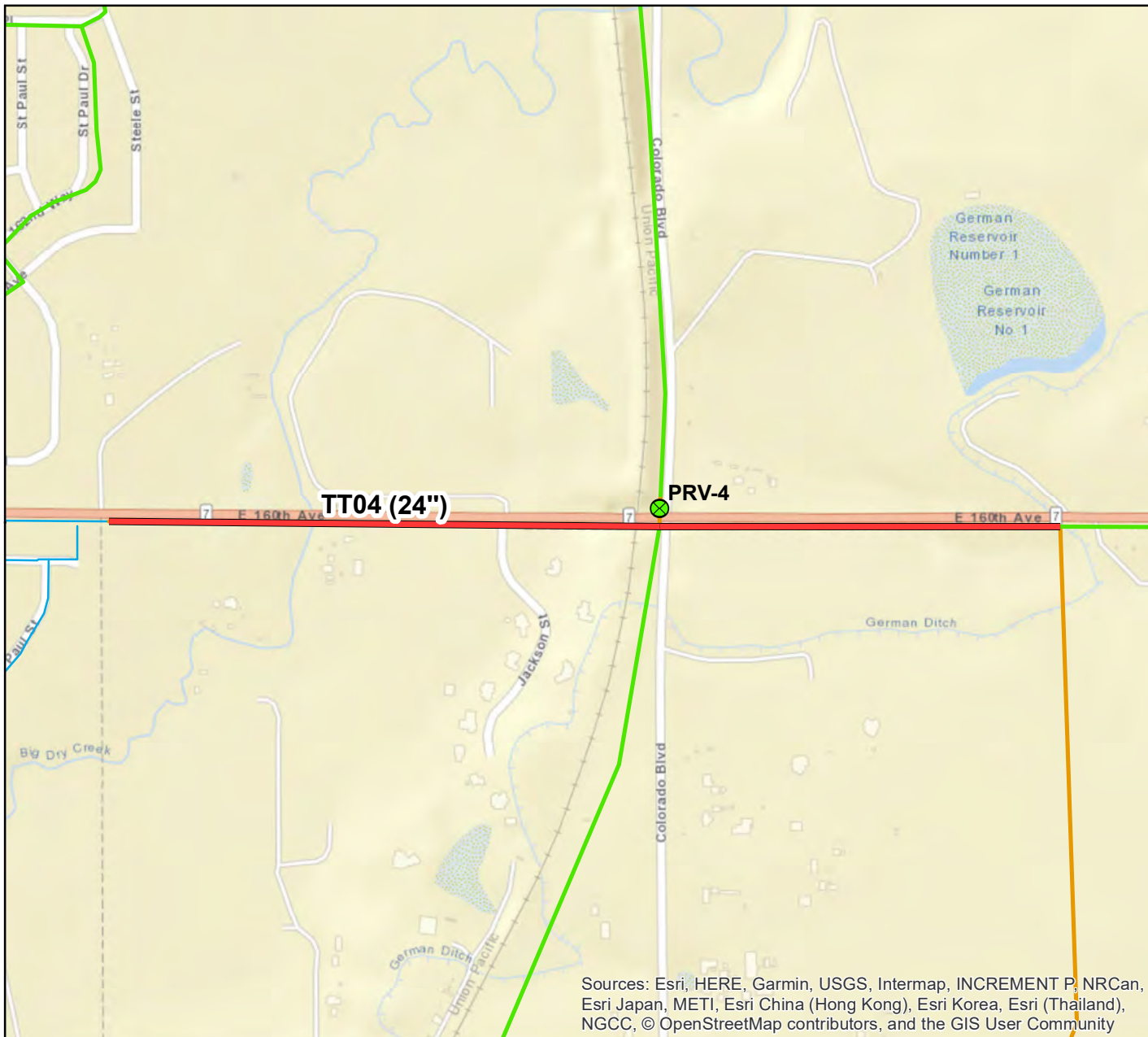
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 Greenwood Village, Colorado 80111

Water Distribution and Transmission Improvements












CIP TT02



1 inch = 500 feet



Legend

-  New PRVs
-  Storage
-  Pump
-  NWTP
-  Pumping CIP
-  Storage CIP
-  CIP Improvements
-  Existing Pipelines
-  Other Improvements
-  Developer
-  COT

Project Information

New pipe along E 160th Ave, from neighborhood east of York St, across Colorado Blvd to east of Holly St. The new line is a 24-in with an approximate length of 4,600 ft.

Cost

\$2,989,400

Phase

2035-2065

Purpose

Facilitate Growth

Trigger

Growth North of E 156th Avenue

Zone

Zone 1

City of Thornton
9500 Civic Center Drive
Thornton, Colorado 80229
(303) 538-7295

Water Distribution and Transmission Improvements

AECOM
6200 South Quebec Street
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CIP TT04



1 inch = 750 feet



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Legend

- New PRVs
- Storage
- Pump
- Existing Pipelines
- NWTP
- Pumping CIP
- Storage CIP
- CIP Improvements
- Other Improvements
- Developer
- COT

Project Information

New pipe along Colorado Blvd from just north of E-470 to the bend in the road. The new line is a 36-in with an approximate length of 1,500 ft.

Cost

\$1,292,000

Phase

2035-2065

Purpose

Facilitate Growth

Trigger

Growth North of E 156th Avenue

Zone

Zone 1

City of Thornton
9500 Civic Center Drive
Thornton, Colorado 80229
(303) 538-7295

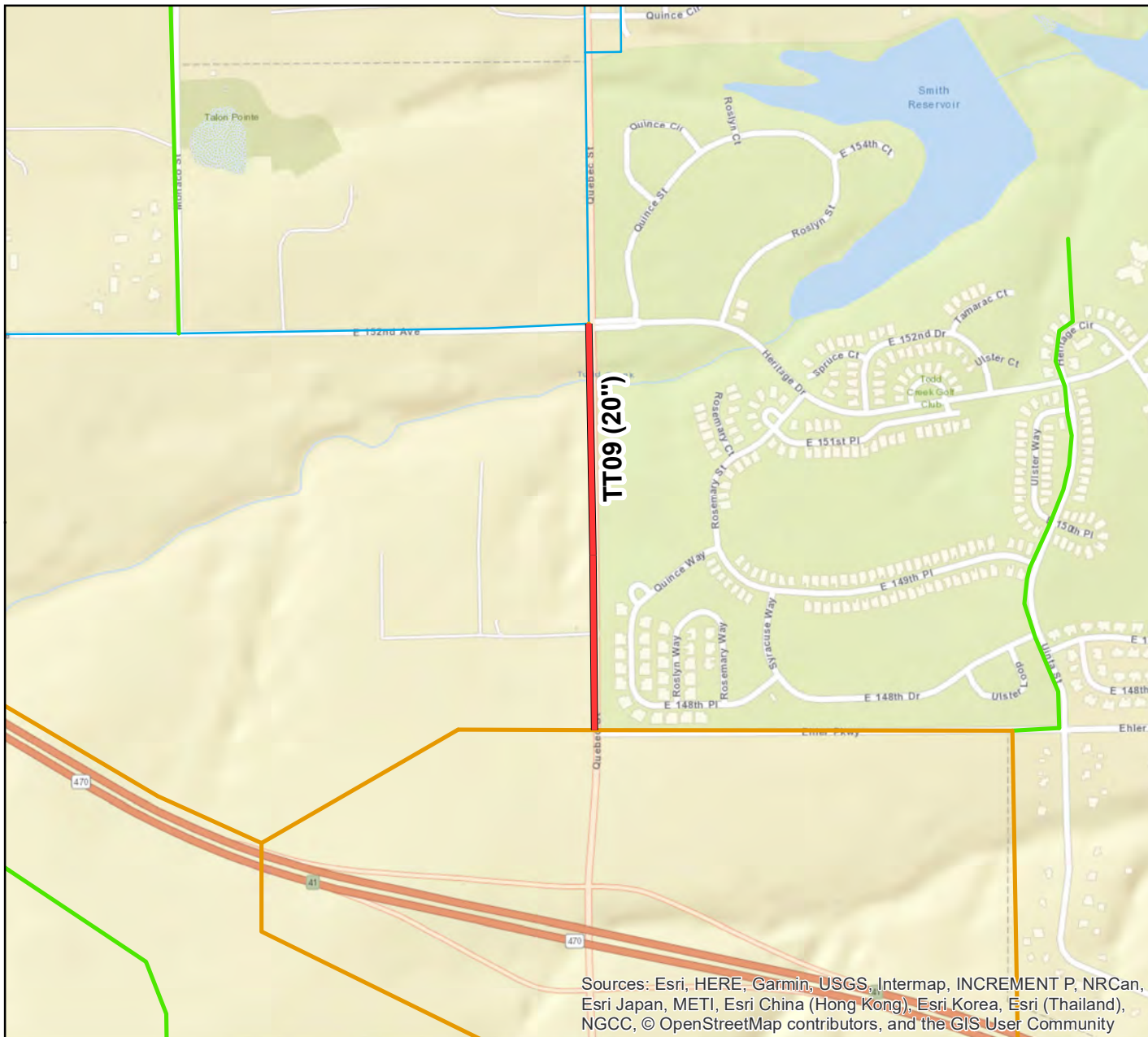
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Water Distribution and Transmission
Improvements

CIP TT05



1 inch = 500 feet



City of Thornton
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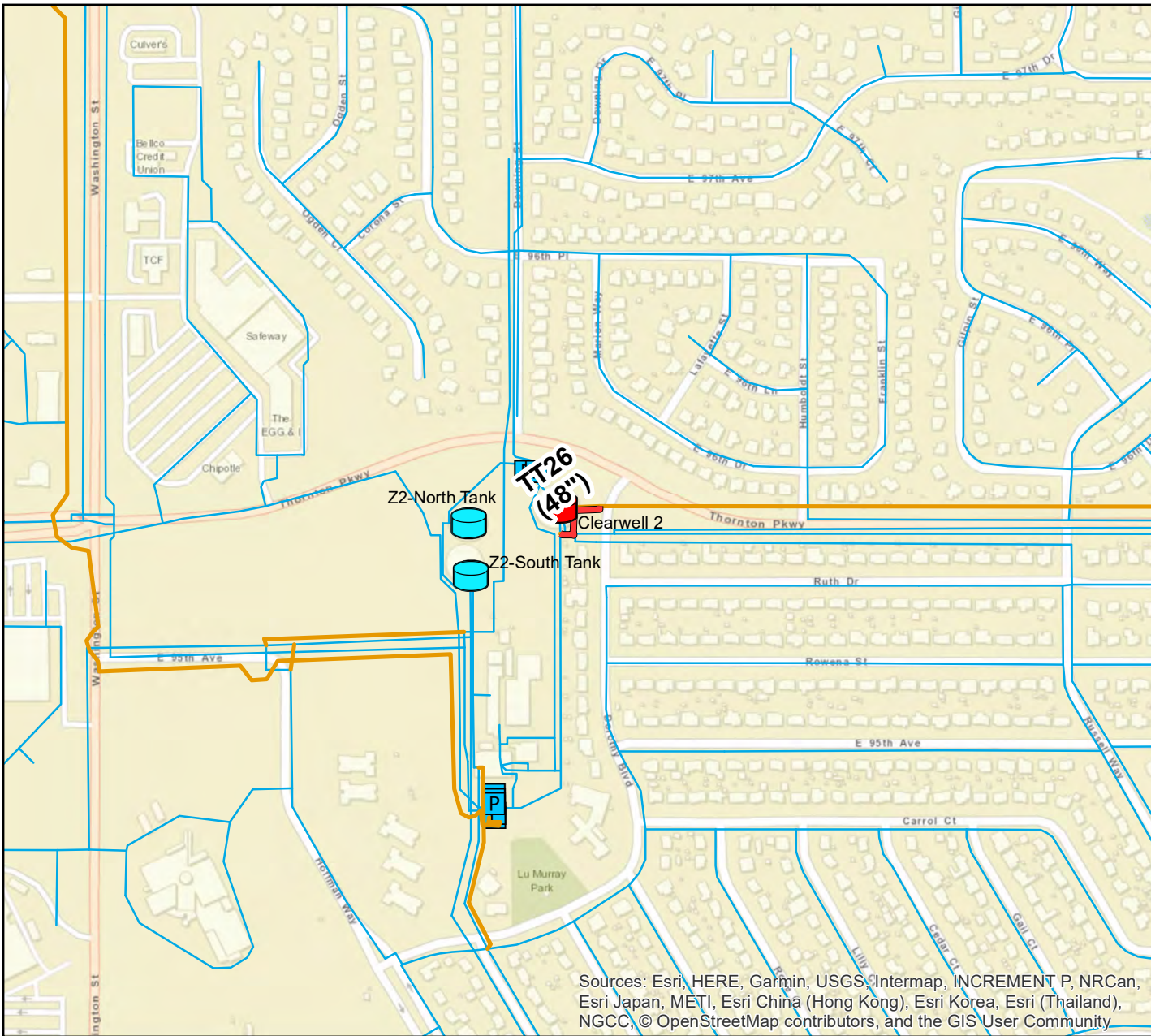
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Water Distribution and Transmission Improvements

CIP TT09



1 inch = 1,000 feet



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(303) 538-7295

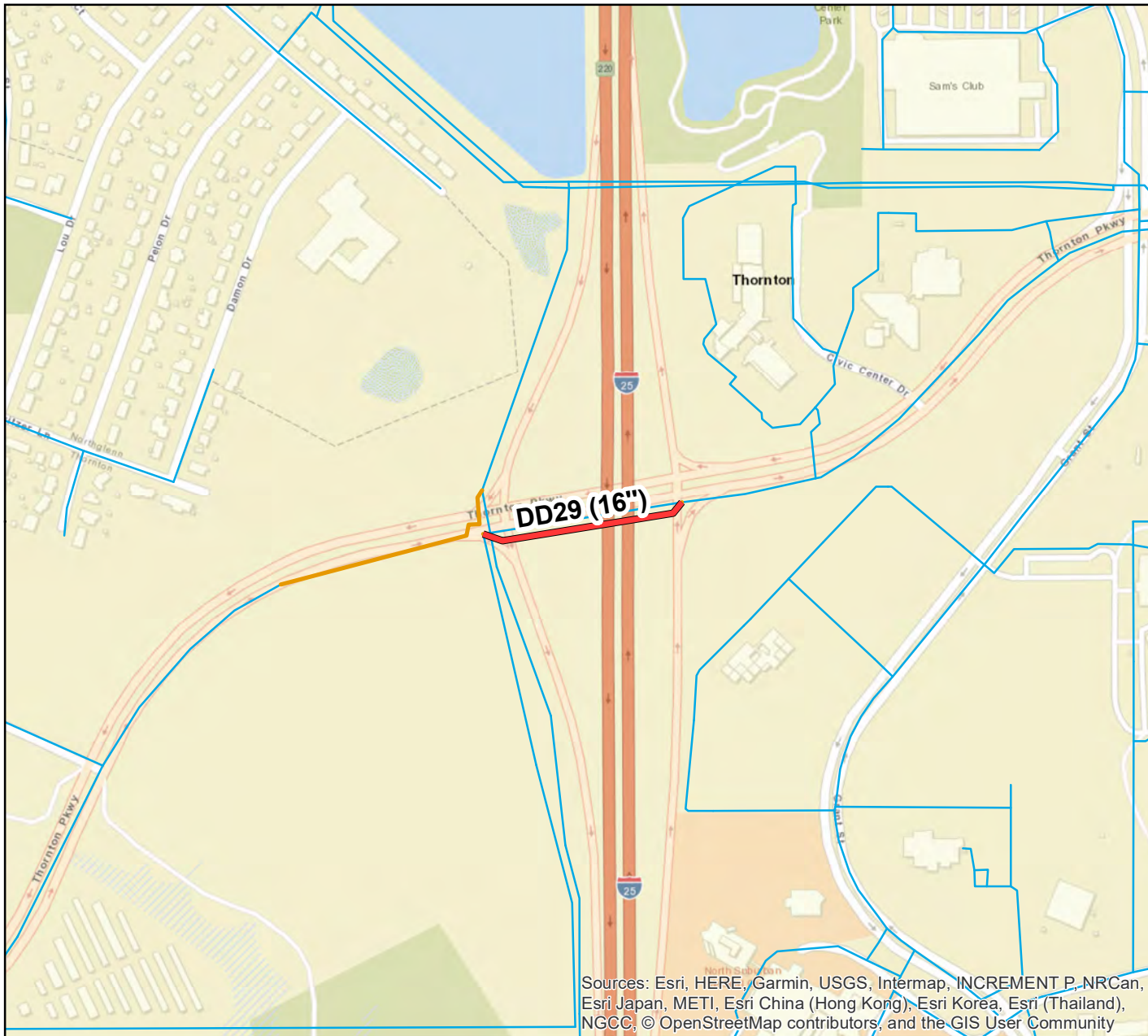
AECOM
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Greenwood Village, Colorado 80111

Water Distribution and Transmission Improvements

CIP TT26



1 inch = 500 feet



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Legend

- | | |
|--------------------|--------------------|
| New PRVs | Pumping CIP |
| Storage | Storage CIP |
| Pump | CIP Improvements |
| Existing Pipelines | Other Improvements |
| NWTP | Developer |
| | COT |

Project Information

Installation of a parallel pipe along Thornton Pkwy, crossing I-25. The line is a 16-in with an approximate length of 700 ft.

Cost

\$358,050

Phase

2035-2065

Purpose

Tier 2 - Capacity

Trigger

Growth - Average System Demand = 37mgd

Zone

Zone 3

City of Thornton
9500 Civic Center Drive
Thornton, Colorado 80229
(303) 538-7295

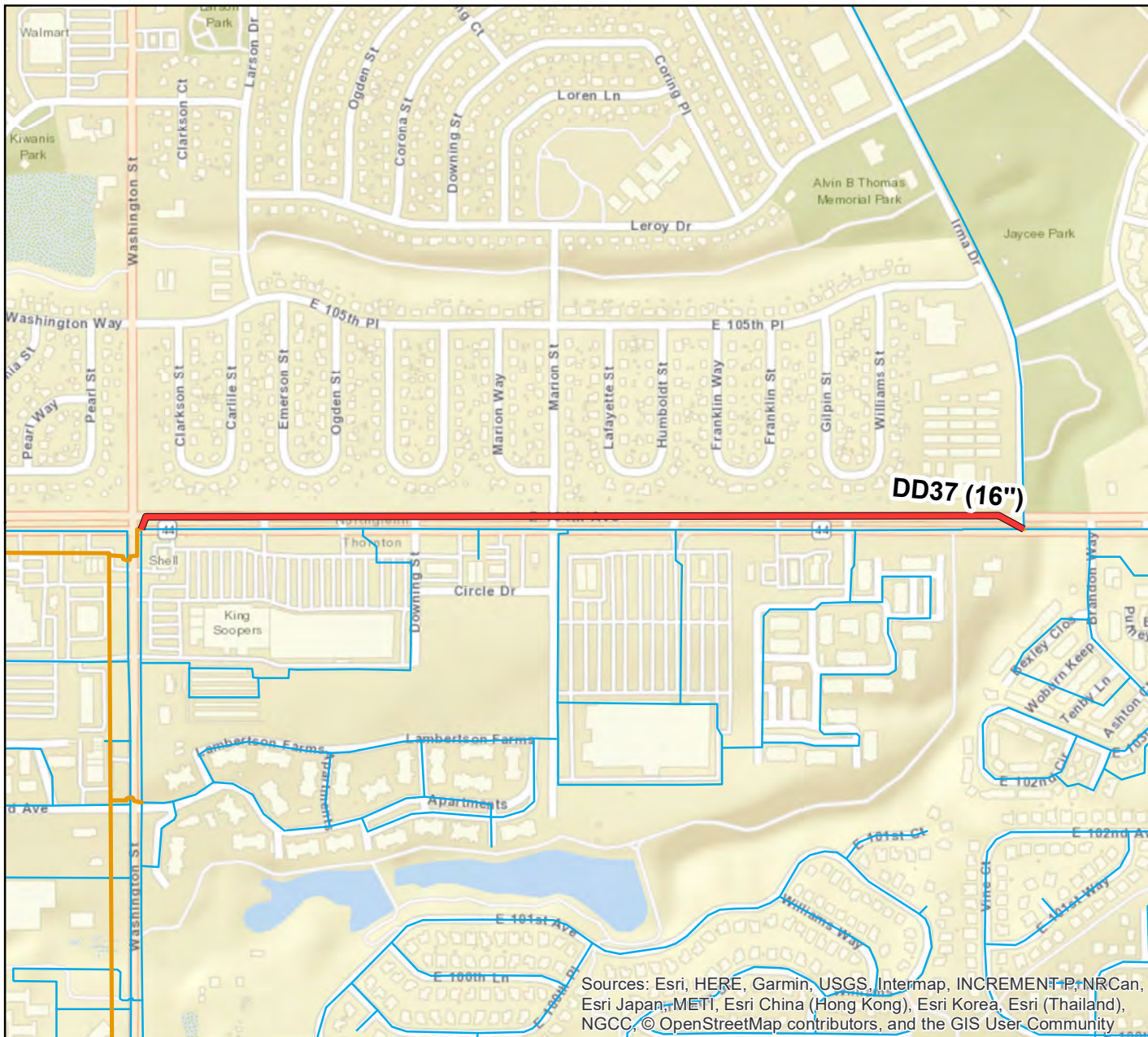
Water Distribution and Transmission Improvements

CIP DD29

AECOM
6200 South Quebec Street
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1 inch = 500 feet



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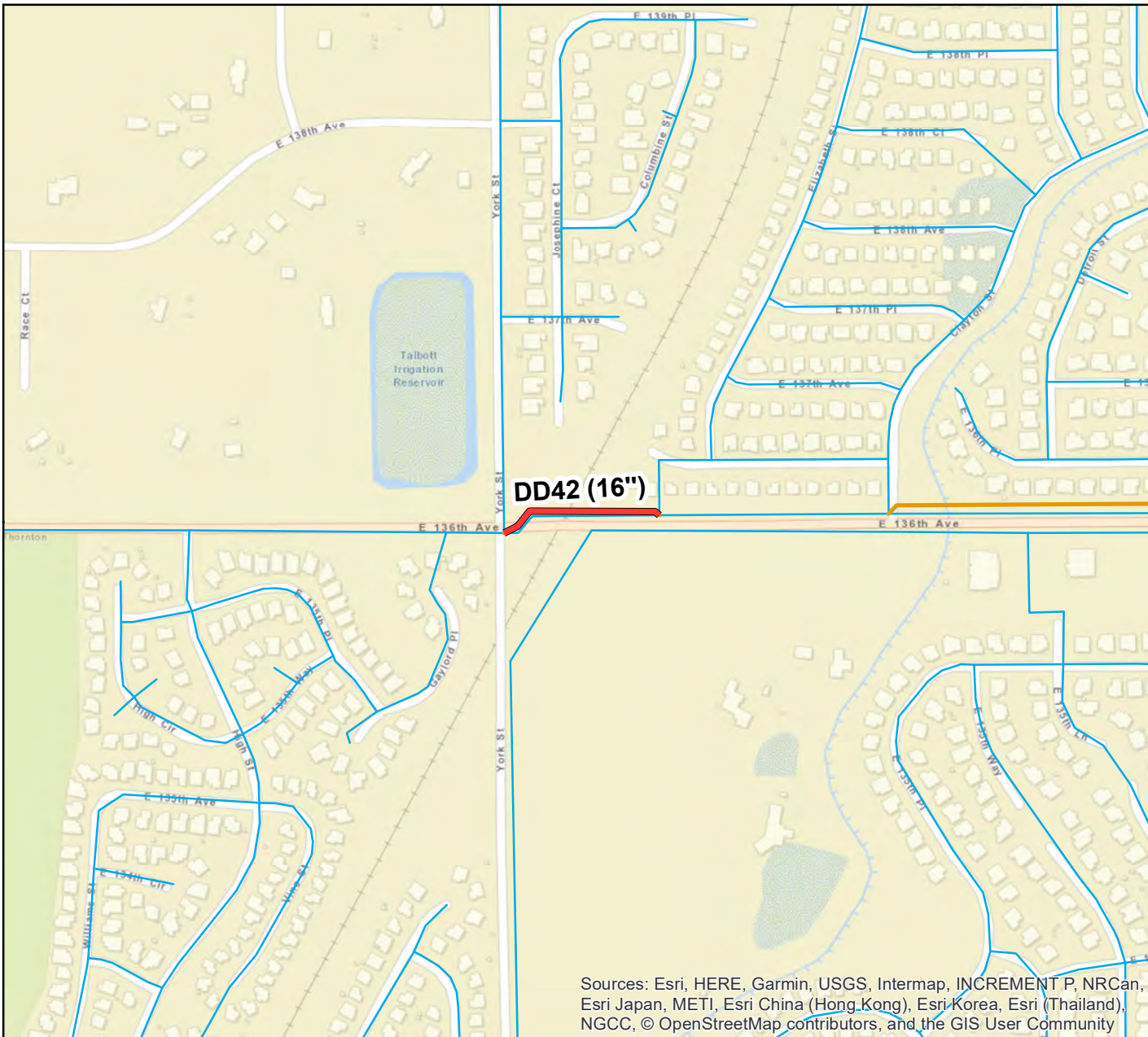
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Water Distribution and Transmission Improvements

CIP DD37



1 inch = 750 feet



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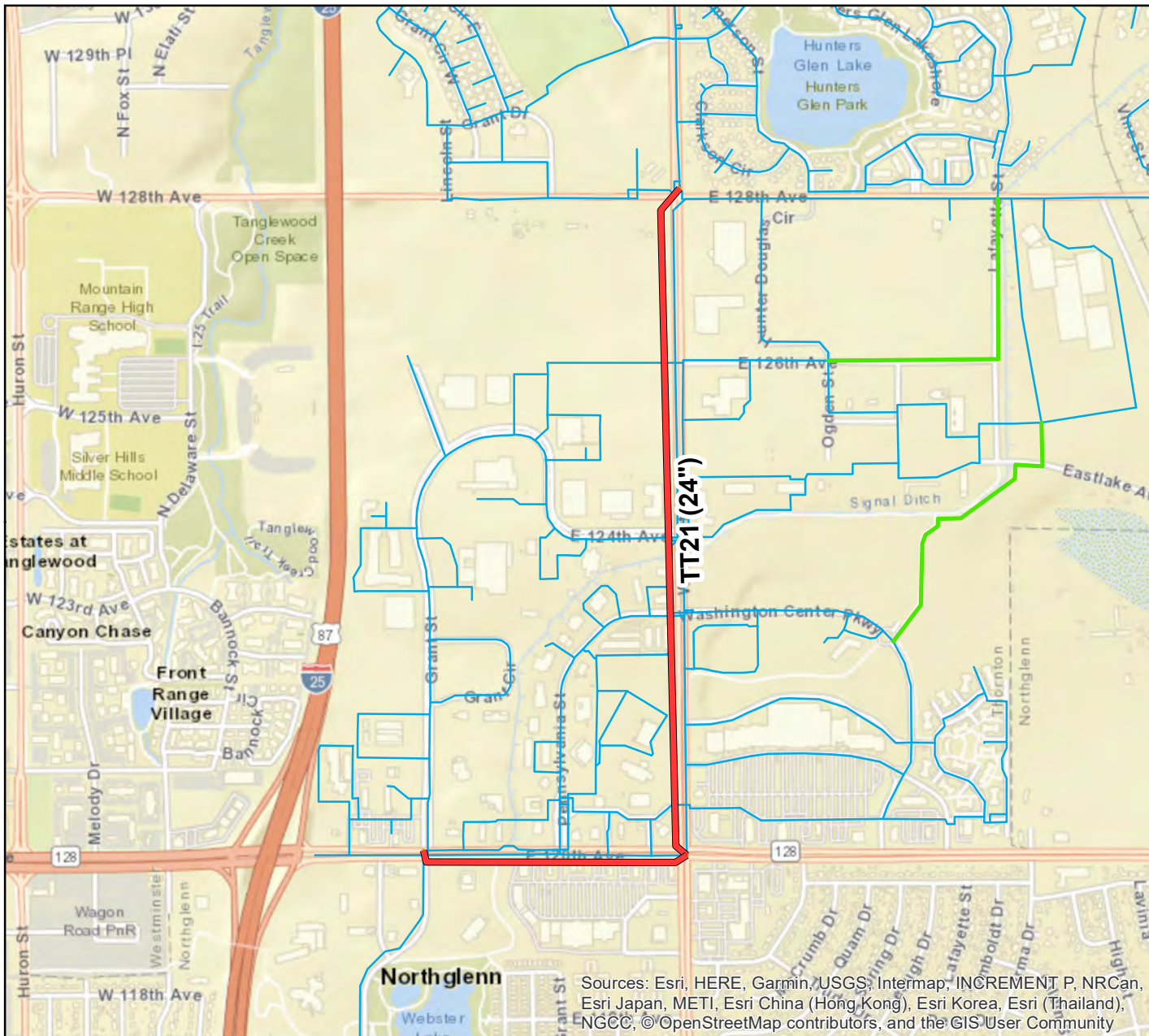
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Water Distribution and Transmission Improvements

CIP DD42



1 inch = 500 feet



Legend

- ⊗ New PRVs
- ⊗ Storage
- P Pump
- Existing Pipelines
- WTP NWTP
- P Pumping CIP
- ⊗ Storage CIP
- CIP Improvements
- Other Improvements
- Developer
- COT

Project Information

New pipe along 120th Ave from Grant St to Washington St, and along Washington St from 120th Ave to 128th Ave. The new line is a 24-in with an approximate length of 7,700 ft.

Cost

\$5,003,940

Phase

2035-2065

Purpose

Tier 2 - Capacity

Trigger

Growth - Average System Demand = 44mgd

Zone

Zone 3A

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Water Distribution and Transmission Improvements

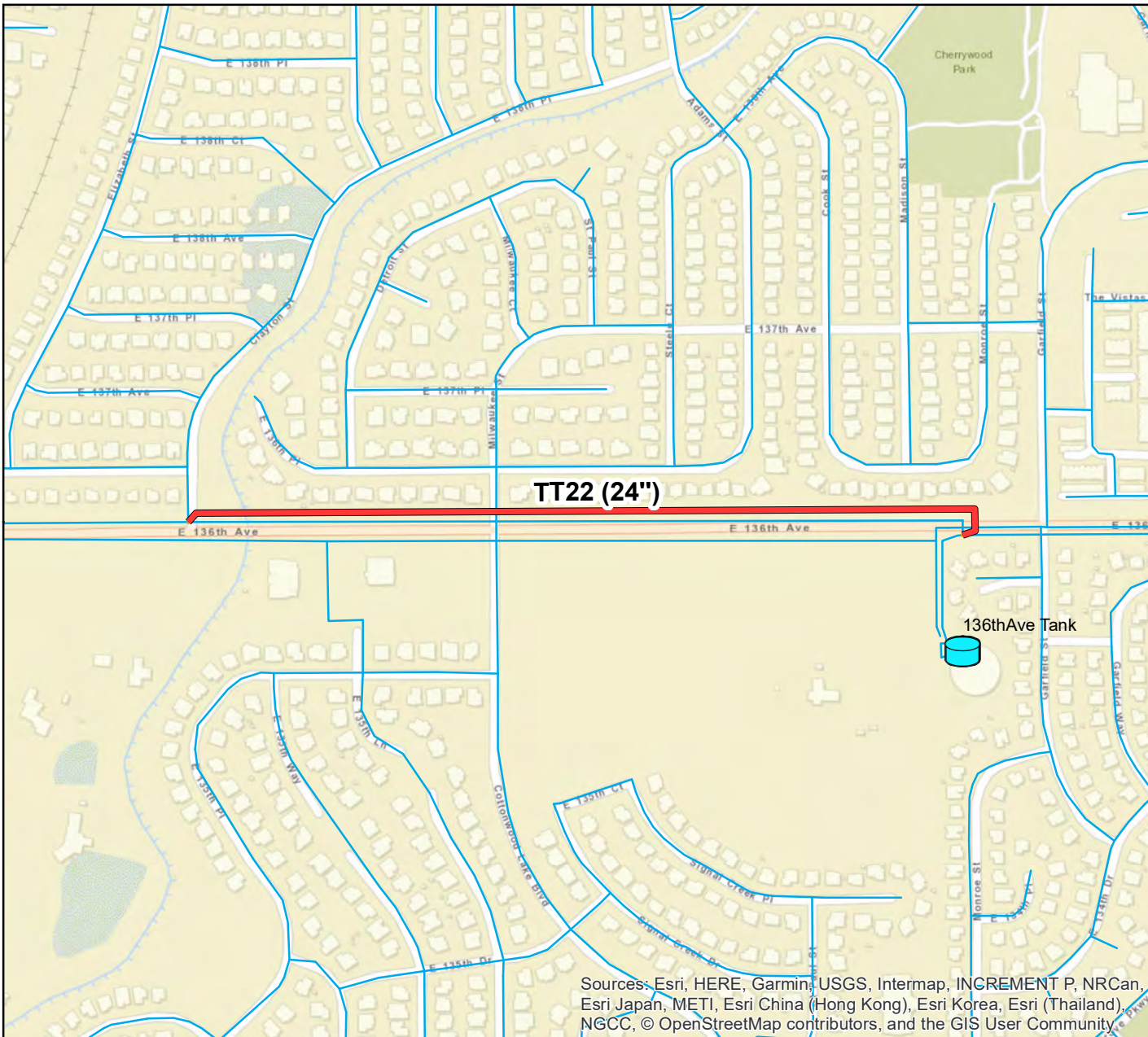
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CIP TT21

1 inch = 1,250 feet



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Legend

- New PRVs
- Storage
- Pump
- Existing Pipelines
- NWTP
- Pumping CIP
- Storage CIP
- CIP Improvements
- Other Improvements
- Developer
- COT

Project Information

New pipe along 136th Ave from 136th Ave from Clayton St to connection north of 136th Ave Tank. The new line is a 24-in with an approximate length of 2,700 ft.

Cost

\$1,754,630

Phase

2035-2065

Purpose

Tier 2 - Capacity

Trigger

Growth - Average System Demand = 44mgd

Zone

Zone 1

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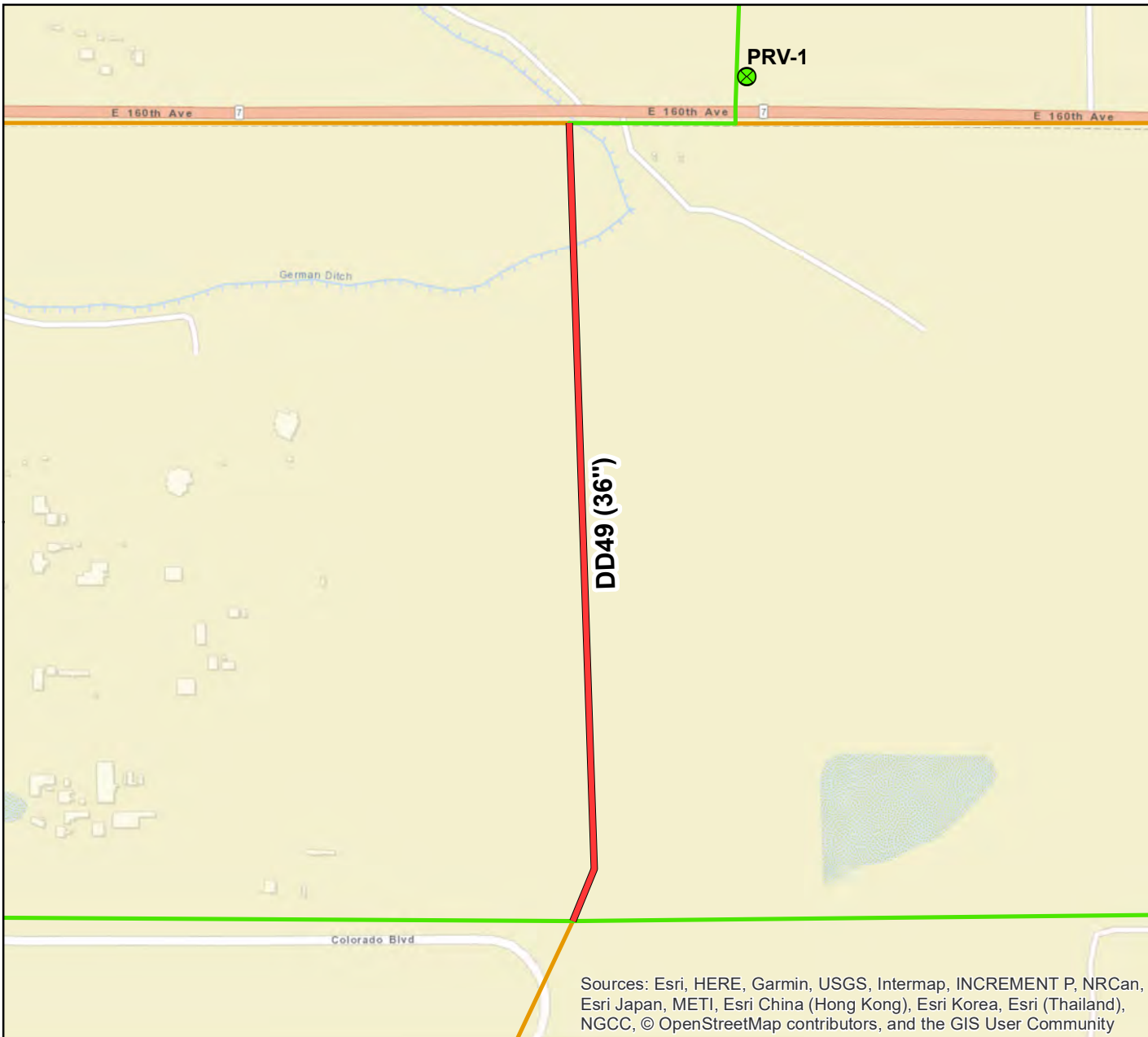
Water Distribution and Transmission Improvements

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CIP TT22



1 inch = 500 feet



Legend

- New PRVs
- Storage
- Pump
- Existing Pipelines
- NWTP
- Pumping CIP
- Storage CIP
- CIP Improvements
- Other Improvements
- Developer
- COT

Project Information

New pipe east of Colorado Blvd, running south from south of E 160th Ave to intersect with bend in Colorado Blvd. The new line is a 36-in with an approximate length of 2,600 ft.

Cost

\$2,239,400

Phase

2065

Purpose

Facilitate Growth

Trigger

Developments north of E 156th Avenue

Zone

Zone 1

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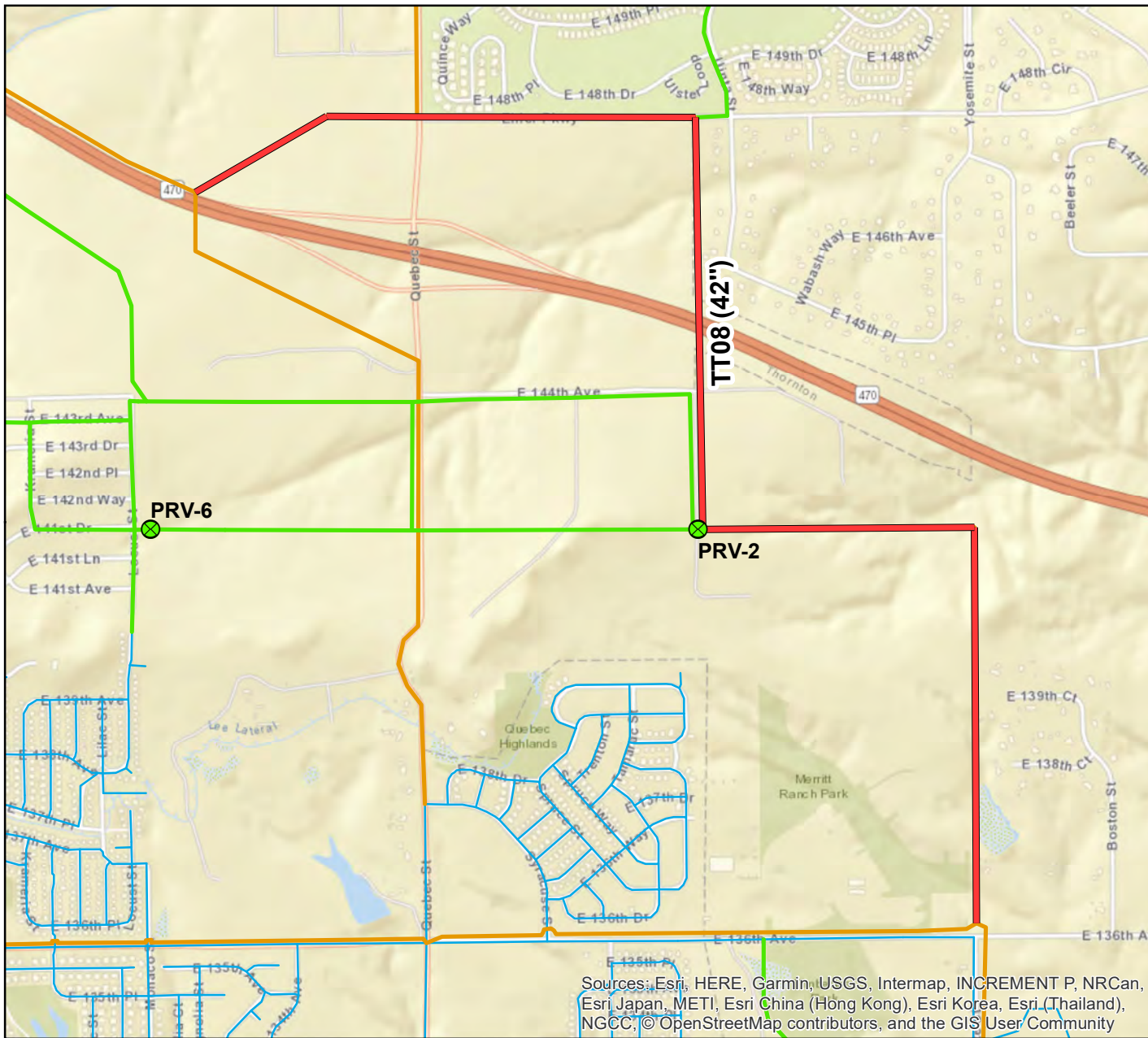
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Water Distribution and Transmission Improvements

CIP DD49



1 inch = 500 feet



Legend

- ⊗ New PRVs
- ⊗ Storage
- P Pump
- Existing Pipelines
- WTP NWTP
- P Pumping CIP
- ⊗ Storage CIP
- CIP Improvements
- Other Improvements
- Developer
- COT

Project Information

New pipe from E-470 west of Quebec St, along Ehler Pkwy, bending south near Unita St, crossing E-470 and bending east south of 144th Ave, then south along Yosemite St to 136th Ave. The new pipe is 36-in and 42-in with an approximate length of 15,400 ft.

Cost

\$15,394,900

Phase

2065

Purpose

Facilitate Growth

Trigger

Growth North of Highway I470

Zone

Zone 1

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Water Distribution and Transmission Improvements

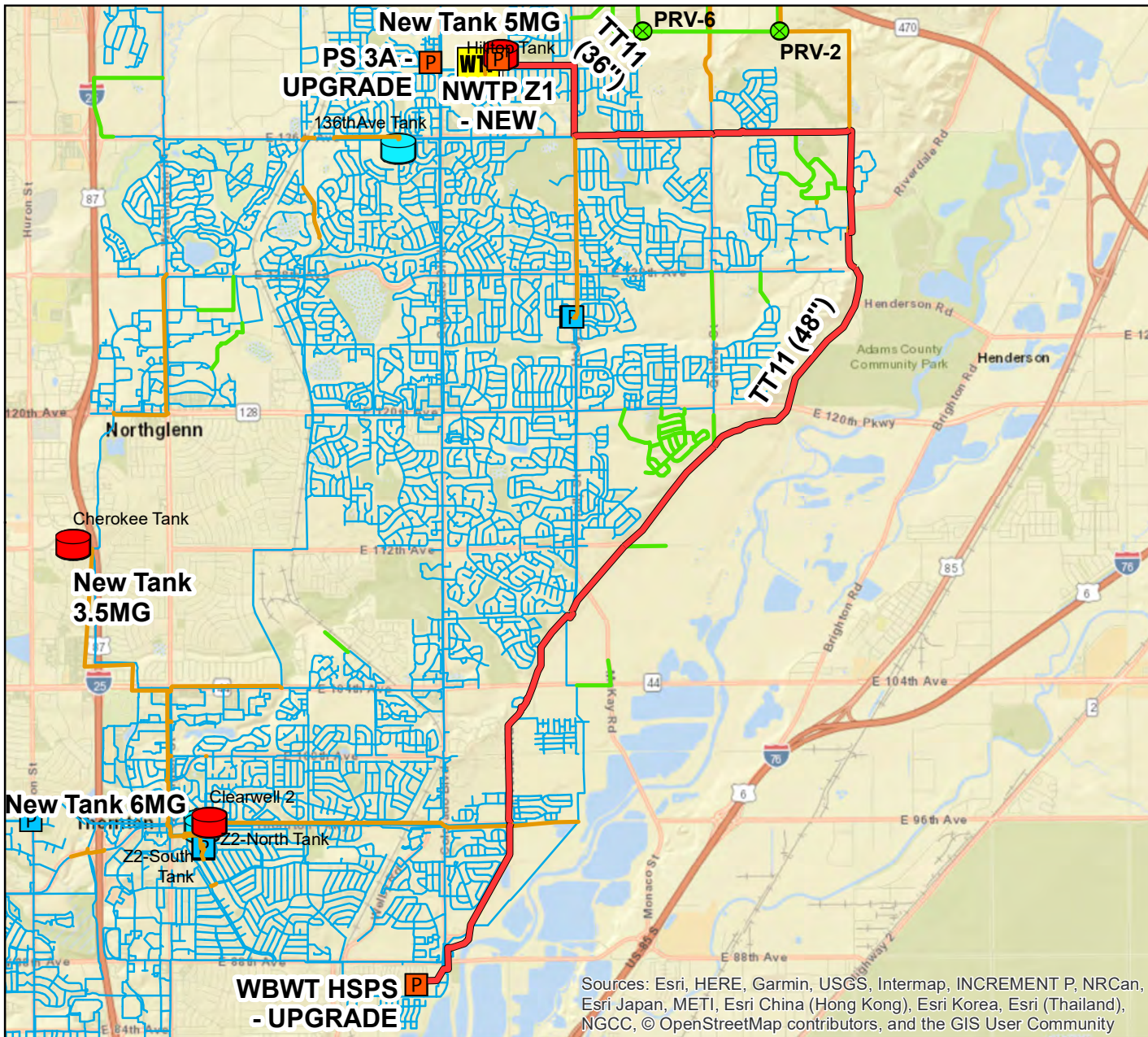
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CIP TT08



1 inch = 1,500 feet

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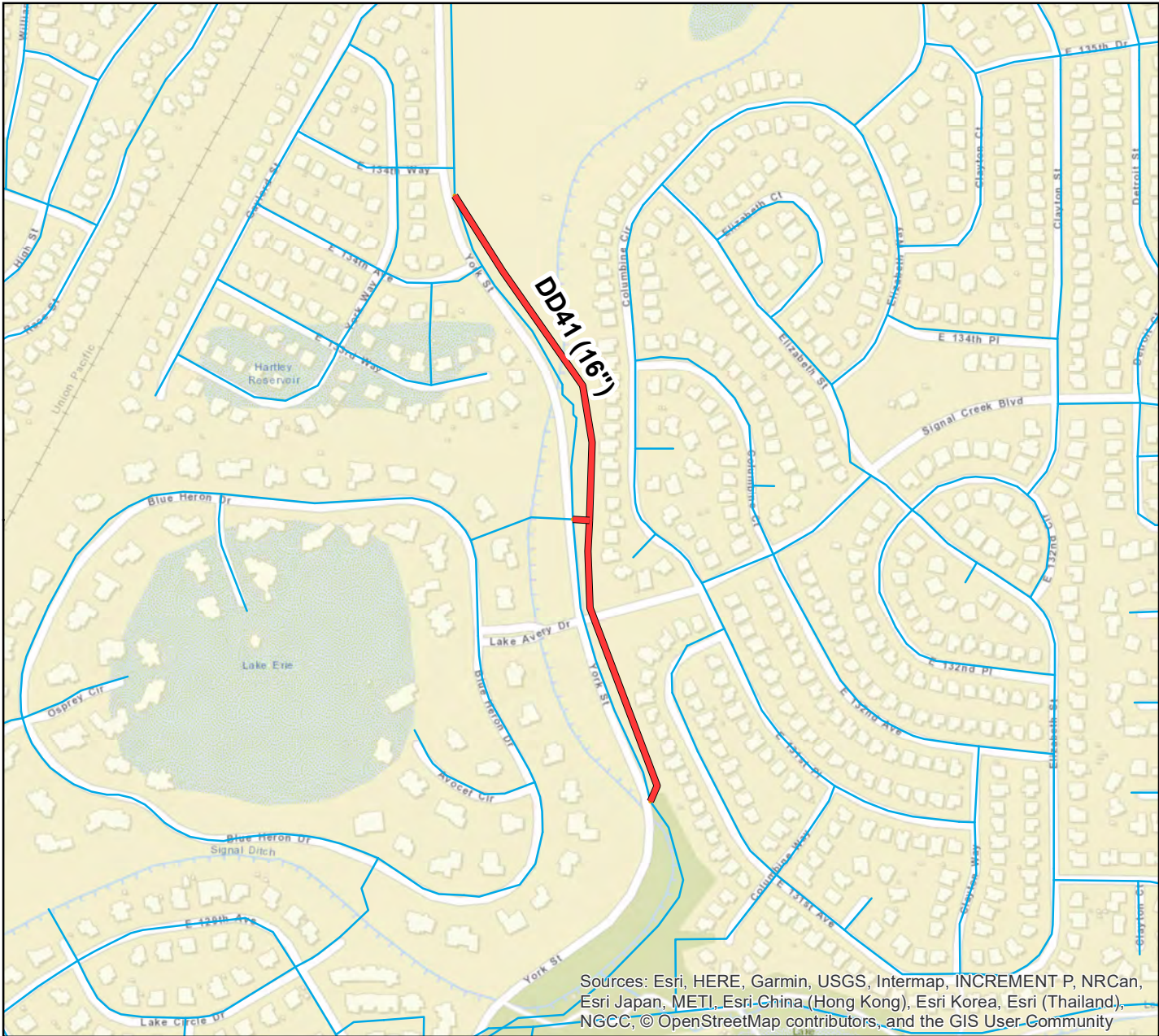
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Water Distribution and Transmission Improvements

CIP TT11














1 inch = 6,000 feet



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Legend

-  New PRVs
-  Storage
-  Pump
-  Existing Pipelines
-  NWTP
-  Pumping CIP
-  Storage CIP
-  CIP Improvements
-  Other Improvements
-  Developer
-  COT

Project Information

Installation of a parallel pipe along York St east of Lake Avery. The new line is a 16-in with an approximate length of 2,200 ft.

Cost

\$1,125,290

Phase

2065

Purpose


Tier 2 - Capacity

Trigger

Growth - Average System Demand = 44mgd

Zone

Zone 1

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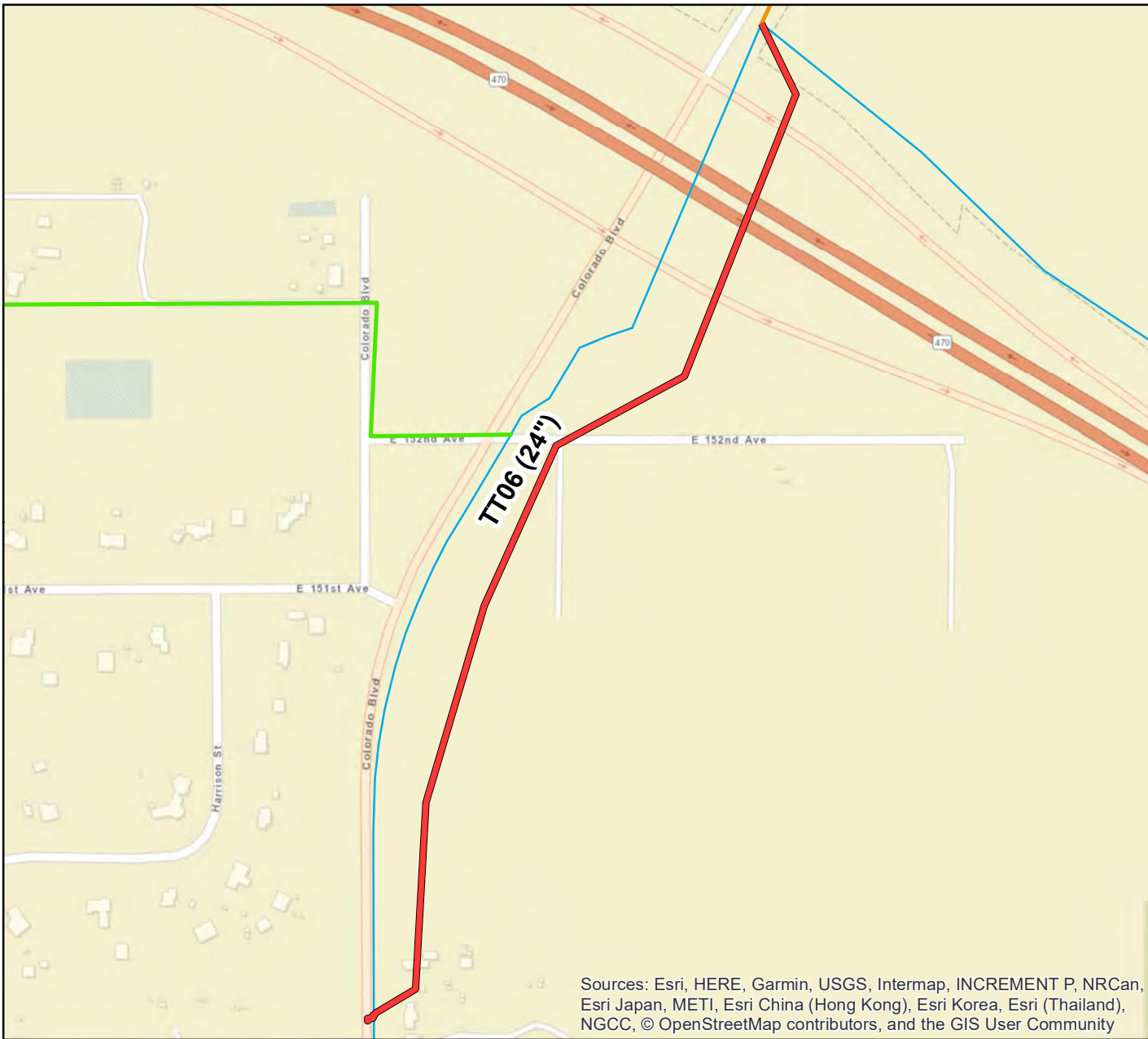
Water Distribution and Transmission Improvements

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CIP DD41



1 inch = 500 feet



Legend

- | | |
|--------------------|--------------------|
| New PRVs | Pumping CIP |
| Storage | Storage CIP |
| Pump | CIP Improvements |
| Existing Pipelines | Other Improvements |
| NWTP | Developer |
| | COT |

Project Information

New pipe along Colorado Blvd, with the north end crossing E-470. The new line is a 24-in with an approximate length of 3,800 ft.

Cost

\$2,469,480

Phase

2065

Purpose

Tier 2 - Capacity

Trigger

Growth North of Highway I470

Zone

Zone 1

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Water Distribution and Transmission Improvements

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CIP TT06



1 inch = 500 feet

Utility Master Plan

Project No. 17-467

Wastewater Collection Capital Improvement
Program Project Cutsheets

The City of Thornton

Project number: 60560104

March 2020

Table 2.16. Wastewater Collection Master CIP Table

CIP ID	Phase (Project Completion Date)	Purpose	Project Type	Project Description	Cost	***Trigger Flow (gpm)	Project Timeline (Start / Completion)	
WW4 (F)	2020-2025	Tier 1 - Buildout PDWQ d/D	Gravity Main Replacement	Todd Creek Collector Improvements. Gravity flow pipe is 12 to 15-in with a length of 3,068 ft.	\$ 624,000	900	2020	2021
WW6 (F)	2020-2025	Tier 1 - Buildout PDWQ d/D	Parallel Gravity Main	Heritage Todd Creek Interceptor Parallel. Gravity flow pipe is 18 to 21-in with a length of 5,708 ft.	\$ 3,022,000	2,300	2021	2022
WW1B (F)	2020-2025	Tier 1 - Buildout PDWQ d/D	Lift Station Expansion	Big Dry Creek Lift Station Expansion. Lift station has a flow of 8,043 gpm.	\$ 5,404,000	3,100	2024	2025
WW1A (F)	2025-2035	Tier 1 - Buildout PDWQ d/D	Parallel Gravity Main	Big Dry Creek Interceptor Parallel. Gravity flow pipe is 15 to 24-in with a length of 8,197 ft.	\$ 2,819,000	6,100	2027	2028
WW2 (F)	2025-2035	Tier 1 - Buildout PDWQ d/D	Gravity Main Replacement	Upstream Big Dry Creek Interceptor Improvement. Gravity flow pipe is 24-in with a length of 188 ft.	\$ 57,000	2,600	2030	2031
WW3 (F)	2025-2035	Tier 1 - Buildout PDWQ d/D	Gravity Main Replacement	Big Dry Creek Lateral Improvement. Gravity flow pipe is 12-in with a length of 1,600 ft.	\$ 225,000	900	2030	2031
WW5 (F)	2025-2035	Tier 1 - Buildout PDWQ d/D	Gravity Main Replacement	Upstream Heritage Todd Creek Interceptor Improvement. Gravity flow pipe is 15-in with a length of 1,269 ft.	\$ 578,000	900	2030	2031
WW17 (F)	2025-2035	Tier 2 - Buildout PDWQ d/D	Gravity Main Replacement	Big Dry Creek Lift Station Inlet. Gravity flow pipe is 27-in with a length of 141 ft.	\$ 53,000	4,600	2031	2032
WW18 (F)	2025-2035	Tier 2 - Buildout PDWQ d/D	Gravity Main Replacement	Upstream Big Dry Creek Interceptor Improvement. Gravity flow pipe is 24-in with a length of 498 ft.	\$ 141,000	2,600	2031	2032
WW19 (F)	2025-2035	Tier 2 - Buildout PDWQ d/D	Gravity Main Replacement	Upstream Big Dry Creek Interceptor Parallel Improvement. Gravity flow pipe is 24-in with a length of 417 ft.	\$ 163,000	2,300	2031	2032

*** Trigger = 70% Measure Flow

CIPID#'s revised from Water and Wastewater Infrastructure Master Plan:

CIPID WW17 is listed as CIP #15 in Table 13 of the Wastewater Collection System Evaluation (Chapter 6) of the Water and Wastewater Infrastructure Master Plan

CIPID WW18 is listed as CIP #16 in Table 13 of the Wastewater Collection System Evaluation (Chapter 6) of the Water and Wastewater Infrastructure Master Plan

CIPID WW19 is listed as CIP #17 in Table 13 of the Wastewater Collection System Evaluation (Chapter 6) of the Water and Wastewater Infrastructure Master Plan

*CIP ID LEGEND:

PREFIX DEFINITION

RAW = Raw Water Supply System Project

WTP = Water Treatment Facilities Project

DD = Water Distribution System Project / Distribution Pipeline

TT= Water Distribution System Project / Transmission Pipeline

P = Water Distribution System Project / Pump

SS = Water Distribution System Project / Storage

WW = Wastewater Collection System Project

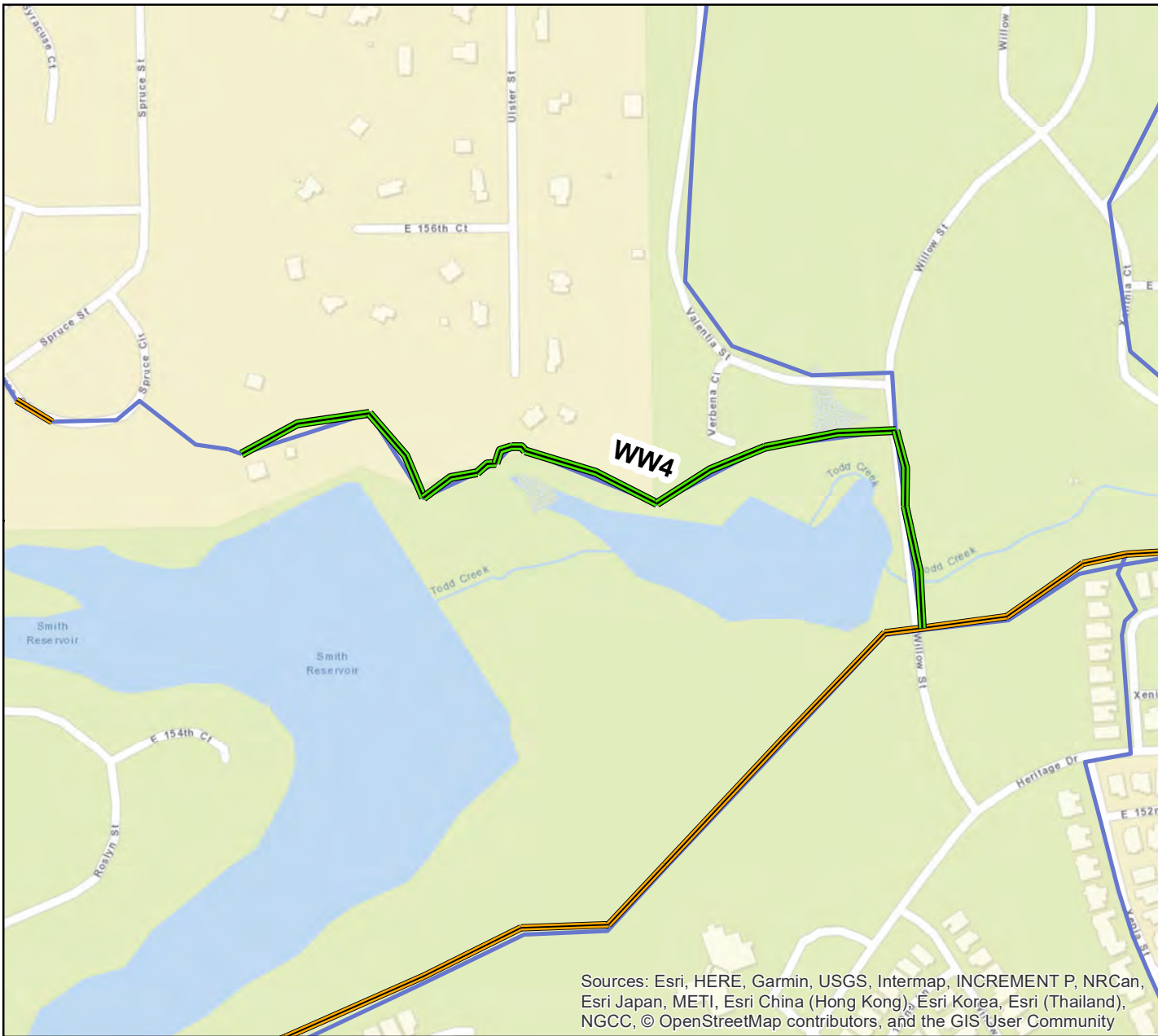
SUFFIX DEFINITION

E = Existing System Deficiency






F = Future System Improvement

*CIP ID's for Water Distribution and Wastewater Collection are organized without suffix in the Water and Wastewater Infrastructure Master Plan and on CIP project cutsheets

Trigger	Description
Existing Improvement	Improvement is required to address an existing deficiency
Growth - Average System Demand = 37mgd	Improvement will be required in the future, pending on expected growth
Growth - Average System Demand = 44mgd	Improvement will be required in the future, pending on expected growth
Developments north of E 156th Avenue	Improvement will serve future developments, pending on localized growth
WBWTP Upgrade	Improvement will support increase in supply capacity at WBWTP
Growth North of E-470	Improvement will serve future developments, pending on localized growth
Zone 1 Storage Upgrade	Improvement will support increase in storage capacity
Zone 3 Storage Upgrade	Improvement will support increase in storage capacity
NWTP Construction	Improvement will support supply improvements at NWTP
70% Measured Sewer Flow =	Improvement is required to meet future flows
Growth - Max Day Demand = 74.8 mgd	Improvement will be required in the future, pending on expected growth
Growth - Max Day Demand = 85.6 mgd	Improvement will be required in the future, pending on expected growth
Tier 2	Improvement identified as Tier 2
Tier 3	Improvement identified as Tier 3



Legend

-  Lift Station Expansion
-  Proposed Lift Station
-  CIP Improvement
-  Other Improvements
-  Gravity Pipes

Project Information

Todd Creek Collector Improvements. Gravity main is 12 to 15-in with a length of 3,100 ft.

Cost

\$624,000

Phase

2025

Purpose


Tier 1 - Buildout PDWQ d/D

Trigger

Flow 900 gpm

Basin

K

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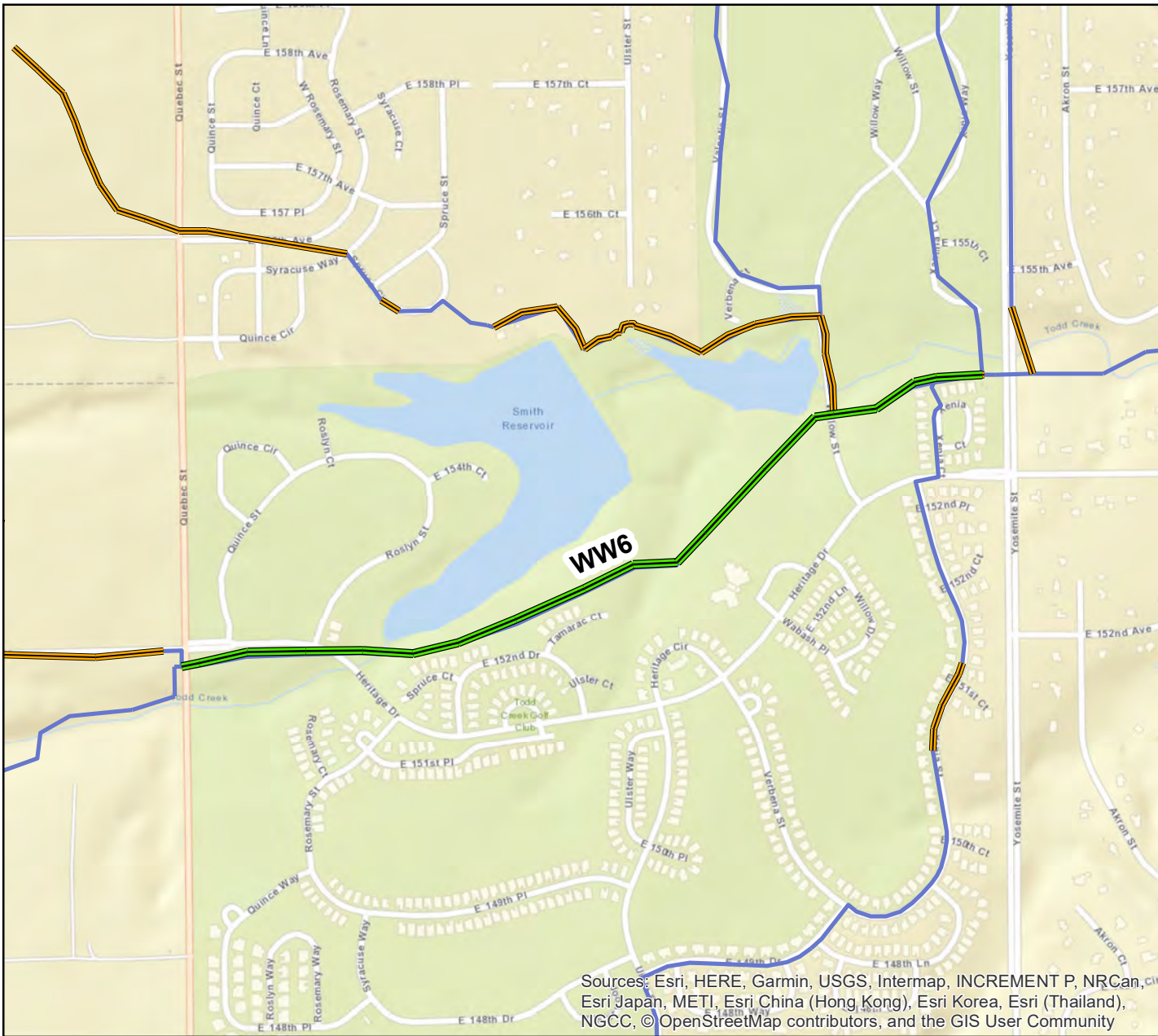
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Wastewater Infrastructure Improvements






CIP WW4



1 inch = 500 feet



Legend

-  Lift Station Expansion
-  Proposed Lift Station
-  CIP Improvement
-  Other Improvements
-  Gravity Pipes

Project Information

Heritage Todd Creek Interceptor Parallel. Gravity main is 18 to 21-in with a length of 5,700 ft.

Cost

\$3,022,000

Phase

2025

Purpose

Tier 1 - Buildout PDWQ d/D

Trigger

Flow 2,300 gpm

Basin

K

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(303) 538-7295

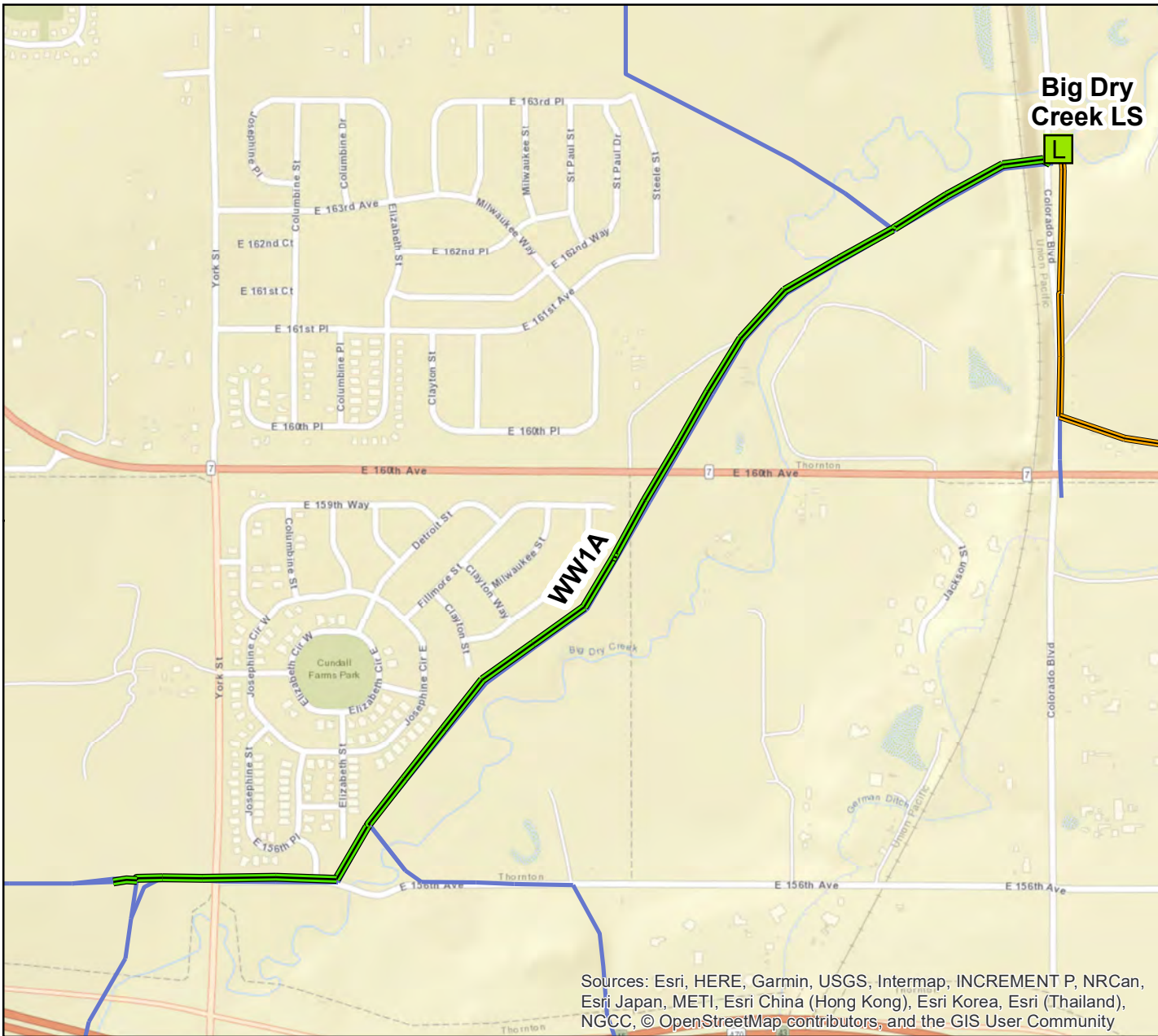
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Wastewater Infrastructure Improvements

CIP WW6



1 inch = 1,000 feet



Legend

- L Lift Station Expansion
- L Proposed Lift Station
- CIP Improvement
- Other Improvements
- Gravity Pipes

Project Information

Big Dry Creek Interceptor Parallel. Gravity main is 15 to 24-in with a length of 8,200 ft.

Cost

\$2,819,000

Phase

2025-2035

Purpose

Tier 1 - Buildout PDWQ d/D

Trigger

Flow 3,100 gpm

Basin

H

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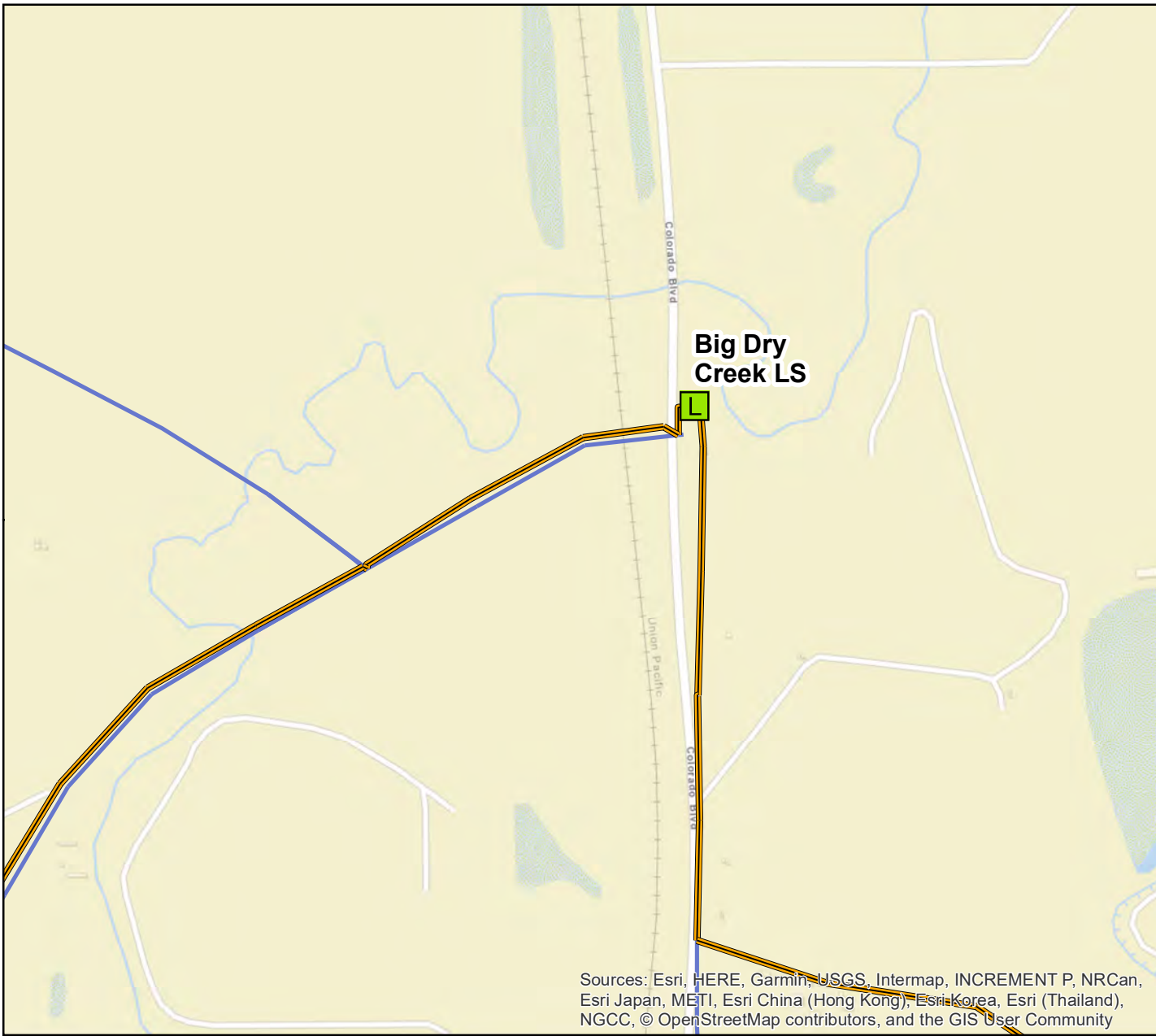
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Wastewater Infrastructure Improvements






CIP WW1A



1 inch = 1,000 feet



Legend

-  Lift Station Expansion
-  Proposed Lift Station
-  CIP Improvement
-  Other Improvements
-  Gravity Pipes

Project Information

Big Dry Creek Lift Station Expansion. Lift station has a flow of 8,000 gpm.

Cost

\$5,404,000

Phase

2025-2035

Purpose


Tier 1 - Buildout PDWQ d/D

Trigger

Flow 6,100 gpm

Basin

H

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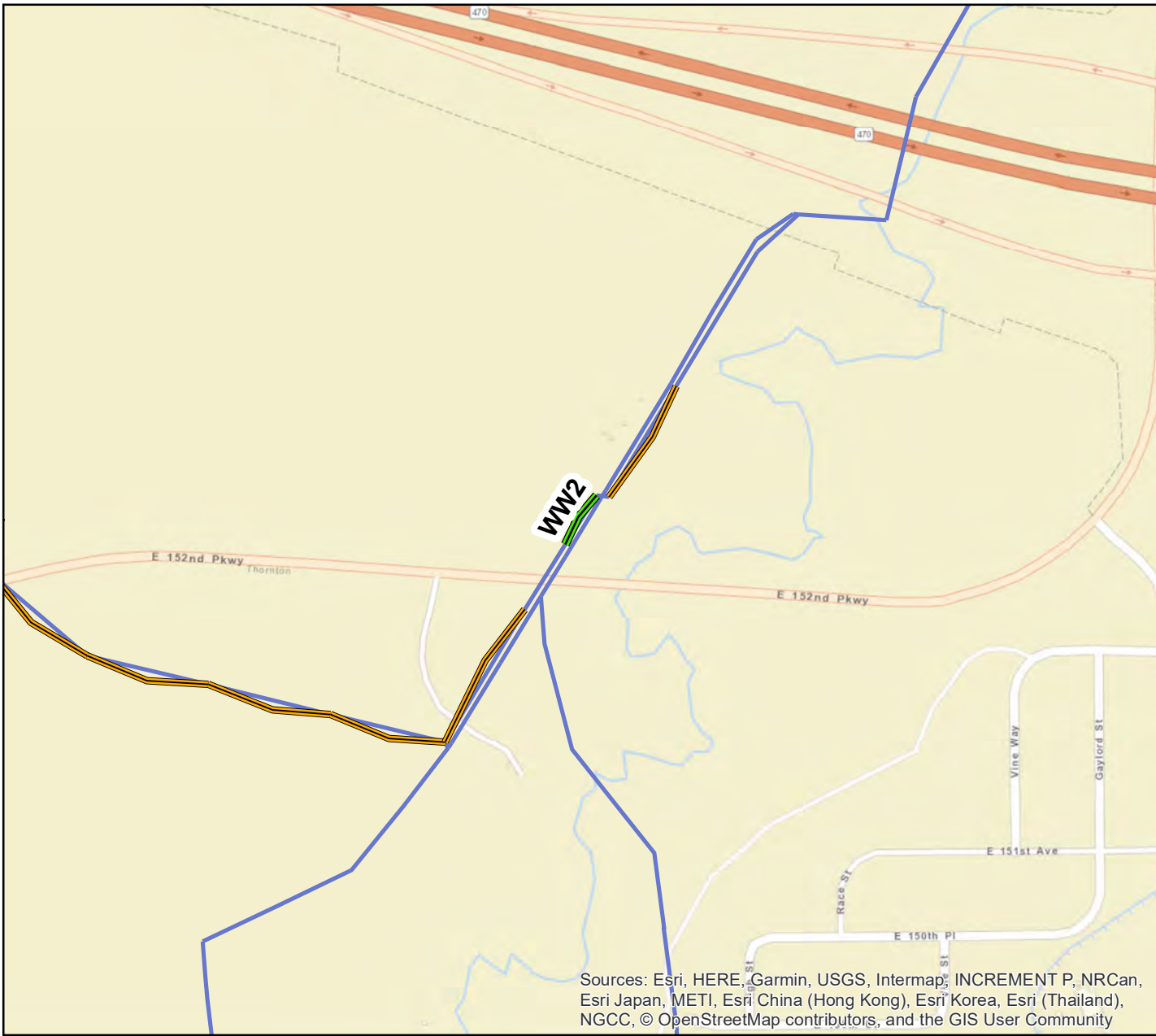
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**Wastewater Infrastructure
Improvements**

CIP WW1B








1 inch = 500 feet



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Legend

-  Lift Station Expansion
-  Proposed Lift Station
-  CIP Improvement
-  Other Improvements
-  Gravity Pipes

Project Information

Upstream Big Dry Creek Interceptor Improvement. Gravity main is 24-in with a length of 200 ft.

Cost

\$57,000

Phase

2035-2065

Purpose

Tier 1 - Buildout PDWQ d/D

Trigger

Flow 2,600 gpm

Basin

H

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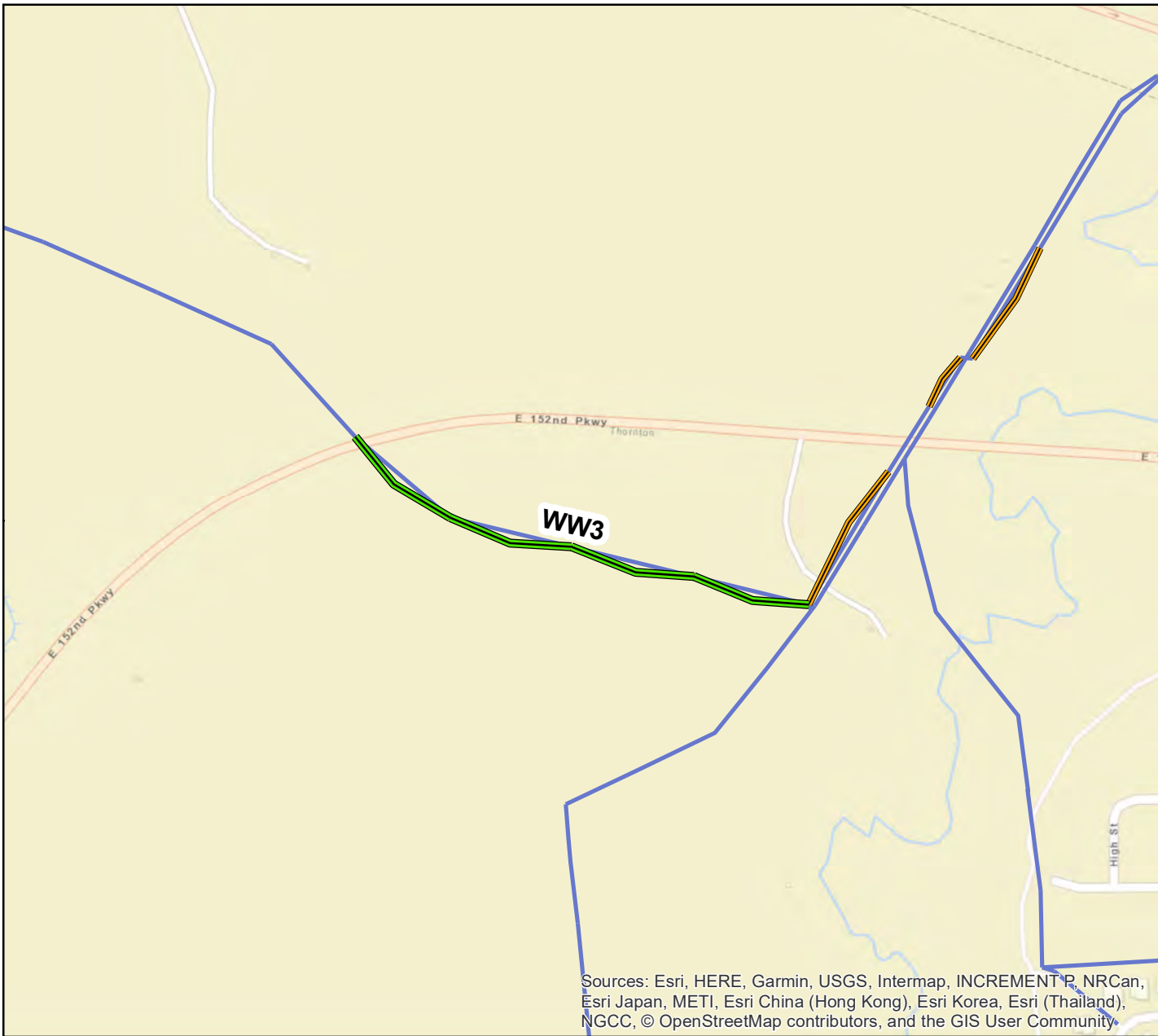
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Wastewater Infrastructure Improvements






CIP WW2



1 inch = 500 feet



Legend

-  Lift Station Expansion
-  Proposed Lift Station
-  CIP Improvement
-  Other Improvements
-  Gravity Pipes

Project Information

Big Dry Creek Lateral Improvement. Gravity main is 12-in with a length of 1,600 ft.

Cost

\$225,000

Phase

2035-2065

Purpose

Tier 1 - Buildout PDWQ d/D

Trigger

Flow 900 gpm

Basin

H

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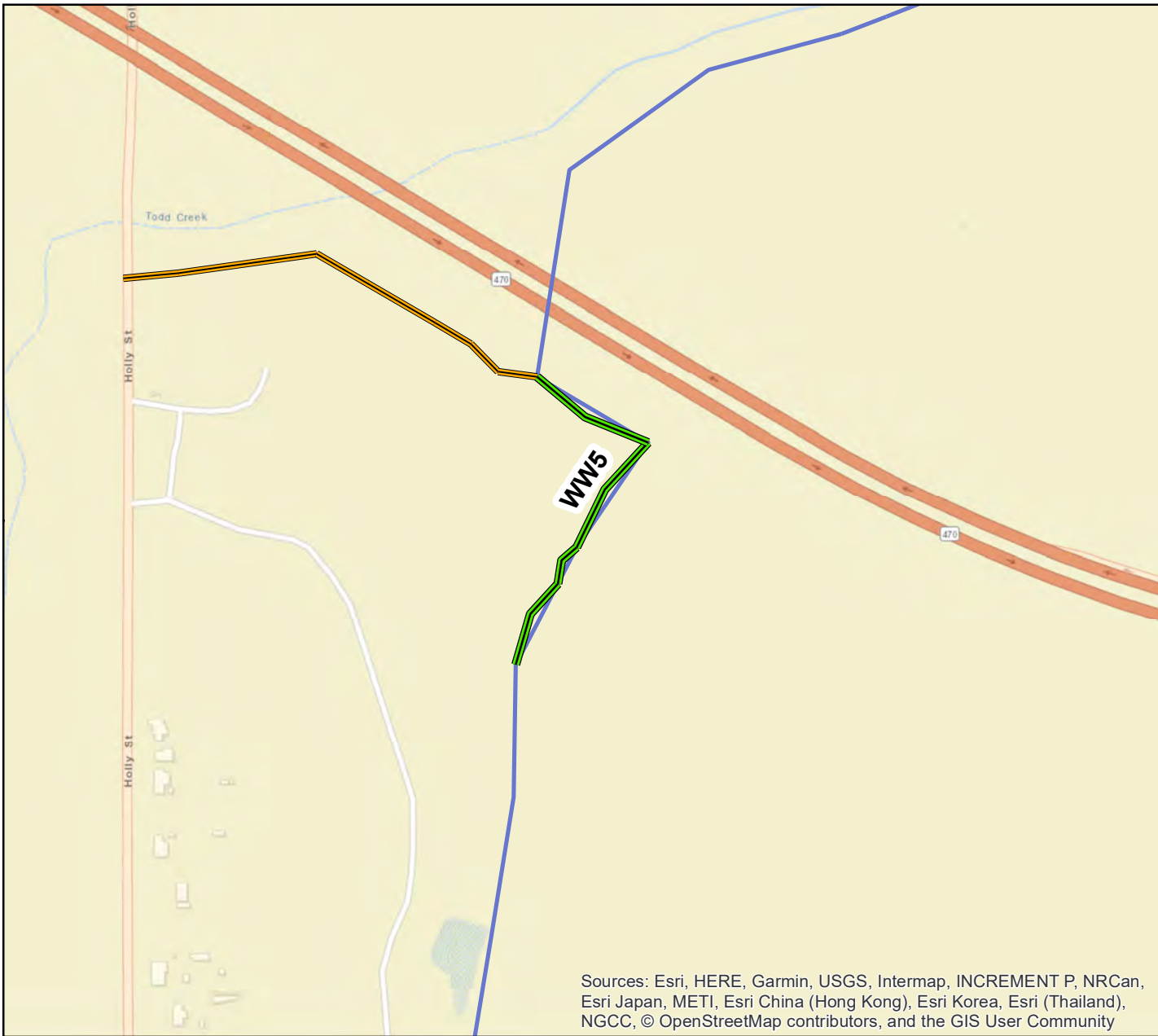
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**Wastewater Infrastructure
Improvements**






CIP WW3



1 inch = 500 feet



Legend

-  Lift Station Expansion
-  Proposed Lift Station
-  CIP Improvement
-  Other Improvements
-  Gravity Pipes

Project Information

Upstream Heritage Todd Creek
Interceptor Improvement. Gravity main is
15-in with a length of 1,300 ft.

Cost

\$578,000

Phase

2035-2065

Purpose

Tier 1 - Buildout PDWQ d/D

Trigger

Flow 900 gpm

Basin

K

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Wastewater Infrastructure Improvements

CIP WW5



1 inch = 500 feet



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Legend

- Lift Station Expansion
- Proposed Lift Station
- CIP Improvement
- Other Improvements
- Gravity Pipes

Project Information

Big Dry Creek Lift Station Inlet Improvement. Gravity main is 27-in with a length of 200 ft.

Cost

\$53,000

Phase

2035-2065

Purpose

Tier 2 - Buildout PDWQ d/D

Trigger

Flow 4,600 gpm

Basin

H

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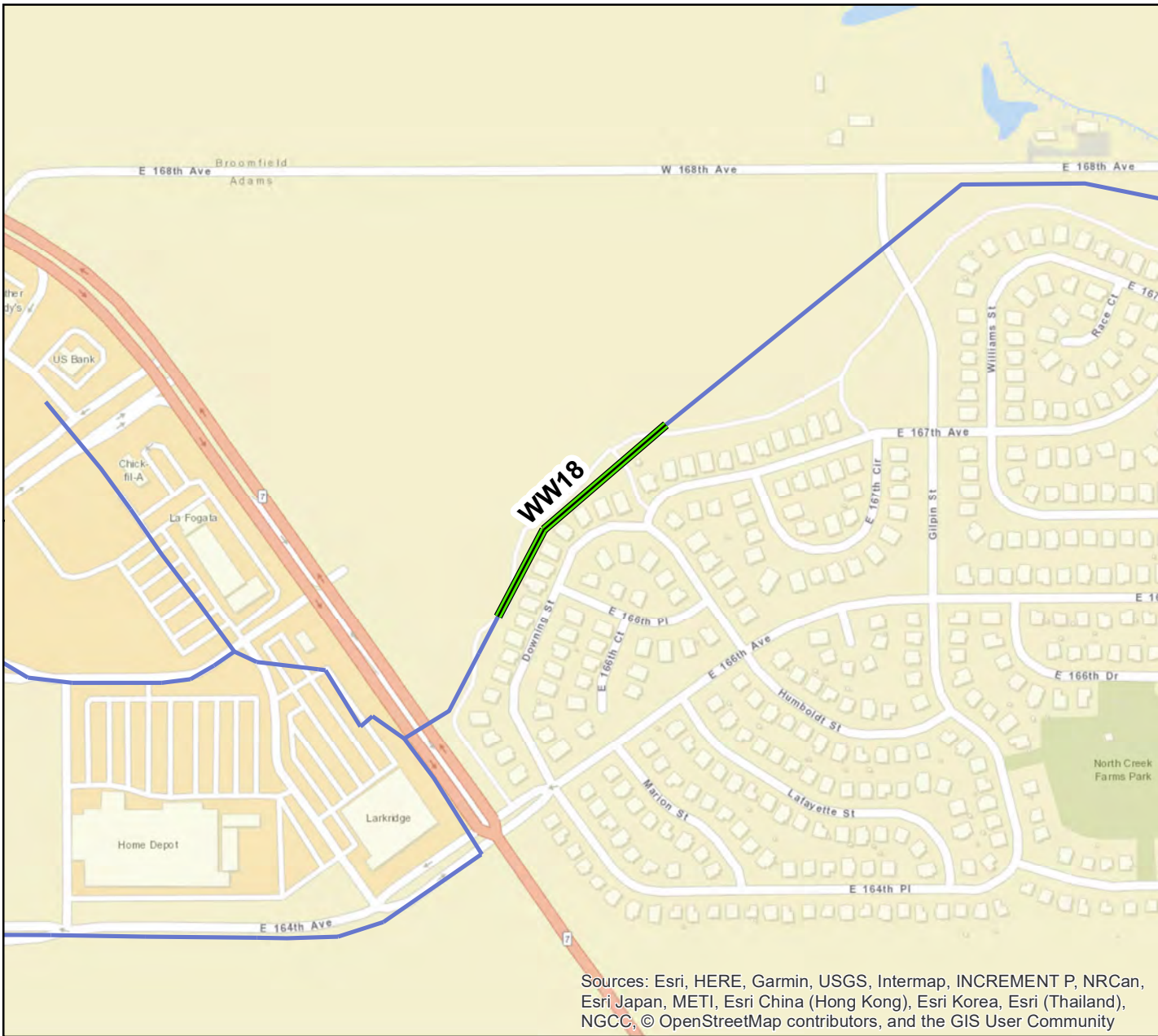
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**Wastewater Infrastructure
Improvements**

CIP WW17



1 inch = 500 feet



Legend

- L Lift Station Expansion
- L Proposed Lift Station
- CIP Improvement
- Other Improvements
- Gravity Pipes

Project Information

Upstream Big Dry Creek Interceptor Improvement. Gravity main is 24-in with a length of 500 ft.

Cost

\$141,000

Phase

2035-2065

Purpose

Tier 2 - Buildout PDWQ d/D

Trigger

Flow 2,600 gpm

Basin

H

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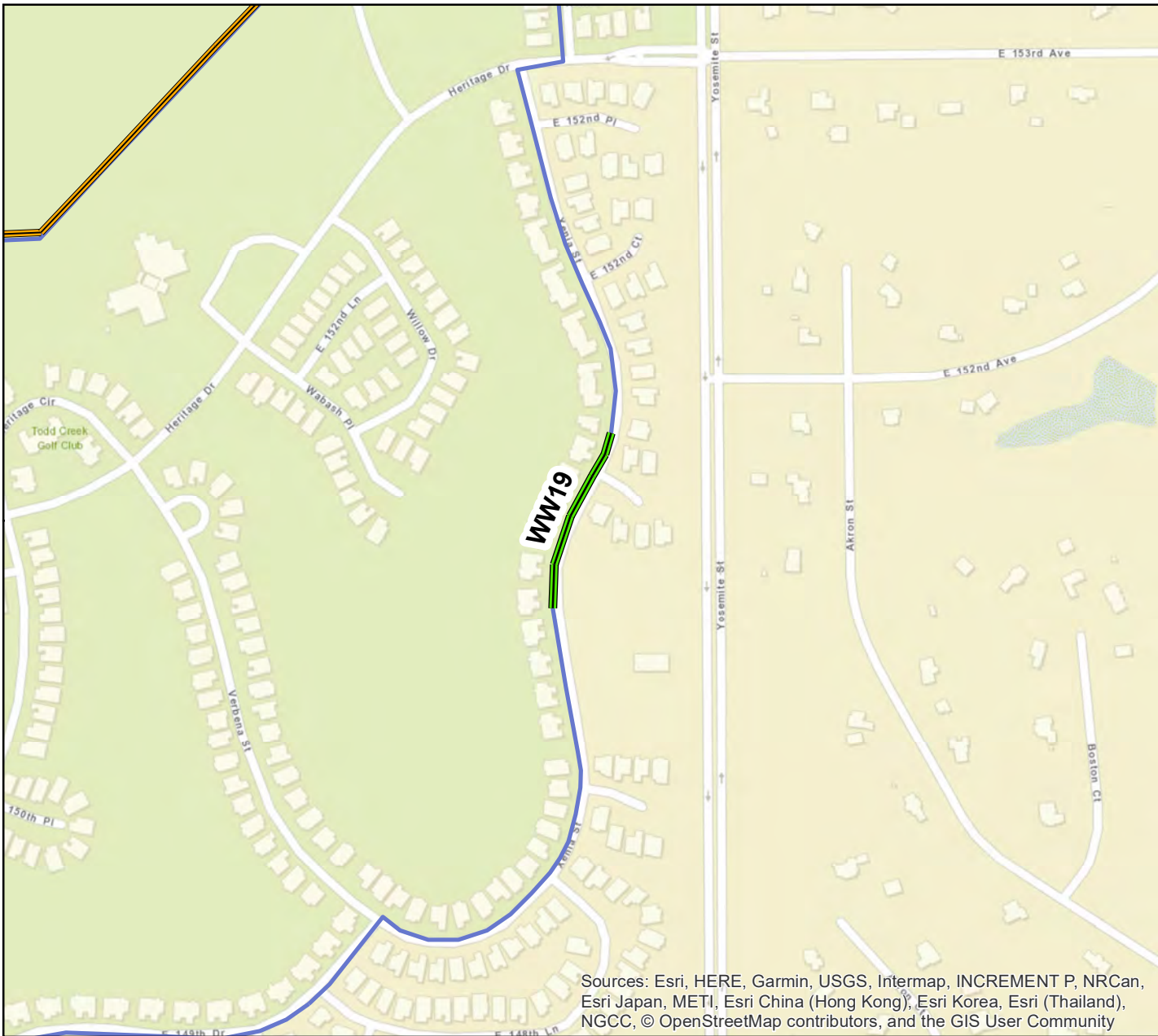
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Greenwood Village, Colorado 80111

Wastewater Infrastructure Improvements

CIP WW18



1 inch = 500 feet



Legend

- Lift Station Expansion
- Proposed Lift Station
- CIP Improvement
- Other Improvements
- Gravity Pipes

Project Information

Upstream Big Dry Creek Interceptor Parallel Improvement. Gravity main is 24-in with a length of 450 ft.

Cost

\$163,000

Phase

2035-2065

Purpose

Tier 2 - Buildout PDWQ d/D

Trigger

Flow 2,300 gpm

Basin

K

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Greenwood Village, Colorado 80111

Wastewater Infrastructure Improvements

CIP WW19



1 inch = 500 feet

Utility Master Plan

Project No. 17-467

Water and Wastewater Infrastructure Capital
Improvement Program CIP Location Maps

The City of Thornton

Project number: 60560104

March 2020

Appendix E

Water Distribution System CIP Projects Funded by Developer

Table E.1 lists the water distribution and transmission by funding source. Table E.1. was originally presented as Table 25 in Chapter 5 of Volume IV Water and Wastewater Collection System Master Plan.

Table E.1. Water Distribution System CIP Projects by Funding Source

CIP ID	Diameter (in)	Length (ft)	Unit Cost	Cost	Primary Funding Source
DD01	16	10,500	511	\$5,475,550	Developer
DD02	12	100	395	\$39,490	Developer
DD03	12	6,900	395	\$2,724,760	Developer
DD04	8	2,800	308	\$861,930	Developer
DD05	8	5,800	308	\$1,785,410	Developer
DD06	12	4,100	395	\$1,619,060	Developer
DD07	12	2,800	395	\$1,105,700	Developer
DD08	12	10,500	395	\$4,146,370	Developer
DD09	16	2,600	511	\$1,329,890	Developer
DD10	12	2,300	395	\$908,260	Developer
DD11	12	3,600	395	\$1,421,620	Developer
DD12	12	33,500	395	\$13,438,610	Developer
DD15	12	3,500	395	\$1,382,130	Developer
DD16	12	1,200	395	\$473,880	Developer
DD17	12	2,600	395	\$1,026,720	Developer
DD18	8	11,700	308	\$3,601,610	Developer
DD19	12	1,300	395	\$513,360	Developer
DD20	12	400	395	\$157,960	Developer
DD21	10	200	351	\$70,280	Developer
DD22	12	1,300	395	\$513,360	Developer
DD23	12	1,700	395	\$671,320	Developer
DD24	12	2,300	395	\$908,260	Developer
DD36	8	1,200	308	\$369,400	Developer
DD39	16	2,600	511	\$1,329,890	Developer
DD40	12	2,700	395	\$1,066,210	Developer
DD43	12	5,400	395	\$2,132,420	Developer
DD45	12	1,400	395	\$552,850	Developer
DD49	36	2,600	861	\$2,239,380	Thornton
DD50	16	2,700	511	\$1,381,040	Developer
DD51	12	600	395	\$236,940	Developer
DD52	12	400	395	\$262,820	Developer
DD53	24	1,400	650	\$909,810	Thornton
DD54	16	2,500	511	\$1,278,740	Developer
DD55	16	700	511	\$358,050	Developer
DD56	12	900	395	\$355,410	Developer
DD57	12	6,600	395	\$2,606,290	Developer

CIP ID	Diameter (in)	Length (ft)	Unit Cost	Cost	Primary Funding Source
DD58	12	2,700	395	\$1,066,210	Developer
DD59	12	2,800	395	\$1,105,700	Developer
DD60	12	2,700	395	\$1,066,210	Developer
DD61	12	100	395	\$39,490	Developer
DD62	12	100	395	\$39,490	Developer
DD63	12	2,700	395	\$1,171,080	Developer
DD64	12	2,200	395	\$868,770	Developer
DD65	12	400	395	\$157,960	Developer
DD66	12	2,500	395	\$987,240	Developer
DD67	12	2,700	395	\$1,066,210	Developer
DD68	12	2,600	395	\$1,026,720	Developer
DD69	12	3,200	395	\$1,263,660	Developer
DD70	12	2,700	395	\$1,066,210	Developer
DD71	12	2,700	395	\$1,066,210	Developer
TT01	16	4,500	511	\$2,406,590	Developer
TT02	20	200	558	\$111,630	Thornton
TT03	16	4,400	511	\$2,250,580	Developer
TT04	24	4,600	650	\$2,989,370	Thornton
TT07	42	5,200	1,000	\$5,198,280	Thornton
TT08	42	15,400	1,000	\$15,394,890	Thornton
TT09	20	2,700	558	\$1,506,970	Thornton
TT10	24	7,400	650	\$4,808,980	Thornton
Total		217,900		\$105,913,230	
Total - Developer		178,400		\$72,753,920	
Total - Thornton		39,500		\$33,159,310	

Note: Cost of PRV Facility included in projects DD01, DD12, DD52, DD63, and TT01

Wastewater Collection System CIP Projects Funded by Developer

Table E.2. lists the CIP projects expected to be funded by developers. Table E.2. was originally presented as Table 12 in Chapter 6 of Volume IV Water and Wastewater Collection System Master Plan.

Table E.2. Wastewater Collection System CIP Projects Funded by Developer

#	Description	Type	Length (ft)	Diameter (in)	Buildout PDWQ (gpm)	Buildout PWWQ (gpm)	Primary Funding Source	Total Cost
7	144 th Ave Extension	Gravity Main Extension	3,593	8"	160	199	Developer	\$1,256,000
8	Lower Big Dry Creek Lift Station	New Lift Station and Gravity Main	4,740	12"	397	492	Developer	\$2,059,000
9	Todd Creek Collector Extension	Gravity Main Extension	2,756	12"	1,077	1,337	Developer	\$313,000
10	152 nd Ave Todd Creek Collector Extension	Gravity Main Extension	3,191	10"	654	813	Developer	\$456,000
11	Sanitary Line D	Gravity Main Extension	4,788	12" to 15"	772	965	Developer	\$1,123,000
12**	88 th Ave Interceptor	Gravity Main Extension	1,141	10"	341	427	Developer	\$220,000
13	Stonehocker Collector	Gravity Main Extension	7,693	12" to 18"	3,491	4,363	Developer	\$1,081,000
14	E-470 and Holly St Collector	Gravity Main Extension	1,882	8"	211	261	Developer	\$567,000
Total								\$7,075,000

*CIP required to extend collection system to meet future growth. Sized to supply PDWQ at $d/D < 0.8$ for pipes $\geq 15"$ and $d/D < 0.7$ for pipes $< 15"$

**Minimum diameter; to be confirmed by Developer

Due to file size Figure E-1 and E-2 are saved in individual PDF files:

Figure_E-1_Volume I_IMP.pdf

Figure_E-2_Volume I_IMP.pdf

Utility Master Plan

Project No. 17-467

Volume I – Integrated Master Plan
The City of Thornton

Project Number: 60560104

March 2020



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Utility Master Plan

Attachments (Provided Separately)

Volume II. Raw Water Supply Master Plan

Volume III. Water Treatment Facilities Master Plan

Volume IV. Water and Wastewater Infrastructure Master Plan

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List of Acronyms

%	Percent
AACE	Association for the Advancement of Cost Engineering
ADD	Average Daily Demand
CapEx	Capital Expenditure
CBA	Cost-Benefit Analysis
CIP	Capital Improvement Program
EGL4	East Gravel Lake #4
ft	Feet
gpm	Gallons per Minute
IMP	Integrated Master Plan
in	Inch
KPI	Key Performance Index
LF	Linear Feet
M	Million
MDD	Maximum Daily Demand
MG	Million Gallons
mgd	Million Gallons per Day
MIB	2-methylisoborneol
N/A	Not Applicable
NTU	Nephelometric Turbidity Unit
NWTP	Northern Water Treatment Plant
O&M	Operation and Maintenance
PDWQ	Peak Dry Weather Flow
PS	Pump Station
SLR	Sludge Loading Rate
TM	Technical Memorandum
TWP	Thornton Water Project
TWTP	Thornton Water Treatment Plant
UMP	Utility Master Plan
WBWTP	Wes Brown Water Treatment Plant
WTP	Water Treatment Plant
WGL2	West Gravel Lake #2
YR	Year

Chapter 1 Utility Master Plan

Section 1-1 Introduction and Purpose

The city of Thornton (Thornton) Utility Master Plan (UMP) includes Thornton's raw water supply, water treatment facilities, water distribution, and wastewater collection systems. The planning basis was carefully developed with Thornton for the Water and Wastewater Infrastructure Master Plan to identify future system requirements for raw water supply, water treatment facilities, water distribution and wastewater collection.

Requirements for each of the systems were identified in the individual master plans through an integrated planning process. This included an update to the 2009 Water and Wastewater Infrastructure Master Plan (presented in Volume IV) and concurrent completion of the Raw Water Supply Master Plan (presented in Volume II) and the Water Treatment Facilities Master Plan (presented in Volume III). The completed master plans were coordinated into a single Integrated Master Plan (IMP) (presented here in Volume I) that supports the 2019 Comprehensive Plan to meet future growth requirements. The IMP presents development of a Capital Improvement Program (CIP), which included a comprehensive evaluation of identified alternatives from each of the individual master plans, and selection of a preferred alternative to meet future system needs.

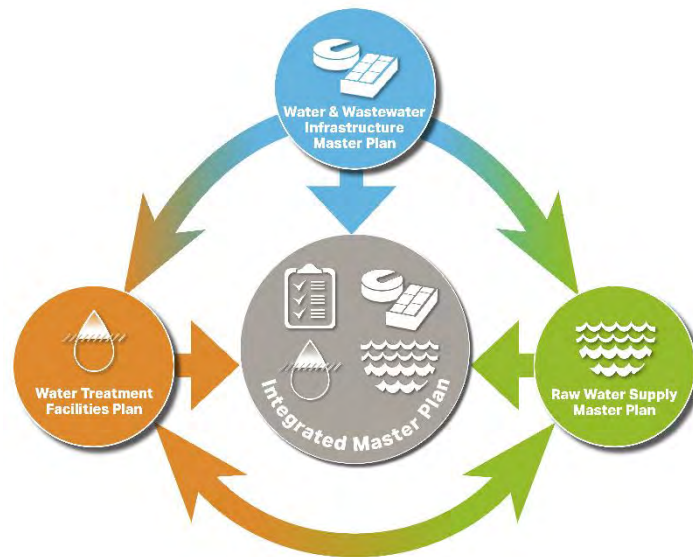


Figure 1.1: Integrated Plan Components

Thornton currently provides service to a population of over 166,000 habitants within the city as well as outside its limits. At build-out, anticipated to occur by 2065, the systems are expected to serve a population of 268,843 within the existing Thornton water and wastewater service areas.

To serve the anticipated future growth, the water treatment facilities will require an overall increase in production capacity of an additional 21.5 million gallons per day (mgd). Three future alternatives were developed and evaluated to meet the expected future need considering impacts across the raw water, water treatment, and water distribution systems. These alternatives involved either the construction of a new Northern Water Treatment Plant (NWTP), or the expansion of the Thornton Water Treatment Plant (TWTP), or the expansion of Wes Brown Water Treatment Plant (WBWTP).

The alternatives development and evaluation process was structured to encourage consideration of a full range of improvement strategies. Alternative improvements were developed to meet performance criteria for each system based on technical analyses outlined in the individual master plans and to meet future system demands.

The performance criteria for each system were divided into three tiers to establish a hierarchical structure for the levels of service associated with the various system improvements. This structure can provide Thornton guidance and flexibility in implementation of improvement projects based on balancing desired level of service and budgetary goals. The three tiers are summarized as follows:

- Tier 1: Criteria that must be met by the system.

- Tier 2: Criteria that represent best practice and should be met by the system, but may not be required.
- Tier 3: Criteria that are desired and should be met if practicable, but are not required.

Construction of a new NWTP located in the northern portion of the service area was selected as the preferred alternative to best meet future system requirements based on a cost-benefit analysis (CBA) of the integrated alternatives described in Chapter 3 of this Volume I report.

The CIP for the preferred alternative was developed for each system to provide a plan that phases and prioritizes the improvement projects and associated costs. This IMP finalized the CIP phasing and costs based on detailed analysis with Thornton on information provided in the individual master plans. CIP projects associated with the Thornton Water Project (TWP) are limited to those located within Thornton's city limits. Costs of improvements north of the city limits are not included in the CIP. This program is described in Chapter 2 of this Volume I report.

Section 1-2 Utility Master Plan Framework

This UMP is comprised of 4 parts:

Volume I: Utility Master Plan Integrated Master Plan

The purpose of the UMP Technical Report is to document the CIP. The report is structured to present the development of the CIP in Chapter 2. The cost-benefit evaluation of the integrated alternatives and selection of a preferred alternative to meet future requirements are presented subsequently in Chapter 3.

Volume II: Raw Water Supply Master Plan

The Raw Water Supply Master Plan includes the definition of performance criteria and the analysis of the alternatives related to the raw water supply system to meet current and future demands. This included evaluation of the current Gravel Lakes operations and water quality and preliminary evaluation of pipeline alignments within city limits for the Thornton Water Project (TWP). A water balance model of the Gravel Lakes system was developed to evaluate the Gravel Lakes' hydraulics. Additionally, an Operational Plan and Water Quality Monitoring Plan were developed to improve the water quality at the Gravel Lakes.

Volume III: Water Treatment Facilities Master Plan

The Water Treatment Facilities Master Plan includes the definition of performance criteria and the analysis of the alternatives related to the water treatment facilities to meet current and future demands. A water treatment performance and regulatory evaluation was also completed for WBWTP and identified recommend improvements to the existing facility. Additionally, an assessment of the sustainable production capacity of the membranes expected to result following completion of recommended WBWTP improvements was completed.

Volume IV: Water and Wastewater Infrastructure Master Plan

The Water and Wastewater Infrastructure Master Plan includes the development of the UMP planning basis utilized in each of the individual master plans, definition of distribution and collection system performance criteria, the analysis of the alternatives related to the water distribution and wastewater collection systems to meet future demands, and the development of improvements to accommodate buildout flows. Thornton's hydraulic models of the distribution and collection systems were updated and utilized to complete the alternatives analysis. Additionally, Thornton's Rehabilitation and Replacement program was evaluated to determine if current funding is adequate to maintain the respective systems. A pipeline risk assessment tool was developed to evaluate and prioritize the recommended rehabilitation and replacement improvements.

Revisions to Utility Master Plan

At the time of completion of the UMP, an alternative centered around an increased treatment capacity of 36.5 mgd at the NWTP and decreased capacity of 40 mgd at WBWTP was in development. This

alternative resulted in revisions to the CIP plan presented in Volume I. An independent document, titled “Thornton Plan Utility Master Plan”, was created to document the revisions necessary to accommodate the alternative WTP capacities in the CIP plan.

Chapter 2 Capital Improvement Program

Section 2-1 Introduction and Purpose

Following the Integrated Alternatives Evaluation presented in Chapter 3 of this Utility Master Plan Thornton selected Alternative 1 – Construction of a new Northern Water Treatment Plant (NWTP) to meet future water demands. Chapter 2 presents the Capital Improvement Program (CIP) for Alternative 1. This CIP provides a plan that phases and prioritizes improvement projects and associated costs across the raw water supply system, water treatment facilities, and the water distribution and wastewater collection systems. The methodology used to prepare the CIP Plan is summarized in this Chapter. Documentation of the CIP Plan includes:

1. An index of all CIP projects organized by system type, phase and priority;
2. Informational cutsheets for each CIP project;
3. CIP Location Map and
4. Annual estimated expenditures to provide guidance of future planning and budgeting efforts.

The following sections summarize key aspects of the CIP necessary to achieve improvement goals in each of the systems (raw water supply, water treatment facilities, water distribution, and wastewater collection).

Section 2-2 Raw Water Supply CIP Plan Summary

A variety of raw water supply CIP projects were identified to supply current and future demands with improved raw water quality. Recommended improvements to meet existing deficiencies include a raw water pipeline interconnect (McKay Interconnect) between the existing 36-inch McKay pipeline and the EGL4 PS. This improvement will allow for McKay Pump Station (PS) to deliver directly to WBWTP, TWTP and East Gravel Lake #4 (EGL4). The interconnect will consist of a valve vault, a moderate length of pipe and flow control valves and meters. Additionally a raw water pipeline from West Gravel Lake #2 (WGL2) to EGL4 (including a new pump station) is recommended to meet Tier 1 performance criteria. These pipelines will allow the Gravel Lakes to be operated in series, which is expected to improve water quality. This new operational plan for the Gravel Lake system is recommended to be followed year-round.

Two studies are recommended to improve the understanding of the raw water quality characteristics under existing conditions and identify new methods for improving the raw water quality as follows:

1. Pilot study on the effectiveness and operational cost of precipitant addition to the Burlington Canal diversions for total suspended solids removal and phosphorus sequestration at Gravel Lakes and resulting reduction of phosphorus in supply to water treatment facilities.
2. Feasibility analysis of floating solar panel installation in the Gravel Lakes. In addition to generating electricity, these solar panels would provide shade and lower the water temperature, thereby reducing algae production.

The following new water quality profiling and monitoring systems are also recommended under the existing improvements for the Gravel Lakes:

- A sonde (water quality sampler) to collect water quality data placed at the deepest location or center of each lake, with samples collected at different strata. It is possible for the individual lakes to have varying water quality between the different bodies of water and therefore it is recommended that a sonde be placed at each lake to identify the unique water quality profiles.
- Nutrient monitoring should continue near the Gravel Lake shorelines. It is possible for the individual lakes to have varying water quality between the different bodies of water and therefore

it is recommended that nutrient monitoring continue at each lake to identify the unique water quality profiles.

- New temperature data monitor and new profiling system at EGL4, WGL2, and South Cell – Cooley West Lake.
- Collection of a monthly integrated water column sample at EGL4 to gain better insight into phytoplankton species, which influence taste and odor events.
- Collection of geosmin, 2-methylisoborneol (MIB), and microcystin-LR samples at EGL4, WGL2, and South Cell – Cooley West Lake, and collection of geosmin and MIB samples at the Burlington Canal Gravel Lake inflows to help document the onset and duration of taste, odor, and toxin events.

The Tier 1 CIP projects that were identified to provide additional raw water supply capacity to meet future demands include the Phase I Thornton Water Project (TWP) pipeline, a bypass pipeline from the TWP pipeline to the Gravel Lakes in the vicinity of McKay PS, a new pipeline from the TWP pipeline on Quebec Street to the NWTP, a new pipeline and pump station from Hammer Reservoir to the TWP pipeline on Quebec Street at the intersection with E-470, a feasibility study to evaluate options to add 10 mgd of capacity to McKay PS, and two pre-treatment chemical feed facilities. One of the chemical feed facilities will be located north of 140th Avenue on the TWP pipeline on Quebec Street, the other will be located at McKay PS.

The Tier 1 CIP projects also include an interconnect between the new Phase I of the TWP 42-inch pipeline and the existing 36-inch pipeline in Thornton Parkway that extends to the TWTP (TWP Interconnect). The interconnect will allow for TWP water to be delivered to TWTP and WBWTP. The interconnect will consist of a valve vault, a moderate length of pipe and flow control valves and meters.

The Tier 2 projects for raw water supply consist of the Phase II TWP pipeline, an increase in the booster pump capacity at the McKay PS, and a new pipeline and pump station from Rogers Reservoir to the TWP pipeline on Quebec Street at the intersection with 168th Avenue.

Tier 3 projects consist primarily of redundant raw water pipelines.

Raw Water CIP Phasing

Prioritization of raw water CIP projects was developed based on phasing considerations to meet population and demand growth, project timing and sequencing with related or dependent projects, performance criteria tier rating, and other considerations and comments from Thornton. The projects were also sequenced to maintain the system's total average annual expenditure as consistently as possible.

Projects were organized into three construction phases, based on required completion date; Phase I: 2020 - 2025 (5-year), Phase II: 2025 - 2035 (15-year), and Phase III: 2035 -2065 (service area buildout). All the raw water Tier 1 and 2 CIP projects are listed by phase in Table 2.1. In order to balance available CIP project budgets, the improvements to the existing raw water system recommended in the Raw Water Supply Master Plan to address Gravel Lakes water quality have been deferred until Phase II.

Table 2.1. Raw Water CIP Project Phasing

CIP ID	RAW WATER CIP PROJECT
	PHASE I (2020-2025)
RAW-E03	Study: Precipitant Addition to Burlington Canal
RAW-E04	Study: Feasibility of Floating Solar Panel Installation on Gravel Lakes
RAW-E05	Mobile Pump Stations Back-up Power
RAW-E06	New water quality profiling system and temperature data monitoring system on EGL4
RAW-F01	Thornton Water Project Phase I - 42-in raw water pipeline from 168th Ave to WBWTP
RAW-F03	TWP Interconnect
RAW-F08	TWP Bypass pipeline
RAW-F09	North Chemical Feed Facility
	PHASE II (2025-2035)
RAW-E01	McKay Interconnect
RAW-E02	Raw water pipeline from WGL2 to EGL4 with pump station
RAW-F04	36-in raw water pipeline from Quebec St & 140th to NWTP
RAW-F05	Hammer Reservoir Raw water pipeline and PS
RAW-F06	Feasibility study to add 10 MG capacity to McKay Pump Station.
RAW-F10	McKay PS Expansion
RAW-F11	McKay Chemical Feed Facility
	PHASE III (2035-2065)
RAW-F02	Thornton Water Project Phase II - 42-in raw water pipeline from WBWTP to TWTP
RAW-F07	Rogers Reservoir Raw water pipeline and Pump Station

Supply Operations

The Raw Water Master Plan developed performance criteria that were used to define the operating requirements of the raw water infrastructure. This section describes the proposed implementation of new raw water supply improvements to satisfy the Tier 1 performance criteria for the raw water infrastructure.

Table 2.2 and Figure 2.1 presents timing of future capacity requirements for the raw water supply system and water treatment facilities. Note that the maximum raw water supply capacities include deliveries from only the WGL2 PS, EGL4 PS, and Standley Lake through 2024. From 2025 onward, it includes delivery from the McKay PS and an additional 40 mgd from the completion of the TWP.

Table 2.2. Future Capacity Requirements for Raw and Water Treatment Systems

Raw Water CIP Phase	WTP Supply Requirement (mgd)			WTP Production Requirement (mgd)		
	WBWTP	TWTP	NWTP	WBWTP	TWTP	NWTP
Phase I: 2020 - 2025	60.3	21.2	0	54.8	20	0
Phase II: 2025 - 2035	60.3	21.2	11.4	54.8	20	10.8
Phase III: 2035 - 2065	60.3	21.2	22.8	54.8	20	21.5

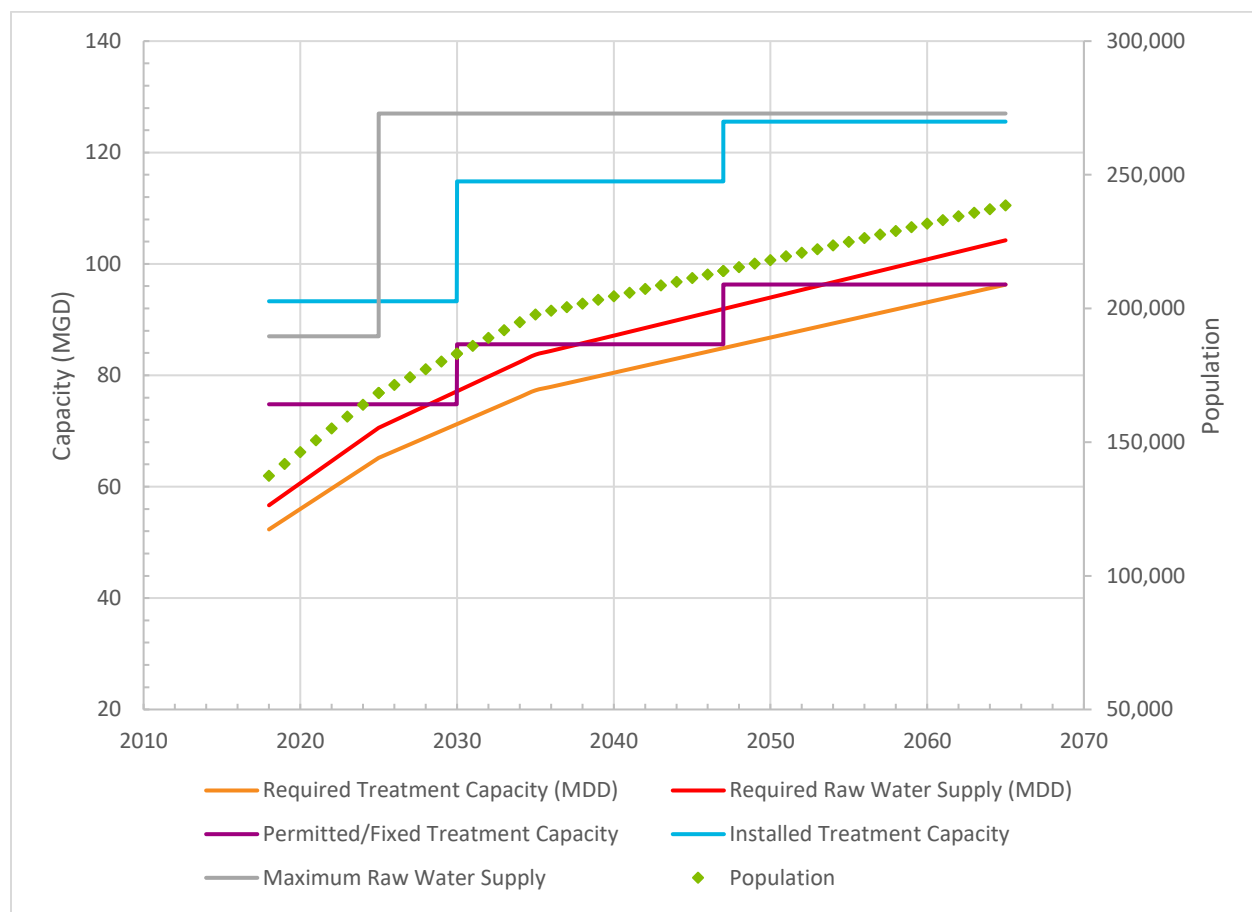


Figure 2.1. Future Capacity Requirements for Raw and Water Treatment Systems

Annual Supply Summary

Figure 2.2 presents one possible combination of how Thornton's different water supplies can be delivered to meet annual demands. Each unit block of available water rights in the figure could be reallocated to a different time of the year within Thornton's water rights operations to generate other combinations of possible delivery of water supplies. This estimated water supply availability provides a basic framework that could be used to deliver water supplies to each of the water treatment facilities under buildout conditions.

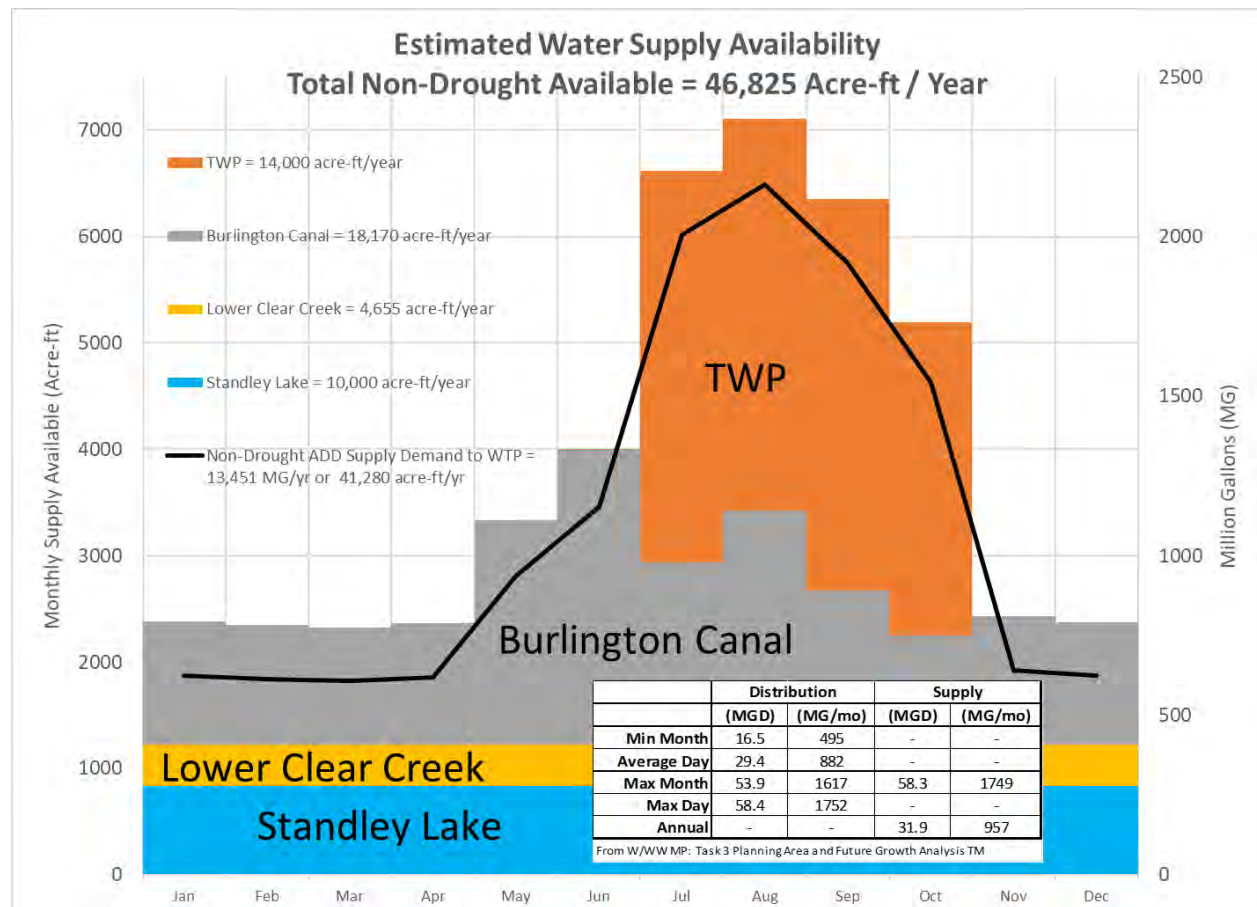


Figure 2.2. Estimated Water Supply Availability

Raw Water Supply Requirements at Buildout

This Utility Master Plan was developed on the basis of the forecasted buildout pumping capacities required for flow deliveries to each WTP presented in Table 2.3.

Table 2.3. Raw Water Delivery Capacity to Each Water Treatment Facility

Water Treatment Facility	Standley Lake Delivery Capacity (mgd)	Gravel Lakes Delivery Capacity (mgd)	TWP Delivery Capacity (mgd)
NWTP	0	10	22.8
TWTP	21.2	21.2	21.2
WBWTP	22	60.3	40.0

Table 2.3 Assumptions

- Annual Standley Lake supply is limited to 6,000 acre-feet under most stringent conditions.
- If not all the available water from Standley Lake is used by TWTP, the remaining raw water will be sent to WBWTP in order to use all volume of available supply from Standley Lake.
- Annual Lower Clear Creek flows are limited to existing use (4,800 acre-feet under most stringent conditions).
- Annual Thornton Water Project flows are limited to 14,000 acre-feet and maximum daily flow is limited to 40 mgd.
- Additional water supplies from Burlington Canal are assumed to be available as needed.

The capacities of existing and future raw water infrastructure facilities are described below for all of the CIP phases. Two possible operation scenarios for each CIP phase are presented as well. Both operation scenarios are for maximum day demand. The objective of Scenario 1 is to maximize the use of Standley Lake supply and minimize raw water pumping costs. The objective of Scenario 2 is to maximize raw water quality and maximize the use of TWP and Standley Lake supply. Operating constraints are provided for each phase. Objectives applied to both scenarios are listed below:

- Allocate Gravel Lakes to TWTP over WBWTP
- Prioritize McKay PS before EGL4 PS and WGL2 PS for series operation of Gravel Lakes (not possible during peak demands)
- TWP allocation first to NWTP, second to WBWTP

Operation Scenario: Current Conditions

Maximum and firm operating capacities for Current Conditions are summarized in Table 2.4. Firm capacity is operational capacity of the pump station with the largest pump out of service.

Table 2.4. Current Raw Water Supply Capacity Summary

Raw Water PS / Source	Firm Capacity ¹ (mgd)			Max Capacity ¹ (mgd)		
	Water Treatment Plant			Water Treatment Plant		
	WBWTP	TWTP	NWTP	WBWTP	TWTP	NWTP
Standley Lake (typ/drought)	-	10.7 / 5.4 ³	-	-	20 ⁴	-
EGL 4 (Gravel Lakes)	22	7.5 ²	-	22	15 ²	-
WGL2 (Gravel Lakes)	22	-	-	22	-	-

1. Capacities are limited by pipe size unless noted. Pipe capacity determined by pipe velocity guideline of 5 ft/s.

2. Capacity limited by pump size

3. Capacity limited by water rights

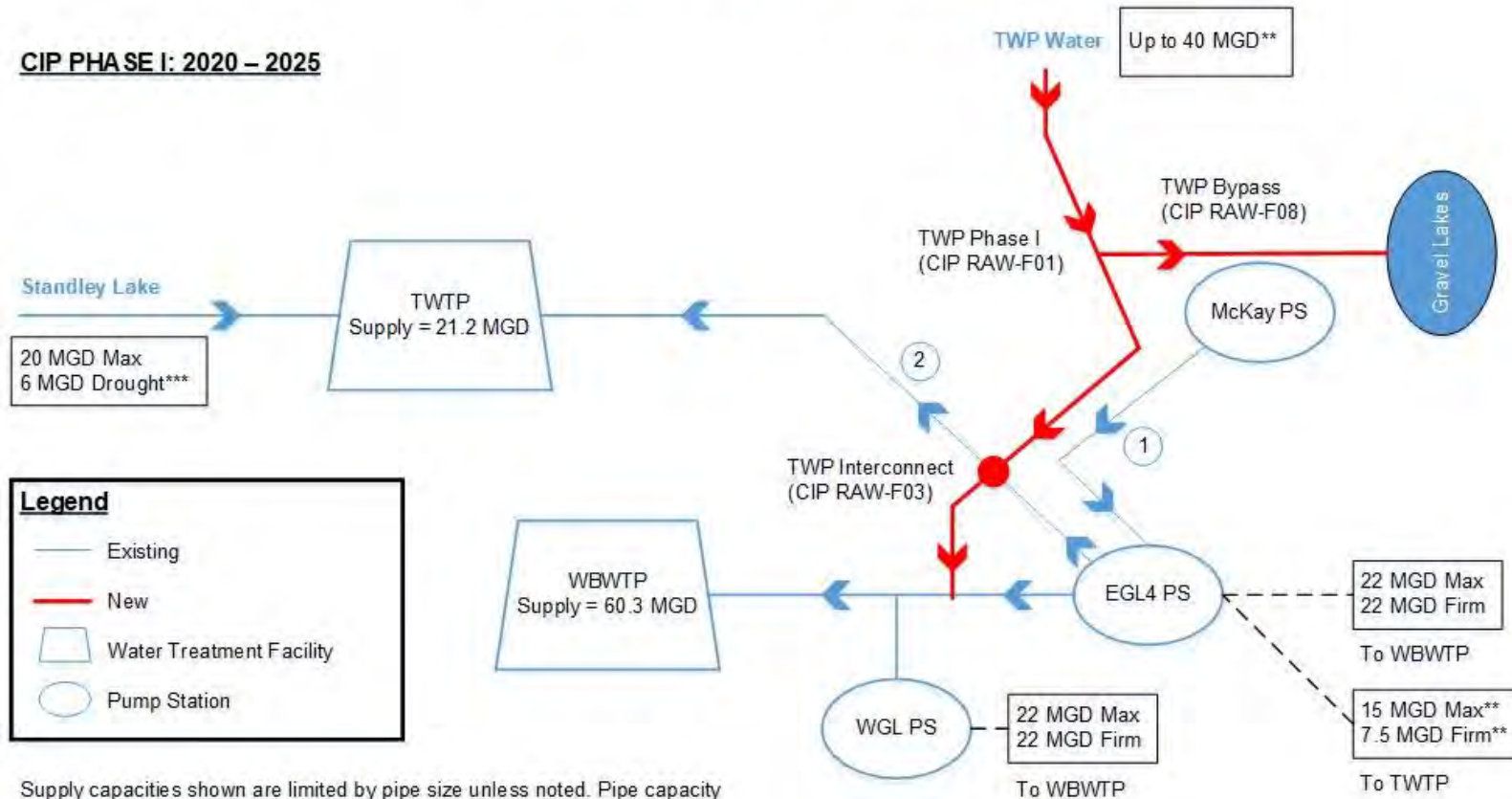
4. Maximum peak capacity over a short time frame

Operation Scenario: CIP Phase I (2020-2025) - TWP Pipeline extension to the WBWTP

Connection of the TWP Pipeline to the existing piping infrastructure via the TWP Interconnect will allow for raw water deliveries to TWTP and WBWTP. The flow capacity of the new TWP Pipeline will be driven by the pumping capabilities of the TWP pumps. The ability to deliver TWP raw water to WBWTP and TWTP will provide increased flexibility in raw water operations to address poor water quality events. Blending of raw water supplies to the water treatment plants will be possible but will increase the complexity of operations.

In addition to delivering all water supply sources to all WTPs, Phase I allows for the delivery of the full 40 mgd from the TWP to WBWTP. This provides operational flexibility in managing current water quality issues in the Gravel Lakes. During poor water quality periods TWP water may be delivered to WBWTP and Gravel Lakes water may be sent to TWTP where the conventional filtration process is better suited for treating poor raw water quality.

Figure 2.3 presents a schematic representation of the raw water infrastructure for Phase I.

Raw Water Supply CIP Phasing**CIP PHASE I: 2020 – 2025**

Supply capacities shown are limited by pipe size unless noted. Pipe capacity determined by 5 f/s velocity guideline.

* CIP RAW-F07, New Pump Station and Pipeline from Rogers Reservoir not shown

** Capacity limited by pump size

*** Capacity limited by water rights

1. Existing 36" diameter pipeline. McKay PS to EGL4 capacity = 22 MGD

2. Existing 36" diameter Thornton Parkway pipeline. EGL4 PS to

TWTP capacity = 22 MGD

TWTP treatment process loss = 6%

WBWTP treatment process loss = 10%

Figure 2.3. Raw Water Supply CIP Phasing – Phase I: 2020 - 2025

Maximum and firm operating capacities for Phase I are summarized in Table 2.5

Table 2.5. Phase I Raw Water Supply Capacity Summary

Raw Water PS / Source	Firm Capacity ¹ (mgd)			Max Capacity ¹ (mgd)		
	Water Treatment Plant			Water Treatment Plant		
	WBWTP	TWTP	NWTP	WBWTP	TWTP	NWTP
Standley Lake (typ/drought)	-	10.7 / 5.4 ³	-	-	20 ⁴	-
EGL 4 (Gravel Lakes)	22	7.5 ²	-	22	15 ²	-
WGL2 (Gravel Lakes)	22	-	-	22	-	-
TWP	30	22	-	30	22	-

1. Capacities are limited by pipe size unless noted. Pipe capacity determined by pipe velocity guideline of 5 ft/s.

2. Capacity limited by pump size

3. Capacity limited by water rights

4. Maximum peak capacity over a short time frame

Maximum demand day operating scenarios for Phase I are presented in Table 2.6.

Table 2.6. Phase I Raw Water Operation Scenarios

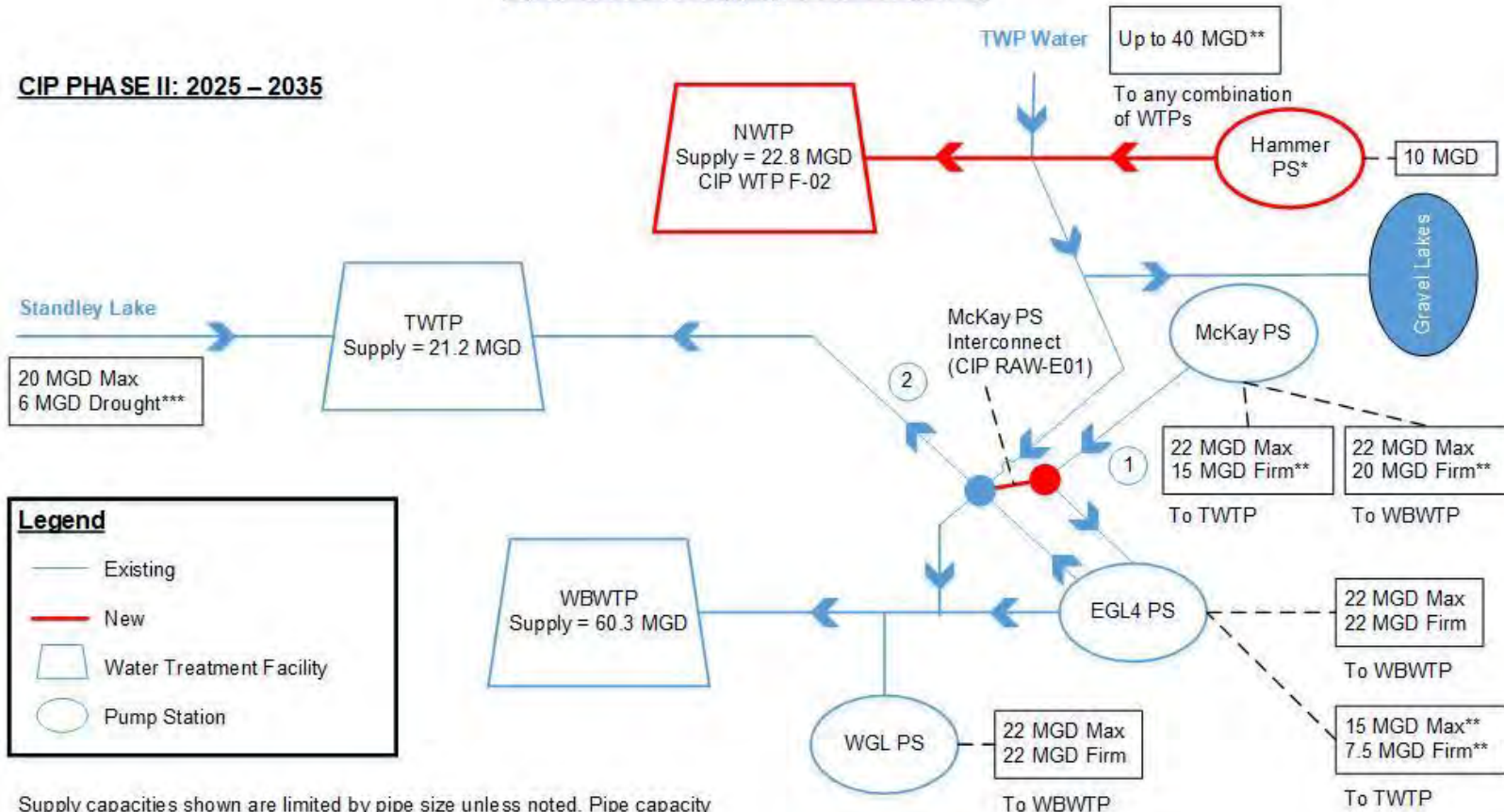
Raw Water Supply / Source	Scenario 1: Maximum Day Demand / Minimize Pumping Costs			Scenario 2: Maximum Day Demand / Maximize Water Quality (TWP and Standley Lake)		
	WTP Supply Requirement (mgd)			WTP Supply Requirement (mgd)		
	WBWTP	TWTP	NWTP	WBWTP	TWTP	NWTP
	60.3	21.2	0	60.3	21.2	0
Standley Lake		20.0			20.0	
EGL 4 (Gravel Lakes)	22.0				1.2	
WGL2 (Gravel Lakes)	22.0			20.3		
TWP	16.3	1.2		40.0		
Total	60.3	21.2	0.0	60.3	21.2	0.0

Operating constraints in Phase I include:

- TWP or Gravel Lakes water deliveries to TWTP utilize a 2-way pipeline that can only deliver these supplies to TWTP when the pipeline is not delivering Standley Lake supplies to the Gravel Lakes.
- The maximum rate at which TWP or Gravel Lakes water supplies can be delivered to TWTP is 22 mgd. This constraint is due to the pipeline capacity limits of the Thornton Parkway pipeline.
- The Gravel Lakes cannot operate in series when EGL4 PS or WGL2 PS is used to deliver water supplies to treatment facilities. The current raw water supply system allows for McKay to deliver to EGL4 PS, however the full benefits of operating the Gravel Lakes in series will not be realized. Short circuiting may occur and some water will have a shorter detention time, however water quality will improve upon existing conditions.

Operation Scenario: Phase II (2025-2035) - Gravel Lakes in Series and NWTP Online

Phase II includes the construction of the NWTP, the supply pipeline from the TWP to NWTP, and the new Hammer Reservoir supply pump stations and pipeline to the NWTP. Additionally the McKay Interconnect will be constructed, allowing for the Gravel Lakes to be operated in series. Figure 2.4 presents a schematic representation of the raw water infrastructure for Phase II.

Raw Water Supply CIP Phasing**CIP PHASE II: 2025 – 2035**

Supply capacities shown are limited by pipe size unless noted. Pipe capacity determined by 5 f/s velocity guideline.

* CIP RAW-F07, New Pump Station and Pipeline from Rogers Reservoir not shown

** Capacity limited by pump size

*** Capacity limited by water rights

1. Existing 36" diameter pipeline. McKay PS to EGL4 capacity = 22 MGD

2. Existing 36" diameter Thornton Parkway pipeline. EGL4 PS to TWTP capacity = 22 MGD

TWTP treatment process loss = 6%

WBWTP treatment process loss = 10%

Figure 2.4. Raw Water Supply CIP Phasing – Phase II: 2025 - 2035

Maximum and firm operating capacities for Phase II are summarized in Table 2.7

Table 2.7. Phase II Raw Water Supply Capacity Summary

Raw Water PS / Source	Firm Capacity ¹ (mgd)			Max Capacity ¹ (mgd)		
	Water Treatment Plant			Water Treatment Plant		
	WBWTP	TWTP	NWTP	WBWTP	TWTP	NWTP
Standley Lake (typ/drought)	-	10.7 / 5.4 ³	-	-	20 ⁴	-
EGL 4 (Gravel Lakes)	22	7.5 ²	-	22	15 ²	-
WGL2 (Gravel Lakes)	22	-	-	22	-	-
TWP	30	22	30	30	22	30
McKay (Gravel Lakes)	20 ²	15 ²	-	22	22	-

1. Capacities are limited by pipe size unless noted. Pipe capacity determined by pipe velocity guideline of 5 ft/s.

2. Capacity limited by pump size

3. Capacity limited by water rights

4. Maximum peak capacity over a short time frame

Maximum demand day operating scenarios for Phase II are presented in Table 2.8.

Table 2.8. Phase II Raw Water Operation Scenarios

Raw Water Supply / Source	Scenario 1: Maximum Day Demand / Minimize Pumping Costs			Scenario 2: Maximum Day Demand / Maximize Water Quality (TWP and Standley Lake)		
	WTP Supply Requirement (mgd)			WTP Supply Requirement (mgd)		
	WBWTP	TWTP	NWTP	WBWTP	TWTP	NWTP
	60.3	21.2	11.4	60.3	21.2	11.4
Standley Lake		20.0			20.0	
EGL 4 (Gravel Lakes)	22.0			9.7		
WGL2 (Gravel Lakes)	17.5					
TWP			11.4	28.6		11.4
McKay (Gravel Lakes)	20.8	1.2		22.0	1.2	
Total	60.3	21.2	11.4	60.3	21.2	11.4

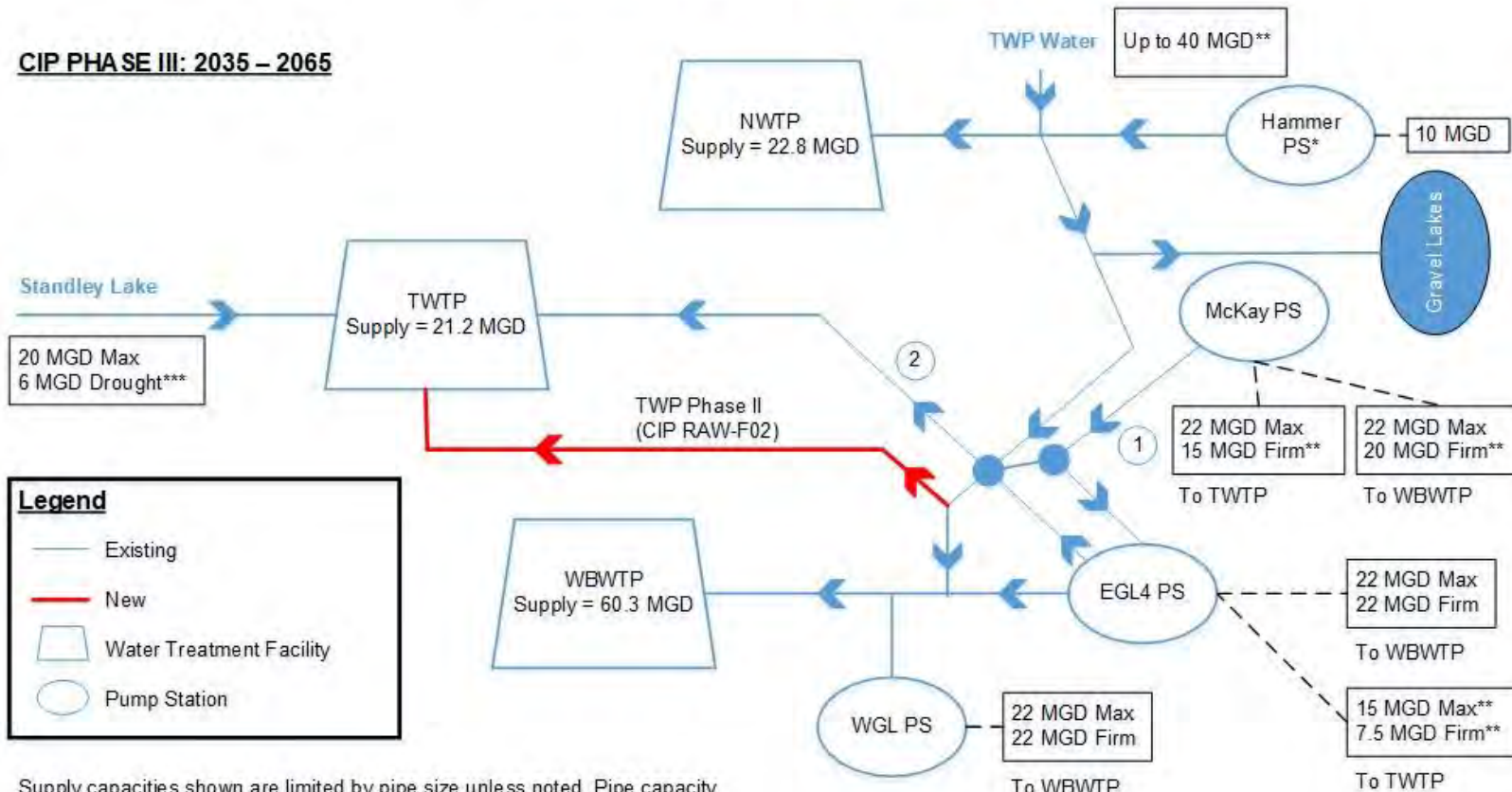
The same operating constraints from Phase II apply to Phase II with the following exceptions:

- TWP water can be delivered to TWTP and/or WBWTP concurrent with the Gravel Lakes operating in series, or when the McKay PS pumps Gravel Lakes water to TWTP.
- The Gravel Lakes cannot operate in series when EGL 4 PS or WGL2 PS is used to deliver water to WBWTP.

Operation Scenario - Phase III (2035-2065): TWP Pipeline Extension to the TWTP

The new TWP pipeline extension to TWTP will allow water from TWP to be delivered to all three WTPs concurrently, and to allow the Gravel Lakes to be operated in series at the same time. Phase III provides for added operational flexibility. The Thornton Parkway pipeline will no longer be required to deliver TWP water to TWTP. The Phase III improvements will remove all operating constraints from Phase I and II and will allow a full range of options for blending raw water from all raw water supplies at all the WTPs.

Figure 2.5 presents a schematic representation of the raw water infrastructure for Phase III.

Raw Water Supply CIP Phasing**CIP PHASE III: 2035 – 2065**

Supply capacities shown are limited by pipe size unless noted. Pipe capacity determined by 5 f/s velocity guideline.

* CIP RAW-F07, New Pump Station and Pipeline from Rogers Reservoir not shown

** Capacity limited by pump size

*** Capacity limited by water rights

1. Existing 36" diameter pipeline. McKay PS to EGL4 capacity = 22 MGD

2. Existing 36" diameter Thornton Parkway pipeline. EGL4 PS to TWTP capacity = 22 MGD

TWTP treatment process loss = 6%

WBWTP treatment process loss = 10%

Figure 2.5. Raw Water Supply CIP Phasing – Phase III: 2035 - 2065

Maximum and firm operating capacities for Phase III are summarized in Table 2.9

Table 2.9. Phase III Raw Water Supply Capacity Summary

Raw Water PS / Source	Firm Capacity ¹ (mgd)			Max Capacity ¹ (mgd)		
	Water Treatment Plant			Water Treatment Plant		
	WBWTP	TWTP	NWTP	WBWTP	TWTP	NWTP
Standley Lake (typ/drought)	-	10.7 / 5.4 ³	-	-	20 ⁴	-
EGL 4 (Gravel Lakes)	22	7.5 ²	-	22	15 ²	-
WGL2 (Gravel Lakes)	22	-	-	22	-	-
TWP	30	30	30	30	30	30
McKay (Gravel Lakes)	20 ²	15 ²	-	22	22	-

1. Capacities are limited by pipe size unless noted. Pipe capacity determined by pipe velocity guideline of 5 ft/s.

2. Capacity limited by pump size

3. Capacity limited by water rights

4. Maximum peak capacity over a short time frame

Maximum demand day operating scenarios for Phase III are presented in Table 2.10.

Table 2.10. Phase III Raw Water Operation Scenarios

Raw Water Supply / Source	Scenario 1: Maximum Day Demand / Minimize Pumping Costs			Scenario 2: Maximum Day Demand / Maximize Water Quality (TWP and Standley Lake)		
	WTP Supply Requirement (mgd)			WTP Supply Requirement (mgd)		
	WBWTP	TWTP	NWTP	WBWTP	TWTP	NWTP
	60.3	21.2	22.8	60.3	21.2	22.8
Standley Lake		20.0			20.0	
EGL 4 (Gravel Lakes)	22.0			21.1		
WGL2 (Gravel Lakes)	17.5					
TWP			22.8	17.2		22.8
McKay (Gravel Lakes)	20.8	1.2		22.0	1.2	
Total	60.3	21.2	22.8	60.3	21.2	22.8

The Raw Water Supply CIP Plan is summarized in Table 2.13. Associated capital expenditures are summarized in Table 2.19. Associated CIP project cutsheets are included in Appendix A.

The Raw Water Supply Master Plan located in Volume II of the Utility Master Plan.

Section 2-3 Water Treatment Facilities CIP Plan Summary

The Water Treatment Facilities CIP Plan consists of improvement projects at the two existing and one new water treatment facilities. Improvements at the existing WBWTP include projects intended to address limitations in the treatment processes with regards to criteria for water quality and production capacity as well as improved redundancy and reduced maintenance activities. The projects include studies to investigate options to eliminate the recycling of the clean-in-place wastes and decant water from treatment residuals to the Gravel Lakes system.

The elimination of the recycling will improve raw water quality delivered to WBWTP. Other WBWTP improvements, some already in-progress, include:

- converting to aluminum-based coagulants
- increasing membrane surface area
- completing an evaluation to improve solids handling
- executing maintenance projects for clarifier rehabilitation and coagulant storage tank repairs

CIP projects intended to address future demands are focused on providing an additional 21.5 mgd of treatment capacity by constructing a new NWTP. The projects include the acquisition of 15 acres of land for the new treatment facility site, construction of the new NWTP, including a mechanical dewatering facility, and developing the necessary power supply and standby power supply. Construction of the NWTP will be divided between two phases. Each phase is identified as a separate CIP project and each phase will provide an additional treatment capacity of 10.75 mgd.

A conceptual site plan for the NWTP at 21.5 mgd buildout capacity has been developed in the CIP as follows that reflects comments from Thornton on the original plan presented in the Water Treatment Facilities Master Plan:

- A new water storage tank associated with the Water Distribution CIP was relocated from 1,000 feet east of the NWTP to a high point on the facility site so the tank will be mostly buried while able to float on the Zone 1 hydraulic grade.
- The NWTP building location was revised to accommodate the new storage tank location and the addition of a mechanical dewatering building.
- The facility site was limited to 15 acres.
- The NWTP finished water clearwell will not be at the same elevation as the TWTP finished water clearwell, which feeds by gravity to Zone 1. Based on site elevations, pumping from the NWTP to new Zone 1 storage tank will be required.

Site plan, site sections, and an isometric rendering of the site are included in Appendix B of this Volume I report with the project cutsheets. Key elevation points for the new Zone 1 storage tank and the NWTP clearwell are summarized below in Table 2.11.

Table 2.11. Key Water Treatment Elevation Points for NWTP

Key Elevation Points	Elevation (feet)
New Storage Tank – High Water Level	5,375
New Storage Tank – Low Water Level	5,344
Estimated NWTP Clearwell Water Level	5,330

The Water Treatment Facilities CIP Plan is summarized in Table 2.14. Associated capital expenditures are summarized in Table 2.20. Associated CIP project cutsheets are included in Appendix B.

The Water Treatment Facilities Master Plan located in Volume III of the Utility Master Plan.

Section 2-4 Water Distribution CIP Plan Summary

Distribution, transmission, storage, and pumping projects were evaluated for the Water Distribution System CIP Plan in order to meet future water demands. Distribution system improvements resulting from future growth in new developed areas are expected to be funded by developers; thus, those projects are not included in the CIP Plan. The proposed CIP projects are summarized as follows:

- Approximately 33,000 linear feet (LF) of distribution improvements are proposed to meet Tier 1 and Tier 2 criteria in the system.
- Approximately 79,000 LF will be improvements to the transmission system with diameters larger or equal to 36 inches.
- Three storage tanks are included, two in Zone 1 near Sintra Lewis Pointe Park and adjacent to TWTP Clearwell 1, and one in Zone 3 near the existing Cherokee Tank. The total storage volume of the three tanks is 14.5 million gallons (MG). These improvements will require additional 12,200 LF of piping.
- Pumping improvements include an upgrade in capacity to Zone 5, Zone 3A, and WBWTP High Service Pump Stations, and a new pump station at the NWTP clearwell to connect the new NWTP to Zone 1.

The Water Distribution System CIP Plan is summarized in Table 2.15. Associated capital expenditures are summarized in Table 2.21. Associated CIP project cutsheets are included in Appendix C.

The Water and Wastewater Infrastructure Master Plan located in Volume IV of the Utility Master Plan.

Section 2-5 Wastewater Collection CIP Plan Summary

A total of seven Tier 1 CIP projects for the existing wastewater collection system were identified to meet the buildout peak dry weather flows. The projects will primarily occur in the northern portion of the collection system, where most of the growth is planned. The largest projects required to meet Tier 1 criteria include completion of a parallel to the Big Dry Creek Interceptor, which is necessary as growth occurs in the northwest portion of the collection system, and a main parallel to the Heritage Todd Creek Interceptor to accommodate planned growth in the northeast portion of the collection system. The remaining CIP projects for the existing system represent smaller but necessary improvement projects along the Big Dry Creek Interceptor and Heritage Todd Creek Interceptor.

As development occurs, portions of the collection system will need to be extended to serve new developments. A total of eight future CIP projects were identified to meet future peak dry weather flows in those areas. The future infrastructure is primarily located in the northern portion of the service area where the majority of future growth is planned, except for construction of an 88th Avenue Interceptor that is necessary for planned infill development.

Three CIP projects were also identified to meet peak wet weather requirements (Tier 2). All three projects are capacity improvement projects along the Big Dry Creek Interceptor upstream of the Big Dry Creek lift station.

CIP projects that are the responsibility of the developer are not included in the CIP Plan.

The Wastewater Collection System CIP Plan is summarized in Table 2.16. Associated capital expenditures are summarized in Table 2.22. Associated CIP project cutsheets are included in Appendix D.

The Water and Wastewater Infrastructure Master Plan is located in Volume IV of the Utility Master Plan.

Section 2-6 Water/Wastewater Rehabilitation and Replacement Program

The current water distribution and wastewater collection system pipeline Rehabilitation and Replacement Program was evaluated to determine if current funding is adequate to maintain the respective systems. The evaluation involved assessing the risk exposure associated with pipeline assets within each system, estimating rehabilitation and replacements schedules for pipeline assets, development of associated long-term funding, and prioritization of pipeline improvements.

The key findings of the risk exposure evaluation and prioritization analysis, are as follows after applying a unit pipe cost of \$19 per foot length, per inch pipe diameter to develop annual projected expenditures:

- The majority of the water system (86%), and the majority of the wastewater system (97%) fall within the Monitor and Forecast category; this action level implies that the assets are at a relatively low risk and monitoring can be completed on a more opportunistic basis.
- Three pipes in the water system and none of those in the wastewater system fall in the Urgent Rehab/Replace category; this action level implies immediate attention to avoid catastrophic system failures and potentially expensive emergency repairs.
- The current annual funding level for water main replacement of \$1 million (M) is significantly below the estimated recommended funding level of approximately \$7M/year.
- The estimated annual level of funding for water main replacement will address approximately 1% of the system in a 100-year average, while addressing approximately 2% of the system in the short-term.
- The current annual funding level for wastewater main replacement of \$1M is significantly below the estimated recommended funding level of approximately \$4.7M/year.
- The estimated annual level of funding for wastewater main replacement will address approximately 1.1% of the system in a 100-year average, while addressing approximately 2.2% of the system in the short-term.

Annual and longer-term expenditures of the Rehabilitation and Replacement Program are presented in Section 2-8.

More information on this evaluation of the Rehabilitation and Replacement Program can be found in the Water and Wastewater Infrastructure Master Plan located in Volume IV of the Utility Master Plan.

Section 2-7 CIP Plan Development

To develop the CIP Plan, the CIP projects summarized in Sections 2-2 through 2-5 were catalogued by system and listed in order by phase and priority. Each CIP project is identified with a CIP ID. A legend of the CIP ID nomenclature is presented in Table 2.12. CIP ID's for Water Distribution and Wastewater Collection are organized without suffix in the Water and Wastewater Infrastructure Master Plan and on CIP project cutsheets.

Table 2.12. CIP ID Legend

*CIP ID LEGEND
PREFIX DEFINITION
RAW = Raw Water Supply System Project
WTP = Water Treatment Facilities Project
DD = Water Distribution System Project / Distribution Pipeline
TT= Water Distribution System Project / Transmission Pipeline
P = Water Distribution System Project / Pump
SS = Water Distribution System Project / Storage
WW = Wastewater Collection System Project
SUFFIX DEFINITION
E = Existing System Deficiency
F = Future System Improvement

*CIP ID's for Water Distribution and Wastewater Collection are organized without suffix in the Water and Wastewater Infrastructure Master Plan and on CIP project cutsheets

Project priority was developed with phasing consideration to meet population and demand growth, project timing and sequencing with related or dependent projects, performance criteria tier rating, and other considerations and comments from Thornton. The projects were also sequenced to maintain the system's total average annual expenditure as close as possible. Projects were organized into three construction phases, based on required completion date; Phase I: 2020 - 2025 (5-year), Phase II: 2025 - 2035 (15-year), and Phase III: 2035 -2065 (service area buildout).

Section 2-8 CIP Plan

Documentation of the CIP Plan consists of four parts:

1. An index of all CIP projects organized by system type, phase and priority;
2. Informational cutsheets for each CIP project;
3. CIP Location Maps
4. Annual estimated expenditures to provide guidance of future planning and budgeting efforts.

Tier 3 level projects were not included in the cutsheets, the CIP location map, nor the annual expenditures. An index of CIP projects and CIP project cutsheets were not developed for the Rehabilitation and Replacement improvements since they are annual recurring expenditures.

A CIP Location Map, in reference to Tables 2.13 through 2.16, is provided in Figure E.1 in Appendix E. This map locates all the CIP projects on one map for planning reference. CIP projects associated with improvements to WBTWP (CIP ID: WTP-E01 through E12) and construction of the NWTP (CIP ID: WTP-F01 through F07) are not included on the map. Additionally CIP projects associated with feasibility studies and other improvements that do not have a specific location (CIP ID: RAW-E03 through E05, and RAW-F06), such as mobile back-up power to be used at multiple pump stations, are not included on the map.

A CIP Location Map of Improvements by Funding Source, in reference to Table E.1 and E.2, is provided in Figure E.2 in Appendix E. This map is limited to major developer funded improvements to the water transmission and wastewater collection systems. Additional developer funded improvements to the water distribution system and wastewater collection system within developments are not shown. Project cutsheets were not developed for developer funded projects. The length and size of the water transmission and wastewater collection projects are provided in Table E.1 and E.2 in Appendix E of Volume I. Some projects listed Tables E.1 and E.2 were eliminated as noted in the Figure E.2 legend. These projects were incorporated into other adjacent CIP projects after the completion of the Water and Wastewater Infrastructure Master Plan. Projects south of 88th Ave are not included in the figure for clarity as there are no improvements by developer.

Index tables for the Raw Water Supply, Water Treatment Facilities, Water Distribution and Wastewater Collection CIP Plans are presented in Tables 2.13 through 2.16, respectively.

Table 2.13. Raw Water Master CIP Table

CIP ID**	Phase (Project Completion Date)	Purpose	Project Type	Project Description	TWP Prj	Cost	Trigger	Project Timeline (Start / Completion)	
RAW-E03	2020-2025	Tier 1 - Raw Water Quality	Raw Water Quality	Study: Precipitant Addition to Burlington Canal		\$ 70,000	Existing Improvement	2020	2021
RAW-E04	2020-2025	Tier 1 - Raw Water Quality	Raw Water Quality	Study: Feasibility of Floating Solar Panel Installation on Gravel Lakes		\$ 70,000	Existing Improvement	2020	2021
RAW-E05	2020-2025	Tier 1 - Redundancy	Raw Water Quality	Mobile Pump Stations Back-up Power		\$ 11,940,000	Existing Improvement	2021	2022
RAW-E06	2020-2025	Tier 1 - Raw Water Quality	Raw Water Quality	New water quality profiling system and temperature data monitoring system on EGL4		\$ 480,000	Existing Improvement	2020	2021
RAW-F01	2020-2025	Tier 1 - Capacity	Raw Water Supply	Thornton Water Project Phase I - 42-in raw water pipeline from 168th Ave to WBWTP (shown on 2 figures)	x	\$ 56,355,000	Growth - MDD = 74.8 MGD	2022	2025
RAW-F03	2020-2025	Tier 1 - Capacity	Raw Water Supply	Interconnect to deliver TWP water to TWTP & WBWTP, includes the pipe, valves, meters, vaults and connection to SCADA, connect new 42-in TWP pipeline to 36-in Thornton Pkwy pipeline	x	\$ 8,600,000	Growth - MDD = 74.8 MGD	2023	2026
RAW-F08	2020-2025	Tier 1 - Capacity	Raw Water Supply	TWP Bypass pipeline to Gravel Lakes, located near McKay PS, includes tee and approx 20 LF pipe	x	\$ 1,500,000	Growth - MDD = 74.8 MGD	2023	2026
RAW-F09	2020-2025	Tier 1 - Capacity	Raw Water Supply	Chemical Feed Facility located north of 140th Avenue on the TWP pipeline on Quebec Street, sized for buildout capacity	x	\$ 595,000	Growth - MDD = 74.8 MGD	2024	2025
RAW-E01	2025-2035	Tier 1 - Raw Water Quality	Raw Water Quality	Interconnect to allow Gravel Lakes operation in series and for McKay PS deliver directly to WBWTP & TWTP, includes moderate length of pipe and valving to connect 36-inch McKay pipeline to 54-inch WBWTP supply and 36-inch Thornton Pkwy pipeline		\$ 3,530,000	Existing Improvement	2026	2027
RAW-E02	2025-2035	Tier 1 - Raw Water Quality	Raw Water Quality	Raw water pipeline from WGL2 to EGL4 with pump station		\$ 6,840,000	Existing Improvement	2026	2027
RAW-F04	2025-2035	Tier 1 - Capacity	Raw Water Supply	36-in raw water pipeline from Quebec St & 140th to NWTP		\$ 10,160,000	Growth - MDD = 74.8 MGD	2026	2027
RAW-F05	2025-2035	Tier 1 - Capacity	Raw Water Supply	24-in Raw water pipeline from Hammer Reservoir to Quebec St & E-470 Ave and New Pump Station		\$ 11,530,000	Growth - MDD = 74.8 MGD	2025	2026
RAW-F06	2025-2035	Tier 2 - Water Quality	Raw Water Supply	Feasibility study to add 10 MG capacity to McKay Pump Station.		\$ 210,000	Growth - MDD = 74.8 MGD	2026	2027
RAW-F10	2025-2035	Tier 2 - Water Quality	Raw Water Supply	Addition of 10 MGD capacity at McKay PS, includes new pump with VFD, electrical upgrade, bldg expansion and chemical feed equipment increase feed capacity		\$ 10,000,000	Growth - MDD = 74.8 MGD	2028	2029
RAW-F11	2025-2035	Tier 1 - Water Quality	Raw Water Supply	Chemical Feed Facility located at McKay PS, building sized for 20 mgd, equipment sized for 10 mgd		\$ 595,000	Growth - MDD = 74.8 MGD	2026	2027
RAW-F02	2035-2065	Tier 2 - Capacity	Raw Water Supply	Thornton Water Project Phase II - 42-in raw water pipeline from WBWTP to TWTP along Hoffman Way	x	\$ 8,645,000	Tier 2 Improvement	2035	2036
RAW-F07	2035-2065	Tier 2 - Redundancy	Raw Water Supply	24-in Raw water pipeline from Rogers Reservoir to Quebec St & 168 th Ave and New Pump Station		\$ 17,660,000	Tier 2 Improvement	2040	2041
RAW-F12	2035-2065	Tier 3 - Redundancy	Raw Water Supply	Redundant Thornton Water Project Phase I - raw water pipeline 168th Ave to WBWTP		\$ 56,355,000	Tier 3 Improvement	N/A	N/A
RAW-F13	2035-2065	Tier 3 - Redundancy	Raw Water Supply	Redundant Thornton Water Project Phase II - WBWTP to TWTP		\$ 8,645,000	Tier 3 Improvement	N/A	N/A
RAW-F14	2035-2065	Tier 3 - Redundancy	Raw Water Supply	Redundant raw water pipeline from Quebec Blvd & 140th to NWTP		\$ 10,160,000	Tier 3 Improvement	N/A	N/A
RAW-F15	2035-2065	Tier 3 - Redundancy	Raw Water Supply	Redundant raw water pipeline from Standley Lake to TWTP - 48 inch portion		\$ 43,830,000	Tier 3 Improvement	N/A	N/A
RAW-F16	2035-2065	Tier 3 - Redundancy	Raw Water Supply	Redundant raw water pipeline from Standley Lake to TWTP - 36 inch portion		\$ 19,580,000	Tier 3 Improvement	N/A	N/A
RAW-F17	2035-2065	Tier 3 - Redundancy	Raw Water Supply	Redundant raw water pipeline from EGL4 to TWTP (include river crossing)		\$ 21,600,000	Tier 3 Improvement	N/A	N/A
RAW-F18	2035-2065	Tier 3 - Redundancy	Raw Water Supply	Redundant raw water pipeline from EGL4 to WBWTP (include river crossing)		\$ 8,000,000	Tier 3 Improvement	N/A	N/A
RAW-F19	2035-2065	Tier 3 - Redundancy	Raw Water Supply	Redundant raw water pipeline from McKay to WBWTP (parallel existing 36 inch to EGL#4, no river crossing)		\$ 15,160,000	Tier 3 Improvement	N/A	N/A
RAW-F20	2035-2065	Tier 3 - Energy Cost Savings	Sustainability	Study: Micro-Hydro Power on Standley Lake Supply Pipeline		\$ 40,000	Tier 3 Improvement	N/A	N/A
RAW-F21	2035-2065	Tier 3 - Reduce Raw Water Losses	Sustainability	Study: Water Evaporation Reduction Technologies on RWGLS		\$ 70,000	Tier 3 Improvement	N/A	N/A

**Project Cutsheets not provided for Tier 3 improvements

*CIP ID LEGEND:

PREFIX DEFINITION

RAW = Raw Water Supply System Project

WTP = Water Treatment Facilities Project

DD = Water Distribution System Project / Distribution Pipeline

TT= Water Distribution System Project / Transmission Pipeline

P = Water Distribution System Project / Pump

SS = Water Distribution System Project / Storage

WW = Wastewater Collection System Project

SUFFIX DEFINITION

E = Existing System Deficiency

F = Future System Improvement

*CIP ID's for Water Distribution and Wastewater Collection are organized without suffix in the Water and Wastewater Infrastructure Master Plan and on CIP project cutsheets

Table 2.14. Water Treatment Master CIP Table

CIP ID**	Phase (Project Completion Date)	Purpose	Project Type	Project Description	Cost	Dependant CIP	Trigger	Project Timeline (Start / Completion)	
WTP-E01	2020-2025	Tier 1 - Water Quality	Water Treatment	Existing WBWTP Improvement: Convert to alumimun-based coagulants from iron-based coagulants	\$ -		Existing Improvement	2020	2021
WTP-E02	2020-2025	Tier 1 - Water Quality	Water Treatment	Existing WBWTP Improvement: Improvements for PAC dry storage and installation of PAC wetting system	\$ 710,000	WTP-E01	Existing Improvement	2020	2021
WTP-E03	2020-2025	Tier 1 - Capacity	Water Treatment	Existing WBWTP Improvement: Increase membrane surface area by using older membranes to equip unused cassettes	\$ -		Existing Improvement	2020	2021
WTP-E04	2020-2025	Tier 1 - Operations	Water Treatment	Existing WBWTP Improvement: Residuals management improvement, addition of 70,000 sq ft of lagoons	\$ 1,100,000		Existing Improvement	2020	2021
WTP-E05	2020-2025	Tier 1 - Operations	Water Treatment	Existing WBWTP Improvement: Study to evaluate clarifier flow distribution	\$ 30,000		Existing Improvement	2020	2021
WTP-E06	2020-2025	Tier 1 - Water Quality	Water Treatment	Existing WBWTP Improvement: Study to Eliminate Recycling for Clean-in-Place Wastes	\$ 30,000		Existing Improvement	2020	2021
WTP-E07	2020-2025	Tier 1 - Water Quality	Water Treatment	Existing WBWTP Improvement: Study to determine best practices for lagoon discharge water management	\$ 50,000	WTP-E06,E08	Existing Improvement	2020	2021
WTP-E08	2020-2025	Tier 1 - Water Quality	Water Treatment	Existing WBWTP Improvement: Study to determine best practices to manage water treatment residuals	\$ 110,000		Existing Improvement	2020	2021
WTP-E09	2020-2025	Tier 1 - Maintenance	Water Treatment	Existing WBWTP Improvement: Clarifier Coating Rehabilitation	\$ 500,000		Existing Improvement	2020	2021
WTP-E10	2020-2025	Tier 1 - Redundancy	Water Treatment	Existing WBWTP Improvement: Additional air compressor and reject pump for membrane system	\$ 500,000		Existing Improvement	2020	2021
WTP-E11	2020-2025	Tier 1 - Capacity	Water Treatment	Existing WBWTP Improvement: Expansion of Membrane Train 8	\$ 1,840,000		Existing Improvement	2020	2021
WTP-E12	2020-2025	Tier 1 - Maintenance	Water Treatment	Existing WBWTP Improvement: Coagulant Tank Repairs	\$ 30,000		Existing Improvement	2020	2021
WTP-F01	2020-2025	Tier 1 - Capacity	Water Treatment	Land Acquisition for NWTP	\$ 3,000,000		Growth - MDD = 74.8 MGD	2025	2026
WTP-F02	2025-2035	Tier 1 - Capacity	Water Treatment	New NWTP Phase I - 10.75 MGD capacity, treatment plant only, does not include dewatering, finished water storage tank, off site power supply to transformer	\$ 43,842,000		Growth - MDD = 74.8 MGD	2027	2030
WTP-F03	2025-2035	Tier 1 - Capacity	Water Treatment	Mechanical Dewatering Infrastructure	\$ 15,620,000		Growth - MDD = 74.8 MGD	2029	2030
WTP-F04	2025-2035	Tier 1 - Capacity	Water Treatment	Power Supply to NWTP, baseline power supply cost, including offsite infrastructure and power supply to transformer	\$ 1,990,000		Growth - MDD = 74.8 MGD	2028	2029
WTP-F05	2025-2035	Tier 1 - Redundancy	Water Treatment	Standby Power (Tier 1 – Provide Standby Generator for Full Production)	\$ 2,210,000		Growth - MDD = 74.8 MGD	2028	2029
WTP-F06	2025-2035	Tier 2 - Redundancy	Water Treatment	Standby Power (Tier 2 – Upgrade to Second Utility feed)	\$ 1,330,000		Growth - MDD = 74.8 MGD	2028	2029
WTP-F07	2035-2065	Tier 1 - Capacity	Water Treatment	NWTP Phase II - additional 10.75 MGD capacity	\$ 43,842,000		Growth - MDD = 85.6 MGD	2046	2047
WTP-F08	2035-2065	Tier 3	Water Treatment	Standby Power (Tier 3 – Upgrade to Emergency Generator meeting NEC)	\$ 220,000		Growth - MDD = 74.8 MGD	N/A	N/A

**Project Cutsheets not provided for Tier 3 improvements

*CIP ID LEGEND:

PREFIX DEFINITION

RAW = Raw Water Supply System Project

WTP = Water Treatment Facilities Project

DD = Water Distribution System Project / Distribution Pipeline

TT= Water Distribution System Project / Transmission Pipeline

P = Water Distribution System Project / Pump

SS = Water Distribution System Project / Storage

WW = Wastewater Collection System Project

SUFFIX DEFINITION

E = Existing System Deficiency

F = Future System Improvement

*CIP ID's for Water Distribution and Wastewater Collection are organized without suffix in the Water and Wastewater Infrastructure Master Plan and on CIP project cutsheets

Table 2.15. Water Distribution Master CIP Table (page 1 of 2)

CIP ID	Phase (Project Completion Date)	Purpose	Project Type	Project Description	Cost	Dependant CIP	Zone	Trigger	Project Timeline (Start / Completion)	
P-01(E)	2020-2025	Tier 1 - Pumping	Pump unit replacement	Replacement of 2 units in Zone 5 Pump Station, each with a capacity of 1,500gpm.	\$ 146,900		Zone 5	Existing improvement	2020	2021
SS-01(F)	2020-2025	Tier 1 - Storage	New ground storage	New 5MG Tank west of Sintra Lewis Pointe Park, north of 140th Ave.	\$ 13,214,900		Zone 1	Zone 1 Storage Upgrade	2021	2022
SS-02(F)	2020-2025	Tier 1 - Storage	New ground storage	New 3.5 MG tank near existing Cherokee Tank.	\$ 9,522,500		Zone 3	Zone 3 Storage Upgrade	2022	2023
TT13(F)	2020-2025	Tier 1 - Supply	New transmission pipe	New pipe from Hilltop Tank to the new 5MG Tank. The new line is a 48-in with an approximate length of 1,900 ft.	\$ 2,209,600		Zone 1	Zone 1 Storage Upgrade	2022	2023
DD31(E)	2020-2025	Tier 1 - Capacity	New pipe or pipe replacement	Installation of a parallel pipe along Eppinger Boulevard, between Hoffman Way and Ellen Court. The new line is a 12-in with an approximate length of 300 ft.	\$ 118,470		Zone 2	Existing improvement	2025	2026
DD32(E)	2020-2025	Tier 1 - Capacity	New pipe or pipe replacement	Installation of a parallel pipe on the west side of TWTP. The new line is a 16-in with an approximate length of 700 ft.	\$ 358,050		Zone 2	Existing improvement	2023	2024
DD34(E)	2020-2025	Tier 1 - Capacity	New pipe or pipe replacement	New pipe on property west of the TWTP. The new line is a 16-in with an approximate length of 700ft. This project will improve service pressure.	\$ 358,050	DD35	Zone 2	Existing improvement	2023	2024
DD35(E)	2020-2025	Tier 1 - Capacity	New pipe or pipe replacement	New pipe on property west of the TWTP. The new line is a 16-in with an approximate length of 100ft. This project will improve service pressure.	\$ 51,150		Zone 1	Existing improvement	2023	2024
DD25(E)	2025-2035	Tier 1 - Capacity, Fire flow	New pipe or pipe replacement	New pipe along Katherine Way between W 84th Ave and N Pecos St, and along N Pecos St between Katherine Way and W 82nd Pl. The new line is a 12-in with an approximate length of 1,700ft.	\$ 671,320		Zone 3	Existing improvement	2026	2027
DD27(E)	2025-2035	Tier 1 - Capacity, Fire flow	New pipe or pipe replacement	Installation of a parallel pipe along W 82nd Pl, between Nela Dr and Pecos Way. The new line is a 12-in with an approximate length of 400ft.	\$ 157,960		Zone 3	Existing improvement	2026	2027
DD28(E)	2025-2035	Tier 1 - Capacity, Fire flow	New pipe or pipe replacement	New pipe along Douglas Dr between Greenwood Blvd and N Pecos St, and along 82nd St between N Pecos St and Nola Dr. The new line is a 8-in with an approximate length of 3,300ft.	\$ 1,015,840		Zone 3	Existing improvement	2025	2026
DD30(F)	2025-2035	Tier 1 - Capacity	New pipe or pipe replacement	New pipe along Thornton Pkwy, just west of I-25. The line is a 12-in with an approximate length of 800 ft.	\$ 315,920		Zone 3	Growth - Average System Demand = 37mgd	2034	2035
P-03(F)	2025-2035	Tier 1 - Pumping	Pump unit replacement	Replacement of two units in Zone 1 - Wes Brown High Service Pump Station, each with a capacity of 10,000gpm.	\$ 4,614,000		Zone 1	Growth - Average System Demand = 37mgd	2029	2030
P-04(F)	2025-2035	Tier 1 - Pumping	New pump station	New pump station, pumping from NWTP to Zone 1, with four units, each with a capacity of 5,000gpm.	\$ 566,300		Zone 1	NWTP Construction	2033	2034
SS-03(F)	2025-2035	Tier 1 - Storage	New ground storage	New 6 MG tank adjacent to TWTP Clearwell 2.	\$ 15,857,900		Zone 1	Zone 1 Storage Upgrade	2034	2035
TT07(F)	2025-2035	Tier 1 - Facilitate Growth	New Pipe	New pipe parallel to and north of E-470 between Holly St and Quebec St, and along Holly St from E-470 to E 152th Ave. The new line is a 42-in with an approximate length of 5,200ft.	\$ 5,198,300		Zone 1	Growth North of Highway I470	2028	2029
TT10(F)	2025-2035	Tier 1 - Facilitate Growth	New Pipe	New pipe crossing E-470, then parallel to and south of E-470 between Holly St and Quebec St, and along Quebec St from E-470 to E 138th Ave. The new line is a 24-in with an approximate length of 7,400ft.	\$ 4,809,000		Zone 1	Growth North of Highway I470	2027	2028
TT14(F)	2025-2035	Tier 1 - Supply	New transmission pipe	New pipe from Clearwell 2 at TWTP along Thornton Pkwy and E 96th Ave to just west of the South Platte River . The new line is a 48-in and 16-in with an approximate length of 14,300 ft.	\$ 16,629,700	TT26	Zone 1	WBWTP Upgrade	2032	2033
TT16(F)	2025-2035	Tier 1 - Supply	Connection to existing pipe	New pipe just south of TWTP. The new line is a 24-in with an approximate length of 200 ft.	\$ 130,000	TT33	Zone 1	Zone 1 Storage Upgrade	2034	2035
TT17(F)	2025-2035	Tier 1 - Storage	New transmission pipe	New pipe from Cherokee Tank to I-25, along I-25 to E 105th Ave, along E 105th Ave to Grant Dr, along Grant Dr to E104th Ave, along E 104th Ave to to Washington St, and along Washington St to Old E 100th Ave. The new line is a 36-in with an approximate length of 12,200 ft.	\$ 10,507,900	TT25, TT18, TT19, or TT20	Zone 1	Zone 3 Storage Upgrade	2030	2031
TT18(F)	2025-2035	Tier 1 - Storage	Connection to existing pipe	New pipe along 102nd Ave crossing Washington St. The new line is a 24-in with an approximate length of 200 ft.	\$ 130,000	TT17	Zone 3	Zone 3 Storage Upgrade	2034	2035

Table 2.15. Water Distribution Master CIP Table (page 2 of 2)

	Phase (Project Completion Date)	Purpose	Project Type	Project Description	Cost	Dependant CIP	Zone	Trigger	Project Timeline (Start / Completion)	
TT19(F)	2025-2035	Tier 1 - Storage	Connection to existing pipe	New pipe crossing Washington St at Old E 100th Ave. The new line is a 24-in with an approximate length of 200 ft.	\$ 130,000	TT17	Zone 1	Zone 1 Storage Upgrade	2034	2035
TT20(F)	2025-2035	Tier 1 - Storage	New transmission pipe	New pipe from TWTP, running along Dorothy Blvd, Hoffman Way, and 95th Ave to Washington St, then running parallel to Washington St until Old E 100th Ave. The new line is a 36-in with an approximate length of 5,100 ft.	\$ 4,392,700	TT17	Zone 3	Zone 1 Storage Upgrade	2031	2032
DD29(F)	2035-2065	Tier 2 - Capacity	New pipe or pipe replacement	Installation of a parallel pipe along Thornton Pkwy, crossing I-25. The line is a 16-in with an approximate length of 700 ft.	\$ 358,050		Zone 3	Growth - Average System Demand = 37mgd	N/A	N/A
DD37(F)	2035-2065	Tier 2 - Capacity	New pipe or pipe replacement	New pipe along 104th Ave between Washington St and Irma Dr. The new line is a 16-in with an approximate length of 4,300 ft.	\$ 2,199,430		Zone 1	Growth - Average System Demand = 37mgd	N/A	N/A
DD41(F)	2035-2065	Tier 2 - Capacity	New pipe or pipe replacement	Installation of a parallel pipe along York St east of Lake Avery. The new line is a 16-in with an approximate length of 2,200 ft.	\$ 1,125,290		Zone 1	Growth - Average System Demand = 44mgd	N/A	N/A
DD42(F)	2035-2065	Tier 2 - Capacity	New pipe or pipe replacement	Installation of a parallel pipe along 136th Ave just east of York St. The new line is a 16-in with an approximate length of 600 ft.	\$ 306,900		Zone 1	Growth - Average System Demand = 37mgd	N/A	N/A
DD49(F)	2035-2065	Tier 1 - Facilitate Growth	New Pipe	New pipe east of Colorado Blvd, running south from south of E 160th Ave to intersect with bend in Colorado Blvd. The new line is a 36-in with an approximate length of 2,600 ft.	\$ 2,239,400	TT04	Zone 1	Developments north of E 156th Avenue	N/A	N/A
P-02(F)	2035-2065	Tier 1 - Pumping	Additional pump unit	Replacement of one unit in Zone 3A Pump Station, with a capacity of 8,000gpm.	\$ 1,153,500		Zone 3A	Growth - Average System Demand = 44mgd	N/A	N/A
TT02(F)	2035-2065	Tier 1 - Facilitate Growth	New Pipe	New pipe along Colorado Blvd at E 160th Ave. The new line is a 20-in with an approximate length of 200 ft.	\$ 111,700	TT04	Zone 1	Growth North of E 156th Avenue	N/A	N/A
TT04(F)	2035-2065	Tier 1 - Facilitate Growth	New Pipe	New pipe along E 160th Ave, from neighborhood east of York St, across Colorado Blvd to east of Holly St. The new line is a 24-in with an approximate length of 4,600 ft.	\$ 2,989,400		Zone 1	Growth North of E 156th Avenue	N/A	N/A
TT05(F)	2035-2065	Tier 1 - Facilitate Growth	New Pipe	New pipe along Colorado Blvd from just north of E-470 to the bend in the road. The new line is a 36-in with an approximate length of 1,500 ft.	\$ 1,292,000	TT06	Zone 1	Growth North of E 156th Avenue	N/A	N/A
TT06(F)	2035-2065	Tier 2 - Capacity	New pipe or pipe replacement	New pipe along Colorado Blvd, with the north end crossing E-470. The new line is a 24-in with an approximate length of 3,800 ft.	\$ 2,469,480	TT14	Zone 1	Growth North of Highway E470	N/A	N/A
TT08(F)	2035-2065	Tier 1 - Facilitate Growth	New Pipe	New pipe from E-470 west of Quebec St, along Ehler Pkwy, bending south near Unita St, crossing E-470 and bending east south of 144th Ave, then south along Yosemite St to 136th Ave. The new pipe is 36-in and 42-in with an approximate length of 15,400 ft.	\$ 15,394,900	TT07	Zone 1	Growth North of Highway I470	N/A	N/A
TT09(F)	2035-2065	Tier 1 - Facilitate Growth	New Pipe	New pipe along Quebec St from E 152nd Ave to Ehler Pkwy. The new line is a 20-in with an approximate length of 2,700 ft.	\$ 1,507,000		Zone 3H	Growth North of Highway I470	N/A	N/A
TT11(F)	2035-2065	Tier 1 - Supply	New transmission pipe	New pipe from WBWTP along Riverdale Rd and Yosemite St to E 136th Ave, along Holly St from E 136th Ave to 140th Ave, and along E 140th Ave to a NWTP tie-in. The new line is 36-in and 48-in with an approximate length of 57,400 ft.	\$ 66,751,100		Zone 1	WBWTP Upgrade	N/A	N/A
TT21(F)	2035-2065	Tier 2 - Capacity	New pipe or pipe replacement	New pipe along 120th Ave from Grant St to Washington St, and along Washington St from 120th Ave to 128th Ave. The new line is a 24-in with an approximate length of 7,700 ft.	\$ 5,003,940		Zone 3A	Growth - Average System Demand = 44mgd	N/A	N/A
TT22(F)	2035-2065	Tier 2 - Capacity	New pipe or pipe replacement	New pipe along 136th Ave from 136th Ave from Clayton St to connection north of 136th Ave Tank. The new line is a 24-in with an approximate length of 2,700 ft.	\$ 1,754,630		Zone 1	Growth - Average System Demand = 44mgd	N/A	N/A
TT26(F)	2035-2065	Tier 1 - Supply	Configuration change	New pipe bypassing the new 6MG tank (CIP SS-03), adjacent to TWTP Clearwell 2. The new line is a 48-in with an approximate length of 300 ft.	\$ 348,900	TT14	Zone 1	Growth - Average System Demand = 44mgd	N/A	N/A

CIPID#'s revised from Water and Wastewater Infrastructure Master Plan: CIPID DD46 was removed from the CIP Plan because the project was incorporated into an adjacent CIP project.

*CIP ID LEGEND:

PREFIX DEFINITION

RAW = Raw Water Supply System Project

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Table 2.16. Wastewater Collection Master CIP Table

CIP ID	Phase (Project Completion Date)	Purpose	Project Type	Project Description	Cost	***Trigger Flow (gpm)	Project Timeline (Start / Completion)	
WW4 (F)	2020-2025	Tier 1 - Buildout PDWQ d/D	Gravity Main Replacement	Todd Creek Collector Improvements. Gravity flow pipe is 12 to 15-in with a length of 3,068 ft.	\$ 624,000	900	2020	2021
WW6 (F)	2020-2025	Tier 1 - Buildout PDWQ d/D	Parallel Gravity Main	Heritage Todd Creek Interceptor Parallel. Gravity flow pipe is 18 to 21-in with a length of 5,708 ft.	\$ 3,022,000	2,300	2021	2022
WW1B (F)	2020-2025	Tier 1 - Buildout PDWQ d/D	Lift Station Expansion	Big Dry Creek Lift Station Expansion. Lift station has a flow of 8,043 gpm.	\$ 5,404,000	3,100	2024	2025
WW1A (F)	2025-2035	Tier 1 - Buildout PDWQ d/D	Parallel Gravity Main	Big Dry Creek Interceptor Parallel. Gravity flow pipe is 15 to 24-in with a length of 8,197 ft.	\$ 2,819,000	6,100	2027	2028
WW2 (F)	2025-2035	Tier 1 - Buildout PDWQ d/D	Gravity Main Replacement	Upstream Big Dry Creek Interceptor Improvement. Gravity flow pipe is 24-in with a length of 188 ft.	\$ 57,000	2,600	2030	2031
WW3 (F)	2025-2035	Tier 1 - Buildout PDWQ d/D	Gravity Main Replacement	Big Dry Creek Lateral Improvement. Gravity flow pipe is 12-in with a length of 1,600 ft.	\$ 225,000	900	2030	2031
WW5 (F)	2025-2035	Tier 1 - Buildout PDWQ d/D	Gravity Main Replacement	Upstream Heritage Todd Creek Interceptor Improvement. Gravity flow pipe is 15-in with a length of 1,269 ft.	\$ 578,000	900	2030	2031
WW17 (F)	2025-2035	Tier 2 - Buildout PDWQ d/D	Gravity Main Replacement	Big Dry Creek Lift Station Inlet. Gravity flow pipe is 27-in with a length of 141 ft.	\$ 53,000	4,600	2031	2032
WW18 (F)	2025-2035	Tier 2 - Buildout PDWQ d/D	Gravity Main Replacement	Upstream Big Dry Creek Interceptor Improvement. Gravity flow pipe is 24-in with a length of 498 ft.	\$ 141,000	2,600	2031	2032
WW19 (F)	2025-2035	Tier 2 - Buildout PDWQ d/D	Gravity Main Replacement	Upstream Big Dry Creek Interceptor Parallel Improvement. Gravity flow pipe is 24-in with a length of 417 ft.	\$ 163,000	2,300	2031	2032

*** Trigger = 70% Measure Flow

CIPID#'s revised from Water and Wastewater Infrastructure Master Plan:

CIPID WW17 is listed as CIP #15 in Table 13 of the Wastewater Collection System Evaluation (Chapter 6) of the Water and Wastewater Infrastructure Master Plan

CIPID WW18 is listed as CIP #16 in Table 13 of the Wastewater Collection System Evaluation (Chapter 6) of the Water and Wastewater Infrastructure Master Plan

CIPID WW19 is listed as CIP #17 in Table 13 of the Wastewater Collection System Evaluation (Chapter 6) of the Water and Wastewater Infrastructure Master Plan

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Individual CIP project cutsheets are provided in Appendix A through D of the Utility Master Plan. The cutsheets are organized by CIP identification (ID) number order and grouped by system. Triggers for each project were used as a basis for the required construction schedules; these triggers are included on the cutsheets. Table 2.17 provides a summary of the trigger descriptions.

Table 2.17. CIP Project Trigger Descriptions

Trigger	Description
Existing Improvement	Improvement is required to address an existing deficiency
Growth - Average System Demand = 37mgd	Improvement will be required in the future, pending on expected growth
Growth - Average System Demand = 44mgd	Improvement will be required in the future, pending on expected growth
Developments north of E 156th Avenue	Improvement will serve future developments, pending on localized growth
WBWTP Upgrade	Improvement will support increase in supply capacity at WBWTP
Growth North of E-470	Improvement will serve future developments, pending on localized growth
Zone 1 Storage Upgrade	Improvement will support increase in storage capacity
Zone 3 Storage Upgrade	Improvement will support increase in storage capacity
NWTP Construction	Improvement will support supply improvements at NWTP
70% Measured Sewer Flow =	Improvement is required to meet future flows
Growth - Max Day Demand = 74.8 mgd	Improvement will be required in the future, pending on expected growth
Growth - Max Day Demand = 85.6 mgd	Improvement will be required in the future, pending on expected growth
Tier 2	Improvement identified as Tier 2
Tier 3	Improvement identified as Tier 3

The total CIP project costs and average annual CIP project costs for each of the planning periods are summarized in Table 2.18.

Table 2.18. Total and Average Annual CIP Costs by Phase

Phase	Total CIP Cost	Average Annual CIP Cost
2020-2025	\$122,554,012	\$20,425,669
2025-2035	\$178,734,448	\$17,873,445
2035-2065	\$357,083,620	\$17,854,181

Annual Expenditures for 2020 to 2035 for Raw Water, Water Treatment, Water Distribution, and Wastewater Collection are presented in Tables 2.19 through 2.22 and on Figures 2.6 through 2.9, respectively.

The total average annual expenditure for each system was calculated by using the project timeline from the master CIP tables. The CIP project costs were distributed over the timeline by assuming 20% of the cost in the first year of the project timeline, and the remaining cost split evenly over the remaining project years. Annual expenditures were calculated through 2035 to assist in annual budgeting. Annual expenditures were not calculated beyond the 15-year projection period because the information for longer projection periods would not be used for planning purposes without refinement.

The annual expenditure schedule was developed by scheduling the construction of each CIP project within the system's project timeline with the intent to meet phasing requirements. It was assumed that

each CIP project has a construction period of two years, design and construction, with the exception of the projects below:

1. The NWTP will be constructed over 4 years
2. Phase I of the TWP will be constructed over 3 years.

Table 2.19. Raw Water Annual Expenditures

*Annual Expenditures	
From	To
2020	2035
Total Cost	\$124,204,000
# of Years	15
Total Average	\$8,280,267
Year	Annual Spending
2020	\$124,000
2021	\$2,884,000
2022	\$20,823,000
2023	\$24,562,000
2024	\$30,741,000
2025	\$2,782,000
2026	\$13,491,000
2027	\$17,068,000
2028	\$2,000,000
2029	\$8,000,000
2030	\$0
2031	\$0
2032	\$0
2033	\$0
2034	\$0
2035	\$1,729,000

*Annual Expenditures do not include Tier 3 CIPs

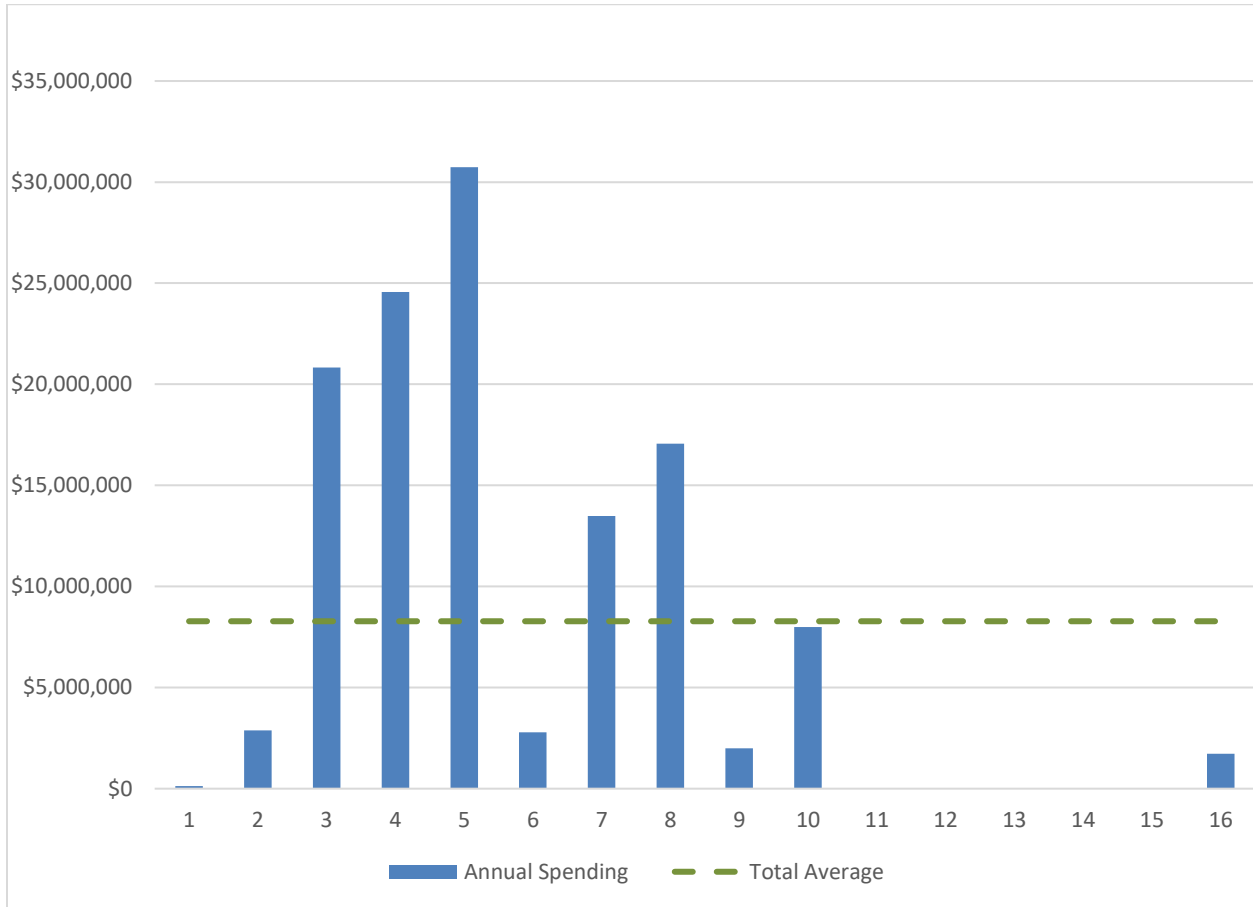


Figure 2.6. Raw Water Annual Expenditures (2020-2035)

Table 2.20. Water Treatment Annual Expenditures

*Annual Expenditures	
From	To
2020	2035
Total Cost	\$72,892,000
# of Years	15
Total Average	\$4,859,467
Year	Annual Spending
2020	\$980,000
2021	\$3,920,000
2022	\$0
2023	\$0
2024	\$0
2025	\$600,000
2026	\$2,400,000
2027	\$8,768,400
2028	\$12,797,200
2029	\$19,239,200
2030	\$24,187,200
2031	\$0
2032	\$0
2033	\$0
2034	\$0
2035	\$0

*Annual Expenditures do not include Tier 3 CIPs

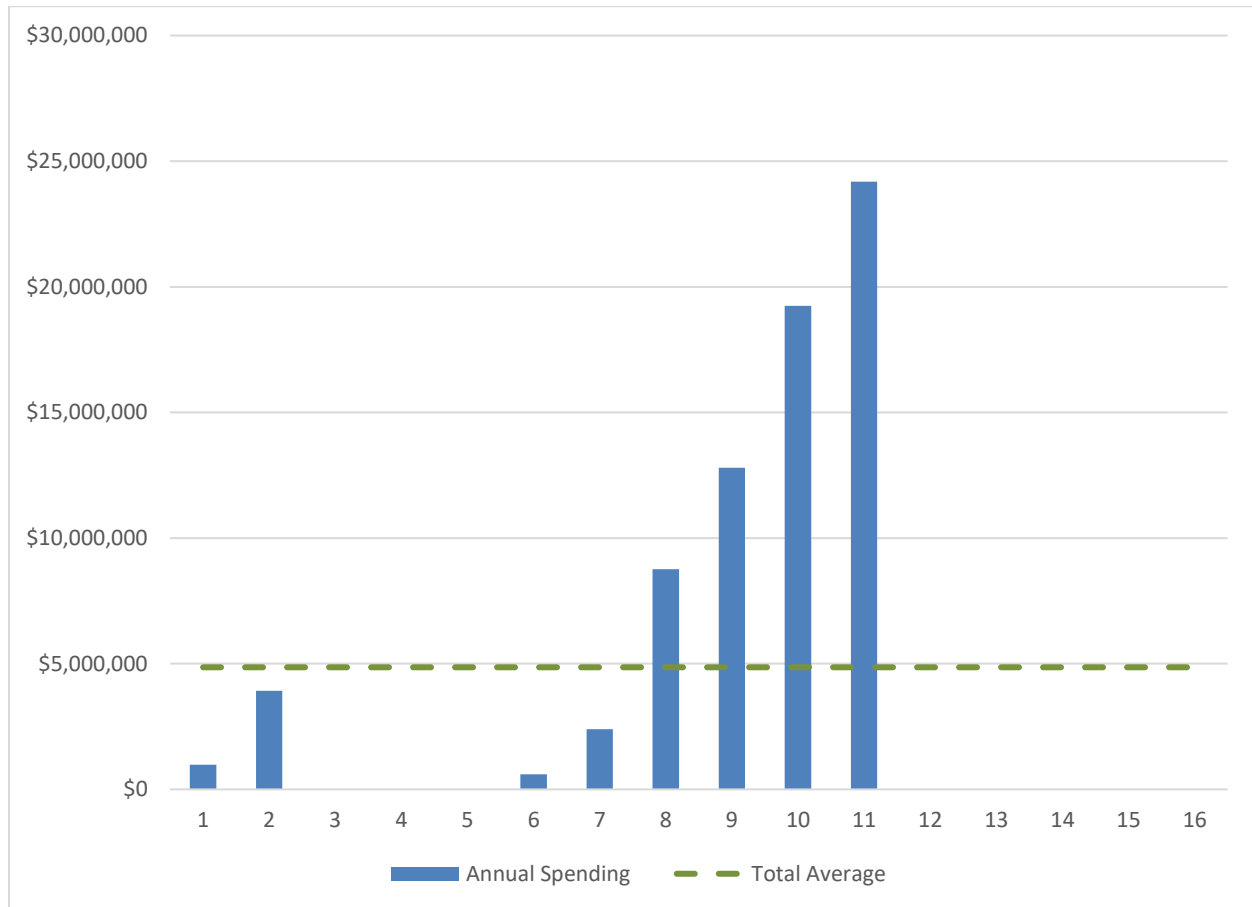


Figure 2.7. Water Treatment Annual Expenditures (2020-2035)

Table 2.21. Water Distribution Annual Expenditures

Annual Expenditures	
From	To
2020	2035
Total Cost	\$91,106,460
# of Years	15
Total Average	\$6,073,764
Year	Annual Spending
2020	\$29,380
2021	\$2,760,500
2022	\$12,918,340
2023	\$9,539,130
2024	\$613,800
2025	\$226,862
2026	\$1,073,304
2027	\$1,625,224
2028	\$4,886,860
2029	\$5,081,440
2030	\$5,792,780
2031	\$9,284,860
2032	\$6,840,100
2033	\$13,417,020
2034	\$3,765,804
2035	\$13,251,056

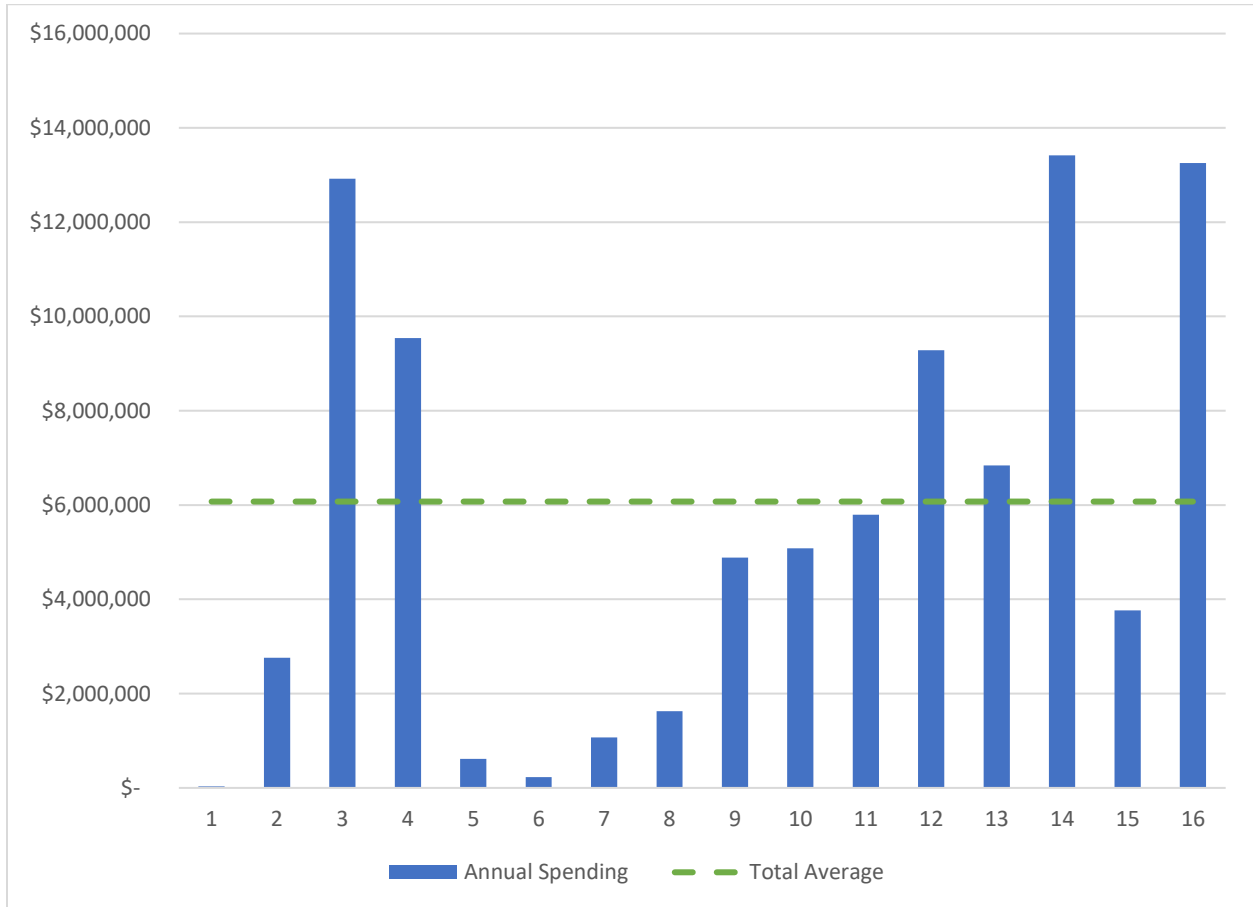


Figure 2.8. Water Distribution Annual Expenditures (2020-2035)

Table 2.22. Wastewater Collection Annual Expenditures

Annual Expenditures	
From	To
2020	2035
Total Cost	\$13,086,000
# of Years	15
Total Average	\$872,400
Year	Annual Spending
2020	\$124,800
2021	\$1,103,600
2022	\$2,417,600
2023	\$0
2024	\$1,080,800
2025	\$4,323,200
2026	\$0
2027	\$563,800
2028	\$2,255,200
2029	\$0
2030	\$172,000
2031	\$759,400
2032	\$285,600
2033	\$0
2034	\$0
2035	\$0

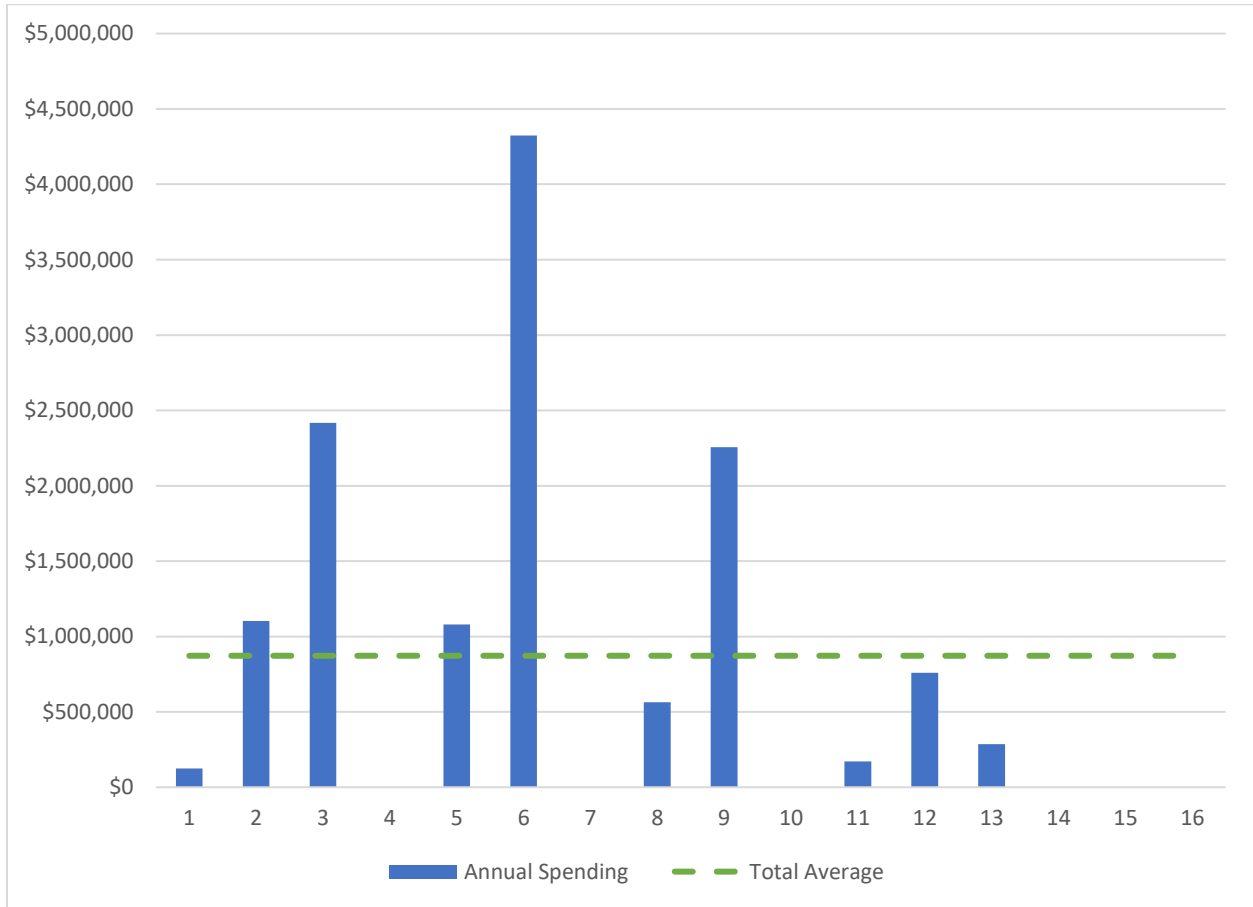


Figure 2.9. Wastewater Collection Annual Expenditures (2020-2035)

Total annual expenditures are presented in Table 2.23 and on Figure 2.10.

Table 2.23. Total Annual Expenditures

*Annual Expenditures	
From	To
2020	2035
Total Cost	\$301,288,460
# of Years	15
Total Average	\$20,085,897
Year	Annual Spending
2020	\$1,258,180
2021	\$10,668,100
2022	\$36,158,940
2023	\$34,101,130
2024	\$32,435,600
2025	\$7,932,062
2026	\$16,964,304
2027	\$28,025,424
2028	\$21,939,260
2029	\$32,320,640
2030	\$30,151,980
2031	\$10,044,260
2032	\$7,125,700
2033	\$13,417,020
2034	\$3,765,804
2035	\$14,980,056

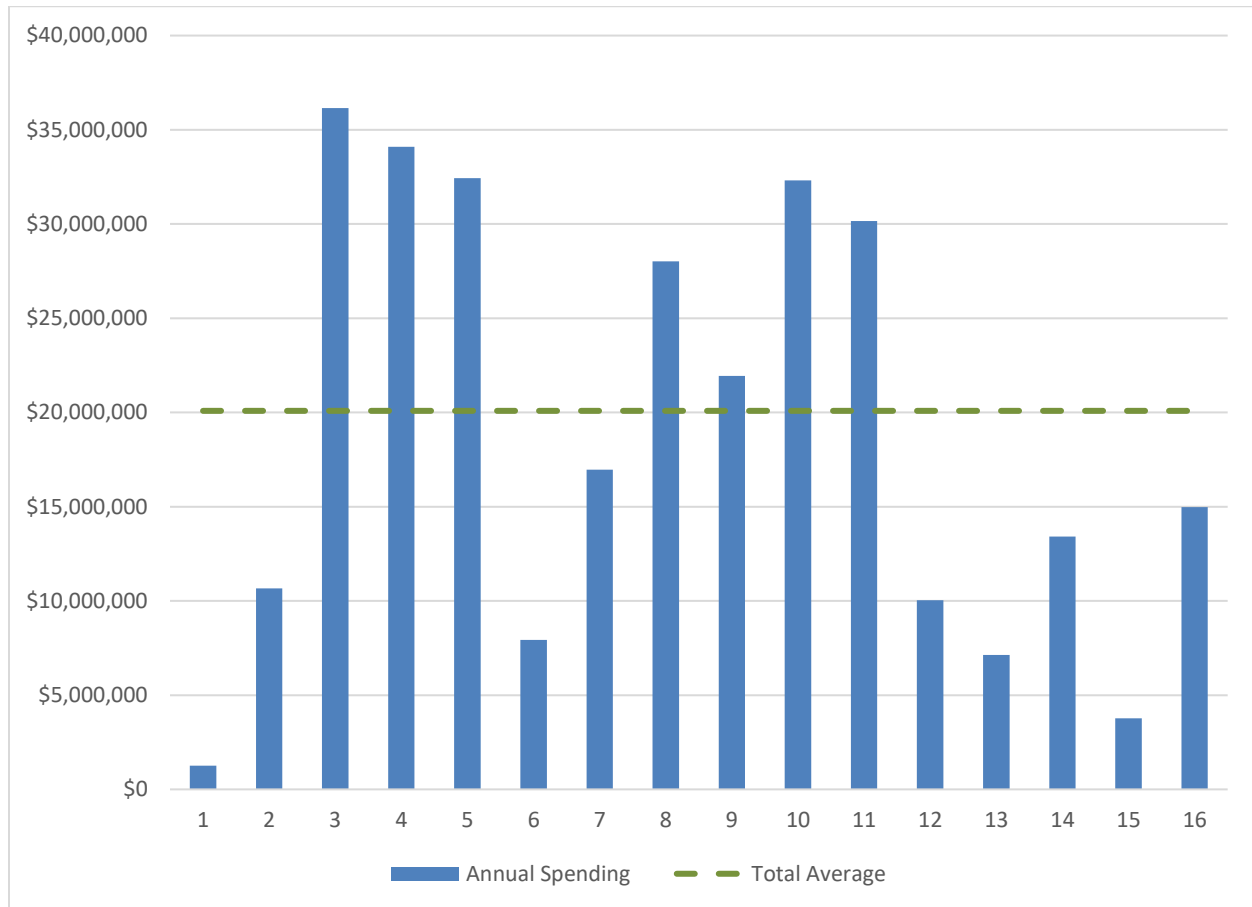


Figure 2.10. Total Annual Expenditures (2020-2035)

A summary of the Rehabilitation and Replacement Program for the water distribution and transmission system is presented in Table 2.24.

Table 2.24. Rehabilitation and Replacement Program Summary – Water Distribution and Transmission System

Timeframe	Average Cost (\$/year)	Average Length (ft)	Average Percent of the System (%)
100 years	7,004,300	33,000	1.0
5 years	9,751,600	67,000	2.1
10 years	9,665,400	66,000	2.0
20 years	6,294,800	40,000	1.2

A summary of the Rehabilitation and Replacement Program for the wastewater collection system is presented in Table 2.25.

Table 2.25. Rehabilitation and Replacement Program Summary – Wastewater Collection System

Timeframe	Average Cost (\$/year)	Average Length (ft)	Average Percent of the System (%)
100 years	4,710,800	26,600	1.1
5 years	10,043,700	53,200	2.1
10 years	9,869,600	53,000	2.1
20 years	5,372,600	33,000	1.3

Annual expenditures for the water pipeline Rehabilitation and Replacement program over 10-year, 25-year, and 100-year planning periods are presented below on Figures 2.11 through 2.13, respectively. Annual expenditures for the wastewater pipeline Rehabilitation and Replacement program over 10-year, 25-year, and 100-year planning periods are presented below on Figures 2.14 through 2.16, respectively. The annual costs are the raw results from the risk assessment, the 10-year average expenditure is the goal of the Rehabilitation and Replacement program, and the long term 100-year average is the minimum required if some of these costs were elected to be deferred by Thornton.

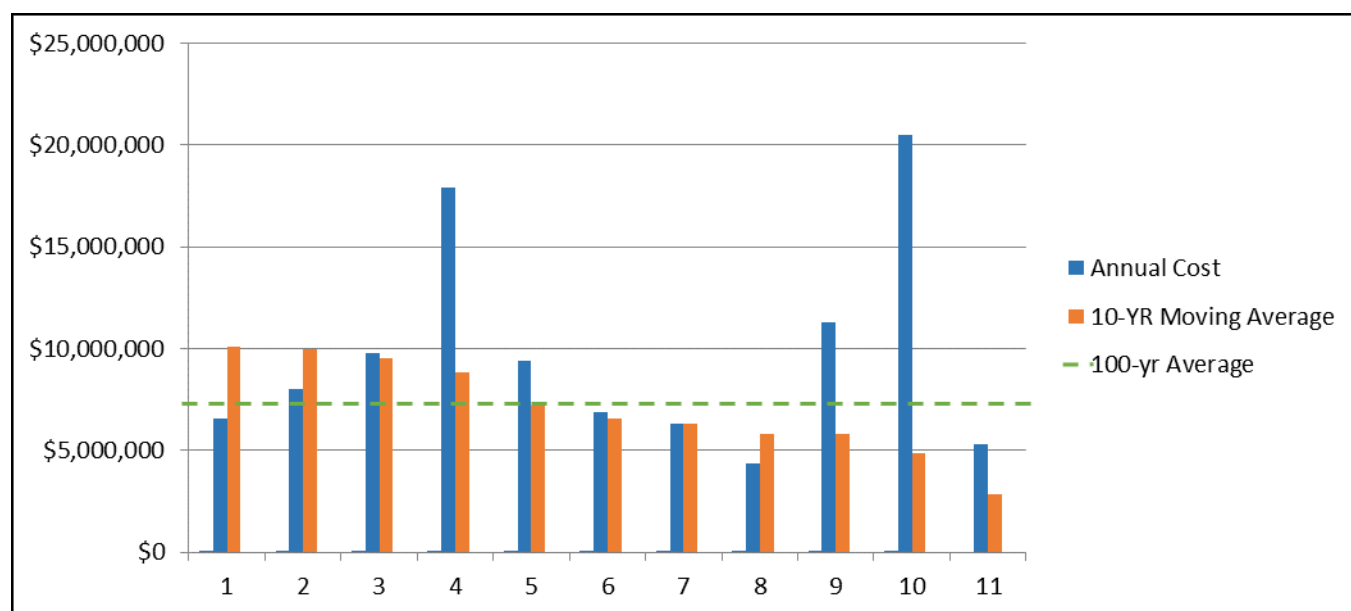


Figure 2.11. 10-year Expenditures for Water Pipeline Rehabilitation and Replacement Program

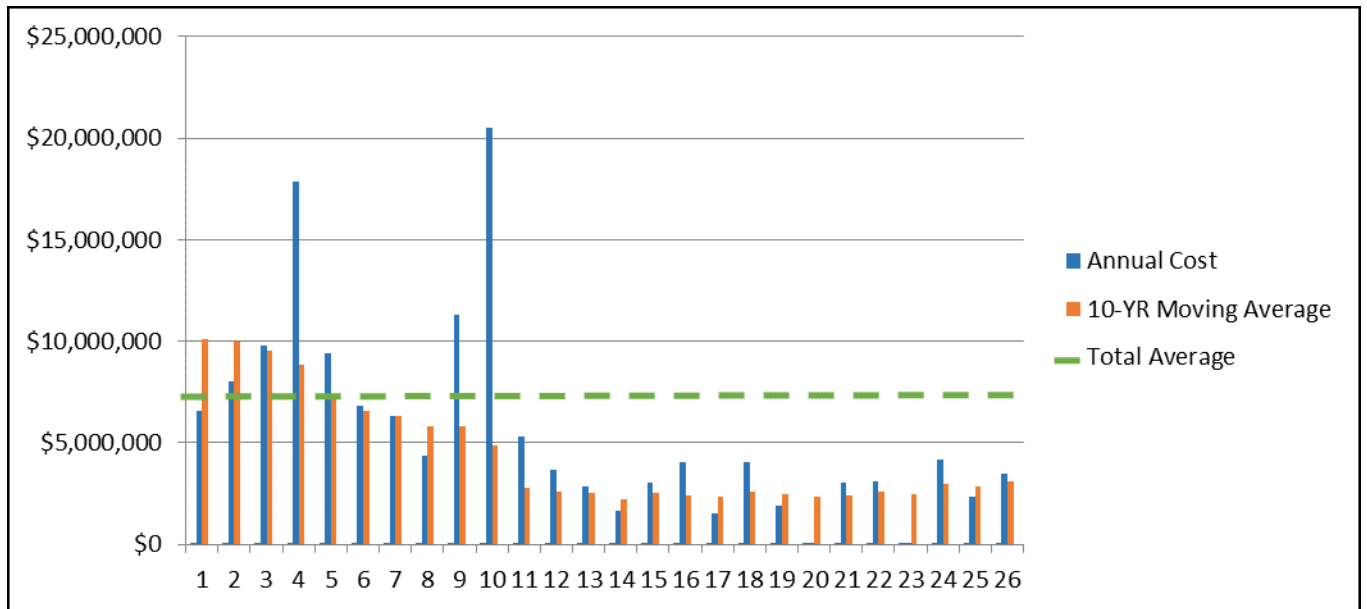


Figure 2.12. 25-year Expenditures for Water Pipeline Rehabilitation and Replacement Program

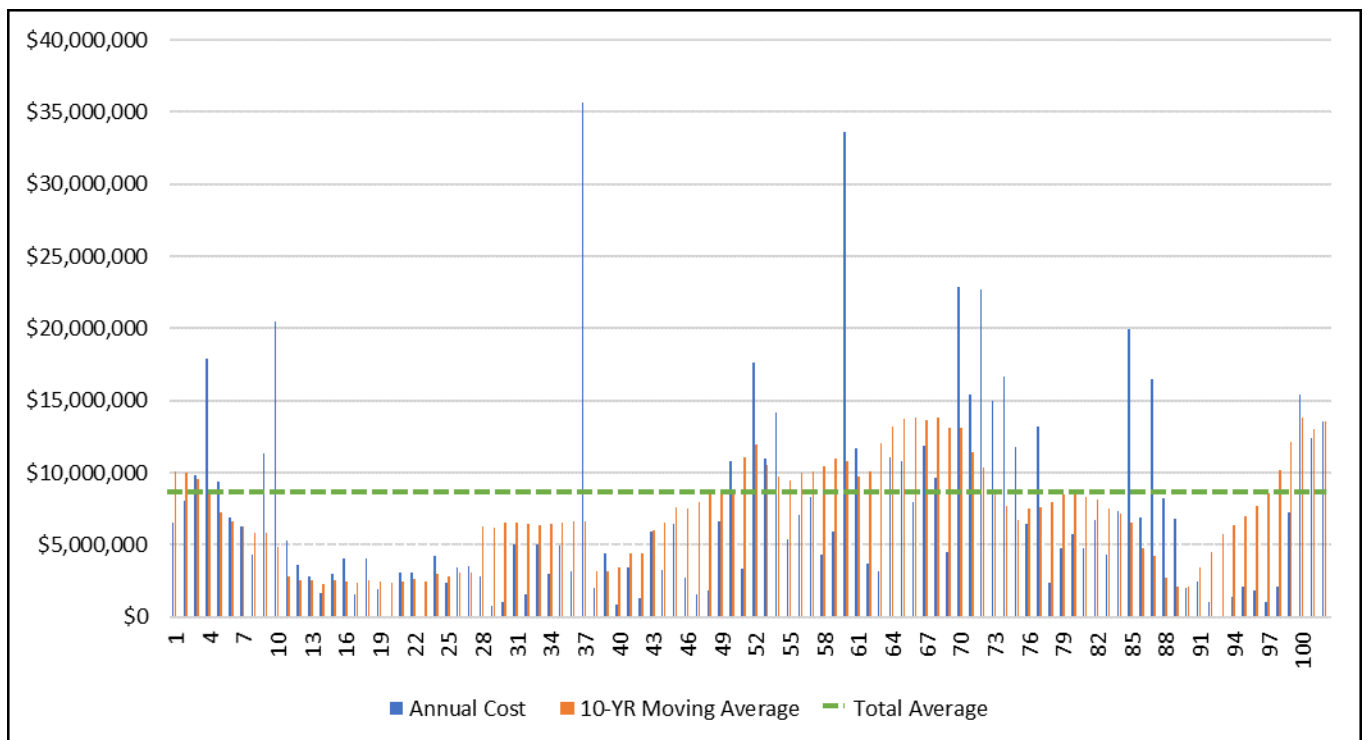


Figure 2.13. 100-year Expenditures for Water Pipeline Rehabilitation and Replacement Program

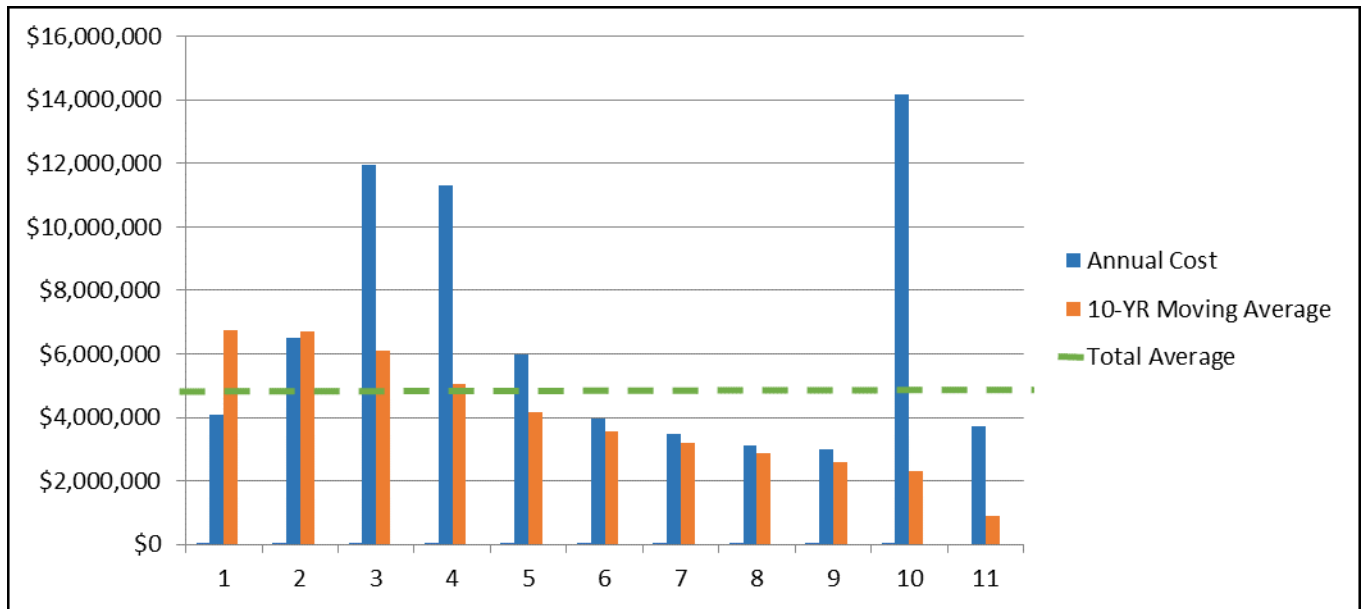


Figure 2.14. 10-year Expenditures for Wastewater Pipeline Rehabilitation and Replacement Program

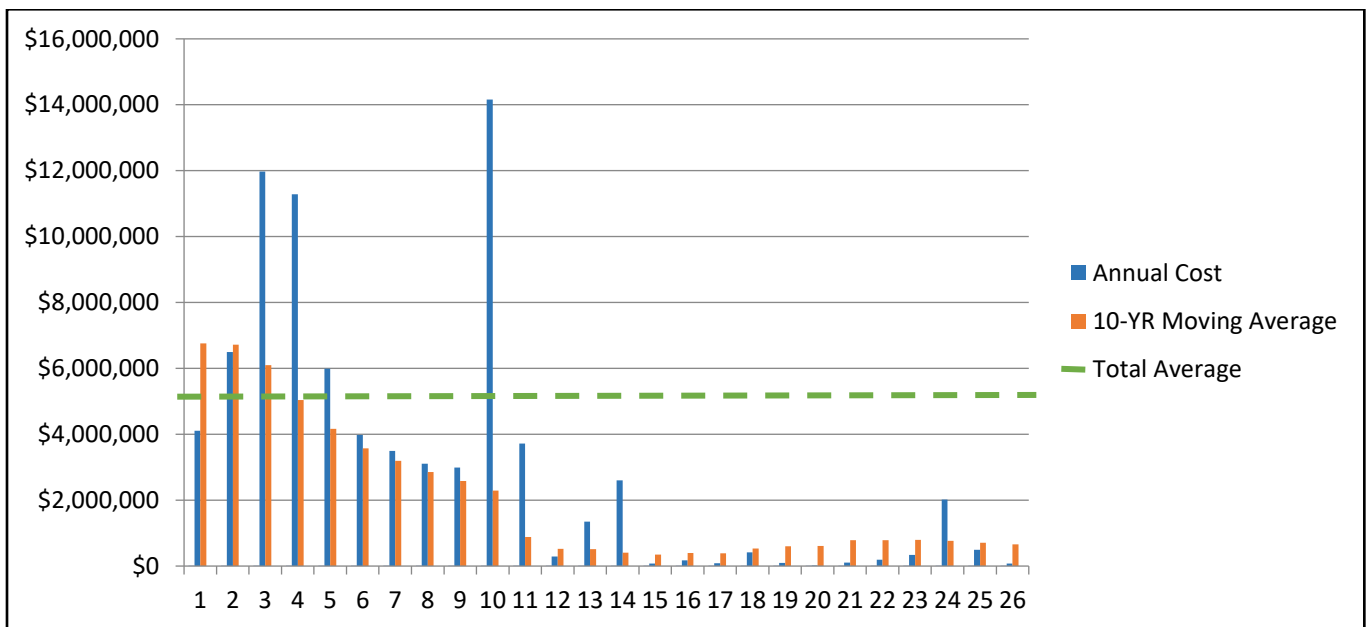


Figure 2.15. 25-year Expenditures for Wastewater Pipeline Rehabilitation and Replacement Program

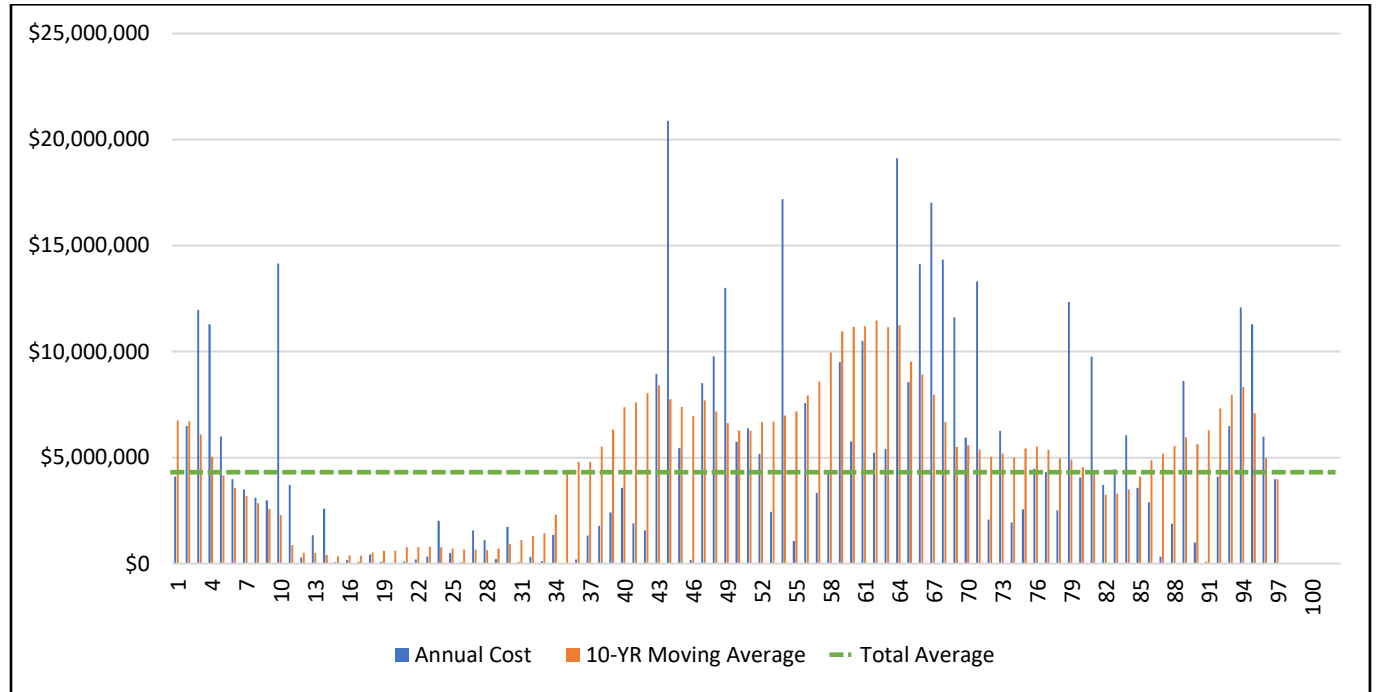


Figure 2.16. 100-year Expenditures for Wastewater Pipeline Rehabilitation and Replacement Program

Chapter 3 Integrated Alternatives Evaluation

Section 3-1 Introduction and Purpose

Thornton has complex raw water, water treatment, water distribution, and wastewater collection systems that provide service to over 166,000 customers within the city as well as outside its limits, including service to Western Hills, Welby, Unincorporated Adams County, and Federal Heights (wastewater service only) communities. Thornton must serve its customer base and plan for future growth in a cost-effective manner, while simultaneously meeting high standards of service. At buildout (anticipated to occur by 2065), the systems are expected to serve a population of 268,843.

To serve the anticipated future population, the water treatment system will need to increase in capacity by 21.5 million gallons per day (mgd). Three future alternatives were developed and evaluated to meet the future need in consideration of impacts across the raw water, water treatment, and water distribution systems as summarized below:

- **Alternative 1:** Construct a new Northern Water Treatment Plant (NWTP) located in the northern portion of the service area with 21.5 mgd capacity. The future capacity of the Thornton Water Treatment Plant (TWTP) would be 20 mgd, and the future capacity of the Wes Brown Water Treatment Plant (WBWTP) would be 54.8 mgd.
- **Alternative 2:** Expand the new TWTP by 21.5 mgd to a permitted production capacity of 41.5 mgd. The future capacity of the WBWTP would be 54.8 mgd.
- **Alternative 3:** Expand the WBWTP by 21.5 mgd to a permitted production capacity of 76.3 mgd. The future capacity of the TWTP would be 20 mgd.

An individual Master Plan was developed for each water system (raw water supply, water treatment facilities, and water and wastewater infrastructure) to identify a capital improvement program (CIP) for each alternative. Identified CIP projects for each system under each alternative were developed based on a combination of data review, hydraulic analyses, technical evaluations related to system performance criteria to meet Thornton's goals and objectives, and through close coordination and input from Thornton staff. The individual Master Plans provide analyses, results, recommendations, and cost estimates for the proposed CIP projects for each of the three alternatives. This Utility Master Plan (UMP), assembles the CIP projects developed for each system into three integrated alternatives across the systems; and establishes a basis and selection of a single preferred alternative utilizing a cost-benefit analysis (CBA) decisions making process. The selection of a single preferred alternative allows for development, phasing, and prioritization of an integrated CIP that provides Thornton with a road map to most effectively serve the future system needs.

The wastewater collection system CIP projects are not impacted based on the three alternatives; therefore, a single set of improvements was identified to meet the performance criteria and accommodate projected buildout conditions.

Chapter 3 describes the development and evaluation of the three integrated alternatives, including review of improvements required to meet service goals in the raw water, water treatment, water distribution, and wastewater collection systems. This IMP also describes the cost-benefit analysis decision making process and identification of the preferred alternative.

Section 3-2 Performance Criteria

The alternatives development and evaluation process was structured to encourage consideration of a full range of improvement strategies. Alternative improvements were developed to meet the performance criteria for each system based on technical analysis as specified in the individual Master Plans, while meeting future system demands.

The performance criteria for each system were divided into three tiers to establish different levels of performance and provide Thornton flexibility in selecting improvements based on these levels of service. The three tiers can be summarized as follows:

- **Tier 1:** Criteria that MUST be met by the system;
- **Tier 2:** Criteria that represent best practice and should be met by the system, but may not be required; and
- **Tier 3:** Criteria that are desired and should be met if practicable but are not required.

These criteria include considerations necessary to provide reasonable reliability and redundancy of the water supply, treatment, and distribution systems.

Section 3-3 Raw Water Supply Evaluation Conclusions

The Raw Water Supply CIP projects for each alternative were developed to meet all supply requirements, separated by each of the three performance criteria tiers. Each alternative is faced with unique challenges and, therefore, differentiators. For Alternative 1, a second raw water supply pipeline will be required from Hammer Reservoir to the NWTP to meet Tier 1 criteria. A third raw water supply pipeline will be required from Rodgers Reservoir to the NWTP to meet Tier 2 criteria. For Alternative 2, negative water quality impacts may be experienced due to the larger proportion of Gravel Lakes water being delivered to the WBWTP. Alternative 3 will require the largest raw water supply due to the higher loss rates at WBWTP.

Section 3-4 Water Treatment Facilities Evaluation Conclusions

The Water Treatment Facilities CIP projects for each alternative were developed to meet production requirements, separated by each of the three performance criteria tiers. During alternatives development, it was assumed the NWTP would follow a similar treatment process to that used for the new TWTP; therefore, Alternative 1 and Alternative 2 are equivalent with regard to the Tier 1 performance criteria. As currently configured, there are no significant performance differentiators between any of the alternatives for Tier 1 criteria. All of the alternatives provide the required water treatment capacity; however, Alternative 1 provides the largest total treatment redundancy. Alternatives 1 and 2 include mechanical dewatering due to land availability, and Alternative 3 includes solids handling lagoons.

Thornton is also continuing to evaluate options to defer the timing associated with construction of additional treatment capacity. These options include operating the TWTP and/or WBWTP at a higher capacity, revising population growth rates to less aggressive assumptions for planning purposes, and implementing a management plan to restrict water use during dry periods.

Section 3-5 Water Distribution and Wastewater Collection Evaluation Conclusions

Water Distribution and Wastewater Collection CIP projects for each alternative were developed to meet all Tier 1 and Tier 2 performance criteria; no Tier 3 improvements were identified. The Water Distribution

evaluation included the assessment of capacity of distribution improvements to serve future developments, storage, pumping, and transmission and distribution pipelines. In general, the distribution system analysis results indicate that the existing system has storage and transmission deficiencies, and infrastructure improvements are needed to meet buildout requirements.

After analyzing the existing infrastructure under buildout conditions for the three future alternatives, the following main conclusions were identified:

- The alternatives do not affect the size and location of distribution improvements except for pumping and transmission improvements described further below.
- Pumping improvements are common for all alternatives, with exception to improvements required for the WBWTP High Service PS in Alternative 3 and the NWTP Finished Water PS in Alternative 1.
- The water distribution system evaluation showed a deficiency in existing transmission capacity from the WBWTP and the TWTP to the northern portion of the buildout service area for all alternatives, where most of the population growth is expected to occur.
- CIP projects that are specific to each alternative include transmission lines that connect treatment plants to existing and proposed treated water storage facilities (tanks). The diameter of these pipeline improvements varies for each alternative, but the alignment is relatively consistent.
- The wastewater collection system improvements are not impacted based on the three alternatives; therefore, a single set of improvements was developed to meet the design criteria and accommodate projected buildout conditions.

Section 3-6 Integrated CIP Alternatives

Figures 3.1 through 3.3 present summaries of each integrated alternative's key components. Full inventory of the alternatives are documented in the Raw Water Future Alternatives Evaluation Technical Memorandum (TM), the Water Treatment Future Alternatives Evaluation TM, and the Water Distribution System Analysis TM.

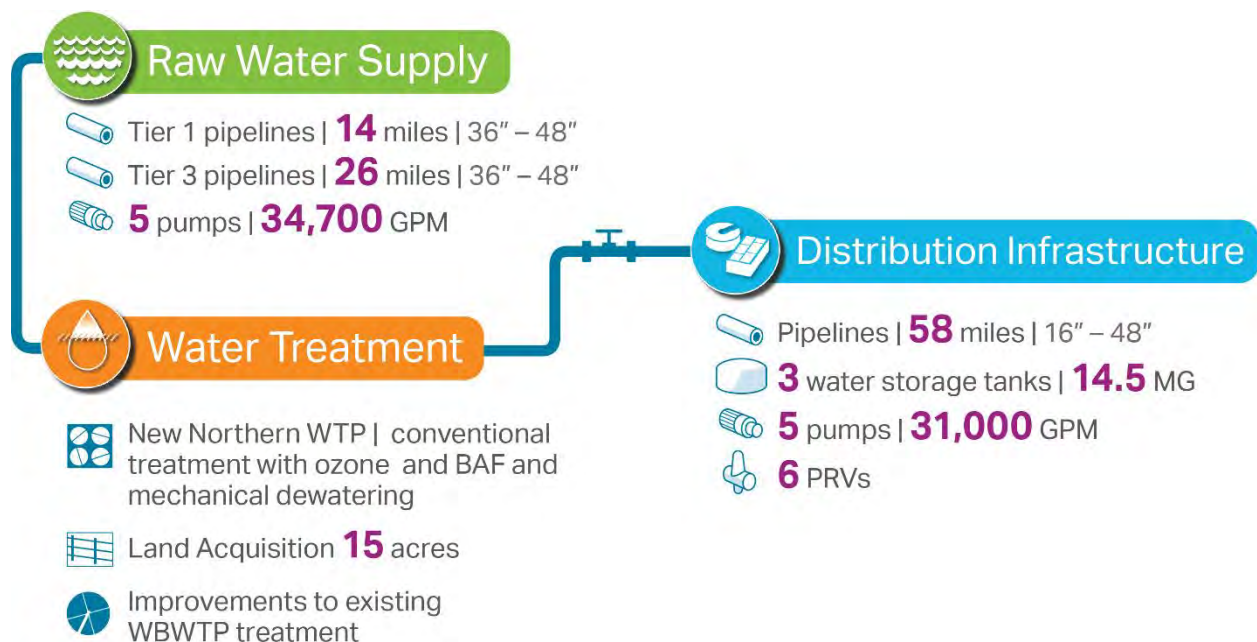


Figure 3.1. Alternative 1 New NWTP

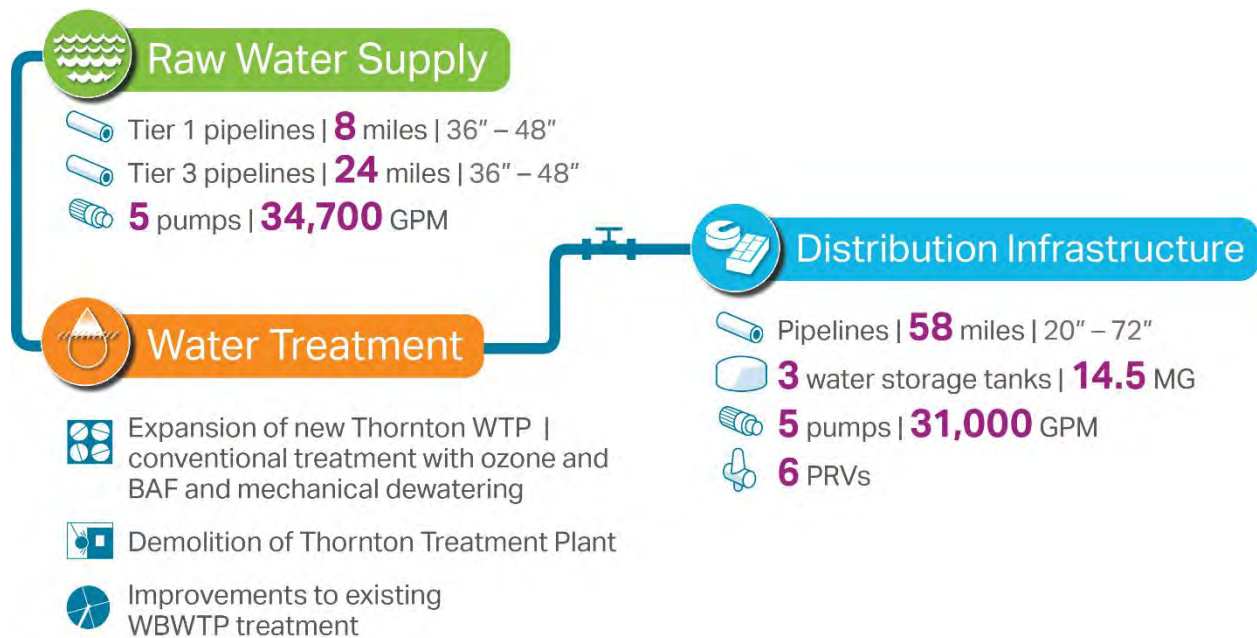


Figure 3.2. Alternative 2 Expanded TWTP

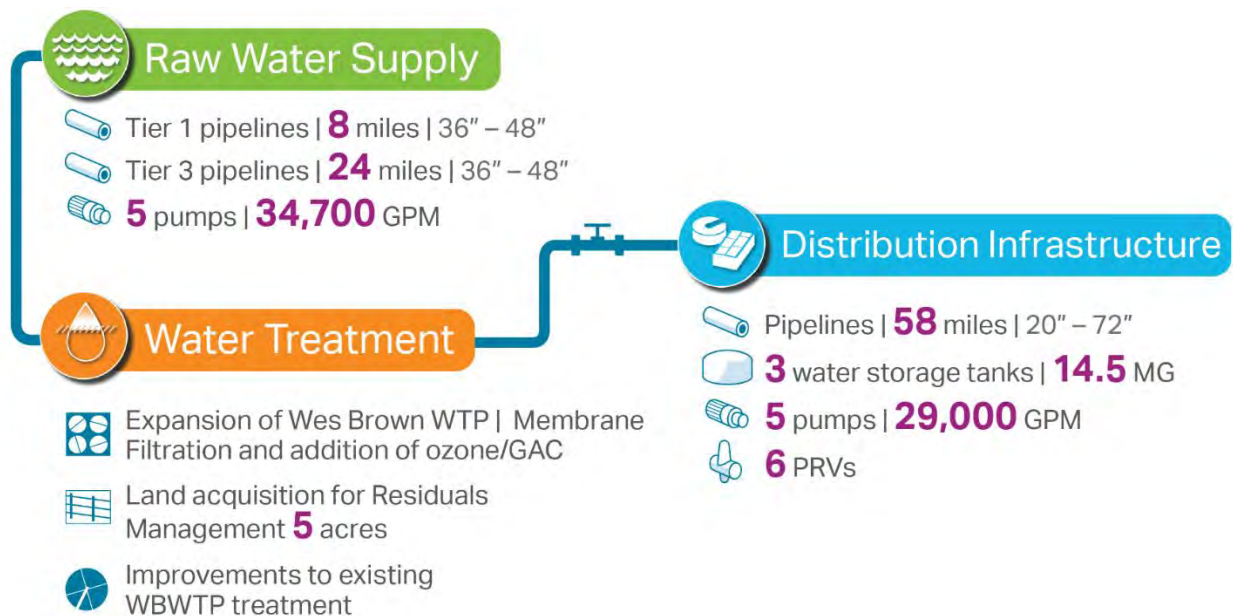


Figure 3.3. Alternative 3 Expanded WBWTP

Section 3-7 Alternative Costs

Estimated project costs were developed for each CIP project to meet buildout demands. The costs are consistent with Association for the Advancement of Cost Engineering (AACE) Class V estimating guidance. This opinion of probable costs is based on conceptual design and the basis of estimate summarized in this report, representing planning-level accuracy and opinions of costs (+50%, -30%). The

estimated costs include the sum of materials, labor, and equipment for key features of a project. The estimated total project costs include the sum of construction costs with additional allowances for direct and indirect costs. Across systems, the CIP costs include \$73M in existing improvements for the raw water, water treatment, water distribution, and wastewater collection systems to meet Tier 1 criteria. The existing improvements will be constructed in accordance with the phasing and prioritization presented in the CIP in Chapter 2. The proposed existing improvements are common to all the alternatives and assumed to be in place prior to proposed future improvements.

Twenty-year net operation and maintenance (O&M) costs that vary significantly between the three future alternatives were developed. Total O&M costs were not developed. O&M pumping costs for the raw water supply and water distribution systems were developed, assuming an energy cost of \$0.10/kilowatt (kW). Water treatment O&M costs include labor, energy, chemicals, membranes, filter media, and equipment replacement.

Raw Water Supply Costs

Capital expenditure (CapEx) and O&M costs for raw water supply are presented in Table 3.1 for each alternative. Raw Water Supply CIP costs do not include:

- Transmission pipeline costs for the Thornton Water Project (TWP) north of McKay PS
- Capital costs for pumps associated with the TWP
- Cost for a second electric utility feed to the EGL4 and TWP pump stations, a Tier 3 improvement
- Costs of additional water rights
- Costs of additional raw water storage volume needed for all alternatives

The resulting costs of additional water rights and storage are significant and, therefore, not a viable option. It was assumed Thornton will meet the criteria of securing additional raw water supply by utilizing existing storage and water rights. The cost for the supplementary water supply needed for WBWTP due to the greater losses through the membrane treatment process in Alternative 3 was included in the capital costs.

Table 3.1. Raw Water Supply CapEx and O&M Alternative CIP Costs

Raw Water	Alternative 1	Alternative 2	Alternative 3
Tier 1 - CapEx	\$108,000,000	\$81,000,000	\$81,000,000
Tier 2- CapEx	\$12,000,000	\$12,000,000	\$34,000,000
Tier 3- CapEx	\$147,000,000	\$138,000,000	\$138,000,000
Total	\$267,000,000	\$231,000,000	\$253,000,000
20-yr Net O&M	\$0	\$200,000	\$210,000

Water Treatment Facilities Costs

Capital and O&M costs for water treatment facilities are presented in Table 3.2 for each alternative. The capital costs have been updated to include mechanical dewatering in Alternative 1 and 2. A raw water turbidity of 50 Nephelometric Turbidity Units (NTU) and a sludge loading rate (SLR) of 25 lb/day/sf were assumed for conceptual sizing of the dewatering system.

Table 3.2. Water Treatment Facilities CapEx and O&M Alternative CIP Costs

Water Treatment	Alternative 1	Alternative 2	Alternative 3
Tier 1 - CapEx	\$100,790,000	\$102,640,000	\$100,660,000
Tier 2- CapEx	\$1,330,000	\$1,330,000	\$1,330,000
Tier 3- CapEx	\$220,000	\$220,000	\$220,000
Total	\$102,000,000	\$104,000,000	\$102,000,000
20 yr Net O&M	\$10,000,000	\$0	\$30,000,000

Water Distribution System Costs

Capital and O&M costs for water distribution are presented in Table 3.3 for each alternative.

Table 3.3. Water Distribution CapEx and O&M Alternative CIP Costs

Water Distribution	Alternative 1	Alternative 2	Alternative 3
Tier 1 - CapEx	\$172,000,000	\$241,000,000	\$241,000,000
Tier 2- CapEx	\$25,000,000	\$25,000,000	\$25,000,000
Tier 3- CapEx	\$0	\$0	\$0
Total	\$197,000,000	\$266,000,000	\$266,000,000
20 yr Net O&M	\$12,200,000	\$6,500,000	\$19,100,000

Wastewater Collection System Costs

Capital and O&M costs for wastewater collection are presented in Table 3.4 for each alternative.

Table 3.4. Wastewater Collection CapEx and O&M Alternative CIP Costs

Collection System	Alternative 1	Alternative 2	Alternative 3
Tier 1 - CapEx	\$14,400,000	\$14,400,000	\$14,400,000
Tier 2- CapEx	\$357,000	\$357,000	\$357,000
Tier 3- CapEx	\$0	\$0	\$0
Total	\$15,000,000	\$15,000,000	\$15,000,000
20 yr Net O&M	\$0	\$0	\$0

Total Capital Costs

Total capital costs are summarized by system in Table 3.5 for each alternative.

Table 3.5. Total CapEx Alternative CIP Costs by System

Total Utility System Capital Cost	Alternative 1	Alternative 2	Alternative 3
Raw Water	\$267,000,000	\$231,000,000	\$253,000,000
Water Treatment	\$102,000,000	\$104,000,000	\$102,000,000
Distribution	\$197,000,000	\$266,000,000	\$266,000,000
Wastewater Collection System	\$15,000,000	\$15,000,000	\$15,000,000
Total Capital Cost	\$581,000,000	\$616,000,000	\$636,000,000

Total capital costs are summarized by performance criteria tiers in Table 3.6 for each alternative.

Table 3.6. Total CapEx Alternative CIP Costs by Performance Criteria Tiers

Total Performance Criteria Capital Cost	Alternative 1	Alternative 2	Alternative 3
Tier 1	\$395,000,000	\$439,000,000	\$437,000,000
Tier 2	\$39,000,000	\$39,000,000	\$61,000,000
Tier 3	\$147,000,000	\$138,000,000	\$138,000,000
Total Capital Cost	\$581,000,000	\$616,000,000	\$636,000,000

Total 20-Year Net O&M Costs

Total 20-year Net O&M costs are summarized in Table 3.7 for each alternative.

Table 3.7. Total 20-year Net O&M Alternative Costs

20-yr Net O&M	Alternative 1	Alternative 2	Alternative 3
Total	\$22,200,000	\$6,700,000	\$49,310,000

Observations from Alternative Cost Evaluation

Alternative 1 has the lowest total capital cost with a savings of \$35M compared to Alternative 2, while Alternative 3 has the highest capital costs. When compared to Tier 1 costs, Alternative 1 offers a cost savings of \$44M compared to Alternative 2, and \$42M compared to Alternative 3, respectively.

Alternative 2 has the lowest net O&M costs, largely due to a reduction in additional personnel being required for the expansion of the conventional treatment system at the TWTP. The higher O&M costs for Alternative 1 are primarily attributed to the additional labor necessary to operate a third water treatment facility. The O&M costs for Alternative 3 are the highest, with costs of the membrane filters and increased pumping being the largest contributors.

A summary of the total capital and O&M costs for each alternative are presented on Figure 3.4 by system and by performance criteria tiers.

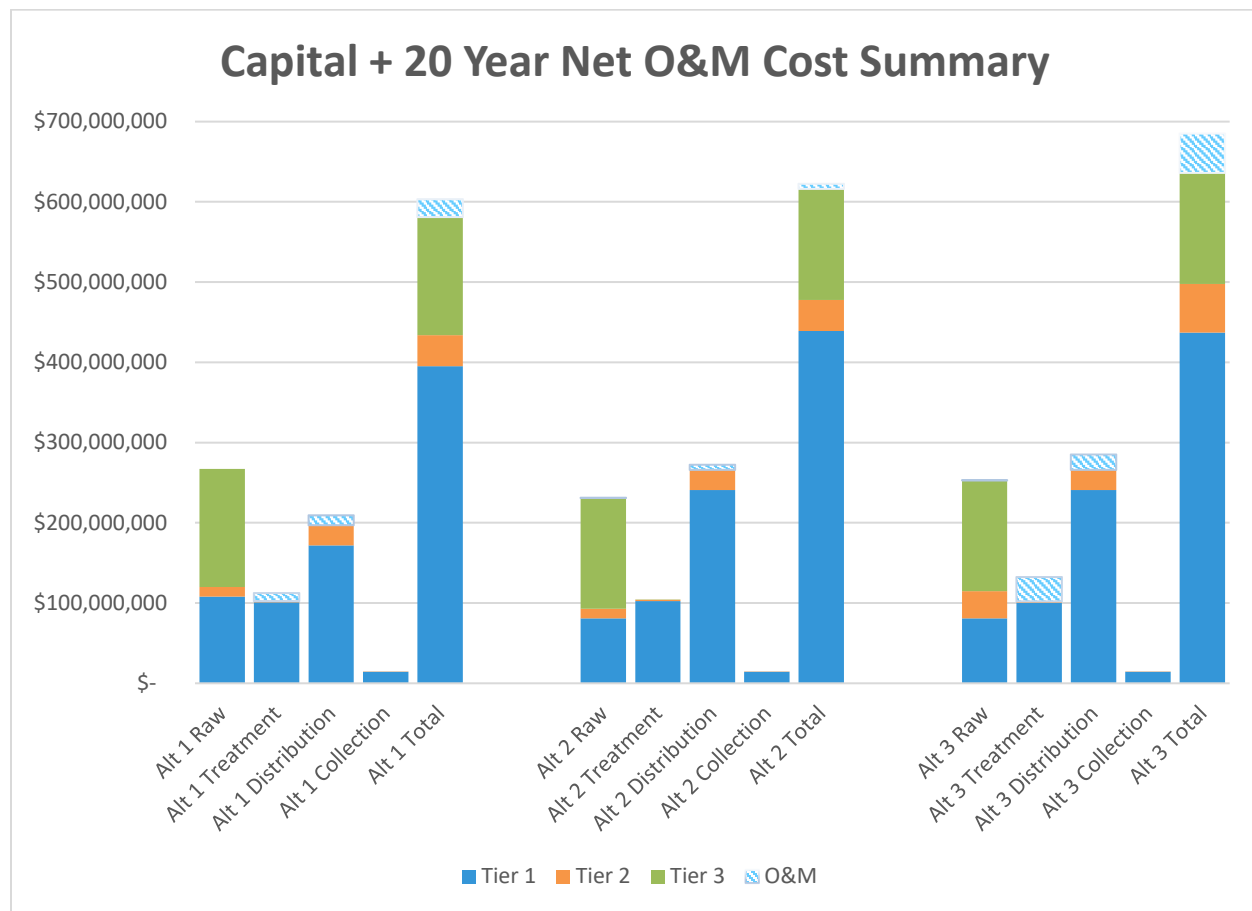


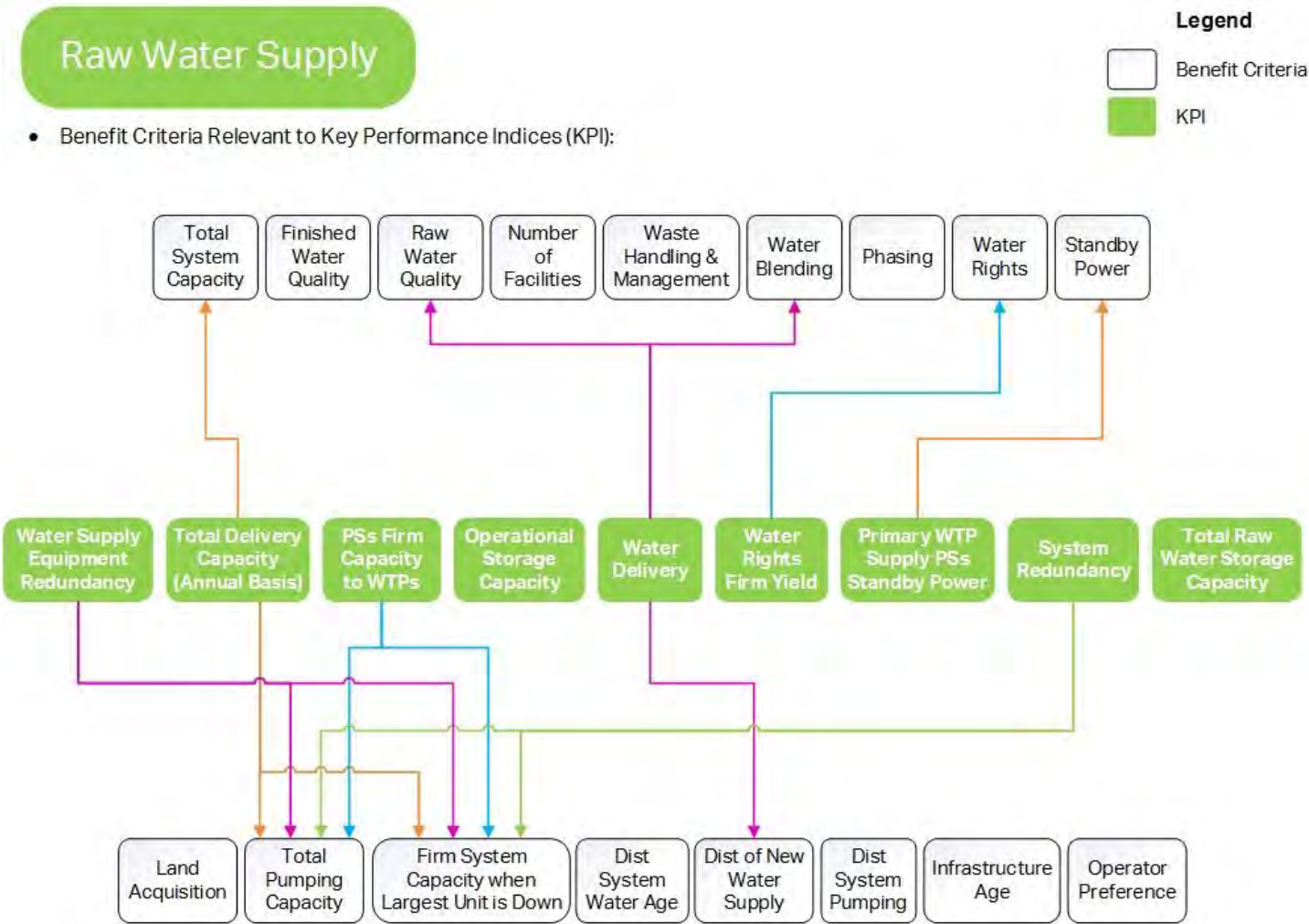
Figure 3.4. Capital and O&M Alternative Cost Summary

Section 3-8 Alternatives Evaluation Framework

This section provides a performance overview of each alternative related to key goals and objectives, including water quality, supply blending, and redundancy by establishing benefit categories and criteria for each alternative that will be used in the CBA.

Alternatives Evaluation Criteria

The integrated alternatives summarized above were evaluated based on benefit categories and criteria developed from the key performance indices (KPIs) identified in the individual Master Plans. Figures 3.5 through 3.7 illustrate the relationship between the benefit criteria and the KPIs for each of the systems. As previously discussed, the wastewater collection system was not impacted by the various supply alternatives; therefore, an alternatives evaluation was not performed.



Note: Benefit Category 'Meets COT Needs' applies to all KPI performance criteria.

Figure 3.5. Raw Water Supply Benefit Criteria from Individual Master Plan KPIs

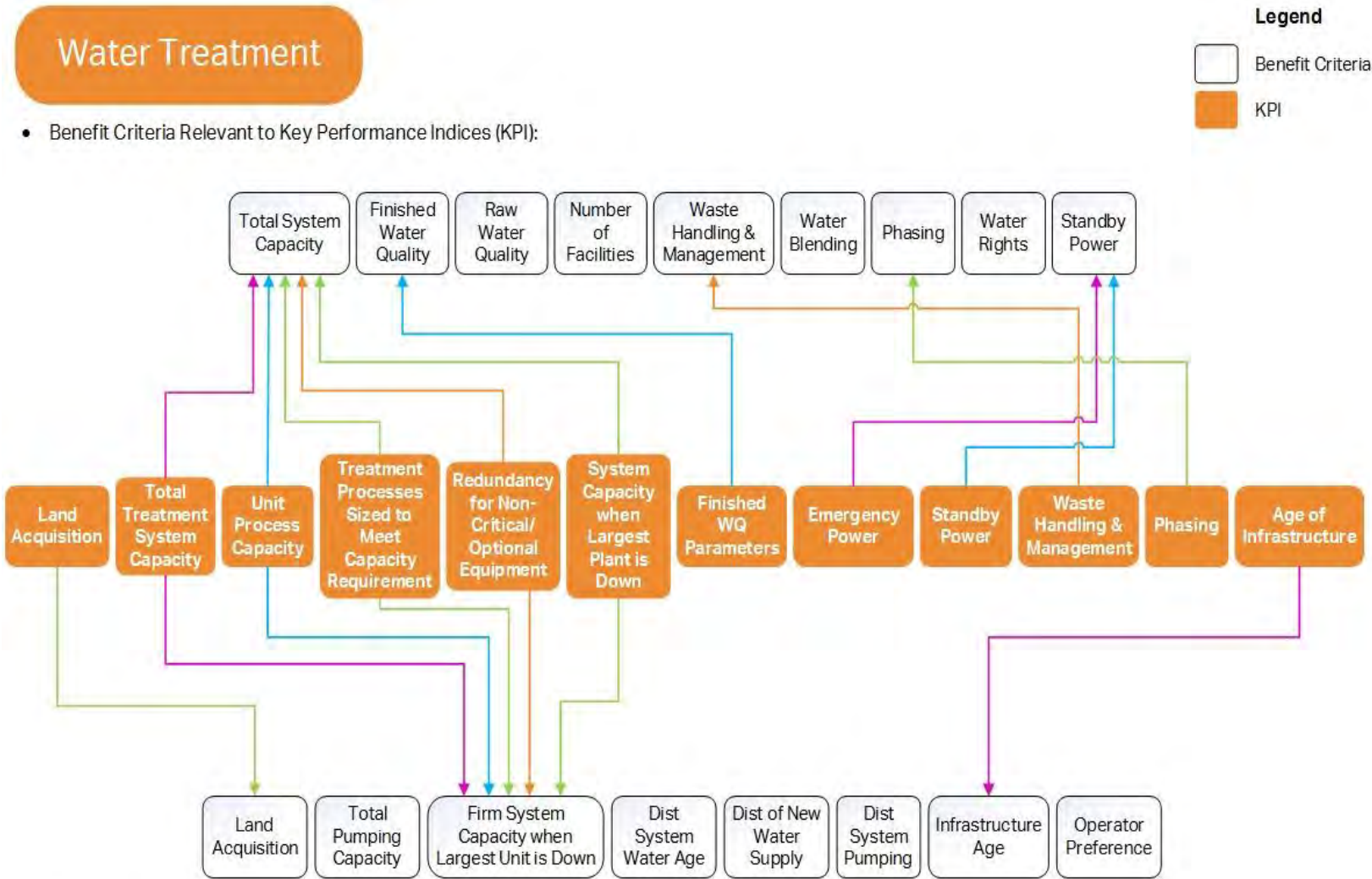
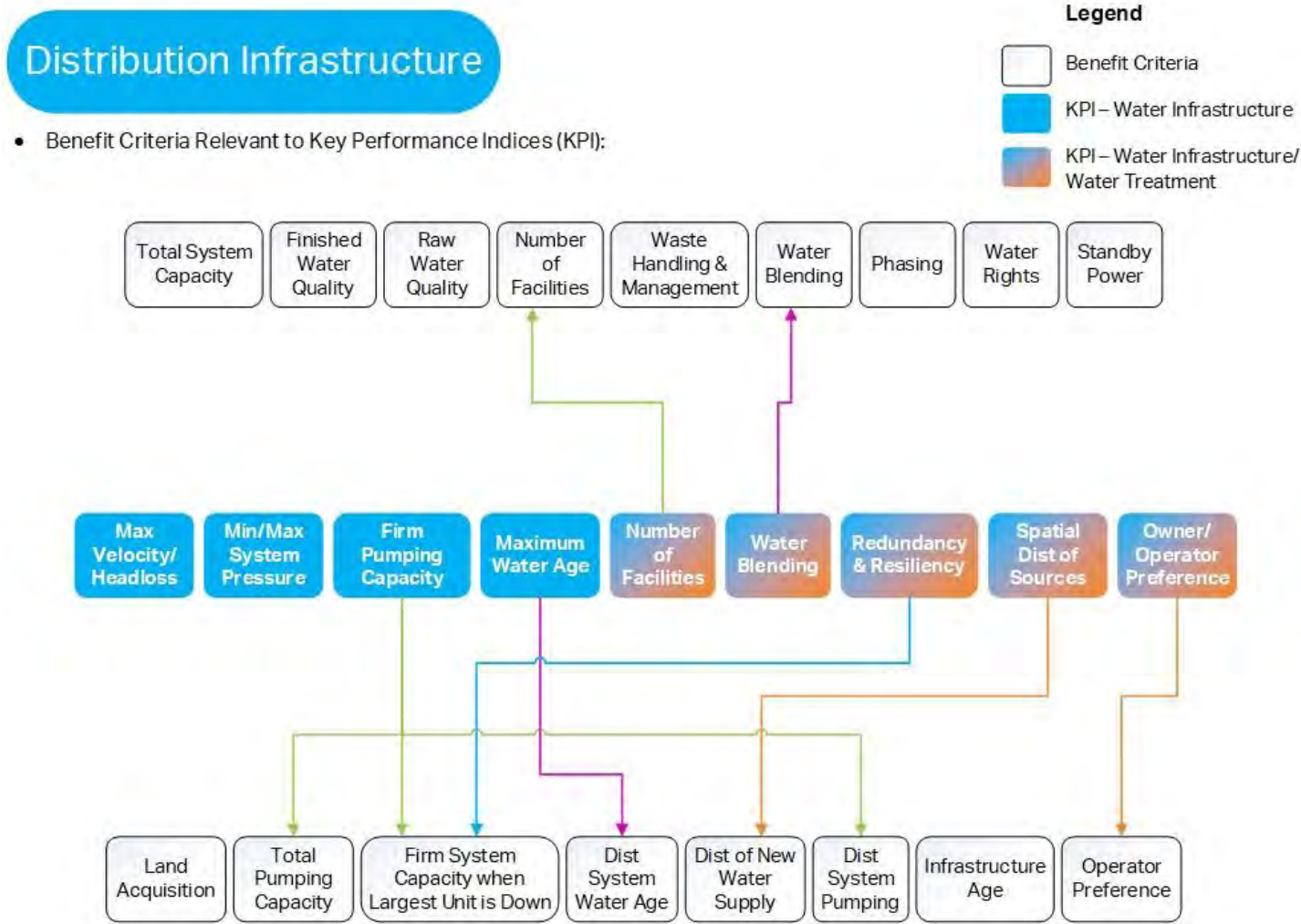


Figure 3.6. Water Treatment Benefit Criteria from Individual Master Plan KPIs



Note: Benefit Category 'Meets COT Needs' applies to all KPI performance criteria.

Figure 3.7. Water Distribution Benefit Criteria from Individual Master Plan KPIs

Alternative Benefit Evaluation

Each of the systems were assigned a score for each of the applicable benefit criteria for each of the alternatives. Scores ranged from 1 to 5, with 1 providing the least benefit and 5 providing the greatest benefit. The scores were assigned based on relative performance related to each alternative. Generally, low scores were not assigned because the alternatives were developed to meet the performance criteria and Thornton's goals' and objectives. Table 3.8 presents the resulting alternative benefit evaluation.

Table 3.8. Alternative Benefit Evaluation Results

Category	Engineering										O&M					Social & Economic		Redundancy & Reliability		Total Benefit Score
Category Weighting	40%										30%					15%		15%		
Criteria	Meets COT Needs	Total System Capacity	Finished Water Quality	Raw Water Quality	Increased No. of Facilities	Waste Handling & Mgmt	Water Blending	Phasing	Water Rights	Standby Power	Operator Preference	Infrastructure Age	Total Pumping Capacity	Dist System Water Age	Distribution of New Water Supply	Land Acquisition	System Capacity when Largest WTP is Down			
Criteria Weighting	20%	10%	10%	10%	10%	10%	10%	10%	10%	18%	23%	13%	23%	23%	50%	50%	100%			
Alternative #1 - Construction of New Water Treatment Plant																				
Raw Water	5	5	5	5	3	-	3	0	5	5	-	-	5	-	3	-	5			
Water Treatment	5	5	5	-	3	5	3	4	-	4	5	5	-	-	5	3	5			
Distribution System	5	5	-	-	3	-	3	0	-	-	5	-	5	5	5	-	5			
Collection System	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-			
Average	5.0	5.0	5.0	5.0	3.0	5.0	3.0	4.0	5.0	4.5	5.0	5.0	5.0	5.0	4.3	3.0	5.0		4.6	
Alternative #2 - Expansion of Thornton Water Treatment Plant																				
Raw Water	5	5	5	4	5	-	5	0	5	5	-	-	5	-	4	-	5			
Water Treatment	5	4	5	-	5	4	5	5	-	5	5	5	-	-	4	5	5			
Distribution System	5	5	-	-	5	-	4	0	-	-	4	-	5	5	5	-	4			
Collection System	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-			
Average	5.0	4.7	5.0	4.0	5.0	4.0	4.7	5.0	5.0	5.0	4.5	5.0	5.0	5.0	4.3	5.0	4.7		4.8	
Alternative #3 - Expansion of Wes Brown Water Treatment Plant																				
Raw Water	5	5	5	3	5	-	4	0	3	5	-	-	5	-	5	-	5			
Water Treatment	5	4	5	-	5	2	3	5	-	4	3	3	-	-	2	4	1			
Distribution System	5	5	-	-	5	-	5	0	-	-	3	-	3	3	2	-	3			
Collection System	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-			
Average	5.0	4.7	5.0	3.0	5.0	2.0	4.0	5.0	3.0	4.5	3.0	3.0	4.0	3.0	3.0	4.0	3.0		3.7	

Sensitivity Analysis

A sensitivity analysis was conducted on the alternative benefit evaluation results. The goal of the sensitivity analysis was to evaluate the impact of each benefit category, benefit criteria, weighting and benefit scores. The sensitivity analysis did not include costs. The sensitivity analysis involved 42 different scenarios that adjusted the benefit weights and scores within a reasonable range. The ranking of the alternatives did not change due to the sensitivity analysis. It was necessary to adjust 40% of the lowest scores to improve the ranking of Alternative 3. This is well beyond a reasonable margin of error; it was then concluded that the alternative benefit evaluation and results were reasonable.

Alternative Cost Benefit Analysis

A summary of the Alternative Benefit Evaluation Results is presented in Table 3.9.

Table 3.9. Summary of Alternative Benefit Evaluation Results

Alternative	Engineering Impacts	O&M Impacts	Social & Economic Impacts	Redundancy & Reliability	Total Benefit Score
Alternative 1	1.8	1.5	0.6	0.8	4.6
Alternative 2	1.9	1.5	0.7	0.7	4.8
Alternative 3	1.7	1.1	0.5	0.5	3.7

A summary of the Alternative Benefit Evaluation Results is presented in Table 3.10.

Table 3.10. Summary of Alternative Costs

Alternative	Capital Cost \$ M	Net O&M Cost \$M	Total Cost \$M
Alternative 1	\$581	\$22	\$603
Alternative 2	\$616	\$7	\$623
Alternative 3	\$636	\$49	\$685

CBA scores for each alternative were calculated by dividing the total benefit score from Table 3.8 by the capital cost and the capital plus (+) O&M costs. The CBA scores are summarized in Table 3.11.

Table 3.11. Cost Benefit Analysis Results

Alternative	CBA Score Capital Only	CBA Score Cap+O&M
Alternative 1	7.9	7.6
Alternative 2	7.7	7.6
Alternative 3	5.8	5.4

Section 3-9 Alternative Cost Benefit Analysis Results

The CBA scores for Alternative 1 and Alternative 2 in Table 3.11 are similar and could be considered roughly comparable, given a reasonable margin of error of the CBA. Alternative 3 has a significantly lower CBA score, roughly 30% less than Alternative 1 and 2. Alternative 3 was removed from further consideration in the alternatives evaluation.

An Alternatives Evaluation Workshop was held to review the advantages and disadvantages associated with Alternatives 1 and 2 to identify the key performance and benefit differentiators between them,

recognizing that the sensitivity of the CBA scores and conclusions is dependent upon Thornton's priorities based on the comparable results for Alternatives 1 and 2 from the CBA.

The top priorities identified by Thornton as the basis to differentiate the performance and benefits associated with Alternatives 1 and 2 are as follows:

Equity of New Water Supply – Based on the New Treatment Plant Supply Trace analysis and discussion in the Water Distribution System Analysis TM, water from the TWP is expected to be distributed to practically all customers within the distribution system for Alternative 1. Depending on the TWP supply delivery throughout the year to the separate WTPs, as much as 98% or greater of all customers will receive TWP water. Alternatives 2 and 3 have similar expectations for water distribution performance.

Smart Planning – The location of the NTWP in Alternative 1 provides the most efficient raw water supply and water distribution. The new treatment facility location best matches the geographic location of future growth. This alternative also utilizes water supplies from the Roger and Hammer reservoirs.

Redundancy and Flexibility – The addition of a third treatment facility in Alternative 1 will provide more redundancy and flexibility. A water treatment system with three independent treatment facilities will allow for one treatment plant to be taken offline for maintenance or expansion while the other two facilities remain in operation.

Limited Public Disruption – Construction in the southern portion of Thornton is difficult because several current roadways and pipeline corridors are located above existing underground utilities. Construction of the NWTP and related capital improvements for supply and distribution will cause less disruption to the public.

Costs – Alternative 1 provides a savings of \$44M in Tier 1 CIP projects compared to Alternative 2. It is difficult to justify the selection of Alternative 2 with this potential savings. The additional staffing of the NWTP does pose a disadvantage in higher O&M costs for Alternative 1; however, these costs do not necessarily outweigh the other advantages of this alternative.

Alternative Selection

Based on the top priorities presented above in parallel with the CBA, Alternative 1 was identified as the preferred alternative for the Utility Master Plan and allows Thornton to best meet future water demands.

Section 3-10 Conclusion

The CIP projects of the three future alternatives developed in the individual Master Plans were combined into three integrated alternatives. Improvements required to meet service goals for the three integrated alternatives in the raw water, water treatment, water distribution and wastewater collection systems were reviewed. A cost comparison was then completed with a review of CBA scores to identify the preferred future treatment supply alternative.

Differentiators between the alternatives were discussed at the Integrated Alternatives Evaluation Workshop. Thornton's top priorities, in parallel with the CBA scores, identified Alternative 1 (construction of a new NWTP) as the preferred alternative for the Utility Master Plan and allows Thornton to best meet future water demands.



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Utility Master Plan

Project No. 17-467

Raw Water Supply Capital Improvement Program
Project Cutsheets Master Plan

The City of Thornton

Project number: 60560104

March 2020

Table 2.13. Raw Water Master CIP Table

CIP ID**	Phase (Project Completion Date)	Purpose	Project Type	Project Description	TWP Prj	Cost	Trigger	Project Timeline (Start / Completion)	
RAW-E03	2020-2025	Tier 1 - Raw Water Quality	Raw Water Quality	Study: Precipitant Addition to Burlington Canal		\$ 70,000	Existing Improvement	2020	2021
RAW-E04	2020-2025	Tier 1 - Raw Water Quality	Raw Water Quality	Study: Feasibility of Floating Solar Panel Installation on Gravel Lakes		\$ 70,000	Existing Improvement	2020	2021
RAW-E05	2020-2025	Tier 1 - Redundancy	Raw Water Quality	Mobile Pump Stations Back-up Power		\$ 11,940,000	Existing Improvement	2021	2022
RAW-E06	2020-2025	Tier 1 - Raw Water Quality	Raw Water Quality	New water quality profiling system and temperature data monitoring system on EGL4		\$ 480,000	Existing Improvement	2020	2021
RAW-F01	2020-2025	Tier 1 - Capacity	Raw Water Supply	Thornton Water Project Phase I - 42-in raw water pipeline from 168th Ave to WBWTP (shown on 2 figures)	x	\$ 56,355,000	Growth - MDD = 74.8 MGD	2022	2025
RAW-F03	2020-2025	Tier 1 - Capacity	Raw Water Supply	Interconnect to deliver TWP water to TWTP & WBWTP, includes the pipe, valves, meters, vaults and connection to SCADA, connect new 42-in TWP pipeline to 36-in Thornton Pkwy pipeline	x	\$ 8,600,000	Growth - MDD = 74.8 MGD	2023	2026
RAW-F08	2020-2025	Tier 1 - Capacity	Raw Water Supply	TWP Bypass pipeline to Gravel Lakes, located near McKay PS, includes tee and approx 20 LF pipe	x	\$ 1,500,000	Growth - MDD = 74.8 MGD	2023	2026
RAW-F09	2020-2025	Tier 1 - Capacity	Raw Water Supply	Chemical Feed Facility located north of 140th Avenue on the TWP pipeline on Quebec Street, sized for buildout capacity	x	\$ 595,000	Growth - MDD = 74.8 MGD	2024	2025
RAW-E01	2025-2035	Tier 1 - Raw Water Quality	Raw Water Quality	Interconnect to allow Gravel Lakes operation in series and for McKay PS deliver directly to WBWTP & TWTP, includes moderate length of pipe and valving to connect 36-inch McKay pipeline to 54-inch WBWTP supply and 36-inch Thornton Pkwy pipeline		\$ 3,530,000	Existing Improvement	2026	2027
RAW-E02	2025-2035	Tier 1 - Raw Water Quality	Raw Water Quality	Raw water pipeline from WGL2 to EGL4 with pump station		\$ 6,840,000	Existing Improvement	2026	2027
RAW-F04	2025-2035	Tier 1 - Capacity	Raw Water Supply	36-in raw water pipeline from Quebec St & 140th to NWTP		\$ 10,160,000	Growth - MDD = 74.8 MGD	2026	2027
RAW-F05	2025-2035	Tier 1 - Capacity	Raw Water Supply	24-in Raw water pipeline from Hammer Reservoir to Quebec St & E-470 Ave and New Pump Station		\$ 11,530,000	Growth - MDD = 74.8 MGD	2025	2026
RAW-F06	2025-2035	Tier 2 - Water Quality	Raw Water Supply	Feasibility study to add 10 MG capacity to McKay Pump Station.		\$ 210,000	Growth - MDD = 74.8 MGD	2026	2027
RAW-F10	2025-2035	Tier 2 - Water Quality	Raw Water Supply	Addition of 10 MGD capacity at McKay PS, includes new pump with VFD, electrical upgrade, bldg expansion and chemical feed equipment increase feed capacity		\$ 10,000,000	Growth - MDD = 74.8 MGD	2028	2029
RAW-F11	2025-2035	Tier 1 - Water Quality	Raw Water Supply	Chemical Feed Facility located at McKay PS, building sized for 20 mgd, equipment sized for 10 mgd		\$ 595,000	Growth - MDD = 74.8 MGD	2026	2027
RAW-F02	2035-2065	Tier 2 - Capacity	Raw Water Supply	Thornton Water Project Phase II - 42-in raw water pipeline from WBWTP to TWTP along Hoffman Way	x	\$ 8,645,000	Tier 2 Improvement	2035	2036
RAW-F07	2035-2065	Tier 2 - Redundancy	Raw Water Supply	24-in Raw water pipeline from Rogers Reservoir to Quebec St & 168 th Ave and New Pump Station		\$ 17,660,000	Tier 2 Improvement	2040	2041
RAW-F12	2035-2065	Tier 3 - Redundancy	Raw Water Supply	Redundant Thornton Water Project Phase I - raw water pipeline 168th Ave to WBWTP		\$ 56,355,000	Tier 3 Improvement	N/A	N/A
RAW-F13	2035-2065	Tier 3 - Redundancy	Raw Water Supply	Redundant Thornton Water Project Phase II - WBWTP to TWTP		\$ 8,645,000	Tier 3 Improvement	N/A	N/A
RAW-F14	2035-2065	Tier 3 - Redundancy	Raw Water Supply	Redundant raw water pipeline from Quebec Blvd & 140th to NWTP		\$ 10,160,000	Tier 3 Improvement	N/A	N/A
RAW-F15	2035-2065	Tier 3 - Redundancy	Raw Water Supply	Redundant raw water pipeline from Standley Lake to TWTP - 48 inch portion		\$ 43,830,000	Tier 3 Improvement	N/A	N/A
RAW-F16	2035-2065	Tier 3 - Redundancy	Raw Water Supply	Redundant raw water pipeline from Standley Lake to TWTP - 36 inch portion		\$ 19,580,000	Tier 3 Improvement	N/A	N/A
RAW-F17	2035-2065	Tier 3 - Redundancy	Raw Water Supply	Redundant raw water pipeline from EGL4 to TWTP (include river crossing)		\$ 21,600,000	Tier 3 Improvement	N/A	N/A
RAW-F18	2035-2065	Tier 3 - Redundancy	Raw Water Supply	Redundant raw water pipeline from EGL4 to WBWTP (include river crossing)		\$ 8,000,000	Tier 3 Improvement	N/A	N/A
RAW-F19	2035-2065	Tier 3 - Redundancy	Raw Water Supply	Redundant raw water pipeline from McKay to WBWTP (parallel existing 36 inch to EGL#4, no river crossing)		\$ 15,160,000	Tier 3 Improvement	N/A	N/A
RAW-F20	2035-2065	Tier 3 - Energy Cost Savings	Sustainability	Study: Micro-Hydro Power on Standley Lake Supply Pipeline		\$ 40,000	Tier 3 Improvement	N/A	N/A
RAW-F21	2035-2065	Tier 3 - Reduce Raw Water Losses	Sustainability	Study: Water Evaporation Reduction Technologies on RWGLS		\$ 70,000	Tier 3 Improvement	N/A	N/A

**Project Cutsheets not provided for Tier 3 improvements

*CIP ID LEGEND:

PREFIX DEFINITION

RAW = Raw Water Supply System Project

WTP = Water Treatment Facilities Project

DD = Water Distribution System Project / Distribution Pipeline

TT= Water Distribution System Project / Transmission Pipeline

P = Water Distribution System Project / Pump

SS = Water Distribution System Project / Storage

WW = Wastewater Collection System Project

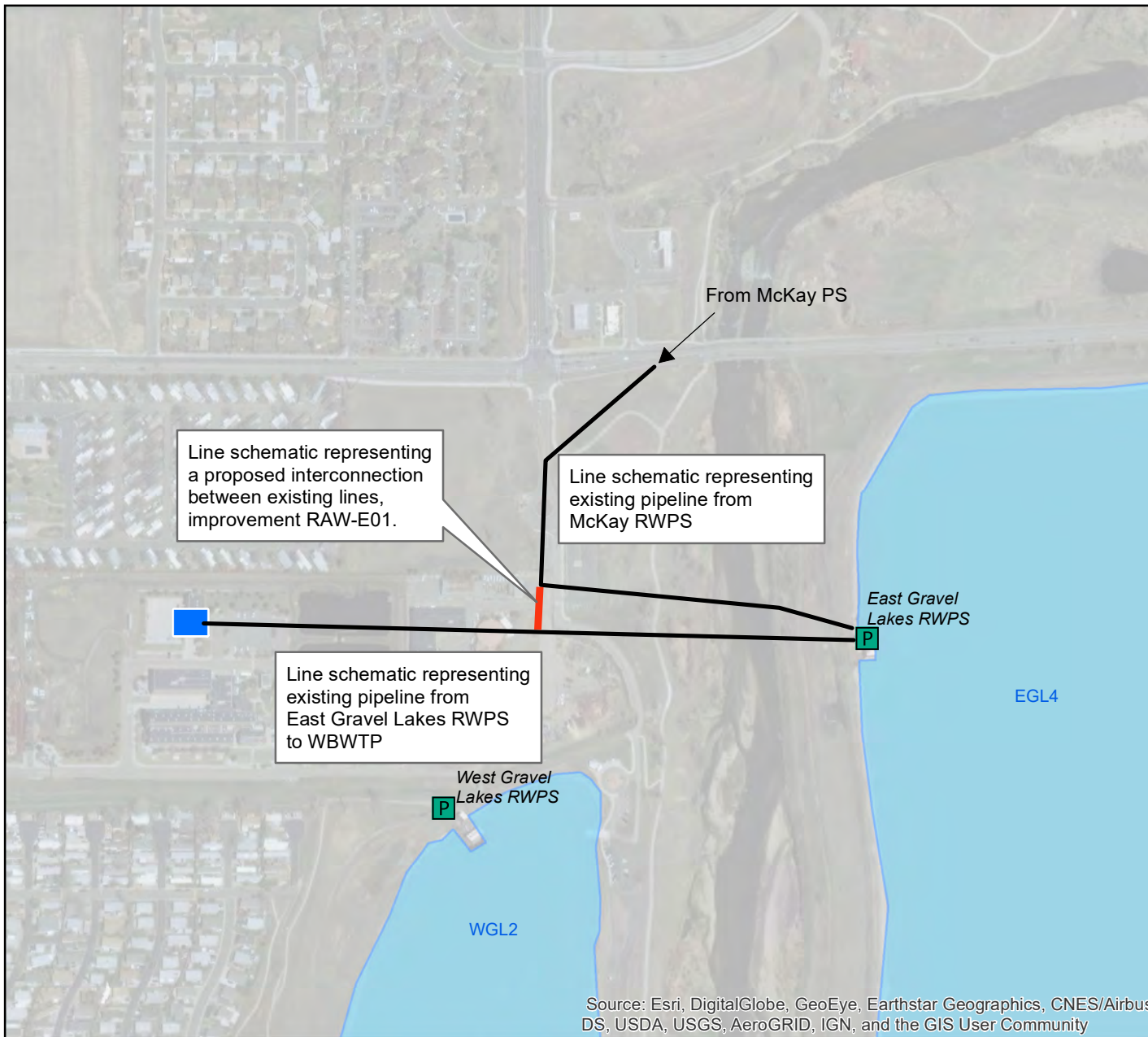
SUFFIX DEFINITION

E = Existing System Deficiency

F = Future System Improvement

*CIP ID's for Water Distribution and Wastewater Collection are organized without suffix in the Water and Wastewater Infrastructure Master Plan and on CIP project cutsheets

Trigger	Description
Existing Improvement	Improvement is required to address an existing deficiency
Growth - Average System Demand = 37mgd	Improvement will be required in the future, pending on expected growth
Growth - Average System Demand = 44mgd	Improvement will be required in the future, pending on expected growth
Developments north of E 156th Avenue	Improvement will serve future developments, pending on localized growth
WBWTP Upgrade	Improvement will support increase in supply capacity at WBWTP
Growth North of E-470	Improvement will serve future developments, pending on localized growth
Zone 1 Storage Upgrade	Improvement will support increase in storage capacity
Zone 3 Storage Upgrade	Improvement will support increase in storage capacity
NWTP Construction	Improvement will support supply improvements at NWTP
70% Measured Sewer Flow =	Improvement is required to meet future flows
Growth - Max Day Demand = 74.8 mgd	Improvement will be required in the future, pending on expected growth
Growth - Max Day Demand = 85.6 mgd	Improvement will be required in the future, pending on expected growth
Tier 2	Improvement identified as Tier 2
Tier 3	Improvement identified as Tier 3



Legend

- P Raw Water Supply Pump Station
- WTP
- CIP Project
- Gravel Lakes

Project Information

Raw water pipeline interconnect to allow for McKay PS to deliver directly to WBWTP and TWTP, and for the Gravel Lakes to operate in series. The interconnect will connect the existing 36-in McKay pipeline to the 54-in WBWTP feed and the 36-in Thornton Pkwy pipeline. The interconnect consists of a valve vault, moderate length of pipe and flow control valves, meters for each WTP and connection to SCADA.

Cost

\$3,530,000

Phase

2025-2035

Purpose

Tier 1 - Raw Water Quality

Trigger

Existing

WTP

Wes Brown/Thornton

 City of Thornton
9500 Civic Center Drive
Thornton, Colorado 80229
(303) 538-7295

AECOM
6200 South Quebec Street
Greenwood Village, Colorado 80111

Raw Water Improvements

CIP RAW-E01








1 inch = 500 feet



Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

Legend

-  Raw Water Supply Pump Station
-  Raw Water Pumping Improvement
-  WTP
-  CIP Project
-  Gravel Lakes

Project Information

Raw water pipeline from WGL2 to EGL4 with pump station. Includes river crossing. Improvement allows for Gravel Lakes to be operated in series.

Cost

\$6,840,000

Phase

2025-2035

Purpose

Tier 1 - Raw Water Quality

Trigger

Existing

WTP

Wes Brown/Thornton

 City of Thornton
9500 Civic Center Drive
Thornton, Colorado 80229
(303) 538-7295

Raw Water Improvements

CIP RAW-E02

AECOM
6200 South Quebec Street
Greenwood Village, Colorado 80111



1 inch = 800 feet

Raw Water Improvements

CIP ID: RAW-E03

Project Information: Pilot study on effectiveness and operational cost of precipitant addition on the Burlington Canal water for phosphorus reduction

Potential Resulting CIP: Addition of new coagulant feed equipment on the Burling Canal Diversion.

Cost: \$70,000

Phase: 2020 - 2025

Purpose: Tier 1 – Raw Water Quality

Trigger: Existing Improvement

WTP: Wes Brown



9500 Civic Center Drive
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Greenwood Village, Colorado 80111

Raw Water Improvements

CIP ID: RAW-E04

Project Information: Evaluation of feasibility of installing floating solar panels on Gravel Lakes. Benefits of the solar panels are renewable power generation for operation of adjacent pump stations, reduction of water temperature, algae production and taste and odor events, and reduction of water evaporation. Goals of the study include identification of equipment capital cost and equipment sizing for maximized rate of return.

Potential Resulting CIP: Addition of solar energy generation equipment on Gravel Lakes.

Cost: \$70,000

Phase: 2020 - 2025

Purpose: Tier 1 – Raw Water Quality

Trigger: Existing Improvement

WTP: Wes Brown



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Raw Water Improvements

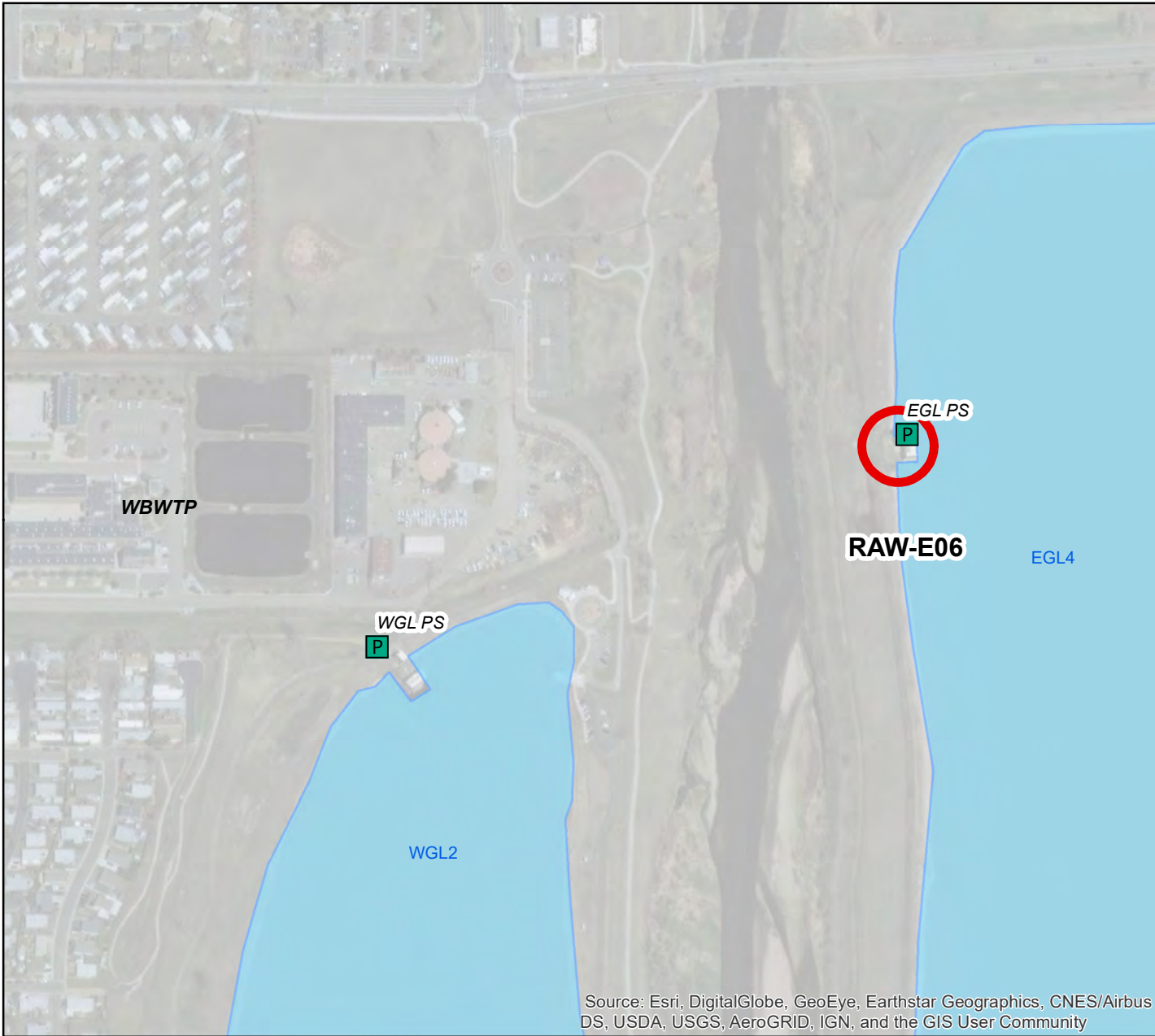
CIP ID:	RAW-E05
Project Information:	New Mobile Generator Sets sized to provide backup power for EGL Pump Station, WGL Pump Station or McKay Pump Station. Includes modifications to pump stations to accommodate generators, installation of transfer switches and conduit/conductors.
Cost:	\$11,940,000
Phase:	2020-2025
Purpose:	Tier 1 – Redundancy
Trigger:	Existing Improvement
WTP:	Wes Brown






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(303) 538-7295



6200 South Quebec Street
Greenwood Village, Colorado 80111



Legend

-  Raw Water Supply Pump Station
-  Project Location
-  Gravel Lakes

Project Information

New water quality profiling system and temperature data monitoring system on EGL4. Buoy mounted.

Cost

\$480,000

Phase

2020-2025

Purpose

Tier 1 - Raw Water Quality

Trigger

Existing

WTP

Wes Brown/Thornton

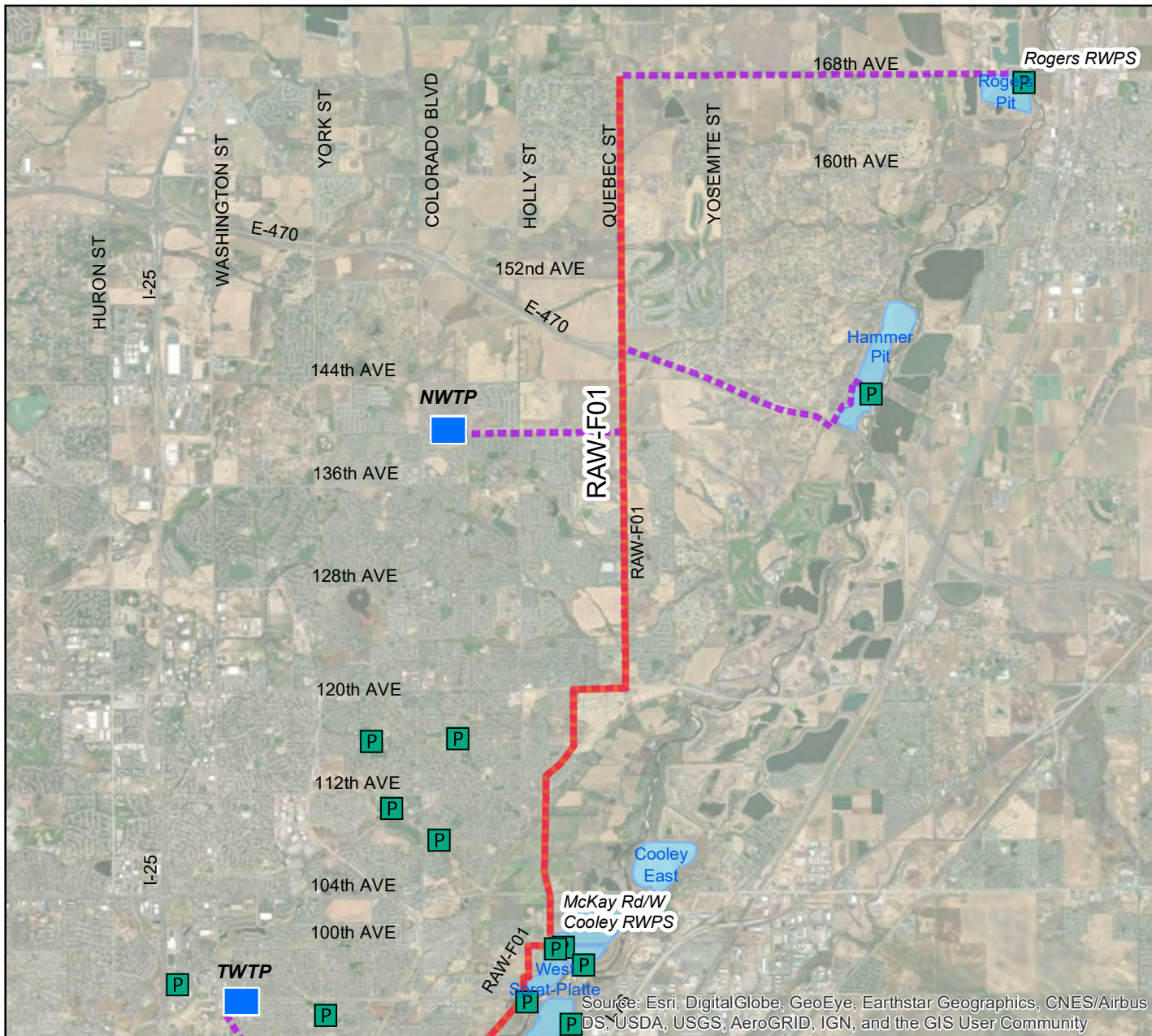
 **City of Thornton**
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Thornton, Colorado 80229
(303) 538-7295

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6200 South Quebec Street
Greenwood Village, Colorado 80111

Raw Water Improvements
CIP RAW-E06



1 inch = 400 feet



Legend

- WTP
- P Raw Water Supply Pump Station
- CIP Project
- Other Improvements
- Gravel Lakes

Project Information

Phase I of New Thornton Water Project (TWP) 42-in, approximately 13 miles raw water pipeline from 168th Ave to WBWTP.

Cost

\$56,355,000

Phase

2020-2025

Purpose

Tier 1 - Capacity

Trigger

Growth - Max Day Demand = 74.8 MGD

WTP

Wes Brown / Thornton / Northern

City of Thornton
9500 Civic Center Drive
Thornton, Colorado 80229
(303) 538-7295

AECOM
6200 South Quebec Street
Greenwood Village, Colorado 80111

Raw Water Improvements

CIP RAW-F01 Figure 1 of 2



1 inch = 8,000 feet



Legend

- WTP
- P Raw Water Supply Pump Station
- CIP Project
- Other Improvements
- Gravel Lakes

Project Information

Phase I of New Thornton Water Project (TWP) 42-in, approximately 13 miles raw water pipeline from 168th Ave to WBWTP.

Cost

\$56,355,000

Phase

2020-2025

Purpose

Tier 1 - Capacity

Trigger

Growth - Max Day Demand = 74.8 MGD

WTP

Wes Brown / Thornton

 City of Thornton
9500 Civic Center Drive
Thornton, Colorado 80229
(303) 538-7295

AECOM
6200 South Quebec Street
Greenwood Village, Colorado 80111

Raw Water Improvements

CIP RAW-F01 Figure 2 of 2



1 inch = 2,500 feet



Legend

- WTP
- P Raw Water Supply Pump Station
- CIP Project
- Other Improvements
- Gravel Lakes

Project Information

Phase II of New Thornton Water Project (TWP) 42-in, approximately 2 miles raw water pipeline from WBWTP to TWTP.

Cost

\$8,645,000

Phase

2035-2065

Purpose

Tier 2 - Capacity

Trigger

Tier 2 Improvement

WTP

Thornton

 City of Thornton
9500 Civic Center Drive
Thornton, Colorado 80229
(303) 538-7295

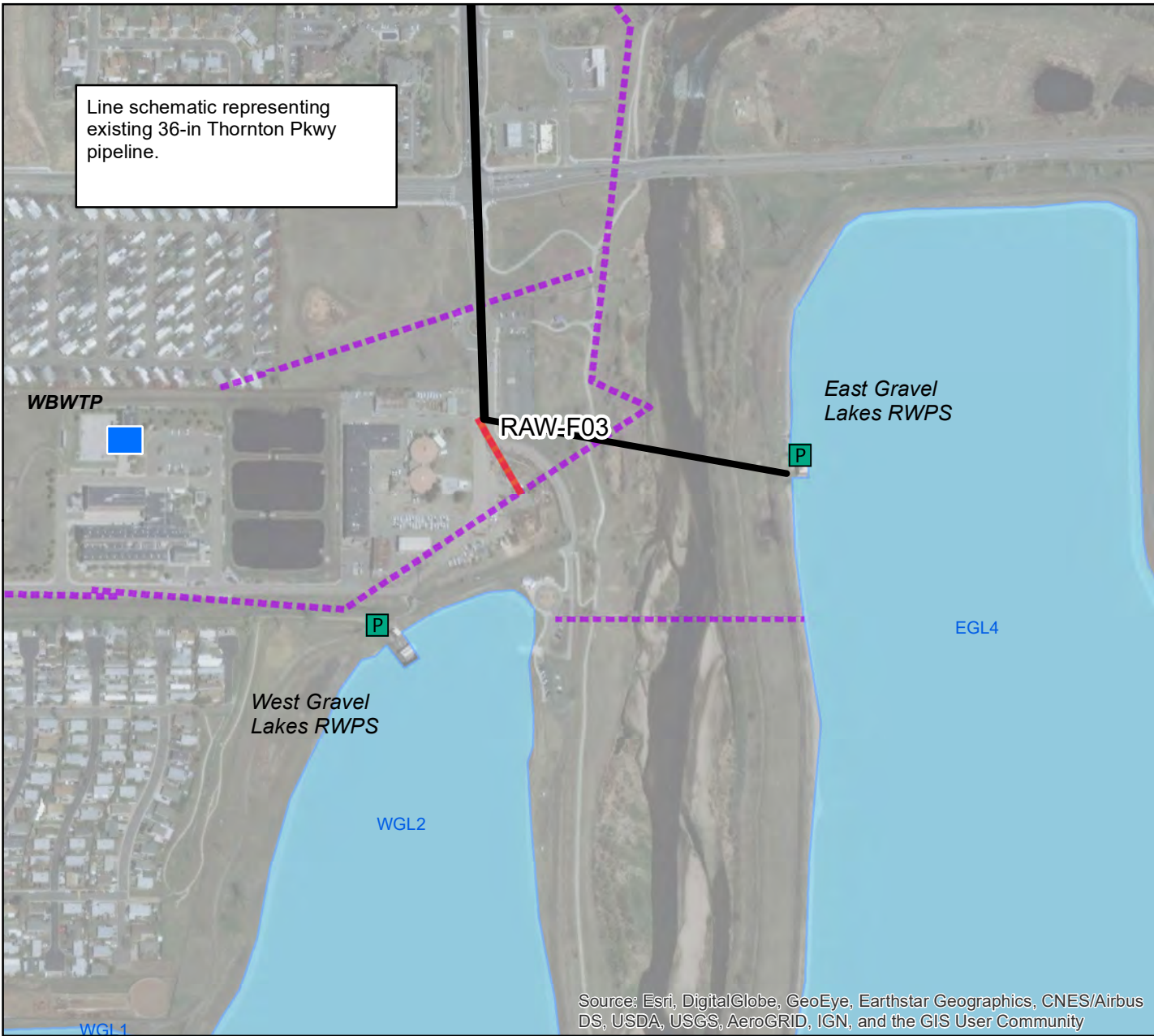
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Greenwood Village, Colorado 80111

Raw Water Improvements

CIP RAW-F02



1 inch = 2,000 feet



Legend

- WTP
- P Raw Water Supply Pump Station
- CIP Project
- Other Improvements
- Gravel Lakes

Project Information

Raw water pipeline interconnect to allow TWP water to be delivered to TWTP & WBWTP. The interconnect will connect the new TWP 42-in pipeline to the existing 36-in Thornton Pkwy pipeline (RAW-F01). The interconnect consists of a valve vault, moderate length of pipe, valves, meters and connection to SCADA.

Cost

\$8,600,00

Phase

2020-2025

Purpose

Tier 1 - Capacity

Trigger

Growth - Max Day Demand = 74.8 MGD

WTP

Wes Brown / Thornton

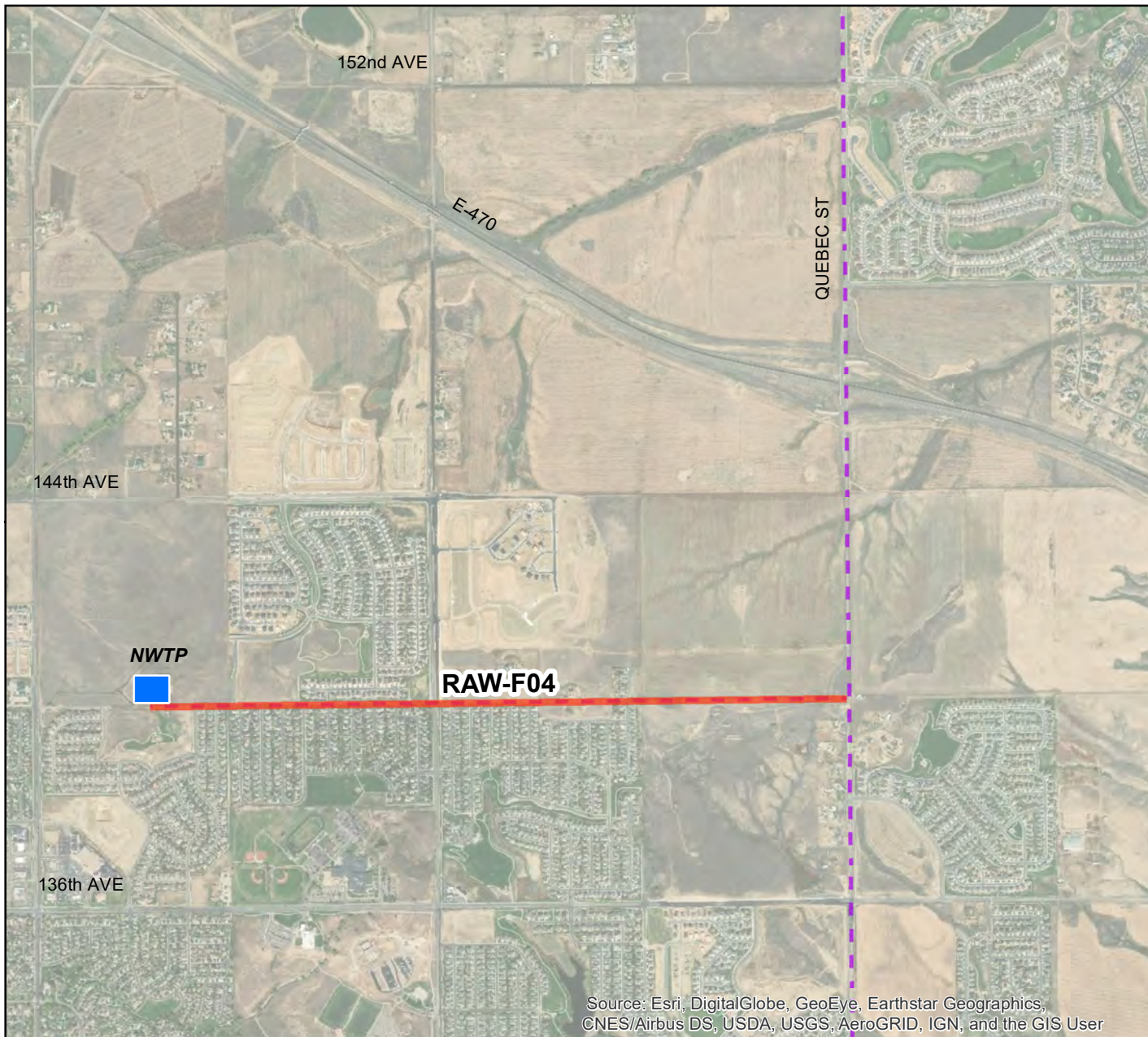
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Greenwood Village, Colorado 80111

Raw Water Improvements CIP RAW-F03



1 inch = 500 feet



Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User

Legend

- WTP
- P Gravel Lakes Pump Station
- CIP Project
- - Other Improvements
- Gravel Lakes

Project Information

New 36-in, approximately 10,600 ft raw water pipeline from intersection of Quebec St and 140th Ave to NWTP.

Cost

\$10,160,000

Phase

2025-2035

Purpose

Tier 1 - Capacity

Trigger

Growth - Max Day Demand = 74.8 MGD

WTP

Northern

 City of Thornton
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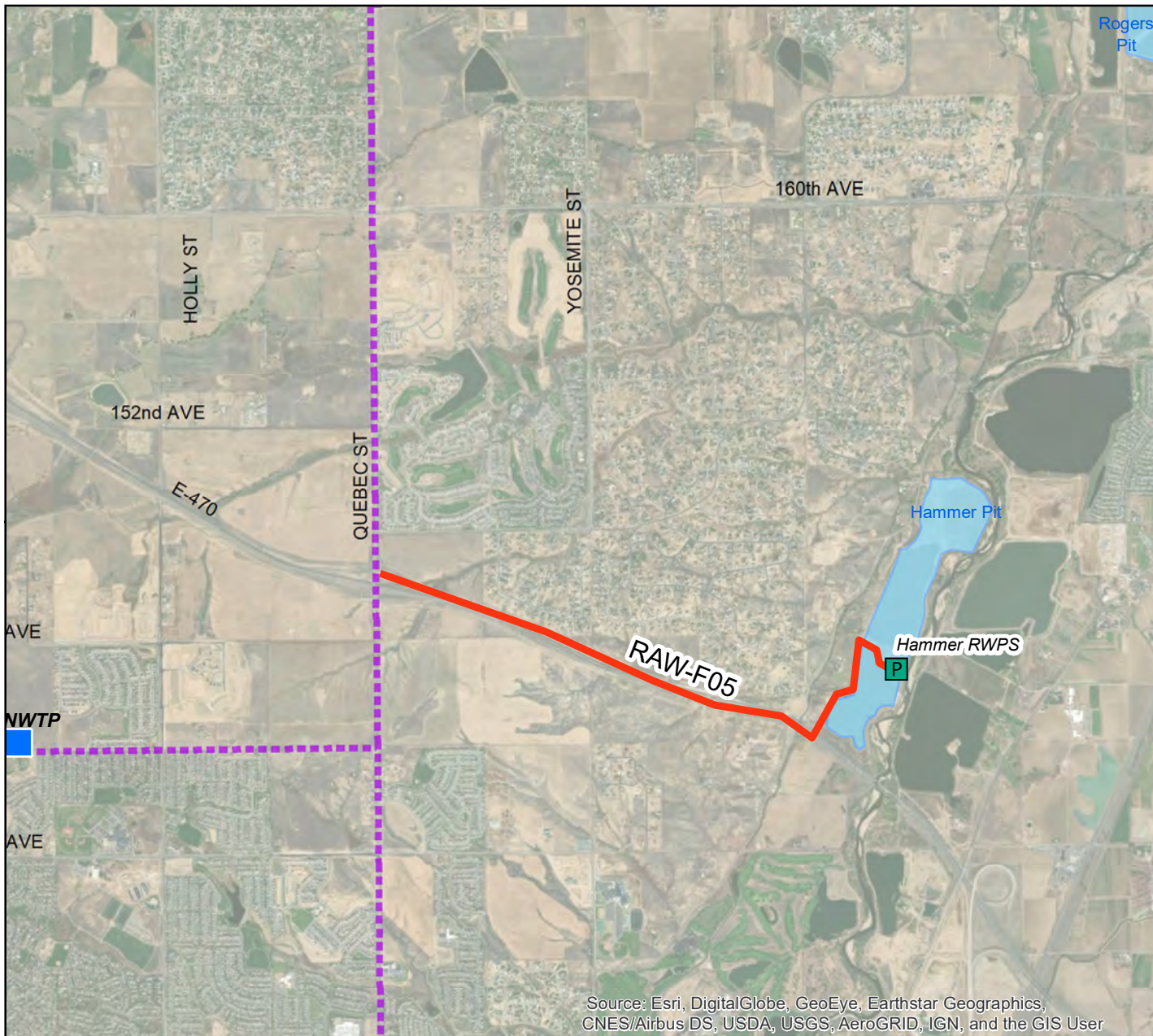
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Raw Water Improvements

CIP RAW-F04



1 inch = 2,000 feet



Legend

- WTP
- P Raw Water Supply Pump Station
- CIP Project
- Other Improvements
- Gravel Lakes

Project Information

New 24-in, 2.7 mile raw water pipeline from Hammer Reservoir to intersection of Quebec St and E-470. Improvements include new pump station.

Cost

\$11,530,000

Phase

2025-2035

Purpose

Tier 1 - Capacity

Trigger

Growth - Max Day Demand = 74.8 MGD

WTP

Northern

 City of Thornton
9500 Civic Center Drive
Thornton, Colorado 80229
(303) 538-7295

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6200 South Quebec Street
Greenwood Village, Colorado 80111

Raw Water Improvements

CIP RAW-F05



1 inch = 3,835 feet



Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

Legend

- Raw Water Supply Pump Station
- Project Location
- Gravel Lakes

Project Information

Study to evaluate options to add 10 MGD of capacity to McKay PS. Existing system curves will be evaluated. Possible outcomes are addition of VFD's to existing pumps, piping improvements to take advantage of available head, or addition of new pumps.

Cost

\$210,000

Phase

2025-2035

Purpose

Tier 2 - Water Quality

Trigger

Growth - Max Day Demand = 74.8 MGD

WTP

Wes Brown/Thornton

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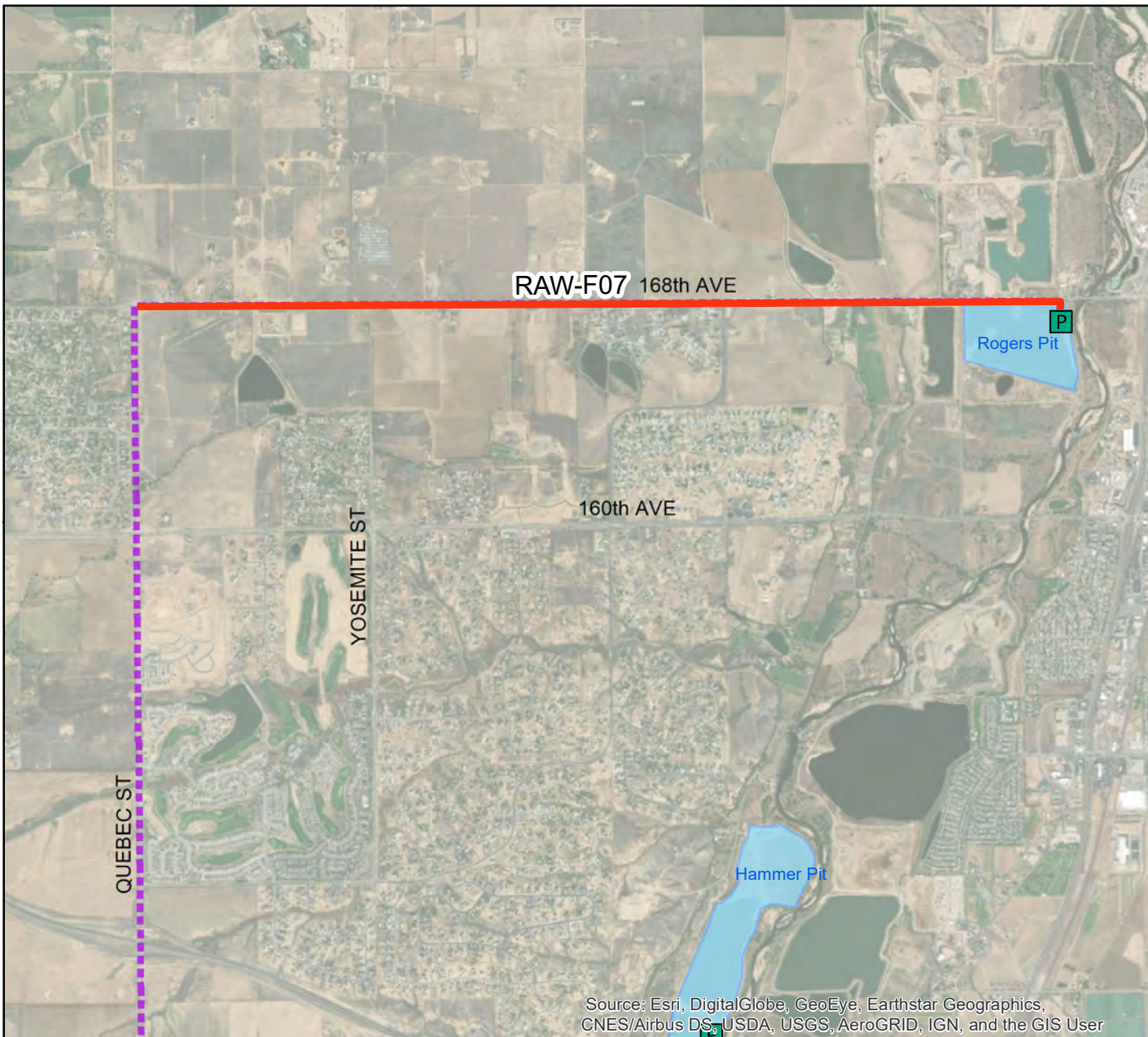
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 Greenwood Village, Colorado 80111

Raw Water Improvements

CIP RAW-F06



1 inch = 400 feet



Legend

- WTP
- Raw Water Supply Pump Station
- CIP Project
- TWP Alignment
- Gravel Lakes

Project Information

New 24-in, 21,600 ft raw water pipeline from Rogers Reservoir to intersection of Quebec St and 168th Ave. Improvements include new pump station.

Cost

\$17,660,000

Phase

2035-2065

Purpose

Tier 2 - Redundancy

Trigger

Tier 2 Improvement

WTP

Northern

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Raw Water Improvements

CIP RAW-F07



1 inch = 3,500 feet



Legend

- WTP
- P Raw Water Supply Pump Station
- CIP Project
- Other Improvements
- Gravel Lakes

Project Information

TWP bypass pipeline to Gravel Lakes. Improvement includes tee and approximately 20 ft of pipe.

Cost

\$1,500,000

Phase

2020-2025

Purpose

Tier 1 - Capacity

Trigger

Growth - Max Day Demand = 74.8 MGD

WTP

Wes Brown / Thornton

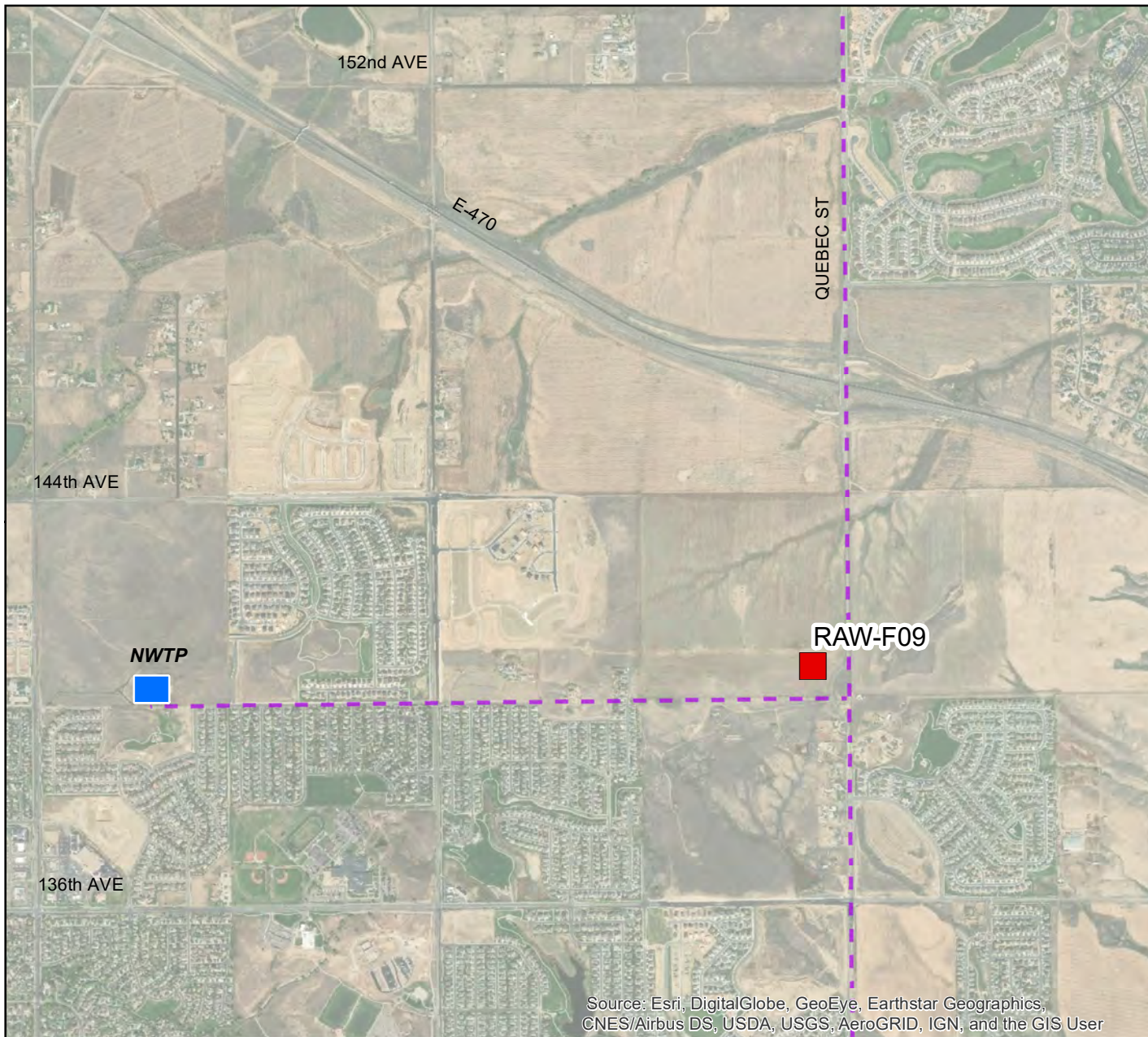
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Raw Water Improvements CIP RAW-F08



1 inch = 500 feet



Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User

Legend

- CIP Project
- WTP
- P Raw Water Supply Pump Station
- Other Improvements
- Gravel Lakes

Project Information

Construction of new chemical feed facility on new 42-in TWP raw water pipeline (RAW-F01), upstream of tee with new 36-in raw water pipeline to NWTP (RAW-F04).

Cost

\$595,000

Phase

2020-2025

Purpose

Tier 1 - Capacity

Trigger

Growth - Max Day Demand = 74.8 MGD

WTP

Northern

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Greenwood Village, Colorado 80111

Raw Water Improvements

CIP RAW-F09






1 inch = 2,000 feet



Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

Legend

-  Raw Water Supply Pump Station
-  Project Location
-  Gravel Lakes

Project Information

Addition of 10 MGD capacity to McKay PS, includes new pump with VFD, electrical upgrade, and building expansion.

Cost

\$10,000,000

Phase

2025-2035

Purpose

Tier 2 - Water Quality

Trigger

Growth - Max Day Demand = 74.8 MGD

WTP

Wes Brown/Thornton

 City of Thornton
9500 Civic Center Drive
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Greenwood Village, Colorado 80111

Raw Water Improvements




CIP RAW-F10



1 inch = 400 feet



Legend

-  Raw Water Supply Pump Station
-  Project Location
-  Gravel Lakes

Project Information

Construction of new chemical feed facility located at McKay PS

Cost

\$595,000

Phase

2025-2035

Purpose

Tier 1 - Water Quality

Trigger

Growth - Max Day Demand = 74.8 MGD

WTP

Wes Brown/Thornton

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Raw Water Improvements
CIP RAW-F11



1 inch = 400 feet



Imagine it.
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Utility Master Plan

Project No. 17-467

Water Treatment Facilities Capital Improvement
Program Project Cutsheets

The City of Thornton

Project number: 60560104

March 2020

Table 2.14. Water Treatment Master CIP Table

CIP ID**	Phase (Project Completion Date)	Purpose	Project Type	Project Description	Cost	Dependant CIP	Trigger	Project Timeline (Start / Completion)	
WTP-E01	2020-2025	Tier 1 - Water Quality	Water Treatment	Existing WBWTP Improvement: Convert to alumimun-based coagulants from iron-based coagulants	\$ -		Existing Improvement	2020	2021
WTP-E02	2020-2025	Tier 1 - Water Quality	Water Treatment	Existing WBWTP Improvement: Improvements for PAC dry storage and installation of PAC wetting system	\$ 710,000	WTP-E01	Existing Improvement	2020	2021
WTP-E03	2020-2025	Tier 1 - Capacity	Water Treatment	Existing WBWTP Improvement: Increase membrane surface area by using older membranes to equip unused cassettes	\$ -		Existing Improvement	2020	2021
WTP-E04	2020-2025	Tier 1 - Operations	Water Treatment	Existing WBWTP Improvement: Residuals management improvement, addition of 70,000 sq ft of lagoons	\$ 1,100,000		Existing Improvement	2020	2021
WTP-E05	2020-2025	Tier 1 - Operations	Water Treatment	Existing WBWTP Improvement: Study to evaluate clarifier flow distribution	\$ 30,000		Existing Improvement	2020	2021
WTP-E06	2020-2025	Tier 1 - Water Quality	Water Treatment	Existing WBWTP Improvement: Study to Eliminate Recycling for Clean-in-Place Wastes	\$ 30,000		Existing Improvement	2020	2021
WTP-E07	2020-2025	Tier 1 - Water Quality	Water Treatment	Existing WBWTP Improvement: Study to determine best practices for lagoon discharge water management	\$ 50,000	WTP-E06,E08	Existing Improvement	2020	2021
WTP-E08	2020-2025	Tier 1 - Water Quality	Water Treatment	Existing WBWTP Improvement: Study to determine best practices to manage water treatment residuals	\$ 110,000		Existing Improvement	2020	2021
WTP-E09	2020-2025	Tier 1 - Maintenance	Water Treatment	Existing WBWTP Improvement: Clarifier Coating Rehabilitation	\$ 500,000		Existing Improvement	2020	2021
WTP-E10	2020-2025	Tier 1 - Redundancy	Water Treatment	Existing WBWTP Improvement: Additional air compressor and reject pump for membrane system	\$ 500,000		Existing Improvement	2020	2021
WTP-E11	2020-2025	Tier 1 - Capacity	Water Treatment	Existing WBWTP Improvement: Expansion of Membrane Train 8	\$ 1,840,000		Existing Improvement	2020	2021
WTP-E12	2020-2025	Tier 1 - Maintenance	Water Treatment	Existing WBWTP Improvement: Coagulant Tank Repairs	\$ 30,000		Existing Improvement	2020	2021
WTP-F01	2020-2025	Tier 1 - Capacity	Water Treatment	Land Acquisition for NWTP	\$ 3,000,000		Growth - MDD = 74.8 MGD	2025	2026
WTP-F02	2025-2035	Tier 1 - Capacity	Water Treatment	New NWTP Phase I - 10.75 MGD capacity, treatment plant only, does not include dewatering, finished water storage tank, off site power supply to transformer	\$ 43,842,000		Growth - MDD = 74.8 MGD	2027	2030
WTP-F03	2025-2035	Tier 1 - Capacity	Water Treatment	Mechanical Dewatering Infrastructure	\$ 15,620,000		Growth - MDD = 74.8 MGD	2029	2030
WTP-F04	2025-2035	Tier 1 - Capacity	Water Treatment	Power Supply to NWTP, baseline power supply cost, including offsite infrastructure and power supply to transformer	\$ 1,990,000		Growth - MDD = 74.8 MGD	2028	2029
WTP-F05	2025-2035	Tier 1 - Redundancy	Water Treatment	Standby Power (Tier 1 – Provide Standby Generator for Full Production)	\$ 2,210,000		Growth - MDD = 74.8 MGD	2028	2029
WTP-F06	2025-2035	Tier 2 - Redundancy	Water Treatment	Standby Power (Tier 2 – Upgrade to Second Utility feed)	\$ 1,330,000		Growth - MDD = 74.8 MGD	2028	2029
WTP-F07	2035-2065	Tier 1 - Capacity	Water Treatment	NWTP Phase II - additional 10.75 MGD capacity	\$ 43,842,000		Growth - MDD = 85.6 MGD	2046	2047
WTP-F08	2035-2065	Tier 3	Water Treatment	Standby Power (Tier 3 – Upgrade to Emergency Generator meeting NEC)	\$ 220,000		Growth - MDD = 74.8 MGD	N/A	N/A

**Project Cutsheets not provided for Tier 3 improvements

*CIP ID LEGEND:

PREFIX DEFINITION

RAW = Raw Water Supply System Project

WTP = Water Treatment Facilities Project

DD = Water Distribution System Project / Distribution Pipeline

TT= Water Distribution System Project / Transmission Pipeline

P = Water Distribution System Project / Pump

SS = Water Distribution System Project / Storage

WW = Wastewater Collection System Project

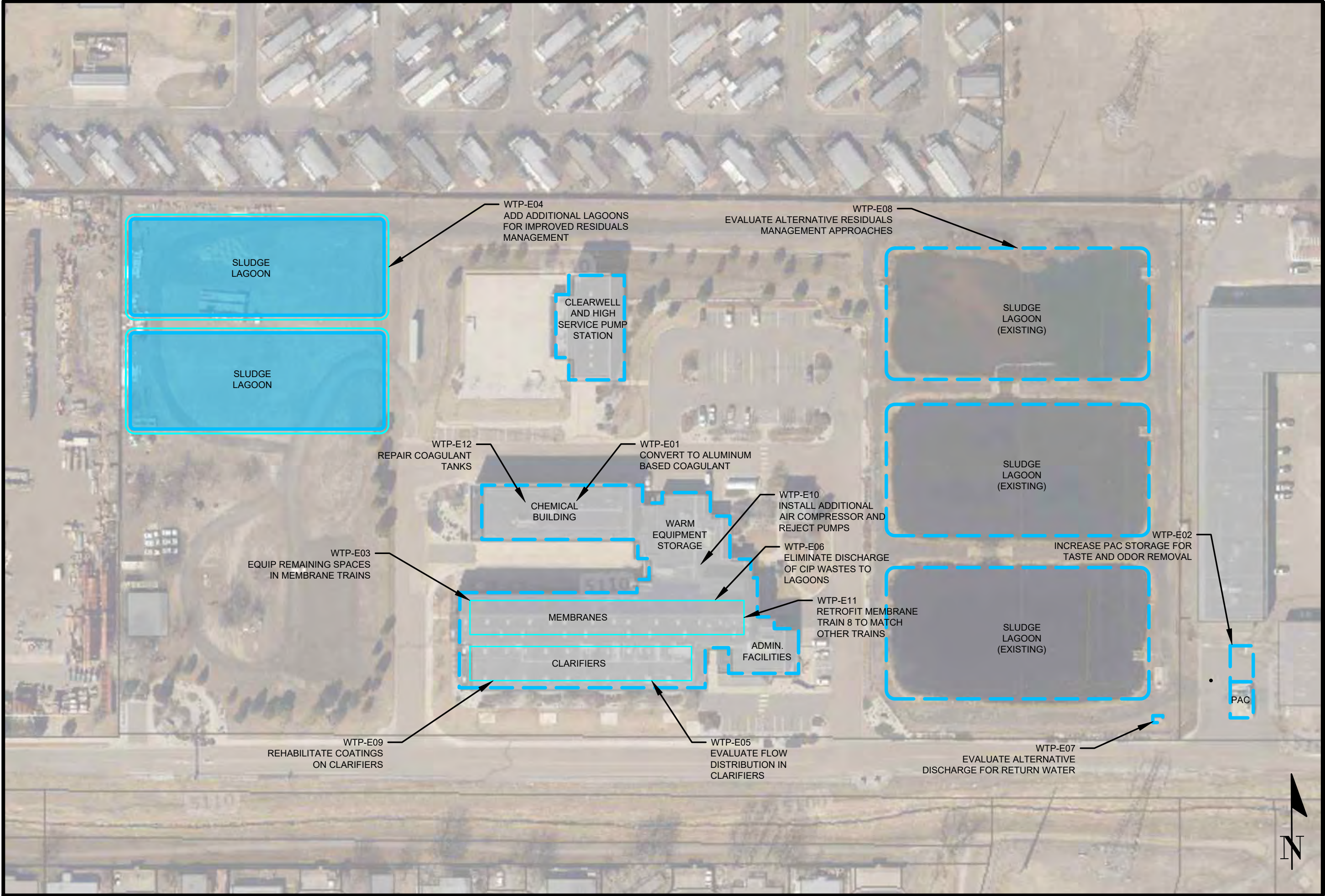
SUFFIX DEFINITION

E = Existing System Deficiency

F = Future System Improvement

*CIP ID's for Water Distribution and Wastewater Collection are organized without suffix in the Water and Wastewater Infrastructure Master Plan and on CIP project cutsheets

Trigger	Description
Existing Improvement	Improvement is required to address an existing deficiency
Growth - Average System Demand = 37mgd	Improvement will be required in the future, pending on expected growth
Growth - Average System Demand = 44mgd	Improvement will be required in the future, pending on expected growth
Developments north of E 156th Avenue	Improvement will serve future developments, pending on localized growth
WBWTP Upgrade	Improvement will support increase in supply capacity at WBWTP
Growth North of E-470	Improvement will serve future developments, pending on localized growth
Zone 1 Storage Upgrade	Improvement will support increase in storage capacity
Zone 3 Storage Upgrade	Improvement will support increase in storage capacity
NWTP Construction	Improvement will support supply improvements at NWTP
70% Measured Sewer Flow =	Improvement is required to meet future flows
Growth - Max Day Demand = 74.8 mgd	Improvement will be required in the future, pending on expected growth
Growth - Max Day Demand = 85.6 mgd	Improvement will be required in the future, pending on expected growth
Tier 2	Improvement identified as Tier 2
Tier 3	Improvement identified as Tier 3



Water Treatment Improvements

CIP ID:	WTP-E01
Project Information:	Convert to aluminum-based coagulants from iron-based coagulants at WBWTP.
Cost:	\$0
Phase:	2020 - 2025
Purpose:	Tier 1 – Water Quality
Trigger:	Existing Improvement
WTP:	Wes Brown



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Water Treatment Improvements

CIP ID: WTP-E02

Project Information: Improvements at WBWTP for PAC dry storage and installation of PAC wetting system. Improve piping configuration, ensure long radius elbows, additional hose connection points for regular flushing, additional dismantling points. This improvement aids in taste & odor removal.

Cost: \$710,000

Phase: 2020 - 2025 / Delay until results known of WTP-E01

Purpose: Tier 1 – Water Quality

Trigger: Existing Improvement

WTP: Wes Brown



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Water Treatment Improvements

CIP ID: WTP-E03

Project Information: Increase membrane surface area at WBWTP by using older membranes to equip unused cassettes to increase treatment capacity.

Cost: \$0

Phase: 2020 - 2025

Purpose: Tier 1 – Capacity

Trigger: Existing Improvement

WTP: Wes Brown



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Water Treatment Improvements

CIP ID: WTP-E04

Project Information: Residuals Management Improvements at WBWTP,
70,000 square feet of additional lagoons, 3 ft deep.

Cost: \$1,100,000

Phase: 2020 - 2025

Purpose: Tier 1 – Operations

Trigger: Existing Improvement

WTP: Wes Brown



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Water Treatment Improvements

CIP ID: WTP-E05

Project Information: Study to evaluate clarifier flow distribution system at WBWTP. Goals include determining differences in hydraulic grade line at each unit and potential to improve tuning of control valves to allow for use of flow balancing control. End goal is to provide recommendation for improvements; expectation is that physical changes would be minor, if any.

Potential Resulting CIP: \$100K CIP to add additional instrumentation to reduce noise in system; similar cost could be applied to physically modifying the influent channel to adjust HGL.

Cost: \$30,000

Phase: 2020 - 2025

Purpose: Tier 1 – Operations

Trigger: Existing Improvement

WTP: Wes Brown



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Water Treatment Improvements

CIP ID: WTP-E06

Project Information: Study to Eliminate Recycling for Clean-in-Place Wastes at WBWTP. Evaluate water quality data from CIP and assemble application for SIC discharges to sewer. Limited analytical work to characterize CIP waste.

Potential Resulting CIP: Up to \$50k CIP; based on the assumption that the existing sewer line from WBWTP could be used to discharge CIP wastes to MWRD. Alternative approach could be creating an unloading station for hauling off wastes by truck. Changes are anticipated to be minor.

Cost: \$30,000

Phase: 2020 - 2025

Purpose: Tier 1 – Water Quality

Trigger: Existing Improvement

WTP: Wes Brown



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Water Treatment Improvements

CIP ID: WTP-E07

Project Information: Evaluate the potential to return lagoon discharge from WBWTP downstream of Gravel Lakes to eliminate potential for foulants accumulation in Gravel Lakes.

Potential Resulting CIP: Up to \$14M CIP; including new 7 MGD return water discharge pump station and 24-inch pipeline extending approximately 4.2 miles to a location downstream of the Gravel Lakes.

Cost: \$50,000

Phase: 2020 - 2025 / Delay until results known of WTP-E06 and WTP-E08

Purpose: Tier 1 – Water Quality

Trigger: Existing Improvement

WTP: Wes Brown



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Water Treatment Improvements

CIP ID: WTP-E08

Project Information: Evaluate means to best manage water treatment residuals. Study would include evaluation of existing lagoon operations at WBWTP as well as potential enhancement, such as addition of residuals management at TWTP or inclusion of mechanical dewatering at WBWT and/or TWTP.

Potential Resulting CIP: Up to \$3M CIP depending on redundancy, and inclusion of a Belt Filter Press.

Cost: \$110,000

Phase: 2020 - 2025

Purpose: Tier 1 – Water Quality

Trigger: Existing Improvement

WTP: Wes Brown



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Water Treatment Improvements

CIP ID: WTP-E09

Project Information: Clarifier Coating Rehabilitation a WBWTP. Existing Maintenance project identified in order to maintain the service life of clarification equipment.

Cost: \$500,000

Phase: 2020 - 2025

Purpose: Tier 1 – Maintenance

Trigger: Existing Improvement

WTP: Wes Brown



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Water Treatment Improvements

CIP ID: WTP-E10

Project Information: Addition of a redundant air compressor and reject pump to the membrane filtration system at WWTP to improve redundancy.

Cost: \$500,000

Phase: 2020 - 2025

Purpose: Tier 1 – Redundancy

Trigger: Existing Improvement

WTP: Wes Brown



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Water Treatment Improvements

CIP ID: WTP-E11

Project Information: Increase capacity of Membrane Train No. 8 at WBWTP by 5 cassettes along with addition of vacuum pumps and blowers.

Cost: \$1,840,000

Phase: 2020 - 2025

Purpose: Tier 1 – Capacity

Trigger: Existing Improvement

WTP: Wes Brown



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Water Treatment Improvements

CIP ID: WTP-E12

Project Information: Coagulant Tank Repairs at WBWTP. Maintenance project to address risk of cracking when the tank is filled to capacity.

Cost: \$30,000

Phase: 2020

Purpose: Tier 1 – Maintenance

Trigger: Existing Improvement

WTP: Wes Brown



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Water Treatment Improvements

CIP ID:	WTP-F01
Project Information:	Purchase of 15 acres in unincorporated Adams County. Northwest of East 140th Ave and Dahlia Way as future site of NWTP.
Cost:	\$3,000,000
Phase:	2020 - 2025
Purpose:	Tier 1 – Capacity
Trigger:	Growth - Max Day Demand = 74.8 MGD
WTP:	Northern



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Water Treatment Improvements

CIP ID: WTP-F02 (page 1 of 2)

Project Information: Construction of Phase I of Northern Water Treatment Plant, does not include land acquisition and mechanical dewatering. Phase I capacity = 10.75 MGD, Phase II/Ultimate capacity = 21.5 MGD.

Cost: \$43,842,000

Phase: 2025 - 2035

Purpose: Tier 1 – Capacity

Trigger: Growth - Max Day Demand = 74.8 MGD

WTP: Northern

NWTP Process Summary:

Conventional Treatment Process

- Pretreatment: Flash mixing, in-line with raw water
- Flocculation: 2 out of 3 trains, each rated at 10.75 MGD. Each train will include 3 stages of flocculation.
- Sedimentation: 2 out of 3 trains constructed, each rated at 10.75 MGD. Each train will include 1 zone of sedimentation.
- Ozone: 2 ozone generators, sized for ultimate plant rated capacity, with companion feed and destruct systems, oxygen storage and feed equipment, 2 parallel contact basins sized for the target contact time at the ultimate plant rated capacity.
- Biological Filtration: 4 filters loaded granular activated carbon (GAC). Each filter will be sized for 20% of the ultimate plant rated capacity
- Clearwell: 0.7 Baffle Factor, 1.5 Safety Factor, designed to work with hypochlorite to achieve the additional 0.5 Log Giardia and 2.0 Log Virus disinfection contact time
- Filter Backwash: supply tank, pumps (1 operational, 1 standby), backwash waste equalization tank



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Water Treatment Improvements

CIP ID: WTP-F02 (page 2 of 2)

NWTP Process Summary (continued):

Solids Handling

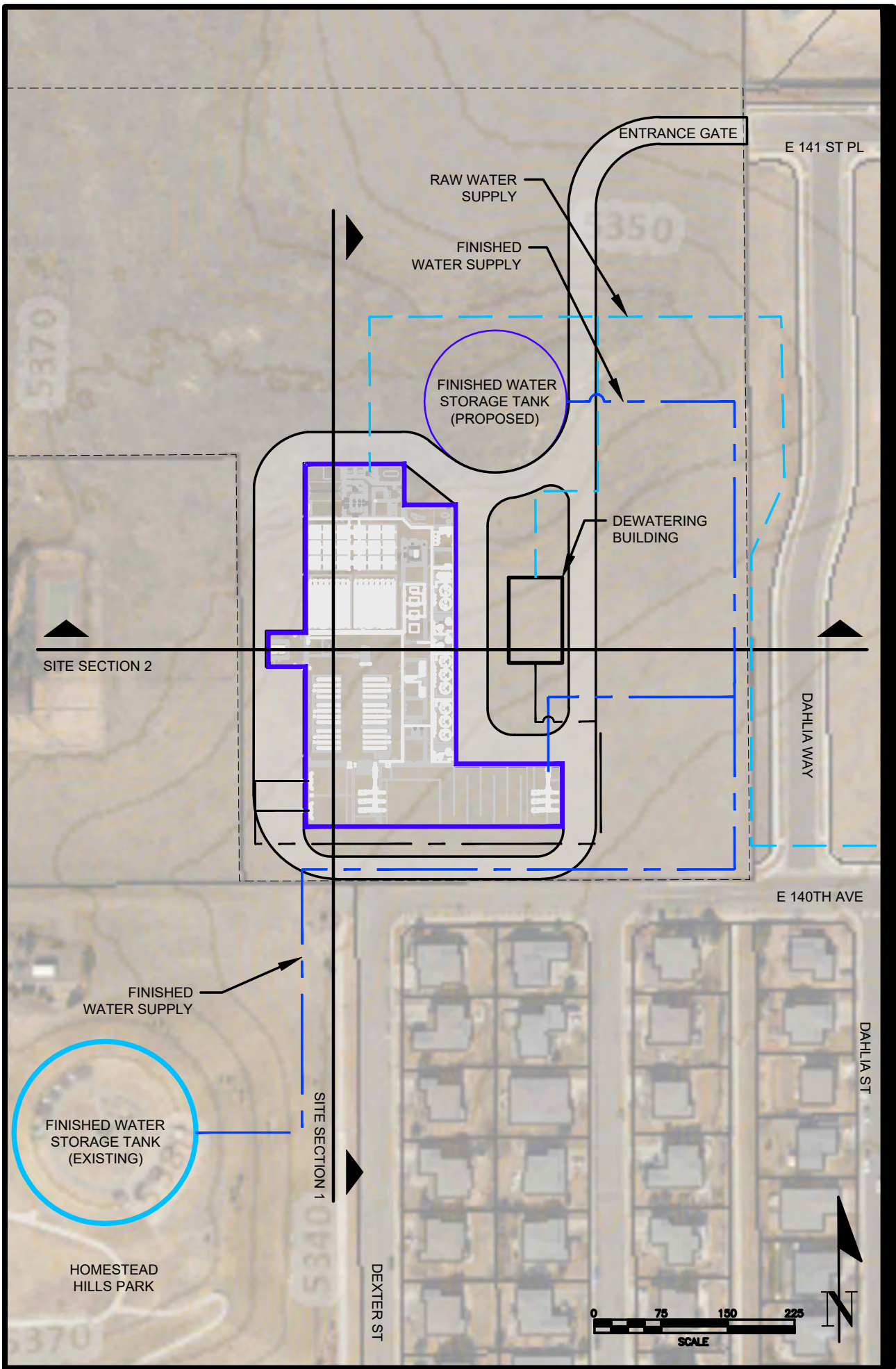
- Gravity Thickener: 2 basins, 1 equipped with mechanical equipment
- Return Water storage tank
- Return Water pumps: 2 operational (duty/standby)
- Belt Filter Press: 1 operational
- Sludge Conditioning Tank
- Polymer Feed System
- Screw Conveyors

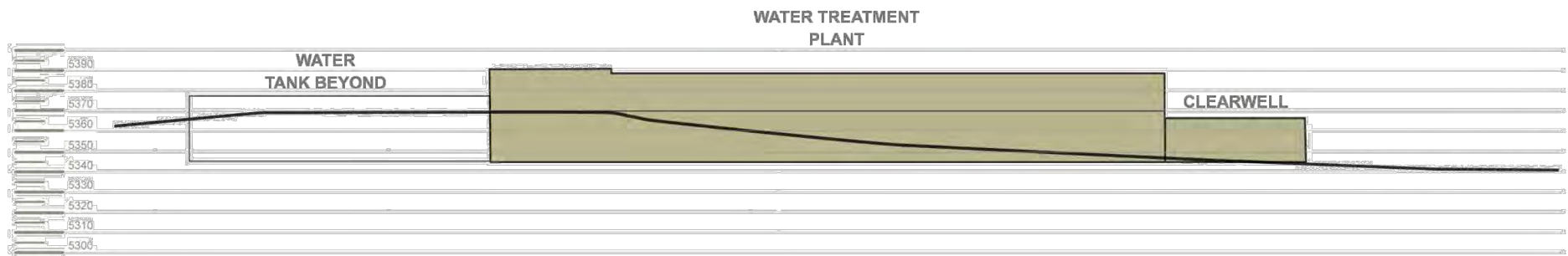


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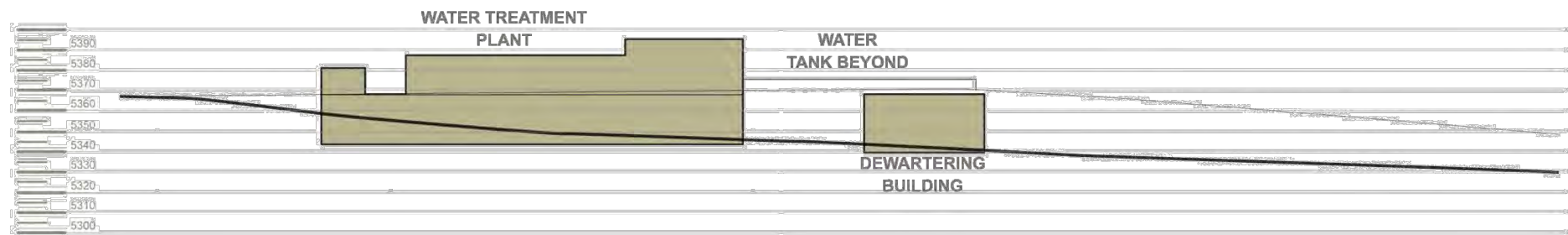
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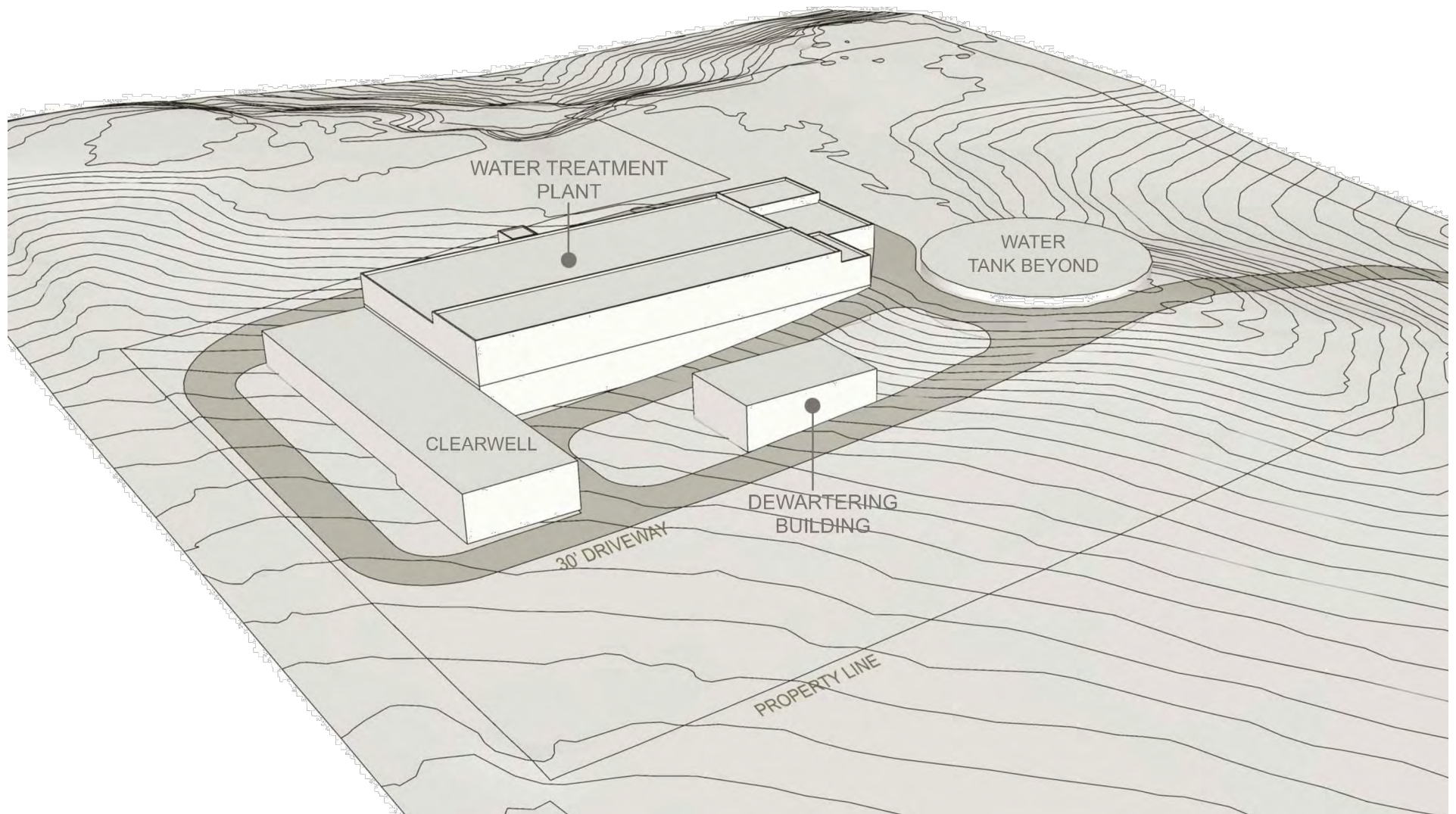




ENLARGED SITE SECTION 1



ENLARGED SITE SECTION 2



Water Treatment Improvements

CIP ID:	WTP-F03
Project Information:	Construction of mechanical dewatering system at NWTP, in concurrence of NWTP construction. Conceptual design assumptions: Turbidity = 50 NTU. SLR = 25 lbs/day/sf
Cost:	\$15,620,000
Phase:	2025 - 2035
Purpose:	Tier 1 – Capacity
Trigger:	Growth - Max Day Demand = 74.8 MGD
WTP:	Northern



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Water Treatment Improvements

CIP ID:	WTP-F04
Project Information:	Baseline Power Supply to NWTP, including offsite infrastructure and power supply to transformer on NWTP site.
Cost:	\$1,990,000
Phase:	2025 - 2035
Purpose:	Tier 1 – Capacity
Trigger:	Growth - Max Day Demand = 74.8 MGD
WTP:	Northern



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Water Treatment Improvements

CIP ID: WTP-F05

Project Information: Standby generator sized for full production

Cost: \$2,210,000

Phase: 2025 - 2035

Purpose: Tier 1 - Redundancy

Trigger: Growth - Max Day Demand = 74.8 MGD

WTP: Northern



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Water Treatment Improvements

CIP ID: WTP-F06

Project Information: Second utility feed to NWTP from different substation

Cost: \$1,330,000

Phase: 2025 - 2035

Purpose: Tier 2 - Redundancy

Trigger: Growth - Max Day Demand = 74.8 MGD

WTP: Northern



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Water Treatment Improvements

CIP ID: WTP-F07

Project Information: Construction of Phase II of Northern Water Treatment Plant, does not include land acquisition and mechanical dewatering. Phase II/Ultimate capacity = 21.5 MGD.

Cost: \$43,842,000

Phase: 2035 - 2065

Purpose: Tier 1 – Capacity

Trigger: Growth - Max Day Demand = 85.6 MGD

WTP: Northern

NWTP Process Summary:

Conventional Treatment Process

- Flocculation: 1 train, rated at 10.75 MGD. Each train will include 3 stages of flocculation.
- Sedimentation: 1 train, rated at 10.75 MGD. Each train will include 1 zone of sedimentation.
- Biological Filtration: 2 filters loaded granular activated carbon (GAC). Each filter will be sized for 20% of the ultimate plant rated capacity

Solids Handling

- Gravity Thickener: equipment for 2nd unit
- Return Water pumps: 3rd pump (reconfigure for lead/lag/standby)
- Belt Filter Press: 2nd operational unit (parallel operation)



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Utility Master Plan

Project No. 17-467

Water Distribution Capital Improvement
Program Project Cutsheets

The City of Thornton

Project number: 60560104

March 2020

Table 2.15. Water Distribution Master CIP Table (page 1 of 2)

CIP ID	Phase (Project Completion Date)	Purpose	Project Type	Project Description	Cost	Dependant CIP	Zone	Trigger	Project Timeline (Start / Completion)	
P-01(E)	2020-2025	Tier 1 - Pumping	Pump unit replacement	Replacement of 2 units in Zone 5 Pump Station, each with a capacity of 1,500gpm.	\$ 146,900		Zone 5	Existing improvement	2020	2021
SS-01(F)	2020-2025	Tier 1 - Storage	New ground storage	New 5MG Tank west of Sintra Lewis Pointe Park, north of 140th Ave.	\$ 13,214,900		Zone 1	Zone 1 Storage Upgrade	2021	2022
SS-02(F)	2020-2025	Tier 1 - Storage	New ground storage	New 3.5 MG tank near existing Cherokee Tank.	\$ 9,522,500		Zone 3	Zone 3 Storage Upgrade	2022	2023
TT13(F)	2020-2025	Tier 1 - Supply	New transmission pipe	New pipe from Hilltop Tank to the new 5MG Tank. The new line is a 48-in with an approximate length of 1,900 ft.	\$ 2,209,600		Zone 1	Zone 1 Storage Upgrade	2022	2023
DD31(E)	2020-2025	Tier 1 - Capacity	New pipe or pipe replacement	Installation of a parallel pipe along Eppinger Boulevard, between Hoffman Way and Ellen Court. The new line is a 12-in with an approximate length of 300 ft.	\$ 118,470		Zone 2	Existing improvement	2025	2026
DD32(E)	2020-2025	Tier 1 - Capacity	New pipe or pipe replacement	Installation of a parallel pipe on the west side of TWTP. The new line is a 16-in with an approximate length of 700 ft.	\$ 358,050		Zone 2	Existing improvement	2023	2024
DD34(E)	2020-2025	Tier 1 - Capacity	New pipe or pipe replacement	New pipe on property west of the TWTP. The new line is a 16-in with an approximate length of 700ft. This project will improve service pressure.	\$ 358,050	DD35	Zone 2	Existing improvement	2023	2024
DD35(E)	2020-2025	Tier 1 - Capacity	New pipe or pipe replacement	New pipe on property west of the TWTP. The new line is a 16-in with an approximate length of 100ft. This project will improve service pressure.	\$ 51,150		Zone 1	Existing improvement	2023	2024
DD25(E)	2025-2035	Tier 1 - Capacity, Fire flow	New pipe or pipe replacement	New pipe along Katherine Way between W 84th Ave and N Pecos St, and along N Pecos St between Katherine Way and W 82nd Pl. The new line is a 12-in with an approximate length of 1,700ft.	\$ 671,320		Zone 3	Existing improvement	2026	2027
DD27(E)	2025-2035	Tier 1 - Capacity, Fire flow	New pipe or pipe replacement	Installation of a parallel pipe along W 82nd Pl, between Nela Dr and Pecos Way. The new line is a 12-in with an approximate length of 400ft.	\$ 157,960		Zone 3	Existing improvement	2026	2027
DD28(E)	2025-2035	Tier 1 - Capacity, Fire flow	New pipe or pipe replacement	New pipe along Douglas Dr between Greenwood Blvd and N Pecos St, and along 82nd St between N Pecos St and Nola Dr. The new line is a 8-in with an approximate length of 3,300ft.	\$ 1,015,840		Zone 3	Existing improvement	2025	2026
DD30(F)	2025-2035	Tier 1 - Capacity	New pipe or pipe replacement	New pipe along Thornton Pkwy, just west of I-25. The line is a 12-in with an approximate length of 800 ft.	\$ 315,920		Zone 3	Growth - Average System Demand = 37mgd	2034	2035
P-03(F)	2025-2035	Tier 1 - Pumping	Pump unit replacement	Replacement of two units in Zone 1 - Wes Brown High Service Pump Station, each with a capacity of 10,000gpm.	\$ 4,614,000		Zone 1	Growth - Average System Demand = 37mgd	2029	2030
P-04(F)	2025-2035	Tier 1 - Pumping	New pump station	New pump station, pumping from NWTP to Zone 1, with four units, each with a capacity of 5,000gpm.	\$ 566,300		Zone 1	NWTP Construction	2033	2034
SS-03(F)	2025-2035	Tier 1 - Storage	New ground storage	New 6 MG tank adjacent to TWTP Clearwell 2.	\$ 15,857,900		Zone 1	Zone 1 Storage Upgrade	2034	2035
TT07(F)	2025-2035	Tier 1 - Facilitate Growth	New Pipe	New pipe parallel to and north of E-470 between Holly St and Quebec St, and along Holly St from E-470 to E 152th Ave. The new line is a 42-in with an approximate length of 5,200ft.	\$ 5,198,300		Zone 1	Growth North of Highway I470	2028	2029
TT10(F)	2025-2035	Tier 1 - Facilitate Growth	New Pipe	New pipe crossing E-470, then parallel to and south of E-470 between Holly St and Quebec St, and along Quebec St from E-470 to E 138th Ave. The new line is a 24-in with an approximate length of 7,400ft.	\$ 4,809,000		Zone 1	Growth North of Highway I470	2027	2028
TT14(F)	2025-2035	Tier 1 - Supply	New transmission pipe	New pipe from Clearwell 2 at TWTP along Thornton Pkwy and E 96th Ave to just west of the South Platte River . The new line is a 48-in and 16-in with an approximate length of 14,300 ft.	\$ 16,629,700	TT26	Zone 1	WBWTP Upgrade	2032	2033
TT16(F)	2025-2035	Tier 1 - Supply	Connection to existing pipe	New pipe just south of TWTP. The new line is a 24-in with an approximate length of 200 ft.	\$ 130,000	TT33	Zone 1	Zone 1 Storage Upgrade	2034	2035
TT17(F)	2025-2035	Tier 1 - Storage	New transmission pipe	New pipe from Cherokee Tank to I-25, along I-25 to E 105th Ave, along E 105th Ave to Grant Dr, along Grant Dr to E104th Ave, along E 104th Ave to to Washington St, and along Washington St to Old E 100th Ave. The new line is a 36-in with an approximate length of 12,200 ft.	\$ 10,507,900	TT25, TT18, TT19, or TT20	Zone 1	Zone 3 Storage Upgrade	2030	2031
TT18(F)	2025-2035	Tier 1 - Storage	Connection to existing pipe	New pipe along 102nd Ave crossing Washington St. The new line is a 24-in with an approximate length of 200 ft.	\$ 130,000	TT17	Zone 3	Zone 3 Storage Upgrade	2034	2035

Table 2.15. Water Distribution Master CIP Table (page 2 of 2)

	Phase (Project Completion Date)	Purpose	Project Type	Project Description	Cost	Dependant CIP	Zone	Trigger	Project Timeline (Start / Completion)	
TT19(F)	2025-2035	Tier 1 - Storage	Connection to existing pipe	New pipe crossing Washington St at Old E 100th Ave. The new line is a 24-in with an approximate length of 200 ft.	\$ 130,000	TT17	Zone 1	Zone 1 Storage Upgrade	2034	2035
TT20(F)	2025-2035	Tier 1 - Storage	New transmission pipe	New pipe from TWTP, running along Dorothy Blvd, Hoffman Way, and 95th Ave to Washington St, then running parallel to Washington St until Old E 100th Ave. The new line is a 36-in with an approximate length of 5,100 ft.	\$ 4,392,700	TT17	Zone 3	Zone 1 Storage Upgrade	2031	2032
DD29(F)	2035-2065	Tier 2 - Capacity	New pipe or pipe replacement	Installation of a parallel pipe along Thornton Pkwy, crossing I-25. The line is a 16-in with an approximate length of 700 ft.	\$ 358,050		Zone 3	Growth - Average System Demand = 37mgd	N/A	N/A
DD37(F)	2035-2065	Tier 2 - Capacity	New pipe or pipe replacement	New pipe along 104th Ave between Washington St and Irma Dr. The new line is a 16-in with an approximate length of 4,300 ft.	\$ 2,199,430		Zone 1	Growth - Average System Demand = 37mgd	N/A	N/A
DD41(F)	2035-2065	Tier 2 - Capacity	New pipe or pipe replacement	Installation of a parallel pipe along York St east of Lake Avery. The new line is a 16-in with an approximate length of 2,200 ft.	\$ 1,125,290		Zone 1	Growth - Average System Demand = 44mgd	N/A	N/A
DD42(F)	2035-2065	Tier 2 - Capacity	New pipe or pipe replacement	Installation of a parallel pipe along 136th Ave just east of York St. The new line is a 16-in with an approximate length of 600 ft.	\$ 306,900		Zone 1	Growth - Average System Demand = 37mgd	N/A	N/A
DD49(F)	2035-2065	Tier 1 - Facilitate Growth	New Pipe	New pipe east of Colorado Blvd, running south from south of E 160th Ave to intersect with bend in Colorado Blvd. The new line is a 36-in with an approximate length of 2,600 ft.	\$ 2,239,400	TT04	Zone 1	Developments north of E 156th Avenue	N/A	N/A
P-02(F)	2035-2065	Tier 1 - Pumping	Additional pump unit	Replacement of one unit in Zone 3A Pump Station, with a capacity of 8,000gpm.	\$ 1,153,500		Zone 3A	Growth - Average System Demand = 44mgd	N/A	N/A
TT02(F)	2035-2065	Tier 1 - Facilitate Growth	New Pipe	New pipe along Colorado Blvd at E 160th Ave. The new line is a 20-in with an approximate length of 200 ft.	\$ 111,700	TT04	Zone 1	Growth North of E 156th Avenue	N/A	N/A
TT04(F)	2035-2065	Tier 1 - Facilitate Growth	New Pipe	New pipe along E 160th Ave, from neighborhood east of York St, across Colorado Blvd to east of Holly St. The new line is a 24-in with an approximate length of 4,600 ft.	\$ 2,989,400		Zone 1	Growth North of E 156th Avenue	N/A	N/A
TT05(F)	2035-2065	Tier 1 - Facilitate Growth	New Pipe	New pipe along Colorado Blvd from just north of E-470 to the bend in the road. The new line is a 36-in with an approximate length of 1,500 ft.	\$ 1,292,000	TT06	Zone 1	Growth North of E 156th Avenue	N/A	N/A
TT06(F)	2035-2065	Tier 2 - Capacity	New pipe or pipe replacement	New pipe along Colorado Blvd, with the north end crossing E-470. The new line is a 24-in with an approximate length of 3,800 ft.	\$ 2,469,480	TT14	Zone 1	Growth North of Highway E470	N/A	N/A
TT08(F)	2035-2065	Tier 1 - Facilitate Growth	New Pipe	New pipe from E-470 west of Quebec St, along Ehler Pkwy, bending south near Unita St, crossing E-470 and bending east south of 144th Ave, then south along Yosemite St to 136th Ave. The new pipe is 36-in and 42-in with an approximate length of 15,400 ft.	\$ 15,394,900	TT07	Zone 1	Growth North of Highway I470	N/A	N/A
TT09(F)	2035-2065	Tier 1 - Facilitate Growth	New Pipe	New pipe along Quebec St from E 152nd Ave to Ehler Pkwy. The new line is a 20-in with an approximate length of 2,700 ft.	\$ 1,507,000		Zone 3H	Growth North of Highway I470	N/A	N/A
TT11(F)	2035-2065	Tier 1 - Supply	New transmission pipe	New pipe from WBWTP along Riverdale Rd and Yosemite St to E 136th Ave, along Holly St from E 136th Ave to 140th Ave, and along E 140th Ave to a NWTP tie-in. The new line is 36-in and 48-in with an approximate length of 57,400 ft.	\$ 66,751,100		Zone 1	WBWTP Upgrade	N/A	N/A
TT21(F)	2035-2065	Tier 2 - Capacity	New pipe or pipe replacement	New pipe along 120th Ave from Grant St to Washington St, and along Washington St from 120th Ave to 128th Ave. The new line is a 24-in with an approximate length of 7,700 ft.	\$ 5,003,940		Zone 3A	Growth - Average System Demand = 44mgd	N/A	N/A
TT22(F)	2035-2065	Tier 2 - Capacity	New pipe or pipe replacement	New pipe along 136th Ave from 136th Ave from Clayton St to connection north of 136th Ave Tank. The new line is a 24-in with an approximate length of 2,700 ft.	\$ 1,754,630		Zone 1	Growth - Average System Demand = 44mgd	N/A	N/A
TT26(F)	2035-2065	Tier 1 - Supply	Configuration change	New pipe bypassing the new 6MG tank (CIP SS-03), adjacent to TWTP Clearwell 2. The new line is a 48-in with an approximate length of 300 ft.	\$ 348,900	TT14	Zone 1	Growth - Average System Demand = 44mgd	N/A	N/A

CIPID#'s revised from Water and Wastewater Infrastructure Master Plan: CIPID DD46 was removed from the CIP Plan because the project was incorporated into an adjacent CIP project.

*CIP ID LEGEND:

PREFIX DEFINITION

RAW = Raw Water Supply System Project

WTP = Water Treatment Facilities Project

DD = Water Distribution System Project / Distribution Pipeline

TT= Water Distribution System Project / Transmission Pipeline

P = Water Distribution System Project / Pump

SS = Water Distribution System Project / Storage

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SUFFIX DEFINITION

E = Existing System Deficiency












F = Future System Improvement

*CIP ID's for Water Distribution and Wastewater Collection are organized without suffix in the Water and Wastewater Infrastructure Master Plan and on CIP project cutsheets

Trigger	Description
Existing Improvement	Improvement is required to address an existing deficiency
Growth - Average System Demand = 37mgd	Improvement will be required in the future, pending on expected growth
Growth - Average System Demand = 44mgd	Improvement will be required in the future, pending on expected growth
Developments north of E 156th Avenue	Improvement will serve future developments, pending on localized growth
WBWTP Upgrade	Improvement will support increase in supply capacity at WBWTP
Growth North of E-470	Improvement will serve future developments, pending on localized growth
Zone 1 Storage Upgrade	Improvement will support increase in storage capacity
Zone 3 Storage Upgrade	Improvement will support increase in storage capacity
NWTP Construction	Improvement will support supply improvements at NWTP
70% Measured Sewer Flow =	Improvement is required to meet future flows
Growth - Max Day Demand = 74.8 mgd	Improvement will be required in the future, pending on expected growth
Growth - Max Day Demand = 85.6 mgd	Improvement will be required in the future, pending on expected growth
Tier 2	Improvement identified as Tier 2
Tier 3	Improvement identified as Tier 3



Legend

-  New PRVs
-  Storage
-  Pump
-  Existing Pipelines
-  NWTP
-  Pumping CIP
-  Storage CIP
-  CIP Improvements
-  Other Improvements
-  Developer
-  COT

Project Information

New pipe from Hilltop Tank to the new 5MG Tank. The new line is a 48-in with an approximate length of 1,900 ft.

Cost

\$2,209,600

Phase

2025

Purpose

Supply

Trigger

Zone 1 Storage Upgrade

Zone

Zone 1

City of Thornton
9500 Civic Center Drive
Thornton, Colorado 80229
(303) 538-7295

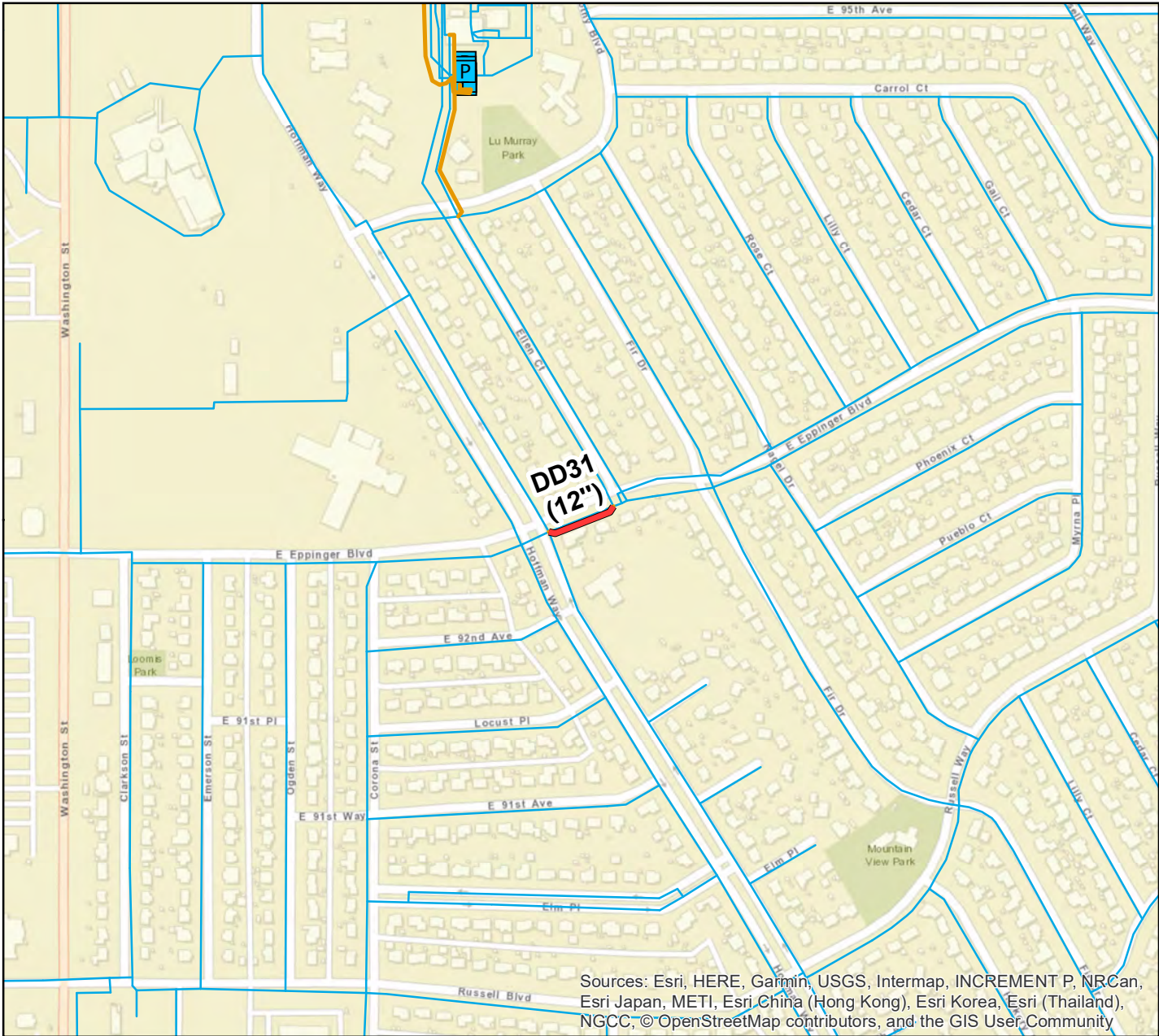
Water Distribution and Transmission Improvements

AECOM
6200 South Quebec Street
Greenwood Village, Colorado 80111

CIP TT13



1 inch = 500 feet



Legend

- New PRVs
- Storage
- Pump
- Existing Pipelines
- NWTP
- Pumping CIP
- Storage CIP
- CIP Improvements
- Other Improvements
- Developer
- COT

Project Information

Installation of a parallel pipe along Eppinger Boulevard, between Hoffman Way and Ellen Court. The new line is a 12-in with an approximate length of 300 ft.

Cost

\$118,470

Phase

2025

Purpose

Tier 1 - Capacity

Trigger

Existing improvement

Zone

Zone 2

Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, © OpenStreetMap contributors, and the GIS User Community

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Thornton, Colorado 80229
(303) 538-7295

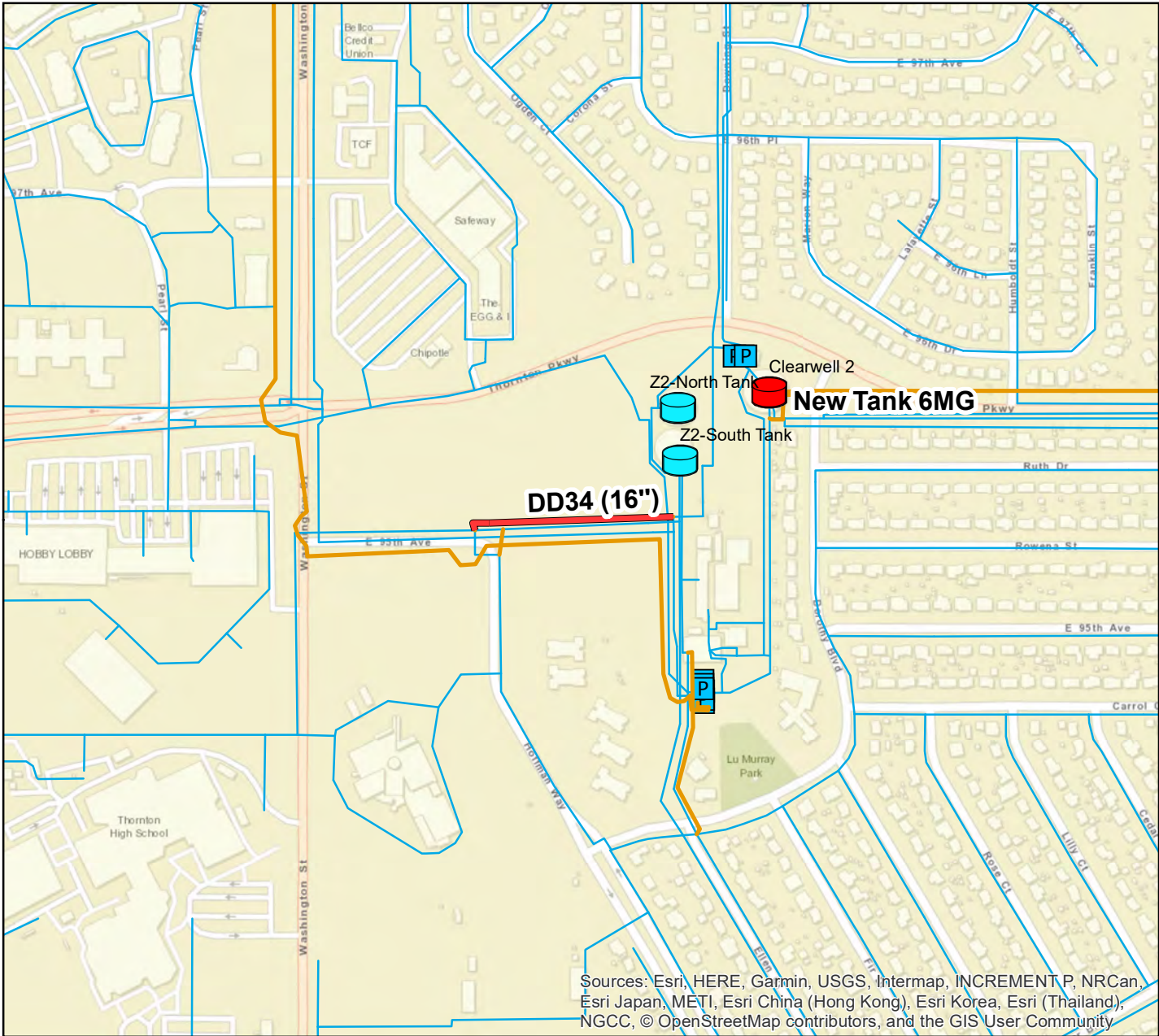
AECOM
6200 South Quebec Street
Greenwood Village, Colorado 80111

Water Distribution and Transmission
Improvements

CIP DD31



1 inch = 500 feet



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Legend

- New PRVs
- Storage
- Pump
- Existing Pipelines
- NWTP
- Pumping CIP
- Storage CIP
- CIP Improvements
- Other Improvements
- Developer
- COT

Project Information

New pipe on property west of the TWTP. The new line is a 16-in with an approximate length of 700ft. This project will improve service pressure.

Cost

\$358,050

Phase

2025

Purpose

Tier 1 - Capacity

Trigger

Existing improvement

Zone

Zone 2

City of Thornton
9500 Civic Center Drive
Thornton, Colorado 80229
(303) 538-7295

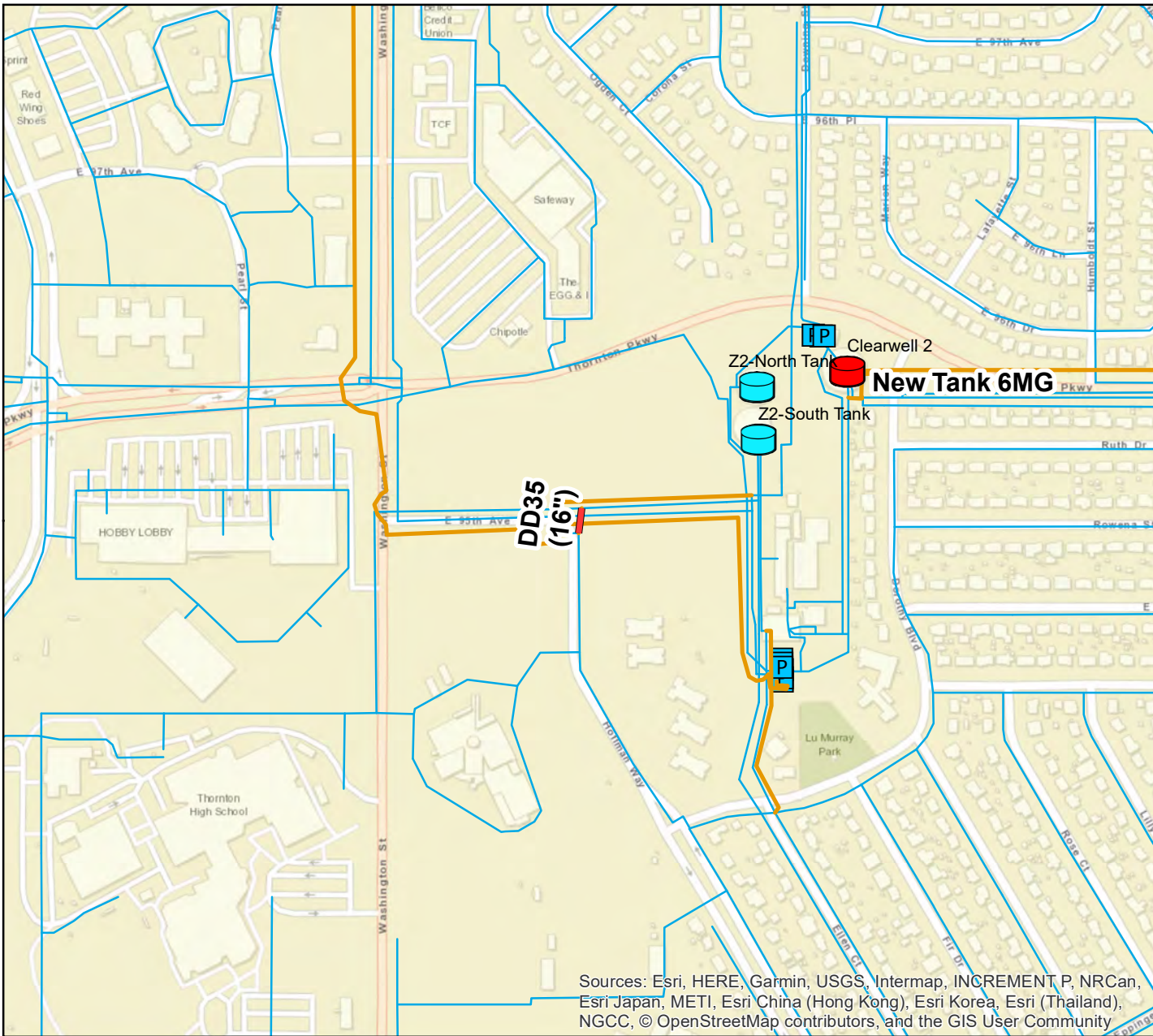
AECOM
6200 South Quebec Street
Greenwood Village, Colorado 80111

**Water Distribution and Transmission
Improvements**

CIP DD34



1 inch = 500 feet



Legend

- New PRVs
- Storage
- Pump
- Existing Pipelines
- NWTP
- Pumping CIP
- Storage CIP
- CIP Improvements
- Other Improvements
- Developer
- COT

Project Information

New pipe on property west of the TWTP. The new line is a 16-in with an approximate length of 100ft. This project will improve service pressure.

Cost

\$51,150

Phase

2025

Purpose

Tier 1 - Capacity

Trigger

Existing improvement

Zone

Zone 1

City of Thornton
9500 Civic Center Drive
Thornton, Colorado 80229
(303) 538-7295

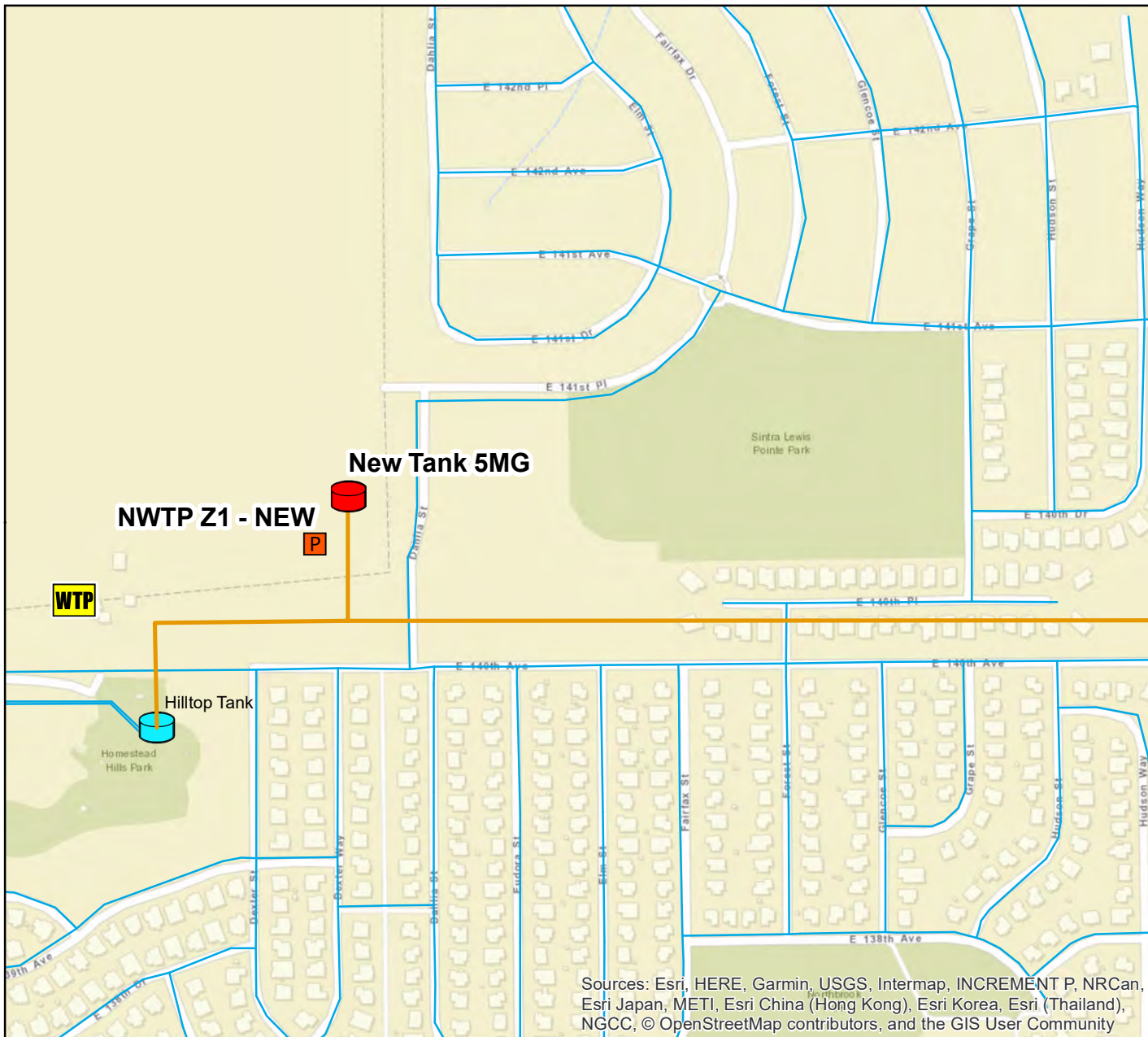
Water Distribution and Transmission Improvements

CIP DD35



1 inch = 500 feet

AECOM
6200 South Quebec Street
Greenwood Village, Colorado 80111



Legend

- New PRVs
- Storage
- Pump
- Existing Pipelines
- NWTP
- Pumping CIP
- Storage CIP
- CIP Improvements
- Other Improvements
- Developer
- COT

Project Information

New 5MG Tank west of Sintra Lewis Pointe Park, north of 140th Ave.

Cost

\$13,214,900

Phase

2025

Purpose

Tier 1 - Storage

Trigger

Zone 1 Storage Upgrade

Zone

Zone 1

City of Thornton
9500 Civic Center Drive
Thornton, Colorado 80229
(303) 538-7295

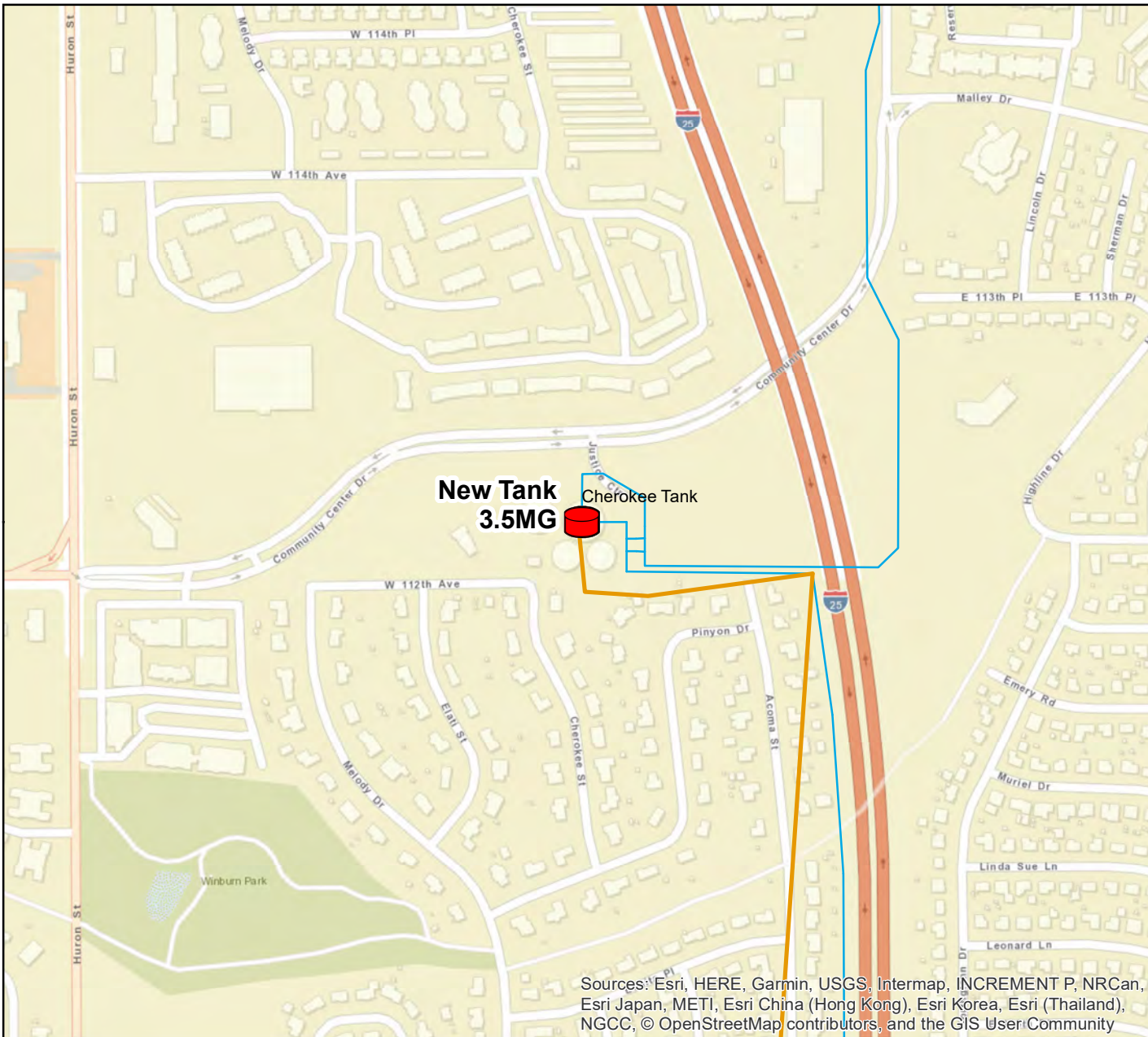
Water Distribution and Transmission Improvements

AECOM
6200 South Quebec Street
Greenwood Village, Colorado 80111

CIP SS-01



1 inch = 500 feet



Legend

- New PRVs
- Storage
- Pump
- Existing Pipelines
- NWTP
- Pumping CIP
- Storage CIP
- CIP Improvements
- Other Improvements
- Developer
- COT

Project Information

New 3.5 MG tank near existing Cherokee Tank.

Cost

\$9,522,500

Phase

2025

Purpose

Tier 1 - Storage

Trigger

Zone 3 Storage Upgrade

Zone

Zone 3

City of Thornton
9500 Civic Center Drive
Thornton, Colorado 80229
(303) 538-7295

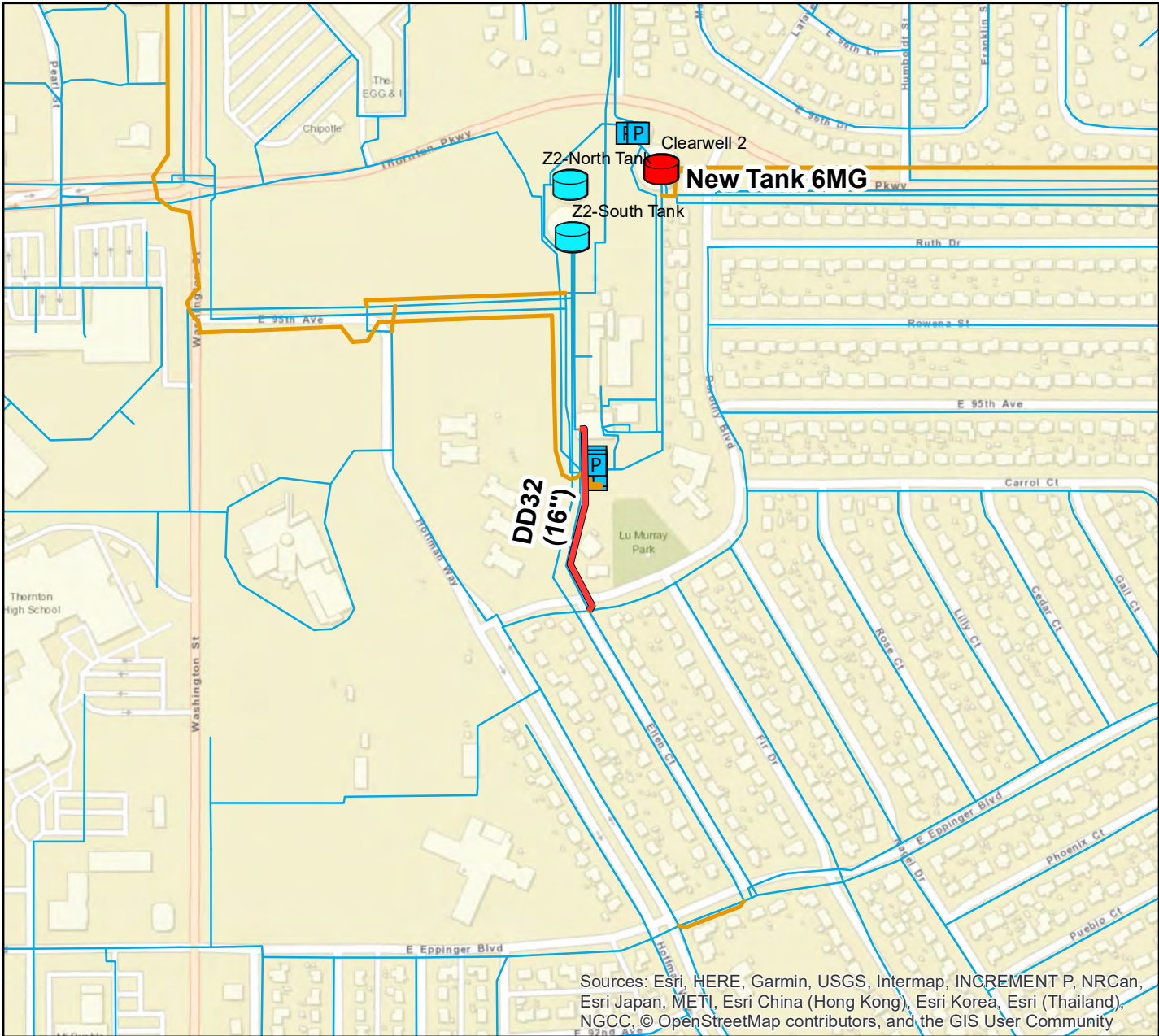
Water Distribution and Transmission Improvements

AECOM
6200 South Quebec Street
Greenwood Village, Colorado 80111

CIP SS-02



1 inch = 500 feet



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Legend

- New PRVs
- Storage
- Pump
- Existing Pipelines
- NWTP
- Pumping CIP
- Storage CIP
- CIP Improvements
- Other Improvements
- Developer
- COT

Project Information

Installation of a parallel pipe on the west side of TWTP. The new line is a 16-in with an approximate length of 700 ft.

Cost

\$358,050

Phase

2025

Purpose

Tier 1 - Capacity

Trigger

Existing improvement

Zone

Zone 2

City of Thornton
9500 Civic Center Drive
Thornton, Colorado 80229
(303) 538-7295

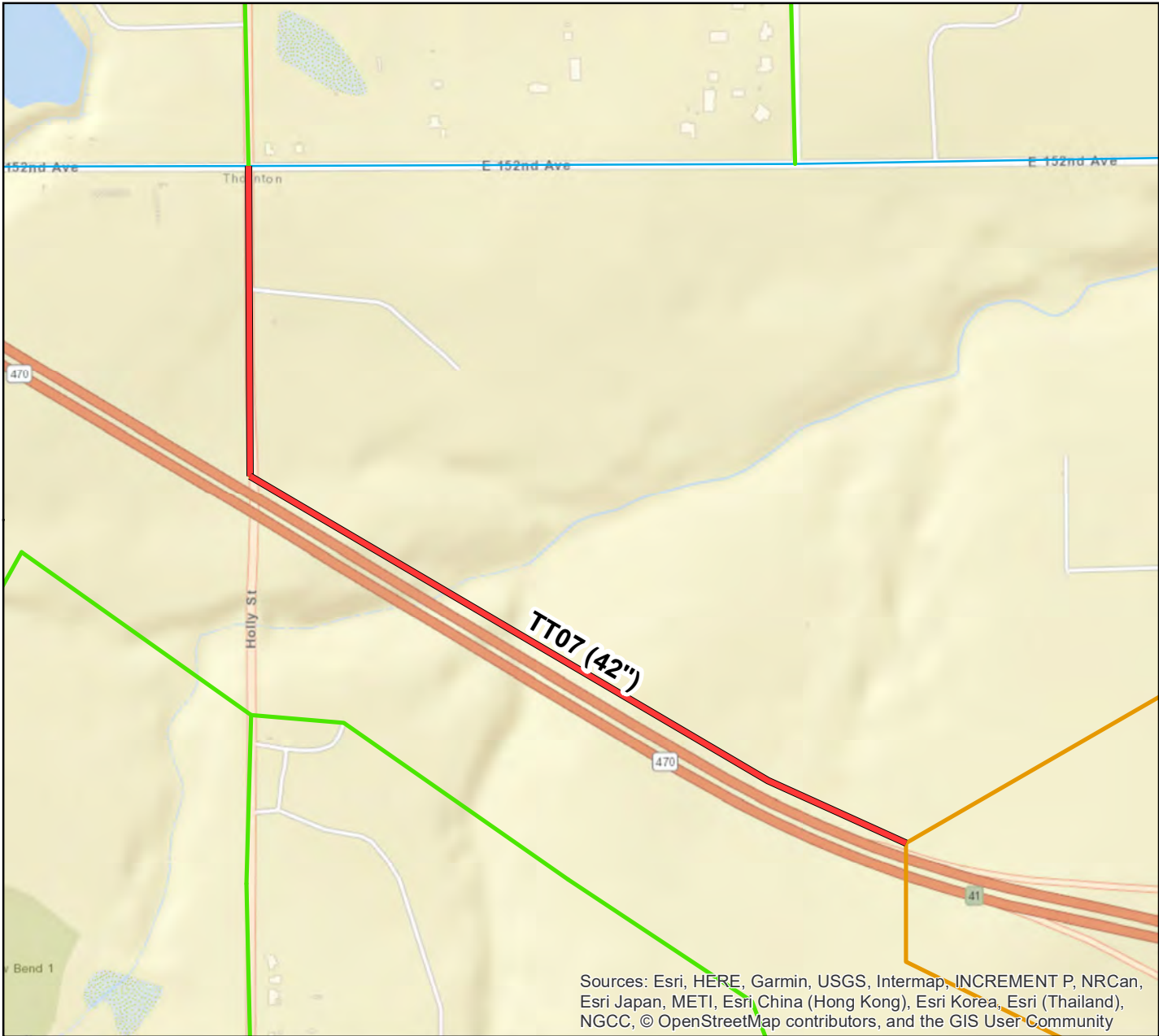
AECOM
6200 South Quebec Street
Greenwood Village, Colorado 80111

Water Distribution and Transmission
Improvements

CIP DD32



1 inch = 500 feet



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Legend

- New PRVs
- Storage
- Pump
- Existing Pipelines
- NWTP
- Pumping CIP
- Storage CIP
- CIP Improvements
- Other Improvements
- Developer
- COT

Project Information

New pipe parallel to and north of E-470 between Holly St and Quebec St, and along Holly St from E-470 to E 152th Ave. The new line is a 42-in with an approximate length of 5,200ft.

Cost

\$5,198,300

Phase

2025-2035

Purpose

Facilitate Growth

Trigger

Growth North of Highway I470

Zone

Zone 1

City of Thornton
9500 Civic Center Drive
Thornton, Colorado 80229
(303) 538-7295

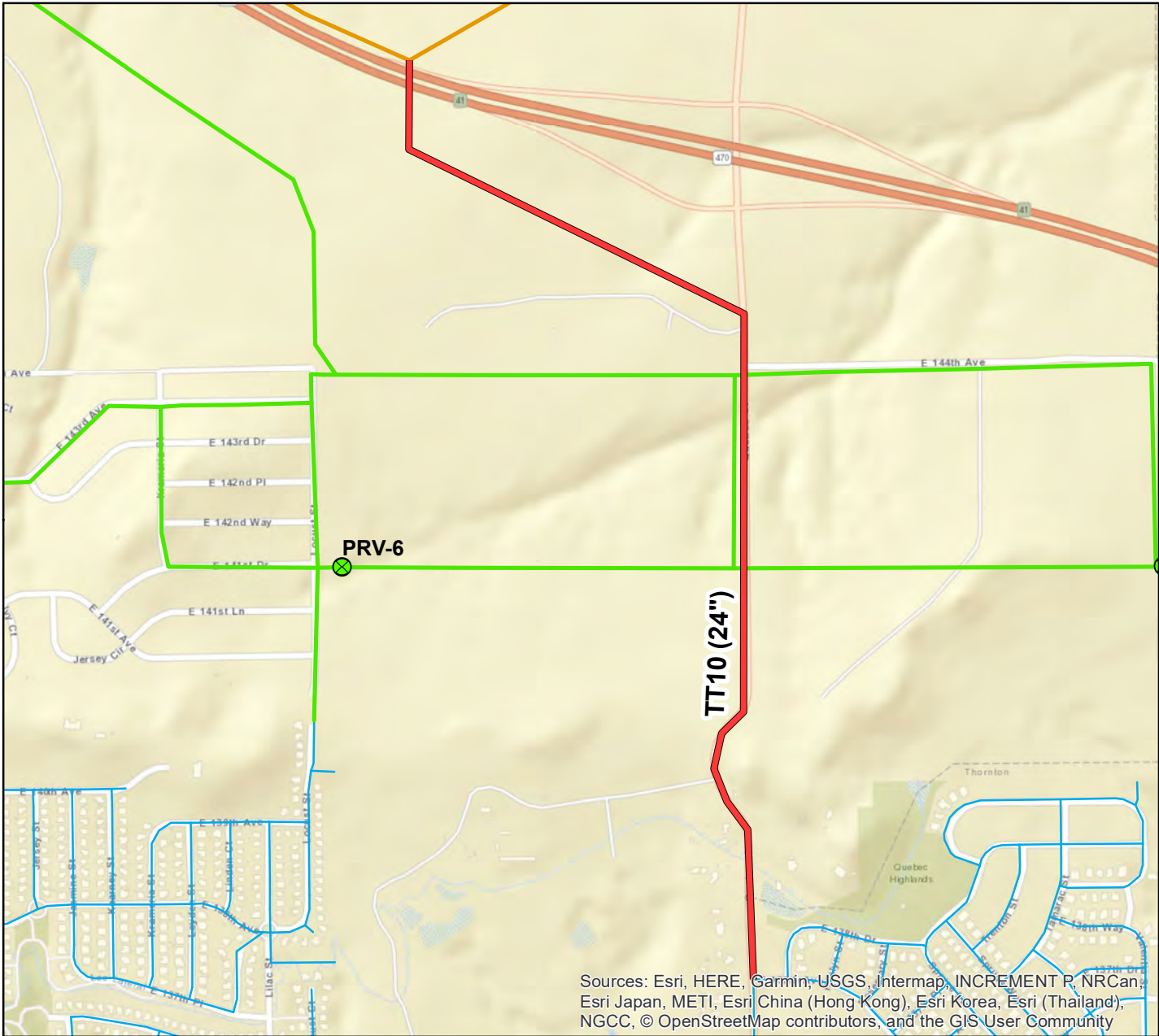
AECOM
6200 South Quebec Street
Greenwood Village, Colorado 80111

Water Distribution and Transmission Improvements

CIP TT07



1 inch = 750 feet



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Legend

- | | |
|--------------------|--------------------|
| New PRVs | Pumping CIP |
| Storage | Storage CIP |
| Pump | CIP Improvements |
| Existing Pipelines | Other Improvements |
| NWTP | Developer |
| | COT |

Project Information

New pipe crossing E-470, then parallel to and south of E-470 between Holly St and Quebec St, and along Quebec St from E-470 to E 138th Ave. The new line is a 24-in with an approximate length of 7,400ft.

Cost

\$4,809,000

Phase

2025-2035

Purpose

Facilitate Growth

Trigger

Growth North of Highway I470

Zone

Zone 1

City of Thornton
9500 Civic Center Drive
Thornton, Colorado 80229
(303) 538-7295

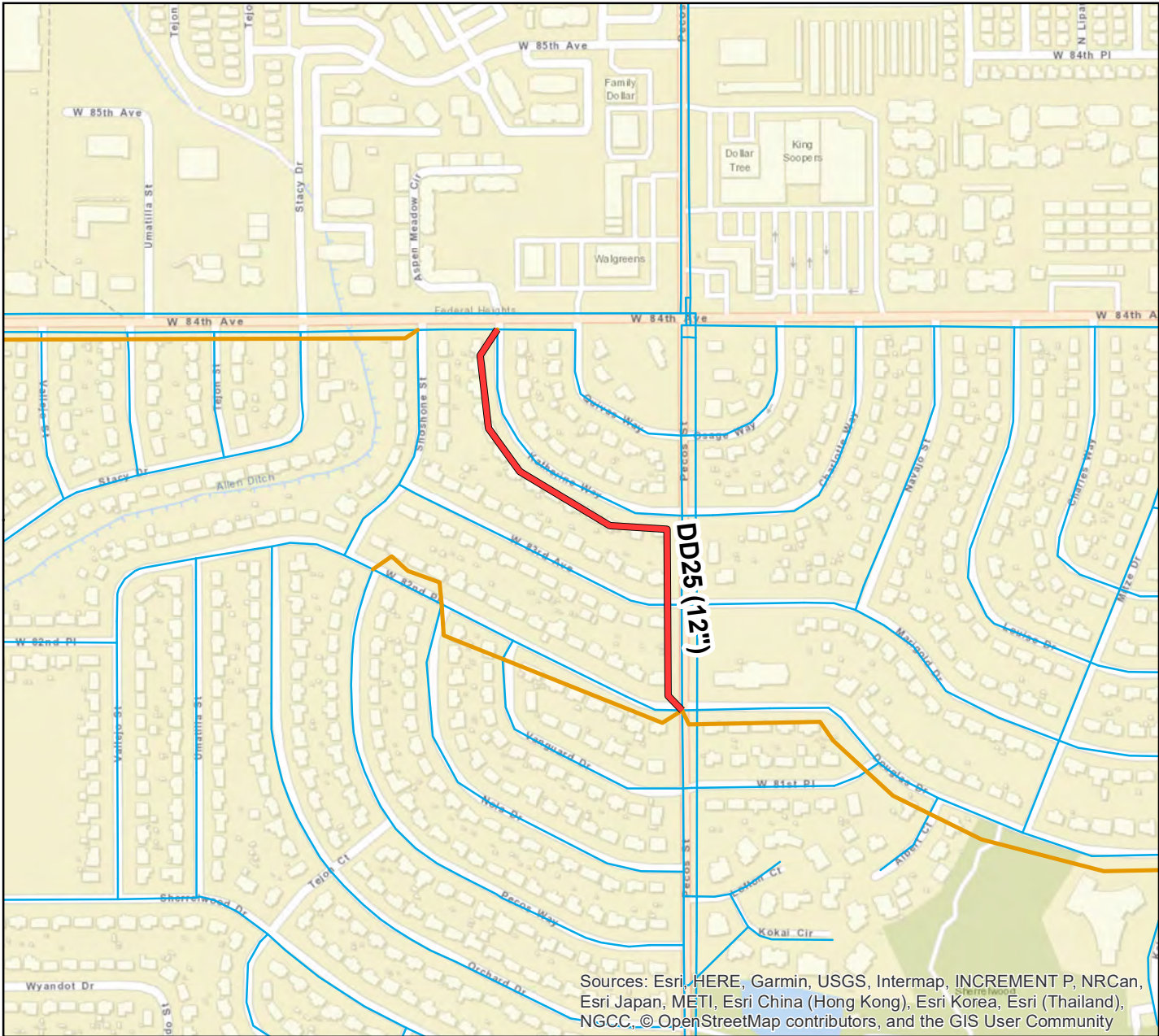
AECOM
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Greenwood Village, Colorado 80111

**Water Distribution and Transmission
Improvements**

CIP TT10



1 inch = 1,000 feet



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Legend

- New PRVs
- Storage
- Pump
- Existing Pipelines
- NWTP
- Pumping CIP
- Storage CIP
- CIP Improvements
- Other Improvements
- Developer
- COT

Project Information

New pipe along Katherine Way between W 84th Ave and N Pecos St, and along N Pecos St between Katherine Way and W 82nd Pl. The new line is a 12-in with an approximate length of 1,700ft.

Cost

\$671,320

Phase

2025-2035

Purpose

Tier 1 - Capacity, Fire flow

Trigger

Existing improvement

Zone

Zone 3

City of Thornton
9500 Civic Center Drive
Thornton, Colorado 80229
(303) 538-7295

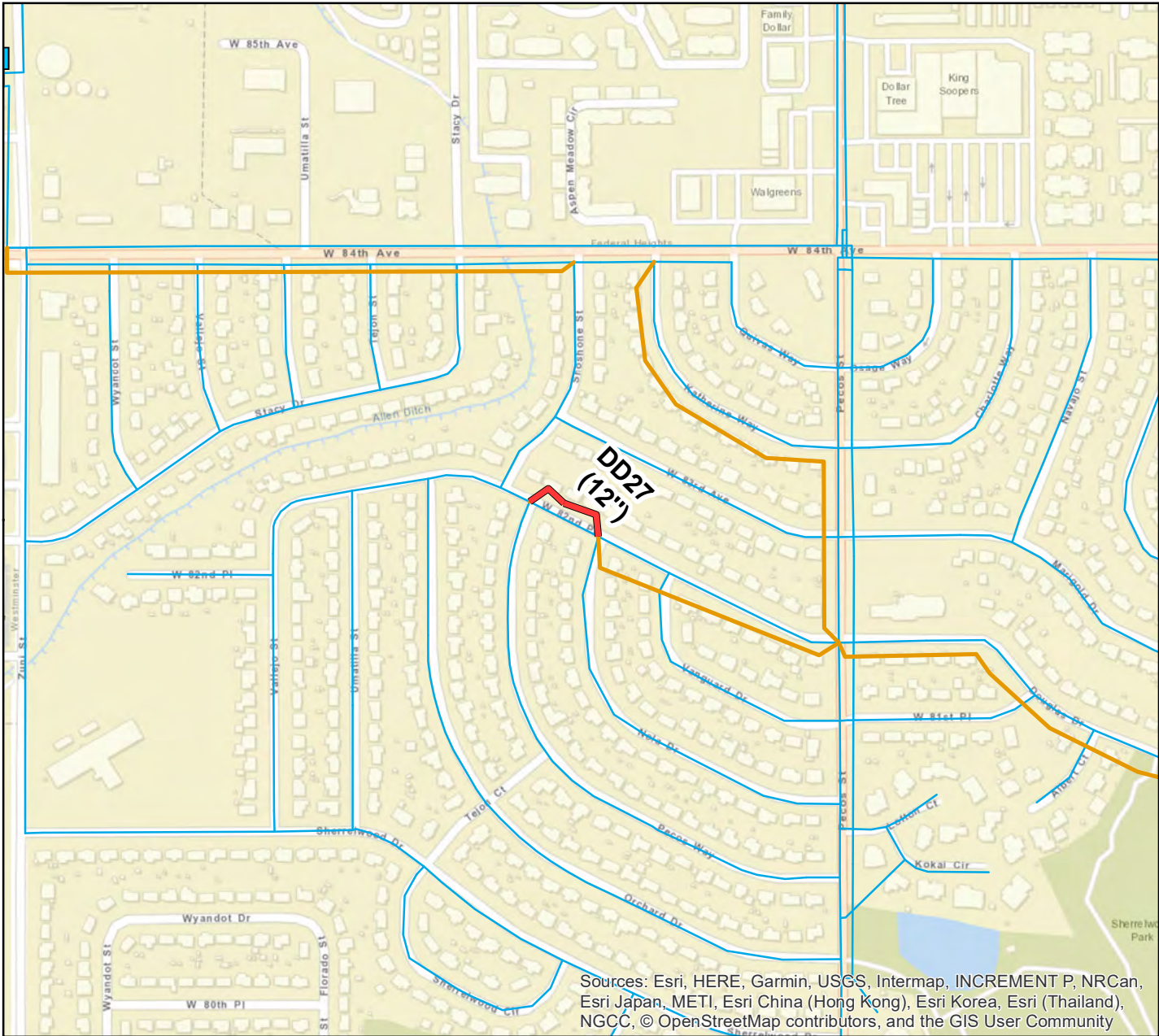
Water Distribution and Transmission Improvements

CIP DD25



1 inch = 500 feet

AECOM
6200 South Quebec Street
Greenwood Village, Colorado 80111



Legend

- New PRVs
- Storage
- Pump
- Existing Pipelines
- NWTP
- Pumping CIP
- Storage CIP
- CIP Improvements
- Other Improvements
- Developer
- COT

Project Information

Installation of a parallel pipe along W 82nd PI, between Nela Dr and Pecos Way. The new line is a 12-in with an approximate length of 400ft.

Cost

\$157,960

Phase

2025-2035

Purpose

Tier 1 - Capacity, Fire flow

Trigger

Existing improvement

Zone

Zone 3

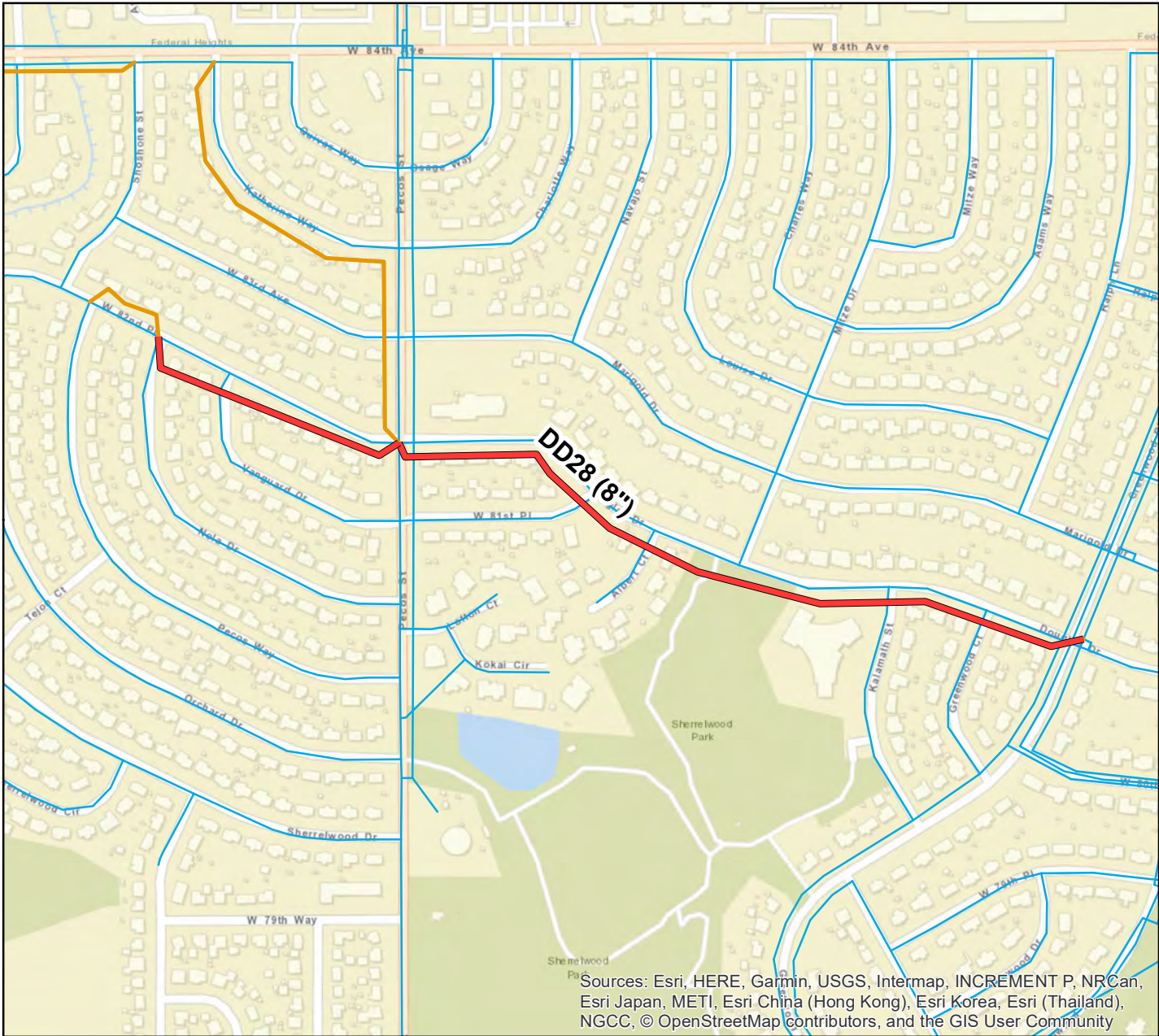
City of Thornton
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AECOM
6200 South Quebec Street
Greenwood Village, Colorado 80111

Water Distribution and Transmission Improvements

CIP DD27

1 inch = 500 feet



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Legend

- | | |
|--------------------|--------------------|
| New PRVs | Pumping CIP |
| Storage | Storage CIP |
| Pump | CIP Improvements |
| Existing Pipelines | Other Improvements |
| NWTP | Developer |
| | COT |

Project Information

New pipe along Douglas Dr between Greenwood Blvd and N Pecos St, and along 82nd St between N Pecos St and Nola Dr. The new line is a 8-in with an approximate length of 3,300ft.

Cost

\$1,015,840

Phase

2025-2035

Purpose

Tier 1 - Capacity, Fire flow

Trigger

Existing improvement

Zone

Zone 3

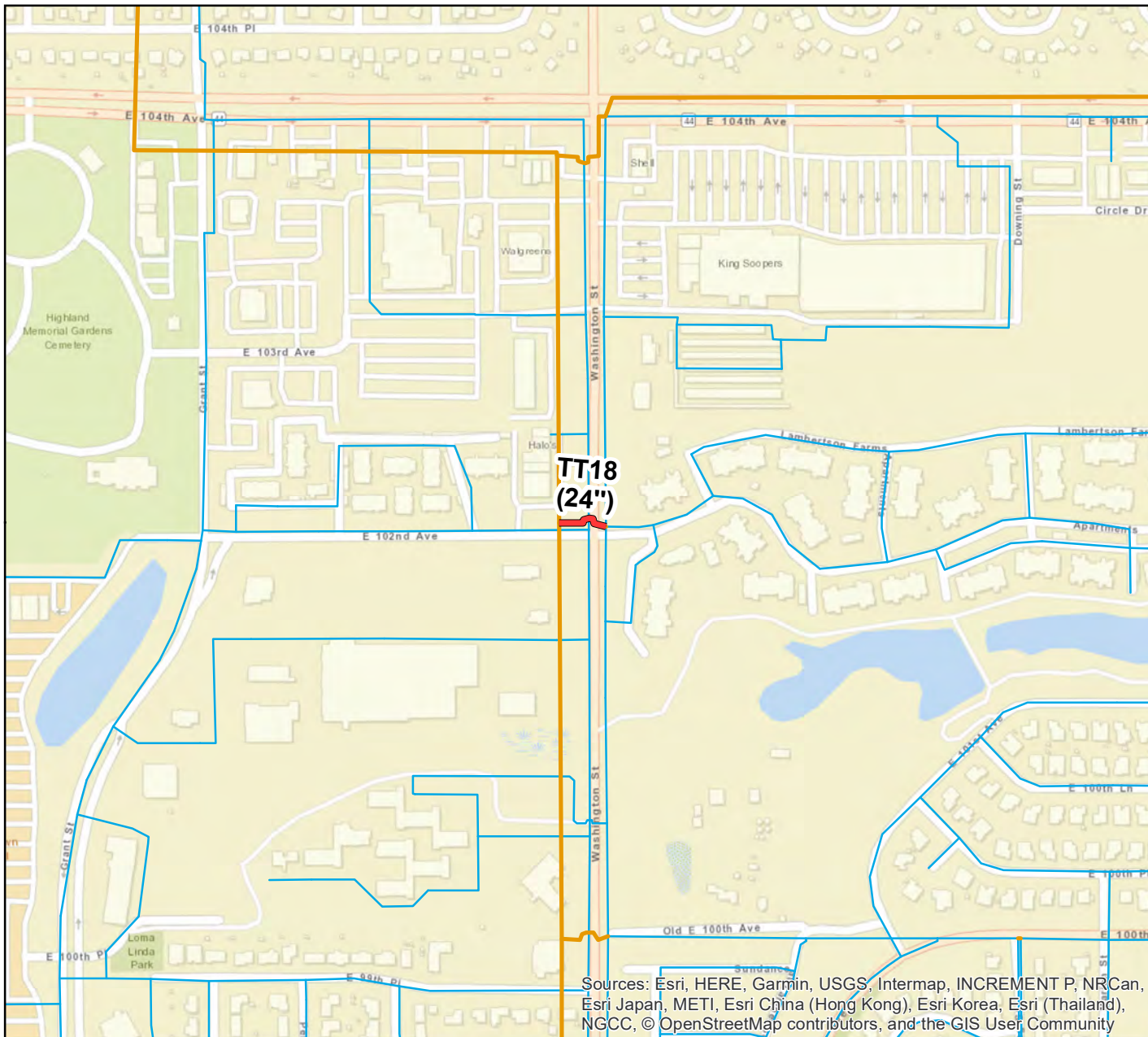
City of Thornton
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Thornton, Colorado 80229
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Water Distribution and Transmission Improvements












AECOM
6200 South Quebec Street
Greenwood Village, Colorado 80111

CIP DD28

1 inch = 500 feet



Legend

-  New PRVs
-  Storage
-  Pump
-  Existing Pipelines
-  NWTP
-  Pumping CIP
-  Storage CIP
-  CIP Improvements
-  Other Improvements
-  Developer
-  COT

Project Information

New pipe along 102nd Ave crossing Washington St. The new line is a 24-in with an approximate length of 200 ft.

Cost

\$130,000

Phase

2035

Purpose

Storage

Trigger

Zone 3 Storage Upgrade

Zone

Zone 3

 City of Thornton
9500 Civic Center Drive
Thornton, Colorado 80229
(303) 538-7295

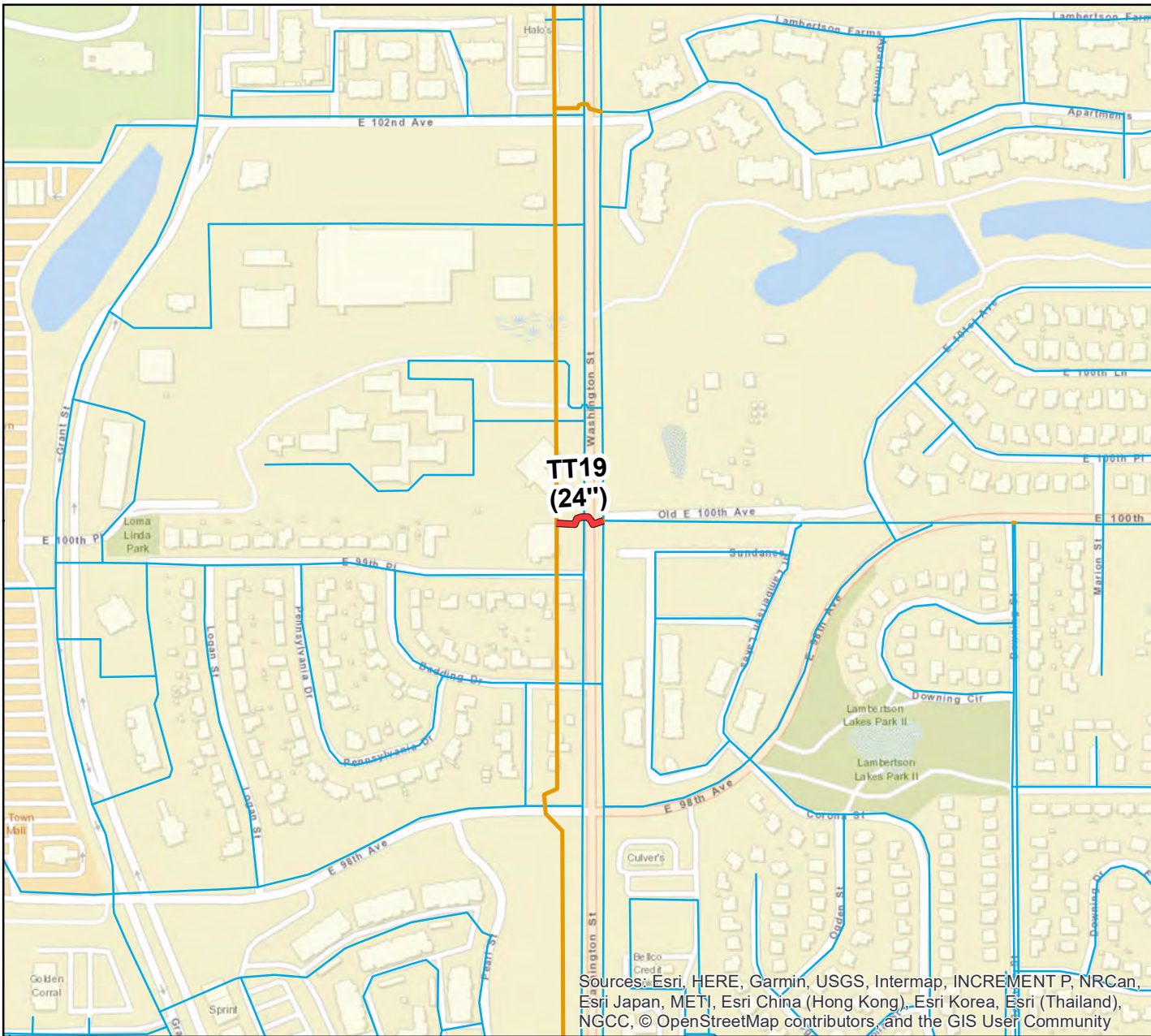
Water Distribution and Transmission Improvements

AECOM
6200 South Quebec Street
Greenwood Village, Colorado 80111

CIP TT18



1 inch = 500 feet



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Legend

- New PRVs
- Storage
- Pump
- Existing Pipelines
- NWTP
- Pumping CIP
- Storage CIP
- CIP Improvements
- Other Improvements
- Developer
- COT

Project Information

New pipe crossing Washington St at Old E 100th Ave. The new line is a 24-in with an approximate length of 200 ft.

Cost

\$130,000

Phase

2035

Purpose

Storage

Trigger

Zone 1 Storage Upgrade

Zone

Zone 1

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9500 Civic Center Drive
Thornton, Colorado 80229
(303) 538-7295

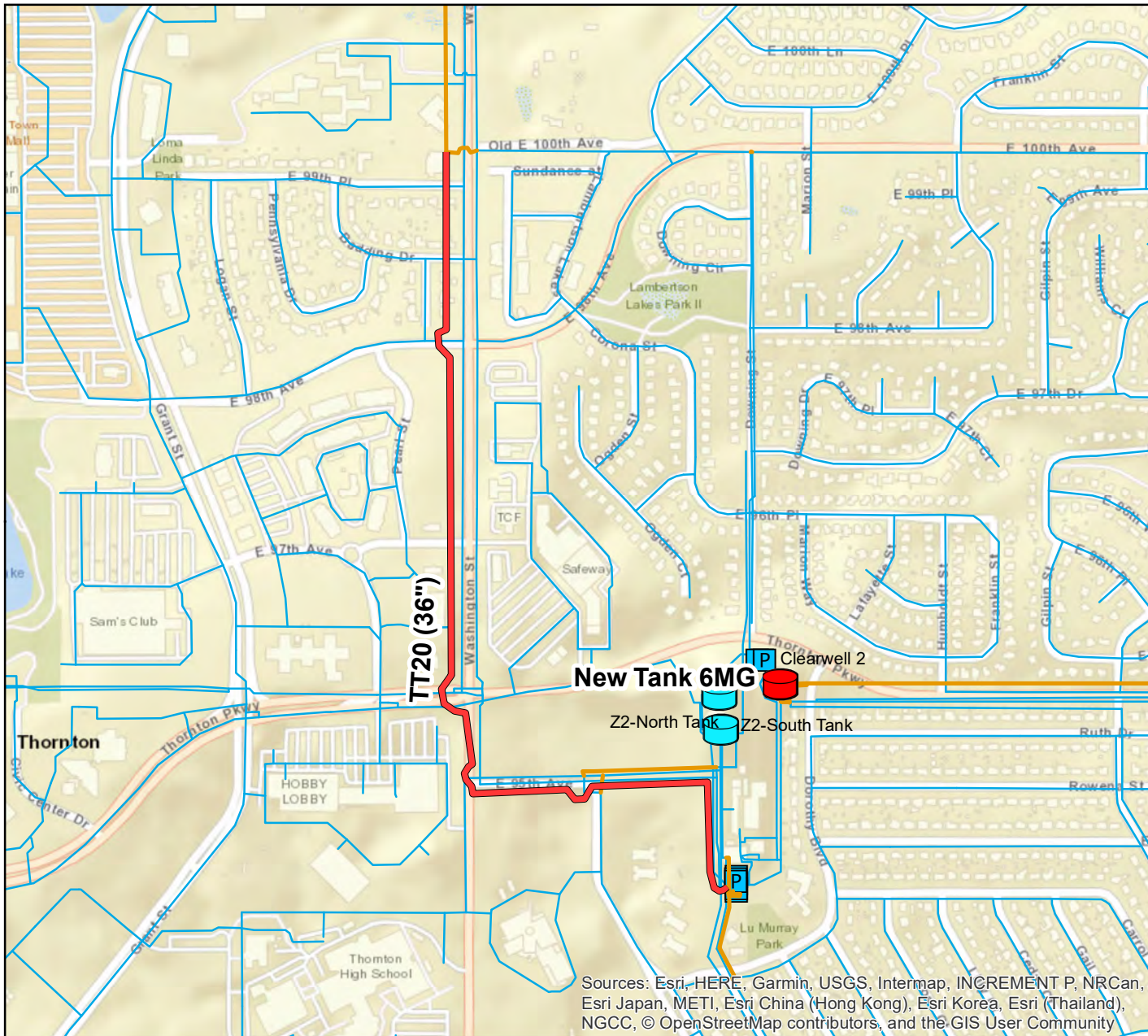
Water Distribution and Transmission Improvements

CIP TT19

AECOM
6200 South Quebec Street
Greenwood Village, Colorado 80111



1 inch = 500 feet



Legend

- New PRVs
- Storage
- Pump
- Existing Pipelines
- NWTP
- Pumping CIP
- Storage CIP
- CIP Improvements
- Other Improvements
- Developer
- COT

Project Information

New pipe from TWTP, running along Dorothy Blvd, Hoffman Way, and 95th Ave to Washington St, then running parallel to Washington St until Old E 100th Ave. The new line is a 36-in with an approximate length of 5,100 ft.

Cost

\$4,392,700

Phase

2035

Purpose

Storage

Trigger

Zone 1 Storage Upgrade

Zone

Zone 3

City of Thornton
9500 Civic Center Drive
Thornton, Colorado 80229
(303) 538-7295

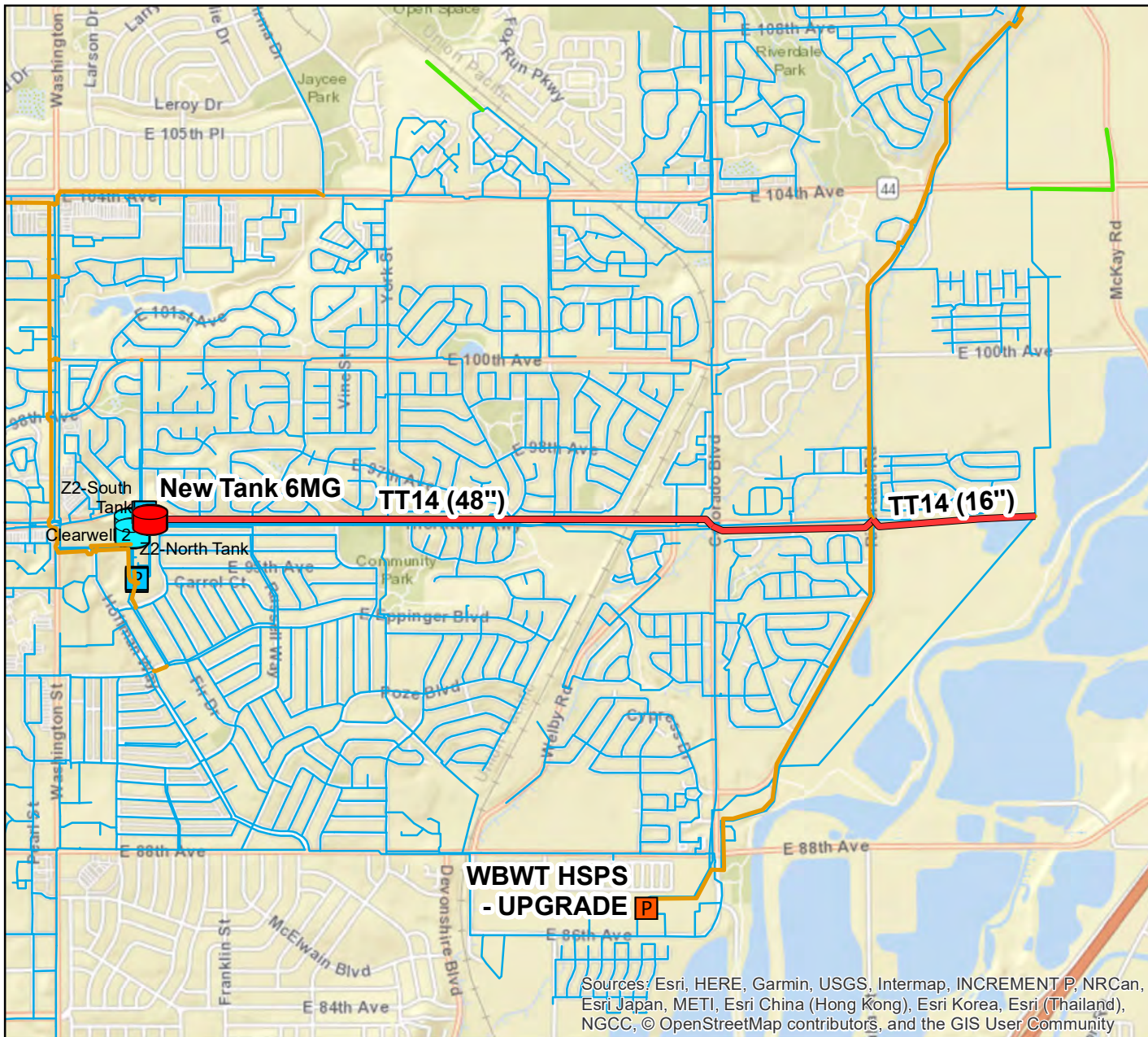
Water Distribution and Transmission Improvements

AECOM
6200 South Quebec Street
Greenwood Village, Colorado 80111

CIP TT20














1 inch = 750 feet



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Legend

-  New PRVs
-  Storage
-  Pump
-  Existing Pipelines
-  NWTP
-  Pumping CIP
-  Storage CIP
-  CIP Improvements
-  Other Improvements
-  Developer
-  COT

Project Information

New pipe from Clearwell 2 at TWTP along Thornton Pkwy and E 96th Ave to just west of the South Platte River . The new line is a 48-in and 16-in with an approximate length of 14,300 ft.

Cost

\$16,629,700

Phase

2035

Purpose

Supply

Trigger

WBWTP Upgrade

Zone

Zone 1

City of Thornton
9500 Civic Center Drive
Thornton, Colorado 80229
(303) 538-7295

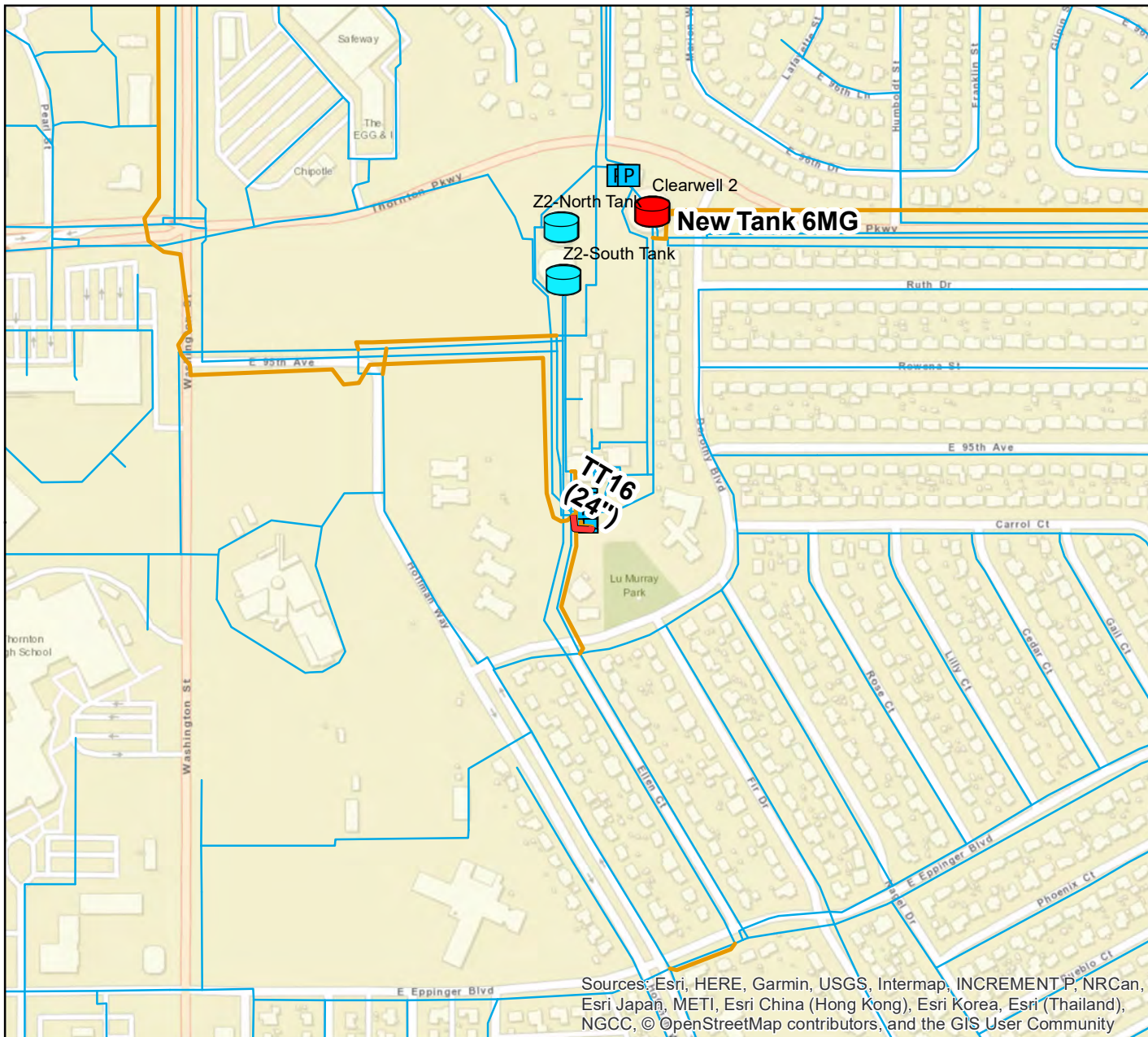
Water Distribution and Transmission Improvements

AECOM
6200 South Quebec Street
Greenwood Village, Colorado 80111

CIP TT14



1 inch = 2,500 feet



Legend

- ✕ New PRVs
- Storage
- P Pump
- WTP NWTP
- P Pumping CIP
- Storage CIP
- CIP Improvements
- Other Improvements
- Developer
- COT

Project Information

New pipe just south of TWTP. The new line is a 24-in with an approximate length of 200 ft.

Cost

\$130,000

Phase

2035

Purpose

Supply

Trigger

Zone 1 Storage Upgrade

Zone

Zone 1

 City of Thornton
9500 Civic Center Drive
Thornton, Colorado 80229
(303) 538-7295

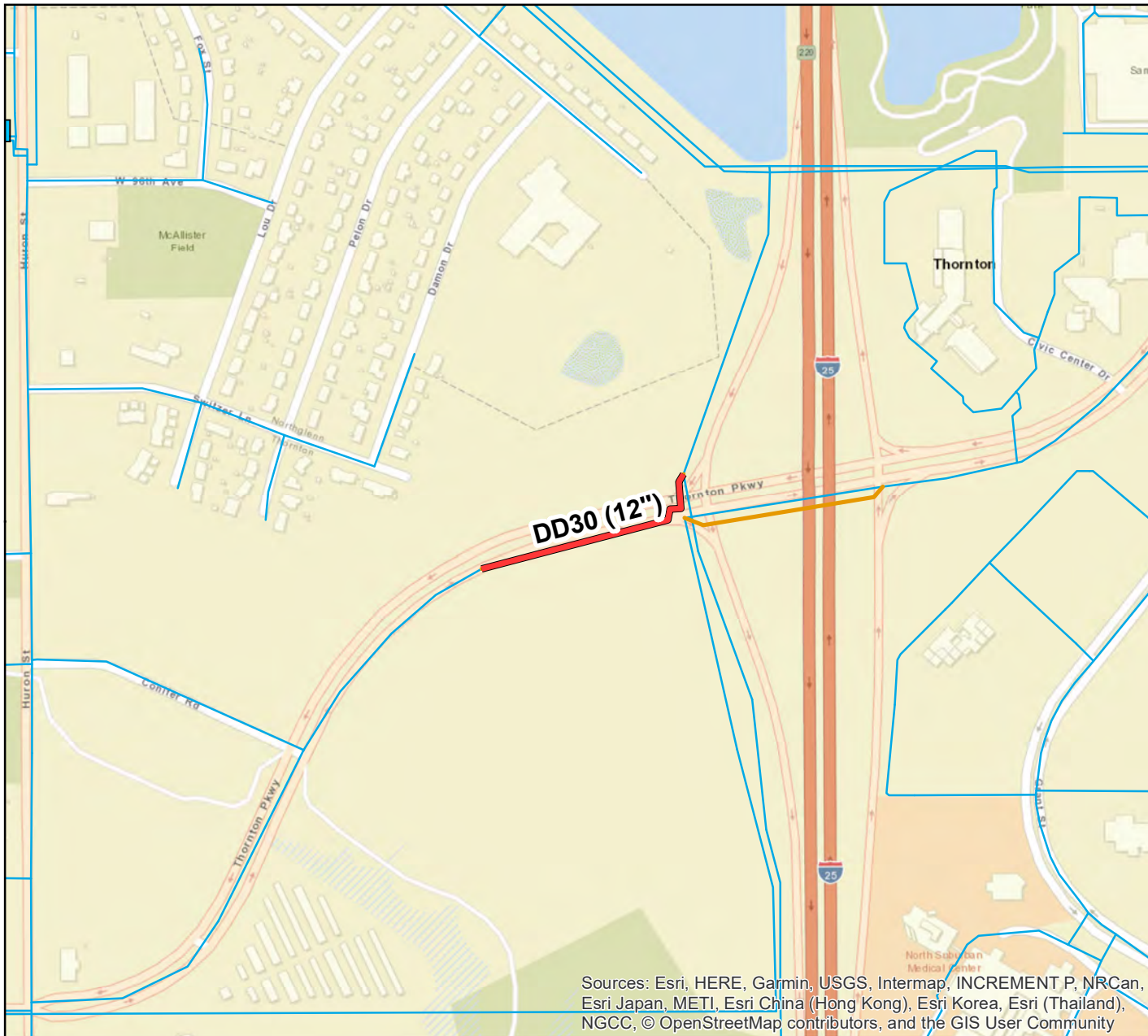
Water Distribution and Transmission Improvements

AECOM
6200 South Quebec Street
Greenwood Village, Colorado 80111












CIP TT16



1 inch = 500 feet



Legend

-  New PRVs
-  Storage
-  Pump
-  NWTP
-  Pumping CIP
-  Storage CIP
-  CIP Improvements
-  Existing Pipelines
-  Other Improvements
-  Developer
-  COT

Project Information

New pipe along Thornton Pkwy, just west of I-25. The line is a 12-in with an approximate length of 800 ft.

Cost

\$315,920

Phase

2035

Purpose

Tier 1 - Capacity

Trigger

Growth - Average System Demand = 37mgd

Zone

Zone 3

City of Thornton
9500 Civic Center Drive
Thornton, Colorado 80229
(303) 538-7295

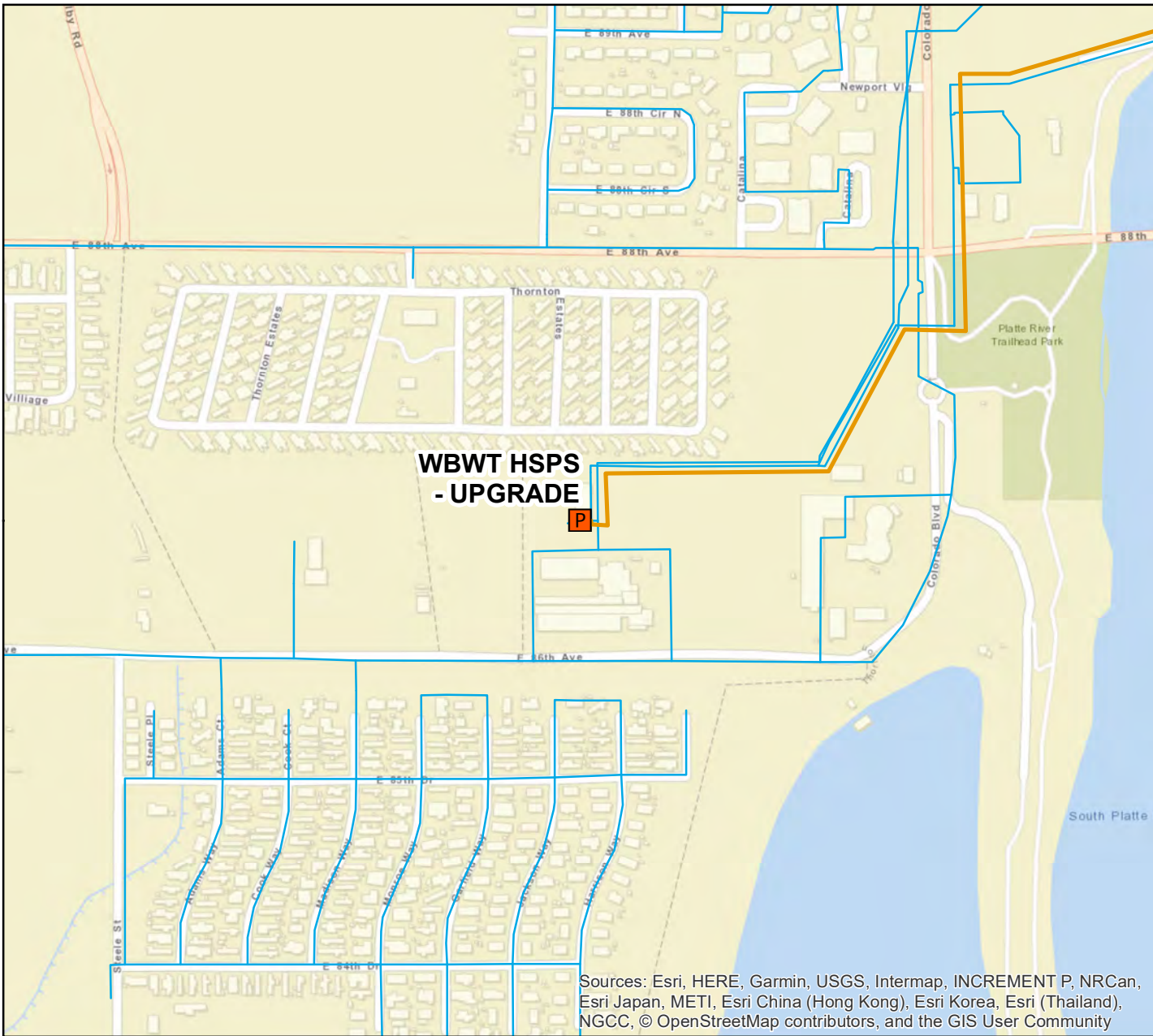
Water Distribution and Transmission Improvements

AECOM
6200 South Quebec Street
Greenwood Village, Colorado 80111











CIP DD30



1 inch = 500 feet



Legend

-  New PRVs
-  Storage
-  Pump
-  NWTP
-  Pumping CIP
-  Storage CIP
-  CIP Improvements
-  Other Improvements
-  Developer
-  COT

Project Information

Replacement of two units in Zone 1 - Wes Brown High Service Pump Station, each with a capacity of 10,000gpm.

Cost

\$4,614,000

Phase

2035

Purpose

Tier 1 - Pumping

Trigger

Growth - Average System Demand = 37mgd

Zone

Zone 1

 City of Thornton
9500 Civic Center Drive
Thornton, Colorado 80229
(303) 538-7295

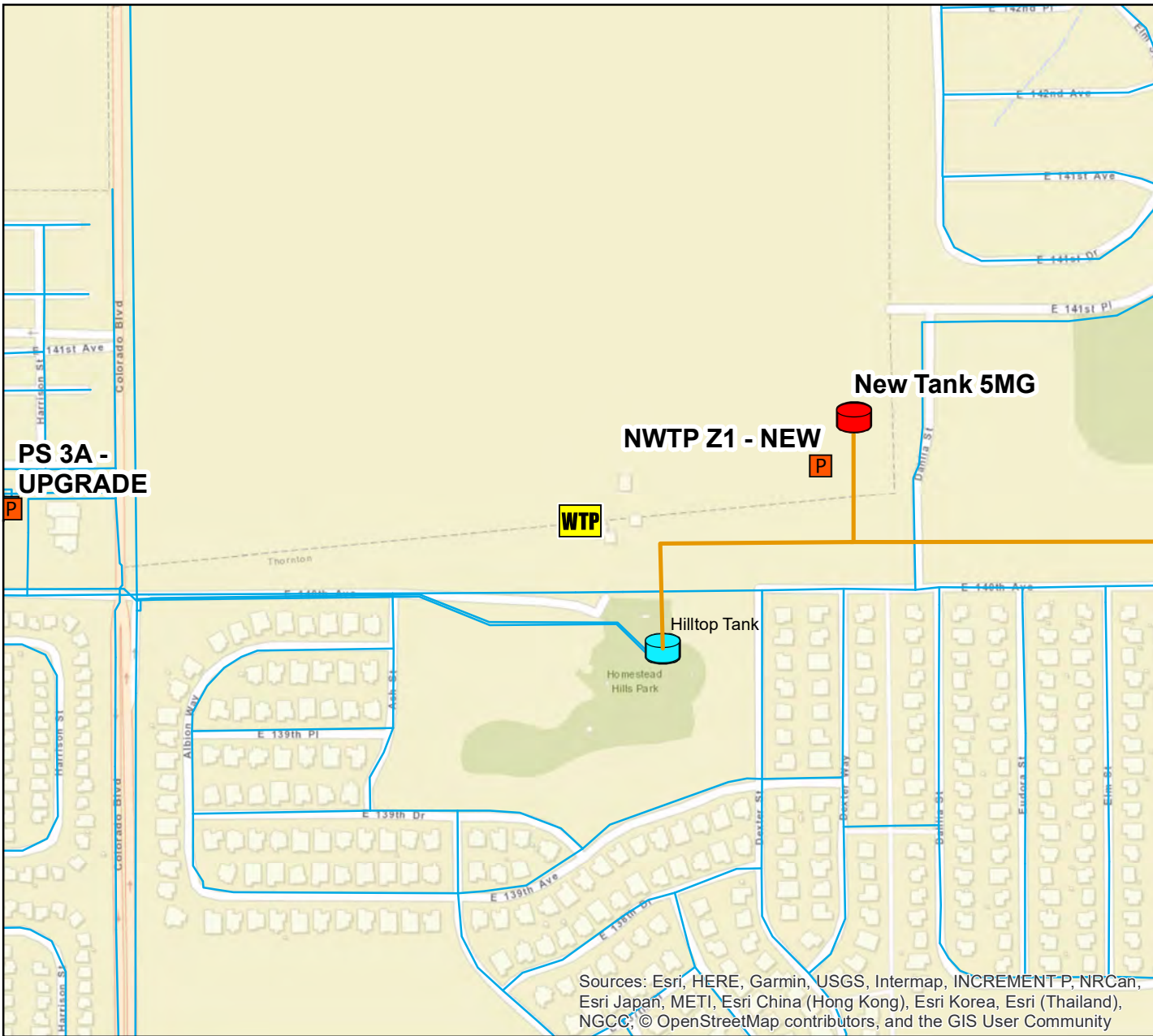
Water Distribution and Transmission Improvements

AECOM
6200 South Quebec Street
Greenwood Village, Colorado 80111

CIP P-03



1 inch = 500 feet



Legend

- New PRVs
- Storage
- Pump
- Existing Pipelines
- NWTP
- Pumping CIP
- Storage CIP
- CIP Improvements
- Other Improvements
- Developer
- COT

Project Information

New pump station, pumping from NWTP to Zone 1, with four units, each with a capacity of 5,000gpm.

Cost

\$566,300

Phase

2035

Purpose

Tier 1 - Pumping

Trigger

NWTP Construction

Zone

Zone 1

City of Thornton
9500 Civic Center Drive
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AECOM
6200 South Quebec Street
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Water Distribution and Transmission Improvements

CIP P-04



1 inch = 500 feet



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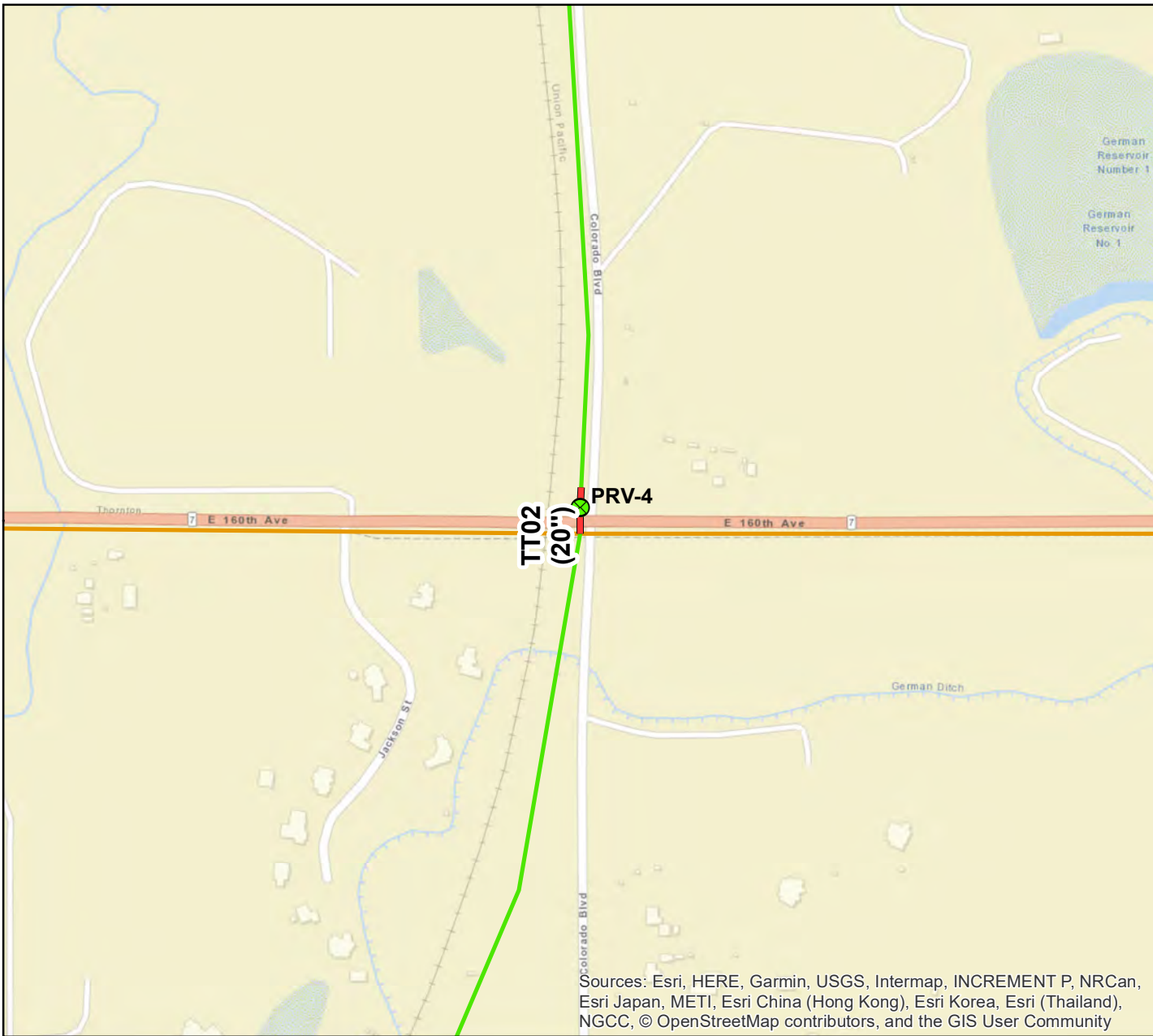
AECOM
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Greenwood Village, Colorado 80111

Water Distribution and Transmission Improvements

CIP SS-03



1 inch = 500 feet



Legend

- New PRVs
- Storage
- Pump
- NWTP
- Pumping CIP
- Storage CIP
- CIP Improvements
- Existing Pipelines
- Developer
- COT

Project Information

New pipe along Colorado Blvd at E 160th Ave. The new line is a 20-in with an approximate length of 200 ft.

Cost

\$111,700

Phase

2035-2065

Purpose

Facilitate Growth

Trigger

Growth North of E 156th Avenue

Zone

Zone 1

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9500 Civic Center Drive
Thornton, Colorado 80229
(303) 538-7295

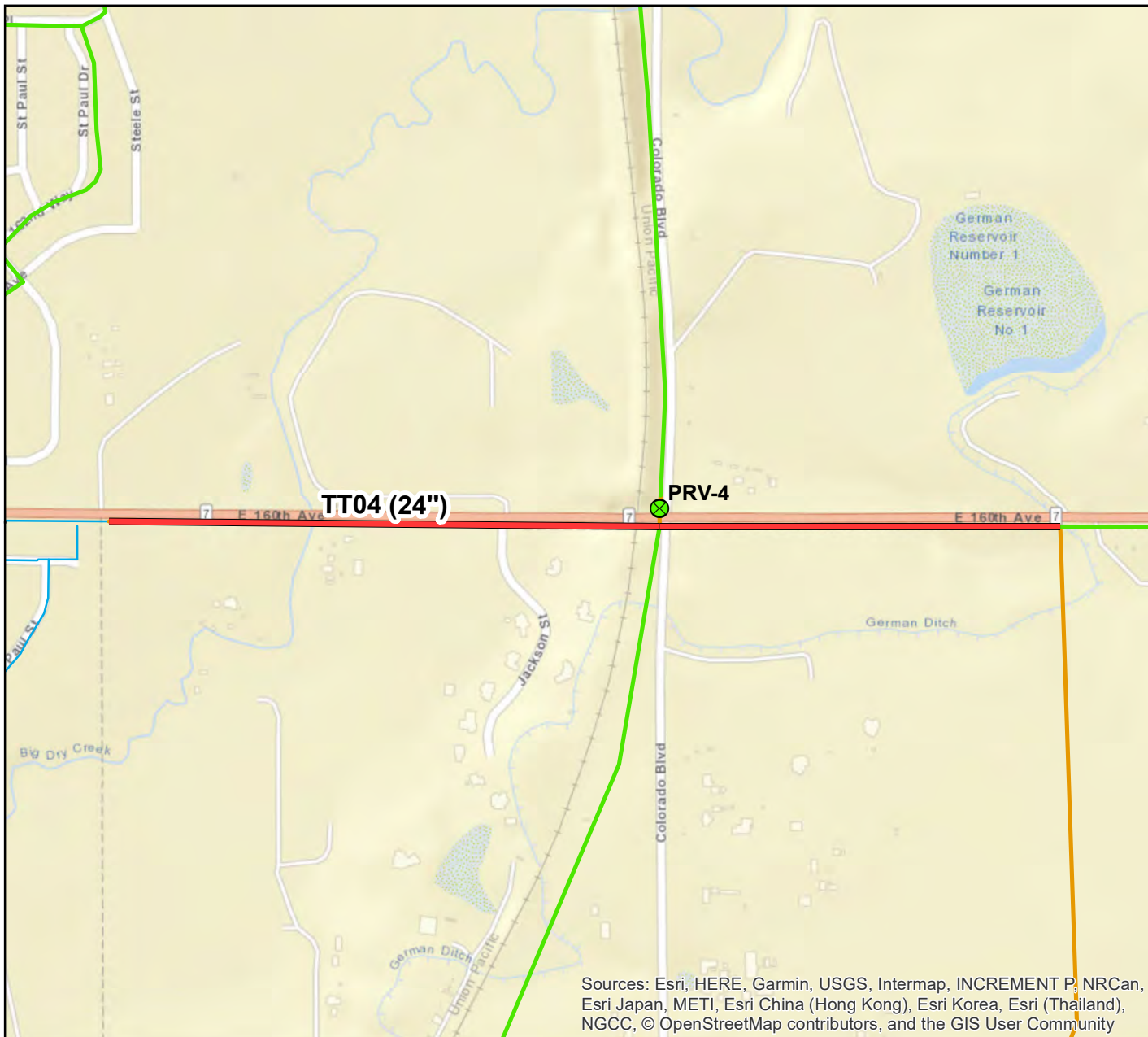
AECOM
6200 South Quebec Street
Greenwood Village, Colorado 80111

Water Distribution and Transmission Improvements

CIP TT02



1 inch = 500 feet



Legend

- | | |
|--------------------|--------------------|
| New PRVs | Pumping CIP |
| Storage | Storage CIP |
| Pump | CIP Improvements |
| Existing Pipelines | Other Improvements |
| NWTP | Developer |
| | COT |

Project Information

New pipe along E 160th Ave, from neighborhood east of York St, across Colorado Blvd to east of Holly St. The new line is a 24-in with an approximate length of 4,600 ft.

Cost

\$2,989,400

Phase

2035-2065

Purpose

Facilitate Growth

Trigger

Growth North of E 156th Avenue

Zone

Zone 1

City of Thornton
9500 Civic Center Drive
Thornton, Colorado 80229
(303) 538-7295

Water Distribution and Transmission Improvements

AECOM
6200 South Quebec Street
Greenwood Village, Colorado 80111

CIP TT04



1 inch = 750 feet



Legend

- New PRVs
- Storage
- Pump
- Existing Pipelines
- NWTP
- Pumping CIP
- Storage CIP
- CIP Improvements
- Other Improvements
- Developer
- COT

Project Information

New pipe along Colorado Blvd from just north of E-470 to the bend in the road. The new line is a 36-in with an approximate length of 1,500 ft.

Cost

\$1,292,000

Phase

2035-2065

Purpose

Facilitate Growth

Trigger

Growth North of E 156th Avenue

Zone

Zone 1

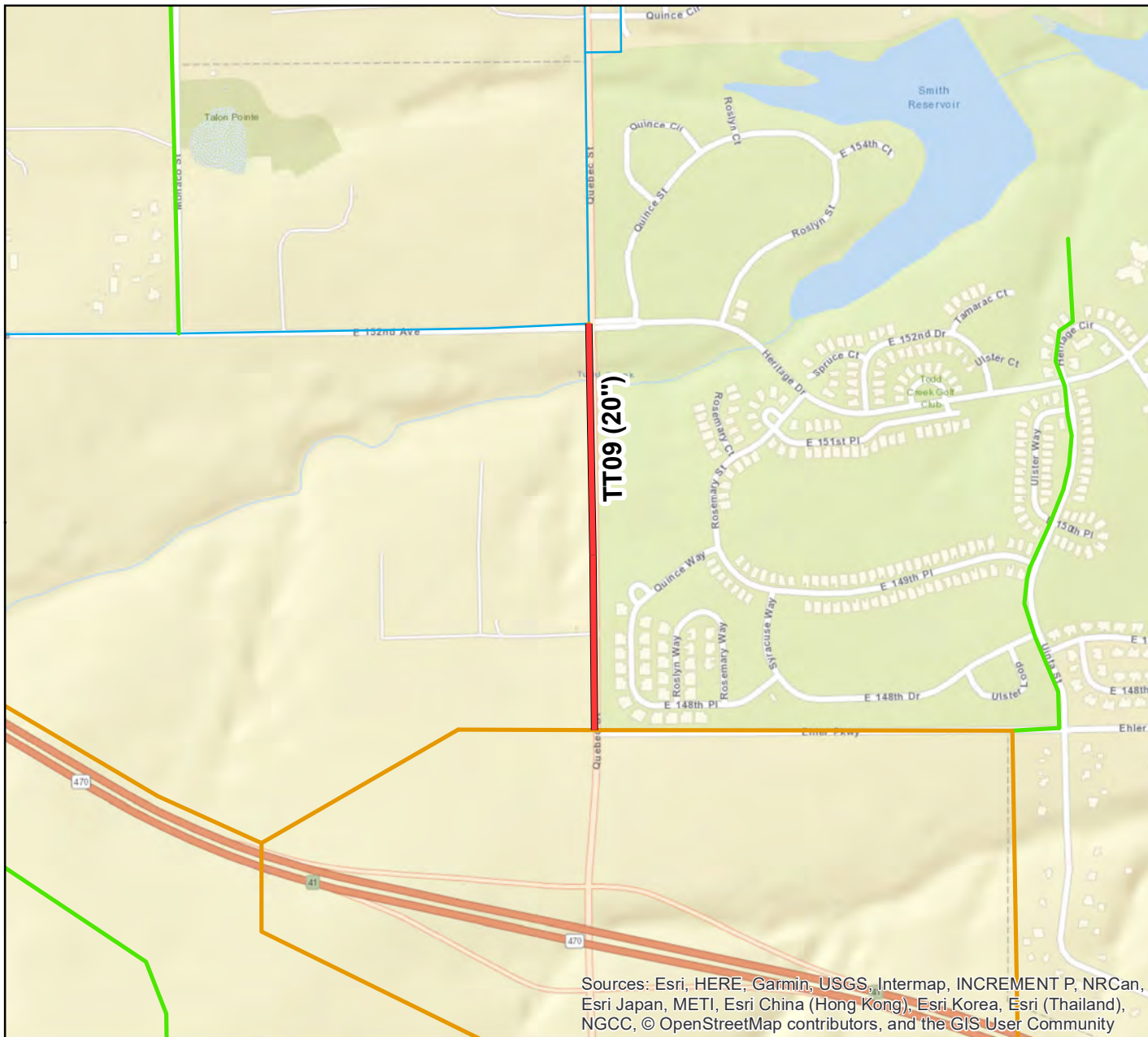
Water Distribution and Transmission Improvements

CIP TT05

1 inch = 500 feet

City of Thornton
9500 Civic Center Drive
Thornton, Colorado 80229
(303) 538-7295

AECOM
6200 South Quebec Street
Greenwood Village, Colorado 80111



City of Thornton
9500 Civic Center Drive
Thornton, Colorado 80229
(303) 538-7295

AECOM
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Greenwood Village, Colorado 80111

Water Distribution and Transmission Improvements

CIP TT09



1 inch = 1,000 feet



Legend

- New PRVs
- Storage
- Pump
- Existing Pipelines
- NWTP
- Pumping CIP
- Storage CIP
- CIP Improvements
- Other Improvements
- Developer
- COT

Project Information

New pipe bypassing the new 6MG tank (CIP SS-03), adjacent to TWTP Clearwell 2. The new line is a 48-in with an approximate length of 300 ft.

Cost

\$348,900

Phase

2035-2065

Purpose

Supply

Trigger

Growth - Average System Demand = 44mgd

Zone

Zone 1

City of Thornton
9500 Civic Center Drive
Thornton, Colorado 80229
(303) 538-7295

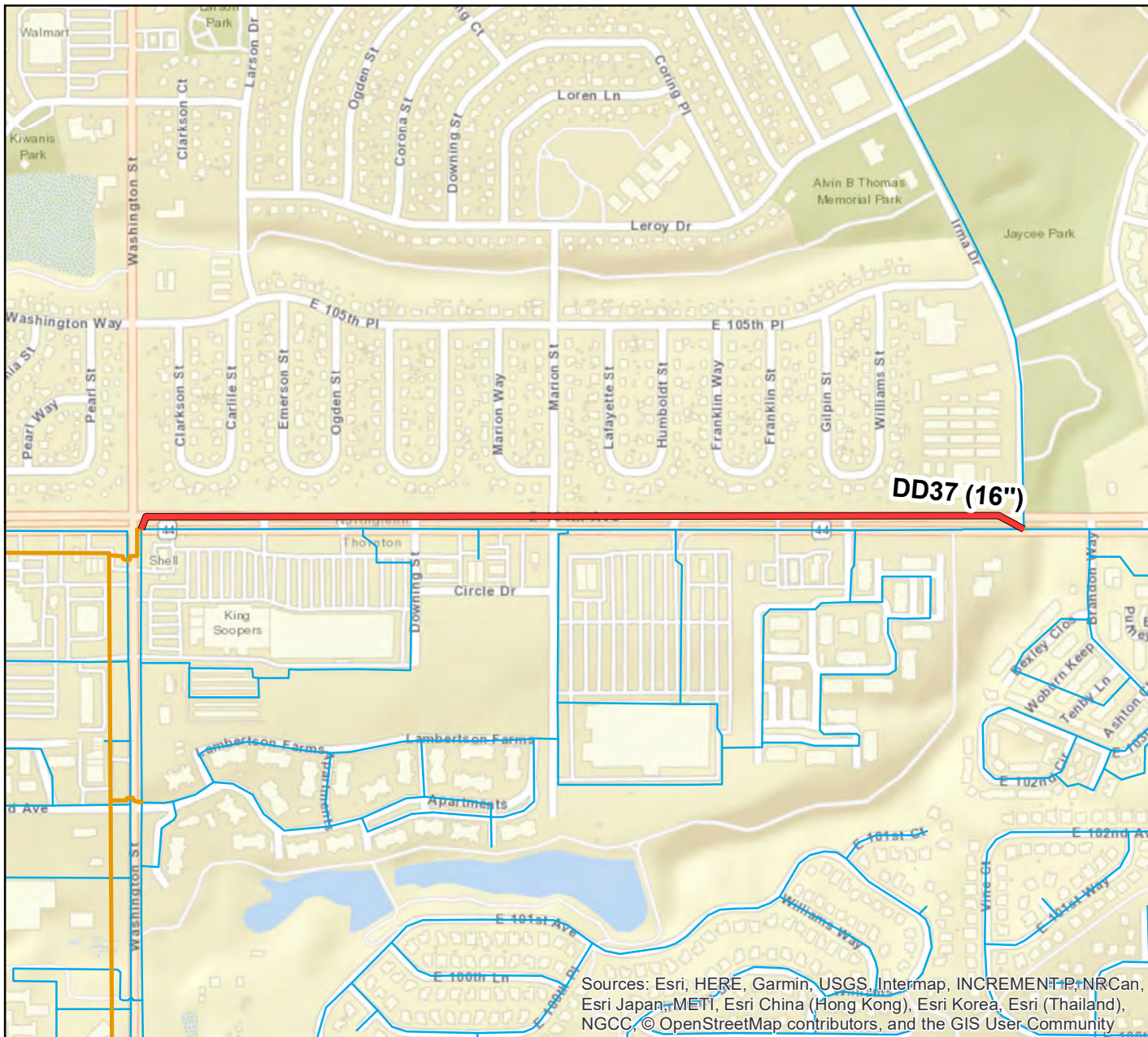
AECOM
6200 South Quebec Street
Greenwood Village, Colorado 80111

**Water Distribution and Transmission
Improvements**

CIP TT26



1 inch = 500 feet



City of Thornton
9500 Civic Center Drive
Thornton, Colorado 80229
(303) 538-7295

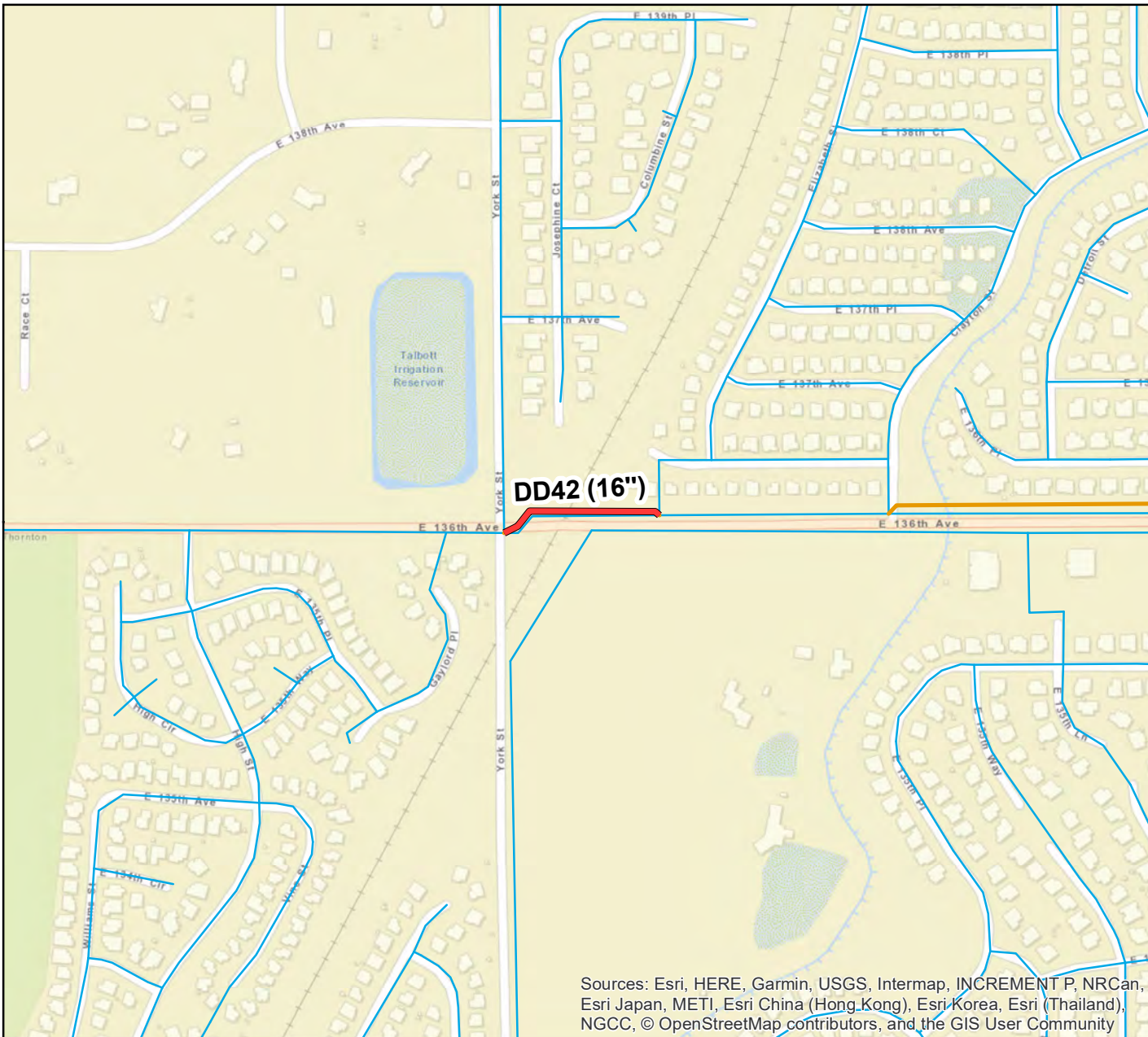
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Water Distribution and Transmission Improvements

CIP DD37



1 inch = 750 feet



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9500 Civic Center Drive
Thornton, Colorado 80229
(303) 538-7295

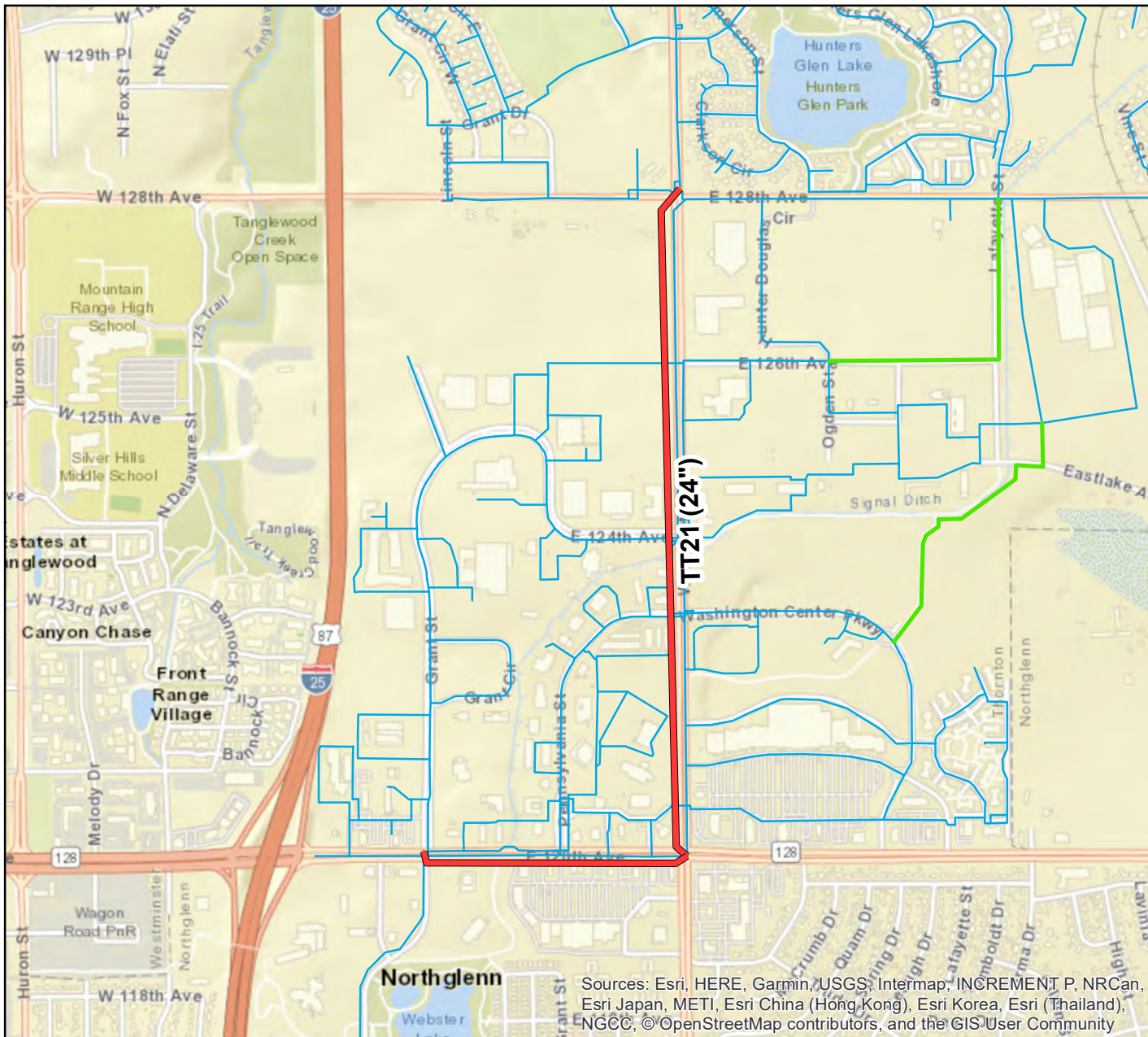
AECOM
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Greenwood Village, Colorado 80111

Water Distribution and Transmission Improvements

CIP DD42



1 inch = 500 feet



City of Thornton
9500 Civic Center Drive
Thornton, Colorado 80229
(303) 538-7295

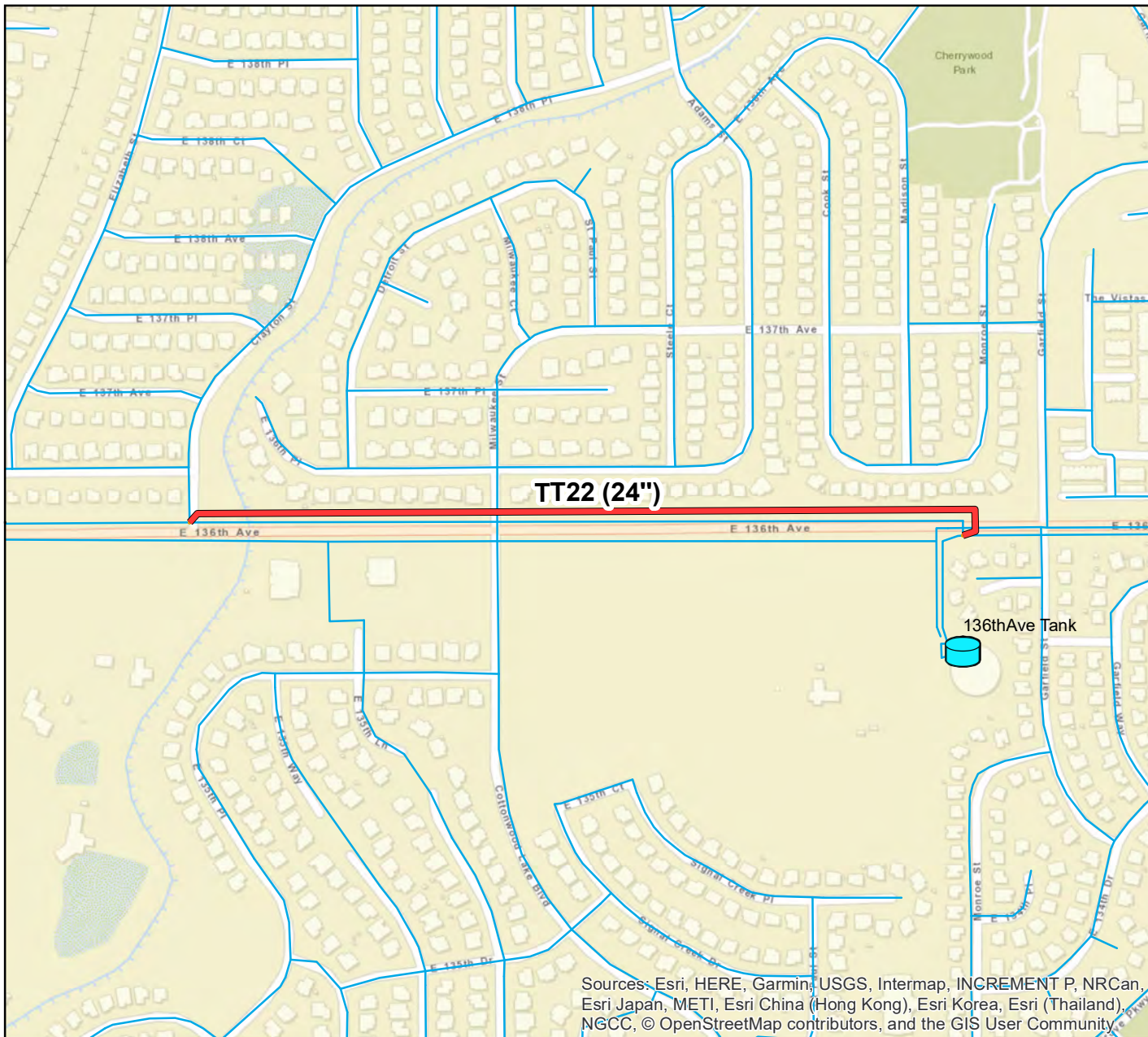
AECOM
6200 South Quebec Street
Greenwood Village, Colorado 80111

Water Distribution and Transmission Improvements

CIP TT21



1 inch = 1,250 feet



Legend

- New PRVs
- Storage
- Pump
- Existing Pipelines
- NWTP
- Pumping CIP
- Storage CIP
- CIP Improvements
- Other Improvements
- Developer
- COT

Project Information

New pipe along 136th Ave from 136th Ave from Clayton St to connection north of 136th Ave Tank. The new line is a 24-in with an approximate length of 2,700 ft.

Cost

\$1,754,630

Phase

2035-2065

Purpose

Tier 2 - Capacity

Trigger

Growth - Average System Demand = 44mgd

Zone

Zone 1

City of Thornton
9500 Civic Center Drive
Thornton, Colorado 80229
(303) 538-7295

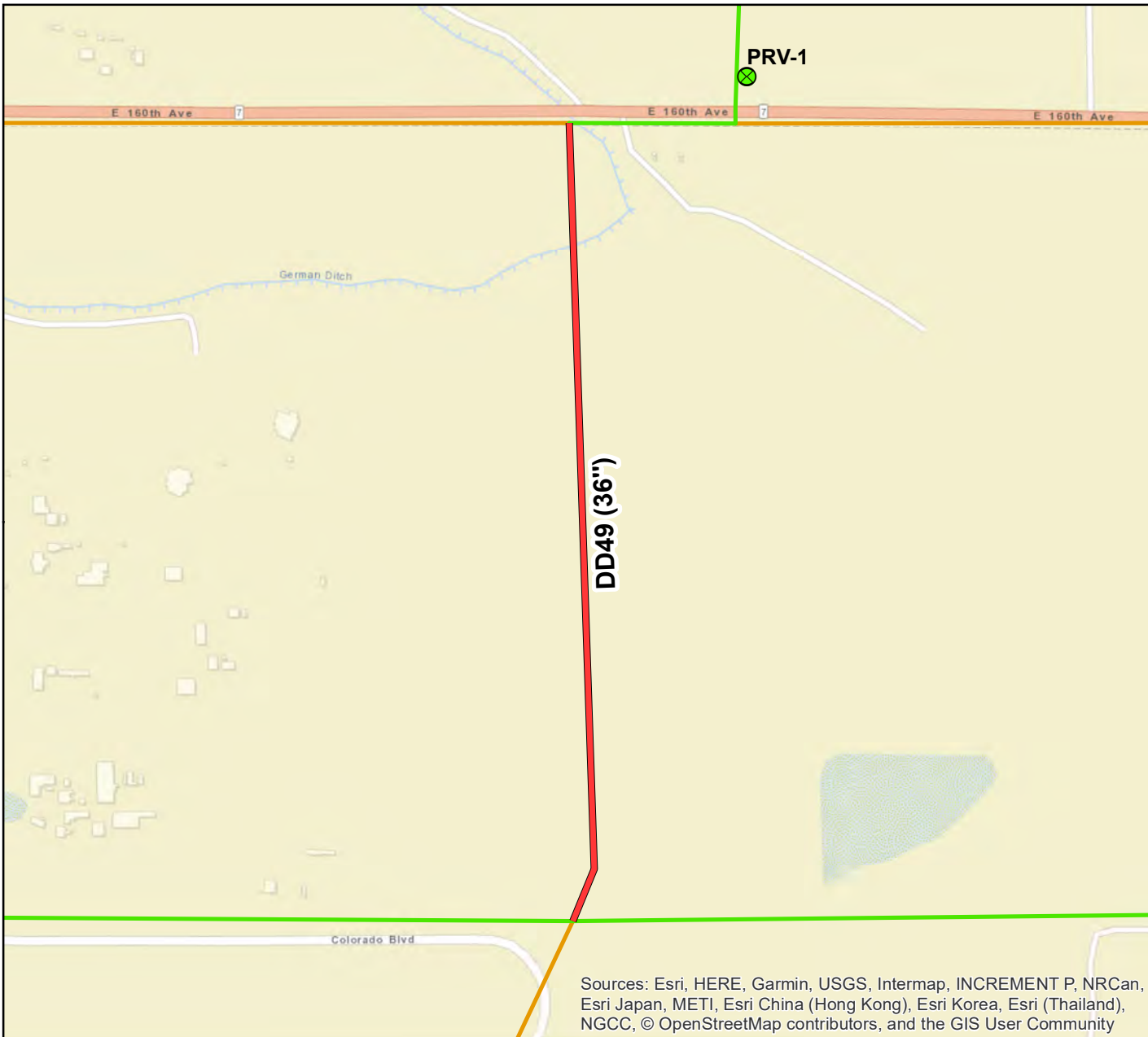
Water Distribution and Transmission Improvements

AECOM
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Greenwood Village, Colorado 80111

CIP TT22



1 inch = 500 feet



Legend

- New PRVs
- Storage
- Pump
- Existing Pipelines
- NWTP
- Pumping CIP
- Storage CIP
- CIP Improvements
- Other Improvements
- Developer
- COT

Project Information

New pipe east of Colorado Blvd, running south from south of E 160th Ave to intersect with bend in Colorado Blvd. The new line is a 36-in with an approximate length of 2,600 ft.

Cost

\$2,239,400

Phase

2065

Purpose

Facilitate Growth

Trigger

Developments north of E 156th Avenue

Zone

Zone 1

City of Thornton
9500 Civic Center Drive
Thornton, Colorado 80229
(303) 538-7295

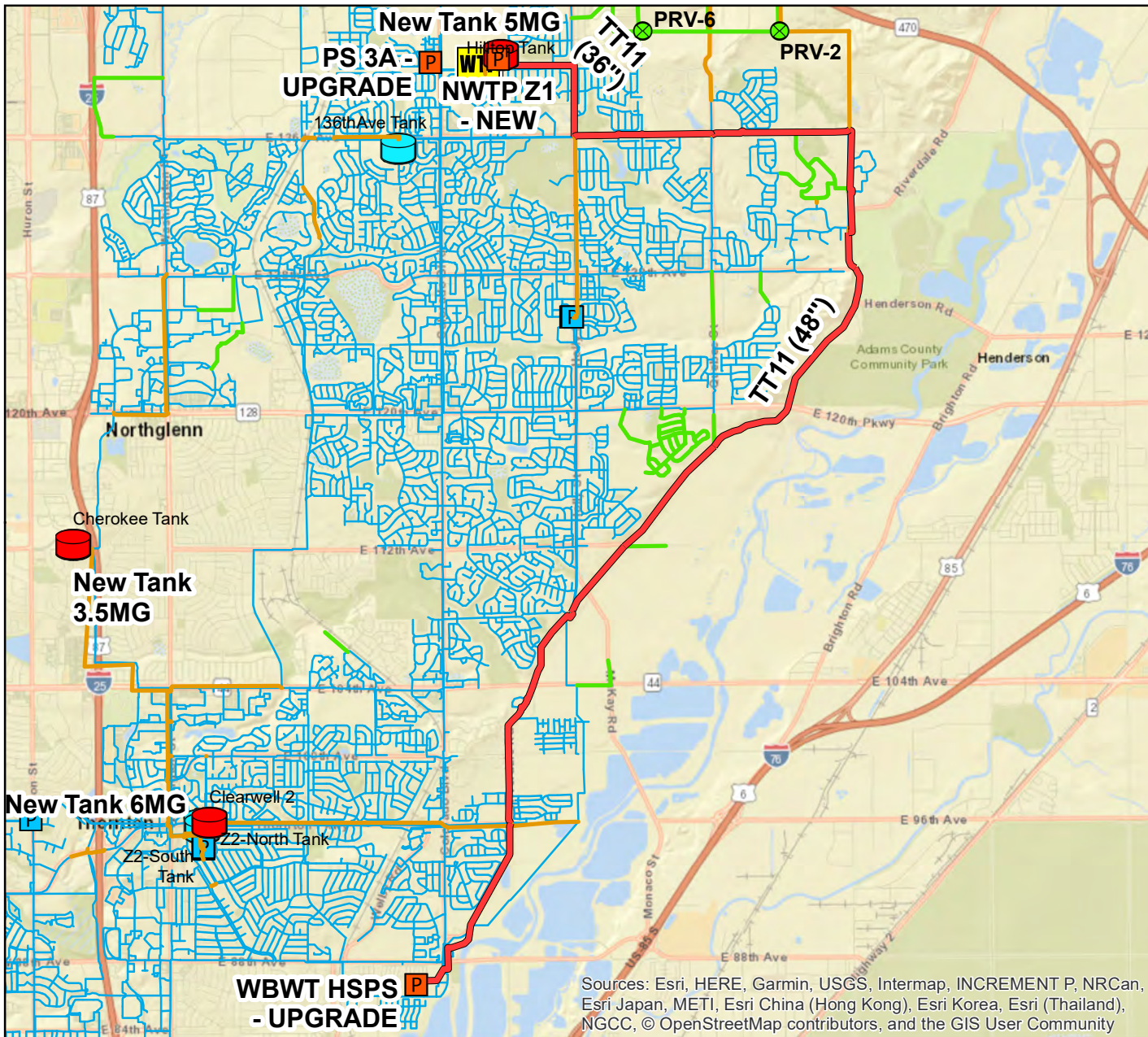
AECOM
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Greenwood Village, Colorado 80111

Water Distribution and Transmission Improvements

CIP DD49



1 inch = 500 feet



Legend

- ⊗ New PRVs
- ⊗ Storage
- P Pump
- Existing Pipelines
- WTP NWTP
- P Pumping CIP
- ⊗ Storage CIP
- CIP Improvements
- Other Improvements
- Developer
- COT

Project Information

New pipe from WBWTP along Riverdale Rd and Yosemite St to E 136th Ave, along Holly St from E 136th Ave to 140th Ave, and along E 140th Ave to a NWTP tie-in. The new line is 36-in and 48-in with an approximate length of 57,400 ft.

Cost

\$66,751,100

Phase

2065

Purpose

Supply

Trigger

WBWTP Upgrade

Zone

Zone 1

City of Thornton
9500 Civic Center Drive
Thornton, Colorado 80229
(303) 538-7295

Water Distribution and Transmission Improvements

AECOM
6200 South Quebec Street
Greenwood Village, Colorado 80111

CIP TT11



1 inch = 6,000 feet

Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, © OpenStreetMap contributors, and the GIS User Community



Legend

- New PRVs
- Storage
- Pump
- Existing Pipelines
- NWTP
- Pumping CIP
- Storage CIP
- CIP Improvements
- Other Improvements
- Developer
- COT

Project Information

Installation of a parallel pipe along York St east of Lake Avery. The new line is a 16-in with an approximate length of 2,200 ft.

Cost

\$1,125,290

Phase

2065

Purpose

Tier 2 - Capacity

Trigger

Growth - Average System Demand = 44mgd

Zone

Zone 1

City of Thornton
9500 Civic Center Drive
Thornton, Colorado 80229
(303) 538-7295

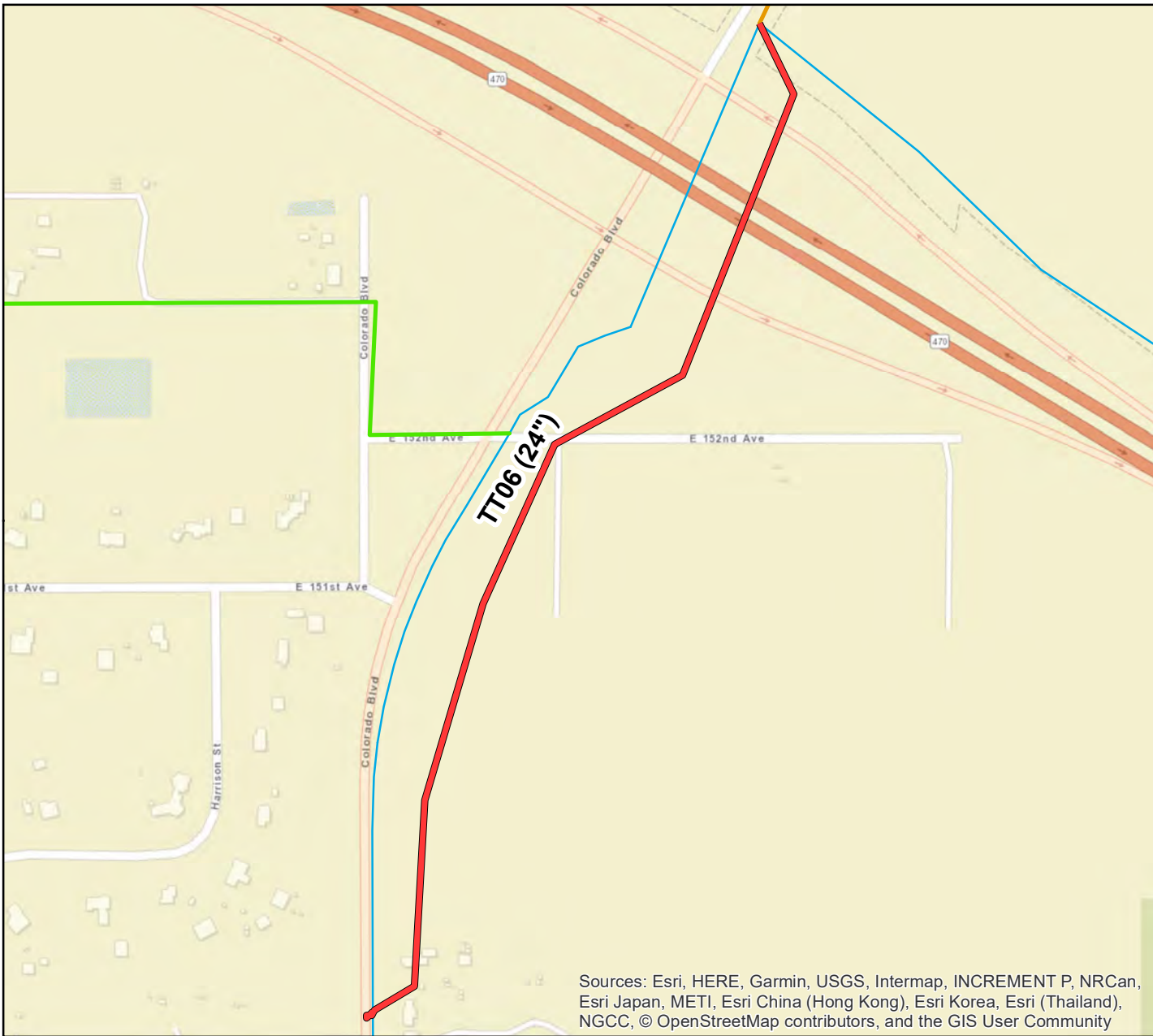
Water Distribution and Transmission Improvements

CIP DD41

AECOM
6200 South Quebec Street
Greenwood Village, Colorado 80111



1 inch = 500 feet



Legend

- New PRVs
- Storage
- Pump
- Existing Pipelines
- NWTP
- Pumping CIP
- Storage CIP
- CIP Improvements
- Other Improvements
- Developer
- COT

Project Information

New pipe along Colorado Blvd, with the north end crossing E-470. The new line is a 24-in with an approximate length of 3,800 ft.

Cost

\$2,469,480

Phase

2065

Purpose

Tier 2 - Capacity

Trigger

Growth North of Highway I470

Zone

Zone 1

City of Thornton
9500 Civic Center Drive
Thornton, Colorado 80229
(303) 538-7295

AECOM
6200 South Quebec Street
Greenwood Village, Colorado 80111

Water Distribution and Transmission Improvements

CIP TT06



1 inch = 500 feet

Utility Master Plan

Project No. 17-467

Wastewater Collection Capital Improvement
Program Project Cutsheets

The City of Thornton

Project number: 60560104

March 2020

Table 2.16. Wastewater Collection Master CIP Table

CIP ID	Phase (Project Completion Date)	Purpose	Project Type	Project Description	Cost	***Trigger Flow (gpm)	Project Timeline (Start / Completion)	
WW4 (F)	2020-2025	Tier 1 - Buildout PDWQ d/D	Gravity Main Replacement	Todd Creek Collector Improvements. Gravity flow pipe is 12 to 15-in with a length of 3,068 ft.	\$ 624,000	900	2020	2021
WW6 (F)	2020-2025	Tier 1 - Buildout PDWQ d/D	Parallel Gravity Main	Heritage Todd Creek Interceptor Parallel. Gravity flow pipe is 18 to 21-in with a length of 5,708 ft.	\$ 3,022,000	2,300	2021	2022
WW1B (F)	2020-2025	Tier 1 - Buildout PDWQ d/D	Lift Station Expansion	Big Dry Creek Lift Station Expansion. Lift station has a flow of 8,043 gpm.	\$ 5,404,000	3,100	2024	2025
WW1A (F)	2025-2035	Tier 1 - Buildout PDWQ d/D	Parallel Gravity Main	Big Dry Creek Interceptor Parallel. Gravity flow pipe is 15 to 24-in with a length of 8,197 ft.	\$ 2,819,000	6,100	2027	2028
WW2 (F)	2025-2035	Tier 1 - Buildout PDWQ d/D	Gravity Main Replacement	Upstream Big Dry Creek Interceptor Improvement. Gravity flow pipe is 24-in with a length of 188 ft.	\$ 57,000	2,600	2030	2031
WW3 (F)	2025-2035	Tier 1 - Buildout PDWQ d/D	Gravity Main Replacement	Big Dry Creek Lateral Improvement. Gravity flow pipe is 12-in with a length of 1,600 ft.	\$ 225,000	900	2030	2031
WW5 (F)	2025-2035	Tier 1 - Buildout PDWQ d/D	Gravity Main Replacement	Upstream Heritage Todd Creek Interceptor Improvement. Gravity flow pipe is 15-in with a length of 1,269 ft.	\$ 578,000	900	2030	2031
WW17 (F)	2025-2035	Tier 2 - Buildout PDWQ d/D	Gravity Main Replacement	Big Dry Creek Lift Station Inlet. Gravity flow pipe is 27-in with a length of 141 ft.	\$ 53,000	4,600	2031	2032
WW18 (F)	2025-2035	Tier 2 - Buildout PDWQ d/D	Gravity Main Replacement	Upstream Big Dry Creek Interceptor Improvement. Gravity flow pipe is 24-in with a length of 498 ft.	\$ 141,000	2,600	2031	2032
WW19 (F)	2025-2035	Tier 2 - Buildout PDWQ d/D	Gravity Main Replacement	Upstream Big Dry Creek Interceptor Parallel Improvement. Gravity flow pipe is 24-in with a length of 417 ft.	\$ 163,000	2,300	2031	2032

*** Trigger = 70% Measure Flow

CIPID#'s revised from Water and Wastewater Infrastructure Master Plan:

CIPID WW17 is listed as CIP #15 in Table 13 of the Wastewater Collection System Evaluation (Chapter 6) of the Water and Wastewater Infrastructure Master Plan

CIPID WW18 is listed as CIP #16 in Table 13 of the Wastewater Collection System Evaluation (Chapter 6) of the Water and Wastewater Infrastructure Master Plan

CIPID WW19 is listed as CIP #17 in Table 13 of the Wastewater Collection System Evaluation (Chapter 6) of the Water and Wastewater Infrastructure Master Plan

*CIP ID LEGEND:

PREFIX DEFINITION

RAW = Raw Water Supply System Project

WTP = Water Treatment Facilities Project

DD = Water Distribution System Project / Distribution Pipeline

TT= Water Distribution System Project / Transmission Pipeline

P = Water Distribution System Project / Pump

SS = Water Distribution System Project / Storage

WW = Wastewater Collection System Project

SUFFIX DEFINITION

E = Existing System Deficiency

F = Future System Improvement

*CIP ID's for Water Distribution and Wastewater Collection are organized without suffix in the Water and Wastewater Infrastructure Master Plan and on CIP project cutsheets

Trigger	Description
Existing Improvement	Improvement is required to address an existing deficiency
Growth - Average System Demand = 37mgd	Improvement will be required in the future, pending on expected growth
Growth - Average System Demand = 44mgd	Improvement will be required in the future, pending on expected growth
Developments north of E 156th Avenue	Improvement will serve future developments, pending on localized growth
WBWTP Upgrade	Improvement will support increase in supply capacity at WBWTP
Growth North of E-470	Improvement will serve future developments, pending on localized growth
Zone 1 Storage Upgrade	Improvement will support increase in storage capacity
Zone 3 Storage Upgrade	Improvement will support increase in storage capacity
NWTP Construction	Improvement will support supply improvements at NWTP
70% Measured Sewer Flow =	Improvement is required to meet future flows
Growth - Max Day Demand = 74.8 mgd	Improvement will be required in the future, pending on expected growth
Growth - Max Day Demand = 85.6 mgd	Improvement will be required in the future, pending on expected growth
Tier 2	Improvement identified as Tier 2
Tier 3	Improvement identified as Tier 3



Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, © OpenStreetMap contributors, and the GIS User Community

Legend

- Lift Station Expansion
- Proposed Lift Station
- CIP Improvement
- Other Improvements
- Gravity Pipes

Project Information

Todd Creek Collector Improvements. Gravity main is 12 to 15-in with a length of 3,100 ft.

Cost

\$624,000

Phase

2025

Purpose

Tier 1 - Buildout PDWQ d/D

Trigger

Flow 900 gpm

Basin

K

City of Thornton
9500 Civic Center Drive
Thornton, Colorado 80229
(303) 538-7295

AECOM
6200 South Quebec Street
Greenwood Village, Colorado 80111

**Wastewater Infrastructure
Improvements**

CIP WW4



1 inch = 500 feet



Legend

- L Lift Station Expansion
- L Proposed Lift Station
- CIP Improvement
- Other Improvements
- Gravity Pipes

Project Information

Big Dry Creek Interceptor Parallel. Gravity main is 15 to 24-in with a length of 8,200 ft.

Cost

\$2,819,000

Phase

2025-2035

Purpose

Tier 1 - Buildout PDWQ d/D

Trigger

Flow 3,100 gpm

Basin

H

City of Thornton
9500 Civic Center Drive
Thornton, Colorado 80229
(303) 538-7295

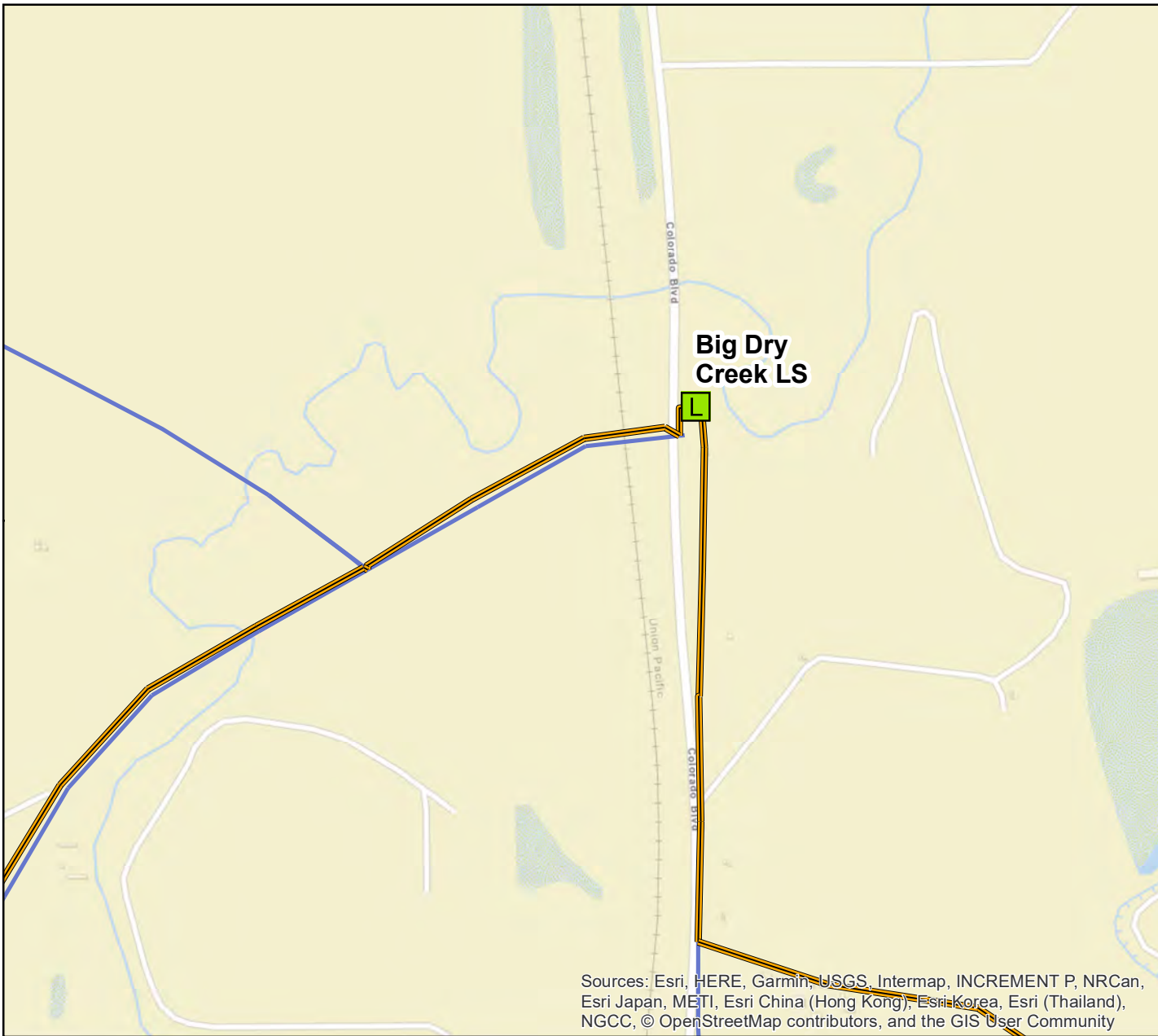
AECOM
6200 South Quebec Street
Greenwood Village, Colorado 80111

Wastewater Infrastructure Improvements

CIP WW1A



1 inch = 1,000 feet



Legend

- Lift Station Expansion
- Proposed Lift Station
- CIP Improvement
- Other Improvements
- Gravity Pipes

Project Information

Big Dry Creek Lift Station Expansion. Lift station has a flow of 8,000 gpm.

Cost

\$5,404,000

Phase

2025-2035

Purpose

Tier 1 - Buildout PDWQ d/D

Trigger

Flow 6,100 gpm

Basin

H

City of Thornton
9500 Civic Center Drive
Thornton, Colorado 80229
(303) 538-7295

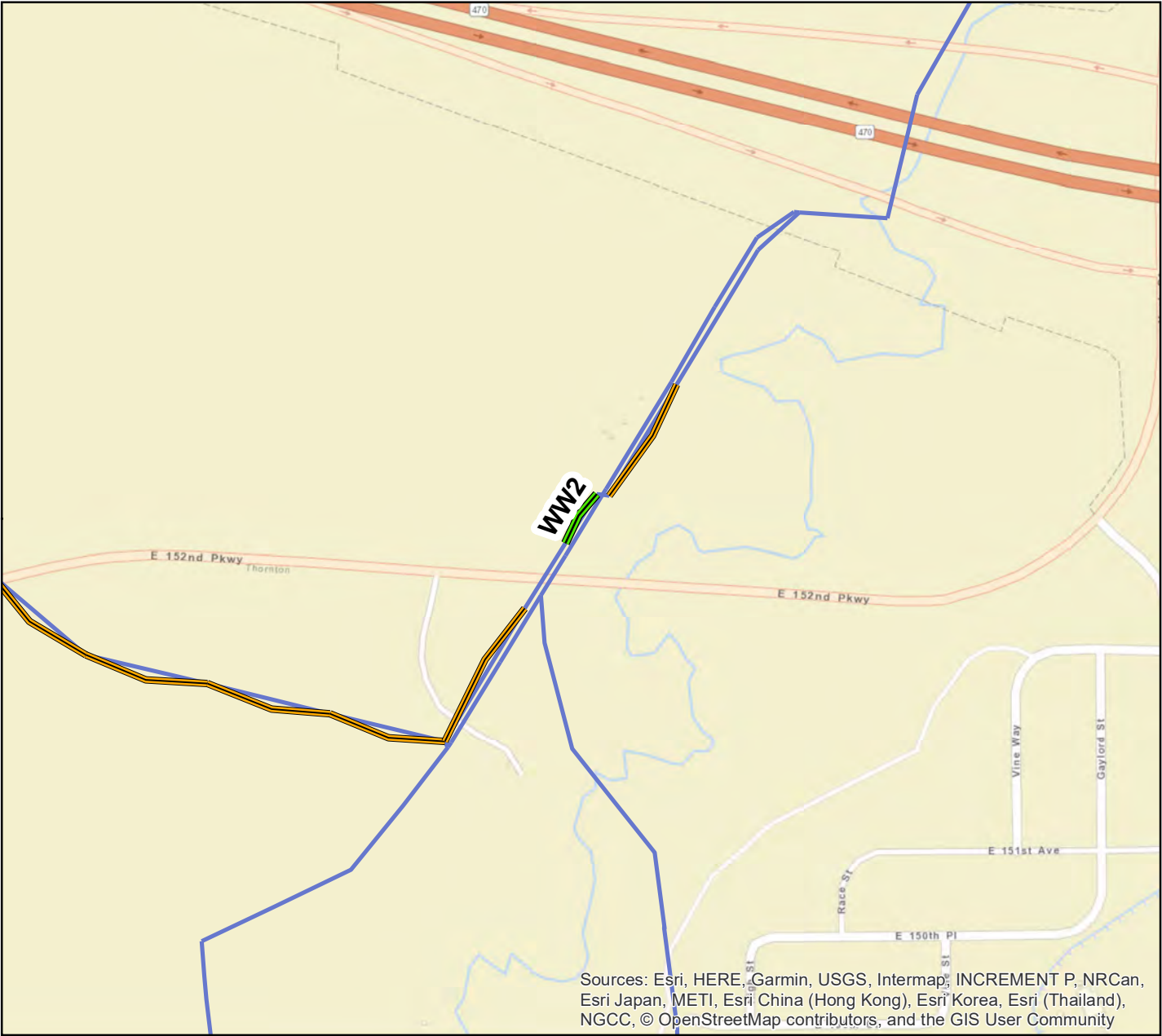
AECOM
6200 South Quebec Street
Greenwood Village, Colorado 80111

Wastewater Infrastructure Improvements






CIP WW1B



1 inch = 500 feet



Legend

-  Lift Station Expansion
-  Proposed Lift Station
-  CIP Improvement
-  Other Improvements
-  Gravity Pipes

Project Information

Upstream Big Dry Creek Interceptor Improvement. Gravity main is 24-in with a length of 200 ft.

Cost

\$57,000

Phase

2035-2065

Purpose

Tier 1 - Buildout PDWQ d/D

Trigger

Flow 2,600 gpm

Basin

H

City of Thornton
9500 Civic Center Drive
Thornton, Colorado 80229
(303) 538-7295

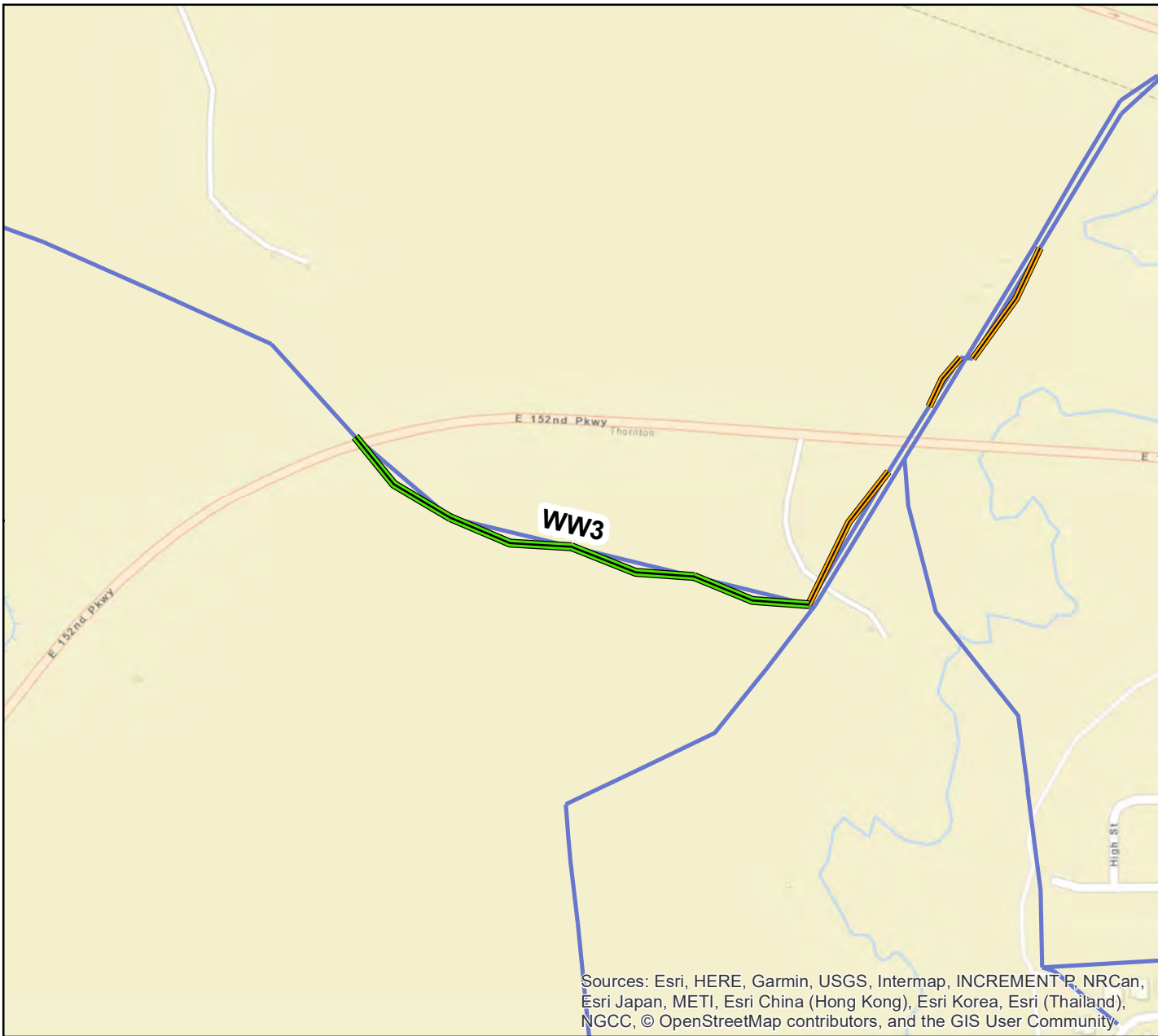
AECOM
6200 South Quebec Street
Greenwood Village, Colorado 80111

Wastewater Infrastructure
Improvements






CIP WW2



1 inch = 500 feet



Legend

-  Lift Station Expansion
-  Proposed Lift Station
-  CIP Improvement
-  Other Improvements
-  Gravity Pipes

Project Information

Big Dry Creek Lateral Improvement. Gravity main is 12-in with a length of 1,600 ft.

Cost

\$225,000

Phase

2035-2065

Purpose

Tier 1 - Buildout PDWQ d/D

Trigger

Flow 900 gpm

Basin

H

 City of Thornton
9500 Civic Center Drive
Thornton, Colorado 80229
(303) 538-7295

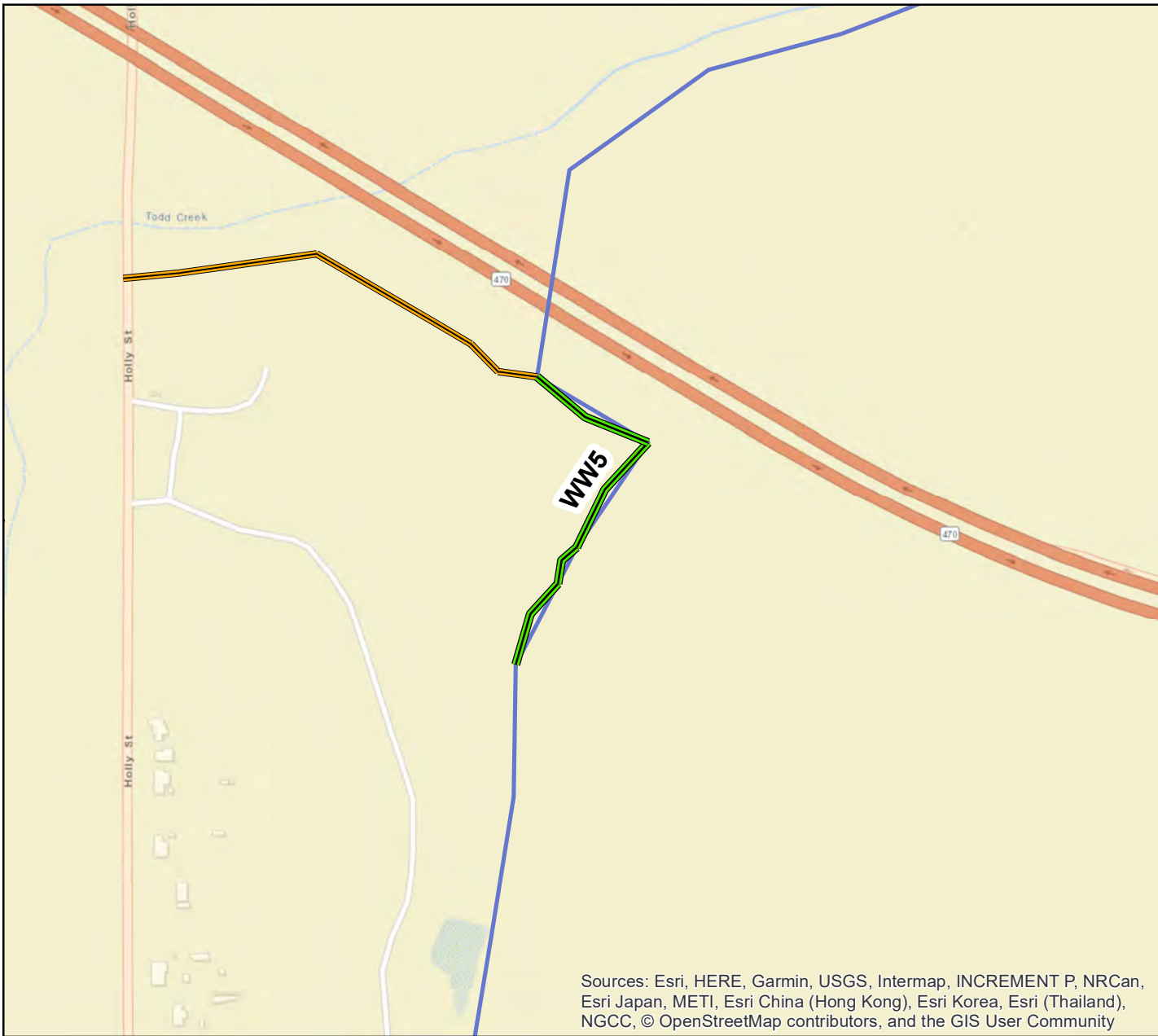
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Greenwood Village, Colorado 80111

**Wastewater Infrastructure
Improvements**






CIP WW3



1 inch = 500 feet



Legend

-  Lift Station Expansion
-  Proposed Lift Station
-  CIP Improvement
-  Other Improvements
-  Gravity Pipes

Project Information

Upstream Heritage Todd Creek
Interceptor Improvement. Gravity main is 15-in with a length of 1,300 ft.

Cost

\$578,000

Phase

2035-2065

Purpose

Tier 1 - Buildout PDWQ d/D

Trigger

Flow 900 gpm

Basin

K

City of Thornton
9500 Civic Center Drive
Thornton, Colorado 80229
(303) 538-7295

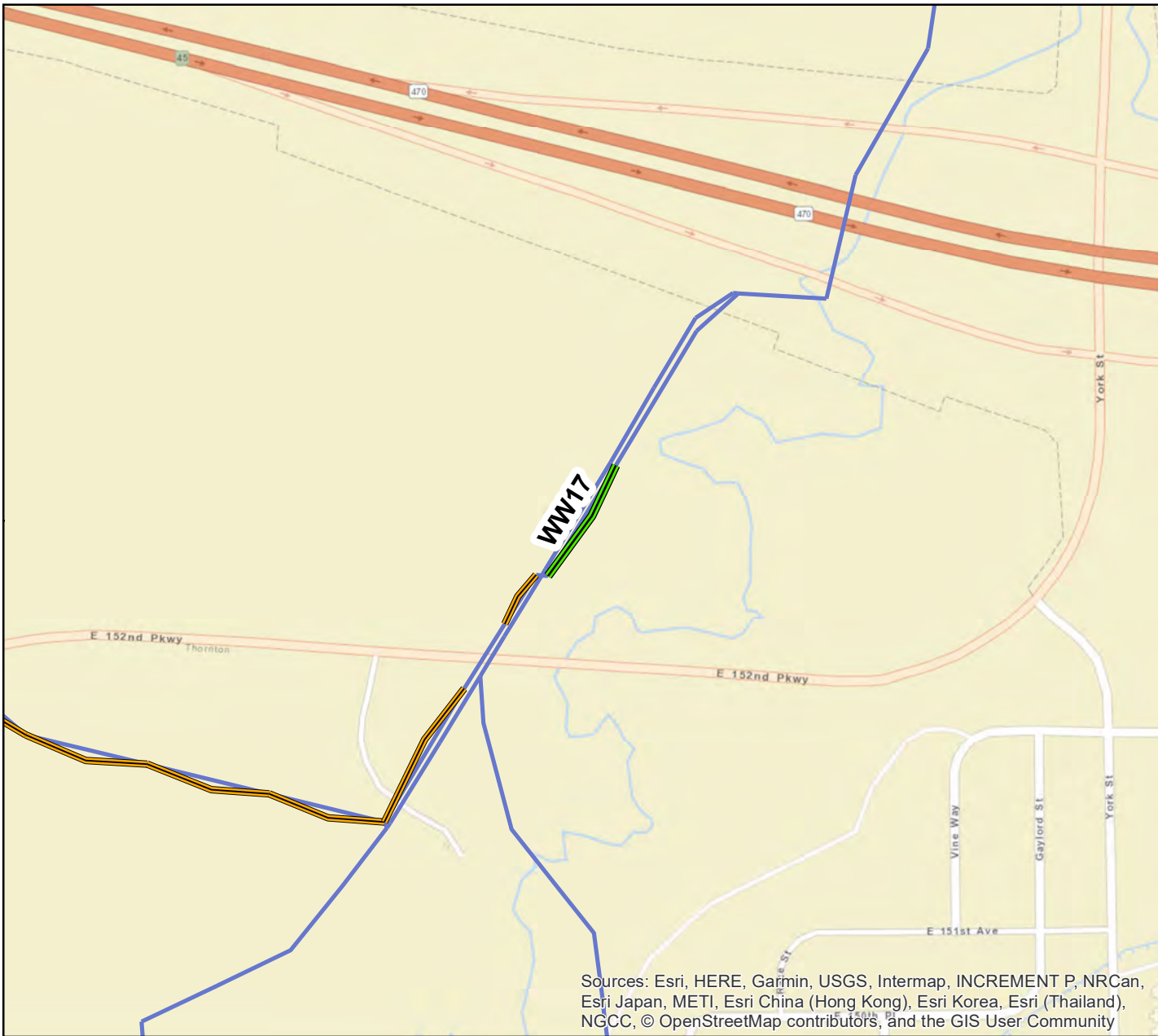
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Greenwood Village, Colorado 80111

**Wastewater Infrastructure
Improvements**






CIP WW5



1 inch = 500 feet



Legend

-  Lift Station Expansion
-  Proposed Lift Station
-  CIP Improvement
-  Other Improvements
-  Gravity Pipes

Project Information

Big Dry Creek Lift Station Inlet Improvement. Gravity main is 27-in with a length of 200 ft.

Cost

\$53,000

Phase

2035-2065

Purpose

Tier 2 - Buildout PDWQ d/D

Trigger

Flow 4,600 gpm

Basin

H

 City of Thornton
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(303) 538-7295

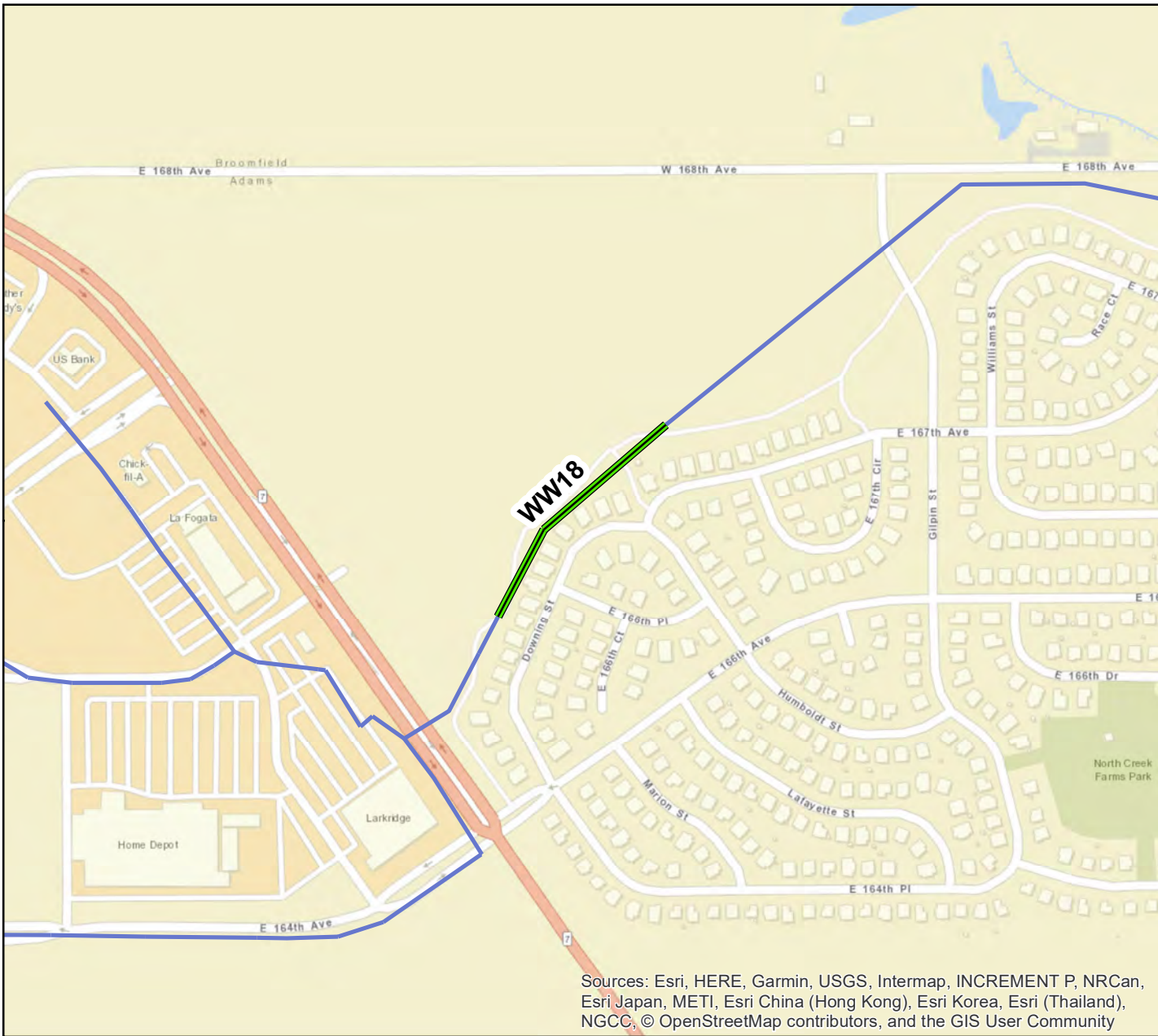
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Greenwood Village, Colorado 80111

Wastewater Infrastructure Improvements






CIP WW17



1 inch = 500 feet



Legend

-  Lift Station Expansion
-  Proposed Lift Station
-  CIP Improvement
-  Other Improvements
-  Gravity Pipes

Project Information

Upstream Big Dry Creek Interceptor Improvement. Gravity main is 24-in with a length of 500 ft.

Cost

\$141,000

Phase

2035-2065

Purpose


Tier 2 - Buildout PDWQ d/D

Trigger

Flow 2,600 gpm

Basin

H

 City of Thornton
9500 Civic Center Drive
Thornton, Colorado 80229
(303) 538-7295

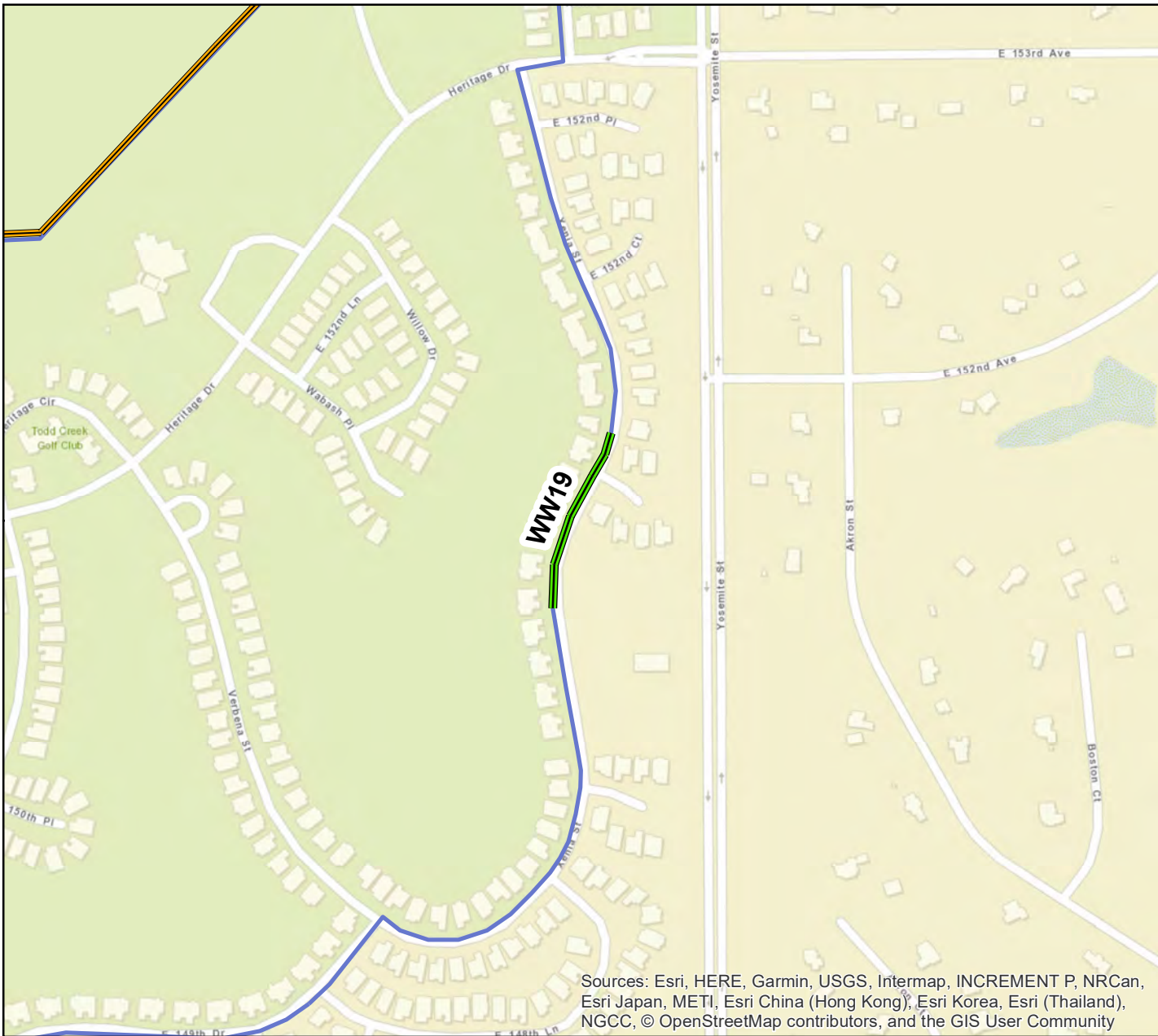
AECOM
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Greenwood Village, Colorado 80111

Wastewater Infrastructure Improvements






CIP WW18



1 inch = 500 feet



Legend

-  Lift Station Expansion
-  Proposed Lift Station
-  CIP Improvement
-  Other Improvements
-  Gravity Pipes

Project Information

Upstream Big Dry Creek Interceptor Parallel Improvement. Gravity main is 24-in with a length of 450 ft.

Cost

\$163,000

Phase

2035-2065

Purpose

Tier 2 - Buildout PDWQ d/D

Trigger

Flow 2,300 gpm

Basin

K

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9500 Civic Center Drive
Thornton, Colorado 80229
(303) 538-7295

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6200 South Quebec Street
Greenwood Village, Colorado 80111

Wastewater Infrastructure Improvements

CIP WW19



1 inch = 500 feet

Utility Master Plan

Project No. 17-467

Water and Wastewater Infrastructure Capital
Improvement Program CIP Location Maps

The City of Thornton

Project number: 60560104

March 2020

Appendix E

Water Distribution System CIP Projects Funded by Developer

Table E.1 lists the water distribution and transmission by funding source. Table E.1. was originally presented as Table 25 in Chapter 5 of Volume IV Water and Wastewater Collection System Master Plan.

Table E.1. Water Distribution System CIP Projects by Funding Source

CIP ID	Diameter (in)	Length (ft)	Unit Cost	Cost	Primary Funding Source
DD01	16	10,500	511	\$5,475,550	Developer
DD02	12	100	395	\$39,490	Developer
DD03	12	6,900	395	\$2,724,760	Developer
DD04	8	2,800	308	\$861,930	Developer
DD05	8	5,800	308	\$1,785,410	Developer
DD06	12	4,100	395	\$1,619,060	Developer
DD07	12	2,800	395	\$1,105,700	Developer
DD08	12	10,500	395	\$4,146,370	Developer
DD09	16	2,600	511	\$1,329,890	Developer
DD10	12	2,300	395	\$908,260	Developer
DD11	12	3,600	395	\$1,421,620	Developer
DD12	12	33,500	395	\$13,438,610	Developer
DD15	12	3,500	395	\$1,382,130	Developer
DD16	12	1,200	395	\$473,880	Developer
DD17	12	2,600	395	\$1,026,720	Developer
DD18	8	11,700	308	\$3,601,610	Developer
DD19	12	1,300	395	\$513,360	Developer
DD20	12	400	395	\$157,960	Developer
DD21	10	200	351	\$70,280	Developer
DD22	12	1,300	395	\$513,360	Developer
DD23	12	1,700	395	\$671,320	Developer
DD24	12	2,300	395	\$908,260	Developer
DD36	8	1,200	308	\$369,400	Developer
DD39	16	2,600	511	\$1,329,890	Developer
DD40	12	2,700	395	\$1,066,210	Developer
DD43	12	5,400	395	\$2,132,420	Developer
DD45	12	1,400	395	\$552,850	Developer
DD49	36	2,600	861	\$2,239,380	Thornton
DD50	16	2,700	511	\$1,381,040	Developer
DD51	12	600	395	\$236,940	Developer
DD52	12	400	395	\$262,820	Developer
DD53	24	1,400	650	\$909,810	Thornton
DD54	16	2,500	511	\$1,278,740	Developer
DD55	16	700	511	\$358,050	Developer
DD56	12	900	395	\$355,410	Developer
DD57	12	6,600	395	\$2,606,290	Developer

CIP ID	Diameter (in)	Length (ft)	Unit Cost	Cost	Primary Funding Source
DD58	12	2,700	395	\$1,066,210	Developer
DD59	12	2,800	395	\$1,105,700	Developer
DD60	12	2,700	395	\$1,066,210	Developer
DD61	12	100	395	\$39,490	Developer
DD62	12	100	395	\$39,490	Developer
DD63	12	2,700	395	\$1,171,080	Developer
DD64	12	2,200	395	\$868,770	Developer
DD65	12	400	395	\$157,960	Developer
DD66	12	2,500	395	\$987,240	Developer
DD67	12	2,700	395	\$1,066,210	Developer
DD68	12	2,600	395	\$1,026,720	Developer
DD69	12	3,200	395	\$1,263,660	Developer
DD70	12	2,700	395	\$1,066,210	Developer
DD71	12	2,700	395	\$1,066,210	Developer
TT01	16	4,500	511	\$2,406,590	Developer
TT02	20	200	558	\$111,630	Thornton
TT03	16	4,400	511	\$2,250,580	Developer
TT04	24	4,600	650	\$2,989,370	Thornton
TT07	42	5,200	1,000	\$5,198,280	Thornton
TT08	42	15,400	1,000	\$15,394,890	Thornton
TT09	20	2,700	558	\$1,506,970	Thornton
TT10	24	7,400	650	\$4,808,980	Thornton
Total		217,900		\$105,913,230	
Total - Developer		178,400		\$72,753,920	
Total - Thornton		39,500		\$33,159,310	

Note: Cost of PRV Facility included in projects DD01, DD12, DD52, DD63, and TT01

Wastewater Collection System CIP Projects Funded by Developer

Table E.2. lists the CIP projects expected to be funded by developers. Table E.2. was originally presented as Table 12 in Chapter 6 of Volume IV Water and Wastewater Collection System Master Plan.

Table E.2. Wastewater Collection System CIP Projects Funded by Developer

#	Description	Type	Length (ft)	Diameter (in)	Buildout PDWQ (gpm)	Buildout PWWQ (gpm)	Primary Funding Source	Total Cost
7	144 th Ave Extension	Gravity Main Extension	3,593	8"	160	199	Developer	\$1,256,000
8	Lower Big Dry Creek Lift Station	New Lift Station and Gravity Main	4,740	12"	397	492	Developer	\$2,059,000
9	Todd Creek Collector Extension	Gravity Main Extension	2,756	12"	1,077	1,337	Developer	\$313,000
10	152 nd Ave Todd Creek Collector Extension	Gravity Main Extension	3,191	10"	654	813	Developer	\$456,000
11	Sanitary Line D	Gravity Main Extension	4,788	12" to 15"	772	965	Developer	\$1,123,000
12**	88 th Ave Interceptor	Gravity Main Extension	1,141	10"	341	427	Developer	\$220,000
13	Stonehocker Collector	Gravity Main Extension	7,693	12" to 18"	3,491	4,363	Developer	\$1,081,000
14	E-470 and Holly St Collector	Gravity Main Extension	1,882	8"	211	261	Developer	\$567,000
Total								\$7,075,000

*CIP required to extend collection system to meet future growth. Sized to supply PDWQ at $d/D < 0.8$ for pipes $\geq 15"$ and $d/D < 0.7$ for pipes $< 15"$

**Minimum diameter; to be confirmed by Developer

