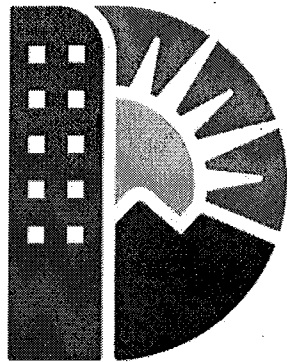


CITY AND COUNTY OF DENVER

STATE OF COLORADO



DENVER[®]
THE MILE HIGH CITY

DEPARTMENT OF PUBLIC WORKS / WASTEWATER
MANAGEMENT DIVISION

BID DOCUMENTS PACKAGE

Contract No. 201207767

IOWA AVENUE EXTENSION PHASE 1

September 18, 2012



DENVER
THE MILE HIGH CITY

Department of Public Works
Engineering Division

Capital Projects Management – Dept. 506
Right-of-Way Services – Dept. 507
Policy and Planning – Dept. 509
Traffic Engineering Services – Dept. 508

201 West Colfax Avenue
Denver, CO 80202
www.Work4Denver.com

NOTICE OF APPARENT LOW BIDDER

B T Construction, Inc.
9885 Emporia St.
Henderson, CO. 80640

The MANAGER OF PUBLIC WORKS has considered the Bids submitted on **October 19, 2012** for work to be done and materials to be furnished in and for:

CONTRACT NO 201207767 IOWA AVENUE EXTENSION PHASE 1

as set forth in detail in the Contract Documents for the City and County of Denver, Colorado. It appears that your Bid is fair, equitable, and to the best interest of the City and County; therefore, said Bid is hereby accepted at the bid price contained herein, subject to the approval and execution of the Contract Documents by the City in accordance with the Charter of the City and County of Denver, and to your furnishing the items specified below. The award is based on the total bid items: **2-1.2a through 50-1 (Fifty [50]) Total Bid Items**, the total estimated cost thereof being: **Two Million Four Hundred Eighty-One Thousand Seven Hundred Eighty-Eight Dollars and Five Cents (\$2,481,788.05)**

It will be necessary for you to appear forthwith at the office of the Department of Public Works, Contract Administration, 201 W. Colfax Ave., Dept 614, Denver, Colorado 80202, to receive the said Contract Documents, execute the same and return them to the Department of Public Works, Contract Administration within the time limit set forth in the Bid Proposal.

In accordance with the requirements set forth in the Contract Documents, you are required to furnish the following documents:

- a. Insurance Certificates: General Liability and Automotive Liability, Workman's Compensation and Employer Liability;
- b. One original plus two copies of the Power of Attorney relative to Performance and/or Payment Bond; and,

All construction Contracts made and entered into by the City and County of Denver are subject to Affirmative Action and Equal Opportunity Rules and Regulations, as adopted by the Manager of Public Works, and each contract requiring payment by the City of one-half million dollars (\$500,000.00) or more shall first be approved by the City Council acting by ordinance and in accordance with Section B1.12.2 of the Charter of the City and County of Denver.

Prior to issuance of Notice to Proceed, all Equal Opportunity requirements must be completed. Additional information may be obtained by contacting the Director of Contract Compliance at (720-913-1700).

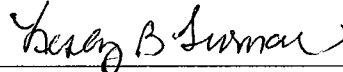
NOTICE OF APPARENT LOW BIDDER
PROJECT NO. 201207767
Page 2

The Bid Security submitted with your Bid, will be returned upon execution of the Contract and furnishing of the Performance Bond. In the event you should fail to execute the Contract and to furnish the performance Bond within the time limit specified, said Bid Security will be retained by the City and County of Denver as liquidated damages, and not as a penalty for the delay and extra work caused thereby.

Dated at Denver, Colorado this 5th day of November 2012.

CITY AND COUNTY OF DENVER

By



for Jose M. Cornejo, P.E.
Manager of Public Works

JMC/tmg

cc: H. (CAO), Gallagher (AUD), Schellinger (Treasury/Tax Compliance), DSBO Inbox, B. Uhernik, J. Wennen, L. Ferreira, Merritt (PW-Aud), PCO, File.

CITY AND COUNTY OF DENVER
DEPARTMENT OF PUBLIC WORKS
Wastewater Management Division

BID FORM AND SUBMITTAL PACKAGE ACKNOWLEDGMENT

CONTRACT NO. 201207767

IOWA AVENUE EXTENSION PHASE 1

BIDDER: B T CONSTRUCTION, INC.

ADDRESS: 9885 EMPORIA ST.
HEWDERSON, CO 80640

The undersigned bidder states that the undersigned bidder has received and had an opportunity to fully and thoroughly examine a complete set of the Contract Documents for **Contract No. 201207767, IOWA AVENUE EXTENSION PHASE 1**, made available to the undersigned bidder pursuant to Notice of Invitation for Bids dated September 18, 2012.

The undersigned bidder acknowledges that a complete and final set of the Contract Documents for the referenced Project, the components of which are identified below, are bound and maintained as the record set of Contract Documents by the Contract Administration Division of the Department of Public Works and that this Record Set is available for examination by the undersigned bidder.

The undersigned bidder, having thoroughly examined each of the components identified below and contained in Contract Documents, HEREBY SUBMITS THIS BID FORM AND SUBMITTAL PACKAGE, fully understanding that the Contract Documents, as defined in Paragraph 1 of the contract, including this executed Bid Form and Submittal Package, constitute all of the terms, conditions and requirements upon which this submission is based and further understanding that, by submission of this Bid Form and Submittal Package, the City shall rely on the representations and commitments of the undersigned bidder contained herein.

The following completed documents comprising this Bid Form and Submittal Package will be included with and, by this reference, are expressly incorporated into the Contract Documents specified at Paragraph 1 of the Contract:

- Bid Form and Submittal Package Acknowledgment Form
- Bid Form
- List of Proposed Minority/Woman Owned Business Enterprise(s)
- Commitment to Minority/Woman Owned Business Enterprise Participation
- Minority/Woman Owned Business Enterprise(s) of Intent
- Joint Venture Affidavit (if applicable)
- Joint Venture Eligibility Form (if applicable)
- Bid Bond
- Bidder / Contractor / Vendor / Proposer Disclosure Form
- Certificate of Insurance

The following designated documents constitute that portion of the Contract Documents made available by the Notice of Invitation for Bids, but not included in the Bid Form and Submittal Package:

- Notice of Invitation for Bids
- Instructions to Bidders
- Addenda (as applicable)
- Equal Employment Opportunity Provisions (Appendix A and Appendix F)
- Contract Form
- General Contract Conditions
- Special Contract Conditions
- Performance and Payment Bond
- Notice to Apparent Low Bidder
- Notice to Proceed
- Contractor's Certification of Payment Form
- Final/Partial Lien Release Form
- Final Receipt
- Change Orders (as applicable)
- Federal Requirements (as applicable)
- Prevailing Wage Rate Schedule(s)
- Technical Specifications
- Contract Drawings
- Accepted Shop Drawings

The undersigned bidder expressly assumes responsibility for the complete contents of these designated documents as bound together with the Bid Form and Submittal Package submitted herewith and designated the Contract Documents.

IN WITNESS WHEREOF, the undersigned bidder has signed personally or by duly authorized officer or agent and duly attested.

BIDDER:

Name: B I CONSTRUCTION, INC.
By: [Signature]
Title: VICE PRESIDENT

ATTEST:

By: [Signature]

[SEAL]

**CITY AND COUNTY OF DENVER
DEPARTMENT OF PUBLIC WORKS
Wastewater Management Division**

BID FORM

**CONTRACT NO. 201207767
IOWA AVENUE EXTENSION PHASE 1**

BIDDER B T CONSTRUCTION, INC.

TO: The Manager of Public Works
City and County of Denver
c/o Contract Administration
201 West Colfax, Dept. 614
Denver, Colorado 80202

The Undersigned Bidder, having examined the plans, technical specifications, and remainder of the proposed Contract Documents as designated and enumerated in the General and Special Contract Conditions and any and all addenda thereto; having investigated the location of and conditions affecting the proposed Work; and being acquainted with and fully understanding the extent and character of the Work covered by this bid, and all factors and conditions affecting or which may be affected by Work, **HEREBY SUBMITS THIS BID**, pursuant to an advertisement of a Notice of Invitation for Bids as published on **September 18, 2012**, to furnish all required materials, tools, appliances, equipment and plant; to perform all necessary labor and to undertake and complete: **CONTRACT NO. 201207767, IOWA AVENUE EXTENSION PHASE 1**, in Denver, Colorado, in full accordance with and conformity to the Plans, Technical Specifications, and Contract Documents hereto attached or by reference made a part hereof, at and for the following price(s) set forth on this Bid Form.

The following documents, which taken as a whole constitute the Contract Documents for this Project, and which are incorporated herein, by reference, were made available to the Bidder as provided in the Advertisement of Notice of Invitation for Bids, were received by the bidder, and form the basis for this bid:

- Advertisement of Notice of Invitation for Bids*
- Instructions to Bidders*
- Commitment to M/WBE Participation*
- Article III, Divisions 1 and 3 of Chapter 28, D.R.M.C.*
- Bid Bond*
- Addenda (as applicable)*
- Equal Employment Opportunity Provisions (Appendix A and Appendix F)*
- Bid Form*
- Contract Form*
- General Contract Conditions*
- Special Contract Conditions*
- Performance and Payment Bond*
- Notice to Apparent Low Bidder*
- Notice to Proceed*
- Contractor's Certification of Payment Form*
- Final/Partial Lien Release Form*
- Final Receipt*
- Change Orders (as applicable)*
- Federal Requirements (as applicable)*
- Prevailing Wage Rate Schedule(s)*
- Technical Specifications*
- Contract Drawing*
- Accepted Shop Drawings*
- Certificate of Insurance*

Bid Form

Pay Item #	Bid Item Description and Unit Price	Estimated Quantity	Estimated Cost
2-1.2a	REMOVE 6" CONCRETE CURB AND/OR GUTTER In Iowa - north flowline all and south flowline broken stones at the unit price \$ <u>4.00</u> PER LINEAR FOOT	1,500 LF	\$ <u>6,000.00</u>
2-1.4	REMOVE HANDICAP CONCRETE CURB RAMP Roughly 56 SF per ramp at the unit price \$ <u>5.00</u> PER SQUARE FOOT	2,576 SF	\$ <u>12,880.00</u>
2-2.1	REMOVE CONCRETE SIDEWALK at the unit price \$ <u>3.00</u> PER SQUARE FOOT	800 SF	\$ <u>2,400.00</u>
2-11.5c	ABANDON EXISTING 12" SEWER PIPE siphon pipes at the unit price \$ <u>9.00</u> PER LINEAR FOOT	421 LF	\$ <u>3,789.00</u>
2-13.1	REMOVE EXISTING STORM INLET siphon inlets at the unit price \$ <u>800.00</u> EACH	15 EA	\$ <u>12,000.00</u>
2-17.3	REMOVE AND REPLACE SIGN at the unit price \$ <u>300.00</u> EACH	12 EA	\$ <u>3,600.00</u>
02-22.13	VIBRATION ASSESSMENT at the unit price \$ <u>23,000.00</u> LUMP SUM	1 LS	\$ <u>23,000.00</u>
3-7	MATERIAL MANAGEMENT PLAN/HEALTH & SAFETY PLAN at the unit price \$ <u>2,300.00</u> LUMP SUM	1 LS	\$ <u>2,300.00</u>
5-2a	SUBGRADE MATERIAL (SELECT BACKFILL) at the unit price \$ <u>.01</u> PER TON	4,500 TON	\$ <u>45.00</u>

Pay Item #	Bid Item Description and Unit Price	Estimated Quantity	Estimated Cost
8-1.1b	6" DIP AWWA C151, CLASS 50 WATER LINE for water lowerings at the unit price \$ <u>350.00</u> PER LINEAR FOOT	30 LF	\$ <u>10,500.00</u>
8-1.1c	8" DIP AWWA C151, CLASS 50 WATER LINE for water lowerings at the unit price \$ <u>320.00</u> PER LINEAR FOOT	60 LF	\$ <u>19,200.00</u>
8-1.1e	12" DIP AWWA C151, CLASS 50 WATER LINE for water lowerings at the unit price \$ <u>350.00</u> PER LINEAR FOOT	60 LF	\$ <u>21,000.00</u>
8-1.5a	LEAD SERVICE LINE REPLACEMENT, <2" ID 37 total replacements from main to ROW (avg 40 LF ea.) at the unit price \$ <u>78.50</u> PER LINEAR FOOT	1,480 LF	\$ <u>116,180.00</u>
8-3	INSTALL FIRE HYDRANT ASSEMBLY at the unit price \$ <u>6200.00</u> EACH	1 EA	\$ <u>6200.00</u>
12-1.1	6" CURB AND GUTTER 2' PAN (CD0T T2, IIB) at the unit price \$ <u>25.00</u> PER LINEAR FOOT	1,500 LF	\$ <u>37,500.00</u>
12-1.8	HANDICAP CONCRETE CURB RAMP Roughly 56 SF per ramp at the unit price \$ <u>16.00</u> PER SQUARE FOOT	2,576 SF	\$ <u>41,216.00</u>
12-2.1	CONCRETE SIDEWALK at the unit price \$ <u>9.00</u> PER SQUARE FOOT	800 SF	\$ <u>7200.00</u>
12-5.1	CONCRETE DRIVEWAY PAVING at the unit price \$ <u>11.00</u> PER SQUARE FOOT	1,000 SF	\$ <u>11,000.00</u>
12-5.2	CONCRETE APRON at alleys at the unit price \$ <u>11.00</u> PER SQUARE FOOT	1,300 SF	\$ <u>14,300.00</u>

Pay Item #	Bid Item Description and Unit Price	Estimated Quantity	Estimated Cost
12-13	CONCRETE ENCASEMENT AROUND PIPE for sanitary sewer in Iowa at the unit price \$ <u>1000.00</u> PER CUBIC YARD	2 CY	\$ <u>2000.00</u>
20-3be	ASPHALT BASE COURSE, S, RAP 20%, N=75, 64-22. 6" in Iowa; 11.5" in Logan at the unit price \$ <u>4.85</u> PER SQUARE YARD INCH	58,833 SY-IN	\$ <u>285,340.05</u>
20-5	ASPHALT PATCH at the unit price \$ <u>5.00</u> PER SQUARE YARD INCH	500 SY-IN	\$ <u>2500.00</u>
34-2.3e	18" DIAMETER C-76 RCP, CLASS III at the unit price \$ <u>117.00</u> PER LINEAR FOOT	365 LF	\$ <u>42,705.00</u>
34-2.3g	24" DIAMETER C-76 RCP, CLASS III at the unit price \$ <u>151.00</u> PER LINEAR FOOT	202 LF	\$ <u>30,502.00</u>
34-2.3i	30" DIAMETER C-76 RCP, CLASS III at the unit price \$ <u>211.00</u> PER LINEAR FOOT	36 LF	\$ <u>7596.00</u>
34-2.3o	54" DIAMETER C-76 RCP, CLASS III at the unit price \$ <u>269.00</u> PER LINEAR FOOT	680 LF	\$ <u>182,920.00</u>
34-2.3p	60" DIAMETER C-76 RCP, CLASS III at the unit price \$ <u>258.00</u> PER LINEAR FOOT	2,690 LF	\$ <u>694,020.00</u>
34-5.4k	48" X 76" C-507 RCP, CLASS HE-III at the unit price \$ <u>365.00</u> PER LINEAR FOOT	479 LF	\$ <u>174,835.00</u>
34-7.1b	10" DIAMETER ASTM D-3034 SDR 35, PVC PIPE at the unit price \$ <u>148.00</u> PER LINEAR FOOT	20 LF	\$ <u>2960.00</u>
34-12.2a	5' DIAMETER PRECAST MANHOLE WITH TYPE A BASE & CONCENTRIC CONE at the unit price \$ <u>6000.00</u> EACH	3 EA	\$ <u>18,000.00</u>

Pay Item #	Bid Item Description and Unit Price	Estimated Quantity	Estimated Cost
34-12.4b	CAST-IN-PLACE TYPE B MANHOLE WITH TYPE B TOP SLAB at the unit price \$ <u>10,300.00</u> EACH	11 EA	\$ <u>113,300.00</u>
34-12.5b	CAST-IN-PLACE TYPE P MANHOLE WITH TOP SLAB FOR H>2' DEPTH at the unit price \$ <u>14,200.00</u> EACH	4 EA	\$ <u>56,800.00</u>
34-14.4	CONCRETE COLLARS at the unit price \$ <u>2100.00</u> EACH	12 EA	\$ <u>25,200.00</u>
34-14.5	FLAP GATE/STORM CONTROL at the unit price \$ <u>4300.00</u> EACH	1 EA	\$ <u>4300.00</u>
34-15.3	UTILITY EXPLORATORY INVESTIGATION for pre-construction at the unit price \$ <u>400.00</u> EACH	8 EA	\$ <u>3200.00</u>
34-16.1a	#14 INLET (L=6') at the unit price \$ <u>3300.00</u> EACH	7 EA	\$ <u>23,100.00</u>
34-16.1a	#14 INLET (L=6') H>6' - extra reinforcement necessary at the unit price \$ <u>3900.00</u> EACH	1 EA	\$ <u>3900.00</u>
34-16.1b	#14 INLET (L=9') at the unit price \$ <u>4800.00</u> EACH	1 EA	\$ <u>4800.00</u>
34-16.1c	#14 INLET (L=12') at the unit price \$ <u>6200.00</u> EACH	4 EA	\$ <u>24,800.00</u>
34-16.1d	#14 INLET (L=15') at the unit price \$ <u>6600.00</u> EACH	1 EA	\$ <u>6600.00</u>

Pay Item #	Bid Item Description and Unit Price	Estimated Quantity	Estimated Cost
34-16.1d	#14 INLET (L=15') H>6' - extra reinforcement necessary at the unit price \$ <u>8300.00</u> EACH	2 EA	\$ <u>16,600.00</u>
34-16.2a	SINGLE #16 INLET WITH OPEN THROAT at the unit price \$ <u>2800.00</u> EACH	6 EA	\$ <u>16,800.00</u>
34-16.2a	SINGLE #16 INLET WITH OPEN THROAT H>6' - extra reinforcement necessary at the unit price \$ <u>3500.00</u> EACH	2 EA	\$ <u>7000.00</u>
40-15	LANDSCAPING IMPROVEMENTS for misc landscaping replacement not associated with other bid item(s) at the unit price \$ <u>5300.00</u> LUMP SUM	1 LS	\$ <u>5300.00</u>
40-15	LANDSCAPING IMPROVEMENTS for tree trimming/protection in ROW only at the unit price \$ <u>11,600.00</u> LUMP SUM	1 LS	\$ <u>11,600.00</u>
41-1	TRAFFIC CONTROL at the unit price \$ <u>160,000.00</u> LUMP SUM	1 LS	\$ <u>160,000.00</u>
43-1	STORM WATER MANAGEMENT at the unit price \$ <u>30,000.00</u> LUMP SUM	1 LS	\$ <u>30,000.00</u>
45-2	QUALITY CONTROL TESTING at the unit price \$ <u>32,600.00</u> LUMP SUM	1 LS	\$ <u>32,600.00</u>
46-1	PAVEMENT MARKING (PAINT) at the unit price \$ <u>160.00</u> GALLONS	20 GAL	\$ <u>3200.00</u>
50-1	MOBILIZATION at the unit price \$ <u>139,000.00</u> LUMP SUM	1 LS	\$ <u>139,000.00</u>

Total Bid Amount of:

TWO MILLION FOUR HUNDRED EIGHTY-ONE THOUSAND
SEVEN HUNDRED EIGHTY-EIGHT DOLLARS AND
FIVE CENTS Dollars (\$ 2,481,788.05)

[Total bid amount equals the sum of each estimated cost for item numbers 2-1.2a through 50-1 (Fifty [50]) Total Bid Items]

If the Manager mails a written Notice of Apparent Low Bidder, addressed to the Bidder's business address stated on this Bid Form, the Undersigned Bidder shall, in accordance with the Contract Documents, be ready to, and shall, within five (5) days after the date of the Notice: (i) execute the attached form of Contract in conformity with this bid; (ii) furnish the required proofs of insurance; and (iii) furnish the required bond or bonds in the sum of the full amount of this bid, executed by a surety company acceptable to the Manager.

The HARTFORD FIRE INS. CO., a corporation of the State of CONN., is hereby offered as Surety on said bond. If such surety is not approved by the Manager, another and satisfactory surety company shall be furnished.

Enclosed with this bid is a bid guarantee, as defined in the attached Instructions to Bidders, in the amount of 5%. The Undersigned Bidder agrees that the entire amount of this bid guarantee is to be paid to and become the property of the City as liquidated damages, and not as a penalty, if: (i) the bid is considered to be the best by the City; (ii) the City notifies the Undersigned Bidder that it is the Apparent Low Bidder; and (iii) the Undersigned Bidder fails to execute the Contract in the form prescribed or to furnish the required bond and proofs of insurance, within five (5) days after the date of such notification.

The following persons, firms or corporations are interested with the Undersigned Bidder in this bid:

Name: _____ Name: _____

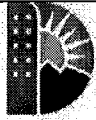
Address: _____ Address: _____

If there are no such persons, firms, or corporations, please so state in the following space: NONE

The Undersigned Bidder proposes to subcontract the following Work in accordance with General Contract Conditions, Title 5, SUBCONTRACTS, and represents that, to the greatest degree practical, all subcontractors known at the time of bid submittal have been identified.

Item of Work	Percent (%) of Total; Work	Proposed Subcontractor and Address
<u>CONCRETE STRUCTURES SUB</u>	<u>5</u>	<u>LE BLANC FT. LUTON, CO</u>
<u>HRLY HAUL-OFF TRUCKING SUB</u>	<u>2</u>	<u>RALPH MARTINEZ TRUCKING COMMERCE CITY, CO</u>
<u>CONCRETE FOOTWORK SUB</u>	<u>3</u>	<u>SILVA BRIGHAM, CO</u>
<u>ASPHALT SUB</u>	<u>10</u>	<u>NEW WEST PAUL & C DENVER, CO</u>
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DENVER
THE MILE HIGH CITY

**List of Proposed
MWBE or DBE
Bidders, Subcontractors,
Suppliers (Manufacturers) or Brokers**

Office of Economic Development
Division of Small Business Opportunity
Compliance Unit
201 West Colfax Avenue, Dept. 907
Denver, CO 80202
Phone: 720-913-1999
Fax: 720-913-1803
DSBO@denvergov.org

City and County of Denver Contract No.: 201207767

The undersigned Bidder proposes to utilize the following MWBE or DBE for the project. All listed firms are **CURRENTLY** certified by the City and County of Denver. Only the level of MWBE or DBE participation listed at the bid opening will count toward satisfaction of the project goal. Only bona fide commissions may be counted for Brokers. MWBE or DBE prime bidders must detail their bid information below. Please copy and attach this page to list additional MWBE or DBE.

Address: 9885 EMPORA ST. ALEXANDRIA CO 80640 Contact Person: DAVE EMM

Type of Service: PRIME Dollar Amount: \$: \$ 1985,000 Percent of Project: 80%

MWBE or DBE Prime Bidder

Business Name:

Address: Contact Person:

Type of Service: Dollar Amount: \$: Percent of Project:

Subcontractors, Suppliers Manufacturers or Brokers (check one box)

Subcontractor (✓) Supplier (✓) Manufacturer (✓) Broker (✓)

Business Name: RALPH MARTINEZ TRUCKING INC.

Address: 7255 IVANHOE ST. COMMERCE CITY, CO Type of Service: HRLY HAUL-OFF TRUCKING SUB

Contact Person: DIANNA RIDLEY Dollar Amount: \$: \$ 71,260.00 Percent of Project: 2.8

Subcontractor (✓) Supplier (✓) Manufacturer (✓) Broker (✓)

Business Name: SILVA CONSTRUCTION, INC.

Address: 154 CISNE CIRCLE BRIGHTON, CO Type of Service: CONCRETE FLATWORK SUB

Contact Person: JOSE SILVA Dollar Amount: \$: \$ 84,612.00 Percent of Project: 3.4

Subcontractor (✓) Supplier (✓) Manufacturer (✓) Broker (✓)

Business Name: LE BLANC CONSTRUCTION LLP

Address: 15022 MORRIS AVE. FT. LUDLOW, CO Type of Service: CONCRETE STRUCTURES SUB

Contact Person: MATHEW LE BLANC Dollar Amount: \$: \$ 149,200.00 Percent of Project: 6.0

Subcontractors, Suppliers Manufacturers or Brokers (check one box)				
<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Business Name:				
Address:			Type of Service:	
Contact Person:			Dollar Amount: \$:	Percent of Project:
<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Business Name:				
Address:			Type of Service:	
Contact Person:			Dollar Amount: \$:	Percent of Project:
<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Business Name:				
Address:			Type of Service:	
Contact Person:			Dollar Amount: \$:	Percent of Project:
<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Business Name:				
Address:			Type of Service:	
Contact Person:			Dollar Amount: \$:	Percent of Project:
<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Business Name:				
Address:			Type of Service:	
Contact Person:			Dollar Amount: \$:	Percent of Project:
<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Business Name:				
Address:			Type of Service:	
Contact Person:			Dollar Amount: \$:	Percent of Project:
<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Bid Form & Submittal Package, Participation Page 1/07-dm

The undersigned Bidder hereby certifies that the aforementioned subcontractors and suppliers have full knowledge that their names have been offered as subcontractors and suppliers for the work, and the Bidder further certifies that the dollar amount of work to be performed by the aforementioned M/WBE(s) was furnished to the Bidder prior to the bid opening. The undersigned Bidder agrees that after the bid opening, it shall submit to the City an executed and completed W/MBE "Letter of Intent" in three working days (3) on each of its M/WBE subcontractors. The "Letter of Intent" form is contained in the Contract Documents.

The undersigned Bidder acknowledges the right of the City to reject any or all bids submitted, to waive informalities in bids and to re-advertise this Project for bids.

The undersigned certifies that it has carefully checked all works and figures and all statements made in these Bid Forms.

This bid is submitted upon the declaration that neither, I (we), nor, to the best of my (our) knowledge, none of the members of my (our) firm or company have either directly or indirectly entered into any agreement, participated in any collusion or otherwise taken any action in restraint of free competitive bidding in connection with this bid.

Business Address of Bidder: 9885 EMPORIA ST.
City, State, Zip Code: HENDERSON, CO 80640
Telephone Number of Bidder: 303-469-0199 Fax No. 303-466-8309
Social Security or Federal Employer ID Number of Bidder: 84-0828528

Name and location of the last work of this kind herein contemplated upon which the Bidder was engaged:
5TH + NEWPORT STORM

For information relative thereto, please refer to:

Name: DAVE EMM
Title: SR. ESTIMATING MGR.
Address: 9885 EMPORIA ST. HENDERSON, CO 80640

The undersigned acknowledges receipt, understanding, and full consideration of the following addenda to the Contract Documents:

Addenda Number 1 Date 10/1/12
Addenda Number 2 Date 10/9/12
Addenda Number _____ Date _____

Dated this 19TH day of OCTOBER, 2012.

Signature of Bidder:

If an Individual: _____ doing business
as _____

If a Partnership: _____
by: _____ General Partner.

If a Corporation: B T CONSTRUCTION, LLC.
a COLORADO Corporation,
by: [Signature] its President.

Attest: [Signature]
Secretary (Corporate Seal)

If a Joint Venture, signature of all Joint Venture participants.

Firm: _____

Corporation (), Partnership () or () Limited Liability Company

By: _____ (If a Corporation)
Attest: _____
Title: _____ Secretary (Corporate Seal)

Firm: _____

Corporation (), Partnership () or () Limited Liability Company

By: _____ (If a Corporation)
Attest: _____
Title: _____ Secretary (Corporate Seal)

Firm: _____

Corporation (), Partnership () or () Limited Liability Company

By: _____ (If a Corporation)
Attest: _____
Title: _____ Secretary (Corporate Seal)



COMMITMENT TO MWBE OR SBE PARTICIPATION

Office of Economic Development
Division of Small Business Opportunity
Compliance Unit
201 West Colfax Avenue, Dept. 907
Denver, CO 80202
Phone: 720-913-1999
Fax: 720-913-1803
DSBO@denvergov.org

The undersigned has satisfied the MWBE or SBE participant requirements in the following manner (Please check the appropriate box):

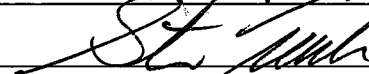
The Bidder/Proposer is committed to a minimum of 12 % MWBE or SBE utilization on the project, and will submit Letters of Intent (LOI) for each subcontractor/subconsultant listed in the Bid Forms as follows:
Hard Bids: Three (3) business days after the bid opening
Request for Proposals: With the proposal when due

The Bidder/Proposer is unable to meet the project goal of _____% MWBE or SBE, but is committed to a minimum of _____% MWBE or SBE utilization on the project. The Bidder/Proposer understands that they must submit a detailed statement of their good faith effort in accordance with DRMC Section 28-62 and 28-67 of Ordinance 760 and must submit Letters of Intent for each MWBE or SBE listed in the Bid Forms, within three (3) business days after the bid opening or at time proposal is submitted.

The Bidder/Proposer is a certified MWBE or SBE in good standing with the City and is committed to self-perform a minimum of _____% of the work on the contract.

Bidder/Proposer (Name of Firm): B T CONSTRUCTION, INC.

Firm's Representative (Please print): STEVE TURNER

Signature (Firm's Representative): 

Title: VICE-PRESIDENT

Address: 9885 EMPORIA ST.

City: HENDERSON State: CO Zip: 80640

Phone: 303-469-0199 Fax: 303-466-8309 Email: STEVE.TURNER@BTCONSTRUCTION.COM

A copy of the MWBE or SBE Certification must be attached.

**CITY AND COUNTY OF DENVER
DEPARTMENT OF PUBLIC WORKS
Wastewater Management Division**

**CONTRACT NO. 201207767
PROJECT NAME: IOWA AVENUE EXTENSION PHASE 1**

ADDENDUM NO. 1 TO CONTRACT DOCUMENTS

Bidders are hereby instructed that the drawings, specifications, and other contract documents are modified, corrected, supplemented and/or superseded for the above mentioned project as hereinafter described in the following attachments:

BID FORM AND SUBMITTAL PACKAGE

Insert attached Bid Form pages BF-6.1 through BF-6.5.

BID DOCUMENT PACKAGE

Replace Highway Construction Projects Wage Rates dated August 17, 2012 with attached Heavy Construction Projects Wage Rates dated September 7, 2012, (8) pages.

CLARIFICATION

Project goal is 12.00% M/WBE.

SPECIFICATIONS / DRAWINGS

None

QUESTIONS AND ANSWERS

Q: Can we submit the forms electronically, instead of hand written.

A: Not at this time.

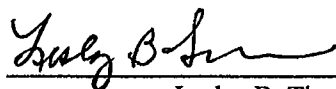
Q: Has everyone been prequalified who is bidding on this?

A: Each bidder must have submitted a prequalification application a minimum of ten (10) calendar days prior to the bid opening date.

Q: Can we push back the question deadline from October 3rd?

A: In order to facilitate meeting the construction schedule the question deadline will stand.

This **ADDENDUM** shall be attached to, become a part of, and be returned with the Bid Proposal.




Lesley B. Thomas
City Engineer

10.1.12

Date

The undersigned bidder acknowledges receipt of this Addendum. The Proposal submitted herewith is in accordance with the stipulations set forth herein.


B T CONSTRUCTION, INC.
Contractor

ADDENDUM NO. 1

DATE: 10/19/12

**CITY AND COUNTY OF DENVER
DEPARTMENT OF PUBLIC WORKS
Wastewater Management Division**

**CONTRACT NO. 201207767
PROJECT NAME: IOWA AVENUE EXTENSION PHASE 1**

ADDENDUM NO. 2 TO CONTRACT DOCUMENTS

Bidders are hereby instructed that the drawings, specifications, and other contract documents are modified, corrected, supplemented and/or superseded for the above mentioned project as hereinafter described in the following attachments:

BID FORM AND SUBMITTAL PACKAGE

Replace Bid Form pages BF-6.1 through BF-6.5 dated September 18, 2012 with attached Bid Form pages BF-6-1 through BF-6-5 dated October 10, 2012.

BID DOCUMENT PACKAGE

Replace Statement of Quantities dated September 18, 2012 (3) pages with attached Statement of Quantities dated October 10, 2012 (3) pages.

SPECIFICATIONS / DRAWINGS

None

QUESTIONS AND ANSWERS

Q: Are the quantities for the 18" RCP and 24" RCP on the bid form correct? The bid form has 203 Lf for 18" and the plans show 367 Lf and the bid form has 343 Lf for 24" and the plans show 201 Lf?

A: No, the Bid Form and Statement of Quantities dated 9/18/12 are incorrect with respect to Items 34-2.3e, 34-2.3g and 34-2.3o. Revised Bid Form and Statement of Quantities are attached.

Item 34-2.3e (18" Diameter C-76 RCP CLIII) shall be revised from 203 LF to 365 LF.

Item 34-2.3g (24" Diameter C-76 RCP CLIII) shall be revised from 343 LF to 202 LF.

Item 34-2.3o (54" Diameter C-76 RCP CLIII) shall be revised from 645 LF to 680 LF.

Q: What are the contractor's requirements for Proof Rolling pavement?

A: The contractor shall proof roll the completed embankment, subgrade reconditioning or roadway subgrade to determine if any soft, yielding or otherwise unacceptable areas exist. The intent is to achieve a stable platform for the proper placement of embankment or pavements. The Engineer may require a witness be present during the proof roll to verify areas to be corrected, and require a load verification of the proof roller from the Contractor. Any areas which show deflections that

are non uniform or in excess of 0.5 inch shall be reworked as approved, or removed and replaced with approved material without additional payment.

All reworked areas shall be retested for moisture and compaction, and proo rolled again after the subgrade has been shaped to the final grade and cross section.

The proof roller shall be provided by the Contractor and shall be a pneumatic tired vehicle with tire pressures of at least 100 psi capable of applying ground loads of at least 18,000 pounds per axle. The proof roller shall be operated between 2 and 6 miles per hour, and shall achieve complete coverage of the area to be constructed with embankment or pavement materials.

Upon approval of the proof rolling; the next soil, aggregate or pavement layer shall be placed prior to moisture or weather or other factors affecting the surface condition of the subgrade. Any lapse of more than 24 hours shall be approved by the Engineer, or another proof roll will be required.

Q: What are the contractor's requirements for submitting labor and equipment rates?

A: The successful bidder will be asked at the time of the preconstruction meeting to submit a schedule of labor and equipment rates to the Project Construction Engineer, for use in accordance with the General Contract Conditions.

This **ADDENDUM** shall be attached to, become a part of, and be returned with the Bid Proposal.

Lesley B Thomas
Lesley B. Thomas
City Engineer

10.9.12
Date

The undersigned bidder acknowledges receipt of this Addendum. The Proposal submitted herewith is in accordance with the stipulations set forth herein.

B T CONSTRUCTION, INC.
Contractor

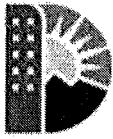
ADDENDUM NO. 2

DATE: 10/19/12

CITY AND COUNTY OF DENVER
DEPARTMENT OF PUBLIC WORKS
Wastewater Management Division

TABLE OF CONTENTS FOR CONTRACT DOCUMENTS

BID FORM AND SUBMITTAL PACKAGE	<u>PAGE</u>
Bid Form and Submittal Package (bound separately and attached as part of these Bid Documents)	
Table of Contents	BF-1
Bidder's Checklist	BF-2 through BF-3
Bid Form and Submittal Package Acknowledgment Form	BF-4 through BF-5
Bid Form	BF-6 through BF-8
List of Proposed Minority and Woman Business Enterprise(s)	BF-9 through BF-12
Commitment to Minority and Woman Business Enterprise Participation	BF-13
Minority and Woman Business Enterprise Letter(s) of Intent & Checklist	BF-14 through BF-15
Joint Venture Affidavit	BF-16
Joint Venture Eligibility Form	BF-17 through BF-19
Bid Bond	BF-20
Bidder / Contractor / Vendor / Proposer Disclosure Form	BF-21 through BF-23
BID DOCUMENTS	
Table of Contents	BDP-1
Statement of Quantities	SQ-1 through SQ-3
Notice of Invitation for Bids	BDP-2 through BDP-3
Instructions to Bidders	BDP-4 through BDP-15
Equal Employment Opportunity Provisions	BDP-16 through BDP-25
Appendix A	
Appendix F	
Contract Form	BDP-26 through BDP-30
Index of the General Contract Conditions	BDP-31 through BDP-35
Special Contract Conditions	BDP-36 through BDP-46
Final/Partial Release and Certificate of Payment Forms (Samples)	BDP-39 through BDP-41
Performance and Payment Bond Form	BDP-45 through BDP-46
Performance and Payment Bond Surety Authorization letter (Sample)	BDP - 47
Notice to Apparent Low Bidder (Sample)	BDP-48 through BDP-49
Notice To Proceed (Sample)	BDP-50
Certificate of Contract Release (Sample)	BDP-51
Prevailing Wage Rate Schedule	8 pages
Technical Specifications	306 pages
Contract Drawings	20 Sheets



CITY AND COUNTY OF DENVER

Department of Public Works - Engineering Division
Wastewater Capital Projects Management

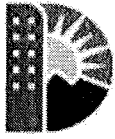
DENVER
THE MILE HIGH CITY

Statement of Quantities

Contract No. 201207767

E. Iowa Ave. Extension, Phase I

Item #	Item Description	Additional Item Information	Est. Qty	Units
2-1.2a	REMOVE 6" CONCRETE CURB AND/OR GUTTER	In Iowa - north flowline all and south flowline broken stones	1,500	LF
2-1.4	REMOVE HANDICAP CONCRETE CURB RAMP	Roughly 56 SF per ramp	2,576	SF
2-2.1	REMOVE CONCRETE SIDEWALK		800	SF
2-11.5c	ABANDON EXISTING 12" SEWER PIPE	siphon pipes	421	LF
2-13.1	REMOVE EXISTING STORM INLET	siphon inlets	15	EA
2-17.3	REMOVE AND REPLACE SIGN		12	EA
02-22.13	VIBRATION ASSESSMENT		1	LS
3-7	MATERIAL MANAGEMENT PLAN/HEALTH & SAFETY PLAN		1	LS
5-2a	SUBGRADE MATERIAL (SELECT BACKFILL)		4,500	TON
8-1.1b	6" DIP AWWA C151, CLASS 50 WATER LINE	for water lowerings	30	LF
8-1.1c	8" DIP AWWA C151, CLASS 50 WATER LINE	for water lowerings	60	LF
8-1.1e	12" DIP AWWA C151, CLASS 50 WATER LINE	for water lowerings	60	LF
8-1.5a	LEAD SERVICE LINE REPLACEMENT, <2" ID	37 total replacements from main to ROW (avg 40 LF ea.)	1,480	LF
8-3	INSTALL FIRE HYDRANT ASSEMBLY		1	EA
12-1.1	6" CURB AND GUTTER 2' PAN (CDOT T2, IIB)		1,500	LF
12-1.8	HANDICAP CONCRETE CURB RAMP	Roughly 56 SF per ramp	2,576	SF
12-2.1	CONCRETE SIDEWALK		800	SF
12-5.1	CONCRETE DRIVEWAY PAVING		1,000	SF
12-5.2	CONCRETE APRON	at alleys	1,300	SF
12-13	CONCRETE ENCASEMENT AROUND PIPE	for sanitary sewer in Iowa	2	CY
20-3be	ASPHALT BASE COURSE, S, RAP 20%, N=75, 64-22.	6" in Iowa; 11.5" in Logan	58,833	SY-IN



CITY AND COUNTY OF DENVER

Department of Public Works - Engineering Division
Wastewater Capital Projects Management

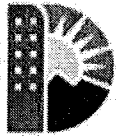
DENVER
THE MILE HIGH CITY

Statement of Quantities

Contract No. 201207767

E. Iowa Ave. Extension, Phase I

Item #	Item Description	Additional Item Information	Est. Qty	Units
20-5	ASPHALT PATCH		500	SY-IN
34-2.3e	18" DIAMETER C-76 RCP, CLASS III		203	LF
34-2.3g	24" DIAMETER C-76 RCP, CLASS III		343	LF
34-2.3i	30" DIAMETER C-76 RCP, CLASS III		36	LF
34-2.3o	54" DIAMETER C-76 RCP, CLASS III		645	LF
34-2.3p	60" DIAMETER C-76 RCP, CLASS III		2,690	LF
34-5.4k	48" X 76" C-507 RCP, CLASS HE-III		479	LF
34-7.1b	10" DIAMETER ASTM D-3034 SDR 35, PVC PIPE		20	LF
34-12.2a	5' DIAMETER PRECAST MANHOLE WITH TYPE A BASE & CONCENTRIC CONE		3	EA
34-12.4b	CAST-IN-PLACE TYPE B MANHOLE WITH TYPE B TOP SLAB		11	EA
34-12.5b	CAST-IN-PLACE TYPE P MANHOLE WITH TOP SLAB FOR H>2' DEPTH		4	EA
34-14.4	CONCRETE COLLARS		12	EA
34-14.5	FLAP GATE/STORM CONTROL		1	EA
34-15.3	UTILITY EXPLORATORY INVESTIGATION	for pre-construction	8	EA
34-16.1a	#14 INLET (L=6')		7	EA
34-16.1a	#14 INLET (L=6')	H>6' - extra reinforcement necessary	1	EA
34-16.1b	#14 INLET (L=9')		1	EA
34-16.1c	#14 INLET (L=12')		4	EA
34-16.1d	#14 INLET (L=15')		1	EA
34-16.1d	#14 INLET (L=15')	H>6' - extra reinforcement necessary	2	EA
34-16.2a	SINGLE #16 INLET WITH OPEN THROAT		6	EA
34-16.2a	SINGLE #16 INLET WITH OPEN THROAT	H>6' - extra reinforcement necessary	2	EA



CITY AND COUNTY OF DENVER

Department of Public Works - Engineering Division
Wastewater Capital Projects Management

DENVER
THE MILE HIGH CITY

Statement of Quantities

Contract No. 201207767

E. Iowa Ave. Extension, Phase I

Item #	Item Description	Additional Item Information	Est. Qty	Units
40-15	LANDSCAPING IMPROVEMENTS	for misc landscaping replacement not associated with other bid item(s)	1	LS
40-15	LANDSCAPING IMPROVEMENTS	for tree trimming/protection in ROW only	1	LS
41-1	TRAFFIC CONTROL		1	LS
43-1	STORM WATER MANAGEMENT		1	LS
45-2	QUALITY CONTROL TESTING		1	LS
46-1	PAVEMENT MARKING (PAINT)		20	GAL
50-1	MOBILIZATION		1	LS

CITY AND COUNTY OF DENVER
DEPARTMENT OF PUBLIC WORKS
Wastewater Management Division

NOTICE FOR INVITATION FOR BIDS
CONTRACT NO. 201207767

IOWA AVENUE EXTENSION PHASE 1

BID SCHEDULE:
11:00 AM, Local Time
OCTOBER 19, 2012

Sealed bids will be received at the Development Permits Counter located on the 2nd floor at 201 West Colfax, Denver, CO 80202, beginning at 10:30 a.m., no later than 11:00 a.m., on bid day.

Bids submitted prior to 10:30 a.m. on the specified bid opening date/time shall be presented at the Office of Contract Administration, Attention: Public Works Contract Administration, 201 West Colfax Avenue, Department 614, Denver, Colorado 80202. All properly delivered bids will then be publicly opened and read aloud in Room 1.D.1 on the 1st floor at 201 West Colfax, Denver, Colorado 80202.

Prior to submitting a bid, the bidder shall consult the Contractor's Bulletin Board located at 201 W. Colfax, 2nd Floor, Denver, Colorado, 80202 and/or www.work4denver.com.

GENERAL STATEMENT OF WORK:

Storm sewer open cut project. New storm sewer starting at Iowa just east of Broadway, then east in Iowa to Logan, then south in Logan to Asbury. Project consists of approximately 4,000 LF of 54"-60" RCP storm pipe, new storm laterals and inlets, asphalt paving and some concrete paving including new handicap ramps at eight (8) intersections.

ESTIMATED CONSTRUCTION COST:

The estimated cost of construction for this project is between \$2,261,828.70 and \$2,764,457.30.

DOCUMENTS AND BID INFORMATION AVAILABLE:

Contract Documents complete with Technical Specifications and, if applicable, construction drawings will be available on the first day of publication at: www.work4denver.com. To download digital Contract Documents at a cost of \$10.00 per download, reference eBid Document Number #2260082. Contact QuestCDN.com at 952-233-1632 or info@questcdn.com for assistance.

PRE-BID CONFERENCE:

A pre-bid conference will be held for this Project at 10:00 AM, local time, on SEPTEMBER 27, 2012. This meeting will take place at: Wastewater Management, 2000 W. 3rd Ave., Denver, CO. 80223, 3rd floor conference room.

DEADLINE TO SUBMIT QUESTIONS: OCTOBER 3, 2012 NO LATER THAN 3:00 PM local time.

PREQUALIFICATION REQUIREMENTS:

Each bidder must be prequalified as **4(a) SEWER in the \$3,000,000.00** monetary level in accordance with the City's Rules and Regulations Governing Prequalification of Contractors. Each bidder must have submitted a prequalification application a minimum of ten (10) calendar days prior to the bid opening date. Applications must be submitted to the Department of Public Works, Prequalification Section, 201 West Colfax Avenue, Department 614, Denver, Colorado 80202. To view the Rules and Regulations and to obtain a prequalification application, please visit our website at www.denvergov.org/prequalification or call 720-865-2539 for prequalification information ONLY.

MINORITY AND WOMAN BUSINESS ENTERPRISE PARTICIPATION:

Construction, reconstruction and remodeling contracts made and entered into by the City and County of Denver are subject to Article III, Divisions 1 and 3 of Chapter 28 of the Denver Revised Municipal Code, (Sections 28-31 to 29-

36 and 28-52 to 28-90 D.R.M.C) and all Minority and Woman Business Enterprise and Equal Employment Opportunity Rules and Regulations adopted by the Director of the Division of Small Business Opportunity.

Article III, Division 3 of Chapter 28 of the D.R.M.C. directs the Director of the Division of Small Business Opportunity to establish a project goal for expenditures on construction, reconstruction, and remodeling work contracted by the City and County of Denver. The specific goal for this project is:

12.00% Minority and Woman Business Enterprise (M/WBE) Participation

Project goals must be met with certified participants as set forth in Section 28-60, D.R.M.C. or through the demonstration of a sufficient good faith effort under Section 28-62 D.R.M.C. For compliance with good faith requirements under Section 28-62(b), **the M/WBE percentage solicitation level required for this project is 100%.**

The Director of the Division of Small Business Opportunity urges all participants in City construction, reconstruction and remodeling projects to assist in achieving these goals.

MISCELLANEOUS:

Contracts for construction, reconstruction, and remodeling are subject to the City prevailing wage rate requirements established pursuant to Section 20-76, D.R.M.C.

As its best interest may appear, the City and County of Denver reserves the right to reject any or all bids and to waive informalities in bids.

If applicable, a shortened version of this Notice of Invitation for Bids and the Statement of Quantities can be viewed on the City and County of Denver website at: www.work4denver.com

Publication Dates: September 18, 19, 20, 2012

Published In: The Daily Journal

CITY AND COUNTY OF DENVER
DEPARTMENT OF PUBLIC WORKS
Wastewater Management Division

INSTRUCTIONS TO BIDDERS

IB-1 INSTRUCTION TO BIDDERS

These Instructions to Bidders are a part of the Contract Documents and are intended to serve as a guide to bidders. They are general in nature and may be amended or supplemented as needed to support any one specific invitation to bid. Each bidder shall prepare its bid in strict compliance with all requirements of the Contract Documents and by careful application of these instructions.

IB-2 BIDDING

The copy of the Contract Documents contains the Bid Form and Submittal Package for this Project, which must be used to submit a bid hereunder. The bidder must fully complete, execute and submit this Bid Form and Submittal Package, along with any other specified components of the Contract Documents, as its bid for the referenced Project.

A bidder is not required to submit as part of its bid the entire set of Contract Documents distributed by the City pursuant to the Notice of Invitation for Bids, if the bidder executes and submits the Bidder Acknowledgment Form included with the Bid Form and Submittal Package as part of its bid. However, each bidder, by submitting its bid, shall be conclusively presumed to have received and reviewed all of the information contained in the Contract Documents as this term is further defined herein.

Each bid must be enclosed in a sealed envelope, must be addressed to the Manager and must show on the face of the envelope the full name of the bidder, the City Project number, and descriptive title of the Project for which the bid is made.

The advertisement for Notice of Invitation for Bids will identify where and when the bid must be delivered.

IB-3 CONTRACT DOCUMENTS AS PUBLISHED BY CITY

Each bidder shall be responsible for, and shall be deemed to have received, all the information contained in the Contract Documents as distributed by the City pursuant to the Notice of Invitation for Bids, including addenda, whether or not such bidder has reviewed all or part of the Contract Documents in either its hard copy form or in any other format. If organizations or companies other than the City or its design professional distribute the City's Contract Documents for review by prospective bidders, whether in hard copy or via electronic or other media, neither the City nor its design professional shall be responsible for the content, completeness or accuracy of any information distributed or transmitted by any such organization or company.

IB-4 COMPLETING AND SIGNING THE BID FORMS

The bidder must complete the Bid Form by legibly writing or printing in ink, in words and figures as required, all the bidder's prices offered for the Work to be performed. All blank spaces, which require a response of the bidder, must be properly completed in full. If in the process of evaluating a bid, words and figures, as written on the Bid Form by the bidder, do not agree, the written words will govern.

For Bid Forms requiring unit price bids, the bidder shall write in the Bid Form spaces provided a unit price for each item for which a quantity is given and shall also write the product of each unit price and the quantity specified in the "Amount" or "Total" space provided.

Each bidder must sign the Bid Form and give the bidder's current business address. If an individual, the signature must be of the individual offering the bid; if a partnership, the signature must be that of a general partner; and if a corporation, both the president and the secretary must sign and the seal of the corporation must be affixed. Signatures of other persons may be acceptable if the bid contains sufficient evidence, satisfactory to the City in its sole discretion, to indicate that the other persons are authorized to bind the bidder.

IB-5 UNACCEPTABLE BIDS

The City will not accept bids from Bidders not prequalified with the Department of Public Works (if prequalification is required for this project), in arrears to the City upon debt or contract, or which are defaulters (as surety or otherwise) upon any obligation to the City.

IB-6 INFORMAL AND UNBALANCED BIDS

Any alteration, interlineations, erasure, omission, deletion or addition by the bidder to the Bid Form and Submittal Package or other parts of the Contract Documents submitted with the Bid Form and Submittal Package, as originally issued to the bidder, shall render the accompanying bid informal and may constitute cause for rejection.

Any unauthorized addition, conditional or alternate bids, failure to provide a unit price, lump sum amount or authorized alternate item specified or other irregularities of any kind which tend to render the bid incomplete, indefinite or ambiguous shall render the bid informal and may constitute cause for rejection.

Bids that are unbalanced so that each item does not reasonably carry its own proportion of cost or that contain inadequate or unreasonable prices for any item may be rejected. Bids, which have not acknowledged all addenda to the Contract Documents issued for this bid, may also be rejected.

The right is reserved by the City to reject any or all bids and to waive any informalities where it is deemed by the City to be in the best interests of the City to do so.

IB-7 ONLY ONE BID ACCEPTED

The City will accept only one bid for the same work from any one bidder. This includes bids that may be submitted under different names by one business enterprise.

IB-8 BID GUARANTEE

As a guarantee of good faith on the part of the bidder, each bid must be accompanied by a bid guarantee, consisting of either a certified or cashier's check made payable without condition to the order of the City and County of Denver or a bid bond written by an approved corporate surety in favor of the City and County of Denver. If the bid of a bidder is acceptable and the bidder is notified by the Manager that it is considered to be the Apparent Low Bidder and said bidder fails to execute a contract in the form prescribed or to furnish a performance and payment bond with a legally responsible and approved surety or to furnish the required evidence of insurance or satisfy all conditions precedent to contract execution within five (5) days after such notice is made by the City, said bid guarantee shall be forfeited to the City as liquidated damages and not as a penalty.

The bid guarantee shall be in the amount of five percent (5%) of the total bid unless otherwise specified in the Notice of Invitation for Bids and on the form appearing in the Contract Documents in the Bid Form and Submittal Package. Failure to submit a proper bid guarantee, satisfying all of the requirements specified herein and on the form provided herein shall render the bid nonresponsive and may constitute cause for rejection.

Following award and execution of the Contract by the Apparent Low Bidder, or earlier in the sole discretion of the City, bid guarantees of all but the Apparent Low Bidder will be returned. When the Apparent Low Bidder executes the Contract and delivers to the City satisfactory performance and payment bonds, required insurance documentation, and has satisfied all conditions precedent to contract execution by the City, and after approval, if any, by the Council of the City of the proposed Contract with the Apparent Low Bidder, the bid guarantee of the Apparent Low Bidder shall be returned. Such return shall be made within one hundred twenty (120) days from date bids are opened unless otherwise specified in the Special Contract Conditions.

IB-9 SITE INSPECTION AND INVESTIGATIONS

Prior to submitting a bid, the bidder is invited to inspect the work site and its surroundings. Although the bidder is not required to make such an inspection before bidding, for purposes of the Contract it shall be conclusively presumed that by failing to make such an inspection, the bidder has waived the right to later

claim additional compensation or time extensions for conditions which would have been evident had the site been inspected.

Drawings and Technical Specifications, defining the Work to be done, were prepared on the basis of interpretation by the design professionals of information derived from investigations of the work site. Such information and data are subject to sampling errors, and the interpretation of the information and data depends to a degree on the judgment of the design professional. In view of this, the bidder is invited to make such additional investigations as the bidder's judgment dictates the need for such investigations. Information about the degree of difficulty of the Work to be done cannot totally be derived from either the Drawings or Technical Specifications or from the Manager or his representatives.

Since the bid information cannot be guaranteed, the Contractor shall have assumed the risks attendant to successful performance of the Work and shall never make claim for additional compensation or time extensions on the grounds that the nature or amount of work to be done was not understood by the bidder at the time of the bidding.

IB-10 INCONSISTENCIES

Any seeming inconsistencies or ambiguities between different provisions of the Contract Documents or any point which the bidder believes requires a decision or interpretation by the City must be inquired into by the bidder by addressing a formal written communication to the Manager of Public Works and sending or delivering it to the offices of the Division of Public Works advertising this Project for bid at least forty-eight (48) hours, excluding Saturdays, Sundays, and holidays, before the time set for the opening of bids

Information about the decision or interpretation made in response to any inquiry will be posted on the Contractor's Bulletin Board (refer to IB-12 CONTRACTOR'S BULLETIN BOARD, for the location of the Contractor's Bulletin Board). If the matter raised requires, in the sole discretion of the Manager, that an addendum to the bid documents be issued, such addendum will be published and each bidder shall be required to acknowledge the addendum by signing and identifying it in the Bid Form when submitting the bid.

After bids are opened, all bidders must abide by the formal response of the Manager, as to any interpretation. The City shall not be bound and the bidder shall not rely on any oral communication, interpretation clarification or determination of the Contract Documents prior to bid opening.

IB-11 WITHDRAWAL OF BID

A bidder may withdraw its bid at any time prior to the time for receipt of bids set forth in the Notice of Invitation for Bids by making written request upon the Manager of Public Works. After such time, no bid may be withdrawn or modified.

Such request must be signed by the persons authorized to bind the bidder as defined in IB-3, COMPLETING AND SIGNING BID FORMS.

IB-12 CONTRACTOR'S BULLETIN BOARD

It shall be conclusively presumed that the bidder has, before submitting any bid, read and shall take full responsibility for all addenda, posted decisions, and other information relevant to the bid posted by the City on the Contractor's Bulletin Board. The Contractor's Bulletin Board is located at 201 W. Colfax, 2nd Floor, Denver, CO 80202, in the Wellington E. Webb Municipal Office Building.

IB-13 PRE-BID MEETING

Bidders are urged to attend the pre-bid meeting(s) scheduled for this Project. Attendance is not mandatory; however, bidders will be held responsible for all information presented at such meeting(s).

IB-14 ADDENDA

As its best interests may require, the City may issue addenda to the Contract Documents. Such addenda shall be posted on the Contractor's Bulletin Board and made available to all persons having purchased a set of Contract Documents as set forth in the Notice of Invitation for Bids contained herein. All bidders must acknowledge receipt of all addenda on the Bid Form at the time of submission of the bid.

IB-15 BID OPENING

Bidders are invited to be present at the bid opening. Unless otherwise suspended, delayed or canceled by posted notice from the Manager, bid opening will occur at the time and place designated in the Notice of Invitation for Bid.

IB-16 EVALUATION OF BIDS AND BASIS OF BID SELECTION

Bids will be evaluated after being read in open meeting at the place designated for such bid opening. All low bidders' bids will be reviewed for responsiveness to the requirements of the Contract Documents and whether or not the bids contain irregularities which could give any bidder an unfair advantage.

Selection will be made on the basis of the lowest, total, responsive, qualified bid, which bid shall include the total base bid set forth on the Bid Form, plus the total of any alternates set forth on the Bid Form and selected by the City during evaluation. Alternates, if any are included in the bid, will be selected in the priority shown on the Bid Form, subject to the limits of available funds. Bid selection will be subject to all requirements and special bidder qualifications contained herein and subject to approval of such resulting Contract in accordance with the Charter and Revised Municipal Code of the City and County of Denver. In addition to all other specified requirements, the City will correct arithmetical errors in all bids and corrected totals only will be considered as the basis of selection.

Upon concluding that the bid is, in fact, the lowest, total, responsive bid to the bidding conditions and that of a responsible, qualified bidder, the City will notify the Apparent Low Bidder.

As its best interests may appear, the City and County of Denver reserves the right to waive informalities in bids, to reject any and all bids and to rebid the Project.

IB-17 NOTICE TO APPARENT LOW BIDDER

The Notice to Apparent Low Bidder, a form of which is included in the Contract Special Conditions Section of the Contract Documents, is issued by the City directly to the selected bidder and informs the bidder that the Manager intends to seek approval of the execution of the Contract by the City in accordance with the Charter and Revised Municipal Code of the City and County of Denver. Specifically, it informs the bidder of its obligations with respect to execution of the Contract and instructs the bidder on how to proceed toward execution of the Contract. The City reserves the right to notify the Apparent Low Bidder, at any time within one hundred twenty (120) days from the date of the opening of the bids, that approval to contract with the Apparent Low Bidder shall be sought in accordance with the Charter and Revised Municipal Code of the City and County of Denver.

In accordance with the terms and conditions contained in the Bid Form and Submittal Package and any additional requirements set forth in the Notice to Apparent Low Bidder or elsewhere in the Contract Documents, the Apparent Low Bidder shall execute the Contract Form contained in the Contract Documents made available by the City for execution in the appropriate number of counterparts. The Apparent Low Bidder shall return the fully executed Contract Document sets, along with any supplemental documents required herein, to the City and shall comply with all other conditions precedent to Contract execution within five (5) days of the date of issuance of the Notice to Apparent Low Bidder by the City. Failure to comply with each of these requirements within five (5) days of the date of issuance of the Notice to Apparent Low Bidder by the City shall render the bid nonresponsive and may constitute cause for rejection.

Issuance of such Notice shall not, however, constitute a commitment on the part of the City or create any rights in the Apparent Low Bidder to any contract with the City.

IB-18 EXECUTION OF CONTRACT

The process of executing a contract requires action by both the apparent low bidder and the City. After it notifies the Apparent Low Bidder, the City will prepare the Contract Documents by incorporating all of the documents submitted by the Apparent Low Bidder into one or more executable copies. Upon notification that contracts documents are ready for execution the Apparent Low Bidder shall execute the contract documents. At this time, the successful bidder shall also provide certain supplemental documents for

incorporation into the Contract Documents. These supplemental documents shall include: the properly executed Certificate of Insurance Forms evidencing the apparent low bidder's satisfactory compliance with the insurance requirements set forth in the Contract Documents; a properly executed Payment and Performance Bond Form and appropriate Power of Attorney evidencing the Apparent Low Bidder's satisfactory compliance with the bonding requirements set forth in the Contract Documents; and documentation of compliance with any other conditions precedent to execution of the Contract by the City set forth in the Contract Documents. The insurance and bond forms contained in the Contract Special Conditions Section of the Contract Documents must be used in satisfying these supplemental document requirements.

These documents are then delivered to the City within the prescribed time period for examination of the documents to determine whether or not the Contractor has correctly executed the Contract and has correctly provided the required supplemental documents and that these documents are satisfactorily and properly completed. From here, all of the documents are forwarded to the City Attorney who will, if the insurance and bonding offered is acceptable and if all other elements of the Contract Documents are in order, recommend that the Manager and the Mayor approve the documents and, when required by the City Charter, prepare an ordinance for submittal to City Council authorizing the execution of the Contract. The City Attorney shall in all applicable instances submit the proposed contract and ordinance to City Council. After City Council approval, the Contract shall be reviewed by the City Attorney and routed for execution by the Mayor, the Clerk for attestation and the Auditor for countersignature and registration. When the total process of contract execution is complete, a Notice to Proceed will be issued and a single executed copy of the Contract will be delivered to the Contractor. Any work performed or materials purchased prior to the issuance of Notice to Proceed is at the Contractor's risk.

IB-19 BONDING REQUIREMENTS

In accordance with the provisions of General Contract Conditions, Title 15, PERFORMANCE AND PAYMENT BONDS, the minimum bonding requirements for this Contract are set forth in the form **CITY AND COUNTY OF DENVER PERFORMANCE AND PAYMENT BOND** contained in the Special Conditions Section of the Contract Documents. Upon receipt of Notice to Apparent Low Bidder, the apparent low bidder must cause this form bond to be purchased, executed and furnished, along with appropriate Powers of Attorney and a surety authorization letter (in form similar to the one attached), to the City in accordance with the instructions contained herein.

IB-20 INSURANCE REQUIREMENTS

The minimum insurance requirements for this Contract are set forth in the Special Conditions Section of the Contract Documents. Bidders are urged to consider, in preparing a bid hereunder, that each condition, requirement or specification set forth in the form certificate must be complied with by the Contractor and all subcontractors performing Work on the Project, unless such requirements are specifically accepted in writing by the City's Risk Management Office. The Contractor must either include all subcontractors performing work hereunder as insureds under each required policy or furnish a separate certificate for each subcontractor. In either case, the Contractor shall insure that each subcontractor complies with all of the coverage requirements.

IB-21 PERMITS AND LICENSES

All permits, licenses and approvals required in the prosecution of the work shall be obtained and paid for by the Contractor.

IB-22 WAGE RATE REQUIREMENTS

In preparing any bid hereunder, the Contractor must comply with and should carefully consider all requirements and conditions of the City's Payment of Prevailing Wages Ordinance, Sections 20-76 through 20-79, D.R.M.C. and any determinations made by the City pursuant thereto.

At the time of the preparation of the Contract Documents, the then-current prevailing wage rates applicable to this Project shall be bound within the Contract Documents made available to potential bidders for the Project. If, more than ten (10) days prior to the actual date of bid opening, the Career Service Board determines that prevailing wages rates different from those bound in the Contract Documents are applicable to one or more of the various classes of laborers, mechanics and workers encompassed by this Project, such

different prevailing wage rates shall be provided in an addendum. If different prevailing wage rates are determined by the Career Service Board ten (10) or less days prior to the actual date of bid opening, the City will determine on a case by case basis in its sole discretion whether such different prevailing wage rates are to be included in an addendum. In conjunction with such determination, the City may elect, in its sole discretion, to postpone the date of bid opening on the Project. In any event, the bidder will be held, at the actual date of bid opening, to those prevailing wage rates incorporated into the Contract Documents and as modified by any such addenda.

These prevailing wage rates shall be considered the **minimum** City prevailing wage rates to be paid by all contractors or subcontractors for a period not to exceed one (1) year from the date of the Contract. Increases in prevailing wages subsequent to the date of the Contract for a period not to exceed one (1) year shall not be mandatory on either the contractor or subcontractors. Future increases in prevailing wages on contracts whose period of performance exceeds one (1) year shall be mandatory for the contractor and subcontractors only on the yearly anniversary date of the Contract. The **minimum** City prevailing wage rate for any such subsequent yearly period or portion thereof shall be the wage rates in effect on the yearly anniversary date of the contract which begins such subsequent period. In no event shall any increases in prevailing wages over the amounts thereof as stated in such Technical Specifications and addenda thereto result in any increased liability on the part of the City and the possibility and risk of any such increase is assumed by all contractors entering into any such contract with the City. Decreases in prevailing wages subsequent to the date of the contract for a period not to exceed one year (1) shall not be permitted. Decreases in prevailing wages on contracts whose period of performance exceeds one (1) year shall not be effective except on the yearly anniversary date of the contract.

IB-23 TAX REQUIREMENTS

General. Bidders are referred to the General Contract Condition 323, TAXES, as to taxes to which they may be subject in performing the Work under this Contract, including but not limited to sales and use taxes and the Denver Occupational Privilege Tax. The following instructions are to be considered along with the General Contract Conditions and not in lieu of them.

Sales and Use Tax. Construction and building materials sold to contractors and subcontractors for use on structures, roads, streets, highways, and other public works owned by the City and County of Denver are exempt from state, RTD, and Cultural Facilities District sales and use taxes. However, such materials will be subject to sales and use taxes imposed by the City and County of Denver.

It is the responsibility of the Contractor and its subcontractors to apply to the Colorado Department of Revenue ("CDOR") for a certificate, or certificates, of exemption indicating that their purchase of construction or building materials is for a public project, and to deliver to the City copies of such applications as soon as possible after approval by the CDOR. Bidders shall not include in their bid amounts the exempt state, RTD, and Cultural Facilities District Sales and Use Taxes.

Denver Occupational Privilege Tax. Any employee working for a contractor, or a subcontractor, who earns over \$500 working in Denver during a calendar month, is subject to the payment of the Employee Occupational Privilege Tax. The Contractor and any subcontractor must pay the Business Occupational Privilege Tax for each of its employees who are subject to such tax.

IB-24 DISCLOSURE OF PRINCIPALS

Pursuant to D.R.M.C. 20-69, any bid in excess of \$100,000.00 must be accompanied by a separate detachable page setting forth the following information:

(1) The name of any officer, director, owner or principal of the business entity, including identity of any shareholder who owns or controls 5% or more of the business entity, and either 1) the names of his or her spouse, and children under eighteen years of age; or 2) a statement that he or she or his or her spouse, or children, if any, under the age of eighteen have or have not made a contribution, as defined in D.R.M.C. 15-32, or contribution in kind, as defined in D.R.M.C. 15-32, to any candidate, as defined in D.R.M.C. 15-32, during the last five years and identifying by name himself or herself or any spouse or child under the age of eighteen who has made such a contribution or contribution in-kind to a candidate.

(2) The names of any subcontractors or suppliers whose share of the bid exceeds \$100,000.00 of the contract or formal bid amount.

(3) The names of any unions with which the bidder has a collective bargaining agreement.

If the total bid amount is in excess of \$500,000.00, the information required in (1) above must be provided at the time of bid submittal. and the information required in (2) and (3) must be submitted in a timely fashion prior to award. The list of subcontractors required by this instrument is different and separate from the bidding list required on BF-4.

If the total bid amount is less than \$500,000.00 but more than \$100,000.00, such information must be provided prior to award of the contract. Failure to provide the required information in a timely fashion shall render any bid to which D.R.M.C. 20-69 applies non-responsive.

While a bidder or supplier who has already disclosed such information need not provide such information with a second or subsequent bid or proposal unless such information has changed, it shall be the responsibility of each such bidder or proposer to verify that such information is still current as of the date of such subsequent bid or proposal and is in fact on file with the City Clerk.

A form, which may be used for such disclosure, is contained in the Special Conditions Section of the Contract Documents. The form is entitled: Bidder/Contractor/Vendor/Proposer Disclosure. Failure to provide or update the required information in a timely fashion shall render any bid to which D.R.M.C. 20-69 applies non-responsive.

IB-25 MINORITY AND WOMAN BUSINESS ENTERPRISE (M/WBE) REQUIREMENTS

Article III, Divisions 1 and 3 of Chapter 28, Denver Revised Municipal Code (D.R.M.C.), designated as Sections 28-31 – 29-36 and 28-52 – 28-90 D.R.M.C. and referred to in these Bid Documents as the “M/WBE Ordinance” and any Rules or Regulations promulgated pursuant thereto apply to this Project and are incorporated into these Bid Documents by reference. Generally, the M/WBE Ordinance provides for the adoption of a good faith goals program, to be administered by the Division of Small Business Opportunity (DSBO), devised to provide increased bidding opportunities for Minority and Woman Business Enterprises (M/WBEs). As such, each bidder must comply with the terms and conditions of the M/WBE Ordinance in making its bid and, if awarded the Contract, in performing all Work thereunder. A bidder’s failure to comply with the M/WBE Ordinance, any Rules or Regulations promulgated pursuant thereto, or any additional requirement contained herein shall render the bid non-responsive and shall constitute cause for rejection. Failure by the contractor awarded the contract to comply with M/WBE Ordinance requirements during the performance of the contract is a material breach of the contract, which may result in the in the imposition of sanctions on the Contractor, as deemed appropriate by DSBO. Copies of the M/WBE Ordinance and its accompanying Rules and Regulations are available for the use and review of bidders from DSBO. In order to comply with the bid requirements of the M/WBE Ordinance, a bidder shall either meet the established project goal or, in the alternative, demonstrate that the bidder has made sufficient good faith efforts to meet the goal in accordance with the M/WBE Ordinance.

Meeting Established Goal

In preparing a bid to meet the established Project goal, bidders should consider the following instructions relating to compliance with the M/WBE Ordinance:

1. Under the M/WBE Ordinance, the Director of DSBO (“Director”) is directed to establish project goals for expenditures on construction, reconstruction, and remodeling work performed for the City and County of Denver. The specific goal for this project is stated in the Notice of Invitation for Bids bound herein.
2. In preparing its bid, each bidder shall list on the Bid Form pages entitled “List of Proposed MWBE or DBE Bidders, Subcontractors, Suppliers, Manufacturers, Manufacturers’ Representatives or Brokers” the name, address, work description/supply, committed level of participation and other required information for each M/WBE of any tier which the bidder intends

to use in performing the work on this Project. **Only the M/WBEs identified and the precise levels of participation listed for each on the Bid Form page, at the time of bid opening, will be considered in determining whether the bidder has met the designated participation goal. Additional, revised or corrected participation submitted after bid opening will not be considered.** M/WBE bidders may count self-performance or joint venture activity in meeting the M/WBE project goal, but only for the scope of work performed as a commercially useful function and at a percentage level the M/WBE will be performing itself.

3. If a bidder/proposer is participating in a joint venture with a certified M/WBE firm, complete the Joint Venture Eligibility Form and Joint Venture Affidavit contained in this bid document/RFP. Submit the aforementioned forms with the firm's Joint Venture Agreement, to the DSBO Director, **at least 10 working days prior to the proposal submittal.** The Joint Venture must be approved prior to the bid opening or proposal submittal by the DSBO Director. Approval by the DSBO Director includes determining the amount the Joint Venture will count towards meeting the project goal.
4. All M/WBEs listed on the Bid Form must be properly certified by the City on or before the date bids are opened in order to count towards meeting the designated goal. DSBO maintains an M/WBE Directory ("Directory"), which is a current listing of M/WBEs that have been certified by the City. A copy of the DSBO Directory is located at DSBO web site at DSBO Compliance. Bidders are encouraged to use the Directory to assist in locating M/WBEs for the work and supplies required on the Project. Bidders are reminded that changes may be made to the Directory at anytime in accordance with the City's M/WBE Ordinance and procedures established to administer this program and a current copy of the Directory must always be used in preparing a bid. M/WBE certification or listing in the Directory is not a representation or warranty by the City as to the qualifications of any listed M/WBE.
5. In accordance with the provisions of the M/WBE Ordinance, DSBO will evaluate each bid to determine the responsiveness of the bid to the requirements of the M/WBE Ordinance. In determining whether a bidder's committed level of participation meets or exceeds the stated M/WBE goal, DSBO shall base its calculation of applicable amounts and percentages on the total base bid amount, not including any listed alternates, of each bid as follows:
 - a. The bid information provided by the agency will be used to determine the total base bid amount of each bid. Each bidder's total base bid amount will be multiplied by the M/WBE percentage established for the project to determine the exact dollar amount of required M/WBE participation for the Project. This amount will then be compared against the exact dollar amounts for the M/WBE committed for participation by the bidder. If the total dollar amount of participation listed meets or exceeds the established M/WBE dollar amount goal listed, then DSBO will determine that the goal has been met.
 - b. In addition, DSBO will determine the exact commitment percentage for each listed M/WBE by dividing the dollar amount listed for each M/WBE by the total base bid dollar amount submitted by the bidder. These individual percentages, when totaled for all listed M/WBE, will establish the total committed percentage level of M/WBE participation that the bidder must comply with during the life of the contract. In all cases, the committed percentage level of M/WBE participation must equal or exceed the assigned M/WBE goal for the Project.
 - c. In providing the exact dollar amount of participation for each listed M/WBE, a bidder should take care never to round up in determining whether or not the total of these amounts meets or exceeds the established percentage goal. The goal must be met or exceeded by dollar amounts and percentages in order for DSBO to determine that the bidder has met or exceeded the applicable M/WBE goal.
 - d. As previously mentioned, compliance with the M/WBE goal will be determined on the base bid alone. If a bid contains alternates, participation contained in any alternate will

not count towards satisfaction of the Project goal. However, should any designated alternate be selected by the City for inclusion in the contract ultimately awarded, the M/WBE goal percentage level submitted at bid time, on the base bid, will also apply to the selected alternates and must be maintained for the life of the contract on the total contract amount, including any alternate work. Thus, even though such participation will not be considered in evaluating bids, bidders are urged to consider participation in preparing bids for designated alternates.

- e. On projects where force account or allowance bid items have been included, bidders must meet the M/WBE goal percentage based upon the total base bid, including all such items that are submitted to the City. However, when a force account or allowance is designated by the City to be either performed or purchased from a specific company, the bidder may back out the dollar amount of the force account or allowance from the total base bid and meet the M/WBE goal on the remaining reduced amount.
 - f. On bids which, at the time of bid opening, are equal to or exceed Five Million Dollars (\$5,000,000.00), including any alternates which may be selected, only sixty percent (60%) of the value of the commercially useful function performed by M/WBE suppliers shall count toward satisfaction of the Project goal. On Projects under Five Million (\$5,000,000.00) the value of the commercially useful function of M/WBE supplier(s) will count at a one hundred percent (100%) level. Manufacturer's representatives and packagers shall be counted in the same manner as brokers.
 - g. In utilizing the M/WBE participation of a Broker only the bona fide commissions earned by such Broker for its performance of a commercially useful function will count toward meeting the Project goals. The bidder must separate the bona fide brokerage commissions from the actual cost of the supplies or materials provided to determine the actual dollar amount of participation that can be counted towards meeting the goal.
6. On or before the third (3rd) working day after bid opening, all of the Bidders are required to submit an executed "Letter of Intent" for each M/WBE listed on the Bid Form as a joint venture member, subcontractor, supplier, manufacturer, manufacturers' representative or broker of any tier. **An MBE or WBE Prime Bidder needs to submit a Letter of Intent for itself for self performed work**, and must identify their level of participation on the designated M/WBE participation page bound herein. A Letter of Intent shall be submitted only for the M/WBEs listed at the time of bid opening, since this is the only participation that will be counted toward satisfaction of the project goal. A form for the M/WBE Letter of Intent is included with the Bid Form. The M/WBE Letter of Intent is a written communication from the Bidder to the City evidencing an understanding that the Bidder has or will enter into a contractual relationship with the M/WBE or that its subcontractor(s) and supplier(s), manufacturer(s), manufacturers' representative(s) and broker(s) will do so. Each M/WBE Letter of Intent shall be accompanied by a copy of the City and County of Denver's M/WBE certification letter for each proposed M/WBE identified at bid time. Bidders are urged to carefully review these Letters before submission to the City to ensure that they are properly completed and executed by the appropriate parties.

Good Faith Effort.

In preparing a bid to demonstrate a good faith effort, bidders should consider the following instructions relating to compliance with the M/WBE Ordinance:

1. If the bidder or proposer has not fully met the project goal as provided in section 28-60, then it shall demonstrate that it has made good faith efforts to meet such goal. The bidder or proposer shall furnish to the director, within three (3) working days after bid opening by the City or on or before the time of the final project-specific proposal submitted to and authorized by the City pursuant to a competitive selection process, or bid selection by a private owner, a detailed statement of its good faith efforts to meet the project goal set by the director. This statement shall address each of the items in subsection (b) and any additional criteria that the director may establish by rule or regulation consistent with the purposes of this division 3. Good faith efforts must be demonstrated to be meaningful and not merely for formalistic compliance with this

Division 3. The scope and intensity of the efforts will be considered in determining whether the bidder or proposer has achieved a good faith effort.

2. The statement of good faith efforts shall include a specific response and verification with respect to each of the following good faith effort categories, which may be further defined by rule or regulation. A bidder or proposer may include any additional information it believes may be relevant. Failure of a bidder or proposer to show good faith efforts as to any one (1) of the following categories shall render its overall good faith effort showing insufficient and its bid or proposal non-responsive:
 - a. If prebid or preselection meetings are scheduled by the City at which MBEs and WBEs may be informed of subcontracting or joint venture opportunities under a proposed contract to be bid, or procured pursuant to the competitive selection process, attendance at such prebid or preselection meetings is not mandatory; however, bidders and proposers are responsible for the information provided at these meetings.
 - b. The bidder or proposer must solicit through all reasonable and available means, the interest of all MBEs and WBEs certified in the scopes of work of the contract. The bidder or proposer must solicit the interest of such MBEs and WBEs within sufficient time, prior to the bid opening or date of final project-specific proposal in the case of a competitive selection process, to allow such MBEs and WBEs to respond to the solicitation. The bidder or proposer must determine with certainty if the MBEs and WBEs are interested by demonstrating appropriate steps to follow up initial solicitations.
 - c. The bidder or proposer must select portions of the work of the contract to be performed by MBEs and WBEs in order to increase the likelihood that the project goal will be achieved. This includes, where appropriate, breaking out contract work items into economically feasible units to facilitate MBE and WBE participation as subcontractors or joint venturers, and for bidder or proposer self-performed work, as suppliers, manufacturers, manufacturer's representatives and brokers, all reasonably consistent with industry practice, even when the bidder or proposer would otherwise prefer to perform these work items with its own forces. The bidder or proposer must identify what portions of the contract will be self-performed and what portions of the contract will be opened to solicitation of bids, proposals and quotes from MBE and WBEs. All portions of the contract not self-performed must be solicited for MBE and WBE participation. The ability or desire of a bidder or proposer to perform the work of a contract with its own forces does not relieve the bidder or proposer of the responsibility to meet the project goal or demonstrate good faith efforts to do so.
 - d. The bidder or proposer, consistent with industry practice, must provide MBEs and WBEs at a clearly stated location with timely, adequate access to and information about the plans, specifications, and requirements of the contract, including bonding and insurance requirements, if any, to assist them in responding to a solicitation.
 - e. The bidder or proposer must negotiate in good faith with interested MBEs and WBEs and provide written documentation of such negotiation with each such MBE or WBE.
 - f. For each MBE or WBE which contacted the bidder or proposer or which the bidder or proposer contacted or attempted to subcontract or joint venture with, consistent with industry practice, the bidder or proposer must supply a statement giving the reasons why the bidder or proposer and the MBE or WBE did not succeed in negotiating a subcontracting, supplier, manufacturer, manufacturer's representative, broker or joint venture agreement, as applicable.
3. The bidder or proposer must provide verification that it rejected each non-utilized MBE and WBE because the MBE or WBE did not submit the lowest bid or it was not qualified. Such verification shall include a verified statement of the amounts of all bids received from potential or utilized subcontractors, suppliers, manufacturers, manufacturer's representatives, brokers or joint venturers

on the contract, whether or not they are MBEs or WBEs. In making such a determination of not being qualified, the bidder or proposer shall be guided by the definition of qualified in section 28-54(42), but evidence of lack of qualification must be based on factors other than solely the amount of the MBE's or WBE's bid. For each MBE or WBE found not to be qualified by the bidder or proposer, the verification shall include a statement giving the bidder's or proposer's reasons for its conclusion. A bidder's or proposer's industry standing or group memberships may not be the cause of rejection of an MBE or WBE. A bidder or proposer may not reject an MBE or WBE as being unqualified without sound reasons based on a reasonably thorough investigation and assessment of the MBE's or WBE's capabilities and expertise.

4. If requested by a solicited MBE or WBE, the bidder or proposer must make reasonable efforts to assist interested MBEs and WBEs in obtaining bonding, lines of credit, or insurance as required by the City or by the bidder or proposer, provided that the bidder or proposer need not provide financial assistance toward this effort.
5. If requested by a solicited MBE or WBE, the bidder or proposer must make reasonable efforts to assist interested MBEs and WBEs in obtaining necessary and competitively priced equipment, supplies, materials, or related assistance or services for performance under the contract, provided that the bidder or proposer need not provide financial assistance toward this effort.
6. The bidder or proposer must use the DSBO MBE/WBE directories to identify, recruit, and place MBEs and WBEs.
7. In determining whether a bidder or proposer has satisfied good faith efforts as to a project goal, the success or failure of other bidders or proposers on the contract in meeting such project goal may be considered.

Continuing Commitments.

In accordance with the provisions of the M/WBE Ordinance, the bidder agrees that it is committed to meeting either the M/WBE participation goal or the M/WBE participation set forth in its statement of good faith. This commitment must be expressly indicated on the "Commitment to MWBE SBE Participation" form included with the Bid Form. This commitment includes the following understandings:

1. The bidder understands it must maintain M/WBE goals throughout the performance of the Contract pursuant to the requirements set out in D.R.M.C. 28-72.
2. The bidder understands that it must establish and maintain records and submit regular reports, as required, which will allow the City to assess progress in achieving the M/WBE participation goal.
3. The bidder understands that if change orders or any other contract modifications are issued under the contract, the bidder shall have a continuing obligation to immediately inform DSBO in writing of any agreed upon increase or decrease in the scope of work of such contract, upon any of the bases discussed in Section 28-73 of the M/WBE Ordinance, regardless of whether such increase or decrease in scope of work has been reduced to writing at the time of notification.
4. The bidder understands that if change orders or other contract modifications are issued under the contract, that include an increase in scope of work of a contract for construction, reconstruction, or remodeling, whether by amendment, change order, force account or otherwise which increases the dollar value of the contract, whether or not such change is within the scope of work designated for performance by an M/WBE at the time of contract award, such change orders or contract modification shall be immediately submitted to DSBO for notification purposes. Those amendments, change orders, force accounts or other contract modifications that involve a changed scope of work that cannot be performed by existing project subcontractors or by the contractor shall be subject to a goal for M/WBEs equal to the original goal on the contract which was included in the bid. The contractor shall satisfy such goal with respect to such changed scope of work by soliciting new M/WBEs in accordance with Section 28-73 of the M/WBE Ordinance as applicable, or the contractor must show each element of modified good faith set out in Section 28-

75(c) of the M/WBE Ordinance. The contractor shall supply to the director the documentation described in Section 28-75(c) of the M/WBE Ordinance with respect to the increased dollar value of the contract.

All bidders are charged with knowledge of and are solely responsible for complying with each and every provision of the M/WBE Ordinance in making a bid and, if awarded, in performing the work described in the Contract Documents. Failure to comply with these provisions could constitute cause for rejection of a bid or subject the selected contractor to sanctions set forth in the M/WBE Ordinance. These instructions are intended only to generally assist the bidder in preparing and submitting a compliant bid. Should any questions arise regarding specific circumstances, bidders must consult the M/WBE Ordinance or contact the Project's designated DSBO representative at (720) 913-1999.

IB- 26 DISCLOSURE OF INFORMATION

All submissions and other materials provided or produced pursuant to this Invitation for Bids may be subject to the Colorado Open Records Law, C.R.S. 24-72-201, et seq. As such, bidders are urged to review these disclosure requirements and any exceptions to disclosure of information furnished by another party and, prior to submission of a bid to the City, appropriately identify materials that are not subject to disclosure. In the event of a request to the City for disclosure of such information, the City shall advise the bidder of such request to give the bidder an opportunity to object to the disclosure of designated confidential materials furnished to the City. In the event of the filing of a lawsuit to compel such disclosure, the City will tender all such material to the court for judicial determination of the issue of disclosure and each bidder agrees to intervene in such lawsuit to protect and assert its claims of privilege against disclosure of such material. Each bidder further agrees to defend, indemnify and save and hold harmless the City, its officers, agents and employees, from any claim, damages, expense, loss or costs arising out of the bidder's intervention to protect and assert its claims of privilege against disclosure under the Open Records Law including, but not limited to, prompt reimbursement to the City of all reasonable attorney fees, costs and damages that the City may incur directly or may be ordered to pay by such court.

IB-27 GENERAL BIDDING INFORMATION

Bidders are instructed to contact the Contract Administrator designated below for this Project for pre-bid, post-bid and general City bidding information. Bidders can also visit DenverGov.com for information, both general and project specific. The Contract Administrator assigned to this project is Toni Green who can be reached via email at toni.green@denvergov.org.

IB-28 PAYMENT PROCEDURE REQUIREMENTS

Contractor recognizes and agrees that it shall be required to use the Textura® Construction Payment Management System (CPM System) for this Project. Bidders are urged, when preparing a bid, to contact the Textura® Corporation for pricing schedule and fees, as all fees associated with the CPM System are to be paid by the Contractor and subcontractor for billings for work performed.

**RULES AND REGULATIONS
REGARDING
EQUAL EMPLOYMENT OPPORTUNITY**

Promulgated and adopted by the Manager of Public Works pursuant to and by authority of Article III, Division 2, Chapter 28 of the Revised Municipal Code of the City and County of Denver, and for the purpose of insuring that contractors, subcontractors and suppliers soliciting and receiving compensation for contract work from or through the City and County of Denver provide equal opportunity in employment without regard to race, color, creed, sex, national origin, age, religion, marital status, political opinion or affiliation or mental or physical handicap and meet certain requirements for the hiring, training, promotion, and treatment during employment of members of ethnic groups subject to differential treatment, including persons of African descent (Black), Spanish-surnamed (Hispanic), Asian-American and American Indian Groups.

RULE I - DEFINITIONS

- A. "City" means the City and County of Denver.
- B. "Manager" shall mean the Manager of Public Works for the City and County of Denver.
- C. "Contract" means a contract entered into with the City and County of Denver, financed in whole or in part by local resources or funds of the City and County of Denver, for the construction of any public building or prosecution or completion of any public work.
- D. "Contractor" means the original party to a contract with the City and County of Denver, also referred to as the "general" or "prime" contractor.
- E. "Director" means the Director of the Division of Small Business Opportunity.
- F. "Subcontractor" means any person, company, association, partnership, corporation, or other entity, which assumes by subordinate agreement some or all of the obligations of the general or prime contractor.
- G. The phrase "Bidding Specifications" as used in Article III, Division 2 of Chapter 28 of the Revised Municipal Code shall include BID CONDITION, INVITATION TO BID, and NOTICE OF PROPOSAL.
- H. "Affirmative Action Program" means a set of specific and result-oriented procedures or steps to which a contractor commits himself to apply every good faith effort to employ members of ethnic minority groups, to include persons of African descent (Black), Spanish surnamed (Hispanic), Asian-American, American Indians, and persons with mental or physical handicap.
- I. "Division of Small Business Opportunity" means the City agency established pursuant to Article III, Division 1 of Chapter 28 of the Denver Revised Municipal Code.

RULE II - NOTICE OF HEARING

When results of conciliation efforts are unsatisfactory to the Manager and he is informed in accordance with Article III, Division 2 of Chapter 28 of the Revised Municipal code that a contractor or subcontractor has apparently failed to meet affirmative action and equal employment opportunity requirements after a reasonable period of notice to correct deficiencies, the Manager will, prior to imposition of any sanctions, afford the general contractor a hearing in order to determine whether the contractor or his subcontractors have failed to comply with the affirmative action and equal employment opportunity requirements of Article III, Division 2 of Chapter 28 of the Revised Municipal Code or of the contract. Written notice of such hearing shall be delivered personally or sent by certified mail, return receipt requested, to the contractor and to any subcontractor involved, at least ten (10) days prior to the date scheduled for the hearing.

RULE III - HEARING

- A. Contractors will appear at hearings and may be represented by counsel, and may present testimony orally and other evidence.
- B. Hearings shall be conducted by one or more hearing examiners designated as such by the Manager.
- C. The Director of the Division of Small Business Opportunity may participate in hearings as a witness.
- D. Hearings shall be held at the place specified in the notice of hearing.
- E. All oral testimony shall be given under oath or affirmation and a record of such proceedings shall be made.
- F. All hearings shall be open to the public.
- G. The hearing officer shall make recommendations to the Manager who shall make a final decision.

REGULATIONS

REGULATION NO. 1 - ORDINANCE:

The Rules and Regulations of the Manager shall be inserted in the bidding specifications for every contract for which bidding is required.

REGULATION NO. 2 - EXEMPTIONS:

Each contract and subcontract, regardless of the dollar amount, shall be subject to affirmative action requirements unless specifically exempted in writing individually by the Manager. Exemptions apply only to "affirmative action" in equal employment opportunity, and are not to be construed as condonation in any manner of "discrimination" or "discriminatory practices" in employment because of race, color, creed, sex, age, national origin, religion, marital status, political opinion or mental or physical handicap.

REGULATION NO. 3 - DIRECTOR OF CONTRACT COMPLIANCE:

The Director of the Division of Small Business Opportunity shall perform the duties assigned to such official by Article III, Division 2 Chapter 28 of the Revised Municipal Code and by the Manager. (1) The Director of the Division of Small Business Opportunity or designated representatives shall inform bidders and contractors of affirmative action procedures, programs, and goals in accordance with the Ordinance at pre-bid and pre-construction conference; (2) make regular on-site inspections; (3) supply contractors and subcontractors with report forms to be completed by them when requested, and furnished to the Director of the Division of Small Business Opportunity; and (4) review payroll records, employment records and practices of general contractors and their subcontractors and suppliers during the performance of any contract. The Director of the Division of Small Business Opportunity shall promptly report apparent affirmative action deficiencies to the Manager.

REGULATION NO. 4 - GOALS AND TIMETABLES:

In general, goals and timetables should take into account anticipated vacancies and the availability of skills in the market place from which employees should be drawn. In addition, where discrimination in employment by a general contractor or any of his subcontractors is indicated, a corrective action program will take into account the need by the general contractor and his subcontractors to correct past discriminatory practices and reach goals of minority manpower utilization on a timely basis through such recruiting and advertising efforts as are necessary and appropriate.

REGULATION NO. 5 - AWARD OF CONTRACTS:

It shall be the responsibility of the Director of the Division of Small Business Opportunity to determine the affirmative action capability of bidders, contractors and subcontractors and to recommend to the Manager the award of contracts to those bidders, contractors and subcontractors and suppliers who demonstrate the ability and willingness to comply with the terms of their contract.

REGULATION NO. 6 - PUBLICATION AND DUPLICATION:

Copies of these Rules and Regulations as amended by the Manager from time to time, shall as soon as practicable and after Notice being published will be made a part of all City Contracts.

REGULATION NO. 7 - NOTICE TO PROCEED:

Prior to issuance of the Notice to Proceed, a sign-off will be required of the Director of the Division of Small Business Opportunity or his designee.

REGULATION NO. 8 - CONTRACTS WITH SUBCONTRACTORS:

To the greatest extent possible, the contractor shall make a good faith effort to contract with minority contractors, subcontractors and suppliers for services and supplies by taking affirmative actions, which include but are not limited to the following:

1. Advertise invitations for subcontractor bids in minority community news media.
2. Contact minority contractor organizations for referral of prospective subcontractors.
3. Purchase materials and supplies from minority material suppliers.

REGULATION NO. 9 - AGENCY REFERRALS:

It shall be no excuse that the union with which the contractor or subcontractor has an agreement providing for referral, exclusive or otherwise, failed to refer minority employees.

REGULATION NO. 10 - CLAUSES:

The Manager shall include the appropriate clauses in every contract and the contractor shall cause to be inserted in every subcontract the appropriate clauses:

1. APPENDIX A: City and County of Denver Equal Opportunity Clause - ALL CONTRACTS funded only with City and County of Denver monies.
2. APPENDIX B: Equal Opportunity Clause (11246) - ALL FEDERAL ASSISTED.
3. APPENDIX C: Section 3 - Assurance of Compliance - HUD ASSISTED PROJECTS.
4. APPENDIX D: Section 3 - Clause - HUD ASSISTED PROJECTS.

All amendments to the appendices shall be included by reference.

REGULATION NO. 11 - SHOW CAUSE NOTICES:

When the Manager has reasonable cause to believe that a contractor has violated Article III, Division 2 of Chapter 28 of the Denver Revised Municipal Code, he may issue a notice requiring the contractor to show cause, within fifteen (15) days why enforcement procedures, or other appropriate action to insure compliance, should not be instituted.

REGULATION NO. 12 - BID CONDITIONS - AFFIRMATIVE ACTION REQUIREMENTS - EQUAL EMPLOYMENT OPPORTUNITY:

1. APPENDIX E: The Bid Conditions - Affirmative Action Requirements - Equal Employment Opportunity as amended and published by the U.S. Department of Labor Employment Standards Administration, Office of Federal Contract Compliance, shall be inserted verbatim for bidding specification for every non-exempt contract involving the use of Federal funds.
2. APPENDIX F: The Bid Conditions - Affirmative Action Requirements - Equal Employment Opportunity as published by the Department of Public Works, City and County of Denver, shall be inserted verbatim as bidding specifications for every non-exempt contract using City funds.

CITY AND COUNTY OF DENVER
DEPARTMENT OF PUBLIC WORKS
Wastewater Management Division

APPENDIX A

**CITY AND COUNTY OF DENVER EQUAL OPPORTUNITY CLAUSE -
ALL CONTRACTS**

1. The Contractor will not discriminate against any employee or applicant for employment because of race, creed, color, sex, age, national origin, religion, marital status, political opinion or affiliation, or mental or physical handicap. The Contractor will take affirmative action to ensure that applicants are employed, and that employees are treated during employment without regard to their race, creed, color, sex, age, national origin, religion, marital status, political opinion or affiliation, or mental or physical handicap. Such action shall include, but not be limited to the following: employment, upgrading, demotion, or transfer; recruitment or recruitment advertising; layoff or termination; rates of pay or other forms of compensation; and selection for training, including apprenticeship. The Contractor agrees to post in conspicuous places, available to employees and applicants for employment, notices to be provided setting forth the provisions of this nondiscrimination clause.
2. The Contractor will, in all solicitations or advertisements for employees placed by or on behalf of the contractor, state that all qualified applicants will receive consideration for employment without regard to race, creed, color, sex, age, national origin, religion, marital status, political opinion or affiliation, or mental or physical handicap.
3. The Contractor will send to each labor union or representative of workers with which he has a collective bargaining agreement or other contract or understanding, a notice to be provided, advising the said labor union or workers' representatives of the contractor's commitments under this section, and shall post copies of the notice in conspicuous places available to employees and applicants for employment.
4. Each Contractor will comply with all provisions of Article III, Division 2 of Chapter 28 of the Revised Municipal Code, and the rules, regulations, and relevant orders of the Manager and the Director.
5. The Contractor will furnish all information and reports required by Article III, Division 2 of Chapter 28 of the Revised Municipal Code, and by rules, regulations and orders of the Manager and Director or pursuant thereto, and will permit access to his books, records, and accounts by the Manager, Director, or their designee for purposes of investigation to ascertain compliance with such rules, regulations, and orders.
6. In the event of the Contractor's noncompliance with the nondiscrimination clauses of this contract or with any of the said rules, regulations or orders, this contract may be canceled, terminated, or suspended in whole or in part and the Contractor may be declared ineligible for further City contracts in accordance with procedures authorized in Article III, Division 2, Chapter 28 of the Revised Municipal Code, or by rules, regulations, or order of the Manager.
7. The Contractor will include Regulation 12, Paragraph 2 and the provisions of paragraphs (1) through (6) in every subcontract of purchase order unless exempted by rules, regulations, or orders of the Manager issued pursuant to Article III, Division 2, Chapter 28 of the Revised Municipal Code, so that such provisions will be binding on each subcontractor or supplier. The Contractor will take such action with respect to any subcontract or purchase order as the administering agency may direct as a means of enforcing such provisions, including sanctions for noncompliance.

The applicant further agrees to be bound by the above equal opportunity clauses with respect to its own employment practices when it participates in City contracts. The Contractor agrees to assist and cooperate actively with the Manager and the Director in obtaining compliance of subcontractors and suppliers with the equal opportunity clause and the rules, regulations and relevant orders of the Manager, and will furnish the Manager and the Director such information as they may require for the supervision of compliance, and will otherwise assist the Manager and Director in the discharge of the City's primary responsibility for

securing compliance. The Contractor further agrees to refrain from entering into any contract or contract modification subject to Article III, Division 2 of Chapter 28 of the Revised Municipal Code with a contractor debarred from, or who has not demonstrated eligibility for, City contracts.

The Contractor will carry out such sanctions and penalties for violation of the equal opportunity clause as may be imposed upon contractors and subcontractors by the Manager and Director. In addition, the Contractor agrees that failure or refusal to comply with these undertakings the Manager may take any or all of the following actions:

- A. Cancellation, termination, or suspension in whole or in part of this contract.
- B. Refrain from extending any further assistance to the applicant under the program with respect to which the failure occurred until satisfactory assurance of future compliance has been received from such applicant.
- C. Refer the case to the City Attorney for appropriate legal proceedings.

SUBCONTRACTS: Each prime Contractor or Subcontractor shall include the equal opportunity clause in each of its subcontracts.

CITY AND COUNTY OF DENVER
DEPARTMENT OF PUBLIC WORKS
Wastewater Management Division

APPENDIX F

AFFIRMATIVE ACTION REQUIREMENTS

EQUAL EMPLOYMENT OPPORTUNITY

For All Non-Exempt Construction Contracts to Be Awarded by the
City and County of Denver, Department of Public Works.

NOTICE

EACH BIDDER, CONTRACTOR OR SUBCONTRACTOR (HEREINAFTER THE CONTRACTOR) MUST FULLY COMPLY WITH THE REQUIREMENTS OF THESE BID CONDITIONS AS TO EACH CONSTRUCTION TRADE IT INTENDS TO USE ON THIS CONSTRUCTION CONTRACT, AND ALL OTHER CONSTRUCTION WORK (BOTH CITY AND NON-CITY) IN THE DENVER AREA DURING THE PERFORMANCE OF THIS CONTRACT OR SUBCONTRACT. THE CONTRACTOR COMMITS ITSELF TO THE GOALS FOR MINORITY MANPOWER UTILIZATION, AS APPLICABLE, AND ALL OTHER REQUIREMENTS, TERMS AND CONDITION OF THESE BID CONDITIONS BY SUBMITTING A PROPERLY SIGNED BID.

THE CONTRACTOR SHALL APPOINT A COMPANY EXECUTIVE TO ASSUME THE RESPONSIBILITY FOR THE IMPLEMENTATION OF THE REQUIREMENTS, TERMS AND CONDITIONS OF THESE BID CONDITIONS.

/s/ _____

Manager of Public Works
City and County of Denver

A. REQUIREMENTS - AN AFFIRMATIVE ACTION PLAN:

Contractors shall be subject to the provisions and requirements of these bid conditions including the goals and timetables for minority* and female utilization, and specific affirmative action steps set forth by the Division of Small Business Opportunity (DSBO). The contractor's commitment to the goals for minority, and female utilization as required constitutes a commitment that it will make every good faith effort to meet such goals.

1. GOALS AND TIMETABLES:

The goals and timetables for minority and female participation, expressed in percentage terms for the contractor's aggregate workforce in each trade are as follows:

GOALS FOR MINORITY PARTICIPATION FOR EACH TRADE	GOALS FOR FEMALE PARTICIPATION FOR EACH TRADE
From January 1, 1982 to Until Further Notice	From January 1, 1982 to Until Further Notice
21.7% - 23.5%	6.9%

The goals for minority and female utilization above are expressed in terms of hours of training and employment as a proportion of the total number of hours to be worked by the contractor's aggregate workforce, which includes all supervisory personnel, in each trade, on all projects for the City and County of Denver during the performance of its contract (i.e., The period beginning with the first day of work on the City and County of Denver funded construction contract and ending with the last day of work).

The hours of minority and female employment and training must be substantially uniform throughout the length of the contract in each trade and minorities and females must be employed evenly on each of a contractor's projects. Therefore, the transfer of minority or female employees from contractor to contractor or from project to project for the purpose of meeting the contractor's goals shall be a violation of these Bid Conditions.

If the Contractor counts the nonworking hours of apprentices they must be employed by the Contractor during the training period; the Contractor must have made a commitment to employ apprentices at the completion of their training subject to the availability of employment opportunities; and the apprentices must be trained pursuant to training programs approved by the Bureau of Apprenticeship and Training.

* "Minority" is defined as including, Blacks, Spanish Surname Americans, Asian Americans, and American Indians, and includes both men and minority women.

2. SPECIFIC AFFIRMATIVE ACTION STEPS:

No contractor shall be found to be in noncompliance solely on account of its failure to meet its goals, but will be given an opportunity to demonstrate that the contractor has instituted all the specific affirmative action steps specified and has made every good faith effort to make these steps work toward the attainment of its goals within the timetables, all to the purpose of expanding minority and female utilization in its aggregate workforce. A contractor, who fails to comply with its obligation under the Equal Opportunity Clause of its contract and fails to achieve its commitments to the goals for minority and female utilization has the burden of proving that it has engaged in an Affirmative Action Program directed at increasing minority and female utilization and that such efforts were at least as extensive and as specific as the following:

- a. The Contractor should have notified minority and female organizations when employment opportunities were available and should have maintained records of the organization's response.

- b. The Contractor should have maintained a file of the names and addresses of each minority and female referred to it by any individual or organization and what action was taken with respect to each such referred individual, and if the individual was not employed by the Contractor, the reasons. If such individual was sent to the union hiring hall for referral and not referred back by the union or if referred, not employed by the Contractor, the file should have documented this and their reasons.
- c. The Contractor should have promptly notified the Department of Public Works, and the Division of Small Business Opportunity when the union or unions with which the Contractor has collective bargaining agreements did not refer to the contractor a minority or female sent by the contractor, or when the Contractor has other information that the union referral process has impeded efforts to meet its goals.
- d. The Contractor should have disseminated its EEO policy within its organization by including it in any employee handbook or policy manual; by publicizing it in company newspapers and annual reports and by advertising such policy at reasonable intervals in union publications. The EEO policy should be further disseminated by conducting staff meetings to explain and discuss the policy; by posting of the policy; and by review of the policy with minority and female employees.
- e. The Contractor should have disseminated its EEO policy externally by informing and discussing it with all recruitment sources; by advertising in news media, specifically including minority and female news media; and by notifying and discussing it with all subcontractors.
- f. The Contractor should have made both specific and reasonably recurrent written and oral recruitment efforts. Such efforts should have been directed at minority and female organizations, schools with substantial minority and female enrollment, and minority and female recruitment and training organizations within the Contractor's recruitment area.
- g. The Contractor should have evidence available for inspection that all tests and other selection techniques used to select from among candidates for hire, transfer, promotion, training, or retention are being used in a manner that does not violate the OFCCP Testing Guidelines in 41 CFR Part 60-3.
- h. The Contractor should have made sure that seniority practices and job classifications do not have a discriminatory effect.
- i. The Contractor should have made certain that all facilities are not segregated by race.
- j. The Contractor should have continually monitored all personnel activities to ensure that its EEO policy was being carried out including the evaluation of minority and female employees for promotional opportunities on a quarterly basis and the encouragement of such employees to seek those opportunities.
- k. The Contractor should have solicited bids for subcontracts from available minority and female subcontractors engaged in the trades covered by these Bid Conditions, including circulation of minority and female contractor associations.

NOTE:

The Director and the Division of Small Business Opportunity will provide technical assistance on questions pertaining to minority and female recruitment sources, minority and female community organizations, and minority and female news media upon receipt of a request for assistance from a contractor.

3. NON - DISCRIMINATION:

In no event may a contractor utilize the goals and affirmative action steps required in such a manner as to cause or result in discrimination against any person on account of race, color, religion, sex, marital status, national origin, age, mental or physical handicap, political opinion or affiliation.

4. COMPLIANCE AND ENFORCEMENT:

In all cases, the compliance of a contractor will be determined in accordance with its obligations under the terms of these Bid Conditions. All contractors performing or to perform work on projects subject to these Bid Conditions hereby agree to inform their subcontractors in writing of their respective obligations under the terms and requirements of these Bid Conditions, including the provisions relating to goals of minority and female employment and training.

B. CONTRACTORS SUBJECT TO THESE BID CONDITIONS:

In regard to these Bid Conditions, if the Contractor meets the goals set forth therein or can demonstrate that it has made every good faith effort to meet these goals, the Contractor shall be presumed to be in compliance with Article III, Division 2 of Chapter 28 of the Revised Municipal Code, the implementing regulations and its obligations under these Bid Conditions. In the event, no formal sanctions or proceedings leading toward sanctions shall be instituted unless the contracting or administering agency otherwise determines that the contractor is violating the Equal Opportunity Clause.

1. Where the Office of Contract Compliance finds that a contractor failed to comply with the requirements of Article III, Division 2 of Chapter 28 of the Revised Municipal Code or the implementing regulations and the obligations under these Bid Conditions, and so informs the Manager, the Manager shall take such action and impose such sanctions, which include suspension, termination, cancellation, and debarment, as may be appropriate under the Ordinance and its regulations. When the Manager proceeds with such formal action it has the burden of proving that the Contractor has not met the goals contained in these Bid Conditions. The Contractor's failure to meet its goals shall shift to it the requirement to come forward with evidence to show that it has met the good faith requirements of these Bid Conditions.
2. The pendency of such proceedings shall be taken into consideration by the Department of Public Works in determining whether such contractor can comply with the requirements of Article III, Division 2 of Chapter 28 of the Revised Municipal Code, and is therefore a "responsible prospective contractor".
3. The Division of Small Business Opportunity shall review the Contractor's employment practices during the performance of the contract. If the Division of Small Business Opportunity determines that the Contractor's Affirmative Action Plan is no longer an acceptable program, the Director shall notify the Manager.

C. OBLIGATIONS APPLICABLE TO CONTRACTORS:

It shall be no excuse that the union with which the Contractor has a collective bargaining agreement providing for exclusive referral failed to refer minority or female employees. Discrimination in referral for employment, even if pursuant to provisions of a collective bargaining agreement, is prohibited by the National Labor Relations Act, as amended, Title VI of the Civil Rights Act of 1964, as amended, and Article III, Division 2 of Chapter 28 of the Revised Municipal Code. It is the policy of the Department of Public Works that contractors have a responsibility to provide equal employment opportunity, if they wish to participate in City and County of Denver contracts. To the extent they have delegated the responsibility for some of their employment practices to a labor organization and, as a result, are prevented from meeting their obligations pursuant to Article III, Division 2, Chapter 28 of the Revised Municipal Code, such Contractors cannot be considered to be in compliance with Article III, Division 2, Chapter 28 of the Revised Municipal Code, or its implementing rules and regulations.

D. GENERAL REQUIREMENTS:

Contractors are responsible for informing their subcontractors in writing regardless of tier, as to their respective obligations. Whenever a Contractor subcontracts a portion of work in any trade covered by

these Bid Conditions, it shall include these Bid Conditions in such subcontracts and each subcontractor shall be bound by these Bid Conditions to the full extent as if it were the prime contractor. The Contractor shall not, however, be held accountable for the failure of its subcontractors to fulfill their obligations under these Bid Conditions. However, the prime contractor shall give notice to the Director of any refusal or failure of any subcontractor to fulfill the obligations under these Bid Conditions. A subcontractor's failure to comply will be treated in the same manner as such failure by a prime contractor.

1. Contractors hereby agree to refrain from entering into any contract or contract modification subject to Article III, Division 2, Chapter 28 of the Revised Municipal Code with a contractor debarred from, or who is determined not to be a "responsive" bidder for the City and County of Denver contracts pursuant to the Ordinance.
2. The Contractor shall carry out such sanctions and penalties for violation of these Bid Conditions and the Equal Opportunity Clause including suspension, termination and cancellation of existing subcontracts and debarment from future contracts as may be ordered by the Manager pursuant to Article III, Division 2, Chapter 28 of the Revised Municipal Code and its implementing regulations.
3. Nothing herein is intended to relieve any contractor during the term of its contract from compliance with Article III, Division 2, Chapter 28 of the Revised Municipal Code, and the Equal Opportunity Clause of its contract with respect to matters not covered in these Bid Conditions.
4. Contractors must keep such records and file such reports relating to the provisions of these Bid Conditions as shall be required by the Office of Contract Compliance.
5. Requests for exemptions from these Bid Conditions must be made in writing, with justification, to the Manager of Public Works, 201 W. Colfax, Dept. 608, Denver, Colorado 80202, and shall be forwarded through and with the endorsement of the Director.

CITY AND COUNTY OF DENVER
DEPARTMENT OF PUBLIC WORKS
Wastewater Management Division

CONTRACT NO. 201207767

IOWA AVENUE EXTENSION PHASE 1

CONTRACT

THIS CONTRACT AND AGREEMENT, made and entered into by and between the City and County of Denver, a municipal corporation of the State of Colorado, hereinafter referred to as the "City," party of the first part, and

B T Construction, Inc.
9885 Emporia St.
Henderson, CO 80640

hereinafter referred to as the "Contractor," party of the second part,

WITNESSETH, Commencing on **September 18, 2012**, and for at least three (3) days the City advertised that sealed bids would be received for furnishing all labor, tools, supplies, equipment, materials, and everything necessary and required for the following:

<p>CONTRACT NO. 201207767</p> <p>IOWA AVENUE EXTENSION PHASE 1</p>
--

WHEREAS, bids pursuant to said advertisement have been received by the Manager of Public Works, who has recommended that a Contract for said work be made and entered into with the above named Contractor who was the lowest, responsive, qualified bidder therefore, and

WHEREAS, said Contractor is now willing and able to perform all of said work in accordance with said advertisement and its bid.

NOW THEREFORE, in consideration of the compensation to be paid the Contractor, the mutual agreements hereinafter contained, and subject to the terms hereinafter stated, it is mutually agreed as follows:

1. CONTRACT DOCUMENTS

It is agreed by the parties hereto that the following list of documents, instruments, technical specifications, plans, drawings and other materials which are attached hereto and bound herewith, incorporated herein by reference or otherwise referenced in these documents constitute and shall be referred to either as the "Contract Documents" or the "Contract," and all of said documents, instruments, technical specifications, Plans, Drawings and other materials taken together as a whole constitute the Contract between the parties hereto, and they are as fully a part of this agreement as if they were set out verbatim and in full herein:

Advertisement of Notice of Invitation for Bids
Instructions to Bidders
Commitment to M/WBE Participation
Article III, Divisions 1, 2, and 3 of Chapter 28, D.R.M.C.
Bid Bond
Addenda (as applicable)

Equal Employment Opportunity Provisions (Appendix A and Appendix F)
Bid Form
Contract Form
General Contract Conditions
Special Contract Conditions
Performance and Payment Bond
Notice to Apparent Low Bidder
Notice to Proceed
Contractor's Certification of Payment Form
Final/Partial Lien Release Form
Certificate of Contract Release
Change Orders (as applicable)
Federal Requirements (as applicable)
Prevailing Wage Rate Schedule(s)
Technical Specifications
Contract Drawings
Accepted Shop Drawings

2. SCOPE OF WORK

The Contractor agrees to and shall furnish all labor, tools, supplies, equipment, materials and everything necessary for and required to do, perform and complete all of the Work described, drawn, set forth, shown and included in said Contract Documents.

3. TERMS OF PERFORMANCE

The Contractor agrees to undertake the performance of the Work under this Contract within ten (10) days after being notified to commence work by issuance of a Notice to Proceed in substantially the form contained herein from the Manager and agrees to fully complete said Work within **210** (Two Hundred Ten Days) consecutive calendar days from the effective date of said Notice, plus such extension or extensions of time as may be granted in accordance with the provisions of the General Contract Conditions and any applicable Special Contract Conditions.

4. TERMS OF PAYMENT

The City agrees to pay the Contractor for the performance of all of the Work required under this Contract, and the Contractor agrees to accept as the Contractor's full and only compensation therefore, such sum or sums of money as may be proper in accordance with the price or prices set forth in the Contractor's Bid Form hereto attached and made a part hereof for **bid item numbers 2-1.2a through 50-1 (Fifty [50] Total Bid Items)**, the total estimated cost thereof being **Two Million Four Hundred Eighty-One Thousand Seven Hundred Eighty-Eight Dollars and Five Cents (\$2,481,788.05)**. Adjustments to said Contract Amount and payment of amounts due hereunder shall be made in accordance with the provisions of the General Contract Conditions and any applicable Special Contract Conditions.

5. NO DISCRIMINATION IN EMPLOYMENT

In connection with the performance of the Work under this Contract, the Contractor agrees not to refuse to hire, discharge, promote or demote, or to discriminate in matters of compensation against any person otherwise qualified, solely because of race, color, religion, national origin, gender, age, military status, sexual orientation, marital status, or physical or mental disability; and the Contractor further agrees to insert the foregoing provision in all subcontracts hereunder.

6. COMPLIANCE WITH M/WBE REQUIREMENT

This Contract is subject to all applicable provisions of Divisions 1 and 3 of Article III, of Chapter 28, Denver Revised Municipal Code (D.R.M.C.), designated as Sections 28-31 – 28-36 and 28-52 – 28-90 D.R.M.C. and referred to in this Contract as the "M/WBE Ordinance". Without limiting the general applicability of the foregoing, the Contractor acknowledges its continuing duty, pursuant to Sections 28-72, 28-73 and 28-75 of the D.R.M.C., to maintain throughout the duration of this Contract, compliance with the level of minority and Woman business enterprise participation, upon which the City approved the award of this Contract to the Contractor and the Contractor further acknowledges that failure to maintain such

participation commitments or otherwise comply with the requirements of the M/WBE Ordinance shall subject the Contractor to sanctions in accordance with Section 28-77 of the D.R.M.C. Nothing contained in this provision or in the M/WBE Ordinance shall negate the City's right to prior approval of subcontractors, or substitutes therefore, under this Contract

7. WAGE RATE REQUIREMENTS

In performance of all Work hereunder, the Contractor agrees to comply with and be bound by all requirements and conditions of the City's Payment of Prevailing Wages Ordinance, Sections 20-76 through 20-79, D.R.M.C. and any determinations made by the City pursuant thereto.

8. APPLICABILITY OF LAWS

The Agreement between the Contractor and the City shall be deemed to have been made in the City and County of Denver, State of Colorado and shall be subject to, governed by, and interpreted and construed by or in accordance with the laws of the State of Colorado and the Charter, Revised Municipal Code, Rules, Regulations, Executive Orders and fiscal rules of the City. As such, the Contractor shall at all times comply with the provisions of the Charter, Revised Municipal Code, Rules, Regulations, Executive Orders and fiscal rules of the City, and those State of Colorado and Federal Laws, Rules and Regulations, which in any manner limit, control or apply to the actions or operations of the Contractor, any subcontractors, employees, agents or servants of the Contractor engaged in the Work or affecting the materials and equipment used in the performance of the Work, as the same may be, from time to time, promulgated, revised or amended. The Charter and Revised Municipal Code of the City and County of Denver, as the same may be amended from time to time, are hereby expressly incorporated into this Agreement as if fully set out herein by this reference.

9. APPROPRIATION

The amount of money, which has been appropriated and encumbered for the purpose of this contract, to date, is equal to or in excess of the Contract Amount. The Manager, upon reasonable written request, will advise the Contractor in writing of the total amount of appropriated and encumbered funds, which remain available for payment for all Work under the Contract.

The issuance of any change order or other form or order or directive by the City which would cause the aggregate payable under the contract to exceed the amount appropriated for the contract is expressly prohibited. In no event shall the issuance of any change order or other form of order or directive by the City be considered valid or binding if it requires additional compensable work to be performed, which work will cause the aggregate amount available under the Contract to exceed the amount appropriated and encumbered for this Contract, unless and until such time as the Contractor has been advised in writing by the Manager that a lawful appropriation, sufficient to cover the entire cost of such additional work, has been made.

It shall be the responsibility of the Contractor to verify that the amounts already appropriated for this Contract are sufficient to cover the entire cost of such work, and any work undertaken or performed in excess of the amount appropriated is undertaken or performed in violation of the terms of this contract, without the proper authorization for such work, and at the Contractor's own risk.

10. APPROVALS

In the event this Contract calls for the payment by the City of five hundred thousand dollars (\$500,000.00) or more, approval by the Board of Councilmen of the City and County of Denver, acting by ordinance, in accordance with Section 3.2.6 of the Charter of the City and County of Denver, is and shall be an express condition precedent to the lawful and binding execution and effect and performance of this contract.

11. ASSIGNMENT

The Contractor shall not assign any of its rights, benefits, obligations or duties under this Contract except upon the prior written consent and approval of the Manager to such assignment.

12. DISPUTES RESOLUTION PROCESS

It is the express intention of the parties to this Contract that all disputes of any nature whatsoever regarding the Contract including, but not limited to, any claims for compensation or damages arising out of breach or

default under this Contract, shall be resolved by administrative hearing pursuant to the provisions of Section 56-106, D.R.M.C., or, as applicable, Section 28-33 D.R.M.C. for Minority and Woman Business Enterprise disputes. The Contractor expressly agrees that this dispute resolution process is the only dispute resolution mechanism that will be recognized by the parties for any claims put forward by the Contractor, notwithstanding any other claimed theory of entitlement on the part of the Contractor or its subcontractors or suppliers.

13. CONTRACT BINDING

It is agreed that this Contract shall be binding on and inure to the benefit of the parties hereto, their heirs, executors, administrators, assigns and successors.

14. PARAGRAPH HEADINGS

The captions and headings set forth herein are for convenience of reference only and shall not be construed so as to define or limit the terms and provisions hereof.

15. SEVERABILITY

It is understood and agreed by the parties hereto that, if any part, term, or provision of this Contract, except for the provisions of this Contract requiring prior appropriation and limiting the total amount to be paid by the City, is by the courts held to be illegal or in conflict with any law of the State of Colorado, the validity of the remaining portions or provisions shall not be affected, and the rights and obligations of the parties shall be construed and enforced as if the Contract did not contain the particular part, term or provision held to be invalid.

16. ELECTRONIC SIGNATURES AND ELECTRONIC RECORDS:

Contractor consents to the use of electronic signatures by the City. The Agreement, and any other documents requiring a signature hereunder, may be signed electronically by the City in the manner specified by the City. The Parties agree not to deny the legal effect or enforceability of the Agreement solely because it is in electronic form or because an electronic record was used in its formation. The Parties agree not to object to the admissibility of the Agreement in the form of an electronic record, or a paper copy of an electronic document, or a paper copy of a document bearing an electronic signature, on the ground that it is an electronic record or electronic signature or that it is not in its original form or is not an original.

Contract Control Number:

IN WITNESS WHEREOF, the parties have set their hands and affixed their seals at Denver, Colorado as of

SEAL

CITY AND COUNTY OF DENVER

ATTEST:

By _____

APPROVED AS TO FORM:

REGISTERED AND COUNTERSIGNED:

By _____

By _____

By _____



IN WITNESS WHEREOF, the parties have executed this agreement and affixed their seals at Denver, Colorado as of the day first above written.

Contract Control Number: 201207767

Vendor Name: B T CONSTRUCTION, INC.

By: [Signature]

Name: HARPER DANIEL
(please print)

Title: VP
(please print)

ATTEST: [if required]

By: [Signature]

Name: Marilee Bergstrom
(please print)

Title: EVP
(please print)



**CITY AND COUNTY OF DENVER
DEPARTMENT OF PUBLIC WORKS**

General Contract Conditions

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CITY AND COUNTY OF DENVER
DEPARTMENT OF PUBLIC WORKS
Wastewater Management Division

SPECIAL CONTRACT CONDITIONS

SC-1 CONSTRUCTION SPECIFICATIONS

Except as amended herein or in the attached Technical Specifications, all Work performed under the terms of this Contract shall be governed by the applicable provisions of the following latest editions:

City and County of Denver:

Standard Specifications for Construction, GENERAL CONTRACT CONDITIONS,
2011 Edition.

Transportation Standards and Details for the Engineering Division

City and County of Denver Traffic Standard Drawings

Wastewater Management Division

– *Standard Detail Drawings*

– *Storm Drainage and Sanitary Sewer Construction Detail and Technical Specifications*

Colorado Department of Transportation:

Standard Specifications for Road and Bridge Construction
(Sections 200 through 700 of the 2011 Edition)

Federal Highway Administration:

Manual on Uniform Traffic Control Devices for Streets & Highways (MUTCD)

Building & Fire Codes:

Building Code of the City and County of Denver
(International Building Code 2006 Series, City and County of Denver Amendments 2006)

National Fire Protection Association Standards

(As referenced in the Building Code of the City and County of Denver)

The aforementioned City and County of Denver documents are available for review at the Capital Projects Management Office, 201 W. Colfax Ave., Dept. 506, (5th floor), Denver, CO 80202. The *Standard Specifications for Construction, GENERAL CONTRACT CONDITIONS* is available at: http://www.denvergov.org/dpw_contract_admin/ContractAdministration/ContractorReferenceDocuments/t_abid/440535/Default.aspx. *Transportation Standards and Details for the Engineering Division* and the *Wastewater Management Division – Standard Detail Drawings*, are available at <http://www.denvergov.org>.

The “*Colorado Department of Transportation Standard Specifications for Road and Bridge Construction*” is available for review on CDOT’s website at <http://www.coloradodot.info/> and can be purchased from the Colorado Department of Transportation.

The *Manual on Uniform Traffic Control Devices for Streets & Highways* is available for review at the Federal Highway Administration Website at: www.fhwa.dot.gov. The FHWA website also contains purchasing information.

SC-2 DEPUTY MANAGER / CITY ENGINEER

General condition 109 DEPUTY MANAGER is hereby deleted in its entirety and replaced with the following:

The "Deputy Manager" means the official who reports directly to the Manager and exercises supervisory responsibility in the City agency defined in Title 2 herein that is responsible for the Project. The Manager hereby designates the City Engineer as the Deputy Manager for purposes of this Contract. The City Engineer shall have responsibility for this Project and shall undertake all duties, responsibilities, rights and authority, including specific actions and decisions, delegated to the Deputy Manager under the various terms and conditions of this Contract.

SC-3 ENGINEERING DIVISION / CITY ENGINEER

The Engineering Division is a unit of the Department of Public Works and is supervised by the City Engineer, who is subordinate to the Manager of Public Works. This Division is responsible for the planning, design, construction, operation and maintenance of all of the City's transportation facilities and the planning, design and construction of all of the City's wastewater facilities, except for the City's Municipal Airport System. All other references to the Transportation Division or the Deputy Manager of Public Works for Transportation are deleted and replaced with references to the Engineering Division and City Engineer, respectively.

SC-4 WASTEWATER MANAGEMENT DIVISION

The Wastewater Management Division is a unit of the Department of Public Works and is supervised by the Deputy Manager of Public Works for Wastewater Management, who is subordinate to the Manager of Public Works. This Division is responsible for the operation and maintenance of the City's wastewater facilities.

SC-5 CITY DELEGATION OF AUTHORITY

With reference to General Contract Condition 109, DEPUTY MANAGER and General Contract Condition 212, CITY'S CONTRACT ADMINISTRATION LINE OF AUTHORITY, the Manager hereby designates the City Engineer as the City official responsible for those certain actions and decisions designated as the responsibility of the Deputy Manager under the General Conditions and delegates to the City Engineer the authority necessary to undertake those responsibilities under this Contract. The Director shall have supervisory responsibility over the Project Manager. Additionally, Contractor questions concerning the Plans and Technical Specifications shall be directed to:

Denver Department of Public Works / Engineering Division,

Project Manager
City Project Manager
Bruce Uhernik

Telephone

(303) 446-3645

SC-6 LIQUIDATED DAMAGES

Should the Contractor fail to complete all Work within the Contract Time allocated under the Contract Form at Paragraph 3, TERMS OF PERFORMANCE, the Contractor shall become liable to the City and County of Denver for liquidated damages, and not as a penalty, at the rate of \$500.00 for each Day that the Contractor exceeds the time limits herein specified, all in accordance with provisions of General Contract Condition 602, LIQUIDATED DAMAGES; ADMINISTRATIVE COSTS; ACTUAL DAMAGES.

Representative hourly rates for the City administrative costs described in General Contract Condition 602.2 shall be as follows for this Project:

Project Manager	\$69 per hour
Project Engineer	\$63 per hour
Inspector	\$49 per hour
Surveying, if necessary	\$100 per hour

SC-7 SUBCONTRACTS

In accordance with General Contract Condition 501, SUBCONTRACTS, no limit shall apply to that percentage of the Work, which may be sublet providing that the subcontractors receive prior approval in accordance with General Contract Condition 502, SUBCONTRACTOR ACCEPTANCE.

SC-8 RESERVED

SC-9 PAYMENTS TO CONTRACTORS

The application for payment shall be submitted through Textura® Corporations Construction Management Website. Contractor recognizes and agrees that it shall be required to use the Textura Construction Payment Management System for this Project. Contractor further agrees that, to the fullest extent possible within the CPM System, the City shall be entitled to all non-Confidential records, reports, data and other information related to the project that are available to Contractor through the CPM System, including, but not limited to, information related to Contractor and subcontractor billings. To that end, Contractor agrees that it will activate any available settings within the CPM System that are necessary to grant the City access to such non-Confidential information related to the contract and the project. Applications for payment shall be based on the Contract Unit Prices or the approved Schedule of Values described in GC 903.1

In accordance with General Contract Condition 902, PAYMENT PROCEDURE, the party(ies) responsible for review of all Pay Applications shall be:

<u>Agency/Firm</u>	<u>Name</u>	<u>Telephone</u>
Public Works/WCPM Division	Jason Wennen	303-446-3628

In accordance with General Contract Condition 906, APPLICATIONS FOR PAYMENT, each Application submitted shall include the following:

1. The estimate of Work completed shall be based on the approved schedule of values or unit prices, as applicable, and the percent of the Work complete.
2. Each Application for Payment shall include each and every independent subcontractor's payroll information including pay dates and pay amounts.
3. The Contractor shall also submit to the Auditor and other appropriate officials of the City in a timely fashion, information required by General Contract Condition 1004, REPORTING WAGES PAID.

In accordance with General Contract condition 907, RELEASES AND CONTRACTORS CERTIFICATION OF PAYMENT, Applications for Payment must be accompanied by completed Partial or Final Claim Release Form, as appropriate, from EACH subcontractor and supplier, **AND/OR** the Contractors' Certification of Payment Form. The forms, Final/Partial Release and Certificate of Payment (Subcontractor/Supplier) and the Contractor's Certification of Payment, both of which must be used are as follows:

DEPARTMENT OF PUBLIC WORKS
Engineering Division

FINAL/PARTIAL RELEASE AND CERTIFICATE OF PAYMENT
(SUBCONTRACTOR/SUPPLIER)

(PROJECT NO. and NAME)

Date: _____, 20__.

(NAME OF CONTRACTOR)

Subcontract #: _____.

(NAME OF SUBCONTRACTOR/SUPPLIER)

Subcontract Value: \$ _____.

Last Progress Payment: \$ _____.

Date: _____.

Total Paid to Date: \$ _____.

Date of Last Work: _____.

Check Applicable Box:

MBE WBE

The Undersigned hereby certifies that all costs, charges or expenses incurred by the undersigned or on behalf of the undersigned for any work, labor or services performed and for any materials, supplies or equipment provided on the above referenced Project or used in connection with the above referenced Subcontract (the "Work Effort") have been duly paid in full.

The Undersigned further certifies that each of the undersigned's subcontractors and suppliers that incurred or caused to be incurred, on their behalf, costs, charges or expenses in connection with the undersigned's Work Effort on the above referenced Project have been duly paid in full.

In consideration of \$ _____ representing the Last Progress Payment referenced above and in further consideration of the Total Paid to Date, also referenced above, and other good and valuable consideration received and accepted by the undersigned this _____ day of _____, 20__, the Undersigned hereby releases and discharges the City and County of Denver (the "City"), the above referenced City Project, the City's premises and property and the above referenced Contractor from all claims, liens, rights, liabilities, demands and obligations, whether known or unknown, of every nature arising out of or in connection with the performance of the work effort.

As additional consideration for the payments referenced above, the undersigned agrees to defend, indemnify and save and hold harmless the City, its officers, employees, agents and assigns and the above-referenced Contractor from and against all costs, losses, damages, causes of action, judgments under the subcontract and expenses arising out of or in connection with any claim or claims against the City or the Contractor which arise out of the Undersigned's performance of the Work Effort and which may be asserted by the Undersigned or any of its suppliers or subcontractors of any tier or any of their representatives, officers, agents, or employees.

It is acknowledged that this release is for the benefit of and may be relied upon by the City and the referenced Contractor.

The foregoing shall not relieve the undersigned of any obligation under the provisions of the Undersigned's subcontract, as the subcontract may have been amended, which by their nature survive completion of the Undersigned's work effort including, without limitation, warranties, guarantees, insurance requirements and indemnities.

STATE OF COLORADO) ss.
CITY OF _____)

(Name of Subcontractor)

Signed and sworn before me this
day of _____, 20__.

By: _____

Notary Public/Commissioner of Oaths
My Commission Expires

Title: _____



DENVER*
THE MILE HIGH CITY

Instructions for Completing the Contractor/Consultant Certification of Payment Form

Office of Economic Development
Division of Small Business Opportunity
Compliance Unit
201 W. Colfax Ave., Dept. 907
Denver, CO 80202
Phone: 720-913-1999
Fax: 720-913-1803
dsbo@denvergov.org

Note: The attached Contractor/Consultant Certification of Payment form must be completed by the Contractor/ Subconsultant and all subcontractors/subconsultant or suppliers used on the project at any tier and submitted with each pay application. The Contractor/Consultant is responsible for the accuracy of all information provided and is required to have each subcontractor/subconsultant or supplier fill out the appropriate forms. Please be sure to complete all information requested at the top of the form, including the name of the person who prepared this form.

If you reproduce this form, you must continue to list each of the originally listed firms, as well as any additional firms used during the performance period of the contract.

If you have any questions, please call the Compliance Unit of DSBO at 720.913.1999.

Instructions for Completing the Contractor/Consultant Certification of Payment Form, per Column

Contractor/Subcontractor or Subconsultant/Supplier Name: In the space provided, list all subcontractors/ subconsultants and suppliers used on the project. For all M/W/S/DBEs use the exact name listed in the DSBO Directory.

M/W/S/DBE/NON: For each name listed, indicate whether the entity is a certified M/W/S/DBE.

Column A: Provide the contract amount, as listed at bid time, for the Contractor/Consultant and each subcontractor/subconsultant or supplier.

Column B: Provide the percentage portion of each listed subcontractor/subconsultant or supplier contract amount (Column A) compared to the total original contract amount in (I).

Column C: Provide the original contract amount (Column A) for each subcontractor/subconsultant or supplier plus any awarded alternate and/or change order amounts applicable. If an alternate/change order does not apply to the listed firm, re-enter the original contract amount (Column A).

Column D: Provide the percent portion of each listed subcontractor/subconsultant or supplier contract amount (Column C) compare to the current total contract amount in (II).

Column E: Provide the amount requested for work performed or materials supplied by each listed subcontractor/subconsultant or supplier for this pay application. The sum of the items in this column should equal the estimated amount requested for this pay application.

Column F: Provide the amount paid to each subcontractor/subconsultant or supplier on the previous pay application. Enter the previous pay application number in the column heading. The sum of the items listed in this column should equal the warrant amount paid to the Contractor/Consultant on the previous pay application. The amounts paid to the subcontractor/subcontractor or suppliers should be the actual amount of each check issued.

Column G: Provide the net paid to date for the Contractor/Subconsultant and each listed subcontractor/subconsultant or supplier.

Column H: Provide the percent portion of the net paid to date (Column G) for the Contractor/Subconsultant and each listed subcontractor/subconsultant or supplier of the current total contract amount in (II).

COMP-REF-031

Rev 032311 JG

SC-10 CONTRACT FORMS

In accordance with the terms and conditions of the Contract Documents, the City requires the use of certain form documents in complying with or satisfying various obligations, notifications and conditions in contracting with the City or performing Work hereunder. These form documents are referenced by title throughout the Contract Documents for mandatory use as directed. The following are the forms that shall be detached and utilized in accordance with the Contract Documents:

1. Performance and Payment Bond
2. Performance and Payment Bond Surety Authorization Letter (Sample)
3. Final/Partial Lien Release.

The following are forms that will be issued by the City during construction:

1. Notice to Apparent Low Bidder (Sample)
2. Notice To Proceed (Sample)
3. Certificate of Contract Release (Sample)

SC-11 CONSTRUCTION INSPECTION BY THE CITY

General Condition 1701, CONSTRUCTION INSPECTION BY THE CITY, is modified as follows:

1701 Persons who are employees of the City or who are under contract to the City or the City as lessee will be assigned to inspect and test the Work. These persons may perform any tests and observe the Work to determine whether or not designs, materials used, manufacturing and construction processes and methods applied, and equipment installed satisfy the requirements of the drawings and specifications, accepted Shop Drawings, Product Data and Samples, and the General Contractor's warranties and guarantees. The General Contractor shall permit these inspectors unlimited access to the Work and provide means of safe access to the Work, which cost shall be included as a Cost of the Work without any increase to the Guaranteed Maximum Price. In addition, General Contractor shall provide whatever access and means of access are needed to off-site facilities used to store or manufacture materials and equipment to be incorporated into the Work and shall respond to any other reasonable request to further the inspector's ability to observe or complete any tests. Such inspections shall not relieve the General Contractor of any of its quality control responsibilities or any other obligations under the Contract. All inspections and all tests conducted by the City are for the convenience and benefit of the City. These inspections and tests do not constitute acceptance of the materials or Work tested or inspected, and the City may reject or accept any Work or materials at any time prior to the inspections pursuant to G.C. 2002, whether or not previous inspections or tests were conducted by the inspector or a City representative.

.2 Building Inspection will perform building code compliance inspections for structures designed for human occupancy. It is the General Contractor's responsibility to schedule and obtain these inspections. If a code compliance inspection results in identification of a condition which will be at variance to the Contract Documents, the General Contractor shall immediately notify the Project Manager and confirm such notification with formal correspondence no later than forty-eight (48) hours after the occurrence.

.3 When any unit of government or political subdivision, utility or railroad corporation is to pay a portion of the cost of the Work, its respective representatives shall have the right to inspect the Work. This inspection shall not make any unit of government or political subdivision, utility or railroad corporation a party to the Contract, and shall not interfere with the rights of either party.

SC-12 DISPOSAL OF NON-HAZARDOUS WASTE AT DADS

In accordance with the Landfill Agreement made between the City and Waste Management of Colorado, Inc., bidders will be required to haul dedicated loads (non-hazardous entire loads of waste) to the Denver-Arapahoe Disposal Site ("DADS") for disposal. DADS is located at Highway 30 and Hampden Avenue in Arapahoe County, Colorado. The City will pay all fees associated with such disposal but the bidder shall be responsible for the costs of transporting the loads. Non-hazardous waste is defined as those substances and materials not defined or classified as hazardous by the Colorado Hazardous Waste Commission pursuant to C.R.S. §25-15-101(6), as amended from time to time, and includes construction debris, soil and asbestos. Bidders shall not use Gun Club Road between I-70 and Mississippi Avenue as a means of access to DADS.

SC-13 PROHIBITION ON USE OF CCA-TREATED WOOD PRODUCTS

The use of any wood products pressure-treated with chromated copper arsenate (CCA) is prohibited. Examples of CCA-treated wood products include wood used in play structures, decks, picnic tables, landscaping timbers, fencing, patios, walkways and boardwalks.

SC-14 WAIVER OF: PART 8 OF ARTICLE 20 OF TITLE 13, COLORADO REVISED STATUTES.

The Contractor specifically waives all the provisions of Part 8 of Article 20 of Title 13, Colorado Revised Statutes regarding defects in the Work under this Construction Contract.

SC-15 ATTORNEY'S FEES

Colorado Revised Statute 38-26-107 requires that in the event any person or company files a verified statement of amounts due and unpaid in connection with a claim for labor and materials supplied on this project, the City shall withhold from payments to the Contractor sufficient funds to insure the payment of any such claims. Should the City and County of Denver be made a party to any lawsuit to enforce such unpaid claims or any lawsuit arising out of or relating to such withheld funds, the Contractor agrees to pay to the City its costs and a reasonable attorney's fee which cost shall be included as a Cost of the Work.

Because the City Attorney Staff does not bill the City for legal services on an hourly basis, the Contractor agrees a reasonable fee shall be computed at the rate of one hundred dollars per hour of City Attorney time.

SC-16 INSURANCE

General Condition 1601 is hereby deleted in its entirety and replaced with the following:

(1) **General Conditions:** Contractor agrees to secure, at or before the time of execution of this Agreement, the following insurance covering all operations, goods or services provided pursuant to this Agreement. Contractor shall keep the required insurance coverage in force at all times during the term of the Agreement, or any extension thereof, during any warranty period, and for eight (8) years after termination of the Agreement. The required insurance shall be underwritten by an insurer licensed or authorized to do business in Colorado and rated by A.M. Best Company as "A-"VIII or better. Each policy shall contain a valid provision or endorsement requiring notification to the City in the event any of the required policies be canceled or non-renewed before the expiration date thereof. Such written notice shall be sent to the parties identified in the Notices section of this Agreement. Said notice shall reference the City contract number listed on the signature page of this Agreement. Said notice shall be sent thirty (30) days prior to such cancellation or non-renewal unless due to non-payment of premiums for which notice shall be sent ten (10) days prior. If such written notice is unavailable from the insurer, contractor shall provide written notice of cancellation, non-renewal and any reduction in coverage to the parties identified in the Notices section by certified mail, return receipt requested within three (3) business days of such notice by its insurer(s) and referencing the City's contract number. If any policy is in excess of a deductible or self-insured retention, the City must be notified by the Contractor. Contractor shall be responsible for the payment of any deductible or self-insured retention. The insurance coverages specified in this Agreement are the minimum requirements, and these requirements do not lessen or limit the liability of the Contractor. The Contractor shall maintain, at its own expense, any additional kinds or amounts of insurance that it may deem necessary to cover its obligations and liabilities under this Agreement.

(2) **Proof of Insurance:** Contractor shall provide a copy of this Agreement to its insurance agent or broker. Contractor may not commence services or work relating to the Agreement prior to placement of coverage. Contractor certifies that the certificate of insurance attached as part of the Contract Documents, preferably an ACORD certificate, complies with all insurance requirements of this Agreement. The City requests that the City's contract number be referenced on the Certificate. The City's acceptance of a certificate of insurance or other proof of insurance that does not comply with all insurance requirements set forth in this Agreement shall not act as a waiver of Contractor's breach of this Agreement or of any of the City's rights or remedies under this Agreement. The City's Risk Management Office may require additional proof of insurance, including but not limited to policies and endorsements.

(3) **Additional Insureds:** For Commercial General Liability and Auto Liability, Contractor and subcontractor's insurer(s) shall name the City and County of Denver, its elected and appointed officials, employees and volunteers as additional insured.

(4) **Waiver of Subrogation:** For all coverages, Contractor's insurer shall waive subrogation rights against the City.

(5) **Subcontractors and Subconsultants:** All subcontractors and subconsultants (including independent contractors, suppliers or other entities providing goods or services required by this Agreement) shall be subject to all of the requirements herein and shall procure and maintain the same coverages required of the Contractor. Contractor shall include all such subcontractors as additional insured under its policies (with the exception of Workers' Compensation) or shall ensure that all such subcontractors and subconsultants maintain the required coverages.

Contractor agrees to provide proof of insurance for all such subcontractors and subconsultants upon request by the City.

(6) **Workers' Compensation/Employer's Liability Insurance:** Contractor shall maintain the coverage as required by statute for each work location and shall maintain Employer's Liability insurance with limits of \$100,000 per occurrence for each bodily injury claim, \$100,000 per occurrence for each bodily injury caused by disease claim, and \$500,000 aggregate for all bodily injuries caused by disease claims. Contractor expressly represents to the City, as a material representation upon which the City is relying in entering into this Agreement, that none of the Contractor's officers or employees who may be eligible under any statute or law to reject Workers' Compensation Insurance shall effect such rejection during any part of the term of this Agreement, and that any such rejections previously effected, have been revoked as of the date Contractor executes this Agreement.

(7) **Commercial General Liability:** Contractor shall maintain a Commercial General Liability insurance policy with limits of \$1,000,000 for each occurrence, \$1,000,000 for each personal and advertising injury claim, \$2,000,000 products and completed operations aggregate, and \$2,000,000 policy aggregate.

(8) **Business Automobile Liability:** Contractor shall maintain Business Automobile Liability with limits of \$1,000,000 combined single limit applicable to all owned, hired and non-owned vehicles used in performing services under this Agreement

(9) **Additional Provisions:**

(a) For Commercial General Liability, the policies must provide the following:

- (i) That this Agreement is an Insured Contract under the policy;
- (ii) Defense costs in excess of policy limits;
- (iii) A severability of interests or separation of insureds provision (no insured vs. insured exclusion); and
- (iv) A provision that coverage is primary and non-contributory with other coverage or self-insurance maintained by the City.

(b) For claims-made coverage:

- (i) The retroactive date must be on or before the contract date or the first date when any goods or services were provided to the City, whichever is earlier

(c) Contractor shall advise the City in the event any general aggregate or other aggregate limits are reduced below the required per occurrence limits. At their own expense, and where such general aggregate or other aggregate limits have been reduced below the required per occurrence limit, the Contractor will procure such per occurrence limits and furnish a new certificate of insurance showing such coverage is in force.

SC-17 GREENPRINT DENVER REQUIREMENTS

In accordance with the City and County of Denver Executive Order 123: Greenprint Denver Office and Sustainability Policy, as amended, Contractor shall adhere to sections of Executive Order 123 pertinent to the construction of the built environment. This includes but is not limited to: all construction and renovation of buildings shall follow instructions and memorandum for high performance buildings; horizontal projects shall include the use of fly ash concrete and recycled aggregate where possible; and, all projects shall recycle construction and demolition waste, and install materials that contain recycled content whenever possible using the U.S. Green Building Council Leadership in Energy and Environmental Design (LEED) as guidance. Non-hazardous solid waste that is eligible for reuse or recycling is not subject to the DADS disposal requirement defined in SC-12.

A completed "Greenprint Denver Closeout Form for Construction Projects" shall be delivered to the Project Manager as a submittal requirement of Final Acceptance.

<http://www.denvergov.org/constructioncontracts/Home/ContractorResources/tabid/443154/Default.aspx>

**CITY AND COUNTY OF DENVER
DEPARTMENT OF PUBLIC WORKS**

Bond No. 34BCSGI9144

PERFORMANCE AND PAYMENT BOND

KNOW ALL MEN BY THESE PRESENTS, that we, the undersigned **B T CONSTRUCTION, INC.**, a corporation organized and existing under and by virtue of the laws of the State of **COLORADO**, hereafter referred to as the "Contractor", and **HARTFORD FIRE INSURANCE CO.**, a corporation organized and existing under and by virtue of the laws of the State of **CONNECTICUT**, and authorized to transact business in the State of Colorado, as Surety, are held and firmly bound unto the **CITY AND COUNTY OF DENVER**, a municipal corporation of the State of Colorado, hereinafter referred to as the "City", in the penal sum of **Two Million Four Hundred Eighty-One Thousand Seven Hundred Eighty-Eight Dollars and Five Cents Dollars (\$2,481,788.05)**, lawful money of the United States of America, for the payment of which sum, well and truly to be made, we bind ourselves and our heirs, executors, administrators, successors and assigns, jointly and severally, firmly by these presents;

THE CONDITION OF THE FOREGOING OBLIGATION IS SUCH THAT:

WHEREAS, the above bounden Contractor has entered into a written contract with the aforesaid City for furnishing all labor and tools, supplies, equipment, superintendence, materials and everything necessary for and required to do, perform and complete the construction of **CONTRACT NO. 201207767 IOWA AVENUE EXTENSION PHASE 1**, Denver, Colorado, and has bound itself to complete the project within the time or times specified or pay liquidated damages, all as designated, defined and described in the said Contract and Conditions thereof, and in accordance with the Plans and Technical Specifications therefore, a copy of said Contract being made a part hereof;

NOW, THEREFORE, if the said Contractor shall and will, in all particulars well and truly and faithfully observe, perform and abide by each and every Covenant, Condition and part of said Contract, and the Conditions, Technical Specifications, Plans, and other Contract Documents thereto attached, or by reference made a part thereof and any alterations in and additions thereto, according to the true intent and meaning in such case, then this obligation shall be and become null and void; otherwise, it shall remain in full force and effect;

PROVIDED FURTHER, that if the said Contractor shall satisfy all claims and demands incurred by the Contractor in the performance of said Contract, and shall fully indemnify and save harmless the City from all damages, claims, demands, expense and charge of every kind (including claims of patent infringement) arising from any act, omission, or neglect of said Contractor, its agents, or employees with relation to said work; and shall fully reimburse and repay to the City all costs, damages, and expenses which it may incur in making good any default based upon the failure of the Contractor to fulfill its obligation to furnish maintenance, repairs or replacements for the full guarantee period provided in the Contract Documents, then this obligation shall be null and void; otherwise it shall remain in full force and effect;

PROVIDED FURTHER, that if said Contractor shall at all times promptly make payments of all amounts lawfully due to all persons supplying or furnishing it or its subcontractors with labor and materials, rental machinery, tools or equipment used or performed in the prosecution of work provided for in the above Contract and that if the Contractor will indemnify and save harmless the City for the extent of any and all payments in connection with the carrying out of such Contract, then this obligation shall be null and void; otherwise it shall remain in full force and effect;

PROVIDED FURTHER, that if the said Contractor fails to duly pay for any labor, materials, team hire, sustenance, provisions, provender, gasoline, lubricating oils, fuel oils, grease, coal, or any other supplies or materials used or consumed by said Contractor or its subcontractors in performance of the work contracted to be done, or fails to pay any person who supplies rental machinery, tools or equipment, all amounts due as the result of the use of such machinery, tools or equipment in the prosecution of the work, the Surety will pay the same in any amount not exceeding the amount of this obligation, together with interest as provided by law;

* Company

PROVIDED FURTHER, that the said Surety, for value received, hereby stipulates and agrees that no change, extension of time, alteration or addition to the terms of the Contract, or to contracts with others in connection with this project, or the work to be performed thereunder, or the Technical Specifications and Plans accompanying the same, shall in any way affect its obligation on this bond and it does hereby waive notice of any change, extension of time, alteration or addition to the terms of the Contract, or contracts, or to the work, or to the Technical Specifications and Plans.

IN WITNESS WHEREOF, said Contractor and said Surety have executed these presents as of this 21st day of November, 2012.

Attest:

Mailee Bergstrom
Secretary

B T Construction, Inc.
Contractor
By: [Signature]
Vice-President
Hartford Fire Insurance Company
Surety
By: [Signature]
Attorney-In-Fact Susan J. Lattarulo

(Accompany this bond with Attorney-in-Fact's authority from the Surety to execute bond, certified to include the date of the bond).

APPROVED AS TO FORM:
Attorney for the City and County of Denver

By: [Signature]
Assistant City Attorney

APPROVED FOR THE CITY AND COUNTY OF DENVER

By: [Signature]
MAYOR
By: [Signature]
MANAGER OF PUBLIC WORKS

POWER OF ATTORNEY

Direct Inquiries/Claims to:

THE HARTFORD

BOND, T-4

One Hartford Plaza
Hartford, Connecticut 06155

call: 888-266-3488 or fax: 860-757-5835

Agency Code: 34-341300

KNOW ALL PERSONS BY THESE PRESENTS THAT:

- Hartford Fire Insurance Company, a corporation duly organized under the laws of the State of Connecticut
- Hartford Casualty Insurance Company, a corporation duly organized under the laws of the State of Indiana
- Hartford Accident and Indemnity Company, a corporation duly organized under the laws of the State of Connecticut
- Hartford Underwriters Insurance Company, a corporation duly organized under the laws of the State of Connecticut
- Twin City Fire Insurance Company, a corporation duly organized under the laws of the State of Indiana
- Hartford Insurance Company of Illinois, a corporation duly organized under the laws of the State of Illinois
- Hartford Insurance Company of the Midwest, a corporation duly organized under the laws of the State of Indiana
- Hartford Insurance Company of the Southeast, a corporation duly organized under the laws of the State of Florida

having their home office in Hartford, Connecticut, (hereinafter collectively referred to as the "Companies") do hereby make, constitute and appoint, up to the amount of unlimited:

J. R. Trojan, Dilynn Guern, Kevin W. McMahon, Donald E. Appleby, Gloria C. Blackburn, Florietta Acosta,
Susan J. Lattarulo, Tiffany McGonigle, Mark Sweigart, Sarah Brown, Todd Bengford, Lindsey Knickerbocker
of

Denver, CO

their true and lawful Attorney(s)-in-Fact, each in their separate capacity if more than one is named above, to sign its name as surety(ies) only as delineated above by , and to execute, seal and acknowledge any and all bonds, undertakings, contracts and other written instruments in the nature thereof, on behalf of the Companies in their business of guaranteeing the fidelity of persons, guaranteeing the performance of contracts and executing or guaranteeing bonds and undertakings required or permitted in any actions or proceedings allowed by law.

In Witness Whereof, and as authorized by a Resolution of the Board of Directors of the Companies on August 1, 2009 the Companies have caused these presents to be signed by its Vice President and its corporate seals to be hereto affixed, duly attested by its Assistant Secretary. Further, pursuant to Resolution of the Board of Directors of the Companies, the Companies hereby unambiguously affirm that they are and will be bound by any mechanically applied signatures applied to this Power of Attorney.



Wesley W. Cowling

Wesley W. Cowling, Assistant Secretary

M. Ross Fisher

M. Ross Fisher, Vice President

STATE OF CONNECTICUT }
COUNTY OF HARTFORD } ss. Hartford

On this 12th day of July, 2012; before me personally came M. Ross Fisher, to me known, who being by me duly sworn, did depose and say: that he resides in the County of Hartford, State of Connecticut; that he is the Vice President of the Companies, the corporations described in and which executed the above instrument; that he knows the seals of the said corporations; that the seals affixed to the said instrument are such corporate seals; that they were so affixed by authority of the Boards of Directors of said corporations and that he signed his name thereto by like authority.



CERTIFICATE

Kathleen T. Maynard

Kathleen T. Maynard
Notary Public

My Commission Expires July 31, 2016

I, the undersigned, Vice President of the Companies, DO HEREBY CERTIFY that the above and foregoing is a true and correct copy of the Power of Attorney executed by said Companies, which is still in full force effective as of
Signed and sealed at the City of Hartford.



Gary W. Stumper

Gary W. Stumper, Vice President

FAX NUMBER: 720-913-3183
TELEPHONE NUMBER: 720-913-3267

City Attorney
City and County of Denver
201 West Colfax Avenue, Dept. 1207
Denver, Colorado 80202

RE: BT Construction, Inc.
Project Name: Contract No. 201207767 – Iowa Avenue Extension Phase 1
Amount: \$2,481,788.05
Performance and Payment Bond No.: 34BCSGI9144

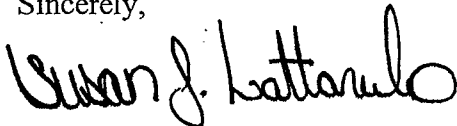
The Performance and Payment Bonds covering the above captioned project were executed by this agency through Hartford Fire Insurance Company, on November 19, 2012.

We hereby authorize the City and County of Denver, Department of Public Works, to date all bonds and powers of attorney to coincide with the date of the contract.

If you should have any additional questions or concerns, please don't hesitate to give me a call.

Thank you.

Sincerely,



Susan J. Lattarulo
Account Manager



CERTIFICATE OF LIABILITY INSURANCE

DATE (MM/DD/YYYY)
11/30/2012

THIS CERTIFICATE IS ISSUED AS A MATTER OF INFORMATION ONLY AND CONFERS NO RIGHTS UPON THE CERTIFICATE HOLDER. THIS CERTIFICATE DOES NOT AFFIRMATIVELY OR NEGATIVELY AMEND, EXTEND OR ALTER THE COVERAGE AFFORDED BY THE POLICIES BELOW. THIS CERTIFICATE OF INSURANCE DOES NOT CONSTITUTE A CONTRACT BETWEEN THE ISSUING INSURER(S), AUTHORIZED REPRESENTATIVE OR PRODUCER, AND THE CERTIFICATE HOLDER.

IMPORTANT: If the certificate holder is an ADDITIONAL INSURED, the policy(ies) must be endorsed. If SUBROGATION IS WAIVED, subject to the terms and conditions of the policy, certain policies may require an endorsement. A statement on this certificate does not confer rights to the certificate holder in lieu of such endorsement(s).

PRODUCER Lockton Companies, LLC Denver 8110 E Union Avenue Suite 700 Denver CO 80237 (303) 414-6000	CONTACT NAME: _____	
	PHONE (A/C, No, Ext): _____	FAX (A/C, No): _____
E-MAIL ADDRESS: _____		
INSURER(S) AFFORDING COVERAGE		NAIC #
INSURER A: Zurich American Insurance Company		16535
INSURER B: American Guarantee and Liab. Ins. Co.		26247
INSURER C:		
INSURER D:		
INSURER E:		
INSURER F:		

COVERAGES BTCON01 VU **CERTIFICATE NUMBER:** 12089386 **REVISION NUMBER:** XXXXXXXX


THIS IS TO CERTIFY THAT THE POLICIES OF INSURANCE LISTED BELOW HAVE BEEN ISSUED TO THE INSURED NAMED ABOVE FOR THE POLICY PERIOD INDICATED. NOTWITHSTANDING ANY REQUIREMENT, TERM OR CONDITION OF ANY CONTRACT OR OTHER DOCUMENT WITH RESPECT TO WHICH THIS CERTIFICATE MAY BE ISSUED OR MAY PERTAIN, THE INSURANCE AFFORDED BY THE POLICIES DESCRIBED HEREIN IS SUBJECT TO ALL THE TERMS, EXCLUSIONS AND CONDITIONS OF SUCH POLICIES. LIMITS SHOWN MAY HAVE BEEN REDUCED BY PAID CLAIMS.

INSR LTR	TYPE OF INSURANCE	ADDL INSR	SUBR WVD	POLICY NUMBER	POLICY EFF (MM/DD/YYYY)	POLICY EXP (MM/DD/YYYY)	LIMITS
A	GENERAL LIABILITY <input checked="" type="checkbox"/> COMMERCIAL GENERAL LIABILITY <input type="checkbox"/> CLAIMS-MADE <input checked="" type="checkbox"/> OCCUR GEN'L AGGREGATE LIMIT APPLIES PER: <input type="checkbox"/> POLICY <input checked="" type="checkbox"/> PROJECT <input checked="" type="checkbox"/> LOC	Y	N	GLO9318839-01	10/3/2012	10/3/2013	EACH OCCURRENCE \$ 1,000,000 DAMAGE TO RENTED PREMISES (Ea occurrence) \$ 300,000 MED EXP (Any one person) \$ 5,000 PERSONAL & ADV INJURY \$ 1,000,000 GENERAL AGGREGATE \$ 2,000,000 PRODUCTS - COMP/OP AGG \$ 2,000,000 \$
A	AUTOMOBILE LIABILITY <input checked="" type="checkbox"/> ANY AUTO <input type="checkbox"/> ALL OWNED AUTOS <input type="checkbox"/> SCHEDULED AUTOS <input checked="" type="checkbox"/> HIRED AUTOS <input checked="" type="checkbox"/> NON-OWNED AUTOS	Y	N	BAP9318842-01	10/3/2012	10/3/2013	COMBINED SINGLE LIMIT (Ea accident) \$ 1,000,000 BODILY INJURY (Per person) \$ XXXXXXXX BODILY INJURY (Per accident) \$ XXXXXXXX PROPERTY DAMAGE (Per accident) \$ XXXXXXXX \$ XXXXXXXX
B	<input checked="" type="checkbox"/> UMBRELLA LIAB <input checked="" type="checkbox"/> OCCUR <input type="checkbox"/> EXCESS LIAB <input type="checkbox"/> CLAIMS-MADE DED RETENTION \$	N	N	AUC-9318835-01	10/3/2012	10/3/2013	EACH OCCURRENCE \$ 1,000,000 AGGREGATE \$ 1,000,000 \$ XXXXXXXX
A	WORKERS COMPENSATION AND EMPLOYERS' LIABILITY ANY PROPRIETOR/PARTNER/EXECUTIVE OFFICER/MEMBER EXCLUDED? (Mandatory in NH) If yes, describe under DESCRIPTION OF OPERATIONS below	Y/N N	N/A	WC9318840-01	10/1/2012	10/1/2013	<input checked="" type="checkbox"/> WC STATUTORY LIMITS <input type="checkbox"/> OTHER E.L. EACH ACCIDENT \$ 1,000,000 E.L. DISEASE - EA EMPLOYEE \$ 1,000,000 E.L. DISEASE - POLICY LIMIT \$ 1,000,000

DESCRIPTION OF OPERATIONS / LOCATIONS / VEHICLES (Attach ACORD 101, Additional Remarks Schedule, if more space is required)
 RE: Contract No. 201207767, Iowa Avenue Extension Phase 1. The City and County of Denver, its elected and appointed officials, employees and volunteers are named as additional insured with regards to the commercial general liability policy and the business auto liability policy.

CERTIFICATE HOLDER

CANCELLATION

12089386 City & County of Denver Dept of Public Works / Wastewater Management Div 201 West Colfax, Dept 611 Denver CO 80202	SHOULD ANY OF THE ABOVE DESCRIBED POLICIES BE CANCELLED BEFORE THE EXPIRATION DATE THEREOF, NOTICE WILL BE DELIVERED IN ACCORDANCE WITH THE POLICY PROVISIONS.
	AUTHORIZED REPRESENTATIVE 



DENVER
THE MILE HIGH CITY

Department of Public Works
Engineering Department

201 W. Colfax Avenue
Denver, CO 80202
www.denvergov.org/PublicWorks

**PERFORMANCE AND PAYMENT BOND
SURETY AUTHORIZATION
(SAMPLE)**

FAX NUMBER: 720-913-3183
TELEPHONE NUMBER: 720-913-3267

Assistant City Attorney
201 W. Colfax Ave. Dept 1207
Denver, Colorado 80202

RE: (Company name)

Contract No: 201207767
Project Name: IOWA AVENUE EXTENSION PHASE 1

Contract Amount:
Performance and Payment Bond No.:

Dear Assistant City Attorney,

The Performance and Payment Bonds covering the above captioned project were executed by this agency, through _____ insurance company, on _____, 20__.

We hereby authorize the City and County of Denver, Department of Public Works, to date all bonds and powers of attorney to coincide with the date of the contract.

If you should have any additional questions or concerns, please don't hesitate to give me a call at _____.

Thank you.

Sincerely,





DENVER
THE MILE HIGH CITY

Department of Public Works
Engineering Department

201 W. Colfax Avenue
Denver, CO 80202
www.denvergov.org/PublicWorks

NOTICE OF APPARENT LOW BIDDER
(SAMPLE)

Current Date

To:

Gentlemen:

The MANAGER OF PUBLIC WORKS has considered the Bids submitted on October 19, 2012 for work to be done and materials to be furnished in and for:

PROJECT No. 201207767 IOWA AVENUE EXTENSION PHASE 1

as set forth in detail in the Contract Documents for the City and County of Denver, Colorado. It appears that your Bid is fair, equitable, and to the best interest of the City and County; therefore, said Bid is hereby accepted at the bid price contained herein, subject to execution of the Contract Documents and your furnishing the items specified below, the total cost thereof (Contract Amount Written), (Contract Amount Numeric).

It will be necessary for you to appear forthwith at the office of the Department of Public Works, Finance and Administration, 201 W. Colfax Ave., Denver, Colorado 80202, to receive the said Contract Documents, execute the same and return them to the Department of Public Works, Finance and Administration, within the time limit set forth in the Bid Proposal.

In accordance with the requirements set forth in the Contract Documents, you are required to furnish the following documents:

- a. Insurance Certificates: General Liability and Automotive Liability, Workman's Compensation and Employer Liability; or any other coverage required by the contract; and
- b. One original plus four copies of the Power of Attorney relative to Performance and/or Payment Bond;

All construction Contracts made and entered into by the City and County of Denver are subject to Affirmative Action and Equal Opportunity Rules and Regulations, as adopted by the Manager of Public Works, and each contract requiring payment by the City of one-half million dollars (\$500,000.00) or more shall first be approved by the City Council acting by ordinance and in accordance with Section 3.2.6 of the Charter of the City and County of Denver.

Prior to issuance of Notice to Proceed, all Equal Opportunity requirements must be completed. Additional information may be obtained by contacting the Director of Contract Compliance at (720-913-1700).



**NOTICE OF APPARENT LOW BIDDER
(SAMPLE)**

PROJECT NO. 201207767

Page 2

The Bid Security submitted with your Bid, will be returned upon execution of the Contract and furnishing of the Performance Bond. In the event you should fail to execute the Contract and to furnish the performance Bond within the time limit specified, said Bid Security will be retained by the City and County of Denver as liquidated damages, and not as a penalty for the delay and extra work caused thereby.

Dated at Denver, Colorado this _____ day of _____ 20____.

CITY AND COUNTY OF DENVER

By

Manager of Public Works



Department of Public Works
Engineering Department

201 W. Colfax Avenue
Denver, CO 80202
www.denvergov.org/PublicWorks

Current Date

**NOTICE TO PROCEED
(SAMPLE)**

Name
Company
Street
City/State/Zip

CONTRACT NO. 201207767, IOWA AVENUE EXTENSION PHASE 1

In accordance with General Contract Condition 302 of the Standard Specifications for Construction, General Contract Conditions, 2011 Edition, you are hereby authorized and directed to proceed on _____ with the work of constructing contract number 201207767, as set forth in detail in the contract documents for the City and County of Denver.

With a contract time of _____ calendar days, the project must be complete on or before _____.

If you have not already done so, you must submit your construction schedule, in accordance with General Contract Condition 306.2.B, to the Project Manager within 10 days. Additionally, you must submit your tax exempt certificate, and copies of your subcontractors' certificates, in accordance with General Contract Condition 323.5, to the Project Manager as soon as possible. Failure to submit these certificates will delay processing of payment applications.

Sincerely,

Lesley B. Thomas
City Engineer

cc:





DENVER
THE MILE HIGH CITY

Certificate of Contract Release
(SAMPLE)

Date

Name

Company

Street

City/State/Zip

RE: Certificate of Contract Release for
201207767, IOWA AVENUE EXTENSION PHASE 1

Received this date of the City and County of Denver, as full and final payment of the cost of the improvements provided for in the foregoing contract, _____ dollars and _____ cents (\$ _____), in cash, being the remainder of the full amount accruing to the undersigned by virtue of said contract; said cash also covering and including full payment for the cost of all extra work and material furnished by the undersigned in the construction of said improvements, and all incidentals thereto, and the undersigned hereby releases said City and County of Denver from any and all claims or demands whatsoever, regardless of how denominated, growing out of said contract.

And these presents are to certify that all persons performing work upon or furnishing materials for said improvements under the foregoing contract have been paid in full and this payment to be made is the last or final payment.

Contractor's Signature

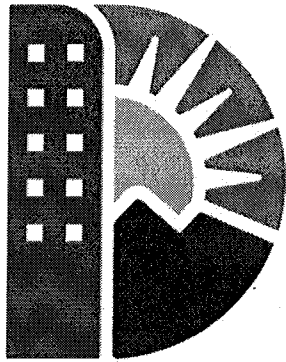
Date Signed

If there are any questions, please contact me by telephone at (720) 913-XXXX. Please return this document via facsimile at (720) 913-1805 and mail to original to the above address.



CITY AND COUNTY OF DENVER

STATE OF COLORADO



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PREVAILING WAGE RATES

Contract No. 201207767

IOWA AVENUE EXTENSION PHASE 1

September 18, 2012



DENVER
THE MILE HIGH CITY

Career Service Authority
Denver's Human Resource Agency

201 W. Colfax, Department 412
Denver, CO 80202
p: 720.913.5751
f: 720.913.5720
www.denvergov.org/csa

TO: All Users of the City of Denver Prevailing Wage Schedules
FROM: Seth Duhon-Thornton Staff HR Professional
DATE: Friday August 17, 2012
SUBJECT: Latest Change to Prevailing Wage Schedules

Please be advised, prevailing wage rates for some building, heavy, and highway construction trades have not been updated by the United States Department of Labor (DOL) since March 1, 2002. The Career Service Authority Board, in their meeting held on April 21, 2011, approved the use of the attached supplemental wage rates until prevailing wage rates for these classifications of work are again published by the United States Department of Labor in accordance with the Davis-Bacon Act. The rates will be provided as a supplemental to the Davis-Bacon Highway rates issued by CSA.

The effective date for this publication is **Friday August 17, 2012** and applies to the City and County of Denver for **HIGHWAY CONSTRUCTION PROJECTS** in accordance with the Denver Revised Municipal Code, Section 20-76(c).

General Wage Decision No. CO120019
Superseded General Decision No. CO20100021
Modification No. 1
Publication Date: 08/10/2012
(8 pages)

Unless otherwise specified in this document, apprentices shall be permitted only if they are employed pursuant to, and individually registered in, a bona fide apprenticeship program registered with the U.S. Department of Labor (DOL). The employer and the individual apprentice must be registered in a program, which has received prior approval, by the DOL. Any employer, who employs an apprentice and is found to be in violation of this provision, shall be required to pay said apprentice the full journeyman scale.

For questions call (720) 913-5009

Attachments as listed above.

General Decision Number: CO120019 08/10/2012 CO19.

Superseded General Decision Number: CO20100021

State: Colorado

Construction Type: Highway

Counties: Denver and Douglas Counties in Colorado.

HIGHWAY CONSTRUCTION PROJECTS

Modification Number	Publication Date
0	01/06/2012
1	08/10/2012

CARP9901-008 10/01/2010

	Rates	Fringes
CARPENTER (Form Work Only).....	\$ 24.00	11.28

ELEC0068-016 03/01/2011

	Rates	Fringes
TRAFFIC SIGNALIZATION:		
Traffic Signal Installation		
Zone 1.....	\$ 26.42	4.75%+8.68
Zone 2.....	\$ 29.42	4.75%+8.68

TRAFFIC SIGNAL INSTALLER ZONE DEFINITIONS

Zone 1 shall be a 35 mile radius, measured from the following addresses in each of the following cities:

- Colorado Springs - Nevada & Bijou
- Denver - Ellsworth Avenue & Broadway
- Ft. Collins - Prospect & College
- Grand Junction - 12th & North Avenue
- Pueblo - I-25 & Highway 50

All work outside of these areas shall be paid Zone 2 rates.

* ENGI0009-008 06/25/2012

	Rates	Fringes
POWER EQUIPMENT OPERATOR:		
(3)-Hydraulic Backhoe (Wheel Mounted, under 3/4 yds), Hydraulic Backhoe (Backhoe/Loader combination), Drill Rig Caisson (smaller than Watson 2500 and similar), Loader (up to and including 6 cu. yd.).....	\$ 24.27	8.62
(3)-Loader (under 6 cu. yd.) Denver County.....	\$ 24.27	8.62
(3)-Motor Grader (blade- rough)		

Douglas County.....	\$ 24.27	8.62
(4)-Crane (50 tons and under), Scraper (single bowl, under 40 cu. yd).....	\$ 24.42	8.62
(4)-Loader (over 6 cu. yd) Denver County.....	\$ 24.42	8.62
(5)-Drill Rig Caisson (Watson 2500 similar or larger), Crane (51-90 tons), Scraper (40 cu.yd and over),.....	\$ 24.57	8.62
(5)-Motor Grader (blade-finish) Douglas County.....	\$ 24.57	8.62
(6)-Crane (91-140 tons).....	\$ 24.72	8.62

 SUCO2011-004 09/15/2011

	Rates	Fringes
CARPENTER (Excludes Form Work)....	\$ 19.27	5.08
CEMENT MASON/CONCRETE FINISHER		
Denver.....	\$ 20.18	5.75
Douglas.....	\$ 18.75	3.00
ELECTRICIAN (Excludes Traffic Signal Installation).....	\$ 35.13	6.83
FENCE ERECTOR (Excludes Link/Cyclone Fence Erection).....	\$ 13.02	3.20
GUARDRAIL INSTALLER.....	\$ 12.89	3.20
HIGHWAY/PARKING LOT STRIPING:Painter		
Denver.....	\$ 12.62	3.21
Douglas.....	\$ 13.89	3.21
IRONWORKER, REINFORCING (Excludes Guardrail Installation).....	\$ 16.69	5.45
IRONWORKER, STRUCTURAL (Includes Link/Cyclone Fence Erection, Excludes Guardrail Installation).....	\$ 18.22	6.01
LABORER		
Asphalt Raker.....	\$ 16.29	4.25
Asphalt Shoveler.....	\$ 21.21	4.25
Asphalt Spreader.....	\$ 18.58	4.65
Common or General		
Denver.....	\$ 16.76	6.77
Douglas.....	\$ 16.29	4.25
Concrete Saw (Hand Held)....	\$ 16.29	6.14
Landscape and Irrigation....	\$ 12.26	3.16
Mason Tender-Cement/Concrete		
Denver.....	\$ 16.96	4.04
Douglas.....	\$ 16.29	4.25

Pipelayer		
Denver.....	\$ 13.55	2.41
Douglas.....	\$ 16.30	2.18
Traffic Control (Flagger)...	\$ 9.55	3.05
Traffic Control (Sets Up/Moves Barrels, Cones, Install Signs, Arrow Boards and Place Stationary Flags) (Excludes Flaggers).....	\$ 12.43	3.22
PAINTER (Spray Only).....	\$ 16.99	2.87
POWER EQUIPMENT OPERATOR:		
Asphalt Laydown		
Denver.....	\$ 22.67	8.72
Douglas.....	\$ 23.67	8.47
Asphalt Paver		
Denver.....	\$ 24.97	6.13
Douglas.....	\$ 25.44	3.50
Asphalt Roller		
Denver.....	\$ 23.13	7.55
Douglas.....	\$ 23.63	6.43
Asphalt Spreader.....	\$ 22.67	8.72
Backhoe/Trackhoe		
Douglas.....	\$ 23.82	6.00
Bobcat/Skid Loader.....	\$ 15.37	4.28
Boom.....	\$ 22.67	8.72
Broom/Sweeper		
Denver.....	\$ 22.47	8.72
Douglas.....	\$ 22.96	8.22
Bulldozer.....	\$ 26.90	5.59
Concrete Pump.....	\$ 21.60	5.21
Drill		
Denver.....	\$ 20.48	4.71
Douglas.....	\$ 20.71	2.66
Forklift.....	\$ 15.91	4.68
Grader/Blade		
Denver.....	\$ 22.67	8.72
Guardrail/Post Driver.....	\$ 16.07	4.41
Loader (Front End)		
Douglas.....	\$ 21.67	8.22
Mechanic		
Denver.....	\$ 22.89	8.72
Douglas.....	\$ 23.88	8.22
Oiler		
Denver.....	\$ 23.73	8.41
Douglas.....	\$ 24.90	7.67
Roller/Compactor (Dirt and Grade Compaction)		
Denver.....	\$ 20.30	5.51
Douglas.....	\$ 22.78	4.86
Rotomill.....	\$ 16.22	4.41
Screed		
Denver.....	\$ 22.67	8.38
Douglas.....	\$ 29.99	1.40
Tractor.....	\$ 13.13	2.95
TRAFFIC SIGNALIZATION:		
Groundsman		
Denver.....	\$ 17.90	3.41

Douglas.....	\$ 18.67	7.17
TRUCK DRIVER		
Distributor		
Denver.....	\$ 17.81	5.82
Douglas.....	\$ 16.98	5.27
Dump Truck		
Denver.....	\$ 15.27	5.27
Douglas.....	\$ 16.39	5.27
Lowboy Truck.....	\$ 17.25	5.27
Mechanic.....	\$ 26.48	3.50
Multi-Purpose Specialty & Hoisting Truck		
Denver.....	\$ 17.49	3.17
Douglas.....	\$ 20.05	2.88
Pickup and Pilot Car		
Denver.....	\$ 14.24	3.77
Douglas.....	\$ 16.43	3.68
Semi/Trailer Truck.....	\$ 18.39	4.13
Truck Mounted Attenuator....	\$ 12.43	3.22
Water Truck		
Denver.....	\$ 26.27	5.27
Douglas.....	\$ 19.46	2.58

WELDERS - Receive rate prescribed for craft performing operation to which welding is incidental.

Career Service Authority
Supplemental to the Davis-Bacon HIGHWAY Construction Projects rates
(Specific to the Denver Projects)
(Supp 35, Date: 01-13-2012)

Classification		Base	Fringe
Millwrights		\$28.00	\$10.00
Line Construction:			
	Lineman, Gas Fitter/Welder	\$36.88	\$9.55
	Line Eq Operator/Line Truck Crew	\$25.74	\$8.09
Power Equipment Operators (Tunnels Above and Below Ground, shafts and raises):			
	GROUP 1	\$25.12	\$10.81
	GROUP 2	\$25.47	\$10.85
	GROUP 3	\$25.57	\$10.86
	GROUP 4	\$25.82	\$10.88
	GROUP 5	\$25.97	\$10.90
	GROUP 6	\$26.12	\$10.91
	GROUP 7	\$26.37	\$10.94
Power Equipment Operators:			
	GROUP 1	\$22.97	\$10.60
	GROUP 2	\$23.32	\$10.63
	GROUP 3	\$23.67	\$10.67
	GROUP 4	\$23.82	\$10.68
	GROUP 5	\$23.97	\$10.70
	GROUP 6	\$24.12	\$10.71
	GROUP 7	\$24.88	\$10.79
Ironworkers (Ornamental)		\$24.80	\$10.03
Laborers (Removal of Asbestos)		\$21.03	\$8.55
Plumbers		\$30.19	\$13.55
Pipefitters		\$30.45	\$12.85
Truck Drivers:			
	GROUP 1	\$18.42	\$10.00
	GROUP 2	\$19.14	\$10.07
	GROUP 3	\$19.48	\$10.11
	GROUP 4	\$20.01	\$10.16
	GROUP 5	\$20.66	\$10.23
	GROUP 6	\$21.46	\$10.31

POWER EQUIPMENT OPERATOR CLASSIFICATIONS
(TUNNELS ABOVE AND BELOW GROUND, SHAFTS, AND RAISES):

GROUP 1 - Brakeman

GROUP 2 - Motorman

GROUP 3 - Compressor

GROUP 4 - Air Tractors; Grout Machine; Gunnite Machine; Jumbo Form

GROUP 5 - Concrete Placement Pumps; Mucking Machines and Front End Loaders, Underground, Slusher; Mine Hoist Operator; Mechanic

GROUP 6 - Mechanic Welder

GROUP 7 - Mole

NOTE: Any equipment listed below being used in tunnel work, below or above ground shall be paid not less than \$2.00 per hour above the listed wage rates.

POWER EQUIPMENT OPERATOR CLASSIFICATIONS:

GROUP 1 - Air compressor, brakeman, drill operator -smaller than Watson 2500 and similar, operators of 5 or more light plants, welding machines, generators, single unit conveyor, pumps, vacuum well point system, tractor, under 70 hp with or without attachments compressors, 360 C.F.M. or less

GROUP 2 - Conveyor, handling building materials, ditch witch and similar trenching machine, forklift, haulage motor man, pugmill, portable screening plant with or without a spray bar, screening plants, with classifier, self-propelled roller, rubber-tires under 5 tons.

GROUP 3 - asphalt plant, backfiller; cableway signalman; C.M.I. and similar, concrete batching plants, concrete finish machine, concrete gang saw on concrete paving, concrete mixer, less than 1 yd., under 8 inches, distributors, bituminous surfaces dozer, drill, diamond or core, elevating graders, elevator operator, lubricating and service engineer, grout machine, gunnite machine, hoist, 1 drum, horizontal directional drill operator, hydraulic backhoes; road stabilization machine, sandblasting Machine, single unit portable crusher, with or without washer, Tie tamper, wheel mounted, trenching machine operator, winch on truck.

GROUP 4 - Cable operated power shovels, draglines, clamshells, 5 cubic yards and under, concrete mixer over 1 Cubic yard, concrete pavers 34E or similar, grade Checker, hoist, 2 drums, mechanic, mixer mobile, Portable crusher, with or without washer; tractor with sideboom, roto-M ill and similar, welder.

GROUP 5 - Cable operated power shovels, draglines, clamshells and Backhoes over 5 cubic yards, caisson drill Watson 2500 similar or larger, motor grader blade-finish, hoist 3 drum or more.

GROUP 6 - Cableway, derrick, quad nine push unit, wheel excavator, belt or elevating loader.

GROUP 7 - tower cranes all types.

TRUCK DRIVER CLASSIFICATIONS:

GROUP 1 - Greasemen, Servicemen and Ambulance Drivers, Battery Men, Shuttle Truck or Bus, Flat Rack Tandem Axle.

GROUP 2 - Fork Lift Driver, Straddle Truck Driver, Lumber Carrier, Liquid and Bulk Tankers Single Axle, Combination, Euclid Electric or Similar, Specialty and Hoisting, Truck Drivers Fuel Truck, Grease Truck, Combination Fuel and Grease.

GROUP 3 - Truck Driver Snow Plow, Truck Driver Dump or Type Jumbo and similar type equipment.

GROUP 4 - Cement Mixer Agitator Truck over 10 cubic yards to and including 15 cubic yards, Tire Man, Cab Operated Distributor Truck Driver.

GROUP 5 - Heavy Duty Diesel Mechanic, Body Man, Welders or Combination Men.

WELDERS - Receive rate prescribed for craft performing operation to which welding is incidental.

CITY AND COUNTY OF DENVER

STATE OF COLORADO



TECHNICAL SPECIFICATIONS

Contract No. 201207767

IOWA AVENUE EXTENSION PHASE 1

September 18, 2012

**CITY AND COUNTY OF DENVER
DEPARTMENT OF PUBLIC WORKS
WASTEWATER MANAGEMENT DIVISION**

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**Storm Drainage and Sanitary Sewer Construction
Detail and Technical Specifications**

September 10, 2012



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CITY AND COUNTY OF DENVER
DEPARTMENT OF PUBLIC WORKS | ENGINEERING DIVISION

Storm Drainage and Sanitary Sewer Construction Detail and Technical Specifications

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Storm Drainage and Sanitary Sewer Construction Detail and Technical Specifications

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DEPARTMENT OF PUBLIC WORKS | ENGINEERING DIVISION

Storm Drainage and Sanitary Sewer Construction Detail and Technical Specifications

1.0 Scope

This part of the Specifications sets forth the detail and construction specifications and provisions applicable to storm, sanitary and other related construction issues as specified. The general contractor is responsible for all materials and equipment necessary to perform all operations in connection with the construction of the facilities as described in the most recent edition of these Detail and Technical Specifications and Standard Details.



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Storm Drainage and Sanitary Sewer Construction Detail and Technical Specifications

022213 Vibration Assessment

Part 1 - General

1.01 Description

This specification covers vibration monitoring during construction activities to include an existing condition survey, baseline equipment monitoring and the establishment of a vibration monitoring program for use during construction operations. . This specification only applies when the corresponding bid item for vibration assessment is included and is specifically stipulated in the contract documents.

The purpose of the vibration monitoring program is to assess possible impacts that construction activities might have to adjacent facilities during all phases of the work. These facilities include, but are not limited to buildings, bridges, underground utilities, surface facilities, structure foundations, and all other facilities within the proximity of the work.

The City and County of Denver is not responsible for the safety of the Work and compliance with this specification does not relieve the Contractor of full responsibility for damage caused by the Contractor's operations.

1.02 Submittals

All submittals are submitted to the Project Construction engineer for record keeping purposes and verification of conformance with the contract documents. These submittals do not shift liability or relieve the Contractor from full responsibility for damage that is deemed to be caused by the Contractor's operations.

- A. An independent vibration monitoring consultant will be used to fulfill the requirements of this section. The Contractor shall submit references for the consultant detailing at least two projects completed in the past five years where the vibration monitoring consultant has satisfactorily monitored construction operations by recording maximum peak particle velocities (PPVs). Include contact information for each reference. This information shall be submitted to the Project Construction Engineer for acceptance prior to beginning use of the Consultant's services.
- B. The Contractor shall submit any facility condition survey that is done to the Project Construction Engineer within 2 weeks of completion of the survey.
- C. At a minimum, the Contractor shall submit any data and documentation derived from vibration monitoring along with interpretations of the results from the vibration monitoring consultant to the Project Construction Engineer on a monthly basis.
- D. The contractor shall offer formal training on how to access any web base data access site. A technical manual detailing all procedures for accessing the site shall be offered at the training session and submitted to the Project Construction Engineer.

Part 2 – Product

Part 3 – Execution

3.01 Facility Condition Survey

This work shall consist of performing a facility condition survey(s) and preparing permanent records as indicated in this specification prior to the commencement of work, after completion of work, and at locations and times during construction as needed to verify that adjacent facilities have not been damaged by any element of the work.

3.02 Vibration Monitoring Consultant

- A. The Contractor shall, as specifically indicated in this specification, provide vibration monitoring to verify that construction activities will not or have not damaged adjacent facilities.
- B. The Contractor will obtain the services of an independent vibration monitoring consultant to assist in developing an existing condition survey, establish a vibration monitoring plan to include baseline and continuous monitoring, and interpret the results of the vibration monitoring as it relates to adjacent facilities.
- C. Vibration monitoring will be done near elements of the construction work which are likely to have the largest potential to damage adjacent facilities during the course of construction operations. This monitoring will be used to establish a baseline reading of these activities and will be done at a location of the work which is least likely to damage adjacent property. The vibration monitoring consultant will review the results of the baseline monitoring program and submit the results and their interpretation of the findings to the Construction Engineer in a report submitted on a monthly basis.
- D. Vibration monitoring will take place on a continuous basis during all construction activities. Continuous vibration monitoring will be done throughout the project at locations that are nearest the construction activities and which have the potential to damage nearby facilities. The location and number of vibration monitoring instruments will be as directed by the vibration monitoring consultant based on the results of the baseline monitoring, their interpretation of these results, and their experience based on the type of activity and proximity to nearby facilities.
- E. The Consultant/Contractor shall provide protection for all instrumentation from vandalism or theft. Any costs associated with vandalism or theft shall be born by the general contractor. The City and County of Denver shall at no time entertain any claim for loss associated with vandalism or theft of instrumentation.
- F. The vibration monitoring consultant will be a PE licensed in the state of Colorado, and will have performed vibration monitoring services in Colorado to include monitoring construction operations to record maximum peak particle velocities.
- G. The Consultant/Contractor will submit monthly reports to the Project Construction Engineer which detail the baseline monitoring results, a summary of the continuous vibration monitoring results at locations nearest the construction activities and include a summary interpretation of all the results collected over the past month.

END OF SECTION



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DEPARTMENT OF PUBLIC WORKS | ENGINEERING DIVISION

Storm Drainage and Sanitary Sewer Construction Detail and Technical Specifications

2.0 Site Preparation

2.0.1 General

The site of all trenches shall be cleared of all vegetation, stumps, roots, sod, and debris prior to excavating. Fences, walls, curbs, sidewalks, gutters, crosspans, poles, or any other structures stipulated on the drawings to be removed, or otherwise authorized by the Project Construction Engineer to be removed, shall be removed and later replaced in a manner acceptable to the City and equivalent to its original undisturbed condition. Except as otherwise shown on the Drawings or otherwise specified herein all unsalvageable materials shall be removed or hauled from the site to an area designated by the Project Construction Engineer and disposed of by the Contractor at his expense. Unless otherwise specified in the Contract Documents or elsewhere in these Detail and Technical Specifications, all salvageable materials and items shall become the property of the City. If, in the event it is specified that certain salvageable materials are to become property of the Contractor, no payment will be made for the removal of those items or materials.

2.0.2 Stockpiling of Excavated Materials, Pipe, Etc.

In accordance with and in addition to the requirements set forth in GC's 801-807 of the General Contract Conditions. No excavated materials, pipe, equipment, or any other items shall be stockpiled or stored on private property without the express written approval of the owner of the property. Duplicated copies of any written approval or authorization given to the Contractor shall be filed with the Project Construction Engineer and shall be so worded as to hold harmless the City of any responsibility whatsoever relative to the stockpiling and storage of material and equipment. All costs incurred shall be borne by the Contractor.

2.0.3 Construction Easements

All additional temporary construction easements, except for those public rights-of-way and permanent or temporary easements obtained by the City, which the Contractor feels are necessary to perform the required work shall be obtained by the Contractor at his sole expense. If these easements are granted to the Contractor, they shall be so worded as to hold harmless the City of any responsibility whatsoever relative to any temporary construction easement obtained by the Contractor. Duplicate copies of the written authorization shall be filed with the Project Construction Engineer and shall be All costs incurred shall be borne by the Contractor.

End of Specification



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DEPARTMENT OF PUBLIC WORKS | ENGINEERING DIVISION

Storm Drainage and Sanitary Sewer Construction Detail and Technical Specifications

3.0 Existing Facilities

3.0.1 General

The Contractor shall at all times take extreme and proper precautions for the protection of utility lines, the presence of which are known or can be determined by the examination of appropriate utility maps, exploratory excavations, etc. The Contractor shall be responsible for the repair of any damaged service or utility lines, and any utility line damaged by construction operations shall be repaired at the Contractor's expense.

The Contractor shall notify the Denver Water Board, Xcel Energy, telephone, cable and fiber optic companies, as well as all other interested parties, prior to commencement of work in order to insure that there will not be interruptions of these services during construction. Existing utility lines and utility poles, trees, shrubbery, fences, water mains, gas mains, sewers, cables, conduits, curb, gutter, walks, and other structures in the vicinity of the work not authorized to be removed, shall be supported and protected from damage by the Contractor until all construction and related work is complete. The Contractor shall be liable for all damages done to existing facilities, structures, and property.

3.0.2 Utilities

Utilities, underground and above-ground, shall include but not be limited to: fiber optics, gas, telephone, electric, steam, water, sanitary and storm sewers, telegraph lines, conduits, fiber

optics (including empty ducts), all abandoned utilities, etc., and their accessories, appurtenances and service connections. The type, size, location, and number of all known above-ground and underground utilities have been shown on the drawings, however, no guarantee is made as to the true, size, location or number of such utilities. It shall be the responsibility of the Contractor to verify the existence and location (vertically and horizontally) of all underground utilities along the route of the work, to ensure construction as shown in the Contract Documents. The omission from or the inclusion of existing or abandoned utility locations on the drawings is not to be considered as the nonexistence of, or a definite location of, said utilities.

3.0.3 Exploratory Excavations

When provided for in the Contract Documents, exploratory excavations shall only be paid at locations designated in the Contract Documents or as specifically approved by the Project Construction Engineer, in writing.

In addition to those areas as may be designated in the Contract Documents, it shall be the Contractor's responsibility to excavate and locate all utilities and appurtenances which may affect construction of the sewer utilities. All exploratory excavations shall occur far enough in advance to permit any necessary relocation or adjustment without delaying the project. All costs incurred by the Contractor in making exploratory excavations shall be considered to be included in the unit price bid for constructing each section of sewer line, structures, laterals and/or appurtenances.

3.0.4 Relocation and Adjustment

If it is determined prior to, or during construction that any underground or aboveground utilities (as defined under Section 3.0.2) are required to be relocated or adjusted, the Contractor shall notify the owner well in advance of his approach of such utility so that arrangements with the owner or owners of the affected utility can be completed without delaying construction. It is the Contractor's responsibility to coordinate all utility relocations and adjustments required to complete the scope of work designated within the construction plans and documents. All utilities requiring relocation and/or adjustment shall be constructed in accordance with each specific owner's requirements, standard specifications, and applicable agreements. The costs associated with utility coordination, relocations, adjustments; and/or construction delays due to improper planning, scheduling or advance notification of utility owners by the Contractor, shall be included within the related pipe segments, structures and appurtenances.

Unless otherwise provided for in the Contract Documents or specified elsewhere, the responsibility of relocating both underground and aboveground utilities within the project limits, shall be borne by the Contractor. However, if excessively wide excavations, cave-ins, improper shoring of trenches, or other unauthorized operations by the Contractor, damage any utilities lying outside of the prescribed maximum trench width, the Project Construction Engineer may order the utility to be adequately protected or relocated at the sole expense of the Contractor.

3.0.4.1 Water Services

The type, size and location of water services are not shown on the construction plans and it shall be the Contractor's responsibility to identify and locate the services affected during construction.

The Contractor is required to maintain service and adjust all water service taps and/or connections encountered during construction. Service adjustments and reconnections for homeowners, businesses, and facilities with special circumstances will be completed during a timeframe which accommodates their needs. All work will be performed by a licensed plumber or journeyman drainlayer and shall be in accordance with the Denver Water Board Standard Construction Specifications. No separate payment will be made for any of the work involved for this item and all costs incurred will be considered to be included in the applicable unit price bid for the associated pipe segments, structures and appurtenances.

3.0.4.2 Gas Services

The type, size and location of gas services are not shown on the construction plans, and it shall be the Contractor's responsibility to identify and locate the services affected during construction. The Contractor is required to coordinate all gas service relocations with the utility owner, well in advance of approach. All work involved and costs incurred for this item will be included within the applicable unit price bid for the associated pipe segments, structures and appurtenances.

3.0.4.3 Sewer Services

1. Adjusting

All storm and sanitary sewer services and/or connections crossed during construction shall be adjusted by the Contractor as required to maintain service. A licensed plumber or a licensed drainlayer shall perform all such work. Unless otherwise provided for in the Contract Documents, no separate payment will be made for any of the work involved for this item and all costs incurred will be considered to be included in the applicable unit price bid for the associated pipe segments, structures and appurtenances.

2. Reconnection

Where existing sanitary and storm sewer lines with service and/or lateral connections are being replaced, reconnection will be required at the locations shown in the Contract Documents, in addition to those located in the field by the Contractor and identified by the Project Construction Engineer as active connections. The foregoing is applicable to all Division Contracts including storm sewer, gulch work, sanitary sewer, and emergency work of any nature. The connections shall be reconnected by the Contractor utilizing standard tee or wye fittings, factory manufactured saddle taps, applicable pipe and reinforced concrete collars, adjustable repair couplings, etc. as specifically approved for construction by the Project Construction Engineer. All service connections on PVC lines shall be constructed in accordance within these Detail and Technical Specifications. Connections to sewer lines and structures shall be made using coring machines, keyhole saws, or other methods approved by the Project Construction Engineer; jack-hammering

is not permitted. The Contractor will perform this work utilizing a licensed plumber or journeyman drain layer. All connections must be reconnected to the new sewer line within twelve hours of discontinuance of service.

3. Location and Verification

All sewer services and/or lateral connections shall be located and verified by the Contractor prior to construction (both vertically and horizontally). The Contractor shall notify owner well in advance of access to mainline sewers to allow coordination and planning with the pertinent maintenance groups. All costs associated with delays and maintenance of mainline facilities will be incurred by the Contractor. The Project Construction Engineer shall be notified immediately of any information acquired from locates and verifications which may effect the design or original scope of work.

Unless provided for elsewhere in the Contract Documents or specified elsewhere, no separate payment will be made for any of the work involved for these items and all costs incurred will be included in the applicable unit price bid for the associated pipe segments, structures and appurtenances.

3.0.5 Abandonment

All existing sewer facilities to be plugged and abandoned in place are specifically shown on the Construction Drawings. Unless otherwise specified in the Contract Documents or elsewhere in the Special Conditions, the procedures and methods for the abandonment of said facilities shall conform to the following.

3.0.5.1 Manholes/Inlets/Structures

Manholes, inlets or miscellaneous structures to be abandoned in place shall have all pipes entering or exiting the structure plugged with lean concrete. Manhole tops or cone sections shall be removed to the first full barrel diameter section, and/or to a point not less than 24-inches below final grade. The structure shall then be backfilled and compacted in accordance with Backfill Method B as specified within these Detail and Technical Specifications. Backfill material may be either: select backfill, clean suitable excavated material, or controlled low strength material approved by the Project Construction Engineer. Surface restoration for the surrounding area shall be done in accordance within these Detail and Technical Specifications.

Manhole rings, covers, inlet grates, frames, precast flat tops, cone sections, or other salvageable items shall be salvaged, stored and delivered to such location as prescribed by the Project Construction Engineer.

The payment for abandoning manholes, inlets, and/or miscellaneous structures as described above; along with the materials, equipment and labor necessary to complete all surface restoration associated with these items shall be included within the appropriate bid item (regardless of the size or depth of item abandoned). Refer to applicable Measurement and Payment description for specific item inclusions.

3.0.5.2 Sewer Lines

Sewer lines to be abandoned in place shall be plugged with lean concrete and standard manufactured plugs or caps at both upstream and downstream ends of the abandoned section. If the manholes, inlets, etc. are also abandoned in place, or if the structure is to be removed completely, all sewer lines shall be plugged upstream and downstream of the removed structure following removal.

Sewer lines with an internal diameter of 24-inches or larger shall be filled with sand, pumped grout mixtures, or flowable fill, prior to final plugging. Unless otherwise noted in the Contract Documents, sewer lines with an internal diameter of 21-inches and smaller shall be plugged at entrance and exit ends with approved grout mixtures or concrete.

Unless provided for elsewhere in the Contract Documents or specified elsewhere, no separate payment will be made for any of the work involved for these items and all costs incurred will be included in the applicable unit price bid for the associated pipe segments, structures and appurtenances.

3.0.6 Crossing of Existing Utilities

See Standard Detail S-350, for requirements and general notes.

End of Specification



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4.0 Utility Trenching and Excavation

4.0.1 General

All excavations, trenching, shoring and stockpiling of excavated materials shall be in strict compliance with the applicable Occupational Safety and Health Act (OSHA) rules and regulations.

Except where shown otherwise on the Drawings, and except when the Project Construction Engineer gives written permission to do otherwise, all trench excavation shall be made by open cut to the depth required to construct the pipe line as shown on the Drawings and specified herein. Permission for tunnel work may be granted for crossing under sidewalks, driveways, or existing utility lines, but such tunnels shall not exceed 10 feet in length. No separate payment will be made for any of the work involved for these items and all costs incurred will be included in the applicable unit price bid for the associated pipe segments, structures and appurtenances.

The length of trench permitted to be open at any one time may be limited when, in the opinion of the Project Construction Engineer, such limitation is necessary for the safety and convenience of the public; however, in no case shall the length of open trench exceed 150 feet. All trenches and excavations left overnight shall be protected as specified by the Project

Construction Engineer. This may include, but is not limited to: fencing, concrete, barriers, additional signage or any other measures required to provide public safety.

4.0.2 Subsurface Information

Whenever subsurface exploration, consisting of test holes and borings, has been made along the route of the work, the information obtained from these test holes will be included in both the Bid Submittal Package and the Contract Documents.

Subsurface information is provided for general information, and conditions may vary due to the location on jobsite and time of year. The City does not accept any responsibility for assumptions or generalizations made by the Contractor. Each bidder and Contractor must form his/her own opinion of the character of the work and of the materials to be excavated, and he/she must make his/her own interpretations and investigations regarding all conditions affecting the work to be done.

4.0.3 Trench Width

Except as may be otherwise specified on the Drawings, the maximum clear trench width measured at a point one (1) foot above the top of the pipe barrel shall not be greater than that set forth in the most recent edition of the Standard Detail Drawings.

The trench width shall be sufficient to permit the pipe to be placed and jointed properly and to allow for the construction of appropriate structures and appurtenances. The width shall be as such to allow backfill to be placed and compacted as specified. No pipe shall be installed in a bedding trench having a width (as measured at one (1) foot above the top of the pipe) greater than the outside diameter of the pipe plus sixteen (16) inches for pipe having internal diameters of thirty-three (33) inches or less. No bedding trench shall be greater than the outside diameter of the pipe plus twenty-four (24) inches for all pipes with internal diameters of thirty-six (36) inches or more.

If the stated maximum trench widths are exceeded either through accident or otherwise and if the Project Construction Engineer determines that the design loading of the pipe will be exceeded, the Contractor will be required to either support the pipe with an improved trench bottom or to use a stronger class. The cost of such remedial measures shall be entirely at the Contractor's own expense. If deemed necessary, the Contractor shall brace or shore this portion of the trench excavation to maintain the required trench width at the top of the pipe.

4.0.4 Trench Walls

All trench sidewalls shall be properly sloped, benched, braced, shored or sheeted to assure safe working conditions and to prevent cave-ins. All trench operations including sloping or benching of the trench sidewalls and stockpiling of excavated materials shall be confined to the width of the permanent rights-of-way plus any temporary construction easements.

4.0.4.1 Sloping or Benching

Sloping or benching of the trench walls will normally be allowed, provided that such sloping or benching complies with all applicable State and Federal Occupational Safety and Health Administration (OSHA) requirements; and provided further, that such sloping or benching does not endanger adjacent utilities or structures or the public. In the event the Contractor elects to slope or bench the trench sidewalls, the sloping or benching shall terminate at a depth not less than one (1) foot above the top of the pipe barrel and, from that point to the bottom of the excavation, the trench wall shall be vertical (with adequate shoring as necessary).

4.0.4.2 Bracing Shoring, Sheeting

The sides of the excavation shall be securely held in place with suitable bracing and shoring wherever necessary to prevent caving. In addition, bracing, shoring, sheeting, etc. shall be in accordance with all applicable State and Federal Occupational Safety and Health Administration (OSHA) requirements. Shoring shall be removed as the work and backfilling operations progress, unless ordered by the Project Construction Engineer to be left in place. The Contractor will be responsible for minimizing the disturbance of compacted bedding during advancement and removal of shoring within the bedding trench zone. All voids and separations shall be backfilled and recompacted with the appropriate bedding materials and in conformance with Section 5.0 of these Details and Technical Specifications. The Contractor will be paid for shoring so ordered left in place on the basis of invoiced material only. All other shoring shall be considered as incidental to construction and all costs incurred, except for materials ordered to be left in place, will be considered to be included in the unit price bid for the construction of each section of sewer, associated structures, laterals and appurtenances.

The decision to brace, shore or sheet the excavation shall be entirely the Contractor's responsibility. However, if the Project Construction Engineer is of the opinion that any part of the excavation is not properly supported, he/she may order the placement of additional supports by and at the expense of the Contractor. Compliance with such order shall not relieve or release the Contractor from his/her responsibilities to provide a safe work zone.

4.0.5 Preparation of Foundation for Pipe Laying

When the excavation is in firm soil, care shall be taken to avoid excavation below the established grade (i.e. the specified overdepth to accommodate the particular class of bedding). The different methods and classes of bedding are described within section 5.0 of these Detail and Technical Specifications.

4.0.5.1 Dewatering

During construction, the Contractor shall provide and maintain adequate equipment to properly remove and dispose of all water entering the trench or other part of the work. In water bearing strata, well points, sub drains or any other method approved by the Project Construction Engineer may be required to provide a dry trench.

The discharge from any trench dewatering operations shall be conducted to natural drainage channels or other structures as approved by the Project Construction Engineer and in

accordance with applicable permits. Ground water shall not be discharged into sanitary sewers.

Pipe trenches shall be kept free from water during excavation, fine grading, pipe laying and jointing. Dewatering, sufficient to provide a completely dry trench, shall be maintained during all pipe laying and jointing operations. The Contractor shall be responsible for damage of any nature resulting from the dewatering operations.

Unless provided for in the Contract Documents, dewatering shall be considered as incidental to construction and all costs incurred will be considered to be included in the unit price bid for the construction of each section of sewer line, associated structures, laterals and appurtenances.

4.0.5.2 Overexcavation and Replacement with Select Backfill Material

If soft or otherwise unsuitable foundation material is encountered in the bottom of the trench, it shall be removed and replaced with select backfill material and/or angular rock bedding material so as to provide a suitable foundation for the pipe structure and/or appurtenance, as determined by the Project Construction Engineer.

In the event that overexcavation and replacement with select backfill material is below the water table, the sub-bedding material shall consist of 3/4 to 1-1/2-inch rock (or larger if approved). All work shall conform to the most recent edition of the Standard Details.

If provided for in the Contract Documents, the cost of overexcavation and replacement with select backfill material will be paid for per the associated measurement and payment description. If no pay item for such work is included in the Contract Documents, the Contractor shall consider all costs incurred are to be included in the unit prices bid for the construction of each section of sewer, associated structures, laterals and appurtenances.

4.0.5.3 Rock Excavation

Rock shall be defined as material consisting of igneous, metamorphic and sedimentary materials which cannot be excavated without blasting or the use of rippers, or boulders or other detached stones each having a volume of 1/2 cubic yard or more, or having a specific gravity of at least 2.25 and weighing not less than 140.4 pounds per cubic foot. The unit price bid for rock excavation will include granular bedding, select material, or any other material specifically approved by the Project Construction Engineer required to fill the excavated area.

4.0.5.4 Muck Excavation

Muck shall be defined as an organic soil consisting of highly decomposed materials. Soils with more than 30% organic material are considered “organic” soils and are generally referred to as peat or muck. These soils have bulk densities as low as 25 to 37 lb/ft³. The unit price bid for muck excavation will include granular bedding, select material, or any other backfill material specifically approved by the Project Construction Engineer required to fill the excavated area.

4.0.6 Pavement and Sidewalk Cuts

Where excavation is required under concrete or asphalt paved areas, including gutters and walks, the surfacing material shall be cut or rotomilled in such a manner as to produce a smooth, straight cut edge and confine the excavation to a minimum practical width. The pavement or concrete shall be cut or removed at least one (1) foot beyond the top width of the trench on each side. All broken pavement, asphalt, concrete or other debris resulting from this initial work shall be immediately removed from the job site or stockpiled in an approved manner so that it is kept separated from the remaining trench excavation. This debris will not be allowed, to be mixed in the trench backfill material.

4.0.7 Cut-off Walls

Cut-off walls are only required as noted in the contract documents and as specifically requested by the Project Construction Engineer to prevent migration of water through the pipe bedding zone. The Project Construction Engineer may specify alternate locations from those shown in the plans. Concrete cut-offs are the preferred installation method. Refer to Standard Detail S-301.1 for typical locations and additional information.

End of Specification



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5.0 Bedding and Backfilling

5.0.1 General

This section outlines the guidelines and requirements for pipe bedding and backfilling operations required to complete construction per the Contract Documents.

5.0.2 Pipe Bedding

Unless specified otherwise on the Drawings or elsewhere in the Contract Documents, or directed otherwise by the Project Construction Engineer, the Contractor shall bed all conduit according to the Class B Bedding method using a crushed granular, mineral aggregate material as noted in these Detail and Technical Specifications and install the required geotextile over the pipe and/or bedding. Substitutions of recycled materials or manufactured materials in place of mineral aggregate mixtures for pipe bedding will not be allowed. If, in the course of construction, it is determined that the pipe foundation is unsatisfactory or the prescribed maximum allowable trench width is exceeded, the Project Construction Engineer

may require that an alternate class of bedding be installed. The Contractor shall be required to place the improved bedding class or make other remedies, at his/her expense.

No separate payment will be made for placement of the required bedding material. All costs incurred will be considered to be included in the unit price bid for each section of sewer line, associated structures, laterals and appurtenances.

5.0.2.1 Bedding Materials

1. #67 Bedding

This bedding shall consist of a durable crushed granular material with a well graded mineral aggregate mixture, which will provide good stability. This bedding shall not contain recycled or manufactured materials. The size range of the aggregate shall be from 1/4-inch minimum to 3/4-inch maximum with a maximum amount of fines passing a No. 8 sieve not to exceed 5% by weight and shall conform to ASTM C-33 or ASTM D-448, gradation size #67. At least 50% of the material greater than the 3/8-inch sieve shall contain particles having 3 or more fractured faces.

CLASS 67 GRADATION	
Nominal Size	Percent Passing by Weight
3/4	90-100
3/8	20-55
No. 4	0-10
No. 8	0-5

2. Special Bedding Material

Special bedding material shall only be used where required within the Contract Documents and as specifically approved by the Project Construction Engineer. This material is intended for use on rigid pipe of sixty (60) inches or greater in diameter and shall not be used with flexible conduits. Additionally, this bedding shall not contain recycled or manufactured materials. The following gradation requirements shall apply:

SPECIAL BEDDING MATERIAL	
Nominal Size	Percent Passing by Weight
3/8	100
No. 4	80-100
No. 16	35-65
No. 50	10-25
No. 100	5-10

SPECIAL BEDDING MATERIAL	
Nominal Size	Percent Passing by Weight
No. 200	3-8

3. Alternate Classes of Bedding

Alternate classes of bedding may be required within the Contract Documents or requested within the project scope. All such bedding materials must be submitted and separately approved for use by the Project Construction Engineer. Recycled or manufactured materials will not be considered and alternate bedding materials used on site which have not been approved shall be rejected and the removal and replacement of these materials will be at the Contractor's expense.

5.0.2.2 Bedding Requirements

On rigid pipe of fifteen (15) inches or less in diameter and on all pipe classified as flexible, the bedding shall be continued until the bedding is filled to one foot above the top of the pipe. On rigid pipes eighteen (18) inches or greater in diameter, the bedding can be terminated at a point equal to the spring line of the pipe.

Conduit Type	Bedding Requirements*	
	≤15" Diameter	≥18" Diameter
Reinforced Concrete Pipe (RCP, HERCP, etc.)	1' Above Top of Pipe	Spring Line of Pipe
Centrifugally Cast Fiberglass Reinforced Mortar Pipe (CCFRMP)	1' Above Top of Pipe	
Ductile Iron Pipe (DIP)	1' Above Top of Pipe	
Corrugated Metal Pipe (CMP, CSP, ASP, etc.)	1' Above Top of Pipe	
Polyvinyl Chloride Pipe (PVC)	1' Above Top of Pipe	
High Density Polyethylene Pipe (HDPE)	1' Above Top of Pipe	

Reinforced Concrete Box Culvert (RCB or RCBC)	6" Below Outside of Box
* Based on internal diameter or equivalent internal diameter of conduit	

5.0.2.3 Bedding Methods

1. Class A Pipe Bedding

Class A Bedding shall be defined as that method of bedding by which additional supporting strength of the pipe is attained by supporting the lower part of the pipe with a concrete cradle or distributing trench loads on the upper portion of the pipe by means of a concrete arch.

In those instances where Class A Bedding is required, the Contractor shall construct either a concrete cradle or concrete arch as specifically noted in the Contract Documents or as directed by the Project Construction Engineer. Class A Bedding shall be constructed of non-reinforced concrete with a minimum 28-day compressive strength (f'_c) of no less than 2000 psi, unless otherwise noted. Additional requirements for either type of construction are specified below. Class A Bedding will normally not be allowed for flexible type installations such as corrugated steel pipe, plastic pipe, etc.

After concrete cradle or arch bedding has been constructed, no backfilling shall be completed above the pipe until the concrete has attained the required minimum compressive strength. Where sheeting is removed or left in place, all cavities remaining, adjoining and/or behind shall be firmly filled with a suitable backfill material.

a. Concrete Cradle

This method of Class A Bedding construction shall consist of bedding the lower part of the pipe in a poured-in-place concrete cradle. The minimum thickness of concrete under and around the conduit shall not be less than that specified on the most recent edition of the Standard Detail Drawings.

The concrete shall extend upward around the pipe a minimum distance of $\frac{1}{4}$ of the outside diameter (but not less than 4-inches), measured from the lowest portion of the pipe exterior. The width of the concrete cradle shall be at least equal to the outside diameter plus 8-inches. Blocking material required to support the pipe prior to placement of concrete shall have a minimum compressive strength of 2000 psi. The remaining excavation to a point two (2) feet above the top of pipe shall be backfilled and compacted in accordance with Backfill Method B as specified in Section 5.0 of the Detail and Technical Specifications.

b. Concrete Arch

This method of Class A Bedding construction shall consist of bedding the upper part of the pipe in a poured-in-place concrete arch. The minimum thickness of concrete over and around the conduit shall not be less than that specified in the most recent edition of the Standard Detail Drawings.

The concrete shall extend upward around the pipe a minimum distance of $\frac{1}{2}$ the outside diameter plus 4-inches, measured from the spring line of the pipe. The width of the concrete arch shall be at least equal to the outside diameter plus 8-inches. Where a concrete arch is required, the lower portion of the pipe (from spring line down) shall be bedded with Class B bedding, in accordance with this section. The remaining excavation to a point two (2) feet above the top of pipe shall be backfilled and compacted in accordance with Backfill Method B as specified in Section 5.0 of these Detail and Technical Specifications.

2. Class B Pipe Bedding

Class B Bedding shall be defined as that method of bedding in which the pipe is set on an approved granular material. The trench shall be excavated to a depth below the bottom of the pipe as specified in the Standard Details. The overexcavation shall be backfilled and compacted with a clean granular material free from organic and/or unsuitable materials. The material shall be placed under the pipe and on either side of the pipe up to depths specified within these Detail and Technical Specifications. The placing shall be done in a manner which will assure no separation or change in uniform gradation.

All bedding material shall be placed under the pipe haunches, then brought up in six inch (6") lifts (maximum) and compacted by hand operated mechanical vibrators equally and thoroughly along each side of the pipe in such a manner as to avoid displacement of, or damage to the pipe. All bedding material shall be compacted to a density of at least ninety percent (90%) as determined by the Modified Proctor Method, AASHTO designation T-180, before the next lift is placed. Refer to Standard Detail S-301.2 for additional information.

In no case will jetting or flooding be allowed as means for consolidation or compaction of the bedding material. Cut-off walls will be required to be installed as described in Section 4.0.7 and as shown on the Standard Details.

5.0.3 Backfill

Excavated material will be considered suitable for backfill purposes, provided its use results in a well-compacted stable condition. All backfill material shall be free from rubbish, organics, frozen material, broken pavement, debris, stones larger than three (3) inches in diameter, or other unsuitable materials

Material having a plasticity index greater than twenty (20) shall not be used for backfill within a street, roadway, or any other area where the degree of compaction is critical. It may be necessary for the Contractor, at his/her sole expense, to dry, wet, mix or otherwise rework satisfactory excavated material as necessary to obtain conformance with these Detail and Technical Specifications.

The use of squeegee material or pea gravel will not be allowed as backfill material due to their free flowing nature if undermined. These materials may be used as pipe bedding if required by a specific utility owner, but they must be consolidated by vibration prior to backfilling operations.

When, in the opinion of the Project Construction Engineer, the excavated material is unsuitable for use as backfill, or when there is a shortage of satisfactory backfill material

within the project limits, the Contractor shall locate and furnish all necessary suitable backfill material and shall dispose of the unacceptable material. All excess backfill or unacceptable excavated material shall be disposed of off the rights-of-way and public property by the Contractor, unless directed otherwise by the Project Construction Engineer. Backfilling shall be performed in strict conformance with these Detail and Technical Specifications.

5.0.3.1 Trench Backfill

The entire area from pipe subgrade to the finished surface elevation shall make up the trench backfill zone. This zone consists of two (2) main sections described below: the Bedding Trench and the Backfill Above Bedding Trench. All areas outside of this zone will be considered Backfill Outside the Trench.

Unless otherwise set forth in the Contract Documents, the cost of the bedding and trench backfill requirements shall be included in the associated unit price bid for the respective sewer line, associated structures, laterals and appurtenances.

1. Bedding Trench

The Bedding Trench is defined as starting at the subgrade of the specified overdepth required to accommodate the particular class of bedding below the bottom of the pipe and extends vertically to a point where the bedding is terminated (as defined under Bedding Requirements above).

The bedding trench shall be backfilled with an approved bedding material, in accordance with Class A or Class B Bedding methods immediately after the pipe is laid, except where the pipe must remain exposed for leakage tests (subject to the provisions of these Detail and Technical Specifications).

2. Backfill Above Bedding Trench

Backfill Above the Bedding Trench shall be considered as starting one foot above rigid pipe fifteen (15) inches in diameter or less and for all pipe classified as flexible; or at the spring-line for rigid pipe eighteen (18) inches and larger in diameter. All material below these areas shall be considered as bedding material. Refer to the Bedding Requirement table included within this section for further clarity based on pipe types.

3. Backfill Outside the Trench

All backfilling required during construction which is outside of the Trench Backfill Zone, as defined above, will be considered Backfill Outside the Trench. These materials shall meet the requirements set forth in this specification.

Backfill for cast-in-place or precast structures and appurtenances, including but not limited to: manholes, transition structures, junction structures, vaults, inlets and concrete box culverts, shall start at the subgrade for the structure, or appurtenance. As a minimum requirement all structures, inlets, manholes and appurtenances will follow Method B backfill procedures as described in this specification. All remaining operations which fall under Backfill Outside the Trench will follow method A backfill procedures as a minimum, unless specified otherwise in the Contract Documents or directed by the Project Construction Engineer.

5.0.3.2 Backfilling Methods

After the specified pipe bedding has been placed, compacted and approved, and after the requirements for the bedding trench have been fulfilled and the Project Construction Engineer has approved the commencement of backfilling operations, the balance of the trench shall be backfilled and compacted in accordance with one of the methods described below. The contractor shall not temporarily backfill trenches and return later to re-excavate and meet the backfill method requirements. The Contractor shall consider the minimum backfill and compaction requirements to be in conformance with Backfill Method A for pipeline trenches and Backfill Method B for pipe bedding, backfill under or around manholes, structures, inlets, utilities and appurtenances, unless specified otherwise in the Contract Documents.

The use of hand held tools or devices to meet compaction requirements shall be continued around and above the pipe section during the trench backfilling process until a minimum vertical height above the pipe of two (2) feet is reached. Thereafter, the use of approved compaction equipment (vibratory, sheepsfoot, rubber-tire, etc.) may be utilized. Impact, free fall, stomping and jetting operations are not permitted unless specifically approved by the Project Construction Engineer.

The Contractor shall exercise the utmost care during compaction by any of the methods described below, to assure that no damage will occur to the sewer, appurtenances or other existing utilities. Any damage resulting from compaction shall be repaired or replaced at the Contractors expense.

1. Backfill Method A

The backfill shall be placed in horizontal layers of such depths as are specified below for the material being placed and the type of equipment being used. Granular soils shall be compacted by vibration; whereas cohesive soils shall be compacted by a kneading action.

Material for mechanically compacted backfill shall be placed in lifts, which, prior to compaction, shall not exceed the thickness specified below for the various type of equipment:

- a. Vibratory equipment, including vibratory plates, vibratory smooth-wheel rollers, and vibratory pneumatic-tired rollers - maximum lift thickness of two (2) feet;
- b. Rolling equipment, including sheepsfoot (both vibratory and non-vibratory), grid, smooth-wheel (non-vibratory), pneumatic-tired (non-vibratory), and segmented wheels-maximum lift thickness of one (1) foot;
- c. Hand-directed mechanical tampers - maximum lift thickness of six (6) inches.

Permission to use specific compaction equipment shall not be construed as guaranteeing or implying that the use of such equipment will not result in damage to adjacent ground, existing improvements, or improvements installed under the Contract Documents. The Contractor shall make his/her own determination in this regard.

It will be the Contractors responsibility to maintain a minimum of eighty-five (85%) density from the top of bedding to a distance of two (2) feet over the top of pipe. The

density from two (2) feet over the top of pipe to the subgrade surface shall maintain a minimum of ninety percent (90%) density. Regardless of facility depth, the last foot of subgrade material shall be compacted to a minimum density of ninety percent (90%). All densities shall be determined by the Modified Proctor Method, AASHTO Designation T-180. Each lift of backfill material shall have the proper moisture content and consistency to permit compaction to the designated density. The compacted material may be tested at any time for adherence to these Detail and Technical Specifications.

2. Backfill Method B

This method of backfilling requires placement in six (6) inch lifts. Each lift will have the proper moisture content and consistency to permit compaction to the prescribed density. Each lift will be uniformly and completely compacted by either handheld pneumatic or mechanical tampers to a density of at least equal to ninety percent (90%) of the density determined by the Modified Proctor Method, AASHTO designation T-180, before the next lift is placed.

3. Backfill Method C

Other methods of backfill placement and compaction to the prescribed density may be submitted to the Project Construction Engineer by the Contractor. These methods will not be used without the prior written approval of the Project Construction Engineer.

5.0.3.3 Select Backfill Materials

Select materials shall only be used as backfill when specifically shown in the Contract Documents or as approved and authorized by the Project Construction Engineer and will only be placed to the specified depths in those areas as shown on the Contract Documents or as ordered by the Project Construction Engineer. The materials listed here are only intended for backfilling purposes and shall not be used for pipe bedding at any time. Prior to using select materials onsite, the Contractor shall submit product documentation for approval. All select material placed without approval from the Project Construction Engineer will be rejected and the Contractor will incur all costs associated with removal and replacement of the material.

1. Subgrade Material (Select Backfill)

Select subgrade material, which may also be specified as “select backfill material” in other locations within the Contract Documents, shall be defined as a well graded mixture of sound mineral aggregate particles containing sufficient, proper quality binding material to secure a firm, stable foundation when placed and compacted. When tested with laboratory sieves, the material shall meet the following gradation requirements:

Standard Sieve Size	% Passing (by Weight)
3 inch	100
No. 10	80 maximum
No. 200	0-15 maximum

All select subgrade material shall be of such quality that material passing a No. 40 sieve will have a liquid limit of not more than thirty five (35) and a plasticity index of not over six (6) when tested in conformity with AASHTO Designations T-89 and T-91 respectively. In addition, the City will take soil-bearing tests where necessary, to evaluate the quality of materials produced from pit sources. If the bearing value or stabilometer values of pit materials are considered to be adequate, minor deviations (less than five percent) from the liquid limit and plasticity index criteria specified shall not be considered to be a basis for rejection of the material. It shall be the responsibility of the Contractor to locate material meeting these Detail and Technical Specifications and to secure approval of the Project Construction Engineer before such material is delivered to the project. If at any time during the construction, such tests reveal that the material being delivered is not of suitable quality for the purpose for which it is intended, the City reserves the right to direct the Contractor to change pit locations as necessary, at no cost to the City. If the Contractor so elects, he/she may, at his/her own expense, remove and dispose of the excavated material even if the Project Construction Engineer considers it satisfactory for use as backfill, and replace it, at his/her own expense with select backfill material.

2. Structural Fill

Structural Fill shall be defined as a well graded mixture of sound mineral aggregate particles void of debris containing sufficient proper quality binding materials to secure a firm, stable foundation when placed and compacted. When tested with laboratory sieves, the material shall meet the following gradation requirements:

Standard Sieve Size	% Passing (by Weight)
2 inch	100
No. 4	30-100
No. 50	10-60
No. 200	5-20

Bearing value and or stabilometer tests by CBR or R value methods may be required to properly evaluate the quality of the material.

Colorado Department of Transportation approved class 4, 5, or 6 base course materials typically meet the above specifications. A report showing the gradation analysis and test results for the materials proposed for Structural Fill shall be required by the Project Construction Engineer prior to placement and in accordance to AASHTO designations T-89 and T-91.

3. Recycled and Processed Materials

Recycled and processed materials shall include: recycled concrete, aggregates, asphalt, crushed gravel base course (road base), crusher fines or any other materials specified as such. The use of these materials within the construction site shall be limited to those areas designated within the Contract Documents or approved by the Project Construction Engineer.

The following gradations are provided as a guideline for recycled and processed materials commonly used in construction and represent only a portion of those available for use. Approved submittals will be required prior to placement, to ensure that the material type and particle distribution are suitable for the intended application. All materials of this category placed without previous approval of the Project Construction Engineer shall be rejected and all costs incurred for removal and replacement of these materials will be at the Contractor’s expense.

a. Crushed Recycled Concrete

Standard Sieve Size	% Passing (by Weight)
1½ inch	100
¾ inch	40-75
¼ inch	25-50
No. 40	5-20
No. 200	10 max

b. Crushed Recycled Asphalt Pavement

Standard Sieve Size	% Passing (by Weight)
1½ inch	100
¾ inch	40 minimum

c. Crushed Gravel Base Course (CDOT Class 6 Road Base)

Standard Sieve Size	% Passing (by Weight)
¾ inch	100
No. 4	30-65
No. 8	25-55
No. 200	3-12

d. Crusher Fines

Crusher fine material shall meet the gradation shown in the following table. The material shall consist of fine mineral fragments resulting from rock crushing operations.

Standard Sieve Size	% Passing (by Weight)
¾ inch	100
No. 4	90-100
No. 8	55-80
No. 16	40-70
No. 30	25-50
No. 200	6-15

4. Controlled Low Strength Material (CLSM)

Controlled Low Strength Materials (CLSMs) consist of a well-graded mixture of mineral aggregates, cementitious materials, water and admixtures. Other common names for CLSMs include: flowable fill, flowfill, non-shrink backfill, fly ash fill and controlled density fill.

The contractor will be required to submit a mix design and test data to the Project Construction Engineer for approval, prior to excavating the area for which CLSMs are proposed for use. All materials of this category placed without previous approval, or which do not perform as specified, will be rejected by the Project Construction Engineer and all costs incurred for removal and replacement of these materials will be at the Contractor's expense.

All CLSMs shall adhere and conform to the following, unless noted otherwise:

- a. The mix must be capable of freely flowing to fill all voids in trenches or other areas without compaction or other additional effort,

- b. The mix must be of uniform density and low permeability to prevent migration of adjacent fines into the set mix,
- c. Must be placed in a uniform manner that will prevent voids or segregation of the backfill and shifting of pipelines, structures and appurtenances. Foreign material that falls into the trench prior to, or during placement shall be immediately removed,
- d. The CLSM shall be produced using a central-mixed concrete plant or other approved method,
- e. Chemical admixtures containing chlorides shall not be used unless approved otherwise,
- f. CLSMs will be classified as either Standard Aggregate or Fine Aggregate CLSM according to the table below. Submitted CLSMs must follow the gradation guideline provided here, unless approved otherwise:

Standard Sieve Size	% Passing (by Weight)
1 inch (For Standard Aggregate CLSM)	100
3/8 inch (For Fine Aggregate CLSM)	100
No. 8	50 minimum
No. 200	0-30 maximum

- g. The 28-day compressive strength must be between 50 and 150psi, unless otherwise directed by the Project Construction Engineer. Test cylinders may be required to insure that the specified strength is obtained. The compressive strength shall be determined by ASTM D4832, "Preparation of Testing of Soil-Cement Slurry Test Cylinders",
- h. The mix shall have a slump between 7 and 10 inches as per AASHTO Designation T 119-82,
- i. When CLSMs are placed within the right-of-way, or they are to be covered by paving materials, the final set product must achieve a maximum indentation diameter of 3-inches prior to covering and opening the area to traffic. Penetration resistance shall be as measured by ASTM C6024, "Standard Test Method for Ball Drop on Controlled Low Strength Material to Determine Suitability for Load Application",
- j. Final set product shall excavate easily, minimizing the risk of damage to buried utilities during future work,
- k. Must be placed within 2 hours after mixing at the batch plant, unless otherwise approved or specified by the Project Construction Engineer,

1. Delivery tags shall be collected from the delivery driver and provided to the Project Inspector or Project Construction Engineer. The delivery tag shall contain the supplier name, the mix identifying name and/or number as listed in the supplier's submitted mix design. The Project Inspector or Project Construction Engineer may reject any mix that does not appear to meet the requirements of this specification (segregation, insufficient slump, open graded aggregates, etc.).

5. Topsoil

Topsoil shall be defined as soil that contains the sufficient organic materials necessary to support growth of grass, which is free of all types of debris, weeds, stones or other unsuitable materials. Topsoil will be required to be placed and compacted whenever excavation occurs through parks or other landscaped areas and the excavated material is deemed to be unsuitable for growth. Placement will be required from the existing subgrade to the depth specified in the Contract Documents or as otherwise directed by the Project Construction Engineer. All topsoil used within the construction site shall conform to the Contract Documents and/or the specifications set forth by the owner of property affected during construction. Topsoil may also be specified as Class B Topsoil.

Class B topsoil shall be the original top layer of the soil profile formed under natural conditions, technically defined as the "A" horizon by the Soil Society of America. It shall have demonstrated by evidence of healthy vegetation growing or having grown on it, prior to stripping, that it is well drained and does not contain substances toxic to plant life. It shall be the responsibility of the Contractor to locate material meeting these Detail and Technical Specifications and to certify that the material is suitable for the intended purpose. The contractor must also secure approval of the Project Construction Engineer before such material is delivered to the project.

Topsoil shall not be placed until the areas to be covered have been properly prepared and grading operations in the area have been completed. Topsoil does not require compaction but shall be keyed to the underlying material by the use of rollers or other equipment suitable for the purpose. Water shall be applied to the surface in a fine spray by nozzles or spray bars in such a manner that the operation does not wash or erode the topsoil areas.

6. Other Classified Select Materials

Alternate select materials, stabilization materials, and angular rock bedding materials shall be considered as other classified select materials.

Whenever the excavated material is deemed to be unsuitable for backfill and there is no requirement for the placement of any of the above specified select materials, other classified select materials shall be placed and compacted. It shall be the responsibility of the Contractor to locate such material and to secure written approval of the Project Construction Engineer before such material is delivered to the project.

5.0.3.4 Unsuitable Material

Unsuitable material encountered within the project boundaries during construction shall be excavated and disposed of by the Contractor. Unsuitable material is defined as:

1. Soil and excavated material containing debris, weeds, asphalt, stones or concrete (larger than 3-inches in diameter), rubbish, and frost or other frozen particles,
2. Material determined to be of such an unstable nature as to be incapable of being compacted to the specified density using ordinary methods, at optimum moisture content,
3. Material which is too wet to be properly compacted and circumstances prevent suitable in-place drying prior to incorporation into the work,
4. Material otherwise unsuitable for the planned use per the Contract Documents.

The presence of excessive moisture in a material is not, by itself, sufficient cause for determining that the material is unsuitable. Additionally, material which becomes unsuitable due to negligence or the means and methods utilized by the contractor will not be considered for payment. The costs incurred to remove and replace these materials shall be included in the associated unit price bid for the respective sewer line, associated structures, laterals and/or appurtenances.

The cost of removal of unsuitable backfill material and replacement with suitable material encountered while completing the project scope and which do not meet the above, will be paid for per the applicable bid items and in accordance with the associated measurement and payment description.

End of Specification



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6.0 Surface Restoration

6.1 General

Where pavement, curb and gutter, sidewalks, drainage culverts, headwalls, or other structures or improved surfaces, landscaping, etc., have been removed during the course of the work, such items shall be restored to a condition at least equal to that prior to removal and to the same elevation and alignment. The subgrade for all restored surfaces shall be thoroughly compacted to the specified limits by mechanical or hand tampers.

6.2 Asphalt Replacement

Except as modified herein, asphaltic concrete paving material to be replaced over trench excavations shall conform to the MGPEC asphalt paving requirements.

6.2.1 Thickness

Unless otherwise stipulated in the **Proposal** or on the Plans, all asphalt pavement required to be removed for trench or structural excavation shall be replaced with a "full depth" asphaltic concrete paving section conforming to the depths specified on the Plans.

6.2.2 Materials

The materials to be used for asphaltic concrete pavement shall confirm to **Item 20** of the **Standard Construction Specifications** and the herein described modifications, additions or deletions.

6.3 Gravel Surfaced Streets and Alleys

Where excavation occurs in streets, alleys, or other areas which have only a gravel surface, such surfacing shall be replaced with gravel surfacing material equal in depth to that which existed before construction but not less than 3 inches compacted depth minimum. The surface shall conform to the original finish grade.

If the Contractor so elects, the existing gravel surfacing may be excavated down to a depth and width designated by the Project Construction Engineer, stockpiled in an area separate from the excavated trench material, and later replaced to the required depth after the trench has been properly backfilled.

No separate measurement for payment will be made of any work or material stipulated above that is necessary to remove and later replace the gravel surfacing, and all costs incurred will be considered to be included in the unit price bid for the construction of the appropriate section of sewer line or the associated structure.

6.4 Sidewalk, Curb and Gutter, Concrete Pavement

Where sidewalks, curb together, culverts and other obstacles are removed in the prosecution of the work. The Contractor shall consolidate the backfill in the same manner as specified for paved streets and shall then replace sidewalks curb and gutter, etc. in accordance with standard specifications for class of work involved. Where sod areas are encountered, the sod shall be removed and replaced with new at the original grade and elevation after consolidation of the backfill. Sprinkler systems shall be protected or removed and replaced as required.

6.5 Sod

Sod, defined as densely grassed turf, which is removed, may be put back if it has been properly stored and remains in a healthy condition. If so stipulated in the Contract, the cost of replacing sod will be paid in the manner described under Measurement and Payment. If no pay item for replacing sod is included in the Contract, the Contractor shall consider that all costs incurred in replacing sod are to be included in the unit price bid for each section of sewer line or the associated structure.

6.6 Concrete Alley Pavement Replacement

Except as modified herein, concrete alley pavement replacement over trench excavations shall conform to **Item 35** of the **Standard Construction Specifications**.

6.6.1 Materials

The materials to be used for concrete alley pavement replacement shall conform to Item 20 and the herein described modifications, additions or deletions.

- a. **Wire Mesh.** Reinforcing steel (6" x 6", W1.4 x W1.4) wire mesh shall be used for reinforcement of the concrete pavement over For replacement of full width alley concrete paving, the reinforcing steel wire mesh will extend the full alley width, per WMD Standard Detail S-205.
- b. **Concrete Aggregates.** Concrete shall conform to Paragraph 12.2, "materials", subparagraph b(2) of the Standard Specifications.
- c. **Joint Sealer.** Silicone joint sealer shall be a one part, low modulus, silicone formulation, designed for use in highway joint sealing applications and meeting Federal Specifications TT-S-001543A and TT-S-00230C. Primer shall be used if required by the manufacturer.

Acetic acid cure sealants are not acceptable.

Test methods shall be as follows:

Flow	MIL S 8802
Extrusion Rate	MIL S 8802
Track Free Time	MIL S 8802
Specific Gravity	ASTM D 792, Method A
Durometer Hardness	ASTM D 2240
Tensile Stress	ASTM D-412 (DIE C)
Elongation	ASTM D-412 (DIE C)
Ozone & Resistance	ASTM D-793-75

Bond to concrete mortar: Briquets molded in accordance with AASHTO T 132-74 sawed in half and bonded with a thin section of sealant and tested in accordance with AASHTO T 132-74. Briquet shall be dried to constant weight in oven at 110 degrees C+ degrees.

GESCS4403 Highway Joint Sealant and Dow Corning 888 Silicone Joint Sealant are approved for sealing joints. "Backer Rod" used in joints for Portland Cement Concrete Pavement shall be closed cell, polyethylene form rod conforming to the following specifications:

Diameter	Joint width + 1/78"	
Density	2.0 lbs./cu. ft.	ASTM D-1622
Tensile	15 psi	ASTM D-1623
Water Absorption	0.5% by volume	ASTM C-509
Compression Reflection	25% @ 8 psi	ASTM D-1621

6.6.2 Construction Requirements

a. Alley Paving.

"Concrete driveways which abut the alley must be placed separately, creating a cold joint between the concrete driveway and the alley for the full depth of the alley paving."

b. Expansion Joints.

"Expansion joints shall be placed at the end of block property lines and where the alley changes directions. Construction of the expansion joints will be as shown on the Standard Details. Expansion joints shall also be required at structures, vaults, retaining walls, poles, etc. or as required by the Project Construction Engineer."

c. Dummy Groove Contraction Joints. The Contractor has the option to use the dummy groove contraction joints as follows:

"All contraction joints will be saw cut as shown on the Standard Details. The saw cut will be 1-1/2 inches deep by 3/8 inch minimum width to a maximum of 1/2 inch for the full width of the alley. Contraction joints will be spaced a maximum of fifteen (15) feet apart along the length of the alley and must be sawed consecutively in the direction of the pour. Only by approval of the Project Construction Engineer may a joint be skipped and sawed later. Transverse contraction joints shall be placed at each utility pole, manhole, and at the ends of retaining walls, or as directed by the Project Construction Engineer. Contraction joints shall extend through any alley curbhead. Concrete joint sealer shall be a grey silicone joint sealant as manufactured by G.E., Dow-Corning or an approved equal. All joint sealers and backer rods shall be installed in accordance with the manufacturer's requirements. The silicone shall meet all applicable AASHTO, ASTM and Federal Specification TT-S-0021543A and TT-S-00230C.

Saw cut joints to be sealed shall be filled with joint sealing material before the pavement is opened to traffic and as soon after completion of the curing period as is feasible. Just before sealing, each joint shall be thoroughly cleaned of all foreign material, including membrane curing compound, and joint faces shall be clean and surface-dry when seal is applied. Where cleaning of the joints is by compressed air, the compressed air shall be oil free. The sealing materials shall be applied to each joint opening in accordance with the details shown in the plans, to the manufacturer's specifications or as directed by the Project Construction Engineer. The joint filling shall be done without spilling material on the exposed surfaces of the concrete. Any excess material on the surface of the concrete pavement shall be removed immediately and the pavement surface cleaned. The use of sand or similar material to cover the seal shall not be permitted. Joint sealing material shall not be placed when the air temperature in the shade is less than 50 degrees F., unless approved by the Project Construction Engineer.

Should other cleaning methods prove unsatisfactory, the Project Construction Engineer may require sandblasting or another method inside of the contraction joints to remove incompressible materials. The Contractor may wish to install the backer rod on top of the sawed joint in order to keep it clean and later depress the rod when the silicone sealant is installed. The joints shall be sealed by first priming the joint, if required by the silicone

sealant manufacturer and then placing a backer rod compatible with silicone and sealing with an approved liquid silicone joint sealant. The joints should be approved by the Project Construction Engineer prior to sealing."

- d. **Opening to Traffic.** Add the following after the first sentence of Paragraph 35.3I: "Or until field-cured concrete cylinders have obtained a compressive strength of 3500 psi and all contraction joints have been cleaned and sealed."
- e. **Raised Lips.** No extra payment will be made for raised slope paving required to widen alleys to meet existing improvements shall be paid for as Concrete Alley Paving.
- f. **Finish.** As shown the plans, or where longitudinal slopes exceed 7%, or where required by the Project Construction Engineer, a 3/16 inch metal time finish shall be applied perpendicular to the centerline in accordance with Colorado Department of Highway specifications.

End of Specification



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7.1 Tunneling, Jacking and Boring

7.1.1 General

Where indicated on the Drawings, or where field conditions dictate that open trenching for the pipeline across railroad tracks, highways, or other obstructions is prohibited, the pipe shall be installed by jacking, tunneling, boring and casing methods, or micro tunneling.

Should the General Contractor, in the process of Project construction, elect to propose that a portion of the pipe be installed by jacking, tunneling, and/or boring rather than by trenching operations, the subject cost shall not total more than the aggregate sum of the removal and replacement costs that such an activity would replace.

7.1.2 Submittals

7.1.2.1 Installation and Receiving Pits

Detailed shop drawings will be required for all pipe jacking, tunneling and boring installations; and receiving pits. These drawings shall include the materials and specific

excavation support system along with applicable dimensions. All shop drawings must be stamped by a Professional Engineer licensed within the State of Colorado

7.1.2.2 Jacking Design

Calculations showing the maximum concentric jacking load and the maximum allowable angular change in alignment shall be submitted to the Project Construction Engineer and the pipe supplier. Design and details of jacking collar, reaction plates, external shield, reaction thrust block, jacking frame and jack capacity shall be submitted to the Project Construction Engineer prior to construction.

7.1.2.3 Jacking Layout

Layout diagrams for jacking pits, receiving pits, intermediate stations (including dimensions) shall be submitted to the Project Construction Engineer prior to construction.

7.1.2.4 Jacking Methods

Design and details of wall support systems, dewatering, excavation method at the bore face, jacking pressure monitoring and control methods, lubrication procedures, method of grade and alignment control, joint cushioning, and grouting procedures shall be submitted to the Project Construction Engineer prior to construction.

7.1.3 Protection of Roadbed

No excavation for boring or jacking pits will be permitted within 25 feet of the center line of any railroad track, or within 15 feet of the paved shoulder of any highway, or 15 feet of the toe of the side slope, whichever is greater.

The sides of boring or jacking pits shall be structurally supported by sheet-piling placed in such manner as to prevent any movement or slippage of the earth during the excavation and tunneling, jacking and/or boring operations. The General Contractor shall work in close cooperation with the agency having jurisdiction or the landowner to ensure the protection of their life, infrastructure, property and environment while maintaining residential/business access as necessary.

7.1.4 Tolerances

Excavation and jacking of the sewer pipe shall be controlled by the General Contractor to allow construction of the sewer to a true circular shape and to within 1.5 inches on line and 1 inch on grade. When excavation is off line and grade, the General Contractor shall inform the Project Construction Engineer immediately to determine how correction will be made. Variations from line and grade tolerances listed herein may be allowed at the discretion of the Project Construction Engineer, in writing.

If the General Contractor is unable to maintain these tolerances, he/she shall bear full responsibility and expense for correction (redesign, easement acquisition, etc.) If these tolerances are exceeded and redesign of structures is required, the General Contractor shall obtain the services of an independent professional engineer registered in the State of

Colorado for the redesign. Plans showing the changes shall be submitted to the Project Construction Engineer for review and approval.

The General Contractor shall survey the sewer at 24-foot intervals or once per pipe jack, whichever is less, to ensure the alignment is within the tolerances specified. The survey shall be conducted immediately behind the excavation face to allow immediate correction of misalignment if necessary. Excavation shall not precede surveyed verification of the alignment by more than 24 feet, or more frequently, if line and grade tolerances have been exceeded. The guidance system may be used; however, the General Contractor shall select times to measure and record this information after the air temperatures have stabilized throughout the pipe to ensure accurate readings.

7.1.5 Jacking

7.1.5.1 Jacking Pit

The jacking pit shall be excavated on one side of the right-of-way, utility, or roadbed under which the pipe or casing is to be installed. The pit shall be only of sufficient length to provide room for the jacking head and the pipe, dependent upon the kind of pipe to be jacked. The pit should be of sufficient width to permit ample working space. The end of the pit nearest the roadbed shall present a vertical face into which the adit shall be excavated.

7.1.5.2 Jacking Frame

The jacking frame shall be constructed of guide rails, a backstop and a pushing or jacking head. Guide rails shall be constructed to the exact line and grade of the pipeline and shall be anchored in such a manner as to be capable of maintaining the alignment and gradient throughout the operations.

The backstop shall be constructed to provide a bearing area capable of supporting no less than 200% (two hundred percent) of the estimated maximum jacking pressure and shall be perpendicular to the center line of the pipe to be jacked. It shall be anchored and braced in a manner to assure that this position will be maintained throughout the jacking operation. Jacking against previously installed pipe will not be allowed.

The pushing or jacking head shall be constructed to fit the pipe to be jacked and to assure that the pressure developed by the jacks will be evenly distributed on the periphery of the pipe. An opening large enough to permit the entrance of men and materials shall be maintained in the jacking head.

7.1.5.3 Jacking Procedure

Depending on soil conditions, the excavating operation inside the pipe shall proceed approximately one foot ahead of the lead pipe. The excavation around the top and sides of the pipe (over-cut) shall be no more than one-inch larger than the periphery of the pipe. The bottom of the excavation shall be cut accurately to line and grade.

The jacking operation shall be continuous until the entire crossing is complete except for sufficient time to place additional pipe sections, position the frame and to prepare each pipe joint.

On pipe 36-inch and larger a 2-inch grout nipple terminating in a coupling capable of accepting a threaded pipe plug which will be flush with the inside face of the pipe, shall be provided. The pipe shall be oriented so that the nipple is in the crown.

Immediately following the completion of the section being jacked, a neat portland cement grout consisting of (by volume) 2 parts Portland Cement (ASTM C150), 1 part fly ash (ASTM 618 Class F) and not to exceed 6 parts of clean, dry sand, shall be pumped to refusal at 5 psi into each grout nipple. Only enough water shall be used to produce a flowable grout, when well mixed, having the consistency of thick cream. After all grouting is complete; the holes shall be filled with dry packed cement mortar grout. Threaded plugs shall be installed flush with the inside face and the remaining void shall be filled with a non-shrink grout rated to 4000 psi.

7.1.5.4 Material

Pipe to be jacked shall be as specified in the Contract Documents and shall be specifically designed by the pipe manufacturer with sufficient reinforcing and wall thickness to resist, without buckling or crushing, the horizontal, vertical and longitudinal loads applied to it during the jacking procedures. The casing material, if required, shall be approved by the Project Construction Engineer, in writing prior to construction. Concrete pipe for jacking shall be as specified in Section 10.1 of these Detail and Technical Specifications, or as otherwise noted in the Contract Documents. Joints for concrete jacking pipe shall include steel joint rings in accordance with ASTM-C361

The joints of concrete jacking pipe shall be cushioned in a manner and with such material to prevent chipping or breaking of the pipe ends due to concentrated pressure caused by any slight irregularity of the pipe ends. The quantity and type of cushioning materials to be used shall be approved by the Project Construction Engineer, in writing.

7.1.6 Boring

7.1.6.1 General

Sewer installations involving boring and casing methods may be used at the General Contractor's option subject to written approval by the Project Construction Engineer.

7.1.6.2 Casing Pipe

The casing pipe shall be of welded steel pipe conforming to the requirements of ASTM A53 Grade B or AWWA C200, having minimum yield strength of 35,000 psi of the size and wall thickness as shown below or as otherwise noted in the Contract Documents.

Casing Diameter	Minimum Thickness
36" and Smaller	$\frac{3}{8}$ - inch
42" and Larger	$\frac{5}{8}$ - inch

Casing shall be kept on line and grade as required within this specification. Joints in the casing shall be field welded around the entire joint perimeter to produce a watertight seal. Welds shall be of a size to develop the full strength of the pipe materials.

7.1.6.3 Carrier Pipe

The carrier pipe shall be as specified in the Contract Documents carrier pipe shall be approved by the Project Construction Engineer and in accordance with the submittal requirements of these Detail and Technical Specifications. Pipe sizes, joints, structural class, etc., shall also be subject to written approval by the Project Construction Engineer. The pipe joints of the carrier pipe shall be as specified within these Detail and Technical Specifications for the specific type of pipe approved for use.

7.1.6.4 Casing Spacers

Factory manufactured casing spacers shall be installed on all carrier pipes passing through a casing pipe. Wooden skids will not be allowed.

All casing spacers shall adhere and conform to the following:

1. All casing spacers shall be Model SSI8 or SSIM (field adjustable) for carrier pipes up to 24-inches in diameter and Model SSI12 for larger diameter carrier pipe sizes as designed and manufactured by Advance Products & Systems, Inc., Lafayette, LA., or an approved equal. The runners shall be at least 7-inches long for SSI8 and SSIM models or 11-inches long for SSI12 models and they shall be manufactured of high abrasion resistant, low coefficient of friction, glass filled polymer.
2. The casing spacers shall be center restrained to limit vertical movement of the carrier pipe in the casing.
3. Casing spacers shall be bolt-on-style with a shell made of at least two halves.
4. Spacing is approximately 3 per joint of pipe or 1 spacer per every 7 feet maximum.
5. The band material shall be manufactured of a minimum 14 gauge T-304 stainless steel and 10 gauge T-304 stainless steel risers when needed.
6. The casing spacers shall have a flexible PVC or EPDM liner having a minimum thickness of 0.090 inches with a hardness of Durometer "A" 85-90.

7. All welds are to be chemically cleaned and passivated.
8. All hardware shall be stainless steel.

7.1.6.5 Casing End Seals

After insertion of the carrier pipe into the casing, the ends of the casing shall be closed by installing $\frac{1}{8}$ " thick synthetic rubber end seals such as the Model "AC" pull-on end seal, as manufactured by Advance Products & Systems, Inc., Lafayette, LA, or an approved equal. Ends seals shall be attached using minimum $\frac{1}{2}$ " wide T-304 stainless steel bandings utilizing a worm gear mechanism.

End of Specification



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7.2 Micro Tunneling

7.2.1 General

Where indicated on the Drawings, or where field conditions dictate that open trenching for the pipeline across railroad tracks, highways, or other obstructions is prohibited, the pipe shall be installed by jacking, tunneling, boring and casing methods, or micro tunneling.

Should the General Contractor, in the process of Project construction, elect to propose that a portion of the pipe be installed by micro tunneling, rather than by jacking, boring or trenching operations, the subject cost shall not total more than the aggregate sum of the removal and replacement costs that such an activity would replace.

7.2.2 Shop Drawings

Detailed shop drawings will be required for all pipe jacking, tunneling and boring installations.

7.2.3 Construction

Work specified in this Section describes the construction of sanitary sewers by jacking fiberglass reinforced polymer mortar (RPM) behind a remotely operated, steerable, micro-tunneling boring machine (MTBM), with RPM serving as both the primary tunnel liner

during construction and sanitary sewer pipe (secondary tunnel liner) after completion of construction. The General Contractor shall select and utilize methods and equipment compatible with the selected dimensions of the tunnel and with the anticipated geologic conditions described in the Geotechnical Report (GR).

The micro-tunneling boring machine (MTBM) may be either of the following:

1. Slurry Shield

An MTBM in which the tendency of soil at the excavation face to run or flow uncontrollably into the MTBM is prevented by the counterbalancing force of bentonite slurry contained at the face of the MTBM. During boring, the excavated material is mixed with the bentonite slurry and pumped through a pipe for disposal.

2. Earth Pressure-Balance Shield

An MTBM in which the tendency of the soil at the excavation face to run or flow uncontrollably into the MTBM is prevented by the counterbalancing force of the excavated material which is contained, under pressure, at the face of the MTBM. During boring, the excavated material is mixed with water or bentonite slurry and pumped through a pipe for disposal or by a balanced screw auger or screw conveyor system.

During tunneling and construction operations, the following shall be followed:

- a. Control groundwater in accordance with specified requirements during all micro-tunnel excavation.
- b. Perform micro-tunneling operations in a manner that will minimize loss of ground and minimize settlement of the ground surface, structures, and utilities above and adjacent to the tunnel.
- c. The General Contractor shall perform pre-construction and post-construction surveys of all structures, residences, and other facilities adjacent to the areas of the tunnel.
- d. Maintain clean working conditions at all times inside the tunnel and pits. All muck, slush, grout spills, ponded water, and any other material not required for tunneling shall be removed from the excavations in a timely manner.
- e. All work of excavating, lining, grouting and construction of the jacking operation shall be so executed that ground settlement or loss will be minimized; the completed sewer pipe shall have full bearing against earth, and no voids or pockets will be left in any portion of the Work. The peripheral space between the support elements and the excavated surface (i.e., the diameter of the excavated hole is no larger in diameter than 3/4 inch more than the pipe outside diameter) shall be filled with the bentonite lubricating material. If the diameter of the excavated hole is greater than 3/4 inch more than the outside diameter of the pipe, it shall be promptly filled with suitable material, such as grout, as accepted by the Project Construction Engineer. This may require jacking or the pipe be discontinued and additional access pits installed at no extra cost to the City.

- f. The General Contractor shall be aware that various existing soil borings, piezometers or instrument wells coincide with the proposed sewer pipe alignment. These may or may not have been backfilled with grout and therefore caution should be used in tunneling through these existing borings. General Contractor shall take mitigating measures at no additional cost to the CITY to counter any effect these bore holes, piezometers or instrument wells may have on tunneling operations.
- g. All excavations shall remain within the easements and rights of way indicated on the Drawings, to the lines and grades designated on the Drawings, and use methods which include due regard for safety of workmen, adjacent structures, utilities, and the public. Methods of excavation shall be at the General Contractor's option, subject to the review of the Project Construction Engineer. Shape the excavation to fit the sewer pipe section and of sufficient size to allow the construction of the sewer pipe to the lines and grades indicated on the Drawings.

7.2.3.1 Casing Pipe Installation Method

The General Contractor shall have the option to select the method of micro-tunneled casing pipe installation, subject to approval by the Project Construction Engineer.

The excavated size of the tunnel shall be determined by the General Contractor based on construction requirements for the secondary lining system, and is subject to the limitations shown on the Drawings.

7.2.4 References

All work shall be performed in accordance with applicable regulations of all federal, state, and local regulations, codes, and standards.

7.2.5 Existing Conditions

7.2.5.1 Restrictions

The General Contractor shall comply with all restrictions set as conditions under which the easement or permission was granted to the Owner to perform the work of this Contract. These restrictions are included with these Specifications. The General Contractor is presumed to have fully determined all special requirements that pertain to each length of sewer in tunnel constructed under this Section.

7.2.5.2 Preliminary Inspections

The General Contractor shall inspect the locations where the access pits and tunnels are to be built to familiarize himself with the conditions under which the Work will be performed and with all necessary detail as to the orderly prosecution of the work in conformance with Instructions for Bidders. The omission of any details necessary for the satisfactory prosecution of the WORK in its entirety, which may not appear herein, shall not relieve the General Contractor of his full responsibility.

7.2.5.3 Soil, Rock and Groundwater

The General Contractor acknowledges that certain soils reports, borings, and other Geotechnical data, more particularly described or referenced in the Technical Specifications of the Contract, have been made available for inspection and review. The borings were made

for the use of the City in the design of the Project and are not intended to be interpreted for use in temporary construction facilities designed by the General Contractor.

7.2.5.4 Utilities

The General Contractor shall be responsible for the protection of all utilities encountered during the Work of this Contract. The known utilities are shown on the Contract Drawings and the General Contractor shall take every precaution when working near the utility to locate and protect these utilities. All damage to the existing utilities shall be the sole responsibility of the General Contractor. The General Contractor shall replace, repair, remedy, or compensate for all damages at no additional cost to the Owner.

7.2.5.5 Structures

The General Contractor shall be responsible for the protection of all structures, roads and railroads above or adjacent to the tunnel, within the framework and criteria set forth in the Contract Documents.

7.2.6 Definitions

1. Micro Tunneling

Shall be defined as a method of installing pipe, by jacking the pipe behind a remotely controlled, steerable, guided articulated Micro-Tunneling Boring Machine (MTBM). The MTBM, which is connected to and followed by the pipe being installed, shall ensure that the soils being excavated are fully controlled at all times.

2. Jacked Pipe

Shall be defined as the General Contractor's sewer pipe that serves as initial construction lining and tunnel support, installed by the General Contractor for stability and safety during construction, and as the sewer line or permanent secondary liner.

3. Jacking System

A system of jacks which pushes the sewer pipe. Capacity of jacks and extension rate is synchronized with excavation rate of the machine.

4. Intermediate Jacking Station

Hydraulic jacks installed at intermediate locations in the pipe string to allow selective shoving of discrete segments of the total pipe.

5. Slurry System

Transportation of excavated material in slurry flow matched to excavation rate. System balances groundwater pressures and separates soil from slurry at end of process. Soil separation methods are not limited to mechanical means. Soil separation method may be chemical in nature.

6. Laser

An optical system projecting a beam to a target to provide guidance for the micro-tunnel excavation.

7. TV

A television system which monitors the progress and alignment of the micro-tunneling machine and pipe.

8. Controls

The system which synchronizes excavation, removal of the excavated material, and jacking of pipe to maintain overall balance to provide complete and adequate ground support at all times.

7.2.7 Quality Assurance

7.2.7.1 General Contractor

The General Contractor must provide proof of successful experience with micro tunnel excavation and support at the depths shown, in the soil and groundwater conditions expected, with the lining systems shown and with the General Contractor's proposed equipment.

7.2.7.2 Project Superintendent

The project superintendent shall have at least five years of tunneling experience and shall have worked on at least two micro-tunneling projects in similar ground conditions using equipment similar to the equipment required for this project. The machine operator shall have at least three years of micro-tunneling experience and shall have worked on at least one tunnel project using the same equipment required for this project.

7.2.8 Quality Control

General Contractor shall establish and maintain quality control for operations under this Section to assure compliance with contract requirements and maintain records of his quality control for materials, equipment, and construction operations including but not limited to the following:

7.2.8.1 Preparatory Inspection

Preparatory inspection shall be conducted prior to commencing work and should include the following as a minimum requirement:

1. Check pipe for conformance to approved certified tests.
2. Check pipe for proper storage and handling.
3. Discuss and review pipe installation procedure with the Project Construction Engineer. Discussion shall include placement of pipe, joint preparation and application of each pipe used.

7.2.8.2 Initial Inspection

Initial inspection shall be conducted after a representative sample of the work is complete and should include the following as a minimum requirement.

1. Check for proper depth and grade for pipe.
2. Check method of joining pipes.
3. Check the pipe for proper alignment.

7.2.9 Tolerances

Excavation and jacking of the sewer pipe shall be controlled by the General Contractor to allow construction of the sewer to a true circular shape and to within 1.5 inches on line and 1 inch on grade. Variations from line and grade tolerances listed herein may be allowed provided the line and grade variation is regular and only in one direction, and that the final grade of flow line is in the direction indicated on the Drawings. When the excavation is off line and grade, the General Contractor shall make corrections to plan line and grade at the rate of 3 inches per 100 feet.

The General Contractor shall survey the sewer at 50-foot intervals or a minimum of once per tunnel drive to ensure the alignment is within the tolerances specified. The survey shall be conducted immediately behind the tunnel excavation to allow immediate correction of misalignment. Tunnel excavation shall not precede surveyed verification of the alignment by more than 100 feet, or more frequently if line and grade tolerances have been exceeded. The tunnel guidance system may be used; however, the General Contractor shall select times to measure and record this information after the air temperatures have stabilized throughout the pipe to ensure accurate readings.

If the General Contractor is unable to maintain these tolerances, he shall bear full responsibility and expense for correction (redesign, easement acquisition, etc.) If these tolerances are exceeded and redesign of structures is required, the General Contractor shall obtain the services of an independent professional engineer registered in the State of Colorado for the redesign. Plans showing the changes shall be submitted to the Project Construction Engineer for review.

7.2.10 General Contractor Submittals

The Project Construction Engineer will base the review of submitted details and data with consideration of requirements for the completed work, utilities, and the possibility of unnecessary details in the execution of the work to be constructed under this Contract. Review of the General Contractor submittals by the Project Construction Engineer shall not be construed in any way as relieving the General Contractor of his responsibilities under this Contract.

The General Contractor shall submit the following to the Project Construction Engineer for approval and/or examination:

1. Working Drawings

Complete working drawings showing details of the proposed method of construction and the sequence of operations to be performed during construction shall be submitted. Working drawings shall show the method of micro-tunneling, including the micro-tunneling system to be used, location of access pits including method of excavation, shoring and bracing appurtenance installation, and dewatering techniques that are proposed to be used. The following shall be included as the minimum level of detail required:

- a. A detailed description of the micro tunneling procedure including construction techniques to provide the access required to install pipe in conformance with the Contract Documents.
- b. Manufacturer's literature describing in detail the micro-tunneling system to be used. Detailed description of projects on which this system has been successfully used including the names, addresses and telephone numbers of owner's representatives for these projects as well as length, diameter, and pipe material used.
- c. Calculations and drawings indicating limits of access pits and any ground support to be utilized.
- d. Method of spoils disposal.
- e. A groundwater stabilization scheme covering the excavations for starter and receiver pits. Verify this plan to stabilize anticipated unstable soil conditions. Such verification shall include all calculations and detail drawings for methods of controlling groundwater.
- f. Certification by the machine manufacturer of the thrust, torque, condition, and operational characteristics of all equipment to be used for installing the specified pipes. The micro-tunneling equipment shall employ a spoil removal system with a pressure balance system that is capable of equalizing pressures between the tunnel face and the micro-tunneling machine head in order to prevent caving beyond the outside diameters of the pipe.
- g. Layout of tunneling and ancillary equipment at each jacking and receiving (access) pit location.
- h. Tunnel machine shop drawings including configuration of cutter head and over cut.
- i. Ventilation system details.
- j. Pipe lubrication system details.
- k. Electrical system and lighting details.
- l. Grade and alignment control system details.
- m. Tunneling machine groundwater control provisions.
- n. Gas monitoring system.
- o. Details of mucking system and soil separation methods including proposed slurry formulations and calculations of the system capacity to handle flows at all distances and changes of elevation to and from the tunnel machine.
- p. Details of jacking system, intermediate jacking stations and their proposed spacing, method of operation, and thrust capacity. Include calculations of anticipated jacking forces required to advance the pipe. Include sleeve details and supporting gasket compression calculations for joints and gaskets used with intermediate jacking stations. Describe controls to prevent the maximum jacking force from being exceeded.

- q. Details of grouting the annulus space after pipe has been installed including injection pressure and method of controlling grout pressures.
- r. Grouting techniques to be used for over excavation if any, including equipment, pumping procedures, pressure grout types and mixtures.
- s. Procedures for measuring excavation quantities versus forward progress during the tunneling operation.
- t. Calculations demonstrating that the pipe selected has been designed to support the maximum anticipated earth loads and superimposed live loads, both static and dynamic, which may be imposed on the pipe. Determine the additional stresses imposed on the pipe during jacking operations and upgrade the quality and strength of the pipe and pipe joints to the extent necessary to withstand the additional stresses imposed by the jacking operation. The details shall be submitted for approval.
- u. Complete information on General Contractor's safety plan for personnel conducting the micro-tunneling operations and appurtenance installation. The plan shall include provisions for lighting, ventilation, and electrical safeguards.
- v. Keep and maintain at the construction site a complete set of field drawings for recording as-built conditions. It shall have marked or noted thereon all field information, properly dated, recording as-built conditions. This set of field drawings shall be kept up to date.
- w. Pipe certification of compliance.
- x. Pipe jointing methods and details.
- y. All General Contractor submittals requiring structural design shall be signed by a professional civil or structural engineer registered in the State of Colorado.
- z. Written documentation summarizing the qualifications of the project superintendent, machine operators, and site safety representative.

2. Log of the Jacking Operations

The General Contractor shall submit a log of jacking operations; the log shall be taken at intervals of no more than 10 minutes apart and a minimum of four readings per pushed 10 foot and accomplished by digital video recording of the TV image at the operator's console. Video shall show a real-time clock that matches the time scale used in the log. Indicators in the tunneling machine being viewed by the digital recorder shall indicate when the tunneling machine is excavating and the number of the pipe joint that is being pushed. The log shall be submitted to the Project Construction Engineer each day. The digital video shall be submitted to the Project Construction Engineer each week. As a minimum, the log shall consist of the following:

- a. The position of the tunneling machine in relation to the design line and grade.
- b. The jacking forces exerted on the pipe at each jacking station.
- c. The date, the starting time, and the finish time.

- d. The position of the steering jacks.
- e. Inclination.
- f. Cutter head torque.
- g. Slurry flow rates in both the supply and return lines (if slurry is used).
- h. Face pressure.
- i. Hydraulic pressure (on hydraulic motor machines).
- j. LEL gas readings.

3. Pipe Lubricant

Submit a separate log tracking pipe lubricant used in gallons, its viscosity, and pumping pressure. Log shall be submitted to the Project Construction Engineer each day

4. Muck Removal

Submit a separate log tracking the volume of muck removed from the site. Log shall be submitted to the Project Construction Engineer each day.

5. Survey Records

Submit survey records of the horizontal and vertical positions of surface control points and other instrumentation within 24 hours of measurements as required herein.”

6. Inclinometer Data

Inclinometer data shall be plotted on a cumulative time-deflection plot, using commercial software from the manufacturer, with past readings shown together with most current so that trends can easily and quickly be established by the Project Construction Engineer and General Contractor.

7.2.11 Products

7.2.11.1 Equipment

No gasoline powered equipment shall be permitted in the tunnel operation. Diesel, electrical or air-powered equipment will be acceptable, subject to applicable federal and state regulations. Diesel engines equipped with scrubbers are acceptable only when jacking in free air. Provide compressed air and electricity for General Contractor’s operations from a source outside the pipe.

1. Micro Tunnel Boring Machine (MTBM)

The General Contractor shall employ MTBM that is capable of handling the various anticipated ground conditions. In addition, the MTBM shall:

- a. Have a “closed” face which is capable of minimizing loss of ground ahead of and around the machine and providing satisfactory support of the excavated face at all times and shall have the capability of setting a calculated earth balancing pressure and positively measuring the earth pressure at the face.

- b. Provide a system to indicate whether the amount of earth material removed is equivalent to that displaced by the advance of the machine such that the advance rate may be controlled accordingly.
- c. Conform to the shape of the tunnel with a uniform perimeter that is free of projections that could produce over excavation or voids.
- d. Be articulated to enable remote steering of the system.
- e. Have a display available to the operator, at an operation console, showing the position of the shield in relation to a design reference together with other information such as face pressure, roll, pitch, steering attitude and valve positions.
- f. Incorporate a seal in the tail of each MTBM shield to prevent leakage of lubricating liquid or grout, into the tunnel space, between the MTBM shield and lining.
- g. Have a cutter head powered by electric or hydraulic motors and have motors and operating controls protected against water inflows.
- h. Provide a bi-directional drive on the cutter head wheel.
- i. Provide means for maintaining the tunnel face under wet and adverse soil conditions. Use closure doors on the cutter wheel or other means acceptable to the Project Construction Engineer.

2. Automated Spoil Transportation

The General Contractor shall provide a MTBM which includes an automated spoil transportation system which shall:

- a. Match the excavation rate to the rate of spoil removal thereby maintaining settlement or heave within tolerances specified.
- b. Balance ground water pressures by the use of a slurry pressure balance system which shall be capable of any adjustment required to maintain face stability for the particular soil condition encountered on the Project and shall monitor and continuously balance the ground water pressure to prevent loss of slurry and or ground water.
 - In a slurry spoil transportation system the ground water pressure shall be managed by use of the slurry pumps, pressure control valves, and a flow meter.
 - A slurry bypass unit shall be included in the system to allow the direction of flow to be changed and isolated, as necessary.
 - A separation process shall be provided when using the slurry transportation system which shall be designed to provide adequate separation of the spoil from the slurry so that the clean slurry can be returned to the cutting face for reuse. Spoil shall be appropriately contained at the site prior to disposal.

- The type of separation process used shall be dependent upon the size of the tunnel being constructed, the soil type being excavated, and the work space available at each work area for erecting the plant.
 - The composition of the slurry shall be carefully monitored for specific gravity and viscosity.
- c. Balance ground water pressures by the use of an auger earth pressure balance system which shall be capable of any adjustment required to maintain face stability for the particular soil condition to be encountered on the Project and shall monitor and continuously balance the ground water pressure to prevent loss of ground water.
- If an auger spoil transportation system is utilized, the ground water pressures shall be managed by controlling the volume of spoil removal with respect to the advance rate (Earth Pressure Balance Method) and the application of compressed air. The speed of rotation of the auger flight, the addition of water, and/or compressed air shall be monitored.
 - The Project Construction Engineer's approval will be required where an auger soil transportation system is proposed for use by the General Contractor in the presence of ground water. Such approval will be based on an evaluation of the equipment's ability to balance soil and water pressures at the face, stability of the soils, and the significance of the ground water present.

3. Pipe Jacking Equipment

The General Contractor shall provide a MTBM which includes a pipe jacking system which shall:

- a. Have the main jacks mounted in a jacking frame located in the starting pit.
- b. Have a jacking frame which shall successively push the MTBM along with a string of connected pipes toward a receiving pit.
- c. Have sufficient jacking capacity to push the MTBM and the string of pipe through the ground.
 - Calculations shall be made to determine the face excavation forces, frictional factor, and weight of the MTBM and pipes.
 - The jacking equipment installed must have a capacity at least 20 percent greater than the calculated theoretical jacking load.
- d. Have hydraulic cylinder extension rates which are synchronized with the excavation rate of the MTBM, which shall be determined by the soil conditions.
- e. Have intermediate jacking stations which shall be provided when the calculation of the total jacking force needed to complete the installation exceeds 80 percent of the capacity of the main jacks or the designed working compressive loads (including safety factor) allowed for the pipe.
- f. Develop a uniform distribution of jacking forces on the end of the pipe by use of spreader rings and packing.

- g. Provide for a pipe lubrication system which shall be used if the calculated jacking forces are expected to exceed the pipe design strength (including the 2.5 to 1 safety factor) or if the actual jacking forces encountered exceed 80 percent of the pipe design strength (including the 2.5 to 1 safety factor). Should either of these conditions occur, an approved lubricant shall be injected to lower the friction developed on the surface of the pipe during jacking.

4. Remote Control System

The General Contractor shall provide a MTBM which includes a remote control system which shall:

- a. Allow for the operation of the system without the need for personnel to enter the micro-tunnel. In man entry sized pipes, intermittent entry of personnel will be permitted for maintenance and removal of equipment once the pipe installation is complete, provided that all safety precautions specified elsewhere and required by law are in place and functional.
- b. Integrate the system of excavation and removal of soil and its simultaneous replacement by pipe. As each pipe section is jacked forward, the control system shall synchronize all of the operational functions of the system.
- c. Provide complete and adequate ground support at all times.

5. Active Direction Control

The General Contractor shall provide a MTBM which includes an active direction control system which shall:

- a. Control line and grade by a guidance system that relates the actual position of the MTBM to a design reference (e.g., by a laser beam transmitted from the jacking pit along the center line of the pipe to a target mounted in the shield).
- b. Be capable of maintaining grade to within plus or minus one inch and line to within plus or minus 1.5 inches.
- c. Provide active steering information which shall be monitored and transmitted to the operation console.
- d. Provide minimum steering information available to the operator on the control console which includes the position relative to the reference, role, inclination, attitude, rate of advance, installed length, thrust force, and cutter head torque.

6. Ventilation and Monitoring

Equipment shall be provided to adequately ventilate the entire micro-tunneling operation at all times during construction.

- a. Portable testing equipment shall be provided for carbon monoxide gas, hydrogen sulfide gas, oxygen deficiency and explosive gases.

- b. An automatic gas alarm to detect explosive gases shall be provided on the Micro-Tunnel Boring Machine. The audible alarm shall be located in the jacking pit and shall be active at all times.

7. Electrical Systems

All electrical systems utilized on the Micro-Tunnel Boring Machine shall be equipped with appropriate ground fault systems. All electrical systems are to be insulated, not permitting any bare wire exposures. Motors and controls shall be equipped with an automatic shutoff such as MSA Methane Monitoring System VI or equal.

8. Additional Safety Equipment

Necessary equipment for tunnel excavation shall include signal systems, fire extinguishers, safety equipment, and other equipment required by the General Contractor's method of construction. Such equipment shall be maintained in good repair.

7.2.11.2 Jacked Pipe

Pipe for jacking shall be designed to carry all jacking loads. Refer to individual pipe specification sections.

7.2.11.3 Pipe Joints

The outside walls shall be straight without bell modifications. All joints shall be watertight.

7.2.12 Design

The General Contractor shall be responsible for the design of the fiberglass reinforced polymer mortar pipe to carry the loads imposed on it during construction, including the jacking forces.

7.2.13 Excavation

7.2.13.1 General Tunnel Requirements

Tunnel excavation shall not begin until:

- a. The work Plan and all required submittals have been submitted by the General Contractor and reviewed and returned approved by the Project Construction Engineer.
- b. The required Pre-Construction Surveys have been completed.
- c. All instrumentation along the tunnel alignment is in place, stable, and baselines have been established.
- d. All pre-job safety meetings required by OSHA and/or General Contractor's Safety Plan have been held.

7.2.14 Micro-Tunneling

The General Contractor shall conduct all micro-tunneling operations in accordance with all applicable safety rules and regulations. The following shall apply to micro tunneling operations:

1. No work shall commence until the design and construction procedure has been approved in writing by the Project Construction Engineer. The General Contractor is totally responsible for the performance of the equipment and methods selected for this phase.

The Project Construction Engineer's approval signifies only that the construction process is compatible with the overall objectives of the project.

2. The pipe used for jacking shall be round, have a smooth, even outer surface, and have joints that allow for easy connections between pipes. Pipe ends shall be square and smooth so that jacking loads are evenly distributed around the entire pipe joint and such that point loads will not occur when the pipe is jacked in a reasonably straight alignment. Pipe used for jacking shall be capable of withstanding all forces that will be imposed by the process of installation, as well as the final in place loading conditions. The driving ends of the pipe and intermediate joints shall be protected against damage.
3. The pipe, insofar as practical, shall be micro-tunneled from the downstream end.
4. A jacking frame shall be provided for developing a uniform distribution of jacking forces around the periphery of the pipe. Special care shall be taken by the General Contractor to ensure that the thrust reaction backstop is properly designed and constructed. The backstop shall be square with the proposed pipe alignment and shall be designed to support the maximum obtainable jacking pressure with a factor of safety of at least 2.0. The jacking system shall be capable of continuously monitoring the jacking pressure and rate of advancement. Special care should be taken when setting the pipe guard rails in the pit to ensure correctness of the alignment.
5. The General Contractor shall maintain an envelope of bentonite slurry, or other similar material, around the exterior of the pipe during the jacking and excavation operation to reduce the exterior friction and the possibility of the pipe freezing in place. Water jetting of the pipe bedding or backfill shall not be permitted.
6. The pipe freezes and the General Contractor is unable to move it again, the General Contractor may be permitted to construct an intermediate access pit, with the location subject to review by the Project Construction Engineer. The General Contractor shall be solely responsible for making arrangements for such an intermediate pit and shall be solely responsible for any and all costs associated with the location and construction of the pit and for maintaining traffic in the area.
7. In the event a section of pipe is damaged during the jacking and excavation operation, one of the following procedures shall be used to correct the damage, as directed by the Project Construction Engineer.
 - a. Slightly damaged pipe which passes leakage test and maintains pipe barrel and joint structural integrity shall be repaired in place with a method approved by the manufacturers.
 - b. Severely damaged pipe shall be removed from the excavation by jacking it through the excavation and removing it at an access pit.
8. The joints shall be made watertight by using rubber gaskets.
9. The pipe joints shall be cushioned by a plywood ring between the joints, or by other methods, to transmit the jacking forces without damage to the pipe or pipe joints.

10. After the pipe is in place and the jacking and excavation operation is complete from one access pit to the next; any over excavation greater than the pipe outside diameter plus 3/4 inch shall require the pipe to be grouted in place.

7.2.15 Grouting

The General Contractor shall furnish and operate suitable equipment for all grouting operations.

After completion of the jacking operation, the lubricate material shall be displaced from between the pipe exterior and surrounding ground by a cement grout. Pressure and the amount of grout shall be controlled by the General Contractor to avoid pipe damage and displacement of the pipe and soil beyond specified tolerances. Grouting shall be accomplished as soon as possible after pipe installation has been completed to prevent any surface settlement due to movement of soil material into the void space or loosened zone around the pipe.

All voids outside the limits of the excavation created by caving or collapse of earth cover over the excavation, or by other cause shall also be completely filled with pea sized gravel or sand cement grout. Pressure-injected grout shall be placed at the same frequency as required when placing grout behind the pipe.

Pressure-injected grout used in conjunction with pea gravel shall be placed behind the pipe if required to minimize ground loss. General Contractor shall provide seals on the tail of the tunnel boring machine which will prevent the pea gravel or grout from moving into the shield.

7.2.16 Jacking Pits

Construction techniques required to provide access for micro-tunneling shall be such as to ensure the safety of the work. Acceptable excavation methods include the use of interlocked steel sheetpiling or open excavation. Final dimensions of access pits selected by the General Contractor shall conform as a minimum with dimensions required to permit installation of the work.

The General Contractor shall be required to properly support all excavations and to prevent all movement of the soil, pavement, utilities or structures outside of the excavation. All pits shall conform to applicable Local Safety Standards, OSHA Standards, trenching, and shoring standards.

If at any time the method being used by the General Contractor for supporting any material or structure adjacent to any excavation is not safe in the opinion of the Project Construction Engineer or applicable federal, state or local inspection authorities, the Project Construction Engineer may require and the General Contractor shall provide additional bracing and support necessary to furnish the added degree of safety required by the Project Construction Engineer . The General Contractor shall provide such added bracing and support by such method approved by the Project Construction Engineer as he may elect to use but the taking of such added precautions shall in no way relieve the General Contractor of his sole final responsibility for the safety of lives, work, and structures. The use of such additional bracing

and support shall be without additional cost to the City. The absence of an order from the Project Construction Engineer for the aforementioned additional bracing shall in no way relieve the General Contractor of his sole final responsibility.

Pits shall be constructed to accommodate the installation of pipe casings, slurry shield, and jacking device. Install thrust block as required and consolidate the ground where the casings enter and exit the ground.

All work of excavating shoring and bracing shall be so executed that settlement is minimized, the in-place casing shall have full bearing against earth, and no voids or pockets are left in any portion of the work.

Before beginning construction, the General Contractor shall adequately protect existing structures and other permanent objects. The repair of or compensation for damage to permanent facilities due to negligence or lack of adequate protection on the part of the General Contractor will be at no cost to the City.

The General Contractor shall provide surface drainage during the period of construction to protect the work. Provide all dewatering and test any groundwater discharges. All discharge limits and reporting requirements shall be the responsibility of the General Contractor.

Size and locate pits and their work areas so as to avoid interference with traffic.

Blasting will not be permitted.

7.2.17 Line and Grade

The Project Construction Engineer has established the baselines and benchmarks as indicated on the Contract Drawings. The General Contractor shall check these baselines and benchmarks at the beginning of the contract period and report any errors or discrepancies to the Project Construction Engineer.

The General Contractor shall use the baselines and benchmarks to furnish and maintain all reference lines and grades for the micro-tunnel construction. These lines and grades shall be used to establish the exact location of all micro-tunneling, excavations and structures.

The General Contractor shall establish and be fully responsible for the accuracy of his own control for the construction of the entire project, including access shaft locations, structures, excavation, pipe alignment and grade. The General Contractor shall submit copies of field notes used to establish all lines and grades.

The General Contractor's control points shall be established sufficiently far from the tunnel operation not to be affected by ground movement.

The General Contractor shall maintain daily surveying records of alignment and grade and shall submit three copies of these records to the Project Construction Engineer. The General Contractor, however, remains fully responsible for the accuracy of his work and the correction of it, as required.

The General Contractor shall check his control for his excavation against an above ground undisturbed reference at least once each week and once for each 250 feet of tunnel constructed, or more often as needed or directed by the Project Construction Engineer .

After installation of the sewer pipe, the General Contractor shall provide the Project Construction Engineer with access to the tunnel for visual inspection of the line and grade of the completed in place sewer pipe.

Guidance laser system shall be mounted in a manner that isolates it from effects of movement by the jacking forces.

7.2.17 Earth Movement

The General Contractor shall be responsible for all damages due to settlement from any construction induced activities or occurrences.

The General Contractor is advised of the proximity of buildings, structures, roads, and utilities to the work. Precautions shall be taken to avoid damage or settlement to any of these. Such precautions shall include the use of construction methods and equipment to minimize loss of earth at the excavation face and settlement of earth around the sewer pipe.

In the event any movement of earth is detected, the Project Construction Engineer may order the work stopped and secured. Before proceeding, the General Contractor shall correct any problems causing or resulting from such movement.

The General Contractor should be aware that if settlement of the ground surface should occur during construction, which will affect the accuracy of the temporary benchmarks established by the Project Construction Engineer, it shall be the General Contractor's responsibility to detect and report such movement. The locations of the permanent City monumentation benchmarks (BM) and temporary benchmarks (TBM) are indicated on the Drawings; the General Contractor may use these to verify temporary benchmark accuracy. Advise the Project Construction Engineer and the City of any settlement affecting the permanent monumentation benchmarks. Upon completion, the field books pertaining to monitoring of the permanent monumentation benchmarks shall be submitted to the City.

7.2.18 Excavated Material

Remove and dispose of all excavated materials from jacking pit and tunnel excavations in accordance with the requirements of State of Colorado.

7.2.19 Infiltration Leakage Test

The tests shall be performed by the General Contractor under the observation of the Project Construction Engineer. A test section is defined as the length of tunnel between manholes or structures.

Leak testing shall be by television inspection after dewatering operations have been discontinued a minimum of 48 hours and until groundwater has been allowed sufficient time to reach its natural elevation. Any leakage found during this operation shall be corrected.

Each joint shall also be tested in place by exerting a pressure of 11.2 psi absolute on it in accordance with ASTM D 3754. The internal test pressure, which is 3.5 psi lower than

normal atmospheric pressure, shall be in addition to the normal external hydrostatic pressure exerted on the pipe by the groundwater above the pipe. Each joint when tested in this manner shall exhibit no infiltration of groundwater into the pipe. The General Contractor may at his option, test sections of the sewer using this method instead of individual joints. If this method is selected each section shall exhibit no infiltration of ground water into the section. The General Contractor shall isolate any joints which are found to leak during this test and jack such joints through until all joints between manholes are found to be watertight under these conditions.

One hundred percent of the sewer and sewer joints shall be tested.

The General Contractor shall repair all visible leaks in manholes, structures, and joints even if the leakage test requirements are met.

Adequate bulkheads, or plugs, shall be installed at each end of the sewer pipe in preparation for testing. The General Contractor shall submit the type of bulkhead, or plug, to be used to the Project Construction Engineer for review. After testing, the bulkheads or plugs shall remain in place until the sewer is put into service, at which time the General Contractor shall remove the bulkheads or plugs.

7.2.20 Restoration

The General Contractor shall promptly restore to their original condition any streets, curbs, sidewalks, or any other facilities which are damaged, moved or disturbed as a result of tunneling operations or jacking pit construction. Any surface or subsurface settlement shall be restored to pre-construction conditions.

End of Specification



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8.0 Structural Excavation

8.0.1 General

All excavation for the construction of structures shall be in conformance with the applicable provisions of CDOT Section 206 except as modified herein.

Unless otherwise stipulated in the Contract Documents, no separate payment will be made for structural excavation, except for overexcavation as directed by the Project Construction Engineer, and all costs incurred will be considered to be included in the unit price bid for the associated structure or appurtenance. The cost of overexcavation will be paid for as specified below.

8.0.2 Over Excavation

In locations where soil with unsuitable bearing characteristics are encountered, the Project Construction Engineer may order that the unsuitable material be removed and be replaced with granular and/or rock backfill material to provide suitable bearing for the structure.

The overexcavation will be paid for in accordance with the unit price set forth in the Contract Documents for excavation and replacement with an approved granular material; provided,

however, no measurement for payment will be made of any material required to fill overexcavated areas: outside of specified pay limits (if applicable), that were for the Contractor's convenience, beyond the limits required for structural excavation, or where excavations for footings, slabs, etc., are made below the required elevations without specific authorization from the Project Construction Engineer. Under these circumstances, the excess excavation and backfill required for over excavated area(s) shall be filled in a manner satisfactory to the Project Construction Engineer by the Contractor at their expense.

8.0.3 Removal of Water

All water encountered in excavations shall be removed as required within these Detail and Technical Specifications.

8.0.4 Backfill

Backfill around structures shall be per the requirements set forth within these Detail and Technical Specifications.

8.0.5 Site Grading

The entire site shall be graded using suitable materials from the excavation. Grading shall be for the purpose of providing a neat and pleasing appearance and for facilitating positive drainage. Compaction of all grading material shall be as specified within these Detail and Technical Specifications.

End of Specification



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9.0 Testing, Inspection and Acceptance

9.1 General

In addition to any other testing or inspection requirements set forth elsewhere in these Specifications, all testing, inspection and acceptance of the completed work will be as specified herein.

Test for water-tightness of sanitary sewers shall be conducted by the Contractor at his own expense, except as noted, with the assistance and under the direction of the Project Construction Engineer prior to final acceptance.

Unless otherwise specified, storm sewer systems normally will not be required to be tested for leakage. All leakage tests shall be completed and approved prior to placing of permanent resurfacing. Where the difference in elevation between the inverts of adjacent structures (manholes) exceeds 20 feet, no exfiltration leakage tests will be required.

9.2 Testing and Inspection

9.2.1 Exfiltration Test

Unless otherwise noted on the plans, each section of sewer will be tested between successive manholes by closing the lower end of a sewer reach by plugging the pipe at the inlet to the lower manhole and then by filling the sewer and the upper manhole(s) to the proper level with water. The water level in the upper manhole shall be a minimum of 4 feet above the level of the ground water. The maximum exfiltration rate for any section of sewer line shall not exceed the limits specified below:

Pipe Material	Maximum Rate of Exfiltration
Clay, Concrete	200 gal per day/inch diam/mile
PVC	50 gal per day/inch diam/mile

For the purposes of exfiltration leakage, manholes shall be considered to be concrete pipe of the same diameter as the manhole i.e. 48, 60 or 72 inch diameter. Air pocket entrapment shall be avoided when filling the line with water. Once filled with water, the system shall be allowed to stabilize for a period of one or two hours before starting the test. Exfiltration leakage rate is determined by measuring the amount of water required to maintain a constant level in the upper manhole. Test duration is to be no less than two hours.

If the leakage, as shown by the test, exceeds the allowable value, the Contractor shall make the necessary corrections at his expense to reduce the exfiltration to within the permissible limits. The Contractor shall furnish all water, material and labor required to perform the test. All tests shall be made in the presence of the Project Construction Engineer.

9.2.2 Infiltration Test

If the Project Construction Engineer determines that excessive ground water is encountered during construction of a sanitary sewer section, the infiltration test for leakage shall be used. The maximum allowable infiltration for sanitary sewers shall not exceed the following limits for the type of projects specified:

Type of Pipe	Max. Allowable Infiltration
Clay, Concrete	200 gal per day/inch diam/mile (3.8 d/inch/100 ft)
PVC	50 gal per day/inch diam/mile (0.95 gpd/inch/100 ft)

Unless otherwise specified, infiltration will be measured by the Project Construction Engineer, using measuring devices furnished by the City.

If the infiltration is found to exceed the prescribed amount, the Contractor shall make the appropriate repairs as approved by the City and shall continue to test the sewer until it meets requirements.

9.2.3 Air Pressure Test

When directed by the Project Construction Engineer and prior to acceptance of any segment of newly constructed sanitary sewers, the pipe will be subjected to an air pressure test, which will be conducted after densification of the backfill and prior to installation of any sanitary taps. The City shall furnish all equipment and materials for conducting the air test, and all costs will be borne by the City. The air pressure test requirement will normally apply to sanitary sewers only, unless otherwise directed by the Project Construction Engineer.

The test shall conform to the recommended practice and calculations established by the ASTM C-828. After a manhole to manhole reach of pipe has been backfilled, the line should be flushed and cleaned with the interior walls moist. Plugs shall be placed in the line at each manhole and low pressure shall be introduced into this sealed line until the internal pressure reaches 4 psig (pounds per square inch gage) greater than the average back pressure of any ground water that may be surrounding the pipe. At least two minutes shall be allowed for the air pressure to stabilize. The test shall then be run with the drop in pressure from 3.5 to 2.5 psig. The calculations generated by ASTM C-828 shall then be used to check the adequacy of the pipe installation. If the installation fails to meet the requirements, the Contractor shall at his own expense determine the source of leakage and then shall repair or replace all defective materials and/or workmanship at his own expense to the satisfaction of the Project Construction Engineer.

Safety precautions shall be used at all times. It is extremely important that the plugs be installed and braced to prevent blowouts. No one shall be allowed into the manholes during testing.

9.2.4 Television Inspection

Prior to acceptance of any segment of newly-constructed sewers, all pipes will be televised and physically inspected by the City for any observable defects. This requirement will apply to sanitary sewers and to small storm sewers which are too small to be physically inspected will also be televised. Any defects discovered during this inspection shall be corrected prior to acceptance of the sewer.

The Contractor shall request these televised inspections through the Chief Construction Project Construction Engineer with at least 48 hours advance notification. The cost of initial inspection and the first re-inspection to confirm correction of previously identified deficiencies will be borne by the City. If additional inspections are required due to inadequate or otherwise unacceptable repairs, the costs for such inspections shall be charged to the Contractor.

9.2.5 Deflection Test (Plastic Pipe)

The City shall conduct deflection tests of all flexible pipes after completion of the work and again 30 days prior to the end of the guarantee period. The Contractor shall, at his expense, furnish a multiarmed test mandrel having an odd number of arms, nine or more in number. The mandrel will be pulled through the lines to be tested by City personnel using the ASTM testing procedure. The Contractor may witness the tests and may receive a copy of the test logs and reports if desired. All test equipment, calibration data, procedures, etc. shall be subject to approval by the Project Construction Engineer.

The maximum allowable deflection after installation and backfilling shall not exceed that specified elsewhere in these Specifications for the particular pipe installed. Any segments of the pipe deemed necessary to be unsatisfactory shall be replaced or reworked by the Contractor in accordance with the requirements of the Project Construction Engineer. Such repair shall be at the Contractor's expense.

9.2.6 Hydrostatic Test

Cast Iron, Ductile Iron, PVC Pressure Mains and Force Mains

9.2.6.1 Hydrostatic Tests

Hydrostatic tests consisting of a Pressure Test and a Leakage Test shall be performed prior to final backfilling. Thrust blocks, anchors, and partial backfill sufficient to anchor the pipeline in place but leaving joints, valves and fittings exposed for inspection shall be performed before testing.

9.2.6.2 Pressure Test

After the pipe has been laid and partially backfilled, all newly laid pipe, or any valved section thereof, shall be subjected to a pressure test. The test pressure shall be determined by the Engineer. For PVC Pressure mains and Force Mains the test pressure shall be defined in general accordance with the requirements of AWWA-900 or UNI Bell B-3-77. The duration of the pressure test shall be at least one hour with no discernable loss of pressure.

- a. **Procedure.** Each valved section of pipe shall slowly be filled with water to the specified test pressure, based on the elevation of the lowest point of the line or section under test and corrected to the elevation on the test gage. Air shall be applied by means of a pump connected to the pipe in a satisfactory manner satisfactory to the Engineer. The pump, pipe connections, gages and all necessary test equipment shall be furnished by the Contractor who will make all taps into the pipe. The Contractor shall furnish all necessary assistance for conducting the tests.
- b. **Air Removal.** Before applying the specified air pressure, all air shall be expelled from the pipe. If permanent air vents are not located at all high points, the Contractor shall install corporation cocks at such points so the air can be expelled as the line is filled with water. After the air has been expelled, the corporation cocks shall be closed and the test pressure applied.

- c. **Examination Under Pressure.** All exposed pipe fittings, valves and joints shall be carefully examined prior to placement of backfill. Any cracked or defective pipe, pipe joints, fittings, or valves discovered in consequence of the pressure test shall be removed and replaced by the Contractor, and the test shall be repeated to the satisfaction of the Project Construction Engineer.

9.2.6.3 Leakage Tests

A leakage test shall be conducted after the pressure test has been satisfactory completed. The Contractor will furnish the gage, measuring device, pump, and pipe connections, other necessary apparatus and the necessary assistance to conduct the test. The duration of each leakage test shall be two hours with an average test pressure determined by the Engineer being maintained during this period.

Leakage shall be defined as the quantity of water that must be supplied into the newly laid pipe, or any valved section thereof, to maintain the specified leakage test pressure after the air in the pipeline has been expelled and the pipe has been filled with water.

No pipe installation will be accepted if the leakage is greater than that determined by the following formula:

$$L = ND\sqrt{P} \text{ divided by } 3700$$

For mechanical joints and push-on joints, where L is the allowable leakage in gallons per hour, N is the number of joints in the length of pipeline tested, D is the nominal diameter of the pipe in inches, and P is the average test pressure applied during the test in pounds per square inch gage.

The allowable leakage for 1,000 feet of 18-foot length of mechanical joint or push-on joint pipe at various pressures and diameters is shown in Table 1 of this section.

- a. **Variation from Permissible Leakage.** If any pipe laid discloses leakage greater than that specified above, the Contractor shall, at his own expense, locate and repair the defective joints until the leakage is within the specified allowance.
- b. **Pressure and Leakage Tests after Backfilling.** After the trench has been completely backfilled, the test connections made, and the main filled with water, the pipe shall be subject to a final pressure and leakage test as specified above. If defects are found, the Contractor shall immediately make the repairs and the test repeated until satisfactory to the Engineer.

A final leakage test shall then be conducted after satisfactory completion of the pressure tests. Should any section fail to meet the final leakage test, the Contractor shall make the necessary repairs at his expense.

The duration of the final pressure test and leakage test shall be a minimum of one hour each.

9.2.6.4 Test Report

The Project Construction Engineer shall be furnished a written report of the reports of the Hydrostatic Tests performed, identifying the specific length of the pipe tested, the pressure, the duration of the test and the amount of leakage.

9.2 Acceptance

Portions of the work completed may be placed in operation after all cleaning, and inspection requirements have been fulfilled. Final acceptance of the work will not be made until all requirements set forth in the Contract documents have been completed. Any items of work which the Contractor considers as extra shall be reported to the Project Construction Engineer during the progress of the testing and inspection. No consideration of any work items will be made unless substantiating records of the work exist. Any work which the Contractor considers to be extra shall be considered in accordance with General Condition 1101, "Change Order".

End of Specification



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Storm Drainage and Sanitary Sewer Construction Detail and Technical Specifications

10.1 Precast Concrete Pipe

10.1.1 General

This section covers material requirements, inspection, marking, delivery, installation, field performance and acceptance of reinforced concrete pipe for storm drainage systems. This shall include circular, elliptical and arch pipe along with all associated special pipe sections.

10.1.2 Referenced Standards

This section references American Society for Testing and Materials (ASTM) Specifications, which are made a part hereof by such references, and shall be the latest edition and revision thereof. All material, manufacturing, operations, testing, inspection and production of concrete pipe shall conform to the following Referenced Standards:

ASTM C14	Concrete Sewer, Storm Drain and Culvert Pipe
ASTM C33	Specification for Concrete Aggregates
ASTM C76	Reinforced Concrete Culvert, Storm Drain and Sewer Pipe

ASTM C150	Standard Specification for Portland Cement
ASTM C361	Reinforced Concrete Low-Head Pressure Pipe
ASTM C443	Standard Specification for Joints for Concrete Pipe and Manholes, Using Rubber Gaskets
ASTM C497	Standard Test Methods for Concrete Pipe, Manhole Sections or Tile
ASTM C506	Reinforced Concrete Arch Culvert, Storm Drain and Sewer Pipe
ASTM C507	Reinforced Concrete Elliptical Culvert, Storm Drain and Sewer Pipe
ASTM C655	Standard Specification for Reinforced Concrete D-Load culvert, Storm Drain and Sewer pipe
ASTM C822	Standard Terminology Relating to Concrete Pipe and Related Products
ASTM C985	Standard Specification for Non-reinforced concrete Specified Strength Culvert, Storm Drain and Sewer pipe
ASTM C1417	Standard Specification for Manufacture of Reinforced Concrete Sewer, Storm drain and Culvert pipe for Direct Design

10.1.3 Diameter of Pipe

The diameter indicated on the Contract Documents shall mean the inside diameter of the pipe.

10.1.4 Wall Thickness and Class of Pipe

The wall thickness and reinforcing steel shall comply with the appropriate ASTM Specification and the designated class of pipe as indicated in the Contract Documents. All jacking pipe shall be specifically designed by the pipe manufacturer to withstand all forces that the pipe may be subjected to during jacking operations.

10.1.5 Submittals

10.1.5.1 Supplier Certification

A letter from the supplier to the Project Construction Engineer shall be submitted certifying that all Precast Reinforced Concrete Pipe is manufactured in accordance with the applicable ASTM specification.

10.1.5.2 Design Calculations

All designs shall be per the applicable ASTM designation, except where pipe sizes and or special load conditions are not covered in the specifications. All special designs and load conditions shall require the submittal of design calculations through the Project Construction Engineer for approval.

10.1.5.3 Shop Drawings

Shop drawings showing a laying diagram and the location of all closure pieces shall be submitted. Drawings shall include: proposed lifting anchors, lugs and any other features pertinent to the manufacture of special sections.

10.1.5.4 Gasket Deformation

Calculations showing the gasket deformation(s) shall be submitted to the Project Construction Engineer.

10.1.5.5 Lifting Anchors

The lifting mechanisms proposed for handling and placement of conduit shall be submitted to the Project Construction Engineer for approval.

10.1.5.6 Maximum Allowable Joint Gap

The manufacturer shall provide the Project Construction Engineer with the maximum allowable joint gaps on all conduit sizes for the project. The maximum allowable joint gap is determined as that point where the bevel of the bell and the shoulder of the spigot are vertically aligned and the rubber gasket has achieved the minimum compression necessary to ensure a water tight seal per these Detail and Technical Specifications.

10.1.6 Materials

All precast reinforced concrete pipe shall be manufactured in accordance with the applicable ASTM designation or as specified in the Contract Documents.

The Project Construction Engineer shall be provided a production schedule at least three working days in advance of when the various types of pipe will be cast so the casting operation may be inspected and appropriate specimens may be selected for testing in accordance with the Contract Documents.

10.1.6.1 Cement

Unless otherwise specified by the Project Construction Engineer, or within the Contract Documents, Type II Portland Cement complying with the requirements of ASTM C150 will be used in the production of concrete pipe.

10.1.6.2 Lifting Anchors

Lifting anchors shall be used on all precast concrete pipe. Lifting holes are not allowed.

10.1.6.3 Fittings and Specials

Details of all fittings and specials shall be submitted for approval to the Project Construction Engineer prior to construction. Fittings and specials shall be made up of pipe segments having the same structural qualities as the adjoining pipe and shall have the interior treated the same as the pipe.

10.1.6.4 Joints and Gaskets

Pipe joints for all reinforced concrete pipes shall be formed using rubber gaskets that provide a watertight seal, in accordance with ASTM C443. The joints shall be of such design that they will withstand the forces caused by the compression of the gasket when joined.

The joint design of concrete pipe shall be a bell and spigot or a tongue and groove style joint. The spigot or tongue shall be grooved to properly contain and seat the rubber gasket. The joint assemblies shall be accurately formed so that when each pipe section is forced together in the trench the assembled pipe shall form a continuous watertight conduit with a smooth and uniform interior surface, and shall provide for slight movement of any piece of the pipeline due to expansion, contraction, settlement or lateral displacement. The gasket shall be the sole element of the joint providing watertightness. The ends of the pipe shall be perpendicular (90° angle) to the longitudinal centerline of the pipe, except where bevel-end pipe is required. The ends shall be finished so that they are uniform and smooth.

Rubber gaskets for bell and spigot pipe shall consist of an o-ring rubber gasket, rubber profile gasket, or another gasket specifically approved, in writing, by the Project Construction Engineer.

Gaskets may be either isoprene or neoprene conforming to ASTM C443. All gaskets shall be stored in a cool place, preferably at a temperature of less than 70 degrees Fahrenheit (F), and in no case shall the gaskets be stored in the open, or exposed to direct sunlight. No gaskets which show signs of deterioration, such as surface cracking or checking, shall be installed in a pipe joint. When the air temperature is 10 degrees F or lower, the gaskets shall be warmed to temperature of 60 degrees Fahrenheit for a period of 30 minutes before being placed on the pipe.

10.1.6.5 Joint Gap

For reinforced concrete pipe 30-inches (or equivalent diameter for arch and elliptical pipes) and larger, if the end face joint gap is greater than or equal to 65% of the maximum allowable joint gap, as submitted by the manufacturer for each specific pipe size and less any factors of safety, the gap shall be grouted with an approved non-shrink grout product around the entire internal joint perimeter. If the end face joint gap is greater than the maximum allowable joint gap submitted by the manufacturer, at any point around the internal joint perimeter, the adjoining pipe sections will be rejected and no payment will be made.

10.1.6.6 Jacking Pipe

All other Requirements set forth in this specification shall apply to reinforced concrete pipe being jacked, with the following additions: Pipe shall be Class V unless specified otherwise in the Contract Documents; grouting nipples shall be spaced no more than 8 feet apart on the installed pipeline, pipe shall include steel joint rings (bell and spigot) conforming to ASTM C361 and as shown on Standard Detail S-401, Joint type R-2.

10.1.7 Acceptance

In addition to any deficiencies not covered by the applicable ASTM specifications, individual concrete pipe sections shall be subject to rejection due to any of the following:

1. Surface defects indicating honeycombed or open texture that would adversely affect the function of pipe sections. Onsite repairs may be made, if approved by the Project Construction Engineer.
2. Damaged ends, where such damage would prevent making a satisfactory joint.

3. Pipe which has been excessively patched or repaired. The manufacturer may request that the Project Construction Engineer perform an inspection at the plant, prior to delivery, to assess patching and/or repair work on conduits. Pipe damaged during shipment or construction may be repaired with the approval of the Project Construction Engineer.
4. Exposure of the reinforcement. The exposure of the ends of longitudinals, stirrups and spacers used to position reinforcement shall not be cause for rejection and may be repaired with the approval of the project Construction Engineer, in writing.
5. Concrete pipe that has been delivered to the jobsite prior to being at least 5 days (120 hours) old
6. Broken Bells or spigots on installed pipeline
7. Joint gaps greater than maximum allowable submitted by manufacturer

Acceptance of the pipe at point of delivery will not relieve the Contractor of full responsibility for any defects in materials due to workmanship.

10.1.8 Marking

The following shall be clearly marked on both the interior and exterior surface of the pipe:

1. ASTM specification designation
2. Class and size
3. Date of manufacture
4. Name or trademark of manufacturer

10.1.9 Protective Coatings

Whenever adverse corrosive conditions warrant additional interior protection, those pipe segments noted in the Contract Documents shall be lined as specified elsewhere in these Detail and Technical Specifications.

10.1.10 Installation

Reinforced concrete pipe shall be constructed continuously, from downstream to upstream, except when otherwise approved by the Project Construction Engineer, in writing. The General Contractor is responsible for matching line and grade as shown within the Contract Documents. Bedding material shall be placed in accordance with these Contract Documents and all applicable Standard Details to provide uniform and continuous support.

Pipe shall be placed with the grove or bell end upstream. Each conduit section shall be set into position and checked for line and grade prior to continuing placement. The manufacturers' recommendations shall be closely followed during installation.

The General Contractor shall ensure that all reinforced concrete pipe is kept clean and free from gravel, dirt and debris during and after installation. Precautions shall be taken by the General Contractor to eliminate soil and debris from being washed into the sewer prior to completion of the entire system and its appurtenances. The General Contractor shall incur all

costs associated with street failures, cave-ins, system washouts and settlements, and conduit cleaning as a result of carelessness during this timeframe.

End of Specification



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Storm Drainage and Sanitary Sewer Construction Detail and Technical Specifications

10.3 Precast Reinforced Box Conduits

10.3.1 General

The work of this section includes furnishing and installing all precast reinforced concrete box conduits for storm drainage systems. This shall include all associated special pieces, except inlets and manholes.

10.3.2 Related Sections

Section 4.0, Trenching and Excavation for Pipework (Capital Project Management Standard Specifications).

10.3.3 Referenced Standards

This section references American Society for Testing and Materials (ASTM) Specifications, which are made a part hereof by such references, and shall be the latest edition and revision thereof. All material, manufacturing, operations, testing, inspection and production of precast reinforced box conduits shall conform to the following standards.

ASTM C150 Standard Specification for Portland Cement

ASTM C497	Standard Test Methods for Concrete Pipe, Manhole Sections, or Tile
ASTM C822	Terminology Relating to Concrete Pipe and Products
ASTM C1433	Standard Specification for Precast Reinforced Concrete Box Sections for Culverts, Storm Drains and Sewers
ASTM C443	Standard Specification for Joints for Concrete Pipe and Manholes, Using Rubber Gaskets

10.3.4 Submittals

10.3.4.1 Supplier Certification

A letter from the supplier to the Project Construction Engineer shall be submitted certifying that all Precast Reinforced Box Conduits are manufactured in accordance with ASTM C1433.

10.3.4.2 Design Calculations

All designs shall be per the tables of ASTM C1433 except where box sizes and or special load conditions are not covered by these tables. All special designs and load conditions shall require the submittal of design calculations through the Project Construction Engineer for City and County of Denver approval.

10.3.4.3 Shop Drawings

Shop drawings showing laying diagram and location of all closure pieces shall be submitted. Drawings shall include: proposed lifting anchors, lugs and any other features pertinent to the manufacture of special sections.

10.3.4.4 Gasket Deformation

Calculations showing the gasket deformation(s) shall be submitted to the Project Construction Engineer.

10.3.4.5 Lifting Anchors

The lifting mechanisms proposed for handling and placement of box conduit shall be submitted to the Project Construction Engineer for approval.

10.3.4.6 Maximum Allowable Joint Gap

The manufacturer shall provide the Project Construction Engineer with the maximum allowable joint gaps on all box conduit sizes for the project. The maximum allowable joint gap is determined as that point where the bevel of the bell and the shoulder of the spigot are vertically aligned and the rubber gasket has achieved the minimum compression necessary to ensure a water tight seal per these Detail and Technical Specifications.

10.3.5 Materials

10.3.5.1 Box Conduits

All precast reinforced concrete box conduits shall be manufactured in accordance with ASTM C1433.

The Project Construction Engineer shall be provided a schedule at least three working days in advance of when the various types of box conduit will be cast so the casting operation may be inspected and appropriate specimens may be selected for testing in accordance with the Contract Documents.

10.3.5.2 Box Joints

Box joints for reinforced concrete box conduits shall be formed using either o-ring or profile rubber gaskets that provide a watertight seal. The gasket shall be properly placed on the spigot using an adhesive, as necessary along the joint perimeter, to maintain the correct position of the gasket. Joints for box conduits shall comply with the requirements set forth in ASTM C443, with the following revisions.

1. Gasket Deformation

The joints shall be of such design that they will withstand the forces caused by the compression of the gasket when the joint is in the assembled and homed position, as well as when the box joint is fully off-centered and the maximum dimensional tolerances are applied.

2. Hydrostatic Testing and Requirements

One box joint per size, for each project, shall be hydrostatically tested at the place of manufacture to verify watertightness and joint integrity. Hydrostatic pressure tests on joints shall be made on an assembly of two sections of box, properly connected in accordance with the joint design. Suitable means shall be provided that allows pressure to be applied to the joint, either external or internal of the two joined box sections. When infiltration is a concern, the joint shall be tested using external pressure only.

Assembled joints shall pass the following performance tests without leakage at the joints. Moisture or beads of water appearing on the surface of the joint will not be considered as leakage.

Box in straight alignment

Concrete box conduit shall be subjected to a hydrostatic pressure of 5psi (11.5 ft of pressure head) for 10 minutes in straight alignment. If leakage of joints should initially occur, the manufacturer shall have the option to extend the test period up to 24 hours.

Box in maximum deflected position

Upon completion of the test for box in straight alignment, the test section shall be deflected to create a position $\frac{1}{2}$ inch wider than the assembled position on one side of the outside perimeter of each joint and shall be subjected to a hydrostatic pressure of 3psi (6.9 ft of pressure head) for 10 minutes.

3. Joint Gap

If the end face joint gap is greater than or equal to 65% of the maximum allowable joint gap, as submitted by the manufacturer for each specific box size and less any factors of safety, the gap shall be grouted with an approved non-shrink grout product around the entire internal joint perimeter.

10.3.5.3 Closure Pieces

All pieces required for closure between precast and cast-in-place elements shall be fabricated with protruding dowels or exposed reinforcing steel, as shown in the Contract Documents, and as approved by the Project Construction Engineer. All dowels and/or exposed reinforcing shall be fully developed.

10.3.5.4 Special Pieces

Special pieces shall be fabricated as shown on the Contract Documents and shall be approved by the Project Construction Engineer prior to fabrication.

10.3.5.5 Lifting Anchors

Lifting anchors shall be used on all box conduits. Lifting holes will not be allowed.

10.3.6 Acceptance

In addition to deficiencies covered by applicable ASTM specifications, individual precast reinforced concrete box conduits shall be subject to rejection due to any of the following:

1. Surface defects indicating honeycombed or open texture that would adversely affect the function of box sections. Onsite repairs may be made, if approved by the Project Construction Engineer.
2. Damaged ends, where such damage would prevent making a satisfactory joint.
3. Conduit which has been excessively patched or repaired. The manufacturer may request that the Project Construction Engineer perform an inspection at the plant, prior to delivery, to assess patching and/or repair work on conduits. Conduit damaged during shipment or construction may be repaired with the approval of the Project Construction Engineer.
4. Exposure of the reinforcement. The exposure of the ends of longitudinals, stirrups and spacers used to position reinforcement shall not be cause for rejection.
5. Box conduit that has been delivered to the jobsite prior to being at least 5 days (120 hours) old.

Acceptance of the conduit shall not relieve the General Contractor of full responsibility for defects in material or workmanship on the completed boxlines.

10.3.7 Marking

The following information shall be legibly marked on each box section by indentation, waterproof paint or other approved means:

1. ASTM specification designation
2. Date of manufacture
3. Name or trademark of manufacturer

10.3.8 Testing

The Project Construction Engineer or other identified representatives shall be permitted to visit the manufacturing facility of the General Contractor's supplier to observe compliance with all applicable testing provisions. These visits may be scheduled or random.

10.3.9 Shipping and Handling Box Conduit and Fittings

All conduits, fittings, and specials shall be hauled, unloaded, stockpiled, distributed, handled and installed as recommended by the manufacturer and in such a manner as to prevent damage to the product.

10.3.10 Installation

Box conduit lines shall be constructed continuously, from downstream to upstream, except when otherwise approved by the Project Construction Engineer. The General Contractor is responsible for matching line and grade as shown within the Contract Documents. Bedding material shall be placed in accordance with the Contract Documents and applicable Standard Details to provide uniform and continuous support.

Box conduits shall be placed with the grove end upstream. Each conduit section shall be set into position and checked for line and grade prior to continuing placement. The manufacturers' recommendations shall be closely followed during installation.

The General Contractor shall ensure that all reinforced concrete box conduits are kept clean and free from gravel, dirt and debris during and after installation. Precautions shall be taken by the General Contractor to eliminate soil and debris from being washed into the sewer prior to completion of the entire system and its appurtenances. The General Contractor shall incur all costs associated with street failures, cave-ins, system washouts and settlements, and conduit cleaning as a result of carelessness during this timeframe.

End of Specification



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10.4 Centrifugally Cast Fiberglass Reinforced Polymer Mortar Pipe

10.4.1 General

This section covers material requirements, inspection and testing, marking and delivery, installation, and field performance and acceptance tests of Centrifugally Cast Fiberglass Reinforced Polymer Mortar Pipe (CCFRPM), for use in gravity, non-pressure, sanitary sewer installations.

10.4.2 Referenced Standards

This section references American Society for Testing and Materials (ASTM), which are made part hereof by such references, and shall be the latest edition and revision thereof. All material, manufacturing, operations, testing, inspection and production of Centrifugally Cast Fiberglass Reinforced Polymer Mortar Pipe (CCFRPM) shall conform to the following referenced standards:

- ASTM D3262 Standard Specification for “Fiberglass” (Glass-Fiber-Reinforced Thermosetting-Resin) Sewer Pipe.
- ASTM D4161 Standard Specification for “Fiberglass” (Glass-Fiber-Reinforced Thermosetting-Resin) Pipe Joints Using Flexible Elastomeric Seals.

ASTM D2412 Standard Test Method for Determination of External Loading Characteristics of Plastic Pipe by Parallel-Plate Loading.

10.4.3 Materials

10.4.3.1 Resin Systems

The manufacturer shall use only polyester resin systems with a proven history of performance in this particular application. The historical data shall have been acquired from a composite material of similar construction and composition as the proposed product.

10.4.3.2 Glass Reinforcements

The reinforcing glass fibers used to manufacture the components shall be of highest quality commercial grade E-glass filaments with binder and sizing compatible with impregnating resins.

10.4.3.3 Silica Sand

Sand shall be minimum 98% silica with a maximum moisture content of 0.2%.

10.4.3.4 Additives

Resin additives, such as curing agents, pigments, dyes, fillers, thixotropic agents, etc., when used, shall not detrimentally affect the performance of the product.

10.4.3.5 Elastomeric Gaskets

Gaskets shall be supplied by qualified gasket manufacturers and be suitable for the service intended.

10.4.4 Manufacture and Product Construction

10.4.4.1 Pipe

The pipe shall be manufactured using the centrifugal casting process only, so as to result in a dense, non-porous, corrosion-resistant, consistent composite structure. The pipe shall meet the ASTM D3262 standard specification Cell Limit Type 1, Liner 2, and Grade 3. The manufacturer of pipe and fittings must demonstrate a 10 – year history of successful installations in the United States for sanitary sewer service.

10.4.4.2 Joints

Unless otherwise specified, the pipe shall be field connected with fiberglass sleeve couplings that utilize built-in double fin elastomeric sealing gaskets made of EPDM rubber compound as the sole means to maintain joint water tightness. The joints must meet the performance requirements of ASTM D4161. Joints at tie-ins, when needed may utilize fiberglass, gasket-sealed closure couplings.

10.4.4.3 Fittings

Flanges, elbows, reducers, tees, wyes, laterals and other fittings shall be capable of withstanding all operating conditions when installed. They may be contact molded or manufactured from mitered sections of pipe joined by glass-fiber-reinforced overlays. Properly protected standard ductile iron, fusion-bonded epoxy coated steel and stainless steel fittings may also be used.

10.4.4.4 Outside Diameter

The actual outside diameter (18" to 48") of the pipes shall be in accordance with ASTM D3262. For other diameters, OD's shall be per manufacturer's literature.

10.4.4.5 Pipe Length

Pipe shall be supplied in nominal lengths of 20 feet. Actual laying length shall be nominal +1, -4 inches. At least 90% of the total footage of each size and class of pipe, excluding special order lengths, shall be furnished in nominal length sections.

10.4.4.6 Wall Thickness

The minimum wall thickness shall be the stated design thickness.

10.4.4.7 End Squareness

Pipe ends shall be square to the pipe axis with a maximum tolerance of 1/8".

10.4.4.8 Packaging, Handling, Shipping

The Contractor shall follow the procedures and recommendations for packaging, handling, and shipping, in accordance with the manufacturer's instructions.

10.4.4.9 Testing

1. All pipes shall be manufactured and tested in accordance with ASTM D3262.
2. All joints shall meet the requirements of ASTM D4161.
3. The minimum pipe stiffness when tested in accordance with ASTM D2412 shall be 46 psi.

10.4.5 Inspection of Product During Manufacturing

10.4.5.1 Customer Inspection

The owner or other designated representative shall be entitled to inspect pipes or witness the pipe manufacturing.

10.4.5.2 Manufacturers Notification to Customer

Should the Owner request to see specific pipes during any phase of the manufacturing process, the manufacturer must provide the Owner with at least 48-hours advance notice of when and where the production of those pipes will take place.

10.4.6 Installation

10.4.6.1 Trenching and Excavation

Trenching and excavation shall be performed in accordance with Section 4.0 of these Detail and Technical Specifications.

10.4.6.2 Bedding and Haunching

The bedding shall be Class B as defined in Section 4.0 of these Detail and Technical Specifications. The bedding material shall conform to ASTM C33 or ASTM D448 gradation No. 67 as modified and shall be brought to proper grade and elevation prior to installation of pipe and assembly of joints. Depressions for pipe bell shall be provided. Additional bedding

material shall then be placed according to Standard Detail S-301, “Standard Detail for Trenching and Bedding”.

10.4.6.3 Pipe Handling

Use textile slings, other suitable materials or a forklift. Use of chains or cables shall not be permitted.

10.4.6.4 Jointing

1. Clean ends of pipe and coupling components.
2. Apply joint lubricant to pipe ends and elastomeric seals of coupling. Use only lubricants approved by the pipe manufacturer.
3. Use suitable equipment and end protection to push or pull the pipes together.
4. Do not exceed forces recommended by the manufacturer for coupling pipe.
5. Join pipes in straight alignment then deflect to required angle. Do not allow the deflection angle to exceed the deflection permitted by the manufacturer.

10.4.7 Field Testing

10.4.7.1 Infiltration/Exfiltration Test

Maximum allowable leakage shall be per local specification requirements.

10.4.7.2 Low Pressure Air Test

Each reach may be tested with air pressure (max 5 psi). The system passes the test if the pressure drop due to leakage through the pipe or pipe joints is less than or equal to the specified amount over the prescribed time period.

10.4.7.3 Individual Joint Testing

For pipes large enough to enter, individual joints may be pressure tested with a portable tester to 5 psi max. with air or water in lieu of line infiltration, exfiltration or air testing.

10.4.7.4 Deflection Testing

A deflection test shall be performed according to section 9.2.5 of these Detail and Technical Specifications. The maximum allowable deflection limits after construction shall be 5%.

End of Specification



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10.5 Ductile Iron Pipe

10.5.1 General

This section covers material requirements, fittings, field joints and protective coatings for ductile iron pipe.

10.5.2 Referenced Standards

This section references American Society for Testing and Materials (ASTM), American National Standards Institute (ANSI), and American Water Works Association (AWWA), which are made a part hereof by such references, and shall be the latest edition and revision thereof. All material, manufacturing, operations, testing, inspection and production of ductile iron pipe shall conform to the following standards;

ASTM A746	Standard Specification for Ductile Iron Gravity Sewer Pipe
AWWA C110/ANSI A21.10	Standard for Ductile-Iron and Gray Iron Fittings, 3 in. – 48 in

- AWWA C111/ANSI A21.11 Standard for Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings
- AWWA C151/ASA A21.51 Standard for Ductile-Iron Pipe, Centrifugally Cast, for Water
- AWWA C153/ANSI A21.53 Standard for Ductile-Iron Compact Fittings

10.5.3 Pipe Diameter

The diameter indicated on the drawings shall represent the nominal diameter of the pipe. The inside diameter of the pipe after protective lining has been applied shall not be less than that required for cast iron pipe.

10.5.4 Wall Thickness

The minimum wall thickness and /or pressure class of each section of the pipeline shall conform to that indicated on the Contract Documents, and shall be subject to the approval of the Project Construction Engineer.

10.5.5 Grade of Iron

The grade of iron shall be 60-42-10 having a minimum tensile strength of 60,000 psi, a minimum yield strength of 42,000 psi, and a minimum percent of elongation of 10 percent.

10.5.6 Fittings and Specials

Fittings and specials shall be ductile iron at least Class 54 thickness and shall be in accordance to the requirements of either AWWA C153/ANSI A21.53 or AWWA C110/ANSI A21.10. Fittings shall be lined as specified in Section 10.5.7a and coated as specified in Section 10.5.7b below.

10.5.7 Field Joints

Mechanical joints shall conform to AWWA C111/ANSI A21.11.

10.5.8 Protective Coatings

Unless otherwise specified. The interior and exterior surfaces shall conform to the following.

1. Interior surfaces shall be lined with calcium aluminate mortar made of fused calcium aluminate cement and fused calcium aluminate aggregates. The thickness of the lining shall be a minimum of 0.125" for 6" through 12" and 0.1875" for 14" through 24" diameter pipe.
2. The lining shall be Sewpercoat as manufactured by Lafarge Calcium Alumnates or approved equal.
3. Exterior coating shall be a minimum of 1 mil bituminous paint according to AWWA C151/ASA A21.51 - Section 51-8.1.

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10.6 Polyvinyl Chloride (PVC) Sewer Pipe

10.6.1 General

This section covers material requirements, inspection and testing, marking and delivery, installation, and field performance and acceptance tests of Polyvinyl Chloride (PVC) Sewer Pipe and Fittings for use in gravity, non-pressure, storm or sanitary sewer installations.

10.6.2 Referenced Standards

This section references American Society for Testing and Materials (ASTM), American National Standards Institute (ANSI), and American Water Works Association (AWWA), UNI-Bell PVC Pipe Association (UNI), which are made part hereof by such references, and shall be the latest edition and revision thereof. All material, manufacturing, operations, testing, inspection and production of Poly (Vinyl Chloride) (PVC) sewer pipe shall conform to the following referenced standards:

ASTM C33	Standard Specification for Concrete Aggregates
ASTM D448	Standard Classification for Sizes of Aggregate for Road & Bridge Construction.
ASTM F477	Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe.
ASTM F679	Standard Specification for Poly (Vinyl Chloride) (PVC) Large-Diameter Plastic Gravity Sewer Pipe and Fittings.
ASTM F789	Standard Specification for Type PS-46 and Type PS-115 Poly (Vinyl Chloride) (PVC) Plastic Gravity Flow Sewer Pipe and Fittings.
ASTM F794	Standard Specification for Poly (Vinyl Chloride) (PVC) Profile Gravity Sewer Pipe and Fittings Based on Controlled Inside Diameter.
ASTM D2321	Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications.
ASTM D3034	Standard Specification for Type PSM Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings.
UNI-B-6	Recommended Practice for Low-Pressure Air Testing of Installed Sewer Pipe.

10.6.3 PVC Sewer Materials

The following described materials are approved for use in PVC pipe sewer construction.

10.6.3.1 Pipe and Fittings

Sanitary sewer pipes shall be PVC and conform to: ASTM D3034 SDR 35 for sizes 8 inches to 15 inches in diameter; ASTM F789 for sizes 8 inches to 18 inches (Solid Wall); ASTM F679 for sizes 18 inches to 36 inches (Solid Wall); ASTM F949 for sizes 8 inches to 36 inches (Profile Wall); ASTM F749 for sizes 8 inches to 48 inches (Profile Wall); ASTM F1803 for sizes 18 inches to 60 inches (Profile Wall).

10.6.3.2 Gaskets

Gaskets shall comply with ASTM F477. It shall consist of a properly vulcanized high grade elastomeric compound. The basic polymer shall be natural rubber, synthetic elastomer, or a blend of both. The gasket shall be the only element depended upon to make the joint flexible and water-tight.

10.6.3.3 Lubricant

The lubricant used for assembly shall have no detrimental effect on the gasket or on the pipe. Lubricants shall be in accordance with the manufacturer's recommendations.

10.6.4 Acceptance

Acceptance of the pipe, fittings, and other associated sewer material shall be based on full compliance with these Detail and Technical Specifications.

10.6.4.1 Certification

A manufacturer's certification that the material was manufactured and tested in accordance with these Detail and Technical Specifications together with a report of all test results shall be furnished at the time of shipment.

10.6.5 Receiving, Storage and Handling

The Contractor shall follow the procedures and recommendation for receiving, storage, and handling contained in the Uni-Bell Plastic Pipe Association, "Handbook of PVC Pipe", and as recommended by the manufacturer.

10.6.5.1 Receiving

Pipes not conforming to the requirements of these Detail and Technical Specifications and pipes damaged in transit shall be rejected by the Project Construction Engineer. Acceptance of pipes at the time of delivery does not preclude rejection of the installed sewer pipe which do not conform to these Detail and Technical Specifications.

10.6.5.2 Storage

Pipe shall be stored in unit packages provided by the manufacturer. The unit packages shall be supported by racks to prevent damage to the underside of the pipe. Supports shall be spaced to prevent pipe bending. Stored pipe shall be covered with an opaque material to prevent exposure to direct sunlight while permitting adequate circulation of the air above and around the pipe to prevent excessive heat accumulation. Pipe determined to have been damaged in storage shall be rejected.

10.6.5.3 Handling

Construction equipment shall be operated in a safe and cautious manner so as to prevent damage to the pipe. Blows to the pipe causing impact damage shall be prevented. Pipe and fittings shall not be thrown, dropped, or dragged.

10.6.6 Installation

Installation of PVC pipe shall be in conformance with ASTM D2321, except where modified by these Detail and Technical Specifications.

10.6.6.1 Trenching and Excavation

Trenching and excavation shall be performed in accordance with Section 4.0 of these Detail and Technical Specifications.

10.6.6.2 Bedding and Haunching

The bedding shall be Class B as defined in Section 4.0 of these Detail and Technical Specifications. The bedding material shall conform to ASTM C33 or ASTM D448 gradation No. 67 as modified and shall be brought to proper grade and elevation prior to installation of

pipe and assembly of joints. Depressions for pipe bell shall be provided. Additional bedding material shall then be placed according to Standard Detail S-301, “Standard Detail for Trenching and Bedding”.

10.6.6.3 Jointing Pipe

Assembly of all joints shall be in accordance with the recommendations of the manufacturer. Proper jointing may be verified by rotation of the spigot or with a strap wrench. If unusual jointing resistance is encountered or if the insertion mark does not reach the flush position, the joint shall be disassembled, inspected for damage, the joint components recleaned and the assembly steps repeated.

10.6.6.4 Cutting and Beveling Pipe

For shorter than standard pipe lengths, field cuts may be made with plastic pipe cutters. Ends shall be cut square and perpendicular to the pipe axis. Spigots shall have burrs removed and ends smoothly beveled by a mechanical beveler or by hand with a rasp or file. Field spigots shall be stop-marked with felt tip marker or wax crayon for the proper length of assembly insertion. The angle and depth of field bevels and length to stop-mark shall be comparable to factory pipe spigots.

10.6.6.5 Sanitary Sewer Connections

On all new PVC sewer construction, connections shall be made with Wye’s or Tee’s conforming to ASTM D3034 or F679 whichever is applicable. Only gasketed fittings will be used. Saddle Wye’s and Tee’s with gaskets for the saddle and joints are approved for sanitary sewer service connection to existing PVC sanitary sewers only. Stainless steel straps shall be used to secure the saddle fittings to the main pipe.

10.6.6.6 Water Stops

Whenever the PVC sewer pipe joints a manhole and is encased by the concrete manhole base or a cutout in precast manhole base, waterstops or seals shall be used. See City and County of Denver, Engineering Division Standard Detail No. S-550.

10.6.6.7 Trench Backfill

Backfilling of the trench shall as specified in Section 5.0 of these Detail and Technical Specifications except that no wheeled vehicles shall be used for compaction or other purpose over the installed pipe until the backfill is at least 30 inches thick measured from the top of the pipe to the backfill surface. Mechanical tampers shall not be used until the backfill is at least 48 inches thick. Direct dumping of material over the top of uncovered pipe will not be allowed.

10.6.7 Field Performance and Acceptance Tests

10.6.7.1 Television Inspection

The City will perform a television inspection to verify accuracy of alignment, freedom from debris or obstructions, displacement of gaskets or joints and leaks at joint and service connections. Any of the above discrepancies observed shall be rectified by the Contractor at no cost to the City.

The cost of the initial inspection and the first re-inspection to confirm correction of previously identified deficiencies will be borne by the City. In the event additional inspections are necessary due to inadequate or otherwise unacceptable repairs, the costs for such inspection shall be charged to the Contractor.

10.6.7.2 Air Pressure Test

An air pressure test using the most recent version of UNI-Bell's UNI-B-6 shall be made. The air pressure test outlined in paragraph 9.2.3 of Section 9.0 of these Detail and Technical Specifications will not apply to PVC sewer air testing. The Contractor shall secure adequate copies of UNI-B-6, as published by the Uni-Bell Plastic Pipe Association, and provide at least one copy to the Project Construction Engineer.

10.6.7.3 Infiltration Test

If the ground water level is above the top of the pipe throughout the length being tested, an infiltration test shall be performed. See paragraph 9.2.2 of Section 9.0 of these Detail and Technical Specifications.

10.6.7.4 Deflection Test

A deflection test shall be performed according to paragraph 9.2.5 of Section 9.0 of these Detail and Technical Specifications. The allowable deflection limits shall be a maximum of 5% after construction and 6% at the end of the guarantee period. The allowable deflection shall be based on the base inside diameter of the PVC pipe.

10.6.7.5 Reports

Copies of all certified reports and logs of all tests and inspections conducted shall be submitted to the Project Construction Engineer.

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10.7 Cured In Place Pipe

10.7.1 General

This section outlines the guidelines & requirements for the reconstruction of pipelines and conduits by the Cured in Place Pipe Method (CIPP). CIPP is the installation of a resin-impregnated flexible tube which is inserted into an existing conduit and cured by the use of pressurized steam or circulated water under a hydrostatic head. When complete, the CIPP is continuous and fits tightly to the existing pipe.

10.7.2 Referenced Standards

This section references American Society for Testing and Materials (ASTM) standards, which are made a part of this specification by such reference. All standards shall be the latest edition and revision. The materials, manufacturing, operations, testing, inspection and production of cured in place pipe shall conform to the following standards.

ASTM D638 Standard Test Method for Tensile Properties of Plastics

ASTM D790 Standard Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials

- ASTM D2122 Determining Dimensions of Thermoplastic Pipe & Fittings
- ASTM D2990 Standard Test Methods for Tensile, Compressive, and Flexural Creep and Creep-Rupture of Plastic
- ASTM D5813 Standard Specification for Cured-In-Place Thermosetting Resin Sewer Piping Systems
- ASTM F1216-09 Standard Practice and Rehabilitation of Existing Pipelines and Conduits by the Inversion and Curing of a Resin-Impregnated Tube
- ASTM F1743 Practice of Rehabilitation of Existing Pipelines and Conduits by Pulled-In-Place

10.7.3 Submittals

Unless otherwise specified, the Contractor is responsible to have all submittals transmitted to the Project Construction Engineer in sufficient time to allow two weeks for review and acceptance prior to starting the construction or any work by the Contractor.

10.7.3.1 Installation

Prior to installation by Inversion or the Pulled-in-Place method, the Contractor shall provide the Project Construction Engineer with the following as applicable to the specific installation method:

- a. The minimum pressure required to hold the tube tight against the existing conduit and the maximum allowable pressure so as not to damage the tube. A complete log of the pressure (or head level) shall be maintained on the site and be furnished to the Project Construction Engineer after each installation.
- b. The maximum allowable force that can be used in pulling the tube into the existing pipeline for each size of line. A complete log of the pulling force used for each line shall be maintained on site by the Contractor and be furnished to the Project Construction Engineer after each installation.
- c. Minimum temperature and time required for cure on each size of line, based on installation method.
- d. For CIPP segments which are wet out on site, the Contractor must also submit (in spreadsheet form) information on allowable head pressure, roller spacing and gallons of resin to felt length with respect to diameter so the procedure can be verified on site.

10.7.3.2 Health and Safety Plan

Prior to site work, the Contractor shall provide the Project Construction Engineer, for review and acceptance, a Health and Safety Plan which includes (at a minimum) the following:

- I) Introduction

- a. Provide project description and location and summary of key work activities.

II) Scope and Applicability

- a. Describe the scope of work for the General Contractor and 1st tier subcontractors performing the work
- b. Detail the planned site activities
- c. Describe who must adhere and abide by the Health and Safety plan
- d. Detail how site visitors will be addressed

III) Key Personnel, Responsibilities and Authority

- a. In relation to Health and Safety, describe the role of project managers, health and safety managers, technical supervisors (10.7.3.4), and other contractor and subcontractor staff.
- b. Provide resumes of Key Personnel, including background and training history.
- c. Identify the name, title, and contact information (phone, email, address) for key personnel.
- d. Identify the name, location, and contact numbers for ambulance, fire, police, hospital, Health and Safety managers (contractor and/or subcontractors), and other key personal or support contacts.

IV) Task/Operation Health and Safety Risk Analysis

- a. Identify, on a task specific basis the individual hazard elements that are present including chemical, physical, and biological.

V) Qualifications and Training Requirements for all Personnel

- a. Detail specific qualifications and training that are required.
- b. Discuss the frequency of safety and training refreshers.
- c. Detail the requirement for site personnel to read and acknowledge, in writing, their understanding of the Health and Safety plan.

VI) Engineering and Administrative Controls

- a. Describe in detail how engineering and administrative controls will be used to protect worker and public safety by preventing chemical exposure, injury, or illness.
- b. List controls in conjunction with each activity identified in the Task/Operation Health and Safety Risk Analysis section above.

VII) Personal Protective Equipment (PPE) Requirements

- a. PPE requirements should be listed in conjunction with each activity identified in the Task/Operation Health and Safety Risk Analysis.
- b. Detail applicable standards (e.g., ANSI, NIOSH, ACGIH, etc)

VIII) Health and Safety Monitoring

- a. Detail instruments, samples, and monitoring that will occur both on the jobsite and in response to complaint(s) or inquiries.
- b. Detail who is responsible for performing monitoring
- c. Detail frequency of monitoring
- d. Define the appropriate action levels and thresholds
- e. Describe standard operating procedures for Health and Safety monitoring

IX) Site control

- a. Describe work zones, buddy systems, and site security
- b. Address policies including drug and alcohol policies, personal hygiene requirements, heat and cold stress prevention
- c. Describe task specific site control (e.g., confined space entry, trenching, etc.)

X) Decontamination plan

- a. Eye and hand wash (if applicable)
- b. Site cleanup

XI) Emergency Contingency Plan

- a. Medical services
- b. Emergency phone numbers
- c. Personnel Injury
- d. Fire/Explosion
- e. Evacuation
- f. Emergency signals and communication
- g. First aid
- h. Emergency equipment list
- i. Map(s), addresses, and phone numbers of nearest medical facilities

XII) Appendices

- a. Safety forms (as needed)
- b. Supporting documentation and information
- c. Material safety data sheets (MSDS)

10.7.3.3 Weekly Installation Schedule

The Contractor shall submit a weekly construction schedule, 7 calendar days in advance of the work, to the Project Construction Engineer and the Denver Fire Department to include the following information:

1. The specific line number and related manhole numbers as designated in the project plans. The line length and service connection count information must also be included from the preliminary video investigation.
2. The specific date and timeframe each installation will occur. Night and weekend work must be approved by the Project Construction Engineer a minimum of 48 hours prior to the proposed commencement of the work.
3. The Technical Supervisor's name for the crew(s) that will be doing each specific installation.
4. The method of installation planned for each line in accordance with ASTM F1216 or F1743.
5. The location and schedule of the "wet-outs" in order to permit inspection of the materials and procedures. This information may be submitted separately.

10.7.3.4 Technical Supervision

Due to the technical aspects and complexity of the products used during the installation of CIPP, the Contractor is required to maintain a full time employee with a minimum of five years experience in the CIPP process of rehabilitation. This employee should be at the superintendent level or higher. This employee must be the direct, first line contact for all aspects of the project construction management. Resume and references, and copies of applicable required OSHA training certificates of this employee shall be submitted to the Project Construction Engineer for review and acceptance prior to the start of the project.

10.7.3.5 Test Results and Performance Studies

CIPP sample test results as well as long term performance studies, from an industry recognized independent laboratory, must be submitted for the materials from the specific supplier(s) to be used on the project in accordance with applicable ASTM standards. The CIPP liner material must meet the requirements of ASTM F1216 or F1743 and ASTM D5813 Sections 6 and 8 (Appendix X.1). The resin shall produce CIPP, which will comply with the structural and chemical resistance requirements of ASTM F1216 or F1743. It is required that CIPP samples with and without plastic coating meet these chemical testing requirements. The long term performance studies must show the proposed material consistently meets the required thickness and strength requirements per the Contract Documents.

The Long Term Performance Studies must be submitted and accepted prior to bidding to pre-qualify the prospective bidder. The CIPP liner material used for the project must be the exact same composition of the material used in the Long Term Performance Studies as outlined in this Section. Any deviation in the composition will require that a new Long term Performance Study is completed, submitted and accepted prior to installation.

10.7.3.6 Street Occupancy Permits

The Contractor shall submit, to the Project Construction Engineer, copies of the street occupancy permits, including the approved traffic control plans prior to beginning work.

10.7.3.7 Digital Video and Log Sheets

The Contractor shall submit all log sheets and digital video files for pre and post installation, together, the week immediately following completion of each work segment. All digital video and log sheets must be submitted electronically, *on a USB Plug and Play device (flash drive or hard drive)*. *Video shall be in MP4 format and logs shall be in .pdf format* All video and logs shall be submitted utilizing the following naming convention:

- a. Video Files and Log Sheets
 - i. Named using the following items sequentially, followed by a space
 1. City of Denver Contract Number
 2. Line Number From Plans
 3. GIS Facility ID From Plans (line segment, manhole, etc.)
 4. Type Of File ('Pre' or 'Post' for Video, 'Pre Log' or 'Post Log' for applicable log sheets)
 5. Extension of file (.mp4 or .pdf)
 - ii. Examples:
 1. CCN2012XXXXXX Line72 31814SAGM Post Log.pdf
 2. CCN2012XXXXXX Line72 31814SAGM Post.mp4
 3. CCN2012XXXXXX Line72 31814SAGM Pre Log.pdf
 4. CCN2012XXXXXX Line72 31814SAGM Pre.mp4
 5. CCN2012XXXXXX Line73 31825SAGM Post Log.pdf
 6. CCN2012XXXXXX Line73 31825SAGM Post.mp4

10.7.4 Materials

10.7.4.1 Textile Tube

1. The tube shall meet the requirements of ASTM F1216 or F1743 and ASTM D5813 Sections 6 and 8. The finished CIPP shall be fabricated from materials which when cured will be chemically resistant to withstand internal exposure to domestic sewage. The textile tube shall be continuous in length for the associated run. The wet-out textile tube shall meet ASTM F1216 or F1743, as applicable, have sufficient strength to bridge missing pipe segments and have a uniform thickness that when compressed at installation pressure will equal the specified nominal tube thickness, with a -5% manufacturing tolerance allowed. The tube shall be fabricated to a size that when installed will tightly fit the internal circumference and length of the original pipe. Allowance should be made for circumferential stretching during installation. The minimum length shall be that deemed necessary by the Contractor to effectively span the distance between respective access points, unless otherwise specified. It is the Contractor's responsibility to verify the CIPP lengths and diameters in the field before fabricating the tube.

2. Prior to installation the outside layer of the tube shall be coated with a translucent plastic coated flexible material that clearly allows inspection of the resin impregnation, or wet-out procedure. The plastic coating shall not be subject to delamination after curing of the CIPP. The tube shall be homogenous across the entire wall thickness containing no intermediate or encapsulated elastomeric layers. No materials shall be included in the tubes that are subject to delamination from the cured CIPP.
3. The wall color of the interior pipe surface of the CIPP after installation shall be light green or light brown so that a clear and detailed examination with closed circuit television inspection equipment may be made.
4. The wet-out textile tube shall meet ASTM F1216 or F1743, as applicable, shall have a uniform thickness and 5% to 10% excess resin distribution that when compressed at installation pressures will meet or exceed the design thickness after the cure.

10.7.4.2 Resin

1. The resin/liner system shall conform to ASTM D2990 and ASTM D5813 Section 8.2.2 – 10,000-hour test.
2. The resin shall be a general purpose, unsaturated, styrene-based, thermoset resin and catalyst system or epoxy resin and hardener that are compatible with the inversion or pulled in place process as per the requirements of ASTM F1216 or F1743. The resin shall be tinted so that adequate saturation can be readily observed. Only resin with a minimum long term (50 years) Modulus of Elasticity of 48% of the initial Modulus of Elasticity will be accepted.
3. The tube shall be impregnated with sufficient amount of resin to insure that the resin will be observed on the outer surface of the tube when squeezed. After the tube is cured, it shall show satisfactory evidence of a fully impregnated tube or the existence of excess resin on the outer surface.

10.7.4.3 Calibration Hose

If a calibration hose is required to be used during the process of the installation of the CIPP, the hose shall be wet and vacuum impregnated with sufficient amount of resin prior to inversion to prevent delamination after the curing of the CIPP. Delaminating or failure of the calibration hose will be cause for rejection or complete removal of the CIPP section at the discretion of the Project Construction Engineer.

10.7.4.4 Structural Requirements

1. The CIPP shall be designed as per ASTM F1216, Appendix X.1. The CIPP design shall assume no bonding to the original pipe wall, a fully deteriorated condition, 5% ovality and a conservative groundwater presence over the pipeline. The CIPP thickness must meet the required minimum nominal thicknesses specified in the table below, or for pipe larger than 18-inches in diameter as specified within the Contract Documents.

Internal Pipe Diameter (inches)	CIPP Minimum Nominal Thickness (mm) Based on Modulus of Elasticity Values	
	Modulus of Elasticity (E) 250,000 psi	Modulus of Elasticity (E) 400,000 psi
8	6	5
10	7.5	6
12	9	7.5
15	10.5	9
18	12.5	10.5
For pipe larger than 18-inches in diameter, the CIPP minimum nominal thickness is specified within the Contract Documents		

- The layers of the cured CIPP shall be uniformly bonded. It shall not be possible to separate any two layers with a probe or point of a knife blade so that the layers separate cleanly or the probe or knife blade moves freely between the layers; nor shall separation of the layers occur during the required testing.
- The cured pipe material (CIPP) shall conform to the minimum structural standards, as listed below:

Flexural Stress	ASTM D790	4,500 psi
Modulus of Elasticity	ASTM D790	250,000 or 400,000 psi
Tensile Strength	Pressure Pipe - ASTM D638	3,000 psi

Either of the listed Modulus of Elasticity values noted may be used as long as minimum nominal thicknesses are adhered to in accordance with the table or as noted within the Contract Documents.

10.7.5 Quality Control

It shall be the contractor's responsibility to ensure that the CIPP installed on the project meets all requirements of the Contract Documents and that the final product provided to the City is of the highest quality possible.

10.7.5.1 Testing

In the event that the results of any tests do not meet the requirements of the Contract Documents and/or referenced ASTM standards, the Contractor may proceed with the work at his/her own risk and will be required to submit to the Project Construction Engineer the proposed changes in the process to meet the required properties of the CIPP.

If any lined pipe segment fails to meet the required properties, the Contractor's attention is directed to General Condition 304 – "Substituted Performance". At the discretion of the Project Construction Engineer and at the Contractor's own expense, the Contractor will be

required to remove and replace any lined pipe segment, or install another liner on top of the one that failed in order to meet the specified requirements of the Contract Documents

The City may elect at any time to decrease or increase the frequency of these sample and testing requirements.

10.7.5.1.1 On-Site Thickness Testing

A minimum of 2 (two) samples will be collected or 2 locations tested using ultrasonic methods, for on-site thickness at each installation by the contractor. All samples collected for testing shall be restrained with equivalent diameter pipe to match the actual field installed liner. A minimum of eight measurements at evenly spaced intervals around the circumference (internal or external based on method) of the pipe will be made to ensure that minimum and maximum thicknesses have been achieved. For pipe diameters fifteen inches or greater, a minimum of sixteen evenly spaced measurements shall be recorded. Any plastic coatings or CIPP layers not included in the structural design of the CIPP must be deducted from the measured thickness value. The average thickness will be calculated using all measured values and shall meet or exceed the minimum required design thickness. Additionally, the minimum wall thickness measured at any one point around the circumference shall not be less than 87.5% of the specified design thickness as specified within the Contract Documents.

The wall thickness will be measured in accordance with the applicable sections of ASTM D2122 or ASTM E797 and shall incorporate the following, as applicable:

1. For onsite samples collected for testing: A cylindrical anvil tubing micrometer accurate to +0.02 mm (+0.001 inch) will be used. The minimum wall thickness tests will be performed by the Project Construction Engineer (or assigned field representative) from the two samples at each installation. All costs associated with providing the required samples shall be borne by the Contractor.
2. For onsite testing using Ultrasonic methods: Testing will be performed by the ultrasonic pulse echo method, in accordance to ASTM E797. Measurements will be taken and calculated at both ends of the pipe run, around the internal circumference of the installed CIPP and at a distance of 12 to 18 inches from the end of pipe, as noted in item 1 above. The ultrasonic method will utilize a flaw detector with A-scan display and a direct thickness readout as defined in 6.1.2 of ASTM E797. A calibration block shall be manufactured from the identical materials used in the installed CIPP to calibrate sound velocity through the liner. Calibration of the transducer shall be performed daily in accordance with the equipment manufacture's recommendations.

If the deviation in thickness of any one sample is less than 5% (five percent), no payment adjustment will be required. If the deviation in thickness is measured to be between 5%-10% (five percent and ten percent) an adjustment of 10% (ten percent) reduction of the liner unit bid cost will be applied. If the deviation in thickness is greater than 10% (ten percent), the entire run will be rejected and removed and replaced solely at the Contractor's expense.

10.7.5.1.2 Allowable Pulling Force

Prior to installation, the Contractor shall submit to the Project Construction Engineer the maximum allowable force, per the material manufacturer, that can be used in pulling the tube

into the pipe without rupturing or diminishing the diameter and/or the thickness of the tube. Such pulling force shall be monitored at all times during the installation operation with a gauge that is available for viewing by the City and the tube shall be rejected and removed if the allowable pulling force is exceeded.

10.7.5.1.3 Allowable Elongation of Flexible Tube

Prior to installation, the flexible tube shall be measured and marked equal to the installation run (distance between manholes less one manhole diameter). After the completion of installation, the length of the flexible tube outside of the installation run (face of the manhole to the mark) shall be measured. This length or elongation shall not exceed 3% (three percent) of the original length of measured flexible tube. In the event that this length is exceeded, the entire run length may be rejected and permanently discarded, the Project Construction Engineer may order an additional tube to be inserted at no cost to the City, or may accept the elongated tube, but reduce the price paid for the work by 5% (five percent) for every percent elongation above the 3% (three percent) allowable tolerance, as provided by General Condition 304, Substituted Performance. Acceptance will be at the sole discretion of the Project Construction Engineer.

10.7.5.1.4 Laboratory Testing

At the start of construction, at least two CIPP field samples will be taken and submitted for laboratory testing. CIPP samples shall be prepared and tested in accordance with ASTM F1216.

A CIPP sample is required to be prepared for each installation segment, using one of the following two methods (depending on the size of the host pipe):

1. For pipe sizes of 18 inches or less: the sample will be cut from a section of cured CIPP at an intermediate manhole or at the termination point. If the sample is taken at a termination point the CIPP must have been inverted through a like diameter pipe which has been held in place by a suitable heat sink, such as sandbags.
2. For pipe sizes greater than 18 inches and areas with limited access: the sample must be fabricated from material taken from the tube and the resin/catalyst system used. This fabricated sample must be cured in a clamped mold which is placed in the down tube (when curing using circulating hot water) or in the silencer (when curing using steam). If approved by the Project Construction Engineer, this method can be used for preparing a test sample on any size of CIPP in situations where preparing samples in accordance with section F1216-09, sec. 8.1.1 is not possible due to physical constraints.

Samples must identify the City contract number, project name, line number, date sample was taken and the specified thickness requirement. Testing for cured liner thickness, modulus of elasticity, flexural stress and tensile strength shall be performed by a Certified Independent laboratory approved by the Project Construction Engineer. Test results are to be submitted to the Project Construction Engineer and all costs of tests shall be included in the related bid price unless specified elsewhere in the Contract Documents. The Contractor shall take samples from the first week's installation and have the short term tests completed and results

to the Project Construction Engineer prior to application for the first pay estimate. Additional testing will commence at intervals required by the Project Construction Engineer.

Additional laboratory testing, at the City's expense, may be requested as frequently as every CIPP installation, at the discretion of the Project Construction Engineer. The Contractor will be reimbursed for additional testing at the Contract unit bid price. At the option of the Project Construction Engineer any sample taken by the Contractor may be sent to an independent laboratory for similar testing.

10.7.5.1.5 Infiltration Test

If the ground water level is above the top of the pipe throughout the length being reconstructed, the Project Construction Engineer, at his/her discretion, may order that an infiltration test be performed. The maximum allowable infiltration shall be 50 gal per day/inch dia/mile (.95 gpd/inch/100 ft.). If the infiltration is found to exceed the prescribed amount, the Contractor shall make the appropriate repairs as approved by the Project Construction Engineer. Additional infiltration tests will be performed until acceptable results are obtained.

Unless otherwise specified, infiltration will be measured by a subcontractor specializing in CIPP testing who is mutually agreed upon by the City and Contractor. Payment for this testing is at the City's expense and will be handled by change order.

10.7.5.1.6 Exfiltration Test

In the absence of ground water, the Project Construction Engineer, at his/her discretion, may order an exfiltration test be performed in accordance with these specifications. The allowable rate of exfiltration shall be equal to the limits of infiltration stated above. Each section of CIPP will be tested between successive manholes by closing the lower end of a sewer and the upper manhole(s) to the proper level with water. The water level in the upper manhole shall be a minimum of 4 feet above the level of the ground water.

For the purposes of exfiltration leakage, manholes shall be considered to be equivalent length of pipe equal to the diameter of the manhole (i.e. 48, 60 or 72 inch diameter). Air pocket entrapment shall be avoided when filling the line with water. Once filled with water, the system shall be allowed to stabilize for a period of two hours before starting the test.

Exfiltration leakage rate is determined by measuring the amount of water required to maintain a constant level in the upper manhole. Test duration is to be no less than two hours.

If the leakage, as shown by the test, exceeds the allowable value, the Contractor shall make the necessary correction at his expense to reduce the exfiltration to within the permissible limits. The Contractor shall furnish all water, material and labor required to perform the test. All tests shall be made in the presence of the Project Construction Engineer.

10.7.6 Public Information and Notification

All written notices shall be issued on current City and County of Denver letterhead templates, prepared in a professional manner and must be approved by the Project Construction Engineer prior to distribution. All contact with the Public shall be executed in a business professional manner, including adhering to professional standards regarding courtesy, grooming and maintaining visible/legible identification.

The Public Information and Notification program shall at a minimum, require the Contractor to be responsible for contacting each home or business affected by the sewer construction and informing them of the work to be done in all of the following ways:

1. Personally contacting each home and business owner on the day of pre-installation inspection of the sewer and coordinating with that owner the verification of their existing service connection. If the owner is unavailable, other arrangements shall be made for existing service connection verification.
2. Written notice shall be delivered a minimum of 48 hours in advance of the installation, to each home or business describing the work, schedule, how the construction affects them, and a local telephone number of the Contractor they can call to discuss the project or any problems that may arise.
3. Personally contacting each home or business owner and providing written notice the day prior to beginning work on the section of sewer to which they are connected.
4. Personally contacting any home or business owner which cannot be reconnected within the time stated in the Written Notice. Anticipated service tap reconnection time shall be noted within another notice.
5. Provide written notice with the time of reactivation posted on the front door of a residence or business if and only if personal contact is not possible.
6. Upon request by residents and businesses affected by the work, portable toilets shall be furnished and serviced by the Contractor. Reimbursement for the costs of these items will be covered through change order with the Project Construction Engineer.

10.7.7 Installation

10.7.7.1 Access Points

The City has shown all existing manhole access points on the Contract Documents, to the best of its knowledge. It is the Contractor's responsibility to fully examine the project site to verify the location of existing manholes and to determine if all manholes are accessible, as necessary for completion of the work. It will be the Contractor's responsibility to notify the Project Construction Engineer far enough in advance of the CIPP lining process to allow time for the City to make necessary repairs and provide access to the manholes that are not accessible. The Contractor will reschedule the work as needed so that repair work, either by the City or by the Contractor, can be completed.

10.7.7.2 Pre-Installation Inspection

Inspections of pipelines shall be performed by experienced personnel trained in locating and identifying defects, breaks, obstacles, and service connections by closed circuit television. Certification by NASSCO, PACP program is preferred for inspection personnel. The pre-inspection of pipelines shall also determine active service connections, the addresses served (both visible on the digital recording and audible), as well as which service connections are opened, capped or misaligned. Only active service connection and laterals shall be re-established unless directed otherwise by the Project Construction Engineer.

The interior of the pipeline shall be carefully inspected to determine the location of any conditions which may prevent proper installation of the CIPP. It is the Contractor's responsibility to notify the Project Construction Engineer of any conditions which may prevent proper installation of the CIPP. These types of conditions shall be recorded and submitted digitally, as described elsewhere in these specifications, to the Project Construction Engineer within 5-calendar days of observance, to allow for remedial action and rescheduling of installation for that section of CIPP.

10.7.7.3 Bypassing Sewage

The Contractor shall provide for the flow of sewage around the section or sections of pipe designated for reconstruction. The bypass shall be made by plugging the line at an existing upstream manhole or adjacent system. The pump and bypass lines shall be of adequate capacity and size to handle the flow with backup pumps onsite. Bypass pumps must be monitored at all times. Leaking equipment will not be permitted. Bypass pumping must be provided for all mainline and service line flows affected by construction. Wastewater shall not be allowed to spill into storm drains, street gutters, or open excavations. Any spills that occur must be addressed immediately and in full conformance with local regulations and requirements. The Project Construction Engineer shall be notified immediately and the Contractor shall bear all costs associated with any spills.

10.7.7.4 Cleaning of the Sewer Line

The Contractor shall be required to remove all existing internal debris from the sewer line with the use of water jet, and/or grinding equipment that is accepted by the Project Construction Engineer. The cleaning operation shall remove any and all existing debris so that each pipe joint can be thoroughly inspected and successfully reconstructed or rehabilitated. Excessively hard deposits that can not be removed by regular cleaning equipment or grinding which require special tools to remove, will be paid for negotiated separately by the City

All sludge, dirt, sand, rocks, grease, and all other solid or semi-solid material resulting from the cleaning operation shall be removed at the downstream manhole of the section being cleaned. Passing material from one manhole section to another shall not be permitted.

All such debris resulting from cleaning operations shall be removed from the site and disposed of in a proper manner. The Contractor shall bear all costs associated with testing of debris and proper dumping. Dumping of the debris shall be in accordance with all local, state, and federal regulations. The City will negotiate for costs associated with material disposal if Hazardous Wastes are encountered during testing.

At the end of each work day, all debris shall be removed from the downstream manhole and from the construction site. No debris shall be left at the construction site unattended by the Contractor. Under no circumstances will the Contractor be allowed to accumulate debris beyond the stated time limit. In the event the Contractor leaves debris unattended at the construction site beyond the stated time, the Contractor will not be allowed to proceed with the work until the debris is properly removed.

During all sewer cleaning operations, precautions shall be taken to protect the sewer lines from damage that might be inflicted by improper use of cleaning equipment. Precautions shall be

taken to ensure that the cleaning operation will not cause any damage or flooding to public and/or private property being served by the sewer line section involved. The Contractor shall bear all costs associated with flooding, damage to basements or structures, and the City's sewer.

10.7.7.5 Line Obstructions

It shall be the responsibility of the Contractor to clear the line of obstructions such as solids and roots that will prevent the installation of the CIPP. If the pre-installation inspection reveals an obstruction such as a protruding service connection, dropped joint, collapse or obstruction that will prevent the rehabilitation process and cannot be removed by conventional sewer cleaning equipment, grinding or extended tap cutting, then the Contractor shall notify the Project Construction Engineer immediately. These conditions shall be recorded and a digital video file and log sheet must be submitted to the Project Construction Engineer so that the existing conditions are documented and may be reviewed to determine the extent of repair required prior to CIPP installation. The Project Construction Engineer will notify the Contractor upon completion of required repair(s), at which time the Contractor shall perform sewer line cleaning and a pre-installation inspection prior to CIPP installation.

10.7.7.6 Methods

All bidders proposing to use the CIPP process for a project must use a method that has been approved by the City prior to bid opening. All approved CIPP methods must meet these Detail and Technical Specifications. Any proposed deviation from these Detail and Technical Specifications must be submitted in writing for acceptance at least eight calendar days prior to the bid opening. CIPP installation shall be in accordance with ASTM F1216, Section 7 for the Inversion Method, or Section 6 of ASTM F1743 for the Pulled-In-Place Installation Method, with the following requirements:

1. The Contractor shall designate a location where the tube will be impregnated prior to installation. The Contractor shall notify the Project Construction Engineer of proposed "wet-outs" in order to inspect the materials and procedure. A resin and catalyst system compatible with the requirements of this method shall be used.
2. Once inversion has started, the pressure shall be maintained between the minimum and maximum pressures, as set by the liner's manufacturer, until cure completion. A continuous, constant pressure must be maintained for all air inversion steam cure (AISC) installations. If pressure is lost at any time during installation/cure (for inversion or pulled in place methods), the City may request that the CIPP product be removed and the line segment re-inspected, at the contractor's expense, prior to allowing re-installation and curing.
3. The Contractor shall pull or invert the flexible tube through the existing sewer line in a method which has been reviewed and approved by the Project Construction Engineer. The Contractor will not be allowed to use water to float the inserted flexible tube into the existing sewer line. Immediately after installation of the tube, a heat source will be applied to start the curing process. Constant pressure shall be maintained until the tube has completely cured out.

4. The heat source shall be fitted with suitable monitors to gauge the temperature of the incoming and outgoing heat supply. Another such gauge shall be placed at the remote manhole to determine the temperature at that location during cure. The Contractor must maintain an on-site written log during the CIPP curing process for each installation, tracking temperature, pressure (for steam cure) and curing time. This log must be available for review at any time by the Project Construction Engineer. If air pressure and steam are used, a Safety Gas Detector shall be used to ensure that it does not reach the explosive limit.
5. As noted within the submittals portion of this specification, before the installation process begins, the Contractor shall submit to the Project Construction Engineer, the minimum pressure required to hold the tube tight against the existing conduit (including considerations for external ground water pressure, if present) and the maximum allowable pressure to avoid damaging the tube. This data shall be obtained by the Contractor from the tube manufacturer.

If the CIPP is installed via inversion, the pressure shall be maintained between the minimum and maximum pressures until the entire operation has been completed (inversion and cure). If the CIPP is installed using the pulled-in-place method, the pressures shall be maintained, after initial inflation, between the minimum and maximum pressures until the entire operation has been completed (inflation and cure).

If the pressure drops below the recommended minimum at any time during installation or curing of the CIPP, the liner should be removed and the host pipe re-inspected for dislodged pipe fragments or fallen debris which may cause bulging or protrusions within the cured CIPP. In addition, under the above circumstances, the CIPP product should be inspected for lifts or delaminations and evaluated for its ability to fully meet the applicable ASTM F1216 and F1743 requirements. Should the pressure deviate from within the range of minimum and maximum pressures, the installed tube may be rejected and the Contractor will be responsible for the removal of the CIPP and replacement with new CIPP at no additional cost to the City.

Once the cure has started and dimpling for laterals is completed, the required pressures shall be sustained until the cure has been completed. A complete log of the pressures shall be maintained on the site and furnished to the Project Construction Engineer after each installation.

6. The plastic coating of the tube shall be translucent to allow visual proof that the resin has wet out the entire tube and that there are no dry areas.
7. The Contractor shall maintain a log on site for each installation section documenting elongation, thickness and pulling force.
8. The finished CIPP shall be continuous over the entire length of an installation run between two manholes and be free, as commercially practicable, from visual defects such as foreign inclusions, dry spots, pinholes, folds and delamination.
9. If the CIPP fails to make a tight seal at each manhole, the Contractor shall apply a joint sealant at that point with a material compatible with the CIPP. The Contractor shall

provide a submittal to the Project Construction Engineer for approval on the proposed sealant material.

10. Individual installation runs can be made over one or more manhole sections as determined in the field by the Contractor. The maximum allowed installation run is 1,200 feet. Intermediate manholes will be reopened as directed by the Project Construction Engineer.

10.7.7.7 Sewer Service Connection and Reactivation

The Contractor shall determine if a service connection is active prior to rehabilitation of the sewer. Only active service connections and laterals shall be re-established. All costs incurred to verify active service connections are included within the "Cured-In-Place-Pipe" bid item within the contract. No additional payment for verification shall be considered.

After the curing of the CIPP has been completed, the Contractor shall reopen and restore the existing active service connections and branch connections. It is the intent of these Detail and Technical Specifications that the active service connections and branch connections be reopened without excavation. When the pipe size is too small to facilitate direct manned reactivation, a remotely controlled cutting device, monitored by a close circuit television camera shall be used. The cutting device is required to re-establish service connections to not greater than 100% (one hundred percent) capacity, and not less than 95% (ninety five percent) capacity, while conforming to the shape of the existing opening. The Contractor shall be responsible for completing point repairs of any active service connections that are damaged or misaligned during reactivation procedures. These point repairs shall be completed as directed and approved by the Project Construction Engineer and all costs shall be born by the Contractor.

The Contractor shall certify he/she has a minimum of 2 (two) complete working cutting devices, plus spare key components on the site before each installation.

Service connections shall not remain out of service for more than 12 hours at a time, without the Contractor providing some means of temporary facilities or hotel accommodations for the affected residents or property owners.

10.7.8 Post Installation Inspection

Post installation video inspection of all CIPP line segments shall be completed by the contractor and recorded using closed circuit television in accordance with ASTM F1216 or F1743. The post inspection of pipelines shall be performed in a manner which allows the invert to be clearly viewed and inspected. The recorded video must show that all active service connections have been reactivated, the addresses served (both visible on the digital recording and audible), as well as any inclusions or visual defects present. All service connections and laterals which are not plugged or capped shall be re-established unless directed otherwise by the Project Construction Engineer. The contractor shall review all post inspection videos and notify the City immediately of any visual defects, inclusions, or issues with the installation. Digital video records shall be submitted, as described elsewhere in these specifications.

10.7.9 Clean-Up

The Contractor shall reinstate all project areas affected by their operations to an equal or better condition than existing upon completion of the CIPP installation. All restoration must be completed prior to submitting that section of CIPP for consideration for payment.

10.7.10 Record Documentation

1. Digital Video and Log Sheets

The Contractor is required to provide pre and post video files, as well as associated log sheets, for all pipe segments rehabilitated under the contract. All video and log sheets must be submitted to the City and County of Denver. All digital video files shall be submitted in .mp4 format and log sheets shall be submitted in .pdf format. All files will be labeled in accordance with the instructions provided by the Project Construction Engineer.

Pre and post inspection log sheets and digital video should be submitted together the week immediately following completion of each work segment, unless the contractor is submitting pre-inspection results separately to convey potential problem areas to the Project Construction Engineer. Log sheets and digital video files not submitted at least 5 business days prior to a pay estimate cut-off date will not be considered for payment until the following month. It is the Contractor's responsibility to submit digital video media and log sheets in a timely fashion and as outlined in these specifications.

2. Redline Drawings

A final set of red-lined drawings shall be submitted by the Contractor on a clean, full size set of project plans for As-Built creation purposes prior to processing final payment and releasing remaining retainage. A clean set of project plans may be obtained from the Project Construction Engineer upon request.

The red-lined drawings shall include the following: location and size of all pipe segments rehabilitated, the location of all restored service connections (showing distances from the upstream manhole), and the field recorded length of each rehabilitated segment (face of manhole to face of manhole). Providing inaccurate or incomplete record information is reason for withholding of progress payment as outlined in the General Contract Conditions.

10.7.11 Patents

The Contractor and the Contractor's suppliers shall warrant and save harmless the City against any and all claims, potential litigation involving patent infringement, copyright violations and any loss thereof.

End of Specification



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CITY AND COUNTY OF DENVER
DEPARTMENT OF PUBLIC WORKS | ENGINEERING DIVISION

Storm Drainage and Sanitary Sewer Construction Detail and Technical Specifications

10.8 Formed-In-Place PVC Trenchless Repair Method

10.8.1 General

This section defines the approved materials and methods for the rehabilitation of existing sewer pipelines by the use of a Formed-In-Place PVC pipeliner for pipes four (4) inches to fifteen (15) inches in diameter.

The Formed-In-Place PVC pipeliner process is defined as the rehabilitation of gravity sanitary sewers by the insertion of a folded PVC pipeliner which is the formed into a circular liner to support and protect the existing pipe. The liner is reformed to fit the host pipe by the use of either steam or hydrostatic head. When cured, the finished Formed-In-Place PVC liner shall be continuous and tight fitting.

10.8.2 Methods

All bidders purposing to use the Formed-In-Place PVC process for a project must use a method that has been approved by the Engineering Division prior to bid opening. All approved methods must meet these Detail and Technical Specifications. Any proposed

deviation from the Detail and Technical Specifications must be submitted in writing for acceptance at least eight calendar days prior to the bid opening.

There will be no deviation from the Formed-In-Place PVC pipeliner thickness specified.

10.8.3 Referenced Standards

This specification references American Society for Testing and Materials (ASTM), which are made part hereof by such references, and shall be the latest edition and revision thereof. All material, manufacturing, operations, testing, inspection and production of Formed-In-Place PVC Liners shall conform to the following referenced standards:

- ASTM D638 Standard Test Method for Tensile Properties of Plastics.
- ASTM D790 Standard Test Method for Flexural Properties of Unreinforced and Reinforced Plastics.
- ASTM D792 Standard Test Method for Density and Specific Gravity of Plastics by Displacement.
- ASTM D1784 Standard Specification for Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds.
- ASTM D2122 Standard Test Method for Determining Dimensions of Thermoplastic Pipe and Fittings.
- ASTM D2152 Standard Test Method for Adequacy of Fusion of Extruded Poly (Vinyl Chloride) (PVC) Pipe and Molded Fittings by Acetone Immersion.
- ASTM D2444 Standard Test Method for Determination of the Impact Resistance of Thermoplastic Pipe and Fittings by Means of a Tup (Falling Weight).
- ASTM D2990 Standard Test Methods for Tensile, Compressive, and Flexural Creep and Creep-Rupture of Plastics.
- ASTM F1057 Standard Practice for Estimating the Quality of Extruded Poly (Vinyl Chloride) (PVC) Pipe by the Heat Reversion Technique.
- ASTM F1504 Standard Specification for Folded Poly (Vinyl Chloride) (PVC) Pipe for Existing Sewer and Conduit Rehabilitation.
- ASTM F1947 Standard Practice for Installation of Folded Poly (Vinyl Chloride) (PVC) Pipe into Existing Sewers and Conduits.

10.8.4 Submittals

The Contractor shall furnish engineering data covering design and installation. Submittals shall be sent to the Project Construction Engineer for approval prior to the start of construction, unless noted otherwise. The data to be submitted shall include the following:

10.8.4.1 Liner Vendor Technical Data

The Contractor shall submit the Vendor's specific technical data with complete physical properties and pertinent dimensions for the proposed project.

The pipeliner shall be sized such that when reformed, it will fit tightly against the internal circumference of the original sewer conduit. The Contractor shall take necessary measurements in the field to properly size the liner and shall verify the length of the pipe to be lined prior to ordering the liner.

10.8.4.2 Certificates

A certificate of “Compliance with Specifications” shall be furnished for all materials supplied.

10.8.4.3 Work Plan

The Contractor shall submit a work plan that lays out the execution of the project from start to finish. The work plan shall include, but is not limited to site access, site preparation, traffic control, bypass pumping, pre-installation preparation and testing.

10.8.4.4 Installation

The Contractor shall submit information about the procedure and the steps to be followed for the installation of the Formed-In-Place PVC pipeliner method selected, even if the process is named in the specifications. Any proposed changes in installation procedures shall require submittal of revised procedures for acceptance by the Project Construction Engineer. The installation submittal shall also include minimum and maximum allowable pressure and temperatures from the liner manufacturer so as not to damage the tube during liner reforming.

10.8.4.5 Resin and Other Components

The Contractor shall submit full details about the resin and other component materials and their properties, except those protected by trade secrets which may harm their claim to the product.

10.8.4.6 Digital Video and Log Sheets

The Contractor shall submit all log sheets and digital video files for pre and post installation, together, the week immediately following completion of each work segment. All digital video and log sheets must be submitted electronically, *on a USB Plug and Play device (flash drive or hard drive)*. *Video shall be in MP4 format and logs shall be in .pdf format* All video and logs shall be submitted utilizing the following naming convention:

- a. Video Files and Log Sheets
 - i. Named using the following items sequentially, followed by a space
 1. City of Denver Contract Number
 2. Line Number From Plans
 3. GIS Facility ID From Plans (line segment, manhole, etc.)
 4. Type Of File (‘Pre’ or ‘Post’ for Video, ‘Pre Log’ or ‘Post Log’ for applicable log sheets)
 5. Extension of file (.mp4 or .pdf)
 - ii. Examples:
 1. 2012xxxxx Line72 31814SAGM Post Log.pdf
 2. 2012xxxxx Line72 31814SAGM Post.mp4
 3. 2012xxxxx Line72 31814SAGM Pre Log.pdf

4. [2012xxxxx Line72 31814SAGM Pre.mp4](#)
5. [2012xxxxx Line73 31825SAGM Post Log.pdf](#)
6. [2012xxxxx Line73 31825SAGM Post.mp4](#)

10.8.4.7 Long Term Performance Studies

Submittals shall include long term performance studies of material from universities, and/or research institutes, and/or independent laboratories, using applicable ASTM standards.

10.8.5 Formed-In-Place PVC Trenchless Process Technical Supervision

Due to the technical aspects and complexity of specifications for the products used during the installation for the approved Engineering Division Formed-In-Place PVC Trenchless Repair (Fold and Form) Methods of Rehabilitation, the Contractor is required to maintain a full time employee with a minimum of three years experience in the Formed-In-Place PVC Trenchless Repair (Fold and Form) Methods of Rehabilitation. This employee should be at the superintendent level or higher. Resume and references of this employee shall be submitted to the Project Construction Engineer for review and approval prior to the start of the project.

10.8.6 Formed-In-Place PVC Material and Physical Property Requirements

10.8.6.1 Material Specifications

The PVC pipeliner shall be manufactured from virgin PVC resin, which has no fillers, and has the following minimum physical properties:

Minimum Pipe Stiffness at 5% Deflection

PIPE SIZE in. (mm)	PIPE STIFFNESS, psi (kPa)					
	PS-1	DR 35	PS-2	DR 35	PS-3	DR 35
	for material with a minimum cell classification of 13223-B [280,000 psi (1.93 GPa) minimum modulus]		for material with a minimum cell classification of 12334-B [320,000 psi (2.21 GPa) minimum modulus]		for material with a minimum cell classification of 12344-B [360,000 psi (2.48 GPa) minimum modulus]	
8 to 15 (203 to 381)	31 (219)		36 (250)		41 (285)	

Rounded Pipe Flexural Properties

Cell Classification	Flexural Modulus, psi (GPa)
13223-B	280,000 (1.93)
12334-B	320,000 (2.21)
12344-B	360,000 (2.48)

10.8.6.2 Linear Physical Properties Before and After Lining

The outside diameter and minimum uniform thickness shall be manufactured to a size that when installed will fit the internal circumference of the pipe and ensure the pipeliner’s ability to attain a tight fit. Allowance shall be made for misaligned and missing conduit.

A Standard Dimension Ratio (SDR) of 35 is required of all pipeliners, unless otherwise approved by the Project Construction Engineer. The following table shows recommended size ranges.

Folded Pipe Nominal Outside Diameter In. (mm)	Recommended Existing Pipe Inside Diameter Range In. (mm)		Resulting DR over Diameter Range
	Minimum	Maximum	DR 35
8 (203)	7.4 (188)	8.4 (213)	32-40
9 (229)	8.3 (211)	9.4 (239)	32-40
10 (254)	9.3 (236)	10.5 (267)	32-40
12 (305)	11.3 (287)	12.8 (325)	32-40
15 (381)	13.9 (353)	15.7 (399)	32-40

Note: The minimum and maximum recommended existing pipe inside diameter shown in the above Table are mean inside diameters along the pipe length and are not intended as absolute limits on localized dimensions. Consult the manufacturer for use of folded PVC pipe for sizes of existing pipe beyond the recommended ranges shown. Special diameters and DR available.

The pipeliner must be capable of lining bends, like those created by offsets, up to 90 degrees without vertical buckling or ripping.

No degradation of the pipeliner’s physical properties may occur due to processing or during installation.

The final product of the reconstructed pipe shall be a continuous pipe without joints, over the entire length of the pipe between two manholes. The Contractor shall verify the liner lengths required in the field prior to manufacturing. Individual insertion runs can be made through more than one manhole section at a time as determined in the field by the Contractor and approved by the Project Construction Engineer.

The pipeliner shall be free from reverse curvatures, flat spots and visual defects. The lining shall be impervious and free of any leakage. The inner surface of the pipe shall be free of cracking and have a smooth finish. The Project Construction Engineer will not allow any imperfections which may affect the flow characteristics of the sewer pipe.

10.8.6.3 General Corrosion Requirements

The Formed-In-Place PVC liner shall be fabricated from materials which, when cured, will be chemically resistant to, and able to withstand exposure to conditions that normally occur in sewer conveying domestic sewage. That includes exposure to hydrogen sulfide gas and dilute sulfuric acid.

10.8.6.4 Markings

The pipeliner shall be marked at maximum five (5') foot intervals with a coded number system to indicate manufacturer, size (diameter and SDR), material, extrusion date, and production shift that fabricated the pipeliner. The marking code shall be changed with each production shift change.

10.8.6.5 Shipping and Handling

Pipeliner shall be coiled continuously for the length of the proposed extrusion (no joints) on wooden reels with a minimum of a 48" diameter core for protection from kinking and gouging during shipping, handling, and storage.

10.8.7 Quality Control

10.8.7.1 Material Testing

Each production spool of pipeliner shall be inspected and tested at the time of manufacture for defects, in accordance with ASTM D-2444, ASTM D-2152, and ASTM D-2122. All pipeliner shall be homogeneous, uniform in color, free of cracks, holes, foreign material, blisters, and deleterious faults. A production spool of pipeliner shall include markings to clearly discern from other production spools.

10.8.7.2 Allowable Pulling Force

The Contractor shall inform the Project Construction Engineer as to the maximum allowable force that can be used in pulling the tube into the pipe without rupturing or diminishing the diameter and/or the thickness of the tube. Such pulling force shall be monitored at all times during the insertion operation and the tube shall be rejected and removed if the allowable pulling force is exceeded.

10.8.7.3 Allowable Elongation of Flexible Tube

Prior to insertion, the flexible tube shall be measured and marked equal to the insertion run (distance between manholes less one manhole diameter). After the completion of insertion,

the length of the flexible tub outside of the insertion run (face of the manhole to the mark) shall be measured. This length or elongation shall not exceed 3% (three percent) of the original length of measured flexible tube. In the event that this length is exceeded, the entire run length may be rejected and permanently discarded, the Project Construction Engineer may order an additional tube to be inserted at no cost to the City, or the Project Construction Engineer may accept the elongated tube, but reduce the price paid for the work by 5% (five percent) for every percent elongation above the 3% (three percent) allowable tolerance, as provided by General Condition 304, Substituted Performance. The acceptance of one of these will be at the sole discretion of the Project Construction Engineer.

10.8.7.4 Laterals and Services (Taps) Reconnection

The Contractor shall determine if a service connection is active prior to rehabilitation of the sewer. Only active service connections and laterals shall be re-established. The Contractor shall be responsible for completing point repairs of any active service connection that is opened and misaligned. This point repair shall be as directed and approved by the Project Construction Engineer.

10.8.8 Installation Responsibilities for Incidental Items

10.8.8.1 Access Points

The Engineering Division will endeavor to locate and designate all manhole access points, open and make access points available to the work.

10.8.8.2 Cleaning of the Sewer Line

The Contractor shall be required to remove all internal debris from the sewer line with the use of water jet equipment.

The cleaning operation shall remove any and all debris so that each joint pipe can be thoroughly inspected and successfully reconstructed.

All sludge, dirt, sand, rocks, grease, and all other solid or semi-solid material resulting from the cleaning operation shall be removed at the downstream manhole of the section being cleaned. Passing material from one manhole section to another shall not be permitted.

All such debris resulting from cleaning operations shall be removed from the site and disposed of in the proper manner. The Contractor shall bear all costs associated with testing of debris and proper dumping unless provided for elsewhere in the Contract Documents. Dumping of the debris shall be in accordance with all local, state, and federal regulations.

All debris shall be removed from the downstream manhole and the site no less often than at the end of each workday. No debris shall be left at the site unattended by the Contractor. Under no circumstances will be the Contractor be allowed to accumulate debris beyond the stated time. In the event the Contractor leaves debris unattended at the site beyond the stated time, the Contractor will not be allowed to proceed with the work until the debris is properly removed.

During all sewer cleaning operations, satisfactory precautions shall be taken to protect the sewer lines from damage that might be inflicted by improper use of cleaning equipment. Precautions shall be taken to ensure that the cleaning operation will not cause any damage or

flooding to public and/or private property being served being served by the sewer line section involved. The Contractor shall bear full costs associated with any flooding or damage to basements or structures.

10.8.8.3 Bypassing Sewage

The Contractor shall provide for the flow of sewage around the section or sections of pipe designated for reconstruction. The bypass shall be made by plugging the line at an existing upstream manhole or adjacent system. The pump and bypass lines shall be of adequate capacity and size to handle the flow. Bypassing includes all mainline and service line bypassing required. Wastewater shall not be allowed to spill into storm drains, street gutters, or open excavations. Any spills that occur must be taken care of properly and immediately. The Project Construction Engineer shall be notified immediately and the Contractor shall bear all costs associated with any spills.

10.8.8.4 Inspection of Pipelines

Inspections of pipelines shall be performed prior to liner insertion by experienced personnel trained in locating breaks, obstacles, and service conditions by closed circuit television. The inspection of pipelines is also to determine active service connections and the addresses which they serve. The interior of the pipeline shall be carefully inspected to determine the location of any conditions which may prevent proper installation of the pipeliner into the pipelines, and it shall be noted so that these conditions can be corrected. A videotape and suitable log shall be kept for later reference by the Engineering Division.

10.8.8.5 Line Obstructions

It shall be the responsibility of the Contractor to clear the line of obstructions such as solids and roots that will prevent the insertion of the pipeliner. If pre-installation inspection reveals an obstruction such as a protruding service connection, dropped joint, or a collapse that will prevent the inversion process, and it cannot be removed by conventional sewer cleaning equipment, then the Contractor shall make a point repair excavation to uncover and remove or repair the obstruction. Such excavation shall be approved in writing by the Project Construction Engineer prior to the commencement of the work and shall be considered as a separate pay item as provided in the Proposal Forms or by Change Order.

10.8.8.6 Additional Convenience Manholes

The Contractor may be allowed to add manholes to the existing lines, for the convenience of manipulation during installation, at no cost to the City and County of Denver, at the sole discretion of the Project Construction Engineer.

The Contractor will be allowed to add manholes only if the **Traffic Control** requirements are not violated, and all materials, equipment, and work required to complete the additional manholes (including surface restoration) is in accordance with these Detail and Technical Specifications and Capital Project Management Standard Details.

10.8.8.7 Laterals and Services (TAPS) Reconnection

All lateral connections shall be provided with a water tight connection between the new rehabilitated pipeliner conduit and the old service connection. During construction and within the warranty period, after the laterals and services (taps) connections have been reactivated, if in the opinion of the Project Construction Engineer there is a gap between the liner and the host pipe, the gap shall be sealed to the satisfaction of the Project Construction Engineer. The Contractor shall submit and obtain approval from the Project Construction Engineer for the material and the method used to seal the connection. No additional payment will be made for this work.

The Contractor shall determine if a service connection is active prior to rehabilitation of the sewer. Only active service connections and laterals shall be re-established. The Contractor shall be responsible for completing point repairs of any active service connection that is opened and misaligned. This point repair shall be as directed and approved by the Project Construction Engineer.

10.8.9 Public Relations

The Public Information and Notification program shall at a minimum, require the Contractor be responsible for contacting each home or business affected by the sanitary sewer construction and informing them of the work to be done in all of the following ways:

1. Written notice shall be delivered to each home or business describing work, schedule, how the construction affects them, and a local telephone number of the Contractor they can call to discuss the project or problems, that may arise.
2. Personally contacting each home and business owner on the day of pre-installation inspection of the sewer and coordinating with that owner the verification of their existing service connection. If the owner is unavailable, other arrangements shall be made for existing service connection verification.
3. Personally contacting each home or business owner and providing written notice the day prior to beginning work on the section of sewer to which they are connected.
4. Personally contacting any home or business owner which cannot be reconnected within the time stated in the written notice.
5. If required, portable toilets shall be furnished and serviced by the Contractor for businesses affected by construction. The costs of these items are considered to be included in the cost of CIPP. No additional payment will be made by the City.
6. A complete Public Information and Notification Program shall be submitted in writing to Project Construction Engineer.

10.8.10 Installation Procedures

Installation instructions and procedures submitted and approved for the project shall be followed during installation. Any proposed changes in installation procedures shall be submitted to the Project Construction Engineer for approval, prior to installation.

10.8.10.1 Liner Insertion

The pipeliner shall be inserted into the existing sewer with a power winch and steel cable connected to the end of the liner by use of an appropriate pulling head. Length of the pipeliner to be inserted at any time shall be governed by the winch drum capacity and winching power available, and consideration of the size and condition of the sewer.

The Contractor shall submit to the Project Construction Engineer the tensile strength of the liner at the recommended temperature of the liner prior to insertion, and the recommended pulling force to pull the liner in place.

Precautions shall be taken to prevent any damage to the liner as it is pulled in place. Once insertion is initiated, it is desirable to continue the pull at a rate of no greater than 5 to 10 feet per minute to completion.

A cable shall be strung through the existing conduit (and containment tube, if applicable) and attached to the folded pipe. The folded pipe shall be heated along the entire length and pulled, with a power winch unit and the cable, directly from the spool, through the insertion point, through the containment tube (if utilized) and within the existing pipe to the termination point. A dynamometer shall be provided on the winch or cable to monitor the pulling force. Pulling forces shall be monitored so as not to exceed the axial strain limits of the folded pipe material as recommended by the manufacturer.

After insertion is complete, the winch cable shall be secured at the termination end and the folded pipe shall be cut off at the insertion point and secured.

10.8.10.2 Liner Reformation and Processing

Temperature and pressure must be logged while reforming and processing and may be accomplished through suitable temperature and pressure gages placed at the insertion and termination points. Through the use of heat and pressure, the PVC pipeliner shall unfold and expand sufficiently to press against the wall of the existing sewer pipe, lock into joints, and form dimples at the services. Pipeliners shall produce visibly recognizable service dimples and shall visibly conform to joints in the host pipe to ensure a tight fit. The heat, pressure, and period of processing shall be in accordance with the manufacturer's recommendations for establishing a new thermoplastic memory. For PVC pipeliners, processing temperatures range from 225 to 235 degrees F, and pressures in the range of 5 to 10 PSI, but may vary based upon field conditions, and in no case shall ever exceed 15 PSI for protection of the host pipe.

The Contractor shall maintain pressure on the liner, the heat shall be discontinued, and cool air in sufficient volume shall be injected to reduce the temperature to below 90 degrees F before relieving pressure.

Air pressure and/or steam shall be used with a Safety Gas Detector to ensure that it does not reach the explosive limit.

Before the insertion process begins, the minimum and maximum pressure and temperature that was submitted for installation shall be posted on-site. Once the insertion has started, the pressure shall be maintained between the minimum and maximum pressures until the

operation has been completed. The equipment shall be fitted with a pressure gage accurate to 0.01 psi. Should the pressure deviate from within the range of minimum and maximum pressures, the installed pipeliner shall be rejected and the Contractor will remove and dispose of the tube at no cost to the City.

A complete log of the temperature, steam pressure, and the air pressure shall be maintained on the site and shall be furnished to the Project Construction Engineer after each insertion. If water is added, that pressure shall also be included.

Pressure testing shall be completed prior to reestablishing services.

10.8.11 Finish

The installed Formed-In-Place PVC pipeliner shall be continuous over the entire length of a segment insertion run from manhole to manhole and shall be free, as commercially practicable, from visual defects such as foreign inclusions, concentrate ridges, discoloration, pitting, dry spots, pinholes, delamination, varying wall thickness (within the bounds of the existing sewer pipe), and other deformities. Pipeliner with gashes, nicks, abrasions, or any such physical damage which may have occurred during storage and/or handling, which are larger/deeper than 10 percent (10%) of the wall thickness shall not be used and shall be removed from the construction site.

The installed Formed-In-Place PVC pipeliner shall meet the physical properties and leakage/pressure test requirements as specified.

10.8.12 Manhole Sealing and Benches

The PVC pipeliner by nature of the processing creates a tight seal at the insertion and termination points of the manholes. The PVC pipeliner within the manhole shall be neatly cut off at a minimum of 4 inches (4") away from the manhole wall. The invert in the manhole shall be a smooth continuation of the pipe(s) and shall be merged with other lines, if any. The channel cross-section shall be U-shaped and in accordance with the Engineering Division Detail and Technical Specifications. The side channels shall be built up with mortar/concrete to provide benches according with the Engineering Division Detail and Technical Specifications and Standard Details.

If due to broken or misaligned pipe at the manhole wall, the Formed-In-Place PVC pipeliner fails to make a tight seal, the Contractor shall apply a seal at that point with material compatible with the PVC pipeliner.

All manholes shall be individually inspected for water migration, cut-offs, benches, and invert works.

10.8.13 Service Reconnections

Once the pipeliner has been reformed, processed and tested the Contractor shall reopen/restore the existing active service connections and branch connections. It is the intent of these specifications that active service connections and branch connections be reopened without excavation, from the interior of the pipeline utilizing a remotely controlled cutting device, monitored by a close circuit television camera, that re-establishes them to not greater

than 100% (one hundred percent) capacity, and not less than 95% (ninety five percent) capacity, while conforming to the shape of the existing opening.

The service reconnection method proposed by the Contractor must be approved by the Project Construction Engineer.

The Contractor shall certify he/she has a minimum of 2 (two) complete working cutting devices, plus spare key components on the site before each insertion.

No additional payment will be made for excavations for the purpose of reopening connections and the Contractor will be responsible for all costs and liability associated with such excavation and restoration.

No service connection shall remain out of service for more than 24 hours at a time without the Contractor providing some means of temporary facilities or hotel accommodations for the residents.

10.8.14 Inspection of the Formed-In-Place PVC Pipeliner

Testing will be required after the pipeliner has been installed in the existing sewer pipe. The test is a low pressure air test of the Formed-In-Place PVC pipeliner before any service connections to the pipeliner have been made. The purpose of this test is to check the integrity of the pipeliner and to verify that the pipeliner has not been damaged when pulling it into the existing sewer pipe.

10.8.14.1 Physical Testing

Sample from each spool (or as directed by the Project Construction Engineer) shall be tested in a local lab. Formed-In-Place PVC Pipeliner shall be sampled and tested in accordance with Sections 10 and 11 of ASTM F1504, and the properties shall meet or exceed these specified herein (please refer to 10.8.6.1 Material Specifications).

10.8.14.2 Low Pressure Test

After a manhole to manhole section of the sewer pipe has been lined, it shall be plugged at each manhole with pneumatic plugs. The design of the plugs shall be such that they will hold against the test pressure without requiring external blocking or bracing. One of the plugs shall have three (3) air hose connections, one for inflation of the plug, one for reading of the pressure into the sealed line, and one for introducing air into the sealed line.

The test section shall be pressurized to 4 PSI and held above 3.5 PSI for not less than two (2) minutes. Air shall be added if necessary to keep the pressure above 3.5 PSI. At the end of this two (2) minutes stabilization period, the pressure shall be noted (must be 3.5 PSI minimum) and the time period shall begin. If the pressure drops 0.5 PSI in less time than given in the following table, the section of pipe shall have failed the test.

Pressures on next page

Sewer Size Inches	Minimum Test Time Minutes
8	4.0
10	5.0
12	6.0
15	7.5
18	7.5

When the prevailing groundwater is above the sewer lined pipe being tested, test pressure shall be increased 0.43 PSI for each foot that the water table is above the invert.

10.8.14.3 Visual Inspection

Visual inspection shall be done prior to rehabilitation and upon completion of the Project. The Contractor will provide the Engineering Division with the original color VHS video tape or streaming video on CD of each section of pipe involved in the Project and the cutsheets for same upon completion of the Project. The tape or CD will include both the before and after conditions, and restored connections with addresses each connection serves, in audio, on the video.

10.8.14.4 Infiltration Test

If the ground water level is above the top of the pipe throughout the length being reconstructed, and is so ordered by the Project Construction Engineer, an infiltration test shall be performed. See paragraph 9.2.2 of Section 9.0 of the Detail and Technical Specifications portion of these Specifications.

10.8.14.5 Exfiltration Test

In the absence of ground water, and if so ordered by the Project Construction Engineer, an exfiltration test shall be performed in accordance with paragraph 9.2.1 of Section 9.0 of the Detail and Technical Specifications portion of these Specifications. The allowable rate of exfiltration shall be equal to the limits of infiltration.

10.8.15 Reports

Copies of all certified reports and logs of all tests and inspections conducted shall be submitted to the Project Construction Engineer.

10.8.16 Clean-Up

Upon acceptance of the installation work and testing, the Contractor shall reinstate the project area affected by this operation.

10.8.17 Patents

The Contractor and the Contractor's supplier shall warrant and hold harmless the City and County of Denver against any and all claims and potential litigation involving patent infringement and copyright violations and any loss thereof.

End of Specification



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DEPARTMENT OF PUBLIC WORKS | ENGINEERING DIVISION

Storm Drainage and Sanitary Sewer Construction Detail and Technical Specifications

10.20 Pipe Bursting

10.20.1 Intent

It is the intent of this specification to provide for the replacement of existing pipelines and conduits by bursting or crushing the existing pipeline and replacing it with either the same size or larger diameter pipe.

10.20.2 Methods

All bidders on this project must construct the Trenchless Replacement of Sanitary Sewers with a process that has been approved by Wastewater Management Division prior to bid opening.

All approved methods must meet these Detail and Technical Specifications. Any proposed deviation from these Detail and Technical Specifications must be submitted in writing for acceptance at least ten (10) calendar days prior to the bid opening. Any and all departures from these Detail and Technical Specifications must be pointed out and shown on the material submitted.

Special Condition SC-8, **Substitution** of these Specifications refer to substitution of processes other than herein approved.

10.20.3 Inspection of Pipelines

Inspections of pipelines shall be performed by experienced personnel trained in locating breaks, obstacles, and service conditions by closed circuit television. The inspection of pipelines is also to determine active service connections and the addresses which they serve. A videotape and suitable log shall be kept for later reference by Wastewater Management Division.

10.20.4 Public Relations

The Public Information and Notification program shall as a minimum require the Contractor to be responsible for contacting each home or business connected to the sanitary sewer and informing them of the work to be done, and when the sewer will be off-line and the following:

10.20.4.a

Written notice to be delivered to each home or business describing work, schedule, how it affects them, and a local telephone number of the Contractor they can call to discuss the project or problems.

10.20.4.b

Personal contact on the day of pre-installation inspection of the sewer. Each lateral shall be verified by having the homeowner run water down their drain. If the homeowner is unavailable, other arrangements shall be made to drain water through the lateral.

10.20.4.c

Personal contact and written notice the day prior to beginning work on the section of sewer to which they are connected.

10.20.4.d

Personal contact with any home or business which cannot be reconnected within the time stated in the written notice.

10.20.4.e

If so required by a served business, portable toilets for their use by their employees will be furnished and serviced by the Contractor. The costs of these items are considered to be included in the cost of CIPP. No additional payment will be made by the City.

10.20.4.f

The Public Information and Notification Program shall include the minimum of the above. A complete program shall be submitted in writing to the Project Construction Engineer.

10.20.5 Approved Material for Trenchless Replacement of Sanitary Sewers

10.20.5.a Materials

High Density Polyethylene Pipe (HDPE) shall conform to requirements of Type III, Class C, Category 5, Grade P34 as defined in the latest revision of ASTM D-1248. All solid wall HDPE pipe and fittings shall be manufactured in accordance with ASTM F-714. Pipe and fittings shall be made from virgin high density plastic compounds, with no rework compound except that obtained from the manufacturer's own production of the same formulation, which comply with the requirements for a minimum cell classification of PE 345434C as defined by ASTM D-3350. HDPE pipe shall have an inside surface in light color (e.g. natural, white, green, etc.) to allow light reflection for television inspection.

10.10.5.b Physical Properties

Pipes, fittings and joints shall meet the following minimum requirements at the time of installation:

Density	0.941 gm/cc	ASTM D-1505
Melt Index	< 0.15 gm/10 min.	ASTM D-1238
Initial Flexural Modulus	110,000 psi	ASTM D-790
Long-Term Flexural Modulus	28,200 psi	Continuous load duration of 50 years at design load conditions, certified by manufacturer.
Initial Flexural Strength	3,000 psi	ASTM D-790
Long-Term Flexure Strength	1,500 psi	Continuous load duration of 50 years at design load conditions, certified by manufacturer.
Environmental Stress Cracking Resistance	F20=192	ASTM D-1693, Test Condition C (failure % = hours).
Hydrostatic Design Basis	1,600 psi	ASTM D-2837
Color & Ultraviolet Stabilizer	Black, with 2% carbon black	ASTM D-3350

Certification

Manufacturer shall provide certification that the pipe and fittings meet the minimum specified physical properties, and has sufficient ultraviolet stabilizer for a minimum two (2) years storage life.

Workmanship

The pipe and fittings shall be homogeneous throughout and free of any blemishes, wrinkles, ribs, protrusions, holes, visible cracks, foreign materials, blisters or other deleterious faults or any defects.

10.20.5.c Joints

Sections of HDPE pipe shall be assembled and joined on the job site. Jointing shall be accomplished by the heating and butt-fusion method in strict conformance with the manufacturer's printed instructions. It is the sole responsibility of the Contractor to provide an acceptable water-tight butt-fusion joint. Joint strength shall be equal to or greater than the pipe and shall indicate a ductile rather than brittle fracture when tested. If sectional HDPE pipe is used, it shall be joined in accordance with the manufacturer's recommendation for a leakproof, stab joint method using EPDM O-ring synthetic elastomer gaskets.

Where excavations for HDPE pipe installation are made between manholes, pipe ends shall be jointed by butt-fusion joints, or when recommended by the pipe supplier, with a full circle seal clamp made of stainless steel hardware and a rubber sleeve. Seal clamps shall be manufactured by Rockwell, Dresser, or approved equal. The minimum clamp length shall be fifteen inches (15").

10.20.5.d Saddles

Reconnection of service laterals to installed HDPE pipe shall be accomplished using heat fusion saddles. Heat fusion saddles shall be made of polyethylene pipe that meets the minimum specified physical properties and is suitable for fusion welding. Fusion saddles shall be Branch Saddle as manufactured by Driscopipe, Miller, Dupont, or approved equal.

10.20.5.e Flexible Couplings

Connections to existing service laterals shall be made using flexible couplings. All flexible couplings shall conform to ASTM C-425 and shall be as manufactured by Fernco Joint Sealer Co., DFW Plastics, Inc., or approved equal.

10.20.5.f Restrained Joint Polyvinyl Chloride (PVC) Pressure Pipe

10.20.5.g Material

Restrained Joint PVC Pressure Pipe shall conform to the requirements of the latest revision of ASTM D-2241. All restrained joint PVC pipe and fittings shall be manufactured from a specially formulated PVC compound which contains impact modifiers and ultraviolet inhibitors. In accordance with ASTM D-1784, all pipe and fittings shall be made from a compound utilizing Type 1, Grade 1, 2000 psi hydrostatic design stress material, Class 12454-B.

10.20.5.h Physical Properties

Pipe, fittings and joints shall meet the following minimum requirements at the time of installation:

Izod Impact	1.15 ft-lb./in. of notch	ASTM D-256
Tensile Strength	7,000 psi	ASTM D-638
Modulus of Elasticity	40,000 psi	ASTM D-638
Deflection Temperature	158° F	ASTM D-648
Chemical Resistance	B	ASTM D-543

Elongation	150%	ASTM D-638
Flammability	Self-Extinguishing	ASTM D-635

Certification

Manufacturer shall provide certification that the pipe and fittings meet the minimum specified physical properties.

Workmanship

The pipe and fittings shall be homogeneous throughout and free of any blemishes, wrinkles, ribs, protrusions, holes, visible cracks, foreign materials, blisters or other deleterious faults or any other defects.

10.20.5.i Joints

Sections of PVC pipe shall be assembled and permanently joined on the job site. Jointing shall be accomplished by use of machined grooves on the pipe and in the joining coupling which, when aligned, allow a spline to be inserted, resulting in a fully circumferential restrained joint that locks the pipe and couplings together. A flexible elastomeric seal (O-ring) in the coupling provides a hydraulic pressure seal.

Joints shall meet the requirements of ASTM D-3139, and the O-rings shall meet the requirements of ASTM F-477. Couplings shall be provided with factory installed O-rings.

10.20.6 Bypassing Sewage

The Contractor shall provide for the flow of sewage around the section or sections of pipe designated for reconstruction. The bypass shall be made by plugging the line at an existing upstream manhole or adjacent system. The pump and bypass lines shall be of adequate capacity and size to handle the flow. Bypassing includes all mainline and service line bypassing required. Wastewater shall not be allowed to spill into storm drains, street gutters, or open excavations. Any spills that occur must be taken care of properly and immediately. The Wastewater Management Division shall be notified immediately and the Contractor shall bear all costs associated with any spills.

10.20.7 Service Connections

After the trenchless replacement of the pipe has been completed, the Contractor shall reopen / restore the existing active service connections and branch connections. No service connection shall remain out of service for more than twenty-four (24) hours at a time without the Contractor providing some means of temporary facilities or hotel accommodations for the residents.

No additional payment will be made for excavations for the purpose of reopening connections and the Contractor will be responsible for all costs and liability associated with such excavation and restoration work.

10.20.8 Reports

The Contractor will provide the Wastewater Management Division with a color videotape. The tape will include both the before and after conditions, and restored connections with addresses each connection serves, in audio, on the videotape. Copies of all certified reports and logs of all tests and inspections conducted shall be submitted to the Field Engineer.

10.20.9 Clean-up

Upon acceptance of the installation work and testing, the Contractor shall reinstate the project area affected by this operation.

10.20.10 Payment

Payment for work included in this section will be in accordance with the prices set forth in the proposal for the quantity of work performed. Progress payments will be made monthly based on the work performed during that period.

10.20.11 Patents

The Contractor and the Contractor's supplier shall warrant and save harmless the City and Wastewater Management Division against any and all claims and potential litigation involving patent infringement and copyright violations and any loss thereof.

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Storm Drainage and Sanitary Sewer Construction Detail and Technical Specifications

10.20 Pipe Bursting

10.20.1 Intent

It is the intent of this specification to provide for the replacement of existing pipelines and conduits by bursting or crushing the existing pipeline and replacing it with either the same size or larger diameter pipe.

10.20.2 Methods

All bidders on this project must construct the Trenchless Replacement of Sanitary Sewers with a process that has been approved by Wastewater Management Division prior to bid opening.

All approved methods must meet these Detail and Technical Specifications. Any proposed deviation from these Detail and Technical Specifications must be submitted in writing for acceptance at least ten (10) calendar days prior to the bid opening. Any and all departures from these Detail and Technical Specifications must be pointed out and shown on the material submitted.

Special Condition SC-8, **Substitution** of these Specifications refer to substitution of processes other than herein approved.

10.20.3 Inspection of Pipelines

Inspections of pipelines shall be performed by experienced personnel trained in locating breaks, obstacles, and service conditions by closed circuit television. The inspection of pipelines is also to determine active service connections and the addresses which they serve. A videotape and suitable log shall be kept for later reference by Wastewater Management Division.

10.20.4 Public Relations

The Public Information and Notification program shall as a minimum require the Contractor to be responsible for contacting each home or business connected to the sanitary sewer and informing them of the work to be done, and when the sewer will be off-line and the following:

10.20.4.a

Written notice to be delivered to each home or business describing work, schedule, how it affects them, and a local telephone number of the Contractor they can call to discuss the project or problems.

10.20.4.b

Personal contact on the day of pre-installation inspection of the sewer. Each lateral shall be verified by having the homeowner run water down their drain. If the homeowner is unavailable, other arrangements shall be made to drain water through the lateral.

10.20.4.c

Personal contact and written notice the day prior to beginning work on the section of sewer to which they are connected.

10.20.4.d

Personal contact with any home or business which cannot be reconnected within the time stated in the written notice.

10.20.4.e

If so required by a served business, portable toilets for their use by their employees will be furnished and serviced by the Contractor. The costs of these items are considered to be included in the cost of CIPP. No additional payment will be made by the City.

10.20.4.f

The Public Information and Notification Program shall include the minimum of the above. A complete program shall be submitted in writing to the Project Construction Engineer.

10.20.5 Approved Material for Trenchless Replacement of Sanitary Sewers

10.20.5.a Materials

High Density Polyethylene Pipe (HDPE) shall conform to requirements of Type III, Class C, Category 5, Grade P34 as defined in the latest revision of ASTM D-1248. All solid wall HDPE pipe and fittings shall be manufactured in accordance with ASTM F-714. Pipe and fittings shall be made from virgin high density plastic compounds, with no rework compound except that obtained from the manufacturer’s own production of the same formulation, which comply with the requirements for a minimum cell classification of PE 345434C as defined by ASTM D-3350. HDPE pipe shall have an inside surface in light color (e.g. natural, white, green, etc.) to allow light reflection for television inspection.

10.10.5.b Physical Properties

Pipes, fittings and joints shall meet the following minimum requirements at the time of installation:

Density	0.941 gm/cc	ASTM D-1505
Melt Index	< 0.15 gm/10 min.	ASTM D-1238
Initial Flexural Modulus	110,000 psi	ASTM D-790
Long-Term Flexural Modulus	28,200 psi	Continuous load duration of 50 years at design load conditions, certified by manufacturer.
Initial Flexural Strength	3,000 psi	ASTM D-790
Long-Term Flexure Strength	1,500 psi	Continuous load duration of 50 years at design load conditions, certified by manufacturer.
Environmental Stress Cracking Resistance	F20=192	ASTM D-1693, Test Condition C (failure % = hours).
Hydrostatic Design Basis	1,600 psi	ASTM D-2837
Color & Ultraviolet Stabilizer	Black, with 2% carbon black	ASTM D-3350

Certification

Manufacturer shall provide certification that the pipe and fittings meet the minimum specified physical properties, and has sufficient ultraviolet stabilizer for a minimum two (2) years storage life.

Workmanship

The pipe and fittings shall be homogeneous throughout and free of any blemishes, wrinkles, ribs, protrusions, holes, visible cracks, foreign materials, blisters or other deleterious faults or any defects.

10.20.5.c Joints

Sections of HDPE pipe shall be assembled and joined on the job site. Jointing shall be accomplished by the heating and butt-fusion method in strict conformance with the manufacturer's printed instructions. It is the sole responsibility of the Contractor to provide an acceptable water-tight butt-fusion joint. Joint strength shall be equal to or greater than the pipe and shall indicate a ductile rather than brittle fracture when tested. If sectional HDPE pipe is used, it shall be joined in accordance with the manufacturer's recommendation for a leakproof, stab joint method using EPDM O-ring synthetic elastomer gaskets.

Where excavations for HDPE pipe installation are made between manholes, pipe ends shall be jointed by butt-fusion joints, or when recommended by the pipe supplier, with a full circle seal clamp made of stainless steel hardware and a rubber sleeve. Seal clamps shall be manufactured by Rockwell, Dresser, or approved equal. The minimum clamp length shall be fifteen inches (15").

10.20.5.d Saddles

Reconnection of service laterals to installed HDPE pipe shall be accomplished using heat fusion saddles. Heat fusion saddles shall be made of polyethylene pipe that meets the minimum specified physical properties and is suitable for fusion welding. Fusion saddles shall be Branch Saddle as manufactured by Driscopipe, Miller, Dupont, or approved equal.

10.20.5.e Flexible Couplings

Connections to existing service laterals shall be made using flexible couplings. All flexible couplings shall conform to ASTM C-425 and shall be as manufactured by Fernco Joint Sealer Co., DFW Plastics, Inc., or approved equal.

10.20.5.f Restrained Joint Polyvinyl Chloride (PVC) Pressure Pipe

10.20.5.g Material

Restrained Joint PVC Pressure Pipe shall conform to the requirements of the latest revision of ASTM D-2241. All restrained joint PVC pipe and fittings shall be manufactured from a specially formulated PVC compound which contains impact modifiers and ultraviolet inhibitors. In accordance with ASTM D-1784, all pipe and fittings shall be made from a compound utilizing Type 1, Grade 1, 2000 psi hydrostatic design stress material, Class 12454-B.

10.20.5.h Physical Properties

Pipe, fittings and joints shall meet the following minimum requirements at the time of installation:

Izod Impact	1.15 ft-lb./in. of notch	ASTM D-256
Tensile Strength	7,000 psi	ASTM D-638
Modulus of Elasticity	40,000 psi	ASTM D-638
Deflection Temperature	158° F	ASTM D-648
Chemical Resistance	B	ASTM D-543

Elongation	150%	ASTM D-638
Flammability	Self-Extinguishing	ASTM D-635

Certification

Manufacturer shall provide certification that the pipe and fittings meet the minimum specified physical properties.

Workmanship

The pipe and fittings shall be homogeneous throughout and free of any blemishes, wrinkles, ribs, protrusions, holes, visible cracks, foreign materials, blisters or other deleterious faults or any other defects.

10.20.5.i Joints

Sections of PVC pipe shall be assembled and permanently joined on the job site. Jointing shall be accomplished by use of machined grooves on the pipe and in the joining coupling which, when aligned, allow a spline to be inserted, resulting in a fully circumferential restrained joint that locks the pipe and couplings together. A flexible elastomeric seal (O-ring) in the coupling provides a hydraulic pressure seal.

Joints shall meet the requirements of ASTM D-3139, and the O-rings shall meet the requirements of ASTM F-477. Couplings shall be provided with factory installed O-rings.

10.20.6 Bypassing Sewage

The Contractor shall provide for the flow of sewage around the section or sections of pipe designated for reconstruction. The bypass shall be made by plugging the line at an existing upstream manhole or adjacent system. The pump and bypass lines shall be of adequate capacity and size to handle the flow. Bypassing includes all mainline and service line bypassing required. Wastewater shall not be allowed to spill into storm drains, street gutters, or open excavations. Any spills that occur must be taken care of properly and immediately. The Wastewater Management Division shall be notified immediately and the Contractor shall bear all costs associated with any spills.

10.20.7 Service Connections

After the trenchless replacement of the pipe has been completed, the Contractor shall reopen / restore the existing active service connections and branch connections. No service connection shall remain out of service for more than twenty-four (24) hours at a time without the Contractor providing some means of temporary facilities or hotel accommodations for the residents.

No additional payment will be made for excavations for the purpose of reopening connections and the Contractor will be responsible for all costs and liability associated with such excavation and restoration work.

10.20.8 Reports

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11.0 Structures and Appurtenances

11.0.1 General

Except where otherwise indicated in these Detail and Technical Specifications, manholes, special structures, box culverts, vaults, storm inlets, and other miscellaneous structures and appurtenances shall conform to the details included in these Specifications or as shown on the drawings. All concrete and reinforcing for structures shall conform to the requirements set forth in the most recent Standard Specifications for Road and Bridge Construction, by the Colorado Department of Transportation, as described below, or otherwise modified herein.

1. CDOT Section 601 Structural Concrete

CDOT Section 601 Structural Concrete shall be utilized and revised as follows:

Class D Concrete will be utilized for all structural concrete work; using $\frac{3}{4}$ " nominal sized aggregate (100% passing the 1" sieve and 90% to 100% passing the $\frac{3}{4}$ " sieve).

Type II Portland Cement will be used.

Subsection 601.05 shall be revised to include:

The concrete used in upper deck slabs shall have a maximum substitution of fly ash for portland cement of 10% by weight.

CDOT Subsection 601.19 shall be revised as follows:

Method of measurement shall be deleted. Method utilized will be as specified elsewhere in the Contract Documents.

Subsection 601.20 shall be revised as follows:

Basis of payment will be deleted. Basis of payment utilized will be as specified elsewhere in the Contract Documents.

2. CDOT Section 602 Reinforcing Steel

CDOT Section 602 Reinforcing Steel shall be utilized and revised as follows:

Subsection 602.02 shall be revised as follows:

Epoxy coated reinforcing steel will not be utilized unless otherwise specified in the Contract Documents.

Subsection 602.07 shall be revised as follows:

Method of measurement will be deleted. Method utilized will be as included otherwise in the Contract Documents.

Subsection 602.08 shall be revised as follows:

Basis of payment will be deleted. Basis of payment will be as included otherwise in the Contract Documents.

11.0.2 Manholes

Except where otherwise specified or indicated on the drawings, storm and sanitary sewer manholes shall conform to the requirements as set forth below. Manholes 6’ (six foot) in diameter or smaller shall be constructed of precast concrete or cast-in-place concrete as outlined in the Standard Detail Drawings or within the Contract Documents. Type B and Type P manholes shall be cast in place only, unless specified otherwise in the contract documents. All manholes and related component items shall be designed for AASHTO HS20 loading.

11.0.2.1 Size

The minimum internal diameter of the manhole barrel shall be as follows for both storm and sanitary sewer installations (please refer to the Standard Detail Drawings).

Pipe Size	MH Barrel I.D.	Standard Top Section	Standard Detail
30” dia. and smaller	4’-0”	Concentric Cone	S501.1
30” to 36”	5’-0”	Concentric Cone	S501.1
42” and larger	Type B or P or Special Detail	As detailed	S503 S504

Note: Standard ring and cover is 24 inch diameter.

11.0.2.2 Materials

The materials to be used in the construction of sewer manholes shall conform to the following requirements:

1. Precast Reinforced Concrete Manhole Sections

Precast manhole sections including barrels, cones, flat tops, etc. shall be manufactured in accordance with ASTM C-478, Precast Reinforced Concrete Manhole Sections. All cones furnished shall be concentric except for manholes with less than 4 feet of cover, which shall be flat top. Concrete used in precast manhole bases shall have a minimum 28 day compressive strength of 5000 psi, and shall be constructed of Type II, Portland Cement. Welded wire fabric used in precast manhole sections shall be as specified in ASTM C-478. These precast manhole elements are intended to be utilized as components of non-pressurized sewer and manhole systems only. Pressure systems were warranted and authorized by the Division will require special design pressure manholes, joints, and other appurtenant items.

2. Cast-in-Place Concrete Manholes

All concrete used in construction of cast-in-place manholes and bases shall be CDOT Class D. Construction shall be in conformance with the Standard Detail Drawings.

3. Structural Reinforcement

All structural reinforcement shall be placed in accordance with the Standard Detail drawings and in conformance with this specification.

4. Frame and Cover

Unless otherwise noted on the drawings, frame and covers for manholes and special structures shall be the current Denver Standard pattern, manufactured by an approved foundry. Castings shall, at the minimum, meet the requirements of ASTM A48, Class 35B, and other Agency requirements as a condition of approval. Horizontal bearing surfaces of all rings and covers shall be machined to eliminate any rocking action or non-uniform bearing. Castings shall not be dipped or painted prior to field inspection and acceptance. Refer to the Standard Detail Drawings for additional requirements.

5. Manhole Steps

Manhole steps shall not be allowed, unless otherwise specified within the Contract Documents.

6. Flexible Plastic Joint Sealing Compound

All joints in the manhole barrel, cone and/or flat top sections including the joint between the cast-in-place base and the bottom barrel section, shall be sealed with an approved preformed, flexible plastic gasket conforming to the following requirements:

- a. The flexible plastic gasket shall be in conformance with ASTM C-990-91, AASHTO M198-B, and ASTM C-990, latest versions.

- b. The plastic sealing compound shall be packaged in extruded pre-formed rope-like shapes of proper size to completely fill the joint when completely compressed, as per the pipe manufacturer's recommendations. The material shall be protected by a suitable, removable two-piece wrapper that may be removed as the compound is applied to the joint surface without disturbing the other wrapper, which remains attached to the compound for protection. The sealing compound shall be impermeable to water, have high immediate bonding strength to the concrete surface and shall maintain permanent plasticity, as well as resistance to water, acids, and alkalis inherent in sewer systems.
- c. All lifting holes shall be permanently and properly sealed with the plastic sealing compound or an approved concrete grout.

7. Adjustment

Grade rings shall be used to adjust and set final rim elevations, brick is not allowed. A 3-inch cast iron riser shall be used in conjunction with grade rings on all construction within streets. Cast iron shall conform to ASTM C62, Grade SW [AASHTO M114].

8. Mortar and Grout

Mortar and grout used in the shaping of inverts, grade ring gaps, setting and anchoring cast iron street fabrications, etc., shall consist of one part Type II Portland Cement and two parts of fine, clean sand. Only sufficient water shall be added to provide a stiff, workable cement mixture for proper troweling. Hydrate lime or masonry cement shall not be used. Where relatively thin portions of grout are to be applied to the flow channel, top of bench, etc., and approved epoxy bonding coat shall be applied to the exposed concrete surfaces prior to grouting.

11.0.2.3 Bases and Inverts

Except as otherwise shown on the drawings, manhole bases shall be constructed of cast-in-place or precast concrete, as shown in the Standard Detail Drawings, and as otherwise described in these Detail and Technical Specifications. Inverts may be cast separately, but shall be constructed of cast-in-place concrete. All concrete used for these applications shall meet the requirements set forth in section 11.0.2.2 of these Detail and Technical Specifications.

1. Sanitary Sewer Manholes

Sanitary Sewer manholes are normally designed and constructed such that inverts of the influent and effluent sewers are at the same relative elevation with sufficient drop to compensate for pressure head losses occurring in the manhole. Therefore except for special cases, the bench around the flow channel shall be constructed to the outside top of the largest pipe in the manhole. The top of the bench shall be poured with a slope towards the flow channel with an overall cross slope not exceeding ½ inch. Flow channels shall have smooth, rounded inverts shaped to match the lower half of the pipe. Proper shaping shall be accomplished by forming or shaping with a proper cement grout mixture. Changes in direction of flow through the manhole shall be made with a smooth continuously-curved channel utilizing the maximum radius possible. Changes in the size

of channels, multiple flow channels, or changes in invert slopes, shall be made gradually and evenly, and shall be formed directly in the concrete.

- a. Outside Drops. Whenever specified on the Drawings, directed by the Project Construction Engineer, or where the elevation difference between the incoming sewer inverts and the outgoing invert is 18 inches or greater, an outside drop shall be constructed. The diameter of the drop shall not be less than the diameter of the incoming sewer pipe to be dropped. A concrete encasement will be required around the drop pipe as shown and detailed within the Wastewater Management Division Standard Details, S-530.

Quantities and costs for the outside drop configuration shall be measured and paid for separately from the manhole unless otherwise specified.

2. Storm Sewer Manholes

Flow channels in storm sewer manholes shall be as shown in the Standard Detail Drawings for the particular type of manhole base utilized. Except for special situations, and where specifically noted, outside manhole drops will not be required. All exposed channel edges and cut pipe edges shall be grouted smooth. The minimum thickness of the cast-in-place concrete at any point shall not be less than 6-inches. The construction of the manhole base and shaping of inverts, including all pipes within the dimensions of the manhole, will be considered to be incidental to the construction of the manhole and all costs shall be included in the unit price bid for the manhole structure.

11.0.2.4 Stub-Outs and Block-Outs

Block-outs are the preferred method of construction for future connections. These shall be constructed as specified within the Contract Documents.

Where stub-outs are specifically indicated on the drawings and where a specified pipe size for future connections is to be constructed, the pipe used for stubbing shall extend a nominal 2 feet beyond the outside of the manhole barrel, unless otherwise noted, and shall terminate with a bell end [or spigot end if applicable]. The pipe end shall be sealed with an approved, pre-fabricated plug or cap conforming to the joint detail of the pipe supplied. For pipe greater than or equal to 30-inches in diameter, a full section of pipe shall be installed as the manhole stub. Shop drawings shall be submitted for approval.

The use of brick or concrete fill as a means of plugging will only be permitted on sewers that are to be abandoned. Unless otherwise stated in the contract documents, stub-outs and plugs or caps will be considered to be incidental to the construction of the associated manholes, and all costs incurred shall be included in the unit price bid for the manhole structure.

11.0.2.5 Flexible Booted Connections

Flexible watertight rubber boots for the jointing of any sewer pipe to any precast manhole base, barrel section, inlet box, or vault shall conform to the Specifications contained herein and to the Standard Detail Drawings. Flexible connectors shall meet the requirements of ASTM C923.

11.0.3 Structures

11.0.3.1 Concrete

All structural concrete shall be CDOT Class D, with the revisions noted within this section.

11.0.3.2 Reinforcement

All structures shall be reinforced as shown on the Drawings or within the Standard Details. All reinforcing steel shall be ASTM A-615, Grade 60 with deformed bars.

11.0.4 Concrete Flatwork

11.0.4.1 Concrete

All flatwork shall be CDOT Class D, unless otherwise approved by the Project Engineer.

11.0.4.2 Reinforcement

All required reinforcement shall be in accordance with the Contract Documents.

11.0.5 Storm Inlets

The work under this subsection shall consist of furnishing all materials and constructing concrete catch basins, including excavation, concrete removal and backfill. Work shall be done at the locations designated on the project plans and in accordance with the Standard Detail Drawings and other requirements of the Contract Documents. All inlet structures and related components shall be designed for AASHTO HS20 loading conditions.

11.0.5.1 Concrete

Concrete shall be Class D, with a minimum 28-day strength of 4500 psi. Cement used in concrete shall conform to ASTM Designation C-150 Type II cement. All concrete used for these applications shall meet the requirements set forth within these Detail and Technical Specifications.

11.0.5.2 Masonry Mortar

Masonry mortar (grout) shall be composed by volume of one part portland cement, two parts fine aggregate, one fifth part hydrated lime and sufficient water to provide a plastic mixture. Mortar in concrete fill shall obtain a 28 day strength of 2000 psi.

11.0.5.3 Reinforcement

All inlets shall be reinforced as shown on the Drawings or Standard Details. All reinforcing steel shall be ASTM A-615, Grade 60 with deformed bars. The diameter of bend measured on the inside of the bar shall be 6 bar diameters. All reinforcing steel shall be 2" clear minimum from formed surfaces and 3" clear against earth unless otherwise noted. Splicing of reinforcing steel shall be permitted only where detailed on the Drawings.

11.0.5.4 Connectors

Connectors for single inlets shall be 15" diameter (min.) with desired slope of 1 percent, for double inlets connectors shall be 18" diameter with desired slope of 1.8 percent and for triple inlets connectors shall be 21" with a desired slope of 1.8 percent. All connections to main

line storm sewers shall be cored and collared in accordance with the Standard Detail Drawings. Saw cutting and/or jack hammering will not be permitted.

11.0.5.5 Castings (No. 16 Inlets)

Frame shall be Denver Standard Pattern and grate where required shall be No. 16 Grate (Standard Detail-S-716). All castings shall conform to ASTM A-48 (Class 35b) with a minimum tensile strength of 35 ksi. Castings shall not be dipped or painted prior to field inspection; once castings are approved by the Division for project usage, they shall be coated with an approved material. All castings shall be heavy duty and capable of withstanding AASHTO H-20 loadings. Horizontal bearing surfaces of all frames and grates shall be machined to eliminate any rocking action or non-uniform bearing.

11.0.5.6 Steps

Manhole steps shall not be allowed, unless otherwise specified within the Contract Documents.

11.0.5.7 Construction Requirements

All storm inlets shall be constructed of cast-in-place concrete, unless specifically approved for precast construction by the City.

1. Bedding and Backfill

All catch basins/inlets shall be cast in place. Subgrade shall be Class B Bedding compacted to 90% maximum dry density (AASHTO designation T-180). Backfill shall be hand tamped in 6" lifts, Backfill Method B.

2. Inlet Depths

Desired depths for single inlets shall be 3.5 feet (flow line to floor), for double inlets depth shall be 4 feet and for triple inlets depth shall be 4.5 feet. Inlets are designed to allow for 6 foot depth maximum; for depths greater than 6 feet, shop drawings and design analysis shall be submitted for approval by the Project Construction Engineer.

3. Forming

Inlets shall be formed both inside and out; casting of sidewalls against earth walls or other structures is not permitted. No formwork shall remain inside structure when complete.

11.0.6 Backfill Requirements

The following outlines backfill requirements around manholes, structures, inlets, utilities and appurtenances. Structures shall include but not be limited to: type B manholes, type P manholes, box culvert and special structures noted within the Contract Documents. All structures shall be constructed in accordance with the most recent addition of the Standard Detail drawings, and/or in conjunction with special details provided within the Contract Documents.

Method B backfilling, as described within these Detail and Technical Specifications, is required around manholes, structures, inlets, utilities and appurtenances, unless otherwise

specified or directed by the Project Construction Engineer. The following backfilling constraints and requirements shall apply for all such facilities:

1. Cast-in-place: Inlets ($\leq 6'$ deep), Manhole Bases and Structure Bases

May be backfilled and compacted around, once the concrete has achieved 80% of the required 28-day compressive strength indicated in the Contract Documents.

For inlet depths larger than six (6) feet, from top of base slab to the top of wall at flow line of the lip, shop drawings and a design analysis must be submitted to the Project Construction Engineer for approval. These submittals shall address the backfilling constraints during and after inlet placement.

2. Cast-in-place: Structure Walls

Shall not be backfilled or compacted against until the deck (top) slab has been placed, the walls have attained 80% of the required 28-day compressive strength, and the deck (top) slab has attained 80% of its required 28-day compressive strength as indicated in the Contract Documents.

3. Cast-in-place: Structure Decks or Top Slabs

May only be backfilled and compacted over once the concrete has attained the required 28-day compressive strength indicated in the Contract Documents.

4. Precast: Structures, Manhole Bases, Barrels, Cone Sections and Inlets

All precast components may be backfilled and compacted against, if manufactured a minimum of 28-days prior to placement, or if concrete test results demonstrate that the required 28-day compressive strength indicated in the Contract Documents has been achieved.

Precast barrels and cone sections may only be placed on cast-in-place manhole bases after 80% of the required 28 day compressive strength indicated in the Contract Documents has been attained.

Alterations and special allowances to these criteria may be granted at the discretion of the Project Construction Engineer on a case by case basis.

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12.0 Riprap, Boulders and Slope/Channel Protection

12.1 General

This work consists of furnishing all labor, equipment and materials necessary to place riprap, soil riprap, grouted riprap, and erosion resistant materials where detailed on the Plans or as directed by the Project Construction Engineer. The work includes water control, excavation and backfill, grading, sub-grade preparation, materials and installation of bedding, rock, riprap, boulders and grout as indicated herein and in the Contract Documents.

12.2 Submittals and Testing

In accordance with the Special Conditions submit documentation indicating source of stone and certifying materials for all types of rock will meet the requirements of this section. Include test results for specific gravity, abrasion, gradation and freeze thaw on samples of rock to be supplied on this project. Submit design mix for grout. In advance of delivery of rock to the work site an inspection of the quarry shall be arranged by the Contractor and shall include the Contractor, Project Construction Engineer, and Quarry Representative. The quarry will identify the rock source and procedures that will be used to stockpile, mix and grade the types of riprap and boulders specified. The Project Construction Engineer,

following receipt and review of current gradation test results, may waive the requirement for field gradation tests at his discretion. If gradation tests are determined to be necessary by the Project Construction Engineer, the following procedures shall be used.

For each type of riprap specified a random sample will be selected by the Project Construction Engineer. The objective is to obtain a sample as it would be handled for normal delivery to the work site. It will then be placed in an approved area at the quarry and sized and sorted to identify and weigh the individual pieces as directed by the Project Construction Engineer. The Contractor and Quarry Representative shall apply all labor and equipment to sort and weigh the riprap. Submit weight data of individual pieces and summary gradation curve. The approved sample shall then be hauled to the work site and stockpiled for comparison of future riprap deliveries. If the riprap being delivered appears to be outside of the specified gradation, or does not resemble the same stockpiles, the Contractor shall make appropriate adjustments at the quarry to ensure riprap meets the requirement of the Specification.

Boulders shall be visually checked by the Contractor at the quarry or work site as required for size, elongation, cracks, deterioration and other defects visible on the entire surface of the stone. If cracks are observed, the Contractor shall notify the Project Construction Engineer to re-inspect and retest the rock. Stone with cracks or defects that are detrimental to a long lasting product shall not be shipped to the work site.

12.3 Riprap and Boulders

Only quarry rock that is sound and durable against disintegration under conditions to be met in handling and placing, and is hard and tenacious and otherwise of suitable quality to ensure permanency in the specified kind of work, shall be used.

All rock shall be angular, each piece having its greatest dimensions greater than 3 times its least dimensions and shall conform to the following requirements and testing standards:

1. The riprap designation and total thickness of riprap shall be as shown in the contract documents. The maximum stone size shall not be larger than the thickness of the riprap.
2. The specific gravity of the riprap shall be two and one-half (2.5) or greater.
3. Neither width nor thickness of a single stone of riprap shall be less than one-third ($\frac{1}{3}$) of its length.
4. Broken concrete or asphalt pavement shall not be acceptable for use in any portion of the Project.
5. Rounded riprap (river rock) is not acceptable unless specifically designated in the Contract Documents.
6. The color of the riprap shall be gray with gray/blue hues or other acceptable colors approved by Project Construction Engineer prior to delivery to the Project site. Color shall be consistent on the entire Project and shall match the color of rock to be used for all other portions of the Project Scope.

7. Minimum density for acceptable riprap shall be one hundred sixty five (165) pounds per cubic foot. The specific gravity shall be according to the bulk-saturated, surface-dry basis, AASHTO T85.
8. The riprap shall have a percentage loss of not more than forty percent (40%) after five hundred (500) revolutions when tested in the Los Angeles machine in accordance with AASHTO Test T96.
9. The riprap shall have a percentage loss of not more than ten percent (10%) after five (5) cycles when tested in accordance with AASHTO Test T104 for ledge rock using sodium sulfate.
10. The riprap shall have a percentage loss of not more than ten percent (10%) after twelve (12) cycles of freezing and thawing when tested in accordance with AASHTO Test T103 for ledge rock, procedure A.
11. Rock shall be free of calcite intrusions.
12. Each load of riprap shall be reasonably well graded from the smallest to the largest size specified. Stones smaller than the two-to-ten percent (2-10%) size will not be permitted in an amount exceeding ten percent (10%) by weight of each load. Control of gradation shall be by visual inspection. However in the event Project Construction Engineer determines the riprap to be unacceptable, the Project Construction Engineer shall pick two (2) random truckloads to be dumped and checked for gradation. Mechanical equipment and labor needed to assist in checking gradation shall be provided by Contractor at no additional cost.

12.3.1 Types, Sizes and Classifications

The types, size, or classification of riprap to be placed will be noted on the Plans. Unless otherwise specified in the Plans or the Contract Documents riprap placed in accordance with the requirements for "dumped riprap" will be considered satisfactory. All riprap shall be placed on a prepared slope on a prepared filter media consisting of either a heavy duty plastic filter cloth or a free draining granular bedding media as described in the materials section of this specification. If the existing soils conditions meet the requirements for filter media the filter media will not be required.

Riprap used shall be the type designated within the contract documents and shall conform to the table on the following page:

Riprap Designation	% Smaller Than Given Size By Weight	Intermediate Rock Dimension (inches)	d ₅₀ * (inches)
Type VL	70 - 100	12	6
	50 - 70	9	
	35 - 50	6	
	2 - 10	2	
Type L	70 - 100	15	9
	50 - 70	12	
	35 - 50	9	
	2 - 10	3	
Type M	70 - 100	21	12
	50 - 70	18	
	35 - 50	12	
	2 - 10	4	
Type H	70 - 100	30	18
	50 - 70	24	
	35 - 50	18	
	2 - 10	6	
Type VH	70 - 100	41	24
	50 - 70	33	
	35 - 50	24	
	2 - 10	9	

* d₅₀ = Mean Particle Size

12.3.1.1 Dumped Riprap

This type of riprap shall consist of angular or fractured rock dumped in place on a prepared slope and filter media to form a well graded mass with a minimum of voids. Asphalt, broken concrete and other materials not classified as rock will not be allowed for use as riprap.

12.3.1.2 Soil Riprap

The soil material shall be native or topsoil and mixed with sixty five percent (65%) riprap and thirty five percent (35%) soil by volume. Soil riprap shall consist of a uniform mixture of soil and riprap without voids. Bedding material is not required for soil riprap. This type of riprap shall consist of angular or fractured rock mixed with 35% soil by volume dumped in place on a prepared slope to form a uniform mixture of soil and riprap without voids per Section 12.2.1C.

12.3.1.3 Grouted Riprap

This type of riprap shall consist of rock with all parts of the interstices filled with Portland cement mortar. The finished product shall be aesthetically pleasing resembling hand placed stone or fireplace rockwork. Colored concrete grout may be specified as defined elsewhere within these Detail and Technical Specifications.

12.3.1.4 Feature Boulders

Feature Boulders shall consist of the same material as riprap, differing only by size. Feature Boulders shall have a minimum dimension of four (4) feet, or as shown on the Plans.

12.3.1.5 Boulders

Boulders shall consist of the same material as riprap, differing only by size. Boulders shall have a minimum dimension of two (2) feet, or as shown on the Plans.

12.3.2 Bedding

The granular bedding designation and total thickness of bedding shall be as shown in the Contract Documents. Granular bedding shall meet the same requirements for specific gravity, absorption, abrasion, sodium sulfate soundness, and freeze-thaw durability as required for riprap and as follows:

1. Broken concrete asphalt pavement or sledge, shall not be acceptable for use in any project. Rounded river rock is not acceptable unless specifically designated in the Contract Documents.
2. Shall conform to the quality requirements of AASHTO M197.
3. The requirements for the wear test in AASHTO T96 shall not apply.
4. Gradation for Granular Bedding:

U.S. Standard	Percent by Weight Passing	Square Mesh Sieves
<u>Sieve Size</u>	<u>Type I</u>	<u>Type II</u>
3 inch		90 - 100
1-½ inch		
¾ inch		20 - 90
⅜ inch	100	
No. 4	95 - 100	0 - 20
No. 16	45 - 80	
No. 50	10 - 30	
No. 100	2 - 10	
No. 200	0 - 2	0 - 3

12.4 Excavation

The excavations shall be finished to smooth and uniform surfaces conforming to the line and grade specified. Variation from the finished grade elevations specified shall not be more than 1.0 inch. Materials shall not be wasted without written permission of the Project Construction Engineer. Excavation operations shall be conducted so material outside of the slope limits will not be disturbed. Prior to beginning grading operations, all necessary clearing and grubbing in that area shall have been performed. The top six (6) inches of material from all areas to be excavated shall be designated as topsoil and shall be removed and stockpiled in the designated location on the plans. Following removal of topsoil, in the designated excavation areas, the remaining material shall be removed and stockpiled separately for use as sub-grade material in the designated location on the plans. Unclassified excavation shall consist of the excavation of all materials of whatever character required for the work, obtained within the project limits, including surface boulders, masonry, organics, muck, and slag that are not removed under some other item. The work will also include hauling of unsuitable unclassified excavation materials off the site.

12.4.1 Unclassified Excavation

All excavation from six (6) inches below existing grade to the top of sub-grade for the associated boulders and/or riprap shall be designated as Unclassified Excavation.

Unless otherwise stipulated in the Contract Documents, no separate payment will be made for unclassified excavation and all costs incurred will be considered to be included within the unit price bid for the associated work.

12.4.2 Overexcavation

In locations where soil with unsuitable bearing characteristics are encountered, the Project Construction Engineer may order that the unsuitable material be removed and be replaced with granular and/or rock backfill material to provide suitable bearing for the structure. At least eight (8) inches of acceptable material must be present below the proposed riprap, soil riprap, grouted riprap or boulders within two (2) feet of existing grade.

The overexcavation will be paid for in accordance with the bid items included within the Contract Documents, regardless of soil classification. No measurement for payment will be made of any material removed or necessary to fill overexcavated areas: outside of the limits for structure excavation, outside of limits defined within the Contract Documents, beyond the limits required for structure excavation performed for the Contractor's convenience or, where excavations for footings, slabs, etc., are made below the required elevations without specific authorization from the Project Construction Engineer. In these situations, excess excavation and backfill shall be at the Contractor's expense and the areas shall be filled in a manner satisfactory to the Project Construction Engineer.

12.4.3 Removal of Water

During construction, the Contractor shall provide and maintain adequate equipment to properly remove and dispose of all water entering the work area. In water bearing strata, well points, sub drains or any other method approved by the Project Construction Engineer may be required to provide a dry trench.

The discharge from any dewatering operations shall be conducted to natural drainage channels or other structures as approved by the Project Construction Engineer and in accordance with applicable permits. Ground water shall not be discharged into sanitary sewers.

Excavation work areas shall be kept free from water during excavation, fine grading, pipe laying and grouting. Dewatering, sufficient to provide a completely dry work area, shall be maintained during all excavation, construction and grouting operations. The Contractor shall be responsible for damage of any nature resulting from the dewatering operations.

Unless provided for in the Contract Documents, dewatering shall be considered as incidental to construction and all costs incurred will be considered to be included in the unit price bid for the construction of each section of sewer line, associated structures, laterals and appurtenances.

12.5 Backfill

Backfill around riprap or boulder structures shall be performed in accordance with these Detail and Technical Specifications. Backfill shall be placed only after walls or other constructed items have been inspected and the approval of the Project Construction Engineer to commence backfilling has been obtained. Backfilling against riprap or boulder structures is allowed only after the concrete has properly cured for not less than seven days, or until

other testing procedures (concrete test cylinders) indicate that the concrete has attained sufficient strength so as not to be damaged by the backfilling operation.

12.6 Topsoil

Top soil material shall be taken from the topsoil stockpile and placed to a minimum depth of six (6) inches to the limits shown on the plans. Additional topsoil material, if necessary, shall be obtained from the sub-grade stockpile as approved by the Project Construction Engineer. The topsoil shall be placed uniformly and compacted to a minimum of 85% Standard Proctor density ASHTO T-99. The intent is to provide a suitable medium for revegetation activities.

12.7 Unsuitable Materials

Materials encountered during construction that are deemed by the Project Construction Engineer to be unsatisfactory as structure sub-grade shall be removed to a maximum depth as approved by the Project Construction Engineer, and replaced with stabilization material including, rock, or other materials approved by the Project Construction Engineer. The source of stabilization material shall be approved by the Project Construction Engineer prior to placement. Excavated muck shall be removed and hauled off the site.

12.8 Construction Requirements

Channel slopes, bottoms, or other areas that are to be protected with riprap, soil riprap, or boulders shall be free of brush, trees, stumps, and other objectionable material and be graded to a smooth compacted surface. Contractor shall excavate areas to receive riprap or boulders to the sub-grade for granular bedding or for soil riprap to the specified depth (bedding material is not required for soil riprap). The sub-grade materials shall be stable. If unsuitable materials are encountered, they shall be removed and replaced in accordance with these Detail and Technical Specifications for sub-grade that has been excavated in undisturbed soil. Additional compaction shall not be required unless specified by Project Construction Engineer. When sub-grade is built up with embankment material it shall be compacted to ninety five percent (95%) optimum density (ASTM D698). After an acceptable sub-grade is established, the soil riprap or bedding shall be immediately placed and leveled to the specified elevation. Immediately following the placement of the bedding material, the riprap shall be placed. If bedding material is disturbed for any reason, it shall be replaced and graded at Contractor's expense. In-place bedding materials shall not be contaminated with soils, debris or vegetation before the riprap is placed. If contaminated, the bedding material shall be removed and replaced at Contractor's expense.

12.8.1 Placement

For the purposes of the following, boulders, riprap and rock are used interchangeably.

When riprap is placed on slopes, placement shall commence at the bottom of the slopes working up the slope. Place the riprap in a stepped fashion with the bottom of the uphill riprap below the top of the downhill riprap by one half ($\frac{1}{2}$) of the height of the riprap minimum.

The entire mass of riprap shall be placed on either channel slopes or bottoms so as to be in conformance with the required gradation mixtures and to lines, grades, and thickness shown on the plan set. Riprap shall be placed to its full course thickness at one operation and in such a manner as to avoid displacing the underlying bedding material. Placing of riprap in layers, or by dumping into chutes, or by similar methods shall not be permitted.

All material going into riprap protection for channel slopes or bottoms shall be so placed and distributed that there shall be no large accumulations of either the larger or smaller sizes of stone. Some hand placement may be required to achieve this distribution.

It is the intent of these Details and Technical Specifications to produce a fairly compact riprap protection in which all sizes of material are placed in their proper proportions. Unless otherwise authorized by Project Construction Engineer, the riprap protection shall be placed in conjunction with the construction of embankments or channel bottoms with only sufficient delay in construction of the riprap protection, as may be necessary, to allow for proper construction of the portion of the embankment and channel bottom which is to be protected. Contractor shall maintain the riprap protection until accepted. Any material displaced for any reason shall be replaced to the lines and grades shown in the Contract Documents at no additional cost to City and County of Denver. If the bedding materials are removed or disturbed, such material shall be replaced prior to replacing the displaced riprap.

The basic procedure shall result in larger materials flush to the top surface with faces and shapes arranged to minimize voids, and smaller material below and between larger materials. Surface grades shall be a plane or as indicated, but projections above or depressions under the finished design grade more than ten percent (10%) of the rock layer thickness shall not be allowed. Smaller rock shall be securely locked between the larger stone. It is essential that the material between the larger stones not be loose or easily displaced by flow or by vandalism. The stone shall be consolidated by the bucket of the backhoe or other means that will cause interlocking of the material. All rock is to be placed in a dewatered condition beginning at the toe of the slope or other lowest point.

Riprap shall be rejected, which is either delivered to the job site or placed, that does not conform to this section. Rejected riprap shall be removed from the Project site by the Contractor at his/her expense.

Following acceptable placement of granular bedding, riprap placement shall commence using one of the following methods:

Machine Placed Riprap

Riprap shall be placed using appropriate construction equipment on the prepared slope or channel bottom areas in a manner which will produce a reasonably well-graded mass of stone with the minimum practicable percentage of voids. Riprap shall be machine placed, unless otherwise stipulated in the Contract Documents.

Hand Placed Riprap

Hand placed riprap shall be performed during machine placement of riprap and shall conform to all the requirements outlined above. Hand placed riprap shall also be required

when the depth of riprap is less than two (2) times the nominal stone size, or when required by the Contract Documents.

After the riprap has been placed, hand placing or rearranging of individual stones by mechanical equipment shall be required to the extent necessary to secure a flat uniform surface and the specified depth of riprap, to the lines and grades as shown in the Contract Documents.

12.8.1.1 Types

Buried Riprap

Where riprap is designated to be buried, place onsite excavated material that is free from trash and organic matter in riprap voids by washing and rodding. Prevent excessive washing of material into stream. When voids are filled and the surface accepted by the Project Construction Engineer, place a nominal six (6) inches of soil over the area, or as designated in the Contract Documents. Fine grade, seed, and mulch per the Contract Documents.

Soil Riprap

Adjacent stockpiles of riprap and soil shall be created and mixing done at the stockpile location, not at the location where soil riprap is to be placed. Mix thirty five percent (35%) soil by volume with stockpiled riprap, using additional moisture and control procedures that assure a homogenous mixture, where the soil fills the inherent voids in the riprap without displacing riprap.

Place a first layer of smaller soil riprap of approximate d_{50} thickness. Then place the top layer with surface rocks that are largely d_{50} or greater, filling voids as necessary with smaller planted riprap. Create a smooth plane as described in Paragraph A. The mixture shall be consolidated by large vibratory equipment or backhoe bucket to create a tight, dense interlocking mass. The soil shall be further wetted to encourage void filling with soil. Any large voids shall be filled with rock and small voids filled with soil. Excessively thick zones of soil prone to washing away shall not be created (e.g., no thicknesses greater than six (6) inches). For buried soil riprap, the top surface shall be covered with four (4) inches of topsoil such that no rock points are protruding. The final surface shall be thoroughly wetted for good compaction, smoothed and compacted by vibrating equipment; the surface shall then be hand raked to receive planting or seeding. With prior approval of Project Construction Engineer, layering the riprap and soil instead of premixing may be allowed if the native soil is granular.

Feature Boulders

Feature Boulders serve an aesthetic function and as such shall be placed and rotated into final position as directed by the Project Construction Engineer in order to achieve the desired result.

Grouted Boulders

Grouted riprap and boulder lined channel edge shall be placed at the locations as shown in the Construction Documents and installed with the following requirements:

1. The sub-grade to receive each boulder shall be excavated and any unstable material shall be removed. Approved material shall be placed and compacted in a maximum of four-inch (4") lifts to ninety five percent (95%) of Maximum Standard Proctor Density (ASTM D698) to re-establish the sub-grade of each boulder. Unstable material shall be removed from the Project site and disposed of by Contractor. Removal and replacement of unstable material shall only be completed at the direction of Project Construction Engineer and shall be paid for under Muck Excavation. Backfill behind boulders shall be compacted to ninety five percent (95%) Maximum Standard Proctor Density (ASTM D698). Care shall be taken during compaction to avoid disturbing and/or damaging the integrity of the boulder channel edge.

The top of all boulders shall be as indicated in the Construction Documents. Finished grades and sub-grades for boulders will be determined from the height of each boulder used.

2. The boulders shall be carefully picked and arranged so that adjacent rock surfaces match within two (2) inches in top elevation and two (2) inches along the vertical exposed face or channel side of rock. Boulders shall be placed such that adjacent boulders "touch" each other and voids do not exceed four (4) inches. It is the intent of construction to minimize voids and grout placed between boulders.
3. Smaller rocks shall be "chinked in" to fill all voids behind the boulders. Placement shall be approved by Project Construction Engineer prior to grouting.
4. Prior to placing the grout, any type of debris, fines, smaller rock, or silt shall be removed from around or under the boulders.
5. Dewatering shall be implemented to guarantee that the grout will not be placed in water and for a period of twenty four (24) hours after the grout has been placed.
6. Keep boulders receiving grout wet at all times prior to receiving grout. The concrete grout shall be placed by injection methods by pumping under low pressure, through a two-inch (2") maximum diameter hose to ensure complete penetration of the grout into the void area as detailed in the Contract Documents. Grout will be placed up to eight (8) inches from the top of boulders, or as directed by the Project Construction Engineer. The Operator shall be able to stop the flow and will place grout in the voids and not on the surface of the rocks.
7. Grout shall be troweled out and finished to minimize visibility. Clean and wash any spillage before the grout sets. The visual surfaces of boulders will be

free of grout to provide a clean, natural appearance. If washing does not clean off grout residue, Contractor shall wash off any grout residue with muriatic acid and water, using a brush to scrub off the residue. A "pencil" vibrator shall be used to make sure all voids are filled between the boulders. The intent is to fill all voids from the sub-grade level around the boulders to a depth as shown in the Contract Documents. The "pencil" vibrator may be used to smooth the appearance of the surface, but Contractor shall use a wood float to smooth and grade the grout around the boulders. The grout mix shall be stiffened and other measures taken to retain the grout between the boulders.

8. Contractor shall, if deemed necessary, support the boulders from falling over before and during the placement of rock, grout, backfill, and compaction work on either side of the boulder.
9. Grout shall receive cold weather protection and curing in accordance with the most recent version of CDOT Standard Specifications for Road and Bridge Construction (section 601.13) as applicable.

12.9 Grouted Rock Retaining Walls

Grouted rock retaining walls shall be placed at locations as shown in the Contract Documents and installed with the following requirements:

1. The grouted rock walls shall be constructed to the dimensions in the locations shown in the Contract Documents. The walls shall be constructed with a one (1) horizontal to four (4) vertical batter on the front and back face, with a minimum width of one (1) foot at the top of the wall.
2. The stone of the wall shall be laid to form substantial masonry, presenting a neat, finished appearance. Headers shall hold the heart of the wall to the face. Headers shall occupy at least twenty percent (20%) of the area and they shall be evenly distributed. The length of stretchers shall not exceed three (3) times their rise. Face stones shall be laid to break joint. Rock shall be hand graded so that only the larger stones are used in the face. Face stones shall be laid to break joint so that each rock laid rests on two beneath it. Spalls and pinnars will not be allowed in the face and shall be used in the backing only where necessary.
3. All face stones shall be pitched to a string line on straight walls or laid to batter stakes for curved walls. The batter shall be consistent with respect to all parts of the wall and shall meet the minimum requirements set forth in the detail. The degree of roughness on the exposed face shall be measured with a six-foot (6') straightedge supported between adjacent projections and stone face. Variations in excess of 3 inches, measured from the straight edge to the extreme depression in the stone, will not be permitted. Rear faces shall present approximately plane surfaces and shall in general conform to the detail.
4. Grout shall be placed to fill all voids between the rocks throughout the walls. Any "loose" rocks shall be re-grouted by machine or hand methods. Grout

shall be recessed approximately two (2) inches from the face of the wall in order to give a "dry stacked" appearance.

5. Prior to placing the grout, any type of debris, fines, smaller rock, or silt shall be removed from around the rocks.

Dewatering shall be implemented to guarantee that the grout will not be placed in water and the area will remain dewatered for a period of ten (10) hours after the grout has been placed.

The surface of the rocks receiving grout shall be wet at all times prior to receiving grout.

6. Clean and wash any spillage before the grout sets on the outside face and top of walls. The visual surfaces of the rocks will be free of grout to provide a clean natural appearance. If washing does not clean off grout residue, then Contractor shall wash off any grout residue with muriatic acid and water, using a brush to scrub off the residue.
7. Grout shall receive cold weather protection and curing in accordance with the CDOT Standard Specifications for Road and Bridge Construction (section 601.13) as applicable.

End of Specification



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Storm Drainage and Sanitary Sewer Construction Detail and Technical Specifications

13.0 Fencing

13.1 Description

This item shall consist of furnishing and installing new fencing and/or removing and salvaging the existing fencing and restoring the same in conformance with the lines, grades and/or alignment shown on the Plans. Wherever the materials to be removed are not in good condition, as judged by the Project Construction Engineer, or wherever the Contractor has damaged the materials during the process of removal, equal or better quality fencing materials than the existing will be furnished and installed by the Contractor. Relocated and/or new fencing will be chain link, heavy construction type. The fence heights shall be as noted on the Plans.

13.1.1 Chain Link Fence

Where specified on the plans or directed by the Project Construction Engineer, chain link fencing shall be constructed as detailed on the drawings and as specified herein.

13.1.2 Security Fence

Where specified on the plans or directed by the Project Construction Engineer, security fencing shall be constructed as detailed on the drawings and as specified herein. The fencing shall be topped with 3-strand barbed wire which will extend the overall height of the fence by one (1) foot.

13.1.3 Shop Drawings and Data

Complete detail drawings and specifications for the fence, gates and accessories shall be submitted in accordance with the procedure set forth in the Special Contract Conditions.

13.2.4 Removal of Existing Fencing

All ties and clamps shall be removed to free the fabric from posts, rails, braces, tension bars and the like. The fabric shall be removed and stored appropriately to be reused. All rails, braces, barbed wire, tension bars and the like shall be removed from posts to a sufficient degree that will allow the removal of the posts.

The post footings shall be excavated and the concrete shall be broken until the post is free. Posts higher than ten (10) feet may be cut in segments or left intact for relocation at the option of the Contractor and as approved by the Project Construction Engineer.

13.3 Materials

Materials for all fencing shall conform to the standards of the existing fence or to the minimum standards as outlined herein. All new steel or malleable iron parts and accessories shall be hot dip galvanized after fabrication.

13.3.1 Posts

All posts shall be steel pipe, ASTM A120, standard weight, Schedule 40. Post diameters shall be as follows.

a. Line Posts

- (1) Up to ten (10) foot high fence inclusive, line posts shall be 2-1/2 inch O.D. pipe, 3.65 lbs. per ft.
- (2) Over ten (10) foot to eighteen (18) foot high fence inclusive, line posts shall be 3 inch O.D. pipe, 5.79 lbs. per ft.
- (3) Over eighteen (18) foot to thirty (30) foot high backstop fence inclusive, line posts shall be 4 inch O.D. pipe 9.1 lbs. per ft.

b. Terminal End. Corner and Pull Posts

- (1) Up to eighteen (18) foot high fence inclusive; terminal, end, corner and pull posts shall be 3 inch O.D. pipe, 5.79 lbs. pr ft.
- (2) Over eighteen (18) foot to thirty (30) foot high backstop fence inclusive; terminal, end, corner and pull posts shall be 4 inch O.D. pipe, 9.1 lbs. Per ft.

- c. **Gate Posts.** Pipe, 9.1 lbs. per ft. and 4 inch O.D.
 - (1) **Top Rail** shall be 1-5/8 inch O.D. pipe, 2.27 lbs.
 - (2) **Post Tops** shall be pressed steel or malleable iron designed to prevent entry of moisture into tubular posts and/or for barbed wire installation.
 - (3) **Stretcher Bars** shall be steel, 3/16 inch by 3/4 inch, or equivalent area.
 - (4) **Fabric** shall be No.9 wire woven into a 2" mesh; galvanized AS~M A392, Class II.
 - (5) **Fabric Ties** shall be No.7 aluminum wire or 12 gauge galvanized steel wire.
 - (6) **Concrete Collars** around posts: f'c -2000 psi, 5 sack mix, with Type r or Type II cement conforming to ASTM C-150.

13.3.8 Gates

Materials for gates shall conform to the

- a. **Fabric** shall be the same as fence fabric.
- b. **Frames** shall be 2 inch O.D. pipe, 2.72 lbs. per ft.
- c. **Hinges** shall be heavy pattern with large bearing surfaces and shall not twist or turn under the action of the gate.
- d. **Latches** shall be forked type and shall be arranged for padlocking, with the padlock accessible from both sides of the gate.
- e. **Stops** shall consist of a roadway plate with anchor set in concrete and arranged to engage the plunger.

13.3.9 Security Fence

Materials for security fencing shall conform to the contract specific specifications and the following special items.

- a. **Barbed Wire Support Arms** shall be galvanized steel and shall extend at an angle of approximately 45°, and shall be fitted with clips or other means for attaching three strands of barbed wire. The top wire shall be approximately twelve inches horizontally from the fence line and the other wires spaced uniformly between the top of the fence fabric and the outside strand. The barbed wire support arm shall be of sufficient strength to withstand a weight of 200 lbs. applied at the outside strand of barbed wire.
- b. **Barbed Wire** shall consist of two strands of 12-1/2 gage steel wire with 14 gag; 4 point barbs spaced not more than 5 inches apart. All wire shall be zinc coated with a minimum coating of .80 ounces per square foot of surface area on 12-1/2 gage wire and .60 ounces per square foot of surface area on 14 gage wire.

13.4 Installation or Replacement of Fence

13.4.1 General Constructions

The Contractor shall perform such clearing and grubbing as may be necessary to construct or replace the fence to the required grade and alignment as shown on the Plans. Where specified

on the plans or ordered by the Project Construction Engineer, a one (1) foot wide concrete mowing strip shall be provided for the entire length of the fence. The fence shall be located along the center line of the mowing strip.

At locations where breaks in a run of fencing are required, appropriate adjustments in fence alignment and/or post spacing shall be made to satisfy requirements of conditions encountered.

13.4.2 Posts

Posts shall be held in proper position by secure bracing until such time as the concrete has set sufficiently to hold the posts. Materials shall not be installed on posts, or stress placed on guys nor bracing set in concrete until the concrete has developed enough strength to withstand the stress.

All line, terminal, corner and gate posts shall be of the size specified. Posts shall be of the proper length to accommodate full height of fabric as shown on the Plans and provide for footing to the depth required. All posts shall be set plumb and firmly in concrete footings with a maximum spacing of 10 feet between posts. Concrete footings shall be domed to shed water. All terminal, corner and gate posts shall be braced with horizontal braces and diagonal truss rods.

All posts shall have a post cap of heavy galvanized malleable iron or pressed steel.

The tops of all posts shall be set to the required grade and alignment.

13.4.3 Fabric

Fabric shall be firmly attached to the posts and braces. All wire shall be stretched taut and be installed to the required spacing. The completed fence shall be plumb and in straight alignment, firmly wired to prevent sag or looseness.

The fabric shall be the full height as shown on the Plans. Fabric shall be attached to the inside of posts with the wires or fabric clips, spaced at one (1) foot intervals on all posts and six (6) ties to each horizontal rail. Top and bottom selvages shall be knuckled for residential chain link fences and security fences.

13.4.4 Top Rails, Braces, Fittings, Ties, Tension Wire, Tension Bars

These items shall be the same lengths, dimensions and quantities as those of the existing fence or as shown on the Plans. The existing items shall be removed and replaced and where new items need to be purchased, the quality shall be equal to or better than the existing. The top rail shall extend through all line posts to form a continuous brace from end to end of each stretch of fence, be securely fastened at the end of each run, and have joints made with expansion sleeve couplings not less than 5 inches long.

13.4.5 Gates

Gates shall be constructed at or relocated to locations shown on the plans. Any materials not up to standard shall be replaced with materials of equal or better quality than the existing. Gates shall be installed to swing horizontally in true vertical plane and shall be provided with offset hinges to permit 180 degree swing.

Gates shall be installed so that they cannot be removed without disassembly of the hardware. Hardware attachment bolts shall be preened so that removal will be difficult.

Gates shall have all necessary latches, straps, locking bars and locking devices. Fabric shall be tightly stretched and securely fastened to gate frame with the proper number of bands, clips or tie wires and stretch bars shall be installed one (1) inch shorter than the full height of the fabric. Gates shall be free from sag or twist. Joints between frame members shall be made by welding or by means of heavy fittings and shall be rigid and water tight.

If welding is employed, it shall conform to the requirements of the American Welding Society. All welds shall be ground smooth. When the spelter coating has been burned by welding, the surface of the welded connection shall be thoroughly cleaned by wire brushing and all traces of the welding flux and loose or cracked spelter removed. The cleaned areas shall then be painted with two coats of zinc oxide-zinc dust paint conforming to the requirements of Federal Specification MIL-P-15145, latest revisions. The paint shall be properly compounded in a suitable vehicle in the ratio of one part zinc oxide to four parts zinc dust, by weight.

A method to padlock all gates shall be provided. Each padlock shall be provided with two keys.

End of Specification



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CITY AND COUNTY OF DENVER
DEPARTMENT OF PUBLIC WORKS | ENGINEERING DIVISION

Storm Drainage and Sanitary Sewer Construction Detail and Technical Specifications

14.0 Removal and Disposal of Construction Debris and Contaminated Materials

14.0.1 General

The Contractor shall be required to transport all non-hazardous solid waste and construction debris to the Denver Arapahoe Disposal Site (DADS) landfill, in accordance with Executive Order 115. Only approved haul routes around DADS may be used (Contractor must contact landfill directly for these routes). Landfill fees, gate fees and applicable State surcharges will be paid for by the City and County of Denver, Engineering Division. The Contractor is responsible for any special handling charges imposed by Waste Management at DADS.

All costs associated with loading, hauling, and disposal of construction debris and/or contaminated soils at DADS shall be considered included within the unit price bid for construction of each section of sewer, the associated structures, laterals and appurtenances unless provided for elsewhere in the Contract Documents. The City and County of Denver, Engineering Division will not provide hauling tickets nor cover the fees associated with

disposal of recyclable materials at the DADS landfill. Recyclable materials shall include: concrete, asphalt, clean soil, damp or saturated soils and any other materials generated onsite with a monetary value. No payment will be made for the loading, hauling and/or processing of recyclable materials.

If the waste material cannot be accepted at DADS, Conservation Services Inc. facilities are licensed to accept industrial waste. Facilities in Utah and Texas are licensed to accept hazardous waste. Landfill fees at these facilities will be paid for by the Contractor.

The work required for this section shall consist of exploratory investigation, testing, identification, removal and disposal of construction debris and contaminated materials associated with the construction of pipelines, box culverts, gulches, open channels, ponds and associated structures and appurtenances.

14.0.2 Contaminants

The contaminants required to be removed or treated may or may not be known at the time of award of the work. Contaminated soils may be encountered and have to be identified on the job site. Potentially and/or suspected contaminated sites of known and unknown origin may be listed at the end of the Contract Documents and are identified on the plans.

14.0.3 Environmental Consultant

The City and County of Denver, Engineering Division shall have an Environmental Consultant under contract to help identify, monitor and document and provide other assistance as required.

14.0.4 Contaminated Soil Identification

1. Remediation of soils with unknown contaminants will be performed by the Contractor as described herein or as directed by the Project Construction Engineer with recommendations by the Environmental Consultant. Materials visibly contaminated or having field instrument (e.g. PID, FID, OVA, etc.) readings above established action levels will be excavated, or otherwise loaded for transport to an approved disposal facility or to a temporary storage area designated by the Project Construction Engineer. Appropriate safeguards will be utilized to prevent or limit exposures to stored materials.
2. The stored material will be tested at the contractor's expense for contaminants. As dictated by the proposed disposal facility the parameters to be tested for will be based on the historical use of the area and the requirements of the facility used for disposal. The material will not be stored for more than 90 days.
3. Material identified as hazardous or non-hazardous will be disposed of in a manner consistent with current established federal, state and local regulations for waste material. A hazardous waste contractor shall be required for handling of hazardous material.
4. Materials with contaminants below action levels may be used for fill on-site or transported off-site. Materials with contaminants not specifically regulated will be disposed of as directed by the Project Construction Engineer.

5. The owner of any contaminated material will be the City and County of Denver, for the purposes of permits and disposal only.

14.0.5 Submittal (OSHA Requirements)

The Contractor will submit the following information for approval prior to beginning work or as otherwise specified:

1. **Health and Safety Plan** meeting OSHA requirements of CFR 1910.120. The Health and Safety Plan for remediation work shall address the protection of health, safety and response to contingencies which could occur during remediation. It shall describe known and potential hazards related to remediation work activities. It shall include descriptions of construction and decontamination procedures for personnel and equipment. The plan will only be implemented if contaminated materials are encountered.

The contractor shall provide a project Health and Safety Officer. The project Health and Safety Officer shall be qualified by certification or training in the area of Industrial Hygiene or Hazardous Waste Health and Safety. The officer will have the authority and knowledge to design and implement a site-specific Health and Safety Plan and Hazardous Communication Program and to verify compliance with applicable safety and health requirements.

All persons working in and entering the areas designated by the Health and Safety Officer to be hazardous due to the presence or potential of contacting hazardous substances shall have previously received training according to the requirements in the Hazardous Waste Operation Regulations (OSHA 1910.120).

General site workers involved in construction activities in the designated areas shall receive 40 hours minimum training in the health and safety of hazardous waste; site workers and workers who are on-site occasionally to perform a single specified task shall receive 24 hours minimum of training. Personnel overseeing the health and safety of other workers shall receive an additional eight hours of supervisor training in that capacity. Documents certifying that the training requirements have been met and that all personnel are current on their refresher training shall be present at the project office or trailer or otherwise be made available to the project Health and Safety Officer and/or the Project Construction Engineer.

In addition to the personnel working in the designated hazardous waste sites, all personnel working on this construction project shall be involved in the communication and understanding of potential hazards through a Hazardous Communication Program in accordance with the provisions of OSHA regulation 29 CFR 1910.12. This program shall include all elements of the regulations including training of personnel, compilation of Material Safety Data Sheets (MSDS), labeling, and placarding of hazardous chemicals, hazard identification of the construction area and monitoring of all activities to determine if new hazards are posed to the employees.

Reduced levels of training are to be identified for persons performing short duration or non-intrusive activities in areas in which the concentrations of or the potential for

exposures to hazardous chemicals are reduced or shown to be minimal in the designated areas.

The training of employees in the non-designated areas are covered in the Hazard Communication Program for this phase of construction activities. This training shall include the following elements:

1. Methods of detecting hazardous chemicals.
 2. Physical and health hazards of chemicals in the area.
 3. Personal protective measures that are implemented to protect the employees.
 4. Details of the Hazardous Communication Program such as emergency response procedures and location of the Material Safety Data Sheet.
2. **A *Sampling and Analysis Plan* (SAP)** which describes methods of sampling, testing and analysis to obtain additional data on chemical constituents of the various materials. The Environmental Consultant will prepare this plan which shall be reviewed by all parties prior to the commencement of this aspect of construction. The purpose of the SAP will be to provide a basis for classifying a material as hazardous or non-hazardous and to provide confirmation and documentation of completed remediation work as it relates to project construction.
3. ***Product Data***: Submit the following as part of a Pre-Construction Submittal Package.
- a. Material list for items proposed to be provided under this section.
 - b. Certificates signed by the materials producer and the subcontractor stating that all material, meet or exceed the specified requirements.
4. ***Materials Samples***: Submit adequate and representative samples of the backfill material to the Testing Laboratory for pre-construction tests.
5. ***Test Reports***: Submit at least one week prior to beginning of the work of this section the test reports for the pre-construction testing performed by the Testing Laboratory.
6. ***Disposal Profile Sampling***: If contaminated soil is known or believed to exist in the project alignment, the contractor shall be responsible for the collection and analysis of samples required for disposal approval. This shall be done in advance of the construction phase.

14.0.6 Materials

14.0.6.1 Backfill Materials

Materials generated on-site or if imported shall be predominantly granular non-expansive soil free from roots and other unsuitable material meeting the requirements of Section 5.0 of these Detail and Technical Specifications. The Contractor shall try to generate all backfill materials on-site. Imported fill materials will only be allowed in cases where sufficient quantities of suitable backfill material cannot be generated on-site.

14.0.6.2 Backfill of Excavated Areas

Excavated areas outside the vertical limits of construction will be backfilled and regraded using uncontaminated soils. Compaction requirements are described in Section 5.0. The fill materials will be from on-site stockpiles as described above. The surface will be regraded to match natural contours and drainage patterns and the areas to be reseeded or otherwise restored to match existing conditions prior to the contaminated material excavation.

14.0.7 Execution

14.0.7.1 Removal

1. Contaminated materials will be removed to a depth of 3 feet below construction within the horizontal limits of construction at the direction of the Project Construction Engineer. If the contamination extends less than three (3) feet, a minimum thickness of three (3) inches of soils below the contaminated materials will be removed, loaded, transported, and disposed of.
2. Upon completion of initial contaminated material removal, the excavated area will be inspected by the Project Construction Engineer and or the Environmental Consultant and additional materials will be removed as deemed necessary based on visual observations, instrument readings, and the results of initial and confirmatory laboratory testing.

14.0.7.2 Disposal

The contaminated soils requiring disposal will be transported to a land fill approved to accept the waste. The landfill will be approved by the Project Construction Engineer prior to transport and landfill fees will be paid for by the Contractor. A payment item is provided for this in Section IV of this Bid Form and Submittal Package. The Denver Arapahoe Disposal Site (DADS) and the Conservation Services Inc. facilities are licensed to accept non-hazardous waste. Facilities in Utah and Texas are licensed to accept hazardous waste.

14.0.7.3 Confirmation Sampling

1. Upon completion of the contaminated material removal in each area, a confirmation soil sample will be collected by the Environmental Consultant in accordance with a Sampling and Analysis Plan (SAP) and the samples shipped to an approved testing laboratory for analysis.
2. The SAP will be prepared by the Environmental Consultant prior to construction and should contain methods of sampling and analysis to confirm if a material is hazardous or non-hazardous and that remediation work has been completed. The sampling will either be from a discrete location or composited, if appropriate. Duplicate and blank samples will be collected for laboratory quality assurance at the frequency described in the SAP. All samples will be labeled and sealed and appropriate chain-of-custody and shipping procedures followed.

14.0.7.4 Field Testing

1. The Testing Laboratory as designated by the Environmental Consultant, will perform tests and report results as approved by City of Denver Environmental Services (CDEVS) and the City and County of Denver, Engineering Division on soil samples obtained by the

Project Construction Engineer. The City's Office of Environmental Services may act as internal consultant to the City and County of Denver, Engineering Division as needed.

2. Obtain the Project Construction Engineer's approval of subgrade materials with respect to the City and County of Denver, Engineering Division requirements before subsequent construction is performed.
3. Notify the City and County of Denver, Engineering Division and the Environmental Consultant of conditions contrary to accepted requirements.
4. The Colorado Department of Hazardous Wastes Management Division (CDHWMD) is the state's agency for reviewing cleanup measures. Since the contaminants and their levels are unknown and the Colorado Department of Hazardous Wastes Management Division does not have specific regulations for cleanup of materials that may be found, they will only "suggest" or review cleanup measures. They will in some cases provide a letter suggesting that they concur with the levels selected but make no commitments regarding long-term liabilities. They will maintain a file on each project if the information is provided to them. The following cleanup levels will be used for the site, but may be modified by CDEVS or CDHWMD.
 - Petroleum Product – 100 ppm TPH, 20 ppm BTEX (RACI)
 - Metals (CERCLA, Ep-Tox or TCLP levels)
 - Volatile and semi-volatile organics – 10 ppm total
 - PCB's – 10 ppm (TSCA regulation)

Cleanup levels are determined on a case-by-case basis for contaminants not specifically regulated under Resource Conservation Recovery Act or Toxic Substances Control Act. The cleanup will be implemented using visual observation of stained areas and an established action level for PID readings in a headspace test of 50 ppm for petroleum contaminated soils and 10 ppm for organic contaminants. If either of these conditions are met, the material will be considered contaminated and stockpiled for sampling, analysis and appropriation of disposal or potential reuse.

5. Test Report: At least once a week prior to the work of this Section, submit test reports for the pre-construction testing performed by the Testing Laboratory.

14.0.7.5 Protection of Storm and Sanitary Sewers

1. Concrete Cut-off Walls as shown in figure 3 of the City and County of Denver, Engineering Division, Standard Detail for Trenching and Bedding (S-301.1) shall be constructed upstream and downstream of the contaminated area to prevent piping of hazardous material from off-site areas.
2. All joints for storm sewer pipe shall be internally and externally grouted to prevent contamination of the storm sewer system.

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Storm Drainage and Sanitary Sewer Construction Detail and Technical Specifications

15.0 Manhole Rehabilitation

15.0.1 General

Manhole rehabilitation shall conform to this specification and one of the specific product subsections contained within these detail and Technical Specifications, as specified in the Contract Documents.

The purpose of manhole rehabilitation is to add structural stability to existing brick manholes and to stop infiltration / exfiltration of water/ sewage in the manhole

15.0.2 Preparation

- a. Safe access to the manhole shall be secured using appropriate traffic control devices. Gases within the manhole and associated sewer lines shall be checked for hazardous conditions. A positive flow ventilation system shall be installed to ventilate the manhole during construction.
- b. Prior to manhole barrel rehabilitation, a cover shall be placed over the manhole invert to prevent extraneous material from entering the sewer.

- c. All foreign materials shall be removed from the manhole walls and bench creating a sound surface for product application. Loose and protruding brick, mortar and concrete shall be removed and all voids filled using products specifically designed for that purpose and according to manufacturer's recommendations. All materials used must be submitted to and approved by the Construction Project Manger.
- d. Active leaks into or out of the manhole shall be stopped using mortar, grout or other products specifically designed for that purpose and in accordance with manufacturer's recommendations.

15.0.3 Manhole Barrel Rehabilitation

- a. All loose and broken concrete and brick will be removed from the manhole barrel prior to rehabilitation. No debris shall be allowed to enter the sanitary sewer.
- b. Remove manhole steps by cutting flush with vertical face of manhole wall prior to rehabilitation product application.

15.0.4 Manhole Invert Rehabilitation

- a. All loose and broken concrete and brick will be removed from the manhole invert prior to shaping. No debris shall be allowed to enter the sanitary sewer.
- b. The manhole invert shall be shaped per Wastewater Management Division Standard Detail Drawings.
- c. At a minimum, the material to be used for manhole invert rehabilitation shall be mortar or grout consisting of one part Type II Portland Cement and two parts of fine, clean sand. Only sufficient water shall be added to provide a stiff, workable cement mixture for proper trowelling. Hydrated lime or masonry cement shall not be used. Where thin layers of grout or mortar are to be applied in the manhole invert rehabilitation process, an approved epoxy coating shall be applied to the exposed concrete surfaces prior to grouting.

15.0.5 Manhole Testing and Inspection

- a. During application of the rehabilitation product a wet film thickness gauge shall be used to ensure a monolithic coating with uniform thickness.
- b. The Contractor, at his expense, shall provide all necessary labor, equipment and materials to re-inspect all rehabilitated manholes at two intervals: once at eighteen (18) months after the date of Final Inspection, and once an thirty-four (34) months after Final Inspection. A City and County of Denver representative will schedule the above inspections.



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**Approved for Specific Capital Projects Only - Product Must Be
Specifically Noted In the Contract Documents at Time of Bid**

15.1 Cured-In-Place Fiberglass/Epoxy Resin Liner

15.1.1 General

The work described within this specification details a complete manhole rehabilitation using a cured-in-place, fiberglass reinforced epoxy resin liner system. The complete system will provide a corrosion resistant liner to rehabilitate deteriorated manholes and prevent any further deterioration from hydrogen sulfide and other corrosive gases/acids caused by the wastewater stream. The completed system will also eliminate all ground water infiltration into the existing manholes.

15.1.2 Referenced Standards

ASTM D638 – Standard Test Method for Tensile Properties of Plastics

ASTM D695 – Standard Test Method for Compressive Properties of Rigid Plastics

ASTM D790 – Standard Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials

ASTM D2240 – Standard Test Method for Rubber Property; Durometer Hardness

ASTM D4787 – Standard Practice for Continuity Verification of Liquid or Sheet Linings Applied to Concrete Substrates

ASTM G62 – Standard Test Methods for Holiday Detection in Pipeline Coatings

15.1.3 Submittals

1. All permits must be obtained by the Contractor, submitted to and approved by the Project Manager prior to beginning any work; with any material. This includes, but is not limited to: Denver Fire Department (hazardous, flammable, hot work, confined space), Street Occupancy, Parks, Confined Space Entry, Hazardous and Flammable materials permits, etc.
2. A letter to the City's Project Manager requesting use of the product/system for a specific Capital Project must be approved in writing prior to product use.
3. Product Data: Technical data sheet for each product used; Material Safety Data Sheet (MSDS); design thickness.
4. Design Variations: Description of variations from application procedures, surface preparation, application equipment, or testing.
5. Applicator Qualifications:
 - a. Manufacturer Certification that the Applicator has been trained and approved in the handling, mixing and application of products to be used
 - b. Certification that the equipment to be used for applying the products has been manufactured or approved by the protective coating manufacturer and Applicator personnel have been trained and certified for proper use of the equipment.
 - c. Five (5) recent references for the Applicator (projects of similar size and scope) indicating successful application of cured-in-place, fiberglass reinforced epoxy resin liner system
 - d. Proof of federal, state or local permits or licenses necessary for the project.
6. Design details for any additional ancillary systems and equipment to be used in site and surface preparation, application or testing.

15.1.4 Quality Control and Assurance

1. Applicator shall initiate and enforce quality control procedures consistent with applicable ASTM, National Association of Corrosion Engineers (NACE) and SSPC standards and the protective coating manufacturer's recommendations. All quality control testing is at the Contractor's cost unless otherwise noted.
2. An NACE certified coating inspector shall be provided by the Owner. The Inspector will observe surface preparation, application and material handling procedures to ensure adherence to the specifications.

15.1.5 Delivery, Storage, and Handling

1. Materials are to be kept dry, protected for weather and stored under cover.
2. All materials should be stored in accordance with manufacturer's recommendations. Do not store near flame, heat or strong oxidants. Keep epoxy away from excessive heat to prevent premature curing.
3. Protective coating materials are to be handled according to their material safety data sheets.

15.1.6 Materials

1. Cured-in-Place Fiberglass Reinforced Resin Liner System: The Liner Manufacturer shall be as noted below, or an approved equal:

Poly-Triplex Liner
Union Station
1701 Wynkoop Street, Suite 250
Denver, CO 80202
Phone: 303-893-3100
Fax: 303-893-3102
www.Poly-triplex.com
2. The PTL5-5600 series is a three-layered composite system with a total pre-saturated fabric weight of 56-ozs. Per square yard. Layer #1 is 18-oz. structural fiberglass impregnated with a modified epoxy resin and bonded to the existing substructure. Layer #2 is a 20-oz. non-porous membrane of special synthetic materials bonded to layer #1 and layer #3. Layer #3 consists of 18-oz. structural fiberglass saturated with epoxy and bonded to the nonporous membrane, forming a smooth interior wall to the host structure.
3. Where active infiltration flows are more severe, pressure grouting may be required. The material for pressure grouting shall be Avanti A-220, DeNeef or approved substitute.

15.1.7 Equipment

Equipment used shall be as recommended by the liner manufacturer and adequate in size and capacity to accomplish the rehabilitation work in a timely manner.

15.1.8 Execution

1. Application shall be in strict accordance with the manufacturer's instructions (Refer to manufacturer's application instructions for additional details and recommendations not included herein). This shall include re-grouting all inlet and outlet lines and benches as needed, plus the preparation, installation, curing and finishing operation.
2. Use only skilled workmen who are trained and experienced in the installation of cured-in-place fiberglass reinforced epoxy resin liners for manhole rehabilitation. Contractor shall identify qualified personnel and ensure that these people are on site during each liner installation from start to finish.
3. All liner installations shall utilize bypass pumping. The use of flow-thru plugs and channel platforms shall only be allowed with prior approval from the Construction Engineer. Contractor shall provide individual flow diversion plans for each pumping setup.
4. No application shall be made to frozen surfaces or if freezing is expected to occur within 24 hours after application of product. No liners will be installed if outside air temperature exceeds 95 degrees F.
5. Do not allow extraneous material from entering sewer lines. Contractor will be fully responsible for any damage caused due to debris entering the sewer line during preparation work and/or liner installation activity.
6. Clean surfaces to be rehabilitated with high-pressure water spray (minimum 3500psi) to remove loose concrete or brick, biological growths, and other contaminants. If surface cannot be cleaned sufficiently with high-pressure water spray, then use means necessary, as recommended by manufacturer. Surfaces may require the application of a 10% solution of muriatic acid or the use of a detergent or degreaser. If an acid or detergent solution is used, the surface shall be thoroughly rinsed and neutralized prior to the installation of the liner system. All surfaces shall be clean and structurally sound. Loose and protruding brick, mortar, concrete and roots shall be removed.
7. Repair mortar shall be used to fill voids, structurally reinforce or rebuild surfaces. Rebuild bench and channel areas after cleaning using mortar or other approved material to ensure adequate surface prior to liner installation.
8. Stop all active hydrostatic infiltration with cementitious grout. Excessive infiltration may require the use of pressure grout and/or heavier liner.

9. Remove manhole steps by cutting flush with vertical face of manhole wall prior to CIPP rehabilitation product application.
10. Contractor shall make a reasonable effort to minimize odors emitting from open manholes during preparation work, liner installations, and inspections.

15.1.9 Installation

1. Rehabilitate manholes as identified on the drawings. Proper equipment shall be used at all times. Contractor shall observe OSHA confined space and safety requirements during all manhole entries.
2. Liner shall extend one (1) foot into pipelines where appropriate, to ensure adequate overlap with pipe materials unless otherwise indicated on the drawings.
3. The liner shall be installed and cured in place via a pressurization blower system with steam heat injection or equivalent process. Pressure shall be approximately 500 to 1000 lbs. per sq. ft. and steam at approximately 250 degrees Fahrenheit. Curing time shall be a minimum of two (2) hours or as recommended by the manufacturer. Liner may be rejected at the sole discretion of City's Construction Project Manager if curing process fails to meet manufacturer recommended procedures, or if installation bladder fails more than once during curing process.
4. Do not install cured-in-place fiberglass epoxy resin liners in no-round structures. Alternative lining methods will be required for the rehabilitation of vaults, diversion structures, or rectangular shaped manholes.
5. Repair any defects or irregularities in final product prior to acceptance.

15.1.10 Testing

Contractor shall perform visual inspection and necessary quality control testing. A Holiday test shall be performed according to ASTM standards. All tests and reports shall be in accordance with ASTM G62 and be submitted to the Project Manager prior to final product acceptance. All hollow spots, holes, tears, or delaminations shall be promptly repaired using mastic epoxy or another method approved by the Construction Project Manager.



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15.2 Spectrashield™ Manhole Liner

15.2.1 General

The work described within this specification details a complete program for manhole rehabilitation. This section details the methods, procedures, materials and equipment as required to produce “A Total System for Manholes”. The complete system will provide a corrosion resistant liner to rehabilitate deteriorated manholes and prevent any further deterioration from hydrogen sulfide and other corrosive gases/acids caused by the wastewater stream. The completed system will also eliminate all ground water infiltration into existing manholes.

15.2.2 Referenced Standards

ASTM 4541 – Standard Test Method for Pull-Off Strength of Coatings
Using Portable Adhesion Testers

ASTM D412 – Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers

ASTM D2240 – Standard Test Method for Rubber Property; Durometer Hardness

ASTM D522 – Standard Test Methods for Mandrel Bend Test of Attached Organic Coatings

ASTM D4060 – Standard Test Method for Abrasion Resistance of Organic Coatings by the Taber Abraser

CIGMAT Report (UH 1996-7) – Evaluation of Spectrashield Liner System for Wastewater Concrete and Clay Brick Facilities. University of Houston Department of Civil Engineering: December 1996

ASTM D4787 – Standard Practice for Continuity Verification of Liquid or Sheet Linings Applied to Concrete Substrates

ASTM G62 – Standard Test Methods for Holiday Detection in Pipeline Coatings

15.2.3 Submittals

All materials and procedures required to establish compliance with the specification shall be submitted to the City's Project Manager for review/approval. Submittals shall include the following as a minimum:

1. All permits must be obtained by the Contractor, submitted to and approved by the Project Manager prior to beginning any work; with any material. This includes, but is not limited to: Denver Fire Department (hazardous, flammable, hot work, confined space), Street Occupancy, Parks, Confined Space Entry, Hazardous and Flammable materials permits, etc.
2. A letter to the City's Project Manager requesting use of the product/system for a specific Capital Project must be approved in writing prior to product use.
3. Descriptive literature, bulletins and or catalogs of materials.
4. Work procedures including flow diversion plan, method of repair, etc.
5. Material and method for repair of leaks or cracks in manholes.
6. Final installation report on completed manholes

15.2.4 Quality Assurance

1. The manufacturer and/or installer of the total liner system of manholes shall be a company that specializes in the design, manufacture or installation of corrosion protection systems for manholes. Installer shall be completely trained in leak repair, surface preparation and corrosion materials application on manholes. Corrosion materials/products shall be suitable for installation in a severe hydrogen sulfide environment without any deterioration to the liner.

2. To ensure total unit responsibility, all materials and installation thereof shall be furnished and coordinated with/by one supplier/installer who turnkeys the work and assumes full responsibility for the entire operation.

15.2.5 Delivery, Storage and Handling

Handle and Store materials in accordance with manufacturer's recommendations and MSDS.

15.2.6 Materials

Products shall be Spectrashield™, by CCI Spectrum, Inc.

1. The materials to be utilized in the lining of manholes shall be designed and manufactured to withstand the severe effects of hydrogen sulfide in a wastewater environment and eliminate all ground water infiltration. Manufacturer of corrosion protection products shall have long proven experience in the production of the lining products utilized and shall have satisfactory installation record.

15.2.7 Equipment

1. 3000 psi hydro blasting equipment shall be suited to remove corroded materials from the existing concrete/brick structure.
2. Equipment for installation of lining materials shall be high quality grade and be as recommended by the manufacturer.
3. The lining system to be utilized for manhole structures shall be a multi-component stress skin panel liner system as described below:

a. Liner

<u>Installation</u>	<u>Liner</u>
Moisture Barrier	Modified Polymer
Surfacer	Polyurethane/Polymeric Blend Foam
Final Corrosion Barrier	Modified Polymer

- b. Moisture Barrier - Modified polymer shall be sprayable, solvent free, two-component polymeric, and moisture/chemical barrier specifically developed for a corrosive wastewater environment. Typical chemical analysis is as follows:

	<u>"A" Component</u>
Viscosity, 77° F, cps, ASTM D-1638	300-400
Physical State	Liquid
Color	Clear to amber
Hygrosopicity	Reacts with water

<u>"B" Component</u>	
Viscosity, 160° F, cps, ASTM D-1638	400-600
Physical State	Liquid
Color	Flamingo Pink
Non-Volatile	100%

<u>Reaction Profile (100 grams, 175° F Sample)</u>	
Gel Time, Seconds	1-2
Tack Free Time, seconds	15
Cure Time, seconds	30

<u>Processing</u>	
A System/B system, volume ratio	1.00/1.00

<u>Typical Physical Properties</u>	
Tensile Strength, PSI	>1500
Elongation, %	>125
Tear Strength, PSI	350
Shore D Hardness	55-65
100% Modulus, PSI	>1500

c. Surfacers - Polyurethane Rigid Structure Foam, low viscosity two-component, containing flame retardants. Typical chemical analysis is as follows:

<u>"A" Component</u>	
Viscosity, 77° F, cps, ASTM D-1638	200
Physical State	Liquid
Color	Dark Brown
Hygroscopicity	Reacts with water and evolves CO2 gas

<u>"B" Component</u>	
Viscosity, 77° F, cps, ASTM D-1638	600-1000
Physical State	Liquid
Color	Tan
Hygroscopicity	Absorbs water rapidly thus changing ratio

<u>Reaction Profile (100 grams, 77° F sample)</u>	
Cream Time, seconds	1-4
Tack free time, seconds	5-8
Rise Time, seconds	6-10

<u>Processing</u>	
A System/B system, volume ratio	1.00/1.00

<u>Typical Physical Properties</u>	
Density, nominal, core, lbs/ft3 ASTM D-1622 @ 74° F	4-10
Compression Strength, ASTM D-1621 @ 74° F parallel rise; PSI	90-150

Closed Cell Content, % - ASTM 1940 @ 74 °	Over 90
Shear Strength, PSI – ASTM C-273 @ 74° F	225-250

d. Final Corrosion Barrier - Total thickness of multi-component stress skin panel liner shall be a minimum of 500 mils.

15.2.8 Execution

15.2.8.1 Initial Inspection

1. Prior to conducting any work, perform inspection of structure to determine need for protection against hazardous gases or oxygen depleted atmosphere and the need for flow control or flow diversion.
2. Submit plan for flow control or bypass to owner/engineer for approval prior to conducting the work. Cost of flow control or bypass shall be included in cost of the manhole rehabilitation.

15.2.8.2 Surface Preparation

1. Conduct surface preparation program to include monitoring of atmosphere for hydrogen sulfide, methane, low oxygen or other gases, approved flow control equipment, and hydro blasting equipment.
2. Remove manhole steps by cutting flush with vertical face of manhole wall prior to rehabilitation product application.
3. Hydro blasting equipment shall remove all corrosion from structure. Final product shall be a cleaned, dry surface ready for liner application.
4. After completion of surface preparation, blasting phase, perform the seven point check list, which is the inspection for:
 1. Leaks
 2. Cracks
 3. Holes
 4. Exposed Rebar
 5. Ring and Cover condition
 6. Invert Condition
 7. Inlet and Outlet Pipe Condition
5. After the defects in the structure are identified, repair all leaks with a chemical or hydraulic sealant designed for used in field sealing of ground water. Severe cracks shall be “repaired with a urethane based chemical” sealant. Product to be utilized shall be as approved by owner/engineer prior to installation. Repairs to exposed rebar, defective pipe penetrations or inverts, etc. shall be repaired utilizing non-shrink grout or approved alternative method.
6. Benches, walls and floors shall be repaired or refinished as necessary to comply with Wastewater Management Division Standard Detail Drawings (Drawing No. S-502) using

chemical grout, hydraulic cement or Portland type II cement. Bench areas and floors shall be lined with Spectrashield™.

15.2.8.3 Material Installation

1. The limits of the corrosion protection system shall include all exposed concrete/brick surfaces including walls, tap sections, risers, benches etc., unless otherwise directed by the owner/engineer.
2. Application of multi-component system shall be in strict accordance with manufacturer's recommendation. Final installation shall be a minimum of 500 mils. A permanent identification number and date of work performed shall be affixed to the structure in a readily visible location.
3. Provide final written report to owner/engineer detailing the location, date of report, and description of repair.

15.2.8.4 Final Inspection & Testing

1. Final concrete/brick structure corrosion protection system shall be completely free of pinholes or voids and all ground water infiltration shall be completely eliminated. A Holiday test shall be performed according to ASTM standards. All reports shall be performed in accordance with ASTM G62 and be submitted to the Project Construction Engineer. Liner thickness shall be the minimum value described within this specification.



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**Approved for Specific Capital Projects Only - Product Must Be
Specifically Noted In the Contract Documents at Time of Bid**

15.3 High Build Novolac Epoxy

15.3.1 General

The work described within this specification details a complete program for trowel applied liner coating for sewer piping and manholes for new construction and remedial work.

15.3.2 Referenced Standards

ASTM D638 – Standard Test Method for Tensile Properties of Plastic.

ASTM D695 – Standard Test Method for Compressive Properties of Rigid Plastic.

ASTM C722 – Standard Specification for Chemical Resistant Resin Monolithic Surfaces.

ASTM D790 – Standard Test Method for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials.

ASTM D1763 – Standard Specifications for Epoxy Resins.

ASTM D2240 – Standard Test Method for Rubber Property-Durometer Hardness.

ICRI Guidelines NO. 03732 – Selecting and Specifying Concrete Surface Preparation for Sealers, Coatings, and Polymer Overlays.

15.3.3 Submittals

1. A Denver Fire Department permit (Hazardous, Flammable, Hot Work, Confined Space) must be obtained by the contractor prior to beginning any work; with any material.
2. A letter to the City’s Construction Project Manager requesting use of the product/system for a specific Capital Project, must be approved in writing prior to product use.
3. Product Data: Technical data sheet for each product used; Material Safety Data Sheet (MSDS); design thickness.
4. Design Variations: Description of variations from application procedures, surface preparation, application equipment, or testing.
5. Quality Assurance/Control: Submit certifications as required under Article 15.3.4 – Quality Assurance.
6. Test Reports: Submit test reports from an independent testing laboratory confirming chemical resistance.
7. Plan to prevent debris from entering sewer line

15.3.4 Quality Assurance

- A. Applicator Qualifications: Trained and certified by Liner Coating Manufacturer. The coating applicator shall submit three (3) references relating to the quality of workmanship performed on other projects using one or more of the coatings listed below, or an approved equivalent coating.

15.3.5 Materials

Product shall be Sewer-Shield® 100 or Sewer-Shield® 150 as manufactured by Environmental Coatings 4702 E. Virginia St., Mesa, Arizona 85215-9101, (480) 984-7608.

- A. Trowel Applied Liner Coating:
 1. Acid Resistance:
 - a. Resistant to 98% sulfuric acid with maximum weight loss in 18 months no greater than 0.08 percent. (Sewershield® 100)
 - b. Resistant to 50% Sulfuric Acid (Sewershield® 150)

2. Gel Time: 15 minimum minutes at 75 degrees Fahrenheit using a 200 gram mass. Shorter gel times are not acceptable since they will not allow for proper adhesion to substrate.
3. Fillers:
 - a. Description: Chemical resistant, non wicking type. Fiberglass filler/roving is not acceptable.
 - b. Size: Pass 40 mesh screen.
 - c. Quantity: Not to exceed 20% (+/- 1%) in volume.
4. Thickness:
 - a. Typical: 3/16 inch.
 - b. Material shall be capable of being applied up to 3/8 inch thickness in one application without sagging.
6. Tack Free Time: Obtained in minimum one hour, and maximum 6 hours at 75 degrees Fahrenheit.

15.3.5.1 Accessories

- A. Water Stop Grout:
 1. Material: Hydrophobic polyurethane liquid which when mixed with catalyst, expands when it meets water or moisture.
 2. Acceptable Manufacturer and Product: **Mountain Grout® - Regular** as manufactured by Green Mountain, Inc. and distributed by Environmental Coatings, 4702 E. Virginia St., Mesa, Arizona 85215-9101, (480) 984-7608 is an acceptable product, or an approved equal.
- B. Patching Compound: Sewer-Shield® Products may require structural build-back using C-120 Calcium Aluminates mortar.
 1. Material: Calcium aluminate cement.
 2. Thickness:
 - a. Typical: 0.75 inches to 2 inches.
 - b. Material shall be capable of being applied up to 4 inches thick.
 3. Acceptable Manufacturer and Product: **Sewer-Shield® C-120 Acid - Resistant Underlayment** as manufactured by Environmental Coatings, 4702 E. Virginia St., Mesa, Arizona 85215-9101, (480) 984-7608 is an acceptable product, or approved equal.
 4. Refer to Section 02942 – Calcium Aluminate Mortar.
- C. Curing Primer:
 1. Material: 100% solids, solvent free epoxy curing primer designed to act as a curing compound for "green" concrete.
 2. Acceptable Manufacturer and Product: **Corro-Cure®** as manufactured by Environmental Coatings, 4702 E. Virginia St., Mesa, Arizona 85215-9101, (480) 984-7608 is an acceptable product, or approved equal.

15.3.6 EXECUTION

15.3.6.1 Initial Inspection

- A. Verification of Conditions:
 - 1. Examine subsurfaces to receive Work and report detrimental conditions in writing to Construction Project Manager. Commencement of Work will be construed as acceptance of subsurfaces.
- B. Coordination: Coordinate with other work, which affects, connects with, or will be concealed by this Work.

15.3.6.2 Surface Preparation

- A. Water Infiltration Remediation (if required): Mix and install specified Water Stop Grout in accordance with manufacturer's instructions if required to fill fissures or voids which are allowing water to infiltrate or exfiltrate into unwanted areas.
- B. Cleaning: Pipes and manholes surfaces to receive liner coatings shall be cleaned with high-pressure water vacuum equipment to remove debris. Recommended minimum cleaning pressure is 4,000 psi for Patching Compound.
- C. Surface Preparation:
 - 1. Concrete and masonry substrates:
 - a. Power wash surfaces using a minimum of 4,000 psi. Sandblast to sound concrete or masonry and to expose "bug holes."
 - b. If required, apply specified manufacturer's approved Patching Compound from 3/4 inch to 2 inches thick (4 inch maximum) to provide a smooth surface.
 - c. Green Concrete (less than 28 days old): Apply specified Curing Primer in accordance with manufacturer's printed instructions.
 - 2. Apply epoxy primer/sealer coat or specified Curing Primer to fill "bug holes" and to provide a smooth surface for application of liner coating.
 - 3. Prior to application of Patching Compound, structure surface shall be adequately sand blasted and roughened. (ICRI Level 5 surface preparation).
 - 4. Surface preparation of concrete for Liner Coating applied without Patching Compound shall be determined on a case-by-case basis.
 - 5. Remove manhole steps by cutting flush with vertical face of manhole wall prior to rehabilitation product application.
 - 6. Benches, walls and floors shall be repaired or refinished as necessary to comply with Wastewater Management Division Standard Detail Drawings (Drawing No. S-502) using chemical grout, hydraulic cement or Portland type II cement. Bench areas and floors shall be lined with Sewer-Shield.

- D. Structure must be dry during product application. Infiltration & moisture must be controlled prior to application of Patching Compound, Curing Primer, and Liner Coating products.
- E. Do not allow extraneous material to enter sewer lines. Extraneous material is defined as soft concrete debris, construction debris, or other materials. Active flows shall be diverted as necessary to ensure that the liquid flow is maintained off the surfaces to be lined. Contractor shall provide submittal explaining how they will prevent debris from entering live flow.

15.3.6.3 Material Installation

- A. Trowel applied liner coating:
 - 1. Provide at benches and channel walls.
 - 2. Provide at smaller manholes that are not accessible to spray equipment.
- B. Spray application of protective coatings may be allowed if the process and spray equipment being proposed complies with coating manufacturers recommendations, and meets or exceeds quality standards as noted for trowel-applied product.
- C. Certified Applicators or approved substitution:
 - 1. Fisher Company, Inc.
Contact: Eric Fisher
P.O. Box 4238
Granby, CO 80446
970-531-6992 (phone)
970-887-3339 (fax)
 - 2. JPCI Services
Contact: Joe Nuciforo
4702 E. Virginia St.
Mesa, AZ 85215-9101
480-984-7608 (phone)
480-380-4461 (fax)

15.3.6.4 Testing and Inspection

- A. Surface preparation work shall be thoroughly inspected by Construction Project Manager prior to application of coating or lining. The Contractor may not proceed with rehabilitation product application until surface preparation work is approved by Construction Project Manager. All structures shall be inspected from the surface to ensure adequate surface preparation has been achieved. A minimum surface roughness profile equivalent to ICRI-4 is required for all

coatings/linings. The Contractor is expected to cooperate and assist with the City's inspection efforts.

- B. The Construction Project Manager shall inspect all structural repairs made during the surface preparation process. Any structural repair deficiencies identified by the Construction Project Manager shall be corrected prior to rehabilitation product application.
- C. Contractor shall perform holiday (spark) test on all rehabilitated structures prior to restoration of service with test equipment and voltage appropriate for coating/lining. Voltage is to be set at a minimum of 100 volts per mil of coating/lining thickness (i.e., 12,500 volts for 125 mils). After identification of pinholes, thin areas, or other imperfections, re-apply coating/lining material within manufacturer recommended recoat time window. Retest. Repeat until no holidays are identified. The Construction Project Manager shall verify voltage and observe final holiday testing performed by Contractor.
- D. A comprehensive visual surface inspection shall be performed by Construction Project Manager for all rehabilitated structures. The finish of the protective coating shall be smooth and uniform, pin hole free, acceptable to City inspections. Construction Project Manager may, at his/her discretion, perform additional entry inspections as deemed necessary. Construction Project Manager reserves the right to reject sub-standard workmanship.

15.3.6.5 Cleaning

- A. During the course of the Work and on completion of the Work, remove and dispose of excess materials, equipment and debris away from premises. Leave Work in clean condition.

End of Specification



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20.0 Grass Sodding

20.0.1 General

This item shall consist of placing grass sodding and fertilizing in conformity with the lines, grades and cross sections shown on the plans, stakes established by the Project Construction Engineer, and in accordance with these Detail and Technical Specifications.

The equipment and methods described in these Detail and Technical Specifications may be modified where it is established to the satisfaction of the Project Construction Engineer that the resultant product is equivalent to that specified herein.

20.0.2 Materials

20.0.2.1 Sod

Sod shall be Kentucky bluegrass and shall be approved by the Parks and Recreation Department before placement. At least 99% of the plants in the sod shall be of the variety specified. The sod shall be materially free from weeds or undesirable plants and stones larger than 1 inch in diameter. Sod shall be nursery grown and shall be mowed to a height not to exceed 2 inches before lifting and shall be of a uniform thickness with not over 1-1/2 inches soil or less than 1 inch of soil.

Delivered sod shall not contain more than 5% broken rolls. Sod shall be laid within 24 hours from the time it is lifted from the field.

Sod that has become moldy, withered, or yellow from storage or white from drying will be rejected at the time of planting. Rejected sod will not be counted for payment.

20.0.2.2 Fertilizers

The area to be sodded shall be fertilized as follows:

- a. Well rotted cow manure shall be roto-tilled into the topsoil prior to sod placement.
- b. In general commercial fertilizer consisting of 20% nitrogen, 20% available phosphoric acid and 10% water soluble potash is acceptable. Commercial fertilizers shall be applied after the sod is laid and shall be a complete formulation or organic base, granular and free flowing.

20.0.2.3 Topsoil

Topsoil may be selected from the material excavated at the job site by the Project Construction Engineer and placed where needed to provide a 4inch minimum friable, fertile loam root-moisture zone. During the excavation operation, the acceptable on-site topsoil shall be removed and stockpiled in the area. Upon completion of the construction, the topsoil shall be placed to the correct line and grade in all areas requiring sodding and seeding. Topsoil will not be required in areas of special slope protection noted on the plans, in paving areas or other structures.

In the event the topsoil available from project excavation is insufficient, in the judgement of the Project Construction Engineer, the Contractor shall import suitable topsoil in conformance with the select material requirements in section 5.0 of these Detail and Technical Specifications. Payment for on-site or imported topsoil shall be as noted in the Measurement and Payment Section of these Detail and Technical Specifications.

20.0.3 Construction

20.0.3.1 Time

The Contractor shall place the sod between March 1 and November 1 of the Calendar year of construction. No sod shall be laid on frozen soil.

20.0.3.2 Site Preparation

The area to be sodded shall be cleared of all stones, roots, wood, weeds, and any other materials that may hinder proper grading, tilling, sodding, or subsequent maintenance, operations and shall be smooth before any sod is laid.

After the cow manure has been roto-tilled into the topsoil as specified in Subsection 20.3.4 below, fine grading shall be performed to insure reasonable grades and alignments per the grade stakes. Where no grade stakes are shown, areas shall be smooth and of continual grade between control points, such as walks and curbs. Areas of settlement shall be filled with topsoil and properly rolled to insure a firm bed true to the proposed grades. Areas of compacted soil, which are, in the judgement of the Project Construction Engineer, too hard to serve as suitable subgrade, shall be scarified to a depth of six inches, and leveled and rolled.

After the fine grading operations have been completed, the entire area to be sodded shall be rolled with a 100 pound roller prior to sod placement.

20.0.3.3 Sod Placement

Sod shall be laid on a smooth, firm earth bed with staggered, tight joints. Care should be exercised to avoid air voids along the joints and at end sections. Sections of sod that leave more than 1/2 inch joints opening shall be filled with a screened topsoil. Exposed edges shall be mounded with topsoil.

The sod shall be laid with staggered joints and shall run parallel to a 90-degree angle to the slope of the ground. If the slope is steeper than 2:1, the prepared sod bed shall be lightly and sufficiently watered prior to placement of the sod.

All sod laid slopes within 4 vertical feet of the flow line of open channels, gulches, etc. shall be held in place with 12 gauge u-shaped metal pins, minimum one inch in width, eight inches long driven flush with the top of the root zone. Prior to pinning, a 12" wide strip of 20 gauge 2" galvanized wire netting shall be placed at each corner and one in the center of each perpendicular edge (3 pins/1e" wide roll). Care shall be taken to insure that each pin will secure the wire netting to the sod. Pins shall be driven at intervals not greater than one foot from beginning to end of the roll and at each grade change in the slope. All sod shall be laid parallel to the center line of the channel.

20.0.3.4 Fertilizer Placement

Fertilizing accomplished in a two step operation as follows:

- a. Cow manure shall be spread over the surface of the ground of the areas to be covered at the minimum rate of one (1) cubic yard per thousand (1,000) square feet. The areas shall then be thoroughly roto-tilled to a depth of from a minimum of 4 inches to a maximum of 6 inches until no manure appears on the surface.
- b. Commercial Fertilizer shall be uniformly applied after the sod has been laid at the rate of 10-pounds per 1,000 square feet of coverage or as recommended by the fertilizer manufacturer. The method of application shall be subject to approval by the Project Construction Engineer.

20.0.3.5 Maintenance

The Contractor shall be responsible for watering and mowing the sodded areas. Watering shall be performed periodically to insure a uniform root extension into the bed root--moisture zone. Mowing shall be performed to limit maximum grass height to three (3) inches and cut length of one and one-half (1-1/2) inches.

The maintenance period for sod shall continue for 90 days after notification in writing to the Project Construction Engineer of the completion of sodding and the owner's initial approval. During this 90-day period the sod shall be kept growing and in place, and any movement or dead grass shall be replaced to the satisfaction of the Project Construction Engineer. During this period, the sod's condition shall show normal to good progress so as to constitute an acceptable planting by the owner's representative. Watering shall be as required. If the planting within the reasonable care of the contractor does not show acceptable progress during this period, the areas affected shall be resodded, fertilized as required and growth progress repeated until results are obtained. This reworking shall be at the contractor's expense. If the planting is damaged or otherwise hindered due to causes beyond the

contractor's control such as inclement weather or vandalism, the contractor shall rework the planing according to the item in the Measurement and Payment Section of these Detail and Technical Specifications.

End of Specification



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21.0 Sprinkler Systems

21.0.1 General

This section outlines the guidelines and requirements required to construct irrigation distribution lines and sprinkler systems required to complete construction per the Contract Documents.

The work shall include the installation of all line pipes, fittings, valves, and blow-offs, drain valves, controllers, electrical control and supply wires, all fittings and tapped couplings necessary for the connection of the lateral sprinkling system lines to the distribution system lines, etc. Also included will be the plugging and blocking of the cut ends of disconnected existing lines if any, connection to existing park water lines and/or city water mains, meter installation, and all fittings, valves, accessories, etc. necessary for these connections.

The pipe shall be installed to the prescribed lines and grades. All work required for the construction of the water lines, accessories and appurtenances thereto, including excavation, trenching, concrete work, pressure tests and miscellaneous items of work covered by the Plans and these Detail and Technical Specifications shall be preformed.

21.0.2 Proposed Substitutions

Substitutions which will result in any changes in layout, installation, or coverage as designed and shown on the Plans and specified herein shall be accompanied by plans clearly showing the proposed installation including but not limited to materials, spacing, precipitation and scheduling. Such plans must be approved by the Project Construction Engineer before work is to start.

21.0.3 Qualifications of Installers

The sprinkler system contractor shall have had considerable experience and demonstrated ability in the installation of sprinkler irrigation systems of this type. All work shall be installed by skilled persons proficient in the trades as required, in a neat, orderly and responsible manner with recognized standards of workmanship. At least one person shall be present at all times during the execution of this work who shall be thoroughly familiar with the type of materials being installed and the material manufacturers' recommended methods of installation and who shall direct work performed under this section.

21.0.4 Staking

All necessary staking for construction of the sprinkler system shall be done by the Contractor and checked by the City before excavation or installation is begun.

21.0.5 Material

Unless otherwise noted or approved, all materials shall be of the type as shown on the Plans and shall conform to the following specifications. Asbestos Cement Pipe shall not be used.

21.0.5.1 Plastic Pipe

1. Rigid Plastic Pipe

Shall be polyvinyl chloride (PVC) and shall conform to all requirements of Product Standard PS-22 or ASTM D-2241 or PVC 1120 (Type I), SDR-21 (Class 200). Pipe shall be National Sanitation Foundation (NSF) approved. Fittings shall be socket type PVC schedule 40 meeting all requirements of ASTM D-2466 and D-1784. Solvent used for joining pipe & fittings shall meet all requirements of ASTM D-2564 Rigid plastic pipe shall not be threaded except as noted below.

2. Riser and Swing Joint Nipples

Shall be PVC Schedule 80 threaded pipe and shall conform to all requirements of Product Standard PS-21 or ASTM D-1785. Fittings shall be threaded PVC Schedule 40 meeting all requirements of ASTM D-2466 and D-1784. Use teflon tape on all threaded joints.

3. Flexible Plastic Pipe

Shall be polyethylene (PE), 80 psi rated and shall conform to all requirements of Product Standard PS-11 or ASTM D-2239 or PE-2306, SDR-15. Pipe shall be National Sanitation Foundation (NSF) approved. Fittings shall be insert type PVC meeting requirements of

ASTM D-2609. Clamps shall be all stainless steel. Flexible plastic pipe shall not be used in any continuous pressure application.

4. Markings

All plastic pipe shall be continuously & permanently marked with the manufacturers name, pipe size, schedule number or SDR number, type of material and code number.

21.0.5.2 Copper Pipe

Copper pipe shall be type K copper, ASTM B-88. Fittings for copper pipe shall be wrought copper or cast bronze, 150 psi class. Joints shall be solder joints with 95-5 tin-antimony.

21.0.5.3 Galvanized Steel Pipe

Galvanized Steel Pipe shall be schedule 40 steel. Fittings shall be malleable galvanized iron, screwed pattern, 150 psi class. Galvanized pipe and fittings shall conform to ASTM A-120. Buried galvanized pipe except risers and casing shall be wrapped with heavy craft paper applied with hot asphalt. Wrap on fittings shall be glass cloth. Use teflon tape on all threaded joints.

21.0.5.4 Gate Valves

Gate Valves shall be Class 125 (200 psi w.o.g.), shall open by turning to the left, shall have non-rising stems and shall have a clear waterway equal to the full nominal diameter of the valve. Gate valves (not buried) shall have solid wedges, union bonnets and shall comply with the following materials specifications: Handwheel Nut -Bronze ASTM B-16. Stem -Silicon Bronze ASTM B-371 Alloy A (Rod) or ASTM B-198 Alloy 13B; Packing -Teflon impregnated Asbestos; Packing Gland -Bronze ASTM B-62 or B16 ; Packing Nut, Stuffing Box, Bonnet, Union Nut, Body Wedge and Wedge Holder- Bronze ASTM B-62. These valves shall conform to Federal Specification WW-V-54C Class A, Type I. Buried gate valves 2 and larger shall conform to AWWA C-500, with double-disk wedges and O-ring seals.

21.0.5.5 Valve Boxes

Unless shown or noted otherwise, all underground valves not located in pits shall have cast iron boxes with flared bases. Valve boxes shall be 2 piece screw type.

21.0.5.6 Angle Valves

Angle Valves shall be rated at 150 psi or more, and shall open by turning to the left. Angle valves shall be designed for above or below ground installation with suitable cross wheel for operation with key. Valves shall have removable bonnet and stem assembly with packing gland nut and with replaceable seat washers. Angle valves shall be heavy pattern brass construction of the make and size shown on Plans or approved equal.

21.0.5.7 Drain Valves

Drain Valves shall be rated at 150 w.o.g. or more, shall open by turning to the left, and shall be the make and size as shown on Plans or approved equal. Unless shown or noted otherwise, drain valves shall be 3/4". If valve discharge is not downward, valves shall be provided with elbow for downward discharge.

21.0.5.8 Quick Coupler Valves

Quick Coupler Valves shall be 2 piece all brass construction of the make and size as shown on Plans or approved equal. Quick coupler keys and hose swivels shall be provided as shown on the Drawings.

21.0.5.9 Manual Control Valves

Manual Control Valves shall be either angle valves as described herein or Class 125 bronze globe valves meeting requirements of Federal Specification WW-V-51d Class A, Type I. They shall be of the make and size as shown on Plans or approved equal. Valves shall be key operated.

21.0.5.10 Electric Control Valves

Electric Control Valves shall be brass construction, normally closed, 24 volt AC electrically operated globe valves with slow-opening and slow-closing devices. They shall be of the make, model numbers, and size as shown on the Plans or approved equal.

21.0.5.11 Valve Keys

Two valve keys shall be provided for each type key operated valve installed.

21.0.5.12 Unions

Brass unions shall be provided where shown and/or required to allow removal of all control valves.

21.0.5.13 Valve Pits

Valve Pits shall be constructed as shown in the Valve Pit and Piping Detail. of these Detail and Technical Specifications. Concrete shall conform to the requirements of Item 12 of the Standard Construction Specifications. Precast concrete rings or fiberglass pits and their respective covers may be submitted for approval by the Project Construction Engineer.

21.0.5.14 Automatic Controllers

Automatic Controllers shall be 110 volt input, 24 volt AC value output with both controller and control valves of the same manufacturer, designed to operate as a unit or as otherwise shown on the Plans. Controllers shall be capable of operating the number of valves shown on the Plan and shall be pedestal mounted unless shown otherwise on the Plans. Controllers shall have a 2 hour clock, 14 day calendar wheel and individual station timers from 0 to 30 minutes. Manufacturer and model numbers shall be as shown on the Plans or approved equal. Unless located inside of a building, the controller shall be enclosed in an approved separate weatherproof, vandal resistant cabinet. A lock and 3 keys shall be furnished with each unit.

21.0.5.15 Sprinkler Heads

Sprinkler Heads of the type and size as shown on the Plans shall be furnished and installed as herein specified.

21.0.5.16 Electric Control Wiring

Electric Control Wiring shall be No.14 direct burial type U.F. cable or larger if required to operate the system as designed. Follow the recommendations of the controller manufacturer for sizing wire.

21.0.6 Installation

21.0.6.1 General

Prior to any work described in this section, the Contractor shall carefully inspect the installed work of all other trades and verify that all such work is complete to the point where this installation may properly commence. The Contractor shall verify that the irrigation system can be installed in strict accordance with all pertinent Permits, codes and regulations, the original design, the referenced standards and the manufacturers recommendation. All necessary field measurements shall be made by the Contractor to ensure precise fit of items in accordance with the original design.

21.0.6.2 Excavation

Plastic pipe up to 2" in diameter may be direct bore if approved by the Project Construction Engineer. All other lines shall be installed in open cut trenches. The width of the trench in which the pipe will be placed shall be sufficient to allow thorough tamping of suitable backfill material under, around and over the pipe. All excavated material shall be deposited at least two feet away from any trench side. Tunneling will be permitted only where pipe must pass under any obstruction which cannot be removed. In backfilling the tunnel, the final density of the backfill must match that of the surrounding soil. It shall be acceptable to use a casing of suitable diameter which shall be installed first by tunneling or jacking, and the pipe shall then be laid through the casing, observing the same precautions as though it were installed in open trench. Any trench deeper than 6 feet shall be adequately shored and/or braced for safety considerations. If ground water is encountered during trench excavation above the elevation of the bottom of the pipe bell, such water shall be removed until the pipe has been installed and the trench backfilled. The Contractor shall take all necessary measures to insure that no ground water enters the pipe.

21.0.6.3 Piping and Control Wiring Depth

All lines shall be installed with the following minimum depths of cover unless noted otherwise on the drawings:

- a. Pressure Lines 30"
- b. Distribution Lines (Laterals) 6" to 18"
- c. Lines to Drinking Fountains 30"
- d. Lines to Quick Couplers 30"
- e. Electrical Lines 24"

21.0.6.4 Piping

All pipes shall be installed according to the following specifications.

1. Rigid Plastic Pipe

Exercise care in handling, loading unloading and storing plastic pipe and fittings; store plastic pipe and fittings under cover until ready to be installed; transport plastic pipe only on a vehicle with a bed long enough to allow the pipe to lay flat to avoid undue bending and concentrated external load. Repair all dented and damaged pipe by cutting out the dented or

damaged section and rejoining with a coupling. In jointing, use only the specified solvent and make all joints in strict accordance with the manufacturer's recommended methods; give solvent welds at least 15 minutes set-up time before moving or handling; and 24 hours curing time before filling with water. If manufacturers recommendations do not cover all aspects of jointing, the recommendations of Plastics Pipe Institute Technical Report TR10 shall be followed. Piping shall be snaked in the trench, centerload the pipe with a small amount of backfill to prevent arching and deflection under pressure. All piping shall be sloped to drain and shall not be installed when air temperature is below freezing.

2. Flexible Plastic Pipe

Shall be installed in strict accordance with the manufacturer's recommendation. If the manufacturer's recommendation does not cover all aspects of installation the recommendations of the Plastics Pipe Institute Technical Report TR8 shall be followed. Piping shall be sloped to drain. Saddle tee connections shall not be used. Pipe shall not be installed when air temperature is below freezing.

3. Copper Pipe

Shall be installed according to manufacturer's recommendations. When copper pipe is jointed to any metal pipe or equipment other than copper it shall be by means of dielectric unions. Pipe shall be sloped to drain.

4. Galvanized Steel Pipe

Make all cuts in galvanized pipe square. Cuts shall be thoroughly reamed with all rough edges and burrs removed. Use joint tape on male threads only. Pipe shall be sloped to drain.

21.0.6.5 Valves and Valve Boxes

Installation of Valves and Valve Boxes shall be in accordance with the following:

1. Gate Valves

Shall be installed where shown on the Plans and shall be set plumb. Gate valves 6. and larger shall be anchored to a block of concrete to insure stability of the valve in an upright position. Anchor valve in such a manner that it may be removed and re-installed without breaking the concrete block.

2. Valve Boxes

Shall be installed where shown on the Plans and shall be set plumb. Gate valves 6" and larger shall be anchored to a block of concrete to insure stability of the valve in an upright position. Anchor valve in such a manner that it may be removed and re-installed without breaking the concrete block.

3. Angle Valves and Drain Valves

Shall be installed where shown on the Plans and also at other low points in the system as necessary to insure complete drainage of the system. Each valve not in a valve pit shall be provided with a C.I. Valve box with the lid set flush with the ground. Drain valves set below valve pits shall have PVC sleeves for key operation. Sleeves shall project a minimum of 12" from the pit bottom and shall have removable caps. A drainage sump shall be provided for

each drain valve and shall contain a minimum of 4 cubic feet of gravel. See "Valve & Pit Piping Detail" of these Detail and Technical Specifications.

4. Quick Coupler Valves

Shall be installed where shown on the plans and as shown in "Valve Pit & Piping Detail". Risers for quick couplers shall be schedule 40 galvanized. In lawn areas install quick coupling valves using a double swing joint top flush to final grade. In planting areas install with top 2" above grade.

5. Manual Control Valves

Shall be installed where shown on the Plans and in accordance with manufacturer's recommendations. All manual control valves shall be in valve pits or valve boxes.

6. Electric Control Valves

Shall be installed as shown in "Valve Pit & Piping Detail". Valves shall be installed in such a way that they are accessible for repairs and/or removal.

21.0.6.6 Valve Pits

Install valve pits where shown on the Plans and as shown in "Valve Pit & Piping Detail".

21.0.6.7 Automatic Controllers

Install controllers where shown on the Plans and in accordance with the manufacturer's recommendations and, if pedestal type, as shown on "Controller Pedestal Detail" of these Detail and Technical Specifications.

21.0.7 Flushing

Before sprinkler heads are set, the lines shall be thoroughly flushed in order to make sure that there is no foreign matter in lines which could cause stoppage of the sprinklers. When the system has been fully completed, it shall be tested and the operation thereof demonstrated to the City.

21.0.8 Inspection

No work shall be covered up or enclosed until it has been inspected, tested and approved by the City. The Contractor shall thoroughly clean, adjust and balance all systems. The Contractor shall demonstrate the entire system to the City proving that all remote control valves are properly balanced, that all heads are properly adjusted for radius and arc of coverage and that the installed system is workable, clean and efficient.

21.0.9 Testing

The Contractor shall furnish all necessary testing equipment and personnel and test the system as follows:

- a. make all necessary provisions for thoroughly bleeding the line of air.
- b. Before testing, fill the line with water for a period of at least 24 hours.

- c. After valves have been installed, test all live water lines for leaks at a hydrostatic pressure of 150 psi for a period of two hours with all couplings exposed and with all pipe sections centerloaded.
- d. Correct all leaks, and replace damaged or faulty pipe and retest until accepted by the City.

21.0.10 Backfilling

Trenches shall be carefully backfilled with suitable materials free from clods of soil or stones larger than three inches (3.) in maximum dimension. Deposit the backfill materials equally on both sides of the pipe in 6" layers and compact thoroughly. Puddling or "ponding" shall be required. An excess of water shall be avoided in order to prevent disturbance of the earth under and around the pipe and also to prevent undue pressure upon the pipe. Likewise, the amount of water used shall be controlled so as not to risk "floating" the pipe out of position. Adequate dikes shall be constructed along the trench to retain and guide the water.

When jetting is used, jets shall be of an approved design and of sufficient length to reach the bottom of each layer and the water supply shall be continuous. All costs incurred in getting the water to the point of use for the above purposes shall be borne by the Contractor. Excavated material will generally be considered satisfactory for backfill purposes. All backfill material shall be free from rubbish, vegetable matter, frozen materials, or stones larger than three inches (3.) in maximum dimension. Any material not suitable for backfill or not used shall be removed from site by the Contractor. Backfill shall not be done in freezing weather except with written approval from the City. All trenches shall be left slightly mounded to allow for settlement after the backfilling is completed. The site of the work shall be continuously cleaned up of excess and/or waste materials as the backfilling progresses and shall be left in a neat and workmanlike condition to the satisfaction of the City. Any undue settling which results within one year after final acceptance of work shall be corrected by the Contractor and at the Contractor's expense including resurfacing as required.

21.0.11 Area Restoration

Where trenches and lines cross existing roadways, paths, curbing, etc., damage to these shall be kept to a minimum and they shall be restored to as near original condition as possible. Match existing road section for blacktop paving thoroughly compacted sub-base, base course, bituminous course matching grades of existing paving. Blacktop curbs hot mix bituminous course material tamped and shaped to match adjoining curbs. Concrete paving or curbs concrete to match adjoining concrete work. The quality of the materials used in this restoration shall be equal to or better than the material which was removed, or as shown on the Plans or specified

21.0.12 Water Service

21.0.12.1 Scope

This work consists of providing water service for the sprinkler system by connecting the system to existing park water lines and/or city water mains. The work includes the furnishing

of all labor, supervision, construction equipment and materials including piping, valves, meters, meter pits and backflow prevention devices. All work required to complete the water service in conformance to the Plans and Specifications including excavation, trenching, concrete work pressure tests, and miscellaneous items of related work shall be preformed.

21.0.12.2 Workmanship

All materials and equipment shall be installed in a first class, workmanlike manner using workmen who are skilled and certified in their respective trades.

21.0.12.3 Building Code

All work shall be in accordance with the Denver Building Code, latest revision.

21.0.12.4 Connection to Existing Park Water Lines

Connection to Existing Park Water Lines shall be made by tapping sleeves, tees or crosses. All fittings shall have a design working pressure of 150 psi; all material shall conform to the requirements herein specified

21.0.12.5 Connections to City Water Mains

Connections to City Water Mains shall be done in accordance with Denver Water Board Requirements and regulations.

21.0.12.6 Materials

Unless otherwise noted or approved, all material shall conform to the following Specifications .

1. Copper Pipe

Shall be Type k copper, ASTM B-88. Fittings for copper pipe shall be wrought copper or cast bronze, 150 psi class. Joints shall be solder joints with 95-5 tin -antimony.

2. Cast Iron Pipe

Shall meet the requirements of AWWA Standards C-101 and C-106 for 150 psi working pressure. Unless otherwise noted, cast iron pipe shall have push on type joints approved by the Project Construction Engineer and installed in strict accordance with manufacturers recommendations. Cement lining shall conform to AWWA Standard C-104. Rubber gasket joints shall conform to AWWA Standard C-111.

3. Curb Valves

All curb valves between the main and the meter shall be rated at 175 psi w.o.g., and shall open by turning to the right. Curb valves shall be all bronze with "O" ring seals. Curb valves shall have cast iron curb boxes complete with lid and foot piece designed for use with the curb valve. Make and size shall be as shown on the Plans. Curb valves must be approved by the Denver Water Board.

4. Gate Valves

All gate valves used in conjunction with water meters shall be as approved by the Denver Water Board.

5. Water Meter

The size shall be as shown on the Meter and shall be of the type approved by the Denver Water Board.

6. Backflow Preventer Device

Shall be of the type as shown on the Plans. The backflow prevention device must be approved by the Denver Water Board and shall be furnished with inlet and discharge shut-off valves.

7. Pit for Water Meter

Shall be as per Denver Water Board requirements. Water Service installation shall conform to the following specifications.

a. Excavation. The width of the trench in which the pipe will be placed shall be sufficient to allow thorough tamping of suitable backfill material under, around and over the pipe. All excavated materials shall be deposited at least two feet away from any trench side. Any trench deeper than 6 feet shall be adequately shored and/or braced for safety considerations. If ground water is encountered during trench excavation above the elevation of the bottom of the pipe bell. All water shall be removed until the pipe has been installed and the trench backfilled.

b. Cast Iron Pipe shall be installed in accordance with the recommendations of the manufacturer. Unless noted otherwise or approved by the Project Construction Engineer, cast iron pipe shall be embedded in and covered by a minimum of 6 inches of pea gravel; max. 3/8" dia.

c. Copper Pipe shall be installed in accordance with the manufacturer's recommendations. When copper pipe is jointed to any metal pipe or equipment other than copper, brass or bronze, it shall be by means of dielectric unions.

d. Testing required for this portion of the system shall be the same as that described in Section 21.3 of these Detail and Technical Specifications.

e. Backfilling requirements shall be the same as those described in Section 21.3 of these Detail and Technical Specifications.

f. Restoration. Requirements for restoring area shall be the same as those described in Section 21.3 of these Detail and Technical Specifications.

21.0.13 Electrical Service

21.0.13.1 Scope

This work consists of providing electrical service to the automatic sprinkler controllers. The work includes the furnishing of all labor, supervision, construction equipment and materials including wire, conduit, devices and appurtenances. All work required to complete the

electrical service in conformity with the Plans and specifications including excavation, trenching and miscellaneous items of related work shall be performed.

21.0.13.2 Workmanship

All materials and equipment shall be installed in a first class, workmanlike manner, using workmen who are skilled and certified in their respective trades.

21.0.13.3 Code

All work shall be done in accordance with the Denver Building Code and the National Electrical Code, latest edition.

21.0.13.4 Materials and Installation

Material and Installation shall conform to the following specifications.

1. Wire

Shall be as shown on the Plans.

2. Sleeves

Shall be Schedule 40 galvanized steel All wires buried in roadways shall have sleeves.

3. Service Connections

Coordinate with Public Service Company, Street Lighting Division for electrical service connection.

End of Specification



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Storm Drainage and Sanitary Sewer Construction Detail and Technical Specifications

22.0 Seeding

22.1.1 General

This work shall consist of furnishing and drilling in seed or hydromulch seeding in accordance with these Detail and Technical Specifications and as shown on the Plans. The work shall also include soil preparation, furnishing and spreading fertilizer and installation of mulch and erosion control blanket.

All areas shall be seeded by drilling. In areas where access is a problem, seeding shall be conducted by hydromulch seeding as directed by the Project Construction Engineer. Mulch shall be required in all areas that are drilled.

Seeding and the installation of erosion control in certain areas designated by the Project Construction Engineer may be permitted before the construction of certain areas to take advantage of growing conditions.

Seeding shall not be accomplished when the ground is frozen or otherwise untillable.

Seeded areas damaged due to circumstances beyond the Contractor's control shall be repaired and reseeded as ordered. Payment for this corrective work shall be at the contract price.

22.1.2 Grading

All areas requiring seeding shall be cleared of vegetation, roots, oversized materials and all other material which is objectionable in the opinion of the Resident Engineer and shall be disposed of as specified in Section 2.0, Site Preparation.

22.2 Materials

22.2.1 Seed

All seed shall be furnished in bags or containers clearly labeled to show the name and address of the supplier, the seed name, the lot number, net weight, the percentage of purity and germination. All brands furnished shall be free from such noxious seeds such as Russian or Canadian Thistle, European Bindweed, Johnson Grass and Leafy Spurge. All seed furnished shall be from a lot that has been tested by a recognized laboratory for seed testing within six months prior to the date of delivery. Seed which has become wet, moldy, or otherwise damaged in transit or in storage will not be acceptable.

Seed Type. The seeds acceptable for drilling and hydromulch seeding are: (1) White Dutch Clover, (2) Fairway Wheatgrass, (3) Perennial Rye, (4) "Sodar" Streambank Wheatgrass, and (5) Luna Pubescent or Western Wheatgrass.

Seeding Mixture. The seeding mixture shall be applied at a bulk rate per acre as follows for hydromulch seeding:

	Pounds	Purity	Germination
(1) White Dutch Clover	1.1	96%	90%
(2) Fairway Wheatgrass	2.9	95%	85%
(3) Perennial Rye	3.5	98%	90%
(4) Sodar Streambank Wheatgrass	5.2	97%	92%
(5) Luna Pubescent Wheatgrass	8.9	93%	85%
(6) Western Wheatgrass	10	80%	80%

The seeding rate per acre for drilling shall be one-half the rate of hydromulch seeding.

- c. Seed Purity. Seed and seed labels shall conform to all current State and Federal regulations and will be subject to the testing provisions of the Association of Official Seed Analysis.

If seed available on the market does not meet the minimum purity and germination percentages specified, the Contractor must compensate for a lesser percentage of purity

of germination by furnishing sufficient additional seed to equal the specified product. Product comparison shall be made on the basis of pure live seed in pounds. The formula used for determining the quantity of pure live seed (PLS) shall be:

$$\text{Pounds of Seed} \times (\text{Purity} \& \text{Germination}) = \text{Pounds of Live Seed (PLS)}$$

21.2.2 Fertilizers

Fertilizers shall consist of a standard brand fertilizer having a minimum content of 18% available nitrogen. The percentage of nitrogen content shall be certified at the time of use.

Super Phosphate (45% minimum Phosphate when called for on the Plans) will be used on subsoil where all topsoil has been removed. The rate of application shall be approximately 250 pounds per acre.

22.2.3 Erosion Control Blanket

Erosion Control Blanket. The blanket shall consist of a material or combination of materials that are biodegradable after a sufficiently long enough period of time to insure germination and rooting of grass seeds. The blanket shall have uniform openings and consist of knitted yarn in a material that has enough strength and flexibility that allows it to be placed over uneven ground surfaces. The erosion control blanket shall be furnished in rolls that have a width of 4' minimum to 10' minimum. Length and weight of the rolls may vary depending on the manufacturer and the blanket material.

Pins and Staples. Pins or staples shall be made of wire .091" or larger in diameter. "U" shaped staples shall have legs 6" long and 1" crown." T" shaped pins shall have a minimum length of 8" after bending. The bar of the "T" shall be at least 4" long with the single wire end bent downward approximately 3/4".

22.2.4 Tackifier

A tackifier will be required with all hydromulch seeding.

22.2.5 Hydromulch

Wood cellulose fiber for hydromulch seeding shall not contain any substance or factor, which might inhibit germination or growth of grass seed. It shall be dyed an appropriate color to allow metering of its application.

The wood cellulose fibers shall have the property of becoming evenly dispersed and suspended when agitated in water. When sprayed uniformly on the surface of the soil, the fibers shall form a blotterlike ground cover, which readily absorbs water, and allows infiltration to the underlying soil. Weight specifications from suppliers, and for all applications, shall refer only to air dry weight of the fiber, a standard equivalent to ten (10%) percent moisture. The mulch material shall be supplied in packages having a gross weight not in excess of one hundred (100) pounds, and shall be marked by the manufacturer to show the air dry weight content. Suppliers shall certify that the laboratory and field testing of their product has been accomplished and that it meets all of the foregoing requirements pertaining to wood cellulose fiber mulch.

22.2.6 Mulch

Materials for straw mulch shall consist of straw of oats, barley, wheat, or rye and shall not contain seed of noxious weeds.

Straw or hay in such an advanced stage of decomposition as to smother or retard the normal growth of grass will not be accepted. Old dry straw which breaks in the crimping process in lieu of bending will not be accepted.

22.3 Construction

22.3.1 Grade Preparation

Prior to seeding, the top 4 inches of the surface shall be tilled and brought to the desired line and grade, except where seeding follows so closely behind the initial grading as to make special seeding preparation unnecessary. Areas to be seeded shall be tilled or handworked into a reasonably even and loose sandbed immediately in advance of the seeding.

22.3.2 Seeding

Hydromulch Seeding. As required, cellulose fiber mulch shall be added with the proportionate quantities of water and other approved materials in the slurry tank. All ingredients shall be mixed to form a homogeneous slurry. Using the color of the mulch as a metering agent, the operator shall spray-apply the slurry mixture uniformly over the designated seeded area. Unless otherwise ordered for specific areas, wood cellulose fiber mulch shall be applied at the rate of 1500 pounds per acre or 35 pounds per 1,000 square feet.

Hydromulch seeding shall not be done in the presence of free surface water resulting from rains, melting snow or other causes.

Drilling. Seeding shall be accomplished by means of an approved mechanical power drawn drill, followed by packer wheels or drag chains. Seed shall not be drilled during windy weather or when the ground is frozen or otherwise untillable.

Mechanical power drawn drills shall have depth bands set to maintain a planting depth recommended for the type of seed being drilled and shall be set to space the rows not more than 7 inches apart.

If the inspections indicate the stripe wider than the specified space between the rows planted have been left or other areas skipped, the Project Construction Engineer shall require immediate re-sowing of seed in such areas at the Contractor's expense.

All seeding shall be done between September 1 to September 15 and March 2 to April 15 of the Calendar year of construction.

The Contractor shall be responsible for maintaining and watering areas seeded for a period of 7 weeks after the time of seeding. Areas in which there is not a satisfactory stand at the expiration of this 7-week period shall be re-seeded. Sprinkling of the seeded areas shall be carefully done in such a manner as to avoid standing water, surface wash or scour. Areas seeded and so maintained shall be protected against damage by vehicle or pedestrian traffic by the use of barriers and appropriate warning signs. Areas shall be re-seeded as many times

as is required to establish a significant growth of grass seedlings (a minimum of 25 plants per square feet).

22.3.3 Mulch

After seeding has been completed, a rate of 1 1/2 tons of hay or straw per acre, or as directed, shall be applied uniformly, crimped in with a crimper or other approved equipment. The Project Construction Engineer may order the employment of hand crimping operations on such areas where excessive ground slopes or confined areas would cause unsatisfactory crimping by mechanical methods.

The seeded area shall be mulched and crimped within 24 hours after seeding. Areas not mulched and crimped within this 24-hour period must be reseeded with the specified seed mix at the Contractor's expense prior to mulching or crimping.

On steep slopes or other specific areas as shown on the plans, which are difficult to mulch or crimp by conventional methods, burlap or other blanketing materials properly anchored or secured may be used when approved by the Project Construction Engineer.

22.3.4 Fertilizer

Fertilizer shall be spread uniformly at the rate specified and washed into the soil by the application of water or tilled into the top two inches of soil. Sufficient fertilizer shall be evenly distributed to provide 50 pounds of free nitrogen per acre.

22.3.5 Erosion Control Blanket (Channels, Etc.)

Erosion control blanket shall be installed on each side and bottom of the low flow channel as shown on the drawings and as directed by the Project Construction Engineer. An additional row of blanket (approximately 4' to 5' wide) may be required in areas of steep slopes or southern exposures.

The area to be covered shall be properly prepared, fertilized and seeded before the erosion control blanket is applied. The blanket shall be placed in accordance with the manufacturer's recommendations and in such a manner to insure contact with the ground creating maximum protection for the newly planted seed. In the low flow channel, the erosion control blanket shall be applied in the direction of the flow of the water, butted snugly at the sides and lapped approximately one foot. On slopes the blankets may be applied either horizontally or vertically to the slope as directed by the Project Construction Engineer. Ends and sides shall be butted snugly. The blanket shall be stapled down at intervals in accordance with the manufacturer's specifications.

The Contractor shall also be responsible for maintaining and caring for the erosion control blanket for a 7-week period. All blankets that are disturbed during this period will be replaced and restapled by the Contractor.

End of Specification



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Storm Drainage and Sanitary Sewer Construction Detail and Technical Specifications

23.0 Storm Water Management

23.0.1 General

Storm Water Management shall include obtaining all the Storm Water Discharge Permits necessary for construction activities (Construction Activities Stormwater Discharge Permit - CASDP Sewer Use and Drainage, State Stormwater Construction Permit and other related NPDES permits, etc.). The Contractor is required to submit these plans for approval by the Project Construction Engineer prior to obtaining permits through local agencies and the Colorado Department of Public Health and Environment, Water Quality Control Division. Depending on the size of the disturbance area, it is the responsibility of the Contractor to determine which jurisdiction requires permits for this project. The plan shall consist of a narrative report, information worksheet and drawing set, as a minimum requirement. It is the responsibility of the Contractor to obtain minimum requirements from the applicable jurisdictions while preparing the plan. No payment shall be made for this item if the approved Storm Water Management Plans (SWMPs) are not followed. All required permits must be in place prior to starting construction and must be closed prior to final payment.

23.0.2 Submittals

Unless otherwise specified, the Contractor must submit the SWMP to the Project Construction Engineer within ten (10) days following the Notice to Proceed. The SWMP

must be stamped by a Professional Engineer, licensed in the State of Colorado, prior to submittal to the Project Construction Engineer.

23.0.3 Soil Erosion and Sediment Control Plan

The Contractor is required to submit a Soil Erosion and Sediment Control Plan for approval by the Project Manager prior to construction. This plan must include construction limits as well as areas which will be used for set-up, staging, storage, hauling, ingress and egress from site, and any other areas affected by the construction. Weekly updates are required as construction proceeds and as site conditions change. The Plan shall be based on the criteria and technical guidance for erosion and sediment control at construction sites as set forth in Volume 3 of the “Urban Storm Drainage Criteria Manual” and in the WMD guide, “Construction Activities Stormwater Management Plans – An Introduction Guide”. The SWMP will be paid for in accordance with Measurement and Payment item 43.1 and the associated bid item.

23.0.3.1 Objectives During Construction

1. Conduct all land disturbing activities in a manner that effectively reduces accelerated soil erosion and reduces sediment movement and prevents disposition off-site.
2. Schedule construction activities to minimize the total amount of soil exposed at any time to reduce the period of accelerated soil erosion.
3. Establish temporary or permanent cover on areas that have been disturbed as soon as possible after final grading is complete.
4. Design and construct all temporary and permanent facilities for the conveyance of water around, through, or from the disturbed area to limit the flow of water to non-erosive velocities.
5. Capture sediment caused by soil erosion from surface runoff water before it leaves the site.
6. Stabilize the areas of land disturbance with permanent vegetative cover or stormwater quality control measures.

23.0.3.2 Minimum Measures

1. The Contractor and/or their authorized agents shall remove all sediment, mud, construction debris, or other potential pollutants that may have been discharged to or, accumulate in, the flowlines, storm drainage appurtenances, and public rights of ways of the City and County of Denver as a result of construction activities associated with this site development or construction project . Said removal shall be conducted in a timely manner.
2. This Construction Activities Stormwater Management Plan has been submitted as part of an application for a Construction Activities Stormwater Discharge Permit filed with the Wastewater Management Division of the City and County of Denver. The contractor may be required to provide additional erosion and sediment control measures at the request of the permitting agency due to unforeseen erosion problems or if the submitted plan does

not function as intended. The requirements of this plan shall be the obligation of the contractor; until such time as the plan is properly completed, modified or voided.

3. The Contractor shall prevent sediment, debris and all other pollutants from entering the storm sewer system during all demolition, excavation, trenching, boring, grading or other construction operations that are part of this project. The Contractor shall be held responsible for remediation of any adverse impacts to the storm drainage system, adjacent waterways, wetlands, etc., resulting from work done as part of this project
4. A layer of suitable mulch shall be applied to all disturbed portions of the site within fourteen (14) days of the completion of the overlot grading. Said mulch shall be applied at a rate of two (2) tons per acre and shall be tacked or fastened by an approved method suitable for the type of mulch used. Rough cut streets shall be mulched unless a layer of paving is to be applied to rough cut streets within the 14 day period after completion of the overlot grading.
5. The Contractor shall locate, install and maintain all erosion control and water quality Best Management Practices as indicated in the approved Construction Activities Stormwater Management Plan (Chapter 10, City and County of Denver, Department of Public Works Rules and Regulations Governing Sewerage Charges and Fees and Management of Wastewater).
6. The General Contractor, Grading Contractor and/or their authorized agents shall insure that all loads of cut and fill material imported to or exported from this site shall be properly covered to prevent loss of the material during transport on public rights of ways (Sec. 49-552; Denver Revised Municipal Code).
7. The use of rebar, steel stakes, or steel fence posts to stake down stray or hay bales; or to support silt fencing used as an erosion measure is strictly prohibited.
8. Soils that will be stockpiled for more than thirty (30) days shall be protected from wind and water erosion within fourteen (14) days of stockpile construction. Stabilization and protection of the stockpile may be accomplished by any of the following: Temporary/Permanent Revegetation Operations, Chemical Soil Stabilizer Application (requires Project Construction Engineer approval prior to application), or erosion control matting/Geotextiles. If stockpiles are located within 100 feet of a storm drainage facility, additional sediment controls such as temporary dikes, inlet protection or silt fences shall be required.
9. Approved erosion and sediment control “Best Management Practices” shall be maintained and kept in good repair for the duration of this project. At a minimum, the Contractor or his agent shall produce and retain weekly written inspection records for all BMPs and after significant precipitation events. All necessary maintenance and repair shall be completed immediately. Street sweeping is to be completed by the close of the business day or on an as needed basis. Accumulated sediment and debris shall be removed from a BMP when the sediment level reaches one half the height of the BMP or, at any time the sediment poses the risk of breaching the BMP during a storm event.

10. Modification of an active Construction Activities Stormwater Discharge Permit by the Contractor or their authorized agents shall require timely notification of and approval by the Wastewater Management Division. Discharge Permits expire if construction has not commenced within twelve (12) months of the acceptance of the Management Plan. Termination of an active Construction Activities Stormwater Discharge Permit upon completion of the project requires notification of and approval by the Wastewater Management Division.
11. Water used in the cleaning of concrete truck delivery chutes shall be discharged into a predefined, bermed containment area on the jobsite. The required containment area is to be bermed so that wash water is totally contained. Wash water discharged into the containment area shall be allowed to infiltrate or evaporate. Dried concrete waste is to be removed from the containment area and properly disposed of. Should a predefined bermed containment area not be available due to the project size, or the lack of an area with suitable ground surface for establishing a containment area, proper disposal of ready mix washout and rinse off water at the jobsite shall conform to the approved techniques and practices identified in the Colorado Department of Public Health and Environment's training video entitled "Building For a Cleaner Environment, Ready Mix Washout Training" and its accompanying manual entitled, "Ready Mix Washout Guidebook, Vehicle and Equipment Washout at Construction Sites". The direct or indirect discharge of water containing waste concrete into the storm sewer system is strictly prohibited. (Sec. 56-102a, c; Denver Revised Municipal Code, City and County of Denver).
12. The Contractor shall protect all storm sewer facilities adjacent to any location where pavement cutting operations involving wheel cutting, saw cutting, or abrasive water jet cutting are to take place. The Contractor shall remove and properly dispose of all waste products generated by said cutting operations on a daily basis. The discharge of any water contaminated by waste products from cutting operations to the storm sewer system is strictly prohibited. (Sec 56-102a, c; Denver Revised Municipal Code, City and County of Denver).
13. Paved Surfaces which are adjacent to construction sites must be swept on a daily basis when sediment and other materials are tracked or discharged on to them. Either sweeping by hand or use of Street Sweepers is acceptable. Street Sweepers using water while sweeping is preferred in order to minimize dust. Flushing off paved surfaces with water is strictly prohibited. (Sec 56-102a, c; Denver Revised Municipal Code, City and County of Denver).
14. Establishing diversion dikes along pipeline trench to prevent surface run-off from entering the construction trench.
15. Construction straw bale barriers and/or silt fences downstream from construction on headwalls and other structures.

23.0.3.3 Special Measures

1. Placement of temporary sediment traps below or above drainage structures to prevent sediment from entering any drainage facility.

2. Use of a removable plug to prevent flow through the pipe during construction. Movement of the plug should keep pace with construction so that as inlets are placed, they can be used.
3. The cleaning of concrete delivery trucks is prohibited at the job site. The Contractor shall be liable for all costs and penalties under law resulting from the cleanup of this type of illicit discharge.

23.0.3.4 Details

The following is a partial listing of BMPs with available details. Additional BMPs and associated details not listed must be approved by the Project Construction Engineer prior to incorporation into the SWMP.

1. Check Dam
2. Temporary Diversion Dike
3. Valley Inlet Protection
4. Curb Inlet Protection
5. Inlet Protection Using Curb Sock
6. Construction Staging Pad
7. Vehicle Tracking Control
8. Straw Bale Erosion Barrier
9. Temporary Sediment Trap
10. Silt Fence Erosion Barrier

End of Specification



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Storm Drainage and Sanitary Sewer Construction Detail and Technical Specifications

25.0 Hot Mix Asphalt Pavement

25.1 Design Intent

These specifications include general requirements applicable to all types of plant mixed hot mix asphalt pavements (HMAP). This work consists of one or more courses of asphalt mixture constructed on a prepared foundation in accordance with specifications. The design intent is to provide pavement with adequate thickness and quality to provide a service life of 20 years. It is also the intent to provide construction in accordance with these specifications and with a high standard of practice. This item shall include all labor, equipment, and materials to manufacture, place and compact asphalt cement concrete for pavement purposes.

TEST PROCEDURE DEFINITIONS	
CP-##	Colorado Department of Transportation: Field Materials Manual (Colorado Testing Procedures)
ASTM	American Society for Testing & Materials
AASHTO	American Association of State Highway & Transportation Officials
CP-L #####	Colorado Department of Transportation: Laboratory Manual of Test Procedures (Lab Testing Procedures)

25.2 Materials

The hot mix asphalt shall be composed of a mixture of aggregate, filler, hydrated lime and asphalt cement. Some mixes may require polymer modified asphalt cement. Some mixes may allow up to 25% reclaimed asphalt pavement (RAP). All RAP shall meet the requirements of section 25.2.5

25.2.1 Aggregate

Aggregates for HMAP shall be of uniform quality, composed of clean, hard, durable particles of crushed stone, crushed gravel, or crushed slag. Excess of fine material shall be wasted before crushing. The material shall not contain clay balls, vegetable matter, or other deleterious substances and shall meet the requirements in Table 25.2.1.1.

Table 25.2.1.1
Aggregate Requirements

Aggregate Test Property	Coarse: Retained on #4	Fine: Passing the #4
Fine Aggregate Angularity, CP-L 5113 Method A or AASHTO T 304 Note: Fine aggregate angularity does not apply to RAP aggregates		45% Min
Two Fractured Faces, CP-45 or ASTM D 5821 SG Mixtures Top and Middle Lifts Bottom Lifts SMA Mixtures	90% Min. 80% Min. 70% Min. 100% required	
LA Abrasion, AASHTO T 96	45% Max.	
Flat and Elongated (Ratio 5:1) %, AASHTO M 283	10% Max.	
Adherent Coating (Dry Sieving) ASTM D 5711	0.5% Max.	

Sand Equivalent. AASHTO-T 176	45% Min.
Micro Deval CP-L 4211 or AASHTO T 327	18% Max

Reclaimed Asphalt Pavement material (RAP) shall be used only where specifically allowed as shown on the plans and shall be of uniform quality and gradation with a maximum size no greater than the nominal aggregate size of the mix. Mixes shall not contain more than 25 percent RAP.

The HMAP gradation for the proposed design job mix gradation shall be wholly within the control point gradation range set forth in Table 25.2.1.2. The allowable job mix gradation for production shall be the design job mix gradation with the tolerances of Section 25.13.2 applied. The proposed design job mix and the final allowable job mix gradation for production shall report all sieve sizes listed in table 25.2.1.2

Table 25.2.1.2

Dense Graded HMA Gradation Range

(Percent by Weight Passing Square Mesh Sieves, CP-31, AASHTO 11 & T27)

Mixture Grading	SX (1/2" nominal)		S (3/4" nominal)		SG (1" nominal)	
	Control Points	Caution Zone*	Control Points	Caution Zone*	Control Points	Caution Zone*
1 1/2"					100	
1"			100		90-100	
3/4"	100		90-100		@	
1/2"	90-100		@		@	
3/8"	@		@		@	
#4	@		@		@	39.5
#8	28-58	39.1	23-49	34.6	19-45	26.8-30.8
#16	@	25.6-31.6	@	22.3-28.3	@	18.1-24.1
#30	@	19.1-23.1	@	16.7-20.7	@	13.6-17.6
#50	@	15.5	@	13.7	@	11.4
#200**	2.0-8.0		2.0-7.0		1.0-7.0	

* The caution zone is guideline only. It is recommended that mix design gradations go above the caution zone boundaries, on the "fine" side

** These limits shall include the weight of lime at 1.0%

@ These sieve sizes used only to determine the final Allowable Job Mix Formula (JMF) in accordance with 25.13.

25.2.2 Performance Graded Asphalt Binders

The Contractor shall provide to the Project Construction Engineer acceptable ‘Certifications of Compliance’ of each applicable asphalt binder grade from the supplier. Upon non-conformance with specifications, the asphalt binder may be rejected as directed by the Project Construction Engineer. When production begins the Contractor shall, upon request, provide to the Project Construction Engineer a one quart can of each specified asphalt binder. Additionally, when requested, the Contractor shall provide the refinery test results that pertain to the asphalt binders used during production.

Asphalt binder shall meet the requirements of the Superpave Performance-Graded Binders (PG) as presented in table 25.2.2

TABLE 25.2.2. -PROPERTIES OF PERFORMANCE GRADED BINDERS

Usage for each Binder Grade	PG 58-28	PG 64-22	PG 76-28
Traffic Loading, Total 18 kip ESALs Over Design Life (Usually 20 Years)***	Low Volume (0-100,000)	100,000 to <10.0 Million	3.0 Million to <10 Million
Superpave Compactor Design gyrations Recommended (alternate) Usage	N _{design} = 50 (75)	N _{design} = 75 (100)	N _{design} = 100
Property of Binder Grade	PG 58-28	PG 64-22	PG 76-28
Flash Point Temperature, °C, AASHTO T 48	230 Min.	230 Min.	230 Min.
Viscosity at 135 °C, Pas, ASTM D 4402	3 Max.	3 Max.	3 Max.
Dynamic Shear, Temperature °C, where C'/Sin δ @ 10 rad/sec. ≥ 1.00 Kpa, AASHTO TP 5	58 °C	64 °C	76 °C
Rolling Thin Film Oven Residue Properties, AASHTO T 240			
Mass Loss, %, AASHTO T 240	1.00 Max.	1.00 Max.	1.00 Max.
Dynamic Shear, Temperature °C, where G'/Sin δ @ 10 rad/sec. ≥ 2.20 Kpa, AASHTO TP 5	58 °C	64 °C	76 °C
Elastic Recovery ¹ , 25°C, % Min.*	N/A	N/A	50 Min.

**TABLE 25.2.2. -PROPERTIES OF PERFORMANCE GRADED BINDERS
continued**

<i>Pressure Aging Vessel Residue Properties, Aging Temperature 100 °C AASHTO PPI</i>			
Dynamic Shear, Temperature °C, where $G^*/\sin \delta @ 10 \text{ rad/sec.}$ 5,000 Kpa, AASHTO TP 5	19 °C	25 °C	28 °C
Creep Stiffness, @ 60 sec. Test Temperature in °C, AASHTO TP 1	-18 °C	-12 °C	-18 °C
S, Mpa, AASHTO TP 1	300 Max.	300 Max.	300 Max.
m-value, AASHTO TP 1	0.300 Min.	0.300 Min.	0.300 Min.
**Direct Tension Temperature in °C, @ 1.0 mm/min., Where Failure Strain >1.0%, AASHTO TP 3	-18 °C	-12 °C	-18 °C

* Elastic Recovery by Task Force 31, Appendix B Method

** Direct tension measurements are required when needed to show conformance to AASHTO MP.1

*** Project Design Engineer is to determine PG Binder

25.2.3 Additives – Hydrated Lime

Lime shall be added at the rate of 1% by dry weight of the aggregate and shall be included in the amount of material passing the No. 200 sieve. Hydrated lime for aggregate pretreatment shall conform to the requirements of ASTM C 207, Type N. In addition, the residue retained on a 200-mesh sieve shall not exceed 10% when determined in accordance with ASTM C 110. Drying of the residue in an atmosphere free from carbon dioxide will not be required.

25.2.4 Tack Coat

The emulsified asphalt, for Tack Coat shall be CSS-1h or SS-1h and conform to AASHTO M208 or M140, respectively.

25.2.5 Reclaimed Asphalt Pavement

Reclaimed Asphalt Pavement (RAP) may be allowed in the HMA mixture by the **Project Design Engineer**. It shall be of uniform quality and gradation with a maximum size particle no greater than the maximum size allowed in the HMA

mixture. HMA mixtures containing RAP shall meet the same gradation requirements as a virgin HMA mix. The Project Design Engineer may allow mixtures with a maximum of 20% RAP may be allowed in the top lift of any asphalt pavement, and a maximum of 25% RAP may be allowed in layers below the top lift, RAP is not allowed in Stone Mastic Asphalt Mixtures, except by agreement by the **Project Design Engineer**.

The reclaimed asphalt pavement shall meet all the requirements for HMA pavement, as contained herein. The **General Contractor** shall have an approved mix design for the amount of RAP to be used prior to placement.

The **Project Construction Engineer** may require the **General Contractor** to maintain separate stockpiles for each type of RAP material. All processed material shall be free of foreign materials and segregation shall be minimized. Any RAP material that cannot be readily broken down in the mixing process, and/or affects the paving operation, shall be processed prior to mixing with the virgin material.

Fine Aggregate Angularity requirements shall not apply to any RAP aggregate. The RAP will not contain clay balls, vegetable matter, or other deleterious substances.

Verification testing for asphalt content and gradation will be performed on RAP at the frequencies listed in section 25.5.2, below. The **Project Construction Engineer** may request the mix supplier's testing results on RAP at any time. In addition, the mixture shall be tested for properties as listed in Table 25.15

When the use RAP is allowed, the following additional conditions shall apply:

25.2.5.1. The processed RAP must be 100 percent passing the 1¼" sieve. The aggregate obtained from the processed RAP shall be 100% passing the 1" sieve. The aggregate and binder obtained from the processed RAP shall be uniform in all the measured parameters in accordance with the following schedule:

Table 25.2.5.1 RAP AGGREGATE UNIFORMITY TOLERANCES

<u>Element</u>	<u>Uniformity*</u>
Binder Content	0.5
% Passing ¾"	4.0
% Passing ½"	4.0
% Passing 3/8"	4.0

% Passing #4	4.0
% Passing #8	4.0
% Passing #30	3.0
% Passing #200	1.5

* Uniformity is the Maximum allowable Standard Deviation of test results of processed RAP.

25.2.5.2. The **General Contractor** shall have an **approved RAP Quality Control (QC) Plan** that details how the RAP will be processed and controlled. The QC plan must address the following:

25.2.5.2. A. RAP Processing Techniques. This requires a schematic diagram and narrative that explains the processing (crushing, screening, and rejecting) and stockpile operation for normal plant operation or a specific project.

25.2.5.2. B. Control of RAP Asphalt Binder Content: - Minimum Testing Frequency: 1/1,000 tons of processed RAP material (minimum 3 tests) for recent production of the mix type.

25.2.5.2. C. Control of RAP Gradation (CP31 or AASHTO T-30): Minimum Testing Frequency: 1/1,000 tons of processed RAP material (minimum 3 tests) for recent production of the mix type.

25.2.5.2. D. Process Control Charts shall be maintained for binder content and each screen listed, during addition of any RAP material to the stockpile. The **General Contractor** shall maintain separate control charts for each RAP stockpile. The control charts shall be displayed and shall be made available to the **Project Construction Engineer** upon request.

25.2.5.3 Example of RAP QUALITY CONTROL PLAN

25.2.5.3. A Initial quality control of the reclaimed asphalt pavement shall be performed prior to and during crushing. Material for reclamation shall be separated by quality and source before being accepted for processing. Reclaimed asphalt must be free of concrete, dirt and organic materials... These stockpiles shall be built from the ground up, completely mixing all loads as they come in.

25.2.5.3. B Crushing of the reclaimed asphalt pavement shall be accomplished by means of a cone crusher and a screen deck. Oversize material shall be to be rejected on a ¾” scalping material, which reprocesses the material through the cone additional times. The processed material shall be stockpiled at the crushing facility and kept in separate piles and separate from other products to prevent

intermingling of products, as well as the feed bins to prevent intermingling of the aggregates.

25.2.5.3. C The reclaimed asphalt pavement material shall be sampled during the crushing operations according to AASHTO T 2 at frequencies greater than 1/1000 tons and tested for gradation and asphalt content in accordance with AASHTO T 27 AND T11, and AASHTO T 308. Testing shall be done randomly on a daily basis to ensure conformance to specifications.

25.2.5.3. D The reclaimed asphalt pavement material at the asphalt plant shall be again sampled and tested according to the appropriate procedures to ensure that the asphalt content and gradation meet specifications and represent initial quality control data. Once data is collected, a statistical analysis shall be performed to determine the blend for the asphalt mixture design. This analysis shall be provided with the Asphalt Mixture Design submittal. The RAP will meet the Uniformity Specification of Table 25.2.5.1 above.

25.2.5.3. E The RAP system at the asphalt plant consists of a feed bin with a variable speed motor controlled by the plant computer, which ensures the proper quantity of RAP material called for by the mix design. Material is delivered to the asphalt-mixing chamber of the asphalt plant by means of conveyor belts. The RAP material falls from one conveyor to another through a shaker screen that serves to break up any RAP material that has recompacted. Any oversize material shall be rejected at the shaker screen. While in production, the front-end loader shall work the full face of the stockpile, to ensure a representative batch is being produced.

25.2.5.3. F Prior to starting a project and at any other time necessary, the RAP feed system shall be calibrated by placing an amount of RAP measured by certified external scales into the feed bin. That measured material is fed from the RAP bin across the belt scales. The weights are compared and, if outside of accepted tolerances for the blending system, adjustments are made by the plant-blending computer. This process is the same as for all other components of the mix design.

25.3 Mix Design and Plant Produced Mixture Requirements

The mix design materials shall be those listed in Section 25.2 and used for the project. No substitutions are allowed during production, unless approved by the **Project Construction Engineer**.

The **Project Design Engineer** shall indicate on MGPEC Form #9 the project specific criteria concerning mix design method, traffic level, asphalt binder type, mixture grading, and maximum amount of RAP allowed. This information shall be provided on MGPEC Form #9, "Requirements for Hot Mix Asphalt (HMA)", or other Contract bidding documents. Grading SG (1-inch nominal aggregate) shall only be designed using the 150 mm Superpave molds. Hveem Stability and Lottman test are not required for Grading SG mixtures.

Grading S and SX shall be designed using 100 mm Superpave molds.

25.3.1 Superpave Mixture Design Method

The **General Contractor** shall submit a Proposed Design Job Mix Formula (PDJMF) for each mixture required by the Contract. The mixture design shall be determined using AASHTO T-312 or Colorado Procedure CP-L 5115 for the Superpave Method of Mixture Design. Guidance is provided in "Superpave Level 1 Mix Design" SP-2 published by the Asphalt Institute. Mixture design and field control testing shall meet the following requirements of Table 25.3.1a (located on the following page) for Dense Graded HMA.

Mixture design and field control testing of SMA shall meet the following requirements of Table 25.3.1b.

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TABLE 25.3.1a SUPERPAVE MIXTURE PROPERTIES FOR DENSE GRADED HMA

Property or Test	Traffic Levels (ESALs)		
	Low (0-100,000)	Medium (100,000 to <3.0 Million)	High (3.0 Million to <30 Million)
Traffic Loading, Total 18 kip ESALs Over Design Life (Usually 20 Years)	Low (0-100,000)	Medium (100,000 to <3.0 Million)	High (3.0 Million to <30 Million)
Design gyrations, N_{design} (Air Void: 3.5% to 4.5%) (See Note 1,2)	50	75	100
Air Voids in Total Mix (VTM) CPL 5115 or AASHTO T 312	(See Note 1)	(See Note 1)	(See Note 1)
Hveem Stability CP-L 5106 or AASHTO T 246 (Grading S & SX only) (See Note 3)	N/A	28 Min.	30 Min.
Voids Filled with Asphalt (VFA), MS-2	70-80	65-78	65-75
Lottman, Tensile Strength Ratio, % Retained, CP-L 5109 or AASHTO T 283, Method B	80 Min.	80 Min.	80 Min.
Lottman, CP-L 5109 or AASHTO T 283 Dry Tensile Strength, psi	30 Min.	30 Min.	30 Min.
VMA %. CP-48 or AASHTO PP 19 (See notes 2,3,4)	Minimum VMA criteria applies to the mix design only (Table 25.2.1.2). The minimum VMA criteria shall be linearly interpolated based on actual air voids. See 25.13 for production tolerances		

Note 1: Select the target Job Mix Optimum Binder Content for HMA gradings as close to 4.0% air voids as possible (3.5% to 4.5% air voids).

VTM is also referred to as Pax in CPL 5115, and %Gmmx in T 312

Note 2: Maximum Theoretical Specific Gravity of mix by CP-51 or AASHTO T 209.

Note 3: Refer to Section 25.13 for production tolerances.

Note 4: VMA shall be based on tests of the Bulk Specific Gravity of the Compacted Mix (CP-L 5103 or AASHTO T 166) and Aggregate (AASHTO T 84 & T 85), and calculated according to CP-48 or AASHTO PP 19. All mixes shall meet the minimum VMA specified in Table 25.3.2, below.

Table 25.3.1b SUPERPAVE MIXTURE PROPERTIES FOR OPEN GRADED SMA

Property	Test Method	Value for SMA
Lab compaction (Revolutions) N_{Design}	CPL 5115 or AASHTO T 312	100
Air Voids, percent at: N_{Design} (See Note 1)	AASHTO T 312	3.0 – 4.0
Hveem Stability	CP-L 5106 or AASHTO T 246	30 Min.
Accelerated Moisture Susceptibility, tensile strength Ratio, (Lottman)	CPL 5109 or AASHTO T 283, Method B	80 Min.
Dry Split Tensile Strength, psi	CPL 5109 or AASHTO T 283, Method B	30 Min.
Grade of Asphalt Binder	n/a	PG 76-28
Voids in the Mineral Aggregate (VMA) %, minimum (see note 2)	CP 48 or AASHTO PP 19	17
Draindown at Production Temperature	AASHTO T 305	0.3 maximum
$\% VCA_{\text{MIX}}$ (See Note 3)	AASHTO PP 41-02	Less than VCA_{DRC} (See Note 4)

General Note: Copies of AASHTO PP 41-02 and MP 8-02 (for designing SMA mixes) can be obtained from the CDOT Region Materials or the Project Design Engineer

Note 1: Select the target Job Mix Optimum Binder Content for SMA grading at 3.0% to 4.0% air voids

Note 2: VMA shall be based on tests of the Bulk Specific Gravity of the Compacted Mix (CP-L 5103 or AASHTO T-166) and Aggregate (AASHTO T 84 & T 85), and calculated according to CP-48 or AASHTO PP 19. All mixes shall meet the minimum VMA specified in Table 25.3.2, below

Note 3: VCA = Voids in the Coarse Aggregate

Note 4: DRC = Dry-Rodded Condition

**TABLE 25.3.2 MINIMUM VOIDS IN MINERAL AGGREGATE (VMA) for
Dense Graded HMA & Open Graded SMA, %**

Nominal Maximum* Particle Size	Air Voids ++		
	3.5%	4.0%	4.5%
1"	12.2	12.7	13.2
¾"	13.2	13.7	14.2
½"	14.2	14.7	15.2
SMA	17.0	17.0	17.0

* Nominal Maximum Particle Size is defined as one sieve size larger than the first sieve to retain more than 10%, but shall not exceed the 100% passing size. The Nominal Maximum Particle Size can vary during mix production even when the 100% passing size is constant.

++ Minimum VMA criteria apply to the mix design only. The minimum VMA criteria shall be linearly interpolated based on actual air voids. See Section 25.13 for tolerances.

25.4 Mixture Design Submittals

25.4.1 General Requirements

The General Contractor shall submit all mixture designs, certificates, refinery reports, and laboratory data to the Project Construction Engineer for approval at least 7 days before construction is to begin. The job mix formula may be rejected as directed by the Project Construction Engineer on the basis of incompleteness, timeliness or changes in materials. Submittals shall be in a timely fashion such that rejection will not delay completion of the project.

Proposed Design Job Mix testing shall be performed in a materials laboratory under the direct supervision of; and shall be stamped and signed by a Professional Engineer licensed in the State of Colorado practicing in this field. In addition, the General Contractor shall submit as part of the Proposed Design Job Mix, documents to verify the following:

1. Source of materials.
2. Gradation, specific gravity, source and description of individual aggregates and the final blend.
3. Aggregate physical properties.
4. Source and Grade of the Performance Graded Binder (PG Binder)
5. Proposed Design Job Mix – aggregate and additive blending, final gradation shown on 0.45 power graph, optimum asphalt content.
6. Mixing and compaction temperatures used.

7. Mixture properties determined at a minimum of four asphalt contents and interpolated at optimum and graphs showing mixture properties versus asphalt content.

The Project Construction Engineer reserves the right to test the General Contractor’s mix for each hot asphalt pavement grading utilizing materials actually produced and stockpiled. General Contractor shall provide a sufficient quantity of each aggregate, mineral filler, RAP, and additive for the required laboratory tests, if required by the Project Construction Engineer.

The Contractor shall not place any materials without acceptance and approval of the Project Construction Engineer.

25.4.2 Change in source or grade

Should a change in the source of Asphalt Cement (AC) or Lime occur, a one point verification test (at optimum asphalt content) of the mix must be performed to verify that the applicable Table 25.3.1a(Dense Graded HMA) or 25.3.1b (SMA) or 25.3.2 (VMA), is still met. If this testing shows noncompliance, a new design job mix shall be established before the new AC or Lime source is used. Any change in aggregate type or source will require a new mix design.

25.4.3 Mix Production Verification

Production verification shall occur prior to the start of the project. The production verification shall be performed by LABCAT Level C certified technicians with current Certification to verify the volumetric properties of the mix. If the mix has been produced for another project within the last 90 days, data from that project can be submitted for this verification. Volumetric properties of the mix verification testing shall be within the following tolerances compared to the Proposed Design Job Mix. The mix verification test reports shall be submitted to the Project Construction Engineer prior to mix placement.

TABLE 25.4.3.1 MIX DESIGN VERIFICATION TOLERANCES

Air Voids	+/- 1.2%
VMA	+/- 1.2%
Asphalt Binder Content	+/-0.3%
Stability	Applicable minimum

The tolerances in this table are for mix design verification only. See section 25.13 for production tolerances.

25.4.4 Pre-paving Meeting

The Project Construction Engineer may require a pre-paving meeting of all parties involved in supply, haul, laydown inspection, quality control and quality acceptance of HMA. Areas of responsibility and contact names and numbers should be shared. A construction (joint)

plan will be submitted at the pre-paving meeting, see section 25.9 for joint requirements. Form 25.1 provided at the end of this specification is an example of a pre-paving meeting agenda.

25.5 Equipment

25.5.1 Mixing Plant

The mixing plant shall be capable of producing a uniform material, have adequate capacity, and be maintained in good mechanical condition. Defective parts shall be replaced or repaired immediately if they adversely affect the proper functioning of the plant or plant units, or adversely affect the quality of the hot bituminous plant mix.

Dust, smoke, or other contaminants shall be controlled at the plant site to meet all air quality requirements in the “Colorado Air Quality Control Act,” Title 25, Article 7, CRS and regulations promulgated there under.

Acceptable safety equipment, approved by the Project Construction Engineer, shall be provided by the General Contractor to accommodate sampling and testing.

25.5.2 Hauling Equipment

Trucks used for hauling HMAP shall have tight, clean, smooth metal beds thinly coated with a minimum amount of paraffin oil, lime solution, or other approved release agent. Petroleum distillates such as kerosene or fuel oil will not be permitted. Each truck shall have and use a cover of canvas or other suitable material to protect the mixture from the weather and excessive temperature loss or cooled layers of mix in truck.

25.5.3 Bituminous Pavers

Self-propelled pavers shall be provided for full lane width paving capable of spreading and finishing the HMA, material in full lane widths applicable to the typical section and thicknesses shown in the Contract and shall be equipped with:

1. anti-segregation devices,
2. A vibratory screed assembly capable of being heated.

Pavers used for shoulders, patching and similar construction, not requiring fine grade control, shall be capable of spreading and finishing courses of HMA material in widths shown in the Contract without segregation.

The paver’s receiving hopper shall have sufficient capacity for a uniform spreading operation and shall have an automatic distribution system that will place and spread the mixture uniformly in front of the screed.

The paver shall be capable of operating at forward speeds consistent with uniform and continuous laying of the mixture. Stop and go operations of the paver shall be avoided. The screed or strike-off assembly shall produce the specified finished surface without tearing, shoving, or gouging the mixture. Self-propelled pavers shall be equipped with automatic screed controls with sensors capable of sensing grade from an outside reference line, and maintaining the screed at the specified longitudinal grade and transverse slope. The sensors may be contact or non-contact

type devices. The sensor shall be constructed to operate from either or both sides of the paver and shall be capable of working with the following devices when they are required for the situation:

1. Grade control device at least 30 feet in length.
2. Joint matching device
3. Adequate length of control line and stakes, if no other type of geometric control is present
4. A straight edge at least 10 feet in length will be available to verify the crown on the screed, at the request of the Project Construction Engineer

The controls shall be capable of maintaining the screed at the specified transverse slope within plus or minus 0.1 percent. Automatic mode should be used where possible. If the automatic controls fail or malfunction, the equipment may be operated manually for the remainder of the normal working day, provided specified results are obtained.

If the Contractor fails to obtain and maintain the specified surface tolerances, the paving operations shall be suspended until satisfactory corrections, repairs, or equipment replacements are made.

Placement of HMA on a waterproofed bridge deck shall be accomplished with equipment that will not damage the membrane or protective covering.

25.6 Manufacture

25.6.1 Preparation of Aggregates

Heating and drying of the aggregates shall be accomplished without damaging the aggregate. Lime shall be added to achieve complete and uniform coating of the aggregate. When hydrated lime is used it shall be added to the aggregate in accordance with one of the following methods:

- a. Lime Slurry Added to Aggregate: The hydrated lime shall be added to the aggregate in the form of a slurry and then thoroughly mixed in an approved pugmill. The slurry shall contain a minimum of 70 percent water by weight.
- b. Dry Lime Added to Wet Aggregate: The dry hydrated lime shall be added to wet aggregate (a minimum of three percent above saturated surface dry) and then thoroughly mixed in an approved pugmill.

The lime-aggregate mixture may be fed directly into the hot plant after mixing or it may be stockpiled for not more than 90 days before introduction into the plant for mixing with the asphalt cement. The hydrated lime may be added to different sized aggregates and

stockpiled, by adding 75 percent of the lime to the aggregate passing the No. 4 sieve and 25 percent to the aggregate retained on the No. 4 sieve.

25.6.2 Mixing

The dried aggregates and asphalt cement shall be combined in the mixer in the quantities required to meet the design job mix. The materials shall be mixed until the aggregate is completely and uniformly coated, and the asphalt cement is uniformly distributed throughout the aggregate. The output rate shall not exceed the manufacturer’s capacity rating.

Baghouse fines shall be fed to the mixing plant in a uniform and continuous manner so as to maintain uniformity in the mixture. The Baghouse, fines feeder, auger, and related equipment, shall be in good working condition and operated in accordance with manufacturer’s recommendation. If the Project Construction Engineer determines that non-uniform operation of the equipment is detrimental to the mixture, he may halt all construction until the General Contractor takes appropriate action.

The minimum temperature of the mixture when discharged from the mixer shall be as shown in the following table:

**Table 25.6.2.1
 Mixture Discharge Temperatures**

Asphalt Grade	Minimum Discharge Temperature	Maximum Discharge Temperature
PG 58-28	275° F	310° F
PG 64-22	290° F	325° F
PG 76-28*	318° F	326° F

* Contractor or Binder supplier must supply production temperature as require by their product

The General Contractor may provide refinery information that recommends revised discharge temperatures depending on the base binder grade or source being used. HMA mix shall be produced at the lowest temperature within the specified temperature range that produces a workable mix and provides for uniform coating of aggregates (95 percent minimum in accordance with AASHTO T 195), and that allows the required compaction to be achieved.

HMA mix may be stored provided that any and all characteristics of the mixture are not altered by such storage. If storing or holding of the mixture causes segregation, excessive heat loss, or adversely affects the quality of the finished product, corrective action shall be taken. Unsuitable mixture shall be disposed of at the **General Contractor's** expense.

When placing hot mix asphalt over bridge decks covered by waterproofing membrane, the minimum temperature of the mixture, when rolling operations begin, shall be 250 ° F. The job mix temperature may be increased up to 30 ° F to obtain this temperature.

The mineral filler for SMA shall be stored in a separate silo and added automatically in the correct proportion. The mineral filler addition equipment shall be electronically or mechanically interlocked to the aggregate feed sensors so that the proper amount of mineral filler is added whenever SMA is produced.

The SMA mineral filler shall be added at the same point the asphalt binder is added to the aggregate.

25.6.3 Hauling

Each truck shall use covers (tarps) to protect the mix during transport. The Project Construction Engineer can reject mix, which is hauled without a cover. Should the mixture show an excess or deficiency of asphalt cement, damage due to burning or overheating, an improper gradation, or thermal segregation with cold areas 10° F below the minimum discharge temperature, the truck shall be rejected.

25.7 Tack Coat

Prior to placement of HMA, a tack coat shall be applied. The material shall be in accordance with 25.2.4. The emulsified asphalt shall be diluted 1:1 with water and applied at 0.10 ± 0.01 gallons per square yard of diluted material. The Project Construction Engineer may direct other application rates to match the age of condition of the surface.

All work shall be done at locations and with the grade and quantities of material designated on the plans. The surface to receive the tack coat shall be dry and cleaned by sweeping or other approved method until dust, debris, and foreign matter are removed. The tack coat shall then be applied uniformly by squeegee, brooms, or distributor. Prior to placement of SMA, tack coat between the existing pavement and Stone Matrix Asphalt pavement shall be placed at a rate between 0.03 and 0.05 gallons per square yard

25.8 Placement

Hot mix asphalt shall be placed only on approved, properly constructed surfaces that are free from loose material, water, frost, snow or ice. The hot mix asphalt and tack coat shall be placed in accordance with the temperature limitations of Table 25.8 and only when weather conditions permit the pavement to be properly placed and finished as determined by the Project Construction Engineer. Placement temperature as stated shall be increased by 5° F for each 10 miles per hour wind velocity to a maximum increased minimum placement temperature of 70° F.

Table 25.8
Placement Air and Surface Temperature Limitations

Compacted Layer Thickness	Top Layer of Pavement*		Lower Layers*	
	PG 58-28 PG 64-22	PG 76-28	PG 58-28 PG 64-22	PG 76-28
<2 inches not permitted	N/A	N/A	N/A	N/A
2 inches to <3 inches	50° F	65° F	40° F	50° F
3 inches or more	50° F	60° F	40° F	40° F
SG mix only	N/A	N/A	38° F	38° F

* Air temperature is taken in the shade. Surface temperature is taken on the subgrade or base.
The Project Construction Engineer may not waive the above temperature limitations for PG 76-28.

The mixture shall not be placed at a temperature lower than 245° F for mixes containing PG 58-28 or PG 64-22 asphalt, and 290° F for mixes containing polymer modified asphalt. Mix, which is too cold or damaged by weather, will be rejected.

The mixture shall be laid upon an approved surface, spread and struck off to obtain the required grade and elevation after compaction. The minimum lift thickness shall be **at least three times (preferably four times)** the normal particle size. The mixture shall be placed approximately 10-25 percent thicker than the existing surrounding mat thickness to account for compaction based on the materials being placed. Raking is not permitted and will not be allowed. Casting that causes any segregation will not be permitted.

On areas where the use of mechanical spreading and finishing equipment is impracticable, the mixture shall be carefully dumped, spread, raked, screeded, and luted by hand tools to the required compacted thickness plus 25 percent based on the materials being placed.. Carefully move or minimally work the HMA mix with the use of rakes, lutes, or shovels to avoid segregation. Mixtures made with modified asphalt cement require more rapid completion of handwork areas than for normal mixtures. Hauling and placement sequences shall be coordinated so that the paver is in constant motion. Starting and stopping shall not be allowed. A construction joint shall be placed at anytime the power stops, and the screed drops enough to cause a surface dip in violation of Section 25.13.1, “Surface Tolerances”; or the mat temperature falls below that allowed in Section 25.12, “Compaction”. Bituminous pavers shall be used to distribute the mixture either over the entire width or over such partial width as may be practicable. Echelon paving will be permitted.

If an unsatisfactory mix has been placed, it shall be removed, disposed of and replaced as directed. No compensation will be allowed for rejected material.

25.8.1 **SMA PLACEMENT & Compaction**

A Roller Pass Study (RPS) for Density and 1000 foot demonstration control strip are required for placement of lifts less than or equal to 1.5 inch thick, optional for thicker lifts.

25.8.1.A **For Thin Lift SMA less than or equal to 1.5 inch thick.**

In-place density shall be determined through the completion of a Roller Pass Study (RPS) to be conducted during placement of the required 1000-foot demonstration control strip. The RPS will determine the necessary roller compaction process needed to produce a minimum pavement density of 94 percent of theoretical maximum density (RICE). During the RPS, a minimum of three sets of three 4-inch diameter cores each shall be taken to measure SMA mat density for the various sections of the RPS. All coring shall be completed by the **General Contractor** and submitted to the **Project Construction Engineer**. The densities of the three cores will be averaged to produce the density for each RPS section tested.

Full production of the thin SMA shall not begin until density test results are determined and the project compaction process is established by the **General Contractor** and approved by the **Project Construction Engineer**. The approved compaction process established from the RPS shall be used for the duration of the thin SMA paving. Changes to the thin SMA mixture will be reviewed and a new RPS may be required.

Using the same method for determining density during the RPS, density will be determined daily for each day of full production and tested to confirm pavement density. If a daily density check shows density below 92 percent of RICE, the **General Contractor** shall stop production and the **General Contractor** will again complete a RPS to establish the necessary compaction process. The **General Contractor** will be allowed two daily density checks below 92 percent of RICE to be addressed in this manner during the project. All subsequent daily checks that identify locations having density below 92 percent of RICE shall be removed and replaced and a new RPS shall be completed and approved prior to again beginning production. Thin SMA density requirements will be enforced when the SMA mix design gradation and specified lift thickness are in accordance with or exceed the 3:1 requirements for the ratio of nominal maximum aggregate size to lift thickness.

The **General Contractor** shall submit a plan for a Roller Pass Study (RPS) to the **Project Construction Engineer** for approval. Upon approval by the **Project Construction Engineer**, the **General Contractor** shall perform a RPS. The plan for the RPS shall include, but is not limited to the following:

- Number, size, and type of rollers.
- Amplitude, frequency, size and speed of vibratory rollers.
- Temperature of mixture being compacted.
- Roller patterns.

The method of measuring density will be by roller passes. If a density element is based on a RPS, the Pay Factor shall be as shown in section 25.14.3.

25.8.1.B **For SMA lifts greater than 1.5 inch thick.**

If in the opinion of the **Project Construction Engineer**, the roller pass study presented by the **General Contractor** is inadequate, then the **General Contractor** shall modify the compaction procedures as directed.

25.8.1.C Before Proceeding with SMA placement,

The General Contractor shall demonstrate the ability to produce and place a satisfactory mix. The actual work may proceed when a full lane width demonstration control strip, having a minimum length of 1000 feet has been successfully placed. The **GENERAL CONTRACTOR** shall determine properties (Superpave Air voids, VMA, in-place density, and Hveem Stability) of the project produced mix that is used in the demonstration control strip and provide the results to the **Project Construction Engineer**. No other SMA production or placement will be allowed until densities are determined. If the material in the demonstration control strip is not in close conformity with the specifications, the demonstration control strip will be removed and replaced at the **General Contractor's** expense. The **Project Construction Engineer** will designate the location of the control strip.

SMA mixture shall be transported and placed on the roadway without drain-down or flushing. All flushed areas behind the paver shall be removed immediately upon discovery. If more than 50 square feet of flushed SMA pavement is ordered removed and replaced in any continuous 500 linear feet of paver width laydown, operations shall be discontinued until the source of the flushing has been found and corrected. The **Project Construction Engineer** will designate the depth and area of all flushed areas requiring removal and replacement. All costs associated with the removal and replacement of the flushed areas shall be at the **General Contractor's** expense.

Stone Matrix Asphalt Pavement shall be placed and compacted in accordance with the temperatures listed in table 25.8 or as revised for the project.

The relative compaction for all SMA mixtures will be measured from roadway cores in accordance with CDOT-CP 44 or AASHTO T-166, Method B, unless the SMA mixture is being placed on a structure (bridge deck) in which case the **Project Construction Engineer** may specify that nuclear gauge measurements be used.

When cores are used, the **General Contractor** shall provide all labor and equipment for the coring operation and filling the core holes. When nuclear density gauges are used, the tests will be performed in accordance with CDOT-CP 81 or ASTM D 2950 and CDOT-CP 82 or AASHTO T 230.

In-place density for SMA shall be 95 ± 2 percent of the SMA Mix maximum specific gravity as measured according to Maximum theoretical value (Rice) (CDOT-CP 51 or AASHTO T 209).

25.9 Longitudinal Joints

25.9.1 Joint Placement

The longitudinal joints in both a new pavement and an overlay pavement layer shall offset the joint in the layer immediately below by 6 inches. The joints in any pavement layer shall not fall in a wheel track. The joints in the top layer of new pavement not built on top of an existing pavement shall be located on lane lines or as shown on the plans. Longitudinal joints

shall be minimized, where feasible, with wide paving pulls or echelon paving. Joints shall be parallel to the flow of traffic and shall not cross any centerline, lane line, or edge line unless approved by the **Project Construction Engineer**. The **General Contractor** shall submit, prior to paving, a joint plan and pavement marking plan showing locations and the methods to establish a field control line. The **Project Construction Engineer** must approve such plans prior to paving. The **General Contractor** shall use a continuous string line to delineate longitudinal joints during paving as shown on the joint plan. All string lines shall be removed at the end of each day's paving.

The free edge of the paved pass shall be laid as straight as possible, to the satisfaction of the **Project Construction Engineer**. This joint, if cold, shall be tack coated prior to placement of adjacent paving.

The new compacted mat shall overlap the previously placed mat no more than 1.5 inches. Excess overlap or thickness shall not be raked or cast onto the new mat, but shall be wasted by pulling back and removing. The hot edge shall be blocked or bumped in a smooth line consistent with the previous longitudinal edge. Minor raking will only be allowed to correct major grade problems or provide mix around manholes and meter covers. The longitudinal joint shall be rolled from the hot side and overlap the joint by approximately 6 inches on the cold side.

25.10 Transverse Joints

The **General Contractor** shall submit, prior to paving, a joint plan showing locations and the methods to be used to construct transverse joints. The **Project Construction Engineer** must approve such plans prior to paving. Placing of the HMA shall be continuous with a minimum of transverse joints, and rollers shall not pass over the unprotected end of a freshly laid mixture. Transverse joints shall be formed by cutting back on the previous run to expose the full depth of the course. Tack coat material shall be applied to contact surfaces of all joints just before additional mixture is placed against the previously compacted material.

The end of transverse joints shall be located so they will be constructed with a full head of mix in front of the screed. When butt joints are constructed, runoff boards shall be used to support the roller on the downstream side of the joint. All tapered sections, rounded edges and segregated areas shall be removed to achieve a vertical face at the butt joint before paving is restarted.

When a temporary tapered joint is required for temporary traffic access, the ramp shall be removed back to a full depth section before paving is restarted.

When restarting paving operations, the paver screed shall be placed on the starter block on the completed side of the transverse joint. The starter block should be approximately 25% greater than the thickness of the existing completed mat, so that adequate grade and compaction can be achieved on starting the paving operation. The screed should be nulled (angle removed) when on starting blocks and an up angle of attack set. Proper head of mix should be introduced into the paver prior to starting. The new compacted (downstream) side of the joint may be up to 3/16 inches higher than the old (upstream) side. Raking of this joint shall not be allowed except to correct major grade problems. The surface tolerance at the transverse joint must be verified by the **General Contractor** with a 10-foot straight edge before the paver is more than 100 feet from the joint. If the surface tolerance is not within the 3/16", the **General Contractor** shall make corrections before proceeding

25.11 Segregation

The asphalt mixture shall be transported and placed on the roadway without segregation. All segregated areas shall be removed immediately and replaced with specification material before the initial rolling. If more than 50 square feet of segregated pavement is removed and replaced in any continuous 500 linear feet of paver width laydown, operations shall be discontinued until the source of the segregation has been determined and corrected.

The Project Construction Engineer will visually determine areas, which are segregated, and may also use density and gradation measures to help in this determination. The Project Construction Engineer will visually determine the extent of the segregation. The General Contractor will not be allowed additional compensation for correction of segregated areas.

25.12 Compaction

The temperature of the mixture immediately behind the screed shall be sufficient to allow for proper compaction of the HMA layer and at least 245 °F for PG 58-28 or PG 64-22 binder and between 297°F and 305 °F for PG 76-28 binder. The breakdown compaction should be completed as quickly as possible after placement occurs.

The HMA shall be compacted by rolling. The number, weight, and type of rollers furnished shall be sufficient to obtain the required density and surface texture while the mixture is in a workable condition. Compaction shall begin immediately after the mixture is placed and be continued until the required density is obtained. Final compaction shall be obtained using steel wheel rollers.

Pavement operations shall be suspended when density requirements are not met and the surface temperature falls below 185 °F, or there is obvious surface distress or breakage, the problem shall be resolved prior to continuing paving operations. The criteria for mixtures containing PG 76-28 asphalt cements shall be 235 °F. The minimum compaction temperatures may be adjusted according to the asphalt binder supplier recommendations. Adjusted minimum compaction temperatures must be shown on the approved mix design or on other asphalt binder supplier documents, and be available on the job site. Pay Reduction criteria in Section 25.14 shall still apply in such cases.

All roller marks shall be removed with the finish rolling. Use of vibratory rollers with the vibrator on will not be permitted on bridge decks.

The **General Contractor** shall establish a rolling pattern or procedure during the beginning of paving operations, which will achieve the required compaction and surface tolerances. This procedure may be re-evaluated by the **General Contractor** and **Project Construction Engineer** throughout the paving operations.

All HMA paving shall be compacted to 94.0 ± 2 percent of Maximum Theoretical (RICE) Density, (CP-51 or AASHTO T-209: Maximum Specific Gravity of Bituminous Paving Mixtures) as determined by ASTM D 2950. RICE values shall be used in calculating Relative Compaction according to CP-44 or AASHTO T 166. The **General Contractor** shall determine the proper RICE value to use for the initial day's placement. Subsequent day's RICE value(s) will be based on the current day's production. The **General Contractor** shall provide the producer's RICE value, which shall be used for production until the actual day's RICE value is determined by the testing firm of record for the project as approved by the **Project Construction Engineer**.

All joints shall be compacted to 92.0 ± 2 percent of RICE, taken fully on each side of joint, every 200 Linear Feet. RICE values shall be used in calculating Relative Compaction according to AASHTO T 166, Cores if need will be used to verify compaction results.

The **General Contractor** shall core the pavement, as required by the **Project Construction Engineer**, for field density tests in accordance with Colorado Procedure 44 or AASHTO T 230, Method B, or for field calibration of nuclear density equipment in accordance with the ASTM D 2950 or Appendix of Colorado Procedure 81. At a minimum, cores for nuclear density equipment calibration shall be taken at the beginning of placement of each pavement layer or change of mixture materials or gradation. Untested areas during placement will also require cores to be taken to verify compaction.

Along forms, curbs, headers, walls, and all other places not accessible to the rollers, the mixture shall be thoroughly compacted with mechanical tampers.

Any mixture that becomes loose and broken, mixed with dirt, or is in any way defective, shall be immediately removed and replaced with fresh hot mixture and compacted to conform to the surrounding area.

Compaction requirements for SMA are covered in section 25.8.1. Rollers shall not be used in a vibratory mode on SMA unless they are first used successfully in the demonstration control strip. Pneumatic wheel rollers shall not be used on SMA Mix.

25.13 Production Tolerances

25.13.1 Top Lift Surface Tolerances

The variation between any two contacts with the surface shall not exceed 3/16 inch in 10 feet. For patching surface tolerances, the variation shall not exceed 3/8 inch in 10 feet. Irregularities exceeding the specified tolerance shall be corrected at the General Contractor's expense. Transverse measurements for variations shall exclude breaks in the crown sections.

25.13.2 Job Mix Formula Tolerances

Production test results that deviate from the design job mix by more than shown in the following table are subject to Section 25.14:

**Table 25.13.2.
Gradation Tolerances**

Item	
Passing No. 3/8" and Larger (note 1)	± 6%
Passing No. 4 and No.8	± 5%
Passing No. 30 to No. 50	± 4%
Passing No. 200 (note 2)	± 2%
Air Voids	± 1.2%
VMA (note 4)	± 1.2%
Hveem Stability	(note 3)
Asphalt Content	± 0.3%

- (Note 1) There is 1.0 percent tolerance for the maximum sieve size.
 (Note 2) Mixes with passing No. 200 sieve material produced over 7.0 percent are allowed only when the above Air Voids and VMA tolerances are still met.
 (Note 3) Hveem Stability must meet the minimum value specified in table 25.3.2.
 (Note 4) When calculating VMA, use the most current aggregate specific gravity G_{sb} .

When disagreements concerning determination of specification compliance occur, only valid tests from the Project Construction Engineer will be considered. The Project Construction Engineer shall determine validity. Generally, valid tests are those in which sampling and test have been performed according to referenced procedures and the results are within stated precision statements. When disagreements occur with Asphalt Content and gradation tests results, solvent extracted aggregate testing shall take precedence over burn off oven extracted aggregate, which shall take precedent over cold feed belt testing.

25.14 CONFORMITY WITH PLANS AND SPECIFICATION

25.14.1 General

All work performed and all materials furnished shall conform to the lines, grades, cross sections, dimensions, and material requirements, including tolerances, shown in the contract.

For those items of work where working tolerances are not specified, the **General Contractor** shall perform the work in a manner consistent with reasonable and customary manufacturing and construction practices.

When the **Project Construction Engineer** determines that the material furnished, work performed, or the finished product is not in conformity with the contract and has resulted in inferior or unsatisfactory product, the finished product or materials shall be removed and replaced or otherwise corrected by, and at the expense of, the **General Contractor**.

Materials shall be sampled and tested by a qualified testing laboratory in accordance with the sampling, testing schedules, and procedures contained in the Section 25.15 Testing and Inspection. The approximate maximum quantity represented by each sample shall be as set forth in the testing schedule. An additional number of samples, in relation to the quantity of materials represented, may

be selected and tested at the **Project Construction Engineer's** discretion. The quantity represented by five consecutive random samples shall constitute a lot, whenever production schedules and material continuity permits. When it is necessary to represent short production runs, significant material changes, or other unusual characteristics of the work, the **Project Construction Engineer** may establish a lot consisting of the quantity represented by any number of consecutive random samples from one to seven inclusive. Testing results that are determined to have sampling or testing errors, as determined by the **Project Construction Engineer**, shall not be used.

25.15 Testing and Inspection

If any materials furnished or work performed by the **General Contractor** fails to fulfill the specification requirements, such deficiencies shall be reported to the **Project Construction Engineer** and the **General Contractor** immediately. Preliminary written field reports of all tests taken and observation results shall be given to the **General Contractor** and **Project Construction Engineer**, within 1 business day after samples were obtained or density testing performed. Field reports shall be forwarded to the Project Manager no later than 1 week following the testing.

Reports of all tests taken, including failing tests, shall be reported to the **Project Construction Engineer** and to the **General Contractor** no later than 1 week following the sampling. Density test results will be given in writing at the time the testing occurs.

Testing of Hot Mix Asphalt Pavement shall be performed in accordance with Table 25.15. The tests shall be performed under the general supervision of and signed by a **Professional Engineer** registered in the State of Colorado. Laboratories shall be inspected by either AASHTO or accredited A2LA or equivalent in the elements listed below. Technicians taking samples and conducting compaction tests must have a LABCAT Level A certification or equivalent. Technicians conducting tests of asphalt content and gradation must have a LABCAT Level B certification or equivalent. Technicians performing volumetric testing must have a LABCAT Level C certification or equivalent.

Table 25.15.1
Schedule for Minimum Materials Sampling and Testing

Test	Standard*	Minimum Frequency
Sampling	AASHTO T 168, ASTM D 979 and ASTM D3665	One test for each day
Density	AASHTO T 166, T 238, T 230 Or CP-44, CP-81, CP-82	One test for each 250 lineal feet per Lane
Thickness (Core)	ASTM D 3549	One test for each 1000 lineal feet per Lane,
Air Voids & VMA	AASHTO T 166 & AASHTO PP 19 or CP-48	One test for each day (See note 4, Table 25.13.2)
Gradation	AASHTO T 27, T 11 or CP-31A, CP-31B	One test for each day
Asphalt (AC) Content	AASHTO T 164 or CP-L 5120 or other methods agreed upon	One test for each day

Table 25.15.1
Schedule for Minimum Materials Sampling and Testing

Test	Standard*	Minimum Frequency
	between Project Construction Engineer and General Contractor	
Maximum Theoretical Specific Gravity (Rice)	AASHTO T 209 or CP-51	One test for each day
Lottman Stripping, TSR & Dry Density	AASHTO T 283 or CP-L 5109, Method B	As requested by the Project Construction Engineer .
Micro Deval	AASHTO T 327 or CP-L 4211	One per 5000 tons or 1 per project minimum

Project Construction Engineer or designee shall be responsible for checking temperatures of mix in truck and on pavement, segregation, rolling patterns and other construction means and method that affect the performance of the pavement system. The General Contractor shall provide assistance in sampling and testing at all facilities and at the job site.

End of Specification



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Storm Drainage and Sanitary Sewer Construction Detail and Technical Specifications

26.0 Excavation and Embankment

26.0.1 General

This work pertains to pond construction and consists of excavation, hauling, disposal, placement, and compaction of all material encountered on-site within the limits identified in the plans. All excavation and embankment for pond construction will be classified as “unclassified excavation” as hereafter described.

26.0.2 Referenced Standards

AASHTO M 145	Classification of soils and soil-aggregate mixtures
AASHTO T 99	Moisture-Density Relations of Soils using a 5.5-lb Rammer and a 12-inch Drop
AASHTO T 180	Moisture-Density Relations of Soils using a 10-lb Rammer and a 18-inch Drop

26.0.3 Excavation

Unclassified Excavation. Unclassified excavation shall consist of the excavation of all materials of whatever character required for the work, obtained within the pond construction

project site, including surface boulders, masonry, organics, rocks, muck material, miscellaneous debris and slag that are not removed under some other item. The work also includes excavation for the ditches, channels, and placement, water and compaction of the material to construction embankments in accordance with the plans.

26.0.4 Embankment

Embankment. Embankment material shall consist of approved material acquired from excavations, hauled and placed in embankments. Approval of the embankment material will be contingent on the material having a maximum dry density of not less than 90 pounds per cubic foot. Soil embankment shall consist of materials obtained on-site and approved by the Engineer.

26.0.5 Construction Requirements

26.0.5.1 General

The excavations and embankments shall be finished to a smooth and uniform surface conforming to the line and grade specified. Variation from the subgrade plan elevations specified shall not be more than 1.0 inch. Excavation operations shall be conducted so material outside of the slope limits will not be disturbed. Prior to beginning grading operations, all necessary clearing and grubbing and site demolition in that area shall be performed.

The Contractor shall notify the Engineer not less than ten working days prior to beginning excavation so the necessary cross sections may be taken. Baseline survey for purposes of payment of the unclassified excavation work item will be obtained by the CCD Survey Group. The baseline survey will be taken once all building and site demolition, including removal of the buildings, parking lots, driveways is complete. The baseline survey is intended to set the topography of the existing native soil below the pavements and building elevations. Once the pond construction is complete a second survey will be completed to determine the final quantity of unclassified excavation. The Contractor shall not excavate beyond the dimensions and elevations established.

26.0.5.2 Unclassified Excavation

All material to be excavated shall be stockpiled as subgrade material or removed from the site. Materials excavated beneath the top twenty six (26) inches shall, at the discretion of the Engineer, either be placed in the subgrade stockpile or removed from the site and disposed of at Denver Arapahoe Disposal Site (DADS). It shall be the responsibility of the Contractor to determine the amount of subgrade material to be stockpiled and necessary for completion of the work. All stockpiled material not used shall be disposed of per Contract requirements.

26.0.5.3 Embankment

Embankment construction shall include preparation of the areas upon which embankments are to be constructed, placing, moisture conditioning and compacting of approved material to the limits shown on the plans or as directed. Only approved materials shall be used in the

construction of embankments and fills. The type of relative compaction required shall be a minimum of 95% of Standard Proctor density AASHTO T-99 within 2% of optimum moisture content.

The soil upon which the embankments are to be constructed shall be scarified to a depth of eight (8) inches and compacted with moisture and density control. The moisture content of the soil at the time of compaction shall be as specified or directed.

Embankment shall be placed in horizontal layers not to exceed six (6) inches loose measurement and shall be compacted as specified before the next layer is placed. Spreading equipment shall be used to obtain uniform thickness prior to compaction. As the compaction progresses, continuous mixing, leveling and manipulating shall be done to assure uniform moisture and density.

Embankments shall be constructed with moisture and density control. The moisture content of the soil at the time of compaction shall be as specified or directed. Maximum dry density of all soil types encountered or used will be determined in accordance with AASHTO T-99. The amount of water to be used in compacting A-2-6, A-2-7, A-4 and A-6 through A-7 soils shall not deviate from optimum on the dry side by more than two percentage points as determined by AASHTO T-99. A-4 soils, which are unstable at the above moisture content, shall be compacted at lower moisture content to the specified density.

Additional work involved in drying embankment material to the required moisture content shall be included in the work.

26.0.6 Finished Grade

Finished grade as shown on the plans or as directed shall be achieved by placement of a minimum of twelve (12) inches of compacted subgrade followed by placement of six (6) inches of topsoil. Materials, compaction, moisture and density requirements for the subgrade are as specified above.

End of Specification



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Storm Drainage and Sanitary Sewer Construction Detail and Technical Specifications

47.0 Construction Survey and Monumentation

47.0.1 Description

The Contractor shall be responsible for construction surveying, calculating, and staking necessary for the construction of all elements of the project. The Contractor shall also provide locating, preserving, referencing, installing and restoring of land monuments based upon the project's Land Survey Control drawing(s) as provided in the Contract Documents. Unless otherwise noted, payment for construction surveying and monumentation shall be via separate bid items.

The work shall be done under the supervision of a Professional Land Surveyor (PLS) who is experienced and competent in storm sewer construction, sanitary sewer construction and roadway construction surveying and licensed in the State of Colorado.

The PLS shall be available to review work, resolve problems, and make decisions in a timely manner.

47.0.2 Materials and Equipment

The Contractor shall furnish all personnel, survey equipment, safety equipment, materials, and traffic control necessary to perform the required construction surveying and staking. If any survey equipment is found to be functioning outside the manufacturer's specified tolerance, certification from an approved repair facility showing that the instruments have been repaired, properly adjusted, or both if necessary shall be included in the survey records and submitted to the City Surveyor's Office before being used.

47.0.3 Construction Requirements

A Construction Survey Conference shall be held with the City Surveyor's Office prior to performing any surveying work under this section. The Contractor's Surveyor (PLS) and Party Chief shall attend. A Construction Survey Checklist shall be completed and signed by the City Surveyor's Office and the contractor.

The Contractor shall check and verify all established Primary horizontal and vertical control points.

All survey records generated shall be the property of the City and shall be available to the City Surveyor's Office for inspection or reproduction at all times. All survey records shall be transmitted to the City Surveyor's Office for inclusion into the project records before final project acceptance.

Electronic formats may be acceptable, please coordinate with the City Surveyor's Office.

Copies of any new Monument Records filed by the PLS with the State Board of Registration shall be submitted to the City Surveyor prior to filing.

47.0.4 Construction Surveying

The Contractor's PLS shall perform all construction surveying and staking that is necessary for construction of the project. Additionally, the contractor shall establish and maintain control points and stationing during construction to allow the City's Project Manager or designee a reference to determine contract pay quantities.

47.0.5 Staking

It is the responsibility of the Contractor's PLS to adhere to industry standards and acceptable practices in regards to staking. Any re-staking will be the responsibility of the Contractor at no cost to the City.

47.0.6 Accuracy and Tolerances

It is the responsibility of the Contractor's PLS to adhere to industry standards and applicable standards with regard to horizontal and vertical accuracy tolerances.

47.0.7 Responsibility and Inspections

Supervision and coordination of construction surveying and staking is the Contractor's responsibility. The City Surveyor may inspect the Contractor's surveying; however such inspection will not relieve the Contractor of any responsibility for accuracy or completeness of work. The Contractor shall check the work to verify the accuracy and include documentation of this check in the Survey Records. All Contractor surveying inaccuracies, errors, or omissions shall be corrected at the Contractor's expense. The City Surveyor's inspection or the Contractor's corrections shall not entitle the Contractor to additional payment or contract time extension.

Survey control, benchmarks, and other significant stakes that are damaged, destroyed, or made inaccessible by the progress of construction shall be replaced, transferred or reestablished at the Contractor's expense.

47.0.8 Changes

All changes in lines and grades required by the field conditions and all discrepancies in grades, alignments, locations or dimensions detected by the Contractor shall be immediately submitted to the City Project Manager in writing. No changes in given data or plans will be allowed unless approved by the City Project Manager in writing. All changes shall be documented in the survey records.

47.0.9 Traffic Control

Traffic control necessary for surveying and monumentation work shall not be measured and paid for separately. All traffic control costs incurred due to this work shall be included within the associated bid item(s).

47.0.10 Survey Records

Survey records shall be completed as the work is done. Field survey notes for construction surveying and checking by the Contractor shall be recorded in survey records in conformance with industry standards and acceptable practices.

All survey records generated shall be the property of the City and shall be available to the City Surveyor's Office or the City Project Manager for inspection or reproduction at all times. All survey records shall be transmitted to the City Surveyor's Office for inclusion into the project records before final project acceptance. All survey records shall be stamped with the seal of, and signed by, the responsible PLS.

"As-built" and "Red-lined" drawings and prints necessary for the construction and preparation of record drawings for all elements of the project shall be the responsibility of the Contractor.

All "As-built" and "Red-lined" drawings generated shall be the property of the City and shall be submitted to the Project Construction Engineer upon completion. In addition to red-lined prints, the Contractor shall supply the Project Construction Engineer with electronic survey data information in the form ".asc", ".txt", and/or ".dwg" files upon request.

47.0.11 Survey Monumentation

This work consists of locating, preserving, referencing, installing and restoring land monuments as indicated in the Land Survey Control drawing(s) for the specific contract. Survey Monumentation includes but is not limited to: City of Denver Range Points and accessories, Primary Control monuments from which the Right of Way or any land boundary will be calculated, described or monumented, Public Land Survey System (PLSS) monuments, Right of Way (ROW) monuments, General Land Office (GLO) monuments, Bureau of Land Management (BLM) monuments, Mineral Survey (MS) monuments, property boundary monuments and offsets, benchmarks, easement monuments, and other monuments that are required by law or regulation to be established and recorded by a Professional Land Surveyor (PLS).

At the closeout of the project the following Survey documents shall be submitted to the City Surveyor for review and acceptance:

1. City and County of Denver Monument Tie Out Sheets for all range points within the project influence.
2. A survey of all project monumentation per State Statute.

The production of additional documentation may be required by the City Surveyors' Office. All such work included in this section shall be under the supervision of a PLS who is licensed in the State of Colorado.

47.0.12 Reset Monuments

Survey monuments, benchmarks, and other significant monuments that are damaged, destroyed, or made inaccessible by the progress of construction shall be replaced, transferred or reestablished at the Contractor's expense.

Locating, preserving, referencing, installing and restoring land monuments as described in this specification shall be done under the supervision of a PLS who is experienced and competent in Right of Way and boundary surveying and licensed in the State of Colorado

47.0.13 Locating Monuments

This work consists of field locating all survey monumentation as discussed in 47.0.11 which is in place within the project limits. A diligent search of construction zones and project limits shall be performed by the PLS.

47.0.14 Preserving and Referencing Monuments

All monuments as described in this specification shall be preserved, referenced and reset by the Contractor's PLS within the project limits.

47.0.15 Installing Monuments

All monuments as described in the contract documents shall be preserved through construction. If any monuments are to be disturbed/removed during construction, it will be

the contractor's responsibility to have all monuments reset to current City of Denver standards. Appropriate documentation will be required for all reset monuments.

47.0.16 Monument Box

This survey work shall consist of installing or adjusting monument boxes to current City or State requirements.

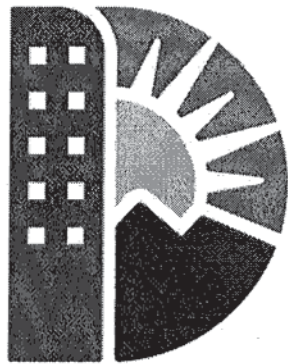
47.0.17 Method of Measurement

All survey work will be paid for via the associated bid item(s) and in accordance with the respective Measurement and Payment portions of the Contract Documents.

End of Specification

CITY AND COUNTY OF DENVER

STATE OF COLORADO



DENVER[®]
THE MILE HIGH CITY

SECTION II MEASUREMENT & PAYMENT

Contract No. 201207767

IOWA AVENUE EXTENSION PHASE 1

September 18, 2012



DENVER®
THE MILE HIGH CITY

Measurement and Payment

September 10, 2012

City and County of Denver - Public Works
Engineering Division - Wastewater Capital Projects Management

Measurement and Payment

02-22.13-01

Vibration Assessment

No quantity measurement will be made for any of the work and materials required to accomplish this aspect of the project and payment will be based upon the completion of the work in accordance with the Contract Documents.

The lump sum price for Vibration Assessment shall include all of the Contractor's costs of whatsoever nature. The price bid shall include: all labor, equipment, materials, subcontractors, and transportation to and from project site required to complete vibration monitoring and assessment during the entire project duration regardless of extensions; furnishing submittals, baseline and monthly reports; theft and vandalism protection; web based data access and site training; incidentals; meetings and coordination with business owners and residents as necessary during construction; and all other related and necessary materials work and equipment required to accomplish this item in accordance with the Contract Documents.

At the option of the Project Construction Engineer, one third of the lump sum price for this item may be paid to the Contractor upon satisfactory completion of and/or incorporation of proper measures. The second third may be paid upon fifty percent completion of the work as determined by the percent of work completed on the day of progress payment. The last third may be paid to the Contractor at the time of final progress payment or at the discretion of the Project Construction Engineer.

2-1.1a Remove Combination Concrete Curb, Gutter and Sidewalk (2'8")

2-1.1b Remove Combination Concrete Curb, Gutter and Sidewalk (3'11")

2-1.2a Remove 6" Concrete Curb and/or Gutter

2-1.2b Remove 9" Concrete Curb and/or Gutter

2-1.3 Remove Concrete Curb Head

2-1.4 Remove Handicap Concrete Curb Ramp

2-1.5 Remove Concrete Median Strip

2-2.1 Remove Concrete Sidewalk

2-2.1a Remove Concrete Sidewalk/Bike Path

2-2.2 Remove Concrete Driveway Paving

2-2.4 Remove Concrete Channel Paving

2-2.5 Remove Miscellaneous Concrete Flatwork

The measurement for payment of this item will be the total number of linear feet or square feet of existing concrete curb and gutter, combination concrete curb and gutter, concrete curb head, concrete handicap curb ramp, concrete median strip, concrete sidewalk, concrete bike path, concrete driveway pavement, concrete slab, concrete alley return, concrete alley paving, concrete channel paving or any other type of miscellaneous concrete flatwork as specified in the Contract Documents or designated by the Project Construction Engineer to be removed for construction of the proposed sewer and/or appurtenances; provided, however, no measurement for payment will be made for concrete flatwork removed or damaged due to negligence or unauthorized operations by the Contractor.

The unit price bid per linear foot or square foot removal of this item shall include all of the Contractor's costs of whatsoever nature. The price bid shall include: excavation, concrete sawing or otherwise effectively cutting the concrete item smoothly and squarely in a manner satisfactory to the Project Construction Engineer; excavation and overexcavation; removal and

Measurement and Payment

disposal of unsuitable material, existing flatwork and/or any reinforcing materials per the requirements set forth in the Contract Documents; and all other related and necessary materials, work, and equipment required to remove this item in accordance with the Contract Documents.

2-2.6 Remove and Replace Flagstone Curb Head

2-2.7 Remove and Replace Flagstone Walk

The measurement for payment of this item will be the total number of linear feet of Flagstone Curb Head or the total square feet of flagstone walk required to be removed or placed for construction of the proposed sewer and/or appurtenances; provided, however, no measurement for payment will be made for flagstone removed and replaced due to negligent or unauthorized operations by the Contractor.

The unit price bid per linear foot or square foot removal and replacement of this item shall include all of the Contractor's costs of whatsoever nature. The price bid shall include: excavation, sawing or otherwise effectively cutting the flagstone item smoothly and squarely in a manner satisfactory to the Project Construction Engineer; excavation and over excavation; removal and disposal of unsuitable material; storing on site for reuse; placement and/or replacement of flagstone; furnishing of new flagstone or equivalent stone as necessary; cutting, shaping, leveling, grouting, spacing; bedding, supply and placement of select subgrade material or select fill as necessary, compaction, and all other related and necessary materials, work, and equipment required to remove and replace this item in accordance with the Contract Documents.

2-2.8 Remove Asphalt Walk

The measurement and payment of this item will be the total number of linear feet of asphalt walk required to be removed, and/or removed and replaced for the proposed sewer and/or appurtenances; provided, however, no measurement for payment will be made for asphalt walk removal or replacement required due to negligent or unauthorized operations by the Contractor.

The unit price bid per linear foot removal, removal and replacement, or placement of this item shall include all of the Contractor's costs of whatsoever nature. The price bid shall include: excavation, grading and shaping; placement of bedding; excavation and overexcavation; removal and disposal of unsuitable material; placement and/or replacement; furnishing of asphalt; leveling and compaction, and all other related and necessary materials, work, and equipment required to remove this item in accordance with the Contract Documents.

2-3 Remove Concrete Wheel Stops

The measurement for payment of this item will be the total number existing wheel stops required to be removed or placed for construction of the proposed sewer and/or appurtenances; provided, however, no measurement for payment will be made for wheel stops removed and replaced due to negligent or unauthorized operations by the Contractor.

The unit price bid per wheel stop removal shall include all of the Contractor's costs of whatsoever nature. The price bid shall include: excavation, sawing or otherwise effectively removing the wheel stop in a manner satisfactory to the Project Construction Engineer; excavation and overexcavation; removal and disposal of unsuitable material; storing on site for reuse; placement of replacement; furnishing of new wheel stops; cutting, leveling, grouting, spacing; bedding, compaction, and all other related and necessary materials, work, and equipment required to remove this item in accordance with the Contract Documents.

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2-3.1 Remove Concrete Alley Gutter

2-3.2 Remove Concrete Alley Returns

2-3.3 Remove Concrete Alley Paving

2-3.4 Remove Concrete Street Intersection Gutter (Crossspan) and/Or Valley Gutter

2-3.5 Remove Concrete Street Paving

The measurement for payment of this item will be the total number of square feet of concrete required to be removed for construction of the proposed sewer; provided, however, no payment will be made for damaged material required to be removed due to negligence or unauthorized operations by the Contractor or any Subcontractors.

The unit price bid per square foot for removing this item shall include all of the Contractor's costs of whatsoever nature. The price bid shall include: concrete sawing and otherwise effectively cutting the existing concrete smoothly and squarely in a manner satisfactory to the Project Construction Engineer; removal and disposal of concrete, asphalt, and/or any reinforcing materials, including removal of the square radius beyond the lip of the standard two-foot gutter; furnishing additional base material; subgrade preparation and compaction; rotomilling within the effective removal limits; and all other related and necessary materials, work, and equipment required to accomplish the removal of this item in accordance with the Contract Documents.

In addition to the above listed items, the unit price bid per square foot removal of concrete street intersection gutter and/or valley gutter shall include repaving of the street within the effective removal limits to a point not less than 2-inches below the new finished street grade (matching cross street crowns to within 2-inches of finished street grade to the satisfaction of the Project Construction Engineer), including surrounding areas damaged during removal. The effective removal limits encompass the surface area shown on the Project Paving Schematic included within the Contract Documents. This area varies based on location within the project. The additional 2-inches of paving within the effective removal limits, as well as all required rotomilling and asphalt placement outside the limits will be paid for using bid items provided for elsewhere in the Contract Documents. No separate measurement or payment will be made for additional paving materials or rotomilling necessary for adherence to this item, all such costs will be included in the square foot price for removal.

2-4 Remove Concrete Steps

The measurement for payment of this item will be the total number of square feet of concrete steps required to be removed for construction of the proposed sewer and/or appurtenances; provided, however, no measurement for payment will be made for concrete steps removed and replaced due to negligent or unauthorized operations by the Contractor.

The unit price bid per square foot of concrete steps, which shall be quantified by the width of the stairs multiplied by the summation of each stair hypotenuse (the hypotenuse of the rise and run of each stair). The unit price shall include all of the Contractor's costs of whatsoever nature. The price bid shall include: excavation, sawing or otherwise effectively removing the steps in a manner satisfactory to the Project Construction Engineer; excavation and overexcavation; removal of any foundation concrete; removal and disposal of unsuitable material; backfilling of foundation with suitable bedding, compaction, and all other related and necessary materials, work, and equipment required to remove this item in accordance with the Contract Documents.

Measurement and Payment

2-5 Remove Concrete Retaining Wall

The measurement for payment of this item will be the total number of linear feet of retaining wall, including attached railing and/or fence required to be removed for construction of the proposed sewer and/or appurtenances; provided, however, no measurement for payment will be made for retaining wall removal required due to negligent or unauthorized operations by the Contractor.

The unit price bid per linear foot of retaining wall removal shall include all of the Contractor's costs of whatsoever nature. The price bid shall include: excavation, sawing or otherwise effectively removing the wall in a manner satisfactory to the Project Construction Engineer; excavation and overexcavation; removal of any foundation concrete; removal of tie backs, drainage pipe; removal and disposal of fence and/or railings; removal and disposal of unsuitable material; removal of brick, wood, cinder block, steel sheeting, or rock walls; backfilling of foundation with suitable bedding, compaction, and all other related and necessary materials, work, and equipment required to remove this item in accordance with the Contract Documents.

2-6 Remove Concrete Headwall

No partial measurement for payment will be made for this item, removal and payment will be based upon complete removal of the concrete headwall and/or attached railing and/or fence to the satisfaction of the Project Construction Engineer or to the requirements of the Contract Documents; provided, however, no measurement for payment will be made for retaining wall removal required due to negligent or unauthorized operations by the Contractor.

The unit price bid per lump sum concrete headwall removal shall include all of the Contractor's costs of whatsoever nature. The price bid shall include: effectively removing the wall in a manner satisfactory to the Project Construction Engineer; excavation and overexcavation; removal of any foundation concrete; removal of tie backs, drainage pipe; removal and disposal of unsuitable material; removal of brick, wood, cinder block, steel sheeting, or rock headwalls; removal and disposal of fence and/or railings; backfilling of foundation with suitable bedding, compaction, and all other related and necessary materials, work, and equipment required to remove this item in accordance with the Contract Documents.

2-11 Remove or Abandon Existing Pipe and Box Culverts

8-4 Remove Existing Waterline

The measurement and payment for this item will be the total number of linear feet of existing pipe, flared end sections, box culvert, and/or waterline of the dimensions specified, required to be removed or abandoned for construction of the proposed sewer and/or appurtenances; however, no payment will be made for pipe removed or abandoned due to negligence or unauthorized operations by the Contractor.

The unit price bid per linear foot of removal or abandonment shall include all of the Contractor's costs of whatsoever nature. The price bid shall include: excavation; care and diversion of drainage courses; removal of pipe, cone sections and sewer appurtenances as necessary to complete the removal or abandonment as specified in the Contract Documents including removal and disposal of the existing conduit and appurtenances (per State and Local requirements where applicable for lines containing asbestos); hauling and disposal of construction debris, unsuitable material and contaminated materials at the Denver Arapahoe Disposal Site (DADS); removal of pavement, sod and other surfacing materials; excavation, including exploratory excavation; diversion, cutting and plugging of pipe, as necessary, per the

Measurement and Payment

Contract Documents, any additional labor, equipment and materials required to disconnect the existing facility as required by the owner, salvaging of pipe when directed by the Project Construction Engineer or when specified in the Contract Documents, placing of the salvaged pipe on the job site in a location designated by the Project Construction Engineer; reforming and reshaping of manhole inverts as required; backfilling to final grade with approved backfill material; filling of abandoned pipe with an approved CLSM or alternately approved product, per the requirements set forth in the Detail and Technical Specifications; compaction of materials as necessary; paving, curb, gutter, sidewalk, landscaping and any other surface restoration required due to removal of associated items; coordination with utility owner as required and all other related and necessary materials, work, and equipment required to complete removal or abandonment in accordance with the Contract Documents.

2-11.8 Remove Abandoned Steam Pipe With Asbestos Lining (<24" Diameter)

The measurement for payment of this item will be the total number of linear feet of pipe required to be removed and transported to an approved disposal site for construction of the proposed sewer; provided, however, no payment will be made for removal due to negligence or unauthorized operations by the Contractor or any Subcontractors.

The removal of abandoned steam pipe with asbestos lining shall comply with Colorado State Regulation No. 8, Part B, which incorporates the Environmental Protection Agency (EPA) National Emissions Standards for Hazardous Air Pollutants (NESHAP) Regulations for Asbestos (40 CFR Part 61). More specifically, the removal activity must comply with § III.S.4. (Other Non-friable Asbestos-Containing Materials) and if at a quantity above trigger levels (§I.B.104) are also subject to § III.E. (State Notifications) of the stated regulation. If during abatement, the asbestos cement product becomes friable, the project activity shall meet and conform with all the requirements in sections I (Definitions), II (Certification Requirements), and III (Abatement, Renovation and Demolition Projects) of the stated regulation. All abatement projects involving asbestos products are subject to Occupation Safety and Health Administration (OSHA) Standards for Asbestos (29 CFR Parts 1910.1001 and 1926.1101). Transportation of asbestos-containing waste materials is regulated by the Colorado Department of Transportation (CDOT). All expenses incurred to comply with the above noted items shall be borne by the Contractor.

The unit price bid per linear foot for removal shall include all of the Contractor's costs of whatsoever nature. The price bid shall include: excavation; care and diversion of drainage courses; removal of pipe, insulating materials and appurtenances; removal of pavement, sod, and other surfacing materials; excavation, including exploratory excavation; coordination and interaction with abandoned facility owner to ensure that a chain of custody is maintained; hauling and disposal of construction debris, excess excavated material, damaged materials and asbestos contaminated materials at the Denver Arapahoe Disposal Site (DADS) unless otherwise specified or required by State regulations; backfilling and compaction to final grade with an approved backfill material; and all other related and necessary materials, work and equipment required to remove the existing abandoned steam pipe with asbestos lining in accordance with the Contract Documents.

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- 2-12.1 Remove Existing Sanitary Manhole**
- 2-12.2 Remove Existing Storm Manhole**
- 2-12.3 Abandon Existing Sanitary Manhole**
- 2-12.4 Abandon Existing Storm Manhole**
- 2-12.7 Remove Existing Structure**
- 2-13.1 Remove Existing Storm Inlet**
- 2-13.2 Remove Existing Special Storm Inlet**

The measurement for payment of this item will be the total number of manholes, inlets or structures required to be removed or abandoned for construction of the proposed sewer and/or appurtenances; however, no payment will be made for structures removed due to negligence or unauthorized operations by the Contractor.

The unit price bid per manhole, inlet or structure removal and/or abandonment shall include all of the Contractor's costs of whatsoever nature. The price bid shall include: excavation, overexcavation, exploratory excavation; care and diversion of drainage courses; removal of brick, grate, ring and cover, manhole barrel sections, concrete and any related reinforcing materials, unsuitable material, reducers, etc. to a minimum of 2 foot below finish grade; removal of pavement and sod; cutting and plugging of associated pipe per the Contract Documents, or as required by the Project Construction Engineer; salvaging of ring and cover or grates when so designated by the Project Construction Engineer; storing of all salvaged materials on the job site at a location designated by the Project Construction Engineer; disposal of unsuitable material; placement of approved backfill material and/or Controlled Low Strength Material to final grade elevation, compaction; removal and replacement of paving, curb, gutter, sidewalk, landscaping and any other surface restoration required due to removal of associated item, unless specifically provided for elsewhere in the Contract Documents; and all other related and necessary materials, work, and equipment required to remove, abandon and/or salvage the existing structure in accordance with the Contract Documents.

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- 2-12.5 Rehabilitate Existing Sanitary Manhole**
 - 2-12.6 Rehabilitate Existing Storm Manhole**

The measurement for payment of this item will be the total number of vertical feet for individual manholes or structures, of the specified diameter, requiring rehabilitation for construction of the proposed sewer facilities, complete, in place, in a manner satisfactory to the Project Construction Engineer, provided, however, no payment will be made for manholes or structures required to be rehabilitated due to negligence or unauthorized operations by the Contractor.

As part of the cost of this bid item, the Contractor, shall provide all necessary labor, equipment and materials required to re-inspect all rehabilitated manholes at two intervals, once at 18 months, and once at 34 months after final acceptance to address any warranty related work. The City's Construction Project Manager will contact the Contractor to schedule these inspections.

The price bid per vertical foot of rehabilitation of manholes and/or structures shall include all of the Contractor's costs of whatsoever nature. The price bid for rehabilitation shall include but not be limited to: furnishing, transporting, installing, setting up of all equipment and all materials and labor necessary to clean the manhole to be rehabilitated; furnishing labor and equipment required to by-pass pump, furnishing water for cleaning; furnishing energy required for power equipment; supplying all materials and equipment necessary to line the entire interior of manhole; reconstruction of the invert, bench, manhole steps and joints in

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accordance with the Contract Documents; concrete sawing or otherwise effectively cutting the manhole smoothly and squarely in a manner satisfactory to the Project Construction Engineer; furnishing, transporting and installing manhole liner, concrete, reinforcement, brick, mortar, plastic joints sealant and grout, steps and other miscellaneous items as required to rehabilitate the specified manholes and/or structure; removal and disposal of unsuitable material; replacement with material as approved by the Project Construction Engineer; flagging, barricading, traffic control; warranty inspections and travel to and from site; and all other related and necessary materials, work, and equipment required for complete rehabilitation of the manhole or structure in a manner satisfactory to the Project Construction Engineer and in accordance with the Contract Documents.

2-14 Remove Riprap

2-15 Remove Gabions

The measurement for payment of this item will be the total number of cubic yards of riprap, gabions or other rock materials required to be removed for construction of the proposed sewer and/or appurtenances; provide, however no measurement for payment will be made for rock required to be removed due to negligence or unauthorized operations by the Contractor.

The unit price bid shall include all of the Contractor's costs of whatsoever nature. The price bid for removal shall include; excavation, backfilling, removal and disposal of unsuitable material, compaction and all other related and necessary materials, work, and equipment required to remove the riprap or gabions in accordance with the Contract Documents.

2-16.1 Remove Chain Link Fence

2-16.2 Remove Wood Fence

2-16.3a Remove Single Swing Gate

2-16.3b Remove Double Swing Gate

2-16.4 Remove Security Fence

2-18 Remove Permanent Barricades

2-21.1 Remove Guard Rail

2-21.2 Remove Hand Rail

The measurement for payment of this item will be the total number of linear feet of wood fence, chain link fence, security fencing, gate work, guard rail, hand rail, or the number of barricades required to be removed for construction of the proposed sewer and/or appurtenances; provided, however, no measurement for payment will be made for items required to be removed due to negligence or unauthorized operations by the Contractor.

The unit price bid per linear foot of removal shall include all of the Contractor's costs of whatsoever nature. The price bid shall include: removal and disposal of materials to include: concrete bases, rails, posts, pickets, wire, fabric, slats, w-beams, nails, nuts, bolts, fencing, etc.; removal and salvage of materials if determined to be reusable by the Project Construction Engineer; filling post holes, backfilling and regrading as necessary to promote drainage and eliminate safety hazards; and all other related and necessary materials, work and equipment required to complete the removal in accordance with the Contract Documents.

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2-17.1 Remove and Replace/Relocate Utility Poles

2-17.2 Temporary Utility Pole

2-17.3 Remove and Replace/Relocate Sign

2-17.5 Remove and Replace Parking Meter Pole

The measurement and payment of this item will be the total number of utility poles, parking meter poles and/or signs required to be removed and/or removed and relocated or replaced, and the total number of temporary poles placed and removed, for construction of the proposed sewer and/or appurtenances; provided, however, no measurement for payment will be made for poles removed due to unauthorized operations of the Contractor.

The unit price bid shall include all of the Contractor's costs of whatsoever nature. The price bid shall include: coordination with the utility owner; adherence to rules and procedures set forth by utility owners; scheduling relocations as required to insure that no time is lost for the project; excavation; removal and storage of poles and/or signs; replacement with new pole and/or signs if necessary; bedding, select fills, backfilling and compaction; removal and replacement of guy wires; drilling, casings; installation of new foundations to utility owner or Project Construction Engineer's requirements as necessary; disposal of all trash and construction unsuitable material associated with this bid item; and all other related and necessary materials, labor and equipment required to complete the construction in accordance with the Contract Documents.

2-17.7 Relocate Existing Utility Line

No quantity measurement will be made for any of the work and materials required to accomplish this aspect of the construction project and payment will be based upon the completion of the work in accordance with the Contract Documents.

The lump sum cost for coordination and relocation of the specified existing utility line shall include all of the Contractor's costs of whatsoever nature. The price bid shall include: coordination with the utility owner as necessary to complete the relocation; adherence to rules, regulations, specifications and procedures set forth by utility owner; obtaining all required permits and paying associated fees; railroad flagging and fees as necessary; shoring and trench support; hand digging as necessary; removal and disposal of concrete encasement material; removal and disposal of abandoned appurtenances; scheduling, rescheduling and facilitating all relocations as required to ensure the project stays on time, all associated delay costs; excavation as necessary for relocation of existing utility; removal, disposal and hauling of all construction debris, excess excavated material, unsuitable materials and manifested contaminated materials at the Denver Arapahoe Disposal Site (DADS), recycle and salvage of materials as required by contract; temporary utility supports; relocation of the utility; providing temporary service and rerouting as necessary; preserving service and continuity as required by utility owner; cutting of existing utility conduit and line as necessary; providing all materials, equipment and specialty labor necessary for reconnection of specific utility; brushing, cleaning and pigging of utility conduit as required by owner; providing and installing marking/tracing wire; concrete encasement of relocated utility as required and per utility company standards; traffic control supporting a standalone configuration; air testing; material testing; relocation engineering and plan development; directional boring if needed; removal and replacement of concrete flatwork at directional bore pits; specialized welding at points of connection and pipe junctions; backfilling and compaction after completion of relocate; and all other related and necessary materials, work and equipment required to relocate the existing utility.

Measurement and Payment

2-19 Remove Existing Culvert

The measurement for payment of this item will be the total number of linear feet of concrete culvert or concrete channel required to be removed for construction of the proposed sewer and/or appurtenances; provided, however, no measurement for payment will be made for removal of culvert due to negligence or unauthorized operations by the Contractor.

The linear foot price bid for culvert removal shall include all of the Contractor's costs of whatsoever nature. The price bid shall include: excavation, including overexcavation to remove unsuitable foundation material; removal and disposal of all culvert materials including pipe, wood, concrete, reinforcing; backfilling and compaction; and all other related and necessary materials, work and equipment required to remove the culvert in accordance with the Contract Documents.

2-20a Remove Trolley Tracks

2-20b Remove Railroad Tracks

The measurement for payment of this item will be the actual number of linear feet per pair of trolley, street car, or railroad tracks required to be removed for construction of the proposed sewer and/or appurtenances; provided, however, no payment will be made for track removal outside the limits of the trench or for track removed due to negligence or unauthorized operations by the Contractor.

The unit price bid per linear foot removal of this item shall include all of the Contractor's costs of whatsoever nature. The linear foot price bid (per pair of rails) shall include: removal of paving within the entire track facility footprint and adjacent paving requiring removal to properly complete this item; cutting and disposal or recycling of rails; removal and disposal of ties, fasteners, spikes, special joints; removal and disposal of special bedding and/or ballast under the tracks, removal and disposal of concrete panels and/or rubber matting; hauling and disposal of all excess excavated at the Denver Arapahoe Disposal Site; backfilling and compaction of subgrade with suitable material; temporary driving surfaces required prior to final pavement or new track installation, maintenance of temporary driving surfaces to includes removal and installation of new temporary surfaces as necessary prior to final treatment; and all other related and necessary materials, work and equipment required for removal of this item in accordance with the Contract Documents.

2-22 Remove Parking Lot Trench Drain

The measurement for payment of this item removal will be the actual number of linear feet of trench drain required to be removed for construction of the proposed sewer and/or appurtenances; provided, however, no payment will be made for trench drain removed due to negligence or unauthorized operations by the Contractor.

The unit price bid per linear foot removal of this item shall include all of the Contractor's costs of whatsoever nature. The price bid shall include: excavation, removal of concrete, unsuitable material, grates, backfilling and compaction; and all other related and necessary materials, work and equipment required for removal of this item in accordance with the Contract Documents.

2-23 Remove Decorative Landscaping

No quantity measurement will be made for any of the work and materials required to remove and replace this item. Payment will be based upon completion of the work in accordance with the Contract Documents; provided, however, no payment will be made for removing and

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replacing decorative landscaping required to be replaced due to negligent or unauthorized operations by the Contractor.

The lump sum bid price shall include all of the Contractor's costs of whatsoever nature. The price bid shall include: excavation; removal and replacement of concrete, rock; removal and replacement of plants; disposal of excess excavated materials; topsoil, fertilizer, water, storage and all other related and necessary materials, work and equipment, required to replace the decorative landscaping in accordance with the Contract Documents.

2-24 Remove and Replace Bus Stop

The measurement and payment of this item will be the total number of bus stops to be removed and replaced for construction of the proposed sewer and/or appurtenances; provided, however, no measurement for payment will be made for bus stops removed and/or replaced due to unauthorized operations by the Contractor.

The unit price bid shall include all of the Contractor's costs of whatsoever nature. The price bid shall include: coordination with the Regional Transportation District (RTD); adherence to the rules and procedures set forth by RTD; scheduling all necessary relocations and utility disconnections/reconnections, as required, to insure that no time is lost on the project; excavation, removal and disposal of materials as necessary; removal, storage, and replacement of poles, signs, benches, shelters, trash cans, guy wires and all other appurtenances associated with the bus stop; installation and removal of temporary bus stops, as required by RTD; removal and replacement of concrete bus pads, pavement, subgrade material, curb, gutter and sidewalk, landscaping materials and all other items required to complete construction of the proposed sewer and/or appurtenance and replace the bus stop in the same or better condition upon completion; and all other related and necessary materials, labor and equipment required to complete the construction in accordance with the Contract Documents.

3-2 Hauling of Contaminated Materials to Denver/Arapahoe Disposal Site (DADS)

The measurement for payment of this item will be the number of tons of contaminated material required to be hauled off to the Denver/Arapahoe Disposal Site for construction of the proposed sewer and/or appurtenances; provided, however, no measurement for payment will be made for hauling of non-contaminated materials and contaminated materials not authorized by the Project Construction Engineer. Payment shall be based upon weights obtained from a certified scale agreed to with the Project Construction Engineer prior to commencement of activities. Certified weight tickets from the agreed to scale shall be used for payment purposes. Payment shall not be made for muck excavation necessary to poor shoring methods or unauthorized operations by the contractor.

The unit price bid per ton of contaminated material disposal shall include all of the Contractor's costs of whatsoever nature. The price bid shall include: excavation; loading; hauling and obtaining weights at a certified scale prior to disposal; disposal of debris at the Denver Arapahoe Disposal Site; acquisition of all required permits; all special personnel and equipment required to haul the construction debris to DADS; laboratory testing as required; and all other related and necessary materials, work, and equipment required for removal of this item in accordance with the Contract Documents.

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3-3 Hazardous Waste Disposal

The measurement for payment of this item will be the total number of tons of hazardous waste required to be removed and hauled off, for construction of the proposed sewer and/or appurtenances; provided, however, no measurement for payment will be made for removal and disposals not authorized by the Project Construction Engineer. Payment shall be based upon weights obtained from a certified scale agreed to with the Project Construction Engineer prior to commencement of activities. Certified weight tickets from the agreed to scale shall be used for payment purposes. Payment shall not be made for muck excavation necessary to poor shoring methods or unauthorized operations by the contractor.

The unit price bid per ton of Hazardous Waste disposal shall include all of the Contractor's costs of whatsoever nature. The price bid shall include: all required permits and fees; excavation, loading, hauling and obtaining weights at a certified scale prior to disposal; and backfilling; disposal of hazardous waste at the Denver Arapahoe Disposal Site; and as required by State and Federal regulations; and all other related and necessary materials, work, and equipment required for hazardous waste disposal in accordance with the Contract Documents.

3-4 Rock Excavation

The measurement for payment of this item will be the total number of cubic yards of rock required to be removed for construction of the proposed sewer and/or appurtenances; provided, however, no measurement for payment will be made for rock excavation beyond the maximum prescribed trench width or for depths exceeding 12 inches below the pipe nor for excavation due to negligence or unauthorized operations by the Contractor.

The unit price bid per cubic yard of rock excavation shall include all of the Contractor's costs of whatsoever nature required to perform the excavation and to replace the void area with granular bedding and/or any other material specifically approved by the Project Construction Engineer. The price bid shall include: excavation, blasting, removal and disposal of rock unsuitable material; furnishing, placing and compacting the approved backfill material required to fill the void area; and all other related and necessary materials, work, and equipment required to excavate the rock in accordance with the Contract Documents.

3-5 Muck Excavation

The measurement and payment for this item will be the total number of tons of muck required to be excavated and disposed of; provided, however, no measurement for payment will be made for any excavation of material that does not meet the definition of muck as described in the technical specifications or as determined by the Project Construction Engineer. Measurement for muck excavation will be made only to the limits specifically determined by the Project Construction Engineer. Payment shall be based upon weights obtained from a certified scale agreed to with the Project Construction Engineer prior to commencement of activities. Certified weight tickets from the agreed to scale shall be used for payment purposes. Payment shall not be made for muck excavation necessary to poor shoring methods or unauthorized operations by the contractor.

The unit price bid per ton of muck removal shall include all of the Contractor's costs of whatsoever nature: The price bid shall include: excavation; loading, hauling and obtaining weights at a certified scale prior to disposal; removal and disposal of muck at the Denver Arapahoe Disposal Site; dewatering; placing and compacting approved select materials in void areas left by the excavation in a timely fashion; and all other related and necessary materials,

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labor, and equipment required to remove the muck in accordance with the Contract Documents or as directed by the Project Construction Engineer.

3-6 Construct, Repair, or Stabilize Embankments

The measurement and payment for this item will be the total number of cubic yards of embankment materials required for construction of the proposed sewer and/or appurtenances; provided, however, no payment will be made for embankment materials not authorized by the Project Construction Engineer.

The unit price bid per cubic yard of embankment construction shall include all of the Contractor's costs of whatsoever nature. The price bid shall include: excavation, haul, furnishing and placement of embankment materials, geotextiles, soils, compaction, placement of riprap, concrete, grouting, grading; and all other related and necessary materials, work, and equipment required to construct the embankment in accordance with the Contract Documents.

3-7 Material Management/Health & Safety Plan

No quantity measurement will be made of any of the work and materials required for this item in construction of the proposed sewer and/or appurtenances; payment will be based upon completion of the work in accordance with the Contract Documents.

The lump sum payment for materials management and health and safety plans shall include all of the Contractor's costs of whatsoever nature. The lump sum price bid shall include: facilities coordination for health and safety; coordination for testing and disposal of materials; management of on-site treatment, storage and disposal; implementation and coordination of Federal and Municipal Rules and Regulations as required by the respective agencies and municipalities; monitoring of the health and safety plan; contaminant testing as required; and all other related and necessary materials, work and equipment required to complete this item in accordance with the Contract Documents.

At the option of the Project Construction Engineer, one third of this item may be paid to the Contractor at the time of the first monthly progress payment, the second third may be paid at the next monthly progress payment and the last third may be paid at the final monthly progress payment. At the discretion of the Project Construction Engineer, payment may be withheld for any Non-conformance reports issued for failure to comply with the approved Material Management/Health & Safety Plan.

3-8 Unclassified Excavation

5-3b Overexcavation

The accepted quantities will be paid for at the contract unit price for unclassified excavation or overexcavation. The measurement for payment of this item will be the number of cubic yards of material required to be removed for construction, excluding demolition and removal items specified elsewhere. The measurement and payment for overexcavation or unclassified excavation shall be defined based on field conditions (insitu) prior to commencing operations (excavated volumes shall not be allowed) and agreed to by the Project Construction Engineer. If feasible, a before and after field survey may be conducted to define this volume. In either method, this area shall be defined as the unclassified or over excavation zone. The quantity paid shall not include any material excavated above the proposed facility subgrade, as shown within the contract documents.

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The unit price bid per cubic yard of excavation shall include all of the Contractor's costs of whatsoever nature. The unit price bid shall include: all labor, equipment, materials and incidentals required to excavate the materials, loading, hauling and disposal on-site and off-site to the Denver Arapahoe Disposal Site, and stockpiling of materials; placement as subgrade and/or topsoil elsewhere on site as specified within the contract documents; placement for embankments, water conditioning and compaction to specified limits. Embankment construction will not be measured separately but will be included as a separate unclassified excavation bid item with additional notes.

5-1 Structural Fill

5-2a Subgrade Material (Select Backfill)

5-2b Topsoil

5-4 Crusher Fines

5-5 Recycled Concrete

5-8 Crushed Gravel Base Course (CDOT Class 6 Road Base)

The measurement for payment of this item will be the number of tons of structural fill, subgrade material, topsoil, crusher fines, and/or recycled concrete placed and accepted for construction of the proposed facilities and/or appurtenances. No measurement for payment will be made for materials that are placed without specific written approval of the Project Construction Engineer. In addition, no payment will be made for: placement due to poor subgrade preparation, cave-ins, and/or negligent or unauthorized activities by the Contractor. This item shall follow the requirements set forth in Section 5.0 of the Detail and Technical Specifications.

All delivery trucks shall be plainly numbered and all records of gross, tare and net weights (determined by use of a certified scale) shall be kept in detail and furnished to the Project Construction Engineer upon request. These records will be used for payment purposes, and may be reviewed by the Project Construction Engineer at any time.

The unit price bid per ton of classified material shall include all of the Contractor's costs of whatsoever nature. The price bid shall include; excavation and preparation of subgrade; removal and disposal of all unsuitable materials; furnishing of approved materials, transporting, weighing at a certified scale as required for payment placing, addition of water as necessary and compacting the classified material; finish grading; and all other related and necessary materials, work, labor and equipment required to complete the site preparation and placement of the classified material in accordance with the Contract Documents.

5-3a Overexcavation And Replacement With Select Backfill Material

The measurement and payment for this item will be the total number of cubic yards of overexcavation and replacement with select backfill material (and/or stabilization materials consisting of 1-1/2 inch angular aggregate as approved by the Project Construction Engineer) required to construct the proposed facilities and/or appurtenances; provided, however, no measurement for payment will be made for overexcavation and replacement required due to negligence or unauthorized activities by the Contractor. The measurement for overexcavation and replacement shall start at the proposed pipe or facility subgrade, extend downward as required to produce a stable subbase for the proposed infrastructure and extend a maximum trench width as defined in the most recent addition of the Standard Detail drawings or a maximum width agreed to by the Project Construction Engineer prior to commencing overexcavation. This area shall be defined as the stabilization zone.

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Payment will be solely based on the cubic yards of approved select material imported and installed within the stabilization zone defined above. Separate payment will not be made for the overexcavation under this bid item. Select material must conform to the requirements set forth in Section 5.0 of the Detail and Technical Specifications. The Contractor must obtain approved submittals for all select materials used under this item from the Project Construction Engineer, to ensure that the material proposed for use meets the field conditions and intended use. All delivery trucks shall be plainly numbered and all records of gross, tare and net weights (determined by use of a certified scale) as well as load volumes and weights shall be kept in detail and furnished to the Project Construction Engineer upon request. These records will be used for verification purposes during payment and may be reviewed by the Project Construction Engineer at any time. All hauling and disposal of construction or contaminated materials generated due to construction activities must be managed in strict conformance with the Detail and Technical Specifications.

The unit price bid per cubic yard of overexcavation and replacement shall include all of the Contractor's costs of whatsoever nature. The unit price bid shall include: trench protection, overexcavation, removal and disposal of material within the stabilization zone, removal and disposal of unsuitable material, hauling and disposal to the Denver Arapahoe Disposal Site (DADS); furnishing and installation of approved select materials, transporting, weighing at a certified scale as required for verification of payment; compaction and installation of approved select materials; dewatering as necessary to allow installation and stabilization of select materials; furnishing and installation of geotextiles or filter fabrics as required in the Contract Documents, and all other related and necessary materials, work, labor and equipment required to complete the removal in accordance with the Contract Documents.

5-7 Controlled Low Strength Material (CLSM)

The measurement and payment for this item will be the total number of cubic yards of Controlled Low Strength Material, controlled density fill, etc. approved for construction of the proposed facilities and/or appurtenances; provided, however, no measurement for payment will be made for materials required due to careless or unauthorized activities by the Contractor.

The unit price bid per cubic yard shall include all of the Contractor's costs of whatsoever nature. The price bid shall include: furnishing and hauling; placement, as directed by the Project Construction Engineer; maintaining the mixture to the requirements provided for within the Contract Documents; protection of existing facilities; and all other related and necessary materials, work, and equipment required to furnish the material in accordance with the Contract Documents.

8-1.1 Dip AWWA C151, Class 50 Water Line

8-1.3 PVC AWWA C900, Class 200 and Class 150 Water Line

The measurement and payment of each specific size of waterline pipe, except segments as may be otherwise provided for in the Contract Documents, will be the actual number of linear feet of pipe required to be removed and relocated or installed, complete, in place, as measured along the centerline of the waterline pipe from given station to given station, from center of valve to center of valve or from center of manhole to center of manhole with deductions made for the internal diameter or dimensions of manholes, structures and/or valves; provided, however, no

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measurement for payment will be made for pipe removed or damaged due to negligence or unauthorized operations by the Contractor.

The unit price bid per linear foot for the construction of each section of waterline shall include all of the Contractor's costs of whatsoever nature for the complete construction of the pipeline in accordance with the requirements of the Board of Water Commissioners of Denver. The price bid shall include: The bid item shall include: trench sloping, benching, bracing, shoring and/or sheeting for pipe and associated appurtenances to assure safe working conditions; removal and disposal of the existing conduit and appurtenances (per State and Local requirements where applicable for lines containing asbestos), including valves, water meter's, stop boxes, fire hydrants, pressure regulating devices, restraints, and fittings; furnishing and installing required waterline pipe, fittings, appurtenances, temporary facilities and blow offs; tapping and/or connecting to mainlines, service lines, or structures; cutting and/or plugging of all abandoned facilities crossed during construction; furnishing and installing special fittings and restraints, including: transitional pipe sections required to properly connect different types of pipe and/or any other special fittings not specifically provided for elsewhere in the Contract Documents; joints and jointing materials, including: grout, mortar, gaskets, seals, bolts, connecting bands, and other miscellaneous items as required to construct the specific pipe section; removal and disposal of asphalt, millings, roadway surfacing materials, sod, surfacing materials, stumps, brush and prior to excavation; excavation, including exploratory excavation, as required by the Project Construction Engineer; over-excavation to remove unsuitable foundation material and replacement with granular or other approved select materials; constructing the specified bedding including the furnishing, placing, and compaction of sand, gravel, rock and controlled low strength materials, as required by the Denver Water Board; supply and installation of protective coatings or wrappings, locate wires and boxes; backfilling to include furnishing, transporting, and placement of any additional suitable backfill material required (except for those classified backfill materials provided for elsewhere in the Contract Documents); compaction and backfilling as specified (no additional or separate payment will be made for excess excavated material used as backfill or select material elsewhere on the project); restoration of ground surface to its original condition; grading and leveling; care and diversion of drainage courses; pumping and provision of facilities for diversion of flows; trench dewatering; protection, adjustment and/or reconnection of aboveground and underground utilities and service connections, replacement of hydrant laterals and assemblies damaged during crossing, reconnection of water services; coordination of gas service and electric relocates; crossing of existing and abandoned utilities; hauling and disposal of construction debris, excess excavated material, damaged materials and contaminated materials at the Denver Arapahoe Disposal Site (DADS), recycle and salvage of materials as necessary; saw cutting and/or rotomilling within mainline (B_f extents) and lateral trench extents prior to excavation; removal and replacement and/or relocation of signs, and pipe bollards; providing for additional traffic control, to include barricades, detours and flagmen unless provided for elsewhere in the Contract Documents; removal and replacement of all traffic signal and/or activated loops; valve operation tests, pipe chlorination, clear water tests, pressure tests, locate wire testing; and all other related and necessary materials, labor and equipment required to construct a complete operable pipeline in accordance with the Contract Documents and in accordance with the Denver Water Board Standards.

In addition to the above, the unit price bid per linear foot for slip lining, bursting, jacking, tunneling, boring and/or micro tunneling shall include the following: installation of jacking, tunneling and/or boring pits and related equipment; launching and access pits; automated spoil transportation systems; hoists; signal systems, safety equipment; sealing materials, grout, sand, casings, skids and end seals as approved by the Project Construction Engineer and as required by the Denver Water Board, filling of all annular spaces and any other necessary labor; purchase, delivery and installation of all equipment and materials required to install the

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pipe segment and/or associated casing per the Contract Documents; heating and butt fusion jointing; removal and replacement of existing waterlines, valves, hydrants, vaults, restraints, sod, seeding, sprinkler systems, trees, bushes, shrubs, bike path, curb, gutter, sidewalk, pavement, asphalt base course, asphalt wearing surface, and any other surface restoration and/or removal/replacement required within the areas impacted due to these operations.

8-1.2 Install Water Valve, Water Meter and Stop Box

The measurement and payment for this item will be the total number of water valves, water meters and stop boxes required to be installed for construction of the proposed sewer and/or appurtenances; provided, however, no measurement for payment will be made for items required to be installed due to negligent or unauthorized operations by the Contractor.

The unit price bid for installation of this item shall include all of the Contractor's costs of whatsoever nature. The price bid shall include: excavation, backfilling and compaction; removal and disposal of the existing water valve, water meter and/or stop box; installation of the item in accordance with the requirements of the Denver Water Board; supply and installation of all components required to complete the work, including stop(curb) boxes; removal and disposal of pavement and unsuitable material; and all other related and necessary materials, labor, and equipment required for removal and replacement of each item in accordance with the Contract Documents, and in accordance with Denver Water Board Standards.

8-1.4 Temporary Water Main Bypass

The measurement for payment of this item will be the actual number of linear feet from the center of intersection to the center of intersection for the block being bypassed. Every block requiring temporary water main bypass will only be paid once and all work necessary within the block measured shall be included within this item. Only those sections specifically authorized by the Project Construction Engineer will be bypassed and measured for payment.

The unit price bid per linear foot for this item shall include all of the Contractor's costs of whatsoever nature. The price bid shall include: furnishing and setting up of all equipment, labor, and materials required to temporarily bypass the existing water main around the facilities being repaired, reconstructed, or constructed to all properties being served within the effected construction areas and as approved by the Project Construction Engineer; installation and maintenance of entire temporary water bypass system during the work to ensure uninterrupted service, safe operation and multimodal access by owners; vacuum breakers and inclement weather devices or procedures to protect system; supply of temporary service connections and fire services in accordance with Denver Water requirements; valve operation tests, pipe chlorination, clear water tests, pressure tests and locate wire testing; permits and fees from applicable entities; compaction and backfilling as specified (no additional or separate payment will be made for excess excavated material used as backfill or select material elsewhere on the project); materials testing and quality control; supplying of energy required to operate all bypass equipment; temporary installation of bypass piping under the pavement of cross streets, or raised transitional crossings as may be required per the approved traffic control plan; temporary surfacing; restoration of ground surface to its original condition including removal and replacement of sod, seeding, sprinkler systems, trees, bushes, shrubs, bike path, curb, gutter, sidewalk, pavement (concrete, asphalt base course, asphalt wearing

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surface, sub grade materials, etc.) and any other surface restoration and/or removal/replacement within the areas impacted due to these operations; removal and replacement of water fixtures, fire hydrants, valves, or any other appurtenances as necessary to permit bypassing; hauling and disposal of construction debris, excess excavated material, damaged materials, unsuitable material and contaminated materials at the Denver Arapahoe Disposal Site (DADS); and all other related and necessary equipment, work, and materials required to complete the water bypassing as required in the Contract Documents or as directed by the Project Construction Engineer.

8-1.5a Lead Service Line Replacement, <2”ID

8-1.5b Lead Service Line Replacement, >2”ID

The measurement for payment of this item will be the actual number of lineal feet of lead water service line removed and replaced as measured from the corporation stop or tee on the water main to the centerline of the external water meter. Lead services shall be replaced with a minimum size copper service line of $\frac{3}{4}$ ” or to a size adequate to supply all the requirements of the property being served in accordance with Denver Water specifications and details. No measurement for payment will be made for lead service line replacement required due to negligence or unauthorized operations by the Contractor.

The unit price bid per lead service line replacement shall include all of the Contractor’s costs of whatsoever nature for the complete removal and replacement of the lead service line in accordance with the requirements of Denver Water, exclusive of appurtenances or items otherwise provided for in the Contract Documents. The price bid shall include: trench sloping, benching, bracing, shoring and/or sheeting for service lines and associated appurtenances to assure safe working conditions; barricades, fencing and signage as necessary to ensure the safety of the public; removal and disposal of the existing lead service line and appurtenances (per State and Local requirements where applicable), including valves, and fittings; furnishing, transporting, and installing required copper service line pipe, fittings, valves, and appurtenances; providing temporary service and facilities as necessary during construction; tapping and/or connecting to mainlines and/or meters; furnishing and installing special fittings for connection to the water meter, not specifically provided for elsewhere in the Contract Documents; gaskets, seals, bolts, connecting bands, and other miscellaneous items as required to construct the service line; saw cutting and/or rotomilling within trench section prior to excavation; removal and disposal of asphalt, millings, roadway surfacing materials, sod, surfacing materials, stumps, brush and unsuitable material prior to excavation; excavation, including exploratory excavation, as required by the Construction Project Manager; over-excavation to remove unsuitable foundation material and replacement with granular or other approved select materials at the specific written approval of the Construction Project Manager; constructing the specified bedding including the furnishing, placing, and compaction of sand, gravel, rock or controlled low strength materials, as required by Denver Water; supply and installation of protective coatings or wrappings, locate wires and boxes; backfilling to include furnishing, transporting, and placement of any additional suitable backfill material required (except for those classified backfill materials provided for elsewhere in the Contract Documents); compaction and backfilling as specified (no additional or separate payment will be made for excess excavated material used as backfill or select material elsewhere on the project); grading and leveling; restoration of ground surface to its original condition including the removal and replacement of sod, seeding, sprinkler systems, trees, bushes, shrubs, bike path, curb, gutter, sidewalk, pavement, asphalt base course, asphalt wearing surface and any other surface restoration and/or removal/replacement required within areas impacted due to these operations; care and diversion of drainage courses; trench dewatering; protection, adjustment

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and/or reconnection of aboveground and underground utilities; coordination of gas service and electric relocates; crossing of existing and abandoned utilities; hauling and disposal of construction debris, excess excavated material, damaged materials and contaminated materials at the Denver Arapahoe Disposal Site (DADS); removal and replacement and/or relocation of signs, and pipe bollards; providing for additional traffic control, to include barricades, detours and flagmen as specified per the approved MHT/Street Occupancy permit; removal and replacement of all traffic signal and/or activated loops; valve operation tests, pipe chlorination, clear water tests, pressure tests, locate wire testing; permits and fees from applicable entities; and all other related and necessary materials, labor and equipment required to construct a complete operable water service line in accordance with the Contract Documents and in accordance with Denver Water Specifications and Standards.

8-2 Remove Fire Hydrant Assembly

The measurement and payment for this item will be the total number of fire hydrants required to be removed for construction of the proposed sewer and/or appurtenances; provided, however, no payment will be made for hydrants replaced due to negligent or unauthorized operations by the Contractor.

The unit price bid for removal of this item shall include all of the Contractor's costs of whatsoever nature. The price bid shall include: excavation; removal and disposal(or recycling as applicable) of hydrant, fittings, restraints, valves and appurtenances; backfilling and compaction; removal and disposal of pavement and unsuitable material; and all other related materials, work, and equipment required for removal of this item in accordance to the Contract Documents, and in accordance to the Denver Water Board Standards.

8-3 Install Fire Hydrant Assembly

The measurement and payment for this item will be the total number of fire hydrants required to be placed for construction of the proposed sewer and/or appurtenances; provided, however, no payment will be made for hydrants installed without authorization by the Project Construction Engineer or due to negligent operations of the Contractor.

The unit price bid for placement of this item shall include all of the Contractor's costs of whatsoever nature. The price bid shall include: excavation; furnishing, installation and assembly of all materials including but not limited to: hydrant, risers, fittings, restraints, valves and appurtenances; backfilling and compaction; removal and disposal of pavement and unsuitable material; operation tests, chlorination tests, clear water tests, pressure tests, and all other related and necessary materials, work, and equipment required for installation of the fire hydrant assembly in accordance with Denver Water Board Standards.

- 12-1.1 6" Curb and Gutter – 2' Pan (CDOT T2, IIB)**
- 12-1.2 6" Curb and Gutter – 1' Spill Pan (CDOT T2 IB)**
- 12-1.4 9" Curb and Gutter**
- 12-1.5 Combination Curb, Gutter and Sidewalk (2'-8")**
- 12-1.6 Combination Curb, Gutter and Sidewalk (3'-11")**
- 12-1.6a Combination Curb, Gutter and Sidewalk (4'-11")**

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- 12-1.7 **6" Concrete Curb Head**
- 12-1.8 **Handicap Concrete Curb Ramp**
- 12-2.1 **Concrete Sidewalk**
- 12-2.2 **Reinforced Concrete Sidewalk**
- 12-2.3 **Concrete Bike Path**
- 12-2.4 **Miscellaneous Concrete Flatwork**
- 12-3 **Concrete Valley Gutter (all sizes)**
- 12-4.1 **Concrete Street Intersection Gutter (Crossspan)**
- 12-4.2 **Concrete Street Intersection Gutter with Slot**
- 12-4.3 **Special Precast Concrete Intersection Gutter**
- 12-5.1 **Concrete Driveway Paving**
- 12-5.2 **Concrete Apron**
- 12-5.3 **Concrete Bus Pad**
- 12-5.4 **Concrete Alley Gutters**
- 12-5.5 **Concrete Alley Paving**
- 12-5.6 **Concrete Alley Returns**
- 12-5.7 **Concrete Street Paving**
- 12-6 **Concrete Median Strip**
- 12-8 **Concrete Steps**

The measurement and payment for installation of this item will be the total number of linear feet for: curb and gutter, curb head, combination curb gutter and sidewalk, or the total number of square feet for: median strips, sidewalk, bike path, driveway pavement, street paving, crossspans, handicap curb ramps, alley paving, alley gutters, alley returns, single or double flare aprons, bus pads, valley gutter, concrete steps or any other type of miscellaneous concrete flatwork placed and accepted; provided, however, no measurement and payment will be made for flatwork placed due to careless or unauthorized operations by the Contractor.

All concrete ingredients and additives must be combined and mixed at the batch plant prior to transport. Onsite additions to the concrete mix, of any type, will not be allowed without prior authorization of the Project Construction Engineer.

The unit price bid per square foot of concrete steps shall be quantified by the width of the stairs multiplied by the summation of each stair hypotenuse (the hypotenuse of the rise and run of each stair). The unit price bid per linear foot or square foot placement of these items shall include all of the Contractor's costs of whatsoever nature. The price bid shall include: sawcutting and/or rotomilling surrounding surface to allow placement, removal of pavement or roadway surfacing; concrete sawing, furnishing and placing the concrete; forming, finishing and curing compounds; contraction and expansion joints where required by Project Construction Engineer, including partial depth sawcuts; joint sealing compounds; reinforcing as required and specified; concrete additives including, but not limited to: set retarders, accelerators, polypropylene fibrillated fibers, etc. as directed and approved by Project Construction Engineer; edging the concrete surface; furnishing, transporting, installing and compaction of materials required for a stable sub-base; removal and disposal of unsuitable subgrade materials (including frost), replacement with suitable backfill as necessary; backfilling and pavement around new flatwork; protection from freezing and vandalism; and all other related and necessary materials, work and equipment required to construct this item in accordance with the Contract Documents.

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- 12-7 **Non-reinforced Concrete Median Barrier**
 - 12-9 **Concrete Headwall**
 - 12-10 **Concrete Lined Ditches**

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- 12-11 Concrete Planters**
- 12-12 Concrete Cradle for Class "A" Bedding**
- 12-13 Concrete Encasement around Pipe**
- 12-14 Concrete Cut-Off Wall**
- 12-16a Concrete Retaining Wall**
- 12-16b Block Retaining Wall**

The measurement for payment of bulk concrete items such as median barriers, cradles, encasements, cut off walls, lined ditches and planters will be the total number of cubic yards of concrete required for construction. The measurement and payment for retaining walls will be a lump sum payment for each wall and type as indicated in the contract documents. The measurement and payment for headwalls will be based upon the actual number required as indicated within the contract documents for construction of the proposed sewer and/or appurtenance. No payment will be made for any of these items replaced due to negligent or unauthorized operations by the Contractor.

The unit price bid per cubic yard, lump sum or each for these items shall include all of the Contractor's costs of whatsoever nature. The price bid shall include: furnishing, transporting, and installing concrete materials, steel reinforcement, add mixtures and fiber reinforcement as required, and block materials; excavation and overexcavation; furnishing, transporting and installing necessary subgrade, bedding and drainage materials, forming and curing compounds; finishing and edging of concrete; winter protection; backfilling and compaction; grinding, patching and finishing of concrete wall surfaces, application of wall finishes as indicated in the contract documents, installation and furnishing of all fence and/or railing noted for individual wall segments; hauling and disposal of construction debris, excess excavated material, damaged materials and contaminated materials to the Denver Arapahoe Disposal Site (DADS); and all other related and necessary materials, work and equipment required to construct this item in accordance with the Contract Documents.

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- 16-1 Security Fence**
 - 16-2a Single Swing Gate**
 - 16-2b Double Swing Gate**
 - 16-3 Chain Link Fence**
 - 16-4 Wood Fence**
 - 16-5 Single Steel Post Guardrail**
 - 16-6 Single Wood Post Guardrail**
 - 16-7 Permanent Barricades**
 - 16-8 Hand Rail**

The measurement and payment for this item will be the total number of linear feet of security fence, chain link fence, wood fence, guardrail, hand rail, and permanent barricades or the total number of swing gates required to be placed for construction of the proposed sewer and/or appurtenances; provided, however, no measurement for payment will be made for fence work required to be placed due to negligence or unauthorized operations by the Contractor.

The unit price bid per lineal foot or per item placement shall include all of the Contractor's costs of whatsoever nature. The price bid shall include: furnishing and placement of new fencing materials to the height specified in the Contract Documents, including rails, posts, pickets, hardware, locks, paints, special treatments, concrete for posts, single swing gates, double swing gates, steel posts for guard rail, guard rail, wood posts; replacement of electric

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outlets, security wire (barbed, razor, etc.) and all other related and necessary materials, work and equipment required to construct the fence work in accordance with the Contract Documents.

20-1 Asphalt Temporary Patching

The measurement for payment of this item will be the actual number of square yards per inch of asphalt temporary patching mix placed, complete and in place, after the area has been properly backfilled and compacted, as required for the proposed sewer and/or appurtenances; provided, however, no measurement for payment will be made for asphalt temporary mix placed in areas not specifically approved by the Project Construction Engineer, or required due to careless or unauthorized operation by the Contractor.

The asphalt temporary mix may consist of either hot or cold asphaltic surface material. Unless otherwise specified in the Contract Documents, the minimum thickness of asphalt temporary patching mix required is two inches (2”).

The unit price bid per square yard per inch of asphalt temporary patching mix shall include all of the Contractor’s costs of whatsoever nature for the complete construction of the sewer, appurtenances, street or items otherwise indicated within the Contract Documents. The price bid shall include: all preparatory work for placement to grade; disposal of construction debris and unsuitable materials at the Denver/Arapahoe Disposal Site (DADS); street sweeping; removal and disposal of backfill or subgrade materials to the required elevation and preparation for temporary asphalt placement; temporary asphalt material, hauling, rolling, and compaction; maintenance of the temporary patch to include regrading, recompacting, and renewing the material at sufficient intervals of time to ensure a smooth, dust/mud free driving and/or walking surface; temporary striping as required; removal and disposal of temporary asphalt mix prior to permanent asphalt paving operations; and all other related and necessary materials, work and equipment required to furnish and place the asphalt temporary patch in a manner satisfactory to the Project Construction Engineer and in accordance with the Contract Documents.

20-2 Asphalt Surface Course

The measurement for payment of this item will be the actual number of square yards per inch of hot mix asphalt surface course, in place, complete, and accepted by the Project Construction Engineer, as required for construction of the proposed improvements in accordance with the Contract Documents; provided, however, no measurement for payment will be made for hot mix asphalt surface course placed in areas not specifically approved by the Project Construction Engineer, nor required due to careless or unauthorized operation by the Contractor.

Unless otherwise directed by the Project Construction Engineer, the hot mix asphalt surface course shall be placed at a minimum of two-inch (2”) thickness and only in the areas indicated within the Contract Documents. This item may be used for work within the trench limits and/or outside the trench limits as indicated within the Contract Documents and as directed by the Project Construction Engineer.

The unit price bid per square yard per inch for hot mix asphalt surface course shall include all of the Contractor’s costs of whatsoever nature for the complete construction of the proposed sewer, appurtenances, street or items otherwise indicated within the Contract Documents. The price bid shall include: obtaining all necessary permits and paying any associated fees; additional milling and/or sawcutting of the existing pavement to ensure a smooth and square joint between existing and new pavement; loading, hauling, and disposal of existing asphalt , all related construction debris and unsuitable materials at the Denver/Arapahoe Disposal Site

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(DADS); recycling of appropriate materials generated during the work; asphalt tack coat; hot mix asphalt, hauling, placing, rolling, and compaction; street sweeping and clean up; traffic control not provided for elsewhere in this Contract Documents; temporary striping as required; QC testing; and all other necessary materials, work, and equipment required for placement of the hot mix asphalt surface course in a manner satisfactory to the Project Construction Engineer and in accordance with the Contract Documents.

20-3 Asphalt Base Course

The measurement for payment of this item will be the actual number of square yards per inch of hot mix asphalt base course, in place, complete, and accepted by the Project Construction Engineer, as required for construction of the proposed improvements in accordance with the Contract Documents; provided, however, no measurement for payment will be made for hot mix asphalt base course placed in areas not specifically approved by the Project Construction Engineer, nor required due to careless or unauthorized operation by the Contractor.

Unless otherwise directed by the Project Construction Engineer, the hot mix asphalt base course paving shall be placed to the depth and only in the areas specified in the Contract Documents. This item may be used for work within the trench limits and/or outside the trench limits as indicated within the Contract Documents and as directed by the Project Construction Engineer.

The unit price bid per square yard per inch of hot mix asphalt base course shall include all of the Contractor's costs of whatsoever nature for the complete construction of the proposed sewer, appurtenances, street or items otherwise indicated within the Contract Documents. The price bid shall include: obtaining all necessary permits and paying any associated fees; saw cutting and/or milling the existing pavement smoothly and squarely in a manner satisfactory to the Project Construction Engineer to assure a smooth joint (ripping and wheel-cutting is not permitted); loading, hauling, removal and disposal of existing asphalt pavement, unsuitable material and excess excavated material at the Denver/Arapahoe Disposal Site (DADS); subgrade preparation, backfilling and compaction to include furnishing, transporting and placement of any additional suitable backfill material required; recycling of appropriate materials generated during the work; asphalt tack coat; hot mix asphalt, hauling, placing, rolling, and compaction; street sweeping and clean up; traffic control not provided for elsewhere in the Contract Documents; temporary striping as required; QC testing; and all other necessary materials, work, and equipment required for placement of the hot mix asphalt base course in a manner satisfactory to the Project Construction Engineer and in accordance with the Contract Documents.

20-4 Asphalt Rotomilling

The measurement for payment of this item will be the actual number of square yards per inch of asphalt or concrete material rotomilled to the depth specified within the Contract Documents or as directed by the Project Construction Engineer to complete the proposed street paving. No measurement for payment will be made for asphalt or concrete rotomilled in areas which are not specifically approved by the Project Construction Engineer, indicated within the Contract Documents or required due to careless or unauthorized operations by the Contractor.

No measurement for payment will be made under this bid item for rotomilling within the designated pipe trench limits or other miscellaneous areas where sewer, appurtenances or associated flatwork are to be constructed. These costs shall be included in the unit price bid for the related pipe, structures, or appurtenances and are provided for elsewhere in the Contract Documents. This pay item will be used to pay for rotomilling required after installation of the proposed sewer and/or appurtenances for milling on either side of the trench limits prior to

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placement of the asphalt base and/or surface course, and as specified within the Contract Documents or as directed by the Project Construction Engineer.

The unit price bid per square yard per inch of rotomill shall include all of the Contractor's work of whatsoever nature for the complete construction as indicated within the Contract Documents. The price bid shall include: obtaining all necessary permits and paying any associated fees; loading; hauling, removal and disposal of unsuitable materials, millings and excess excavated material at the Denver/Arapahoe Disposal Site (DADS) or recycling as appropriate; traffic control not provided for elsewhere in the Contract Documents; street sweeping; surface preparation; and all other necessary materials, work, and equipment required for rotomilling in a manner satisfactory to the Project Construction Engineer and in accordance with the Contract Documents.

20-5 Asphalt Patch

The measurement for payment of this item will be the actual number of square yards per inch thickness of hot mix asphalt used for asphalt patching purposes, complete, in place and accepted by the Project Construction Engineer; provided, however, no measurement for payment will be made for asphalt patching placed in areas not specifically approved by the Project Construction Engineer, or required due to careless or unauthorized operations by the Contractor.

This pay item will be used to pay for asphalt material used outside the limits established in Pay Items 20-2 and 20-3. This pay item will be used to pay for replacement of street paving outside the normal specified limits in areas deemed necessary by the Project Construction Engineer.

The unit price bid per square yard per inch of thickness of hot mix asphalt patching shall include all of the Contractor's costs of whatsoever nature. The price bid shall include: obtaining all necessary permits; paying any associated fees; saw cutting and/or milling the existing pavement smoothly and squarely in a manner satisfactory to the Project Construction Engineer to assure a smooth joint (ripping and wheel-cutting is not permitted); loading, hauling, removal and disposal of existing asphalt pavement, rotomillings, unsuitable material and/or excess excavated material; subgrade preparation, backfilling and compaction of subgrade to include furnishing, transporting and placement of any additional suitable backfill material required; asphaltic tack coat; fresh asphalt hauling, placing, rolling, and compaction; street sweeping and clean up; traffic control not provided for elsewhere in the Contract Documents; temporary striping as required; QC testing; and all other necessary materials, work, and equipment required for placement of the hot mix asphalt trench pavement in a manner satisfactory to the Project Construction Engineer and in accordance with the Contract Documents.

20-6 Placement (Only) For Recycled Asphalt

The measurement for payment of this item will be the actual number of square yards per inch thickness of recycled asphalt pavement placed, complete, in place, and accepted by the Project Construction Engineer, as required for construction of the proposed sewer and/or appurtenances; provided, however, no measurement for payment will be made for recycled asphalt pavement placed in areas not specifically approved by the Project Construction Engineer, or required due to careless or unauthorized operations by the Contractor, or pavement damage caused by the Contractor's equipment or method of operation.

The unit price bid per square yard per inch of recycled asphalt shall include all of the Contractor's costs of whatsoever nature for the complete construction of the proposed sewer, appurtenances, or items otherwise provided for elsewhere in the Contract Documents. The

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price bid shall include: obtaining all necessary permits and paying all associated fees; saw cutting to achieve a smooth joint; asphalt tack coat; asphalt hauling, placement, rolling, and compaction; disposal of unsuitable material; street sweeping and cleanup; and all necessary materials, work, and equipment required to furnish and place the recycled asphalt pavement smoothly and squarely in a manner satisfactory to the Project Construction Engineer in accordance with the Contract Documents.

20-7 Install Asphalt Path

The measurement and payment for this item will be the actual number of square yards per inch thickness of hot mix asphalt placed to the dimensions shown in the Contract Documents or as directed by the Project Construction Engineer, complete, in place, accepted, and as required for construction of the proposed sewer and/or appurtenances; provided, however no measurement for payment will be made for asphalt path placed in areas not specifically approved by the Project Construction Engineer or required due to careless or unauthorized operations by the Contractor.

The unit price bid per square yard per inch of hot mix asphalt shall include all of the Contractor's costs of whatsoever nature for the complete construction of the proposed sewer, appurtenances, or items otherwise provided for elsewhere in the Contract Documents. The price bid shall include: obtaining all necessary permits and paying all associated fees; saw cutting to achieve a straight joint; weed removal, grubbing, subgrade preparation, removal and disposal of unsuitable material and excess excavated material, placement of select subgrade material as necessary, compaction, installation of weed block fabric; asphalt tack coat; asphalt hauling, placement, rolling, and compaction; permanent stripping as required; disposal of unsuitable material; street sweeping and cleanup; and all necessary materials, work, and equipment required to furnish and place the hot mix asphalt path smoothly and squarely in a manner satisfactory to the Project Construction Engineer in accordance with the Contract Documents.

20-8 Asphalt Curb Head

The measurement for payment of this item will be the total number of linear feet of asphalt curb head required to be placed for construction of the proposed sewer and/or appurtenances; provided, however, no measurement for payment for asphalt curb will be made for curb head required to be placed due to negligence or unauthorized operations by the Contractor.

The unit price bid for placement of this item shall include all of the Contractor's costs of whatsoever nature. The price bid shall include: asphalt hauling, placement, rolling, compaction, shaping; excavation, backfilling and compaction; stabilizing the sub base; establishing grade; providing all labor, equipment and materials required to place asphalt curb as required and specified in the Contract Documents; disposal of excess or unsuitable materials including asphalt, concrete, landscaping materials etc; saw cutting, milling; street sweeping and clean up; traffic control not provided for elsewhere in the Contract Documents; asphalt tack coat; replacement and reestablishment of landscaping, sod, seed, irrigation systems and/or any other items impacted during placement of this item; and all other related and necessary materials work and equipment required to place this item in accordance with the Contract Documents or at the direction of the Project Construction Engineer.

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20-9a Saw Cut Asphalt/Concrete (0-150 LF)

The measurement and payment for saw cutting from 0-150 linear feet will be the actual number of linear feet up to 10-inches of depth of asphalt or concrete that is saw cut and accepted; however, no measurement for payment will be made due to negligent or unauthorized operations by the Contractor.

The unit price bid will be the actual number of linear feet of asphalt or concrete that is saw cut to the full depth and shall include all of the Contractor's costs of whatsoever nature. The unit price bid shall include but not be limited to: mobilization, traffic control, surface preparation, clean up and disposal of debris, protection of utilities, street cut and occupancy permits, and all other related and necessary materials, work and equipment required to complete the saw cut as directed by the Construction Project Manager and in accordance with the Contract Documents.

20-9b Saw Cut Asphalt/Concrete (>150 LF)

The measurement and payment for saw cutting distances greater than 150 lineal feet will be the actual number of linear feet up to 10-inches of depth of asphalt or concrete that is saw cut and accepted; however, no measurement for payment will be made due to negligent or unauthorized operations by the Contractor.

The unit price bid will be the actual number of linear feet of asphalt or concrete that is saw cut to the full depth and shall include all of the Contractor's costs of whatsoever nature. The unit price bid shall include but not be limited to: mobilization, traffic control, surface preparation, clean up and disposal of debris, protection of utilities, street cut and occupancy permits, and all other related and necessary materials, work and equipment required to complete the saw cut as directed by the Construction Project Manager and in accordance with the Contract Documents.

21-1 Concrete Pavement

The measurement and payment for this item will be the actual number of square feet of concrete placed and accepted; provided, however, no measurement for payment will be made for concrete pavement outside of the prescribed trench width or other dimensions as shown in the Contract Documents. Pavement required to be replaced due to careless or unauthorized operations by the Contractor will not be included in the amount computed for payment.

All concrete ingredients and additives must be combined and mixed at the batch plant prior to transport. Onsite additions, to the concrete mix, of any type will not be allowed without prior authorization of the Project Construction Engineer.

The unit price bid per square foot of pavement shall include all of the Contractor's costs of whatsoever nature. The price bid shall include: forming, reinforcing chairs or supports as required by the Project Construction Engineer, concrete, reinforcement, doweling; excavation; disposal of unsuitable material; curing compounds; contraction and expansion joints where required by Project Construction Engineer, including partial depth sawcuts; joint sealing compounds; reinforcing as required and specified; concrete additives including, but not limited to; set retarders, accelerators, polypropylene fibrillated fibers, etc. as directed and approved by Project Construction Engineer; finishing and edging; furnishing, transporting, installing, and compaction of all materials required for a stable subbase; removal and disposal of excess

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subgrade materials; QC testing; and all other related and necessary materials, work and equipment required to construct the pavement in accordance with the Contract Documents.

22-1 Earthwork

The measurement and payment for this item will be the total number of square yards of material to be removed and/or filled for construction as shown in the plans. The measurement for payment of this item will be based on the actual surface area within the footprint of the proposed embankment prior to construction activities.

The unit bid price per square yard of earthwork shall include: all labor, equipment, material, subcontractors and incidentals required to perform earthwork as identified within the contract documents; clearing and grubbing; excavation; loading, hauling and disposal of excess excavated material and debris, stockpiling as necessary; hauling, procurement, placement and compaction of embankment materials as required; grading; diversion of water courses and/or dewatering operations as necessary; compaction to specified limits; excavation below the grades shown on plans to remove unsuitable foundation material, replacement of unsuitable foundation materials with suitable select materials; QC testing; and all other materials, work and equipment required to complete the construction in accordance with the contract documents.

27-1 Steel Sheet Piling

The measurement and payment for this item will be the actual number of horizontal lineal feet of steel sheet piling installed, regardless of depth needed, accepted, and left in place (or removed after completion of construction activities) up to one foot above the top of the new sewer pipe and/or appurtenance or the utility being protected. Provided, however, no measurement for payment will be made for steel sheet piling placed due to careless or unauthorized operations by the Contractor.

The unit bid price per linear foot of steel sheet piling shall include all of the Contractor's costs of whatsoever nature. The price bid shall include: placement, excavation, materials, diversion of water courses, welding where required, removal where applicable, backfilling and compaction; cutting of the steel sheeting smoothly and squarely in a manner satisfactory to the Project Construction Engineer.

30-1 Riprap

30-2 Grouted Rip Rap

30-2a Grouted Boulders (2-Foot Diameter)

30-2b Grouted Boulders (3-Foot Diameter)

30-2c Grouted Boulders (5-Foot Diameter)

30-2k Boulder (4-Foot Diameter)

30-2l Boulder (5-Foot Diameter)

30-3 Rock Filled Gabions

30-4 Derrick Stone/Riprap Outfall

The measurement for payment of this item will be the total number of square yards of riprap, soil riprap, grouted riprap, grouted boulders and/or derrick stone, or the total number of boulders, or the total number of tons used for rock filled gabions required to be furnished and

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placed on site for construction of the proposed sewer and/or appurtenances; provided, no measurement for payment will be made for items installed due to careless or unauthorized operations by the Contractor.

The unit price bid per square yard of riprap, soil riprap, grouted riprap, grouted boulders and derrick stone, shall be quantified based on the area of the installed surface directly parallel with the ground. The unit price bid per square yard, per ton, or per boulder shall include: clearing and grubbing; excavation; preparation of bedding/subgrade areas to include over excavation, furnishing, transporting, installing and compaction of all materials required for a stable sub-base and as shown in the details; removal and disposal of excess excavated materials; diversion of water courses and/or dewatering operations as necessary; supply and installation of filter and/or stabilization materials; filter and riprap drains; drain materials; concrete and/or grout; grouting of riprap or boulders; placing of riprap or boulders to the elevations shown on the Contract Documents or as directed by the Project Construction Engineer; mattress units and materials for rock filled gabions; overexcavation and replacement with suitable materials; hauling and placing of all materials; and all other materials, work and equipment required to complete construction in accordance with the Contract Documents.

30-2e 36" Grouted Boulder Edge

30-2f 48" Grouted Boulder Edge

The measurement and payment of this item will be the total linear feet of boulder edge required to be furnished and placed on site for construction of the proposed channel; provided, no measurement for payment will be made for items installed due to careless or unauthorized operations by the Contractor.

The unit price bid per linear foot of boulder edge shall be quantified based on the length of installed boulder along the proposed channel edge. The unit price bid per linear foot of boulder shall include: excavation; preparation of bedding/subgrade areas to include over-excavation as necessary; clearing and grubbing; furnishing, transporting, installing and compaction of all materials (bedding, rip rap, rock, or select fill) required for a stable sub-base and as shown in details; removal and disposal of excess excavated materials; diversion of water courses and/or dewatering operations as necessary placing of boulders to the elevations shown on the Contract Documents or as directed by the Project Construction Engineer; grouting of boulders as shown in the details; installation of weep holes as required; hauling and placing of all materials; and all other materials, work and equipment required to complete construction in accordance with the Contract Documents.

34-2 C-76 RCP

34-3 C-361 RCP

34-4 C-506 ARCH Pipe

34-5 C-507 RCP

34-6.1 Box Culvert - Cast-In-Place

34-6.2 Box Culvert - Precast

34-7.1 PVC Pipe

34-7.2 PVC Slipliner Pipe

34-7.3 PVC Pipe with Steel Casing

34-8.1 HDPE SDR 17 Sewer Pipe By Bursting (PE 345434E)

34-9.1 ASTM A746 D.I. Pipe

34-10.1 Aluminized Steel Pipe

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- 34-10.4 Steel Casing Pipe with Centrifugally Cast Concrete Liner**
- 34-11.1 PVC Pipe by Jacking/Boring With Steel Casing**
- 34-11.2 C-76 RCP, Class V by Jacking**
- 34-11.3 C-361 RCP, Class C By Jacking/Boring**
- 34-11.4 HDPE SDR 17 Sewer Pipe By Jacking/Boring With Steel Casing (PE 345434E)**
- 34-11.5 C-76 RCP, Class III by Jacking/Boring with Steel Casing**

The measurement and payment of each specific size or type of pipe, except segments as may be otherwise provided for in the Contract Documents, will be the actual number of linear feet of sewer pipe installed, complete, in place, as measured along the centerline of the pipe from inside face of manhole to inside face of manhole, from inside face of manhole to given station, from given station to given station, or from center of manhole to center of manhole with deductions made for the internal diameter or dimensions of manholes and/or structures. Where special fittings have been specified and provided for elsewhere in the Contract Documents, deductions will be made for their lengths.

The unit price bid per linear foot for the construction of each section of pipeline shall include all of the Contractor's costs of whatsoever nature for the complete construction of the pipeline, exclusive of manholes, appurtenances, or items otherwise provided for in the Contract Documents. The bid item shall include: trench sloping, benching, bracing, shoring and/or sheeting for pipe and associated appurtenances to assure safe working conditions; design of shoring, stamping and approval by an Engineer licensed in the State of Colorado, submittal as required; furnishing, transporting and installing all pipe and materials; tapping and/or connecting to mainline pipes, structures, stub outs or block outs; concrete coring; plugging of all abandoned lines crossed during construction; furnishing and installing special fittings, including: trash racks, concrete pipe plugs as required, transitional pipe sections required to properly connect different classes of pipe without a manhole or structure and any other special fittings not provided for elsewhere in the Contract Documents; joints and jointing materials, including: grout, mortar, gaskets, seals, bolts, concrete collars, connecting bands, and other miscellaneous items as required to construct the specific pipe joint; saw cutting and/or rotomilling within mainline (B_f extents) and lateral trench extents prior to excavation; removal and disposal of pavement millings, sod, surfacing materials, stumps, brush and unsuitable material prior to excavation; excavation, including exploratory excavation, as required by the Project Construction Engineer; over-excavation to remove unsuitable foundation material and replacement with granular or other approved select materials; constructing the specified bedding including the furnishing, placing, and compaction of sand, gravel and rock as required for class B bedding or approved substitution; supply and installation of protective coatings or wrappings; backfilling to include furnishing, transporting, and placement of any additional suitable backfill material required (except for those classified backfill materials provided for elsewhere in the Contract Documents); compaction and backfilling as specified, no additional or separate payment will be made for excess excavated material used as backfill or select material elsewhere on the project; restoration of ground surface to its original condition; grading and leveling; care and diversion of drainage courses; pumping and provision of facilities for diversion of flows; trench dewatering; protection and adjustment of aboveground and underground utilities and service connections or laterals, including water service reconnections and adjustments; adjustment and reconnection of sanitary sewer services from mainline sewer to a point where proper connection and drainage can be achieved, unless provided for elsewhere in the Contract Documents; removal and replacement of hydrant laterals and assemblies damaged or relocated during crossing; coordination of gas service and electric relocates; crossing of existing and abandoned utilities; cutting and/or plugging of abandoned or crossed lines where indicated in the Contract Documents, or as directed by the Project Construction Engineer; hauling and disposal of construction debris, excess excavated material, damaged materials, unsuitable materials and manifested contaminated materials at

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the Denver Arapahoe Disposal Site (DADS), recycle and salvage of materials as necessary; removal and replacement and/or relocation of signs, and pipe bollards; providing for additional traffic control, to include barricades, detours and flagmen unless provided for elsewhere in the Contract Documents; removal and replacement of all traffic signal and/or activated loops; QC testing for all associated work components; and all other related and necessary materials, labor and equipment required to construct a complete operable pipeline in accordance with the Contract Documents.

In addition to the above, the unit price bid per linear foot for slip lining, bursting, jacking, tunneling, boring and/or micro tunneling shall include the following: installation of jacking, tunneling and/or boring pits and related equipment; launching and access pits; ground stabilization within areas impacted by operations using chemical grout injection or other approved means, all equipment and materials necessary to complete the work; steel joint rings on reinforced concrete pipe; automated spoil transportation systems; hoists; fluids and slurries; signal systems, safety equipment; sealing materials, joint cushions, reaction thrust blocks, grout, sand, casings, skids and end seals as approved by the Project Construction Engineer; filling of all annular spaces; steel casing pipe and welding to create water tight joints and any other necessary labor, equipment and materials; purchase, delivery and installation of all equipment and materials required to install the pipe segment and/or associated casing per the Contract Documents; heating and butt fusion jointing; removal and replacement of existing waterlines, valves, hydrants, vaults, restraints, sod, seeding, sprinkler systems, trees, bushes, shrubs, bike path, curb, gutter, sidewalk, pavement, asphalt base course, asphalt wearing surface, and any other surface restoration and/or removal/replacement required within the areas impacted due to these operations.

34-12.1 4' Diameter Precast Manhole

34-12.2 5' Diameter Precast Manhole

34-12.3 6' Diameter Precast Manhole

The measurement and payment for manholes shall be the total number of individual manholes, complete, in place required for construction of the proposed sewer and /or appurtenances.

The unit price bid per manhole structure shall include all of the Contractor's costs of whatsoever nature. The price bid shall include: furnishing, transporting and installation of all materials, excavation including overexcavation to remove unsuitable foundation material and replacement with suitable material; sheeting and/or bracing; forming; cast-in-place or precast bases; concrete; steel reinforcement; precast barrel sections, flat tops and cones; brick, mortar, plastic joint sealant and grout; manhole steps, rings, cover, cast iron riser rings as specified by the Project Construction Engineer; construction and shaping of the manhole base invert as shown in the standard details, and to incorporate lateral connections and flows into the main channel; water stop gaskets, all boots and bands; cutting and plugging of existing sewer lines as required; reconnection of existing lateral sewer lines to new structure as required, including pipe, couplings and all other materials, equipment and labor required to complete proper reconnection; core drilling into structure as necessary; construction of stub-outs or block-outs; elimination of infiltration; removal and replacement of pavement, base course, sub-base material, sod and other surfacing materials; backfill and compaction; and all other related and necessary materials, work and equipment required to construct the manholes, complete in accordance with the Contract Documents.

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34-12.4 Type B Manhole

34-12.5 Type P Manhole

34-12.6 Outfall Structure

34-12.7 Special Structure

The measurement and payment for cast in place manholes and/or structures shall be the total number of manholes or structures, complete, in place, required for construction of the proposed sewer and/or appurtenances.

The unit price bid per manhole and/or structure shall include all of the Contractor's costs of whatsoever nature. The price bid shall include: furnishing, transporting and installation of all materials, excavation (including overexcavation to remove unsuitable foundation material and replacement with suitable material); sheeting and/or bracing; forming; concrete; steel reinforcement; precast barrel sections, flat tops and cones; brick, mortar, plastic joint sealant and grout; manhole rings, covers and cast iron riser rings as specified by the Project Construction Engineer; construction and shaping of the manhole base invert as shown in the Details and Technical Specifications, and to incorporate lateral connections and flows into the main channel; beveling and shaping of entrance/exit as required; cutting and plugging of existing sewer lines as required; reconnection of existing lateral sewer lines to new structure as required, including pipe, couplings and all other materials, equipment and labor required to complete proper reconnection; core drilling into structure as necessary; construction of stub-outs or block-outs; construction of waterproof joints; installation of water stop gaskets, boots and bands; elimination of infiltration; removal and replacement of pavement, base course, sub-base material, sod, decorative landscaping and other surfacing materials; backfill and compaction; and all other related and necessary materials, work and equipment required to construct the manholes and/or structures, complete, in accordance with the Contract Documents.

34-12.8 Uncover and Raise (Adjust) Manhole

The measurement and payment for this item will be the number of vertical feet of manhole height required to be located, uncovered, and raised for construction of the proposed sewer and/or appurtenances as required in the Contract Documents, by the Project Construction Engineer or as determined via video inspection. Payment will be based upon completion of the work to a manner satisfactory to the Project Construction Engineer and in accordance with the Contract Documents. No measurement for payment will be made for manhole adjustments required due to negligence or unauthorized operations by the Contractor.

The unit bid for completion of this item shall include all of the Contractor's costs of whatsoever nature. The price bid shall include: locating, including electronic sensing if needed; excavation and overexcavation; removal and disposal of unsuitable material and excess excavated materials; backfill with approved materials; compaction; furnishing and transporting of all materials and equipment; cutting or adjusting of the manhole in a manner satisfactory to the Project Construction Engineer; furnishing and placement of concrete, brick, mortar, concrete risers, concrete barrels, flat tops, cones, rings, covers, cast iron risers, plastic joint sealant, grout, manhole steps and all other related and necessary materials, work and equipment required to adjust manholes in accordance with the Contract Documents.

34-12.9 Adjust Utility Lids

The measurement and payment for this item will be the number of utility lids including but not limited to fiber optic, telecommunications, pull boxes, valve boxes, electrical vaults, water vaults, utility manhole lids, etc. required to be uncovered, raised and adjusted to final grade for

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construction of the proposed sewer and/or appurtenances as required in the Contract Documents, or as required by the Project Construction Engineer. Payment will be based upon completion of the work to a manner satisfactory to the Project Construction Engineer and in accordance with the Contract Documents. No measurement for payment will be made for utility lid adjustments required due to negligence or unauthorized operations by the Contractor.

The unit bid for completion of this item shall include all of the Contractor's costs of whatsoever nature. The price bid shall include: locating, including electronic sensing if needed; excavation and overexcavation; removal and disposal of unsuitable material and excess excavated materials; backfill with approved materials; compaction; furnishing and transporting of all materials and equipment; cutting or adjusting of the utility lid in a manner satisfactory to the Project Construction Engineer; furnishing and placement of concrete, brick, mortar, concrete and/or cast iron risers, concrete barrels, flat tops, cones, rings, covers, grout, joint sealants, and all other related and necessary materials, work and equipment required to adjust utility lids in accordance with the Contract Documents.

34-13.1 Pipe Outside Drop

The measurement for payment of this item will be the total number of outside sanitary drops of the specified diameter required for construction of the proposed sewer facilities; provided, however, no measurement for payment will be made for outside drops not approved by the Project Construction Engineer.

The unit price bid per outside drop shall include all of the Contractor's costs of whatsoever nature. The price bid shall include: pipe and fittings, including additional pipe and/or materials necessary to connect the existing sewer to drop; concrete encasement and reinforcement; excavation and backfill; trench supporting; reshaping of inverts and benches to the top of the highest incoming pipe; reconnection of sidelines; forming and steel reinforcement; and all other related and necessary materials, work and equipment required to construct the outside drop in accordance with the Contract Documents.

34-14.1 RCP Precast Bend

34-14.3 RCP Flared End Section with Trash Rack

34-14.4 Concrete Collars

34-14.5 Flap Gate/Storm Control

The measurement for payment of each specific size or type of special fitting shall be the total number of fittings required for construction of the proposed sewer and/or appurtenances.

The price bid per special fitting shall include all of the contractor's costs of whatsoever nature. The price bid shall include: furnishing, transporting and installing all pipe specials and materials; joints and jointing materials; fasteners and tie downs; pipe collars and closures; bolts, grout, mortar, O-rings, connecting bands; excavation and compaction; shoring and backfilling; removal and disposal of unsuitable material and construction debris; adaptable trash racks for flared end sections; flap gates, assembly and installation; and all other related and necessary materials, work and equipment required to furnish and install these items in accordance with the Contract Documents.

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34-15.1 Sewer Tap Location and Verification

The measurement for payment of this item will be the actual number of sewer service connections (sewer taps) required to be located and determined to be active; provided, however, no payment will be made due to negligence or unauthorized operations by the Contractor and only those sections specifically authorized by the Project Construction Engineer shall be measured for payment.

The unit price bid for locating all sewer service connections and verification of active sewer taps shall include all of the Contractor's costs of whatsoever nature for the complete verification and location of each active sewer tap. The price bid shall include: providing 48 hours public notification in advance of the work, furnishing and setting up all equipment required for location and/or verification and digital video and written log documentation of active sewer taps; labor; energy supply required for all equipment; permits and fees; coordination with locators (IUG and/or related utility companies); advance coordination and planning with facility owner to ensure access to mainline sewer; location (vertically and horizontally) and verification of active and capped sewer taps by digging, vacuuming, sensing, electronic locators, televising, dye testing, smoke tracing, and/or any other means necessary to ensure tap location, verification and adequate elevation for connection to sewer main per the Contract Documents; excavation, backfill, compaction; temporary and/or permanent paving; removal and replacement of curb, gutter, sidewalk, sod, sprinkler lines, etc. damaged during location and verification; removal and disposal of unsuitable material and construction debris; and all other related and necessary materials, work, and equipment required to complete this item in accordance with the Contract Documents.

34-15.2 Reconnect Sanitary Sewer Services (Open Cut)

The measurement and payment for each service connection, reconnection and/or adjustment shall be the total number of connections, reconnections and/or adjustments required for construction of the proposed sewer and/or appurtenance.

The price bid for this item of work shall include all of the Contractor's costs of whatsoever nature. The price bid shall include; locating and verifying of service connections unless provided for elsewhere in the Contract Documents; furnishing and installing all pipe, fittings and materials; disconnecting/reconnecting and plugging existing services; plugging all necessary lines; construction of new services from mainline sewer to a point where proper connection and drainage can be achieved; chasing sewer taps from point of crossing or conflict with mainline to a point where proper relocation/reconnection can be attained; removal and replacement of sod, curb, gutter, and pavement outside mainline trench extents and all other surface items within affected areas; crossing of existing and abandoned facilities; excavation and backfill; bedding and compaction; temporary bypass pumping; extension of building sewers where required; loading, hauling and disposal of construction debris, excess excavated material, and contaminated materials at the Denver Arapahoe Disposal Site (DADS); and all other related and necessary materials, work, and equipment required to construct the service connection or reconnection in accordance with the Contract Documents.

34-15.3 Utility Exploratory Investigation

The measurement for payment of this item will be the actual number of field locations or verifications required for construction of the proposed sewer and/or appurtenances as required in the Contract Documents, or as directed by the Project Construction Engineer.

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The unit price bid per location or verification shall include all of the Contractor's costs of whatsoever nature. The price bid shall include: mobilization and furnishing of all equipment required for location or verification of storm , sanitary or any other utility; acquisition of all permits; coordinating and scheduling the work with appropriate locating entities; coordination of this component of the work in a manner that ensures completion of the overall project per the critical path schedule and in accordance with the contract documents, excavation and backfill, including Controlled Low Strength Materials as required; paving ,patching and compaction; location of the utility by digging, vacuuming , sensing, or employment of other methods in utility location and/or verification; and all other related and necessary materials, work, and equipment required for location or verification of the sewer or utility as required in the Contract Documents or as directed by the Project Construction Engineer.

34-16.1 #14 Inlet

34-16.2 Single #16 Inlet

34-16.3 Double #16 Inlet

34-16.4 Triple #16 Inlet

34-16.5 Parking Lot Trench Drain

The measurement for payment of each specific size and/or type of inlet will be the individual structure, complete, in place in accordance with the Contract Documents.

The unit price bid per inlet structure shall include all of the Contractor's costs of whatsoever nature. The price bid shall include: furnishing, transporting, and installing all materials; excavation, including overexcavation to remove unsuitable foundation materials; concrete, pipe collars, reinforcement steel, mortar and grout; manhole lids, rings, covers, grates, frames and curb boxes; open throat construction; galvanized steel rods; manhole steps; concrete ribbed deflectors; backfilling and compaction; removal and replacement of pavement, base coarse, sub-base materials, sod, decorative landscaping and any other surfacing materials; constructing and shaping of the base and invert; replacement of curb, gutter and sidewalk between the transitions as stipulated on the Details; and all other related and necessary materials, work, and equipment required to construct the storm inlet in accordance with the Contract Documents.

34-16.8 Adjust Existing Inlet Structure

The measurement and payment for this bid item will be the actual number of existing inlet structures (excluding flagstone curb head) adjusted. Payment will be based upon completion of the work to a manner satisfactory to the Construction Project Manager and in accordance with the Contract Documents. No measurement for payment will be made for existing inlet structure adjustments due to negligence or unauthorized operations by the Contractor.

The unit price bid will be the actual number of existing inlet structures (Inlet Grates, Frames, Beams, Curb Boxes, etc.), excluding flagstone curb head, adjusted. The unit price bid will include but shall not be limited to: mobilization; raising, lowering, moving, adding and/or removing of concrete, masonry, brick, mortar, concrete risers, inlet grates, plastic joint sealant, grout and all other related and necessary materials, work and equipment required to adjust inlet structures in accordance with the Contract Document; resetting of grates; replacement of curb, gutter and sidewalk between the inlet transitions as stipulated in the Details; traffic control; surface preparation and compaction as necessary; obtaining of a street occupancy permits and street cut permits; locating, including electronic sensing if needed; removal and disposal of construction debris; furnishing and transporting of all materials and equipment; and all other related and necessary materials, work and equipment required for the adjustment of the existing inlet structure.

Measurement and Payment

34-17.1 Pre-Video Inspection of Sewer Pipe

34-17.2 Cleaning of Sanitary Sewer Pipe

34-18.2 Cleaning of Storm Sewer Pipe

The measurement for payment of this item will be the actual number of linear feet of sewer line cleaned and/or pre-video inspected and documented on the log sheet as measured along the centerline of the pipe from center of manhole to center of manhole with deductions made for the diameter of structures and appurtenances. Only those sections specifically authorized by the Project Construction Engineer or noted in the Contract Documents will be measured for payment.

The unit price bid per linear foot of sewer line cleaning and/or pre-video inspection shall include all of the Contractor's costs of whatsoever nature. The price bid shall include: providing 48 hours public notification in advance of the work furnishing and setting up of all equipment, labor, and materials necessary to clean and perform pre-video inspection of the sewer, including an intrinsically safe camera, as necessary; recording all information on USB Plug and Play device (flash drive or hard drive) for review by City; submittal of video in MP4 format and logs in .pdf format, both of which must be submitted in accordance to the naming convention required within the applicable Detail and Technical specification section; Identification and locating of all active and inactive (capped) sewer taps, to include linear footage from center downstream manhole, by dye testing, electronic sensing, smoke tracing or use of any other means necessary to verify the active taps; determination of taps requiring trimming; locating, identifying and reporting structurally deficient pipe sections for replacement or point repair; completion of additional pre-installation inspections and sewer cleaning as necessary prior to CIPP installation; supply energy for all equipment; obtain permits for the inspection and covering any related fees; furnishing and setting up all equipment and labor necessary to clean the sewer; furnishing of water for jetting; removal of all foreign material from the sewer line that will prevent installation of cured in place products; all inspection and cleaning of manholes; by-pass pumping and/or diversion of sewer flows around the section of pipe to be cleaned and to another sewer line accepted by the Project Construction Engineer to receive such bypass; temporary installation of bypass piping under the pavement of cross streets, or raised transitional crossings as may be required per the approved traffic control plan; repaving of street cuts after completion of bypassing; removal and replacement of manhole rings, covers, steps and cone sections as necessary to permit bypassing; storage of cleaning sediment on the job site in containers or other approved methods; maintaining storage during the waiting time for laboratory test results on the sediment; disposal of sediment according to Local, Federal, and State environmental requirements; removal and disposal of unsuitable material and construction debris; and all other related and necessary equipment, work, and materials required to accomplish this item in accordance with the Contract Documents.

34-17.3 Sanitary Sewer By-Pass Pumping

34-18.3 Storm Sewer By-Pass

The measurement for payment of this item will be the actual number of linear feet of sewer line segment to be CIPP lined as measured along the centerline of the pipe from center of manhole to center of manhole, submittal by the Contractor to the Project Manager for review of written by-pass pumping plans included on the MHT map of the proposed bypass pumping including plans for contingency activities in the event of weather changes, equipment malfunction, or other disruptions including providing 48 hours public notification in advance of the work. Only those sections specifically authorized by the Project Construction Engineer will be bypassed and measured for payment.

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The unit price bid per linear foot for this item shall include all of the Contractor's costs of whatsoever nature. The price bid shall include: furnishing and setting up of all equipment, labor, and materials required to pump or divert sewer flows around the section of pipe being lined, repaired, reconstructed, or constructed to another sewer line accepted by the Project Construction Engineer to receive such bypass; supplying of energy required to operate all bypass equipment; temporary installation of bypass piping under the pavement of cross streets, or raised transitional crossings as may be required per the approved traffic control plan; repaving of streets after completion of bypassing; removal and replacement of manhole rings, covers, steps and cone sections as necessary to permit bypassing; cleanup and removal of unsuitable material; and all other related and necessary equipment, work, and materials required to complete the sewage bypassing as required in the Contract Documents or as directed by the Project Construction Engineer.

34-17.4 Cured-in-Place-Pipe

The measurement for payment of this item will be the actual number of linear feet of cured-in-place pipe installed, measured along the centerline of the pipe from center of manhole to center of manhole. Only those sections specifically authorized by the Project Manager or noted in the Contract Documents will be measured for payment.

The unit price bid per linear foot of the Cured-In-Place-Pipe shall include all of the Contractor's costs of whatsoever nature. The price bid shall include, but is not limited to: providing 48 hours public notification in advance of the work, furnishing all equipment, materials, and labor necessary to complete CIPP installation, post-installation inspection video and engineering inspections of the sewer being rehabilitated; use of intrinsically safe equipment as necessary; recording all information on USB Plug and Play device (flash drive or hard drive) for review by City; submittal of video in MP4 format and logs in .pdf format, both of which must be submitted in accordance to the naming convention required within the applicable Detail and Technical specification section; Identification and locating of all active and inactive (capped) sewer taps, to include linear footage from center downstream manhole, by dye testing, electronic sensing, smoke tracing or use of any other means necessary to verify the active taps; completion and submittal of written logs and digital as-constructed drawings; determination of taps requiring trimming; locating, identifying and reporting structurally deficient pipe sections for replacement or point repair, completion of additional pre-installation inspections and sewer cleaning as necessary prior to CIPP installation; supply energy for all equipment; obtain all required permits for CIPP installation, materials used, the inspection and covering any related fees; furnishing and setting up all equipment and labor necessary to clean the sewer; furnishing of water for jetting; providing power for de-rooting equipment and other types of machinery; removal and disposal of all foreign material from the sewer line that will prevent installation of cured in place linings; storage of cleaning sediment on the job site in containers or other approved methods; maintaining storage during the waiting time for laboratory test results on the sediment; disposal of sediment according to Local, Federal, and State environmental requirements; all public information and notifications; attending the weekly construction meeting and any other meeting required by the Project Manager; all inspection and cleaning of manholes; removal and disposal of unsuitable material and construction debris; furnishing and setting up all equipment, materials, and labor necessary for the construction process; furnishing water, steam and energy required for the rehabilitation process; furnishing, installing and applying the Cured-In-Place-Pipe Material; curing the CIPP liner, cutting, trimming and brushing active sewer service connection; hydrophilic water swelling material as needed to prevent infiltration between the CIPP liner and host pipe at each manhole; providing access to the City and County of Denver, or their designee, for the purpose of obtaining samples of installed material for onsite and laboratory

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testing; incidentals referenced in other sections of the Specifications; and all other related and necessary materials, work, and equipment required to complete this item in accordance with the Contract Documents.

34-17.5 Grinding

The measurement for payment of this item will be the actual number of linear feet of sewer line submitted and approved by the Project Manager. It shall be the Contractor's responsibility to notify the Project Manager of pipe segments that require grinding to facilitate CIPP installation. Only those sections specifically designated by the Project Construction Engineer will be ground and measured for payment. Payment for grinding will not be made due to negligence or unauthorized operations by the Contractor.

The unit price bid per linear feet of sewer line grinding shall include all of the Contractor's costs of whatsoever nature. The price bid shall include: providing 48 hours public notification in advance of the work, providing pre and post digital verification video of the specific pipe segments proposed for grinding, removal of roots, protruding objects, chemical deposits, unsuitable material or any other materials as directed by the Project Construction Engineer prior to placement of any liner; grinding via mechanical, chemical or other approved methods; furnishing and setting up of all equipment and labor necessary to inspect the line to be rehabilitated; video inspection of the line to locate and identify live sewer taps and to locate taps that require trimming; recording of the video inspection on tape; removal of all materials from the pipe walls that will prevent the proper installation of cured-in-place or formed-in-place plastic liners; furnishing of water and power for de-rooting equipment; storing of cleaning sediments on the job site in containers or other Federal or locally approved storage methods; maintaining of stored materials during the time required to obtain laboratory tests; transporting of the sediment for disposal to a landfill upon receipt of laboratory tests results showing that all tests meet Federal and local standards for normal disposal, payment of disposal and landfill fees, if the material is being hauled to any site other than Denver/Arapahoe Disposal Site (DADS); cleaning and inspection of manholes; and all other related and necessary materials, work and equipment required to complete this item in accordance with the Contract Documents.

34-17.6a Sanitary Sewer Service Reactivation for CIPP

34-17.6b Storm Sewer Service Reactivation for CIPP

The measurement for payment of this item will be the actual number of sewer service taps required to be reactivated as determined to be active during the pre-video inspection study. No measurement for payment will be made for taps which are opened/reactivated and have not been determined to be active. The Contractor shall accept all responsibility to provide residents, businesses, etc. with an established and reconnected sewer service. No measurement will be made for sewer service reactivations due to negligent or unauthorized operations by the Contractor.

The unit price bid shall include all of the Contractor's costs of whatsoever nature. The price bid shall include: furnishing and setting up of all equipment and labor necessary to locate and reactivate active services; cutting and brushing of CIPP material and linings, coatings and/or coverings required to open active sewer services; removal and disposal of all unsuitable material; providing 48 hours public notification in advance of the work and notifying residents and business upon reactivation; and all other related and necessary materials, work and equipment required to complete this item in accordance with the Contract Documents or at the direction of the Project Construction Engineer.

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34-17.7 Extended Tap Cutting

The measurement and payment for this item will be the actual number of approved extended taps or services that would have to be cut or otherwise repaired for construction of the proposed sewer and or appurtenances. No measurement will be made for extended tap cutting required due to negligent or unauthorized operations by the Contractor.

The unit price bid shall include all of the Contractor's costs of whatsoever nature. The price bid shall include: furnishing of all equipment and labor required to cut the extended tap; cutting of the tap to a smooth and hydraulically functional opening; furnishing of power for all equipment; video-inspection and locating of the extended tap; removal and disposal of materials; and all other related and necessary materials, work and equipment required to complete this item in accordance with the Contract Documents or at the direction of the Project Construction Engineer.

34-17.8 Intrinsically Safe Electrical Equipment

No measurement for payment will be made for any of the work and materials required to accomplish this aspect of the construction project and payment will be based upon the completion of the work in accordance with the Contract Documents.

The areas/extents within the Contract Documents requiring the use of explosion proof equipment shall be determined by the Contractor. Damage and repair to the sanitary system and surrounding areas due to misuse of equipment, faulty equipment or negligence are the responsibility of the Contractor.

The lump sum price bid for Intrinsically Safe Electrical Equipment shall include all of the Contractor's costs of whatsoever nature. The lump sum price bid shall include: furnishing, installing, and activating the camera; all labor of whatsoever nature to the various areas of construction, and all other related and necessary materials, work, and equipment required to accomplish this item in a manner satisfactory to the Project Construction Engineer and in accordance with the Contract Documents.

36-1 Install Railroad Tracks

The measurement for payment of this item will be the actual number of linear feet of railroad tracks constructed, including appurtenances, as shown within the contract documents; provided, however, no payment will be made for track installation outside the project limits or for track installation due to negligence or unauthorized operations by the Contractor. Payment will be based upon each pair of tracks constructed, as measured along the centerline of the newly installed tracks.

The unit price bid per pair of railroad tracks shall include all of the Contractor's costs of whatsoever nature. The linear foot price bid per pair of railroad tracks shall include: all work and materials required to install the tracks per the Governing Railroad Company, contract documents and design criteria; procurement, hauling, delivery and installation of ballast; track hardening; railroad ties; pre-stressed concrete panels; full depth asphalt or concrete paving up to the concrete panels as delineated by the area perpendicular to the length of tracks being replaced and within 25 feet of the centerline of the tracks on each side; joining of rails; fasteners, spikes, special joints; grading the subgrade and special bedding under the tracks; hauling and disposal of all excavated material which is not recyclable to the Denver Arapahoe Disposal site; backfilling and compaction; and all other related and necessary materials, work

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and equipment required for the installation of this item in accordance with the Contract Documents.

40-1 Seeding and Mulching

The measurement and payment for this item will be the total number of square feet of seed, mulch and required soil amendment placed for construction of the proposed sewer and or appurtenances; however, no measurement will be made for seed and mulch placed due to negligent or unauthorized operations by the Contractor.

The unit price bid per square foot of seed and mulch placed shall include all of the Contractor's costs of whatsoever nature. The price bid shall include: furnishing, transporting and placing of seed, mulch, erosion control fabric, blankets or protective coverings; protection and care of stockpiled seed and mulch; preparation, fertilization and soil amendment; furnishing of new seed and mulch of like quality to replace any improperly maintained seed and mulch; watering, raking and rolling the ground surface after placement of seed and mulch; placement of erosion blanket on all slopes greater than 3:1; and all other related and necessary materials, work and equipment required to furnish and place the seed and mulch, complete, in accordance with the Contract Documents.

40-2 Seeding

The measurement and payment for this item will be the total number of square feet of seed to be placed for construction of the proposed sewer and/or appurtenances; however, no measurement for payment will be made for seeding required due to negligent or unauthorized operations by the Contractor.

The unit per square foot of seed placed shall include all of the Contractor's costs of whatsoever nature. The price bid shall include: preparation of soils, ripping and tilling, cleaning, fertilization, leveling to the elevations specified in the Contract Documents; furnishing of seed as specified in the Contract Documents; placing of the seed, wetting, and compaction; erosion control fabric, blankets, or protective coverings as required; watering; reseeding and/or replacement of any improperly maintained seed; and all other related and necessary materials, work, and equipment required to place the seed in accordance with the Contract Documents.

40-3 Sodding

The measurement and payment for this item will be the total number of square feet of sod required to be placed for construction of the proposed sewer and/or appurtenances; provided, however no measurement will be made for sod placed due to negligent or unauthorized operations by the Contractor.

The unit price bid per square foot shall include all of the Contractor's costs of whatsoever nature. The price bid shall include: preparation and cleaning of the ground surface; furnishing of sod as specified in the Contract Documents or to the same quality as the existing sod; replacement of any improperly maintained sod; proper placement of the sod; watering, rolling and compaction; clean up and disposal of unsuitable material; and all other related and necessary materials, work and equipment required to place the sod in accordance with the Contract Documents.

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40-4 Sprinkler System

40-5 Relocate Sprinkler System

The measurement and payment for this item will be the total number of linear feet of sprinkler system required to be placed for construction of the proposed sewer and/or appurtenances; provided, however no measurement will be made for sprinkler placed due to negligent or unauthorized operations by the Contractor.

The unit price bid shall include all of the Contractor's costs of whatsoever nature. The price bid shall include: excavation, furnishing of materials, protection and installing pipework and heads; adjusting heads; backfilling, grading, installing and adjusting valves; and all other related and necessary materials, work, and equipment required to install the sprinkler system in accordance with the Contract Documents or as directed by the Project Construction Engineer.

40-6 Decorative Landscaping

No quantity measurement will be made for any of the work and materials required to remove and replace this item. Payment will be based upon completion of the work in accordance with the Contract Documents; provided, however, no payment will be made for removing and replacing decorative landscaping required to be replaced due to negligent or unauthorized operations by the Contractor.

The lump sum bid price shall include all of the Contractor's costs of whatsoever nature. The price bid shall include: excavation; removal and replacement of concrete, rock; removal and replacement of plants, mulch, support systems and retaining structures; disposal of excess excavated materials; topsoil, fertilizer, water, storage and all other related and necessary materials, work and equipment, required to replace the decorative landscaping in accordance with the Contract Documents.

40-7 Remove Trees (>6" Diameter)

40-8 Remove Bushes

The measurement for payment of this item will be the total number of trees, bushes, shrubs or landscaping units, required to be removed for construction of the proposed sewer as specified in the Contract Documents and directed by the Project Construction Engineer; provided, however, no measurement for payment will be made for items removed which are less than six (6) inches in diameter at a height of one (1) foot above the existing ground.

The unit price bid per tree, bush, shrub or specified landscaping item removal shall include all of the Contractor's costs of whatsoever nature. The price bid shall include: removal of a sufficient length of the root system to insure that the tree, bush, shrub or landscaping unit will not continue to grow; disposal of all materials removed; acquisition of all permits required for removal; backfilling with soil material approved by the Project Construction Engineer; and all other related and necessary materials, work and equipment required to remove trees in accordance with the Contract Documents.

40-9 Remove and Transplant Trees (>6" Diameter)

40-10 Replace Bushes and/or Shrubs

The measurement for payment of this item will be the total number of trees required to be removed and transplanted and/or the total number of shrubs and/or bushes required to be replaced for construction of the proposed sewer; provided, however, no measurement for payment will be made for trees required to be removed and transplanted, or shrubs and/or bushes required to be replaced due to negligent or unauthorized operations by the Contractor.

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The unit price bid per tree removal and transplant or shrub and/or bush replacement shall include all of the Contractor's costs of whatsoever nature. The price bid shall include: removal, storing, planting, replanting or replacing, puddling, backfilling, and all other related and necessary materials, work and equipment required to remove and transplant the tree or replace the shrub and/or bush in accordance with the Contract Documents.

40-11 Replace Green Ash Tree (2" Caliper)

40-12 Replace Tree (>6" Diameter)

The measurement for payment for tree planting or replanting will be the total number of trees required to be placed per plans and due to construction of the proposed sewer; provided, however, no measurement for payment will be made for trees planted due to negligent or unauthorized operations by the Contractor.

The unit price bid per tree placement or replacement shall include all of the Contractor's costs of whatsoever nature. The price bid shall include: removal, storing, replanting or replacing, backfilling, staking and supporting devices; formed wells and/or cages; insulating wrap; protection from animals; watering and care throughout the warranty period; and all other related and necessary materials, work and equipment required to plant and replant the tree in accordance with the Contract Documents.

40-13 Shade Trees (> 2" Caliper)

40-14 Ornamental Trees (> 2" Caliper)

The measurement for payment for tree planting will be the total number of trees required to be placed per plans and due to construction of the work; provided, however, no measurement for payment will be made for trees planted due to negligent or unauthorized operations by the Contractor.

The unit price bid per tree placement shall include all of the Contractor's costs of whatsoever nature. The price bid shall include: delivery, temporary protection, storage, planting, backfilling, staking and temporary support devices; formed wells and/or cages; insulating wrap; protection from animals; watering and care throughout the warranty period; and all other related and necessary materials, work and equipment required to plant the tree in accordance with the Contract Documents.

40-15 Landscape Improvements

No quantity measurement will be made for any of the work and materials required for this item in construction of the proposed landscape and irrigation improvements. Payment will be based upon completion of the work in accordance with the Contract Documents; provided, however, no payment will be made for any work performed due to negligent or unauthorized operations by the Contractor.

The lump sum bid price shall include all of the Contractor's costs of whatsoever nature. The price bid shall include all of the work and equipment, and all other related and necessary materials, required to construct all of the proposed landscape and irrigation improvements shown on the landscape/irrigation plans, in accordance with the Contract Documents.

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41-1 Traffic Control

No quantity measurement will be made for any of the work and materials required to accomplish this aspect of the construction project and payment will be based upon the completion of the work in accordance with the Contract Documents.

The lump sum price for Traffic Control shall include all of the Contractor's costs of whatsoever nature. The lump sum bid price shall include: All coordination with relevant agencies and utility companies; including by-pass pumping plans on the MHT plans submitted to City and County of Denver- Public Works Right of Way Services; furnishing, installing, moving, maintaining and removing all temporary traffic signs, barricades, channeling devices, warning lights, delineators, and any other equipment or personnel as required by the latest revision of the "Manual on Uniform Traffic Control Devices for Streets and Highways", and the requirements set forth by the City and County of Denver, Transportation Engineering Division; all signs, emergency replacements, warning lights, variable message boards, traffic cones, and barricades; approved traffic maintenance plans as required; concrete median barriers as required; lane markings and temporary striping; flagging and notification of property owners; traffic control management; furnishing, installing, adjusting, maintaining and removing all special signs required to direct pedestrians and/or vehicles to businesses or parking facilities disrupted due to construction activities; additional traffic control and safety devices as required by the Project Construction Engineer; and all other related and necessary materials, work, and equipment required to accomplish this item in accordance with the Contract Documents.

At the option of the Project Construction Engineer payment will be made in percentage installments based upon type, location and scope of work in relation to the period of performance.

41-2 Rerouting and Construction of Bike Path

No quantity measurement will be made for any of the work and materials required to accomplish this aspect of the construction project and payment will be based upon the completion of the work in accordance with the Contract Documents.

The lump sum price bid for rerouting and construction of bike paths shall include all of the Contractor's costs of whatsoever nature. The price bid shall include: furnishing, installing, moving, maintaining and removing all temporary traffic signs, barricades, channelization devices, warning lights, delineators, bike path signage and any other equipment or personnel required for safe conductance and detouring of bike path personnel off and around the designated construction zone in a safe and professional manner; construction of safety fence, including placement of concrete barriers; coordination with Parks and/or Traffic personnel; obtaining of necessary permits and paying associated fees; water control; placement of rock or pavement for temporary bike path; and all other related and necessary materials, work, and equipment required to accomplish this item in accordance with the Contract Documents or the direction of the Project Construction Engineer.

At the option of the Project Construction Engineer, one third of the lump sum price for this item may be paid to the Contractor upon satisfactory completion of and/or incorporation of proper controls, the second third may be paid upon fifty percent completion of the work as determined by the percent of work completed on the day of progress payment, and the last third may be paid to the Contractor at the last progress payment or at the discretion of the Project Construction Engineer.

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42-1 Railroad Control

No measurement will be made for any of the work and materials required to accomplish this aspect of the construction project and payment will be based upon the percent completion of the work in accordance with the Contract Documents.

The City and County of Denver will obtain all necessary license agreements and acquire all railroad protective liability insurance policies necessary to complete construction. In the event that the contractor is required to obtain any of these agreements or liability policies, the City and County of Denver will reimburse the contractor for all such costs. Unless noted elsewhere in the Contract Documents, the costs associated with removal and replacement of railroad facilities shall not be the responsibility of the Contractor.

The lump sum price for Railroad Control shall include all of the Contractor's costs of whatsoever nature. The price bid shall include: acquisition of additional insurance required by the railroad company to work within railroad right-of-ways, or as otherwise noted within the license agreement; payment of railroad flagging and inspection fees; detouring, railroad traffic control, as required; furnishing of approved base materials, as required to bring the subgrade up to ballast elevation; adhering to the conditions of permits, easements, and railroad agreements; preparation of submittals required by the railroad and receipt of approvals prior to work, design and stamping by an Engineer licensed in the State of Colorado as necessary; notification of the railroad and the public of proposed work; arrangements with the railroad for use of railroad property not covered under permits, easements, or railroad agreements; coordination with the railroad and its sub tiers for removal and replacement of the track and its related facilities; railroad safety training for all personnel working within the railroad right-of-way; and all other related and necessary materials, work and equipment required to accomplish this item in accordance with the Contract Documents or as directed by the Project Construction Engineer.

At the option of the Project Construction Engineer, one third of the lump sum price for this item may be paid to the Contractor upon satisfactory completion of and/or incorporation of proper controls, the second third may be paid upon fifty percent completion of the work as determined by the percent of work completed on the day of progress payment, and the last third may be paid to the Contractor at the last progress payment or at the discretion of the Project Construction Engineer.

43-1 Storm Water Management

No quantity measurement will be made for any of the work and materials required to accomplish this aspect of the construction project and payment will be based upon the completion of the work in accordance with the Contract Documents.

The lump sum price for Storm Water Management shall include all of the Contractor's costs of whatsoever nature. The price bid shall include: implementing measures per Best Management Practices (BMPs); obtaining all permits and paying any associated fees (i.e. NPDES, etc.); coordination with State and Local agencies as required to setup all required plans for the project; furnishing, installing and removing erosion control materials required by the Contractor's plans; protection of existing flow lines, inlets and manholes; construction and design of special erosion control plans for emergency situations that develop during construction or unexpected weather conditions; providing filter fabric, bales, stakes, rock, filter material, silt fence, gabions, wire mesh, temporary berms, temporary diversions, temporary slope drains, check dams, geotextile protection, sediment traps and basins; clearing and grubbing for placement of planned control features, etc.; flushing, jetting and/or removal of construction debris from existing systems as required by the Project Construction Engineer;

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stabilization of the work area by seeding and/or mulching during and after construction; disposal of work materials; maintenance of all erosion control features and seeded areas, so they function properly during construction; testing of sediment and disposal as required; and all other related and necessary materials, work and equipment required to accomplish this item in accordance with the Contract Documents.

At the option of the Project Construction Engineer, one third of the lump sum price for this item may be paid to the Contractor upon satisfactory completion of and/or incorporation of proper controls, the second third may be paid upon fifty percent completion of the work as determined by the percent of work completed on the day of progress payment and the last third may be paid to the Contractor at the time of final progress payment or at the discretion of the Project Construction Engineer.

44-1 Dewatering

No quantity measurement will be made for any of the work and materials required to accomplish this aspect of the construction project and payment will be based upon the completion of the work in accordance with the Contract Documents.

The lump sum price for dewatering shall include all of the Contractor's costs of whatsoever nature. The price bid shall include: pumping and bypass pumping; furnishing of all equipment and manpower; furnishing and installing erosion control materials; obtaining all required discharge permits and paying associated fees; excavation, haul, backfill; installation of caissons, pump pits, piping and drainage courses; disposal of excess and contaminated water; water testing; and all other related and necessary materials, work and equipment required to accomplish this item in accordance with the Contract Documents.

44-2 Water Treatment

No quantity measurement will be made for any of the work and materials required to accomplish this aspect of the construction project and payment will be based upon the completion of the work in accordance with the Contract Documents

The lump sum price for treatment of contaminated water shall include all of the Contractor's costs of whatsoever nature. The price bid shall include: pumping and bypass pumping; sampling and/or water testing; furnishing of all labor, equipment and materials for treatment of contaminated water on site; furnishing and installing of erosion control materials; obtaining all required discharge permits and paying of associated fees; installation of caissons, pumps, pump pits and drainage courses; disposal of excess and contaminated water; excavation, haul, backfill; and all other related and necessary materials and equipment required to accomplish this item in accordance with the Contract Documents. All work must proceed in a manner that does not delay the project

45-1 CIPP Laboratory Testing

The measurement for payment of this item will be the actual number of laboratory tests required for completion of this project and/or installation of related appurtenances.

The unit price bid shall include all of the Contractor's costs of whatsoever nature. The price bid shall include: coordination with a third party tester, creating the sample, for third party transport to the testing lab; receipt of written results by the Project Construction Engineer; testing of: final CIPP product, sediment removed from sewer line during cleaning, water quality, soils or other types of laboratory tests as required by the Project Construction Engineer; tests shall determine materials composition, concentrations of chemicals, or

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contaminants present, Atterberg soils limits, soil stress, permeability, volatile organic compounds; testing of CIPP pipe as outlined in the Technical Specifications; and all other related and necessary materials, work and equipment required to complete this item in accordance with the Contract Documents and as directed by the Project Construction Engineer.

45-2 Quality Control Testing

No quantity measurement will be made for any of the work and materials required to accomplish this aspect of the construction and payment will be based upon completion of the work in accordance with the Contract Documents. The lump sum price bid shall include the coordination and performance of quality control testing for all facets of the Work in accordance with the City's Frequency of Testing standards.

The lump sum price for Quality Control Testing shall include all of the Contractor's costs of whatsoever nature. The price bid shall include: procurement and payment of professional services; testing of: soils, asphalt, concrete and any materials incorporated into the work (bedding, controlled low strength materials, select or imported fill, etc.) in accordance with the Contract Documents; coordination and scheduling of testing; travel to and from work site; additional testing by the Contractor for its own use; re-testing of work components (backfill, concrete used in structures, etc.) as necessary to ensure conformance with Contract Documents, re-testing of work components due to failing QA test results by owner; delivery and transport to testing lab; furnishing of written results to the Project Construction Engineer; and all other related and necessary materials, work and equipment required to complete this item in accordance with the Contract Documents and as directed by the Project Construction Engineer.

At the option of the Project Construction Engineer, one quarter of the lump sum price for quality control testing may be paid to the Contractor at the time of the first monthly progress payment, the second quarter may be paid at the time of the second monthly progress payment, and the third quarter may be paid to the Contractor at the time of the third monthly progress payment, or at the discretion of the Project Construction Engineer. The total payment for this bid item shall not exceed seventy-five percent (75%) of the lump sum price during construction. The remaining twenty-five percent (25%) shall be paid after substantial completion of the work and only after all project testing and/or results have been completed and/or provided for project recordation. Any costs paid by the City which are the result of retesting previously failing QA events may be deducted from the Contractor's payment, as applicable and as determined by the Project Construction Engineer.

46-1 Pavement Marking (Paint)

46-2 Epoxy Pavement Marking

46-3 Thermoplastic Pavement Marking

46-4 Preformed Plastic Pavement Marking

46-5 Pavement Marking Tape

The measurement for payment of this item will be the total number of gallons, linear feet or square feet of pavement marking material required to accomplish this aspect of the construction

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and payment will be based upon completion of the work in accordance with the Contract Documents.

The unit price per gallon, per linear foot, or per square foot shall include all of the Contractor's costs of whatsoever nature. The price bid shall include: pavement marking plans when required, furnishing of paint, marking tape, thermoplastic and methyl methacrylate materials, furnishing of all equipment required for application of all pavement marking materials, sandblasting and high pressure cleaning to remove all dirt, laitance, and curing compound residues, and all other related and necessary materials, work and equipment for pavement marking as required in the Contract Documents or as required by the Project Construction Engineer.

47-1 Construction Surveying

No quantity measurement will be made for any of the work or materials required to accomplish this aspect of the construction project and payment will be based upon the completion of the work in accordance with the Contract Documents.

The lump sum cost shall include all of the Contractor's cost of whatsoever nature. The price bid shall include: construction surveying and staking; boundary staking; re-staking as necessary during construction; maintenance and submittal of as-built records, red-lined drawings, final survey and recordation, and prints necessary for the creation of as-built documents for all elements of the project to the Construction Project Manager ; elevation/survey checks as requested by the City during construction; verification of all survey control points, City of Denver range points, section corners and benchmarks prior to starting work; submittal of required items to the City Survey per the specifications; traffic control required to perform work under this bid item; and all other related and necessary materials, work and equipment required to accomplish this item in accordance with the Contract Documents.

All work performed within this bid item shall be done under the supervision of a Professional Land Surveyor (PLS) or Professional Engineer (PE) who is experienced and competent in storm sewer construction, sanitary sewer construction and roadway construction surveying and is licensed in the State of Colorado.

At the option of the Project Construction Engineer, one quarter of the lump sum price for Construction Surveying may be paid to the Contractor at the time of the first monthly progress payment, the second quarter may be paid to the Contractor at the time of the second monthly progress payment, and the third quarter may be paid to the Contractor at the time of the third monthly progress payment, or at the discretion of the Construction Project Manager. The total payment for this bid item shall not exceed seventy-five percent (75%) of the lump sum price during construction. The remaining twenty-five percent (25%) shall be paid after submittal of final survey and recordation documents to the Construction Project Manager for creation of as-built drawings.

47-2 Survey Monumentation

The measurement and payment of this item will be the total number of survey monuments removed and replaced for construction of the proposed sewer and/or appurtenances as indicated within the contract documents; provided, however, no measurement for payment will be made for survey monumentation required due to careless or unauthorized operations by the Contractor. No measurement will be made for locating survey monuments, preserving and referencing monuments within the project limits.

Measurement and Payment

The unit price bid shall include all of the Contractor's costs of whatsoever nature. The price bid shall include: record searches and research; locating, preserving, referencing, adjusting, installing and/or restoring survey monumentation as described within the contract documents; the preparation and depositing of monument tie-out sheets and final monumentation diagram; traffic control required to perform work under this bid item; construction survey checklists, equipment calibrations; monumentation related survey records; and all other related and necessary materials, work and equipment required to accomplish this item in accordance with the Contract Documents.

All work performed within this bid item shall be done under the supervision of a Professional Land Surveyor (PLS) who is experienced and competent in storm sewer construction, sanitary sewer construction, roadway construction surveying, boundary surveying and is licensed in the State of Colorado.

50-1 Mobilization

No quantity measurement will be made for any of the work and materials required to accomplish this aspect of the construction project and payment will be based upon the completion of the work in accordance with the Contract Documents

The lump sum cost shall include all of the Contractor's costs of whatsoever nature. The price bid shall include: mobilization and demobilization to the site or sites defined within the contract documents, multiple mobilizations and demobilizations to accommodate construction moratoriums, events, schools, and/or special circumstances outlined in the Contract Documents; transporting all equipment and materials; temporary sanitary facilities; complete setup, removal, repair, coordination and payment of fees associated with temporary staging facilities; project signs; obtaining groundwater discharge permits and all additional permits required by state and local agencies to complete any facet of the work; fugitive dust control in accordance with D.R.M.C. Title II Chapter 4 Sec. 4-25 throughout entire project duration, development of fugitive particulate control plans as required and street sweeping and site cleanup as necessary; loading, hauling and disposal of all construction related debris and excess excavated material not provided for elsewhere in the Contract Documents; advance coordination, notification and scheduling with City and County of Denver agencies, all affected utility companies, railroads, businesses, and homeowners; scheduling of work to accommodate residents, business owners and special circumstances encountered during construction and/or as indicated in the Contract Documents; night and weekend work as necessary; any labor of whatsoever nature required in various areas of construction site as necessary to complete the work in accordance with the Contract Documents.

At the option of the Project Construction Engineer, payment may be made in percentage installments based upon type, location and scope of work in relation to the period of performance. . The total payment for this bid item shall not exceed seventy-five percent (75%) of the lump sum price during construction. The remaining twenty-five percent (25%) shall be paid after final site cleanup, completion of all punch list items and demobilization from site.

50-1a Emergency Mobilization

No quantity measurement will be made for any of the work and materials required to accomplish this aspect of the construction and payment will be based upon the completion of

Measurement and Payment

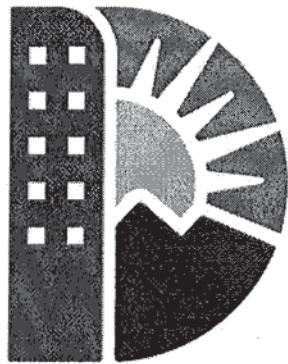
the work in accordance with the Contract Documents. The required time for mobilization to site shall be five (5) hours from official written notification.

The measurement for payment of this item will be the actual number of emergency mobilizations required to complete the work in accordance with the Contract Documents and shall include all of the Contractor's costs of whatsoever nature. Each individual site response officially requested by the Construction Project Manager shall be considered one emergency mobilization. The price bid shall include: emergency mobilization; demobilization; transporting all equipment and materials; temporary sanitary facilities; complete setup, removal, repair, coordination and payment of fees associated with temporary staging facilities; obtaining groundwater discharge permits and all additional permits required by state and local agencies to complete any facet of the work; fugitive dust control in accordance with D.R.M.C. Title II Chapter 4 Sec. 4-25 throughout entire project duration, development of fugitive particulate control plans as required and street sweeping and site cleanup as necessary; loading, hauling and disposal of all construction related debris and excess excavated material not provided for elsewhere in the Contract Documents; advance coordination and scheduling with all affected utility companies, railroads, businesses, and homeowners, night and weekend work as necessary; any labor of whatsoever nature required in various areas of construction site as necessary to complete the work in accordance with the Contract Documents.

END OF MEASUREMENT AND PAYMENT

CITY AND COUNTY OF DENVER

STATE OF COLORADO



DENVER[®]
THE MILE HIGH CITY

SECTION III

**DEPT OF ENVIRONMENTAL HEALTH
PHASE 1 SITE ASSESSMENT**

Contract No. 201207767

IOWA AVENUE EXTENSION PHASE 1

September 18, 2012



DENVER
THE MILE HIGH CITY

Department of Environmental Health

Division of Environmental Quality
200 W. 14th Ave, Dept. 310

Denver, CO 80204

p: 720-865-5452

f: 720-865-5534

www.denvergov.org/deh

INTEROFFICE MEMORANDUM

TO: Beverly Van Slyke, Public Works
FROM: Rebecca Myers, Environmental Quality
DATE: May 18, 2010
SUBJECT: Iowa Ave. Extension (Environmental Quality No. 20105038)

At your request, Denver Department of Environmental Health, Division of Environmental Quality (EQ) conducted a limited environmental review of the Iowa Ave. Extension (Site), see Figure 1.

Executive Summary and Recommendations

Based on available information, it is EQ's opinion that the Site is not a likely source of petroleum or hazardous waste contamination or other environmental concerns that would negatively impact its acquisition with the following exceptions:

- Diamond Shamrock located at 1696 S. Broadway has an open Leaking Underground Storage Tank (LUST) that is being remediated and may contribute to soil or groundwater contamination in nearby locations. OPS notes that groundwater and soil have been impacted. If petroleum hydrocarbons are encountered EQ can assist with disposal of impacted material. EQ recommends that a material management plan (MMP) be developed that describes management and disposition of contaminated environmental media. EQ can prepare the MMP if requested.

Project Description

This evaluation was performed to obtain information that would indicate or identify recognized environmental conditions in connection with the Site. The scope of the evaluation consisted of the following tasks:

- Review of City and County of Denver Historical Landfill database (Pinyon 1997);
- Review of historical aerial photographs (1933, 1995, 2000, 2002, 2004, 2006 and 2008);
- Review of county, state and federal lists of known potential hazardous waste sites or landfills, and sites currently under investigation for environmental violations, including any registered underground storage tanks (FirstSearch report run May 14, 2010);

- Review of available Sanborn® Fire Insurance Maps which document historical land uses of the Site and surrounding area (1890, 1897, 1904, 1925, 1929, 1951, 1956, 1958, 1961, 1967);
- Review of reverse City Directories (1965, 1970, 1976, 1980, 1985, 1990, 1995, 1998);
- Site visit (May 18, 2010); and
- Preparation of this memorandum to present a summary of the findings.

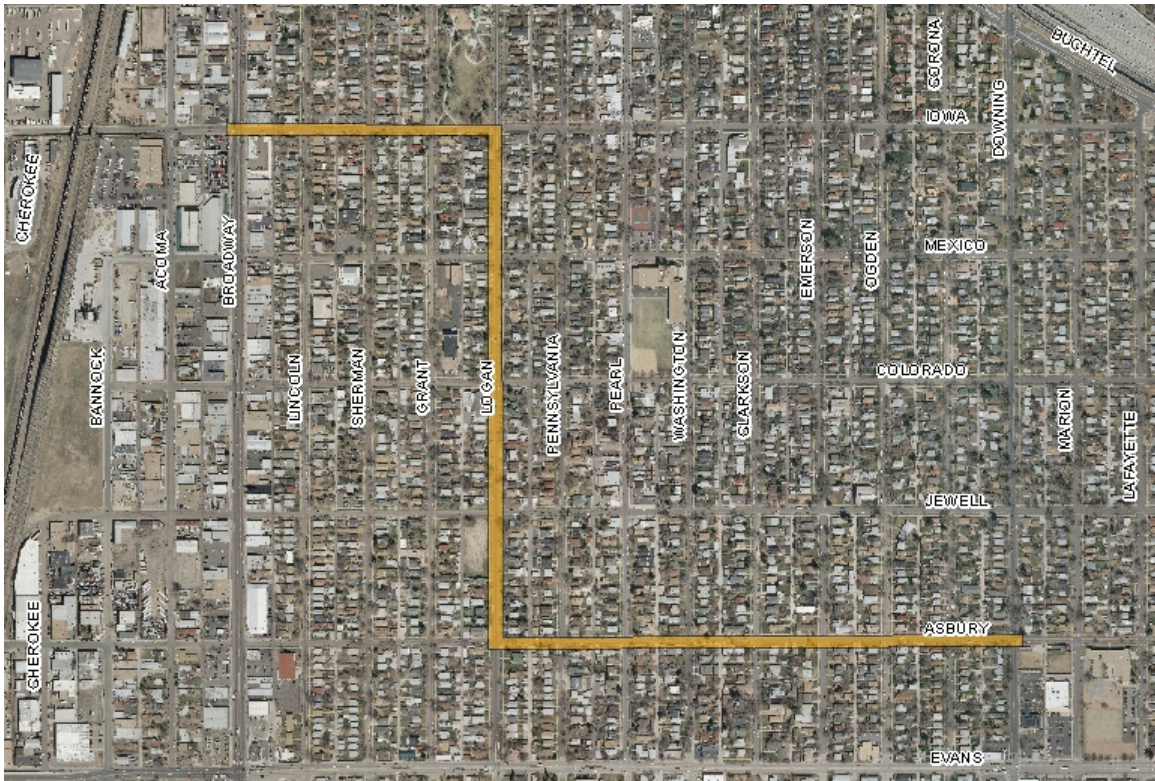


Figure 1. Site

Findings

Historical Occupants.

Historical use of the Site was evaluated through a review of available aerial photographs, Sanborn® Fire Insurance Maps, reverse city directories and database searches.

Available aerial photographs dated from 1933 indicate that the Site was originally developed with residential housing which is still present.

Available Sanborn® Fire Insurance Maps indicate that the Site had been developed as residential since before 1904.

Available reverse city directories indicate that a 7-Eleven has been present at 1585 S. Broadway since before 1985 but after 1980.

Current Conditions

Rebecca Myers of EQ conducted a site visit on May 18, 2010, and no recognized environmental conditions were identified.

On May 14, 2010, EQ performed a regulatory database search for the Site, which included known underground storage tanks (USTs); landfills and hazardous waste generation or treatment, storage and disposal (TSD) facilities. The specific database search distances from the Site consisted of the following:

- 0.25-mile radius for registered USTs and Resource Conservation and Recovery Act (RCRA) generators.
- 0.50 mile radius for leaking USTs (LUSTs), Resource Conservation and Recovery Information System (RCRIS) -TSD and Comprehensive Environmental Response, Compensation and Liability Information System (CERCLIS) sites.
- 1.0 mile radius for Corrective Action, state and federal Superfund sites.

Based on results of the regulatory database search EQ identified the following environmental issues that were up gradient of the Site and could likely impact the Site:

- Diamond Shamrock located at 1696 S. Broadway has an open Leaking Underground Storage Tank (LUST) that is being remediated and may contribute to soil or groundwater contamination in nearby locations. OPS notes that groundwater and soil have been impacted. LUST. If petroleum hydrocarbons are encountered EQ can assist with disposal of impacted material.

The following LUSTs are considered historical recognized environmental conditions because of their closed status:

- 7-Eleven located at 1585 S. Broadway
- Frohlick Crane Services located at 1595 S. Acoma St.
- PacWest Development located at 1658 S. Broadway
- Kennedy Property located at 55 E. Mexico Ave.
- Sales Oil Co located at 1900 S. Pearl St.
- Vickers located at 1696 S. Broadway
- S. Broadway located at 1490 S. Broadway
- Dependable Cleaners located at 1701 S. Broadway
- Grant Middle School located at 1751 S. Washington St.
- John Bellio located at 310 W. Iowa Ave.
- Denver Lumber Company located at 1490 S. Cherokee St.
- Foreign Motor Co. located at 1790 S. Broadway
- Flanagan Ready Mix Bannock Plant located at 1751 S. Bannock St.

Because of the potential to encounter contaminated soil EQ recommends that MMP be developed that describes management and disposition of contaminated environmental media. EQ can prepare the MMP if requested.

Regional groundwater is shallow, approximately 17 feet below ground surface, and flows to the southeast.

Limitations

The limited scope of this environmental review must be understood. Future regulatory changes, agency interpretations, and/or concepts of due diligence industry standards are beyond the control of EQ.

EQ's objective is to perform our work with care, exercising the customary skill and competence of Environmental Site Assessment professionals in the relevant disciplines. The opinions presented herein apply to subject property conditions existing at the time of our investigation and those reasonably foreseeable. EQ does not warrant or guarantee the subject property suitable for any particular use or purpose, or certify that the subject property is "clean".

As with any environmental concern, Denver's Department of Environmental Health, Division of Environmental Quality is available to advise all city agencies and is pleased to be of service. If you have any questions or concerns that you would like to discuss regarding this limited site assessment, please telephone Rebecca Myers (720-865-5422).

CITY AND COUNTY OF DENVER

STATE OF COLORADO



**SECTION IV
DENVER WATER
APPLICATION
Contract No. 201207767**

IOWA AVENUE EXTENSION PHASE 1

September 18, 2012

Application for Main Extension

Water Line Contractor ("Applicant"): _____

Address: _____

Telephone () _____ Email: _____

Fax () _____

Property Owner: City and County of Denver

Address: _____

Telephone () _____ Email: _____

For and in consideration of the approval of this Application for Main Extension ("Application") by the City and County of Denver, acting by and through its Board of Water Commissioners ("Board"), the Applicant agrees:

1. The above identified main and its appurtenances shall be installed pursuant to [Project ID] and in conformance with the Board's Operating Rules and Engineering Standards, as amended from time to time.
2. The Applicant hereby agrees that it shall be responsible for a period of one (1) year subsequent to completion of the construction of the main extension for the correction, whether by repair or replacement, to the Board's satisfaction of all work and materials furnished by the Applicant which are found to be defective or of poor workmanship with all costs and expenses for such work to be borne by the Applicant.
3. The Applicant hereby agrees that any work, whether performed by the Applicant or by the Board in the event of the refusal or inability of the Applicant to timely perform the work during the above one (1) year period, shall not impair or void the Applicant's general warranty of materials and workmanship or any obligation or liability of the Applicant imposed by law or contract.
4. The Applicant agrees to post a **maintenance bond** in the amount of \$5,000.00 to indemnify and hold harmless the Board by reason of any defect in the materials or workmanship related to the work performed pursuant to this Application. The Applicant further agrees that the obligation imposed under the maintenance bond shall not be impaired or made void, notwithstanding that the Applicant may be required by the Board to perform any work for any reason or cause upon the facilities constructed hereunder, or if the Board performs such work upon the refusal or inability of the Applicant to perform the required work.
5. In order that the Board may account for the main extension and appurtenances, the Applicant shall provide all information required by the Board relative to the cost of installation, location and type of materials related to the main extension, in such manner as may be required by the Board.
6. No work shall be performed on the main extension except by contractors duly pre-qualified and bonded by the Board, and without having notified and afforded the Board adequate opportunity to inspect said work. Additional inspection costs for work outside normal Board hours will be the Applicant's responsibility.
7. It is expressly understood and agreed that the main extension and its appurtenances shall automatically convey to the Board one (1) year from the date of acceptance by the Board. Transfer of all right, title and interest in the main extension and its appurtenances to the Board shall be automatic and self-executing, with no additional transfer proceedings or documents being necessary.
8. All work to be performed by the Applicant shall be without cost to the Board, except as provided in this Application.
9. The obligations and benefits of this Application shall be binding upon and inure to the heirs, successors and assigns, of the parties.

10. This Application is made under and conformable to the provisions of the Article X of Charter of the City and County of Denver which control the operations of the Denver Municipal Water System. Insofar as applicable, said provisions are incorporated herein and made a part hereof and shall supersede any apparently conflicting provisions otherwise contained in this Agreement.

11. The parties understand and agree that the Board is relying upon, and has not waived, the monetary limitations and all other rights, immunities and protection provided by the Colorado Governmental Immunity Act, C.R.S.24-10-101, et. seq.

THIS APPLICATION IS SUBMITTED BY:

APPLICANT

By execution, signer certifies that s/he is authorized to accept and bind Applicant to the terms of this Application.

By: _____

Date _____

Title: _____

[for other than individual]

APPLICANT'S SIGNATURE MUST BE NOTARIZED BELOW:

STATE OF _____)

) ss.

COUNTY OF _____)

The foregoing instrument was acknowledged before me this ____ day of _____, _____, by _____, City and County of Denver.

Witness my hand and official seal. My commission expires: _____

(SEAL)

Notary Public

APPROVED:

THE CITY AND COUNTY OF DENVER,
acting by and through its
BOARD OF WATER COMMISSIONERS

By: _____
Sales Administrator

By: _____
Distribution Engineering Supervisor

DATE: _____

IOWA AVE EXTENSION - WATER SVC LINE REVIEW, #16317

Plan Review Checklist for Main Extension
(Items required prior to approval of plans)

Item	Received?	Received By	Date Received	Item Details
Main Extension Agreement	No			
Filing Fees	Yes		02/10/2012	not required per MOU with C&C
Inspection Fee	No			Less than 300 feet of pipe, the \$900.00 minimum fee applies.
Reproduction Fees	Yes		02/10/2012	not required per MOU with C&C
Acknowledgment Letter	No			
Blue Prints with P. E. Stamp and Signature	No			
AutoCad Design files	No			
Water Line Contractor's \$5,000.00 Maintenance Bond	No			Specific to the construction site. Include Project ID number or Project Name on the Bond.
Water Line Contractor's Certificate of Insurance	No			Denver Water must be listed as additionally insured. Include project ID number or Project Name on insurance certificate.
Water Line Contractor's Proof of Workmen's Compensation Insurance	No			
Other	No			List of addresses of service lines to be converted from corp to meter.

CITY AND COUNTY OF DENVER

STATE OF COLORADO



DEPARTMENT OF PUBLIC WORKS / WASTEWATER
MANAGEMENT DIVISION

Drawings

Contract No. 201207767

IOWA AVENUE EXTENSION PHASE 1

September 18, 2012

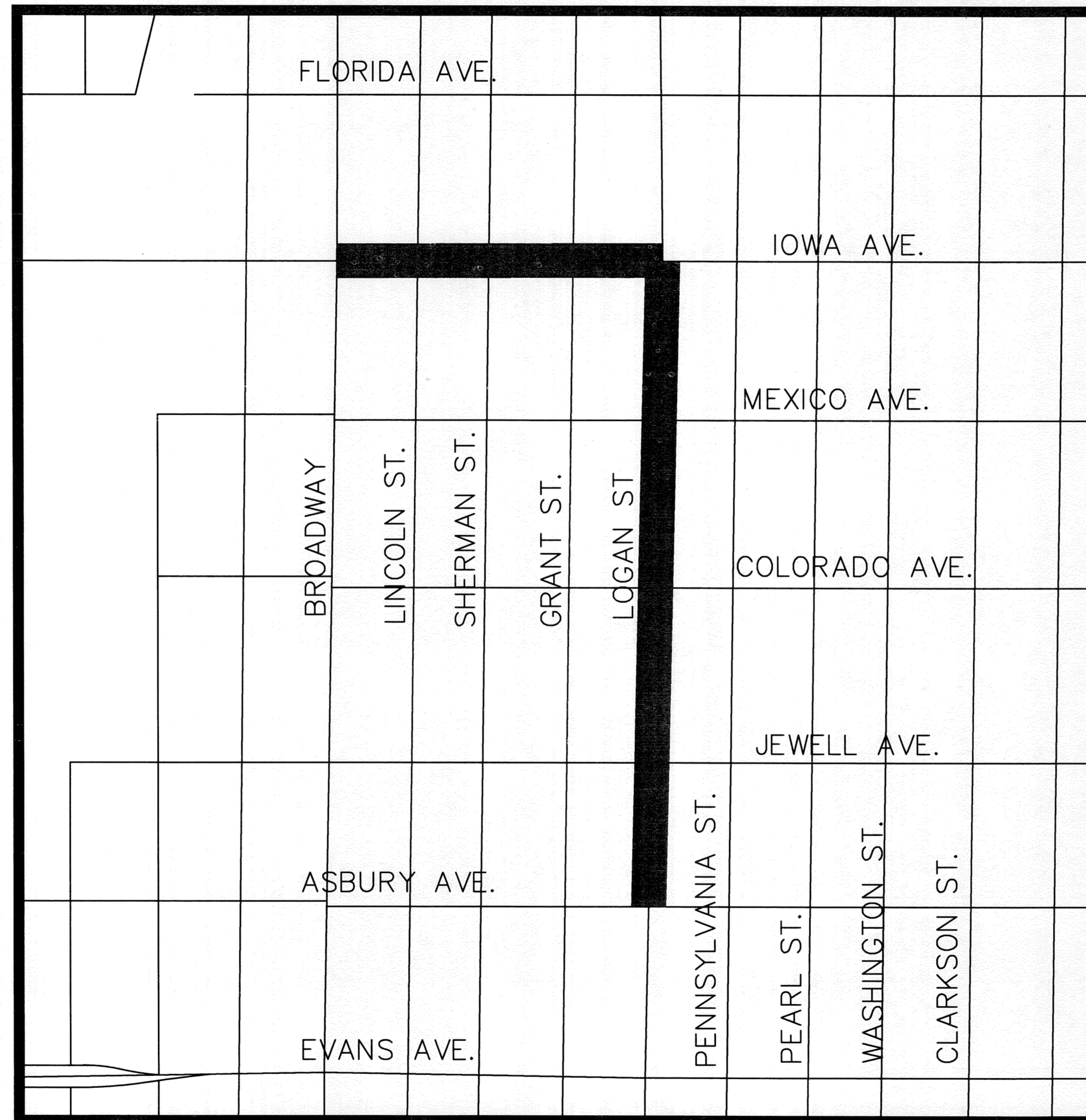
CITY AND COUNTY OF DENVER

DEPARTMENT OF PUBLIC WORKS ENGINEERING DIVISION

WASTEWATER CAPITAL PROJECTS MANAGEMENT

IOWA AVENUE EXTENSION - PHASE 1

CONTRACT CONTROL NO. _____
 PCO TRACKING NO. PWC2010-5203
 PILAR NO. 2010-0225-01



VICINITY MAP
N.T.S

SHEET NUMBER AND INDEX OF SHEETS	
SHEET NO.	CONSTRUCTION PLANS
1	COVER SHEET
2	GENERAL NOTES
3-4	SURVEY CONTROL PLAN
5-6	EXISTING CONDITIONS
7-10	STORM SEWER PLAN & PROFILE
11-12	STORM SEWER LATERAL PROFILES
13-14	PAVING PLAN
15	TRAFFIC CONTROL COORDINATION PLAN
SHEET NO.	WATER ONLY PLANS
1	COVER SHEET
2	WATER NOTES
3	WATER SERVICES PLAN
4	WATER SERVICES PLAN
5	WATER SERVICES PLAN

CITY OF COUNTY OF DENVER
DEPARTMENT OF PUBLIC WORKS

APPROVED BY:

Luciano Starnan _____ 8-13-12
MANAGER OF PUBLIC WORKS DATE

Luciano Starnan _____ 8-13-12
CITY ENGINEER DATE

[Signature] _____ 8/13/12
DIRECTOR OF ENGINEERING CAPITAL PROJECTS DATE

B. L. M. H. L. _____ 8-15-12
CITY TRAFFIC ENGINEER DATE

Janet Robinson for Chris Martiney _____ 8-13-12
DIRECTOR OF SMALL BUSINESS OPPORTUNITY DATE

No.	Description of Revisions	Date Initial
1	50% Review	1/20/04 BJP
2	95% Review	1/15/10 BJP
3	100% Review	5/03/10 BJP
4	BID DOCUMENTS	9/10/12 BJJ
City and County of Denver Department of Public Works Engineering Division Wastewater Capital Projects Management 2000 W. 3rd Ave. Denver, Colorado 80223 Telephone: (303) 446-3617 Fax: (303) 446-3647		
IOWA AVENUE EXTENSION - PHASE 1 COVER SHEET		
Checked by:	CAW	BJP
Approved by:	MJM	BJP
Designed by:	Merrick Project: 0301579809	WMD Project No.: PWC2010-5203
Date:	9/10/12	
Sheet Name:	CVRO1	
Sheet No:	01	



GENERAL NOTES:

- CONTRACTORS PERFORMING WORK ON ANY WASTEWATER FACILITY OR APPURTENANCE MUST BE PROPERLY LICENSED AND HAVE A LICENSED PLUMBER OR DRAINLAYER ON SITE DURING THE WORK.
- THE MOST RECENT EDITION OF THE WASTEWATER MANAGEMENT DIVISION STANDARD DETAILS AND TECHNICAL SPECIFICATIONS APPLY TO ALL WORK. THE CONTRACTOR MUST BE IN POSSESSION OF THE STANDARD DETAILS AND TECHNICAL SPECIFICATIONS AT THE PRE-CONSTRUCTION CONFERENCE AND A COPY MUST REMAIN ON THE JOB SITE AT ALL TIMES DURING CONSTRUCTION. WASTEWATER MANAGEMENT DIVISION STANDARD DETAILS AND TECHNICAL SPECIFICATIONS CAN BE VIEWED AT THE FOLLOWING WEBSITE ADDRESS: WWW.DENVERGOV.ORG.
 --TYPE PUBLIC WORKS INTO THE SEARCH BOX (TOP RIGHT OF PAGE).
 --SELECT DIVISIONS AND AGENCIES.
 --UNDER ENGINEERING DIVISION, SELECT CAPITAL PROJECTS MANAGEMENT.
 --ON THE RIGHT SIDE UNDER RELATED LINKS CLICK ON WASTEWATER CAPITAL PROJECTS.
 --SELECT CONSTRUCTION DETAIL AND TECHNICAL SPECIFICATIONS.
 THE MOST RECENT EDITION OF THE CITY AND COUNTY OF DENVER'S TRANSPORTATION STANDARDS AND DETAILS FOR THE ENGINEERING DIVISION SHOULD BE FOLLOWED FOR ALL ROADWAY WORK IN THE PLAN SET.
 --TYPE TRANSPORTATION DETAILS INTO THE SEARCH BOX (TOP RIGHT OF PAGE).
 --SELECT TRANSPORTATION STANDARDS AND DETAILS - CITY AND COUNTY OF DENVER.
- THE CONSTRUCTION ACTIVITIES STORMWATER DISCHARGE PERMITS (STATE AND LOCAL), STREET-CUT PERMIT, AND STREET OCCUPANCY PERMIT (INCLUDING THE ASSOCIATED TRAFFIC CONTROL PLANS) ARE REQUIRED AND IT IS THE CONTRACTOR'S RESPONSIBILITY TO OBTAIN ALL OF THESE PERMITS. APPROVED COPIES OF ALL REQUIRED PERMITS MUST BE SUBMITTED TO THE PROJECT CONSTRUCTION ENGINEER PRIOR TO THE START OF CONSTRUCTION.
- A PARKS AND RECREATION PERMIT WILL BE REQUIRED FOR ANY WORK OR OCCUPANCY OF PARK LAND. THIS INCLUDES BUT IS NOT LIMITED TO: DESIGNATED CITY PARKS, PARKWAYS, OPEN SPACE, TRAILS AND BIKE PATHS. THE CONTRACTOR WILL BE RESPONSIBLE FOR ALL MAINTENANCE OF PARKS FACILITIES AFFECTED BY CONSTRUCTION ACTIVITIES. THIS INCLUDES BUT IS NOT LIMITED TO THE MAINTENANCE AND IRRIGATION OF LANDSCAPING ITEMS OUTSIDE OF THE WORK AREA WHICH ARE DISCONNECTED FROM SERVICE DUE TO CONSTRUCTION OPERATIONS. ALL COST FOR THIS WORK SHALL BE INCLUDED WITHIN ASSOCIATED BID ITEMS AND NO ADDITIONAL PAYMENT WILL BE MADE.
- ALL DESIGN DRAWINGS PROVIDED AS PART OF THIS CONTRACT ARE FORMATTED FOR PRINTING FULL SIZE, ON STANDARD 22 X 34 INCH (ANSI D) PAPER SIZE AND TO HALF-SIZE (AND SCALE WHERE APPROPRIATE) ON STANDARD 11 X 17 PAPER SIZE. IT IS THE USER'S RESPONSIBILITY TO ENSURE THAT HARD COPIES OF PLANS UTILIZED FOR BIDDING OR CONSTRUCTION ARE PRINTED ON THE PROPER MEDIA SIZE AND THAT SCALES PROVIDED WITHIN THE DRAWINGS ARE CORRECTLY INTERPRETED.
- "RED-LINED" DRAWINGS AND PRINTS ARE TO BE MAINTAINED BY THE CONTRACTOR AND SUBMITTED TO THE PROJECT CONSTRUCTION ENGINEER AT THE COMPLETION OF THE PROJECT. ANY AND ALL FIELD CHANGES MADE DURING CONSTRUCTION MUST BE NOTED. THE DRAWINGS WILL STATE "RED LINES" IN LARGE BLOCK LETTERS. THE RED-LINED DRAWINGS MUST BE RECEIVED AND ACCEPTED BY THE PROJECT CONSTRUCTION ENGINEER PRIOR TO FINAL ACCEPTANCE AND SETTLEMENT.
- THE CONTRACTOR SHALL NOTIFY THE PROJECT CONSTRUCTION ENGINEER IMMEDIATELY OF "ANY" DISCREPANCIES OR VARIATIONS IN DRAWINGS & SPECIFICATIONS THAT EFFECT PRICING OR THAT COULD REQUIRE MODIFICATION TO THE DESIGN.
- THE CITY AND COUNTY OF DENVER ASSUMES NO RESPONSIBILITY FOR UTILITY LOCATIONS. THE UTILITIES SHOWN ON THESE DRAWINGS HAVE BEEN PLOTTED FROM THE BEST AVAILABLE INFORMATION. IT IS, HOWEVER, THE CONTRACTOR'S RESPONSIBILITY TO FIELD VERIFY THE LOCATION OF ALL UTILITIES PRIOR TO THE COMMENCEMENT OF ANY CONSTRUCTION.
- ALL RANGE POINTS OR OTHER SURVEY MONUMENTS WHICH MAY BE DESTROYED DURING CONSTRUCTION SHALL BE TIED OUT AND RESET BY THE CITY SURVEY CREWS PER CITY SURVEYING STANDARDS.
- ALL ELEVATIONS SHOWN ARE NAVD88 DATUM, UNLESS OTHERWISE NOTED.
- INLETS AND MANHOLES ARE NOT SHOWN TO SCALE ON THE PLAN AND PROFILE SHEETS.
- INVERT ELEVATIONS AND CALCULATED PIPE SLOPES ON STORM AND SANITARY PROFILES ARE TO THE CENTER OF MANHOLE OR STRUCTURE. PIPE LENGTHS ARE TWO DIMENSIONAL LENGTHS AND ARE CENTER TO CENTER BETWEEN MANHOLES AND TO THE INSIDE EDGE OF INLETS.
- NORTHING AND EASTING CALLOUTS ON TYPE 16 AND TYPE 14 INLETS ARE TO THE CENTER OF THE STRUCTURE AT THE FLOWLINE. NORTHING AND EASTING CALLOUTS ON MANHOLES ARE TO THE CENTER OF THE MANHOLE.
- LOCATION OF INLETS AND/OR INLET CONNECTORS MAY BE ADJUSTED IN THE FIELD AT THE DIRECTION OF THE PROJECT CONSTRUCTION ENGINEER IN CONJUNCTION WITH DESIGN INTENTION. ALL INLET CONNECTIONS SHOWN IN PLAN AND PROFILE ARE APPROXIMATE LOCATIONS AND DEPTHS.
- DEPTHS OR BOTTOM OF STRUCTURE ELEVATIONS WILL NOT BE PROVIDED FOR INLETS WITHIN THE PROJECT SCOPE, AS THESE ARE REQUIRED TO BE DETERMINED BASED ON FIELD CONDITIONS IN ACCORDANCE WITH APPLICABLE STANDARD DETAIL DRAWINGS. IT SHALL BE THE RESPONSIBILITY OF THE GENERAL CONTRACTOR TO ESTABLISH INLET DEPTHS AND COMPLETE CONSTRUCTION IN CONFORMANCE WITH APPLICABLE STANDARD DETAIL DRAWINGS BASED ON CLEARANCES OF ADJACENT UTILITIES WHILE MAINTAINING MINIMUM REQUIRED GRADES ON LATERAL CONNECTIONS.
- ALL SEWER MANHOLES MUST BE MAINTAINED AND ACCESSIBLE DURING CONSTRUCTION.
- THE CONTRACTOR SHALL LOCATE AND VERIFY ALL LIVE SANITARY SEWER SERVICES (TAPS) AND ENSURE THAT ALL ACTIVE TAPS AFFECTED BY THE CONSTRUCTION OPERATIONS ARE PROPERLY RECONNECTED. IN THE EVENT OF A SANITARY SEWER BACKUP, WITHIN THE CONSTRUCTION LIMITS, THE CONTRACTOR ASSUMES ALL RESPONSIBILITY FOR ENSURING BUSINESSES AND RESIDENCES AFFECTED ARE IMMEDIATELY ADDRESSED AND PLACED BACK INTO SERVICE.
- ALL SANITARY MANHOLES ARE 4' DIAMETER WITH "A" BASE AND CONCENTRIC CONE UNLESS NOTED OTHERWISE.
- CHANGES IN THE ELEVATION OF AN EXISTING BRICK MANHOLE RING AND COVER MAY REQUIRE THE USE OF A PRE-CAST CONCRETE MANHOLE FLAT-TOP SECTION OR MANHOLE RECONSTRUCTION AT THE DISCRETION OF THE PROJECT INSPECTOR OR THE PROJECT CONSTRUCTION ENGINEER.
- ALL MANHOLES BUILT WITHIN THIS PROJECT SHALL INCLUDE EITHER A 4" OR 8" CAST IRON RISER WITH 3" STEEL ADJUSTING RINGS.
- REINFORCING STEEL:
 - ALL REBAR SHALL BE PLACED PER SHOP DRAWINGS APPROVED BY THE PROJECT CONSTRUCTION ENGINEER.
 - REINFORCING STEEL SHALL BE HOT ROLLED DEFORMED BARS, ASTM DESIGNATION A615, GRADE 60, UNLESS OTHERWISE SHOWN OR NOTED.
 - LAPS SHALL BE CLASS B (SPLICE NO MORE THAN HALF OF BARS AT ANY LOCATION), EXCEPT WHERE OTHERWISE SHOWN OR NOTED. LAPS IN HORIZONTAL STEEL SHALL BE STAGGERED UNLESS OTHERWISE SHOWN.
 - ALL CROSSING REINFORCING BARS SHALL BE TIED.
 - FOR ALL CAST-IN-PLACE REINFORCED CONCRETE STRUCTURES THE CONTRACTOR SHALL SUPPLY ADEQUATE BAR CHAIRS AND SUPPORTS FOR REINFORCING SUBJECT TO THE APPROVAL OF THE PROJECT CONSTRUCTION ENGINEER.
- EXACT LOCATION OF ALL SAW CUTS SHALL BE DETERMINED IN THE FIELD BY THE CONSTRUCTION PROJECT ENGINEER.
- DOWELS, PIPES, WATER STOPS AND OTHER INSTALLED MATERIALS AND ACCESSORIES SHALL BE HELD SECURELY IN POSITION WHILE CONCRETE IS BEING PLACED.
- #67 BEDDING OR SPECIAL BEDDING IS REQUIRED FOR ALL STORM AND SANITARY SEWER PIPE, IN ACCORDANCE WITH THE STANDARD DETAILS AND TECHNICAL SPECIFICATIONS. OTHER FACILITIES MAY REQUIRE DIFFERENT BEDDING TYPES, PER SPECIFIC OWNER REQUIREMENTS.
- THE CONTRACTOR SHALL BACKFILL AND FINE GRADE ALL CUT OR FILL SLOPES TO MATCH EXISTING CONDITIONS TO THE SATISFACTION OF THE PROJECT CONSTRUCTION ENGINEER. WHERE EXISTING LAWNS ARE DAMAGED BY THE CONTRACTOR'S OPERATIONS THE CONTRACTOR SHALL RE-SEED AND/OR SOD THE AFFECTED AREA TO A CONDITION EQUAL TO, OR BETTER THAN THAT WHICH EXISTED PRIOR TO CONSTRUCTION. ALL COSTS ARE INCLUDED WITHIN APPURTENANT BID ITEMS.
- DENVER WATER
 - IT SHALL BE THE CONTRACTOR'S RESPONSIBILITY TO TAKE WHATEVER STEPS NECESSARY TO PROTECT ALL WATER FACILITIES. IF ANY WATER FACILITIES CANNOT BE ADEQUATELY PROTECTED, THEN SAID WATER FACILITIES SHALL BE RELOCATED OR REMOVED IN ACCORDANCE WITH THE DENVER WATER DEPARTMENT REQUIREMENTS, BY A DENVER WATER PREQUALIFIED CONTRACTOR.

b. CONSTRUCTION ACTIVITIES BY ANY PARTY THAT DISTURB, RELOCATE, SEVER, OR IN ANY OTHER WAY IMPACT A SERVICE LINE SHALL BE REQUIRED TO MEET CURRENT DENVER WATER REQUIREMENTS FOR SERVICE LINES AS SPECIFIED IN CHAPTER 3 OF THE LATEST DENVER WATER STANDARDS.

27. TREE PROTECTION

IF EXISTING TREES ARE TO BE REMOVED THEY MUST FIRST BE EVALUATED BY THE CITY AND COUNTY OF DENVER FORESTRY (PARKS) DEPARTMENT AND A PERMIT MUST BE OBTAINED. EXISTING TREES TO REMAIN MUST HAVE FORESTRY APPROVED TREE PROTECTION SET UP AROUND THEM DURING THE CONSTRUCTION AS SHOWN IN THE "INDIVIDUAL TREE PROTECTION DETAIL" WHICH CAN BE FOUND BY GOING TO WWW.DENVERGOV.ORG. TYPE "LANDSCAPE PLANNING" INTO THE SEARCH BOX (TOP RIGHT OF PAGE). THE CONTRACTOR MUST FOLLOW ALL OF THE CITY AND COUNTY OF DENVER TREE RETENTION AND PROTECTION GUIDELINES.

28. METRO WASTEWATER RECLAMATION DISTRICT

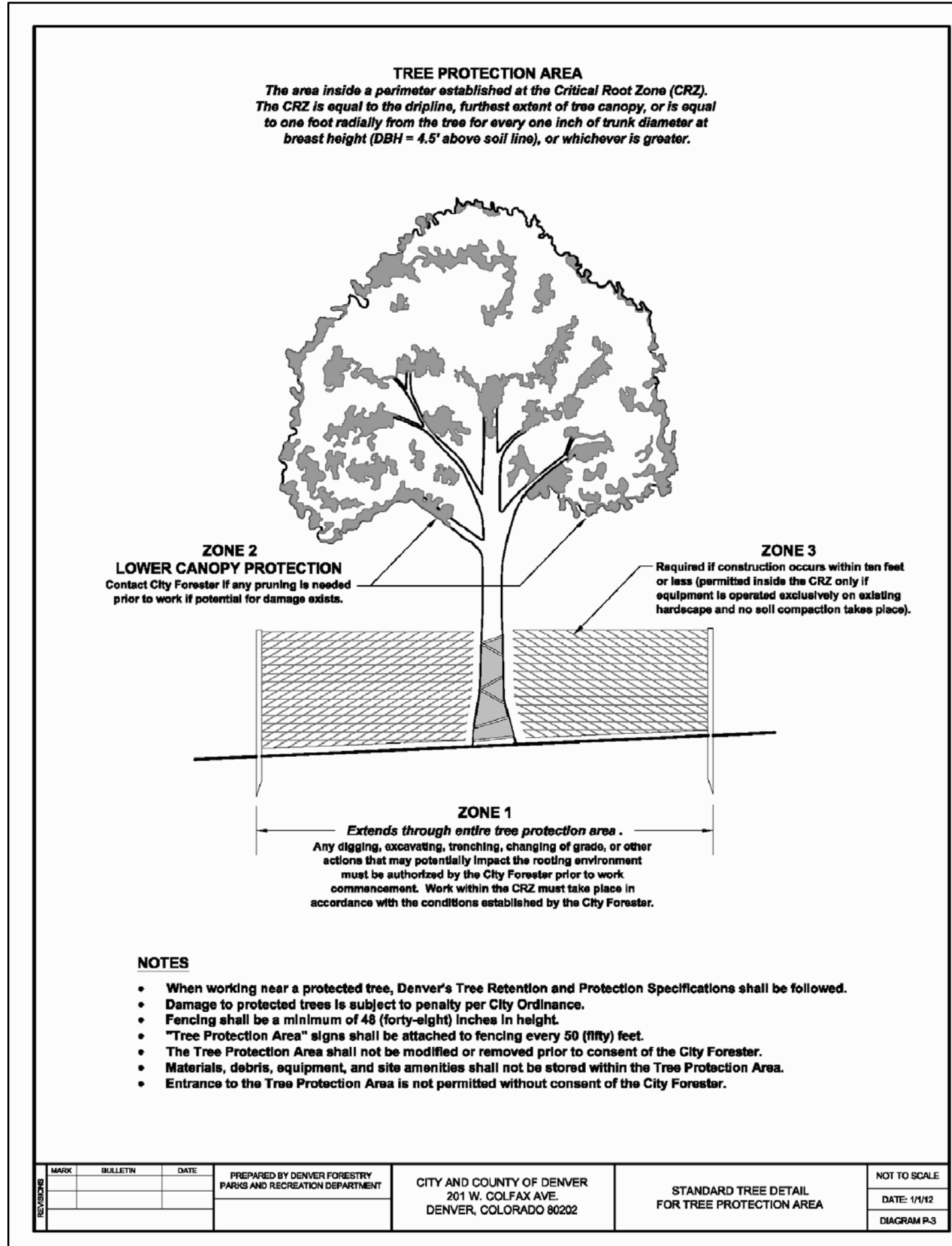
METRO WASTEWATER RECLAMATION DISTRICT MUST BE NOTIFIED AT LEAST 48 HOURS PRIOR TO CONSTRUCTION ON METRO FACILITIES IN ORDER FOR A DISTRICT INSPECTOR TO BE PRESENT DURING CONSTRUCTION. CONTRACTOR MUST CONTACT METRO WASTEWATER RECLAMATION DISTRICT TO SCHEDULE THE INSPECTION 303-286-6000.

ADDITIONAL NOTES

- ALL RCP SHALL MEET THE ASTM C-76 SPECIFICATION.
- ALL RCP SHALL BE CLASS III UNLESS NOTED OTHERWISE.

ABBREVIATIONS

APPROX - APPROXIMATELY	EX - EXISTING	RCBC - REINFORCED CONCRETE BOX CULVERT
CL - CENTER LINE	EW - EACH WAY	RCP - REINFORCED CONCRETE PIPE
CCD - CITY AND COUNTY OF DENVER	FG - FINAL GRADE	R.L. - RANGE LINE
CFS - CUBIC FEET PER SECOND	FL - FLOW LINE	S - SOUTH
C & G - CURB AND GUTTER	FO - FIBER OPTIC LINE	STM - STORM SEWER
C G & SW - CURB, GUTTER, & SIDEWALK	G - GAS	SS - SANITARY SEWER
CH - CURB HEAD	H.G.L. - HYDRAULIC GRADE LINE	SW - SIDEWALK
CIP - CORRUGATED IRON PIPE (WATER)	I - INLET	TELE - TELEPHONE LINE
CPM - CAPITAL PROJECTS MANAGEMENT	INV. - INVERT	TOC - TOP OF CONCRETE
DIP - DUCTILE IRON PIPE (WATER)	LF - LINEAR FEET	T.O.P. - TOP OF PIPE
DT - DECIDUOUS TREE	MH - MANHOLE	T.O.W. - TOP OF WALL
DWD - DENVER WATER DEPARTMENT	MJ - MECHANICAL JOINT	TYP. - TYPICAL
E - EAST	N - NORTH	UE - UNDERGROUND ELECTRIC LINE
EF - EACH FACE	NTS - NOT TO SCALE	U.N.O. - UNLESS NOTED OTHERWISE
E.G.L. - ENERGY GRADE LINE	OHE - OVERHEAD ELECTRIC LINE	VCP - VITRIFIED CLAY PIPE
EOA - EDGE OF ASPHALT	PL - PROPERTY LINE	W - WEST
ES - EACH SIDE	PVC - PLY VINYL CHLORIDE	WAT - WATER
	q - DESIGN FLOW	WMD - WASTEWATER MANAGEMENT DIVISION
	Qfull - FULL FLOW CAPACITY	

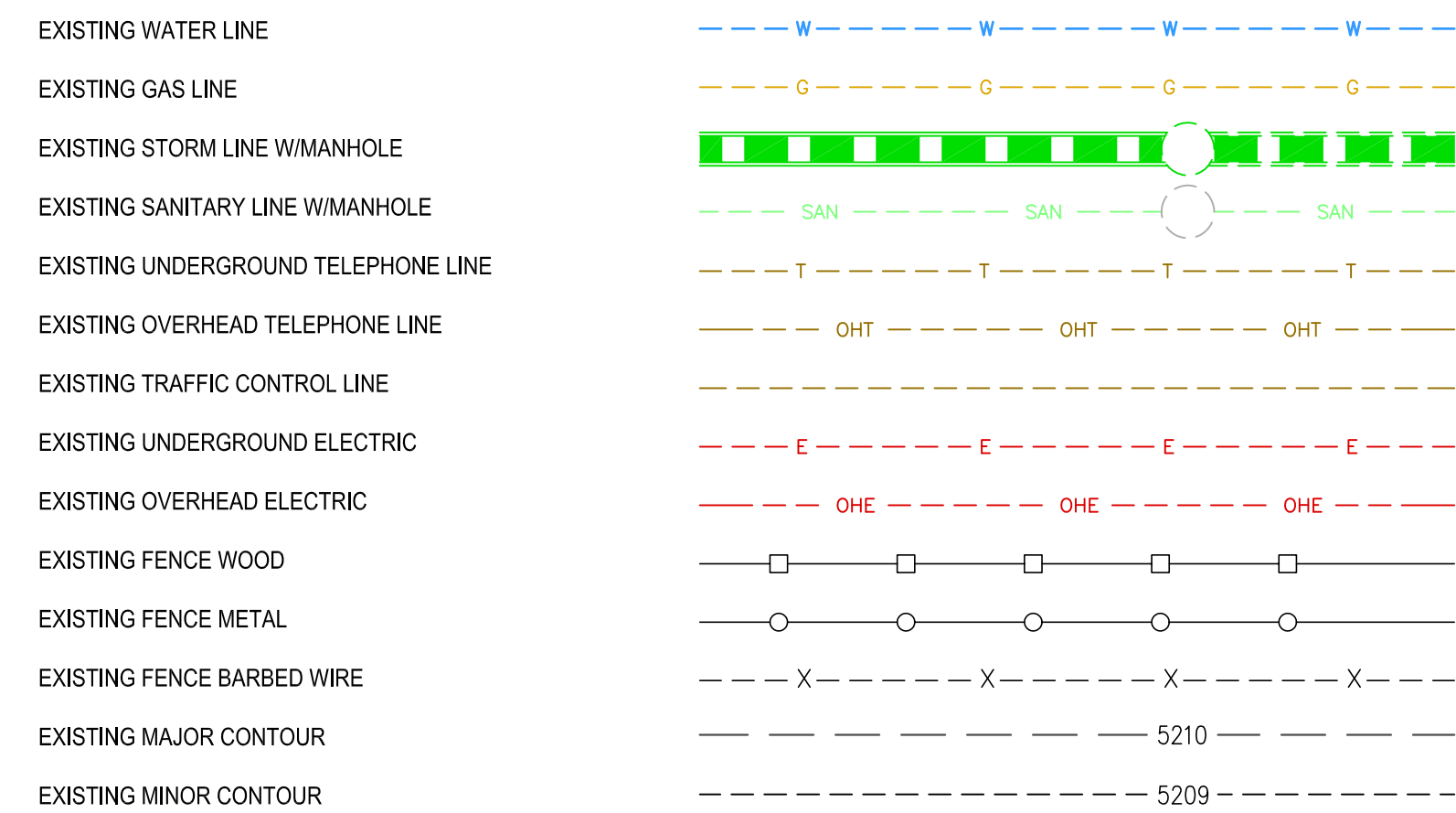


SURVEY FEATURES LEGEND

	BENCHMARK		RANGE POINT
	CHISELED 'X'		LAND CORNER
	TRAVERSE POINT		PIN & CAP
			REBAR
	EASEMENT LINE		
	SECTION LINE		
	PROPERTY LINE (NOT R.O.W.)		
	RANGELINE		
	R.O.W. LINE		

EXISTING FEATURES LEGEND

	EXISTING STREET LIGHT		EXISTING STORM INLETS
	EXISTING UTILITY/POWER POLE		EXISTING STREET SIGN
	EXISTING GUY WIRE		EXISTING POST
	EXISTING TRAFFIC POLE		EXISTING TRASH RECEPTACLE
	EXISTING TRAFFIC CONTROL BOX		EXISTING TRASH DUMPSTER
	EXISTING TRAFFIC CONTROL SWITCH BOX		EXISTING BUS BENCH
	EXISTING ELECTRIC METER		EXISTING MAIL BOX
	EXISTING ELECTRIC BOX		EXISTING NEWSPAPER BOX
	EXISTING FIRE HYDRANT		EXISTING TELEPHONE MH
	EXISTING WATER VALVE		EXISTING TELEPHONE BOX
	EXISTING WATER MH		EXISTING TELEPHONE BOOTH
	EXISTING WATER METER		EXISTING TREE
	EXISTING GAS MANHOLE		EXISTING SHRUB



PROPOSED FEATURES LEGEND

	PROPOSED STORM INLET		PROPOSED STORM SEWER W/MANHOLE
	PROPOSED SANITARY SEWER W/MANHOLE		PROPOSED MAJOR CONTOUR
	PROPOSED MINOR CONTOUR		PROPOSED CURB & GUTTER
	PROPOSED FH		PROPOSED WATER
	PROPOSED WATER VALVE		PROPOSED WATER REDUCER
	PROPOSED WATER BENDS AND/OR TEES		PROPOSED GRASS AND/OR MULCH-REPLACE EXISTING LANDSCAPING MATERIAL
	PROPOSED CONCRETE UNLESS SPECIFIED OTHERWISE		PROPOSED CURB RAMP
	PROPOSED DRAINAGE FLOW ARROW		

No.	Description of Revisions	Date	Initial
1	50% Review	1/20/09	BJP
2	95% Review	1/15/10	BJP
3	100% Review	5/03/10	BJP
4	BID DOCUMENTS	9/10/12	BJU

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**City and County of Denver
 Department of Public Works
 Engineering Division
 Wastewater Capital Projects Management**
 2000 W. 3rd Ave. Denver, Colorado 80223
 Telephone: (303) 446-3617 Fax: (303) 446-3647

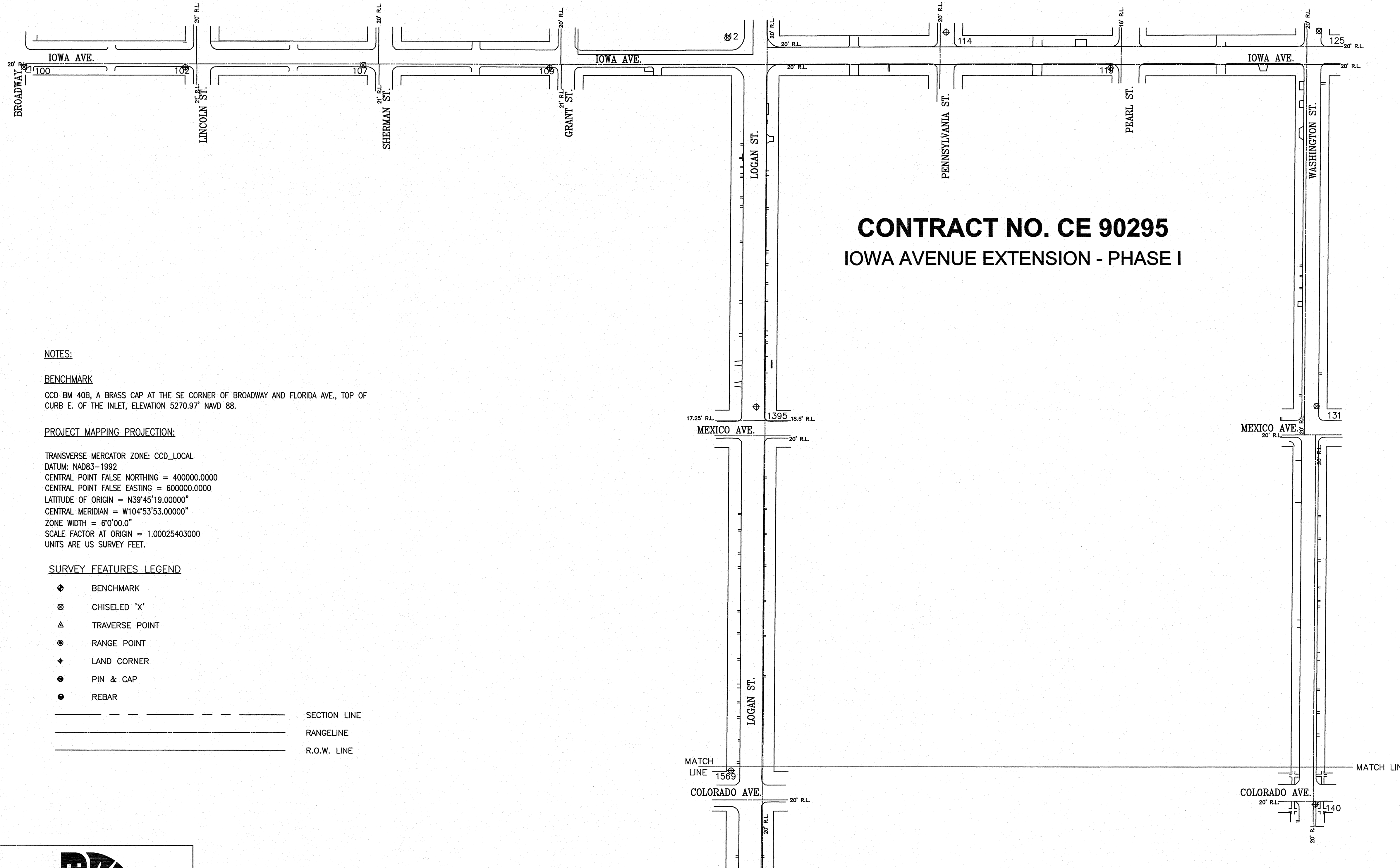
Drawn by: CAW	Checked by: BJP
Designed by: MJM	Approved by: BJP
Merrick Project: 03015799809 WMD Project No.: PWC2010-5203	

Date: 9/10/12
 Sheet Name: GNO1
 Sheet No: 2

CITY AND COUNTY OF DENVER

DEPARTMENT OF PUBLIC WORKS

ENGINEERING DIVISION



NOTES:

BENCHMARK

CCD BM 40B, A BRASS CAP AT THE SE CORNER OF BROADWAY AND FLORIDA AVE., TOP OF CURB E. OF THE INLET, ELEVATION 5270.97' NAVD 88.

PROJECT MAPPING PROJECTION:

TRANSVERSE MERCATOR ZONE: CCD_LOCAL
 DATUM: NAD83-1992
 CENTRAL POINT FALSE NORTHING = 400000.0000
 CENTRAL POINT FALSE EASTING = 600000.0000
 LATITUDE OF ORIGIN = N39°45'19.000000"
 CENTRAL MERIDIAN = W104°53'53.000000"
 ZONE WIDTH = 6°0'00.0"
 SCALE FACTOR AT ORIGIN = 1.00025403000
 UNITS ARE US SURVEY FEET.

SURVEY FEATURES LEGEND

- ◆ BENCHMARK
- ⊗ CHISELED 'X'
- △ TRAVERSE POINT
- ⊙ RANGE POINT
- ⊕ LAND CORNER
- PIN & CAP
- REBAR

- SECTION LINE
- RANGELINE
- R.O.W. LINE

No.	Description of Revisions	Date	Initial

City and County of Denver
Department of Public Works
Engineering Division
Wastewater Capital Projects Management

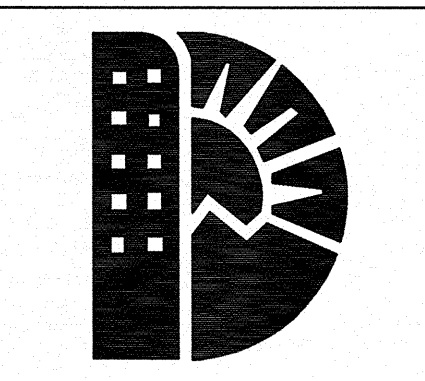
2000 W. 3rd Ave. Denver, Colorado 80223
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IOWA AVENUE EXTENSION - PHASE I	
HORIZONTAL CONTROL	
Drawn by: RSC	Checked by:
Designed by:	Approved by:
Project:	WMD Project No.:

Date: 02/01/10

Sheet Name:

Sheet No: 03



DENVER
THE MILE HIGH CITY

MATCH LINE 15698
 COLORADO AVE. 20' R.L.

MATCH LINE
 COLORADO AVE. 20' R.L. 140

CITY AND COUNTY OF DENVER

DEPARTMENT OF PUBLIC WORKS

ENGINEERING DIVISION

CONTRACT NO. CE 90295

IOWA AVENUE EXTENSION - PHASE I

NOTES:

BENCHMARK

CCD BM 40B, A BRASS CAP AT THE SE CORNER OF BROADWAY AND FLORIDA AVE., TOP OF CURB E. OF THE INLET, ELEVATION 5270.97' NAVD 88.

PROJECT MAPPING PROJECTION:

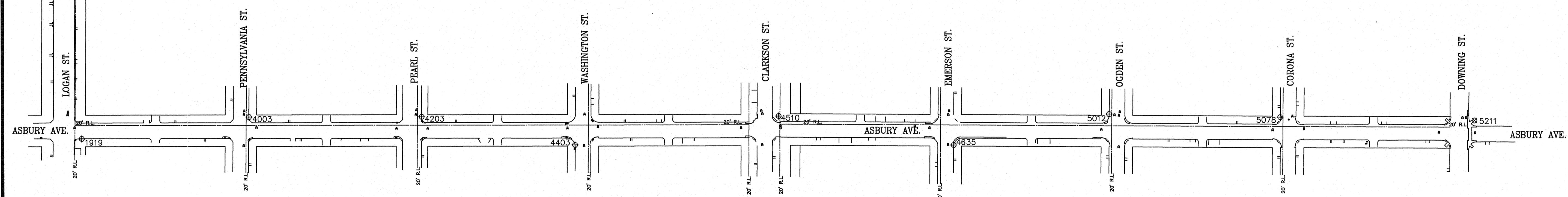
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SURVEY FEATURES LEGEND

- ◆ BENCHMARK
- ⊗ CHISELED 'X'
- ▲ TRAVERSE POINT
- RANGE POINT
- ◆ LAND CORNER
- PIN & CAP
- REBAR

----- SECTION LINE
 - - - - - RANGELINE
 _____ R.O.W. LINE

NUMBER	NORTHING	EASTING	ELEVATION	DESCRIPTION
100	375314.19	574857.17	5272.64	CUT X, SE COR. BROADWAY & IOWA, TOP OF WALK @ INTERSECTION OF WALKS
102	375313.50	575143.83	5272.50	CH+, SW COR. LINCOLN & IOWA, IN RAMP
107	375317.48	575460.66	5273.76	CUT X, SW COR. SHERMAN & IOWA, IN RAMP
109	375313.22	575792.05	5274.66	CH+, SW COR. GRANT & IOWA, IN RAMP
112	375366.00	576108.37	5281.99	CUT X, NW COR. LOGAN & IOWA, TOP OF WALK @ INTERSECTION OF WALKS, NE OF LP
114	375375.67	576497.38	5283.84	CH+, NE COR. PENNSYLVANIA & IOWA, IN RAMP
119	375312.98	576789.57	5289.73	CH+, SW COR. PEARL & IOWA, TOP OF CURB
125	375378.15	577160.42	5291.52	CUT X, NE COR. WASHINGTON & IOWA, TOP OF WALK @ INTERSECTION OF WALKS
131	374713.38	577154.44	5295.26	CUT X, NE COR. WASHINGTON & MEXICO, TOP OF WALK @ INTERSECTION OF WALKS
140	374007.49	577150.73	5304.39	CH+, SE COR. WASHINGTON & COLORADO, TOP OF WALK NEAR INTERSECTION OF BACK OF WALKS
1395	374712.11	576158.22	5283.07	CH+, NE COR. MEXICO & LOGAN, IN RAMP
1569	374067.20	576112.21	5285.40	CH+, NW COR. COLORADO & LOGAN, IN RAMP
1738	373340.79	576101.16	5289.59	CUT X, SW COR. JEWELL & LOGAN, IN WALK, 5' W. OF W. FLOWLINE OF LOGAN
1919	372690.90	576156.21	5297.44	CH+, SE COR. ASBURY & LOGAN, TOP OF CURB
4003	372732.54	576475.09	5303.60	CH+, NE COR. PENNSYLVANIA & ASBURY, TOP CURB
4203	372733.20	576804.38	5308.77	CH+, NE COR. PEARL & ASBURY, TOP OF CURB
4403	372679.75	577096.70	5312.24	CH+, SW COR. WASHINGTON & ASBURY, TOP CURB
4510	372734.62	577484.87	5316.90	CH+, NE COR. CLARKSON & ASBURY, TOP OF WALK @ INTERSECTION OF WALKS
4635	372679.15	577818.38	5317.90	CH+, SE COR. EMERSON & ASBURY, TOP OF CURB
5012	372737.80	578114.71	5319.78	CH+, NW COR. OGDEN & ASBURY, NORTHERLY OF 2 CH+'S, TOP OF CURB
5078	372731.62	578440.84	5326.19	CH+, NW COR. CORONA & ASBURY, IN RAMP
5211	372724.34	578810.59	5335.10	CUT X, NE COR. DOWNING & ASBURY, TOP OF WALK @ INTERSECTION OF WALKS

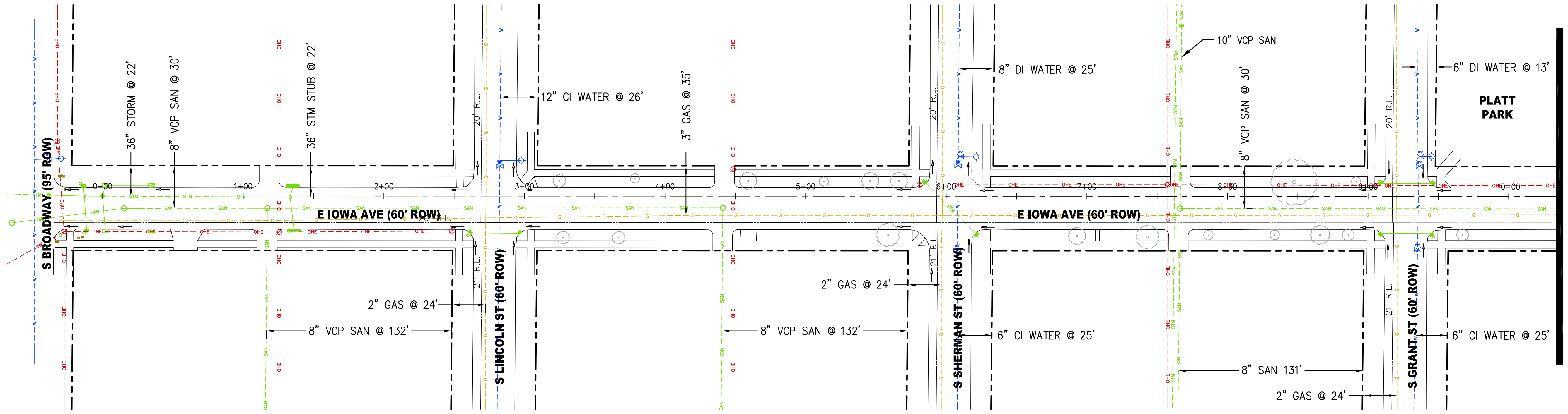


No.	Description of Revisions	Date	Initial

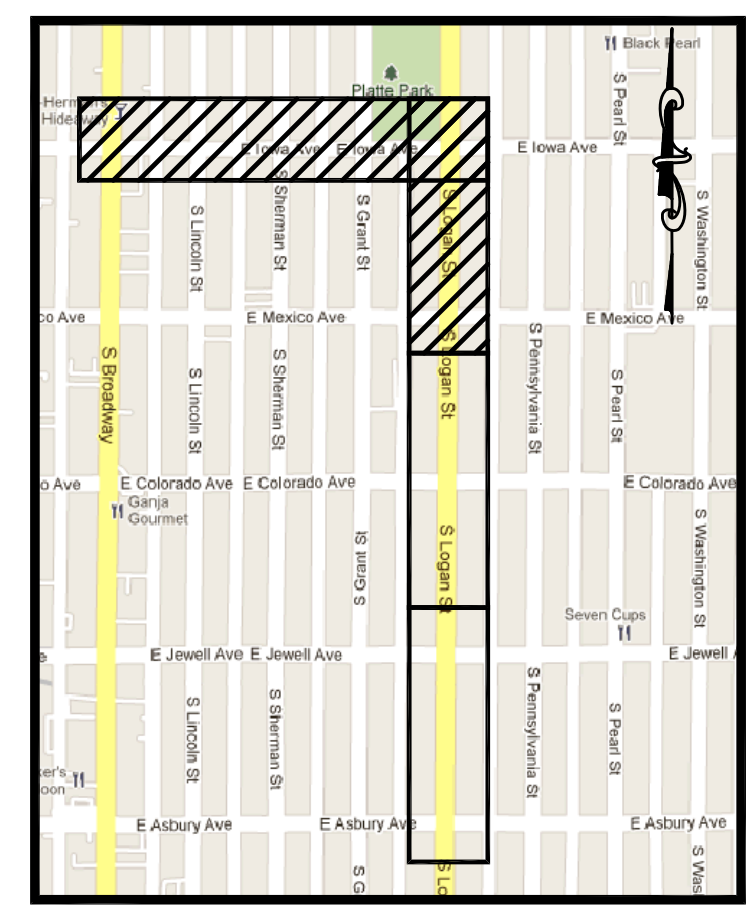
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Engineering Division
Wastewater Capital Projects Management
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 Telephone: (303) 446-3617 Fax: (303) 446-3647

IOWA AVENUE EXTENSION - PHASE I	
HORIZONTAL CONTROL	
Drawn by: RSC	Checked by:
Designed by:	Approved by:
Project:	WMD Project No.:
Date:	02/01/10
Sheet Name:	
Sheet No:	04

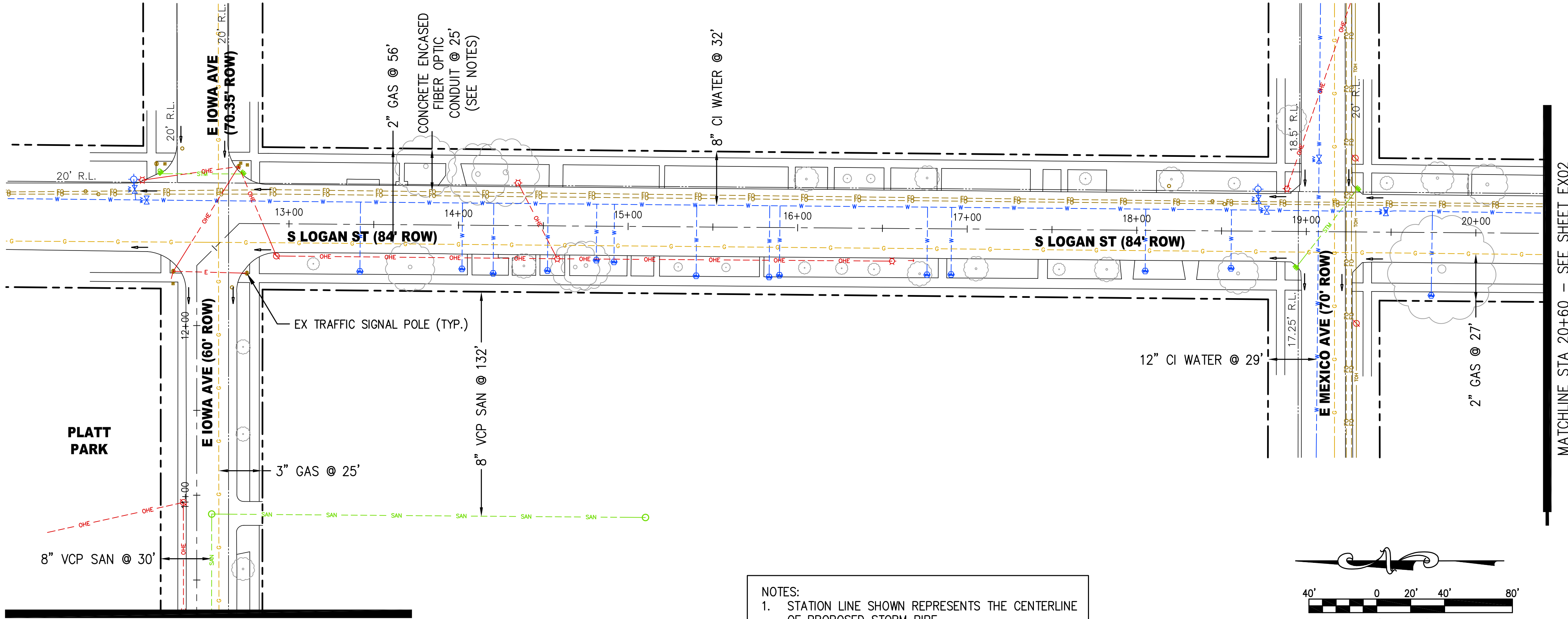




MATCHLINE STA 10+30 - SEE BELOW



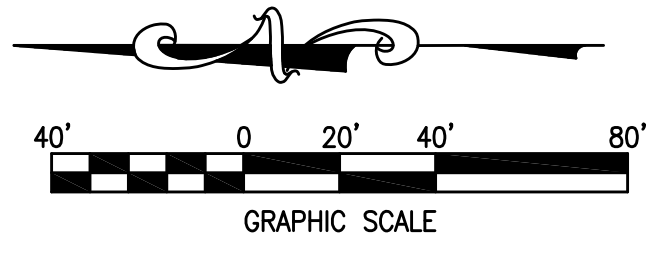
KEYMAP



MATCHLINE STA 10+30 - SEE ABOVE

MATCHLINE STA 20+60 - SEE SHEET EX02

- NOTES:
1. STATION LINE SHOWN REPRESENTS THE CENTERLINE OF PROPOSED STORM PIPE.
 2. FIBER OPTIC LINES MAY CONSIST OF ONE OR TWO CONCRETE ENCASEMENTS, OR ONE ENCASED AND ONE NON-ENCASED LINE.



No.	Description of Revisions	Date	Initial
1	50% Review	1/20/09	BJP
2	95% Review	1/15/10	BJP
3	100% Review	5/03/10	BJP
4	BID DOCUMENTS	9/10/12	BJU

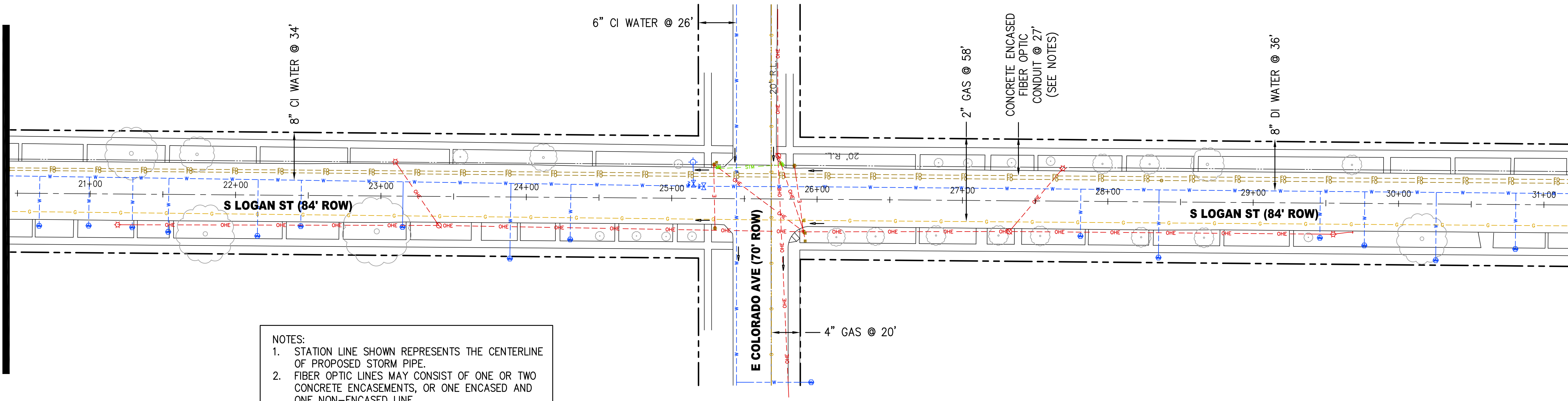
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IOWA AVENUE EXTENSION - PHASE I EXISTING CONDITIONS	
Drawn by: CAW	Checked by: BJP
Designed by: MJM	Approved by: BJP
Merrick Project: 0301579809 WMD Project No.: PWC2010-5203	

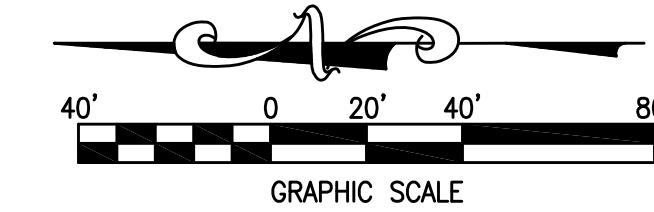
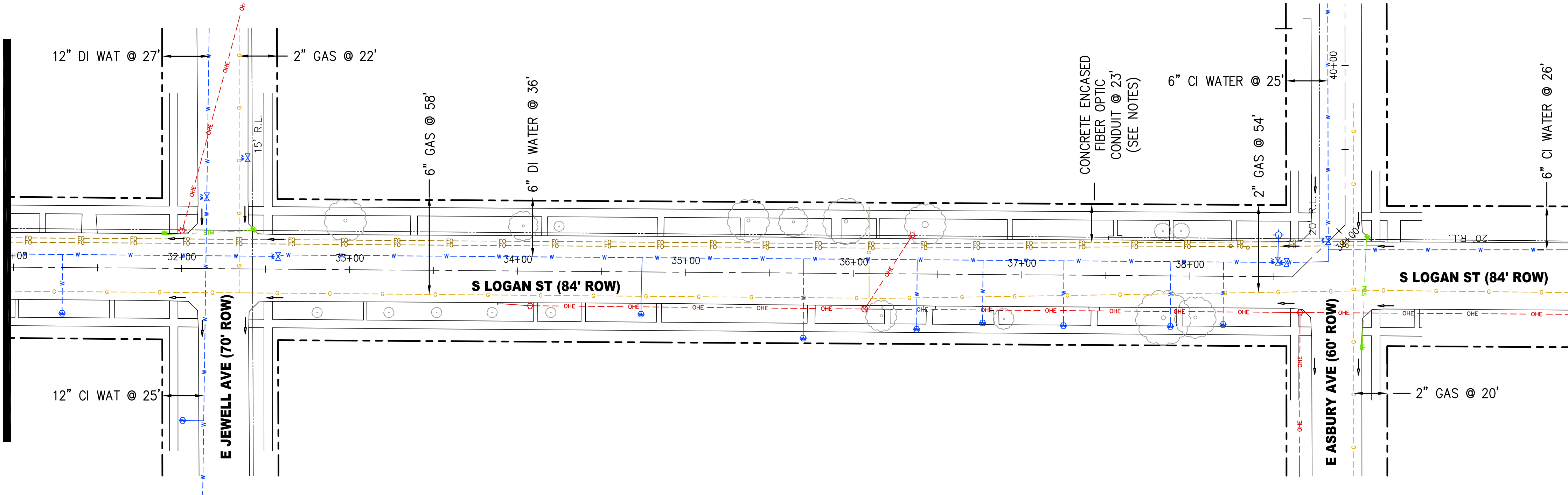
Date: 9/10/12
 Sheet Name: EX01
 Sheet No: 05

MATCHLINE STA 20+60 - SEE SHEET EX01

MATCHLINE STA 31+40 - SEE ABOVE



NOTES:
 1. STATION LINE SHOWN REPRESENTS THE CENTERLINE OF PROPOSED STORM PIPE.
 2. FIBER OPTIC LINES MAY CONSIST OF ONE OR TWO CONCRETE ENCASUREMENTS, OR ONE ENCASED AND ONE NON-ENCASED LINE.

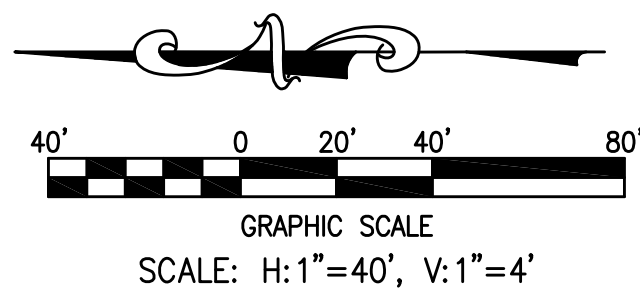


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4	BID DOCUMENTS	9/10/12	BJU

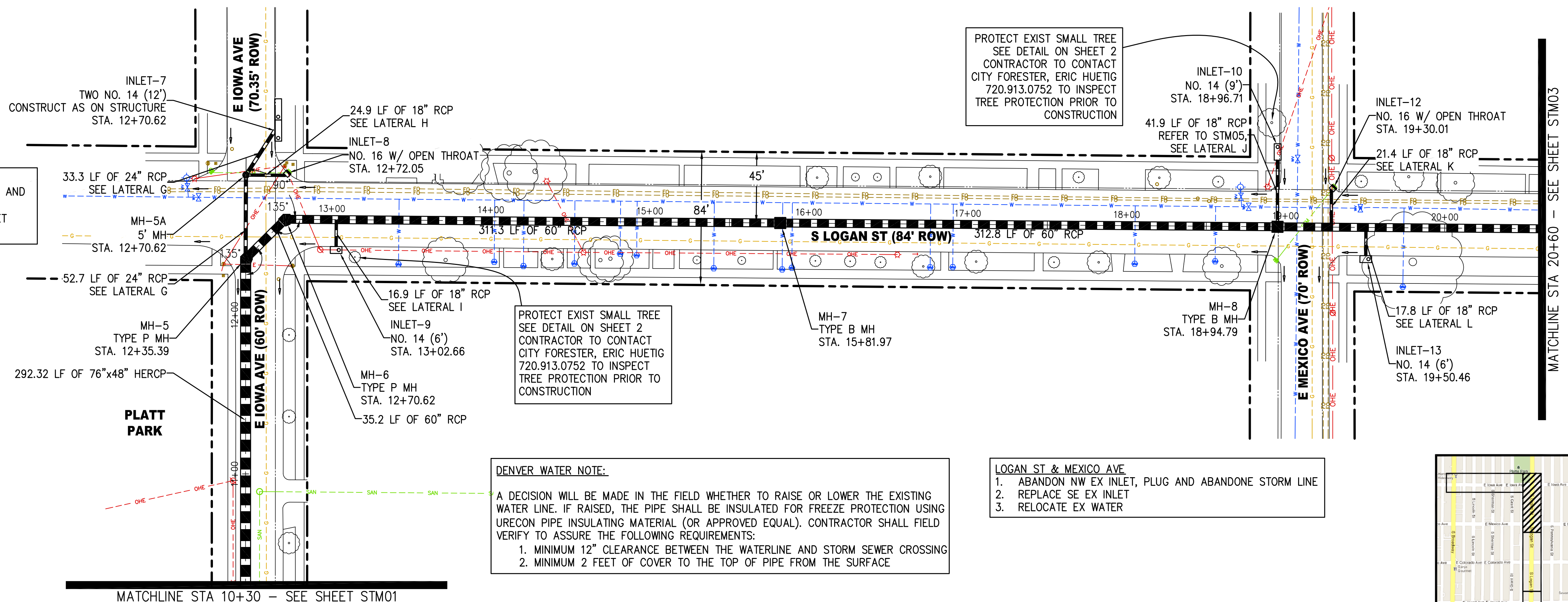
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IOWA AVENUE EXTENSION - PHASE I EXISTING CONDITIONS	
Drawn by: CAW	Checked by: BJP
Designed by: MJM	Approved by: BJP
Merrick Project: 0301579809 WMD Project No.: PWC2010-5203	

Date: 9/10/12
 Sheet Name: EX02
 Sheet No: 06



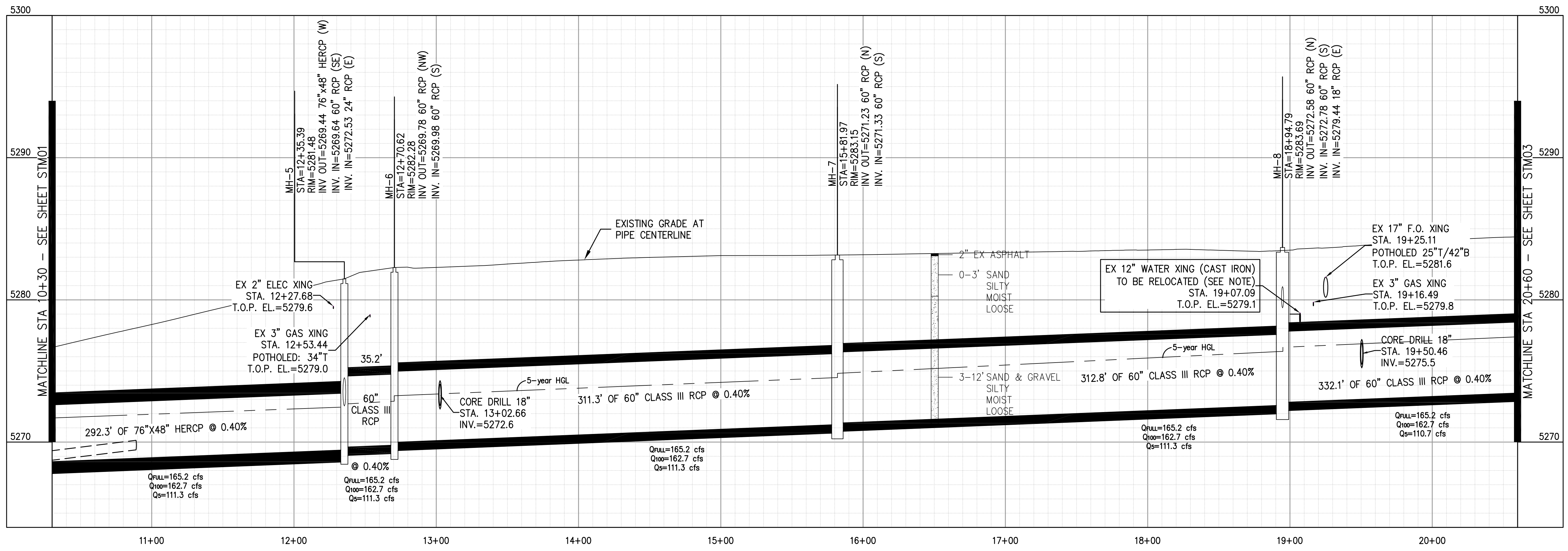
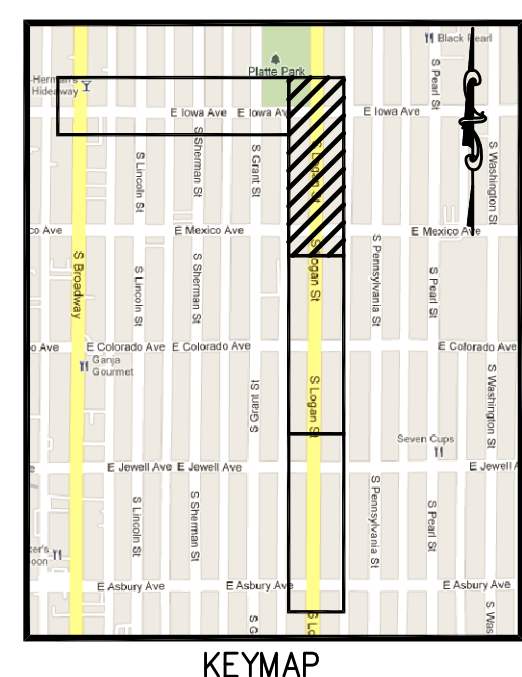
LOGAN ST & IOWA AVE
 2. ABANDON NE EX INLET, PLUG AND ABANDON STORM PIPE
 3. REMOVE/REPLACE SE EX INLET
 4. PROTECT EX SIGNAL POLE



PROTECT EXIST SMALL TREE
 SEE DETAIL ON SHEET 2
 CONTRACTOR TO CONTACT CITY FORESTER, ERIC HUETIG 720.913.0752 TO INSPECT TREE PROTECTION PRIOR TO CONSTRUCTION

DENVER WATER NOTE:
 A DECISION WILL BE MADE IN THE FIELD WHETHER TO RAISE OR LOWER THE EXISTING WATER LINE. IF RAISED, THE PIPE SHALL BE INSULATED FOR FREEZE PROTECTION USING URECON PIPE INSULATING MATERIAL (OR APPROVED EQUAL). CONTRACTOR SHALL FIELD VERIFY TO ASSURE THE FOLLOWING REQUIREMENTS:
 1. MINIMUM 12" CLEARANCE BETWEEN THE WATERLINE AND STORM SEWER CROSSING
 2. MINIMUM 2 FEET OF COVER TO THE TOP OF PIPE FROM THE SURFACE

LOGAN ST & MEXICO AVE
 1. ABANDON NW EX INLET, PLUG AND ABANDONE STORM LINE
 2. REPLACE SE EX INLET
 3. RELOCATE EX WATER



No.	Description of Revisions	Date	Initial
1	50% Review	1/20/09	BJP
2	95% Review	1/15/10	BJP
3	100% Review	6/03/10	BJP
4	BID DOCUMENTS	9/10/12	BJJ

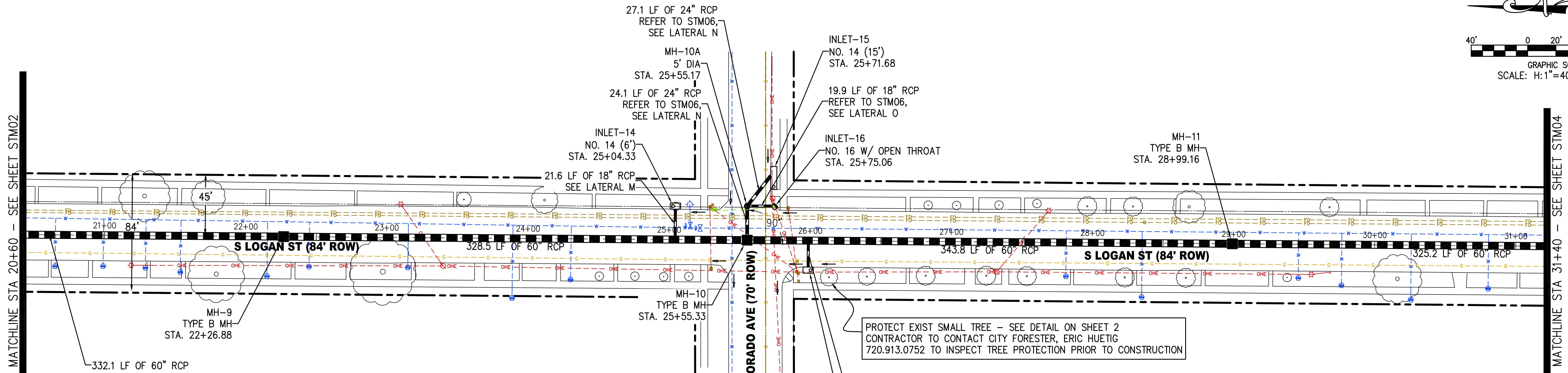
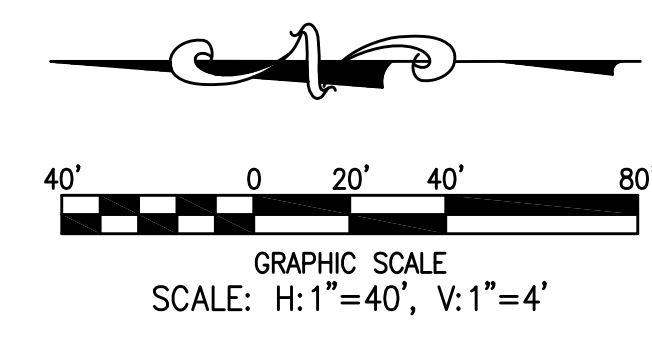
City and County of Denver
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Engineering Division
Wastewater Capital Projects Management
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 Telephone: (303) 446-3617 Fax: (303) 446-3647

IOWA AVENUE EXTENSION - PHASE I
STORM SEWER PLAN & PROFILE

Drawn by: CAW
 Checked by: BJP
 Designed by: MJM
 Approved by: BJP
 Merrick Project: 0301579809
 WMD Project No.: PWC2010-5203

Date: 9/10/12
 Sheet Name: STM02
 Sheet No: 08

MATCHLINE STA 20+60 - SEE SHEET STM02

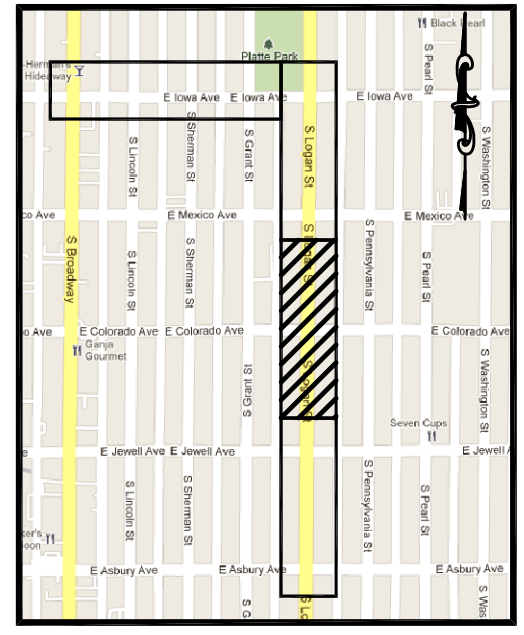


- LOGAN ST & COLORADO AVE**
1. ABANDON NE EX INLET, PLUG AND ABANDON STORM LINE
 2. PROTECT EX SIGNAL POLE
 3. RELOCATE EX WATER
 4. RELOCATE EX GAS

DENVER WATER NOTE:

A DECISION WILL BE MADE IN THE FIELD WHETHER TO RAISE OR LOWER THE EXISTING WATER LINE. IF RAISED, THE PIPE SHALL BE INSULATED FOR FREEZE PROTECTION USING URECON PIPE INSULATING MATERIAL (OR APPROVED EQUAL). CONTRACTOR SHALL FIELD-VERIFY TO ASSURE THE FOLLOWING REQUIREMENTS:

1. MINIMUM 12" CLEARANCE BETWEEN THE WATERLINE AND STORM SEWER CROSSING
2. MINIMUM 2' OF COVER TO THE TOP OF PIPE FROM THE SURFACE

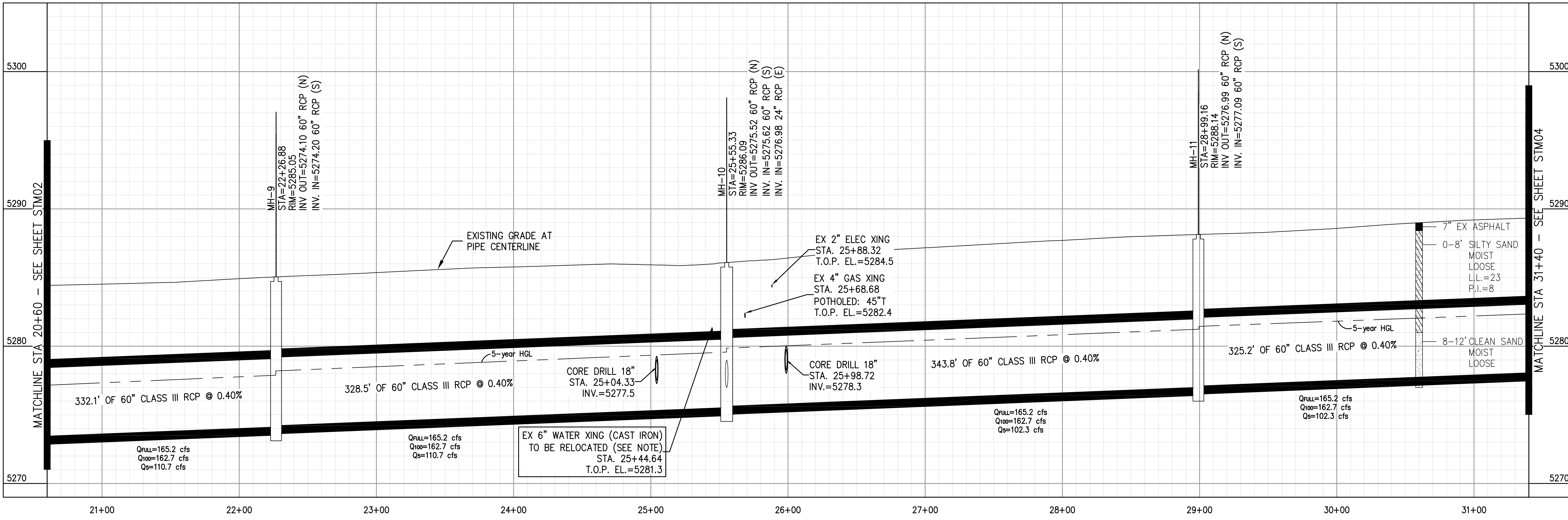


KEYMAP

No.	Description of Revisions	Date	Initial
1	50% Review	1/20/09	BJP
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City and County of Denver
Department of Public Works
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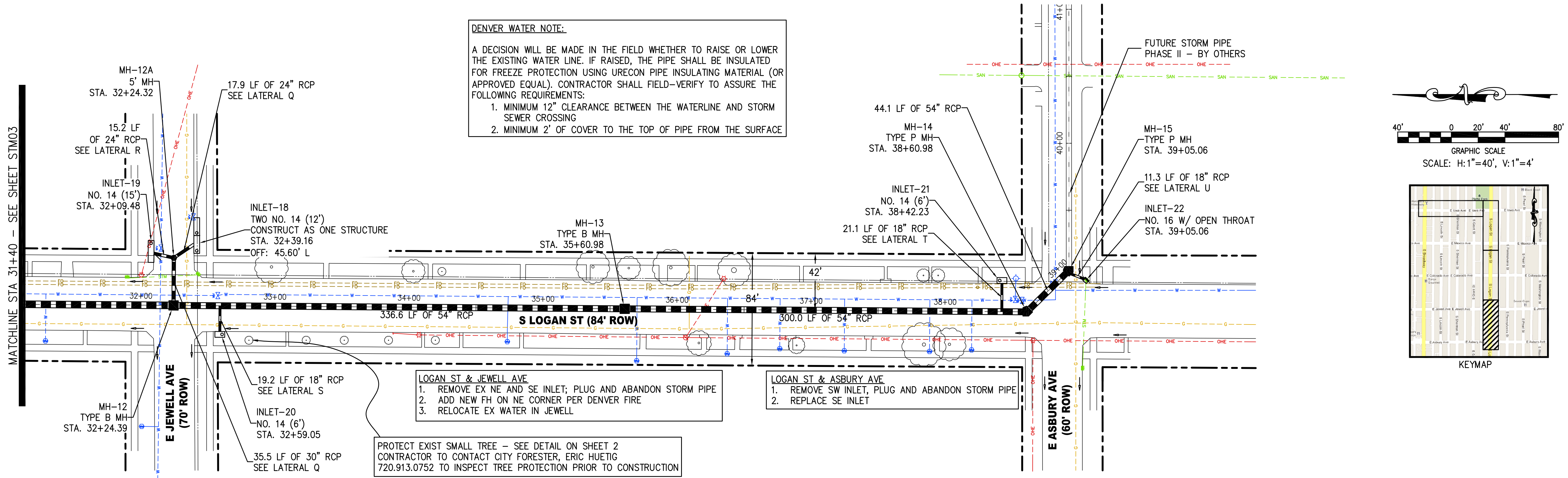


IOWA AVENUE EXTENSION - PHASE I
STORM SEWER PLAN & PROFILE

Drawn by:	CAW	Checked by:	BJP
Designed by:	MJM	Approved by:	BJP
Merrick Project: 0301579809		WMD Project No.: PWC2010-5203	

Date: 9/10/12
 Sheet Name: STM03
 Sheet No: 09

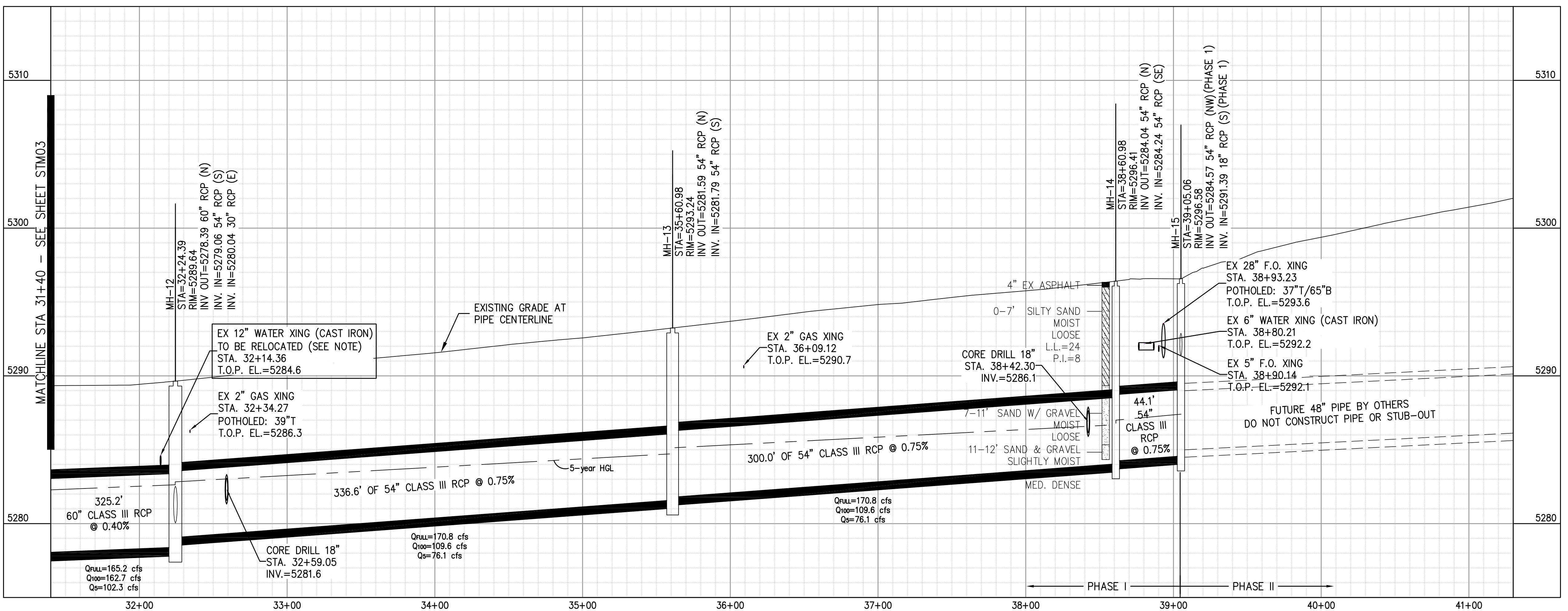
DENVER WATER NOTE:
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 2. MINIMUM 2' OF COVER TO THE TOP OF PIPE FROM THE SURFACE



LOGAN ST & JEWELL AVE
 1. REMOVE EX NE AND SE INLET; PLUG AND ABANDON STORM PIPE
 2. ADD NEW FH ON NE CORNER PER DENVER FIRE
 3. RELOCATE EX WATER IN JEWELL

LOGAN ST & ASBURY AVE
 1. REMOVE SW INLET, PLUG AND ABANDON STORM PIPE
 2. REPLACE SE INLET

PROTECT EXIST SMALL TREE - SEE DETAIL ON SHEET 2
 CONTRACTOR TO CONTACT CITY FORESTER, ERIC HUETIG
 720.913.0752 TO INSPECT TREE PROTECTION PRIOR TO CONSTRUCTION

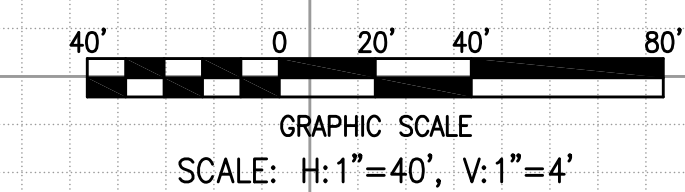
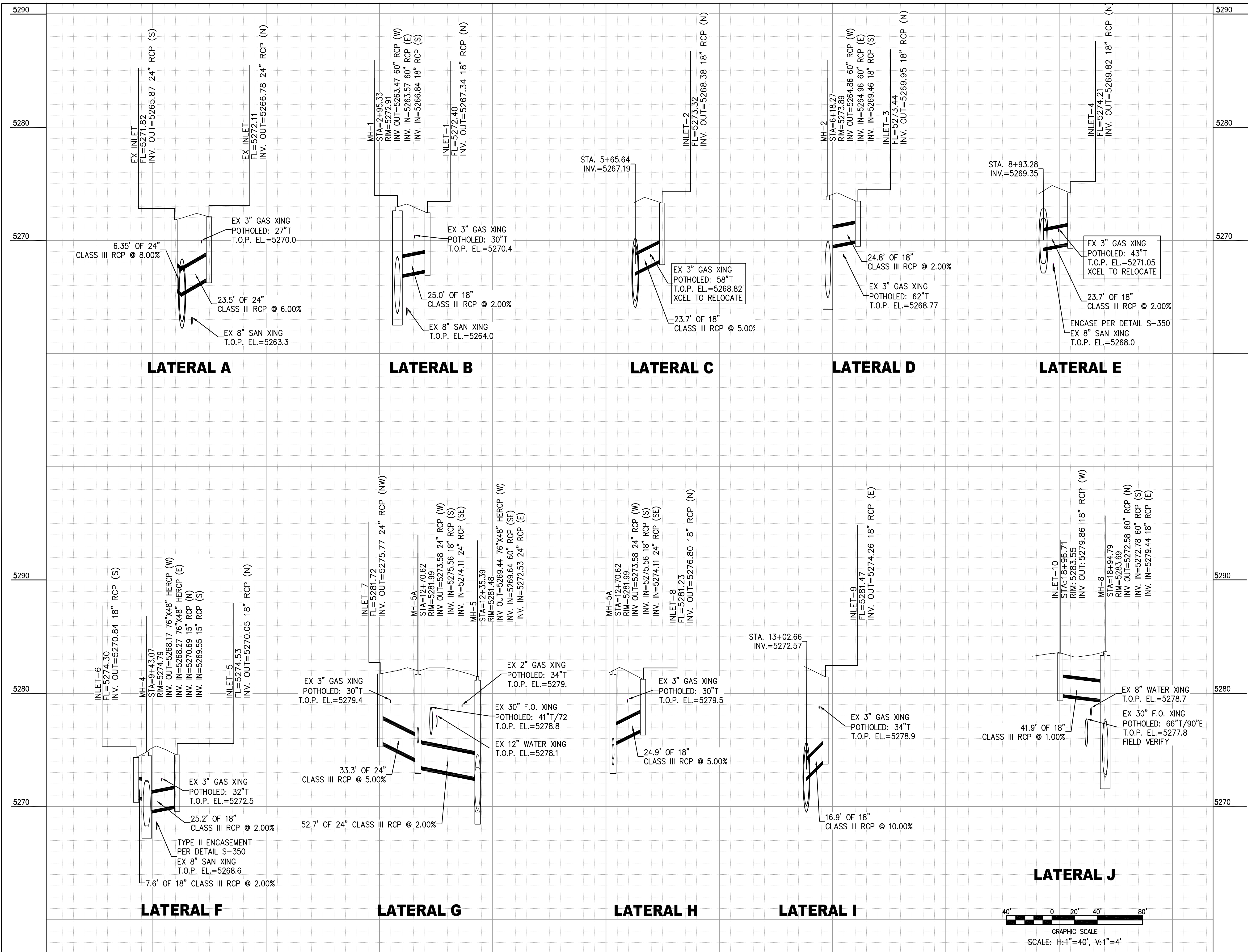


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Wastewater Capital Projects Management
 2000 W. 3rd Ave. Denver, Colorado 80223
 Telephone: (303) 446-3617 Fax: (303) 446-3647

IOWA AVENUE EXTENSION - PHASE I STORM SEWER PLAN & PROFILE	
Drawn by: CAW	Checked by: BJP
Designed by: MJM	Approved by: BJP
Merrick Project: 0301579809 WMD Project No.: PWC2010-5203	

Date: 9/10/12
 Sheet Name: STM04
 Sheet No: 10

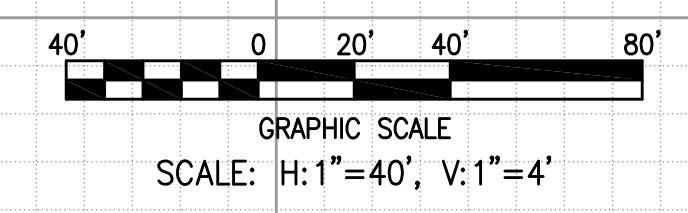
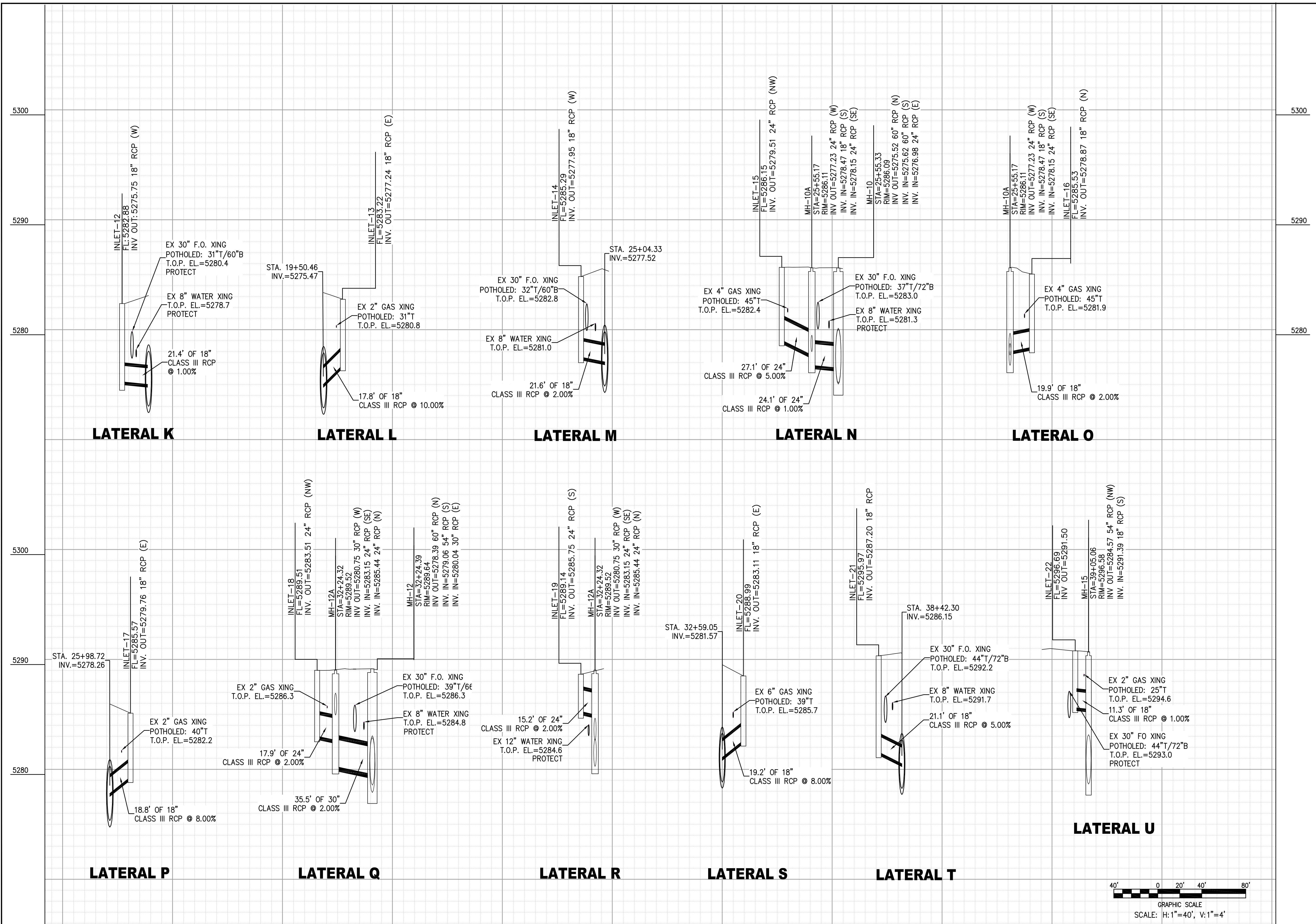


No.	Description of Revisions	Date	Initial
1	50% Review	1/20/09	BJP
2	95% Review	1/15/10	BJP
3	100% Review	6/03/10	BJP
4	REVISIONS	9/10/12	BJP

City and County of Denver
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Drawn by:	CAW	Checked by:	BJP
Designed by:	MJM	Approved by:	BJP
Merrick Project: 0301579809		WMD Project No.: PWC2010-5203	

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 Sheet No: 11



No.	Description of Revisions	Date	Initial
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4	BID DOCUMENTS	9/10/12	BJU

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IOWA AVENUE EXTENSION - PHASE I STORM SEWER PLAN & PROFILE	
Drawn by: CAW	Checked by: BJP
Designed by: MJM	Approved by: BJP
Merrick Project: 0301579809 WMD Project No.: PWC2010-5203	

Date: 9/10/12
 Sheet Name: STM06
 Sheet No: 12

S BROADWAY (95' ROW)

IOWA AVE & LINCOLN ST

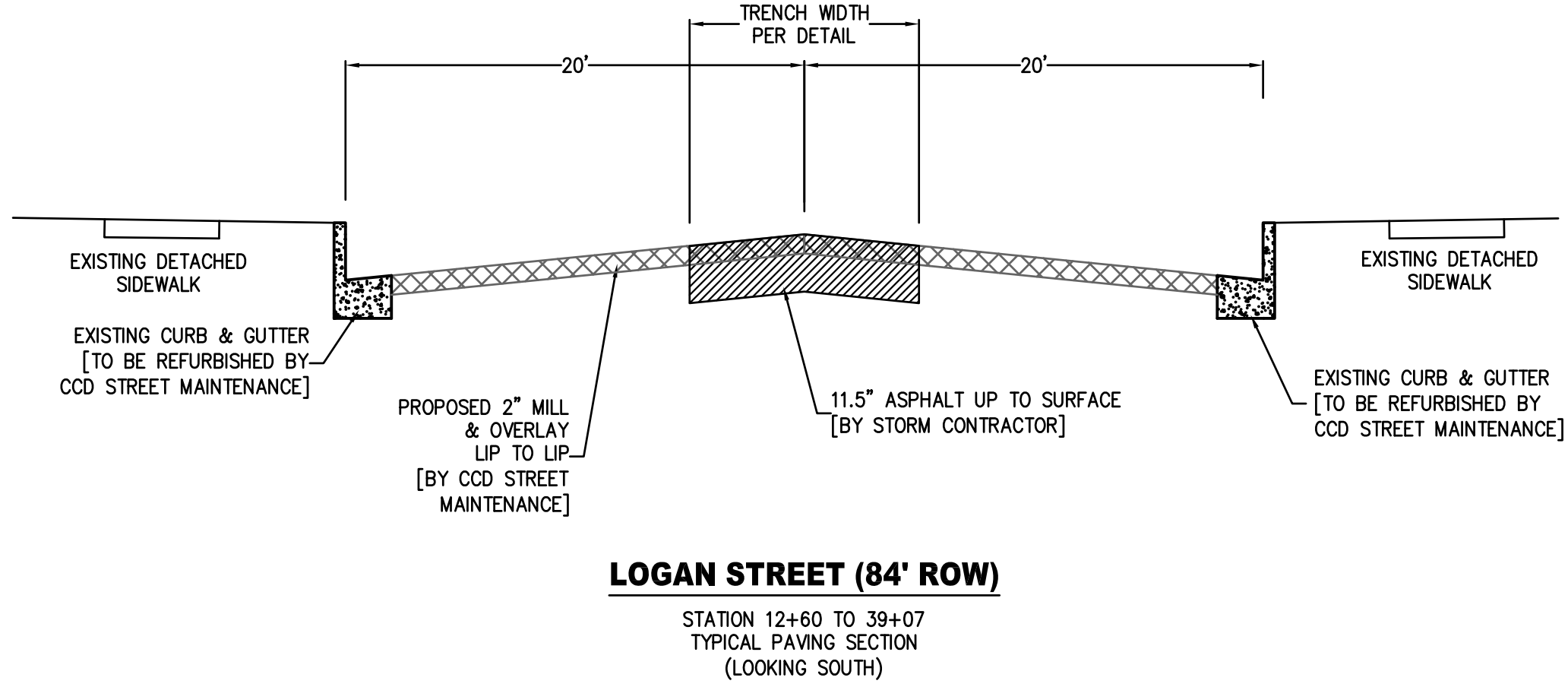
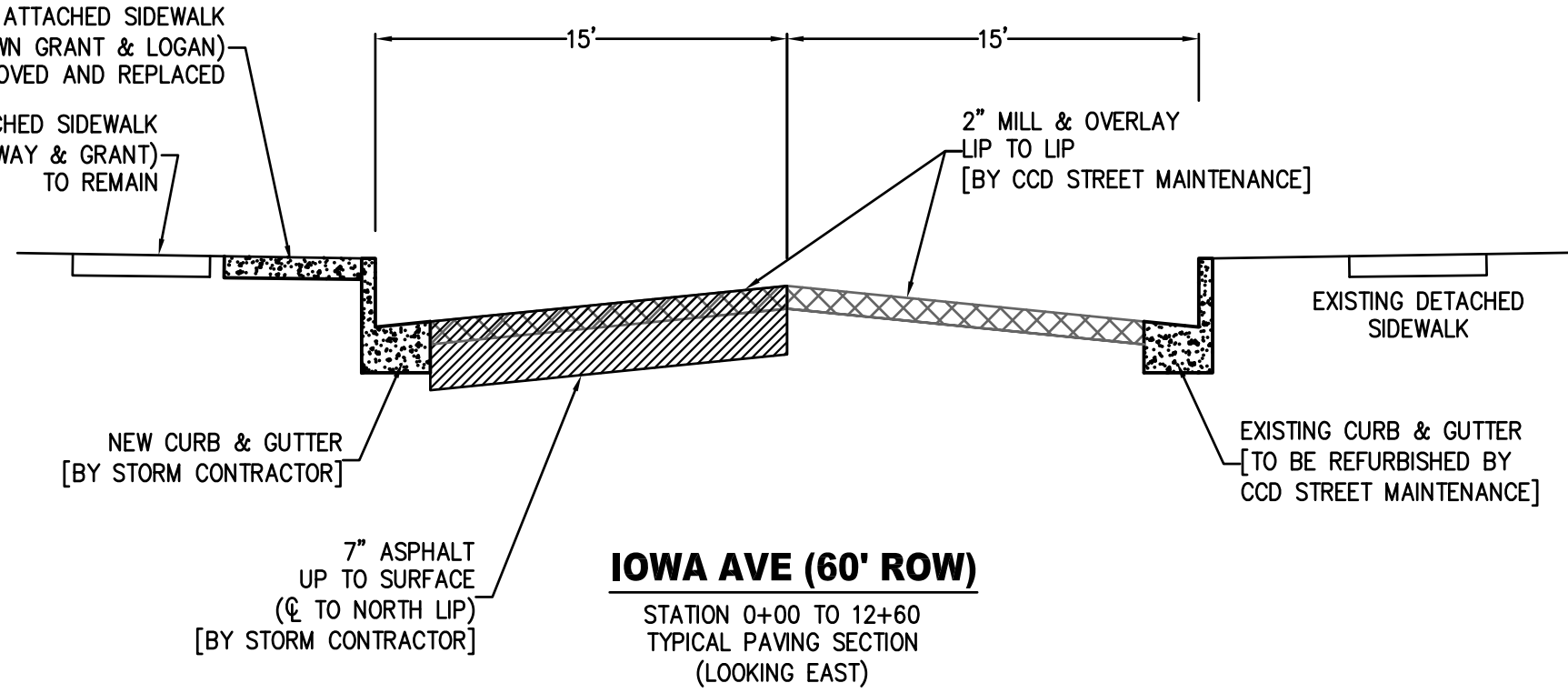
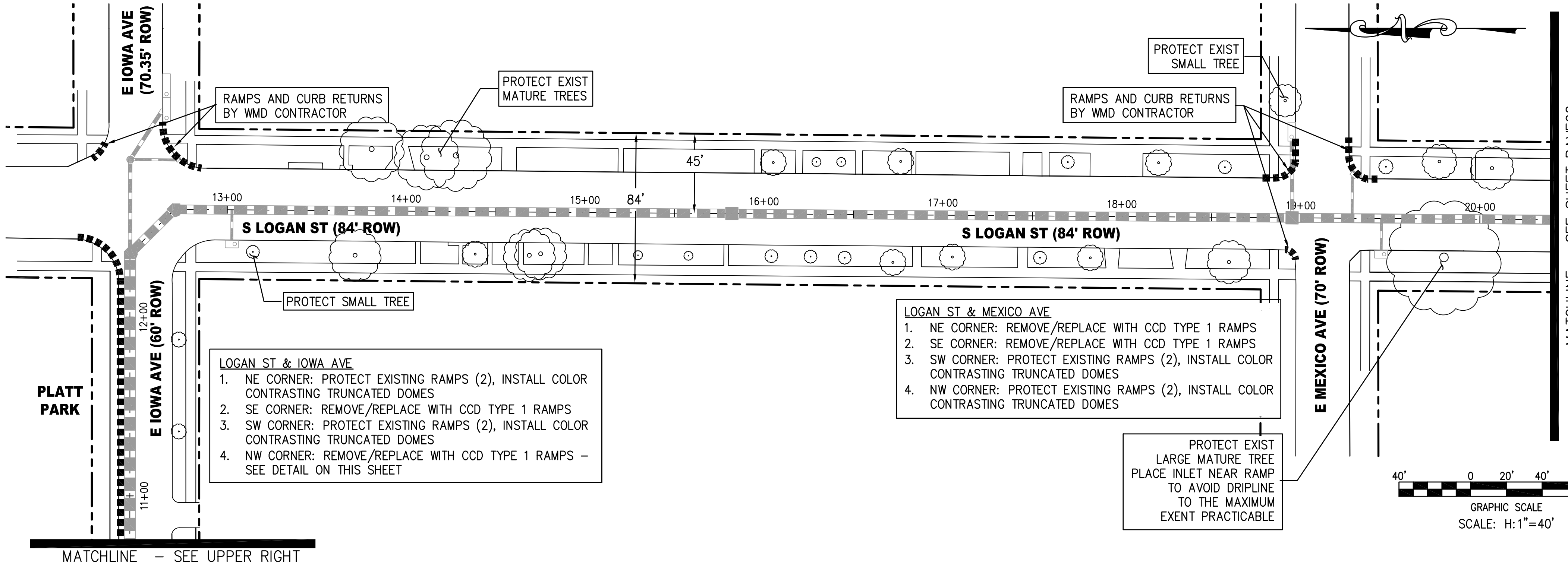
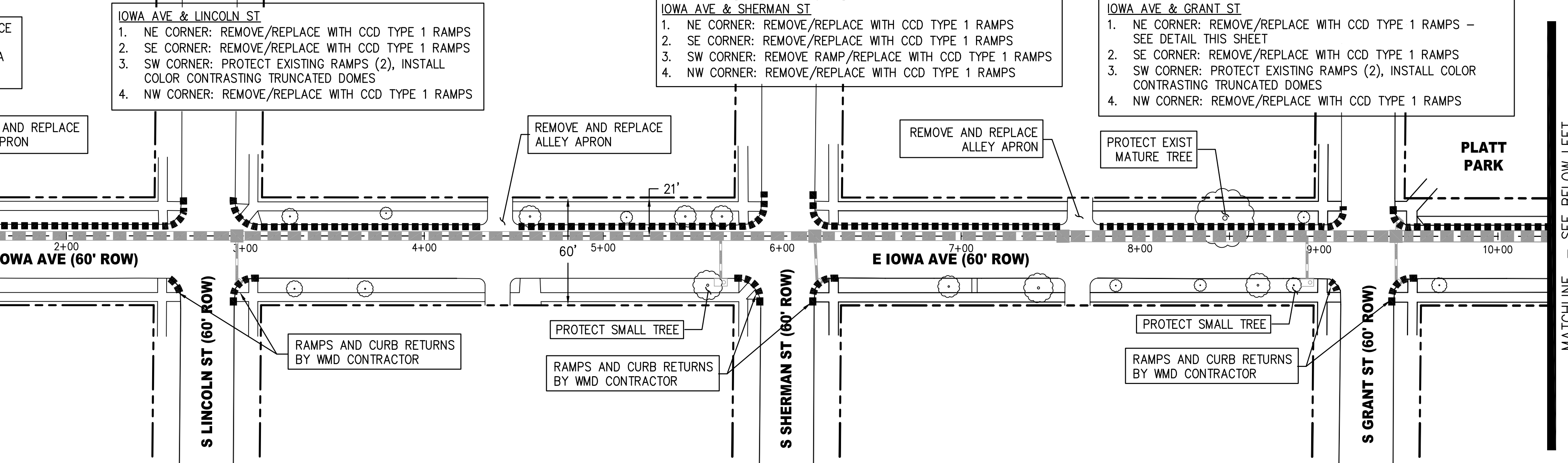
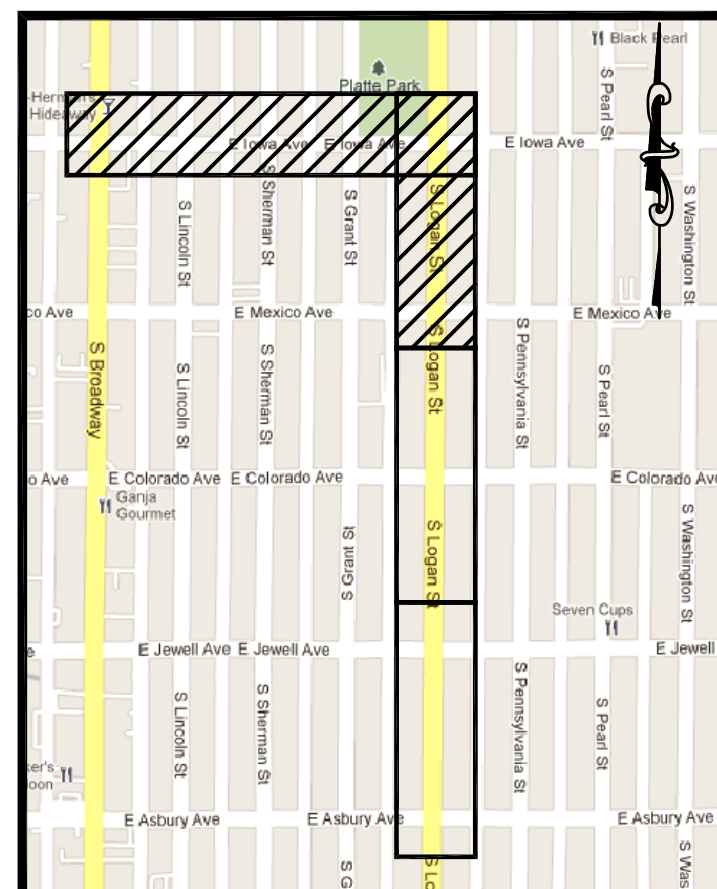
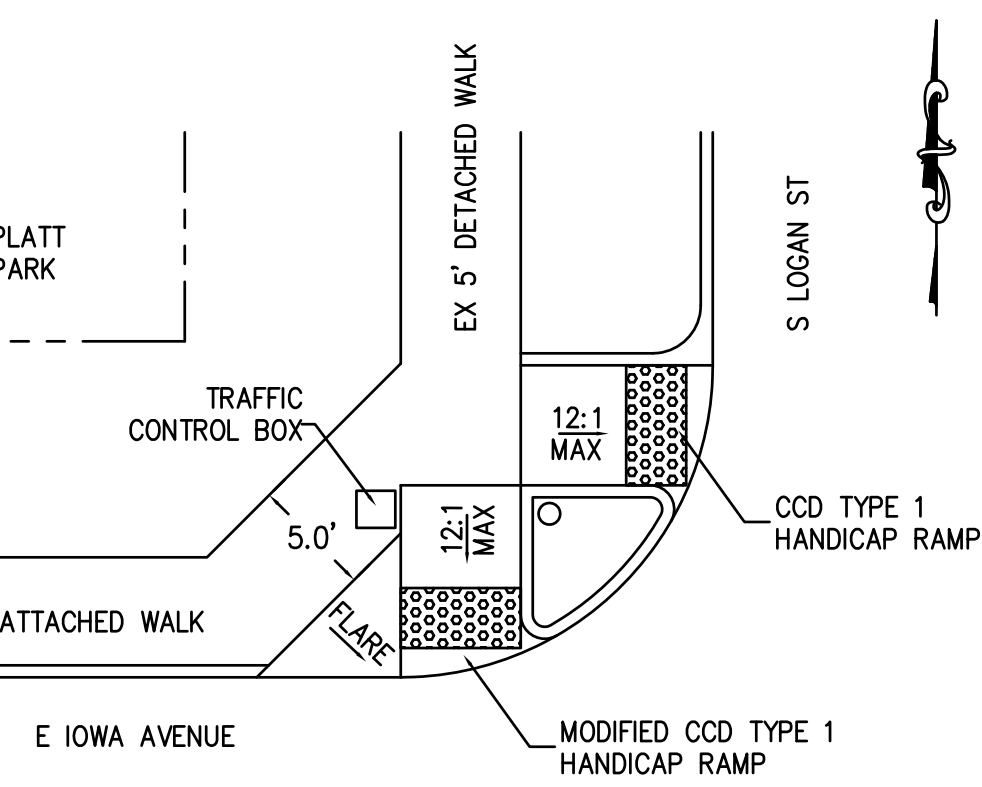
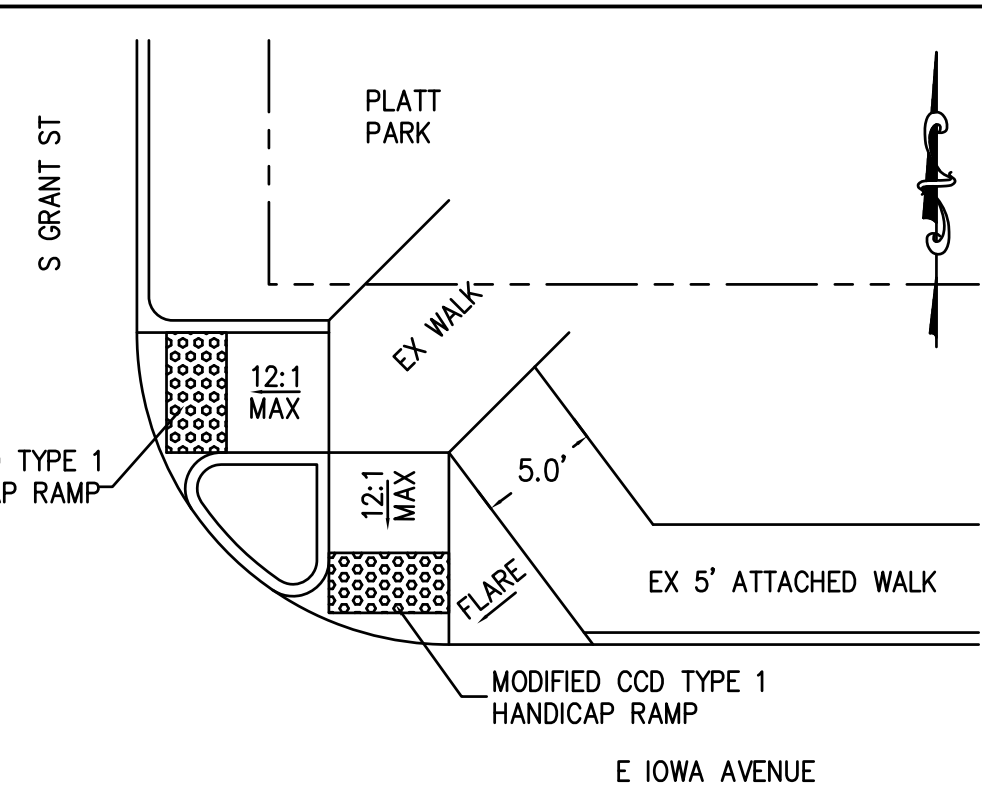
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2. SE CORNER: REMOVE/REPLACE WITH CCD TYPE 1 RAMPS
3. SW CORNER: PROTECT EXISTING RAMPS (2), INSTALL COLOR CONTRASTING TRUNCATED DOMES
4. NW CORNER: REMOVE/REPLACE WITH CCD TYPE 1 RAMPS

IOWA AVE & SHERMAN ST

1. NE CORNER: REMOVE/REPLACE WITH CCD TYPE 1 RAMPS
2. SE CORNER: REMOVE/REPLACE WITH CCD TYPE 1 RAMPS
3. SW CORNER: REMOVE RAMP/REPLACE WITH CCD TYPE 1 RAMPS
4. NW CORNER: REMOVE/REPLACE WITH CCD TYPE 1 RAMPS

IOWA AVE & GRANT ST

1. NE CORNER: REMOVE/REPLACE WITH CCD TYPE 1 RAMPS - SEE DETAIL THIS SHEET
2. SE CORNER: REMOVE/REPLACE WITH CCD TYPE 1 RAMPS
3. SW CORNER: PROTECT EXISTING RAMPS (2), INSTALL COLOR CONTRASTING TRUNCATED DOMES
4. NW CORNER: REMOVE/REPLACE WITH CCD TYPE 1 RAMPS

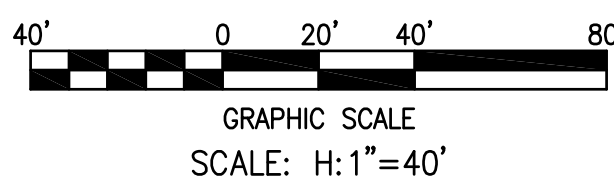


LEGEND

- 7" ASPHALT - BY STORM CONTRACTOR
- 2" MILL & OVERLAY (LIP TO LIP) - BY CCD STREET MAINTENANCE

LEGEND

- 11.5" ASPHALT - BY STORM CONTRACTOR
- 2" MILL & OVERLAY (LIP TO LIP) - BY CCD STREET MAINTENANCE



No.	Description of Revisions	Date	Initial
1	50% Review	1/20/04	BJP
2	95% Review	1/15/10	BJP
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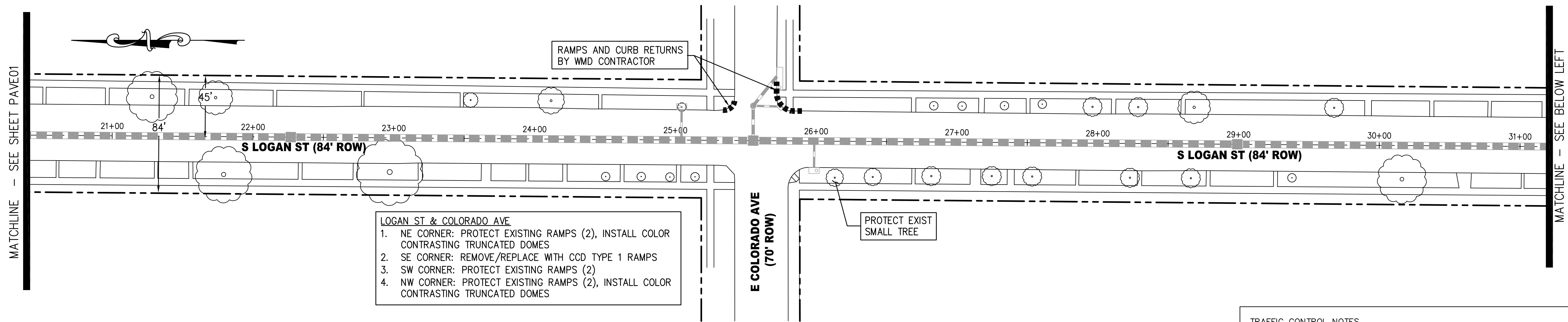
City and County of Denver
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Engineering Division
Wastewater Capital Projects Management

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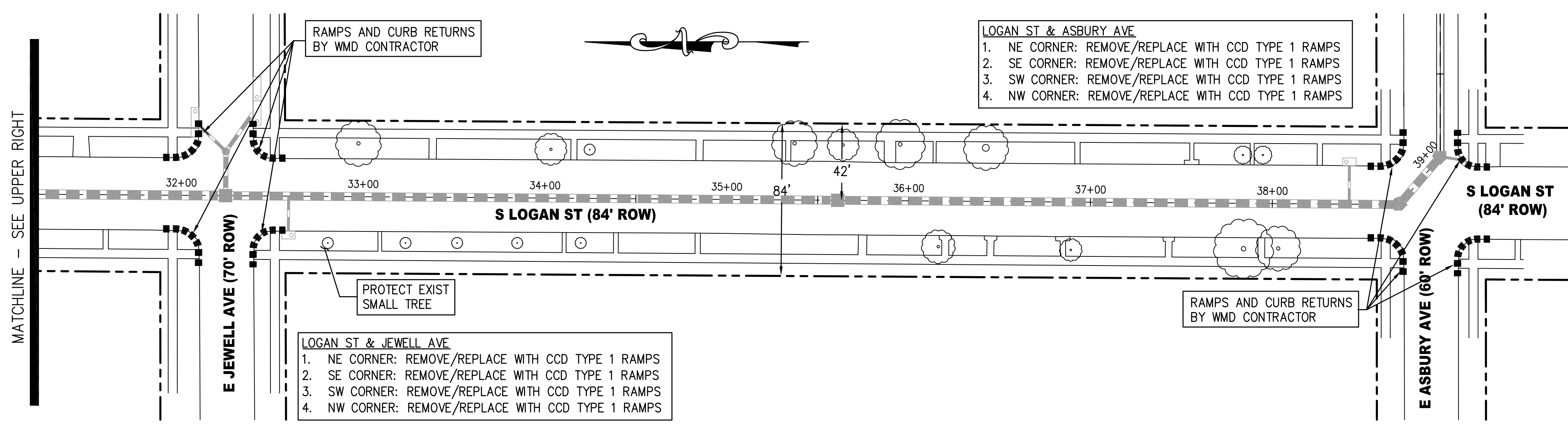
IOWA AVENUE EXTENSION - PHASE I
PAVING PLAN

Drawn by: CAW
Checked by: BJP
Designed by: MJM
Approved by: BJP
Merrick Project: 0301579809
WMD Project No.: PWC2010-5203

Date: 9/10/12
Sheet Name: PAVE01
Sheet No.: 13



LOGAN ST & COLORADO AVE
 1. NE CORNER: PROTECT EXISTING RAMPS (2), INSTALL COLOR CONTRASTING TRUNCATED DOMES
 2. SE CORNER: REMOVE/REPLACE WITH CCD TYPE 1 RAMPS
 3. SW CORNER: PROTECT EXISTING RAMPS (2)
 4. NW CORNER: PROTECT EXISTING RAMPS (2), INSTALL COLOR CONTRASTING TRUNCATED DOMES

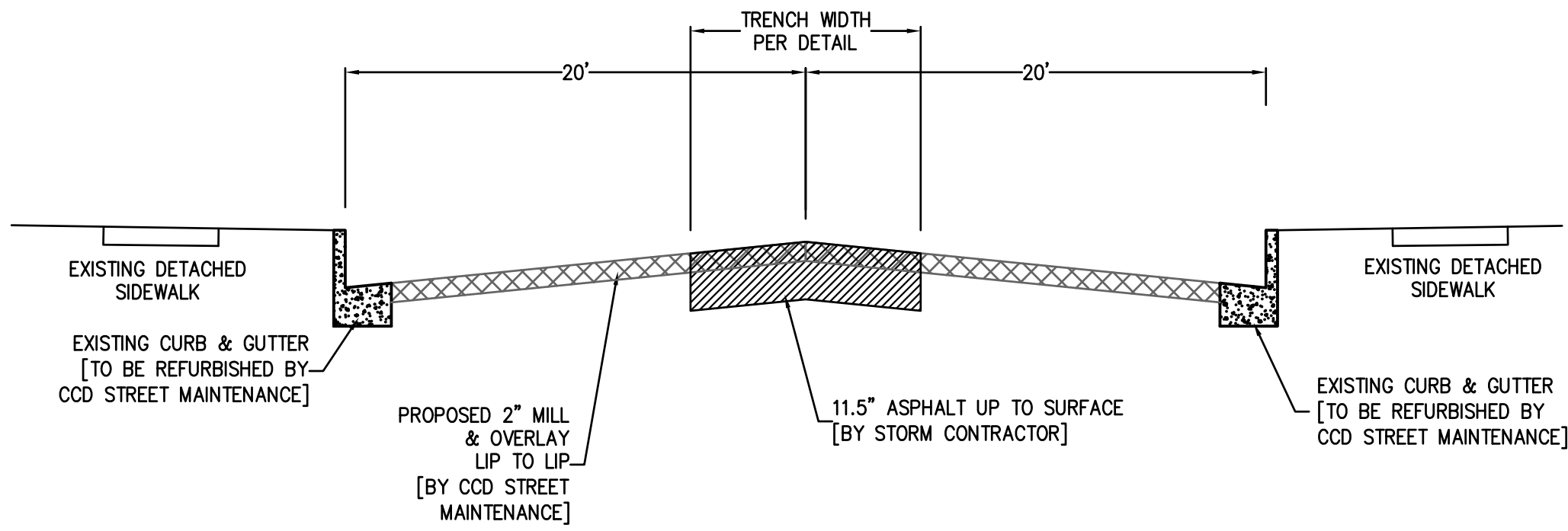
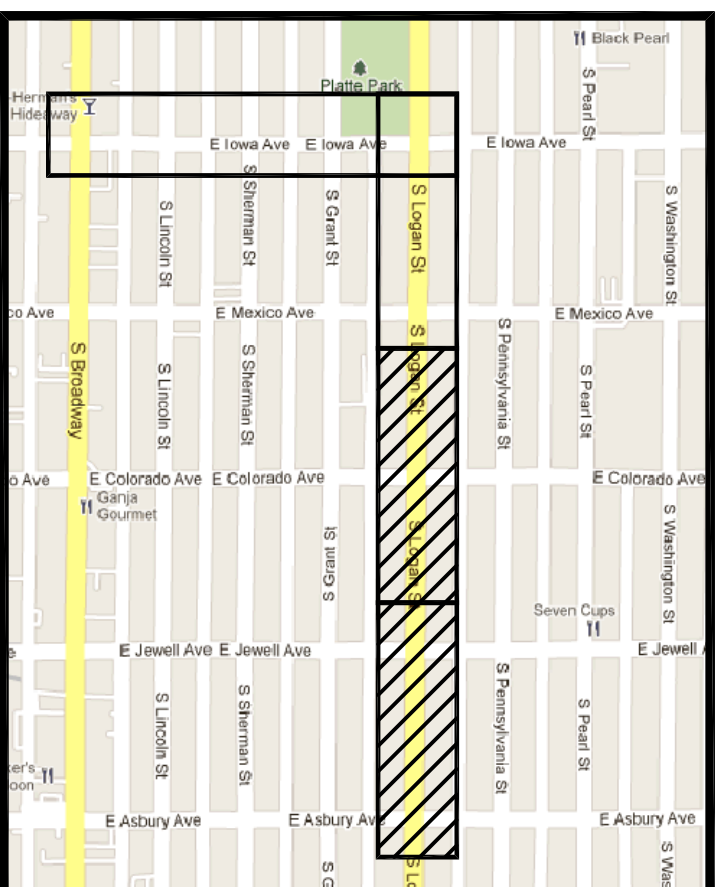
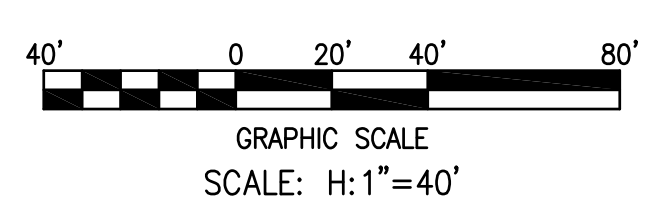


LOGAN ST & JEWELL AVE
 1. NE CORNER: REMOVE/REPLACE WITH CCD TYPE 1 RAMPS
 2. SE CORNER: REMOVE/REPLACE WITH CCD TYPE 1 RAMPS
 3. SW CORNER: REMOVE/REPLACE WITH CCD TYPE 1 RAMPS
 4. NW CORNER: REMOVE/REPLACE WITH CCD TYPE 1 RAMPS

LOGAN ST & ASBURY AVE
 1. NE CORNER: REMOVE/REPLACE WITH CCD TYPE 1 RAMPS
 2. SE CORNER: REMOVE/REPLACE WITH CCD TYPE 1 RAMPS
 3. SW CORNER: REMOVE/REPLACE WITH CCD TYPE 1 RAMPS
 4. NW CORNER: REMOVE/REPLACE WITH CCD TYPE 1 RAMPS

- TRAFFIC CONTROL NOTES**
- THE CONTRACTOR SHALL OBTAIN (RIGHT-OF-WAY OCCUPANCY AND OTHER PERMITS FOR THE ROW) FROM PW-RWS-CONSTRUCTION ENGINEERING FOR THIS CAPITAL PROJECT. ALLOW AT LEAST 5 WORKING DAYS FOR REVIEW AND ISSUING PERMIT. ALLOW LONGER LEAD TIMES FOR TIES TO APPROVE ANY LANE CLOSURES ON ARTERIALS SUCH AS LOGAN OR IOWA. CONTACT 303-446-3469 FOR FORMS AND/OR REVIEW PERSON.
 - THE MOST CURRENT SPECIAL SPECIFICATION FOR SECTION 630 - CONSTRUCTION TRAFFIC CONTROL SHOULD BE USED FOR THIS PROJECT. A COPY OF THIS SPECIFICATION CAN BE PROVIDED IF NEEDED.
 - WORK ON LOCAL ROADWAYS SHOULD BE RESTRICTED TO A MAXIMUM LENGTH OF TWO BLOCKS, ONE INTERSECTION AT A TIME AND WORK BETWEEN THE HOURS OF 7:00 AM AND 5:00 PM AS LONG AS LOCAL ACCESS FOR RESIDENTS CAN BE PROVIDED. WORK ON ARTERIALS AND COLLECTORS THAT WILL IMPACT TRAFFIC OPERATIONS WILL BE RESTRICTED TO 8:30AM TO 3:30PM ON WEEKDAYS OR TO VARIABLE HOURS ON THE WEEKEND BASED ON LOCATION. ANY EXCEPTIONS TO THESE REQUIREMENTS MUST BE APPROVED BY TRAFFIC ENGINEERING SERVICES PRIOR TO ANY WORK BEGINNING
 - ACCESS TO ALL BUSINESSES, SCHOOLS, ETC WILL REMAIN OPEN DURING CONSTRUCTION.
 - TEMPORARY TRAFFIC DETOUR TO AVOID LOCAL ROADWAYS; SEE SHEET 15.
 - DENVER TRAFFIC ENGINEERING SERVICES APPROVAL REQUIRED FOR FULL CLOSURES. CONTRACTOR TO CONTACT TRAFFIC ENGINEER AT A MINIMUM 5 WORKING DAYS PRIOR TO CLOSURE.
 - ALL LOCATIONS WILL REQUIRE A STREET OCCUPANCY PERMIT OBTAINED FROM CONSTRUCTION ENGINEERING AT 303-446-3469.
 - CONTRACTOR TO RESTORE DISTURBED PAVEMENT MARKINGS, INCLUDING ALL EXISTING LANE LINES, MEDIANS, CENTERLINES, CROSS-WALKS, STOP BARS ETC. TO PREVIOUS CONDITION BASED ON FIELD CONSULTATION WITH CITY OF DENVER TRAFFIC ENGINEERING SERVICES.

- SHEET NOTES:**
- INLET CONSTRUCTION SHALL REQUIRE THE REMOVAL OF A CURB/GUTTER/SIDEWALK SECTION IN THE QUANTITIES LISTED BELOW:
 SINGLE NO. 16 INLET - 15'
 DOUBLE NO. 16 INLET - 19'
 6" NO. 14 INLET - 16'
 9" NO. 14 INLET - 19'
 12" NO. 14 INLET - 22'
 15" NO. 14 INLET - 25'
 REMOVALS ACCOUNT FOR INLET LENGTH AND TRANSITION LENGTH PER CCD STANDARD DETAILS S-616.1, S-616.2, S-616.3, S-620.1.
 - INLET CONSTRUCTION SHALL REQUIRE A 5' TRANSITION ON EITHER SIDE OF THE INLET TO CHANGE FROM THE EXISTING MOUNTABLE CURB/GUTTER/SIDEWALK SECTION TO A 6" VERTICAL CURB SECTION AT THE INLET.
 - CURB TRANSITIONS TO BE PAID FOR AS L.F. OF CURB/GUTTER/SIDEWALK. SIDEWALK TIE IN DIRECTLY BEHIND THE INLET SHALL BE PAID FOR AS S.F. OF SIDEWALK.
 - REPLACE IN KIND ANY DISTURBED LANDSCAPING DUE TO INLET, CURB/GUTTER, AND/OR CROSSSPAN INSTALLATION. LANDSCAPING REPLACEMENT SHALL BE PAID FOR UNDER 40-15 LANDSCAPE.
 - ANY CURB/GUTTER, SIDEWALK, AND/OR LANDSCAPING REMOVAL REQUIRED FOR THE WATER SERVICE REPLACEMENTS SHALL BE REPLACED IN KIND AND SHALL BE INCLUDED IN THE COST OF THE WATER SERVICE REPLACEMENT.
 - DRIVEWAY CONSTRUCTION SHALL BE DONE PER CCD STANDARD DETAIL 6.0 (RESIDENTIAL) AND 6.1 (COMMERCIAL).
 - THE CONTRACTOR SHALL PROOF ROLL THE COMPLETED EMBANKMENT, SUBGRADE RECONDITIONING OR ROADWAY SUBGRADE TO DETERMINE IF ANY SOFT, YIELDING OR OTHERWISE UNACCEPTABLE AREAS EXIST. THE INTENT IS TO ACHIEVE A STABLE PLATFORM FOR THE PROPER PLACEMENT OF EMBANKMENT OR PAVEMENTS. THE ENGINEER MAY REQUIRE A WITNESS BE PRESENT DURING THE PROOF ROLL TO VERIFY AREAS TO BE CORRECTED, AND REQUIRE A LOAD VERIFICATION OF THE PROOF ROLLER FROM THE CONTRACTOR. ANY AREAS WHICH SHOW DEFLECTIONS THAT ARE NON UNIFORM OR IN EXCESS OF 0.5 INCH SHALL BE REWORKED AS APPROVED, OR REMOVED AND REPLACED WITH APPROVED MATERIAL WITHOUT ADDITIONAL PAYMENT.
 - ALL REWORKED AREAS SHALL BE RETESTED FOR MOISTURE AND COMPACTION, AND PROOF ROLLED AGAIN AFTER THE SUBGRADE HAS BEEN SHAPED TO THE FINAL GRADE AND CROSS SECTION.
 - THE PROOF ROLLER SHALL BE PROVIDED BY THE CONTRACTOR AND SHALL BE A PNEUMATIC TIRED VEHICLE WITH TIRE PRESSURES OF AT LEAST 18,000 POUNDS PER AXLE. THE PROOF ROLLER SHALL BE OPERATED BETWEEN 2 AND 6 MILES PER HOUR, AND SHALL ACHIEVE COMPLETE COVERAGE OF THE AREA. TO BE CONSTRUCTED WITH EMBANKMENT OR PAVEMENT MATERIALS.
 - UPON APPROVAL OF THE PROOF ROLLING; THE NEXT SOIL AGGREGATE OR PAVEMENT LAYER SHALL BE PLACED PRIOR TO MOISTURE OR WEATHER OR OTHER FACTORS AFFECTING THE SURFACE CONDITION OF THE SUBGRADE. ANY LAPSE OF MORE THAN 24 HOURS SHALL BE APPROVED BY THE ENGINEER, OR ANOTHER PROOF ROLL WILL BE REQUIRED.
 - COMPACTION OF THE TOP TWO-FOOT OF STREET PAVING SUBGRADE IN TRENCHES SHALL MEET 95% PROCTOR COMPACTION, WITHIN 2% OF OPTIMUM MOISTURE BY AASHTO T-180 FOR GRANULAR SUBGRADE (A-1 THRU A-5), OR 95% STANDARD PROCTOR COMPACTION, WITHIN 2% OF OPTIMUM MOISTURE BY AASHTO T-99 FOR COHESIVE CLAY OR SILT (A-6 OR A-7) TYPES OF SOIL SUBGRADE. THE T-99 METHOD MAY BE ALLOWED FOR NON SWELLING MIXED SOILS (A-4 OR A-5). RECONDITION ON THE 12-INCHES OF OTHER SUBGRADE THAT MAY BE EXPOSED AFTER ROTOMILL OR OUTSIDE THE TRENCH, TO THE PROPER MOISTURE AND COMPACTION LIMITS PRIOR TO PAVING.



LOGAN STREET (84' ROW)

STATION 12+60 TO 39+07
 TYPICAL PAVING SECTION
 (LOOKING SOUTH)

- LEGEND**
- 11.5" ASPHALT - BY STORM CONTRACTOR
 - 2" MILL & OVERLAY (LIP TO LIP) - BY CCD STREET MAINTENANCE

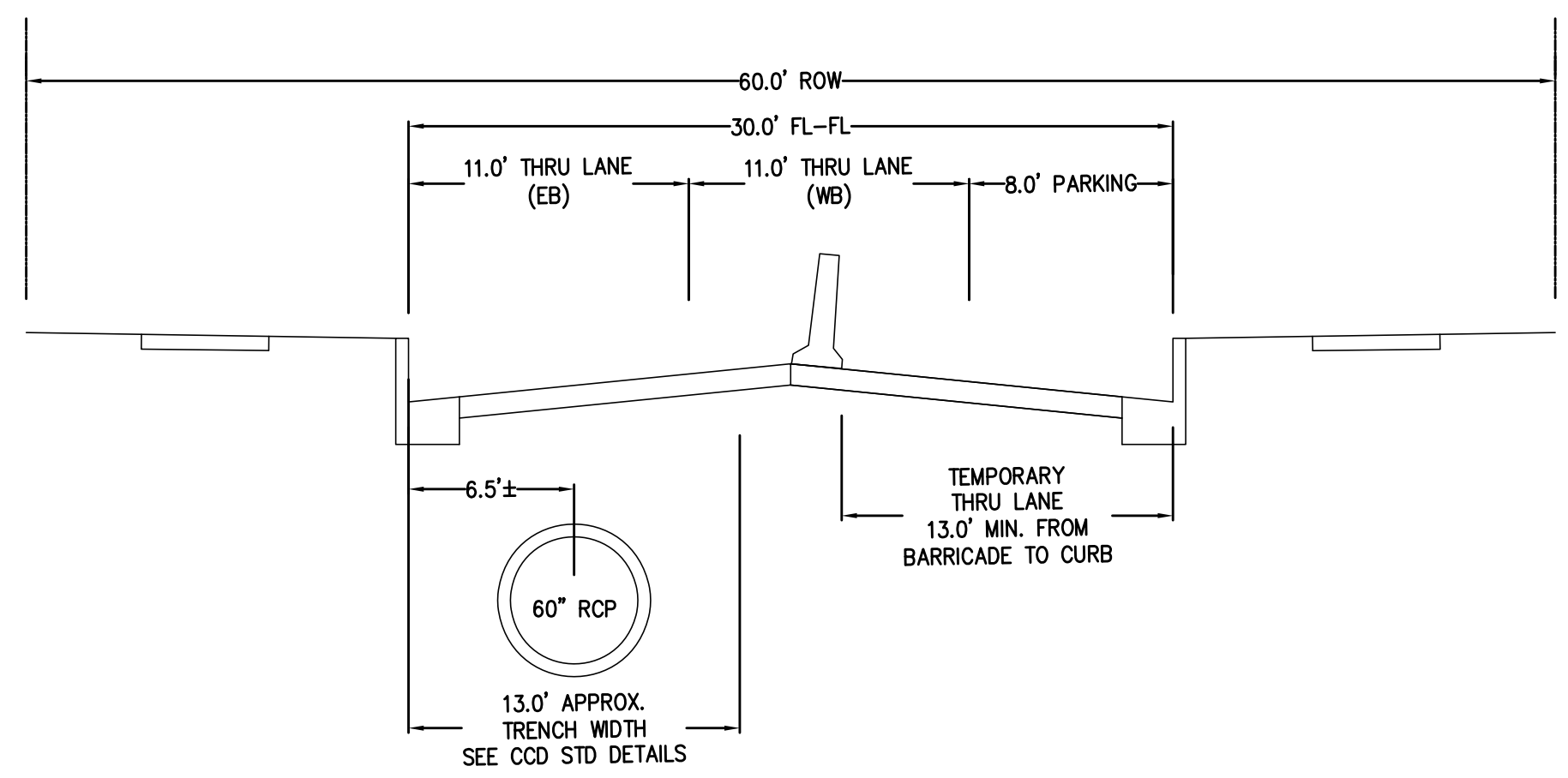
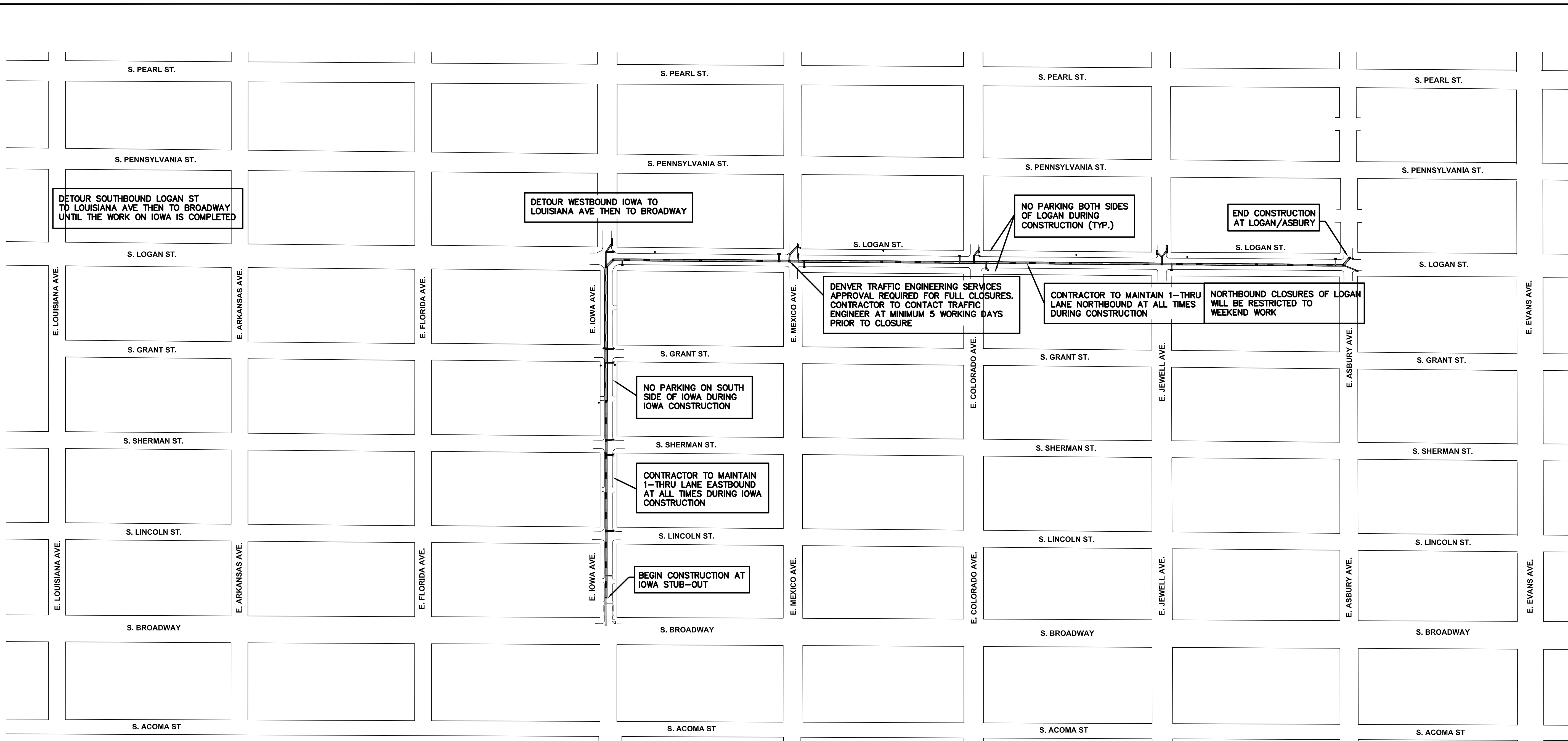
No.	Description of Revisions	Date	Initial
1	50% Review	1/20/09	BJP
2	95% Review	1/15/10	BJP
3	100% Review	6/03/10	BJP
4	BID DOCUMENTS	9/10/12	BJJ

No.	Description of Revisions	Date	Initial

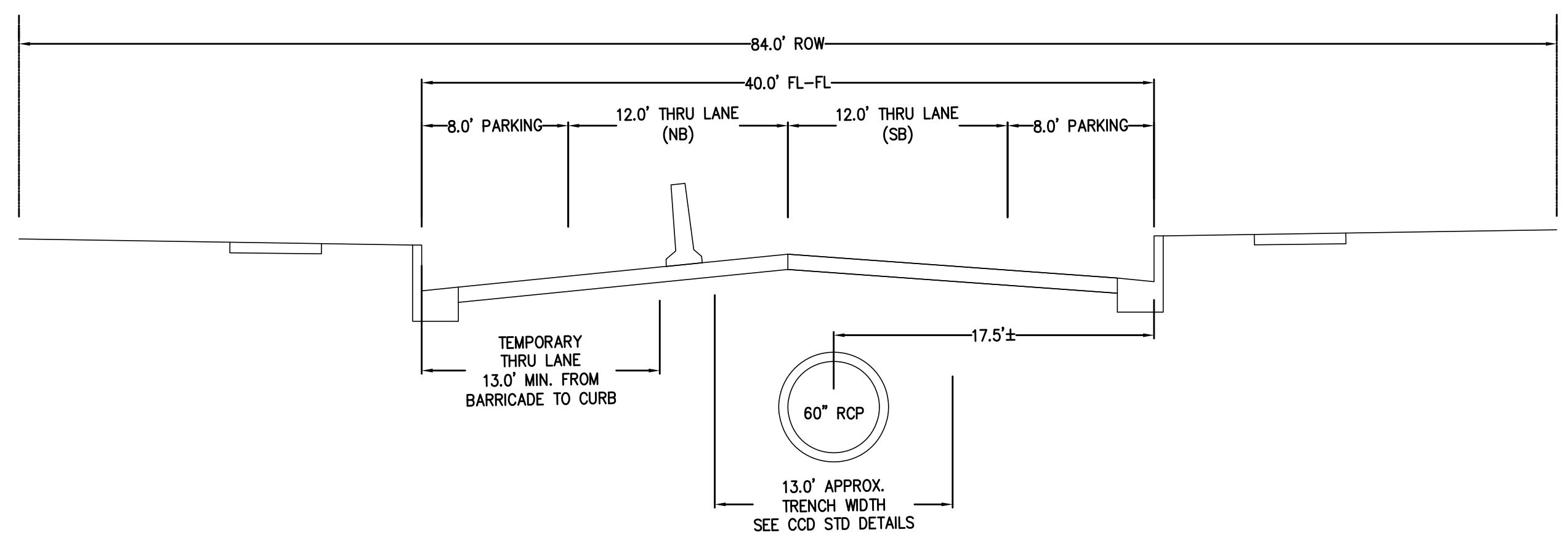
City and County of Denver
Department of Public Works
Engineering Division
Wastewater Capital Projects Management
 2000 W. 3rd Ave. Denver, Colorado 80223
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IOWA AVENUE EXTENSION - PHASE I PAVING PLAN	
Drawn by:	CAW
Checked by:	BJP
Designed by:	MJM
Approved by:	BJP
WMD Project No.:	PWC2010-5203

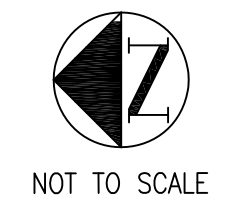
Date: 9/10/12
 Sheet Name: AVE02
 Sheet No: 14



**E IOWA AVE
LOOKING EAST**



**S LOGAN ST
LOOKING SOUTH**



NOT TO SCALE

NOTES

1. THIS SHEET IS FOR INFORMATION ONLY
2. CONTRACTOR MUST OBTAIN A TRAFFIC CONTROL PERMIT

No.	Description of Revisions	Date	Initial
1	50% Review	1/20/09	BJP
2	95% Review	1/15/10	BJP
3	100% Review	5/03/10	BJP
4	BID DOCUMENTS	9/10/12	BJJ

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Drawn by:	CAW	Checked by:	BJP
Designed by:	MJM	Approved by:	BJP
Merrick Project: 0301579809 WMD Project No.: PWC2010-5203			

Date: 9/10/12
Sheet Name: TC
Sheet No: 15

CITY AND COUNTY OF DENVER

DEPARTMENT OF PUBLIC WORKS
ENGINEERING DIVISION

WASTEWATER CAPITAL PROJECTS MANAGEMENT

IOWA AVENUE EXTENSION PHASE 1 (STORM SEWER) WATER ONLY PLANS

DENVER WATER DEPARTMENT PROJECT #16317

OF MAIN LINE RELOCATIONS

NONE

OF MAIN LINE WATER LOWERINGS

SIX

- A. 12" CAST IRON AT IOWA/LINCOLN
- B. 8" DUCTILE IRON AT IOWA/SHERMAN
- C. 6" DUCTILE IRON AT IOWA/GRANT
- D. 12" CAST IRON AT LOGAN/MEXICO
- E. 6" CAST IRON AT LOGAN/COLORADO
- F. 12" CAST IRON AT LOGAN/JEWELL

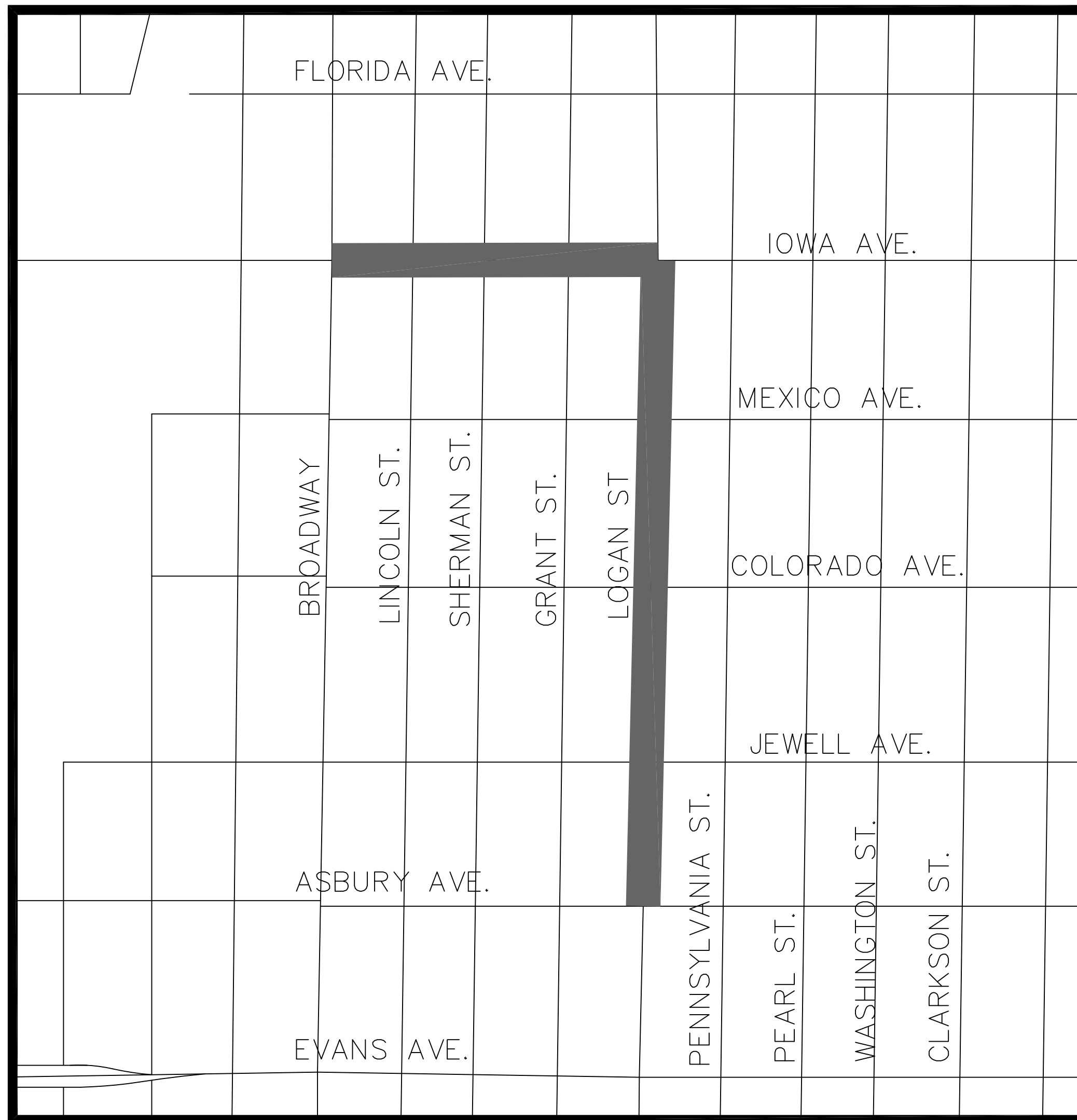
OF NEW OR REPLACED FIRE HYDRANTS

ONE

- A. NE CORNER OF LOGAN/JEWELL (NEW)

OF SERVICE LINE REPLACEMENTS

37 - EXTERNAL METER SETS



SHEET NUMBER AND INDEX OF SHEETS	
SHEET NO.	SHEET NAME
1	COVER SHEET
2	WATER NOTES
3	WATER SERVICES PLAN
4	WATER SERVICES PLAN
5	WATER SERVICES PLAN

Fire hydrants shall be installed according to Denver Water Standards. The number and location(s) of fire hydrant(s) and fire flow as shown on this water main installation is correct as specified by the City and County of Denver Fire Department.

Signature of Fire Chief or Designated Representative

Date Signed _____ gpm fire flow

TO BE COMPLETED BY DENVER WATER	
DENVER WATER'S REVIEW OF THESE PLANS RELATES ONLY TO DENVER WATER REQUIREMENTS, AND DOES NOT INCLUDE A FULL ANALYSIS OF: SOIL CONDITIONS, SUPPORT OR LOAD FACTORS, OR ANY OTHER MATTERS. ANY MODIFICATION OF THESE PLANS MUST BE RESUBMITTED TO DENVER WATER FOR REVIEW PRIOR TO CONSTRUCTION. THE PROFESSIONAL ENGINEER, CONTRACTORS, AND OWNERS DESIGNING AND CONSTRUCTING THIS PROPOSED WATER DISTRIBUTION SYSTEM SHALL BE SOLELY RESPONSIBLE FOR THE ADEQUACY OF THE DESIGN, INSTALLATION, AND MATERIALS UTILIZED IN THIS WATER DISTRIBUTION SYSTEM FOR ANY SPECIFIC SITE LOCATION.	
DATE	I.D. NO.
CONTRACT NO.	MAP NO.
<input type="checkbox"/> APPROVED FOR CONSTRUCTION APPROVAL VALID FOR ONE YEAR	
SALES ADMINISTRATOR	

No.	Description of Revisions	Date	Initial
1	1st DWD Submittal	7/27/12	BJU
2	2nd DWD Submittal	2/16/12	BJU
3	Bid Documents	9/10/12	BJU

**City and County of Denver
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IOWA AVENUE EXTENSION - PHASE I
COVER SHEET
Checked by: TEB
Approved by: TEB
Drawn by: BJU
Designed by: BJU
WMD Project No.: PWC2010-5203
Date: 09/10/12
Sheet Name: CVR01
Sheet No: 01



GENERAL CONSTRUCTION AND WATER NOTES:

MAIN EXTENSION NOTES:

- ALL MATERIALS AND WORKMANSHIP SHALL BE IN CONFORMANCE WITH DENVER WATER'S **ENGINEERING STANDARDS, MATERIALS SPECIFICATIONS, AND DRAWINGS**. ALL MAIN INSTALLATIONS/SYSTEM MODIFICATIONS WILL BE APPROVED AND INSPECTED BY DENVER WATER.
- CONTRACTORS SHALL MAINTAIN A COPY OF THE CURRENT ENGINEERING STANDARDS ON-SITE AT ALL TIMES DURING CONSTRUCTION. SEE THE CHART BELOW FOR A QUICK REFERENCE TO THE FREQUENTLY USED MATERIAL SPECIFICATIONS.

MATERIAL SPECIFICATION QUICK REFERENCES:

MATERIAL SPECIFICATION	DESCRIPTION
MS 01	DI PIPE
MS 02	PVC PIPE
MS 03	FITTINGS
MS 4, MS 5	VALVES
MS 8	TAPPING VALVES
MS 9	TAPPING SLEEVES
MS 12	VALVE BOXES (RECYCLED WATER SYSTEM VALVES BOXES SHALL BE FITTED WITH TRIANGULAR CONVERSE CAST WITH THE WORDS "DENVER WATER RECYCLES" AND SHALL BE COATED WITH A FUSION BONDED EPOXY COATING PANTONE 2577U IN COLOR.)
MS 13	DRY BARREL FIRE HYDRANTS
MS 23	BRASS AND BRONZE GOODS
MS 29	RESTRAINT DEVICES

- TRACER WIRE, 12 GAUGE, SHALL BE INSTALLED ON ALL NON-METALLIC WATER MAINS.
- FOR ALL PIPE INSTALLATIONS, THE DEPTH OF COVER OVER THE PIPE, MEASURED FROM OFFICIAL STREET GRADE TO THE TOP OF THE PIPE, SHALL BE A MINIMUM OF 4-1/2 FEET AND SHALL BE KNOWN AS THE COVER OVER THE PIPE. IF DIFFICULTIES ARISE WHEN CROSSING INTERFERENCE, AND WHERE SPECIFICALLY APPROVED BY DENVER WATER, DEVIATIONS FROM 4-1/2 FEET OF COVER WILL BE PERMITTED. THE COVER OVER THE PIPE SHALL BE A MINIMUM OF 4-1/2 FEET AND A MAXIMUM OF 10 FEET. REFER TO STANDARD DRAWING SHEET 16.
- ANY CHANGES IN ALIGNMENT AND GRADE SHALL BE AUTHORIZED BY DENVER WATER AND SHALL BE ACCOMPLISHED BY THE INSTALLATION OF ADDITIONAL FITTINGS. THE DEFLECTION OF JOINTS IS PERMITTED ONLY WHEN INSTALLING PIPE ON HORIZONTAL OR VERTICAL CURVES.
- THE CONTRACTOR SHALL ADJUST ALL VALVE BOXES AND FIRE HYDRANTS TO THE FINAL FINISHED GRADE.
- ALL BENDS, TEES, FIRE HYDRANTS, BLOW-OFFS, AND PLUGS AT DEAD-END MAINS SHALL BE PROTECTED FROM THRUST WITH MECHANICAL RESTRAINT AND CONCRETE THRUST BLOCKS IN ACCORDANCE WITH DENVER WATER'S ENGINEERING STANDARDS, DRAWINGS 28 AND 32.
- ALL VALVES ARE TO BE LOCATED ON PROPERTY LINE EXTENSIONS, EXCEPT FOR TAPPING TEES WHERE AN ADDITIONAL VALVE SHALL BE PLACED ON THE TAPPING TEE. OTHER VALVE LOCATIONS MAY BE REQUIRED AS SHOWN ON THE PLANS.
- WHEN IT IS NECESSARY TO LOWER OR RAISE WATER LINES AT STORM DRAINS AND OTHER UTILITY CROSSINGS, A MINIMUM CLEARANCE OF 1.5 FEET SHALL BE MAINTAINED BETWEEN THE OUTSIDE OF THE PIPES.
- THE CONTRACTOR SHALL HAVE ONE SIGNED COPY OF THE APPROVED WATER PLANS IN HIS/HER POSSESSION AT ALL TIMES.
- ONLY ONE POINT OF CONNECTION WILL BE ALLOWED UNTIL THE TESTING OF THE NEW INSTALLATIONS IS COMPLETE.
- NEWLY INSTALLED WATER MAINS AND FIRELINES SHALL BE HYDROSTATICALLY TESTED IN ACCORDANCE WITH DENVER WATER ENGINEERING STANDARDS, **SECTION 8.25**.
- PRIOR TO THE INSTALLATION OF WATER MAINS, ROAD CONSTRUCTION MUST HAVE PROGRESSED TO AT LEAST THE SUB-GRADE STATE. SUB-GRADE IS DEFINED AS AN ELEVATION OF NO MORE THAN 7 INCHES BELOW THE FINISHED STREET GRADE.
- THE CONTRACTOR IS RESPONSIBLE FOR:
 - NOTIFYING CUSTOMERS WHO MAY BE AFFECTED BY A WATER OUTAGE DURING CONSTRUCTION.
 - OBTAINING, AT THE CONTRACTOR'S EXPENSE, APPLICABLE LICENSES, PERMITS, BONDS, ETC. THAT ARE REQUIRED FOR THE MAIN INSTALLATION/SYSTEM MODIFICATION.
 - CONTACT DENVER WATER'S CONSTRUCTION ENGINEERING PERSONNEL FOR THE PRE-CONSTRUCTION MEETING AND INSPECTION, 303-628-6038, AT LEAST 48 HOURS PRIOR TO BEGINNING CONSTRUCTION. IN THE EVENT OF AN EMERGENCY IN DENVER OR IN A TOTAL SERVICE AREA AFTER WORKING HOURS, CALL DENVER WATER'S WESTSIDE DISPATCHER: 303-628-6390. IN A MASTER METER DISTRICT, PLEASE CONTACT THE REPRESENTATIVE OF THE DISTRICT IN WHICH THE PROJECT IS TAKING PLACE.
 - PAYING ALL ADDITIONAL CHARGES FOR INSPECTION OUTSIDE NORMAL WORK HOURS.

NOTE: BE ADVISED THAT ON OCCASION VALVES IN OUR SYSTEM MAY BE INOPERABLE. ON SUCH OCCASIONS, IT MAY BECOME NECESSARY TO BACK UP AN ADDITIONAL BLOCK FOR THE SHUT OUT. IF THAT OCCURS, MAKE ADDITIONAL NOTIFICATIONS TO CUSTOMERS WITH THE MANDATORY 24 HOURS ADVANCE NOTICE. WHEN VALVE MAINTENANCE IS REQUIRED, A DELAY OF SEVERAL DAYS SHOULD BE EXPECTED.

TAP AND METER NOTES (FOR DENVER, TOTAL SERVICE, AND READ AND BILL AREAS ONLY. IN MASTER METER DISTRICTS, PLEASE REFER TO THE SPECIFICATION FOR THAT DISTRICT).

- BEFORE ANY TAPS ARE MADE FROM MAINS, APPLICATION(S) FOR THE TAPS MUST BE RECEIVED AND APPROVED BY THE DISTRIBUTOR AND BY DENVER WATER.
- DENVER WATER WILL MAKE ALL TAPS THAT ARE 2 INCHES AND SMALLER.
- INDIVIDUAL SERVICE LINE PRVS ARE REQUIRED WHEN AREA PRESSURE EXCEEDS 80 PSI.
- SERVICES AND METERS:
 - THE CONTRACTOR SHALL HOLD AN ON-SITE PRE-CONSTRUCTION CONFERENCE WITH THE METER INSPECTOR FOR ALL TAPS, SERVICE LINES, AND METERS LARGER THAN ONE INCH, AND FOR PROJECTS INVOLVING MORE THAN ONE TAP AND SERVICE. TO SCHEDULE A PRE-CONSTRUCTION CONFERENCE CALL 303-628-6145.
 - A COPY OF THESE PLANS WITH DENVER WATER'S APPROVAL STICKER MUST BE PRESENT ON-SITE AT THE TIME THE TAP IS MADE AND AT THE TIME THE METER IS INSPECTED OR INSTALLED.
 - PRIOR TO THE TAP BEING MADE, THE CURB VALVE, METER YOKE, AND METER PIT/VAULT SHALL BE IN PLACE. THE CONTRATOR WILL HAVE 3 ADDITIONAL WORKING DAYS TO COMPLETE THE INSTALLATION OF SERVICE LINE. DENVER WATER METER INSPECTIONS WILL MOBILIZE TO THE PREMISE 3 WORKING DAYS AFTER THE TAP IS MADE TO CONDUCT THE METER INSPECTION.
 - A SOIL AMENDMENT INSPECTION WILL BE REQUIRED PRIOR TO THE COMPLETION OF THE CERTIFICATE OF OCCUPANCY. CONTACT CONSERVATION AT 303.628.6670 FOR INFORMATION AND TO SCHEDULE A SOIL AMENDMENT INSPECTION.
 - METERS CANNOT BE SET OR INSPECTED, OR SERVICES ACTIVATED, UNTIL THE REQUIREMENTS FOR BACKFLOW PREVENTION HAVE BEEN COMPLETED. CONTACT THE BACKFLOW PREVENTION PROGRAM PERSONNEL AT 303-628-5940 FOR FURTHER INFORMATION.
 - ALLOW AT LEAST 3 WORKING DAYS ADVANCE NOTICE WHEN SCHEDULING TAPS. TO SCHEDULE A TAP CALL 303-628-6701; FOR QUESTIONS RELATED TO METER INSPECTION CALL 303-628-6145. SERVICE ACTIVATION WILL TAKE PLACE WHEN THE SERVICE AND METER SETTING PASS INSPECTION.
 - ALL METER AND AUTOMATIC METER READING DEVICE LOCATIONS SHALL BE APPROVED BY A DENVER WATER METER INSPECTOR, EXCEPT IN MASTER METER DISTRIBUTOR DISTRICTS.
 - METER PITS AND VAULTS MUST BE SET FLUSH WITH THE FINAL GRADE OF THE LANDSCAPE, INCLUDING PROPER DEPTH OF SOIL AMENDMENT. IF FINAL GRADING HAS NOT BEEN COMPLETED AT THE TIME OF METER INSPECTION, THE OWNER WILL BE REQUIRED TO RAISE OR LOWER THE METER PIT/VAULT WHEN FINAL GRADE IS ESTABLISHED. ADJUSTMENT OF THE PIT MAY REQUIRE ADJUSTMENT OF THE METER SETTING WITHIN THE PIT.
 - METER SETTING, VALVES, AND SERVICE LINES FROM THE MAIN TO THE BACKFLOW PREVENTER ASSEMBLY, IF PRESENT, OR TO 5 FEET AFTER THE METER VAULT, MUST MEET ALL APPLICABLE ENGINEERING STANDARDS IN EFFECT AT THE TIME OF ACTIVATION. IF NECESSARY TO COMPLY WITH CURRENT STANDARDS, MODIFICATIONS MAY BE REQUIRED FROM THE DETAILS ON THESE PLANS.

- NO PRESENT OR FUTURE FENCES OR WALLS ARE PERMITTED BETWEEN THE RIGHT OF WAY (ROW) OR EASEMENT AND THE METER SETTING. THERE SHALL BE NO PERMANENT OBSTRUCTIONS WITHIN 5 FEET OF THE OUTSIDE WALL OF THE METER PIT OR VAULT.
- TAP RELOCATION (FROM WHAT IS SHOWN ON THESE PLANS) MAY BE NECESSARY TO AVOID PAVED AREAS OR OTHER OBSTRUCTIONS THAT ARE NOT SHOWN ON THE PLANS. DEVIATIONS FROM THESE PLANS AND STANDARDS MUST BE APPROVED PRIOR TO CONSTRUCTION.
- INSIDE THE CITY OF DENVER AND IN TOTAL SERVICE AND READ & BILL DISTRIBUTOR DISTRICTS, METERS MUST BE FURNISHED WITH AUTOMATIC METER READING (AMR) DEVICES AS SPECIFIED BY DENVER WATER. THE AMR DEVICES WILL BE INSTALLED BY DENVER WATER AT THE TIME OF SERVICE ACTIVATION.
- METER PITS AND VAULTS SHALL HAVE APPROPRIATE LIDS BASED ON THE LOCATION AND THE APPLICATION. CONTACT METER INSPECTION AT 303-628-6145 TO DETERMINE THE CORRECT LID CONFIGURATION.
- THE CONTRACTOR SHALL PROVIDE A REMOTE AMR DEVICE MOUNTING BOX WHEN REQUIRED. INSTALL A DOUBLE-GANG 4X4 ELECTRICAL JUNCTION BOX; MOUNT AS DIRECTED 7 FEET ABOVE GRADE. INSTALL BELDEN #9451 CABLE IN 3/4-INCH OR LARGER CONDUIT FROM THE METER TO THE MOUNTING BOX. TWO BOXES AND TWO CABLES ARE REQUIRED FOR COMPOUND METERS.
- INSIDE THE CITY OF DENVER, ALL MULTI-FAMILY DWELLINGS WITH A SINGLE TAP, SERVICE LINE, AND METER ARE REQUIRED TO SUB-METER EACH INDIVIDUAL UNIT (SEC 401.3.2 OF DENVER MODIFICATIONS TO THE INTERNATIONAL PLUMBING CODE, ORDINANCE NUMBER 576, SERIES OF 2004). CALL THE CITY AND COUNTY OF DENVER PLUMBING INSPECTOR FOR INFORMATION AT 720-865-2625.
- INSIDE THE CITY OF DENVER, ALL SERVICE LINES MUST BE INSTALLED TO AVOID EXISTING OR PROPOSED STREET TREES. CONTACT THE CITY AND COUNTY OF DENVER'S FORESTER AT 720-913-0647 FOR INFORMATION.
- EXISTING SERVICES MUST BE METERED AT ALL TIMES UNTIL THE TAP HAS BEEN CUT AT THE MAIN AND WITNESSED BY DENVER WATER.

CROSS-CONNECTION CONTROL REQUIREMENTS:

THE LICENSEES LISTED BELOW SHALL BE IN CONFORMANCE WITH DENVER WATER'S ENGINEERING STANDARDS, CHAPTER 5.05, CROSS-CONNECTION CONTROL AND BACKFLOW PREVENTION. BACKFLOW PREVENTION ASSEMBLIES ARE REQUIRED TO BE INSTALLED ON THE FOLLOWING WATER SERVICE LINES:

- COMMERCIAL PROPERTIES: REAL ESTATE ZONED FOR BUSINESSES AND/OR INDUSTRIAL USE THAT CONSIST OF SIX OR MORE UNITS WITH A DOMESTIC, FIRELINE, OR DEDICATED WATER IRRIGATION SERVICE TAP (DEFINED AS SUCH FOR CROSS-CONNECTION PURPOSES).
 - DOMESTIC, DEDICATED IRRIGATION, FIRELINE AND/OR RECYCLED WATER SERVICE LINES.
 - MULTI-FAMILY RESIDENTIAL: A DWELLING WITH TWO TO FIVE UNITS WITH A DOMESTIC, FIRELINE, AND/OR DEDICATED WATER SERVICE TAP (DEFINED AS SUCH FOR CROSS-CONNECTION PURPOSES).
 - PREMISES OVER THREE STORIES/GREATER THAN 30 FEET, FIRE PROTECTION SYSTEM, COMMON BOILER, AUXILIARY WATER, SWIMMING POOL AND IRRIGATION SYSTEMS.
 - SINGLE FAMILY RESIDENTS: A SINGLE UNIT DWELLING (DEFINED AS SUCH FOR CROSS-CONNECTION PURPOSES)
 - DUAL WATER SUPPLY AGREEMENT.
- A. ALL BACKFLOW PREVENTION ASSEMBLIES SHALL BE A MODEL MANUFACTURED IN COMPLIANCE WITH AWWA C510 AND C511 AND SHALL HAVE MET THE SPECIFICATIONS BY THE UNIVERSITY OF CALIFORNIA FOUNDATION FOR CROSS-CONNECTION CONTROL AND HYDRAULIC RESEARCH:
- FOUNDATION FOR CROSS-CONNECTION CONTROL AND HYDRAULIC RESEARCH
SCHOOL OF ENGINEERING MC-2531
UNIVERSITY OF SOUTHERN CALIFORNIA
P.O. BOX 77902
LOS ANGELES, CA 90007
FOUNDATION OFFICE: (866) 545-6340
HTTP://WWW.USC.EDU/DEPT/FCOCHR/

- THE LICENSEE IS REQUIRED TO HAVE A CERTIFIED AMERICAN BACKFLOW PREVENTION ASSOCIATION (ABPA) OR AMERICAN SOCIETY OF SANITARY ENGINEERING (ASSE) TESTER INSPECT AND TEST THE EXISTING AND/OR NEWLY INSTALLED CONTAINMENT BACKFLOW PREVENTION ASSEMBLIES ON THE DEDICATED WATER SERVICE LINES (DOMESTIC, DEDICATED IRRIGATION, FIRELINE, AND RECYCLED) UPON INSTALLATION AND ANNUALLY THEREAFTER.
- THE ABPA OR ASSE CERTIFIED BACKFLOW TESTER IS RESPONSIBLE TO MEET THE REQUIREMENTS LISTED IN THE ENGINEERING STANDARDS, CHAPTER 5.05.
 - IF THE ABPA OR ASSE CERTIFIED BACKFLOW TESTER IS TESTING A BACKFLOW PREVENTION ASSEMBLY INSTALLED ON A RECYCLED WATER SERVICE LINE, THE TESTER IS REQUIRED TO HAVE A DEDICATED RECYCLED WATER TEST GAUGE.
- WITHIN 48 HOURS OF DENVER WATER SETTING THE METER AND TURNING ON THE WATER SERVICE, THE ABPA OR ASSE CERTIFIED BACKFLOW TESTER IS REQUIRED TO SUBMIT THE CONTAINMENT BACKFLOW ASSEMBLY TEST REPORT(S) TO THE CROSS-CONNECTION CONTROL OFFICE:

PHONE: 303-628-5969
FAX: 303-794-8325
E-MAIL: CROSSCONNECTIONCONTROL@DENVERWATER.ORG
DENVER WATER
ATTN: CROSS-CONNECTION CONTROL
6100 W. QUINCY AVENUE
DENVER, CO 80235

- THERE SHALL BE NO UNPROTECTED TAKEOFFS FROM THE SERVICE LINE AHEAD OF ANY METER OR AHEAD OF A BACKFLOW PREVENTION ASSEMBLY LOCATED AT THE POINT OF DELIVERY TO THE CUSTOMER'S WATER SYSTEM.
- NO BRANCH LINES OR TAPS ARE ALLOWED ON DEDICATED COMMERCIAL IRRIGATION WATER SERVICE LINES OR RECYCLED WATER SERVICE LINES FOR DOMESTIC (POTABLE) USE (E.G., DRINKING FOUNTAINS, WATER PLAY FEATURES, SWIMMING POOL, RESTROOM FACILITIES, ETC.):
 - BETWEEN THE IRRIGATION TAP AND THE METER.
 - BETWEEN THE METER AND THE BACKFLOW PREVENTION ASSEMBLY
 - DOWNSTREAM FROM THE BACKFLOW PREVENTION ASSEMBLY.
- COMMERCIAL IRRIGATION WATER SERVICE LINE TAPS:
 - COMPLY WITH THE CROSS-CONNECTION CONTROL REQUIREMENTS LISTED ABOVE (A-F).
 - REQUIRE AN APPROVED USC FCCOHR REDUCED PRESSURE PRINCIPLE (RP) BACKFLOW PREVENTION ASSEMBLY TO BE INSTALLED 5 FEET DOWNSTREAM FROM THE METER PIT AS AN ABOVE GROUND INSTALLATION BEFORE ANY CONNECTIONS. REFER TO THE MANUFACTURER'S INSTALLATION INSTRUCTIONS FOR HEIGHT AND ORIENTATION REQUIREMENTS.
 - IF THE BACKFLOW PREVENTION ASSEMBLY CANNOT BE INSTALLED 5 FEET DOWNSTREAM FROM THE METER PIT, INCLUDE A VARIANCE LETTER JUSTIFYING THE NEED FOR RELOCATION.
- RECYCLED WATER SERVICE LINES TAPS: BACKFLOW PREVENTION ASSEMBLIES ARE REQUIRED TO BE INSTALLED ON COMMERCIAL RECYCLED WATER SERVICE LINE TAPS:
 - IF CHEMICAL INJECTION IS USED DOWNSTREAM FROM THE METER.
 - IF PUMPS ARE USED DOWNSTREAM FROM THE METER.
 - IF THE EXISTING OR PROPOSED SYSTEM POSES A RISK TO THE INTEGRITY OF THE RECYCLED WATER SYSTEM.
 - COMPLY WITH THE CROSS-CONNECTION CONTROL REQUIREMENTS LISTED ABOVE (A-F).
 - REQUIRE AN APPROVED USC FCCOHR REDUCED PRESSURE PRINCIPLE (RP) BACKFLOW PREVENTION ASSEMBLY TO BE INSTALLED 5 FEET DOWNSTREAM FROM THE METER PIT AS AN ABOVE GROUND INSTALLATION BEFORE ANY CONNECTIONS. REFER TO THE MANUFACTURER'S INSTALLATION INSTRUCTIONS FOR HEIGHT AND ORIENTATION REQUIREMENTS.
 - IF THE BACKFLOW PREVENTION ASSEMBLY CANNOT BE INSTALLED 5 FEET DOWNSTREAM FROM THE METER PIT, INCLUDE A VARIANCE LETTER JUSTIFYING THE NEED FOR RELOCATION.
 - BACKFLOW PREVENTION ASSEMBLIES INSTALLED ON RECYCLED WATER SERVICE LINES SHALL BE IDENTIFIED AS "RECYCLED WATER."

- RECYCLED OR RAW WATER (DITCH WATER, POND, WELL, ETC.) USED FOR IRRIGATION ON THE PREMISES:
 - COMPLY WITH THE CROSS-CONNECTION CONTROL REQUIREMENTS LISTED ABOVE (A-F).
 - REQUIRES AN APPROVED USC FCCOHR BACKFLOW PREVENTION ASSEMBLY (CONTAINMENT) TO BE INSTALLED 5 FEET DOWNSTREAM FROM THE METER PIT ON ANY POTABLE WATER SERVICE LINE.
 - THE BACKFLOW ASSEMBLY TYPE IS DETERMINED BY THE "DEGREE OF HAZARD" DOWNSTREAM FROM THE METER; REFER TO DENVER WATER'S ENGINEERING STANDARDS, 1.06, DEGREE OF HAZARD, OR CONTACT CROSS-CONNECTION CONTROL AT 303-628-5940.
- IT IS AT THE SOLE DISCRETION OF DENVER WATER'S CROSS-CONNECTION CONTROL SECTION TO APPROVE A VARIANCE REQUEST RELATED TO A PROPOSED BACKFLOW PREVENTION ASSEMBLY INSTALLATION.

HEALTH NOTES/WATER QUALITY:

- THE COLORADO DEPARTMENT OF PUBLIC HEALTH & ENVIRONMENT (CDPHE) REGULATES ASBESTOS ACTIVITIES THROUGH THE AIR POLLUTION CONTROL DIVISION (APCD) AND THE SOLID WASTE AND MATERIALS MANAGEMENT DIVISION (SWMD) WHEN SOIL CONTAMINATION IS INVOLVED. DENVER WATER WILL REQUIRE CONTRACTORS AND DEVELOPERS TO FOLLOW THE PROCEDURES BELOW WHEN CEMENT ASBESTOS PIPE IS ENCOUNTERED:
 - THE PIPE MUST BE REMOVED FROM THE EXCAVATION FOR PROPER DISPOSAL.
 - THE CONTRACTOR/DEVELOPER WILL MANAGE THE PIPE IN ACCORDANCE WITH THE FOLLOWING REGULATIONS:
 - COLORADO AIR REGULATIONS NO 8 - CONTROL OF HAZARDOUS AIR POLLUTANTS
 - OSHA 29 CFR 190.11001 - GENERAL INDUSTRY STANDARDS - ASBESTOS
 - OSHA 29 CFR 1926.1101 - CONSTRUCTION STANDARDS - ASBESTOS
 - IF LARGE AMOUNTS OF CEMENT ASBESTOS PIPE ARE ANTICIPATED TO BE REMOVED, THE MATERIAL MUST BE MANAGED BY AN APPROPRIATE ASBESTOS ABATEMENT CONTRACTOR (160 SQUARE FEET OR 260 LINEAR FEET WILL REQUIRE A PERMIT).

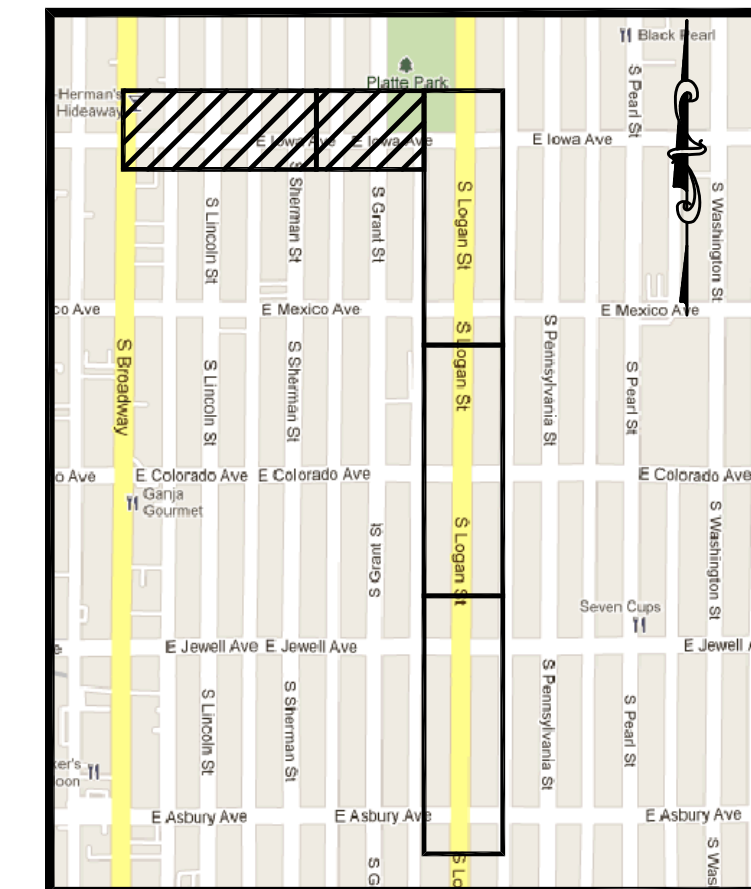
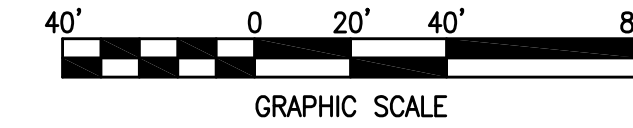
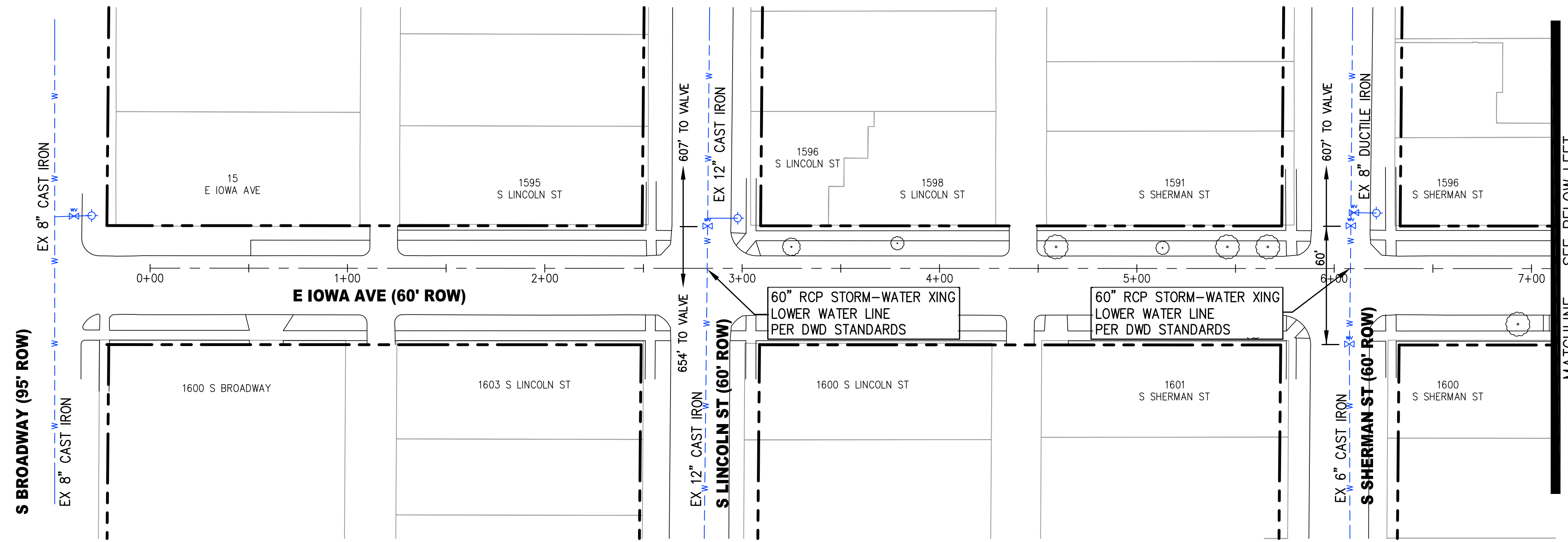
NOTE: CEMENT ASBESTOS PIPE IS CONSIDERED A NON-FRIABLE ASBESTOS MATERIAL, DEFINED AS CONTAINING MORE THAN 1% ASBESTOS BY WEIGHT, AND CANNOT BE CRUMBLED, PULVERIZED, OR REDUCED TO POWDER BY HAND PRESSURE. THEREFORE, A RELEASE OF ASBESTOS FIBERS IS NOT LIKELY DURING NORMAL USE AND HANDLING OF THIS MATERIAL.
- DENVER WATER PERSONNEL ARE NOT RESPONSIBLE FOR WORK SITE SAFETY OR THE COMPLIANCE/ENFORCEMENT OF SAFETY REGULATIONS AND STANDARDS ESTABLISHED BY OTHER AGENCIES. ALL SAFETY COMPLIANCE/ENFORCEMENT AT THE WORK SITE SHALL BE THE CONTRACTOR'S SOLE RESPONSIBILITY.
- THE WATER QUALITY CONTROL DIVISION OF THE COLORADO DEPARTMENT OF PUBLIC HEALTH AND ENVIRONMENT (CDPHE) REQUIRES ALL WATER LINE CONTRACTORS TO POSSESS A CURRENT DISCHARGE PERMIT FOR DISCHARGES OF CHLORINATED AND PROCESS WATERS ASSOCIATED WITH THE INSTALLATION OF NEW MAINS OR CONDUITS. CONTACT CDPHE WATER QUALITY CONTROL DIVISION AT 303-692-3539 FOR INFORMATION ON OBTAINING THE REQUIRED PERMIT.
- CHLORINATION AND FLUSHING: ALL WATER MAINS SHALL BE INSTALLED AND CHLORINATED IN ACCORDANCE WITH DENVER WATER'S ENGINEERING STANDARDS, SECTION 8.24. THE LINES SHALL BE CHLORINATED IN ACCORDANCE WITH AWWA C-651, "DISINFECTING WATER MAINS." THE PREFERRED METHOD IS TO USE SUFFICIENT CHLORINE TABLETS TO PRODUCE A 25 MG/L SOLUTION. TABLETS SHOULD BE ATTACHED TO THE TOP OF THE PIPE WITH AN APPROVED ADHESIVE CERTIFIED TO NSF STANDARD 61, PRIOR TO PIPE INSTALLATION IN THE TRENCH. CHLORINATION OF 16 INCH AND LARGER PIPE REQUIRES A CHLORINE SLURRY. THE CHLORINATION OF ANY FINISHED PIPELINE SHALL BE COMPLETED PRIOR TO HYDROSTATIC TESTING.

IRRIGATION NOTES:

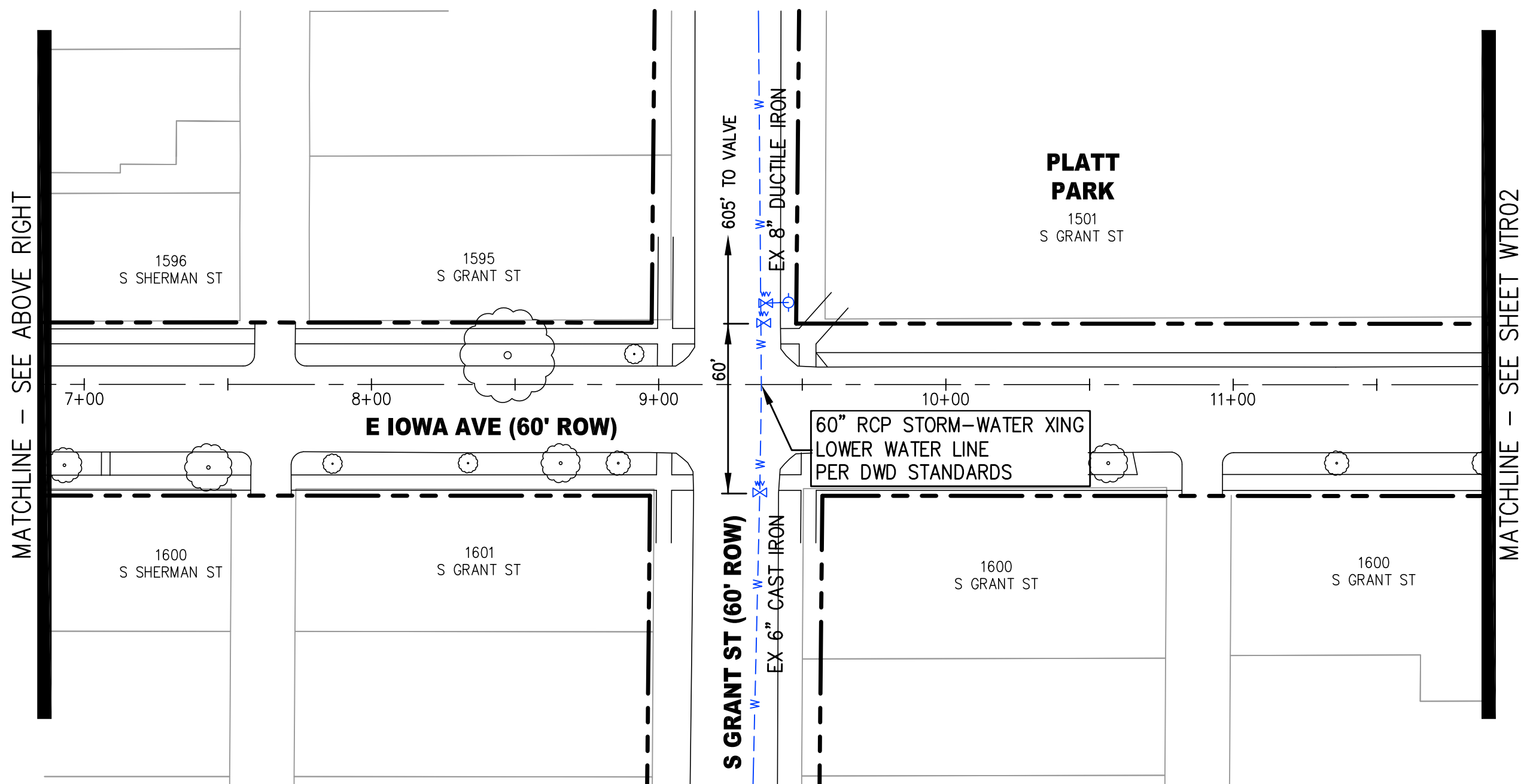
- IRRIGATION OF MEDIANS AND OTHER PUBLIC LANDSCAPED AREAS LESS THAN 25 FEET IN WIDTH MUST BE DONE IN ACCORDANCE WITH DENVER WATER OPERATING RULE 14.02.3. (CALL DW CONSERVATION SECTION AT 303-628-6343 FOR INFORMATION REGARDING IRRIGATION SYSTEMS.)
 - FOR STRIPS OF LAND LESS THAN 6 FEET IN WIDTH - SPRAY IRRIGATION SHALL BE PROHIBITED. LOW-FLOW IRRIGATION SYSTEMS ARE REQUIRED.
 - FOR STRIPS OF LAND BETWEEN 6 FEET AND 15 FEET IN WIDTH - ONLY LOW FLOW IRRIGATION, OR SPRAY IRRIGATION USING LOW-ANGLE SPRAY NOZZLES DESIGNED FOR THE SPECIFIC WIDTH TO BE IRRIGATED SHALL BE PERMITTED. ALL SPRAY HEADS MUST BE PRESSURE REDUCING AND DESIGNED TO PREVENT LOW HEAD DRAINAGE.
 - FOR STRIPS OF LAND MORE THAN 15 FEET IN WIDTH - ONLY GEAR-DRIVEN ROTORS WITH LOW ANGLE NOZZLES MAY BE USED TO IRRIGATE TURF AREAS. PLANTING BEDS MAY BE IRRIGATED WITH LOW-FLOW OR SPRAY IRRIGATION. ALL SPRAY HEADS MUST BE PRESSURE REDUCING AND DESIGNED TO PREVENT LOW HEAD DRAINAGE.
- IRRIGATION SERVICE LINES REQUIRE AN APPROVED UNIVERSITY OF SOUTHERN CALIFORNIA (USC) REDUCED PRESSURE PRINCIPLE (RP) BACKFLOW PREVENTION ASSEMBLY (CONTAINMENT) TO BE INSTALLED 5 FEET DOWNSTREAM FROM THE METER PIT AS AN ABOVE GROUND INSTALLATION BEFORE ANY CONNECTIONS. REFER TO THE MANUFACTURER'S INSTALLATION INSTRUCTIONS FOR HEIGHT AND ORIENTATION REQUIREMENTS.
- IF RECYCLED OR RAW WATER (DITCH WATER, POND, WELL, ETC.) IS USED FOR IRRIGATION ON THE PREMISES, AN APPROVED UNIVERSITY OF SOUTHERN CALIFORNIA (USC) BACKFLOW PREVENTION ASSEMBLY (CONTAINMENT) SHALL BE INSTALLED 5 FEET DOWNSTREAM FROM THE METER PIT ON ANY POTABLE WATER SERVICE LINE. THE BACKFLOW ASSEMBLY TYPE IS DETERMINED BY THE DEGREE OF HAZARD DOWNSTREAM FROM THE METER (RP-HIGH HAZARD INSTALLED ABOVE GROUND OR DC-LOW HAZARD INSTALLED BELOW GROUND - 60 INCH DIAMETER MANHOLE). FOR ADDITIONAL INFORMATION, PLEASE REFERENCE DENVER WATER'S ENGINEERING STANDARDS, 6.11, OR CONTACT CROSS-CONNECTION CONTROL AT 303-628-5940.
- A SOIL AMENDMENT WILL BE REQUIRED ON EVERY PROPERTY REQUIRING NEW WATER SERVICE. METERS WILL NOT BE SET WITHOUT A SOIL INSPECTION BY DENVER WATER OR ITS DESIGNATED PERSONNEL.

DISCLAIMER: DENVER WATER STANDARD OPERATING PROCEDURES REPRESENT RECOMMENDED PRACTICES THAT SHOULD BE APPLICABLE TO MOST SITUATIONS ENCOUNTERED. THESE PROCEDURES SHOULD BE FOLLOWED TO THE EXTENT APPLICABLE; HOWEVER, THEY BY NO MEANS REPRESENT THE ONLY METHOD TO PERFORM THE TASKS THEY DESCRIBE. IT IS UNDERSTOOD THAT FIELD CONDITIONS, EMERGENCIES, AND OTHER CIRCUMSTANCES MAY REQUIRE DEVIATION FROM STANDARD OPERATING PROCEDURES.

<p style="text-align: center;">City and County of Denver Department of Public Works Engineering Division Wastewater Capital Projects Management</p> <p style="text-align: center;">2000 W. 3rd Ave. Denver, Colorado 80223 Telephone: (303) 446-3617 Fax: (303) 446-3647</p>	Initial	
	Date	1/31/12
	1st DWD Submittal	2/7/12
<p>No. Description of Revisions</p>	1	
	2	
	3	
2nd DWD Submittal	2/7/12	BJU
Bid Documents	2/10/12	BJU
<p style="text-align: center;">IOWA AVENUE EXTENSION - PHASE I WATER NOTES</p>		<p>Checked by: TEB</p> <p>Approved by: TEB</p> <p>Drawn by: BJU</p> <p>Designed by: BJU</p> <p>WMD Project No.: PWC2010-5203</p>
Date:		09/10/12
Sheet Name:		NTSO1
Sheet No.:		02



THERE ARE NO KNOWN AFFECTED LEAD SERVICE LINES IN IOWA REFER TO SHEETS WT02-WT04 FOR LEAD SERVICE RELOCATIONS



NOTES

1. STATIONING REPRESENTS CENTERLINE OF PROPOSED STORM PIPE.
2. ALL UTILITY SURFACE FEATURES, INCLUDING VALVES, METERS, MANHOLES, ETC., SHALL BE PROTECTED DURING CONSTRUCTION AND ADJUSTED TO FINAL GRADE.
3. ALL TREES WITHIN THE RIGHT-OF-WAY AFFECTED BY CONSTRUCTION ACTIVITIES MUST BE PROTECTED PER CCD STANDARDS. SEE SHEET 2 OF THE STORM PLANS FOR TREE PROTECTION DETAIL. THE CONTRACTOR WILL CONTACT THE CITY FORESTER, ERIC HUETIG, 303.913.0681, TO INSPECT TREE PROTECTION PRIOR TO CONSTRUCTION.
4. THE CONTRACTOR IS RESPONSIBLE FOR CONFIRMING EXACT LIMITS OF CONSTRUCTION IN ACCORDANCE WITH APPROPRIATE CCD STANDARDS PRIOR TO PERFORMING WORK.
5. CONTRACTOR IS RESPONSIBLE FOR AND REQUIRED TO OBTAIN ANY AND ALL TEMPORARY CONSTRUCTION EXEMPTIONS, PERMITS, LICENSES, ETC., IN ACCORDANCE WITH THE SCOPE OF WORK IN THE CONTRACT.
6. ALL UTILITIES ARE TO BE FIELD VERIFIED BY CONTRACTOR.
7. POLY WRAP ALL VALVES & FITTINGS.
8. LOCAL ACCESS MUST BE MAINTAINED ON LOGAN ST. ANY ROAD CLOSURES MUST HAVE DETOUR PLANS PER MUTCD STANDARDS WITH ADVANCE NOTICE OF THE ROAD CLOSURE. VMS SHOULD BE INSTALLED 1 WEEK PRIOR TO ANY ROAD CLOSURES PROVIDING THE DATES AND LOCATION OF THE ROAD CLOSURE. ALL LOCATIONS WILL REQUIRE A STREET OCCUPANCY PERMIT OBTAINED FROM CONSTRUCTION ENGINEERING AT 303-446-3469.
9. CONSTRUCTION ACTIVITIES BY ANY PARTY THAT DISTURB, RELOCATE, SEVER OR IN ANY OTHER WAY IMPACT A SERVICE LINE SHALL BE REQUIRED TO MEET CURRENT DENVER WATER REQUIREMENTS FOR SERVICE LINES AS SPECIFIED IN CHAPTER 9.04.3 OF DENVER WATER OPERATING RULES.
10. ALL FIRE HYDRANTS TO BE WATEROUS OR AVK BRAND. IF FIRE HYDRANT OR 6" D.I.P. IS REMOVED AND REPLACED, THE FIRE HYDRANT SHALL BE REPLACED WITH A WATEROUS OR AVK BRAND FIRE HYDRANT.
11. CONTRACTOR MUST COORDINATE WITH DENVER FIRE IF THEY MUST REMOVE/REPLACE FIRE SUPPRESSION LINES.

List of Pertinent Denver Water Standard Details

Sheet 11	Typical Trench Section - Pipe Protection
Sheet 26	Concrete Kickblocks - Bearing Surfaces and Installation
Sheet 27	Concrete Kickblocks
Sheet 28	Length of Restrained Pipe
Sheet 34	Mechanical Joint Restraint Details
Sheet 37	Polyethylene Wrap on Pipe and at Tap Installation
Sheet 46	Open Cut Crossing Beneath Conduit or Conflicting Utility
Sheet 47	Crossing Storm and Sanitary Sewers
Sheet 49	Tracer Wire Installation for PVC Water Main
Sheet 50	Plan, Profile and Locations for Fire Hydrants, Mains & Valves
Sheet 53	General Meter Notes
Sheet 54	Service Line, Stop Box and Outside Meter Installation
Sheet 57	Outside Setting for 3/4" and 1" Meters
Sheet 60	Outside Setting for 1-1/2" and 2" Meter with Check Valve and Bypass in Manhole

LEGEND

- EXISTING WATER METER
- EXISTING STOP BOX
- PROPOSED WATER METER
- PROPOSED STOP BOX

TO BE COMPLETED BY DENVER WATER

DENVER WATER'S REVIEW OF THESE PLANS RELATES ONLY TO DENVER WATER REQUIREMENTS, AND DOES NOT INCLUDE A FULL ANALYSIS OF: SOIL CONDITIONS, SUPPORT OR LOAD FACTORS, OR ANY OTHER MATTERS. ANY MODIFICATION OF THESE PLANS MUST BE RESUBMITTED TO DENVER WATER FOR REVIEW PRIOR TO CONSTRUCTION. THE PROFESSIONAL ENGINEER, CONTRACTORS, AND OWNERS DESIGNING AND CONSTRUCTING THIS PROPOSED WATER DISTRIBUTION SYSTEM SHALL BE SOLELY RESPONSIBLE FOR THE ADEQUACY OF THE DESIGN, INSTALLATION, AND MATERIALS UTILIZED IN THIS WATER DISTRIBUTION SYSTEM FOR ANY SPECIFIC SITE LOCATION.

DATE	I.D. NO.
CONTRACT NO.	MAP NO.

APPROVED FOR CONSTRUCTION APPROVAL VALID FOR ONE YEAR

DENVER WATER

SALES ADMINISTRATOR

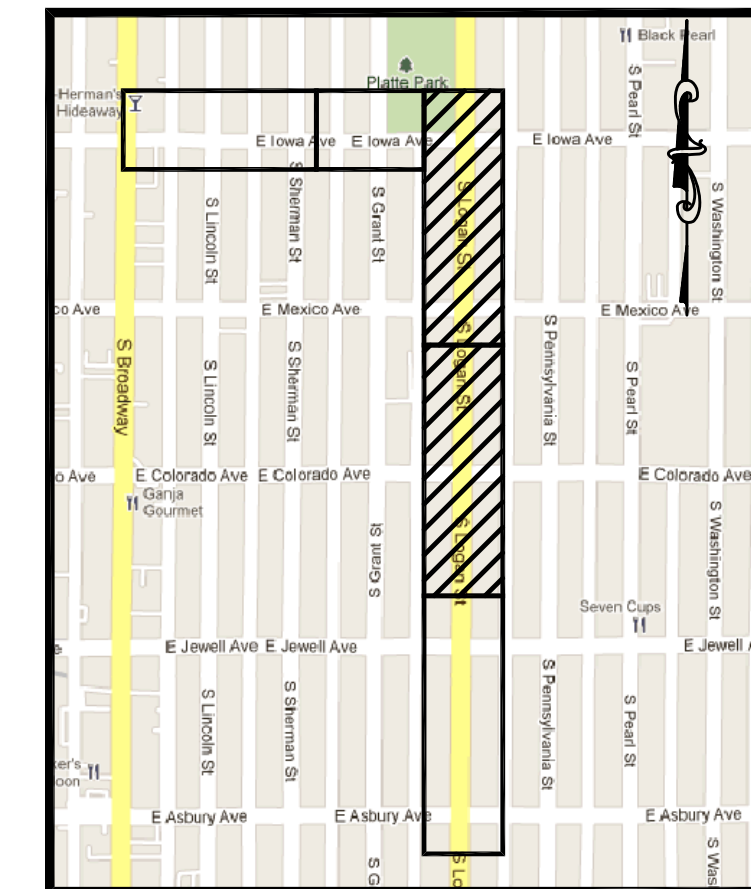
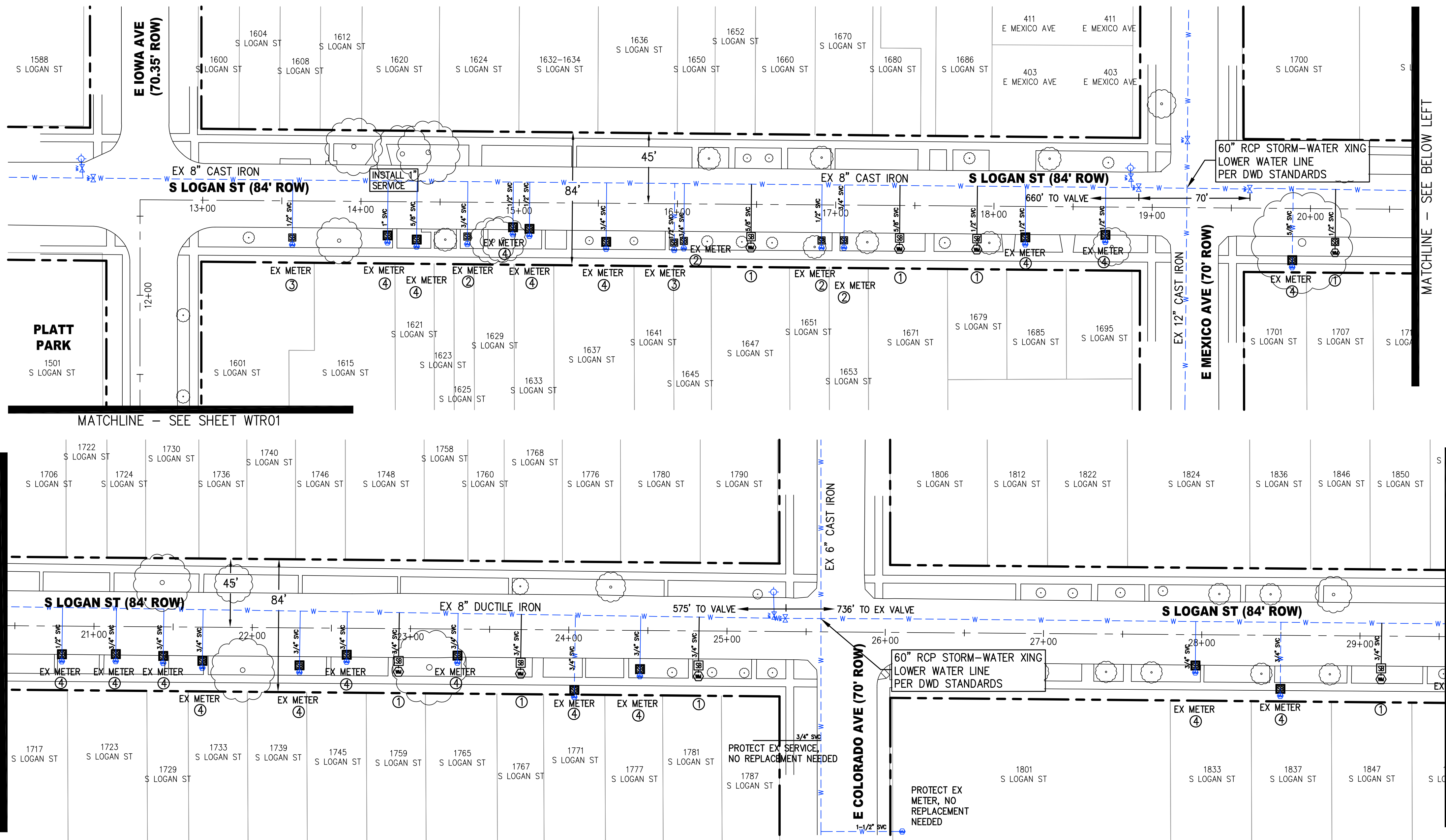
No.	Description of Revisions	Date	Initial
1	1st DWD Submittal	7/31/12	BJU
2	2nd DWD Submittal	8/16/12	BJU
3	Bid Documents	9/10/12	BJU

**City and County of Denver
Department of Public Works
Engineering Division
Wastewater Capital Projects Management**

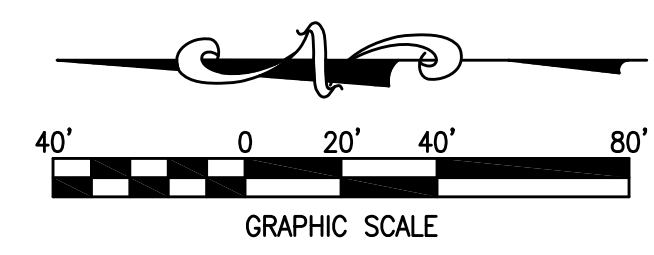
2000 W. 3rd Ave. Denver, Colorado 80223
Telephone: (303) 446-3617 Fax: (303) 446-3647

IOWA AVENUE EXTENSION - PHASE I WATER SERVICES PLAN	
Drawn by: BJU	Checked by: TEB
Designed by: BJU	Approved by: TEB
WMD Project No.: PWC2010-5203	

Date: 09/10/12
Sheet Name: WTRO1
Sheet No: 03



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LEGEND

	EXISTING WATER METER
	EXISTING STOP BOX
	PROPOSED WATER METER
	PROPOSED STOP BOX

SERVICE LINE REPLACEMENT CONDITIONS & CALL OUT NOTES

- | | | | |
|---|--|--|--|
| <p>① NEW EXTERNAL METER
 IN 2012, AS PART OF A MEMORANDUM OF UNDERSTANDING (MOU) BETWEEN DENVER WATER AND DENVER WASTEWATER, THE INTERNAL METERS AND LEAD SERVICE LINES FOR THESE LOTS WERE REPLACED WITH EXTERNAL METERS AND COPPER SERVICE LINES. WORK WAS COMPLETED APRIL 2012.</p> | <p>② EXISTING OUTSIDE METER WITH STOP BOX
 ALL WORK TO BE COMPLETED BY CONTRACTOR.
 PROTECT EXISTING METER IN PLACE.
 INSULATORS SHOULD BE INSTALLED WHERE THERE ARE NONE EXISTING.
 CONTRACTOR SHALL REMOVE EXISTING WATER SERVICE AND ASSOCIATED APPURTENANCES WITHIN THE RIGHT-OF-WAY BETWEEN THE EXISTING WATER MAIN AND THE EXISTING WATER METER.
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|---|--|--|--|

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TO BE COMPLETED BY DENVER WATER

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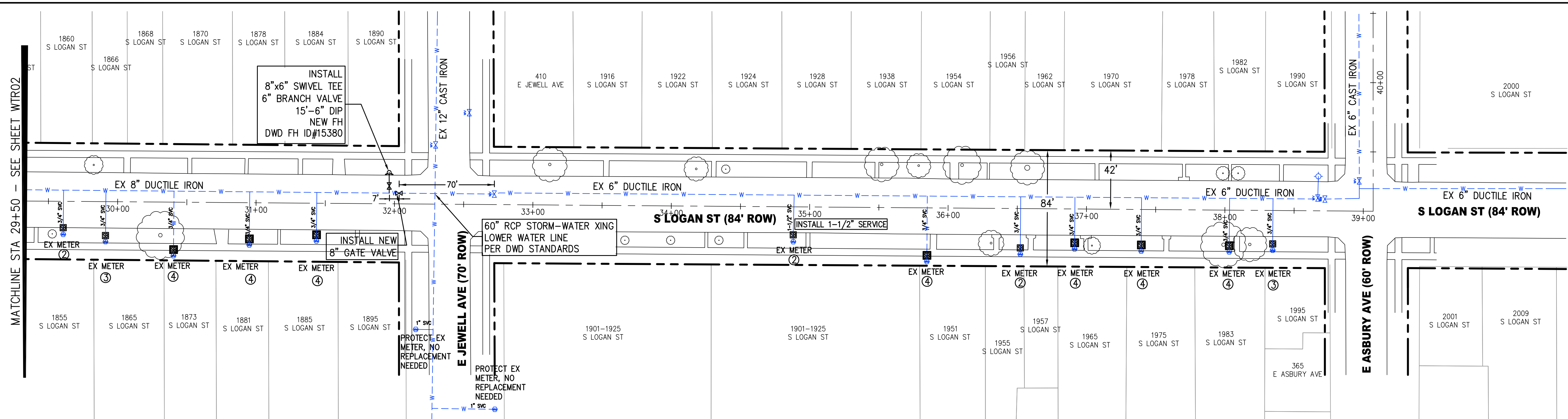
City and County of Denver
Department of Public Works
Engineering Division
Wastewater Capital Projects Management

2000 W. 3rd Ave. Denver, Colorado 80203
 Telephone: (303) 446-3617 Fax: (303) 446-3647

IOWA AVENUE EXTENSION - PHASE I
WATER SERVICES PLAN

Checked by: TEB
 Approved by: TEB
 Drawn by: BJU
 Designed by: BJU
 WMD Project No.: PWC2010-5203

Date: 09/10/12
 Sheet Name: WTR02
 Sheet No: 04



SERVICE LINE REPLACEMENT CONDITIONS & CALL OUT NOTES

- 1 NEW EXTERNAL METER**

IN 2012, AS PART OF A MEMORANDUM OF UNDERSTANDING (MOU) BETWEEN DENVER WATER AND DENVER WASTEWATER, THE INTERNAL METERS AND LEAD SERVICE LINES FOR THESE LOTS WERE REPLACED WITH EXTERNAL METERS AND COPPER SERVICE LINES. WORK WAS COMPLETED APRIL 2012.
- 2 EXISTING OUTSIDE METER WITH STOP BOX**

ALL WORK TO BE COMPLETED BY CONTRACTOR.

PROTECT EXISTING METER IN PLACE.

INSULATORS SHOULD BE INSTALLED WHERE THERE ARE NONE EXISTING.

CONTRACTOR SHALL REMOVE EXISTING WATER SERVICE AND ASSOCIATED APPURTENANCES WITHIN THE RIGHT-OF-WAY BETWEEN THE EXISTING WATER MAIN AND THE EXISTING WATER METER.

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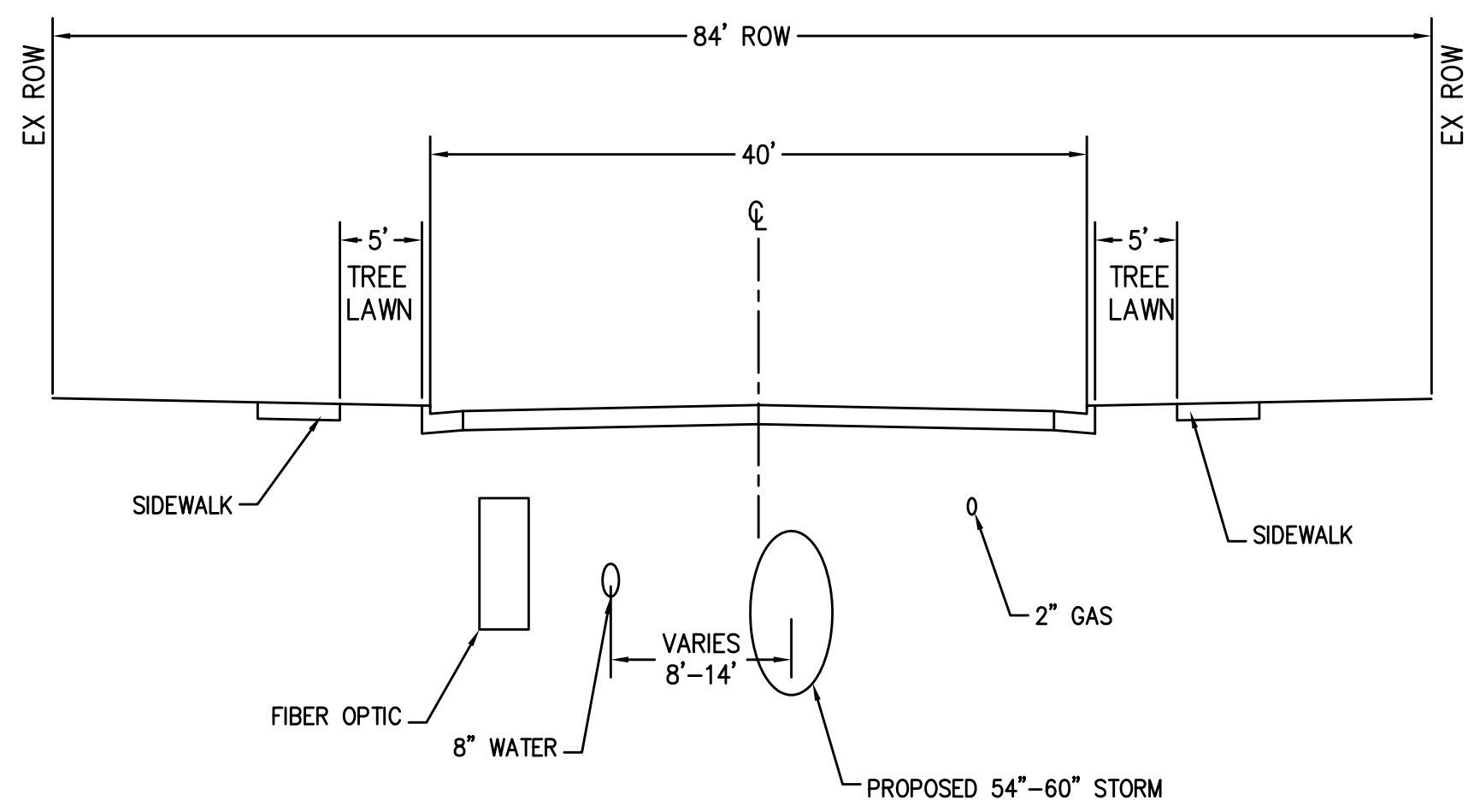
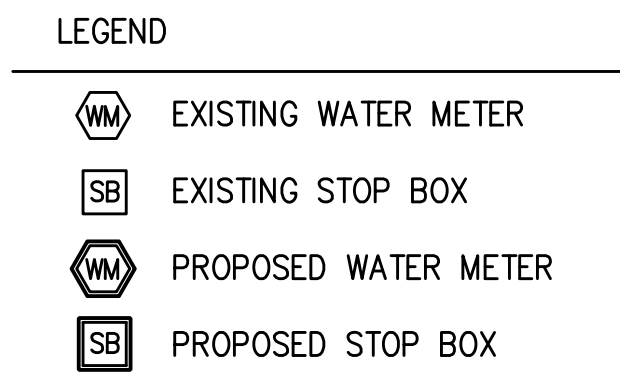
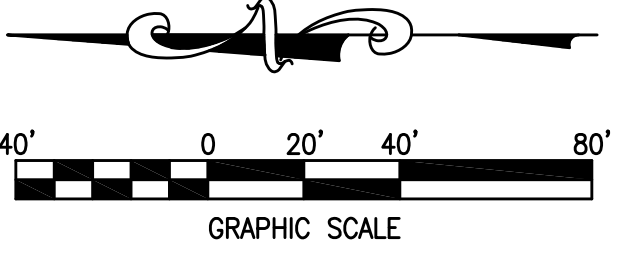
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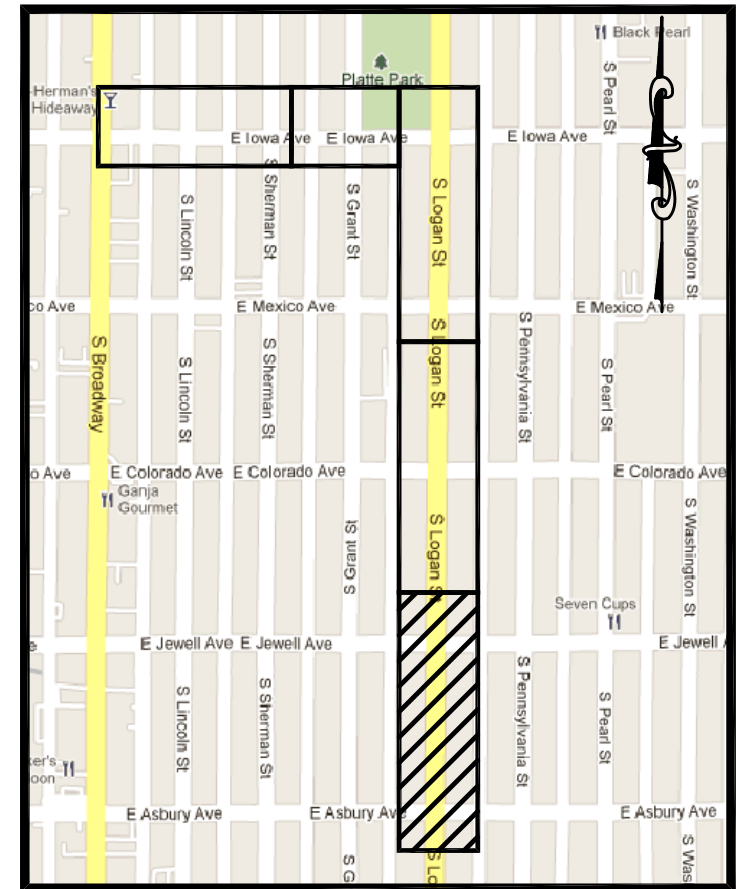
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TYPICAL CROSS SECTION - S LOGAN STREET (LOOKING SOUTH)

List of Pertinent Denver Water Standard Details	
Sheet 11	Typical Trench Section - Pipe Protection
Sheet 26	Concrete Kickblocks - Bearing Surfaces and Installation
Sheet 27	Concrete Kickblocks
Sheet 28	Length of Restrained Pipe
Sheet 34	Mechanical Joint Restraint Details
Sheet 37	Polyethylene Wrap on Pipe and at Tap Installation
Sheet 46	Open Cut Crossing Beneath Conduit or Conflicting Utility
Sheet 47	Crossing Storm and Sanitary Sewers
Sheet 49	Tracer Wire Installation for PVC Water Main
Sheet 50	Plan, Profile and Locations for Fire Hydrants, Mains & Valves
Sheet 53	General Meter Notes
Sheet 54	Service Line, Stop Box and Outside Meter Installation
Sheet 57	Outside Setting for 3/4" and 1" Meters
Sheet 60	Outside Setting for 1-1/2" and 2" Meter with Check Valve and Bypass in Manhole



KEYMAP

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Drawn by: BJU
 Checked by: TEB
 Designed by: BJU
 Approved by: TEB
 WMD Project No.: PWC2010-5203

Date: 09/10/12
 Sheet Name: WTR03
 Sheet No: 05