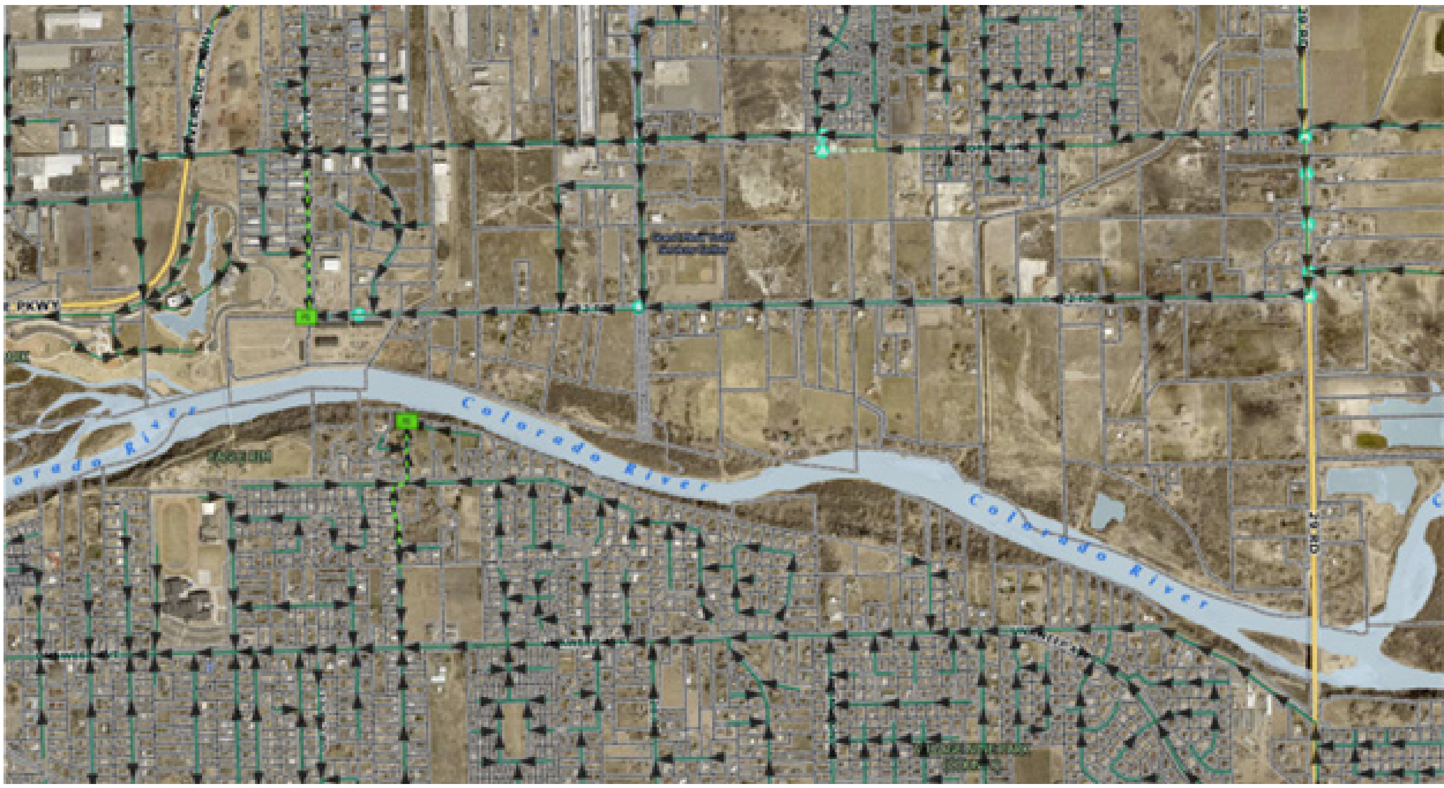
CITY OF Grand Junction COLORADO

Grand Valley Byproducts Lift Station Replacement Feasibility Study

TECHNICAL MEMORANDUM

Grand Valley Byproducts Lift Station Alternatives Analysis



FINAL / August 2025

carollo®

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Abbreviations

2020 Master Plan	2020 Wastewater Treatment Facilities Master Plan
Carollo	Carollo Engineers
CDPHE	Colorado Department of Public Health and Environment
City	City of Grand Junction
fps	feet per second
gpcd	gallons per capita per day
GVBPLS	Grand Valley Byproducts Lift Station
I/I	infiltration/inflow
$/lf	dollar per linear foot
lf	linear foot
LS	lift station
$M	million dollars
mgd	million gallons per day
OM	Orchard Mesa
OPCC	opinion of probable construction cost
PHF	peak hour flow
Rd	Road
WWTP	wastewater treatment plant

SECTION 1 INTRODUCTION

The City of Grand Junction (City) owns and operates the Grand Valley Byproducts Lift Station (GVBPLS), located at the intersection of 27 1/2 Road (Rd) and C 1/2 Rd as shown in Figure 1. Challenges with the existing lift station are summarized below:

- Nearing the end of its useful life.
- Limited access for operations and maintenance due to new development in the area.
- Undersized for anticipated buildout flows.

For these reasons, the City has engaged Carollo Engineers (Carollo) to conduct a preliminary study evaluating options to relocate and replace the lift station. This technical memorandum evaluates and summarizes the following:

- Preliminary sizing of the lift station.
- Feasibility of incorporating parcels east of the lift station on septic systems onto the City's collection system.
- Feasibility of diverting a portion of the Orchard Mesa (OM) collection area flows to the new GVBPLS by routing OM flows along the 29 Rd Bridge across the Colorado River.
- Alternative locations for a new GVBPLS.

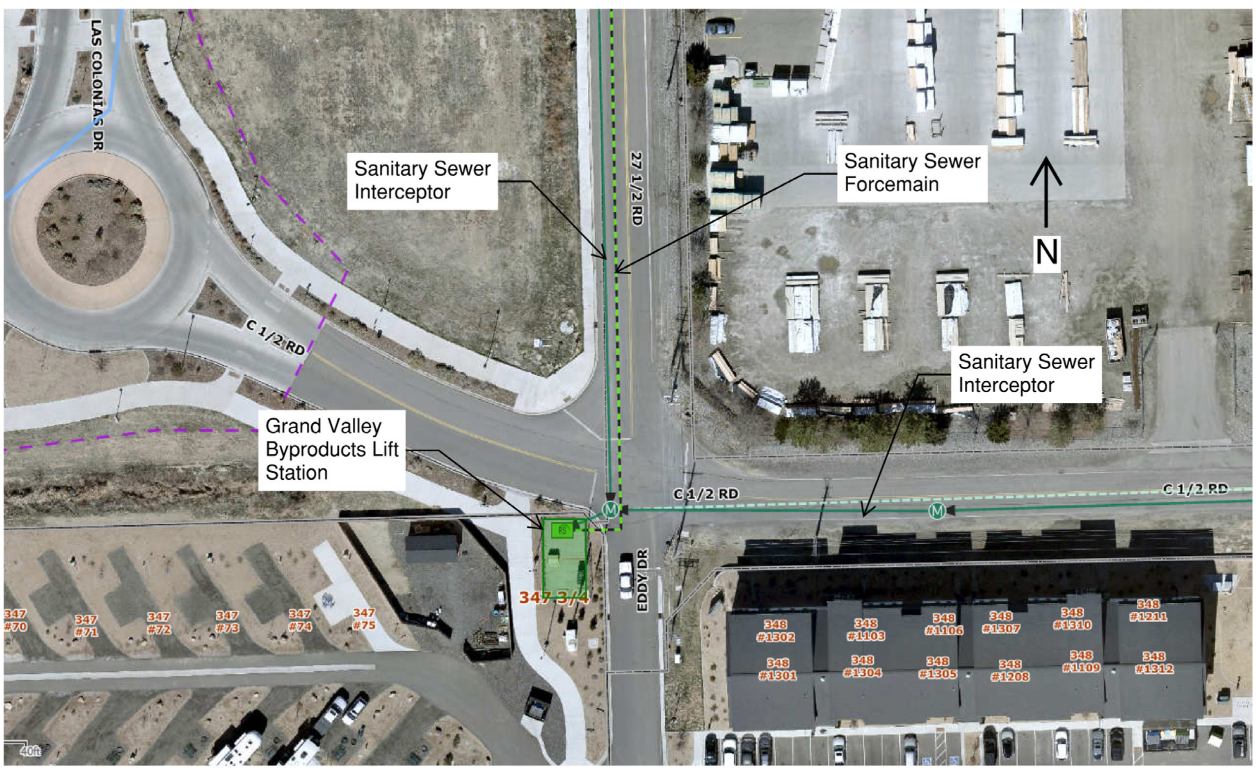

Figure 1 Existing GVBPLS Location

SECTION 2 PRELIMINARY LIFT STATION SIZING AND EVALUATION

Table 6.3 of the 2020 Master Plan calls for 2040 WWF instantaneous peak flow of 1.26 mgd

2.1 Lift Station Capacity

The total capacity of the existing GVBPLS is 1.12 million gallons per day (mgd), as identified in Chapter 6 of the 2020 Comprehensive Wastewater Basin Study Update (2020 Master Plan). The 2020 Master Plan also identifies buildout peak hour flow (PHF) for the new GVBPLS as 2.6 mgd. A summary of the modeled flows is included below in Table 1.

Table 1 Lift Station Flow Summary

Criteria	Value
Total Capacity, mgd(1)(2)	1.12
Firm Capacity, mgd(1)(3)	0.56
Current DWF, mgd(1)	0.51
Current WWF, mgd(1)	1.22
2040 DWF, mgd(1)	0.64
2040 WWF, mgd(4)	2.60

Notes:
(1) Obtained from Table 6.3 of the 2020 Master Plan.
(2) Total pumping capacity assuming both pumps in operations.
(3) Based on fixed discharge capacity included in hydraulic model. Pump sizing information provided by the City. Assumes one pump in service.
(4) Design peak hour flowrate for improved lift station based on predicted 2040 flows as detailed in the 2020 Master Plan.

Note, as indicated in the 2020 Master Plan, the flow assumptions, contributing area (service area, future development), and total predicted flows should be reviewed during design of new lift station (LS) facilities. This is particularly true in large future growth areas, similar to upstream of the existing lift station due to how wet weather flows were assumed in the model. For this study, a cursory review of the contributing area to the LS was performed. The service area, and future land-use are illustrated in Figure 2. As part of the 2020 Master Plan, the overall service area was used to predict future flows, while Figure 2 demonstrates that parks and open space are included in the upstream area. Development may not occur in all parcels within the service area, which implies that the actual design flows to the lift station may be lower than what was included in the 2020 Master Plan. Also, the flood plain overlaps some of the service area closer to the LS, which may limit development and should also be reviewed to verify LS sizing.

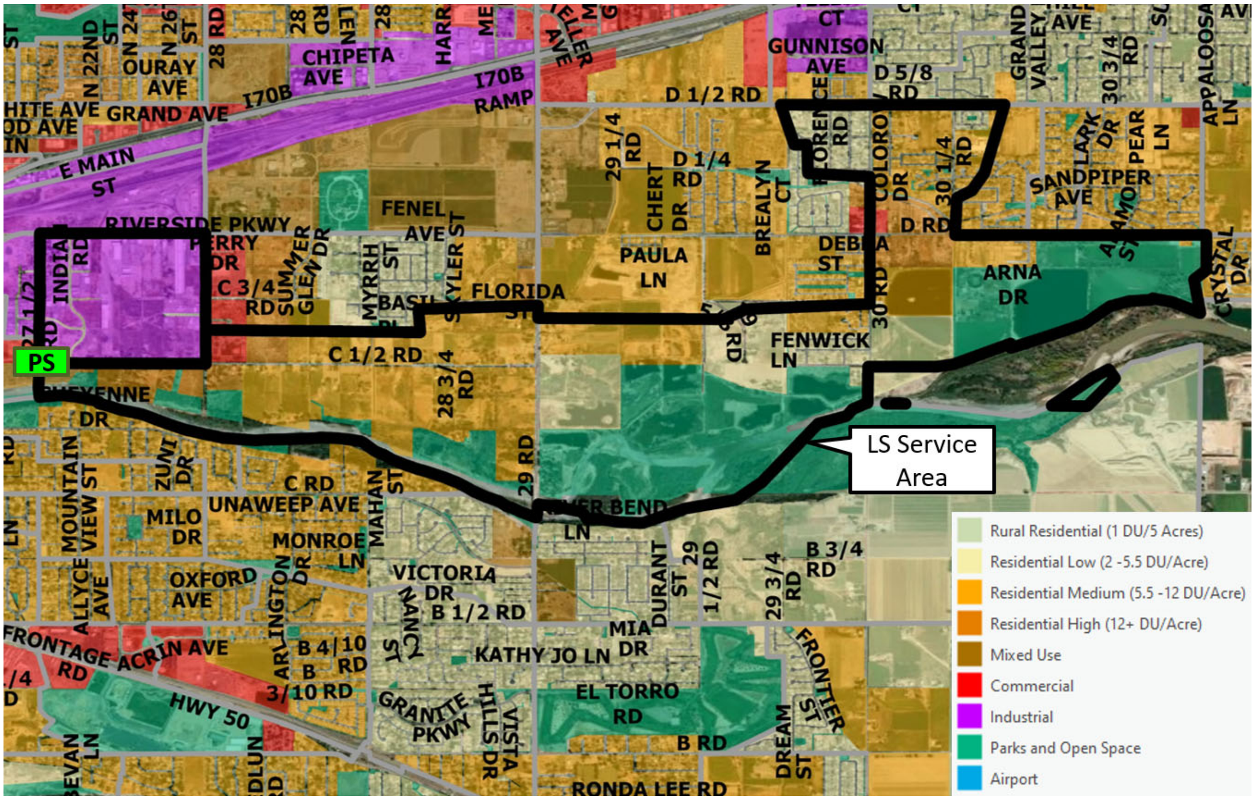

Figure 2 Contributing Service Area and Land Use GVBPLS Grand Junction, Colorado

2.2 Forcemain Sizing and Replacement

The new GVBPLS project will also include a new forcemain. The existing forcemain needs to be replaced as it is over 30 years old and may be constructed of Asbestos Cement pipe. Also, the capacity of the existing 6-inch forcemain (based on the max allowable velocity of 8 feet per second [fps]) only provides 1.02 mgd of capacity which does not meet the proposed design flow of 2.6 mgd. To provide the required future hydraulic capacity of 2.6 mgd, a new 10-inch forcemain would have an approximate velocity of 7.4 fps, and a new 12-inch forcemain would have an approximate velocity of 5.1 fps. The forcemain sizing should be confirmed during final design, based on final alignment, cost, and how the system curve fits with pump selection.

For this study it was assumed the forcemain would discharge to the same manhole (C3-272-042) located north of the existing LS at the intersection of 27 1/2 Rd and C 3/4 Rd. As part of the 2020 Master Plan, the future flows were routed to this manhole for the modeling scenarios. During design, the discharge location, alignment, and downstream capacity should be reviewed and verified.

2.3 Permitting Considerations

Colorado Department of Public Health and Environment (CDPHE) Regulation 22, Section 22.9, and Chapter 4 of the Wastewater Design Criteria Policy, govern site application requirements and permitting criteria for lift stations. Design of the new lift station will be required to comply with these requirements. Some important requirements that need to be included in the site application to CDHPE are summarized below. See CDPHE Section 22.9 and Chapter 4 of the for all requirements:

- Service area for the lift station, including existing and projected population, and flow/loading projections showing projected flow and loading over the following 20 years.
- Identification of the treatment entity responsible for receiving and treating the wastewater.
- Legal arrangements showing control of the site or right-of-way for the project life or showing the ability of the entity to acquire the site or right-of-way and use it for the project life.
- Confirmation, in writing, from the wastewater treatment entity that it:
  - Will treat the wastewater.
  - Is not presently receiving wastes in excess of its design capacity as defined in its site location approval and/or discharge permit, or is under construction, or will be in a phased construction of new or expanded facilities, and will have the necessary capacity to treat the projected discharge from the new or expanded lift station.
- Evidence that the lift station will be properly operated and maintained.
- An emergency operations plan, which outlines procedures to minimize the possibility of sanitary sewer overflows and health hazards to the public and operations personnel. The emergency operations plan shall include information on, but not be limited to telemetry, backup power supply identification, portable emergency pumping equipment, emergency storage/overflow protection, and operator emergency response time.

CDPHE requires a minimum of one hour of emergency storage at PHF (See Chapter 4, part 4.1.1.C.2 of the design criteria policy), which is 108,333 gallons at 2.6 mgd for the new lift station. If phased construction of the lift station is desired for cost or other reasons, the emergency storage volume would be equal to the equivalent volume of one hour at the design PHF.

If the lift station is built within the 100-year floodplain, it must be constructed at an elevation of 12 inches above the floodplain (See Chapter 2, part 2.2.4 of the design criteria policy).

2.4 Lift Station Sizing Summary

It is recommended that the lift station have an N+1 pumping configuration, where the "N" represents the total number of duty pumps needed for firm capacity, and the "+1" indicates one additional standby pump of the same size as the duty pump(s). The building footprint, including a wet well and space for a generator, is estimated to be approximately 80 feet by 60 feet, based on a similar layout to the City's Lake Rd Lift Station. A summary of the preliminary lift station sizing is shown in Table 2. Preliminary design of the lift station including pump selection, building layout, emergency overflow options, and other items will be evaluated as part of the lift station pre-design process.

Table 2 Preliminary Lift Station Sizing

Criteria	Value	Comment
Buildout PHF	2.6 mgd	From 2020 Master Plan
Emergency Overflow Storage	108,333 gallons	1 hour at PHF per CDPHE
Elevation if Built within Floodplain	1 foot above flood elevation	
Approximate Building Footprint	80 feet x 60 feet	
Emergency Standby Generator	Sized to run pumps at PHF	
Number of Pumps	N+1 configuration	

In addition, phasing of the lift station could be considered based on anticipated near term growth, pump selection, turndown, and corresponding pumping envelopes. If phasing makes sense, potential phases could be as follows, based on providing firm capacity halfway between current and future peak flows:

- Existing lift station peak flow – 1.2 mgd.
- Phase 1 – 1.9 mgd flow, 79,167-gallon overflow storage.
- Phase 2 – 2.6 mgd, 108,333-gallon overflow storage.

The lift station in Phase 1 could leave space for future Phase 2 pump or pumps. The overflow storage could have a pipe stubout or wall blockout for future connection to additional storage.

SECTION 3 FEASIBILITY OF CONNECTING SEPTIC SYSTEM PARCELS TO COLLECTION SYSTEM EAST OF GVBPLS

The areas shown in Figure 3 between C 1/2 Rd on the north, the Colorado River on the south, the GVBPLS on the west, and 29 Rd on the east, are on individual septic systems. As part of this study, a preliminary evaluation was performed to determine relative feasibility of the parcels being developed and connected to the sewer collection system.

This preliminary evaluation reviewed the flood plain, ownership, and existing grading in the area. Figure 4 indicates that the floodplain covers most of the parcels in the area. Development of these parcels would require construction of levees or significant earth fill adjacent to the floodway along with compensating removal of material downstream to offset fills elsewhere. This would involve a detailed development plan for these areas along with the preparation of a Federal Emergency Management Agency Letter of Map Revision to update and modify the adopted Flood Insurance Rate Map for the area. The project team determined that this analysis was not a priority at this phase of the planning effort as development of these parcels is not anticipated in the near-term. As a result, and in concurrence with City staff, inclusion of potential flows from these parcels was not considered in GVBPLS sizing. A parallel sewer and lift station expansion could be considered in the future when redevelopment occurs.

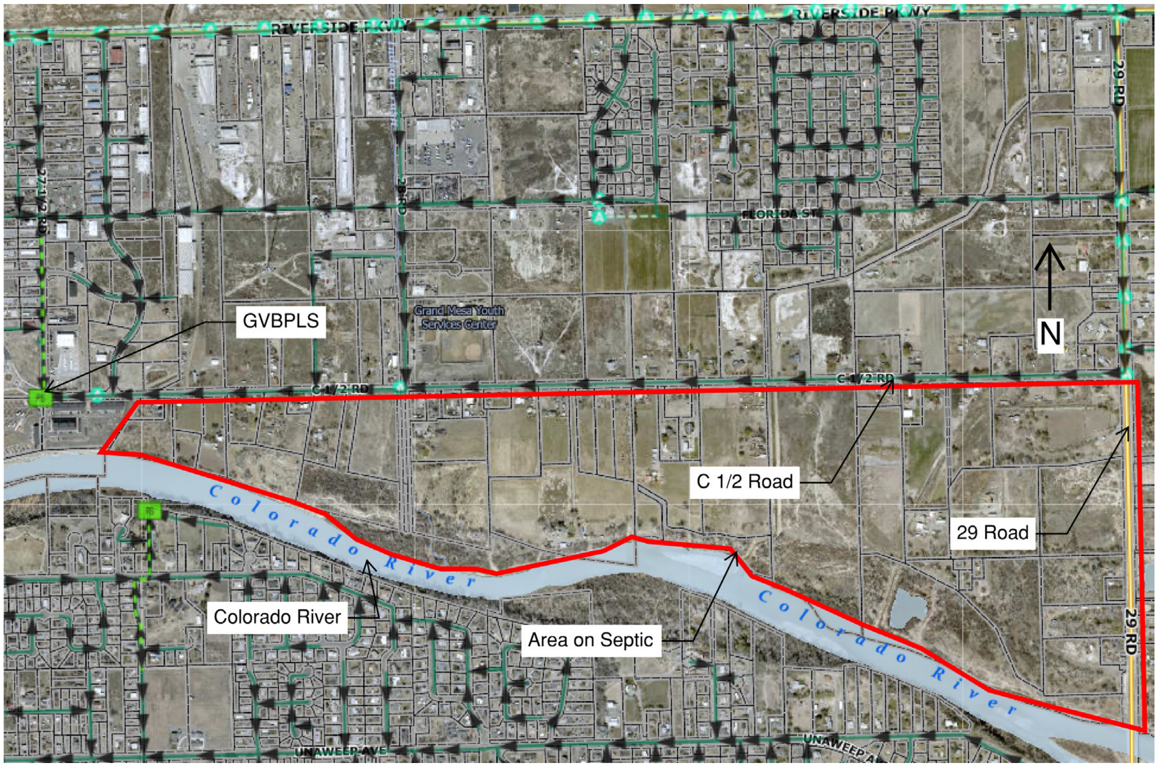

Figure 3 GVBPLS Septic System Parcels

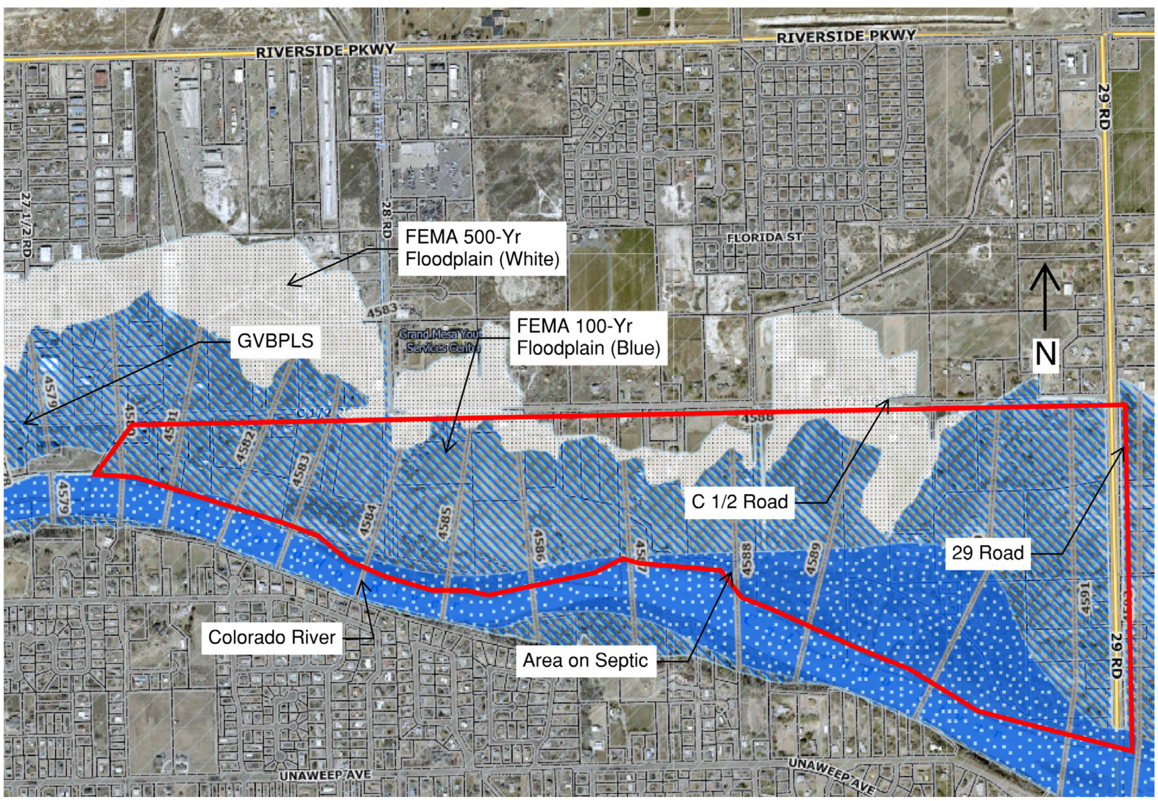

Figure 4 GVBPLS Septic System Parcels with Floodplain

SECTION 4 ORCHARD MESA COLLECTION SYSTEM FLOW DIVERSION

The following subsections evaluate the feasibility of transferring a portion of the flows from the OM sewer basin to the proposed GVBPLS over the 29 Rd bridge to determine if this strategy would minimize the need for collection system interceptor improvements in the densely populated OM community.

4.1 Alternative Summary

As part of the 2020 Master Plan, an alternative evaluation was performed with the goal of minimizing improvements within the OM sewer basin. Three alternatives were considered in the 2020 Master Plan, two of which conveyed flows north across the 29 Rd bridge away from the capacity limited sewers within the OM basin. The two alternative alignments conveyed flows over the 29 Rd Bridge to two different downstream locations, one of which routed flows through the proposed GVBPLS.

Due to the significant impact to the public of upsized sewer construction on the heavily traveled roads through OM, the City wanted to more closely evaluate the feasibility of the flow diversion over the 29 Rd bridge. This re-evaluation assesses the impacts of re-routing a portion of the OM flows and this strategy's ability to minimize the capital improvements required in the OM community. Instead, the offset in OM sewer improvement costs would be applied to upsized improvements elsewhere in the system, such as increased flow capacity at the new GVBPLS.

The three alternatives are illustrated in Figure 5. The base alignment included in the 2020 Master Plan was termed OM-1, and the two alternatives which routed flows north over the 29 Rd Bridge were termed OM Alt-2 and OM Alt-3. OM-1 was the base project included in the 2020 Master Plan, and addresses capacity deficient sewers within the OM basin. OM Alt-2 conveyed flows north to C 3/4 Rd, and west to Riverside Parkway to convey flows by gravity downstream. OM Alt-3 conveyed flows north to C 1/2 Rd, and west to the GVBPLS.

Each alternative was reviewed and updated using a recent bid tab, and as-built information from the bridge. While diverting a portion of the OM flows over the 29 Rd Bridge does reduce a some of the capacity projects required within the OM basin, there are still significant improvements required through the OM basin in each alternative as illustrated in the Figure 5.

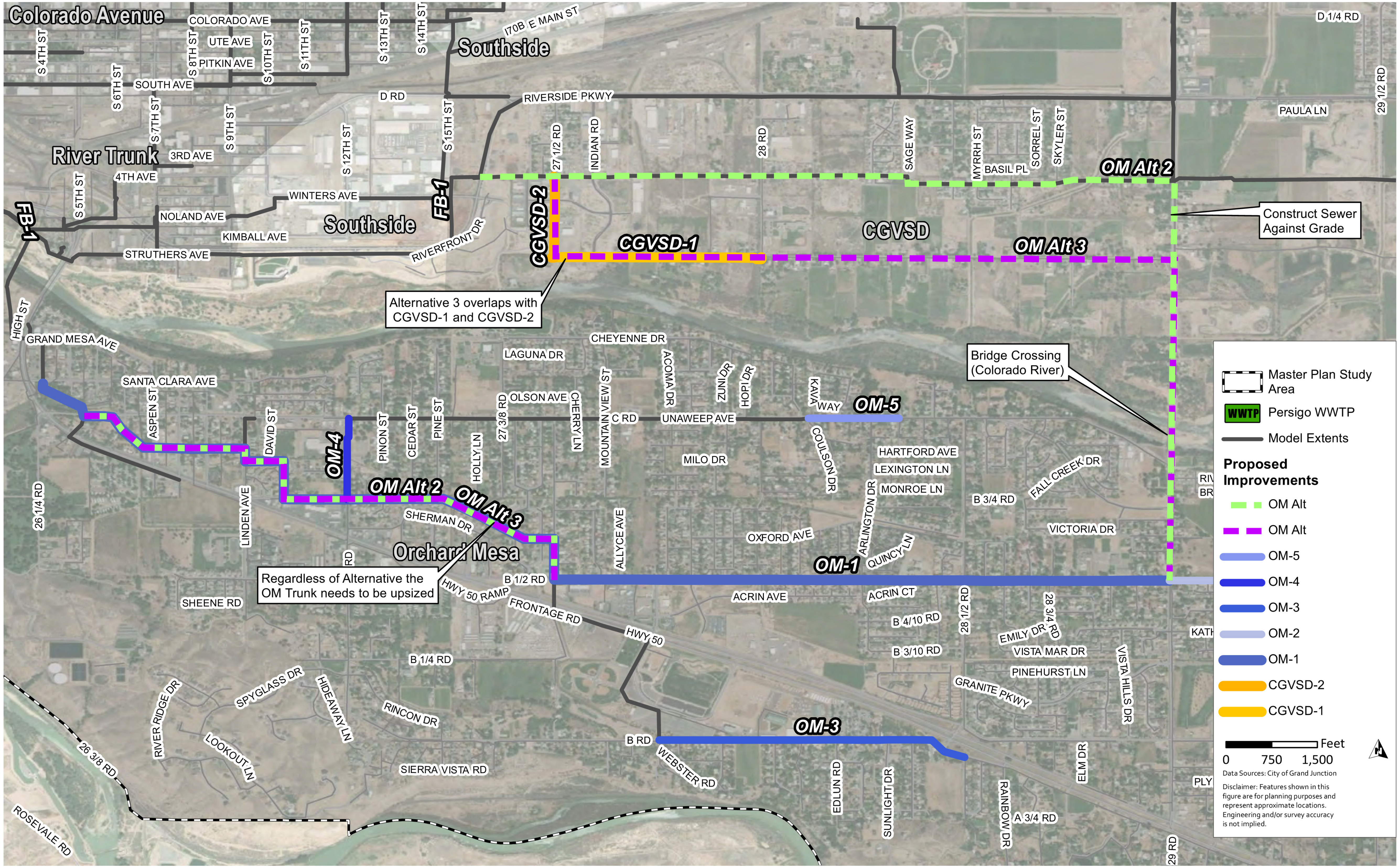

Figure 5 Orchard Mesa Capacity Improvement Overview

4.2 29 Road Bridge Crossing Review

A key focus of this alternatives analysis is evaluating the 29 Rd bridge crossing. This includes a review of record drawings from the 29 Rd bridge construction to validate sewer elevations and methods of elevated sewer construction.

The record drawings for the bridge construction indicate utility knockout windows in the bridge girder cross member structural steel, as shown in Figure 6 and illustrated in Figure 7. There are utility windows on both the east and west side of the bridge, but the westerly window is encumbered with existing communication conduits. The easterly utility window is unencumbered, and elevations have been estimated to evaluate the planned sewer crossing grade and pipeline capacity.

Figure 6 Utility Window in Existing 29 Rd Bridge

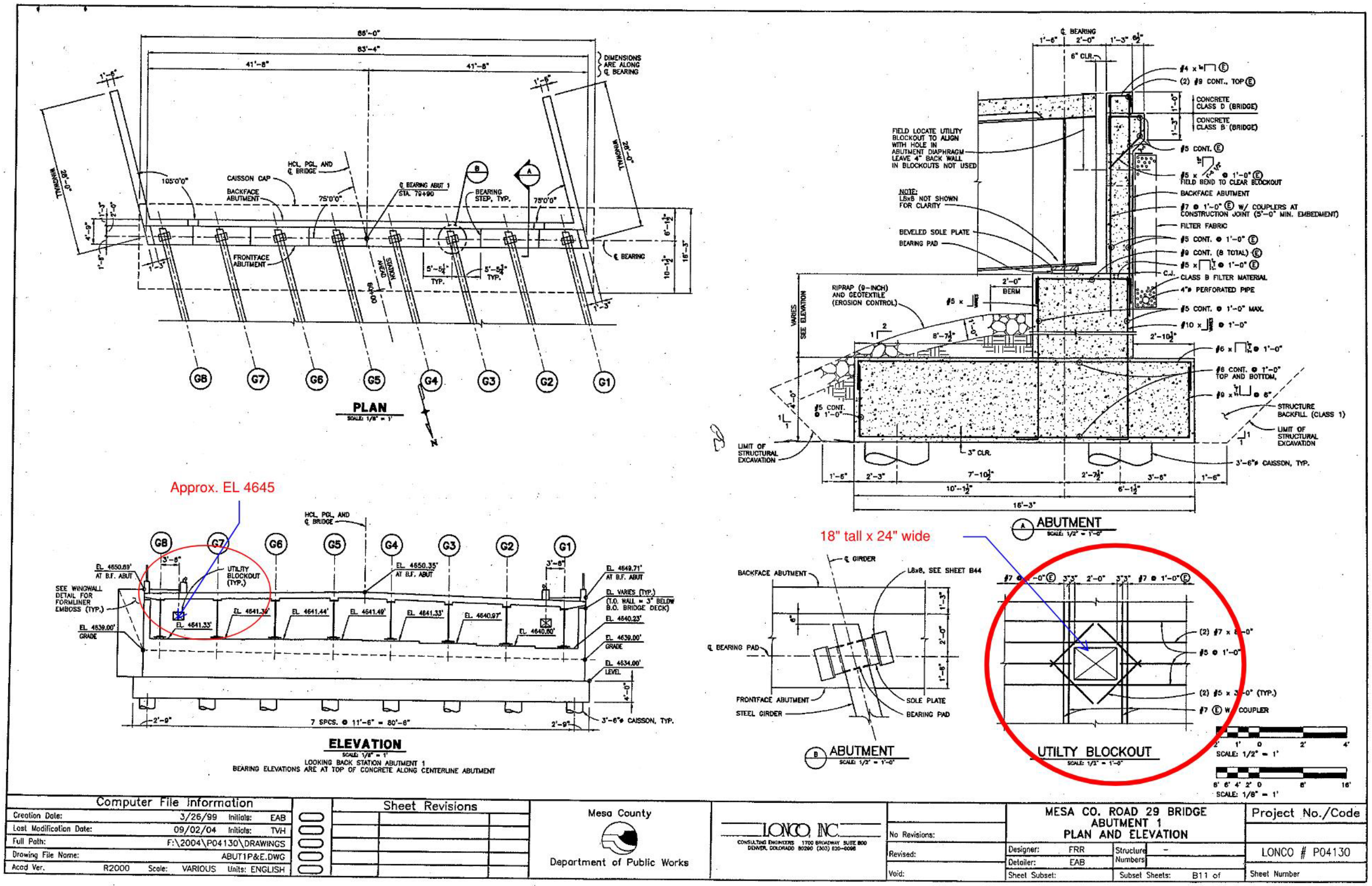

Figure 7 29 Rd Bridge Window Details

Based on the record drawings, the windows are approximately 18 by 24 inches, limiting the sewer diameter to 10-inch ductile iron pipe. This allows for pipe supports (approximately 6 inches) to be placed in the windows, and accounts for the outside diameter of the pipe. More detailed future design could evaluate the feasibility of installing bridge girder cross members on either side of the windows, and mounting the pipe supports to these new cross members. This could potentially allow larger pipe to be installed. For this study, 10-inch pipe was considered the maximum sewer diameter that could be installed for the bridge crossing.

The slope of the bridge sewer was estimated to be approximately 5.58 percent based on the opening elevations, and overall bridge slope as illustrated in Figure 8. A 10-inch sewer at 5.58 percent slope has capacity to convey ~3.5 mgd (n=0.013) which is adequate for the planned flows.

Another critical aspect of the bridge sewer crossing is how the sewer transitions from the ground to the bridge on the north and south ends of the bridge.

On the south end, there are conflicts which may include a storm sewer, and a segmental block retaining wall with tie-backs, as shown in Figure 9. The storm sewer may parallel and cross the proposed sanitary sewer, and the sewer construction may affect the retaining wall which will be costly to reconstruct. Lastly, there are slope stability issues nearby, which are shown in Figure 8. Supplemental ground stability and permanent erosion control measures may be needed on the downstream side of the bridge to stabilize soils in the area.

On the north side of the bridge, a drop structure will be needed to convey the flows from the bridge into a buried sewer. This will require rapid energy dissipation to reduce head in a vertical structure. This can be accomplished by implementing a vortex drop structure as illustrated in Figure 10.

4.3 Gravity Alignment Details

The alternative gravity alignments from the 2020 Master Plan were reviewed in more detail as part of this study. This involved a more detailed evaluation of the segments downstream of the bridge crossing, which included verifying infrastructure sizing, updating profiles, and reviewing potential utility conflicts and elevation restrictions. A critical component of this review was refining the sewers downstream of the bridge to account for the bridge crossing elevations, and how the alignments affected the GVBPLS sizing. A detailed overview of alternatives OM-1, OM Alt-2, and OM Alt-3 are included in Figures 11 through 13, respectively. The sewer replacements identified within the OM basin for all three alternatives were not reviewed or updated as part of this study.

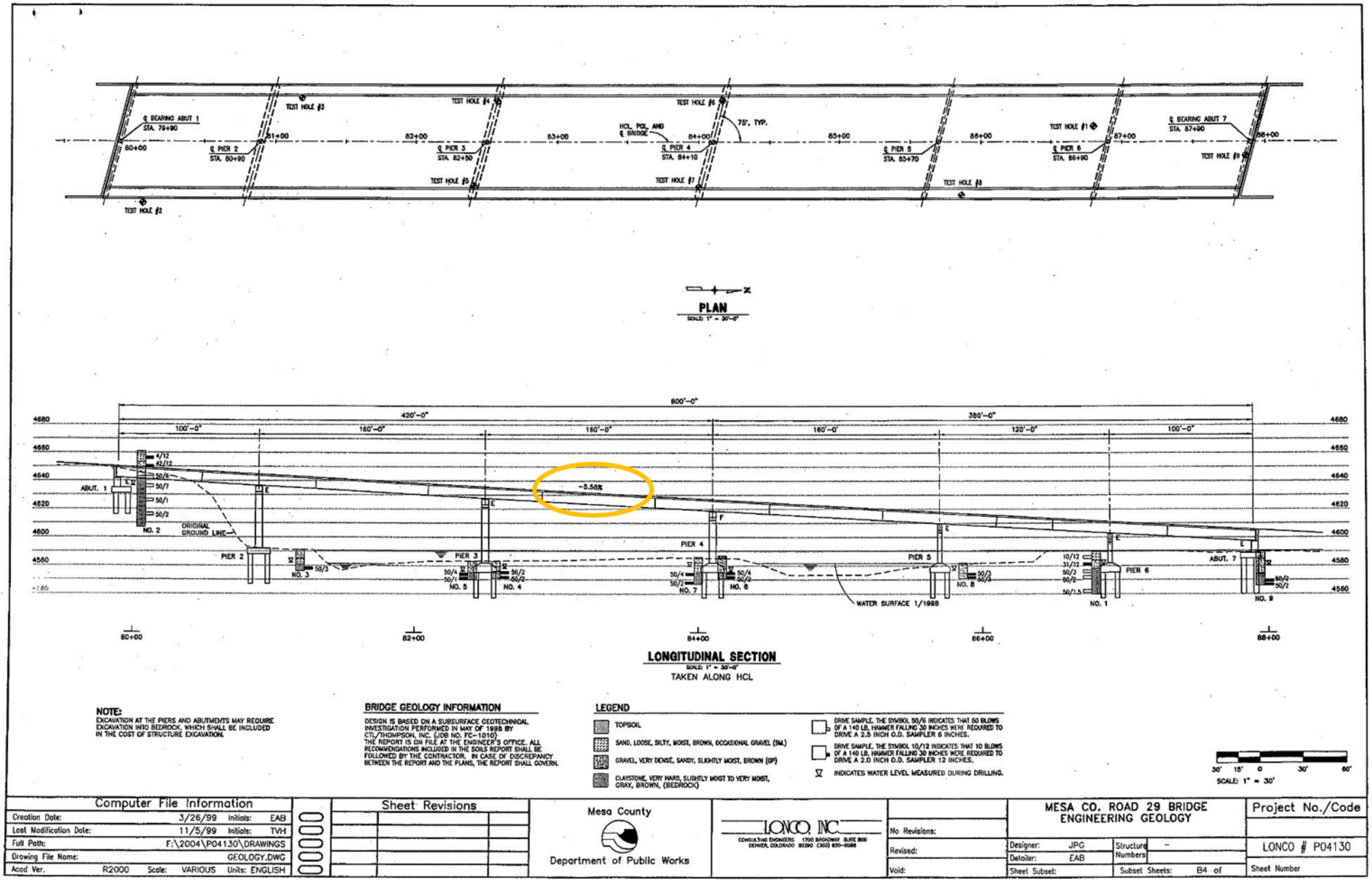

Figure 8 Existing Bridge Slope

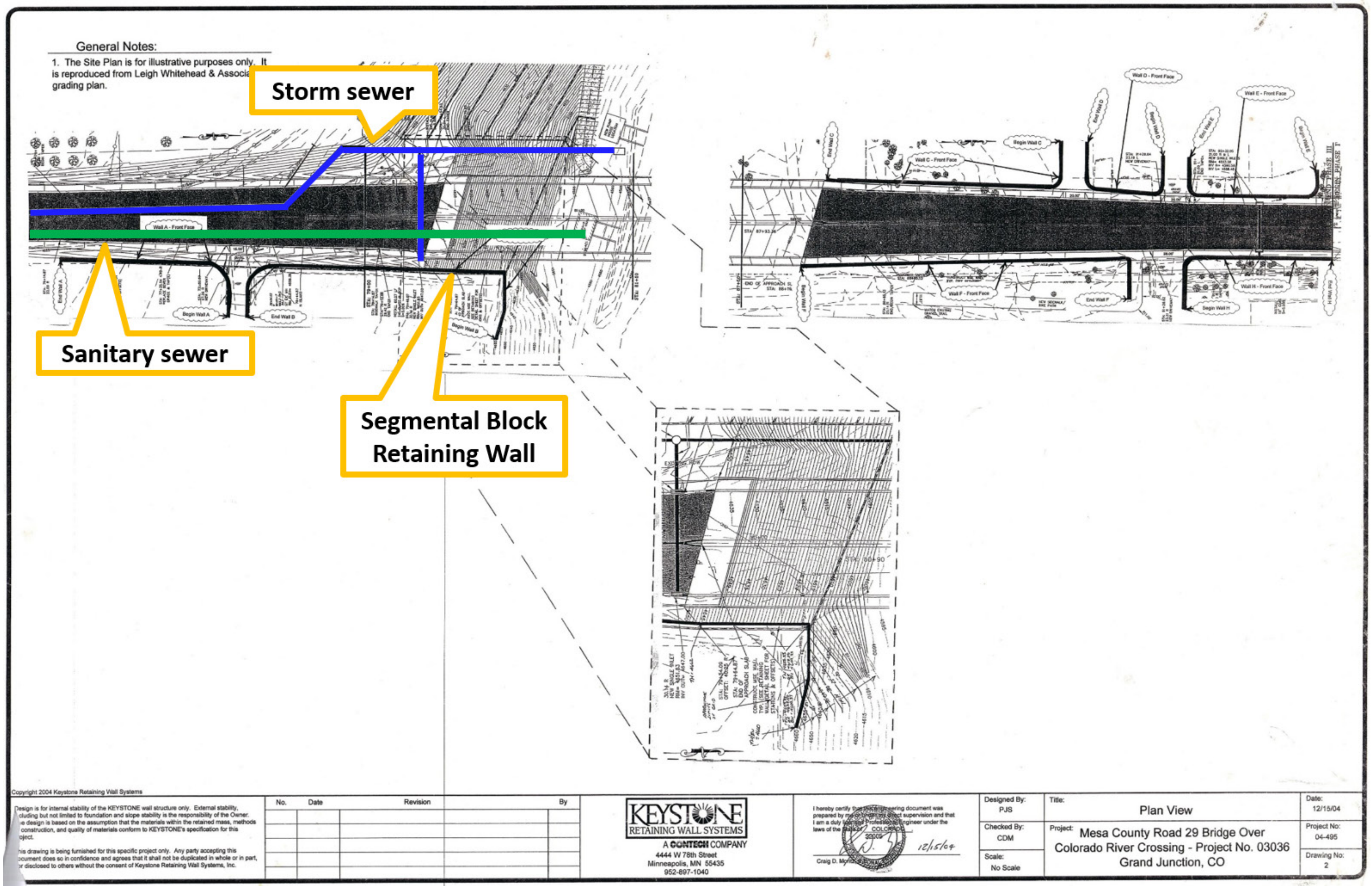

Figure 9 Existing Storm Sewer Location

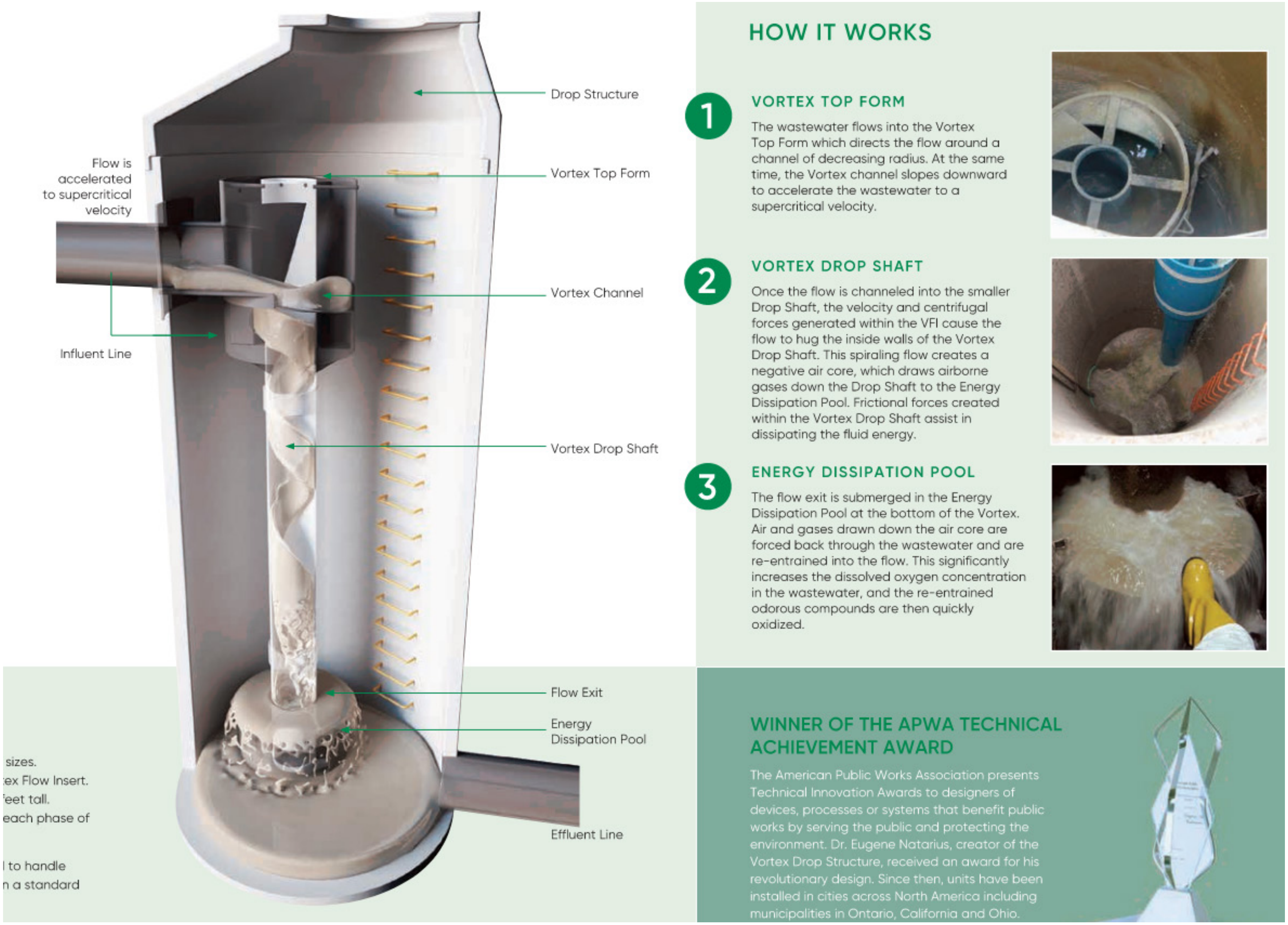

Figure 10 Vortex Drop Structure Example

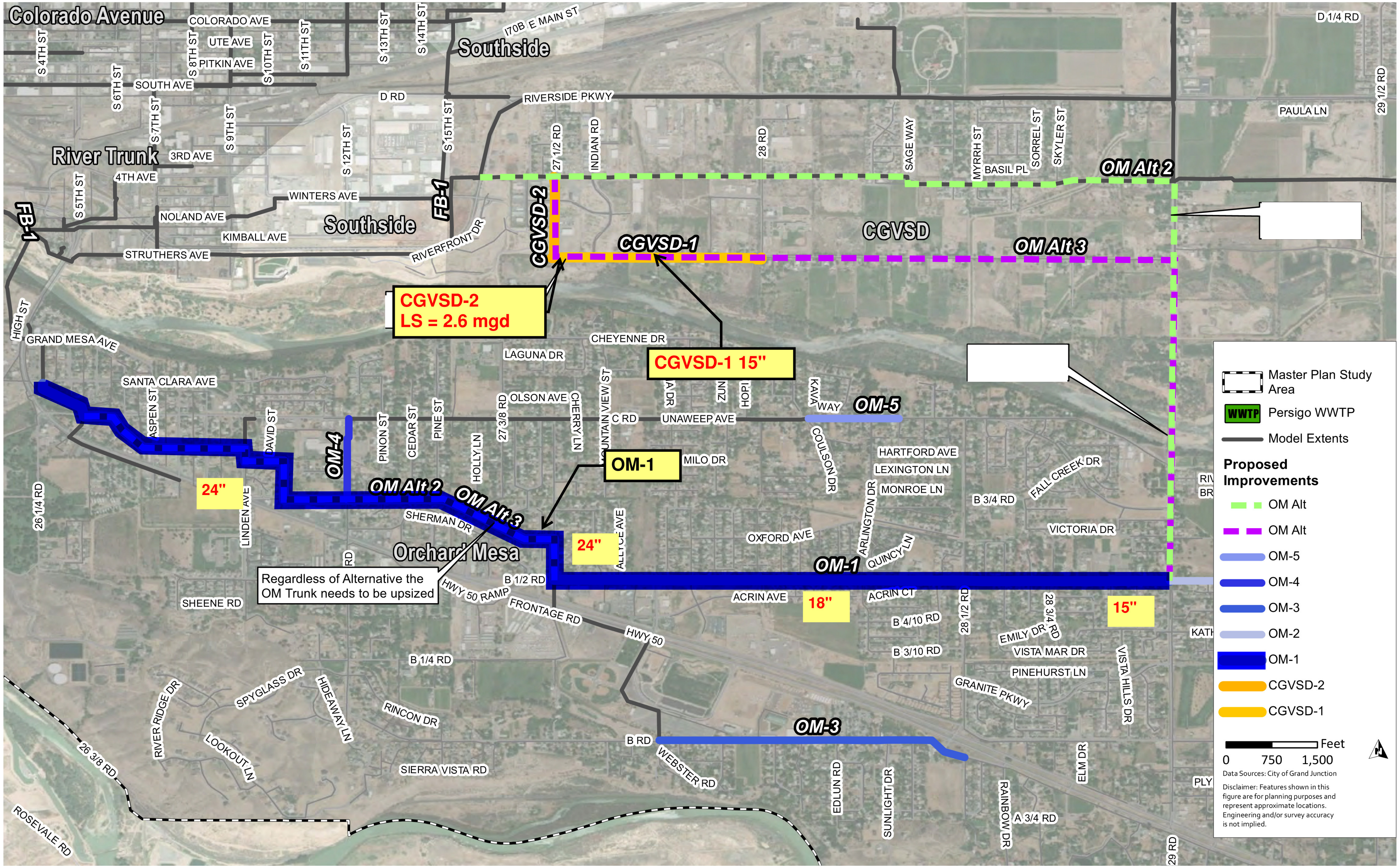

Figure 11 Base Alignment OM-1

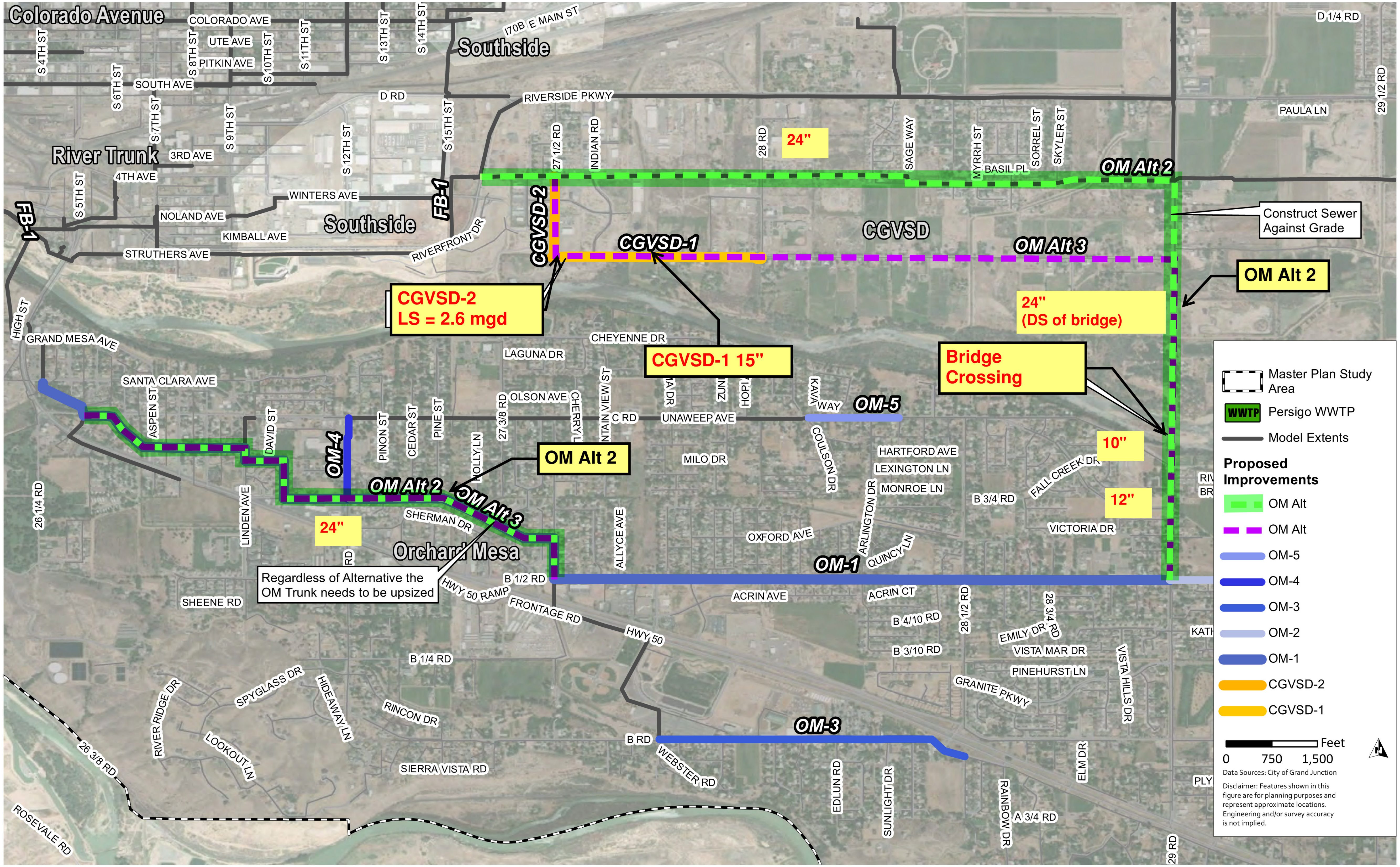

Figure 12 OM Alt-2

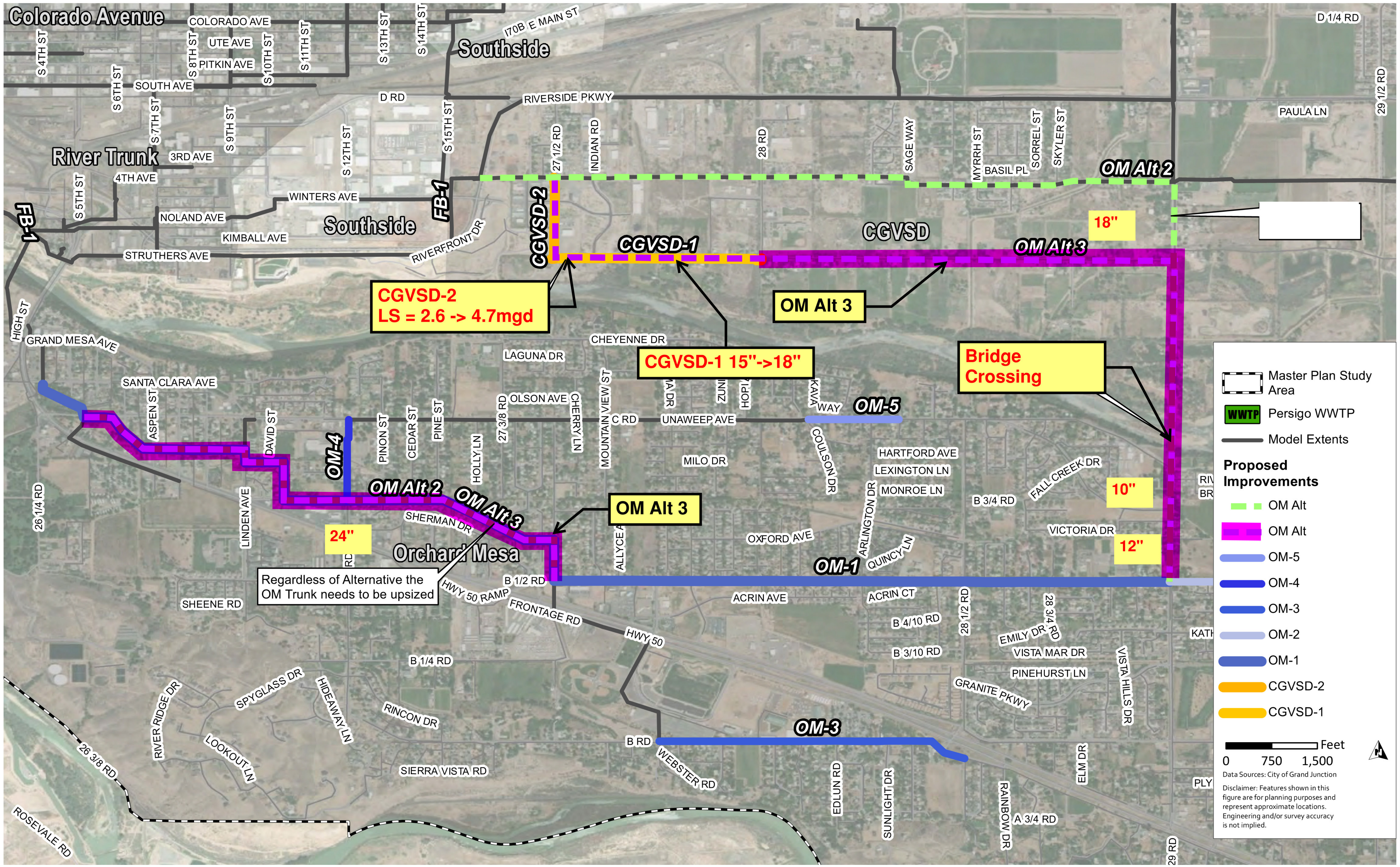

Figure 13 OM Alt-3

As discussed above, the sewer invert elevations near the bridge abutments were estimated using the utility windows elevation. Updated profiles for OM Alt-2 and OM Alt-3 are included in Figures 14 and 15, respectively. These reflect the updated elevations which were evaluated during this project.

The OM Alt-2 alignment goes against grade, which results in a sewer that is over 20 feet deep. The sewer along this reach was upsized from 18 inches to 24 inches to offset the capacity reduction from shallower slopes that are needed to minimize sewer depth.

The OM Alt-3 alignment includes a storm sewer crossing and two storm ditch crossings, but the sewer is deep enough to avoid these. At the downstream end, the sewer would be a little deeper than 10 feet close to the anticipated location of the new GVBPSL, and the maximum depth is only 15 feet.

For each alternative, the total footage by pipe diameter was quantified, which is included below in Table 3. These pipe lengths and sizes were used as the basis for developing the construction costs associated with the pipeline portion of each alternative. Although the construction complexity of OM-1 in the heart of the OM community is impactful to the neighbor and construction costs, this option still includes the least amount of new pipe, as described in the 2020 Master Plan.

Table 3 Project Alignment Details

Alternative	10-inch (Bridge)	12-inch	15-inch	18-inch	24-inch	Subtotal (lf)
OM-1			5,680	4,892	8,766	19,388
OM Alt-2	807	2,100	2,700		20,657	26,264
OM Alt-3	807	2,100		9,389	8,000	20,296

Notes:
lf - linear foot
(1) Table summarizes the estimated pipeline length (in linear feet) by pipeline diameter (in inches).

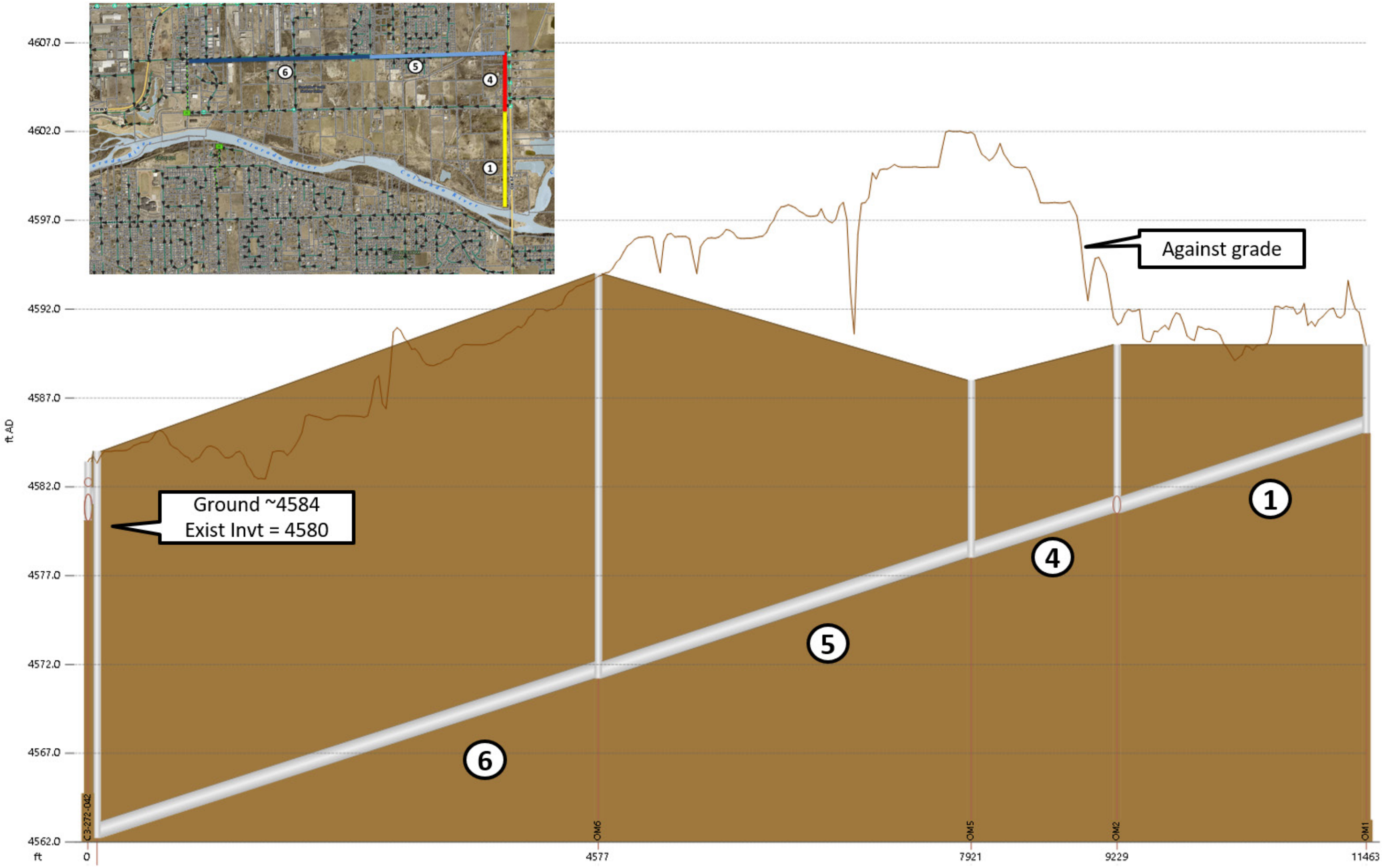

Figure 14 OM Alt-2 (C 3/4 Rd) Profile View

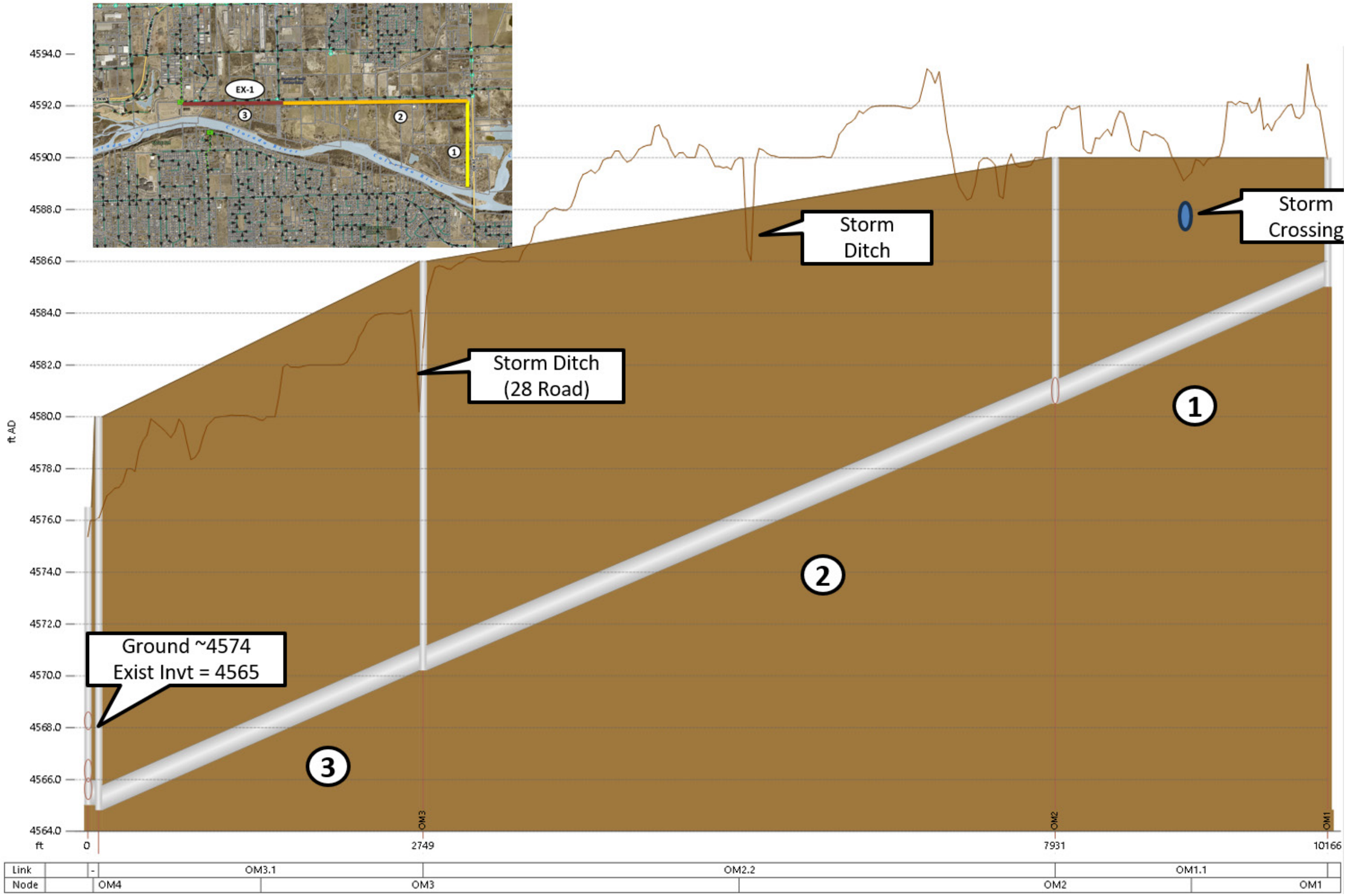

Figure 15 OM Alt-3 (C 1/2 Rd) Profile View

4.4 GVBPLS Hydraulics

The selected OM alternative effects the final capacity of the proposed lift station. A summary of the predicted design flows to the lift station is detailed in Table 4 for the three alternatives, which were developed using the 2020 Master Plan model. The assumptions related to the flow predictions have not been updated since the 2020 Master Plan, which are also detailed in Table 5. Currently, the City is performing an infiltration/inflow (I/I) study in the OM basin which may result in updated flow factors for the I/I factor for the OM basin. When the I/I study is complete and the model is updated, the projected future flows should be re-evaluated if OM flows are intended to be diverted to the proposed lift station. Also, the contributing area (service area, future development) should be reviewed. The 2020 Master Plan model included some areas that may not be developed in the future (floodplain or green space) areas. The flows along the bridge sewer were estimated to be 2.1 mgd, which will be accounted for in the GVBPLS capacity evaluation for OM Alt-3 if selected.

Table 4 Anticipated Peak Hour Lift Station Flows

Alternative	Flow to GVBPLS, mgd	Comment
OM-1	2.6	
OM Alt-2	2.6	
OM Alt-3	4.7	Includes 2.1 mgd from OM area

Table 5 Master Planning Flow Assumptions

Parameter	Value	Data Source/Comment
Dry Weather Per Capita Flow Rate	90.5 gpcd	Historical influent Persigo WWTP flows. Refer to Chapter 2 of the 2020 Master Plan for additional details.
Dry Weather Diurnal Pattern	Varies	Monitored diurnal patterns collected during monitoring period.
Wet Weather Design Storm Event	5-year, 6-hour 0.75 inches	Based on storm event depths included in Table 601 of the Grand Junction Stormwater Management Manual (2007).
Wet Weather Peaking Factor	3.4	Corresponds to peaking factor at Persigo WWTP, generally applied throughout the model. The contributing area percentage for most sub-catchments were updated 0.60 percent to achieve this value. Used to calculate design peak hour flow rates.

Notes:
gpcd - gallons per capita per day; WWTP - wastewater treatment plant

4.5 Alternate GVBPLS Locations

Regardless of which OM alternative is chosen, the GVBPLS must be relocated from its existing location due to limited access for operations and maintenance, and lack of sufficient space for lift station expansion for future flows.

The initial evaluation of alternate GVBPLS locations focused on properties along the Colorado River because of the possibility of saving project costs by using anticipated regional trail easements along the river for construction of the new interceptor. However, the easements do not currently allow construction of utilities and new separate easements for the interceptor would be needed. This was considered too costly and time-consuming by the project team and was not used as a deciding factor.

The existing GVBPLS collects flow from two influent sewers: An 8-inch sewer from the north along 27 1/2 Rd, and a 10-inch sewer from the east along C 1/2 Rd. Figure 15 shows the revised invert elevations for the sewer interceptor along C 1/2 Rd and for the invert of the connection to the lift station from the 8-inch sewer from 27 1/2 Rd. To minimize gravity sewer relocations and depth of the new lift station, the alternative analysis was limited to undeveloped parcels near the existing lift station along C 1/2 Rd or 27 1/2 Rd. Figure 16 shows the undeveloped parcels that were considered the best options. Figure 17 shows these parcels overlain with floodplain boundaries. A comparison of the potential benefits and considerations of each parcel is described in Table 6.

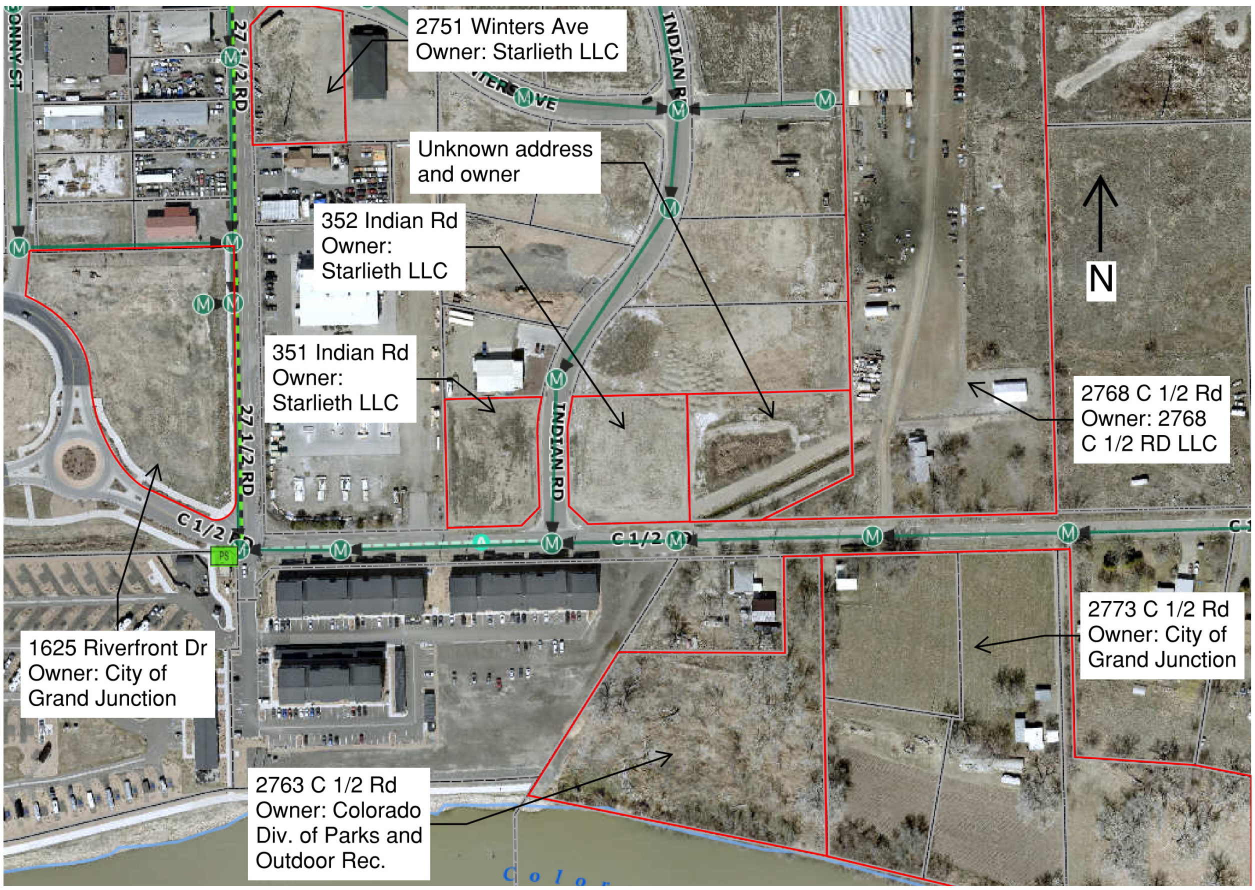

Figure 16 Potential GVBPLS Relocation Parcels

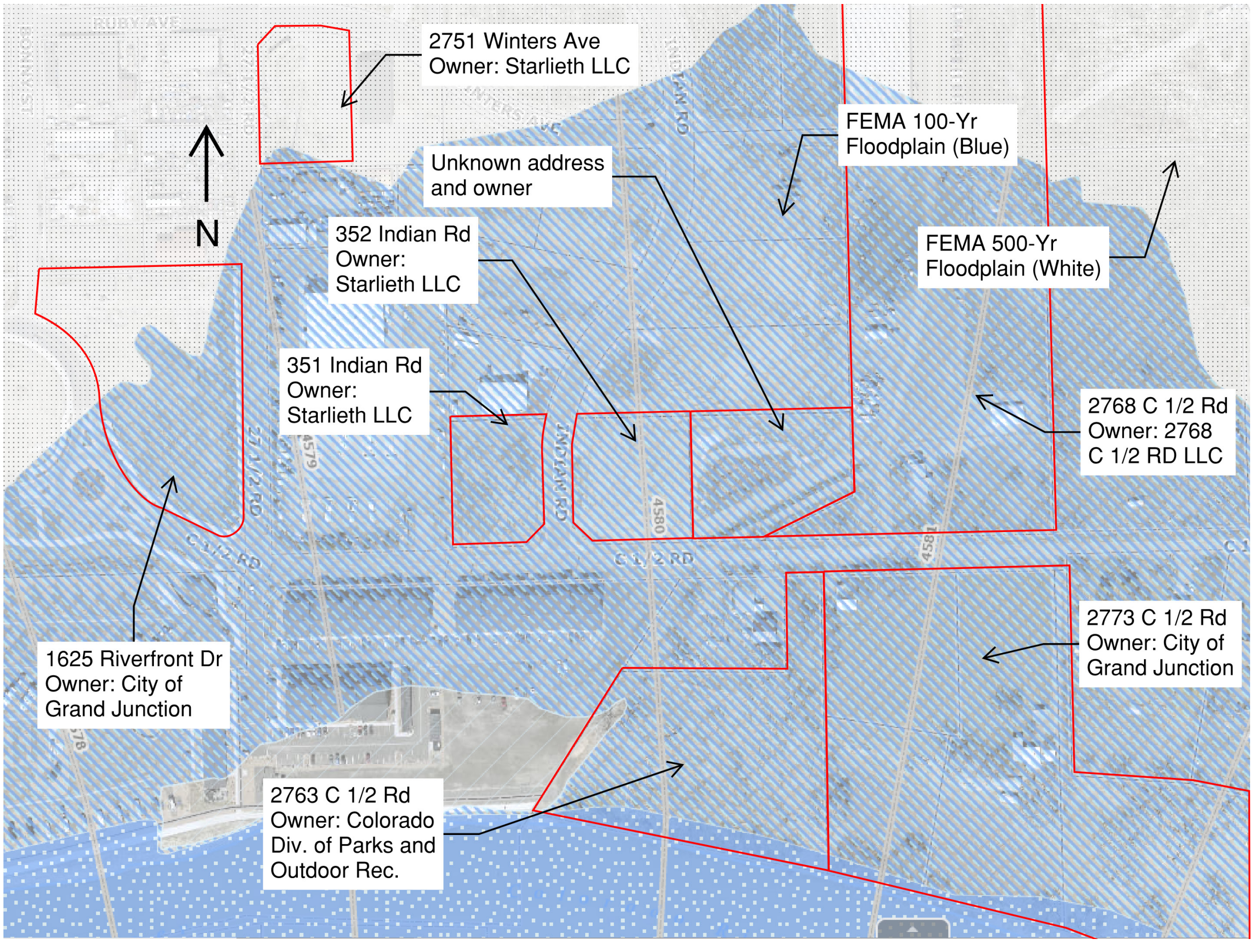

Figure 17 Potential GVBPLS Relocation Parcels with Floodplain

Table 6 GVBPLS Relocation Parcels Comparison

Address	Owner	In 100-year Floodplain?	Benefits and Considerations
2773 C 1/2 Rd	City of Grand Junction	Yes	Parcel was recently purchased by the City, and conditions of the sale include allowing the previous landowner lifetime rights to continue living and farming the parcel. Installing a lift station on this property would require coordination and agreement with the previous landowner. A portion of the property near the river will be set aside for regional trail easement.
2763 C 1/2 Rd	Colorado Division of Parks and Outdoor Recreation	Yes	The City has already approached the State about potential purchase of this property. The property is a good option, provided the narrow neck that connects to C 1/2 Rd is used for access and pipe installation only, and that the lift station be built further south on the property. A portion of the property near the river will be set aside for regional trail easement.

Address	Owner	In 100-year Floodplain?	Benefits and Considerations
A portion of 2768 C 1/2 Rd	2768 C 1/2 Rd LLC	Yes	A portion of this property near C 1/2 Rd is a good option for the new lift station. The potential location would need to be coordinated with the house near the front of the property, the buildings near the back of the property, and the access road to each of these from C 1/2 Rd.
Property with unknown address and owner	Unknown	Yes	The majority of this property appears to be used by a stormwater pond and a ditch and may be less expensive as a result. The northeast corner of the property appears to have enough room for a 2.6-mgd lift station, but not a 4.7-mgd lift station. However, easement from the adjacent property would be needed for construction and an access road.
352 Indian Rd	Starlieth, LLC	Yes	This property is a good option but may be more expensive due to being more desirable for commercial or residential development than other properties. Discussions with the property owner by the City will be needed before further consideration.
351 Indian Rd	Starlieth, LLC	Yes	This property is a good option but may be more expensive due to being more desirable for commercial or residential development than other properties. Discussions with the property owner by the City will be needed before further consideration.
2751 Winters Avenue	Starlieth, LLC	No	This property is furthest away from the lift station and is less desirable due to the distance needed to extend the gravity sewer. This property may be more expensive due to being more desirable for commercial or residential development than other properties. Discussions with the property owner by the City will be needed before further consideration. This is the only property under consideration that is not in the 100-year floodplain.
A portion of 1625 Riverfront Drive	City of Grand Junction	Partially	The property is less desirable for relocating the lift station due to the City's desire to attract new development to this area.

The following four properties are recommended as a short list for further consideration by the City, based on the benefits and considerations described in Table 6.

- 2763 C 1/2 Rd.
- 351 Indian Rd.
- 352 Indian Rd.
- Unknown address and owner.

Factors for final consideration include the following. The City may have additional factors:

- Ease of easement acquisition.
- Cost of property and/or easement acquisition.
- Room for expansion on property.

- Separation from residents and housing.
- Ease of access.
- Space for construction.

The 2763 C 1/2 Rd property is the recommended location and appears to be the best option due to the following:

- A portion of the property will already be used for regional trail easement.
- There is limited frontage to C 1/2 Rd, which provides visual separation from potential nearby businesses.
- It is in the floodplain and other development options are limited.
- The site does not have limitations that would prevent building the lift station.
- Ample space exists for either a 2.6-mgd or 4.7-mgd capacity lift station.

4.5.1 Preliminary GVBPLS Site Layout at 2763 C 1/2 Rd

A preliminary site layout for the relocated GVBPLS at 2763 C 1/2 Rd is shown below in Figure 18. Key features of the lift station at this location include:

- Access Rd from C 1/2 Rd to the lift station.
- Rerouting the sewer interceptor to direct sewer flows east to the new location.
- Installing a new forcemain to the existing discharge manhole (C3-272-042) at the intersection of 27 1/2 Rd and C 3/4 Rd.
- Space for 2.6-mgd or 4.7-mgd lift station.

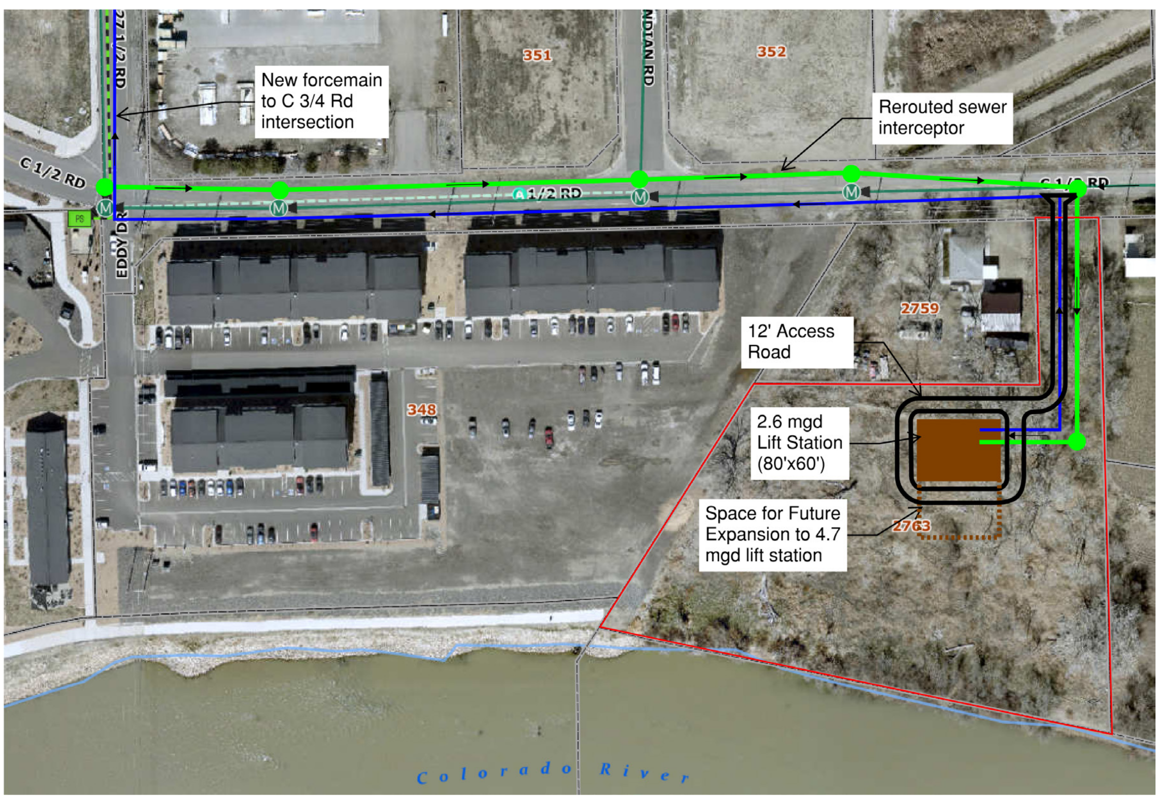

Figure 18 Preliminary GVBPLS Site Layout at 2763 C 1/2 Rd

SECTION 5 OPINION OF PROBABLE CONSTRUCTION COSTS

The opinion of probable construction cost (OPCC) for the revised project alternatives OM-1, OM Alt-2, and OM Alt-3 consists of three main categories:

- Pipeline costs.
- Bridge crossing costs.
- Lift station costs.

The OPCC for the project alternatives is considered a planning level AACE International Class 5 estimate with an expected accuracy range of -50 percent to +100 percent as shown in Figure 19. Although the costs could vary in the future, they can still be used for comparison purposes to determine the most cost-effective alternative for this study.

	Primary Characteristic	***Secondary Characteristic***			
ESTIMATE CLASS	**LEVEL OF PROJECT DEFINITION** Expressed as % of complete definition	**END USAGE** Typical purpose of estimate	**METHODOLOGY** Typical estimating method	**EXPECTED ACCURACY RANGE** Typical variation in low and high ranges [a]	**PREPARATION EFFORT** Typical degree of effort relative to least cost index of 1 [b]
Class 5	0% to 2%	Concept Screening	Capacity Factored, Parametric Models, Judgment, or Analogy	L: -20% to -50% H: +30% to +100%	1
Class 4	1% to 15%	Study or Feasibility	Equipment Factored or Parametric Models	L: -15% to -30% H: +20% to +50%	2 to 4
Class 3	10% to 40%	Budget, Authorization, or Control	Semi-Detailed Unit Costs with Assembly Level Line Items	L: -10% to -20% H: +10% to +30%	3 to 10
Class 2	30% to 70%	Control or Bid/ Tender	Detailed Unit Cost with Forced Detailed Take-Off	L: -5% to -15% H: +5% to +20%	4 to 20
Class 1	50% to 100%	Check Estimate or Bid/Tender	Detailed Unit Cost with Detailed Take-Off	L: -3% to -10% H: +3% to +15%	5 to 100

Notes: [a] The state of process technology and availability of applicable reference cost data affect the range markedly. The +/- value represents typical percentage variation of actual costs from the cost estimate after application of contingency (typically at a 50% level of confidence) for given scope.
[b] If the range index value of "1" represents 0.005% of project costs, then an index value of 100 represents 0.5%. Estimate preparation effort is highly dependent upon the size of the project and the quality of estimating data and tools.

Source: AACE International

Figure 19 AACE International Cost Estimate Classifications

5.1 Assumptions

5.1.1 Pipeline Cost Assumptions

Pipeline replacement unit costs were estimated using a recent bid tab by pipe diameter per lf of pipe. The Chuluota and 29 Rd project was used as the basis for the costs. The project included approximately 460 lf of new 8-inch sewer, and the total cost per lf was calculated to be $344/lf. This cost was escalated based on the anticipated pipe sizes The pipeline unit costs used for this assessment are shown in Table 7. For this study it was assumed that the gravity and forcemain costs would be similar.

Table 7 Pipeline Unit Costs

Pipe Diameter	8-inch	10-inch	12-inch	15-inch	18-inch	24-inch
Unit Cost, $/lf	$344(1)	$379	$396	$430	$447	$516
Percent Increase(2)	0%	10%	15%	25%	30%	50%

Notes:
$/lf - dollar per linear foot
(1) Cost based on Chuluota and 29 Rd bid tab provided by the City April 2025. Assumed these represent March 2025 dollars.
(2) Assumed percent increase from 8-inch replacement cost.

5.1.2 Bridge Cost Assumptions

The basis for the bridge estimate was an assumption that the pipe would be installed underneath the bridge using the utility windows (shown on the bridge record drawings) in the bridge abutments with intermediate girder cross member supports between the abutments. In addition, the assumption was made that the pipe would be installed through the utility window in the south abutment retaining wall and not go through the segmental block retaining wall adjacent to the bridge. Also, the estimate assumed push-on restrained joint ductile iron pipe and a vortex drop structure at the north end of the bridge.

The estimate was prepared by Carollo's Cost Estimating Team using Sage Estimating software and includes direct and indirect construction costs intended to replicate the pricing approach of a general contractor.

Direct labor and equipment costs were calculated by applying the hourly cost of various crews comprised of labor and equipment resources to an anticipated production rate based on the perceived level of effort. Labor and equipment rates were updated and localized to best reflect current market conditions. Project-specific quotes were used for major material purchases and process equipment items when available. Historical pricing data was referenced as necessary.

A procurement strategy was applied to the direct costs to replicate the contracting approach commonly used by general contractors. Specifically, distinctions were made within the estimate to identify work that would be self-performed, subcontracted, or provided by a vendor as each scenario contains its own unique set of mark-ups.

Indirect costs such as sales tax, builder's risk and general liability insurance premiums, contractor home office overhead and profit, payment and performance bond premiums, and contingency have been included to best predict overall project costs. Unless otherwise noted, third-party expenses such as engineering, inspection services, legal fees, land acquisition, and owner management costs have not been included.

A copy of the bridge crossing estimate is included in Appendix A.

5.1.3 Lift Station Cost Assumptions

The final cost estimate for the proposed lift station will depend greatly on the location of the lift station and final direction on the diversion of OM flows for lift station sizing. Factors that could impact the final cost of the lift station include final excavation depth, geotechnical report, and recommendations for foundation construction, dewatering, fill requirements, etc.

For this study, lift station replacement costs were developed based on the 90 percent Lake Rd Lift Station cost estimate developed by the City's engineering consultant for that project, dated July 2024. This estimate was provided by the City for use in developing lift station costs as no recent bid tabs were available. From that estimate, a cost curve was developed using the six-tenth rule to scale costs for all lift stations, and the anticipated capacity. The cost curve is presented in Figure 20.

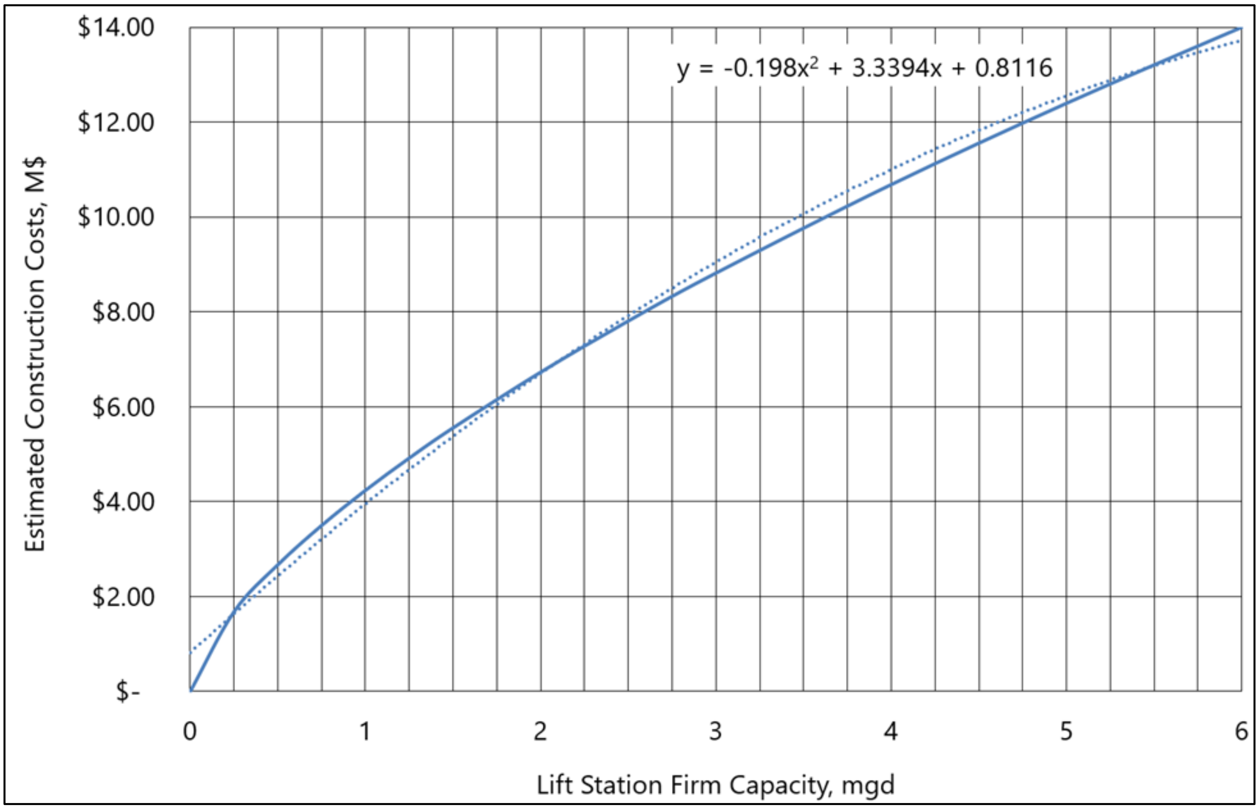

Figure 20 Lift Station Cost Curve

5.2 OPCC Summary

A summary of the infrastructure and design considerations for each of the revised options is shown in Table 8.

Table 8 Project Alternative Needs

Alternative	Total OM Pipeline Replacement Length (lf)	Bridge Crossing Needed	GVBPLS Capacity, mgd	GVBPLS 12-inch Forcemain Replacement Length (lf)	GVBPLS 15-inch Gravity Sewer Extension Length (lf)
OM-1	19,388	No	2.6	2,700	1,300
OM Alt-2	26,264	Yes	2.6	2,700	1,300
OM Alt-3	20,296	Yes	4.7	2,700	1,300

Table 9 shows the OPCC for each revised alternative. These are Carollo's OPCC, and do not include design, construction management, or other parts of the overall project costs.

Table 9 Project Alternative OPCC

Alternative	Pipeline Costs ($M)	Bridge Crossing Costs ($M)	Lift Station Costs ($M)	Lift Station Forcemain Cost ($M)	Lift Station Gravity Sewer Cost ($M)	Total Alternative Cost ($M)
OM-1	$9.2	$0.0	$8.1	$1.1	$0.6	$18.9
OM Alt-2	$14.5	$1.8	$8.1	$1.1	$0.6	$24.2
OM Alt-3	$10.9	$1.8	$11.6	$1.1	$0.6	$24.3

Notes:
$M - million dollars
(1) Cost savings associated with reduced installation of OM sewer can be estimated by comparing Pipeline Costs.
(2) Pipeline Costs are based on the sum of individual pipe length and cost for each pipe size as summarized in Table 2.
(3) Lift Station Forcemain and Gravity sewer alignments overlap along C 1/2 Rd for approximately 920 LF, so costs may be overestimated.

5.3 Risk Evaluation, Advantages Disadvantages

In addition to the estimated construction costs, construction risks were evaluated for each alternative. This includes the risk of constructing sewers on a bridge, potentially damaging the existing 29 Rd bridge retaining wall, and construction through the heavily used roads in OM. A summary of these risks is listed in Table 10.

Table 10 Project Alternative Cost and Risk

Alternative	Costs ($M)	Disruptions	Constructability Risks	Other Considerations
OM-1	$18.9	Significant construction through OM (3 miles)	Typical construction	
OM Alt-2	$24.2	Moderate construction through (1.5 miles)	▪ Bridge crossing ▪ Permitting of crossing ▪ Typical construction	Construction of Lake Rd bridge crossing of pipeline in near future could better define costs and risk.
OM Alt-3	$24.3	Moderate construction through OM (1.5 miles)	▪ Bridge crossing ▪ Permitting of crossing ▪ Typical construction	Construction of Lake Rd bridge crossing of pipeline in near future could better define costs and risk.

Notes:
(1) Cost savings associated with reduced installation of OM sewer is approximately $3.0M.
(2) Pipeline costs are based on the sum of individual pipe length and cost for each pipe size.

SECTION 6 SUMMARY AND CONCLUSIONS

6.1 Orchard Mesa Collection System Flow Diversion Alternative Recommendation

The revised OM-1 alternative is the recommended alternative for the City based on the following:

- Although OM-1 includes considerable construction disruption to the OM neighborhood, OM Alt-2 and OM Alt-3 only reduce a portion of the capacity and do not eliminate the need for construction in the area.
- OM-1 is the least cost alternative.
- OM-1 eliminates potential risk associated with installing a new sewer on the 29 Rd bridge.

6.2 GVBPLS Recommendations

The relocated GVBPLS should be designed for the anticipated PHF from the current sewer basin contributing to the lift station, aligning with the recommended OM-1 alternative. These flows should be reviewed in detail during design to confirm future development upstream of the LS. However, if refinements in flow projections for OM (as part of the ongoing I/I study) result in OM Alt-2 and OM Alt-3 significantly reducing or eliminating the need for construction in OM, the City may want to reconsider those options coupled with a lift station capacity of 4.7 mgd. If the City desires to keep this design avenue open, the GVBPLS could include design considerations for expansion to provide future flexibility, such as:

- Providing space for expansion in the site layout.
- Designing wet well to be connected or expanded.
- Providing stubouts of pipe and conduits for future connections.
- Providing utility electrical feed sized for load of 4.7-mgd lift station.
- Provide space for backup power to support the 4.7-mgd lift station connected load.

Any changes in flow projections would be subject to the CDPHE permitting requirements detailed in Section 2.3, which include verification of downstream hydraulic and treatment capacity.

APPENDIX A BRIDGE CROSSING COST ESTIMATE

Spreadsheet Level	Takeoff Quantity	PRICE TYPE	Labor Hours	Labor Cost/Unit	Labor Amount	Material Price	Material Amount	Equip Cost/Unit	Equip Amount	Sub Price	Sub Amount	Other Cost/Unit	Other Amount	Total Amount
10 Bridge Crossing														
00 General														
01 A 020 Traffic Control														
Traffic Control Plan	1.00 ls	06 Internal Database	40.0	1,998.90 /ls	1,999	319.01 /ls	319	-	-	-	-	-	-	2,318
Traffic Control Device Installation/Removal	25.00 ls	06 Internal Database	1,000.0	1,867.58 /ls	46,689	/ls		-	-	-	-	-	-	46,689
Purchase Traffic Cones	60.00 ea	06 Internal Database		-	-	10.34 /ea	620	-	-	-	-	-	-	620
Traffic Flaggers	160.00 mh	06 Internal Database	160.0	46.69 /mh	7,470	-	-	-	-	-	-	-	-	7,470
Traffic Control	*1.00 ls*		*1,200.0*	*56,158.63 /ls*	*56,159*		*939*	*/ls*				*/ls*		*57,098*
01 H 010 Rent Bridge Inspection Truck (Allowance)														
Rent Bridge Inspection Truck (Allowance)	1.00 ls	09 Allowance		-	-	-	-	255,209.65 /ls	255,210	/ls		-	-	255,210
Rent Bridge Inspection Truck (Allowance)	*1.00 ls*			*/ls*				*255,209.65 /ls*	*255,210*			*/ls*		*255,210*
00 General			*1,200.0*		*56,159*		*939*		*255,210*					*312,307*
01 Sitework & Demo														
01 A 020 Traffic Control														
Temporary LED Traffic Message Board	1.00 mo	06 Internal Database		-	-	310.08 /week	930	-	-	-	-	-	-	930
Traffic Control	*1.00 ls*			*/ls*			*930*	*/ls*				*/ls*		*930*
31 A 050 Erosion Control														
Silt Fence	200.00 lf	06 Internal Database	2.7	0.81 /lf	161	1.63 /lf	325	-	-	-	-	-	-	486
Maintain Silt Fence	200.00 lf	06 Internal Database		-	-	-	-	-	-	1.49 /lf	297	-	-	297
Remove Silt Fence	200.00 lf	06 Internal Database	1.6	0.48 /lf	97	-	-	-	-	-	-	-	-	97
Erosion Control Mats - Slopes - Coconut Blanket	300.00 sf	06 Internal Database	0.8	0.15 /sf	45	0.44 /sf	132			-	-	-	-	177
Stone Lined Construction Entrance, 70'x25' 18" Deep	1.00 ea	06 Internal Database	64.0	4,640.83 /ea	4,641	15,447.46 /ea	15,447	3,350.69 /ea	3,351	-	-	-	-	23,439
Erosion Control	*1.00 ls*		*69.0*	*4,943.96 /ls*	*4,944*		*15,904*	*3,350.69 /ls*	*3,351*		*297*	*/ls*		*24,496*
32 A 130 Pavement Restoration														
Rough Grading	144.00 sf	06 Internal Database	2.0	1.18 /sf	169	-	-	1.31 /sf	188	-	-	-	-	357
Fine Grade	144.00 sf	06 Internal Database	2.0	1.18 /sf	169	-	-	0.94 /sf	135	-	-	-	-	304
Purchase Crushed Gravel, Delivered	3.57 cy	06 Internal Database		-	-	89.44 /cy	320	-	-	-	-	-	-	320
Bituminous by SY - 4"	16.00 sy	06 Internal Database		-	-	-	-	-	-	77.31 /sy	1,237	-	-	1,237
Sawcut Asphalt	48.00 lf	06 Internal Database	1.1	1.34 /lf	64	-	-	6.50 /lf	312	-	-	-	-	377
Pavement Restoration	*16.00 sy*		*5.1*	*25.18 /sy*	*403*		*320*	*39.71 /sy*	*635*		*1,237*	*/sy*		*2,595*
01 Sitework & Demo			*74.1*		*5,347*		*17,154*		*3,986*		*1,534*			*28,021*
02 Buried Pipe														
01 H 010 Relocate Existing 24" Storm (Allowance)														
Relocate Existing 24" Storm (Allowance)	1.00 ls	09 Allowance		-	-	-	-	-	-	29,736.21 /ls	29,736	-	-	29,736
Relocate Existing 24" Storm (Allowance)	*1.00 ls*			*/ls*				*/ls*			*29,736*	*/ls*		*29,736*
33 A 001 Install 10" DIP Beneath Bridge														
Bridge Install Crew	800.00 lf	06 Internal Database	960.0	72.08 /lf	57,667	-	-	23.17 /lf	18,534	-	-	-	-	76,201
Install 10" DIP Beneath Bridge	*800.00 lf*		*960.0*	*72.08 /lf*	*57,667*			*23.17 /lf*	*18,534*			*/lf*		*76,201*
33 A 001 Install 10" DIP Between MH														
Trench Bedding - Crushed or Screened Gravel	19.60 cy	06 Internal Database	0.5			82.94 /cy	1,626			-	-	-	-	1,626
Trench Box Rental by LF	88.00 lf	06 Internal Database		-	-	-	-	1.91 /lf	168	-	-	-	-	168
Spoils to Waste	19.60 cy	06 Internal Database	0.5	2.07 /cy	40	-	-	5.50 /cy	108	-	-	-	-	148
Yard Pipe Excavation and Backfill Crew	88.00 lf	06 Internal Database	80.0	57.04 /lf	5,020	-	-	53.49 /lf	4,707	-	-	-	-	9,727
Install 10" DIP Between MH	*88.00 lf*		*81.0*	*57.50 /lf*	*5,060*		*1,626*	*56.63 /lf*	*4,983*			*/lf*		*11,670*
33 A 020 72" Manholes														
Trench Bedding - Crushed or Screened Gravel	1.45 cy	06 Internal Database	0.0	1.64 /cy	2	82.94 /cy	121	8.27 /cy	12	-	-	-	-	135
Spoils to Waste	17.10 cy	06 Internal Database	0.4	2.07 /cy	35	-	-	5.49 /cy	94	-	-	-	-	129
Light Plant Pipe Crew-MH	3.00 ea	06 Internal Database	240.0	5,019.64 /ea	15,059	-	-	4,707.29 /ea	14,122	-	-	-	-	29,181
6' Dia Manhole	50.00 vf	06 Internal Database	300.0	425.84 /vf	21,292	2,531.68 /vf	126,584	1,294.60 /vf	64,730	-	-	-	-	212,606
72" Manholes	*3.00 ea*		*540.5*	*12,129.53 /ea*	*36,389*		*126,705*	*26,319.31 /ea*	*78,958*			*/ea*		*242,051*
33 A 020 Vortex Drop Structure														
Light Plant Pipe Crew-MH	1.00 ea	06 Internal Database	20.0	1,254.93 /ea	1,255	-	-	1,176.82 /ea	1,177	-	-	-	-	2,432
Vortex Drop Structure	1.00 ea	06 Internal Database	1.5			76,562.90 /ea	76,563			-	-	-	-	76,563
Vortex Drop Structure	*1.00 ea*		*21.5*	*1,254.93 /ea*	*1,255*		*76,563*	*1,176.82 /ea*	*1,177*			*/ea*		*78,995*
40 A 21 10" DIP RJ														
10" DIP Restrained Joint	920.00 lf	05 Historical Data		-	-	134.04 /lf	123,313	-	-	-	-	-	-	123,313
10" DIP RJ	*920.00 lf*			*/lf*			*123,313*	*/lf*				*/lf*		*123,313*
02 Buried Pipe			*1,603.0*		*100,370*		*328,207*		*103,653*		*29,736*			*561,966*
07 Process Pipe														
40 D CL 110 10" Expansion Couplers and Supports														
10" Clevis Hangar Assembly, All Thread up to 10' - 304 SST	80.00 ea	06 Internal Database				716.63 /ea	57,330	-	-	-	-	-	-	57,330
Expansion Joint / Bellows 10"	4.00 ea	06 Internal Database				2,713.96 /ea	10,856	-	-	-	-	-	-	10,856
10" Expansion Couplers and Supports	*1.00 ls*			*/ls*			*68,186*	*/ls*				*/ls*		*68,186*
40 D CL 110 10" Insulation														
Pipe Insulation - Pipe 10"	800.00 lf	06 Internal Database				84.22 /lf	74,113	-	-	-	-	-	-	74,113
10" Insulation	*800.00 lf*			*/lf*			*74,113*	*/lf*				*/lf*		*74,113*
07 Process Pipe							*142,299*							*142,299*

Spreadsheet Level	Takeoff Quantity	PRICE TYPE	Labor Hours	Labor Cost/Unit	Labor Amount	Material Price	Material Amount	Equip Cost/Unit	Equip Amount	Sub Price	Sub Amount	Other Cost/Unit	Other Amount	Total Amount
			2,877.1		*161,876*		*488,599*		*362,848*		*31,271*			*1,044,594*

Estimate Totals

Description	Amount	Totals	Hours	Rate	Cost Basis	Percent of Total	
Labor	161,876		2,877.086 hrs			8.88%	
Material	488,599					26.80%	
Subcontract	31,271					1.72%	
Equipment	362,848		618.337 hrs			19.91%	
Other							
DIRECT COST TOTALS	**1,044,594**	**1,044,594**				**57.31%**	**57.31%**
Builder's Risk & GL Insurance	27,048			2.900 %	T	1.48%	
	27,048	**1,071,642**				**1.48%**	**58.79%**
General Contractor OH&P	214,328			20.000 %	T	11.76%	
	214,328	**1,285,970**				**11.76%**	**70.55%**
Performance & Payment Bond	16,075			1.250 %	T	0.88%	
COST OF WORK	**16,075**	**1,302,045**				**0.88%**	**71.43%**
Design / Bid Risk Contingency	520,818			40.000 %	T	28.57%	
TOTAL CONSTRUCTION COSTS	**520,818**	**1,822,863**				**28.57%**	**100.00%**
Total		***1,822,863***					

Price Type Definitions

00 General Conditions - Supervisory Staff and Expenses.
01 Firm Quote - Currently Valid, Project-Specific At-Risk Quote from Vendor or Subcontractor.
02 Budget Quote - Project Specific Budgetary Quote from Vendor or Subcontractor.
03 Phone Quote - Non-Binding Verbal Pricing Assistance from Vendor or Subcontractor.
04 Published Price - Pricing found on-line, from catalog, or pricing subscription service.
05 Historical Data - Reference to previous Vendor or Subcontractor pricing from similar projects received withing the past 12 months.
06 Internal Database - Material pricing and installation costs imported from Carollo's Master Database. May be adjusted for project-specific conditions.
07 Consultant Estimate - Pricing prepared by third party subconsultant or subject matter expert.
08 Industry Metric - Commonly accepted pricing guideline based on ratios or typical unit price bid results.
09 Allowance - Placeholder costs representing allocation for anticipated scope yet to be designed. Generally based on project history and experience.