

**LICENSE AGREEMENT**

This License Agreement (“Agreement”) is made by and between DALLAS AREA RAPID TRANSIT (“DART”), a regional transportation authority created, organized, and existing pursuant to Chapter 452, Texas Transportation Code, with offices at 1401 Pacific Avenue, Dallas, Texas 75202, and CITY OF CARROLLTON (“Licensee”), a Texas municipality located at P. O. Box 10535, Carrollton, Texas 75011.

DART and Licensee (individually referred to herein as a “Party” or collectively as “Parties”) agree as follows:

**I. Definitions.**

- 1.1 “Corridor” shall mean DART’s railroad corridor between Dallas and Denton, Texas.
- 1.2 “Effective Date” shall mean the date this Agreement is last signed by a Party.
- 1.3 “Permitted Improvement” shall mean the following items more particularly detailed in Exhibit A-1 through A-13, attached to this Agreement and fully incorporated herein:
  - A rock riprap channel, one (1) 6’x6’ storm drain manhole, and an 18-inch storm drain connecting to an existing 30-inch RCP storm sewer at Donald Avenue.
  - A concrete apron headwall, outflow with rock riprap to existing culvert, a 3’x2’ RCB, and one (1) 6’x6’ storm drain manhole at Northside Drive.
  - A wing-wall and combination of V Notch and trapezoid concrete storm drain channel along with stabilizing rock riprap running longitudinally along the Corridor (parallel to the railroad tracks) between Northside Drive and Vinylex Drive.
- 1.4 “Permitted Use” shall mean designing, constructing, installing, operating, reconstructing, maintaining, repairing, replacing, and removing the Permitted Improvement at the Property.
- 1.5 The “Property” where the Permitted Improvement is located shall mean the tract of right-of-way on the Corridor located between:
  - Mile Post 743.90 to 744.30
  - Starting: Latitude: 32.962666 / Longitude: -96.914072
  - Ending: Latitude: 32.958556 / Longitude: -96.911250
  - Carrollton, Dallas County, Texas
- 1.6 “Railroad” shall mean Dallas, Garland & Northeastern Railroad, Inc, which holds certain rights and obligations with respect to freight railroad operations on the Corridor, and any future freight operators, passenger operators, and entities providing passenger service or railroad maintenance on the Corridor during the term of this Agreement pursuant to an agreement with DART.

**II. Consideration.**

- 2.1 License Fee. Licensee shall pay Ten Dollars and No/100 DOLLARS (\$10.00) on the Effective Date. No additional License Fee shall be assessed during the term of this Agreement.

### **III. Purpose and Term.**

- 3.1 Permitted Improvement. DART hereby grants a license to Licensee for the Permitted Use so long as the Permitted Use does not interfere with the operations of DART or Railroad, and Licensee otherwise complies with the requirements of this Agreement.
- 3.2 Limitations. Licensee's right to enter upon and use the Property shall be limited solely to the Permitted Use, for the term of this Agreement, and in accordance with the conditions of this Agreement. This Agreement is not intended to convey and does not convey to Licensee any real property interest in the Property or any portion of the Corridor. This Agreement may not be recorded in the real property records. The license granted pursuant to this Agreement is non-exclusive and is subject to (a) any existing utility, drainage, or communication facility located in, on, under, or upon the Property; (b) all vested rights presently owned by any railroad, utility or communication company, or other entity located within the boundaries of the Property; and (c) any existing lease, license, easement, or other interest in the Property granted by DART or its predecessors in interest. The license granted by this Agreement is granted expressly subject and subordinate to DART's right to use the Property for any purpose whatsoever, except as expressly provided in this Agreement.
- 3.3 No Warranty. DART and Railroad make no representations as to the condition of the Property or its suitability for any particular purpose, including by example and not limitation, warranties regarding the Property's state of repair, use of the Property, access to the Property, or subsurface or aerial installations on or near the Property. The Property is available for Licensee's use on an "as is, where is, and with all faults" basis. Licensee shall, at its sole cost, conduct its own inspections of the Property and shall not rely on any information disclosed or not disclosed by DART, Railroad, or any of their respective employees, agents, or representatives.
- 3.4 Term. The term of this Agreement shall begin on the Effective Date and continue until terminated in accordance with this Agreement.

### **IV. Design, Construction, Operation, and Maintenance of the Permitted Improvement.**

- 4.1. Construction Plans. During the design phase and prior to commencing any construction on the Property, a copy of the construction plans ("the Plans") for the Permitted Improvement showing the exact location, type, depth of the construction, the working area, and any cathodic protection measures shall be submitted for written approval to DART. No work shall commence on the Property until the Plans have been approved in writing by DART, which approval shall not be unreasonably withheld. To the extent necessary for construction of the Permitted Improvement, Licensee shall also coordinate with Railroad and obtain Railroad's approval of the Plans prior to the start of any work.
- 4.2. Safety. Licensee agrees to design, construct, and operate the Permitted Improvement in such a manner so as not to create a dangerous, unsafe, or otherwise hazardous condition on or near the Property. Licensee shall implement any cathodic protection, including stray current corrosion control measures, necessary to ensure the safety of the Permitted Improvement and maintain compliance with applicable laws, regulations, ordinances, and rules. If applicable to the Permitted Improvement, Licensee shall institute and maintain a continuous testing program to determine whether additional cathodic protection of its Permitted Improvement is needed.
- 4.3. Authority to Enter the Property. Licensee shall ensure that anyone working on the Property under Licensee's control possesses authority to be on the Property and can readily demonstrate such authority, either through photo identification issued by Licensee or Licensee's contractor ("Contractor") or immediate confirmation by the worker's on-site supervisor.

- 4.4. Foul Zone. Licensee shall not perform any activities, or permit Contractor to perform any activities, that could result in equipment, people, or materials entering within 25 feet of any railroad tracks (the “Foul Zone”) unless:
- a. Flagger(s) qualified on DART and Railroad’s operating and safety rules are present; and
  - b. Anyone working under Licensee’s control and engaged in an activity that necessitates flaggers has, within the last 365 calendar days from the date the Work is to be performed, attended a creditable Roadway Worker Protection course, successfully passed all required examinations associated with that course, and can provide proof of course completion upon request from DART or Railroad. DART and Railroad shall determine whether the Roadway Worker Protection course is creditable.

Licensee shall pay all costs associated with flaggers and Roadway Worker Protection courses.

- 4.5. Maintenance. Licensee shall maintain the Property and Permitted Improvement in a good, clean, and safe condition. Licensee shall use diligent care to avoid damaging any existing structures, equipment, and/or vegetation on or about the Property and any adjacent property. If Licensee, Contractor, or anyone under Licensee’s control causes damage to the Property or an adjacent property, Licensee shall immediately replace or repair the damage at no cost or expense to DART or Railroad.

- 4.6. Costs and Reimbursement. Licensee agrees to pay for any damages, costs, or expenses that DART incurs by reason of Licensee’s use of the Property. If Licensee fails to repair or replace damage to the Property or fails to properly maintain the Property or Permitted Improvement, DART and/or Railroad shall notify Licensee of such noncompliance with this Agreement. In the event Licensee has not remedied the failure within ten (10) days from the date of such notice, DART and Railroad, individually or collectively, shall have the right, but not the obligation, to remedy such failure at the sole cost and expense of Licensee. Licensee shall immediately reimburse DART and/or Railroad, as applicable, for all costs resulting from Licensee’s failure to repair, replace, or maintain the Property and/or Permitted Improvement in accordance with this Agreement.

- 4.7. As-builts. Licensee shall provide certified final construction drawings (“As-Builts”), signed and sealed by a Texas professional engineer, to DART within ninety (90) days after the last date of construction work on the Property. The Parties agree that DART will suffer damages if As-Builts are not timely provided by Licensee and it is impossible to determine the amount of such damages in advance. Accordingly, the Parties agree, not as a penalty but as a measure of reasonable damages, that a fee of \$500 per month (prorated as applicable) until As-Builts are provided represents reasonable compensation for DART’s actual damages suffered by the delay. DART shall comply with state and local laws, including Chapter 251 of the Texas Utilities Code, before performing work around the Permitted Improvement and shall not exclusively rely on As-Builts provided by Licensee pursuant to this Agreement.

- 4.8. Electrically Powered Equipment. DART and Railroad may, in compliance with applicable state and federal safety regulations, use electrically powered equipment on the Property or adjoining properties, which could result in live electrical current in proximity to the Permitted Improvement and produce corrosive effects to the Permitted Improvement. **Licensee WAIVES any claim against DART or Railroad arising from the use of electrically powered equipment pursuant to this paragraph.**

- 4.9. Governmental Approvals. Licensee, at its sole cost and expense, shall be responsible for obtaining any licenses, permits, or other approvals from any federal, state, or local agencies required to carry on any activity on the Property permitted by this Agreement.

- 4.10. Other Required Agreements. Prior to the start of any construction work on the Property, Licensee or Contractor, as applicable, shall execute any additional agreements that DART or Railroad determine are

necessary in connection with such work, including but not limited to a contractor's right-of-entry agreement. Licensee shall be responsible for ensuring Contractor complies with the terms and conditions of this Agreement and any contractor's right-of-entry agreement or other agreement related to the Permitted Use. Licensee shall be responsible for obtaining a copy of any such agreement entered into by Contractor pursuant to this section.

- 4.11. Mechanic's Liens Not Permitted. Licensee shall fully pay for all labor and materials used in, on, or about the Property and, to the extent permitted by law, shall not permit or suffer any mechanic's or materialmen's liens of any nature to be affixed against the Property by reason of any work done or materials furnished to the Property on behalf of Licensee. In the event a lien is attached to the Property, Licensee shall (at DART's option) immediately seek removal of the lien or provide a bond that discharges the lien in accordance with Texas law. Licensee shall pay all costs associated with such removal, including reasonable attorney's fees.
- 4.12. Compliance with Laws and Regulations. Licensee agrees to abide by all laws, ordinances, and regulations of any governmental entity or regulatory agency with jurisdiction over the Property and/or Licensee. Licensee shall also abide by all rules, policies, and operating procedures established by DART or Railroad that are communicated to Licensee in advance, so long as such rules, policies, or operating procedures do not conflict with any rules or guidance promulgated by a regulatory agency and applicable to Licensee.

## **V. Insurance**

- 5.1. Required Insurance. Prior to entry onto the Property, Licensee shall procure and maintain, at its sole cost and expense, commercial general liability insurance in the following form and amount:
  - a. Per occurrence limit of at least \$5,000,000
  - b. Primary and non-contributory endorsement
  - c. Endorsement naming DART, Railroad, and their respective directors, officers, representatives, contractors, agents, and employees as additional insureds with respect to ongoing and completed operations without qualifications or restrictions
  - d. Endorsement waiving the issuing insurance company's rights of recovery against DART and Railroad, whether by way of subrogation or otherwise
  - e. Endorsement removing exclusions for operations within fifty (50) feet of a railroad or, alternatively, purchase of a Railroad Protective Policy
  - f. Endorsement removing exclusions for XCU hazards
  - g. The form of coverage and insurer(s) must be satisfactory to DART.
- 5.2. Proof of Insurance. Licensee shall furnish Certificates of Insurance and copies of required endorsements to DART as evidence of the coverages required. Upon DART's request, Licensee shall also provide any additional documentation necessary to demonstrate the insurance coverage required. Licensee's insurance shall be primary and non-contributory coverage in all instances.
- 5.3. Notice of Cancellation or Nonrenewal. Licensee shall provide written notice to DART within fifteen (15) days of learning (through notice from Licensee's insurer or other means) that an insurance policy required by this Agreement will be cancelled, non-renewed, or modified in a manner that will result in Licensee's noncompliance with the terms of this Agreement.

## **VI. Environmental Protection**

- 6.1. Licensee shall not use or permit the use of the Property for any purpose that may be in violation of any local, state, or federal laws pertaining to health or the environment, including but not limited to, the

Comprehensive Environmental Response, Compensation, and Liability Act (“CERCLA”), the Resource Conservation and Recovery Act (“RCRA”), the Clean Water Act (“CWA”), and the Clean Air Act (“CAA”).

- 6.2. Licensee warrants that the Permitted Use of the Property will not result in the disposal or other release of any hazardous substance or solid waste on or to the Property, and that it will take all steps necessary to ensure that no such hazardous substance or solid waste will ever be discharged onto the Property by Licensee, Contractor, or any other person under Licensee’s control.
- 6.3. The terms “hazardous substance” and “release” shall have the meanings specified in CERCLA and the terms “solid waste” and “disposal” (or “disposed”) shall have the meanings specified in the RCRA; provided, however, that in the event either CERCLA or RCRA is amended so as to broaden the meaning of any term defined thereby, such broader meaning shall apply subsequent to the effective date of such amendment. To the extent that the laws of the State of Texas establish a meaning for “hazardous substance,” “release,” “solid waste,” or “disposal,” that is broader than that specified in either CERCLA or RCRA, such broader meaning shall apply.

## **VII. Termination and Relocation.**

- 7.1. Methods of Termination. This Agreement shall terminate and be of no further force and effect: (a) if Licensee discontinues or abandons the use of the Permitted Improvement for ninety (90) days or more; (b) if either Party materially breaches this Agreement and fails to cure such breach within thirty (30) days’ after receiving written notice of the breach (provided, however, if the breach cannot be cured within 30 days, the period to cure shall be extended so long as the breaching Party is promptly and diligently pursuing the cure to completion); (c) if Licensee relocates the Permitted Improvement from the Property; or (d) if DART determines, in its sole discretion, that relocation of the Permitted Improvement is necessary or useful for DART or Railroad’s use of the Property and provides written notice to Licensee.
- 7.2. Restoration of the Property. Upon termination of this Agreement, Licensee shall remove all improvements and appurtenances owned by it, situated in, on, under or attached to the Property, regardless of whether or not such improvements were placed on the Property by Licensee, unless otherwise directed or permitted by DART. Licensee shall restore the Property to a condition satisfactory to DART at its sole cost (unless otherwise provided by this Agreement).
- 7.3. Relocation of the Permitted Improvement. If DART elects to terminate this Agreement by providing written notice to Licensee that relocation of the Permitted Improvement is necessary or useful for DART or Railroad’s use of the Property (as addressed above), DART shall work collaboratively with Licensee to identify another property site that, in DART’s sole discretion, is suitable for the relocation of the Permitted Improvement. If the Parties determine a mutually-acceptable property site owned by DART for the relocation of the Permitted Improvement, the Parties shall execute a new license agreement comprised of either the same terms and conditions contained in this Agreement or such other new terms and conditions agreed-to by the Parties at that time. Licensee shall promptly and diligently remove or relocate the Permitted Improvement within the period of time provided in DART’s relocation/termination notice (which shall be no shorter than 90 days).
- 7.4. Relocation Costs. Licensee shall pay all costs and expenses associated with any relocation of the Permitted Improvement. Licensee hereby **WAIVES** any claim that it may have regarding the payment of relocation benefits, including claims arising under Chapter 460 of the Texas Transportation Act.

## VIII. INDEMNITY AND SHIFTING OF RISK.

- 8.1. **To the extent permitted by law, Licensee agrees to RELEASE, DEFEND, HOLD HARMLESS, AND INDEMNIFY DART, Railroad, and their respective directors, officers, employees, contractors, agents, and representatives (collectively “Indemnitees”) from and against all liabilities, losses, damages, claims, costs, and expenses (including attorney’s fees) for bodily injury or death to any person and for damage to, loss of, or loss of the use of any property arising out of or resulting from Licensee’s (including Licensee’s employees, contractors, subcontractors, agents, or invitees) entry onto the Property, performance under this Agreement, or breach of any of the terms of this Agreement, except to the extent proximately caused by the gross negligence or intentional misconduct of one or more Indemnitees. Additionally, Licensee shall INDEMNIFY, DEFEND, AND HOLD DART AND RAILROAD HARMLESS against all costs, expenses, claims, and liability related to any environmental contamination and related clean-up of the Property resulting from Licensee’s use of the Property under this Agreement.**
- 8.2. In the event any of the provisions of this indemnification section are determined by statutory authority or judicial decision to be void or unenforceable, then this section shall not fail in its entirety, but will be enforceable to the greatest extent permitted by law. This indemnification section and all other indemnification and waiver provisions shall survive the termination of this Agreement.

## IX. **Miscellaneous.**

- 9.1. Notice. Notices permitted or required by this Agreement shall be in writing and shall be deemed delivered when hand delivered or sent by certified mail, return receipt requested, and addressed to: Licensee at the address set out in the first paragraph of this Agreement; and DART at 1401 Pacific Avenue, Dallas Texas 75202, Attn: Railroad Management. Either Party may designate a different address for receipt of notice by giving written notice of such change of address.
- 9.2. Assignment. Licensee shall not, absent DART’s prior written consent, assign or transfer its rights under this Agreement in whole or in part or permit any other person or entity to use the license granted pursuant to this Agreement.
- 9.3. Governing Law. This Agreement shall be construed under and in accordance with the laws of the State of Texas. Any action brought by a Party to enforce any provision of this License shall be commenced in a state district court of competent jurisdiction in Dallas County, Texas.
- 9.4. Entirety. This Agreement embodies the entire agreement between the Parties and supersedes all prior agreements and understandings, if any, relating to the Property and the matters addressed herein.
- 9.5. Amendments; Counterparts. This Agreement may be amended or supplemented only by a written instrument executed by the Parties. The Parties may execute this Agreement in multiple originals and when taken together, those originals constitute a whole.
- 9.6. Parties Bound; Third-Party Beneficiaries. This Agreement shall be binding upon and inure to the benefit of the Parties and their respective heirs, personal representatives, successors and assigns. There are no third-party beneficiaries to this Agreement.
- 9.7. No Joint Enterprise. The Parties do not intend that this Agreement be construed as finding that the Parties have formed a joint enterprise. The purposes for which each Party has entered into this Agreement are separate and distinct.

- 9.8. Severability. If any provision of this Agreement is determined to be illegal or unenforceable in any respect, such determination will not affect the validity or enforceability of any other provision, each of which will be deemed to be independent and severable.
- 9.9. No Waiver of Governmental Immunity. By entering into this Agreement, DART does not waive or diminish any immunities, protections, or defenses available to it, including by example and without limitation, governmental immunity and statutory caps on damages, except as provided by Chapter 271 of the Texas Local Government Code.
- 9.10. Signature Authority. Each of the individuals signing this Agreement warrants that he or she is duly and properly authorized to execute this Agreement on behalf of his or her respective Party.

DALLAS AREA RAPID TRANSIT:

BY: \_\_\_\_\_  
 Caitlin Holland  
 Vice President, Real Estate & Economic Development  
 Development Department

Date: \_\_\_\_\_

LICENSEE:

CITY OF CARROLLTON

BY: \_\_\_\_\_

Printed Name: \_\_\_\_\_

Title: \_\_\_\_\_

Date: \_\_\_\_\_

Tie in at this existing crossing culvert. Replace riprap at outfall and around support



Install new outfall with rock riprap between new outfall and existing culvert. Install concrete sloping apron headwall around existing culvert

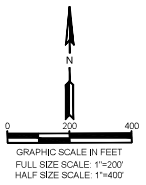


ex. rail to be removed



Remove existing culvert & rail + install concrete channel connecting to Vinylex





**LEGEND**

DRAINAGE AREAS OUTSIDE OF PHASE 1 PROJECT LIMITS

**EXCAVATION SAFETY NOTE:**

CONTRACTOR SHALL CONTACT TEXAS 811 OR 800-344-8377 FOR UTILITY LOCATES NO LATER THAN TWO FULL WORKING DAYS PRIOR TO CONSTRUCTION.

**REVISIONS**

NO.	DESCRIPTION	DATE

**FILE LOG**

ACTIVITY	BY
MANAGER	AWD
DESIGN	LAN
DRAWN	LAN
CHECK	SJM



**DUNCAN HEIGHTS PAVING, DRAINAGE, & UTILITY IMPROVEMENTS PHASE 1**

PROJECT NO. 130-10931-000  
DATE: NOV 01, 2023

**EXISTING DRAINAGE AREA MAP**

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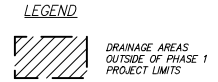
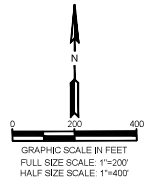
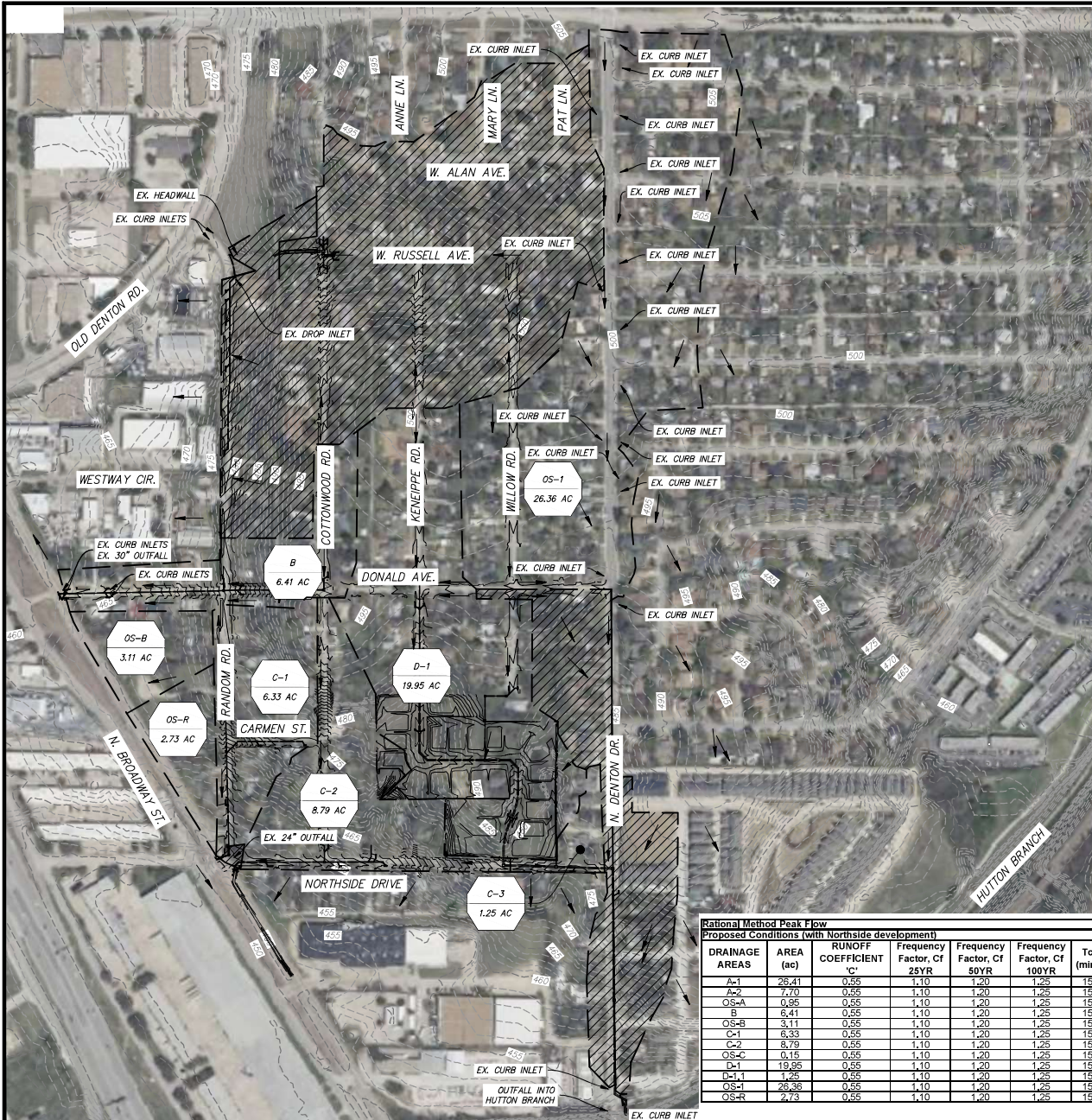
DRAWING NO. SHEET 30 OF 106

Exhibit A-2

**Rational Method Peak Flow Existing Conditions**

AREA ID	AREA (ac)	RUNOFF COEFFICIENT "C"	Frequency Factor, Cf 25 YR	Frequency Factor, Cf 50 YR	Frequency Factor, Cf 100 YR	Tc (min)	I2 (in/hr)	I5 (in/hr)	I10 (in/hr)	I25 (in/hr)	I50 (in/hr)	I100 (in/hr)	Q2 (cfs)	Q5 (cfs)	Q10 (cfs)	Q25 (cfs)	Q50 (cfs)	Q100 (cfs)
A-1	27.35	0.55	1.10	1.20	1.25	15	3.90	4.78	5.50	6.47	7.20	7.93	58.67	71.90	82.73	107.08	120.97	148.1
A-2	7.70	0.55	1.10	1.20	1.25	15	3.90	4.78	5.50	6.47	7.20	7.93	18.52	20.24	23.28	30.14	36.59	42.0
B	6.61	0.55	1.10	1.20	1.25	15	3.90	4.78	5.50	6.47	7.20	7.93	14.18	17.38	20.00	25.87	31.41	36.0
OS-B	3.11	0.55	1.10	1.20	1.25	15	3.90	4.78	5.50	6.47	7.20	7.93	6.67	8.18	9.41	12.17	14.78	17.0
C-1	6.33	0.55	1.10	1.20	1.25	15	3.90	4.78	5.50	6.47	7.20	7.93	13.53	16.64	19.15	24.78	30.68	34.5
C-2	24.80	0.55	1.10	1.20	1.25	15	3.90	4.78	5.50	6.47	7.20	7.93	53.41	65.46	75.32	97.47	118.32	138.0
D-1	6.95	0.55	1.10	1.20	1.25	15	3.90	4.78	5.50	6.47	7.20	7.93	14.91	18.27	21.02	27.20	33.03	37.9
OS-1	26.37	0.55	1.10	1.20	1.25	15	3.90	4.78	5.50	6.47	7.20	7.93	56.56	69.33	79.77	103.22	125.31	143.8
OS-2	2.63	0.55	1.10	1.20	1.25	15	3.90	4.78	5.50	6.47	7.20	7.93	5.84	6.91	7.98	10.29	12.60	14.3
OS-R	2.73	0.55	1.10	1.20	1.25	15	3.90	4.78	5.50	6.47	7.20	7.93	5.86	7.18	8.26	10.69	12.97	14.9
DD-2	6.09	0.55	1.10	1.20	1.25	15	3.90	4.78	5.50	6.47	7.20	7.93	14.91	18.27	21.02	27.20	33.03	37.9

EXISTING DRAINAGE AREAS ARE SHOWN IN HATCHED AREAS. THE DRAINAGE AREAS AND DRAINAGE NETWORK SHOWN ARE BASED ON THE AVAILABLE DATA AND THE DESIGNER'S VISUAL INSPECTION OF THE PROJECT AREA. THE DESIGNER HAS CONDUCTED VISUAL INSPECTIONS OF THE PROJECT AREA AND HAS FOUND NO OTHER DRAINAGE AREAS OR DRAINAGE NETWORKS THAT WOULD AFFECT THE DESIGN OF THIS PROJECT. THE DESIGNER HAS CONDUCTED VISUAL INSPECTIONS OF THE PROJECT AREA AND HAS FOUND NO OTHER DRAINAGE AREAS OR DRAINAGE NETWORKS THAT WOULD AFFECT THE DESIGN OF THIS PROJECT. THE DESIGNER HAS CONDUCTED VISUAL INSPECTIONS OF THE PROJECT AREA AND HAS FOUND NO OTHER DRAINAGE AREAS OR DRAINAGE NETWORKS THAT WOULD AFFECT THE DESIGN OF THIS PROJECT.



**EXCAVATION SAFETY NOTE:**  
 CONTRACTOR SHALL CONTACT TEXAS 811 (DIAL 811 OR 800-344-8377) FOR UTILITY LOCATES NO LATER THAN TWO FULL WORKING DAYS PRIOR TO CONSTRUCTION.

**REVISIONS**

NO.	DESCRIPTION	DATE

**FILE LOG**

ACTIVITY	BY
MANAGER	AWD
DESIGN	LAN
DRAWN	LAN
CHECK	SJM



**DUNCAN HEIGHTS PAVING, DRAINAGE, & UTILITY IMPROVEMENTS PHASE 1**

PROJECT NO. 130-10931-000  
 DATE: NOV 01, 2023

**PROPOSED DRAINAGE AREA MAP**

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DRAWING NO. SHEET 31 OF 106

Exhibit A-3

**Rational Method Peak Flow**  
**Proposed Conditions (with Northside development)**

DRAINAGE AREAS	AREA (ac)	RUNOFF COEFFICIENT 'C'	Frequency Factor, Cf 25YR	Frequency Factor, Cf 50YR	Frequency Factor, Cf 100YR	Tc (min)	I2 (in/hr)	I5 (in/hr)	I10 (in/hr)	I25 (in/hr)	I50 (in/hr)	I100 (in/hr)	Q2 (cfs)	Q5 (cfs)	Q10 (cfs)	Q25 (cfs)	Q50 (cfs)	Q100 (cfs)
A-1	26.41	0.55	1.10	1.20	1.25	15	3.90	4.78	5.50	6.47	7.20	7.93	56.65	69.43	79.89	103.38	126.50	144.0
A-2	7.70	0.55	1.10	1.20	1.25	15	3.90	4.78	5.50	6.47	7.20	7.93	16.52	20.24	23.29	30.14	36.59	42.0
OS-A	0.55	0.55	1.10	1.20	1.25	15	3.90	4.78	5.50	6.47	7.20	7.93	2.04	2.50	2.87	3.72	4.51	5.2
B	6.41	0.55	1.10	1.20	1.25	15	3.90	4.78	5.50	6.47	7.20	7.93	13.75	16.85	19.39	25.09	30.46	34.9
OS-B	3.11	0.55	1.10	1.20	1.25	15	3.90	4.78	5.50	6.47	7.20	7.93	6.67	8.18	9.41	12.17	14.78	17.0
C-1	6.33	0.55	1.10	1.20	1.25	15	3.90	4.78	5.50	6.47	7.20	7.93	13.59	16.64	19.15	24.78	30.08	34.5
C-2	8.79	0.55	1.10	1.20	1.25	15	3.90	4.78	5.50	6.47	7.20	7.93	18.85	23.11	26.59	34.41	41.77	47.9
OS-C	0.15	0.55	1.10	1.20	1.25	15	3.90	4.78	5.50	6.47	7.20	7.93	0.32	0.39	0.45	0.59	0.71	0.8
D-1	19.95	0.55	1.10	1.20	1.25	15	3.90	4.78	5.50	6.47	7.20	7.93	42.79	52.45	60.35	78.09	94.80	108.8
D-1-1	1.25	0.55	1.10	1.20	1.25	15	3.90	4.78	5.50	6.47	7.20	7.93	2.68	3.29	3.78	4.89	5.94	6.8
OS-1	26.36	0.55	1.10	1.20	1.25	15	3.90	4.78	5.50	6.47	7.20	7.93	56.64	69.30	79.74	103.18	126.26	143.1
OS-R	2.73	0.55	1.10	1.20	1.25	15	3.90	4.78	5.50	6.47	7.20	7.93	5.86	7.18	8.26	10.69	12.87	14.6

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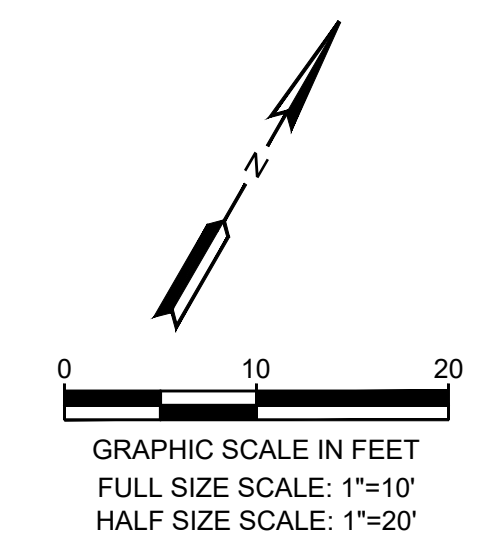
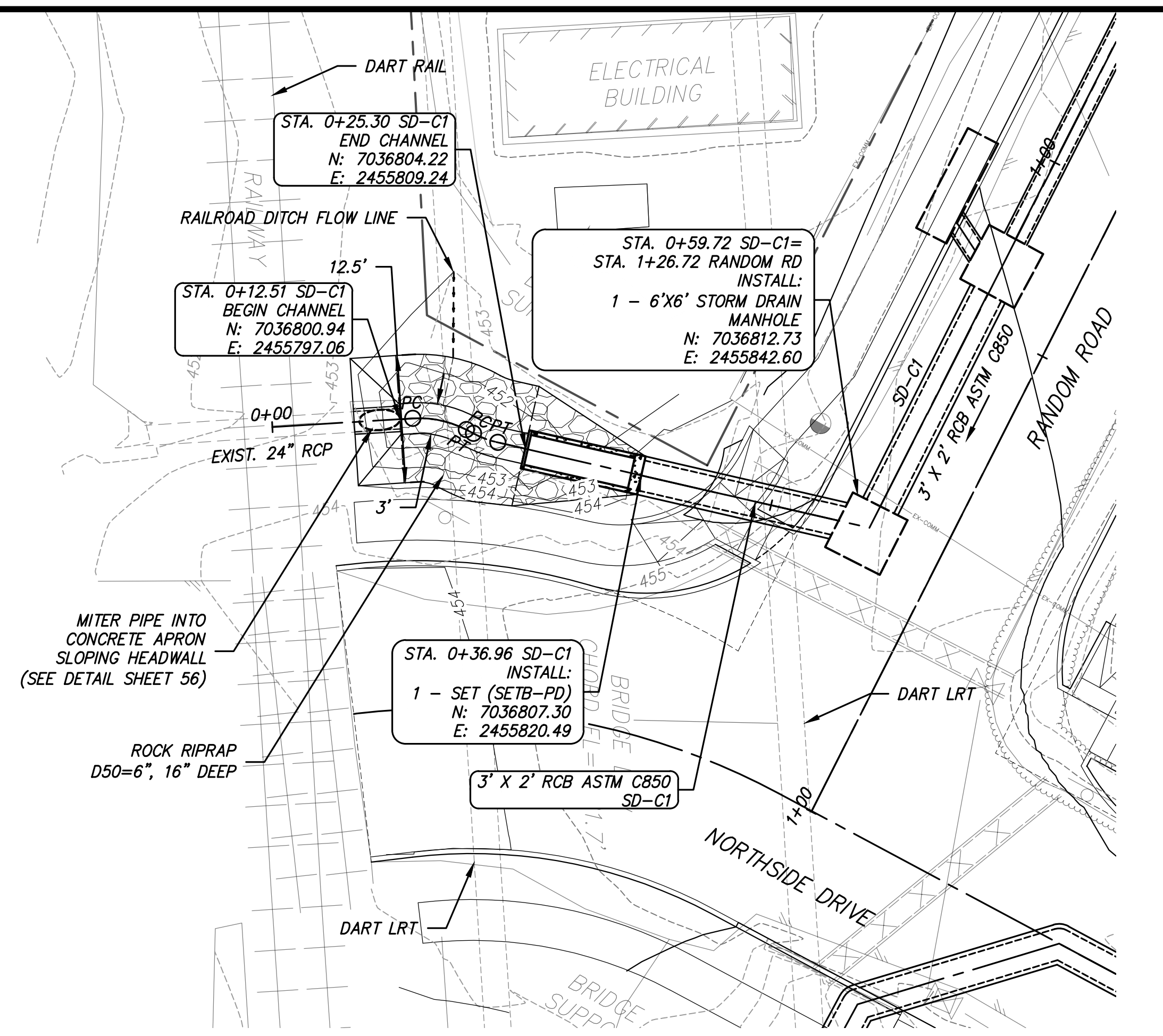
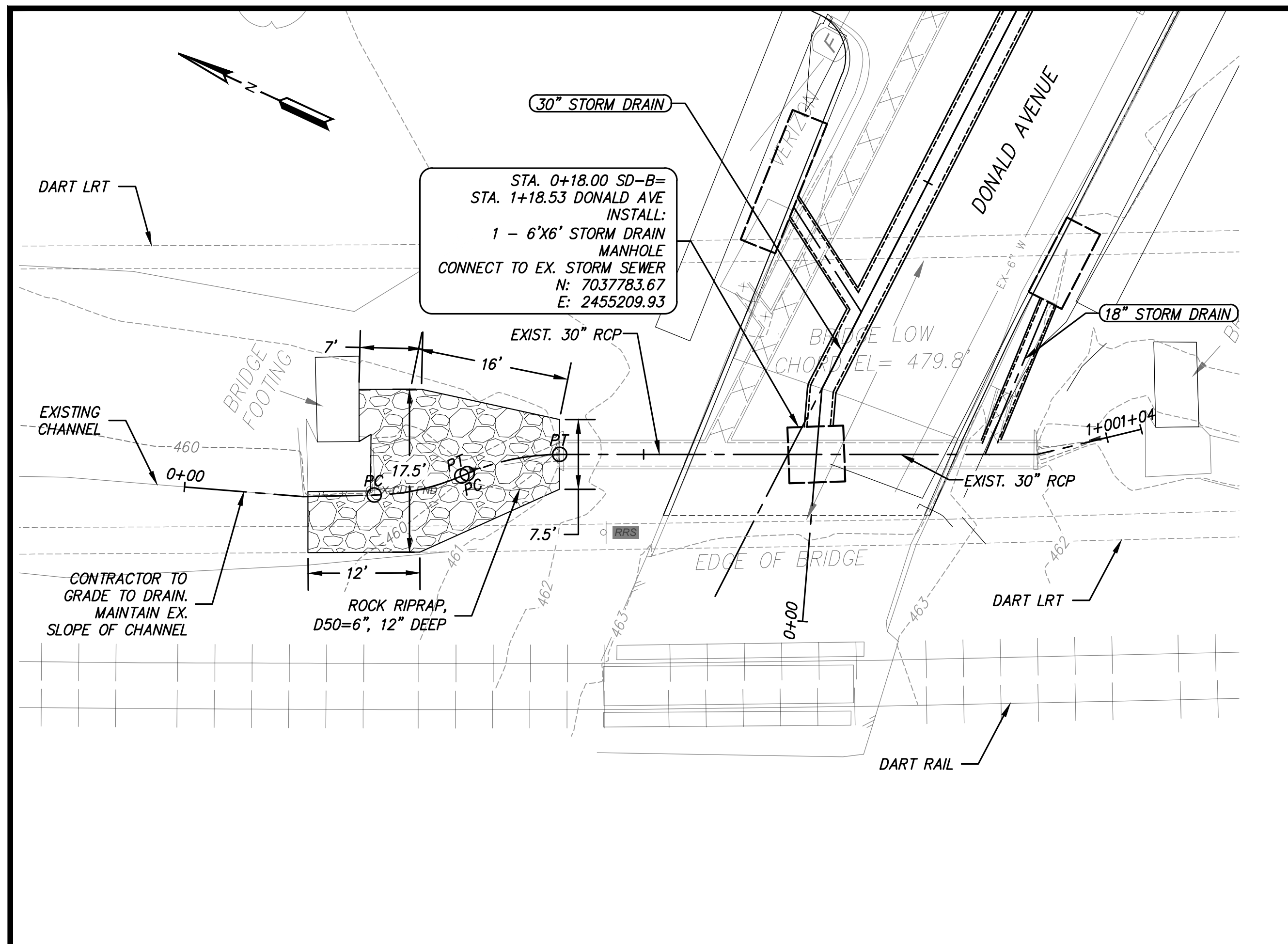
DUNCAN HEIGHTS  
PAVING, DRAINAGE, &  
UTILITY  
IMPROVEMENTS

PROJECT NO.  
130-10931-000

CHANNEL STATION	Channel Type	Flow, Q	Roughness Coeff., n	Slope, S	S <sup>1/2</sup>	$\frac{Q \times n}{1.486 \times S^{1/2}}$	Width, b	Depth, d	Side Slope	Area, A	wetted Perimeter, P <sub>w</sub>	Hydraulic Radius, R	R <sup>2/3</sup>	AxR <sup>2/3</sup>	Velocity, V	Velocity Head, V <sup>2</sup> /2g	Calc. Q	REMARKS	
<b>Northside</b>																			
From (1)	To (2)	(3)	(cfs) (4)	(ft/ft) (5)	(6)	(7)	(8)	(ft) (9)	(ft) (10)	(X:1) (11)	(ft <sup>2</sup> ) (12)	(ft) (13)	(ft) (14)	(15)	(16)	(ft/sec) (17)	(ft) (18)	(cfs) (19)	(20)
0+00	0+65	III	47.9	0.015	0.007	0.0837	5.78	0	1.84	2:1	6.77	8.23	0.82	0.88	5.95	7.28	0.82	49.28	
1+00	4+71	III	47.9	0.015	0.007	0.0837	5.78	4	1.26	3:1	9.80	11.97	0.82	0.88	8.58	7.26	0.82	71.13	
<b>Northside - Full Flow</b>																			
(1)	(2)	(3)	(cfs) (4)	(ft/ft) (5)	(6)	(7)	(8)	(ft) (9)	(ft) (10)	(X:1) (11)	(ft <sup>2</sup> ) (12)	(ft) (13)	(ft) (14)	(15)	(16)	(ft/sec) (17)	(ft) (18)	(cfs) (19)	(20)
0+00	0+65	III	47.9	0.015	0.007	0.0837	5.78	0	4	2:1	32	17.89	1.79	1.47	47.16	12.21	2.32	390.85	
1+00	4+71	III	47.9	0.015	0.007	0.0837	5.78	4	2	3:1	20	16.65	1.20	1.13	22.60	9.37	1.36	187.33	
<b>Random</b>																			
(1)	(2)	(3)	(cfs) (4)	(ft/ft) (5)	(6)	(7)	(8)	(ft) (9)	(ft) (10)	(X:1) (11)	(ft <sup>2</sup> ) (12)	(ft) (13)	(ft) (14)	(15)	(16)	(ft/sec) (17)	(ft) (18)	(cfs) (19)	(20)
0+12	0+16	III	34.5	0.04	0.0054	0.0735	12.64	3	1.82	2:1	12.03	11.12	1.08	1.05	12.69	2.88	0.13	34.63	
0+16	0+25	III	49.4	0.04	0.0054	0.0735	18.10	3	2.15	2:1	15.70	12.62	1.24	1.16	18.16	3.16	0.15	49.56	
<b>Random - Full Flow</b>																			
(1)	(2)	(3)	(cfs) (4)	(ft/ft) (5)	(6)	(7)	(8)	(ft) (9)	(ft) (10)	(X:1) (11)	(ft <sup>2</sup> ) (12)	(ft) (13)	(ft) (14)	(15)	(16)	(ft/sec) (17)	(ft) (18)	(cfs) (19)	(20)
0+12	0+16	III	34.5	0.04	0.0054	0.0735	12.64	3	2.375	2:1	18.41	13.62	1.35	1.22	22.50	3.34	0.17	61.42	
0+16	0+25	III	49.4	0.04	0.0054	0.0735	18.10	3	2.375	2:1	18.41	13.62	1.35	1.22	22.50	3.34	0.17	61.42	

Exhibit A-4





NOTES:  
1. THE CONTRACTOR SHALL PROTECT EXISTING FOOTINGS.



**LAN** Lockwood, Andrews & Newnam, Inc.  
A LEO A DALY COMPANY  
TEXAS REGISTERED ENGINEERING FIRM F-2614  
8350 N. CENTRAL EXPRESSWAY  
SUITE 300  
DALLAS, TX 75206  
WWW.LAN-INC.COM

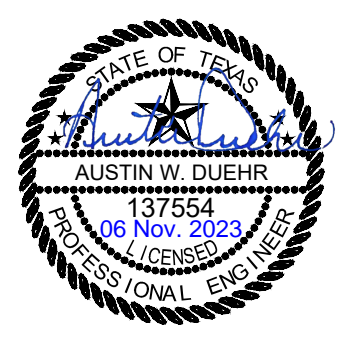
EXCAVATION SAFETY NOTE:  
CONTRACTOR SHALL CONTACT TEXAS 811 (DIAL 811 OR 800-344-8377) FOR UTILITY LOCATES NO LATER THAN TWO FULL WORKING DAYS PRIOR TO CONSTRUCTION.

REVISIONS

NO.	DESCRIPTION	DATE

FILE LOG

ACTIVITY	BY
MANAGER	AWD
DESIGN	LAN
DRAWN	LAN
CHECK	SLM



**DUNCAN HEIGHTS PAVING, DRAINAGE, & UTILITY IMPROVEMENTS PHASE 1**

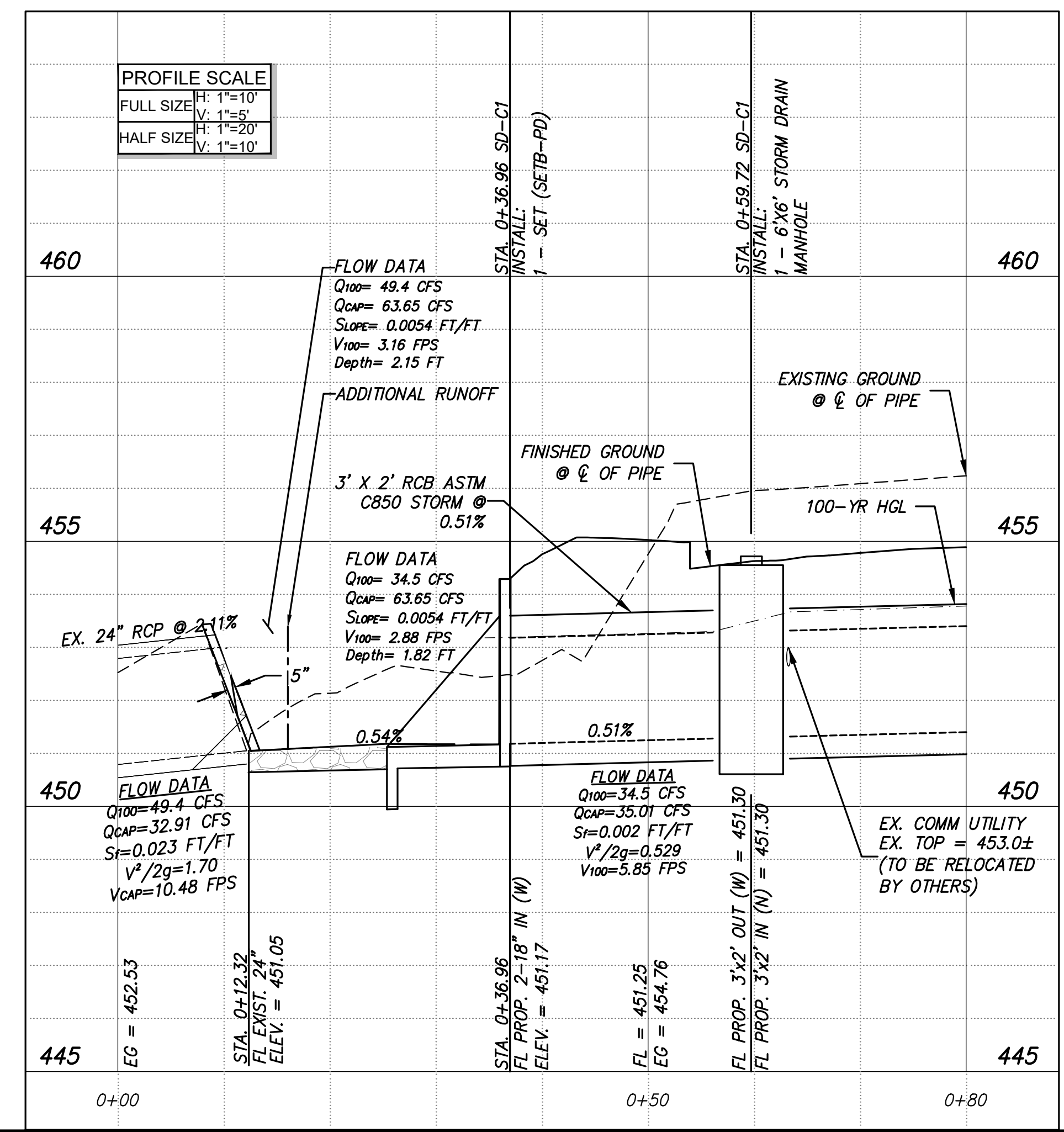
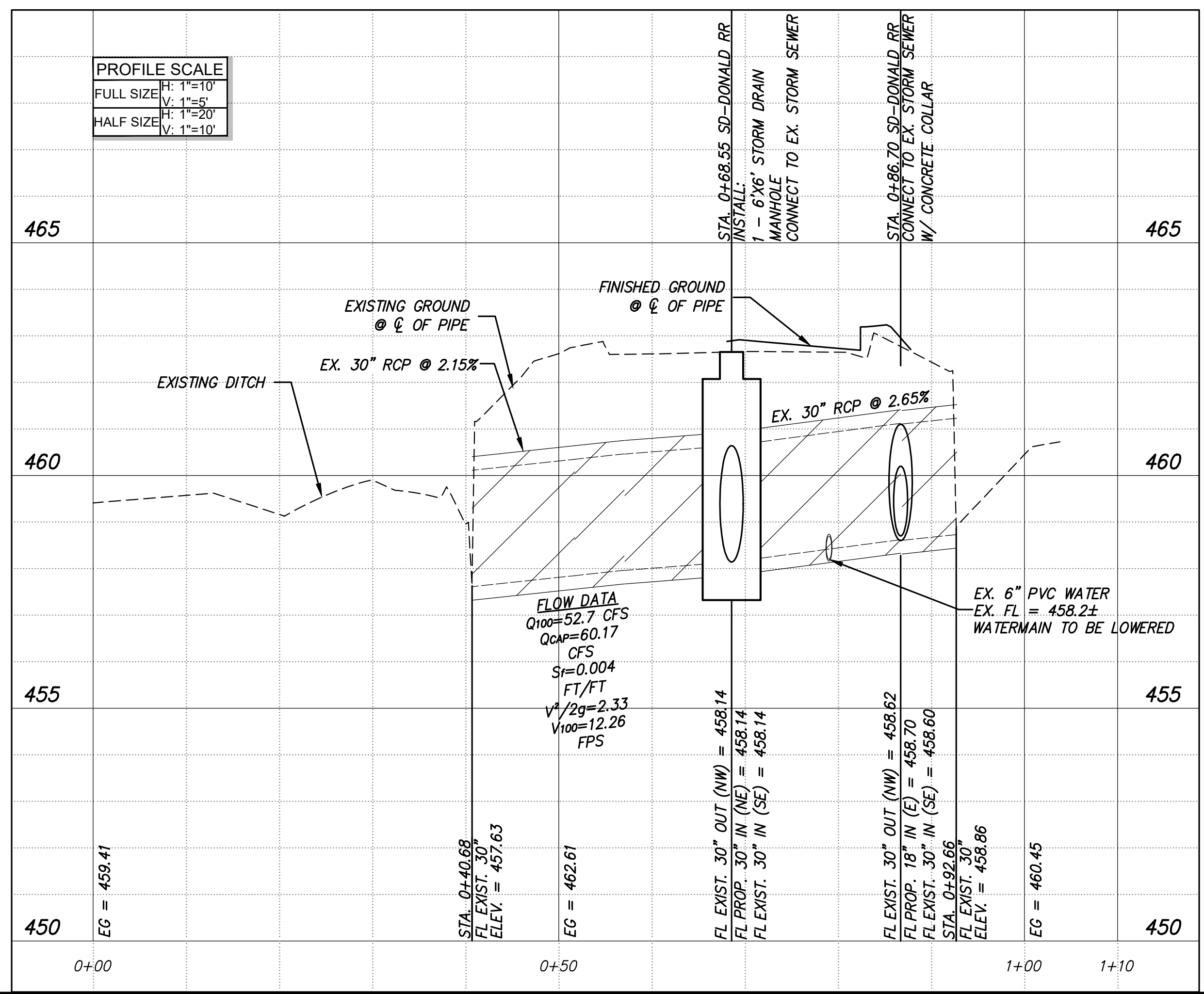
PROJECT NO. 130-10931-000  
DATE: NOV 06, 2023

**RAILROAD CHANNEL IMPROVEMENTS**

**DONALD AVENUE AND RANDOM ROAD**

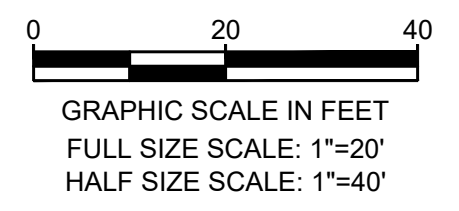
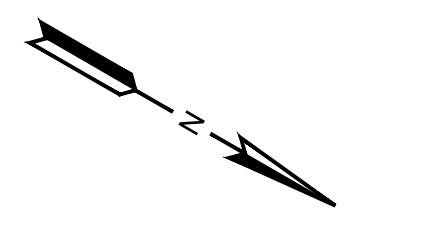
DRAWING NO: SHEET 54 OF 106

Exhibit A-6

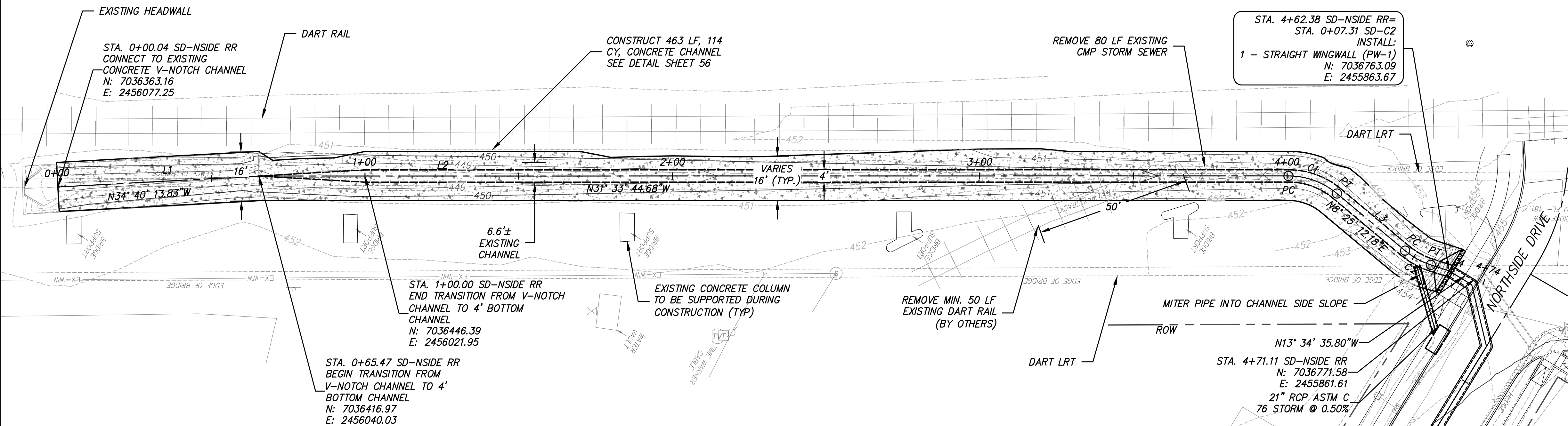


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LAST PLOTTED BY: CLEVER, KIRSTIN  
LAST PLOTTED ON: Monday, November 6, 2023 11:52:47 AM

ID	ALIGNMENT	LENGTH	CHORD LENGTH	RADIUS	LINE/CHORD BEARING	START STATION	START NORTHING	START EASTING	END STATION	END NORTHING	END EASTING
L1	SD-NSIDE RR	65.45			N34° 40' 13.83"W	0+00.00	7,036,363.13	2,456,077.27	0+65.45	7,036,416.96	2,456,040.04
L2	SD-NSIDE RR	334.98			N31° 33' 44.68"W	0+65.45	7,036,416.96	2,456,040.04	4+00.43	7,036,702.38	2,455,864.70
C1	SD-NSIDE RR	17.13	16.78	24.55	N11° 34' 16.25"W	4+00.43	7,036,702.38	2,455,864.70	4+17.56	7,036,718.83	2,455,861.33
L3	SD-NSIDE RR	28.94			N8° 25' 12.18"E	4+17.56	7,036,718.83	2,455,861.33	4+46.50	7,036,747.45	2,455,865.57
C2	SD-NSIDE RR	9.60	9.54	25.00	N2° 34' 41.81"W	4+46.50	7,036,747.45	2,455,865.57	4+56.09	7,036,756.98	2,455,865.14
L4	SD-NSIDE RR	18.16			N13° 34' 35.80"W	4+56.09	7,036,756.98	2,455,865.14	4+74.26	7,036,774.63	2,455,860.88



**Lockwood, Andrews & Newnam, Inc.**  
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 SUITE 300  
 DALLAS, TX 75206  
 WWW.LAN-INC.COM

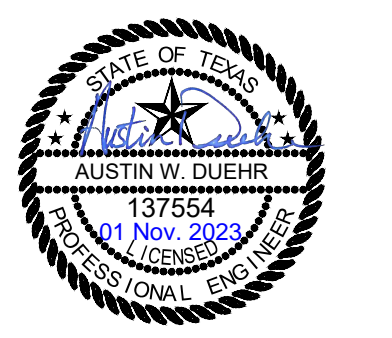


NOTES:  
 1. THE CONTRACTOR SHALL PROTECT EXISTING FOOTINGS.

EXCAVATION SAFETY NOTE:  
 CONTRACTOR SHALL CONTACT TEXAS 811 (DIAL 811 OR 800-344-8377) FOR UTILITY LOCATES NO LATER THAN TWO FULL WORKING DAYS PRIOR TO CONSTRUCTION.

NO.	DESCRIPTION	DATE

ACTIVITY	BY
MANAGER	AWD
DESIGN	LAN
DRAWN	LAN
CHECK	SLM



### DUNCAN HEIGHTS PAVING, DRAINAGE, & UTILITY IMPROVEMENTS PHASE 1

PROJECT NO. 130-10931-000  
 DATE: NOV 01, 2023

### RAILROAD CHANNEL IMPROVEMENTS

### BROADWAY

DRAWING NO:  
 SHEET 55 OF 106

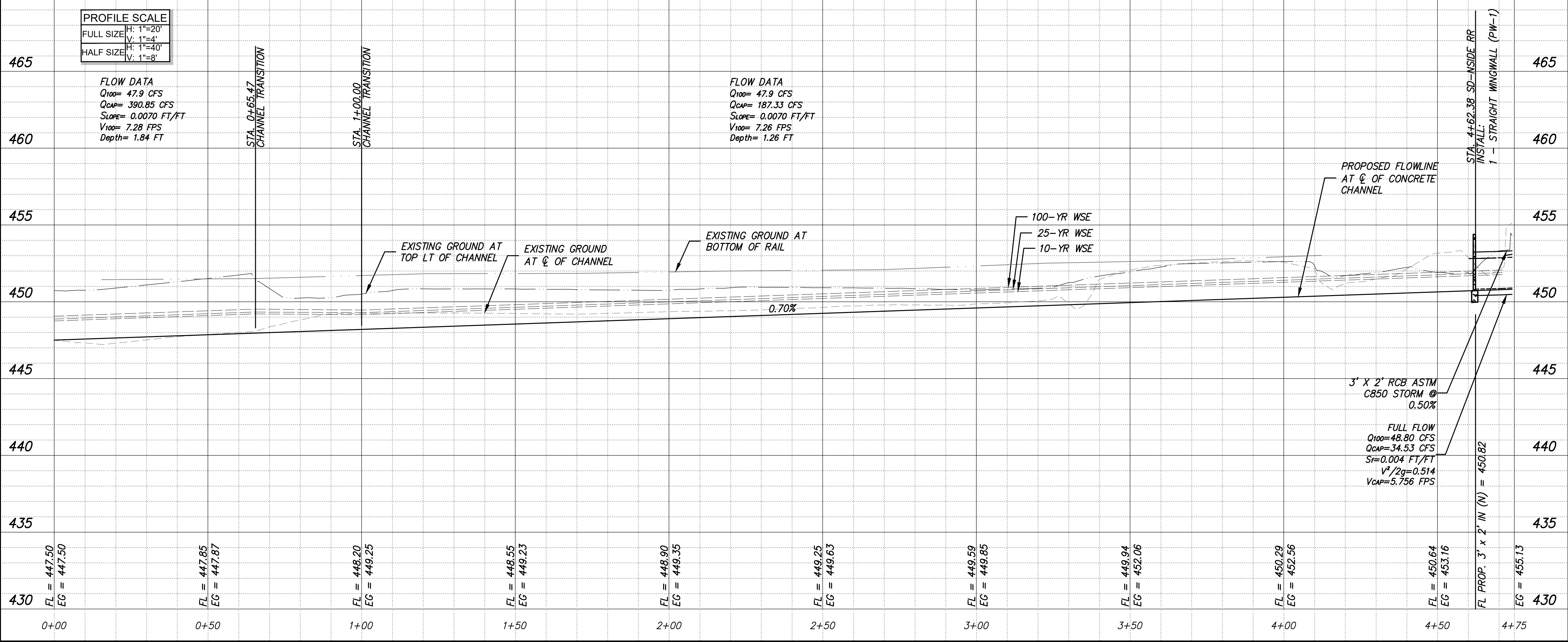


Exhibit A-7

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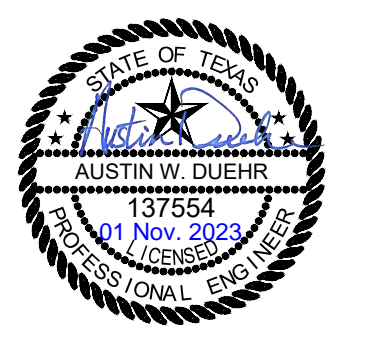
**EXCAVATION SAFETY NOTE:**  
CONTRACTOR SHALL CONTACT TEXAS 811 (DIAL 811 OR 800-344-8377) FOR UTILITY LOCATES NO LATER THAN TWO FULL WORKING DAYS PRIOR TO CONSTRUCTION.

**REVISIONS**

NO.	DESCRIPTION	DATE

**FILE LOG**

ACTIVITY	BY
MANAGER	AWD
DESIGN	LAN
DRAWN	LAN
CHECK	SLM

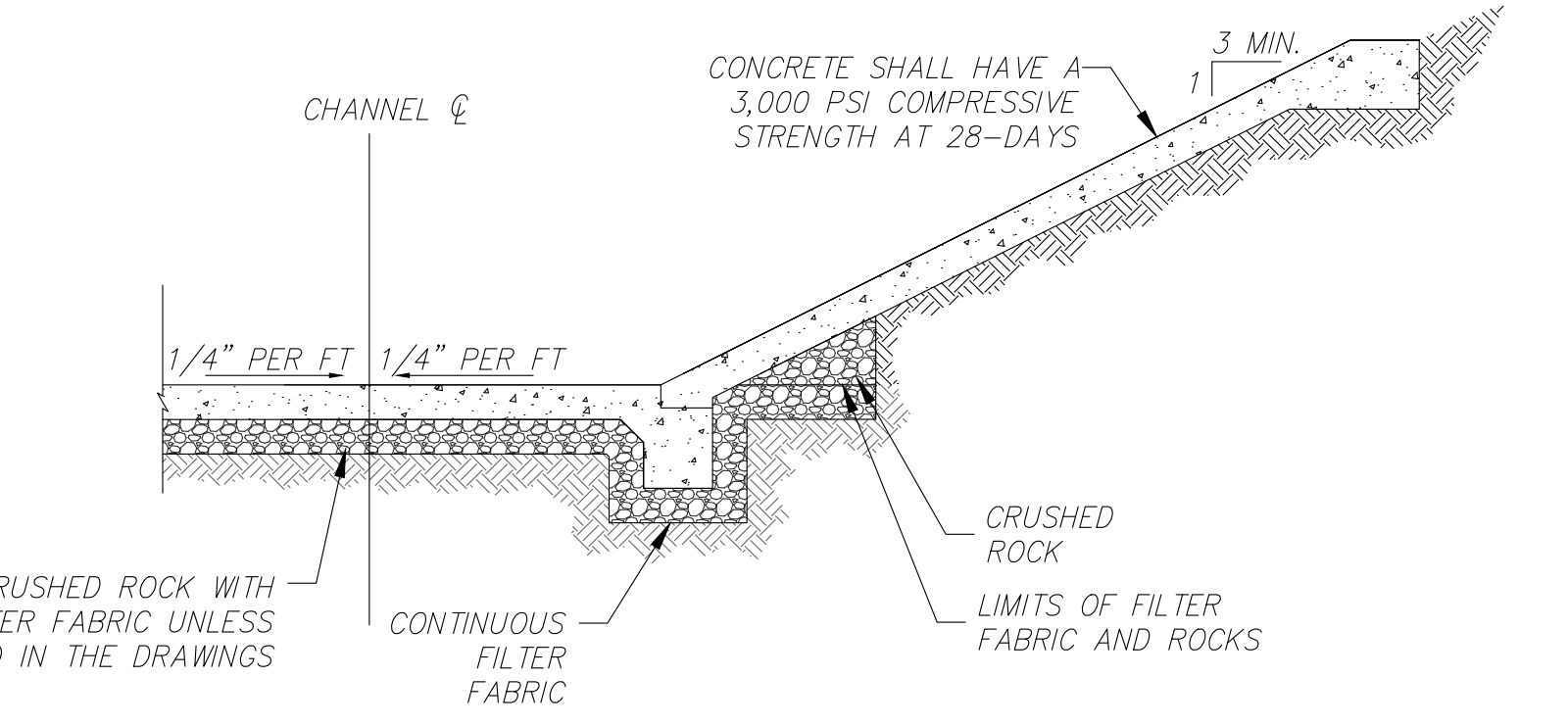
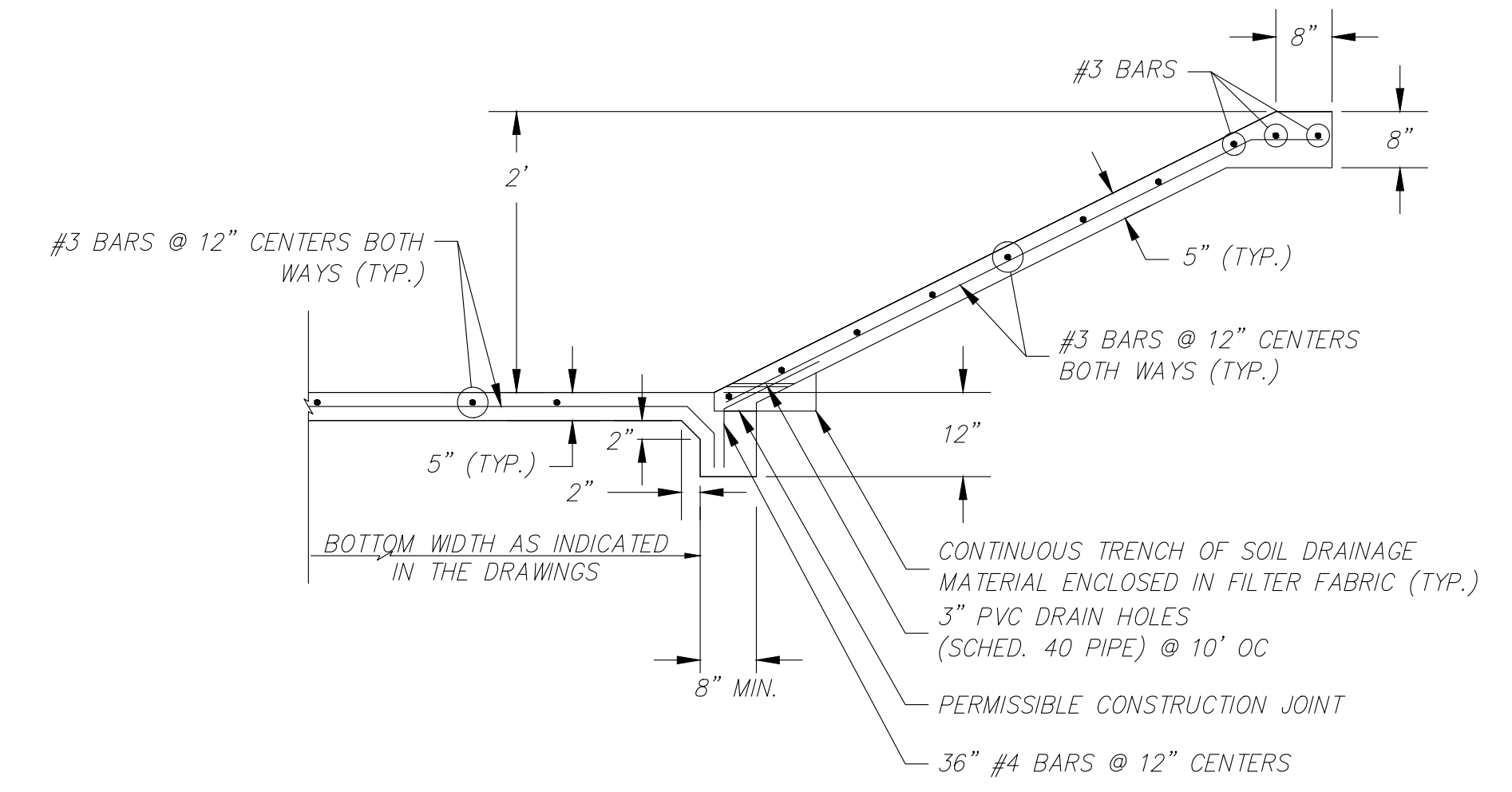


**DUNCAN HEIGHTS PAVING, DRAINAGE, & UTILITY IMPROVEMENTS PHASE 1**

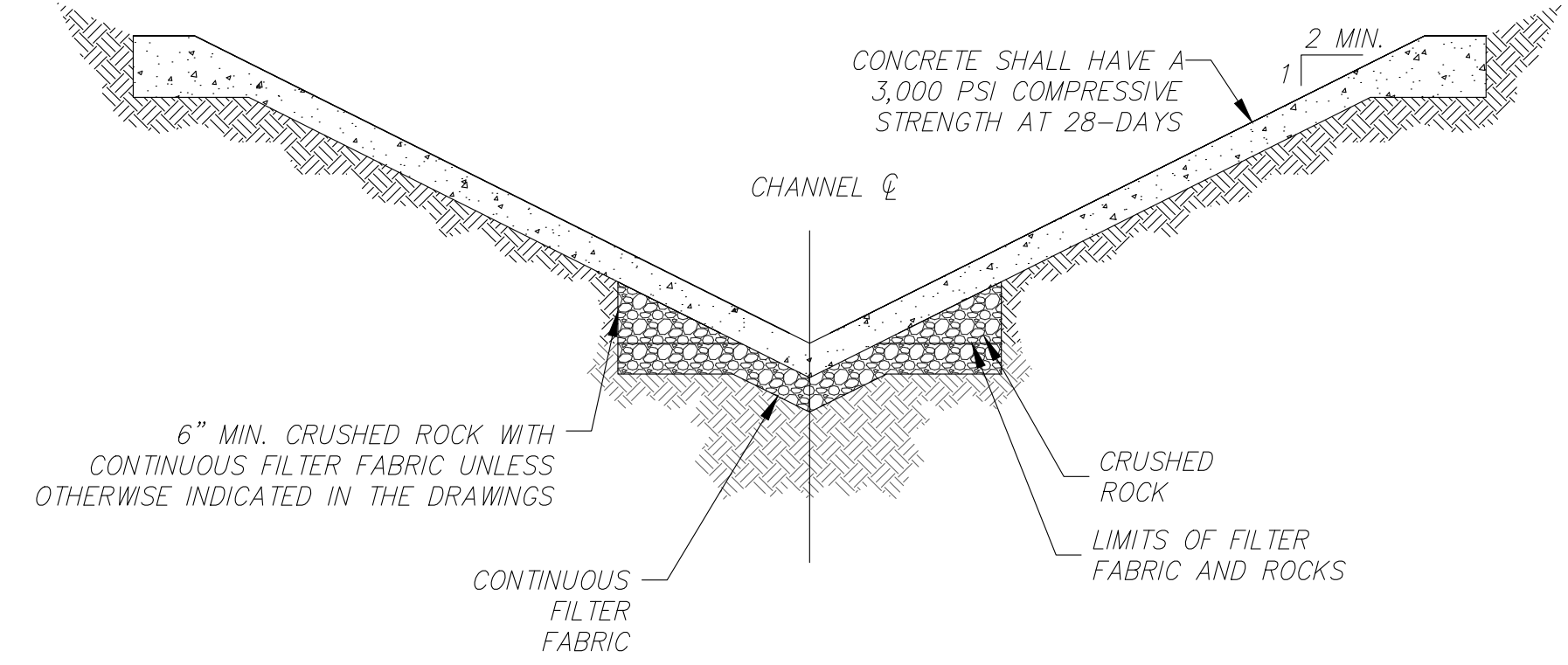
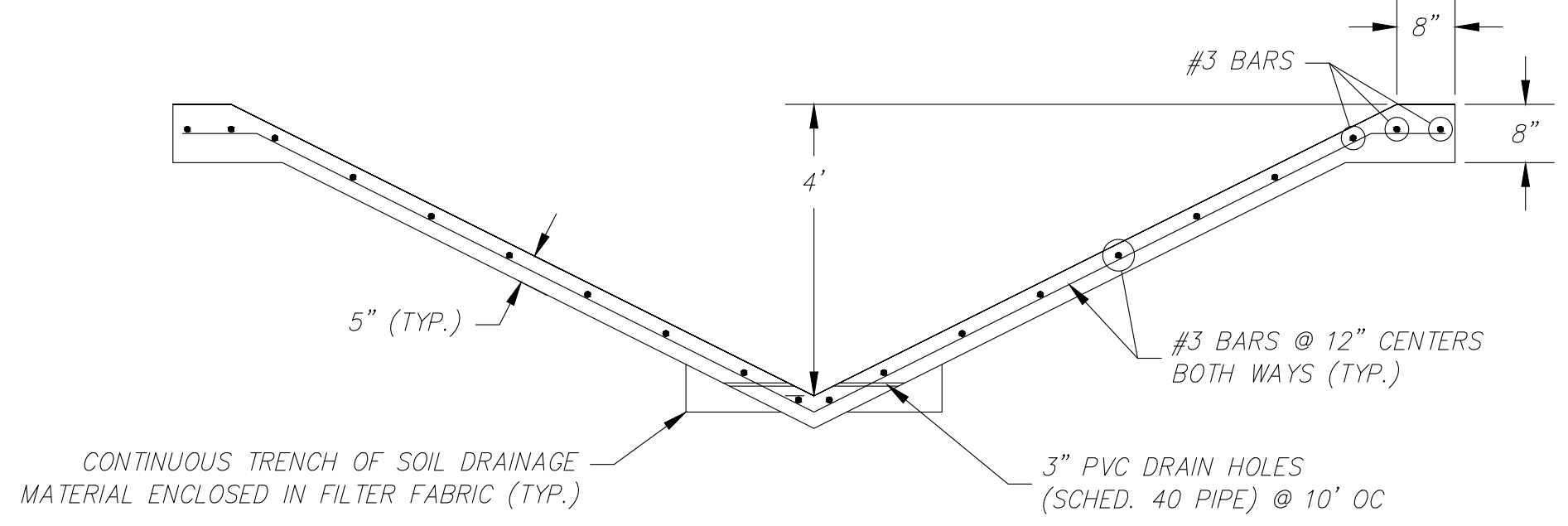
PROJECT NO. 130-10931-000  
DATE: NOV 01, 2023

**RAILROAD CHANNEL IMPROVEMENTS**

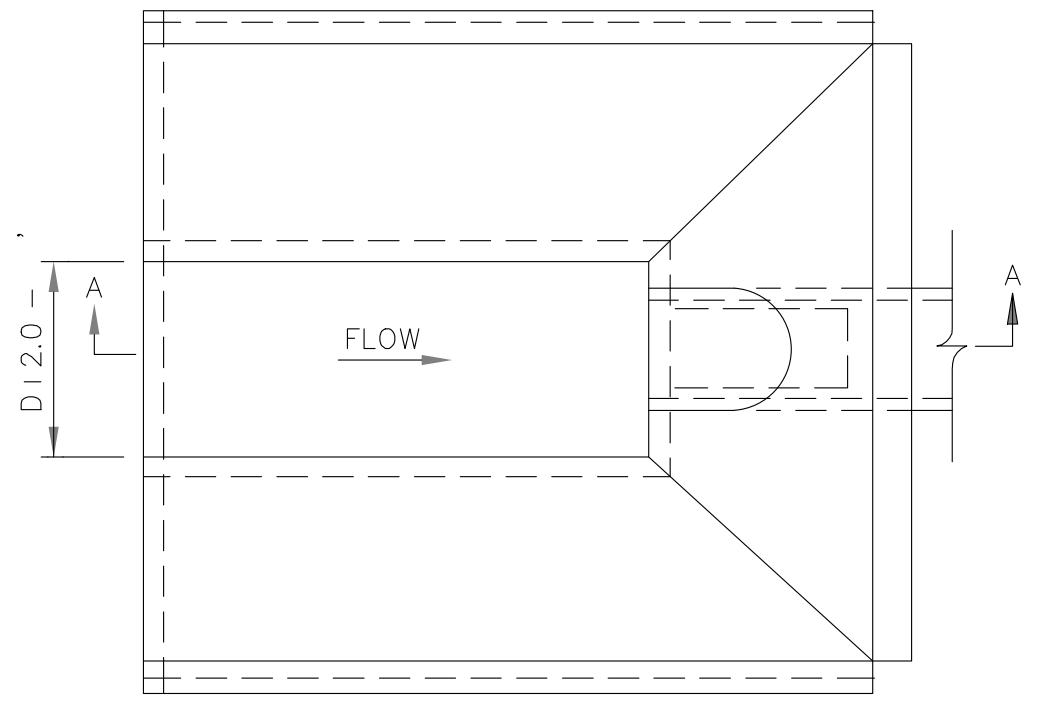
**DETAILS**



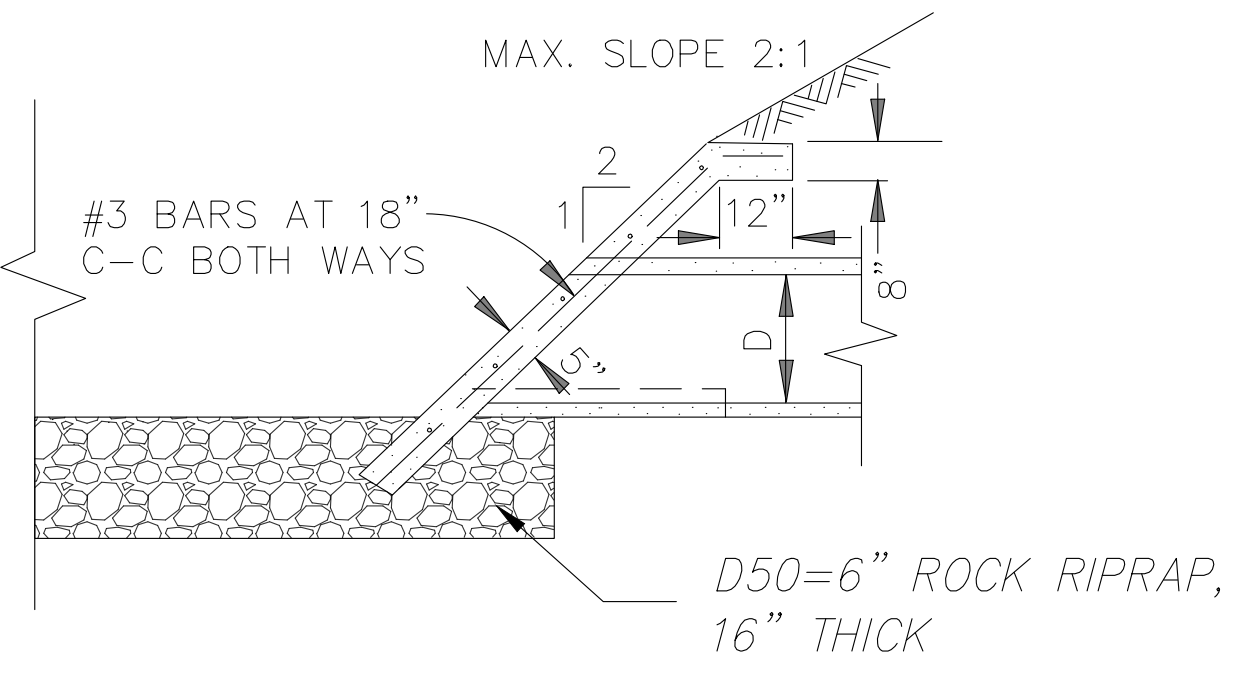
**TRAPEZOIDAL CHANNEL TYPICAL SECTION BROADWAY NTS**



**V-NOTCH CHANNEL TYPICAL SECTION BROADWAY NTS**



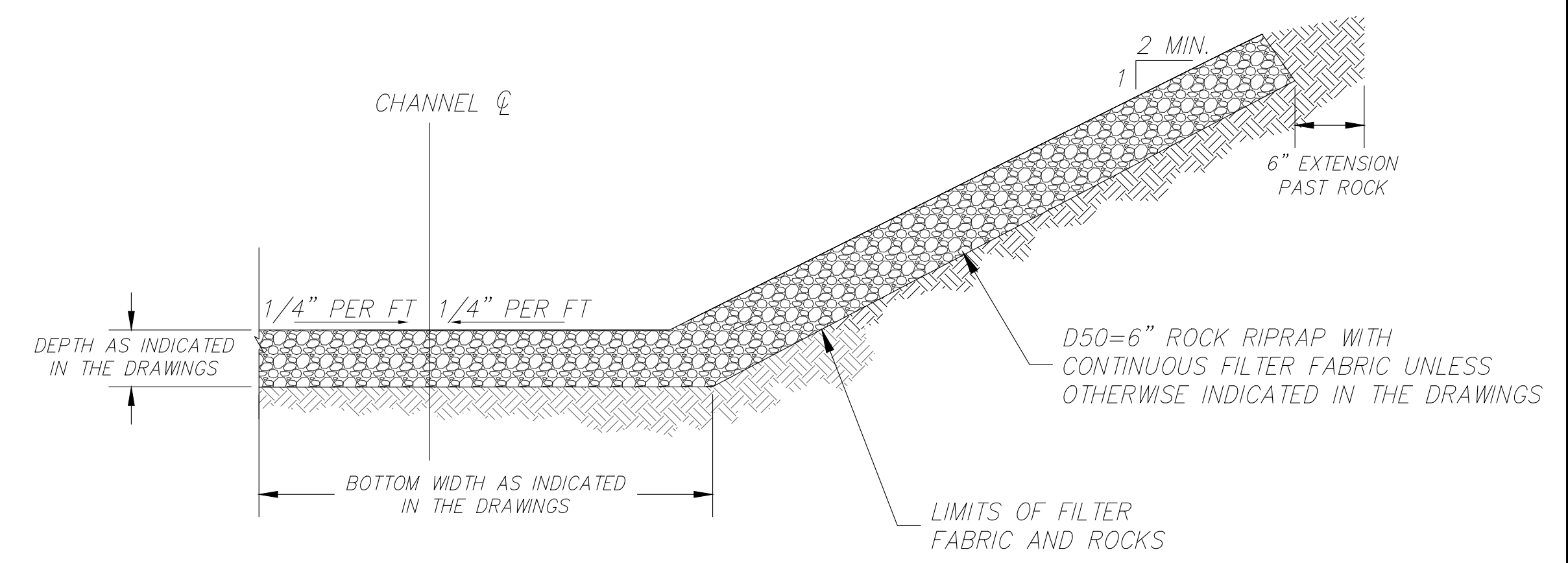
**PLAN N.T.S.**



**SECTION A-A N.T.S.**

**NOTE:**  
CONCRETE SHALL BE CLASS "A".

**CONCRETE APRON - SLOPING HEADWALL RANDOM NTS**



**TRAPEZOIDAL CHANNEL TYPICAL SECTION DONALD & RANDOM NTS**

**Exhibit A-8**

EXCAVATION SAFETY NOTE:

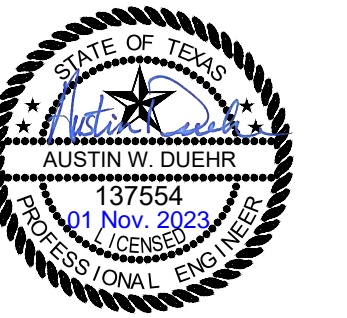
CONTRACTOR SHALL CONTACT TEXAS 811 (DIAL 811 OR 800-344-8377) FOR UTILITY LOCATES NO LATER THAN TWO FULL WORKING DAYS PRIOR TO CONSTRUCTION.

REVISIONS

NO.	DESCRIPTION	DATE

FILE LOG

ACTIVITY	BY
MANAGER	AWD
DESIGN	LAN
DRAWN	LAN
CHECK	SLM



DUNCAN HEIGHTS  
PAVING, DRAINAGE, &  
UTILITY  
IMPROVEMENTS  
PHASE 1

PROJECT NO. 130-10931-000  
DATE: NOV 01, 2023

RAILROAD CHANNEL  
IMPROVEMENTS

CROSS SECTIONS -  
NORTHSIDE DR

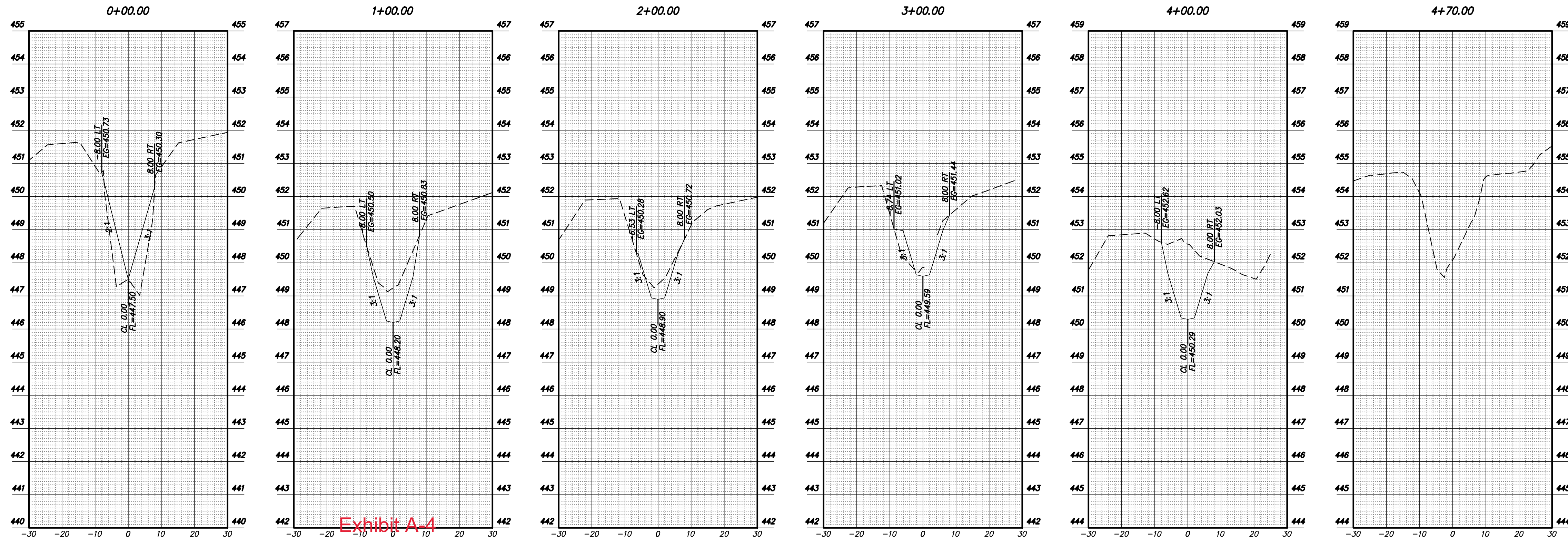
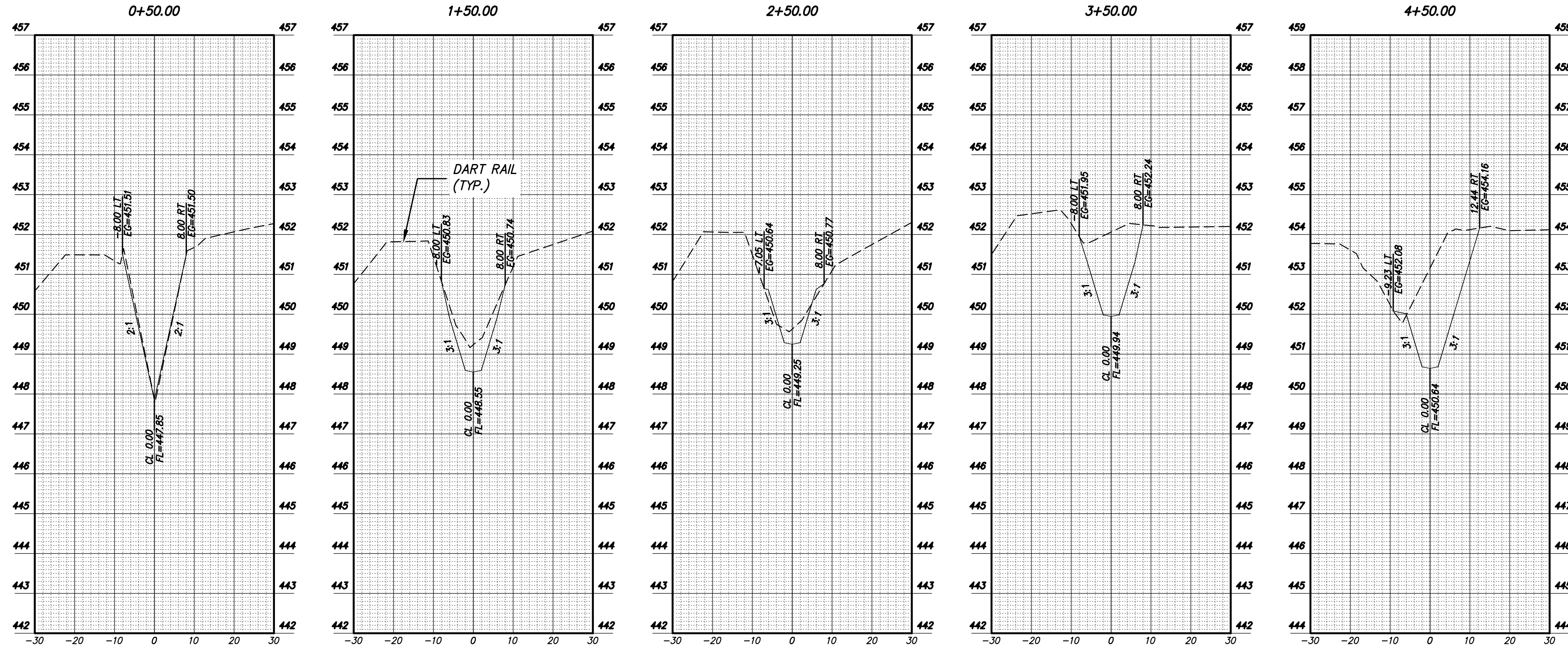
DRAWING NO:  
SHEET 57 OF 106

PROFILE SCALE

FULL SIZE	H: 1"=20'
HALF SIZE	V: 1"=4'

LEGEND

--- EXISTING CHANNEL  
—— PROPOSED CHANNEL



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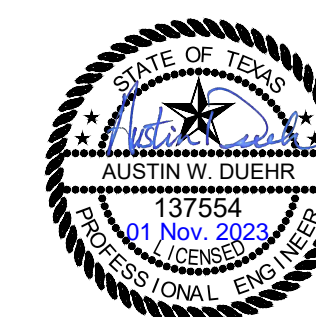
CONTRACTOR SHALL CONTACT TEXAS 811 (DIAL 811 OR 800-344-8377) FOR UTILITY LOCATES NO LATER THAN TWO FULL WORKING DAYS PRIOR TO CONSTRUCTION.

REVISIONS

NO.	DESCRIPTION	DATE

FILE LOG

ACTIVITY	BY
MANAGER	AWD
DESIGN	LAN
DRAWN	LAN
CHECK	SLM



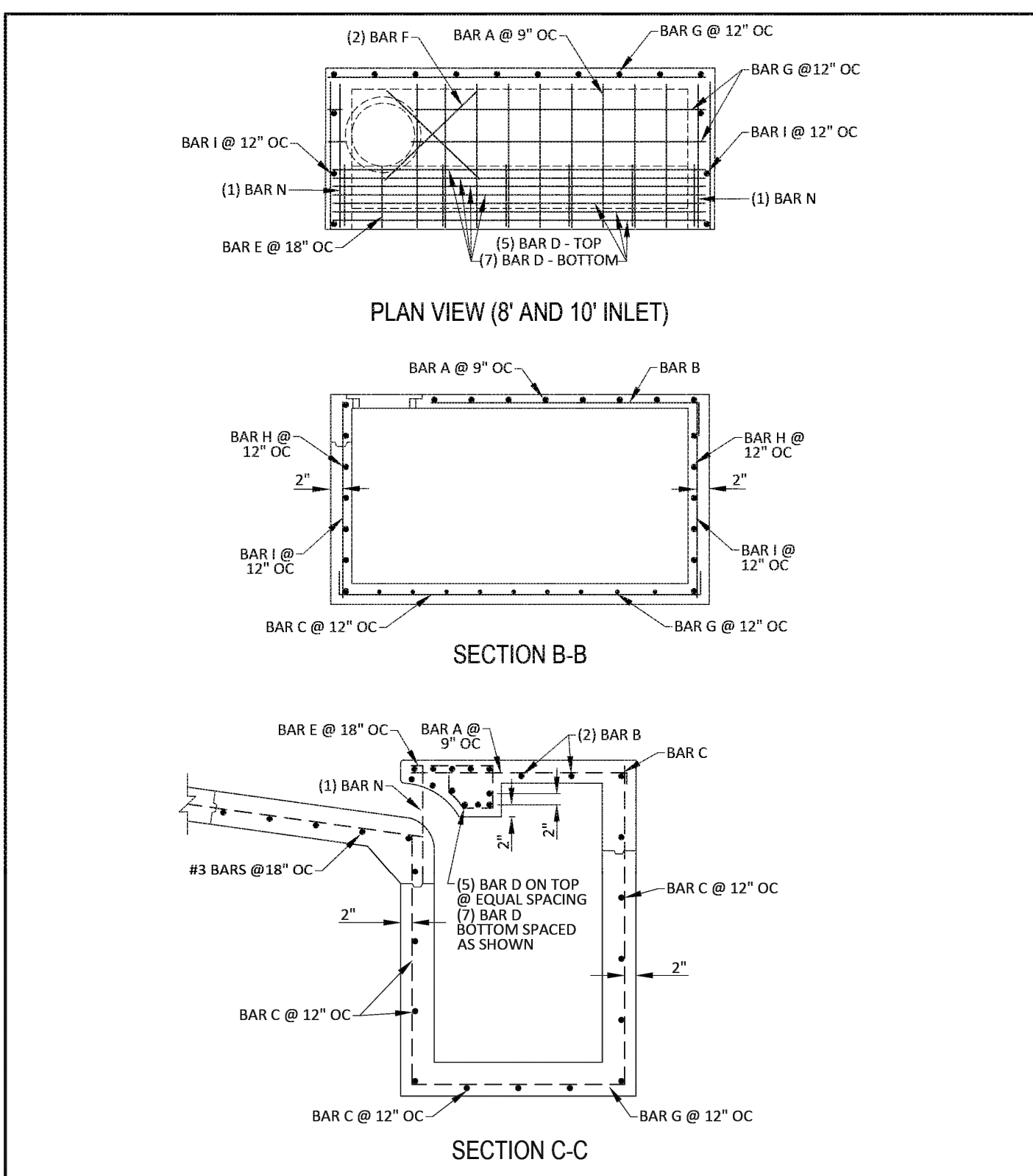
**DUNCAN HEIGHTS  
PAVING, DRAINAGE, &  
UTILITY  
IMPROVEMENTS  
PHASE 1**

PROJECT NO. 130-10931-000  
DATE: NOV 01, 2023

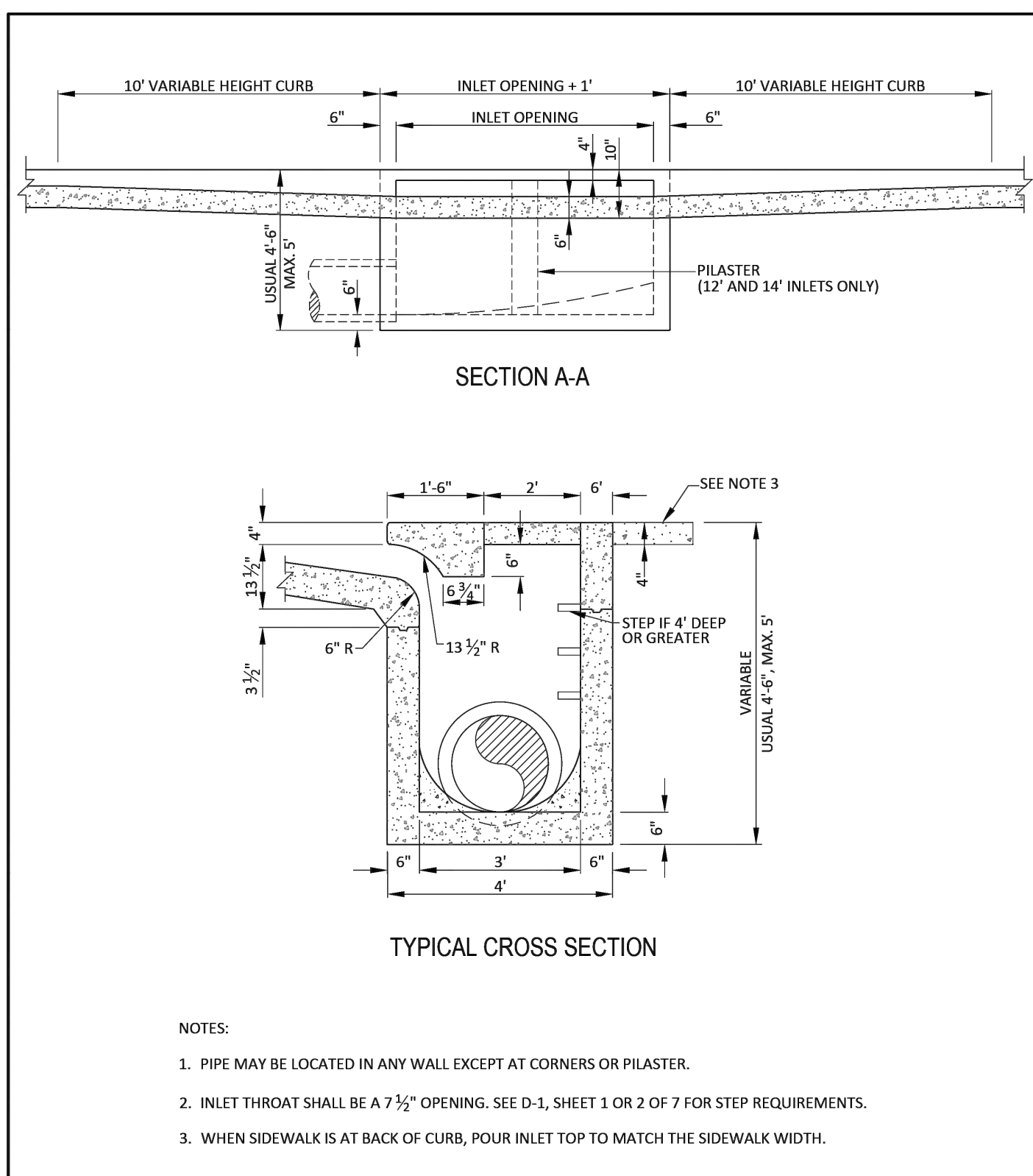
**CARROLLTON  
DRAINAGE DETAILS**

SHEET 1 OF 2

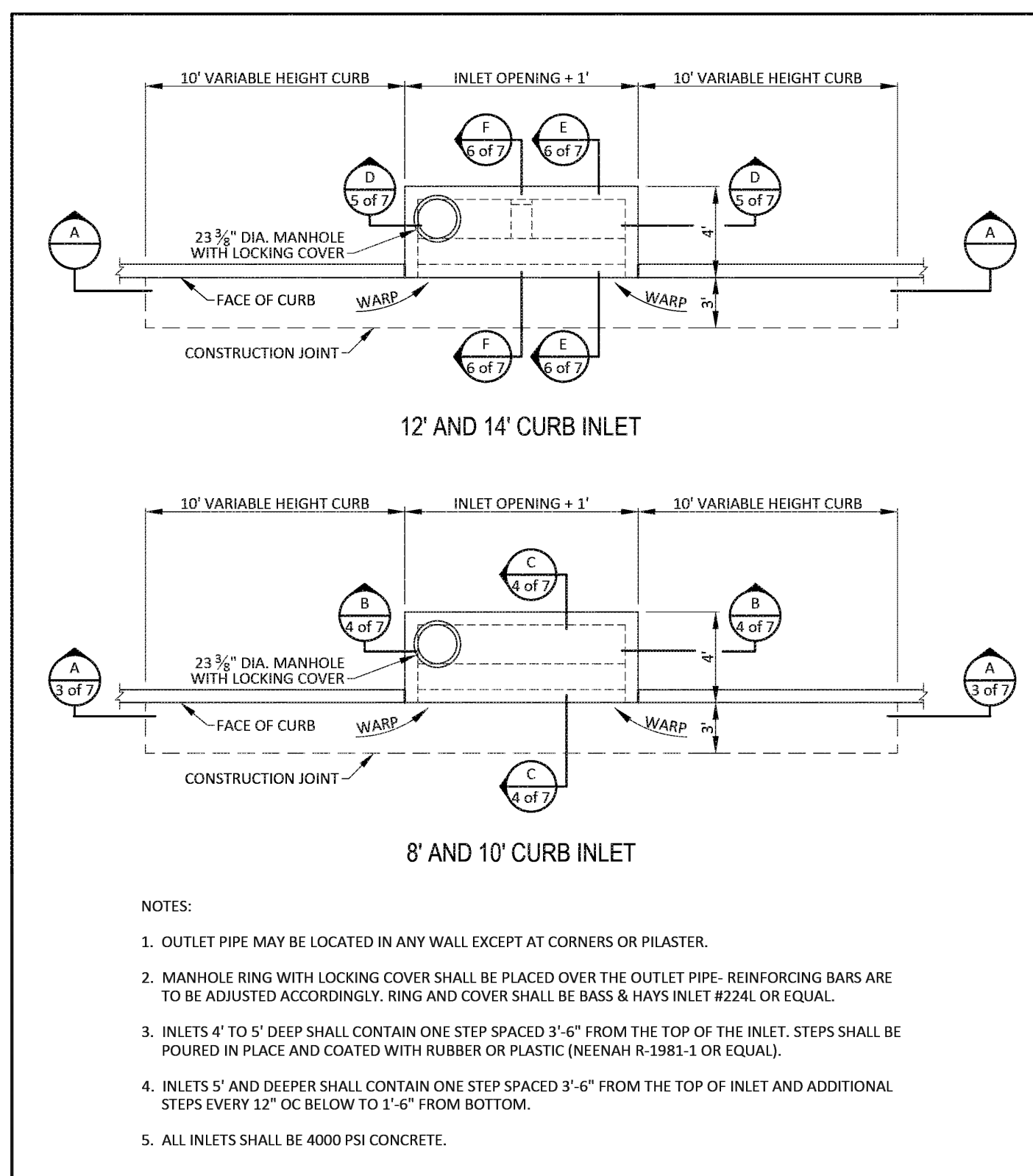
DRAWING NO:  
SHEET 68 OF 106



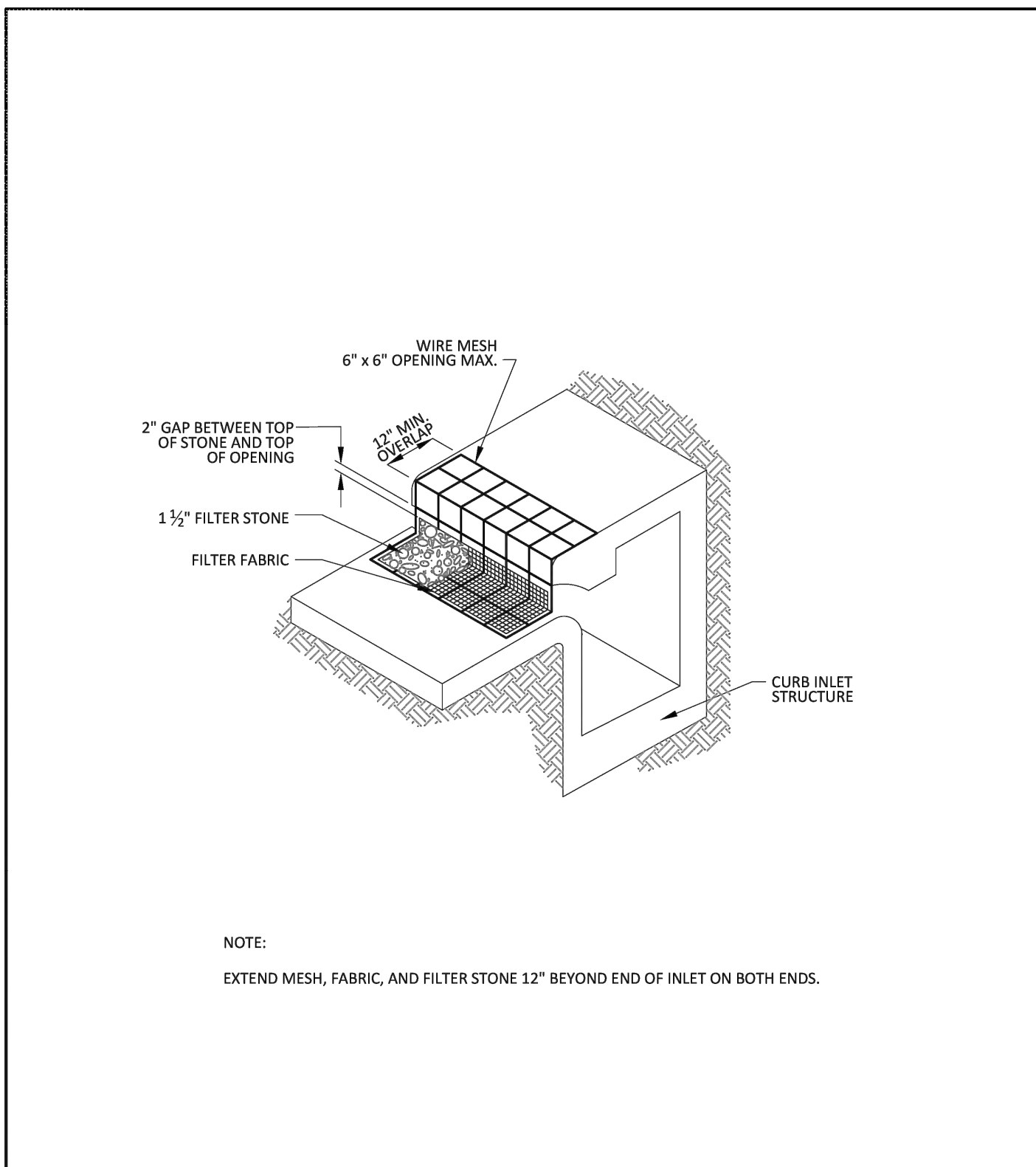
**CARROLLTON**  
TEXAS



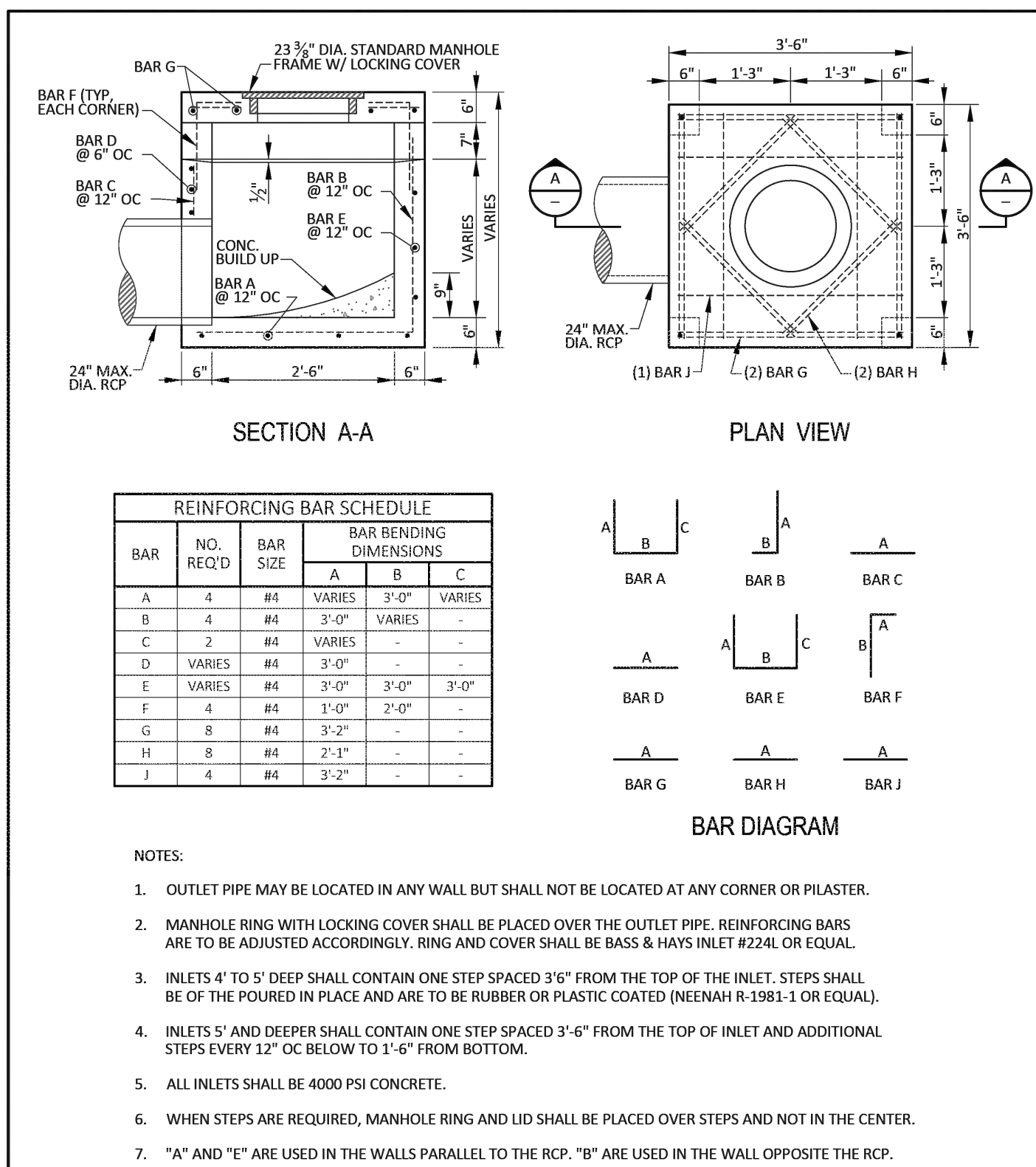
**CARROLLTON**  
TEXAS



**CARROLLTON**  
TEXAS



**CARROLLTON**  
TEXAS



**CARROLLTON**  
TEXAS

**REINFORCING BAR SCHEDULE**

INLET LENGTH	BAR MARK NUMBER	BAR DIAGRAM TYPE	BAR SIZE	NUMBER REQUIRED	BAR BENDING DIMENSIONS		
					A	B	C
8	A	I	#3	9	3'-2"	6"	-
	B	I	#3	2	6'-8"	6"	-
	C	II	#4	VARIES	8'-8"	6"	-
	D	II	#4	12	8'-8"	6"	-
	E	IV	#3	7	*	*	*
	F	III	#3	2	4'-0"	-	-
	G	V	#4	10	**	3'-2"	**
	H	III	#4	VARIES	3'-2"	-	-
	I	III	#4	4	**	-	-
	N	III	#4	2	1'-6"	-	-
10	A	I	#3	14	3'-2"	6"	-
	B	I	#3	2	8'-8"	6"	-
	C	II	#4	VARIES	10'-8"	6"	-
	D	II	#4	12	10'-8"	6"	-
	E	IV	#3	8	*	*	*
	F	III	#3	2	4'-0"	-	-
	G	V	#4	12	**	3'-2"	**
	H	III	#4	VARIES	3'-2"	-	-
	I	III	#4	4	**	-	-
	N	III	#4	2	1'-6"	-	-
12	A	I	#3	10	3'-2"	6"	-
	B	I	#3	2	10'-8"	6"	-
	C	II	#4	VARIES	12'-8"	6"	-
	D	II	#5	6	12'-8"	-	-
	E	IV	#3	12	*	*	*
	F	III	#3	2	4'-0"	-	-
	G	V	#4	10	**	3'-2"	**
	H	III	#4	VARIES	3'-2"	-	-
	I	III	#4	4	**	-	-
	L	III	#4	5	**	-	-
14	A	I	#3	14	3'-2"	6"	-
	B	I	#3	2	12'-8"	6"	-
	C	II	#4	VARIES	14'-8"	6"	-
	D	II	#5	6	14'-8"	-	-
	E	IV	#3	16	*	*	*
	F	III	#3	2	4'-0"	-	-
	G	V	#4	14	**	3'-2"	**
	H	III	#4	VARIES	3'-2"	-	-
	I	III	#4	4	**	-	-
	L	III	#4	5	**	-	-

\* SEE BAR DIAGRAM FOR DIMENSIONS.  
\*\* LENGTH VARIES DUE TO DEPTH OF INLET.

**GENERAL DESIGN STANDARDS  
DRAINAGE DETAILS**  
SCALE: NTS DATE: 01/2015  
SHEET 7 OF 7

CURB AND RECESSED INLETS  
REINFORCING BAR SCHEDULE

**D-1  
ENGINEERING  
DEPARTMENT**

**CARROLLTON**  
TEXAS

**Exhibit A-10**

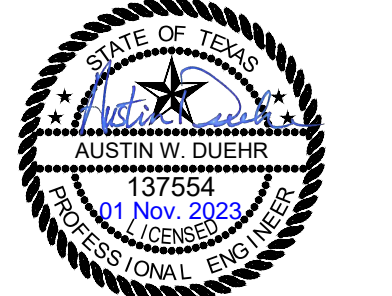
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LAST PLOTTED BY: CLETHE, JUSTIN  
LAST PLOTTED ON: Wednesday, November 1, 2023 3:07:48 PM



**EXCAVATION SAFETY NOTE:**  
CONTRACTOR SHALL CONTACT TEXAS 811 (DIAL 811 OR 800-344-8377) FOR UTILITY LOCATES NO LATER THAN TWO FULL WORKING DAYS PRIOR TO CONSTRUCTION.

REVISIONS		
NO.	DESCRIPTION	DATE

FILE LOG	
ACTIVITY	BY
MANAGER	AWD
DESIGN	LAN
DRAWN	LAN
CHECK	SLM



**DUNCAN HEIGHTS PAVING, DRAINAGE, & UTILITY IMPROVEMENTS PHASE 1**

PROJECT NO. 130-10931-000  
DATE: NOV 01, 2023

**TXDOT DRAINAGE DETAILS**

**CROSS PIPE LENGTHS, REQUIRED PIPE SIZES, & RIPRAP QUANTITIES**

Nominal Culvert I.D.	Cross Riprap (CY)	Single Bar (CY)	Bar (CY)	Bar (CY)	Conditions for Cross Pipes	Cross Pipe Size
12"	0.5	0	N/A	2'-11"	1'-0"	3" STD
15"	0.7	11"	N/A	2'-5"	2'-2"	3" STD
18"	0.8	1'-2"	N/A	2'-10"	2'-8"	3" STD
21"	0.9	1'-4"	N/A	2'-5"	2'-3"	3 1/2" STD
24"	0.9	1'-7"	N/A	3'-0"	2'-7"	3 1/2" STD
27"	1.0	1'-8"	N/A	3'-10"	3'-11"	3 or more Pipe Culverts
33"	1.2	1'-11"	4'-2"	4'-5"	4'-8"	All Pipe Culverts
36"	1.3	2'-1"	4'-5"	4'-5"	5'-1"	4" STD
42"	1.5	2'-4"	4'-11"	5'-5"	5'-10"	All Pipe Culverts
48"	1.7	2'-7"	5'-5"	6'-0"	6'-7"	4" STD
54"	2.0	3'-0"	5'-11"	6'-5"	7'-8"	4" STD
60"	2.2	3'-3"	6'-5"	7'-4"	8'-3"	All Pipe Culverts
66"	2.4	3'-3"	6'-11"	7'-10"	8'-9"	5" STD
72"	2.7	3'-4"	7'-5"	8'-5"	9'-4"	5" STD

**GENERAL NOTES:**  
1. The proper installation of the first Cross Pipe is critical for vehicle safety. The top of the first Cross Pipe must be placed at no more than 6" above the flow line.  
2. Size of Cross Pipes, including the concrete base pipes, shall be as shown in the PIPE SIZE table. The first bottom pipe shall be 3/4" Stoker Pipe (4" O.D.).  
3. The third Cross Pipe from the bottom of the Culvert shall always be installed using a bolted connection. Care shall be taken to ensure that concrete does not flow into the connection to allow for disassembly of the bolted connection. All other Cross Pipes may also be installed using the bolted connection details.  
4. Match Cross Pipes as shown elsewhere in the plans. Cross Slope of 6:1 or flatter is required for vehicle safety.  
5. Riprap placed beyond the limits shown will be paid as Concrete Riprap in accordance with Item 452, "Riprap".  
6. Quantities shown are for one end of an reinforced Concrete Pipe Culvert. For multiple pipe culverts or for Corrugated Metal Pipe culverts, quantities will need to be adjusted. Riprap quantities are for contractor's information only.

**DESIGNER NOTES:**  
Type PW-1 can be used for all applications and must be used if falling is to be mounted to the wingwall. Type PW-2 can only be used for applications without a falling mounted to the wingwall.  
**MATERIAL NOTES:**  
Provide Class C concrete (f'c=3,600 psi).  
Provide galvanized reinforcing steel if required in accordance with the plans.  
**GENERAL NOTES:**  
Designed in accordance with AASHTO LRFD Bridge Design Specifications.  
Depth of toe walls for wingwalls and culverts may be reduced or eliminated when founded on solid rock, when dictated by the Engineer.  
See the Box Culvert Supplement (BCS) standard sheet for wingwall type and additional dimensions and information. Quantities for concrete and reinforcing steel resulting from the formulas given on this sheet are for the Contractor's information only.  
Cover dimensions are clear dimensions, unless noted otherwise. Reinforcing dimensions are out-to-out of bars.

**TABLE OF DIMENSIONS AND REINFORCING STEEL** (Wings for one structure end)  
Table with 8 columns: Dimensions (W, X, Y, Z), Variable Reinforcing, Estimated Quantities (Rebar, Concrete), and Estimated Volume (CY/FT).

**TABLE OF WINGWALL REINFORCING (2-WINGS)**  
Table with 8 columns: Bar Size, No., Spa, and Estimated Quantities (Rebar, Concrete).

**WING DIMENSION FORMULAS:**  
All values are in feet.  
Hw = H + T + C  
Lw = (HW/SL) \* cosine (theta) for Type PW-1  
Lw = (HW - T) \* cosine (theta) for Type PW-2 and Hw <= T  
Lw = (HW/SL) \* cosine (theta) for Type PW-2 and Hw < T  
For cast-in-place culverts:  
Lw = (HW/SL) \* cosine (theta)  
For precast culverts:  
Lw = (HW/SL) \* cosine (theta) \* (1 + 0.03) \* cosine (theta)  
Total wingwall area (from wing to toe wall):  
A = (LW/SL) \* (H + S) \* (1 + 0.03) \* cosine (theta)  
= (LW/SL) \* (H + S) \* (1 + 0.03) \* cosine (theta) \* (1 + 0.03) \* cosine (theta)  
= (LW/SL) \* (H + S) \* (1 + 0.03) \* cosine (theta) \* (1 + 0.03) \* cosine (theta)

**TABLE OF DIMENSIONS AND REINFORCING STEEL** (Wings for one structure end)

**TABLE OF WINGWALL REINFORCING (2-WINGS)**

**WING DIMENSION FORMULAS:** (All values are in feet)

**DESIGNER NOTES:**  
Type PW-1 can be used for all applications and must be used if falling is to be mounted to the wingwall. Type PW-2 can only be used for applications without a falling mounted to the wingwall.  
**MATERIAL NOTES:**  
Provide Class C concrete (f'c=3,600 psi).  
Provide galvanized reinforcing steel if required in accordance with the plans.  
**GENERAL NOTES:**  
Designed in accordance with AASHTO LRFD Bridge Design Specifications.  
Depth of toe walls for wingwalls and culverts may be reduced or eliminated when founded on solid rock, when dictated by the Engineer.  
See the Box Culvert Supplement (BCS) standard sheet for wingwall type and additional dimensions and information. Quantities for concrete and reinforcing steel resulting from the formulas given on this sheet are for the Contractor's information only.  
Cover dimensions are clear dimensions, unless noted otherwise. Reinforcing dimensions are out-to-out of bars.

**CONCRETE WINGWALLS WITH PARALLEL WINGS FOR BOX CULVERTS TYPES PW-1 AND PW-2**

**SECTION C-C - PW-1**  
**SECTION C-C - PW-2**  
**DETAILS FOR NON-SKEWED BOX CULVERTS**  
**DETAILS FOR SKEWED BOX CULVERTS**

**PARTIAL ELEVATION - PW-1**  
**PARTIAL ELEVATION - PW-2**  
**SECTION A-A**  
**SECTION B-B**  
**SECTION A-A**  
**SECTION B-B**

**WING DIMENSION CALCULATIONS:**  
For cast-in-place culverts:  
Hw = H + T + C  
Lw = (HW - 0.33T) / SL  
For precast culverts:  
Lw = (HW/SL) \* cosine (theta)  
Total Wingwall Area (SW) = (HW/SL) \* (H + T) \* cosine (theta) \* (1 + 0.03) \* cosine (theta)  
Total Reinforcing (TR) = (HW/SL) \* (H + T) \* cosine (theta) \* (1 + 0.03) \* cosine (theta) \* (1 + 0.03) \* cosine (theta)

**PIPE RUNNER DIMENSION CALCULATIONS:**  
Pipe Runner Length (Lr) = (HW/SL) \* cosine (theta) \* (1 + 0.03) \* cosine (theta)  
Lr = (HW/SL) \* cosine (theta) \* (1 + 0.03) \* cosine (theta)  
C = Height of curb above top of top slab (feet)  
Hw = Height of wingwall (feet)  
SL = Side slope ratio (vertical:1 horizontal)

**GENERAL NOTES:**  
1. Recommended values of slope are 3:1, 4:1, and 6:1. Provide 3:1 or flatter slope.  
2. 0" Min to 5'-0" Max. Estimated curb heights are shown elsewhere in the plans. For structures without railing and curbs taller than 3'-0", refer to the Extended Curb Details (ECD) standard sheet.  
3. Wingwall and slab thicknesses may be the same as the adjacent culvert wall and slab thicknesses (T' minimum). If thicknesses greater than the minimum (T') are used, no changes will be made in quantities and no additional compensation will be allowed.  
4. For vehicle safety, reduce curb height. If necessary, to provide a maximum 3' projection. No changes will be made in quantities and no additional compensation will be allowed for this work.  
5. For culverts with C = 0", the precast concrete reinforcing may extend 1'-0" minimum into wingwall. Wingwall Bars D and E may be omitted. Dimensions refer to the Wingwall Connection detail on the Box Culvert Precast Miscellaneous Details (BCP-MD) standard sheet.

**TABLE OF REINFORCING BAR SIZES AND SPACING**

**SECTION A-A**  
**SECTION B-B**  
**SECTION C-C**  
**SECTION D-D**  
**SECTION E-E**  
**SECTION F-F**  
**SECTION G-G**  
**SECTION H-H**  
**SECTION I-I**  
**SECTION J-J**  
**SECTION K-K**

**SHEET 1 OF 2**

**CROSS PIPE INSTALLATION DETAILS**

**BOTTOM ANCHOR PIPE DETAILS**  
**BOTTOM ANCHOR TOEWALL DETAILS**

**CROSS PIPE SLEEVE PIPE DETAILS**

**CROSS PIPE AND CONNECTIONS DETAILS**  
**PIPE RUNNER DETAILS**

**SECTION A-A**  
**SECTION B-B**  
**SECTION C-C**  
**SECTION D-D**  
**SECTION E-E**  
**SECTION F-F**  
**SECTION G-G**  
**SECTION H-H**  
**SECTION I-I**  
**SECTION J-J**  
**SECTION K-K**

**SHEET 2 OF 2**

**Exhibit A-12**

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