DESIGN STUDY REPORT

FINAL

December 2020

42ND AVENUE UPGRADE

Lake Otis Parkway to Florina Street

MOA Project #18-06

Prepared for:

Municipality of Anchorage

Project Management & Engineering Department
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Executive Summary

I. Introduction

The Municipality of Anchorage Project Management and Engineering Department (MOA PM&E) has contracted with CRW Engineering Group, LLC (CRW) to provide professional services to develop and evaluate alternatives to upgrade East 42nd Avenue (42nd Avenue) from Lake Otis Parkway to Florina Street (see FIGURE 1 for project location and vicinity map). The purpose of the project is to upgrade 42nd Avenue to meet current MOA Design Criteria for a local roadway. The existing roadway in the project corridor is narrow with no pedestrian facilities and discontinuous curb and gutter, storm drain, and lighting infrastructure. The existing roadway pavement has deteriorated over time due to lack of adequate drainage facilities and road structural section. Improvements also include replacing the Anchorage Water and Wastewater Utility (AWWU) water main from Lake Otis Parkway to Piper Street.

Improvements are expected to include:

- Road structural section
- Asphalt pavement and curbs and gutters
- Storm drain system infrastructure
- Pedestrian facilities
- Street lighting
- Signage and landscaping
- Approximately 2,700 feet of water main replacement

The project is currently funded through the design study phase only. Additional funding will be necessary to complete design and construction of the project.

Stakeholder comments were solicited using the Context Sensitive Solutions (CSS) process through the following venues:

- Project Website and Interactive Project Map
- Direct Mailings (4) and Electronic Newsletters (12)
- Door-to-Door Business Outreach
- Project Questionnaire
- University Area Community Council Meeting Presentations (5)
- Community Open House Meeting (2)
- Business Open House Meeting (1)
- Agency Coordination Meetings

The Design Study Report (DSR) evaluates existing and future conditions and a range of conceptual design alternatives. Recommended improvements are summarized below.

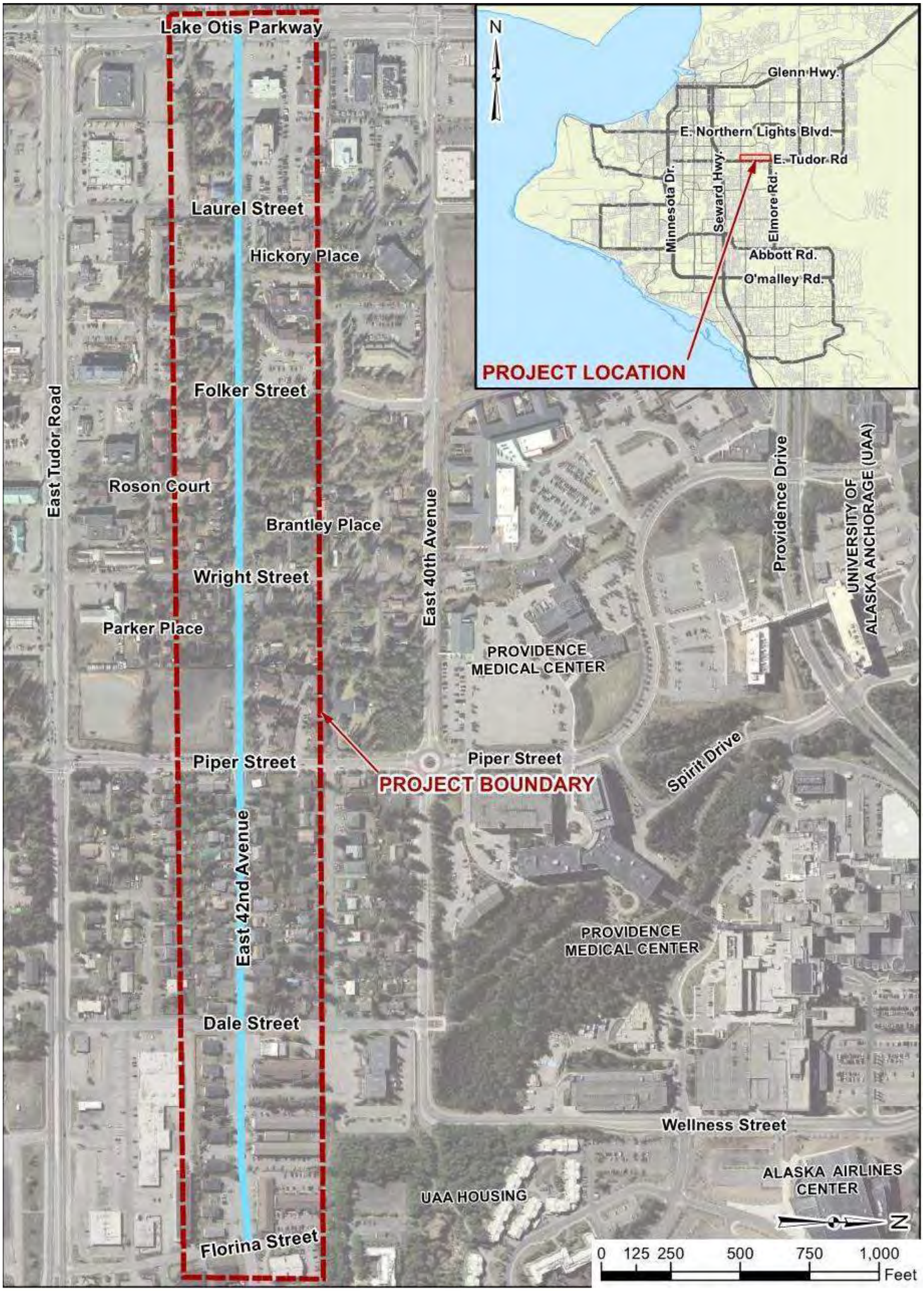

Figure 1 - Project Location and Vicinity Map

II. Recommended Improvements

Based on comments received from public, agency, and business stakeholders and requirements of MOA Title 21, Design Criteria Manual (DCM), and AWWU Design and Construction Practices Manual (DCPM) the preferred alternatives for the project corridor are as follows:

A. Preferred Alternative Typical Cross Sections

To accommodate any on-street parking needs but not designate parking lanes, no roadway traffic markings are proposed along the project corridor for any of the segments. MOA Traffic Engineering prefers 10-foot wide travel lanes for this local roadway. MOA Street Maintenance was involved in the development of the alternatives and understands that these preferred alternatives reduce snow storage by 1-foot on each side compared to providing 11-foot wide travel lanes.

1. Segments A & B: Lake Otis Parkway to Piper Street: Alternative 1 is the preferred alternative with two, 10-foot wide travel lanes, 3.5-foot wide shoulders, and barrier (Type 1) curb and gutter (see FIGURE 2). An 8-foot wide paved pathway is proposed on the north side of the roadway and a 5-foot wide concrete sidewalk is proposed on the south side of the roadway. The non-motorized facilities would be detached from back of curb where feasible. This section balances the needs of the commercial and multi-family residential context of this area which observed no on-street parking needs; thus the recommended alternative does not provide for on-street parking. This reduces the overall street width which allows for detaching the pathway/sidewalk where feasible, minimizes impacts to adjacent properties, provides traffic calming with the narrower roadway and allows for the retention of existing landscaping where feasible. The barrier (Type 1) curb provides for designated driveways and additional vertical separation between the travelled way and pedestrian facilities.

Figure 2 - Segments A and B – Preferred Typical Section

2. Segment C: Piper Street to Dale Street: Alternative 1 is the preferred alternative with two, 10-foot wide travel lanes, a single 7-foot wide parking lane, and rolled (Type 2) curb and gutter (see FIGURE 3). The un-marked 7-foot wide parking lane and 3-foot wide buffers behind the back of curb will provide space for snow storage. Additionally, the adjacent developed properties have minimal set-back from the ROW for infrastructure. The 1-foot reduced lane width on each side of the roadway will minimize impacts to adjacent properties.

   No roadway traffic markings are proposed, effectively allowing parking along either side of the roadway. Pedestrian facilities will consist of 5-foot wide sidewalks on both sides of the roadway, detached from the back of curb by 3 feet to accommodate installation of individual mailboxes. This section balances the needs of the single- and multi-family homes (up to 4-plex) of this area which observed on-street parking needs; the reduced lane widths also provide traffic calming measures in this residential context. The rolled (Type 2) curb and gutter is proposed due to the close spacing between the wide residential driveways along this segment, as there is insufficient room to construct barrier curb with curb cuts at each driveway.

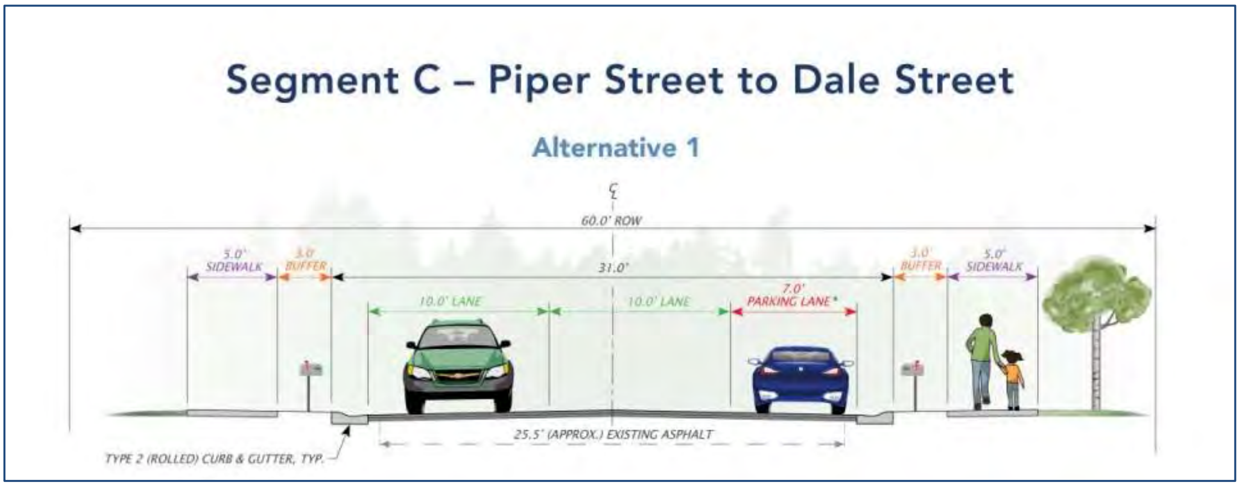

Figure 3 - Segment C – Preferred Typical Section

3. Segment D: Dale Street to Florina Street: Alternative 1 is the preferred alternative with two, 10-foot wide travel lanes, 3.5-foot wide shoulders, and barrier (Type 1) curb and gutter (see FIGURE 4). Pedestrian facilities will consist of 5-foot wide concrete sidewalks along both sides of the roadway, attached to the back of curb. The un-marked 7-foot wide parking lane and 3-foot wide buffers behind the back of curb will provide space for snow storage. Additionally, the adjacent developed properties have minimal set-back from the ROW for infrastructure. The 1-foot reduced lane width on each side of the roadway will minimize impacts to adjacent properties.

This section balances the needs of the high density and multi-family residential context of this area which observed on-street parking needs but also has sufficient off-street parking associated with each parcel; the reduced lane widths also provide traffic calming measures in this residential context. The barrier (Type 1) curb provides for designated driveways and additional vertical separation between the travelled way and pedestrian facilities.

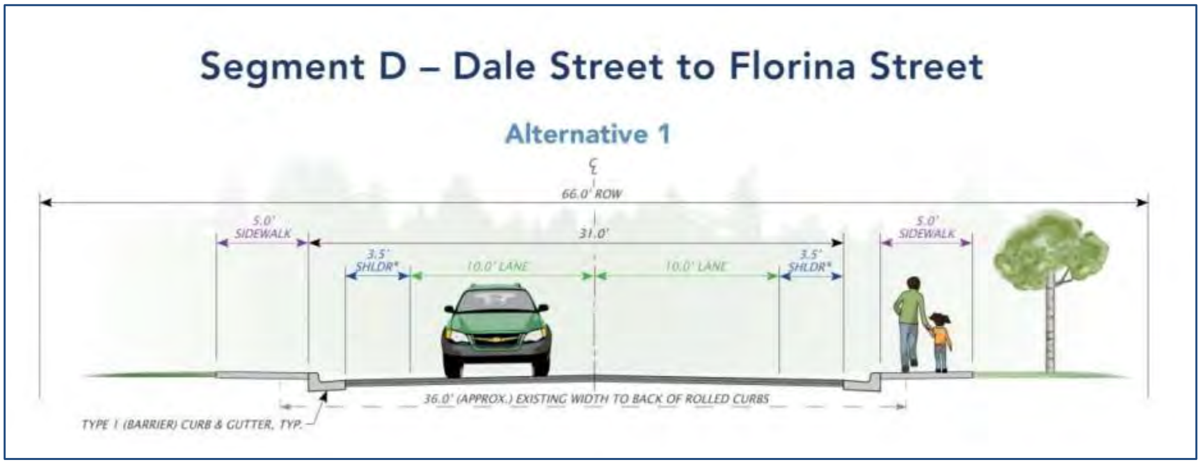

Figure 4 - Segment D – Preferred Typical Section

B. Other Recommended Improvements

1. Design and Posted Speed Limit: Maintain the current posted speed limit of 25 MPH. Following submittal of the Final DSR for signatures, a comment was received from MOA Traffic Engineering Department requesting further investigation and analysis to using a 30 MPH design speed instead of a 25 MPH design speed. Thus, during detailed design, the impacts to intersection sight distance and vertical curves with a 30 MPH design speed will be investigated and the results will be presented to the Traffic Engineering Department to determine if a 30 or 25 MPH design speed is appropriate. Note, the entire body of the Final DSR has not been updated and still shows use of a 25 MPH design speed.
2. Roadway Horizontal and Vertical Alignment: The project roadways will typically follow the center of the ROW. The proposed profile for 42nd Avenue will force high/low spots by raising the grades to a minimum of 0.65%.
3. Landscaping: Proposed landscaping will be in character with the adjacent residential, business, and park properties. Landscaping will focus on retaining existing vegetation where feasible and installing new landscaping and features that fit the context of the corridor. Where new landscaping elements are installed it will maintain clear sight lines and avoid creating comfortable or hidden areas where transients may loiter or sleep. Opportunities for green infrastructure, specifically along Folker Park north of the pathway, will be sought to incorporate into the landscaping design.
4. Retaining Walls: Retaining walls will be installed to reduce impacts to adjacent infrastructure and properties. It is anticipated that a retaining wall will only be required adjacent to Parcel 104 and along Hickory Place, but the exact locations and extents of retaining walls will require further refinement during the design phase.

5. Lighting: A continuous LED lighting system, consistent with current MOA standards will be installed along the roadway.
6. Storm Drain: The proposed drainage improvements consist of the following:
    - Replace aging 42nd Avenue (West) system to align with new roadway improvements and maintain separation distance from proposed water main from Lake Otis Parkway to Laurel Street
    - Extend 42nd Avenue (West) system with new piping from Laurel Street to Parker Place to provide continuous storm drain system
    - Upgrade outfall pipe to open channel/Fish Creek headwaters at Lake Otis Parkway and 42nd Avenue to accommodate future improvements to connecting subsystems
    - Remove sediment from open channel/Fish Creek headwaters and replace 2 downstream driveway culverts
    - Replace aging 42nd Avenue (East) system from Piper Street to Florina Street to accommodate current design storm and improve overall surface drainage
    - Install catch basins at new roadway low points and other low lying areas to alleviate ponding issues, provide positive roadway drainage to minimize ponding
    - Replace catch basins and leads as required to match new curb and gutter
    - Provide water quality treatment for storm runoff
7. Water: The project will replace approximately 2,700 feet of AWWU water main along 42nd Avenue from Lake Otis Parkway to Piper Street. All main line valves, water services and AWWU owned fire hydrants will be replaced. Design and construction of the water main improvements are being done as part of the 42nd Avenue Upgrade Project.
8. Traffic Calming: Traffic calming features will be installed as part of the 42nd Avenue Upgrade project. Locations and types of traffic calming will be further refined during the design phase.
9. Intersections: The existing all-way stop-controlled intersections at Laurel Street, Folker Street, and Dale Street will be removed. Stops signs will be reinstalled for the minor street as the stop-controlled street. 42nd Avenue is considered the major street at the intersection with Laurel and Folker Streets but is the minor street at the intersection with Dale Street. Channelization and intersection layout at Lake Otis Parkway will be unchanged.
10. Driveways: Curb returns will be typically installed at commercial properties (including 8-plexes and greater) and curb cuts will be installed for residential homes (7-plex and less). The proposed design will incorporate MOA driveway access standards wherever possible to improve the safety and operations of the corridor.

III. Construction Schedule, Phasing and Project Costs

A. Construction Schedule and Phasing

It is anticipated that the project will be phased over multiple construction seasons. Phasing for construction is expected to begin at Lake Otis Parkway and work eastward. Ideally the first phase would terminate at Piper Street in conjunction with the proposed water main improvements, however funding availability may instead require an intermediate phase between Lake Otis Parkway and Piper Street.

Two different construction phasing options were evaluated for the preferred Alternative 1. The three phase option includes Phase A1 (Lake Otis Parkway to Roson Court), Phase A2, (Roson Court to Piper Street) and Phase C (Piper Street to Florina Street). The two phase option includes Phase B (Lake Otis Parkway to Piper Street) and Phase C (Piper Street to Florina Street). Based upon anticipated project funding availability, the current schedule calls for design of the 42nd Avenue improvements to begin in 2021 and construction of Phase 1 beginning in 2023.

B. Project Costs

A summary of estimated project costs for the Alternative 1 (preferred) phased construction is presented in TABLE 1 for the entire project corridor. The Alternative 1 (preferred) cost shown is for the most expensive phased construction option. A summary of estimated project costs for each phase of the Alternative 1 three phase construction option is presented in TABLE 2 below and the two phase construction option is presented in TABLE 3 below.

Table 1 - Summary of Estimated Project Costs

Category	Alternative 1 Phased (preferred)
Design & Management Total (estimated)	$2,259,000
ROW Acquisition Total	$161,000
Utility Relocation (15% Contingency) Total	$1,286,000
A. Design, ROW Acquisition, Utility Relocation	***$3,706,000***
Construction Roadway Improvements	$5,389,000
Drainage Improvements	$1,488,000
Illumination Improvements	$480,000
Water Improvements	$1,788,000
Construction Subtotal	*$9,145,000*
Construction Contingency (15%)	$1,372,000
Construction Management / Inspection / Testing	$948,000
B. Total Estimated Construction Cost (rounded)	***$11,465,000***
C. Overhead / Grant Accounting	***$2,677,000***
Total Estimated Project Cost (A + B + C)	***$17,848,000***

Table 2 – Alternative 1: Three Phase Construction Option

Category	Phase A1	Phase A2	Phase C	Total (A1 + A2 + C)
Design & Management Total (estimated)	$771,000	$741,000	$747,000	$2,259,000
ROW Acquisition Total	$85,000	$39,000	$37,000	$161,000
Utility Relocation (15% Contingency) Total	$876,000	$172,000	$238,000	$1,286,000
A. Design, ROW Acquisition, Utility Relocation	***$1,732,000***	***$952,000***	***$1,022,000***	***$3,706,000***
<u>Construction</u> Roadway Improvements	$2,163,000	$1,184,000	$2,042,000	$5,389,000
Drainage Improvements	$851,000	$267,000	$370,000	$1,488,000
Illumination Improvements	$183,000	$122,000	$175,000	$480,000
Water Improvements	$1,198,000	$590,000	$0	$1,788,000
Construction Subtotal	*$4,395,000*	*$2,163,000*	*$2,587,000*	*$9,145,000*
Construction Contingency (15%)	$659,000	$324,000	$388,000	$1,372,000
Construction Management / Inspection / Testing	$435,000	$234,000	$279,000	$948,000
B. Total Estimated Construction Cost (rounded)	***$5,489,000***	***$2,721,000***	***$3,254,000***	***$11,465,000***
C. Overhead / Grant Accounting	***$1,274,000***	***$648,000***	***$755,000***	***$2,677,000***
Total Estimated Project Cost (A + B + C)	***$8,495,000***	***$4,321,000***	***$5,031,000***	***$17,848,000***

Table 3 - Alternative 1: Two Phase Construction Option

Category	Phase B	Phase C	Total (B +C)
Design & Management Total (estimated)	$1,506,000	$747,000	$2,253,000
ROW Acquisition Total	$124,000	$37,000	$161,000
Utility Relocation (15% Contingency) Total	$1,048,000	$238,000	$1,286,000
A. Design, ROW Acquisition, Utility Relocation	***$2,678,000***	***$1,022,000***	***$3,700,000***
<u>Construction</u> Roadway Improvements	$3,321,000	$2,042,000	$5,363,000
Drainage Improvements	$1,118,000	$370,000	$1,488,000
Illumination Improvements	$309,000	$175,000	$484,000
Water Improvements	$1,776,000	$0	$1,776,000
Construction Subtotal	*$6,524,000*	*$2,587,000*	*$9,111,000*
Construction Contingency (15%)	$979,000	$388,000	$1,367,000
Construction Management / Inspection / Testing	$587,000	$279,000	$866,000
B. Total Estimated Construction Cost (rounded)	***$8,090,000***	***$3,254,000***	***$11,344,000***
C. Overhead / Grant Accounting	***$1,900,000***	***$755,000***	***$2,655,000***
Total Estimated Project Cost (A + B + C)	***$12,668,000***	***$5,031,000***	***$17,699,000***

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I. Introduction

The Municipality of Anchorage Project Management and Engineering Department (MOA PM&E) has contracted with CRW Engineering Group, LLC (CRW) to provide professional services to develop and evaluate alternatives to upgrade East 42nd Avenue (42nd Avenue) from Lake Otis Parkway to Florina Street (see FIGURE 1 for project location and vicinity map). Alternatives developed for analysis will follow Complete Streets design methodologies to balance corridor improvements for all users, including motorists, bicyclists, pedestrians, and persons with disabilities, while minimizing impacts to existing residences and businesses in the project area. A Complete Streets design considers walking, biking, and transit as efficient modes of transportation and of equal importance to vehicular modes. Improvements also include replacing the Anchorage Water and Wastewater Utility (AWWU) water main from Lake Otis Parkway to Piper Street.

In addition to CRW, the project team includes:

- Huddle AK (Public Involvement)
- Bettisworth North Architects & Planners (Landscape Architecture)

A. Project Purpose and Goals

The purpose of the project is to upgrade 42nd Avenue to meet current MOA Design Criteria for a local roadway. The existing roadway in the project corridor is narrow with no pedestrian facilities and discontinuous curb and gutter, storm drain, and lighting infrastructure. The existing roadway pavement has deteriorated over time.

42nd Avenue lacks existing pedestrian facilities (viewing west at Laurel Street)

Improvements are expected to include:

- Roadway structural section
- Asphalt pavement and curbs and gutters
- Storm drain system infrastructure
- Pedestrian facilities
- Street lighting
- Signage and landscaping
- Approximately 2,700 feet of water main replacement

B. Project Approach

Prior to beginning this Design Study Report (DSR), the project team submitted a Technical Memorandum to MOA PM&E, MOA Street Maintenance, and MOA Traffic Engineering Department which outlined the conceptual roadway design elements. The Technical Memorandum intended to gain concurrence from the MOA Departments on the design elements before presenting the concepts to the public.

A meeting was held on August 5, 2019 with PM&E, Traffic Engineering, and Street Maintenance to discuss the conceptual roadway design elements. The draft Technical Memorandum was submitted for their review and comment. Review comments and responses from the draft Technical Memorandum were incorporated and the Final Technical Memorandum was submitted September 27, 2019. See APPENDIX O for the Final Technical Memorandum.

Following the Technical Memorandum and concurrence on the conceptual roadway design elements, the project team organized a survey and several meetings with the public and area businesses to identify and document issues and concerns that could potentially be addressed as part of this project. Public surveys and meetings included (see SECTION XVI for a full summary of Stakeholder Coordination/Public Involvement):

- Community Council Meeting #1 (November 7, 2018), Meeting #2 (October 2, 2019), Meeting #3 (January 8, 2020), Meeting #4 (February 5, 2020), and Meeting #5 (October 7, 2020)
- Survey Questionnaire (mailed/emailed in February 2019)
- Pubic Open House #1 (October 17, 2019) and Public Open House #2 (October 14, 2020)
- Business Stakeholder Meeting (October 24, 2019)

Comments from these meetings were used to identify project issues and concerns with improvements along the corridor. Documents and figures presented to the public and input and comments received from stakeholders can be found in APPENDIX L.

C. Evaluation Factors

The Design Study Report will consider the following factors during the evaluation of improvements for the project corridor.

- Stakeholder input and needs
- Conditions of existing area
- Neighborhood connectivity
- Previous planning and design documents
- Traffic, pedestrian, and bicycle volumes and crash history
- Vehicle speeds and on-street parking
- Intersection and driveway sight distances
- Area drainage patterns and infrastructure
- Environmental impacts
- Right-of-Way (ROW) restrictions
- Adjacent neighborhood and property owner impacts
- Emergency access
- Utility relocation requirements
- Project costs

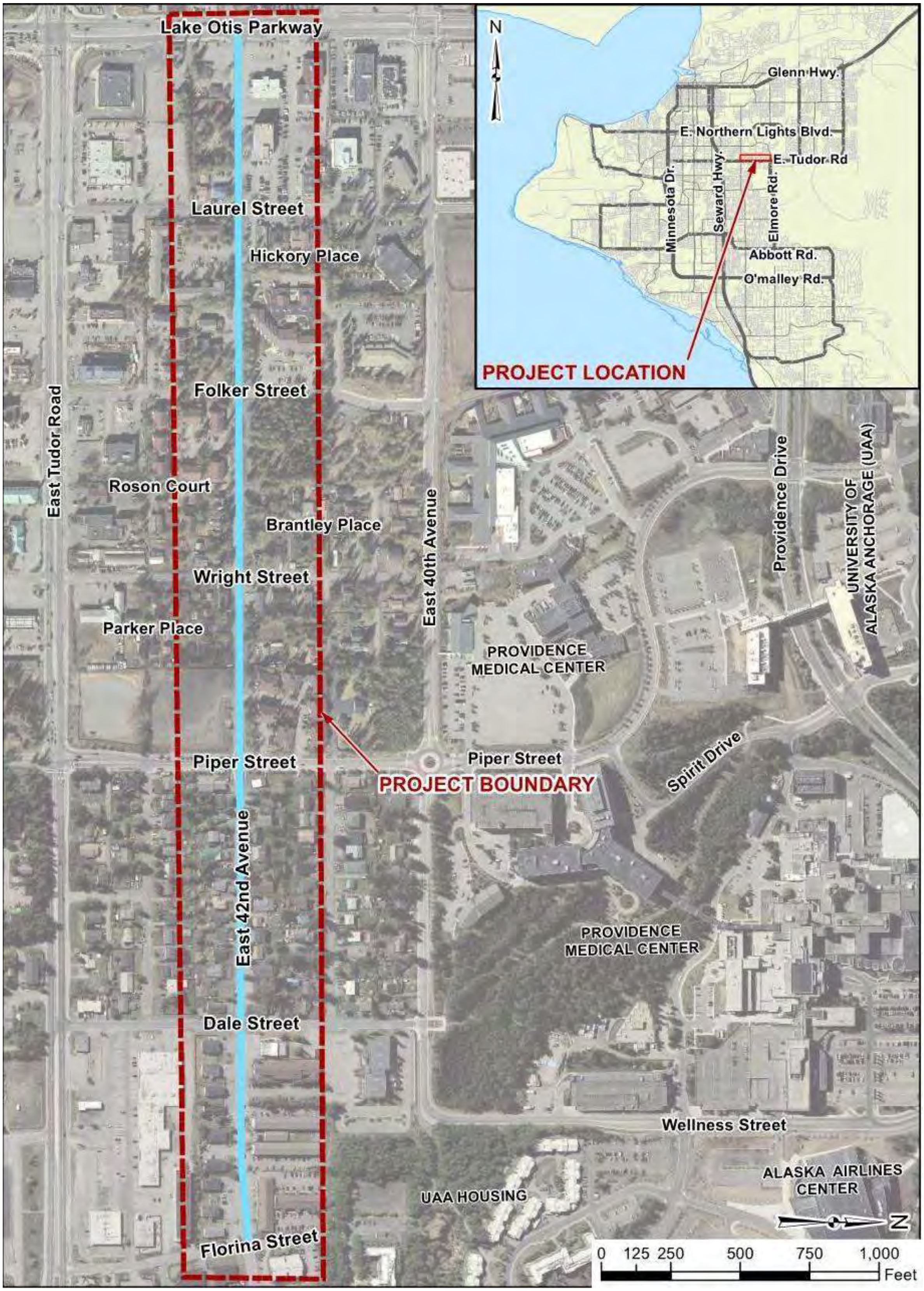


Figure 1 - Project Location and Vicinity Map

II. Existing Conditions

42nd Avenue is a local road that spans 4,350 feet from Lake Otis Parkway (west) to Florina Street (east). It is situated north of East Tudor Road and south of the Providence Medical Center complex and University of Alaska Anchorage. The existing roadway abuts 70 parcels consisting of a mixture of single family housing, multifamily housing, and office buildings, primarily medical. See FIGURE 5 and FIGURE 6 for parcel location maps. 42nd Avenue is a two-lane roadway throughout the entire length of the project, and the posted speed limit is 25 miles per hour.

A. Previous Studies/Reports

1) Anchorage Bowl 2020 Comprehensive Plan (MOA - 2001)

The Anchorage Bowl 2020 Comprehensive Plan (Anchorage 2020 Plan) was developed in 2001. Policy 1 of the 2020 Plan states: "The Land Use Policy Map shall guide land use decisions until such time as other strategies are adopted that provide more specific guidance." Strategies include Neighborhood, District, or Functional Plans. Thus, the UMED District Plan (see below), supersedes the Land Use Plan

2) Anchorage 2040 Land Use Plan (MOA - 2017)

The Anchorage 2040 Land Use Plan (2040 LUP) is a visual guide for growth and development in the Anchorage Bowl and is aligned with the visions and goals of the Anchorage 2020 Plan. The 2040 LUP incorporates the adopted neighborhood and district plans, public facility plans, and recent analysis into a land use amendment element of the Anchorage 2020 Plan. The 2040 LUP features policies and strategies and a land use plan map, which recommends future land development patterns and shows where land uses may occur within the Anchorage Bowl to accommodate future growth.

Map 3-1 in the 2040 Plan identifies the project area as a Candidate Future Reinvestment Focus Area. These areas are second to the initial priority Reinvestment Focus Areas and could become top priorities as phasing progresses. The 2040 LUP designates Reinvestment Focus Areas for direct infrastructure investment, incentives and other actions to catalyze infill and redevelopment. Infrastructure investment includes streetscapes, sidewalks, drainage systems, utilities, parks, schools, and civic amenities.

Map 3-1 of the LUP also identifies the project area as a Greenway Supported Development (GSD) Corridor. GSD aims to restore creek sections or other natural functions during redevelopment with open channels, drainage features, and/or mini-greenbelts. Linear features of GSD can also include pedestrian, trail, street, or greenways. The 2040 LUP identifies, as its second priority for GSD:

- Eastern extension of the midtown Fish Creek GSD from the channel of Fish Creek drainage near Lake Otis Parkway, crossing Lake Otis eastward to generally follow 42nd Avenue to Dale Street and into the UMED.

Specific policies from the 2040 Plan that are directly related to this project are listed below:

- Policy 3.2: Promote the development of main street, transit-oriented, and mixed use corridors that help meet the city's need for retail, services, jobs, and housing: and that support these uses and adjoining neighborhoods with access to multiple modes of travel and attractive pedestrian environments.
- Policy 6.1: Provide sufficient transportation infrastructure to support the growth that the Anchorage 2020 Plan anticipates in Centers, Corridors, other employment areas, and neighborhoods.
- Policy 6.2: Provide new or upgraded pedestrian and local/collector street connections in centers and commercial corridors to improve access to and from surrounding neighborhoods.
- Policy 6.3: Adopt and execute a Complete Streets policy to design streets to serve all users including pedestrians, transit riders, and bicyclists, and align the design and scale of streets to be compatible with compact, accessible, and walkable land use patterns.
- Policy 8.2: Provide new and improved trails, greenbelts, and other pedestrian facilities as alternative travel ways connecting open spaces, neighborhoods, and centers.
- Policy 8.3: Provide greenways and trail extensions into designated centers and reinvestment focus areas, to improve their connectivity with the trails system and overcome barriers to neighborhoods.

3) UMED District Plan (MOA – 2016)

The UMED District Plan (UMED Plan) is an area land use study completed at the request of UMED District organizations and in partnership with the MOA. The purpose of the UMED Plan is to assess existing development issues, identify future land uses, and assist in identifying new strategies and programs for implementation. The plan places emphasis on developing complete streets with sidewalks, adequate lighting, relocated utility boxes and poles, and buffer landscaping. This aims to support the quality of life in residential neighborhoods.

The plan identifies the addition of sidewalks to 42nd Avenue between Lake Otis Parkway and Dale Street as a short term (1-3 years) proposed improvement to support the pedestrian-friendly walking environment in the UMED District.

Specific goals from the UMED Plan directly related to this project are listed below:

- Plan for a pedestrian-oriented UMED Village to serve as the identifiable heart of the District to be a go-to destination for the District to serve the needs of residents, students, staff, and visitors.
- Develop a UMED District identity to unite the publicly owned rights-of-way at primary entrances to the UMED by implementing UMED District Design Guidelines, including (a full list of design guidelines are found in Section 3.3. of the UMED Plan):
  - Treat Piper Street as a principal gateway into the District.
  - Treat Dale Street, Piper Street, Florina Street, Wright Street, Cornell Court, 40th Avenue, and 42nd Avenue as entrances to the UMED District by acknowledging it as a gateway with monument and landscaping treatment appropriate to its context.

- Connect public open spaces with multi-use pathways consistent with MOA trails plans connecting adjacent neighborhoods and the regional trail system.
- Extend direction-finding signage to trails where appropriate and celebrate significant points of connection to the trail system
- Design streets to encourage driving at appropriate speeds, making appropriate use of traffic calming measures.
- Maintain equity between modes within streets and intersections throughout the District.
- Control street intersections to regulate vehicular flows to acceptable levels.
- Minimize conflicts between vehicles and pedestrians by introducing controls at busy crossing points.
- Minimize frontage areas used for surface parking

- Design and implement roadway sections that are complete streets, accommodating pedestrians, active transportation, public transit, and vehicles. Design streets that encourage pedestrian use and address the needs of pedestrian and bicycle traffic.
- Coordinate standards for lighting, street furnishings, and signage with other corridors in the district to create a consistent and understandable circulation system.
- Continue to support the pedestrian friendly walking environment found in the UMED District.
    - Add sidewalks to 42^{nd} Avenue between Lake Otis Parkway and Dale Street.
    - Provide 5- to 10-foot wide multi-use paths with landscaping where R.O.W. permits.
- Design roadways and trails to minimize vehicle and human/animal conflicts.
- Reinforce the natural landscape and ecology of the District by use of appropriate materials and techniques, such as placing an emphasis on native plantings in naturalistic patterns.
- Listen to and incorporate residential and neighborhood community council input early in the process.

4) Tudor Road Corridor Study (2006)

The Tudor Road Corridor Study evaluated transportation issues along Tudor Road between Bragaw Street (now Elmore Road) and Lake Otis Parkway and analyzed overall access and transportation issues adjacent to the corridor. This study was conducted in advance of the many development and transportation projects planned for the area. Public outreach from the study identified the following concerns/comments applicable to the 42^{nd} Avenue project:

- Cut through traffic on 42^{nd} and 46^{th} Avenues
- Lack of pedestrian facilities along 42^{nd} Avenue

Traffic volumes along 42^{nd} Avenue (in 2003) were 4,500 vehicles/day between Lake Otis Parkway and Piper Street and 2,200 vehicles/day from Piper Street to Florina Street. The public perceived most of this traffic as cut-through traffic, but an origin-destination study conducted as part of the corridor study determined that the majority of this traffic is local traffic that collects onto 42^{nd} Avenue because there is no alternative east/west intra-neighborhood routes to disperse traffic. This issue has largely been addressed with construction of the new, east-west collector roadway of 40^{th} Avenue. Current traffic volumes along 42^{nd} Avenue are discussion in SECTION V.

At the time of the study, the signalized intersections on Tudor Road included Lake Otis Parkway, Folker Street, and Bragaw Street (now Elmore Road). This study recommended removing the signal at Tudor Road/Folker Street and installing a new signal at Tudor Road/ Piper Street. This change was subsequently constructed and there is now a signal at Tudor/Piper but no signal at Tudor/Folker. In conjunction with the new signal at Piper Street, the study also identified the need to construct an additional connection between Tudor Road and Providence Drive, which was accomplished with the Piper Street expansion to Providence Drive.

5) Tudor Area Traffic Calming Study (2006)

As part of the Tudor Road Corridor Study, MOA Traffic also undertook the Tudor Area Traffic Calming Study. The intent of the study was to identify transportation and safety issues that improve pedestrian and non-motorized accommodations and reduce travel speeds and cut-through traffic in residential areas. Roadways and intersections were evaluated for traffic calming needs, including 42^{nd} Avenue (Lake Otis Parkway to Florina Street) and the intersection of 42^{nd} Avenue/Dale Street.

As part of the overall planned improvements for the project area, the study recommended the following improvements along 42^{nd} Avenue:

- Upgrade the roadway to urban standards, including pathways or sidewalks on both side of the roadway
- Install a diverter at Folker Street
- Install chokers at Wright Street, Piper Street, and Dale Street

With the construction of the alternative east/west collector roadway (40^{th} Avenue) removal of the traffic signal at Tudor/Folker, and the addition of a new traffic signal at Tudor/Piper, the traffic volumes along 42^{nd} Avenue have reduced significantly since 2003. The diverter recommendation is no longer warranted and will not be carried forward.

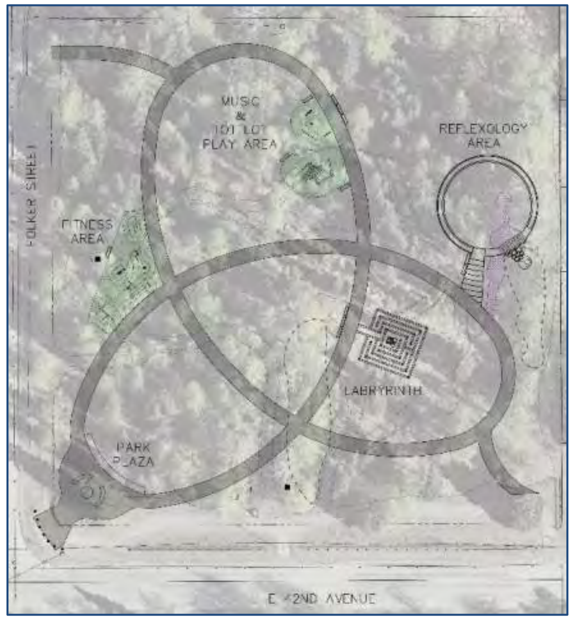
6) Chester Creek Watershed Plan (MOA – 2005)

The Chester Creek Watershed Plan was prepared to guide development in the Chester Creek Watershed and recommends policies and objectives that are most beneficial to the watershed as a whole. General overall goals of the plan include improving water quality and managing the quantity of water discharged during storm events. Approximately half of the project falls within the Chester Creek Watershed area.

B. Planned and Recent Area Development

1) Folker Park Improvements

Folker Park Improvement project was constructed by MOA Parks & Recreation Department in fall 2019. It included two intertwined ADA accessible 8-foot wide paved trails, fitness area, playground, paved labyrinth, and a reflexology area. Trail lights were also installed throughout the park in the spring of 2020.



Folker Park improvements, completed in 2020

2) Parcel 155 Site Improvements

Parcel 155 is an undeveloped lot located on the southwest corner of the 42nd Avenue and Piper Street intersection, owned by Legacy LLC and Providence Real Estate LLC. A conceptual plan for the parcel (and the adjacent Parcel to the south of Parcel 155) has been developed and it includes a 100,000 square foot building and a parking lot with 305 spaces, two driveways, and landscape islands. This is a potential project with no construction plans or a timeline for construction. The 42nd Avenue design team will coordinate with the Parcel 155 owners during detailed design to ensure the potential site improvements are accounted for.

C. Project Area Context

1) Community Council

The project area is within the boundaries of the University Area Community Council (UACC). The UACC currently ranks the 42nd Avenue Upgrade project as the highest capital improvement project priority in their boundary limits. The UACC issued a resolution on November 1, 2017 requesting “a full Traffic Engineering Study” for 42nd Avenue between Lake Otis Parkway and Florina Street “for the purpose of pedestrian, child, and motorized and non-motorized vehicle safety.” The UACC subsequently issued a resolution on February 5, 2020 requesting MOA to give “the highest priority funding” for replacing the water main along “a segment of the East 42nd Avenue Project that includes the necessary work between Folker Street and Wright Street to eliminate frequent flooding.”

2) Demographics

The population in Anchorage has grown steadily over the past decades but has been recently declining since 2014. Recently published (May 2020) population projections by the State of Alaska show that Anchorage is expected to grow 5% total between 2019 and 2045. To plan for the long-term, the 2040 LUP used a “healthy yet moderate” growth rate of 0.8% over a 25-year horizon. The 2040 LUP anticipates little to moderate growth in the project area.

3) Zoning and Land Use

Existing zoning along 42nd Avenue is a mixture of Residential-Office (R-O) and mixed residential (R-2M & R-3). See FIGURE 2 for area zoning.

- R-2M (Mixed Residential) is intended for a variety of single-family, two-family, and multi-family dwellings, with gross densities between 5 and 15 dwelling units per acre. The minimum lot size varies between 2,400 to 20,000 square feet depending on the number of dwelling units. Minimum setbacks on R-2M zoned properties are 20 feet for the front, 5 or 10 feet for the sides depending on the number of dwelling units, and 10 feet for the back.
- R-3 (Mixed Residential) zoning is intended primarily for multi-family and townhouse development with low-rise, multistory buildings with gross densities between 15 and 40 dwelling units per acre. The minimum lot size varies depending on the number of dwelling units. Minimum setbacks on R-3 zoned properties are 20 or 10 feet for the front depending on the number of dwelling units, 5 feet for the sides, and 20 or 10 feet from the back depending on the number of dwelling units and if the lot is abutting an alley. There is also one R-3SL parcel along 42nd Avenue which is essentially the same as the R-3 designation with special limitations.
- R-O (Residential-Office) allows for small- to medium- sized office buildings for professional, business, and medical outpatient service use. This zoning also allows for multifamily residential, group living, and visitor accommodations. The minimum lot size is 6,000 square feet. Minimum setbacks on R-O zoned properties are 10 feet for the front, 5 or 10-15 for the sides depending on use and building height, and 15 or 10 for the rear depending on adjacent zoning. There are also R-OSL parcels along 42nd Avenue which are essentially the same as the R-O designation with special limitations.

Existing land use designations as outlined in the 2040 LUP along 42nd Avenue are a mixture of designations, as outlined below. See FIGURE 3 for area land use designations.

- Compact Mixed Residential – Low: this designation provides for a compatible, diverse range of single-family, attached, and smaller-scale apartment housing and is primarily associated with R2M zoning. Uses include single-family, two-family and other compact housing, townhomes, and smaller apartment structures. Density is 5 to 15 units per acre and lot sizes are generally 6,000 square feet or larger.

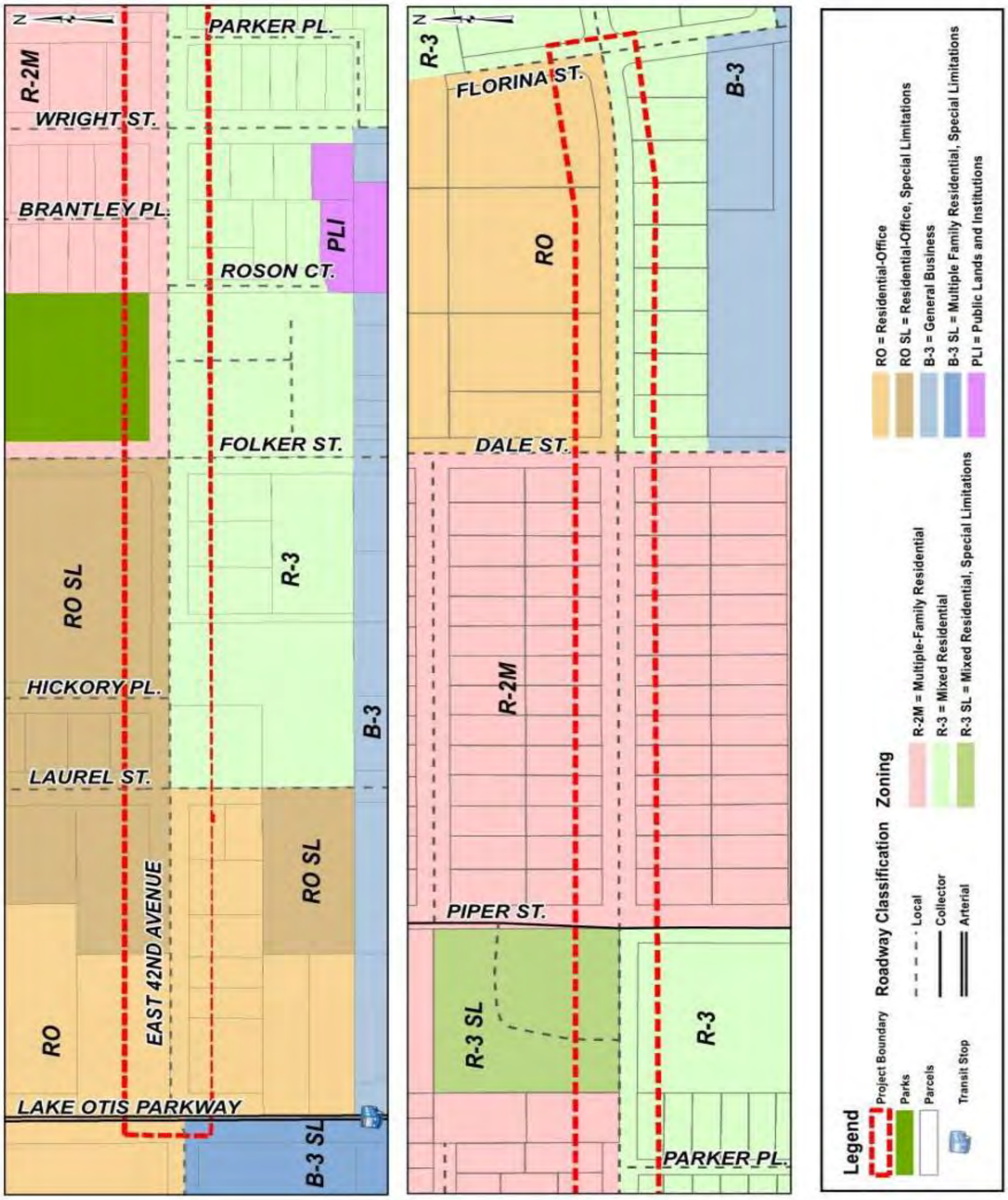


Figure 2 - Project Area Zoning

- Compact Mixed Residential – Medium: this designation provides for multi-unit apartment and townhouse living and a mix of compact, single-family, and attached housing and is primarily associated with R-3 zoning. Uses include townhomes, garden apartments, low-rise apartments, and single- and two-family homes with a density of 10 to 30 housing units per acre.
- Urban Residential – High: this designation provides for urban living opportunities close to major employment centers, such as the UMED. This designation is primarily

associated with R-4 zoning. Uses include apartment buildings, condominiums, townhomes, and compact single- and two-family homes with a density of 15 to 80 housing units per acre.

- Main Street Corridor: this land use designation provides for commercial and mixed-uses within urban neighborhoods. Main streets feature transit access, wider sidewalks, pedestrian amenities, and street tree landscaping and is primarily associated with B-3, B-1B, RO, and R-3 zoning. Uses include a mix of retail, services, office, public facilities,

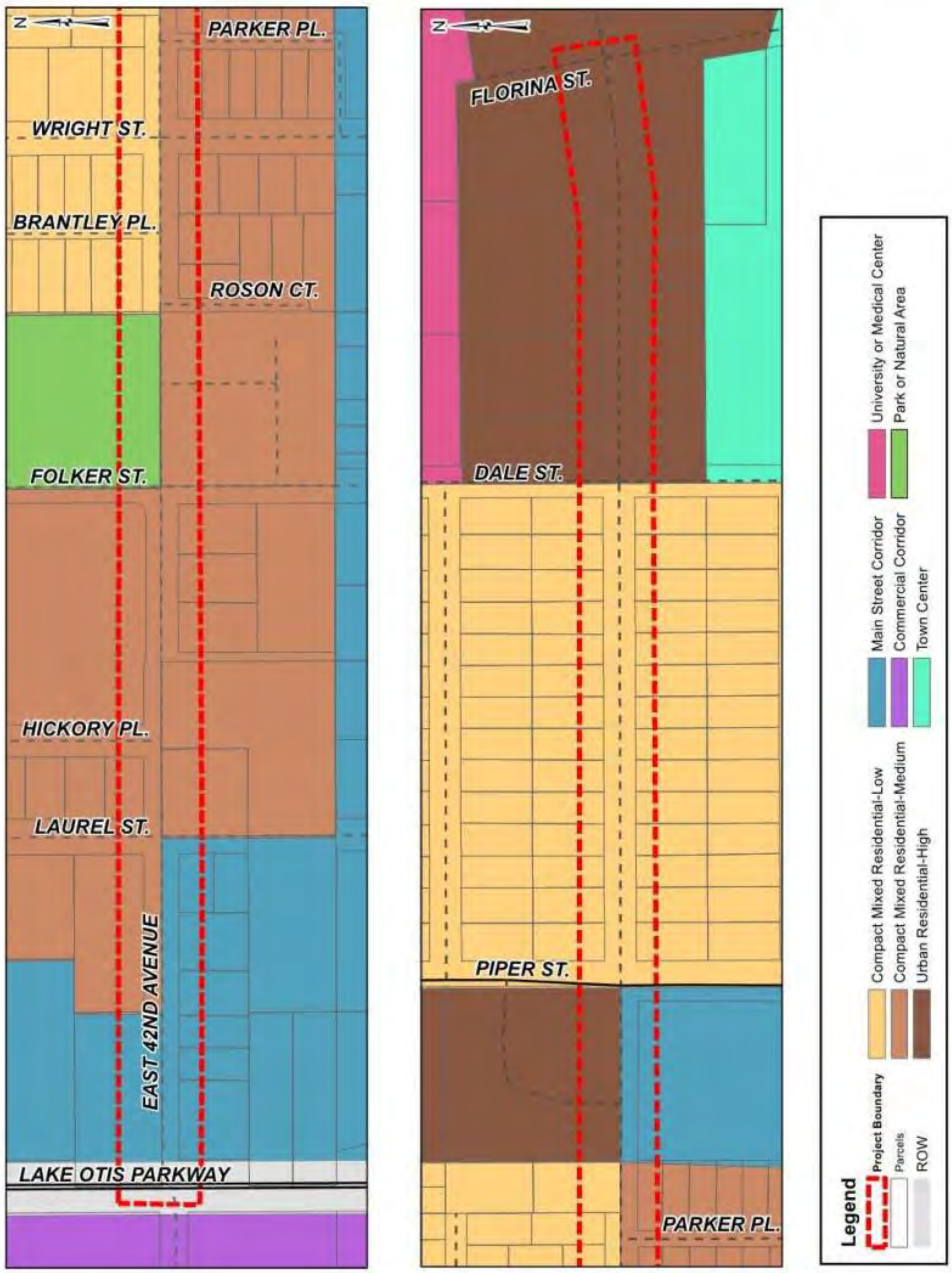


Figure 3 - Project Area Land Use Designations

and housing with a density of 15 or more units per acres.

- Park or Natural Area: this designation provides for active and passive outdoor recreation needs, greenbelts, and trail connections and is primarily associated with PR and PLI zoning. Uses include parks, passive park areas, outdoor recreation facilities, community gardens, trails, and natural habitats.

4) Varying Area Contexts

42nd Avenue consists of varying contexts, including businesses, a park, single-family, multi-family, and high-density multi-family housing. There are four distinct roadway segments along the project corridor:

a) <u>Segment A: Lake Otis Parkway to Laurel Street</u>

This segment consists primarily of businesses, including outpatient medical services and medical related businesses. Multiple, large parcels along this portion of 42nd Avenue contain full-frontage pavement and driveway access. This segment is strip-paved with no curb and gutter or pedestrian facilities.

b) <u>Segment B: Laurel Street to Piper Street</u>

This segment consists of businesses, a retirement home (Providence Horizon House), a park (Folker Park), multi-family (over 7-plex) housing, and some single family homes. Driveways within this area are generally distinct driveways with designated access to the parcel and off-street parking. This segment is strip-paved with no curb and gutter or pedestrian facilities, except for a separated path in Folker Park that parallels 42nd Avenue.


42nd Avenue, Segments A & B: businesses (left) and Folker Park and multi-family housing (right)

c) <u>Segment C: Piper Street to Dale Street</u>

This segment consists of single family and multi-family (up to 4-plex) housing with a total of 30 residential driveways. Many of the parcels along this segment consist of wide or full-frontage access to accommodate the two-, three-, and four-plex units interspersed with the single-family homes. Many of these structures were constructed prior to the 1983 Anchorage Ordinance that limited driveway width. Parcels along this segment have individual mailboxes and many structures are set close to the roadway with limited on-site parking space. This segment is currently strip-paved with no curb and gutter or pedestrian facilities.

d) <u>Segment D: Dale Street to Florina Street</u>

This segment consists of high-density and multi-family housing and one business located at the northeast quadrant of the Dale Street intersection. Most of the adjacent parcels within this segment have full-frontage driveways and unrestricted access, with parking both on and off the parcel being utilized by residents. This segment currently has rolled (Type 2) curb and gutter but no pedestrian facilities.

Segment C with single family homes and wide driveways

Segment D with multifamily homes and full frontage access

Additional items that establish the area context are outlined below.

a) <u>Schools</u>

Project area students are within the following school boundaries:

- Lake Otis Elementary School (west of Piper Street) and College Gate Elementary School (east of Piper Street)
- Wendler Middle School
- East High School

Transportation is provided by Anchorage School District (ASD) for students who live more than 1.5 miles from their neighborhood school. Students who live within 1.5 miles of their neighborhood school are within the designated walking boundary; although, other factors also influence if a safe walking route to school can be established, such as street crossing requirements, presence of pedestrian facilities, maintenance of pedestrian facilities, lighting, etc. Although all of 42nd is within the designated walking boundary of Lake Otis Elementary School and the majority of 42nd Avenue is within the designated walking area of Wendler Middle School, ASD provides bus service for all grade levels and all students along 42nd Avenue. Bus service is also provided for College Gate Elementary and East High School.

Along the project corridor, school bus stops are located at the following locations:

- 42^{nd} Avenue at Hickory Place
- 42^{nd} Avenue at Folker Street
- 42^{nd} Avenue at Wright Street
- 42^{nd} Avenue at 3221 E. 42^{nd} Avenue
- 42^{nd} Avenue at Florina Street

b) Public Parks

Improvements to Folker Park at the intersection of Folker Street and 42^{nd} Avenue (2019)

Folker Park is located at the northeast corner of 42^{nd} Avenue and Folker Street. The park is owned and managed by the MOA Parks and Recreation Department. The park is 2.02 acres in size and features benches, art, flowers, entwined ADA accessible pathway (a longer fitness path and a reflective-paced healing path). These features were added as part of the Folker Park Improvement Phase 1 project which was completed in fall 2019. Trail lighting was installed throughout the park in the spring of 2020. Residents from Horizon House utilize this park for outdoor recreation.

c) Public and Religious Institutions

There are no known public or religious institutions along the project corridor.

D. Environmental Constraints

1) Wetlands/Creeks

There are no mapped wetlands, creeks, or other water bodies along the project corridor based on MOA Watershed Management Services (WMS) Wetland Mapping data. However, the existing 42^{nd} Avenue storm drain system outfalls across Lake Otis Parkway into an existing open channel ditch just outside the west limits of the project. This ditch is mapped as the headwaters of Fish Creek per WMS mapping.

2) Contaminated Sites

According to the Alaska Department of Environmental Conservation (ADEC) Contaminated Sites Program Database, there are no active contaminated sites within the project area. However, parcel 155 has been subject to contamination originating from a fuel distribution system serving Piper Mobile Home Park. The mobile park is no longer present onsite and the lot is considered vacant. In 2012, ADEC determined that cleanup is complete and the site is designated a status of

"Cleanup Complete – Institutional Controls." ADEC has been trying to contact the owner since 2017 to verify compliance with Institutional Controls but has not received a response (last recorded effort was in May 2019).

3) Flood Plain

A review of the Federal Emergency Management Agency (FEMA) Flood Insurance Rate Map (FIRM) #0200050762D shows that a portion of the project area is within Zone AE, a special flood hazard area subject to inundation by a 100-year flood. A small section of 42nd Avenue just east of Lake Otis Parkway and portions of the adjacent parcels are within the flood plain. A section of 42nd Avenue west of Lake Otis Parkway is also within the flood plain and within the limits of the ditch/culvert upgrades anticipated for this project; see FIGURE 4 for the FEMA flood plain map.

These areas have a base flood elevation determined and will require an MOA Flood Hazard Permit for work within the flood plain.

E. Roadway Characteristics and Function

1) Facility Description

42nd Avenue extends 4,350 feet between Lake Otis Parkway and Florina Street. Between Lake Otis Parkway and Laurel Street the existing pavement width varies from approximately 30 to 34 feet with curb and gutter at the Lake Otis Parkway intersection curb returns only. From Laurel Street to Dale Street, the existing pavement width is typically approximately 26 feet with no curb and gutter except for at the Piper Street raised intersection. East of Dale Street, the pavement width is approximately 30 feet with rolled (Type 2) curb and gutter on both sides of the roadway. There are no pedestrian or bike facilities present, except for the detached pathway along Folker Park and the short sections of sidewalk installed at the Piper Street raised intersection. Currently, the road has no on-street parking restrictions.

The existing roadway grades are generally flat, varying between 0.1% and 0.8%, with the exception of the western 1,000 feet of 42nd Avenue near Laurel Street where the existing grade is approximately 4%.

2) Roadway Function

The functional classification affects the basic design criteria including design speed, number of lanes, lane and shoulder width, right-of-way (ROW) width, distance between intersections, and alignment. The most current version of the Official Streets & Highways Plan (OS&HP) lists 42nd Avenue as a local road.

3) Condition of Facilities

The existing conditions of the roadway pavement in the project area includes significant pavement distress along the alignment including transverse and longitudinal asphalt cracks and potholes. Pavement patches are present in multiple locations along the alignment. The road shoulders contain potholes in many locations due to the lack of adequate drainage infrastructure.

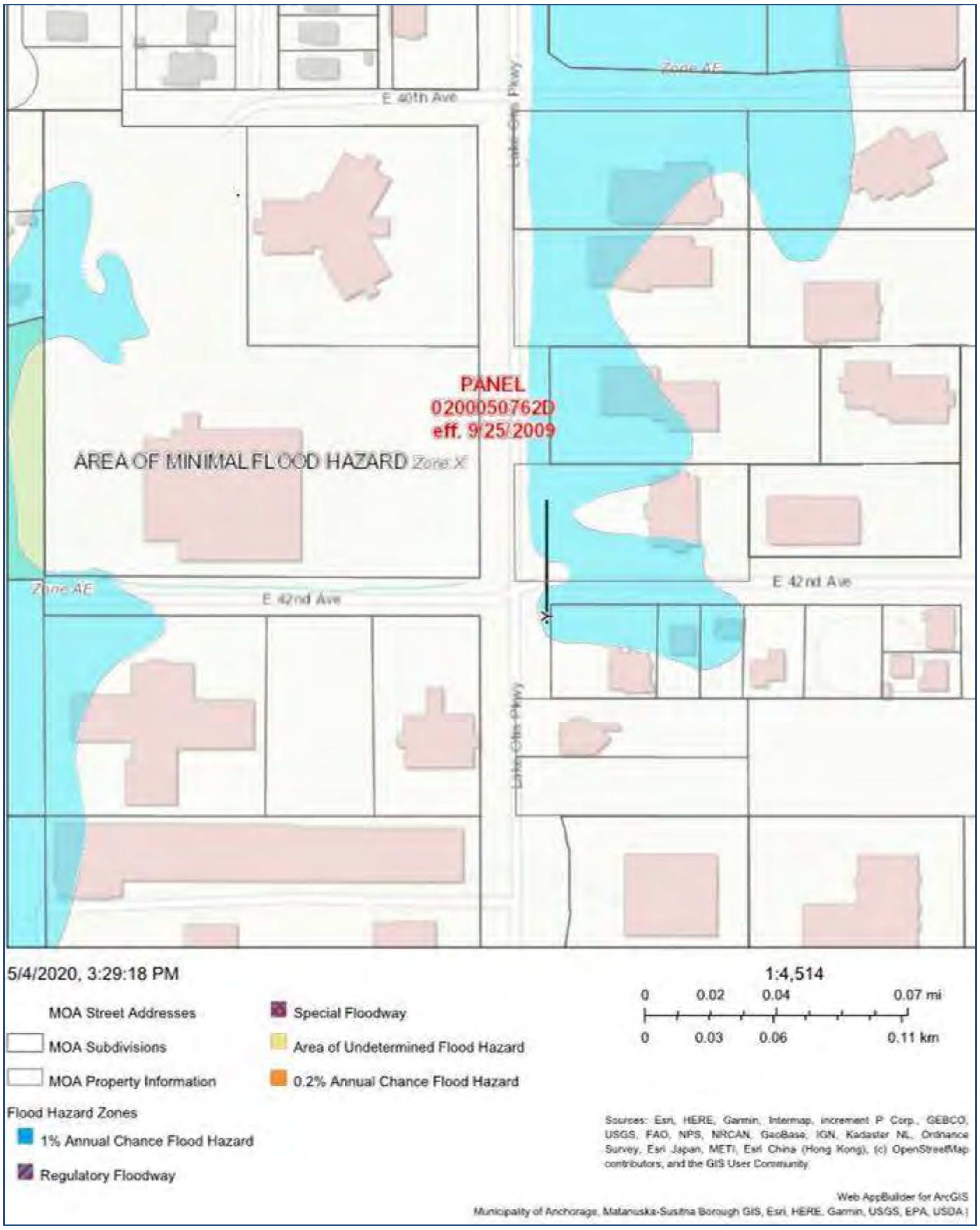


Figure 4 - Flood Plain Map

F. Lighting

Street lighting is inconsistent along the project corridor and, for much of the roadway, is limited to street intersections. Existing lighting conditions for roadway segments are summarized below:

Segments A, B, and C: Lake Otis Parkway to Dale Street

There are MOA owned street lights at the intersection of 42nd Avenue with Laurel Street and with Piper Street. The pole at Laurel Street is direct imbedded and the two poles at Piper Street are on concrete foundations. There are ML&P owned lights at the intersection of 42nd Avenue with Hickory Place, Folker Street, and Wright Street. Additionally, there is one ML&P owned light along 42nd Avenue between Piper Street and Dale Street. All of the ML&P lights are on wood power poles except for the light pole at Folker Street which is direct imbedded. All of the existing light fixtures are Light-Emitting Diode (LED).

Segment D: Dale Street to Florina Street

There are continuous MOA owned street lights along this segment, starting on the east side of Dale Street. The poles are direct imbedded and have LED fixtures.

G. Landscaping

Segment A (Lake Otis Parkway to Laurel Street)

The intersection of 42nd Avenue and Lake Otis Parkway is marked by an absence of any formal landscaping and is comprised of mostly paved surfaces with small patches of poorly maintained lawn. Midway along this segment, the character of the landscaping changes to commercial lots with maintained formal landscape beds and groomed lawn. No pedestrian or bicycle facilities exist along this segment.

Segment B (Laurel Street to Piper Street)

Laurel Street to Piper Street is a mix of detached single family homes, multi-family housing, and large apartment complexes. Existing landscape conditions in this segment vary from dense stands of native vegetation comprised mostly of cottonwood to well maintained landscape beds, street trees, and groomed lawns at the apartment complexes.

This segment also includes Folker Park along the north side of 42nd Avenue. Anchorage Parks and Recreation Department recently completed construction at Folker Park, updating the park to make it an “Intergenerational Healing and Fitness” park. The park has an asphalt pathway running along 42nd Avenue from the southeast corner of the park to the Folker Street and 42nd Avenue intersection. No other pedestrian or bicycle facilities exist along this segment.

Segment C (Piper Street to Dale Street)

At the intersection of 42nd Avenue and Piper Street, streetscape improvements, installed in approximately 2005, include tree and shrub plantings, decorative concrete walls, gateway pergolas at each corner spanning the sidewalks, raised crosswalks, and changes in pavement color and texture at the crosswalks. The new sidewalks along 42nd Avenue installed as part of the Piper Steet improvements end approximately twenty feet east and west of Piper Street.

The area between Piper Street and Dale street is comprised of primarily single to four-plex homes. The landscape treatment varies from yard to yard, but generally consists of lawn, a few trees, and occasional woody shrub plantings. The pedestrian experience in this segment is complicated by numerous extra wide driveways, a lack of sidewalks or bike lanes, and cars parked in the right-of-way.

Streetscape and raised crosswalk at the intersection of 42nd Avenue and Piper Street (viewing west)

Pedestrian walking along 42nd Avenue (between Piper and Dale Streets viewing east)

<u>Segment D (Dale Street to Florina Street)</u>

There is very little landscaping on either side of the street along Segment D. Most of the area is paved for driveways or parking. A rolled (Type 2) curb and a slight change in elevation is the only thing that differentiates the street from the adjacent properties for a majority of the alignment. Where lanscape does occur, it is in the form of lawn and formal landscape beds with shrubs and tree plantings. While the paved surface allows for pedestrian and bicycle traffic at the back of curb in some places, no specific protected pedestrian or bicylce facilites exist in this segment.

There is an existing trail connection to the University of Alaska trail system just north of the 42nd Avenue and Florina Street intersection. Although the trail connection is paved and marked with bollards, there is no wayfinding signage at the intersection or at the end of Florina Street indicating that the pedestrian connection leads to the University.

H. Utilities

Existing utilities within the project area include telephone, cable television, electric, fiber optic, storm drain, natural gas, water, and sanitary sewer (See <u>Appendix A</u> for the layout, size, and type of existing utility). The location of utilities in the project planning documents and drawings are based on utility company facility maps and utility company field locates.

1) Water

Anchorage Water and Wastewater Utility (AWWU) has identified a water pipe replacement project on 42nd Avenue from Lake Otis Parkway to Piper Street which will be included as part of this 42nd Avenue Upgrade project.

The project area is primarily served by a public, piped water system owned and operated by AWWU. The water main along 42nd Avenue within the project area is 8 inches in dimeter, cast iron (CI) pipe west of Piper Street and ductile iron (DI) pipe east of Piper Street. The depth of bury of the water mains are generally 10 feet or more below ground surface. This segment has been selected due to the age of the cast iron pipe and the numerous breakages that have occurred along it (8 incidents between 1997 and 2019). Service lines, hydrants, valves, key boxes, and other water appurtenances are located throughout the project area.

The 8-inch cast iron water main was installed in 1966 per record drawing information shown on AWWU Plan Set 7964 and 7965. The existing water main generally has 10 feet or more of earth cover based on the record drawing information, in addition to field information identifying the elevation of the top of nut for several water valves with respect to the existing grade surface elevation.

The horizontal alignment of the water main generally lies below the north edge of the roadway pavement the entire length of the project limits. The existing alignment does not include any angled fittings, however small deflection angles at fittings or at pipe joints may occur slightly affecting the alignment.

The majority of the valves within the project limits were installed in the 1960's and 1970's and may pose a challenge to actuate, if they haven't been exercised on a regular basis or recently confirmed they can isolate a specific water service area. Verifying the ability of the gate valves function during the design phase will confirm the approach of the water main temporary water design and better prepare AWWU and the contractor prior to construction of the new water system. The recent AWWU project Lake Otis 36th – 42nd Water Rehabilitation Project (Plan Set 10547) installed a new 8-inch gate valve that isolates the 42nd Avenue project on the west side, at the intersection of Lake Otis Parkway and 42nd Avenue. This gate valve is new and is expected to operate smoothly when exercising between the open and close positons.

The following parcels maintain and are served by private wells along 42nd Avenue: Parcels 107, 117 and 156.

2) Sanitary Sewer

The project area is also served by a public, piped sewer system owned and operated by AWWU. The gravity sewer mains in the project area are 8 inches in diameter and made of DI and asbestos concrete (AC) pipe. West of Folker Street, the sewer system flows west, towards Lake Otis Parkway. Between Folker Street and Piper Street, the system flows towards Wright Street, where the sewer then flows south. Between Piper Street and Dale Street, properties are served by sewer mains that run along the back side of their properties, located in utility easements. This system, along with the system that runs along 42nd Avenue east of Dale Street, both flow towards the system along Dale Street, which flows north, towards 40th Avenue. Service lines, manholes, cleanouts, and other sewer appurtenances are present throughout the project area.

3) Storm Drain

See Section III: Drainage Analysis for summary of the existing storm drain facilities in the project area.

4) Electric

Municipal Light & Power (ML&P) owns and operates overhead (OH) and underground (UG) electric lines, junction boxes, below grade vaults, switch cabinets, roadway lights and utility poles in the project area. An underground electric vault is located within and below 42nd Avenue, just east of Lake Otis Parkway, with multiple lines in conduits running north, south, and east from this vault. A 12.5 kV, 3-phase, 4 wire, in conduit, runs along the south side of 42nd Avenue from this vault to Piper Street. This line runs through three vaults (one west of Laurel Street, one east of Roson Court, and one west of Piper Street.) From Piper Street to Florina Street, properties are generally served from overhead electric lines that run along the back of the property, located in utility easements. ML&P has not indicated any future extension or improvement plans within the project area. Undergrounding electric facilities along 42nd Avenue is not currently in ML&P's 5-year (2018-2022) plan. However some sections of overhead lines on 42nd Avenue are included in their list of "requested projects that are not currently included in the underground plan but will remain on ML&P's list for re-evaluation each year."

5) Telephone

Alaska Communications (ACS) owns and operates OH and UG telephone and fiber optic lines within the project area. ACS has underground telephone and fiber optic lines that cross Lake Otis Parkway at 42nd Avenue and underground copper telephone lines that cross 42nd at three other locations but they do not have any active lines that run along 42nd Avenue. However, ACS does own an underground duct that runs along the south side of 42nd Avenue from Lake Otis Parkway to Piper Street. ACS owns one pole along the project corridor (at Wright Street) but utilizes other utility company poles to serve the majority of properties from overhead lines along the back side of the property. ACS has not indicated any future extension or improvement plans within the project area. Per MOA/ACS policy, ACS follows the electric utility and will underground when ML&P undergrounds.

6) Cable

General Communications, Inc. (GCI) owns and operates UG and OH cable and fiber optic lines within the project area. GCI's lines cross 42nd Avenue at three locations. At Parcel 111, an underground cable line runs along the north side of 42nd Avenue for approximately 300 feet. No other GCI facilities are located along 42nd Avenue as all other properties are served by GCI from infrastructure that runs along the back of the property in utility easements. GCI infrastructure in the project area also includes utility poles and pedestals. GCI has not indicated any future improvement plans within the project area.

7) Natural Gas

ENSTAR Natural Gas (ENSTAR) owns and operates natural gas facilities within the project area. Natural gas mains along 42nd Avenue are 1-¼ or 2 inches in diameter and are made of steel or plastic. These lines run on the south side of the roadway between Lake Otis Parkway and Laurel Street and between Wright Street and Florina Street and on the north side of the roadway from Laurel Street to Wright Street. Numerous services and mains cross 42nd Avenue providing natural gas service to neighborhoods and residences surrounding the project area. There are no pressurized transmission gas mains within the project area. ENSTAR has not indicated any future natural gas extension or improvement plans within the project area.

I. Right-of-Way (ROW) and Easements

The existing ROW for 42nd Avenue is 66 feet west of Piper Street and 60 feet east of Piper Street. There are several government lots along the corridor including Parcels 101, 105, 110, 111, and 161. All of these government lots have 33-foot Roadway Reservations by patent. Parcels 108, 109, 155, and part of Parcel 104 have a 30 foot dedicated ROW with a 33-foot Roadway Easement.

Existing easements on private properties vary in width and include: sanitary sewer, telephone and electric, utility, CEA ROW, roadway, water, and street lighting. See APPENDIX I for layout of existing ROW and easements.

Figure 5 - Parcel Location Map (1 of 2)

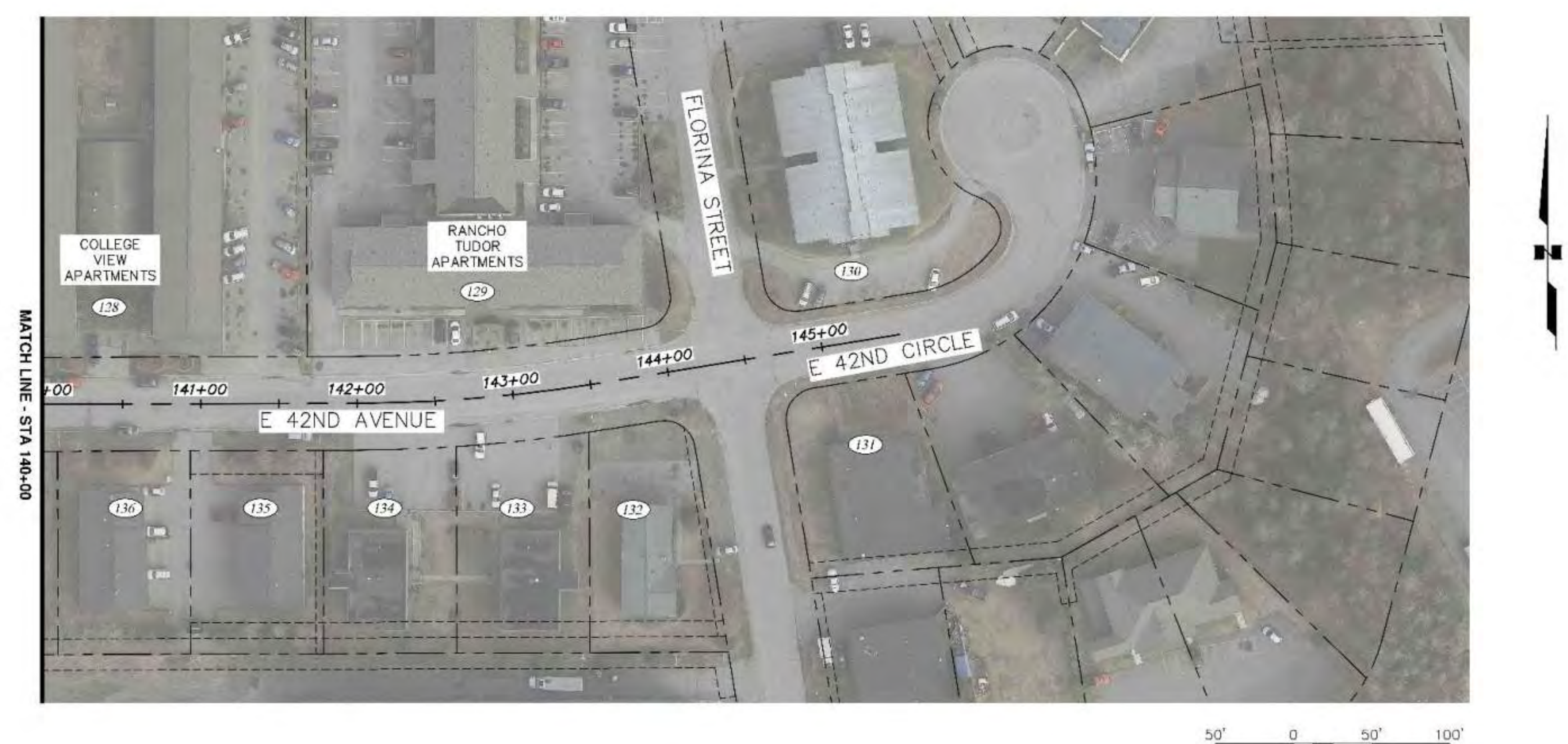


Figure 6 – Parcel Location Map (2 of 2)

III. Drainage Analysis

There are several piped storm drain systems located along 42nd Avenue within the project limits. Additional storm drain subsystems extend from 42nd Avenue towards Tudor Road, Lake Otis Parkway and numerous other connecting side streets. These subsystems eventually discharge flow into either Fish Creek to the west or South Fork Chester Creek to the north.

The majority of 42nd Avenue is strip paved and lacks typical urban residential roadway features such as curb and gutter and stormwater infrastructure to help convey stormwater runoff. While several storm drain systems do exist along the project corridor, most only collect drainage at intersections and do not provide a continuous system along the roadway. This has resulted in a number of drainage issues within the project area that include widespread ponding issues and deteriorating roadway surfaces. Additionally, many of these pipe systems that are in place were installed in the 1970s and 80s and are nearing or are at the end of their design life. One of the primary goals for this project is to improve drainage along the entire project corridor to alleviate these issues and extend the life of the proposed road and pedestrian improvements.

Existing drainage issues and deteriorated pavement along 42nd Avenue

In order to evaluate the infrastructure currently in place, a condition assessment of the existing storm drain piping was conducted, see APPENDIX E FOR condition assessment memorandum. Additionally, a hydrologic and hydraulic (drainage) analysis was performed to determine if the existing piping is adequately sized to meet MOA design criteria.

The information gathered from the condition assessment and the existing condition drainage analysis will be used to develop the proposed storm drain system. The proposed drainage improvements are discussed in SECTION IX.

A. Existing Conditions

1) Drainage Basin Delineation

The drainage basins that contribute runoff to the project area were delineated using several methods, including topographical mapping, aerial photography, parcel boundaries, and MOA Watershed Management's hydrography geodatabase (HGDB). Based on HGDB data, the project area spans across the Fish Creek and Upper Chester Creek watershed boundaries (MOA Subasins

175 & 788) in the Midtown area. Refer to FIGURE 1, APPENDIX F which illustrates the project location and watershed boundaries.

The larger scale watersheds and subbasins identified from HGDB mapping were further refined for this project to better reflect the drainage contributing directly to the project corridor, as well as to the connecting storm drain systems extending to the north and south. For this drainage study, a total of 42 catchments were delineated within Subbasins 175 and 788 for the existing condition of the 42nd Avenue system. See FIGURE 2.A, APPENDIX F for the refined catchment areas.

The contributing catchments are characterized primarily by commercial property, densely spaced single family homes, multi-family housing, and some wooded areas. The density of the buildings increases the impervious surfaces (roofs and driveways) throughout the project area, resulting in increased runoff. The majority of stormwater runoff from these catchments is generally directed toward the adjacent roadways, where it is conveyed by gravel shoulders and discontinuous curb and gutter to several piped systems. These systems are described in more detail in SECTION III.A.3).

In order to develop the drainage model, each catchment was characterized in terms of its area, ground cover type, imperviousness, slope, soil type, and various other factors. Some of the more influential factors are briefly discussed below:

a) Composite Curve Number

A composite curve number was calculated for each catchment area. The composite curve number characterizes the storm runoff properties for a particular area based on ground cover and soil type. For example, high curve number values (such as 98 for paved areas) result in high runoff, with minimal losses. Lower values (such as 70 for naturally vegetated surfaces), correspond to an increased ability of the soil to retain rainfall, and will produce much less runoff than an impervious surface. The composite curve number combines the different ground cover types, weighting them by the percentage of area for that particular catchment.

a) Time of Concentration

Time of concentration (Tc) is defined as the time for runoff to travel from the hydraulically most distant point of a watershed to the design point or point of interest per Section 4.6 of the Anchorage Stormwater Manual (ASM). Travel times can depend on many factors including catchment size, topography, land cover, and use. There are several different methods available to compute Tc. For this analysis, the SCS TR-55 method was used.

For a complete summary of each catchment and the input parameters used for the hydrologic and hydraulic analysis, refer to APPENDIX F.

2) Floodplains

As previously discussed, floodplains have been mapped in the project area based on FEMA maps. Approximately, 275 feet of 42nd Avenue east of the Lake Otis Parkway intersection is mapped as Zone AE. There is also approximately 125 feet of 42nd Avenue west of Lake Otis

Parkway and within the open channel ditch upgrade limits anticipated for this project mapped as Zone AE. Areas in Zone AE are subject to inundation by the 1-percent-annual-chance flood event. For additional information regarding floodplains within project area, refer to SECTION II. D.

Additional investigation and analysis into the existing floodplains is anticipated in regards to the potential impacts of the roadway and storm drainage system improvements may have.

3) Conveyance Systems

The following provides a description of the existing storm runoff conveyance systems within the project area or systems adjacent to 42nd Avenue that influence drainage. The drainage systems described below are owned and maintained by either MOA or Alaska Department of Transportation and Public Facilities (ADOT&PF). See FIGURE 7 for existing storm drain systems map within the roadway improvement limits.

a) 42nd Avenue (West) System

The 42nd Avenue (West) storm drain system extends from Wright Street to the outfall pipe located on the west side of the Lake Otis Parkway/42nd Avenue intersection. This system is discontinuous, with no piping installed along 42nd Avenue from Laurel Street to Wright Street besides catch basin inlets located at each of the intersections. This segment of 42nd Avenue currently does not have curb and gutter installed. At Wright Street and Folker Street, piped storm drain systems convey flow to the south and connect into a system located in Tudor Road. This segment of the Tudor Road system runs westward and is then conveyed north along Laurel Street. Additional side street storm drain pipes extend north from Laurel Street and Hickory Place that connect to the 42nd Avenue (West) system, as well as some adjacent private systems from commercial properties. The 42nd Avenue (West) system generally flows to the west and outfalls into an open channel ditch west of Lake Otis Parkway. The open channel ditch continues westward flowing through three driveway culverts and eventually flows into a wetland area, which is currently an undeveloped parcel of land owned by MOA Parks & Recreation Department named University Park. Per WMS mapping, the ditch beginning at Lake Otis Parkway is mapped as the headwaters of Fish Creek. Storm drain pipe in 42nd Avenue (West) system ranges in size from 10-inch to 30-inch and was mainly constructed of corrugated metal pipe (CMP) in 1970s.

University Park culvert impeding flow at west end of 42nd Avenue

Based on feedback from MOA Street Maintenance, the outfall pipe of the 42nd Avenue (West) system can be partially to fully submerged in the ditch during large rain events. This tailwater condition results in flow restriction in the 42nd Avenue system and flow from the creek backs up into this system. While surveying the two driveway culverts west of Lake Otis Parkway, a third culvert was located at the southeast corner of the University Park parcel. This culvert was hardly visible due to the amount of overgrowth near the inlet end of the culvert, as well as the culvert being full of sediment. This culvert is significantly impeding flow to the west and either the cause of the tailwater condition in the ditch or, at the least, exasperating the issue.

b) 42^{nd} Avenue (East) System

The 42^{nd} Avenue (East) storm drain system extends from Florina Street to Piper Street. This system consists of two subsystems that run northward along Piper Street and Dale Street and eventually tie into one another along 40^{th} Avenue and discharge into South Fork Chester Creek. Similar to the 42^{nd} Avenue (West) system, this system is also discontinuous, with curb and gutter only installed east of Dale Street and at intersections. A piped system extends along 42^{nd} Avenue east of Dale Street to Florina Street. A short piped segment also extends along 42^{nd} Avenue west of Dale Street to the mid-point between Dale/Piper Street. Runoff from these systems tie into the Dale Street system. Curb inlets are installed at the intersection of Piper Street and 42^{nd} Avenue. Runoff collected from these inlets flows northward into the Piper Street system. Storm drain pipe along 42^{nd} Avenue ranges in size from 10-inch to 18-inch and was mainly constructed of CMP in 1980s. Piping at 42^{nd} Avenue/Piper Street intersection was constructed of 12-inch corrugated polyethylene pipe (CPEP) in 2010. Piping along Dale Street was constructed of 36” reinforced concrete pipe (RCP) in 1977.

c) Tudor Road System

Although the Tudor Road storm drain system is located entirely outside of the project boundaries, it contributes a significant amount of runoff to the 42^{nd} Avenue (West) storm drain system. Piping extends along Tudor Road from Piper Street to Lake Otis Parkway. This system generally flows westward and connects with the 42^{nd} Avenue (West) system at Laurel Street, Folker Street, and Wright Street. Piping in Tudor Road was constructed of 18-inch to 30-inch CMP in 1970s.

d) Lake Otis Parkway System

Similar to the Tudor Road system, the Lake Otis Parkway storm drain system is located outside of project boundary and contributes a significant amount of stormwater runoff to the 42^{nd} Avenue (West) system. The Lake Otis Parkway system extends along Lake Otis Parkway from 36^{th} Avenue to Tudor Road. The northern segment of the system flows southward toward 42^{nd} Avenue and the southern segment flows northward. Both north and south segments connect with the 42^{nd} Avenue (West) system at a manhole located in the Lake Otis Parkway/42^{nd} Avenue Intersection, which is just upstream of the Fish Creek outfall pipe. Piping in Lake Otis Parkway was constructed in different phases. The northern segment was constructed of 18-inch and 29-inch x 18-inch CMP in the 1970s. The south segment was constructed of 18-inch CPEP in 2009.

4) Water Quality Treatment

Based on available storm drain record drawings and HGDB data, water quality treatment is not being provided for the 42nd Avenue (West) system beyond natural treatment provided by the wetlands located in University Park parcel at the west end of 42nd Avenue. Water quality treatment is provided for the 42nd Avenue (East) system by two OGSs located near the South Fork Chester Creek outfall according to HGDB mapping data. No Green Infrastructure (GI), also referred to as Low Impact Development (LID), is currently being implemented along the project corridor.

5) Storm Drain Condition Assessment

In late June to early July 2019, Municipality of Anchorage (MOA) Street Maintenance inspected the existing storm drain system using a closed circuit television (CCTV) camera along 42nd Avenue from Lake Otis Parkway to Florina Street and the connecting side streets. For the complete CCTV Storm Drain Condition Assessment Memorandum, refer to APPENDIX E.

The data collected for each pipe was used to score/grade the condition of the infrastructure to determine if replacement was warranted. Pipes with significant defects were identified and are anticipated to be replaced. FIGURE 1 and PIPE CONDITION SUMMARY TABLE in APPENDIX E summarizes the deficiencies identified in the report.

Note that several CMP pipe segments located along the project corridor were not assessed using CCTV. Based on record drawing info, these pipe segments are nearing the end of their design life and were assumed to be replaced as part of this project.

6) Drainage Concerns

Significant ponding occurs throughout the project limits due to flat grades, discontinuous curb and gutter, and inadequate storm runoff collection and conveyance systems. Poor drainage typically leads to roadway degradation, such as heaving, cracking, and pavement failure over time. 42nd Avenue is showing significant signs of pavement distress due to these issues throughout the project boundaries.

The storm drain condition assessment identified several issues with many of the pipes installed along 42nd Avenue. These issues included pipes with significant debris buildup, root intrusion at joints, metal loss and pinholes, and ovality issues. A majority of the pipe along the project corridor was installed in the 1970s and 80s and is nearing the end of its design life and therefore is assumed to require replacement.

Based on information from MOA Street Maintenance, the 36-inch CMP outfall pipe on the west side of Lake Otis Parkway is partially to fully submerged during large storm events. Raising the elevation of the outfall to alleviate this issue is not an option due to the downstream elevation of the open channel ditch/Fish Creek, the roadway and surrounding topography. Upgrading or removing the clogged culvert in University Park may relieve the backwater issues at the outfall.

A. Hydrologic and Hydraulic Analysis

A hydrologic and hydraulic (drainage) analysis provides the basis for locating and sizing storm drain infrastructure within the project area. Analysis of the model includes calculating the peak discharge from each drainage basin and peak capacities of each pipe segment for both the existing and the proposed conditions. This process helps determine where problem areas for the existing system are located and ensures the proposed storm drain system is properly sized. Preparation and evaluation of the drainage model was performed in accordance with the ASM. Supporting data and modeling for the drainage analysis can be found in APPENDIX F.

In addition to sizing the conveyance systems, the drainage model provides runoff flows and volumes to size water quality treatment systems. Per the ASM, treatment must be provided for stormwater runoff generated from the first 0.52 inches of rainfall. While there is no known water quality treatment provided within the project corridor itself, treatment is currently being provided outside the limits of the project area as noted above. Proposed methods for treatment will be discussed in SECTION IX.

1) Updated MOA Stormwater Management Policies

MOA updated their stormwater-related design criteria to meet the most recent Alaska Pollutant Discharge Elimination System (APDES) and Municipal Separate Storm Sewer System (MS4) permit requirements and policies. These updates are reflected in the ASM, which was adopted by the Anchorage Assembly and as of January 2019 all projects must comply with the stormwater design criteria.

Some of the more notable changes to the updated stormwater design criteria that will impact this project include increased design storm depths and the preferred use of Green Infrastructure (GI) for water quality treatment.

2) Design Storm Depth and Distribution

The new design storms outlined in the ASM are based on data from the National Oceanic and Atmospheric Administration (NOAA) released Volume 7 of Atlas 14, Precipitation-Frequency Atlas of the United States (Atlas 14). Atlas 14 is considered the most up-to-date design storm analysis available for Alaska and for the majority of the United States.

Per ASM Table 4.2-1 (MOA Design Storm Depths), the following design storms and depths were evaluated to predict runoff response and meet design requirements:

- Water Quality Treatment: 90th Percentile, 24-hour – 0.52-inches.
- Conveyance Design and Peak Flow Control: 10-year, 24-hour – 2.28-inches.
- Project Flood Bypass: 100-year, 24-hour – 3.59-inches.

It should be noted that both the volume and peak intensity for the majority of Atlas 14 design storms increased significantly compared to the previous MOA design storms.

Similar to the design storm depths, the storm distribution was also updated based on Atlas 14 data to better reflect the shape of storms in the Anchorage and Eagle River areas. The design storm distribution used for drainage modeling is based on the hyetograph provided in Appendix D of the ASM, as required in Section 4.2.4 of the ASM.

3) Orographic Factor

Based on project location, a 1.08 orographic factor was applied to the design storm volumes listed above. Refer to FIGURE 4.2-3 in APPENDIX F.

4) Model Information

A drainage model was assembled to analyze the existing and proposed conditions of each contributing catchment, as well as the conveyance systems contributing to storm drain systems within the project area. The model was developed using 2016 Autodesk Storm and Sanitary Analysis (SSA) computer software.

The NRCS SCS TR-55 TOC method was used to model precipitation loss and to estimate runoff from each catchment. As noted in SECTION III.A, a composite curve number was calculated based on land cover type for each catchment area. The drainage analysis approach is consistent with the guidelines provided in the ASM.

The existing storm drain piping systems included in the model were input based on surveyed data, record drawings and information from the condition assessment report. This information includes pipe size, type, inverts, and slopes.

5) Model Results

A total of 42 contributing catchments were delineated and evaluated for runoff response for the existing condition. These catchments were grouped based on the piped system the runoff will be conveyed to. The peak stormwater runoff during the 10-year, 24-hour design storm event for each of these catchments is shown on FIGURE 2.A in APPENDIX F. The peak flow being conveyed from the project corridor at specific design points is also shown on this figure.

The modeling effort indicates that the existing storm drain pipe is undersized to accommodate the 10-year, 24-hour design storm event in numerous locations along 42^{nd} Avenue and the contributing side street subsystems. The peak flow during the simulated storm causes pipes to surcharge, and overtop manholes and flow into the roadway at select locations. Complete modeling results for the existing drainage systems described in SECTION III.A are provided in APPENDIX F, as well as maps that can be used to identify the location of each pipe segment to help correlate with the pipe results from SSA.

Several of the subsystems that experience surcharging and overtopping during peak flows can be attributed to a bottleneck effect. In many cases, a downstream pipe is insufficiently sized, which results in water backing up into the upstream system. This occurs on most of the subsystems that connect or contribute to the pipe systems on 42^{nd} Avenue. This bottleneck condition decreases the peak flow at each of the design points, as runoff is essentially metered out downstream from undersized pipe upstream. Additionally, the model does not account for the volume of runoff that overtops manholes. The overtopping flow, in effect, is removed from the model, decreasing peak flows and volumes in the respective storm drain system

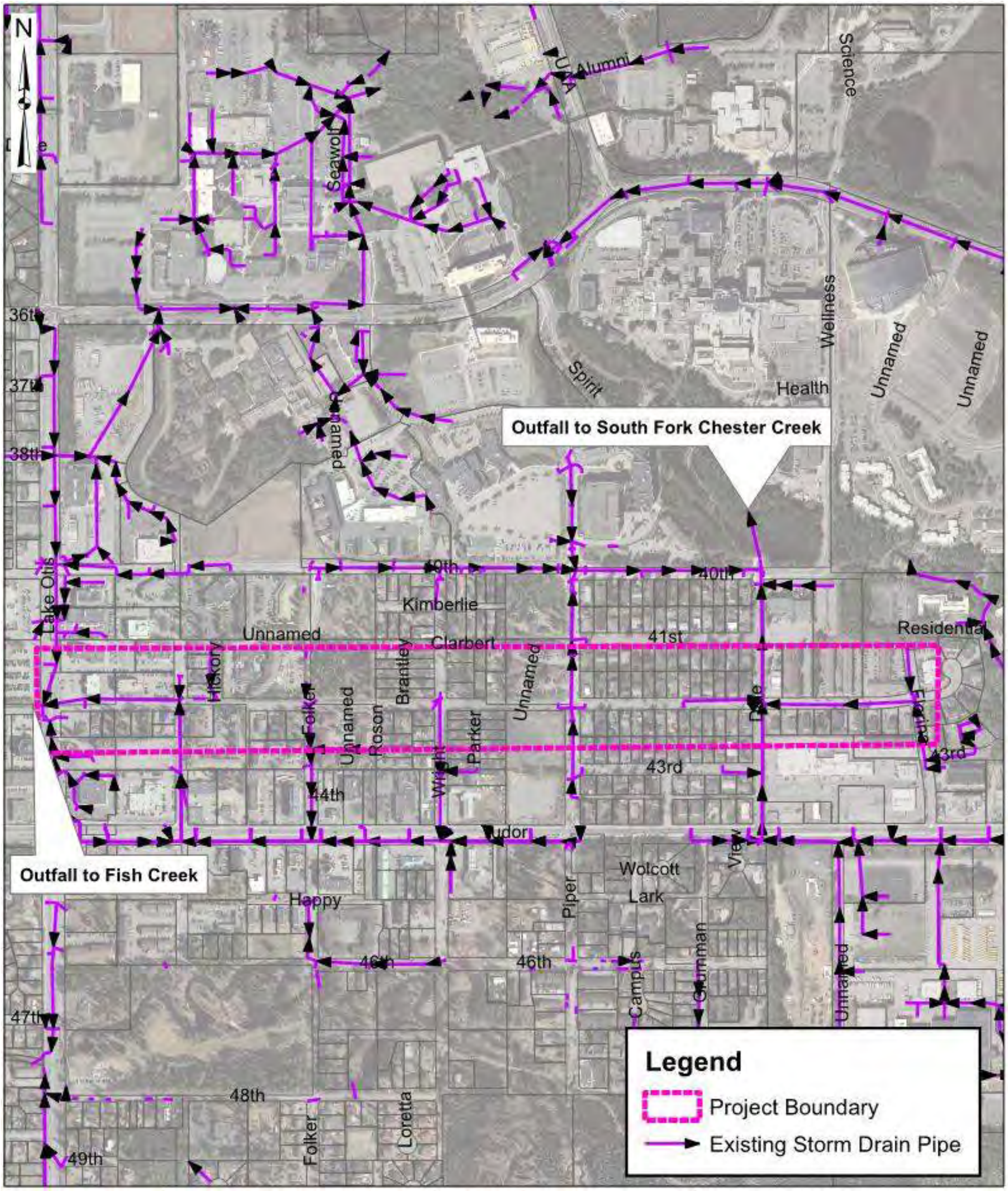


Figure 7 - Existing Storm Drain System Map

IV. Geotechnical Analysis

A. Existing Conditions

CRW conducted a geotechnical investigation for the 42nd Avenue Upgrade project, which consisted of reviewing existing historic borehole logs and completing a field investigation in the project area.

1) Historic Bore Logs

Test holes completed by MOA and for AWWU projects were reviewed, dating from 1976 to 2017. Bore logs, with boring depths ranging from 6.0 to 16.5 feet below ground surface (BGS), indicate that the area is generally comprised of sand and gravel with varying fines content. Occasional layers of sandy silt to silty sand were noted from Lake Otis Parkway to Folker Street at depths of 2 to 4 feet BGS. A layer of peat starting at 8 feet BGS was encountered in AWWU's project on Lake Otis Parkway from 36th Avenue to 42nd Avenue project which extended to 10.3 feet BGS.

The groundwater table in the project corridor was generally found at 7 to 9 feet BGS, but was as shallow as 5 feet BGS in some locations, and was not encountered in several of the borings.

2) CRW Field Investigation

CRW's geotechnical field investigation was conducted in May 2019; the final Geotechnical Report was published in February 2020 and can be found in <u>Appendix G</u>. The investigation included drilling and sampling 23 borings along 42nd Avenue and one boring on an adjacent property. Fourteen piezometers were installed to monitor groundwater levels.

Based on the recovered samples, the existing pavement along 42nd Avenue is generally 2 inches thick. Soil conditions consist typically of 2 to 8 feet of granular fill underlain by coarse grained material. The granular fill classification varies between well- to poorly-graded sand and gravel with varying fines content. The coarse grained material below the granular fill ranged from clean, poorly- to well-graded sand and gravel to silty sand and gravel. In BH-07 thru BH-22, a gray silt was observed which undulated along the project alignment. This silt was encountered in depths varying from 7.5 to 15 feet BGS. See the Geotechnical Report for detailed soil boring and laboratory testing information.

The groundwater table was observed during drilling at depths ranging from 5 to 15 feet BGS, with several borings not encountering groundwater. Subsequent groundwater measurements varied between 5.4 to 14.8 feet BGS with one boring not indicating subsequent groundwater.

Seasonal frost was not observed in the borings at the time of drilling.

Photoionization detector (PID) readings were collected for each sample during the field investigation per the MOA Design Criteria Manual (DCM) to screen for potential contaminants. Past practice in Anchorage has been to perform additional analytical testing if PID readings exceed 20 ppm. PID readings ranged from 0.0 to 20.4 parts per million (ppm) with all but one reading less than 6 ppm; however, no action was recommended for the one reading of 20.4 ppm as this reading was considered a false positive due to contamination from drilling materials (see APPENDIX G for further discussion).

B. Recommendations

The recommended road structural section was developed based on a Berg one-dimensional thermal analysis to determine a design that limits the depth of frost as required by the MOA DCM for the use of the Limited Subgrade Method. The analysis uses the default Anchorage climate parameters with typical soil parameters for classified fill and native soils. The recommended structural section is shown in FIGURE 8 in APPENDIX G as follows:

- 2 inches of asphalt concrete
- 2 inches of leveling course
- 16 inches of MOA Type II-A classified material
- 2 inches of rigid board insulation (R4.5 per inch minimum)
- 24 inches of MOA Type II classified material
- Separation geotextile

The thickness of the recommended section totals 46 inches. If the rigid insulation is increased from 2 inches to 3 inches, the Type II classified fill can be reduced from 24 inches to 15 inches, resulting in a total section thickness of 38 inches.

Board insulation is recommended to extend a minimum of 4 feet beyond the back of the curb when no pathway/sidewalk is present. When sidewalk/pathway is present, the insulation should extend one foot minimum beyond the back of the sidewalks/pathway; however, the pathway/sidewalk will not perform as well as the curb.

Longitudinal transitions between insulated and non-insulated sections should include extending the insulation 8 to 12 feet into the non-insulated section, reducing the insulation thickness along the extension to minimize the possibility of differential heave. The insulation can be tapered from an R-value of 9 to an R-value of 4.5 in the transition zone. The subgrade transition should be tapered at a 10 horizontal to 1 vertical (H:V) slope, if construction distances permit, but should not be steeper than 5H:1V.

A geotextile should be used for separation between the structural section and the existing subgrade. Geotextile should be placed on top of the existing soils prior to placement of classified fill and insulation and extended up the sides of the excavation.

Any existing fill that meets MOA Type II and Type II-A classified fill gradations can be reused as classified fill in the roadway structural section. It is anticipated that the majority of existing fill and native soils along 42nd Avenue contain frost susceptible material and will not meet MOA Type II and II-A classification.

No subdrains are required as part of the project based on groundwater level measurements.

Water lines should be bedded, backfilled, and compacted per AWWU Design and Construction Procedures Manual (DCPM). With the presence of groundwater, bedding material Chip E may be required to allow groundwater to drain away from the water pipe. Chip E material should meet ASTM D2321.

Water lines must be buried to adequate depths to protect from freezing per AWWU DCPM. If adequate burial depths cannot be achieved, alternate freeze protection measures such as insulation, heat tape, or some combination of methods are recommended.

Other utilities lines should be installed per the utility owner's requirements for depth, bedding, and backfilling.

V. Traffic and Safety Analysis

A. Existing Traffic Volumes and Operations

Existing traffic data was gathered from MOA and the State of Alaska for the project area. Additionally, new traffic data was gathered in select locations by CRW. The following table summarizes traffic data used for this study.

Table 1 - Traffic Data Summary

Location	Date	Speed	Bike/Ped Count	Volume (Link counts)	Turning Movements
42nd Ave. and Laurel St.	10/3/2019 & 10/5/2019		X		
42nd Ave. and Folker Park	6/21/2019	X		X	
42nd Ave. and Folker Park	10/30/2019	X		X	
42nd Ave. – Between Piper St. and Dale St.	6/21/2019	X		X	
42nd Ave. west of Wright St.	11/6/2019	X		X	
42nd Ave. and Laurel St.	5/10/2016				X
42nd Ave. and Laurel St.	8/1/2018				X
42nd Ave. and Folker St.	8/1/2018				X
42nd Ave. and Piper St.	6/3/2015				X
42nd Ave. and Dale St.	6/27/2018				X
42nd Ave. and Dale St.	10/10/2019 & 10/12/2019		X		

B. Traffic Volumes

The existing annual average daily traffic (AADT) volume was determined using the volume data (link counts) taken at 42nd Avenue in June, October, and November of 2019 and the turning movement counts at Laurel Street, Folker Street, Piper Street, and Dale Street in August of 2018, June of 2015, and June of 2018 respectively. Seasonal adjustments were factored into the AADT using the nearest permanent traffic recorder on Tudor Road west of Tudor Center Drive.

The Anchorage Metropolitan Area Transportation Solutions (AMATS) travel demand model includes forecasted future daily traffic volumes for higher volume roadways. The model does not include future traffic volumes for 42nd Avenue.

Although much of the area north and south of the project area is built out, traffic volumes on the roadways are anticipated to increase as the local population grows. Much of the traffic on these roadways is destination based and will increase as the population rises. There is a large undeveloped parcel (Parcel 155) on the southwest corner of Piper Street and 42nd Avenue that, when developed, is also expected to contribute to the projected traffic volumes (See FIGURE 5 for parcel numbers). Local population rates were obtained from the Anchorage 2040 Land Use Plan which estimates population growth between 0.3% and 1.1% with a 0.8% annual growth rate. A 0.8% growth rate was used to determine traffic volumes in the anticipated construction year (2025) and the design year (2045).

The following table summarizes AADT for 42nd Avenue.

Table 2 - AADT Traffic Data

Roadway	Location	2025 Daily Traffic Volumes[1]	2045 Projected Daily Traffic Volumes[1]
42nd Ave.	Lake Otis Pkwy. to Laurel St.	2,730	3,200
42nd Ave.	Laurel St. to Piper St.	1,950	2,280
42nd Ave.	Piper St. to Dale St.	1,390	1,620
42nd Ave.	Dale St. to Florina St.	1,580	1,850

1. Annual Growth Rate of 0.8% Source: Anchorage Land Use Plan 2040.

C. Traffic Characteristics

42nd Avenue exhibits different traffic characteristics in the project area and has been separated into four separate segments for traffic analysis as follows:

1. Segment A: Lake Otis Parkway to Laurel Street is primarily commercial and fully built out. Parcels in this area are zoned RO or RO SL.
2. Segment B: Laurel Street to Piper Street has a mixture of business and single and multi-family residential developments as well as Folker Park. Parcels in this area are zoned RO SL, R-2M, R3, or R3 SL.
3. Segment C: Piper Street to Dale Street is primarily residential and fully built out. The parcels in this segment are zoned R-2M.
4. Segment D: Dale Street to Florina Street is primarily residential and fully built out. Parcels in this location are primarily zoned R-3 and RO.

Development and zoning in the project area is not anticipated to change substantially and traffic characteristics are expected to remain relatively consistent for the life of the project.

Future development of the parcel on the southwest corner of the 42nd Avenue and Piper Street intersection may increase traffic volumes in the area. Conceptual plans of this parcel includes a new 100,000 square foot building with direct access to Piper Street and 42nd Avenue. The development schedule and timeline for this parcel has not yet been determined.

Design hour volume (DHV) represents traffic volumes during the peak hour and was estimated using the 30th Highest Hour of the closest permanent traffic recorder. Directional distribution (DD), representing the distribution of traffic during the peak hour, was estimated using available link counts and turning movement counts. Peak Hour Factors (PHF) are a measure of the uniformity of the traffic and used to convert volumes to 15 minute increments for operations analysis. PHF for each segment were determined using available link counts and turning movement counts.

Traffic data for each segment is summarized in the following table and provided in APPENDIX H.

Table 3 - Existing and Future Traffic Characteristics

Location	DHV	DD	PHF	ESAL
42^{nd} Ave. - Lake Otis Pkwy. to Laurel St.	9.5%	70/30	.92	325,000
42^{nd} Ave. - Laurel St. to Piper St.	9.5%	60/40	.92	232,000
42^{nd} Ave. - Piper St. to Dale St.	9.5%	60/40	.92	165,000
42^{nd} Ave. - Dale St. to Florina St.	9.5%	60/40	.92	188,000

D. Speeds

The current posted speed limit for 42^{nd} Avenue is 25 miles per hour (mph). The traffic speed analyses conducted by CRW in June, October and November of 2019 recorded the 85^{th} percentile speed as follows:

Table 4 - Observed Speeds

Road Segment	Location	Date	85^{th} Percentile Speed	
			Eastbound	Westbound
42^{nd} Ave.	At Folker Park	06/21/2019	29 mph	28 mph
42^{nd} Ave.	At Folker Park	10/30/2019	27 mph	28 mph
42^{nd} Ave.	West of Wright St.	11/06/2019	27 mph	27 mph
42^{nd} Ave.	Piper St. to Dale St.	6/27/2019	25 mph	26 mph

The 85^{th} percentile speed is the speed at which 85 percent of the drivers are driving at or below and is typically used to determine a reasonable posted speed limit for a given roadway. The remaining 15 percent of drivers whose speed is above the 85^{th} percentile are the minority and considered to be exceeding the reasonable speed. Posted speed limits are often set at the 85^{th} percentile speed but can be set lower where high volumes of pedestrians and bicyclists are present.

The roadway may be considered eligible for installation of traffic calming measures if the observed 85^{th} percentile speeds exceed the posted speed limit by more than 6 miles per hour. The 85^{th} percentile speeds along 42^{nd} Avenue are 1-4 mph higher than the posted speed limit. However, speed is not the only criterion used to determine the need for traffic calming measures. Furthermore, improvements to the roadway will likely increase speeds on 42nd Avenue due to wider street sections and smoother driving surface. The probability of serious injury or death to a pedestrian struck by a vehicle increases substantially with vehicle speed. A study by the insurance company AAA found that the risk of severe injury for a pedestrian struck by a vehicle is 10% when the vehicle speed is 16 mph but increases to 90% when the vehicle is traveling 46 mph. The risk of pedestrian death is 10% when struck by a vehicle travelling 23 mph and increases to 90% when the vehicle is travelling 58 mph. Limiting traffic speeds on the project corridor could help improve pedestrian and bicyclist safety.

E. Collision Data

The MOA collects collision information obtained from the Anchorage Police Department, Alaska State Troopers, University of Alaska Anchorage Police, and Ted Stevens International Airport Police. This collision data was reviewed for the project area between 2012 and 2018. A total of 33 collisions were reported within the project corridor on 42nd Avenue and the cross streets: Laurel Street, Folker Street, Wright Street, Piper Street, Dale Street, and Florina Street during this time frame. A summary of these collisions, including their locations and characteristics, is provided in TABLE 5 below and a figure of these are included in APPENDIX H.

Table 5 - Project Area Collision History: 2012-2018

Intersection	Collision Type							Total Collisions*
	Angle	Side-Swipe	Rear End	Head On	Fixed Object	Ped/ Bike	Parked Vehicle	
Laurel Street	2		1					**3**
Folker Street	3				1			**4**
Wright Street	6							**6**
Piper Street	10		1		2			**13**
Dale Street	2				2	1		**5**
Florina Street				1			1	**2**

**No fatalities were reported in the collision data.*

This report identifies the intersection collision rate for intersections with over 3 collisions during the seven year study period. The collision rate represents the number of collisions divided by the total number of vehicles entering the intersection. The average collision rate was used to identify intersections with higher crash rates for further study. Collision rates for each intersection are summarized in TABLE 6 below. Wright Street and Piper Street were identified for further study.

Table 6 - Intersection Collision Rate Analysis

Intersection: 42nd Avenue @	Total Collisions	Annual Million Entering Vehicles (MEV)	Collision Rate (per MEV)
Laurel Street	3	9.96	0.30
Folker Street	4	12.52	0.32
Wright Street	6	7.92	**0.76**
Piper Street	13	19.16	**0.73**
Dale Street	5	15.59	0.32

F. Side Street Intersections/Access Control

The intersection of Lake Otis Parkway is a channelized intersection with left turns from 42nd Avenue onto Lake Otis Parkway prohibited. This intersection is "minor street stop controlled" intersection with 42nd Avenue being the stop controlled approach.

Eleven side streets intersect 42nd Avenue in the project area. Four of these intersections are tee intersections: Hickory Place, Roson Court, Brantley Place, and Parker Place. The remaining side streets (Laurel Street, Folker Street, Wright Street, Piper Street, Dale Street, and Florina Street) are four-way intersections. 42nd Avenue access is as follows:

1) Segment A: Lake Otis Parkway to Laurel Street

This segment has six commercial driveways and two residential driveways. Many of the parcels include wide access and parking areas across the full site frontage. These configurations make access and circulation unclear to drivers and increase conflict points between vehicles utilizing the driveways and the street traffic. The intersection of Laurel Street is a four-way, all-way stop intersection.

2) Segment B: Laurel Street to Piper Street

This segment has nineteen residential driveways. Two parcels have parking access across the full site frontage (Parcels 163 & 108). Two driveways are connected to undeveloped parcels (Parcels 109 & 155). Hickory Place, Roson Court, Brantley Place, and Parker Place are tee intersections with stop control on the minor streets; 42nd is the major street at each of these intersections. Folker Street is a four-way, all-way stop intersection. Wright Street is a four-way intersection with stop control on Wright Street. Piper Street is a four-way intersection with stop control on the minor street (42nd Avenue).

3) Segment C: Piper Street to Dale Street

This segment has thirty residential driveways and ten of the parcels have parking access across the full site. The intersection of Dale Street is a four-way, all-way stop intersection.

4) Segment D: Dale Street to Florina Street

This segment has one commercial driveway (Parcel 126) and thirteen residential driveways; street frontage is primarily driveway access or parking areas. Eight of the parcels have parking access across the full site frontage. Two of these parcels (Parcel 127 & 129) have parking that is perpendicular and immediately adjacent to the street, requiring vehicles to make back out parking maneuvers into the street. Two parcels (Parcels 135 and 136) have on-site parallel parking directly adjacent to the street along the full lot frontage. The intersection of Florina Street is a four-way intersection with stop control on 42^{nd} Avenue and 42^{nd} Circle.

The proposed design will incorporate MOA driveway access standards wherever possible to improve the safety and operations of the corridor.

G. Level of Service Analysis

A Level of Service (LOS) analysis was performed in accordance with the Transportation Research Board's Highway Capacity Manual, 2010 for each of the major intersections including Laurel Street, Folker Street, Piper Street, and Dale Street. The analysis used Trafficware Synchro (Version 10) software. The MOA intersection operation standard for urban areas allows a minimum LOS D during the design year. LOS analysis was not completed for 42^{nd} Avenue at the intersection of Lake Otis Parkway because proposed roadway improvements do not extend through the intersection.

1) 42^{nd} Avenue and Laurel Street

The intersection of 42^{nd} Avenue and Laurel Street operates as an all-way stop intersection. There is currently one approach lane in each direction. LOS was determined for both the construction year (2025) and the design year (2045). In 2025, the intersection will operate at an overall LOS of A with a total delay of 8.3 secs. None of the approaches operate with a LOS less than A. In the design year (2045), the intersection will continue to operate at a LOS of A with a total delay of 8.6 secs.

2) 42^{nd} Avenue and Folker Street

The intersection of 42^{nd} Avenue and Folker Street operates as an all-way stop intersection. There is currently one approach lane in each direction. LOS was determined for both the construction year (2025) and the design year (2045). In 2025, the intersection will operate at an overall LOS of A with a total delay of 8.6 secs. None of the approaches operate with a LOS less than A. In the design year (2045), the intersection will continue to operate at a LOS of A with a total delay of 9.2 secs.

3) 42^{nd} Avenue and Piper Street

The intersection of 42^{nd} Avenue and Piper Street operates as stop controlled intersection where the minor approaches (42^{nd} Avenue) are the stop controlled approaches. There is currently one approach lane in each direction. LOS was determined for both the construction year (2025) and the design year (2045). In 2025, the 42^{nd} Avenue approaches will each operate at a LOS of B with an average delay of 13.6 secs. In the design year (2045), the 42^{nd} Avenue approaches will deteriorate to a LOS of C with a total delay of 15.9 secs. LOS C exceeds the minimum requirements for LOS during the design year and is acceptable.

4) 42nd Avenue and Dale Street

The intersection of 42nd Avenue and Dale Street operates as an all-way stop intersection. There is currently one approach lane in each direction. LOS was determined for both the construction year (2025) and the design year (2045). In 2025, the intersection will operate at an overall LOS of A with a total delay of 8.8 secs. None of the approaches operate with a LOS less than A. In the design year (2045), the intersection will continue to operate at a LOS of A with a total delay of 9.5 secs.

H. All-Way Stop Analysis

An all-way stop analysis based on current conditions was performed on the intersections of Laurel Street, Folker Street, Wright Street, Piper Street, and Dale Street utilizing recommendations from the latest edition of the Manual of Uniform Traffic Control Devices (MUTCD) guidelines. Currently, the following intersections along 42nd Avenue within the project corridor are all-way stop controlled: Laurel Street, Folker Street, and Dale Street. Wright Street and Piper Street are two-way stop controlled, but these intersections were also analyzed for all-way stop warrants due to the crash history at these intersections. 42nd Avenue is considered the major street at the intersection with Laurel, Folker, and Wright Streets but is the minor street at the intersection with Piper and Dale Streets.

The MUTCD provides warrants for when an all-way stop should be considered at an intersection. Applicable warrants for the intersections on 42nd Avenue include:

- *Crash rate:* five or more crashes in a 12-month period that are susceptible to correction by installation of a multi-way stop.
- *Intersection Volume:* (must meet *both* of the following conditions):
  - The combined minimum vehicular volume from the major street approaches averages at least 300 vehicles per hour for any eight hours during an average day.
  - The combined minimum vehicular volume from the minor street approaches averages at least 200 vehicles per hour for the same eight hours.
- *Combination*: Where no single criterion is established but 80% of their minimum values for the crash rate and major and minor intersection volumes are met.

The MUTCD also allows the option of installing an all-way stop on residential streets of similar classification where installing the all-way stop will improve the traffic operations of the intersection.

Each of the previously noted intersections were analyzed to determine if it met the criteria for an all-way stop.

- Six years of crashes were reviewed to determine the number of crashes in the highest year.
- Existing intersection count data was reviewed to determine the eight highest hours of vehicular volumes for the intersection.

Results of the analysis are summarized in TABLE 7 below. None of the intersections, including the existing all-way stop intersections, currently meet the warrants for an all-way stop.

Table 7 - 42nd Avenue All-Way Stop Analysis

Intersection: 42nd Avenue @	Crashes in a 12 month period	Crash Warrant Met?	Highest Hour Int. Volume		Intersection Warrant Met?	Combined Warrant Met?
			Major	Minor		
Laurel Street	1	No	283	120	No	No
Folker Street	1	No	233	229	No	No
Wright Street	2	No	190	50	No	No
Piper Street	4	No	388	181	No	No*
Dale Street	2	No	300	154	No	No

**Meets criteria for the mid-day peak only and not 8 hours of the day*

On May 7, 2020, CRW met with MOA Traffic Engineering and PM&E to discuss existing and possible proposed all-way stop controlled intersections along the project corridor. Removing the existing all-way stop intersections will cause a change in traffic patterns and may result in additional crashes. However, existing all-way stop signs likely were installed for traffic calming measures. Stop-signs are not considered appropriate traffic calming methods. Installing un-warranted stop signs can create unsafe conditions. MOA Traffic Engineering recently collected video data of the 42nd Avenue/Folker Street intersection which shows some non-compliance of the stop signs at this intersection. MOA Traffic Engineering requested that all-way stops *not* be re-installed.

It is recommended to remove all existing all-way stop controls and install stop signs on the minor approach only. See FIGURE 8 for the recommended stop-control approaches along the project corridor.

I. Sight Distance Analysis

Adequate sight distance is necessary at intersections to allow the driver of a stopped vehicle at a minor road a sufficient view of the intersecting main roadway to decide when to enter or cross the main roadway. If the available sight distance for a minor-road vehicle is at least equal to the required stopping sight distance of the major road vehicle, then drivers have sufficient sight distance to anticipate and avoid collisions. However,

Sight distance issues on Wright Street at 42nd Avenue (viewing northwest) (photo from Google) in some cases, a major-road vehicle may need to stop or slow to accommodate the maneuver from the minor-road vehicle. Therefore, to provide safe traffic operations, intersection departure sight distances should exceed stopping sight distances along the major road.

The intersection departure sight triangles, per requirements of the DCM, have been drawn at each intersection within the project area for each alternative to determine any potential issues; see Appendix J for intersection departure sight triangles. Features listed below that hinder the sight triangle should be removed or reset to be outside of the intersection departure sight triangles where feasible. Existing light poles, utility poles, and parked vehicles are not specifically noted in the list below. Existing items within intersection departure sight triangles are:

1. Various locations: existing trees and landscaping over two feet tall.
2. 42nd Avenue and Piper Street intersection north/south views: landscape features including landscape walls and vegetation.
3. 42nd Avenue and Wright Street intersection west view: trees and landscaping.
4. 42nd Avenue and Parker Place intersection west view: dumpster.

Sight distance issues on 42nd Avenue at Piper Street (viewing northeast, photo from Google)

The landscape features at 42nd Avenue and Piper Street were installed as part of the Urban Design Commission (UDC) landscaping requirements for the Piper Street project. The MOA Planning Director reported that there should not be an issue with removing the existing landscaping that impedes the departure sight triangles and that the project is not required to go through a UDC review provided:

- Legitimate reasons for the need to remove the landscaping is documented, and
- The public is included in the process, including the community councils, Providence Hospital, and other public agencies.

New landscape plantings will be limited to areas outside of the intersection departure sight triangles. New light poles will also be located outside the sight triangles where feasible. Existing features located on private property that conflict with the intersection departure sight triangles are difficult to remove or relocate since they are outside of the ROW and not owned by the MOA. However, Title 21 requires: “sight distance triangles shall be unobstructed as required by the traffic engineer” for development (21.06.030.C.8) and “all landscaping and screening materials shall comply with the clear vision area requirements of the traffic engineer” (21.07.080.F.2.b), which requires property developers and owners to comply with clear sight distance triangles.

J. Parking Study

On-street parking needs along 42nd Avenue

Two on-street parking studies were conducted along the project corridor between Lake Otis Parkway and Florina Street. The first parking study was completed in late June 2019 and the other study completed in early November 2019. The purpose of the studies were to document the existing use of on-street parking and to approximate the demand for on-street parking along the project corridor for consideration in the design of proposed improvements. Each parking study was based upon observations from four separate site visits, documenting parked vehicles located along the roadway and within visible adjacent parking lots. Site visits were organized to include one weekday afternoon/evening and one weekend afternoon/evening.

The parking studies showed there was sufficient off-street parking for most of the project area but was almost at capacity in a few specific lots on the eastern half of the project corridor. The greatest demand for on-street parking on 42nd Avenue was between Piper Street and Florina Street. The parking studies are included in <u>Appendix H</u>.

K. Pedestrian and Bicycle Study

A total of four, twenty-four hour pedestrian and bicycle counts were collected at the intersections of 42nd Avenue/Laurel Street and 42nd Avenue/Dale Street in October of 2019. Two additional, twenty-four hour pedestrian and bicycle counts were collected at the intersection of 42nd Avenue/Folker Street in June 2020. The counts were taken during a weekday and a weekend at each intersection. <u>Table 8</u> below summarizes the 24-hour pedestrian counts and <u>Table 9</u> summarizes the 24-hour bicycle counts.

MOA Traffic Engineering has received requests to install additional crosswalk delineation (striping, signs) at the north leg of the 42nd Avenue/Folker Street intersection. Residents of the Providence Horizon House use Folker Park for outdoor recreation and thus cross Folker Street at 42nd Avenue. MOA Traffic Engineering plans to install a handicap sign on the north end of the 42nd Avenue/Folker Street intersection.

Table 8 - Pedestrian 24 Hour Counts

Intersection: 42nd Avenue @	Date	East-bound	West-bound	Total East/ Westbound	North-bound	South-bound	Total North/ Southbound
Laurel Street	Thursday, 10/03/19	*30*	*17*	**47**	*14*	*12*	**26**
Laurel Street	Saturday, 10/05/19	*13*	*3*	**16**	*20*	*8*	**28**
Dale Street	Thursday, 10/10/19	*17*	*24*	**41**	*3*	*11*	**14**
Dale Street	Saturday, 10/12/19	*9*	*33*	**42**	*7*	*14*	**21**
Folker Street	Thursday, 06/04/20	*31*	*27*	**58**	*25*	*24*	**49**
Folker Street	Saturday, 06/06/20	*29*	*30*	**59**	*13*	*8*	**21**

Table 9 - Bicycle 24 Hour Counts

Intersection: 42nd Avenue @	Date	East-bound	West-bound	Total East/ Westbound	North-bound	South-bound	Total North/ Southbound
Laurel Street	Thursday, 10/03/19	*0*	*0*	**0**	*1*	*0*	**1**
Laurel Street	Saturday, 10/05/19	*1*	*0*	**1**	*0*	*0*	**0**
Dale Street	Thursday, 10/10/19	*0*	*1*	**1**	*1*	*3*	**4**
Dale Street	Saturday, 10/12/19	*0*	*0*	**0**	*1*	*0*	**1**
Folker Street	Thursday, 06/04/20	*2*	*2*	**4**	*0*	*1*	**1**
Folker Street	Saturday, 06/06/20	*1*	*0*	**1**	*0*	*1*	**1**

L. Traffic Calming & Pedestrian Safety

Survey results from the project questionnaire (see SECTION XVI for Public Involvement) indicated that 27 out of the 41 respondents have concerns about speeding along 42nd Avenue. However, based on the existing traffic data, it appears that speeding issues are more of a community perception of speeding rather than documented speeding.

It is anticipated that the public may express concern with removing existing stop signs in conjunction with perceived concerns about speeding. Information regarding the unsafe conditions that can be created from un-warranted stop signs, data regarding current non-compliance of existing stop signs, stop signs are not proper traffic calming measures, and the use of appropriate traffic calming measures to control speed will be shared with the public.

If speeding is a concern, appropriate traffic calming measures could be installed. Traffic calming measures which may be appropriate along 42^{nd} Avenue, in order of preference from MOA Traffic, include:

1. Neckdowns and chokers
2. Raised intersections, speed cushions, etc.
3. Voluntary Speed Compliance (VSC) signs

Furthermore, the pedestrian crossing at the intersection of Folker Street and 42^{nd} Avenue could be considered to be formally identified with striping and signage. Raised intersections and speed cushions are appropriate calming measures if there are large truck counts. VSC signs are the least preferred measure due to maintenance concerns and are not recommended along the project corridor.

Potential locations for traffic calming measures are listed below. These are conceptual locations and types and may change during detailed design development. See FIGURE 8 for conceptual traffic calming types and locations.

- Locations where stop signs are removed – install a neckdown for the non-stop controlled approach (at Laurel Street, Folker Street and Dale Street)
- At Wright Street – install a neckdown for the east/west approach
- At Piper Street – re-install the neckdown and raised intersection
- Install a raised intersection at Folker Street and Dale Street

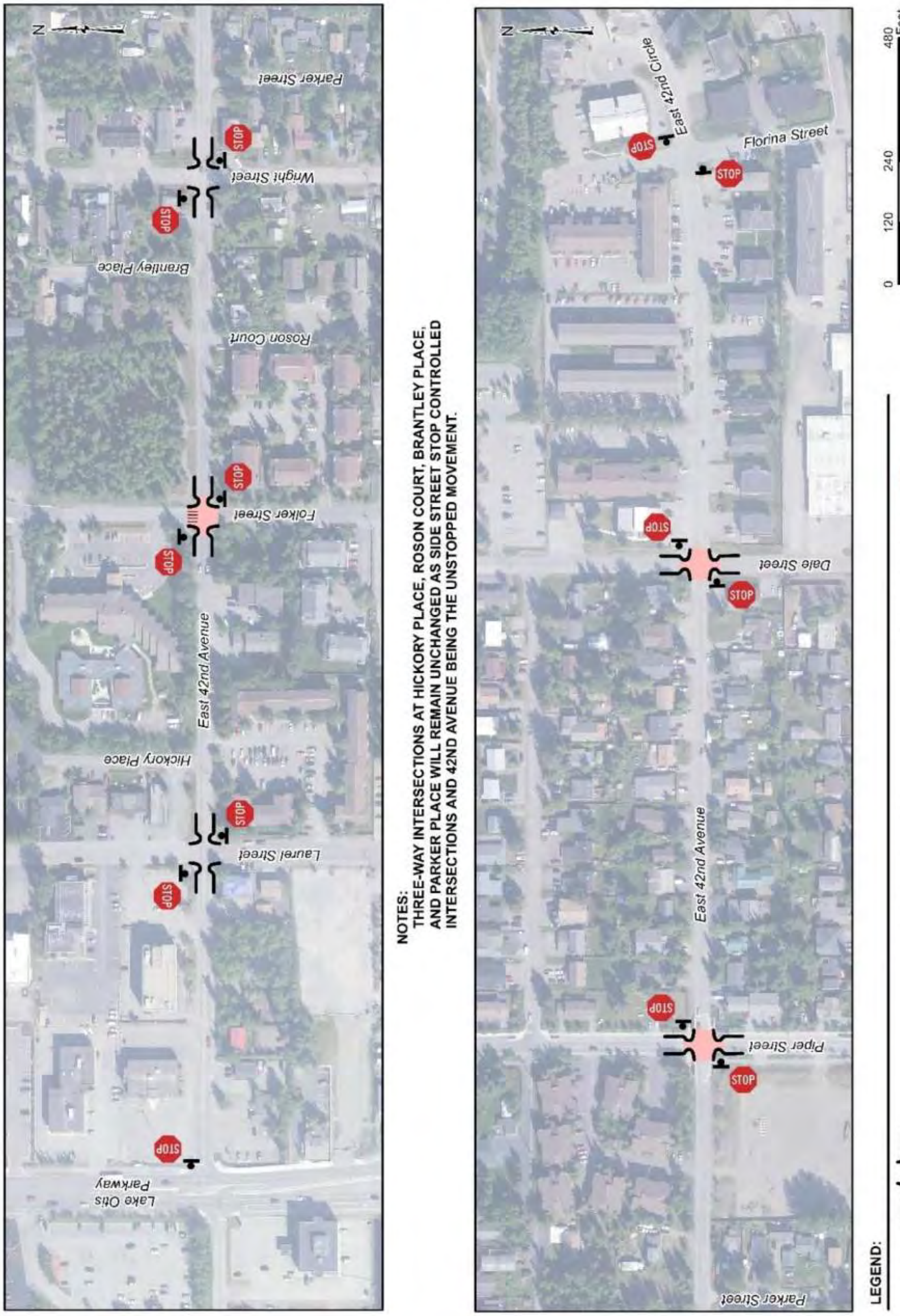


Figure 8 - Conceptual Traffic Control and Traffic Calming

VI. Design Criteria and Standards

Project design criteria are based on the roadway characteristics, functional classification, and road or facility ownership. 42nd Avenue is classified as a secondary (local) urban residential roadway and is owned and maintained by MOA. AWWU owns and maintains the water main in the project area.

A. Project Design Standards

The PM&E Design Criteria Manual (DCM) provides detailed design criteria for the development of roadways and infrastructure within the MOA. The documents listed below provide additional design guidance, standards and requirements for this project.

- Anchorage Pedestrian Plan (APP), 2007, MOA.
- Anchorage Bicycle Plan, 2010, MOA.
- Official Streets and Highways Plan (OS&HP), 2014, MOA.
- Anchorage Bowl 2020 Comprehensive Plan, 2001, MOA.
- Anchorage 2040 Land Use Plan, 2017, MOA.
- 2035 Metropolitan Transportation Plan (MTP), 2012, MOA.
- Anchorage Stormwater Manual (ASM), July 2017, MOA.
- Neighborhood Traffic Calming Policy Manual, 2016, MOA Traffic Engineering.
- Roadside Design Guide (RDG), 4th Edition, 2011, American Association of State Highway and Transportation Officials (AASHTO).
- A Policy on Geometric Design of Highways and Streets, 7th Edition (AASHTOGB), 2018, AASHTO.
- Manual on Uniform Traffic Control Devices (MUTCD), 2009 with Revisions 1 and 2, Federal Highway Administration (FHWA).
- Alaska DOT&PF Preconstruction Manual (PCM), 2019, ADOT&PF.
- Alaska Traffic Manual (ATM), 2015, ADOT&PF.
- Proposed Accessibility Guidelines for Pedestrians in Public Right-of-Way (PROWAG), 2011, United States Access Board.
- Anchorage Municipal Code Title 21 – Land Use Planning.
- A Strategy for Developing Context Sensitive Transportation Projects, 2008, MOA.
- Vision Zero Final Report, 2016, MOA.
- AWWU Design and Construction Practices Manual, 2018, AWWU.

B. Design Criteria Summary

A summary of roadway design criteria pertinent to this project can be found in TABLE 10 below. Potential deviations from design criteria are described in SECTION XVIII. Detailed lighting design criteria is discussed in SECTION VII. E.

Table 10 - Design Criteria Summary

	Criteria	Design Standard Value	Reference
Traffic Data	Functional Classification	Secondary Street: Urban Residential	OSH&P
	42nd Avenue: AADT – 2025	1,390 – 2,730 vpd	Assumed Growth
	42nd Avenue: AADT – 2045	1,620 – 3,200 vpd	Assumed Growth
	Design Vehicle	WB-50	DCM 6.4 B
	Design Structural Loading	HS 20	
	Design Speed	30 MPH	DCM Table 1-6
	Posted Speed	25 MPH	DCM 1.5.E
Horizontal Alignment	Horizontal Curve Radius, Minimum, No Super-elevation	150 ft	DCM Table 1-9
	Stopping Sight Distance, Min	200 ft	DCM Figure 1-20
	Clear Sight Triangle Length	335 ft	DCM Figure 1-19
Vertical Alignment	Vertical Grade, Maximum	6.0%	DCM 1.9.D.2.b
	Vertical Grade, Minimum	0.5% for street with curb and gutter	DCM 1.9.D.2.a
	Vertical Curve K-Value, Min Crest Curve	19	DCM Figure 1-16
	Vertical Curve K-Value, Min Sag Curve	37	DCM Figure 1-17
Cross Section	Street width (measured to back of curb)	38 ft	DCM Table 1-6
	Number of Moving Lanes	2	DCM Table 1-6
	Number of Parking Lanes	2 (depending on AADT & parking demand)	DCM Table 1-6
	Shoulder Width (No Parking Lane)	3.5 ft minimum	DCM Table 1-6
	Curb & Gutter	Type 2 (DCM) Type 1 (Title 21)	DCM Figure 1-13 Title 21.08.050.G
	Side slopes	2H:1V maximum	DCM 1.9.D.5
	Clear Zone	12 feet minimum	See SECTION VI.C.4)
	Sidewalk Requirements & Width	Both sides of roadway, 5 ft	DCM Figure 1-13, Title 21.07.060.E.2
	Sidewalk Separation from Back of Curb	7 ft (for collectors and higher classification)	DCM 4.2 H
Inter-sections & Driveways	Curb Return Radii at Side Streets	20 ft (local/local) 30 ft (local/collector)	DCM Figure 1-22
	Driveway width: up to 7-plex	14 – 20 ft; (28 ft with restrictions)	DCM Appendix 1D
	Driveway width: commercial or ≥ 8-plex	24 – 34 ft	DCM Appendix 1D
	Max driveway grade: residential	± 10%	DCM Appendix 1D
	Max driveway grade: commercial, ≥ 8-plex	± 8%	DCM Appendix 1D
	Landing grade/length: residential	± 2% for 12 ft	DCM Appendix 1D
	Landing grade/length: commercial, ≥ 8-plex	± 2% for 20 ft	DCM Appendix 1D

C. Specific Design Criteria

The appropriate street section is determined by traffic volumes and land use. The DCM classifies 42nd Avenue as a secondary (local) street. Secondary streets typically have lower design volumes and often provide direct access to adjacent lots. Based on Title 21 Land Use Zoning, 42nd Avenue is an "urban" street. Urban streets are required to include a paved surface, curb and gutter, sidewalks or trails, street lights, traffic control devices, street signs, landscaping, and storm drains.

1) Design Speed

The design speed governs various geometric features of the roadway and should be a logical speed with respect to anticipated speed limit, topography, and functional classification of the roadway. The design speed affects the length of sight distance available along the roadway's horizontal alignment and vertical profile, particularly at intersecting roadways and pedestrian facilities. As design speeds increase, longer sight distances are required to provide more reaction time and braking distance to respond to roadway obstacles.

The DCM indicates a secondary roadway with more than 1,000 Average Daily Traffic (ADT) should have a design speed of 30 MPH. Generally, the posted speed limit should be the same as the 85th percentile speed.

2) Accessibility Guidelines

The current requirements for accessibility in the MOA are based on the Americans with Disabilities Act (ADA). The project uses guidelines published in Proposed Accessibility Guidelines for Pedestrian Facilities in Public Right-of-Way, July 26, 2011 (ADA Guidelines) by the United States Access Board. A summary of some of the ADA design criteria pertinent to the project is provided below:

- R302.3 – The continuous clear width of pedestrian access routes shall be 4.0 feet minimum.
- R302.4 – Where the clear width of pedestrian access routes is less than 5.0 feet, passing spaces shall be provided at intervals of 200 feet maximum.
- R302.5 – Where pedestrian access routes are contained within a street or highway right-of-way, the grade of pedestrian access routes shall not exceed the general grade established for the adjacent street or highway.
- R302.5.1 – Where pedestrian access routes are contained within pedestrian street crossings, the running grade of the pedestrian access route shall be 5% maximum.
- R302.6 – The cross slope of pedestrian access routes shall be 2% maximum.
- R304.3 – Parallel curb ramps shall include a turning space with minimum dimensions of 4.0 feet x 4.0 feet at the bottom of the ramp.
- R304.3.2 – The running slope of the curb ramp shall be in-line with the direction of sidewalk travel and shall be 5% minimum and 8.33% maximum but shall not require the

ramp length to exceed 15.0 feet maximum. The running slope of the turning space shall be 2% maximum in any direction.

- R304.5.1 – The clear width of curb ramp runs and turning spaces shall be 4.0 feet minimum.
- R304.5.2 – Grade breaks at the top and bottom of curb ramp runs shall be perpendicular to the direction of the ramp run.
- R304.5.3 – The cross slope of curb ramps and turning spaces shall be 2% maximum.

The Public Rights-of-Way Accessibility Guidelines recognize that it is not always possible for altered elements (reconstruction of existing facilities) to fully comply with new construction requirements because of existing physical constraints. The guidelines state:

> *Where existing physical constraints make it impractical for altered elements, spaces, or facilities to fully comply with new construction requirements, compliance is required to the extent practicable within the scope of the project. Existing physical constraints include, but are not limited to, underlying terrain, right-of-way availability, underground structures, adjacent developed facilities, drainage, or the presence of a notable natural or historic feature.*

All elements included in the project that cannot meet the requirements of ADA due to technical infeasibility should be documented.

3) Roadway Cross Section

Based on the DCM, secondary urban roadways with over 1,000 ADT and houses located on both sides of the roadway should have a street width of 38 feet (measured from back of curb) with 2 travel lanes, 2 parking lanes, curb and gutter, and pedestrian facilities. The typical lane width for a local street is 10 or 11 feet depending on existing and forecasted neighborhood densities, zoning, and traffic volumes. If a parking lane is not provided, shoulders should be provided with minimum widths of 3.5 feet for urban local streets.

Per the DCM Figure 1-13, 5-foot wide sidewalks must be provided on both sides of a local street. It is preferable for the sidewalks to be separated from the roadway to provide pedestrian comfort and safety, increase intersection sight distances, and provide room for snow storage however separation is not required for a local roadway. A clear area of 7 feet beyond the back of curb is required for snow storage. The sidewalk can be considered as part of the snow storage area. Roadway sections with narrow shoulders provide little room for snow storage on the street and require snow to be temporarily plowed behind the curb. This may impede pedestrian passage on an attached sidewalk and/or buffer area during major snow events until the snow is cleared.

4) Roadway Clear Zone and Horizontal Offset

The DCM defines the roadway clear zone to be:

> *…the total roadside border area, starting at the edge of the traveled way, available for safe use by errant vehicles. The desired width of the clear zone is dependent on the traffic volume, design speed, and roadside geometry.*

The DCM references AASHTO's Roadside Design Guide (RDG) for rural conditions (i.e. no curb and gutter) but it is unclear as to the applicability of the clear zone concept to curbed urban roadways. In 2011, FHWA published on their website the following guidance regarding clear zone along curbed roadways:

> *Since curbs are now generally recognized as having no significant containment or redirection capability, clear zone should be based on traffic volumes and speeds, both without and with a curb.*

The recommended clear zone width is a function of the design speed, traffic volume, functional classification of the roadway, and the side slope of the roadway. The clear zone required for a urban roadway with a design speed of <40 MPH and an ADT of 1,500 to 6,000 is 12 to 14 feet, with a foreslope of 6H:1V or flatter.

However, the AASHTOGB, similar to the DCM, recognizes the impracticability of constructing a full clear zone in urban areas in accordance with the RDG.

> *Where establishing a full-width clear zone in an urban area is not practical due to right-of-way constraints, consideration should be given to establishing a reduced clear zone or incorporating as many clear zone concepts as practical, such as removing roadside objects or making them crashworthy.*

The typical minimum roadway cross section for a local road will meet the minimum clear zone width of 12 feet specified in the RDG (3.5-foot wide shoulder + 2-foot wide curb + 5-foot wide sidewalk + 1.5-foot wide sidewalk shoulder = 12 feet).

5) Landscaping

42nd Avenue from Lake Otis Parkway to Florina Street, is classified as a local road, therefore there are no specific design requirements for landscaping defined within the DCM. However, landscape work for this project will meet the General Considerations for Landscape Installation and Maintenance in the DCM Section 3.3. New landscape plantings will also meet the guidelines for tree and shrub placement in sight triangles found in Title 21 and the AMATS Vision Zero solutions Toolbox.

However, 42nd Avenue lies in the boundaries of the UMED District Plan, which places special emphasis on "protecting natural resources and open space, planting more landscaping, creating a unique sense of place through quality design, and physically connecting places through multi-modal transportation networks." Specific considerations from the UMED District Plan are outline in SECTION II.A.3) above.

In addition to the UMED District Plan, a 2017 Site Plan for Folker Park shows community gardens/perennial beds in the ROW on 42nd Avenue, along the south edge of the park. The existing pathway on the north side of 42nd Avenue that meanders into Folker Park could be relocated closer to the roadway to provide an opportunity to include a green infrastructure system such as a rain garden north of the pathway, designed per the 2017 Anchorage Stormwater Manual guidelines.

6) Storm Drain

A summary of the pertinent storm drain design criteria per the Anchorage Stormwater Manual (ASM) is provided below:

- Storm drain pipes shall be corrugated polyethylene pipe (CPEP) due to corrosion issues in Anchorage area.
- Minimum diameter of storm drain pipe is 12 inches.
- Minimum pipe slope is 0.3%.
- The storm drain system shall not be surcharged during the design storm event.
- At the design flow, minimum pipe flow velocity is two feet per second (fps). Maximum pipe flow velocity is 13 fps.
- Minimum depth of cover over a gravity storm drain pipe without thaw protection is four feet.
- Insulation is required for pipes if the depth of cover is less than four feet. If storm drain pipe is located under a roadway structural section and insulation is included in roadway section, additional insulation for pipe is not required.
- A thaw system is required if the depth of cover is less than three feet.
- Maximum manhole spacing is 300 feet.
- Minimum invert elevation difference across a manhole is 0.05 feet

The outfall invert elevation of a storm drain or subdrain outfall shall be the highest of the following:

- One foot above the ordinary high water surface elevation of lakes and ponds,
- One foot above the 100-year water surface elevation of regulated streams,
- One foot above the bankfull water surface elevation for non-regulated streams, or
- The highest elevation practical based on high water and the incoming pipe slope.

7) Water

The basis of design criteria for this water main improvement project is the 2018 AWWU Design and Construction Practices Manual (DCPM) and the 2015 Municipality of Anchorage Standard Specifications (MASS). Additional design criteria may be in the form of manufacturer recommendations and industry standards for design fundamentals not covered in either the DCPM or MASS.

VII. General Design Considerations

A. Complete Streets

A complete streets network is a roadway network that is safe, comfortable, and convenient for users of all ages and abilities and all modes of transportation. Complete streets should provide facilities that balance the needs of pedestrians, bicyclists, transit users, motorists, and movement of goods. A network-based complete streets approach recognizes that, while all roadway users need to be accommodated within a given neighborhood or corridor, no single street can accommodate and prioritize all transportation users at all times. Through a network-based approach, MOA can designate priority streets for a given mode to create a high quality experience for those users, while providing a high-quality facility for other modes on parallel but equally convenient routes.

B. Right-of-Way Acquisition

A key element for the successful completion of any project is the acquisition of any required ROW, easements, and/or permits while providing fair and equitable treatment to all affected property owners, tenants and lessees.

The MOA's process for residential and business acquisitions (partial or full) follows the guidelines addressed in the State of Alaska's *Acquiring Real Property for Federal and Federal-Aid Programs and Projects* brochure, the *Relocation Services for Residential Property* brochure, and the *Relocation Services for Businesses, Farms & Non-Profit Organizations* brochure. Individual parcel's acquisition details are determined on a case-by-case basis and negotiated privately between the MOA and the property owner.

In general, <u>public use easements</u> (PUE) are required in areas where the footprint of the improvements exceeds the ROW. <u>Slope easements</u> (SE) are required for areas where the cut and fill slopes are outside of the ROW and need to be maintained. <u>Storm drain easements</u> (DE) are required for drainage facilities installed on private property. <u>Temporary construction permits</u> (TCP) are required on private properties for matching new driveway grades to existing driveway grades, installation of storm drain footing services or water key boxes at the property line, and the relocation, removal or repair of improvements such as mailboxes, curbs, landscaping, fencing, and encroaching structures. <u>Temporary construction easements</u> (TCE) allow contractors temporary access onto private property to construct improvements that are within the ROW but where there is insufficient space within the ROW to conduct the work.

Property owners who have personal improvements in the ROW, such as fences, retaining walls or landscaping boulders, have the option of applying for encroachment permits for the improvements, removing them at their own expense, or allowing the corrective action be incorporated into the project design. Encroachment permits for fences, rock gardens, planters, and decorative retaining walls within the roadway clear zone are usually not granted.

C. Retaining Walls

Along the north side of 42nd Avenue, just east of Hickory Place, the terrain increases steeply and thus a retaining wall will be required to reduce the impacts from roadway grading and slopes onto private property. Retaining walls should also be installed as needed to minimize impacts to utilities, the environment, and adjacent properties.

1) Retaining Wall Types

Below is a description of the four basic types of retaining walls along with their characteristics. Some walls may be a combination of types. For example, many piling walls use anchors to reduce embedment depth and required structural strength.

Steep grades along north side 42nd Avenue, just east of Hickory Place (viewing northeast)

a) Gravity and Semi-Gravity:

Gravity and semi-gravity retaining walls rely on the mass of the wall for stability. The wall mass must be sufficient to counteract sliding and overturning forces from the retained soil in addition to adequate bearing capacity and global stability. Common types of retaining walls in this category include gabions, bin walls, modular block, mass concrete, and mechanically stabilized earth (MSE). Gravity and semi-gravity walls are “bottom-up” construction which requires temporarily removing soil behind the wall sufficiently to permit construction. For MSE walls, the reinforcement often extends horizontally into the embankment about as far as the exposed wall face is tall, however the horizontal extent increases with surcharge, hydrostatic, and seismic loads.

b) Piling:

Piling retaining walls have structures that extend significantly below grade to provide support to counteract horizontal forces from the retained soils in addition to considering global stability and structural requirements. Piling retaining structures typically consist of steel sheet piles or beams with lagging. Sheet piles are driven into the soil while beams can either be driven or drilled and set into holes. Lagging can be either timber beams or concrete panel. Frequently, the structural face of a piling wall is covered with a facade of concrete blocks or panels. These are typically more expensive retaining walls but they do allow construction with little to no removal of soil behind the wall.

c) Cantilever:

Cantilever retaining walls can be either gravity, semi-gravity, or piling type walls. Gravity and semi-gravity walls have a large effective mass due to the soil placed over a horizontal section (heel) of the wall that extends behind the wall into the soil. Gravity and semi-gravity walls are typically constructed of cast-in-place, reinforced concrete and have a horizontal leg of the structure extending back into the retained soil. The slope behind the wall typically needs to be temporarily removed during construction and can significantly increase cost on tall walls due to the required length of the heel of the wall. Cantilever walls are relatively expensive due to the work required to build concrete forms, install reinforcing, pour concrete, and provide joints between pours. The concrete needs time to cure before the soil can be replaced behind the wall. Piling cantilever walls rely on their embedment below the ground to maintain stability and typically have maximum heights of 20 feet, at which height anchors need to be included to minimize deformations.

d) <u>Anchored:</u>

Anchored (or tieback) retaining walls use horizontal elements advanced into the soil sufficiently behind the wall to counteract opposing horizontal forces from the retained soils. The anchors can vary but include soil nails, tieback cables or rods with deadman anchors, or helical piles. The anchors need to extend considerably behind the wall and potentially beyond the project limits, which can have a significant impact on buried utilities, adjacent properties, and future development.

2) Retaining Wall Design Considerations

The decision to construct a retaining wall should balance the cost of installing a retaining wall with the overall impacts to current and future utilities, construction noise and vibration, and adjacent property limits. General locations of retaining walls have been determined but the preferred wall type and extents will require further refinement during the design phase. Below are important considerations that affect the decision to provide a retaining wall and which type of wall should be constructed.

a) <u>Excavation Considerations:</u>

Gravity and cantilever retaining walls require the soil behind the wall to be temporarily removed during construction. In some cases, short slopes can be cut to near vertical for short periods of time to reduce impacts, but OSHA excavation requirements and worker safety must be considered in design. Piling walls can minimize excavation requirements thus reducing impacts to adjacent properties and structures; however, the installation of piling can result in unwanted noise or damage due to ground vibrations.

b) <u>Foundation Soils:</u>

Soils below and in front of any retaining wall require adequate strength and stiffness to resist the developed forces on the wall. Soils with low strength and high compressibility may produce excessive movement and result in poor wall performance. Gravity and cantilever retaining walls are feasible where moderate to high soil strength and stiffness is present. Where foundation soils are low strength, a piling or anchor wall should be considered, or the poor soil can be replaced.

c) Groundwater/Drainage:

Groundwater and surface infiltration needs to be removed from behind the retaining wall to reduce hydrostatic forces unless the retaining wall is designed for full hydrostatic force. The latter solution is typically uneconomical. Wall types, like gabions, are inherently porous while other types, like reinforced concrete, require weep holes to be integrated into the design to relieve hydrostatic forces from water behind the wall. In areas where substantial groundwater and glaciation is expected, a subdrain should be considered to direct the runoff to drainage ditches or a piped storm drain collection system.

d) Utilities & Structures:

Some types of retaining walls require removing or disturbing soil for a considerable horizontal distance behind the face of the wall. For example, modular block walls, MSE, and anchored walls rely on horizontal elements that may impinge on existing utilities or structures behind the wall.

e) Aesthetics:

Retaining walls are highly visible along a roadway corridor. They should be selected to complement the landscaping design and blend in with the surrounding neighborhood. Additionally, retaining walls can be targets for vandalism like graffiti.

f) Safety Fence or Handrail:

When the exposed face of the retaining wall exceeds 2.5 feet, a fence, handrail, or guardrail on top of the wall needs to be provided for safety. Where space is limited, a fence or handrail can be placed near the face of a reinforced concrete wall. Most other types of wall require the fence to be set back in the soil behind the wall with consideration given to safe fence post installation to avoid damaging any horizontal design elements behind the wall.

g) Construction Schedule and Logistics:

In some cases, the amount of time required to construct a retaining wall is critical since it can affect adjacent property owners or the construction schedule. Reinforced concrete headwalls take a considerable amount of time to construct since adequate curing time must be allowed before backfilling can occur. Pile driving can be faster, but creates more noise and ground vibration disturbance which may affect adjacent property owners. The large equipment required for pile driving may impede traffic flow.

h) Maintenance:

Retaining walls and associated fences or handrails should be designed to require little, if any, maintenance. Concrete surfaces can be coated with finishes that facilitate removal of spray paint vandalism.

i) Cost:

The estimated installed cost for retaining walls varies considerably from $45 to over $200 per square foot of the exposed vertical face. Major cost-contributing factors include soil conditions, wall height, tiebacks, construction access, type of fence, and the extent of excavation behind or below the wall for construction.

D. Mailboxes

The project corridor consists of a mixture of single residences, multi-family residences, apartment complexes, and office buildings. For the latter two, mail is delivered to secure boxes located on or within the apartment buildings or to front offices of commercial establishments. For the remainder of properties, individual mailboxes are present on both sides of the road. The project anticipates impacting these mailboxes.

Individual mailboxes along 42nd Avenue between Piper Street and Dale Street (viewing west)

Previous communication with the United States Postal Service (USPS) indicates that in order to change from individual to cluster mailboxes the following must occur:

- Every affected resident must agree to the change from individual mailboxes to cluster. If even one resident doesn't agree, the mailboxes cannot be switched to cluster style. In order to officially make the change in mail service, a signed concurrence from each owner is required.
- MOA is required to purchase the cluster mailboxes and install concrete foundations.

From past PM&E project experiences, it is very hard to gain concurrence from all affected residents, thus this project plans to re-install individual mailboxes. For individual mailboxes, if a new sidewalk is proposed, the sidewalk will need to be separated from the curb by a minimum of 3 feet so that the mailbox can be installed between the curb and the sidewalk. Individual mailboxes can be re-used where feasible. If the existing mailboxes do not meet current postal standards, they will be replaced with new boxes that meet current standards. If cluster mailboxes are elected, the design team will work with the USPS and residents to determine appropriate installation locations.

E. Lighting

Lighting systems shall be designed to the DCM's Chapter 5 criteria and enhance traffic and pedestrian safety. A properly designed lighting system will:

- Provide the minimum maintained average luminance and illuminance levels specified for roadways, sidewalks, and intersections.
- Provide a uniformity of lighting that does not exceed the maximum ratios specified for roadways, sidewalks, stand-alone pathways, and intersections.
- Minimize construction and maintenance costs.
- Avoid adverse impacts to adjacent properties.

- Reveal hazards to pedestrians and vehicular traffic.

The MOA has retrofitted many existing luminaire poles with luminaires that use LEDs as the light source and new roadway projects with lighting improvements now incorporate LED lighting into the design. The new proposed LED lighting system for this project will be designed to provide the light levels specified in the DCM as summarized below:

1) Roadway (not including intersections):

For a local roadway with medium pedestrian activity, the DCM recommends a minimum maintained average of 0.7 foot-candles with an average-to-minimum uniformity ratio no greater than 6:1 and a veiling luminance ratio no greater than 0.4.

2) Pedestrian Facilities:

It is anticipated that pedestrian activity along the project roadways will be in the medium range per Chapter 5 of the DCM. For adjacent pedestrian facilities within the medium pedestrian volume criteria, the DCM requires a minimum maintained average of 0.5 foot-candles with an average-to-minimum uniformity ratio no greater than 4:1.

3) Intersections:

For the purpose of lighting intersections, the DCM uses the following roadway classifications based upon the ADT (note these do not apply to standard MOA DCM street classifications):

- Major: over 3,500 ADT
- Collector: 1,500 to 3,500 ADT
- Local: 100 to 1,500 ADT

Below, in TABLE 11, is a summary from the DCM of lighting for intersections. This table will be used to design lighting improvements at the project intersections. Intersection lighting classifications for the project intersections will be based upon the design year ADT as stated in SECTION V.B.

Table 11 - Illuminance for Intersections (MOA DCM Table 5-5)

Functional Lighting Classification	Average Maintained Illuminance (low pedestrian area)	Maximum Uniformity Ratio
Major/Major	2.6	3.0
Major/Collector	2.2	3.0
Major/Local	2.0	3.0
Collector/Collector	1.8	4.0
Collector/Local	1.6	4.0
Local/Local	1.4	6.0

The luminaires will also provide a full cutoff light distribution to reduce the negative effects of casting light on nearby properties (especially residences) and illuminating the night sky. To minimize the trespass of light on adjacent properties and reduce glare, luminaires are to be installed 30 feet above the pavement and fixtures in certain areas should have backlight control optics.

All luminaire poles and light fixtures within the project area will be removed with the exception of the two luminaire poles at Piper Street. A new continuous lighting system with LED luminaires will be installed to meet minimum illumination requirements.

F. Landscaping

The overall goal of the landscape design is to limit impacts to existing vegetation where feasible and provide new landscape amenities where space allows. The existing ROW provides limited room for new landscape improvements in some segments.

Landscape design considerations for this project will include the following where possible within the ROW:

- Green Infrastructure stormwater system south of Folker Park (see discussion below)
- Landscape amenities that reference the design language and design guidelines of the UMED district, such as using native species in the landscape design, providing decorative fall protection fencing at retaining walls similar in color and style to other landscape amenities in the area (e.g., existing fall protection railing along E. 40th Ave near Piper Street), and providing trail wayfinding signage where appropriate
- Protection of existing mature trees in the ROW and on private property adjacent to the proposed improvements, wherever possible
- Proper sizing and placement of planting beds for tree health
- Protection of new plantings from moose grazing
- Selection of plant material that is appropriate to the application, neighborhood aesthetics, expected maintenance, and site microclimate

An opportunity to include a green infrastructure system for treatment and temporary retention of stormwater runoff from the pathway north of 42nd Avenue at Folker Park will be explored during detailed design. FIGURE 9 is a conceptual section of one type of rain garden that could be used to capture stormwater from the

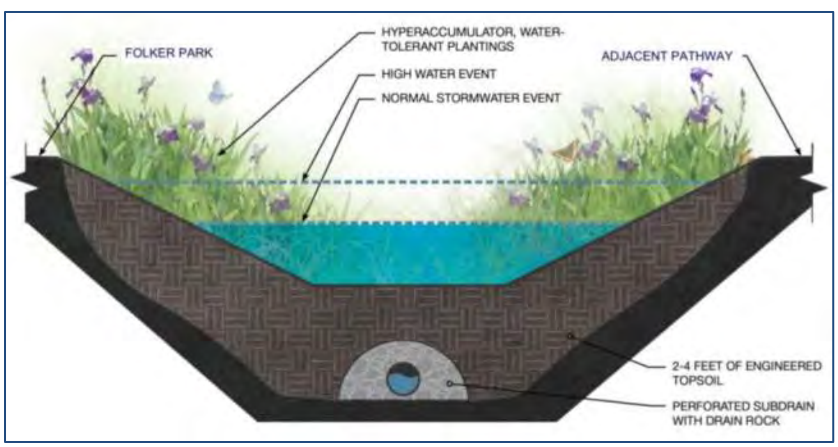


Figure 9 - Example rain garden with vegetative swale

adjacent pathway. The existing pathway on the north side of 42^{nd} Avenue that meanders into Folker Park could be relocated closer to the roadway to provide a space for a rain garden and not disturb existing park trees and infrastructure. Hyper-accumulator, water-tolerant plants will help capture pollutants and sediment before they enter the stormwater system. Bioswales also help reduce the stormwater runoff volume and flow rate, which eases the burden of a large rain event on the downstream facilities. Long-term performance of the rain garden will be contingent on performing on-going maintenance. MOA Parks and Recreation Department has expressed positive support for the rain garden concept and is interested in maintaining it. A memorandum of agreement will need to be established for Parks to maintain the rain garden if it is installed. The rain garden design will be closely coordinated with MOA Parks and Recreation Department and the MOA Watershed Management Department in selection of plants and layout.

Additional landscape design considerations will include proper placement of new plant materials to account for snow storage and clearing within the ROW. Placement of new planting will also adhere to requirements for clear sight lines at intersections per AMATS Vision Zero goals for transportation safety.

G. Nonconformities

MOA Code of Ordinances Title 21.12 defines “nonconformities” as legal uses, structures, lots, or signs established prior to the effective date of the current title, or future amendments to the current title, that don’t conform to the requirements of the current title. The acknowledgement and relief granted to existing property, land uses, and structures are intended to minimize negative economic effects on development that was lawfully established prior to the current title. In all cases, the burden of establishing the existence of a legal nonconformity is solely the responsibility of the owner of the nonconformity. Verification of nonconforming status can be requested by the owner or on behalf of the owner by submitting a Nonconforming Determination application along with supporting documentation to the MOA Planning Department for a determination.

Improvements made to the structure or lot that require a permit from Building Safety may require dedicating a portion of the construction cost to bring the affected areas towards compliance with current codes. However, if improvements do not require a permit, the area is not subject to upgrading to current standards. For example, per current code, improvements to lots that place fills (including pavement) less than 1 foot in depth, on natural terrain with a slope flatter than 5H:1V, and do not obstruct drainage courses do not require a building safety permit.

Two parcels along the project corridor have previously established nonconforming status. TABLE 12 below provides a summary of these existing parcels and the relevant nonconformities (see FIGURE 5 and FIGURE 6 for the parcel location map). Some of these parcels also may have additional nonconforming features associated with the lots that have not yet established nonconforming status, including:

- Driveway widths exceed two-fifths of the frontage of the lot.
- Parking and maneuvering not entirely located on property.
- Vehicles not able to enter abutting street in forward

Depending on the preferred design, these additional nonconformities may need to be established in order to construct the proposed project improvements and not negatively impact current development. Since the MOA is making improvements to the ROW with this project, the project team will work with the owners of the lots in order to gain approval from them to submit a Nonconforming Determination application on their part. The MOA Planning Department will review the application and determine whether a property has valid nonconformities. Once the nonconforming uses have been established, the design team will work with the MOA Traffic Department in order to provide the safest possible roadway design.

Table 12 - Summary of Nonconforming Uses

Parcel No.	Year of Nonconforming Status Determination	Nonconformity
101	2017	• The office building encroaches 1.3' into the required 10' north side yard setback. At the time of construction, a side-yard setback required 5' and this encroachment is a legal non-conformity. • The lack of continuous pedestrian access from the street to the primary entrance is a legal non-conformity. • The lack of interior parking lot landscaping and additional perimeter landscaping at the east and south perimeters are legal non-conformities.
156	2018	• The existing dwelling encroaches 2.2' into the required 5' south side yard setback. The dwelling was constructed prior to the effective zoning of this parcel and this encroachment is a legal non-conformity. • The gravel driveway was constructed prior to the requirements for paved driveways and is a legal non-conformity • Note: encroachment of the shed 2.4' into the required 20' west primary set back and 3.8' into the required 5' south side setback is NOT a legal non-conformity as the shed was constructed after the effective zoning date of the parcel and is in violation of Anchorage Municipal Code 21.06.020

VIII. Project Alternatives

The 42nd Avenue project corridor has 11 street intersections (including Lake Otis Parkway and Florina Street) and serves 70 parcels. Roadway plan and profile drawings depicting alternatives for upgrades to the project and the locations of individual parcels can be found in Appendix B.

A. Design Challenges

1) Buffers

Buffers between curb and pedestrian and/or bicycle facilities are desirable to provide better separation from moving vehicles and provide a space for plowed snow to be stored during winter. Ideally, pedestrian facilities are separated from the back of curb by a 7-foot wide buffer space to maximize separation from the travelled way and available space for snow storage. However, limited right-of-way, existing utilities, close spacing of driveways, impacts to existing infrastructure, and existing buildings set close to the property line limit the areas where wide buffers can be provided without acquiring easements, moving infrastructure, and/or relocating utilities.

Residents may perceive the existing grassed ROW area in front of their house as part "of their front yard." Expanding the improvements to include buffers may be perceived as impacting private property. Some private improvements also extend into the ROW. At driveway crossings, it is ideal for the pedestrian facility to be within at least 3 feet of the back of curb for increased visibility to drivers exiting or entering the driveway.

2) Full Frontage Driveways and Parking

The lack of curb and gutter and the existing rolled (Type 2) curb along 42nd Avenue between Dale Street and Florina Street allows for full frontage access to on-property parking. Installation of barrier (Type 1) curb along the roadway will limit property access to driveway curb cut locations and could affect the ability for property owners to access parking spaces.

Several properties appear to have nonconforming rights, based on the year of construction; this may allow the parcel to maintain full-frontage access, lack of on-site parking, and/or lack of on-site maneuvering. These properties were reviewed for conformance to Anchorage Municipal Code (AMC) Title 21 parking requirements and DCM driveway requirements. Properties were analyzed against current requirements to see if an expanded corridor footprint may reduce available on-site parking stalls and/or result in a non-compliant property. Parcels where full-frontage access, full frontage parking, and/or available parking areas are a concern are described below in Table 13:

Table 13 - Property Summary for Potential Nonconformities

Parcel No.	Construct-ion Year	Item not to current MOA Code
101	1976	Driveway width
103	1983	Driveways widths
108	1972	Driveway width; no on-site maneuvering
113	1975	Driveway width
114	1999	Driveway width
116	1982	Driveway width
118	1973	Driveway width
119	1978	Driveway width
121	1972	Driveway width
122	1961	Driveway width
123	1995	Driveway width
124	1986	Driveway width; no on-site maneuvering
126	1971	Required parking spaces; driveway width; no on-site maneuvering
127	1978	Driveway width
128	1973	Driveway width
129	1976	Driveway width
132	1978	Required parking; driveway width
133	1974	Driveway width
138	1977	Driveway width; no on-site maneuvering

Parcel No.	Construct-ion Year	Item not to current MOA Code
134	1974	Driveway width; no on-site maneuvering
137	1977	Driveway width; no on-site maneuvering
138	1977	Driveway width; no on-site maneuvering
139	1971	Driveway width
140	1971	Driveway width
141	1965	Driveway width
144	1974	Driveway width
147	1974	Driveway width
148	1974	Driveway width
151	1995	Driveway width
152	1957	Driveway width
153	1964	Driveway width
156	1953	Driveway width
161	1983	Number of Driveways
163	1976	Driveway width; no on-site maneuvering
164	1998	Driveway width
171	1970	Driveway width
172	1976	Driveway width

3) Driveway Grades and Landings

There are 75 existing driveways/access areas along the project corridor. Driveways will need to be reconstructed to match into the proposed roadway design grades. The length of driveway improvements will depend on the proposed grade adjustments required at each driveway. Proposed conceptual driveway grades were analyzed for the preferred alternative only and are summarized along with existing grades in Appendix M. Proposed conceptual plan view driveway locations and reconstruction limits are shown on the roadway plan and profile drawings in Appendix B.

Many driveways do not have the DCM required landings and have relatively steep grades (9-14%) up to the existing parking lots or structures. Proposed improvements will widen the roadway and install pedestrian facilities that are ADA compliant (2% max cross slope). Where pedestrian facilities cross driveways, the ADA compliant pedestrian facility will function as a partial driveway landing. The proposed driveway grades shown in Appendix M reference the grade beyond the pedestrian facility.

4) Driveway Curb Returns and Curb Cuts

There are a variety of existing driveway access types along the project corridor including full frontage access, unrestricted rolled (Type 2) curb access, and paved driveway approaches without curbs.

The MOA DCM requires curb returns be installed at driveways accessing commercial buildings, including 8-plex residential structures and greater. For driveways to residential structures up to 7-plex, either curb cuts or curb returns can be installed. Curb returns allow for vehicles to travel into/out of driveways at a higher speed. However, curb returns prevent a continuous gutter/concrete flow path for stormwater drainage across the driveway, compared to curb cuts that construct continuous curb and gutter across the driveway. The curb cuts also promote positive drainage across the driveways, which will be critical along some sections of the corridor that have longitudinal roadway grades less than 1%.

Curb returns are proposed to be installed at commercial structures, including 8-plexes and greater. However, many of the parcels were constructed prior to the current AMC codes and DCM that require curb returns and also restrict driveway widths. Curb cuts and/or full-frontage driveways may be required at these parcels, as discussed above, if the curb returns restrict access to required parking and if the parcel has a nonconforming right.

Between Piper Street and Dale Street, the existing roadway has no curb and gutter and the adjacent parcels are closely spaced single- and multi-family units (up to four-plex). There is insufficient space to construct a barrier (Type 1) curb with curb cuts for these closely spaced driveways and thus a rolled (Type 2) curb is proposed along this section to provide access to the parcels. Roadway cross sections are discussed in more detail in the following section.

5) Other Design Challenges

Roadway grades are typically flat, as low as 0.1% percent in some locations. Roadway improvements will require forced high and low spots to facilitate adequate drainage. Grading beyond the roadway improvements may be a challenge with the forced high spots combined with the addition of curb and gutter.

The limited ROW and adjacent developed parcels make for incorporating GSD elements difficult along the project corridor.

B. Roadway Cross Sections

The standard cross section for a Secondary Urban Street has two detached 5-foot sidewalks and the roadway width varies depending on the ADT, as shown below in TABLE 14.

Table 14 - Secondary Urban Street Design Values

AADT	Street Width[1]	Number of Lanes		Shoulder Width	Curb & Gutter Type	Pedestrian facilities[4]	Design Speed (mph)
		Moving	Parking[2]				
301 – 1,000	33’	2 – 11’	1 – 7’	3.5’	Type 2[3] (rolled)	5-foot wide, both sides	25
> 1,000	38’	2 – 10’	2 – 7’	3.5’	Type 2[3] (rolled)	5-foot wide, both sides	30

1. Street width is measured from back of curb to back of curb.
2. When off street parking is utilized, the parking lane may be eliminated and the street width reduced. Minimum 3.5’ shoulder sections are required if parking is eliminated.
3. Anchorage Municipal Code 21.08.050.G requires the use of vertical, Type 1 curb and gutter.
4. Anchorage Municipal Code 21.07.060.E.2 also requires sidewalks to be installed on both sides of all streets in Class A zoning districts. This area falls under Class A per 21.08.050.B, Table 21.08-1.

A parking study was performed to determine on- and off-street parking demand, as discussed above. The parking studies are included in APPENDIX H. To accommodate any on-street parking needs but not designate parking lanes, no roadway traffic markings are proposed along the project corridor for any of the alternatives. This effectively allows use of the full roadway width for travel lanes and parking.

Two different typical cross section alternatives were developed for each of the four segments along the project corridor. Due to the similar context and access requirements along Segment A (Lake Otis Parkway to Laurel Street) and Segment B (Laurel Street to Piper Street), Segments A and B have been combined. All alternatives are described in more detail below.

1) Segments A & B – Lake Otis Parkway to Piper Street

This segment of roadway has projected (2045) traffic volumes over 1,000 vehicles per day and the observed 85th percentile speed is 27 mph. There was no observed on-street parking within this segment during the parking studies.

a) Alternative 1 (preferred):

Full frontage access to businesses (Parcel 101)

This alternative includes two, 10-foot wide travel lanes with 3.5-foot wide shoulders and barrier (Type 1) curb and gutter for a total roadway width (measured from back of curb) of 31.0 feet (see FIGURE 10). An 8-foot wide paved pathway is proposed on the north side of the roadway and a 5-foot wide concrete sidewalk is proposed on the south side of the roadway. The non-motorized facilities would be detached from back of curb where feasible.

Driveway access would be by curb return (commercial, including 8-plex and greater) or curb cut (residential, including 7-plex and below). Exceptions to this are listed below. For all alternatives a rolled (Type 2) curb will be proposed for curb cut driveways that exceed 2/5th's of the lot frontage to provide more protection of the sidewalk than the standard Type 4 curb cut:

- Parcel 172: the primary driveway to P172 would include curb returns, but the secondary driveway access, located along the eastern property line, would be a curb cut. The curb cut will also be a shared driveway to access the residential Parcel 171.
- Parcel 163: installing a curb return would reduce the required on-site parking and thus a curb cut is proposed for P163. The driveway width would also exceed 2/5th's of the lot frontage.
- Parcel 161: the primary driveway to the parking lot located on P161 would include curb returns. This parcel contains two structures, each with an underground parking garage with direct access to 42nd Avenue. The driveways to access the parking garages would be curb cuts. This parcel would have three driveways.
- Parcel 108: Installing a curb return would reduce the required on-site parking and thus a curb cut is proposed for P108. The driveway width would also exceed 2/5th's of the lot frontage.

Full frontage access to 4-plex structure (Parcel 108)

b) Alternative 2:

This alternative includes two, 10-foot wide travel lanes with a 3.5-foot wide shoulder on the north side and a 7-foot parking lane on the south side and rolled (Type 2) curb and gutter. The total roadway width (measured from back of curb) of Alternative 2 is 34.5 feet. Two, 5-foot wide concrete sidewalks would be attached to the back of curb on both sides of the roadways. Driveway access would be designated through pavement but could not be enforced as rolled (Type 2) curb allows for full-frontage access.

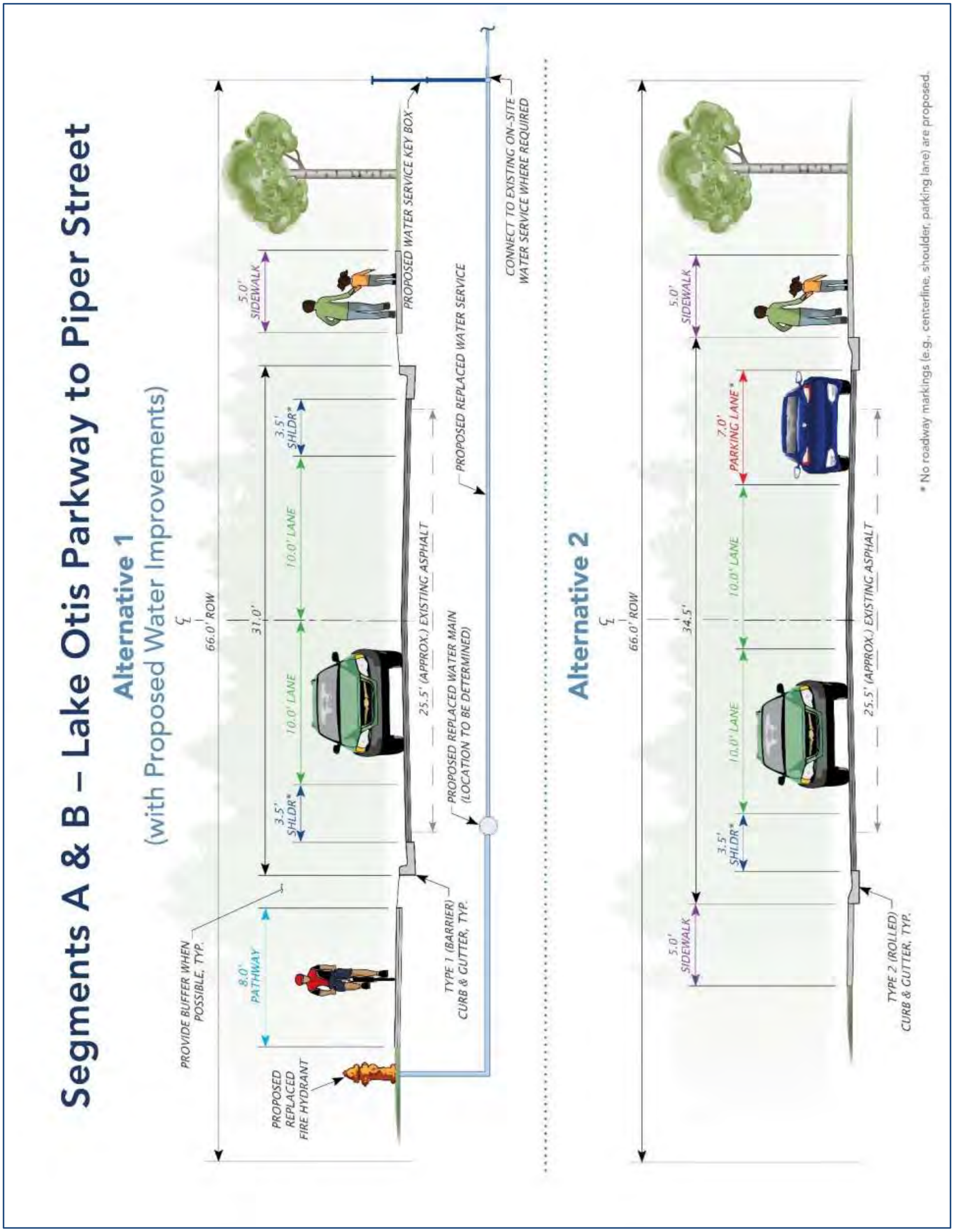


Figure 10 - Segments A and B Typical Cross Sections

2) Segment C – Piper Street to Dale Street

This segment of roadway has projected (2045) traffic volumes over 1,000 vehicles per day and the observed 85th percentile speed is 25.5 mph. Parking studies indicate there is on-street parking demand along this segment.

c) Alternative 1 (preferred):

This alternative includes two, 10-foot wide travel lanes with a single, 7-foot wide parking lane along the south side of the roadway and rolled (Type 2) curb and gutter for a total roadway width (measured from back of curb) of 31.0 feet (see FIGURE 11). No roadway traffic markings are proposed, effectively allowing parking along either side of the roadway. Pedestrian facilities would consist of 5-foot wide concrete sidewalks along both sides of the roadway. The sidewalks would be separated from the back of curb with a 3-foot buffer in order to provide space to install the individual mailboxes.

Rolled (Type 2) curb and gutter is proposed due to the close spacing between the wide residential driveways along this segment as there is insufficient room to construct barrier (Type 1) curb with curb cuts at each driveway. The wider driveways are most likely allowed non-conformities based on the date of construction of the property; driveways would be reconstructed to match existing widths. Driveway access would be designated through pavement but could not be enforced as rolled (Type 2) curb allows for full-frontage access.

d) Alternative 2:

This alternative is identical to Alternative 1, except that the travel lanes would be 11 feet wide for a total roadway width (measured from back of curb) of 33.0 feet.

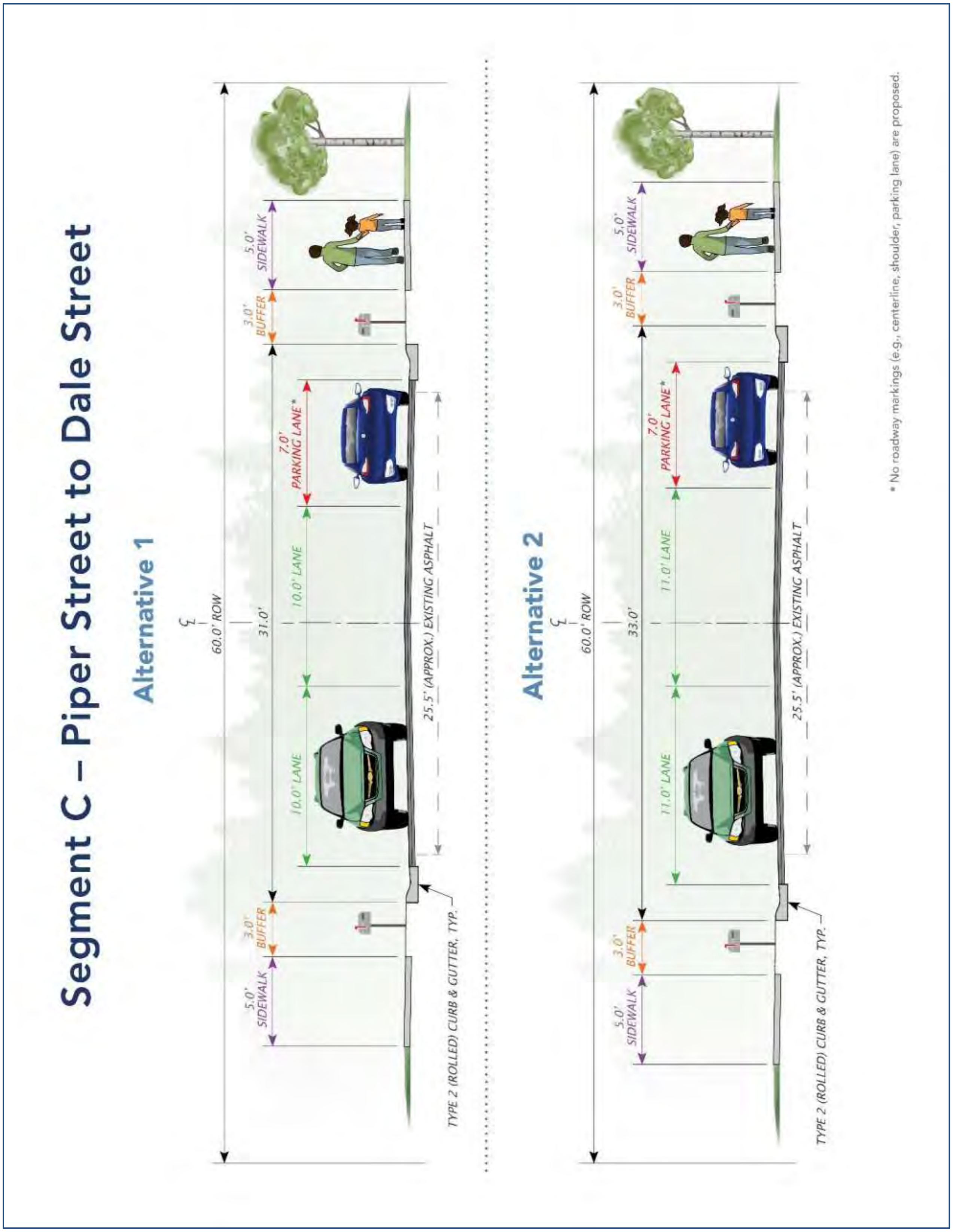


Figure 11 - Segment C Typical Cross Sections

3) Segment D – Dale Street to Florina Street

This segment of roadway has projected (2045) traffic volumes over 1,000 vehicles per day and the observed 85th percentile speed is 25.5 mph. Parking studies indicate there is on-street parking demand along this segment.

Full frontage access along 42nd Avenue between Dale Street and Florina Street

a) Alternative 1 (preferred):

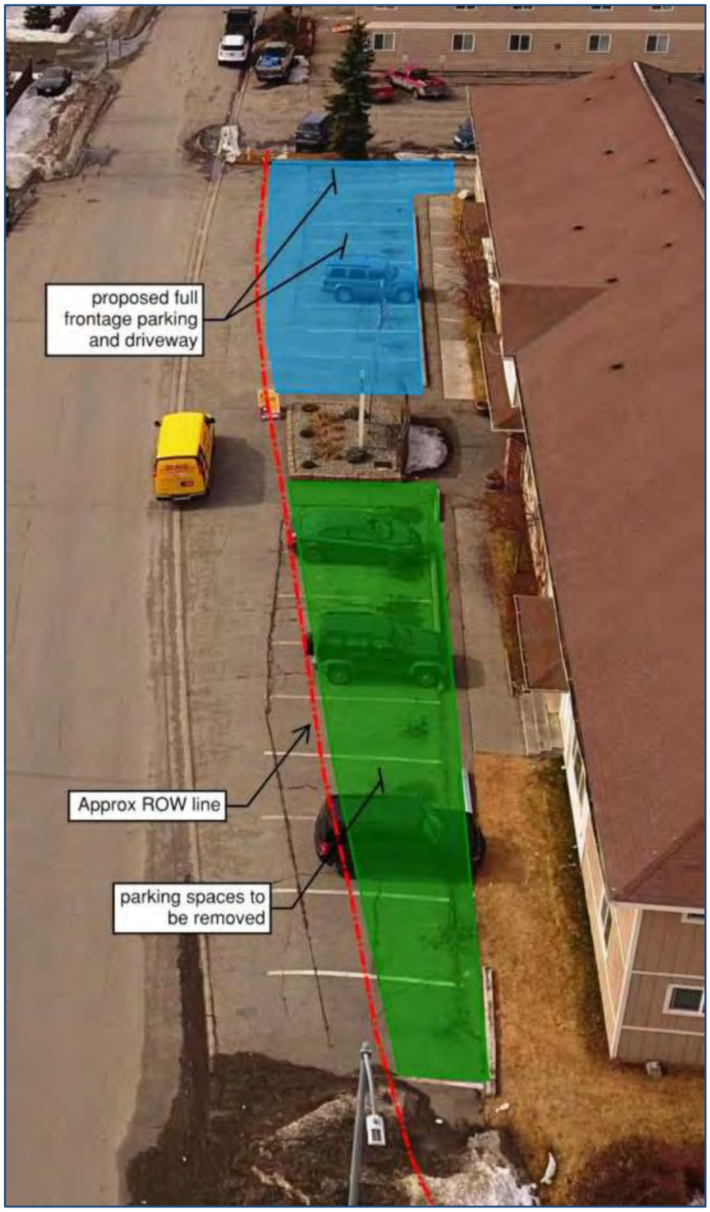
This alternative includes two, 10-foot wide travel lanes with 3.5-foot wide shoulders and barrier (Type 1) curb and gutter for a total roadway width (measured from back of curb) of 31.0 feet (see FIGURE 12). Pedestrian facilities would consist of attached 5-foot wide concrete sidewalks along both sides of the roadway.

Driveway access would be by curb return (commercial, including 8-plex and greater) or curb cut (residential, including 7-plex and below). Exceptions to this are listed below:

- Parcels 140 and 139: these parcels may have nonconforming rights for driveway widths. Curb cuts would be installed and the width is proposed to be reduced to current standards, as this does not prevent access to required parking.
- Parcels 138, 137, 134, 133, and 132: these parcels may have nonconforming rights for driveway widths. Curb cuts would be installed and the driveway widths will exceed 2/5th's of the lot frontages.
- Parcel 129: this parcel may have nonconforming rights for driveway width. A curb cut would be installed and the driveway width will exceed 2/5th's of the lot frontage. In addition, this parcel currently utilizes the ROW for designated on-site parking. Parking spaces in the ROW would be removed and no driveway access would be designated at this location.
- Parcel 127: this parcel may have nonconforming rights for driveway width. This parcel currently utilizes the ROW for designated on-site parking. Parking spaces in the ROW would be removed and no driveway access would be designated at this location.

b) Alternative 2:

This alternative includes two, 11-foot wide travel lanes with a single, 7-foot wide parking lane along the south side of the roadway and rolled (Type 2) curb and gutter for a total roadway width (measured from back of curb) of 33.0 feet. No roadway traffic markings are proposed, effectively allowing parking along either side of the roadway. Driveway access would be designated through pavement but could not be enforced as rolled (Type 2) curb allows for full-frontage access.



Parcel 129: parking in ROW

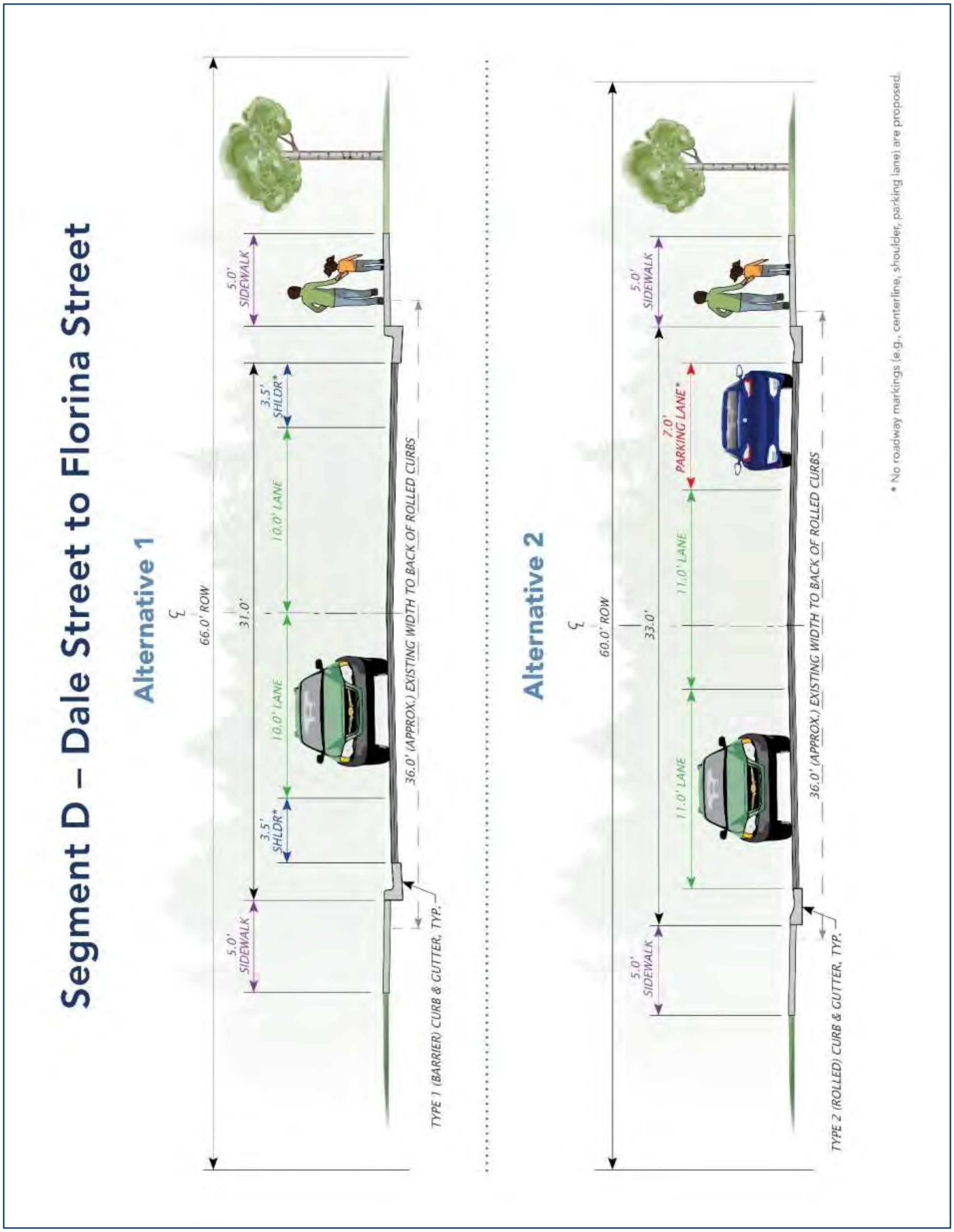


Figure 12 - Segment D Typical Cross Sections

C. Horizontal Alignment

The existing roadways within the project corridor are generally centered on the existing ROW centerlines with the exception of some of the side streets. The side streets that are not centered in the ROW are: Hickory Place, Roson Court, and Brantley Place. The proposed roadways will be typically centered within the ROW, however during design development the proposed roadway centerline locations may be adjusted to balance improvements within the ROW and limit impacts to adjacent properties and utilities.

D. Vertical Alignment

The overall intent of the roadway profile is to maintain adequate grades for drainage along the project corridor while minimizing adverse effects on surrounding driveways, side streets, and infrastructure. The more the proposed roadway grade is changed from the existing grade, the more the cut and fill slopes will impact adjacent properties. Driveways and side streets must also be adjusted to match the new roadway grades. The proposed conceptual roadway profiles for each Alternative are shown in APPENDIX B. During design development the proposed profiles will be iteratively modified in more detail to provide a well-balanced design that minimizes impacts to adjacent properties and provides acceptable driveway grades.

The existing roadway grades in the project area are generally very flat, between 0.1% and 0.8% with the exception of one hill, with a grade of approximately 4.0%. While flat grades can be beneficial for matching side street and driveway slopes and minimizing impacts to adjacent properties, it can cause drainage issues and ponding. To ensure adequate grades for positive drainage, alternate low and high spots will be built into the roadway profile, with drainage inlets installed at the low points to catch surface drainage.

E. Design and Posted Speed

Based on comments from local residents, speeding is a concern along 42nd Avenue and could potentially worsen as the roadway is improved. The project aims to not make speeding worse upon completion of the proposed project. In order to minimize speeding along the corridor, conceptual traffic calming measures have been incorporated into the design as previously discussed. The proposed design/posted speed will match the current posted speed of 25 MPH. The lower design speed allows for the vertical curves proposed along the alignment to better match into the existing topography and ROW.

IX. Drainage Improvements

The condition assessment and drainage analysis discussed in SECTION III identified a number of deficiencies in the existing storm drain systems within the project limits, as well as contributing systems beyond 42nd Avenue. One of the primary goals for this project is to improve drainage and correct any issues within the project corridor.

The proposed drainage improvements consist of the following:

- Replace aging 42nd Avenue (West) system to align with new roadway improvements and maintain separation distance from proposed water main from Lake Otis Parkway to Laurel Street
- Extend 42nd Avenue (West) system with new piping from Laurel Street to Parker Place to provide continuous storm drain system
- Upgrade outfall pipe to open channel ditch/Fish Creek headwaters at Lake Otis Parkway and 42nd Avenue to accommodate future improvements to connecting subsystems
- Remove sediment from open channel ditch/Fish Creek headwaters and replace 2 downstream driveway culverts
- Replace aging 42nd Avenue (East) system from Piper Street to Florina Street to accommodate current design storm and improve overall surface drainage
- Install catch basins at new roadway low points and other low lying areas to alleviate ponding issues
- Replace catch basins and leads as required to match new curb and gutter
- Provide positive roadway drainage to minimize ponding
- Provide water quality treatment for storm runoff
- Provide freeze protection for storm drain systems

The proposed storm drain configuration as described below is shown on the plan and profile sheets in APPENDIX C.

A. Hydrologic and Hydraulic Model Results

A hydrologic and hydraulic (drainage) model was developed for the proposed storm drain conveyance system, similar to the existing conditions drainage model. The purpose of the proposed drainage model is to properly size the new stormwater system and correct any issues identified in the existing system. The two primary systems that will be upgraded are the 42nd Avenue (West) system from Lake Otis Parkway to Parker Place, and the 42nd Avenue (East) system from Piper Street to Florina Street. Improvements to adjacent and/or connecting storm drain systems previously discussed that are outside of the project limits will not be upgraded as part of this project.

A total of 45 contributing catchments were delineated and evaluated for runoff response for the proposed condition. The majority of contributing catchments within the project boundaries were adjusted in size to account for the addition of new inlets planned along 42nd Avenue. For example, the five existing catchments (C-2.1 to C-2.5) delineated for the 42nd Avenue (East) system were subdivided into seven new catchments (C-2.1 to C-2.7) in the proposed model to better evaluate the overall effectiveness of the proposed system.

Peak runoff and pipe flows at key locations for the proposed drainage systems are reflected in FIGURE 3.A, APPENDIX F. The complete SSA modeling results can also be found in APPENDIX F.

Note that several pipe segments outside the project boundary are still experiencing surcharging conditions in the proposed model results. This has not changed from the existing condition model. However, since many of these subsystems contribute runoff to the proposed 42nd Avenue (West) system, a separate drainage analysis was prepared to correctly size the pipe segments within the project corridor in the event these contributing subsystems are upgraded in the future. The proposed model results in APPENDIX F incorporates the pipe sizes along 42nd Avenue required for these potential future upgrades outside the project limits.

B. Replace 42nd Avenue (West) System – Lake Otis Parkway to Laurel Street

The majority of existing storm drain pipe from Lake Otis Parkway to Laurel Street is constructed of CMP. Some of this pipe was assessed using CCTV and was found to be in fair condition. However, much of it was not assessed knowing that the CMP pipe was nearing the end of its design life and will be replaced regardless of current condition. In addition, the existing pipe along this segment of roadway is undersized to convey the design storm event. Pipe and structures along this stretch of roadway will be removed and replaced.

The proposed storm drain pipe for this segment of 42nd Avenue ranges in size from 30-inch to 48-inch corrugated polyethylene pipe (CPEP) at the outfall. To meet separation distance from the water utility, the main line pipe will be relocated from the north side of 42nd Avenue to roadway centerline. Type II manholes will be installed for main line pipe, with connecting catch basins located to the north and south to intercept curb flow. Several field inlets are also required at low points behind the proposed pedestrian facilities to capture runoff from adjacent low lying properties.

The current outfall pipe discharges stormwater runoff into an open channel ditch/Fish Creek headwaters located on the west side of Lake Otis Parkway. Over time, sediment from runoff has accumulated in the ditch resulting in a partially buried outfall pipe. This sedimentation decreases the overall capacity of the ditch and outfall pipe. To alleviate these issues, it is recommended that the deposited sediment in the open channel be removed and the ditch be regraded to provide positive and continuous drainage to the west. Once these improvements are made, the open channel ditch will be able to convey the 10-year design storm. It should be noted that at peak flow, the ASM requirement of one-foot minimum of channel freeboard will be exceeded in the most western ditch segment, but overtopping of the ditch is not anticipated based on modeling results. Two 36-inch CMP driveway culverts are located in this ditch downstream of the outfall that have a significant amount of sedimentation, as well. These culverts were determined to be undersized to convey the 10-year design storm event in the existing conditions model. It is recommended that these culverts be replaced with CPEP culverts, which have better flow characteristics than CMP and do not corrode. Due to existing driveway elevation constraints it will be difficult to upsize the driveway culverts to be larger than the existing. While 36-inch CPEP culverts are also slightly undersized to convey the design storm, they are a significant improvement over the CMP culverts and will help alleviate the tailwater conditions at the outfall pipe. Another option that will be considered during the design phase is replacing the CMP driveway culverts with arch pipes to maximize flow capacity and meet the 10-year design flow. Additional analysis will be required to determine if the arch pipe can be accommodated within the regraded ditch.

As noted in SECTION III, a third culvert downstream and to the west of the two driveway culverts discussed above is located in University Park, just upstream of the wetland boundary. This culvert is almost entirely filled with sediment and thus impeding flow to the west. This impediment is likely the primary cause for water backing up into the ditch and submerging the outfall on the west side of Lake Otis Parkway. While this culvert is outside of the project limits, additional investigation and coordination with MOA Parks & Recreation and WMS is warranted to determine whether the culvert should be removed or upgraded. This work, in conjunction with the ditch and driveway culvert upgrades mentioned above, would alleviate the tailwater conditions and sedimentation issues occurring in the area.

Additional survey points were shot along Fish Creek, downstream of the open channel ditch along 42^{nd} Avenue and at the Fish Creek culvert crossing beneath Tudor Road. The purpose of the additional survey was to determine if the open channel ditch/Fish Creek could be re-graded to provide an elevation drop between the outfall located on the west side of Lake Otis Parkway and the open channel ditch bottom. This would also possibly help alleviate any issues with raising the 42^{nd} Avenue roadway grade within the flood plain by providing more downstream capacity during large storm events. The survey points were analyzed and found that the existing open channel ditch/Fish Creek west of the outfall is very flat, with slopes ranging from 0.08%-0.35%. It will not be possible to regrade the open channel ditch/Fish Creek to provide an elevation drop at the outfall pipe as desired.

C. Extend 42^{nd} Avenue (West) System – Laurel Street to Parker Place

There is currently no storm drain infrastructure extending along 42^{nd} Avenue from Laurel Street to Piper Street, aside from catch basins connected to subsystems at Folker Street and Wright Street. These two subsystems divert runoff to the Tudor Road system discussed in SECTION III. The existing catch basins and the connecting manholes at these intersections will need to be removed and replaced due to the proposed realigned roadway and curb and gutter. Runoff from these intersections will be conveyed to the proposed system on 42^{nd} Avenue. Subsequently, the old connecting pipe segment from the Folker Street and Wright Street subsystems will be removed or abandoned in place, as those pipe segments will no longer be needed.

The proposed storm drain system extension will consist of installing CPEP ranging in size from 18-inch to 24-inch from Laurel Street to Parker Place. Existing water and sewer mains are located on the north and south of the roadway, respectively. To meet separation distance requirement from theses utilities, the storm drain pipe extension will be installed along the center of the road. Type I and II manholes will be installed along the roadway centerline, with connecting catch basins located to the north and south to intercept curb flow. Type II catch basin manholes will be installed at the intersection of 42^{nd} Avenue and Wright Street, to connect leads to the east. The Type II catch basin manholes are installed under curb line to collect curb flow, while also providing safer maintenance access through a manhole opening off the roadway. This section of roadway is relatively flat, causing widespread ponding issues. These improvements will provide a continuous storm drain system along this segment of 42^{nd} Avenue and will alleviate the ponding issues.

As requested by MOA Street Maintenance, storm drain manholes are also located along 42^{nd} Avenue at the following side street intersections: Roson Court, Brantley Place and Parker Place. Installing these structures as part of the 42^{nd} Avenue project allow extension of a storm drain system down the side street if necessary in the future.

D. Replace 42^{nd} Avenue (East) System – Piper Street to Florina Street

The existing pipe (CPEP) and storm drain structures at the intersection of 42^{nd} Avenue and Piper were installed in 2010 and are in good condition. However, to match the proposed curb lines the piping and structures will need to be replaced. The existing CMP piping west of Dale Street to Florina Street was installed in phases during mid-1970s and mid-1980s. The CMP piping is in fair to poor condition and is nearing the end of its design life. In addition to being in poor condition, it also is undersized to handle the design storm event. This section of roadway is also relatively flat, causing significant ponding issues in low lying areas.

The proposed storm drain system at Piper Street will collect runoff from the east and west along 42^{nd} Avenue via a combination of curb inlets and Type II catch basin manholes using 12-inch CPEP. Runoff collected by these structures will continue to direct flow into the Piper Street subsystem that flows north and eventually discharges into South Fork Chester Creek.

The proposed storm drain system west of Dale Street will be 18-inch CPEP. Type II catch basin manholes will be installed under the south curb line to collect flow and provide maintenance access for cleaning. Standard catch basins will be installed along the north curb line. The proposed storm drain system from Dale Street to Florina Street will be upsized to 24-inch CPEP to accommodate peak design flows. Type I and II manholes will be installed along the roadway centerline, with connecting catch basins to the north and south to intercept curb flow. Both systems east and west of Dale Street will continue to direct flow into the Dale Street subsystem that flows north and eventually discharges into South Fork Chester Creek.

E. Replace existing Catch Basins and Leads

The proposed roadway layout will install new or adjust the existing curb line along the entire project corridor. In most cases, the locations of the existing catch basins will not line up with the proposed curb line. Therefore, these existing catch basins will need to be removed. New catch basins and connecting leads will be installed to match the proposed curb line.

F. Minimize Ponding

The proposed roadway profile is designed to establish high and low points throughout the project corridor. These high and low points are used to direct roadway runoff to curb inlets. The curb inlets capture curb flow and direct runoff to the storm drain system, eliminating standing water. These improvements will help alleviate ponding issues along the entire project corridor.

G. Water Quality Treatment

The new permit requirements referenced in ASM Section 3.B.1 state that stormwater management systems are to provide water quality treatment through the use of Green Infrastructure (GI) whenever feasible. GI treatment techniques include methods such as retention, infiltration, bioretention, evaporation, and/or any combination of these techniques.

In some cases GI treatment may be determined to be infeasible due to site constraints such as poorly infiltrating soils, high ground water, on-site space constraints, shallow bedrock, etc. For cases where GI treatment is determined to be infeasible, water quality treatment may be provided through the use of traditional gray infrastructure such as an oil and grit separator (OGS). In such cases, a form available in the ASM must be completed and submitted to request an infeasibility concurrence.

Section 3.3.2.1 of the ASM also states that roadway projects with narrow ROW (60 feet or less) may choose to provide stormwater treatment through either GI or traditional treatment, regardless of site constraints. The ROW corridor along 42^{nd} Avenue project limits ranges between 60 feet (between Piper Street and Florina Street) and 66 feet (between Lake Otis Parkway and Piper Street).

CRW met with representatives of MOA WMS, Street Maintenance and PM&E in September 2020 to discuss implementing GI options for water quality treatment, while maintaining other project goals. Due to the limited amount of ROW along the project corridor, the existing driveway layout and the desire to provide pedestrian facilities on both sides of the roadway, even in stretches of roadway with 66-feet of ROW, providing water quality treatment solely through GI will not be achievable. The most practical GI solution discussed was to install vegetative swales located within a buffer between the back of curb and pedestrian facility to provide intermittent treatment. While these type of GI applications work well in a more rural environment, they are not ideal in an urban environment with closely spaced driveways that prohibit constructing the swales in long lengths. MOA Street Maintenance also noted that they are currently not set up to mow or maintain grass in this type of setting and voiced concerns of damaging snow plowing equipment at the curb cuts required to allow drainage into the vegetative swale. Additionally, due to the urban environment of 42^{nd} Avenue, MOA Street Maintenance is concerned that the winter sanding operations used in the project area will eventually clog the swales with sand and sediment, which will be difficult to remove in the spring and summer months.

After evaluating other GI alternatives and the maintenance concerns associated with vegetative swales for this project, it has been determined that implementing GI for this project is not feasible. As a result, water quality treatment will be provided primarily by means of OGSs. CRW intends to submit the infeasibility concurrence form to ASM for their review and approval prior to the design stage for this project. This will provide the project team ample time to revise the storm drain design and associated water quality treatment plan if necessary.

As noted in SECTION III, MOA maintains two existing OGSs that treat runoff for the 42nd Avenue (East) storm drain system, which includes the Piper Street and Dale Street subsystems. These OGSs are located just upstream of the outfall into South Fork Chester Creek and will provide water quality treatment for these subsystems.

An OGS is proposed east of Lake Otis Parkway to provide water quality treatment for the 42nd Avenue (West) storm drain system. Due to lack of cover over the proposed storm drain and existing utility constraints, the OGS may not be able to be installed near the end of the storm drain system as desired. Regardless of location, a bypass manhole will be installed upstream of the OGS for maintenance of the structure. Modified catch basins with deeper sumps will be installed downstream of the proposed OGS to provide additional sediment storage if they are not treated by the OGS. Additional water quality treatment for this system will be provided naturally by the wetlands located in University Park downstream of the roadway improvements.

H. Freeze Protection

According to ASM Section 5.3.3, the minimum depth of cover over a gravity storm drain pipe without thaw protection is four feet. Insulation is required for pipes with a diameter less than 30-inches if the depth of cover is less than four feet. However, if a storm drain pipe is located under a roadway structural section with insulation, additional insulation for the pipe is not required. A thaw system is required if the depth if the depth of cover is less than three feet.

The roadway structural section includes insulation for this project, so additional insulation will not be required for storm drain pipe that is located between three and four feet of cover. A thaw system may be warranted at the west end of the 42nd Avenue (West) storm drain system due to lack of cover over several segments of larger diameter pipe. It is assumed that there is base storm drain flow contributing to this system throughout the year so a thaw system may not be required. Additional review and consideration for this area will be discussed with MOA Street Maintenance as the project moves forward. No heat trace system is currently included in the DSR project costs.

X. Water Improvements

The 42nd Avenue Upgrade project includes replacing the existing water main beginning at the Lake Otis Parkway intersection and extending to Piper Street. AWWU is partnering with PM&E to combine this roadway rehabilitation project with the proposed water main project improvement that has been scheduled for several years. The combined project approach provides an excellent opportunity to lower the costs for each individual project by joining the two projects into the same design development and producing a single construction project. Another benefits includes the well-developed coordination of the water main alignment with other utilities that share space within the ROW for a compatible, long term solution.

A. Alternative Evaluation

The basis of the water main improvements use the preferred Alternative 1 roadway improvements design. Design elements of the roadway improvements (including limits of pavement, curb and gutter location, pedestrian facility location, subsurface drainage infrastructure, etc.) directly influence the proposed location of the water main.

Alternative alignments of the water main were considered, and upon review did not meet the intent of the project needs or fulfill the requirements of the design criteria manual. The preferred conceptual water main alignment (horizontal and vertical layout) and fire hydrant layout is shown on the plan and profile drawings included in APPENDIX D. Since the roadway project is a complete reconstruction of the roadway, the water replacement construction method will be by open-cut removal of existing pipe and installation of new pipe.

B. Service Connections

All existing water services currently connecting to the 8-inch water main will be removed and replaced with a new service as part of the improvements, which includes a new water service pipe and key box or valve at the property boundary where applicable. There are small water services (3/4-inch to 1.5-inch) and large water services (6-inch to 8-inch) within the segment of the water main replacement. Nearly every property boarding the 42nd Avenue alignment has an existing water service with the exception of a few properties that are not developed or have another source of water supply. TABLE 15 below identifies the existing size and proposed size for each parcel within the water replacement limits. Large diameter water services for commercial buildings between Lake Otis Parkway and Laurel Street will be increased to a minimum of 8-inch diameter as a benefit to facilitate future fire protection systems or major property re-development that may require higher flow rates. Residential properties served with a ¾-inch diameter pipe will be increased to a minimum of 1-inch diameter service to conform to MASS and DCPM requirements with an added benefit of possible increased pressure and flow to the dwelling. Proposed water services are not shown currently on the water plan and profile drawings but will be added during detailed design development.

Table 15 - Existing Water Services within 42nd Avenue Water Main Replacement

Parcel ID	Existing Water Service Size (inch)	Proposed Water Service Size (inch)	Comments
101	6	8	
174	6	8	
102	6	8	
103	*	*	
104	*	*	
105	**	1	Folker Park requested service by Parks & Recreation, service to be paid by PM&E. Location of service to be coordinated with Parks & Recreation during detailed design.
106	**	**	Vacant land
107	**	**	Served by water well
108	1	1	
109	**	**	Vacant land
110	0.75	1	
111	8	8	
155	**	**	Vacant land
156	**	**	Served by water well
157	*	*	
158	1.5	1.5	
159	0.75	1	
160	*	*	
161	8	8	
162	1	1	Vacant land, not currently connected to water service
163	1.5	1.5	
164	1.5	1.5	
165/166	6	8	
167	0.75	1	
167a	1	1	Property south of Parcel 167
168	**	**	Vacant Land (Parking lot for Parcel 169)
169	1	1	
170	1	1	
171	0.75	1	
172	1	1	

** Water service to property from adjacent roadway other than 42nd Avenue*
*** No existing water service to property*

C. Temporary Water Service

A complex temporary water system may be necessary to provide continual service to the many residential properties and several commercial businesses affected by the water main construction. The existing fire hydrants within the project area may possibly be a source for the temporary water; this will be further investigated during the design phase. There are critical medical businesses within the affected zone of temporary water that must maintain water service on a near continuous basis to facilitate proper medical treatment, vital medical equipment, and general operations of their services. Initial discussions with businesses who attended the Business Stakeholder Meeting have occurred however detailed discussions with all affected medical businesses needing temporary water service will be completed during detailed design development to better understand any specific requests they may have and define any possible unique challenges that may occur to facilitate their requests during a water shut down event.

Fire hydrants within the core project area or beyond the limits of work will supply the water for the temporary water systems. The network of temporary piping will be placed on the existing ground surface of landscaped areas, parking lots, driveway access, and roadways. When temporary piping crosses locations where vehicular traffic is anticipated, adequate protection is necessary using a two-sided ramp to completely cover the pipe or a shallow bury method are two possible options to employ.

The current temporary water service approach identifies three phases to facilitate construction of the new water main and continued service to the AWWU water customers. The Temporary Water Service drawings graphically depict these areas outlined in colored linework to define each of the phase boundaries as shown in APPENDIX D, SHEET D1.7 and as described in more detail below.

1) Phase 1 – Lake Otis Parkway to Laurel Street

The properties within this phase are primarily medical related businesses with large and small diameter services. The impacted area of Phase 1 includes the adjacent properties along the south side of 42nd Avenue and properties bounded by Laurel Street, Lake Otis Parkway and 40th Avenue. There is one property north of 40th Avenue and one property east of Laurel Street that is within Phase 1 temporary water limits zone. The colored boundary line on Sheet D1.7 outlines the specific properties in Phase 1. The Phase 1 zone is isolated by closing the easterly 8-inch gate valve at the Lake Otis Parkway intersection and the two 8-inch gate valves at the intersection of Laurel Street and 42nd Avenue.

Properties South of 42nd Avenue. The six properties along the south side of 42nd Avenue may be served by a temporary water system connection via an existing hydrant east of Laurel Street fronting the Deer Apartments, beyond the Phase 1 boundary. The alignment of the temporary water piping for these properties can be placed within the 42nd Avenue ROW and beyond the limits of work for the deep utilities. The benefit of this temporary water service connection is it will not cross the active work area associated with the new water main work within 42nd Avenue nor any other utility installation extending in an east-west direction.

Properties North of 42nd Avenue. Temporary water service for several medical office buildings north of 42nd Avenue would be served by connecting to an active hydrant located on Hickory Place, then extend to the existing hydrant within Laurel Street that will back-feed the supply water via the existing water main that is currently serving these buildings. A temporary water connection to each business is not necessary for this scenario since each property will receive water supply through the existing piped water system. Temporary piping from the fire hydrant to Laurel Street will require a temporary agreement from the property owner where the piping is routed on. This would be Parcel 176, located at 4107 Laurel Road or the property of the Surgery Center business, located at 4001 Laurel Road.

The temporary water service for the three properties with large diameter services currently connected to the water main within 42nd Avenue will require excavation to the depth of the existing service, near the ROW limits, for a direct connection. The water pipe crossing at street and driveways will require protection from vehicular traffic. See APPENDIX D, SHEET D1.8 for Phase 1 temporary water service map.

2) Phase 2 – Laurel Street to Wright Street

The area of Phase 2 includes a mix of single family, multi-family, and high density multi-family residential with large and small diameter services. Phase 2 is largest area of all the temporary water systems which encompass several properties along the 42nd Avenue roadway, several properties on Wright Street (north of 42nd Avenue and that have AWWU water service), all the properties on Kimberlie Court, all the lots on Roson Court, and all the properties on Hickory Place, with the exception of the Providence Horizon House, which is served by the water main within Folker Street. The total affected properties include; 24 single family or multi-family residential lots, four commercial lots, and two high density residential lots (College Place Condominiums and Deer Park Apartments).

Isolating the Phase 2 area includes closing the (new, this project installed) easterly gate valve at the intersection of Laurel Street and 42nd Avenue and three existing gate valves at the intersection of Wright Street and 42nd Avenue.

Properties South of 42nd Avenue. Properties on Roson Court and the two high density properties with large diameter water services will be isolated from the water main via existing gate valves. Temporary water service to the properties along the south side of 42nd Avenue corridor will connect to an active hydrant located on Folker Street, south of the project limits, which is not affected by this projects work. The water pipe will connect to three existing hydrants to serve the high density housing properties and feed the users through the existing water system. The single family residences and multifamily dwellings can be served by connecting to an exterior hose bib. Placement of the temporary piping to serve these properties can be located within the ROW of both 42nd Avenue and Folker Street.

Properties North of 42nd Avenue - Hickory Place. Temporary water service for the properties along Hickory Place will use the same two hydrants and piping system as the Phase 1 temporary system that served the medical office buildings. Once the new water main is installed for the Phase 1 area, chlorinated, and flushed, it can be reinstated for use that could supply water to the hydrant on Laurel Street that would back-feed into the existing water main within Hickory Place. Temporary piping from the fire hydrant to Hickory Place will require a temporary agreement from the parcel owner where the piping is routed on. The properties along Hickory Place would receive water service using the existing water system and would not need a direct connection to individual buildings.

Properties North of 42nd Avenue – Wright Street and Kimberlie Court. Temporary water service for the properties along these two roadways may connect to an active hydrant located on Folker Street, then extend piping to an existing hydrant within Kimberlie Court that will back-feed the supply water via the existing water main that currently serves the residential and business properties. The temporary water service piping will cross Folker Street and extend through the central area of parcel 177, which is owned by the Anchorage Community Mental Health Services Inc. A temporary agreement from this property owner is needed to route this temporary water piping.

Although temporary water is not needed to the north of project, along Folker Street, there need to be a temporary shutdown of the water main that serves the Providence Horizon House and Anchorage Community Mental Health facility, both of which are large commercial structures. The temporary shutdown will allow connection of the new 8-inch PVC pipe to the existing 8-inch ductile iron pipe. See APPENDIX D, SHEET D1.9 for Phase 2 temporary water service map.

3) Phase 3 –Wright Street to Piper Street

The smallest area of all the Phases, this section includes three water services on the north side of 42nd Avenue that will require temporary water service connections during construction. The type properties include a single family residential, multi-family residential, and high density residential (Country Square Condominiums). The high density residential property has a large diameter service and the two other properties have a small diameter service.

The isolation of Phase 3 requires closing of the (new, this project installed) east valve at the intersection of Wright Street and 42nd Avenue and the two existing values at the intersection of Piper Street and 42nd Avenue. The source of water supply for the properties for Phase 3 is new hydrant located on the northwest quadrant of the 42nd Avenue and Wright Street intersection. The water main within Phase 2 will need to be chlorinated and flushed prior to being activated for use intended to serve as the water source. The temporary piping will extend along the north side of the ROW and connect to the outside hose bibs of the two smaller residential properties and to the existing private fire hydrant located within the Country Square Condominium complex. Temporary piping on the Country Square Condominium property will require a temporary agreement from the parcel owner. The water will back-feed into the existing water system to serve this high density residential facility. See APPENDIX D, SHEET D1.10 for Phase 3 temporary water service map.

D. Utility Trench Excavation and Backfill

The new water main is a deep utility that will likely be installed as one of the first tasks of the project that requires removal of the asphalt pavement of the roadway surface to an excavated depth of 10 feet, or more, below the existing grade surface. The utility trench excavation will encounter silty sands and silty gravels with a high water table that ranges between 5 feet and 15 feet below grade surface. Although the in-situ soil type is acceptable for trench backfill, the wet and saturated condition may create a challenge for immediate reuse as proper compaction requires an optimum moisture content near 6% of the dry weight of soil. The contractor could elect to manage segregation of wet and saturated soils from the lower sections of the trench excavation as a method to immediately reuse the upper trench section of drier soils as backfill. However, this approach may increase the project cost due to the necessary man-hours spent on a segregation effort rather than importing new classified material for immediate placement. Additionally, the urban condition of the project with limited space within the ROW for equipment and material staging near the trench excavation may not be a reasonable approach. Considerations for maintaining local traffic and emergency vehicle access through the local area requires adequate space adjacent to the utility trench work. Quantities for the utility trench excavation and backfill are calculated based on side slopes of 1.5(H):1(V), however the use of trench box system may reduce the engineer’s estimated material if the contractor selects this method for pipe installation. The utility trench backfill between the top of the pipe bedding and bottom of the new roadway structural section will be replaced with Type II Classified Fill. The backfill of material placed within the new roadway structural section, up to the temporary roadway grade, should be Type III Classified Fill, given this is a temporary backfill that will ultimately be removed and replaced with classified fill as part of the roadway improvements. Type III Classified Material provides a competent base to temporarily support vehicular traffic.

XI. Right-of-Way Impacts

Preliminary estimated easement and permit requirements are summarized in TABLE 16 below and are detailed in APPENDIX I. The number of estimated easements and permits for each alternative are identical, however larger temporary construction easements are required in Alternative 2 which results in a slightly higher land acquisition cost compared to Alternative 1. As the planning and design of this project progresses, the required easements and temporary construction permits will be refined.

Table 16 - Estimated Right-of-Way Easements / Permits

Alternative	Public Use Easements (PUE)	Slope Easements (SE)	Drainage Easements (DE)	Temporary Construction Easements (TCE)	Temporary Construction Permits (TCP)
1 & 2	7	0	3	24	83

XII. Utility Impacts

When roadway and drainage improvements are made in urban areas, impacts to utilities need to be analyzed. Existing utility facilities are shown in APPENDIX A. For safety, overhead and underground clearances must be maintained. A minimum of 18.5 feet of vertical clearance should be maintained between primary overhead electrical lines and the grade of the roadway. ML&P will be notified for relocation to any of these lines as required.

In the ROW, the Municipality requires a minimum burial depth of 42 inches for buried gas lines, electric cables, fiber optic lines, telephone cables, and cable television lines. For the purpose of this report, it is assumed that the existing buried facilities in the project area are buried at the minimum depth. As a result, any reduction of cover or impacts from storm drain improvements over existing facilities will require relocation of the facility. In some locations, the structural section excavation will impact utilities. In these locations the utilities will either require relocation or will require support in place for the contractor to work around the utility.

AWWU requires a minimum depth of cover of 10 feet over their water mains and 8 feet over their sewer mains. Changes to the roadway grade along the corridor are minor and are not anticipated to substantially reduce the existing cover over the water and sewer utilities. The assumed roadway cross section includes 2-inches of rigid board insulation which would mitigate some reduction in cover above water and sewer mains.

The utility relocation cost estimates for each Alternative are shown in APPENDIX K.

XIII. Permitting and Agency Approvals

Permits and agency approvals for the 42nd Avenue Upgrade project required for construction of proposed improvements are listed below. Because the roadway is classified as a secondary (local) urban residential road, it is not necessary to obtain approval of the DSR from the MOA Planning and Zoning Commission or the MOA Urban Design Commission. Anticipated permits and agency approvals required for this project include:

- MOA Flood Hazard Permit (see discussion below)
- MOA Watershed Management Services Stormwater Plan Approval
- ADEC Approval to Construct Storm Drain Improvements, Approval to Construct Water Improvements, and Separation Waivers (assumed)
- Department of Natural Resources (DNR) Temporary Water Use Permit for dewatering
- United States Army Corps of Engineers (USACE) Nationwide Permit, likely Nationwide Permit #3 for regrading open channel ditch/Fish Creek

A meeting was held with MOA Watershed Management Services and PM&E on May 14, 2020 to discuss the proposed improvements on 42nd Avenue located within the flood plain. Improvements include installing new curb and gutter and pedestrian facilities, which will raise the existing grade within the flood plain. The proposed finish grade cannot be lowered, due to lack of cover over the storm drain facilities and need to up-size the storm drain pipe. Based on the meeting, the following modeling efforts are required to raise the grade within the flood plain along 42nd Avenue and obtain the flood hazard permit:

- Obtain Effective Model from FEMA.
- Modify Effective Model to current software.
- Modify Effective Model to existing conditions to make Corrected Effective Model.
- Create a Proposed Model to compare against Corrected Effective Model to determine if raising the grade in the 42nd Avenue roadway will not raise the flood plain levels by more than 1 foot.

The Effective Model has been requested from FEMA but not provided yet. The analysis will be completed prior to beginning the detailed design.

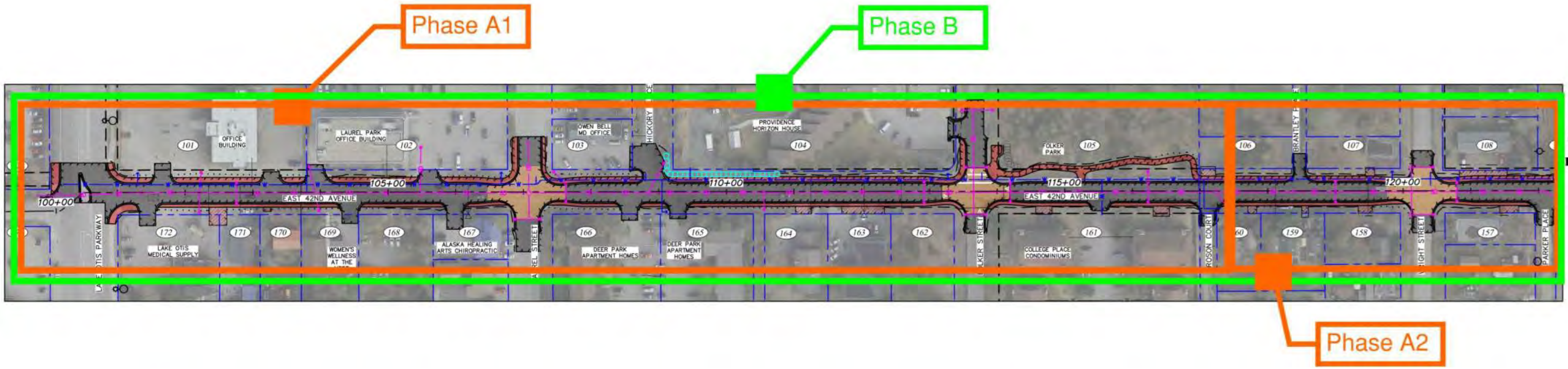
Additional permits may be identified as the design develops.

XIV. Construction Schedule and Phasing

The project is currently funded only through the design study phase and additional funding will be necessary to complete design and construction. It is anticipated that the project will be phased over multiple construction seasons. Phasing for construction is expected to begin at Lake Otis Parkway and work eastward. Ideally the first phase would terminate at Piper Street in conjunction with the proposed water main improvements, however funding availability may instead require an intermediate phase between Lake Otis Parkway and Piper Street. MOA Traffic Safety Division also recommends that a segment from Lake Otis Parkway to Piper Street be constructed first to prioritize the pedestrian and safety improvements near Folker Park.

Two different construction phasing options were evaluated for the preferred Alternative 1. The three phase option includes Phase A1 (Lake Otis Parkway to Roson Court), Phase A2, (Roson Court to Piper Street) and Phase C (Piper Street to Florina Street). The two phase option includes Phase B (Lake Otis Parkway to Piper Street) and Phase C (Piper Street to Florina Street). See FIGURE 13 below for the construction phase limits described above.

Based upon anticipated project funding availability, the current schedule calls for design of the 42nd Avenue improvements to begin in 2021 and construction of Phase 1 beginning in 2023.



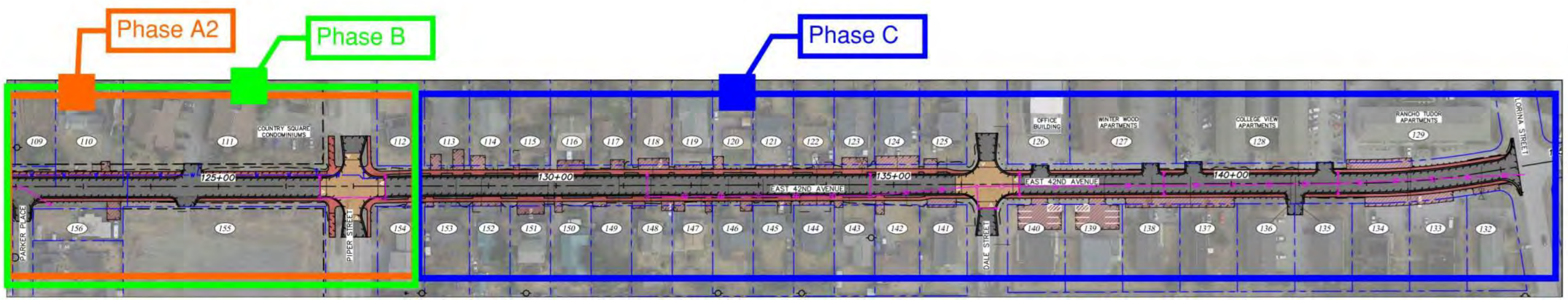


Figure 13 – Construction Phase Limits

XV. Quantity and Cost Estimates

A summary of estimated project costs for the proposed improvements is presented below in TABLE 17 for each Alternative for the entire project corridor. The Alternative 1 (preferred) cost shown is for the most expensive phased construction option.

A summary of estimated project costs for each phase of the Alternative 1 three phase construction option is presented in TABLE 18 below and the two phase construction option is presented in TABLE 19 below. A breakdown of the ROW, construction, utility, design and management cost estimates can be found in APPENDIX K.

Table 17 - Summary of Estimated Project Costs

Category	Alternative 1 Phased (preferred)	Alternative 2
Design & Management Total (estimated)	$2,259,000	$2,239,000
ROW Acquisition Total	$161,000	$164,000
Utility Relocation (15% Contingency) Total	$1,286,000	$1,280,000
A. Design, ROW Acquisition, Utility Relocation	***$3,706,000***	***$3,683,000***
Construction Roadway Improvements	$5,389,000	$5,098,000
Drainage Improvements	$1,488,000	$1,487,000
Illumination Improvements	$480,000	$421,000
Water Improvements	$1,788,000	$1,776,000
Construction Subtotal	*$9,145,000*	*$8,782,000*
Construction Contingency (15%)	$1,372,000	$1,317,000
Construction Management / Inspection / Testing	$948,000	$720,000
B. Total Estimated Construction Cost (rounded)	***$11,465,000***	***$10,819,000***
C. Overhead / Grant Accounting	***$2,677,000***	***$2,559,000***
Total Estimated Project Cost (A + B + C)	***$17,848,000***	***$17,061,000***

Table 18 – Alternative 1: Three Phase Construction Option

Category	**Phase A1**	**Phase A2**	**Phase C**	**Total (A1 + A2 + C)**
Design & Management Total (estimated)	$771,000	$741,000	$747,000	$2,259,000
ROW Acquisition Total	$85,000	$39,000	$37,000	$161,000
Utility Relocation (15% Contingency) Total	$876,000	$172,000	$238,000	$1,286,000
A. Design, ROW Acquisition, Utility Relocation	***$1,732,000***	***$952,000***	***$1,022,000***	***$3,706,000***
Construction Roadway Improvements	$2,163,000	$1,184,000	$2,042,000	$5,389,000
Drainage Improvements	$851,000	$267,000	$370,000	$1,488,000
Illumination Improvements	$183,000	$122,000	$175,000	$480,000
Water Improvements	$1,198,000	$590,000	$0	$1,788,000
Construction Subtotal	*$4,395,000*	*$2,163,000*	*$2,587,000*	*$9,145,000*
Construction Contingency (15%)	$659,000	$324,000	$388,000	$1,372,000
Construction Management / Inspection / Testing	$435,000	$234,000	$279,000	$948,000
B. Total Estimated Construction Cost (rounded)	***$5,489,000***	***$2,721,000***	***$3,254,000***	***$11,465,000***
C. Overhead / Grant Accounting	***$1,274,000***	***$648,000***	***$755,000***	***$2,677,000***
Total Estimated Project Cost (A + B + C)	***$8,495,000***	***$4,321,000***	***$5,031,000***	***$17,848,000***

Table 19 - Alternative 1: Two Phase Construction Option

Category	Phase B	Phase C	Total (B +C)
Design & Management Total (estimated)	$1,506,000	$747,000	$2,253,000
ROW Acquisition Total	$124,000	$37,000	$161,000
Utility Relocation (15% Contingency) Total	$1,048,000	$238,000	$1,286,000
A. Design, ROW Acquisition, Utility Relocation	***$2,678,000***	***$1,022,000***	***$3,700,000***
Construction Roadway Improvements	$3,321,000	$2,042,000	$5,363,000
Drainage Improvements	$1,118,000	$370,000	$1,488,000
Illumination Improvements	$309,000	$175,000	$484,000
Water Improvements	$1,776,000	$0	$1,776,000
Construction Subtotal	*$6,524,000*	*$2,587,000*	*$9,111,000*
Construction Contingency (15%)	$979,000	$388,000	$1,367,000
Construction Management / Inspection / Testing	$587,000	$279,000	$866,000
B. Total Estimated Construction Cost (rounded)	***$8,090,000***	***$3,254,000***	***$11,344,000***
C. Overhead / Grant Accounting	***$1,900,000***	***$755,000***	***$2,655,000***
Total Estimated Project Cost (A + B + C)	***$12,668,000***	***$5,031,000***	***$17,699,000***

XVI. Stakeholder Coordination/Public Involvement

The public involvement for 42nd Avenue is following the MOA Context Sensitive Solutions (CSS) process as a general guide for best practices. The goal of the CSS process is to collaborate with all stakeholders to improve the roadway, balance diverse interests, find areas of compromise that address concerns, and solicit feedback from stakeholders. The project team began the public and agency outreach in October 2018 with the identification of over 1,600 project stakeholders. See TABLE 20 below for list of stakeholders.

Table 20 - List of Stakeholders

MOA Agencies	Other
Project Management & Engineering Anchorage Water & Wastewater Utility (AWWU) Traffic Engineering Watershed Management Services Economic and Community Development Maintenance and Operations Planning Transit Parks & Recreation Anchorage Fire & Police Department Anchorage Assembly Members Felix Rivera, Forest Dunbar, Pete Peterson, and Meg Zaletel Vision Zero Anchorage	Area property owners, business owners, property managers, employees and residents University Area Community Council Alaska Communications Systems (ACS) and GCI Municipal Light and Power (ML&P) ENSTAR Natural Gas Company Representative Ivy Spohnholz Representative Andy Josephson Senator Elvi Gray-Jackson Senator Bill Wielechowski

A. Stakeholder Involvement Activities

A variety of forms of outreach to keep stakeholders aware of project meetings and updates were utilized, including website updates, mailed postcards, e-newsletters, business stakeholder meetings, and public open houses. It also included in-person delivery of meeting notices to businesses in the project area.

The public involvement consisted of open-house style meetings, website updates, in-person presentations during Community Council meetings, and agency scoping meetings. TABLE 21 below summarizes each major stakeholder coordination/public involvement event for the duration of the project.

Table 21 - Stakeholder Coordination/Public Involvement Events

Date	Activity	Comments
October 2018	Mailing List Developed	Over 1600 stakeholders
October 2018 - Present	Website Development & Maintenance	Launched and updated at key project milestones
November 1, 2018	Interactive Map Active	Allows stakeholders to provide comments throughout duration of project
November 6, 2018	Mailer & E-Newsletter #1	Introduce Project & Field Work
November 7, 2018	University Area Community Council Mtg. #1	Presentation – Introduce Project
December 2018	Posted Project Fact Sheet on the Website	
January 7, 2019	Meeting with Providence Health and Services (Providence)	Discuss project and Providence owned properties along 42nd Avenue and future developments
February 1, 2019 – February 28, 2019	Online Questionnaire Launched	Query stakeholders about specific project area issues and concerns
February 4, 2019	E-Newsletter #2	Announce Questionnaire
February 4, 2019	Mailer #2	Announce Questionnaire
February 27, 2019	E-Newsletter #3	Reminder to complete the project questionnaire
March 29, 2019	E-Newsletter #4	Announce Survey Crews in project area
April 24, 2019	E-Newsletter #5	Announce Geotechnical Field Work
August 5, 2019	Agency Stakeholder Meeting with MOA Traffic Engineering & Street Maintenance	Discuss conceptual proposed roadway design elements to gain concurrence
October 2, 2019	Mailer #3 & E-Newsletter #6	Announce Open House #1
October 2, 2019	University Area Community Council Mtg. #2	Announce Open House #1
October 10, 2019	Door-to-door Business Outreach	Announce Business Stakeholder Meeting – Add building managers to project contact list
October 14, 2019	E-Newsletter #7	Open House #1 Reminder
October 17, 2019	Open House #1	Introduce project, preliminary designs and receive comments on the designs, existing conditions and issues in the project area.

Date	Activity	Comments
October 24, 2019	Business Stakeholder Meeting	Introduce project and receive comments on existing conditions and issues in the project area.
October 28, 2019	E-Newsletter #8	Thank you for attending Open House #1 and Business Stakeholder Meeting
January 2020	Revised Project Fact Sheet for Anchorage Transportation Fair	
January 8, 2020	University Area Community Council Mtg. #3	PM&E and AWWU staff answered questions regarding recent water main breaks on 42^{nd} Avenue
January 17, 2020	E-Newsletter #9	Announce Project at Transportation Fair
January 23, 2020	Anchorage Transportation Fair	Present Preliminary Designs
January 27, 2020	Providence Horizon House Presentation	Provide presentation of Open House #1 graphics to Horizon House residents
February 5, 2020	University Area Community Council Mtg. #4	Answer project questions as the UACC prepared a project resolution
May 7, 2020	MOA Traffic Engineering Department Meeting	Discuss traffic analysis and traffic design elements
May 14, 2020	MOA Flood Plain Administrator Meeting	Discuss proposed improvements within the flood plain on 42^{nd} Avenue
September 29, 2020	Mailer #4 and E-Newsletter #10	Announce Open House #2
October 7, 2020	University Area Community Council #5	Announce Open House #2
October 12, 2020	E-Newsletter #11	Open House #2 reminder
October 14, 2020	Open House #2	Present Draft DSR & preferred alternative
October 15, 2020	E-Newsletter #12 & Self-Guided Virtual Open House #2	Thank you for attending Open House #2. Self-Guided Virtual Open House #2 posted on website

B. Project Website

The project website (www.42ndavenueupgrade.com) has been developed for ease of project information sharing and soliciting comments from the public. Website content includes a project home page overview, how to get involved page, project documents and other resources page, project team contact information, a link to provide comments and sign up for project updates, and an interactive map page to allow users to place comments along the project corridor on a map. An

Open House self-guided virtual tour was also developed and posted on the website after Open House #2 for those that were not able to attend the Open House #2. The website will be updated as the project progresses.

C. Agency Stakeholder Meeting

The agency stakeholder meeting, held in August 2019, included representatives from MOA Traffic Engineering and Street Maintenance Departments. The purpose of the meeting was to discuss the traffic analysis and gain concurrence of the proposed conceptual roadway cross sections to present at the public Open House #1.

D. Community Council Meetings

Project representatives have attended the University Area Community Council (UACC) five times since the beginning of the project including November 7, 2018 to provide a project introduction, October 2, 2019 to announce Open House #1, January 8, 2020 to answer questions from the UACC about the recent water main breaks on 42^{nd} Avenue, February 2, 2020 to answer project questions and support the UACC as they developed a resolution in support of project funding, and October 7, 2020 to announce Open House #2. Full meeting summaries can be found in APPENDIX L.

E. Public Open House Events

Public Open House #1 was held on October 17, 2019 from 4:30 – 6:30 pm. The meeting was held at University Baptist Church (4313 Wright St.) and 15 community members were in attendance. Open House #1 presented scrolls with aerial images of the existing layout of the project roadways. Attendees left comments regarding known issues or concerns of existing conditions along the project corridor. Displays also included a project timeline, summary of proposed improvements, questionnaire responses, and cross-sections of conceptual designs. Comment sheets were provided for attendees to share written comments.

Open House #2 was held on October 14, 2020 from 5:00-6:30 pm. The open house was a virtual meeting using Microsoft Teams and attendees could attend the meeting by accessing via a computer link or by using a call-in number. There were 13 community members in attendance. Open House #2 included a short presentation provided by the project team to summarize the Draft DSR and recommended roadway typical sections. The conceptual traffic calming and pedestrian safety improvements were also presented. A question and answer session followed the presentation. The presentation video and the slides were posted on the website for those that were not able to attend the live meeting. Additionally, a self-guided virtual tour of the project was available the project website. As of October 14, 2020, it had been viewed 131 times.

Materials presented at Open House #1 and #2, comments received, and sign-in sheets are included in the APPENDIX L in Open House #1 and #2 Meeting Summaries.

F. Business Stakeholder Meeting

All project-adjacent business stakeholders (business owners, building managers, and/or building owners) were invited to attend an open house on Thursday, October 24th, 2019 from 2-4 PM. The meeting was held at University Baptist Church (4313 Wright St.) and 2 business representatives attended. A full summary of the meeting including all comments received can be found in the APPENDIX L.

G. Summary of Public Comments Received

Comments were received from individuals through public and business stakeholder meetings, telephone calls, comment forms and on-line questionnaire responses. Additional comments were recorded on project scrolls, documented in meeting records and acquired from the interactive map on the project website. All project comments that were received from the beginning of the project through October 19, 2020 are documented in the APPENDIX L.

Stakeholders and members of the public will have the continued opportunity to obtain information and provide feedback via the project website, interactive map tool, and through direct feedback by phone calls and emails to project staff.

XVII. Design Recommendations

Based on comments received from public, agency, and business stakeholders and requirements of MOA Title 21, DCM and AWWU DCPM, the preferred alternatives for the project corridor are as follows:

A. Preferred Alternative Typical Cross Sections

To accommodate any on-street parking needs but not designate parking lanes, no roadway traffic markings are proposed along the project corridor for any of the segments. MOA Traffic Engineering prefers 10-foot wide travel lanes for this local roadway. MOA Street Maintenance was involved in the development of the alternatives and understands that these preferred alternatives reduce snow storage by 1-foot on each side compared to providing 11-foot travel lanes.

1. Segments A & B: Lake Otis Parkway to Piper Street: Alternative 1 is the preferred alternative with two, 10-foot wide travel lanes, 3.5-foot wide shoulders, and barrier (Type 1) curb and gutter. An 8-foot wide paved pathway is proposed on the north side of the roadway and a 5-foot wide concrete sidewalk is proposed on the south side of the roadway. The non-motorized facilities would be detached from back of curb where feasible. This section balances the needs of the commercial and multi-family residential context of this area which observed no on-street parking needs; thus the recommended alternative does not provide for on-street parking. This reduces the overall street width which allows for detaching the pathway/sidewalk where feasible, minimizes impacts to adjacent properties, provides traffic calming with the narrower roadway and allows for the retention of existing landscaping where feasible. The barrier (Type 1) curb provides for designated driveways and additional vertical separation between the travelled way and pedestrian facilities.

2. Segment C: Piper Street to Dale Street: Alternative 1 is the preferred alternative with two, 10-foot wide travel lanes, a single 7-foot wide parking lane, and rolled (Type 2) curb and gutter. The un-marked 7-foot wide parking lane and 3-foot wide buffers behind the back of curb will provide space for snow storage. Additionally, the adjacent developed properties have minimal set-back from the ROW for infrastructure. The 1-foot reduced lane width on each side of the roadway will minimize impacts to adjacent properties.

   No roadway traffic markings are proposed, effectively allowing parking along either side of the roadway. Pedestrian facilities will consist of 5-foot wide sidewalks on both sides of the roadway, detached from the back of curb by 3 feet to accommodate installation of individual mailboxes. This section balances the needs of the single- and multi-family homes (up to 4-plex) of this area which observed on-street parking needs; the reduced lane widths also provide traffic calming measures in this residential context. The rolled (Type 2) curb and gutter is proposed due to the close spacing between the wide residential driveways along this segment, as there is insufficient room to construct barrier curb with curb cuts at each driveway.

3. Segment D: Dale Street to Florina Street: Alternative 1 is the preferred alternative with two, 10-foot wide travel lanes, 3.5-foot wide shoulders, and barrier (Type 1) curb and gutter.

Pedestrian facilities will consist of 5-foot wide concrete sidewalks along both sides of the roadway, attached to the back of curb. The un-marked 7-foot wide parking lane and 3-foot wide buffers behind the back of curb will provide space for snow storage. Additionally, the adjacent developed properties have minimal set-back from the ROW for infrastructure. The 1-foot reduced lane width on each side of the roadway will minimize impacts to adjacent properties.

This section balances the needs of the high density and multi-family residential context of this area which observed on-street parking needs but also has sufficient off-street parking associated with each parcel; the reduced lane widths also provide traffic calming measures in this residential context. The barrier (Type 1) curb provides for designated driveways and additional vertical separation between the travelled way and pedestrian facilities.

B. Other Recommended Improvements

1. Design and Posted Speed Limit: Maintain the current posted speed limit of 25 MPH. A Design speed of 25 MPH is proposed. By using a lower design speed than required by the DCM, the vertical curves proposed along the alignment can better match into the existing topography and ROW.
2. Roadway Horizontal and Vertical Alignment: The project roadways will typically follow the center of the ROW. The proposed profile for 42^{nd} Avenue will force high/low spots by raising the grades to a minimum of 0.65%.
3. Landscaping: Proposed landscaping will be in character with the adjacent residential, business, and park properties. Landscaping will focus on retaining existing vegetation where feasible and installing new landscaping and features that fit the context of the corridor. Where new landscaping elements are installed it will maintain clear sight lines and avoid creating comfortable or hidden areas where transients may loiter or sleep. Opportunities for green infrastructure, specifically along Folker Park north of the pathway, will be sought to incorporate into the landscaping design.
4. Retaining Walls: Retaining walls will be installed to reduce impacts to adjacent infrastructure and properties. It is anticipated that a retaining wall will only be required adjacent to Parcel 104 and along Hickory Place, but the exact locations and extents of retaining walls will require further refinement during the design phase.
5. Lighting: A continuous LED lighting system, consistent with current MOA standards will be installed along the roadway.
6. Storm Drain: The proposed drainage improvements consist of the following:
    - Replace aging 42^{nd} Avenue (West) system to align with new roadway improvements and maintain separation distance from proposed water main from Lake Otis Parkway to Laurel Street
    - Extend 42^{nd} Avenue (West) system with new piping from Laurel Street to Parker Place to provide continuous storm drain system
    - Upgrade outfall pipe to open channel/Fish Creek headwaters at Lake Otis Parkway and 42^{nd} Avenue to accommodate future improvements to connecting subsystems

- Remove sediment from open channel/Fish Creek headwaters and replace 2 downstream driveway culverts
- Replace aging 42nd Avenue (East) system from Piper Street to Florina Street to accommodate current design storm and improve overall surface drainage
- Install catch basins at new roadway low points and other low lying areas to alleviate ponding issues
- Replace catch basins and leads as required to match new curb and gutter
- Provide positive roadway drainage to minimize ponding
- Provide water quality treatment for storm runoff

7. Water: The project will replace approximately 2,700 feet of AWWU water main along 42nd Avenue from Lake Otis Parkway to Piper Street. All main line valves, water services and AWWU owned fire hydrants will be replaced. Design and construction of the water main improvements are being done as part of the 42nd Avenue Upgrade project.
8. Traffic Calming: Traffic calming features will be installed as part of the 42nd Avenue Upgrade project. Locations and types of traffic calming will be further refined during the design phase.
9. Intersections: The existing all-way stop-controlled intersections at Laurel Street, Folker Street, and Dale Street will be removed. Stops signs will be reinstalled for the minor street as the stop-controlled street. 42nd Avenue is considered the major street at the intersection with Laurel and Folker Streets but is the minor street at the intersection with Dale Street. Channelization and intersection layout at Lake Otis Parkway will be unchanged.
10. Driveways: Curb returns will be typically installed at commercial properties (including 8-plexes and greater) and curb cuts will be installed for residential homes (7-plex and less). The proposed design will incorporate MOA driveway access standards wherever possible to improve the safety and operations of the corridor.

XVIII. Proposed Variances from Design Criteria Manual

A. AMC Title 21

AMC Title 21.08.050.G requires that curb and gutters be in accordance with the DCM and MASS. However, it also states that "Curbs shall be of the American Association of State Highway and Transportation Officials (AASHTO) vertical type." A variance requesting relief from these requirements for Segment C could be required from the MOA Urban Design Commission, however, the project is not required to be approved by the UDC as it is a local roadway.

B. MOA DCM

The proposed variances from the DCM for this project will be justified and approved under a separate document during the design process. There are several design criteria that may not be able to meet the MOA DCM. Below is a list of potential variances for this project for the preferred alternative. Additional variances may be required as the design progresses:

- Roadway width – the DCM requires a roadway width of 38 feet (measured from back of curb) for urban residential roadways with over 1,000 ADT. One parking lane may be replaced with a shoulder, reducing the roadway width to 34.5 feet, if allowed by the platting authority. The proposed roadway width is 31 feet for all segments.
- Curb Type – DCM Section 1.9.F requires Type 2 (rolled) curb on local roadways. Type 1 (barrier) curb is recommended along Segments A, B, and D to delineate driveways and prevent unnecessary full-frontage access.
- Design Speed - the DCM requires a design speed of 30 MPH for a local roadway with traffic volumes greater than 1,000 vpd. The proposed design and posted speed will match the current posted speed of 25 MPH. The lower design speed allows for the vertical curves proposed along the alignment to better match into the existing topography and ROW.
- Driveway Width – the DCM allows for driveway widths (up to 7-plexes) of 28 feet, with restrictions; commercial driveways can be up to 34 feet wide. Many of the existing driveways exceed this width and are located on parcels with structures constructed before adoptions of the code that restricted driveway widths. Proposed driveway widths will need to match existing driveway widths when a reduced width would impede access to required on-site parking.
- Number of Driveways – The DCM requires frontages with 50 feet or less have one driveway; frontages of 50 feet to 1,000 feet may have up to two driveways; and frontages over 1,000 feet may have two or more driveways. This may not be reasonable given some of the existing lot and driveway configurations.
- Driveway landings and grades – The DCM requires that residential driveways have a minimum 12-foot landing length and a maximum grade of ±10%; commercial driveways must have a 20-foot landing length with a maximum driveway grade of ±8%. The grade of the landings must be 2% maximum. Some of the driveways will not be able to meet these landing or grade requirements due to existing infrastructure and grades.

- Driveway Corner Clearance – The DCM recommends that the minimum distance from the nearest face of curb of an intersecting public roadway to the nearest edge of driveway is 40 feet for a local roadway (with less than 10 vehicles per hour). Several existing driveways do not currently meet to this requirement. Driveways will typically be replaced in the same location because existing improvements on property restrict relocating the driveways.

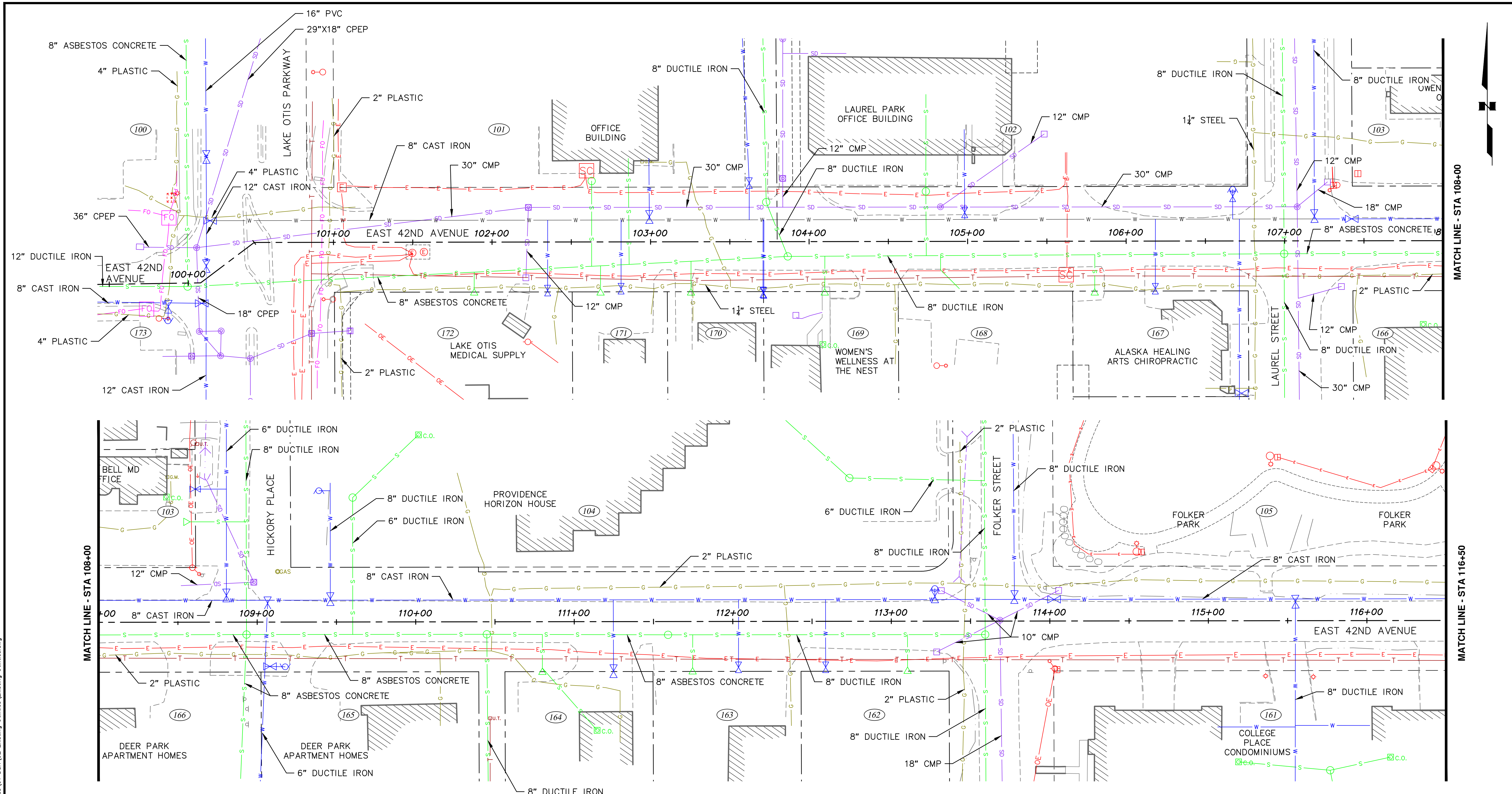
The following design variances from the DCM (ASM Volume 1) will be requested for the proposed storm drain improvements:

- Minimum cover over culvert – The ASM requires a minimum of 12 inches of cover over a culvert. The proposed driveway culverts (2 total) west of Lake Otis Parkway may not be able to meet this requirement due to existing driveway elevations. Cover will be maximized and additional mitigation measures will be evaluated to specify a culvert type that can support expected traffic loads without compromising the structural integrity of the culvert. These measures may include increasing the gauge thickness of the culvert or encasing the pipe in concrete to provide additional strength.
- Minimum Pipe Slope for Culverts – The ASM requires a minimum pipe slope of 0.5 percent for culverts. The proposed driveway culverts (2 total) west of Lake Otis Parkway will not be able to meet these grades due to relatively flat topography in the area and the proposed invert elevation of the outfall pipe west of Lake Otis Parkway. The open channels upstream and downstream of the culvert will be maximized to provide maximum conveyance capacity and minimize siltation. Based on the preliminary design, the culvert slopes will be 0.17 percent.
- Minimum Open Channel Slope – The ASM requires a minimum channel slope of 0.5 percent for conveyance channels that are not intended to provide stormwater treatment. Similar to the minimum pipe slopes for culverts, the open channels connecting the driveway culverts west of Lake Otis Parkway will not be able to meet the minimum grade due to topography limitations and the proposed invert of the outfall pipe. Based on the preliminary design, the channel slopes will match the driveway culvert slope of 0.17 percent. If the open channels are designed to provide water quality treatment, this design variance will not be required.
- Open Channel Freeboard – The ASM requires a minimum of one-foot of freeboard in an open channel during the design storm event. Due to existing topography and surrounding infrastructure, this requirement cannot be met. Based on the drainage analysis model during the 10-year conveyance design storm, available freeboard within the open channel west of Lake Otis Parkway is 0.7 feet between the eastern driveway culvert and western driveway culvert.

****** End Report ******

Existing Utilities Drawings

Appendix A



EXISTING UTILITY LEGEND

SANITARY SEWER	EDGE OF PAVEMENT
NATURAL GAS	PROPERTY LINE
WATER	EASMENT
STORM DRAIN	CONCRETE
FIBER OPTIC	SANITARY SEWER MANHOLE
CABLE TELEVISION	SANITARY SEWER SERVICE
CABLE TELEVISION (OVERHEAD)	SANITARY SEWER CLEANOUT
TELEPHONE	KEY BOX / WATER VALVE
TELEPHONE (OVERHEAD)	FIRE HYDRANT
ELECTRIC	WELL
ELECTRIC (OVERHEAD)	WATER VENT
ELECTRIC/CABLE (OVERHEAD)	STORM DRAIN CATCH BASIN
ELECTRIC/TELEPHONE/CABLE (OVERHEAD)	STORM DRAIN MANHOLE
ABANDON ELECTRIC LINE	STORM DRAIN CATCH BASIN MANHOLE
GRAVEL	FIBER OPTIC VAULT
CURB & GUTTER	

CABLE PEDESTAL	SATELLITE DISH
TELEPHONE PEDESTAL	PARCEL NUMBER
GAS METER	
FUEL VENT	
ELECTRIC JBOX	
ELECTRIC SWITCH CABINET	
LUMINAIRE	
LIGHT POLE	
POWERLINE POLE	
GUY WIRE	
LOAD CENTER	
JUNCTION BOX TYPE 1	
ELECTRIC MANHOLE	
ELECTRIC OUTLET	

30' 0 30' 60'

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MUNICIPALITY OF ANCHORAGE

PROJECT MANAGEMENT AND ENGINEERING DEPARTMENT

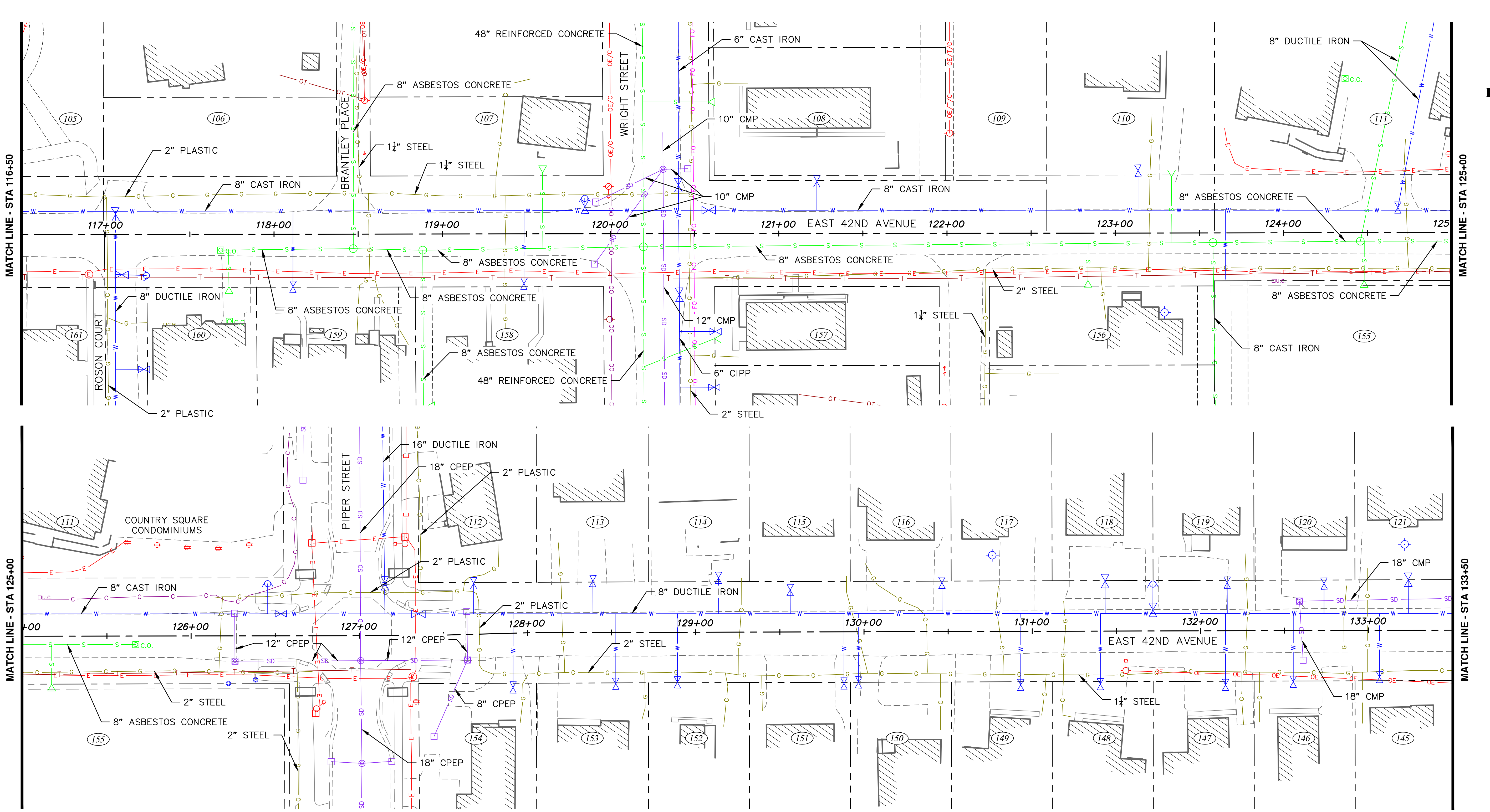
18-06

42ND AVE UPGRADE
LAKE OTIS PARKWAY TO FLORINA STREET

EXISTING UTILITIES

SCALE	HOR. 1"=30' VER. N/A	GRID SW1734, SW1735 DATE DEC 2020	STATUS DSR	SHEET A1 of A3

File:J:\JobsData\10142.00 42nd Avenue Upgrade\00 CADD\02 Figures\01 DSR\02 Existing Utilities\Existing Utilities.dwg



EXISTING UTILITY LEGEND

S	SANITARY SEWER
G	NATURAL GAS
W	WATER
SD	STORM DRAIN
FO	FIBER OPTIC
C	CABLE TELEVISION
OC	CABLE TELEVISION (OVERHEAD)
T	TELEPHONE
OT	TELEPHONE (OVERHEAD)
E	ELECTRIC
OE	ELECTRIC (OVERHEAD)
OE/C	ELECTRIC/CABLE (OVERHEAD)
OE/T/C	ELECTRIC/TELEPHONE/CABLE (OVERHEAD)
E B	ABANDON ELECTRIC LINE
	GRAVEL
	CURB & GUTTER
	EDGE OF PAVEMENT
	PROPERTY LINE
	EASMENT
	CONCRETE
	SANITARY SEWER MANHOLE
	SANITARY SEWER SERVICE
C.O.	SANITARY SEWER CLEANOUT
	KEY BOX / WATER VALVE
	FIRE HYDRANT
	WELL
	WATER VENT
	STORM DRAIN CATCH BASIN
	STORM DRAIN MANHOLE
	STORM DRAIN CATCH BASIN MANHOLE
FO	FIBER OPTIC VAULT
U.C.	CABLE PEDESTAL
U.T.	TELEPHONE PEDESTAL
G.M.	GAS METER
GAS	FUEL VENT
E	ELECTRIC JBOX
SC	ELECTRIC SWITCH CABINET
	LUMINAIRE
	LIGHT POLE
	POWERLINE POLE
	GUY WIRE
	LOAD CENTER
	JUNCTION BOX TYPE 1
E	ELECTRIC MANHOLE
	ELECTRIC OUTLET
	SATELLITE DISH
100	PARCEL NUMBER

30' 0 30' 60'

CRW ENGINEERING GROUP, LLC
3940 ARCTIC BLVD. SUITE 300
ANCHORAGE, ALASKA 99503
PHONE: (907) 562-3252
#AECL882-AK
CONSULTANT

MUNICIPALITY OF ANCHORAGE

PROJECT MANAGEMENT AND ENGINEERING DEPARTMENT

18-06
42ND AVE UPGRADE
LAKE OTIS PARKWAY TO FLORINA STREET

EXISTING UTILITIES

SCALE HOR. 1"=30' VER. N/A	GRID SW1734, SW1735		SHEET A2 of A3
	DATE DEC 2020	STATUS DSR	

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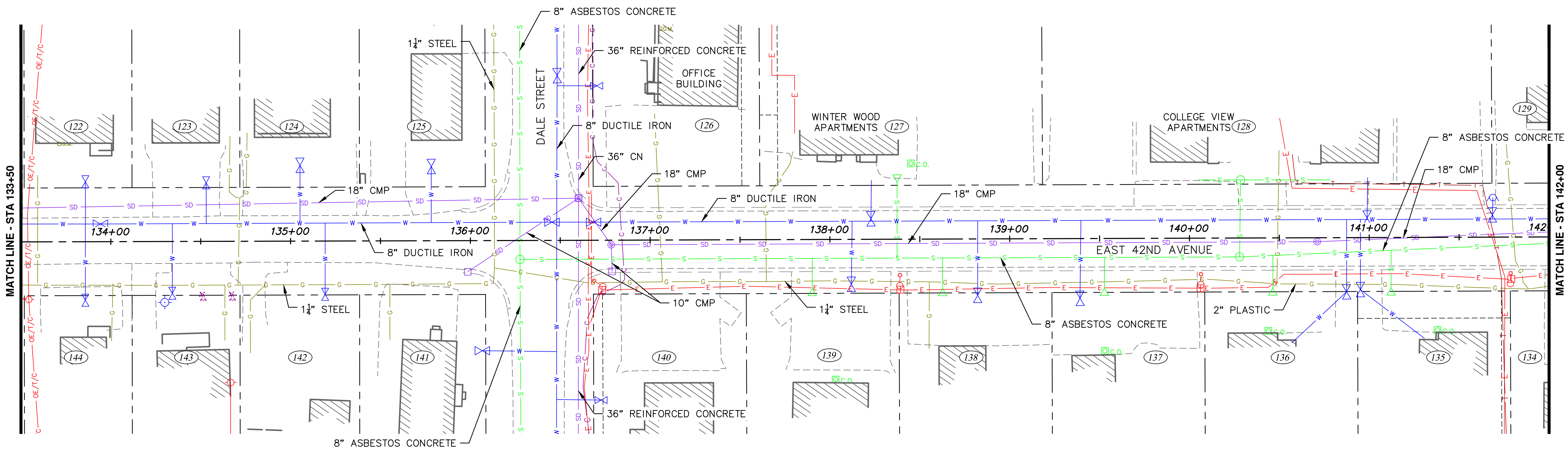

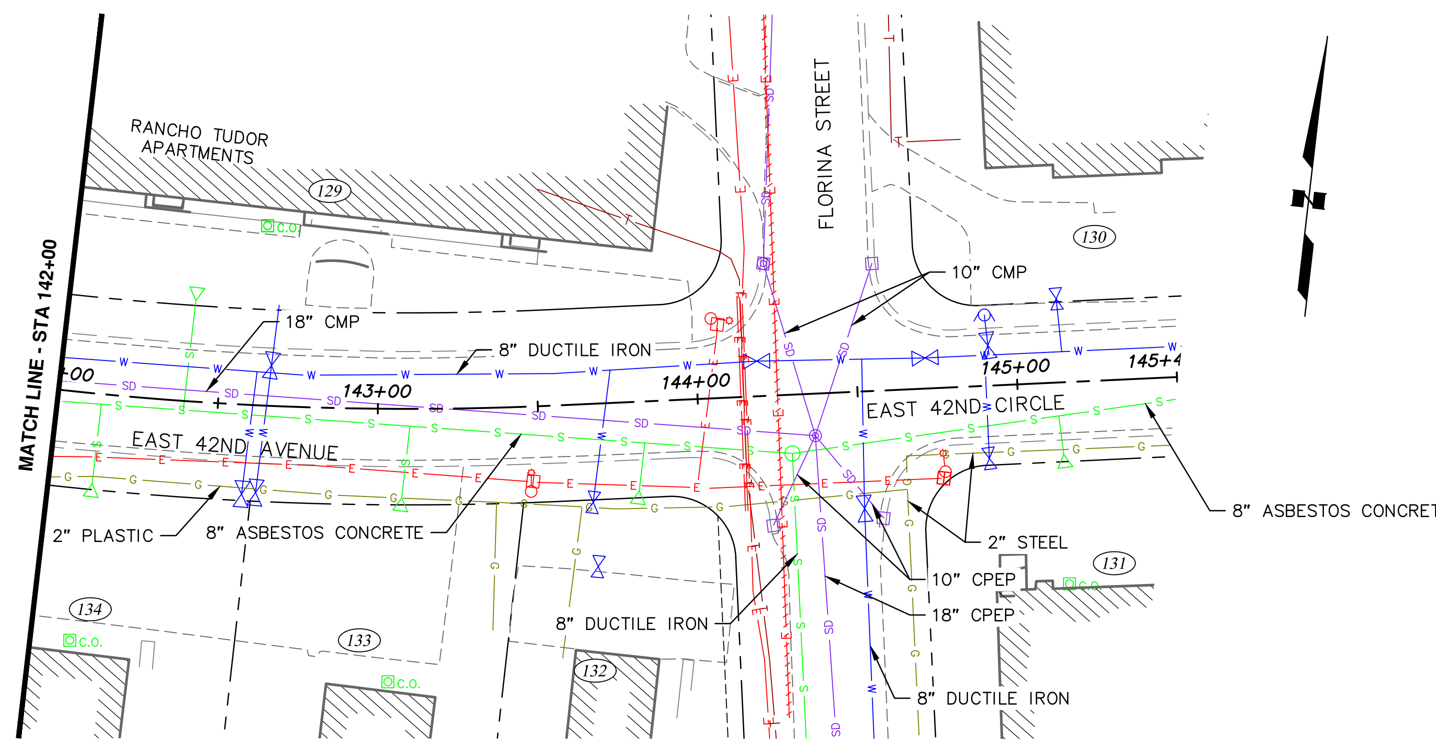

EXISTING UTILITY LEGEND

SANITARY SEWER
NATURAL GAS
WATER
STORM DRAIN
FIBER OPTIC
CABLE TELEVISION
CABLE TELEVISION (OVERHEAD)
TELEPHONE
TELEPHONE (OVERHEAD)
ELECTRIC
ELECTRIC (OVERHEAD)
ELECTRIC/CABLE (OVERHEAD)
ELECTRIC/TELEPHONE/CABLE (OVERHEAD)
ABANDON ELECTRIC LINE
GRAVEL
CURB & GUTTER

EDGE OF PAVEMENT
PROPERTY LINE
EASMENT
CONCRETE
SANITARY SEWER MANHOLE
SANITARY SEWER SERVICE
SANITARY SEWER CLEANOUT
KEY BOX / WATER VALVE
FIRE HYDRANT
WELL
WATER VENT
STORM DRAIN CATCH BASIN
STORM DRAIN MANHOLE
STORM DRAIN CATCH BASIN MANHOLE
FIBER OPTIC VAULT

CABLE PEDESTAL
TELEPHONE PEDESTAL
GAS METER
FUEL VENT
ELECTRIC JBOX
ELECTRIC SWITCH CABINET
LUMINAIRE
LIGHT POLE
POWERLINE POLE
GUY WIRE
LOAD CENTER
JUNCTION BOX TYPE 1
ELECTRIC MANHOLE
ELECTRIC OUTLET

SATELLITE DISH
PARCEL NUMBER

30' 0 30' 60'

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PROJECT MANAGEMENT AND ENGINEERING DEPARTMENT

18-06

42ND AVE UPGRADE
LAKE OTIS PARKWAY TO FLORINA STREET

EXISTING UTILITIES

SCALE	HOR. 1"=30' VER. N/A	GRID SW1734, SW1735		SHEET A3 of A3
		DATE DEC 2020	STATUS DSR	

File:J:\JobsData\10142.00 42nd Avenue Upgrade\00 CADD\02 Figures\01 DSR\02 Existing Utilities\Existing Utilities.dwg

Roadway Plan & Profile Drawings

Appendix B

PLAN LEGEND

PROPERTY

EXISTING	PROPOSED	DESCRIPTION
		CENTERLINE
		EASEMENT LINE
		PROPERTY LINE
		ROW LINE
		SECTION LINE
		TEMPORARY CONSTRUCTION EASEMENT/PERMIT

UTILITY

EXISTING	PROPOSED	DESCRIPTION
		ABANDONED UTILITY
C		CABLE TV LINE (UNDERGROUND)
OC		CABLE TV LINE (OVERHEAD)
U.C.		CABLE TV PEDESTAL
		CONTROLLER OR ATR CABINET
		CULVERT
		DRY WELL
E		ELECTRIC LINE (UNDERGROUND)
OE		ELECTRIC LINE (OVERHEAD)
OEC		ELECTRIC & CABLE TV LINE (OVERHEAD)
OET		ELECTRIC & TELEPHONE LINE (OVERHEAD)
		ELECTRIC JB TYPE IA
		ELECTRIC JB TYPE II
		ELECTRIC JB TYPE III
		ELECTRIC LOAD CENTER
E		ELECTRIC MANHOLE/JB
E.M.		ELECTRIC METER
U.E.		ELECTRIC PEDESTAL UNDERGROUND
		ELECTRIC SIGN
SC		ELECTRIC SWITCH CABINET
T		ELECTRIC TRANSFORMER
E		ELECTRIC VAULT
FO		FIBER OPTIC LINE (UNDERGROUND)
FO		FIBER OPTIC VAULT
FD		FLOOR DRAIN
FS	FS	FOOTING DRAIN SERVICE LINE
FS	FS	FOOTING DRAIN SERVICE CONNECTION
G		GAS LINE
G.M.		GAS METER
		GAS VALVE
		GUY POLE
		GUY ANCHOR
		JOINT USE ELECTRIC & TELEPHONE POLE
L		LIGHTING LINE
		LUMINAIRE
		LUMINAIRE (PEDESTRIAN)
S	S	SANITARY SEWER LINE
		SANITARY SEWER MANHOLE
		SANITARY SEWER SERVICE CONNECTION
C.O.		SANITARY SEWER CLEANOUT
SD	SD	STORM DRAIN LINE
SB	SB	SUBDRAIN LINE
		STORM DRAIN CATCH BASIN
		STORM DRAIN CATCH BASIN MANHOLE OR MH
		STORM DRAIN MANHOLE
		STUBOUT CAPPED OR PLUGGED END
OHT/C		TELEPHONE & CABLE TV LINE (OVERHEAD)
OT		TELEPHONE LINE (OVERHEAD)

UTILITY

EXISTING	PROPOSED	DESCRIPTION
T		TELEPHONE LINE (UNDERGROUND)
T		TELEPHONE MANHOLE
U.T.		TELEPHONE PEDESTAL
413	414	TRAFFIC DETECTOR LOOPS
		TRAFFIC LINE (UNDERGROUND)
S	S	TRAFFIC SIGNAL POLE
S	S	TRAFFIC SIGNAL POLE/LUMINAIRE
		UTILITY POLE
W	W	WATER LINE
		WATER FIRE HYDRANT
		WATER KEY BOX
W		WATER MANHOLE
		WATER VALVE
		WATER WELL

ROADWAY

EXISTING	PROPOSED	DESCRIPTION
		APPROX SLOPE LIMITS (CUT)
		APPROX SLOPE LIMITS (FILL)
		CURB & GUTTER
		EDGE OF PAVEMENT
		EDGE OF SIDEWALK/CONCRETE
		GUARDRAIL, BARRIER RAIL
		INTERLOCKING CONCRETE PAVERS
		RETAINING WALL (TYPE VARIES)
		STREET SIGN
		UNPAVED (GRAVEL) EDGE OF ROAD/DWY

MISCELLANEOUS

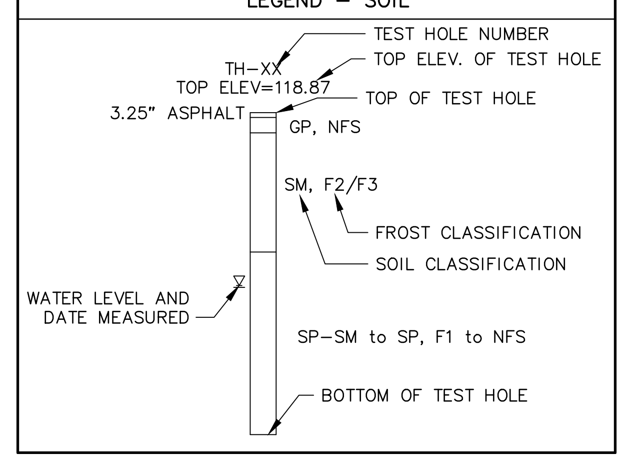
EXISTING	PROPOSED	DESCRIPTION
		BLUFF AREA/ EARTHWORK SLOPE
		BOULDER
		DECK
		DRAINAGE ARROW (DIRECTION OF FLOW)
		DRAINAGE SWALE
		FENCE (TYPE VARIES)
		FENCE (DECORATIVE)
		HOUSE OR STRUCTURE
		LANDSCAPING ROCK
M.B.	M.B.	MAILBOX (INDIVIDUAL)
		MAILBOX (CLUSTER)
N.B.		NEWS BOX
P		PARKING METER
	1	PARCEL NUMBERS
		RIPRAP (CLASS I)
		STREAM SUBSTRATE
		STREAM/EDGE OF WATERWAY
		TREE/SHRUB (CONIFEROUS)
		TREE/SHRUB (DECIDUOUS)
		TEST BORING OR TEST HOLE
		VEGETATION & BRUSH

PROFILE LEGEND

SYMBOL

EXISTING	PROPOSED	DESCRIPTION
		APPROXIMATE EXCAVATION LIMITS
		EXISTING GROUND OVER PIPE
	0.00%	GRADE AT CENTER LINE
		GRADE AT LEFT ROW
		GRADE AT RIGHT ROW
		PIPE (PROFILE)
		PIPE (SECTION)
		STORM DRAIN CATCH BASIN/OGS
		STORM DRAIN/SANITARY SEWER MANHOLE & PIPE
UTILITY CROSSING		UTILITY CROSSING (WATER/SEWER/STORM DRAIN)
C		UTILITY CROSSING (CABLE)
E		UTILITY CROSSING (ELECTRIC)
FO		UTILITY CROSSING (FIBER OPTIC)
G		UTILITY CROSSING (GAS)
T		UTILITY CROSSING (TELEPHONE)
		INSULATION
		RIPRAP (CLASS I)
		STREAM SUBSTRATE

LEGEND - SOIL



NOTES:

1. STANDARD LEGEND AND ABBREVIATIONS SHOWN. NOT ALL LEGEND ITEMS AND ABBREVIATIONS ARE PART OF THIS CONTRACT.
2. SOIL CLASSIFICATION IS BASED UPON UNIFIED SOIL CLASSIFICATION (ASTM D 2487-00), SEE GEOTECHNICAL SOIL BORING LOGS FOR MORE INFORMATION.
3. SEE LEGEND ON SHEET V1 FOR SURVEY CONTROL SYMBOLS. ADDITIONAL LEGEND AND ABBREVIATION ITEMS NOT SHOWN HERE ARE PROVIDED ON SPECIFIC SHEETS THROUGHOUT THE DRAWINGS.

COMMON ABBREVIATIONS

ABBR.	DESCRIPTION	ABBR.	DESCRIPTION
AC	ASPHALT CONCRETE	OC	ON CENTER
AC	ASBESTOS CONCRETE	OCEW	ON CENTER EACH WAY
APPROX/ APPX	APPROXIMATE	OD	OUTSIDE DIAMETER
		OGS	OIL AND GRIT SEPARATOR
BM	BENCH MARK	OH	OVERHEAD
BOP	BEGINNING OF PROJECT	PC	POINT OF CURVATURE
C&G	CURB AND GUTTER	PCC	PORTLAND CONCRETE CEMENT/ POINT OF CONTINUOUS CURVATURE
CB	CATCH BASIN		
CBMH	CATCH BASIN MANHOLE	PI	POINT OF INTERSECTION
CI	CAST IRON	PL, P/L	PROPERTY LINE
C/L, CL	CENTERLINE	PCMP	PRECOATED CORRUGATED METAL PIPE
CMP	CORRUGATED METAL PIPE	PCPEP	PERFORATED CORRUGATED POLYETHYLENE PIPE
CO	CLEANOUT		
CONST	CONSTRUCTION	PSL	POSTED SPEED LIMIT
CPEP	CORRUGATED POLYETHYLENE PIPE	PT	POINT OF TANGENCY
CY	CUBIC YARD	PUE	PUBLIC USE EASEMENT
DIA	DIAMETER	PVC	POINT OF VERTICAL CURVATURE
DI	DUCTILE IRON	PVC	POLYVINYL CHLORIDE
DW	DETECTABLE WARNING	PVI	POINT OF VERTICAL INTERSECTION
DWY	DRIVEWAY	PVT	POINT OF VERTICAL TANGENT
E	EAST	REINF	REINFORCEMENT
ELEC	ELECTRIC / ELECTRICAL	ROW, R/W	RIGHT OF WAY
ELEV, EL	ELEVATION	RT, R	RIGHT
EOP	END OF PROJECT / EDGE OF PAVEMENT	S	SOUTH
F&I	FURNISH AND INSTALL	S/W	SIDEWALK
FG	FINISHED GRADE	SS	STAINLESS STEEL
GA	GAUGE	SEC COR	SECTION CORNER
GALV	GALVANIZED	SF	SQUARE FOOT
GB	GRADE BREAK	SI	STREET INTERSECTION
JB	JUNCTION BOX	ST	STREET
LC	LOAD CENTER	STA	STATION / STATIONING
IAW	IN ACCORDANCE WITH	STD	STANDARD
ID	INSIDE DIAMETER	STRUCT	STRUCTURE
IE	INVERT ELEVATION	TBC	TOP BACK OF CURB
INTX	INTERSECTION	TBM	TEMPORARY BENCH MARK
INV	INVERT	TCP	TEMPORARY CONSTRUCTION PERMIT/ TRAFFIC CONTROL PLAN
KB	KEYBOX		
LF	LINEAR FOOT	TELE	TELEPHONE
LT, L	LEFT	TH	TEST HOLE
LUM	LUMINAIRE	TW	TOP OF WALL
MAX	MAXIMUM	TYP	TYPICAL
ME	MATCH EXISTING	UG	UNDERGROUND
MH	MANHOLE	UON	UNLESS OTHERWISE NOTED
MIN	MINIMUM	UTIL	UTILITY
MON	MONUMENT	VERT	VERTICAL
MSL	MEAN SEA LEVEL	VB	VALVE BOX
N	NORTH	VC	VERTICAL CURVE
N/A	NOT APPLICABLE	W	WEST
N.I.C.	NOT IN CONTRACT	W/	WITH
NTS	NOT TO SCALE		
NWT	NO WATER TABLE		

RECORD DRAWING

1. DATA PROVIDED BY: ____ TITLE: ____
   THIS WILL SERVE TO CERTIFY THAT THESE RECORD DRAWINGS ARE A TRUE AND ACCURATE REPRESENTATION OF THE PROJECT AS CONSTRUCTED.
   CONTRACTOR: ____
   BY: ____ TITLE: ____ DATE: ____
2. DATA TRANSFERRED BY: ____ TITLE: ____
   COMPANY: ____ DATE: ____
3. BASED ON PERIODIC FIELD OBSERVATIONS BY THE ENGINEER (OR AN INDIVIDUAL UNDER HIS/HER DIRECT SUPERVISION), THE CONTRACTOR-PROVIDED DATA APPEARS TO REPRESENT THE PROJECT AS CONSTRUCTED.
   DATA TRANSFER CHECKED BY: ____ TITLE: ____
   COMPANY: ____ DATE: ____
   BY: ____

PLAN CHECK

DATA	DRAWN BY	CHECKED BY
BASE	—	—
TOPOGRAPHY	—	—
PROFILE	—	—
STORM SEWER	—	—
WATER/SANITARY SEWER	—	—
GAS	—	—
TELEPHONE	—	—
ELECTRIC	—	—
DESIGN	—	—
QUANTITIES	—	—
PRELIMINARY/FINAL	—	—
MUNICIPAL/STATE	—	—

CONSTRUCTION RECORD

FIELD BOOKS
DESIGN MOA BOOK No. xxxx, xxxx,
xxxx, xxxx, xxxx & xxxx
STAKING
ASBUILT
CONTRACTOR
INSPECTOR

VERTICAL DATUM

BM NO.	LOCATION	ELEV.
GAAB xx	See MOA Benchmark Book, Page x-x	xxx.xx
GAAB xx	See MOA Benchmark Book, Page x-x	xxx.xx

BASIS OF THIS DATUM GAAB 1972 ADJUST

REVISIONS

REV	DATE	DESCRIPTION	BY

CONSULTANT

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ANCHORAGE, ALASKA 99503
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#AECL882-AK

SEAL

MUNICIPALITY OF ANCHORAGE

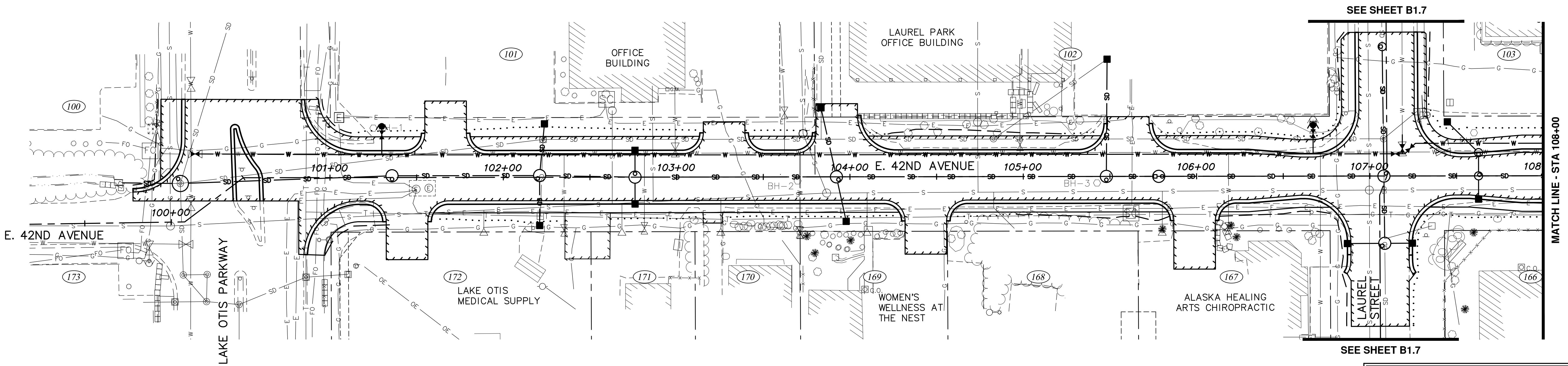
PROJECT MANAGEMENT AND ENGINEERING DEPARTMENT

18-06 42ND AVENUE UPGRADE ALL
LAKE OTIS PARKWAY TO FLORINA STREET

LEGEND & ABBREVIATIONS

SCALE HOR. N/A VER. N/A | GRID SW1733, SW1734, SW1735 | DATE DEC 2020 | STATUS DSR | SHEET B1.0 of B1.11

File: J:\JobsData\10142.00 42nd Avenue Upgrade\00 CADD\01 Working Set\01 Civil\10142.00 Legend & Abbreviations.dwg



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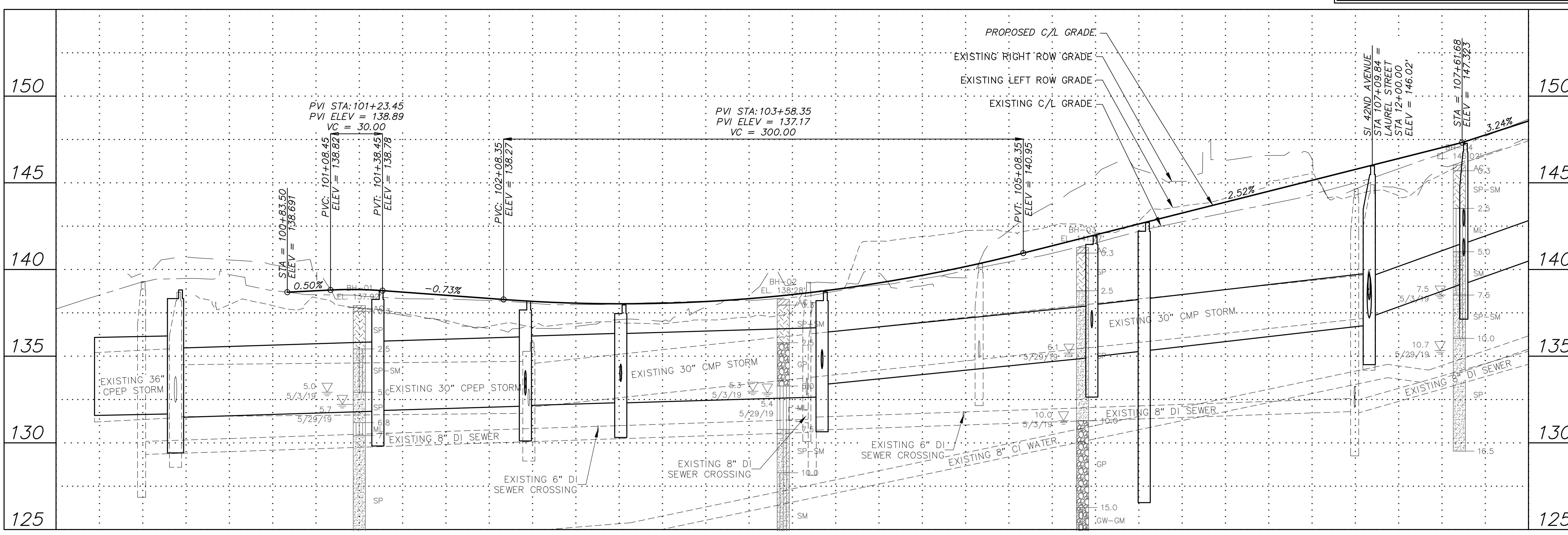
PREFERRED ALTERNATIVE



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   COMPANY: ______ DATE: ______
   BY: ______

DATA	DRAWN BY	CHECKED BY
BASE		
TOPOGRAPHY		
PROFILE		
STORM SEWER		
WATER/SANITARY SEWER		
GAS		
TELEPHONE		
ELECTRIC		
DESIGN		
QUANTITIES		
PRELIMINARY/FINAL		
MUNICIPAL/STATE		
PLAN CHECK		

GRAPHIC SCALE 60 30 0 30 60

FIELD BOOKS	
DESIGN	
STAKING	
ASBUILT	
CONTRACTOR	
INSPECTOR	
CONSTRUCTION RECORD	

BM NO.	LOCATION	ELEV.
BASIS OF THIS DATUM		
VERTICAL DATUM		

REV	DATE	DESCRIPTION	BY
REVISIONS			

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PROJECT MANAGEMENT AND ENGINEERING DEPARTMENT

18-06 | 42ND AVENUE UPGRADE | SCHED A
LAKE OTIS PARKWAY TO FLORINA STREET

ROADWAY PLAN & PROFILE

BOP TO STA 108+00

SCALE HOR. 1"=30' VER. 1"=3'
GRID SW1733, SW1734, SW1735
DATE DEC 2020
STATUS DSR
SHEET B1.1 of B1.11

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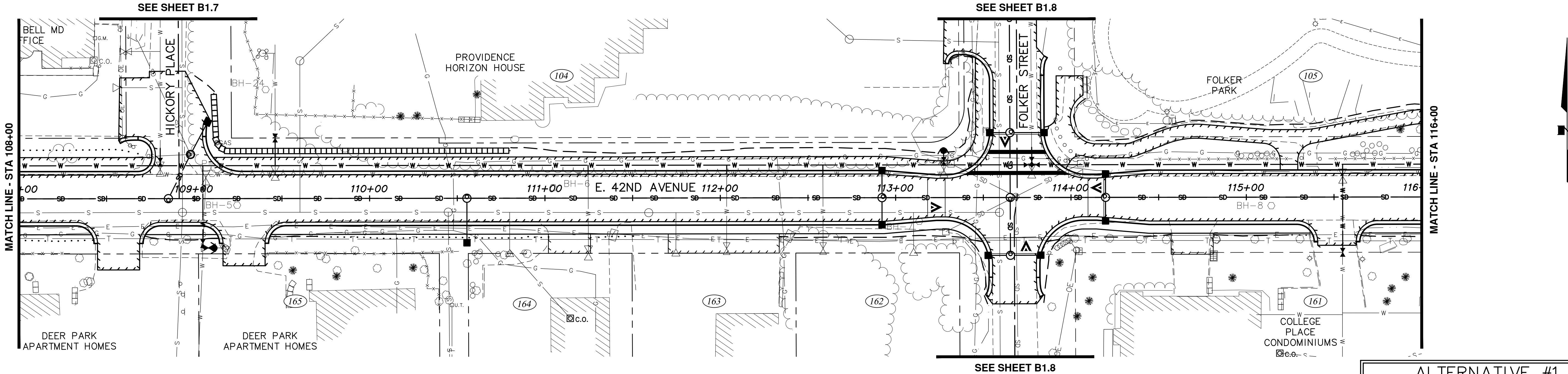

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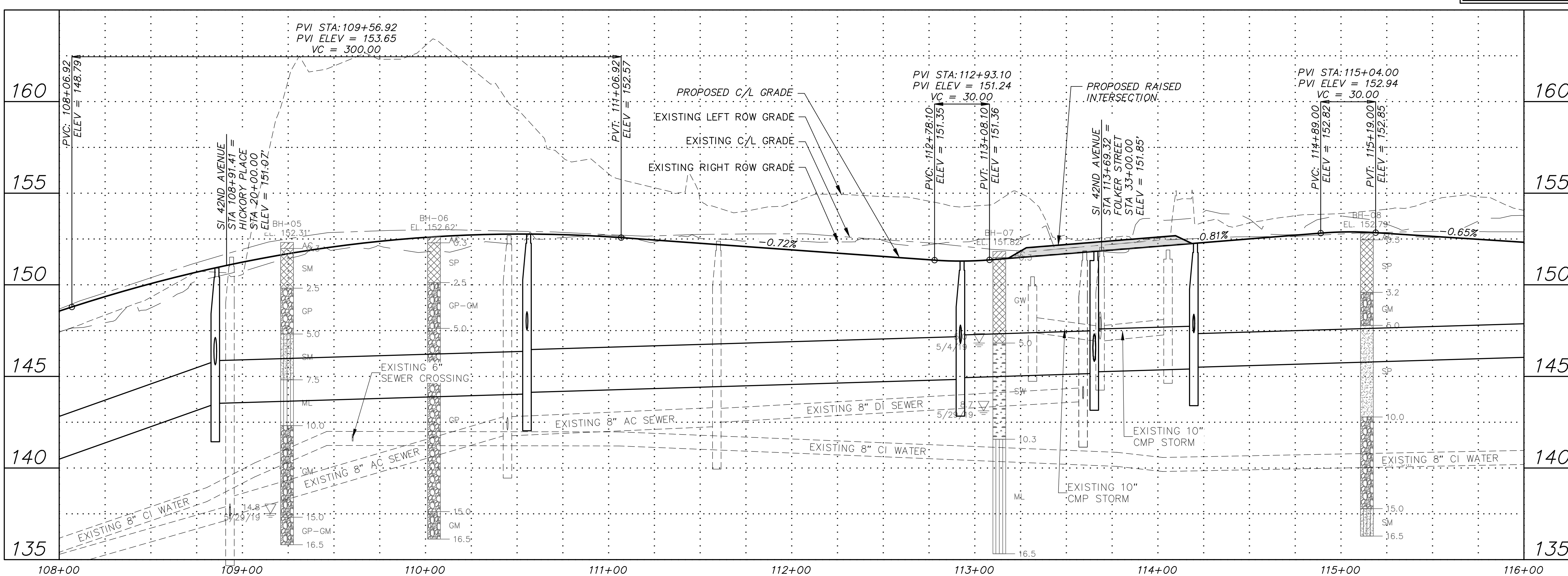

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COMPANY: ________ DATE: ________
BY: ________

DATA	DRAWN BY	CHECKED BY
BASE		
TOPOGRAPHY		
PROFILE		
STORM SEWER		
WATER/SANITARY SEWER		
GAS		
TELEPHONE		
ELECTRIC		
DESIGN		
QUANTITIES		
PRELIMINARY/FINAL		
MUNICIPAL/STATE		
PLAN CHECK		

GRAPHIC 60 30 0 30 60 SCALE

FIELD BOOKS	
DESIGN	
STAKING	
ASBUILT	
CONTRACTOR	
INSPECTOR	
CONSTRUCTION RECORD	

BM NO.	LOCATION	ELEV.
	BASIS OF THIS DATUM	
VERTICAL DATUM		

REV	DATE	DESCRIPTION	BY
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PROJECT MANAGEMENT AND ENGINEERING DEPARTMENT

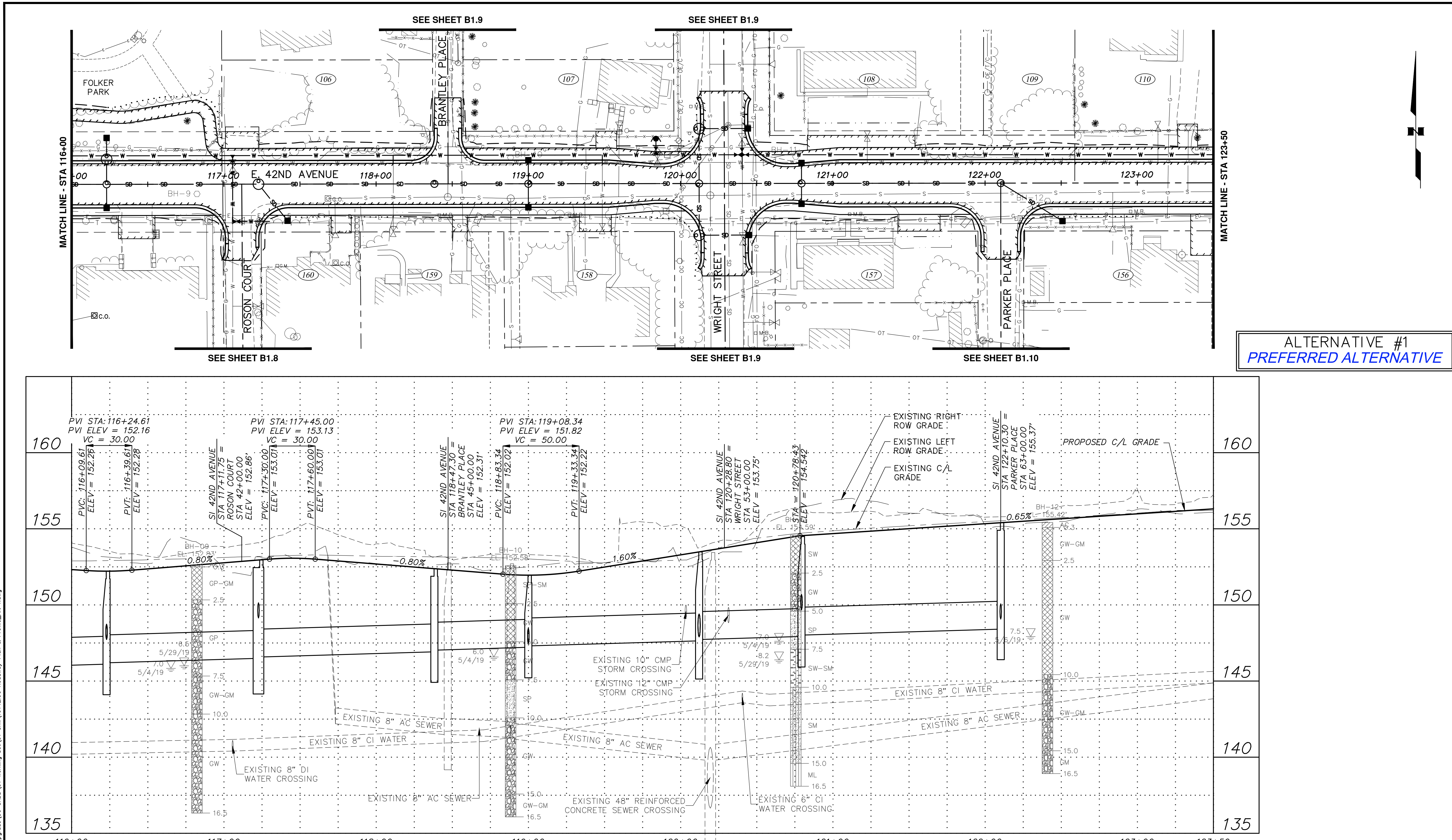
18-06 42ND AVENUE UPGRADE
LAKE OTIS PARKWAY TO FLORINA STREET SCHED A

ROADWAY PLAN & PROFILE

STA 108+00 TO STA 116+00

SCALE HOR. 1"=30' VER. 1"=3' | GRID SW1733, SW1734, SW1735 | DATE DEC 2020 | STATUS DSR | SHEET B1.2 of B1.11

File: J:\JobsData\10142.00 42nd Avenue Upgrade\00 CADD\01 Working Set\01 Civil\10142.00 Roadway-Plan & Profile_Alt 1.dwg



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   BY: ______

DATA	DRAWN BY	CHECKED BY
BASE		
TOPOGRAPHY		
PROFILE		
STORM SEWER		
WATER/SANITARY SEWER		
GAS		
TELEPHONE		
ELECTRIC		
DESIGN		
QUANTITIES		
PRELIMINARY/FINAL		
MUNICIPAL/STATE		

PLAN CHECK

GRAPHIC SCALE 60 30 0 30 60

FIELD BOOKS	
DESIGN	
STAKING	
ASBUILT	
CONTRACTOR	
INSPECTOR	

CONSTRUCTION RECORD

BM NO.	LOCATION	ELEV.

BASIS OF THIS DATUM

VERTICAL DATUM

REV	DATE	DESCRIPTION	BY

REVISIONS

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18-06 42ND AVENUE UPGRADE SCHED A
LAKE OTIS PARKWAY TO FLORINA STREET

ROADWAY PLAN & PROFILE

STA 116+00 TO STA 123+50

SCALE HOR. 1"=30' VER. 1"=3'
GRID SW1733, SW1734, SW1735
DATE DEC 2020 STATUS DSR
SHEET B1.3 of B1.11

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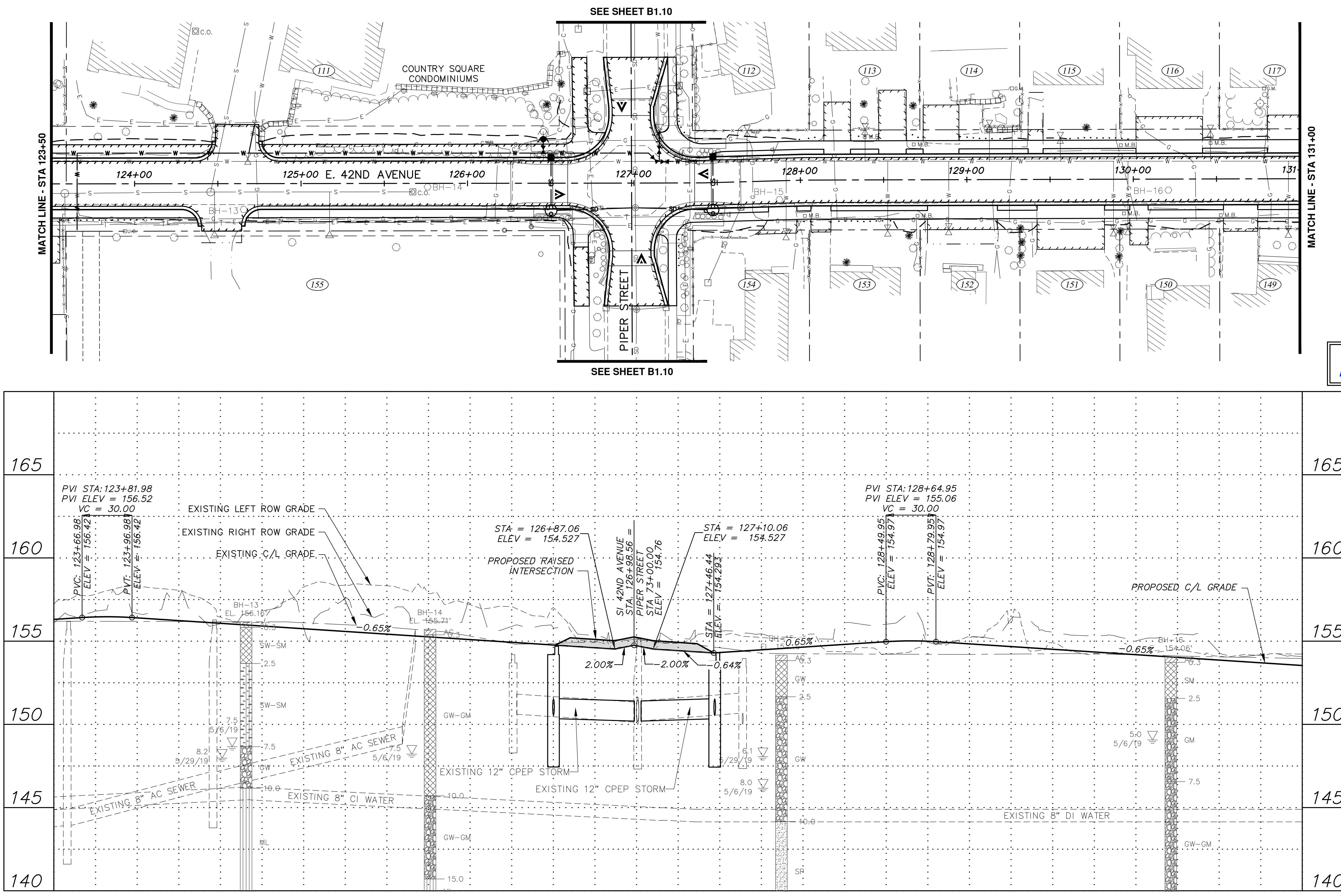

ALTERNATIVE #1
PREFERRED ALTERNATIVE

RECORD DRAWING

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DATA	DRAWN BY	CHECKED BY
BASE		
TOPOGRAPHY		
PROFILE		
STORM SEWER		
WATER/SANITARY SEWER		
GAS		
TELEPHONE		
ELECTRIC		
DESIGN		
QUANTITIES		
PRELIMINARY/FINAL		
MUNICIPAL/STATE		

PLAN CHECK

GRAPHIC 60 30 0 30 60 SCALE

FIELD BOOKS	BM NO.	LOCATION	ELEV.
DESIGN			
STAKING			
ASBUILT			
CONTRACTOR	BASIS OF THIS DATUM		
INSPECTOR			

CONSTRUCTION RECORD — VERTICAL DATUM

REV	DATE	DESCRIPTION	BY

REVISIONS

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ANCHORAGE, ALASKA 99503
PHONE: (907) 562-3252
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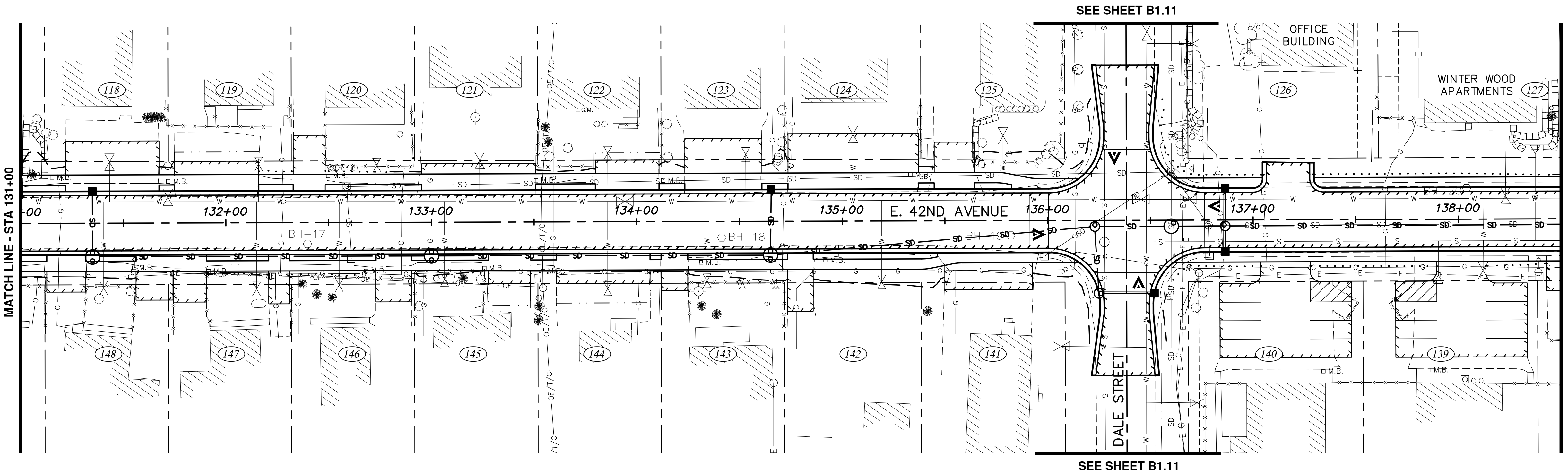
18-06 — 42ND AVENUE UPGRADE — SCHED A
LAKE OTIS PARKWAY TO FLORINA STREET

ROADWAY PLAN & PROFILE

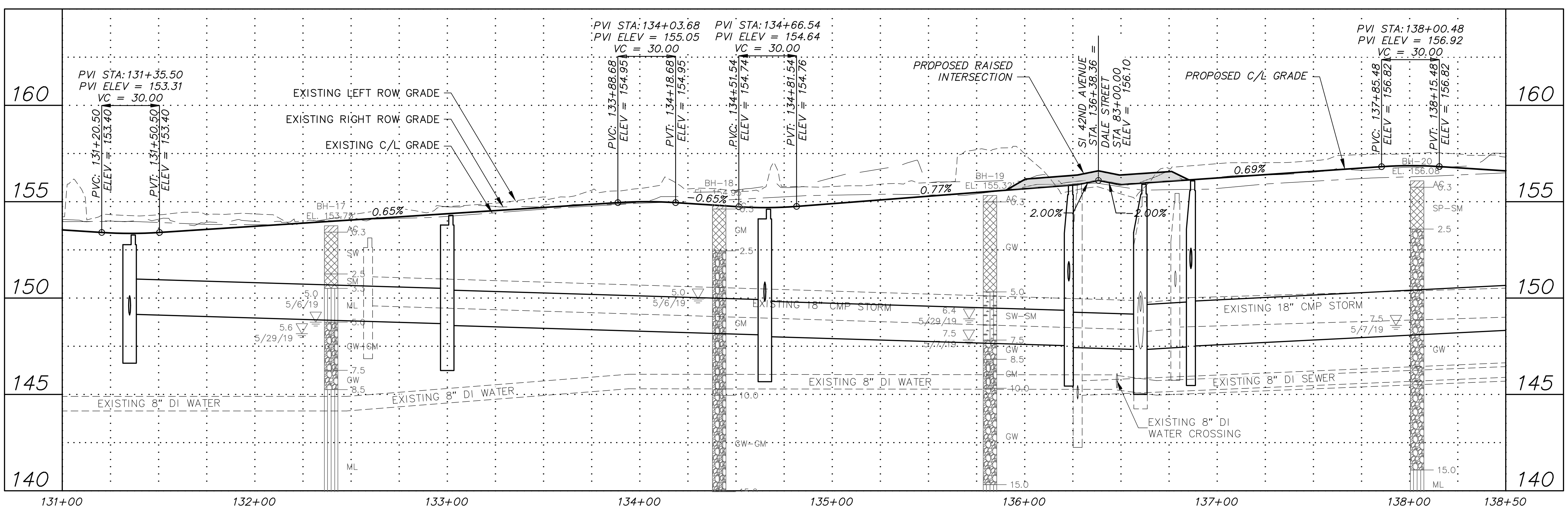
STA 123+50 TO STA 131+00

SCALE HOR. 1"=30' VER. 1"=3' | GRID SW1733, SW1734, SW1735 | DATE DEC 2020 | STATUS DSR | SHEET B1.4 of B1.11

File: J:\JobsData\10142.00 42nd Avenue Upgrade\00 CADD\01 Working Set\01 Civil\10142.00 Roadway-Plan & Profile_Alt 1.dwg



ALTERNATIVE #1
PREFERRED ALTERNATIVE



RECORD DRAWING

1. DATA PROVIDED BY:____ TITLE:____
THIS WILL SERVE TO CERTIFY THAT THESE RECORD DRAWINGS ARE A TRUE AND ACCURATE REPRESENTATION OF THE PROJECT AS CONSTRUCTED.
CONTRACTOR:____
BY:____ TITLE:____ DATE:____
2. DATA TRANSFERRED BY:____ TITLE:____
COMPANY:____ DATE:____
3. BASED ON PERIODIC FIELD OBSERVATIONS BY THE ENGINEER (OR AN INDIVIDUAL UNDER HIS/HER DIRECT SUPERVISION), THE CONTRACTOR-PROVIDED DATA APPEARS TO REPRESENT THE PROJECT AS CONSTRUCTED.
DATA TRANSFER CHECKED BY:____ TITLE:____
COMPANY:____ DATE:____
BY:____

DATA	DRAWN BY	CHECKED BY
BASE		
TOPOGRAPHY		
PROFILE		
STORM SEWER		
WATER/SANITARY SEWER		
GAS		
TELEPHONE		
ELECTRIC		
DESIGN		
QUANTITIES		
PRELIMINARY/FINAL		
MUNICIPAL/STATE		

PLAN CHECK

GRAPHIC 60 30 0 30 60 SCALE

FIELD BOOKS	
DESIGN	
STAKING	
ASBUILT	
CONTRACTOR	
INSPECTOR	

CONSTRUCTION RECORD

BM NO.	LOCATION	ELEV.
	BASIS OF THIS DATUM	

VERTICAL DATUM

REV	DATE	DESCRIPTION	BY

REVISIONS

CRW ENGINEERING GROUP, LLC
3940 ARCTIC BLVD. SUITE 300
ANCHORAGE, ALASKA 99503
PHONE: (907) 562-3252
#AECL882-AK

CONSULTANT

SEAL

MUNICIPALITY OF ANCHORAGE

PROJECT MANAGEMENT AND ENGINEERING DEPARTMENT

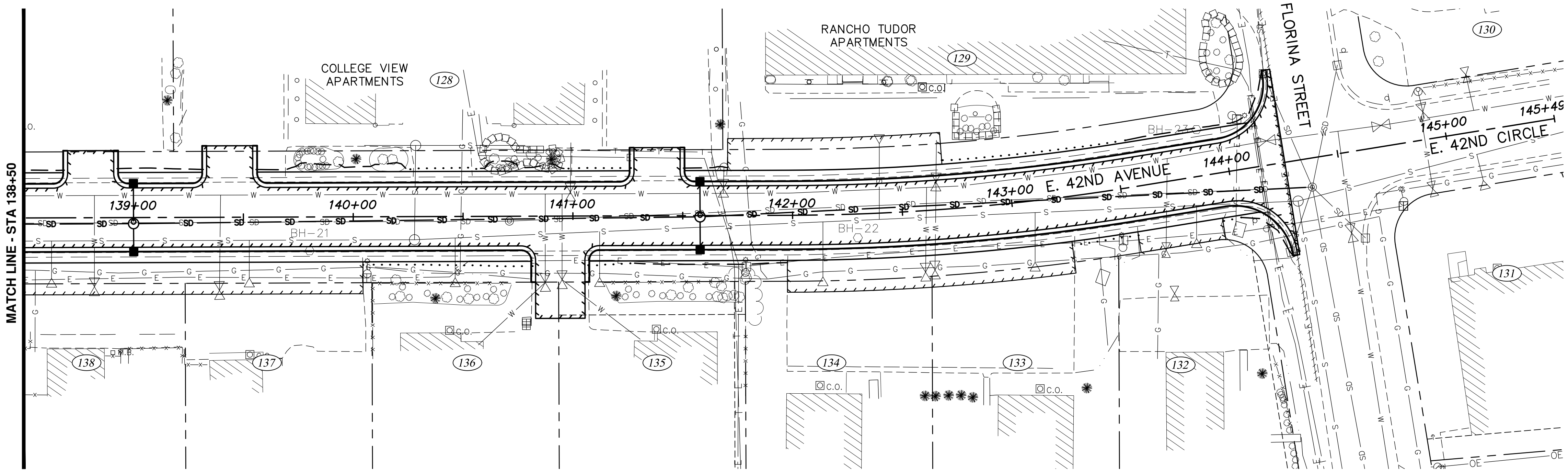
18-06 42ND AVENUE UPGRADE LAKE OTIS PARKWAY TO FLORINA STREET SCHED A

ROADWAY PLAN & PROFILE

STA 131+00 TO STA 138+50

SCALE HOR. 1"=30' VER. 1"=3' | GRID SW1733, SW1734, SW1735 | DATE DEC 2020 | STATUS DSR | SHEET B1.5 of B1.11

File:J:\JobsData\10142.00 42nd Avenue Upgrade\00 CADD\01 Working Set\01 Civil\10142.00 Roadway-Plan & Profile_Alt 1.dwg



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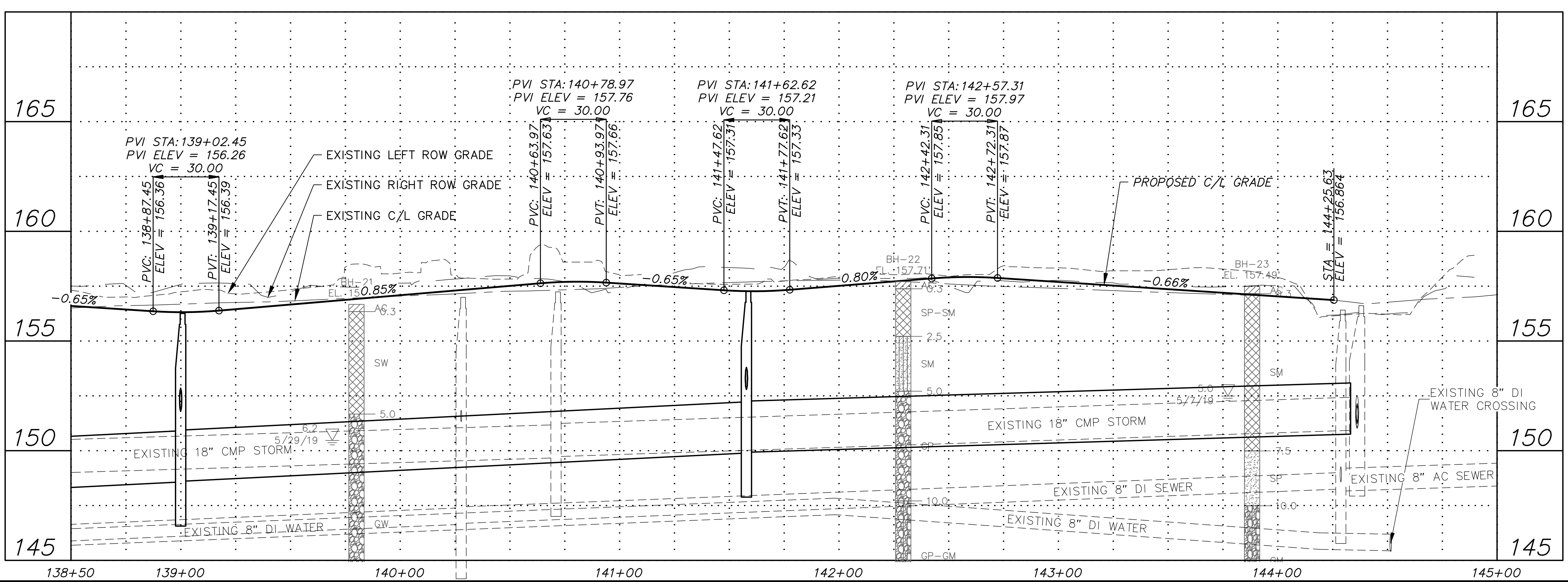
PREFERRED ALTERNATIVE



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CONTRACTOR: ____
BY: ____ TITLE: ____ DATE: ____
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COMPANY: ____ DATE: ____
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DATA TRANSFER CHECKED BY: ____ TITLE: ____
COMPANY: ____ DATE: ____
BY: ____

DATA	DRAWN BY	CHECKED BY
BASE		
TOPOGRAPHY		
PROFILE		
STORM SEWER		
WATER/SANITARY SEWER		
GAS		
TELEPHONE		
ELECTRIC		
DESIGN		
QUANTITIES		
PRELIMINARY/FINAL		
MUNICIPAL/STATE		
PLAN CHECK		

GRAPHIC SCALE 60 30 0 30 60

FIELD BOOKS	
DESIGN	
STAKING	
ASBUILT	
CONTRACTOR	
INSPECTOR	
CONSTRUCTION RECORD	

BM NO.	LOCATION	ELEV.
	BASIS OF THIS DATUM	
VERTICAL DATUM		

REV	DATE	DESCRIPTION	BY
REVISIONS			

CRW ENGINEERING GROUP, LLC
3940 ARCTIC BLVD. SUITE 300
ANCHORAGE, ALASKA 99503
PHONE: (907) 562-3252
#AECL882-AK
CONSULTANT

SEAL

MUNICIPALITY OF ANCHORAGE

PROJECT MANAGEMENT AND ENGINEERING DEPARTMENT

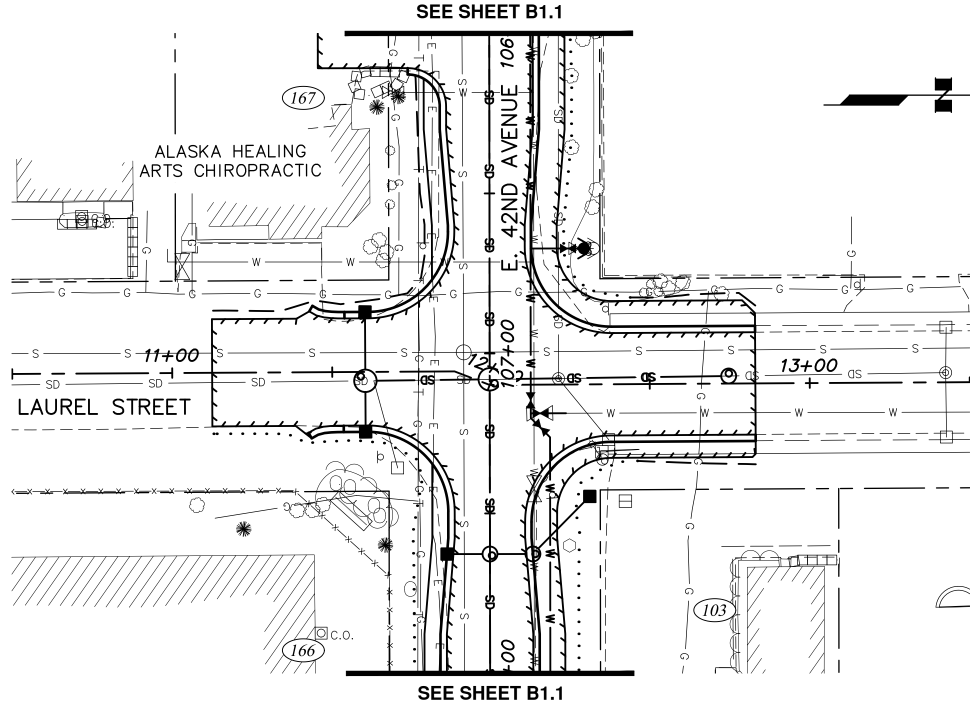
18-06 42ND AVENUE UPGRADE LAKE OTIS PARKWAY TO FLORINA STREET SCHED A

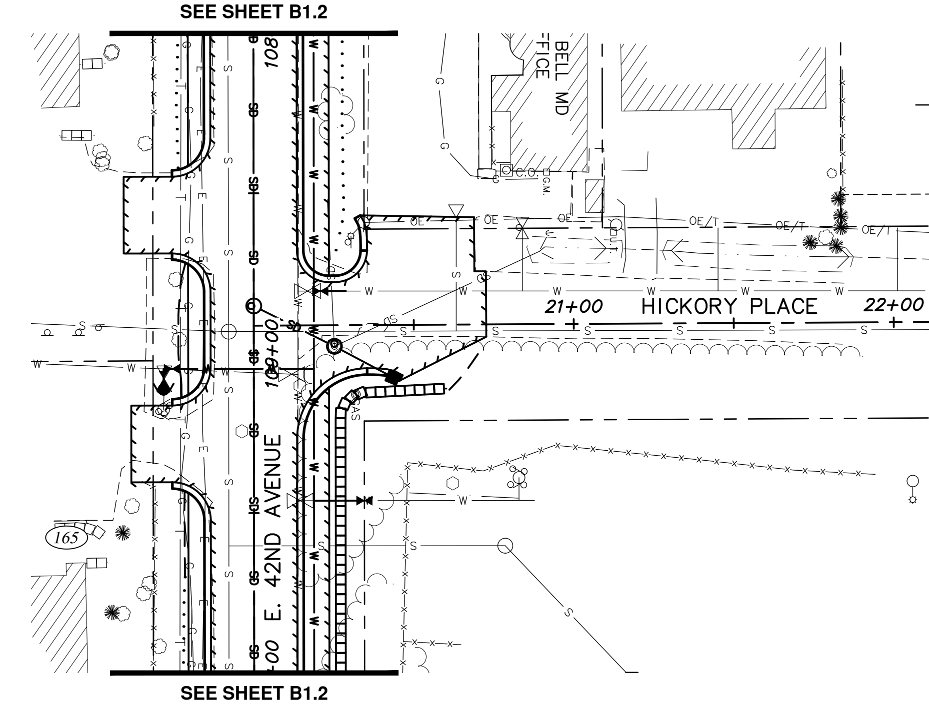
ROADWAY PLAN & PROFILE

STA 138+50 TO EOP

SCALE HOR. 1"=30' VER. 1"=3' | GRID SW1733, SW1734, SW1735 | DATE DEC 2020 | STATUS DSR | SHEET B1.6 of B1.11

File: J:\JobsData\10142.00 42nd Avenue Upgrade\00 CADD\01 Working Set\01 Civil\10142.00 Roadway-Plan & Profile_Alt 1.dwg





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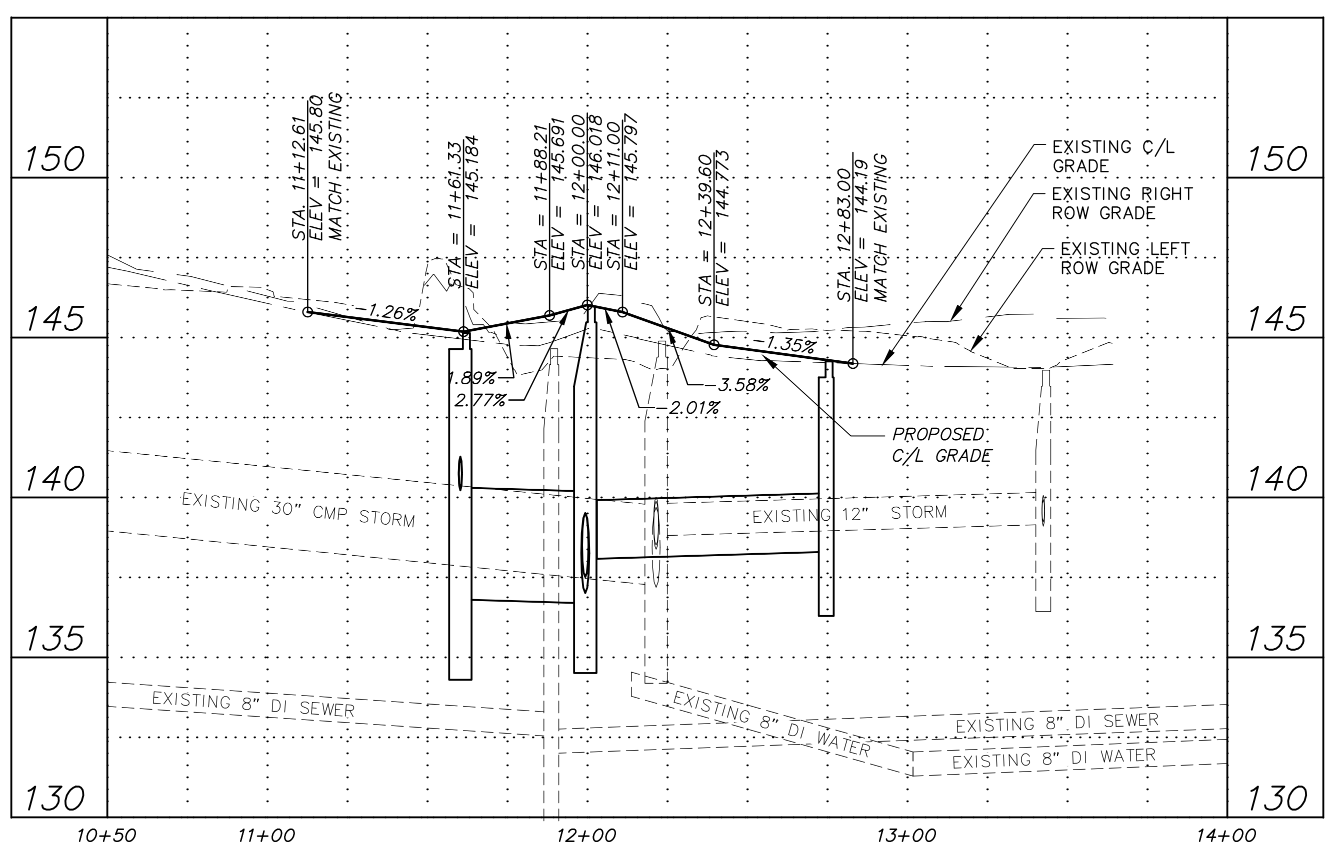
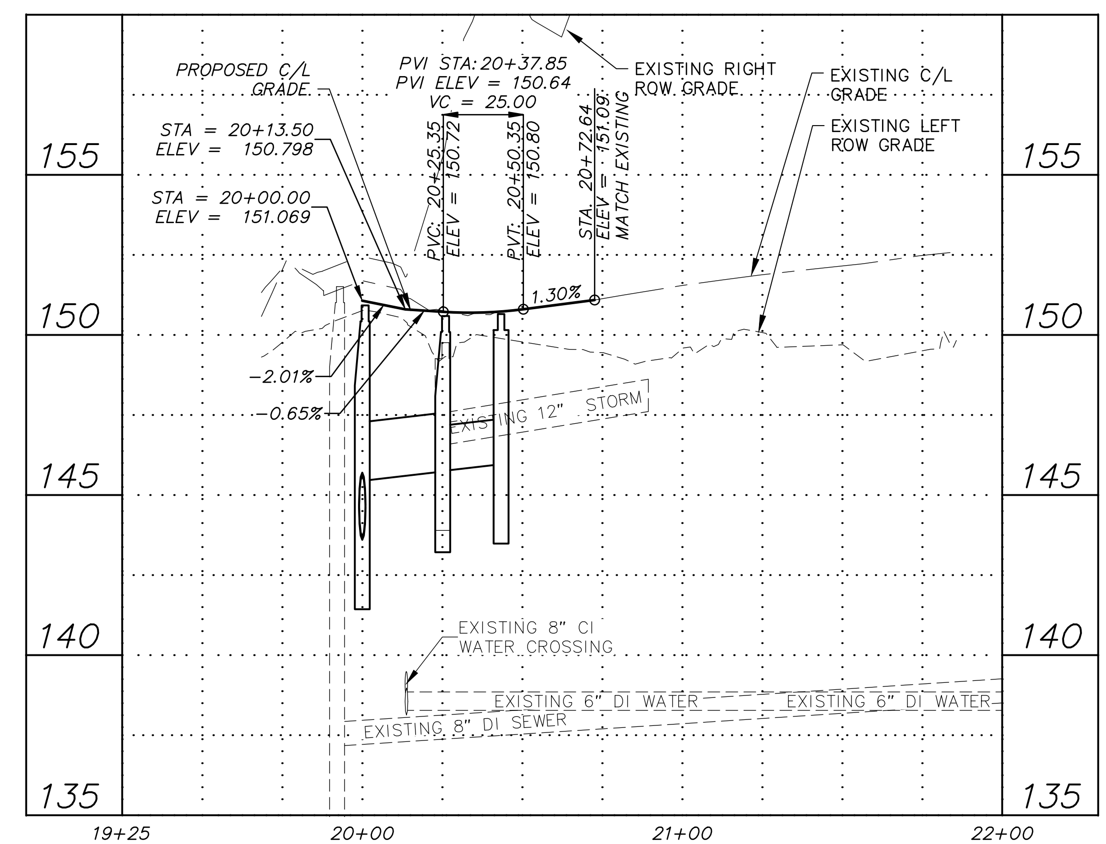
PREFERRED ALTERNATIVE





RECORD DRAWING

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CONTRACTOR: ____
BY: ____ TITLE: ____ DATE: ____
2. DATA TRANSFERRED BY: ____ TITLE: ____
COMPANY: ____ DATE: ____
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DATA TRANSFER CHECKED BY: ____ TITLE: ____
COMPANY: ____ DATE: ____
BY: ____

DATA	DRAWN BY	CHECKED BY
BASE		
TOPOGRAPHY		
PROFILE		
STORM SEWER		
WATER/SANITARY SEWER		
GAS		
TELEPHONE		
ELECTRIC		
DESIGN		
QUANTITIES		
PRELIMINARY/FINAL		
MUNICIPAL/STATE		

PLAN CHECK

GRAPHIC 60 30 0 30 60 SCALE

FIELD BOOKS	BM NO.	LOCATION	ELEV.	REV	DATE	DESCRIPTION	BY
DESIGN							
STAKING							
ASBUILT							
CONTRACTOR	BASIS OF THIS DATUM						
INSPECTOR							

CONSTRUCTION RECORD — VERTICAL DATUM — REVISIONS

CRW ENGINEERING GROUP, LLC
3940 ARCTIC BLVD. SUITE 300
ANCHORAGE, ALASKA 99503
PHONE: (907) 562-3252
#AECL882-AK

CONSULTANT — SEAL

MUNICIPALITY OF ANCHORAGE

PROJECT MANAGEMENT AND ENGINEERING DEPARTMENT

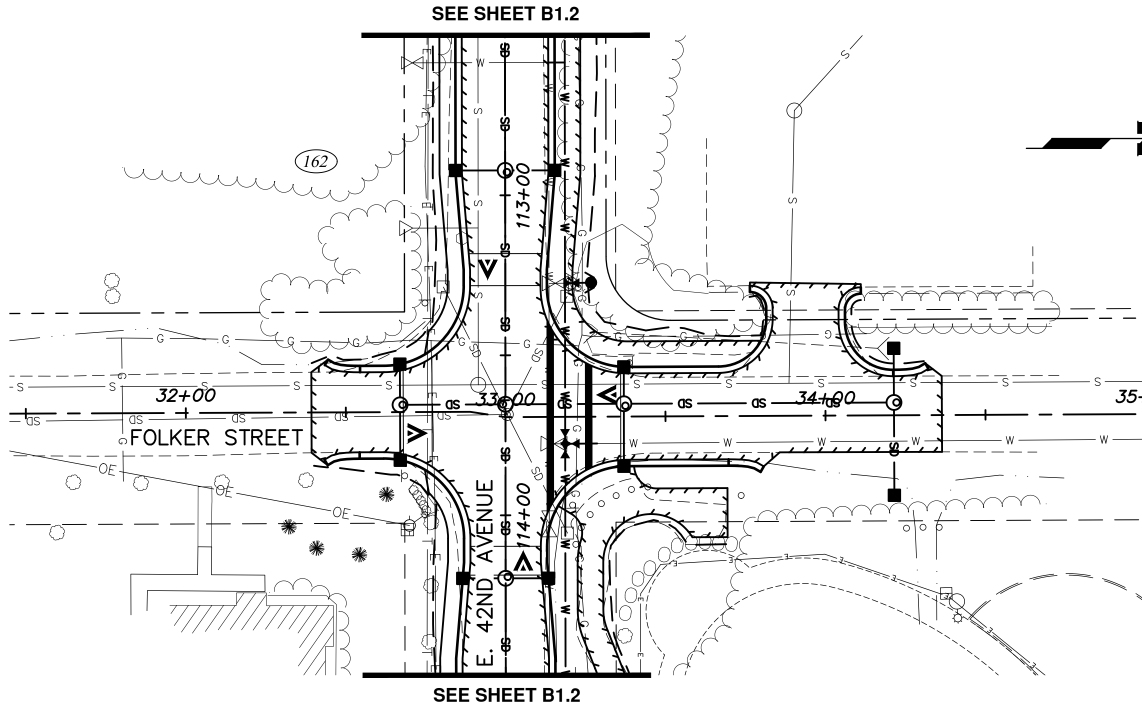
18-06 — 42ND AVENUE UPGRADE — LAKE OTIS PARKWAY TO FLORINA STREET — SCHED A

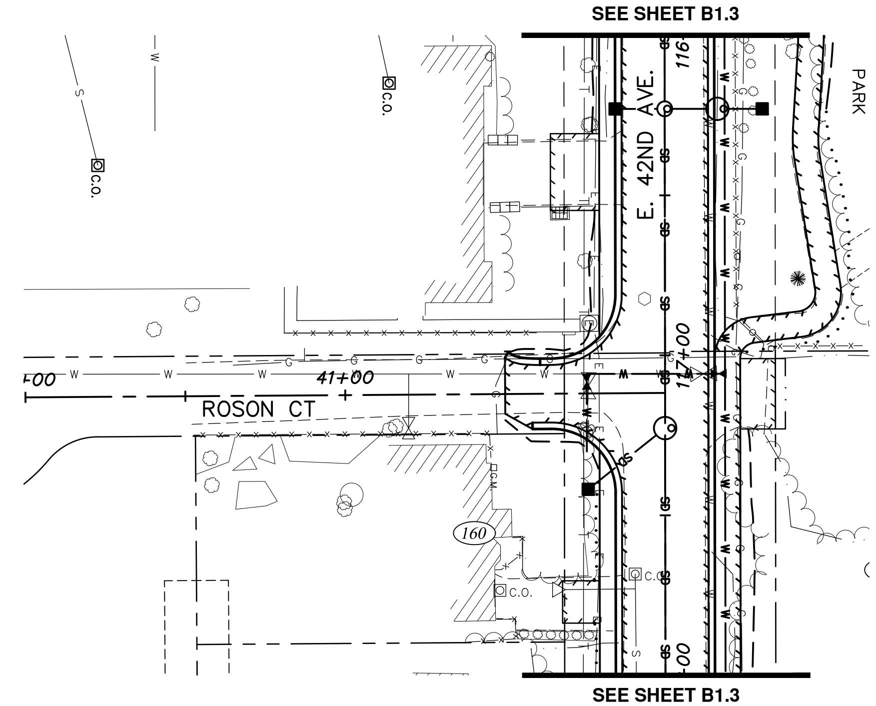
ROADWAY PLAN & PROFILE

LAUREL STREET & HICKORY PLACE

SCALE HOR. 1"=30' VER. 1"=3' | GRID SW1733, SW1734, SW1735 | DATE DEC 2020 | STATUS DSR | SHEET B1.7 of B1.11

File: J:\JobsData\10142.00 42nd Avenue Upgrade\00 CADD\01 Working Set\01 Civil\10142.00 Sidestreets-Plan & Profile_Alt 1.dwg





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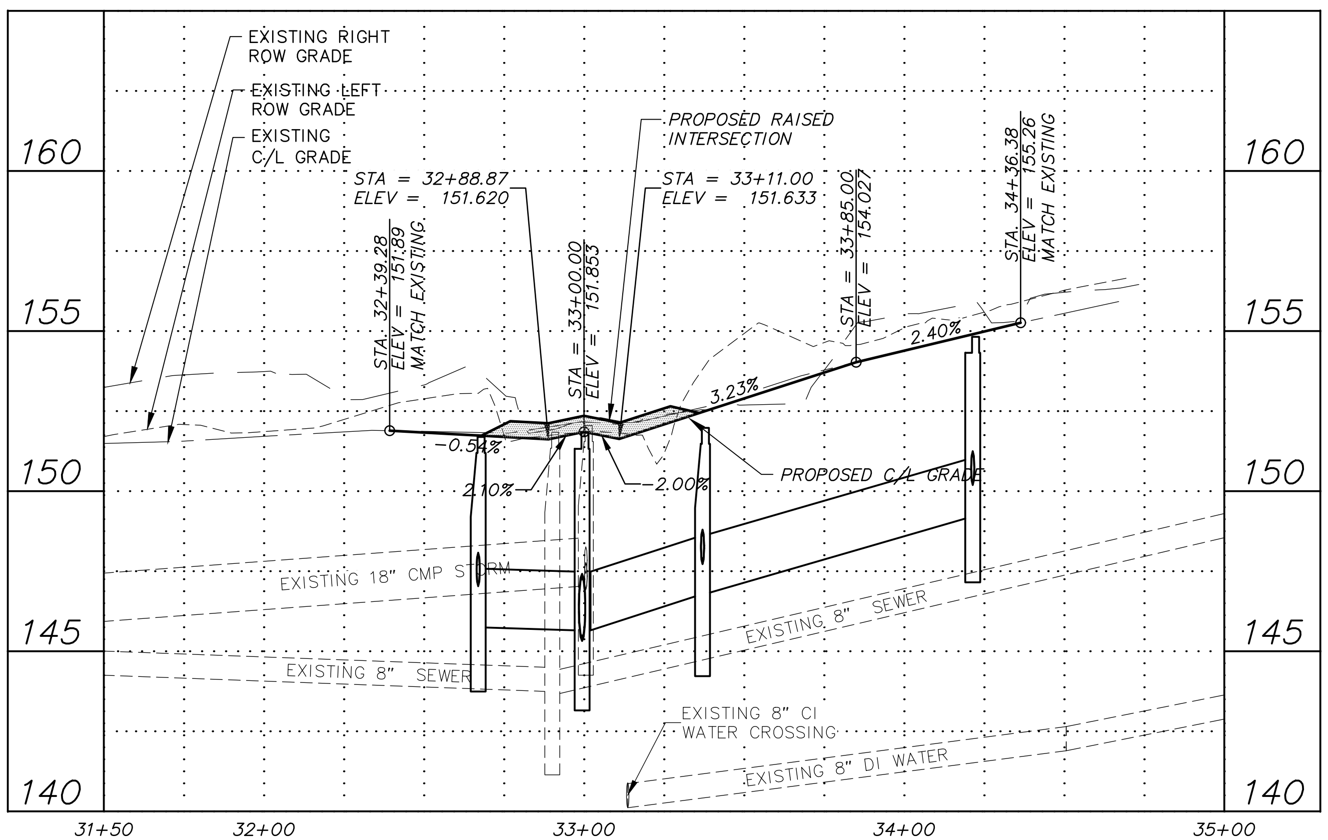

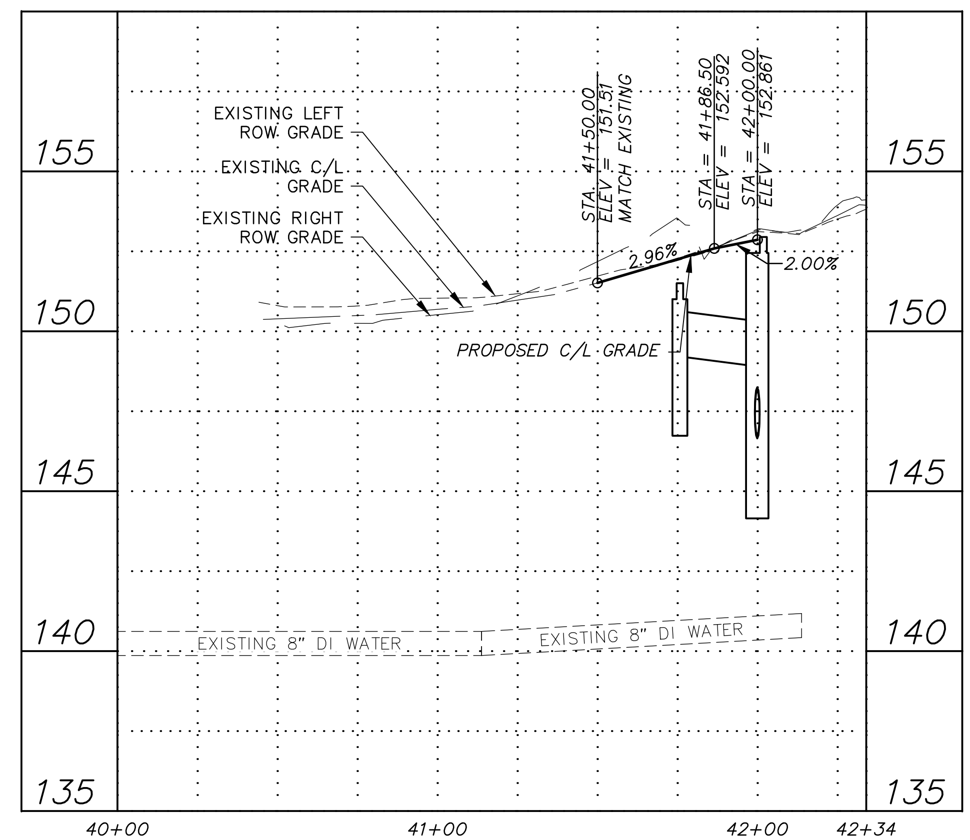

RECORD DRAWING

1. DATA PROVIDED BY:______ TITLE:______
   THIS WILL SERVE TO CERTIFY THAT THESE RECORD DRAWINGS ARE A TRUE AND ACCURATE REPRESENTATION OF THE PROJECT AS CONSTRUCTED.
   CONTRACTOR:______
   BY:______ TITLE:______ DATE:______
2. DATA TRANSFERRED BY:______ TITLE:______
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   DATA TRANSFER CHECKED BY:______ TITLE:______
   COMPANY:______ DATE:______
   BY:______

DATA	DRAWN BY	CHECKED BY
BASE		
TOPOGRAPHY		
PROFILE		
STORM SEWER		
WATER/SANITARY SEWER		
GAS		
TELEPHONE		
ELECTRIC		
DESIGN		
QUANTITIES		
PRELIMINARY/FINAL		
MUNICIPAL/STATE		
PLAN CHECK		

GRAPHIC SCALE 60 30 0 30 60

FIELD BOOKS	BM NO.	LOCATION	ELEV.
DESIGN			
STAKING			
ASBUILT			
CONTRACTOR	BASIS OF THIS DATUM		
INSPECTOR			
CONSTRUCTION RECORD	VERTICAL DATUM		

REV	DATE	DESCRIPTION	BY
REVISIONS			

CRW ENGINEERING GROUP, LLC
3940 ARCTIC BLVD. SUITE 300
ANCHORAGE, ALASKA 99503
PHONE: (907) 562-3252
#AECL882-AK
CONSULTANT

SEAL

MUNICIPALITY OF ANCHORAGE

PROJECT MANAGEMENT AND ENGINEERING DEPARTMENT

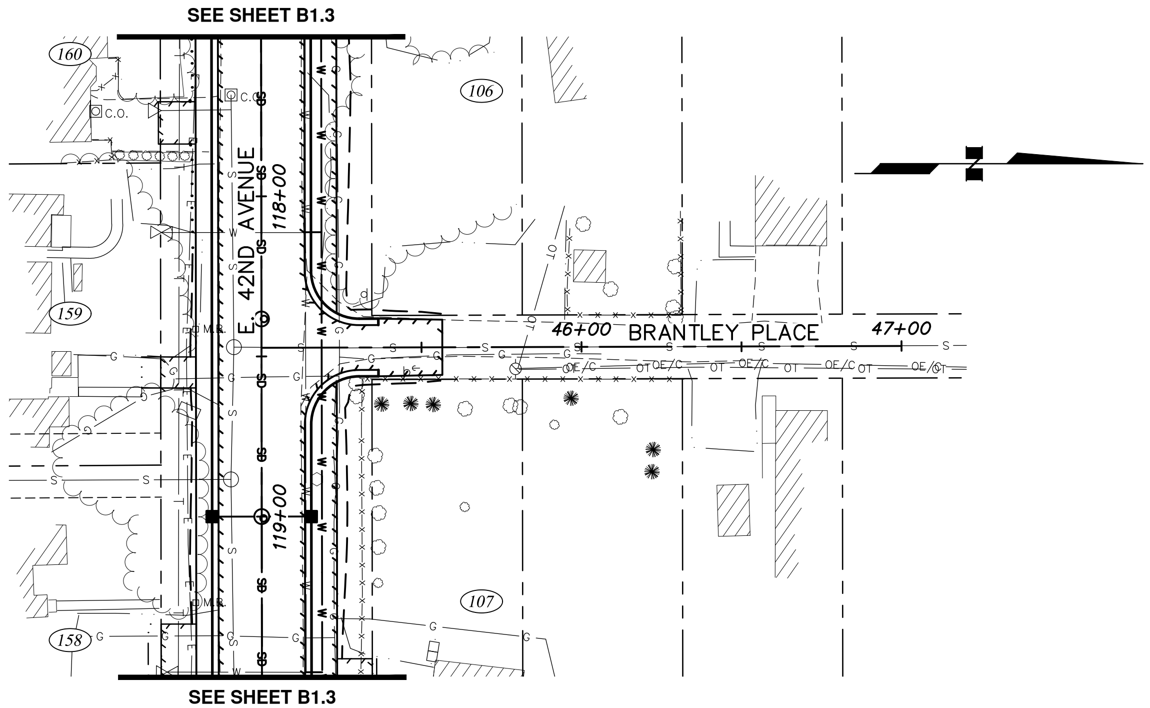
18-06 | 42ND AVENUE UPGRADE LAKE OTIS PARKWAY TO FLORINA STREET | SCHED A

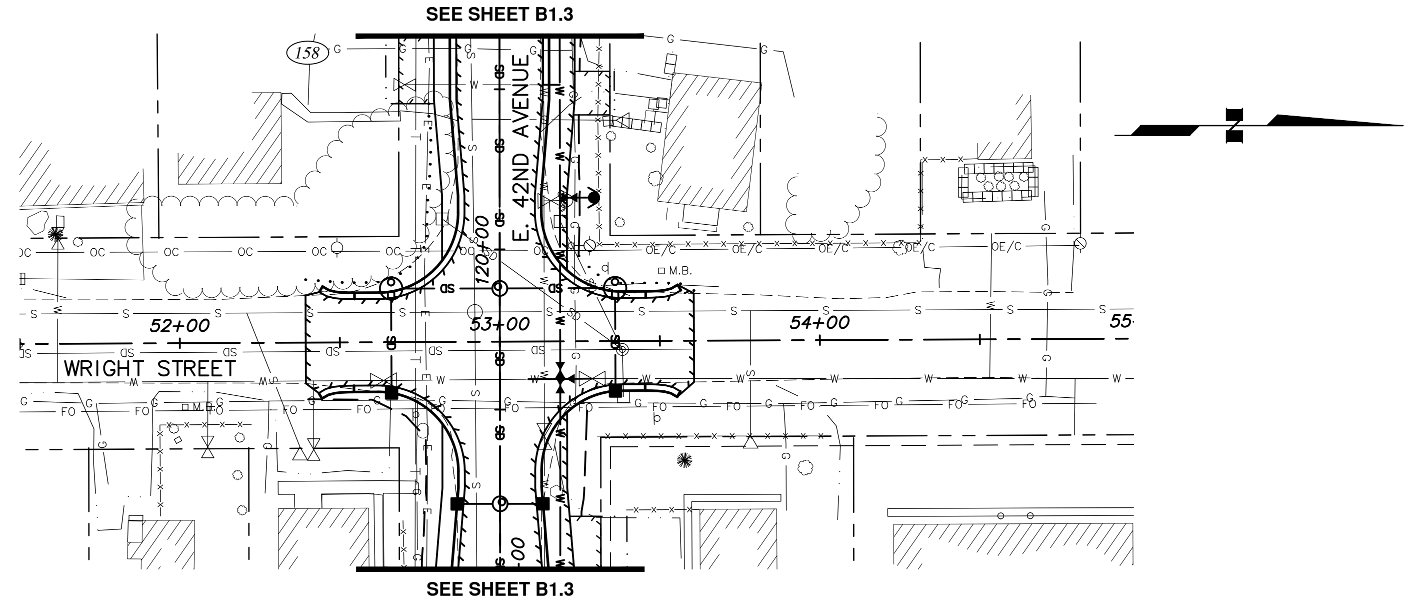
ROADWAY PLAN & PROFILE

FOLKER STREET & ROSON COURT

SCALE HOR. 1"=30' VER. 1"=3' | GRID SW1733, SW1734, SW1735 | DATE DEC 2020 | STATUS DSR | SHEET B1.8 of B1.11

File:J:\JobsData\10142.00 42nd Avenue Upgrade\00 CADD\01 Working Set\01 Civil\10142.00 Sidestreets-Plan & Profile_Alt 1.dwg





ALTERNATIVE #1
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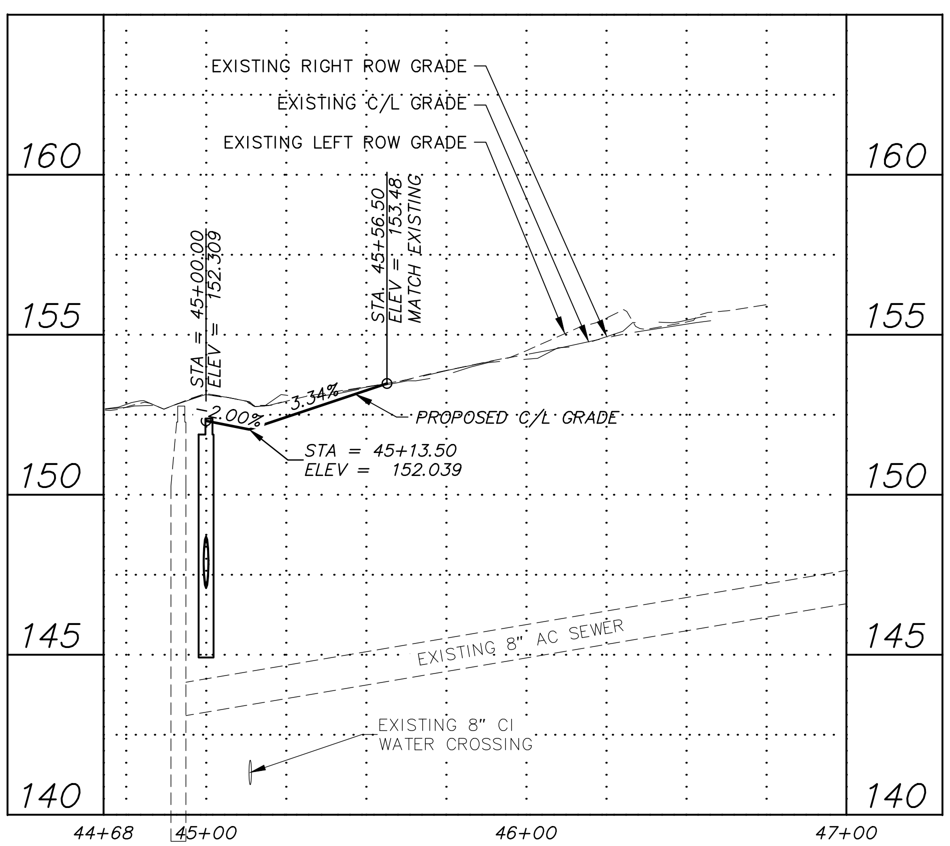

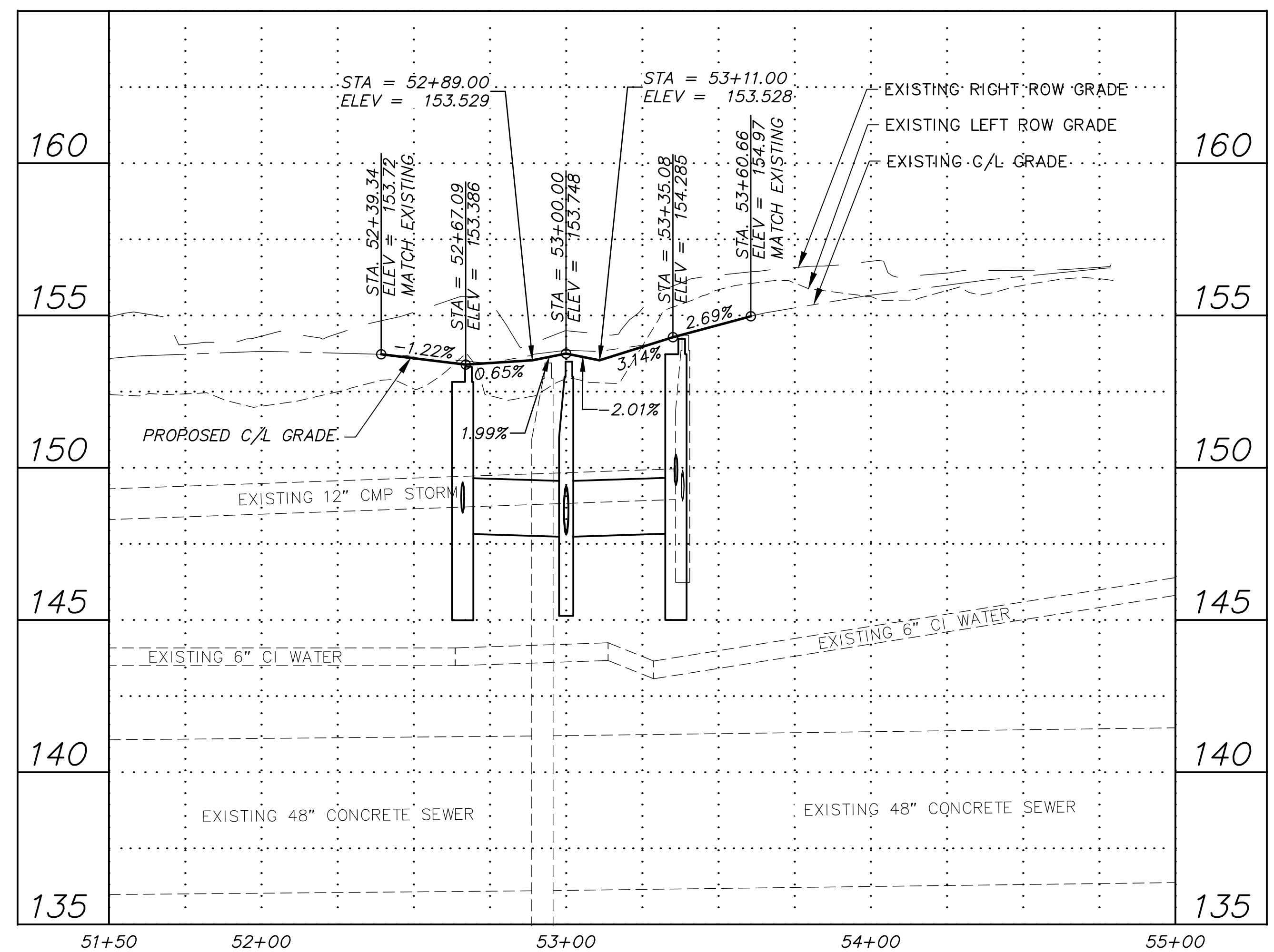

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CONTRACTOR:______
BY:______ TITLE:______ DATE:______
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DATA TRANSFER CHECKED BY:______ TITLE:______
COMPANY:______ DATE:______
BY:______

DATA	DRAWN BY	CHECKED BY
BASE		
TOPOGRAPHY		
PROFILE		
STORM SEWER		
WATER/SANITARY SEWER		
GAS		
TELEPHONE		
ELECTRIC		
DESIGN		
QUANTITIES		
PRELIMINARY/FINAL		
MUNICIPAL/STATE		
PLAN CHECK		

GRAPHIC 60 30 0 30 60 SCALE

FIELD BOOKS	
DESIGN	
STAKING	
ASBUILT	
CONTRACTOR	
INSPECTOR	
CONSTRUCTION RECORD	

BM NO.	LOCATION	ELEV.
	BASIS OF THIS DATUM	
VERTICAL DATUM		

REV	DATE	DESCRIPTION	BY
REVISIONS			

CRW ENGINEERING GROUP, LLC
3940 ARCTIC BLVD. SUITE 300
ANCHORAGE, ALASKA 99503
PHONE: (907) 562-3252
#AECL882-AK
CONSULTANT

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MUNICIPALITY OF ANCHORAGE

PROJECT MANAGEMENT AND ENGINEERING DEPARTMENT

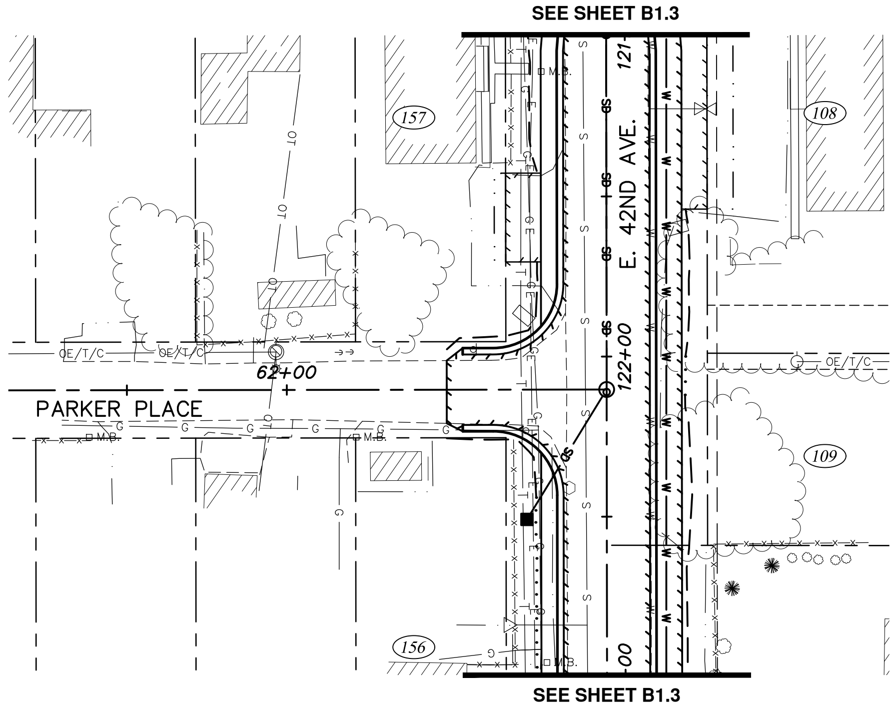
18-06 | 42ND AVENUE UPGRADE
LAKE OTIS PARKWAY TO FLORINA STREET | SCHED A

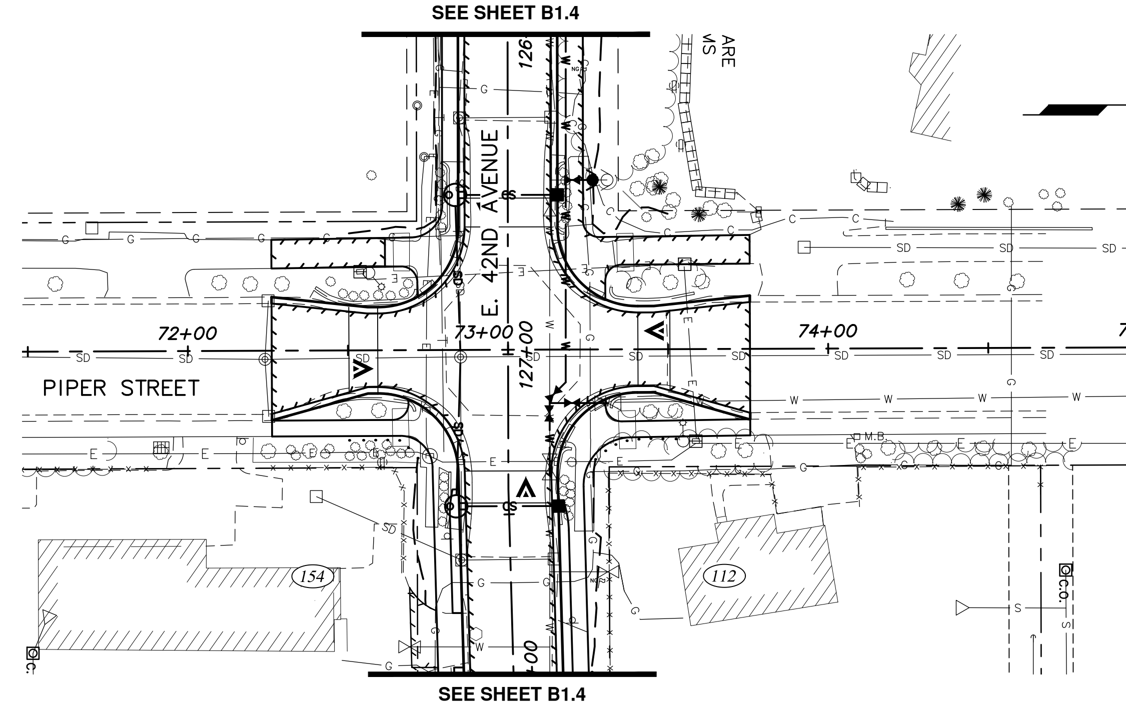
ROADWAY PLAN & PROFILE

BRANTLEY PLACE & WRIGHT STREET

SCALE HOR. 1"=30' VER. 1"=3' | GRID SW1733, SW1734, SW1735 | DATE DEC 2020 | STATUS DSR | SHEET B1.9 of B1.11

File: J:\JobsData\10142.00 42nd Avenue Upgrade\00 CADD\01 Working Set\01 Civil\10142.00 Sidestreets-Plan & Profile_Alt 1.dwg





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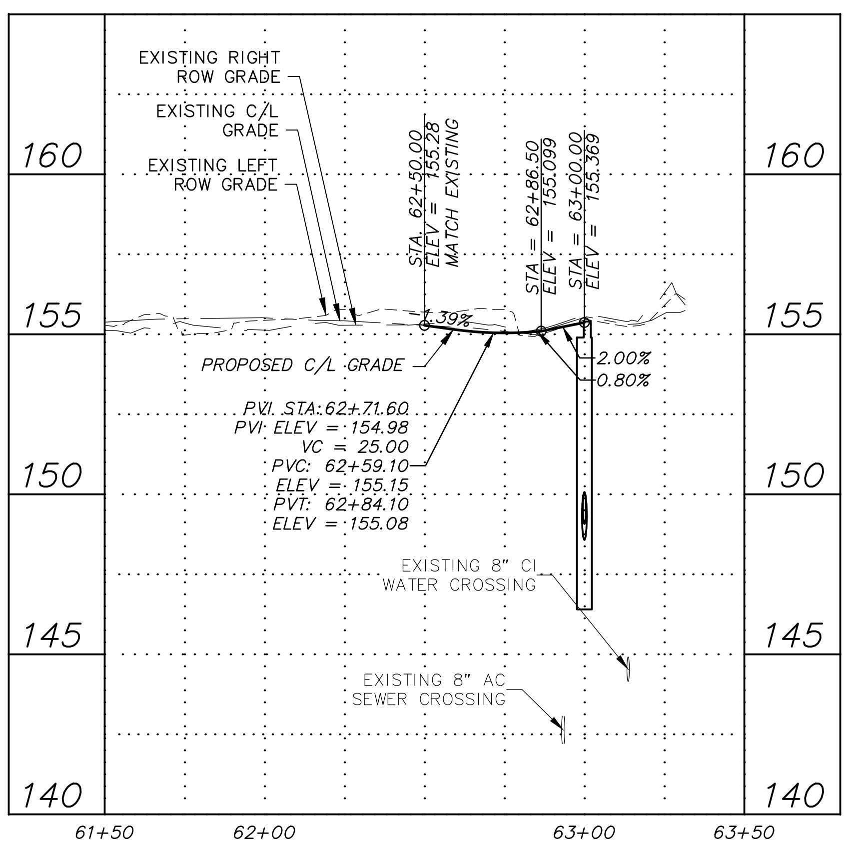

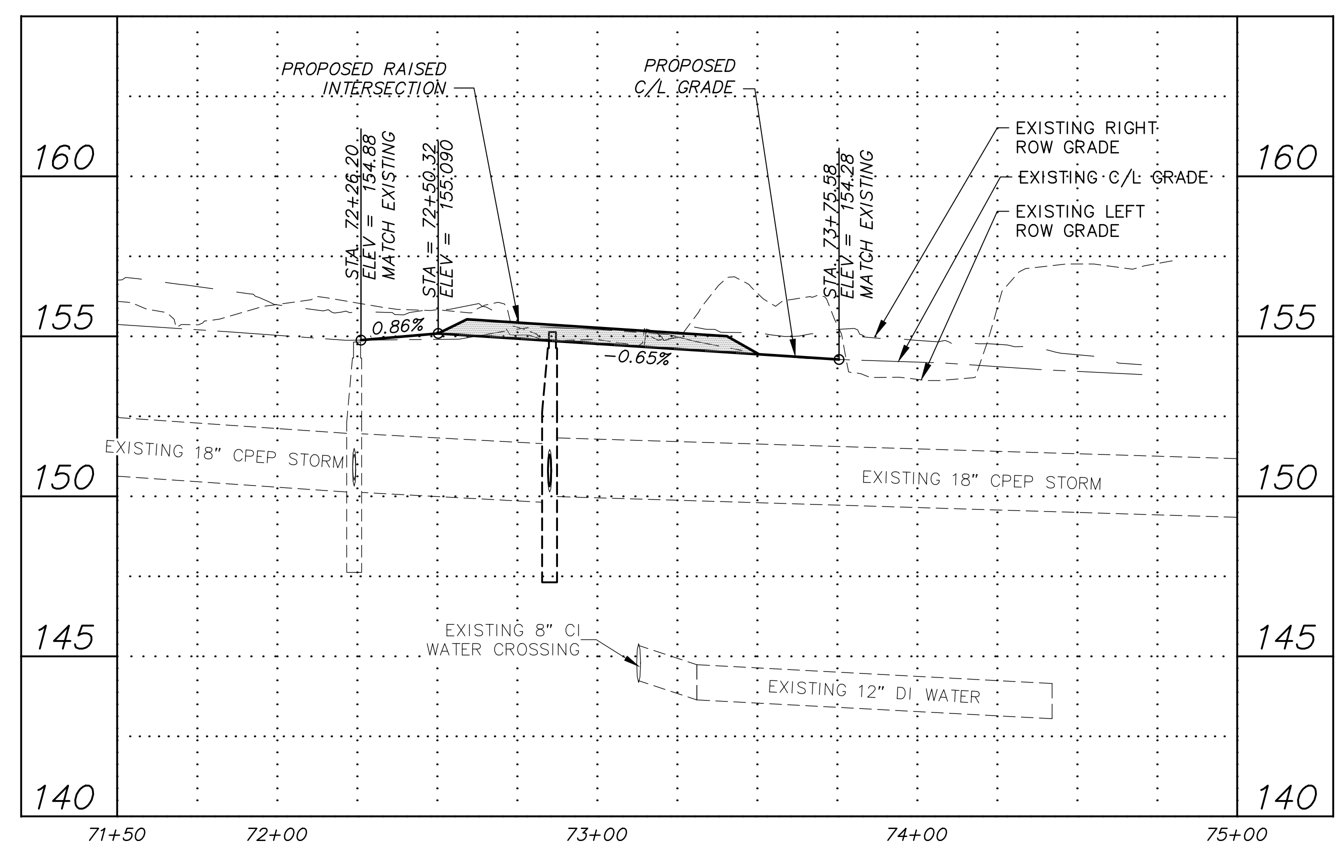

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   BY: ____________ TITLE: ____________ DATE: ____________
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   COMPANY: ____________ DATE: ____________
   BY: ____________

DATA	DRAWN BY	CHECKED BY
BASE		
TOPOGRAPHY		
PROFILE		
STORM SEWER		
WATER/SANITARY SEWER		
GAS		
TELEPHONE		
ELECTRIC		
DESIGN		
QUANTITIES		
PRELIMINARY/FINAL		
MUNICIPAL/STATE		
PLAN CHECK		

GRAPHIC SCALE 60 30 0 30 60

FIELD BOOKS	
DESIGN	
STAKING	
ASBUILT	
CONTRACTOR	
INSPECTOR	
CONSTRUCTION RECORD	

BM NO.	LOCATION	ELEV.
BASIS OF THIS DATUM		
VERTICAL DATUM		

REV	DATE	DESCRIPTION	BY
REVISIONS			

CRW ENGINEERING GROUP, LLC
3940 ARCTIC BLVD. SUITE 300
ANCHORAGE, ALASKA 99503
PHONE: (907) 562-3252
#AECL882-AK
CONSULTANT

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MUNICIPALITY OF ANCHORAGE

PROJECT MANAGEMENT AND ENGINEERING DEPARTMENT

18-06 42ND AVENUE UPGRADE LAKE OTIS PARKWAY TO FLORINA STREET SCHED A

ROADWAY PLAN & PROFILE

PARKER PLACE & PIPER STREET

SCALE HOR. 1"=30' VER. 1"=3'
GRID SW1733, SW1734, SW1735
DATE DEC 2020
STATUS DSR
SHEET B1.10 of B1.11

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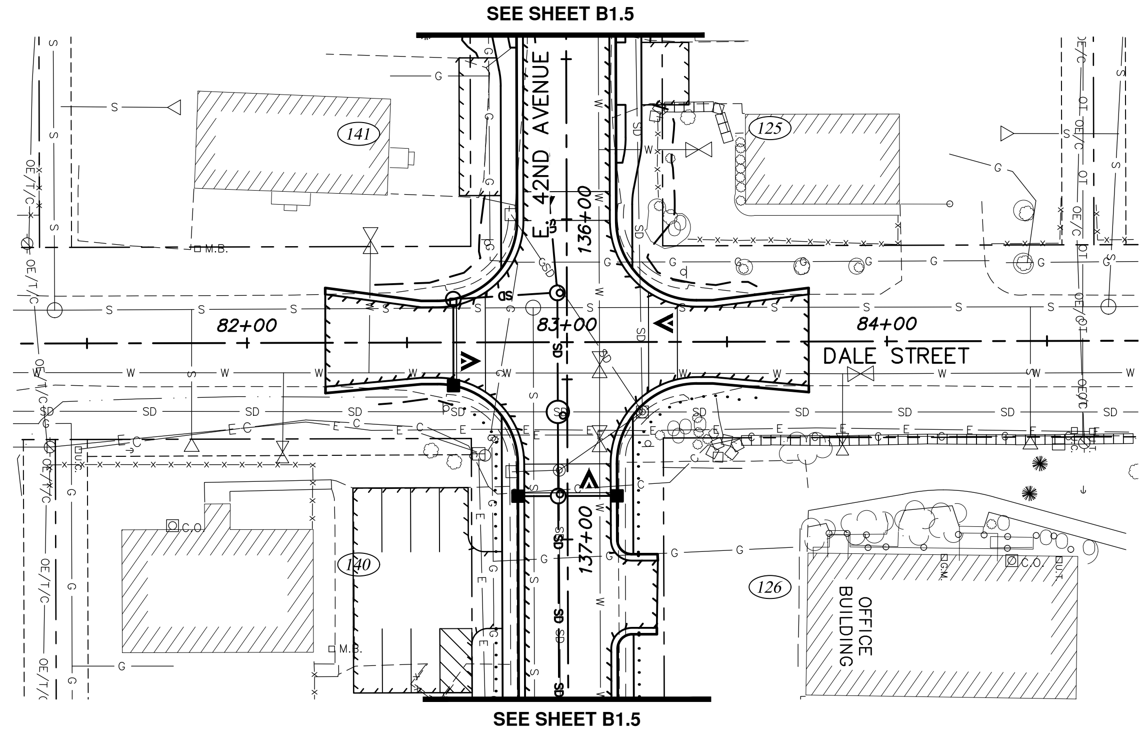
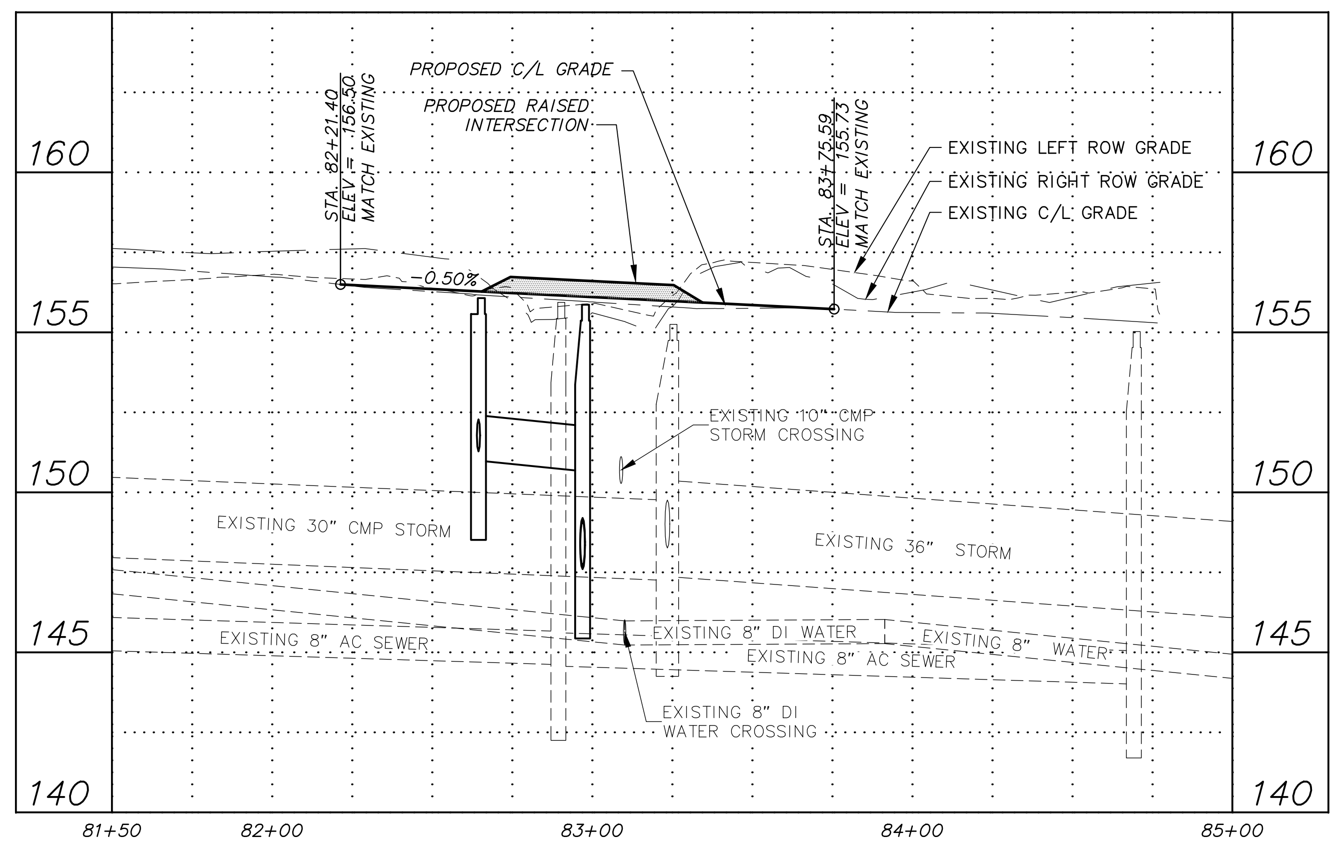


ALTERNATIVE #1
PREFERRED ALTERNATIVE



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RECORD DRAWING

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   CONTRACTOR: ____
   BY: ____ TITLE: ____ DATE: ____
2. DATA TRANSFERRED BY: ____ TITLE: ____
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   COMPANY: ____ DATE: ____
   BY: ____

DATA	DRAWN BY	CHECKED BY
BASE		
TOPOGRAPHY		
PROFILE		
STORM SEWER		
WATER/SANITARY SEWER		
GAS		
TELEPHONE		
ELECTRIC		
DESIGN		
QUANTITIES		
PRELIMINARY/FINAL		
MUNICIPAL/STATE		
PLAN CHECK		

GRAPHIC SCALE 60 30 0 30 60

FIELD BOOKS	
DESIGN	
STAKING	
ASBUILT	
CONTRACTOR	
INSPECTOR	
CONSTRUCTION RECORD	

BM NO.	LOCATION	ELEV.
BASIS OF THIS DATUM		
VERTICAL DATUM		

REV	DATE	DESCRIPTION	BY
REVISIONS			

CRW ENGINEERING GROUP, LLC
3940 ARCTIC BLVD, SUITE 300
ANCHORAGE, ALASKA 99503
PHONE: (907) 562-3252
#AECL882-AK

CONSULTANT

SEAL

MUNICIPALITY OF ANCHORAGE

PROJECT MANAGEMENT AND ENGINEERING DEPARTMENT

18-06

42ND AVENUE UPGRADE
LAKE OTIS PARKWAY TO FLORINA STREET

SCHED A

ROADWAY PLAN & PROFILE

DALE STREET

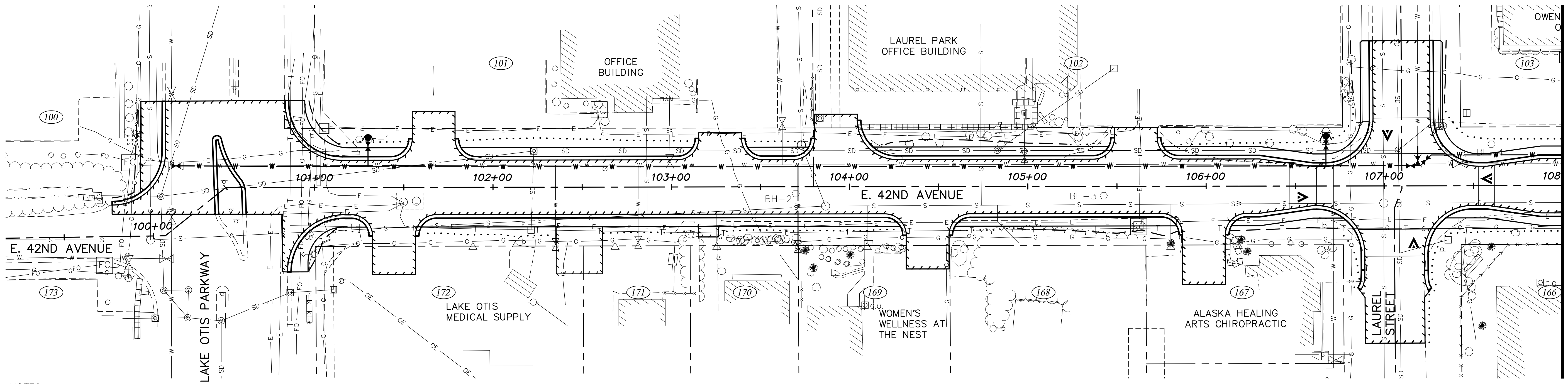
SCALE HOR. 1"=30' VER. 1"=3'

GRID SW1733, SW1734, SW1735

DATE DEC 2020

STATUS DSR

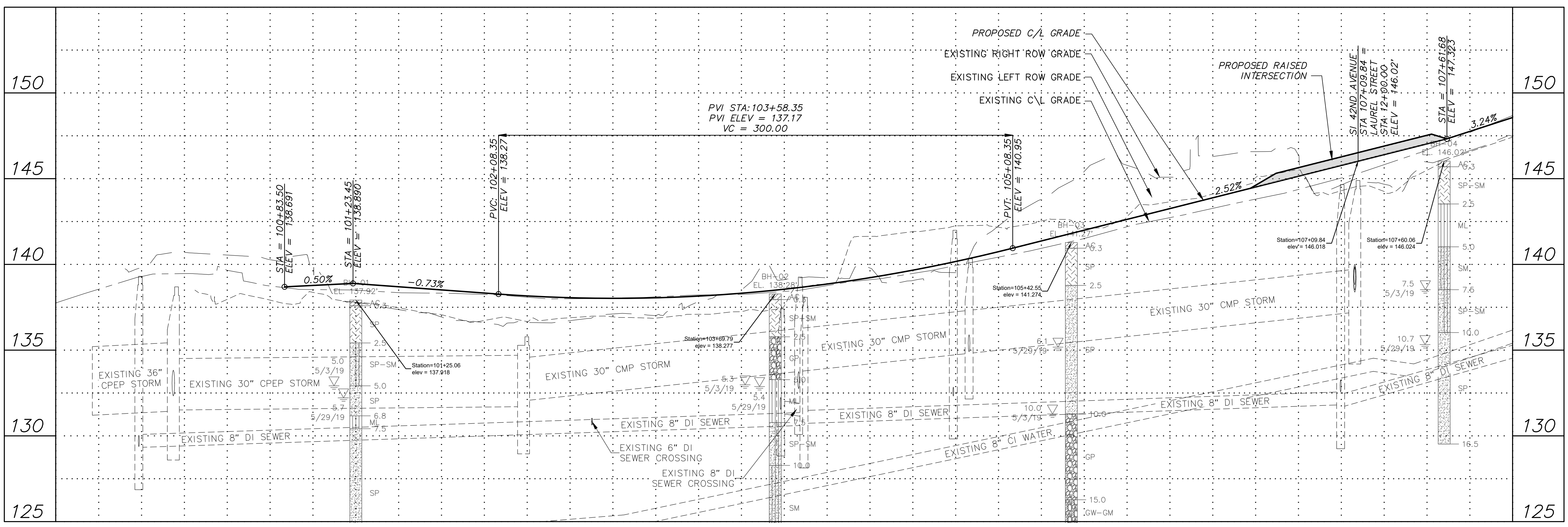
SHEET B1.11 of B1.11



NOTES:

1. *SEE ALTERNATIVE 1 PLAN AND PROFILE DRAWINGS FOR PROPOSED STORM DRAIN FACILITIES.*

ALTERNATIVE #2



RECORD DRAWING

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   THIS WILL SERVE TO CERTIFY THAT THESE RECORD DRAWINGS ARE A TRUE AND ACCURATE REPRESENTATION OF THE PROJECT AS CONSTRUCTED.
   CONTRACTOR: ______
   BY: ______ TITLE: ______ DATE: ______
2. DATA TRANSFERRED BY: ______ TITLE: ______
   COMPANY: ______ DATE: ______
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   COMPANY: ______ DATE: ______
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TOPOGRAPHY		
PROFILE		
STORM SEWER		
WATER/SANITARY SEWER		
GAS		
TELEPHONE		
ELECTRIC		
DESIGN		
QUANTITIES		
PRELIMINARY/FINAL		
MUNICIPAL/STATE		

PLAN CHECK

GRAPHIC SCALE 60 30 0 30 60

FIELD BOOKS	
DESIGN	
STAKING	
ASBUILT	
CONTRACTOR	
INSPECTOR	

CONSTRUCTION RECORD

BM NO.	LOCATION	ELEV.
	BASIS OF THIS DATUM	

VERTICAL DATUM

REV	DATE	DESCRIPTION	BY

REVISIONS

CRW ENGINEERING GROUP, LLC
3940 ARCTIC BLVD. SUITE 300
ANCHORAGE, ALASKA 99503
PHONE: (907) 562-3252
#AECL882-AK

CONSULTANT

SEAL

MUNICIPALITY OF ANCHORAGE

PROJECT MANAGEMENT AND ENGINEERING DEPARTMENT

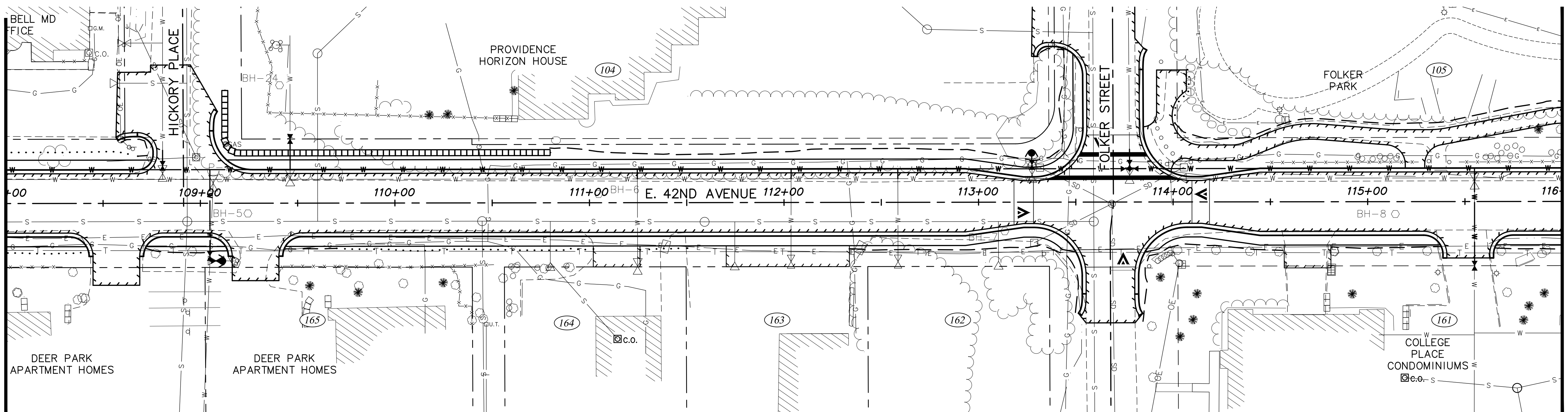
18-06 42ND AVENUE UPGRADE SCHED A
LAKE OTIS PARKWAY TO FLORINA STREET

ROADWAY PLAN & PROFILE

BOP TO STA 108+00

SCALE HOR. 1"=30' VER. 1"=3' | GRID SW1733, SW1734, SW1735 | DATE DEC 2020 | STATUS DSR | SHEET B2.1 of B2.6

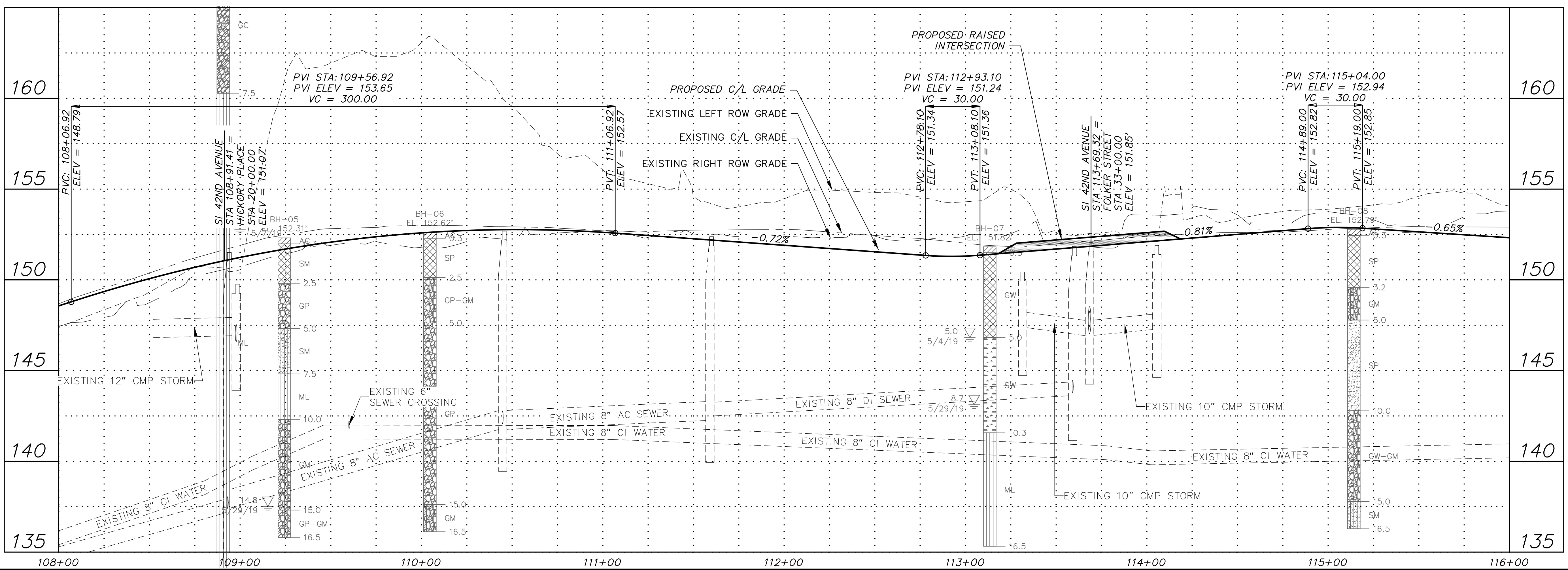
File: J:\JobsData\10142.00 42nd Avenue Upgrade\00 CADD\01 Working Set\01 Civil\10142.00 Roadway-Plan & Profile_Alt 2.dwg



NOTES:

1. SEE ALTERNATIVE 1 PLAN AND PROFILE DRAWINGS FOR PROPOSED STORM DRAIN FACILITIES.

ALTERNATIVE #2



RECORD DRAWING

1. DATA PROVIDED BY: ______ TITLE: ______
THIS WILL SERVE TO CERTIFY THAT THESE RECORD DRAWINGS ARE A TRUE AND ACCURATE REPRESENTATION OF THE PROJECT AS CONSTRUCTED.
CONTRACTOR: ______
BY: ______ TITLE: ______ DATE: ______
2. DATA TRANSFERRED BY: ______ TITLE: ______
COMPANY: ______ DATE: ______
3. BASED ON PERIODIC FIELD OBSERVATIONS BY THE ENGINEER (OR AN INDIVIDUAL UNDER HIS/HER DIRECT SUPERVISION), THE CONTRACTOR-PROVIDED DATA APPEARS TO REPRESENT THE PROJECT AS CONSTRUCTED.
DATA TRANSFER CHECKED BY: ______ TITLE: ______
COMPANY: ______ DATE: ______
BY: ______

DATA	DRAWN BY	CHECKED BY
BASE		
TOPOGRAPHY		
PROFILE		
STORM SEWER		
WATER/SANITARY SEWER		
GAS		
TELEPHONE		
ELECTRIC		
DESIGN		
QUANTITIES		
PRELIMINARY/FINAL		
MUNICIPAL/STATE		
PLAN CHECK		

GRAPHIC 60 30 0 30 60 SCALE

FIELD BOOKS		BM NO.	LOCATION	ELEV.
DESIGN				
STAKING				
ASBUILT				
CONTRACTOR		BASIS OF THIS DATUM		
INSPECTOR				
CONSTRUCTION RECORD		VERTICAL DATUM		

REV	DATE	DESCRIPTION	BY
REVISIONS			

CRW ENGINEERING GROUP, LLC
3940 ARCTIC BLVD. SUITE 300
ANCHORAGE, ALASKA 99503
PHONE: (907) 562-3252
#AECL882-AK

CONSULTANT | SEAL

MUNICIPALITY OF ANCHORAGE

PROJECT MANAGEMENT AND ENGINEERING DEPARTMENT

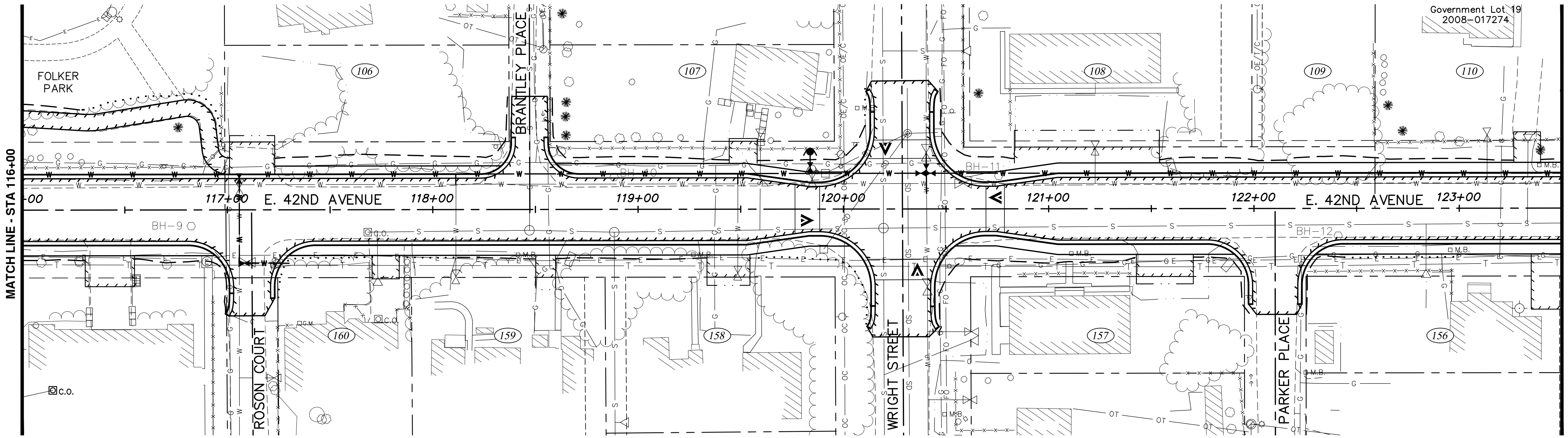
18-06 | 42ND AVENUE UPGRADE LAKE OTIS PARKWAY TO FLORINA STREET | SCHED A

ROADWAY PLAN & PROFILE

STA 108+00 TO STA 116+00

SCALE HOR. 1"=30' VER. 1"=3' | GRID SW1733, SW1734, SW1735 | DATE DEC 2020 | STATUS DSR | SHEET B2.2 of B2.6

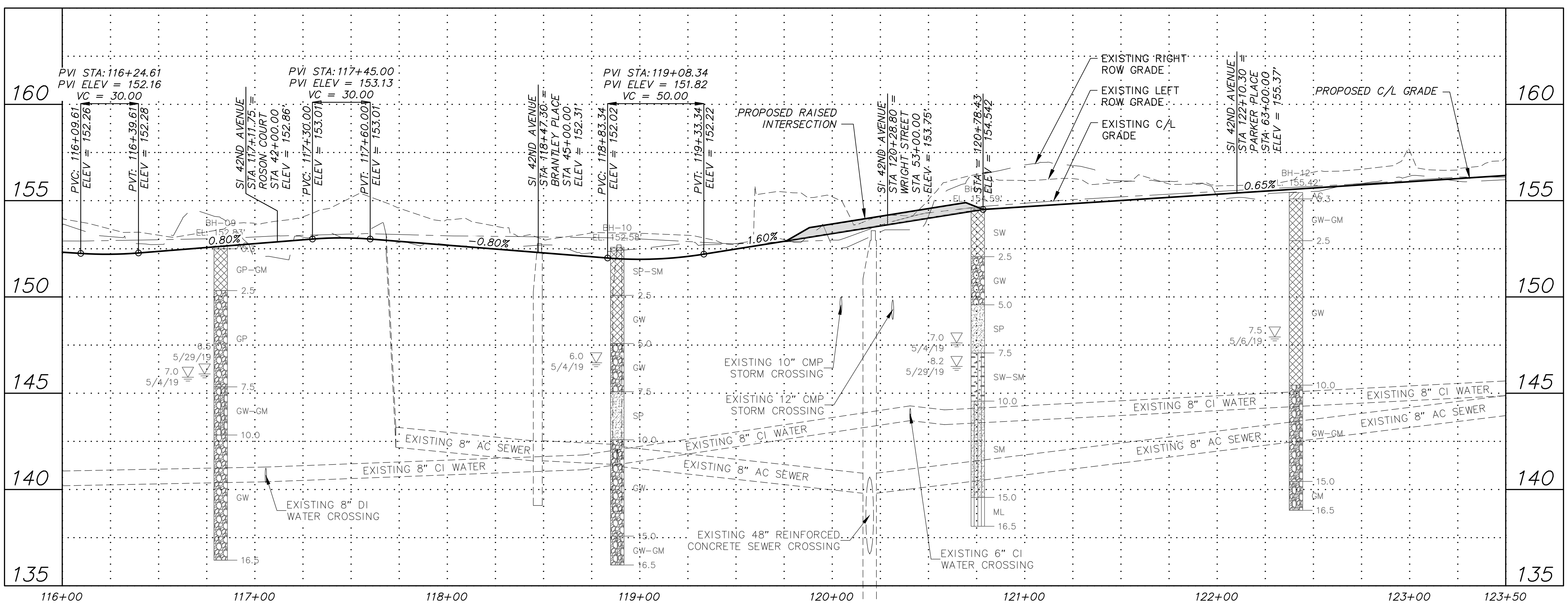
File: J:\JobsData\10142.00 42nd Avenue Upgrade\00 CADD\01 Working Set\01 Civil\10142.00 Roadway-Plan & Profile_Alt 2.dwg



NOTES:

1. SEE ALTERNATIVE 1 PLAN AND PROFILE DRAWINGS FOR PROPOSED STORM DRAIN FACILITIES.

ALTERNATIVE #2



RECORD DRAWING

1. DATA PROVIDED BY: ______ TITLE: ______
THIS WILL SERVE TO CERTIFY THAT THESE RECORD DRAWINGS ARE A TRUE AND ACCURATE REPRESENTATION OF THE PROJECT AS CONSTRUCTED.
CONTRACTOR: ______
BY: ______ TITLE: ______ DATE: ______
2. DATA TRANSFERRED BY: ______ TITLE: ______
COMPANY: ______ DATE: ______
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DATA TRANSFER CHECKED BY: ______ TITLE: ______
COMPANY: ______ DATE: ______
BY: ______

DATA	DRAWN BY	CHECKED BY
BASE		
TOPOGRAPHY		
PROFILE		
STORM SEWER		
WATER/SANITARY SEWER		
GAS		
TELEPHONE		
ELECTRIC		
DESIGN		
QUANTITIES		
PRELIMINARY/FINAL		
MUNICIPAL/STATE		

PLAN CHECK

GRAPHIC SCALE 60 30 0 30 60

FIELD BOOKS	
DESIGN	
STAKING	
ASBUILT	
CONTRACTOR	
INSPECTOR	

CONSTRUCTION RECORD

BM NO.	LOCATION	ELEV.
	BASIS OF THIS DATUM	

VERTICAL DATUM

REV	DATE	DESCRIPTION	BY

REVISIONS

CRW ENGINEERING GROUP, LLC
3940 ARCTIC BLVD. SUITE 300
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PHONE: (907) 562-3252
#AECL882-AK

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PROJECT MANAGEMENT AND ENGINEERING DEPARTMENT

18-06

42ND AVENUE UPGRADE
LAKE OTIS PARKWAY TO FLORINA STREET

SCHED A

ROADWAY PLAN & PROFILE

STA 116+00 TO STA 123+50

SCALE HOR. 1"=30' VER. 1"=3'

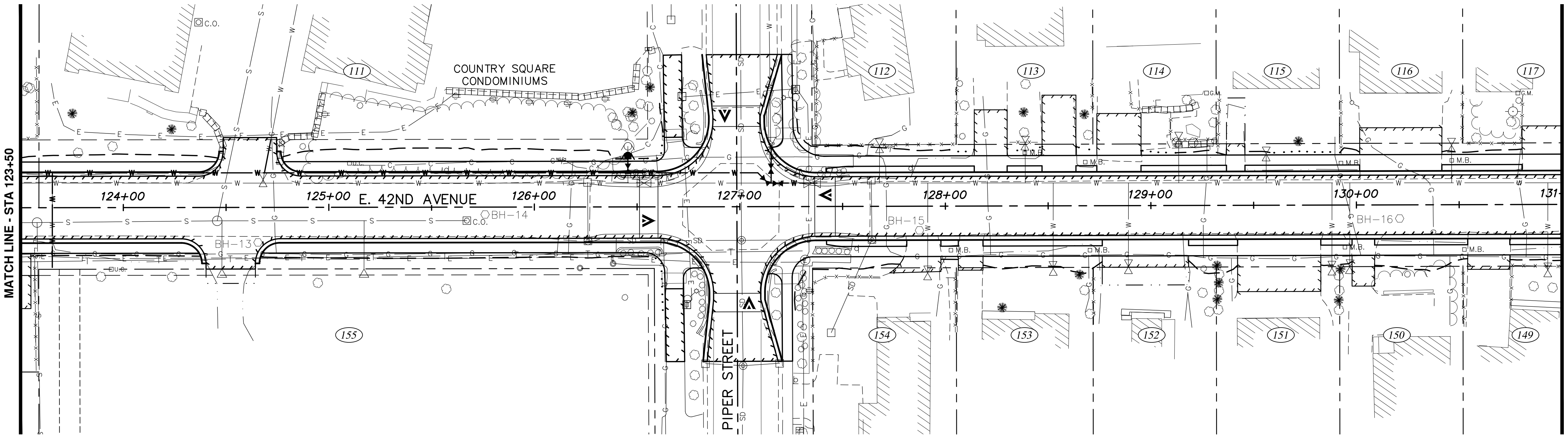
GRID SW1733, SW1734, SW1735

DATE DEC 2020

STATUS DSR

SHEET B2.3 of B2.6

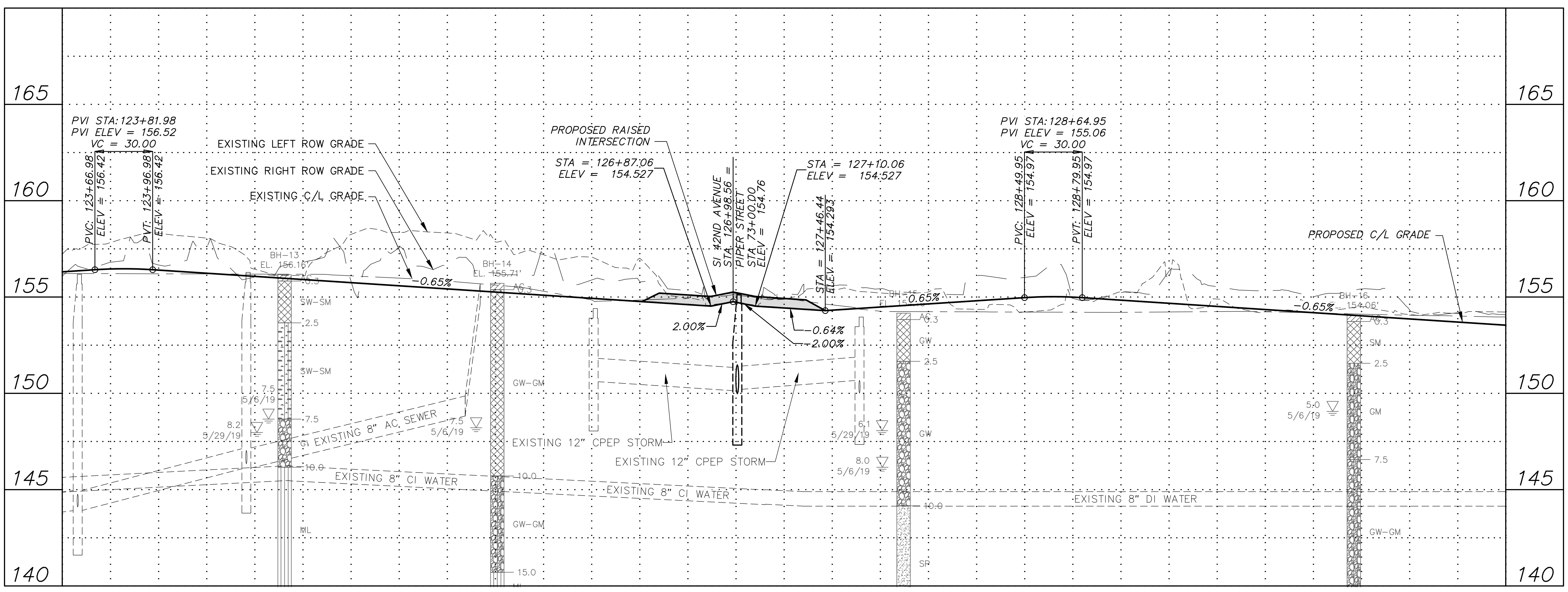
File: J:\JobsData\10142.00 42nd Avenue Upgrade\00 CADD\01 Working Set\01 Civil\10142.00 Roadway-Plan & Profile_Alt 2.dwg



NOTES:

1. SEE ALTERNATIVE 1 PLAN AND PROFILE DRAWINGS FOR PROPOSED STORM DRAIN FACILITIES.

ALTERNATIVE #2



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   CONTRACTOR: ____
   BY: ____ TITLE: ____ DATE: ____
2. DATA TRANSFERRED BY: ____ TITLE: ____
   COMPANY: ____ DATE: ____
3. BASED ON PERIODIC FIELD OBSERVATIONS BY THE ENGINEER (OR AN INDIVIDUAL UNDER HIS/HER DIRECT SUPERVISION), THE CONTRACTOR-PROVIDED DATA APPEARS TO REPRESENT THE PROJECT AS CONSTRUCTED.
   DATA TRANSFER CHECKED BY: ____ TITLE: ____
   COMPANY: ____ DATE: ____
   BY: ____

DATA	DRAWN BY	CHECKED BY
BASE		
TOPOGRAPHY		
PROFILE		
STORM SEWER		
WATER/SANITARY SEWER		
GAS		
TELEPHONE		
ELECTRIC		
DESIGN		
QUANTITIES		
PRELIMINARY/FINAL		
MUNICIPAL/STATE		

PLAN CHECK

GRAPHIC 60 30 0 30 60 SCALE

FIELD BOOKS	
DESIGN	
STAKING	
ASBUILT	
CONTRACTOR	
INSPECTOR	

CONSTRUCTION RECORD

BM NO.	LOCATION	ELEV.
	BASIS OF THIS DATUM	

VERTICAL DATUM

REV	DATE	DESCRIPTION	BY

REVISIONS

CRW ENGINEERING GROUP, LLC
3940 ARCTIC BLVD. SUITE 300
ANCHORAGE, ALASKA 99503
PHONE: (907) 562-3252
#AECL882-AK

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MUNICIPALITY OF ANCHORAGE

PROJECT MANAGEMENT AND ENGINEERING DEPARTMENT

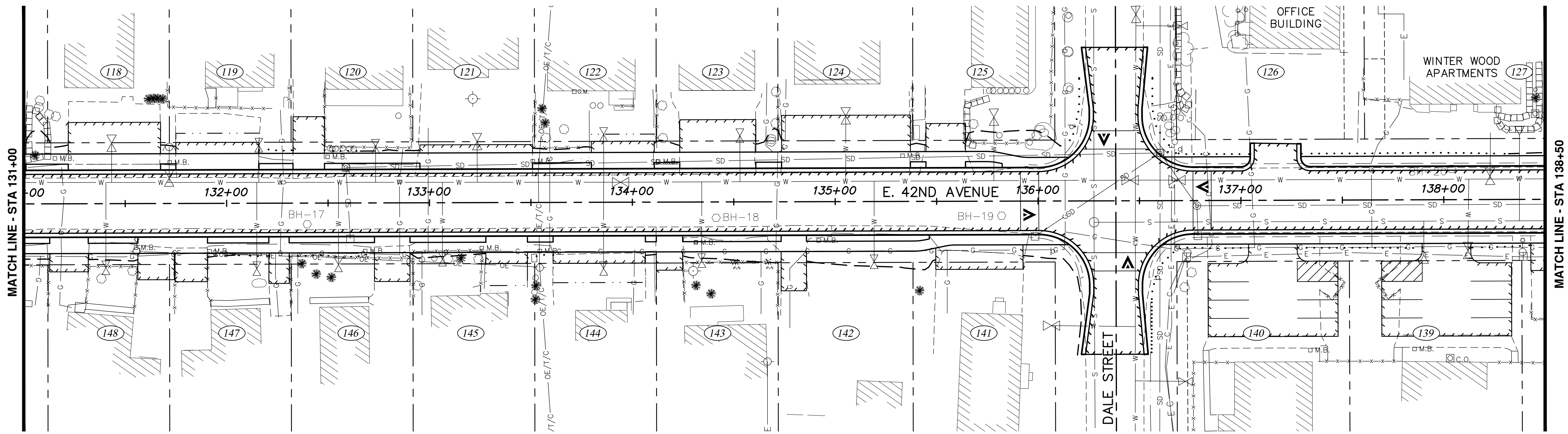
18-06 42ND AVENUE UPGRADE LAKE OTIS PARKWAY TO FLORINA STREET SCHED A

ROADWAY PLAN & PROFILE

STA 123+50 TO STA 131+00

SCALE HOR. 1"=30' VER. 1"=3'
GRID SW1733, SW1734, SW1735
DATE DEC 2020
STATUS DSR
SHEET B2.4 of B2.6

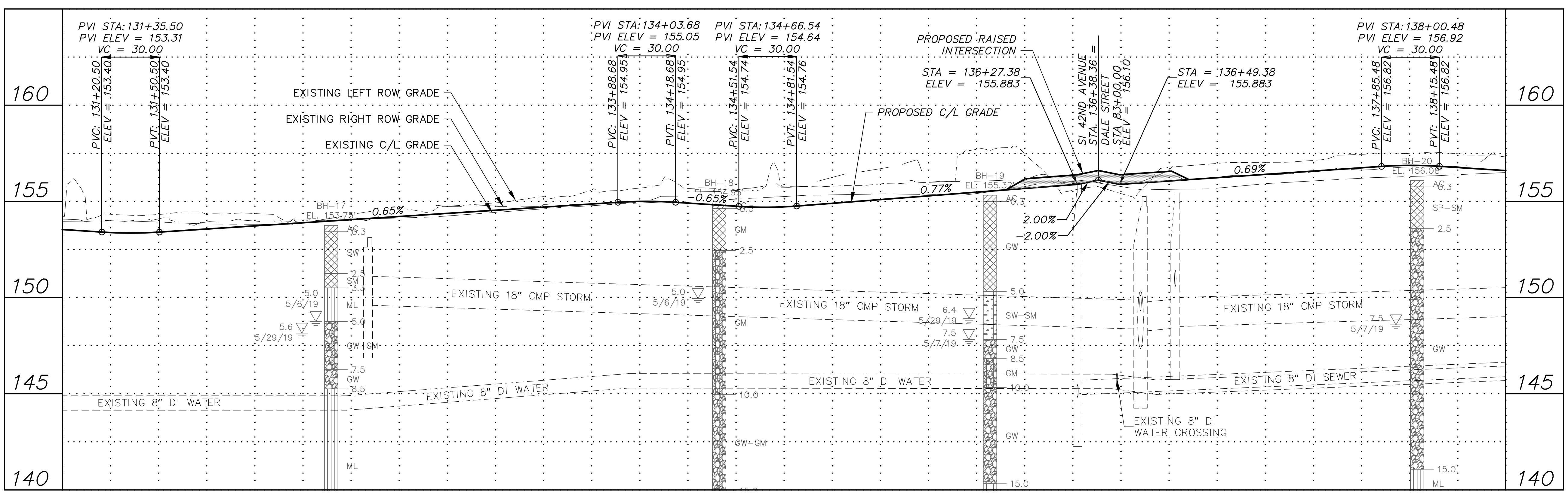
File: J:\JobsData\10142.00 42nd Avenue Upgrade\00 CADD\01 Working Set\01 Civil\10142.00 Roadway-Plan & Profile_Alt 2.dwg



NOTES:

1. *SEE ALTERNATIVE 1 PLAN AND PROFILE DRAWINGS FOR PROPOSED STORM DRAIN FACILITIES.*

ALTERNATIVE #2



RECORD DRAWING

1. DATA PROVIDED BY: ____ TITLE: ____
   THIS WILL SERVE TO CERTIFY THAT THESE RECORD DRAWINGS ARE A TRUE AND ACCURATE REPRESENTATION OF THE PROJECT AS CONSTRUCTED.
   CONTRACTOR: ____
   BY: ____ TITLE: ____ DATE: ____
2. DATA TRANSFERRED BY: ____ TITLE: ____
   COMPANY: ____ DATE: ____
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   DATA TRANSFER CHECKED BY: ____ TITLE: ____
   COMPANY: ____ DATE: ____
   BY: ____

DATA	DRAWN BY	CHECKED BY
BASE		
TOPOGRAPHY		
PROFILE		
STORM SEWER		
WATER/SANITARY SEWER		
GAS		
TELEPHONE		
ELECTRIC		
DESIGN		
QUANTITIES		
PRELIMINARY/FINAL		
MUNICIPAL/STATE		
PLAN CHECK		

GRAPHIC SCALE 60 30 0 30 60

FIELD BOOKS	
DESIGN	
STAKING	
ASBUILT	
CONTRACTOR	
INSPECTOR	
CONSTRUCTION RECORD	

BM NO.	LOCATION	ELEV.
BASIS OF THIS DATUM		
VERTICAL DATUM		

REV	DATE	DESCRIPTION	BY
REVISIONS			

CRW ENGINEERING GROUP, LLC
3940 ARCTIC BLVD. SUITE 300
ANCHORAGE, ALASKA 99503
PHONE: (907) 562-3252
#AECL882-AK

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MUNICIPALITY OF ANCHORAGE

PROJECT MANAGEMENT AND ENGINEERING DEPARTMENT

18-06

42ND AVENUE UPGRADE
LAKE OTIS PARKWAY TO FLORINA STREET

SCHED A

ROADWAY PLAN & PROFILE

STA 131+00 TO STA 138+50

SCALE HOR. 1"=30' VER. 1"=3'

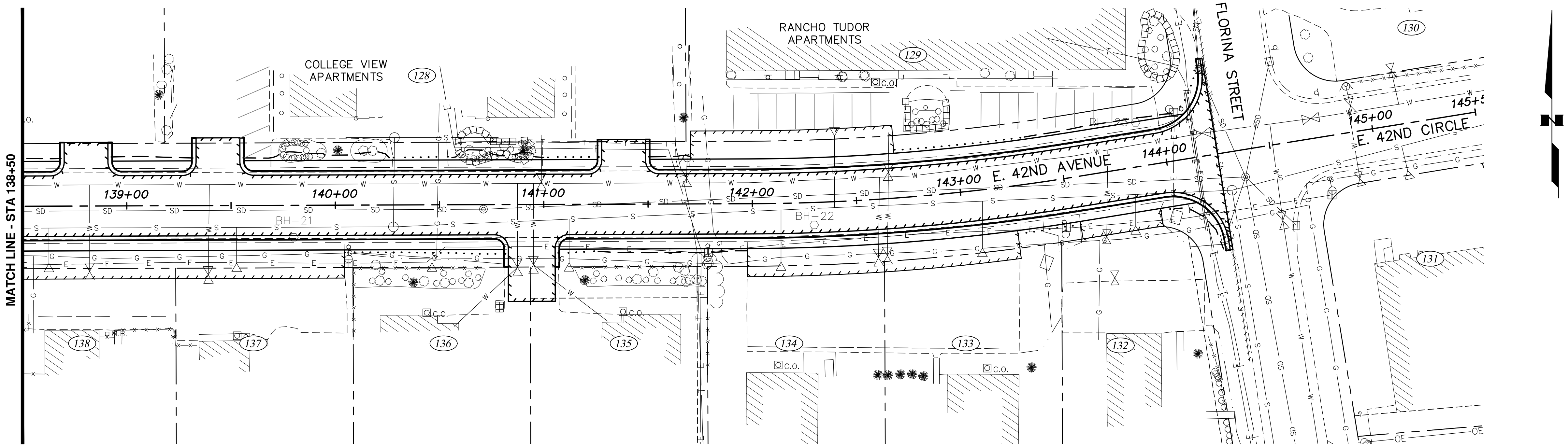
GRID SW1733, SW1734, SW1735

DATE DEC 2020

STATUS DSR

SHEET B2.5 of B2.6

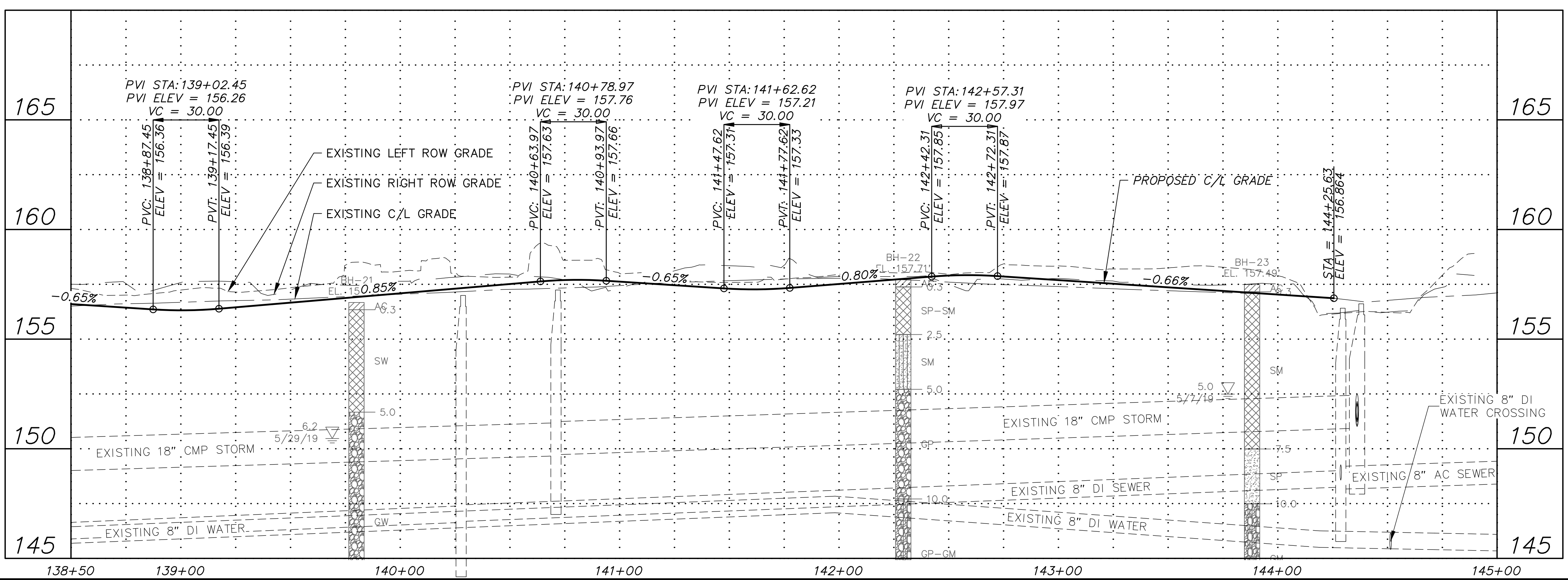
File: J:\JobsData\10142 42nd Avenue Upgrade\00 CADD\01 Working Set\01 Civil\10142.00 Roadway-Plan & Profile_Alt 2.dwg



NOTES:

1. SEE ALTERNATIVE 1 PLAN AND PROFILE DRAWINGS FOR PROPOSED STORM DRAIN FACILITIES.

ALTERNATIVE #2



RECORD DRAWING

1. DATA PROVIDED BY: ____ TITLE: ____
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   CONTRACTOR: ____
   BY: ____ TITLE: ____ DATE: ____
2. DATA TRANSFERRED BY: ____ TITLE: ____
   COMPANY: ____ DATE: ____
3. BASED ON PERIODIC FIELD OBSERVATIONS BY THE ENGINEER (OR AN INDIVIDUAL UNDER HIS/HER DIRECT SUPERVISION), THE CONTRACTOR-PROVIDED DATA APPEARS TO REPRESENT THE PROJECT AS CONSTRUCTED.
   DATA TRANSFER CHECKED BY: ____ TITLE: ____
   COMPANY: ____ DATE: ____
   BY: ____

DATA	DRAWN BY	CHECKED BY
BASE		
TOPOGRAPHY		
PROFILE		
STORM SEWER		
WATER/SANITARY SEWER		
GAS		
TELEPHONE		
ELECTRIC		
DESIGN		
QUANTITIES		
PRELIMINARY/FINAL		
MUNICIPAL/STATE		
PLAN CHECK		

GRAPHIC 60 30 0 30 60 SCALE

FIELD BOOKS	
DESIGN	
STAKING	
ASBUILT	
CONTRACTOR	
INSPECTOR	
CONSTRUCTION RECORD	

BM NO.	LOCATION	ELEV.
BASIS OF THIS DATUM		
VERTICAL DATUM		

REV	DATE	DESCRIPTION	BY
REVISIONS			

CRW ENGINEERING GROUP, LLC
3940 ARCTIC BLVD. SUITE 300
ANCHORAGE, ALASKA 99503
PHONE: (907) 562-3252
#AECL882-AK

CONSULTANT

SEAL

MUNICIPALITY OF ANCHORAGE

PROJECT MANAGEMENT AND ENGINEERING DEPARTMENT

18-06

42ND AVENUE UPGRADE
LAKE OTIS PARKWAY TO FLORINA STREET

SCHED A

ROADWAY PLAN & PROFILE

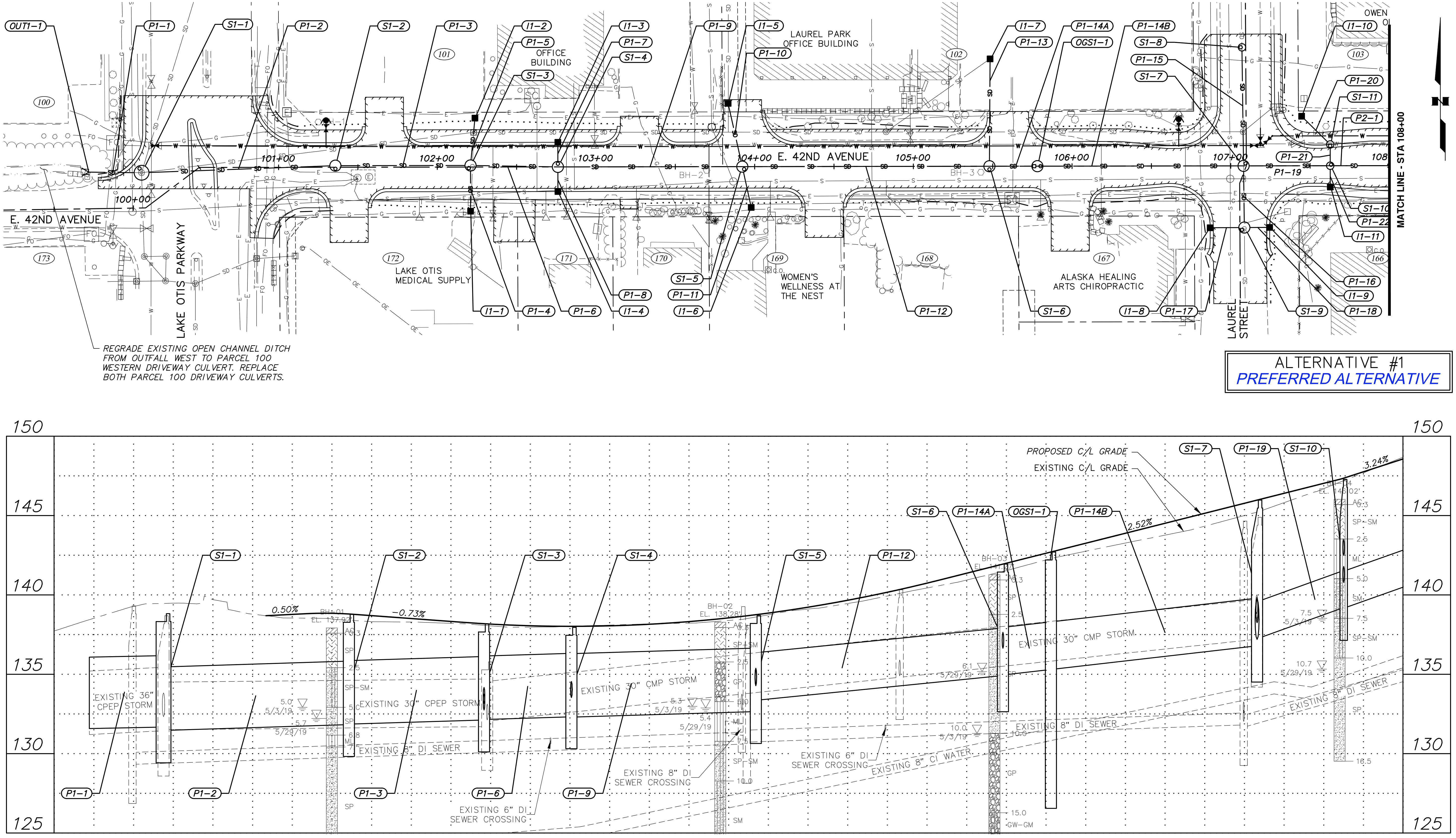
STA 138+50 TO EOP

SCALE	HOR. 1"=30' VER. 1"=3'	GRID SW1733, SW1734, SW1735	DATE DEC 2020	STATUS DSR	SHEET B2.6 of B2.6

File:J:\JobsData\10142.00 42nd Avenue Upgrade\00 CADD\01 Working Set\01 Civil\10142.00 Roadway-Plan & Profile_Alt 2.dwg

Storm Drain Plan & Profile Drawings

Appendix C



RECORD DRAWING

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CONTRACTOR:________
BY:________ TITLE:________ DATE:________
2. DATA TRANSFERRED BY:________ TITLE:________
COMPANY:________ DATE:________
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DATA TRANSFER CHECKED BY:________ TITLE:________
COMPANY:________ DATE:________
BY:________

DATA	DRAWN BY	CHECKED BY
BASE		
TOPOGRAPHY		
PROFILE		
STORM SEWER		
WATER/SANITARY SEWER		
GAS		
TELEPHONE		
ELECTRIC		
DESIGN		
QUANTITIES		
PRELIMINARY/FINAL		
MUNICIPAL/STATE		
PLAN CHECK		

GRAPHIC SCALE 60 30 0 30 60

FIELD BOOKS	
DESIGN	
STAKING	
ASBUILT	
CONTRACTOR	
INSPECTOR	
CONSTRUCTION RECORD	

BM NO.	LOCATION	ELEV.
	BASIS OF THIS DATUM	
VERTICAL DATUM		

REV	DATE	DESCRIPTION	BY
REVISIONS			

CRW ENGINEERING GROUP, LLC
3940 ARCTIC BLVD. SUITE 300
ANCHORAGE, ALASKA 99503
PHONE: (907) 562-3252
#AECL882-AK

CONSULTANT

SEAL

MUNICIPALITY OF ANCHORAGE

PROJECT MANAGEMENT AND ENGINEERING DEPARTMENT

18-06 42ND AVENUE UPGRADE LAKE OTIS PARKWAY TO FLORINA STREET SCHED B

STORM DRAIN PLAN & PROFILE

BOP TO STA 108+00

SCALE HOR. 1"=30' VER. 1"=3' | GRID SW1733, SW1734, SW1735 | DATE DEC 2020 | STATUS DSR | SHEET C1.1 of C1.6

File: J:\JobsData\10142.00 42nd Avenue Upgrade\00 CADD\01 Working Set\01 Civil\10142.00 Storm Drain-Plan & Profile_Alt 1.dwg

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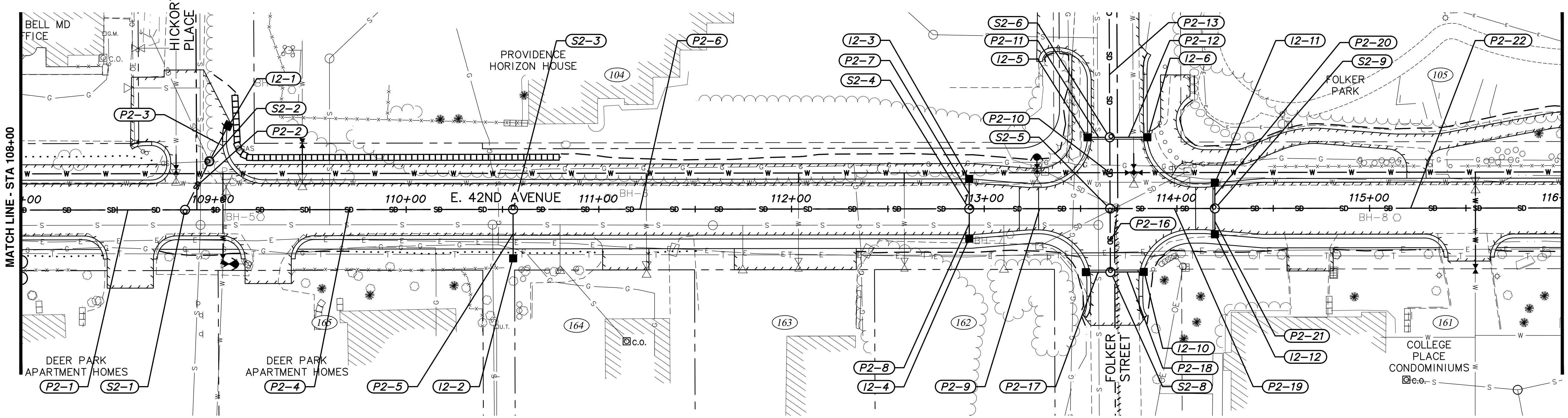

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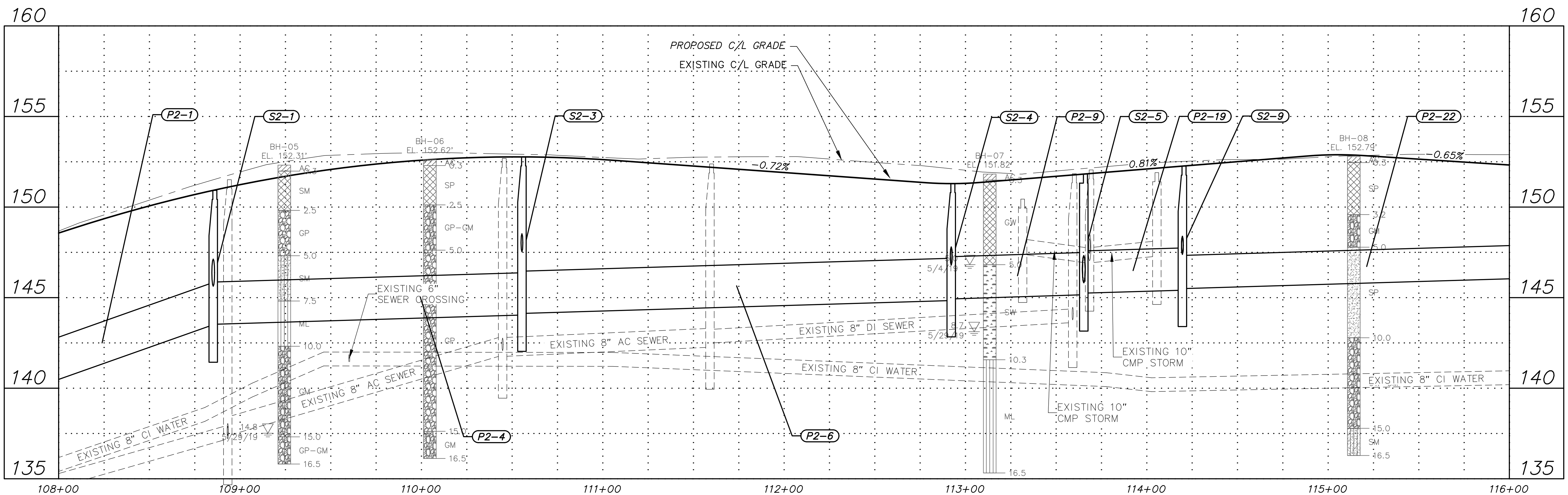
PREFERRED ALTERNATIVE



RECORD DRAWING

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   BY: ____ TITLE: ____ DATE: ____
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   DATA TRANSFER CHECKED BY: ____ TITLE: ____
   COMPANY: ____ DATE: ____
   BY: ____

DATA	DRAWN BY	CHECKED BY
BASE		
TOPOGRAPHY		
PROFILE		
STORM SEWER		
WATER/SANITARY SEWER		
GAS		
TELEPHONE		
ELECTRIC		
DESIGN		
QUANTITIES		
PRELIMINARY/FINAL		
MUNICIPAL/STATE		

PLAN CHECK

GRAPHIC SCALE 60 30 0 30 60

FIELD BOOKS	BM NO.	LOCATION	ELEV.
DESIGN			
STAKING			
ASBUILT	BASIS OF THIS DATUM		
CONTRACTOR			
INSPECTOR			

CONSTRUCTION RECORD — VERTICAL DATUM

REV	DATE	DESCRIPTION	BY

REVISIONS

CRW ENGINEERING GROUP, LLC
3940 ARCTIC BLVD. SUITE 300
ANCHORAGE, ALASKA 99503
PHONE: (907) 562-3252
#AECL882-AK

CONSULTANT — SEAL

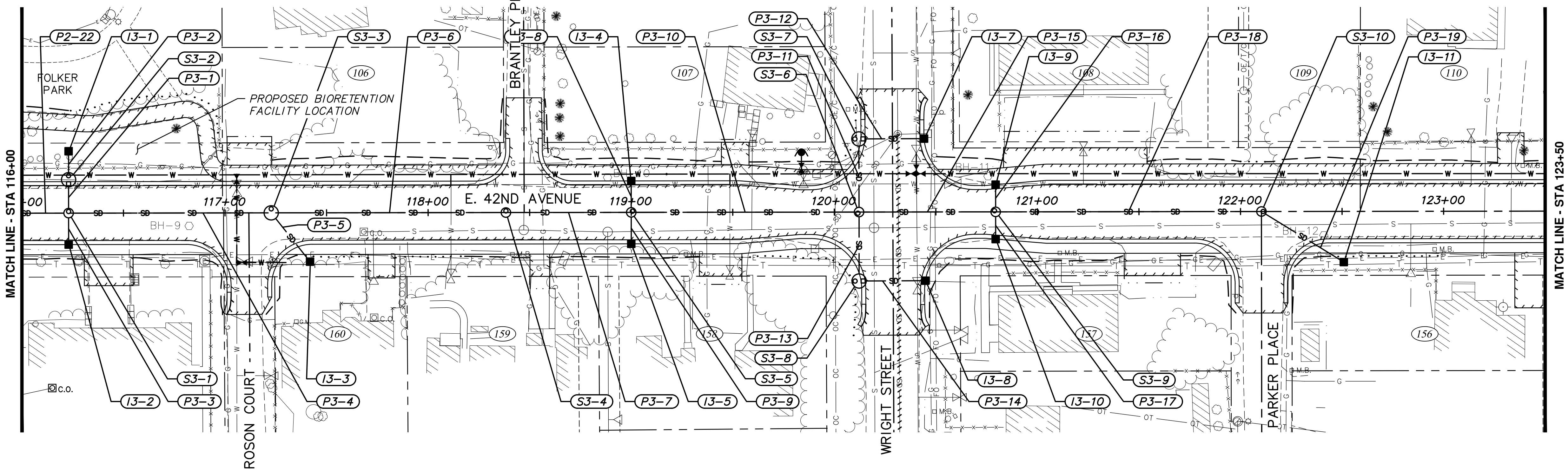
PROJECT MANAGEMENT AND ENGINEERING DEPARTMENT

18-06 — 42ND AVENUE UPGRADE — LAKE OTIS PARKWAY TO FLORINA STREET — SCHED B

STORM DRAIN PLAN & PROFILE

STA 108+00 TO STA 116+00

SCALE HOR. 1"=30' VER. 1"=3' | GRID SW1733, SW1734, SW1735 | DATE DEC 2020 | STATUS DSR | SHEET C1.2 of C1.6



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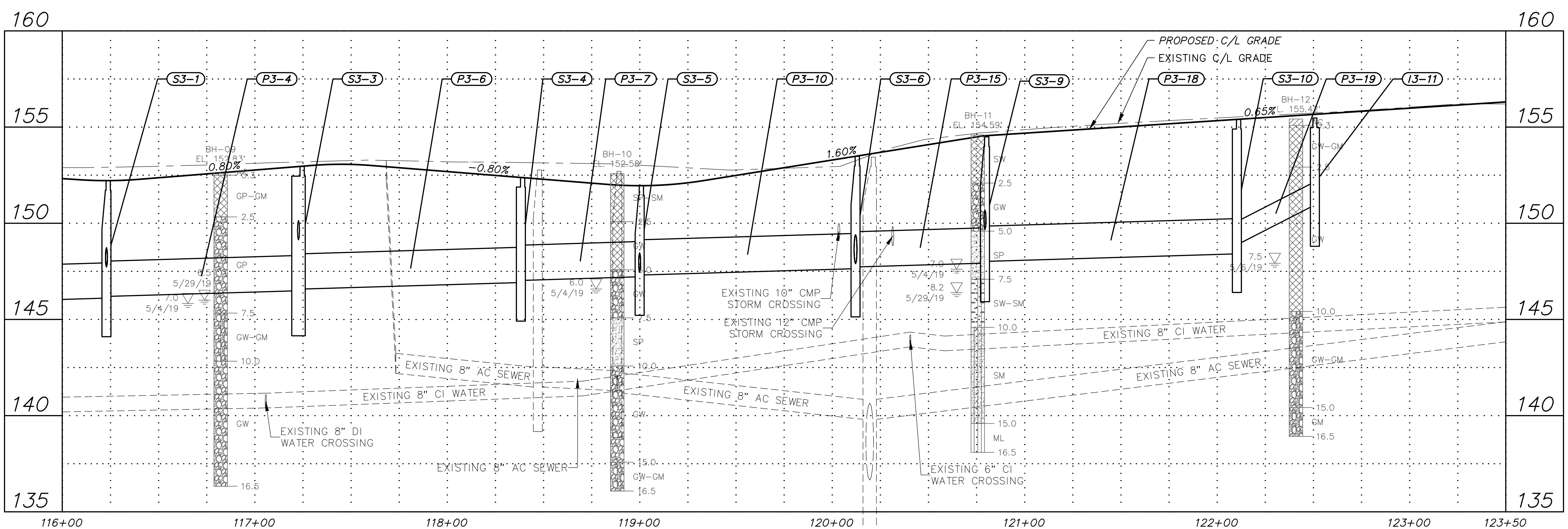

DATA	DRAWN BY	CHECKED BY
BASE		
TOPOGRAPHY		
PROFILE		
STORM SEWER		
WATER/SANITARY SEWER		
GAS		
TELEPHONE		
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DESIGN		
QUANTITIES		
PRELIMINARY/FINAL		
MUNICIPAL/STATE		
PLAN CHECK		

RECORD DRAWING

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   BY: ______ TITLE: ______ DATE: ______
2. DATA TRANSFERRED BY: ______ TITLE: ______
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   COMPANY: ______ DATE: ______
   BY: ______

GRAPHIC 60 30 0 30 60 SCALE

FIELD BOOKS	BM NO.	LOCATION	ELEV.
DESIGN			
STAKING			
ASBUILT			
CONTRACTOR	BASIS OF THIS DATUM		
INSPECTOR			
CONSTRUCTION RECORD	VERTICAL DATUM		

REV	DATE	DESCRIPTION	BY
		REVISIONS	

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MUNICIPALITY OF ANCHORAGE

PROJECT MANAGEMENT AND ENGINEERING DEPARTMENT

18-06 | 42ND AVENUE UPGRADE | SCHED B
LAKE OTIS PARKWAY TO FLORINA STREET

STORM DRAIN PLAN & PROFILE

STA 116+00 TO STA 123+50

SCALE HOR. 1"=30' VER. 1"=3' | GRID SW1733, SW1734, SW1735 | DATE DEC 2020 | STATUS DSR | SHEET C1.3 of C1.6

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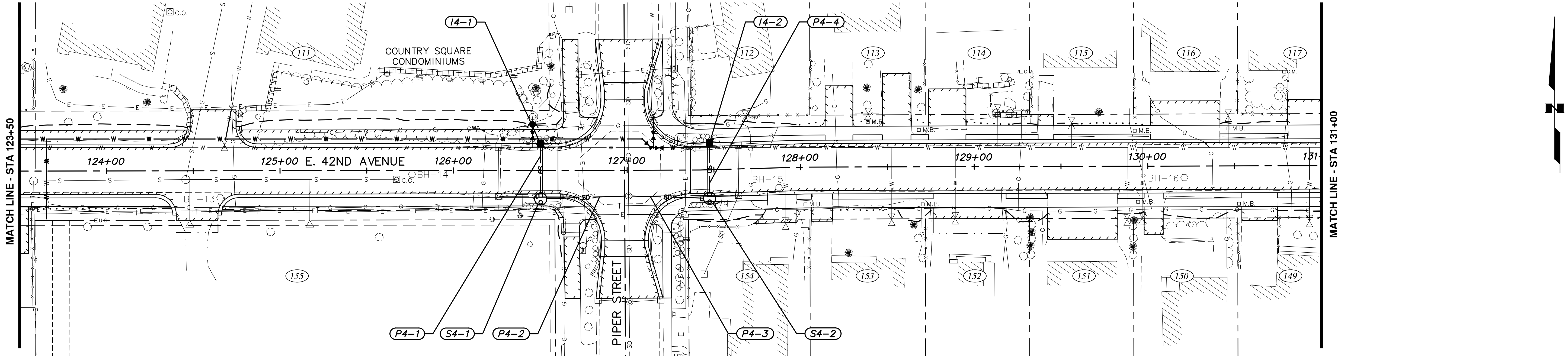
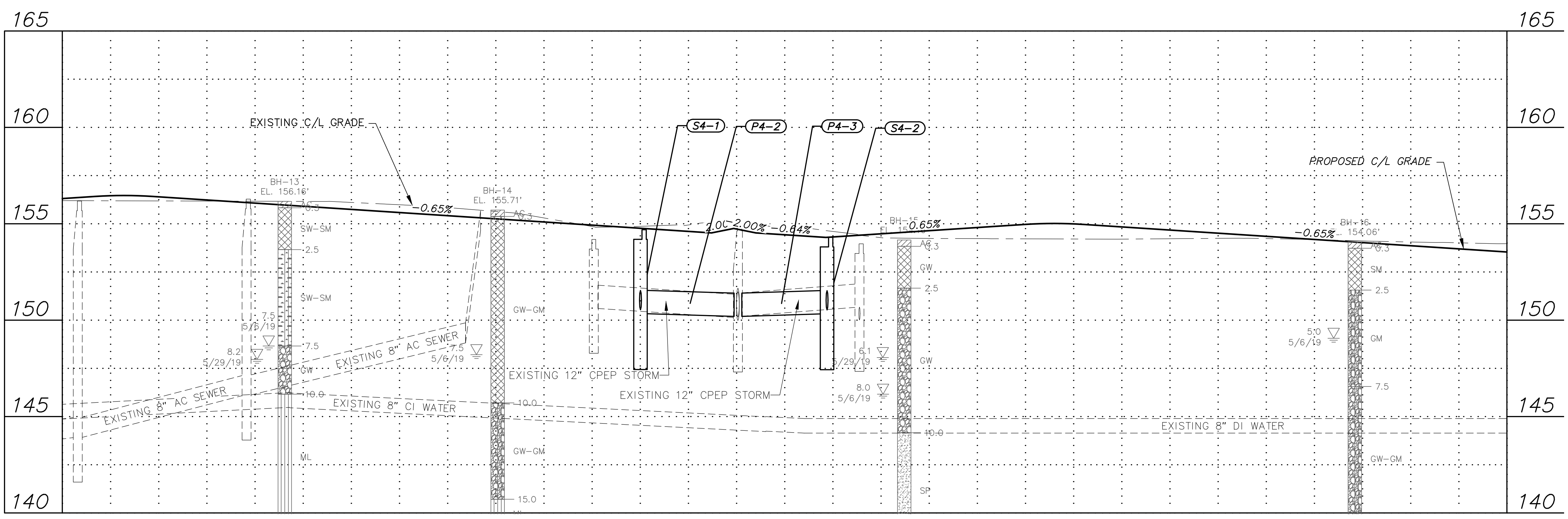


ALTERNATIVE #1
PREFERRED ALTERNATIVE



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   BY: ______ TITLE: ______ DATE: ______
2. DATA TRANSFERRED BY: ______ TITLE: ______
   COMPANY: ______ DATE: ______
3. BASED ON PERIODIC FIELD OBSERVATIONS BY THE ENGINEER (OR AN INDIVIDUAL UNDER HIS/HER DIRECT SUPERVISION), THE CONTRACTOR-PROVIDED DATA APPEARS TO REPRESENT THE PROJECT AS CONSTRUCTED.
   DATA TRANSFER CHECKED BY: ______ TITLE: ______
   COMPANY: ______ DATE: ______
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DATA	DRAWN BY	CHECKED BY
BASE		
TOPOGRAPHY		
PROFILE		
STORM SEWER		
WATER/SANITARY SEWER		
GAS		
TELEPHONE		
ELECTRIC		
DESIGN		
QUANTITIES		
PRELIMINARY/FINAL		
MUNICIPAL/STATE		

PLAN CHECK

GRAPHIC 60 30 0 30 60 SCALE

FIELD BOOKS		BM NO.	LOCATION	ELEV.
DESIGN				
STAKING				
ASBUILT				
CONTRACTOR		BASIS OF THIS DATUM		
INSPECTOR				

CONSTRUCTION RECORD — VERTICAL DATUM

REV	DATE	DESCRIPTION	BY

REVISIONS

CRW ENGINEERING GROUP, LLC
3940 ARCTIC BLVD. SUITE 300
ANCHORAGE, ALASKA 99503
PHONE: (907) 562-3252
#AECL882-AK

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MUNICIPALITY OF ANCHORAGE

PROJECT MANAGEMENT AND ENGINEERING DEPARTMENT

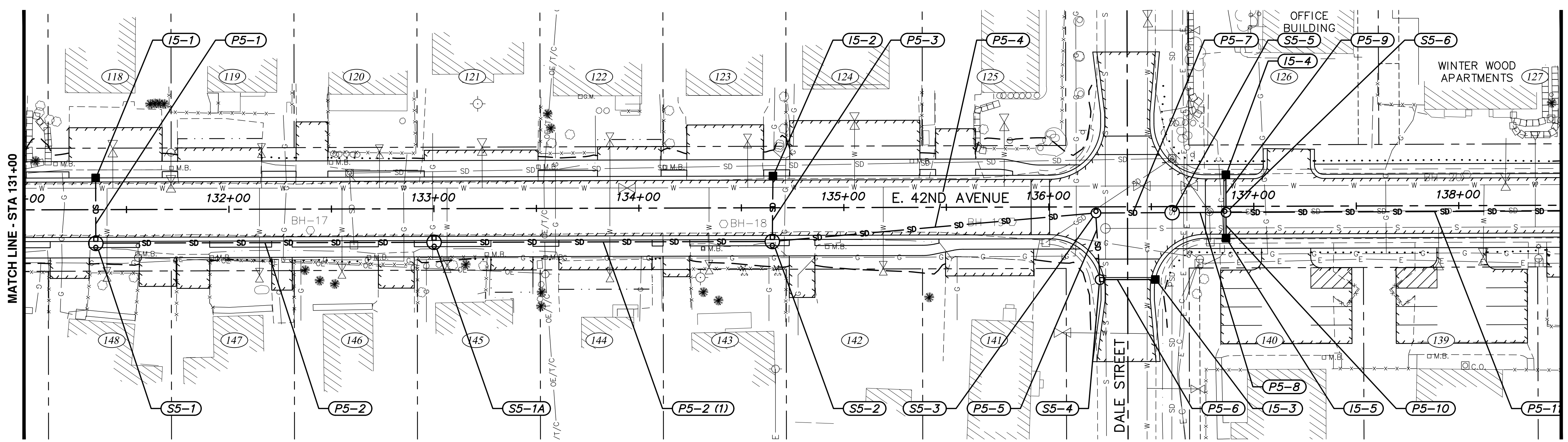
18-06 42ND AVENUE UPGRADE SCHED B
LAKE OTIS PARKWAY TO FLORINA STREET

STORM DRAIN PLAN & PROFILE

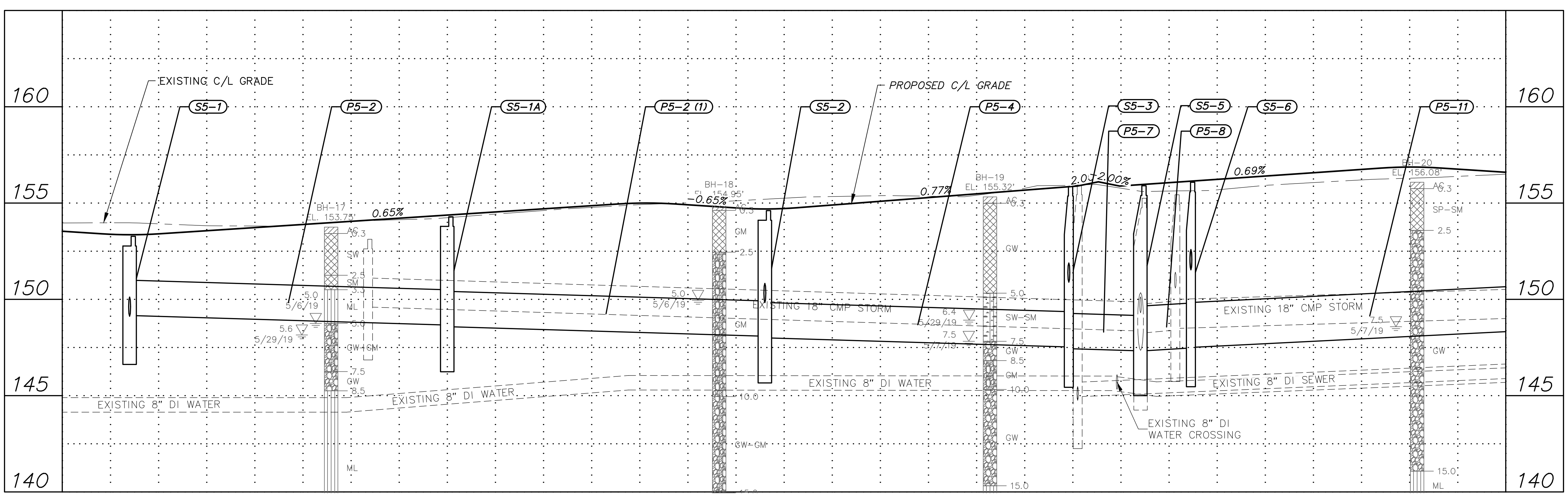
STA 123+50 TO STA 131+00

SCALE HOR. 1"=30' VER. 1"=3'
GRID SW1733, SW1734, SW1735
DATE DEC 2020 STATUS DSR
SHEET C1.4 of C1.6

File: J:\JobsData\10142.00 42nd Avenue Upgrade\00 CADD\01 Working Set\01 Civil\10142.00 Storm Drain-Plan & Profile_Alt 1.dwg



ALTERNATIVE #1
PREFERRED ALTERNATIVE



RECORD DRAWING

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2. DATA TRANSFERRED BY:______________ TITLE:______________
   COMPANY:______________ DATE:______________
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   COMPANY:______________ DATE:______________
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DATA	DRAWN BY	CHECKED BY
BASE		
TOPOGRAPHY		
PROFILE		
STORM SEWER		
WATER/SANITARY SEWER		
GAS		
TELEPHONE		
ELECTRIC		
DESIGN		
QUANTITIES		
PRELIMINARY/FINAL		
MUNICIPAL/STATE		

PLAN CHECK

GRAPHIC 60 30 0 30 60 SCALE

FIELD BOOKS	
DESIGN	
STAKING	
ASBUILT	
CONTRACTOR	
INSPECTOR	

CONSTRUCTION RECORD

BM NO.	LOCATION	ELEV.
BASIS OF THIS DATUM		

VERTICAL DATUM

REV	DATE	DESCRIPTION	BY

REVISIONS

CRW ENGINEERING GROUP, LLC
3940 ARCTIC BLVD. SUITE 300
ANCHORAGE, ALASKA 99503
PHONE: (907) 562-3252
#AECL882-AK

CONSULTANT

SEAL

MUNICIPALITY OF ANCHORAGE

PROJECT MANAGEMENT AND ENGINEERING DEPARTMENT

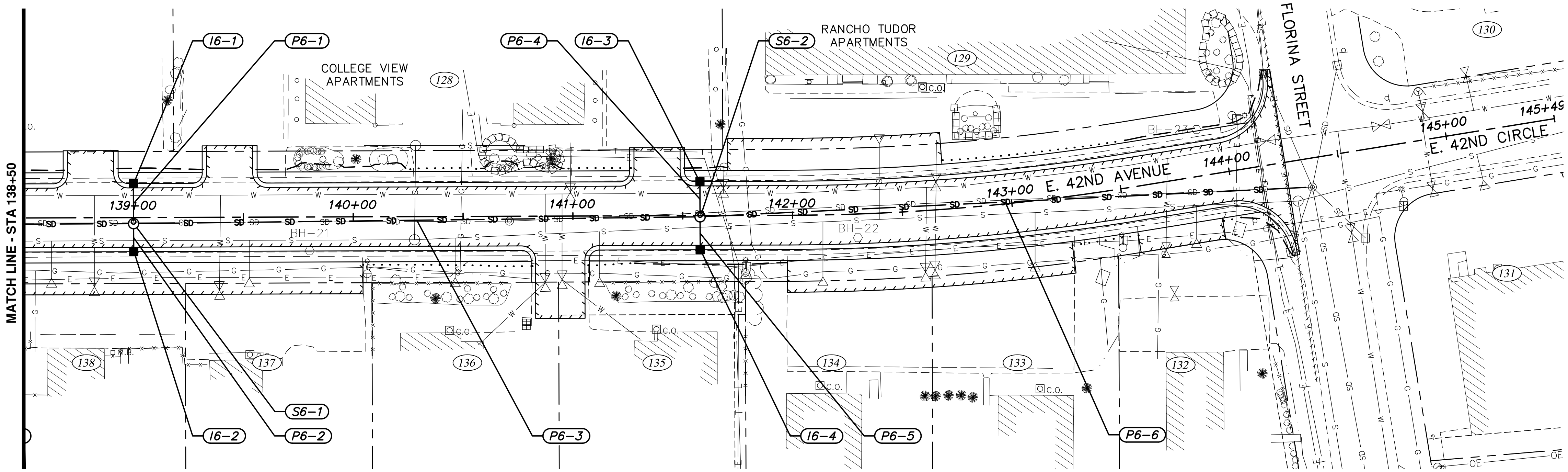
18-06 | 42ND AVENUE UPGRADE | SCHED B
LAKE OTIS PARKWAY TO FLORINA STREET

STORM DRAIN PLAN & PROFILE

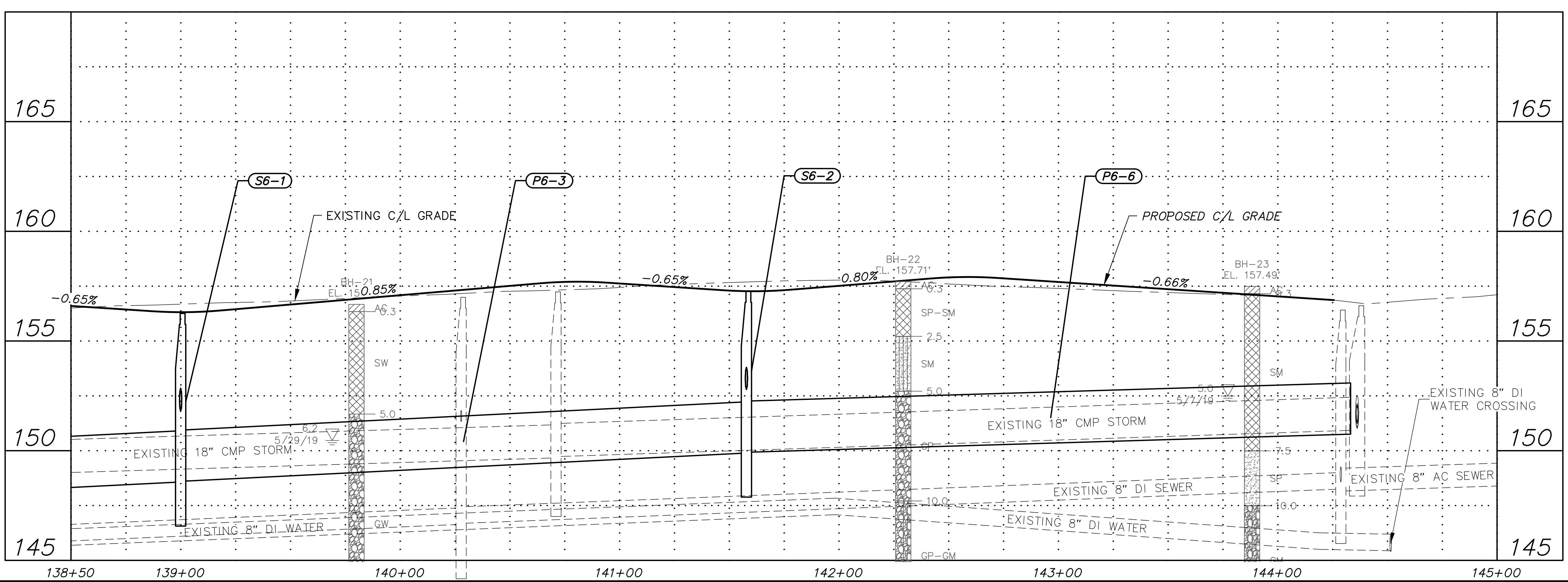
STA 131+00 TO STA 138+50

SCALE HOR. 1"=30' VER. 1"=3' | GRID SW1733, SW1734, SW1735 | DATE DEC 2020 | STATUS DSR | SHEET C1.5 of C1.6

File: J:\JobsData\10142.00 42nd Avenue Upgrade\00 CADD\01 Working Set\01 Civil\10142.00 Storm Drain-Plan & Profile_Alt 1.dwg



ALTERNATIVE #1
PREFERRED ALTERNATIVE



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   COMPANY: ____ DATE: ____
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   DATA TRANSFER CHECKED BY: ____ TITLE: ____
   COMPANY: ____ DATE: ____
   BY: ____

DATA	DRAWN BY	CHECKED BY
BASE		
TOPOGRAPHY		
PROFILE		
STORM SEWER		
WATER/SANITARY SEWER		
GAS		
TELEPHONE		
ELECTRIC		
DESIGN		
QUANTITIES		
PRELIMINARY/FINAL		
MUNICIPAL/STATE		

PLAN CHECK

GRAPHIC 60 30 0 30 60 SCALE

FIELD BOOKS	
DESIGN	
STAKING	
ASBUILT	
CONTRACTOR	
INSPECTOR	

CONSTRUCTION RECORD

BM NO.	LOCATION	ELEV.
BASIS OF THIS DATUM		

VERTICAL DATUM

REV	DATE	DESCRIPTION	BY

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CONSULTANT

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MUNICIPALITY OF ANCHORAGE

PROJECT MANAGEMENT AND ENGINEERING DEPARTMENT

18-06 42ND AVENUE UPGRADE SCHED B
LAKE OTIS PARKWAY TO FLORINA STREET

STORM DRAIN PLAN & PROFILE

STA 138+50 TO EOP

SCALE HOR. 1"=30' VER. 1"=3'
GRID SW1733, SW1734, SW1735
DATE DEC 2020 STATUS DSR
SHEET C1.6 of C1.6

File: J:\JobsData\10142.00 42nd Avenue Upgrade\00 CADD\01 Working Set\01 Civil\10142.00 Storm Drain-Plan & Profile_Alt 1.dwg

Water Improvement Drawings

Appendix D

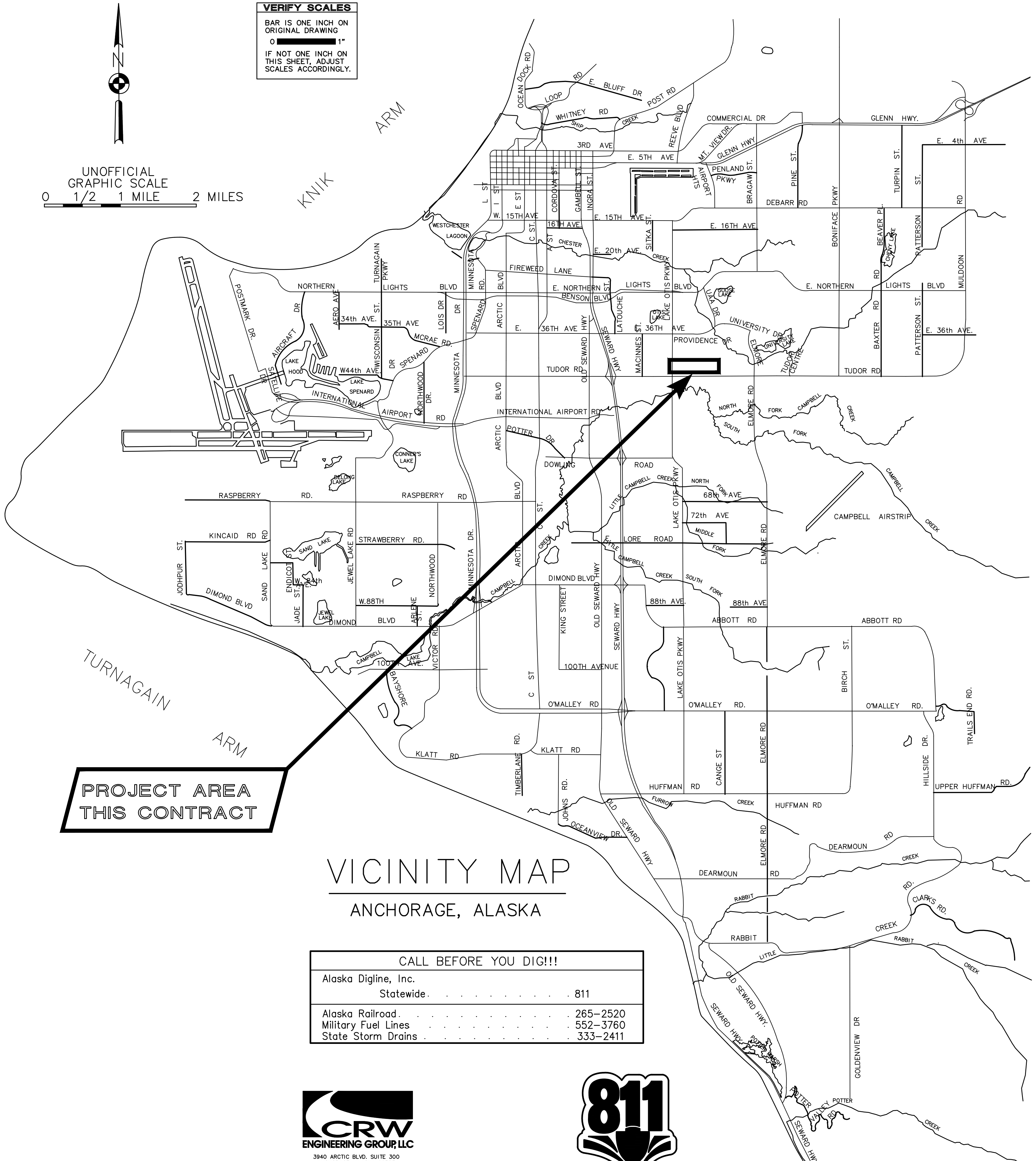
AWWU PLAN SET NO. XXXXX

MUNICIPALITY OF ANCHORAGE
WATER & WASTEWATER UTILITY

42ND AVENUE UPGRADE
LAKE OTIS PARKWAY TO PIPER STREET

PROJECT ID

DEC 2020
35% DESIGN



VICINITY MAP

ANCHORAGE, ALASKA

CALL BEFORE YOU DIG!!!	
Alaska Digline, Inc.	
Statewide	811
Alaska Railroad	265–2520
Military Fuel Lines	552–3760
State Storm Drains	333–2411

CRW ENGINEERING GROUP, LLC
3940 ARCTIC BLVD. SUITE 300
ANCHORAGE, ALASKA 99503
PHONE: (907) 562–3252
#AECL882–AK

811 Call before you dig.

SHEET INDEX

SHEET NO.	SUBJECT
D1.0	COVER SHEET
D1.1	KEY MAPS, NOTES, LEGEND & ABBREVIATIONS
D1.2	WATER FACILITY MAP
D1.3	WATER MAIN PLAN & PROFILE BOP – STA 57+50
D1.4	WATER MAIN PLAN & PROFILE STA 57+50 – STA 65+50
D1.5	WATER MAIN PLAN & PROFILE STA 65+50 – STA 73+50
D1.6	WATER MAIN PLAN & PROFILE STA 73+50 – EOP
D1.7	TEMPORARY WATER SERVICE OVERALL PHASING MAP
D1.8	TEMPORARY WATER SERVICE MAP PHASE 1
D1.9	TEMPORARY WATER SERVICE MAP PHASE 2
D1.10	TEMPORARY WATER SERVICE MAP PHASE 3

PROJECT TITLE 1
PROJECT TITLE 2
INVITATION TO BID No.
PROJECT ID

PLOT DATE: 12/21/2020 7:42 AM

PLOT SCALE:

ACAD FILE: J:\JobsData\10142.00 42nd Avenue Upgrade\00 CADD\01 Working Set\01 Civil\02 AWWU Design\10142.00 Key Map Notes.dwg

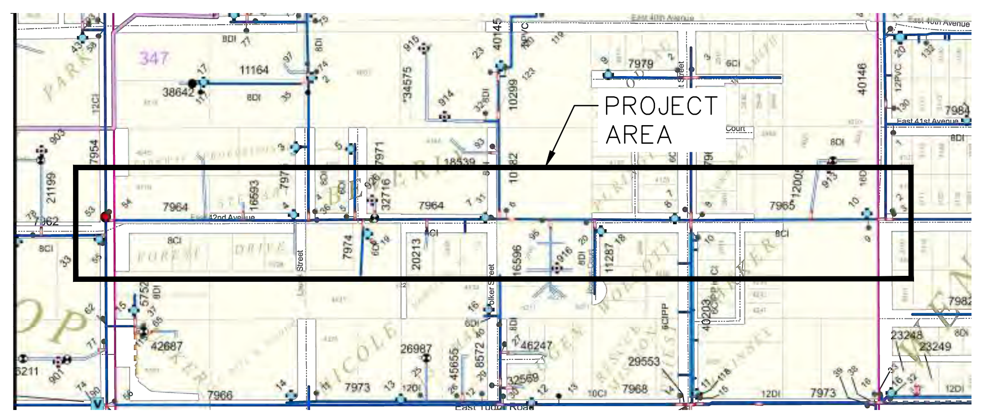
AWWU PLAN SET NO. XXXXX

GENERAL NOTES

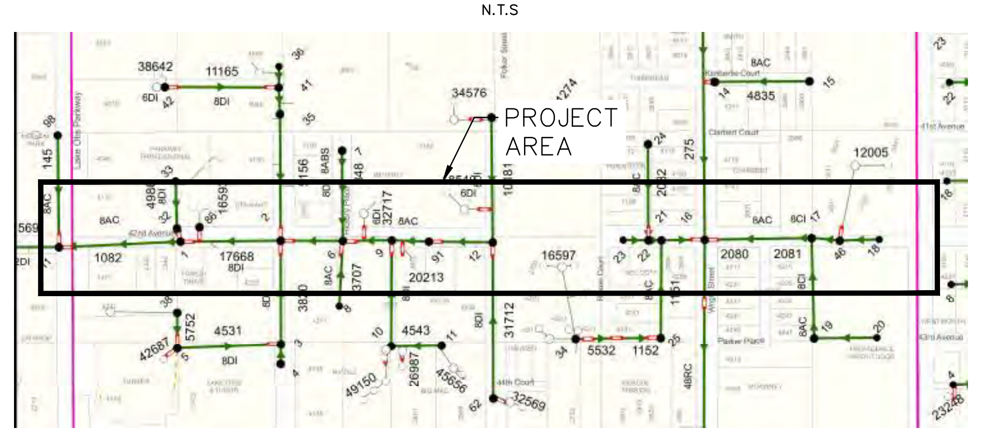
1. ALL WORK SHALL BE IN ACCORDANCE WITH THE MUNICIPALITY OF ANCHORAGE (MOA) STANDARD SPECIFICATIONS, DATED 2009, REVISION 1, (HEREINAFTER REFERRED TO AS MASS), THE LATEST EDITION OF THE AWWU DESIGN CRITERIA MANUAL AND THE SPECIAL PROVISIONS.
2. MAINTAIN A MINIMUM OF TEN (10) FEET HORIZONTAL AND EIGHTEEN (18) INCHES VERTICAL SEPARATION BETWEEN WATER AND SANITARY OR STORM SEWER MAINS AND SERVICES. SANITARY AND STORM SEWER PIPE JOINTS SHALL BE PLACED AT LEAST NINE (9) FEET FROM ANY WATERLINE CROSSING.
3. MAINTAIN A MINIMUM OF 36-INCHES OF VERTICAL SEPARATION BETWEEN ANY STORM SEWER (STORM DRAIN OR FOOTING DRAIN) AND WATERLINE (MAINS OR SERVICES) OR SANITARY SEWER (MAINS OR SERVICES). IF 36-INCHES CANNOT BE MAINTAINED, PROVIDE A MINIMUM OF 4-INCH THICK (R-20) INSULATION.
4. HORIZONTAL AND VERTICAL LOCATIONS OF EXISTING UTILITIES AS SHOWN ON THESE PLANS ARE APPROXIMATE. CONTRACTOR SHALL FIELD VERIFY THE LOCATION OF ALL UTILITIES PRIOR TO CONSTRUCTION.
5. CONTRACTOR SHALL VERIFY AND RECORD THE HORIZONTAL AND VERTICAL LOCATIONS OF ALL UTILITIES ENCOUNTERED IN THE FIELD AND RECORD ANY CHANGES ON THE CONTRACTOR RECORD DRAWINGS.
6. THE CONTRACTOR SHALL RESTORE ALL PROPERTY, INCLUDING DRAINAGE SWALES, DISTURBED BY CONTRACT ACTIVITIES TO PRECONSTRUCTION CONDITION.
7. IN CASE OF CONFLICT BETWEEN STATIONING LOCATION OF PIPE OR FITTINGS, USE DIMENSIONED LOCATIONS RELATIVE TO THE CENTERLINE AND PROPERTY LINE. THE DIMENSIONED LOCATIONS SHALL GOVERN.
8. THE CONTRACTOR SHALL RECORD SURVEY NOTES FOR SUBMITTAL WITH RECORD DRAWING PLANS PRIOR TO CONTRACT FINAL PAYMENT.
9. ALL WATER/SEWER PIPE INSULATION SHALL BE RIGID BOARD, HIGH DENSITY EXTRUDED POLYSTYRENE MIN. 60 P.S.I., FOR UNDERGROUND INSTALLATIONS EQUIVALENT TO R-20 PER FOUR (4) INCH THICK INSULATION.
10. CONTRACTOR SHALL USE DUCTILE IRON PIPE (DIP) LONG SOLID SLEEVES WITH RESTRAINED JOINTS TO FACILITATE CONNECTING DIP TO DIP OF SAME SIZE.
11. THE CONTRACTOR SHALL BE RESPONSIBLE FOR EROSION AND SEDIMENT CONTROLS AS NECESSARY TO COMPLY WITH FEDERAL, STATE, AND MUNICIPAL LAWS THAT PROHIBIT UNPERMITTED DISCHARGE OF POLLUTANTS, INCLUDING SEDIMENTS, THAT ARE A RESULT OF EROSION AND OTHER CONSTRUCTION ACTIVITIES. THE CONTRACTOR SHALL CONDUCT ALL WORK SO SEDIMENT IS NOT TRANSPORTED ONTO THE ROADWAY OR ADJACENT PROPERTY. AT A MINIMUM, THE CONTRACTOR SHALL SWEEP UP ANY SEDIMENT TRACKED ONTO PAVED SURFACES IN PUBLIC RIGHT-OF-WAY WITHIN 24 HOURS OF THE TRACKING TO MINIMIZE THE WASH-OFF OF SEDIMENT INTO THE STORM DRAINS OR WATERWAYS.
12. WATER RESULTING FROM CONTRACTOR'S DEWATERING EFFORT MAY NOT BE PUMPED OR OTHERWISE DIVERTED INTO EXISTING STORM DRAINS UNLESS PERMITS ARE OBTAINED BY THE CONTRACTOR, INCLUDING BUT NOT LIMITED TO, THOSE REQUIRED BY THE MOA STORM WATER PLAN REVIEW OFFICE. UNDER NO CIRCUMSTANCES WILL THE CONTRACTOR BE ALLOWED TO DIVERT WATER FROM AN EXCAVATION ONTO ROADWAYS. CONTRACTOR SHALL PROVIDE A DISPOSAL SITE FOR EXCESS WATER AND SHALL BE RESPONSIBLE FOR SECURING ALL NECESSARY PERMITS AND APPROVALS. CONTRACTOR SHALL PROVIDE COPIES OF NECESSARY PERMITS AND APPROVALS TO THE MOA RIGHT OF WAY PERMIT OFFICE.
13. "BOP" IS DEFINED AS THE OUTSIDE BOTTOM OF PIPE. "INVERT" IS DEFINED AS THE INSIDE BOTTOM OF PIPE.
14. ALL NUTS, BOLTS AND WASHERS SHALL BE STAINLESS STEEL (TYPE 316).
15. DAMAGE TO ALL OTHER UTILITIES AND SERVICE CONNECTIONS MADE DURING WATERLINE CONSTRUCTION SHALL BE REPAIRED USING APPROVED MATERIALS WITH APPROVED COUPLINGS.

WATER NOTES

1. HYDRANTS WILL BE ADJUSTED TO FINAL GRADE BY AWWU O&M DIVISION. THE CONTRACTOR'S ENGINEER SHALL GIVE A MINIMUM FORTY-EIGHT (48) HOURS WRITTEN NOTICE TO AWWU ENGINEERING INDICATING THE TYPE OF FIRE HYDRANT AND THE AMOUNT OF VERTICAL ADJUSTMENT. ALL HYDRANTS ADJUSTED BY AWWU ARE ON A REIMBURSABLE BASIS.
2. AWWU, ANCHORAGE FIRE DEPARTMENT AND EXISTING CUSTOMERS SHALL BE NOTIFIED SEVENTY-TWO (72) HOURS IN ADVANCE OF WATER SERVICE INTERRUPTION. THE CONTRACTOR SHALL BE RESPONSIBLE TO PROVIDE TEMPORARY WATER SERVICE TO THE EXISTING CUSTOMERS IF THE OUTAGE EXCEEDS 6-HOURS UNLESS OTHERWISE SPECIFIED. THE CONTRACTOR SHALL HAVE A TEMPORARY WATER SERVICE PLAN REVIEWED AND APPROVED BY ADEC.
3. UNLESS OTHERWISE LABLED ON THE PLANS, ALL PIPE AND FITTINGS ARE TO BE RESTRAINED. REGARDLESS OF NOTES DELINEATING RESTRAINT, ALL PIPES EIGHT (8') FEET IN LENGTH AND LESS ARE TO BE RESTRAINED.
4. ALL WATER MAINS SHALL BE 8" PVC DR18 RJIB, AS SHOWN IN THE PLANS, CONFORMING TO THE REQUIREMENTS OF AWWA C900.
5. ALL FITTINGS SHALL BE MECHANICALLY RESTRAINED, EBAA IRON MEGALUG SERIES 2000PV OR APPROVED EQUAL UNLESS OTHERWISE NOTED. INSTALL THRUST BLOCK AT ALL FITTINGS.
6. ALL WATER MAIN STATIONING IS PIPE CENTERLINE STATIONING.
7. THE CONTRACTOR SHALL PROVIDE ALL SETUP AND TEAR DOWN REQUIRED TO OPEN BORE FLUSH NEWLY INSTALLED WATER PIPE. AWWU WILL PROVIDE FLUSH WATER FROM THE AWWU WATER DISTRIBUTION SYSTEM. THE CONTRACTOR MUST REQUEST WATER AT LEAST 48 HOURS PRIOR TO OPEN BORE FLUSHING. OPEN BORE FLUSHING MUST TAKE PLACE PRIOR TO INSTALLATION OF WATER SERVICES.
8. WATER SERVICES SIZE SPECIFIED IN PLANS.
9. ALL WATER MAINS AND SERVICES SHALL HAVE A MINIMUM OF 10 FEET OF BURY AT ALL POINTS, UNLESS OTHERWISE NOTED.
10. ALL PIPE BEDDING SHALL BE CLASS 'E' PER THE SPECIFICATIONS.
11. ALL WATER MAIN AND SERVICE TRENCH BACKFILL MATERIALS AND BEDDING SHALL BE COMPACTED TO A MINIMUM 95% OF MAXIMUM DENSITY.
12. ALL DUCTILE IRON PIPE AND FITTINGS SHALL BE ENCASED IN 8-MILS OF POLYETHYLENE WRAP, AS PER MASS SECTION 60.07 "POLYETHYLENE ENCASEMENT".
13. WATER SERVICES SHALL BE PLACED NO CLOSER THAN: 15 FEET HORIZONTALLY MEASURED TO ANY FIRE HYDRANT OR FIRE HYDRANT LEG; 10 FEET HORIZONTALLY MEASURED TO ANY SANITARY SEWER MAIN, SANITARY SEWER SERVICE, STORM SEWER, FOOTING DRAIN, STREET LIGHT, TRANSFORMER PAD, ELECTRICAL/TELEPHONE/CABLE BOX; AND 5 FEET HORIZONTALLY MEASURED TO ANY SIDE LOT LINE.
14. PROVIDE A TRACER WIRE AND WARNING TAPE ON ALL PVC WATER LINES AS SHOWN IN THESE PLANS AND AS SPECIFIED IN THE SPECIAL PROVISIONS.
15. THE CONTRACTOR SHALL RELOCATE ANY WATER SERVICE CONNECTIONS INSTALLED WITH LESS THAN MINIMUM STANDARD DISTANCES PRIOR TO ACCEPTANCE BY AWWU.
16. ALL BENDS, TEES, FIRE HYDRANTS AND DEAD-ENDS SHALL HAVE RESTRAINED FITTINGS.
17. PVC PIPE SHALL NOT BE DEFLECTED AT PIPE JOINTS, BUT MAY BE DEFLECTED UP TO 80% OF THE MANUFACTURERS RECOMMENDED DEFLECTION LIMITS IN FITTINGS AND COUPLERS.
18. NO PIPE LENGTH LESS THAN EIGHT FEET (8') SHALL BE INCORPORATED IN THE WATER SYSTEM EXCEPT FOR THOSE NECESSARY FOR FIRE HYDRANTS OR VALVE LOCATIONS UNLESS RESTRAINED.



WATER KEY MAP
SW1733, SW1734, SW1735
N.T.S



SEWER KEY MAP
SW1733, SW1734, SW1735
N.T.S

ABBREVIATIONS

AD	ALGEBRAIC DIFFERENCE
ADEC	ALASKA DEPARTMENT OF ENVIRONMENTAL CONSERVATION
AC	ASPHALT PAVEMENT
AFD	ANCHORAGE FIRE DEPARTMENT
AWG	AMERICAN WIRE GAUGE
AWWA	AMERICAN WATER WORKS ASSOCIATION
AWWU	ANCHORAGE WATER & WASTEWATER
BOH	BOTTOM OF HOLE
BOP	BOTTOM OF PIPE (OUTSIDE)
BV	BUTTERFLY VALVE
CI	CAST IRON
CONST.	CONSTRUCT
CPEP	CORRUGATED POLYETHYLENE PIPE
DCPM	DESIGN AND CONSTRUCTION PRACTICES MANUAL
DI	DUCTILE IRON
E	EAST
ELEV	ELEVATION
EOP	EDGE OF PAVEMENT
F&I	FURNISH AND INSTALL
FF	FINISHED FLOOR
FG	FINISHED GRADE
FH	FIRE HYDRANT
GV	GATE VALVE
H	HORIZONTAL
HORIZ.	HORIZONTAL
HMWPE	HIGH MOLECULAR WEIGHT POLYETHYLENE
IAW	IN ACCORDANCE WITH
INV	INVERT (INSIDE BOTTOM OF PIPE)
LT	LEFT
MASS	MUN. OF ANCHORAGE STD SPECIFICATIONS
N	NORTH
PL	PROPERTY LINE
PC	POINT OF CURVATURE
POB	POINT OF BEARING
PUE	PUBLIC USE EASEMENT
PT	POINT OF TANGENCY
PVC	POLYVINYL CHLORIDE
PVI	POINT OF VERTICAL INTERSECTION
RJIB	RESTRAINED JOINT INTEGRAL BELL
RT	RIGHT
ROW	RIGHT OF WAY
S	SOUTH
SI	STREET INTERSECTION
SP	SINGLE PUMPER
STA	STATION
STD	STANDARD
TBC	TOP BACK OF CURB
TOP	TOP OF PIPE
UG	UNDERGROUND
UNK	UNKNOWN
VB	VALVE BOX
VC	VERTICAL CURVE
W	WEST

LEGEND – PLAN

EXISTING	PROPOSED	DESCRIPTION
		PROPERTY LINE
		EASEMENT
		CENTERLINE
		CURB & GUTTER
		EDGE OF PAVEMENT
	— RL —	RAIN LEADER
— W —	— W —	WATER MAIN
— S —	— S —	SEWER MAIN
— SD —	— SD —	STORM DRAIN MAIN
— O/E —	— OHP —	OVERHEAD ELECTRIC
— O/T —	— OHT —	OVERHEAD TELEPHONE
— E —	— E —	UNDERGROUND ELECTRIC
		ELECTRIC LINE (ABANDONED)
		WATER LINE (ABANDONED)
— C —	— C —	UNDERGROUND CABLE
— T —	— T —	UNDERGROUND TELEVISION
— G —	— G —	UNDERGROUND NATURAL GAS
— x —	— x —	FENCE
		DRAINAGE ARROW
		EDGE OF PAVEMENT (EOP)
E	E	ELECTRICAL HAND HOLE
T	T	TELEPHONE HAND HOLE
E	E	ELECTRICAL VAULT
E.M.	E.M.	ELECTRICAL METER
U.E.	U.E.	UNDERGROUND ELECTRICAL PEDESTAL
U.T.	U.T.	UNDERGROUND TELEPHONE PEDESTAL
G.M.	G.M.	GAS METER
		GAS VALVE
M.B.	M.B.	MAILBOX
		STREET SIGN
I.P.	I.P.	IRON PIN OR REBAR
		SECTION CORNER/SURVEY MONUMENT
		LIGHT POLE
		WATER KEYBOX
		WATER VALVE
		WATER PLUG
		WATER STUB
		FIRE HYDRANT
		SEWER MANHOLE
		SEWER SERVICE
		SEWER PLUG
		CLEANOUT
		STORM DRAIN MANHOLE
		STORM DRAIN CATCH BASIN
		STORM DRAIN CATCH BASIN MANHOLE
		STORM DRAIN SERVICE
	20	RETURN RADIUS
		PAVEMENT REMOVAL LIMITS
		PROPOSED PAVEMENT LIMITS
		MONITOR WELL
W		EXISTING TEST HOLE

LEGEND – PROFILE

EXISTING	PROPOSED	DESCRIPTION
		CENTERLINE GRADE
		LEFT PROPERTY LINE GRADE
		RIGHT PROPERTY LINE GRADE
		LIMIT OF EXCAVATION
		INSULATION
		WATER LEVEL
		UTILITY MAIN
		STORM DRAIN/SEWER MANHOLE

VERIFY SCALE THIS BAR REPRESENTS ONE INCH ON ORIGINAL DRAWING. 0" 1" IF BAR IS NOT ONE INCH, ADJUST DRAWING SCALE ACCORDINGLY.

FULL SIZE SCALE
HORZ SCALE: N/A
VERT SCALE: N/A

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BASE	---	---	TELEPHONE	---	---
TOPOGRAPHY	---	---	ELECTRIC	---	---
PROFILE	---	---	CABLE TV	---	---
SANITARY SEWER	---	---	TRAFFIC SIGNAL	---	---
STORM SEWER	---	---	DESIGN	---	---
WATER	---	---	QUANTITIES	---	---
GAS	---	---	MUN. FINAL CHECK	---	---

PLAN CHECK

REV	DATE	DESCRIPTION	BY

REVISIONS

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#AECL882-AK

CONSULTANT

SEAL

ANCHORAGE WATER & WASTEWATER UTILITY — MUNICIPALITY OF ANCHORAGE — AWWU

MUNICIPALITY OF ANCHORAGE
WATER & WASTEWATER UTILITY

42ND AVENUE UPGRADE
LAKE OTIS PARKWAY TO PIPER STREET

KEY MAPS, NOTES, LEGEND & ABBREVIATIONS

HORZ SCALE: N/A
VERT SCALE: N/A
DATE: DEC 2020
GRID: SW1733-35
PROJ. ID.: ----
SHEET D1.1 of D1.10

AWWU PLAN SET NO. XXXXX

PLOT DATE: 12/21/2020 7:43 AM

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FULL SIZE SCALE
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VERT SCALE: N/A

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TOPOGRAPHY	---	---	ELECTRIC	---	---
PROFILE	---	---	CABLE TV	---	---
SANITARY SEWER	---	---	TRAFFIC SIGNAL	---	---
STORM SEWER	---	---	DESIGN	---	---
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ANCHORAGE WATER & WASTEWATER UTILITY
AWWU
MUNICIPALITY OF ANCHORAGE

MUNICIPALITY OF ANCHORAGE
WATER & WASTEWATER UTILITY

42ND AVENUE UPGRADE
LAKE OTIS PARKWAY TO PIPER STREET

WATER FACILITY MAP

HORZ SCALE: N/A
VERT SCALE: N/A

DATE: DEC 2020

GRID: SW1733-35

PROJ. ID.: ----

SHEET D1.2 of D1.10

PLOT DATE: 12/21/2020 7:43 AM

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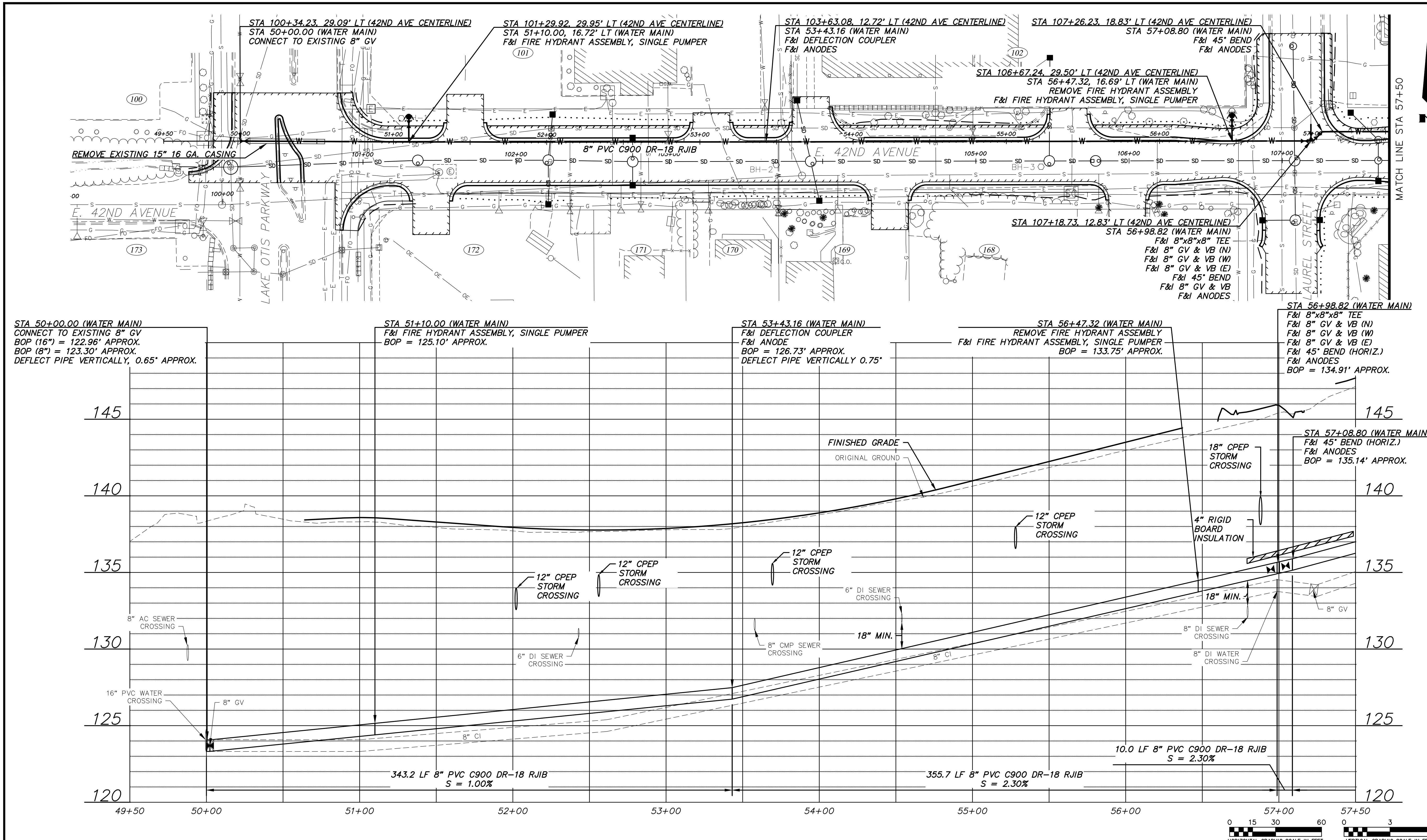

AWWU PLAN SET NO. XXXXX

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FULL SIZE SCALE HORZ SCALE: N/A VERT SCALE: N/A

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TOPOGRAPHY	---	---	ELECTRIC	---	---
PROFILE	---	---	CABLE TV	---	---
SANITARY SEWER	---	---	TRAFFIC SIGNAL	---	---
STORM SEWER	---	---	DESIGN	---	---
WATER	---	---	QUANTITIES	---	---
GAS	---	---	MUN. FINAL CHECK	---	---

PLAN CHECK

REV	DATE	DESCRIPTION	BY

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CONSULTANT

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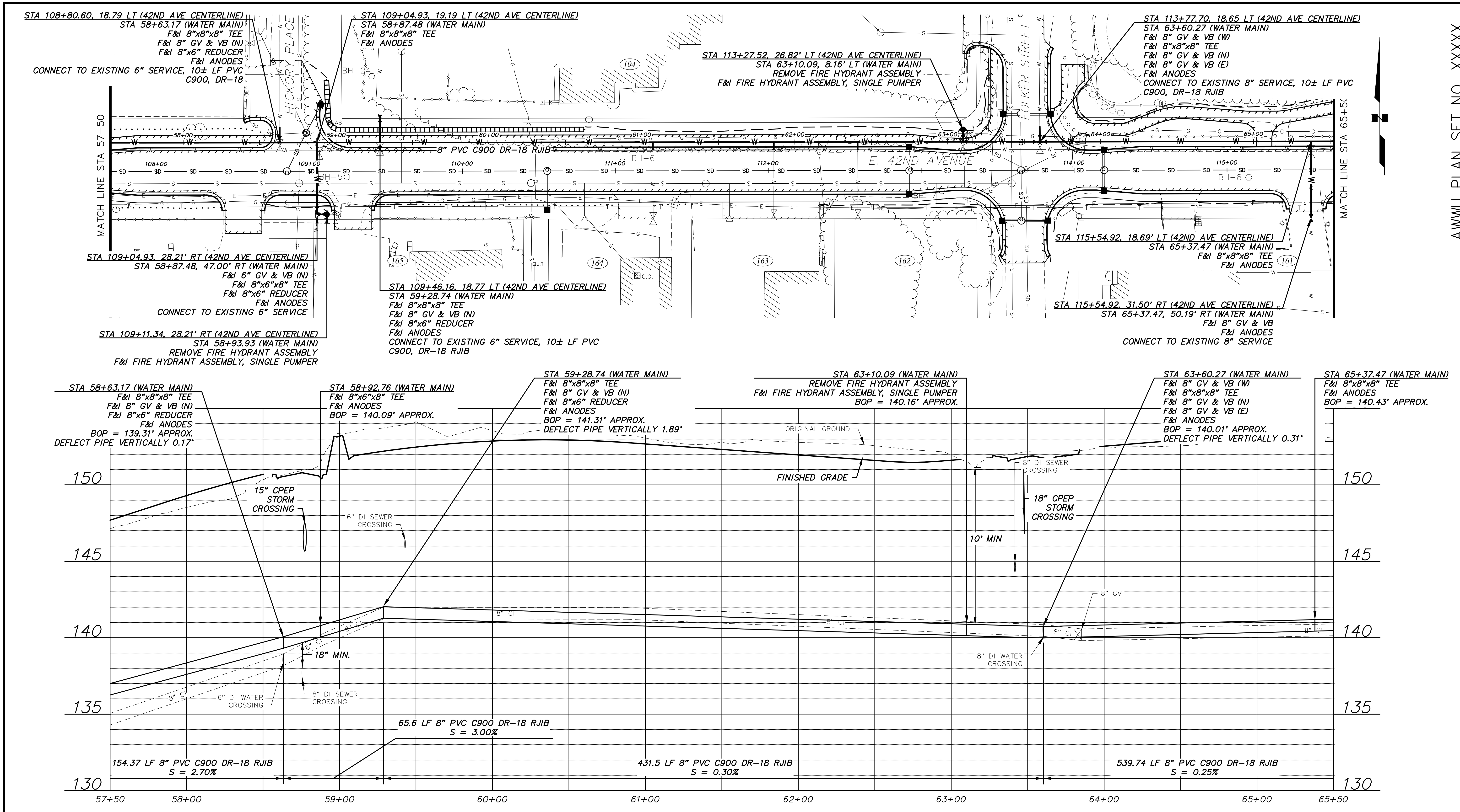
MUNICIPALITY OF ANCHORAGE
WATER & WASTEWATER UTILITY

42ND AVENUE UPGRADE
LAKE OTIS PARKWAY TO PIPER STREET

WATER MAIN PLAN & PROFILE
BOP - STA 57+50

HORZ SCALE: 1:30
VERT SCALE: 1:3
DATE: DEC 2020
GRID: SW1733-35
PROJ. ID.: ----
SHEET D1.3 of D1.10



NOTES

1. RAISING THE WATER MAIN WILL CREATE A VERTICAL OFFSET TO THE EXISTING 6" SERVICE, SO OUR DESIGN WILL ADD 10 LF OR MORE SERVICE PIPE TO ADJUST FOR THIS DELTA OFFSET.

VERIFY SCALE
THIS BAR REPRESENTS ONE INCH ON ORIGINAL DRAWING. 0" 1"
IF BAR IS NOT ONE INCH, ADJUST DRAWING SCALE ACCORDINGLY.
FULL SIZE SCALE HORZ SCALE: N/A VERT SCALE: N/A

DATA	DRAWN BY	CHECKED BY	DATA	DRAWN BY	CHECKED BY
BASE	---	---	TELEPHONE	---	---
TOPOGRAPHY	---	---	ELECTRIC	---	---
PROFILE	---	---	CABLE TV	---	---
SANITARY SEWER	---	---	TRAFFIC SIGNAL	---	---
STORM SEWER	---	---	DESIGN	---	---
WATER	---	---	QUANTITIES	---	---
GAS	---	---	MUN. FINAL CHECK	---	---

PLAN CHECK

REV	DATE	DESCRIPTION	BY

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WATER & WASTEWATER UTILITY

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LAKE OTIS PARKWAY TO PIPER STREET

WATER MAIN PLAN & PROFILE
STA 57+50 - STA 65+50

HORZ SCALE: 1:30
VERT SCALE: 1:3
DATE: DEC 2020
GRID: SW1733-35
PROJ. ID.: ----
SHEET D1.4 of D1.10

PLOT DATE: 12/21/2020 7:44 AM
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PLOT DATE: 12/21/2020 7:44 AM

PLOT SCALE:

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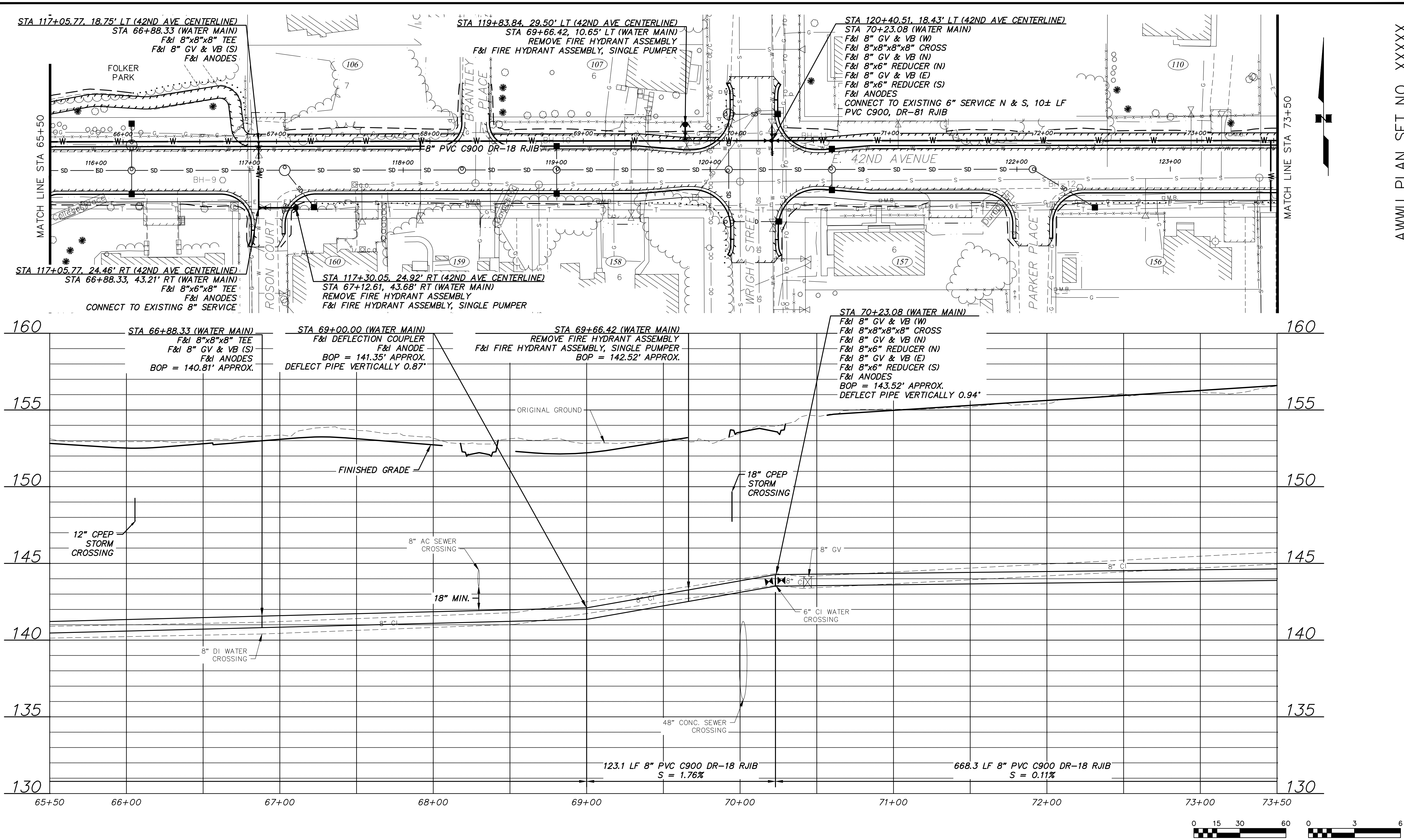

VERIFY SCALE — THIS BAR REPRESENTS ONE INCH ON ORIGINAL DRAWING. 0" 1" IF BAR IS NOT ONE INCH, ADJUST DRAWING SCALE ACCORDINGLY.

FULL SIZE SCALE HORZ SCALE: N/A VERT SCALE: N/A

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TOPOGRAPHY	---	---	ELECTRIC	---	---
PROFILE	---	---	CABLE TV	---	---
SANITARY SEWER	---	---	TRAFFIC SIGNAL	---	---
STORM SEWER	---	---	DESIGN	---	---
WATER	---	---	QUANTITIES	---	---
GAS	---	---	MUN. FINAL CHECK	---	---

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REV	DATE	DESCRIPTION	BY

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   BY: TITLE:
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WATER MAIN PLAN & PROFILE
STA 65+50 - STA 73+50

HORZ SCALE: 1:30 VERT SCALE: 1:3 | DATE: DEC 2020 | GRID: SW1733-35

PROJ. ID.: ----

SHEET D1.5 of D1.10

PLOT DATE:12/21/2020 7:44 AM

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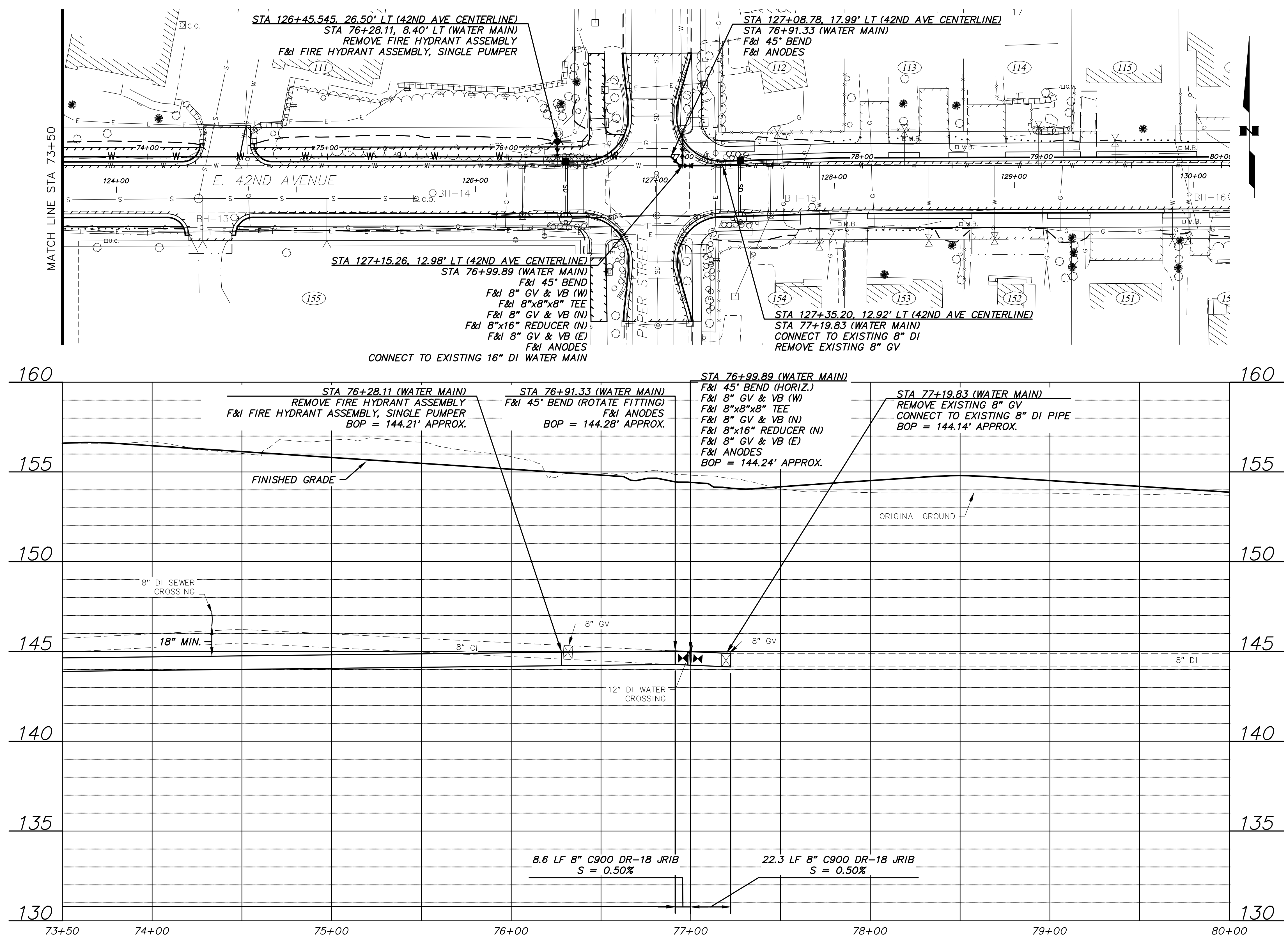

AWWU PLAN SET NO. XXXXX

0 15 30 60 HORIZONTAL GRAPHIC SCALE IN FEET

0 3 6 VERTICAL GRAPHIC SCALE IN FEET

VERIFY SCALE THIS BAR REPRESENTS ONE INCH ON ORIGINAL DRAWING. 0" 1" IF BAR IS NOT ONE INCH, ADJUST DRAWING SCALE ACCORDINGLY.

FULL SIZE SCALE HORZ SCALE: N/A VERT SCALE: N/A

DATA	DRAWN BY	CHECKED BY	DATA	DRAWN BY	CHECKED BY
BASE	---	---	TELEPHONE	---	---
TOPOGRAPHY	---	---	ELECTRIC	---	---
PROFILE	---	---	CABLE TV	---	---
SANITARY SEWER	---	---	TRAFFIC SIGNAL	---	---
STORM SEWER	---	---	DESIGN	---	---
WATER	---	---	QUANTITIES	---	---
GAS	---	---	MUN. FINAL CHECK	---	---

PLAN CHECK

REV	DATE	DESCRIPTION	BY

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WATER MAIN PLAN & PROFILE
STA 73+50 - EOP

HORZ SCALE: 1:30 VERT SCALE: 1:3 | DATE: DEC 2020 | GRID: SW1733-35 | SHEET D1.6 of D1.10

PROJ. ID.: ----

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AWWU PLAN SET NO. XXXXX

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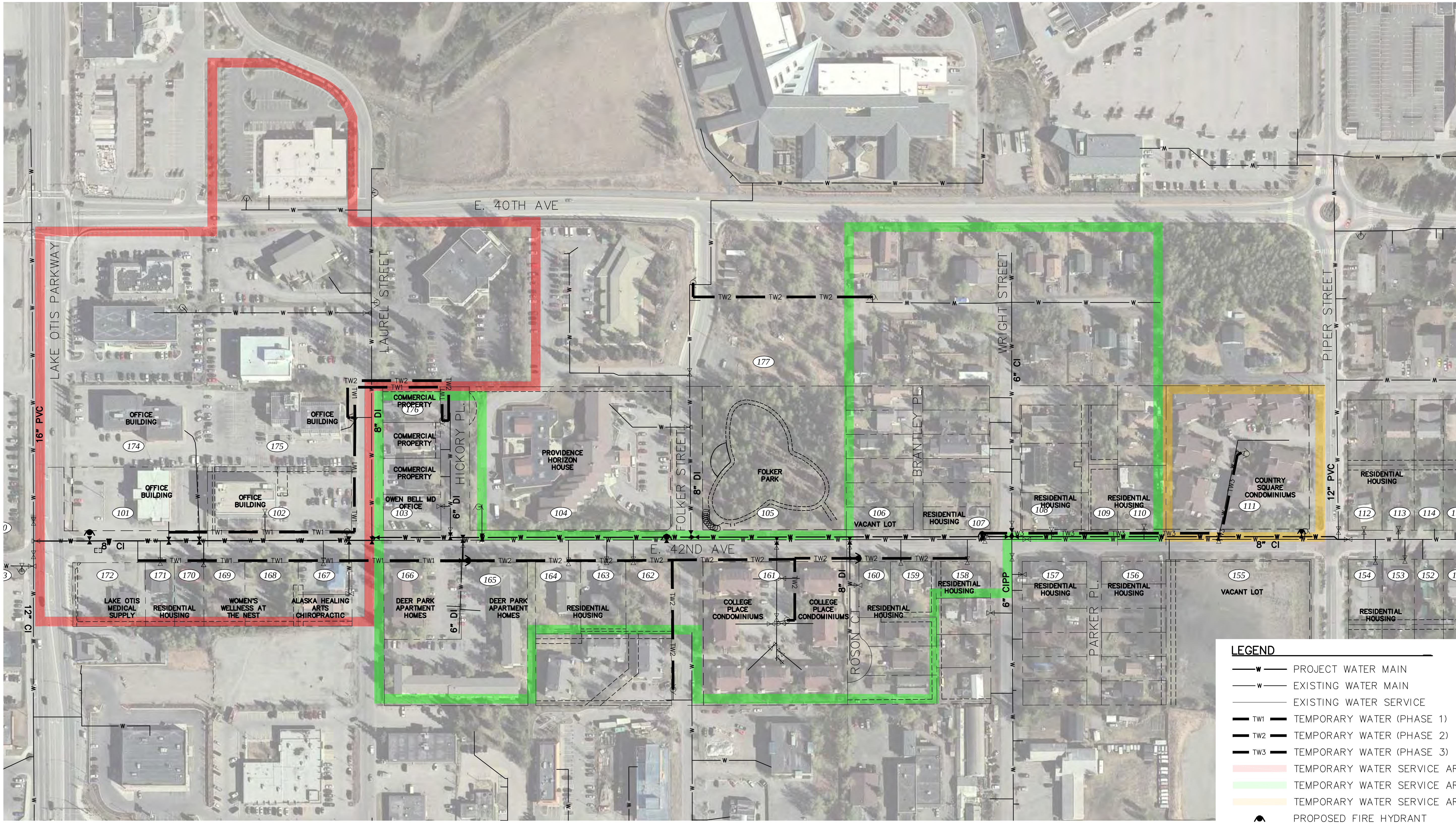

LEGEND

—W—	PROJECT WATER MAIN
—W—	EXISTING WATER MAIN
——	EXISTING WATER SERVICE
— TW1 —	TEMPORARY WATER (PHASE 1)
— TW2 —	TEMPORARY WATER (PHASE 2)
— TW3 —	TEMPORARY WATER (PHASE 3)
	TEMPORARY WATER SERVICE AREA (PHASE 1)
	TEMPORARY WATER SERVICE AREA (PHASE 2)
	TEMPORARY WATER SERVICE AREA (PHASE 3)
	PROPOSED FIRE HYDRANT
	EXISTING FIRE HYDRANT
	PROPOSED GATE VALVE
	EXISTING GATE VALVE

0 100' 200'
SCALE IN FEET

ACAD FILE: J:\JobsData\10142.00 42nd Avenue Upgrade\00 CADD\01 Working Set\01 Civil\02 AWWU Design\10142.00 Temp Water.dwg

VERIFY SCALE THIS BAR REPRESENTS ONE INCH ON ORIGINAL DRAWING. 0" 1" IF BAR IS NOT ONE INCH, ADJUST DRAWING SCALE ACCORDINGLY.

FULL SIZE SCALE
HORZ SCALE: N/A
VERT SCALE: N/A

DATA	DRAWN BY	CHECKED BY	DATA	DRAWN BY	CHECKED BY
BASE	---	---	TELEPHONE	---	---
TOPOGRAPHY	---	---	ELECTRIC	---	---
PROFILE	---	---	CABLE TV	---	---
SANITARY SEWER	---	---	TRAFFIC SIGNAL	---	---
STORM SEWER	---	---	DESIGN	---	---
WATER	---	---	QUANTITIES	---	---
GAS	---	---	MUN. FINAL CHECK	---	---

PLAN CHECK

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TEMPORARY WATER SERVICE OVERALL PHASING MAP

HORZ SCALE: **1:100** VERT SCALE: **N/A** | DATE: DEC 2020 | GRID: SW1733-35
PROJ. ID.: ----
SHEET D1.7 of D1.10

PLOT DATE: 12/21/2020 7:52 AM

PLOT SCALE:

AWWU PLAN SET NO. XXXXX

LEGEND

- PROJECT WATER MAIN
- EXISTING WATER MAIN
- EXISTING WATER SERVICE
- TW1 TEMPORARY WATER (PHASE 1)
- TW2 TEMPORARY WATER (PHASE 2)
- TW3 TEMPORARY WATER (PHASE 3)
- PROPOSED FIRE HYDRANT
- EXISTING FIRE HYDRANT
- PROPOSED GATE VALVE
- EXISTING GATE VALVE
- (1) CONNECT TO EXISTING SERVICE OR HOSE BIB AT DWELLING OR BUSINESS

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HORZ SCALE: N/A
VERT SCALE: N/A

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PROFILE	---	---	CABLE TV	---	---
SANITARY SEWER	---	---	TRAFFIC SIGNAL	---	---
STORM SEWER	---	---	DESIGN	---	---
WATER	---	---	QUANTITIES	---	---
GAS	---	---	MUN. FINAL CHECK	---	---

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TEMPORARY WATER SERVICE MAP PHASE 1

HORZ SCALE: 1:50
VERT SCALE: N/A
DATE: DEC 2020
GRID: SW1733-35
PROJ. ID.: ----
SHEET D1.8 of D1.10

ACAD FILE: J:\JobsData\10142.00 42nd Avenue Upgrade\00 CADD\01 Working Set\01 Civil\02 AWWU Design\10142.00 Temp Water.dwg

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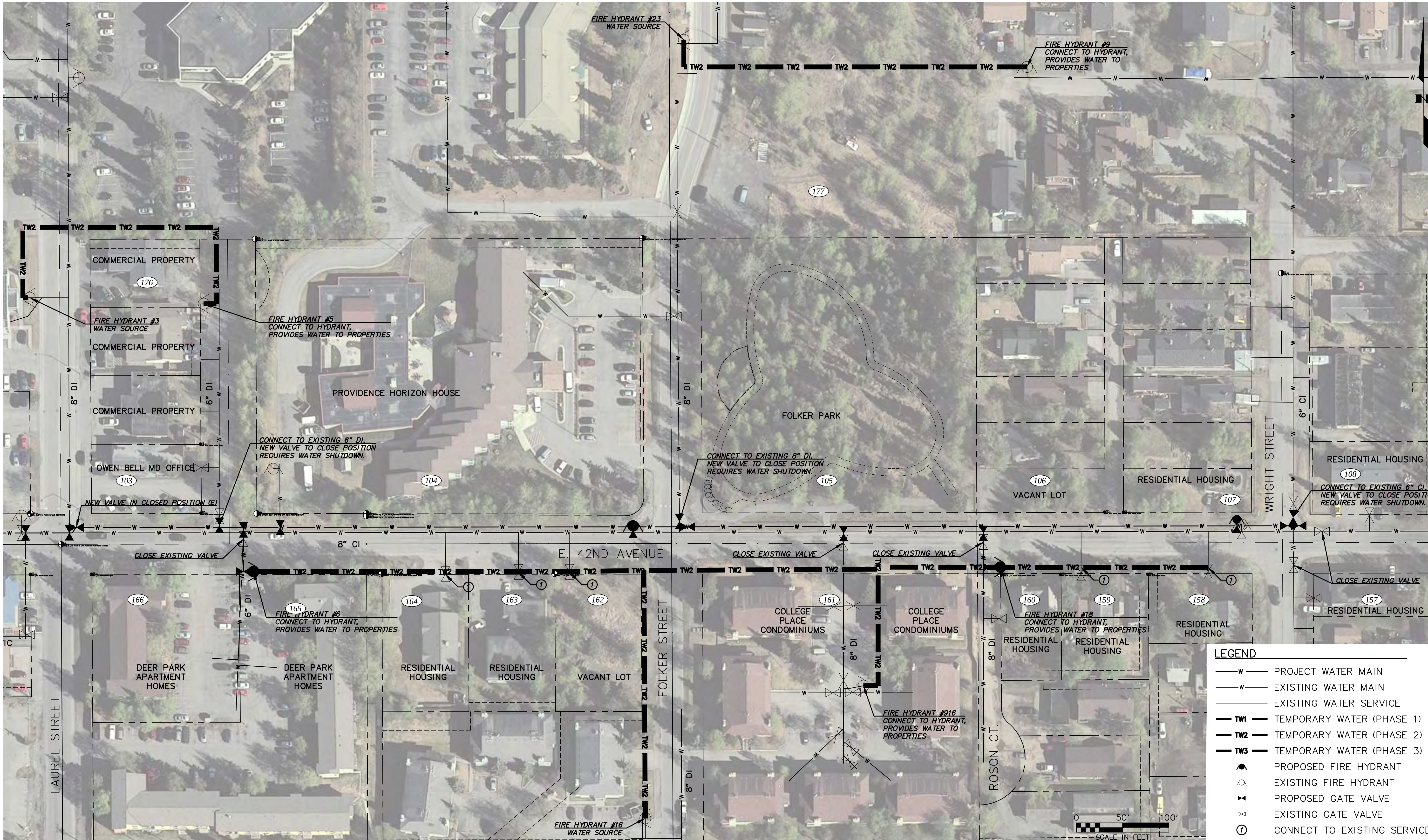

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FULL SIZE SCALE
HORZ SCALE: N/A
VERT SCALE: N/A

DATA	DRAWN BY	CHECKED BY	DATA	DRAWN BY	CHECKED BY	REV	DATE	DESCRIPTION	BY
BASE	---		TELEPHONE	---					
TOPOGRAPHY	---		ELECTRIC	---					
PROFILE	---		CABLE TV	---					
SANITARY SEWER	---		TRAFFIC SIGNAL	---					
STORM SEWER	---		DESIGN	---					
WATER	---		QUANTITIES	---					
GAS	---		MUN. FINAL CHECK	---					
PLAN CHECK						REVISIONS			

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TEMPORARY WATER SERVICE MAP PHASE 2

HORZ SCALE: 1:50
VERT SCALE: N/A
DATE: DEC 2020
GRID: SW1733-35
PROJ. ID.: ----
SHEET D1.9 of D1.10

AWWU PLAN SET NO. XXXXX

PLOT DATE: 12/21/2020 7:52 AM

PLOT SCALE:

ACAD FILE: J:\Jobs\Data\10142.00 42nd Avenue Upgrade\00 CADD\01 Working Set\01 Civil\02 AWWU Design\10142.00 Temp Water.dwg

LEGEND

- PROJECT WATER MAIN
- EXISTING WATER MAIN
- EXISTING WATER SERVICE
- TW1 — TEMPORARY WATER (PHASE 1)
- TW2 — TEMPORARY WATER (PHASE 2)
- TW3 — TEMPORARY WATER (PHASE 3)
- PROPOSED FIRE HYDRANT
- EXISTING FIRE HYDRANT
- PROPOSED GATE VALVE
- EXISTING GATE VALVE
- (1) CONNECT TO EXISTING SERVICE OR HOSE BIB AT DWELLING OR BUSINESS

VERIFY SCALE

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FULL SIZE SCALE
HORZ SCALE: N/A
VERT SCALE: N/A

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TOPOGRAPHY	---	---	ELECTRIC	---	---
PROFILE	---	---	CABLE TV	---	---
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STORM SEWER	---	---	DESIGN	---	---
WATER	---	---	QUANTITIES	---	---
GAS	---	---	MUN. FINAL CHECK	---	---

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TEMPORARY WATER SERVICE MAP PHASE 3

HORZ SCALE: 1:50
VERT SCALE: N/A
DATE: DEC 2020
GRID: SW1733-35
PROJ. ID.: ----
SHEET D1.10 of D1.10

CCTV Storm Drain Condition Assessment Memorandum

Appendix E

Memorandum

Date: April 1, 2020
From: Marliese von Huene, P.E. & Joey Hegna, P.E. – CRW Engineering Group, LLC
Project: 42nd Avenue Upgrade
Project No: PM&E# 18-06 (CRW# 10142.00)
Subject: CCTV Storm Drain Condition Assessment (FINAL)

This memorandum presents the findings from the closed circuit television (CCTV) data review of the existing storm drain piping along East 42nd Avenue from Lake Otis Parkway to Florina Street and connecting side streets.

Background

The Municipality of Anchorage Project Management & Engineering Department (PM&E) plans to upgrade East 42nd Avenue from Lake Otis Parkway to Florina Street. The storm drain pipe within the project area was inspected using a CCTV camera operated by Municipality of Anchorage (MOA) Street Maintenance in late June to early July 2019. MOA provided this CCTV data to CRW Engineering Group, LLC (CRW) for evaluation.

The purpose of this condition assessment memo is to describe the condition of the pipe based on the CCTV video. The results of this assessment will serve as a tool to determine if the existing pipe should remain or be replaced in conjunction with the planned roadway upgrades. Some of the pipe segments reviewed extend outside of the anticipated roadway upgrade limits. As discussed with PM&E on 12/12/19, pipe segments outside of the anticipated roadway upgrades will not be upgraded as part of the 42nd Avenue project. Instead, a storm drain manhole will be installed where the 42nd Avenue roadway improvements stop on the side streets and the storm drain pipe within the limits will be replaced as required. Pipe segments that are in need of replacement but fall outside of the 42nd Avenue roadway improvement limits may be upgraded by MOA in the future as funding becomes available.

CCTV Data Collection

The CCTV data collection process works by operating a camera which is mounted on a self-propelled robotic crawler that is connected to a video monitor on the ground surface. The crawler is driven through the storm drain pipe to provide visual documentation of the condition of the interior walls of the pipe. The remotely controlled crawler and camera are typically inserted into the storm drain pipe from a manhole and are operated from the ground surface.

The purpose for collecting video images of the interior of the storm drain pipe is to identify obstructions, structural deficiencies, damaged areas, sags, and confirm the pipe size and material type. For the most comprehensive pipe assessment, it is preferred to collect CCTV data when no water is present in the piped system. This typically requires bypassing stormwater flows or the work is performed during dry conditions and has no base flow. In most cases, however, some stormwater is present during CCTV recording, preventing the observer from assessing the condition of the pipe invert.

CCTV Data Review

CRW evaluated the CCTV data provided by MOA using GraniteNet software. This software is an interface that allows the observer to view the CCTV video images in detail and assess the condition of the interior of the pipe. The observer can input pertinent information into the CCTV data file while performing the assessment, such as pipe size, pipe material, installation date, location and type of defects, date of inspection and any other notes relevant to the inspection. The findings and notes generated during the CCTV review process are then used to develop a comprehensive summary of the condition of each pipe segment.

The CCTV data provided by MOA included video of approximately 2,943 linear feet (LF) of main line storm drain pipe. The videoed pipe consisted of 1,953 LF of corrugated metal pipe (CMP), 698 LF of reinforced concrete pipe (RCP), and 480 LF of corrugated polyethylene pipe (CPEP). The majority of pipe evaluated was installed in the 1970's and 1980's (CMP and RCP), with CPEP installed as part of a more recent roadway improvements project located along Piper Street in 2009. Of the pipes with available CCTV, approximately 92% of these pipes' lengths were recorded. Approximately 210 LF was not recorded likely due to obstructions in the pipe. Several main line pipe segments along East 42nd Avenue and adjacent cross streets were not inspected with CCTV. Four of those pipe segments are CMP and were not inspected since they are assumed to be replaced as part of the project. One of the pipe segments was not inspected for unknown reasons.

Pipe Inspection Results & Recommendations

The condition of the storm drain pipe throughout the project corridor ranged widely from poor to good. Some of the issues identified included blockages due to debris, joint offsets, metal loss, pipe damage, and ovality issues. Ovality in pipes is generally known as 'out of roundness' and typically occurs when a circular pipe begins to collapse and becomes more oval in shape (see *Photo 1*).

Photo 1 - Pipe with Ovality Issues

Refer to the *Pipe Condition Summary Table (Appendix B)* and the individual *CCTV Inspection Forms (Appendix C)* for a detailed assessment for each pipe segment that was inspected. A corresponding CCTV Inspection Map (*Figure 1, Appendix A*) provides an overview of the project area and the existing storm drain system along East 42nd Avenue and the adjacent side streets. Note that the pipe identification numbers used throughout this memo and the appendices are based on the naming convention provided in MOA's GIS stormwater asset map.

As noted above, several pipes have significant debris (rocks, soil, iron, etc.) deposited at the invert. These blockages reduce the overall capacity of the piping system and can further deteriorate the condition of the pipe. *Figure 1* recommends these pipes to be cleaned and others to be cleaned and lined to improve flow efficiency and extend the life of the piped system. While cleaning these pipes is recommended and good practice, it won't necessarily resolve the source of the debris entering into the pipe (joint offsets & holes). This is where lining, also known as cured in place pipe (CIPP), is an option to repair these pipes and reduce the amount of debris entering the system. CIPP is a trenchless method (no excavation required) for rehabilitating existing pipe. CIPP consists of a liner that is constructed of a soft fabric tube that is impregnated with resin. After the tube is inserted into the existing (host) pipe, it is inflated with water or air and cured until hard (see *Photo 2*). A CIPP liner provides a long-term fully structural repair to the host pipe. Further investigation would be required to determine if CIPP is a suitable repair option for the pipes noted on *Figure 1*.

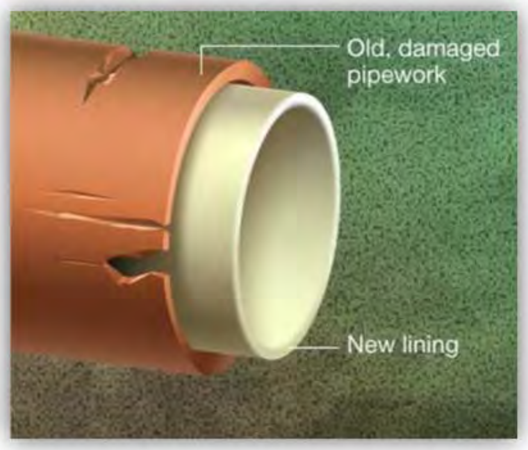


Photo 2 - CIPP Lining

Several storm drain pipes (10702, 12873, 25184 & 29630) are identified on *Figure 1* that require complete replacement. These pipes or certain segments of the pipe have significant enough defects where cleaning or rehabilitation is not a suitable long-term fix. Open cut excavation and removal and replacement of the pipe will be required for these pipes.

The most notable pipe defects identified during review of the CCTV data include:

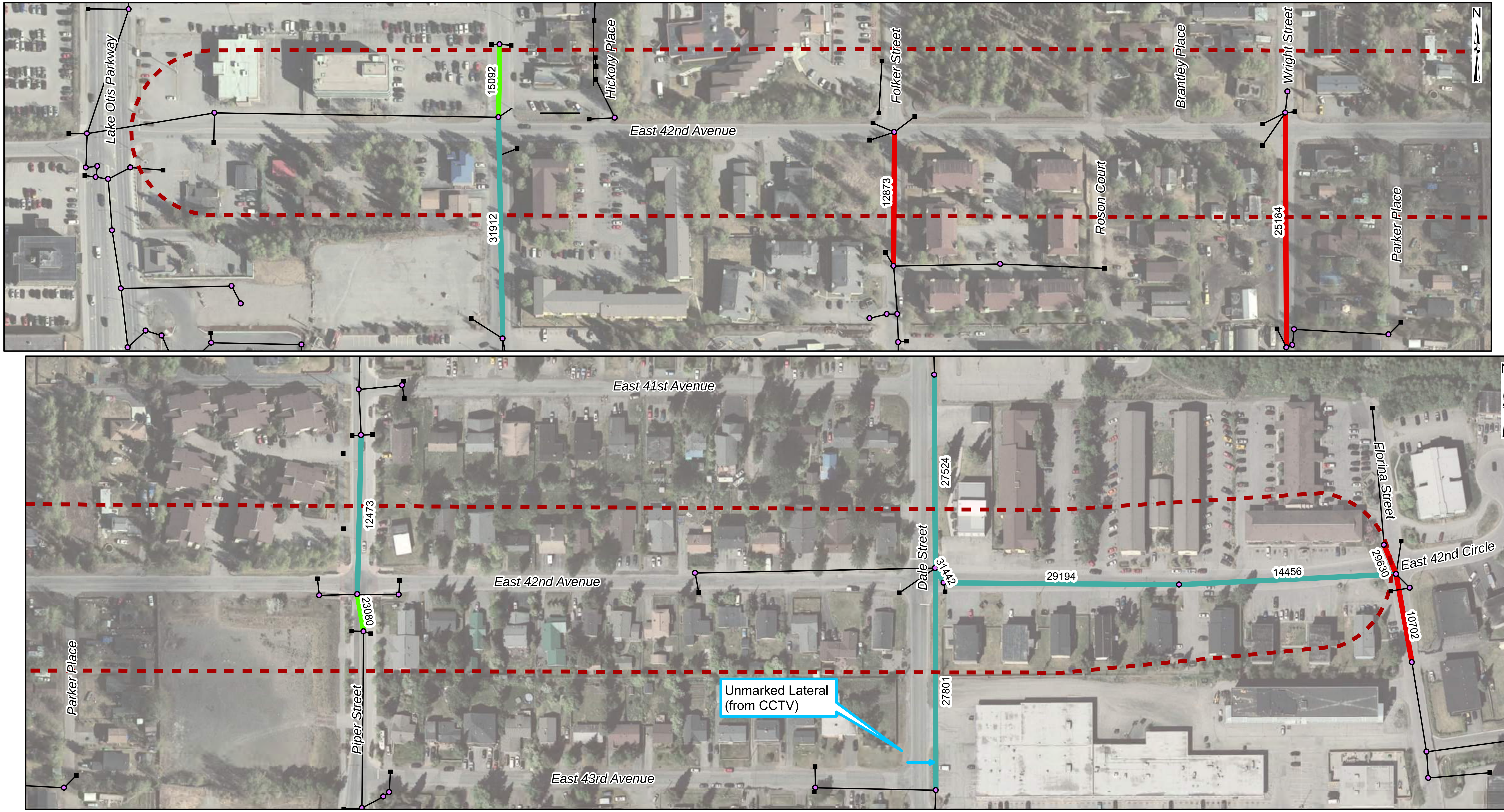
- Pipe 10702 (CPEP) has significant ovality issues and inconsistent pipe grades along its length.
- The walls and inverts of Pipes 25184 & 29630 (CMP) are partially or completely missing due to abrasion and corrosion. The CCTV investigation was not fully completed due to excessive debris buildup in the pipe.
- Pipe 12873 (CMP) is in relatively good condition considering its age (installed 1977). However, one segment of pipe has significant deformation with damage (holes) and should be replaced (see Photo 3).
- Two pipes (27801 & 31912) have blind connection laterals tying into the main line pipe. The lateral into Pipe 27801 is unmarked in GIS data and appears to be introducing rocks and other debris into the main pipe.
- Joint offsets and infiltration were identified in several pipes. Some of these joints may be repaired by repairing or replacing pipe band or installing a pipe coupler such as the Mar Mac Polyseal Pipe Coupler manufactured by Advanced Drainage Systems, Inc. (ADS).

Photo 3 - Pipe 12873 (Holes)

Figure 1 still shows the original draft recommendations as described above, however per meeting with PM&E on 12/12/19, the 42nd Avenue project will replace all existing CMP pipe along 42nd Avenue.

42nd Avenue Upgrade
Appendix A

CCTV Inspection Map



Legend

Manholes	Storm Pipes without CCTV
Inlets	Cleaning Recommended
Project Boundary	Cleaning and Lining Recommended
	Requires Replacement

0 85 170 340
Feet

CRW ENGINEERING GROUP, LLC

Project: 10142.00

MUNICIPALITY OF ANCHORAGE

CCTV Inspection Map

42nd Avenue Upgrades

Date: April 2020

Figure: 1

42^{nd} Avenue Upgrade
Appendix B

Pipe Condition Summary Table

42nd Avenue Upgrade
Pipe Condition Summary Table

MOA Pipe ID Number	SW Grid Map	Diameter (in)	Material	Install Date	As-built/ Drawing Name	CCTV Date	CCTV Length (ft)	Length (ft)	Pipe Condition Comments	Recommendations
42nd Avenue and Laurel Street										
15092	1734	12	CMP	1986	1986-88	7/1/2019	118	121	Good condition: significant debris buildup, pipe is perforated for a short stretch	Cleaning recommended
31912	1734	30	CMP	-	-	7/3/2019	381	380	Fair condition: root intrusion common at joints, lateral pipe located at north end of pipe, significant debris/buildup in invert.	Lining candidate
42nd Avenue and Folker Street										
12873	1734	18	CMP	1977	1977-530	7/1/2019	230	232	Good condition: pipe overall in good condition, except one short (approx. 2') section damaged	Damaged section should be replaced
42nd Avenue and Wright Street										
25184	1734	12	CMP	1977	1977-531	7/1-7/2/19	240	406	Poor condition: CCTV not completed due to severe debris/obstructions, surrounding soil & rock entering through pipe side wall, corrosion present	Replace Pipe
42nd Avenue and Piper Street										
12473	1735	18	CPEP	2009	2010-2176	7/2/2019	270	269	Fair condition: significant joint offsets allowing surrounding soil to enter pipe	Lining candidate
23080	1735	18	CPEP	2009	2010-2175	7/2/2019	59	62	Good condition: moderate debris present	Cleaning recommended
42nd Avenue, including Dale Street & Florina Street										
10702	1735	18	CPEP	-	-	6/27/2019	150	152	Poor condition: pipe has significant ovality in areas with possible grade inconsistencies	Replace Pipe
14456	1735	18	CMP	1984	1984-7014	7/1/2019	364	366	Fair condition: joint offsets and infiltration common, some significant debris areas	Lining candidate
27524	1735	36	Concrete	1977	1977-826	7/3/2019	323	325	Fair condition: minor longitudinal cracking, joint offsets and infiltration	Lining candidate
27801	1735	36	Concrete	1977	1977-826	7/3/2019	370	372	Fair condition: unmarked lateral discharges significant debris, significant iron deposits present throughout pipe.	Lining candidate
29194	1735	18	CMP	1984	1984-7014	7/1/2019	393	393	Fair to Poor condition: significant infiltration and buildup at pipe joints and along walls. Metal loss and pinholes common water flow level to invert.	Lining candidate, possibl full replacement
29630	1735	10	CMP	-	-	7/2/2019	19	56	Poor condition: Severe metal loss with missing invert and pipe walls. Surrounding soil and rock entering pipe, impeding flow. Significant grade break and ovality issues. CCTV not completed due to severe debris/obstructions.	Replace Pipe
31442	1735	18	CMP	1984	1984-7014	7/1/2019	27	32	Fair condition: small holes allowing water to enter into pipe, signifcant infiltration in several areas.	Lining candidate

42nd Avenue Upgrade
Appendix C

CCTV Inspection Forms

General Inspection Data

CCTV Recording Date: 7/1/2019
CCTV Recorded By: MOA Street Maintenance

Pipe Data

MOA Pipe ID Number: 15092
Location: Laurel Street, near 42nd Avenue intersection
Diameter: 12"
Material: CMP (partially perforated)
Installation Year: 1986
Shape: Circular
Length (ft): 121
Flow Depth: 1/4 of diameter
Blockage: Moderate debris present in invert
Ovality: None
Condition: Good
Other Notes: Pipe appears to be in good condition, but invert of pipe not visible due to debris present. Pipe is perforated along one side for approx. 17 feet.

CCTV Interior Pipe Images

Image 1: Typical Pipe Condition, Debris present in invert

Image 2: Beginning of perforated section (on left side of image)

General Inspection Data

CCTV Recording Date: 7/3/2019
CCTV Recorded By: MOA Street Maintenance

Pipe Data

MOA Pipe ID Number: 31912
Location: Laurel Street, near 42nd Avenue intersection
Diameter: 30"
Material: CMP
Installation Year: Unknown
Shape: Circular
Length (ft): 380
Flow Depth: 1/4 of diameter
Blockage: Significant debris present in invert with root intrusion
Ovality: None
Condition: Fair
Other Notes: Pipe appears to be in fair condition, but invert of pipe not visible due to debris present. Root intrustion common at joints. Lateral located at north end of pipe. Significant debris in invert with iron deposits.

CCTV Interior Pipe Images

Image 1: Root Intrusion at 10 o'clock position

Image 2: Lateral Pipe at 3 o'clock position, significant debris/buildup in invert

General Inspection Data

CCTV Recording Date: 7/1/2019
CCTV Recorded By: MOA Street Maintenance

Pipe Data

MOA Pipe ID Number: 12873
Location: Folker Street, near 42nd Avenue intersection
Diameter: 18"
Material: CMP
Installation Year: 1977
Shape: Circular
Length (ft): 232
Flow Depth: Minimal
Blockage: Minor debris present in invert
Ovality: None
Condition: Good with short segment requiring replacement
Other Notes: Majority of pipe is in good condition. Exceptions include minor pipe deformation in one location, and more significant deformation and damage (holes) in another area.

CCTV Interior Pipe Images

Image 1: Minor deformation at 1 o'clock position

Image 2: Deformation and damaged pipe segment (holes) at 2 o'clock position

General Inspection Data

CCTV Recording Date: 7/1/2019 & 7/2/2019
CCTV Recorded By: MOA Street Maintenance

Pipe Data

MOA Pipe ID Number: 25184
Location: Wright Street, near 42nd Avenue intersection
Diameter: 12"
Material: CMP
Installation Year: 1977
Shape: Circular
Length (ft): 406
Flow Depth: Minimal
Blockage: Severe debris present
Ovality: None
Condition: Poor
Other Notes: Majority of pipe has significant to severe debris buildup. CCTV not completed due to obstructions - approx. 50 feet of middle section of pipe was not able to be videoed. Surrounding soil & rock entering through side wall of pipe.

CCTV Interior Pipe Images

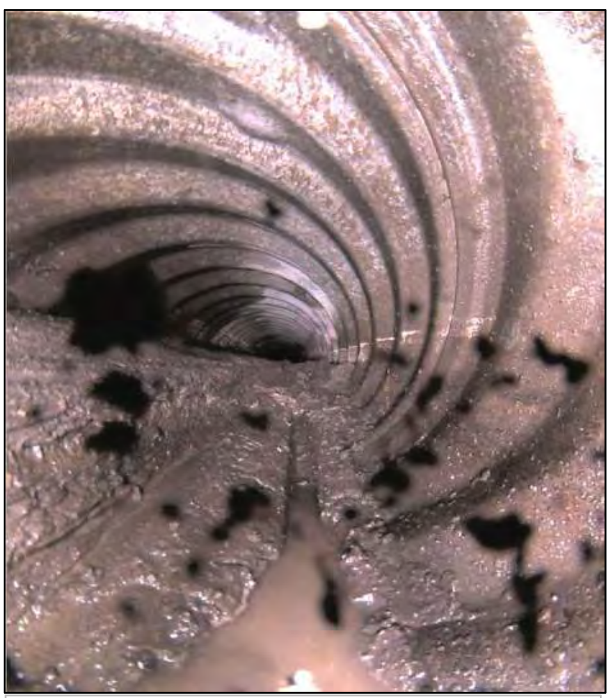


Image 1: Severe Debris present in Invert

Image 2: Surrounding Soil & Rock Entering through Pipe Wall at 1 o'clock position

Note: Photos are spotted, as camera lens was dirty during this inspection

General Inspection Data

CCTV Recording Date: 7/2/2019
CCTV Recorded By: MOA Street Maintenance

Pipe Data

MOA Pipe ID Number: 12473
Location: Piper Street, near 42nd Avenue intersection
Diameter: 18"
Material: CPEP
Installation Year: 2009
Shape: Circular
Length (ft): 269
Flow Depth: None
Blockage: Moderate debris present in invert
Ovality: None
Condition: Fair
Other Notes: Signifant joint offsets in pipe, some appear to be allowing surrounding soil to enter pipe. Pipe walls appear to be in good condition.

CCTV Interior Pipe Images

Image 1: Debris in invert, likely from join offsets

Image 2: Significant joint offset, no debris present upstream of joint

General Inspection Data

CCTV Recording Date: 7/2/2019
CCTV Recorded By: MOA Street Maintenance

Pipe Data

MOA Pipe ID Number: 23080
Location: Piper Street, near 42nd Avenue intersection
Diameter: 18"
Material: CPEP
Installation Year: 2009
Shape: Circular
Length (ft): 62
Flow Depth: None
Blockage: Moderate debris present in invert
Ovality: None
Condition: Good
Other Notes: Pipe appears to be in good condition, but invert of pipe not visible due to debris present. Moderate debris buildup throughout.

CCTV Interior Pipe Images

Image 1: Typical Pipe Condition

Image 2: Moderate debris buildup near manhole

General Inspection Data

CCTV Recording Date: 6/27/2019
CCTV Recorded By: MOA Street Maintenance

Pipe Data

MOA Pipe ID Number: 10702
Location: Florian Street, near 42nd Avenue intersection
Diameter: 18"
Material: CPEP
Installation Year: Unknown
Shape: Circular
Length (ft): 152
Flow Depth: 1/4 of diameter
Blockage: Minor debris present in invert
Ovality: Yes, approx. 28% ovality
Condition: Poor
Other Notes: Interior of pipe appears to be in good condition. Invert not visible due to water & minor debris present. Significant ovality issues in a large percentage of pipe and possible grade inconsistencies.

CCTV Interior Pipe Images

Image 1: Ovality Issues

Image 2: Grade inconsistencies & Offset Joint

General Inspection Data

CCTV Recording Date: 7/1/2019
CCTV Recorded By: MOA Street Maintenance

Pipe Data

MOA Pipe ID Number: 14456
Location: 42nd Avenue, near Florina Street intersection
Diameter: 18"
Material: CMP
Installation Year: 1984
Shape: Circular
Length (ft): 366
Flow Depth: 1/4 of diameter
Blockage: Significant debris present in invert
Ovality: None
Condition: Fair
Other Notes: Pipe appears to be in fair condition, but invert of pipe not visible due to debris present. Offset joints present. Infiltration common at joints. Some sections of significant debris in pipe invert.

CCTV Interior Pipe Images

Image 1: Offset Joint & Infiltration

Image 2: Significant Debris in Invert

General Inspection Data

CCTV Recording Date: 7/3/2019
CCTV Recorded By: MOA Street Maintenance

Pipe Data

MOA Pipe ID Number: 27524
Location: Dale Street, near 42nd Avenue intersection
Diameter: 36"
Material: Concrete
Installation Year: 1977
Shape: Circular
Length (ft): 325
Flow Depth: 1/4 of diameter
Blockage: Minor debris present in invert
Ovality: None
Condition: Fair
Other Notes: Pipe appears to be in fair condition, but invert of pipe not visible due to debris present. Minor infiltration present at joints and debris buildup in sections. Minor longitudinal cracks in two sections.

CCTV Interior Pipe Images

Image 1: Minor Longitudinal Cracks at 9 o'clock position

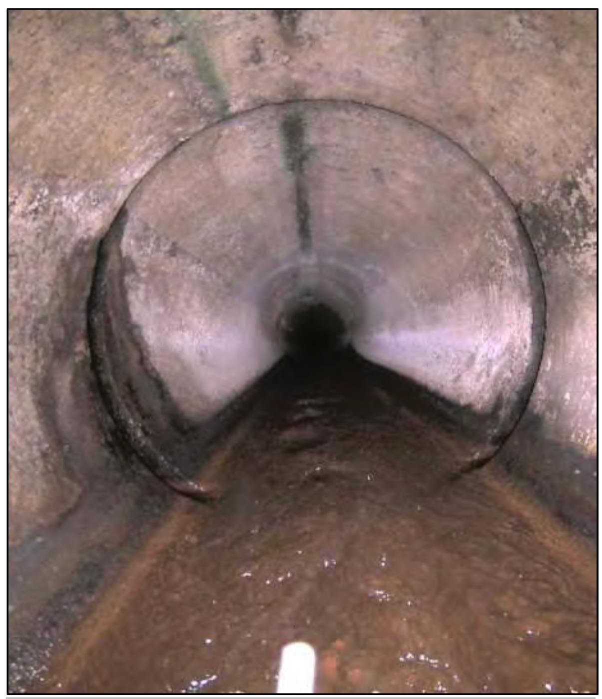


Image 2: Infiltration at Joint Offset

General Inspection Data

CCTV Recording Date: 7/3/2019
CCTV Recorded By: MOA Street Maintenance

Pipe Data

MOA Pipe ID Number: 27801
Location: Dale Street, near 42nd Avenue intersection
Diameter: 36"
Material: Concrete
Installation Year: 1977
Shape: Circular
Length (ft): 372
Flow Depth: 1/4 of diameter
Blockage: Minor debris present in invert
Ovality: None
Condition: Fair
Other Notes: Pipe appears to be in fair condition, but invert of pipe not visible due to debris present. Debris buildup most prevalent downstream of unmarked lateral. Iron deposits present throughout pipe.

CCTV Interior Pipe Images

Image 1: Unmarked Lateral Pipe at 10 o'clock position

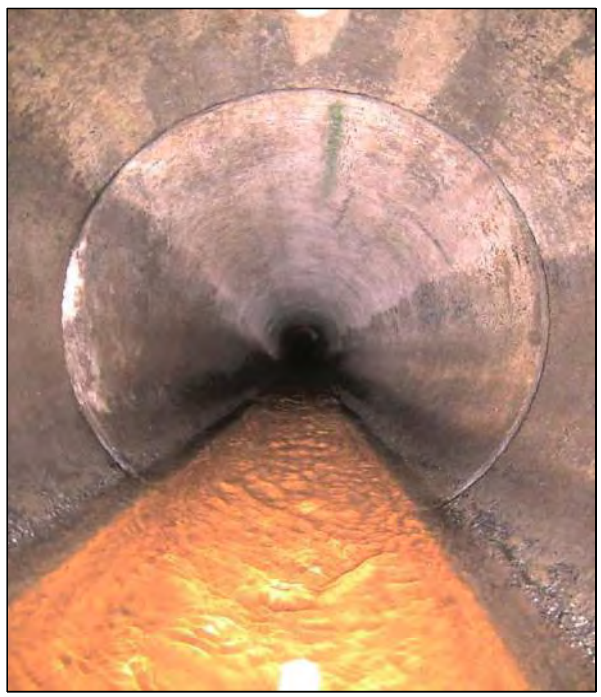


Image 2: Iron Deposits present in Pipe.

General Inspection Data

CCTV Recording Date: 7/1/2019
CCTV Recorded By: MOA Street Maintenance

Pipe Data

MOA Pipe ID Number: 29194
Location: 42nd Avenue, near Dale Street intersection
Diameter: 18"
Material: CMP
Installation Year: 1984
Shape: Circular
Length (ft): 393
Flow Depth: 1/4 of diameter
Blockage: Significant debris present in invert and along walls from infiltration
Ovality: None
Condition: Fair to Poor
Other Notes: Infiltration and buildup common at joints and along walls. Metal loss and small holes common through pipe from flow level to invert. Water entered pipe through pinholes during CCTV.

CCTV Interior Pipe Images

Image 1: Significant Infiltration and Buildup at Pipe Joints and along Walls

Image 2: Pinhole with Water Entering Pipe at 5 o'clock position

General Inspection Data

CCTV Recording Date: 7/2/2019
CCTV Recorded By: MOA Street Maintenance

Pipe Data

MOA Pipe ID Number: 29630
Location: Florina Street, near 42nd Avenue intersection
Diameter: 10"
Material: CMP
Installation Year: Unknown
Shape: Circular
Length (ft): 56
Flow Depth: 1/4 of diameter
Blockage: Severe debris present in invert and along pipe walls
Ovality: Yes, approx. 34%
Condition: Poor
Other Notes: Severe metal loss with missing invert and pipe walls. Surrounding soil and rock entering pipe, blocking flow. One significant grade change with ovality issues. Iron deposits presents. CCTV not completed due to severe debris obstructions.

CCTV Interior Pipe Images

Image 1: Missing Invert and Pipe Wall, Surrounding Soil and Rock entering Pipe

Image 2: Significant Grade Break

General Inspection Data

CCTV Recording Date:	7/2/2019
CCTV Recorded By:	MOA Street Maintenance

Pipe Data

MOA Pipe ID Number:	31442
Location:	Dale Street and 42nd Avenue intersection
Diameter:	18"
Material:	CMP
Installation Year:	1984
Shape:	Circular
Length (ft):	32
Flow Depth:	1/4 of diameter
Blockage:	Minor debris present in invert
Ovality:	None
Condition:	Fair
Other Notes:	Pipe appears to be in fair condition, but invert of pipe not visible due to debris present. Infiltration present in several areas. Small holes allowing water to enter into pipe.

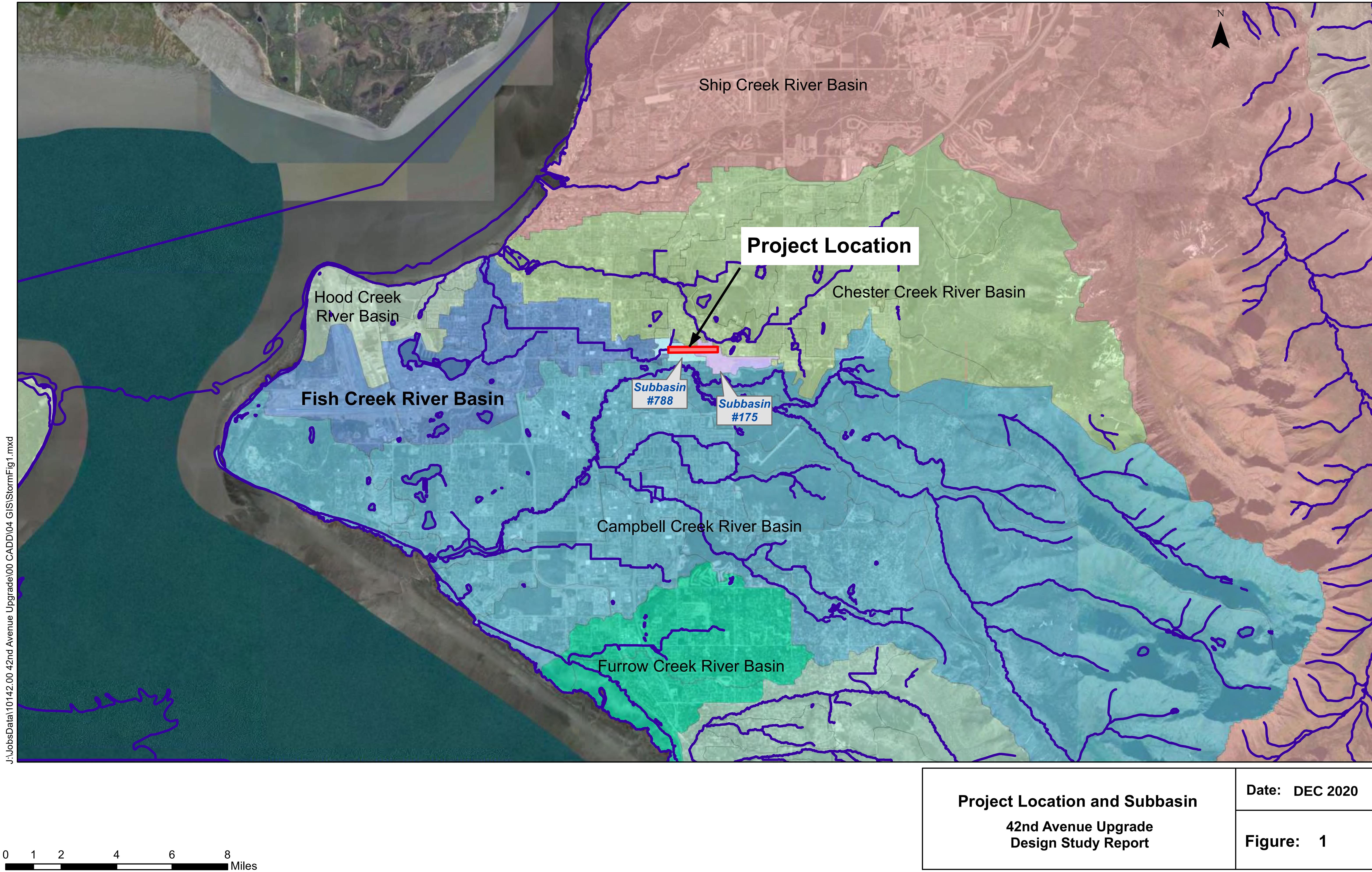
CCTV Interior Pipe Images

Image 1: Pinholes located at 4 o'clock position

Image 2: Water entering pipe through hole at 8 o'clock position

Storm Drain Modeling Data

Appendix F



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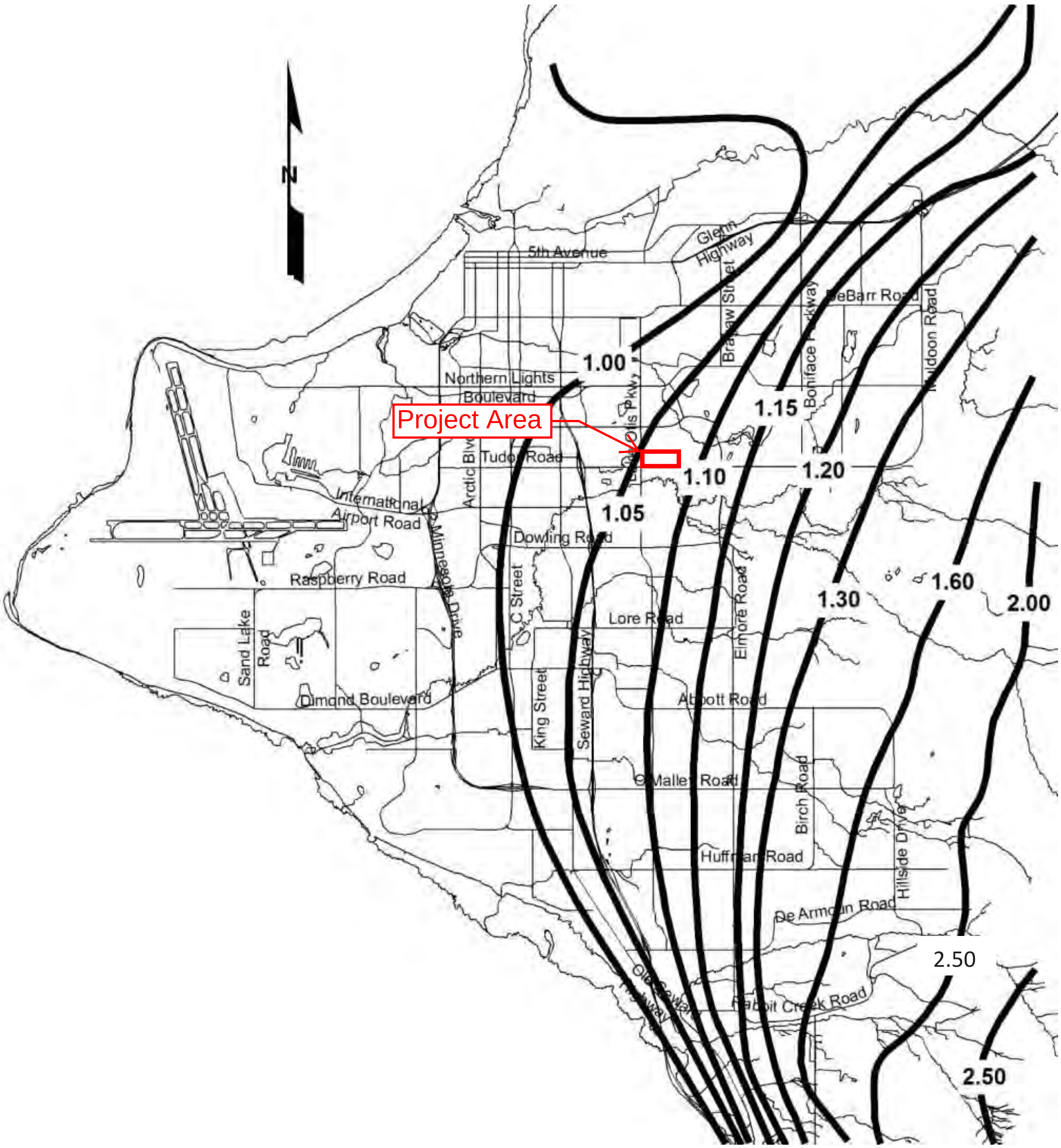
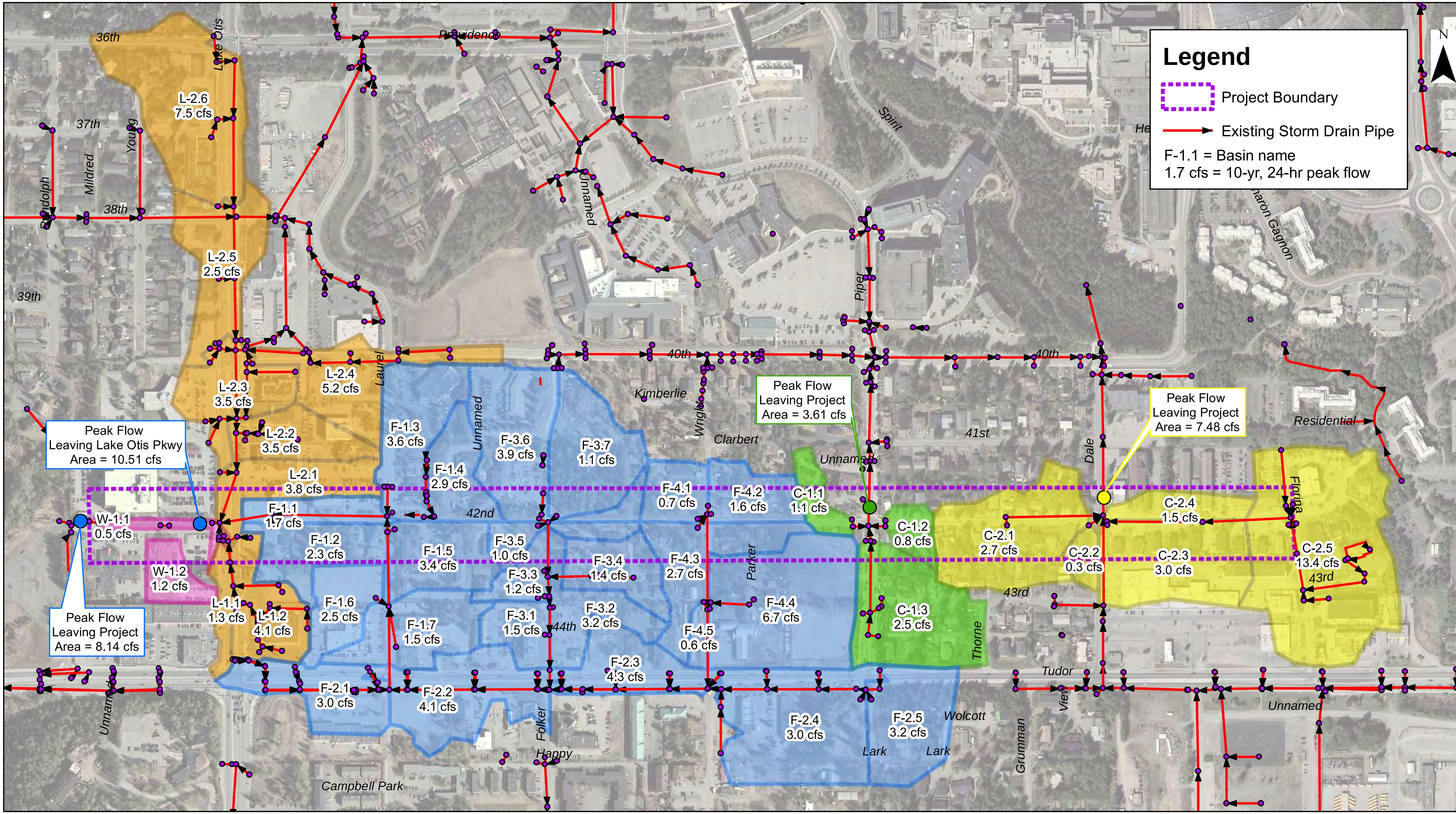
Project Location and Subbasin 42nd Avenue Upgrade Design Study Report	Date: DEC 2020
	Figure: 1

based on NOAA Atlas 14 data from AIA. A second distribution was developed for Girdwood based on data from the Alyeska station. The resulting hyetographs are presented in Appendix D.

Figure 4.2-3: Orographic Factor Map (Anchorage)





0 120 240 480 720 960 Feet

Figure 2.A
Existing Stormwater System
42nd Avenue Upgrade
Design Study Report

Date: DEC 2020

CRW ENGINEERING GROUP, LLC

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Figure 2.B
Existing Model Pipe Layout

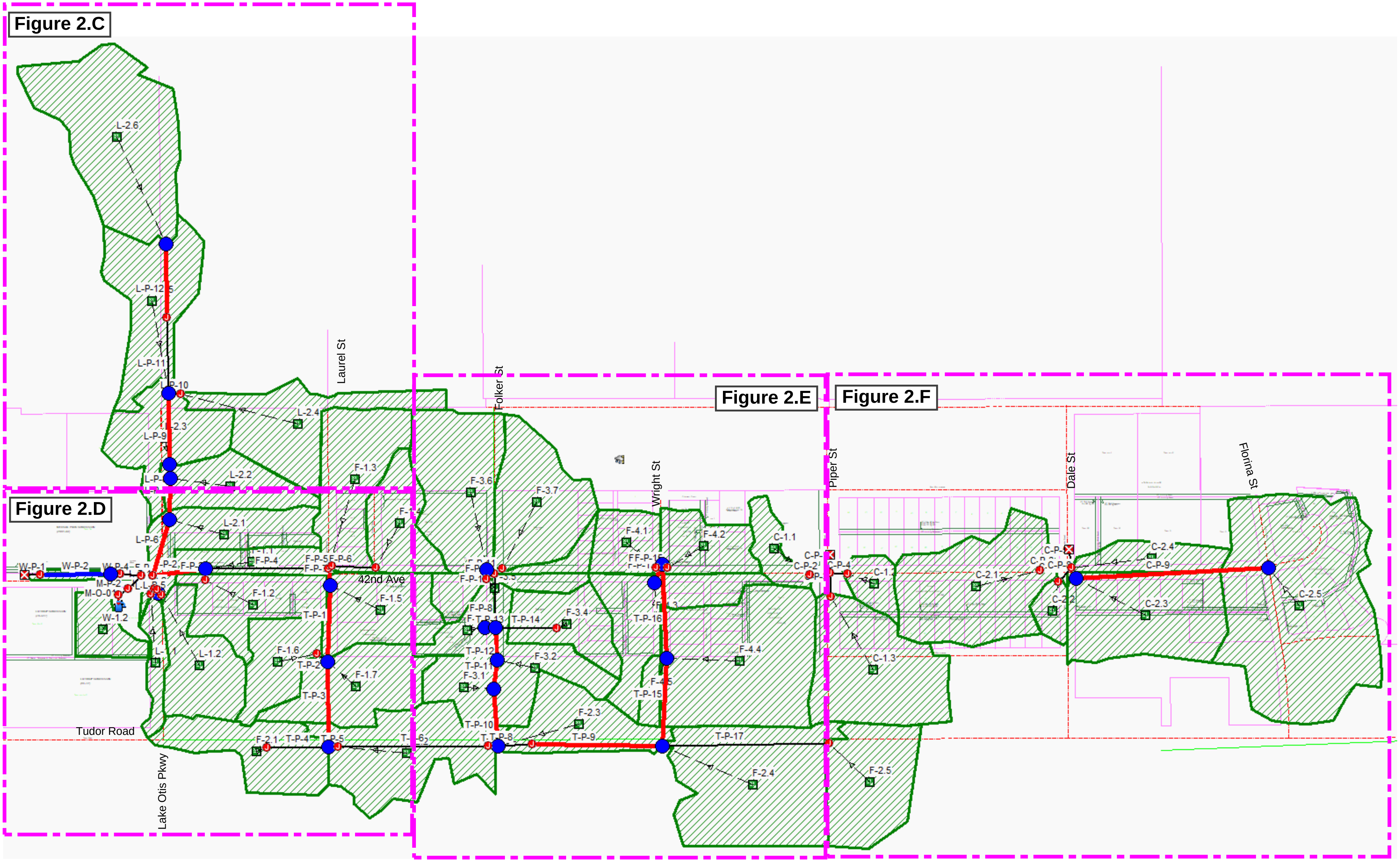


Figure 2.C
Existing Model Pipe Layout
Lake Otis Pkwy

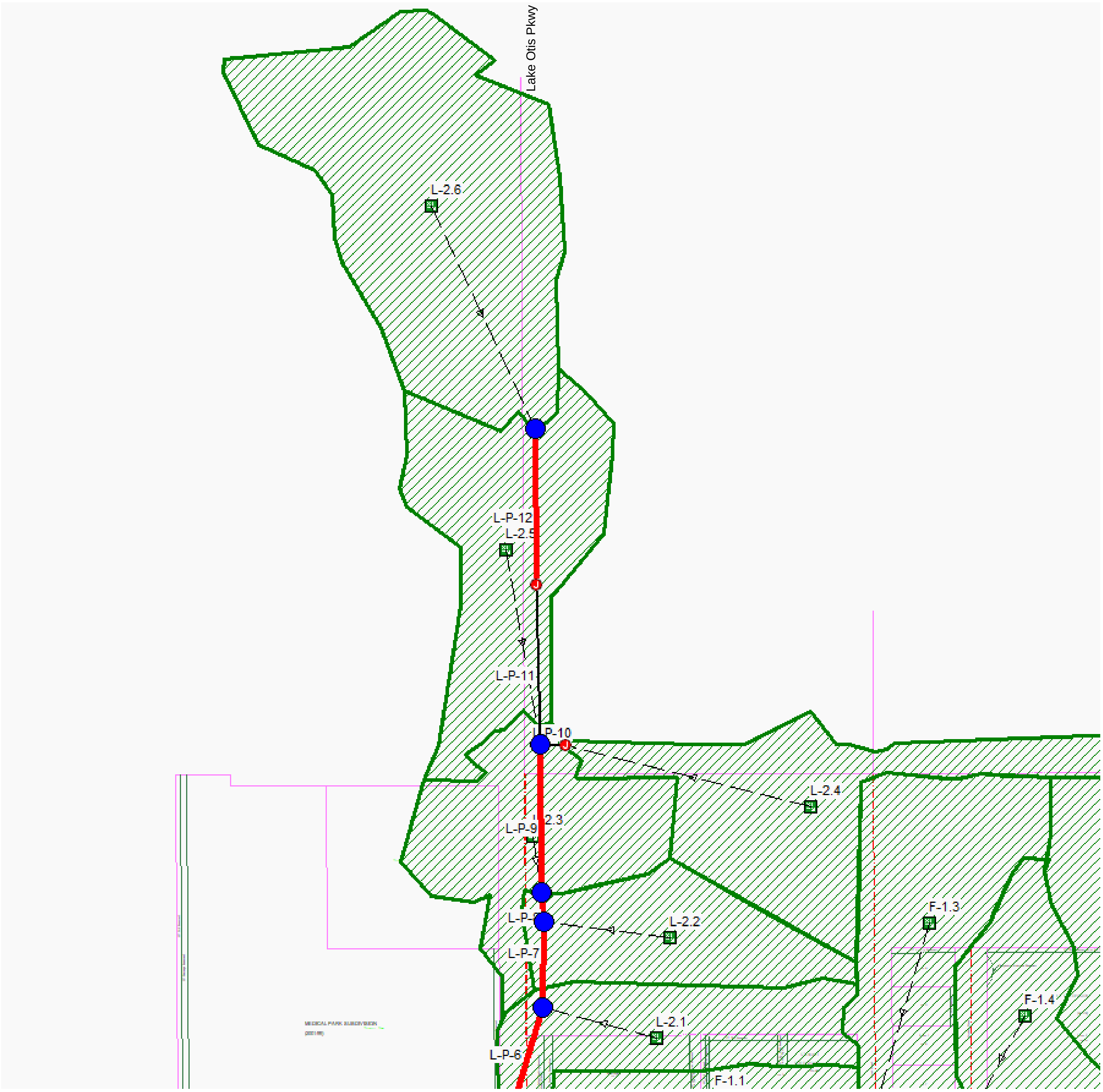


Figure 2.D
Existing Model Pipe Layout
Lake Otis Pkwy, 42nd Ave, Tudor Rd & Laurel St

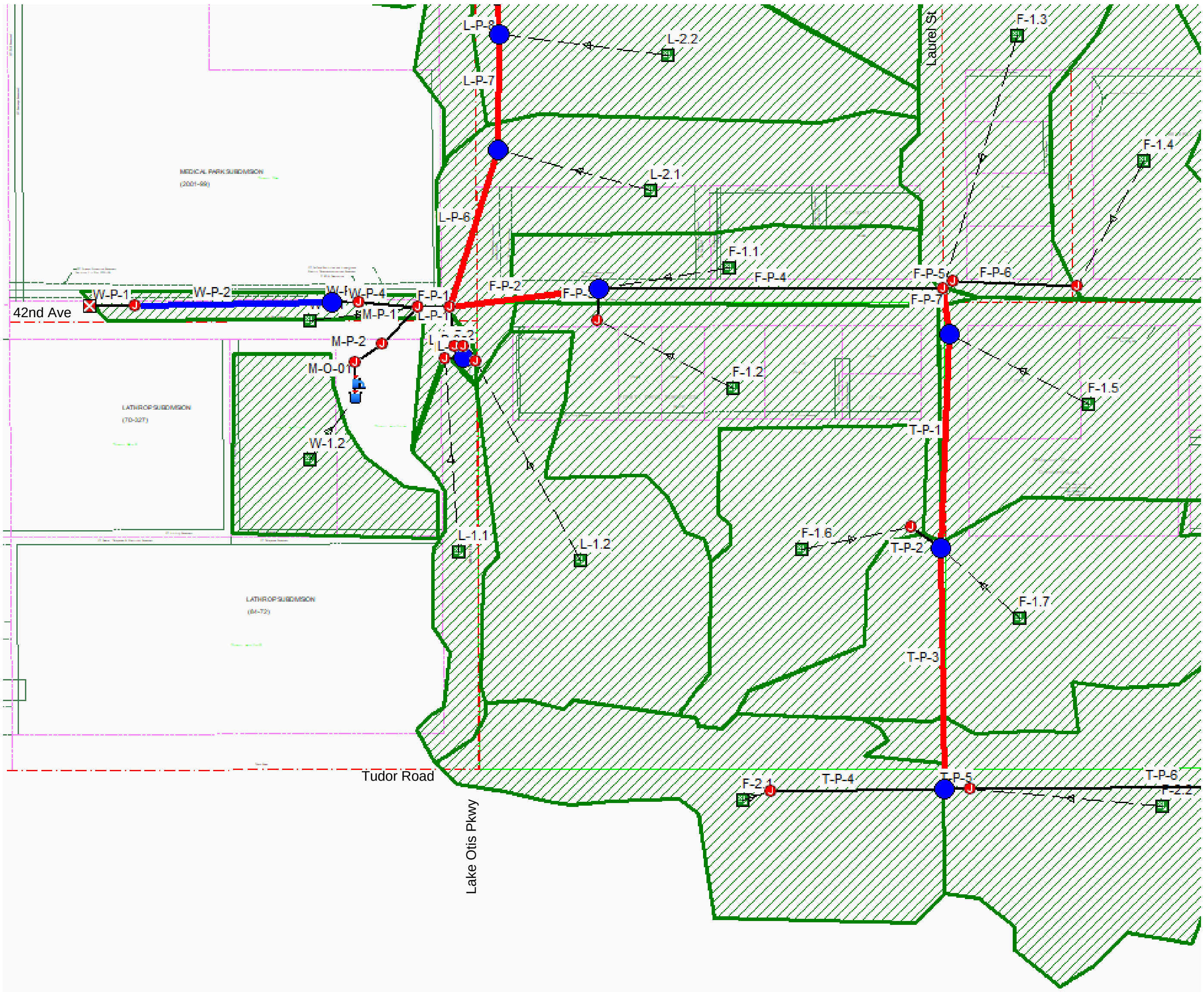


Figure 2.E
Existing Model Pipe Layout
42nd Ave, Tudor Rd, Laurel St, Folker St & Wright St

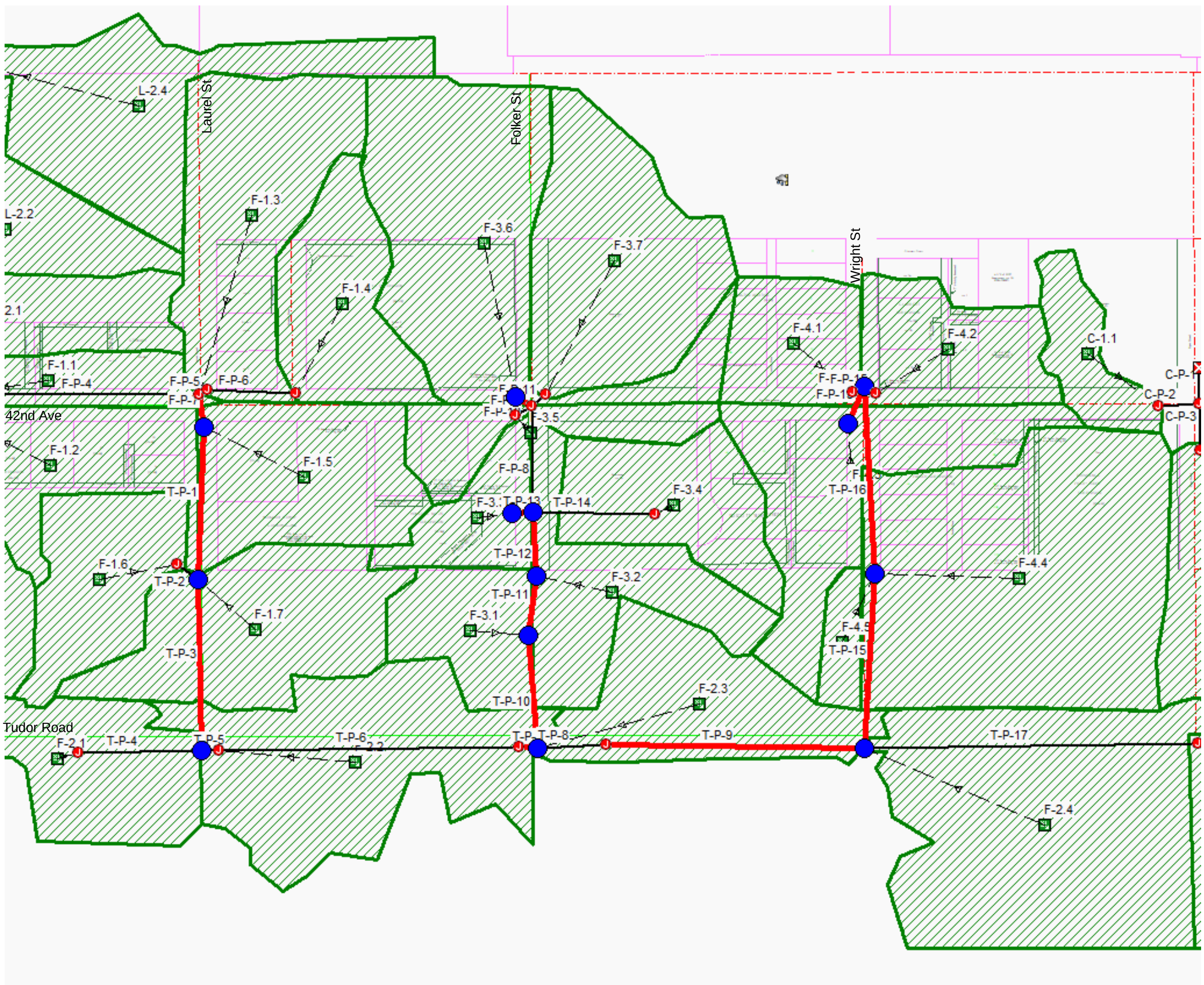
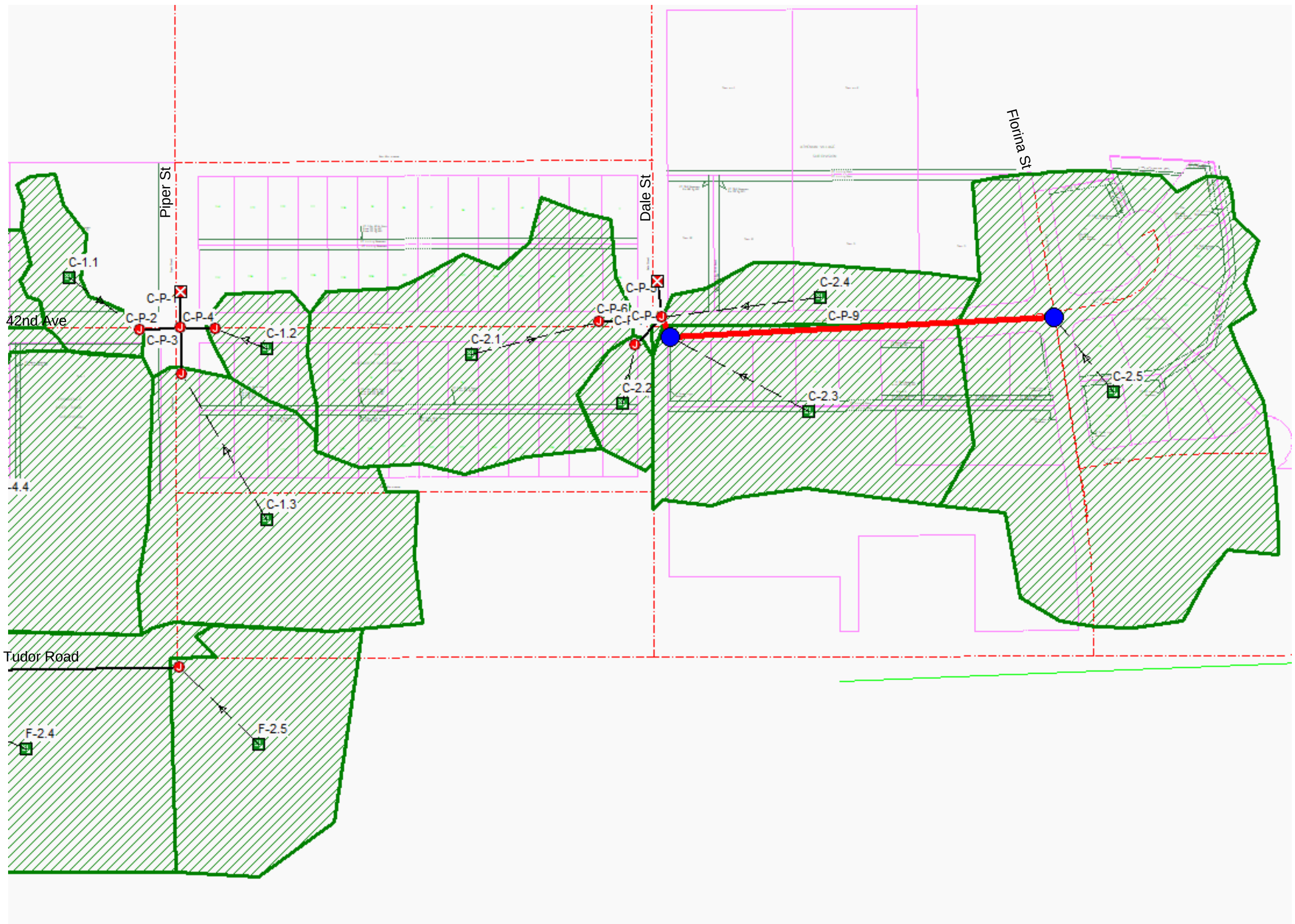


Figure 2.F
Existing Model Pipe Layout
42nd Ave, Tudor Rd, Piper St, Dale St & Florina St



Project Description

File Name	10142.00 42ndExistingStorm 2020.12.14.SPF

Project Options

Flow Units	CFS
Elevation Type	Elevation
Hydrology Method	SCS TR-55
Time of Concentration (TOC) Method	SCS TR-55
Link Routing Method	Kinematic Wave
Enable Overflow Ponding at Nodes	YES
Skip Steady State Analysis Time Periods	YES

Analysis Options

Start Analysis On	Jan 21, 2020	00:00:00
End Analysis On	Jan 22, 2020	00:00:00
Start Reporting On	Jan 21, 2020	00:00:00
Antecedent Dry Days	0	days
Runoff (Dry Weather) Time Step	0 01:00:00	days hh:mm:ss
Runoff (Wet Weather) Time Step	0 00:05:00	days hh:mm:ss
Reporting Time Step	0 00:05:00	days hh:mm:ss
Routing Time Step	30	seconds

Number of Elements

	Qty
Rain Gages	1
Subbasins	42
Nodes	62
Junctions	58
Outfalls	3
Flow Diversions	0
Inlets	0
Storage Nodes	1
Links	59
Channels	2
Pipes	56
Pumps	0
Orifices	1
Weirs	0
Outlets	0
Pollutants	0
Land Uses	0

Rainfall Details

SN	Rain Gage ID	Data Source	Data Source ID	Rainfall Type	Rain Units	State	County	Return Period (years)	Rainfall Depth (inches)	Rainfall Distribution
1	Rain Gage-01	Time Series	10-year, 24-hour, Anchorage	Cumulative	inches				0.00	

Subbasin Summary

SN	Subbasin ID	Area (ac)	Weighted Curve Number	Total Rainfall (in)	Total Runoff (in)	Total Runoff Volume (ac-in)	Peak Runoff (cfs)	Time of Concentration (days hh:mm:ss)
1	C-1.1	1.01	93.86	2.46	1.82	1.83	1.10	0 00:11:39
2	C-1.2	0.89	93.06	2.46	1.75	1.55	0.78	0 00:18:05
3	C-1.3	5.13	87.40	2.46	1.31	6.70	2.48	0 00:34:30
4	C-2.1	5.46	85.09	2.46	1.15	6.31	2.71	0 00:25:44
5	C-2.2	0.64	86.28	2.46	1.23	0.79	0.31	0 00:30:55
6	C-2.3	4.88	86.88	2.46	1.27	6.20	2.99	0 00:20:45
7	C-2.4	1.46	94.00	2.46	1.83	2.67	1.49	0 00:14:11
8	C-2.5	10.88	91.85	2.46	1.65	17.90	13.38	0 00:06:07
9	F-1.1	1.41	96.30	2.46	2.05	2.90	1.70	0 00:11:24
10	F-1.2	2.78	92.86	2.46	1.73	4.81	2.28	0 00:20:45
11	F-1.3	3.75	95.12	2.46	1.94	7.28	3.57	0 00:18:18
12	F-1.4	2.23	93.86	2.46	1.82	4.05	2.93	0 00:06:31
13	F-1.5	2.87	93.61	2.46	1.80	5.15	3.41	0 00:09:05
14	F-1.6	2.09	96.79	2.46	2.10	4.40	2.45	0 00:12:42
15	F-1.7	3.35	94.99	2.46	1.93	6.44	1.53	0 01:11:34
16	F-2.1	3.07	97.44	2.46	2.17	6.67	2.96	0 00:20:34
17	F-2.2	4.60	96.54	2.46	2.08	9.55	4.08	0 00:23:17
18	F-2.3	2.82	96.67	2.46	2.09	5.90	4.27	0 00:05:00
19	F-2.4	6.61	90.64	2.46	1.55	10.23	2.96	0 00:53:30
20	F-2.5	3.60	88.40	2.46	1.38	4.96	3.24	0 00:10:16
21	F-3.1	1.50	94.00	2.46	1.83	2.75	1.47	0 00:15:24
22	F-3.2	2.39	95.61	2.46	1.99	4.75	3.16	0 00:08:10
23	F-3.3	1.13	94.10	2.46	1.84	2.07	1.20	0 00:12:48
24	F-3.4	2.24	90.00	2.46	1.50	3.35	1.39	0 00:27:54
25	F-3.5	1.32	94.66	2.46	1.89	2.51	1.04	0 00:26:06
26	F-3.6	5.06	92.57	2.46	1.71	8.63	3.93	0 00:22:36
27	F-3.7	3.85	78.63	2.46	0.79	3.06	1.08	0 00:33:46
28	F-4.1	1.51	81.24	2.46	0.93	1.40	0.69	0 00:18:21
29	F-4.2	1.91	91.09	2.46	1.58	3.03	1.55	0 00:18:00
30	F-4.3	3.27	92.86	2.46	1.73	5.65	2.66	0 00:21:03
31	F-4.4	7.13	88.31	2.46	1.37	9.78	6.73	0 00:08:48
32	F-4.5	0.47	94.55	2.46	1.88	0.89	0.56	0 00:10:18
33	L-1.1	0.88	96.36	2.46	2.06	1.81	1.32	0 00:05:00
34	L-1.2	2.73	96.33	2.46	2.06	5.61	4.10	0 00:05:00
35	L-2.1	2.75	94.00	2.46	1.83	5.04	3.82	0 00:05:00
36	L-2.2	2.31	96.91	2.46	2.12	4.88	3.52	0 00:05:00
37	L-2.3	3.09	97.34	2.46	2.16	6.67	3.45	0 00:14:33
38	L-2.4	3.74	96.40	2.46	2.06	7.73	5.22	0 00:07:18
39	L-2.5	3.92	95.98	2.46	2.02	7.92	2.54	0 00:41:04
40	L-2.6	6.98	93.21	2.46	1.76	12.30	7.46	0 00:11:39
41	W-1.1	0.51	85.29	2.46	1.17	0.59	0.47	0 00:05:00
42	W-1.2	0.84	94.00	2.46	1.83	1.54	1.17	0 00:05:00

Subbasin Hydrology

Subbasin : C-1.1

Input Data

Area (ac) 1.01
Weighted Curve Number 93.86
Rain Gage ID .... Rain Gage-01

Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
Paved parking & roofs	0.82	C	98.00
Woods & grass combination, Fair	0.19	C	76.00
Composite Area & Weighted CN	1.01		93.86

Time of Concentration

TOC Method : SCS TR-55

Sheet Flow Equation :

Tc = (0.007 * ((n * Lf)^0.8)) / ((P^0.5) * (Sf^0.4))

Where :

Tc = Time of Concentration (hr)
n = Manning's roughness
Lf = Flow Length (ft)
P = 2 yr, 24 hr Rainfall (inches)
Sf = Slope (ft/ft)

Shallow Concentrated Flow Equation :

V = 16.1345 * (Sf^0.5) (unpaved surface)
V = 20.3282 * (Sf^0.5) (paved surface)
V = 15.0 * (Sf^0.5) (grassed waterway surface)
V = 10.0 * (Sf^0.5) (nearly bare & untilled surface)
V = 9.0 * (Sf^0.5) (cultivated straight rows surface)
V = 7.0 * (Sf^0.5) (short grass pasture surface)
V = 5.0 * (Sf^0.5) (woodland surface)
V = 2.5 * (Sf^0.5) (forest w/heavy litter surface)
Tc = (Lf / V) / (3600 sec/hr)

Where:

Tc = Time of Concentration (hr)
Lf = Flow Length (ft)
V = Velocity (ft/sec)
Sf = Slope (ft/ft)

Channel Flow Equation :

V = (1.49 * (R^(2/3)) * (Sf^0.5)) / n
R = Aq / Wp
Tc = (Lf / V) / (3600 sec/hr)

Where :

Tc = Time of Concentration (hr)
Lf = Flow Length (ft)
R = Hydraulic Radius (ft)
Aq = Flow Area (ft²)
Wp = Wetted Perimeter (ft)
V = Velocity (ft/sec)
Sf = Slope (ft/ft)
n = Manning's roughness

Sheet Flow Computations	Subarea A	Subarea B	Subarea C
Manning's Roughness :	.2	0.00	0.00
Flow Length (ft) :	47	0.00	0.00
Slope (%) :	10.64	0.00	0.00
2 yr, 24 hr Rainfall (in) :	1.50	0.00	0.00
Velocity (ft/sec) :	0.16	0.00	0.00
Computed Flow Time (min) :	5.05	0.00	0.00

Shallow Concentrated Flow Computations	Subarea A	Subarea B	Subarea C
Flow Length (ft) :	75	0.00	0.00
Slope (%) :	1.33	0.00	0.00
Surface Type :	Paved	Unpaved	Unpaved
Velocity (ft/sec) :	2.34	0.00	0.00
Computed Flow Time (min) :	0.53	0.00	0.00

Channel Flow Computations	Subarea A	Subarea B	Subarea C
Manning's Roughness :	.013	.014	0.00
Flow Length (ft) :	194	158	0.00
Channel Slope (%) :	.52	.63	0.00
Cross Section Area (ft^2) :	.2	.04	0.00
Wetted Perimeter (ft) :	4	1.31	0.00
Velocity (ft/sec) :	1.12	0.83	0.00
Computed Flow Time (min) :	2.88	3.19	0.00

Total TOC (min) 11.65

Subbasin Runoff Results

Total Rainfall (in) 2.46
Total Runoff (in) 1.82
Peak Runoff (cfs) 1.10
Weighted Curve Number 93.86
Time of Concentration (days hh:mm:ss) 0 00:11:39

Subbasin : C-1.2

Input Data

Area (ac) 0.89
Weighted Curve Number 93.06
Rain Gage ID .... Rain Gage-01

Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
Paved parking & roofs	0.69	C	98.00
Woods & grass combination, Fair	0.20	C	76.00
Composite Area & Weighted CN	0.89		93.06

Time of Concentration

Sheet Flow Computations	Subarea A	Subarea B	Subarea C
Manning's Roughness :	.3	0.00	0.00
Flow Length (ft) :	62	0.00	0.00
Slope (%) :	3.23	0.00	0.00
2 yr, 24 hr Rainfall (in) :	1.50	0.00	0.00
Velocity (ft/sec) :	0.07	0.00	0.00
Computed Flow Time (min) :	14.03	0.00	0.00

Shallow Concentrated Flow Computations	Subarea A	Subarea B	Subarea C
Flow Length (ft) :	93	0.00	0.00
Slope (%) :	2.15	0.00	0.00
Surface Type :	Paved	Unpaved	Unpaved
Velocity (ft/sec) :	2.98	0.00	0.00
Computed Flow Time (min) :	0.52	0.00	0.00

Channel Flow Computations	Subarea A	Subarea B	Subarea C
Manning's Roughness :	.021	0.00	0.00
Flow Length (ft) :	161	0.00	0.00
Channel Slope (%) :	.62	0.00	0.00
Cross Section Area (ft²) :	.2	0.00	0.00
Wetted Perimeter (ft) :	4	0.00	0.00
Velocity (ft/sec) :	0.76	0.00	0.00
Computed Flow Time (min) :	3.54	0.00	0.00

Total TOC (min) 18.09

Subbasin Runoff Results

Total Rainfall (in) 2.46
Total Runoff (in) 1.75
Peak Runoff (cfs) 0.78
Weighted Curve Number 93.06
Time of Concentration (days hh:mm:ss) 0 00:18:05

Subbasin : C-1.3

Input Data

Area (ac) 5.13
Weighted Curve Number 87.40
Rain Gage ID .... Rain Gage-01

Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
1/3 acre lots, 30% impervious	3.20	C	81.00
Paved parking & roofs	1.93	C	98.00
Composite Area & Weighted CN	5.13		87.40

Time of Concentration

Sheet Flow Computations	Subarea A	Subarea B	Subarea C
Manning's Roughness :	.3	0.00	0.00
Flow Length (ft) :	81	0.00	0.00
Slope (%) :	2.47	0.00	0.00
2 yr, 24 hr Rainfall (in) :	1.50	0.00	0.00
Velocity (ft/sec) :	0.07	0.00	0.00
Computed Flow Time (min) :	19.35	0.00	0.00

Shallow Concentrated Flow Computations	Subarea A	Subarea B	Subarea C
Flow Length (ft) :	60	0.00	0.00
Slope (%) :	1.67	0.00	0.00
Surface Type :	Paved	Unpaved	Unpaved
Velocity (ft/sec) :	2.63	0.00	0.00
Computed Flow Time (min) :	0.38	0.00	0.00

Channel Flow Computations	Subarea A	Subarea B	Subarea C
Manning's Roughness :	.028	.013	0.00
Flow Length (ft) :	160	111	0.00
Channel Slope (%) :	.37	.37	0.00
Cross Section Area (ft²) :	.08	.08	0.00
Wetted Perimeter (ft) :	4	4	0.00
Velocity (ft/sec) :	0.24	0.51	0.00
Computed Flow Time (min) :	11.18	3.60	0.00

Total TOC (min) 34.51

Subbasin Runoff Results

Total Rainfall (in) 2.46
Total Runoff (in) 1.31
Peak Runoff (cfs) 2.48
Weighted Curve Number 87.40
Time of Concentration (days hh:mm:ss) 0 00:34:31

Subbasin : C-2.1

Input Data

Area (ac) 5.46
Weighted Curve Number 85.09
Rain Gage ID .... Rain Gage-01

Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
Paved parking & roofs	0.76	C	98.00
1/4 acre lots, 38% impervious	4.70	C	83.00
Composite Area & Weighted CN	5.46		85.09

Time of Concentration

Sheet Flow Computations	Subarea A	Subarea B	Subarea C
Manning's Roughness :	.2	0.00	0.00
Flow Length (ft) :	93	0.00	0.00
Slope (%) :	2.15	0.00	0.00
2 yr, 24 hr Rainfall (in) :	1.50	0.00	0.00
Velocity (ft/sec) :	0.09	0.00	0.00
Computed Flow Time (min) :	16.51	0.00	0.00

Shallow Concentrated Flow Computations	Subarea A	Subarea B	Subarea C
Flow Length (ft) :	111	0.00	0.00
Slope (%) :	1.8	0.00	0.00
Surface Type :	Paved	Unpaved	Unpaved
Velocity (ft/sec) :	2.73	0.00	0.00
Computed Flow Time (min) :	0.68	0.00	0.00

Channel Flow Computations	Subarea A	Subarea B	Subarea C
Manning's Roughness :	.025	0.00	0.00
Flow Length (ft) :	259	0.00	0.00
Channel Slope (%) :	.39	0.00	0.00
Cross Section Area (ft^2) :	.2	0.00	0.00
Wetted Perimeter (ft) :	4	0.00	0.00
Velocity (ft/sec) :	0.51	0.00	0.00
Computed Flow Time (min) :	8.55	0.00	0.00

Total TOC (min) 25.74

Subbasin Runoff Results

Total Rainfall (in) 2.46
Total Runoff (in) 1.15
Peak Runoff (cfs) 2.71
Weighted Curve Number 85.09
Time of Concentration (days hh:mm:ss) 0 00:25:44

Subbasin : C-2.2

Input Data

Area (ac) 0.64
Weighted Curve Number 86.28
Rain Gage ID .... Rain Gage-01

Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
Paved parking & roofs	0.14	C	98.00
1/4 acre lots, 38% impervious	0.50	C	83.00
Composite Area & Weighted CN	0.64		86.28

Time of Concentration

Sheet Flow Computations	Subarea A	Subarea B	Subarea C
Manning's Roughness :	.4	0.00	0.00
Flow Length (ft) :	81	0.00	0.00
Slope (%) :	2.47	0.00	0.00
2 yr, 24 hr Rainfall (in) :	1.50	0.00	0.00
Velocity (ft/sec) :	0.06	0.00	0.00
Computed Flow Time (min) :	24.35	0.00	0.00

Channel Flow Computations	Subarea A	Subarea B	Subarea C
Manning's Roughness :	.025	0.00	0.00
Flow Length (ft) :	216	0.00	0.00
Channel Slope (%) :	.46	0.00	0.00
Cross Section Area (ft²) :	.2	0.00	0.00
Wetted Perimeter (ft) :	4	0.00	0.00
Velocity (ft/sec) :	0.55	0.00	0.00
Computed Flow Time (min) :	6.56	0.00	0.00

Total TOC (min) 30.92

Subbasin Runoff Results

Total Rainfall (in) 2.46
Total Runoff (in) 1.23
Peak Runoff (cfs) 0.31
Weighted Curve Number 86.28
Time of Concentration (days hh:mm:ss) 0 00:30:55

Subbasin : C-2.3

Input Data

Area (ac) 4.88
Weighted Curve Number 86.88
Rain Gage ID .... Rain Gage-01

Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
Woods & grass combination, Good	0.78	C	72.00
Urban commercial, 85% imp	2.50	C	94.00
1/4 acre lots, 38% impervious	1.60	C	83.00
Composite Area & Weighted CN	4.88		86.88

Time of Concentration

Sheet Flow Computations	Subarea A	Subarea B	Subarea C
Manning's Roughness :	.11	0.00	0.00
Flow Length (ft) :	104	0.00	0.00
Slope (%) :	.96	0.00	0.00
2 yr, 24 hr Rainfall (in) :	1.50	0.00	0.00
Velocity (ft/sec) :	0.11	0.00	0.00
Computed Flow Time (min) :	15.45	0.00	0.00

Shallow Concentrated Flow Computations	Subarea A	Subarea B	Subarea C
Flow Length (ft) :	111	114	0.00
Slope (%) :	.9	.88	0.00
Surface Type :	Unpaved	Paved	Unpaved
Velocity (ft/sec) :	1.53	1.91	0.00
Computed Flow Time (min) :	1.21	0.99	0.00

Channel Flow Computations	Subarea A	Subarea B	Subarea C
Manning's Roughness :	.013	0.00	0.00
Flow Length (ft) :	399	0.00	0.00
Channel Slope (%) :	.5	0.00	0.00
Cross Section Area (ft^2) :	.4	0.00	0.00
Wetted Perimeter (ft) :	2.92	0.00	0.00
Velocity (ft/sec) :	2.15	0.00	0.00
Computed Flow Time (min) :	3.09	0.00	0.00

Total TOC (min) 20.75

Subbasin Runoff Results

Total Rainfall (in) 2.46
Total Runoff (in) 1.27
Peak Runoff (cfs) 2.99
Weighted Curve Number 86.88
Time of Concentration (days hh:mm:ss) 0 00:20:45

Subbasin : C-2.4

Input Data

Area (ac) 1.46
Weighted Curve Number 94.00
Rain Gage ID .... Rain Gage-01

Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
Urban commercial, 85% imp	1.46	C	94.00
Composite Area & Weighted CN	1.46		94.00

Time of Concentration

Sheet Flow Computations	Subarea A	Subarea B	Subarea C
Manning's Roughness :	.11	0.00	0.00
Flow Length (ft) :	63	0.00	0.00
Slope (%) :	1.59	0.00	0.00
2 yr, 24 hr Rainfall (in) :	1.50	0.00	0.00
Velocity (ft/sec) :	0.12	0.00	0.00
Computed Flow Time (min) :	8.46	0.00	0.00

Channel Flow Computations	Subarea A	Subarea B	Subarea C
Manning's Roughness :	.013	.013	0.00
Flow Length (ft) :	226	367	0.00
Channel Slope (%) :	.44	.27	0.00
Cross Section Area (ft^2) :	.4	.4	0.00
Wetted Perimeter (ft) :	2.92	2.92	0.00
Velocity (ft/sec) :	2.02	1.58	0.00
Computed Flow Time (min) :	1.86	3.86	0.00

Total TOC (min) 14.19

Subbasin Runoff Results

Total Rainfall (in) 2.46
Total Runoff (in) 1.83
Peak Runoff (cfs) 1.49
Weighted Curve Number 94.00
Time of Concentration (days hh:mm:ss) 0 00:14:11

Subbasin : C-2.5

Input Data

Area (ac) 10.88
Weighted Curve Number 91.85
Rain Gage ID .... Rain Gage-01

Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
Urban commercial, 85% imp	9.58	C	94.00
Woods & grass combination, Fair	1.30	C	76.00
Composite Area & Weighted CN	10.88		91.85

Time of Concentration

Sheet Flow Computations	Subarea A	Subarea B	Subarea C
Manning's Roughness :	.4	0.00	0.00
Flow Length (ft) :	17	0.00	0.00
Slope (%) :	23.53	0.00	0.00
2 yr, 24 hr Rainfall (in) :	1.50	0.00	0.00
Velocity (ft/sec) :	0.10	0.00	0.00
Computed Flow Time (min) :	2.84	0.00	0.00

Shallow Concentrated Flow Computations	Subarea A	Subarea B	Subarea C
Flow Length (ft) :	148	0.00	0.00
Slope (%) :	1.35	0.00	0.00
Surface Type :	Paved	Unpaved	Unpaved
Velocity (ft/sec) :	2.36	0.00	0.00
Computed Flow Time (min) :	1.05	0.00	0.00

Channel Flow Computations	Subarea A	Subarea B	Subarea C
Manning's Roughness :	.013	0.00	0.00
Flow Length (ft) :	322	0.00	0.00
Channel Slope (%) :	.62	0.00	0.00
Cross Section Area (ft²) :	.4	0.00	0.00
Wetted Perimeter (ft) :	2.92	0.00	0.00
Velocity (ft/sec) :	2.40	0.00	0.00
Computed Flow Time (min) :	2.24	0.00	0.00

Total TOC (min) 6.12

Subbasin Runoff Results

Total Rainfall (in) 2.46
Total Runoff (in) 1.65
Peak Runoff (cfs) 13.38
Weighted Curve Number 91.85
Time of Concentration (days hh:mm:ss) 0 00:06:07

Subbasin : F-1.1

Input Data

Area (ac) 1.41
Weighted Curve Number 96.30
Rain Gage ID .... Rain Gage-01

Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
Paved parking & roofs	1.31	C	98.00
> 75% grass cover, Good	0.10	C	74.00
Composite Area & Weighted CN	1.41		96.30

Time of Concentration

Sheet Flow Computations	Subarea A	Subarea B	Subarea C
Manning's Roughness :	.01	0.00	0.00
Flow Length (ft) :	85	0.00	0.00
Slope (%) :	3.53	0.00	0.00
2 yr, 24 hr Rainfall (in) :	1.50	0.00	0.00
Velocity (ft/sec) :	1.23	0.00	0.00
Computed Flow Time (min) :	1.15	0.00	0.00

Shallow Concentrated Flow Computations	Subarea A	Subarea B	Subarea C
Flow Length (ft) :	69	0.00	0.00
Slope (%) :	1.45	0.00	0.00
Surface Type :	Paved	Unpaved	Unpaved
Velocity (ft/sec) :	2.45	0.00	0.00
Computed Flow Time (min) :	0.47	0.00	0.00

Channel Flow Computations	Subarea A	Subarea B	Subarea C
Manning's Roughness :	.022	0.00	0.00
Flow Length (ft) :	325	0.00	0.00
Channel Slope (%) :	1.23	0.00	0.00
Cross Section Area (ft^2) :	.08	0.00	0.00
Wetted Perimeter (ft) :	4	0.00	0.00
Velocity (ft/sec) :	0.55	0.00	0.00
Computed Flow Time (min) :	9.79	0.00	0.00

Total TOC (min) 11.40

Subbasin Runoff Results

Total Rainfall (in) 2.46
Total Runoff (in) 2.05
Peak Runoff (cfs) 1.70
Weighted Curve Number 96.30
Time of Concentration (days hh:mm:ss) 0 00:11:24

Subbasin : F-1.2

Input Data

Area (ac) 2.78
Weighted Curve Number 92.86
Rain Gage ID .... Rain Gage-01

Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
Paved parking & roofs	2.13	C	98.00
Woods & grass combination, Fair	0.65	C	76.00
Composite Area & Weighted CN	2.78		92.86

Time of Concentration

Sheet Flow Computations	Subarea A	Subarea B	Subarea C
Manning's Roughness :	.2	0.00	0.00
Flow Length (ft) :	70	0.00	0.00
Slope (%) :	2.86	0.00	0.00
2 yr, 24 hr Rainfall (in) :	1.50	0.00	0.00
Velocity (ft/sec) :	0.10	0.00	0.00
Computed Flow Time (min) :	11.74	0.00	0.00

Shallow Concentrated Flow Computations	Subarea A	Subarea B	Subarea C
Flow Length (ft) :	187	128	0.00
Slope (%) :	4.28	.78	0.00
Surface Type :	Grassed waterway	Unpaved	Unpaved
Velocity (ft/sec) :	3.10	1.42	0.00
Computed Flow Time (min) :	1.01	1.50	0.00

Channel Flow Computations	Subarea A	Subarea B	Subarea C
Manning's Roughness :	.022	0.00	0.00
Flow Length (ft) :	156	0.00	0.00
Channel Slope (%) :	.64	0.00	0.00
Cross Section Area (ft²) :	.08	0.00	0.00
Wetted Perimeter (ft) :	4	0.00	0.00
Velocity (ft/sec) :	0.40	0.00	0.00
Computed Flow Time (min) :	6.51	0.00	0.00

Total TOC (min) 20.76

Subbasin Runoff Results

Total Rainfall (in) 2.46
Total Runoff (in) 1.73
Peak Runoff (cfs) 2.28
Weighted Curve Number 92.86
Time of Concentration (days hh:mm:ss) 0 00:20:46

Subbasin : F-1.3

Input Data

Area (ac) 3.75
Weighted Curve Number 95.12
Rain Gage ID .... Rain Gage-01

Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
> 75% grass cover, Good	0.45	C	74.00
Paved roads with curbs & sewers	3.30	C	98.00
Composite Area & Weighted CN	3.75		95.12

Time of Concentration

Sheet Flow Computations	Subarea A	Subarea B	Subarea C
Manning's Roughness :	.4	0.00	0.00
Flow Length (ft) :	76	0.00	0.00
Slope (%) :	22.4	0.00	0.00
2 yr, 24 hr Rainfall (in) :	1.50	0.00	0.00
Velocity (ft/sec) :	0.13	0.00	0.00
Computed Flow Time (min) :	9.58	0.00	0.00

Shallow Concentrated Flow Computations	Subarea A	Subarea B	Subarea C
Flow Length (ft) :	153	80	0.00
Slope (%) :	9.8	8.8	0.00
Surface Type :	Grassed waterway	Paved	Unpaved
Velocity (ft/sec) :	4.70	6.03	0.00
Computed Flow Time (min) :	0.54	0.22	0.00

Channel Flow Computations	Subarea A	Subarea B	Subarea C
Manning's Roughness :	0.013	0.00	0.00
Flow Length (ft) :	478	0.00	0.00
Channel Slope (%) :	.8	0.00	0.00
Cross Section Area (ft²) :	.04	0.00	0.00
Wetted Perimeter (ft) :	1.31	0.00	0.00
Velocity (ft/sec) :	1.00	0.00	0.00
Computed Flow Time (min) :	7.95	0.00	0.00

Total TOC (min) 18.30

Subbasin Runoff Results

Total Rainfall (in) 2.46
Total Runoff (in) 1.94
Peak Runoff (cfs) 3.57
Weighted Curve Number 95.12
Time of Concentration (days hh:mm:ss) 0 00:18:18

Subbasin : F-1.4

Input Data

Area (ac) 2.23
Weighted Curve Number 93.86
Rain Gage ID .... Rain Gage-01

Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
Paved parking & roofs	1.81	C	98.00
Woods & grass combination, Fair	0.42	C	76.00
Composite Area & Weighted CN	2.23		93.86

Time of Concentration

Sheet Flow Computations	Subarea A	Subarea B	Subarea C
Manning's Roughness :	.4	0.00	0.00
Flow Length (ft) :	35	0.00	0.00
Slope (%) :	40	0.00	0.00
2 yr, 24 hr Rainfall (in) :	1.50	0.00	0.00
Velocity (ft/sec) :	0.14	0.00	0.00
Computed Flow Time (min) :	4.09	0.00	0.00

Shallow Concentrated Flow Computations	Subarea A	Subarea B	Subarea C
Flow Length (ft) :	114	91	0.00
Slope (%) :	2.63	10.99	0.00
Surface Type :	Paved	Paved	Unpaved
Velocity (ft/sec) :	3.30	6.74	0.00
Computed Flow Time (min) :	0.58	0.23	0.00

Channel Flow Computations	Subarea A	Subarea B	Subarea C
Manning's Roughness :	.022	0.00	0.00
Flow Length (ft) :	283	0.00	0.00
Channel Slope (%) :	2.12	0.00	0.00
Cross Section Area (ft²) :	.33	0.00	0.00
Wetted Perimeter (ft) :	2.1	0.00	0.00
Velocity (ft/sec) :	2.87	0.00	0.00
Computed Flow Time (min) :	1.64	0.00	0.00

Total TOC (min) 6.53

Subbasin Runoff Results

Total Rainfall (in) 2.46
Total Runoff (in) 1.82
Peak Runoff (cfs) 2.93
Weighted Curve Number 93.86
Time of Concentration (days hh:mm:ss) 0 00:06:32

Subbasin : F-1.5

Input Data

Area (ac) 2.87
Weighted Curve Number 93.61
Rain Gage ID .... Rain Gage-01

Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
Paved parking & roofs	2.27	C	98.00
Brush, Poor	0.60	C	77.00
Composite Area & Weighted CN	2.87		93.61

Time of Concentration

Sheet Flow Computations	Subarea A	Subarea B	Subarea C
Manning's Roughness :	.2	0.00	0.00
Flow Length (ft) :	45	0.00	0.00
Slope (%) :	11.11	0.00	0.00
2 yr, 24 hr Rainfall (in) :	1.50	0.00	0.00
Velocity (ft/sec) :	0.16	0.00	0.00
Computed Flow Time (min) :	4.79	0.00	0.00

Shallow Concentrated Flow Computations	Subarea A	Subarea B	Subarea C
Flow Length (ft) :	259	0.00	0.00
Slope (%) :	.77	0.00	0.00
Surface Type :	Paved	Unpaved	Unpaved
Velocity (ft/sec) :	1.78	0.00	0.00
Computed Flow Time (min) :	2.43	0.00	0.00

Channel Flow Computations	Subarea A	Subarea B	Subarea C
Manning's Roughness :	.028	0.00	0.00
Flow Length (ft) :	92	0.00	0.00
Channel Slope (%) :	4.35	0.00	0.00
Cross Section Area (ft²) :	.08	0.00	0.00
Wetted Perimeter (ft) :	4	0.00	0.00
Velocity (ft/sec) :	0.82	0.00	0.00
Computed Flow Time (min) :	1.88	0.00	0.00

Total TOC (min) 9.09

Subbasin Runoff Results

Total Rainfall (in) 2.46
Total Runoff (in) 1.80
Peak Runoff (cfs) 3.41
Weighted Curve Number 93.61
Time of Concentration (days hh:mm:ss) 0 00:09:05

Subbasin : F-1.6

Input Data

Area (ac) 2.09
Weighted Curve Number 96.79
Rain Gage ID .... Rain Gage-01

Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
Paved parking & roofs	1.97	C	98.00
Brush, Poor	0.12	C	77.00
Composite Area & Weighted CN	2.09		96.79

Time of Concentration

Sheet Flow Computations	Subarea A	Subarea B	Subarea C
Manning's Roughness :	.01	0.00	0.00
Flow Length (ft) :	68	0.00	0.00
Slope (%) :	4.41	0.00	0.00
2 yr, 24 hr Rainfall (in) :	1.50	0.00	0.00
Velocity (ft/sec) :	1.29	0.00	0.00
Computed Flow Time (min) :	0.88	0.00	0.00

Shallow Concentrated Flow Computations	Subarea A	Subarea B	Subarea C
Flow Length (ft) :	219	0.00	0.00
Slope (%) :	1.83	0.00	0.00
Surface Type :	Paved	Unpaved	Unpaved
Velocity (ft/sec) :	2.75	0.00	0.00
Computed Flow Time (min) :	1.33	0.00	0.00

Channel Flow Computations	Subarea A	Subarea B	Subarea C
Manning's Roughness :	.016	0.00	0.00
Flow Length (ft) :	234	0.00	0.00
Channel Slope (%) :	.43	0.00	0.00
Cross Section Area (ft²) :	.09	0.00	0.00
Wetted Perimeter (ft) :	6	0.00	0.00
Velocity (ft/sec) :	0.37	0.00	0.00
Computed Flow Time (min) :	10.50	0.00	0.00

Total TOC (min) 12.71

Subbasin Runoff Results

Total Rainfall (in) 2.46
Total Runoff (in) 2.10
Peak Runoff (cfs) 2.45
Weighted Curve Number 96.79
Time of Concentration (days hh:mm:ss) 0 00:12:43

Subbasin : F-1.7

Input Data

Area (ac) 3.35
Weighted Curve Number 94.99
Rain Gage ID .... Rain Gage-01

Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
Paved parking & roofs	2.87	C	98.00
Brush, Poor	0.48	C	77.00
Composite Area & Weighted CN	3.35		94.99

Time of Concentration

Sheet Flow Computations	Subarea A	Subarea B	Subarea C
Manning's Roughness :	.4	0.00	0.00
Flow Length (ft) :	149	0.00	0.00
Slope (%) :	.67	0.00	0.00
2 yr, 24 hr Rainfall (in) :	1.50	0.00	0.00
Velocity (ft/sec) :	0.04	0.00	0.00
Computed Flow Time (min) :	66.83	0.00	0.00

Shallow Concentrated Flow Computations	Subarea A	Subarea B	Subarea C
Flow Length (ft) :	159	0.00	0.00
Slope (%) :	.63	0.00	0.00
Surface Type :	Paved	Unpaved	Unpaved
Velocity (ft/sec) :	1.61	0.00	0.00
Computed Flow Time (min) :	1.65	0.00	0.00

Channel Flow Computations	Subarea A	Subarea B	Subarea C
Manning's Roughness :	.016	0.00	0.00
Flow Length (ft) :	148	0.00	0.00
Channel Slope (%) :	1.35	0.00	0.00
Cross Section Area (ft²) :	.08	0.00	0.00
Wetted Perimeter (ft) :	4	0.00	0.00
Velocity (ft/sec) :	0.80	0.00	0.00
Computed Flow Time (min) :	3.09	0.00	0.00

Total TOC (min) 71.57

Subbasin Runoff Results

Total Rainfall (in) 2.46
Total Runoff (in) 1.93
Peak Runoff (cfs) 1.53
Weighted Curve Number 94.99
Time of Concentration (days hh:mm:ss) 0 01:11:34

Subbasin : F-2.1

Input Data

Area (ac) 3.07
Weighted Curve Number 97.44
Rain Gage ID .... Rain Gage-01

Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
Paved parking & roofs	2.98	C	98.00
50 - 75% grass cover, Fair	0.09	C	79.00
Composite Area & Weighted CN	3.07		97.44

Time of Concentration

Sheet Flow Computations	Subarea A	Subarea B	Subarea C
Manning's Roughness :	.4	0.00	0.00
Flow Length (ft) :	57	0.00	0.00
Slope (%) :	5.26	0.00	0.00
2 yr, 24 hr Rainfall (in) :	1.50	0.00	0.00
Velocity (ft/sec) :	0.07	0.00	0.00
Computed Flow Time (min) :	13.59	0.00	0.00

Shallow Concentrated Flow Computations	Subarea A	Subarea B	Subarea C
Flow Length (ft) :	281	0.00	0.00
Slope (%) :	.71	0.00	0.00
Surface Type :	Paved	Unpaved	Unpaved
Velocity (ft/sec) :	1.71	0.00	0.00
Computed Flow Time (min) :	2.74	0.00	0.00

Channel Flow Computations	Subarea A	Subarea B	Subarea C
Manning's Roughness :	0.022	0.00	0.00
Flow Length (ft) :	117	0.00	0.00
Channel Slope (%) :	.85	0.00	0.00
Cross Section Area (ft²) :	.08	0.00	0.00
Wetted Perimeter (ft) :	4	0.00	0.00
Velocity (ft/sec) :	0.46	0.00	0.00
Computed Flow Time (min) :	4.24	0.00	0.00

Total TOC (min) 20.57

Subbasin Runoff Results

Total Rainfall (in) 2.46
Total Runoff (in) 2.17
Peak Runoff (cfs) 2.96
Weighted Curve Number 97.44
Time of Concentration (days hh:mm:ss) 0 00:20:34

Subbasin : F-2.2

Input Data

Area (ac) 4.60
Weighted Curve Number 96.54
Rain Gage ID .... Rain Gage-01

Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
Paved parking & roofs	4.28	C	98.00
Woods, Poor	0.32	C	77.00
Composite Area & Weighted CN	4.60		96.54

Time of Concentration

Sheet Flow Computations	Subarea A	Subarea B	Subarea C
Manning's Roughness :	.4	0.00	0.00
Flow Length (ft) :	55	0.00	0.00
Slope (%) :	1.81	0.00	0.00
2 yr, 24 hr Rainfall (in) :	1.50	0.00	0.00
Velocity (ft/sec) :	0.05	0.00	0.00
Computed Flow Time (min) :	20.23	0.00	0.00

Shallow Concentrated Flow Computations	Subarea A	Subarea B	Subarea C
Flow Length (ft) :	225	0.00	0.00
Slope (%) :	.44	0.00	0.00
Surface Type :	Paved	Unpaved	Unpaved
Velocity (ft/sec) :	1.35	0.00	0.00
Computed Flow Time (min) :	2.78	0.00	0.00

Channel Flow Computations	Subarea A	Subarea B	Subarea C
Manning's Roughness :	.013	0.00	0.00
Flow Length (ft) :	33	0.00	0.00
Channel Slope (%) :	3.03	0.00	0.00
Cross Section Area (ft²) :	.04	0.00	0.00
Wetted Perimeter (ft) :	1.31	0.00	0.00
Velocity (ft/sec) :	1.95	0.00	0.00
Computed Flow Time (min) :	0.28	0.00	0.00

Total TOC (min) 23.29

Subbasin Runoff Results

Total Rainfall (in) 2.46
Total Runoff (in) 2.08
Peak Runoff (cfs) 4.08
Weighted Curve Number 96.54
Time of Concentration (days hh:mm:ss) 0 00:23:17

Subbasin : F-2.3

Input Data

Area (ac) 2.82
Weighted Curve Number 96.67
Rain Gage ID .... Rain Gage-01

Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
Paved parking & roofs	2.65	C	98.00
Woods & grass combination, Fair	0.17	C	76.00
Composite Area & Weighted CN	2.82		96.67

Time of Concentration

User-Defined TOC override (minutes): 5

Subbasin Runoff Results

Total Rainfall (in) 2.46
Total Runoff (in) 2.09
Peak Runoff (cfs) 4.27
Weighted Curve Number 96.67
Time of Concentration (days hh:mm:ss) 0 00:05:00

Subbasin : F-2.4

Input Data

Area (ac) 6.61
Weighted Curve Number 90.64
Rain Gage ID .... Rain Gage-01

Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
Paved parking & roofs	4.15	C	98.00
Woods, Poor	1.86	C	77.00
Woods & grass combination, Poor	0.60	C	82.00
Composite Area & Weighted CN	6.61		90.64

Time of Concentration

Sheet Flow Computations	Subarea A	Subarea B	Subarea C
Manning's Roughness :	.3	0.00	0.00
Flow Length (ft) :	141	0.00	0.00
Slope (%) :	2.13	0.00	0.00
2 yr, 24 hr Rainfall (in) :	1.50	0.00	0.00
Velocity (ft/sec) :	0.07	0.00	0.00
Computed Flow Time (min) :	31.98	0.00	0.00

Shallow Concentrated Flow Computations	Subarea A	Subarea B	Subarea C
Flow Length (ft) :	181	0.00	0.00
Slope (%) :	4.42	0.00	0.00
Surface Type :	Grass pasture	Unpaved	Unpaved
Velocity (ft/sec) :	1.47	0.00	0.00
Computed Flow Time (min) :	2.05	0.00	0.00

Channel Flow Computations	Subarea A	Subarea B	Subarea C
Manning's Roughness :	.025	0.00	0.00
Flow Length (ft) :	261	0.00	0.00
Channel Slope (%) :	.38	0.00	0.00
Cross Section Area (ft^2) :	.09	0.00	0.00
Wetted Perimeter (ft) :	6	0.00	0.00
Velocity (ft/sec) :	0.22	0.00	0.00
Computed Flow Time (min) :	19.47	0.00	0.00

Total TOC (min) 53.50

Subbasin Runoff Results

Total Rainfall (in) 2.46
Total Runoff (in) 1.55
Peak Runoff (cfs) 2.96
Weighted Curve Number 90.64
Time of Concentration (days hh:mm:ss) 0 00:53:30

Subbasin : F-2.5

Input Data

Area (ac) 3.60
Weighted Curve Number 88.40
Rain Gage ID .... Rain Gage-01

Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
Paved parking & roofs	2.27	C	98.00
Woods & grass combination, Good	1.33	C	72.00
Composite Area & Weighted CN	3.60		88.40

Time of Concentration

Sheet Flow Computations	Subarea A	Subarea B	Subarea C
Manning's Roughness :	.2	0.00	0.00
Flow Length (ft) :	62	0.00	0.00
Slope (%) :	8.06	0.00	0.00
2 yr, 24 hr Rainfall (in) :	1.50	0.00	0.00
Velocity (ft/sec) :	0.15	0.00	0.00
Computed Flow Time (min) :	7.04	0.00	0.00

Shallow Concentrated Flow Computations	Subarea A	Subarea B	Subarea C
Flow Length (ft) :	56	282	0.00
Slope (%) :	1.79	9.57	0.00
Surface Type :	Unpaved	Unpaved	Unpaved
Velocity (ft/sec) :	2.16	4.99	0.00
Computed Flow Time (min) :	0.43	0.94	0.00

Channel Flow Computations	Subarea A	Subarea B	Subarea C
Manning's Roughness :	.013	0.00	0.00
Flow Length (ft) :	223	0.00	0.00
Channel Slope (%) :	3.14	0.00	0.00
Cross Section Area (ft²) :	.04	0.00	0.00
Wetted Perimeter (ft) :	1.31	0.00	0.00
Velocity (ft/sec) :	1.98	0.00	0.00
Computed Flow Time (min) :	1.87	0.00	0.00

Total TOC (min) 10.28

Subbasin Runoff Results

Total Rainfall (in) 2.46
Total Runoff (in) 1.38
Peak Runoff (cfs) 3.24
Weighted Curve Number 88.40
Time of Concentration (days hh:mm:ss) 0 00:10:17

Subbasin : F-3.1

Input Data

Area (ac) 1.50
Weighted Curve Number 94.00
Rain Gage ID .... Rain Gage-01

Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
Commercial	1.50	-	94.00
Composite Area & Weighted CN	1.50		94.00

Time of Concentration

Sheet Flow Computations	Subarea A	Subarea B	Subarea C
Manning's Roughness :	.11	0.00	0.00
Flow Length (ft) :	69	0.00	0.00
Slope (%) :	1.45	0.00	0.00
2 yr, 24 hr Rainfall (in) :	1.50	0.00	0.00
Velocity (ft/sec) :	0.12	0.00	0.00
Computed Flow Time (min) :	9.44	0.00	0.00

Shallow Concentrated Flow Computations	Subarea A	Subarea B	Subarea C
Flow Length (ft) :	241	0.00	0.00
Slope (%) :	.41	0.00	0.00
Surface Type :	Paved	Unpaved	Unpaved
Velocity (ft/sec) :	1.30	0.00	0.00
Computed Flow Time (min) :	3.09	0.00	0.00

Channel Flow Computations	Subarea A	Subarea B	Subarea C
Manning's Roughness :	.019	0.00	0.00
Flow Length (ft) :	100	0.00	0.00
Channel Slope (%) :	1	0.00	0.00
Cross Section Area (ft²) :	.08	0.00	0.00
Wetted Perimeter (ft) :	4	0.00	0.00
Velocity (ft/sec) :	0.58	0.00	0.00
Computed Flow Time (min) :	2.88	0.00	0.00

Total TOC (min) 15.41

Subbasin Runoff Results

Total Rainfall (in) 2.46
Total Runoff (in) 1.83
Peak Runoff (cfs) 1.47
Weighted Curve Number 94.00
Time of Concentration (days hh:mm:ss) 0 00:15:25

Subbasin : F-3.2

Input Data

Area (ac) 2.39
Weighted Curve Number 95.61
Rain Gage ID .... Rain Gage-01

Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
Paved parking & roofs	2.13	C	98.00
Woods & grass combination, Fair	0.26	C	76.00
Composite Area & Weighted CN	2.39		95.61

Time of Concentration

Sheet Flow Computations	Subarea A	Subarea B	Subarea C
Manning's Roughness :	.01	0.00	0.00
Flow Length (ft) :	109	0.00	0.00
Slope (%) :	.92	0.00	0.00
2 yr, 24 hr Rainfall (in) :	1.50	0.00	0.00
Velocity (ft/sec) :	0.76	0.00	0.00
Computed Flow Time (min) :	2.40	0.00	0.00

Shallow Concentrated Flow Computations	Subarea A	Subarea B	Subarea C
Flow Length (ft) :	128	202	0.00
Slope (%) :	.78	.5	0.00
Surface Type :	Grass pasture	Paved	Unpaved
Velocity (ft/sec) :	0.62	1.44	0.00
Computed Flow Time (min) :	3.44	2.34	0.00

Total TOC (min) 8.18

Subbasin Runoff Results

Total Rainfall (in) 2.46
Total Runoff (in) 1.99
Peak Runoff (cfs) 3.16
Weighted Curve Number 95.61
Time of Concentration (days hh:mm:ss) 0 00:08:11

Subbasin : F-3.3

Input Data

Area (ac) 1.13
Weighted Curve Number 94.10
Rain Gage ID .... Rain Gage-01

Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
Paved parking & roofs	0.92	C	98.00
Brush, Poor	0.21	C	77.00
Composite Area & Weighted CN	1.13		94.10

Time of Concentration

Sheet Flow Computations	Subarea A	Subarea B	Subarea C
Manning's Roughness :	.4	0.00	0.00
Flow Length (ft) :	21	0.00	0.00
Slope (%) :	4.76	0.00	0.00
2 yr, 24 hr Rainfall (in) :	1.50	0.00	0.00
Velocity (ft/sec) :	0.06	0.00	0.00
Computed Flow Time (min) :	6.36	0.00	0.00

Channel Flow Computations	Subarea A	Subarea B	Subarea C
Manning's Roughness :	.025	0.00	0.00
Flow Length (ft) :	142	0.00	0.00
Channel Slope (%) :	.7	0.00	0.00
Cross Section Area (ft^2) :	.08	0.00	0.00
Wetted Perimeter (ft) :	4	0.00	0.00
Velocity (ft/sec) :	0.37	0.00	0.00
Computed Flow Time (min) :	6.44	0.00	0.00

Total TOC (min) 12.80

Subbasin Runoff Results

Total Rainfall (in) 2.46
Total Runoff (in) 1.84
Peak Runoff (cfs) 1.20
Weighted Curve Number 94.10
Time of Concentration (days hh:mm:ss) 0 00:12:48

Subbasin : F-3.4

Input Data

Area (ac) 2.24
Weighted Curve Number 90.00
Rain Gage ID .... Rain Gage-01

Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
1/8 acre lots, 65% impervious	2.24	C	90.00
Composite Area & Weighted CN	2.24		90.00

Time of Concentration

Sheet Flow Computations	Subarea A	Subarea B	Subarea C
Manning's Roughness :	.2	0.00	0.00
Flow Length (ft) :	104	0.00	0.00
Slope (%) :	.96	0.00	0.00
2 yr, 24 hr Rainfall (in) :	1.50	0.00	0.00
Velocity (ft/sec) :	0.07	0.00	0.00
Computed Flow Time (min) :	24.93	0.00	0.00

Shallow Concentrated Flow Computations	Subarea A	Subarea B	Subarea C
Flow Length (ft) :	77	0.00	0.00
Slope (%) :	1.3	0.00	0.00
Surface Type :	Paved	Unpaved	Unpaved
Velocity (ft/sec) :	2.32	0.00	0.00
Computed Flow Time (min) :	0.55	0.00	0.00

Channel Flow Computations	Subarea A	Subarea B	Subarea C
Manning's Roughness :	.019	0.00	0.00
Flow Length (ft) :	89	0.00	0.00
Channel Slope (%) :	1.12	0.00	0.00
Cross Section Area (ft²) :	.08	0.00	0.00
Wetted Perimeter (ft) :	4	0.00	0.00
Velocity (ft/sec) :	0.61	0.00	0.00
Computed Flow Time (min) :	2.43	0.00	0.00

Total TOC (min) 27.91

Subbasin Runoff Results

Total Rainfall (in) 2.46
Total Runoff (in) 1.50
Peak Runoff (cfs) 1.39
Weighted Curve Number 90.00
Time of Concentration (days hh:mm:ss) 0 00:27:55

Subbasin : F-3.5

Input Data

Area (ac) 1.32
Weighted Curve Number 94.66
Rain Gage ID .... Rain Gage-01

Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
Paved parking & roofs	1.11	C	98.00
Woods, Poor	0.21	C	77.00
Composite Area & Weighted CN	1.32		94.66

Time of Concentration

Sheet Flow Computations	Subarea A	Subarea B	Subarea C
Manning's Roughness :	.2	0.00	0.00
Flow Length (ft) :	29	0.00	0.00
Slope (%) :	3.45	0.00	0.00
2 yr, 24 hr Rainfall (in) :	1.50	0.00	0.00
Velocity (ft/sec) :	0.09	0.00	0.00
Computed Flow Time (min) :	5.38	0.00	0.00

Shallow Concentrated Flow Computations	Subarea A	Subarea B	Subarea C
Flow Length (ft) :	36	0.00	0.00
Slope (%) :	5.56	0.00	0.00
Surface Type :	Paved	Unpaved	Unpaved
Velocity (ft/sec) :	4.79	0.00	0.00
Computed Flow Time (min) :	0.13	0.00	0.00

Channel Flow Computations	Subarea A	Subarea B	Subarea C
Manning's Roughness :	.019	0.00	0.00
Flow Length (ft) :	371	0.00	0.00
Channel Slope (%) :	.27	0.00	0.00
Cross Section Area (ft²) :	.08	0.00	0.00
Wetted Perimeter (ft) :	4	0.00	0.00
Velocity (ft/sec) :	0.30	0.00	0.00
Computed Flow Time (min) :	20.59	0.00	0.00

Total TOC (min) 26.10

Subbasin Runoff Results

Total Rainfall (in) 2.46
Total Runoff (in) 1.89
Peak Runoff (cfs) 1.04
Weighted Curve Number 94.66
Time of Concentration (days hh:mm:ss) 0 00:26:06

Subbasin : F-3.6

Input Data

Area (ac) 5.06
Weighted Curve Number 92.57
Rain Gage ID .... Rain Gage-01

Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
Paved parking & roofs	3.81	C	98.00
Woods & grass combination, Fair	1.25	C	76.00
Composite Area & Weighted CN	5.06		92.57

Time of Concentration

Sheet Flow Computations	Subarea A	Subarea B	Subarea C
Manning's Roughness :	.35	0.00	0.00
Flow Length (ft) :	118	0.00	0.00
Slope (%) :	10.17	0.00	0.00
2 yr, 24 hr Rainfall (in) :	1.50	0.00	0.00
Velocity (ft/sec) :	0.12	0.00	0.00
Computed Flow Time (min) :	16.79	0.00	0.00

Shallow Concentrated Flow Computations	Subarea A	Subarea B	Subarea C
Flow Length (ft) :	85	0.00	0.00
Slope (%) :	17.65	0.00	0.00
Surface Type :	Grassed waterway	Unpaved	Unpaved
Velocity (ft/sec) :	6.30	0.00	0.00
Computed Flow Time (min) :	0.22	0.00	0.00

Channel Flow Computations	Subarea A	Subarea B	Subarea C
Manning's Roughness :	.013	.026	0.00
Flow Length (ft) :	271	263	0.00
Channel Slope (%) :	.74	2.66	0.00
Cross Section Area (ft²) :	.04	1.76	0.00
Wetted Perimeter (ft) :	1.31	4.71	0.00
Velocity (ft/sec) :	0.96	4.85	0.00
Computed Flow Time (min) :	4.69	0.90	0.00

Total TOC (min) 22.61

Subbasin Runoff Results

Total Rainfall (in) 2.46
Total Runoff (in) 1.71
Peak Runoff (cfs) 3.93
Weighted Curve Number 92.57
Time of Concentration (days hh:mm:ss) 0 00:22:37

Subbasin : F-3.7

Input Data

Area (ac) 3.85
Weighted Curve Number 78.63
Rain Gage ID .... Rain Gage-01

Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
Woods & grass combination, Fair	3.39	C	76.00
Paved parking & roofs	0.46	C	98.00
Composite Area & Weighted CN	3.85		78.63

Time of Concentration

Sheet Flow Computations	Subarea A	Subarea B	Subarea C
Manning's Roughness :	.4	0.00	0.00
Flow Length (ft) :	85	0.00	0.00
Slope (%) :	4.71	0.00	0.00
2 yr, 24 hr Rainfall (in) :	1.50	0.00	0.00
Velocity (ft/sec) :	0.07	0.00	0.00
Computed Flow Time (min) :	19.55	0.00	0.00

Shallow Concentrated Flow Computations	Subarea A	Subarea B	Subarea C
Flow Length (ft) :	394	104	0.00
Slope (%) :	1.02	.96	0.00
Surface Type :	Woodland	Unpaved	Unpaved
Velocity (ft/sec) :	0.50	1.58	0.00
Computed Flow Time (min) :	13.13	1.10	0.00

Total TOC (min) 33.78

Subbasin Runoff Results

Total Rainfall (in) 2.46
Total Runoff (in) 0.79
Peak Runoff (cfs) 1.08
Weighted Curve Number 78.63
Time of Concentration (days hh:mm:ss) 0 00:33:47

Subbasin : F-4.1

Input Data

Area (ac) 1.51
Weighted Curve Number 81.24
Rain Gage ID .... Rain Gage-01

Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
1/4 acre lots, 38% impervious	1.13	C	83.00
Woods & grass combination, Fair	0.38	C	76.00
Composite Area & Weighted CN	1.51		81.24

Time of Concentration

Sheet Flow Computations	Subarea A	Subarea B	Subarea C
Manning's Roughness :	.15	0.00	0.00
Flow Length (ft) :	55	0.00	0.00
Slope (%) :	1.82	0.00	0.00
2 yr, 24 hr Rainfall (in) :	1.50	0.00	0.00
Velocity (ft/sec) :	0.10	0.00	0.00
Computed Flow Time (min) :	9.21	0.00	0.00

Channel Flow Computations	Subarea A	Subarea B	Subarea C
Manning's Roughness :	.021	.025	0.00
Flow Length (ft) :	219	155	0.00
Channel Slope (%) :	.91	.65	0.00
Cross Section Area (ft²) :	.33	.08	0.00
Wetted Perimeter (ft) :	2.1	4	0.00
Velocity (ft/sec) :	1.97	0.35	0.00
Computed Flow Time (min) :	1.85	7.30	0.00

Total TOC (min) 18.36

Subbasin Runoff Results

Total Rainfall (in) 2.46
Total Runoff (in) 0.93
Peak Runoff (cfs) 0.69
Weighted Curve Number 81.24
Time of Concentration (days hh:mm:ss) 0 00:18:22

Subbasin : F-4.2

Input Data

Area (ac) 1.91
Weighted Curve Number 91.09
Rain Gage ID .... Rain Gage-01

Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
Paved parking & roofs	1.31	C	98.00
Woods & grass combination, Fair	0.60	C	76.00
Composite Area & Weighted CN	1.91		91.09

Time of Concentration

Sheet Flow Computations	Subarea A	Subarea B	Subarea C
Manning's Roughness :	.3	0.00	0.00
Flow Length (ft) :	46	0.00	0.00
Slope (%) :	8.7	0.00	0.00
2 yr, 24 hr Rainfall (in) :	1.50	0.00	0.00
Velocity (ft/sec) :	0.10	0.00	0.00
Computed Flow Time (min) :	7.44	0.00	0.00

Shallow Concentrated Flow Computations	Subarea A	Subarea B	Subarea C
Flow Length (ft) :	120	0.00	0.00
Slope (%) :	1.67	0.00	0.00
Surface Type :	Unpaved	Unpaved	Unpaved
Velocity (ft/sec) :	2.09	0.00	0.00
Computed Flow Time (min) :	0.96	0.00	0.00

Channel Flow Computations	Subarea A	Subarea B	Subarea C
Manning's Roughness :	.019	0.00	0.00
Flow Length (ft) :	281	0.00	0.00
Channel Slope (%) :	.71	0.00	0.00
Cross Section Area (ft²) :	.08	0.00	0.00
Wetted Perimeter (ft) :	4	0.00	0.00
Velocity (ft/sec) :	0.49	0.00	0.00
Computed Flow Time (min) :	9.62	0.00	0.00

Total TOC (min) 18.01

Subbasin Runoff Results

Total Rainfall (in) 2.46
Total Runoff (in) 1.58
Peak Runoff (cfs) 1.55
Weighted Curve Number 91.09
Time of Concentration (days hh:mm:ss) 0 00:18:01

Subbasin : F-4.3

Input Data

Area (ac) 3.27
Weighted Curve Number 92.86
Rain Gage ID .... Rain Gage-01

Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
Paved parking & roofs	0.97	C	98.00
1/8 acre lots, 65% impervious	1.90	C	90.00
Urban commercial, 85% imp	0.40	C	94.00
Composite Area & Weighted CN	3.27		92.86

Time of Concentration

Sheet Flow Computations	Subarea A	Subarea B	Subarea C
Manning's Roughness :	.35	0.00	0.00
Flow Length (ft) :	33	0.00	0.00
Slope (%) :	9.1	0.00	0.00
2 yr, 24 hr Rainfall (in) :	1.50	0.00	0.00
Velocity (ft/sec) :	0.09	0.00	0.00
Computed Flow Time (min) :	6.33	0.00	0.00

Channel Flow Computations	Subarea A	Subarea B	Subarea C
Manning's Roughness :	.019	0.00	0.00
Flow Length (ft) :	427	0.00	0.00
Channel Slope (%) :	.7	0.00	0.00
Cross Section Area (ft²) :	.08	0.00	0.00
Wetted Perimeter (ft) :	4	0.00	0.00
Velocity (ft/sec) :	0.48	0.00	0.00
Computed Flow Time (min) :	14.72	0.00	0.00

Total TOC (min) 21.05

Subbasin Runoff Results

Total Rainfall (in) 2.46
Total Runoff (in) 1.73
Peak Runoff (cfs) 2.66
Weighted Curve Number 92.86
Time of Concentration (days hh:mm:ss) 0 00:21:03

Subbasin : F-4.4

Input Data

Area (ac) 7.13
Weighted Curve Number 88.31
Rain Gage ID .... Rain Gage-01

Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
Paved parking & roofs	0.23	C	98.00
Gravel roads	3.90	C	89.00
1/4 acre lots, 38% impervious	2.00	C	83.00
Urban commercial, 85% imp	1.00	C	94.00
Composite Area & Weighted CN	7.13		88.31

Time of Concentration

Sheet Flow Computations	Subarea A	Subarea B	Subarea C
Manning's Roughness :	.35	0.00	0.00
Flow Length (ft) :	15	0.00	0.00
Slope (%) :	20	0.00	0.00
2 yr, 24 hr Rainfall (in) :	1.50	0.00	0.00
Velocity (ft/sec) :	0.10	0.00	0.00
Computed Flow Time (min) :	2.46	0.00	0.00

Shallow Concentrated Flow Computations	Subarea A	Subarea B	Subarea C
Flow Length (ft) :	60	245	0.00
Slope (%) :	3.33	.41	0.00
Surface Type :	Unpaved	Unpaved	Unpaved
Velocity (ft/sec) :	2.94	1.03	0.00
Computed Flow Time (min) :	0.34	3.96	0.00

Channel Flow Computations	Subarea A	Subarea B	Subarea C
Manning's Roughness :	.016	0.00	0.00
Flow Length (ft) :	216	0.00	0.00
Channel Slope (%) :	.46	0.00	0.00
Cross Section Area (ft²) :	.6	0.00	0.00
Wetted Perimeter (ft) :	4.04	0.00	0.00
Velocity (ft/sec) :	1.77	0.00	0.00
Computed Flow Time (min) :	2.03	0.00	0.00

Total TOC (min) 8.80

Subbasin Runoff Results

Total Rainfall (in) 2.46
Total Runoff (in) 1.37
Peak Runoff (cfs) 6.73
Weighted Curve Number 88.31
Time of Concentration (days hh:mm:ss) 0 00:08:48

Subbasin : F-4.5

Input Data

Area (ac) 0.47
Weighted Curve Number 94.55
Rain Gage ID .... Rain Gage-01

Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
Paved parking & roofs	0.14	C	98.00
Urban commercial, 85% imp	0.27	C	94.00
Gravel roads	0.06	C	89.00
Composite Area & Weighted CN	0.47		94.55

Time of Concentration

Sheet Flow Computations	Subarea A	Subarea B	Subarea C
Manning's Roughness :	.11	0.00	0.00
Flow Length (ft) :	58	0.00	0.00
Slope (%) :	1.72	0.00	0.00
2 yr, 24 hr Rainfall (in) :	1.50	0.00	0.00
Velocity (ft/sec) :	0.13	0.00	0.00
Computed Flow Time (min) :	7.67	0.00	0.00

Channel Flow Computations	Subarea A	Subarea B	Subarea C
Manning's Roughness :	.025	0.00	0.00
Flow Length (ft) :	191	0.00	0.00
Channel Slope (%) :	.52	0.00	0.00
Cross Section Area (ft²) :	.6	0.00	0.00
Wetted Perimeter (ft) :	4.04	0.00	0.00
Velocity (ft/sec) :	1.21	0.00	0.00
Computed Flow Time (min) :	2.64	0.00	0.00

Total TOC (min) 10.31

Subbasin Runoff Results

Total Rainfall (in) 2.46
Total Runoff (in) 1.88
Peak Runoff (cfs) 0.56
Weighted Curve Number 94.55
Time of Concentration (days hh:mm:ss) 0 00:10:19

Subbasin : L-1.1

Input Data

Area (ac) 0.88
Weighted Curve Number 96.36
Rain Gage ID .... Rain Gage-01

Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
Paved parking & roofs	0.82	C	98.00
> 75% grass cover, Good	0.06	C	74.00
Composite Area & Weighted CN	0.88		96.36

Time of Concentration

User-Defined TOC override (minutes): 5

Subbasin Runoff Results

Total Rainfall (in) 2.46
Total Runoff (in) 2.06
Peak Runoff (cfs) 1.32
Weighted Curve Number 96.36
Time of Concentration (days hh:mm:ss) 0 00:05:00

Subbasin : L-1.2

Input Data

Area (ac) 2.73
Weighted Curve Number 96.33
Rain Gage ID .... Rain Gage-01

Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
Paved parking & roofs	2.49	C	98.00
50 - 75% grass cover, Fair	0.24	C	79.00
Composite Area & Weighted CN	2.73		96.33

Time of Concentration

User-Defined TOC override (minutes): 5

Subbasin Runoff Results

Total Rainfall (in) 2.46
Total Runoff (in) 2.06
Peak Runoff (cfs) 4.10
Weighted Curve Number 96.33
Time of Concentration (days hh:mm:ss) 0 00:05:00

Subbasin : L-2.1

Input Data

Area (ac) 2.75
Weighted Curve Number 94.00
Rain Gage ID .... Rain Gage-01

Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
Urban commercial, 85% imp	2.75	C	94.00
Composite Area & Weighted CN	2.75		94.00

Time of Concentration

User-Defined TOC override (minutes): 5

Subbasin Runoff Results

Total Rainfall (in) 2.46
Total Runoff (in) 1.83
Peak Runoff (cfs) 3.82
Weighted Curve Number 94.00
Time of Concentration (days hh:mm:ss) 0 00:05:00

Subbasin : L-2.2

Input Data

Area (ac) 2.31
Weighted Curve Number 96.91
Rain Gage ID .... Rain Gage-01

Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
Paved parking & roofs	2.10	C	98.00
< 50% grass cover, Poor	0.21	C	86.00
Composite Area & Weighted CN	2.31		96.91

Time of Concentration

User-Defined TOC override (minutes): 5

Subbasin Runoff Results

Total Rainfall (in) 2.46
Total Runoff (in) 2.12
Peak Runoff (cfs) 3.52
Weighted Curve Number 96.91
Time of Concentration (days hh:mm:ss) 0 00:05:00

Subbasin : L-2.3

Input Data

Area (ac) 3.09
Weighted Curve Number 97.34
Rain Gage ID .... Rain Gage-01

Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
Paved parking & roofs	2.92	C	98.00
< 50% grass cover, Poor	0.17	C	86.00
Composite Area & Weighted CN	3.09		97.34

Time of Concentration

Sheet Flow Computations	Subarea A	Subarea B	Subarea C
Manning's Roughness :	.35	0.00	0.00
Flow Length (ft) :	39	0.00	0.00
Slope (%) :	2.56	0.00	0.00
2 yr, 24 hr Rainfall (in) :	1.50	0.00	0.00
Velocity (ft/sec) :	0.05	0.00	0.00
Computed Flow Time (min) :	12.02	0.00	0.00

Shallow Concentrated Flow Computations	Subarea A	Subarea B	Subarea C
Flow Length (ft) :	55	194	0.00
Slope (%) :	1.82	0.52	0.00
Surface Type :	Paved	Paved	Unpaved
Velocity (ft/sec) :	2.74	1.47	0.00
Computed Flow Time (min) :	0.33	2.20	0.00

Total TOC (min) 14.56

Subbasin Runoff Results

Total Rainfall (in) 2.46
Total Runoff (in) 2.16
Peak Runoff (cfs) 3.45
Weighted Curve Number 97.34
Time of Concentration (days hh:mm:ss) 0 00:14:34

Subbasin : L-2.4

Input Data

Area (ac) 3.74
Weighted Curve Number 96.40
Rain Gage ID .... Rain Gage-01

Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
Paved parking & roofs	3.24	C	98.00
< 50% grass cover, Poor	0.50	C	86.00
Composite Area & Weighted CN	3.74		96.40

Time of Concentration

Sheet Flow Computations	Subarea A	Subarea B	Subarea C
Manning's Roughness :	.01	0.00	0.00
Flow Length (ft) :	76	0.00	0.00
Slope (%) :	1.32	0.00	0.00
2 yr, 24 hr Rainfall (in) :	1.50	0.00	0.00
Velocity (ft/sec) :	0.81	0.00	0.00
Computed Flow Time (min) :	1.55	0.00	0.00

Shallow Concentrated Flow Computations	Subarea A	Subarea B	Subarea C
Flow Length (ft) :	87	162	0.00
Slope (%) :	1.15	1.85	0.00
Surface Type :	Paved	Paved	Unpaved
Velocity (ft/sec) :	2.18	2.76	0.00
Computed Flow Time (min) :	0.67	0.98	0.00

Channel Flow Computations	Subarea A	Subarea B	Subarea C
Manning's Roughness :	.013	0.00	0.00
Flow Length (ft) :	197	0.00	0.00
Channel Slope (%) :	0.51	0.00	0.00
Cross Section Area (ft²) :	.04	0.00	0.00
Wetted Perimeter (ft) :	1.31	0.00	0.00
Velocity (ft/sec) :	0.80	0.00	0.00
Computed Flow Time (min) :	4.11	0.00	0.00

Total TOC (min) 7.30

Subbasin Runoff Results

Total Rainfall (in) 2.46
Total Runoff (in) 2.06
Peak Runoff (cfs) 5.22
Weighted Curve Number 96.40
Time of Concentration (days hh:mm:ss) 0 00:07:18

Subbasin : L-2.5

Input Data

Area (ac) 3.92
Weighted Curve Number 95.98
Rain Gage ID .... Rain Gage-01

Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
Paved parking & roofs	3.49	C	98.00
Woods, Fair	0.22	C	73.00
< 50% grass cover, Poor	0.20	C	86.00
Composite Area & Weighted CN	3.91		95.98

Time of Concentration

Sheet Flow Computations	Subarea A	Subarea B	Subarea C
Manning's Roughness :	.8	0.00	0.00
Flow Length (ft) :	70	0.00	0.00
Slope (%) :	2.86	0.00	0.00
2 yr, 24 hr Rainfall (in) :	1.50	0.00	0.00
Velocity (ft/sec) :	0.03	0.00	0.00
Computed Flow Time (min) :	35.58	0.00	0.00

Shallow Concentrated Flow Computations	Subarea A	Subarea B	Subarea C
Flow Length (ft) :	87	0.00	0.00
Slope (%) :	2.3	0.00	0.00
Surface Type :	Bare & untilled	Unpaved	Unpaved
Velocity (ft/sec) :	1.52	0.00	0.00
Computed Flow Time (min) :	0.95	0.00	0.00

Channel Flow Computations	Subarea A	Subarea B	Subarea C
Manning's Roughness :	.013	.013	0.00
Flow Length (ft) :	101	243	0.00
Channel Slope (%) :	0.99	.82	0.00
Cross Section Area (ft^2) :	.4	.04	0.00
Wetted Perimeter (ft) :	2.92	1.31	0.00
Velocity (ft/sec) :	3.03	1.01	0.00
Computed Flow Time (min) :	0.56	3.99	0.00

Total TOC (min) 41.08

Subbasin Runoff Results

Total Rainfall (in) 2.46
Total Runoff (in) 2.02
Peak Runoff (cfs) 2.54
Weighted Curve Number 95.98
Time of Concentration (days hh:mm:ss) 0 00:41:05

Subbasin : L-2.6

Input Data

Area (ac) 6.98
Weighted Curve Number 93.21
Rain Gage ID .... Rain Gage-01

Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
Paved parking & roofs	5.58	C	98.00
Woods, Fair	0.87	C	73.00
Woods & grass combination, Fair	0.53	C	76.00
Composite Area & Weighted CN	6.98		93.21

Time of Concentration

Sheet Flow Computations	Subarea A	Subarea B	Subarea C
Manning's Roughness :	.3	0.00	0.00
Flow Length (ft) :	79	0.00	0.00
Slope (%) :	15.19	0.00	0.00
2 yr, 24 hr Rainfall (in) :	1.50	0.00	0.00
Velocity (ft/sec) :	0.14	0.00	0.00
Computed Flow Time (min) :	9.17	0.00	0.00

Shallow Concentrated Flow Computations	Subarea A	Subarea B	Subarea C
Flow Length (ft) :	131	42	0.00
Slope (%) :	12.21	2.38	0.00
Surface Type :	Unpaved	Paved	Unpaved
Velocity (ft/sec) :	5.64	3.14	0.00
Computed Flow Time (min) :	0.39	0.22	0.00

Channel Flow Computations	Subarea A	Subarea B	Subarea C
Manning's Roughness :	.013	.013	0.00
Flow Length (ft) :	154	253	0.00
Channel Slope (%) :	7.14	.79	0.00
Cross Section Area (ft^2) :	.4	.4	0.00
Wetted Perimeter (ft) :	2.92	2.92	0.00
Velocity (ft/sec) :	8.14	2.71	0.00
Computed Flow Time (min) :	0.32	1.56	0.00

Total TOC (min) 11.65

Subbasin Runoff Results

Total Rainfall (in) 2.46
Total Runoff (in) 1.76
Peak Runoff (cfs) 7.46
Weighted Curve Number 93.21
Time of Concentration (days hh:mm:ss) 0 00:11:39

Subbasin : W-1.1

Input Data

Area (ac) 0.51
Weighted Curve Number 85.29
Rain Gage ID .... Rain Gage-01

Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
> 75% grass cover, Good	0.27	C	74.00
Paved parking & roofs	0.24	C	98.00
Composite Area & Weighted CN	0.51		85.29

Time of Concentration

User-Defined TOC override (minutes): 5

Subbasin Runoff Results

Total Rainfall (in) 2.46
Total Runoff (in) 1.17
Peak Runoff (cfs) 0.47
Weighted Curve Number 85.29
Time of Concentration (days hh:mm:ss) 0 00:05:00

Subbasin : W-1.2

Input Data

Area (ac) 0.84
Weighted Curve Number 94.00
Rain Gage ID .... Rain Gage-01

Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
Urban commercial, 85% imp	0.84	C	94.00
Composite Area & Weighted CN	0.84		94.00

Time of Concentration

User-Defined TOC override (minutes): 5

Subbasin Runoff Results

Total Rainfall (in) 2.46
Total Runoff (in) 1.83
Peak Runoff (cfs) 1.17
Weighted Curve Number 94.00
Time of Concentration (days hh:mm:ss) 0 00:05:00

Channel Input

SN	Element ID	Length (ft)	Inlet Invert Elevation (ft)	Inlet Invert Offset (ft)	Outlet Invert Elevation (ft)	Outlet Invert Offset (ft)	Total Drop (ft)	Average Slope (%)	Shape	Height (ft)	Width (ft)	Manning's Roughness	Entrance Losses	Exit/Bend Losses	Additional Losses	Initial Flow (cfs)	Flap Gate
1	W-P-2	250.93	130.68	0.00	130.40	0.00	0.28	0.1100	Trapezoidal	1.450	10.090	0.0800	0.5000	0.5000	0.0000	0.00	No
2	W-P-4	172.24	131.66	0.00	131.11	0.00	0.55	0.3200	Trapezoidal	2.400	12.440	0.0800	0.5000	0.5000	0.0000	0.00	No

Channel Results

SN	Element ID	Peak Flow (cfs)	Time of Peak Flow Occurrence (days hh:mm)	Design Flow Capacity (cfs)	Peak Flow/ Design Flow Ratio	Peak Flow Velocity (ft/sec)	Travel Time (min)	Peak Flow Depth (ft)	Peak Flow Depth/ Total Depth Ratio	Total Time Surcharged (min)	Froude Number	Reported Condition
1	W-P-2	8.14	0 10:45	8.14	1.00	0.66	6.34	1.45	1.00	0.00		
2	W-P-4	10.70	0 11:45	28.31	0.38	1.06	2.71	1.44	0.60	0.00		

Pipe Input

SN	Element ID	Length (ft)	Inlet Invert Elevation (ft)	Inlet Invert Offset (ft)	Outlet Invert Elevation (ft)	Outlet Invert Offset (ft)	Total Drop (ft)	Average Slope (%)	Pipe Shape	Pipe Diameter or Height (in)	Pipe Width (in)	Manning's Roughness	Entrance Losses	Exit/Bend Losses	Additional Losses	Initial Flow (cfs)	Flap Gate	No. of Barrels
1	C-P-1	270.68	150.16	0.68	149.35	0.00	0.81	0.3000	CIRCULAR	18.000	18.000	0.0130	0.5000	0.5000	0.0000	0.00	No	1
2	C-P-2	72.75	150.71	0.50	150.24	0.76	0.47	0.6500	CIRCULAR	12.000	12.000	0.0130	0.5000	0.5000	0.0000	0.00	No	1
3	C-P-3	61.36	150.29	0.50	149.98	0.50	0.31	0.5100	CIRCULAR	18.000	18.000	0.0130	0.5000	0.5000	0.0000	0.00	No	1
4	C-P-4	60.42	150.77	1.26	150.31	0.83	0.46	0.7600	CIRCULAR	12.000	12.000	0.0130	0.5000	0.5000	0.0000	0.00	No	1
5	C-P-5	333.41	147.35	0.60	145.68	0.00	1.67	0.5000	CIRCULAR	36.000	36.000	0.0140	0.5000	0.5000	0.0000	0.00	No	1
6	C-P-6	400.00	149.60	0.58	148.37	1.62	1.23	0.3100	CIRCULAR	18.000	18.000	0.0250	0.5000	0.5000	0.0000	0.00	No	1
7	C-P-7	75.80	152.30	0.50	149.30	2.55	3.00	3.9600	CIRCULAR	9.960	9.960	0.0250	0.5000	0.5000	0.0000	0.00	No	1
8	C-P-8	32.50	148.40	0.50	148.26	1.51	0.14	0.4300	CIRCULAR	18.000	18.000	0.0250	0.5000	0.5000	0.0000	0.00	No	1
9	C-P-9	762.80	150.93	0.50	148.50	0.60	2.43	0.3200	CIRCULAR	18.000	18.000	0.0250	0.5000	0.5000	0.0000	0.00	No	1
10	F-P-1	34.00	131.93	0.84	131.66	0.00	0.27	0.7900	CIRCULAR	36.000	36.000	0.0260	0.5000	0.5000	0.0000	0.00	No	1
11	F-P-10	43.00	147.40	0.00	146.92	0.50	0.48	1.1200	CIRCULAR	9.960	9.960	0.0250	0.5000	0.5000	0.0000	0.00	No	1
12	F-P-11	38.00	147.29	0.50	146.92	0.50	0.37	0.9700	CIRCULAR	9.960	9.960	0.0250	0.5000	0.5000	0.0000	0.00	No	1
13	F-P-13	68.00	149.27	0.50	148.93	0.53	0.34	0.5000	CIRCULAR	9.960	9.960	0.0250	0.5000	0.5000	0.0000	0.00	No	1
14	F-P-14	42.00	149.14	0.50	148.97	0.57	0.17	0.4000	CIRCULAR	9.960	9.960	0.0250	0.5000	0.5000	0.0000	0.00	No	1
15	F-P-15	12.66	150.85	0.50	148.90	0.50	1.95	15.4000	CIRCULAR	12.000	12.000	0.0250	0.5000	0.5000	0.0000	0.00	No	1
16	F-P-2	208.00	131.95	0.50	131.76	0.67	0.19	0.0900	CIRCULAR	30.000	30.000	0.0250	0.5000	0.5000	0.0000	0.00	No	1
17	F-P-3	42.00	133.15	0.50	132.12	0.67	1.03	2.4500	CIRCULAR	12.000	12.000	0.0250	0.5000	0.5000	0.0000	0.00	No	1
18	F-P-4	482.00	137.19	0.50	132.07	0.62	5.12	1.0600	CIRCULAR	30.000	30.000	0.0250	0.5000	0.5000	0.0000	0.00	No	1
19	F-P-5	21.00	138.30	0.50	138.24	1.55	0.06	0.3000	CIRCULAR	18.000	18.000	0.0250	0.5000	0.5000	0.0000	0.00	No	1
20	F-P-6	168.00	146.93	0.87	142.95	5.15	3.98	2.3700	CIRCULAR	12.000	12.000	0.0250	0.5000	0.5000	0.0000	0.00	No	1
21	F-P-7	65.00	137.47	0.00	137.27	0.58	0.19	0.3000	CIRCULAR	30.000	30.000	0.0250	0.5000	0.5000	0.0000	0.00	No	1
22	F-P-8	229.00	147.03	0.61	145.35	0.50	1.68	0.7300	CIRCULAR	18.000	18.000	0.0250	0.5000	0.5000	0.0000	0.00	No	1
23	F-P-9	42.00	148.54	0.50	147.43	1.01	1.11	2.6400	CIRCULAR	9.960	9.960	0.0250	0.5000	0.5000	0.0000	0.00	No	1
24	L-P-1	50.50	133.01	0.50	132.33	1.24	0.68	1.3500	CIRCULAR	18.000	18.000	0.0250	0.5000	0.5000	0.0000	0.00	No	1
25	L-P-10	38.50	134.65	0.50	133.92	0.74	0.73	1.9000	CIRCULAR	18.000	18.000	0.0130	0.5000	0.5000	0.0000	0.00	No	1
26	L-P-11	297.00	134.19	0.50	133.73	0.55	0.46	0.1500	Horizontal Ellipse	18.000	29.040	0.0250	0.5000	0.5000	0.0000	0.00	No	1
27	L-P-12	297.00	135.74	0.50	134.24	0.55	1.50	0.5100	CIRCULAR	18.000	18.000	0.0250	0.5000	0.5000	0.0000	0.00	No	1
28	L-P-2	15.00	133.08	0.50	133.08	0.57	0.00	0.0000	CIRCULAR	12.000	12.000	0.0130	0.5000	0.5000	0.0000	0.00	No	1
29	L-P-3	16.00	133.30	0.49	133.30	0.72	0.00	0.0000	CIRCULAR	12.000	12.000	0.0130	0.5000	0.5000	0.0000	0.00	No	1
30	L-P-4	17.00	133.77	0.50	133.56	0.75	0.21	1.2400	CIRCULAR	18.000	18.000	0.0130	0.5000	0.5000	0.0000	0.00	No	1
31	L-P-5	16.40	136.37	0.49	134.97	2.16	1.40	8.5400	CIRCULAR	12.000	12.000	0.0130	0.5000	0.5000	0.0000	0.00	No	1
32	L-P-6	224.00	131.84	0.50	131.59	0.50	0.25	0.1100	Horizontal Ellipse	18.000	29.040	0.0250	0.5000	0.5000	0.0000	0.00	No	1
33	L-P-7	160.00	132.64	0.50	132.21	0.87	0.43	0.2700	Horizontal Ellipse	18.000	29.040	0.0250	0.5000	0.5000	0.0000	0.00	No	1
34	L-P-8	60.00	132.81	0.50	132.64	0.50	0.17	0.2800	Horizontal Ellipse	18.000	29.040	0.0250	0.5000	0.5000	0.0000	0.00	No	1
35	L-P-9	284.00	133.68	0.50	132.86	0.55	0.82	0.2900	Horizontal Ellipse	18.000	29.040	0.0250	0.5000	0.5000	0.0000	0.00	No	1
36	M-P-1	54.00	132.50	1.28	132.00	0.34	0.50	0.9300	CIRCULAR	12.000	12.000	0.0130	0.5000	0.5000	0.0000	0.00	No	1
37	M-P-2	50.00	132.75	0.00	132.60	1.38	0.15	0.3000	CIRCULAR	12.000	12.000	0.0130	0.5000	0.5000	0.0000	0.00	No	1
38	T-P-1	315.00	138.41	0.50	137.47	0.00	0.94	0.3000	CIRCULAR	30.000	30.000	0.0250	0.5000	0.5000	0.0000	0.00	No	1
39	T-P-10	225.00	143.50	0.50	142.22	0.70	1.28	0.5700	CIRCULAR	18.000	18.000	0.0250	0.5000	0.5000	0.0000	0.00	No	1
40	T-P-11	113.00	144.14	0.50	143.50	0.50	0.64	0.5700	CIRCULAR	18.000	18.000	0.0250	0.5000	0.5000	0.0000	0.00	No	1
41	T-P-12	130.00	145.37	0.52	144.47	0.83	0.90	0.6900	CIRCULAR	18.000	18.000	0.0250	0.5000	0.5000	0.0000	0.00	No	1
42	T-P-13	20.00	146.70	0.50	146.60	1.75	0.10	0.5000	CIRCULAR	9.960	9.960	0.0250	0.5000	0.5000	0.0000	0.00	No	1
43	T-P-14	354.00	147.71	0.50	145.94	1.09	1.77	0.5000	CIRCULAR	12.000	12.000	0.0250	0.5000	0.5000	0.0000	0.00	No	1
44	T-P-15	324.00	147.44	0.50	145.82	2.76	1.62	0.5000	CIRCULAR	18.000	18.000	0.0250	0.5000	0.5000	0.0000	0.00	No	1
45	T-P-16	403.00	148.96	0.56	147.54	0.60	1.42	0.3500	CIRCULAR	12.000	12.000	0.0250	0.5000	0.5000	0.0000	0.00	No	1
46	T-P-17	630.84	152.88	0.50	145.55	2.49	7.33	1.1600	CIRCULAR	18.000	18.000	0.0250	0.5000	0.5000	0.0000	0.00	No	1
47	T-P-2	50.00	138.60	0.50	138.45	0.54	0.15	0.3000	CIRCULAR	18.000	18.000	0.0250	0.5000	0.5000	0.0000	0.00	No	1
48	T-P-3	337.33	139.46	0.50	138.45	0.54	1.01	0.3000	CIRCULAR	30.000	30.000	0.0250	0.5000	0.5000	0.0000	0.00	No	1
49	T-P-4	586.23	151.45	0.50	141.63	2.67	9.82	1.6800	CIRCULAR	18.000	18.000	0.0250	0.5000	0.5000	0.0000	0.00	No	1
50	T-P-5	71.90	139.84	0.50	139.60	0.64	0.24	0.3300	CIRCULAR	30.000	30.000	0.0250	0.5000	0.5000	0.0000	0.00	No	1
51	T-P-6	544.84	141.97	0.50	139.89	0.55	2.08	0.3800	CIRCULAR	30.000	30.000	0.0250	0.5000	0.5000	0.0000	0.00	No	1
52	T-P-7	48.50	142.22	0.70	142.02	0.55	0.20	0.4100	CIRCULAR	24.000	24.000	0.0250	0.5000	0.5000	0.0000	0.00	No	1
53	T-P-8	276.60	143.51	0.50	142.21	0.69	1.30	0.4700	CIRCULAR	24.000	24.000	0.0250	0.5000	0.5000	0.0000	0.00	No	1
54	T-P-9	380.00	145.58	2.52	143.56	0.55	2.02	0.5300	CIRCULAR	18.000	18.000	0.0250	0.5000	0.5000	0.0000	0.00	No	1
55	W-P-1	43.36	130.40	0.00	130.37	0.00	0.03	0.0700	CIRCULAR	36.000	36.000	0.0240	0.5000	0.5000	0.0000	0.00	No	1
56	W-P-3	38.88	131.11	0.00	130.68	0.00	0.43	1.1100	CIRCULAR	36.000	36.000	0.0240	0.5000	0.5000	0.0000	0.00	No	1

Pipe Results

SN	Element ID	Peak Flow (cfs)	Time of Peak Flow Occurrence (days hh:mm)	Design Flow Capacity (cfs)	Peak Flow/ Design Flow Ratio	Peak Flow Velocity (ft/sec)	Travel Time (min)	Peak Flow Depth (ft)	Peak Flow Depth/ Total Depth Ratio	Total Time Surcharged (min)	Froude Number	Reported Condition
1	C-P-1	3.61	0 12:21	5.75	0.63	3.44	1.31	0.86	0.58	0.00		Calculated
2	C-P-2	1.09	0 12:15	2.86	0.38	3.42	0.35	0.43	0.43	0.00		Calculated
3	C-P-3	2.47	0 12:30	7.47	0.33	3.79	0.27	0.59	0.40	0.00		Calculated
4	C-P-4	0.76	0 12:20	3.11	0.24	3.27	0.31	0.34	0.34	0.00		Calculated
5	C-P-5	7.48	0 12:22	43.83	0.17	4.63	1.20	0.83	0.28	0.00		Calculated
6	C-P-6	2.66	0 12:26	3.03	0.88	1.98	3.37	1.09	0.72	0.00		Calculated
7	C-P-7	0.31	0 12:25	2.27	0.14	2.91	0.43	0.21	0.25	0.00		Calculated
8	C-P-8	3.77	0 12:38	3.59	1.05	2.35	0.23	1.50	1.00	38.00		SURCHARGED
9	C-P-9	3.32	0 12:30	3.08	1.08	2.20	5.78	1.50	1.00	26.00		SURCHARGED
10	F-P-1	10.50	0 13:39	29.72	0.35	3.84	0.15	1.23	0.41	0.00		Calculated
11	F-P-10	1.27	0 12:48	1.20	1.06	2.56	0.28	0.83	1.00	46.00		SURCHARGED
12	F-P-11	1.07	0 12:30	1.12	0.95	2.35	0.27	0.65	0.78	0.00		Calculated
13	F-P-13	0.86	0 12:47	0.81	1.07	1.73	0.66	0.83	1.00	43.00		SURCHARGED
14	F-P-14	0.68	0 12:20	0.72	0.94	1.52	0.46	0.64	0.77	0.00		Calculated
15	F-P-15	1.52	0 12:20	7.27	0.21	7.31	0.03	0.31	0.31	0.00		Calculated
16	F-P-2	6.97	0 11:15	6.45	1.08	1.55	2.24	2.50	1.00	247.00		SURCHARGED
17	F-P-3	2.27	0 12:20	2.90	0.78	4.09	0.17	0.67	0.67	0.00		Calculated
18	F-P-4	17.26	0 12:16	21.98	0.79	4.98	1.61	1.66	0.67	0.00		Calculated
19	F-P-5	2.55	0 12:11	2.99	0.85	1.90	0.18	1.03	0.71	0.00		Calculated
20	F-P-6	2.54	0 12:11	2.85	0.89	4.12	0.68	0.73	0.74	0.00		Calculated
21	F-P-7	12.56	0 12:36	11.68	1.07	2.76	0.39	2.50	1.00	31.00		SURCHARGED
22	F-P-8	3.25	0 12:26	4.68	0.69	2.86	1.33	0.92	0.61	0.00		Calculated
23	F-P-9	1.02	0 12:25	1.85	0.55	3.48	0.20	0.44	0.53	0.00		Calculated
24	L-P-1	0.30	0 16:39	6.34	0.05	1.87	0.45	0.22	0.15	0.00		Calculated
25	L-P-10	4.45	0 12:15	14.46	0.31	7.20	0.09	0.57	0.38	0.00		Calculated
26	L-P-11	4.19	0 12:26	3.98	1.05	1.75	2.83	1.26	0.85	0.00		> CAPACITY
27	L-P-12	4.18	0 12:25	3.88	1.08	2.70	1.83	1.50	1.00	15.00		SURCHARGED
28	L-P-2	0.31	0 16:09	0.29	1.05	0.44	0.57	0.92	0.92	0.00		> CAPACITY
29	L-P-3	0.30	0 16:08	0.28	1.07	0.42	0.63	1.00	1.00	428.00		SURCHARGED
30	L-P-4	3.86	0 12:10	11.67	0.33	5.92	0.05	0.59	0.40	0.00		Calculated
31	L-P-5	1.24	0 12:10	10.41	0.12	8.90	0.03	0.23	0.23	0.00		Calculated
32	L-P-6	3.77	0 11:43	3.37	1.12	1.48	2.52	1.50	1.00	112.00		SURCHARGED
33	L-P-7	5.85	0 12:01	5.24	1.12	2.27	1.17	1.50	1.00	47.00		SURCHARGED
34	L-P-8	6.01	0 12:03	5.38	1.12	2.32	0.43	1.50	1.00	40.00		SURCHARGED
35	L-P-9	6.05	0 12:07	5.43	1.11	2.39	1.98	1.50	1.00	30.00		SURCHARGED
36	M-P-1	0.18	0 12:36	3.43	0.05	2.31	0.39	0.16	0.16	0.00		Calculated
37	M-P-2	0.18	0 12:36	1.95	0.09	1.55	0.54	0.20	0.20	0.00		Calculated
38	T-P-1	12.62	0 12:12	11.68	1.08	2.79	1.88	2.50	1.00	38.00		SURCHARGED
39	T-P-10	4.45	0 12:48	4.12	1.08	2.75	1.36	1.50	1.00	42.00		SURCHARGED
40	T-P-11	4.38	0 12:06	4.11	1.07	2.72	0.69	1.50	1.00	35.00		SURCHARGED
41	T-P-12	4.88	0 12:22	4.54	1.07	3.00	0.72	1.50	1.00	10.00		SURCHARGED
42	T-P-13	0.85	0 12:21	0.81	1.06	1.71	0.19	0.83	1.00	11.00		SURCHARGED
43	T-P-14	1.42	0 12:28	1.31	1.08	1.99	2.96	0.91	0.92	0.00		> CAPACITY
44	T-P-15	4.17	0 12:25	3.86	1.08	2.64	2.05	1.50	1.00	18.00		SURCHARGED
45	T-P-16	1.19	0 12:00	1.10	1.08	1.67	4.02	1.00	1.00	58.00		SURCHARGED
46	T-P-17	3.07	0 12:16	5.89	0.52	3.52	2.99	0.76	0.51	0.00		Calculated
47	T-P-2	2.42	0 12:15	2.99	0.81	1.90	0.44	1.02	0.68	0.00		Calculated
48	T-P-3	12.62	0 12:17	11.67	1.08	2.81	2.00	2.50	1.00	17.00		SURCHARGED
49	T-P-4	2.90	0 12:21	7.07	0.41	3.84	2.54	0.67	0.45	0.00		Calculated
50	T-P-5	11.58	0 12:20	12.32	0.94	2.85	0.42	1.93	0.77	0.00		Calculated
51	T-P-6	7.77	0 12:58	13.18	0.59	2.82	3.22	1.37	0.55	0.00		Calculated
52	T-P-7	8.10	0 12:56	7.55	1.07	2.78	0.29	2.00	1.00	57.00		SURCHARGED
53	T-P-8	4.28	0 12:01	8.06	0.53	2.67	1.73	1.02	0.51	0.00		Calculated
54	T-P-9	4.30	0 12:01	3.98	1.08	2.67	2.37	1.50	1.00	76.00		SURCHARGED
55	W-P-1	8.14	0 10:51	9.50	0.86	1.51	0.48	2.14	0.71	0.00		Calculated
56	W-P-3	10.68	0 11:45	37.99	0.28	4.62	0.14	1.08	0.36	0.00		Calculated

Storage Nodes

Storage Node : Stor-01

Input Data

Invert Elevation (ft) 133.00
Max (Rim) Elevation (ft) 136.00
Max (Rim) Offset (ft) 3.00
Initial Water Elevation (ft) 0.00
Initial Water Depth (ft) .... -133.00
Ponded Area (ft²) 0.00
Evaporation Loss 0.00

Outflow Orifices

SN	Element ID	Orifice Type	Orifice Shape	Flap Gate	Circular Orifice Diameter (in)	Rectangular Orifice Height (in)	Rectangular Orifice Width (in)	Orifice Invert Elevation (ft)	Orifice Coefficient
1	M-O-01	Side	CIRCULAR	No	2.00			132.75	0.61

Output Summary Results

Peak Inflow (cfs) 1.10
Peak Lateral Inflow (cfs) 1.10
Peak Outflow (cfs) 0.18
Peak Exfiltration Flow Rate (cfm) 0.00
Max HGL Elevation Attained (ft) 135.87
Max HGL Depth Attained (ft) 2.87
Average HGL Elevation Attained (ft) 133.64
Average HGL Depth Attained (ft) 0.64
Time of Max HGL Occurrence (days hh:mm) 0 12:35
Total Exfiltration Volume (1000-ft³) 0.000
Total Flooded Volume (ac-in) 0
Total Time Flooded (min) 0
Total Retention Time (sec) 0.00

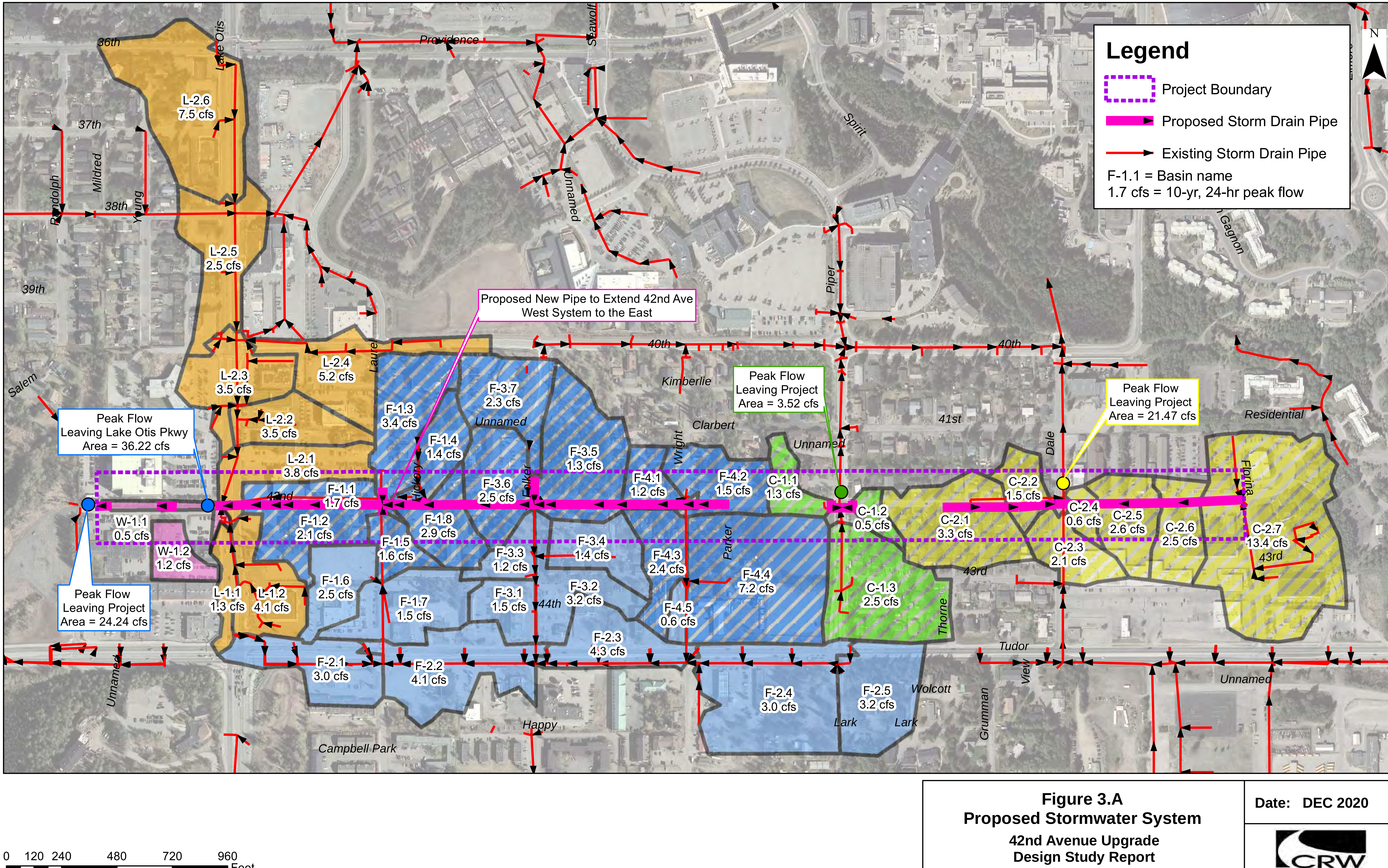


Figure 3.A
Proposed Stormwater System
42nd Avenue Upgrade Design Study Report

Date: DEC 2020

CRW ENGINEERING GROUP, LLC

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Figure 3.B
Proposed Model Pipe Layout

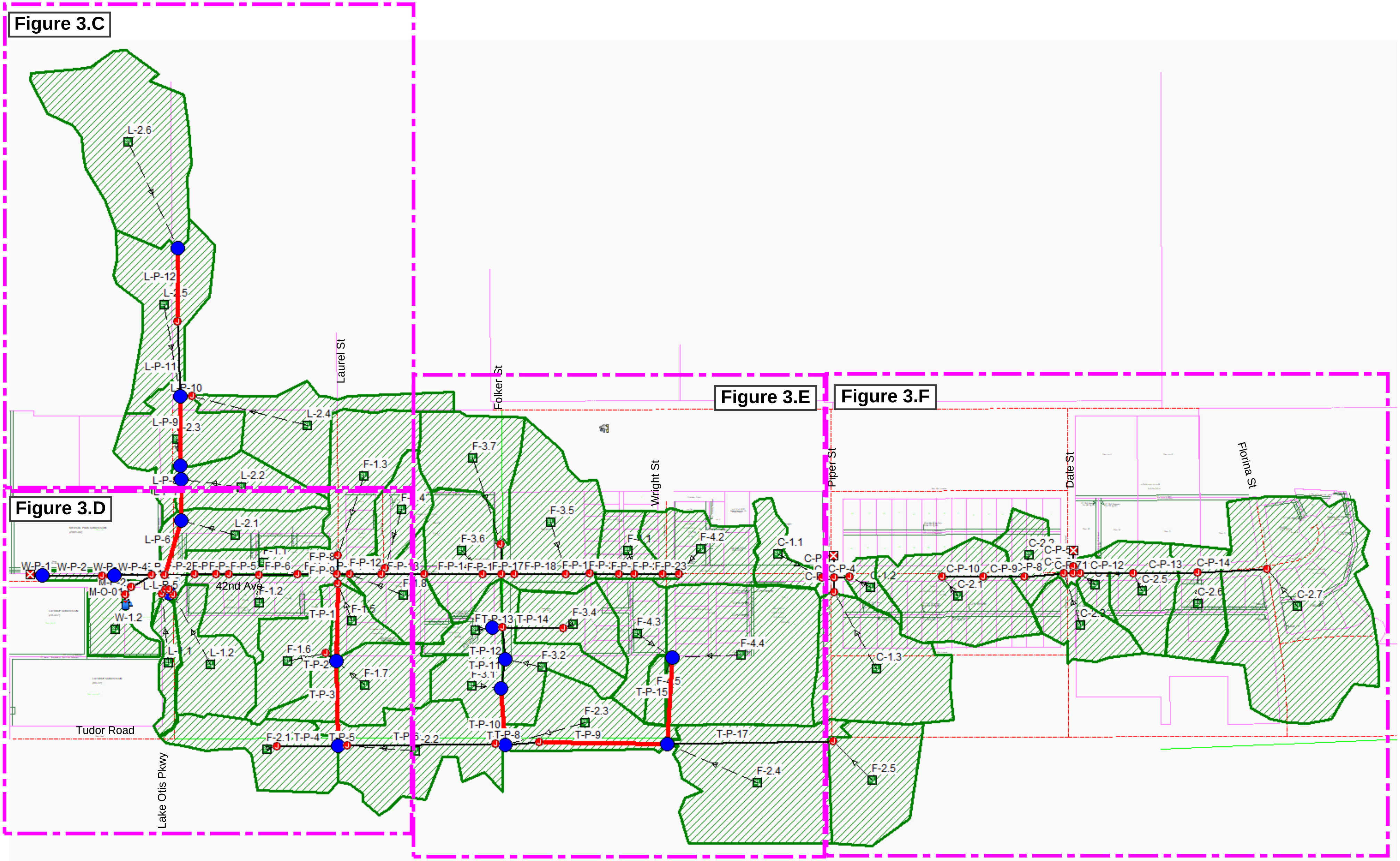


Figure 3.C
Proposed Model Pipe Layout
Lake Otis Pkwy

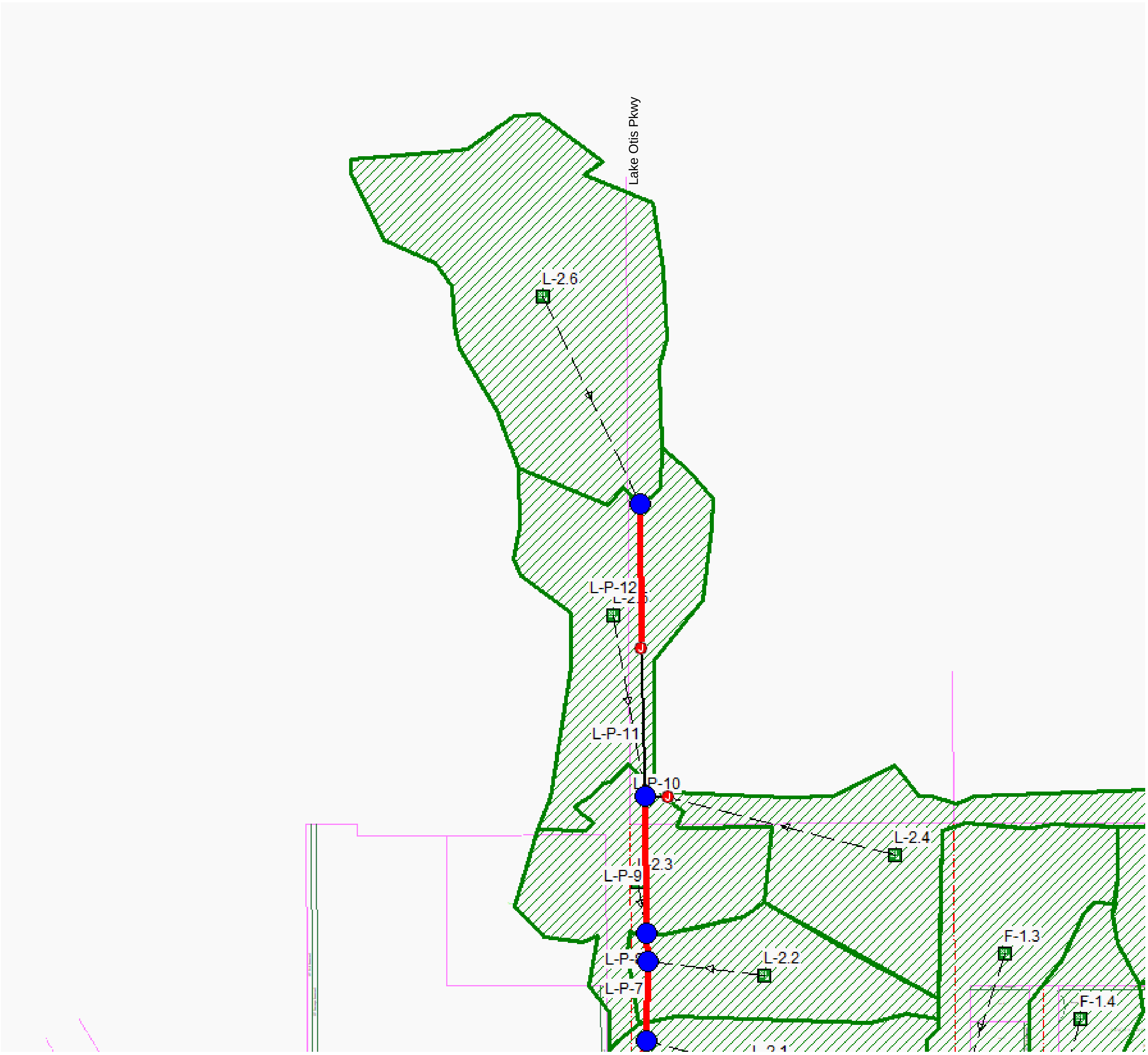


Figure 3.D
Proposed Model Pipe Layout
Lake Otis Pkwy, 42nd Ave, Tudor Rd & Laurel St

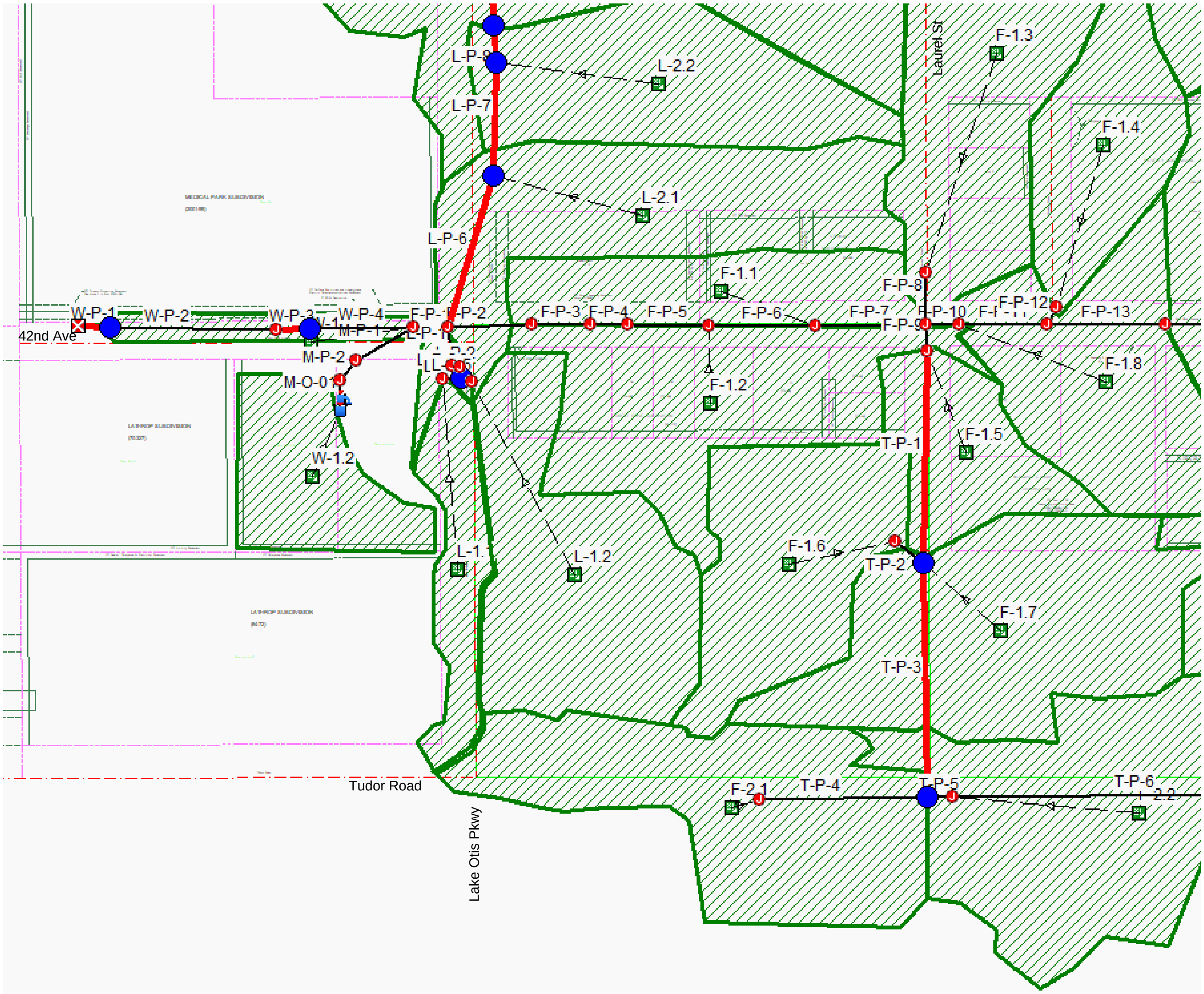


Figure 3.E
Proposed Model Pipe Layout
42nd Ave, Tudor Rd, Laurel St, Folker St & Wright St

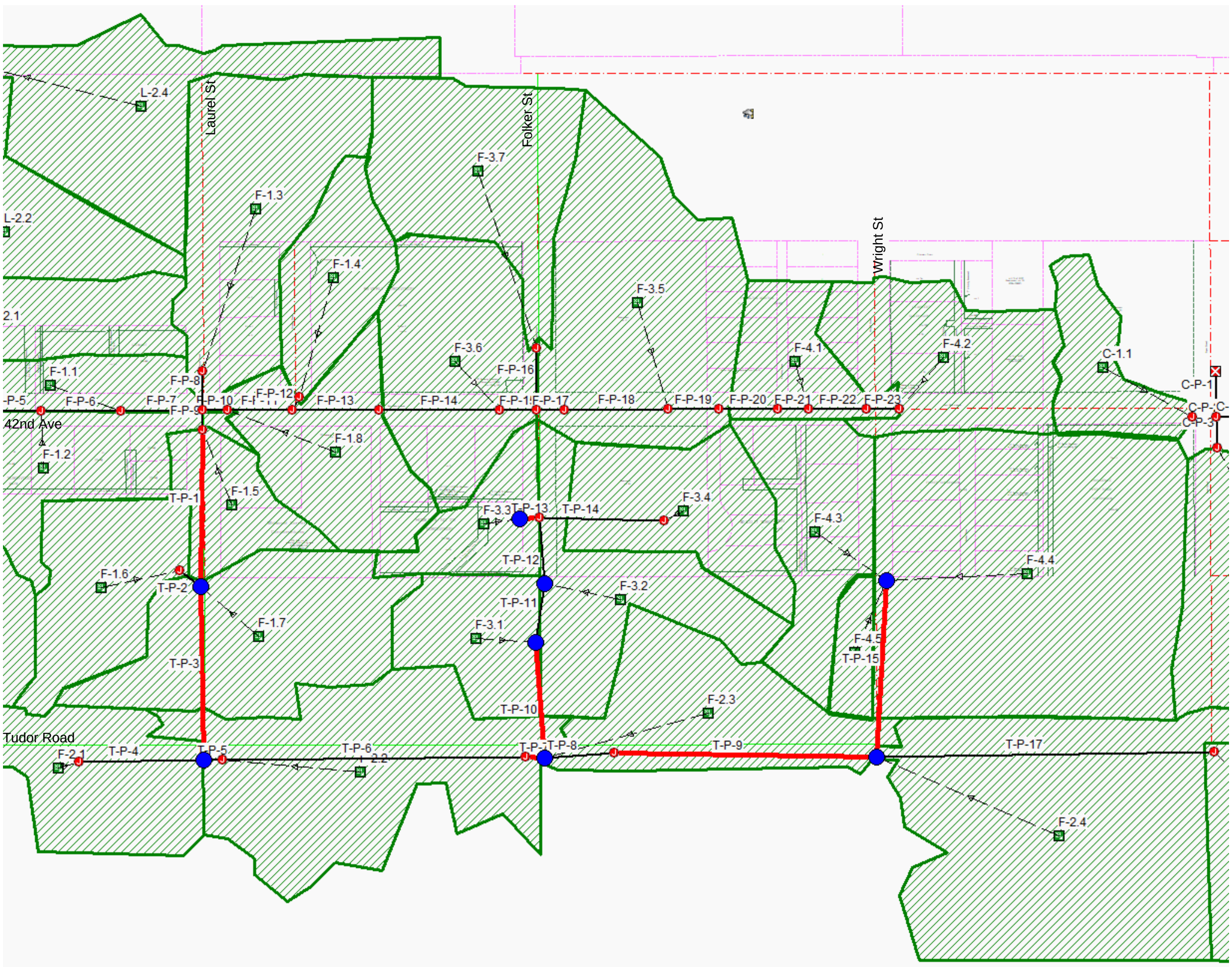
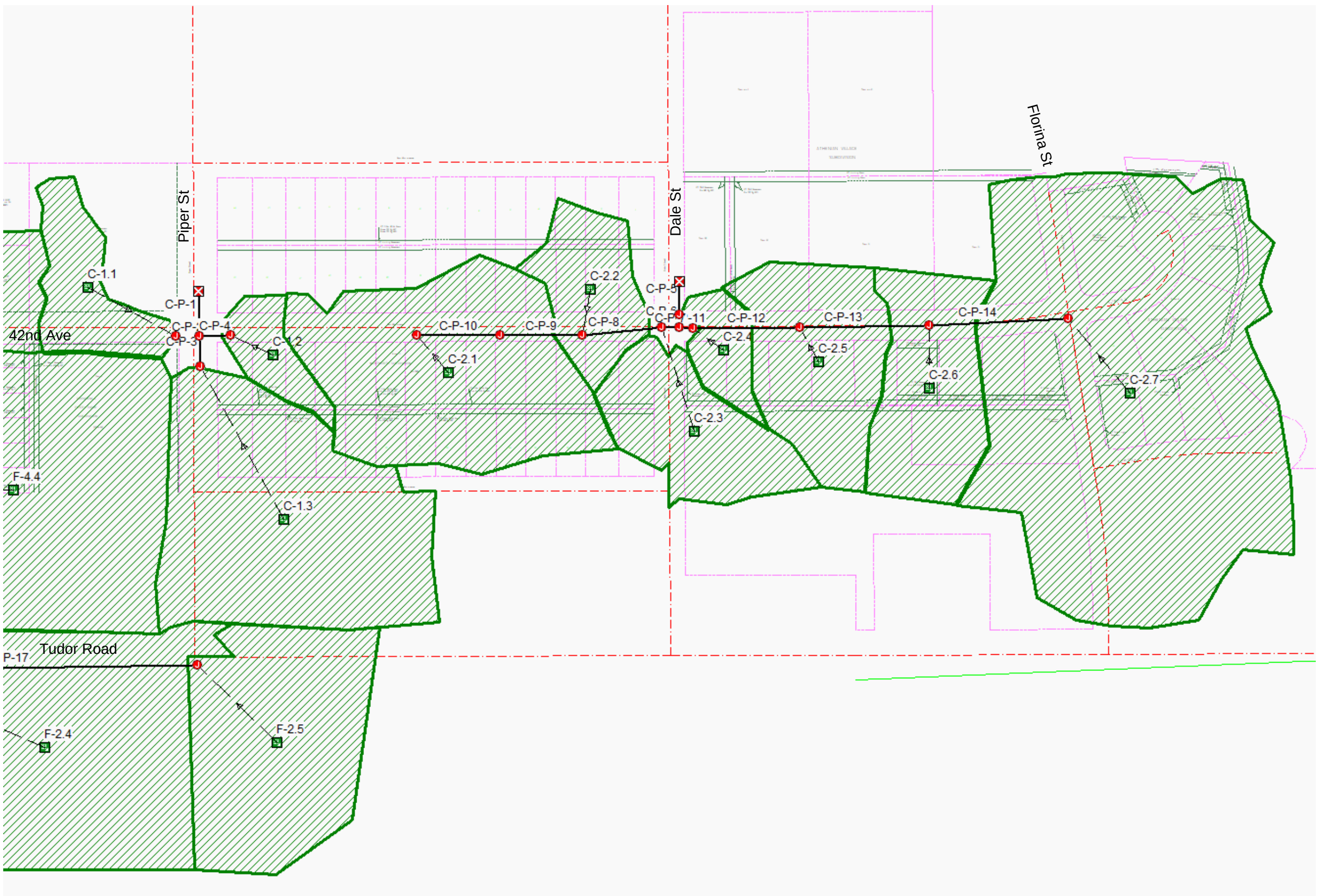


Figure 3.F
Proposed Model Pipe Layout
42nd Ave, Tudor Rd, Piper St, Dale St & Florina St



Project Description

File Name 10142.00 42ndProposedStorm2020.12.14.SPF

Project Options

Flow Units	CFS
Elevation Type	Elevation
Hydrology Method	SCS TR-55
Time of Concentration (TOC) Method	SCS TR-55
Link Routing Method	Kinematic Wave
Enable Overflow Ponding at Nodes	YES
Skip Steady State Analysis Time Periods	YES

Analysis Options

Start Analysis On	Jan 21, 2020	00:00:00
End Analysis On	Jan 22, 2020	00:00:00
Start Reporting On	Jan 21, 2020	00:00:00
Antecedent Dry Days	0	days
Runoff (Dry Weather) Time Step	0 01:00:00	days hh:mm:ss
Runoff (Wet Weather) Time Step	0 00:05:00	days hh:mm:ss
Reporting Time Step	0 00:05:00	days hh:mm:ss
Routing Time Step	30	seconds

Number of Elements

	Qty
Rain Gages	1
Subbasins	45
Nodes	75
Junctions	71
Outfalls	3
Flow Diversions	0
Inlets	0
Storage Nodes	1
Links	72
Channels	2
Pipes	69
Pumps	0
Orifices	1
Weirs	0
Outlets	0
Pollutants	0
Land Uses	0

Rainfall Details

SN	Rain Gage ID	Data Source	Data Source ID	Rainfall Type	Rain Units	State	County	Return Period (years)	Rainfall Depth (inches)	Rainfall Distribution
1	Rain Gage-08	Time Series	10-year, 24-hour, Anchorage	Cumulative	inches				0.00	

Subbasin Summary

SN	Subbasin ID	Area (ac)	Weighted Curve Number	Total Rainfall (in)	Total Runoff (in)	Total Runoff Volume (ac-in)	Peak Runoff (cfs)	Time of Concentration (days hh:mm:ss)
1	C-1.1	1.19	93.86	2.46	1.82	2.17	1.31	0 00:11:39
2	C-1.2	0.62	91.93	2.46	1.65	1.02	0.53	0 00:17:31
3	C-1.3	5.13	87.40	2.46	1.31	6.70	2.48	0 00:34:30
4	C-2.1	4.45	90.00	2.46	1.50	6.66	3.30	0 00:19:28
5	C-2.2	1.29	90.00	2.46	1.50	1.93	1.52	0 00:05:00
6	C-2.3	1.84	91.01	2.46	1.58	2.90	2.05	0 00:07:48
7	C-2.4	0.59	88.34	2.46	1.37	0.81	0.64	0 00:05:00
8	C-2.5	2.35	89.49	2.46	1.46	3.43	2.63	0 00:05:44
9	C-2.6	2.12	90.52	2.46	1.54	3.26	2.51	0 00:05:33
10	C-2.7	10.87	91.85	2.46	1.65	17.88	13.36	0 00:06:07
11	F-1.1	1.42	96.30	2.46	2.05	2.92	1.71	0 00:11:24
12	F-1.2	2.60	92.85	2.46	1.73	4.50	2.13	0 00:20:45
13	F-1.3	3.57	95.12	2.46	1.94	6.92	3.39	0 00:18:18
14	F-1.4	1.54	85.43	2.46	1.18	1.81	1.36	0 00:06:31
15	F-1.5	1.17	97.08	2.46	2.13	2.50	1.61	0 00:08:06
16	F-1.6	2.09	96.82	2.46	2.11	4.40	2.45	0 00:12:42
17	F-1.7	3.35	94.99	2.46	1.93	6.44	1.53	0 01:11:34
18	F-1.8	2.32	94.55	2.46	1.88	4.37	2.92	0 00:08:30
19	F-2.1	3.07	97.44	2.46	2.17	6.67	2.96	0 00:20:34
20	F-2.2	4.60	96.54	2.46	2.08	9.55	4.08	0 00:23:17
21	F-2.3	2.82	96.67	2.46	2.09	5.90	4.27	0 00:05:00
22	F-2.4	6.61	90.64	2.46	1.55	10.23	2.96	0 00:53:30
23	F-2.5	3.60	88.40	2.46	1.38	4.96	3.24	0 00:10:16
24	F-3.1	1.50	94.00	2.46	1.83	2.75	1.47	0 00:15:24
25	F-3.2	2.39	95.61	2.46	1.99	4.74	3.15	0 00:08:10
26	F-3.3	1.13	94.10	2.46	1.84	2.08	1.21	0 00:12:48
27	F-3.4	2.24	90.00	2.46	1.50	3.35	1.39	0 00:27:54
28	F-3.5	4.59	78.63	2.46	0.79	3.64	1.28	0 00:33:46
29	F-3.6	2.92	92.05	2.46	1.66	4.85	2.53	0 00:16:58
30	F-3.7	3.06	91.69	2.46	1.63	4.99	2.31	0 00:22:15
31	F-4.1	1.32	90.00	2.46	1.50	1.98	1.22	0 00:11:42
32	F-4.2	2.57	83.00	2.46	1.03	2.64	1.49	0 00:14:05
33	F-4.3	2.05	90.00	2.46	1.50	3.07	2.41	0 00:05:00
34	F-4.4	7.77	87.97	2.46	1.35	10.47	7.20	0 00:08:48
35	F-4.5	0.47	94.55	2.46	1.88	0.89	0.56	0 00:10:18
36	L-1.1	0.88	96.36	2.46	2.06	1.81	1.33	0 00:05:00
37	L-1.2	2.73	96.33	2.46	2.06	5.61	4.10	0 00:05:00
38	L-2.1	2.75	94.00	2.46	1.83	5.04	3.82	0 00:05:00
39	L-2.2	2.31	96.91	2.46	2.12	4.88	3.52	0 00:05:00
40	L-2.3	3.09	97.34	2.46	2.16	6.67	3.45	0 00:14:33
41	L-2.4	3.74	96.40	2.46	2.06	7.73	5.22	0 00:07:18
42	L-2.5	3.92	95.98	2.46	2.02	7.92	2.54	0 00:41:04
43	L-2.6	6.98	93.21	2.46	1.76	12.30	7.46	0 00:11:39
44	W-1.1	0.51	85.29	2.46	1.17	0.59	0.47	0 00:05:00
45	W-1.2	0.84	94.00	2.46	1.83	1.54	1.17	0 00:05:00

Subbasin Hydrology

Subbasin : C-1.1

Input Data

Area (ac) 1.19
Weighted Curve Number 93.86
Rain Gage ID .... Rain Gage-08

Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
Paved parking & roofs	0.97	C	98.00
Woods & grass combination, Fair	0.22	C	76.00
Composite Area & Weighted CN	1.19		93.86

Time of Concentration

TOC Method : SCS TR-55

Sheet Flow Equation :

Tc = (0.007 * ((n * Lf)^0.8)) / ((P^0.5) * (Sf^0.4))

Where :

Tc = Time of Concentration (hr)
n = Manning's roughness
Lf = Flow Length (ft)
P = 2 yr, 24 hr Rainfall (inches)
Sf = Slope (ft/ft)

Shallow Concentrated Flow Equation :

V = 16.1345 * (Sf^0.5) (unpaved surface)
V = 20.3282 * (Sf^0.5) (paved surface)
V = 15.0 * (Sf^0.5) (grassed waterway surface)
V = 10.0 * (Sf^0.5) (nearly bare & untilled surface)
V = 9.0 * (Sf^0.5) (cultivated straight rows surface)
V = 7.0 * (Sf^0.5) (short grass pasture surface)
V = 5.0 * (Sf^0.5) (woodland surface)
V = 2.5 * (Sf^0.5) (forest w/heavy litter surface)
Tc = (Lf / V) / (3600 sec/hr)

Where:

Tc = Time of Concentration (hr)
Lf = Flow Length (ft)
V = Velocity (ft/sec)
Sf = Slope (ft/ft)

Channel Flow Equation :

V = (1.49 * (R^(2/3)) * (Sf^0.5)) / n
R = Aq / Wp
Tc = (Lf / V) / (3600 sec/hr)

Where :

Tc = Time of Concentration (hr)
Lf = Flow Length (ft)
R = Hydraulic Radius (ft)
Aq = Flow Area (ft²)
Wp = Wetted Perimeter (ft)
V = Velocity (ft/sec)
Sf = Slope (ft/ft)
n = Manning's roughness

Sheet Flow Computations	Subarea A	Subarea B	Subarea C
Manning's Roughness :	.2	0.00	0.00
Flow Length (ft) :	47	0.00	0.00
Slope (%) :	10.64	0.00	0.00
2 yr, 24 hr Rainfall (in) :	1.5	0.00	0.00
Velocity (ft/sec) :	0.16	0.00	0.00
Computed Flow Time (min) :	5.05	0.00	0.00

Shallow Concentrated Flow Computations	Subarea A	Subarea B	Subarea C
Flow Length (ft) :	75	0.00	0.00
Slope (%) :	1.33	0.00	0.00
Surface Type :	Paved	Unpaved	Unpaved
Velocity (ft/sec) :	2.34	0.00	0.00
Computed Flow Time (min) :	0.53	0.00	0.00

Channel Flow Computations	Subarea A	Subarea B	Subarea C
Manning's Roughness :	.013	.014	0.00
Flow Length (ft) :	194	158	0.00
Channel Slope (%) :	.52	.63	0.00
Cross Section Area (ft^2) :	.2	.04	0.00
Wetted Perimeter (ft) :	4	1.31	0.00
Velocity (ft/sec) :	1.12	0.83	0.00
Computed Flow Time (min) :	2.88	3.19	0.00

Total TOC (min) 11.65

Subbasin Runoff Results

Total Rainfall (in) 2.46
Total Runoff (in) 1.82
Peak Runoff (cfs) 1.31
Weighted Curve Number 93.86
Time of Concentration (days hh:mm:ss) 0 00:11:39

Subbasin : C-1.2

Input Data

Area (ac) 0.62
Weighted Curve Number 91.93
Rain Gage ID .... Rain Gage-08

Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
Paved parking & roofs	0.15	C	98.00
1/8 acre lots, 65% impervious	0.47	C	90.00
Composite Area & Weighted CN	0.62		91.93

Time of Concentration

Sheet Flow Computations	Subarea A	Subarea B	Subarea C
Manning's Roughness :	.3	0.00	0.00
Flow Length (ft) :	66	0.00	0.00
Slope (%) :	3.03	0.00	0.00
2 yr, 24 hr Rainfall (in) :	1.5	0.00	0.00
Velocity (ft/sec) :	0.07	0.00	0.00
Computed Flow Time (min) :	15.13	0.00	0.00

Shallow Concentrated Flow Computations	Subarea A	Subarea B	Subarea C
Flow Length (ft) :	125	0.00	0.00
Slope (%) :	1.6	0.00	0.00
Surface Type :	Paved	Unpaved	Unpaved
Velocity (ft/sec) :	2.57	0.00	0.00
Computed Flow Time (min) :	0.81	0.00	0.00

Channel Flow Computations	Subarea A	Subarea B	Subarea C
Manning's Roughness :	.013	0.00	0.00
Flow Length (ft) :	104	0.00	0.00
Channel Slope (%) :	.96	0.00	0.00
Cross Section Area (ft^2) :	.04	0.00	0.00
Wetted Perimeter (ft) :	1.31	0.00	0.00
Velocity (ft/sec) :	1.10	0.00	0.00
Computed Flow Time (min) :	1.58	0.00	0.00

Total TOC (min) 17.52

Subbasin Runoff Results

Total Rainfall (in) 2.46
Total Runoff (in) 1.65
Peak Runoff (cfs) 0.53
Weighted Curve Number 91.93
Time of Concentration (days hh:mm:ss) 0 00:17:31

Subbasin : C-1.3

Input Data

Area (ac) 5.13
Weighted Curve Number 87.40
Rain Gage ID .... Rain Gage-08

Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
1/3 acre lots, 30% impervious	3.20	C	81.00
Paved parking & roofs	1.93	C	98.00
Composite Area & Weighted CN	5.13		87.40

Time of Concentration

Sheet Flow Computations	Subarea A	Subarea B	Subarea C
Manning's Roughness :	0.3	0.00	0.00
Flow Length (ft) :	81	0.00	0.00
Slope (%) :	2.47	0.00	0.00
2 yr, 24 hr Rainfall (in) :	1.5	0.00	0.00
Velocity (ft/sec) :	0.07	0.00	0.00
Computed Flow Time (min) :	19.35	0.00	0.00

Shallow Concentrated Flow Computations	Subarea A	Subarea B	Subarea C
Flow Length (ft) :	60	0.00	0.00
Slope (%) :	1.67	0.00	0.00
Surface Type :	Paved	Unpaved	Unpaved
Velocity (ft/sec) :	2.63	0.00	0.00
Computed Flow Time (min) :	0.38	0.00	0.00

Channel Flow Computations	Subarea A	Subarea B	Subarea C
Manning's Roughness :	0.028	0.013	0.00
Flow Length (ft) :	160	111	0.00
Channel Slope (%) :	0.37	0.37	0.00
Cross Section Area (ft²) :	0.08	0.08	0.00
Wetted Perimeter (ft) :	4	4	0.00
Velocity (ft/sec) :	0.24	0.51	0.00
Computed Flow Time (min) :	11.18	3.60	0.00

Total TOC (min) 34.51

Subbasin Runoff Results

Total Rainfall (in) 2.46
Total Runoff (in) 1.31
Peak Runoff (cfs) 2.48
Weighted Curve Number 87.40
Time of Concentration (days hh:mm:ss) 0 00:34:31

Subbasin : C-2.1

Input Data

Area (ac) 4.45
Weighted Curve Number 90.00
Rain Gage ID .... Rain Gage-08

Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
1/8 acre lots, 65% impervious	4.45	C	90.00
Composite Area & Weighted CN	4.45		90.00

Time of Concentration

Sheet Flow Computations	Subarea A	Subarea B	Subarea C
Manning's Roughness :	.2	0.00	0.00
Flow Length (ft) :	93	0.00	0.00
Slope (%) :	2.15	0.00	0.00
2 yr, 24 hr Rainfall (in) :	1.5	0.00	0.00
Velocity (ft/sec) :	0.09	0.00	0.00
Computed Flow Time (min) :	16.51	0.00	0.00

Shallow Concentrated Flow Computations	Subarea A	Subarea B	Subarea C
Flow Length (ft) :	111	0.00	0.00
Slope (%) :	1.8	0.00	0.00
Surface Type :	Paved	Unpaved	Unpaved
Velocity (ft/sec) :	2.73	0.00	0.00
Computed Flow Time (min) :	0.68	0.00	0.00

Channel Flow Computations	Subarea A	Subarea B	Subarea C
Manning's Roughness :	.013	0.00	0.00
Flow Length (ft) :	133	0.00	0.00
Channel Slope (%) :	.75	0.00	0.00
Cross Section Area (ft²) :	.04	0.00	0.00
Wetted Perimeter (ft) :	1.31	0.00	0.00
Velocity (ft/sec) :	0.97	0.00	0.00
Computed Flow Time (min) :	2.29	0.00	0.00

Total TOC (min) 19.48

Subbasin Runoff Results

Total Rainfall (in) 2.46
Total Runoff (in) 1.50
Peak Runoff (cfs) 3.30
Weighted Curve Number 90.00
Time of Concentration (days hh:mm:ss) 0 00:19:29

Subbasin : C-2.2

Input Data

Area (ac) 1.29
Weighted Curve Number 90.00
Rain Gage ID .... Rain Gage-08

Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
1/8 acre lots, 65% impervious	1.29	C	90.00
Composite Area & Weighted CN	1.29		90.00

Time of Concentration

User-Defined TOC override (minutes): 5

Subbasin Runoff Results

Total Rainfall (in) 2.46
Total Runoff (in) 1.50
Peak Runoff (cfs) 1.52
Weighted Curve Number 90.00
Time of Concentration (days hh:mm:ss) 0 00:05:00

Subbasin : C-2.3

Input Data

Area (ac) 1.84
Weighted Curve Number 91.01
Rain Gage ID .... Rain Gage-08

Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
Urban commercial, 85% imp	1.34	C	94.00
1/4 acre lots, 38% impervious	0.50	C	83.00
Composite Area & Weighted CN	1.84		91.01

Time of Concentration

Sheet Flow Computations	Subarea A	Subarea B	Subarea C
Manning's Roughness :	.01	0.00	0.00
Flow Length (ft) :	103	0.00	0.00
Slope (%) :	1.94	0.00	0.00
2 yr, 24 hr Rainfall (in) :	1.5	0.00	0.00
Velocity (ft/sec) :	1.01	0.00	0.00
Computed Flow Time (min) :	1.70	0.00	0.00

Shallow Concentrated Flow Computations	Subarea A	Subarea B	Subarea C
Flow Length (ft) :	81	0.00	0.00
Slope (%) :	2.47	0.00	0.00
Surface Type :	Paved	Unpaved	Unpaved
Velocity (ft/sec) :	3.19	0.00	0.00
Computed Flow Time (min) :	0.42	0.00	0.00

Channel Flow Computations	Subarea A	Subarea B	Subarea C
Manning's Roughness :	.025	0.00	0.00
Flow Length (ft) :	197	0.00	0.00
Channel Slope (%) :	.51	0.00	0.00
Cross Section Area (ft²) :	.2	0.00	0.00
Wetted Perimeter (ft) :	4	0.00	0.00
Velocity (ft/sec) :	0.58	0.00	0.00
Computed Flow Time (min) :	5.68	0.00	0.00

Total TOC (min) 7.81

Subbasin Runoff Results

Total Rainfall (in) 2.46
Total Runoff (in) 1.58
Peak Runoff (cfs) 2.05
Weighted Curve Number 91.01
Time of Concentration (days hh:mm:ss) 0 00:07:49

Subbasin : C-2.4

Input Data

Area (ac) 0.59
Weighted Curve Number 88.34
Rain Gage ID .... Rain Gage-08

Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
Paved parking & roofs	0.21	C	98.00
1/4 acre lots, 38% impervious	0.38	C	83.00
Composite Area & Weighted CN	0.59		88.34

Time of Concentration

User-Defined TOC override (minutes): 5

Subbasin Runoff Results

Total Rainfall (in) 2.46
Total Runoff (in) 1.37
Peak Runoff (cfs) 0.64
Weighted Curve Number 88.34
Time of Concentration (days hh:mm:ss) 0 00:05:00

Subbasin : C-2.5

Input Data

Area (ac) 2.35
Weighted Curve Number 89.49
Rain Gage ID .... Rain Gage-08

Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
Paved parking & roofs	0.28	C	98.00
1/4 acre lots, 38% impervious	0.78	C	83.00
Urban commercial, 85% imp	0.66	C	94.00
Gravel roads	0.63	C	89.00
Composite Area & Weighted CN	2.35		89.49

Time of Concentration

Sheet Flow Computations	Subarea A	Subarea B	Subarea C
Manning's Roughness :	.01	0.00	0.00
Flow Length (ft) :	88	0.00	0.00
Slope (%) :	2.27	0.00	0.00
2 yr, 24 hr Rainfall (in) :	1.5	0.00	0.00
Velocity (ft/sec) :	1.04	0.00	0.00
Computed Flow Time (min) :	1.41	0.00	0.00

Shallow Concentrated Flow Computations	Subarea A	Subarea B	Subarea C
Flow Length (ft) :	149	0.00	0.00
Slope (%) :	1.34	0.00	0.00
Surface Type :	Grass pasture	Unpaved	Unpaved
Velocity (ft/sec) :	0.81	0.00	0.00
Computed Flow Time (min) :	3.07	0.00	0.00

Channel Flow Computations	Subarea A	Subarea B	Subarea C
Manning's Roughness :	.013	0.00	0.00
Flow Length (ft) :	90	0.00	0.00
Channel Slope (%) :	1.11	0.00	0.00
Cross Section Area (ft^2) :	.04	0.00	0.00
Wetted Perimeter (ft) :	1.31	0.00	0.00
Velocity (ft/sec) :	1.18	0.00	0.00
Computed Flow Time (min) :	1.27	0.00	0.00

Total TOC (min) 5.74

Subbasin Runoff Results

Total Rainfall (in) 2.46
Total Runoff (in) 1.46
Peak Runoff (cfs) 2.63
Weighted Curve Number 89.49
Time of Concentration (days hh:mm:ss) 0 00:05:44

Subbasin : C-2.6

Input Data

Area (ac) 2.12
Weighted Curve Number 90.52
Rain Gage ID .... Rain Gage-08

Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
1/4 acre lots, 38% impervious	0.65	C	83.00
Urban commercial, 85% imp	1.10	C	94.00
Paved parking & roofs	0.18	C	98.00
Gravel roads	0.19	C	89.00
Composite Area & Weighted CN	2.12		90.52

Time of Concentration

Sheet Flow Computations	Subarea A	Subarea B	Subarea C
Manning's Roughness :	0.01	0.00	0.00
Flow Length (ft) :	105	0.00	0.00
Slope (%) :	.95	0.00	0.00
2 yr, 24 hr Rainfall (in) :	1.5	0.00	0.00
Velocity (ft/sec) :	0.76	0.00	0.00
Computed Flow Time (min) :	2.30	0.00	0.00

Shallow Concentrated Flow Computations	Subarea A	Subarea B	Subarea C
Flow Length (ft) :	168	0.00	0.00
Slope (%) :	1.19	0.00	0.00
Surface Type :	Unpaved	Unpaved	Unpaved
Velocity (ft/sec) :	1.76	0.00	0.00
Computed Flow Time (min) :	1.59	0.00	0.00

Channel Flow Computations	Subarea A	Subarea B	Subarea C
Manning's Roughness :	.013	0.00	0.00
Flow Length (ft) :	108	0.00	0.00
Channel Slope (%) :	.93	0.00	0.00
Cross Section Area (ft²) :	.04	0.00	0.00
Wetted Perimeter (ft) :	1.31	0.00	0.00
Velocity (ft/sec) :	1.08	0.00	0.00
Computed Flow Time (min) :	1.67	0.00	0.00

Total TOC (min) 5.55

Subbasin Runoff Results

Total Rainfall (in) 2.46
Total Runoff (in) 1.54
Peak Runoff (cfs) 2.51
Weighted Curve Number 90.52
Time of Concentration (days hh:mm:ss) 0 00:05:33

Subbasin : C-2.7

Input Data

Area (ac) 10.87
Weighted Curve Number 91.85
Rain Gage ID .... Rain Gage-08

Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
Urban commercial, 85% imp	9.57	C	94.00
Woods & grass combination, Fair	1.30	C	76.00
Composite Area & Weighted CN	10.87		91.85

Time of Concentration

Sheet Flow Computations	Subarea A	Subarea B	Subarea C
Manning's Roughness :	.4	0.00	0.00
Flow Length (ft) :	17	0.00	0.00
Slope (%) :	23.53	0.00	0.00
2 yr, 24 hr Rainfall (in) :	1.5	0.00	0.00
Velocity (ft/sec) :	0.10	0.00	0.00
Computed Flow Time (min) :	2.84	0.00	0.00

Shallow Concentrated Flow Computations	Subarea A	Subarea B	Subarea C
Flow Length (ft) :	148	0.00	0.00
Slope (%) :	1.35	0.00	0.00
Surface Type :	Paved	Unpaved	Unpaved
Velocity (ft/sec) :	2.36	0.00	0.00
Computed Flow Time (min) :	1.05	0.00	0.00

Channel Flow Computations	Subarea A	Subarea B	Subarea C
Manning's Roughness :	.013	0.00	0.00
Flow Length (ft) :	322	0.00	0.00
Channel Slope (%) :	.62	0.00	0.00
Cross Section Area (ft²) :	.4	0.00	0.00
Wetted Perimeter (ft) :	2.92	0.00	0.00
Velocity (ft/sec) :	2.40	0.00	0.00
Computed Flow Time (min) :	2.24	0.00	0.00

Total TOC (min) 6.12

Subbasin Runoff Results

Total Rainfall (in) 2.46
Total Runoff (in) 1.65
Peak Runoff (cfs) 13.36
Weighted Curve Number 91.85
Time of Concentration (days hh:mm:ss) 0 00:06:07

Subbasin : F-1.1

Input Data

Area (ac) 1.42
Weighted Curve Number 96.30
Rain Gage ID .... Rain Gage-08

Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
Paved roads with curbs & sewers	1.32	C	98.00
> 75% grass cover, Good	0.10	C	74.00
Composite Area & Weighted CN	1.42		96.30

Time of Concentration

Sheet Flow Computations	Subarea A	Subarea B	Subarea C
Manning's Roughness :	.01	0.00	0.00
Flow Length (ft) :	85	0.00	0.00
Slope (%) :	3.53	0.00	0.00
2 yr, 24 hr Rainfall (in) :	1.50	0.00	0.00
Velocity (ft/sec) :	1.23	0.00	0.00
Computed Flow Time (min) :	1.15	0.00	0.00

Shallow Concentrated Flow Computations	Subarea A	Subarea B	Subarea C
Flow Length (ft) :	69	0.00	0.00
Slope (%) :	1.45	0.00	0.00
Surface Type :	Paved	Unpaved	Unpaved
Velocity (ft/sec) :	2.45	0.00	0.00
Computed Flow Time (min) :	0.47	0.00	0.00

Channel Flow Computations	Subarea A	Subarea B	Subarea C
Manning's Roughness :	.022	0.00	0.00
Flow Length (ft) :	325	0.00	0.00
Channel Slope (%) :	1.23	0.00	0.00
Cross Section Area (ft²) :	.08	0.00	0.00
Wetted Perimeter (ft) :	4	0.00	0.00
Velocity (ft/sec) :	0.55	0.00	0.00
Computed Flow Time (min) :	9.79	0.00	0.00

Total TOC (min) 11.40

Subbasin Runoff Results

Total Rainfall (in) 2.46
Total Runoff (in) 2.05
Peak Runoff (cfs) 1.71
Weighted Curve Number 96.30
Time of Concentration (days hh:mm:ss) 0 00:11:24

Subbasin : F-1.2

Input Data

Area (ac) 2.60
Weighted Curve Number 92.85
Rain Gage ID .... Rain Gage-08

Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
Paved parking & roofs	1.99	C	98.00
Woods & grass combination, Fair	0.61	C	76.00
Composite Area & Weighted CN	2.60		92.85

Time of Concentration

Sheet Flow Computations	Subarea A	Subarea B	Subarea C
Manning's Roughness :	.2	0.00	0.00
Flow Length (ft) :	70	0.00	0.00
Slope (%) :	2.86	0.00	0.00
2 yr, 24 hr Rainfall (in) :	1.5	0.00	0.00
Velocity (ft/sec) :	0.10	0.00	0.00
Computed Flow Time (min) :	11.74	0.00	0.00

Shallow Concentrated Flow Computations	Subarea A	Subarea B	Subarea C
Flow Length (ft) :	187	128	0.00
Slope (%) :	4.28	.78	0.00
Surface Type :	Grassed waterway	Unpaved	Unpaved
Velocity (ft/sec) :	3.10	1.42	0.00
Computed Flow Time (min) :	1.01	1.50	0.00

Channel Flow Computations	Subarea A	Subarea B	Subarea C
Manning's Roughness :	.022	0.00	0.00
Flow Length (ft) :	156	0.00	0.00
Channel Slope (%) :	.64	0.00	0.00
Cross Section Area (ft²) :	.08	0.00	0.00
Wetted Perimeter (ft) :	4	0.00	0.00
Velocity (ft/sec) :	0.40	0.00	0.00
Computed Flow Time (min) :	6.51	0.00	0.00

Total TOC (min) 20.76

Subbasin Runoff Results

Total Rainfall (in) 2.46
Total Runoff (in) 1.73
Peak Runoff (cfs) 2.13
Weighted Curve Number 92.85
Time of Concentration (days hh:mm:ss) 0 00:20:46

Subbasin : F-1.3

Input Data

Area (ac) 3.57
Weighted Curve Number 95.12
Rain Gage ID .... Rain Gage-08

Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
> 75% grass cover, Good	0.43	C	74.00
Paved roads with curbs & sewers	3.14	C	98.00
Composite Area & Weighted CN	3.57		95.12

Time of Concentration

Sheet Flow Computations	Subarea A	Subarea B	Subarea C
Manning's Roughness :	.4	0.00	0.00
Flow Length (ft) :	76	0.00	0.00
Slope (%) :	22.4	0.00	0.00
2 yr, 24 hr Rainfall (in) :	1.5	0.00	0.00
Velocity (ft/sec) :	0.13	0.00	0.00
Computed Flow Time (min) :	9.58	0.00	0.00

Shallow Concentrated Flow Computations	Subarea A	Subarea B	Subarea C
Flow Length (ft) :	153	80	0.00
Slope (%) :	9.8	8.8	0.00
Surface Type :	Grassed waterway	Paved	Unpaved
Velocity (ft/sec) :	4.70	6.03	0.00
Computed Flow Time (min) :	0.54	0.22	0.00

Channel Flow Computations	Subarea A	Subarea B	Subarea C
Manning's Roughness :	0.013	0.00	0.00
Flow Length (ft) :	478	0.00	0.00
Channel Slope (%) :	.8	0.00	0.00
Cross Section Area (ft²) :	.04	0.00	0.00
Wetted Perimeter (ft) :	1.31	0.00	0.00
Velocity (ft/sec) :	1.00	0.00	0.00
Computed Flow Time (min) :	7.95	0.00	0.00

Total TOC (min) 18.30

Subbasin Runoff Results

Total Rainfall (in) 2.46
Total Runoff (in) 1.94
Peak Runoff (cfs) 3.39
Weighted Curve Number 95.12
Time of Concentration (days hh:mm:ss) 0 00:18:18

Subbasin : F-1.4

Input Data

Area (ac) 1.54
Weighted Curve Number 85.43
Rain Gage ID .... Rain Gage-08

Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
Paved parking & roofs	0.66	C	98.00
Woods & grass combination, Fair	0.88	C	76.00
Composite Area & Weighted CN	1.54		85.43

Time of Concentration

Sheet Flow Computations	Subarea A	Subarea B	Subarea C
Manning's Roughness :	.4	0.00	0.00
Flow Length (ft) :	35	0.00	0.00
Slope (%) :	40	0.00	0.00
2 yr, 24 hr Rainfall (in) :	1.5	0.00	0.00
Velocity (ft/sec) :	0.14	0.00	0.00
Computed Flow Time (min) :	4.09	0.00	0.00

Shallow Concentrated Flow Computations	Subarea A	Subarea B	Subarea C
Flow Length (ft) :	114	91	0.00
Slope (%) :	2.63	10.99	0.00
Surface Type :	Paved	Paved	Unpaved
Velocity (ft/sec) :	3.30	6.74	0.00
Computed Flow Time (min) :	0.58	0.23	0.00

Channel Flow Computations	Subarea A	Subarea B	Subarea C
Manning's Roughness :	.022	0.00	0.00
Flow Length (ft) :	283	0.00	0.00
Channel Slope (%) :	2.12	0.00	0.00
Cross Section Area (ft²) :	.33	0.00	0.00
Wetted Perimeter (ft) :	2.1	0.00	0.00
Velocity (ft/sec) :	2.87	0.00	0.00
Computed Flow Time (min) :	1.64	0.00	0.00

Total TOC (min) 6.53

Subbasin Runoff Results

Total Rainfall (in) 2.46
Total Runoff (in) 1.18
Peak Runoff (cfs) 1.36
Weighted Curve Number 85.43
Time of Concentration (days hh:mm:ss) 0 00:06:32

Subbasin : F-1.5

Input Data

Area (ac) 1.17
Weighted Curve Number 97.08
Rain Gage ID .... Rain Gage-08

Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
Paved parking & roofs	1.05	C	98.00
Gravel roads	0.12	C	89.00
Composite Area & Weighted CN	1.17		97.08

Time of Concentration

Sheet Flow Computations	Subarea A	Subarea B	Subarea C
Manning's Roughness :	.3	0.00	0.00
Flow Length (ft) :	22	0.00	0.00
Slope (%) :	13.64	0.00	0.00
2 yr, 24 hr Rainfall (in) :	1.5	0.00	0.00
Velocity (ft/sec) :	0.11	0.00	0.00
Computed Flow Time (min) :	3.44	0.00	0.00

Shallow Concentrated Flow Computations	Subarea A	Subarea B	Subarea C
Flow Length (ft) :	185	0.00	0.00
Slope (%) :	1.62	0.00	0.00
Surface Type :	Paved	Unpaved	Unpaved
Velocity (ft/sec) :	2.59	0.00	0.00
Computed Flow Time (min) :	1.19	0.00	0.00

Channel Flow Computations	Subarea A	Subarea B	Subarea C
Manning's Roughness :	.019	0.00	0.00
Flow Length (ft) :	163	0.00	0.00
Channel Slope (%) :	1.84	0.00	0.00
Cross Section Area (ft²) :	.08	0.00	0.00
Wetted Perimeter (ft) :	4	0.00	0.00
Velocity (ft/sec) :	0.78	0.00	0.00
Computed Flow Time (min) :	3.47	0.00	0.00

Total TOC (min) 8.10

Subbasin Runoff Results

Total Rainfall (in) 2.46
Total Runoff (in) 2.13
Peak Runoff (cfs) 1.61
Weighted Curve Number 97.08
Time of Concentration (days hh:mm:ss) 0 00:08:06

Subbasin : F-1.6

Input Data

Area (ac) 2.09
Weighted Curve Number 96.82
Rain Gage ID .... Rain Gage-08

Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
Paved parking & roofs	1.97	C	98.00
Brush, Poor	0.12	C	77.00
Composite Area & Weighted CN	2.09		96.82

Time of Concentration

Sheet Flow Computations	Subarea A	Subarea B	Subarea C
Manning's Roughness :	0.01	0.00	0.00
Flow Length (ft) :	68	0.00	0.00
Slope (%) :	4.41	0.00	0.00
2 yr, 24 hr Rainfall (in) :	1.5	0.00	0.00
Velocity (ft/sec) :	1.29	0.00	0.00
Computed Flow Time (min) :	0.88	0.00	0.00

Shallow Concentrated Flow Computations	Subarea A	Subarea B	Subarea C
Flow Length (ft) :	219	0.00	0.00
Slope (%) :	1.83	0.00	0.00
Surface Type :	Paved	Unpaved	Unpaved
Velocity (ft/sec) :	2.75	0.00	0.00
Computed Flow Time (min) :	1.33	0.00	0.00

Channel Flow Computations	Subarea A	Subarea B	Subarea C
Manning's Roughness :	0.016	0.00	0.00
Flow Length (ft) :	234	0.00	0.00
Channel Slope (%) :	0.43	0.00	0.00
Cross Section Area (ft²) :	0.09	0.00	0.00
Wetted Perimeter (ft) :	6	0.00	0.00
Velocity (ft/sec) :	0.37	0.00	0.00
Computed Flow Time (min) :	10.50	0.00	0.00

Total TOC (min) 12.71

Subbasin Runoff Results

Total Rainfall (in) 2.46
Total Runoff (in) 2.11
Peak Runoff (cfs) 2.45
Weighted Curve Number 96.82
Time of Concentration (days hh:mm:ss) 0 00:12:43

Subbasin : F-1.7

Input Data

Area (ac) 3.35
Weighted Curve Number 94.99
Rain Gage ID .... Rain Gage-08

Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
Paved parking & roofs	2.87	C	98.00
Brush, Poor	0.48	C	77.00
Composite Area & Weighted CN	3.35		94.99

Time of Concentration

Sheet Flow Computations	Subarea A	Subarea B	Subarea C
Manning's Roughness :	0.4	0.00	0.00
Flow Length (ft) :	149	0.00	0.00
Slope (%) :	0.67	0.00	0.00
2 yr, 24 hr Rainfall (in) :	1.5	0.00	0.00
Velocity (ft/sec) :	0.04	0.00	0.00
Computed Flow Time (min) :	66.83	0.00	0.00

Shallow Concentrated Flow Computations	Subarea A	Subarea B	Subarea C
Flow Length (ft) :	159	0.00	0.00
Slope (%) :	0.63	0.00	0.00
Surface Type :	Paved	Unpaved	Unpaved
Velocity (ft/sec) :	1.61	0.00	0.00
Computed Flow Time (min) :	1.65	0.00	0.00

Channel Flow Computations	Subarea A	Subarea B	Subarea C
Manning's Roughness :	0.016	0.00	0.00
Flow Length (ft) :	148	0.00	0.00
Channel Slope (%) :	1.35	0.00	0.00
Cross Section Area (ft²) :	0.08	0.00	0.00
Wetted Perimeter (ft) :	4	0.00	0.00
Velocity (ft/sec) :	0.80	0.00	0.00
Computed Flow Time (min) :	3.09	0.00	0.00

Total TOC (min) 71.57

Subbasin Runoff Results

Total Rainfall (in) 2.46
Total Runoff (in) 1.93
Peak Runoff (cfs) 1.53
Weighted Curve Number 94.99
Time of Concentration (days hh:mm:ss) 0 01:11:34

Subbasin : F-1.8

Input Data

Area (ac) 2.32
Weighted Curve Number 94.55
Rain Gage ID .... Rain Gage-08

Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
Paved parking & roofs	1.82	C	98.00
Woods & grass combination, Poor	0.50	C	82.00
Composite Area & Weighted CN	2.32		94.55

Time of Concentration

Sheet Flow Computations	Subarea A	Subarea B	Subarea C
Manning's Roughness :	.2	0.00	0.00
Flow Length (ft) :	45	0.00	0.00
Slope (%) :	11.11	0.00	0.00
2 yr, 24 hr Rainfall (in) :	1.5	0.00	0.00
Velocity (ft/sec) :	0.16	0.00	0.00
Computed Flow Time (min) :	4.79	0.00	0.00

Shallow Concentrated Flow Computations	Subarea A	Subarea B	Subarea C
Flow Length (ft) :	259	0.00	0.00
Slope (%) :	.77	0.00	0.00
Surface Type :	Paved	Unpaved	Unpaved
Velocity (ft/sec) :	1.78	0.00	0.00
Computed Flow Time (min) :	2.43	0.00	0.00

Channel Flow Computations	Subarea A	Subarea B	Subarea C
Manning's Roughness :	.028	0.00	0.00
Flow Length (ft) :	65	0.00	0.00
Channel Slope (%) :	4.62	0.00	0.00
Cross Section Area (ft²) :	.08	0.00	0.00
Wetted Perimeter (ft) :	4	0.00	0.00
Velocity (ft/sec) :	0.84	0.00	0.00
Computed Flow Time (min) :	1.29	0.00	0.00

Total TOC (min) 8.50

Subbasin Runoff Results

Total Rainfall (in) 2.46
Total Runoff (in) 1.88
Peak Runoff (cfs) 2.92
Weighted Curve Number 94.55
Time of Concentration (days hh:mm:ss) 0 00:08:30

Subbasin : F-2.1

Input Data

Area (ac) 3.07
Weighted Curve Number 97.44
Rain Gage ID .... Rain Gage-08

Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
Paved parking & roofs	2.98	C	98.00
50 - 75% grass cover, Fair	0.09	C	79.00
Composite Area & Weighted CN	3.07		97.44

Time of Concentration

Sheet Flow Computations	Subarea A	Subarea B	Subarea C
Manning's Roughness :	0.4	0.00	0.00
Flow Length (ft) :	57	0.00	0.00
Slope (%) :	5.26	0.00	0.00
2 yr, 24 hr Rainfall (in) :	1.5	0.00	0.00
Velocity (ft/sec) :	0.07	0.00	0.00
Computed Flow Time (min) :	13.59	0.00	0.00

Shallow Concentrated Flow Computations	Subarea A	Subarea B	Subarea C
Flow Length (ft) :	281	0.00	0.00
Slope (%) :	0.71	0.00	0.00
Surface Type :	Paved	Unpaved	Unpaved
Velocity (ft/sec) :	1.71	0.00	0.00
Computed Flow Time (min) :	2.74	0.00	0.00

Channel Flow Computations	Subarea A	Subarea B	Subarea C
Manning's Roughness :	0.022	0.00	0.00
Flow Length (ft) :	117	0.00	0.00
Channel Slope (%) :	0.85	0.00	0.00
Cross Section Area (ft²) :	0.08	0.00	0.00
Wetted Perimeter (ft) :	4	0.00	0.00
Velocity (ft/sec) :	0.46	0.00	0.00
Computed Flow Time (min) :	4.24	0.00	0.00

Total TOC (min) 20.57

Subbasin Runoff Results

Total Rainfall (in) 2.46
Total Runoff (in) 2.17
Peak Runoff (cfs) 2.96
Weighted Curve Number 97.44
Time of Concentration (days hh:mm:ss) 0 00:20:34

Subbasin : F-2.2

Input Data

Area (ac) 4.60
Weighted Curve Number 96.54
Rain Gage ID .... Rain Gage-08

Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
Paved parking & roofs	4.28	C	98.00
Woods, Poor	0.32	C	77.00
Composite Area & Weighted CN	4.60		96.54

Time of Concentration

Sheet Flow Computations	Subarea A	Subarea B	Subarea C
Manning's Roughness :	0.4	0.00	0.00
Flow Length (ft) :	55	0.00	0.00
Slope (%) :	1.81	0.00	0.00
2 yr, 24 hr Rainfall (in) :	1.5	0.00	0.00
Velocity (ft/sec) :	0.05	0.00	0.00
Computed Flow Time (min) :	20.23	0.00	0.00

Shallow Concentrated Flow Computations	Subarea A	Subarea B	Subarea C
Flow Length (ft) :	225	0.00	0.00
Slope (%) :	0.44	0.00	0.00
Surface Type :	Paved	Unpaved	Unpaved
Velocity (ft/sec) :	1.35	0.00	0.00
Computed Flow Time (min) :	2.78	0.00	0.00

Channel Flow Computations	Subarea A	Subarea B	Subarea C
Manning's Roughness :	0.013	0.00	0.00
Flow Length (ft) :	33	0.00	0.00
Channel Slope (%) :	3.03	0.00	0.00
Cross Section Area (ft²) :	0.04	0.00	0.00
Wetted Perimeter (ft) :	1.31	0.00	0.00
Velocity (ft/sec) :	1.95	0.00	0.00
Computed Flow Time (min) :	0.28	0.00	0.00

Total TOC (min) 23.29

Subbasin Runoff Results

Total Rainfall (in) 2.46
Total Runoff (in) 2.08
Peak Runoff (cfs) 4.08
Weighted Curve Number 96.54
Time of Concentration (days hh:mm:ss) 0 00:23:17

Subbasin : F-2.3

Input Data

Area (ac) 2.82
Weighted Curve Number 96.67
Rain Gage ID .... Rain Gage-08

Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
Paved parking & roofs	2.65	C	98.00
Woods & grass combination, Fair	0.17	C	76.00
Composite Area & Weighted CN	2.82		96.67

Time of Concentration

User-Defined TOC override (minutes): 5

Subbasin Runoff Results

Total Rainfall (in) 2.46
Total Runoff (in) 2.09
Peak Runoff (cfs) 4.27
Weighted Curve Number 96.67
Time of Concentration (days hh:mm:ss) 0 00:05:00

Subbasin : F-2.4

Input Data

Area (ac) 6.61
Weighted Curve Number 90.64
Rain Gage ID .... Rain Gage-08

Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
Paved parking & roofs	4.15	C	98.00
Woods, Poor	1.86	C	77.00
Woods & grass combination, Poor	0.60	C	82.00
Composite Area & Weighted CN	6.61		90.64

Time of Concentration

Sheet Flow Computations	Subarea A	Subarea B	Subarea C
Manning's Roughness :	0.3	0.00	0.00
Flow Length (ft) :	141	0.00	0.00
Slope (%) :	2.13	0.00	0.00
2 yr, 24 hr Rainfall (in) :	1.5	0.00	0.00
Velocity (ft/sec) :	0.07	0.00	0.00
Computed Flow Time (min) :	31.98	0.00	0.00

Shallow Concentrated Flow Computations	Subarea A	Subarea B	Subarea C
Flow Length (ft) :	181	0.00	0.00
Slope (%) :	4.42	0.00	0.00
Surface Type :		Unpaved	Unpaved
Velocity (ft/sec) :	1.47	0.00	0.00
Computed Flow Time (min) :	2.05	0.00	0.00

Channel Flow Computations	Subarea A	Subarea B	Subarea C
Manning's Roughness :	0.025	0.00	0.00
Flow Length (ft) :	261	0.00	0.00
Channel Slope (%) :	0.38	0.00	0.00
Cross Section Area (ft²) :	0.09	0.00	0.00
Wetted Perimeter (ft) :	6	0.00	0.00
Velocity (ft/sec) :	0.22	0.00	0.00
Computed Flow Time (min) :	19.47	0.00	0.00

Total TOC (min) 53.50

Subbasin Runoff Results

Total Rainfall (in) 2.46
Total Runoff (in) 1.55
Peak Runoff (cfs) 2.96
Weighted Curve Number 90.64
Time of Concentration (days hh:mm:ss) 0 00:53:30

Subbasin : F-2.5

Input Data

Area (ac) 3.60
Weighted Curve Number 88.40
Rain Gage ID .... Rain Gage-08

Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
Paved parking & roofs	2.27	C	98.00
Woods & grass combination, Good	1.33	C	72.00
Composite Area & Weighted CN	3.60		88.40

Time of Concentration

Sheet Flow Computations	Subarea A	Subarea B	Subarea C
Manning's Roughness :	0.2	0.00	0.00
Flow Length (ft) :	62	0.00	0.00
Slope (%) :	8.06	0.00	0.00
2 yr, 24 hr Rainfall (in) :	1.5	0.00	0.00
Velocity (ft/sec) :	0.15	0.00	0.00
Computed Flow Time (min) :	7.04	0.00	0.00

Shallow Concentrated Flow Computations	Subarea A	Subarea B	Subarea C
Flow Length (ft) :	56	282	0.00
Slope (%) :	1.79	9.57	0.00
Surface Type :	Unpaved	Unpaved	Unpaved
Velocity (ft/sec) :	2.16	4.99	0.00
Computed Flow Time (min) :	0.43	0.94	0.00

Channel Flow Computations	Subarea A	Subarea B	Subarea C
Manning's Roughness :	0.013	0.00	0.00
Flow Length (ft) :	223	0.00	0.00
Channel Slope (%) :	3.14	0.00	0.00
Cross Section Area (ft²) :	0.04	0.00	0.00
Wetted Perimeter (ft) :	1.31	0.00	0.00
Velocity (ft/sec) :	1.98	0.00	0.00
Computed Flow Time (min) :	1.87	0.00	0.00

Total TOC (min) 10.28

Subbasin Runoff Results

Total Rainfall (in) 2.46
Total Runoff (in) 1.38
Peak Runoff (cfs) 3.24
Weighted Curve Number 88.40
Time of Concentration (days hh:mm:ss) 0 00:10:17

Subbasin : F-3.1

Input Data

Area (ac) 1.50
Weighted Curve Number 94.00
Rain Gage ID .... Rain Gage-08

Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
Urban commercial, 85% imp	1.50	C	94.00
Composite Area & Weighted CN	1.50		94.00

Time of Concentration

Sheet Flow Computations	Subarea A	Subarea B	Subarea C
Manning's Roughness :	0.11	0.00	0.00
Flow Length (ft) :	69	0.00	0.00
Slope (%) :	1.45	0.00	0.00
2 yr, 24 hr Rainfall (in) :	1.5	0.00	0.00
Velocity (ft/sec) :	0.12	0.00	0.00
Computed Flow Time (min) :	9.44	0.00	0.00

Shallow Concentrated Flow Computations	Subarea A	Subarea B	Subarea C
Flow Length (ft) :	241	0.00	0.00
Slope (%) :	0.41	0.00	0.00
Surface Type :	Paved	Unpaved	Unpaved
Velocity (ft/sec) :	1.30	0.00	0.00
Computed Flow Time (min) :	3.09	0.00	0.00

Channel Flow Computations	Subarea A	Subarea B	Subarea C
Manning's Roughness :	0.019	0.00	0.00
Flow Length (ft) :	100	0.00	0.00
Channel Slope (%) :	1	0.00	0.00
Cross Section Area (ft²) :	0.08	0.00	0.00
Wetted Perimeter (ft) :	4	0.00	0.00
Velocity (ft/sec) :	0.58	0.00	0.00
Computed Flow Time (min) :	2.88	0.00	0.00

Total TOC (min) 15.41

Subbasin Runoff Results

Total Rainfall (in) 2.46
Total Runoff (in) 1.83
Peak Runoff (cfs) 1.47
Weighted Curve Number 94.00
Time of Concentration (days hh:mm:ss) 0 00:15:25

Subbasin : F-3.2

Input Data

Area (ac) 2.39
Weighted Curve Number 95.61
Rain Gage ID .... Rain Gage-08

Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
Paved parking & roofs	2.13	C	98.00
Woods & grass combination, Fair	0.26	C	76.00
Composite Area & Weighted CN	2.39		95.61

Time of Concentration

Sheet Flow Computations	Subarea A	Subarea B	Subarea C
Manning's Roughness :	.01	0.00	0.00
Flow Length (ft) :	109	0.00	0.00
Slope (%) :	.92	0.00	0.00
2 yr, 24 hr Rainfall (in) :	1.5	0.00	0.00
Velocity (ft/sec) :	0.76	0.00	0.00
Computed Flow Time (min) :	2.40	0.00	0.00

Shallow Concentrated Flow Computations	Subarea A	Subarea B	Subarea C
Flow Length (ft) :	128	202	0.00
Slope (%) :	.78	.5	0.00
Surface Type :	Grass pasture	Paved	Unpaved
Velocity (ft/sec) :	0.62	1.44	0.00
Computed Flow Time (min) :	3.44	2.34	0.00

Total TOC (min) 8.18

Subbasin Runoff Results

Total Rainfall (in) 2.46
Total Runoff (in) 1.99
Peak Runoff (cfs) 3.15
Weighted Curve Number 95.61
Time of Concentration (days hh:mm:ss) 0 00:08:11

Subbasin : F-3.3

Input Data

Area (ac) 1.13
Weighted Curve Number 94.10
Rain Gage ID .... Rain Gage-08

Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
Paved parking & roofs	0.92	C	98.00
Brush, Poor	0.21	C	77.00
Composite Area & Weighted CN	1.13		94.10

Time of Concentration

Sheet Flow Computations	Subarea A	Subarea B	Subarea C
Manning's Roughness :	.4	0.00	0.00
Flow Length (ft) :	21	0.00	0.00
Slope (%) :	4.76	0.00	0.00
2 yr, 24 hr Rainfall (in) :	1.5	0.00	0.00
Velocity (ft/sec) :	0.06	0.00	0.00
Computed Flow Time (min) :	6.36	0.00	0.00

Channel Flow Computations	Subarea A	Subarea B	Subarea C
Manning's Roughness :	.025	0.00	0.00
Flow Length (ft) :	142	0.00	0.00
Channel Slope (%) :	.7	0.00	0.00
Cross Section Area (ft²) :	.08	0.00	0.00
Wetted Perimeter (ft) :	4	0.00	0.00
Velocity (ft/sec) :	0.37	0.00	0.00
Computed Flow Time (min) :	6.44	0.00	0.00

Total TOC (min) 12.80

Subbasin Runoff Results

Total Rainfall (in) 2.46
Total Runoff (in) 1.84
Peak Runoff (cfs) 1.21
Weighted Curve Number 94.10
Time of Concentration (days hh:mm:ss) 0 00:12:48

Subbasin : F-3.4

Input Data

Area (ac) 2.24
Weighted Curve Number 90.00
Rain Gage ID .... Rain Gage-08

Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
1/8 acre lots, 65% impervious	2.24	C	90.00
Composite Area & Weighted CN	2.24		90.00

Time of Concentration

Sheet Flow Computations	Subarea A	Subarea B	Subarea C
Manning's Roughness :	.2	0.00	0.00
Flow Length (ft) :	104	0.00	0.00
Slope (%) :	.96	0.00	0.00
2 yr, 24 hr Rainfall (in) :	1.5	0.00	0.00
Velocity (ft/sec) :	0.07	0.00	0.00
Computed Flow Time (min) :	24.93	0.00	0.00

Shallow Concentrated Flow Computations	Subarea A	Subarea B	Subarea C
Flow Length (ft) :	77	0.00	0.00
Slope (%) :	1.3	0.00	0.00
Surface Type :	Paved	Unpaved	Unpaved
Velocity (ft/sec) :	2.32	0.00	0.00
Computed Flow Time (min) :	0.55	0.00	0.00

Channel Flow Computations	Subarea A	Subarea B	Subarea C
Manning's Roughness :	.019	0.00	0.00
Flow Length (ft) :	89	0.00	0.00
Channel Slope (%) :	1.12	0.00	0.00
Cross Section Area (ft²) :	.08	0.00	0.00
Wetted Perimeter (ft) :	4	0.00	0.00
Velocity (ft/sec) :	0.61	0.00	0.00
Computed Flow Time (min) :	2.43	0.00	0.00

Total TOC (min) 27.91

Subbasin Runoff Results

Total Rainfall (in) 2.46
Total Runoff (in) 1.50
Peak Runoff (cfs) 1.39
Weighted Curve Number 90.00
Time of Concentration (days hh:mm:ss) 0 00:27:55

Subbasin : F-3.5

Input Data

Area (ac) 4.59
Weighted Curve Number 78.63
Rain Gage ID .... Rain Gage-08

Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
Woods & grass combination, Fair	4.04	C	76.00
Paved roads with curbs & sewers	0.55	C	98.00
Composite Area & Weighted CN	4.59		78.63

Time of Concentration

Sheet Flow Computations	Subarea A	Subarea B	Subarea C
Manning's Roughness :	.4	0.00	0.00
Flow Length (ft) :	85	0.00	0.00
Slope (%) :	4.71	0.00	0.00
2 yr, 24 hr Rainfall (in) :	1.5	0.00	0.00
Velocity (ft/sec) :	0.07	0.00	0.00
Computed Flow Time (min) :	19.55	0.00	0.00

Shallow Concentrated Flow Computations	Subarea A	Subarea B	Subarea C
Flow Length (ft) :	394	104	0.00
Slope (%) :	1.02	.96	0.00
Surface Type :	Woodland	Unpaved	Unpaved
Velocity (ft/sec) :	0.50	1.58	0.00
Computed Flow Time (min) :	13.13	1.10	0.00

Total TOC (min) 33.78

Subbasin Runoff Results

Total Rainfall (in) 2.46
Total Runoff (in) 0.79
Peak Runoff (cfs) 1.28
Weighted Curve Number 78.63
Time of Concentration (days hh:mm:ss) 0 00:33:47

Subbasin : F-3.6

Input Data

Area (ac) 2.92
Weighted Curve Number 92.05
Rain Gage ID .... Rain Gage-08

Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
Paved roads with curbs & sewers	2.30	C	98.00
Brush, Fair	0.62	C	70.00
Composite Area & Weighted CN	2.92		92.05

Time of Concentration

Sheet Flow Computations	Subarea A	Subarea B	Subarea C
Manning's Roughness :	.4	0.00	0.00
Flow Length (ft) :	116	0.00	0.00
Slope (%) :	16.38	0.00	0.00
2 yr, 24 hr Rainfall (in) :	1.5	0.00	0.00
Velocity (ft/sec) :	0.13	0.00	0.00
Computed Flow Time (min) :	15.23	0.00	0.00

Shallow Concentrated Flow Computations	Subarea A	Subarea B	Subarea C
Flow Length (ft) :	266	0.00	0.00
Slope (%) :	3	0.00	0.00
Surface Type :	Paved	Unpaved	Unpaved
Velocity (ft/sec) :	3.52	0.00	0.00
Computed Flow Time (min) :	1.26	0.00	0.00

Channel Flow Computations	Subarea A	Subarea B	Subarea C
Manning's Roughness :	.013	0.00	0.00
Flow Length (ft) :	92	0.00	0.00
Channel Slope (%) :	1.09	0.00	0.00
Cross Section Area (ft²) :	.4	0.00	0.00
Wetted Perimeter (ft) :	2.92	0.00	0.00
Velocity (ft/sec) :	3.18	0.00	0.00
Computed Flow Time (min) :	0.48	0.00	0.00

Total TOC (min) 16.97

Subbasin Runoff Results

Total Rainfall (in) 2.46
Total Runoff (in) 1.66
Peak Runoff (cfs) 2.53
Weighted Curve Number 92.05
Time of Concentration (days hh:mm:ss) 0 00:16:58

Subbasin : F-3.7

Input Data

Area (ac) 3.06
Weighted Curve Number 91.69
Rain Gage ID .... Rain Gage-08

Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
Paved parking & roofs	2.37	C	98.00
Brush, Fair	0.69	C	70.00
Composite Area & Weighted CN	3.06		91.69

Time of Concentration

Sheet Flow Computations	Subarea A	Subarea B	Subarea C
Manning's Roughness :	.35	0.00	0.00
Flow Length (ft) :	118	0.00	0.00
Slope (%) :	10.17	0.00	0.00
2 yr, 24 hr Rainfall (in) :	1.5	0.00	0.00
Velocity (ft/sec) :	0.12	0.00	0.00
Computed Flow Time (min) :	16.79	0.00	0.00

Shallow Concentrated Flow Computations	Subarea A	Subarea B	Subarea C
Flow Length (ft) :	85	0.00	0.00
Slope (%) :	17.65	0.00	0.00
Surface Type :	Grassed waterway	Unpaved	Unpaved
Velocity (ft/sec) :	6.30	0.00	0.00
Computed Flow Time (min) :	0.22	0.00	0.00

Channel Flow Computations	Subarea A	Subarea B	Subarea C
Manning's Roughness :	.013	.026	0.00
Flow Length (ft) :	271	157	0.00
Channel Slope (%) :	.74	2.55	0.00
Cross Section Area (ft²) :	.04	1.76	0.00
Wetted Perimeter (ft) :	1.31	4.71	0.00
Velocity (ft/sec) :	0.96	4.75	0.00
Computed Flow Time (min) :	4.69	0.55	0.00

Total TOC (min) 22.25

Subbasin Runoff Results

Total Rainfall (in) 2.46
Total Runoff (in) 1.63
Peak Runoff (cfs) 2.31
Weighted Curve Number 91.69
Time of Concentration (days hh:mm:ss) 0 00:22:15

Subbasin : F-4.1

Input Data

Area (ac) 1.32
Weighted Curve Number 90.00
Rain Gage ID .... Rain Gage-08

Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
1/8 acre lots, 65% impervious	1.32	C	90.00
Composite Area & Weighted CN	1.32		90.00

Time of Concentration

Sheet Flow Computations	Subarea A	Subarea B	Subarea C
Manning's Roughness :	.15	0.00	0.00
Flow Length (ft) :	55	0.00	0.00
Slope (%) :	1.82	0.00	0.00
2 yr, 24 hr Rainfall (in) :	1.5	0.00	0.00
Velocity (ft/sec) :	0.10	0.00	0.00
Computed Flow Time (min) :	9.21	0.00	0.00

Channel Flow Computations	Subarea A	Subarea B	Subarea C
Manning's Roughness :	.021	.025	0.00
Flow Length (ft) :	219	72	0.00
Channel Slope (%) :	.91	1.39	0.00
Cross Section Area (ft²) :	.33	.4	0.00
Wetted Perimeter (ft) :	2.1	2.92	0.00
Velocity (ft/sec) :	1.97	1.87	0.00
Computed Flow Time (min) :	1.85	0.64	0.00

Total TOC (min) 11.71

Subbasin Runoff Results

Total Rainfall (in) 2.46
Total Runoff (in) 1.50
Peak Runoff (cfs) 1.22
Weighted Curve Number 90.00
Time of Concentration (days hh:mm:ss) 0 00:11:43

Subbasin : F-4.2

Input Data

Area (ac) 2.57
Weighted Curve Number 83.00
Rain Gage ID .... Rain Gage-08

Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
1/4 acre lots, 38% impervious	2.57	C	83.00
Composite Area & Weighted CN	2.57		83.00

Time of Concentration

Sheet Flow Computations	Subarea A	Subarea B	Subarea C
Manning's Roughness :	.3	0.00	0.00
Flow Length (ft) :	46	0.00	0.00
Slope (%) :	8.7	0.00	0.00
2 yr, 24 hr Rainfall (in) :	1.5	0.00	0.00
Velocity (ft/sec) :	0.10	0.00	0.00
Computed Flow Time (min) :	7.44	0.00	0.00

Shallow Concentrated Flow Computations	Subarea A	Subarea B	Subarea C
Flow Length (ft) :	120	0.00	0.00
Slope (%) :	1.67	0.00	0.00
Surface Type :	Unpaved	Unpaved	Unpaved
Velocity (ft/sec) :	2.09	0.00	0.00
Computed Flow Time (min) :	0.96	0.00	0.00

Channel Flow Computations	Subarea A	Subarea B	Subarea C
Manning's Roughness :	.013	0.00	0.00
Flow Length (ft) :	245	0.00	0.00
Channel Slope (%) :	.41	0.00	0.00
Cross Section Area (ft²) :	.04	0.00	0.00
Wetted Perimeter (ft) :	1.31	0.00	0.00
Velocity (ft/sec) :	0.72	0.00	0.00
Computed Flow Time (min) :	5.70	0.00	0.00

Total TOC (min) 14.09

Subbasin Runoff Results

Total Rainfall (in) 2.46
Total Runoff (in) 1.03
Peak Runoff (cfs) 1.49
Weighted Curve Number 83.00
Time of Concentration (days hh:mm:ss) 0 00:14:05

Subbasin : F-4.3

Input Data

Area (ac) 2.05
Weighted Curve Number 90.00
Rain Gage ID .... Rain Gage-08

Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
1/8 acre lots, 65% impervious	2.05	C	90.00
Composite Area & Weighted CN	2.05		90.00

Time of Concentration

User-Defined TOC override (minutes): 5

Subbasin Runoff Results

Total Rainfall (in) 2.46
Total Runoff (in) 1.50
Peak Runoff (cfs) 2.41
Weighted Curve Number 90.00
Time of Concentration (days hh:mm:ss) 0 00:05:00

Subbasin : F-4.4

Input Data

Area (ac) 7.77
Weighted Curve Number 87.97
Rain Gage ID .... Rain Gage-08

Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
Paved parking & roofs	0.23	C	98.00
1/4 acre lots, 38% impervious	2.57	C	83.00
Gravel roads	3.90	C	89.00
Urban commercial, 85% imp	1.07	C	94.00
Composite Area & Weighted CN	7.77		87.97

Time of Concentration

Sheet Flow Computations	Subarea A	Subarea B	Subarea C
Manning's Roughness :	.35	0.00	0.00
Flow Length (ft) :	15	0.00	0.00
Slope (%) :	20	0.00	0.00
2 yr, 24 hr Rainfall (in) :	1.5	0.00	0.00
Velocity (ft/sec) :	0.10	0.00	0.00
Computed Flow Time (min) :	2.46	0.00	0.00

Shallow Concentrated Flow Computations	Subarea A	Subarea B	Subarea C
Flow Length (ft) :	60	245	0.00
Slope (%) :	3.33	.41	0.00
Surface Type :	Unpaved	Unpaved	Unpaved
Velocity (ft/sec) :	2.94	1.03	0.00
Computed Flow Time (min) :	0.34	3.96	0.00

Channel Flow Computations	Subarea A	Subarea B	Subarea C
Manning's Roughness :	.016	0.00	0.00
Flow Length (ft) :	216	0.00	0.00
Channel Slope (%) :	.46	0.00	0.00
Cross Section Area (ft²) :	.6	0.00	0.00
Wetted Perimeter (ft) :	4.04	0.00	0.00
Velocity (ft/sec) :	1.77	0.00	0.00
Computed Flow Time (min) :	2.03	0.00	0.00

Total TOC (min) 8.80

Subbasin Runoff Results

Total Rainfall (in) 2.46
Total Runoff (in) 1.35
Peak Runoff (cfs) 7.20
Weighted Curve Number 87.97
Time of Concentration (days hh:mm:ss) 0 00:08:48

Subbasin : F-4.5

Input Data

Area (ac) 0.47
Weighted Curve Number 94.55
Rain Gage ID .... Rain Gage-08

Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
Paved parking & roofs	0.14	C	98.00
Urban commercial, 85% imp	0.27	C	94.00
Gravel roads	0.06	C	89.00
Composite Area & Weighted CN	0.47		94.55

Time of Concentration

Sheet Flow Computations	Subarea A	Subarea B	Subarea C
Manning's Roughness :	0.11	0.00	0.00
Flow Length (ft) :	58	0.00	0.00
Slope (%) :	1.72	0.00	0.00
2 yr, 24 hr Rainfall (in) :	1.5	0.00	0.00
Velocity (ft/sec) :	0.13	0.00	0.00
Computed Flow Time (min) :	7.67	0.00	0.00

Channel Flow Computations	Subarea A	Subarea B	Subarea C
Manning's Roughness :	0.025	0.00	0.00
Flow Length (ft) :	191	0.00	0.00
Channel Slope (%) :	0.52	0.00	0.00
Cross Section Area (ft²) :	0.6	0.00	0.00
Wetted Perimeter (ft) :	4.04	0.00	0.00
Velocity (ft/sec) :	1.21	0.00	0.00
Computed Flow Time (min) :	2.64	0.00	0.00

Total TOC (min) 10.31

Subbasin Runoff Results

Total Rainfall (in) 2.46
Total Runoff (in) 1.88
Peak Runoff (cfs) 0.56
Weighted Curve Number 94.55
Time of Concentration (days hh:mm:ss) 0 00:10:19

Subbasin : L-1.1

Input Data

Area (ac) 0.88
Weighted Curve Number 96.36
Rain Gage ID .... Rain Gage-08

Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
Paved parking & roofs	0.82	C	98.00
> 75% grass cover, Good	0.06	C	74.00
Composite Area & Weighted CN	0.88		96.36

Time of Concentration

User-Defined TOC override (minutes): 5

Subbasin Runoff Results

Total Rainfall (in) 2.46
Total Runoff (in) 2.06
Peak Runoff (cfs) 1.33
Weighted Curve Number 96.36
Time of Concentration (days hh:mm:ss) 0 00:05:00

Subbasin : L-1.2

Input Data

Area (ac) 2.73
Weighted Curve Number 96.33
Rain Gage ID .... Rain Gage-08

Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
Paved parking & roofs	2.49	C	98.00
50 - 75% grass cover, Fair	0.24	C	79.00
Composite Area & Weighted CN	2.73		96.33

Time of Concentration

User-Defined TOC override (minutes): 5

Subbasin Runoff Results

Total Rainfall (in) 2.46
Total Runoff (in) 2.06
Peak Runoff (cfs) 4.10
Weighted Curve Number 96.33
Time of Concentration (days hh:mm:ss) 0 00:05:00

Subbasin : L-2.1

Input Data

Area (ac) 2.75
Weighted Curve Number 94.00
Rain Gage ID .... Rain Gage-08

Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
Urban commercial, 85% imp	2.75	C	94.00
Composite Area & Weighted CN	2.75		94.00

Time of Concentration

User-Defined TOC override (minutes): 5

Subbasin Runoff Results

Total Rainfall (in) 2.46
Total Runoff (in) 1.83
Peak Runoff (cfs) 3.82
Weighted Curve Number 94.00
Time of Concentration (days hh:mm:ss) 0 00:05:00

Subbasin : L-2.2

Input Data

Area (ac) 2.31
Weighted Curve Number 96.91
Rain Gage ID .... Rain Gage-08

Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
Paved parking & roofs	2.10	C	98.00
< 50% grass cover, Poor	0.21	C	86.00
Composite Area & Weighted CN	2.31		96.91

Time of Concentration

User-Defined TOC override (minutes): 5

Subbasin Runoff Results

Total Rainfall (in) 2.46
Total Runoff (in) 2.12
Peak Runoff (cfs) 3.52
Weighted Curve Number 96.91
Time of Concentration (days hh:mm:ss) 0 00:05:00

Subbasin : L-2.3

Input Data

Area (ac) 3.09
Weighted Curve Number 97.34
Rain Gage ID .... Rain Gage-08

Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
Paved parking & roofs	2.92	C	98.00
< 50% grass cover, Poor	0.17	C	86.00
Composite Area & Weighted CN	3.09		97.34

Time of Concentration

Sheet Flow Computations	Subarea A	Subarea B	Subarea C
Manning's Roughness :	0.35	0.00	0.00
Flow Length (ft) :	39	0.00	0.00
Slope (%) :	2.56	0.00	0.00
2 yr, 24 hr Rainfall (in) :	1.5	0.00	0.00
Velocity (ft/sec) :	0.05	0.00	0.00
Computed Flow Time (min) :	12.02	0.00	0.00

Shallow Concentrated Flow Computations	Subarea A	Subarea B	Subarea C
Flow Length (ft) :	55	194	0.00
Slope (%) :	1.82	0.52	0.00
Surface Type :	Paved	Paved	Unpaved
Velocity (ft/sec) :	2.74	1.47	0.00
Computed Flow Time (min) :	0.33	2.20	0.00

Total TOC (min) 14.56

Subbasin Runoff Results

Total Rainfall (in) 2.46
Total Runoff (in) 2.16
Peak Runoff (cfs) 3.45
Weighted Curve Number 97.34
Time of Concentration (days hh:mm:ss) 0 00:14:34

Subbasin : L-2.4

Input Data

Area (ac) 3.74
Weighted Curve Number 96.40
Rain Gage ID .... Rain Gage-08

Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
Paved parking & roofs	3.24	C	98.00
< 50% grass cover, Poor	0.50	C	86.00
Composite Area & Weighted CN	3.74		96.40

Time of Concentration

Sheet Flow Computations	Subarea A	Subarea B	Subarea C
Manning's Roughness :	0.01	0.00	0.00
Flow Length (ft) :	76	0.00	0.00
Slope (%) :	1.32	0.00	0.00
2 yr, 24 hr Rainfall (in) :	1.5	0.00	0.00
Velocity (ft/sec) :	0.81	0.00	0.00
Computed Flow Time (min) :	1.55	0.00	0.00

Shallow Concentrated Flow Computations	Subarea A	Subarea B	Subarea C
Flow Length (ft) :	87	162	0.00
Slope (%) :	1.15	1.85	0.00
Surface Type :	Paved	Paved	Unpaved
Velocity (ft/sec) :	2.18	2.76	0.00
Computed Flow Time (min) :	0.67	0.98	0.00

Channel Flow Computations	Subarea A	Subarea B	Subarea C
Manning's Roughness :	0.013	0.00	0.00
Flow Length (ft) :	197	0.00	0.00
Channel Slope (%) :	0.51	0.00	0.00
Cross Section Area (ft²) :	0.04	0.00	0.00
Wetted Perimeter (ft) :	1.31	0.00	0.00
Velocity (ft/sec) :	0.80	0.00	0.00
Computed Flow Time (min) :	4.11	0.00	0.00

Total TOC (min) 7.30

Subbasin Runoff Results

Total Rainfall (in) 2.46
Total Runoff (in) 2.06
Peak Runoff (cfs) 5.22
Weighted Curve Number 96.40
Time of Concentration (days hh:mm:ss) 0 00:07:18

Subbasin : L-2.5

Input Data

Area (ac) 3.92
Weighted Curve Number 95.98
Rain Gage ID .... Rain Gage-08

Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
Paved parking & roofs	3.49	C	98.00
Woods, Fair	0.22	C	73.00
< 50% grass cover, Poor	0.20	C	86.00
Composite Area & Weighted CN	3.91		95.98

Time of Concentration

Sheet Flow Computations	Subarea A	Subarea B	Subarea C
Manning's Roughness :	0.8	0.00	0.00
Flow Length (ft) :	70	0.00	0.00
Slope (%) :	2.86	0.00	0.00
2 yr, 24 hr Rainfall (in) :	1.5	0.00	0.00
Velocity (ft/sec) :	0.03	0.00	0.00
Computed Flow Time (min) :	35.58	0.00	0.00

Shallow Concentrated Flow Computations	Subarea A	Subarea B	Subarea C
Flow Length (ft) :	87	0.00	0.00
Slope (%) :	2.3	0.00	0.00
Surface Type :	Bare & untilled	Unpaved	Unpaved
Velocity (ft/sec) :	1.52	0.00	0.00
Computed Flow Time (min) :	0.95	0.00	0.00

Channel Flow Computations	Subarea A	Subarea B	Subarea C
Manning's Roughness :	0.013	0.013	0.00
Flow Length (ft) :	101	243	0.00
Channel Slope (%) :	0.99	0.82	0.00
Cross Section Area (ft^2) :	0.4	0.04	0.00
Wetted Perimeter (ft) :	2.92	1.31	0.00
Velocity (ft/sec) :	3.03	1.01	0.00
Computed Flow Time (min) :	0.56	3.99	0.00

Total TOC (min) 41.08

Subbasin Runoff Results

Total Rainfall (in) 2.46
Total Runoff (in) 2.02
Peak Runoff (cfs) 2.54
Weighted Curve Number 95.98
Time of Concentration (days hh:mm:ss) 0 00:41:05

Subbasin : L-2.6

Input Data

Area (ac) 6.98
Weighted Curve Number 93.21
Rain Gage ID .... Rain Gage-08

Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
Paved parking & roofs	5.58	C	98.00
Woods, Fair	0.87	C	73.00
Woods & grass combination, Fair	0.53	C	76.00
Composite Area & Weighted CN	6.98		93.21

Time of Concentration

Sheet Flow Computations	Subarea A	Subarea B	Subarea C
Manning's Roughness :	0.3	0.00	0.00
Flow Length (ft) :	79	0.00	0.00
Slope (%) :	15.19	0.00	0.00
2 yr, 24 hr Rainfall (in) :	1.5	0.00	0.00
Velocity (ft/sec) :	0.14	0.00	0.00
Computed Flow Time (min) :	9.17	0.00	0.00

Shallow Concentrated Flow Computations	Subarea A	Subarea B	Subarea C
Flow Length (ft) :	131	42	0.00
Slope (%) :	12.21	2.38	0.00
Surface Type :	Unpaved	Paved	Unpaved
Velocity (ft/sec) :	5.64	3.14	0.00
Computed Flow Time (min) :	0.39	0.22	0.00

Channel Flow Computations	Subarea A	Subarea B	Subarea C
Manning's Roughness :	0.013	0.013	0.00
Flow Length (ft) :	154	253	0.00
Channel Slope (%) :	7.14	0.79	0.00
Cross Section Area (ft^2) :	0.4	0.4	0.00
Wetted Perimeter (ft) :	2.92	2.92	0.00
Velocity (ft/sec) :	8.14	2.71	0.00
Computed Flow Time (min) :	0.32	1.56	0.00

Total TOC (min) 11.65

Subbasin Runoff Results

Total Rainfall (in) 2.46
Total Runoff (in) 1.76
Peak Runoff (cfs) 7.46
Weighted Curve Number 93.21
Time of Concentration (days hh:mm:ss) 0 00:11:39

Subbasin : W-1.1

Input Data

Area (ac) 0.51
Weighted Curve Number 85.29
Rain Gage ID .... Rain Gage-08

Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
> 75% grass cover, Good	0.27	C	74.00
Paved parking & roofs	0.24	C	98.00
Composite Area & Weighted CN	0.51		85.29

Time of Concentration

User-Defined TOC override (minutes): 5

Subbasin Runoff Results

Total Rainfall (in) 2.46
Total Runoff (in) 1.17
Peak Runoff (cfs) 0.47
Weighted Curve Number 85.29
Time of Concentration (days hh:mm:ss) 0 00:05:00

Subbasin : W-1.2

Input Data

Area (ac) 0.84
Weighted Curve Number 94.00
Rain Gage ID .... Rain Gage-08

Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
Urban commercial, 85% imp	0.84	C	94.00
Composite Area & Weighted CN	0.84		94.00

Time of Concentration

User-Defined TOC override (minutes): 5

Subbasin Runoff Results

Total Rainfall (in) 2.46
Total Runoff (in) 1.83
Peak Runoff (cfs) 1.17
Weighted Curve Number 94.00
Time of Concentration (days hh:mm:ss) 0 00:05:00

Channel Input

SN	Element ID	Length (ft)	Inlet Invert Elevation (ft)	Inlet Invert Offset (ft)	Outlet Invert Elevation (ft)	Outlet Invert Offset (ft)	Total Drop (ft)	Average Slope (%)	Shape	Height (ft)	Width (ft)	Manning's Roughness	Entrance Losses	Exit/Bend Losses	Additional Losses	Initial Flow (cfs)	Flap Gate
1	W-P-2	251.58	130.83	0.00	130.40	0.00	0.43	0.1700	Trapezoidal	3.000	14.000	0.0350	0.5000	0.5000	0.0000	0.00	No
2	W-P-4	171.73	131.20	-0.63	130.90	0.00	0.30	0.1700	Trapezoidal	3.500	16.500	0.0350	0.5000	0.5000	0.0000	0.00	No

Channel Results

SN	Element ID	Peak Flow (cfs)	Time of Peak Flow Occurrence (days hh:mm)	Design Flow Capacity (cfs)	Peak Flow/ Design Flow Ratio	Peak Flow Velocity (ft/sec)	Travel Time (min)	Peak Flow Depth (ft)	Peak Flow Depth/ Total Depth Ratio	Total Time Surcharged (min)	Froude Number	Reported Condition
1	W-P-2	34.83	0 12:17	61.21	0.57	2.28	1.84	2.32	0.78	0.00		
2	W-P-4	36.59	0 12:18	155.52	0.24	3.24	0.88	1.82	0.52	0.00		

Pipe Input

SN	Element ID	Length (ft)	Inlet Invert Elevation (ft)	Inlet Invert Offset (ft)	Outlet Invert Elevation (ft)	Outlet Invert Offset (ft)	Total Drop (ft)	Average Slope (%)	Pipe Shape	Pipe Diameter or Height (in)	Pipe Width (in)	Manning's Roughness	Entrance Losses	Exit/Bend Losses	Additional Losses	Initial Flow (cfs)	Flap Gate	No. of Barrels
1	C-P-1	270.68	150.16	2.18	149.35	0.00	0.81	0.3000	CIRCULAR	18.000	18.000	0.0130	0.5000	0.5000	0.0000	0.00	No	1
2	C-P-10	159.04	149.32	1.70	148.84	1.60	0.48	0.3000	CIRCULAR	18.000	18.000	0.0120	0.5000	0.5000	0.0000	0.00	No	1
3	C-P-11	21.28	147.63	0.74	147.50	1.50	0.13	0.6100	CIRCULAR	24.000	24.000	0.0120	0.5000	0.5000	0.0000	0.00	No	1
4	C-P-12	209.57	148.73	1.11	147.68	0.79	1.05	0.5000	CIRCULAR	24.000	24.000	0.0120	0.5000	0.5000	0.0000	0.00	No	1
5	C-P-13	253.90	150.05	1.56	148.78	1.16	1.27	0.5000	CIRCULAR	24.000	24.000	0.0120	0.5000	0.5000	0.0000	0.00	No	1
6	C-P-14	274.05	150.92	1.99	150.10	1.61	0.82	0.3000	CIRCULAR	24.000	24.000	0.0120	0.5000	0.5000	0.0000	0.00	No	1
7	C-P-2	43.38	150.42	2.00	150.22	2.24	0.20	0.4600	CIRCULAR	12.000	12.000	0.0120	0.5000	0.5000	0.0000	0.00	No	1
8	C-P-3	61.36	150.29	0.50	149.98	2.00	0.31	0.5100	CIRCULAR	18.000	18.000	0.0130	0.5000	0.5000	0.0000	0.00	No	1
9	C-P-4	39.55	150.39	2.00	150.22	2.24	0.17	0.4300	CIRCULAR	12.000	12.000	0.0120	0.5000	0.5000	0.0000	0.00	No	1
10	C-P-5	333.41	147.35	0.60	145.68	0.00	1.67	0.5000	CIRCULAR	36.000	36.000	0.0140	0.5000	0.5000	0.0000	0.00	No	1
11	C-P-6	21.49	147.34	1.34	147.25	0.50	0.09	0.4200	CIRCULAR	36.000	36.000	0.0140	0.5000	0.5000	0.0000	0.00	No	1
12	C-P-7	32.16	147.60	1.50	147.50	1.50	0.10	0.3100	CIRCULAR	18.000	18.000	0.0120	0.5000	0.5000	0.0000	0.00	No	1
13	C-P-8	153.51	148.16	1.56	147.70	1.60	0.46	0.3000	CIRCULAR	18.000	18.000	0.0120	0.5000	0.5000	0.0000	0.00	No	1
14	C-P-9	159.01	148.74	1.50	148.26	1.66	0.48	0.3000	CIRCULAR	18.000	18.000	0.0120	0.5000	0.5000	0.0000	0.00	No	1
15	F-P-1	30.23	131.92	1.50	131.83	0.00	0.09	0.3000	CIRCULAR	48.000	48.000	0.0120	0.5000	0.5000	0.0000	0.00	No	1
16	F-P-10	49.70	139.30	1.50	137.51	2.00	1.79	3.6000	CIRCULAR	24.000	24.000	0.0120	0.5000	0.5000	0.0000	0.00	No	1
17	F-P-11	118.65	143.60	1.50	139.40	1.60	4.20	3.5400	CIRCULAR	24.000	24.000	0.0120	0.5000	0.5000	0.0000	0.00	No	1
18	F-P-12	26.60	148.66	6.42	144.01	1.91	4.65	17.4700	CIRCULAR	18.000	18.000	0.0120	0.5000	0.5000	0.0000	0.00	No	1
19	F-P-13	166.24	144.20	1.50	143.70	1.60	0.50	0.3000	CIRCULAR	24.000	24.000	0.0120	0.5000	0.5000	0.0000	0.00	No	1
20	F-P-14	232.75	145.00	1.50	144.30	1.60	0.70	0.3000	CIRCULAR	24.000	24.000	0.0120	0.5000	0.5000	0.0000	0.00	No	1
21	F-P-15	69.12	145.32	1.50	145.10	1.60	0.22	0.3200	CIRCULAR	24.000	24.000	0.0120	0.5000	0.5000	0.0000	0.00	No	1
22	F-P-16	117.91	146.17	6.17	145.82	2.00	0.35	0.3000	CIRCULAR	18.000	18.000	0.0120	0.5000	0.5000	0.0000	0.00	No	1
23	F-P-17	50.37	145.57	1.50	145.42	1.60	0.15	0.3000	CIRCULAR	24.000	24.000	0.0120	0.5000	0.5000	0.0000	0.00	No	1
24	F-P-18	199.26	146.27	1.50	145.67	1.60	0.60	0.3000	CIRCULAR	18.000	18.000	0.0120	0.5000	0.5000	0.0000	0.00	No	1
25	F-P-19	94.78	146.65	1.50	146.37	1.60	0.28	0.3000	CIRCULAR	18.000	18.000	0.0120	0.5000	0.5000	0.0000	0.00	No	1
26	F-P-2	116.23	132.32	1.50	131.97	1.55	0.35	0.3000	CIRCULAR	36.000	36.000	0.0120	0.5000	0.5000	0.0000	0.00	No	1
27	F-P-20	110.56	147.08	1.50	146.75	1.60	0.33	0.3000	CIRCULAR	18.000	18.000	0.0120	0.5000	0.5000	0.0000	0.00	No	1
28	F-P-21	57.70	147.38	1.50	147.20	1.62	0.18	0.3100	CIRCULAR	18.000	18.000	0.0120	0.5000	0.5000	0.0000	0.00	No	1
29	F-P-22	108.18	147.80	2.00	147.48	1.60	0.32	0.3000	CIRCULAR	18.000	18.000	0.0120	0.5000	0.5000	0.0000	0.00	No	1
30	F-P-23	63.27	148.09	1.50	147.90	2.10	0.19	0.3000	CIRCULAR	18.000	18.000	0.0120	0.5000	0.5000	0.0000	0.00	No	1
31	F-P-3	79.16	132.61	1.50	132.37	1.55	0.24	0.3000	CIRCULAR	36.000	36.000	0.0120	0.5000	0.5000	0.0000	0.00	No	1
32	F-P-4	49.06	132.81	1.50	132.66	1.55	0.15	0.3100	CIRCULAR	36.000	36.000	0.0120	0.5000	0.5000	0.0000	0.00	No	1
33	F-P-5	110.24	133.14	1.50	132.81	1.50	0.33	0.3000	CIRCULAR	36.000	36.000	0.0120	0.5000	0.5000	0.0000	0.00	No	1
34	F-P-6	149.77	135.14	1.50	133.64	2.00	1.50	1.0000	CIRCULAR	30.000	30.000	0.0120	0.5000	0.5000	0.0000	0.00	No	1
35	F-P-7	154.16	137.01	1.50	135.24	1.60	1.77	1.1500	CIRCULAR	30.000	30.000	0.0120	0.5000	0.5000	0.0000	0.00	No	1
36	F-P-8	69.67	138.46	1.50	138.25	2.74	0.21	0.3000	CIRCULAR	18.000	18.000	0.0120	0.5000	0.5000	0.0000	0.00	No	1
37	F-P-9	32.86	137.30	2.00	137.20	1.69	0.10	0.3000	CIRCULAR	30.000	30.000	0.0120	0.5000	0.5000	0.0000	0.00	No	1
38	L-P-1	50.50	133.01	0.50	132.33	1.91	0.68	1.3500	CIRCULAR	18.000	18.000	0.0250	0.5000	0.5000	0.0000	0.00	No	1
39	L-P-10	38.50	134.65	0.50	133.92	0.74	0.73	1.9000	CIRCULAR	18.000	18.000	0.0130	0.5000	0.5000	0.0000	0.00	No	1
40	L-P-11	297.00	134.19	0.50	133.73	0.55	0.46	0.1500	Horizontal Ellipse	18.000	29.040	0.0250	0.5000	0.5000	0.0000	0.00	No	1
41	L-P-12	297.00	135.74	0.50	134.24	0.55	1.50	0.5100	CIRCULAR	18.000	18.000	0.0250	0.5000	0.5000	0.0000	0.00	No	1
42	L-P-2	15.00	133.08	0.50	133.08	0.57	0.00	0.0000	CIRCULAR	12.000	12.000	0.0130	0.5000	0.5000	0.0000	0.00	No	1
43	L-P-3	16.00	133.30	0.49	133.30	0.72	0.00	0.0000	CIRCULAR	12.000	12.000	0.0130	0.5000	0.5000	0.0000	0.00	No	1
44	L-P-4	17.00	133.77	0.50	133.56	0.75	0.21	1.2400	CIRCULAR	18.000	18.000	0.0130	0.5000	0.5000	0.0000	0.00	No	1
45	L-P-5	16.40	136.37	0.49	134.97	2.16	1.40	8.5400	CIRCULAR	12.000	12.000	0.0130	0.5000	0.5000	0.0000	0.00	No	1
46	L-P-6	224.00	131.84	0.50	131.59	1.17	0.25	0.1100	Horizontal Ellipse	18.000	29.040	0.0250	0.5000	0.5000	0.0000	0.00	No	1
47	L-P-7	160.00	132.64	0.50	132.21	0.87	0.43	0.2700	Horizontal Ellipse	18.000	29.040	0.0250	0.5000	0.5000	0.0000	0.00	No	1
48	L-P-8	60.00	132.81	0.50	132.64	0.50	0.17	0.2800	Horizontal Ellipse	18.000	29.040	0.0250	0.5000	0.5000	0.0000	0.00	No	1
49	L-P-9	284.00	133.68	0.50	132.86	0.55	0.82	0.2900	Horizontal Ellipse	18.000	29.040	0.0250	0.5000	0.5000	0.0000	0.00	No	1
50	M-P-1	54.00	132.50	1.28	132.00	0.17	0.50	0.9300	CIRCULAR	12.000	12.000	0.0130	0.5000	0.5000	0.0000	0.00	No	1
51	M-P-2	50.00	132.75	0.00	132.60	1.38	0.15	0.3000	CIRCULAR	12.000	12.000	0.0130	0.5000	0.5000	0.0000	0.00	No	1
52	T-P-1	315.00	138.41	0.50	137.47	2.17	0.94	0.3000	CIRCULAR	30.000	30.000	0.0250	0.5000	0.5000	0.0000	0.00	No	1
53	T-P-10	225.00	143.50	0.50	142.22	0.70	1.28	0.5700	CIRCULAR	18.000	18.000	0.0250	0.5000	0.5000	0.0000	0.00	No	1
54	T-P-11	113.00	144.14	0.50	143.50	0.50	0.64	0.5700	CIRCULAR	18.000	18.000	0.0250	0.5000	0.5000	0.0000	0.00	No	1
55	T-P-12	130.00	145.37	0.52	144.47	0.83	0.90	0.6900	CIRCULAR	18.000	18.000	0.0250	0.5000	0.5000	0.0000	0.00	No	1
56	T-P-13	20.00	146.70	0.50	146.60	1.75	0.10	0.5000	CIRCULAR	9.960	9.960	0.0250	0.5000	0.5000	0.0000	0.00	No	1
57	T-P-14	354.00	147.71	0.50	145.94	1.09	1.77	0.5000	CIRCULAR	12.000	12.000	0.0250	0.5000	0.5000	0.0000	0.00	No	1
58	T-P-15	324.00	147.44	0.50	145.82	2.76	1.62	0.5000	CIRCULAR	18.000	18.000	0.0250	0.5000	0.5000	0.0000	0.00	No	1
59	T-P-17	630.84	152.88	0.50	145.55	2.49	7.33	1.1600	CIRCULAR	18.000	18.000	0.0250	0.5000	0.5000	0.0000	0.00	No	1
60	T-P-2	50.00	138.60	0.50	138.45	0.54	0.15	0.3000	CIRCULAR	18.000	18.000	0.0250	0.5000	0.5000	0.0000	0.00	No	1
61	T-P-3	337.33	139.46	0.50	138.45	0.54	1.01	0.3000	CIRCULAR	30.000	30.000	0.0250	0.5000	0.5000	0.0000	0.00	No	1
62	T-P-4	586.23	151.45	0.50	141.63	2.67	9.82	1.6800	CIRCULAR	18.000	18.000	0.0250	0.5000	0.5000	0.0000	0.00	No	1
63	T-P-5	71.90	139.84	0.50	139.60	0.64	0.24	0.3300	CIRCULAR	30.000	30.000	0.0250	0.5000	0.5000	0.0000	0.00	No	1
64	T-P-6	544.84	141.97	0.50	139.89	0.55	2.08	0.3800	CIRCULAR	30.000	30.000	0.0250	0.5000	0.5000	0.0000	0.00	No	1
65	T-P-7	48.50	142.22	0.70	142.02	0.55	0.20	0.4100	CIRCULAR	24.000	24.000	0.0250	0.5000	0.5000	0.0000	0.00	No	1
66	T-P-8	276.60	143.51	0.50	142.21	0.69	1.30	0.4700	CIRCULAR	24.000	24.000	0.0250	0.5000	0.5000	0.0000	0.00	No	1
67	T-P-9	380.00	145.58	2.52	143.56	0.55	2.02	0.5300	CIRCULAR	18.000	18.000	0.0250	0.5000	0.5000	0.0000	0.00	No	1
68	W-P-1	40.70	130.40	0.00	130.33	0.00	0.07	0.1700	CIRCULAR	36.000	36.000	0.0120	0.5000	0.5000	0.0000	0.00	No	1
69	W-P-3	40.15	130.90	0.00	130.83	0.00	0.07	0.1700	CIRCULAR	36.000	36.000	0.0120	0.5000	0.5000	0.0000	0.00	No	1

Pipe Results

SN	Element ID	Peak Flow (cfs)	Time of Peak Flow Occurrence (days hh:mm)	Design Flow Capacity (cfs)	Peak Flow/ Design Flow Ratio	Peak Flow Velocity (ft/sec)	Travel Time (min)	Peak Flow Depth (ft)	Peak Flow Depth/ Total Depth Ratio	Total Time Surcharged (min)	Froude Number	Reported Condition
1	C-P-1	3.52	0 12:21	5.75	0.61	3.42	1.32	0.85	0.57	0.00		Calculated
2	C-P-10	3.26	0 12:20	6.25	0.52	3.58	0.74	0.77	0.51	0.00		Calculated
3	C-P-11	16.58	0 12:12	19.15	0.87	6.86	0.05	1.34	0.72	0.00		Calculated
4	C-P-12	16.05	0 12:12	17.35	0.93	6.30	0.55	1.43	0.76	0.00		Calculated
5	C-P-13	13.87	0 12:11	17.33	0.80	6.16	0.69	1.30	0.68	0.00		Calculated
6	C-P-14	11.74	0 12:11	13.41	0.88	4.85	0.94	1.44	0.72	0.00		Calculated
7	C-P-2	1.29	0 12:15	2.63	0.49	3.35	0.22	0.50	0.50	0.00		Calculated
8	C-P-3	2.47	0 12:30	7.47	0.33	3.79	0.27	0.59	0.40	0.00		Calculated
9	C-P-4	0.51	0 12:20	2.52	0.20	2.51	0.26	0.31	0.31	0.00		Calculated
10	C-P-5	21.47	0 12:12	43.83	0.49	6.19	0.90	1.44	0.49	0.00		Calculated
11	C-P-6	21.58	0 12:12	40.08	0.54	5.77	0.06	1.51	0.52	0.00		Calculated
12	C-P-7	5.33	0 12:15	6.35	0.84	4.03	0.13	1.05	0.70	0.00		Calculated
13	C-P-8	3.70	0 12:21	6.23	0.59	3.68	0.70	0.83	0.55	0.00		Calculated
14	C-P-9	3.25	0 12:21	6.25	0.52	3.58	0.74	0.76	0.51	0.00		Calculated
15	F-P-1	36.22	0 12:17	84.91	0.43	6.49	0.08	1.81	0.46	0.00		Calculated
16	F-P-10	10.50	0 12:16	46.51	0.23	11.96	0.07	0.64	0.32	0.00		Calculated
17	F-P-11	8.58	0 12:19	46.11	0.19	11.23	0.18	0.58	0.29	0.00		Calculated
18	F-P-12	1.18	0 12:10	47.57	0.02	11.02	0.04	0.17	0.11	0.00		Calculated
19	F-P-13	8.04	0 12:21	13.44	0.60	4.47	0.62	1.11	0.56	0.00		Calculated
20	F-P-14	8.06	0 12:20	13.44	0.60	4.48	0.87	1.12	0.56	0.00		Calculated
21	F-P-15	5.65	0 12:20	13.83	0.41	4.18	0.28	0.89	0.45	0.00		Calculated
22	F-P-16	2.28	0 12:20	6.20	0.37	3.24	0.61	0.63	0.42	0.00		Calculated
23	F-P-17	3.44	0 12:18	13.37	0.26	3.57	0.24	0.69	0.35	0.00		Calculated
24	F-P-18	3.44	0 12:18	6.24	0.55	3.62	0.92	0.79	0.53	0.00		Calculated
25	F-P-19	2.61	0 12:16	6.19	0.42	3.36	0.47	0.66	0.45	0.00		Calculated
26	F-P-2	30.11	0 12:17	39.65	0.76	6.17	0.31	1.93	0.65	0.00		Calculated
27	F-P-20	2.61	0 12:16	6.22	0.42	3.37	0.55	0.67	0.45	0.00		Calculated
28	F-P-21	2.61	0 12:16	6.36	0.41	3.43	0.28	0.67	0.45	0.00		Calculated
29	F-P-22	1.45	0 12:16	6.19	0.23	2.86	0.63	0.49	0.33	0.00		Calculated
30	F-P-23	1.46	0 12:15	6.24	0.23	2.89	0.36	0.49	0.33	0.00		Calculated
31	F-P-3	30.12	0 12:17	39.79	0.76	6.19	0.21	1.92	0.65	0.00		Calculated
32	F-P-4	30.12	0 12:16	39.95	0.75	6.21	0.13	1.92	0.65	0.00		Calculated
33	F-P-5	30.12	0 12:16	39.53	0.76	6.16	0.30	1.93	0.65	0.00		Calculated
34	F-P-6	28.24	0 12:16	44.47	0.63	9.59	0.26	1.44	0.58	0.00		Calculated
35	F-P-7	26.60	0 12:16	47.61	0.56	9.97	0.26	1.33	0.53	0.00		Calculated
36	F-P-8	3.31	0 12:20	6.25	0.53	3.60	0.32	0.78	0.52	0.00		Calculated
37	F-P-9	14.01	0 12:12	24.51	0.57	5.16	0.11	1.33	0.54	0.00		Calculated
38	L-P-1	1.64	0 12:00	6.34	0.26	3.04	0.28	0.52	0.35	0.00		Calculated
39	L-P-10	4.45	0 12:15	14.46	0.31	7.20	0.09	0.57	0.38	0.00		Calculated
40	L-P-11	4.06	0 12:26	4.52	0.90	1.91	2.59	1.04	0.70	0.00		Calculated
41	L-P-12	4.18	0 12:25	3.88	1.08	2.70	1.83	1.50	1.00	15.00		SURCHARGED
42	L-P-2	1.67	0 12:20	1.59	1.05	2.33	0.11	1.00	1.00	0.00		> CAPACITY
43	L-P-3	1.72	0 12:20	1.59	1.08	2.34	0.11	1.00	1.00	20.00		SURCHARGED
44	L-P-4	3.86	0 12:10	11.67	0.33	5.92	0.05	0.59	0.40	0.00		Calculated
45	L-P-5	1.25	0 12:10	10.41	0.12	8.88	0.03	0.23	0.23	0.00		Calculated
46	L-P-6	5.05	0 11:55	4.52	1.12	1.96	1.90	1.50	1.00	68.00		SURCHARGED
47	L-P-7	5.85	0 12:00	5.24	1.12	2.26	1.18	1.50	1.00	48.00		SURCHARGED
48	L-P-8	6.01	0 12:03	5.38	1.12	2.32	0.43	1.50	1.00	40.00		SURCHARGED
49	L-P-9	6.07	0 12:06	5.43	1.12	2.39	1.98	1.50	1.00	30.00		SURCHARGED
50	M-P-1	0.18	0 12:36	3.43	0.05	2.31	0.39	0.16	0.16	0.00		Calculated
51	M-P-2	0.18	0 12:36	1.95	0.09	1.55	0.54	0.20	0.20	0.00		Calculated
52	T-P-1	12.62	0 12:12	11.68	1.08	2.82	1.86	2.50	1.00	32.00		SURCHARGED
53	T-P-10	4.45	0 12:25	4.12	1.08	2.79	1.34	1.50	1.00	14.00		SURCHARGED
54	T-P-11	4.34	0 12:17	4.11	1.06	2.72	0.69	1.41	0.94	0.00		> CAPACITY
55	T-P-12	2.05	0 12:23	4.54	0.45	2.51	0.86	0.69	0.47	0.00		Calculated
56	T-P-13	0.86	0 12:21	0.81	1.07	1.71	0.19	0.83	1.00	11.00		SURCHARGED
57	T-P-14	1.42	0 12:28	1.31	1.08	1.99	2.96	0.91	0.92	0.00		> CAPACITY
58	T-P-15	4.16	0 12:24	3.86	1.08	2.71	1.99	1.50	1.00	18.00		SURCHARGED
59	T-P-17	3.07	0 12:16	5.89	0.52	3.52	2.99	0.76	0.51	0.00		Calculated
60	T-P-2	2.42	0 12:15	2.99	0.81	1.90	0.44	1.02	0.68	0.00		Calculated
61	T-P-3	12.61	0 12:17	11.67	1.08	2.84	1.98	2.50	1.00	18.00		SURCHARGED
62	T-P-4	2.90	0 12:21	7.07	0.41	3.84	2.54	0.67	0.45	0.00		Calculated
63	T-P-5	11.58	0 12:20	12.32	0.94	2.85	0.42	1.93	0.77	0.00		Calculated
64	T-P-6	7.78	0 12:35	13.18	0.59	2.84	3.20	1.37	0.55	0.00		Calculated
65	T-P-7	8.12	0 12:31	7.55	1.07	2.79	0.29	2.00	1.00	28.00		SURCHARGED
66	T-P-8	4.26	0 12:03	8.06	0.53	2.67	1.73	1.01	0.51	0.00		Calculated
67	T-P-9	4.30	0 12:02	3.98	1.08	2.68	2.36	1.50	1.00	61.00		SURCHARGED
68	W-P-1	34.37	0 12:17	32.31	1.06	5.28	0.13	2.76	1.00	0.00		> CAPACITY
69	W-P-3	34.72	0 12:16	32.31	1.07	5.26	0.13	3.00	1.00	7.00		SURCHARGED

Storage Nodes

Storage Node : Stor-01

Input Data

Invert Elevation (ft) 133.00
Max (Rim) Elevation (ft) 136.00
Max (Rim) Offset (ft) 3.00
Initial Water Elevation (ft) 0.00
Initial Water Depth (ft) .... -133.00
Ponded Area (ft²) 0.00
Evaporation Loss 0.00

Outflow Orifices

SN	Element ID	Orifice Type	Orifice Shape	Flap Gate	Circular Orifice Diameter (in)	Rectangular Orifice Height (in)	Rectangular Orifice Width (in)	Orifice Invert Elevation (ft)	Orifice Coefficient
1	M-O-01	Side	CIRCULAR	No	2.00			132.75	0.61

Output Summary Results

Peak Inflow (cfs) 1.10
Peak Lateral Inflow (cfs) 1.10
Peak Outflow (cfs) 0.18
Peak Exfiltration Flow Rate (cfm) 0.00
Max HGL Elevation Attained (ft) 135.87
Max HGL Depth Attained (ft) 2.87
Average HGL Elevation Attained (ft) 133.64
Average HGL Depth Attained (ft) 0.64
Time of Max HGL Occurrence (days hh:mm) 0 12:35
Total Exfiltration Volume (1000-ft³) 0.000
Total Flooded Volume (ac-in) 0
Total Time Flooded (min) 0
Total Retention Time (sec) 0.00